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Waldorf Conference on Long-Range Geographic Estimation of Lightning Sources

September 11-16, 1972

Sponsored by

International Commission on Atmospheric Electricity

Hosted by

Office of Naval Research
Naval Research Laboratory

July 1974

NAVAL RESEARCH LABORATORY
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Preface

The Waldorf Conference on Long-Range Geographic Estimation of Lightning Sources was held in sessions 1 to 4 and 6 to 8 in the building of the Office of Naval Research on 800 North Quincy Street, Arlington, Virginia, 22217, on 11 to 13 September 1972, interrupted by session 5, which was an excursion to the Waldorf Observatory of Atmospheric Electricity of the Naval Research Laboratory, at Waldorf, Maryland, in the late morning and early afternoon of 12 September, including a luncheon at the Collingwood Restaurant in Mt. Vernon (the old tea house

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of the George Washington estate). On 14 and 15 September, workshop sessions were held at the Waldorf Observatory, followed by a concluding session at 1812 Drury Lane in Alexandria, Virginia.

Most papers presented during the first three days of the Conference are reproduced in these Proceedings. Some authors who gave presentations did not find the time to prepare a full text paper; in these cases, only the abstracts are reproduced here. Some authors changed the title of their papers slightly; others included with the agreement of the Program Committee, remarks which they had made during the discussion following their presentation. For example, H. Volland gave a second paper during the Workshop Session on Thursday, in which he responded to some points made in other papers and in the discussion. He was then asked to combine his original paper and the short ex-tempore one he gave at Waldorf, into one document. Unfortunately, the discussions themselves could not be recorded. In one case, the presentation of the Conference is now split into two papers by the same author. As a special addition, to amplify the report given by G. Hagn, the full text of F. Horner's paper from the XVI General Assembly of UGGI (which was held shortly before the Waldorf Conference) is included at the end of these Proceedings.

All papers are reproduced in this volume in the form as they have been submitted without any editorial work.

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PREFACE

The Waldorf Conference on Long-Range Geographic Estimation of Lightning Sources was held on September 11-16, 1972. Sessions 1 to 4 and 6 to 8 were held in the building of the Office of Naval Research, Arlington, Virginia on September 11 to 13. Session 5 was an excursion to the Waldorf Observatory of Atmospheric Electricity of the Naval Research Laboratory at Waldorf, Maryland, in the late morning and early afternoon of September 12 and included luncheon at the Collingwood Restaurant in Mt. Vernon. Workshop sessions were also held at the Observatory, on September 14 and 15, followed by a concluding session on the premises of the International Commission on Atmospheric Electricity, 1812 Drury Lane, Alexandria, Va.

The Conference was sponsored by the International Commission on Atmospheric Electricity (President: L. Koenigsfeld; Secretary, H. Dolezalek) as part of their program to monitor global lightning activity for the atmospheric electricity ten-year program. The program was organized by a committee of R. V. Anderson, R. B. Bent, H. Dolezalek, and F. J. Kelly of the Office of Naval Research and the Naval Research Laboratory and was hosted by the Naval Research Laboratory.

Most of the papers presented during the first three days of the Conference are reproduced in these Proceedings. Some authors who gave presentations did not find time to prepare the full text; in these cases, the abstracts are reproduced here. Some authors changed the titles of their papers slightly; others, with the agreement of the Program Committee, included remarks which they had made during the discussion that followed their presentations. For example, H. Volland gave a second paper during the Workshop Session on September 14 in which he responded to some points made in other papers and in the discussion. He then combined the formal presentation and the extemporaneous one into one document. (Unfortunately, the discussions themselves could not be recorded.) In another case, the formal Conference presentation was split into two papers by the same author. As a special addition, to amplify the report given by G. Hagn, the full text of F. Horner's paper from the XVI General Assembly of UGGI, held shortly before the Waldorf Conference, is included at the end of the Proceedings.

All papers are reproduced in this report as they were submitted, without being edited. The Program Committee members handled all arrangements necessary for publication.

The Workshop Sessions are not recorded herein, since the discussions though beneficial, were too detailed and specialized to merit distribution beyond the actual users of the Atmospherics Analyzer.

December 1973

Welcoming Remarks

Dr. R. R. Goodman
Associate Director of Research
Naval Research Laboratory, Washington, D.C. 20375, USA

Opening Address

Prof. Dr. L. Koenigsfeld
President,
International Commission on Atmospheric Electricity
17, Rue de l'Etat Tiers; B-4000 Liège, Belgium

Chairmen of Sessions

Session 1: Review of Methods for Long-Range Geographic Estimation of Lightning Sources
Dr. R. B. Bent,
Atlantic Science Corporation, Indialantic, Florida, USA

Session 2: The Physics of Sferics Emitters, Lightning
Dr. R. E. Orville
Department of Atmosph. Science, State University of New York, Albany, USA

Session 3: Propagation of Sferics Over Long Range
Dr. G. Jean
Space Environment Laboratory, NOAA, Boulder, Colorado, USA

Session 4: ULF, SLF, & EFL Methods for Localization of Thunderstorms
Dr. E. T. Pierce
Stanford Research Institute, Menlo Park, California, USA

Session 5: Excursion to Waldorf Observatory

Session 6: General Results Obtained with Various Systems
Hans Dolezalek
Office of Naval Research, Arlington, Virginia, USA

Session 7: The Analyzator for Atmospherics as Developed in Leningrad
(Session omitted)

Session 8: Results Obtained with the Heinrich-Hertz Institute Atmospherics Analyzer
R. V. Anderson
Naval Research Laboratory, Washington, D.C., USA

Chairmen of the Workshop Sessions at Waldorf and Alexandria:
R.V. Anderson, H. Dolezalek, Dr. W. Harth, G. Heydt, Dr. T. Takeuti

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WELCOMING REMARKS

On the part of the Office of Naval Research and the Naval Research Laboratory, we wish to welcome you to the Washington area; and we hope that you have an excellent meeting. I'd like to explain, briefly, the relationship between the Office of Naval Research and the Naval Research Laboratory. The Naval Research Laboratory is actually part of the Office of Naval Research. The Office of Naval Research has two sides to its research program. One is the contract research program that many of you are familiar with, and the other is this laboratory, the Naval Research Laboratory. Both report to the Chief of Naval Research. Thus, it is really not correct to say "The Office of Naval Research and The Naval Research Laboratory." We are very proud of the organization that we work for.

We at the laboratory and in the ONR contract program are dedicated to naval research but also, and it's not to be forgotten, are dedicated to basic research. The meeting here exemplifies the kind of relationship that we like to see between our laboratory and the worldwide community in a field. I have reviewed with Mr. Anderson the origins of this meeting and the events that ultimately led to this conference. You and the general field of the earth sciences have common concern and it is one that I view as extremely important. It is that of the means to have efficient data exchange. It is essential to solve this problem to find a means and a format that is acceptable to everyone in the community. I hope that you are more successful in your meeting in the next few days than we have been in the field of oceanography.

I look at your program with envy. It's a good mixture of formal papers and work sessions. I believe that, if it is possible, we ought to use this kind of a distribution of work sessions and papers as a model for meetings in the future. I have two more conferences to attend this week, and neither one has the kind of work sessions that you have here. I must apologize to Professor Polk for that comment. I wish to thank you for inviting me to open your conference. I hope that your work sessions and your formal papers go well and that the meeting is a success. Thank you.

Ralph R. Goodman

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Following the request of Dr. Berman in his letter of 16 February 1972, we are very happy to sponsor this conference on V.L.F., variations and propagation of these frequencies.

These researches needing investigations of many countries and at the international level, this meeting must have the help of an international commission on atmospheric electricity and it is why we have decided to sponsor this conference.

Furthermore, we hope that the results which are going to be examined during the meeting will bring, at a larger scale, a more general view on repartition of storms in the world and will allow us to obtain a better theory. This might bring some changes in the classical theory of atmospheric electricity.

The objective of the conference is an assessment of the present possibilities and potentials to work towards the aim of a global lightning monitoring system.

As it seems the method of dispersion of electromagnetic waves in the atmosphere hold the greatest promise to approach the aim and a network of stations. With this network, we hope to obtain good results and to supply a good theory. This is the aim of this conference and I hope to have practical results after the discussions.

As regards atmospheric electricity, it is a capital problem and we will reach great improvement if we obtain good results thanks to a good international co-operation.

It is indeed what I hope and I sincerely wish that during this conference we will have a valuable work, interesting discussions and that everything will be settled perfectly.

L. Koenigsfeld

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The Waldorf Conference - an Introduction

by Hans Dolezalek, Office of Naval Research, Arlington, VA 22217 USA

It was E. T. Pierce who at first made me see the peculiar situation that many a meteorologist did not acknowledge information on the electrical hazards related to thunderstorms as being a "meteorological parameter". Going back to the outspoken or not-outspoken mandate people are giving their meteorologists in the weather services, however, we hardly can fail to see that information on the dangers, benefits, and damages in many varied forms stemming from the fact that the meteorological event called "thunderstorm" may generate lightning is part of the expectations to be derived from that mandate. If we agree on this, we probably must conclude that - whether the officials in the meteorological profession do acknowledge it or not - part of that mandate is the obligation for scientists who know something about lightning in the broadest sense to make such knowledge available. Such obligation is visible in this volume of the proceedings of a conference which dealt with some aspects of obtaining information on the locality and time where and when lightning does occur.

To some extent, many of us are harboring the feeling that man can "out-engineer" nature or the environment - a multi-faceted concept which has its haunting overtones in a period of increasing ecological awareness, but here meant only to express the feelings that the dangers of nature can be overcome by planned counteractions; and the conclusion derived from such feelings that with progressing technology natural hazards become less and less menacing. Such conclusion has its drawbacks because technological development also creates often new dependencies, mostly because it may lead to a specialization which is not adapted to the full spectrum of natural possibilities: to start the motor of my car on a cold and stormy winter morning can easily be more difficult than to mount a horse and ride it out. While the number of people killed by lightning is decreasing in countries where urbanization of the population is in progress, it still about equals the number of fatalities caused by tornadoes in, e.g., the contiguous United States of America; while less people than did a hundred years ago still depend in their work on the absence of lightning danger, we even in our day experience shut-downs of professional activities because of such danger; while more aircraft can fly over a thunderstorm than they could thirty years ago, the number of airplanes - both civilian and military - who cannot or are not supposed to fly through or over a thundercloud, is greater now than it was thirty years ago, and is increasing. In fact, we would find more and more of such unexpected vulnerabilities in our modern technique the more we look. Making the airplanes faster and larger requires better information on lightning danger, going from metal skins of airplanes to the "more modern" fiberglass or boron-fiber structure makes the plane much more vulnerable from lightning; replacing functions of the pilot by electronic gear - a necessity increased by increased speed - opens new dangers from the magnetic and electric fields generated by lightning .....

we now find that lightning hazard to overland power lines is larger than concluded from many years of earlier research .....plastic houses do not offer the protection we had in structures which involved steel or even wood unless we pay special attention to this hazard....and we find it necessary to educate the public better on the danger from lightning than has been done before. Work is being done to find remedies to de-electrify clouds, but although this does look promising, it will always be a rare case in which such effort will be seriously undertaken. In conclusion, information on the occurrence of lightning - a necessity for any attempt to predict it - is wanted.

We also want it for scientific reasons. Knowledge on the electrical circuits and balances in the atmosphere probably requires an incessant monitoring of lightning activity on a world-wide scale; some of us hope that by incessant monitoring of tropical thunderstorm activity we may gain information on the heat input into the general global atmospheric circulation; understanding of the process of lightning initiation and development may receive some assistance from a better knowledge under which situations lightning does occur; the attempts to understand development of thunderclouds, and maybe of tornadoes, may be helped if we can measure the lightning activity. Admittingly, some of this is speculative, but I hope it is the type of speculation which usually stands at the beginning of a scientific endeavor. Did lightning play a role in the development of the early terrestrial atmosphere, or even of life on our planet - does it have a role in the Venusian atmosphere, are there lightning-like sparks on Mars, what about Jupiter? Was lightning the source of fire and did it regulate in this way the growth and decay of forests - still more speculations.

The attempt to monitor lightning, in addition to the information provided by eye and ear, began shortly after Dalibart and Franklin established as a fact that lightning is an electric spark: by connecting his frog legs to a kind of antenna and by grounding the other part to a well, Aloysius Galvani already in 1791 observed a jerk in the frog leg when there was a lightning. Obviously, this was caused by the "electrostatic member" in the well-known, over-simplified formula

$$E_v = \frac{1}{4\pi\varepsilon_0}\frac{2h}{r^3}Q + \frac{\mu_0 c}{4\pi}\frac{2h}{r^2}\frac{dQ}{dt} + \frac{1}{4\pi c}\sqrt{\frac{\mu_0}{\varepsilon_0}}\frac{2h}{r}\frac{d^2Q}{dt^2}$$

Here, E_v is the vertical component of the electric field, generated by a vertical dipole with 2h the distance between the two charges Q, at a distance r from the dipole ($r \gg h$); t, c, ε_0, and μ_0 are time, velocity of light, capacitivity and "inductivity" (permeability), respectively. (For a derivation of this formula from the Maxwell Equations, given by H. W. Kasemir, see Appendix III.A of Israël 1973) *).

This formula, which can be written in several different forms (and also

*) for the correct formula, valid also for close distances, see McLain & Uman 1971

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looks different in different systems of dimensions and units), is convenient, because in an approximation it allows a separation of purely electric ("electrostatic"), magnetic and electromagnetic effects and shows how these vary with distance r.

For a more detailed discussion on these effects from lightning, and for reports on former measurements and networks of stations, we refer to sections (§) 67, 68, and 91 and Appendix I/III.E of Israel 1973, and to the many references quoted there. More references are to be found quoted on pages IUGG 359/360 of Dolezalek 1970 and in the bibliographies of papers in this volume.

We see from the formula that the electric and magnetic fields as represented in the first and second members of the formula decay relatively quickly with distance while the electromagnetic effects of the third member should be detectable over a much wider area. However, this formula is an approximation only for the direct propagation along the ground (ground wave, zero mode), not accounting for the fact that some of these electromagnetic waves can use other modes of propagation, too. The frequency emitted from lightnings covers a wide range from less than 1 Hz well into the tens of megahertz. Waves with low frequencies are refracted by the ionosphere and may reach a receiver via one or more "hops" (higher modes) - and the so-called "Schumann Frequencies" of about 8 Hz and higher harmonics excite the resonance of the earth-ionosphere cavity and can be measured anywhere on earth.

Consequently, the electric and magnetic effects and the higher frequencies of the electromagnetic emission can be used to monitor lightning activity only within limited ranges (20 to 250 km, depending on antenna height, receiver threshold, frequency) and if a larger area is to be covered, a relatively dense network of stations is required. The higher frequencies of the electromagnetic emission penetrate the ionosphere and could - in principle - be used for lightning tracing from satellites passing overhead. For "Long-Range Geographic Estimation of Lightning Sources" we are restricted to the VLF and ELF ranges.

Obviously, for a determination of the geographical coordinates of a lightning source from receivers more than 400 km away, we shall need two parameters: the direction of the lightning as seen from the receiver, and the distance between lightning and receiver. (We are not considering here the monitoring of lightnings from satellites). The distance could also be computed if we have the direction to the lightning from two or more receiver stations located sufficiently apart and not on one straight line with the lightning - this method is often called "triangulation". Vice versa, knowing the distance from two separated stations also could give the direction with a certain degree of accuracy and not always unambiguous. As far as I know, this has never been tried, for a good reason: the direct measurement of the distance is by far more difficult than the determination of the direction (azimuth).

In the following, we consider only the VLF range, from 3 to 30 kHz. Direction of the incoming sferic is mostly determined by either a cross-loop antenna receiving the magnetic vector, or by an array of stations and comparing the time of arrival - the latter method being more complicated but allowing higher precision. There are a number of problems with both techniques, and it is sometimes difficult to avoid wrong results because of disturbing factors in the neighborhood of the receiver. For a description of some of the methods applied, and of networks which used the direction finding for a triangulation to get the locality of the lightnings see again the references quoted above.

The United States Air Force has maintained, in the 1950's, two station networks for triangulation, at first a smaller network and then a larger one. Details have remained unpublished except for a number of government reports (see for these USAF 1950's). The results from this experiment were good. Very seldom there was a thunderstorm reported by ground observers which was not "seen" at the same time by the stations of the network, but there were many more thunderstorms recorded by the stations than reported from weather and other observatories which relied on optical and/or acoustical observation. I did not really find out why this experiment was discontinued; as it seems, at the time when equipment should have been replaced because of wear and because better electronics means became available, funding was difficult to get and not enough for the renewal. It may also be mentioned that the method of triangulation is a rather complex one: sources which are seen by several stations must be identified at each one and a relatively large amount of incessant communication between the stations is required.

At this point, we may briefly discuss some of the problems which still beset the task of lightning monitoring. During the 1950's, no method for direct measurement of the distance seemed to be practical (although several had been tried) so triangulation was still necessary, and that certainly was a shortcoming. However, there were others, too. Sometimes, a thunderstorm was located in an area where according to the weather reports there were no clouds at that time. This was obviously due to some error in the determination of the direction. Then, now and then reports were heard that somebody has received sferics from areas with snowstorms, from which no thunderstorms were reported. It is difficult to see how meteorological processes other than lightning might generate sferics, but a suspicion remains. Another problem is one of economy: we have a relatively dense network of radar stations, and the question is obvious whether these could not be used for thunderstorm monitoring. A radar scanning the horizon will only rarely detect a lightning, but it will easily see the accumulation of echoes typical for cumulonimbus clouds. Whether these are recognizable as active (electrically active, that is) thunderclouds must be asked. Hiser (1973) has shown that the strength of the radar echo is not a reliable information on thunderstorm activity. By observing the height extension of that echo, the probability of correct detection may be improved. It remains, however, the fact that the range of radar is limited, and for this reason we do not have to deal here with these possibilities more in detail. The application of over-the-horizon radar for lightning detection is not very promising either, since at the radar frequencies

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the signal strength of the emitted sferic is not large. However, we are only beginning to learn more about the electric, magnetic, and electromagnetic emissions from lightning - and the last word is probably not yet spoken. The Fifth Conference on Atmospheric Electricity (Garmisch-Partenkirchen, September 1974) will bring more discussion on this.

At the time when the USAF experiment reported above came to an end, the situation was about as follows: the need for a direct estimation of the distance was obvious, only then could one hope to get a one-station method for the localization of lightning for a rather wide area (estimated to have a radius of around 10Mm, depending on the geomagnetic coordinates of the direction and on the time of the day.) Methods to do this were known, theoretically and with some amount of experimentation. All these methods were rather complicated, and the number of observable parameters was bewildering. Again, only a method could be successful which could be operated by untrained personnel and permitted hope for later automatization and computer handling.

One of the groups which tried to investigate these problems was centered in Germany, and the names Frisius, Harth, Heydt, and Volland - given here in alphabetical order - are often quoted in this connection. They used direction finding by cross-loop antenna, and for the distance finding investigated the fact that VLF waves have a kind of dispersion in the atmosphere-ionosphere system. That means that two different frequencies emitted by the lightning at the same time would arrive at a distant receiver with a slight difference in time (micro-seconds), this difference increasing with distance. It became quickly known that a statistical approach would be needed: the lightning does not transmit as an ideal and perfectly vertical antenna would do - but there was (and is) hope that by combining the various lightnings of a thunderstorm conditions would improve. However, with this object we are already in the midst of the discussions of this conference, and I do not want to go into more details on this.

A similar method, also applying VLF sferics, has been used by the USSR Hydrometeorological Service in Leningrad and the names B.K. Inkov, T.V. Lobodin, L.G. Makhotkin and Solov'yev have become known in this regard. - Others have tried even longer wavelengths, in the ELF (or SLF) ranges with at least some success; and a combination of VLF and ELF has been developed by K. Sao and H. Jindoh at Toyokawa. These methods seem to require larger antennae and may encounter some difficulty for oceanborne receiving stations. - The application of Schumann resonances for obtaining a measure of global lightning activity and also finding the main activity center has successfully been investigated by Ch. Polk and others. New reports may be expected at the Fifth Conference on Atmospheric Electricity.

How do we obtain a global coverage of all lightning activity centers at any one time? Obviously, any method to achieve this should give the location of the centers. This would avoid duplication of counts and give better confidence that no large areas have been left unmonitored. E.T. Pierce has suggested to locate

sferics stations around the globe on about eight places where local thunderstorm activity is low (to avoid local disturbances) and all within the tropics. Islands such as St. Helena, and deserts, would be ideal locations for such stations - and in spite of difficulties of logistics and cost we still hope that one day such a network can be achieved. At the present time, we do not have high hopes of becoming soon able to install such a network, and we have to look to another possibility. A beginning which has some promise was made by the offer of the Heinrich-Hertz-Institute in Berlin to equip a number of stations with identical "Atmospherics Analyzers" which are the result of the work done by Volland, Heydt, Harth, Frisius, as quoted above. These stations are geophysical observatories which are interested in using these instruments for their own, much varied, purposes, but agree to collaborate with the other stations of this network for purposes of research and global monitoring. At first, such stations were installed at Berlin, Germany; Toyokawa, Japan; San Miguel near Buenos Aires, Argentina; and Waldorf, near Washington, D.C., USA. A slightly different station on the Stockert near Bonn also collaborated and will continue doing so. Since the Waldorf Conference, a new station near Toronto (Canada) and at least one new station in Argentina have been installed; negotiation for additional stations are prepared for locations in Antarctica, Australia or/and New Zealand, India, South Africa, West Africa - and maybe another portable station which can be set up for a limited time at various places. More definitive plans for this may be considered during a specail meeting at the occasion of the Fifth International Conference on Atmospheric Electricity - and some form of cooperation will be suggested with stations operating on similar principles elsewhere.

While expanding the network, the degree of automatization is also expanded by research and experiments made at several of the stations now in operation. Quite a number of special experiments using the various stations have been carried out, some in relation to the Atmospheric Electricity Ten-Year Program, and many others are planned. Comparisons with weather maps and satellite pictures are, of course, standard procedure.

After the initial stations of Berlin, Waldorf, Toyokawa, San Miguel, and Bonn had been in operation for about one year, several co-workers suggested a meeting to discuss possibilities and problems of this effort. This then initiated the idea to use such a meeting for a discussion of methods for long-range geographic estimation of lightning sources on a more general basis. The International Commission on Atmospheric Electricity, recognizing that this effort constituted a true example of international scientific cooperation as stated as one of their objectives, agreed to sponsor such a conference, and the Office of Naval Research and the Naval Research Laboratory agreed to host this Conference. I see it as a step in an effort to establish a global coverage in the old attempt to obtain the lighntning activity, based on realistic possibilities as given by present knowledge, available instrumentation and within present-day financial capabilities. It will not be the last attempt in this direction, I hope (and I expect that later attempts will have even better facilities) - it is the first one which promises to give useable results within a reasonable time after so many decades of theories and insufficient starts.

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I.

Review of Methods for Long-Range Geographic Estimation of Lightning Sources

Monday, 11 September 1972, 0840 - 1200 EDT, Arlington, Virginia

Chairman: R. E. Bent

Papers presented:

"A Summary of the Session on Thunderstorm Location by Radio Methods at the XVIIth General Assembly of the International Union of Radio Science (URSI) Warsaw, Poland, August 1972"	G. H. Hagn
"A Review of Techniques and Problems in the Long-Range Localization of Lightning"	G. Jean (Abstract only)
"Canadian Interest and Activity in Lightning Location"	R. C. Murty
"Present status of the study on direction finding and location of atmospherics at the Research Institute of Atmospherics"	K. Sao, A. Iwai, T. Takeuti, T. Kamada
"Critical Comparison Between Single Station Techniques of Locating Thunderstorm Areas"	Hans Volland
"An Instrument to Digitize the Individual Sferics Parameters Provided by the Atmospherics Analyzer at Waldorf, Maryland"	R. V. Anderson
"Digital Data Presentation for Spherics Analysis"	Bodo W. Reinisch

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A Summary of the Session on Thunderstorm Location by Radio Methods at the XVIIth General Assembly of the International Union of Radio Science (URSI) Warsaw, Poland, August 1972

by

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ABSTRACT

This paper summarizes the review paper given by Dr. Fred Horner before Commission VIII at the XVIIth General Assembly of URSI. Dr. Horner's paper, "Thunderstorm Location by Radio Methods," covered three basic topics:

- The definition of requirements for thunderstorm and lightning location.
- Categories of lightning location systems and some of their features.
- Data handling problems.

The discussion following Dr. Horner's paper is also summarized.

I have been asked to summarize the presentation that Dr. Fred Horner made before Commission VIII of the International Union of Radio Science (URSI), which has just held its XVIIth General Assembly in Warsaw. Commission VIII deals with "Radio Noise of Terrestrial Origin." Dr. Horner sends his regrets for not being able to attend this meeting and make this presentation to you personally. He has asked me to extend to you his wishes for a successful conference and his hope that the scientific output from this meeting will be generally available in the near future.

I will summarize the major points of Dr. Horner's paper, entitled "Thunderstorm Location by Radio Methods," and then mention some of the highlights of the discussion during the session.

Dr. Horner covered three basic topics in his paper:

- The definition of requirements for thunderstorm and lightning location.
- Categories of lightning location systems and some of their features.
- Data handling problems.

Regarding the requirements, Dr. Horner observed that the ultimate requirements should be stated more explicitly than at present by the end users of the data, for example, by weather forecasters and physicists engaged in studies of atmospheric electricity. He noted briefly his own interpretation of some of the many diverse requirements of specialists in the germane disciplines:

- Tracking thunderstorms as an aid to weather forecasting. Only a random sample of discharges need be located, provided they cover all significant centers of thunderstorm activity. Processing delays must be avoided.
- Investigations of the meteorological characteristics of the source discharges. Only small samples are required for some research purposes, and processing delays are usually not critical.
- Research on atmospheric electricity. This may require long-term statistical observations or shorter-term but more comprehensive recordings. Processing delays are not critical.

- Research on radio propagation. Where accurate location of a few selected discharges is needed, more elaborate analysis can be justified.
- Study of ground discharges by power engineers. Cloud-to-ground discharges must be differentiated from other discharges. General surveys do not require high accuracy or rapid analysis, but if studies of the influence of local topography are to be made, high accuracy is needed. A warning system would need immediate processing of data.
- Other operations requiring early warning (aviation, rocket launches, storage of explosives, etc.). Obviously, location techniques based on observations of lightning cannot give warning of the first stroke in a storm.
- Radio noise surveys. These require data on the total activity in an area of the world.

Three categories of lightning location systems can be used: long-range, short-range, and satellite. Taking these in reverse order, for the moment, it was observed that satellites can in principle be used as sensors to monitor the whole world, and should also be considered as a means for providing network control and data collection. The short-range systems discussed were primarily lightning flash counters. However, VHF systems were also mentioned; a great number of short-range detectors would be required to cover the whole world. I will add some comments on short-range and satellite methods later, but most of the discussion at URSI was concerned with the long-range methods that formed the primary focus of this conference. Such systems are capable of operating over some thousands of kilometers and have potential for monitoring large areas (perhaps the whole world) by using only a few stations.

Research on all three categories of systems has been reviewed periodically. A comprehensive review was prepared by Pierce for the Fourth International Conference on the Universal Aspects of Atmospheric Electricity in 1966, and a brief review of short-range lightning flash counters was presented by Horner at that conference. These reviews were published in 1969. More recently, at the XVIth General Assembly of URSI in Ottawa, Jean reviewed long-range and satellite methods; that review was published in 1970. There have been some significant developments since 1969. It is desirable also to keep under review some of the older

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methods which seem to merit further development even though they have not been the subject of recent work.

Now, I will turn to more detailed discussion of the long-range systems. The discussion of these systems can be further subdivided into the following categories:

- Systems employing cathode-ray direction finders (CRDF) using crossed loops and operating at about 10 kHz.
- Systems employing single-station techniques that can be used as the basis for a network of stations working either independently or in collaboration. A distance-measuring technique must be included, for example, one based on the dispersion of atmospherics at VLF.
- Systems based on time-of-arrival measurements.

CRDF networks have been in routine use by meteorologists for many years in some parts of the world, for example, the British European network shown in Slide 1, while other such nets have been set up for shorter periods for specific purposes. Accuracies at distances up to 2000 km, obtained with baselines of the order of 500 km, are thought to be about 10 percent of the range. Some of these networks have yielded rather disappointing results, however, because of inadequate synchronization facilities or improper use of such facilities. Photographic recordings can mitigate these problems, but long time-delays in processing and analyzing the film records are not normally acceptable for forecasting. Recent research work has concentrated on the development of all-electronic automatic techniques of data transmission and analysis.

To summarize the work on direction finders, the basic techniques are well established, and work is now concentrated on automation. Little work has been done recently on the determination and possible reduction of bearing errors. Indeed, the move towards automation has a tendency to increase these errors, and further practical experience and controlled experiments are needed to show whether any reductions in accuracy are significant. Finally, it would be desirable to know the number and locations of the CRDF instruments currently active.

Regarding single-station location systems, it may first be noted that all such stations include a direction finder. In contrast with the requirement for CRDF networks, the direction finder must be able to resolve the 180-degree phase ambiguity, but this presents no technical difficulty. By far the greatest effort on single-station location has been devoted to methods based upon the spectra of atmospherics at VLF or ELF, and Dr. Horner noted that this was the primary motivation for the present Waldorf Conference. The method adopted by the Heinrich-Hertz Institute relies on the measurement of two parameters to determine the distance to the source of a flash: spectral amplitude ratio (SAR) and group delay-time difference (GDD). It was explained that the SAR is the ratio of the amplitudes of atmospherics in two narrow bands at spaced frequencies, and the GDD is the difference in the times of arrival of impulsive disturbances at two separated frequencies divided by the frequency difference. Extensive tests of the system are under way using cooperating installations in Argentina, Germany, Japan, and the USA. The results have been reported by workers from the Heinrich-Hertz Institute as a mass plot of GDD (which is considered more accurate than SAR) as a function of bearing. The corresponding fixes are plotted on world maps. Dr. Horner showed one example of such a world map taken from a report by Heydt and Frisius, which indicated little activity over Africa (see Slide 2). He expressed doubt as to whether such a map represented worldwide activity comprehensively, and emphasized again the necessity for users to state precisely how they would use such maps, in order to judge whether the maps served their purpose. [Dr. Frisius, in the discussion of the paper, agreed that coverage of the African continent from Berlin was inadequate, perhaps owing to the long overland paths. He stated that Africa would also not be well-covered from the stations in the western hemisphere because of the reluctance of VLF waves to travel in an east-west direction.]

Work in the USSR has indicated that SAR is reasonably satisfactory only for short ranges. More recent work in the USSR by Inkov has been based upon the phase spectrum, and accuracies at 4000 km are said to be about 400 km when compared with CRDF fixes.

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A difficulty in these methods is that they are influenced by differences in the spectra of atmospherics as well as by variations in radio propagation characteristics. Also, interpretation can be difficult if more than one storm exists at the same time in the same direction. Despite these difficulties, VLF spectral measurements offer promise of leading to estimates of source distances with sufficient accuracy for some purposes, and, with automatic facilities, of enabling global lightning activity to be monitored in a reasonably comprehensive manner. This method is not yet so well proven as the CRDF network, however, and more tests are needed in which records are obtained on storms whose locations are accurately known by other means. Perhaps the Berlin instrument working in conjunction with the British European network, which can cover North Africa, would offer one possibility for such comparison.

The validity of timing methods was demonstrated by monitoring storms in Europe from North America, by Lewis et al. in 1960, but no follow-up has taken place toward developing an operational system. Time-difference systems have been developed for short-range work at VHF, notably by Proctor in South Africa and by Cianos, Oetzel, and Pierce in the USA. While the technique as so far developed is not suitable for routine measurements on a large scale, it has proved useful for research and for calibration of lightning flash counters.

This brings us to a discussion of ground-based short-range techniques, namely local lightning-flash counters. Recent developments have been characterized by an increase in the number of proposed designs (almost an average of one per year for the last 20 years), but the past three years have shown only marginal progress toward solution of two of the three main problems:

- Establishment of effective range
- Differentiation between ground and cloud discharges.

The solution of the third problem, presentation of the data in the most useful form, depends upon a more precise statement of end user requirements. Despite the shortcomings of counters, a considerable quantity of useful data exists from several networks, and it would be

desirable for these data to be collected in a common format to facilitate comparison. This leads naturally to a discussion of what kind of information should be presented. Most data exist in the form of hourly counts; and hourly values for every station represent a large, and perhaps unnecessary, volume of data. It can be reduced if there is no interest in what occurred in a particular hour or day, but presumably any summary presentation needs to show diurnal and seasonal trends. Perhaps a reasonable compromise is to show the statistics of the variations with time of day on a monthly basis, perhaps with a separate presentation of times with exceptionally high activity if this is of interest to any users. For any statistical presentation, the problems of incomplete and possibly erroneous data need to be solved in an agreed way.

Similar comments can be made regarding the data-handling problems from other types of systems (CRDF, VLF spectra, etc.), and the data problems should not be underestimated. They can perhaps be underlined by recalling that the total number of lightning discharges over the world each year is probably between 10^9 and 10^{10}. There is a tendency to assume that a knowledge of the precise location of every one of these discharges is a desirable, if perhaps unattainable, objective. If this is so, then the data-processing procedures for realizable systems need to be based on a knowledge of what users would do with the more comprehensive data if they existed.

A few additional comments on satellite systems are appropriate. Although earth satellites appear at first sight to be excellent platforms for recording the occurrence of lightning discharges, there are serious difficulties in using radio techniques, as explained by Pierce in 1969. First, there is a lack of spatial resolution:

- High-altitude satellites obtain good geographical coverage but suffer inadequate angular resolution.
- Low-orbit satellites move a considerable distance in an observation time interval that is long enough to obtain a meaningful sample of atmospherics.

Another problem is concerned with receiver sensitivity and the background of cosmic noise. Although adequate sensitivities for reception

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in a low-orbit satellite seem attainable over a wide range of frequencies, there is conflicting evidence on whether atmospherics can be detected at high altitudes.

The optical results of Sparrow and Ney (Nature, 1971) are encouraging, but the small fraction of useful time (near new moon at midnight) is a serious limitation. Nevertheless, the promise of satellites should be pursued, and satellite results should be compared with the results from ground-based measurements when possible, for better assessment of the relative usefulness of the techniques.

Dr. Horner concluded:

1. For locating areas of thunderstorm activity at long ranges there are three systems which need further investigation:

   a. CRDF networks with improved back-up facilities to enable comprehensive data to be collected and processed rapidly. Further work is needed to develop these facilities and to ascertain the optimum locations and separations of stations to provide wide coverage. Part of the study should be concerned with the way in which correlation between the incidence of the recorded atmospherics varies with the separation and the local environment of the stations.

   b. Stations which depend on the measurement of bearing and distance, and which can be used either independently or in a coordinated way. Some automatic recording techniques are well-developed, but more experience and checks against information obtained by other means are needed to assess the accuracies, particularly in the measurement of distance.

   c. Timing methods. These are the least developed, despite their early promise, but are perhaps the most readily applicable, in principle, to an

automatic system. Considerable work is needed to assess timing accuracies in a wider range of conditions than were chosen for the early transatlantic tests, to develop the technical facilities, and to determine the optimum locations and separations of stations.

2. For those applications in which it is important to know the distribution of ground discharges, a network designed solely for locating the sources may need to be supplemented by additional facilities. This problem will involve further study if a clear requirement emerges.

3. Simple lightning flash counters, suitable for use on a wide scale, are unlikely to provide all the information which has been specified as a requirement, i.e., accurate maps of the rate of occurrence, with, for some purposes, unambiguous discrimination between ground discharges and others. Development of more complicated systems seems justified as a means for evaluating the performance of simple instruments, but further progress in general surveys is most likely to be made by improvements in reliability and additional experience rather than by the development of new types of instrument.

4. The collection, standardization, and dissemination of lightning counter data need some attention, and agreement should be reached on methods of presenting data in statistical form, taking into account the fact that many records will be incomplete or incorrect. Past experience has shown that faulty operation of instruments can continue undetected for a considerable period, and the analysis of the results is then difficult. More rapid collection and intercomparison of data would help to overcome this problem. Consideration should be given to the desirability of using duplicate instruments on each site as a routine procedure, and reporting data only for those periods when the results agree

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within some specified limits. Otherwise, erroneous data may be detectable only on the basis of past experience or by comparison with other nearby stations.

5. Reports on observations with satellite sensors suggest widely varying experience, and apparent discrepancies need to be resolved before the potentialities of the technique can be adequately assessed. Satellites should also be considered an an adjunct to ground-based location systems, to simplify the control of networks and the collection of the data.

6. Clearer statements of the requirements for thunderstorm location are needed for at least two reasons. The first is to enable future research to be concentrated on the most important issues. The second is concerned with the desirability of making the maximum use of the many facilities which already exist. In the present research climate, it is not so easy as at some times in the past for agencies owning facilities to provide support to research projects on a voluntary basis; applications for such support are more likely to be considered favorably if the aims of the research are clearly stated as specifically as possible and exhibit evident scientific merit.

This completes my summary of Dr. Horner's formal presentation.

The lively discussion that followed the presentation of Dr. Horner's paper clarified some aspects of user needs. Professor Mühleisen summarized his view of the needs for research on lightning for use in studies of atmospheric electricity. In studies of the general circulation, anything short of the complete world distribution of discharges to ground would be of limited value. This involves both the problem of location and also that of either differentiating between ground and cloud discharges or recording ground discharges only.

Professor Kimpara considered DF networks to be still the most reliable system of location, technically, but mentioned the work of Sao and others on distance measurement based on automatic measurement of the delay times of slow-tail atmospherics.

Dr. D. Ll. Jones, following up on Kimpara's comment, showed a comparison of calculations using Williams' source and the measured data of Hepburn (1957) for the slow-tail time of separation from the oscillatory head of the atmospheric as a function of propagation distance. Dr. Jones also mentioned theoretical calculations by Dr. J. R. Wait.

Errors in CRDF bearings were discussed, particularly in relation to the influence of high mountains. These mountains were thought to be the cause of errors in Switzerland, for example, but the mechanism giving rise to the errors was not well understood.

Work in Sweden had been partly directed towards distinguishing ground discharges from others; simultaneous direction-finding at 10 and 27 kHz was said to facilitate the distinction. Gating on the 27-kHz direction finder had been introduced to reduce polarization errors by excluding sky-waves, but it seemed likely to be successful only at short ranges at which the ground wave would predominate.

Dr. Frisius, aided by Dr. Heydt, showed some results obtained by using the GDD method, including a chart of thunderstorm activity as a function of broad geographical area and GMT. Since I am sure this method will receive more discussion during this conference, I will not pursue it further here.

In closing, I would like to mention that Dr. Horner was kind enough to provide copies of the full text of his URSI paper for use during this conference. His paper was prepared to stimulate discussion at the URSI meeting in Warsaw, and I am sure he hopes it will serve that same purpose here.

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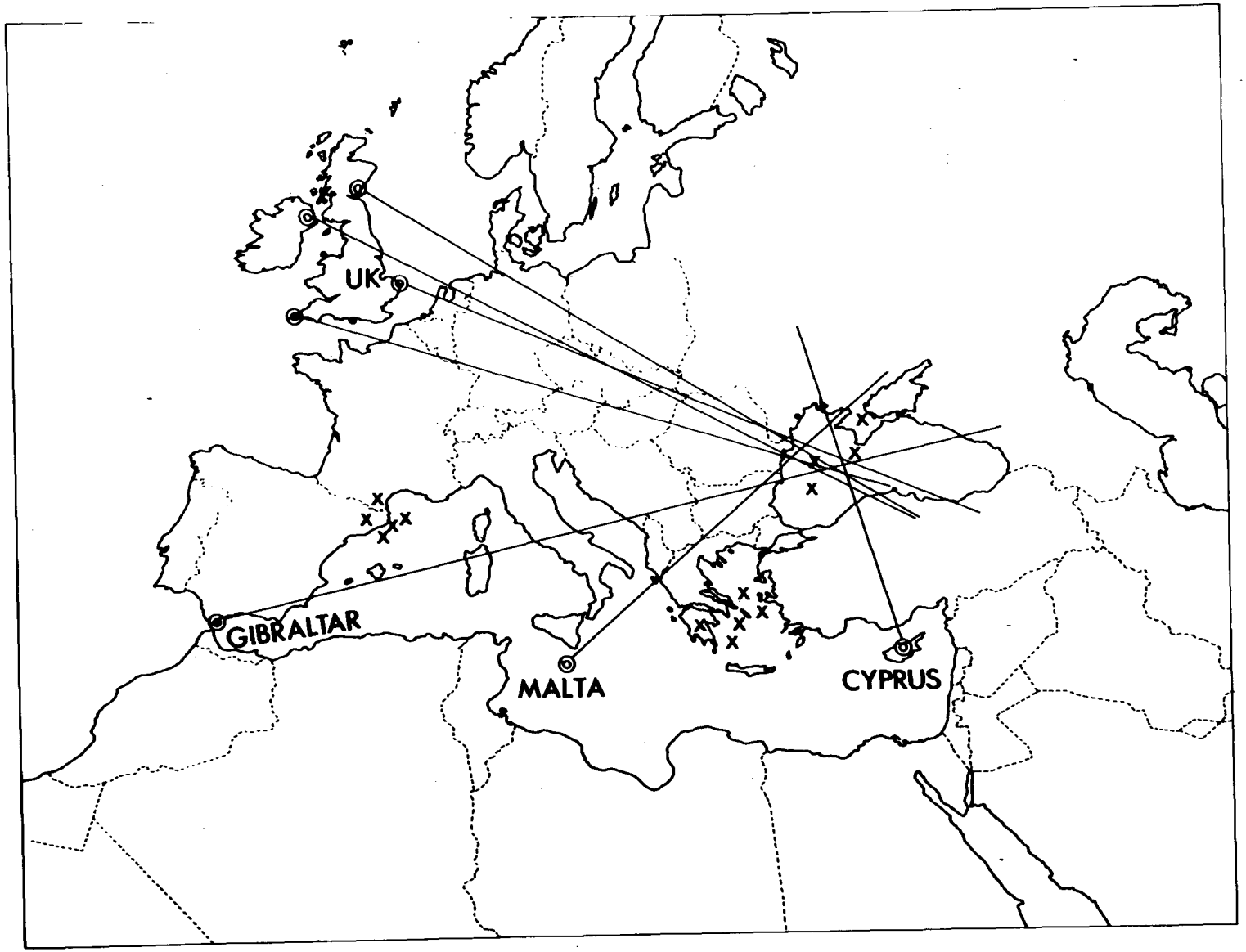
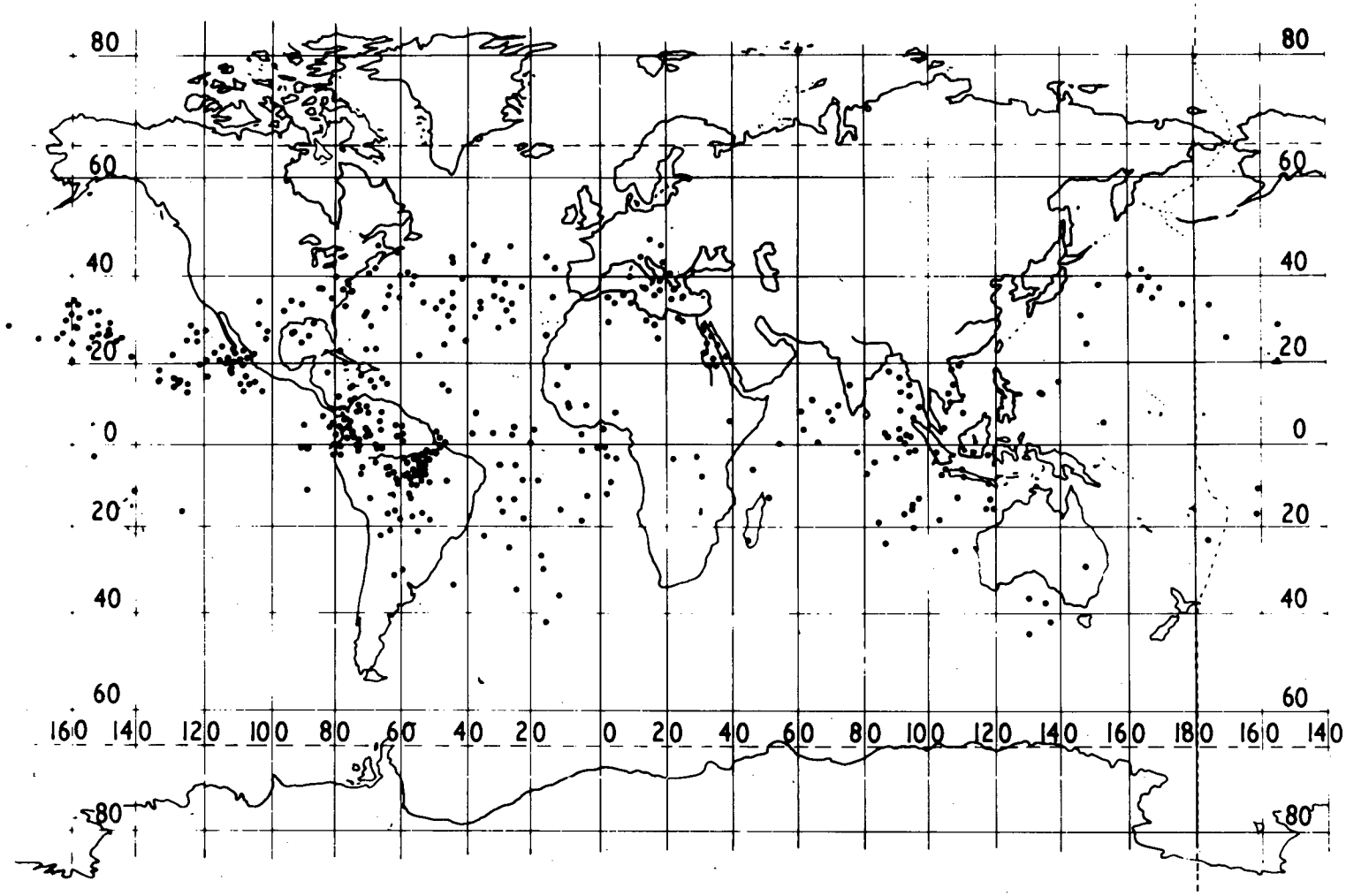


SLIDE 1 THE BRITISH EUROPEAN CRDF NETWORK



SLIDE 2 MAP OF LIGHTNING LOCATIONS OBSERVED BY USING GDD METHOD

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A Review of Techniques and Problems in the Long-Range Localization of Lightning

by

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A b s t r a c t:

Techniques and problems in the long-range localization of lightning are reviewed, such as the pros and cons of single versus multiple station systems, groundbased versus satellite systems, real-time versus after-the-fact systems, etc. A wide spectrum of demonstrated technical capabilities and a good working knowledge of propagation appear to offer potential solutions to the long-range m nitoring of thunderstorm activity; however, pre-requisites to the design and implementation of a system are its justification and perfomance specification.

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Canadian Interest and Activity in Lightning Location

by

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Canada has a natural interest in lightning location for a considerable time. Considering that the forest products contribute a large portion to the national economy it is hardly surprising. The importance of lightning location can be seen from the following two tables[1]:

TABLE 1

Forest fires, by cause, 1963 and 1964

Cause	1963		1964	
	No.	%	No.	%
Totals, Man caused (including unknown)	5319	69	4955	71
Lightning	2351	31	1989	29
Total	7670	100	6944	100

TABLE 2

Forest fire losses, 1963 and 1964, compared with ten year average 1954-63

Item	1963	1964	Average 1954-63
Total fires	7,670	6,944	6,142
Area burned (acres)	470,001	2,993,290	2,388,025
Average size of fire (acres)	61	431	389
Estimated values destroyed ($)	4,265,926	6,522,947	13,605,475
Cost of fire fighting ($)	4,772,714	4,430,041	5,661,610
Totals: damaged and fire fighting costs ($)	9,038,640	10,952,988	19,267,085

It is interesting to note that in some years, for example in 1963 and also in 1966, the cost of fire fighting exceeded the estimated values destroyed. However, in general the process is reversed and it is safe to say that on an average the cost to Canada is about 20 million dollars in total damage and fire fighting. In 1964, lightning accounted for 29% of all forest fires and 80% of the

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total area burned. It is reasonable to assume that on an average, lightning is the cause of 20-25% of all forest fires damaging in excess of 50% of forests.

The pulp and paper industry[2], the forestry departments, the Meteorological Branch (now changed to Atmospheric Environment Service), the Hydro companies all have a vested interest in lightning location.

In 1964 the Meteorological Branch, Department of Transport, Canada approached a number of universities for a survey on lightning detection. In 1965 the author of this article from the University of Western Ontario was given the task of preparing a comprehensive survey on lightning detection and to make a set of recommendations. A report "Lightning Detection Studies" was submitted in 1966 to the Meteorological Branch[3].

A five year contract for research into the development of equipment and techniques for the detection and tracking of lightning strokes and their differentiation into types or classes was awarded to the University of Western Ontario in 1967-68. Under the direction of the author, work was undertaken to test lightning counters, VLF and VHF direction finders and microbarograph networks. At the same time the meteorological Branch developed Atmospheric Electricity Research in its cloud Physics group. Work on VLF direction finding networks and the development

Present status of the study on direction finding and location of atmospherics at the Research Institute of Atmospherics

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Abstract

Functions of three locating equipments operating at R.I.A. including Atmospherics Analyser developed by the Heinrich-Hertz-Institute are briefly compared in this paper. Further studies as to the improvements for respective methods will be made by cooperative observations between them.

There exist three kinds of locating equipments at the Research Institute of Atmospherics at the present time. They are Sferics Fix Network (SFN) with three stations developed several years ago, Atmospherics Analyser (AA) introduced through German scientists a few years ago and the Locator by Single Station (LSS) which is reported in detail by Sao(Waldorf Conf. paper 44, Washington D.C., Sept. 1972). The present paper presents some characteristics of three types of location and a sample of the tests of the simultaneous observations carried out on 6 th August 1972. This is, indeed, a preliminary report because continuing improvements for each apparatus are being made except for the Atmospherics Analyser. Finally, general aspects of bearing and frequency of received atmospherics observed at Syowa Station in Antarctica are briefly stated.

1. Sferics Fix Network (S F N)

This is a conventional triangulation method, consisting of three stations (Moshiri, Sakushima and Kagoshima Observatories) which are situated at both extremities and near the center of Japan. The triangulation is fixed by a computer from the data recorded simultaneously at each station. Here, the identification of atmospherics at three stations is ascertained by only the time received, thus high accuracy of electronic clocks is required. And, since the bearing of received atmospherics are measured digitally, it is natural that the calibration of bearing must be made carefully. By operating the network, location maps will be obtained periodically to collect abundant data to investigate the relation between the meteorological factors and thunderstorms. However,

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the difficulty is the impossibility of fixing atmospherics originating along the base line of these three stations, which coincides with the most active region of thunderstorms in Asia. Thus, it can be said that the most reliable fixes are obtained only for atmospherics originating in China or Siberia. Attempts to obtain fixes during the summer season sometimes fails because of frequent local thunderstorms at each station, thus it appears to be necessary to improve the triangulation technique for the typhoons.

2. Atmospherics analyser (A A)

Observations of source location in the Far East are being made on the roof of the building of the R.I.A. by the Atmospherics Analyser developed by Heinrich-Hertz-Institute. This apparatus has its own merit of location by single station, and global geophysical aspects such as global circulit or general circulation and the nature of atmospherics originating from the typhoon or frontal lines will be investigated by the use of this apparatus. One main difficulty is how to display the realistic distribution of sources, and thus digital representation of sources rather than by photographic methods is currently discussed. The principle of this apparatus is the dispersion involved in the propagation of VLF components of atmospherics. There is, therefore, great difficulty in locating atmospherics of the so-called ionospheric reflection type waveforms originating within approximately 1500 Km during the summer season.

3. Locator by Single Station (L S S)

Details are not written here because this apparatus is stated elsewhere (refer to Sao, paper 44). This is also one of the dispersion methods, but the frequencies adopted are different from the Atmospherics Analyser. This is based on the difference of group velocities between VLF and ELF (slow tail) components, thus the atmospherics originating within approximately 1000 Km should be excluded because of inadequate mode excitation. An important matter to be studied would be the ionospheric perturbations by height and conductivity which give some errors on the estimation of traversing distances. Another anxiety is for the term corresponding to the pulse width which is assumed to be constant at the present time. However, the remarkable merit of this apparatus is not only the single station technique but the separation of ground discharges from inter-cloud discharges. Thus, this apparatus is convenient for investigating the difference of genesis of thunderstorms between land and sea discharges, between daytime and nighttime and between discharges to high mountains and to low plains. Improvements of electronic circuits are now being made to reduce the scatterings of distribution of sources and to stabilize the whole system.

A sample of the test of cooperative observation made by these three locating equipments is shown in Fig.1. Although locations by Atmospherics Analyser show wide distributions of sources, and no distribution of mark ⊙ exist approximately along the baseline of Sferics Fix Network, Fig.1 would be the present status of the study on direction finding and

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location of atmospherics at R.I.A.

As mentioned above, although these three types of equipment are in operation, fundamental problems on the long wave propagation such as refractions or polarisations are not yet fully studied. Since there is no method which is, indeed, standard for locations, it can be said that they are complementary to each other at the present time. Hence, it would be a good policy to do research independently on appropriate objectives, paying attention to the probable errors involved with each apparatus. Cooperative observations will be made intermittently (for example every season)to improve functions of the respective apparatus by comparing the results of locations obtained.

4. Another matter to be mentioned here is the arrival direction and occurrence frequency of atmospherics at Syowa station in Antarctica. The observations for distant sources of atmospherics were carried out at a frequency of 10 KHz. The principal results obtained were such that A) the arrival direction of atmospherics at Syowa station is mostly the north in almost all seasons, suggesting the active thunderstorm area of Central and South Africa, and B) the monthly averages of diurnal variation of the frequency of atmospherics in each azimuth were obtained as is shown in Fig. 2. The above results obtained from the diurnal variations of the frequency of atmospherics at each azimuth seem to indicate that in Antarctica there is a fair chance of watching the diurnal thunderstorm activity from distant sources which are distributed along the equatorial zone in every season.

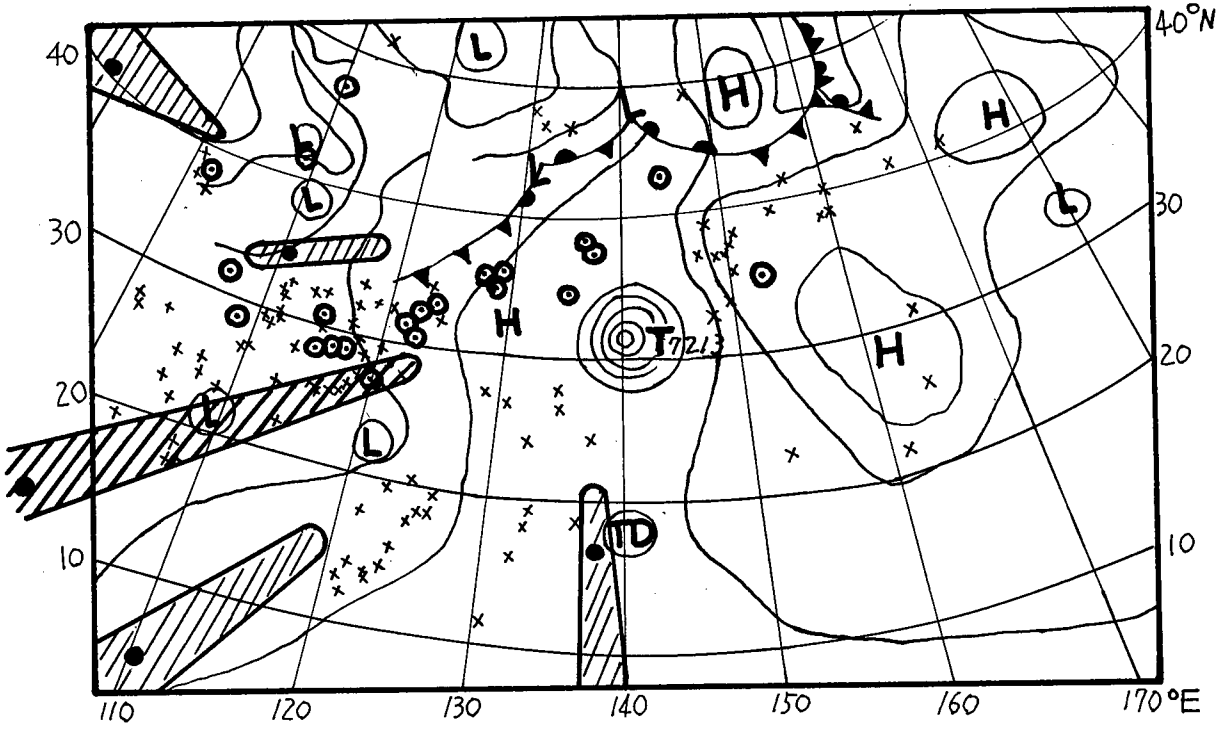

Fig. 1 A sample of results of respective locations of atmospherics at 21 hour JST 6, Aug. 1972

(⊙ S.F.N., A.A., X L.S.S.)

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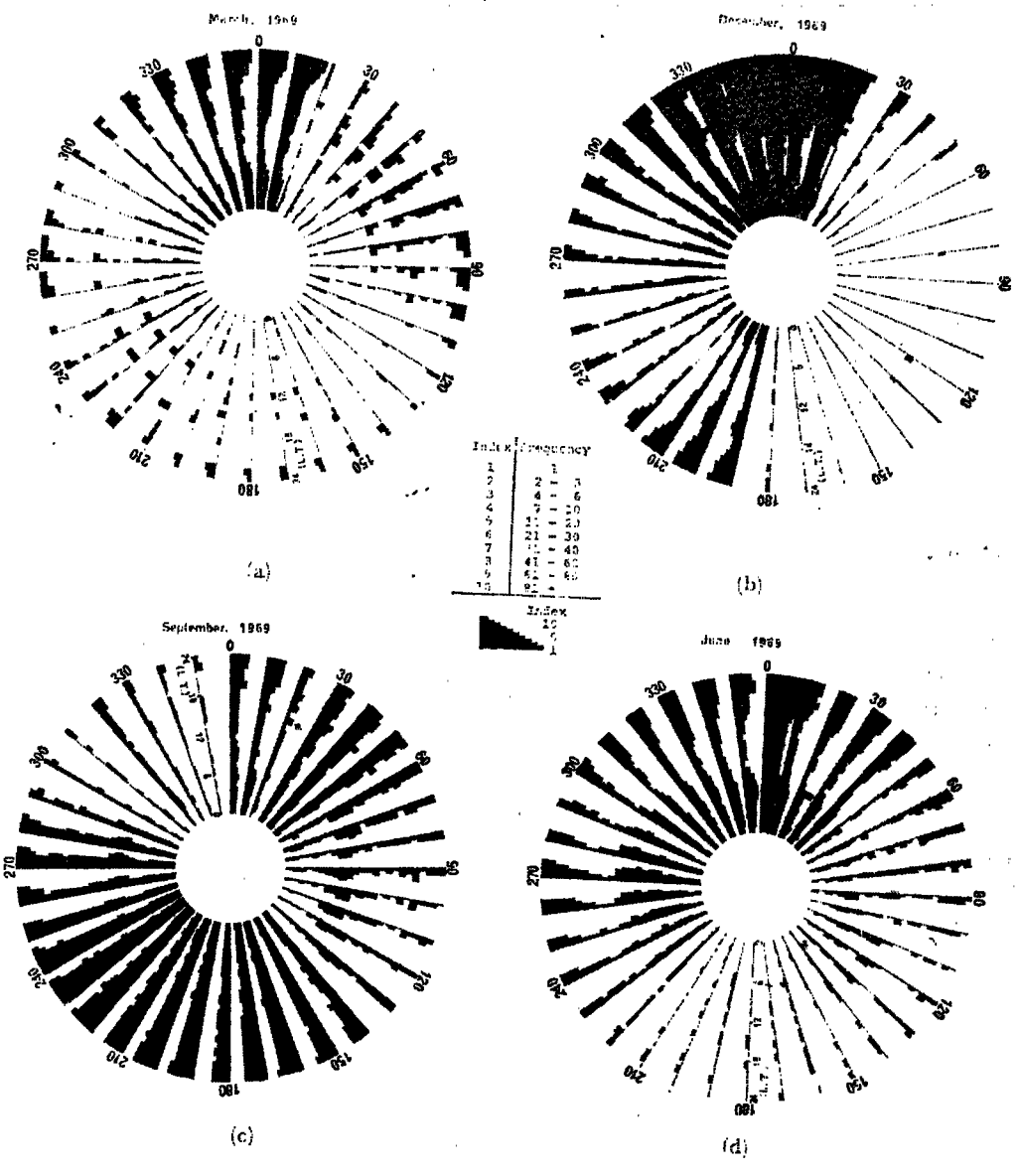

Fig. 2 Monthly averaged diurnal variation of frequency of atmospherics in each azimuth at Syowa Station in Antarctica (from March 1969 to January 1970)

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CRITICAL COMPARISON BETWEEN SINGLE STATION TECHNIQUES OF LOCATING THUNDERSTORM AREAS

by

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The most widely used and least complicated method, from a theoretical point of view, to locate thunderstorms is the direction-finding method in which three or more stations are spaced on long baselines with at least 1000 km between them. This method needs expensive communication networks to observe simultaneously single lightning discharges. The interpretation of these measurements is straightforward. The errors involved are bearing errors due to the orography and/or the anisotropic and inhomogeneous ionosphere. The disadvantages of this method are the limited range of application (which is of the order of the baselines) and the difficulty in obtaining enough data to do a statistical analysis.

The second multistation technique is based on the difference in the times of arrival of an atmospheric at different stations. Although this technique is in principle of great accuracy, the difficulties involved here are similar to those of the direction-finding method: great expenditure, limited range of application if only a few stations are available, and inaptitude for a statistical approach.

Relatively inexpensive methods to locate distant thunderstorms are single station techniques. Their only source of information is the angle of arrival and the wave form of the vertical electric field strength of a single atmospheric. It is well known that from a Fourier analysis of such a wave form a product

$$G\,B = g \quad b \quad \exp\left\{ j(\Psi + \Phi) \right\} \tag{1}$$

can be derived where G is the source function of the atmospheric with magnitude g and phase Ψ, and B is the transmission function of the wave guide between earth and ionosphere.

A very old and common method is to measure the wave form of successive atmospherics with a broad band receiver and to do a Fourier analysis for each individual wave form. This gives the most complete information available from an atmospheric. If the transmission function B is known it is then possible to relate uniquely the observed atmospheric to a certain distance. Together with the measured angle of arrival, the origin of the atmospheric is then given.

The transmission function B is very complicated, depending on time, angle of arrival, distance, and frequency. However, the VLF-theory is far advanced, and B can in principle be uniquely determined (see e.g. the textbooks by Wait (1962) and Galejs (1972)). On the other hand, it is well known that the source functions vary in a wide and unpredictable range. Therefore in order to locate thunderstorms with the help of atmospherics, the evaluation of the data based on a statistical approach is absolutely necessary. From such statistical data reduction one obtains mean values $\overline{g}\,b$ and $\overline{\Psi} + \Phi$ instead of equ. (1), and probability distributions of the scattered data which might now be expected to be predictable.

The above-mentioned wave form analysis is not suitable for such a statistical method because this would become very time consuming, and moreover, a complete wave form analysis contains much abundant information unnecessary for the purpose of thunderstorm locating. In fact, because of the known behavior of the transmission function B in equ. (1), it is in most cases sufficient to evaluate the function in (1) at a few discrete frequencies in order to obtain enough information about the distance of the source.

One of the more appropriate methods is based on the measurement of the difference in the times of arrival between the VLF-pulse and the ELF-slow tail of the wave form. Pierce in this conference read a paper by Sao where such a method has been used. This method works reasonably well because the wave guide between earth and ionosphere has two windows in which electromagnetic wave propagation is least attenuated. One window is located within the VLF-range near 15 kHz where the 1st mode predominates. The other window is within the ELF-range near 2 kHz where the 0th mode is the dominant carrier of electromagnetic energy. From electromagnetic wave theory one can determine the difference in the times of arrival of both these modes and obtains a simple relationship between distance and time of arrival (Wait, 1962). However, the time of arrival depends on frequency as well, and the frequency where minimum attenuation occurs shifts with distance. Moreover, the onset of the VLF- and ELF-pulses, respectively, of the wave form depends on the highly variable phase Ψ of the source function in (1). Therefore the output data obtained from this method are ill adjusted to the theory.

The HHI-analyser developed in BERLIN measures the difference in the times of arrival of two well-defined adjacent frequencies within the lower VLF-range. That means the only number subtracted from the available information in (1) is the second derivative of the phase with respect to the frequency f at one particular frequency f_o:

$$\left.\frac{\partial^2(\Psi+\Phi)}{\partial f^2}\right|_{f=f_o} \propto \rho \qquad (2)$$

which is proportional to the distance ρ if only the 1st mode contributes to the wave propagation, and which is immediately

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available at the output of the receiver without further data reduction. Thus that method provides the least redundant information necessary for the purpose of locating thunderstorms, and there remains sufficient capacity for receiver (and observer) to measure (and evaluate) every atmospheric exceeding the threshold of the receiver, or to repeat the measurement at other frequencies.

It should be emphasized again that any single station technique has to deal with the same available information given in (1). The only difference between the various methods is the different preparation of the data so that they are optimally adjusted to the theory and, moreover, appropriate for a statistical analysis.

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An Instrument to Digitize the Individual Sferics Parameters Provided by the Atmospherics Analyzer at Waldorf, Maryland

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Abstract

Information from the Atmospherics Analyzer has been available only in the form of statistical averages whether the data are in the form of dot clusters on photographic film or frequency histograms of received impulses as functions of time or azimuth. Occasions have often arisen when such a degree of averaging masks the required information.

An instrument system is described which records the values of azimuth, spectral amplitude, spectral amplitude ratio, group delay time difference, and time of receipt on magnetic tape in a format which permits either digital or analog playback to be made. The system is shown to be simple and relatively inexpensive to build.

Typical data recordings obtained by the recording system are shown. Some analyses are outlined which show promise and which would be impossible without the detailed information inherent in the magnetic recordings.

The atmospherics analyzer indicates the source region of distant very low frequency impulses created in lightning activity by estimating the distance of the source through measurement of the frequency dispersion of the received wave packet. The analyzer circuitry develops analog output voltages which are proportional to definable characteristics of the received impulse (Frisius and Heydt, 1968). The existing analyzer generates outputs in this manner which indicate the azimuth (Ø), the net amplitude of the impulse (SA), and two distance related parameters, the amplitude ratio between 5 and 9 KHz spectral energy (SAR), and the time difference measured between the arrivals of two spectral components of the received impulse (GDD). As has already been described (Frisius and Heydt, 1973), recording and analysis of these outputs have relied on oscillogram photography in which time exposures are made of scatter plots of either SA, SAR, or GDD as functions of azimuth. A typical such recording is shown in Fig. 1.

Analysis of these oscilloscope photographs has revealed several shortcomings which indicate the need of an improved data recording technique. If an active source area is examined, it is seen that a large area of the film is totally exposed, and determination of the point of maximum activity is impossible requiring that the precise source location be inferred from the outer fringes of the dot cluster. As a corollary to this, the identification and separation of closely adjacent activity centers become practical impossibilities. Photographic recording also necessarily destroys the identity of individual sferics impulses. The data points seen on a GDD vs azimuth photograph are not the ones responsible for the SAR - azimuth recording obtained immediately preceding. All that is available is a statistical average of each obtained at different times. It is

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categorically impossible to study correlations of parameter fluctuations without some form of stroke by stroke recording. Finally, the labor inherent in manual reading of oscilloscope photographs can easily become overwhelming; and mechanized data handling becomes an attractive prospect. For these reasons, the possibility of digital recording of the individual sferics parameters has been studied; and a suitable instrument has been fabricated and installed.

A computer model of typical sferics parameters was formulated in which source areas could be arbitrarily located in coordinates of range and azimuth after which each such area would "produce" a specified number of data points at the receiving location. A Gaussian spread was imposed on each parameter which was doubly randomized and related to the specified range in a manner similar to that observed with real data. By use of this model, it was learned that adjacent clusters can be resolved with digital data processing at separations half that at which the same clusters can be distinguished to be separate in an oscillogram photograph. Further, it was found that, although resolution did improve monotonically as the number of strokes increased, the improvement was minimal with an increase from 300 to 1000 strokes and negligible with further increases. Consequently, it was concluded that recording intervals which are long enough to provide several hundred strokes per source area would be the maximum required, with hourly repetition to follow changes and motions in activity.

Another possibility with the recording of individual strokes is determination of the time of receipt. One proposed experiment (Wait, 1972) involves the recording and identification of individual sferics at two stations located on the same great circle with the source in order to achieve a separation between source and propagation effects. It should be possible to achieve an adequate identification if the absolute time of receipt is known at each station to an accuracy of one millisecond. Knowledge of the time of receipt has also been seen to make

possible the identification of impulses attributable to multiple return strokes, and there are numerous conceivable investigations which could be based on this information.

There are many approaches to digital data recording in existence (Malmstadt and Enke, 1969), and new schemes are constantly being devised. The choice of a suitable technique for the atmospherics analyzer is thus primarily that of finding the most economical system which will reliably fulfill the stated requirements. The viable options range from a high of an on-line computer system to a low of a paper tape punch. The hope of implementing the two station experiment introduces the additional possibility that the recording equipment might profitably be simplified at the expense of introducing an intermediate buffer unit which would not need duplication. A final consideration is that of background expertise-if a suitable system or subsystem already exists, prudence and economy may well dictate their inclusion in preference to a wholly new design.

The technique which was decided on after consideration of these factors is shown in Fig. 2 as a functional block diagram. The four parameters are digitized with a ramp type converter. The use of a ramp circuit is justified because of the inclusion of sample and hold circuits and because of the limited accuracy requirements in this application. Driving of the ramp generator from a frequency standard provides a suitable time reference, and detection of the receipt of data is facilitated by the suppression of recording on two of the four tracks on the magnetic tape. The recording of two different frequencies derived from the standard on the other two tracks between sferics provides a continuous maintenance of cumulative time with the possibility of error correction. Recording is initiated on the exact hour and continues until either a specified number of sferics has been

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received or a fixed time has elapsed. In this manner it is possible to operate the system unattended for one or more weeks.

In conclusion it would be well to present some typical data analyses from the system to demonstrate the possibilities inherent in digital recording of individual stroke parameters. Figure 3 is a histogram of received sferics as a function of azimuth. Ten degree aximuthal segments are used and the indicated frequencies represent roughly one hour's data. It is seen that a sharply defined peak exists between 80 and 90 degrees where some 1300 signals were recorded. Figures 4 and 5 are histograms for SAR and GDD, respectively, which were derived from the same data by selecting only those impulses which had azimuths within the 80 - 90 degree range of the modal azimuth for inclusion. Well defined maxima are seen to exist in both of these plots.

A further level of analysis is indicated in Figure 6 which is a point scatter of SAR and GDD values for sferics received within a ten degree segment of azimuth. Each point indicates the SAR and GDD for a single signal received within the indicated segment. If there were no spread in source characteristics or propagation, and if the most elementary theories were totally valid, the scatter would collapse into a single point. The presence of a well defined area of high density is indicative of the validity of the dispersion technique; while the obvious spread shows the effect of the real world and is indicative of accuracies to be expected. The point to be made, however, is that such a second order of analysis would be completely impossible without stroke by stroke recording of all parameters. Other analyses which suggest themselves include the fitting of Gaussian and higher curves to observed distributions and studies of the interrelations of the various parameters. Included in the latter would be answers to questions

such as whether parameter spreads are azimuth dependent, whether the spreads in SAR and in GDD are statistically related, whether SA correlates in any way with uncertainty in the other parameters, and whether any relation exists between the deviation of any one parameter from its mean and the value of any of the others. Only use and experience can determine the usefulness of these or other analyses, but none can be made without a data recording capability which is at least functionally equivalent to that described.

Finally it is a pleasure to thank Günter Heydt and Joachim Frisius for the provision and installation of the basic analyzer, Hans Volland and Wolfgang Harth for numerous stimulating discussions, and Joseph Marshall whose contributions to the design, construction, and installation of this recording apparatus made it a reality.

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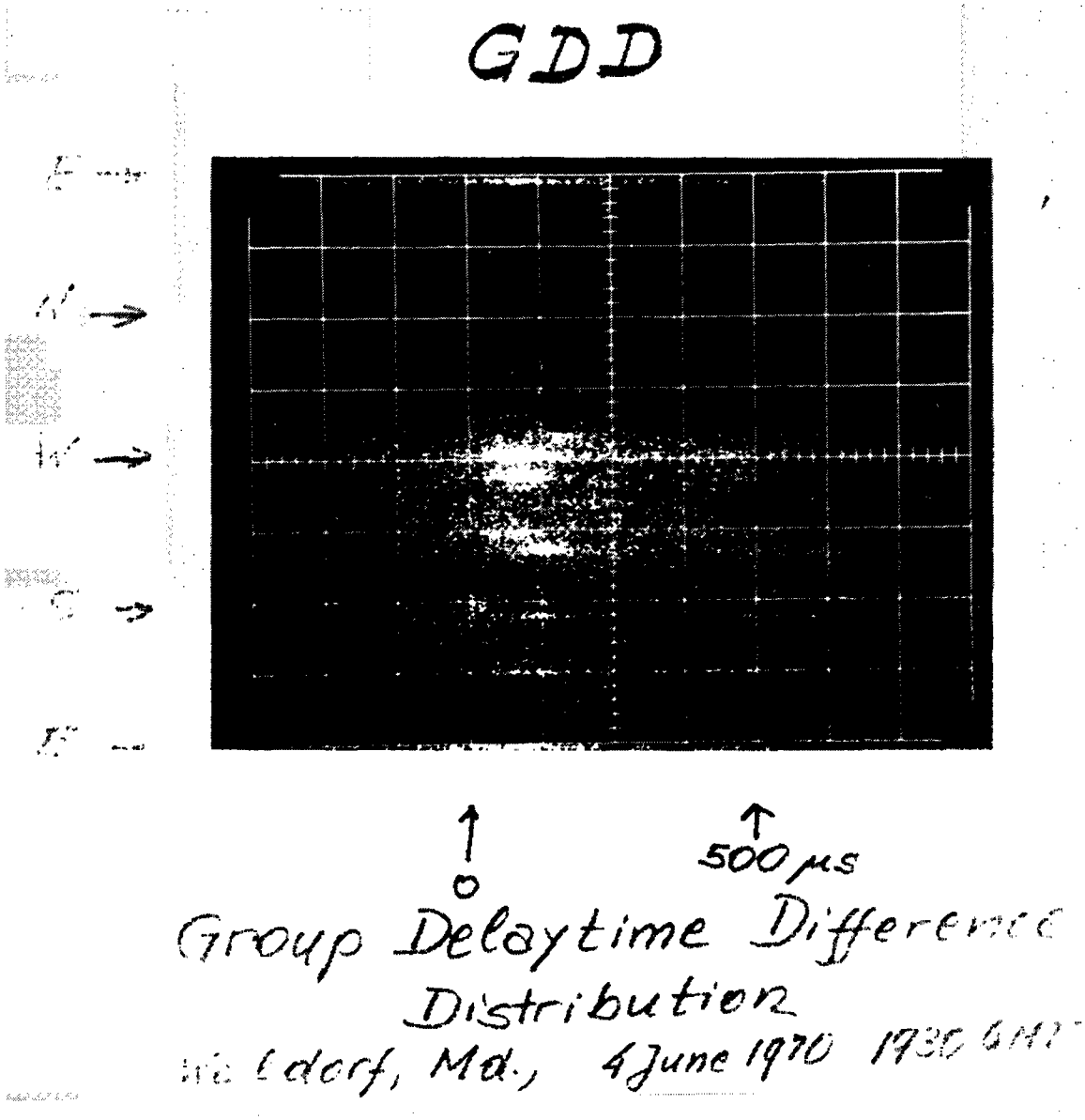

Figure 1. Typical photograph of GDD vs. azimuth.

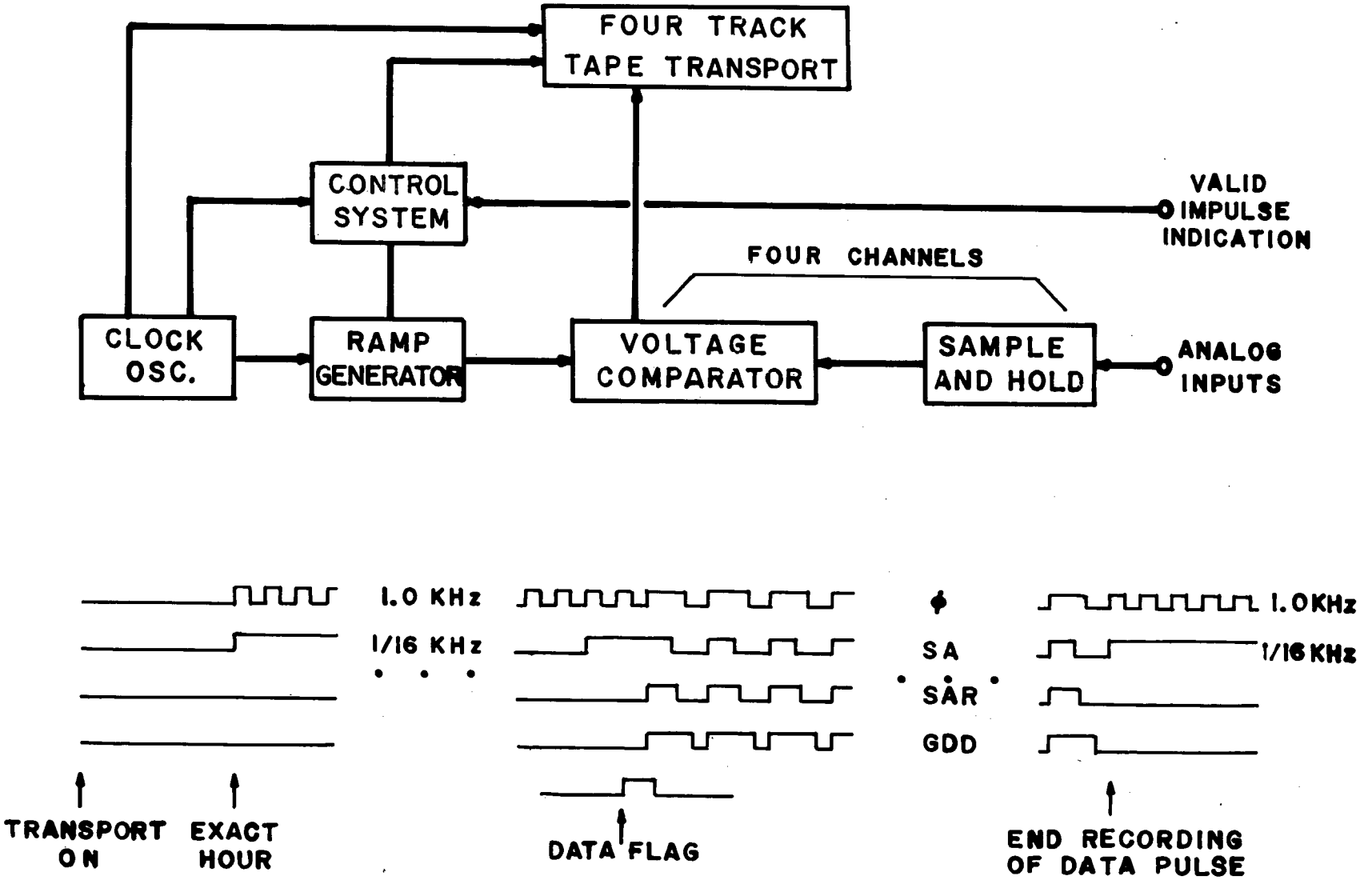

Figure 2. System block diagram with timing sequences indicated.

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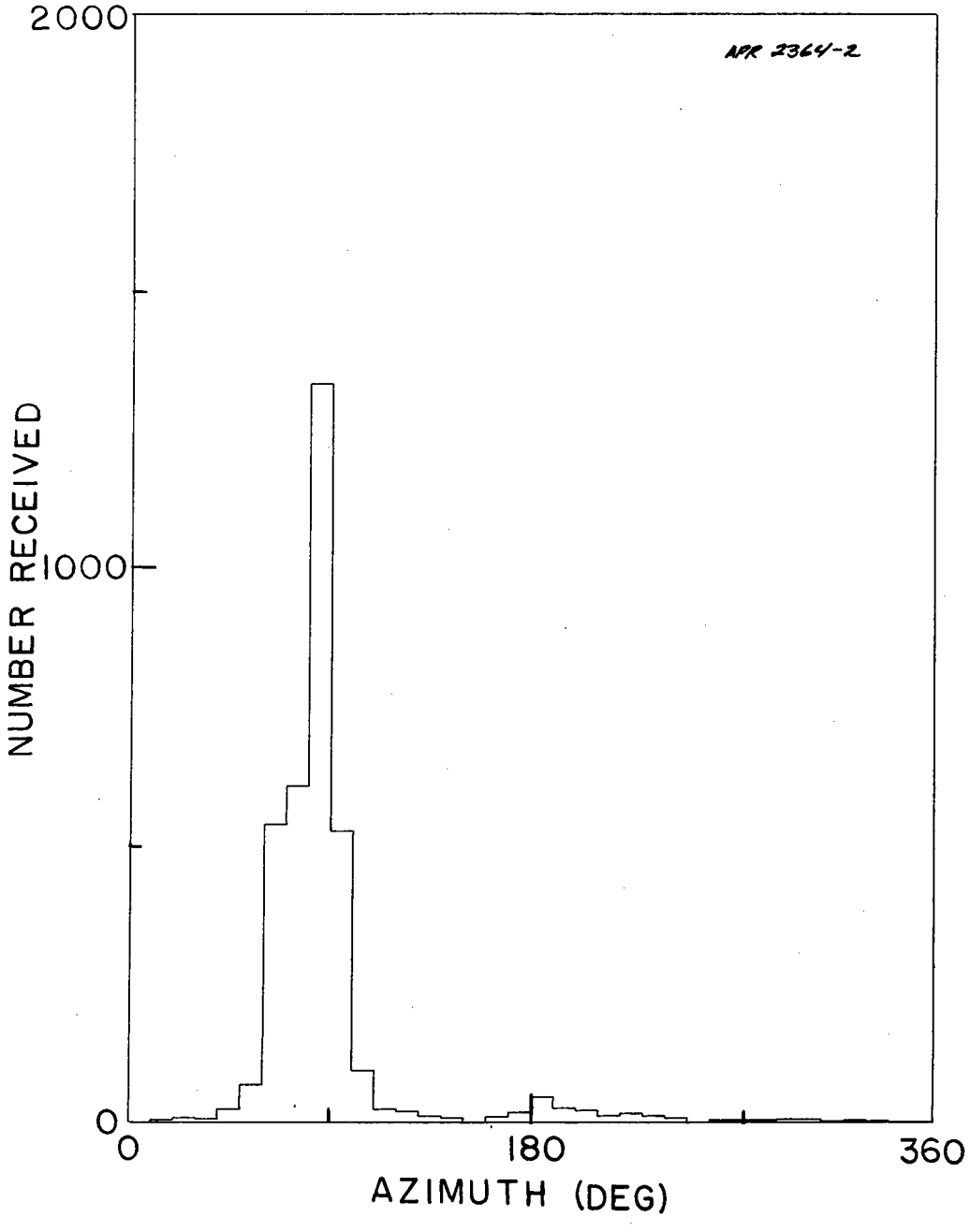

Figure 3. Typical azimuthal distribution of natural signals.

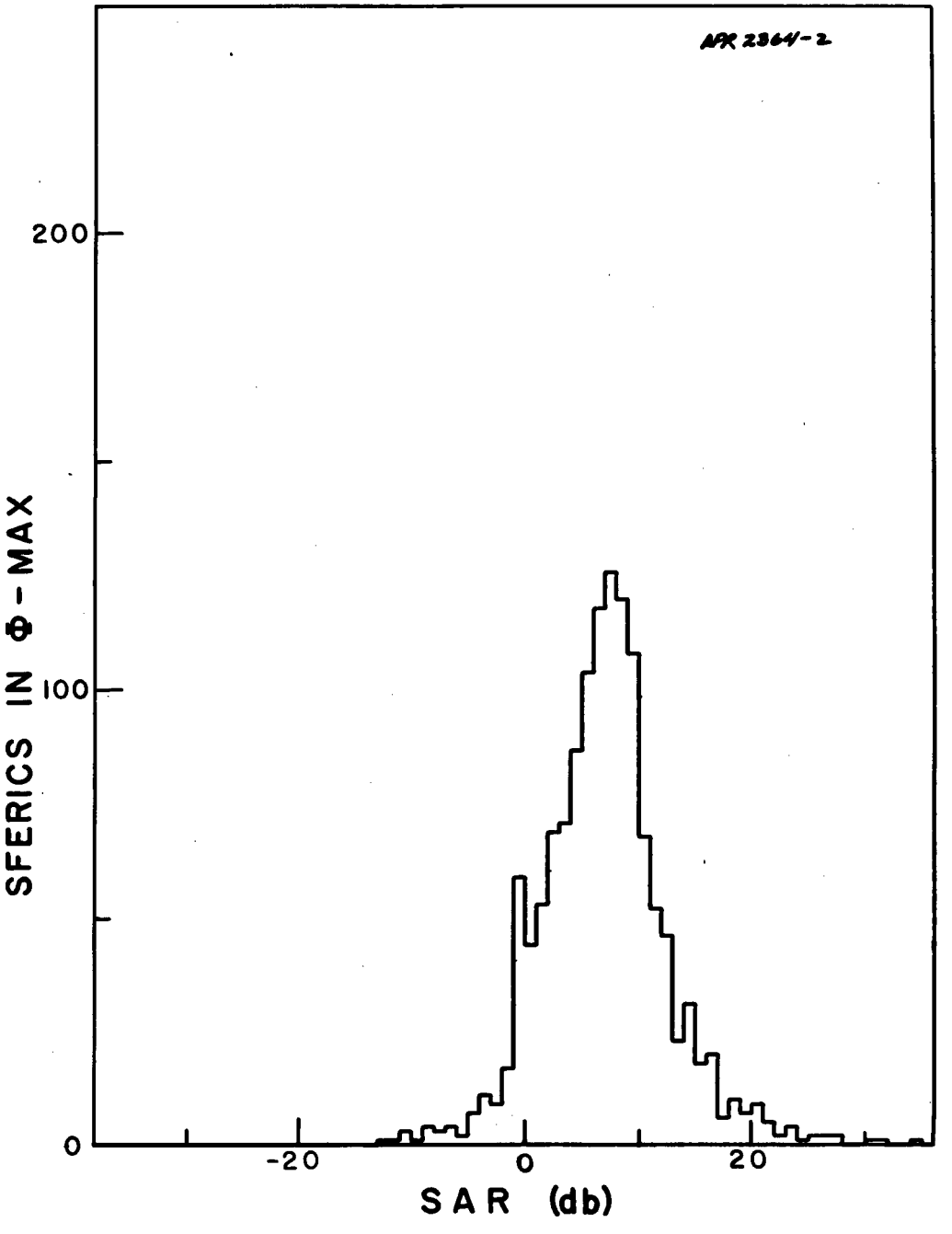

Figure 4. SAR distribution for sferics between 80° and 90° in Fig. 2.

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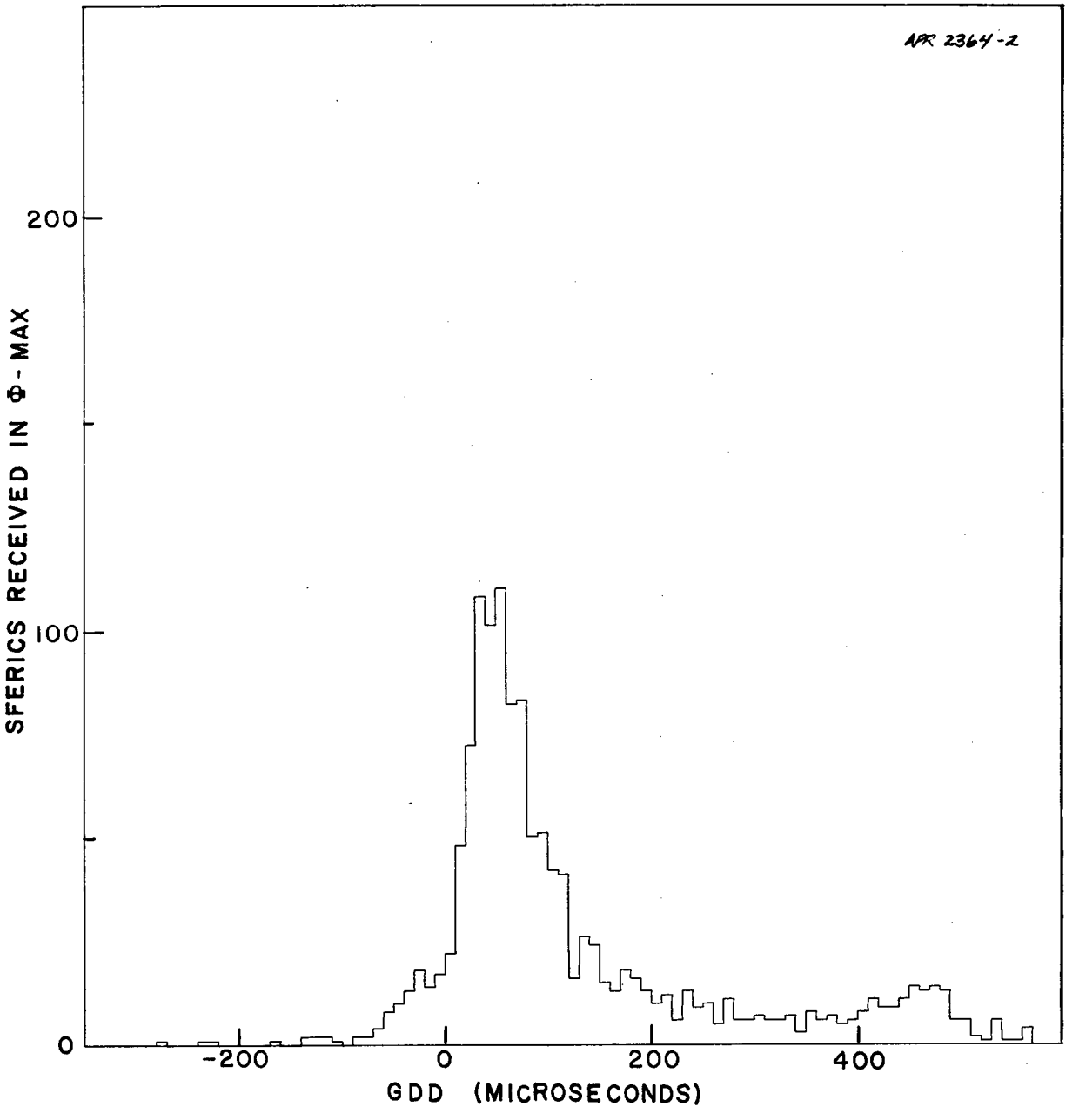

Figure 5. GDD distribution of signals received from the 80°-90° sector.

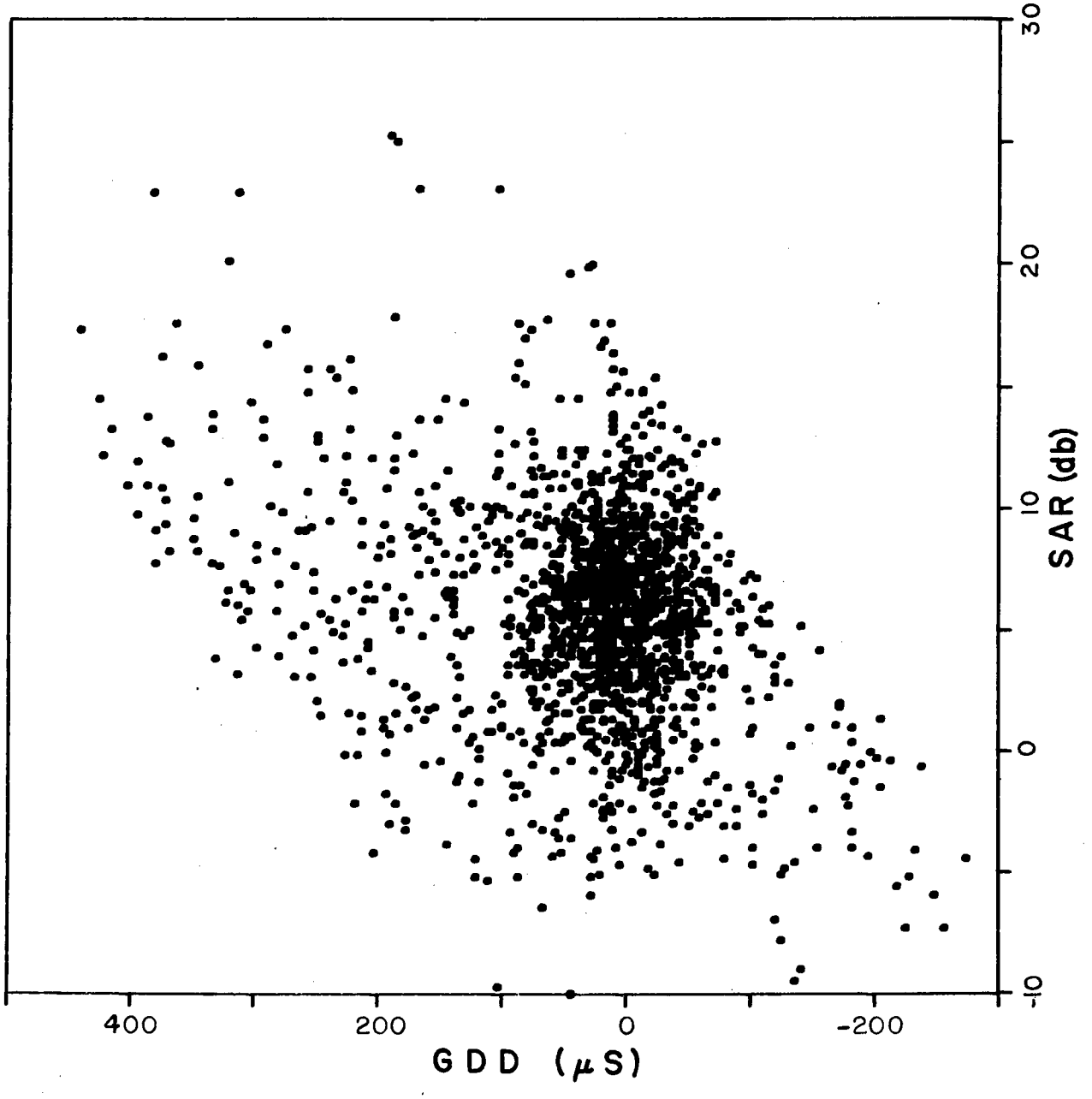

Figure 6. SAR vs. GDD for the sferics in Figs. 4 and 5.

DIGITAL DATA PRESENTATION FOR SPHERICS ANALYSIS

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ABSTRACT

Continuous monitoring of long range lightning activity results in vast amounts of data necessitating digital processing. The multi-dimensional character of the data requires special automatic format and display techniques that compress the data without loss of essential information. Methods known in ionospheric physics for several years are applied to group delay differences (GDD) and spectral amplitude ratios (SAR) collected by NRL at their Waldorf site.

1. Introduction

Technological progress in the last two decades has increased not only the quality of geophysical data but also its quantity, requiring new methods of on-line preprocessing and storage of data. Magnetic tape recording became the most important data storage carrier. The first approach, analog recording, failed because of several reasons. First, accuracy and reproducibility are limited; second, the storage density is insufficient;

third and, above all, access to and use of the data are too difficult. The advantages of digital magnetic tape recording became evident and hence the available analog signals were digitized before recording. Of course, this was too simple an approach if certain elementary rules were not followed, and in most cases they were not.

Only in very recent years did the geophysical community, and here again only a few groups, adopt fully digital methods of on-line digital data handling. The experience in this area that we at the Lowell Technological Institute Research Foundation have accumulated mainly but not exclusively in the field of ionospheric physics may be summarized by the following recommendations.

(1) Measurements should be carried out "digitally", e.g. by counting and by yes/no or larger/smaller decisions.

(2) Transition from analog signals to digital data samples should occur as early as possible, a request which, together with point (1), strongly influences the decision on the method of measurement and the system concept.

(3) Storage of data on digital magnetic tape is presently the best solution considering simplicity, speed, reliability and price. Computer compatible formatting of the data is mandatory and the record length should be limited to

5×2^{10} characters according to an URSI recommendation[1].

(4) Each set of data must be preceded by identifying information, or preface, containing location, year, day, time and all the system variables.

(5) On-line printing of the data as well as on-site replay capabilities are recommended to assure "good data" tapes. The on-line printout is absolutely necessary to allow the operator to control the system performance (analog and digital) and to react to variations of the observables.

2. Data Display

Presentation of data has not always received the attention it deserves. Retrieval of certain signal characteristics depends very much on the formatting of the data and its display. Curves, gray shading, coloring and contour plots are the most common methods used for analog signal display. The latter ones are attempts for a three-dimensional presentation, but the third dimension, say the gray shading, is limited to normally not more than six levels.

Digital data are necessarily presented in form of numbers. Therefore large quantities of data result

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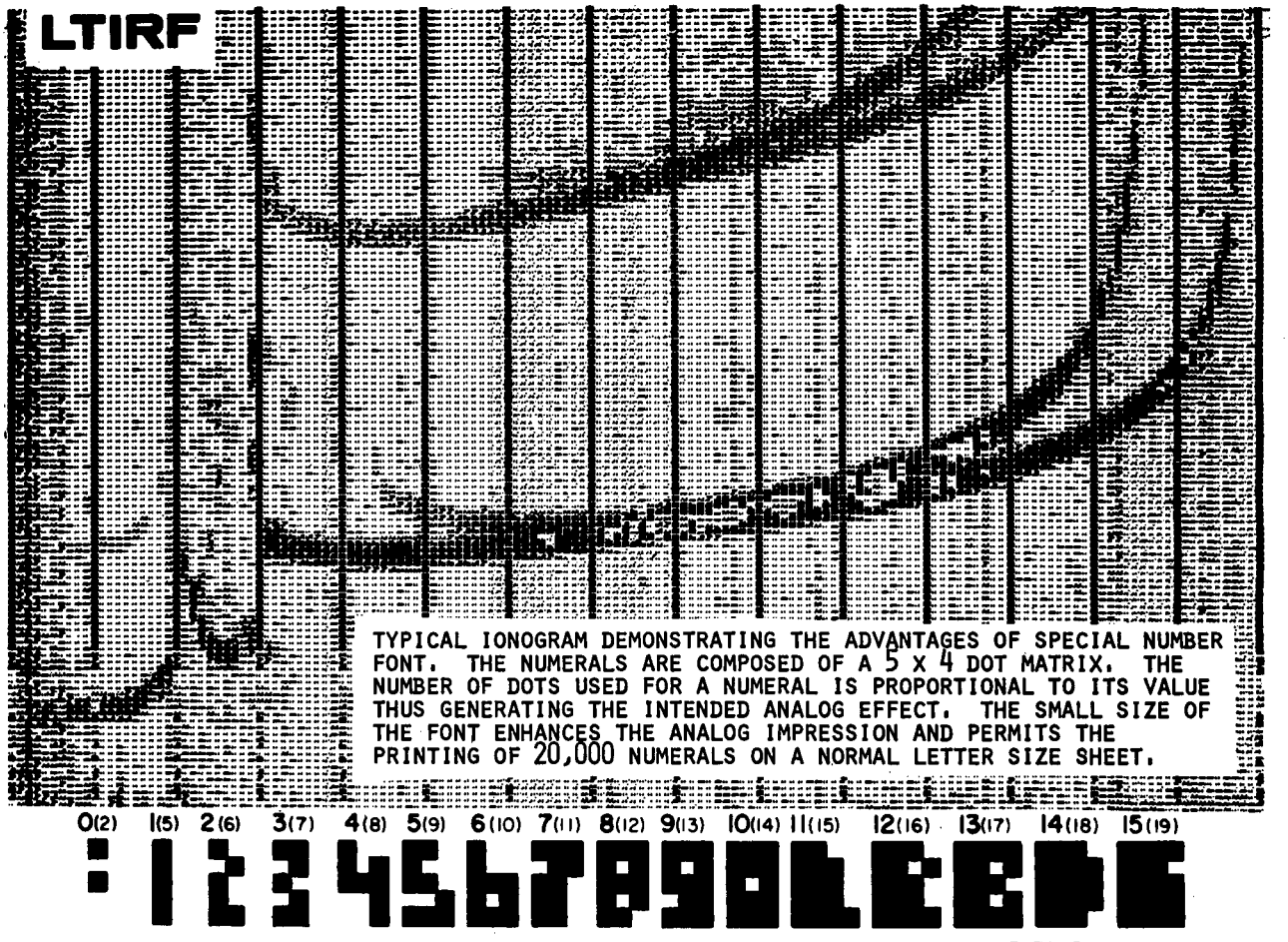
in big number arrays or tables. Trends or periodicities are often not easy to recognize in these tables. To overcome this difficulty we came up with a three-dimensional display system having a special printing font that uses optically weighted numerals and creates a quasi-analog impression while preserving digital accuracy. Figure 1 shows as an example an on-line recorded ionogram[2]. The number font devised by K. Bibl is based on a 5 x 4 dot matrix as shown at the bottom of Figure 1. The small size of the numerals permits to print 30,000 numbers on a letter size sheet. Because of the optical weighting the significant data points emerge by forming a pattern, in Figure 1 the echo traces of E, Es and F-layer (o- and x-component) reflections. Every tenth line of data (amplitude) numbers is replaced by preface lines that contain all system parameters; at the same time they form a clear frequency grid. A photographical blowup of these prefaces is shown in Figure 2.

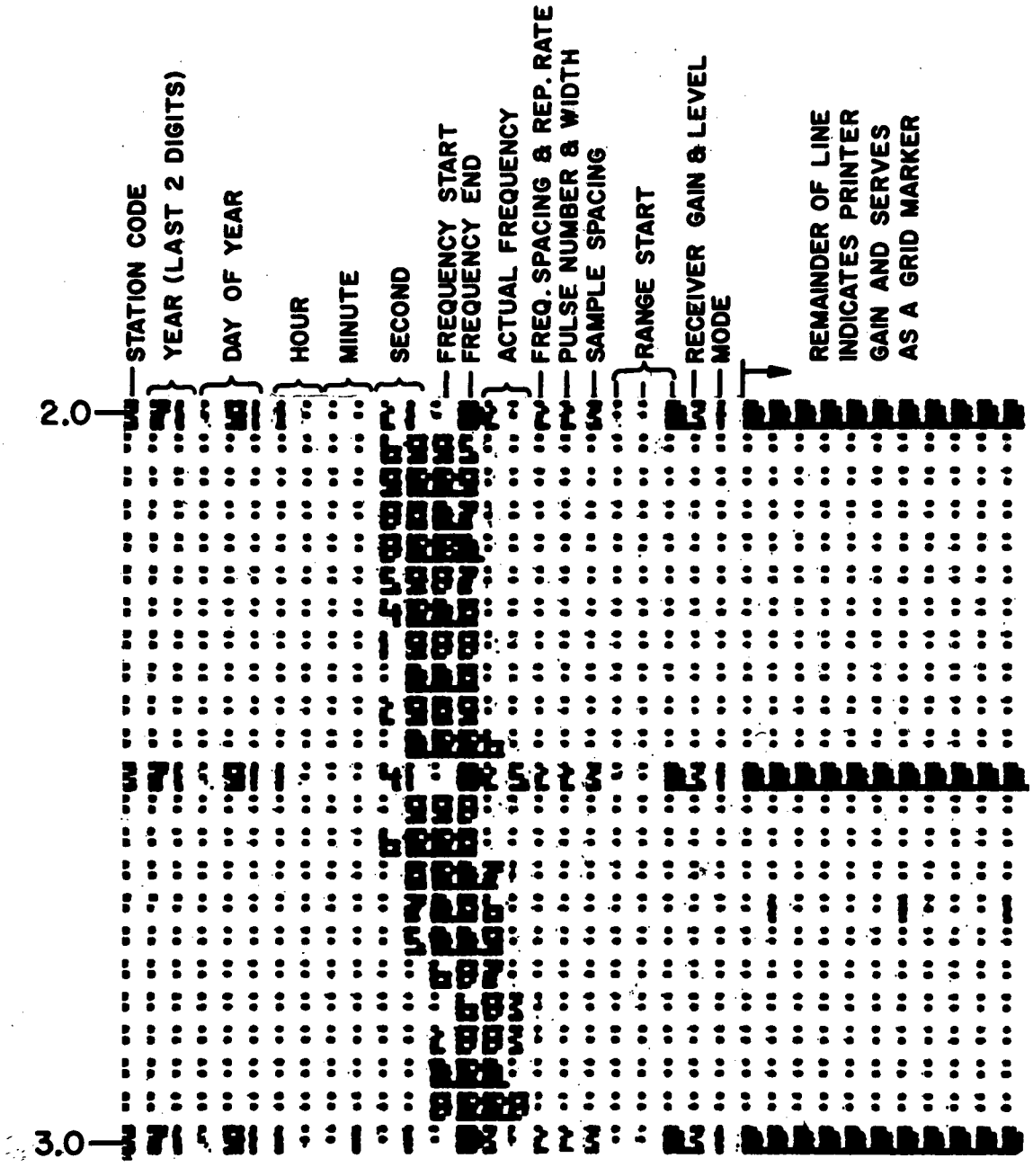
This digital display method is now really three-dimensional allowing 16 levels for the third dimension, which means it is by far superior to analog methods. An excellent control over the quality of taped data is obtained by printing some parts or all of the data while the data are tape recorded. The display system also provides for replay of the tapes and printout of all or selected parts of the data thus giving easy access to the data without use of a computer.



DIGIONOGRAM PRODUCED IN REAL TIME WITH DIGISONDE 128 PATENT PENDING

MAGNITUDE OF COMPLEX AMPLITUDE AS A FUNCTION OF FREQUENCY AND RANGE PRINTED WITH ONLINE PRINTER

Figure 1



DIGIONOGRAM PREFACE

PROPER IDENTIFICATION AND DESCRIPTION OF THE DATA IS MANDATORY FOR THE RECORDING OF ALL DIGITAL DATA. UP TO 99 PREFACE CHARACTERS CAN BE PRINTED IN THE THREE-DIMENSIONAL DISPLAY SYSTEM BY SKILLFULLY INTERLACING THE DATA WITH THE PREFACE. THE PHOTOGRAPHIC BLOW-UP SHOWS A 24 CHARACTER PREFACE AS AN EXAMPLE.

Figure 2

3. Display of Spherics Data

Different techniques for locating thunderstorms by radio observation are known and a detailed survey was given by Horner[3]. The demand for on-line digital data processing is urgent but fast access to the measurements must be preserved to make them useful for meteorological warning and forecasting services.

Once in digital form the data can be easily formatted in many desired ways. One highly desired output format is, of course, a world map that covers the observational range of the system and indicates the different regions of instantaneous activity. This presumes that a unique relation exists between the observed parameters and the thunderstorm location. The Heinrich-Hertz Institut's VLF-Atmospherics Analyzer seems to be well prepared for this goal.

From NRL's Waldorf station we received a digital magnetic tape with a sequence of four parameters of atmospherics observed with the VLF-Atmospherics Analyzer on 8 March 1972 from 1735 h to 2100 h. Since the tape provided no preface information, i.e. no time of occurrence of the individual atmospherics, we simply presumed - of course incorrectly - that the same number of atmospherics was observed in each 2.5 min interval. Then the apparent distribution of atmospherics as function of time and bearing appears as in Figure 3. Each line of

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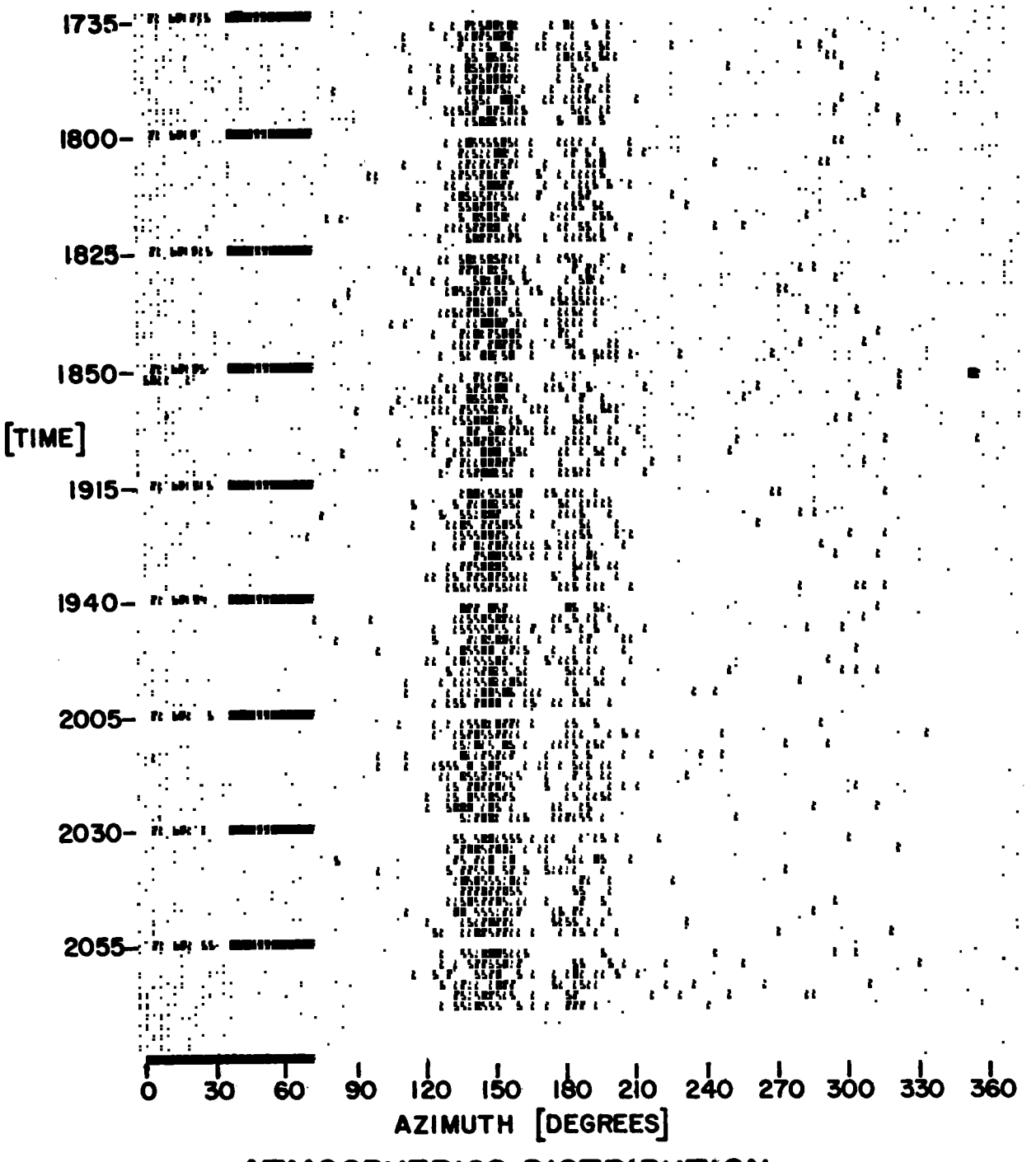

ATMOSPHERICS DISTRIBUTION AS FUNCTION OF TIME AND AZIMUTH

Figure 3

numbers represents a 2.5 min observation time, and the numerals indicate the number of atmospherics within a $\Delta\phi = 3°$ azimuth interval (before printing all numbers were multiplied by 2.5). Year 72 and day 068 are printed in the preface as well as the time varying from 17 h 35 min to 21 h 10 min. Two clear distribution peaks occur around bearings of 150° and 190°.

In Figure 4 the atmospherics distribution is presented as functions of GDD and bearing, the latter incrementing in 1° steps. The azimuth angles ϕ are indicated in the preface. The number of atmospherics within each digital bin, defined by $\Delta\phi = 1°$ and ΔGDD = 8 μsec, is scaled to a maximum of 63, as permitted by a six bit binary representation. A small computer program, prepared by Piotrowski of LTIRF to sort and format the original NRL data, automatically determines the highest density number of all bins. Since this number was 16 we listed the fraction 63:16 = 3.93 in the preface. The value of 1 was subtracted from all numbers to eliminate insignificant scatter.

The appearance of Figure 4 is very similar to the photographic recordings of Heydt, Frisius and Volland[4], the digital display, however, permits definite rules for the determination of the center and spread of the clusters.

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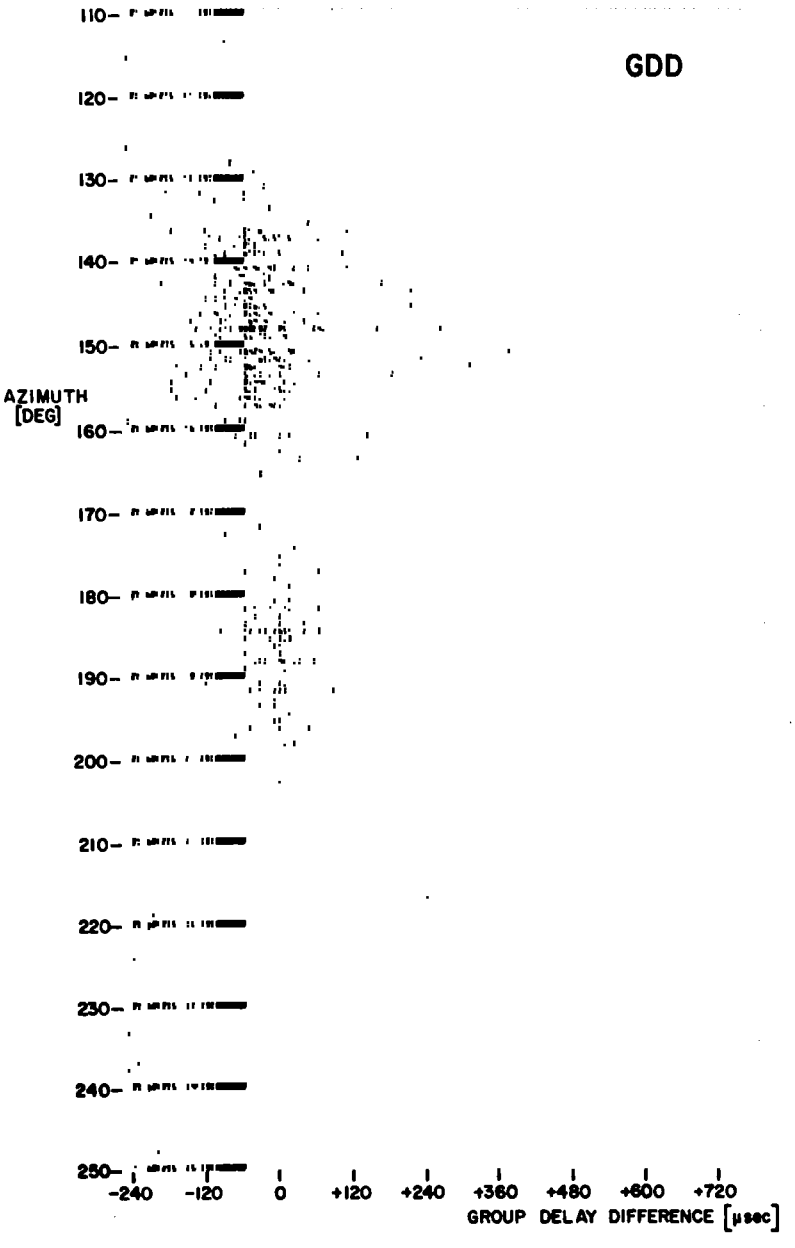

ATMOSPHERIC DISTRIBUTION AS A FUNCTION OF AZIMUTH AND GROUP DELAY DIFFERENCE

Figure 4

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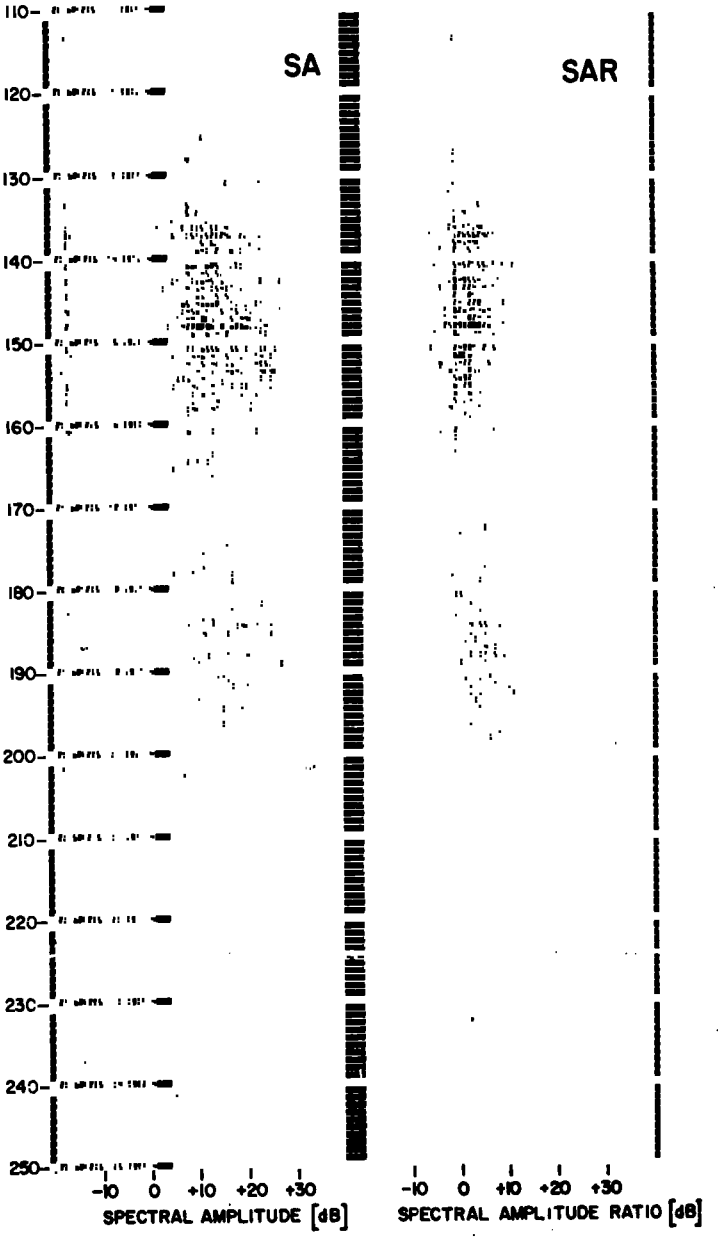

ATMOSPHERIC DISTRIBUTION AS A FUNCTION OF AZIMUTH AND SPECTRAL AMPLITUDE vs SPECTRAL AMPLITUDE RATIO

Figure 5

This applies as well to the SA and SAR distributions shown in Figure 5 as function of bearing. As in Figure 4 only the azimuth range from 110° to 250° is shown because the activity outside this range is negligibly small.

4. Conclusion

The ease of formatting and the high storage density of digital data makes the digital approach very attractive for geophysical research where the important phenomena are often buried in the vast data reservoir. The three-dimensional digital display system gives fast and convenient access to the data for surveys and analysis. Properly formatted digital tape recordings allow rapid computer analysis.

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II

The Physics of the Sferics Emitter: - Lightning

Monday, 11 September 1972, 1330 - 1445 EDT, Arlington, Virginia

Chairman: R. E. Orville

Papers presented:

"Source Characteristics of Atmospherics Generated by Lightning"	Edward T. Pierce
"Return Stroke Current Forms and a Semi-Theoretic Description of the Source Current"	Robert D. Hill
"Electric Field Intensity of the Lightning Return Stroke"	Martin A. Uman D. Kenneth McLain Richard J. Fisher E. Philip Krider
"Currents in Florida Lightning Return Strokes"	Martin A. Uman D. Kenneth McLain Richard J. Fisher E. Philip Krider

SOURCE CHARACTERISTICS OF ATMOSPHERICS GENERATED BY LIGHTNING

by

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ABSTRACT

Past work is briefly discussed. It is pointed out that the source properties of atmospherics can be deduced in two ways. Firstly, experimental data obtained at various ranges can be extrapolated to zero distance thus eliminating the propagational effects. Secondly, semi-empirical models of the source, based on close observations, can be developed and used to determine the sferic characteristics. The two approaches yield comparable results, and indeed--whatever the approach--almost all the researches of the past ten or more years are in fairly good agreement. Throughout the paper the main emphasis is on the VLF (3 to 30 kHz) band, but some consideration is also given to the LF and ELF bands. Special discussions are given of the amplitude spectrum of the VLF pulse due to the return stroke; of the VLF-ELF dispersion involved in the propagation of a "slow tail" atmospheric; and of the VLF signals associated with K phenomena.

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I INTRODUCTION

The duration of a lightning discharge is appreciable; the average is some 300 to 400 ms. During this time the field as measured close to the flash (where the electrostatic or near field component is dominant) is continually changing. However, the rates of change of field over the discharge duration are quite variable, since a multiplicity of various types of sparks is involved.

At frequencies of the order of a few hertz the flash--because of the long time it occupies--is essentially generating signals over its entire duration. However, as the frequency increases to the VLF range, the atmospherics are produced more discretely and largely in association with return strokes (for flashes to earth) and--to a lesser extent--with K recoil streamers (for all discharges). With a further increase in frequency to the HF and VHF bands smaller sparks become significant pulse generators; as many as 10^4 pulses can be generated per flash.[1*] However, at radar frequencies the signals are again discrete and associated with return strokes. Some of these features are illustrated in Figure 1.

II THE EXPERIMENTAL APPROACH

The characteristics of an atmospheric (A) are due to both source (S) and propagation (P) effects. Generally we may write

$$A = S \times P \quad .$$

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*References are listed at the end of the paper.

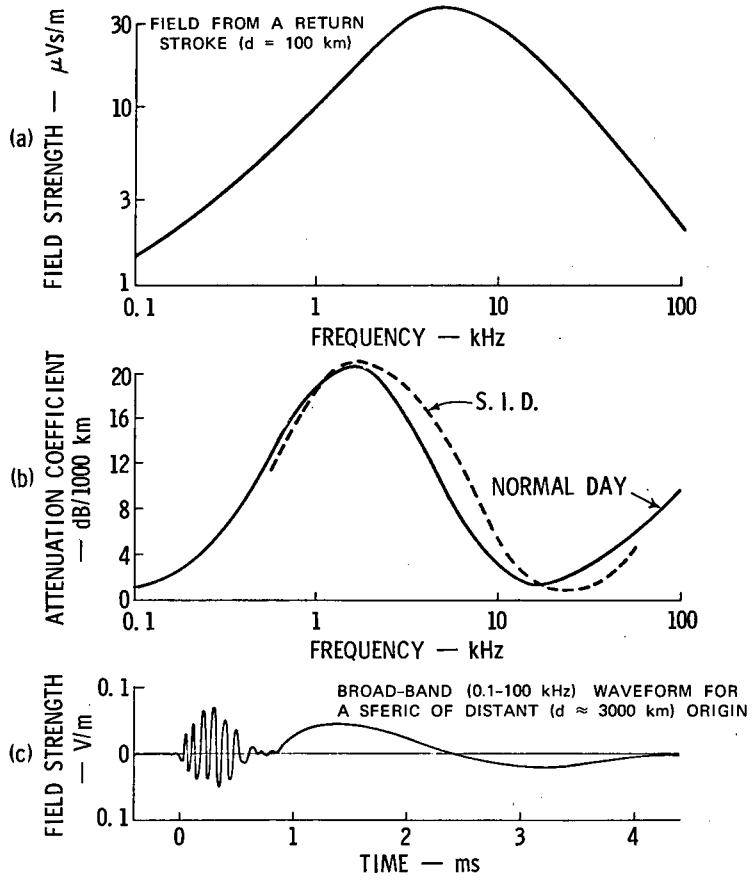

FIGURE 1 ILLUSTRATING SOME FACTORS IN THE FORMATION OF A SFERIC

For an individual atmospheric, S can be considered as being a Fourier representation containing both phase and amplitude spectra over the frequency range of interest; the form of the disturbance is thus defined.

Considering the VLF and EEF bands alone, the propagation factor, P, is primarily a function of distance, and may be considered to contain an amplitude attenuation factor and a phase shifting or dis-

persive factor; both of these will be frequency and distance dependent, and will be complicated by other influences. The propagation takes place in the quasi waveguide formed by the earth and the lower edge of the ionosphere. As such it is responsive to effects at either boundary. For a given path between source and receiver, the propagation influences may be relatively stable, may vary in a smooth and foreseeable manner, or may be transient and largely unpredictable. Examples falling in the first category would be the effect of the path orientation with respect to the earth's magnetic field, and the influence of the conductivity of the lower boundary (land, water, ice, or permafrost). The transition of the ionospheric D region from day to night represents a regular variation; while a transient effect would be the extra ionization or sudden ionospheric disturbance (SID) resulting from a solar flare.

Figure 2 illustrates how source and propagation effects combine in producing the characteristic waveform at VLF and ELF of an atmospheric of distant origin.

If atmospheric waveforms (of various polarizations and component fields) which may of course be translated into phase and amplitude spectra, are recorded over a series of distances, then information both on propagation effects and on source characteristics (by extrapolating to zero distance) can be obtained. This approach has been very effective in the past. Initially recording techniques were simple; only a simple experimental station was employed; and the distance and direction of the flash generating the atmospheric could only be roughly estimated. Subsequently, recording methods have become much more sophisticated; individual flash

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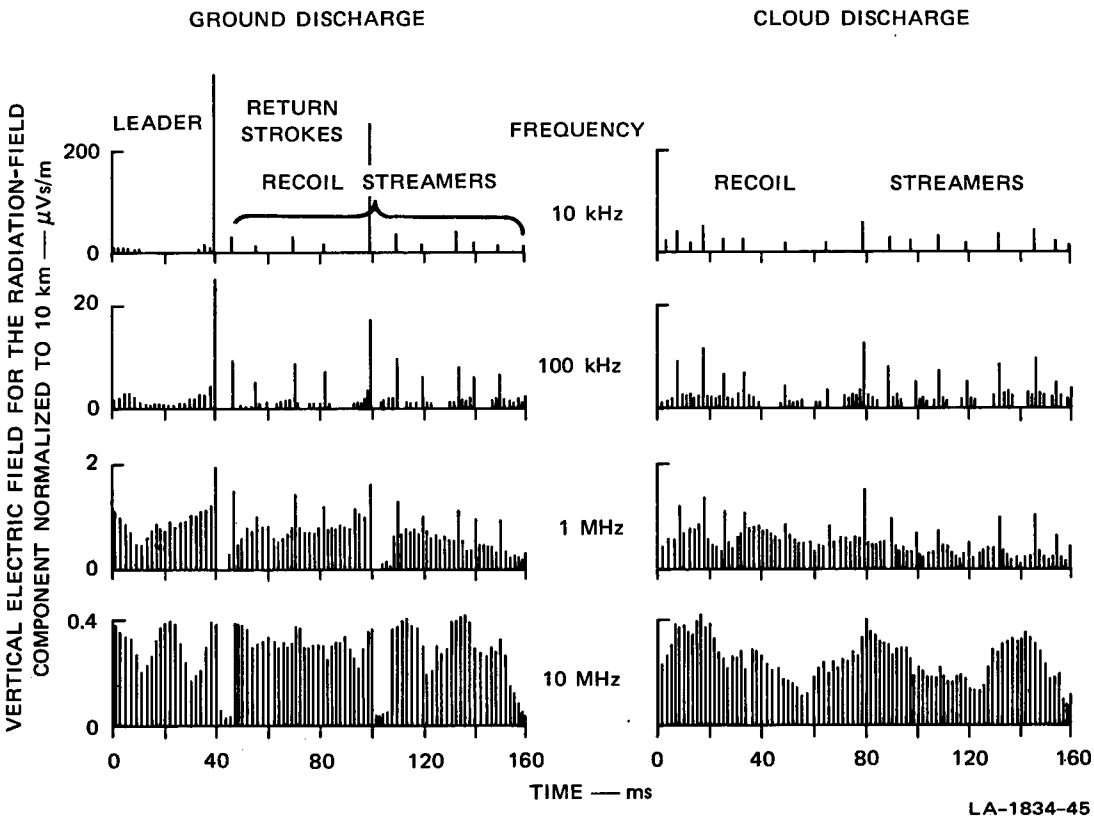

FIGURE 2 STRUCTURE OF THE FIELDS RADIATED BY LIGHTNING AS A FUNCTION OF TIME AND FREQUENCY

location can be made precisely; and several stations widely separated spatially often record the same atmospheric. Unless all these three factors are achieved a present-day investigation is most unlikely to yield results that have not been effectively obtained before; it is regrettable therefore that there is still some tendancy to employ the cruder methods of the past.

III THE THEORETICAL-EMPIRICAL APPROACH

At VLF and ELF, the propagation effects can be estimated from theoretical analyses applied to the earth-ionosphere waveguide system, with the electrical properties of the boundaries being represented semi-empirically on the basis principally of experimental information. These analyses, as developed by Wait,[2] Galejs,[3] and others, have proved extremely profitable.

A somewhat similar approach can also be applied to the source characteristics. These are derived from theoretical analyses of the signals radiated by lightning channels of known length and orientation and energized by currents with known properties. The information on the channel and current variations is derived semi-empirically from experimental observations on close discharges. Typically, for example, the properties of the VLF pulse radiated by a return stroke are deduced from the variation with time of channel length, ℓ_t, and channel current, i_t.

The theoretical-empirical approach to source characteristics has yielded some valuable results; these have been quite consistent with the deductions from the experimental approach (extrapolating back to the source). However, there is perhaps now an over-proliferation of source models. It is dubious if there is any justification for further models unless they involve significantly novel physical developments or incorporate substantial new experimental information. The mere alteration--with no justification--of a parameter value is a quite trivial exercise.

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IV SOME ILLUSTRATIVE EXAMPLES

The relevant literature on atmospherics is very extensive; there are over a hundred papers, for example, directly bearing on the VLF amplitude spectrum of the pulse due to a return stroke. We select, therefore, three illustrations of how source characteristics can be deduced either by the experimental or by the theoretical-empirical (model) approaches. These illustrations are chosen because of their relevance to the general problem of flash location by VLF and ELF methods.

A. Spectrum of the Return-Stroke Pulse

Figure 3 shows ten representations (arbitrarily chosen from the hundred or so available in the literature) for the amplitude spectrum of the VLF pulse due to a return stroke.[4-13] Five of the representations are deduced by the experimental approach of extrapolating to zero source distance; the other five are derived by the model method of postulating source characteristics and then calculating the VLF spectrum. With the exception of the spectrum due to Chapman and Matthews[9] (propagation influences were obviously not completely eliminated in this instance) the spectra are all remarkably similar. Perhaps the only discernible trend is an acceptance of a shift in the frequency of maximum amplitude from about 8 kHz in the earlier work to perhaps 5 kHz in the later papers. Generally, however, the feeling given by Figure 3 is one of "plus ça change c'est la même chose."

The representations By Pierce[10]--experimental--and Hepburn[5]--semitheoretical--are of some interest. The experimental curves give

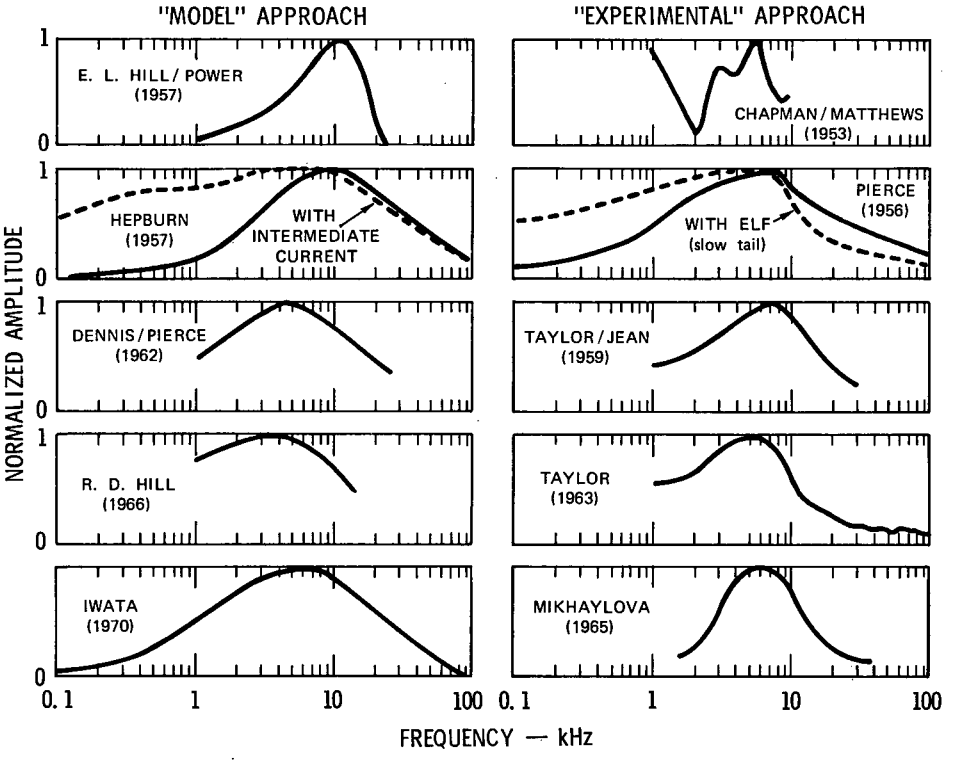

FIGURE 3 AMPLITUDE SPECTRUM OF "SOURCE" VLF PULSE DUE TO "AVERAGE" RETURN STROKE

spectra for atmospherics with and without strong ELF ("slow tail") components; the Hepburn curves are derived for sources with and without the intermediate current mainly responsible for the "slow tail." I do not know of any later data covering entirely this wide (0.1 to 100 kHz), and fundamentally important, frequency range.

B. VLF/ELF Dispersion in Atmospheric Waveforms

Figure 4 shows some of the experimental information readily available[14-18] on the separation of the VLF and ELF (slow tail)

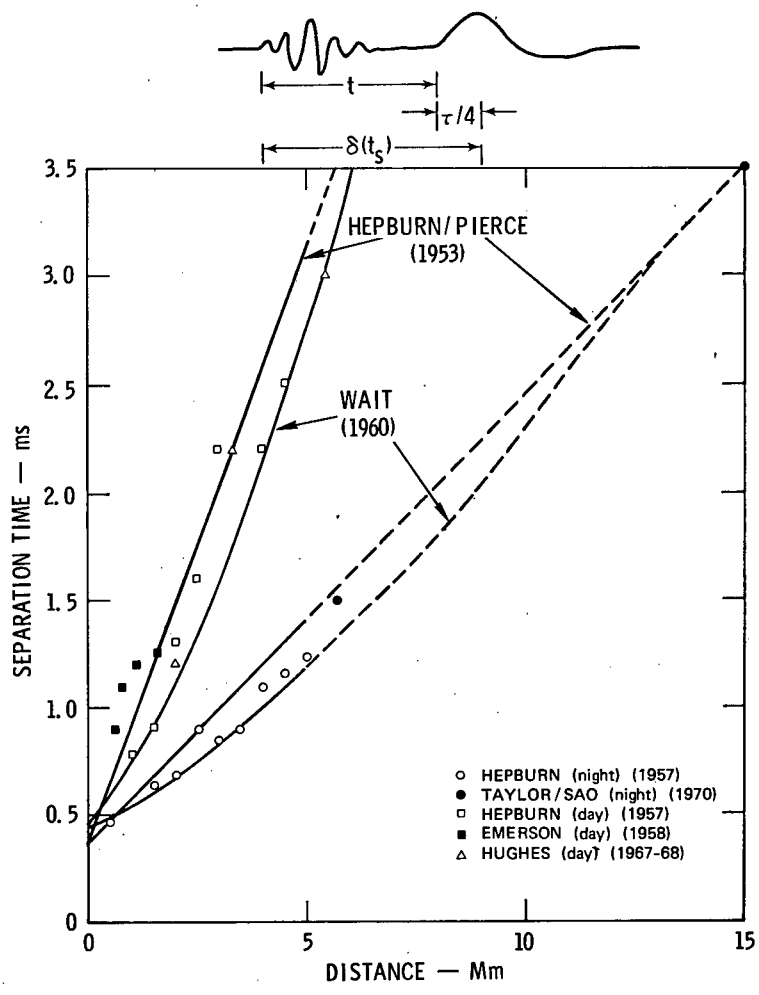

FIGURE 4 VLF-ELF DISPERSION IN AN ATMOSPHERIC

components of an atmospheric as a function of distance. The propagation is dispersive and--as has been well-known for very many years--the separation time, t_s, or δ as it is sometimes denoted, can therefore be used to estimate the distance of an incoming atmospheric.

As an appropriate digression, this dispersive technique is of course that involved in the GDD approach used in the Berlin equipment; the potentialities of this equipment are discussed in several papers at this conference. The Berlin method, however, considers the dispersion only over a limited range in the VLF band; the effective time separation is consequently much less than that between the VLF and ELF components.

The dispersion technique is not the only method of determining the source distance from the characteristics of an incoming atmospheric, and therefore--in conjunction with a direction-finding system--of locating the source of the atmospheric from a single observing station. Several such techniques are available.[19,20] Among them are methods based on the amplitude; the amplitude spectrum; the spacing of successive ionospheric echoes; the skip distance; and so on. All these techniques have had some success for limited geographical and temporal conditions. Generally speaking, however, no single-station method-including the dispersion technique--has ever achieved location accuracy comparable with that attained by multistation systems.

The two straight lines on Figure 4 were an empirical fit by Hepburn and Pierce[21] to their experimental data. They have the general form

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$$t_s = A + Bd \tag{1}$$

where A is a constant representing the effective time between the generation of the main VLF and ELF impulses at the source, while B is a propagational constant depending mainly on lower ionospheric conditions (conductivity and height of boundary). With t_s in ms and d in Mm, Hepburn and Pierce[21] found A to be 0.36, while by day $B_d = 0.56$ and at night $B_n = 0.21$. Wait[22], using wave-guide theory, deduced that the relationship between t_s and d should have the form

$$t_s = 0.9\{C + Dd\}^2 \tag{2}$$

where, again, $0.9\ C^2$ is the source separation and D is a propagational constant. With the same units as before Wait found $C = 0.7$ giving a source separation of 0.44 ms, while $D_d = 0.21$ and $D_n = 0.09$.

Note that as regards fitting the experimental data Figure 4 shows that there is little to choose between the empirical straight lines of Hepburn and Pierce[21] and the more correct, wave-guide deduced, curves of Wait.[22] In both instances, extrapolation to zero distance shows that the main contribution to the slow tail appears to be generated at the source about 400 μs after the VLF pulse. This time is quite consistent with an origin for the slow tail principally in the intermediate current that often follows the first surge of current in the return stroke. However, the 400 μs is an average figure. It should always be remembered that the physical picture of the source indicates substantial ELF generation before, during, and after (principally), the initial surge of the return stroke.

C. VLF Pulses Due to K. Pheonomena

Figures 3 and 4 bring together some past information. For my last example let me present something more novel. The K recoil-streamers generate substantial VLF pulses, as we have seen earlier (Figure 1), although these pulses are about an order of magnitude less in amplitude than those due to return strokes. There is a good deal of information scattered in the literature on K effects. Much of this is not apparently self-consistent. Thus estimates from electrostatic measurements or luminosity observations of the charge carried and velocity of a K streamer, are not obviously compatible with records of the radiated VLF pulses.

A study and analytical development that is still continuing has enabled most of the information on K effects to be reconciled.[23] As an illustration of part of this study the typical model form deduced for a K pulse is shown on Figure 5 with a return-stroke pulse also given for comparison purposes. For both pulses, only the VLF component is effectively represented since the continuing or intermediate currents, that certainly exist, are not included. The K pulse besides being about an order of magnitude less than the return-stroke pulse also occurs rather more rapidly. Thus the amplitude spectrum--as compared with that of the return-stroke pulse--is shifted towards higher frequencies.

The existence of K pulses as well as return-stroke pulses can cause practical complications in studies of VLF noise,[24] and also when VLF techniques are used for locating thunderstorms. K pulses in a flash to ground can occur in the intervals between return strokes or after the last return stroke; the pulses will usually--

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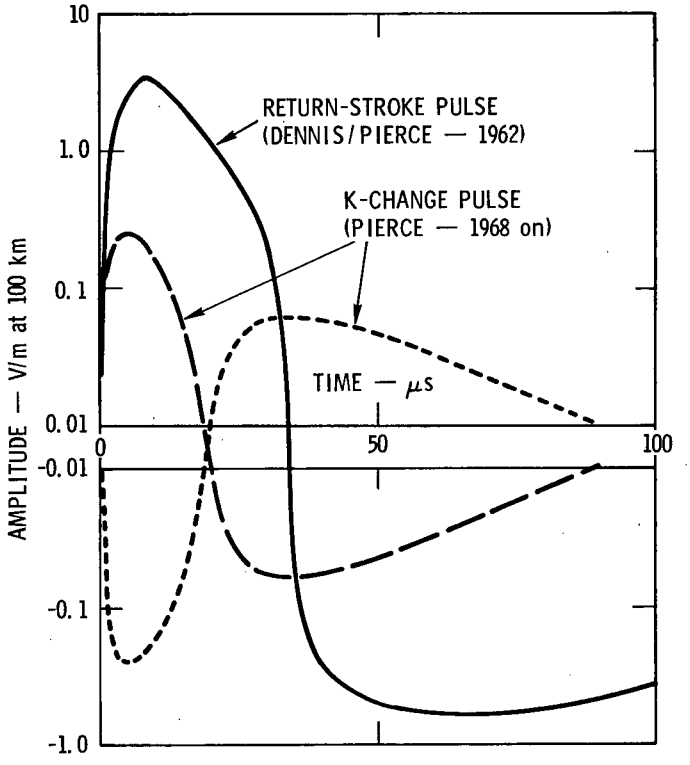

FIGURE 5 MODEL PULSES (excluding ELF-continuing current)

but not invariably--be positive. For an intracloud flash K pulses can take place at any time; the pulses will then normally--but again not invariably--be negative. Although K pulses are much smaller than return-stroke pulses they occur much more often. Thus an intracloud discharge lasting 300 ms might produce 50 K pulses; consequently the statistical amplitude distribution of the pulses implies that the larger K pulses will be comparable in magnitude with those due to the less energetic return strokes.

V ACKNOWLEDGMENTS

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RETURN STROKE CURRENT FORMS AND A SEMI-THEORETIC DESCRIPTION OF THE SOURCE CURRENT

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ABSTRACT

An analysis of the first return stroke of a lightning discharge has been made using an elementary circuit model and network theory of lumped circuit elements that vary with time. The Bruce-Golde formula customarily used to describe the current pulse can be understood in terms of theoretical characteristics of the return-stroke channel. The possibility of oscillation of the pulse is suggested, and it is conceivable that oscillations have been observed but not associated with the theory postulated.

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CURRENT FORMS

Three often-quoted formulas for representing the return-stroke current of a lightning flash are shown in Figure 1. A single pulse lasting approximately 60 microseconds is often represented by the 2-exponential Bruce-Golde formula. A third exponential term was introduced by Hepburn to represent the continuing current of a return stroke pulse lasting for some 100's of microseconds after the main pulse. This formula was further elaborated by Williams and Galejs. The numerical values of the parameters in the formulas have often been modified by other workers.

MODELS OF RETURN STROKE CIRCUIT

Brief references to the workers who have proposed transmission-line models to represent the lightning return-stroke circuit are given in Figure 2. The circuit diagrams shown in Figure 2 illustrate the approach taken by Oetzel who pointed out that when $(R^2/2L)^2 >> (1/LC)$, where R, L and C are the resistance, inductance and capacitance per unit length of the transmission line, then the current $I(t)$ can be shown to be given by the usual 2-exponential formula.

FIGURE 1: CURRENT FORMS

BRUCE-GOLDE (1941)

$$I(t) = 3.0 \times 10^4 \, e^{-4.4 \times 10^4 t} - 3.0 \times 10^4 \, e^{-4.6 \times 10^5 t} \quad (t \text{ in s})$$

(I(t) IN AMPERES)

$$I(t) = I_o(e^{-at} - e^{-bt})$$

HEPBURN (1957)

$$I(t) = 2.0 \times 10^4 \, e^{-5.0 \times 10^4 t} - 2.5 \times 10^4 \, e^{-5.0 \times 10^5 t}$$
$$+ 5 \times 10^3 \, e^{-7.0 \times 10^2 t}$$

WILLIAMS-GALEJS (1966)

$$I(t) = 1.5 \times 10^4 \, e^{-3.0 \times 10^4 t} - 1.7 \times 10^4 \, e^{-5.9 \times 10^5 t}$$
$$+ 1.0 \times 10^3 \, e^{-2.0 \times 10^3 t} + 4.5 \times 10^2 \, e^{-1.5 \times 10^2 t}$$

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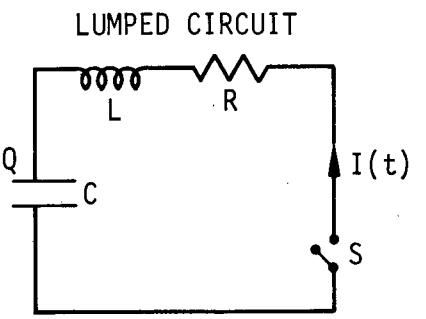
FIGURE 2: TRANSMISSION-LINE MODELS

FORTESQUE, ATHERTON AND COX (1929) Z_o = 200 ohm

GOODLET (1937) Z_o = 500 ohm

BEWLEY (1933)

OETZEL (1968)



FOR $(\frac{R}{2L})^2 >> \frac{1}{LC}$

$$I(t) = I_o(e^{-at} - e^{-bt})$$

SEMI-THEORETIC APPROACH TO CURRENT FORMULA

The circuit considered in the present treatment is given in Figure 3. All circuit elements are now considered to be variable with time and are shown in Figure 3 with arrows. A difference of the model from earlier models is the distinction between the stroke channel elements (signified with sub-s) and the leader column elements (signified with sub-ℓ).

The semi-theoretic basis of the present study is the numerical calculation of the variation of the return-stroke characteristics from the author's computer analysis of heating of the lightning return-stroke channel. An illustration of the variation of the diameter d_s and resistance per unit length r_s of the return-stroke channel for a particular set of "typical conditions" is given in Figure 4. Since it was assumed in the code that the current everywhere along the channel was the same and also had the same time variation, the value of r_s shown is taken to represent some "average" value of the resistance per unit length of the channel as a function of time.

Calculated values of C_s , R_s and L_s of the whole stroke channel as a function of time, and of C_ℓ , R_ℓ and L_ℓ of the whole leader channel as a function of time are given in Figures 5 and 6, respectively. Certain

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FIGURE 3: EQUIVALENT LUMPED CIRCUIT

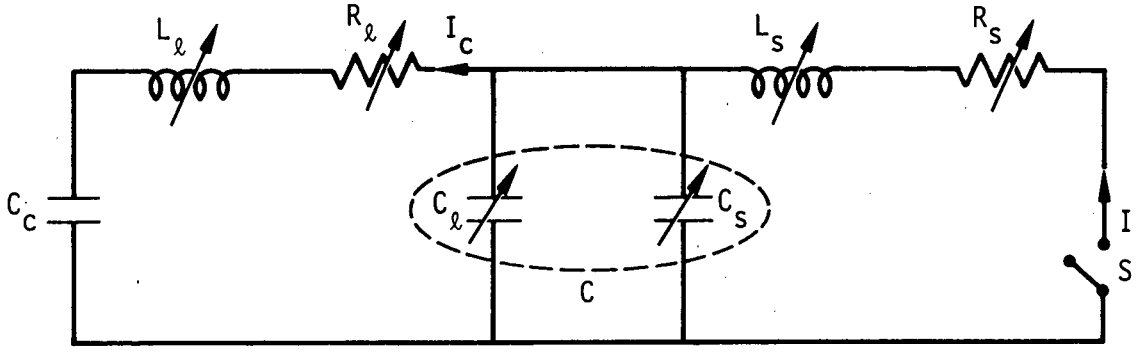


FIGURE 4: STROKE CHANNEL CHARACTERISTICS

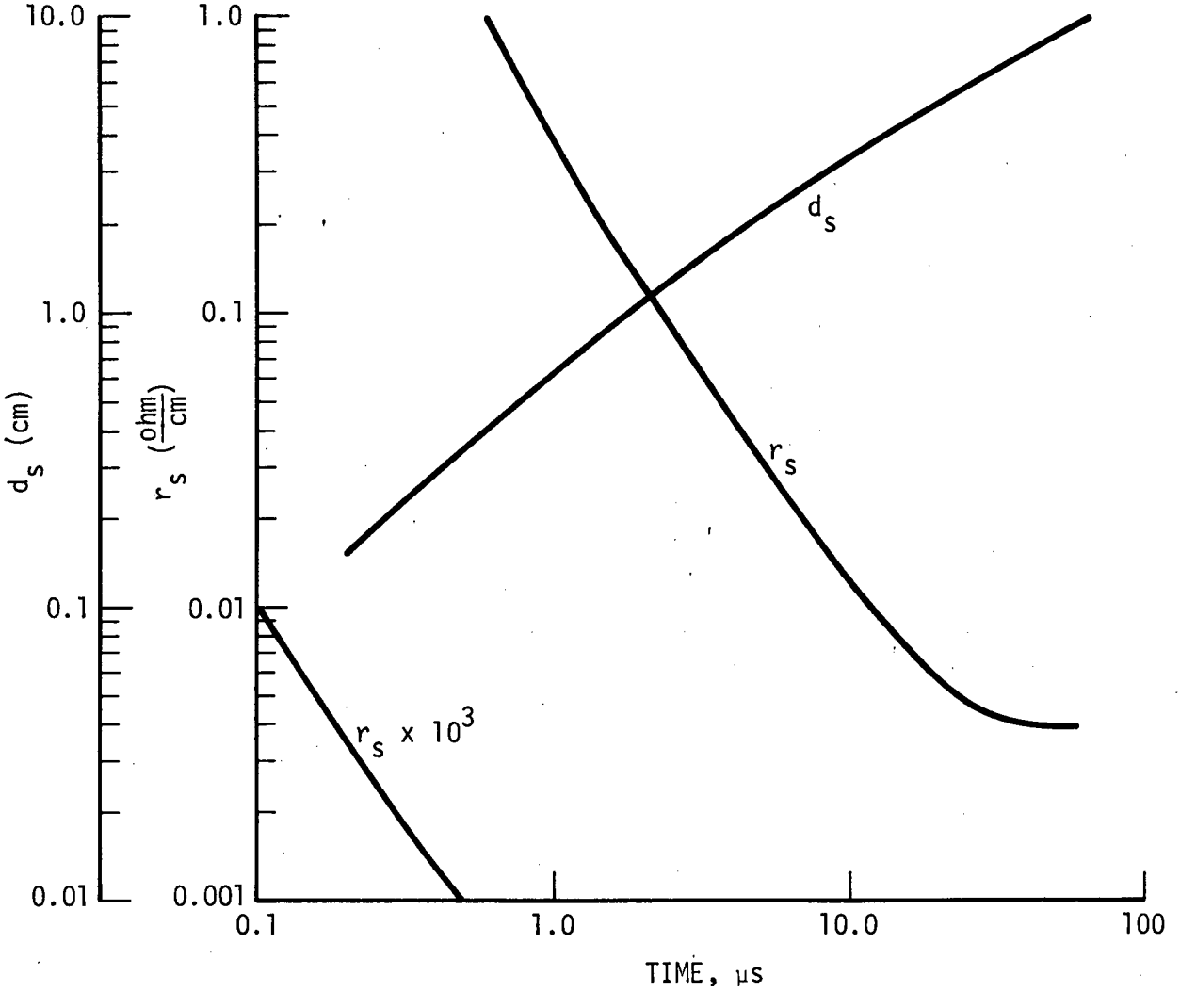


FIGURE 5: STROKE CHARACTERISTICS

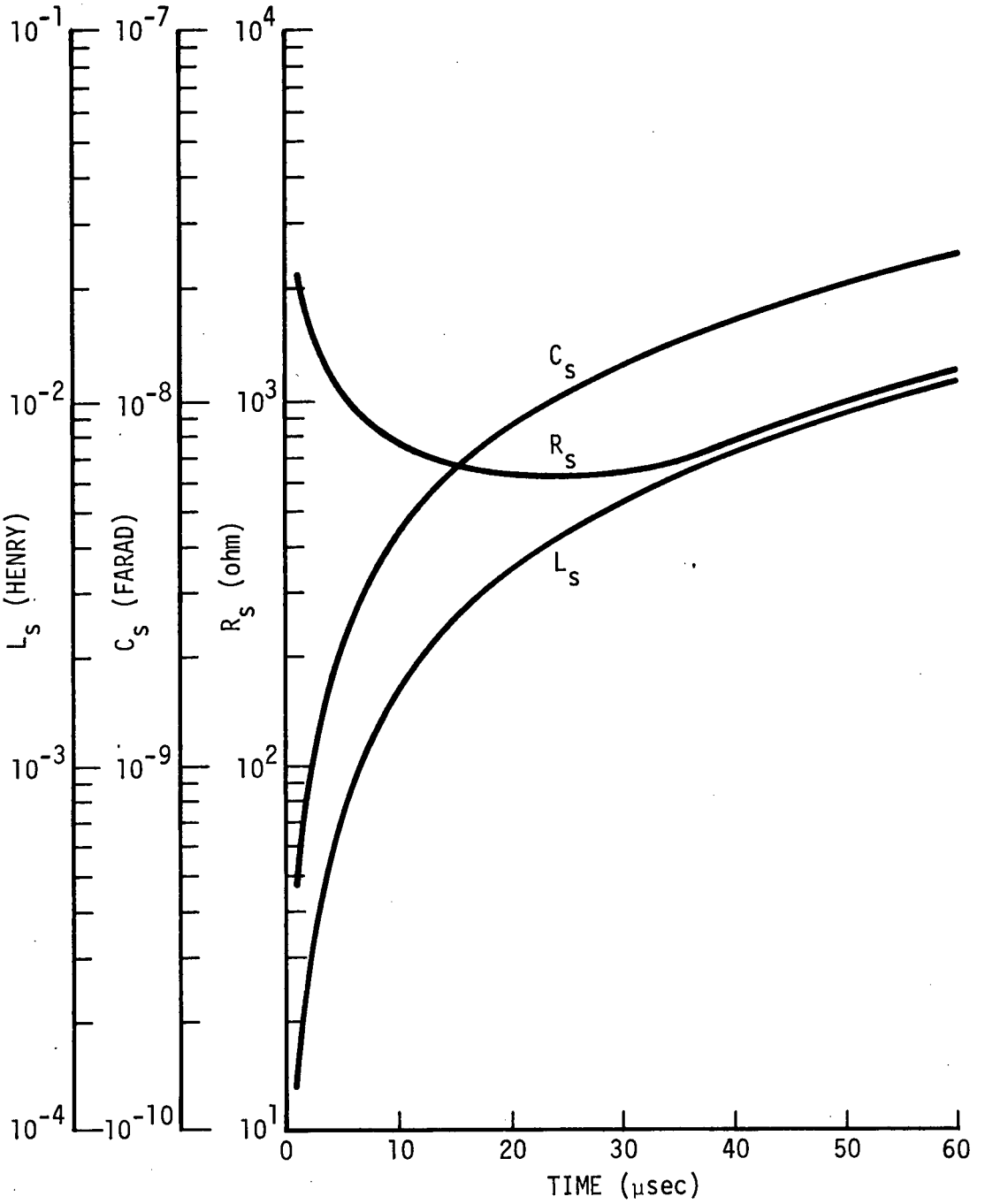
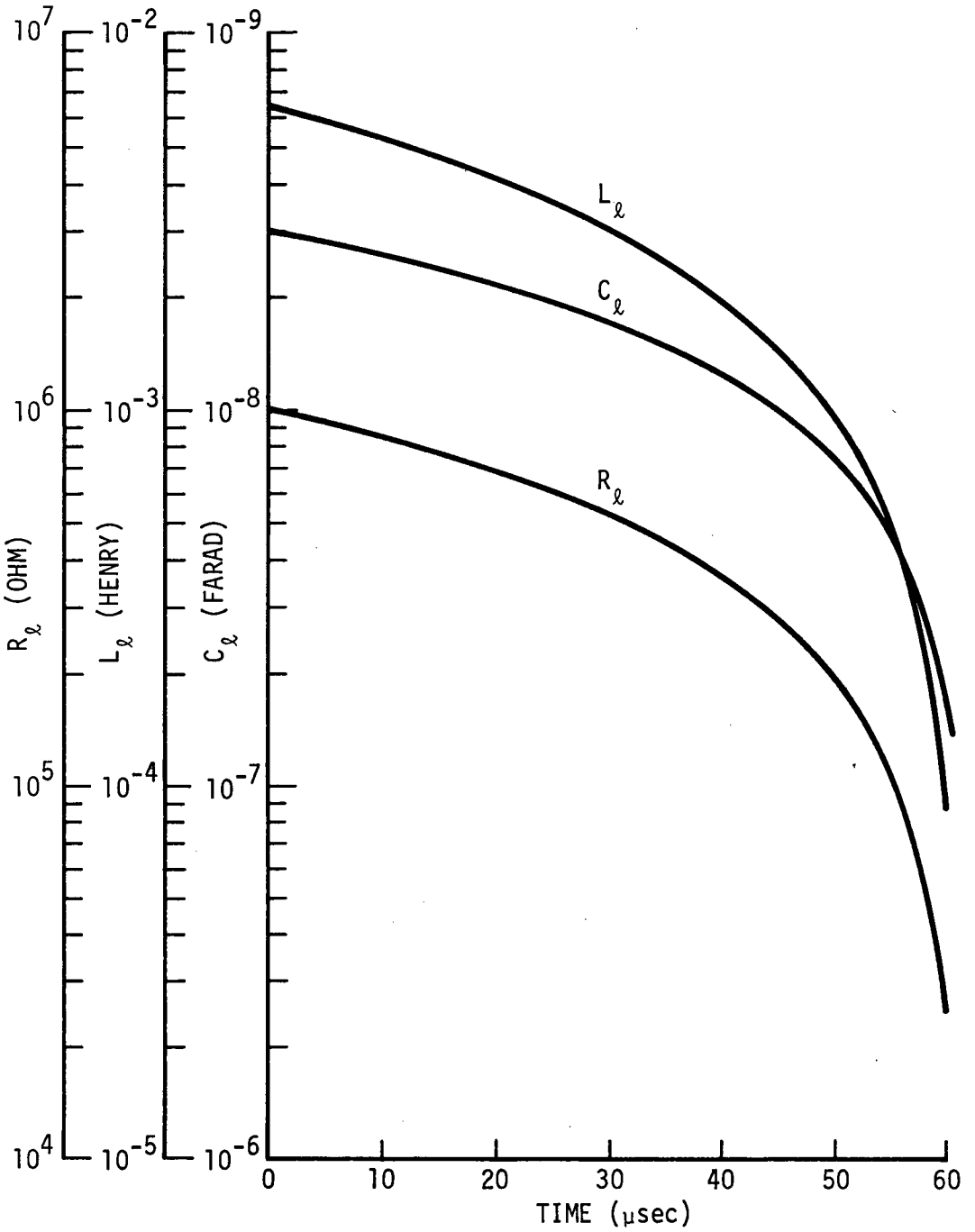


FIGURE 6: LEADER CHARACTERISTICS



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specific assumptions used in obtaining Figures 5 and 6 should be mentioned: (1) the final return stroke channel length and initial leader column length were assumed equal to 4 km, (2) the velocity of advance of the return-stroke current front was assumed constant and equal to 6.5×10^9 cm/sec, (3) the channel was assumed to be vertical and cylindrical with a constant radius of 0.5 cm, (4) the column was assumed cylindrical with a constant radius of 2.5 meters.

APPROXIMATE ANALYTIC SOLUTIONS

As outlined in Figure 7, a first-order approximation solution can be obtained by ignoring L_s compared with R_s. This assumption is legitimate as long as the component frequencies of the main return-current pulse are less than approximately 10^5 Hz. Since the peak of the frequency distribution of the main pulse is at 3 to 5 kHz, this requirement would appear to be valid.

If the cloud capacitance is assumed to be isolated during the main pulse from the return stroke by the high resistance R_ℓ of the leader column, the current pulse may be described by the first-order differential equation shown in Figure 7 and its solution is shown immediately below the equation.

For the numerical values of the circuit elements used in this analysis (i.e., Figures 5 and 6), and for an assumed initial charge Q_o of 1 coulomb on the leader capacitance C_ℓ, the variation of I with respect to t is shown in Figure 8. The customary Bruce-Golde pulse is also shown for comparison. Note that for I_o = 30,000 amp and

constants a and b as given in their expression (Figure 1), the total charge that passes in the whole pulse, i.e., $\int_0^\infty I dt$, is equal to 0.617 coulomb. The Bruce-Golde pulse shown in Figure 8 has been normalized so as to integrate a total charge of 1 coulomb in the time interval from

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FIGURE 7: FIRST ORDER APPROXIMATION SOLUTION

ASSUMPTIONS

NEGLECT L_s COMPARED WITH R_s

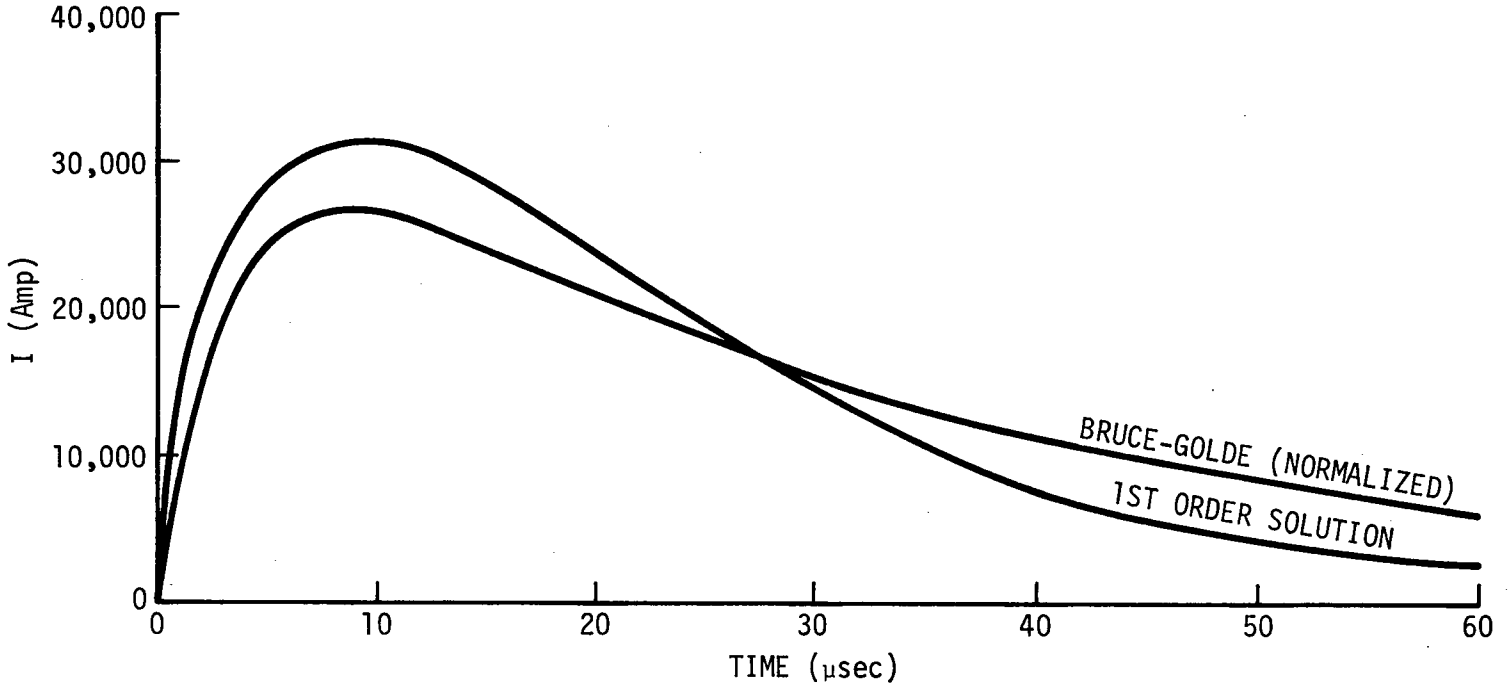
CONSIDER CLOUD ISOLATED FROM STROKE BY LEADER

$$R_s \frac{dQ}{dt} + \frac{Q}{(C_\ell + C_s)} = 0$$

SOLUTION

$$I = \frac{Q_o}{R_s(C_\ell + C_s)} \cdot e^{-\int_o^t \frac{dt}{R_s(C_\ell + C_s)}}$$

FIGURE 8: SOLUTION OF FIRST ORDER DIFFERENTIAL EQUATION



zero to 60 microseconds. The agreement between the first-order approximation solution and Bruce-Golde's pulse is considered to be very satisfactory. In the author's opinion this agreement gives very strong evidence: (1) that the initial growth of the return-current pulse is attributable to the discharge of the leader-channel capacitance by a rapidly-rising conductance of the return-stroke channel, and (2) that the later decay of the return-current pulse is due to a loss of potential from the leader channel capacitance and an increasing total resistance of the return-stroke channel.

A second approximate solution of the transmission line circuit problem is indicated in Figure 9. A second-order differential equation can be written which includes L_s , R_s and $(C_\ell + C_s)$. For the numerical values of the circuit elements given in Figures 5 and 6, the variations of the coefficients α , β and ω with respect to t of the second order differential equation are shown in Figure 10. That the coefficient β changes from a real value at approximately 17 microseconds into an imaginary value (ω) beyond 17 microseconds, indicates that the solution for the current I is expected to be oscillatory in the latter part of the pulse from 17 to 60 microseconds.

An analytic solution of the second order differential equation can be obtained by substitution of the approximate analytic expressions

FIGURE 9: SECOND ORDER APPROXIMATION SOLUTION

ASSUMPTIONS

INCLUDE L_s

CONSIDER CLOUD ISOLATED FROM STROKE BY LEADER

$$L_s \frac{d^2Q}{dt^2} + R_s \frac{dQ}{dt} + \frac{Q}{(C_\ell + C_s)} = 0$$

WHERE: $L_s = L_s(t)$, $R_s = R_s(t)$, $(C_\ell + C_s) = C(t)$

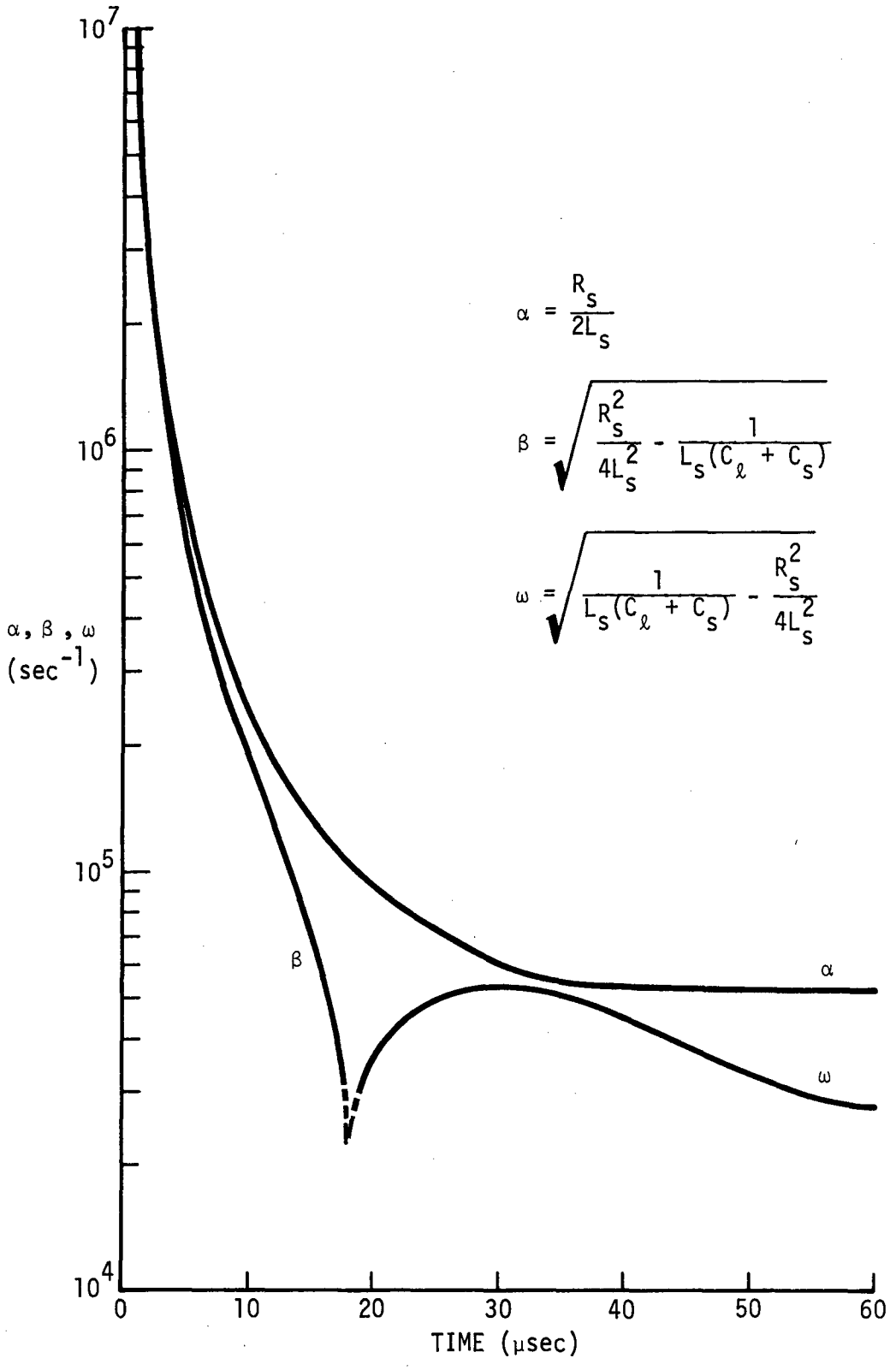
USUAL SOLUTIONS (CONSTANT COEFFICIENTS)

$$\frac{R_s^2}{4L_s^2} > \frac{1}{L_s C} \quad , \quad I = (\beta-\alpha)\, A_1 e^{-(\alpha-\beta)t} - (\beta+\alpha) A_2 e^{-(\alpha+\beta)t}$$

$$\frac{R_s^2}{4L_s^2} < \frac{1}{L_s C} \quad , \quad I = Ae^{-\alpha t}\, [\omega \cos(\omega t + \varepsilon) - \alpha \sin(\omega t + \varepsilon)]$$

$$\alpha = \frac{R_s}{2L_s} \quad , \quad \beta = \sqrt{\frac{R_s^2}{4L_s^2} - \frac{1}{L_s C}} \quad , \quad \omega = \sqrt{\frac{1}{L_s C} - \frac{R_s^2}{4L_s^2}}$$

FIGURE 10: VARIABLE COEFFICIENTS OF SECOND ORDER EQUATION



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for R_s , L_s and $(C_\ell + C_s)$ shown in Figure 11, and a solution of this equation obtained by series substitution is given at the foot of this figure. A plot of this solution is also shown in Figure 12. As before, it was assumed that the initial charge Q_o on the leader capacitance was equal to 1 coulomb, and the Bruce-Golde pulse, shown for comparison, has been normalized to the same amount of charge discharged by the pulse between zero and 60 microseconds. It would appear from the comparison of curves that the agreement between the semi-theoretic and Bruce-Golde pulses is improved over the first-order solution. However, the semi-theoretic pulse gives evidence of the slow oscillation after the pulse-peak has been passed.

Finally, we briefly note that there may be some indication from Berger's experimental pulse-form data that the return-current pulse does indeed oscillate. Figure 13 illustrates examples, taken from Berger's publication, of single strokes or first downward strokes which are comparable to the type of current pulse considered in this report. Although the frequencies of the "oscillations" indicated in Berger's pulses are somewhat higher than would be suggested by the solution in Figure 10, it must be remembered that the values of the circuit parameters can vary widely and may be significantly affected by the many simplifying assumptions made in this analysis. The question of possible oscillation of the return-current pulse might well warrant further experimental and theoretical study.

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FIGURE 11: SECOND ORDER DIFFERENTIAL EQUATION APPROXIMATE SOLUTION

$$R_s(\text{ohm}) = \frac{0.333\ell(\text{cm})}{t^{3/2}(\mu\text{sec})}$$

$$L_s(\text{henry}) = 2 \times 10^{-9} \left[\ell n \left(\frac{2\ell}{r}\right)\right] \ell(\text{cm})$$

$$(C_\ell + C_s)(\text{farad}) = 3 \times 10^{-8}$$

$$\frac{d^2Q}{dt^2} + \frac{a}{t^{3/2}} \cdot \frac{dQ}{dt} + \frac{bQ}{t} = 0$$

SOLUTION

$$Q = Q_o \left[1 - \left(\frac{2b}{3a}\right) t^{3/2} + \left(\frac{b}{4a^2}\right) t^2 - \left(\frac{b}{5a^3}\right) t^{5/2} + \left(\frac{b}{12a^2}\right) \left(\frac{3}{a^2} + \frac{8b}{3}\right) t^3 - \left(\frac{b}{7a^3}\right) \left(\frac{3}{a^2} + \frac{13b}{6}\right) t^{7/2} + \ldots\right]$$

$$I = -Q_o \left[\left(\frac{b}{a}\right) t^{1/2} - \left(\frac{b}{2a^2}\right) t + \left(\frac{2b}{a^3}\right) t^{3/2} + \ldots\right]$$

FIGURE 12: APPROXIMATE SOLUTION OF SECOND ORDER DIFFERENTIAL EQUATION

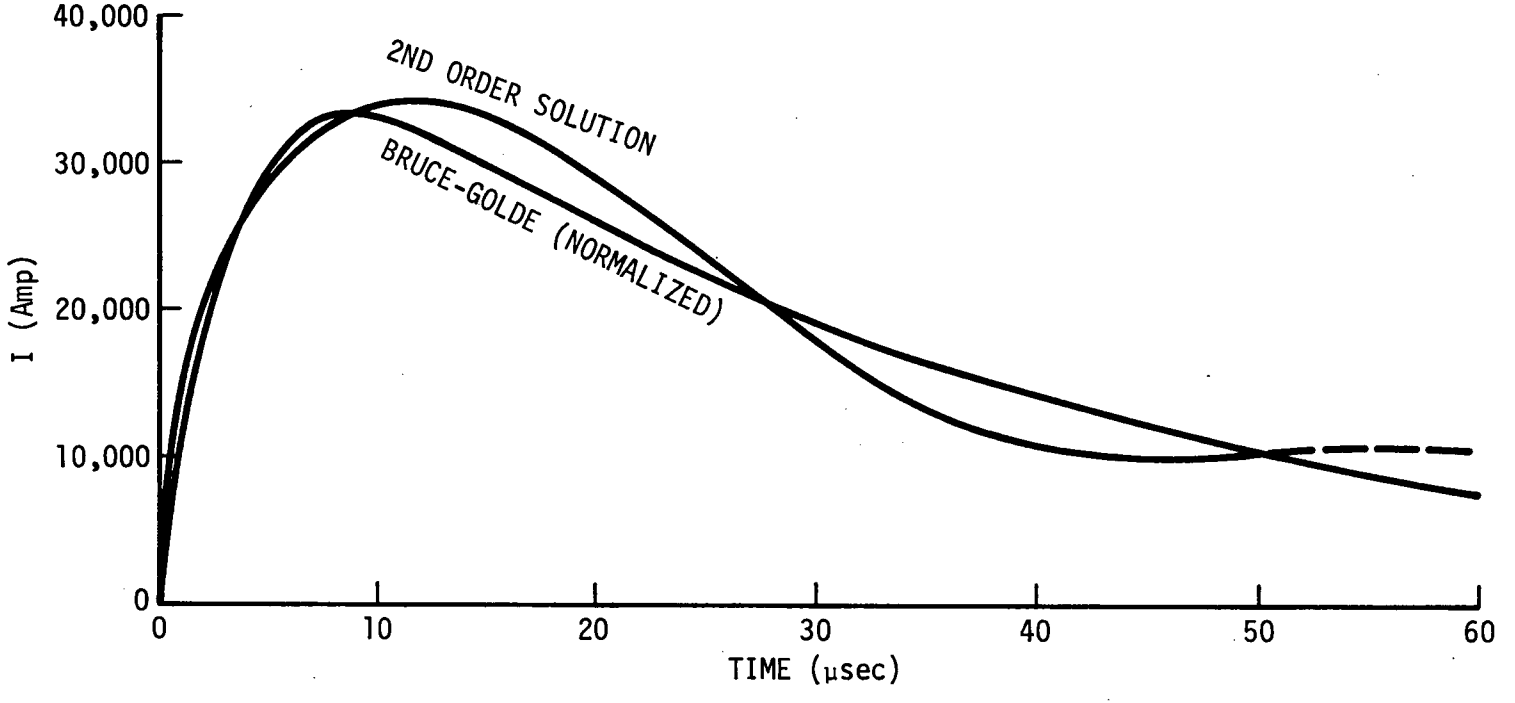

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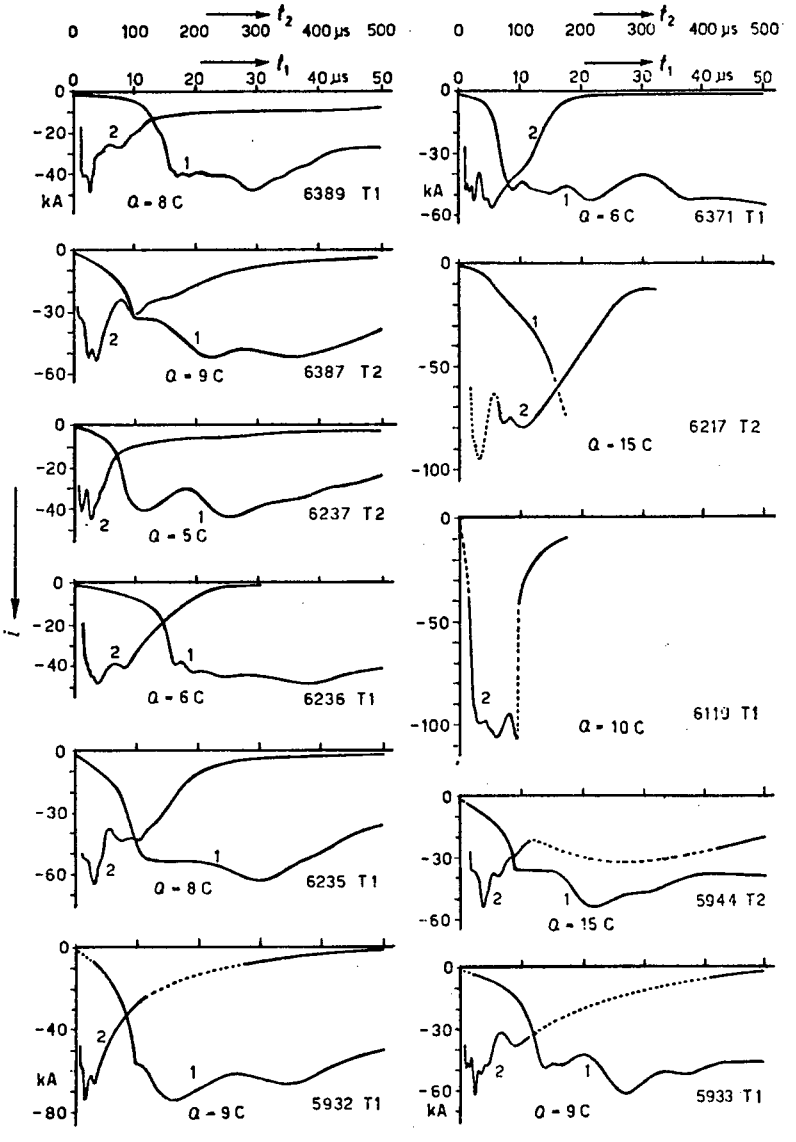
FIGURE 13: BERGER'S EXPERIMENTAL CURRENT FORMS

K. Berger



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ELECTRIC FIELD INTENSITY OF THE LIGHTNING RETURN STROKE

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ABSTRACT

From an examination of about 1000 electric field waveforms produced by lightning return strokes in 16 storms at distances between 20 and 100 km from an observation site at the Kennedy Space Center, Florida, a typical return-stroke current waveform is derived. For this current waveform, the electric field intensity at distances between 0.5 and 100 km is computed for three values of return stroke velocity. The resultant curves for close lightning are compared with measured field waveforms. The transmission-line return-stroke model is used in all calculations since, as discussed, the Bruce-Golde model cannot account for the observed electric field characteristics.

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INTRODUCTION

We have been unable to find in the literature any detailed analysis on a microsecond time-scale of the electric field intensity produced by close (within 10 km) lightning return strokes in cloud-to-ground flashes. A number of calculations of the electric field due to distant (over 100 km) lightning have been made using the moment equation approximation [see McLain and Uman, 1971]; and Morrison [1952], using the same approximation, has computed the electric field at distances between 16 and 100 km for an atypical lightning current rising to peak value in about 50 μsec and decreasing to half of peak value in about 200 μsec.

In the present paper we first find a "typical" lightning return-stroke current waveform from measured radiation (distant electric) fields using the technique described by Uman and McLain [1970a], and then, with the derived current, compute the electric field intensity at

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distances between 0.5 and 100 km using the expression given by McLain and Uman [1971]. The predicted electric field waveforms for close lightning are then compared with measured waveforms. In a companion paper (following, and hereafter referred to as II), individual current vs. time waveforms are derived from measured electric fields and statistics on peak current are presented.

The bulk of the electric field measurements on which this paper is based were obtained at Kennedy Space Center, Florida during June and July of 1971. Data were also obtained near Pittsburgh, Pennsylvania during the summer of 1970 [Fisher and Uman, 1972] and near Tucson, Arizona during the summer of 1971. Electric field waveforms recorded at these three locations are qualitatively similar. At each location a range of electric field parameters (e.g., risetime, peak value) was observed. The system used to record the electric field waveforms presented in this paper is that described by Fisher and Uman [1972] but modified to have a 2.5 μsec signal delay, a system rise time of slightly less than 0.5 μsec, and a system response to a step function input which decays 30 percent from peak in about 60 μsec. Other details of the experiment are given in II.

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THEORY

The electric field intensity E at a distance D from the bottom of a straight vertical channel of height H due to the return stroke current i(z,t) is given by McLain and Uman [1971] as

$$E(D,t) = \frac{2}{4\pi\varepsilon_o}\Big[\int_o^H \int_o^t \frac{(2-3\sin^2\theta)}{r^3}\, i(z,\tau - \tfrac{r}{c})\, d\tau\, dz$$

$$+ \int_o^H \frac{(2-3\sin^2\theta)}{cr^2}\, i(z,t-\tfrac{r}{c})\, dz \qquad (1)$$

$$- \int_o^H \frac{\sin^2\theta}{c^2 r} \frac{\partial i(z,t-\frac{r}{c})}{\partial t}\, dz\Big]$$

where E is perpendicular to the ground plane, assumed infinitely conducting, and all geometrical parameters are as defined in Fig. 1. The first term on the right of (1) is called the electrostatic field, the second the induction or intermediate field, the third the radiation field. For D >> H (the radiation field dominant) and a constant return-stroke wavefront velocity v, Uman and McLain [1970a] have solved (1) for current in terms of electric field for two return stroke models. In this paper we consider only the transmission line model of Uman and McLain [1969] in which a given current waveshape propagates up the lightning channel at velocity v behind the wavefront: that is, $i(z,t) = i(t - \frac{z}{v})$. In this case

$$i(t) = \frac{2\pi c^2 \varepsilon_o D}{v}\, E(t + \tfrac{D}{c}) \qquad (2)$$

as long as $t < H/v$. That is, the current and the electric field have the same waveshape until the return stroke wavefront reaches the top of the channel, a time typically between 20 and 200 μsec.

In order to use the approach described above, we must justify the approximation of a constant return stroke wavefront velocity. According to Schonland [1956], this is the case for return strokes subsequent to the first, with two-dimensional velocities ranging from 2.4×10^7 to 1.1×10^8 m /sec. For first return strokes, the wavefront velocity according to Schonland et al. [1935] is constant between major branches (14 strokes were analyzed). For three first strokes for which detailed data are presented, Schonland et al. [1935] report constant return stroke velocities from ground upward of 1.6×10^8 m/sec for 10 μsec, 5.2×10^7 m/sec for 13 μsec, and 9.2×10^7 m/sec for 17 μsec. Thus for first return strokes it may be reasonable to assume a constant return stroke velocity for about 10 μsec. It follows that calculations for current rise time and peak value are probably valid if, as is usually the case, they occur before about 10 μsec. In this paper we will carry the calculations to 30 μsec and in the absence of other information, will assume that v for first and subsequent strokes is constant for that time.

As stated, we use a transmission-line model to describe the return-stroke. The most commonly used return stroke model has been that of Bruce and Golde [1941]. In the Bruce-Golde model the channel current is assumed uniform along the channel but time-varying below the return stroke wavefront and zero above. We reject the Bruce-Golde model for

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several reasons: (1) our computer studies show that it cannot account for the broad initial hump (mostly electrostatic field) observed by us on very close (less than 1 km) electric field waveforms (see Figs. 6 and 8) whereas the transmission line model can; (2) it cannot account for the mirror image effect (Fig. 7 of Fisher and Uman, 1972; Fig. 2c of Taylor, 1963) observed previously and in a number of Florida storms during Summer 1971 whereas the transmission line theory can as illustrated by Eqs. (11) and (12) of Uman and McLain [1970b]; and (3) it is not physically reasonable in that it requires an infinitely fast information transfer along the channel, and even a version of it which is physically reasonable [Dennis and Pierce, 1964] makes less physical "sense" than the transmission line model. Both the Bruce-Golde and the transmission line models are of about equal complexity to use. It is interesting to note that for a linear or concave current-rise to peak, as is observed, both models predict that the peak field and the peak current are attained in the same time. On the other hand, for linearly rising currents and for a given measured electric field value, the Bruce-Golde model yields a peak current 1/2 that found from the transmission line model and for concave rising currents even less (compare Eqs. (6) and (12) of Uman and McLain, 1970a).

The sign of all measured electric field waveforms presented in this paper and in II are indicative of the lowering of negative charge from cloud to ground.

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RESULTS

Typical electric field waveforms from a multiple-stroke lightning flash at a distance between 20 and 40 km are shown in Fig. 2. Distant waveforms from Florida are very similar to the distant waveforms recorded in Pennsylvania (see, for example, Figs. 4-6 of Fisher and Uman, 1972). The waveforms in Fig. 2 are primarily radiation field. The first few tens of microseconds of more distant waveforms (100 km) are essentially pure radiation field, but may suffer propagation distortion as evidenced by a degradation of the risetime and a rounding of the initial peaks and other high frequency components (Fisher and Uman, 1972). Closer strokes produce waveforms with little propagation distortion of the radiation field peaks, but the electric field fall-off after the peaks is not primarily radiation field. We have examined about a thousand waveforms from 16 Florida storms in the distance range 20 to 100 km. The waveforms from the closer part of this range were used to determine typical radiation-field risetime and behavior around peak while the more distant waveforms were used to obtain data on radiation-field fall time. In this way a "typical" radiation field waveform was derived. A "typical" return-stroke current was found from this radiation field using (2). As evident from (2), the current has the shape of the electric field intensity at 100 km (in the absence of propagation distortion). The "typical" current is shown in Figs. 3-5. Roughly 30 percent of the distant first-stroke fields and 60 percent of the distant subsequent-stroke fields could

be well approximated by the shape of the 100 km field of Figs. 3-5. The most common variations from the "typical" were slower field fall-times, multiple peaks, and a range of risetimes mostly between 0.5 and 5 μsec.

In Figs. 3-5 is shown the electric field intensity computed from (1) using the transmission line model for various distances from a typical stroke current for a constant product vI_p, where I_p is peak current, and three values of v and I_p. Keeping vI_p constant forces the distant radiation field magnitude to be the same in each drawing via (2). It is assumed that the return stroke wavefront takes more than 30 μsec to reach the channel top, and hence no electric field variation associated with the end of the channel is shown. Figs. 3-5 scale linearly with I_p. For example, if Fig. 3 is to be used for a peak current of 100 kA, the values of electric field given on the ordinate should be multiplied by 5. The field waveshapes at close range are strong functions of v.

We have computed the electric field intensity as a function of distance and return stroke velocity for a range of observed distant waveforms (and currents) and find them all qualitatively similar to the waveforms of Figs. 3-5. Two quantitative differences are worth noting. First, the distance at which the initial field peak, essentially radiation field, can no longer be discerned is a function of the sharpness (width) of the peak. Sharper peaks can be discerned at closer distances. Second, for a given v, the value at which the close

electric field rises at a given time after the initial peak, essentially electrostatic field, depends primarily on the time integral of the current, the charge transferred, to that time. Thus, the slower the distant radiation field falls with time, the higher the close electrostatic field will rise. After the electrostatic field maximum, the field decreases slowly with time.

When the stroke current has ceased to flow at all points in the channel, the total charge involved in the current waveform has effectively been lowered from the top to the bottom of the channel. The final field value (actually the field change) can be computed from the standard formula (Eq. 3-37, Uman, 1969). For example, for the case given in Fig. 4 and a 5 km high channel, the field at 0.5 km will reach a final value of 58 V/m (its peak is about 1300V/m), while the field at 10 km will reach a final value of 5.3 V/m.

Figs. 6-11 show measured return-stroke field waveforms from close strokes. All the data shown are from the same storm. The field of the single stroke flash at 0.5 km shown in Fig. 6 could have been produced by a range of return stroke velocities and current waveshapes: For example, a current risetime to a peak of 41 kA at 5 μsec and fall-time to half value at 17 μsec in conjunction with a return stroke velocity of 4×10^7 m/sec; or a risetime of 10 μsec to 58 kA and fall-time to half value at 30 μsec in conjunction with a velocity of 1×10^8 m/sec. Figs. 7 and 8 show the fields of close multiple stroke flashes for which no distance ranging was available. From the size of

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the fields and the time of occurrence during the storm we strongly suspect that the flashes were at about 1 km. The waveforms of Fig. 7 are very similar to the calculated field in Fig. 5 for $v = 1.6 \times 10^8$ m/sec, a distance between 0.5 and 1 km, and peak currents in the 25 to 50 kA range. In Fig. 8 initial radiation field peaks are apparently present on both the first and subsequent strokes. The waveforms are qualitatively similar to those shown in Fig. 4 for a distance slightly greater than 1 km. Some of the late-time decrease in the first-stroke field may be due to system response. Fig. 9 shows fields at 1.1 km. The various stroke fields can be produced by peak currents in the range 20 to 60 kA with return stroke velocities of $1.6 (\pm 0.4) \times 10^8$ m/sec. Computer analysis using (1) shows that velocities outside of this range do not allow the measured wave shape to be adequately reproduced. Fig. 10 shows return stroke field waveforms at 1.5 km. Two of these are analyzed in detail in Fig. 2 of II. Currents which produced the waveforms of Fig. 10 fall in the range 30 to 120 kA with velocities of $1.6 (\pm 0.4) \times 10^8$ m/sec. Fig. 11 shows return stroke field waveforms at 4.5 km. The first and a subsequent stroke field are analyzed in detail in Fig. 1 and Fig. 2 of II. The first stroke peak current is in the range 37 to 75 kA with a velocity of $1.2 (\pm 0.4) \times 10^8$ m/sec. Several of the subsequent stroke fields shown in Fig. 11 required a velocity of $2.4 (\pm 0.4) \times 10^8$ m/sec, remarkably close to the speed of light, in order that the computed waveform match the measured.

While most of the close strokes measured in Florida (the majority from a single storm) have electric field waveshapes indicative of return stroke velocities near or above the upper limit of the range reported by Schonland et al. [1935] and Schonland [1956], most of the electric field waveshapes recorded from close lightning in Pennsylvania (Fisher and Uman, 1972) are indicative of lower return stroke velocities. For example, if it is assumed that the flash whose fields are shown in Fig. 3 of Fisher and Uman [1972] was at 7.5 km, then the best theoretical fit to the waveshape is attained with a velocity of 6×10^7 m/sec and a peak current of 53 kA. The current waveshape is qualitatively similar to that called "typical" in the Florida measurements but with a risetime of 3 μsec and a fall time to half-value at 8 μsec.

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DISCUSSION

The moment equation [McLain and Uman, 1971] is inadequate to describe the electric field from a close lightning return stroke. For example, the electrostatic humps in Fig. 3 (due to θ in (1) increasing above 90° and r increasing above D as the current wave progresses up the channel) cannot be predicted by the moment equation. As shown by McLain and Uman [1971], the moment equation should not be used for distances less than about 50 km.

The transmission-line return stroke model with a straight vertical channel and the calculations which proceed from it are definitely not good approximations to all return strokes. A discussion of the assumptions implicit in the model and the errors made in applying the results of the calculations to lightning which does not satisfy these assumptions is given in the Errors section of II.

ACKNOWLEDGMENT

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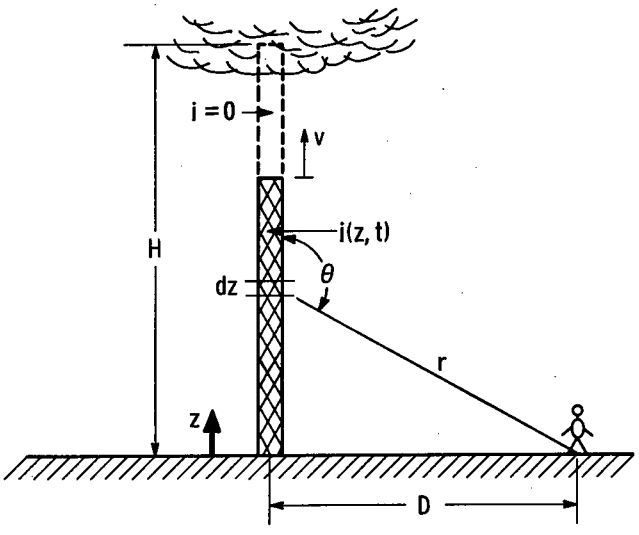

FIG. 1. Drawing defining the pertinent geometrical factors used in computing the electric field intensity of the lightning return stroke.

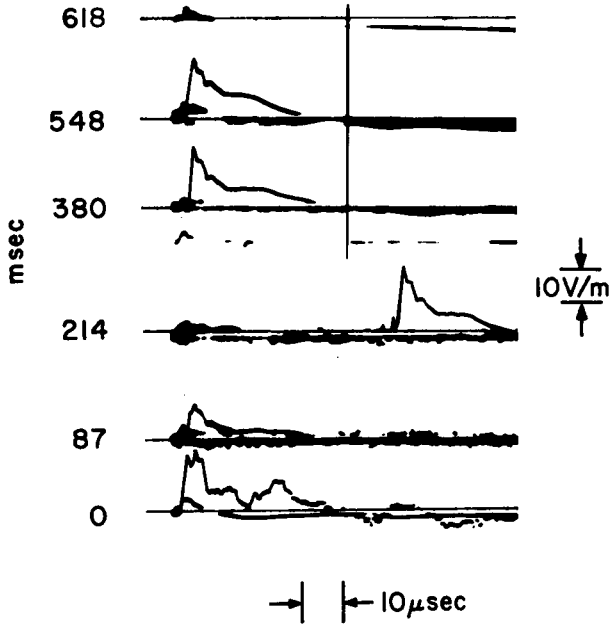

FIG. 2. Electric field waveforms for the various return strokes in a typical Florida lightning flash at a distance between 20 and 40 km.

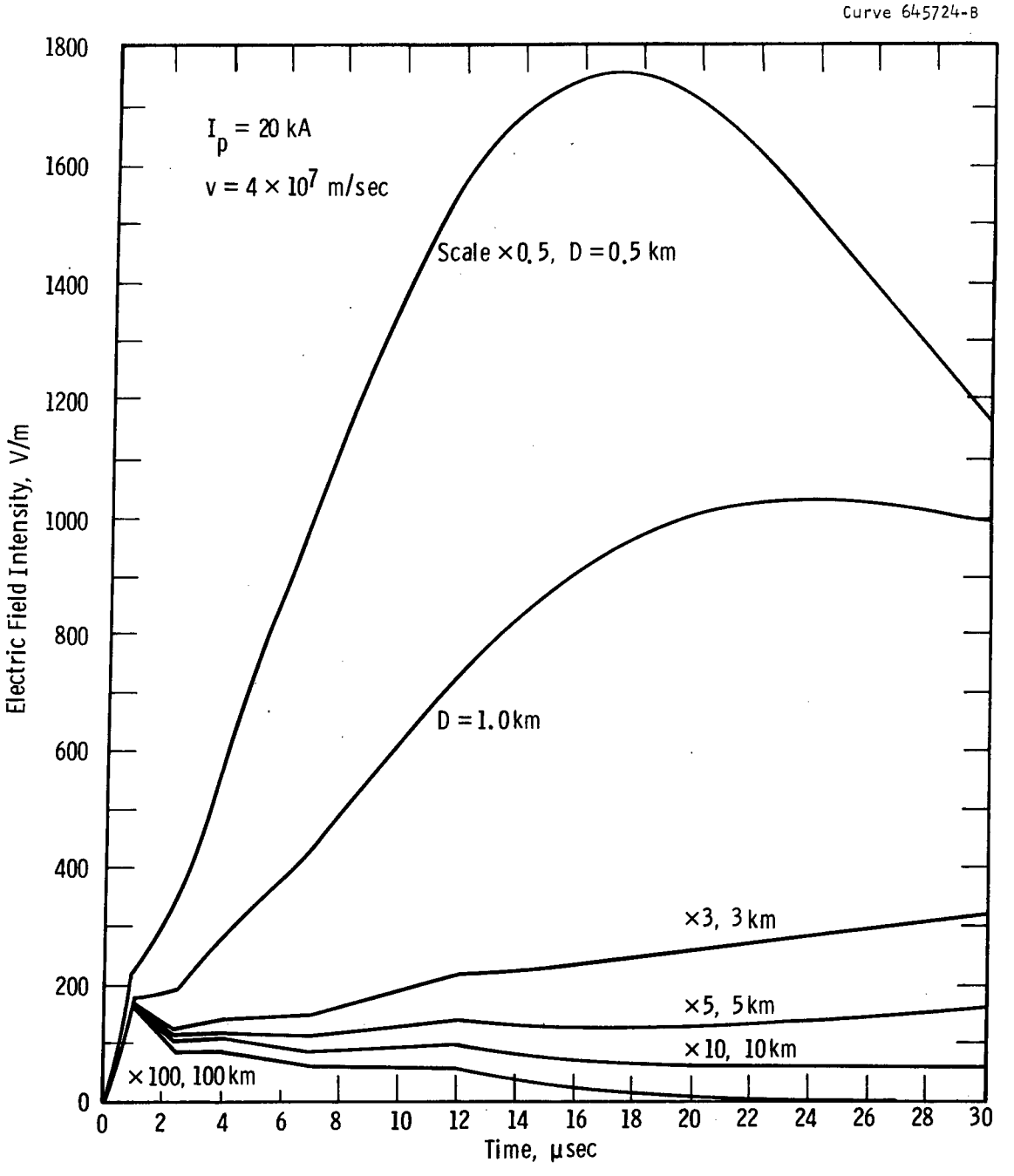

FIG. 3. Calculated electric field intensity for $v = 4 \times 10^7$ m/sec and various distances for a typical current whose waveshape is that of the electric field at 100 km. The ordinate scales with I_p.

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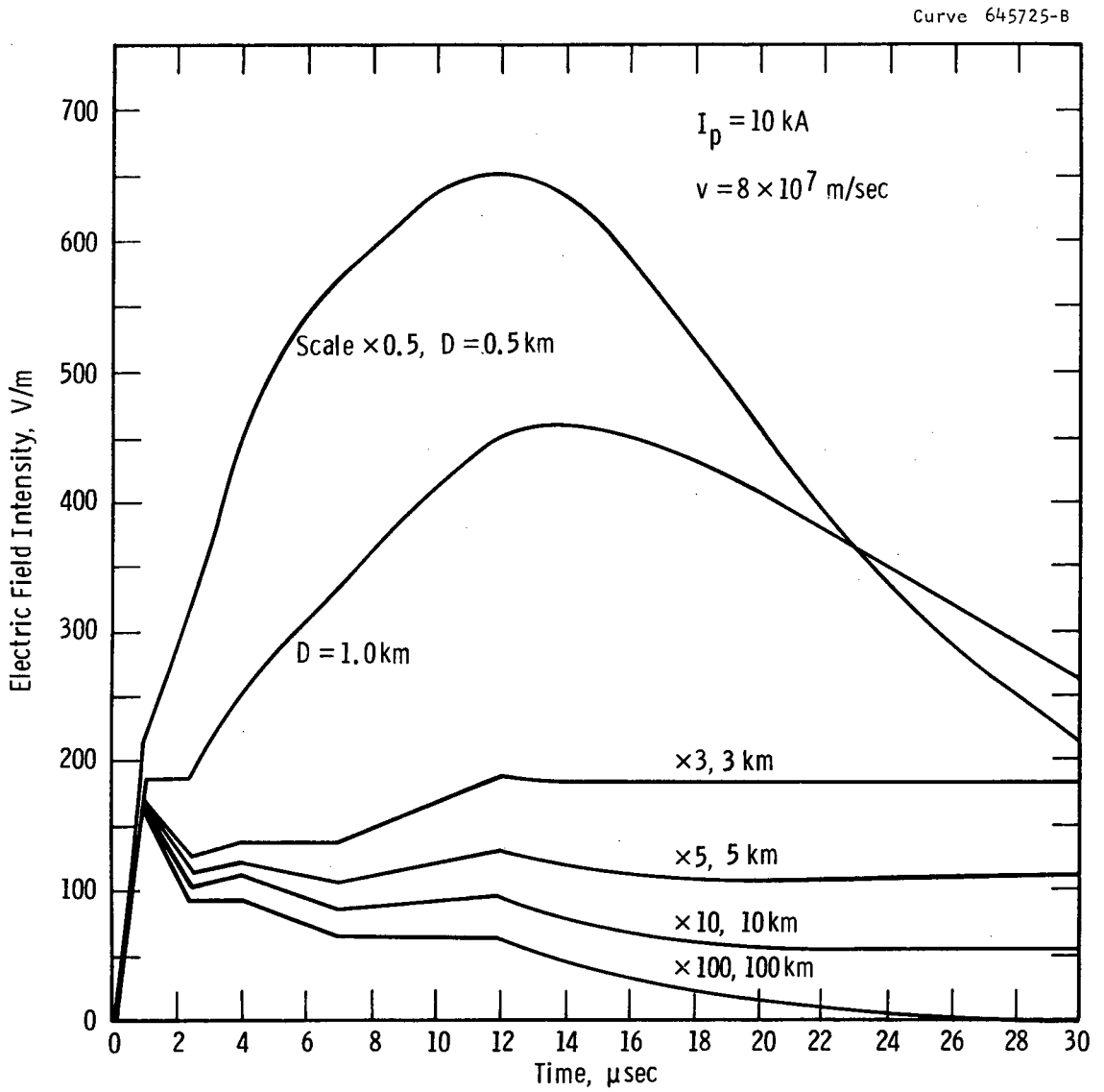

FIG. 4. Calculated electric field intensity for $v = 8 \times 10^7$ m/sec and various distances for a typical current whose waveshape is that of the electric field at 100 km. The ordinate scales with I_p.

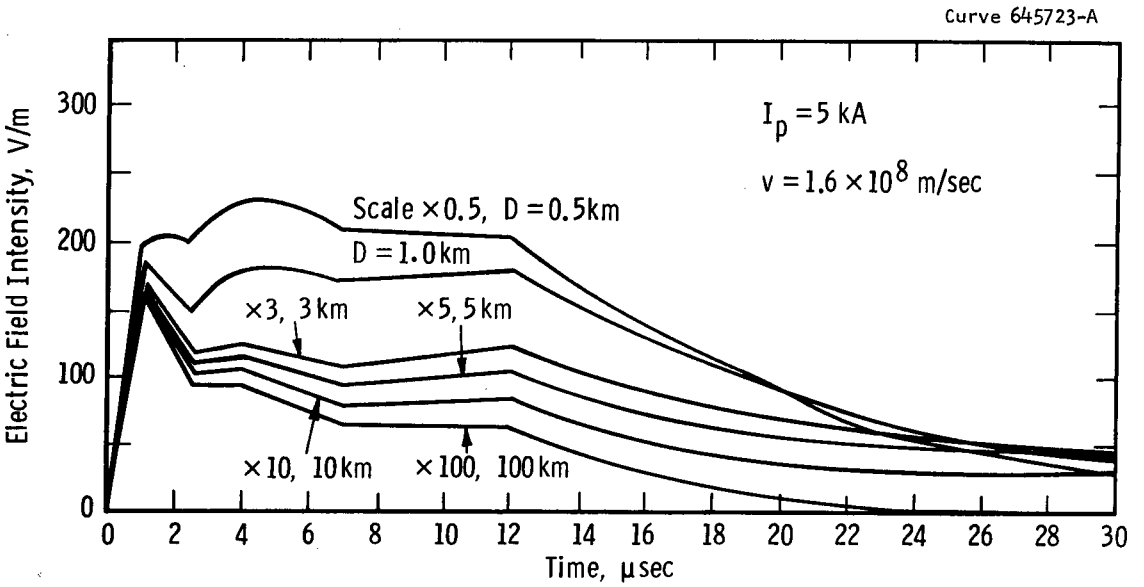

FIG. 5. Calculated electric field intensity for $v = 1.6 \times 10^8$ m/sec and various distances for a typical current whose waveshape is that of the electric field at 100 km. The ordinate scales with I_p.

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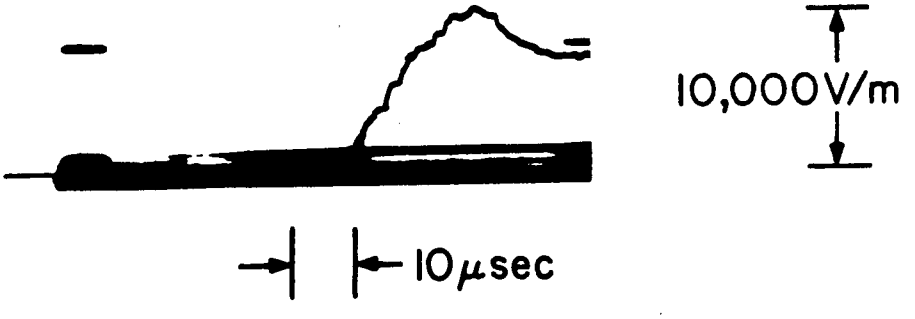

FIG. 6. The return-stroke electric field intensity for a single stroke flash at 0.5 km.

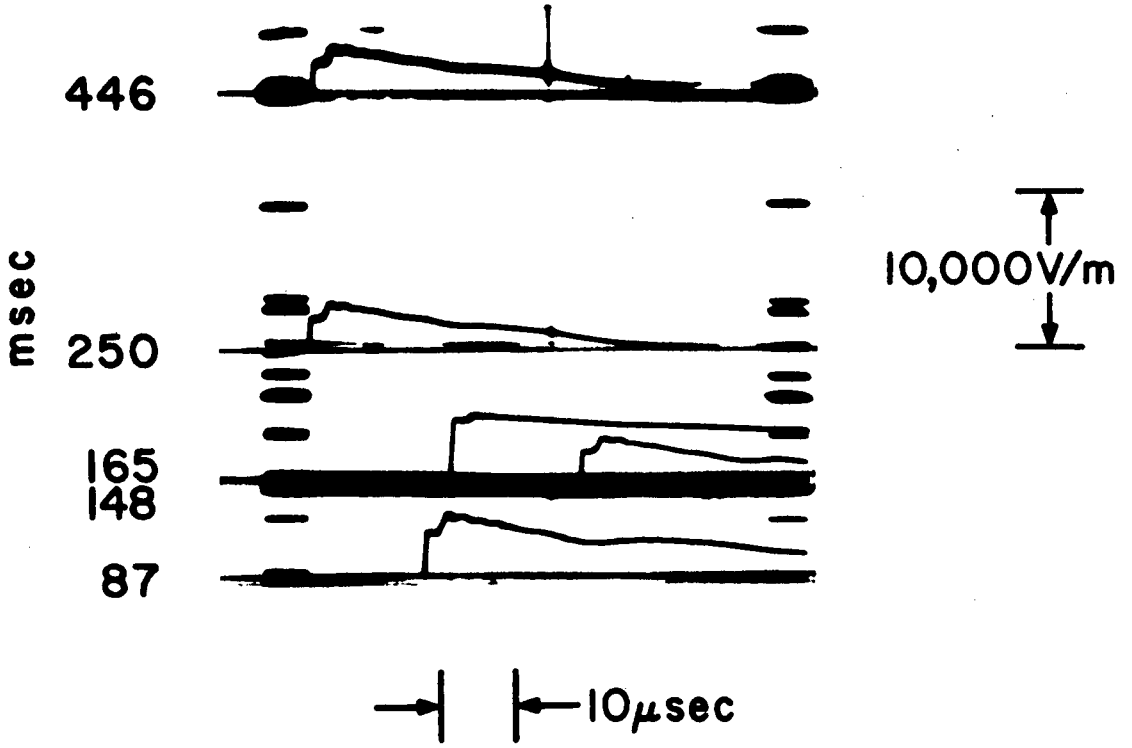

FIG. 7. The electric fields of the subsequent strokes in a multiple stroke flash at a distance probably near 1 km.

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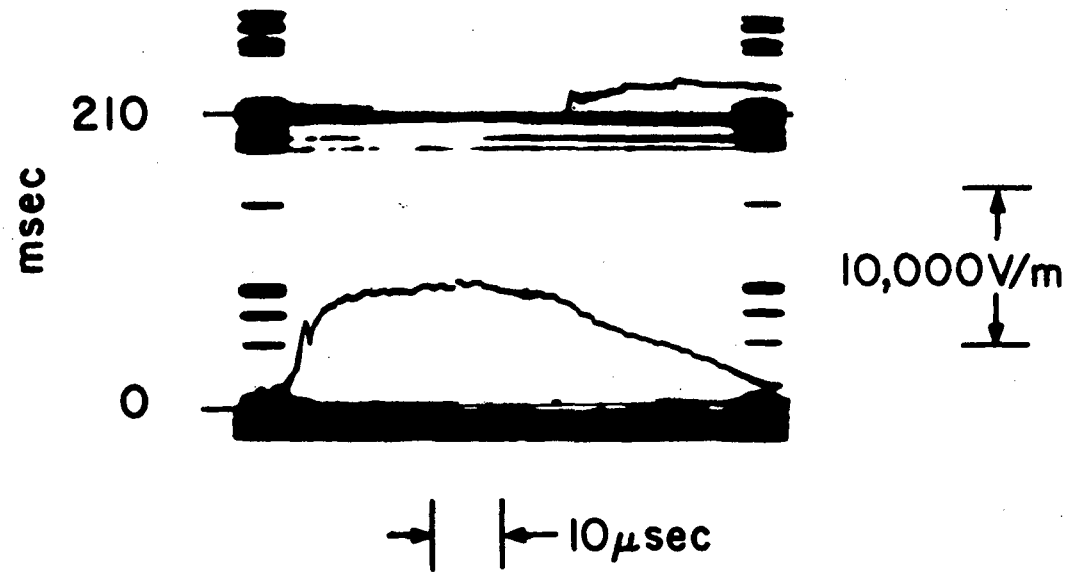

FIG. 8. The electric fields of the first and subsequent strokes in a 2 stroke flash at a distance probably near 1 km.

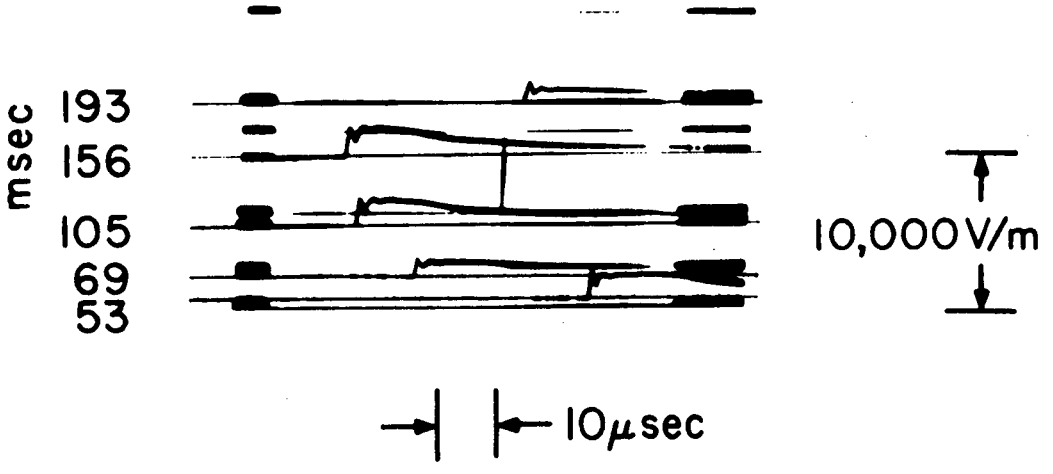

FIG. 9. The electric fields of the subsequent strokes in a multiple stroke flash at 1.1 km.

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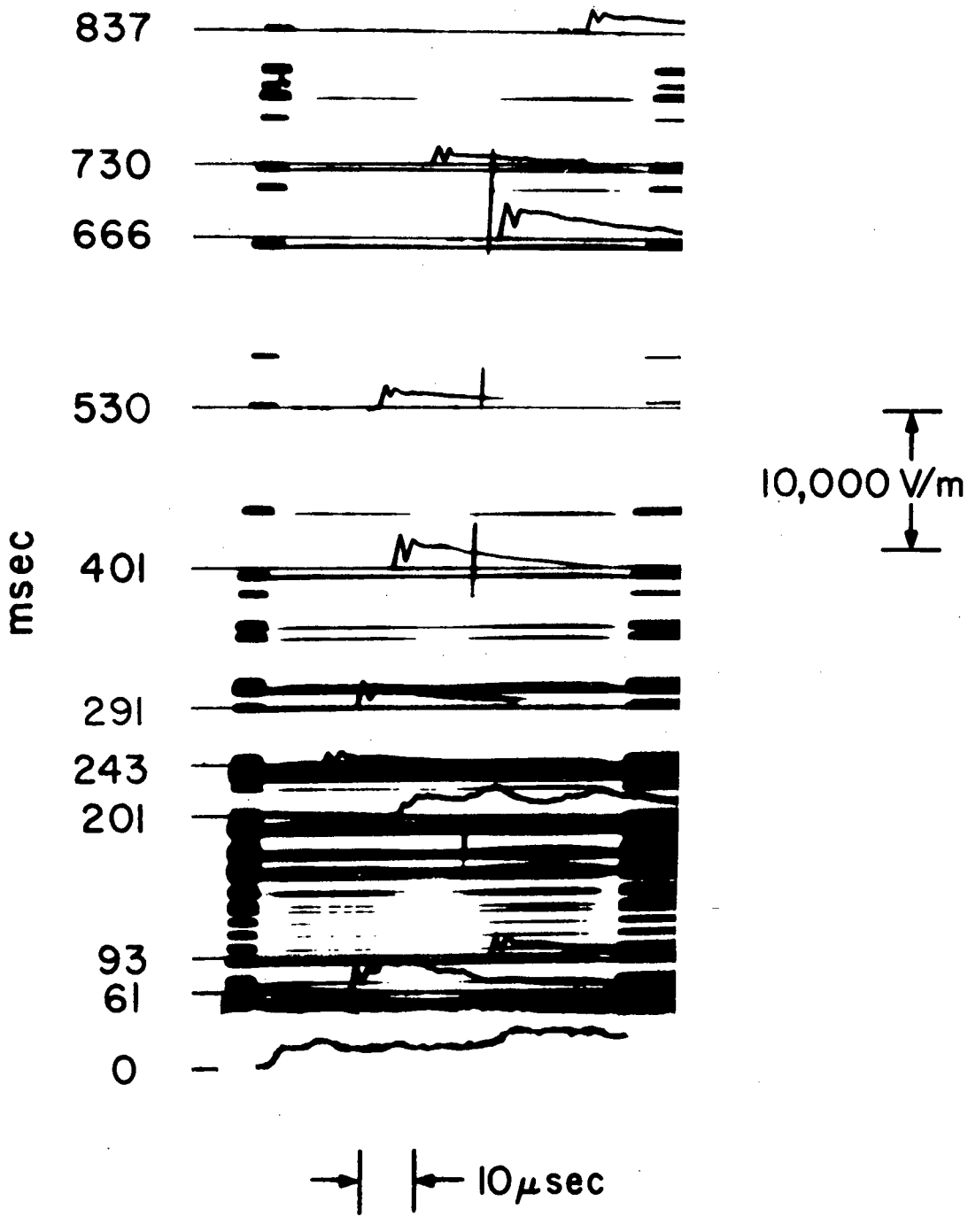

FIG. 10. The electric fields of a multiple stroke flash at 1.5 km. Two waveforms are analyzed in detail in Fig. 2 of II.

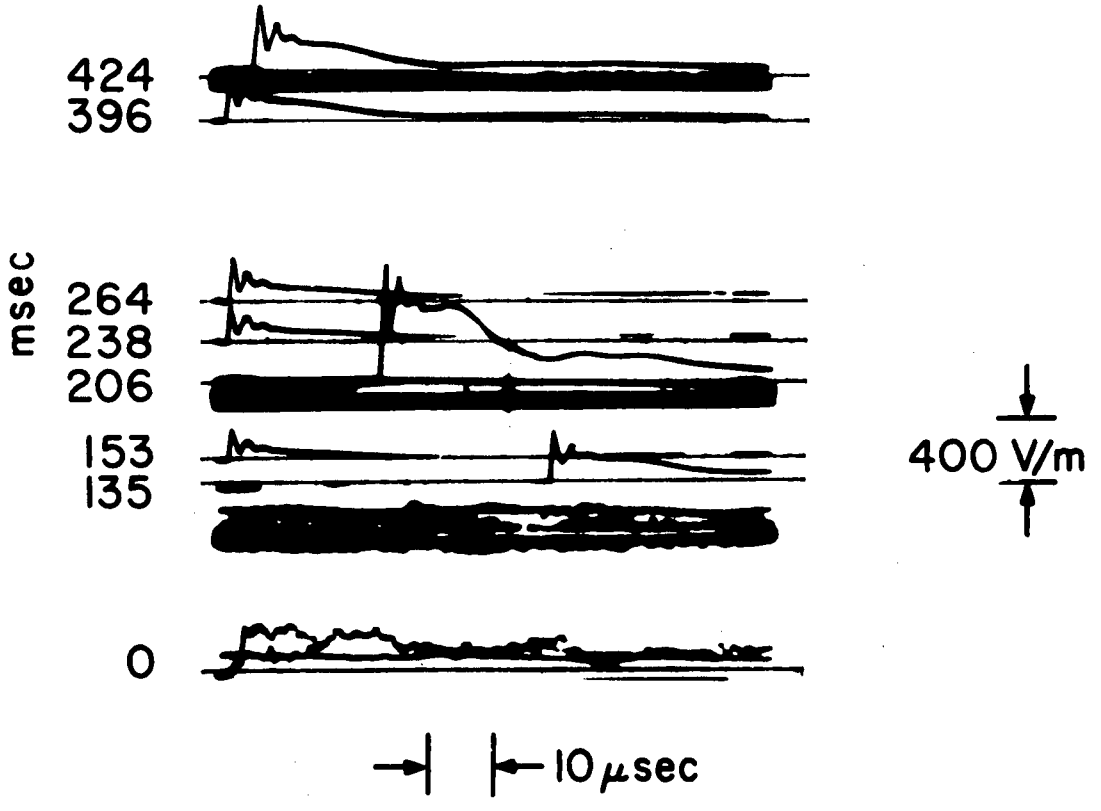

FIG. 11. The electric fields of a multiple stroke flash at 4.5 km. Two waveforms are analyzed in detail in Figs. 1 and 2 of II.

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ABSTRACT

The transmission-line return-stroke model is used to derive individual current vs. time waveforms from measured electric fields. A total of 98 strokes in 21 flashes at distances less than or equal to 10 km and 63 strokes in 18 flashes at distances between 10 and 32 km are analyzed for current waveshape and magnitude. For the closer strokes, return stroke velocity is also determined from the electric field waveforms. Values are in the range 0.8 to 2.4 x 10^8 m/sec. Eighteen detailed current and field waveforms and a statistical distribution of peak currents are presented. The maximum value of peak current is near 100 kA; the maximum value of rate-of-change of current averaged from zero to peak is near 200 kA/μsec. Return-stroke channel currents are found to exhibit a sharp initial peak which currents measured in tall structures at the base of the lightning channel apparently do not exhibit. A complete discussion of errors is given.

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INTRODUCTION

Several attempts have been made to derive return-stroke channel current waveforms from measured electric or magnetic fields (e.g., Norinder and Dahle, 1945; Croom, 1964; Srivastava and Tantry, 1966). In none of these studies was the time resolution of the measurement adequate to allow the current risetimes to be properly calculated. Further, the most extensive work, that of Norinder and co-workers, employed theory which was in error [Uman and McLain, 1969]. All previous studies designed to extract current from measured fields have employed the return stroke model of Bruce and Golde [1941] which we feel is not adequate for the reasons described in the previous paper (hereafter referred to as I).

In the present paper we derive from electric fields measured close to lightning the return stroke currents necessary to produce

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those fields. In the calculations we use the transmission-line return stroke model with a straight, vertical channel. For convenience we assume the return stroke velocity is constant, an assumption that is apparently valid for subsequent return strokes but is probably only the case for first return strokes until the first major branch is reached (see I). For a measured electric field from a stroke at distance D the return stroke current is determined by assuming a likely current waveshape and return stroke velocity v, computing the field for these inputs from (1) of I, comparing the result with the measurement, and iterating until a best fit for current and v is achieved.

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EXPERIMENT

The experimental apparatus and calibration technique are described by Fisher and Uman [1972] except for the minor changes noted in I. The antenna was placed on a sandy beach about 10 m from the Atlantic Ocean at Kennedy Space Center, Florida. Distances to the lightning flashes studied were determined from the time separation on strip chart records between the channel light output and thunder arrival for strokes within about 18 km. Several more distant lightning flashes were located from a comparison of visual channel observation with radar maps. Measurements were made on flashes both over land and over water. A total of 98 strokes in 21 flashes at distances less than or equal to 10 km and 63 strokes in 18 flashes at distances between 10 and 32 km were analyzed. Of the latter 18 flashes, 31 strokes in 8 flashes were over water. Of the 98 close strokes, 95 were from a single storm system.

RESULTS

For the 98 electric field waveforms due to strokes at distances less than or equal to 10 km (95 of these from the storm system recorded on data rolls 26a, b and 27a, b), both the current waveforms and the return stroke velocities could be determined within limits. Individual return stroke velocities were found to be in the range 0.8 to 2.4 x 10^8 m/sec for best fits to the electric field data. A typical variation of v for an allowable fit around the best fit value was found to be $\pm$ 0.4 x 10^8 m/sec.

Fig. 1 shows examples of measured electric fields for first strokes at various distances, calculated best fit currents and return stroke velocities, and the calculated electric fields that these yield. Figs. 2 and 3 show similar data for subsequent strokes. For those curves marked "photo", reproductions of the original film records are given in I. Also given on the curves are the data roll number and the GMT time (EDST plus 4 hours) as well as a notation if the stroke was over the Atlantic Ocean.

The computed currents for the first return strokes in Fig. 1 are probably valid to a few microseconds after the initial peak at which time it might be expected that a change in velocity due to a major branch would occur. The field dip near 10 μsec and the peak near 20 μsec observed on a number of first stroke waveforms may be due to this change in velocity and the occurrence of a major branch. The field from a first return stroke at 0.5 km which could have been

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produced by a relatively wide range of currents and velocities is shown in Fig. 6 of I and discussed in I.

A characteristic of the lightning fields recorded on data rolls 26a, b and 27a, b is the initial double peak. The majority of observed storms (on which we had no good ranging) produced strokes whose fields had single initial peaks, although these strokes were all at distances greater than 10 km.

Calculated peak current statistics are displayed in Fig. 4. For the 98 close strokes, the limits on the peak current are due to the range of return stroke velocities which can be used to fit a given field waveform. For the 63 strokes at $D > 10$ km, velocities could not be determined from field waveshapes so that currents were calculated by assuming $v = 1.7 \times 10^8$ m/sec, the average of the velocities for $D \leq 10$ km. This choice of velocity might be relatively bad since it represents data from primarily one storm system whose lightning could have had an anomalously high v. A lower average v would raise the values of peak current as indicated by (2) of I.

The maximum value of "best-fit" peak current is 106 kA due to a first stroke at 7.7 km. The probable upper limit to this peak current is 150 kA. The highest peak currents recorded in previous studies are near 200 kA [Uman, 1969].

During June and July of 1971 measurements were made by NASA (using magnetic links) of the peak currents in several discharges which struck the launch umbilical tower of Apollo 15. The largest of these was reported to be 98 kA.

The maximum value of "best fit" rate-of-change of current averaged from zero to peak is 170 kA/μsec due to a subsequent stroke at 4.5 km with a 0.5 μsec risetime from zero to peak and a peak value of 85 kA. The probable upper and lower limits to the rate-of-rise are 210 kA/μsec and 140 kA/μsec, respectively. A total of four subsequent strokes were observed with risetimes of 0.5 μsec. Since this is close to the system response time, it is possible that the risetimes were less the 0.5 μsec and hence that the maximum rate-of-rise was even greater than that calculated above. The highest value of current rate-of-rise previously reported is 80 kA/μsec [Berger and Vogelsanger, 1965] and represents not the average from zero to peak but the maximum value during the current rise to peak. The measurement by Berger and Vogelsanger was of the current produced by a subsequent stroke on a tower top on Mount San Salvatore near Lugano, Switzerland.

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ERRORS

The calculation of currents from measured fields presented in this paper is made assuming (1) that the return stroke velocity is constant, (2) that the return-stroke channel is straight and vertical, (3) that the peak current does not change with height, (4) that the current waveshape does not change with height, and (5) that the return stroke starts at ground level.

(1) The matter of return stroke velocity has been discussed in I.

(2) For a straight return stroke channel inclined at some angle to the vertical the calculated current (assuming a vertical channel) can be significantly in error. The worst case occurs if the channel is slanted away from the observer. For example, for a channel slanted away from the observer at 15° from vertical, $D = 1.5$ km, $v = 8 \times 10^{7}$ m/sec, and a "typical current", the peak electric field is decreased about 15 percent from the vertical-channel case and the maximum value of the electrostatic hump at about 15 μsec is decreased about 30 percent. The field waveshape is changed such that it appears to be due to a vertical channel of higher return stroke velocity. Thus, too high a velocity estimate coupled with too low an electric field measurement would result in a computed current smaller than the actual. For channels slanted toward the observer at about 15° from vertical, $D = 1.5$ km, $v = 8 \times 10^{7}$ m/sec, and a typical current, the initial field peak is practically the same as in the vertical case due to two effects which tend to cancel: The peak field decreases with

respect to the vertical case because θ from (1) of I is less than 90° near the channel base, while the peak field increases due to the fact that the time at which signals arrive from higher and higher parts of the channel is less for the slanted channel. For a channel slanted toward the observer, the electrostatic hump is changed such that it appears to be due to a vertical channel of lower return stroke velocity. The net effect would be the computation of a larger current than existed. A channel slanted to the side with respect to the observer at about 15° from vertical would have exactly the same waveshape as a vertical channel with the same return stroke velocity but would have a magnitude about 4 percent lower. From the above it follows that straight non-vertical channels not more than about 15° from vertical do not produce electric field peaks which are too much different from the vertical channel case. However, relatively large errors in computed return stroke velocity may occur if velocities are determined from electric field waveshapes of non-vertical channels. Currents determined using these velocities will be similarly in error. Clearly, to extract properly the currents from the measured fields, it is necessary to independently measure return stroke velocity and channel shape. Note however that if one wishes to measure and analyze only the first few microseconds of the field waveform (in which the peak generally occurs), only the portion of the channel traversed by the return stroke in that time need be straight and vertical.

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(3) According to Schonland [1956] the luminosity of subsequent strokes tends to decrease as the return stroke propagates upward, but the decrease is not pronounced. Thus one might expect the current not to decrease much with height. For first strokes, luminosity decreases abruptly at each major branch [Schonland, 1956], but is apparently roughly constant between major branches. The primary effect of the magnitude of the current waveform decreasing slowly with height is to cause the field after the initial peak to decrease more rapidly. For example, for the typical current shown in Fig. 3 of I but decreasing linearly to half-magnitude at a 5 km channel top, the field at 100 km would pass through zero and go negative at about 20 μsec.

(4) The leader channel is an imperfect conductor and hence there will be different propagation velocities and attenuation coefficients for the various frequency components of the current waveshape. (Strictly speaking, this statement is only valid for a linear system, which the lightning channel, its currents, and fields may not well approximate.) One therefore would expect some distortion in the waveshape with height. The fact that "mirror image" waveforms exist (see I) indicates that in some cases at least this distortion is not too great.

(5) When the stepped leader nears ground, the electric field at ground will probably become large enough to initiate from ground one or more upward-going leaders (connecting discharges) which, from the meager observational evidence available, are of 10 to 50 m in length

above flat ground [Uman, 1969]. Perhaps a reasonable upper limit would be 100 m in view of the fact that Berger and Vogelsanger [1965] found connecting discharges of 20 to 70 m in length above a 55 m tower on Mount San Salvatore near Lugano, Switzerland. If the return-stroke current starts to flow at the connection of the upward and downward-moving leaders and propagates components both upward and downward, the total measured electric field will be due to both components. Any significant current wave $i(t+(z-h)/v)$, where h is the height of the connecting discharge, which propagates down the connecting discharge will cause an increase in the measured field while it is propagating. For the upper-limit length of 100 m and $v = 1 \times 10^8$ m/sec, the propagation time down the connecting discharge would be 1 μsec. Thus, it is conceivable that the field due to current traversing the connecting discharge may contribute to the initial field peak for first strokes. The result would be that too large a channel current would be calculated during the time of the downward propagation. After the downward propagating front (voltage discontinuity and resultant current wave) reflects from the ground, the resultant upward propagating front and the main front ahead of it may be treated as one system with an overall channel current $i(t-z/v)$ which would probably have two peaks. It is not known whether subsequent strokes have connecting discharges. Not infrequently electric field waveforms are observed which have a very sharp pulse occurring during the waveform rise to peak. This pulse might be due to the field from the connecting discharge. High-speed photographs time-correlated with

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the electric field traces will be necessary to settle these questions.

It is difficult to assess properly the errors in computed current due to differences between the model and actual return strokes. In view of the fact that most return stroke velocities as determined from electric field wave shapes were relatively high compared to the ranges reported by Schonland et al. [1935] and Schonland [1956] (see I), it would appear that most channels were either vertical or leaning away from the observer. Since it is more reasonable to expect the channels to have been randomly oriented, it follows that most were probably more or less vertical. On the other hand, much of the close data were taken on a single storm while it was moving toward the observation point. It is possible that the meteorological conditions were such as to slant these channels away from the observation point. If there is an error in calculated current due to this effect, it is probably in the direction of too small a computed current.

The uncertainty in current magnitude due to drift and calibration errors in the electric field measuring system and errors in extracting the field data from the 35 mm film on which the waveforms were recorded is estimated to be $\pm$ 15 percent.

Thunder ranging generally results in a slight underestimation of the distance to the main-current channel since sound is heard first from the nearest branches or in-cloud channels. This error becomes larger as the strokes become closer. Assuming that the initial thunder clap comes from the vertical main channel, we were sometimes able to

differentiate between the initial thunder and that due to the main channel. If this approach is correct, the underestimation of distance for the closest strokes probably does not exceed 20 percent. Any distance underestimate leads to an underestimate of the current magnitude.

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DISCUSSION

The available statistics on lightning peak current, current risetime, and time to half of peak current value have been summarized by Uman [1969]. The most reliable data on current waveshapes come from the Empire State Building study [Hagenguth and Anderson, 1952], the Mount San Salvatore study [Berger and Vogelsanger, 1965; Berger, 1967], and the study by McCann [1944]. The total number of strokes analyzed in these studies was about 300 although not all salient properties of the current were published for all 300 strokes. (For example, there are only 115 published risetime measurements). Information on peak currents is more plentiful (about 3000 measurements) primarily due to the magnetic link data reported by Lewis and Foust [1945]. All of the above data refer to the currents flowing at the base of the lightning channel, generally in structures which project high above the normal terrain.

The peak current statistics of Fig. 4 are in reasonable agreement with previous measurements. The 98 close strokes have a median peak current about twice that indicated by previous work. The 63 strokes for which $D > 10$ km have a peak current distribution very close to that reported by Lewis and Foust [1945]. Our measured current risetimes, generally in the range 0.5 to 5.0 μsec, are in good agreement with the literature which shows median risetimes in the range 1 to 3 μsec.

The primary discrepancy between the current waveshapes reported in this paper and those measured directly due to current flow in tall structures is in the current waveshape around peak and its fall-time. We generally find sharply peaked currents with a fall-time to half of peak value of about 10 μsec. The waveforms from direct current measurement generally show no sharp peak and a time to half of peak value of 30 to 40 μsec. If an initial peak were superimposed on these data, the resultant currents would be very similar to those derived from our field measurements. Three possible explanations for the discrepancy are:

(1) The current in a structure at the base of the lightning may not have the same waveshape as the current wave propagating up the channel due to the effects of the connecting discharge and since the structure has different impedence characteristics from the channel;

(2) The measurement techniques used on structures may have failed to detect sharp peaks which did exist;

(3) The return stroke model is deficient and field peaks do not translate into current peaks.

The current waveshapes for first strokes given in Fig. 1 are remarkably similar to the first stroke currents of Berger and Vogelsanger [1965] and Berger [1967]. In particular both sets of data usually show a broad second peak near 20 μsec. Berger [1967] attributes the second peak to branch currents. The similarity between our data and his is probably fortuitious since the model calculations

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do not take into account the effects of branches or of expected changes in the return stroke velocity.

Kalakowsky and Lewis [1967] have presented data on stroke location and electric field intensities for very large strokes in New England. The study lasted for 30 months. From these data and assumed return stroke velocities we can compute peak currents for the New England strokes. The largest of half a million waveforms is indicative of a peak current of about 110 kA if $v = 2 \times 10^8$ m/sec, 220 kA if $v = 1 \times 10^8$ m/sec, and proportionally higher if v is lower. Twenty-seven of the half million waveforms (or about 0.005 percent) were indicative of a current over about 38 kA if $v = 2 \times 10^8$ m/sec or over about 76 kA if $v = 1 \times 10^8$ m/sec.

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ACKNOWLEDGMENT

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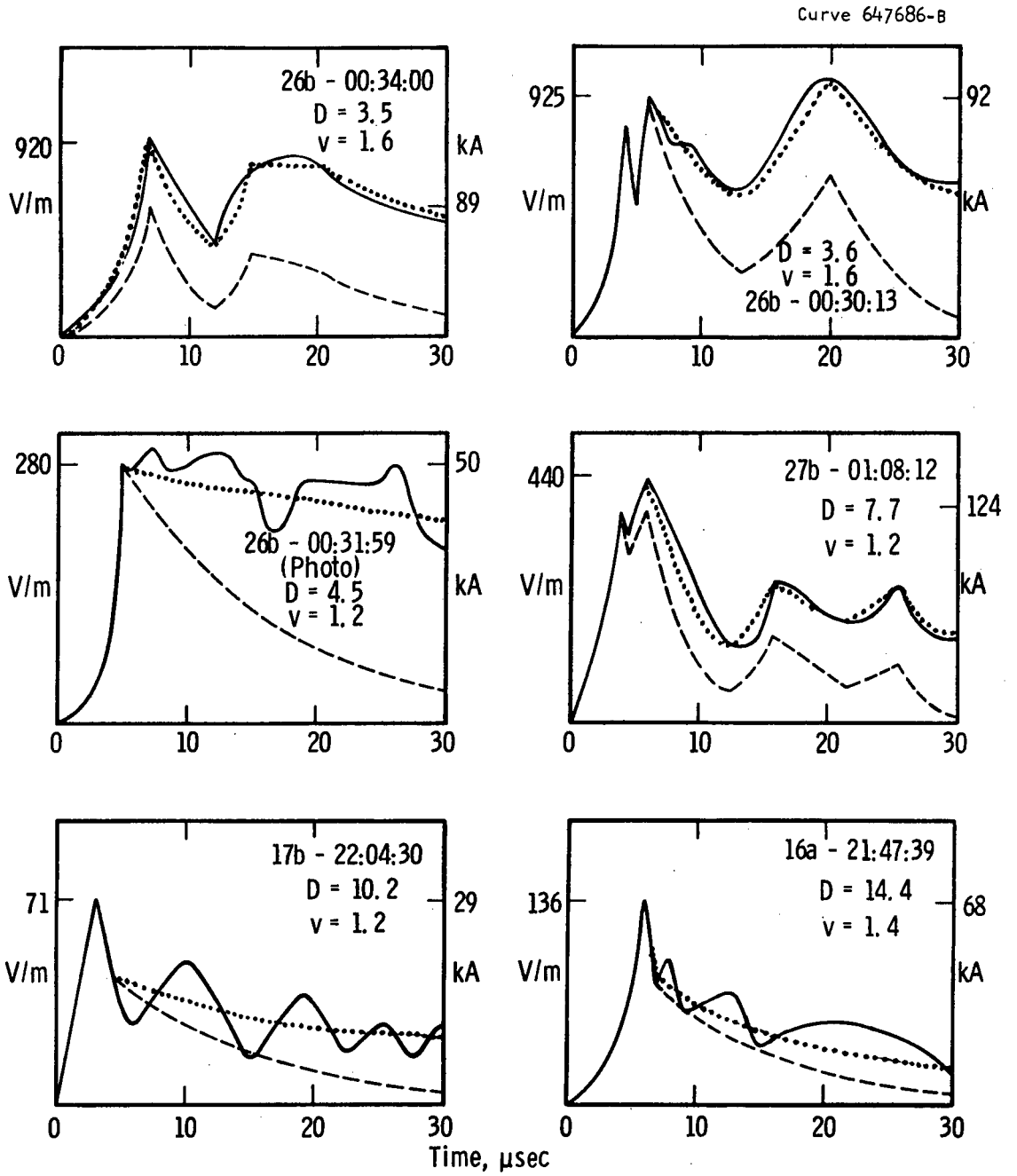

Fig. 1. Electric fields and currents of 6 first return strokes at distances between 3.5 and 14.4 km. The calculated current waveforms (dashed lines) and return stroke velocities are of those which give calculated electric fields (dotted lines) closely matching the measured fields (solid lines). Stroke distance D is in km; return stroke velocity v in 10^8 m/sec.

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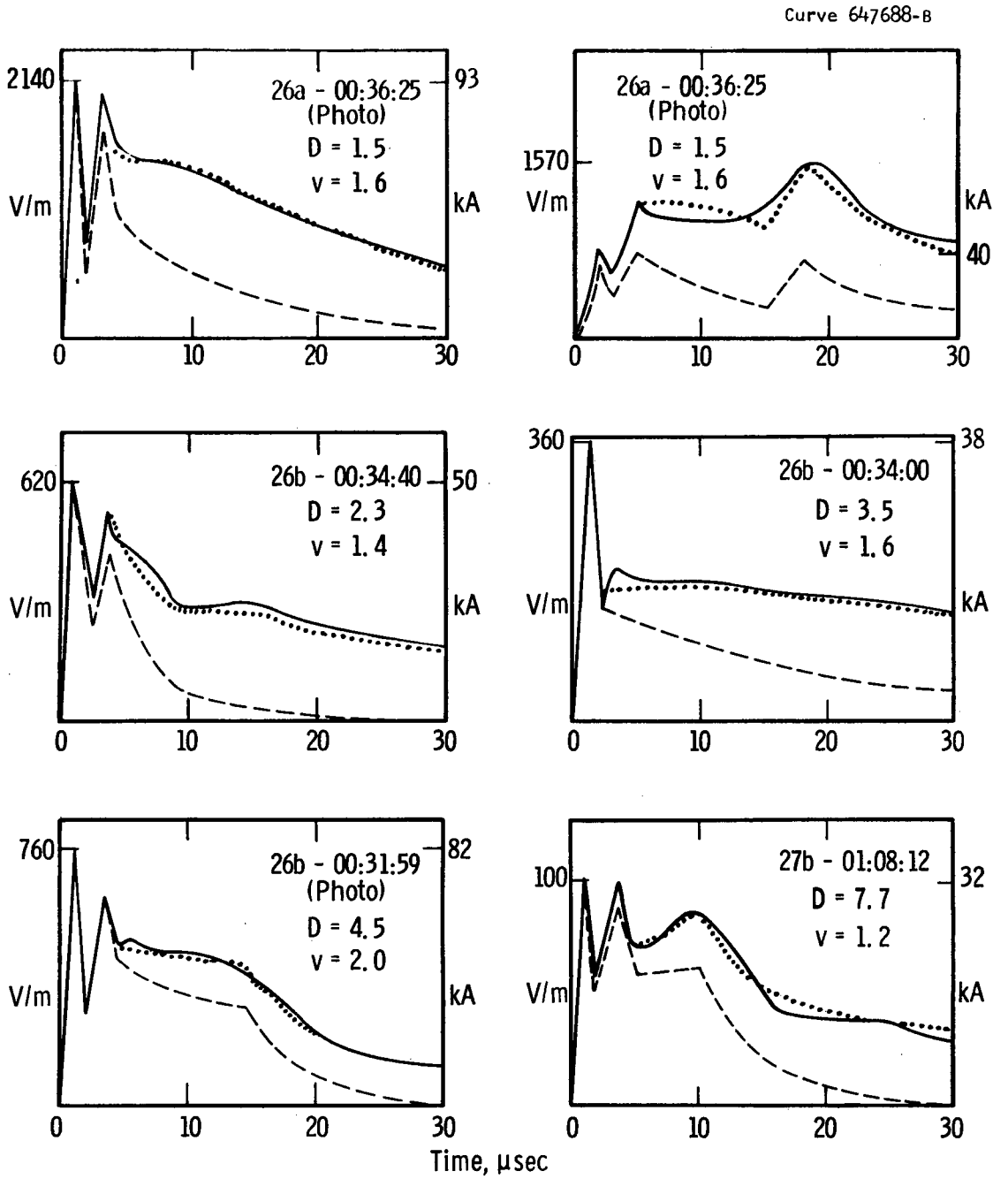

Fig. 2. Electric fields and currents of 6 subsequent return strokes at distances between 1.5 and 7.7 km.

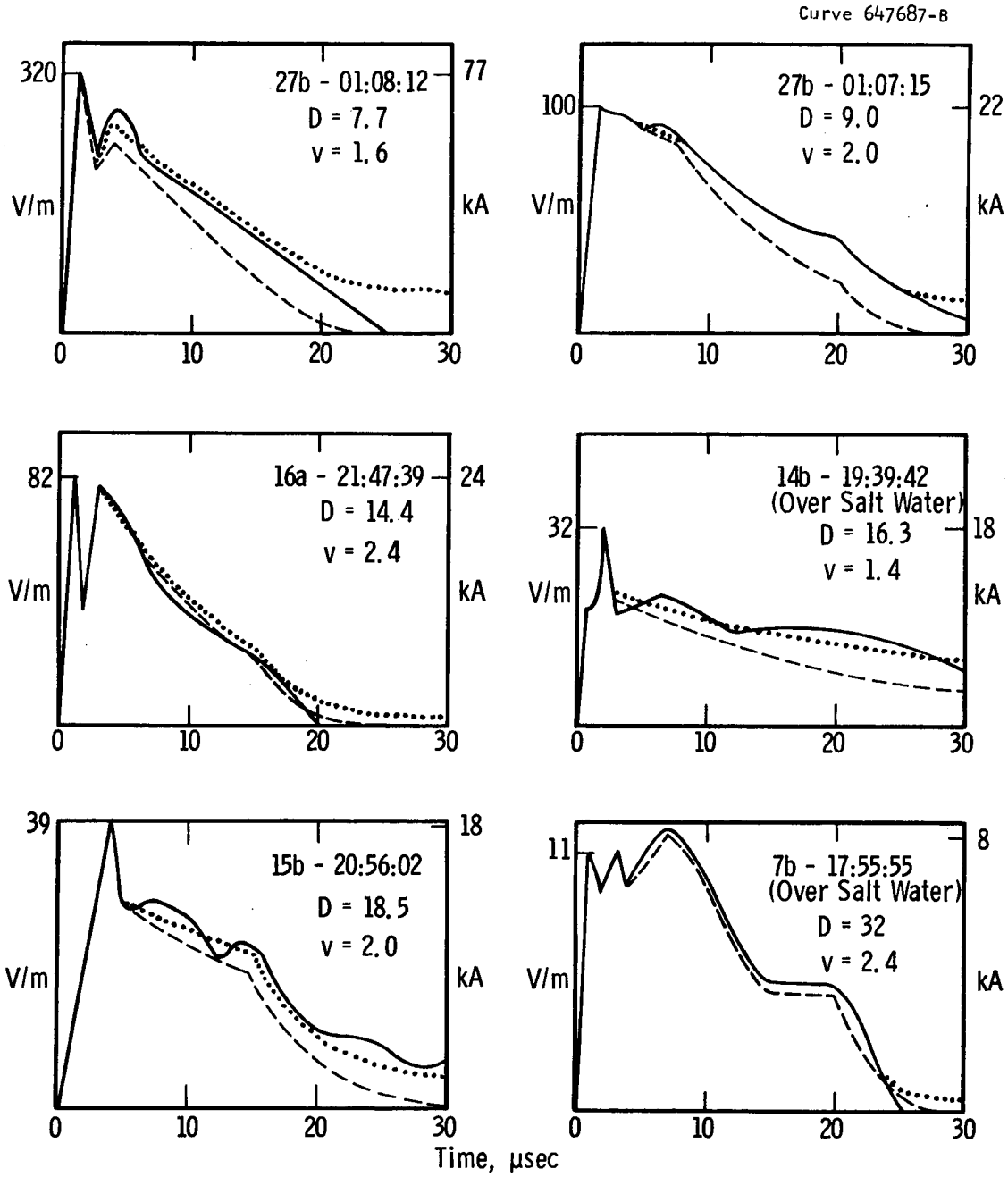

Fig. 3. Electric fields and currents of 6 subsequent return strokes at distances between 7.7 and 32 km. Two waveforms due to strokes over the Atlantic Ocean are shown.

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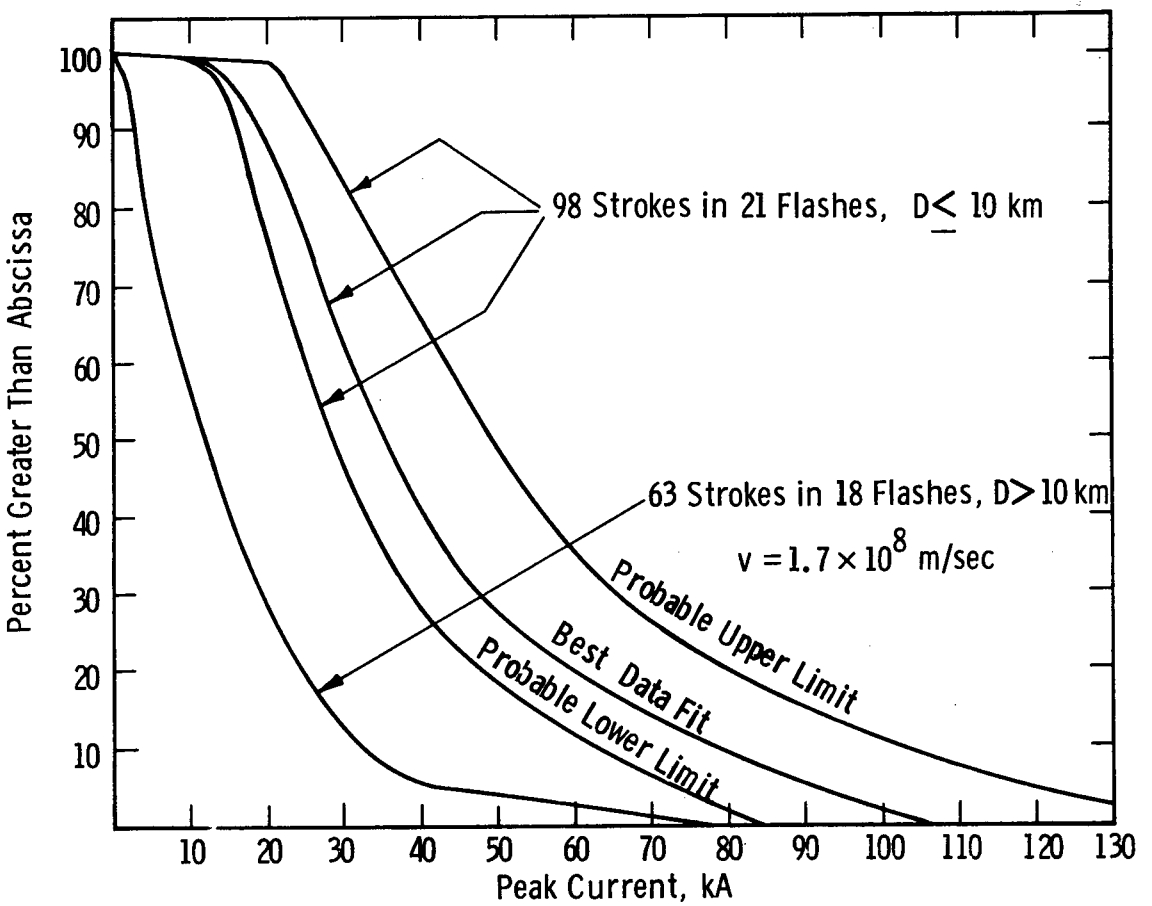

Fig. 4. Statistical distribution of peak currents. For the 98 close strokes, the probable upper and lower limits are due to the range of return stroke velocities for which reasonable fits to the measured fields can be obtained. This spread in peak values does not include the effect of measurement errors and errors due to possible deficiencies in the model. These are discussed in the Errors section.

III

Propagation of Sferics Over Long Range

Monday, 11 September 1972, 1500 - 1800 EDT, Arlington, Virginia

Chairman: G. Jean

Papers presented:

"The Delay Time Difference and the Amplitude Ratio of Spectral Groups Within Various Propagation Models"	W. Harth
"VLF Propagation Research at the Naval Research Laboratory"	Francis J. Kelly (Abstract only)
"Omega Navigation System"	John W. Brogden
"Multimodel Influences on the Apparent Propagational Dispersion of VLF Sferics"	Gary H. Price

THE DELAY TIME DIFFERENCE AND THE AMPLITUDE RATIO OF SPECTRAL GROUPS WITHIN VARIOUS PROPAGATION MODELS

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by

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Abstract: The classical Wait and Walters model and the "surface impedance concept" is the basis for a first approach in the discussion of the VLF atmospherics parameters as measured by the VLF atmospherics analyzer of the Heinricht-Hertz-Institut in Berlin-Charlottenburg. Since the analyzer is mainly tuned to frequencies within the lower VLF-range (3 - 10 kHz) the mode calculations by Wait and others are extended to this range. From attenuation rates and phase velocities the parameter GDD (group delay time difference) and SAR (spectral amplitude ratio) of spectral groups are derived. These parameters show a significant dependence on the propagation direction relative to the earth's magnetic field and are proportional to the distance for far away thunderstorms. All calculations presented in this paper refer to the first mode.

1. INTRODUCTION

During the last decade, an atmospherics analyzer has been developed at the Heinrich-Hertz-Institut in Berlin-Charlottenburg, which evaluates incoming atmospherics according to the direction of arrival and parameters of the Fourier spectrum (Heydt, 1967; Heydt and Volland, 1965). An automatic technique allows a continuous recording of the VLF atmospherics activity within a region up to 4000 to 14000 km depending on direction and time of day. In order to interpret these measurements in terms of meteorological and geophysical factors, it is necessary to study the influence of the propagation path on the form of the signals.

An idealized flat waveguide model with ideal reflecting boundaries was used in our first attempt. A good qualitative agreement was found in describing the GDD (group delay time difference) parameter in relation to its variables i.e. distance, frequency and waveguide height (Volland, Heydt and Harth, 1967; Volland, 1968). In the case of a quantitative analysis, however, the measured values diverge from those of the model by a factor of two. Furthermore, the parameter SAR (spectral amplitude ratio) and SA (spectral amplitude) in this idealized model could not be determined. Another disadvantage was the impossibility of estimating the influence of the anisotropy of the ionospheric plasma.

In this paper, the model calculations by Wait and others (Wait and Walters 1963, 1964; Wait and Spies, 1964) are extended to the lower VLF-range (3 - 10 kHz), the measuring range of the equipment, in order to derive the theoretical behaviour of the atmospherics parameters in more realistic models. The reason for the selection

of this particular model and the outlined formalism was to follow up the first attempt of Frisius and Heydt (1968) who used the same approach. Moreover, for a first discussion of the parameters within the first mode approximation, it seems to be convenient to use a rather simplified model with only a horizontal component of the earth's static magnetic field rather than those improved models and model calculations which include the real dipping field at the expense of greater complexity (e.g. Pappert, Gossard and Rothmuller, 1967; Pappert, 1968; Galejs, 1969). In this simplified model the atmospherics parameters show a significant dependence on the propagation direction relative to the earth's magnetic field which is in quantitative agreement with measurements as far as they are available.

In the first section a description of the physical significance of the atmospherics parameters in question is given. There follows a short outline of the Wait and Walters model and of the solution of the modal equation from which attenuation rates and phase velocities are calculated. The next section deals with the derivation of the parameters GDD (group delay time difference) and SAR (spectral amplitude ratio) from the propagation function. In the last section, graphical results are presented and discussed. Frequencies and pairs of frequencies for which the parameters are studied are those which are possible to measure with the analyzer.

All calculations presented in this paper refer to the first mode. It is assumed that the reflection on the earth surface is ideal, i.e. $R_g = +1$, corresponding to an assumed infinite ground conductivity δ_g. Preliminary results of these calculations have been confirmed by measurements (Harth, 1970; Frisius, Heydt and Harth, 1970; Harth, 1972).

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2. THE SPECTRAL PARAMETERS AND THEIR PHYSICAL INTERPRETATION

Atmospherics parameters are considered in the following as those quantities, which can be measured by the VLF atmospherics analyzer of the Heinrich-Hertz-Institut from the Fourier spectrum. Let the vertical electric field of the incoming signal at the receiver input be

$$E(t,\varrho,p_1,p_2,\cdots) = \int_{-\infty}^{\infty} A(\omega,\varrho,p_1,p_2,\cdots)\, \exp(i\omega t)\, d\omega \qquad (1)$$

with

$$A(\omega,\varrho,p_1,p_2,\cdots) = |A(\omega,\varrho,p_1,p_2,\cdots)|\, \exp(i\phi(\omega,\varrho,p_1,p_2,\cdots)) = q_r\, T \qquad (2)$$

then the voltages u_{SA}, u_{SAR}, and u_{GDD} are proportional to the parameters defined below:

1. The spectral amplitude: SA
   $u_{SA} = f_1\ (|A(\omega,\varrho,p_1,p_2,\cdots)|)$
2. The spectral amplitude ratio: SAR
   $u_{SAR} = f_2\ (|A(\omega_1,\varrho,p_1,p_2,\cdots)| / |A(\omega_2,\varrho,p_1,p_2,\cdots)|)$
3. The spectral group delay time difference: GDD
   $u_{GDD} = f_3\ \left(\dfrac{\phi(\omega_2) + \phi(\omega_1) - 2\phi(\omega_m)}{\Delta\omega} \right)$

with

$$\Delta\omega = \omega_2 - \omega_m = \omega_m - \omega_1$$

The symbols are:

$A(\omega,\varrho,p_1,p_2,\cdots)$	:	Spectral function
$\phi(\omega,\varrho,p_1,p_2,\cdots)$	:	Phase spectrum
$T(\omega,\varrho,p_1,p_2,\cdots)$	:	Propagation- or transmission-function

$q_r(\omega)$	:	Source spectrum
ρ	:	Distance: Source-receiver
$\omega = 2\pi f$	:	Angular frequency
$p_1, p_2, p_3, \ldots$	:	Sum of the terrestrial parameters
f_1, f_2, f_3	:	Receiver functions

The receiver is mounted with narrow band amplifiers having a bandwidth of approximately 120 Hz.

3. WAVEGUIDE MODEL

The calculations presented are based on models of the terrestrial waveguide, discussed by Wait (1962), and Wait and Walters (1963, 1964). In these models, the reflection of VLF-waves on the D-layer is considered as a reflection of vertically polarized plane waves at oblique incidence on a plane multi-slabbed anisotropic and inhomogeneous plasma. With the aid of the "non uniform transmission line theory" (Wait 1962) both the surface impedance and the corresponding reflection coefficient are calculated and referred to a level in the D-layer where the "bulk of energy is being reflected" (Wait and Spies, 1964). In the ionosphere model of Wait and Walters both the electron density and the effective collision frequency vary exponentially with height.

Electron density: $N(z) = N(0) \exp(b\, z)$

$N(0) = 300$ Electr./cm^3 at H=70 km

$$b \begin{cases} = 0.15 \text{ in the daytime model} \\ = 0.35 \text{ in the nighttime model} \end{cases}$$

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Collision frequency: $\nu(z) = \nu(0)\ \exp(-a\ z)$

$\nu(0) = 0.5 \cdot 10^7$/sec at H = 70 km

$a = 0.15$ in the day- and nighttime model

Both these profiles are combined in the conductivity parameter (Wait and Spies, 1964):

$$\omega_r(z) = \omega_r(0)\ e^{\beta\ z} \tag{3}$$

with

$$\omega_r(0) = \omega_o^2/\nu(0); \quad \omega_o^2 = 3.18 \cdot 10^9\ N(z) \tag{4}$$

and

$$\beta = a + b \tag{5}$$

In order to describe the relative importance of the earth's magnetic field a parameter has been introduced which is defined by (Wait and Spies, 1964):

$$\Omega = \frac{\omega_T}{\nu(0)} \tag{6}$$

Here ω_T is the angular gyrofrequency of electrons in the earth's magnetic field and determines in the (ε)-tensor the reflection characteristics of the D-layer for various propagation directions. In middle latitudes, where the geomagnetic field H_o has a magnitude of 0.5 gauss and a declination of 67°, Ω has the values:

$$\Omega \sim \begin{cases} -1 & \text{Propagation from WEST TO EAST} \\ +1 & \text{Propagation from EAST TO WEST} \end{cases}$$

Ω is zero for propagation along the magnetic meridian, i.e. isotropic propagation.

A convenient representation of the reflection coefficient for the application in mode theory is:

$$R_i = - \exp(\alpha C) \tag{7}$$

where α, in general, is a complex function of C, the cosinus of the (complex) angle of incidence. Thus

$$\alpha = \alpha_1 + i\,\alpha_2 \tag{8}$$

The calculations for the reflection coefficient by Wait and Walters have been extended to the lower VLF-range for C = 0.1. The gradient β of the conductivity parameter has, as mentioned above, the value of 0.3 in the daytime model, and in the nighttime model it is 0.5. The influence of anisotropy is described by the parameter Ω. It extends formally in the calculations from -3 to +3. Fig. 2 shows the results of the calculations. In part (a) of Fig. 2 α_1 and α_2 for the isotropic model are plotted versus the wavelength; solid lines corresponding to the daytime model (β = 0.3) and dashed lines to the nighttime model (β = 0.5). Part (b) and (c) show α_1 and α_2 again for the daytime- and nighttime-model with various non-zero values of Ω. It should be mentioned that α_1, which is primarily related to the attenuation, has only a small variation with the wavelength for waves longer than 30 km, but is quite sensitive to changes in Ω. In the nighttime model (β = 0.5) and for propagation from east to west ($\Omega \sim +1$), α exceeds the corresponding value for the daytime model, whereas for Ω = -1, the daytime value is greater than the nighttime value. A similarly weak dependence on the wavelength can be recognized for α_2, which is mainly related to the phase, while contrary to

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α_1 the variation with Ω is not so significant. These results are consistent with those of Wait and Spies (1964). We should note that the effective nighttime magnitudes of Ω may considerably exceed unity.

4. THE SOLUTION OF THE MODAL EQUATION

In the spherical model as well as in the flat model, the modal equation determines the poles and, therefore, the residues of the integral representation of the potential. The waves associated with the terms of the corresponding residue series are called waveguide modes.

In the spherical model, the modal equation has the form (Wait, 1962):

$$A(t)\ B(t) - 1 = 0 \tag{9}$$

with

$$A(t) = - \frac{W_1'\ (t-Y_o) + q_i\ W_1\ (t-Y_o)}{W_2'\ (t-Y_o) + q_i\ W_2\ (t-Y_o)} \tag{10}$$

and

$$B(t) = - \frac{W_2'(t) - q\ W_2(t)}{W_1'(t) - q\ W_1(t)} \tag{11}$$

W_1, W_2, W_1' and W_2' are Airy integral functions and their derivatives, which are related to Sommerfeld's third-order approximation of the spherical Hankel or spherical wavefunction (Sommerfeld, 1949). The factors q and q_i are defined by the boundary conditions:

$$iq = \left(\frac{ka}{2}\right)^{1/3} \frac{Z_e}{\eta} \; ; \quad iq_i = \left(\frac{ka}{2}\right)^{1/3} \frac{Z_i}{\eta} \qquad (12)$$

Z_e and Z_i are the surface impedances of the earth and the ionosphere, respectively. $\eta = \sqrt{\frac{\mu_0}{\varepsilon_0}}$ is the free space impedance, k is the free space wavenumber and a the earth's radius. Y_o finally consideres the height of the waveguide.

The modal equation can only be solved by an iterative process. Beginning with the modal equation for the idealized model ($R_i = -1$, $R_g = +1$ or $q = 0$, $q_i = \infty$) one obtains, by graphical means, the real roots t_o or the starting roots of Newton's method (Wait and Spies, 1964). Successive change of the boundary conditions finally gives the eigenvalue t_n or C_n, respectively.

$$(-t_n)^{1/2} = \left(\frac{ka}{2}\right)^{1/3} C_n \qquad (13)$$

In the flat model the modal equation has a much simpler form:

$$R_g \, R_i \, e^{-i2HkC_n} = e^{-i2\pi n} \qquad (14)$$

As indicated in the previous section, with the representation of the reflection coefficient $R_i = -\exp(\alpha\, C)$, one obtains the approximate solution for the flat case (Wait, 1962):

$$C_n \cong \frac{\pi(2n - 1)}{2\,k\,H + i\alpha} \; ; \quad (R_g = +1) \qquad (15)$$

The eigenvalues determine the propagation function T (for transmitter and receiver on the ground) according

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to:

$$T(\omega, \rho, p_1, p_2, \cdots) = f(H, \lambda, \rho, a) \sum_n \Lambda_n e^{-ik\rho\left(1 - \frac{C_n^2}{2}\right)} \tag{16}$$

Clearly the phase velocity, relative to c, is given by

$$\frac{v_n}{c} \cong \frac{1}{Re\left(1 - \frac{C_n^2}{2}\right)} \tag{17}$$

wheras the attenuation in nepers per unit distance is

$$A_{TT_n} \cong -k \, Jm \left(1 - \frac{C_n^2}{2}\right) \tag{18}$$

Here, Λ_n is the excitation factor, a is the earth's radius, $k = 2\pi/\lambda$ the free space wavenumber, ρ is the distance, and c is the velocity of light.

For both wave guide models, attenuation rates and phase velocities are calculated and graphically presented in Figures 3 to 5. As mentioned in the introduction, attenuation is only given in the lower part of the VLF-range. In the case of the spherical model, Newton's method is applied to low frequencies as far as the iteration process converges. The results are plotted by dashed lines. The flat model is calculated from 3 kHz up to 13 kHz and shown by solid lines. In Fig. 3 attenuation rates in dB/1000 km (part (a)) and the phase velocity relative to c (part (b)), are shown versus frequency for the isotropic daytime model, $\Omega = 0$ and $\beta = 0.3$. H is the height to which the reflection coefficient is referred, and is simply called the reflection height in the following. We note that a good overlapping is obtained for the two models which is the best at the lower frequencies in contrast to the considerable deviations above 10 kHz.

The influence of the earth's magnetic field is illustrated in Fig. 4. Here attenuation rates (Fig. 4 (a)) and phase velocities relative to c (Fig. 4 (b)), are plotted for various frequencies versus the earth's magnetic field parameter Ω. The upper parts are related to a daytime model ($\beta = 0.3$, $H = 70$ km), whereas the lower parts are orientated to nighttime conditions ($\beta = 0.5$, $H = 85$ km). In Figure 4 (a) the non-reciprocity in propagation along the magnetic equator is obvious. Waves propagating from west to east ($\Omega < -1$) are less attenuated than those which travel in the opposite direction ($\Omega > +1$). This non-reciprocity effect increases with lower frequencies. Some similarities are seen for the phase velocity, plotted in Figure 4 (b) versus Ω. At frequencies near 10 kHz a non-reciprocity cannot be ascertained, but it becomes again noticeable at lower frequencies. Fig. 5 indicates the reason for the non-reciprocity of the parameters discussed in the next section. The amplitude ratio of two spectral groups (SAR) is, as will be shown, proportional to the difference of the corresponding attenuation rates. This is greater in case of $\Omega = +1$. The delay time difference of two groups (GDD) is proportional to the curvature of the spectral phase with respect to the frequency. With Figure 5 (b) it becomes clear that the expected value for the group delay time difference should be greater for propagation from west to east ($\Omega \sim -1$) than in the opposite direction ($\Omega \sim +1$).

5. THE GROUP DELAY TIME DIFFERENCE AND THE SPECTRAL AMPLITUDE RATIO

The delay time difference of two spectral groups is deduced out of the phase spectrum of atmospherics by the following principle (Heydt and Volland, 1965; Heydt,

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1965, 1967):

With the definition of the group delay time

$$\frac{\partial(\phi-\omega t)}{\partial\omega}=0 \quad ; \quad t_g=-\frac{\partial\phi}{\partial\omega} \tag{19}$$

the second derivative of the phase with respect to the angular frequency becomes:

$$\frac{\partial t_g}{\partial\omega}=-\frac{\partial^2\phi}{\partial\omega^2} \tag{20}$$

This second differential quotient corresponds to a second difference quotient which is obtained by a twofold subtraction of three spectral phases with respect to their frequency separation. This quantity is called the group delay time difference (GDD).

The procedure is illustrated by Figure 1. Let $\phi(\omega,\varrho,P_1,P_2,\cdots)$ be the phase spectrum of an atmospheric, then the group delay times at ω_1' and ω_2' are given approximately by the difference quotients:

$$t_g\Big|_{\omega_2'}\simeq\frac{\phi_2-\phi_m}{\Delta\omega} \quad ; \quad t_g\Big|_{\omega_1'}\simeq\frac{\phi_m-\phi_1}{\Delta\omega} \tag{21}$$

A subtraction of both these group delay times yields:

$$t_g\Big|_{\omega_2'}-t_g\Big|_{\omega_1'}\simeq\frac{2\phi_m-\phi_2-\phi_1}{\Delta\omega}=-\frac{\Delta^2\phi}{\Delta\omega}=GDD \tag{22}$$

In the first mode approximation GDD can be determined by the phase velocity. If

$$\phi(\omega,\varrho,P_1,P_2,\cdots)\sim\phi_{\Lambda_1}(\omega)+\phi_{q_r}(\omega)-\frac{\omega}{v_1(\omega)}\varrho \tag{23}$$

is the phase of the first mode, then we obtain for the contribution of the last term to GDD:

$$t_g\Big|_{\omega_2'} = -\frac{\varrho}{v_g} \simeq -\varrho\frac{\Delta k}{\Delta\omega} = -\varrho\frac{k_2-k_m}{\omega_2-\omega_m}\ ; \quad t_g\Big|_{\omega_1'} \simeq -\varrho\frac{k_m-k_1}{\omega_m-\omega_1} \tag{24}$$

or:

$$t_g\Big|_{\omega_2'} \simeq -\frac{\dfrac{f_2}{v_{ph}(f_2)}-\dfrac{f_m}{v_{ph}(f_m)}}{f_2-f_m}\ ; \quad t_g\Big|_{\omega_1'} \simeq -\frac{\dfrac{f_m}{v_{ph}(f_m)}-\dfrac{f_1}{v_{ph}(f_1)}}{f_m-f_1} \tag{25}$$

With

$$\Delta f = f_m - f_1 = f_2 - f_m \tag{26}$$

the group delay time difference is written by:

$$GDD = -\varrho\frac{1}{\Delta f}\left[\left(\frac{f_2}{v_{ph}(f_2)}-\frac{f_m}{v_{ph}(f_m)}\right)-\left(\frac{f_m}{v_{ph}(f_m)}-\frac{f_1}{v_{ph}(f_1)}\right)\right] \tag{27}$$

v_g and v_{ph} are the group velocities and the phase velocities, respectively. The contribution of both the excitation factor $\Delta^2\phi_{\Lambda_1}$ and the source spectrum $\Delta^2\phi_{q_r}$ are neglected here. This can be justified in the case of the first term by calculations (Harth, 1971) and in the case of the second term by measurements as far as they are available (see Fig. 14).

Now in the case of the idealized model ($R_i = -1$, $R_g = +1$), the GDD can immediately be calculated because α as the reflection parameter of the ionosphere and only known numerical function of frequency in this model disappears.

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A second derivative of

$$\phi \sim \omega t - \rho k (1 - C_n^2/2)$$

with respect to ω gives (Volland, 1967):

$$GDD_{ideal} = - \frac{c\ \Delta f}{16\ H^2\ f_m^{\ 3}}\ \rho \qquad (28)$$

The symbols mean: ρ = propagation distance, $\Delta f = \Delta\omega/2\pi$ frequency separation between the two groups, H = reference level of the reflection coefficient or reflection height, f_m = mid-frequency, and c = velocity of light.

The spectral amplitude ratio (SAR) is defined by:

$$SAR = -20 \log \frac{|A(f_1, \rho, p_1, p_2 ..)|}{|A(f_2, \rho, p_1, p_2 ..)|} \qquad (29)$$

In the first mode approximation SAR can be written (Frisius and Heydt, 1968):

$$SAR = -20 \log \frac{|q_r(f_1)\, H(f_2)\, \sqrt{\lambda_1}\ \Lambda_1(f_1)|}{|q_r(f_2)\, H(f_1)\, \sqrt{\lambda_2}\ \Lambda_1(f_2)|} - (A_{TT_1}(f_2) - A_{TT_1}(f_1))\rho \qquad (30)$$

$\lambda = 2\pi/k$ is the wavelength, and $A^*_{TT_1}$ stands for the attenuation factor of the first mode which is given in dB per meter by:

$$A_{TT}^*(f) = 20 \log(e)\ A_{TT}(f) \qquad (31)$$

The SAR in this first mode approximation is a linear function of the distance ρ.

$$SAR = - \text{const} - \rho (A_{TT_1}^*(f_2) - A_{TT_1}^*(f_1)) \qquad (32)$$

Because information about the source spectrum is scarce, we neglect in the following figures the contribution of the constant term to SAR. Using the data of Taylor (1963) and Watt and Maxwell (1957) we estimate for the groups of 6 and 8 kHz a value for the constant of approximately 2.3 dB in the case of isotropic propagation.

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6. GRAPHICAL PRESENTATION OF PARAMETER CHARACTERISTICS

The above presented connections between the propagation function and the spectral atmospherics parameters are reflected in Figures 6 to 12. In the same way as the attenuation rates and phase velocities, which have been determined in the flat and spherical model as functions of electron density, wave guide height and propagation direction in section 3, the GDD's and SAR's per 1000 km have been calculated. The spectral amplitude has not been considered and can be evaluated immediately by means of the calculated attenuation rates. It may be noted here that a comprehensive study on the statistics and the connection of the statistical parameters of the spectral amplitude have been given by Frisius and Volland (Frisius, 1969, Volland, 1968).

The newly constructed instrument is already in operation within a worldwide network (Washington, Buenos Aires, Berlin, and Toyokawa). In contrast to its predecessor of 1966, it is designed to operate at fixed frequencies. Consequently, those frequency combinations have been mainly considered through which the parameters may be measured with this new instrument. These are the

group delay time difference of groups at 8 and 6 kHz, the spectral amplitude ratio of 5 to 9 kHz, and the spectral amplitude at 7 kHz.

GDD graphs:

In regard to the idealized model, GDD will be discussed first as function of H^{-2} and f_m^{-3} and then the influence of propagation direction i.e. of the earth's magnetic field parameter Ω, will be pointed out.
Fig. 6 shows the group delay time difference as function of H^{-2} for the flat propagation model. While part (a) of this figure describes the group delay time difference for several combinations of frequency groups in the isotropic model, part (b) presents GDD 7/2 versus H^{-2} for various Ω. GDD 7/2 signifies: the mid-frequency f_m is 7 kHz, the frequency separation Δf of both groups is 2 kHz, i.e. the group delay time difference is determined for the groups at $f_m + \Delta f/2$ and $f_m - \Delta f/2$, thus at 8 and 6 kHz. The solid lines relate to the daytime-model ($\beta = 0.3$); the dashed lines to the nighttime-ionospheric-model ($\beta = 0.5$). The reflection on the earth's surface is presupposed as ideal, meaning that the ground conductivity is infinite. When considering the conditions in the isotropic model, all curves except GDD 5/2 show good linearity with respect to H^{-2} within the interesting region of 70 km to 90 km as well as a relatively weak dependence on the electron density. The dashed-dotted line corresponds to GDD 7/2 in the idealized model and clearly illustrates the factor of two difference in the GDD-value of both models. Up to now, it has not been tested whether the curves GDD 5/2 and GDD 6/2 show an unusual behaviour at lower heights. Figure 6 (b) indicates a quasi linearity of GDD 7/2 against H^{-2} only for $\Omega < 0$, which disappears starting with $\Omega = +1$ in the

nighttime model ($\beta = 0.5$, dashed lines). Further upon changing the propagation direction of west to east over north-south/south-north to east-west, i.e. from $\Omega = -1$ to $\Omega = +1$, an inversion of GDD values for the daytime and nighttime models occurs. While the GDD value at a certain height for the daytime model and for $\Omega > 0$ is always higher than that for the nighttime model, this trend is reversed in the cases for $\Omega < 0$.

The dependence of GDD on f_m^{-3} is shown in Figure 7. The first presentation of this figure corresponds again to the isotropic model ($\Omega = 0$). The upper part is related to a frequency separation of the groups of $\Delta f = 1$ kHz, while the lower part corresponds to the frequency separation of 2 kHz. The parameter is the reflection height. With regard to the idealized model (Eq. 28) this model too shows a sufficient linearity of GDD with f_m^{-3} if the lower reflection rates and frequencies are disregarded. It is questionable whether the calculated GDD-values for smaller heights and lower frequencies are real or if the model's extent of validity has been surpassed. It is interesting, nevertheless, that Heydt (1965) finds a similar curve with a maximum at 5 kHz when analyzing an synthetic atmospheric in reference to the second derivative of the spectral phase with respect to the frequency. The Figures 7 (b) and 7 (c) present GDD as a function of f_m^{-3} with the parameter Ω. Part (b) is orientated to the daytime ionosphere ($\beta = 0.3$, $H = 70$ km); in part (c) the nighttime model is shown ($\beta = 0.5$, $H = 85$ km). While in both models (part (b) and (c)) a linearity can be recognized for the isotropic case ($\Omega = 0$), this disappears as Ω increases negatively or positively.

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The influence of anisotropy is specifically emphasized by Fig. 8. Here the GDD is plotted versus Ω for several combinations of frequency groups, using the reflection height as a parameter. Figure 8 (a) corresponds to the daytime model ($\beta = 0.3$) and Figure 8 (b) to the nighttime model. Here it is obvious that the influence of anisotropy considerably increases with decreasing mid-frequency. In both models no significant dependence on Ω can be ascertained for GDD 10/2.

SAR - SAR/GDD-graphs:

The amplitude ratio (SAR) dependencies upon H^{-2} and Ω may be investigated in analogy to the GDD. Three specific ratios of frequency groups have been selected where the characteristics are clearly recognized. In Fig. 9 (a) the SAR is plotted versus H^{-2} as done previously for the GDD. Solid lines correspond to the daytime model ($\beta = 0.3$) and dashed lines to the nighttime model ($\beta = 0.5$), using Ω again as parameter. While theoretically no linearity with H^{-2} can be expected within the region of 90 to 70 km due to possible errors in measurement, the dependency is still practically linear. Contrary to GDD, the SAR is smaller for negative Ω than for $\Omega > 0$. Further, the inversion of SAR-values at a given height (greater than 70 km) is such that the daytime value surpasses the nighttime value for $\Omega < 0$, and is smaller than the nighttime value for $\Omega > 0$, in contrast to the GDD behaviour (Fig. 6(b)). Similarly weak is the dependence upon electron density. At a given height the values at SAR for $\beta = 0.3$ and $\beta = 0.5$ differ only slightly.

Fig. 10 shows explicitly the dependence of SAR on Ω for the amplitude ratios of 5 to 9 kHz. The upper part

is related to the daytime model ($\beta = 0.3$) and the lower part is, as before, orientated to the night-time model. In each case, the parameters are the three wave guide heights. In addition to what has been mentioned above, namely that the SAR-values, contrary to the GDD, are higher for $\Omega > 0$ than those for $\Omega < 0$, it can be seen here that the SAR is larger with the participation of lower frequencies to the SAR and at greater frequency separation.

The evaluation of atmospherics registration in regard to theoretical propagation studies always has the disadvantage that the location of thunderstorms is unknown in most cases. Frisius thus has collected correlations between SAR and GDD in relation to certain sources so that the unknown quantity, the distance, vanishes. These plots GDD to SAR have been worked out for comparable propagation conditions and after selections under different directions. A considerable dependence on the direction of incidence could be noted (Frisius and Heydt, 1968; Frisius, Heydt and Harth, 1970).

How the ratio SAR/GDD as a function of Ω presents itself in view of these correlations is shown in Fig. 11. The solid lines correspond to the daytime model ($\beta = 0.3$), the nighttime model is described by the dashed lines ($\beta = 0.5$). The significant dependence on Ω, which is not surprising after the previous results, is clear here. It should be pointed out that this presentation is qualitative character only, the constant not being considered in the SAR-value (Eq. 32). By means of SAR/GDD correlations and daily courses of GDD and SAR for long lasting thunderstorms it should be possible, however, to determine the constant experimentally.

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Comparison of models:

The parameters discussed in the previous paragraphs are all calculated for the flat wave guide model. It should be tested now how far GDD and SAR agree in both the flat and the spherical models. This is clear in Fig. 12, where the parameters and the ratio SAR/GDD are plotted as a function of Ω for both models. In part (a) of this figure the model comparison for GDD for propagation conditions during daytime (β = 0.3, H = 70 km) and during the night (β = 0.5, H = 85 km) has been made. The solid lines correspond to the flat model, the spherical model is described by the dashed ones. Since the iterative solving process for the spherical model fails in the case of lower frequencies, the model comparison is only made for combinations of groups, for which the phase velocities in the spherical model still could be calculated.

Through these presentations it becomes clear that no essential difference is to be found between the two models. The same applies to part (b) where SAR's are shown again in a day and night time model. Any differences occurring here between the models may be neglected in view of the uncertainty of evaluation. SAR 5/9 for the spherical wave guide cannot be calculated in the daytime model and thus any comparison is impossible.

The same statement applies for the SAR/GDD ratio as a function of Ω in part (c). In the nighttime propagation model (β = 0.5, H = 85 km) the ratios SAR/GDD in the spherical and flat wave guide models are actually identical. Summarizing, it may be stated that the flat model is a usable model to describe the atmospherics parameters in the lower VLF-range.

7. CONCLUSIONS

With the aid of plausible waveguide models, the VLF atmospherics parameters are calculated from measurements taken by the atmospherics analyzer of the Heinrich-Hertz-Institut. The model calculations, based on mode theory by Wait et al., have been extended to the lower VLF-range. By means of attenuation rates and phase velocities (here only the first mode), the spectral amplitude ratio (SAR) and the delay time difference of two spectral groups (GDD) have been calculated. It has been found that the functional dependencies for GDD, as they have been determined for the idealized propagation model with ideally reflecting boundaries, are similar in the real model. The GDD for the real model is double that for the idealized model, thus explaining the deviations of measurements in relation to the values of the idealized model. GDD as well as SAR show a significant dependence on the propagation direction. The GDD is greater for the propagation in the west to east direction than in the reverse direction. For the parameter SAR this is just the contrary. GDD and SAR both are calculated per 1000 km. In order to eliminate the distance of the thunderstorm, and unknown in many cases, the ratio SAR/GDD has been formed and investigated concerning its dependence on Ω. The direction dependences occurring in preliminary evaluations of such plots may thus be explained. A comparison of the calculated parameters within the flat as well as in the spherical model reveals that the flat waveguide model in the lower VLF-range describes the atmospherics parameters adequately.

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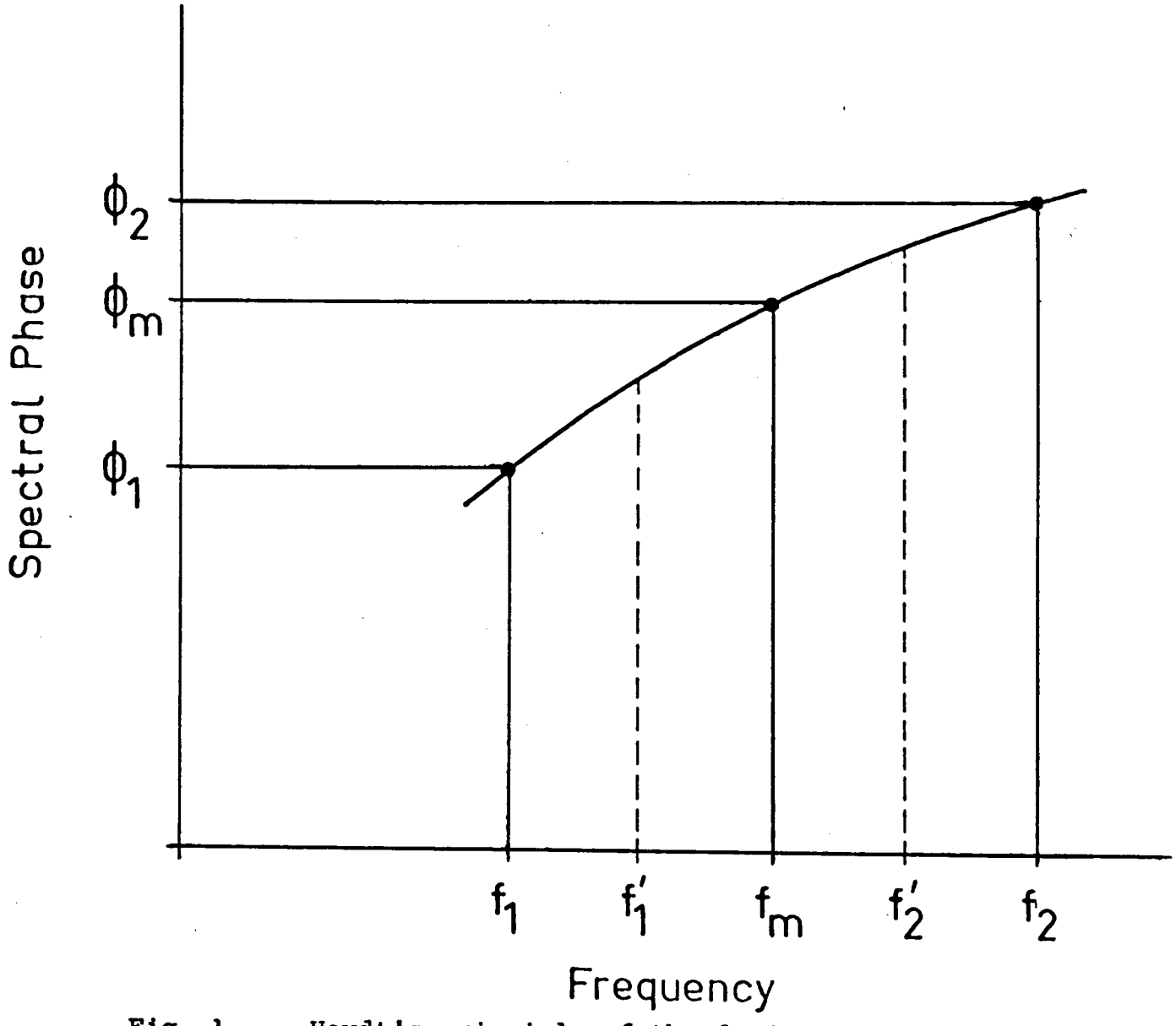
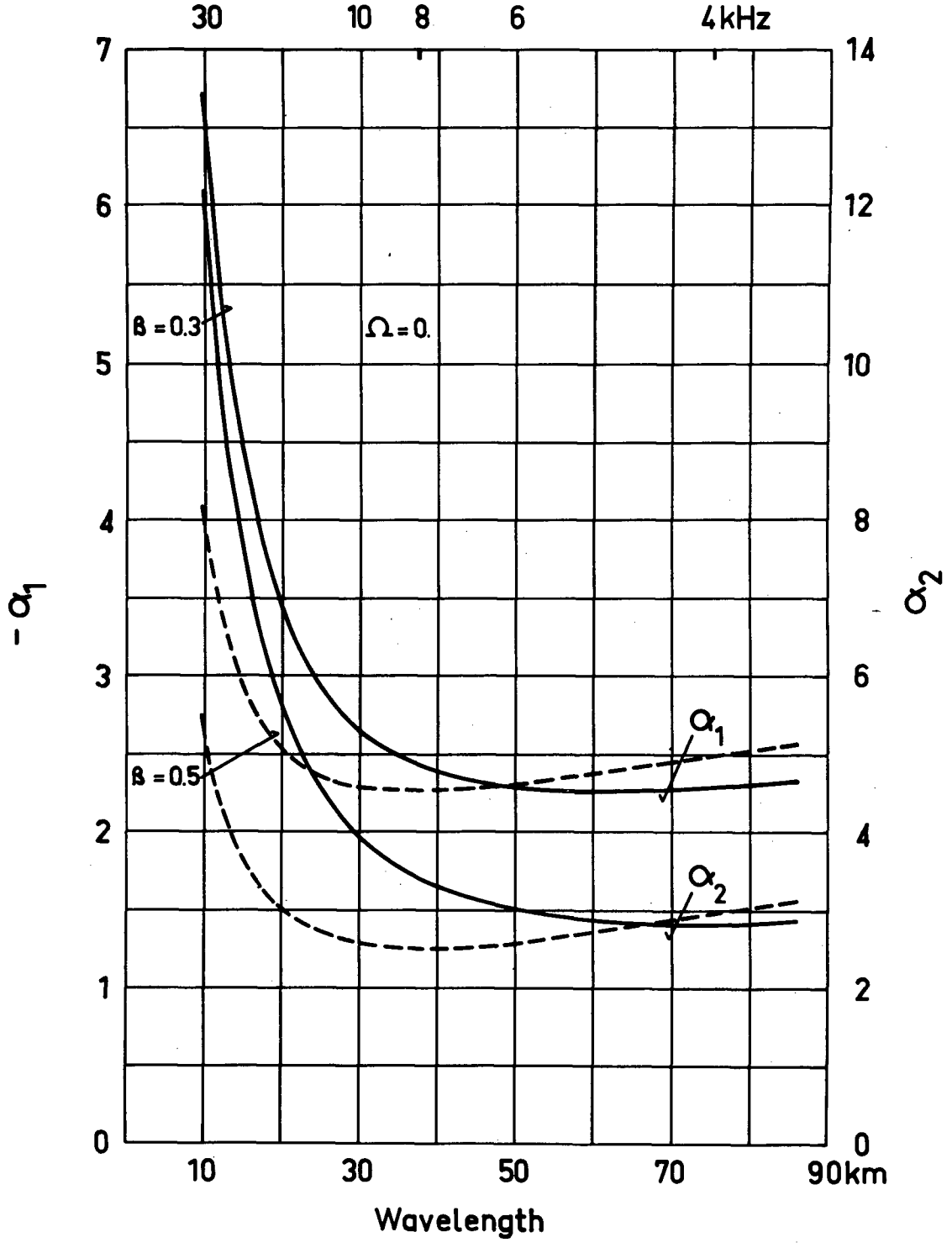


Fig. 1 Heydt's principle of the derivation of the group delay time difference.



(a)

Fig. 2 The Parameter α of the ionospheric reflection coefficient $R_i = -\exp(\alpha C)$ in the Wait and Walters model. $\alpha = \alpha_1 + i\alpha_2$. $C = 0.1$. Solid lines: daytime model, dashed lines: nighttime model.

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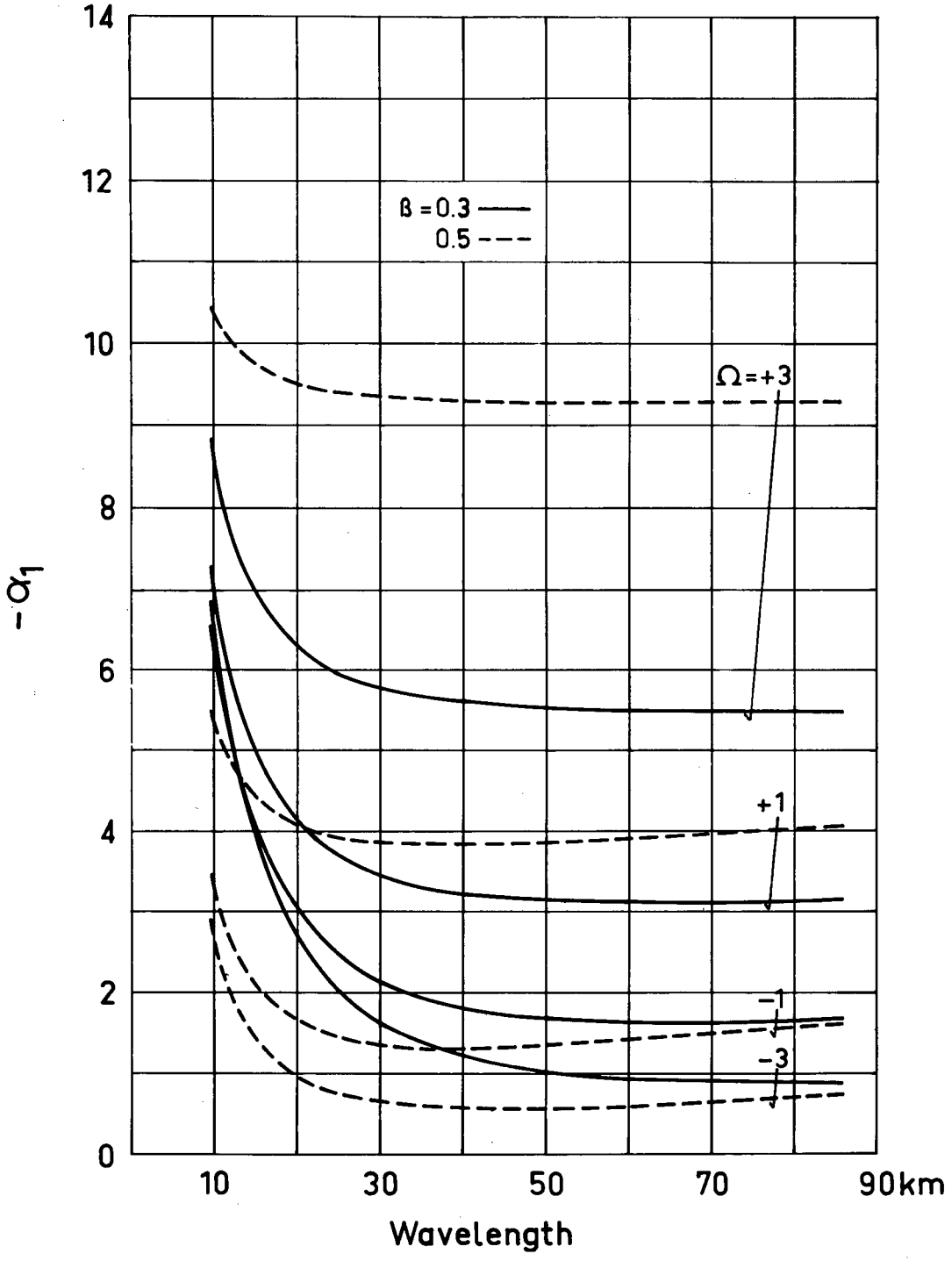
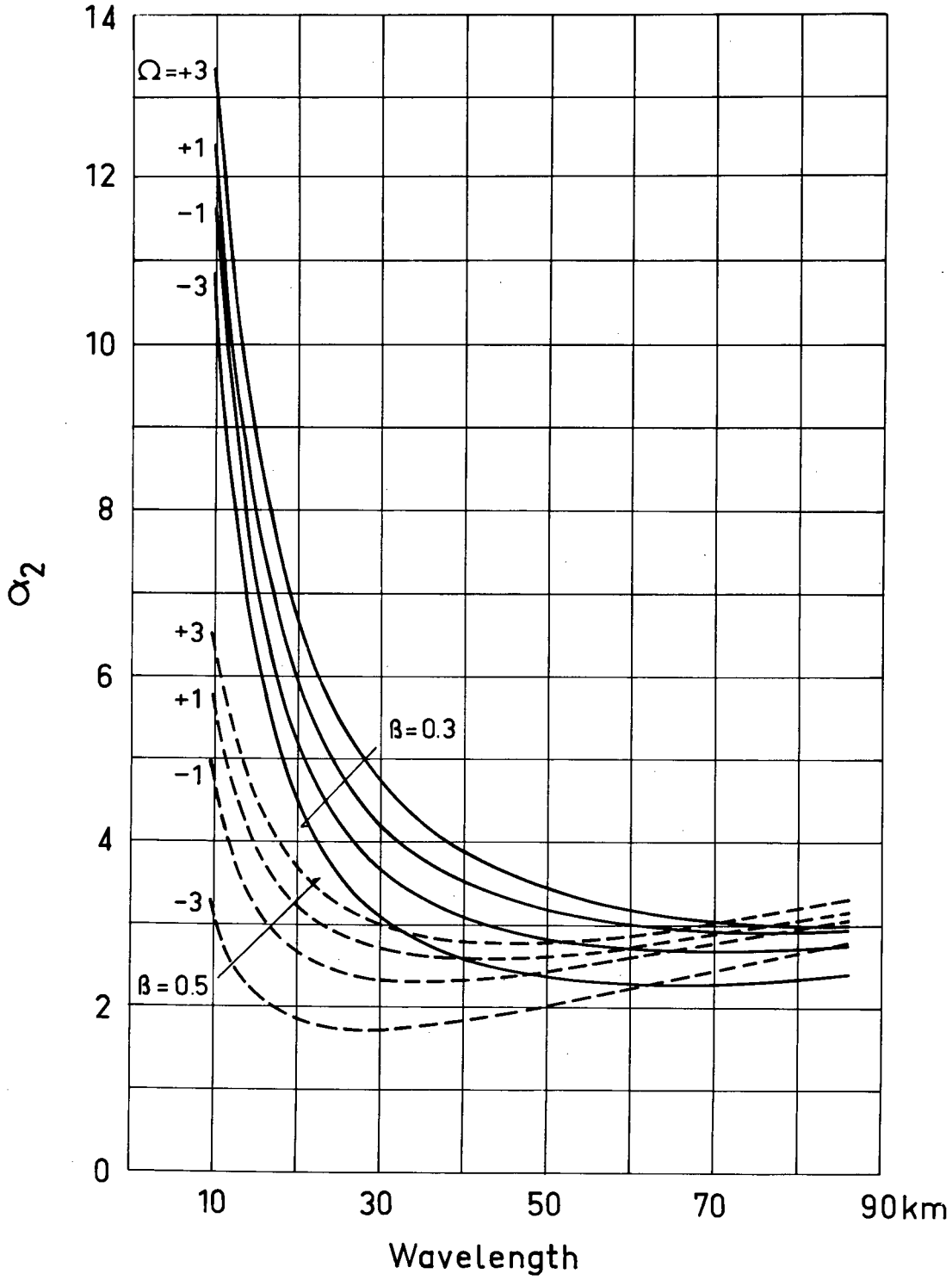


(b)

Fig. 2 The Parameter α of the ionospheric reflection coefficient $R_i = -\exp(\alpha C)$ in the Wait and Walters model. $\alpha = \alpha_1 + i\alpha_2$. C = 0.1. Solid lines: daytime model, dashed lines: nighttime model.



(c)

Fig. 2 The Parameter α of the ionospheric reflection coefficient $R_i = -\exp(\alpha C)$ in the Wait and Walters model. $\alpha = \alpha_1 + i\alpha_2$. C = 0.1. Solid lines: daytime model, dashed lines: nighttime model.

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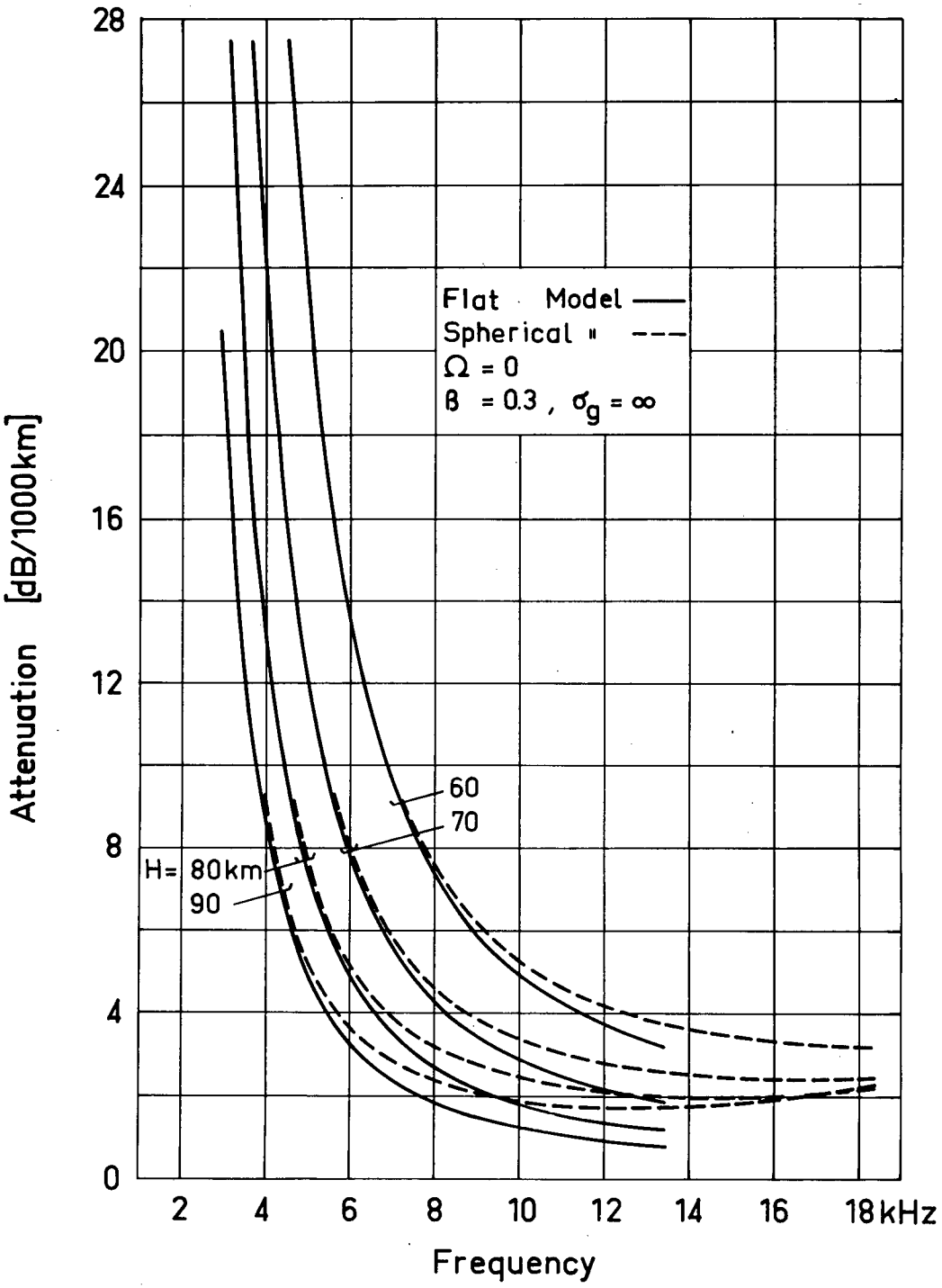
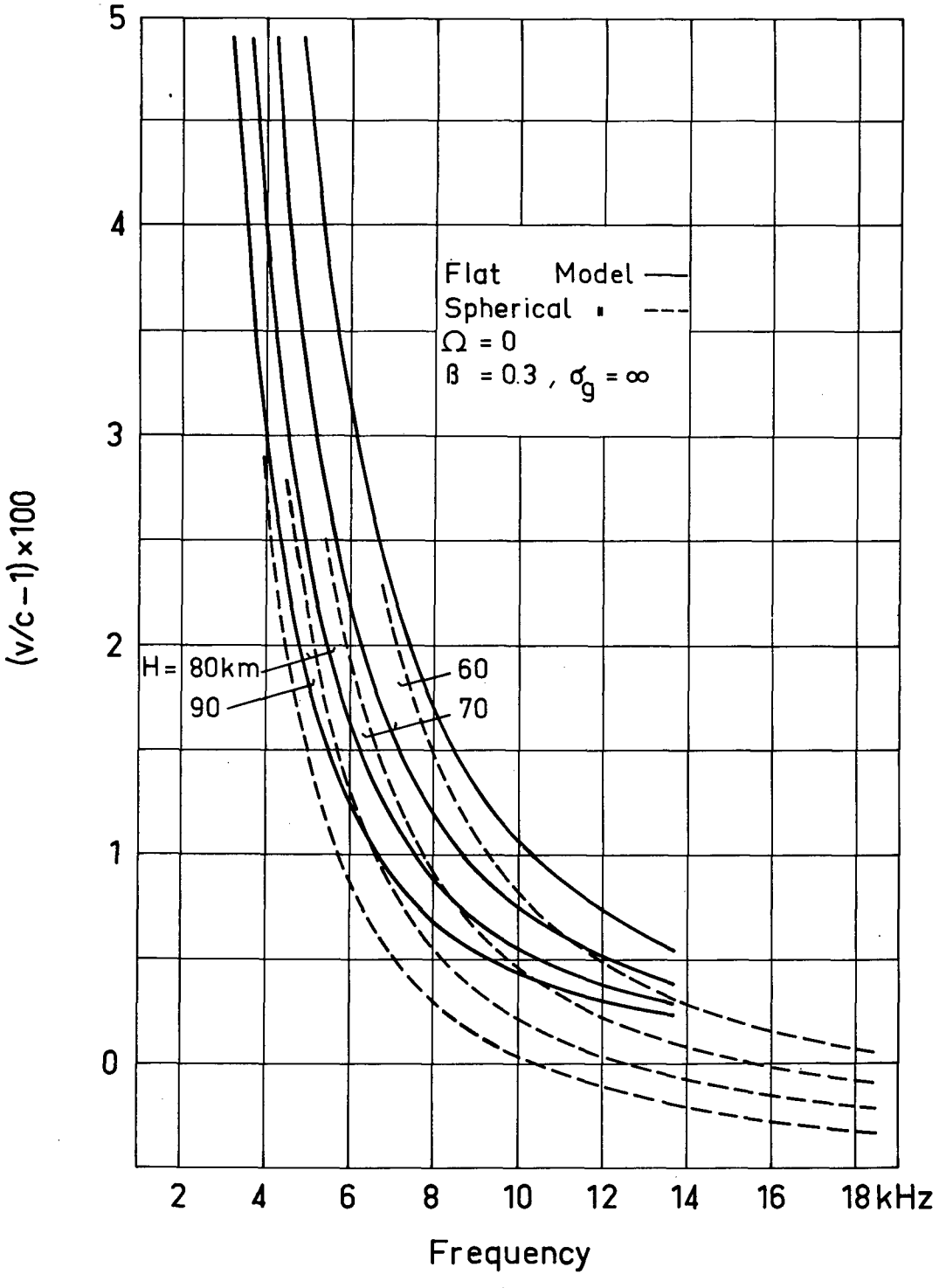


(a)

Fig. 3 Attenuation rates and phase velocities, relative to c, for the first mode within a spherical model and a flat model versus frequency. First mode, nighttime conditions.



(b)

Fig. 3 Attenuation rates and phase velocities, relative to c, for the first mode within a spherical model and a flat model versus frequency. First mode, nighttime conditions.

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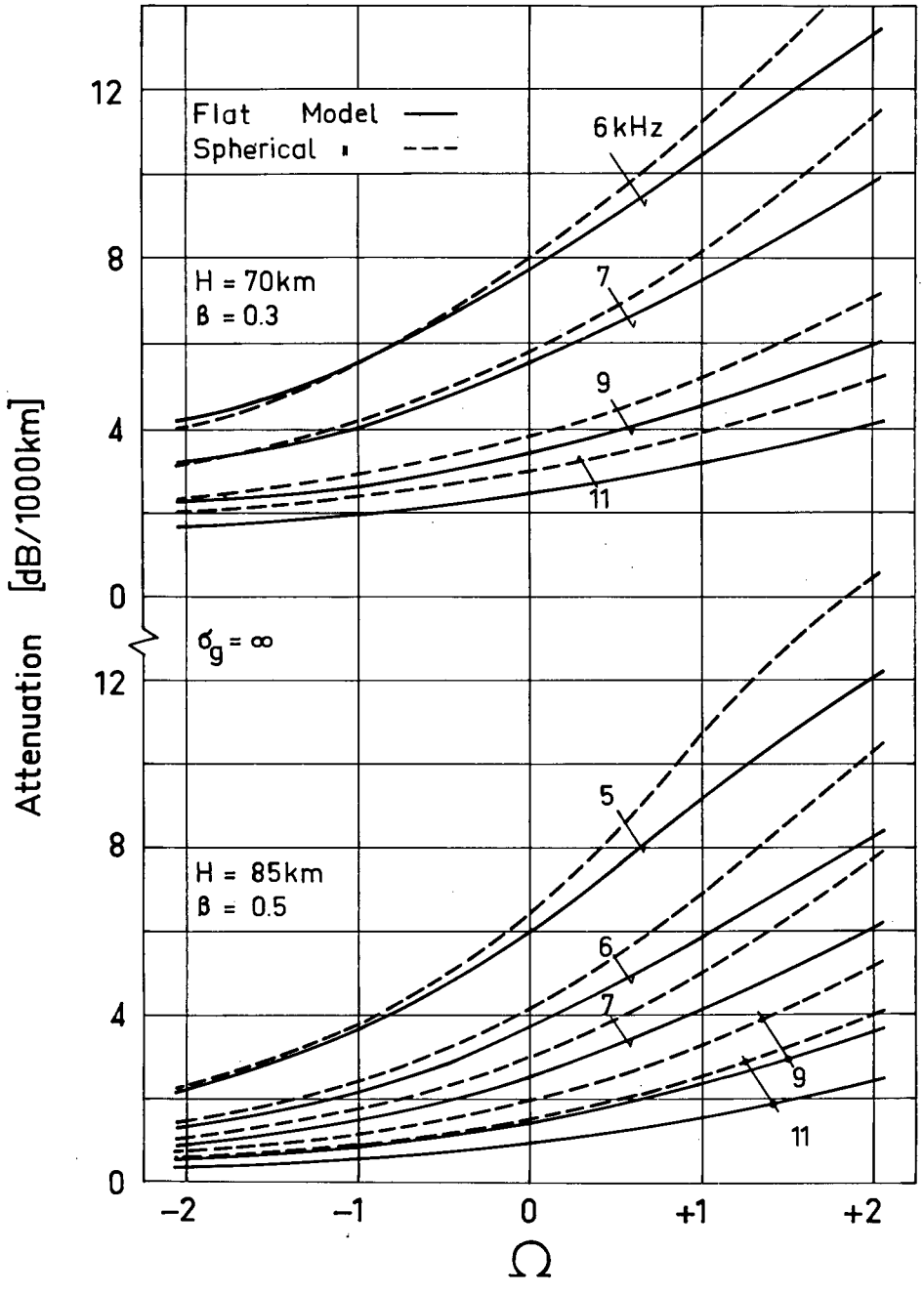
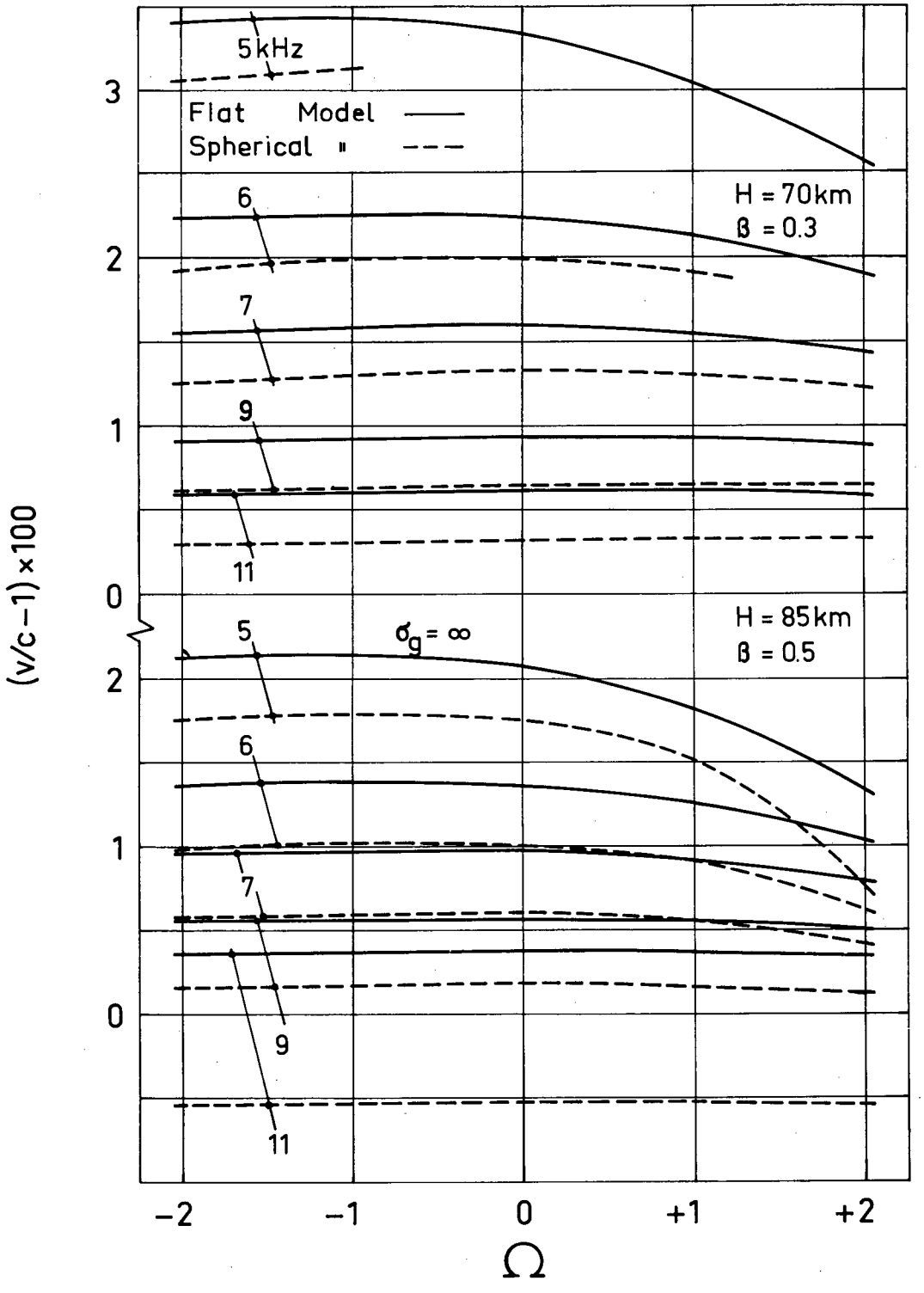


(a)

Fig. 4 Attenuation and phase velocity, relative to c, in a spherical model and a flat model versus the earth's magnetic field parameter Ω. First mode. Upper part: daytime model, lower part: nighttime model.



(b)

Fig. 4 Attenuation and phase velocity, relative to c, in a spherical model and a flat model versus the earth's magnetic field parameter Ω. First mode. Upper part: daytime model, lower part: nighttime model.

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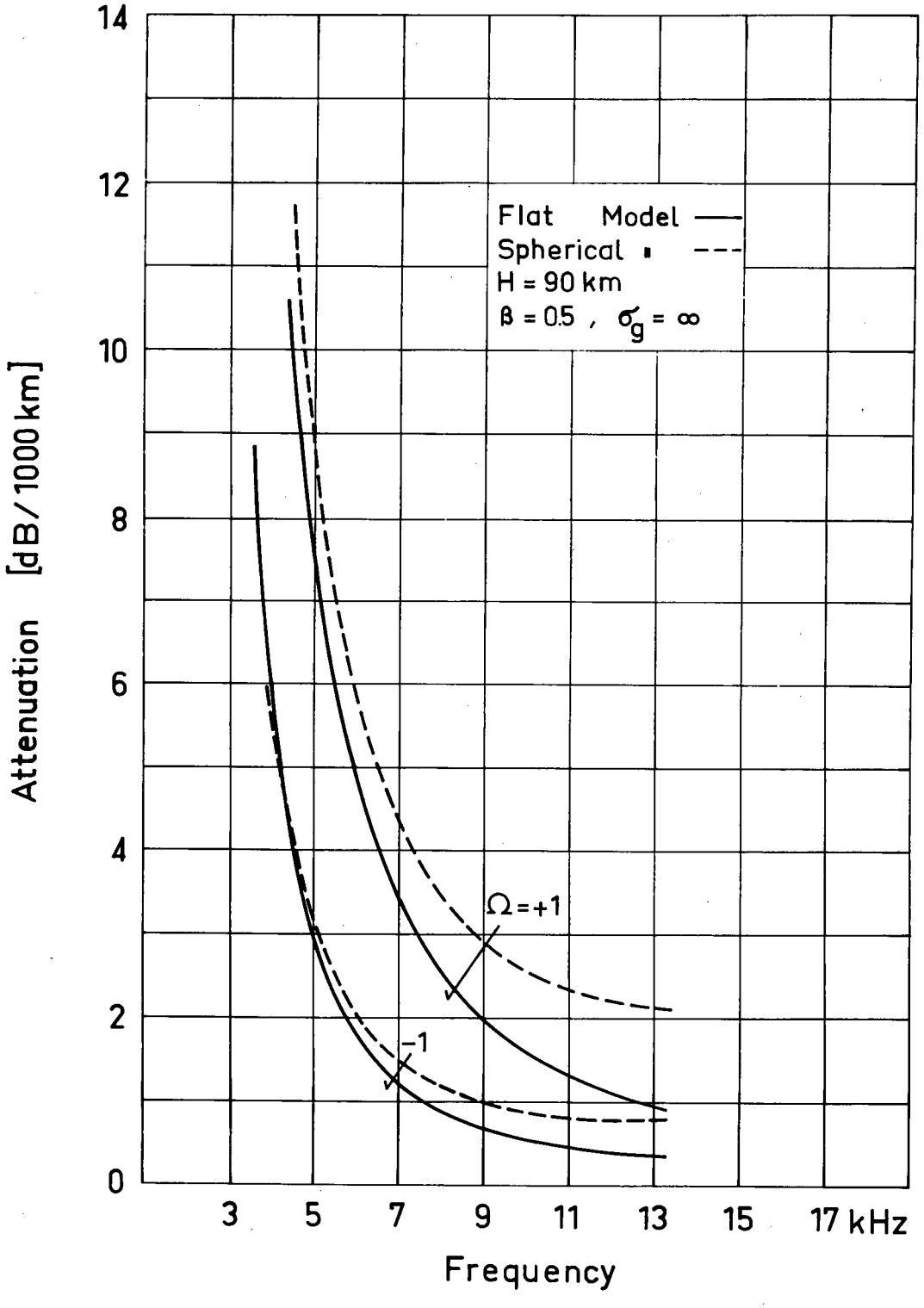

(a)

Fig. 5 Attenuation and phase velocity, relative to c, within a spherical model and a flat model versus frequency. First mode, nighttime conditions.

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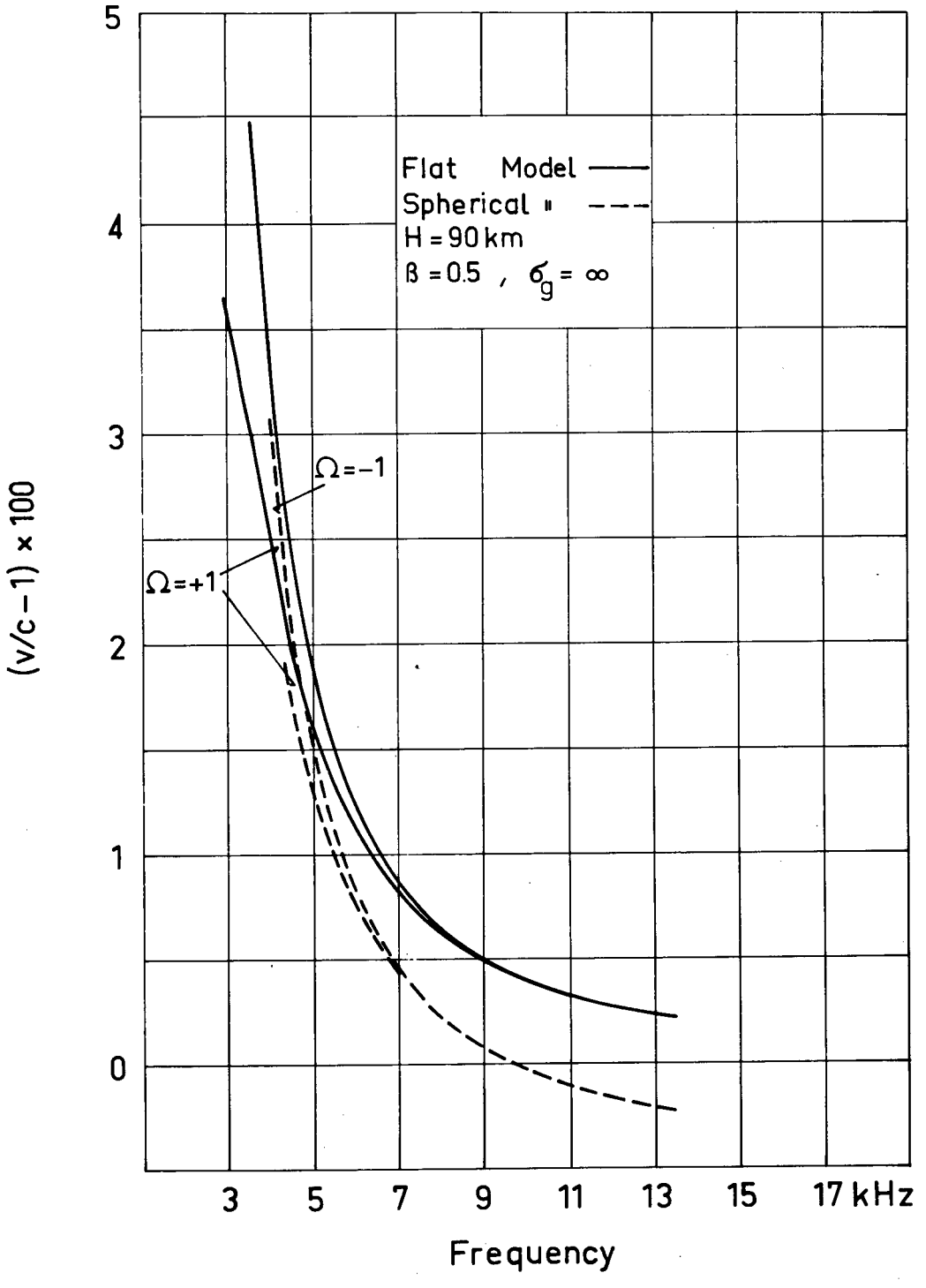
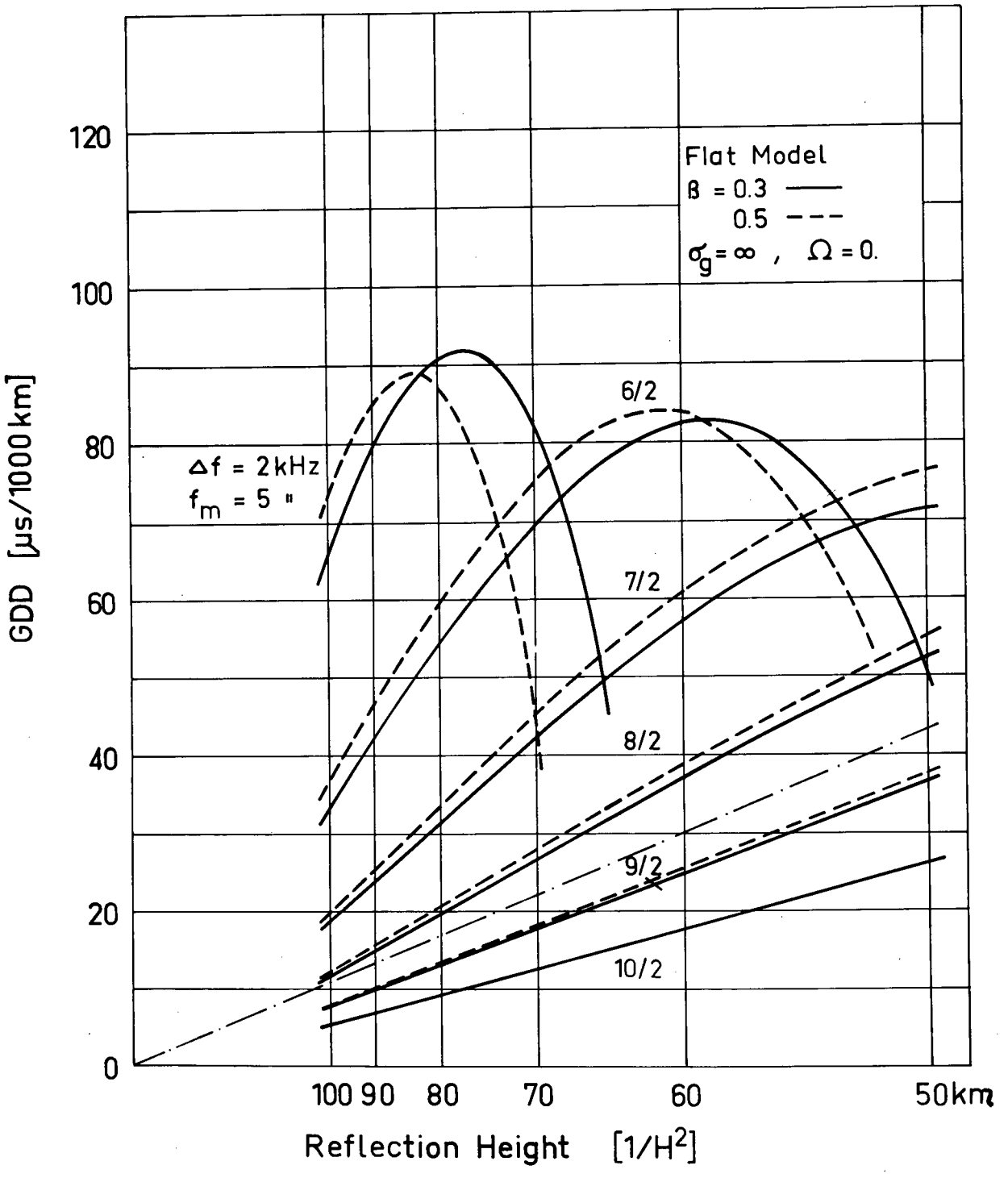


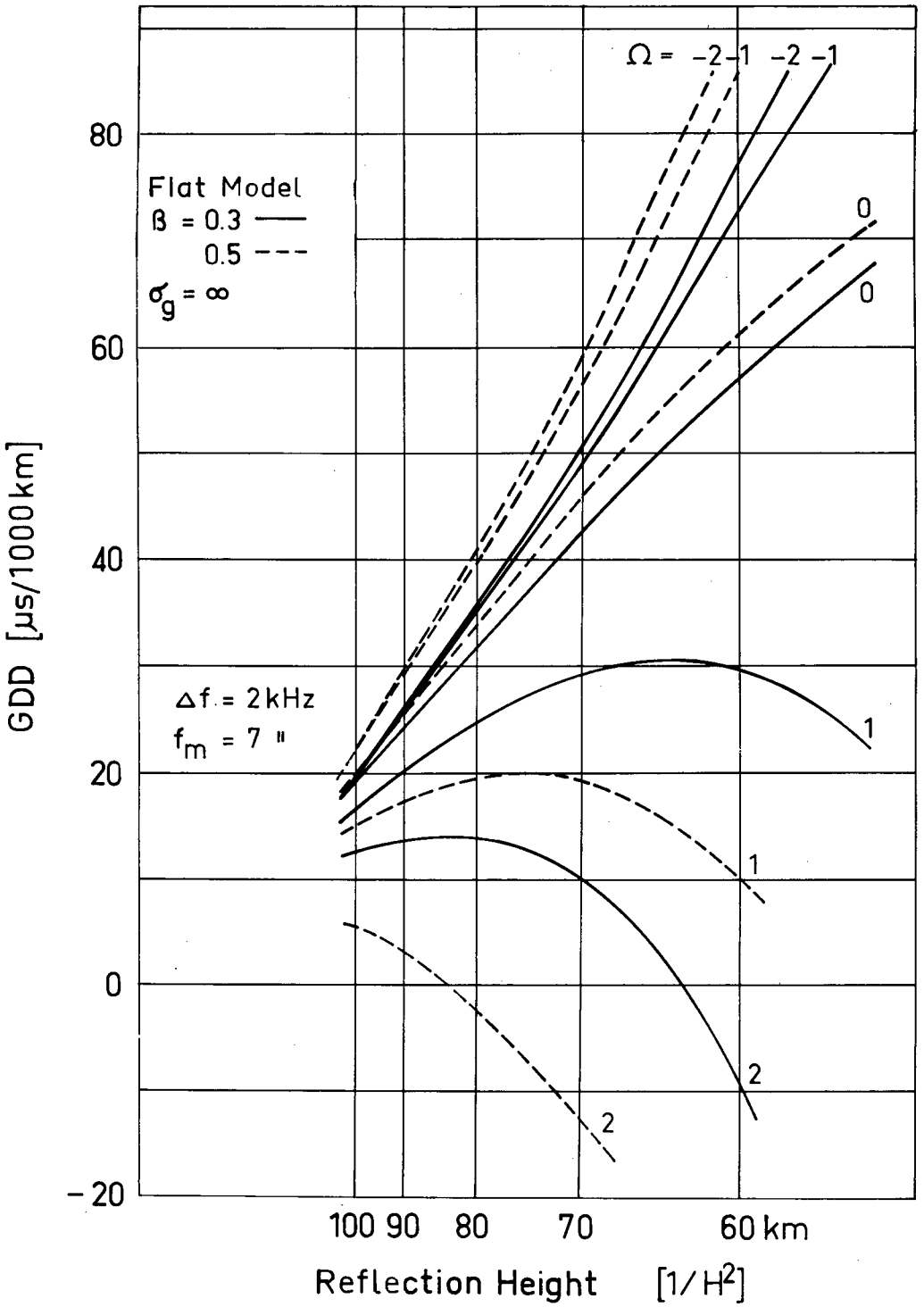
(b)

Fig. 5 Attenuation and phase velocity, relative to c, within a spherical model and a flat model versus frequency. First mode, nighttime conditions.



(a)

Fig. 6 The group delay time difference (GDD) versus H^{-2}. (The reflection height is the height to which the reflection coefficient is referred.) Solid lines: daytime model, dashed lines: night-time model.



(b)

Fig. 6 The group delay time difference (GDD) versus H^{-2}. (The reflection height is the height to which the reflection coefficient is referred.) Solid lines: daytime model, dashed lines: night-time model.

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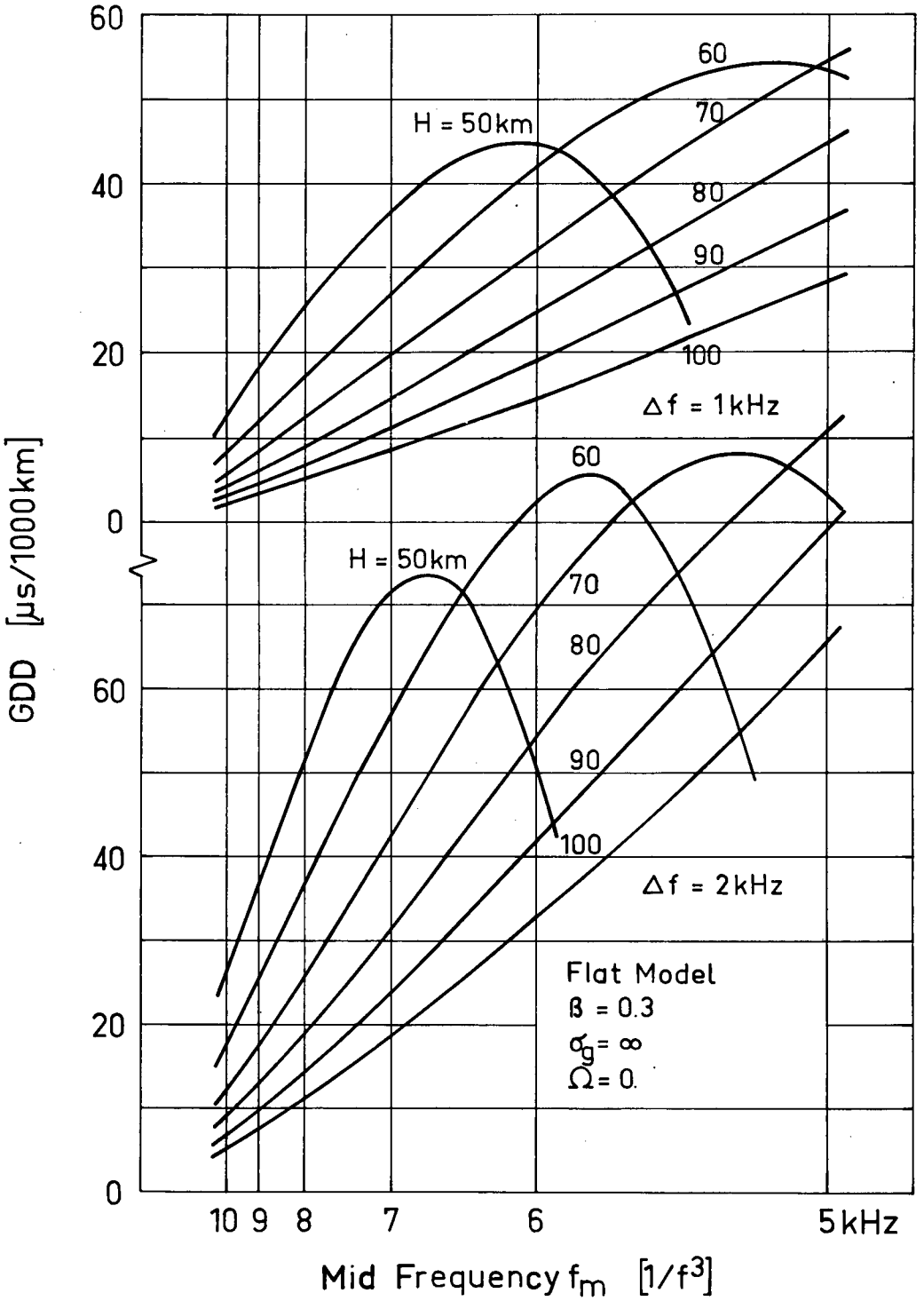
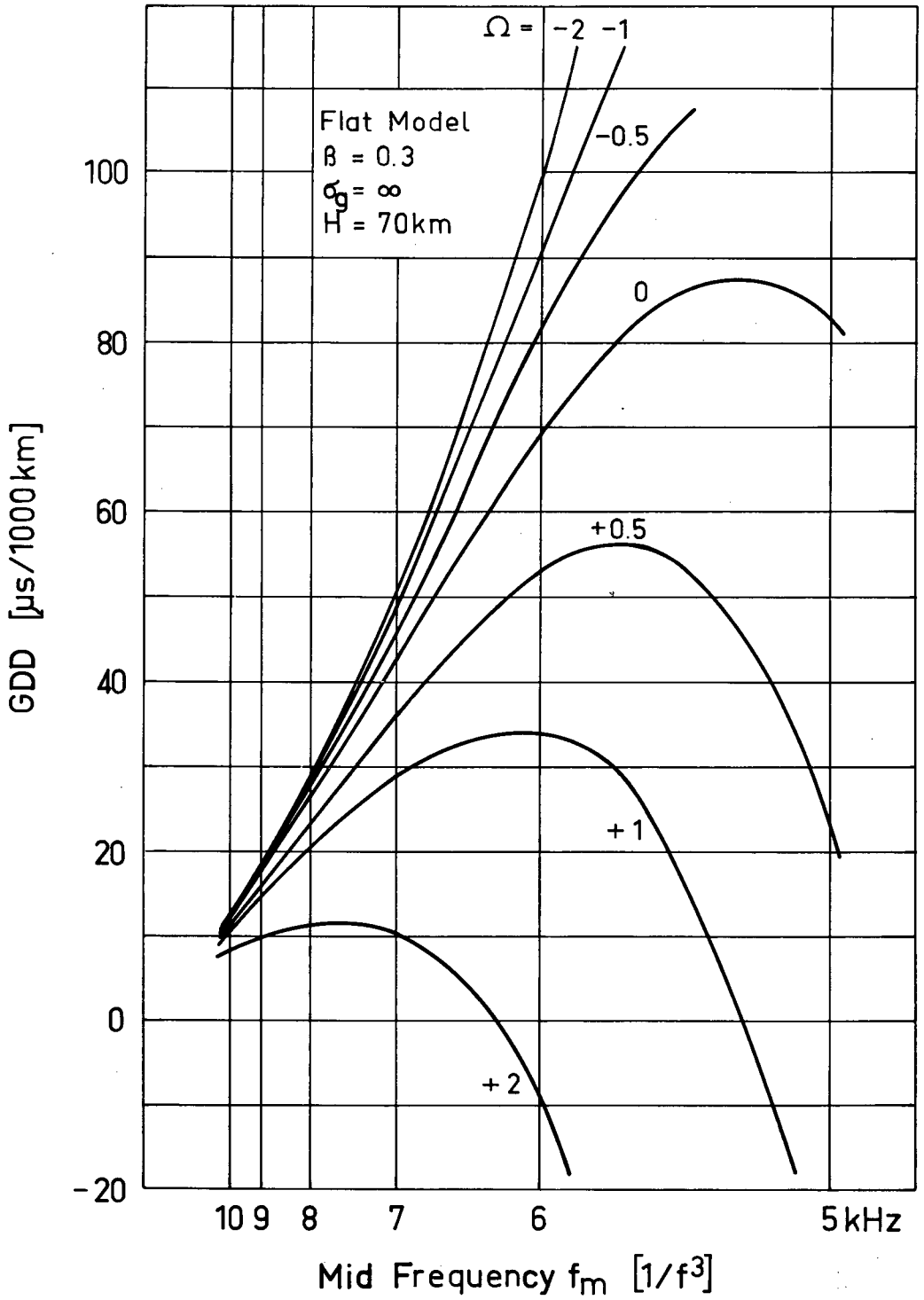


(a)

Fig. 7 The group delay time difference versus f_m^{-3}. f_m is the mid-frequency.



(b)

Fig. 7 The group delay time difference versus f_m^{-3}. f_m is the mid-frequency.

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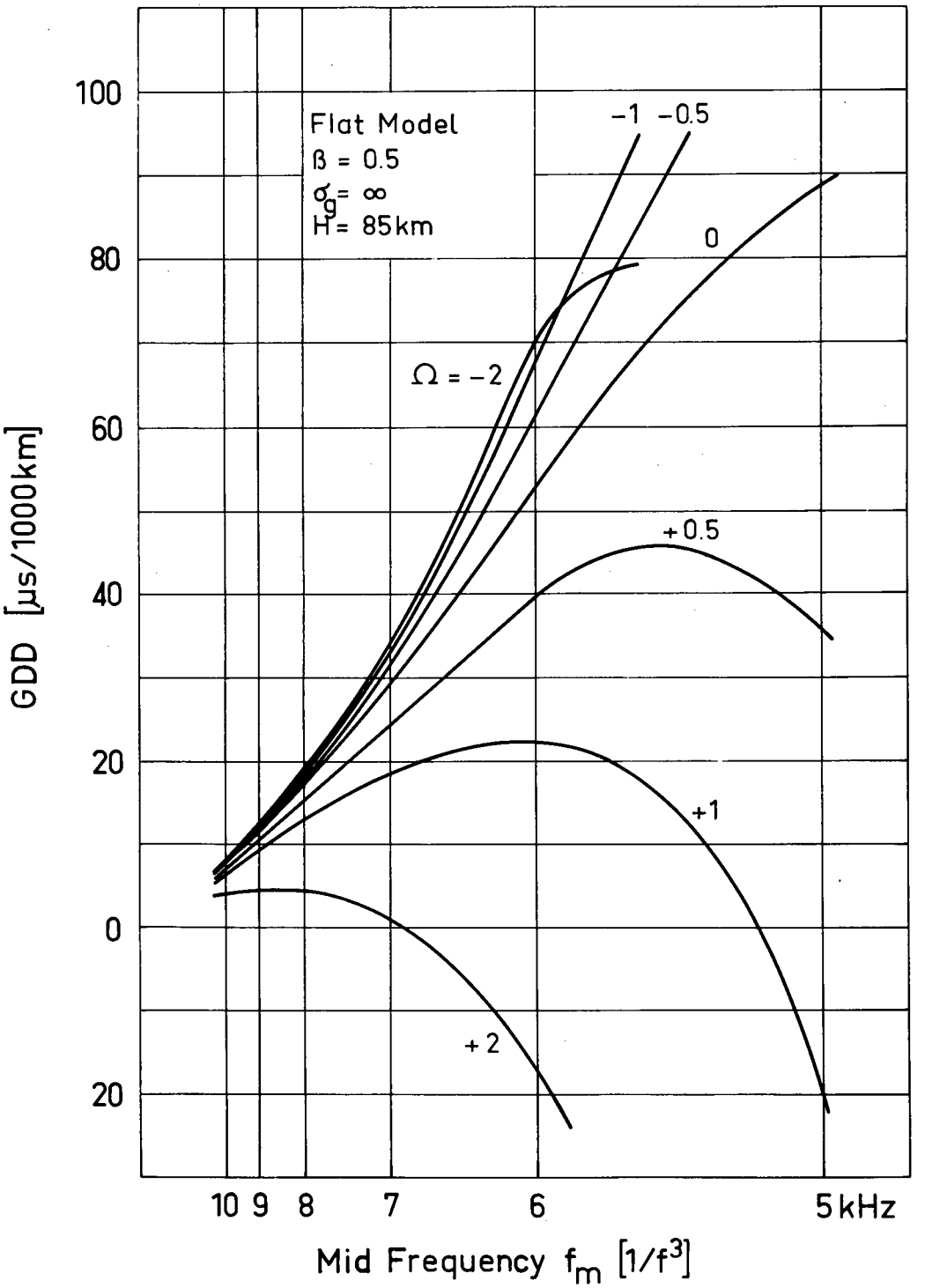
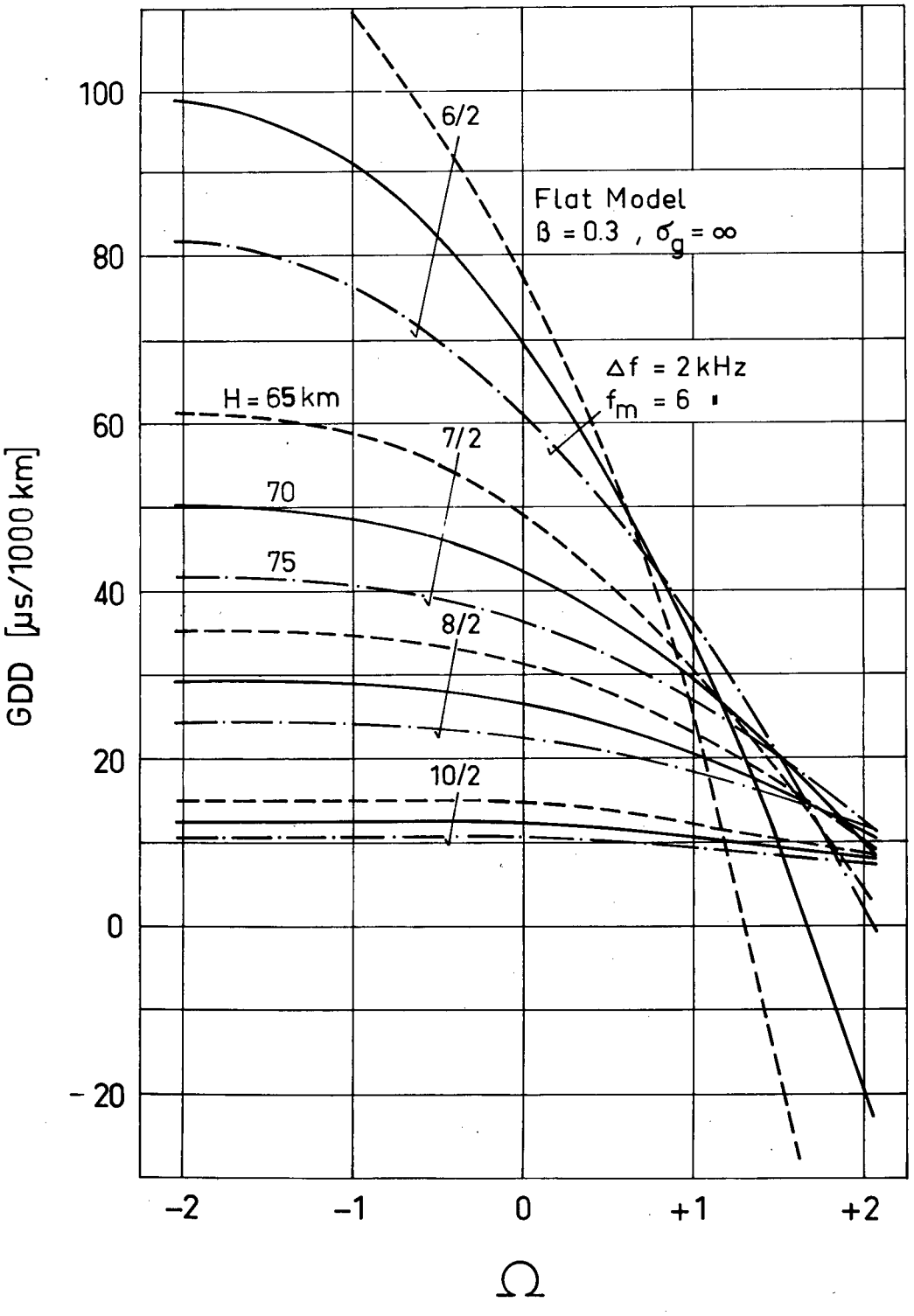


(c)

Fig. 7 The group delay time difference versus f_m^{-3}. f_m is the mid-frequency.



(a)

Fig. 8 The group delay time difference versus the earth's magnetic field parameter Ω. Part (a) shows the daytime model (β = 0.3), part (b) describes the nighttime model.

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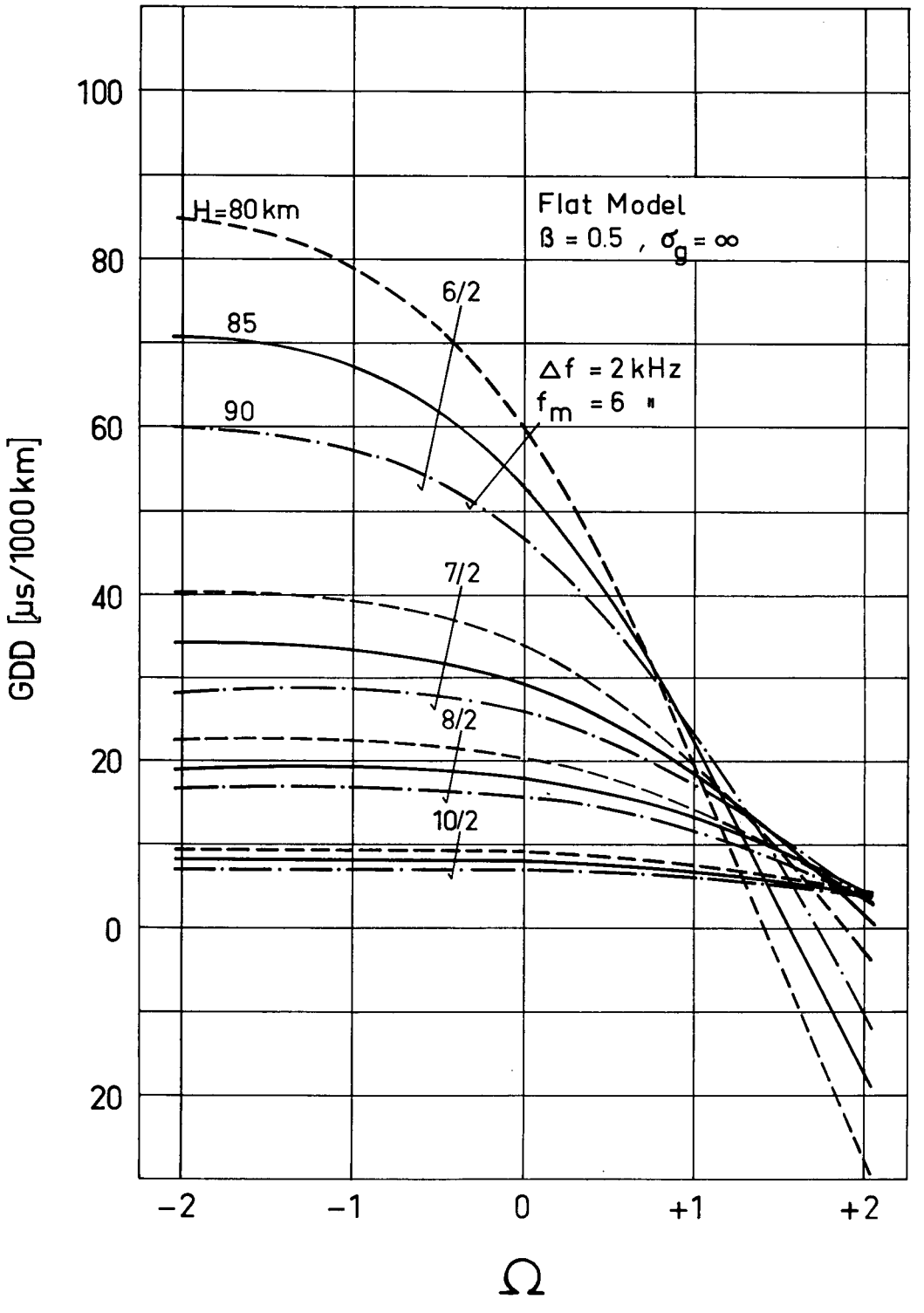

(b)

Fig. 8 The group delay time difference versus the earth's magnetic field parameter Ω. Part (a) shows the daytime model (β = 0.3), part (b) describes the nighttime model.

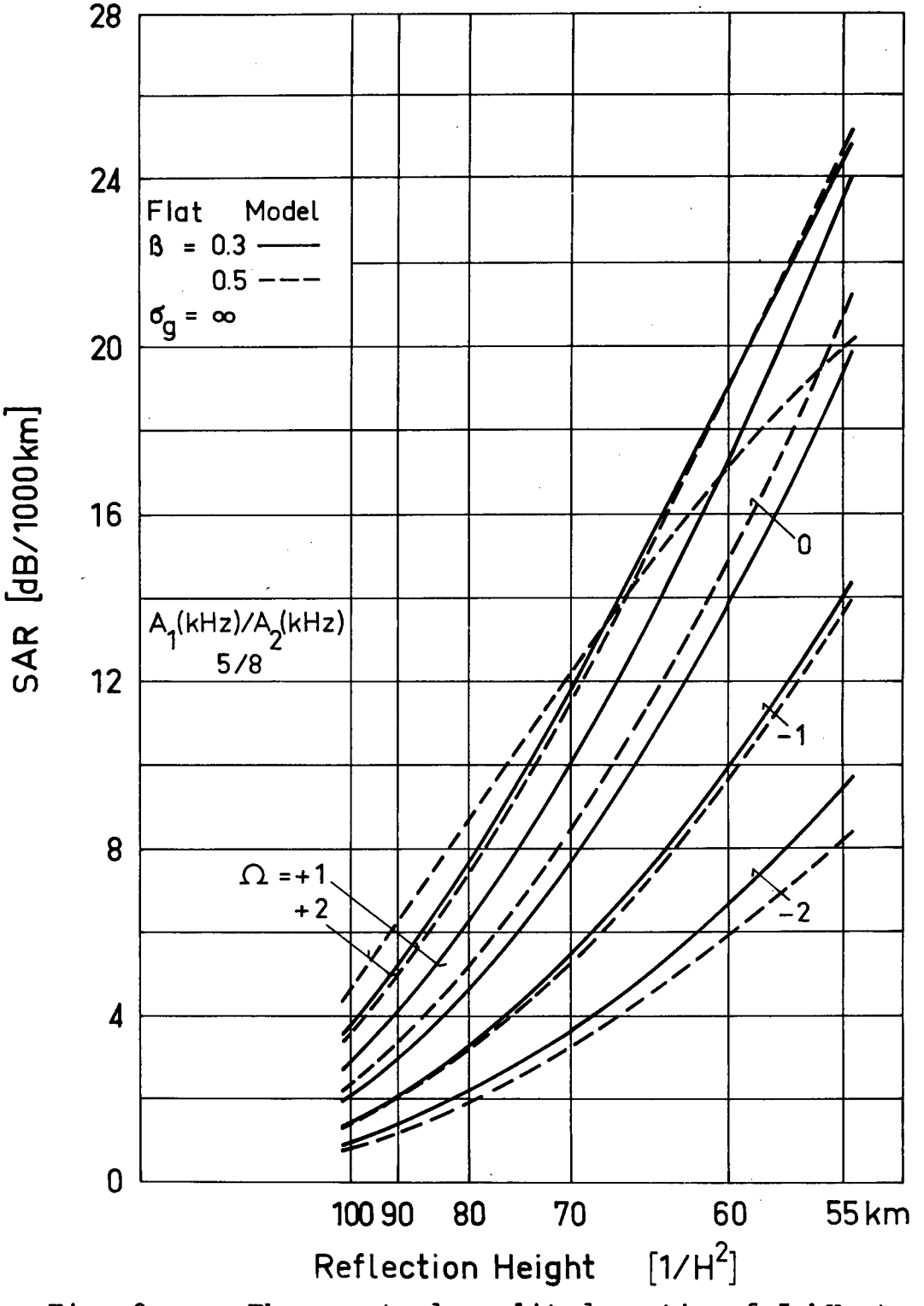

Fig. 9 The spectral amplitude ratio of 5 kHz to 8 kHz versus H^{-2}. Solid lines: daytime model, dashed lines: nighttime model.

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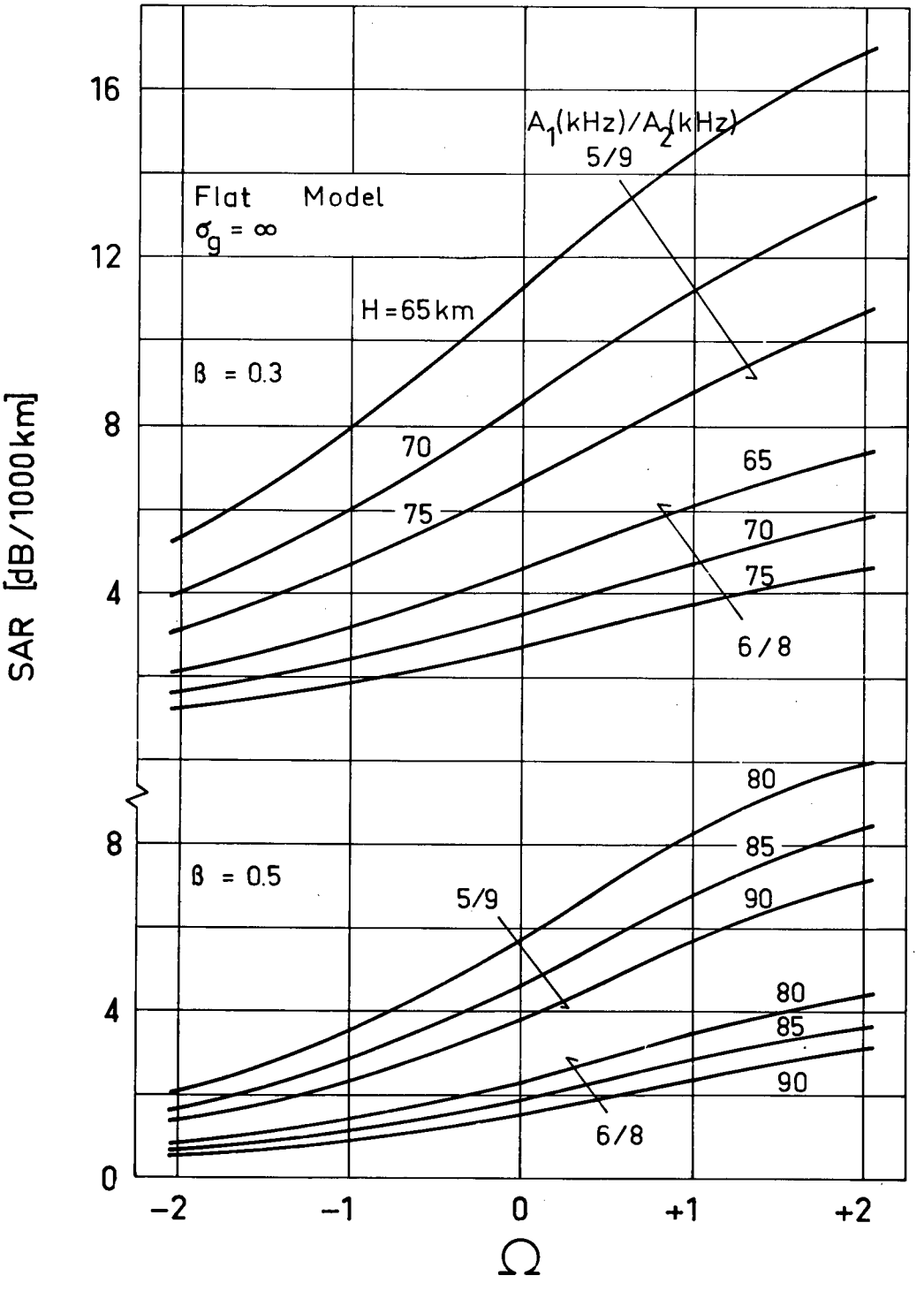

Fig. 10 Two spectral amplitude ratios of 5 kHz to 9 kHz and 6 kHz to 8 kHz versus Ω. Upper part: daytime model (β = 0.3), lower part: nighttime model (β = 0.5).

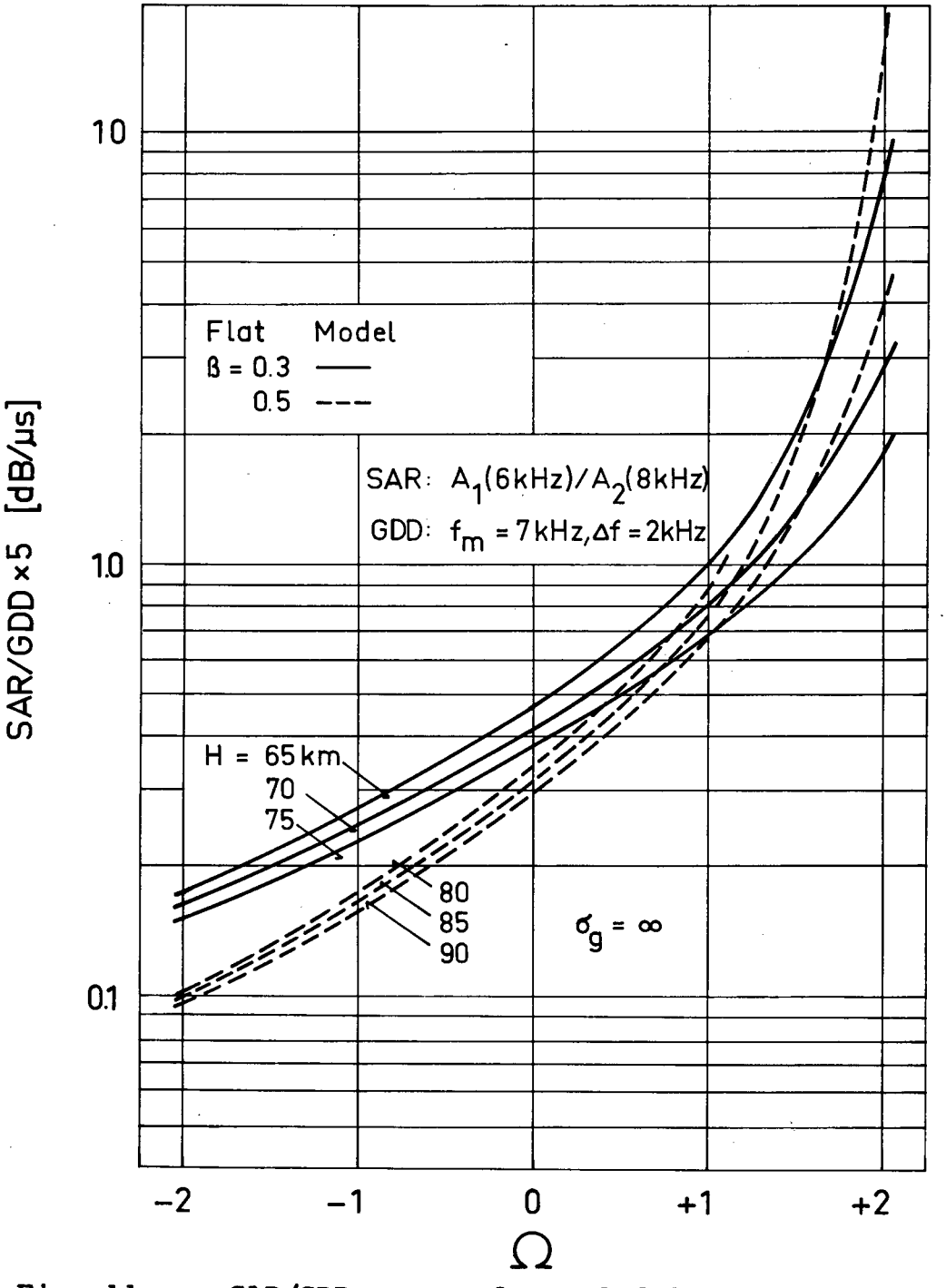

Fig. 11 SAR/GDD versus Ω. Solid lines: daytime model, dashed lines: nighttime model.

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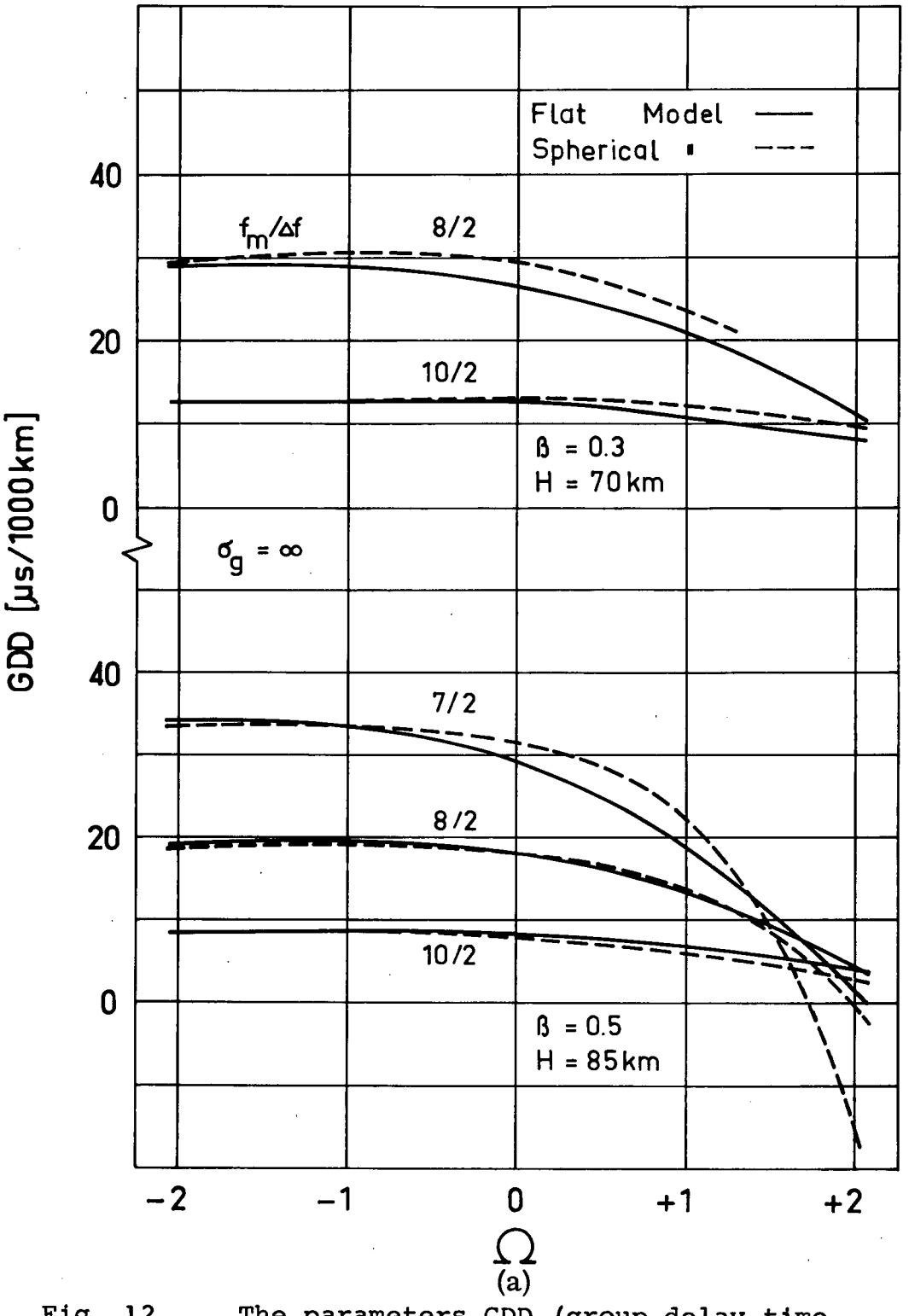

Fig. 12 The parameters GDD (group delay time difference), SAR (spectral amplitude ratio) and the ratio SAR/GDD in a spherical model and a flat model versus Ω.
Solid lines: flat model, dashed lines: spherical model.

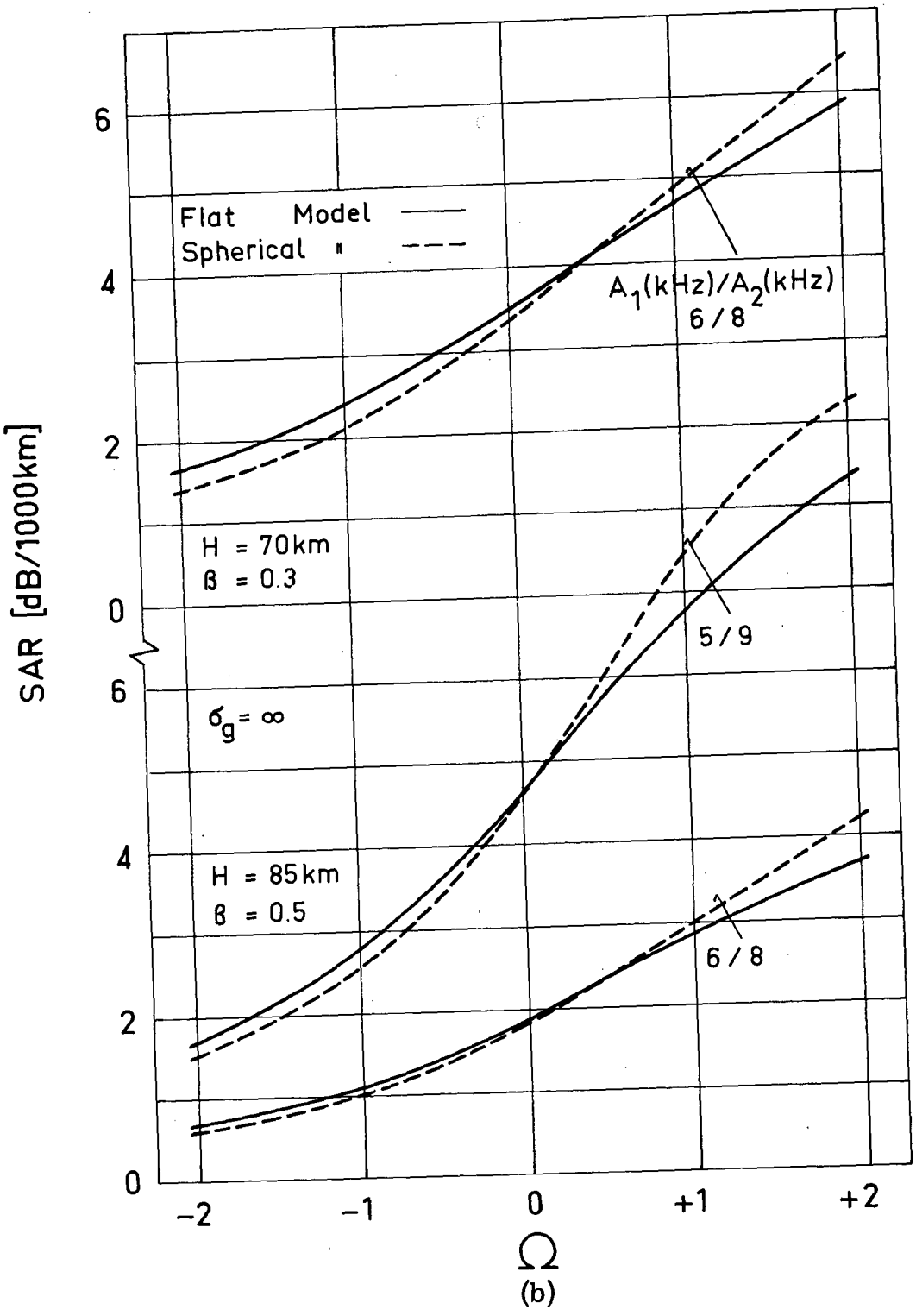

Fig. 12 The parameters GDD (group delay time difference), SAR (spectral amplitude ratio) and the ratio SAR/GDD in a spherical model and a flat model versus Ω.
Solid lines: flat model, dashed lines: spherical model.

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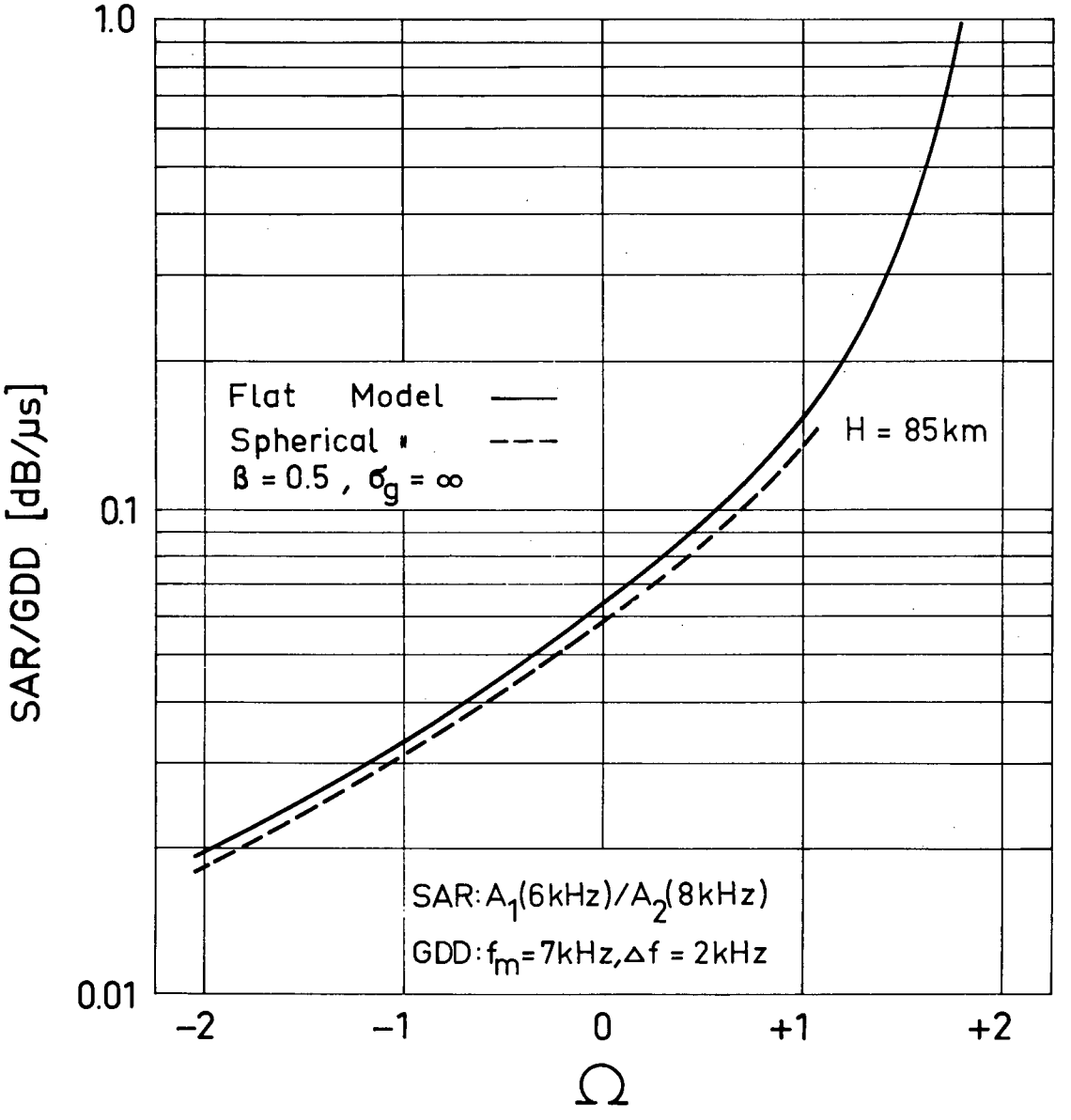

(c)

Fig. 12 The parameters GDD (group delay time difference), SAR (spectral amplitude ratio) and the ratio SAR/GDD in a spherical model and a flat model versus Ω.
Solid lines: flat model, dashed lines: spherical model.

VLF Propagation Research at the Naval Research Laboratory

by

Francis J. Kelly

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A b s t r a c t :

A broad review of very low frequency propagation studies of the Naval Research Laboratory is given. Experiments on the modal interference of VLF waves in the earth ionosphere wavegiude and the development of an effective ground condctivity map for Greenland and North America will be described. Experimental and theoretical work on the stability of modal interference nulls will be described. The Westinghouse VLF noise model will be discussed. A description of the Automatic Phase and Amplitude Data Acquisition System will be presented. Long term data collection efforts in Norway, Madagascar, Bahrain, Japan, and elsewhere will be described.

Omega Navigation System

by

John W. Brogden

Naval Research Laboratory

Abstract

A brief description of the Omega Navigation System is given. Some of the factors effecting the accuracy which are due to propagation uncertainties are discussed and compared with the problems of the location of spherics.

Curves are included which show the effects of diurnal variations and dispersion on system accuracy.

INTRODUCTION:

The study of spherics and the development of the Omega navigation system have many problems in common; both are concerned with propagation in the VLF portion of the radio spectrum as an integral part of a position fixing problem. In the case of spherics it is the location of the source whereas for the Omega system it is the location of the user must be resolved. The accuracy of each depends on knowing the characteristics of the propagation. A brief description of the Omega system will be presented along with some of the position fixing problems associated with it.

Omega is a radio navigation system utilizing the VLF portion of the radio spectrum and is presently being implemented to provide worldwide coverage. This will be done with eight transmitting stations located as shown in Figure 1. A partial system is now being operated with stations in Norway, Trinidad, Hawaii and North Dakota. These stations are using developmental type transmitters with the exception of the one in North Dakota, which will be replaced with ones more suitable for operational use. Other stations will be established in Japan, Australia, Argentina and on the island of La Reunion. The frequency of each transmitting station will be controlled by cesium standards and have a radiated power of about 10 kW. This network of eight stations will provide a fix accuracy of 1 to 2 miles or better throughout the world a high percentage of the time. It is

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expected that the system will be completed on a global basis by mid-1974.

SYSTEM DESCRIPTION:

Transmissions on the same basic frequency will be made sequentially from each station in short bursts of approximately one second each. The principal frequency is 10.2 kHz. This transmission will provide the navigator families of hyperbolae with approximately 8 mile intervals between lines of the same phase difference. This requires that the navigator know his position within four miles or better to obtain a fix. However, this causes no great difficulty as once the proper lane has been determined, the Omega receivers will automatically track the signals and indicate the proper lane number.

In some cases however (such as for aircraft for example)wider lanes are required. For these applications transmissions are made at 13.6 kHz and 11 1/3 kHz, which when compared with the 10.2 kHz transmissions produce difference frequencies of 3.4 kHz and 1.1 1/3 kHz, respectively. These difference frequencies provide lane widths of 24 miles and 72 miles; which satisfies the requirements of most users.

EFFECTS OF PROPAGATION:

The usefulness of the Omega system depends upon the ability to predict the phase velocities and the diurnal variations of the signals being used and to be able to tolerate unpredictable phase variations such as those produced by PCA and SID events. Unlike observation of

spherics the location of the signal source and the frequencies of interest are accurately known. Therefore, since the frequency and propagation paths are known, the phase velocities can be determined for various paths and times of day.

The principal phase variation is the well known diurnal shift as shown in Figure 2. These are data taken at NRL of the differences in phase between the Trinidad and Hawaii stations which is used to determine a line of position for the navigation. This plot covers data recorded over a two week period. The solid curves in the plot represent plus and minus one standard deviation and the horizontal line is the charted position for this station pair at NRL. To compensate for this type of variation, and the phase velocities over the two paths, "Sky Wave Correction" tables are published by the Naval Oceanographic Office which are based on work by Swanson of NELC. The Figure 3 shows the results of applying the corrections. As can be seen, the diurnal variation has been essentially removed and only a small offset remains. The tables are continually being improved to provide increase accuracy as more data are being obtained from monitor stations.

The lane identification system requires information on the phase velocity and the dispersion of the signals used for this purpose. If the phase velocity of 10.2 kHz and 13.6 kHz signals were the same, a simple moire pattern as shown in Figure 4 would be obtained. Two crossovers (zero phase difference) would occur simultaneously between

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every third cycle of the 10.2 kHz transmission, and every fourth cycle of the 13.6 kHz transmissions and lane identification would be a simple matter. Since this is not the case separate correction factors are required for each frequency to compensate for the differences in the phase velocities.

The effect of dispersion on the navigator is shown in Figure 5. A flight was made from over a temporary station in New York to England. Tracking receivers were locked to transmissions from the New York station at 10.2 kHz and 13.6 kHz and the phase of each compared with a frequency standard aboard the aircraft. The plot shows the excess of lanes of 13.6 kHz over lanes of 10.2 kHz with the 4 to 3 ratio of lane widths considered. That is, for every 3 lanes from the transmitter at 10.2 kHz there would be 4 lanes at 13.6 kHz but as can be seen at approximately 180 wave lengths from the station at 10.2 kHz there is an excess of approximately 80 centi lanes for the 13.6 kHz transmissions. This corresponds to phase velocities. V_p/V_o of 1.0026 for 10.2 kHz and 0.9996 for 13.6 kHz. A flight was made to the west with similar results. Flights were also made during the nighttime when effects of the second order made were evident, and instead of a linear variation between the two signals a sinusoidal variation was observed.

This effect is shown in Figure 6. A comparison was made between the 10.2 kHz and the 11 1/3 kHz transmissions. The resulting difference frequency of 1.1 1/3 kHz is used to obtain the 72 mile lane width. A

flight was made at night from the Azores toward the Trinidad station and a second flight from the Azores to Great Britain. The data were referenced to the 10.2 kHz transmissions since the aircraft did not have a doppler radar or inertial system that would have been suitable for obtaining distance traveled.

The change in phase of each transmitted frequency with respect to a frequency standard was recorded. This change in phase was converted to time in micro-seconds. The difference of the time in micro-seconds between the 1.1 1/3 kHz differences and the 10.2 kHz are shown. If there were no second order mode effect or dispersion, the difference would be zero as the change phase as expressed in time would be the same.

The computed difference as shown by the solid line is based on a simple vector addition of the first and second modes. Values of excitations factor, attenuation rates and velocity differences between the first and second order modes are shown. An accuracy of 150 micro-seconds or better is required to identify one 3.4 kHz lane which corresponds to three 10.2 kHz lanes. As can be seen a lane could not be identified without consideration of the second order mode in the propagation model. As more data are collected the navigator will be supplied with tables to compensate for these effects.

Other effects, such as those produced by PCAs, which are unpredictable, also cause errors in the Omega system. Figure 7 shows the result of a PCA event on the phase difference of the

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Norway-signal vs a frequency standard as recorded at Frobisher Bay, Canada. It is a plot of the differences from the hourly averages over a one month period. As can be seen there was a phase advance of approximately 40 centi-lanes which corresponds to a position error of about 7 miles. The effect of this event lasted for almost one week. SID effects are also experienced, however these events rarely last for more than about $\frac{1}{2}$ an hour. In an operational situation monitor stations could be established and broadcast warnings and correction factors for users in the effected areas.

Monitor stations are also used in an operational technique known as Differential Omega. This is a method whereby an Omega receiver at a known location is used to obtain corrections for the variations in propagation on a continuing basis. The charted line-of-position for each suitable pair is known at the location of the monitor. The variation in phase difference is then provided to the users in the area. This could be accomplished over standard VHF or UHF communication links in the case of aircraft.

Data on this concept has been obtained by NRL and it was found that accuracies of 350 yards or better could be obtained at separations of up to 100 miles between the monitor and the mobile unit. The accuracy of the equipment available contributed a substantial part of this error, and it is believed that better results can be obtained with improved equipment.

OMEGA RECEIVERS:

The Omega receivers, since the frequency of the transmissions are known, and are very stable, have narrow bandwidth as compared with

what are required for spheric studies. They are basically hard limiting receivers followed by analog or digital phase tracking loops with bandwidths of the order of 0.1 to 0.01 Hertz, depending on the application. The aircraft receivers use a velocity aiding technique to compensate for the narrow bandwidth of the receiver. Thus the receiver is only required to track the error in velocity. The shipboard receivers are able to track the signals without velocity aiding techniques.

The aircraft receivers also utilize computers to obtain the sky wave correction factors and present the information in the form of latitude and longtitude or in most cases distance to a destination and cross track error.

This is just a brief description of the Omega system and some of the problems connected with it. The work at NRL has been more concerned with the effect of propagation on the accuracy of navigation than with the propagation phenomena itself. Omega is an optimum case of location and because of this spheric location could never obtain comparable accuracy because of the many unknowns involved.

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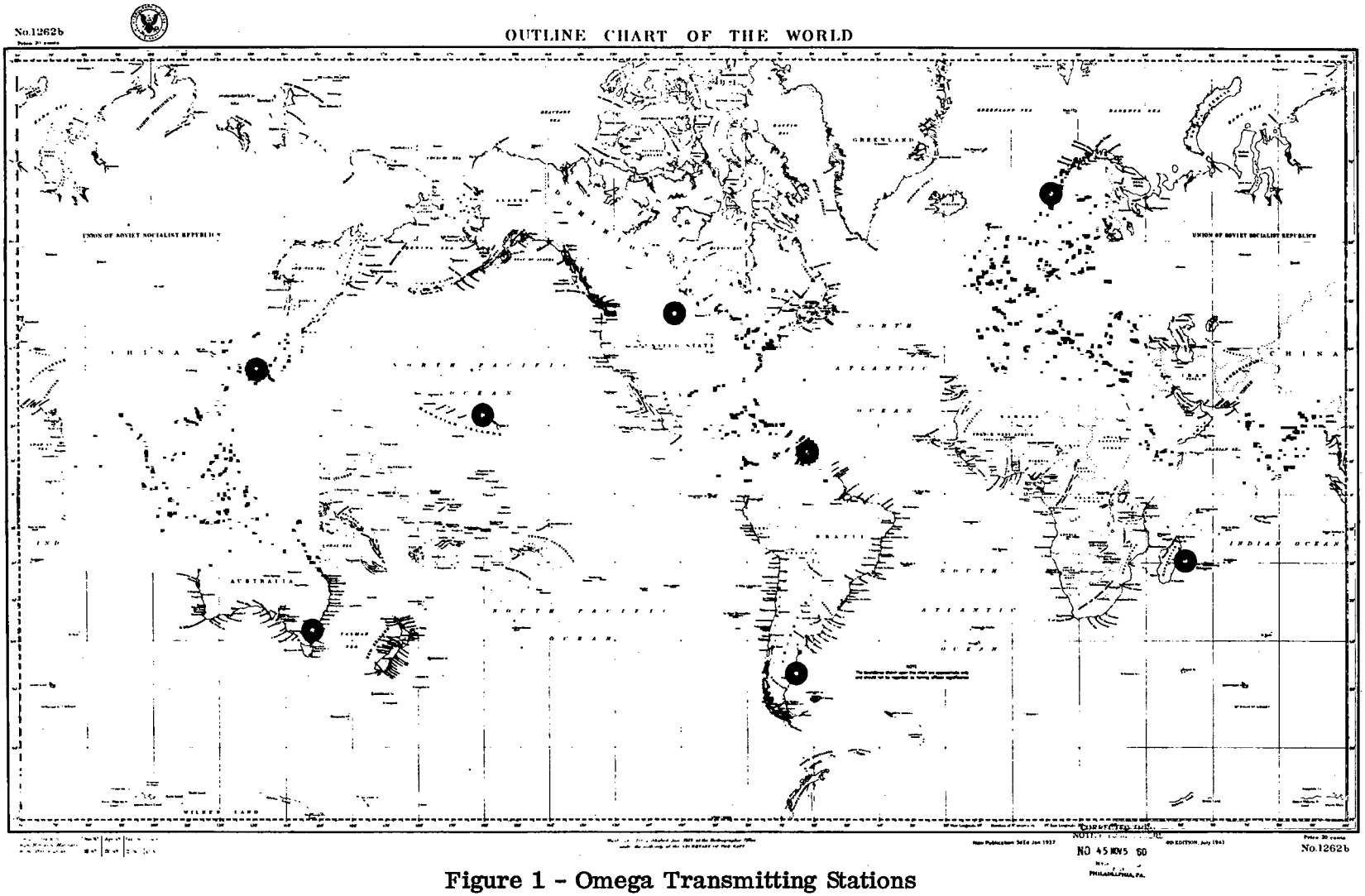

Figure 1 - Omega Transmitting Stations

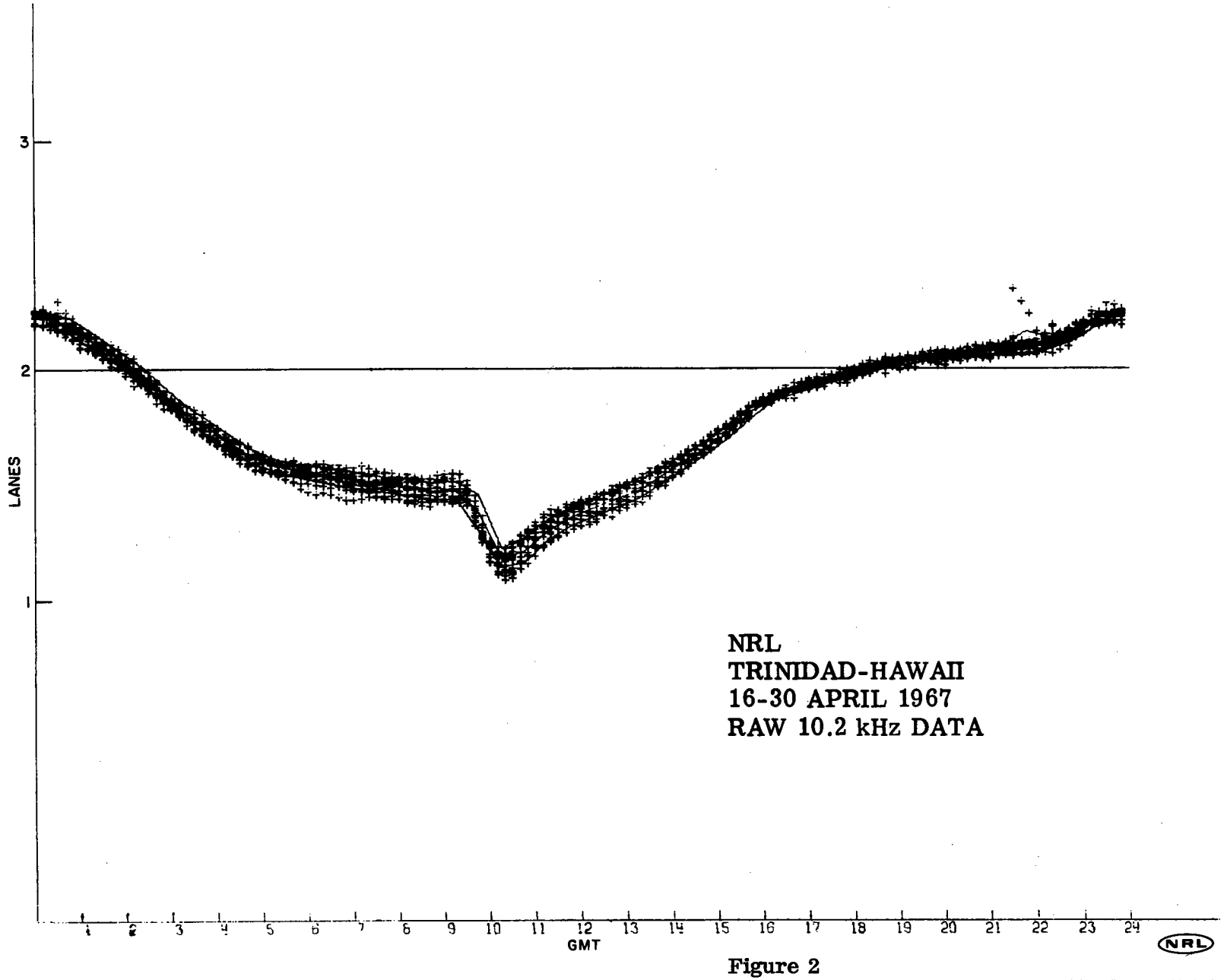

Figure 2

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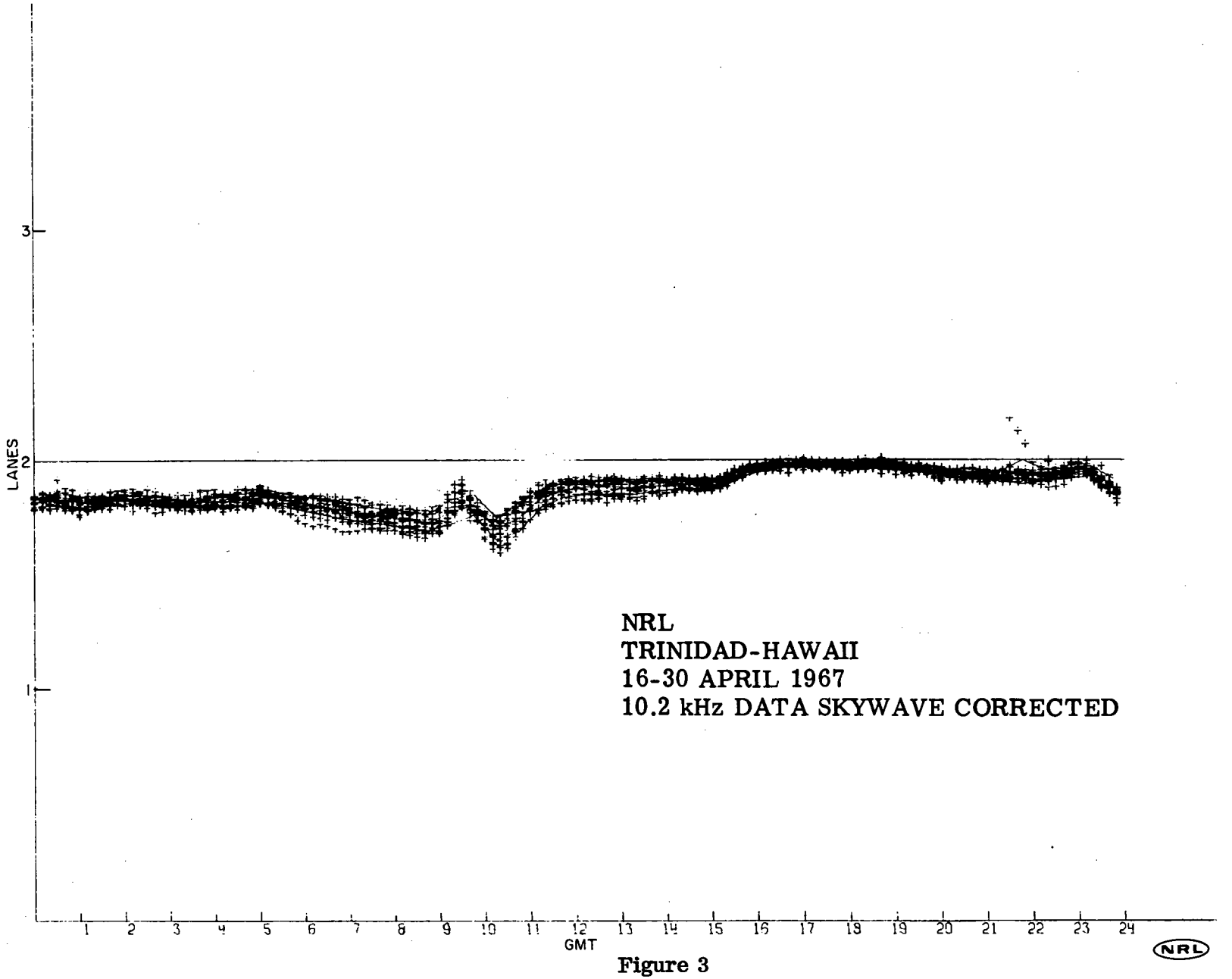
LANES
3
2
1
NRL
TRINIDAD-HAWAII
16-30 APRIL 1967
10.2 kHz DATA SKYWAVE CORRECTED
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24
GMT
NRL

Figure 3

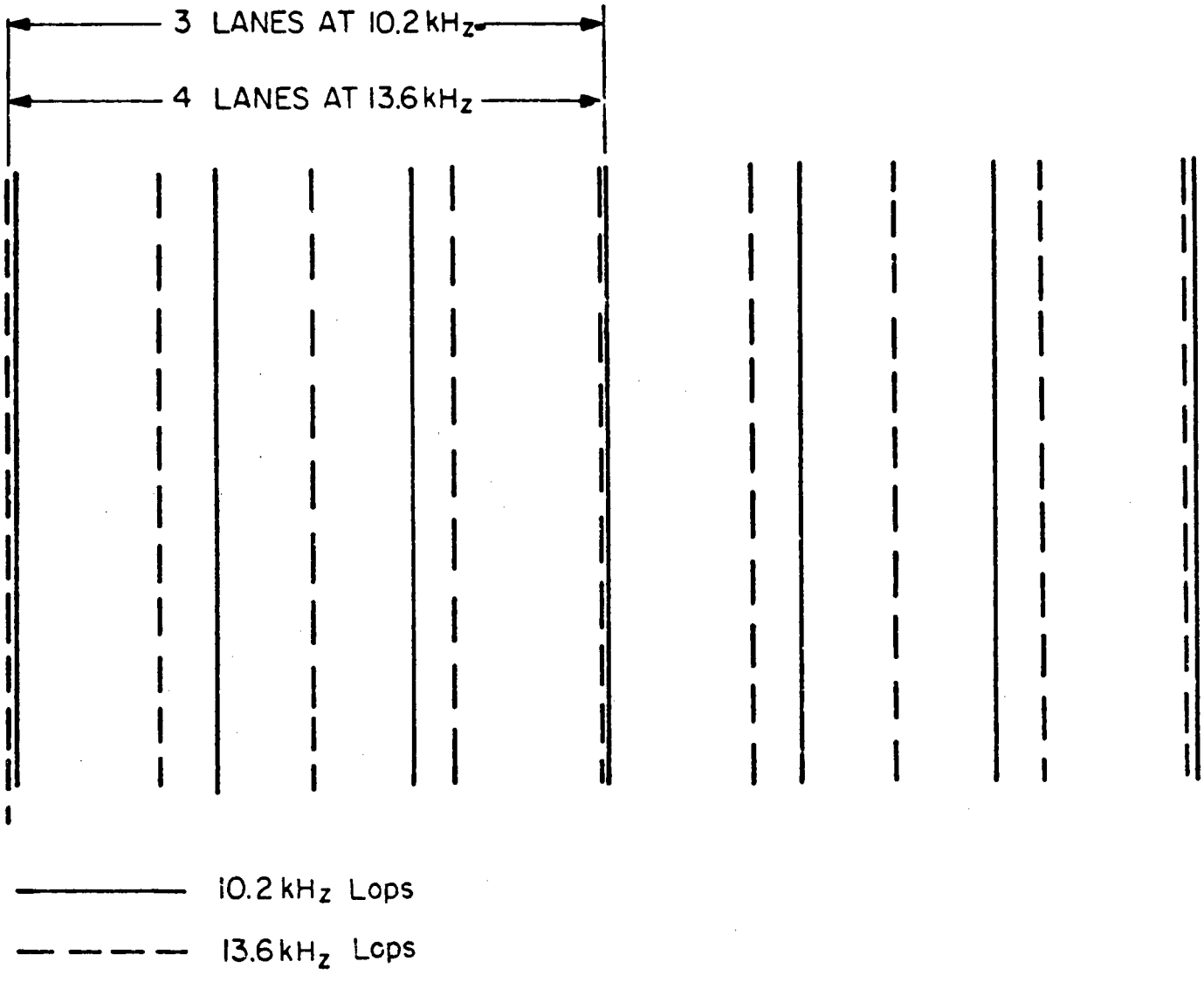

Figure 4 – Lane identification moire pattern

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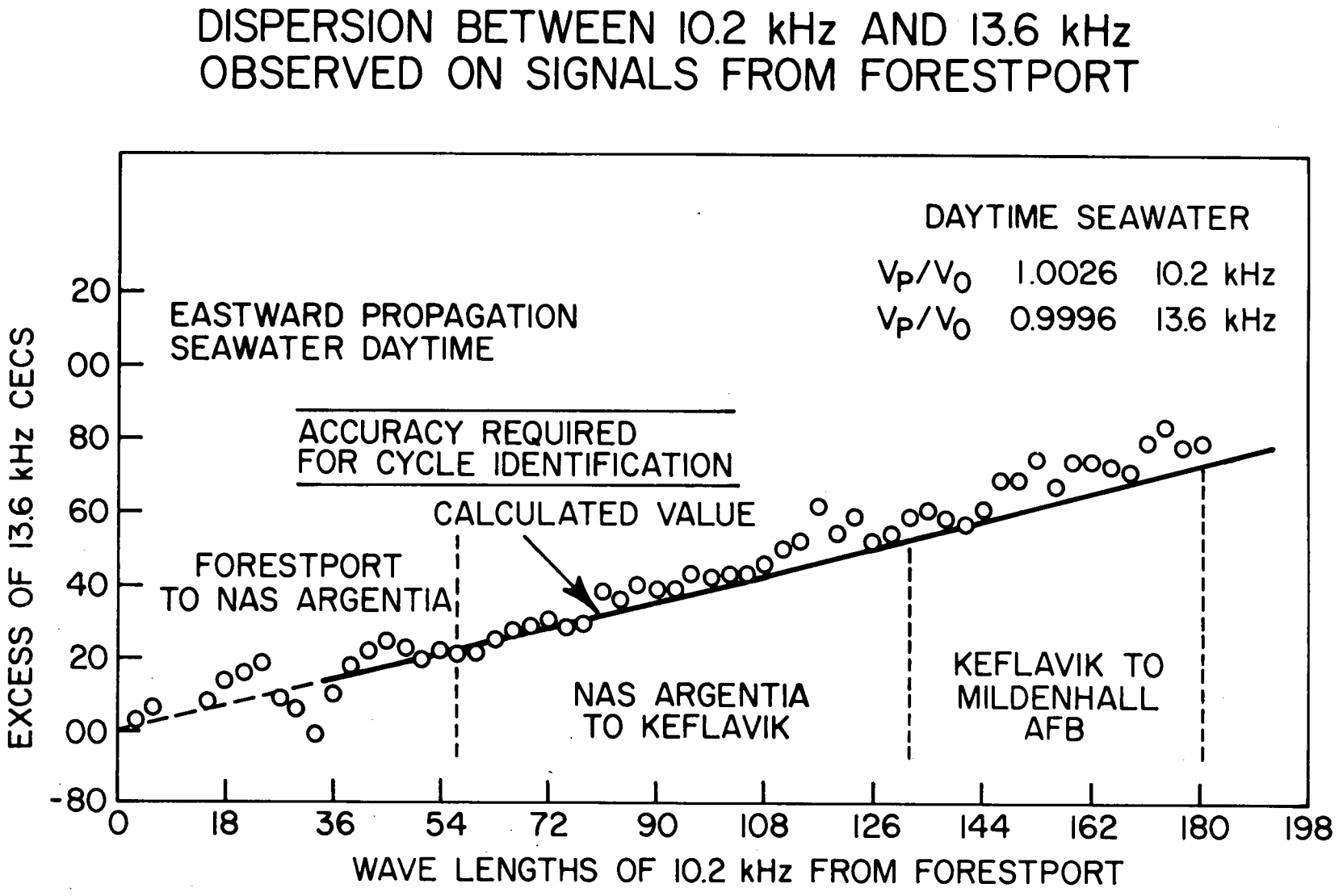
DISPERSION BETWEEN 10.2 kHz AND 13.6 kHz
OBSERVED ON SIGNALS FROM FORESTPORT
DAYTIME SEAWATER
V_P/V_O 1.0026 10.2 kHz
V_P/V_O 0.9996 13.6 kHz
EASTWARD PROPAGATION
SEAWATER DAYTIME
ACCURACY REQUIRED
FOR CYCLE IDENTIFICATION
CALCULATED VALUE
FORESTPORT
TO NAS ARGENTIA
NAS ARGENTIA
TO KEFLAVIK
KEFLAVIK TO
MILDENHALL
AFB
EXCESS OF 13.6 kHz CECS
20
00
80
60
40
20
00
-80
0
18
36
54
72
90
108
126
144
162
180
198
WAVE LENGTHS OF 10.2 kHz FROM FORESTPORT

Figure 5

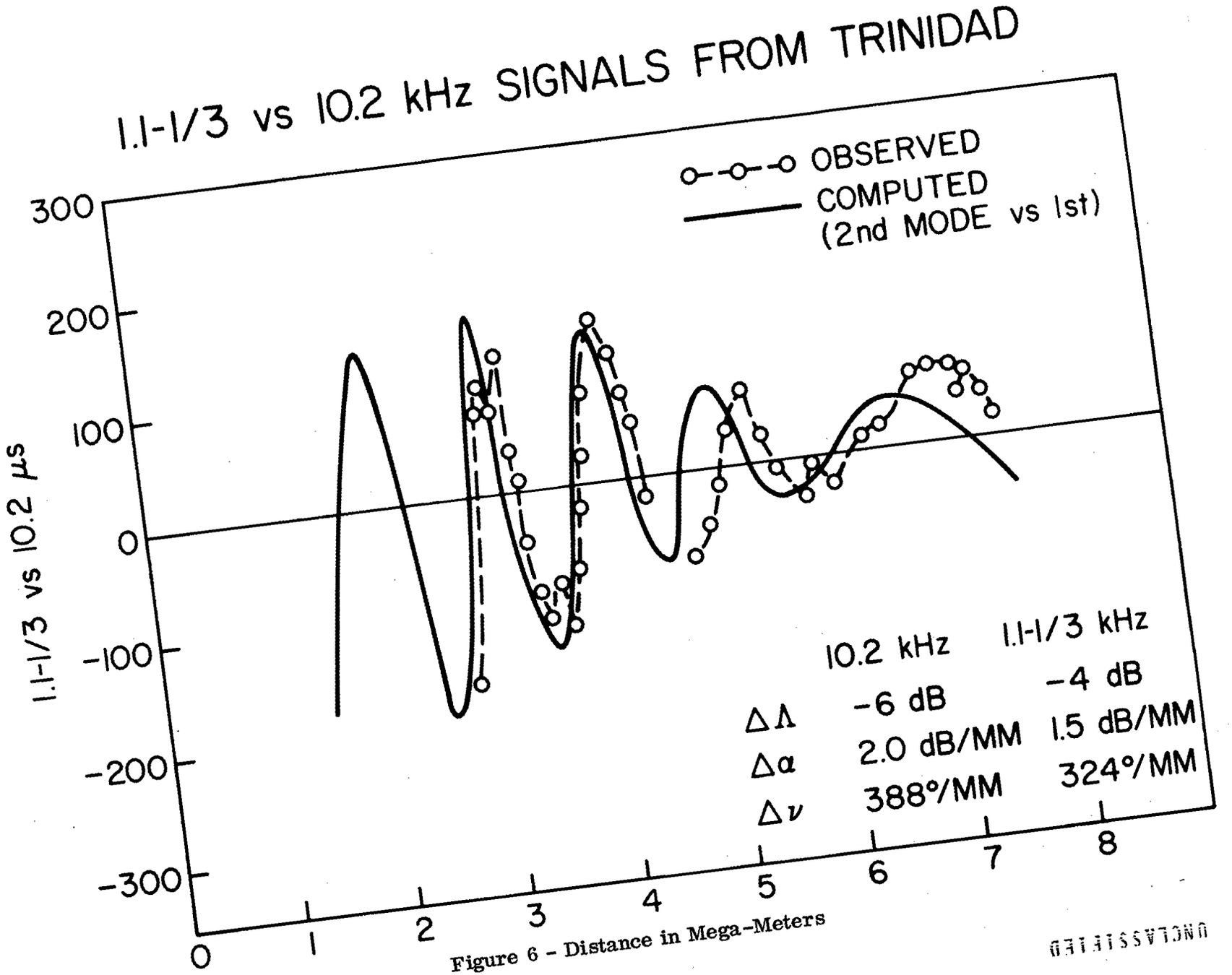

Figure 6 - Distance in Mega-Meters

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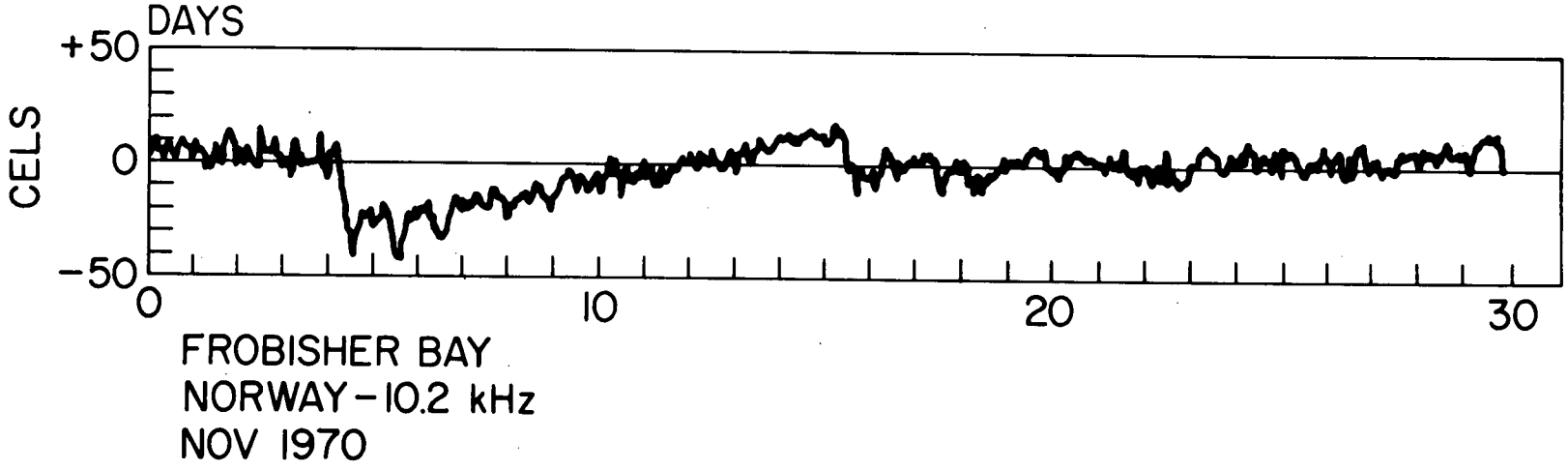
DAYS
+50
0
-50
CELS
0
10
20
30
FROBISHER BAY
NORWAY-10.2 kHz
NOV 1970

Figure 7

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Multimodal Influences on the Apparent Propagational Dispersion of VLF Sferics

by

Gary H. Price

Stanford Research Institute
Menlo Park, Calif., 94025

ABSTRACT

The effects are examined of an unrecognized presence of two modes upon source-distance calculations based upon a single-mode interpretation of dispersion (group-delay-difference) measurements at VLF. For nominal values of the modal parameters, the fractional error in the calculated distance is found to exceed the ratio of the magnitude of the second-order mode to that of the first by about two orders of magnitude. Thus, even if the second-order mode is only present at small amplitude, the distance errors can remain appreciable. The size of the fractional error depends strongly upon the position of the observation point relative to the model interference pattern; consequently, the maximum error experienced over a range of source distances is considerably larger than the average error for this range. Typically, for frequencies around 7.5 kHz and distances on the order of 5000 km, the maximum and the average errors from modal interference are about 3000 km and 700 km, respectively, at night, and perhaps two orders magnitude less by day.

I INTRODUCTION

Many methods for the location of distant (> 1000 km) lightning discharges from a single observing station have been suggested in the past. Such methods have a natural logistic appeal when compared to multi-station methods, such as crossed-loop or time-of-arrival systems. Critical reviews of the capabilities of the various single- and multi-station techniques exist [Pierce, 1956; Horner, 1964]. The performance of crossed-loop systems in particular is well established by extensive use, and the sources of their errors are reasonably well understood. This and the time-of-arrival multi-station technique can readily fix the position of an individual flash, occurring at any time, to a distance accuracy of well under ten percent.

Several of the single-station techniques yield satisfactory results under some circumstances. However, no single-station technique appears to approach the capability of the crossed-loop and the time-of-arrival multi-station techniques. The sources of error in some single-station methods are also somewhat less well understood.

Single-station methods commonly employ a crossed-loop direction finder to fix the bearing of the sferic radiated by a lightning discharge. One method for determination of the source distance along this bearing

is to measure the dispersion of the sferic caused by its propagation through the earth-ionosphere waveguide. In the simplest circumstance, this dispersion increases linearly with increasing propagation distance, so that once the constant of proportionality is known the measured dispersion can be readily converted into source distance. Distance estimation by the dispersion technique was first applied by Watson-Watt et al. [1937] using the separation (typically on the order of a millisecond) between the VLF and ELF components of a sferic. This method was later revived [Hepburn and Pierce, 1953] and has--in a second revival--received considerable recent attention [Hughes, 1967; Taylor and Sao, 1970].

Another relatively recent application of this basic approach has been developed by a group of workers in Berlin [Heydt and Volland, 1965; Frisius and Heydt, 1968]. In this application, the dispersion measurement is made on the sferic within a much more limited frequency range, typically on the order of 2 kHz, located in the lower VLF band, typically between 5 and 10 kHz. Consequently, the time-delay variation over the measurement bandwidth is much less than the time interval which separates the VLF and ELF components of the sferic.

It has been recognized for some time [Frisius and Heydt, 1968] that the presence at the receiver of more than one waveguide mode of appreciable amplitude is a potential source of error in the determination of source distance from such a VLF dispersion measurement; this realization

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in large part has dictated location of the measurement interval in the lower VLF band. Quantitative evaluation of the errors due to multimodel interference and other possible sources of error has been lacking, however. Without such information, determination of which of the alternative error sources, or combination thereof, is responsible for the observed errors has not been possible. The errors due to multimodal interference are examined here as a first step toward such a determination.

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II THE VLF DISPERSION TECHNIQUE

The dispersion technique for measurement of the source distance is based upon the linear dependence of the group propagation time, t_g, upon the distance, d, between the source and the point of observation:

$$t_g = F(\omega)\ d \quad , \tag{1}$$

where F represents, as indicated in Eq. (1), a function of the angular frequency, ω, but not of d. The group time cannot be used directly to determine the source distance, however, because the moment at which the sferic impulse is generated by the source is not known. This difficulty can be overcome by measurement of the dispersion, $dt_g/d\omega$:

$$\frac{dt_g}{d\omega} = \frac{dF}{d\omega}\ d \quad , \tag{2}$$

which, as indicated by Eq. (2), is also linearly dependent upon d, given such a dependence for t_g.

The quantity $dF/d\omega$ must be determined either from theory or by experimental calibration of the measuring system with known sources. In either event, its form will be an idealization. Use of a single-mode expression dictated by waveguide propagation theory is a reasonable

first approximation which has commonly been employed in the past [Frisius and Heydt, 1968; Frisius et al., 1970]. The linear dependence of the dispersion upon the distance indicated by Eq. (2) actually holds only in this single-mode approximation.

In the presence of two (or more) significant modes at the observation point, the concept of a group propagation time for the entire signal becomes somewhat obscure. Experimentally, the dispersion is actually defined in terms of measurement of the phase, ϕ, of the received signal at several frequencies:

$$\frac{dt_g}{d\omega} = -\frac{d^2\phi}{d\omega^2} \cong -\frac{\Delta(\Delta\phi)}{(\Delta\omega)^2} \quad . \tag{3}$$

Since the phase remains a well-defined quantity in a multimode environment, the "effective" dispersion can be considered to be defined in terms of the phase measurement.

In order to examine theoretically the effects of a multimode environment upon the accuracy of distances calculated from the measured dispersion under the assumption of a single dominant mode, the $dt_g/d\omega$ of Eq. (2) is replaced by $-(d^2\phi/d\omega^2)_{two}$, calculated for two modes, while the single-mode form of $dF/d\omega$ is retained:

$$\frac{dF}{d\omega} = -\frac{1}{d}\left(\frac{d^2\phi}{d\omega^2}\right)_{one} . \tag{4}$$

Thus, the ratio of the apparent, or calculated, distance, d_{calc}, to the actual distance of the source is, from Eqs. (2) and (4),

$$\frac{d_{calc}}{d} = \frac{(d^2\phi/d\omega^2)_{two}}{(d^2\phi/d\omega^2)_{one}} . \tag{5}$$

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III MODAL CHARACTERISTICS

The received time waveform is written as a Fourier transform, which makes apparent the definition of the signal (spectral) amplitude and phase as a function of frequency:

$$E(d,t) = \frac{1}{2\pi} \int d\omega e^{i\omega t} A e^{i\phi} \tag{6}$$

The spectral function can be described in terms of a modal expansion,

$$Ae^{i\phi} = \sum_n A_n e^{i\phi_n} \quad , \tag{7}$$

of which only the first two terms will be considered further here.

The amplitude of each mode, A_n, involves the degree of excitation of that mode by the source, expressed by the excitation factor, Λ_n, and its rate of attenuation, α_n:

$$A_n = |\Lambda_n(\omega)| e^{-\alpha_n(\omega)d} \quad . \tag{8}$$

The source spectrum can be considered for the purpose of this discussion to be incorporated into the Λ_n. The phase of each mode can be described in terms of its phase velocity, v_{p_n}, and the phase of the excitation factor:

$$\phi_n = -\frac{\omega d}{v_{p_n}(\omega)} + \arg[\Lambda_n(\omega)] \quad . \tag{9}$$

The modal phase can more conveniently be expressed here in terms of the modal eigenvalue S_n:

$$\frac{\omega d}{v_{p_n}(\omega)} = k_o d \; \mathrm{Re}[S_n(\omega)] \quad . \tag{10}$$

The imaginary part of S_n is similarly related to α_n, the modal attenuation rate.

A fairly simple model of the earth-ionosphere waveguide suffices to represent the basic phase behavior of signals propagating within it. Namely, a form is chosen for S_n,

$$S_n = \frac{c}{v_n} \left\{ 1 - \left[\left(1 - \frac{1}{2n}\right)\frac{\omega_n}{\omega} + \frac{1}{2n}\left(\frac{\omega_n}{\omega}\right)^2 \right]^2 \right\}^{1/2} \tag{11}$$

which is a slight modification to that for an ideal planar waveguide with perfectly reflecting walls. In Eq. (11), v_n is the asymptotic phase velocity of the mode at high frequencies, and ω_n is its low-frequency cutoff. For a planar guide, v_n would be c. In the curved earth-ionosphere waveguide, however, the limiting phase velocity along

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the earth's surface can depart significantly from this value [Wait and Spies, 1964].

The cutoff frequency for a sharply-bounded waveguide with infinitely conducting walls is related to the guide width, h, by

$$\omega_n = \frac{n\pi c}{h} \quad . \tag{12}$$

This expression appears to fit VLF sferics data well [Helliwell, 1965, p. 78; Lynn and Crouchley, 1967] with a value for h consistent with other measurements [Wait and Spies, 1964]. The phase shift upon reflection of the wave from the guide walls is zero in this case. For the ionosphere, however, the phase shift upon reflection at the modal eigenangle is nearly π for frequencies far from cutoff [Wait and Spies, 1964]. This behavior has been represented here by an ionospheric reflection coefficient, R_i, of the form

$$R_i = \exp\left[-i\pi\left(1-\frac{\omega_n}{\omega}\right)\right] \tag{13}$$

which, when inserted into the modal equation, yields the expression for S_n given in Eq. (11).

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Although Eq. (11) incorporates the major feature, the cutoff frequency, responsible for the dispersion of a mode at low frequencies, the resultant S_n, which is purely real above this frequency, does not describe well the modal attenuation. This is only to be expected since the attenuation results from the lossy nature of reflection from the earth and ionospheric boundaries of the guide. Consequently, the modal amplitudes are modelled separately by fits to attenuation rates and excitation factors calculated with more accurate propagation models, as described below.

The group propagation time, t_{g_n}, for each mode is defined by the stationary-phase condition

$$\frac{d}{d\omega}(\omega t + \phi_n)\Big|_{t=t_{g_n}} = \frac{d}{d\omega}\left[\omega t - k_o d\, \mathrm{Re}(S_n)\right]_{t=t_{g_n}} = 0 \qquad (14)$$

As is indicated in Eq. (14), the dependence of the phase of the excitation factor (which here incorporates that of the source) upon the frequency has not been included in the definition of t_{g_n}. This simplification, which eliminates a possible source of additional error, does not appreciably affect the contribution to the error calculated to arise from multimodal propagation.

Equations (11) and (14) taken together lead to

$$t_{g_n} = \frac{d}{v_n\left(\frac{v_n}{c} S_n\right)} \left\{ 1 + \frac{1}{2n}\left(\frac{\omega_n}{\omega}\right)^2 \left[1-\left(\frac{v_n}{c} S_n\right)^2\right]^{1/2} \right\} \tag{15}$$

and

$$\frac{dt_{g_n}}{d\omega} = - \frac{d}{\omega v_n\left(\frac{v_n}{c} S_n\right)^3} \left\{ \left[\left(1-\left(\frac{v_n}{c} S_n\right)^2\right)^{1/2} + \frac{1}{2n}\left(\frac{\omega_n}{\omega}\right)^2\right]^2 \right.$$

$$\left. + \frac{1}{n}\left(\frac{\omega_n}{\omega}\right)^2 \left(\frac{v_n}{c} S_n\right)^2 \left[1-\left(\frac{v_n}{c} S_n\right)^2\right]^{1/2} \right\} \qquad)16)$$

for the group propagation time and its derivative for each mode.

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IV THE DISTANCE ERROR

In order to determine the ratio of the apparent to the actual distance of the source according to Eq. (5), the derivatives of the phase with respect to frequency must be calculated. Equation (7) gives, for two modes,

$$\phi = \arctan\left(\frac{A_1 \sin \phi_1 + A_2 \sin \phi_2}{A_1 \cos \phi_1 + A_2 \cos \phi_2}\right) \tag{17}$$

The variation of the modal amplitudes with frequency plays no essential role in the errors introduced into the distance determination by multiple modes. Thus the $dA_n/d\omega$ can be set to zero in the differentiation of Eq. (17), with the result

$$\frac{d\phi}{d\omega} = -\frac{t_{g_1} + \rho\left(t_{g_1} + t_{g_2}\right)\cos(\phi_1 - \phi_2) + \rho^2 t_{g_2}}{1 + 2\rho \cos(\phi_1 - \phi_2) + \rho^2} \tag{18}$$

where $\rho = A_2/A_1$ is the ratio of the modal amplitudes.

A second differentiation and insertion of the result into Eq. (5) then gives

$$\frac{d_{calc}}{d} = \frac{[1+2\rho \cos(\phi_1-\phi_2)+\rho^2][1+\rho(1+R)\cos(\phi_1-\phi_2)+\rho^2 R]-\rho(1-\rho^2)\dfrac{\left(t_{g_1}-t_{g_2}\right)^2}{dt_{g_1}/d\omega}\sin(\phi_1-\phi_2)}{[1 + 2\rho \cos(\phi_1 - \phi_2) + \rho^2]^2}, \tag{19}$$

where

$$R = \frac{dt_{g_2}/d\omega}{dt_{g_1}/d\omega} \quad . \tag{20}$$

Evaluation of Eq. (19) requires specification of the modal amplitude ratio, ρ, and of the parameters in the expression for the modal eigenvalues, Eq. (11). There are a variety of experimental data and calculated results available above 10 kHz, but the data in the region of greatest interest here, roughly 5 to 10 kHz, are sparse. Furthermore, the experimental data that are available provide scant information concerning the second-order mode.

For the modal phase velocities, spectral analysis of sferics [Helliwell, 1965, pp. 78 and 121-123; Lynn and Crouchley, 1967] indicates a cutoff frequency for the lowest mode of about 1.7 kHz at night, which implies an ionospheric reflection height of about 90 km according to Eq. (12). This height is typical of values considered representative of the height range in which VLF waves are reflected from the ionosphere at night [Wait and Spies, 1964]. The cutoff frequency for the second-order (n = 2) mode is also consistent with this reflection height.

The daytime modal cutoff frequency is not evident in the data reviewed by Helliwell [1965] and by Lynn and Crouchley [1967]. However,

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the consistency in the nighttime data between the steep-incidence reflection heights associated with the modal cutoff frequency and the oblique-incidence height associated with modal propagation at frequencies well above this cutoff suggest the assumption of a similar relationship by day as a reasonable first approximation. Thus, a reflection height of 70 km, which is representative of daytime propagation in the 10 to 30 kHz frequency range [Wait and Spies, 1964], has been used with Eq. (12) to specify these cutoff frequencies.

It is also difficult to infer directly the appropriate asymptotic phase velocities for high frequencies (the v_n) to be used in Eq. (11) from relevant theoretical calculations, such as those of Wait and Spies, [1964]. Consequently, the flat-earth value of c has been adopted as a first approximation for this parameter; this choice is not grossly inconsistent with experimental data [Jean et al., 1960].

The phase velocities which result from this choice of parameter values are shown in Figure 1 for day and for night. The corresponding group velocities are shown in Figure 2, and the dispersion in Figure 3.

In the absence of comprehensive data, either experimental or from theoretical calculations, on the excitation factors and attenuation rates of both the first- and second-order modes below 10 kHz, calculations of these quantities in the 10 to 20 kHz frequency range by Wait and Spies [1964] have been extrapolated to the lower frequencies. This extrapolation

is performed by a least mean-square-error fit of a second-order polynomial in frequency to the attenuation-rate and to the log of the excitation factor values sampled at 2 kHz intervals in the 10 to 20 kHz frequency range. The polynomial order and the sampling procedure have been chosen to reproduce the general trend of the modal parameters without the extreme excursions that can result from the use of polynomial orders that provide nearly as many fitting coefficients as there are data samples.

Applications of this procedure to the modal parameters calculated by Wait and Spies [1964] for an isotropic exponential profile with the gradient parameter, β, = 0.5 km^{-1} and infinite ground conductivity results in the modal amplitude ratios, ρ, illustrated in Figure 4a for day (reflecting height of 70 km) and in Figure 4b for night (reflecting height of 90 km). As is to be expected, this ratio is generally small, especially during the day, for most of the frequency and distance ranges examined here. It becomes greatest for the higher frequencies and the shorter distances within this range.

The relative phase between the two modes, $\phi_1 - \phi_2$, remains to be specified. The modal interference pattern involves a definite relation between this phase and the frequency and distance at which the signal is observed. However, this pattern is sufficiently variable, being a relatively sensitive function of the propagation parameters, that it is useful

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to consider $\phi_1 - \phi_2$ a random variable. To this end, calculations were made of the error, over the range of distances and frequencies of interest, for values of $\phi_1 - \phi_2$ every $\pi/4$ radians between 0 and 2π. The error was then expressed as the logarithm of the fractional error,

$$\log \left| \frac{d_{calc} - d}{d} \right| ,$$

and this latter quantity was averaged, as well as its maximum noted, for the eight values of $\phi_1 - \phi_2$ at each distance and frequency. The results of this series of calculations for the modal parameter values discussed above are shown in Figure 5 for day and in Figure 6 for night.

The average fractional error is substantial at night over most of the distance and frequency range considered, falling below 10 percent only for distances beyond 4,000 km at 5 kHz, and beyond 6,000 km at 8.5 kHz, Figure 6a. By day, the average error is less, falling below 10 percent beyond 2,500 km at 5 kHz and beyond 4,500 km at 12 kHz, Figure 5a. The maximum error both by day, Figure 5b, and for night, Figure 6b, follows a pattern similar to that of the average error, Figures 5a and 6a respectively, but is larger than the latter by a factor that varies between 3 at the shorter distances to 10 or more at the longer. In general, the error patterns have a form similar to the amplitude ratios, Figure 4, but the average fractional

error exceeds the amplitude ratio at a given distance and frequency by a factor which increases from about 30 at the higher frequencies to 100 or more at the lowest frequency considered, 5 kHz.

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V DISCUSSION AND CONCLUSIONS

The substantial difference between the maximum error and the average error noted above can be traced to the dependence of the error upon the phase difference between the two modes, $\phi_1 - \phi_2$. This dependence is made clearer by consideration of the approximate form of the fractional error for a large difference between the amplitudes of the two modes, that is, for $\rho << 1$. In this limit, Eq. (11) can be written, to first order in ρ, as

$$\frac{d_{calc}-d}{d} \cong \left[\rho \quad (R-1)\cos(\phi_1 - \phi_2) - \frac{\left(t_{g_1} - t_{g_2}\right)^2}{dt_{g_1}/d\omega} \sin(\phi_1 - \phi_2) \right] . \quad (21)$$

Thus, the fractional error varies sinusoidally with $\phi_1 - \phi_2$, and the average value can reasonably be expected to be appreciably less than the maximum value. Furthermore, the averaging is performed on the logarithm of the fractional error, which accentuates this tendency. The variability in the ratio of these two values appears to be partly an artifact of the coarseness of the sampling of the variation of the error as a function of $\phi_1 - \phi_2$ and partly the result of departure, for ρ not small, from the strictly sinusoidal behavior displayed in Eq. (21).

The dependence of the error upon $\phi_1 - \phi_2$ seen in Eq. (21) also indicates that the variation of the fractional error with distance and

frequency will correlate closely with the modal interference pattern in these two variables. The locations of the regions of maximum error relative to the modal interference nulls depends upon the relative magnitude of the coefficients multiplying the phase factors in the two bracketed terms in Eq. (21). Checks of the magnitudes of these coefficients for a few frequencies and distances indicate that their ratio can vary from near unity to greater than 50:1, with the magnitude of the second term generally the larger of the two. The second term, it should be noted, is proportional to the distance, while the first is independent of distance. Both coefficients appear to remain appreciably greater than unity over the entire frequency and distance range considered, so the maximum fractional error substantillay exceeds the modal-amplitude ratio within this range, as is evident from comparison of Figures 4a and 4b with Figures 5b and 6b, for day and night respectively.

The major conclusion to emerge from this analysis is that a small modal-amplitude ratio is no guarantee of small distance errors. The numerical results obtained here, although subject to substantial uncertainties as a result of the lack of comprehensive information on modal characteristics in the frequency range of interest, still suggest strongly that multimode interference should <u>not</u> be dismissed as an insignificant contributor to errors in source distances determined by means of dispersion measurements, even at relatively low frequencies and long distances.

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Further investigation of multimodal propagation effects upon source-distance determination might profitably proceed along several lines. One of these is the obvious need to improve the data input to the calculation. Additional comparisons between dispersion measurements of source distance and source locations determined by other means should also prove profitable, although such comparisons may not be so straight-forward as they would first appear [Frisius and Heydt, 1968].

Finally, variability in source characteristics has not been considered here, although it has been recognized as a potential source of error in the determination of source distance from dispersion measurements [Heydt and Volland, 1965; Frisius et al., 1970]. There are two major and several minor radiators of VLF pulses during a lightning flash. Large VLF sferics are generated by the return strokes of a flash to earth; smaller, but much more numerous "k" pulses are radiated intermittently throughout most stages of both intra-cloud and ground discharges. The average forms of the current surges involved in return strokes and K streamers differ substantially; so, consequently, do their average source characteristics [Arnold and Pierce, 1964]. Furthermore, a considerable variability in the individual current surges is superimposed upon this average behavior. Also, the channel energized by the current develops in length and orientation during the passage of the current surge; this is true for both return strokes and K streamers. The variability in this

channel development is yet another source of spread in the source characteristics.

Fairly obviously, variability of the source characteristics is best determined by measurements at close distances where the influence of propagation effects is minimal. Extension of the error analysis to include the effects of this variability appears to be straightforward. Propagation effects such as those discussed in this paper must, of necessity, be studied by measurements at substantial distances; such measurements contain a combination of source and propagation effects. These two effects could be best separated by comparison of dispersion measurements made at several stations along a common path on individual signals from a single storm center. Such measurements would be particularly sensitive to multimodal effects if the stations were separated by a distance near a half period of the modal interference pattern at the observation frequency. Several installations currently under development, such as that in Argentina [Hofmann, 1972], appear to be well suited for such measurements.

ACKNOWLEDGMENT

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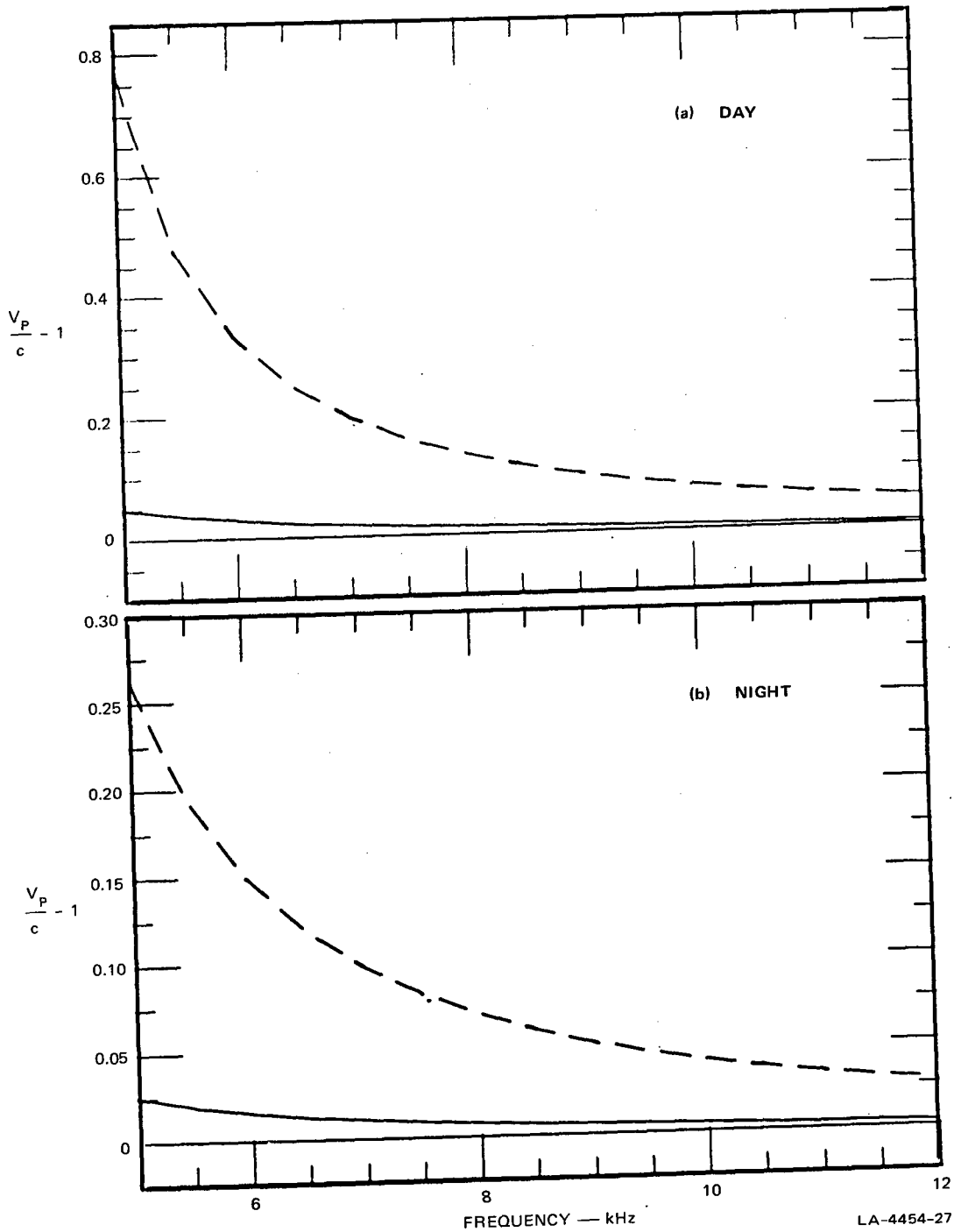

FIGURE 1 PHASE VELOCITY

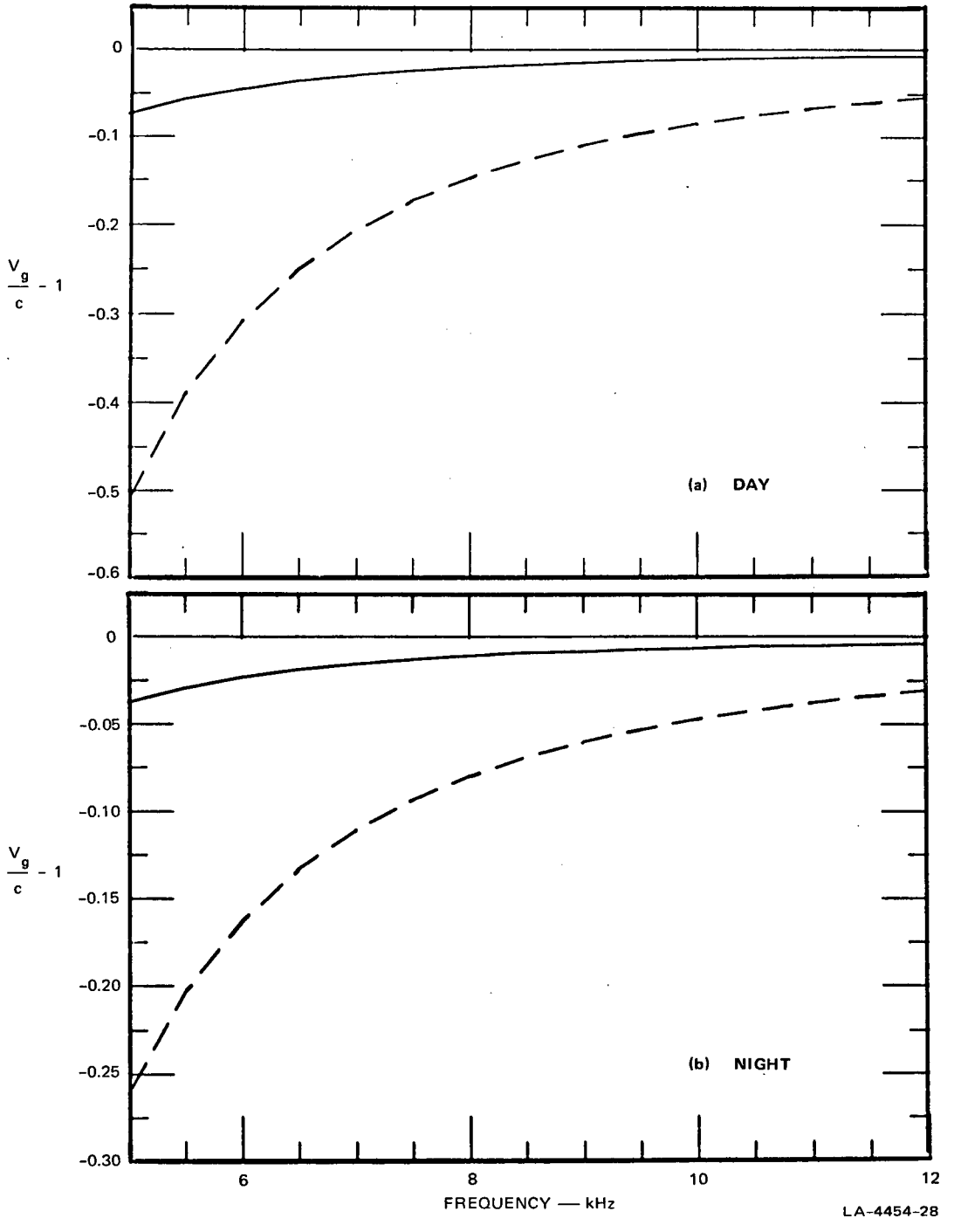

FIGURE 2 GROUP VELOCITY

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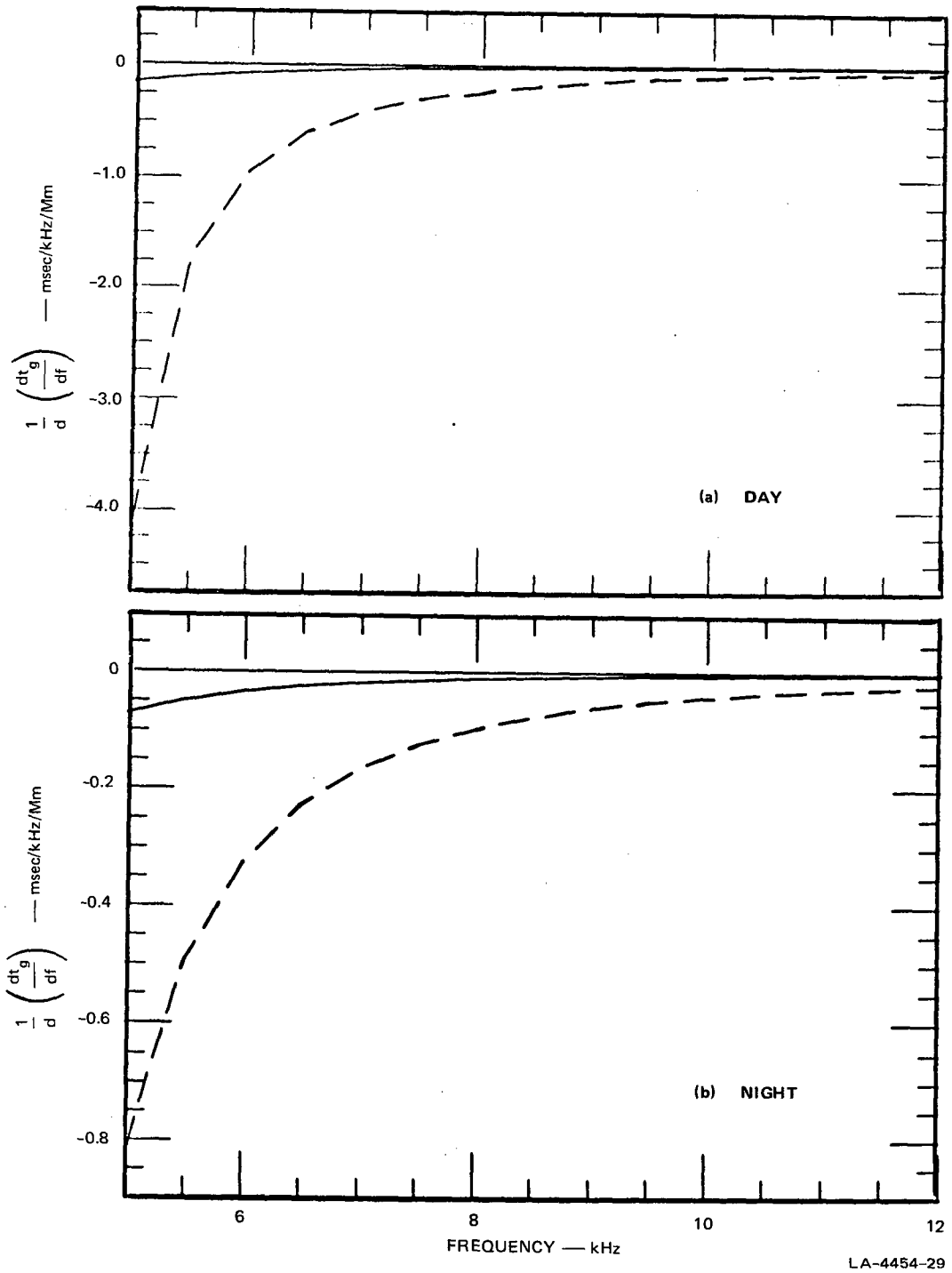

FIGURE 3 DISPERSION

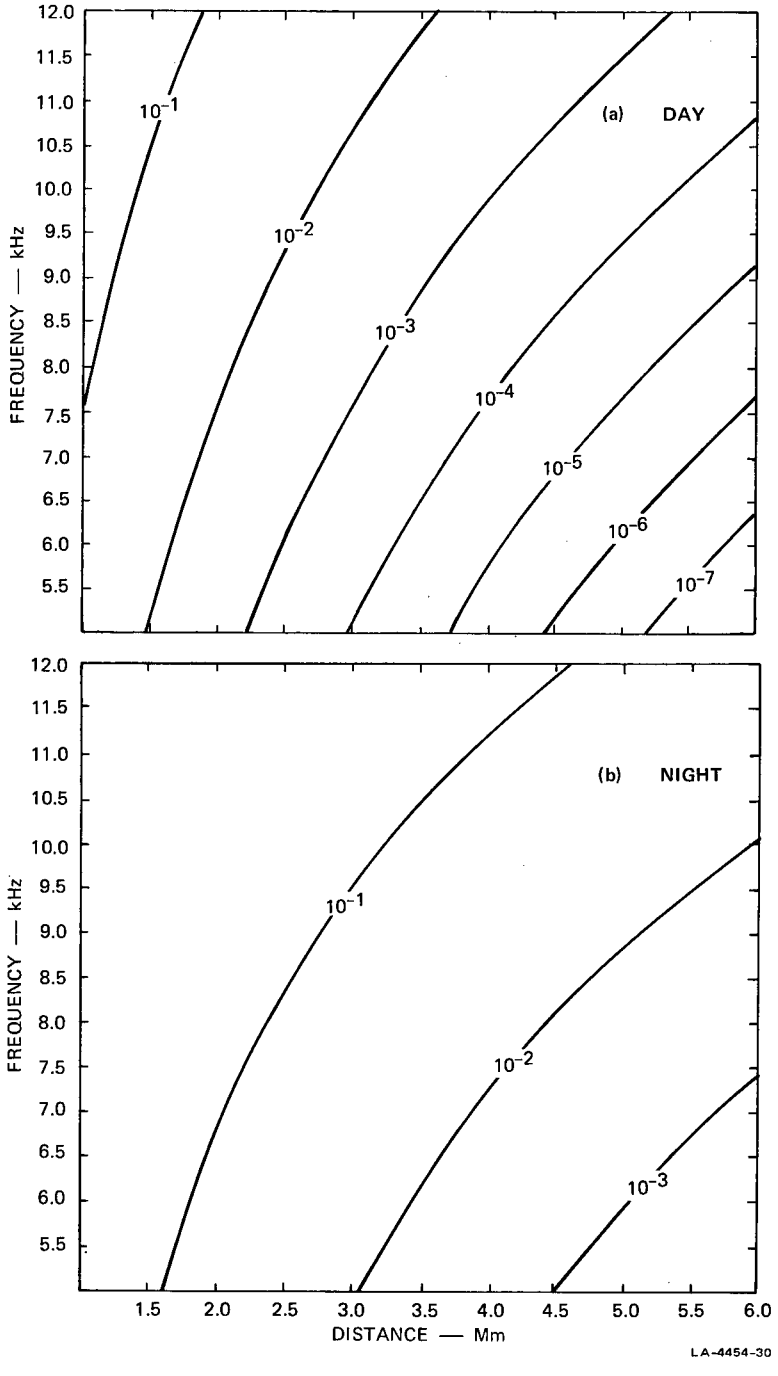

FIGURE 4 RATIO OF AMPLITUDE OF SECOND-ORDER MODE TO THAT OF FIRST-ORDER MODE

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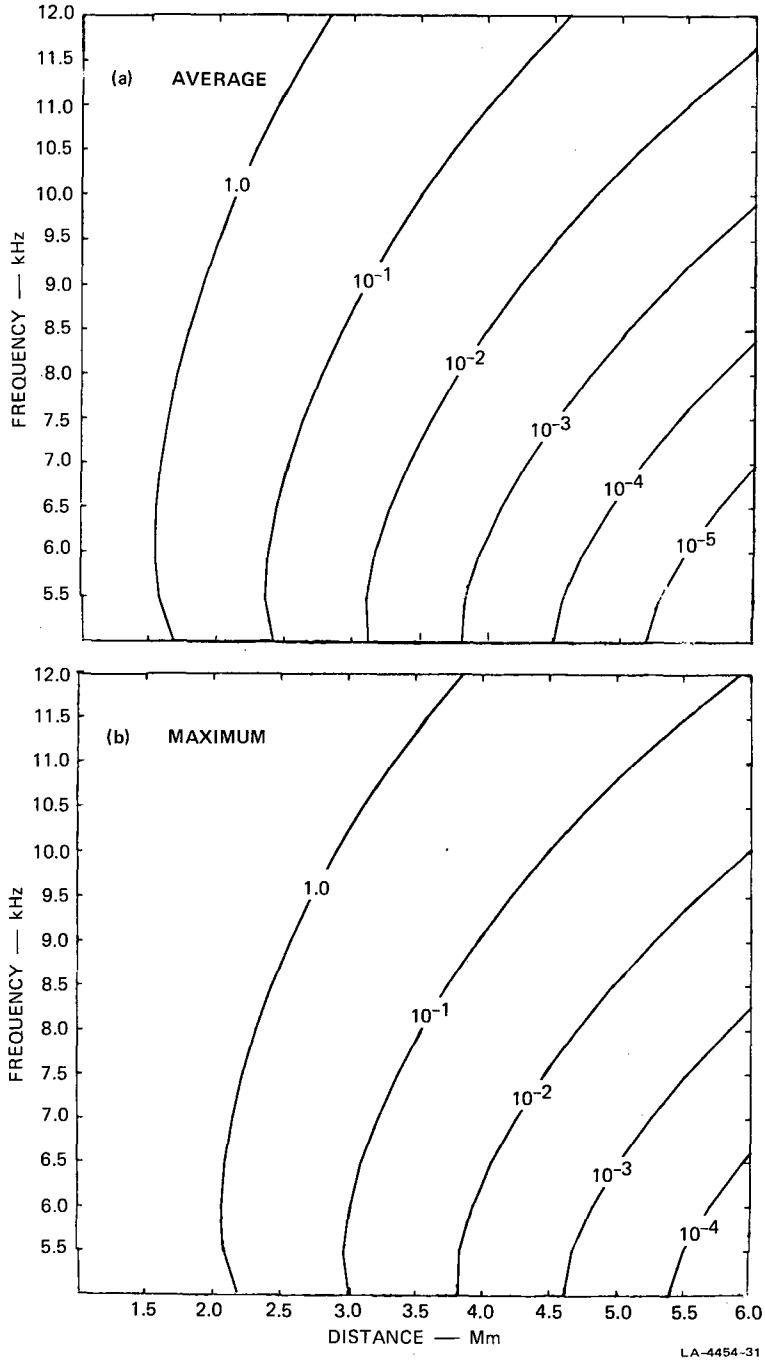

FIGURE 5 DAYTIME FRACTIONAL ERROR

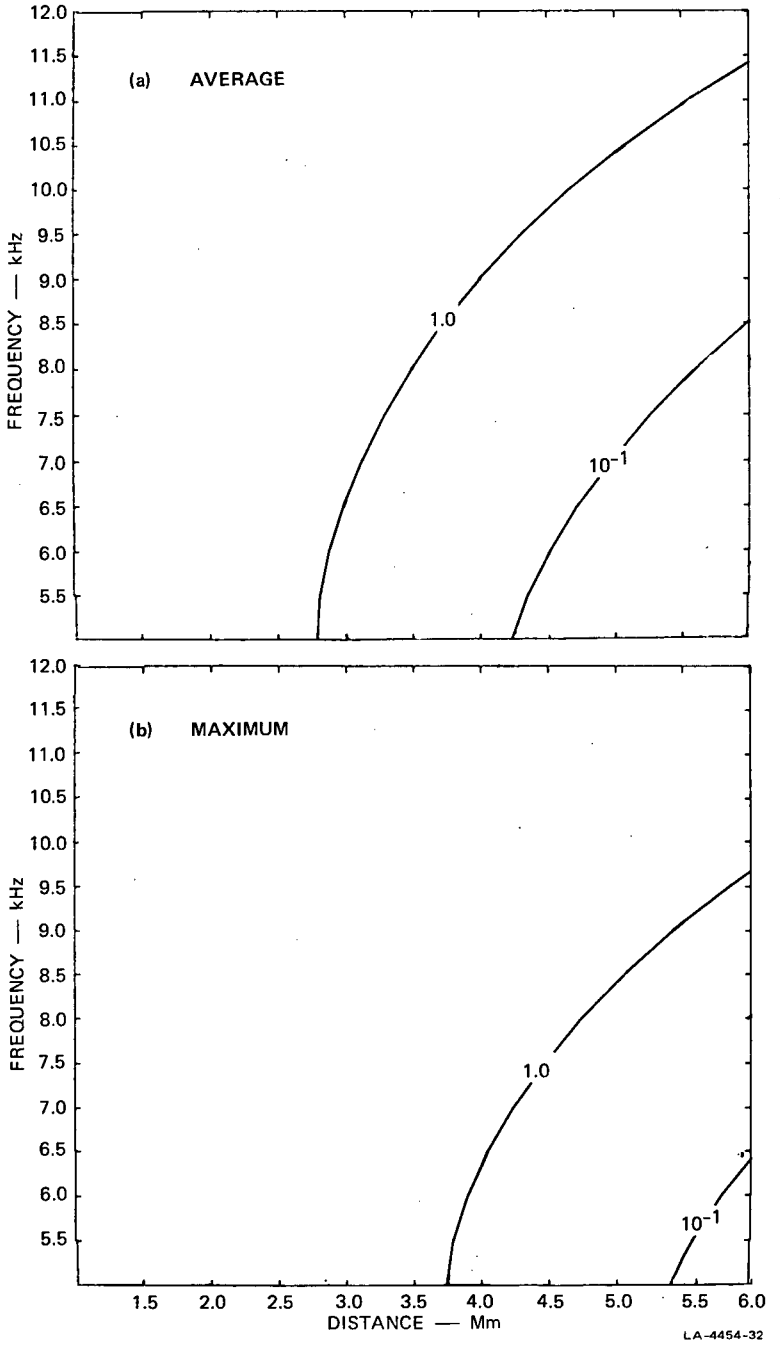

FIGURE 6 NIGHTTIME FRACTIONAL ERROR

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IV

ULF, SLF & ELF Methods for Localization of Thunderstorms

Tuesday, 12 September 1972, 0830 - 1000 EDT, Arlington, Virginia

Chairman: E. T. Pierce

Papers presented:

"Location of Major Thunderstorm Regions Employing ELF Noise"	C. Polk and M. Clayton
"Accuracies of ELF Source Location Using Direction of Arrival in Conjunction with Time Difference Techniques"	William L. Taylor (Abstract only)
"Real Time Location of Atmospherics by Single Station Techniques and Preliminary Results"	Kazuo Sao Hidehiko Jindoh

LOCATION OF MAJOR THUNDERSTORM REGIONS EMPLOYING ELF NOISE

C. Polk and M. Clayton
University of Rhode Island, Kingston, R. I.

Schumann resonances have been discussed by many authors (1,2,3,4) and a method for extracting information about atmospherics location from the extremely low frequency (ELF) noise spectrum has also been outlined (5) and later developed in considerable detail (6).

The basic phenomenon is illustrated by Fig. 1 which shows the power spectrum of natural electromagnetic field noise in the 3 to 30 Hz frequency band as obtained at a field site near Kingston, R. I. The particular spectrum illustrated is that of the vertical electric field and represents an averaging or integration period of 17 minutes. Similar spectra are obtained for two orthogonal components of the horizontal magnetic field. These field components are monitored continuously (7) and methods for obtaining and processing power spectra very rapidly (7,8) have been developed so that a significant fraction of the available data can be analyzed.

The surface of the earth and the diffuse, lower boundary of the Ionosphere together form a concentric sphere resonant cavity for electromagnetic waves in the ELF frequency range. This is apparent if one considers the following facts: -[1] The ratio of conduction current to displacement current (equal to $\sigma/\omega\varepsilon_o$, electrical conductivity divided by radian frequency times dielectric permittivity) is equal to about $2(10^6)$ at 10 Hz for average dry land ($\sigma = 10^{-3}$ mho m^{-1}) or to $8(10^9)$ for the ocean ($\sigma = 4$ mho m^{-1}); this same ratio is equal to $2(10^3)$ for the Ionosphere ($\sigma \approx 10^{-6}$ mho m^{-1}) at a height of 80 km. Since a material behaves as an electrical conductor when $(\sigma/\omega\varepsilon_o) \gg 1$, both, the surface of the earth and the lower boundary of the Ionosphere are good electrical conductors. -[2] The circumference of the earth is equal to one free space wavelength at 7.5 Hz; one can therefore expect standing wave or "resonance" phenomena in the vicinity of that frequency. Since boundaries are present, the actual wavelength in the earth-ionosphere cavity will, of course, be different than in free space. -[3] The attenuation for a 10 Hz electromagnetic wave in the cavity is of the order of 0.25 db per 1000 kilometer (9) and electromagnetic noise generated in the cavity can therefore travel around the earth several times, "reverberate" and form standing waves.

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At the "Schumann" ELF frequencies, below 50 Hz, only the lowest transverse magnetic (TM) mode is characterized by extremely low attenuation (1,2,3,4,9) and therefore only that mode contributes to world wide standing waves and to the resonance spectrum illustrated by Fig. 1. The lowest three resonance frequencies occur typically in the vicinity of 8 Hz, 14 Hz and 20 Hz. Their exact values depend upon "losses" in the cavity (1,2,3,9), primarily the electric conductivity profile of the lower Ionosphere, and upon source-receiver separation.

The importance of source receiver separation (10) arises from the fact that each of the resonance peaks in Fig. 1 is primarily the result of one of several possible standing waves which correspond to terms in the series expansions (1,2)

$$E_r = K(\omega)\nu(\nu+1)\sum_{n=0}^{\infty} \frac{2n+1}{n(n+1) - \nu(\nu+1)} P_n(\cos\theta) \tag{1}$$

for the vertical electric field or

$$H_\phi = a\omega\varepsilon_o K(\omega)\sum_{n=0}^{\infty} \frac{2n+1}{n(n+1) - \nu(\nu+1)} \frac{d}{d\theta} P_n(\cos\theta) \tag{2}$$

for the horizontal magnetic field. Each resonance peak corresponds to a single n in $n(n+1) = \nu(\nu+1)$ where the complex number ν is a function of frequency and ionospheric conductivity and θ is the angle between source and receiver which has its vertex at the center of the earth. $P_n(\cos\theta)$ are the Legendre polynomials, $K(\omega)$ is the excitation function, ω is the radian frequency $2\pi f$, a is the radius of the earth and ε_o the dielectric permittivity of free space.

As shown by Fig. 2 for the first two terms in the series, the standing wave patterns in the cavity are very different for the different values of n. As an illustration one might consider the idealized case of a single, discrete source in a cavity with infinite "Q" (quality factor) which would give real values of ν in equations (1) and (2), leading to discrete resonance lines of infinite height in place of the experimental spectrum shown on Fig. 1. For this simplified model it is clearly apparent that a receiver located at 55° from the vertical electric dipole exciter, so that $P_2(\cos\theta) = (1/4)(3\cos 2\theta+1) \approx 0$, would not detect the second resonance peak in the spectrum of the vertical electric field. Similarly at $\theta = 90^\circ$ the first resonance peak in the spectrum of the vertical electric field and the second resonance peak in the horizontal

magnetic field would disappear.

Since the actual cavity has a Q value between four and ten, many terms in the series of (1) and (2) contribute to each resonance peak in addition to the dominant term. The effect illustrated by the idealized example is nevertheless clearly apparent (6,10) and one can obtain information about the relative separation of source and receiver by examining the ratio of power densities at the adjacent resonance peaks, for example the value of $|E|^2$ at 8 Hz to the value of $|E|^2$ at 14 Hz in Fig. 1, or by evaluating the ratios of the measured electric to the measured magnetic field amplitudes at the resonance frequencies. The results depend only weakly upon the model which is employed for the ionospheric conductivity (5,6,11) and it should therefore be possible to obtain correct results for source-receiver separation from experimental data if any reasonably realistic model of the Ionosphere below 100 km is employed.

While the ratios of power at adjacent resonance peaks are only very weakly dependent upon the Ionospheric conductivity profile, the exact values of the resonance frequencies (i.e. 8.0 Hz versus 8.2 Hz) are very sensitive to the exact nature of this profile and it has become feasible to obtain information about Ionospheric conductivity between 40 km and 100 km (and possibly below 40 km) from Schumann resonance data (11).

For both, source location and the determination of Ionospheric conductivity profiles assumptions have to be made about the nature of the exciting source which seems to be primarily lightning in the 5 Hz to 30 Hz frequency range (1 to 7). The power spectrum of the individual lightning stroke is not very well known and information is lacking about the differences between the spectra of cloud to earth and cloud to cloud strokes or between the spectra of temperate zone and tropical zone lightning (12). Fortunately the ELF source location method is again not critically dependent upon the exact form of the source spectrum which is employed, because that spectrum is entirely cancelled out when ratios of electric to magnetic field are evaluated, and it is partially cancelled out when ratios of power at adjacent resonant peaks in either the electric or magnetic field spectrum are evaluated.

Details of the ELF source location method have been given in (6). Although two simultaneously active major thunderstorm regions can be located from the ELF spectra obtained at a single observation site, the information is ambiguous in that four possible azimuthal locations are given for each of two

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values of the angular source-receiver separation θ. Frequently several of these sources can be eliminated from such considerations as the unlikeliness of a major thunderstorm occurring over the North Atlantic in winter, but for unambiguous location of major thunderstorm centers on the surface of the earth two widely separated ELF receiving sites would be required. Only one such site, the one near Kingston, R. I. at 71°43'53"W, 41°37'18"N is currently in continuous operation. It is nevertheless of interest to compare results obtained by the analysis of data from this fieldsite with results obtained from other methods for the location of atmospherics, in particular the VLF system of Heydt and Volland (13,14).

Such results are summarized in Table I which is based upon 30 randomly selected samples of 34-minute ELF spectra taken between 14 December 1970 and 17 April 1971. The availability of processed VLF data (15) determined the selection of this period.

The thirty data samples (identified by the "sample number" in column 2 of Table I) gave sixty angular loci (θ) with each locus (line of constant θ) having on it four possible sources at azimuth angles given by analysis of the ELF spectra. Most of the Heydt-Volland data available to us (14,15) were obtained at the Berlin receiving station and do not include registrations due to Far East sources. Only very limited VLF data taken at the Waldorf station near Washington, D.C. or at the Toyokawa station in Japan were listed for the selected time period. Twenty-nine of the sixty θ locations had to be excluded therefore from further consideration, because no VLF data were available for comparison. The remaining 31 angles are listed in Table I; three pairs among these angles - 2,3; 26,27 and 28,29 - each correspond to a single sample of ELF data (sample numbers 2, 28 and 29). The 31 angular locations were then examined to determine whether one or more of the four possible sources at each θ coincided with a major source appearing in the VLF data for the same - or nearly the same - time period. Twenty-two among the thirty-one samples did give such coincidence. The location of the sources thus identified by ELF and VLF data is given in the last two columns of Table I. No entry in the column "VLF Station" means that the VLF data were taken at Berlin-Waidmannslust (15); T indicates the Toyokawa station and "W" identifies Waldorf.

Among the 22 angles determined from the ELF spectra which locate sources also located by the VLF data, twelve are based upon ELF data taken exactly at the same time as the VLF data, while ten, or 45.5 percent of the data, were

taken one hour before or after the VLF reception. Among the nine angles which do not locate sources confirmed by VLF, six or 66.7 percent of the data were taken one hour before or after the VLF recordings.

Probably more must be known about what effects can produce false locations of atmospherics in the VLF and in ELF methods before the data summarized in Table I can be evaluated further. For example, some type of lightning sources may produce more energy at ELF than at VLF frequencies or vice versa, or excite the earth-ionosphere cavity more efficiently in one or the other frequency band. Nevertheless the 71 percent agreement (22 among 31 sources) between the results of the ELF and VLF location procedures which is apparent from Table I can be considered encouraging.

As indicated above, data from a single ELF receiving station give ambiguous results in the sense that only one of four possible azimuthal locations corresponding to each value of the polar angle θ is likely to be real. Data from a single station are nevertheless useful for two applications other than precise source location; these are determination of total world-wide thunderstorm activity and determination of the conductivity profile of the Mesosphere (11). In both applications only the angle θ, which is obtained exactly from the ELF spectra, must be known to correct for the effects of source-receiver separation; the azimuthal location of the source, which would require a second receiver, is not needed. At the present time data are therefore processed to obtain information about diurnal and seasonal variations of world-wide thunderstorm activity and about variations in the electrical conductivity profile below one hundred kilometers.

TABLE I

COMPARISON OF ATMOSPHERICS LOCATION BY ELF AND VLF

ANGLE NUMBER	DATA SAMPLE NUMBER	ANGLE θ FROM KINGSTON, DEGREES	DATE, U. T.			VLF STATION	LOCATION (DEGREES)	
			DAY	SAMPLE TIME				
				ELF	VLF		LAT.	LONG
1	1	152	14 Dec. '70	2100	2100	T	16S	108E
2	2	77	15 Dec. '70	1500	1500			
3	2	134	15 Dec. '70	1500	1500	T	0	90E
4*	3	74	15 Dec. '70	2100	2100	T	40N	175W
5	4	74	7 Jan. '71	1700	1800		11S	18W
6	5	74	7 Jan. '71	2100	2100		10S	17W
7	6	92	8 Jan. '71	0500	0600		18S	3W
8	7	38	8 Jan. '71	1500	1500	W	9N	90W
9	8	68	8 Jan. '71	2100	2100	W	8S	22W
10	9	92	27 Jan. '71	1900	1800		45S	95W
11	10	47	15 Feb. '71	1800	1800		3N	40W
12	11	41	15 Feb. '71	2100	2100		3N	80W
13	12	89	16 Feb. '71	0300	0300		23S	7W
14	13	83	10 Mar. '71	0600	0600	W	34S	110W
15*	14	101	17 Apr. '71	0100	0000		22S	1W
16	16	77	26 May '71	1700	1800		8S	10W
17	17	56	26 May '71	2100	2100		4N	24W
18	18	80	27 Dec. '70	1700	1800			
19	19	89	27 Dec. '70	2300	0000			
20	20	89	28 Dec. '70	0100	0000			
21	21	89	28 Dec. '70	0300	0300		37N	60E
22	22	89	10 Mar. '71	0000	0000	W		
23	23	89	10 Mar. '71	0200	0300	W		
24	26	83	16 Feb. '71	0500	0600		18S	10W
25	27	92	16 Feb. '71	0900	0900			
26	28	44	25 Mar. '71	1700	1800		22N	70E
27	28	98	25 Mar. '71	1700	1800		11N	32W
28	29	44	25 Mar. '71	1900	1800			
29	29	80	25 Mar. '71	1900	1800		11S	9W
30	30	92	16 Apr. '71	1900	1800			
31	30	137	16 Apr. '71	1900	1800		1S	94E

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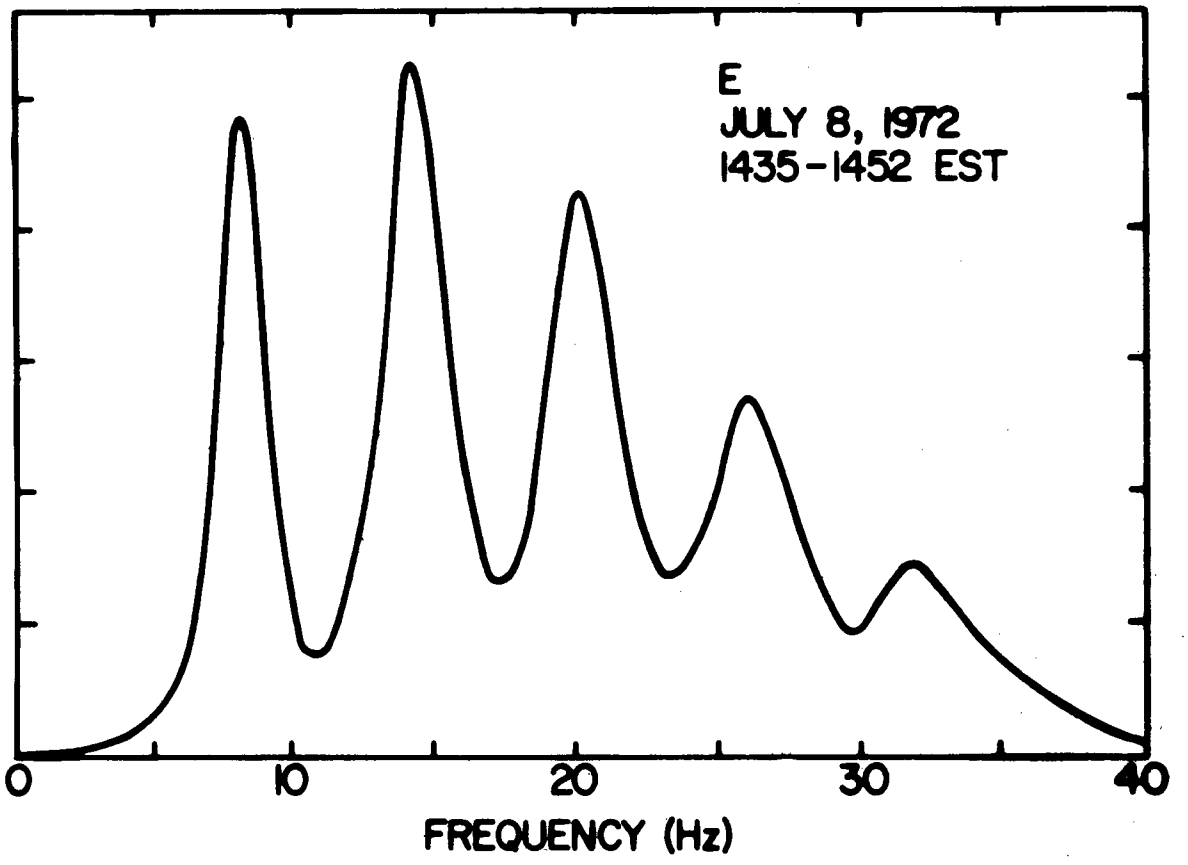

FIG. 1: EXPERIMENTAL VERTICAL ELECTRIC FIELD SPECTRUM

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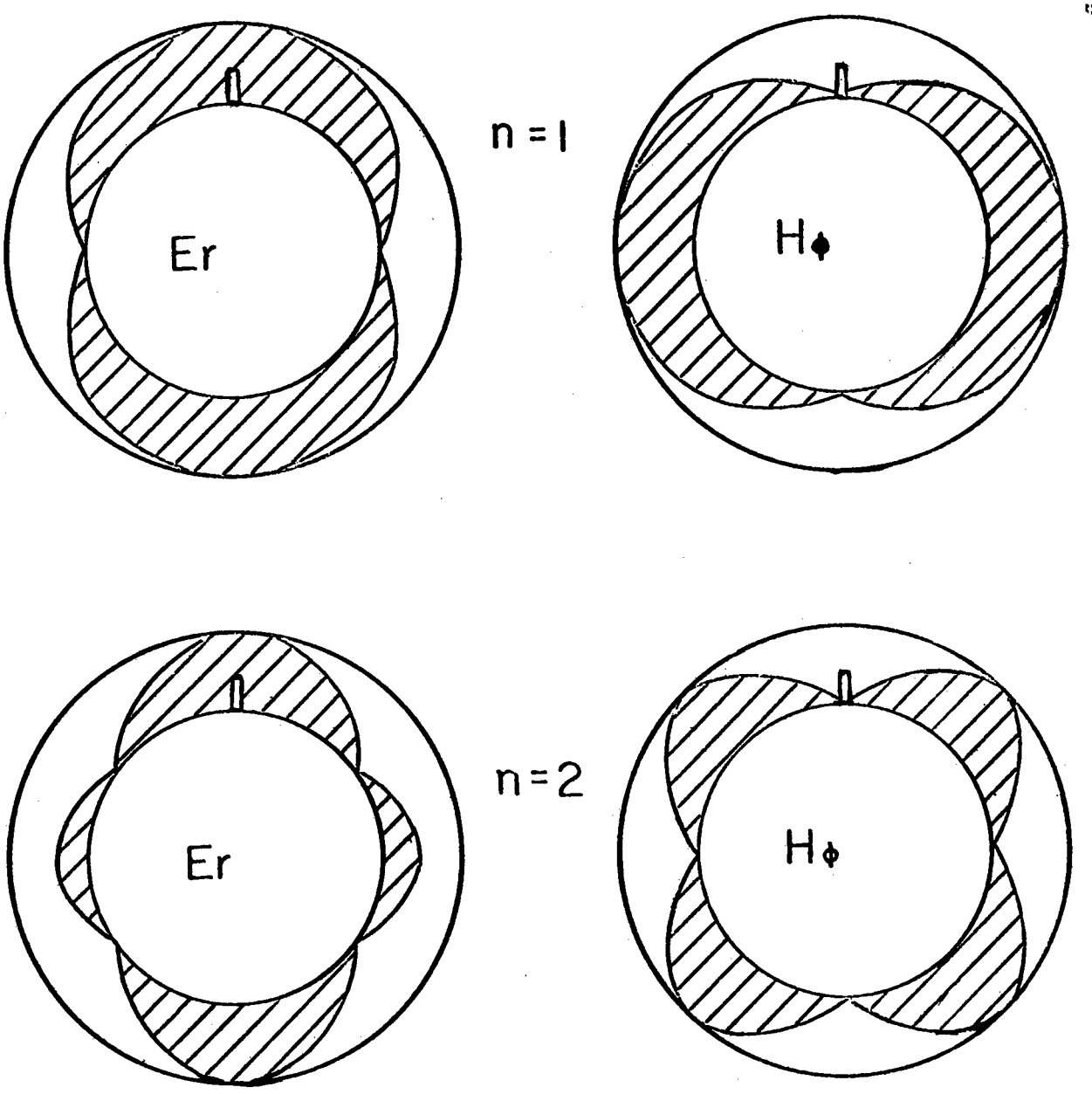

FIG. 2: AMPLITUDE DISTRIBUTIONS FOR FIRST AND SECOND "MODES" (SINGLE SOURCE).

Accuracies of ELF Source Location Using Direction of Arrival in Conjunction with Time Difference Techniques

by

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A b s t r a c t:

A method for determining the approximate location of ELF atmospheric sources was developed using the direction of arrival for the VLF component observed at Lafayette, Colorado, and the time difference of arrival for the VLF components between Lafayette, Colorado and Tottori, Japan. Errors of ± 5 degree in direction of arrival and of ± 3 msec in time of arrival resulted in source location errors of up to ± 1000 km over the Pacific Ocean area. It should not be difficult to reduce measurement errors to attain indicated source locations within 400 km of actual lightning strokes at ranges extending to half way around the world.

Real time location of atmospherics by single station techniques and preliminary results

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Abstract

A real time locator by single station was developed by the use of the dispersion characteristics of VLF and ELF propagation. A remarkable merit of this apparatus is the real time locations of atmospherics, separating ground discharges from cloud discharges. Brief description of the apparatus and preliminary results are mentioned, although it is natural that further studies for improvements are strongly required.

1. Introduction

To date, the cross-bearing method from two or three stations has been used to locate the source of atmospherics. The largest scale network is the U.K. sferics network with three stations in the Mediteranean Sea.(refer to the paper by Chapman et al appeared in Radio Science vol.1 No.11 p.1273 1966) At the present time, this corss-bearing method is standard for fixing sferics in spite of the existing bearing errors. Since more than two stations are necessary for this method , an alternate technique for source location by a single station has been sought for many years. It is obvious that a technique of locating the source by a single station would makedly improve the research of atmospherics. However another important requirement for this technique exists for Japanese atmospherics scientists. The geographic orientation of Japan is the SW-NE direction and since the majority of atmospherics received in Japan normally originate in South East Asia, it is impossible to fix the source location by triangulation techniques. What is needed is a single station technique based on the results of direction finding and traversing distance estimation. A possible way to get the information of the propagation distance is to utilize the phase-frequency spectrum which was suggested by one of the authors.(1) However, this is not realistic because of the tedious computation for large number of atmospherics.

An alternate and promising way is to make use of the dispersion characteristics caused by the wave guide propagation of VLF and ELF waves. Frisius et al(2) completed an apparatus which is capable of locating the origin by the use of differences of phase velocities at three frequencies between 4 KHz and 11 KHz (say 5,7 and 9 KHz). In Fig.1(3) is shown the phase velocity against frequency below 10 KHz, and it is seen that the most promising way of source location is to employ the difference of phase velocities between VLF component and ELF component. Because the group velocity at ELF is much less than that at VLF, the difference in their arrival times is related to the source diatance. Another advantage in using the ELF component of the atmospheric (slow tail) is due to only a single zero-order mode excitation. This paper presents a brief description of the apparatus which shows the origin of each received atmospheric on the screen of the C.R.O. as a bright spot in real time. Naturally, a transparent map of Asia is mounted on the surface of the cathoderay tube.

2. Principle of the function

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Normally, the VLF component of an atmospheric is followed by a very slow variation called a "slow tail". Originally, Waston Watt et al(1937)(4) observed the time delay between the "slow tail" and the VLF components. Hepburn and Pierce(5) presented the experimental formulae showing the separation between the onset of VLF component and the first maximum of slow tail as a function of the traversing distance. A theoretical expression was introduced by Wait(6) which relates the spuare root of the separation time τ (s) and the source distance D (Km).

$$\tau^{\frac{1}{2}} = 0.3 \left[\frac{D}{2h\sqrt{\omega_r}} + \delta^{\frac{1}{2}} \right]$$

h (km) and ω_r (s^{-1}) denote the height of the ionosphere, and the conductivity parameter of the ionosphere respectively. δ (s) is an approximately constant term corresponding to the pulse width at the source impulse. Since this expression was verified by Wait using Hepburn's data, the necessary function of the apparatus is to display the result of analogous computation of the above expression. The measuring apparatus must somehow copmensate for the changes in the value of $h\sqrt{\omega_r}$ with time of day. However, this is difficult because of the hourly, seasonal and local changes in the value of $h\sqrt{\omega_r}$. Thus, further study and successive improvements must be made in order to be able to estimate exactly the traversing distance of atmospherics.

3. Brief description of the apparatus function

The occurrence rate of the ground discharge per second is approximately 10 or 100 over the globe. Hence, it may be assumed that at least one third of ten ground discharges per second would occur in Asia which is one of the three active regions in the world. The apparatus can compute the traversing distance of each atmospheric and show the source location at the maximum rate of several atmospherics per second. Here, only noteworthy circuits peculiar

to the apparatus are described, and in Fig. 2 the block diagram of the apparatus is shown.

Conventional crossed loop aerial tuned at a frequency of 10 KHz and a vertical rod aerial for unidirectional direction finding are employed.

Distance estimating circuit ——The input atmospheric waveform is divided into the VLF component and the slow tail, and the VLF component is converted into a rectangular waveform at a definite level so that it makes up a starting pulse. The starting pulse acts as a switch which begins every computation for the incoming waveform and at the same time maintains the apparatus to reject the subsequent arriving atmospherics. As to the slow tail, it is likewise amplified to a square wave and differentiated so that the leading edge and the trailing edge of the first half cycle of it are produced. The time difference between the onset of the VLF component and the first maximum of the slow tail which is related to the distance can be approximated by the mean value of the following two time differences. One is the difference between the starting pulse and leading edge of the slow tail and the other is the time difference between the starting pulse and the trailing edge of the slow tail. The mean value of the two time differences can be transformed into a voltage. In this case, it is necessary to compensate with an appropriate voltage corresponding to the time lag of the slow tail waveform introduced by the low pass filter. In order to obtain the quantity corresponding to the square root of the above mentioned voltage, ten linear connected segments representing the square root are employed. Furthermore, a constant voltage corresponding to the zero distance must be subtracted to obtain the voltage corresponding to the traversing distance. Because some of the slow tail waveforms start with positive polarity, while other start with negative polarity, it should be noted that this equipment can be adjusted such that only the positive or negative polarity "slow tail" can be received. This allows the types of lightning discharges occurring at a given location to be investigated.

Direction finding circuit ——— In order to make up the secondary directional signals for computation in place of the input signals, respective pulses corresponding to N-S and E-W circuits are produced from the tuned responses of the main amplifiers at 10 KHz. These pulses are integrated against time so that the square root of the sum of those squared values reach a normalised level. They are clamped respectively. To display a bright spot showing the position of the source on the screen of the CRO, two voltages corresponding to N-S and E-W components are multiplied by an amount corresponding to the separation between the onset of VLF and the first maximum of slow tail. In this case, a bright spot appears for 1 ms by the intensity modulation circuit

controlled by a pulse which originates when both calculations for the distance and direction are completed. The map mounted on CRO is drawn in linear scale of both direction and distance from the observing station.

Auxiliary circuits ———There are some cases in which the amplitudes of slow tails are much smaller than those of VLF components, and no computation can be made in those cases. Every operation and computation is reset for those cases including others, for instance, too small amplitude of VLF component, or slow tail with opposite polarity, or very distant origin. For the calibration of the distance, a circuit for generating the artificial atmospheric waveform with slow tail corresponding to each 1000 Km propagation up to 5000 Km is included, and is used before measurements to adjust the distance estimation for daytime or nighttime conditions.

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4. Preliminary measurements

An important matter is how to investigate the accuracy of the equiment. To compare the locations of atmospherics obtained by the equipment with the weather maps published by the Japan Meteorological Agency would be an approach to the above investigation. But the weather maps do not include distant regions. Thus, it is required that rather long term observation be made of the locations of sources and compared with the existing knowledge of atmospherics.

It is worth while to note that the apparatus receives only the slow tail with identical (positive or negative) polarity so that the atmospherics originated from the ground discharges can be separated from those by inter cloud discharges. Accordingly, how the ratio of ground discharges to inter cloud discharges changes with the latitute would be clarified, and the difference between the nature of thunderstorms on land and that on the sea could be studied by the use of the apparatus. Naturally, the genesis of atmospherics accompanied by the cold frontal line or the storm center would be investigated in the course of the observations.

However, the most active local thundestorms occur during the transitional period from daytime to nighttime. Since wave propagation parameters are rapidly changing during this period, source distance estimates become less reliable. But this does not seem to be a serious matter at the present time.

Photo 1 shows samples of the results obtained on 15 May 1972.

Here, plus sign means the location in the case of positive slow tail, and it can be seen that a lot of sources distribute along the cold frontal line situated near Japan. However, difficulty may be the constancy of the value of δ corresponding to the pulse width of the origin. If this is the case, δ would give some influence on the estimation of the traversing distance.

In the observation made 1 to 7 August, the following fact was recognized. Although not much data were obtained it is likely that ground discharges occurred scarcely on the sea in the daytime on the first inspection of a few couples of distribution maps (day and night).

Acknowledgement The work described in this paper, particularly the construction of the apparatus and its preliminary measurements, were greatly sponsored by the TORAY Science Foundation. The authors wish to acknowledge its financial support.

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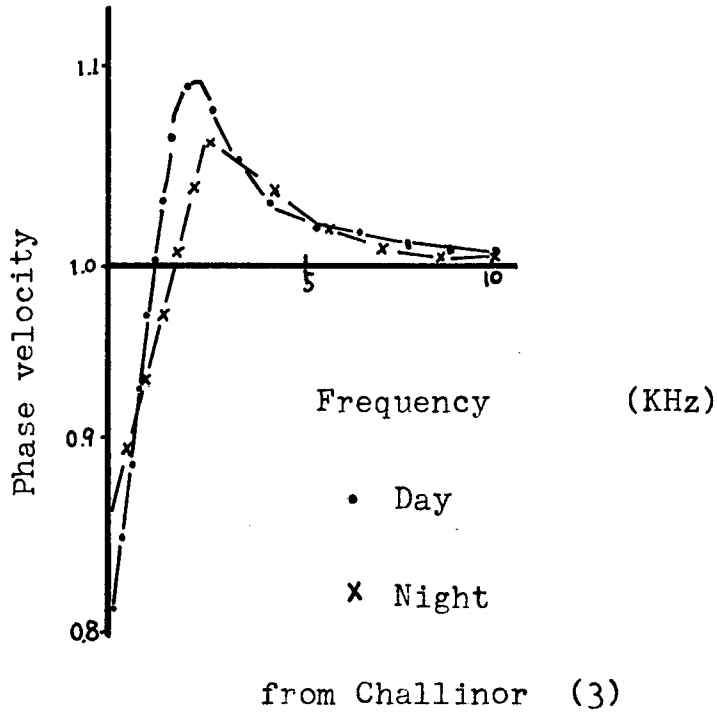

Fig. 1 Observational results of the phase velocity below VLF against frequency

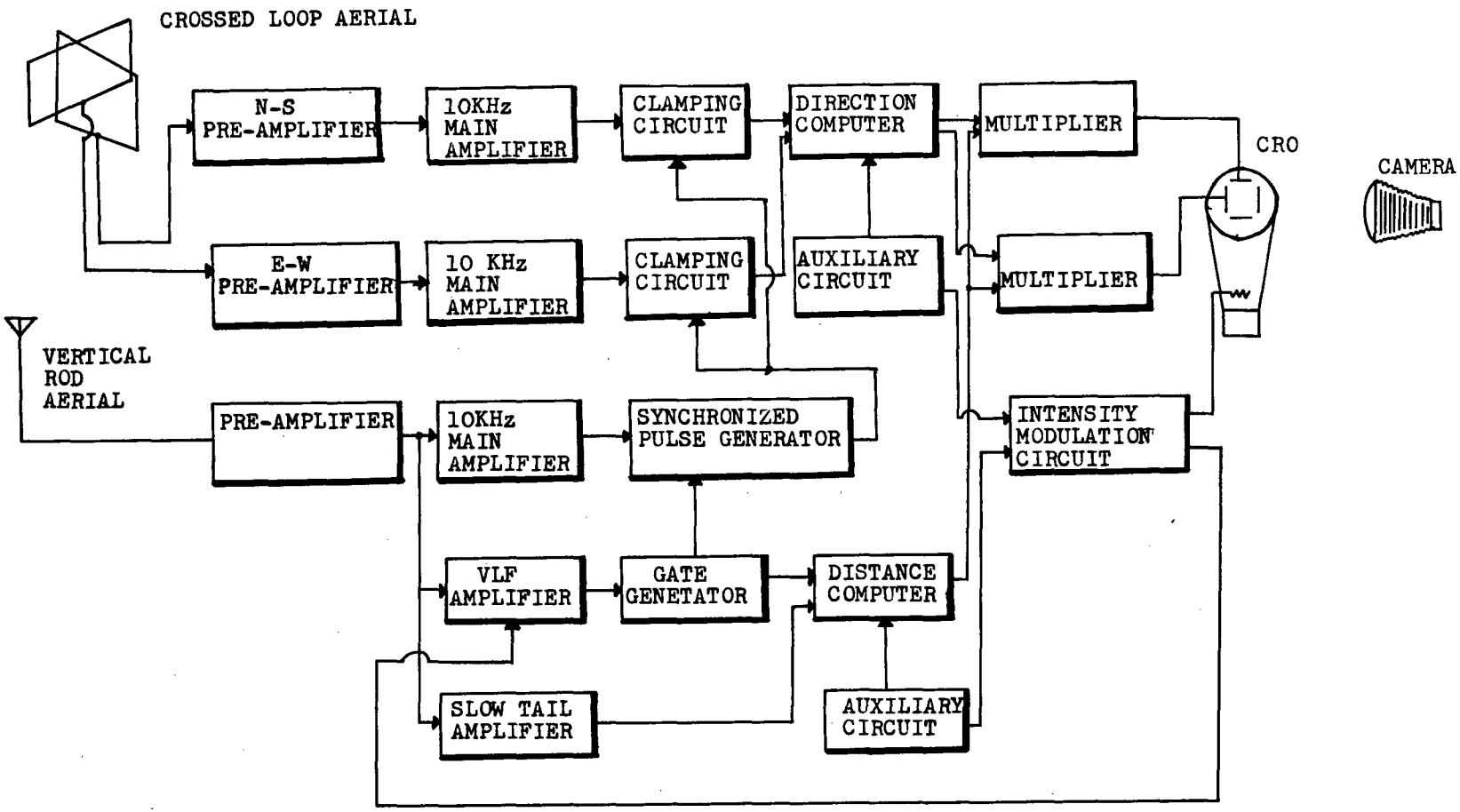

Fig. 2 Block diagram of the apparatus for locating atmospherics in real time.

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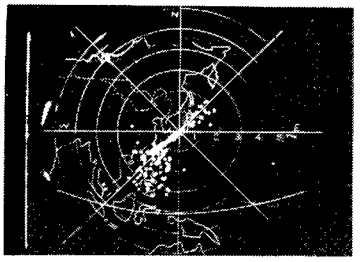

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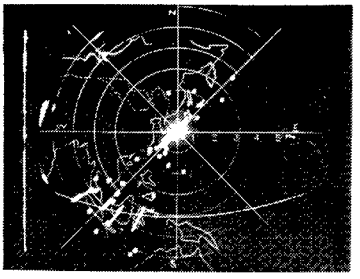

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Photo 1

Samples of locations of atmospherics in
Far East on 15 May 1972

V

General Results Obtained with Various Systems

Tuesday, 12 September 1972 1500 - 1800 EDT, Arlington, Virginia

"Severe Storm Observations from the Vela 4B Satellite"	R. Chiburis R. Jones
"Radio Astronomy Explorer (RAE) I Observations of Terrestrial Radio Noise"	John H. Herman Joseph A. Caruso Robert G. Stone
"Airborne Sferics Measurements"	R. Markson and B. Vonnegut
"A Model of World-Wide Sferic Activity"	E.M. Connelly J. J. Kühns D. G. Loental A. R. Schuler
"Cathode-Ray Direction Finding (CRDF) Lightning Location in Sweden"	R. C. Murty

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SLA-73-7039

Severe Storm Observations from the Vela 4B Satellite*

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Increased interest in severe storm location and early warning provides impetus for the development of satellite monitoring techniques to supplement ground-based monitoring methods. VHF, differential-group-time delay measurements made by the Vela 4B satellite indicate greatly increased EMR atmospheric activity during severe storm conditions. Although present resolution capabilities identify thundery regions rather than individual storms, improvement can be obtained with further technique and satellite concept development.

Introduction

Earth-orbiting satellites provide an ideal platform for the observation of global thunderstorms. One satellite can monitor a hemisphere; presumably, only two satellites are needed for global coverage. Several studies concerned with the possibility of locating global thunderstorms by the use of satellite observations of atmospherics have been made (Dennis, 1964; Horner, 1965; Kirkwood, 1965; Massa and Coroniti, 1969). Evidence

*This work was supported by the United States Atomic Energy Commission.

indicating the feasibility of such a scheme was obtained from VLF measurements made by the Lofti I satellite and HF measurements made by the Alouette satellite. However, the first HF atmospherics observed regularly in satellites are those reported by Horner and Bent (1969) from Ariel III.

The most attractive method of observing global thunderstorms from a satellite is to monitor VHF or UHF atmospherics (Pierce, 1969). Although signals at these frequencies are only slightly absorbed during transionospheric propagation, their signal waveforms are distorted, sometimes markedly, by ionospheric dispersion. This apparent disadvantage can be exploited to detect and locate atmospheric disturbances. The ratio of lightning signal to unwanted noise in these frequency bands, however, is relatively low and decreases as the frequency increases. In spite of this limitation, these regions of the radiofrequency spectrum have been suggested for satellite utilization (Hallgren and MacDonald, 1963; Dennis, 1964; Kirkwood, 1965; Jean, 1970).

The present paper is concerned with VHF differential-group-time delay data acquired by the Vela 4B satellite during passes over the geographical region bounded by 10 to 35 degrees north latitude and 55 to 135 degrees west longitude. Processed data cover the six-month period from June through November 1968. Correlations with ground level observations of severe storms catalogued by the National Weather Service, National Severe Storms Forecast Center, Kansas City, Missouri, are established. Incentive for analysis of Vela 4B monitoring capabilities and applicability to severe storm identification and location was provided by the current interest in detecting severe storm activity, in particular, tornado-producing severe storms. Enhanced radio emission from these severe storms has been reported (Brook, 1967; Stanford, Lind, and Tarkle, 1970; Shanmugan, 1971). In the material which follows, the VHF radio environment of the Vela 4B satellite is described and criteria are established for the discrimination of these enhanced radio emissions from other known sources. In addition, a scheme is presented for the identification of thundery regions. The instrumentation is described in Appendix A.

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Discrimination Criteria

Satellites designed for the investigation of global thunderstorm activity by HF, VHF, or UHF radio techniques are subjected to interference from a variety of natural and man-made noise sources. These noise sources can be divided conveniently into two categories: those external to our solar system and those internal to our solar system. The principal source of external radiation is the background galactic continuum, and the principal sources of internal radiation are the disturbed sun, man-made transmitters, and lightning discharges.

Estimates of the noise field strengths which would be expected in a bandwidth of 1 MHz at an altitude of 100,000 km for natural noise sources are given in Figure 1. Noise emissions from the sun and background radiation attributable to the galaxy are broadband, and indicated intensities (Mills, 1963; Kraus, 1966) are scaled as the square root of bandwidth. Figure 1 shows that only the 30 to 100 MHz region of the VHF spectrum is suitable for monitoring emissions from lightning discharges. Moreover, signal intensities must be greater than 20 μV/m in order to discriminate lightning from other noise sources.

At satellite altitudes, electric field strength values for radio emissions from lightning discharges scale with distance as R^{-1}. The manner in which lightning signals scale with bandwidth is not as certain. If a quasi-continuous source is assumed and narrow-band equipment is used for the observation, field strength should scale as the square root of bandwidth. On the other hand, if a coherent source of the lightning emission is assumed and broadband equipment is used for the observation, field intensities should scale directly with bandwidth (Oetzel and Pierce, 1969). Two lightning field strength curves are shown in Figure 1, one scaled as the square root of bandwidth, the other scaled directly with bandwidth. Dispersive effects of the ionosphere have been neglected.*

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*Ionospheric effects are addressed at some length in the discussion of the data.

Potential interference from man-made sources can be significant (Brown, 1962; Herman, 1970). However, by judicious choice of surveillance frequencies and instrumentation design, the effects of man-made noise can be minimized. Obviously, frequency bands assigned to TV and FM stations should be avoided. Radar interference is easily recognized because of the characteristic emissions from radar equipment.

Differential-group-time delay measurements and coincidence techniques used in the Vela 4B instrumentation provide a practical means of discrimination against unwanted signals. Basically, these techniques utilize the dispersive effects inherent in transionospheric propagation. Broadband electromagnetic signals originating near the earth's surface are dispersed. Higher-frequency components of the signal arrive earlier than do those of lower frequency which experience a longer group path delay. The delay is calculable if the electron density along the propagation path is known. Comparison of various component group delays allows incoherent or nondispersed signals to be recognized and rejected because they do not satisfy the proper delay requirements.

On the basis of solar radio emission data compiled by the National Oceanic and Atmospheric Administration (NOAA) and the Air Force Cambridge Research Laboratories (AFCRL), and published in Solar Geophysical Data and Geophysics and Space Data Bulletin, respectively, it is possible to confirm Vela 4B observations of signals having their origins in solar disturbances. Information on man-made transmissions can be obtained from other sources, e.g., the International Radio Consultative Committee. In other words, on the basis of equipment design, a comprehensive background radio source data bank, and considerable experience in satellite data processing, radio emissions from electrical storms (particularly severe storms) can be identified and estimates of electrical activity obtained.

If an impulsive (broadband) signal from a coherent source exceeds the discriminator thresholds of the satellite electronics, it is possible to make a differential-group-time delay measurements. (As described in Appendix A, time intervals between pulses observed on three channels, A, B, and

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C, are measured.) The differential group time delay can be approximated by the relation

$$\Delta t = 1.35 \times 10^{-7} \frac{f_2^2 - f_1^2}{f_1^2 f_2^2} \sec \phi \int N ds \text{ (MKS)}$$

where f_2 and f_1 are the center frequencies of the higher and lower channels respectively, ϕ is the look angle (the complement of the elevation angle), and $\int N ds$ is the total electron content (TEC) of the ionosphere. Magneto-ionic effects were neglected, and a stratified ionosphere over a plane earth was assumed in the derivation of this formula. The variation of the two differential-group-time delays as a function of the TEC and look angle is shown in Figures 2 and 3, respectively. The two group delays increase with increased TEC and/or look angle. The criterion used to separate broadband signals propagating from the earth's surface to the satellite from other sources is that the ratio of the two group delays, i.e., the ratio of the differential-group-time delay between Channels A and B and Channels C and B, has a value between 1 and 2. The look angle of a broadband source to satellite propagation path can be obtained if the electron density along the propagation path is known. Possible source locations with respect to the subsatellite position can then be predicted.

Presentation of Data

The processed data presented here consist of the two values of differential-group-time delay, universal time, and subsatellite local time of their occurrence (hr, min, sec), and the subsatellite position in geographic latitude and longitude. Modified severe storm data from the National Weather Service provide storm type, universal and local time of storm occurrence (hr, min), and geographic latitude and longitude of storm observation. Table I shows the variation of satellite-observed atmospheric activity rates during severe conditions as a function of the time of day

(daytime hours range between 0900 to 1630 local time of severe storm) and the look angle of the storm to the satellite.

Because of the limited capacity of the satellite memory for differential-group-time delay measurements and the normal, nonrealtime transmission of group delay data to earth tracking stations, exact correlation of some satellite observations and some severe storm reports is not possible; that is, during certain satellite passes, only limited numbers of satellite observations are obtained because of the long time interval between the collection and transmission processes. Atmospheric activity rates for severe conditions therefore are calculated from observations obtained up to 1-1/2 hours after the last reported severe storm during a particular satellite pass. This processing procedure results in atmospheric rates of lower value than activity rates calculated from satellite observations closely correlated with severe storm reports. In fact, activity rates as high as 1 per 2 sec (the maximum measurement rate) are sometimes observed during relatively well correlated time periods.

Average atmospheric activity rates during nonsevere conditions are 1 per 13 minutes during daytime hours and 1 per 11 minutes during nighttime hours. Comparison of satellite observations of severe and nonsevere conditions provides evidence of the distinct increase in electrical emission from severe storms and substantiates similar ground-level observations of severe local storm characteristics (Stanford et al., 1970).

To illustrate the severe storm location and resolution capabilities of the Vela 4B satellite, predicted ionospheric total electron contents were obtained* for the region bounded by 0 to 80 degrees north latitude and 0 to 160 degrees west longitude during the time period beginning at 1900 UT, August 17, 1968, and extending to 0300 UT, August 18, 1968. The position of the satellite and the location of severe storms during the hours of interest are shown in Figure 4. Eight principal locations of severe storms

*Supplied by Dr. R. B. Bent.

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and twelve reports of severe activity from these locations are indicated. Resolution of satellite observations to specific thundery regions is possible since only certain geographic areas contain atmospheric activity which, on propagation to the satellite, can produce satellite-measured differential-group-time delay values. With a code Price (1972), delay values which may be expected to be measured between two channels were calculated for possible atmospheric activity positioned at geographic regions around several subsatellite points. Isograms depicting areas or geographic zones containing atmospheric activity capable of producing specific satellite-measured differential-group-time delay values during several different points and times of the August 17 pass are presented in Figure 5. Actual satellite data are also noted. Resolution of satellite observations to specific thundery regions is evident. Figure-to-figure changes in similar valued isograms are due to the diurnal and geographical variation in the ionosphere.

The latitudinal variation of the ionosphere also produces a convenient "cutoff" mechanism for any thunderstorm activity occurring at the equator or in the southern hemisphere. Ideally, correct and more concise estimation of thundery areas requires continuously updated ionospheric total electron contents and heights of the peak ionospheric electron density data.

Conclusions

Differential-group-time delay measurements made by the Vela 4B satellite confirm ground-level observations that severe storms produce distinct and detectable EMR atmospheric activity. Increased atmospheric activity is also observed, in some instances up to approximately 1 hour prior to severe storm reports. Identification of thundery regions is apparently possible, provided continuously updated ionospheric total electron content and heights of peak electron density data are available.

Differences in apparent correlation between satellite and ground-level observed severe storm electromagnetic pulse rates are produced by the data-processing procedure, inherent instrumentation and satellite orbit limitations, and lightning source and transionospheric propagation effects. These differences can be resolved by taking into account the satellite monitoring capabilities. The Vela 4B data indicate that satellites utilizing differential-group-time delay measurements and coincidence techniques may provide the global monitoring system which is presently unattainable because of the geopolitical factors involved in multination cooperation. Information on relative degrees of atmospheric activity for ocean and land areas may be an especially interesting contribution to our present knowledge of atmospheric electricity. Furthermore, correlative analysis of satellite-observed solar radio events and atmospheric activity rates may result in the establishment of relationships between atmospheric activity and solar activity. Clearly, before such eventualities are possible, either ground-level or airborne spectral measurements with broadband VHF equipment are required to quantitatively identify the source of wide-band VHF fine structure emission with any of the well-known lightning processes.

Recommended improvements in instrumentation suggested by this study for severe storm-monitoring satellites for the continental United States include use of a geo-stationary satellite with directive sensors. The satellite should be equipped with beacons for running Faraday rotation or Doppler shift determinations of the total electron content. Severe storm location could be further improved if the Vela 4B differential-group-time delay equipment were placed on cloud-monitoring satellites so that thunderstorms containing severe activity could be positively identified. Finally, provision should be made for more elaborate coincidence schemes and more accurate measurements of the time delays between dispersed components. Significant insights into the distribution of continental thunderstorm activity in addition to a better capability to detect and locate thunderstorms could then be obtained.

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APPENDIX A

Instrumentation

The Vela 4B pair of satellites, launched in April 1967 into near-circular orbits with radius 19 R_E, inclination 35 degrees, and period 4.6 days, was designed to detect nuclear detonations. This is accomplished in part by sensing the radioflash emission associated with a nuclear explosion. The radio equipment (four receivers--three VHF and one UHF) provides surveillance of the radio noise environment of the satellite; observations of severe storm activity are incidental. The VHF frequency receivers have center frequencies of 27.70 (Channel A), 34.58 (Channel B), and 42.94 (Channel C) MHz. Additional circuitry is incorporated into the satellite payload to provide coarse measurements of the time intervals between the arrivals of the frequency components of a broadband signal having detectable energy in the passbands of the VHF receivers.

The antenna system feeding each VHF receiver consists of two monopoles located in the spacecraft equatorial plane (the plane perpendicular to the direction of earth orientation) at 60-degree angles to one another. Each monopole is only a fractional part of a wavelength at the frequencies of interest; all can be regarded as capacitive probes. Directly connected to each antenna is a passive RLC filter network which provides preliminary filtering of incoming signals. Adjacent antennas are connected to obtain phasing which tends to discriminate against one of the two characteristic ionospheric propagation modes (Lawrence, Little, and Chivers, 1964). The antennas complete one revolution in the equatorial plane of the satellite every 64 seconds, the spin stabilization period of the satellite.

Each pair of VHF antennas feeds one of three identical, synchronously tuned TRF (tuned radio frequency) receivers. The typical receiver has four RF stages, each with a gain of about 20 dB, followed by an envelope detector and a video output stage. Depending on the center frequency, the

receiver bandwidths vary from 1 to 2 MHz. Nominal receiver sensitivity is -95 dBm and the dynamic range is about 40 dB. Measurements on a prototype indicated a probable sensitivity of 30 microvolts/meter, which is consistent with the calculated free space estimate, where a -6 dB antenna gain, a 3 dB antenna coupling loss, and a -95 dBm receiver sensitivity are assumed. The video output signal from each receiver, if present, consists of a pulse of not more than a few microseconds nor less than several tenths of a microsecond duration. Those video pulses having amplitudes exceeding a preset threshold are standardized in amplitude and duration by a level discriminator, one of which is incorporated into each receiver.

Two different methods of processing pulses from the discriminators exist within the satellite. The first counts pulses from each discriminator for a nominal 1 second sampling period at a sweep rate of once every 4 seconds (a nominal 1 second sampling of UHF video pulses is also made). After the sampling period is over, the accumulated total of the number of pulses counted from the sampled channel is transmitted back to an earth tracking station, the counter is reset, and another receiver is monitored. If the total number of pulses counted exceeds $2^{15}-1$, or 32,767, a special data bit is sent, indicating that the counter has "spilled." Spills are encountered rarely and usually occur only during major solar disturbances.

The second method provides coarse measurements of differential-group-time delay by using a trigger signal from the highest VHF frequency receiver to open gate circuits which are subsequently closed by trigger signals from the lower-frequency receivers. The time intervals between trigger signals are recorded as the number of clock pulses from the 262 kHz spacecraft clock that pass through the gate circuits to a counter. This results in a measurement precision of about 4 μsec. The differential-group-time delays between pulses on Channels C and B and between pulses on Channels B and A are then stored in the satellite's memory. Thirty-two pairs of such measurements can be stored before transmission to an earth tracking station is necessary. Measurements can be made at a maximum rate of approximately 1 per 2 sec.

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TABLE I.

Occurrence Rate of Atmospheric Activity
(Minutes Between Observations)

Time of day*	Look Angle (deg)	Satellite Observations of Severe Storms
Nighttime	5 to 15	2.7
Daytime		No data
Nighttime	15 to 25	2.4
Daytime		3.7
Nighttime	25 to 35	2.7
Daytime		3.6
Nighttime	35	2.9
Daytime		No data

*Time of day divides the day into two periods; daytime hours range between 0900 to 1630 local time of severe storm.

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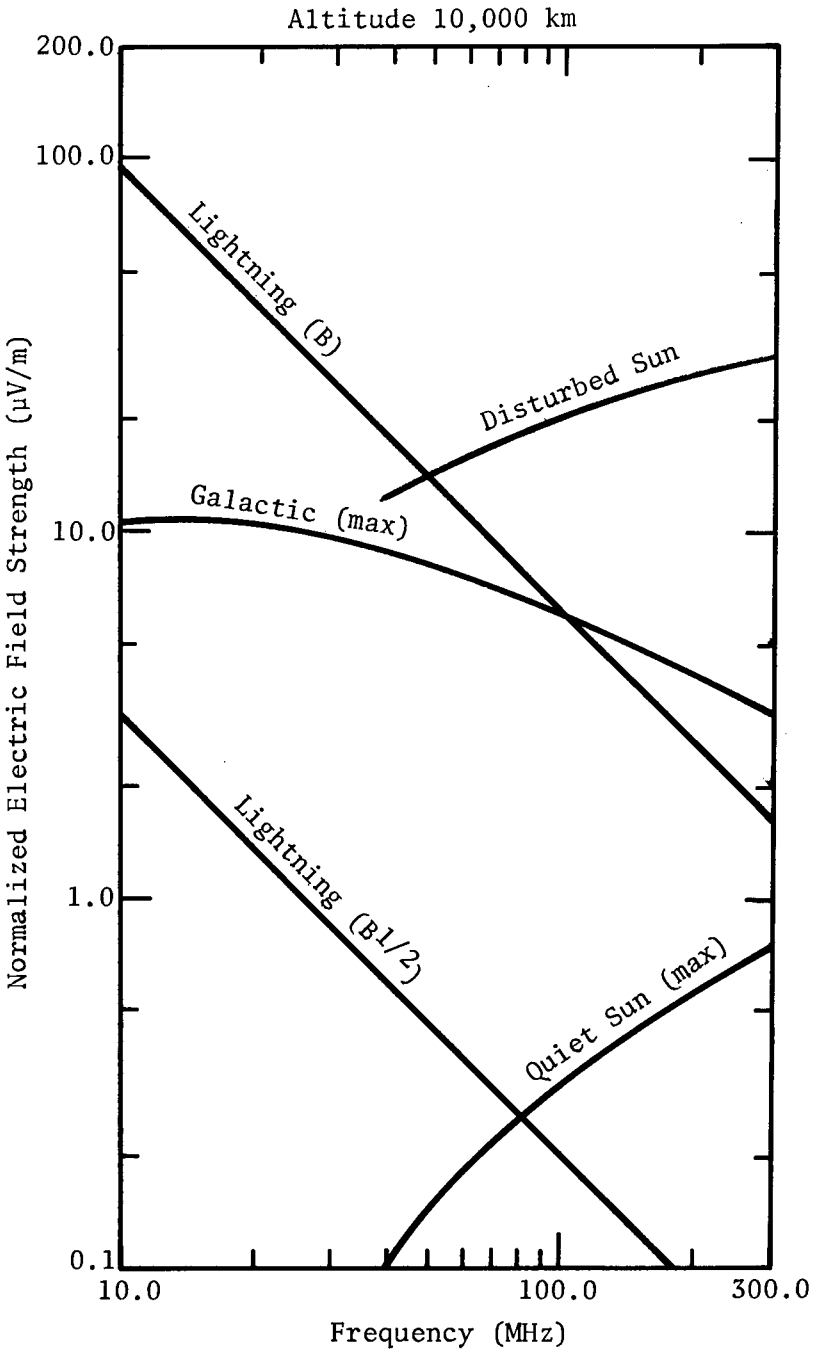

Figure 1. Variation of background noise intensity with frequency and altitude, electric field strength in microvolts/meter. Data have been normalized to 1 MHz bandwidth and the indicated ranges.

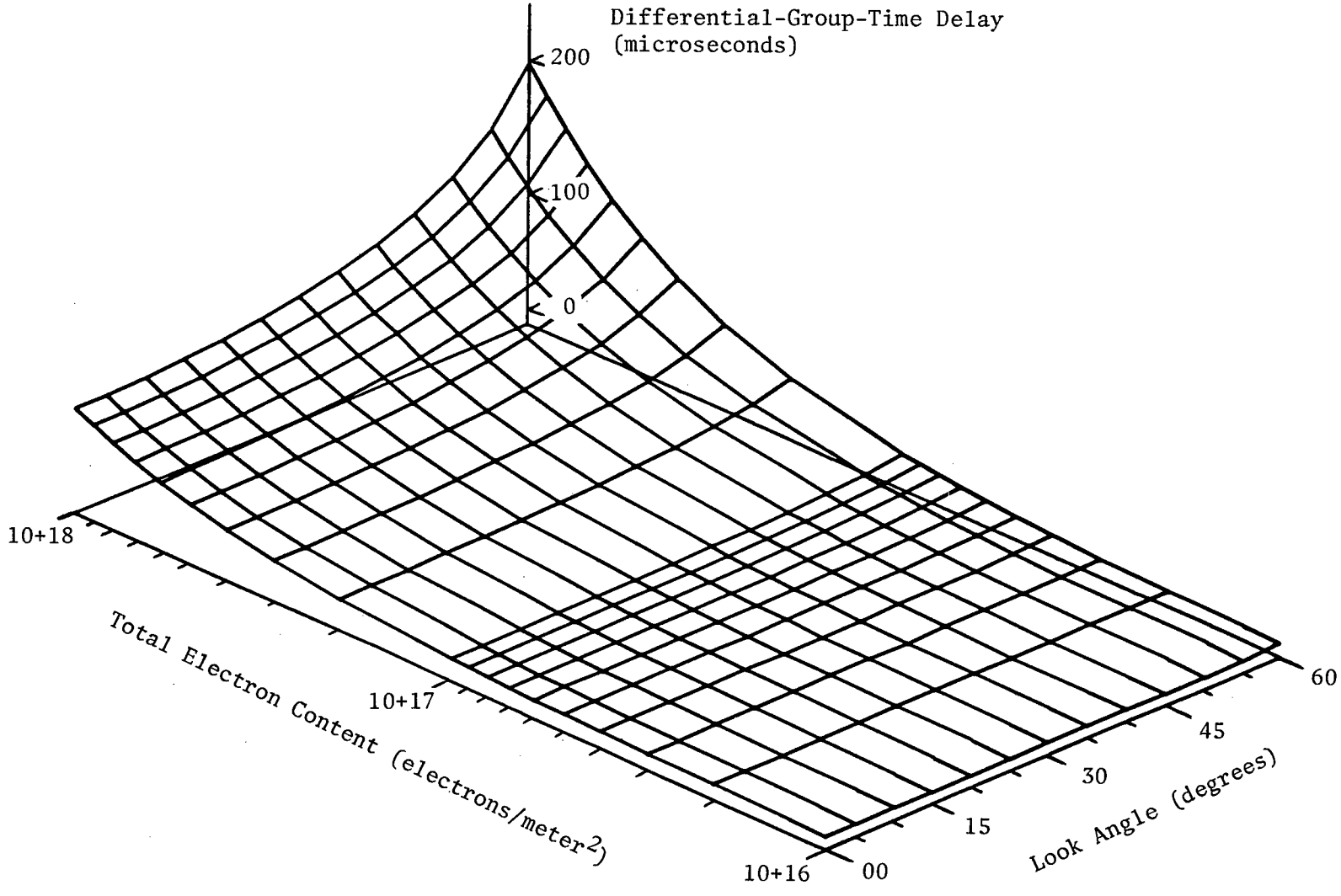

Figure 2. Differential-group-time delay between Channels A and B as a function of total electron content and look angle.

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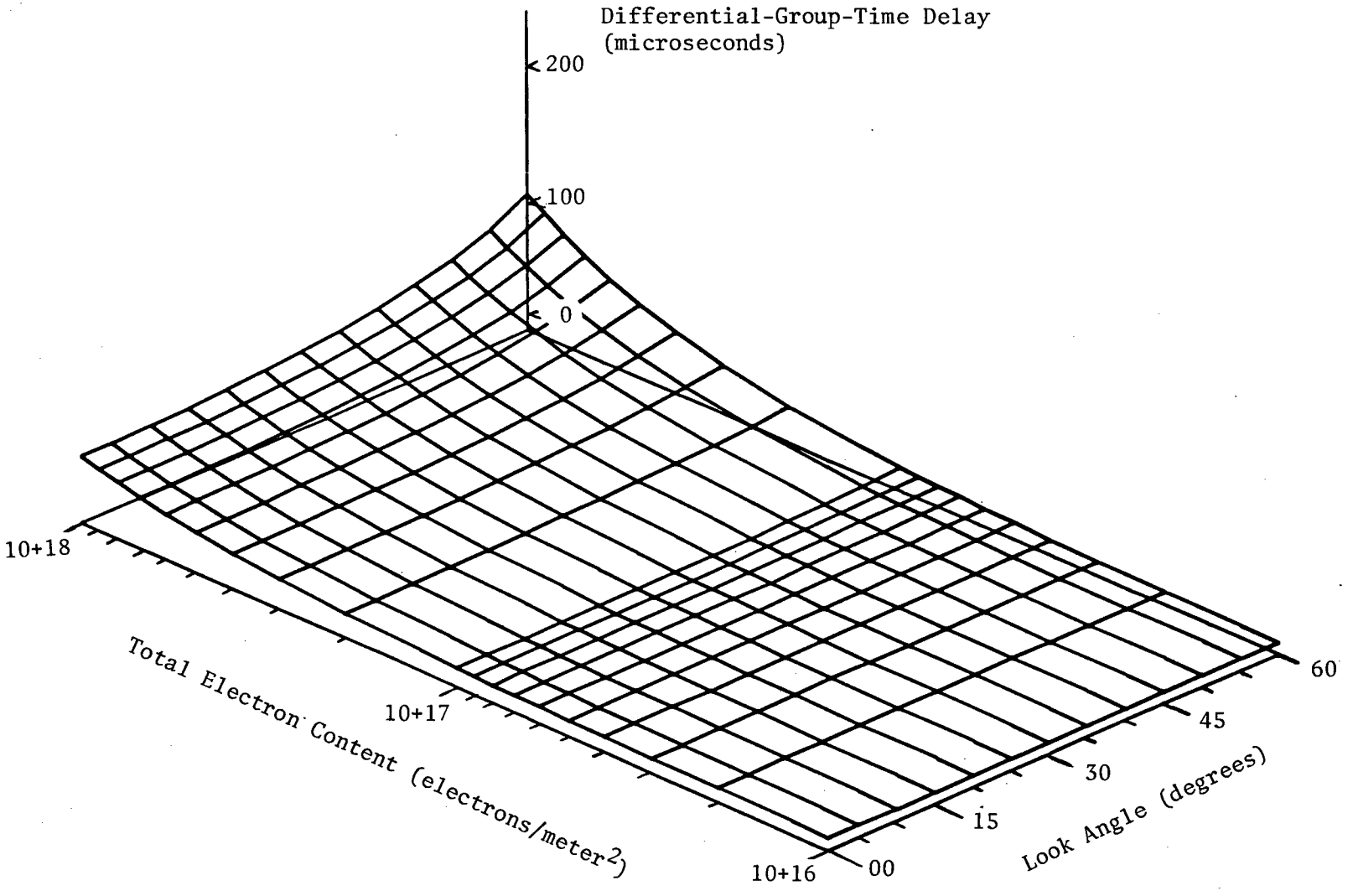

Figure 3. Differential-group-time delay between Channels B and C as a function of total electron content and look angle.

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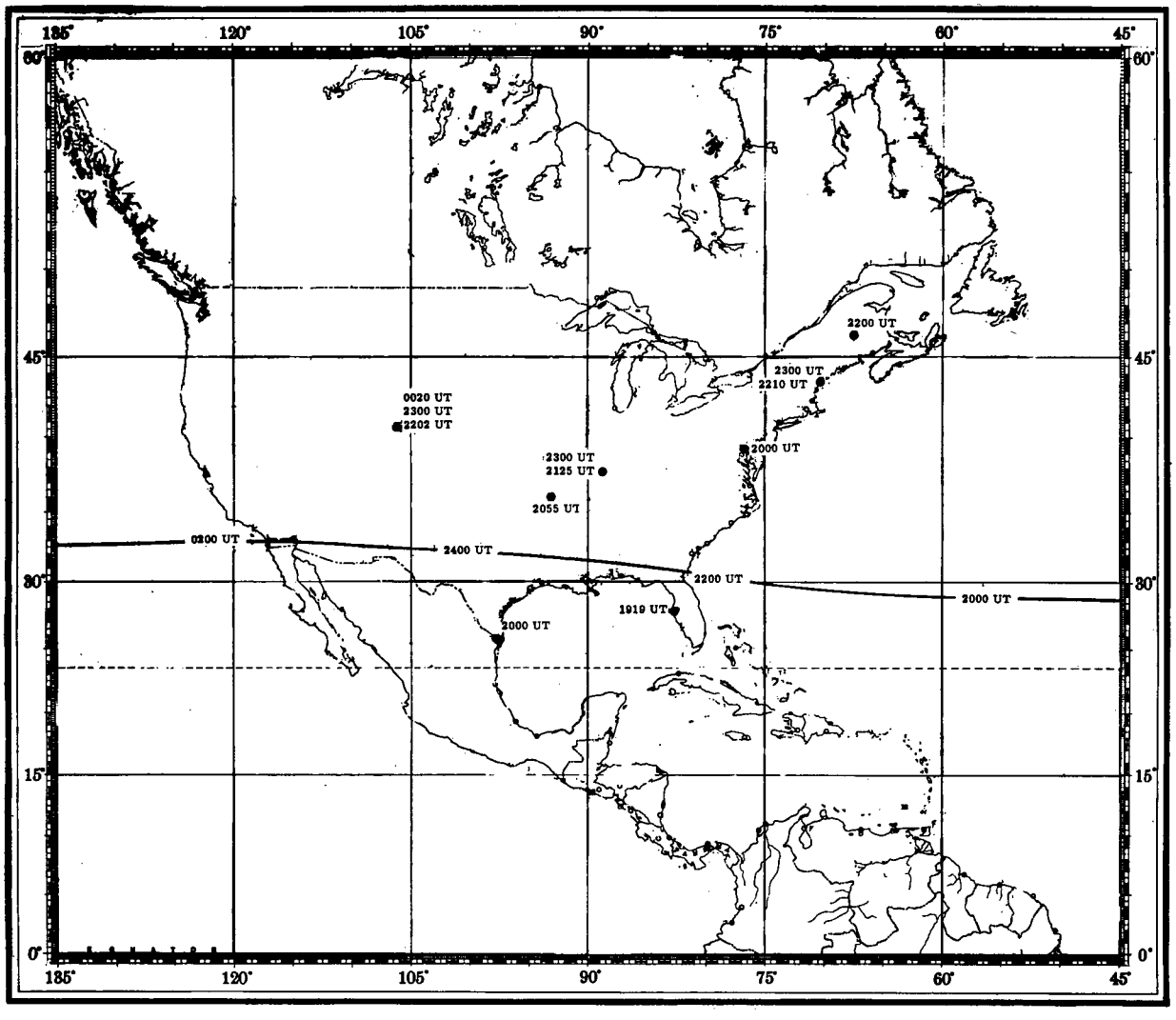

Figure 4. Vela 4B subsatellite positions and reported severe storm locations during the satellite pass beginning at 1900 UT, August 17, 1968, and extending to 0300 UT, August 18, 1968.

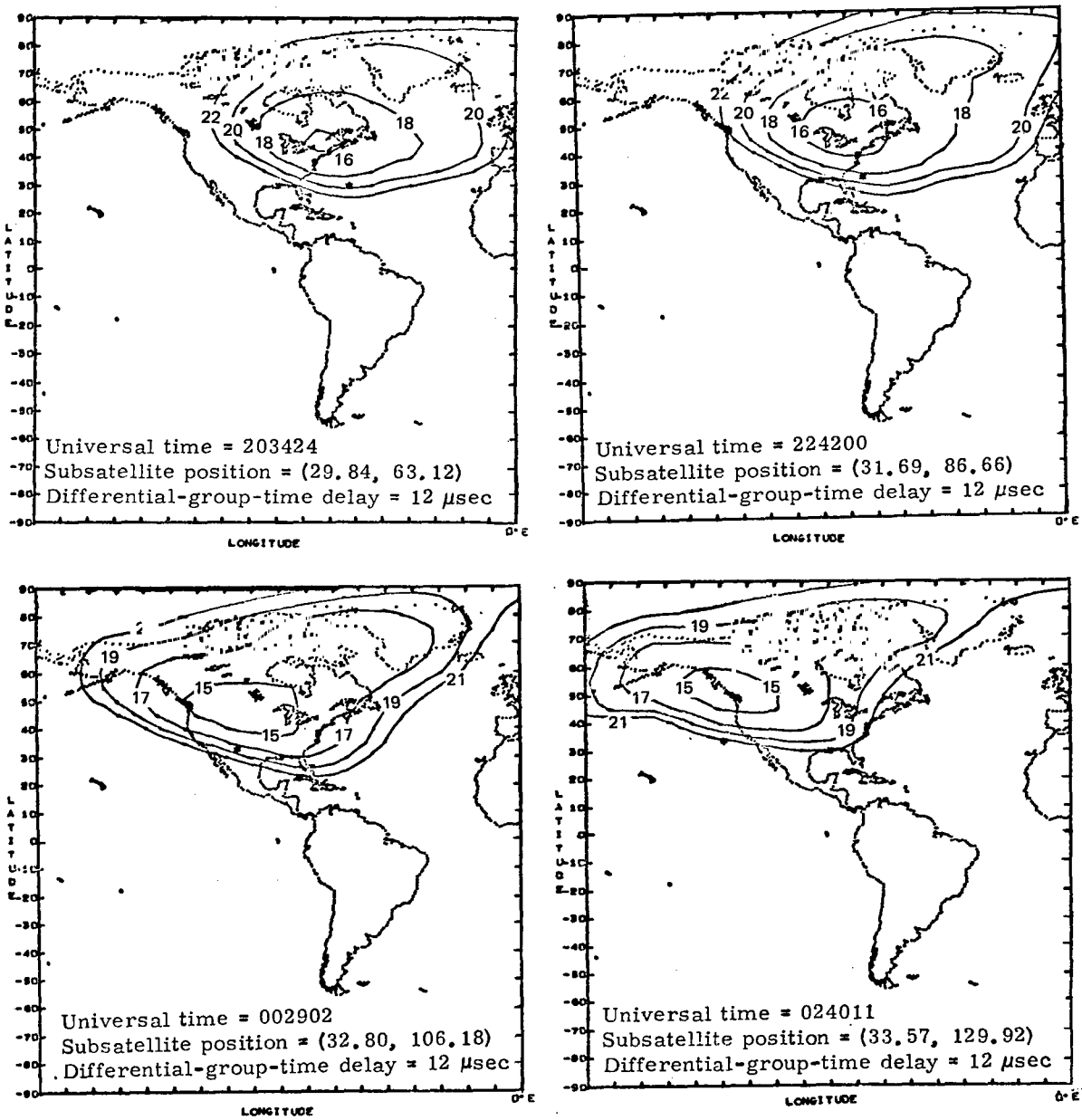

Figure 5. Isograms depicting areas containing atmospheric activity capable of producing particular satellite-measured, Channel B to Channel A, differential-group-time delay values (in μsec).

Radio Astronomy Explorer (RAE) I Observations Of Terrestrial Radio Noise

JOHN R. HERMAN*, JOSEPH A. CARUSO*, ROBERT G. STONE**

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ABSTRACT - Radio Astronomy Explorer (RAE) I data are analyzed to establish characteristics of HF terrestrial radio noise at an altitude of about 6000 km. Time and frequency variations in amplitude of the observed noise well above cosmic noise background are explained on the basis of temporal and spatial variations in ionospheric critical frequency coupled with those in noise source distributions. It is shown that terrestrial radio noise regularly breaks through the ionosphere and reaches RAE with magnitudes 15 dB and more above cosmic noise background, on frequencies above the F-layer critical frequency. A first description of the worldwide distribution of composite terrestrial noise on 9.18 MHz at 6000 km altitude between ±60° latitudes is presented for a period in December 1968. Maximum magnitudes are observed with RAE on the dark side of the Earth over continental land masses; the noise is 20-40 dB lower over southern hemisphere oceans and 10-20 dB lower over northern hemisphere oceans. In the December period it appears that: man made radio noise from cities dominated over the United States; thunderstorm activity contributed most noise over northern South America; and ground-based transmissions on frequencies near 9.18 MHz were most intense over China and Eastern Europe.

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1.0 INTRODUCTION

The radio noise environment within which a radio receiving system must operate is one of the main limiting performance factors for successful communications or data reception. An accurate knowledge of this environment, therefore, is required in order to assess the performance of receiving equipment both in satellites and on the ground.

Synoptic measurements of the atmospheric radio noise level at Earth's surface have been made for many years [1,2,3], but these are limited to land based receivers widely scattered throughout the world while ocean areas have been almost totally neglected. Thus, surface noise distributions as presently known contain large geographic areas of unverified noise levels. The contribution of terrestrial noise sources to the noise environment at satellite heights is even less well known, although some understanding has been provided by recent experiments. [4,5]

The development and launching of Radio Astronomy Explorer (RAE) I on July 4, 1968, by NASA[6] has presented an opportunity to further investigate terrestrial radio noise characteristics both near the Earth's surface and above the ionosphere. Although the satellite was designed principally for radio astronomy applications, the noise data on frequencies near and above the ionospheric penetration or critical frequency enables us to isolate and identify the terrestrial noise contribution at the satellite, and to investigate its spatial, temporal, and frequency characteristics.

Because RAE I is positioned in near space (5850 km altitude) it is exposed to a radio noise environment made up of noise of cosmic (or galactic) origin; that generated within the magnetosphere at or near the satellite; and that generated by terrestrial sources near or at Earth's surface. This article is concerned with only the noise of terrestrial origin.

The terrestrial noise characteristics as viewed by RAE I will be influenced by variations in the intervening ionosphere, the distribution and intensity of noise sources near Earth's surface, and satellite antenna orientation with respect to the arrival direction of incoming noise. It is, therefore, of interest to present first those characteristics of the satellite, ionosphere, and terrestrial noise sources germane to the analysis.

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2.0 SATELLITE CHARACTERISTICS

RAE I is in a retrograde, circular orbit at 5850 km with an inclination of 121° and a period of 3 hours and 45 minutes which allows it to cover geographic latitudes from 59°S to 59°N. The satellite is equipped with a 37 meter dipole antenna coupled to a burst receiver (BR Receiver) which sweeps continuously through the frequency range from .202 to 5.4 megahertz (MHz). In addition, RAE I is equipped with two 229 meter Vee antennas coupled to Ryle Vonberg (RV) receivers operating at fixed frequencies from .45 to 9.18 MHz. The nominal antenna beamwidths for 3.93, 4.7, 6.55 and 9.18 MHz are respectively, 23°x52°, 15°x46°, 14°x34° and 13°x27°. The satellite antenna configuration is shown in Figure 1. Due to the gravity stabilized orientation of the satellite, the upper Vee continuously views the celestial sphere, while the lower Vee views the terrestrial sphere.

Note that although the main lobe of the lower Vee views the Earth's surface, its back lobe views the celestial sphere, and is therefore, able to receive galactic radiation with diminished intensity. For the upper Vee the situation is reversed. The front-to-back ratio of both Vees is a function of frequency and the ratios are identical on both upper and lower Vees. The dipole antenna responds equally well to noise originating above and below the satellite. These antenna orientations allow determination of noise arrival direction so that the contributions of various sources may be separated.

Additional details of the receiving equipment are given elsewhere.[7]

Both sweep and fixed-frequency data have been utilized in the present investigation, with emphasis on frequencies near and above the ionospheric critical frequency. Thus, the burst receiver band of interest is from 2 to 5.4 MHz, while the RV frequencies considered are 3.93, 4.7, 6.55 and 9.18 MHz.

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3.0 Radiowave Propagation Through The Ionosphere

The RAE I - Earth Geometry is shown in Figure 2 on a distorted scale for purposes of illustration. The satellite is at a height of 5850 km in a circular orbit, and the peak of the ionospheric F layer is depicted at a height of 300 km. R is the distance from a noise source located at the point A to the sub-satellite point (i.e. the point of intersection of the Earth's surface with a radial vector from the center of the Earth to the satellite). R_e is the radius of the Earth (6370 km) and ϕ is the angle of incidence on the ionosphere of a radiowave ray path from point A to the satellite.

The importance of the angle ϕ becomes clear when Snell's Law is applied at the F-layer boundary. The result reveals that due to the refractive property of the ionosphere, total internal reflection at the boundary occurs when the frequency (f) of radiation from the source at A equals the critical frequency (foF2) multiplied by the secant of ϕ. That is,

$$f = foF2 \sec \phi$$

Total internal reflection implies that all of the radiated energy is refracted back towards Earth's surface and cannot reach the satellite. Thus, for a given frequency of radiation and critical frequency, the radiowave will penetrate the ionosphere for any angle of incidence $< \phi$ and be totally reflected at angles $\geq \phi$

Upon rearranging expression 1:

$$\phi = \sec^{-1}\left(\frac{f}{foF2}\right) \qquad (2)$$

it is clear that for penetration through the ionosphere, the angle of incidence is a monotonically increasing function of radiated frequency, (or equivalently, the observing frequency) and a monotonically decreasing function of the critical frequency. This being the case, the satellite should observe noise on the highest frequency earliest in time followed by successively lower frequencies as it approaches a noise source located below the ionosphere.

The concept of ionospheric penetration dependence on ϕ and f can be graphically illustrated by ray tracing techniques. Essentially, a ray-tracing computer program calculates the trajectories of radio ray paths from a point source through space when the observing frequency, critical frequency and take off angles are specified, as illustrated in Figure 3 [8]. In this figure, the radio source is located on the left side at Earth's surface, radiating on frequencies from 4 to 14 MHz over a range of take off angles corresponding to incidence angles from 0° (vertical incidence at the ionosphere) to approximately 90°. The critical frequency is held constant at 4 MHz, and the rays are traced out to a ground range of 4000 km and upward to an altitude well above the F-layer maximum height.

When the observing frequency equals the critical frequency of 4MHz (top of Fig. 3), no penetration occurs even when the

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ray is directed vertically upward (0° incidence), and the radio energy is reflected back toward Earth at all angles. As the observing frequency is increased, rays on successively larger angles penetrate through the F layer until at 14MHz no internal reflection takes place and all the rays penetrate. In this respect, the ionosphere may be regarded as an "iris" whose diameter increases with increasing observing frequency. Viewed from RAE's perspective, as the satellite moves toward the radio noise source, it will detect the highest frequency first at a ground range (R) greater than 4000km, followed successively later by the lower frequencies.

The range, R (Fig. 2) over which the satellite can receive noise from point A obviously depends upon the ratio of the observing frequency to foF2. Consideration of the geometry involved, with an assumed ionospheric height of 300 km reveals that R varies implicitly with foF2 /f in accordance with (See appendix for derivation):

$$\frac{foF2}{f} = \sqrt{1 - \frac{\sin^2(R/R_e)}{1.39-1.14 \cos (R/R_e)}} \qquad (3)$$

where R is in km and R_e = 6370 km (Earth's radius). The greatest range obtainable, 6500 km, would occur with A located at the satellite horizon (i.e. tangent to Earth's surface). This range corresponds to foF2/f=.292. On the RAE I frequency of 9.18 MHz, the satellite can see all the way to the horizon if foF2 $\leq$ 2.7 MHz.

It should be mentioned that the directivity of the Vee

antenna imposes a maximum ground range beyond which RAE detects only a fraction of the terrestrial noise penetrating through the ionosphere due to the relative orientation of the ray path and antenna beam. Since the antenna beam broadens with decreasing frequency, the somewhat simplified picture gained from consideration of Fig. 3 must be modified for detailed analysis of the RAE data, but the added complexity does not affect the present results. The spatial and temporal variability in the critical frequency as it affects the ground range over which RAE can view ground based sources (see Eq. 3), is, however, of direct concern here.

The critical frequency is proportional to the square root of the maximum electron density in the F region and it varies with season, time of day, and geographic location with a total range of about 1MHz to 15MHz. It would, at times, shield all of the frequencies under consideration, and sometimes none of them. Grossly speaking, the critical frequency is high on the dayside and low on the nightside of the Earth.

Representative geographic distributions of predicted median critical frequencies (foF2) for 10 hours universal time (UT) and 12 UT in December 1968, are reproduced in Figure 4 (for later discussion an RAE I orbit is superimposed on the maps[9]). The position of the twilight line separating day from night for these two times is depicted as a dashed line. Gross features of diurnal and latitudinal variations in foF2 as mentioned above are evident in the contour maps, and as the subsolar (noon) position shifts from 30°E longitude to 0° between 10 UT

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and 12 UT, so in concert shift the twilight line and region of minimum foF2. Note, in particular, the predicted 4 MHz low area in the northern hemisphere centered at a longitude of about 90° W at 10 UT, which can be seen to have moved westward to about 115° W at 12 UT. It is important to remember that the illustrated maps are predicted monthly median values. On a day-to-day basis, there is considerable fluctuation of foF2 about its median value, so prediction maps are best used as qualitative guides in determining the extent of ionospheric shielding. A specific example of their use in analyzing RAE data is discussed below.

4.0 Terrestrial Radio Noise Sources

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The distribution and intensity of terrestrial noise sources are the remaining critical factors in the determination of the noise power received at RAE I. The three prime sources of terrestrial noise are thunderstorms, urban industrial areas and radio transmitters operating on discrete frequencies. These sources give rise respectively to atmospheric radio noise generated by lightning flashes and similar atmospheric electrical phenomena; noise produced incidentally by electrical equipment, power lines, ignition systems and the like; and radio interference. The first two sources produce broadband noise from a few kilohertz (KHz) to more than 10 MHz, while the last generates narrowband noise at discrete frequencies throughout the radio spectrum.

Because the basic data from the RV receivers consist of 32-second averages of noise temperature on the lower Vee antenna, the relative contribution of each of the three prime sources cannot be isolated directly. In attempting separation of contributing sources, then, it is necessary to consider the spatial and temporal distributions of those sources when analyzing the RAE data.

For example, man made noise [10] may be the dominant factor at times when RAE is passing over large metropolitan cities concentrated in the industrial areas of the northern hemisphere (e.g. New York, London, Tokyo), because the antenna beamwidth can cover several cities simultaneously.

It is expected, however, that those urban areas in the north would contribute little to the noise level observed over the oceans, or in the southern hemisphere.

Radio interference on the other hand, will be contributed by those transmitters operating on frequencies within the 200 KHz bandwidths of the RAE frequencies of interest. Possible candidates include HF commercial broadcast stations, [11] amateurs, [12] radio navigation and other radio services [13]. Information regarding military frequencies, operating powers and transmitter locations is generally unavailable, except that the general allocation listing for frequency bands in the U.S. [12] shows none in the 4 RAE frequencies under consideration here. Of the 5 amateur bands [12] only 3.5 to 4.0 MHz is partly within the bandwidth of RAE's 3.93 MHz frequency. The industrial band (4.43 - 6.5 MHz), which includes press relay services, may, at times, affect 6.55 MHz noise measurements. Aeronautical mobile bands assigned for ground-air-ground and air-air communications of concern here are 4.65 - 4.75 MHz and 6.52 - 6.77 MHz, but the impact of these on RAE measurements is impossible to assess without knowing airline schedules. In the maritime mobile bands set aside for ship-to-ship and ship-to-shore communications, only the U.S. Coast Guard facsimile system operating in the 6.3 to 6.5 MHz band overlaps any of the RAE frequencies.

Commercial broadcast stations listings [11,13] reveal that only 16 highpower transmitters operate within the bandwidth centered on 9.18 MHz, and all of these are in the

northern hemisphere. For 6.55 MHz, the number of transmitters is 30, and these are concentrated in China, Indonesia, and the Mediterranean Countries. There are 106 transmitters within ±100 KHz of 4.7 MHz, located mainly in South America, Central America and China. Of the 94 transmitters germane to 3.93 MHz most are low powered (<1 kw) and concentrated in Indonesia and Southern Africa.

It is expected that the largest contribution to the observed terrestrial noise would be made by an interfering transmitter when its location is in RAE's field of view. There is, at present, no way to ascertain what its relative contribution would be in cases where the signal escaped through the ionosphere after propagating below the ionosphere over some distance. It might be presumed that the available signal strength from a single transmitter would be relatively small after propagation over distances of, say the 6000-10,000 km required for a northern hemisphere station to contribute to the observed noise level over the southern hemisphere or overmid-ocean. The collective total from all possible contributing transmitters, however, may not be so small.

Since the maritime bands are not close to 9.18, 4.7 or 3.93 MHz, interfering transmissions with RAE over the oceans would be seen only indirectly (i.e. after being propagated there by ionospheric-ground reflections) on these frequencies.

For the broad survey of terrestrial noise intended in this paper, detailed consideration of the possible effect of discrete transmitters is inappropriate, but the general global distri-

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bution of transmitters as a function of frequency is of concern. For example, preliminary examination of data on 9.18 MHz when RAE was over certain portions of the northern hemisphere where the 16 high powered 9 MHz transmitters are located reveals a much higher terrestrial noise temperature than at comparable latitudes and times in the southern hemisphere. As will be discussed later in this paper, selection of 9.18 MHz data for examination of the spatial distribution of noise over the southern hemisphere ensures that the direct contribution of radio interference is minimized, but the possible indirect contribution cannot be eliminated.

Lightning and similar atmospheric electrical phenomena associated with thunderstorms generate electromagnetic radiation on frequencies from below 10 KHz to more than 10 MHz. The spatial distribution and intensity of atmospheric radio noise sources can thus be approximated by the distribution of world wide thunderstorm activity. The number of thunderstorm days observed worldwide during the three month period of September, October and November is shown is Fig. 5 to illustrate the distribution of atmospheric noise sources. It is clear that thunderstorm activity is most pronounced over the equatorial land masses of South America, Africa, and Indonesia. In general, over continental land masses anywhere from 150 to 1000 thunderstorms will be in progress at any given time, depending upon season, time of day, and geographic region.[14] No similar diurnal or seasonal statistics exist for ocean

regions, but recent optical satellite measurements by Sparrow and Ney[15] indicate far fewer storm occurrences over oceans compared to land masses.

Bearing in mind that thunderstorm occurrence varies with time of day and location in a given season and that ionospheric shielding of RAE I frequencies also varies with these parameters in a different way, it is instructive to examine Figure 5 in more detail. Superimposed on the distribution is a representative RAE I orbit indicated by the solid line. The orbit begins at 1915 UT and terminates at 2245 UT. Also illustrated are the twilight lines separating day from night. The broken line beginning at the far right is the position of the twilight line at 1900UT, with subsolar position A at 105° W longitude corresponding to local noon. The remaining broken line indicates the movement of the twilight line and its subsequent position at 2100UT, with subsolar position B (135°W longitude). Because RAE I has a component of motion in the direction of the movement of the twilight line, the satellite gains an apparent extra two hours of night-time viewing on this pass.

At the risk of oversimplification let us assume for the moment that the ionosphere is opaque on the day side and transparent on the night side to illustrate expected effects due to variations in noise source distribution and intensity. After RAE I passes point A' and emerges in the night side, it would see a gradually increasing noise intensity as it approaches the high density thunderstorm area over Indonesia

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and Northern Australia. Tracing the path further, the measured noise intensity should fall off as the satellite traverses the Indian and South Atlantic Oceans, with a subsequent increase in noise intensity, as it approaches the South American Coast. However, as RAE I crosses the twilight line at the point B' and emerges on the day side, the intensity will fall off rapidly due to the opacity of the ionosphere in spite of the fact that RAE I is traversing a region of high thunderstorm activity over South America. This qualitative picture will be modified by the temporal and spatial variations of the intervening ionosphere, and as shown previously, the modification will vary with frequency due to the iris effect.

The distribution of thunderstorm activity based on photometer measurements taken by the OSO-5 Satellite as reported by Sparrow and Ney [15] is illustrated in Figure 6. Since these measurements were made utilizing the visible portion of the spectrum and observational periods of time near new moon, the distribution is representative of nighttime thunderstorm activity. As we have indicated, this is also the case with RAE I due to severe daytime ionospheric shielding of RAE I observing frequencies. Examination of the figure shows a very high density of thunderstorms over the equatorial land masses and a paucity of storms over ocean areas.

Part of the difficulty in analyzing the RAE data stems from the fact that all three major source types are found mainly on land. As we have seen, thunderstorm activity occurs

predominantly over the low-latitude continental land masses, most transmitters (with the exception of transcontinental aircraft and ships at sea) are concentrated on land, and obviously metropolitan areas where man made noise is generated are also on land. Except where otherwise specified in this preliminary report, then, the term "terrestrial noise" may be read as "composite noise."

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5.0 RAE Noise Measurements

Based upon the foregoing discussion of pertinent ionospheric properties, satellite characteristics and terrestrial noise distributionsand their expected impact on noise measurements in space, a selection of the RAE I observations is utilized below to establish that a significant portion of the noise environment in near-Earth space has its origin in terrestrial sources.

Figure 7 illustrates the format used for displaying sweep frequency data received by the dipole antenna. The BR receiver sweeps through the frequency band from 0.2 to 5.4 MHz (vertical axis) each 8 seconds, and the measurements are subsequently processed to plot contours of constant noise level in decibels (dB) above cosmic background [16]. In Figure 7 only the data on frequencies greater than foF2 have been retained. The illustrated contours represent increasing noise magnitude as the frequency is increased at fixed times.

The characteristic toroidal pattern of the dipole antenna allows it to receive galactic and terrestrial, as well as in situ (magnetospheric-origin) radiation. Due to ionospheric shielding and absorption, it is safe to assume that on frequencies below about 2 MHz, the radiation received on the dipole antenna is almost totally of galactic and in situ origin. Consequently, the relevant contours for our purposes are between 2.1 and 5.4 MHz.

On the frequencies of interest ionospheric shielding will tend to limit reception of terrestrial noise to periods and locations where foF2 is low (generally on the night side of Earth). In crossing the twilight transition from postdawn to predawn, there is a fairly steep horizontal gradient in foF2 which would permit the highest frequencies to penetrate to RAE I first, followed gradually by the lower frequencies as the satellite crossed the region. Also, the iris effect would allow the highest frequency to be received at the largest slant range. Thus, as RAE I crosses morning twilight toward the night side the noise level should gradually exceed the cosmic noise background at successively lower frequencies. That this behavior in fact happens is illustrated in Fig. 7.

The geographic location of the satellite during the transition period is noted on Fig. 4, between points A and B. On 5.4 MHz the cosmic noise level begins to be exceeded (Fig. 7) about the time RAE is at A in Fig. 4; by the time it reaches B the cosmic noise level has been exceeded on 2.7 MHz.

The ground range from the point A (Fig. 4) where 5.4 MHz comes in, to the region of critical frequency of 4 MHz (approximately 55°W longitude), along the orbital path is about 5300km, and from B (where 2.7 MHz comes in), it is about 2800km. From Eq. 3 and neglecting refraction, these ranges correspond to calculated ratios (foF2) of 0.38 and 0.73 respectively. The corresponding critical frequencies computed with observing frequencies of 5.4 and 2.7 MHz in the ratio are both approximately 2 MHz. This magnitude is less than the predicted foF2 of 4 MHz (Fig. 4) but the fact that 2.7 MHz comes in at all is an

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indication that the predicted value was too high for the specific day in question; however, the predicted minimum foF2 of 4 MHz is in the correct geographic position.

Following this twilight transition, or ground breakthrough the noise level on 2.7 MHz and above exceeded the cosmic background until about 1130 UT, or approximately at point C (Figure 4) on this orbit.

Assuming a constant db level to represent a threshold above which the terrestrial noise exceeds the cosmic noise background over the range of frequencies here, it is found that the time required for the noise to break through from 5.4 MHz down to 2.7 MHz is typically about 15 minutes (as it is in the Figure 7 example), and ranges from about 12 to 20 minutes in the 100 odd cases investigated to date.

As a general rule, the terrestrial noise disappears in a manner similar to its appearance in the sweep frequency data. That is, the lower frequencies go out first and 5.4 MHz is the last to be seen. The contours thus slope upward (opposite to those in Figure 7), rather than downward. Again, in general, the shape of the contours in a, shall we say, "ground cessation" period, are less regular than those for morning ground breakthrough; usually because the satellite is traversing the twilight line from the night side to the evening side where the horizontal gradient in foF2 is positive but smaller than it is in the morning.

In keeping with this property of the ionosphere, ground cessation usually requires a lengthier period than ground breakthrough.

In the present example, however, cessation takes place at point C (Figure 4) when the satellite is well into the night side. Upon inspection of the predicted foF2 contours it is seen that RAE is again passing over a region of expected high foF2 near the equator. Beyond point C along the orbit where foF2 begins to decrease toward higher (southern) latitudes, terrestrial noise is again seen to break through on frequencies above 6 MHz. This was not evident in the BR (sweep frequency) data, but was observed on the RV downward Vee antenna.

Figure 8 is a typical example of fixed frequency data received on the upper and lower Vee antennas. Noise temperature in degrees Kelvin is plotted as a function of universal time for the period 00UT to 04 UT on December 2, 1968, representing a full orbit of data on 9.18 MHz. Tracing RAE I's orbit beginning at 00 UT on the lower Vee the noise temperature begins to decrease as RAE I approaches the dayside, reaching an ambient level of 10^5 °K while the satellite is shielded by the ionosphere on the dayside. As RAE I reemerges into the night side at about 0230 UT , the noise temperature increases to a peak at a time, when in this particular example, RAE I is passing over Central Africa. On this pass, the temperature is slightly higher on the upper Vee while the satellite is passing over the dayside (0115 to 0230 UT).

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The peak noise temperatures on the upper and lower Vee antennas on the night side are approximately 10^9 °K and at least 10^{10} K respectively. In this example (Figure 8), the lower-Vee RV receiver is saturated, in which case a temperature of 10^{10} °K has been recorded. Since the noise power is directly proportional to temperature, the measured difference in temperatures represents a power level on the lower Vee at least 10 dB greater than the received noise power on the upper Vee. The front to back ratio on both Vees for a frequency of 9.18 MHz is 13 dB, and since they are mirror images of each other (Figure 1), a priori one would expect approximately a 13 dB enhancement on the lower Vee for noise arriving from terrestrial sources below the satellite. This magnitude is in good agreement with the difference in power levels obtained empirically from the raw data displayed in Figure 8, and strongly suggests that the noise received by RAE I on the nightside is primarily of terrestrial origin.

An illustration of the combined effect of the ionospheric iris and terrestrial source distribution is given in Fig. 9, where noise temperatures received on the lower Vee for the frequencies of 9.18, 6.55, 4.7 and 3.93 MHz are plotted as a function of time for the orbital period 00UT to approximately 0430 UT, December 2, 1968. The predicted critical frequencies[9] and surface noise temperatures (for 1 MHz due to thunderstorm activity only)[3] along this orbital path at the subsatellite point are given in Figure 10 for comparison.

In Figure 9, a characteristic decrease in measured noise temperature occurs over the dayside followed by an increase on the nightside, reaching a maximum as RAE I crossed central Africa (~0330UT), and decreasing again as RAE I traversed the Atlantic Ocean (~0400UT). We note that on the dayside, where the critical frequency is above 9 MHz (Figure 10), no terrestrial noise is received by the satellite, even though a subsidiary maximum in surface noise temperature is expected in the South Pacific Ocean (0130 UT, Fig.10). On the night side the critical frequency is low and the source (surface noise) temperature is high (Fig. 10) and the noise power received by RAE is also high (Fig. 9). The comparative behavior of the ionosphere surface noise distribution and measured noise temperature supports the hypothesis that a substantial amount of radio noise in near space on Earth's night side is due to terrestrial sources.

Examination of the sequence of times at which RAE received each frequency in the raw data clearly reveals the iris effect; i.e. , 9.18 MHz is received earliest at 0230 UT, followed by 6.55, 4.7, and 3.93 MHz at 0240 UT, 0244 UT and 0246 UT respectively. To demonstrate that this sequential breakthrough is an ionospheric effect, let us assume that as RAE approached the region of minimum critical frequency centered at 0320 UT (Fig. 10), it initially received the noise on 9.18 and 6.55 MHz from the same ground location where the overhead critical frequency was f_c.

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Denoting the ground range from the point of first reception on 6.55 MHz to this common location as R_1 and that for 9.18 MHz as R_2 it is evident that

$$R_2 = R_1 + \Delta t \ (\nu_g) \qquad (4)$$

where Δt is the time delay between breakthrough of 9.18 and 6.55 MHz and ν_g is the velocity of the subsatellite point along Earth's surface. For the particular example under discussion the data gives Δt = 10 minutes (0230UT to 0240UT) and for RAE I $\nu_g \simeq 179$ km/min. Now we may utilize equations 3 and 4 to obtain a simultaneous solution for R_1, R_2, and f_c. The values are 1274 km, 3064 km and 6.07 MHz, respectively. The time required for RAE to reach the location where f_c = 6.07 MHz is simply R_2/ν_g= 17.1 minutes, so it must have crossed this point at 0247 UT. From Fig. 10 it is evident that the predicted critical frequency at this time is about 8 MHz or 2 MHz higher than that deduced form the RV data. A similar computation utilizing the data from 6.55 and 4.7 MHz gave similar results, i.e. the deduced critical frequency at the location corresponding to 0310UT was about 2.3 MHz, approximately 2 MHz lower than predicted.

Comparison with ground-based ionospheric observations leads to further insight. Ionosonde critical frequency measurements at Sverdlovsk (57°N, 61°E) and Rostov (47°N 40°E) indicate that foF2 was about 2 MHz lower than the

predicted curve in Fig. 10. RAE I passed directly over Sverdlovsk at 0310 UT , where foF2 was measured to be 2.5 MHz, which is in embarrassingly good agreement with the 2.3 MHz deduced above.Thus there appears to be little question that the observed sequential breakthrough observed on successively lower frequencies as RAE I approaches a region of low critical frequency is an ionospheric effect. This behavior is very strong evidence for the terrestrial origin of the composite noise received by RAE I on the dark side of the Earth on frequencies above foF2.

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6.0 Terrestrial Noise Distribution Viewed By RAE I

Having demonstrated that the nighttime HF noise measured on the lower Vee antenna is principally of terrestrial origin, it is of interest to examine its spatial distribution over Earth's surface. As a first approach, part of the RV data on 9.18 MHz has been analyzed for this purpose.

The choice of frequency and time periods for this first preliminary analysis was governed be several factors: the highest available frequency (9.18 MHz) is least refracted by the ionosphere and is shielded from the satellite for the smallest fraction of time; the directivity of the lower Vee is greatest on this frequency; and the number of listed ground-based transmitters [11] operating within the RV receiver's 200 KHz bandwidth centered on this frequency is small.

Selection of the data points was made by restricting the time of interest to the local time (LT) hours between 00 and 08 LT. For the December 2-6, 1968 period, all times within 00-08 LT appearing in the 15 minute UT emphemeris were used to determine the satellite positions (geographic latitude and longitude), along with the appropriate universal times. The 00-04 LT points fall mainly in the southern hemisphere, while the 04-08 LT points cover the northern hemisphere. Using the UT times to enter the RV

(whole orbit) data, the noise magnitude for 9.18 MHz on the downward Vee was then established, and converted to dB above 288°K. This reference temperature agrees with that utilized by C.C.I.R. [3] so that a direct comparison can be made between the RAE measurements and CCIR predictions. Against this reference, the lowest noise level recorded by RAE is approximately 25 dB and the highest is 75 dB.

The dB values were plotted at their corresponding geographic positions on a base map drawn in modified cylindrical projection. Isocontours of dB levels at 5 dB increments were then manually constructed through the data points. Some smoothing was necessary to maintain continuity in the contours but all data points, with one or two exceptions, lying between two adjacent contours have magnitudes within the 5 dB interval defined by the two contours and are approximately linearly proportional to their distance from the lines.

A preliminary map constructed by this technique is illustrated in Figure 11 for December, 1968. It represents the first worldwide view of terrestrial radio noise as seen from 6000 km altitude on 9 MHz. To gain full longitudinal coverage around the Earth, it was necessary to utilize noise data on consecutive orbits for a period of several days. This procedure tends to smear the geographic distribution of atmospheric noise to some extent, because an active tropospheric weather region (such as a cold front) may generate thunderstorm activity for two or three days with some dis-

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placement in location. An obvious limitation to the present results is that, being based upon a small sampling of data over a few days, they do not necessarily represent average conditions for December. In spite of the above limitations, however, the results exhibit rather striking characteristics.

Gross features apparent in the December distribution lend credence to the assumption that the observed noise is emanating from sources at or near the Earth's surface. For example, the most intense noise is observed over the major land masses of the world, while the lowest noise levels are observed in mid-ocean. As a matter of fact, the noise level in the South Pacific is lower than it is in the South Atlantic Ocean, at least partly because of the longer distance from continental land masses to the Mid-Pacific compared to Mid-Atlantic.

In the Southern Hemisphere, where it is summer, the most intense noise regions (70 dB or greater) are found over parts of Australia, Borneo, South America and West Central Africa. These highs are in rough agreement with the nighttime thunderstorm areas observed by Sparrow and Ney (Figure 6) in the Southern Hemisphere. The lowest noise levels ($\leq$30 dB) are observed over the middle of the Southern Pacific Ocean and off the tip of South America, and in general, the level is 20 to 40 dB lower over the southern oceans than over the land masses.

In the northern hemisphere, where few, if any, thunder-

storms are expected to occur in December especially at latitudes higher than about 30°, a large maximum region ($\leq$ 70 dB) appears to cover nearly the whole of Europe and Asia. A large portion of North America exhibits a noise level of 65 dB, and the level over the north Atlantic Ocean is between 60 and 65 dB. The highest regions of 75 dB (maximum recordable) over China and the Eastern Mediterranean area correspond to the locations of the 16 transmitters mentioned earlier. A rather large subsidiary high of 60-65 dB is evident over the Mid-Pacific area, but apart from that, the northern hemisphere Pacific Ocean level is 55-60 dB. In contrast to the southern hemisphere, the ocean areas of the north have only 10-20 dB lower noise levels than the bounding land masses.

Turning now to the possible causes of the various regions of maximum intensity in Figure 11, it appears possible to identify at least the major noise contributor in some cases. For example, since there are no 9.18$\pm$ .1 MHz broadcast (or amateur) stations and essentially no thunderstorms in December in the United States , the only direct contributor to the 65 dB level observed by RAE must have been man made radio noise (The indirect contributions of distant transmitters and thunderstorms via ionospheric reflections and subsequent breakthrough is, as intimated earlier, unknown).

The high of 75 dB in South America between about 0° and 10°S is over the upper Amazonus tropical jungle region, an area devoid of 9 MHz transmitters and major cities. It seems safe to conclude that the prime contributor here is thunderstorm

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activity. Another lesser high of 65 dB in the Pacific centered at 170°W, 4°N, might also be attributed to an isolated tropical disturbance, since it is near the spawning area of typhoons.

Finally, the saturated highs ($\geq$ 75dB) over China and Eastern Europe where Winter thunderstorms are rare, probably are due mainly to transmitted signals from the broadcast stations in those areas.

From this first worldwide look at terrestrial radio noise viewed from an altitude of 6000km, it may be postulated that the noise environment at any point on Earth's surface at any time is comprised of HF radiation generated at the spot by one of the major source types (direct contribution) plus noise arriving there from all directions and distant sources via ionospheric and groundwave propagation paths (indirect contributions). The relative contribution of each source depends upon its distance from the observation point and propagation conditions along the path, but the noise can be expected to be coming in over all vertical and azimuthal arrival angles with reduced intensity from distant sources. The incoming rf energy will be scattered outward again in all directions, with a significant fraction of it directed upwards, but the highest intensity noise would be found directly over a major source area. Thus, on the December 2-6, 1968 orbits, RAE saw on 9.18 MHz indirect noise over the oceans and direct contributions over the major land masses of the world where the sources are located; the direct sources appear to have been urban man made noise over North America, thunderstorm activity over South America, and man made transmissions over China and Eastern Europe.

7.0 Summary And Conclusions

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Preliminary investigation of certain features of radio noise observed by RAE I on its dipole and Vee antennas has revealed that a significant amount of terrestrially generated noise will, at times, penetrate through the ionosphere to 6000 km altitude. This noise can be at least 15 dB above the cosmic noise background but the upper limit cannot be ascertained due to receiver saturation.

As the satellite approaches a region of low peak ionospheric electron density (critical frequency) terrestrial noise in excess of cosmic noise on successively lower frequencies is received by RAE, producing the typical "ground breakthrough" pattern observed in the dipole antenna sweep frequency data. Terrestrial noise is usually observed by RAE over the night side of the Earth or at high declination angles where foF2 is low.

Fixed frequency data from the Ryle-Vonberg receivers on the lower Vee reveal that the terrestrial noise level is lowest when RAE is over oceans and highest when it is over continental land masses where the major source types are concentrated. The geographic distribution for a period in December 1968 of terrestrial noise as observed by RAE on 9 MHz is marked by maximum intensity areas centered over

the northern and southern hemisphere major land masses. Over the United States the principal contributor appears to have been man made noise from populated areas. Thunderstorm activity is apparently the main cause of the high over South America and ground-based transmissions apparently dominated the measurements over China and Eastern Europe.

It appears that a qualitative model taking into account the spatial and temporal variations in both terrestrial noise source distributions and ionospheric critical frequencies, is adequate to explain the gross features of the terrestrial noise component observed in the RAE data. The magnitude of noise available to penetrate through the ionosphere from any point on the Earth's surface is the total of all contributions from thunderstorms, urban noise centers on terrestrial transmitters that originate or have arrived at that point after propagation over an appropriate distance via ionospheric reflections or groundwave propagation. As viewed from 6000 km altitude on frequencies slightly above foF2, the Earth would appear as an rf sphere radiating outward with localized"hot spots" in areas where surface source intensities are highest. The hot spots would appear over regions where thunderstorm activity is high, where population densities and industrial activity is high and where radio transmitters operating on the observing frequencies are concentrated.

Based on this model, the noise level over the oceans in locations well removed from noise sources is lower than it is over continental land masses.

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APPENDIX
DERIVATION OF EQUATION (3)

The derivation of Eq. (3) is based on the assumption of an isotropic, homogeneous, horizontally stratified ionosphere with no refraction. The various parameters employed in the derivation are shown in Figure A-1. By repeated application of the law of sines and eliminating the angle γ it can be shown that:

$$\mathrm{SIN}^2\phi = R_e^{\,2} \left(\frac{R_e+h_s}{R_e+h_i}\right)^2 \frac{\mathrm{SIN}^2\alpha}{d^2} \qquad (1)$$

where $\alpha = R/R_e$

and $d^2 = R_e^{\,2} + (R_e+h_s)^2 - 2R_e(R_e+h_s)\ \mathrm{COS}\alpha$

It will be noticed that the expression for d^2 follows directly from the law of cosines.

Making use of the well known secant law of reflection on a plane ionosphere, expression (1) can be re-written as

$$\frac{foF2}{f} = \sqrt{1-R_e^{\,2}\left(\frac{R_e+h_s}{R_e+h_i}\right)^2 \frac{\mathrm{SIN}^2\ R/R_e}{R_e^{\,2}+(R_e+h_s)^2 - 2R_e(R_e+h_s)\ \mathrm{COS}\ R/R_e}}$$

It is necessary to assume a plane ionosphere only in the immediate neighborhood of the ionospheric penetration point of a ray traveling from the ground to the satellite along path d. Thus, equation (2) is generally applicable to a curved earth-curved ionosphere with no refraction and no magnetic field.

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For the particular case under consideration here, the following values were substituted into Equation (2):

$$h_s = 5850 \text{ km}$$

$$h_i = 300 \text{ km}$$

$$R_e = 6370 \text{ km}$$

The result is

$$\frac{foF2}{f} = \sqrt{1 - \frac{SIN^2\ R/R_e}{1.39 - 1.14\ COS\ R/R_e}} \qquad (3)$$

If we allow R_e to approach infinity, i.e. for the flat earth case, then in the limit, the right hand side of Equation (2) becomes

$$\sqrt{1 - \frac{R^2}{h_s^{\ 2} + R^2}}$$

and we arrive at the well known expression [4] for the flat earth case;

$$\left(\frac{R}{h_s}\right)^2 \quad \left(\frac{f}{foF2}\right)^2 - 1$$

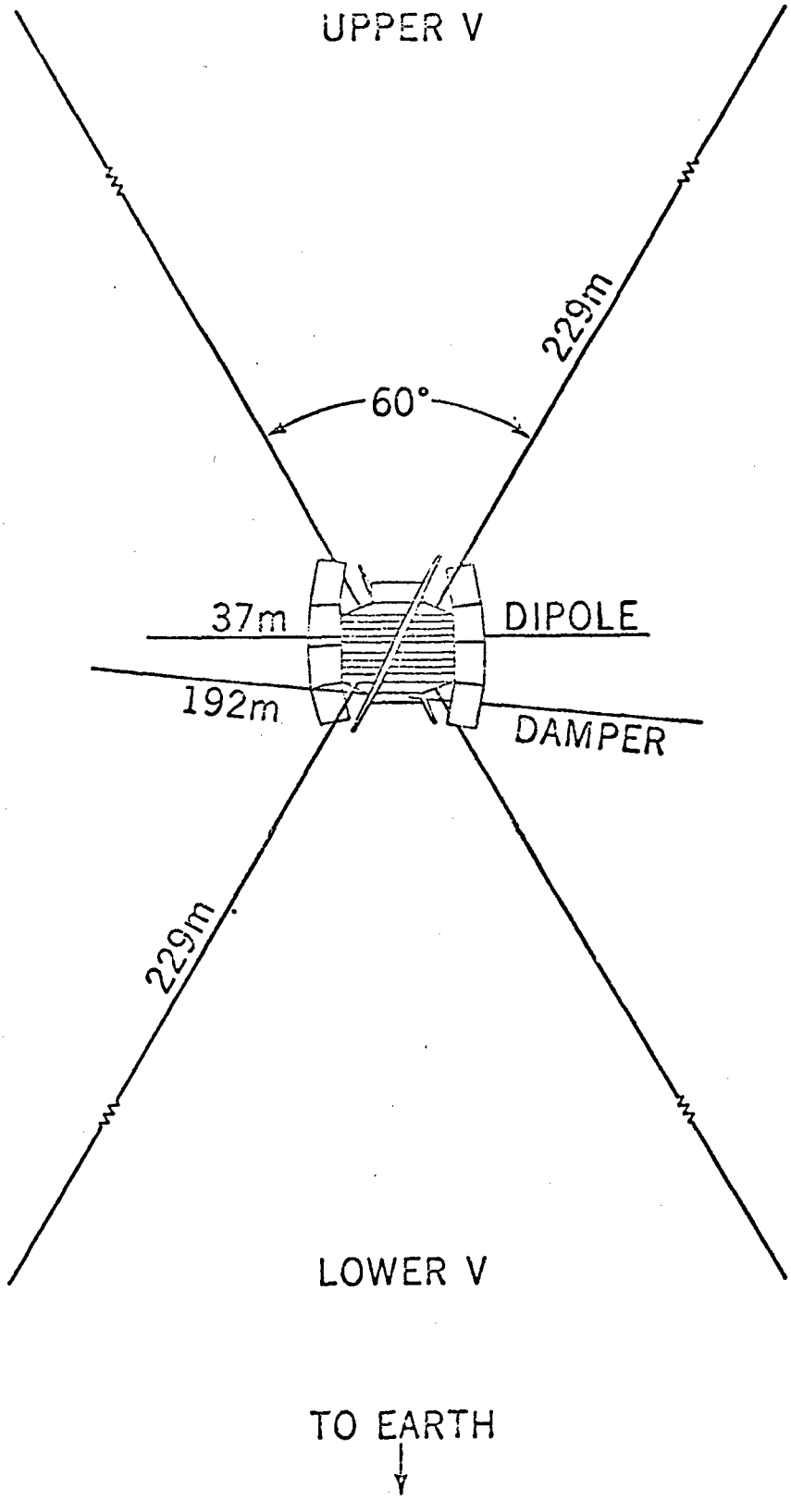

Figure 1 RAE-I Antenna Boom Deployment.

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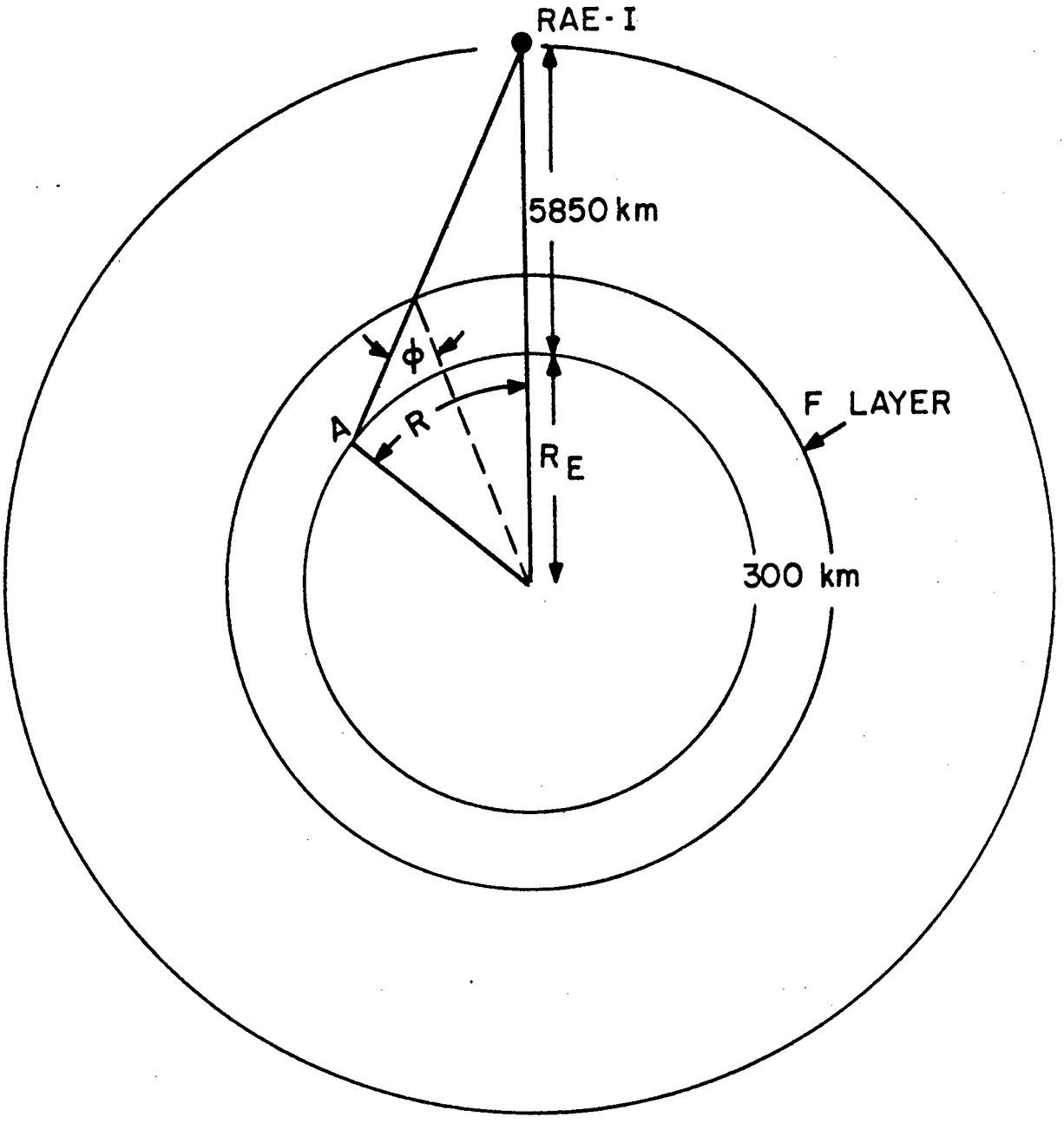

Figure 2 Geometry of the satellite-ground source configuration.

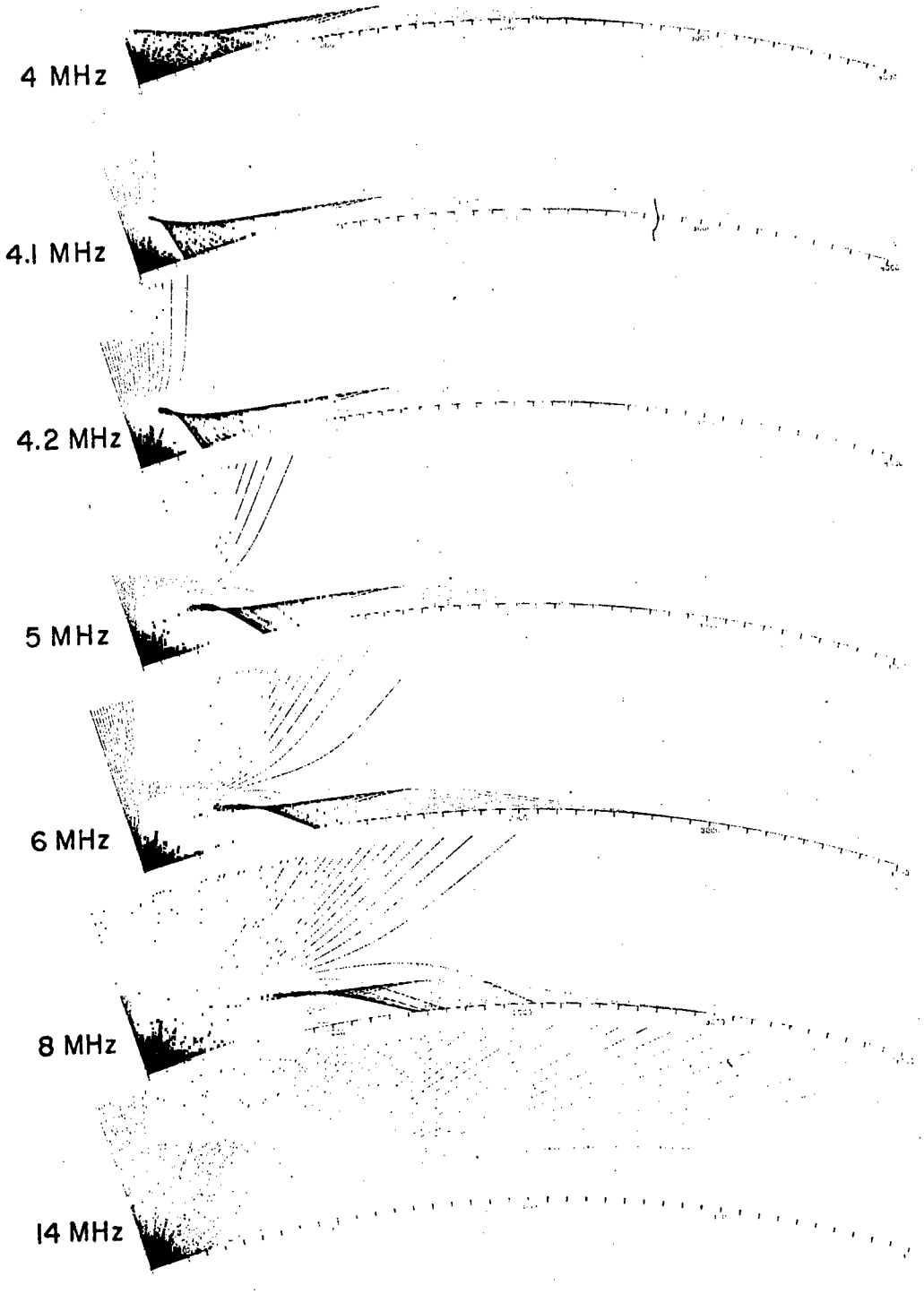

Figure 3 Families of Rays at seven frequencies computed for a single layer ionosphere without tilts or irregularities. The vertical incidence critical frequency is 4 MHz (reproduced by permission of T.A. Croft[8]).

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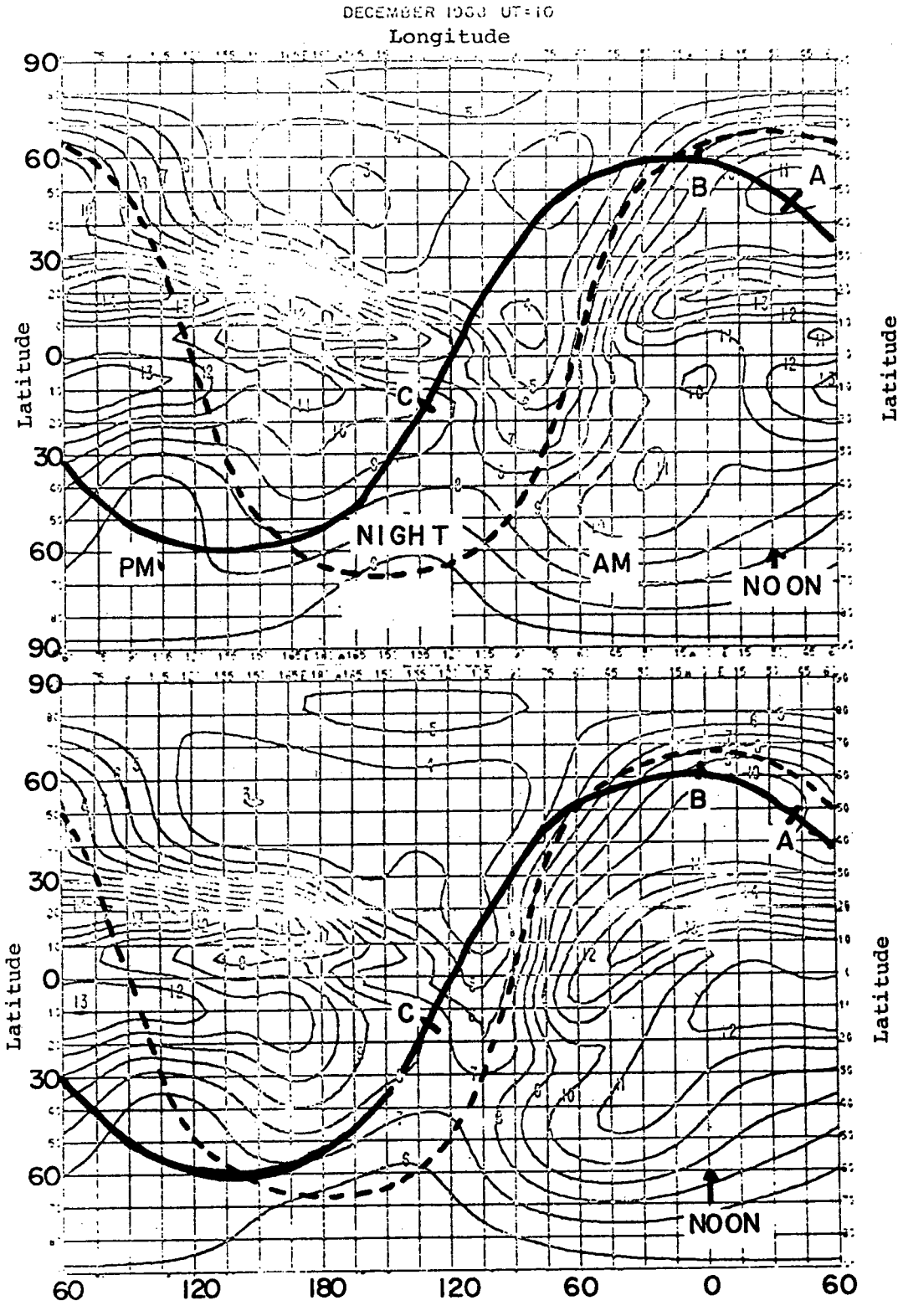

Figure 4 Predicted median foF2 (MHz) for December 1968 10 UT (Top) and 12 UT (Bottom) (After ESSA, 1968). The RAE I orbit is for December 2, 1968 showing satellite positions at 1006 UT (Point A), 1021 UT (B) and 1130 UT (C).

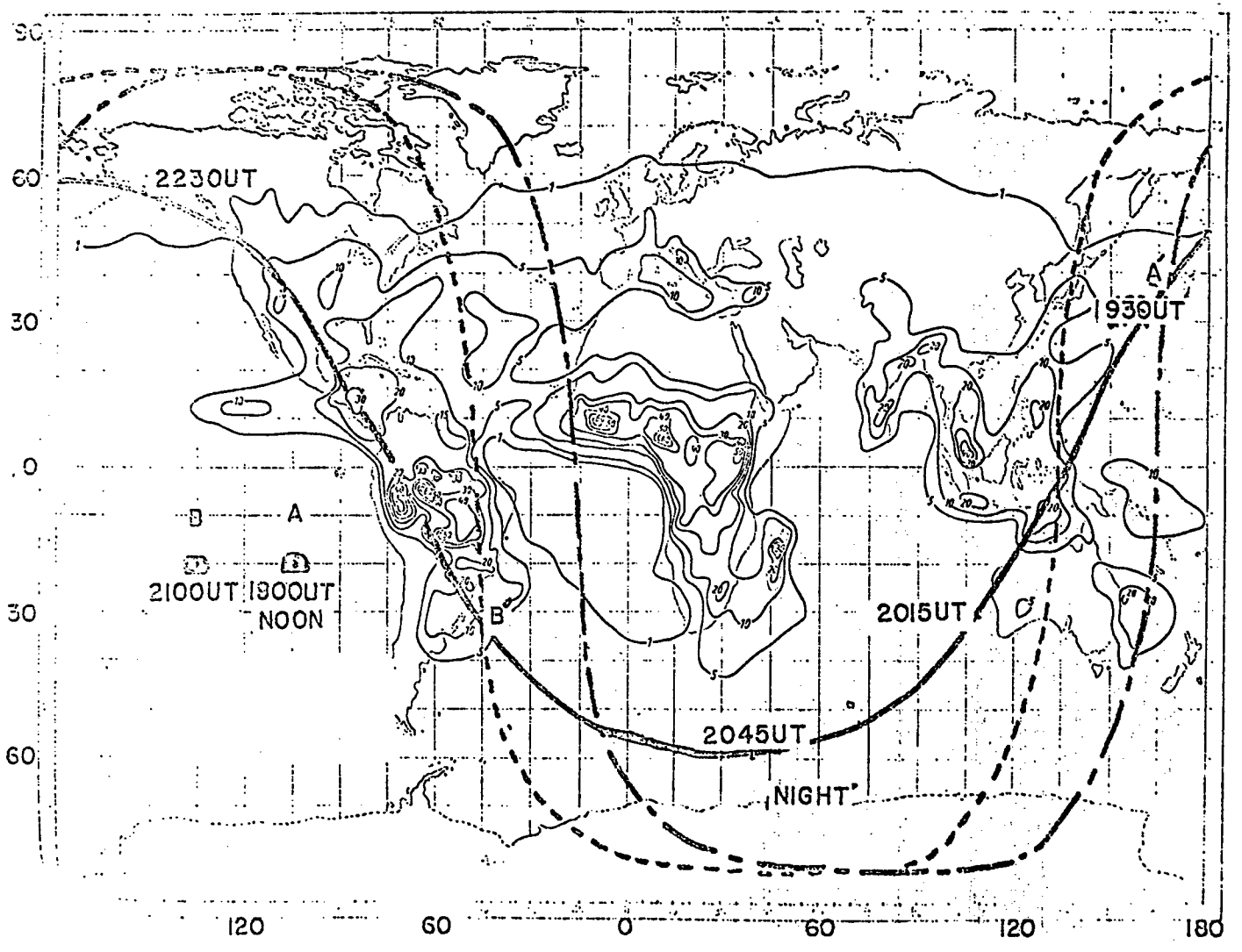

Figure 5 Distribution of thunderstorm days for Sept., Oct., Nov., (Ref. 14). Twilight lines are for 1900 UT (broken line; local noon at A), and 2100 UT (dashed line; noon at B), with the satellite at corresponding Orbital positions A and B.

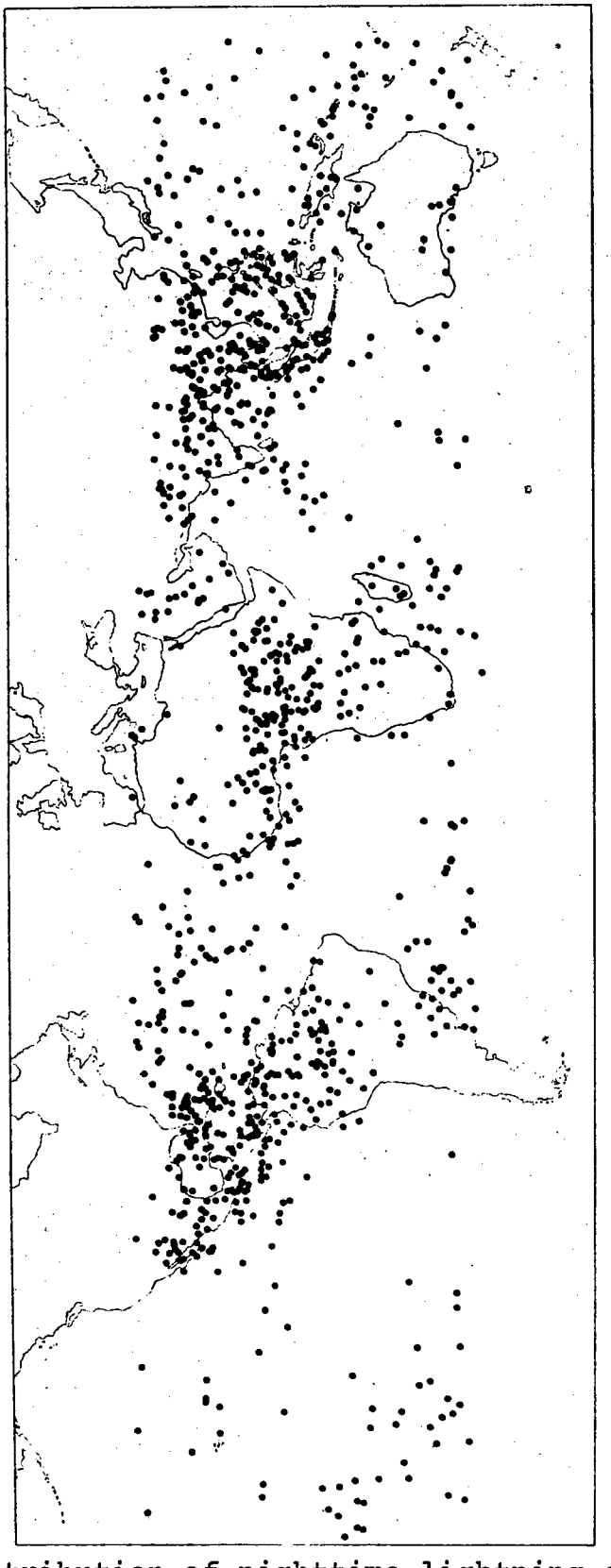

Figure 6 Distribution of nighttime lightning storm complexes observed by photometers on board satellite OSO-5 (Ref. 15).

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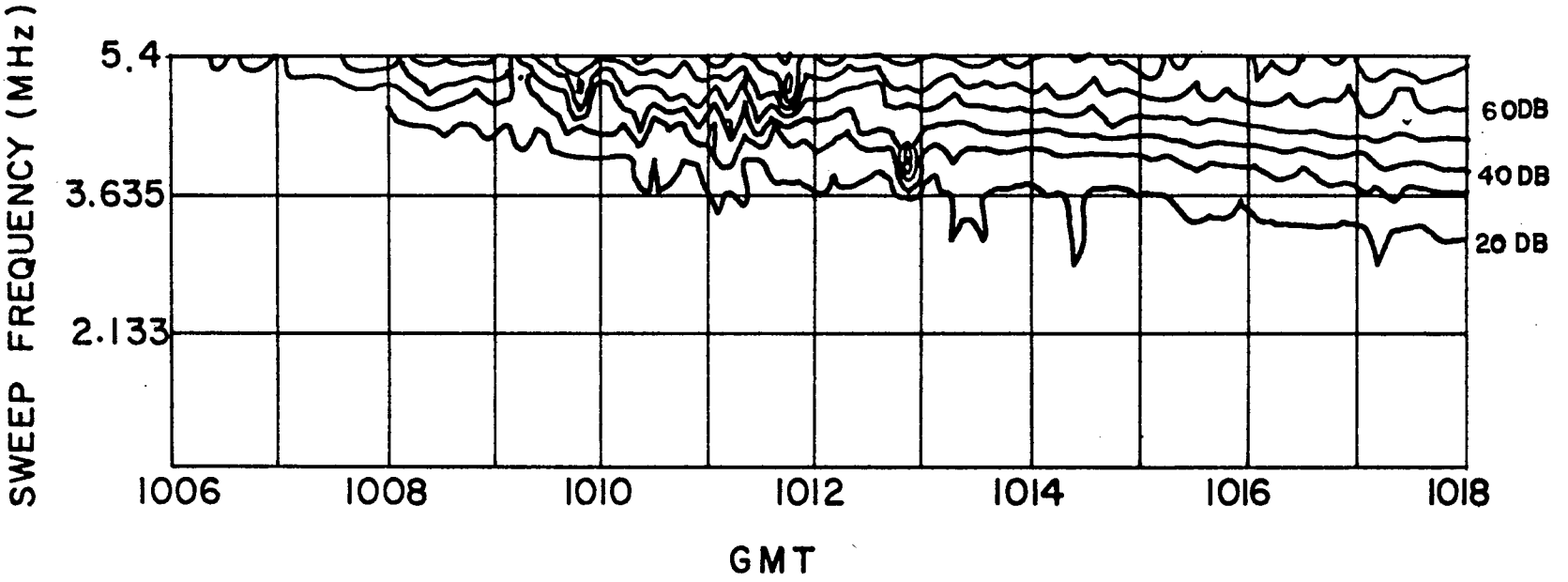
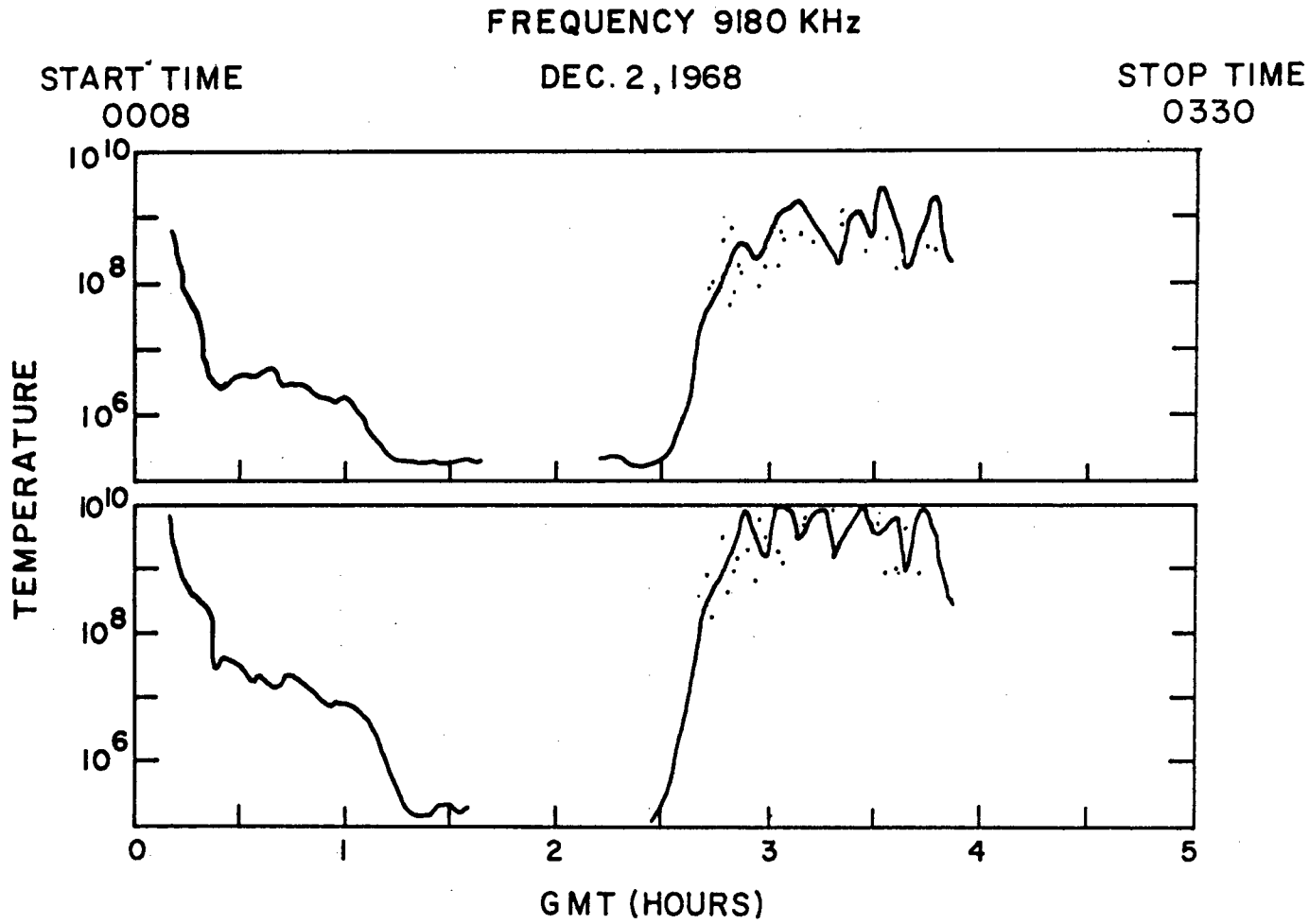


Figure 7 Typical example of terrestrial noise "ground breakthrough" observed in Burst receiver sweep frequency data (1006-1018) Dec. 2, 1968 UT).



GMAG-LAT	1	-32	-48	-30	2	34	48	27	-6	-39	-50
LMT	3.7	1.9	21.7	17.2	15.3	13.2	8.2	4.6	2.8	0.3	18.8

Figure 8 Representative RV temperature variation on 9.18 MHz measured by upper and lower Vee antennas for one orbit.

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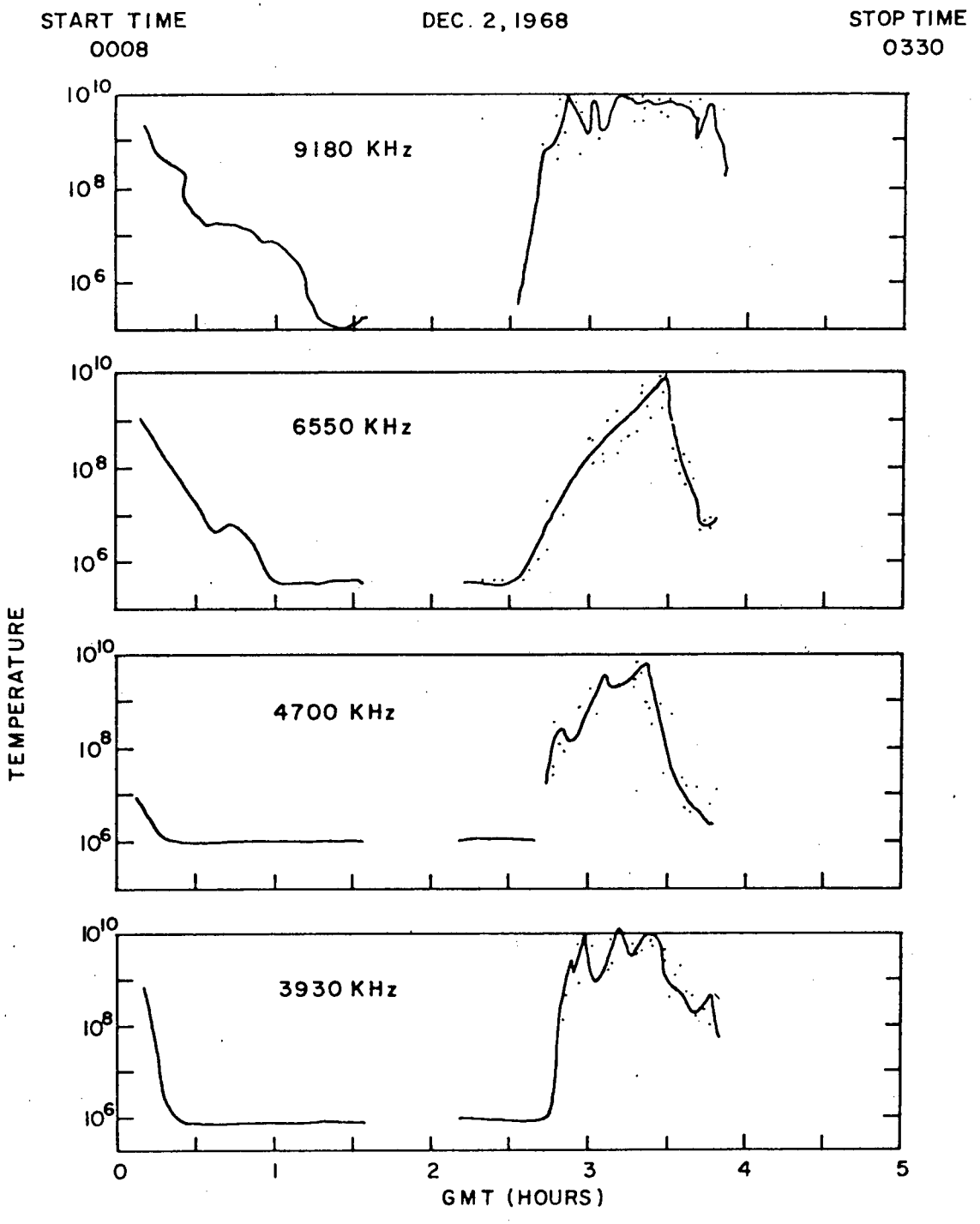

GMAG-LAT	1	-32	-48	-30	2	34	48	27	-6	-39	-50
LMT	3.7	1.9	21.7	17.2	15.3	13.2	8.2	4.6	2.8	0.3	18.8

Figure 9 Full orbit temperature variations measured by lower Vee antenna on 3.9 MHz, 4.7 MHz, 6.55 MHz, and 9.18 MHz.

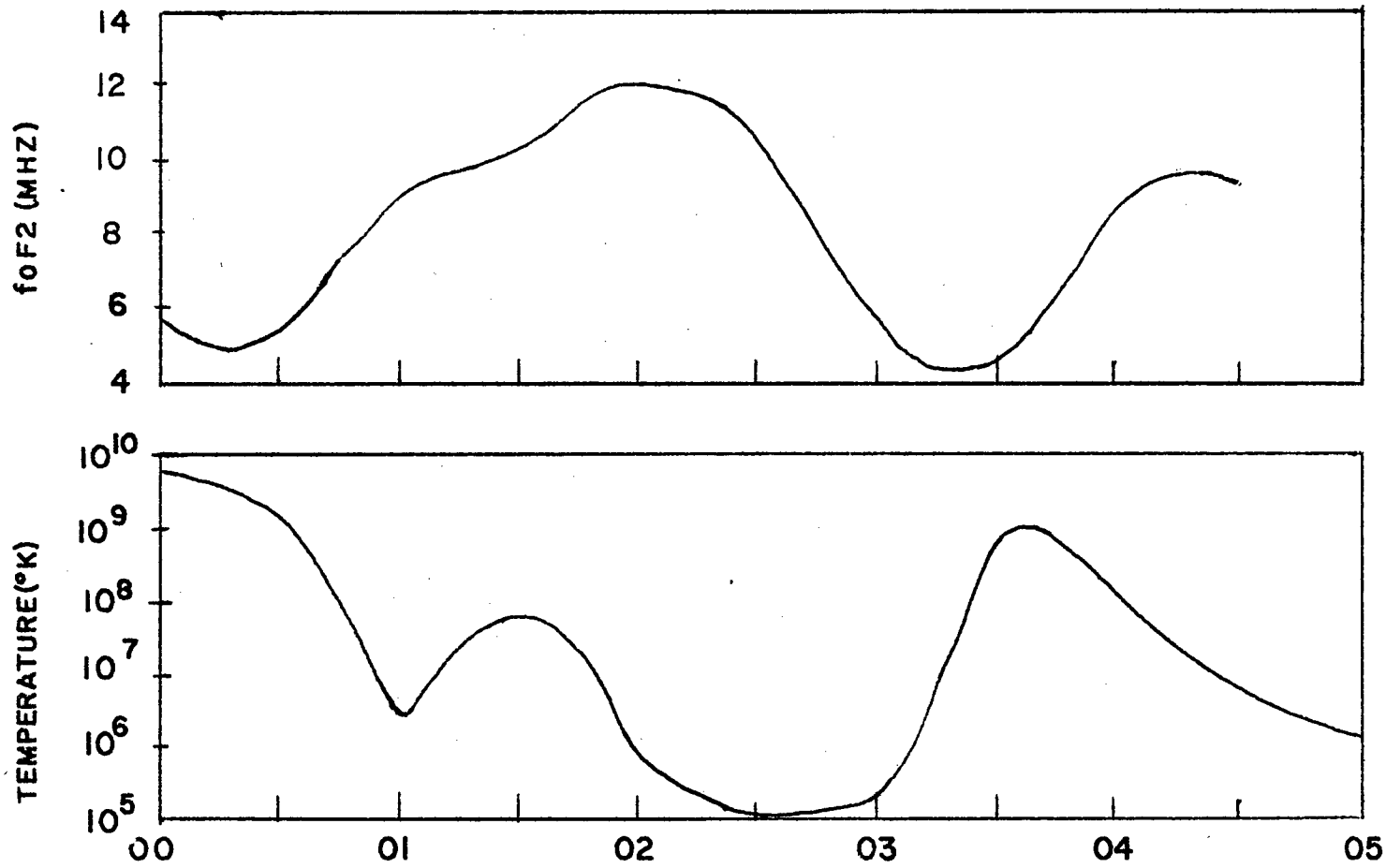

Figure 10 Predicted subsatellite point critical frequencies [9] and surface radio noise temperatures [3] for the orbit of 00-04UT, Dec. 2, 1968.

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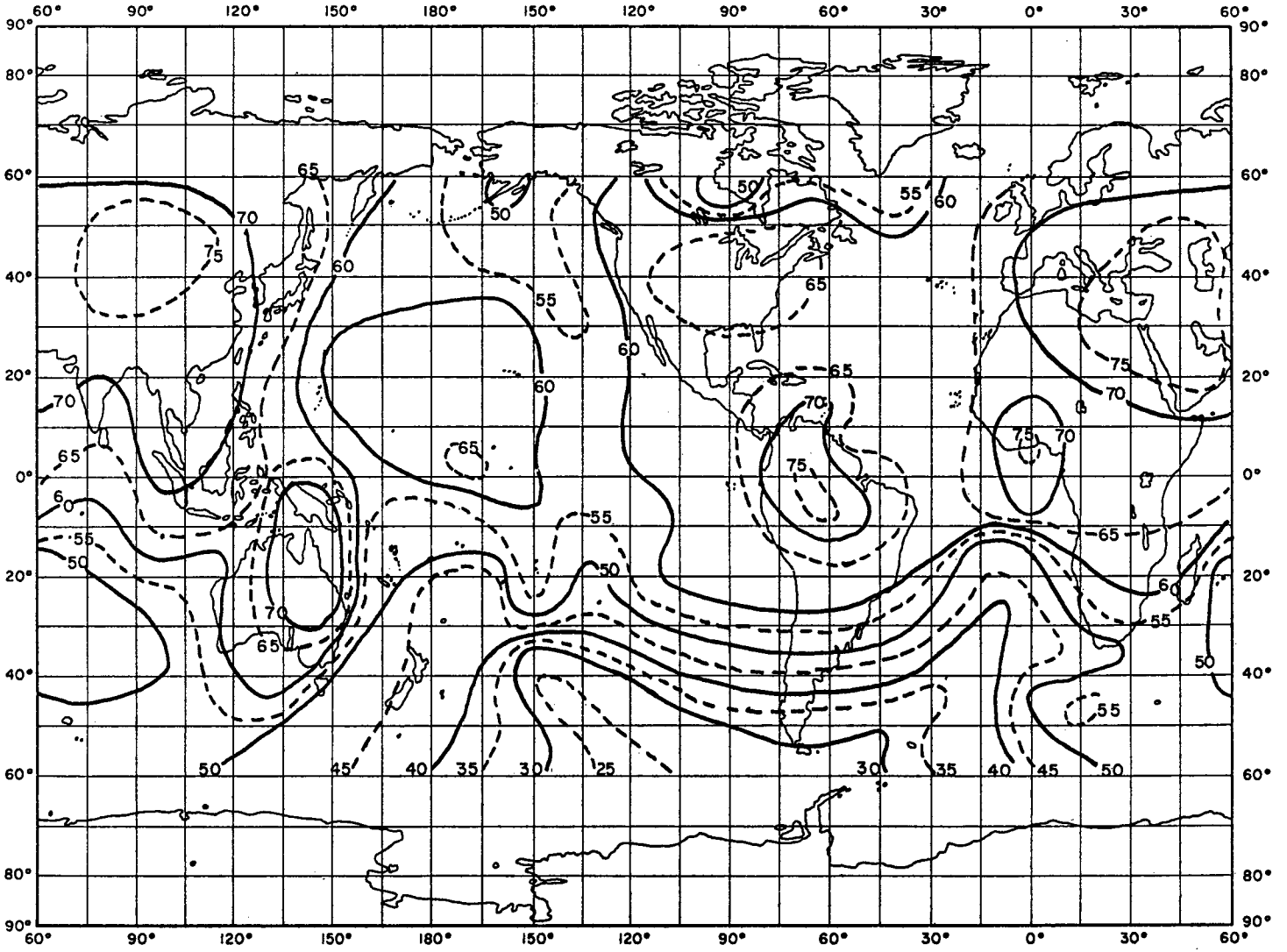

Figure 11 Terrestrial Radio noise distribution derived from RV lower Vee data on 9.18 MHz for Dec. 2-6, 1968, 0000 - 0800LT (Approx. 120 data points). Contour levels are dB above 288°K.

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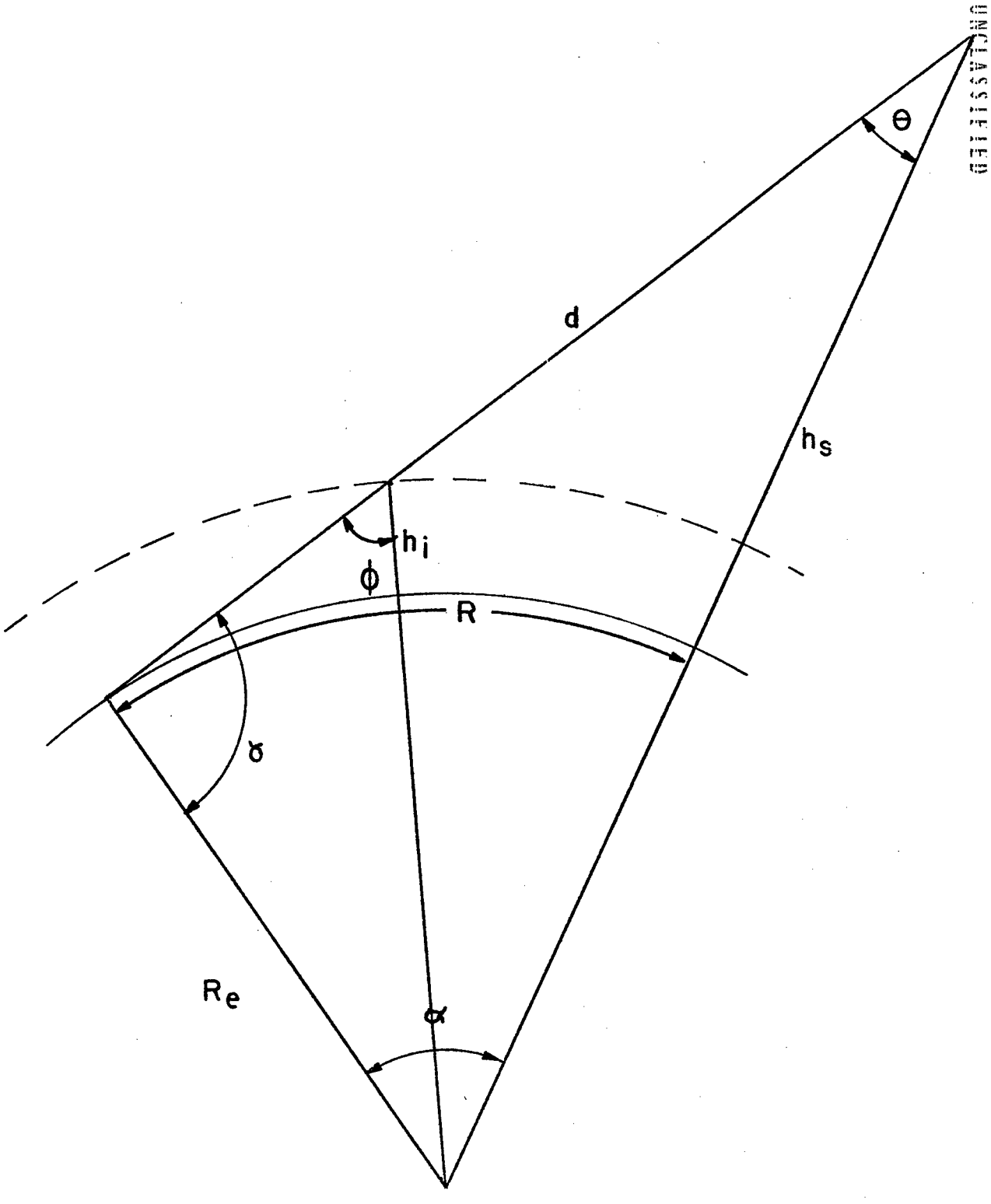

Figure A1 Earth-Satellite Geometry.

AIRBORNE SFERICS MEASUREMENTS

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Introduction

Sferics measurements were made from an aircraft in a preliminary investigation of whether noise originating in ground sources could be reduced, to learn the problems associated with sferics measurements from aircraft and to explore directional effects associated with antenna orientation. Being mobile, an aircraft can take a sferics recording system to remote locations where it would be difficult to set up a ground station. In addition, sferics measurements made aloft may offer other advantages. A horizontal antenna, such as a wire trailing from an aircraft, will sense the horizontal component of an electromagnetic signal; this has theoretical significance in lightning research and may for some lightning flashes increase the signal to noise ratio. To reduce noise the instrumentation can be physically removed from noise sources on the earth.

Procedure

Data were recorded in the vicinity of Albany, New York, on 1 Sept and 6 Sept, 1972. Noise from the aircraft was minimized by having all instruments battery operated and by turning off the aircraft's electrical system. Two methods of sferics recording were attempted. The antenna in both cases was a 25 m wire with a metal funnel on the end deployed through a hole in the aircraft's belly.

The first technique utilized the audio amplifier of a cassette tape recorder as a sferics detector. The antenna was connected directly to the audio input of the tape recorder. Sferics were heard and recorded. For data analysis the tapes were played back into an amplifier/integrator and converted to a strip chart record.

The second technique utilized a narrow band 27 kHz sferics receiver which integrates signal pulses producing a dc voltage that is graphically recorded. This receiver is normally used to record variations in sferics activity due to solar particles modulating ionospheric propogation. Instrumentation problems prevented recording the 27 kHz signal when this equipment was used in the aircraft and the sferics were observed only on an oscilloscope. The following description of the observational procedure and data refers to measurements made with the audio receiver.

The antenna was deployed shortly after takeoff and data were recorded while the aircraft spiraled up to 3.7 km and back

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down to near the earth's surface over the same location. In addition, records were made while the aircraft was flown at a constant altitude of 3.7 km, first west for 10 min and then north for 10 min. These runs were for comparison of signals with the antenna oriented east-west and north-south. At the time of these measurements, a cold front with some thunderstorm activity located approximately 800 km to the west of Albany was the only thunderstorm area near the northeastern United States.

Another series of measurements made within 200 m of the earth investigated the effect on the signal of the proximity of 60 Hz noise sources.

Results

a) Audio receiver

1. Tha amplitude and frequency of sferics increased with height above the earth; each approximately doubling in the first km of altitude. There were continued but less rapid increases in amplitude and frequency to the maximum height of the measurement, 3.7 km.

2. Sixty Hz noise was strong in the lower 200 m of altitude. It was clearly associated with proximity of the aircraft to noise sources, e.g., powerlines or houses. Sixty Hz "hum" decreased rapidly with height and was negligable at altitudes above approximately 1 km.

3. Connecting the antenna to the microphone input of the tape recorder in an attempt to increase signal strength resulted in reception of a local radio station; apparently because of rectification of the signal in the tape recorder.

4. No obvious correlation existed between signal and heading for data made when the plane was spiraling;although statistical treatment of the data might bring out such an effect. However during the 10 minute duration constant heading measurements, the east-west oriented antenna resulted in about a 20% higher sferics rate than when the antenna was oriented north-south.

5. The average rate of the more easily identifiable sferics at 3.7 km was about 2 per second. Weaker sferics could be heard but did not appear on the graphic record.

b) 27 KhZ receiver

1. No 60 Hz signal was observed.

2. There was slight noise when the aircraft engine was running (seen on the oscilloscope) which would not have interfered with the sferics measurements.

3. With the plane's electrical system on, noise was present that would have appeared in the measurement. Turning the master switch off eliminated this noise.

4. The estimated frequency of sferics observed on the scope was about 4 per second.

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Discussion and Summary

Sferics can easily be measured from an aircraft and signal to noise ratio increases with altitude.

Variations in antenna orientation did not have a large influence on signal strength. Since the east-west alignment seemed to produce a stronger signal,it would appear that sferic sources to the south were larger than those to the east or west,despite the relatively close thunderstorm area to the west. The measurements were made near the approximate time of the maximum in world-wide thunderstorm activity which is mostly due to storms in South America and Africa.

Sferics measurements made aloft are capable of sensing the horizontal and vertical components of the associated electric field while measurements made at the earth's surface can only sense the vertical component. Hill (1968, 1969) has suggested the importance of the horizontal component in studying the tortuosities of lightning stroke channels.

Mobile sferics equipment may be useful for certain applications. Geographical position is important for recording "whistlers". A long wire should be a sensitive antenna capable of sensing field changes in the vicinity of thunderstorms. This application may be of most value in studying maritime thunderstorms.

The research reported in this paper was sponsored in part by the Air Force Cambridge Research Laboratories, Office of Aerospace Research, under Contract F19628-68-C-0057 and in

part by the Office of Naval Research under Contract N00014-71-C-0156, but the report does not necessarily reflect endorsement by the sponsor.

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Hill, R.D., 1969: Electromagnetic radiation from erratic paths of lightning strokes, J. Geophys. Res., 74, 1922 - 1929.

A MODEL OF WORLD-WIDE SFERIC ACTIVITY

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ABSTRACT

Modeling and computer simulation of world-wide sferic activity is presented. Functions modeled include the sferic propagation attenuation losses, the sferic generating mechanisms of electrical storms, and the world distribution of the storms.

INTRODUCTION

Environment models for a multistation sferic detection system have been developed for the purpose of performance assessment. Two models are required for a system capability assessment. One is a lightning discharge model which represents the world distribution of thunderstorm activity as well as the sferic generating mechanisms. A second model provides a functional equivalent of the individual receiving station signal processing characteristics. This model also incorporates a signal propagation attenuation function.

Performance assessment is associated with each 5° by 5° geographical region on earth and is evaluated by the following factors.

a. System detection capability (i.e., source field strength required to exceed thresholds of at least N stations.)

This study was supported by the Air Force under Contract No. F33657-71-C-0095

b. Probability that a given source signal is detected by at least four (4) stations.

c. Expected accuracy of a source location fix.

Note that each station has a specific detection capability (as a function of its threshold) associated with each geographical element which is specified as the lowest source field strength (that exceeds the station threshold with a specified probability) attenuated by propagation losses.

Four (4) or more stations must record a signal in order to have a successful detection of that signal. The N stations with the greatest detection capability for a given region are termed "contributing" stations; the contributing station with the least detection capability is termed the "controlling" station. System capability is defined as the minimum field strength of a source that exceeds the controlling station threshold with a specified probability. This field strength is termed minimum detectable field strength (MDFS) at the given geographical region.

MDFS is obtained by considering only the N stations which have the best detection capability for the region of interest. A given source field strength may produce a signal that exceeds threshold at other than contributing stations. It is possible, for example, that a given field strength would not exceed threshold at a contributing station and yet exceed threshold on noncontributing stations. Thus, the probability that a given event is detected (recorded by a sufficient number of stations) must be computed considering the capability of all stations. This system performance measure (item b above) is the probability that at least four (4) stations record the signal and, therefore, includes the probability that each system station records the signal.

The third performance measure, fix accuracy, is specified by the length of the major axis of an error ellipse fitted around the location fix by at least squares estimation procedure. A 50% confidence factor is used for the error ellipse.

To facilitate computation, performance measures b and c are not treated explicitly. Instead, it is required that:

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- The probability of detection at each station will equal or exceed 0.90.

- Each region will be within the azimuth purview of at least N stations.

These constraints ensure (with reasonable station location restriction) that performance measures b and c above will have satisfactory values and offer the advantage of considerably reduced computation.

SYSTEM MODELS

STORM MODEL

The storm model is used in stationary simulation of worldwide sferic generation for a particular time-of-day and day-of-the-year. Inputs for the model consist of the statistical parameters and distributions that characterize the sferic generating mechanisms. During a storm, flashing occurs at a rate dependent on the storm's age; a certain percentage of the flashes travel to earth (a function of latitude), while the remainder travel between clouds. (References 2, 3, and 4) Each ground flash produces several return strokes which produce the sferics of interest; their intensities follow a log-normal distribution in dB. (References 2 and 4) In addition to these sferic-generating mechanisms, the model employs a historical storm activity array made up of an expected lightning flash density in each 5° by 5° region (Reference 1) and a constant representing the number of storms in existence over the earth during the chosen time of day and year. (Reference 2) The distributions used in the storm model are shown in Figure 1. The model output is an array of strokes per second expected to occur in each 5° by 5° region during the selected period.

Two types of storm models have been developed. One storm model is used in a Monte Carlo simulation that generates the number and location of strokes worldwide via random-number generators applied to the distributions identified above. For faster computation a second model was developed which uses the averages of the distributions. With the second model, the strokes per second from a region, i, are computed as:

$$S_i = NS \times H_i \times F \times f(L_i) \times R$$

where,

NS = total number of storms on earth at specified time

H_i = historical lightning activity density for region i

F = average flashes per second from a storm

L_i = latitude in degrees of region i (See Figure 1)

R = average number of return strokes per flash to ground

f( ) = the fraction of strokes which go to ground as a function of latitude

STATION MODEL

Each station records signals that exceed its trigger threshold and are within its assigned azimuth purview. The station has the ability to analyze one pulse at a time via a gating device that closes when a signal enters the system and reopens when analysis and/or recording of the signal is complete. If a signal impinges on a closed gate, its presence is never detected. A signal intensity greater than or equal to the threshold is termed a "trigger" and is admitted through the gate (if it is presently uninhibited). Each trigger undergoes azimuth discrimination which requires T_1 seconds. If the signal source is not within the station's required azimuth purview, the signal is not recorded and the gate is reopened. If, however, the source is within the required sector, the signal is recorded which requires an additional T_2 seconds.

The arrival rate of triggers at a station is computed by summing the strokes per second contributed by each 5° by 5° region.

$$TR = \sum_{i=1}^{2520} S_i \times P_i$$

where P_i is the fraction of pulses from region i which will arrive at the station with an intensity greater than the threshold:

$$P_i = \int_T^\infty N_i(x)\, dx$$

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where,

N_i (x) is a log normal distribution with mean μ_i and standard deviation σ

μ_i = average source field strength of a signal minus the signal attenuation

σ = standard deviation of field strength (See Figure 1)

T = station threshold expressed in field strength

x = field strength (dB)

Attenuation of a pulse is a nonlinear function of the range between region i and the station. The arrival rate of 'records' is:

$$RR = \sum_{i=1}^{2520} S_i \times P_i \times K_i, \quad K_i = 1 \text{ if region i is in the station azimuth purview.}$$

$$K_i = 0 \text{ if region i is not in the station purview.}$$

The probability that a station will detect a given signal is simply equal to the proportion of time its gate is open. Since the arrival rates TR and RR are assumed to be generated by a Poisson process, the mean duration of gate-open time is equal to the mean interarrival rate of incoming sferics. (Reference 6) Therefore, the proportion of time the gate is open (G) at a station is:

$$G = \frac{1}{1 + TR \times T_1 + RR \times T_2}$$

NETWORK MODEL

The network consists of stations which record signal data independently. The goal of the system is to maintain a required level of performance in each 5° by 5° region or, as stated previously, to detect a certain field strength in each region on earth with a specified

probability and a specified location fix accuracy. The main task of the network model is to compute the system probability of detection as a function of the gate-open times of the stations which can detect the signal.

System probability of detection at a geographical element is a function of the stations which are capable of seeing a particular signal from that element; i.e., the element is within their azimuth purview, and the signal is of sufficient field strength to trigger the station. It is assumed that the trigger and record rates experienced at any station are independent of those computed by the other stations; therefore, the basic addition and multiplication theorems concerning independent events can be applied. In the actual model, MDFS is computed using five (5) stations, although four (4) are sufficient for an accurate location fix. Consequently if each of the five (5) stations is required to maintain a minimum gate-open time of 90%, then the overall system probability of detection at a geographical element has a lower bound of 91.8%. [P (at least 4 detections) = $(0.9)^5 + 5 \times (0.1) \times (0.9)^4 = 0.918$]. If more than five (5) stations are capable of detecting a certain signal from the element, or any station's gate-open time exceeds 90%, then the system probability of detection will be higher.

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LIGHTNING DISCHARGE CHARACTERISTIC	PROBABILITY DENSITY FUNCTION	MEAN	STANDARD DEVIATION	REFERENCE
Number of New Storms Per Interval	Gaussian	6 Storms	2 Storms	Function Of Season and Region
Location of New Storm Regions ($5^{o} \times 5^{o}$)	Empirical	Thunderstorm Day Data		Ref 1
Location of Storm Cell Within in $5^{o} \times 5^{o}$ Region	Uniform			Assumed
Storm Lifetime	Gaussian	30 min	4 min	Ref 4, P. 3 Ref 3, P. 54
Storm Cell Flashing Rate	Empirical (Triangular)	Function of Storm Age		Ref 4, P. 3
Time Interval Between Flashes	Exponential	1/Flashing Rate		Ref 2
Flash to Earth	Empirical	Function Of Latitude		Ref 3, P. 38 Ref 4, P. 5
Number of Return Strokes per Flash	Exponential	3 Strokes		Ref 2, P. 89 Ref 4, P. 71
Time Interval Between Return Strokes	Exponential	50 Msec		Ref 2, P. 28
Amplitude of First Return Stroke	Log-Normal	60 dB+	6-8 dB+	Ref 4, PP. 39-41 Ref 2, P. 116
Amplitude of Remaining Return Strokes	Log-Normal	54 dB+	6-8 dB+	

+ dB Above 1 Millivolt/Meter at 1000 KM From Stroke

FIGURE 1

PROBABILITY DISTRIBUTION FUNCTIONS OF THUNDERSTORM CHARACTERISTICS

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Cathode-Ray Direction Finding (CRDF)

Lightning Location in Sweden

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Cathode-Ray Direction Finding (CRDF) Lightning Location in Sweden

1. Introduction

VLF systems using crossed-loop antennas are used routinely to locate distant thunderstorms (Horner 1964). Cathode-ray direction finding (CRDF) systems using VLF have been in operation notably in the United Kingdom for over two decades. However, there were not many observations where the CRDF measurements have been correlated with visual observations of lightning. The accuracy of lightning location is of importance to forestry departments, electrical companies etc.; detailed investigation of CRDF measurements with visual observations is very useful. This paper describes such investigations conducted in Sweden during the summer of 1971.

2. Experimental Arrangement

The author in cooperation with Institutet for Hogspanningsforskning, Uppsala, University, Sweden used two direction finders simultaneously. The Institute has a 10 KHz direction finder at its field station in Vitemolla (S.E. Sweden) and a 27 KHz direction finder in Uppsala (Central Sweden).

2.1 10 KHz CRDF

The 10 KHz CRDF was designed by C. Plath G.M.B.H. of Hamburg, West Germany, and is commercially available. The DF has been constructed as a twin channel receiver with a wide bandwidth (3 KHz). It consists of the usual twin loops placed 90° to each other and a sense antenna to eliminate the 180° ambiguity in reading the bearing of a sferic. For accurate reading of the bearing a cursor is arranged in front of the CRT which can be turned to

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coincide with the bearing. The CRT itself is of long persistance type enabling the observer sufficient time to read the bearing. The sensitivity of the instrument can be changed by turning a switch manually to ten different positions covering a range of amplification 1:1000. As there is no gating circuit, the bearings of sferics are continuously displayed on the CRT.

2.2 27 KHz CRDF

The 27 KHZ CRDF consists of the following units:

(i) the antennae unit
(ii) the connecting cables
(iii) the gating unit with phase compensating network
(iv) the X-Y oscilloscope, and
(v) the calibrating unit.

The antennae unit consists of two vertical electrostatically screened loop antenna. The vertical antenna, which acts as a sense channel is a 7 m metal pole with a capacitance to ground of 25 PF. The main function of the gating unit is to produce a brilliance pulse of a definite length (approximately 18 μs) and certain amplitude for the first half-cycle of a sferic which has an amplitude exceeding a certain threshold level. After receiving a sferic with the above characteristics, the input of the unit must be closed for a certain time (e.g. 0.5 to 1.5 s) so that only one display will be obtained for each sferic. The gating time of the instrument is between 0.5 and 1.5 sec and is manually changeable. Thus, the design of the instrument enables the reception of the ground wave preferentially, thereby reducing polarization errors.

3. Observations

Both instruments were tested initially in Vitemolla to see that the bearings obtained from both are the same within the limits of error. Photographic observations were made both with 35 mm camera and polaroid oscilloscope camera to test the convenience, speed and reliability. On the basis of several observations it was decided to use the polaroid oscilloscope cameras. Next, photographs were taken with different lens openings and shutter speeds taking into consideration the differences in the two CRDF's to choose suitable values. Photographs were also taken at different sensitivity settings of the CRDF to estimate the approximate range (distance) of the sferic sources. Then the two stations - Uppsala (27 KHz) and Vitemolla (10 KHz) were set up and photographs of the CRT taken at the same time at both stations, e.g. 0855, 0900, 0905, 1455, 1500 hours irrespective of the local weather conditions. In addition, cooperation of individuals from many parts of Sweden was enlisted to phone in to the central station in Vitemolla if there was a storm and/or lightning in their area. As soon as a telephone message was received in Vitemolla, Uppsala station was contacted and the equipment was ready for operation very shortly. Both stations are equipped by accurate omega clocks and are checked regularly with time signals.

Five typical observations are given in figures 1-5. The latitude and longitude values of relevant places in Sweden are given in Table 1 (see following page).

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TABLE 1

Latitude and longitude of relevant places in Sweden

Place name	Lat.	Long.
Göteborg	57° 43'	12° 01'
Halmstad	56° 41'	12° 50'
Ludvika	60° 10'	15° 12'
Uppsala	59° 53'	17° 38'
Vitemolla	55° 40'	14° 17'
Visby	57° 39'	18° 21'

4 August 1971 (1203GMT)

Telephone call from Goteborg, Western Sweden received at Vitemolla around 1230 hours. The message was that a thunderstorm was in progress in Goteborg. The CRDF station in Uppsala was alerted immediately. Simultaneous photographs of sferics bearings observed by the two direction finders were taken at 1303 hours (1203GMT) with one minute exposure and the bearings of the observed sferics plotted on a map. The crossover point corresponds to Goteborg on the map (figure 1).

Also plotted on the map are sferics fixes at 1200GMT from the United Kingdom network. It is important to note that the UK observations were taken during 1150 to 1200GMT (ten minute period) and represent averaged values of bearings of sferics within a close range. In addition to these, meteorological information regarding thunderstorms was also plotted on the same map. The meteorological information is obtained from both Swedish and European maps. These maps list among other things the occurrence of TSTMS at various observing stations and usually cover three hour periods.

The results of Swedish observations are in general agreements with UK bearings and meteorological information from European maps.

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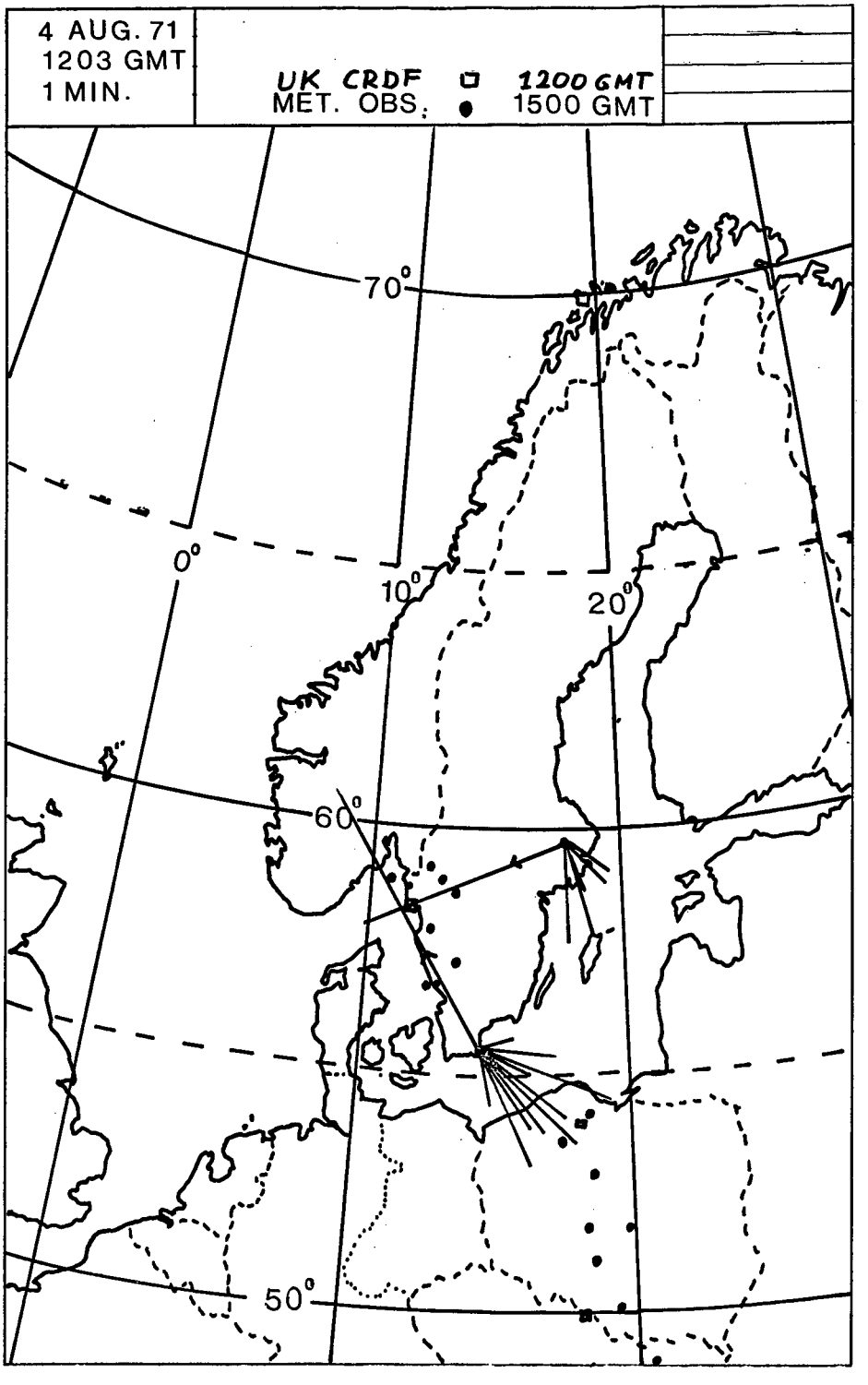

Figure 1

4 August 1971 (1945GMT)

The observing station at Vitemolla received at 2030ET a telephone call from Ludvika, Sweden regarding the progress of a thunderstorm. Simultaneous observations were taken at Uppsala and Vitemolla at 2045 (1945GMT) for a 30 second period. Figure 2 shows the observations together with the information from the United Kingdom network (1950-2000GMT) and European meteorological maps (1800GMT).

The intersection of bearing lines from Vitemolla and Uppsala intersect near Ludvika. It is interesting to note the general agreement with UK data. Even a 30 second exposure gave enough information to locate the thunderstorm near Ludvika.

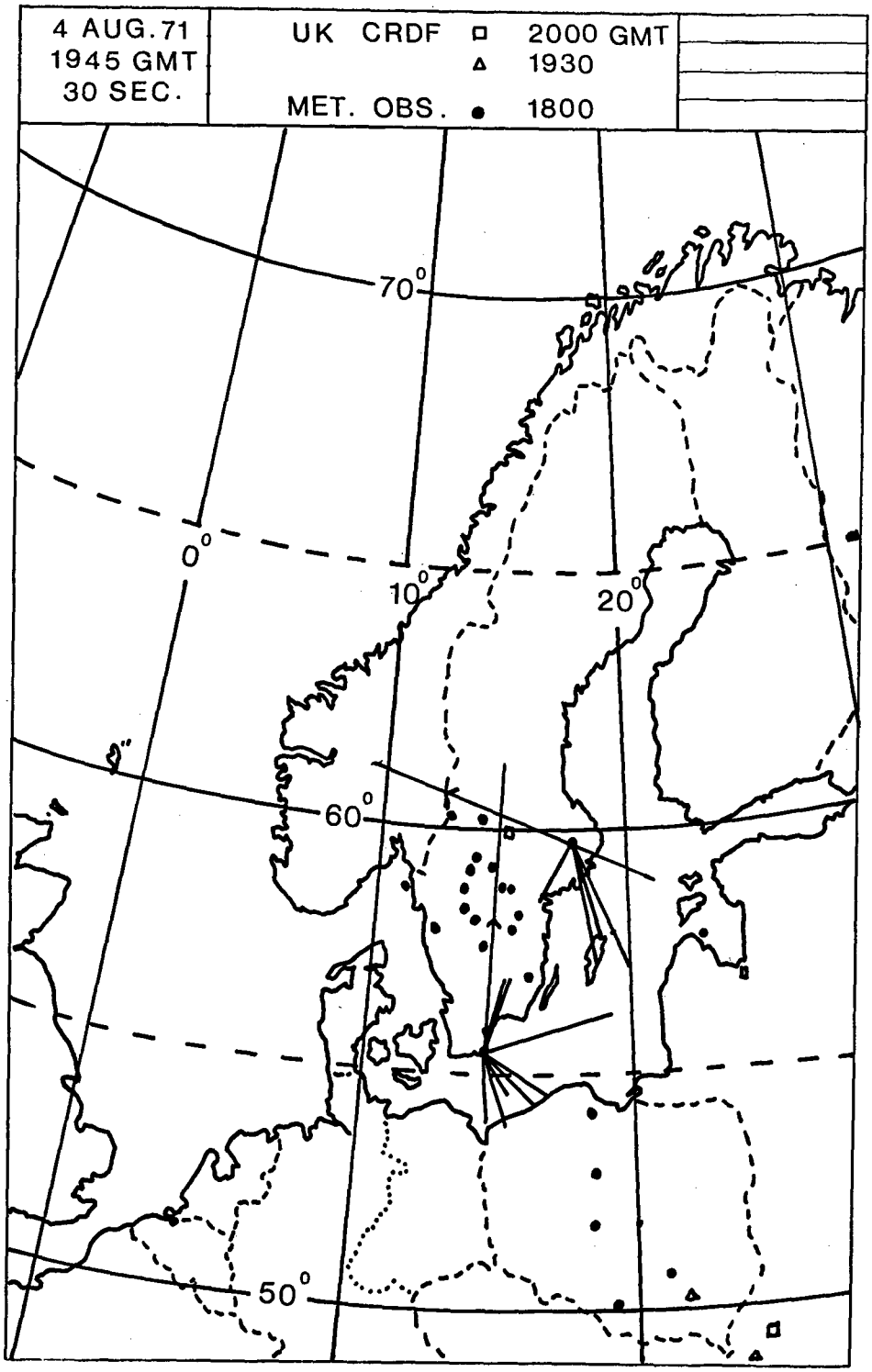

Figure 2

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7 August 1971 (0840GMT)

A local thunderstorm occurred during 0800-0830ET. Simultaneous observations at both stations taken at 0940 hours (0840GMT) are shown in figure 3. Note the long range of the detection system. (TSTMS in S.E. England.)

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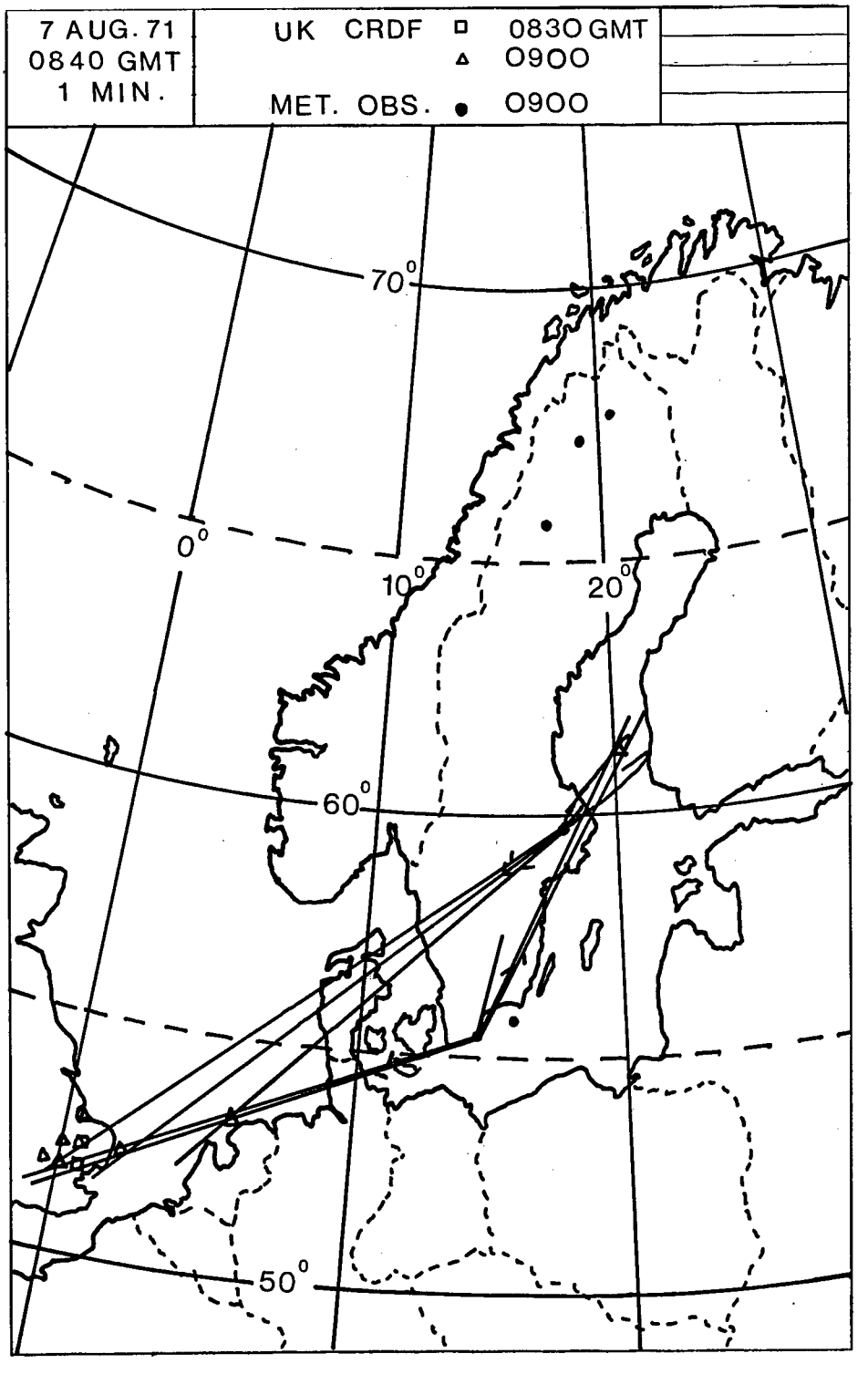

Figure 3

11 August 1971 (1400 and 1843GMT)

Figures 4 and 5 show crossover points at Halmstad and visby respectively. Information was received from both the above places regarding TSTMS in the area prior to CRDF measurements.

The above examples are important for the following reasons:

(i) Even with two CRDF stations one could get useful information regarding bearings of sferics.

(ii) While both stations should normally have identical equipment, reasonable variation in the detection frequency of the equipment is tolerable.

(iii) The information obtained from CRDF stations agree with visual observations (telephone reports to the central observing station at Vitemolla).

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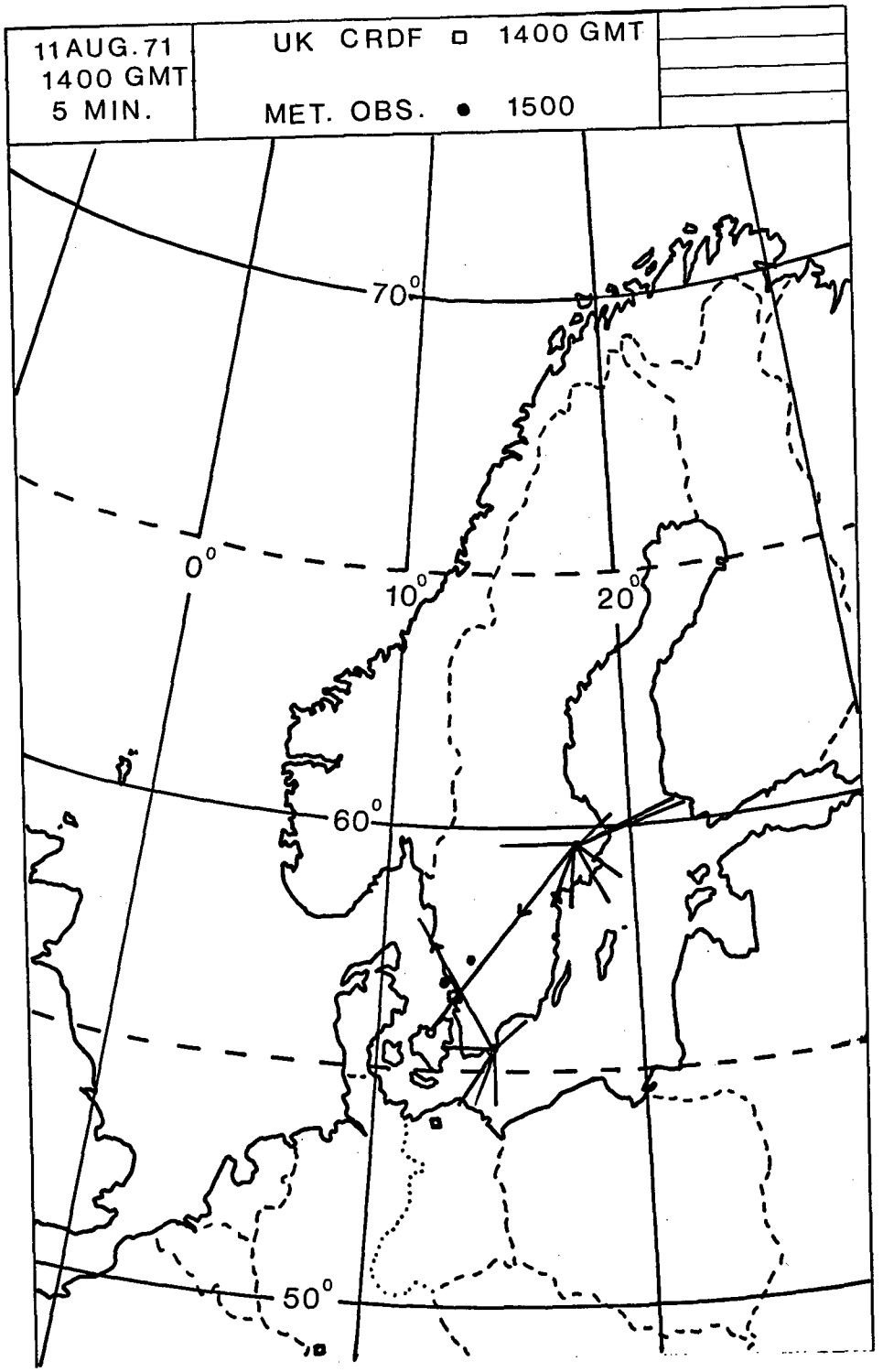

Figure 4

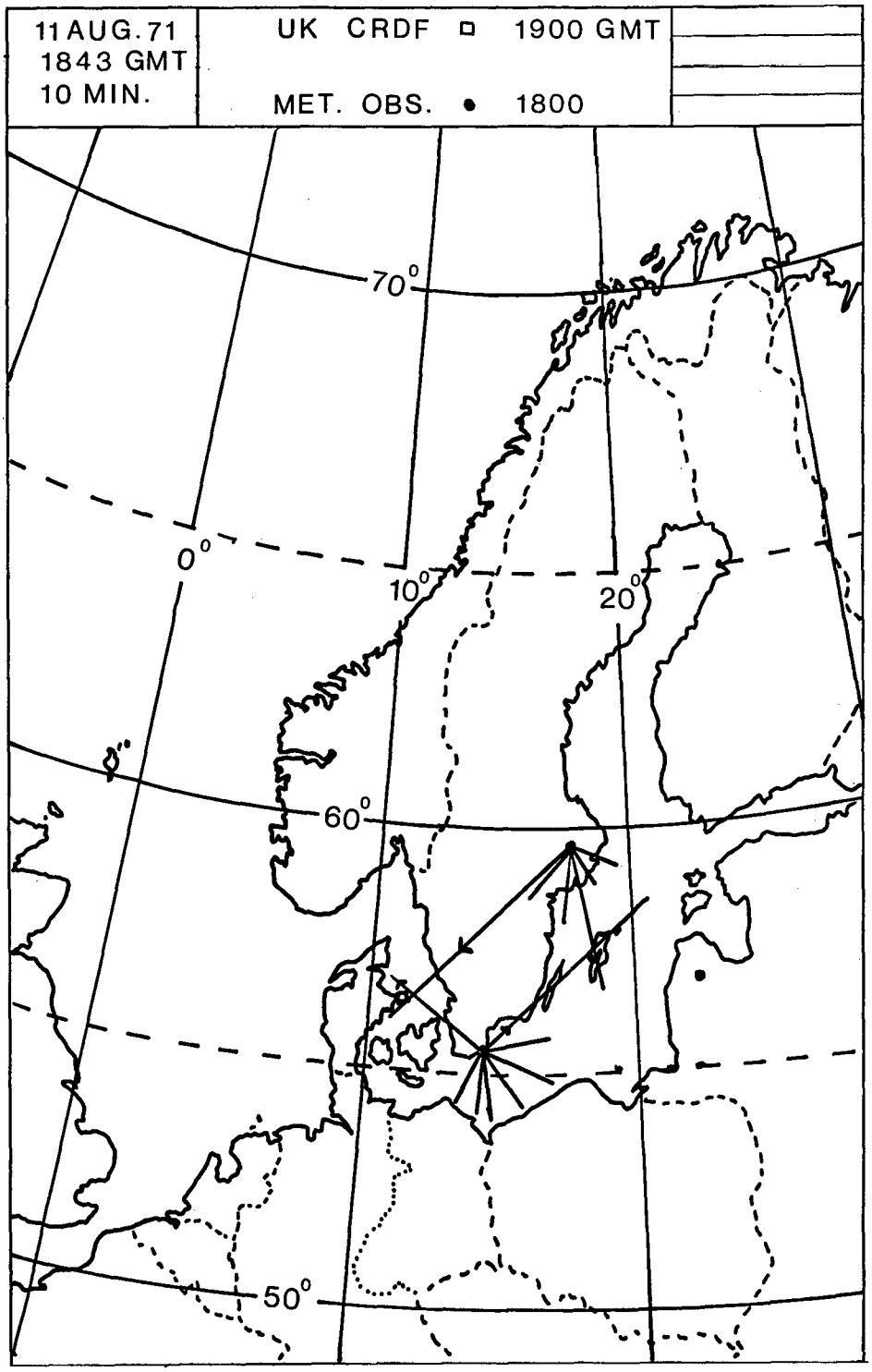
11 AUG. 71
1843 GMT
10 MIN.
UK CRDF ▫ 1900 GMT
MET. OBS. • 1800
70°
0°
10°
20°
60°
50°

Figure 5

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4. Conclusions

The purpose of these experiments is not only to obtain the intersection points of bearings to locate the sources but also to check the reliability of these with visual observations (telephone communication).

In addition, data from the United Kingdom sferics network was obtained for comparison. The bearings were also compared with European Meteorological maps from the Swedish Meteorological office. The results show good agreement with visual observations.

It is important to note the following factors in the interpretation of data:

(i) The two CRDF's are not identical and operate at different frequencies.

(ii) One instrument displays sferics continuously while the other blocks off incoming signals for short intervals (e.g. 0.5 to 1.5 sec).

(iii) Difficult to match the sensitivities of both instruments exactly.

(iv) Observation times varied between 30 sec and 10 minutes.

(v) U.K. sferics fixed are obtained from observations for the ten minute period prior to every hour, e.g. 1150 to 1200 etc., and bearings within a close range of values are averaged.

(vi) European meteorological maps contain TSTM information for every three hours (usually).

(vii) Gnemonic projection map drawn for U.K. network stations (4 in U.K. plus Gibralter, Malta and Cyprus) was used in

our experiments instead of one drawn specifically with Vitemolla and Uppsala as observing stations.

(viii) Larger number of observations over much longer period is required to estimate all the sources or error.

Taking into consideration all the above factors, the agreement with visual observations is very good. In many instances, the intersection points coincide or at least close to the UK fixes. It should be remembered that some of the UK fixes are based on one observation while others are averages of 4 or 6, or 10 observations. The method certainly shows promise for further experimentation in Canada.

5. Acknowledgements

The author is greatly indebted to Professor Stig Lundquist, Director Institutet for Hogspanningsforskaning, Uppsala University, Uppsala, Sweden, for making the the facilities available. The author expresses deep appreciation to Dr. Viktor Scuka of the above Institute for operating the Uppsala CRDF station and for helpful comments. This work was supported by the Atmospheric Environment Service, Government of Canada under contract No. 81423.

6. References

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VI

Results Obtained with the HHI Atmospherics Analyzer

Wednesday, 13 September 1973 0900-1200 EDT, Arlington, Virginia

"Review of German Equipment for Locating Thunderstorm Areas"	H. Volland
"Statistical Analysis of Data from the Atmospherics Analyzer"	Joachim Frisius and Günter Heydt
"Results Obtained with the Atmospherics Analyzer at Toyokawa"	Tosio Takeuti
"Applications and Plans for the Atmospherics Analyzer in Argentina"	Carlos A. Hofman
"Observation of Single Storm Complexes with the Atmospherics Analyzer Network"	Günter Heydt
"Computer Analysis of Data from the Atmospherics Analyzers"	Rodney B. Bent and George Nesterczuk
"The Omnidirectional Activity and Dispersion of VLF Atmospherics"	W. Harth
"Daily Variations of VLF Atmospherics Parameters for Long-Lasting Thunderstorms"	W. Harth

REVIEW OF GERMAN EQUIPMENT FOR LOCATING THUNDERSTORM AREAS

by

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Bonn University
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ABSTRACT

A short description is given of an apparatus which within the VLF-range measures as a function of azimuth a) the statistical distribution of the spectral amplitudes b) the ratio of the spectral amplitudes at two different frequencies c) the group time delay of atmospherics coming from discrete thunderstorms. A theoretical interpretation of these measurements follows. Two specific anomalies are considered in greater detail: a) the frequency dependence of the total number of atmospherics from a single thunderstorm b) a splitting of the group time delay value during sunrise observed from thunderstorms south of the receiving station.

1. MEASUREMENT

At the Heinrich-Hertz-Institut in Berlin-Charlottenburg, Germany, an apparatus has been developed which allows the measurement of the statistical amplitude distribution of the VLF spectrum for a given frequency between 5 and 50 kHz, the ratio of spectral amplitudes at two different frequencies and the statistical group time delay of the phase of the VLF spectrum of atmospherics coming from discrete thunderstorms. The apparatus' three receivers are within a compact unit. They can be operated manually or automatically. In manual operation a polaroid camera is used while for the automatic operation a camera recorder is included. Since October 1965 three versions of this equipment have been working at three widely spaced stations in West-Germany on an automatic basis, giving each hour five different measurements of the kinds described below. A short description of the technique can be found in Reference 1. A detailed technical description of this equipment has been given by Heydt (Reference 2).

Figure 1 to 4 show oscillographs of the three kinds of measurements. The oscillograph screen is exposed for 5 minutes. Each point on the Figures 1 to 4 belongs to a single atmospheric coming from a distinct azimuthal direction. Figure 1 gives the spectral amplitudes of the atmospherics measured with a narrow band amplifier at 9 kHz. Three distinct thunderstorms of different sizes and direction can be separated from the background noise (which consists of atmospherics from more distant thunderstorms).

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Figure 2 gives the spectral amplitude ratio between 8 and 6 kHz of the same thunderstorms (2 hours earlier) which produce the accumulations of spots. Each spot is due to a single lightning discharge. Figures 3 and 4 show measurements of the group time delay versus azimuth at 7 kHz midst frequency and at a bandwidth of 1.4 kHz. The group time delay is the second derivative of the spectral phase of an atmospheric with respect to the angular frequency. Each cluster again results from a single thunderstorm placed within a discrete distance from the receiver.

2. THEORY

The vertical component of the electric field strength of a single atmospheric at a distance ρ from the receiving station can be expressed by the Fourier integral (Reference 3)

$$E(\rho, t) = \int_{-\infty}^{\infty} b(\rho, f)\, g(f)\, e^{j\left\{\omega t + \Psi(\rho, f) + \psi(f)\right\}} d\omega \qquad (1)$$

where ρ is the distance, t the time, f the frequency, $\omega = 2\pi f$ the angular frequency,

$$B(\rho, f) = b e^{j\Psi}$$

is the transmission function of the wave guide between earth and ionosphere and $G(f) = g e^{j\psi}$ the radiative component of the spectral function of the atmospheric at its origin, related to a distance of $\rho = 1$ km.

By a measurement of the kind described in Figure 1 values proportional to the amplitude of the Fourier component in Equation (1),

$$U = Ab(\rho, f)\, g(f)$$

can be determined. The number of atmospherics exceeding a certain threshold S (indicated by a vertical fictive line in Figure 1) is

$$N = N_0 \int_{S/Ab}^{\infty} W(g, f)\, dg \tag{2}$$

where $W(g, f)$ is the probability function of the spectral amplitude g. Figure 5 shows the counting of N versus S of a thunderstorm located 800 km east of the receiving station Berlin at three different frequencies. To a first order approximation the counted points can be fitted by a straight line (on semi-log paper) indicating that the probability function in Equation (2) can be represented by the following expression:

$$W = \frac{1}{g_0} e^{-g/g_0} \tag{3}$$

with

$$g_0(f) = \int_0^{\infty} g(f)\, W(g, f)\, dg \tag{4}$$

the mean value of g.

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The slope of the lines equals

$$\Lambda = Ab(\rho, f)\, g_0(f) . \tag{5}$$

Measurements of thunderstorms situated at different distances from the receiver allows us to separate the value $g_0(f)$ from $b(\rho, f)$ (Reference 3). Thus the transmission function of the wave guide b and the mean amplitude g_0 of the spectral function of the lightning discharges can be derived as functions of distance and frequency. Moreover the total number N_0 of discharges in a thunderstorm within a defined time interval can be determined.

Table I gives values of g_0 as function of frequency derived from this method.

Measurements of the kind shown in Figure 2 give the ratio

$$\frac{U(f_1)}{U(f_2)} = \frac{b(\rho, f_1)\, g(f_1)}{b(\rho, f_2)\, g(f_2)}$$

of each atmospheric. The scattering of the points within a cluster in Figure 2 results from the statistical distribution of the values of g for the individual atmospherics and from the spaced area of the thunderstorm in which lightning discharges are generated at different distances from the receiver. Measurements of this ratio as function of frequency, time and distance of the thunderstorms allow us an additional determination of b and g_0 within the VLF range (Reference 4).

Measurements of the kind shown in Figures 3 and 4 give the value

$$\Delta^2 \phi = \phi(\rho, f_1) + \phi(\rho, f_2) - 2\phi(\rho, f_m)$$

where

$$\phi(\rho, f) = \Psi(\rho, f) + \psi(f)$$

is the phase of the spectral function in Equation (1) and

$$f_1 = f_m - \Delta f$$

$$f_2 = f_m + \Delta f .$$

Within the frequency range $5 < f_m < 10$ kHz and the distance $\rho > 2000$ km the relation

$$\frac{1}{2\pi} \frac{\Delta^2 \phi}{\Delta f^2} = -\frac{\Delta t_{gr}}{\Delta f} \sim \frac{c\rho}{16 f_m^3 h^2} \frac{1}{\left\{1 - \left(\frac{\Delta f}{f_m}\right)^2\right\}} \tag{6}$$

can be derived (Reference 1) where

- $\Delta t_{gr}/\Delta f$ is the normalized group time delay (in μsec/kHz),

c the velocity of light (in km),

ρ the distance (in km),

f_m and Δf are midstfrequency and frequency difference (in kHz),

h virtual reflection height of the wave guide (in km).

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The simple dependence of the group time delay on frequency, distance and virtual height given in Equation (5) has been varified in Reference 1 showing that the measurement of the group time delay provides a unique and quick locating of distant thunderstorms from one receiving station.

3. INTERPRETATION

The essential results of the interpretation of the measurements described in Section 1 have been already mentioned in section 2. In this section we confine ourselves to two selected and very specific results in order to show the various possible applications of this method of measurement.

3a. Logarithmic Normal Distribution of the Spectral Amplitudes

Equation (3) represented by a straight line in Figure 5 is only a first order approximation of the probability distribution of the amplitudes. A better fitting curve should possess a concave bending in this plot. The logarithmic normal distribution occurs frequently in nature. If we replace W(g, f) in Equation (2) by a log-normal distribution we obtain

$$\frac{N}{N_0} = \frac{0.174}{\sigma} \int_s^\infty \exp\left\{-\frac{(\log y - \log \bar{y})^2}{2\sigma^2}\right\} \frac{dy}{y} . \tag{7}$$

With help of a log-normal paper we can derive from a log-normal distribution the values N_0, σ and

$$\bar{y} = \Lambda e^{-2.65\sigma^2}$$

where Λ equals the value defined in Equation (5) and σ is equivalent to a root mean square value (Reference 3).

Figure 6 gives the same points as in Figure 5 plotted in a log-normal paper and shows that the spectral amplitudes can be approximated very nicely by a logarithmic-normal distribution. For the frequencies 5 and 40 kHz the parameters N_0 and Λ derived from Figures 5 and 6 are nearly the same. But at 10 kHz N_0 increases by a factor 2 and Λ decreases by about 30% compared with the values in Figure 5. This difference mainly comes from the dominating influence of the numbers N at small values S within the log-normal distribution. Such behavior — namely a frequency depending value of N_0 with a maximum around 10 kHz — is seen on all log-normal plots determined so far (Reference 5). A possible explanation for this peculiar behavior might be the existence of a mixed distribution resulting from the influence of the horizontal components of the lightning discharge "dipoles." These horizontal components are strongly attenuated as compared to the vertical components in the atmospheric wave guide. However, the damping is frequency dependent with a minimum around 10 kHz. Because the horizontal components are predominant in a thunderstorm their influence on the statistical amplitude distribution should become visible around 10 kHz and at small values of S. Here a possibility opens to determine the ratio between ground and cloud strokes. The parameter σ moreover should be a measure for the different types of thunderstorms.

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3b. Group Time Delay Anomaly at Sunrise

From Equation (6) follows that the nighttime value of the group time delay is smaller by a factor

$$\left\{\frac{h_{day}}{h_{night}}\right\}^2 \sim 0.6$$

than the daytime value. This relationship has been varified quite well for distant thunderstorm which are directed mainly west or east from the receiver (References 1 and 5). In the group time delay measurements of Figures 3 and 4 a thunderstorm is seen in SSW direction and in a distance of about 2500 km from the receiving station Stockert near Münstereifel (West-Germany). The measurement at 5^{45} local time (Figure 3) shows a normal behavior: a rather narrow cluster of points resulting from the individual variability of the single strokes and from their spacing within the thunderstorm. In Figure 4 however which is exposed 3.25 hours earlier the cluster of the same thunderstorm is extended over more than 150 units with a maximum density around 140 μsec/kHz, well above the expected theoretical nighttime value of 80 μsec/kHz. At 80 μsec/kHz there exists a small secondary cluster which arrives exactly from the same azimuthal direction as the equivalent cluster in Figure 3. This cluster therefore is due to the normal nighttime value. The center of the primary cluster however is more than 5° east from the center of the secondary cluster. The splitting disappears shortly after 3^{00} (see Figure 7 where the group time delay of this thunderstorm is plotted versus daytime).

We explain this splitting of Δt_{gr} before and during sunrise by the peculiar propagation conditions during this time. The line of sunrise is roughly parallel to the propagation path of the atmospherics of this thunderstorm. Due to the derivation from a horizontally stratified ionosphere during sunrise a second transitory propagation path exists besides the normal path. The propagation plane of this second path is bent out of the geometric optic plane and lies within the (easterly extended) daytime hemisphere. The influence of higher order modes (neglected in Equation (6)) on the propagation further complicates an exact interpretation of Figure 4.

ACKNOWLEDGMENT

We are very indebted to Mr. W. Harth, Bonn, who kindly prepared the data which are presented in Section 3.

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Table I

Mean Spectral Amplitude g_0

Frequency (kHz)	g_0 (mV/m Hz)
5	1.3
10	1.65
40	0.4

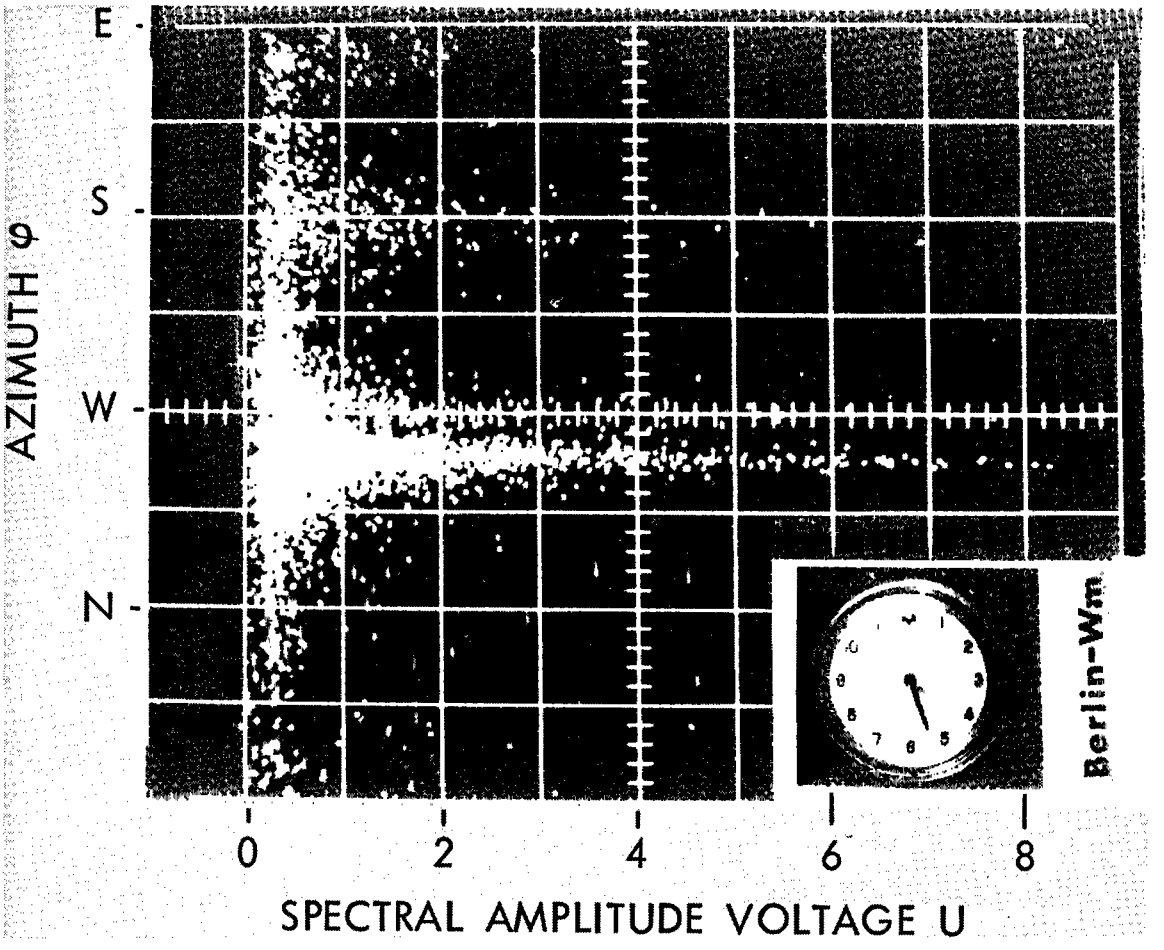

Figure 1 Oscillograph of spectral amplitude voltage U versus azimuth at 9 kHz (5-minute picture). Date: April 30, 1967, 4^{20} UT; Receiving station: Berlin.

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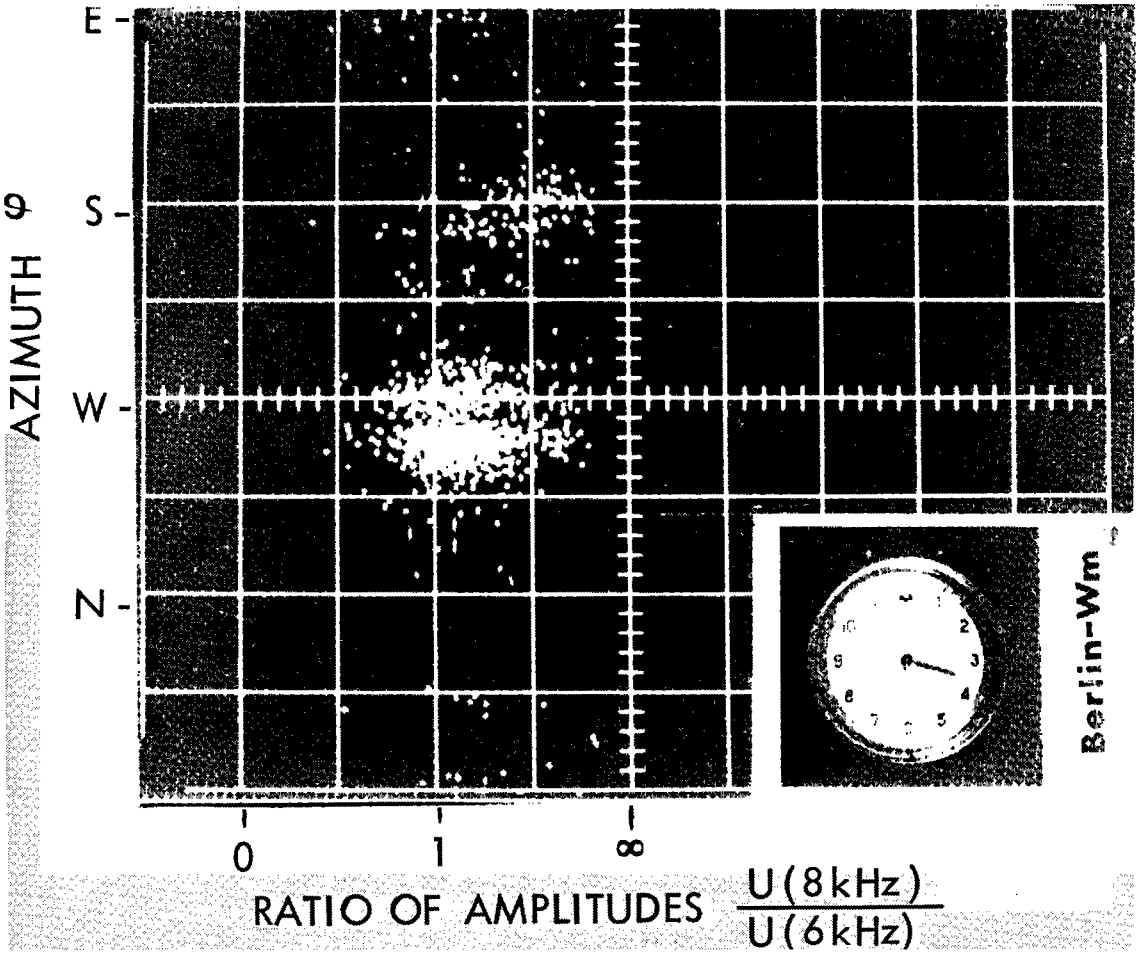

Figure 2 Oscillograph of spectral amplitude ratio between 8 and 6 kHz versus azimuth (5-minute picture). Date: April 30, 1967, 2^{30} UT; Receiving station: Berlin.

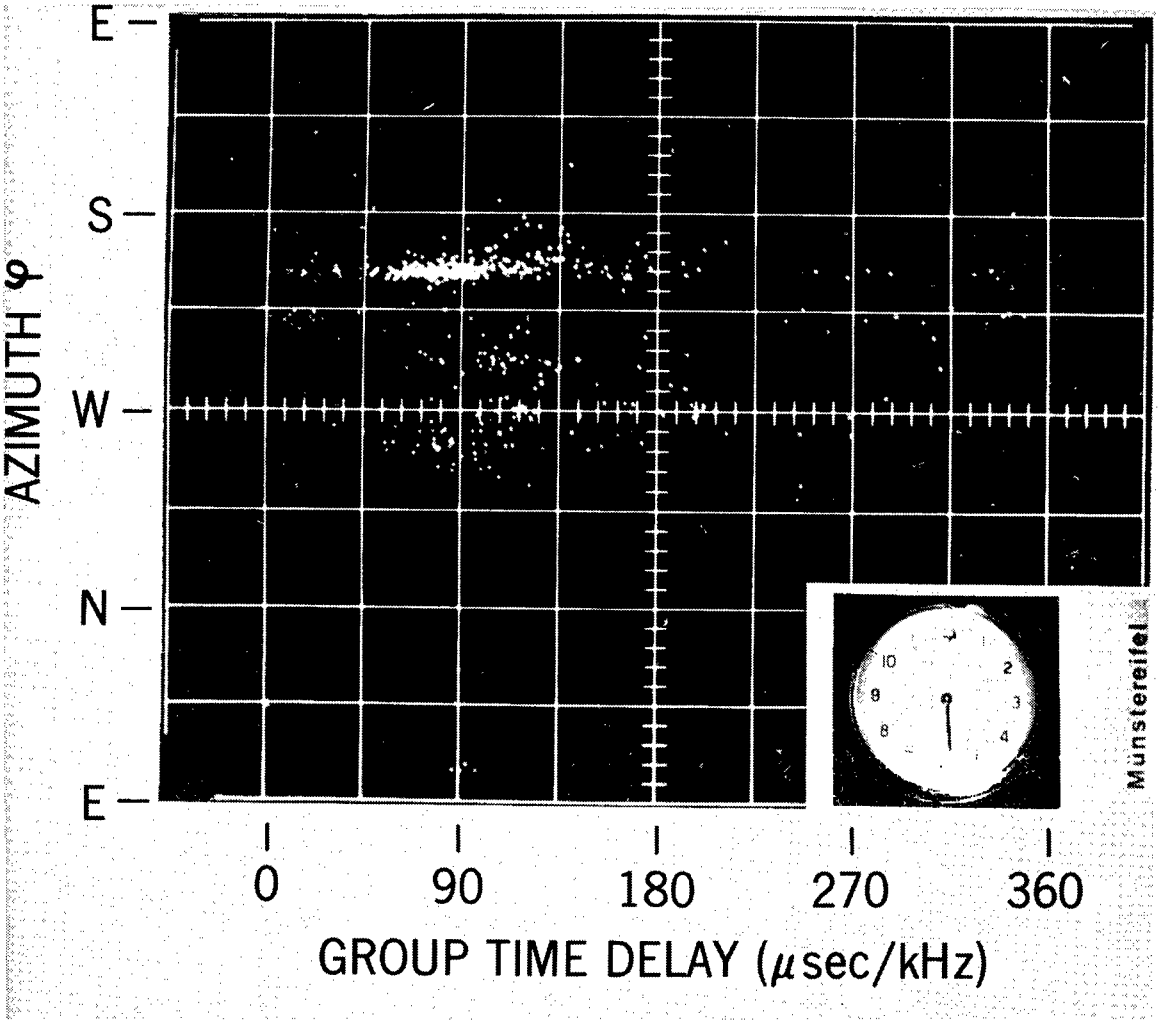

Figure 3 Oscillograph of group time delay versus azimuth at 7 kHz; bandwidth Δf = 1.4 kHz (5-minute picture). Date: May 6, 1967, 4^{45} UT; Receiving station: Stockert.

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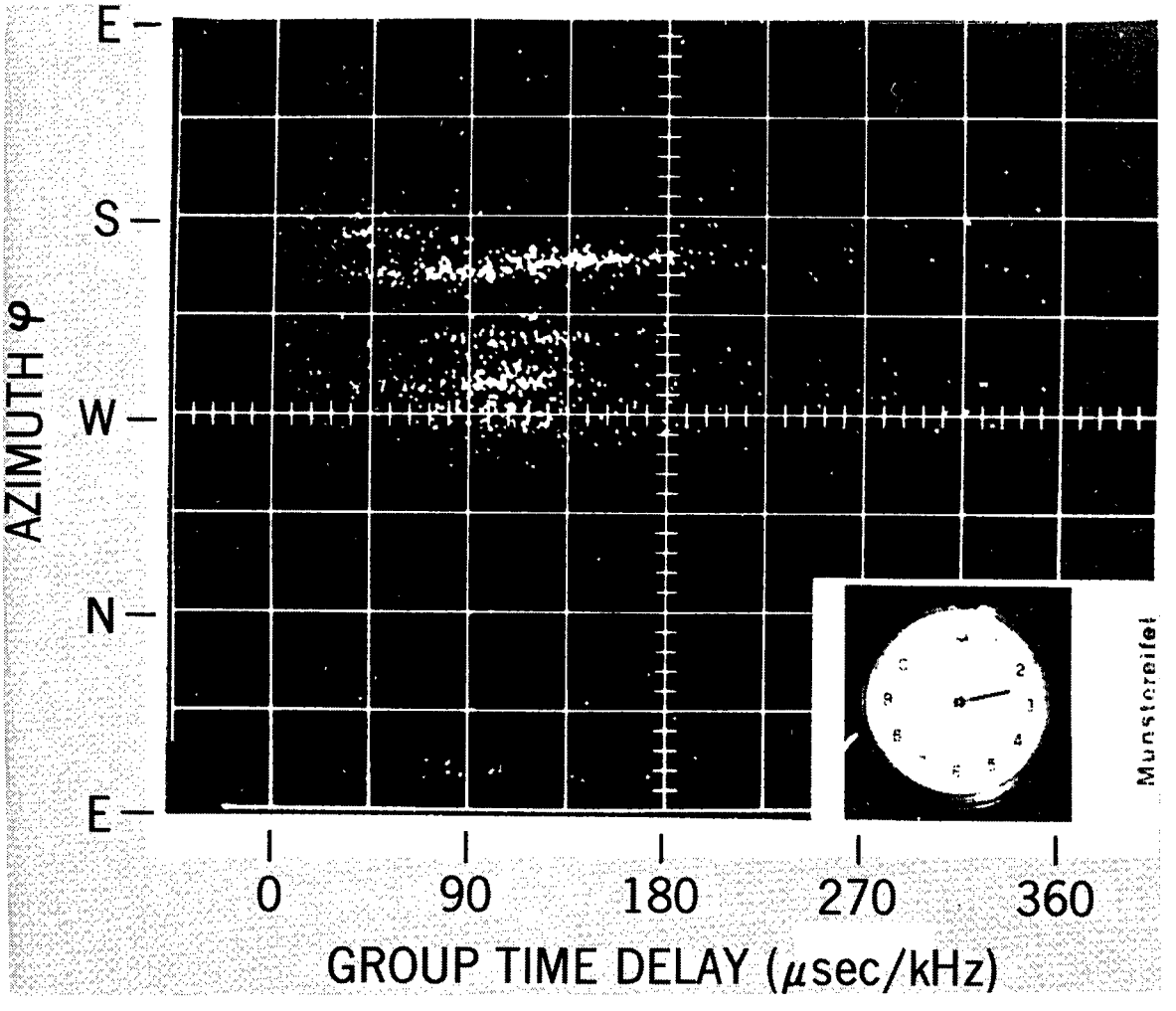

Figure 4 Oscillograph of group time delay versus azimuth at 7 kHz; bandwidth $\Delta f = 1.4$ kHz (5-minute picture). Date: May 6, 1967, 1^{30} UT; Receiving station: Stockert.

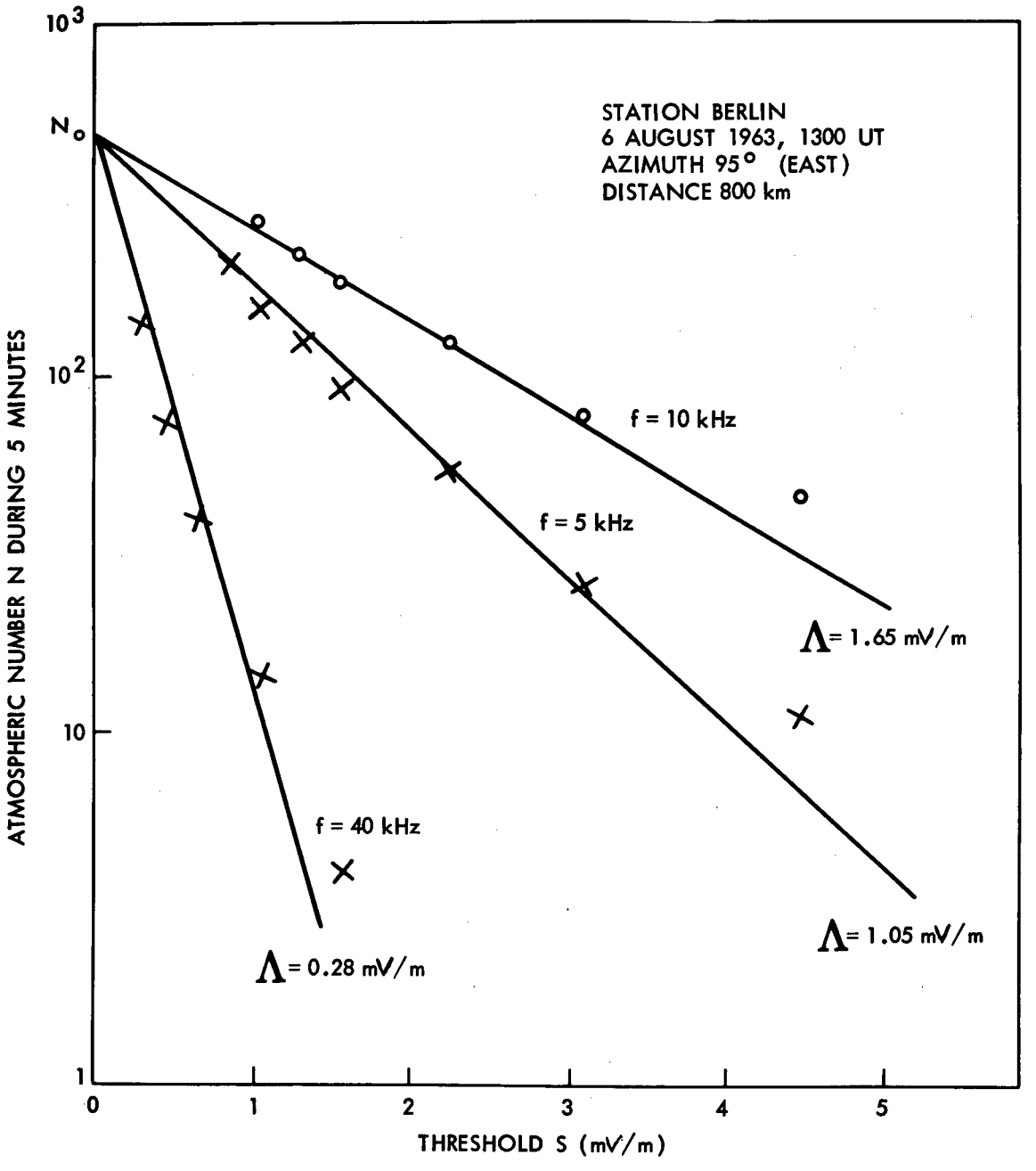

Figure 5 Number of atmospherics N exceeding threshold S of the receiver for a thunderstorm located 800 km east of the receiving station Berlin at three different frequencies.

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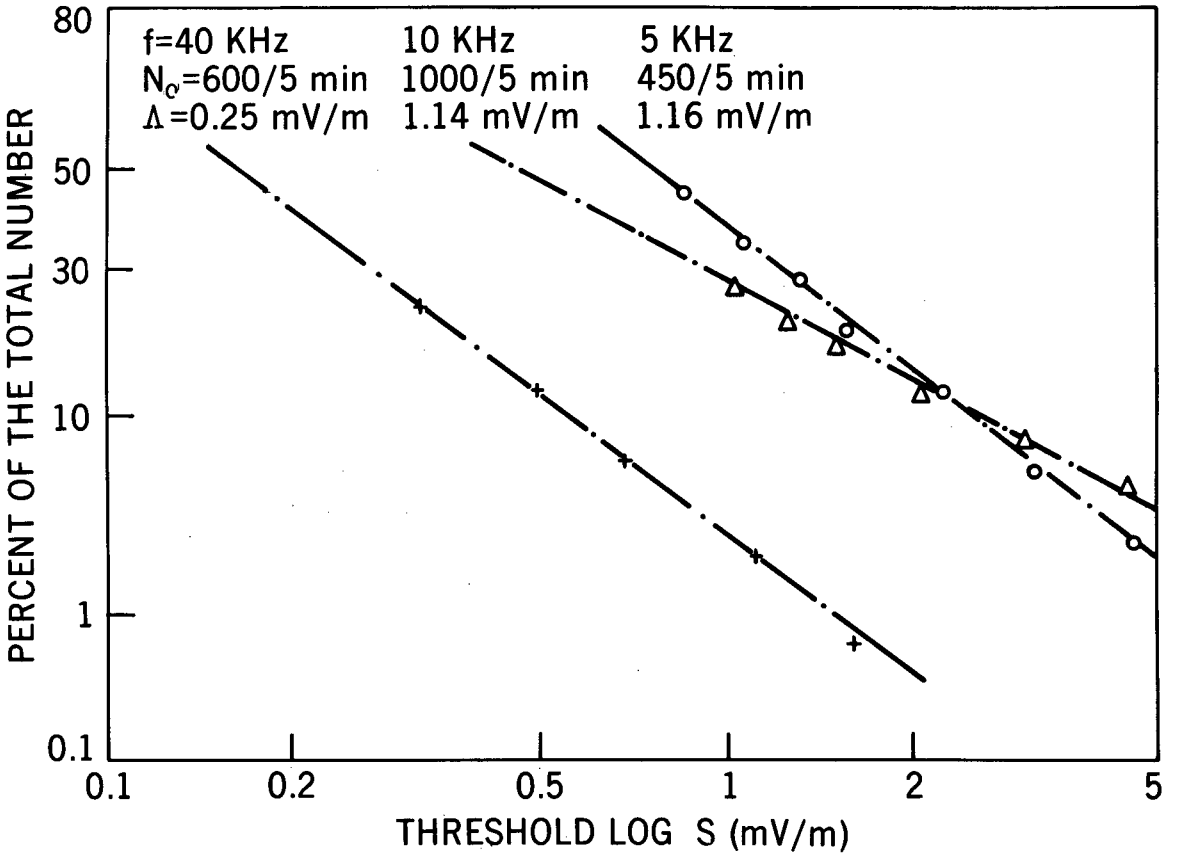

Figure 6 Probability distribution of N from Figure 5 plotted in logarithmic-normal paper.

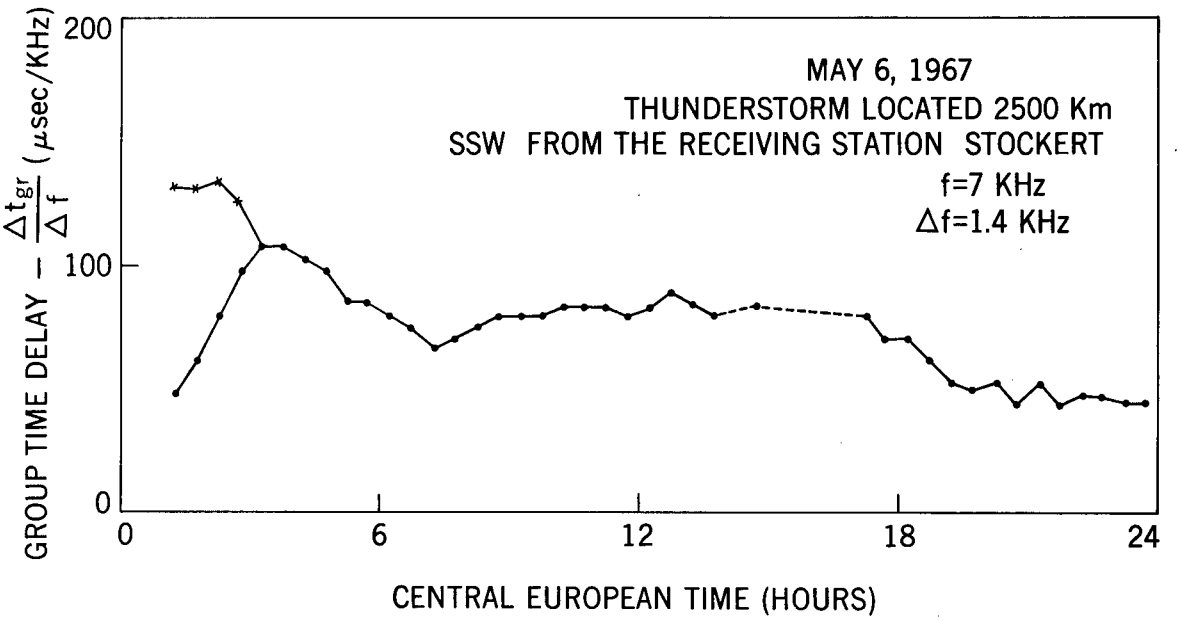

Figure 7 Group time delay versus daytime of a thunderstorm located 2500 km SSW from the receiving station Stockert at May 6, 1967. The second trace (crosses) between 1^{00} and 3^{00} is due to propagation effects.

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Statistical Analysis of Data from the Atmospherics Analyzer

by

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Abstract: A statistical analysis of photographic records of group delaytime differences (GDD) and spectral amplitude ratios (SAR) obtained with the Atmospherics Analyzer network leads to a review of the behaviour of these atmospherics parameters as functions of the azimuth. Location of areas of enhanced lightning activity becomes possible by means of GDD-observations using a simple one mode propagation model. These results are supplemented by the results of observations of atmospherics rates coming from these areas.

1. Introducing remarks on the name of the equipment

As early as 1967 these authors selected the term "atmospherics analyzer" for the equipment developed since 1964 (Heydt and Volland, 1964) at the H.H.I. for routine observations of the atmospherics activity. Their intention was, not to enhance the disturbing variety of names in the scientific terminology, but to express as concisely as possible what the equipment does. This provoked the critical remark that the H.H.I. equipment is not the only one in the world that analyzes atmospherics and, as an alternative, the name "Berlin instrument", has been suggested. It seems to us that this is not essentially better because the variety of instruments developed at Berlin is a bit larger than that of atmospherics analyzing ones. We admit, however, that it is not easy to find a name that concisely meets the distinction between the V.L.F.-Atmospherics Analyzer of the H.H.I. and other equipments previously constructed for comparable purposes. The first routine observations with the H.H.I.-Atmospherics Analyzer confronted us to the problem - new for us at that time - to analyze sample observations of two dimensinal distributions. A comprehensive description of this problem has been published (Frisius, Heydt and Harth, 1970).

2. Remarks on the present state of data processing at Berlin

The VLF Atmospherics Analyzer reveals the incoming atmospherics to be distributed with respect to a) the direction of arrival Ψ, and b) to one of the spectral Parameters SA (= spectral amplitude), SAR (= spectral amplitude ratio), and GDD (= group delaytime difference) (see Frisius and Heydt, 1968). The authors hope that there is general agreement that these two dimensional distributions depict in any way the geographical distributions of the sources of the atmospherics, i.e. of the lightnings activity. Much of our work during the last years has been devoted to the technological problem to find out the most economic way of storing such distributions in a way that permits optimal processing for the physical interpretation. According to our limited facilities, we stored the Ψ - GDD and Ψ - SAR-distributions photographically and the azimuth distributions of pulse rates and other, similar quantities not discussed here by analog methods (Frisius and Heydt, 1968, Heydt, 1971, 1972).

The latter have been complemented by methods of storing by means of very simple and cheap tape recorders enabling automatical processing (Heydt, 1972).

Probably the proposals of Dr. Reinisch will initiate a completely new concept of storing and processing the two-dimensional-distributed atmospherics data, provided our economic situation will permit new developments.

3. Remarks on the conversion of GDD's into distances

Whatever the technical effort of data storing is, it is justified only if the conversion of the two dimensional direction-parameter-distributions into geographical distributions can be carried out without too gross errors. Here, pessimists and optimists differ. Optimists formulate the relationship between the observed average GDD- and SAR-values of single atmospherics sources by means of the dominant mode approximation of the wave guide mode theory in the form

$$\overline{GDD} = s_{GDD}\, D + c_{GDD} \quad , \quad \overline{SAR} = s_{SAR}\, D + c_{SAR}$$

where s_{GDD}, c_{GDD}, s_{SAR} and c_{SAR} are nearly constants (Frisius and Heydt, 1968). Pessimists object the neglection of the higher order modes, which may influence considerably the above relationship, if the propagation is nearly unattenuated.

The decision between both argumentations was searched after the first year of routine atmospherics observations by means of a little atmospherics analyzer network - which preceded the present world wide network - operating during 1967 at three stations in Germany (Heydt et al.,1967). It has been found that observed pairs of SAR- and GDD-values correlated in a way that reasonably agrees with predictions resulting from simple dominant mode propagation theory (Frisius and Heydt, 1968). For 1971, more than 700 correlation plots of this kind have been computed. Two typical examples are shown by Fig. 1. They show the strong influence of the direction of arrival on the SAR-GDD-regression slope, in agreement with predictions of computations of Harth (1972) which base upon the work of Wait and Spies(1964). The correlation in most cases is so strong, that we felt encouraged to use the dominant mode approximation

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at least for investigations of climatological type, as described below. But even being used for the location of single storm centers, the approximation led to surprising coincidence with otherwise documented meteorological events (Heydt and Raupach, 1972).

4. Areas of enhanced lightning activity

The computations of Harth (1972) are the basis of a program of converting observed GDD-values to distances (Heydt, 1971). These conversions are carried out by a minicomputer operating in connection with a x,y-plotter, drawing the located sources onto a world map. Figure 2 shows an example of collected source locations observed at 21^{00} GMT at Berlin during the period from December 1970 to March 1971. A comparison with simultaneous observations at Waldorf led to reasonable agreement within the overlapping of the both observation ranges (Heydt, 1972). Similar plots, carried out for other times of the day and the same period of the year, led to rough delimiting of the areas of the earth that mainly contribute to the atmospherics activity observed at Berlin.

5. Quantitative analysis of the contributions of different source regions to the total, observed atmospherics activity

Figure 3 shows the averaged diurnal variation of the "all round activity", observed at Berlin between December 1970 and April 1971, represented in a conventional way without regarding the direction dependence. The observed quantity is the average pulse rate (counts per minute) at the observation frequency of 5 kHz (band width about 120 Hz) and a receiver threshold of 0.8 μVolt/(Hz·m). The Atmospherics Analyzer provides - with a samplig rate of one per hour - automatic records of the direction distribution of the atmospherics pulse rate. With the aid of the localisation plots, the pulse rates observed in certain direction sectors (sector width = 12 degrees) can be attributed to certain areas of the earths surface. In this way, the diurnal variation of the total activity (Fig. 3) can be splitted up into the contributions of different geographic regions. The figures 4 through 7 show the diurnal variations of the observed activity of that regions that mainly supply the

signals observable at Berlin. Some preliminary considerations on the separation of propagation- and meteorological influences of the source regions have been given by Heydt (1972), a mathematical analysis basing upon wave guide mode theory and statistic models of the source (Frisius, 1969) is under way but not yet ready for publication.

Acknowledgements: This work is enabled by grants of the Deutsche Forschungsgemeinschaft. The authors wish to express their deep gratitude to H. Dolezalek for his initiative and support in arranging the cooperation in the VLF Atmospherics Analyzer network.

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AVERAGE SPECTRAL PARAMETERS OF ATMOSPHERICS SOURCES

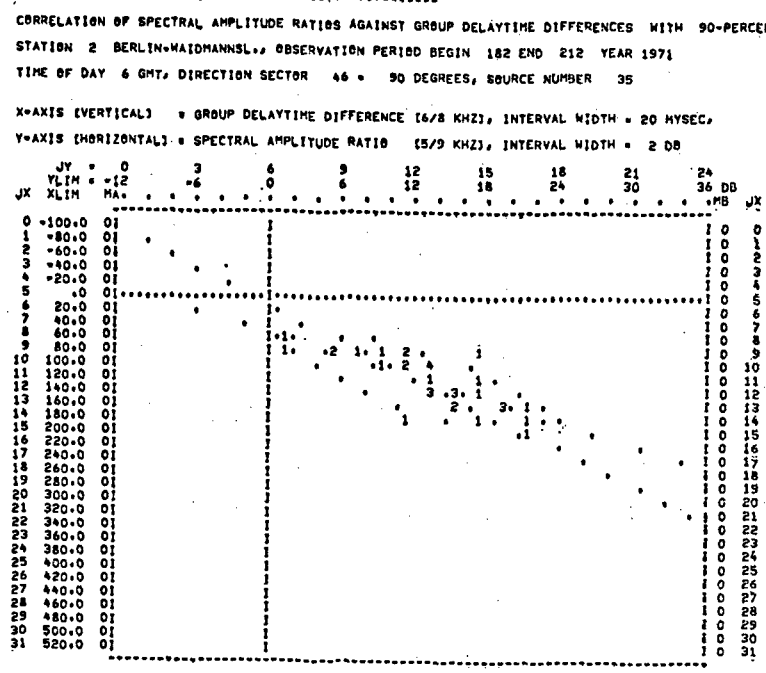
CORRELATION OF SPECTRAL AMPLITUDE RATIOS AGAINST GROUP DELAYTIME DIFFERENCES WITH 90-PERCENT CONFIDENCE ELLIPSES

STATION 2 BERLIN-WAIDMANNSL., OBSERVATION PERIOD BEGIN 182 END 212 YEAR 1971

TIME OF DAY 6 GMT, DIRECTION SECTOR 46 - 90 DEGREES, SOURCE NUMBER 35

X-AXIS (VERTICAL) - GROUP DELAYTIME DIFFERENCE (6/8 KHZ), INTERVAL WIDTH - 20 MYSEC,

Y-AXIS (HORIZONTAL) - SPECTRAL AMPLITUDE RATIO (5/9 KHZ), INTERVAL WIDTH - 2 DB



REGRESSION: XAV - 112.7143 MYSEC , YAV - 12.7143 DB, SDXDX - .43057E 05 MYSEC-MYSEC
SLYVX - .1136 DB/MYSEC , Y0 - -.0871 DB, SDXDY - .48901E 04 MYSEC-DB
SLXVY - 1/(.1831 DB/MYSEC), Y0 - -7.9181 DB, SDYDY - .89514E 03 DB-DB

CORRELATION COEFFICIENT - .7877

AVERAGE SPECTRAL PARAMETERS OF ATMOSPHERICS SOURCES

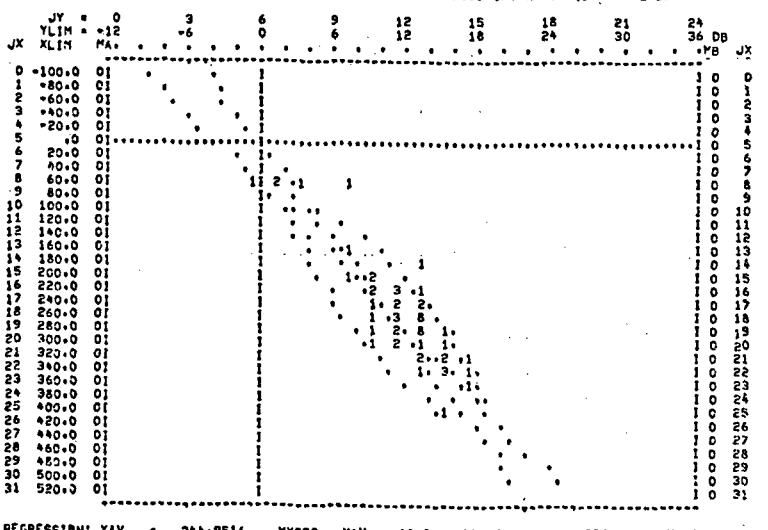
CORRELATION OF SPECTRAL AMPLITUDE RATIOS AGAINST GROUP DELAYTIME DIFFERENCES WITH 90-PERCENT CONFIDENCE ELLIPSES

STATION 2 BERLIN-WAIDMANNSL., OBSERVATION PERIOD BEGIN 182 END 212 YEAR 1971

TIME OF DAY 6 GMT, DIRECTION SECTOR 271 - 315 DEGREES, SOURCE NUMBER 62

X-AXIS (VERTICAL) - GROUP DELAYTIME DIFFERENCE (6/8 KHZ), INTERVAL WIDTH - 20 MYSEC,

Y-AXIS (HORIZONTAL) - SPECTRAL AMPLITUDE RATIO (5/9 KHZ), INTERVAL WIDTH - 2 DB



REGRESSION: XAV - 244.9516 MYSEC , YAV - 10.8710 DB, SDXDX - .33305E 06 MYSEC-MYSEC
SLYVX - .0425 DB/MYSEC , Y0 - .4501 DB, SDXDY - .14169E 05 MYSEC-DB
SLXVY - 1/(.0565 DB/MYSEC), Y0 - -2.9764 DB, SDYDY - .80097E 03 DB-DB

CORRELATION COEFFICIENT - .8675

Fig.1: Correlation Plot GDD/SAR

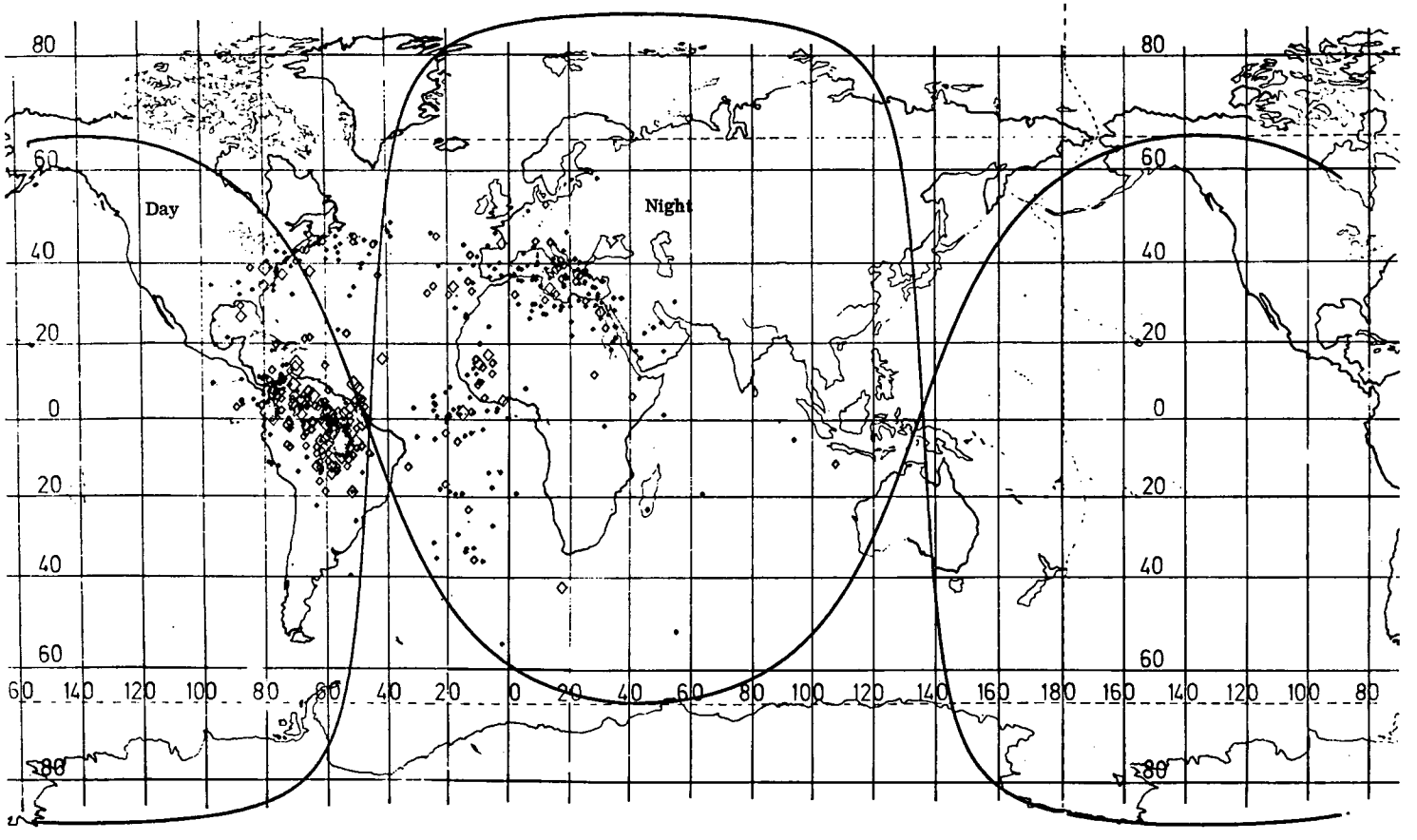


Fig.2: GDD locations, Berlin, 1.12.1970 - 31.3.1971, 2100 GMT

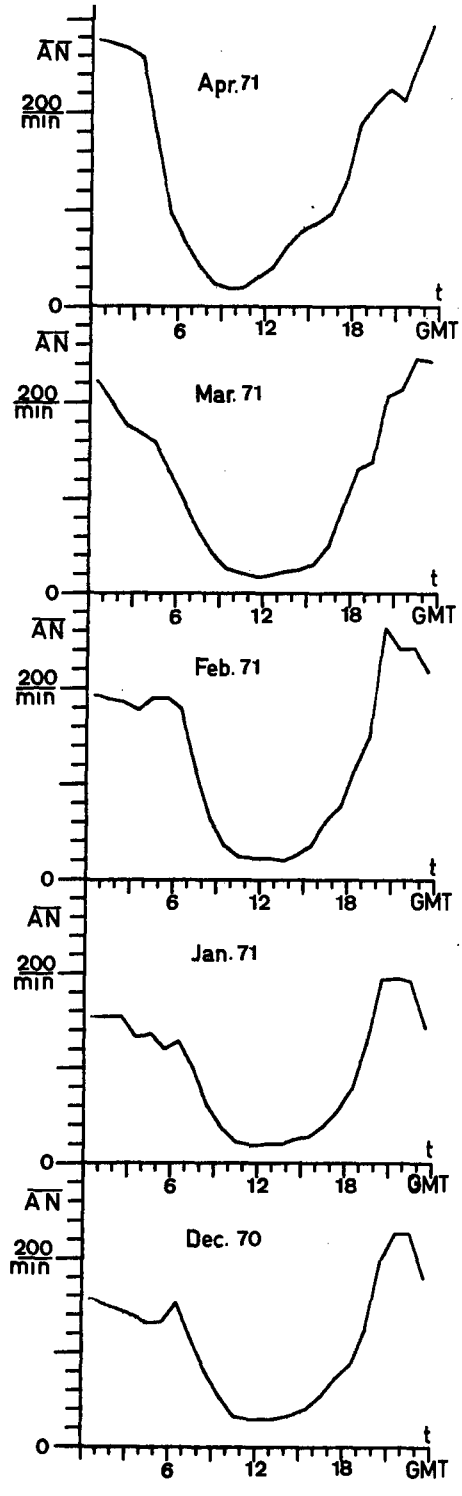


Fig.3: Monthly averaged all-around activity as functions of day-time

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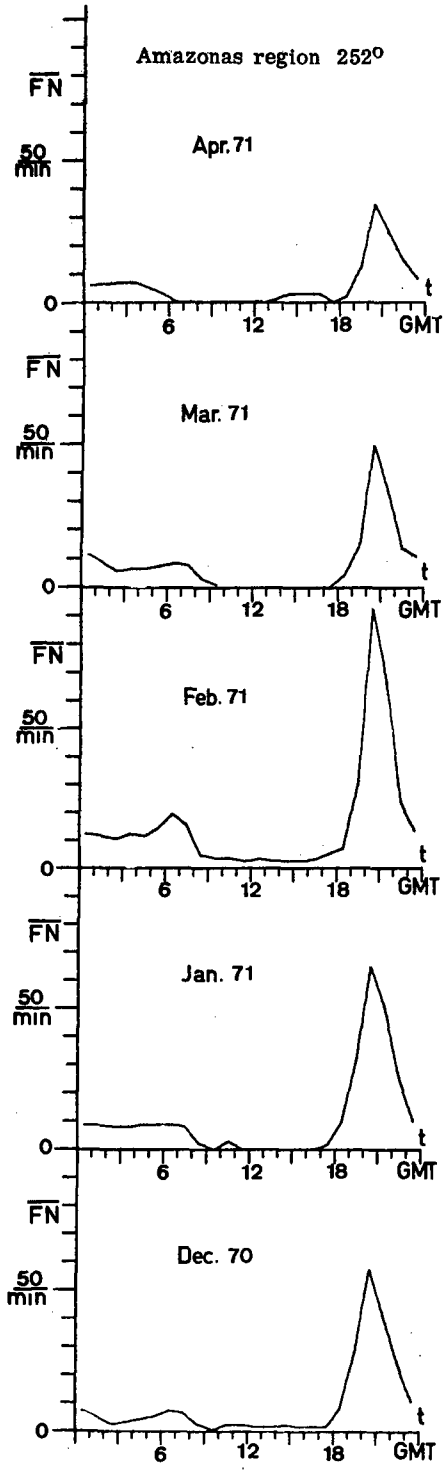

Fig.4: Rates $\overline{FN}$ of the sector 252°

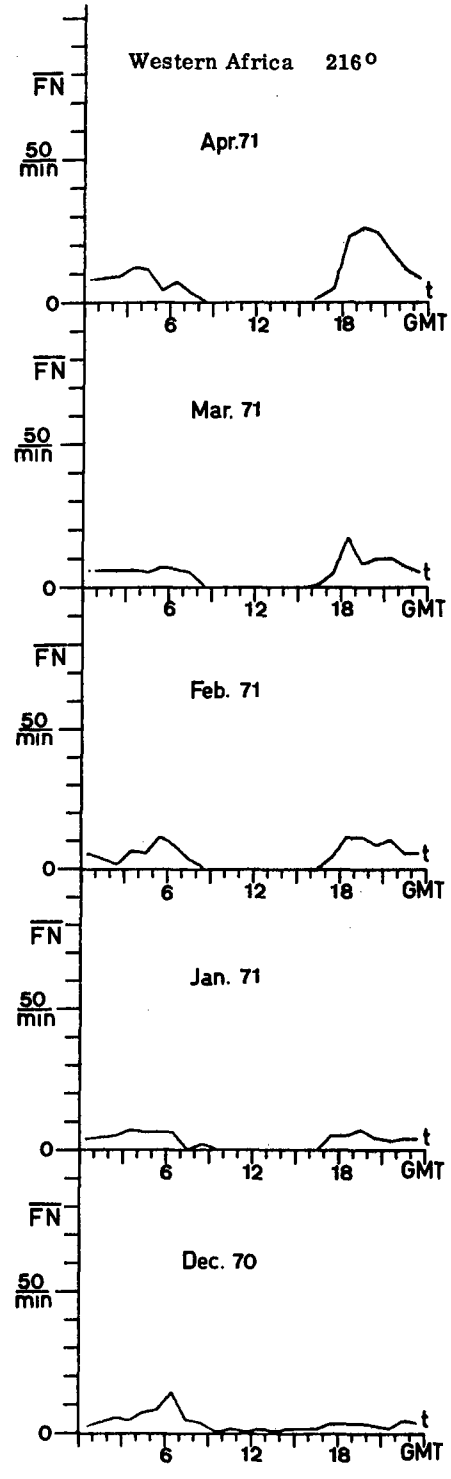

Fig.5: Rates $\overline{FN}$ of the sector 216°

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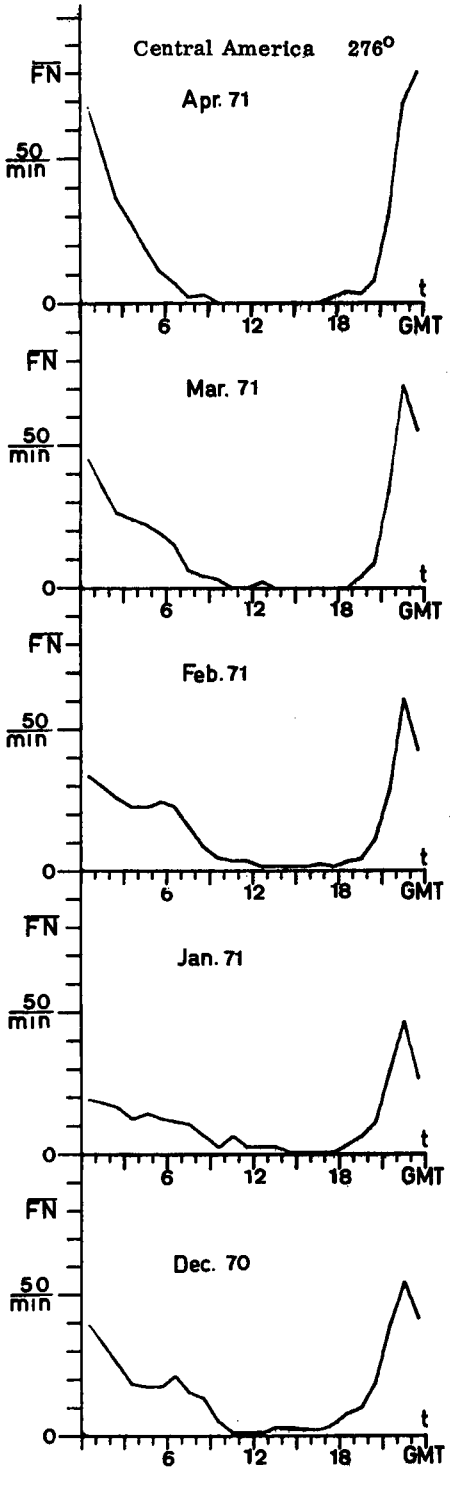

Fig.6: Rates $\overline{FN}$ of the sector 276°

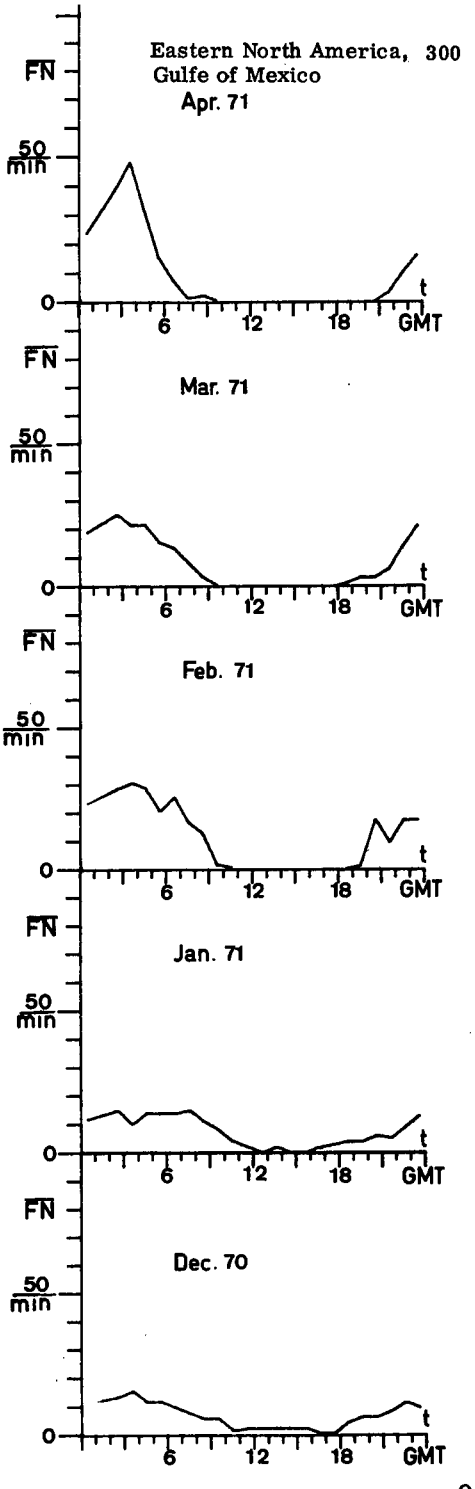

Fig.7: Rates $\overline{FN}$ of the sector 300°

Results Obtained with the Atmospherics Analyzer at Toyokawa

Tosio Takeuti

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The discussion in this paper is divided into three parts. 1) Thunderstorm in typhoon center is less active than ordinary summer one and main thunderstorm region in the typhoon is frontal region which is produced or intensified by the typhoon itself. 2) We have obtained a very rough correlation, factor 0.2, between number of sferics come from cold fronts on the Pacific near Japan and sea surface pressures on the fronts. 3) Thunderstorm active regions in northern hemisphere winter are deduced from data obtained our network as follows: the Middle America, the Atlantic, the Mediteranean, Southeast Asia, the Pacific near Japan. As for the thunderstorm activity at the Middle America some harmonic analyses have been done.

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I. Introduction

A cooperative observation of sferics activity with VLF Atmospherics Analyzer developed at the Heinrich-Hertz-Institut, Berlin-Charlottenburg is being done since December 1970 among four stations: Toyokawa Japan, Berlin Germany, Waldorf USA, and San Miguel Argentina. Data obtained at each station are exchanged each other and analyses of the data are made at each station by different ways.

At Toyokawa, as the first step, only two kinds of data out of nine are analyzed. That is: 1) Uñü, number of sferics, amplitude of which exceed a difined threshold. It is counted by nondirectional system and it corresponds, in general, to activity of thunderstorm in some hundred of kilometers from a station. 2) Un, number of sferics, exceeding 0.8μV/mHz at 5KHz, falling into a selected azimuth interval of 12° width. When a sampling time of 2 minutes has passed, the middle of the observed sector is changed automatically by +12°. In this way the total horizon is scanned every hour. Technical details of the equipment are given by Heydt(1971).

The data from the Analyzer can be used for two objects, electro-magnetic wave propagation and meteorology, but in this paper the discussion is concentrated to only meteorology. The discussions are divided into three parts, typhoon, cold front, and global storm activity.

II. Thunderstorm in typhoon

When Kimpara (1953a and 1953 b) and Kitagawa et al. (1953) had studied the sferics from typhoon, an interesting point might be to find a typhoon far from a station with sferics finder. However now it is not interesting because of progress of meteorological method as using satellite, but continueous observation of character change of typhoon is still very important for weather forecast at short time range and typhoon meteorology.

1. Thunderstorm in typhoon center

Two typhoons passed through near Toyokawa were evaluated as shown in Fig.1 which shows the thunderstorm regions in typhoons centers and numbers of sferics Uñü. Comparision of Uñü between in typhoon centers and in Fig.2 drawn from ordinary summer thunderstorms,

tells us less activity of thunderstorm in typhoon centers than ordinary summer storms.

2. Thunderstorm active region in typhoon

Number of sferics, Un, from two typhoons appeared at 500-1000 Km southeast from Toyokawa were counted without disturbance by very active storms in Southeast Asia located southwest from Toyokawa. As shown in Fig.3, we can find apparent sferics source at the region of frontal line, which is produced or intensified near Japan by mixing warm air mass brought by typhoon. When we can not find apparent front in a typhoon, then we also can not find apparent sferics source in it. This result may be able to apply to heavy rain forecast accompanied by a typhoon.

3. Sferics from very far typhoon

One of the most fundamental matters is to know a limit of distance in which we can observe the sferics from typhoon. We could not find apparent number of sferics, Un, from two typhoons over Mariana Islands located at 2000-4000 Km southeast from Toyokawa as shown in Fig.4, though we have found some symbols of thunderstorm around one typhoon on the weather map. It may be due not to the distance but weak activity of thunderstorms.

III. Thunderstorm accompanied by cold front in the Pacific zone near Japan

Wichmann(1948) and Mühleisen et al. (1968) have reported that a occurrence probability of thunderstorm increases with a decreases of surface pressure and the relation to frontal storm is more clear (Wichmann 1948). Higashimura et al. have also found negative correlation between surface pressure and number of sferics counted with a sferics counter for about 100 Km range (1964).

There have many times cold fronts in the Pacific zone near to Japan, within some thousands of kilometers, in winter and they becomes frequently a cause of disasters. If we can obtain continueously some informations of the front by sferics count at real time, it is no doubt very useful to fill up scarcity of information of the front founded by satellite etc. The first analysis is made to find a relation between Un and sea surface pressure on

the front. The relation was not so clear as shown in Fig.5 with correlation factor 0.2. However this analysis seems to be too rough, for example we have no consideration as to distance between Toyokawa and fronts, so that the more clear relation would be expected by more strict analysis.

IV. Monitoring of global thunderstorm activity

We have global network of stations though not perfect, so that we can obtain the data of sferics in very wide area. Followings are some results by analyses of the data obtained from the four stations on northern hemisphere winter.

1. Thunderstorm active regions

From diurnal variations of sferics obtained at Waldorf and San Miguel, see Fig.6, we can see very active region where is south of Waldorf and north northwest of San Miguel. Accordingly the active region is Middle America. The most active direction at Berlin is west, see Fig.6, it is thought due to sferics from the Middle America and the Atlantic, because the active directions at Waldorf are not only south, correspond to the Middle America, but also east, correspond to the Atlantic. There are some additional other storm active regions such as south of Berlin, probably the Mediterranean and west of Waldorf.

On the other hand, there are two active regions on Far East as shown in Fig.6, that is Southeast Asia and the Pacific near Japan. The former is more active than the latter.

We can find from Fig.6 that the active time of thunderstorms in Southeast Asia appears earlier than that over the Pacific near Japan which is east of the former. In other words, Southeast Asia reaches its maximum activity at local afternoon, but the Pacific near Japan has maximum activity at local midnight. Heydt (1971) has found that an active time in South America is at local afternoon but over the Atlantic the greatest activity occurs at local midnight. Krumm(1962) has reported that the maximum activity of oceanic storm occurs at local

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midnight. A problem for further investigation is to see whether the maximum activity of oceanic storms occuring at local midnight is a proper characteristic of these storms or is it due some characteristic of cold fronts,which are major source of oceanic storms.

2.Harmonic analysis of stórm sctivity

If we could find some tendencies of storm activity over very wide area, the results could be applied to a study of meteorology and global circuit problem in atmospheric electricity. For such a purpose use of harmonic analysis is very common. The results by the analysis to data of Un obtained at Waldorf is shown in Fig.7. From the figure we can see follows: a) Storm active periods on the Middle America are 3,5, and 7.5 days. b) Phase of storm active region moves with one day from southwest to west.

V.Concluding remark

During the above evaluations, we have such a impression that for study of sferics on the temperate zone the cold front plays always very important role even study for typhoon. In the same way the intertropical convergence zone may be very important for a study of tropical sferics.

The author is grateful to J.Frisius and G.Heydt who have developed the Analyzer and allowed me to use it. We also wish to express our grtitude to the German Research Association (Deutsche Forschungsgemeinschaft) for their financial assistance in this project. We again wish to express our gratitude to J.Frisius,G.Heydt, H.Dolezalek,R.B.Bent,R.V.Anderson, and C.A.Hofmann who provided some of the results as well as useful discussion on this paper. Some meteorological data are provided by courtesy of Japan Meteorologica Agency, Nagoya- and Osaka-Meteorological Observatory.

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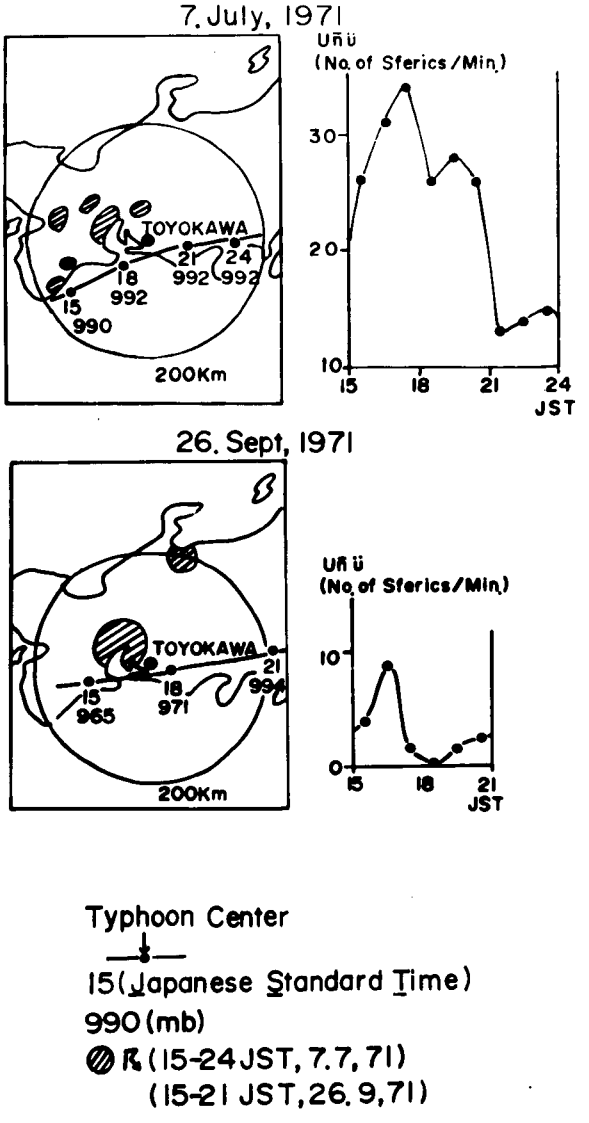

Fig.1. Thunderstorms accompanied by the two typhoons.

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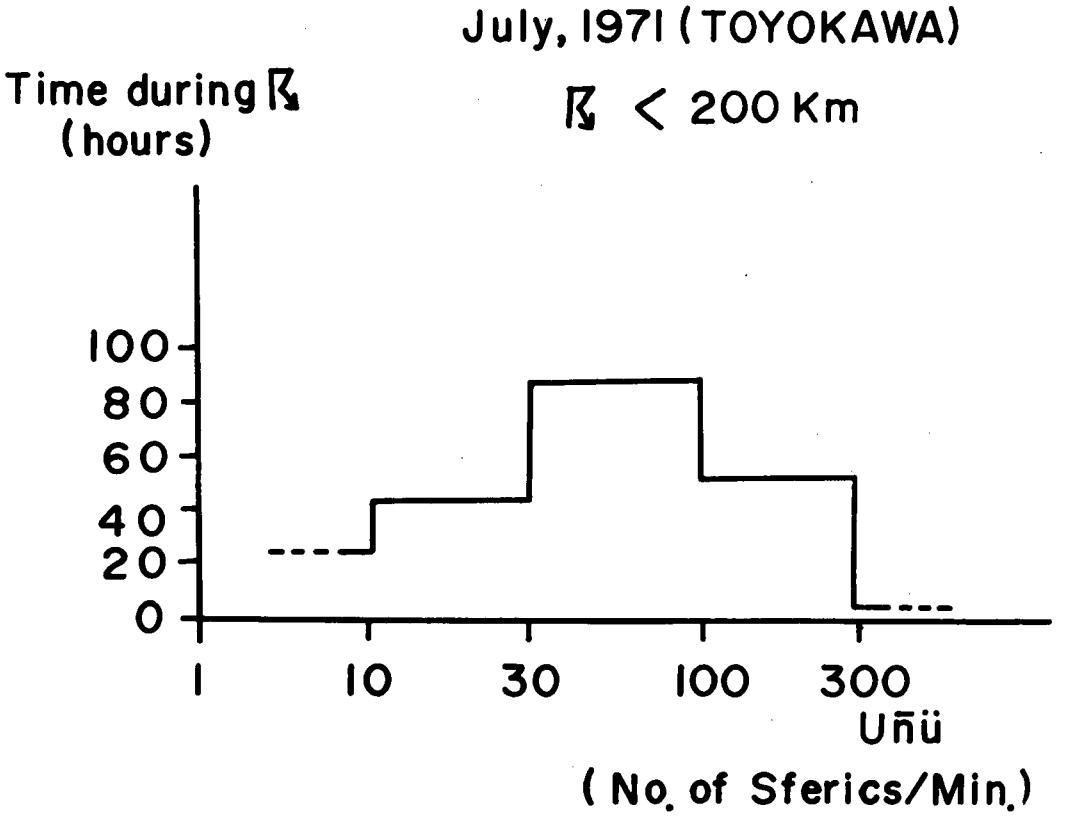

Fig.2. Numbers of sferics per minute , Uñü, counted at Toyokawa on July 1971 when thunderstorms have been within 200 Km from Toyokawa. The ordinate means total hours of thunderstorm durations, in which hourly means of the Uñüs were in regions shown on abscissa.

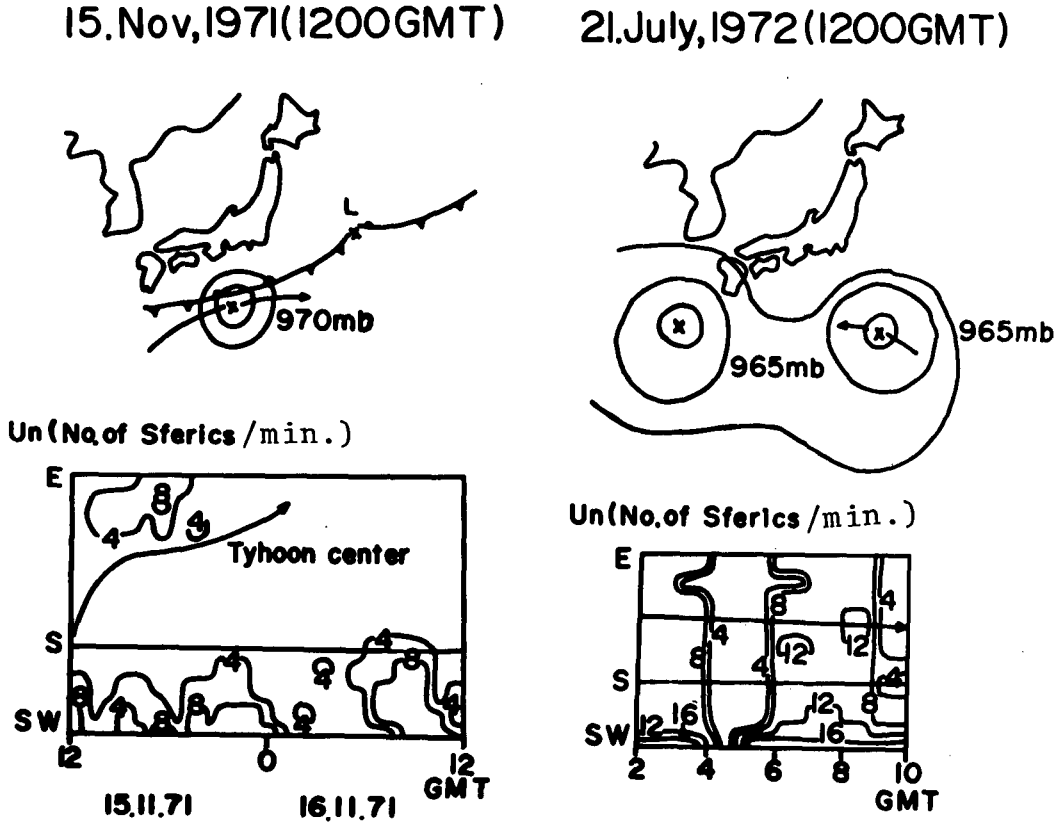

Fig.3. Numbers of sferics per minute , Un, from the typhoons over the Pacific near Toyokawa.

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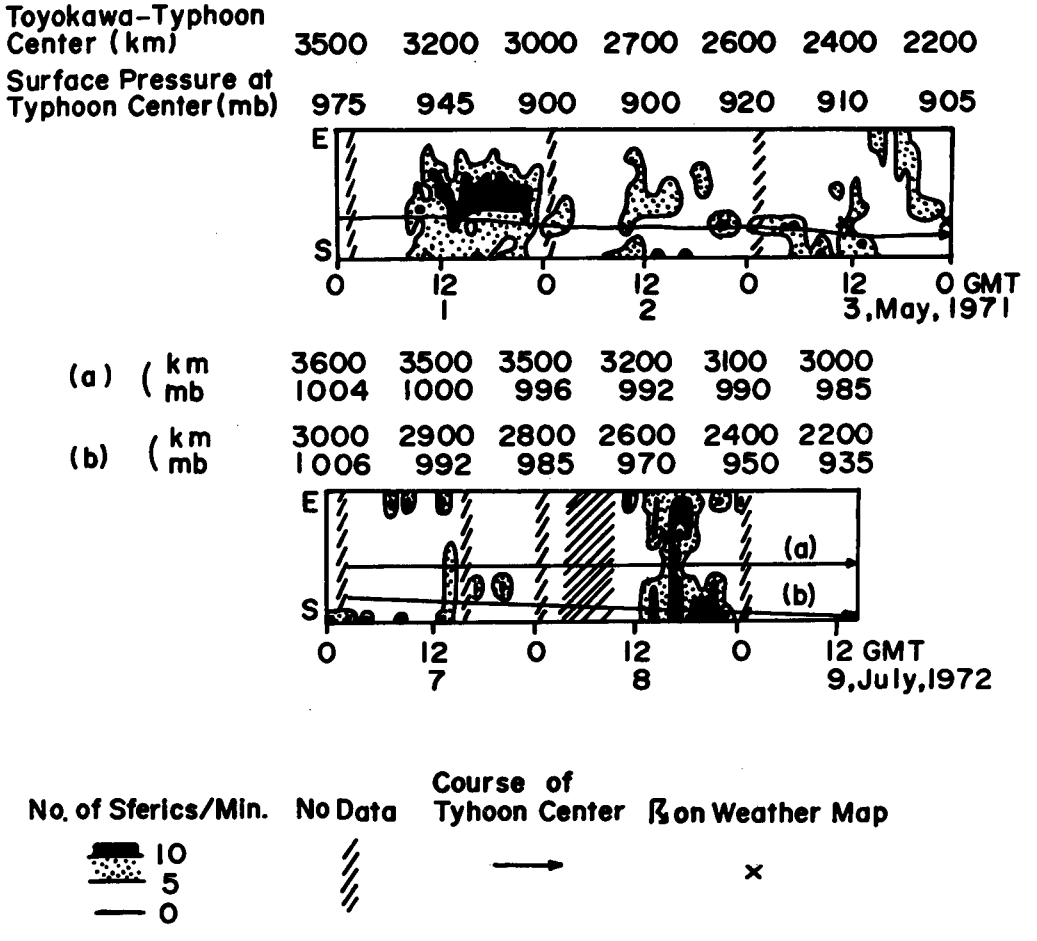

Fig.4. Numbers of sferics per minute , Un, from the typhoons over the Mariana Islands located at 2000-4000 Km from Toyokawa.

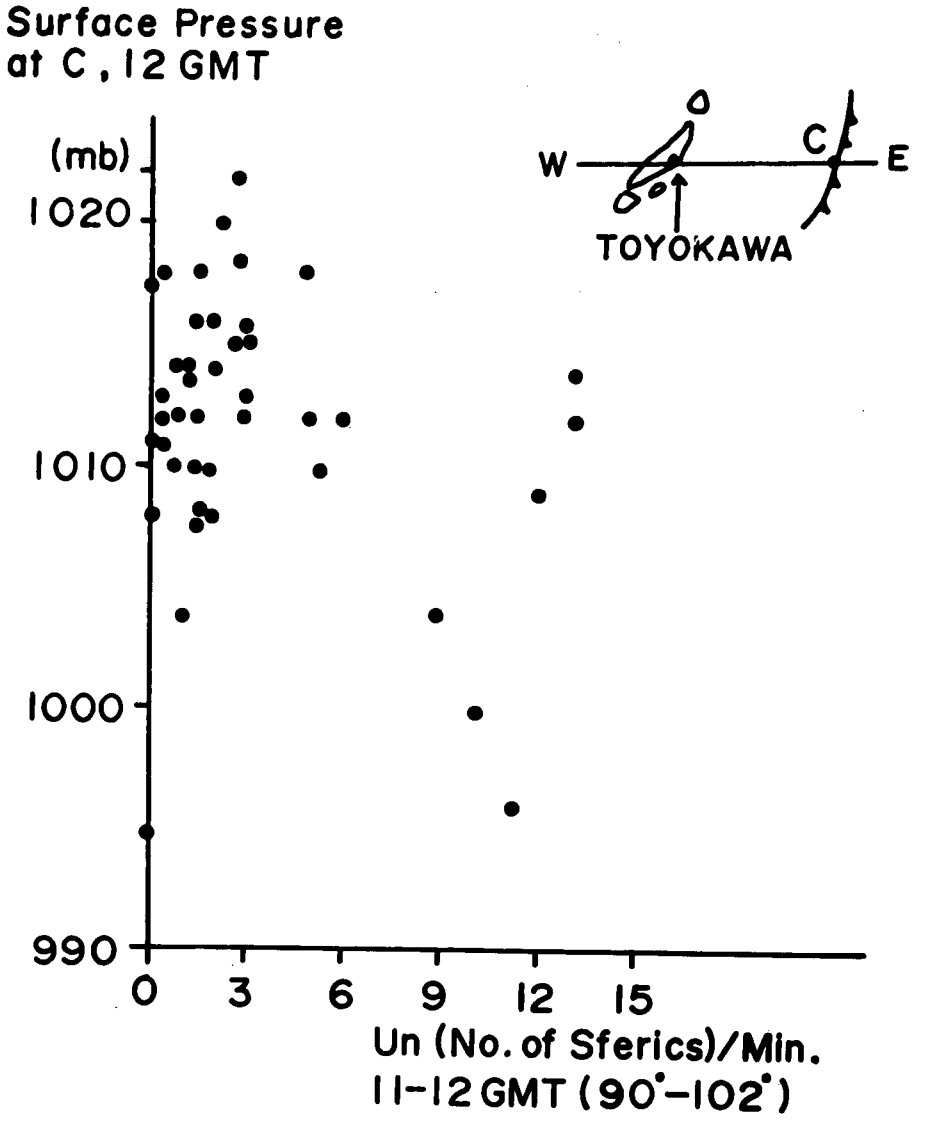

Fig.5.The relation between the sea-surface pressure measured on weather maps to the cold front along an east-west line through Toyokawa at 12 GMT and number of sferics per minute, Un, coming from 90°-102° in azimuth during 11-12 GMT.

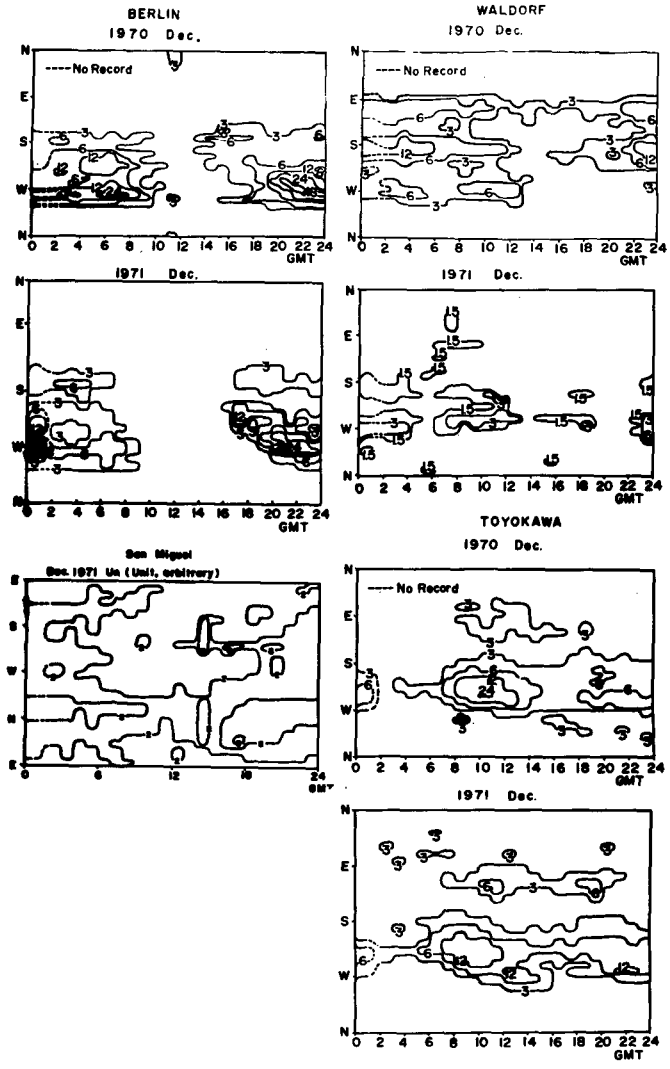

Fig.6.Diurnal variations of Un on December at Toyokawa, Berlin, Waldorf, and San Miguel. Numbers in the figures mean the numbers of sferics per minute except the figure of San Miguel which is drawn with arbitrary unit.

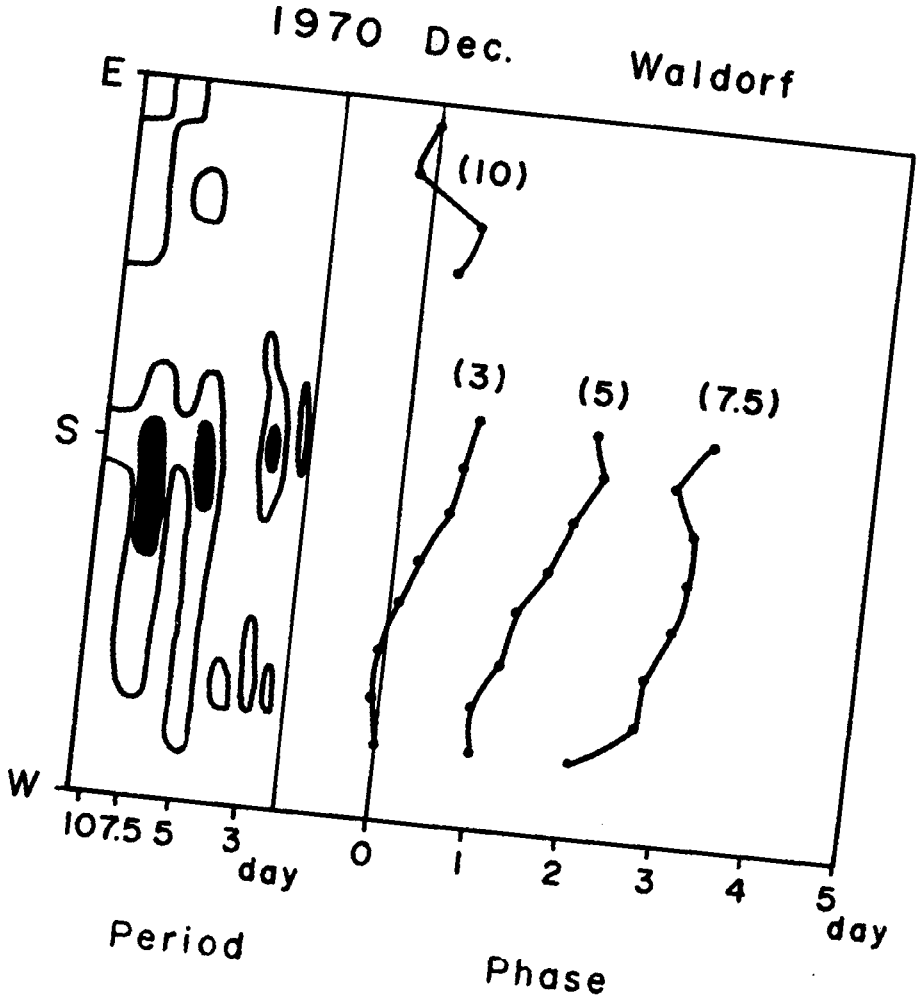

Fig.7. Results of harmonic analysis to Un obtained at Waldorf Dec.1970. (3) means the results of phase analysis to 3 day period.

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APPLICATIONS AND PLANS FOR ATMOSPHERIC ANALIZER IN ARGENTINA

by

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San Miguel, Argentina

The installation in Argentina of a triangulation network with bases relatively near from each other, the stations being separated by distances near 1.000 Km, is intended for the study of atmospheric phenomena in the near field. The location of the stations is illustrated in Fig. 1, and they will be equipped with the V.L.F.A.A. designed by Eng. Heydt.

The location of the sources will be achieved by radiogoniometric triangulation. The complete system will be designed and equipped in such a way that it will make possible the triangulation in real time of individual pulses and the statistical processing of a great number of samples.

The need of locating the origin of each pulse is due to the following events in the near field:

a) The functions SAR and GDD depend in a very complex way on the distance.

b) The dimensions of the stormy areas are of the order of 1.000 Km in diameter and this, in the event of not using the triangulation of each individual pulse, would lead to location errors of the same order.

The objetive of this network is to provide information about the internal structure of the stormy areas with such a definition that it will allow the study of the evolution and parameters of the stormy cells in certain geographical areas.

This information will be used for the study of the temporal and spatial dynamics of electrical cells and storms and their correlation with meteorological, climatological and geophysical phenomena associated with them.

The proposed triangulation system for Argentina is similar in certain phases to the American C.R.D.F. system and the Hyperbolic Triangulation system. It consists of three stations located as in Fig. 1. The central station is located in San Miguel, while the auxiliary ones are located in La Rioja and Puesto Madryn, respectively.

Each of the stations is equipped with the V.L.F.A.A. which allow, according to Heydt, the obtention of incidence angles relatively free of p olarization errors.

The incidence angles for each atmospheric, obtained in La Rioja and Puerto Madryn, are codified and transmitted to San Miguel by a H.F. transmission system at a rate which will allow the transmission of angular data each 4 msec. This allows an adequate synchronization among the measurements of the three stations. In San Miguel, these pulses are received in the V.L.F.A.A. and the incidence angle is also codified and afterwards compared with that of some of the auxiliary stations in a computer whose objetive is the determination of the exact source of each pulse.

The data transmission system is accomplished by H.F. with an special code differing from the C.D.R.F. system, where the transmission is dome via telephone line and from the hyperbolic system, which uses a microwave line. The H.F. frequency was selected since it is the most economical one.

The code to be used is temporal. Its operation is explained according to the diagram of Fig. 2.

The pulse is taken from the V.L.F.A.A. as well as the voltage $U\varphi$. The needle (or spike) pulse is directly fed in channel 1 to an square wave generator which is triggered by the pulse arrival generatin a pulse of 1 msec which modulates the transmitters output at the frequency f_1.

In channel 2, the V.L.F.A.A. pulse starts the operation of delay network whose delay time is proportional to $U\varphi$. After the time $\Delta t \sim U\varphi$ the delay network triggers a spike pulse which in turn triggers a square wave generator which modulates the transmitters output at frequency f_2. Frequencies f_1 and f_2 are selected very near from each other but clearly separated. In this way, two pulses triggered in time are obtained, as can be seen in Fig. 3.

The system allows the transmission of one of the 180 values of angles in a maximun time of 2 msec. with a channel bandwidth of 3 KHz and the must be guaranteed with an accuracy of 5 usec.

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In the receiving end, the Δt is decodified after being obtained from the arrival time of the two wave fronts, after filtering both frequencies. Afterwards, the decodified angle is compared with that of San Miguel, which is delayed in a Δt time, which is equal to the difference of operating time between stations.

For the computing and locating system of the pulses, the following method is applied. All the adjoining space to the stations, within a radius of 3.000 Km, is divided in areas resulting from the intersection of the angular sectors of 2 degrees according to Fig. 4.

To each of these areas, two memory units are assigned. In the first, the count of the pulses arriving from those areas is accomplished, and in the second, the average of magnitude of some of the parameters, SAR, GDD or SA. This operation is done taking note of the first value and averaging for each of the following, noting in the cell the average values obtained.

After a definite time, the information is extracted from the memory and printed.

In this way, the average values of the parameters to be studied and the number of pulses for each of the areas are obtained.

In the actual stage, the system is in the design process and several previous essays were needed to achieve a satisfactory operation of it. A typical example of this is the definition of the synchronism level which was initially fixed in 4 msec according to a non-completed study of the time intervals between pulses. The historiograms on the distribution for storms very near to the receiving station, are illustrated in Fig. 5.

The maximun interval is between 5 and 10 msec. For a better statistical study of this factor, an equipment for intervals between pulses is being constructed in San Miguel, and its block diagram is given in Fig. 6.

Another of the studied problems is the definition of the spatial distribution of the angle measurement error and the distance between stations.

The obtained functions are shown in Fig. 7. Here, the distribution of error is obtained measuring the distance between station E_1 and the station's angel, E_2. The family of curves thus obtained can be simmetrized along the Y axis, and then the distribution illustrated in Fig. 8 will be obtained.

From this, it can be concluded that the measurement errors are not only proportional to the distance, but also to the incidence angle. Accordingly, the measurements can be optimized by the adecuate location of the stations with realtion to the most important sources of atmospherics. For that reason, a first approach to locate the main stormy areas of Argentina was made on the basis of atmospheric's measurements.

For this task, the azimuth distributions of the number of atmospherics were used, obtaining the monthly averages from January through December 1971, a typical example being depicted in Fig. 9.

From their analysis, the following main characteristics can be derived:

a) There is a current maximum in northly direction from San Miguel which is sustained all year long. Its angular position is slightly deviated from NNW to NNE, from Summer to Winter. The activity also decreases.

b) A second maximum is observed during the central Summer month with a NW direction, relative to San Miguel. Its duration is of 3 (three) months.

c) A lower maximum is observed in SW direction and it lasts all year long excepting June.

These characteristics are represented in the vectorial chart of Fig. 10.

The correlation of these maximums with certain areas of activity was studied, analyzing synoptical charts of the Servicio Meteorológico Nacional, where the summaries of electrical activity with surface data for each month of the year were completed. In the map of Fig. 11 a characteristic example can be observed.

a) From the analysis of this information the existence of maximums of activity in the coastal area which is displaced from SW to NE, from Summer to Winter.

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b) A maximum of activity in the Tucumano-Orense forest, located in the NW area of the country, whose duration is of 3 (three) months, approximately, in midsummer.

Their characteristics are summarized in the diagram of Fig. 12.

These two maximums are coincident with these of azimuth distrubution; on the contrary, the maximum for SW distribution cannot be defined by this method.

Complementary information was obtained on the rain and clouds averages shown in Figs. 13, 14, 15 and 16 respectively, as Summer and Winter examples, extracted form the Atlas Climático de la República Argentina. The maximums of rain and clouds for the above mentioned areas, appear again with similar characteristics in the temporal and spatial development.

From the analysis of these data it is evidente that:

a) The main focuses of activity are two, located in NW an NNE, respectively.

b) Their yearly activity cycles can be observed in Fig. 17.

c) The electrical activity decreases form Summer to Winter and is displaced from SW to NE.

d) The principal focus, according to its duration and amplitude, is that of NNE.

e) The location of stations in La Rioja and San Miguel seems adequate for the study of these areas with sufficient accuracy.

f) The origin of the pulses which give the SW maximum is not defined and can only be studied on the basis of synoptical triangulations. For this purpose, the inclusion of Puerto Madryn in the network would be sufficiently adequate.

At the same time of realization of these tasks, necessary for the design of the triangulation system, other tasks were accomplished and they

will be mentioned since they define the area of interest of our Department. They are:

a) Analysis of daily cycles of the number of atmospherics for all azimuths on a period of 10 years and the daily cycle for the four main directions: East, South, West and North. For the period January-December 1971, these data was compared with the daily cycles of activity for U.S.A. and Japan.

b) Study on the influence of Sun Flares on the propagation on V.L.F., with the records obtained in the Laboratorio Ionosférico de la Armada from the stations NBA, NAA and NPG.

c) A work on the propagation of electromagnetic waves, with the objective of obtaining a theoretical tool adequate for calculating the ionospheric relfection in the presence of very intense fields.

The same system of triangulation planned for this network will be probably used in a lesser scale on an anti-hail-fight proyect, directed by Dr. Nuñez of the Comisión Nacional de Investigaciones Espaciales (National Comission for Spatial Research), on the Mendoza-San Juan area.

Lastly, it must be mentioned that during 1973, a proyect will be developed in collaboration with Dr. Harth from Germany, consisting in a chain of stations for the obtention of pure propagation data based on atmospherics records, with bases in San Miguel, Puerto Madryn, Ushuaia and Argentine Antarctic Territory.

To obtain a better definition of the area of interest of our Department, it is necessary to explain the method to be followed to accomplish the research based on the study of the parameters of atmospherics in their origin, on the basis of:

a) Knowledge of the distance source-observer and, consequently, of the place of the measured parameters.

b) Use of suitable propagation theory for the near field.

c) Monitoring of the ionospheric conditions during measurements.

This method would allow us to study, as was stated in the beginning, the electromagnetical dynamic of storm cells and areas, and their relationship with meteorological, climatological and geophysical phenomena.

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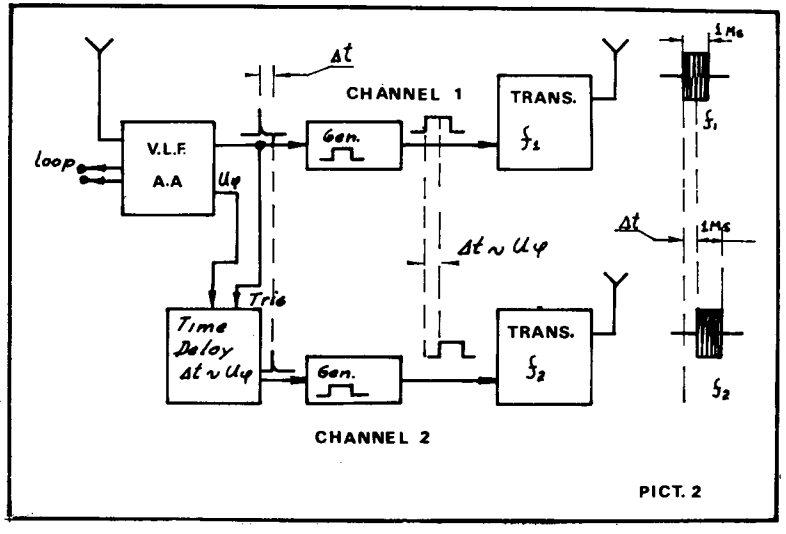
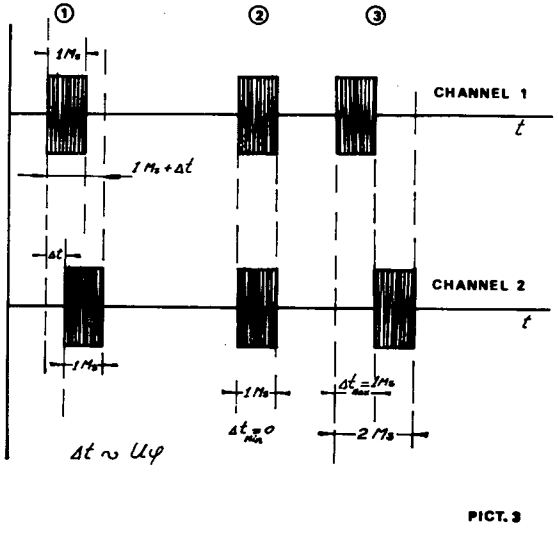


PICT.2



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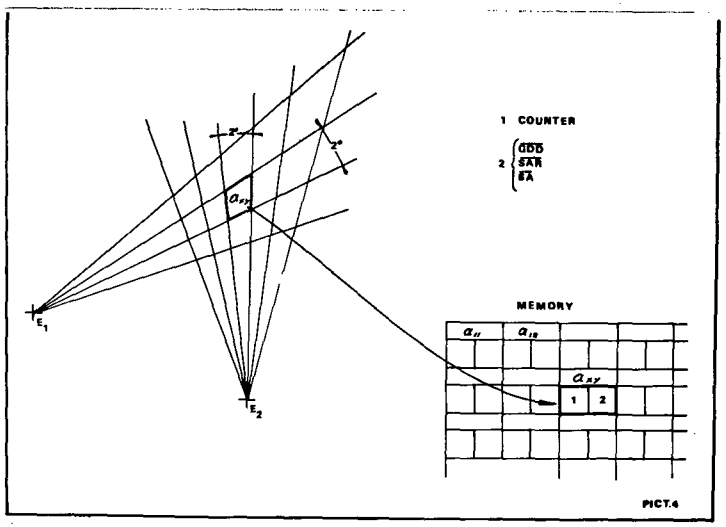

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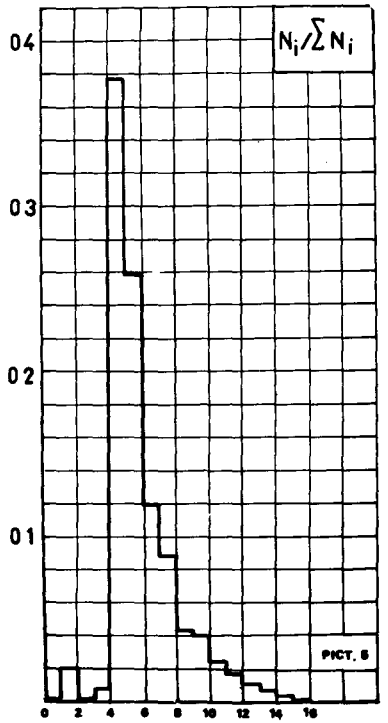

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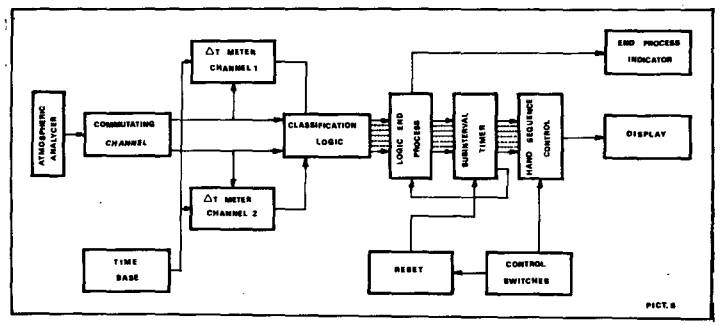

PICT. 6

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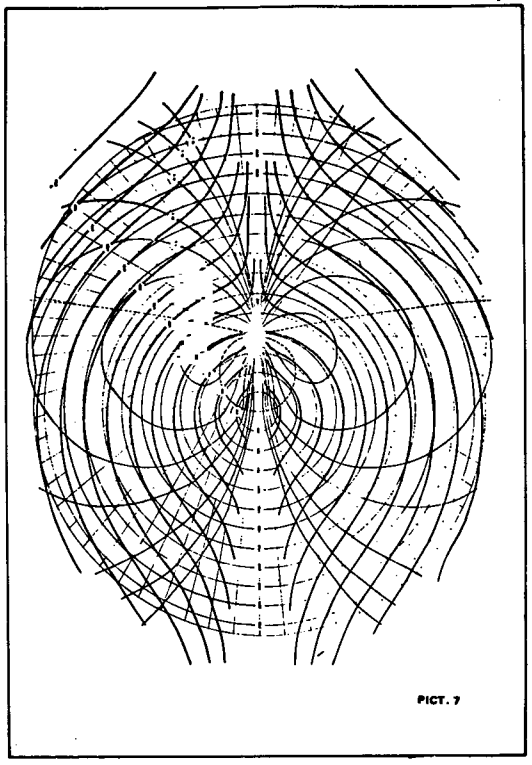
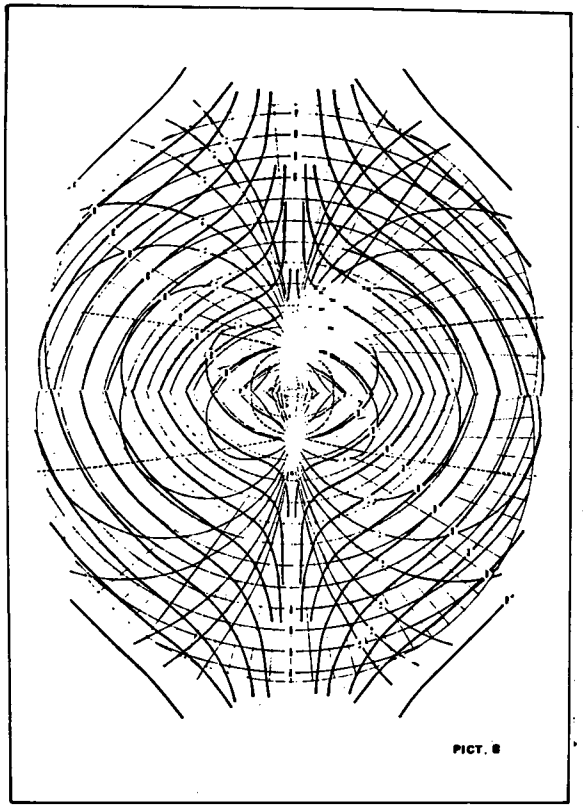


PICT,7



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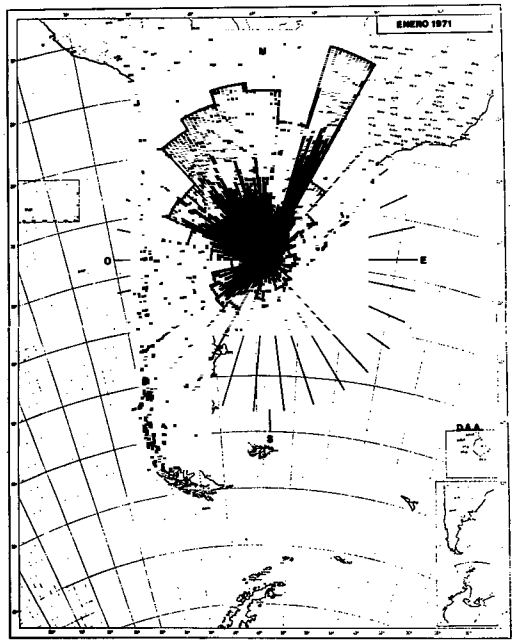

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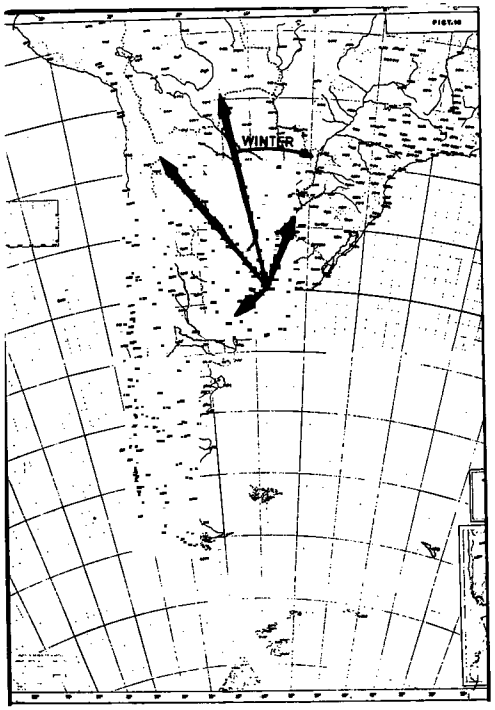

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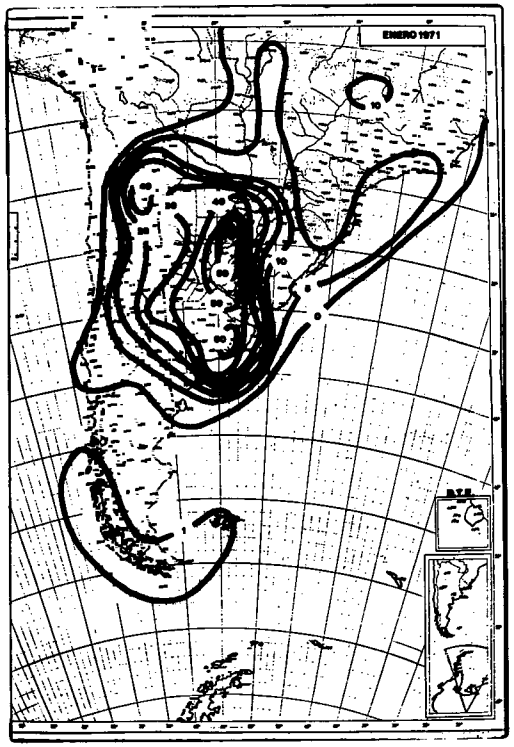

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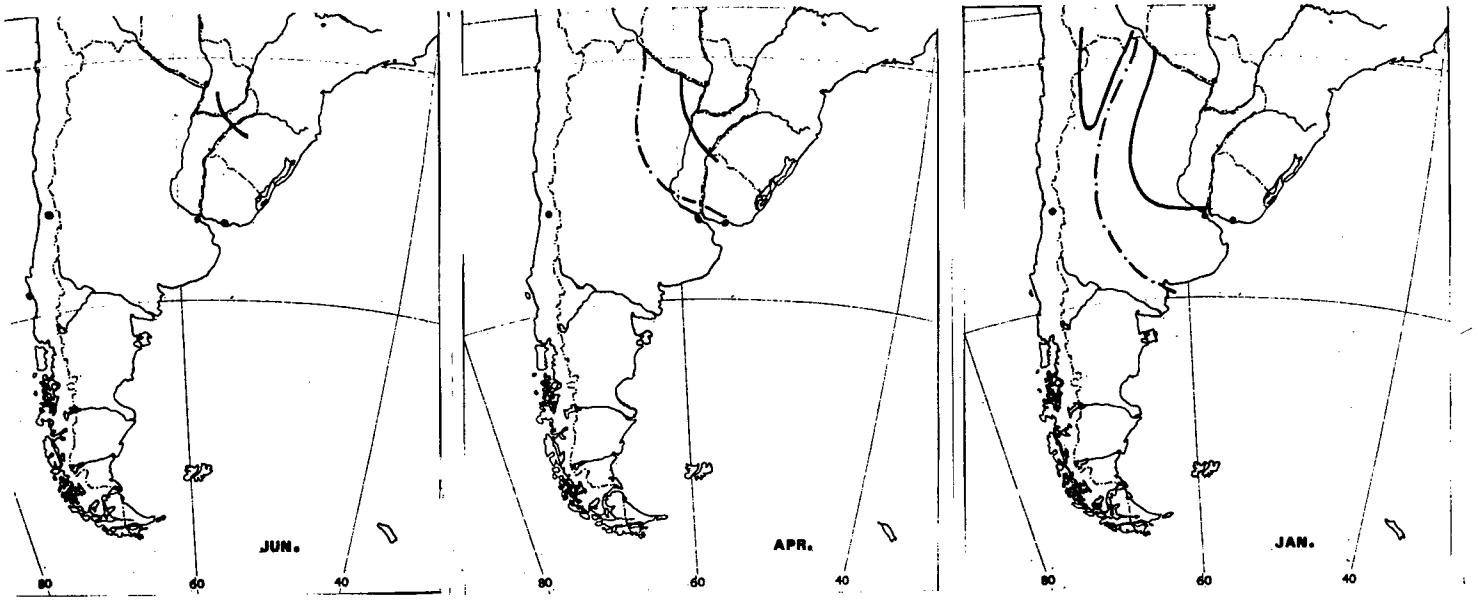

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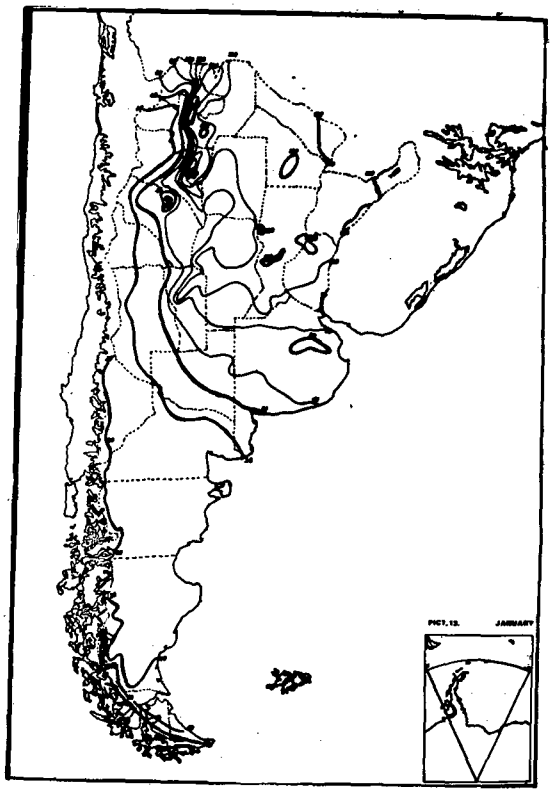
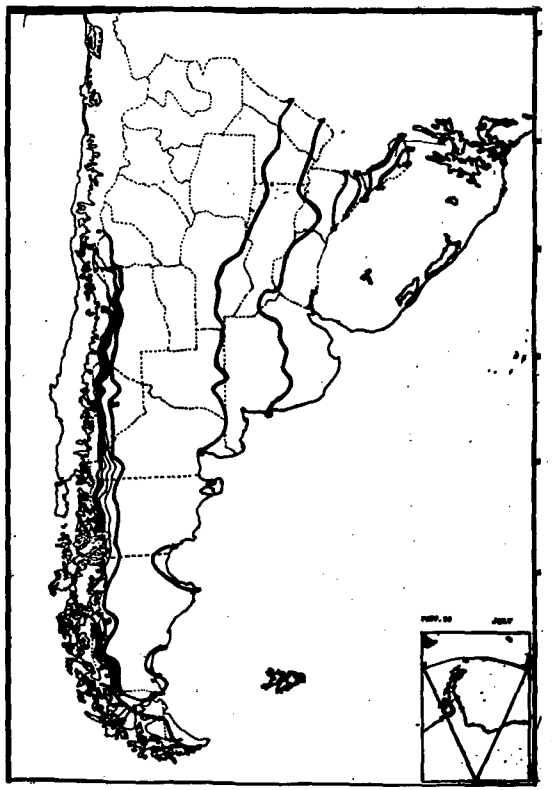


PICT. 13



PICT. 14

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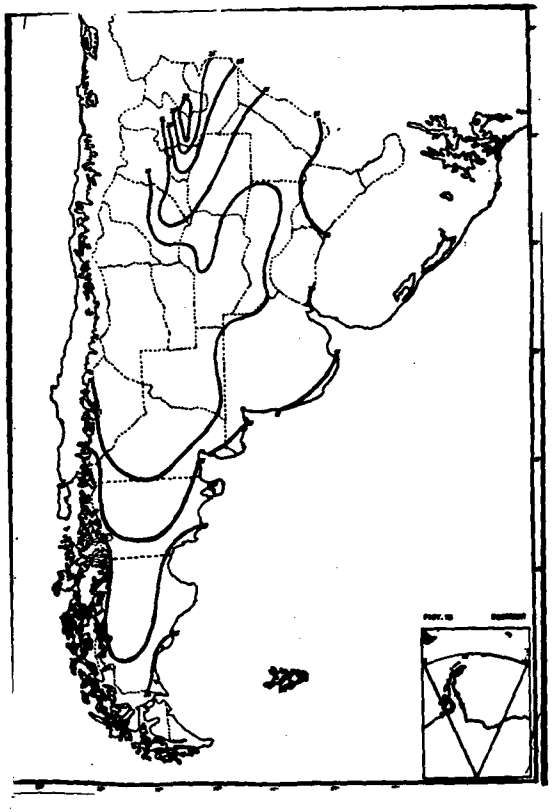
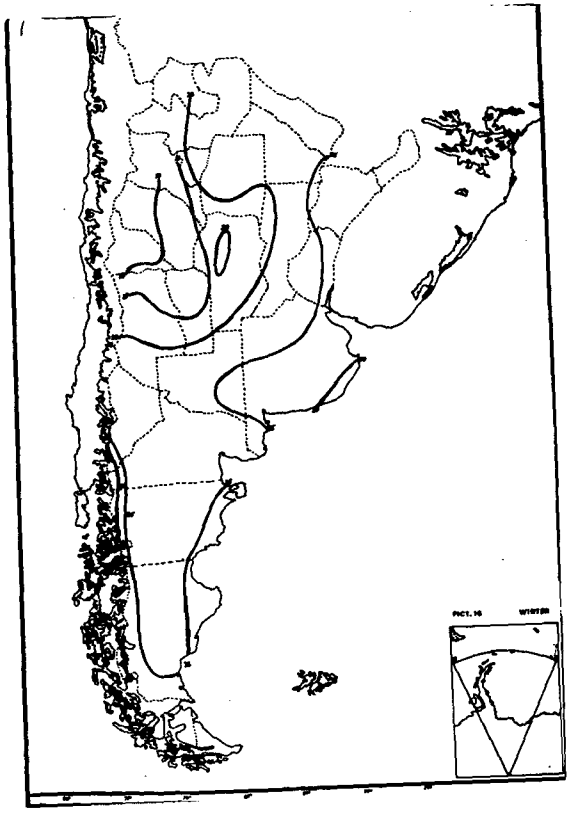


PICT.15



PICT.16

PICT.17

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Observation of Single Storm Complexes with the Atmospherics Analyzer Network

by

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Abstract: During the Intensification Interval X-4 of the ICAE in February 1972, the VLF-Atmospherics Analyzer network carried out an intensive observing program. First results of this program are presented in form of bearing plots and of GDD- and SAR-plots. Comparisons of storm locations obtained by GDD measurements with crossbearings from two of the stations and with weather maps are given.

1. Introduction

During the routine observation program of the stations of the Atmospherics Analyzer network, the interval between the photographic records is three hours. This low recording frequency is adequate for the purpose of statistical evaluations with a more climatological background as presented in the preceding paper. Generally, the storm situation shown by the photos is found considerably changed after an interval of three hours. Thus, the observation of the behaviour of single storms and the determination of the diurnal variation of the GDD (Group Delay Difference) and SAR (Spectral Amplitude Ratio) caused by single sources becomes rather difficult.

For this reason, the recording frequency was increased by the network on special occasions, as during the hurricane Ginger in 1971 and during the Intensification Interval X-4 of the ICAE in February 1972. Especially on the latter occasion we obtained a lot of data which are at present not completely evaluated.

In this paper, a few of the first results of these observations are presented which shall show the potentialities of the network with regard to single storm monitoring.

2. Observation Program and Data Processing

During the days from Feb.10 till Feb.17 in 1972, the Atmospherics Analyzer of the four stations were switched to continuous operation of the camera systems, at which records in the GDD- and in the SAR-mode of operation were carried out alternately with exposure times of 10 minutes.

The results of this observation program were a lot of photos which show the direction of arrival and the GDD or SAR respectively in form of dot clusters. For the purpose of further data processing we read the centers of the clusters and estimated some keynumbers for the scattering ranges of the direction of arrival and of GDD or SAR respectively and for the density of dots. Now, it is experienced that GDD- and SAR-records taken in short intervals show a very similar cluster configuration. Therefore, we developed a computer program which assorts the cluster data of the successive records to data of cluster sequences. It may be assumed that these sequences are caused in most of the cases by one and the same at-

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mospherics source, that is to say, to one and the same storm complex. Fig.1 shows an example of such a sequence of cluster data, which gives the data of PSI (direction of arrival), GDD and SAR and the keynumbers KKK of the successive records.

3. Examples of Bearing Results

A first result of this assorting of data was that the number of sequences obtained during the observation period was surprisingly high. On the average, there occured about 20 sequences/day at the stations Toyokawa and Berlin.

Fig.2 shows as an example a plot of the bearing results of 14. Feb. 1972 obtained at Berlin. We have got quite a number of these bearing plots from the Intensification Interval and the main results of them may be summarized as follows:

1. The duration of the cluster sequences shows a wide spread: there are sequences with durations of less than one hour and there are other ones which could be observed for more than a whole day. On the average, the duration of the sequences is about a few hours.
2. Generally, the straying of the center of the bearings within one and the same sequence is restricted to a few degrees. The influence of sunrise and sunset effects on the bearings seems to be very low and their constancy during the night hours is not considerably lower than during day-time.
3. The accuracy of reading the angle of arrival is sufficient to observe slow shiftings of the bearing of the sources.
4. There is a considerable number of sequences which occur simultanously and which have low bearing differences with respect to each other. At present, it is not clear whether this effect is due to a propagation effect or due to the geographic configuration of the sources.

At the Berlin station, the atmospherics activity was restricted during this observation period on the range between southeast and northwest with an only exception of one source in the east at 12. Feb., which will be mentioned later.

Fig.3 shows a similar plot obtained from the Toyokawa station. At this station, the main activity during this period was observed in southwestern directions, but there was activity in the west,

in the northwest and in the east observed too. Directions close to the north were found to be completely free.
At the San Miguel station, the main activity was observed between west and east with a maximum in northern directions.

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4. Results of GDD- and SAR-Observations

As mentioned in preceding papers, the abilities of the VLF-Atmospherics Analyzer of the Heinrich-Hertz-Institute exceed the usual direction finding possibilities by GDD and SAR observation techniques. Thus, a great number of GDD and SAR sequences has been obtained from the Intensification Interval, and many of them have been discussed in a rather extensive report (Heydt and Raupach, 1972). In this paper, the presentation must be restricted on showing a few examples of the location plots which we derived from the data and on giving some of the general results.
Fig.4 shows a compilation of plots which consists of three different parts. On the right side, sequences of GDD measurements are plotted versus observation time, showing the center and the scattering range of the clusters. The middle part shows maps which contain storm locations which have been found by the GDD sequences and the respective bearing sequences by means of an one-mode-propagation model as given by Harth 1970. On the left side, sequences of SAR measurements are plotted which correspond to the GDD measurements on the right side. Sunset and sunrise times at Berlin are marked by little arrows on the right time scale.
The special example on this plot compilation shows very active and long lasting atmospherics sources in westnorthwestern directions of Berlin. It may be stated that in this case the diurnal variation of the GDD shows a good accordance to theoretical calculations. For instance, the day/night ratio of the GDD of 1.45 corresponds quite well to the squared day/night ratio of the assumed reflection height of the ionosphere of $(85km/70km)^2$.
Generally, one would expect that the GDD remains at a constant level for a longer time during daylight. In fact, this is not the case because of the short duration of the daylight time during winter and due to the circumstance that especially long paths are merely for a short time on the whole under daytime conditions.
The shape of the SAR curves looks in general as predicted by the

theory, showing low values during nighttime and high values during daytime. However, there are some interesting features of these curves which are worth to be pointed out. Firstly, the increase of SAR begins rather late, when the path is about half under daytime conditions. Secondly, there are marked increases of the SAR at the occurrence of solar flare effects. These effects, marked by stars at the right time scale were unusually frequent during the Intensification Interval. Thus, it may be possible that some of the results obtained during this interval are not representative for undisturbed ionospheric conditions.

The interpretation of the GDD curves on Fig.4 and of those of the preceding day leads to the locating of a very active atmospherics source which has traveled along the area of the Northamerican East coast in northeastern directions. An independent confirmation of this interpretation is given by the weather maps of the Free University Berlin which show a low pressure area traveling just in this direction along the coast. Fig.5 shows as an example the weather map of 14.Feb. which shows the low pressure area on the upper left side. The thick black circles show the locatings of the activity centers found by the GDD locating technique. These centers are located just at the front line. Weather stations which had observed storms were marked by arrows on this figure.

This is one example of a number of cases which show that the single station locating technique by means of GDD works quite well in the case of propagation direction from the west to the east. In this special case, one would expect to get further information on the real storm situation by the observations of the Waldorf station because this station must have been very near to the source. Unfortunately, there were no photographic observations for this day available from the Waldorf station because of some shortcomings of the camera system. On the other hand, results of the observations of azimuthal dependent atmospherics rates are suitable likewise to see what has happened in Waldorf.

These rates are shown by the Fig.6 and 7, whereas Fig.6 gives the rates of the 13. Feb., the day which preceeds the two days shown by the plot compilation Fig.4.

Obviously, there occured a very active source in Waldorf too.

The direction of arrival with respect to Waldorf started a little bit western to south, and then it traveled rather fast to the east. It seems that the Waldorf station was streaked by this source at about 18 GMT. Fig.7 shows that this activity remains at the next day in the east of Waldorf and vanished at about 20 GMT. Thus, the results of the Berlin locatings are partly confirmed. On the other hand, there are some surprising discrepancies in the details: It seems that the Berlin station received signals from that source several hours before Waldorf. Furthermore, the activity vanished at Waldorf in the evening of 14. Feb., while considerable activity eastern and northeastern of Waldorf could be observed by the Berlin station for many hours after that time.

This leads to the problem of the "visibility" of sources from different stations. It seems that there exist some kind of blind spots in the vicinity of the stations, probably caused by interference pattern of the modes. At present, it seems that the observation from distant stations gives a more realistic impression of the storm situation than the observation from short distances. It would be very interesting to get further information from meteorological observations about the storm situation in order to investigate this special case in further details.

As afore-mentioned, the GDD locating technique works quite well in the case of sources which are situated western or northwestern with respect to the receiving station. However, in the case of other directions the GDD values become somewhat dubious at least at nighttime conditions.

Fig.8 shows as an example of these cases a plot compilation obtained from results of the Toyokawa station for southwestern sources. These sources occur with rather high pulse rates short after local sunset at Toyokawa and their GDD points to locations in the area of Indonesia. The GDD remains at this level for a few hours after which it increases considerably. At sunrise at Toyokawa, the GDD decreases markedly at the one day whereas at the other day the GDD remains rather constant at this time. The mentioned increase of the GDD in the night occurs not regularly at every night and the sources were in no case lasting as long as the one at the Northamerican coast. It is rather difficult to decide what is the reason for this behaviour of the GDD. It may be that it is due to

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propagation effects, but it may be too that there were sources behind the Indonesia sources which came into the receiving range when the day/night boundary gets on to the west during the night. This point will surely need further investigation.
Unfortunately, these areas are not within the receiving range of two stations of our network, so that an independent test of the source locations by means of crossbearing is not possible. On the other hand, there are some areas the lightning activity of which can be observed by two of the stations. One of these areas is the area of the Mediterranean. It came out very clearly from the observations of the Intensification Interval that the Toyokawa station could receive atmospherics coming from this region which is of course within the receiving range of the Berlin station.
Fig.9 and 10 show examples of comparisons of crossbearing and GDD locatings from Berlin and Toyokawa. These figures confirm once more the statement that GDD locations western of the receiving station are reliable. There seems to be no considerable difference of the GDD indication between land or sea path propagation. It should be pointed out that these locations were confirmed by the weather maps too.
Fig.11 shows a further example of this kind. It was carried out for the only case where an atmospherics source was observed eastern of Berlin during the Intensification Interval. In this case, the GDD location from Berlin came out much too far. It is very interesting to see that this easterly source could be received in Berlin at a distance of about 6.000 km although the propagation attenuation is expected to be rather high. This may be caused by a very active source or by exceptional propagation conditions.
Therefore, it is obvious that the "receiving range" of the Atmospherics Analyzer is a function of the azimuthal and diurnal dependent propagation conditions and of the features of the sources. Thus, it will be rather difficult to characterize the receiving range by one or two simple figures.
Another important matter of interest is to get an idea of the accuracy which is attainable by means of the GDD locating technique. One of the main factors with respect to this problem is the accuracy which can be obtained at the determination of the cluster center. This determination may be difficult in case of very weak

or of very strong sources if photographic recording techniques are applied. However, in the case of west-east propagation an accuracy of the reading of ± 10 µsec is attainable by means of averaging the results of a few successive taken records. This corresponds to a straying of the distance of ± 300 km. It may be that an on-line data storing and the determination of the centers by means of a computer will improve the accuracy of reading. In this case, the accuracy would come to values which will be rather difficult to proof by independent meteorological information because of the very limited possibilities of weather maps or satellite photos with respect of indicating the real position of the main lightning activity center within a storm complex.

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References:

Harth, W., 1970, Die Berechnung der Atmosphericsparameter im unteren VLF-Bereich mit Hil-fe des Wait-Formalismus, Thesis, Bonn 1970

Heydt, G. and Raupach, R., 1972, First Results Obtained during the Program X 4 of the VLF-Atmospherics-Analyzer Network, Technischer Bericht Nr. 155 des Heinrich-Hertz-Instituts, Berlin-Charlottenburg

CLUSTER SEQUENCIES OF SPECTRAL ATMOSPHERICS-PARAMETERS, FITTED WITH RESPECT TO PSI,KKK,GDD AND SAR
STATION: BERLIN - WAIDMANNSLUST, 52.62 NORTH, 13.13 EAST
CLUSTER SEQUENCE NO.:119. TIME OF BEGIN: DAY 45,1971, 21 GMT
TIME OF END: DAY 46,1971, 16 GMT. CONTINUATION OF CLUSTER SEQ. NO.: 98

GMT	PSI	GDD	SAR	KKK
21/3	296	192		112
	296		12	131
21/5	296	186		122
	0		0	0
22/1	296	174		131
	294		18	141
22/3	292	181		222
	292		19	141
22/5	293	161		122
	292		16	131
23/1	296	180		121
	293		23	141
23/3	293	160		121
	292		8	131
23/5	293	178		112
	292		10	131
0/1	292	185		121
	293		16	141
0/3	294	186		131
	291		29	141
0/5	293	175		121
	294		31	141
2/1	293	168		211
	292		31	141
2/3	293	189		111
	294		37	130
2/5	293	180		110
	0		0	0
3/1	296	173		110
	290		38	220
3/3	296	167		211
	294		36	141
3/5	292	160		111
	292		27	230
4/1	291	168		111
	295		33	140
4/3	292	181		311
	290		26	221
4/5	288	187		321
	286		13	230
5/1	292	164		112
	290		16	241
5/3	292	160		222
	291		27	141
5/5	290	165		222
	292		36	131
6/1	291	159		221
	289		26	130
6/3	292	173		122
	291		31	141
0/0	0	0		0
	0		0	0
0/0	0	0		0
	0		0	0
7/1	292	176		121
	291		31	131
7/3	291	179		111
	291		24	141
7/5	290	168		111
	291		14	130
8/1	291	169		111
	291		25	121
8/3	291	195		111
	290		23	140
8/5	292	179		112
	289		48	121
9/1	294	189		121
	290		48	130
9/3	292	199		111
	287		37	131
9/5	291	187		511
	289		58	121
10/1	289	221		121
	289		70	131
10/3	291	217		111
	0		0	0
10/5	290	241		121
	289		103	130
11/1	291	238		111
	288		122	121
11/3	290	240		111
	287		140	130
11/5	290	242		111
	289		146	120
12/1	290	247		111
	284		144	120
12/3	285	250		111
	285		151	141
12/5	287	259		121
	288		143	140
13/1	285	250		111
	290		137	130
13/3	290	248		111
	287		148	120
13/5	288	244		111
	286		147	120
14/1	286	243		111
	282		144	120
14/3	286	218		110
	285		166	110
14/5	0	0		0
	282		147	120
15/1	283	241		110
	280		151	120
15/3	283	233		111
	281		131	120
15/5	284	220		110
	0		0	0
0/0	0	0		0
	0		0	0
0/0	0	0		0
	0		0	0

Fig.1: Table of data of cluster sequences

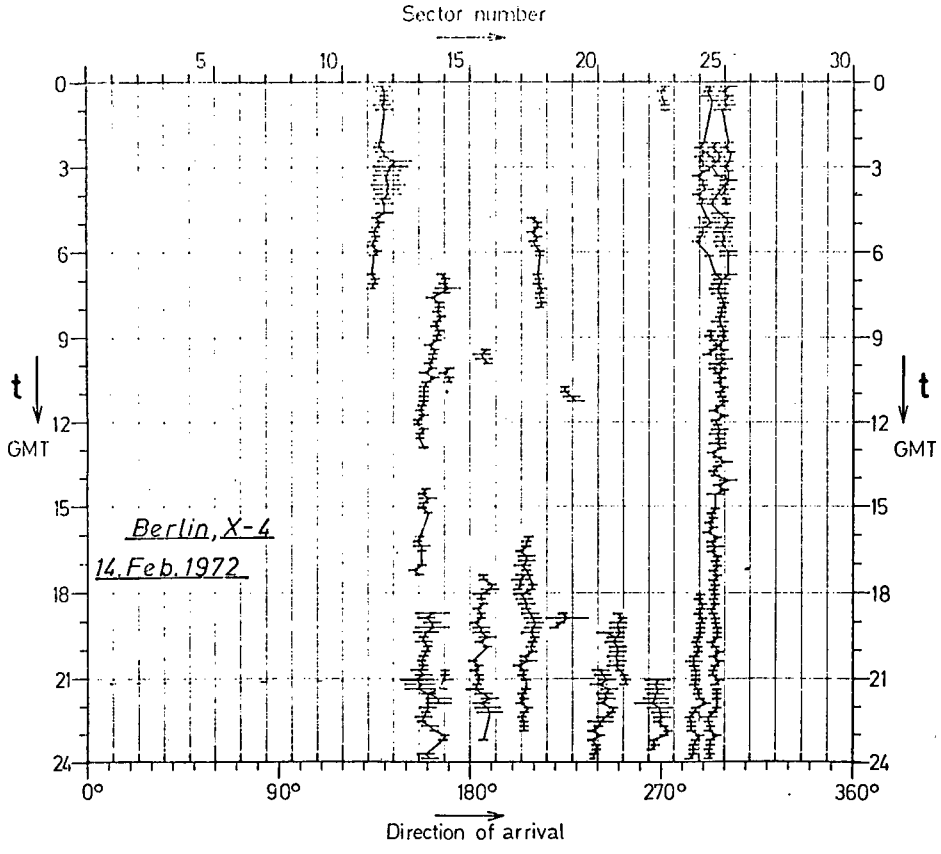


Figure 2

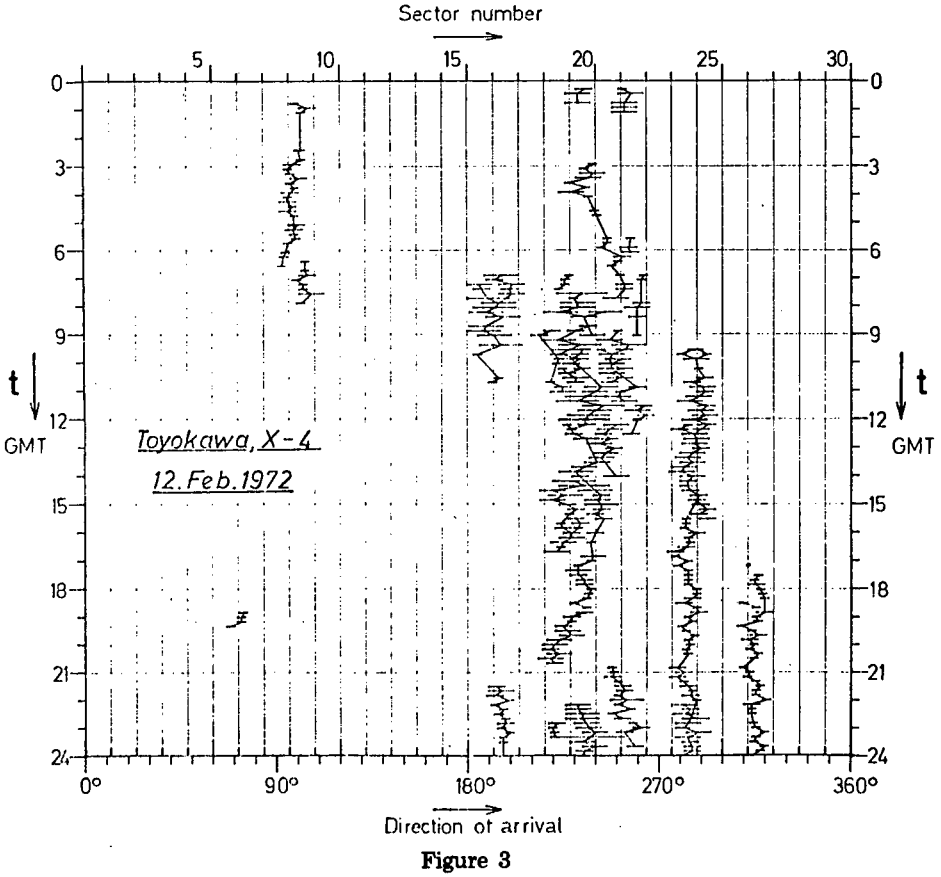
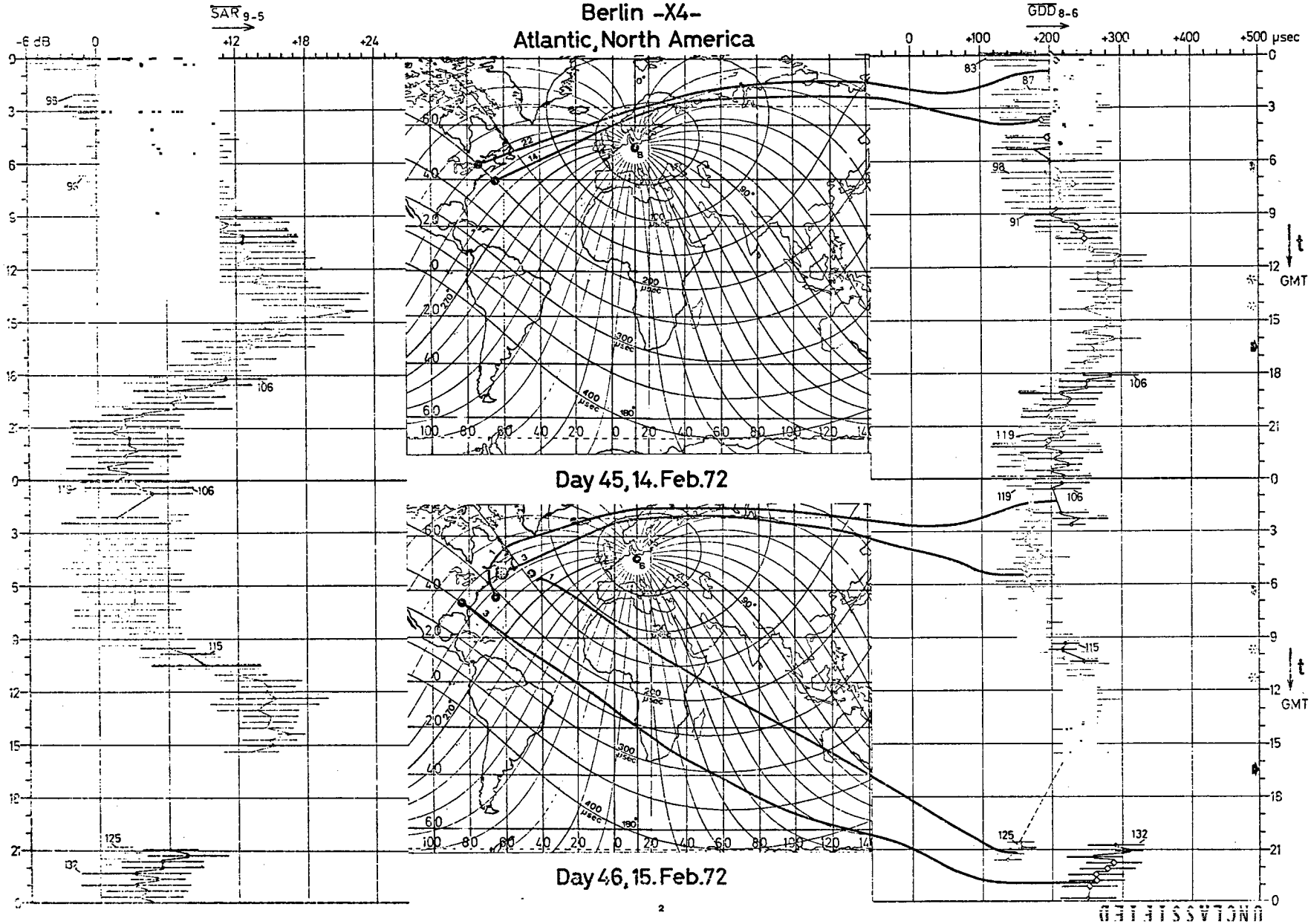


Figure 3

Fig.4: Example of Location Plot, Berlin



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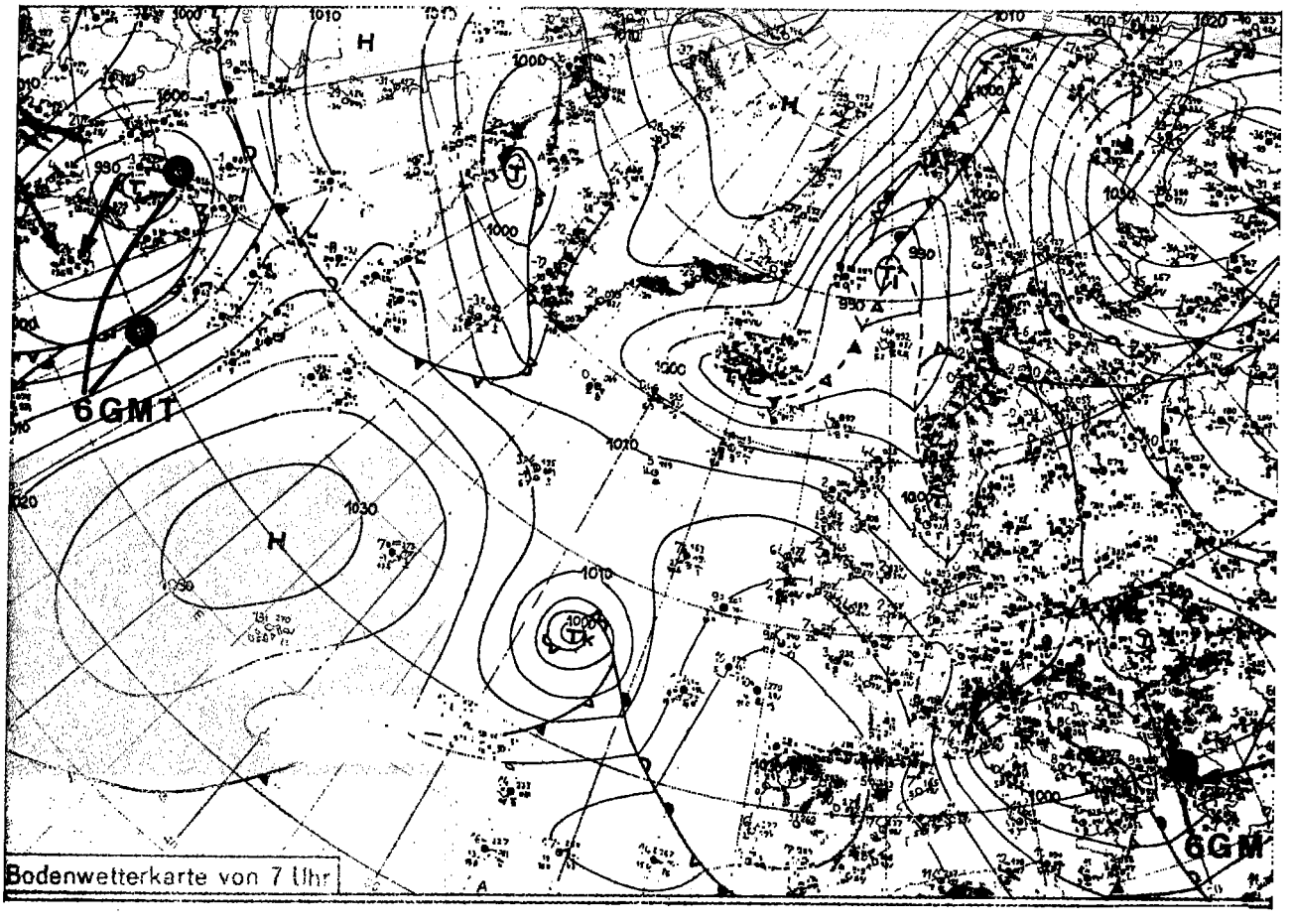

Fig.5: Weather map of the Free University Berlin, 14.Feb.1972, 6 GMT

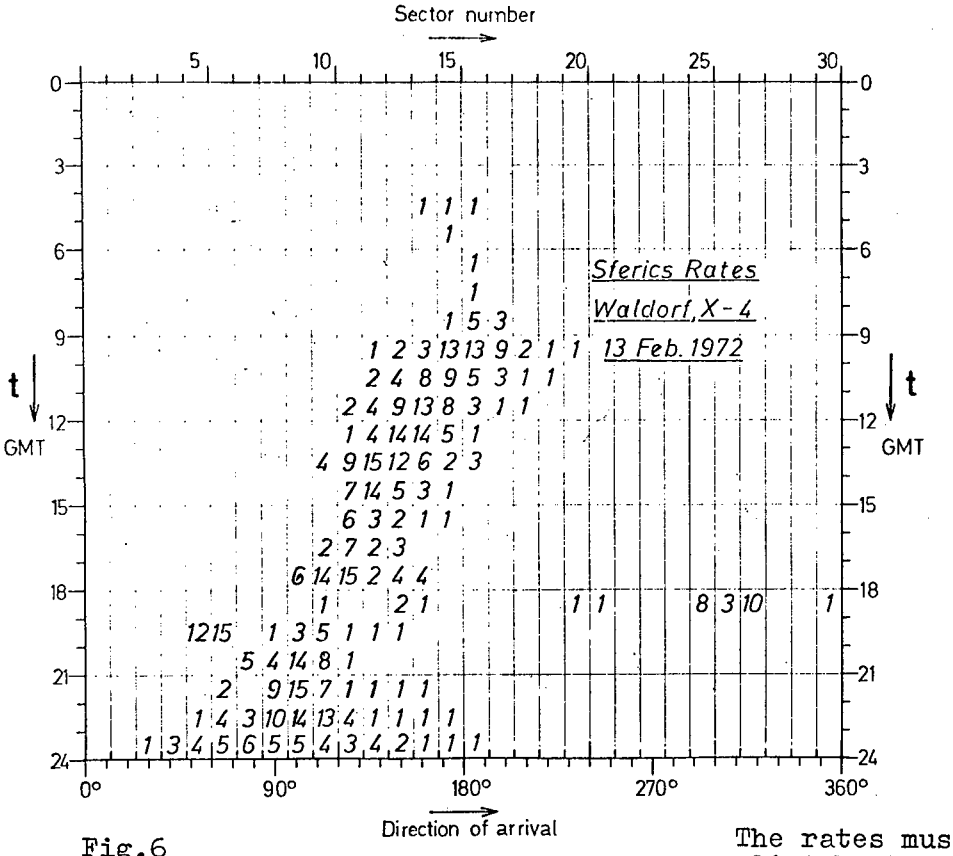

Fig.6

The rates must be multiplied by ten to get rates/minute!

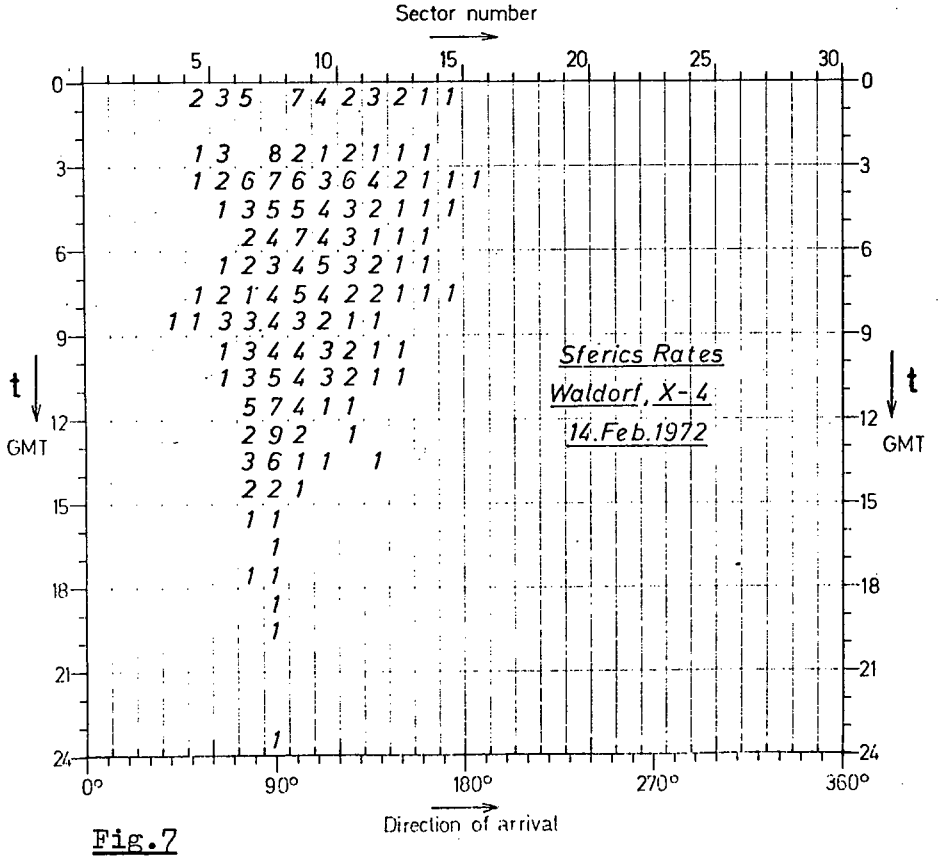

Fig.7

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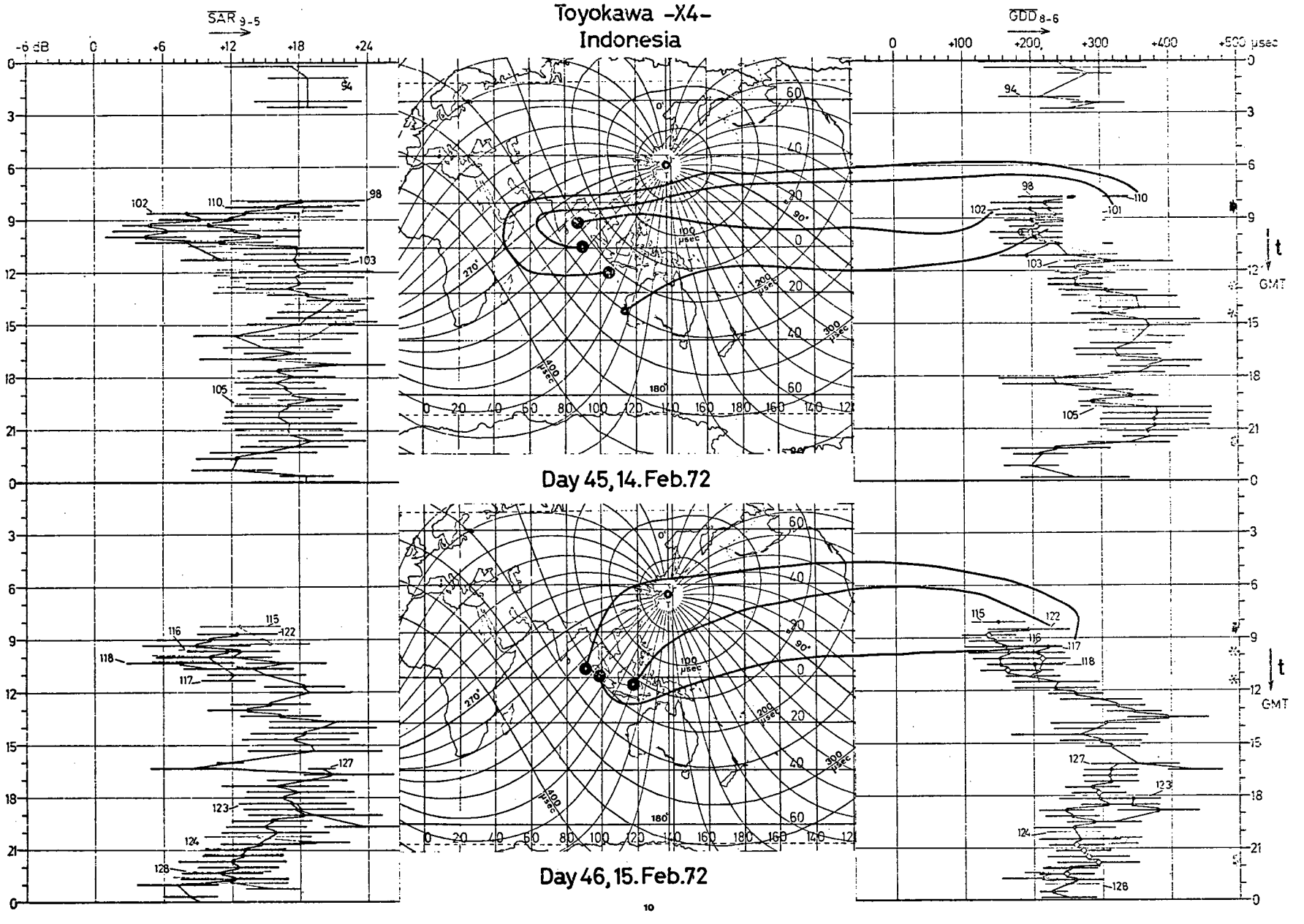
Fig.8: Example of Location Plot, Toyokawa



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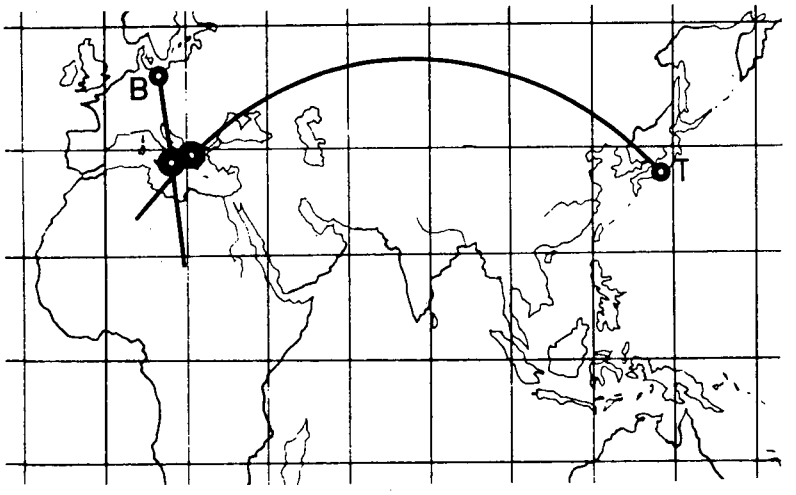

Fig.9: Comparison between GDD location and cross bearing, 12.Feb.1972, 19 GMT
Lines: great circles
Black circles: GDD locations

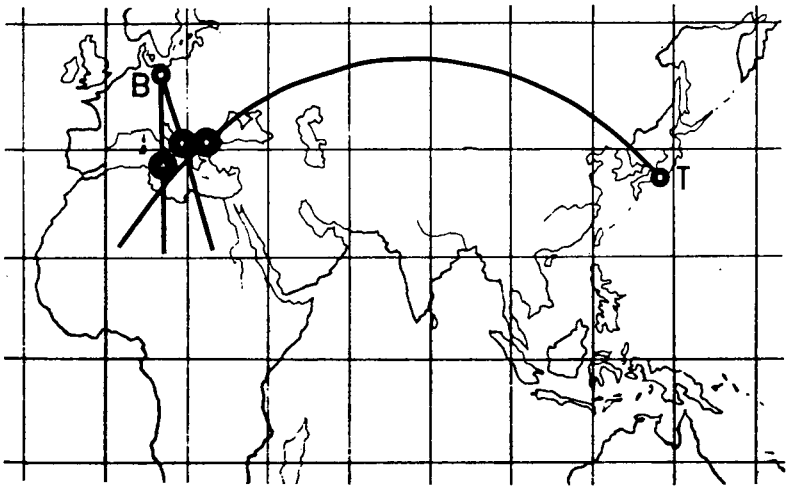

Fig.10: Comparison between GDD location and cross bearing, 10.Feb.1972,18 GMT

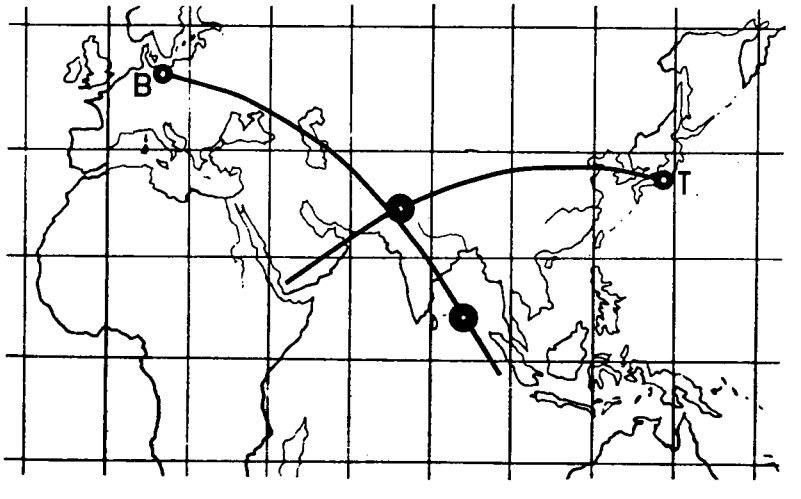

Fig.11: Comparison between GDD location and cross bearing, 12.Feb.1972,1430 GMT

COMPUTER ANALYSIS OF DATA FROM THE ATMOSPHERICS ANALYZERS

by

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Atlantic Science Corporation
Indialantic, Florida

Abstract

Analysis techniques of digitized data from the atmospherics analyzer are discussed along with the problems encountered in the ensuing reduction.

Introduction

This paper is directed towards the computer analysis of data obtained from the atmospherics analyzers installed at Berlin, Germany, and Waldorf, Maryland, USA.

The atmospherics analyzer developed at the Heinrich Hertz Institute in Berlin has been described in detail elsewhere (Reference 1) and this aspect will not be discussed further in this paper. During the last year digitized data was obtained from Berlin and Waldorf covering the period December 1970 through March 1971. This data had been reduced in Berlin manually in a format that gave, for each storm cluster, the time, the angle of arrival, the spectral parameter GDD (group delay difference) or SAR (spectral amplitude ratio), the scattering of the cluster and the density of the spots. A full description of this reduction technique is given in Reference 2.

In order for a thorough investigation of this data to take place a period of low activity in the Northern hemisphere was chosen, namely Jan. 1-30 1971, to correlate the Berlin and Waldorf results against each other, as well as with data from satellite cloud photographs, radar echoes and lightning direction finding equipment installed in Europe operated by the British Meteorological Office.

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Analysis

A computer program was written which would accept the reduced GDD & SAR information and plot possible storm regions on a map of the world. To aid in this objective a Stromberg-Carlson 4060 visual display unit was used. This unit would rapidly plot the world map, add to it the pre-computed great circle line from observing station to storm position and mark the expected position of the storm center. Certain information pertaining to the computations as well as the time of day are also marked on the map. An example of such a map which is computed and printed in less than 1 second is shown in figure 1.

This figure illustrates the situation at zero hours UT on January 2nd 1971. Great circle lines are drawn from Berlin and from Waldorf in the direction of storm centers, and the storm distance, computed from GDD is marked by a star at a point close to the end of the great circle lines. This distance is computed from the method of Harth (Reference 3) and given approximately by the equation.

$$D = \frac{GDD \times 1000}{\left(1 - \frac{360 - \tau}{900} \cdot \sin \tau\right)\left(102.629 - 0.851\, h\right)}$$

where D is the storm distance in kilometers
GDD is in μsec.
τ is the azimuth in degrees
h is the reflecting layer height in kilometers

h is taken as 70 km by day and 85 km by night.

The areas marked by dashed lines have been indicated by hand after investigation of satellite cloud photographs and show areas where thunderstorms are possible. The large dots in Europe, Africa and the north Atlantic show storms located close to that time by the European CRDF network. The lettering on the figure is self explanatory except K indicates the density of the cluster of spots observed at Waldorf and at Berlin. This figure is a typical one of over 200 produced for the first few days of 1971. It poses many problems; we know that errors exist in the CRDF system, small errors will also exist in obtaining the azimuth from the atmospherics analyzer equipment, but by far the largest error is obtaining an accurate time difference (GDD) and having good theory to support it.

Figure 1 shows the difficulties in attempting to triangulate storm fixes with two such systems and it also gives an indication of the errors that can be expected. Great problems were also encountered in adjusting the theory to take account of the night/day reflecting layer heights. It was extremely difficult to monitor the position of a storm accurately when a sunrise/sunset barrier moved inbetween the storm and observer. The computed storm position seemed to move many hundreds of miles.

Examination of figure 1 also indicates a common situation, namely that the Waldorf equipment rarely, if ever can locate storms on the European mainland. Many occasions have arisen when known storms of large magnitude have existed in Iberia and have been undetected by the Waldorf equipment. This is probably due to the larger attenuation for propagation from E to W that exists on these frequencies. However similar cases have occured where very large North African storms have remained undetected by the Berlin equipment. Perhaps site problems influence the reception field viewed by the antenna.

Probably the main cause of error in the atmospherics analyzer system is obtaining a good GDD or SAR and this problem will now be investigated.

Figure 2 shows GDD and SAR as a function of azimuth from Berlin for a five minute period in 1971. These records are somewhat better than those obtained on average as the storm clusters are well defined but they can be used to illustrate the problems that arise in analysis. In the GDD mode one horizontal division on the figure is 125 μsec and for propagation E to W this one division is equivalent to the distance between Waldorf, Maryland and the African coast, or 5500 km. It is evident therefore that in positioning the center of a cluster by eye a large error may arise in the measured value of GDD, particularly when the cluster spreads over 3 or 4 horizontal divisions as is often the case. A similar argument can be applied to the SAR clusters; in this case for a specific azimuth the distance is approximately proportional to the SAR value. Again investigation of figure 2 can show how the center of an SAR cluster can be in

Computer plot of storm positions DAY = 2

STORM NO.	RANGE (KM)	K	GDD	STORM NO.	RANGE (KM)	K	GDD
1	5940.0	1	125.0	6	9790.0	0	256.0
2	2820.0	2	63.0	7	7200.0	0	233.0
3	3980.0	2	103.0	8	9490.0	1	317.0
4	4200.0	5	129.0	9	7130.0	4	233.0
5	6090.0	0	273.0				

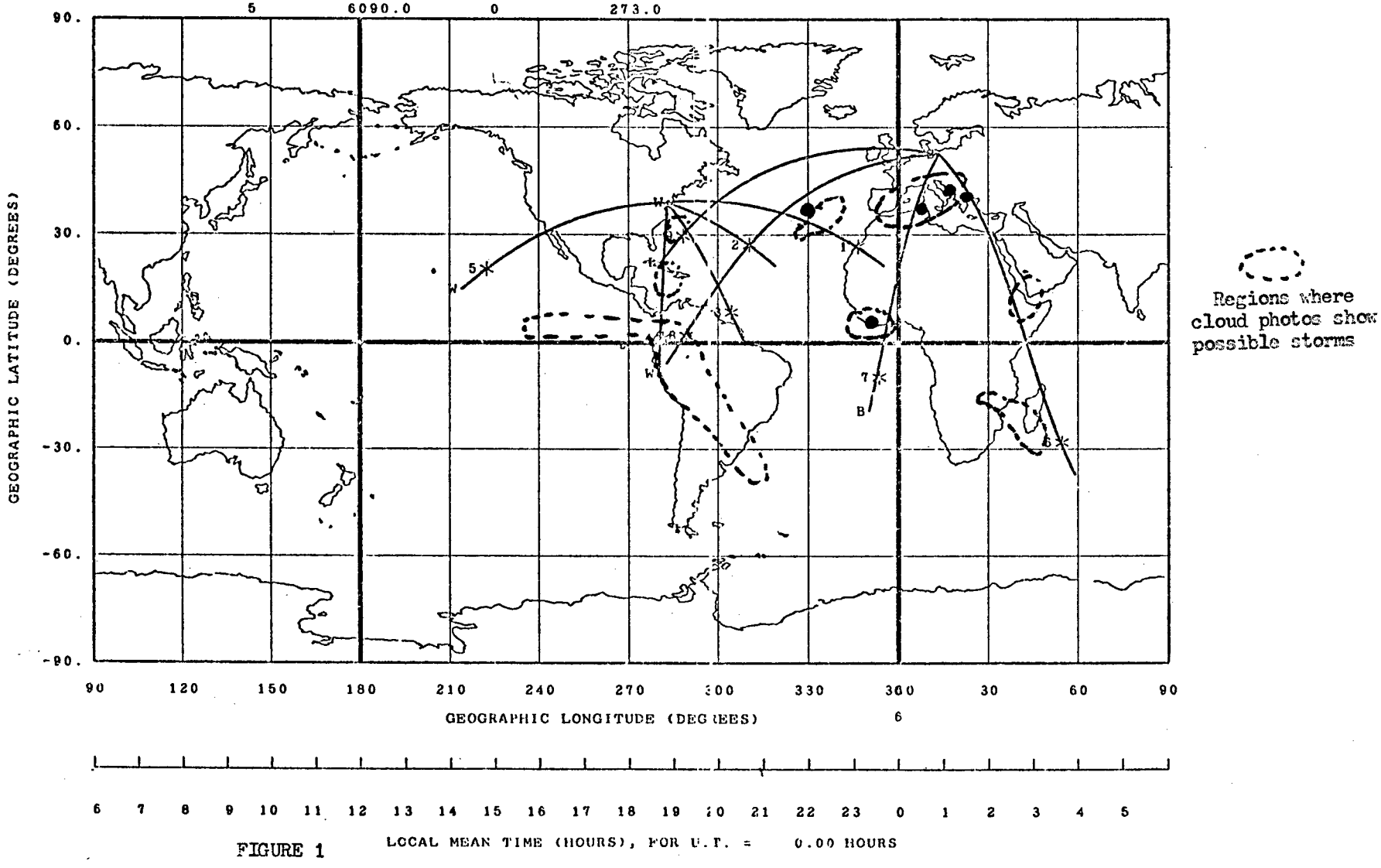

FIGURE 1

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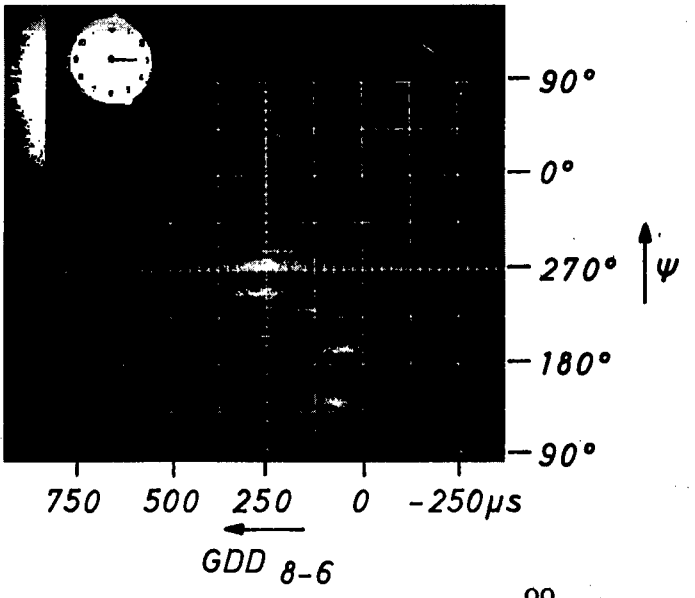
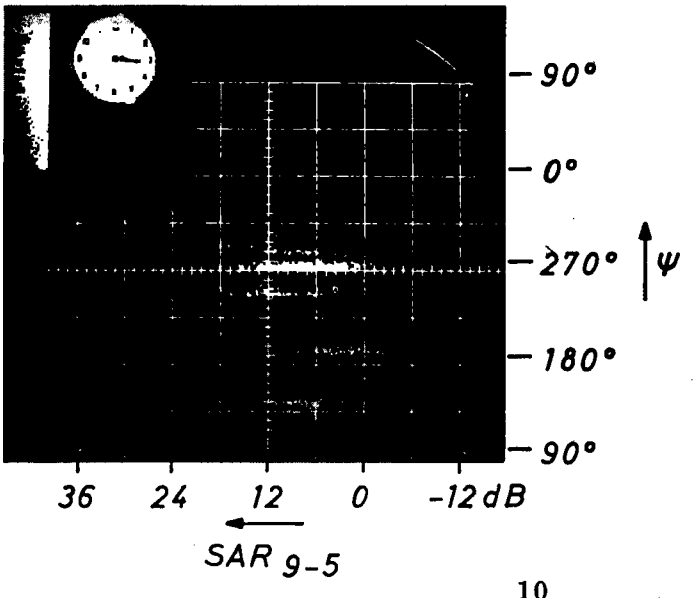


Photographic record GDD mode, 1.4.71, 3^{00} GMT, Berlin-Wm



Photographic record SAR mode, 1.4.71, 3^{10} GMT, Berlin -WM

Figure 2

error by 50% thereby giving a distance error of the same order. It is mandatory therefore that if the GDD and SAR values are to be used for computing distance, the center of the cluster must be measured much more accurately than can be done by eye.

In session 1 of this conference Anderson described an instrument to digitize the individual sferic parameters and with this equipment there is considerable hope that it may be possible to accurately measure the center of a cluster of data points thereby leading to an accurate GDD and SAR. If this is possible the largest source of error may be removed; preliminary investigations indicate that this objective may be achieved.

On the 29th February, 1972 the individual sferics digitizer was run at Waldorf from 1900 to 1908 UT. During this period over 1000 different sferics were recorded, a sample of these results is shown in table 1. These sferics were being recorded approximately 450 msec apart and whilst it was later found there was a slight error bias in the values of SA, SAR & GDD, the results show a marked variation of these values for the same or similar azimuths. This variation obviously gives rise to the spread in data points on the film records, but when these records are plotted in number density form, a much clearer picture exists. For the 1000 sferics recorded in this period all data in the azimuth range 160 to 210 degrees was extracted and curves of number of points versus GDD and SAR were plotted.

Figure 3 shows the number of sferics recorded in this azimuth range for specific SAR's and a strikingly sharp peaked curve implies the center of the cluster is very well defined. The dashed line indicates the actual data and the continuous line shows a gaussian curve fit to this data. In this case the value of SAR for the peak number of sferics can be read to less than 1 db which, where good theory exists, would lead to an accurate location of the storm. A similar picture exists for GDD and implies that for a well defined storm region the values of the centers of the clusters of sferics shown on a photograph can be computed very accurately if the data is digitized.

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TABLE 1

AZIMITH (DEG)	SA(DB)	SAR(DB)	GDD(DB)
187	7	7	-5
190	23	9	10
177	17	7	-69
148	17	31	258
182	10	2	-20
201	17	12	58
170	14	8	69
196	25	2	20
201	19	-1	-2
192	12	2	-12
197	13	10	51
173	7	0	194
194	20	3	35
161	11	9	2
208	10	4	35
189	10	9	-12
221	12	13	264
181	20	15	346
178	6	7	64
196	15	-6	-282
190	-16	7	269
187	14	6	10
199	16	7	-15
92	23	11	-35
213	8	4	17
192	18	8	-53
190	13	8	374
181	15	8	17
189	13	12	35
183	5	5	58
197	13	8	-2
179	17	12	312
190	21	6	276
185	27	3	-38
174	15	6	48
196	15	5	-61
158	5	9	310
204	14	9	-38
131	17	23	199
197	6	2	-48
187	11	0	117
187	11	8	35
177	6	0	12
198	11	12	35
179	15	8	-20
186	12	3	58
184	8	10	74
183	15	7	120

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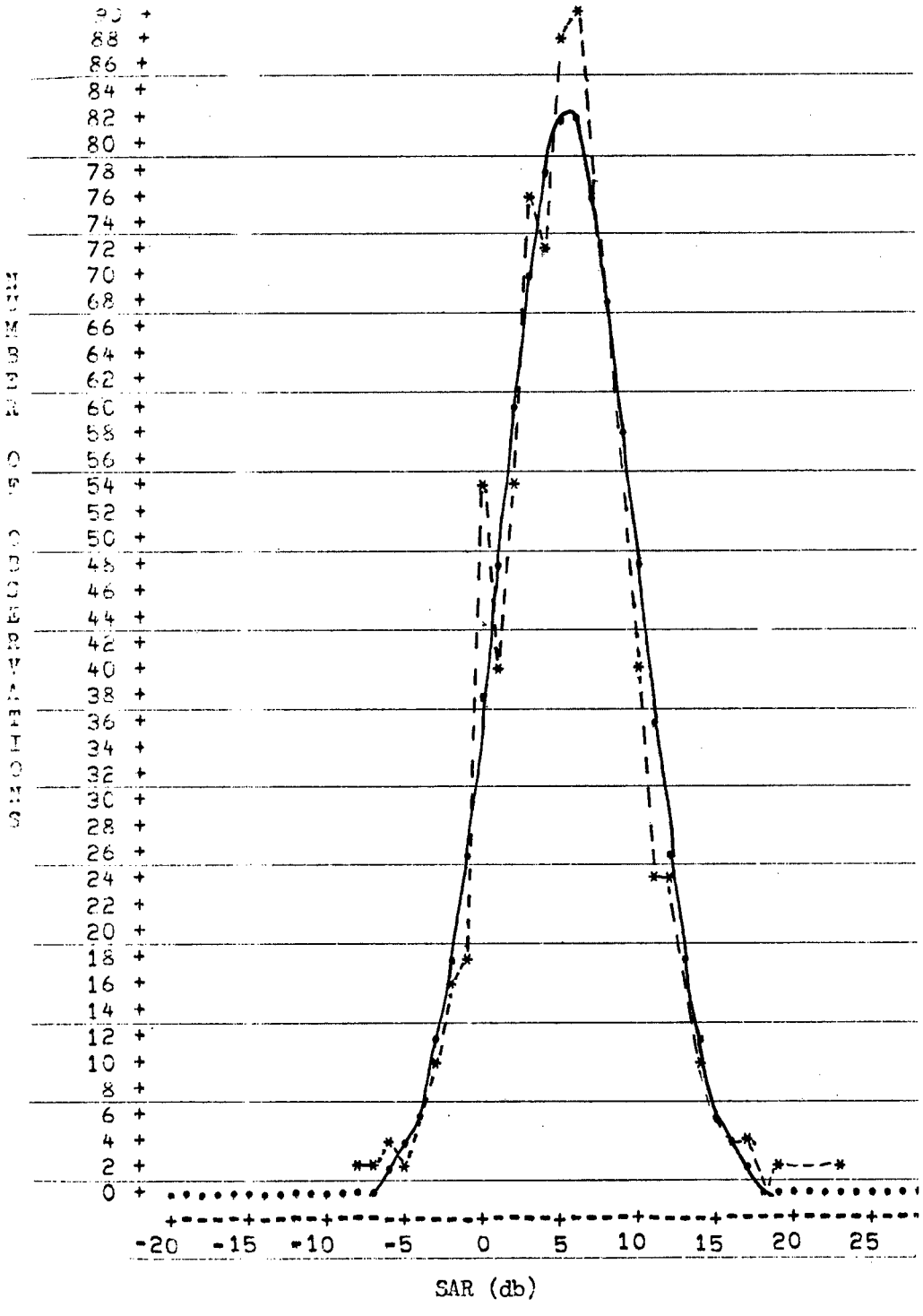

Figure 3 Number of sferics versus SAR in azimuth range 160-210 deg

This simple picture displayed by Figure 3 unfortunately does not occur very often. It is more likely that a number of storms exist over a wide azimuth and distance range. Figure 4a is a computer plot of azimuth versus number of observations for 18th May 1972. It can be seen that whilst there is peak activity around 200 degrees azimuth from Waldorf, the storms continue through 270 degrees. In other words from Waldorf, Maryland there were active storms from the direction of Florida due south, to California due east. The sharp spikes, displayed on this three minute record have a time constant of less than three minutes, but the overall picture remains constant over a number of hours. Figure 4b illustrates the storm conditions in these next three minutes. The problem now is how to extract individual storms from such a picture, or even a picture with a longer time constant which still shows storms over large azimuth regions. The results from this particular record are discouraging as can be shown in figure 4c. In order to obtain this graph, the azimuth range 190 to 210 degrees was investigated and the value of GDD plotted as a function of number of counts. It appears that no well defined peak value can be obtained more accurately than $\pm$ 40 μsec, which as we have shown is over $\pm$ 1200 km. This picture does not improve when a longer time period is considered.

Computer plots of this type have been placed on movie film to indicate the development of storms. Twenty four hours of data at three minute intervals has been investigated but the three minute time period was found to be too short. Such a technique with a twenty minute time interval may give a much improved indication of storm development and movement.

Conclusions

We have shown that analysis of the photographic records by eye can often lead to large errors in the computation of GDD & SAR. On days when storm activity is not widespread however accurate values of time difference and amplitude ratio can be obtained from digitizing the individual sferics parameters, but at times

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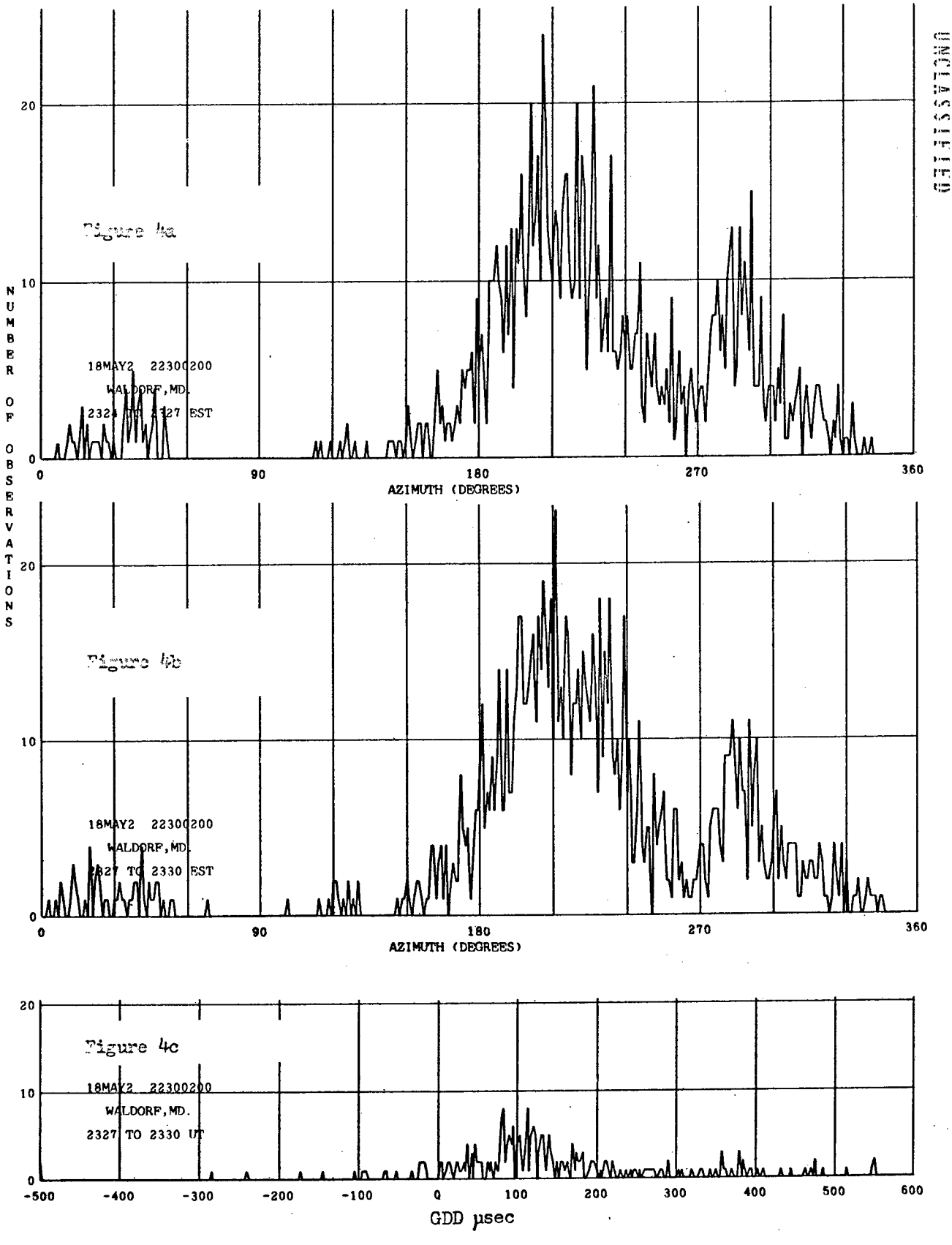

Figure 4 Computer plots of azimuth and GDD against no. of observations.

when storm areas spread over large azimuth ranges it is impossible to position individual regions of activity with any accuracy. Computer techniques in the analysis of atmospherics parameters of this kind must therefore be used with extreme caution, but this technique is probably the only approach that will lead to storm positioning of any accuracy with data from the atmospherics analyzers.

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THE OMNIDIRECTIONAL ACTIVITY AND DISPERSION OF VLF ATMOSPHERICS

by

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Abstract: Measurements of the impulse rates of VLF atmospherics at 7 kHz are displayed along with the simultaneously measured group delay time differences of the spectral groups at 6.3 and 7.7 kHz. Of particular interest is the increase in the impulse rate prior to sunrise at the receiving station. No correlation between the changes in total activity and the GDD (group delay time difference) can be found. The observation of unusually sharp increases in the activity and the divergence with time of the GDD measurements for two simultaneously observed westerly storm centers are two additional noteworthy details presented and discussed.

INTRODUCTION

The impulse rates of atmospherics are today still the most accessible source of information, from which the atmospherics activity, and consequently the thunderstorm frequency, may be determined. The ELF and VLF atmospherics possess the additional feature that they may be observed globally from a few stations due to their small propagation losses in terrestrial wave guides. A quantitative description of the number of storm centers, the time variations, and the geographic distribution of storm activity with these measurements is, however, extremely difficult, because the observed impulse rates at a fixed operating threshold in the receiver is sensitively dependent upon propagation conditions and distance from the source location.

Technological improvements in the VLF Atmospherics Analyzer of the Heinrich-Hertz-Institut have made possible the control of uncertainties in the propagation conditions, in that measurements of the spectral parameters GDD (group delay time difference) and SAR (spectral amplitude ratio) are taken concurrently with the total activity. With the help of suitable propagation models the distances of the atmospherics sources may then be determined (Frisius and Heydt, 1969; Volland, 1968; Harth, 1972).

Particular emphasis is given here to the investigation of the counting rate fluctuations over a five day measuring period, which are observed almost regularly before sunrise at the receiving station, and the correlation of these fluctuations with the simultaneously measured GDD. Should the rise in total activity

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be caused by an improvement in the propagation conditions, for example an increase in the reflection height (Harth, 1972), then in view of the first mode approximation there must also be a connected decrease in the dispersion. This presunrise enhancement was observed by Lauter and Schmelovsky [1958] at 27 and 40 kHz. With comprehensive observational data these authors attributed the rise to a bending effect in the waves at the transition from night to day conditions in the lower ionosphere.

MEASUREMENTS

The propagation time difference of spectral groups at 6.3 and 7.7 kHz were continuously measured in five minute intervals in an intensive measuring program at the Stockert receiving station near Bonn during April and May, 1967. In the continuous five day run from 9 to 13 May additional measurements every five minutes were made of the rates of all incident impulses, for which the spectral amplitude at 7 kHz exceeded the operating threshold.

DISCUSSION OF MEASUREMENTS

The impulse rates of the total activity display their expected daytime behaviour (Figure 1). After a morning minimum follows a steady rise up to the high activity values in the afternoon hours. The activity then decreases again at late evening. Shortly before sunrise one observes a short increase, which is accompanied by secondary maxima in some instances. It

is this phenomenon that is to be investigated in comparison with the GDD.

In Figure 2 are shown the counting rates for the times 0 to 10 hours for each day. With the exception of 11 May, the maximum of the nighttime activity is attained shortly before sunrise. This maximum exhibits especially well resolved secondary peaks on 10 and 12 May. A particularly sharp rise in the activity occurs within such a secondary peak on 13 May. The causes for this VLF burst are not yet clear. As will be seen later, the total counting rate in this case is controlled during the remaining measuring time only by a single distant storm center. Local activity is thus excluded as a cause for the burst. Further, the weather at the time of measurement is noted to have been cloudless and storm free. From the location of the receiving station and the high operating threshold (low sensitivity) one must also exclude the possibility of man made noise. The appropriate GDD photographic displays are presented in Figure 3. During such an occasion, the direction of the incident wave can no longer be determined, and the dispersion assumes various random values. One would be inclined to ascribe the rise in the impulse rate to an antenna discharge were it not for the clear weather conditions. On 11 May this same phenomenon is observed at about 20 hours. Upon closer considerations one is tempted in this case to read off a resonant building-up process from the counting rates, which ends either in a breakdown or to this "burst". The pulse rate during this second occurrence is so high that the counter is "closed" (resolution is >20 pulses per second).

In Figure 4 through Figure 6 are shown the GDD of the individual storm centers together with the counting

rate. Three storm centers contribute to the total impulse rate in Figure 4. The main maximum (denoted A-effect by Lauter and Schmelovsky) and the secondary peaks are indicated with vertical marks. The time difference between secondary peaks and the main maximum is about 2 hr. 20 min. Considering the two longer lasting storm centers, one observes that for the storm at 259° (measured CW from North) a rise in the GDD occurs, whereas for the storm center at 273°, the trend is toward smaller values. The given values of azimuth are here, and in the following, the value at 5 hours. A rough mean of the GDD is indicated by the dash-dotted line. The source at 259° vanishes after sunrise; the GDD values for the source at 273° increase. In the first case the propagation attenuation becomes so large that the signal no longer exceeds the threshold. The storm center at 273° exhibits the expected behaviour by the increase in GDD at the transition from night to day propagation conditions for centers lying west of receiver (for example, see Harth, 1972). A relatively intensive center is seen for a short time south of the station. One observes here an abrupt fall in the GDD, which can only be attributible to a contribution from a higher mode (Harth, 1971). The primary conclusion is, however, that in no case is it possible to detect an unambiguous correlation between the main or secondary peaks and the variation in GDD. Assuming that the storm centers are sufficiently distant, i.e. the first mode approximation is valid, then the following distances are obtained from the mean GDD values drawn in Figure 4.

Table 1:

	1 hr		4 hrs.		V_{MA} (km/hr)	
Reflection Height (km)	85	90	85	90	85	90
Source at 259° (km)	7800	9050	9100	10550	433	500
Source at 273° (km)	7020	8140	5140	5960	707	726

The distances in the table 1 are computed using the Wait and Walters model with $\Omega = -1$ and $\beta = 0.5$ (Wait and Walters, 1964; Wait and Spies, 1964; Harth, 1972). These distances and azimuths localize the associated centers and are displayed on the map in Figure 7. Associated with this picture are unusually high values for the displacement velocity (V_{MA}) of the maximum in activity, to which an additional possible undulation is overlayed. It should once again be emphasized, that this picture is a result of a formal interpretation of the first mode approximation with the prerequisite of absolutely stabile propagation conditions. It is also possible that this effect can be produced by not yet interpreted propagation conditions or by a time variation of the source structure. Measurements performed during this same time at the stations in Berlin and in Weissenau on Lake Constance are unable to resolve the uncertainty in the interpretation of this effect. While the measured values at Berlin agree with those discussed here (a rise in the GDD is registered for the southern thunderstorm together with a simultaneous drop for the northern storm center), the GDD measurements at Weissenau show a decline for both the northern and southern storms. This could be a selection effect, however, in view of the known undulation of the measured GDD values, which were taken only once per hour at this

station. Three measurements were made hourly at the Berlin station. Similar measurements in the morning and the afternoon hours have already been reported (Harth and Heydt, 1969).

In Figure 5 two sources again contribute to the total activity. The GDD of the source at 260° shows a certain periodic fluctuation (period ca. one hour) in the time between 0 and 3 hours, and prior to sunrise it displays a noticeable drop to smaller values. Toward the end the GDD does not rise as one would expect from the model calculations (Figure 4). As seen in the photographs, the second source (at 283°) is obviously a composite of point clusters which represent two storm centers lying close together in azimuth and distance. When the distance between the two sources along the same direction to the receiver is not large enough, one can no longer visually separate the two point clusters on the photos. This situation explains the large shorttime scale variations of the GDD. Shortly before 6 hours it is possible to separate these sources on three photographs. At the same time two cluster points, lying about 90 μsec from one another, began to appear at every measurement. After sunrise the expected rise in GDD is again seen to be reduced. This can be explained in this case, however, that at this point more signal is being received from the nearer storm center. Here again, no connection between the time variations of the total activity and the GDD can be established.

The same result may be seen in the example shown in Figure 6, in which the situation is particularly easy to follow. Only one storm center contributes to the total activity. The corresponding computed GDD values are drawn as dash-dotted lines for a distance from

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source to receiver of 8100 km and two assumed reflection heights (85 km and 90 km). The GDD falls to low values again after sunrise and then rises again. As previously mentioned, no agreement between variations in the total activity and the GDD is observed.

CONCLUSION

The nighttime increase in activity of atmospherics rates prior to sunrise at the receiving station, as investigated earlier by Lauter and Schmelovsky at 27 and 40 kHz, is measured here at 7 kHz. While the copious data of these authors indicate the rise due to a bending at the day-night interface in the lower ionosphere, no influence of this effect upon the GDD may be established. In the first mode approximation improved propagations such as an increase in the reflection height should lead to an increased counting rate as well as a fall in the GDD. Two additional details are discussed. In one case it was observed that for two westerly storm centers, the GDD for the one storm source was climbing from 0 to 5 hours, and yet was falling for the other in the same time interval. When one interprets this case according to the first mode approximation, uncommonly large displacement velocities of the maximal activity are derived. Another noteworthy characteristic of the data is the appearance of abrupt burstlike increases in activity observed once in the early morning hours and once at evening.

ACKNOWLEDGEMENT

I am indebted to my colleague M.K. Bird for helping in the translation.

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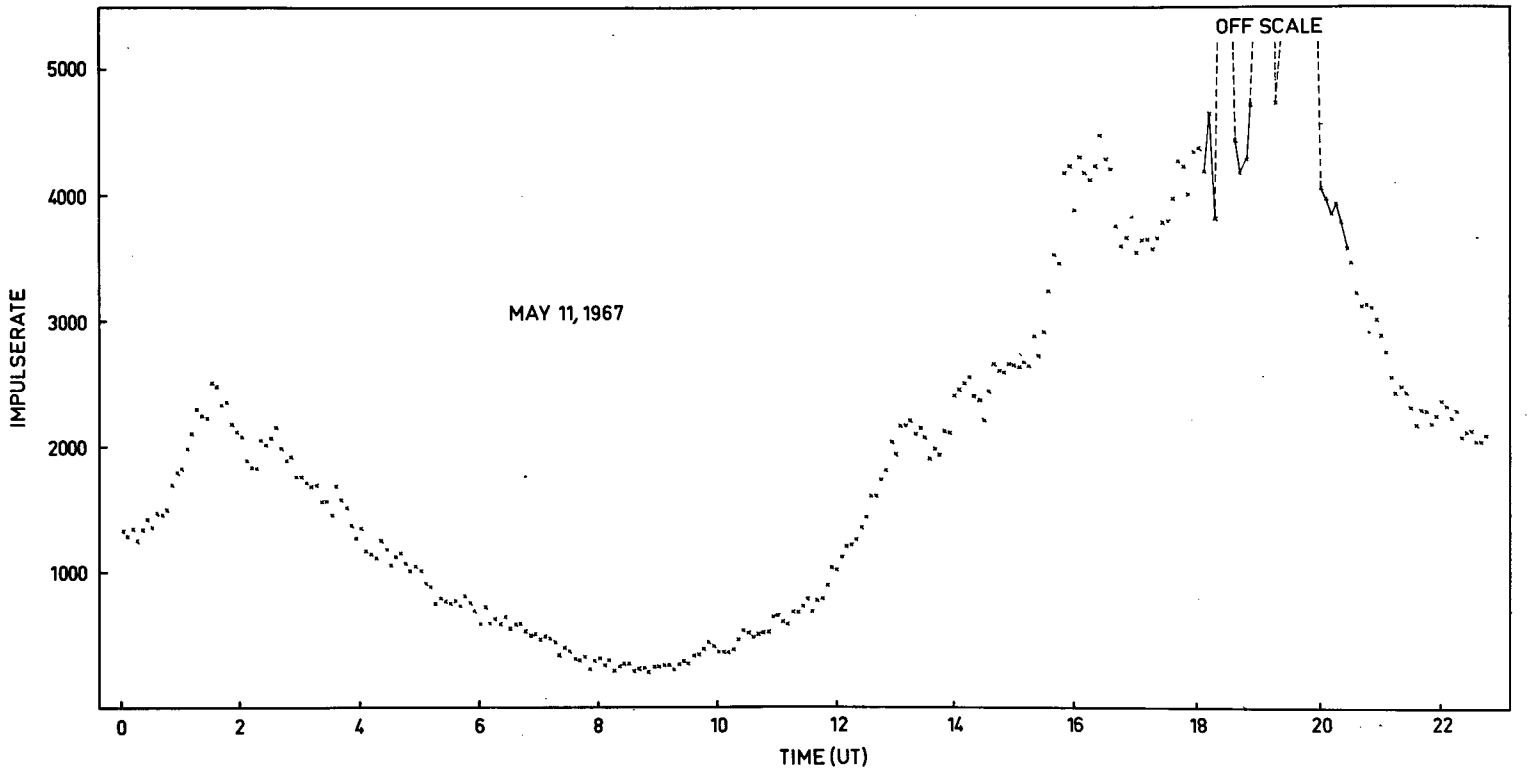

Figure 1 Total activity of VLF atmospherics, measured in 5 min. intervals at 7 kHz. Receiving station was Stockert near Bonn.

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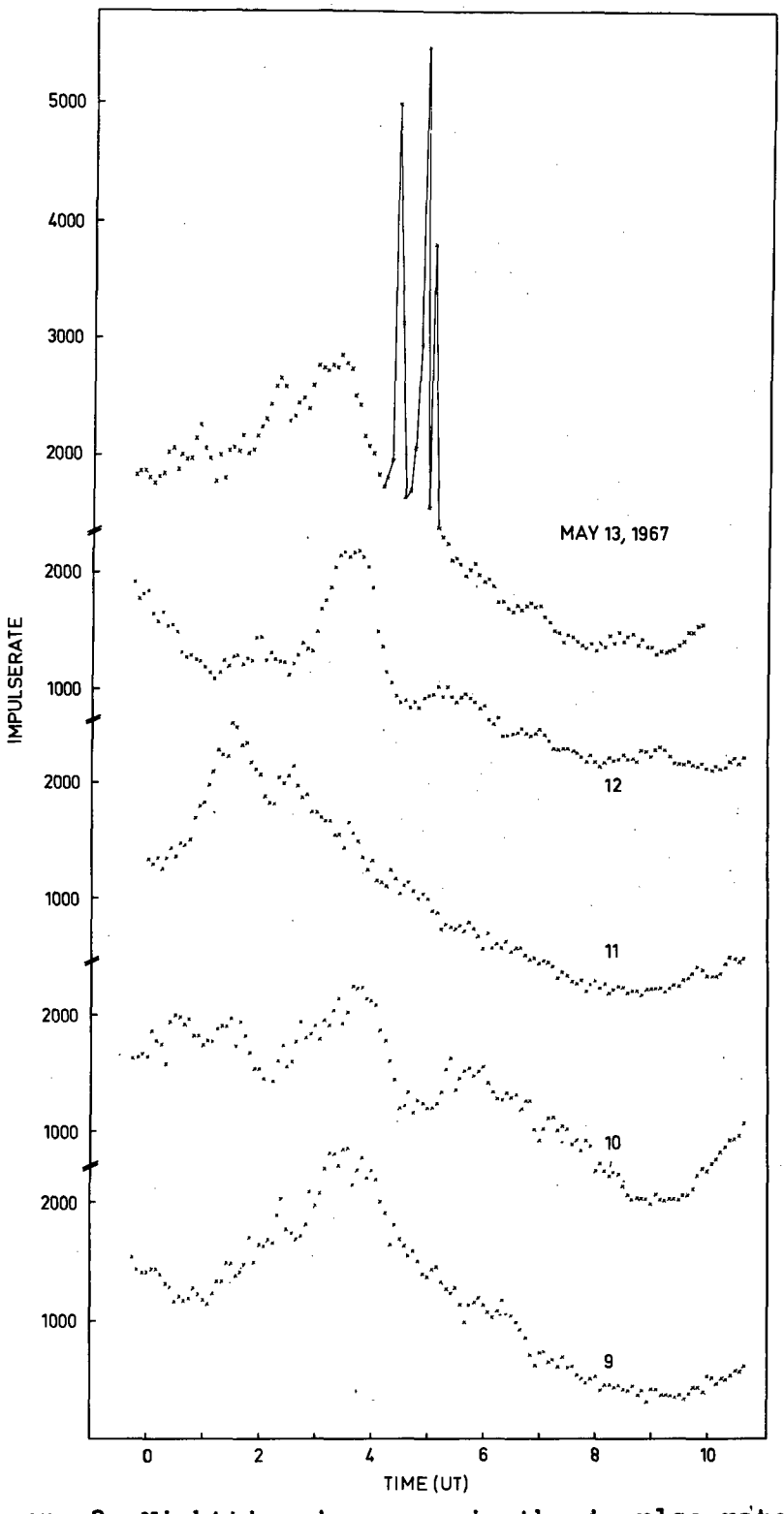
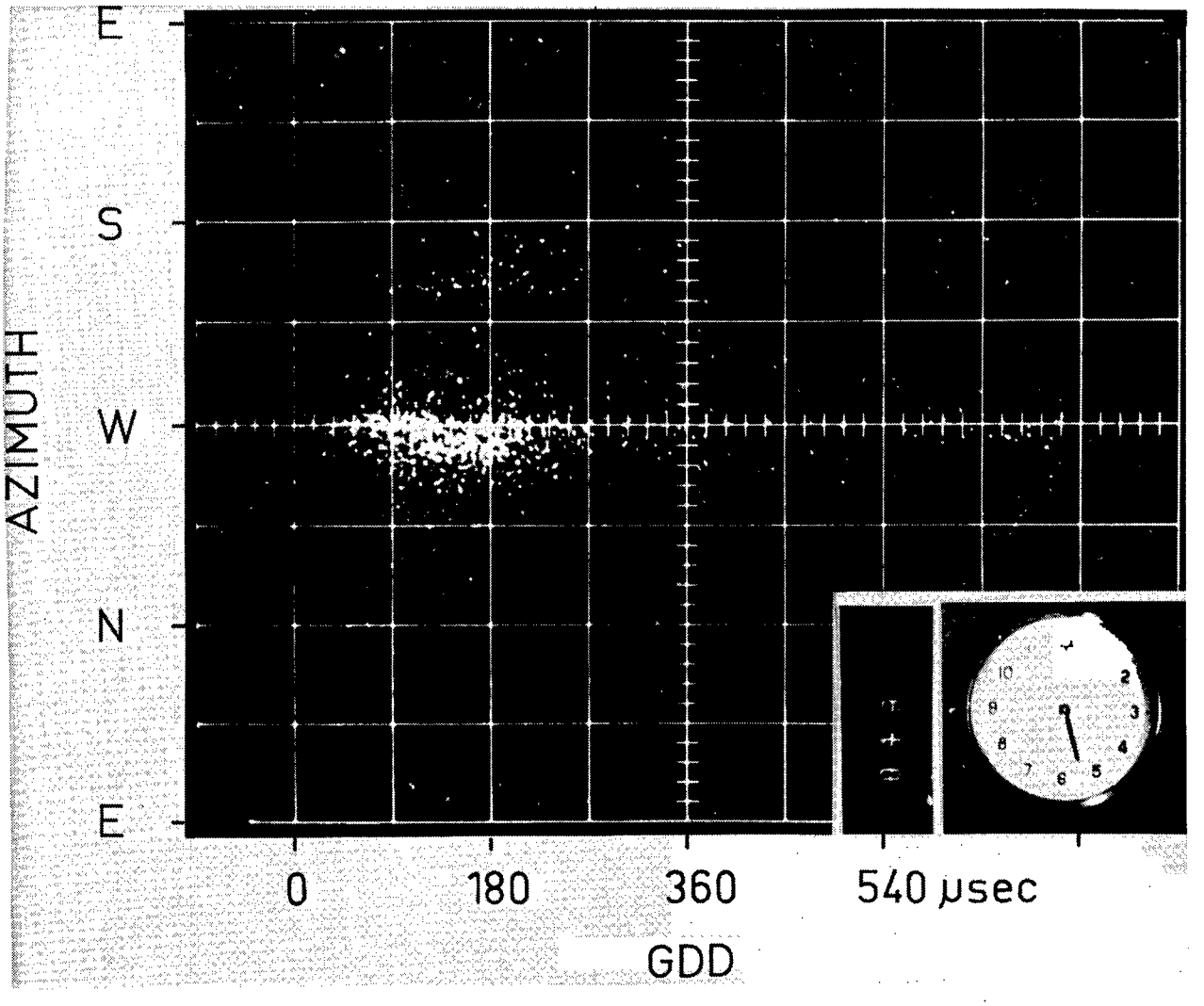


Figure 2 Nighttime increase in the impulse rates before sunrise (see also Figure 1).



(a)

Figure 3 Photographic trace of the GDD. The mid-points of the clusters are used to yield mean values for the parameters GDD and azimuth. The three prints show the GDD before and during a "VLF burst" (13 May at 5.40, and 5.50 hours).

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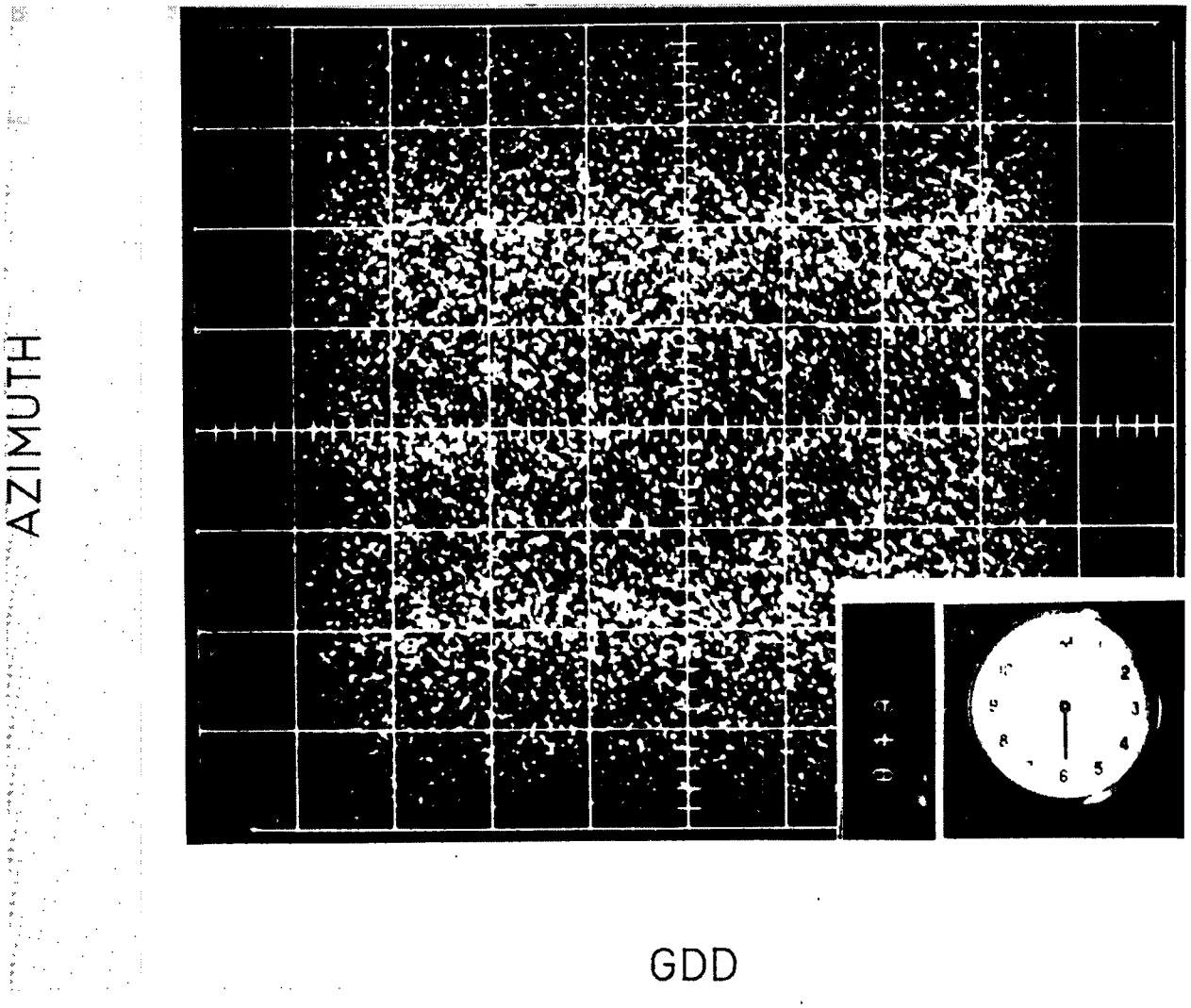

(b)

Figure 3 Photographic trace of the GDD. The mid-points of the clusters are used to yield mean values for the parameters GDD and azimuth. The three prints show the GDD before and during a "VLF burst" (13 May at 5.40, and 5.50 hours).

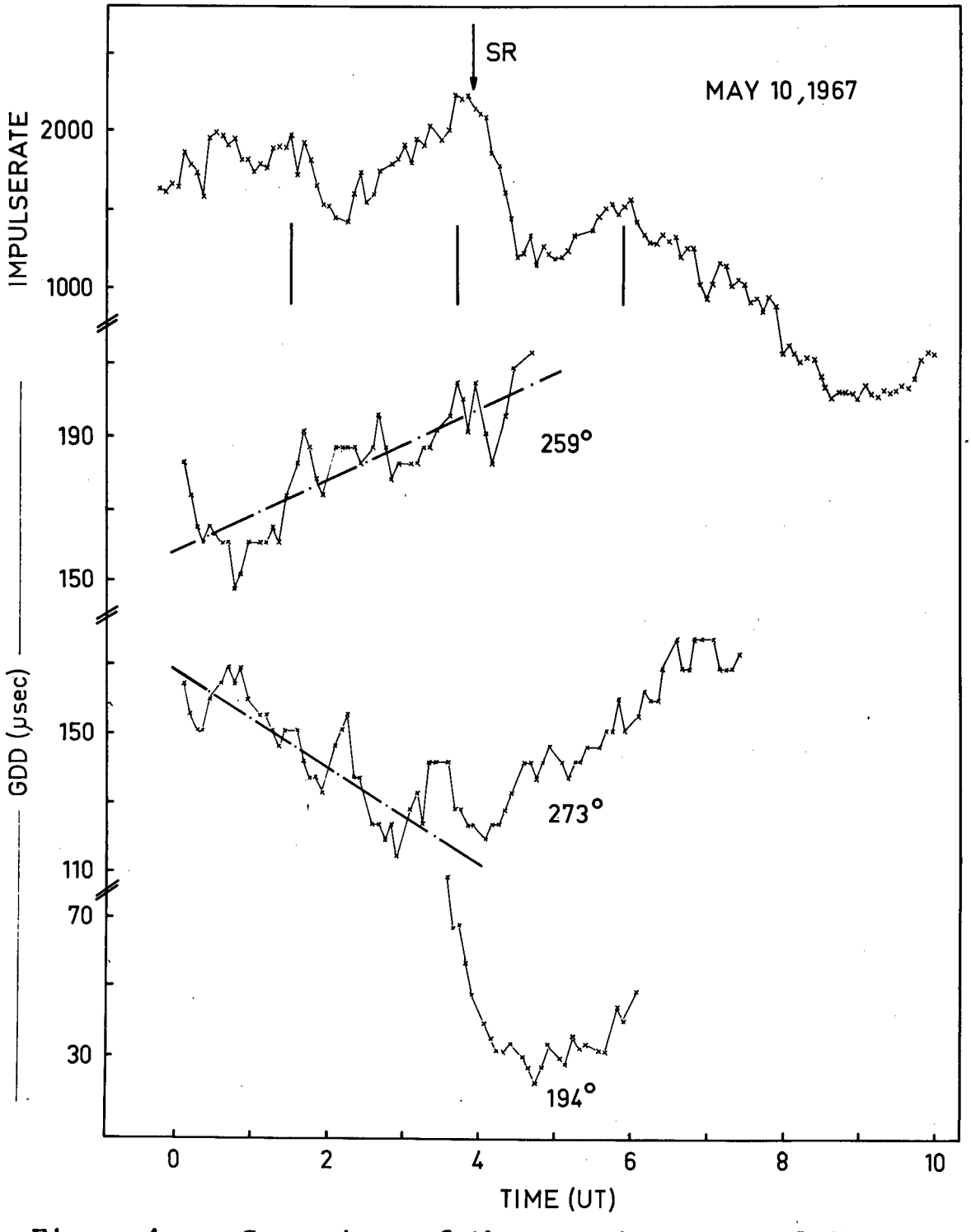

Figure 4 Comparison of the counting rates of the total activity with the measured GDD values. The azimuth is given for the value at 5 hours. The vertical marks indicate the position of main and secondary peaks.

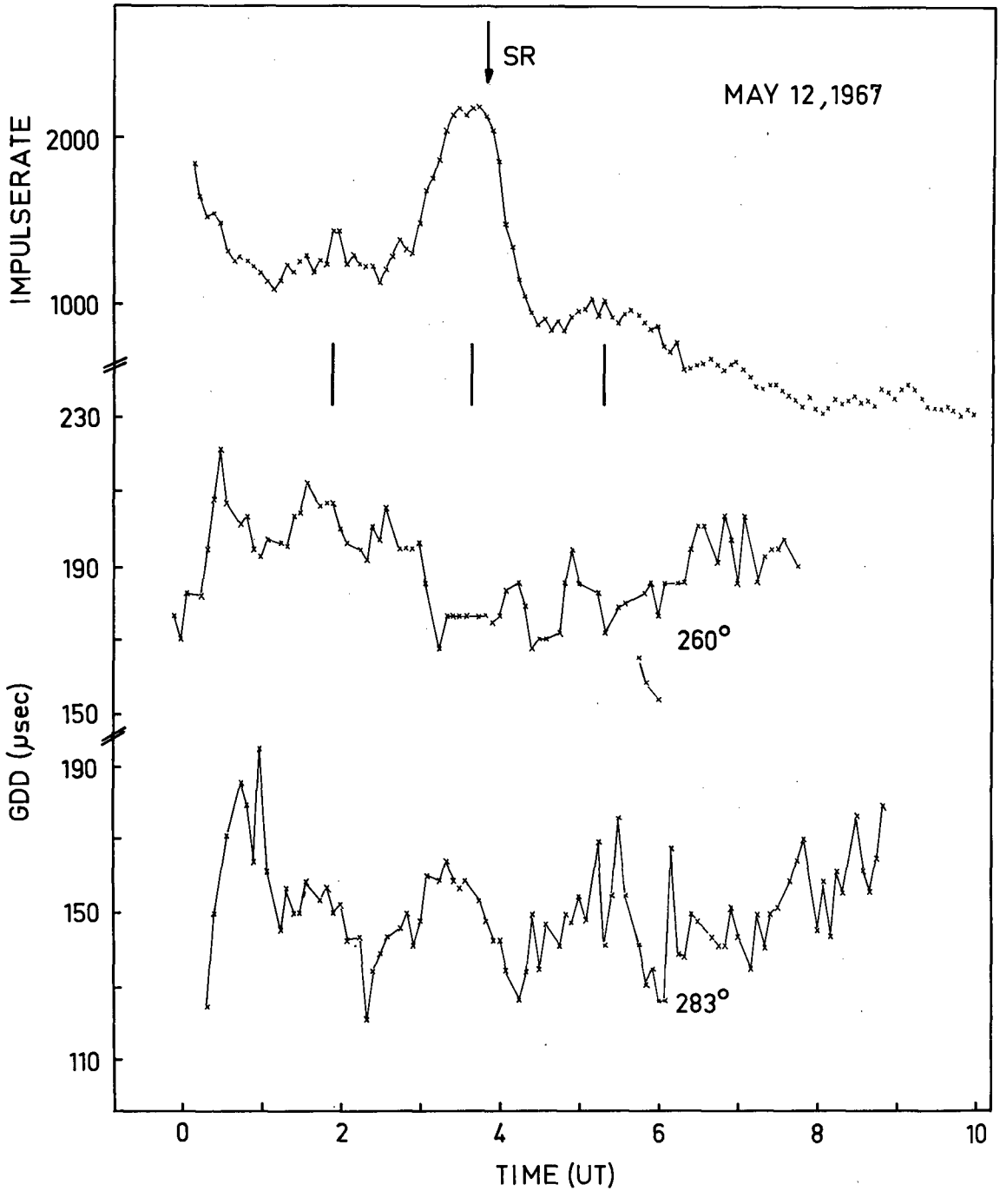

Figure 5 Same as Figure 4. The three single points of the GDD at 6 hours belong to the source at 283° (see text).

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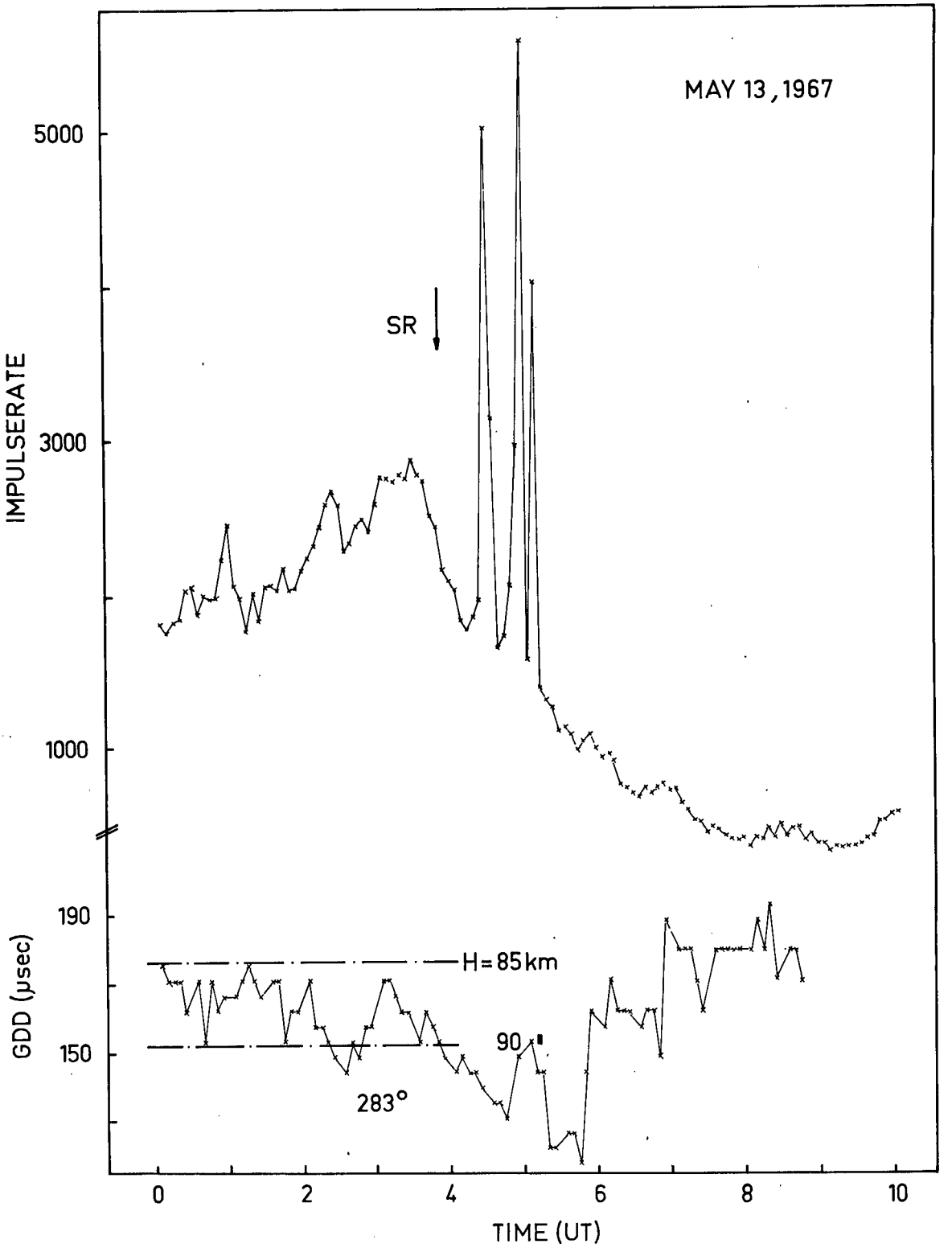

Figure 6 Total counting rate compared with the GDD. The calculated GDD values were based on a distance of 8100 km for a model with $\Omega = -1$ and $\beta = 0.5$ (Wait and Walters, 1964). H is the assumed reflection height.

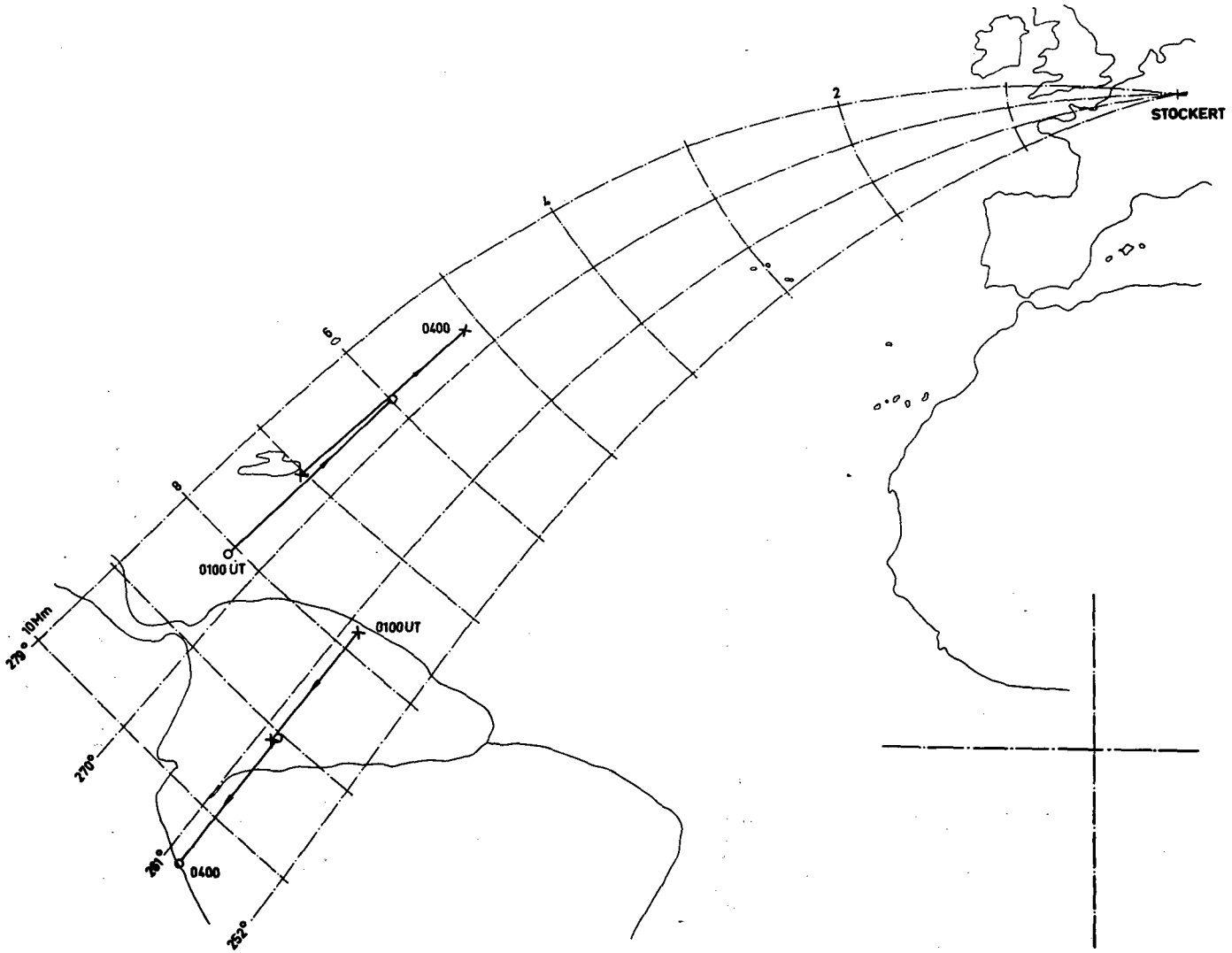

Figure 7 Formally determined locations of the storm centers on the map as computed from the data of Figure 4. X: Reflection height H = 85 km; O: Reflection height H = 90 km.

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DAILY VARIATIONS OF VLF ATMOSPHERICS PARAMETERS FOR LONG-LASTING THUNDERSTORMS

by

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Abstract: The parameters of VLF atmospherics, which can be measured using the VLF atmospherics analyzer of the Heinrich-Hertz-Institut show a daytime behaviour for long-lasting thunderstorms that correlates with the varying propagation conditions within the terrestrial waveguide. A distinction is made between diurnal variations which can be explained by simple propagation models and those showing unexpected behaviour, particularly at night-time. For perturbed propagation conditions during solar flares a variation of the parameters is observed which can be described either by a simple decrease of the reflection level or a profile perturbation.

INTRODUCTION

For long-lasting thunderstorm centres the VLF parameters which can be measured by the atmospherics analyzer of the Heinrich-Hertz-Institut show daily variations which are attributable to the varying propagation conditions. It is therefore possible to use thunderstorms as a substitute for standard-frequency transmitters in order to study the propagation behaviour of the terrestrial waveguide in the lower VLF range.

By reference to examples, it will be shown how such diurnal variations, particularly those of the parameter GDD (group delay time difference), can be interpreted by means of model calculations, as discussed in previously papers.

DIURNAL VARIATIONS WHICH CAN BE DESCRIBED BY MODEL CALCULATIONS

The first measurements made with a network of atmospherics analyzers in the Federal Rèpublic and in West-Berlin clearly indicated a daytime dependence of the parameters GDD and SAR (SAR: spectral amplitude ratio) (Frisius, Heydt, Volland and Harth 1967). Unfortunately the time intervals between the measured points were too great for the true form of the diurnal variations to be accurately determined. The delay time difference for the groups has therefore been measured at 5-minute intervals at 6.3 and 7.7 kHz at the Stockert station running from April until May, 1967. The GDDs of two distant centres in WNW and WSW gathered from these

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measurements are given in Figure 1. The farther WSW-centre can be observed from sunset at the receiving station. The GDD decreases, reaches a quasi-constant value at sunset at the centre of the storm, and rises again to higher values after sunrise at the receiving station. At full daytime propagation, the centre can no longer be observed. The dash-dotted lines correspond to the GDD values obtained from a flat model for west-east propagation ($\Omega = -1$) for reflection heights of 85 and 90 km and a propagation distance of 9600 km. The second centre in WNW can be observed for the whole day. The day and night values can be satisfactorily described by the first-mode approximation - dashed-dotted lines. About 02.00 UT, a short increase of the GDD is observed for approximately one hour. Here, as in the examples given in the contribution "The omnidirectional activity.." to this report, a propagation effect cannot be excluded. The remarkable GDD fluctuations during the daytime hours of April 25 are probably due to the inaccuracies in the visual evaluation of the point-clusters, since the centre "dies" at that time and the point-density of the clusters becomes very small.

DIURNAL VARIATIONS WHICH CANNOT BE INTERPRETED BY MEANS OF THE MODEL CALCULATIONS

For sources east of the observing station the parameters often show an unexpected behaviour during the night. Figure 2 shows a centre measured at the Stockert in 1968. The time interval between measuring points was 10 minutes. Instead of the expected decrease of the GDD values at night, an increase with marked undulations occurs. For the daytime propagation, the GDD values

resulting from model calculations for the distances of 2760 and 1940 km on November 30 and 2540 and 1680 on December 1 have been entered, respectively. It is to be noted that the GDD values for daytime propagation are in good agreement with the Wait and Walters model (1963) for the east-west propagation (Harth and Pelz 1972).

For centres in the south, diurnal variations, whose night-time behaviour is not in accordance with the first-mode propagation, are frequently observed. Figure 3 shows a measurement of GDD during the period April to May, 1967. As in the case of east-west propagation, the values rise at midnight and sunrise at the observing station. The midnight values occasionally show a directional splitting with different parameters. The centre shown is located in the gulf of Guinea, ρ = 6500 km.

The above examples show that the existing propagation theory does not completely account for the observed phenomena, particularly at night when the parameter measurements for the centre localization must be carefully analyzed.

PERTURBED PROPAGATION CONDITIONS

During strong solar flares, the parameters show the variations expected as deduced from a knowledge of the amplitudes and phases of standard-frequency transmitters. As the reflection level decreases, an increase of the GDD and SAR is to be expected in the first-mode approximation, as is also shown in the measurements. Figure 4(a)

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and 4(b) give the GDD and SAR observations on July 8, 1968, for two centres registered at the same time, whilst Figure 4(c) shows the GDD and SAR behaviour for a flare on June 9, 1968. As an "indicator" of the event on July 8, the GBR registration at 16 kHz is shown in Figure 4(d). Both cases are due to flares of importance 3B.

Figure 5 shows the results of a model study in which the GDD and the SAR were calculated for a simple decrease of the exponential electron density profile (β = 0.3) (upper part) and for a profile variation by an assumed perturbation (lower part). This perturbed profile has been discussed by Wait and Walters (1963) and calculated for the variations of the GDD and the SAR (regarding terms, reference is made to that paper).

Figure 6 shows a comparison of the measured parameters with the model calculations. Figure 6(a) shows the results for the source in WSW - S2 -, while Figure 6(b) those for the two sources in eastern direction.

The maximum value for sources 1 and 2, A_o (A_o is the relative electron density increase $\Delta N_o/N_o$ at a height of 70 km) is about 100 and occurs between the F-values -7 and -12 at D = 4. For the occurence on June 9 - S3 -, the maximum value no longer fits into the model curves. The A_o-value, however, may be assumed to be between 200 and 500.

In Figure 6(c) the respective GDD - SAR variation has been interpreted by a simplified decrease of the reflection level. Although the same level variation over about 55 km for S1 and S2 is obtained, the electron density would increase at 70 km in height only by a

factor 10. However, in this model for the decreasing reflection height, the measuring values follow the curve $\Omega = 0$, i.e. that the propagation conditions become more isotropic. Figure 6(d) gives a comparison of the location of the storm centre derived from the GDD parameter - S2 - and a synoptic observation.

CONCLUSION

VLF atmospherics parameters as can be measured by the VLF atmospherics analyzer show a daytime behaviour for long-lasting thunderstorm centres which can be attributed to the varying propagation conditions within the terrestrial waveguide. On the basis of the Wait and Walters model, the daytime behaviour, especially of those centres west of the observing station, can be described satisfactorily in the first-mode approximation. This does not apply, however, to centres in the east or south of the station. Their daytime measuring values can be described by means of this simple model, but the nighttime values often show an entirely different behaviour. Perturbed propagation conditions, as can be observed during solar flares, cause similar variations of the parameters. Both a simple model, which is characterized by a decrease in the reflection height, and a more complex one, as discussed by Wait and Walters (1963) have been used to try to explain the data.

ACKNOWLEDGEMENT

I am indebted to my colleague Peter Thomasson for helping in the translation.

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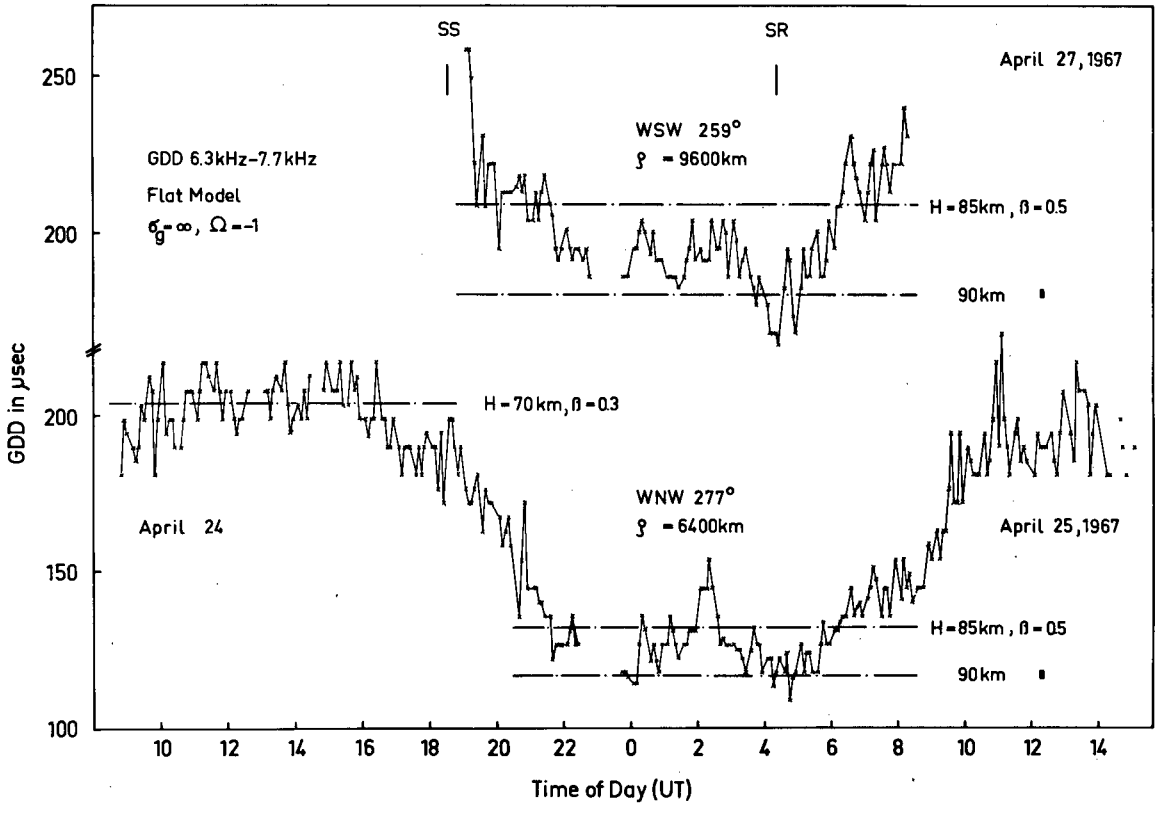

Figure 1 Daily variations of the GDD for long-lashing thunderstorms. Upper part: A source in south America; lower part: A source in the Sargasso sea. Station Stockert near Bonn.

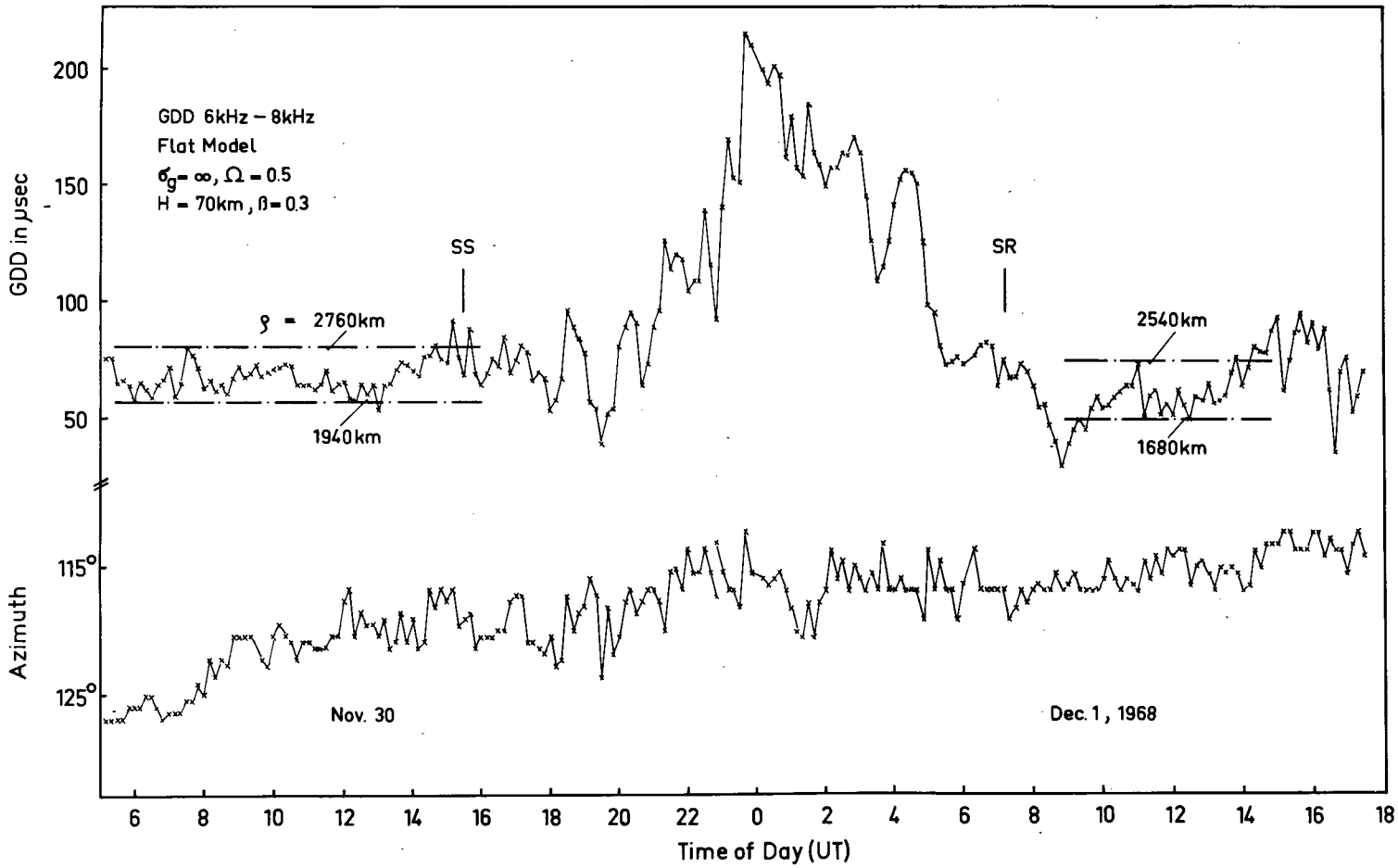

Figure 2 The enhancement of the parameter GDD during the night for a source located to the east of the observing station (Stockert).

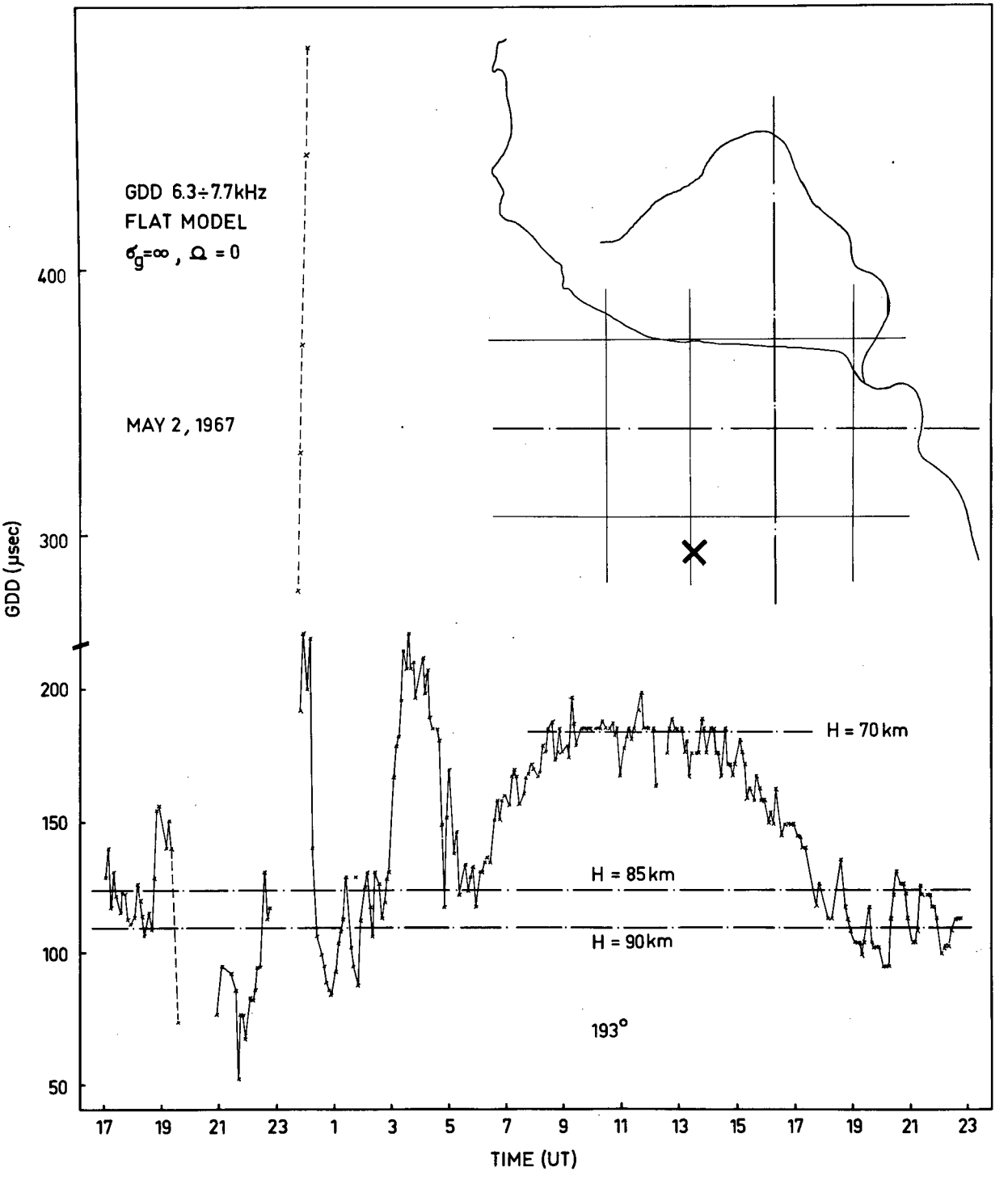

Figure 3 Sudden enhancement of the parameter GDD during night time propagation for sources south of the observing station (Stockert).

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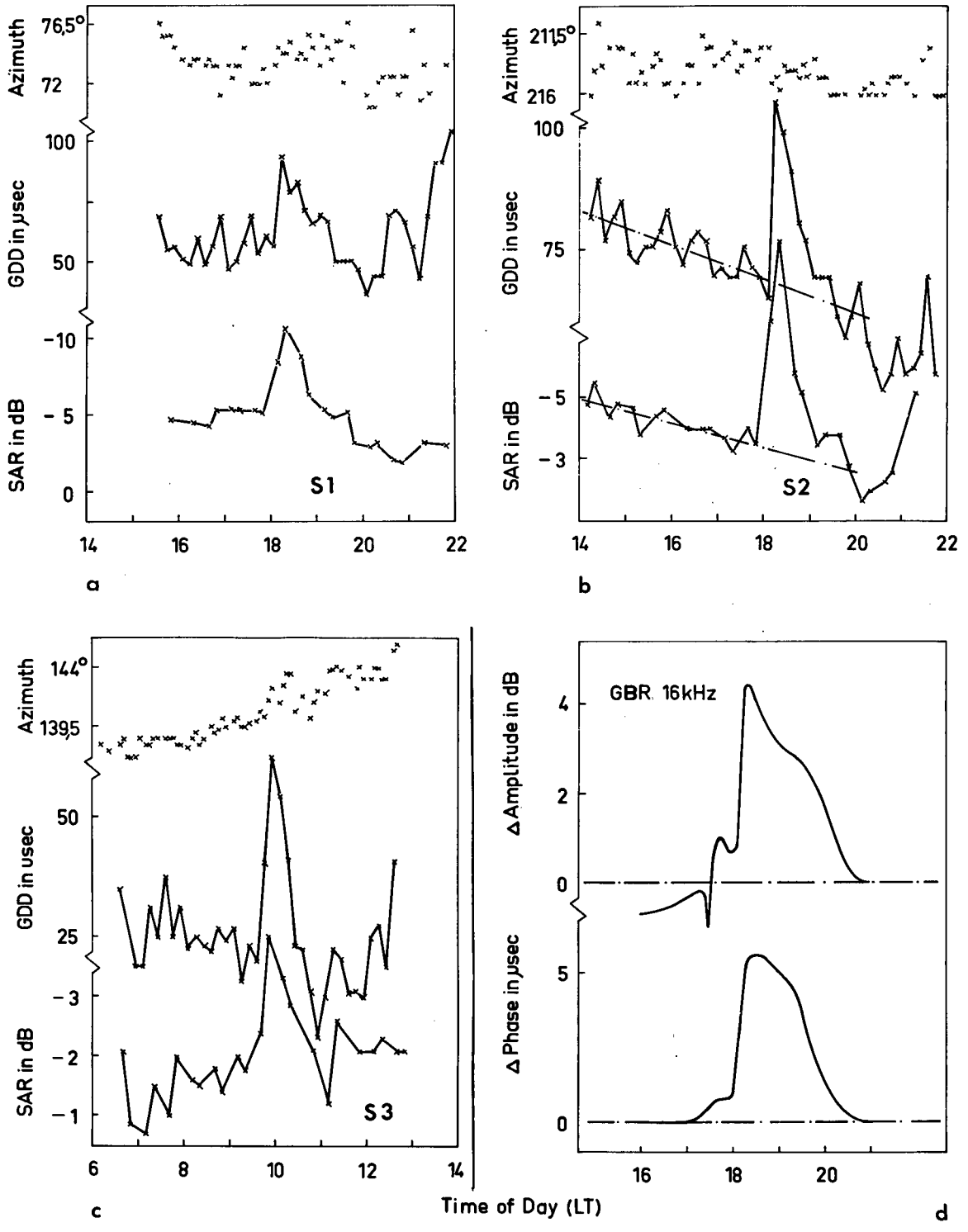

Figure 4 Solar flare effects observed by GDD and SAR registrations. Figure 4(a) and (b): July 8, 1968; Figure 4(c): June 9, 1968. The GBR registrations are shown for comparison, Figure 4(d).

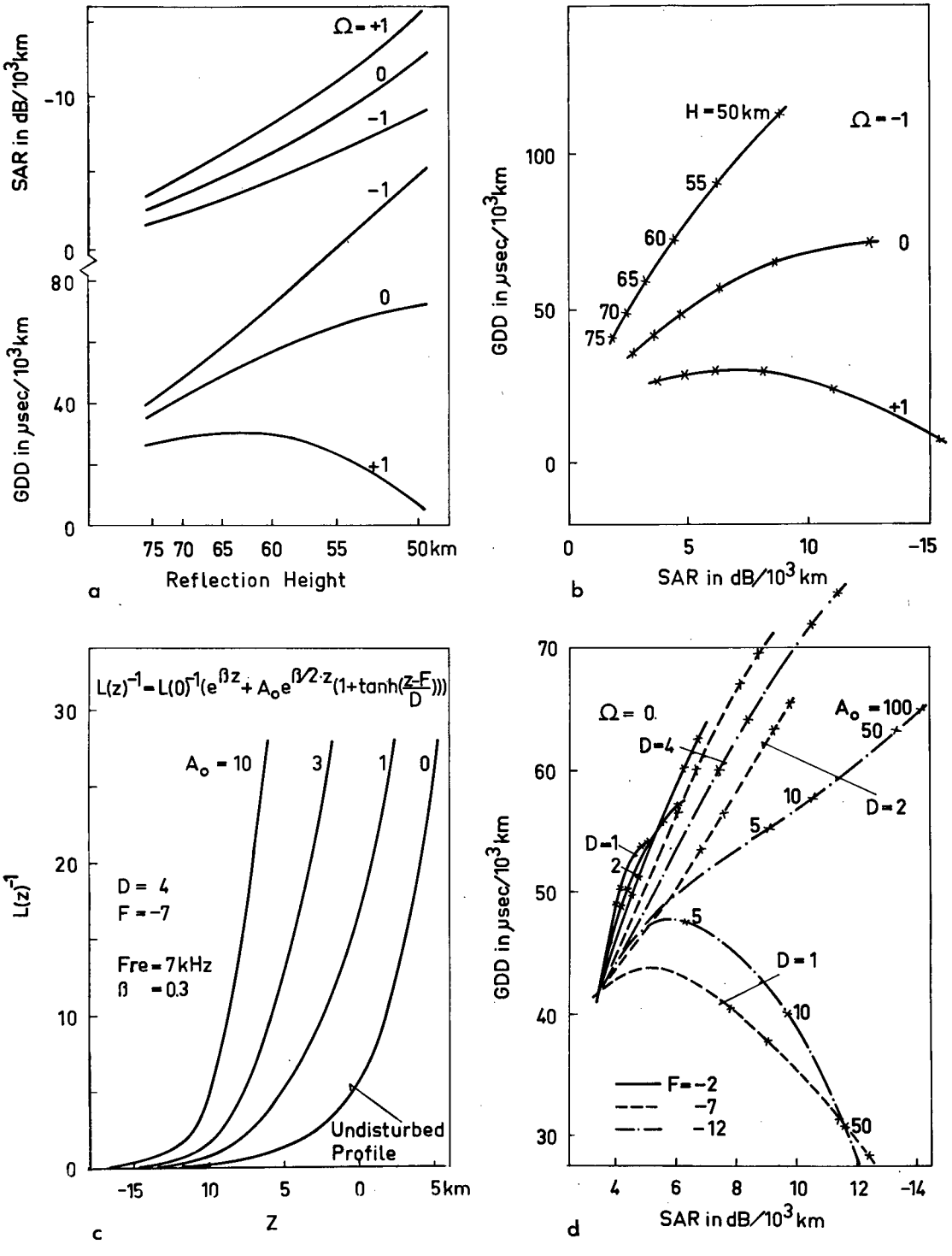

Figure 5 Model calculations. - The upper part is related to a simple lowering of the exponential profile. The lower part shows the exponential profile with a perturbing term of "tanh" (Wait and Walters, 1963).

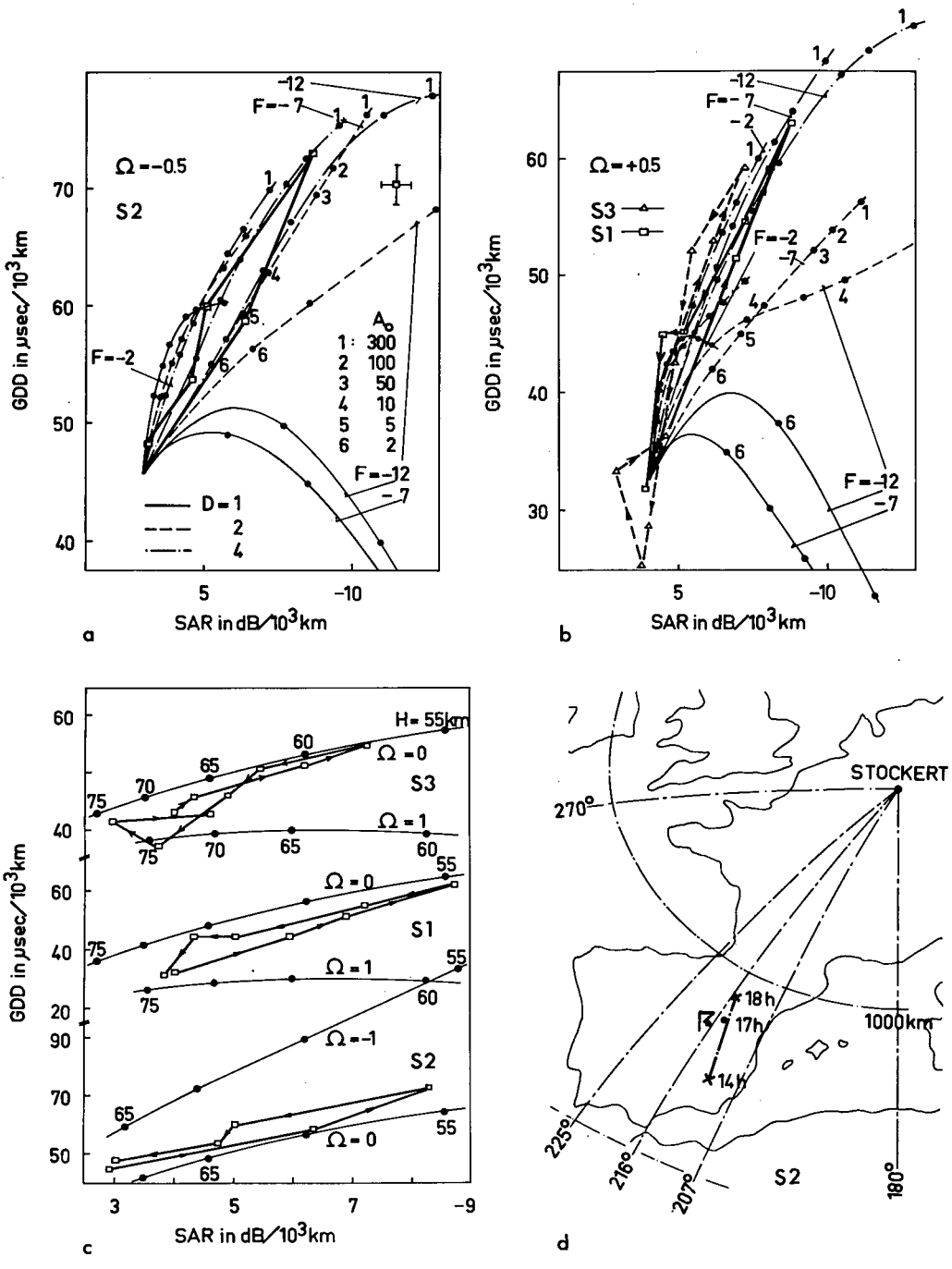

Figure 6 The interpretation of the sudden anomalies of the GDD and the SAR during the flare activity in both models. The upper part is related to the exponential profile with the perturbing term. The lower part shows the simplified lowered exponential profile. The map indicates the tracking of the source S2 in comparison with meteorological observations (flash symbol).

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A d d e n d u m

Paper "Thunderstorm Location by Radio Methods"

by F. Horner

presented at XVI General Assembly URSI (Union Radio Scientifique Internationale)
Warszawa, Poland, August 1972

F.Horner did not attend the Waldorf Conference. G. Hagn gave a summary report on Horner's paper presented at the URSI General Assembly and on related discussions (see p. 11 of these Proceedings). In addition, and with the permission from Dr. Horner, we are adding the full text of his paper here.

1. Introduction

The techniques for locating thunderstorms by radio observations of the radiation from lightning can be divided broadly into three categories. The first is capable of operating over some thousands of kilometres and is intended to enable large areas, perhaps the whole world, to be monitored from a few stations. The second is the use of short-range detectors, a vast number of which would be necessary to cover a substantial area of the world. The third is the use of a satellite, which hopefully could monitor the whole world. The first two techniques are well-established in principle, and current work is aimed at developments which could lead to improved accuracy and convenience. The use of satellites is much more in the experimental phase of attempts to demonstrate that techniques are viable, and have operational potential. Research in all three categories is proceeding and has been well-reviewed periodically. An excellent review by Pierce (1969) for the Fourth International Conference on the Universal Aspects of Atmospheric Electricity, held in 1966, dealt with work in all categories, and a short review by Horner (1969), at the same conference, dealt specifically with short-range lightning flash counters. More recently, Jean (1970), at the XVIth General Assembly of URSI in 1969 concentrated on work in the first and last categories. There is little virtue in covering again the same ground as these reviews but there have been some significant developments since that time. Additionally, it is desirable to keep under review some of the older methods which seem to merit further development, even though they have not been the subject of recent work. Furthermore, it seems appropriate to examine again the many varied requirements for information on thunderstorms. because/

because a clearer understanding of these requirements might lead to more rapid progress towards meeting them.

2. Requirements for thunderstorm and lightning location

Although many of the requirements for location have not been stated in specific terms, it is useful to review a few of those which are known, as a background to the discussion of the various techniques.

The most universal practical need is for tracking thunderstorms as an aid to weather forecasting. Only a random sample of the discharges needs to be located, provided that they cover all significant centres of thunderstorm activity. The type of discharge is usually regarded as of minor importance; it might be a useful guide to the type of meteorological activity, but meteorologists have not specified this requirement. Accurate locations are needed to a radius of about 2000 km. Regular observations and rapid availability of the results are essential.

Investigations of the meteorological characteristics of the source discharges are possible as a research activity by using small samples of atmospherics, but there may be a bias introduced by the method of location. The results should therefore not necessarily be taken as typical of discharges as a whole; some investigations may need more comprehensive records.

Research on atmospheric electricity may need long-term statistical observations or shorter-term but more comprehensive recordings, correlated with other types of observation. In studying a major thunderstorm area and its effect on the general electrical circulation it is likely that ground discharges are of major interest, and it seems necessary that the total number of these over a specified time should be recorded, rather than a sample. The location system should preferably operate over many thousands of kilometres to obtain a comprehensive survey. High accuracy on individual discharges is unimportant provided that they can be identified with general areas of thunderstorm activity. Data are required for long-term analysis and delays in processing and analysis are not serious.

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Another category of research is concerned with radio propagation. Although some work is carried out on the integrated noise from a thunderstorm area, another common requirement is for accurate location of a few chosen discharges. To this end an elaborate analysis technique can be justified. It would be interesting to know whether the discharge was to ground or not, but much useful work can be done without this differentiation.

Power engineers are interested primarily in ground discharges and their potential damaging effects. Long-term probabilities of occurrence are the main requirement, and systematic observations over long periods, e.g. years, are needed. Although good use can be made of general data of limited accuracy, highly-accurate location is needed if the possible effects of local topography on the frequency of occurrence of discharges are to be investigated. General surveys do not need rapid analysis, but there is an additional use for accurate and immediate information which might enable action to be taken to minimise the chance of damage.

Other operations are subject to severe damage by lightning; aviation, rocket launches and storage of explosives can be cited as examples. Early warning of lightning occurrence is needed, but it must be borne in mind that location techniques alone cannot give warning of the first lightning in a storm.

Radio noise surveys are normally concerned not with individual discharges, but with the total activity in an area of the world. All discharges must be located in a given period if they are to be correlated with the amplitude of the noise.

This summary of some types of interest is certainly not comprehensive, and may not necessarily be a correct interpretation of the needs of specialists in a range of disciplines, but it serves to show that the needs vary considerably in respect of the required accuracy, the completeness of data, the rapidity of analysis and the types of discharge of interest. This needs to be borne in mind in any review of techniques.

3. Location at long ranges

3.1 Direction finding techniques and networks

Some networks using crossed-loop, cathode-ray direction-finders operating at about 10 kHz have been in routine use by meteorologists for many years, while others have been set up for shorter periods for specific purposes. Accuracies attained at distances up to 2000 km, using networks with baselines of the order of 500 km, are usually of the order of ten percent of the range, and adequate for most purposes, provided that the stations are well-sited and used effectively. However, some networks have yielded disappointing results. sometimes because the facilities for synchronizing observations at the several stations have either been inadequate or have not been properly-used. For example one station may concentrate its attention on a local storm, and fail to record more distant activity being recorded at the other stations. Photographic recording of bearings, with appropriate adjustment of sensitivities, can greatly reduce the correlation problems, but the delay involved in processing is not normally acceptable in a meteorological forecasting system. For purposes in which longer-term analysis is permissible, the network with photographic recording is still the most accurate system for distances up to 2000-3000 km. The British network, including stations in the Mediterranian region and having a maximum baseline of about 2700 km, demonstrates high correlation even without photographic recording, but extension to longer baselines would probably increase the correlation problems substantially and make photographic recording necessary. It was used in a wide-baseline system in the Atlantic area several years ago, but there is no published record of what correlation difficulties were encountered. In a short test between Singapore and Gan (Indian Ocean), separated by 6000 km, correlation without photography was poor, probably because Singapore is in a high-thunderstorm area. Greater success is likely with the stations in relatively storm-free locations.

Recent work on DF systems has been mainly on the development/

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development of automatic techniques, but some has been aimed at improved instrumental accuracy. Measurements of errors of a conventional CRDF (Nishino et al 1972) showed a maximum of 4° and indicated that the use of angular calibrations could lead to a significant improvement in some sectors.

One failing of the crossed-loop system is its liability to polarisation errors when the received waves are not vertically-polarised. With narrow-bandwidth amplifiers, sky-waves of mixed polarisation, following the ground-wave, are received before the maximum amplitude has been reached on the display, and a bearing taken on the peak deflection is subject to error. In an attempt to minimise such errors, wide-band amplifiers have been used (Taylor and Jean 1959); the faster response of the receiver may then enable the display to rise to an observable maximum during the arrival of the energy received by the vertically polarised ground wave and before the sky-wave arrives. A disadvantage of the system is that many signals from transmitters are received in the wideband receivers and cause errors, and it is not readily adaptable to automatic operation. No further development of the method has been reported.

An objection to the direction finding system is the need for several stations remote from the base station, introducing problems of manning and supervision. Unmanned outstations, subject to occasional checking, have been proposed, but the telemetering of bearings to the central station has hitherto been regarded as a technical difficulty. It is technically possible to transmit information about the bearings and it is interesting to review some recent developments, for example in Japan and France which produce bearing data in a suitable form for this to be done.

One system used in Japan (Iwai et al 1969) is a development of that described by Grubb (1967) and has been used effectively to study the meteorology of storms (Kashiwagi 1971). Amplitudes of the signals in the N-S and E-W aerials of a crossed-loop direction finder, represented by

A/

A cos θ and A sin θ (where θ is the bearing) are used to modulate a local oscillator of angular frequency ϕ to give voltages $V_1 = A \cos \theta \sin \phi t$ and $V_2 = A \sin \theta \cos \phi t$. With a transient signal such as an atmospheric the circuit which detects the aerial signals must have peak response characteristics. The difference voltage $V_1 - V_2 = A \sin (\phi t - \theta)$ contains the bearing information in its phase, and in the Japanese system a phase detector is used to record the bearing in digital form. The French system (Tixier 1972) is based on the same principle but is more similar to that used by Grubb. A pulse, produced when $V_1 - V_2 = 0$, is used to gate a synchronized sawtooth waveform: a voltage is thus obtained which represents the bearing. This voltage can then be converted to digital form if desired. By comparison Grubb used a timing signal to measure the delay of the pulse.

Little information has been published on the errors of these systems, particularly under conditions of mixed polarization. The use of peak amplitudes as the input signals tends to increase polarization errors, since an ellipsed trace, which could indicate the correct bearing by the direction of its major axis, would be telemetered as an erroneous bearing. This is equivalent to a system which has been used in some visual displays, by which a linear trace is always obtained by discarding the phase information in the original signals. A few published results from the Japanese work indicate errors generally of the order of a few degrees, although much larger errors occur occasionally. Further experience and comparison with other location techniques is required, because the fixes are calculated and plotted automatically, and there is a loss of the critical inspection and selection procedures which are normally available at various stages in the traditional bearing-acquisition and plotting techniques.

Another method with automatic recording of bearings has been developed in Japan for use in the Antarctic, and is suitable for relaying the bearings to a distant station (Kamada and Tokuda, 1970). It is based on the automatic/

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automatic surveillance of the visual display and presumably leads to the difficulties already discussed when the traces are complex. So far, no system has been developed by which all the amplitude and phase data from both loops can be telemetered to enable the whole display to be reproduced centrally, though in principle, with a direction finder operating at 10 kHz, the information could be transmitted on a radio link with less than this bandwidth.

The majority of CRDF networks have incorporated VLF instruments on wide baselines, to obtain long ranges, but relatively short baselines have been used on occasion, for example in the USA for tracking tornadoes in limited areas. Higher frequencies can be used for these shorter ranges (say 200 km) and 500 kHz has been favoured for some networks, for example in Florida (Jean 1970). No further information on the performance of this network has been published. According to a report to URSI, a frequency of 40 MHz has been used in Canada. The basis of this system was the measurement of phase differences between the signals on vertical aerials; a signal processing unit was used to convert the signals into a radial trace on a cathode ray tube. Only a single station experiment has been reported but the system is suitable for development as a network, with remotely-operated un-manned stations if desired. Very high frequencies are not appropriate for a long-range system, but a similar instrument designed for the HF band might have some applications.

To summarize the work on direction-finders, the basic techniques are well-established and recent work has concentrated on the development of automatic techniques to improve convenience and economy of operation, and to provide a basis for machine processing of data. The introduction of automatic techniques extends, in some instances, to the plotting of bearings and computation of the most probable location of the source (Mineeva and Leushin 1967, Iwai et al, 1969). Little work has been done recently on the determination and possible reduction of bearing errors; on the contrary, the move/

move towards automatic operation has a tendency to increase these errors. Further practical experience and controlled experiments are needed to show whether any reductions in accuracy are significant.

It is well-known that direction finders designed with spaced-loop aerials enable polarisation errors to be avoided. It has now been reported that a spaced-loop instrument has been developed in Japan for location of atmospherics at a frequency of 170 kHz, but no details are available.

Information about the availability of direction finders on a world-wide basis is rather sparse and out-of-date. A survey carried out by the World Meteorological Organization in 1956 revealed that about 30 instruments of the crossed-loop cathode-ray type were in regular operation, mainly in meteorological services, and that about 20 more were planned, partly as a result of interest in the IGY. It is known that additional networks have been set up since then, but others may have fallen into disuse. It would be useful for another survey to be made of the existence and capabilities of existing networks.

3.2 Single-station location systems

All single-station methods include a direction finder. The type of instrument can be that used in direction-finding networks, but perhaps with one difference. Those used in networks need not necessarily incorporate means for resolving the 180° ambiguity which occurs with many basic instruments, since this disappears during the plotting of the associated bearings. The sensing facility is essential with a single station if atmospherics are liable to be received from opposite sectors. Most types of direction finder so far developed can incorporate, if required, means for determining the bearing unambiguously, and are therefore suitable for single station operation.

Several techniques for measuring the distance of the source are available and have been reviewed from time to time. Most of these have not been widely used/

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used operationally either because the accuracy is low (e.g. reliance on amplitude only), or because they operate only in special circumstances (e.g. analysis of suitable reflection-type waveforms which mainly occur at night), or because the required capital investment has not been considered to be justified (e.g. recording of high-frequency spectra, with associated backscatter ionospheric sounders), or because the necessary analysis is tedious and not readily simplified by automatic methods (which so far has applied to waveform analysis). Good use has been made recently of analysis of reflection-type waveforms for specialised research (Tixier 1972) but the technique is not suitable for general, routine surveys. By far the greatest effort has been devoted to methods based on the spectra of atmospherics at VLF or ELF.

The method which has been adopted by the group at the Heinrich-Hertz Institute in Berlin relies on the measurement of two parameters of the atmospherics at VLF, the spectral amplitude ratio (SAR) and the group delay time difference (GDD) (Heydt et al, 1967; Frisius and Heydt, 1968). The SAR is the ratio between the amplitudes of atmospherics in two narrow bands at spaced frequencies; the GDD is the difference between the times of arrival of impulsive disturbances at two separated frequencies divided by the frequency difference. Either measurement provides a measure of distance, together they would be expected to provide a more accurate estimate.

Extensive tests of the system are under way using co-operating installations in Argentina, Germany, Japan and the United States, and results from this network have been reported (Heydt 1971). The GDD is considered to yield more accurate distance measurements than the SAR (Heydt and Frisius 1970). Results from the network are displayed as mass plots of the GDD as a function of bearing, and of corresponding fixes on world maps. In computing distance from the GDD, the varying propagation characteristics in different directions are taken into account. The GDD/bearing plots vary considerably in the degree to which the individual/

individual points fall into well-defined groups representing discrete thunderstorm areas.

In parallel work in the USSR, the SAR was found to be reasonably satisfactory at short ranges, but subject to large errors at long ranges. The later work there has been based on the recording of the phase spectrum (Inkov 1967), and accuracies, when compared with CRDF fixes, are said to be about 400 km at 4000 km range, and not markedly dependent of distance. A difficulty with these methods is that they are influenced by differences in the spectra of the sources and by variations in radio propagation characteristics. So far, therefore, the results have been interpreted by studying groups of "fixes" on a statistical basis. A given storm will be associated with a mean value of a parameter from which the distance can be calculated. Some error will occur in estimating the mean value of the parameter, and additional errors are likely in converting the mean value into an estimate of distance. Some of these errors may be systematic if, for example, the propagation conditions vary with direction or time in ways for which full allowance cannot be made. Interpretation can also be seriously affected if more than one storm exists at the same time and in the same direction, and cannot be resolved. Furthermore, in correlating observations at different stations, there is no way to associate conclusively a group of fixes recorded at one station with a group recorded at another, unless there is only one storm, or individual fixes are correlated on a fine time-scale, or the activity represented by the two groups varies on a longer time scale in such a way that the groups clearly originate from a common source.

Despite these difficulties of interpretation, VLF spectral measurements offer promise of leading to estimates of source distances with sufficient accuracy for some purposes and, with automatic facilities, of enabling global lightning activity to be monitored in a reasonably comprehensive manner. It is, however, not so well-proven as the DF network. It would be desirable for more comparisons to be made with results from other methods. For example more/

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more records could be examined for times when storms are known to exist from first-hand local experience. Some correlation was made in the early development of the system with results from a CRDF network, and indicated errors of the order of 10% in distance (Heydt et al 1967), but these tests were at relatively short ranges, and similar comparisons are needed at the longer distances which are involved in global surveys. Not all the reported locations are consistent with meteorological situations and the proving of the system cannot be regarded as fully satisfactory while it depends mainly on internal evidence.

It has been argued that there are advantages in the use of ELF spectral analysis to monitor global lightning activity in a comprehensive manner. The radiated energy travels long distances with low attenuation and the propagation mechanisms are becoming increasingly well-understood. On the other hand, and as a result of good propagation, individual atmospherics become more difficult to distinguish from the general noise background as the frequency is decreased. Further studies of "slow-tails" have confirmed the dependence of their characteristics on the distance of propagation (Jones 1970) and the accuracy of interpretation should improve with increasing knowledge of propagation mechanisms, particularly their variation with direction of travel (Taylor and Sao 1970). Additional weight has been given to the time delay between the slow tail and the VLF component, as a distance-dependent parameter, by the demonstration that their origins are both connected with the return stroke (Sao et al 1970), but delay time may not always increase with distance (Iwato et al. 1970).

At still lower frequencies, where the Schumann resonances of the Earth-ionosphere cavity occur, the characteristic waveform of an atmospheric has been shown to be related to the distance of propagation (Jones and Kemp 1970, 1971). It is advantageous to base the analysis on the waveform representing the ratio of the electric to the magnetic field, as this is independent of the source spectrum (Polk 1970, Kemp & Jones 1971). In one series of measurements, 50 events, recorded in England, were found to be located in the tropical areas/

areas of the world: it was possible to record them because they had unusually large amplitudes and could be distinguished from the background (Kemp 1971). In theory the apparent resonance frequencies should be dependent on distance (Jones 1969) but this has not been verified experimentally. Ogawa et al (1969) and Sao et al (1971), however, have reported changes in resonance frequencies with time of day, and this may obscure changes with distances. It may be difficult to isolate the radiation from one thunderstorm area from the general background, and to determine the associated resonance frequencies.

3.3 Timing methods

Many years ago a technique based on the measurement of time differences between disturbances at spaced stations was demonstrated by locating storms near Europe from stations in the United States.(Lewis et al 1960). Although the results were encouraging, no further development has taken place towards an operational system. The problems of accurate measurement of time differences without laborious comparison of waveforms needs to be solved, but does not appear insuperable.

In passing, it is interesting to note that a time-difference system has been developed in South Africa for detecting sources of VHF radiation at distances of a few tens of kilometres (Proctor 1971). The technique as so far developed is not suitable for routine use but is discussed later in connection with lightning flash counters.

3.4 Discussion of ground-based long-range systems

Ignoring the operational problems, the VLF CRDF network is still the most reliable proved system for thunderstorm tracking as applied to weather forecasting. For the future, the main requirements are for automatic operation and the acquisition of comprehensive data in a form suitable for machine processing. Three systems should continue to be studied for this purpose; CRDF networks with centralised control, data analysis and plotting, time-difference measurements, and a CRDF with associated distance measurements based/

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based on VLF/ELF spectra. Most effort is at present being devoted to the last of these, but it may be that similar effort would show that the alternative methods hold at least comparable promise.

The operational difficulties of a CRDF network are less important for research, which often involves short series of observations for which special arrangements can be made, but a research project may not have the resources necessary to set up a network if one does not already exist. Furthermore, if the research requires recordings at long ranges, as may be necessary for some studies of atmospheric electricity or radio propagation, it is by no means certain that if the baseline is large enough to provide accurate fixes, correlation among stations is adequate for cross-bearings to be taken on all discharges of interest. A single station technique would overcome this difficulty.

One problem which has received little attention is that of distinguishing ground discharges from others. If a CRDF network or other system were capable of recording every discharge in the world, it would be possible to estimate roughly the number of ground discharges, using general knowledge of the proportion which reach the ground. Any world-wide system based on VLF atmospherics, however, would be expected to record ground discharges preferentially to an extent which might depend markedly on distance. It is in connection with this type of problem that clarification of the objectives of potential users of the data is needed, so that future research can be planned effectively. The power-line damage problem may be quoted as an example for which the need, i.e. the incidence of ground discharges over long periods, is reasonably clear. Direction finding networks seem potentially capable of providing this information, but no exhaustive studies have been made of the types of discharge which are recorded, at different distances. Nor is it known whether fixes from a DF network designed to cover a large area would be sufficiently accurate for a study of the effects of topography on lightning incidence.

The/

The precise definition of requirements for other applications could stimulate more thorough appraisals of the relevant technical possibilities and limitations.

4. Location at short ranges

Recent developments in the use of local lightning flash counters are characterised by a further increase in the number of proposed designs, with only marginal progress towards solutions of the two main problems, that of establishing clearly the effective range of operation and that of distinguishing between ground and cloud discharges. Solutions to a third problem, that of presenting lightning flash data in the most useful form, are dependent on more precise statements of requirements by potential users of data, and no universal system has been agreed.

The measurement of the effective range of counters has been facilitated in South Africa by the establishment of networks to locate accurately the location of near discharges. Several techniques are used. First the network of five "time of arrival" stations mentioned previously, which enables the sources of VHF atmospherics to be located to an accuracy of 25 m horizontally and with an estimate of height above ground, for example to an accuracy of 200 m if the height is about 4 km (Proctor 1971). A second network incorporates three direction finders, operating at 10 kHz, and an all-sky camera. With these facilities, tests on the CIGRE type of counter have shown the effective range to be between 30 and 40 km, in closer agreement with experience in Australia (Bunn 1968; Prentice and Mackerras 1969) than with that in Europe (Frühauf et al, 1966). The CCIR counter also has an effective range of about 30 km with a 3-volt sensitivity setting (Horner 1960). Tests in the Far East have shown the range to be 11 km with a 6V sensitivity and slightly shorter aerial; these two results are mutually consistent (Pierce 1968).

A new type of counter developed in Japan has been reported. No details are available except that it responds to thunderstorms within 200 km. Counters operating at frequencies of 1.6 and 3.0 MHz continue to be used in India (Aiya et al 1972) and a new, portable design has been developed (Aiya/

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(Aiya and Hari Shankar 1969).

Another counter has been designed to distinguish between cloud and ground strokes by taking into account the suppression of HF radiation when a return stroke occurs. (Kreielsheimer and Lodge-Osborn, 1969, 1971). The basis for the counter has been investigated by analysis of typical waveforms, but no field tests of the latest design have been reported. Seemuller and Zegel (1968) in the USA have redesigned, with solid state components, an old design which has been in use for ten years. Plans have been announced for an expanded network of counters, of new design, for meteorological purposes in Holland (Ottevanger, 1970).

Most recorders of nearby lightning are of the counting type, that is they count the number of atmospherics in a given time which have an amplitude exceeding some predetermined level. A different principle has been used by Kohl (1969). He finds that the peak amplitude of an atmospheric in a bandwidth of 4.8 kHz at 500 kHz is well-correlated with the distance of the source. The instrument therefore records peak field-strengths in successive short intervals of time, and the amplitude of the trace is said to indicate the distance of the source to high accuracy.

About twenty designs of local lightning flash counter have now been proposed in the past twenty years, ignoring minor modifications of the same basic principle. Although there is some variation in objectives in respect of the types of discharge of interest or the range of operation, this proliferation of designs is a commentary on the difficulty of evolving one which is clearly able to fulfil its task, and also of evaluating performance in a rapid and generally-agreed manner. It now seems that further progress will be dependent on more thorough field tests leading to a better understanding of performance, and possibly on a combination of methods, rather than the discovery of a new and infallible technique.

Despite the shortcomings of counters, a considerable quantity of useful data exist from several networks, and it would be useful if this were collected in a common format so that the results of different investigations could be more/

more readily compared. To this end agreement is needed on the kind of information which should be presented. The majority of data are in the form of hourly counts, although some are in greater detail, including precise times of individual discharges. Considering only the hourly counts as a basis for presentation, it is desirable for the large number of these to be summarised in a statistical way to reduce the volume of data. It is therefore necessary to know what the potential users of data need from each station. At one end of the scale there may be a requirement to know the count in a particular hour chosen in relation to other investigations. At the other end the user may wish to know only the total count over a long period, perhaps a year or more. Between these two limits there are a large number of statistical parameters which may be of interest. A widespread need is for long-term statistics which reveal diurnal and seasonal trends. For other purposes, total numbers of counts in defined circumstances may be needed, or the number of occasions on which the count exceeded a defined number in an hour, a day, or some other period.

A reasonable compromise appears to be to suppress the information on what occurred on a particular day and to show the statistics of the variations with time of day on a monthly basis, perhaps with a separate presentation of times with exceptionally high activity. Such a compilation of data would satisfy many of the known requirements, but it will be unwise to standardise on a data-presentation system before all interests have been identified.

5. Techniques involving satellites

Although an earth-satellite appears at first sight to be an excellent platform for recording the occurrence of lightning discharges, there are serious difficulties in using radio techniques, as explained by Pierce (1969). The first is a lack of spatial resolution; a satellite placed in a high orbit to obtain good geographical coverage suffers from inadequate angular resolution, while a low orbit satellite moves a considerable distance in an observation time which is long enough to obtain a meaningful sample of atmospherics. Another/

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Another problem is concerned with receiver sensitivity; a receiver in a near-earth satellite can be designed with sufficient sensitivity to detect the radiation from the discharges at frequencies up to at least the VHF band; this becomes more difficult as the altitude is increased. Moreover, it is only at the lower altitudes that the atmospherics are expected to be clearly detectable against the background of cosmic noise.

The only satellite experiment flown with the specific and sole objective of detecting radio signals from lightning discharges (other than whistlers) was that in the Ariel 3 satellite (Horner and Bent 1969; Bent 1969). This experiment demonstrated that the atmospherics could be received in the HF band, but it was found that the problems of interference from transmitters were greater than expected, partly because the standard frequency service with which the band was shared increased the frequency spread of the transmissions while the experiment was in progress, partly because these transmissions were propagated to greater distances than had been expected, and partly because other transmissions were apparent in a nominally clear band. The data were useful for studying particular situations, but the problems of large-scale data-processing in the presence of these interfering transmissions were too great for the world-wide distribution of thunderstorms to be deduced. The successful application of this technique to world-wide coverage depends either on the provision of a wider guaranteed clear channel, or on a more complex receiver to obtain better filtering of unwanted signals than was possible with the facilities available on the Ariel 3 satellite. An earth-oriented directional aerial would also improve the chances of success. It must be emphasised, however, that the objective of a similar experiment can be only to define thunderstorm areas in geographical extent and electrical intensity, not to locate individual discharges or even storm cells (Pierce 1969).

A system based on the differential times of reception of atmospherics at a number of satellites has been proposed by Massa and Coroniti (1969). The/

The receivers would operate at VHF to avoid serious ionospheric effects. Up to 18 satellites would be needed to provide world-wide coverage, but it was suggested that the thunderstorm location system could be an addition to a navigational satellite system, with a consequent reduction in the cost of implementation. The proposed altitude was 10,000 km to enable atmospherics to be received from a large area of the world. It might be expected, therefore, that many atmospherics per second would be received and, since each might last for a substantial part of a second, the problem of identifying individual atmospherics and measuring their times of arrival would be formidable. Lowering the altitude to survey a smaller area at a given time and increase the chances of identification would enhance problems of maintaining satellites in relative positions which would continue to form a viable network.

Apart from specifically-designed experiments, other satellites with radio receivers have provided information on terrestrial noise. Unpublished reports suggest that relevant data have been obtained recently on the RAE-A radioastronomical satellite and on survey satellites of the Vela series. The long aerials on these satellites should improve the chances of detecting the sources, but this advantage is partly offset by the greater altitudes. It is hoped that the results will be published and that, in particular, it will become clear whether the problems of interference from transmitters have been overcome.

Detailed consideration of optical systems is outside the scope of this review, but it may be noted that some success in plotting the distribution of lightning flashes has been achieved with the OSO-2 and OSO-5 satellites (Vorpahl, Sparrow and Ney 1970, Sparrow and Ney 1971). The field of view was about one degree square on the Earth's surface at vertical incidence, and correspondingly larger when the Earth's surface was viewed obliquely. This small field of view entails a consequential reduction in the size of the sample which can be obtained, and this was further restricted because the system operated satisfactorily only at night-time and near new moon. There is evident potential/

potential in this technique and it gave results consistent with the known general areas of thunderstorm activity: further studies are needed to determine to what extent it can be applied to specific problems.

The use of radio location from satellites to obtain accurate plots of the incidence of lightning must at present be regarded as unpromising. It is therefore worth considering whether they should be used in another way, that is as control and data-reception platforms used in conjunction with the more conventional ground-based location systems. It has been stated, for example, that one of the problems of operating a widely distributed direction-finding network is that of collecting and correlating the bearings at a central location. This problem might be simplified if bearings could be relayed to a satellite, at a frequency unaffected by the ionosphere, for onward transmission to a plotting centre. It should be possible to make allowance for the different transmission delays from the different stations when the bearings are being correlated. Investigations could be made with existing ground based facilities to determine the optimum spacing of direction-finding stations in the light of correlation problems and economic considerations.

An analogous use of a satellite would be as a data-relay station for a ground-based network based on timing methods. The atmospherics received on the ground at a low frequency or pulses derived from them would be relayed to a satellite at a higher frequency and thence to an earth-station for data-processing. Again the delays in transmission could be compensated by using a knowledge of the satellite position. An assessment of the practicability of such a system would be dependent on a prior demonstration that the timing method itself was soundly based.

6./

6. Conclusions

1. For locating areas of thunderstorm activity at long ranges there are three systems which need further investigation

   a) CRDF networks with improved back-up facilities to enable comprehensive data to be collected and processed rapidly. Further work is needed to develop these facilities and to ascertain the optimum locations and separations of stations to provide wide coverage. Part of the study should be concerned with the way in which correlation between the incidence of the recorded atmospherics varies with the separation of, and with the local environment at the stations.

   b) Stations which depend on the measurement of bearing and distance, and which can be used either independently or in a co-ordinated way. Some automatic recording techniques are well-developed, but more experience and checks against information obtained by other means are needed to assess the accuracies, particularly in the measurement of distance.

   c) Timing methods. These are the least developed; despite their early promise, but are perhaps the most readily applicable, in principle, to an automatic system. Considerable work is needed to assess timing accuracies in a wider range of conditions than were chosen for the early tests, to develop the technical facilities and to determine the optimum locations and separations of stations.

2. For those applications in which it is important to know the distribution of ground discharges, a network designed solely for locating the sources may need to be supplemented by additional facilities. This problem will involve further study if a clear requirement emerges.

3. Simple lightning flash counters, suitable for use on a wide scale, are unlikely to provide all the information which has been specified as a requirement; i.e. accurate maps of the rate of occurrence, with, for some purposes, unambiguous discrimination between ground discharges and others. Development/

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Development of more complicated systems seems justified as a means for evaluating the performance of simple instruments, but further progress in general surveys is most likely to be made by improvements in reliability and additional experience rather than the development of new types of instrument.

4. The collection, standardisation and dissemination of lightning counter data needs some attention, and agreement should be reached on methods of presenting data in statistical form, taking into account the fact that many records will be incomplete or incorrect. Past experience has shown that faulty operation of instruments can continue undetected for a considerable period, and the analysis of the results is then difficult. More rapid collection and intercomparison of data would help to overcome this problem. Consideration should be given to the desirability of using duplicate instruments on each site as a routine procedure, and reporting data only for those periods when the results agree within some specified limits. Otherwise, erroneous data may be detectable only on the basis of past experience or by comparison with other nearby stations.

5. Reports on observations with satellite sensors suggest widely-varying experience, and apparent discrepancies need to be resolved before the potentialities of the technique can be adequately assessed. Satellites should also be considered as an adjunct to ground-based location systems, to simplify the control of networks and the collection of the data.

6. Clearer statements of the requirements for thunderstorm location are needed for at least two reasons. The first is to enable future research to be concentrated on the most important issues. The second is concerned with the desirability of making the maximum use of the many facilities which already exist. In the present research climate, it is not so easy as at some times in the past for agencies owning facilities to provide support to research projects on a voluntary basis; applications for such support are more likely to be considered favourably if the aims of the research are clearly stated, as specific as possible and of evident scientific merit.

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OBLATE RADIAL FUNCTIONS

H = 26.0 X = 1.20000000 M = 2

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22	1.23957042784897187−002	−4.91561610216510802−001	2.70100392209357645−002	2.00539410402887434−001	1.99101649055948690+002	20
23	2.93886694044871146−002	−1.39740153469953441−001	6.70653644063477569−003	5.04471739209173294−001	2.42361026461283413+002	19
24	2.43804128868406119−002	2.91224546742163779−001	−1.85375104113867037−002	4.25109598422802764−001	2.87991718104578867+002	20
25	2.74552229618219418−003	5.01200469840980266−001	−3.10577209182386864−002	7.16735328842667636−002	3.35923575719240953+002	19
26	−2.05389242009808716−002	3.97400786741509104−001	−2.42928835120102263−002	−2.97431088372522081−001	3.86103945327489922+002	19
27	−3.23013595229370349−002	9.10491768859252690−002	−3.97275515380803531−003	−4.76797563314055291−001	4.38492117628645458+002	18
28	−2.79512026610818156−002	−2.28574003999215214−001	1.82885517111234457−002	−4.14387826079491380−001	4.93055975105300498+002	19
29	−1.13531161895238915−002	−4.19097051272125631−001	3.24946142332276055−002	−1.88893388900494767−001	5.49769751435326596+002	18
30	9.52737222009637077−003	−4.38387335995383624−001	3.43530178741737055−002	7.37871464964401637−002	6.08612487446534139+002	18
31	2.73245608490956195−002	−3.27378621025926611−001	2.51906046329896321−002	2.75066092843811371−001	6.69566933201726787+002	17
32	3.79270420975241354−002	−1.61274393412651646−001	9.42568985559613910−003	3.75531610095264633−001	7.32618747545934139+002	17
33	4.07559371929412449−002	−6.39496317504334357−003	−8.25139161495895949−003	3.88058624922282681−001	7.97755902115597091+002	16
34	3.75880487850957547−002	1.00435981043202677−001	−2.46977111230520693−002	3.53367285138048769−001	8.64968229568632236+002	17
35	3.10506398247647699−002	1.51745801514509684−001	−3.89135964956162736−002	3.17479793156769350−001	9.34247075808805956+002	15
36	2.35073119995121336−002	1.58600108111115041−001	−5.18506469864384347−002	3.20726052449861027−001	1.00558502863728653+003	16
37	1.65434528962801749−002	1.38586244029497892−001	−6.60438343522281170−002	3.99563422234294223−001	1.07897570351085353+003	15
38	1.09283845941952079−002	1.07617355911513152−001	−8.55928495608660919−002	5.99507583929546124−001	1.15441357259761282+003	15
39	6.82436764145911401−003	7.64357663976150110−002	−1.16936582046755485−001	1.00006164510659529+000	1.23189382708805854+003	15
40	4.05032450861528660−003	5.04808932448122168−002	−1.71010350954416943−001	1.76039483096652429+000	1.31141226534565871+003	15
41	2.29453076593913154−003	3.13328383945287628−002	−2.67983601627412777−001	3.21034645783044704+000	1.39296520134485822+003	16
42	1.24504566311346011−003	1.84142688867998548−002	−4.47296954479830220−001	6.04498246926310268+000	1.47654938918803973+003	14
43	6.48965526392535518−004	1.03037592653956743−002	−7.89242048726064578−001	1.17583526650603821+001	1.56216196047560154+003	14
44	3.25738546980387571−004	5.51298600169820344−003	−1.46255558117122586+000	2.36382129921890030+001	1.64980037203124937+003	14
45	1.57777683459971563−004	2.83022619281279437−003	−2.83214848187071447+000	4.91026653058405177+001	1.73946236203023970+003	14
46	7.38840783318025063−005	1.39806255858935803−003	−5.70910959325192346+000	1.05316780143592498+002	1.83114591299172320+003	14
47	3.35034793705492111−005	6.66093168921287794−004	−1.19450546168724468+001	2.33002854120367894+002	1.92484922041266224+003	14
48	1.47329478358344702−005	3.06710088065377784−004	−2.58788187499404870+001	5.31165311135833461+002	2.02057066606503975+003	14
49	6.29089095783481514−006	1.36732067155100149−004	−5.79401917286625452+001	1.24634864363740207+003	2.11830879516825019+003	14
50	2.61134910823674440−006	5.91061734031961035−005	−1.33832937418583786+002	3.00709421352373164+003	2.21806229679778926+003	13
51	1.05489461817900362−006	2.48090579063544187−005	−3.18461930385459103+002	7.45305264772431384+003	2.31982998700930349+003	13

OBLATE RADIAL FUNCTIONS

H = 28.0 X = 1.20000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	2.08214255002029827−002	2.74064410723698659−001	−1.06357043104585157−002	5.62984235028902499−001	−6.19086728618735091+002	22
3	−1.06357043104585157−002	5.62984235028902499−001	−2.08214255002029827−002	−2.74064410723698659−001	−6.19086728618735091+002	24
4	−1.58608058800658591−002	4.67189610162666569−001	−1.76636882528492796−002	−4.02546425529440718−001	−5.15556857122093756+002	23
5	−1.76636882528493207−002	−4.02546425529439511−001	1.58608058800658145−002	−4.67189610162667584−001	−5.15556857122093555+002	24
6	−1.22587509015611556−002	−5.16026260724338158−001	2.07606182400055212−002	−3.20096082603743536−001	−4.16726482444936697+002	23
7	2.07606182399737631−002	−3.20096082605100367−001	1.22587509016165139−002	5.16026260723472819−001	−4.16726482444731002+002	23
8	2.41161184986762897−002	−1.17629248946597360−001	4.25700200181529794−003	5.86174528643927711−001	−3.23015743758797240+002	23
9	4.25700203171635137−003	5.86174528488670355−001	−2.41161184938046117−002	1.17629249670726651−001	−3.23015743663663544+002	23
10	−6.05194826667530799−003	5.74335562104297836−001	−2.41264776833404407−002	−1.28935044663049397−001	−2.34997053607513293+002	22
11	−2.41264795753216919−002	−1.28934873765428988−001	6.05194114562364380−003	−5.74335597989489330−001	−2.34997031060060739+002	23
12	−1.86365432547590406−002	−3.79743232271843492−001	1.70496530606942571−002	−4.37984226364211796−001	−1.53517411535571647+002	23
13	1.70489553975232202−002	−4.37998416651232943−001	1.86372005174078766−002	3.79726374639039996−001	−1.53514551533449524+002	22
14	2.49137162511418414−002	−1.50084497424127898−001	6.02806559251071676−003	5.51193688191714484−001	−8.01126548436684260+001	21
15	6.09104606271977538−003	5.50791823751389655−001	−2.48994163181658493−002	1.51469453389871727−001	−7.99245236641393532+001	22
16	−1.31188586038374105−002	4.95136720994156666−001	−2.23993602584847637−002	−2.70317461164653779−001	−2.03367735248305959+001	21
17	−2.32579839530868029−002	−2.35994435498182154−001	1.15916157895135179−002	−5.11714409175295500−001	−1.53399042848566641+001	22
18	−1.02758044362543612−003	−5.57540629935965068−001	2.61801184676132027−002	−3.94349658369793598−002	2.17069566529501212+001	21
19	2.45298673491710913−002	−2.19399491731227372−001	9.61536734155566656−003	5.10699689323731379−001	4.62974136118358733+001	21
20	1.97343152562609185−002	3.55153994695308992−001	−1.77716181221176106−002	4.21871297054984357−001	8.02913722649942752+001	21
21	−6.24397055594645074−003	5.35729363422412097−001	−2.60526974858886966−002	−1.08874200523116201−001	1.16577476995090491+002	20
22	−2.57711943232742861−002	1.83498163815019068−001	−8.24021326547349751−003	−5.09287158896183970−001	1.56056382794577208+002	20
23	−2.13407069467423858−002	−3.18774964028770343−001	1.71146346668551902−002	−4.30224046210876322−001	1.98224602049158264+002	20
24	1.40905565905435748−003	−5.28973525826845617−001	2.76559224283403537−002	5.50123407661687412−003	2.42947924524825354+002	20
25	2.29580239276829304−002	−3.18450838485766474−001	1.61498823592393522−002	4.13539893201614729−001	2.90108121240223999+002	19
26	2.75727682003972144−002	1.06534515842521208−001	−7.18937882887438776−003	5.03071916768151784−001	3.39623244688258942+002	19
27	1.35497928844094843−002	4.34632707090515127−001	−2.56123055279091695−002	2.58679721926140841−001	3.91431476186741774+002	19
28	−8.80916831359632768−003	4.81348124881555638−001	−2.81778847187841858−002	−1.21876473599430911−001	4.45485170717582506+002	18
29	−2.61861738464235835−002	2.66348677997493060−001	−1.49432462566242102−002	−4.06966230308327773−001	5.01746763382887056+002	18
30	−3.03247584750136620−002	−5.71939213299427996−002	5.80558994019841478−003	−4.71725369202641755−001	5.60186116151554335+002	18
31	−2.08444686350328578−002	−3.24015771731265474−001	2.39160787923230593−002	−3.30438531959690302−001	6.20778698010439135+002	18
32	−3.16640456460388797−003	−4.41088207747992780−001	3.25802995993598273−002	−8.40752905431099170−002	6.83504298180208709+002	17
33	1.55640351767730276−002	−4.04874719876199575−001	3.01762188695440105−002	1.55449030583114200−001	7.48346091552609687+002	17
34	2.98338192653296506−002	−2.70483255914066213−001	1.91678063714713687−002	3.16836124190751347−001	8.15289944755555467+002	16
35	3.71860169908185598−002	−1.07787461621590362−001	3.73587862981769773−003	3.82786934965380026−001	8.84323891127911972+002	16
36	3.79202071098012501−002	3.00879548025204998−002	−1.23456112456334813−002	3.76199109552464537−001	9.55437727035278204+002	16
37	3.39359276717514151−002	1.18115354146332737−001	−2.68771815581586119−002	3.37765763605884575−001	1.02862269710 +003	15
38	2.75373121075140935−002	1.55356065509904205−001	−3.94825203460950932−002	3.08786612554536180−001	1.10387124576 +003	15
39	2.06415274244712686−002	1.54483164503314504−001	−5.13590593508934474−002	3.24728504322518843−001	1.18117681894 +003	16
40	1.44655443338373974−002	1.31842352898633663−001	−6.50069179605929028−002	4.19364607601880830−001	1.26053370434 +003	14
41	9.55759646579980432−003	1.01246338668191855−001	−8.43272927905012164−002	6.38149216584562200−001	1.34193690152 +003	15
42	5.99084521196264474−003	7.16474595905570536−002	−1.15444769355364628−001	1.06256757925903687+000	1.42538201549658042+003	14
43	3.57969189744268584−003	4.73889261477619068−002	−1.68776973255926553−001	1.85458497855506754+000	1.51086516895909473+003	15
44	2.04689026467223254−003	2.95721250289617235−002	−2.63438218138285566−001	3.34486637407717212+000	1.59838929932268214+003	14
45	1.12358965934466263−003	1.75274942437334564−002	−4.36406505426917419−001	6.21925430872878288+000	1.68793224777575593+003	13
46	5.93656660547685344−004	9.91673349186929630−003	−7.61927610448635030−001	1.19280549846296085+001	1.77951040806372958+003	14
47	3.02592089283892147−004	5.37691944238411276−003	−1.39361210547550129+000	2.36082256272910910+001	1.87311498322599213+003	13
48	1.49080787042948712−004	2.80278380453173538−003	−2.65805219187573095+000	4.82091411608984365+001	1.96874379887694627+003	13
49	7.11162575605128487−005	1.40823115929357802−003	−5.26802016488613990+000	1.01501575667118797+002	2.06639490190151150+003	14
50	3.28968541997012706−005	6.83511581616507020−004	−1.08193157804981131+001	2.20138821080620231+002	2.16606653365472399+003	13
51	1.47761849571087903−005	3.21090984214386657−004	−2.29750299982669794+001	4.91326236677147197+002	2.26775710692704885+003	14

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 30.0 X = 1.20000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	−7.65416675073771760−003	−5.83095707657955593−001	2.04001723728328098−002	−2.30717372278429016−001	−7.23080508972632228+002	23
3	2.04001723728328098−002	−2.30717372278429016−001	7.65416675073771760−003	5.83095707657955593−001	−7.23080508972632228+002	24
4	2.19779089840681975−002	−7.65845867493385856−002	2.32271643750468994−003	6.13494118892940374−001	−6.11514915258733847+002	22
5	2.32271643750469144−003	6.13494118892940368−001	−2.19779089840681973−002	7.65845867493386274−002	−6.11514915258733841+002	24
6	−4.24963727318629403−003	6.00579332033472772−001	−2.20144876004582034−002	−1.03480814803818026−001	−5.04588552263729785+002	22
7	−2.20144876004585808−002	−1.03480814803767559−001	4.24963727318445373−003	−6.00579332033480869−001	−5.04588552263722792+002	23
8	−1.95766953737832996−002	−2.94863206589574378−001	1.15882235644990780−002	−5.23288595510669510−001	−4.02671891900056997+002	22
9	1.15882235635804865−002	−5.23288595524321061−001	1.95766953743422232−002	2.94863206564646333−001	−4.02671891896150555+002	23
10	1.85474619217125678−002	−3.63117700494668706−001	1.37419441544493673−002	4.67517284073867824−001	−3.06252328489318816+002	21
11	1.37419444164430262−002	4.67517278903064121−001	−1.85474617327242602−002	3.63117706980362901−001	−3.06252327343771551+002	22
12	4.06252131105973263−003	5.72029282322985414−001	−2.30647088767462875−002	1.15079598171172726−001	−2.16011477327802496+002	21
13	−2.30647002368826610−002	1.15080913021052844−001	−4.06257451960277414−003	−5.72028999525536676−001	−2.16011290678724179+002	23
14	−2.21582357634064070−002	−1.93321241109420321−001	8.55338313364762188−003	−5.41904674673669091−001	−1.33008878987799469+002	21
15	8.54873967314574041−003	−5.41943862036731833−001	2.21601028512478776−002	1.93206311878263729−001	−1.32991945155235469+002	22
16	2.05309602562039816−002	−3.09373012603435081−001	1.25561654958753589−002	4.76191240817964368−001	−5.95867223891883919+001	20
17	1.27601786197669777−002	4.73038637125471871−001	−2.04088991091156430−002	3.14024159487683062−001	−5.87994530771537448+001	21
18	−7.93306649508736151−003	5.36338254724094836−001	−2.29842038947724004−002	−1.68143602914888735−001	−4.79462299800932247+000	20
19	−2.39607456362706202−002	−8.63894043472546186−002	4.44693588908037288−002	−5.54116063194049099−001	6.98657136135910497+000	20
20	−6.43421420601352770−003	−5.32878143896721825−001	2.36810575845763086−002	−1.61959819994489762−001	4.24096831077116137+001	20
21	1.93209796152583271−002	−3.57819049818426642−001	1.53849019254303143−002	4.22141700871316896−001	7.44159832424490523+001	20
22	2.27736476408354869−002	2.05594610181148332−001	−1.00483816823097012−002	5.09154670948492078−001	1.12203725883143840+002	19
23	2.64728724048800904−003	5.39149388981899115−001	−2.49689336150235315−002	7.52532179643970360−002	1.52793956003048568+002	20
24	−1.99169633015331139−002	3.48037631724845996−001	−1.56858067330935711−002	−4.11807313923276256−001	1.96287720178026379+002	18
25	−2.44437053049989576−002	−1.41430556775275381−001	7.68526241518856867−003	−5.14417560126474823−001	2.42418444331190136+002	19
26	−8.42904089824044664−003	−4.91732533590447050−001	2.45171786590690583−002	−1.90449640315992390−001	2.91060012959114621+002	19
27	1.41203924414797671−002	−4.50004208130355488−001	2.21438998958487913−002	2.61774172606189139−001	3.42115069428159448+002	19
28	2.63773083751406173−002	−9.40058127369945272−002	3.73121781820381092−003	5.04617295782833531−001	3.95511847023206956+002	18
29	2.09467506741755702−002	3.01215625845844334−001	−1.71361582964649927−002	4.05768115166803388−001	4.51195066002262908+002	18
30	2.63619697182306480−003	4.91322106942635476−001	−2.74143070945000719−002	7.28121099454088970−002	5.09121221627751093+002	17
31	−1.71230098937723814−002	4.02311032485939674−001	−2.22592794686916655−002	−2.74837689725420963−001	5.69255429562935315+002	17
32	−2.81200421934633551−002	1.24887246665287913−001	−5.76432839437063481−003	−4.60216631067258275−001	6.31569293082606945+002	16
33	−2.62229766286904220−002	−1.81173825449365173−001	1.33461536077370344−002	−4.28754852694435433−001	6.96039403355749116+002	18
34	−1.36668208991900244−002	−3.86044926607096615−001	2.70049859540549999−002	−2.36782525285401273−001	7.62646255400242138+002	16
35	3.73395571486934874−003	−4.38801765979820807−001	3.10446412746983458−002	1.03800830016101063−002	8.31373445934623471+002	17
36	1.99769707318581192−002	−3.61768527600174312−001	2.56130873224092018−002	2.20013001814157839−001	9.02207068013530489+002	15
37	3.11179880500457739−002	−2.15271955948094343−001	1.36664807727192138−002	3.44469318571715714−001	9.75135246403698975+002	16
38	3.58864296381348941−002	−6.10406136076367899−002	−1.06334322386637093−003	3.82487459662651106−001	1.05014777573624252+003	15
39	3.51046616014512460−002	5.96661836410043407−002	−1.56163577542809364−002	3.62613770807452165−001	1.12723583507923487+003	15
40	3.06438744177995690−002	1.31017634772555658−001	−2.85211235311611966−002	3.23863487507282222−001	1.20639176023893749+003	14
41	2.44933331102157968−002	1.56570544173312651−001	−3.98408810733907935−002	3.03074053759190860−001	1.28760886028288803+003	15
42	1.82045642091990744−002	1.49646671509031460−001	−5.09215448431671089−002	3.31837797515745292−001	1.37088126836155015+003	14
43	1.27116757150165671−002	1.25217207550636586−001	−6.42106428572014558−002	4.42185980684057745−001	1.45620381942946533+003	14
44	8.40052007409815983−003	9.52410471426799352−002	−8.34453554590242324−002	6.80169692147891741−001	1.54357194927541212+003	13
45	5.28315332496812440−003	6.71799318350980592−002	−1.14505010760738027−001	1.12977288391397708+000	1.63298161058681534+003	13
46	3.17574148680118177−003	4.44894731405032197−002	−1.67404496104342422−001	1.95653971791579758+000	1.72442920274414864+003	13
47	1.83096425463358807−003	2.78929141647047794−002	−2.60428093097677659−001	3.49384414400864076+000	1.81791151276594635+003	13
48	1.01543432785644050−003	1.66557606679740026−002	−4.28604330301494786−001	6.42333123875839616+000	1.91342566537266947+003	12
49	5.43022894535825420−004	9.51601432783213936−003	−7.41395797283052234−001	1.21653602872482133+001	2.01096908055574098+003	13
50	2.80597571461220626−004	5.22073525431744045−003	−1.34051239238477245+000	2.37448308811968388+001	2.11053943736030738+003	12
51	1.40357193717598394−004	2.75845280235726949−003	−2.52267301544968413+000	4.77533609739928638+001	2.21213464284087018+003	13

OBLATE RADIAL FUNCTIONS

H = 35.0 X = 1.20000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	−1.48247859422388909−003	−6.26124585510338930−001	1.85607546654579289−002	−5.95334409624774726−002	−1.01806827407736223+003	24
3	1.85607546654579289−002	−5.95334409624774726−002	1.48247859422388909−003	6.26124585510338930−001	−1.01806827407736223+003	24
4	1.85978098373115227−002	9.09107061529990304−002	−3.05269824818022062−003	6.14700280308642009−001	−8.86433410489711463+002	23
5	−3.05269824818022062−003	6.14700280308642009−001	−1.85978098373115227−002	−9.09107061529990304−002	−8.86433410489711463+002	23
6	−8.12544368049932540−003	5.59653228350428266−001	−1.72627551634820547−002	−2.52102567763371852−001	−7.59324741722267464+002	23
7	−1.72627551634820548−002	−2.52102567763371845−001	8.12544368049932518−003	−5.59653228350428269−001	−7.59324741722267463+002	23
8	−1.40602239846860845−002	−4.07913671146180700−001	1.32469449233771299−002	−4.48498682897124841−001	−6.37027656521040913+002	23
9	1.32469449233769811−002	−4.48498682897129153−001	1.40602239846862276−002	4.07913671146175862−001	−6.37027656521039876+002	22
10	1.75568640067965580−002	−2.73881746474632042−001	8.62356693627755681−003	5.32427903785609631−001	−5.19895762714263522+002	22
11	8.62356693636441449−003	5.32427903784232997−001	−1.75568640067550236−002	2.73881746477240561−001	−5.19895762713789927+002	22
12	9.78255614610633114−004	5.89910781945934273−001	−1.97822092138278839−002	4.07494390971561774−002	−4.08382770826656287+002	21
13	−1.97822092128127472−002	4.07494398838713790−002	−9.78255641002386769−004	−5.89910781882937382−001	−4.08382770699403414+002	21
14	−1.83611914495328242−002	−2.23739109258981084−001	8.06284349642332526−003	−5.39487237458330173−001	−3.03099932316189017+002	22
15	8.06283948145271972−003	−5.39487285327215904−001	1.83611932676179989−002	2.23738990013439114−001	−3.03099911510684225+002	21
16	1.64354632386396591−002	−3.48708847116398684−001	1.19122852868658731−002	4.59718262571894272−001	−2.04934494439546174+002	20
17	1.19126513933667871−002	4.59710431824374746−001	−1.64352044720387550−002	3.48718920028718007−001	−2.04932419854586278+002	21
18	2.66394508900600540−004	5.69995741112967494−001	−2.05337509175298498−002	2.04632651487227700−002	−1.15402824368908533+002	20
19	−2.05337176889251807−002	2.12037237013318771−002	−2.93052804657618436−004	−5.69959529011574852−001	−1.15281782660834263+002	20
20	−1.53473362605718211−002	−3.69769764966556059−001	1.39627959150454465−002	−4.26561456568362120−001	−3.92177248198125719+001	20
21	1.33858342515612005−002	−4.39891784694273979−001	1.58660883799435347−002	3.53376550991893874−001	−3.57545315190426002+001	20
22	2.06264242197388118−002	7.72459904584725547−002	−3.39452461935968546−003	5.54986571362350622−001	1.39421067166020134+001	19
23	2.01724928911634186−003	5.54306417355480755−001	−2.08784315325439054−002	6.76928188632577713−002	3.78427624814586937+001	20
24	−1.82151677870052187−002	2.92446299369683933−001	−1.06453590379773995−002	−4.71936691329898411−001	7.75819348001275458+001	19
25	−1.75738236329284610−002	−2.97250151488754011−001	1.19059564589921147−002	−4.64927535586110932−001	1.18448708567825046+002	19
26	2.17461455765159357−003	−5.46524836166577039−001	2.12633442099694858−002	4.07686789906039613−002	1.63447906582629480+002	18
27	1.96090122748532240−002	−2.38917699708481199−001	8.90617248032022617−003	4.88640605504589777−001	2.11403574932213464+002	18
28	1.81358998669857094−002	2.83277468359774808−001	−1.19443032552863841−002	4.59092184403485743−001	2.62190262318690378+002	19
29	2.62229655568356649−004	5.34145686544634953−001	−2.19108880288531217−002	2.28637167254446928−002	3.15623221354916617+002	19
30	−1.77769520423757825−002	3.28835680929288266−001	−1.31771895311731808−002	−4.14945810943013438−001	3.71585738675545032+002	17
31	−2.15194299882181651−002	−1.25516282433533089−001	6.09193800742036011−003	−5.08608474667855613−001	4.29988647975368956+002	19
32	−9.06373905447937745−003	−4.66763522297043890−001	2.07307175924705927−002	−2.24328954982941412−001	4.90763395878593413+002	17
33	9.74935056251388410−003	−4.70767929008656518−001	2.07348236268002914−002	1.99840172316605190−001	5.53855767923505703+002	17
34	2.21160524147077277−002	−1.73745326181541497−001	7.10655385814269664−003	4.73632055079619606−001	6.19222082617918303+002	17
35	2.09418142502417182−002	2.08979429970261080−001	−1.08421164213937865−002	4.50955320836790211−001	6.86826592589418579+002	18
36	7.92150090866641601−003	4.53313588429103376−001	−2.26285343287546656−002	1.83270795877719210−001	7.56639664925755623+002	16
37	−9.20527219886943105−003	4.53592792085430374−001	−2.26144402396603360−002	−1.57719918804570702−001	8.28636466848116313+002	17
38	−2.19264182939760674−002	2.46967595205559526−001	−1.18319339868868966−002	−4.00772140362666538−001	9.02795993090560426+002	15
39	−2.51606138777971316−002	−4.37945381128703412−002	4.04889790570079927−003	−4.58346617292457093−001	9.79100331183253855+002	15
40	−1.86262678477348868−002	−2.90934915274032127−001	1.83409621919617525−002	−3.42182107777901357−001	1.05753409662786782+003	15
41	−5.68161134388427249−003	−4.17597377387522465−001	2.63000441906809985−002	−1.27916598011279031−001	1.13808399205225158+003	15
42	8.96200909985939924−003	−4.12115124656093150−001	2.63315903557820543−002	9.57324660252188349−002	1.22073845855298427+003	15
43	2.12809271255190532−002	−3.10408766045577052−001	1.95698219174109972−002	2.64789102804824926−001	1.30548739672056516+003	15
44	2.90143035896166477−002	−1.66612149845395214−001	8.60564852835734889−003	3.54163119568729278−001	1.39232194110373400+003	15
45	3.17457532436807002−002	−2.85288204130283720−002	−3.83226214546500356−003	3.72299617568926285−001	1.48123427618606388+003	14
46	3.03636247171244312−002	7.47643563495173996−002	−1.57652240052349859−002	3.46827005872588038−001	1.57221748498264471+003	13
47	2.63418376606357325−002	1.33948078111034613−001	−2.63194760100614682−002	3.10690497395635801−001	1.66526542353579248+003	13
48	2.11497859126137452−002	1.53853181123798404−001	−3.56956649304138342−002	2.93984548938318954−001	1.76037261616665395+003	13
49	1.59147915066611264−002	1.46123511127558786−001	−4.49891264614400807−002	3.22695572246739616−001	1.85753416750281818+003	13
50	1.13206502636368865−002	1.23293860856151246−001	−5.60814267823014439−002	4.23571626324804413−001	1.95674568817071985+003	12
51	7.66024317260844572−003	9.54050395450031164−002	−7.17824950412380764−002	6.34599971038314330−001	2.05800323169799590+003	12

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 40.0 X = 1.20000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	3.23865739183862423−003	−6.19304155979785266−001	1.59297968553155931−002	1.17490736714691539−001	−1.36305927072589725+003	23
3	1.59297968553155931−002	1.17490736714691539−001	−3.23865739183862423−003	6.19304155979785266−001	−1.36305927072589725+003	26
4	1.48999554364797438−002	2.54952283082677377−001	−6.91924945497812166−003	5.69251581304254589−001	−1.21137424430981044+003	23
5	−6.91924945497812166−003	5.69251581304254589−001	−1.48999554364797438−002	−2.54952283082677377−001	−1.21137424430981044+003	23
6	−1.06783026702106156−002	4.78197263059925100−001	−1.27157555885304520−002	−3.90067808322190841−001	−1.06413650947451040+003	22
7	−1.27157555885304520−002	−3.90067808322190841−001	1.06783026702106156−002	−4.78197263059925100−001	−1.06413650947451040+003	23
8	−9.14682355362193220−003	−5.06851057783776369−001	1.40738956598838101−002	−3.40285643288829192−001	−9.21577771344244604+002	24
9	1.40738956598838101−002	−3.40285643288829193−001	9.14682355362193223−003	5.06851057783776368−001	−9.21577771344244604+002	22
10	1.64616299153452706−002	−1.55689612905661747−001	4.11790812873868750−003	5.83465074005000481−001	−7.83974360303797126+002	22
11	4.11790812873870796−003	5.83465074005000281−001	−1.64616299153452657−002	1.55689612905662469−001	−7.83974360303796989+002	22
12	−2.13893743789375985−003	5.93797658934958425−001	−1.70216183511484301−002	−6.47538860624108043−002	−6.51663421527715605+002	22
13	−1.70216183511495693−002	−6.47538860621158110−002	2.13893743788532752−003	−5.93797658934987832−001	−6.51663421527661150+002	21
14	−1.48880940368556984−002	−2.94334650117016147−001	8.89723653561819930−003	−5.12297720429737780−001	−5.25068638051493288+002	21
15	8.89723653375226240−003	−5.12297720466246219−001	1.48880940379953024−002	2.94334650052035552−001	−5.25068638037752172+002	21
16	1.47704351561142183−002	−3.23729762526647608−001	9.44726256318711255−003	4.86616778535568665−001	−4.04744152201091400+002	20
17	9.44726287273574127−003	4.86616771687848554−001	−1.47704349624491323−002	3.23729772600928595−001	−4.04744149947013533+002	21
18	8.57669491512971928−004	5.76963407757858226−001	−1.77005339436293230−002	3.88742475092955167−002	−2.91457619080057121+002	21
19	−1.77005324318944790−002	3.88755405108207098−002	−8.57709172669104954−004	−5.76963307231014019−001	−2.91457378199954325+002	20
20	−1.53411376022012691−002	−2.85388799585985160−001	9.23256609466173648−003	−4.96119054652009037−001	−1.86380622956493572+002	20
21	9.23022951419957086−003	−4.96162023921912447−001	1.53425778381494122−002	2.85312208427456647−001	−1.86364251580315460+002	19
22	1.70107361331587444−002	−2.02891264676680416−001	6.12155733786853760−003	5.29306377971625036−001	−9.19128960405979765+001	19
23	6.22658683676267506−003	5.28010138356657820−001	−1.69738835688037942−002	2.06135248954095833−001	−9.12593849007389399+001	20
24	−9.07904805133394849−003	4.93503888094619517−001	−1.57988679471239341−002	−2.69752827179420506−001	−1.73844779372964364+001	19
25	−1.66637893120982168−002	−2.17567516637593429−001	7.42469495895711431−003	−5.17921166289973535−001	−6.56815315497912029+000	19
26	−5.03318947705868625−004	−5.58210276864873263−001	1.83300223838956128−002	−2.76062913067360290−002	4.05019585185363204+001	18
27	1.71246822398305267−002	−2.15988229497326081−001	6.76292854724329346−003	5.13013237452936341−001	7.71462663006720323+001	18
28	1.34739590584959155−002	3.70292068963116005−001	−1.26883852347089121−002	4.11719613730376588−001	1.23184337474188895+002	19
29	−5.28714909276364923−003	5.31479503046982457−001	−1.78459534196746057−002	−1.43960983717625411−001	1.72001827698425130+002	18
30	−1.82988432722019570−002	1.29417586055131696−001	−3.98774884258337569−003	−5.31717588134310371−001	2.24313669728313076+002	18
31	−1.28204473152964258−002	−3.89239038601973039−001	1.38249041962032599−002	−3.79449258018127427−001	2.79591652607638695+002	18
32	4.89344626522885082−003	−5.24863344450127935−001	1.83504892666006597−002	1.25556190316382486−001	3.37668901293314178+002	17
33	1.81069119997668391−002	−1.87093200454320552−001	6.20544152731376721−003	5.01736890524677428−001	3.98397520692535385+002	17
34	1.56852420621203765−002	2.97355693729177745−001	−1.12496309088412492−002	4.39952396585182670−001	4.61671354434069849+002	18
35	4.59149002867737668−004	5.25525908211909554−001	−1.94722919121271810−002	2.76767393086666191−002	5.27407900597712077+002	18
36	−1.50875253976508076−002	3.46350592614686485−001	−1.26174897354457000−002	−3.89449325671247033−001	5.95541866590887259+002	17
37	−1.95740777181618846−002	−7.31544568351958029−002	3.44644801591383982−003	−5.10561915132102513−001	6.66020480324958888+002	16
38	−1.05576574111479882−002	−4.24713894653967822−001	1.71049518624542288−002	−2.82372386209918325−001	7.38800405010956611+002	17
39	5.29092853721417075−003	−4.90916701387749999−001	1.96474834615361901−002	1.13519557788771334−001	8.13845577573775151+002	16
40	1.78974562853307524−002	−2.63193922673355668−001	1.02358878671170656−002	4.21952597014741243−001	8.91125652373745731+002	16
41	2.03136143419750208−002	9.71565891415422565−002	−4.98081682096731102−003	4.80563542338627197−001	9.70614851194045134+002	15
42	1.19812846285703996−002	3.86223770262673061−001	−1.75434975024393900−002	2.89633874658429880−001	1.05229109509473048+003	16
43	−2.21093550176516518−003	4.73970806330597409−001	−2.14969713561077063−002	−2.57650175587021672−002	1.13613533698067874+003	16
44	−1.53904476417546567−002	3.50008421562284775−001	−1.57484203159475247−002	−3.07581820402487435−001	1.22213104034853483+003	14
45	−2.22065891096175273−002	9.75924858006345427−002	−3.50770494850921309−003	−4.45974658470844190−001	1.31026376658501212+003	14
46	−2.07040407297359450−002	−1.67713484810474018−001	1.00346594485179000−002	−4.13588537915142821−001	1.40052084425562288+003	14
47	−1.22414058635888504−002	−3.54069002789063098−001	2.01913478961480885−002	−2.52975128779875620−001	1.49289110125587682+003	14
48	−1.33693867245250724−004	−4.21143168375199863−001	2.43163179995238200−002	−3.92720617184457926−002	1.58736464580404355+003	14
49	1.19997444661561231−002	−3.78267644614977195−001	2.21021110872243785−002	1.57119023882494751−001	1.68393268583492835+003	13
50	2.14492521386727040−002	−2.64876557731757056−001	1.49617230636126330−002	2.92918927704187508−001	1.78258737890970295+003	12
51	2.69145052670145410−002	−1.27606776870733794−001	5.05122679259922302−003	3.56734436462703865−001	1.88332170661068463+003	12

OBLATE RADIAL FUNCTIONS

H = 0.1 X = 1.40000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	1.96936564740835501−003	1.85897295642156541−003	−6.81694285100527611+002	1.07198332651306541+003	5.99857123417190307+000	21
3	3.94091096298196560−005	6.53669321775521433−005	−2.23201471226365812+004	4.87039380805414764+004	1.19966664421869860+001	21
4	6.57917367262622013−007	1.49753479189230430−006	−1.01549617135878267+006	2.82351192287899523+006	1.99959740046062577+001	21
5	9.13372615885351276−009	2.63057214289527356−008	−5.91497304946067698+007	1.99524489096175647+008	2.99956410515004519+001	21
6	1.08139007520629112−010	3.75838327277680679−010	−4.20003648617713114+009	1.66437970180648371+010	4.19954545802252094+001	21
7	1.11423944015328279−012	4.53126311491528826−012	−3.51863379170738123+011	1.60108569358049425+012	5.59953394001596214+001	20
8	1.01556136459410454−014	4.72769209088894552−014	−3.39737290270956844+013	1.74504972320667355+014	7.19952631879514903+001	21
9	8.29534943881248999−017	4.34851903981084605−016	−3.71460948591659584+015	2.12537565040025521+016	8.99952101102423571+001	20
10	6.13735156286237649−019	3.57673573824835381−018	−4.53653415463828056+017	2.86081052474628729+018	1.09995171647438028+002	21
11	4.14920228492276631−021	2.66074993241305526−020	−6.12069459660525477+019	4.21723137315565031+020	1.31995142876876673+002	20
12	2.58221248272287521−023	1.80675307693858560−022	−9.04128562101705580+021	6.75715623143906977+022	1.55995120790161862+002	20
13	1.48864215284574479−025	1.12849272835605047−024	−1.45127104865844579+024	1.16927332049963045+025	1.81995103463378979+002	20
14	7.99293008509698255−028	6.52549326356492795−027	−2.51530846554560336+026	2.17318995051204077+027	2.09995089619064503+002	20
15	4.01585808740425400−030	3.51274488391491025−029	−4.68152070043280211+028	4.31758182610582656+029	2.39995078381740073+002	20
16	1.89581333910708858−032	1.76880300380292796−031	−9.31277366766443059+030	9.13134293845385062+031	2.71995069134989622+002	20
17	8.43991754475974981−035	8.36625209741096683−034	−1.97181898609285204+033	2.04824857162295730+034	3.05995061434544711+002	20
18	3.55478286430283402−037	3.73082475061053881−036	−4.42752972231703499+035	4.85696228736763994+036	3.41995054953608932+002	18
19	1.42062788152721235−039	1.57371433959089579−038	−1.05086986749974128+038	1.21397687689759431+039	3.79995049447434870+002	20
20	5.40101179589164300−042	6.29750076412898005−041	−2.62884086633194904+040	3.18989424025884726+041	4.19995044729773045+002	20
21	1.95805675370935582−044	2.39705540481744110−043	−6.91303254010364665+042	8.79078797754014707+043	4.61995040656851186+002	20
22	6.78368639527809090−047	8.69945722542911137−046	−1.90647483490616574+045	2.53527160661965301+046	5.05995037116251116+002	21
23	2.25035340063278088−049	3.01684287359306781−048	−5.50192197907186846+047	7.63673370828038401+048	5.51995034019043052+002	19
24	7.16083208488710984−052	1.00165856470252424 4−050	−1.65829836219122133+050	2.39822616168609374+051	5.99995031294130486+002	20
25	2.18939943304489763−054	3.18993292056694272−053	−5.21063926492913578+052	7.83876792711111294+053	6.49995028884122796+002	20
26	6.44170720319083568−057	9.76029976631612701−056	−1.70403021530502471+055	2.66263857243472497+056	7.01995026742281287+002	19
27	1.82645099634140491−059	2.87364907941078807−058	−5.79101677314757342+057	9.38565217414216305+058	7.55995024830230942+002	20
28	4.99710919171362672−062	8.15291282412351455−061	−2.04223728433107586+060	3.42870259206448494+061	8.11995023116226001+002	20
29	1.32089033031890483−064	2.23190423069621659−063	−7.46376659015411503+062	1.29650215170816883+064	8.69995021573821253+002	18
30	3.37714473988355512−067	5.90279198570430367−066	−2.82342642461049953+065	5.06868560006030220+066	9.29995020180844063+002	19
31	8.36052269820811459−070	1.50993517034907544−068	−1.10423910431983876+068	2.04658127255346854+069	9.91995018918591754+002	20
32	2.00611043714642542−072	3.73977500612104193−071	−4.46017341785578667+070	8.52582110935543366+071	1.05599501777119960+003	19
33	4.67007970859625385−075	8.97753703231068687−074	−1.85868243991809282+073	3.66104957837062409+074	1.12199501672513917+003	19
34	1.05566982180071307−077	2.09076447866863436−076	−7.98385773447132832+075	1.61901167172265453+077	1.18999501576881722+003	18
35	2.31915917545762025−080	4.72799036279709212−079	−3.53173386091308814+078	7.36723046276077337+079	1.25999501489225267+003	18
36	4.95536587792155959−083	1.03905094883401046−081	−1.60755648504613730+081	3.44686008937715817+082	1.33199501408681479+003	19
37	1.03059760100564652−085	2.22090927010567389−084	−7.52321271967067691+083	1.65684559104622880+085	1.40599501334500976+003	18
38	2.08775326931788833−088	4.62045523152390613−087	−3.61720892130545842+086	8.17655618156467195+087	1.48199501266030551+003	19
39	4.12228944519540831−091	9.36284366429684466−090	−1.78553531625223505+089	4.13995571818084700+090	1.55999501202698728+003	18
40	7.93862099597890610−094	1.84923902866452060−092	−9.04263813648760600+091	2.14921261870832205+093	1.63999501144003789+003	18
41	1.49198136871246642−096	3.56220699029708187−095	−4.69543243176426016+094	1.14329052028349119+096	1.72199501089503800+003	18
42	2.73807518280615145−099	6.69654862221695618−098	−2.49830358096155379+097	6.22837988083958516+098	1.80599501038808257+003	19
43	4.90943107157798700−102	1.22925222780391756−100	−1.36129428241658965+100	3.47291636069966973+101	1.89199500991571068+003	19
44	8.60498426357393358−105	2.20459932520194012−103	−7.59199230127196345+102	1.98100102885967656+104	1.97999500947484627+003	18
45	1.47509916563599254−107	3.86497482593148636−106	−4.33138783899594687+105	1.15538529352841868+107	2.06999500906274787+003	18
46	2.47431033664343655−110	6.62691554144289900−109	−2.52665993941004008+108	6.88669546055481705+109	2.16199500867696586+003	19
47	4.06302616361792080−113	1.11181839965922906−111	−1.50627850704851749+111	4.19310669098318112+112	2.25599500831530599+003	18
48	6.53431241184347444−116	1.82605934173751667−114	−9.17279730293105050+113	2.60681009803390371+115	2.35199500797579802+003	19
49	1.02964966539157497−118	2.93729186017271399−117	−5.70353321988928851+116	1.65404240444263054+118	2.44999500765666890+003	19
50	1.59036019150582535−121	4.62929882125019040−120	−3.61948924530574397+119	1.07070628263394818+121	2.54999500735631947+003	20
51	2.40872993096136228−124	7.15149023150444487−123	−2.34333615850727621+122	7.06822210254709808+123	2.65199500707330447+003	19

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 0.2 X = 1.40000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	7.83000100716658062−003	7.34400533570986211−003	−8.64400591462224872+001	1.34658084032839480+002	5.99428260216102775+000	21
3	3.13894869370482754−004	5.19183000061601600−004	−1.40598159013965274+003	3.05588763241921447+003	1.19866630743779954+001	22
4	1.04904921025044233−005	2.38374666249284305−005	−3.19067329375461425+004	8.85195373683411821+004	1.99838957634995984+001	21
5	2.91443447657035310−007	8.38416075082869857−007	−9.28058331626270313+005	3.12613020695283389+006	2.99825645168181086+001	21
6	6.90390362044476210−009	2.39748583214830027−008	−3.29233995263059744+007	1.30340079983105634+008	4.19818187383378792+001	22
7	1.42315378908304276−010	5.78392906256064534−010	−1. -373670285454+009	6.26744199033017970+009	5.59813580044443829+001	21
8	2.59484342576384042−012	1.20737830104345101−011	−6. 536286851653+010	3.41474590046709210+011	7.19810531125249704+001	21
9	4.23985581916332379−014	2.22171517849275535−013	−3.- -039067629946+012	2.07911705223376020+013	8.99808407554937990+001	21
10	6.27471717700457880−016	3.65561859856274020−015	−2. -374363417765+014	1.39906616761295291+015	1.09980686862451590+002	21
11	8.48522827676917605−018	5.43984662475418137−017	−1. - - 562613212207+016	1.03108067203735422+017	1.31980571744318647+002	21
12	1.05625363020303163−019	7.38884108158696838−019	−1.10542060841088604+018	8.25948847755035752+018	1.55980483367231199+002	21
13	1.21797175319008460−021	9.23125697425984190−021	−8.87074970743685387+019	7.14554738952524989+020	1.81980414034755664+002	21
14	1.30803165018071425−023	1.06770653649251298−022	−7.68645008828855874+021	6.63976203404775761+022	2.09980358636216366+002	21
15	1.31447275520562520−025	1.14962246201554139−024	−7.15238463724583783+023	6.59530585294104159+024	2.39980313668970715+002	21
16	1.24115555677618911−027	1.15785188204643368−026	−7.11340629445689605+025	6.97384061074211381+026	2.71980276666747091+002	20
17	1.10515517385622667−029	1.09538090311606245−028	−7.53016665368610159+027	7.82106562647030844+028	3.05980245851978774+002	20
18	9.31000737362658420−032	9.77003776738555751−031	−8.45359780811423966+029	9.27248987019089385+030	3.41980219917083926+002	20
19	7.44161192083372106−034	8.24273872091462624−033	−1.00317009832803997+032	1.15875739967014343+033	3.79980197882755149+002	20
20	5.65860915188173518−036	6.59729058717727616−035	−1.25469453307789556+034	1.52233653673883267+035	4.19980179003739211+002	21
21	4.10304363090984778−038	5.02255947700301122−037	−1.64965273757405896+036	2.09756797032082084+037	4.61980162704741063+002	20
22	2.84309594455284387−040	3.64575078901936224−039	−2.27461071993735985+038	3.02460002499874518+039	5.05980148535920975+002	20
23	1.88634076734817852−042	2.52867919574627364−041	−3.28204180186876578+040	4.55520085059514986+041	5.51980136141423603+002	20
24	1.20053688778853161−044	1.67921239246270791−043	−4.94592384736852800+042	7.15232939741732999+043	5.99980125236751170+002	20
25	7.34139614416438303−047	1.06957456598700807−045	−7.77019751666332202+044	1.16886299102581844+046	6.49980115592248967+002	19
26	4.32011619944082115−049	6.54538555687150759−048	−1.27050307136716832+047	1.98512240011376930+048	7.01980107020885664+002	19
27	2.44986696470087242−051	3.85431693176020839−050	−2.15879590178206429+049	3.49864234219153776+050	7.55980099369097288+002	20
28	1.34057977565777214−053	2.18709303281863514−052	−3.80646770002323489+051	6.39036412534158734+052	8.11980092509847162+002	20
29	7.08727552782332440−056	1.19748484571065656−054	−6.95558954217183715+053	1.20817637024863928+055	8.69980086337309181+002	20
30	3.62410194891429444−058	6.33419286494459370−057	−1.31556709844408460+056	2.36164332135732513+057	9.29980080762754417+002	20
31	1.79441063078171700−060	3.24064027910367453−059	−2.57253267693801599+058	4.76771522244557408+059	9.91980075711339461+002	20
32	8.61153265272827496−063	1.60529985422822445−061	−5.19530834929429989+060	9.93071094422396912+061	1.05598007111957740+003	21
33	4.00946753388107561−065	7.70735850936262915−064	−1.08249797330272846+063	2.13212648655976607+064	1.12198006693333047+003	20
34	1.81270412831552157−067	3.58996880387578856−066	−2.32486349597300736+065	4.71434048976343170+066	1.18998006310620487+003	21
35	7.96462681657908848−070	1.62367435943526965−068	−5.14204450554820749+067	1.07260343389541755+069	1.25998005959825826+003	20
36	3.40366127484851385−072	7.13666972371668894−071	−1.17024739117366920+070	2.50912828169848491+071	1.33198005637495213+003	20
37	1.41577803236546481−074	3.05088351603056323−073	−2.73828540995998103+072	6.03039592173449912+073	1.40598005340629747+003	20
38	5.73614833566361159−077	1.26944914460045033−075	−6.58283878867531880+074	1.48798676796734172+076	1.48198005066615398+003	20
39	2.26524190492296151−079	5.14486218211174523−078	−1.62469792414072833+077	3.76694646434019660+078	1.55998004813165212+003	20
40	8.72480722385351172−082	2.03232978621652535−080	−4.11399883282342709+079	9.77773984525581071+080	1.63998004578271391+003	19
41	3.27950742136209606−084	7.82988143840342898−083	−1.06809453987017763+082	2.60064612878967262+083	1.72198004360165372+003	20
42	1.20371820515149432−086	2.94389100923821732−085	−2.84148020418748673+084	7.08378740918255218+085	1.80598004157284413+003	20
43	4.31662853811980720−089	1.08080202885195766−087	−7.74135511525197621+086	1.97492545443285146+088	1.89198003968243500+003	19
44	1.51320394020288035−091	3.87676128001680842−090	−2.15867111039450218+089	5.63257806061544953+090	1.97998003791811628+003	20
45	5.18802793417270811−094	1.35931500071330160−092	−6.15777385625001538+091	1.64253886567592496+093	2.06998003626891693+003	20
46	1.74047907762216836−096	4.66142550830521326−095	−1.79601342334509966+094	4.89515169506795861+095	2.16198003472503389+003	20
47	5.71607158354809881−099	1.56413731035702779−097	−5.35345740118399014+096	1.49024540836934440+098	2.25598003327768593+003	18
48	1.83857435990437882−101	5.13794504916599164−100	−1.63003644185725064+099	4.63231426001950203+100	2.35198003191898844+003	20
49	5.79433929692625898−104	1.65293232641121186−102	−5.06764383980608729+101	1.46961010289041414+103	2.44998003064184575+003	19
50	1.78995844688868570−106	5.21022468667334274−105	−1.60796329094959539+104	4.75655838431386345+105	2.54998002943985828+003	19
51	5.42211169942007328−109	1.60979629147538396−107	−5.20511456879087986+106	1.57000044157303627+108	2.65198002830724213+003	20

OBLATE RADIAL FUNCTIONS

H = 0.3 X = 1.40000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	1.74406467578215308−002	1.61827057880587297−002	−2.62490700540501422+001	4.02132534400859084+001	5.98712708737664133+000	22
3	1.05168158525089629−003	1.73127622598424780−003	−2.81402119864106463+002	6.07542563285824563+002	1.19699818088618035+001	22
4	5.28039912507677950−005	1.19643973677972976−004	−4.23995193649484080+003	1.17195956892987441+004	1.99637645230817575+001	23
5	2.20260561264432584−006	6.32428901670755898−006	−8.20420827568093968+004	2.75704501865121150+005	2.99607713321740383+001	21
6	7.83181058131811511−008	2.71598139964487221−007	−1.93777927383018224+006	7.65887879263751348+006	4.19590937280665220+001	21
7	2.42286405288069581−009	9.83671621770752545−009	−5.40361962751144966+007	2.45406834599959474+008	5.59580570248754014+001	21
8	6.62901864765021329−011	3.08197924440897976−010	−1.73733694713078443+009	8.91055699738167653+009	7.19573708561621501+001	22
9	1.62523520731807202−012	8.51081061967215071−012	−6.32692380884193909+010	3.61580662330330603+011	8.99568928794732675+001	21
10	3.60879215239772301−014	2.10134098753551875−013	−2.57404121619009610+012	1.62168468089437801+013	1.09956546463218970+002	21
11	7.32176022853172307−016	4.69185545204879929−015	−1.15705959561889235+014	7.96598728606687755+014	1.31956287312807962+002	21
12	1.36738353352729082−017	9.56167197548229786−017	−5.69491109376884059+015	4.25335974716848324+016	1.55956088350987227+002	21
13	2.36547528117582336−019	1.79225826133815008−018	−3.04604120049268441+017	2.45277082431309367+018	1.81955932257866896+002	20
14	3.81109369596325840−021	3.11000021754564976−020	−1.75926486224260786+019	1.51923505924272936+020	2.09955807531342102+002	21
15	5.74547446031039627−023	5.02367855155679544−022	−1.09118212089290511+021	1.00592441661938646+022	2.39955706287730863+002	21
16	8.13837103367452315−025	7.59047709220616769−024	−7.23392155511567197+022	7.09032514282371375+023	2.71955622975643487+002	22
17	1.08709250087287577−026	1.07726772171158090−025	−5.10455373993111640+024	5.30064394599772715+025	3.05955553593705667+002	21
18	1.37379211577779809−028	1.44142249252929559−027	−3.81995062373717139+026	4.18920624580585375+027	3.41955495198372220+002	23
19	1.64726010248307190−030	1.82430840514325446−029	−3.02175122924708089+028	3.48982840465106608+029	3.79955445585009771+002	21
20	1.87899638225140510−032	2.19038203172476392−031	−2.51938366024194475+030	3.05633827456617154+031	4.19955403075841025+002	21
21	2.04381131023406776−034	2.50151628402223935−033	−2.20812980331259789+032	2.80729858588700884+033	4.61955366375679668+002	21
22	2.12442924464734486−036	2.72386871436106960−035	−2.02963526374135928+034	2.69851362630052630+035	5.05955334471759936+002	21
23	2.11438934237558297−038	2.83407433407798056−037	−1.95225502408710136+036	2.70925760412940379+037	5.51955306562896473+002	21
24	2.01861073204714612−040	2.82318370509355406−039	−1.96120827673596728+038	2.83581669294493397+039	5.99955282008550218+002	21
25	1.85168196140069593−042	2.69748203964360901−041	−2.05397069795865742+040	3.08946801492634815+041	6.49955260291652243+002	21
26	1.63452819048021877−044	2.47625253174013580−043	−2.23885309250654499+042	3.49782625717086896+043	7.01955240991094979+002	21
27	1.39042469274022301−046	2.18734730256229193−045	−2.53600877066291091+044	4.10962876832698486+045	7.55955223761119846+002	21
28	1.14131225251767120−048	1.86185902452943694−047	−2.98093168861683792+046	5.00405273202462227+047	8.11955208315693158+002	21
29	9.05100811457348668−051	1.52917615760080309−049	−3.63124707176560368+048	6.30697127270067471+049	8.69955194416536449+002	21
30	6.94261268470285485−053	1.21334861180136007−051	−4.57855015972778384+050	8.21864050325727232+051	9.29955181863865691+002	21
31	5.15642158189176559−055	9.31174217878331918−054	−5.96856626511592124+052	1.10609385732081207+054	9.91955170489160556+002	21
32	3.71202013886711756−057	6.91928409163867470−056	−8.03554847172678928+054	1.53588525309029571+056	1.05595516014947050+003	20
33	2.59250236127152811−059	4.98327205249645784−058	−1.11616193728362013+057	2.19830953995362248+058	1.12195515072289528+003	20
34	1.75817188952952151−061	3.48179332767054567−060	−1.59806434702144500+059	3.24037229496277070+060	1.18995514210497094+003	20
35	1.15878056310820331−063	2.36218456377017589−062	−2.35629696289474192+061	4.91486751605182910+062	1.25995513420575964+003	20
36	7.42818866996797617−066	1.55744398599909063−064	−3.57494943428320815+063	7.66469191554685259+064	1.33195512694749098+003	21
37	4.63481161296939412−068	9.98720170561922964−067	−5.57660073891889449+065	1.22805371510792902+067	1.40595512026263839+003	20
38	2.81680741650510531−070	6.23353382831279240−069	−8.93723583138798736+067	2.02009020540873238+069	1.48195511409234127+003	20
39	1.66859450241999055−072	3.78959746272390320−071	−1.47049069932196201+070	3.40927255237941191+071	1.55995510838510360+003	21
40	9.64031235704374316−075	2.24550166116150300−073	−2.48229812559448936+072	5.89945272114064563+073	1.63995510309571512+003	20
41	5.43553831704124720−077	1.29769855899858726−075	−4.29635357990935188+074	1.04605819700292375+076	1.72195509818435236+003	20
42	2.99265813805579844−079	7.31879204752596071−078	−7.61966532804129457+076	1.89951086901843774+078	1.80595509361582630+003	21
43	1.60981131342165589−081	4.03053325721911501−080	−1.38391545973527199+079	3.53044106985346746+080	1.89195508935894983+003	21
44	8.46497113345498875−084	2.16862147085217660−082	−2.57264997298334005+081	6.71255365586006227+082	1.97995508538600365+003	20
45	4.35339191135794937−086	1.14059856758112165−084	−4.89237713684470720+083	1.30496473154365811+085	2.06995508167228361+003	21
46	2.19074308126432187−088	5.86717688592414066−087	−9.51279284271788771+085	2.59269901664843154+087	2.16195507819571545+003	20
47	1.07923802348267981−090	2.95313126825143866−089	−1.89032013259553978+088	5.26195116102606922+089	2.25595507493652581+003	20
48	5.20711879617410989−093	1.45510560679681211−091	−3.83708244694879663+090	1.09041128140503145+092	2.35195507187696031+003	21
49	2.46159556393633668−095	7.02193929394466986−094	−7.95266988511452969+092	2.30620530383863904+094	2.44995506900104106+003	20
50	1.14064897762444627−097	3.32013053189460028−096	−1.68223352718307943+095	4.97613768760399597+096	2.54995506629435757+003	20
51	5.18290946978065331−100	1.53874311128400881−098	−3.63031197147009847+097	1.09497257408008647+099	2.65195506374388570+003	20

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 0.4 X = 1.40000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	3.05695946209307579−002	2.79318764882697232−002	−1.14753595771228138+001	1.71433829832042679+001	5.97709295201319849+000	22
3	2.46746379458606316−003	4.03488655018648694−003	−9.07119520009737596+001	1.93957115226888015+002	1.19466091507941440+001	22
4	1.65548909214787797−004	3.73597903282854596−004	−1.01906279580218172+003	2.80204123947136035+003	1.99355790647381016+001	22
5	9.21986980372379812−006	2.64017560569116551−005	−1.47443982778338761+004	4.93842752392641389+004	2.99302630704997057+001	22
6	4.37523074568048462−007	1.51435544550855512−006	−2.60706720015877044+005	1.02804167277792411+006	4.19272816436791530+001	22
7	1.80597993633020534−008	7.32154298088720035−008	−5.44564508406396845+006	2.46896070221210825+007	5.59254384834979519+001	22
8	6.59188458699464534−010	3.06123581566914526−009	−1.31194597136549353+008	6.72003566160532452+008	7.19242182238810373+001	23
9	2.15578582217251173−011	1.12788323893419571−010	−3.58086007495922642+009	2.04433754091092386+010	8.99233680555316056+001	21
10	6.38478059068955911−013	3.71497059908620620−012	−1.09203740174033431+011	6.87425204834500327+011	1.09922751813636743+002	21
11	1.72770121605262883−014	1.10643496720146565−013	−3.68002307761579868+012	2.53182650571811950+013	1.31922290766635277+002	22
12	4.30321204639588406−016	3.00749967081279732−015	−1.35796301199510059+014	1.01363181441360129+015	1.55921936774488503+002	22
13	9.92783461422872830−018	7.51862704382482599−017	−5.44588110240735639+015	4.38302129480280966+016	1.81921659038999403+002	21
14	2.13307931636564282−019	1.73998575565835039−018	−2.35838395514646388+017	2.03573839205215177+018	2.09921437104290732+002	22
15	4.28839115484167707−021	3.74834418364411779−020	−1.09684898376226558+019	1.01077030541649004+020	2.39921256948110966+002	21
16	8.10044207787127731−023	7.55278221139713931−022	−5.45258056804911950+020	5.34258569135540860+021	2.71921108695648153+002	21
17	1.44289086679606459−024	1.42945971621516946−023	−2.88519310223904618+022	2.99515280901987463+023	3.05920985228743512+002	21
18	2.43152003243665518−026	2.55059653774469855−025	−1.61909383034440742+024	1.77514096960175632+025	3.41920881310728035+002	21
19	3.88779925757584542−028	4.30471166155463581−027	−9.60455231250648391+025	1.10897266703745566+027	3.79920793019286720+002	22
20	5.91354763072950039−030	6.89215771771083447−029	−6.00513505696844816+027	7.28346573330384873+028	4.19920717369320786+002	21
21	8.57708510452644912−032	1.04959861405122521−030	−3.94700933002063862+029	5.01705459496733272+030	4.61920652056353970+002	21
22	1.18881616794820205−033	1.52400501653495541−032	−2.72070189520801480+031	3.61669257625717963+032	5.05920595278354645+002	22
23	1.57771316555625226−035	2.11440451261716788−034	−1.96255870594223818+033	2.72312043508290445+034	5.51920545609721790+002	21
24	2.00846287198891444−037	2.80859662490434963−036	−1.47855074566997926+035	2.13760153188987069+036	5.99920501910676208+002	22
25	2.45665142351926794−039	3.57832146882577275−038	−1.16127754988555610+037	1.74649179645466171+038	6.49920463261123456+002	21
26	2.89156850782617697−041	4.38009762179439391−040	−9.49290586812995715+038	1.48291852420198794+040	7.01920428911713336+002	22
27	3.27982518961568755−043	5.15908227135249015−042	−8.06414546328031886+040	1.30665102829044299+042	7.55920398247167440+002	21
28	3.58978357423919440−045	5.85551882825152564−044	−7.10878925858975040+042	1.19321427667942387+044	8.11920370758480771+002	21
29	3.79594460803625602−047	6.41266008443626858−046	−6.49437269728579609+044	1.12786827287952904+046	8.69920346021624705+002	21
30	3.88243038439327532−049	6.78464031266941247−048	−6.14113684381227891+046	1.10224912300646153+048	9.29920323681069369+002	21
31	3.84490670963957058−051	6.94274594562507754−050	−6.00387508194175861+048	1.11253882881020023+050	9.91920303436917797+002	21
32	3.69065365072275505−053	6.87890480597679720−052	−6.06204678430342817+050	1.15858112810137887+052	1.05592028503477437+003	20
33	3.43689866025836621−055	6.60586003211089236−054	−6.31501343534402657+052	1.24366089401844196+054	1.12192026825770286+003	22
34	3.10786826537200473−057	6.15422433207980529−056	−6.78087470636763925+054	1.37484705593313599+056	1.18992025291979561+003	21
35	2.73121163358192038−059	5.56722469530230205−058	−7.49836969356649087+056	1.56393411633615742+058	1.25992023886099506+003	21
36	2.33447487302672676−061	4.89430527180304185−060	−8.53204219181252907+058	1.82914971046409485+060	1.33192022594289644+003	21
37	1.94218141373132350−063	4.18480585395266593−062	−9.98159013321534347+060	2.19796370907548657+062	1.40592021404532481+003	21
38	1.57385837152822323−065	3.48271499032021823−064	−1.19972372248444286+063	2.71158461943605302+064	1.48192020306352724+003	20
39	1.24310980244673643−067	2.82311208555454467−066	−1.48043333780573056+065	3.43213181147088717+066	1.55992019290585695+003	21
40	9.57633710185598858−070	2.23048447140977386−068	−1.87425943241952025+067	4.45414498379993885+068	1.63992018349185340+003	21
41	7.19946135273887689−072	1.71873861270086321−070	−2.43290734894880407+069	5.92324055265834694+070	1.72192017475064266+003	21
42	5.28522154938122110−074	1.29248364129182149−072	−3.23602444970389314+071	8.06671440742620631+072	1.80592016661959848+003	20
43	3.79078595590785448−076	9.49067888895642026−075	−4.40794651644101410+073	1.12443844121015448+075	1.89192015904321664+003	21
44	2.65783216063738633−078	6.80874656603754024−077	−6.14552223277257841+075	1.60341787911625853+077	1.97992015197216448+003	21
45	1.82254067789627083−080	4.77490172762999090−079	−8.76495730288776457+077	2.33781611615269332+079	2.06992014536247530+003	20
46	1.22289154318489537−082	3.27497946766947779−081	−1.27817440818850942+080	3.48350679728587123+081	2.16192013917486281+003	21
47	8.03267909277764816−085	2.19790818618011969−083	−1.90489056251609014+082	5.30230491672957475+083	2.25592013337413560+003	20
48	5.16757787332773293−087	1.44400380877342590−085	−2.89993830811183235+084	8.24065759280415949+085	2.35192012792869543+003	20
49	3.25725910875292347−089	9.29132353924527475−088	−4.50768836764090395+086	1.30714404350584523+088	2.44992012281010570+003	21
50	2.01248846585561258−091	5.85763137471219497−090	−7.15123147985362855+088	2.11530064879852847+090	2.54992011799271929+003	20
51	1.21927176496095798−093	3.61975407207827870−092	−1.15742384551021149+091	3.49090038033985733+092	2.65192011345335643+003	21

OBLATE RADIAL FUNCTIONS

H = 0.5 X = 1.40000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	4.69001777020530515−002	4.19933271716611829−002	−6.15946969511494892+000	8.89163047982495157+000	5.96416367140576943+000	22
3	4.75607426418665007−003	7.70998630732006917−003	−3.80716616457688685+001	8.03485531265619420+001	1.19165261752530774+001	23
4	4.00005699825431454−004	8.98012846448762134−004	−3.39476692219362569+002	9.27039902567857311+002	1.98993377613406211+001	22
5	2.78955655231781018−005	7.96040396861354647−005	−3.91393997880464096+003	1.30526209254020630+004	2.98910419602430505+001	22
6	1.65673243188502072−006	5.72002671985182293−006	−5.52315423062243322+004	2.17144163403697526+005	4.18863854270495889+001	22
7	8.55596510362517132−008	3.46213943023010443−007	−9.21446695278026856+005	4.16853011551942003+006	5.58835052153919181+001	22
8	3.90644626859230561−009	1.81147932870383888−008	−1.77385615945748275+007	9.07078389966550159+007	7.18815977446971031+001	22
9	1.59783850376223894−010	8.34989671581896175−010	−3.86985798204406412+008	2.20639651814636666+009	8.98802684873799165+001	21
10	5.91812365848376343−012	3.44012804183419321−011	−9.43482107415435132+009	5.93272074846715652+010	1.09879304823718740+002	22
11	2.00255470411764563−013	1.28142043756422571−012	−2.54210771389817559+011	1.74739195412880469+012	1.31878583764130687+002	21
12	6.23678445637693009−015	4.35588790154848718−014	−7.50104301004644735+012	5.59484864599311934+013	1.55878030084212708+002	21
13	1.79909767268851207−016	1.36170715696657140−015	−2.40560700176165175+014	1.93487242991487625+015	1.81877595647077788+002	21
14	4.83307341821986421−018	3.94040279975320672−017	−8.33141918265111046+015	7.18764584940374119+016	2.09877248474931037+002	21
15	1.21482550645262704−019	1.06136521523468321−018	−3.09898243676901991+017	2.85440549060625483+018	2.39876966644291330+002	22
16	2.86893413451221715−021	2.67391292496669634−020	−1.23213452153653034+019	1.20676745160314128+020	2.71876734714355031+002	21
17	6.38893822506746313−023	6.32724146439274490−022	−5.21468031949531674+020	5.41138837293092213+021	3.05876541553743558+002	21
18	1.34601162277310792−024	1.41148381472260087−023	−2.34062774311778431+022	2.56535569428539292+023	3.41876378972725810+002	22
19	2.69056863896493561−026	2.97824912386734604−025	−1.11059055440347979+024	1.28193771427296910+025	3.79876240836722682+002	22
20	5.11625370536553675−028	5.96138967918487242−027	−5.55422849650679418+025	6.73474;69127343108+026	4.19876122476727720+002	22
21	9.27689443886644233−030	1.13497037070160606−028	−2.92011330826453869+027	3.71084816742369452+028	4.61876020288133236+002	22
22	1.60743097564459129−031	2.06020841370566589−030	−1.61008446572696841+029	2.13984130317629441+030	5.05875931452132127+002	21
23	2.66683866819508529−033	3.57331717054213699−032	−9.29033389422867813+030	1.28880154443359722+032	5.51875853738668134+002	21
24	4.24404841895164787−035	5.93372534766674454−034	−5.59873693814948835+032	8.09279180920276719+033	5.99875785364740575+002	21
25	6.48940713152116552−037	9.45079551857701802−036	−3.51753719236329874+034	5.28924170388839597+035	6.49875724890972471+002	22
26	9.54854894209582841−039	1.44617394578479472−037	−2.30013817459065384+036	3.59254257140124221+037	7.01875671145068614+002	21
27	1.35392533897129452−040	2.12938445533045384−039	−1.56303269343567035+038	2.53223655507213953+039	7.55875623164458140+002	22
28	1.85246650214673710−042	3.02126871302750961−041	−1.10220623898220647+040	1.84980161727354117+041	8.11875580152814879+002	21
29	2.44871474159968776−044	4.13620702061058915−043	−8.05497576004271221+041	1.39871417834711632+043	8.69875541446745375+002	21
30	3.13080896558445381−046	5.47052381604061828−045	−6.09309098297314666+043	1.09349272370949875+045	9.29875506490014452+002	21
31	3.87589270306258888−048	6.99792940183514754−047	−4.76523415116132124+045	8.82913899228603075+046	9.91875474813419798+002	21
32	4.65072755265005981−050	8.66746543396140813−049	−3.84890565429860089+047	7.35526010997224470+048	1.05587544601894327+003	21
33	5.41395628769493176−052	1.04048353518756125−050	−3.20744459898670298+049	6.31601601449336252+050	1.12187541976717067+003	21
34	6.11983733386534609−054	1.21174383645427910−052	−2.75510966307969484+051	5.58555631021208891+052	1.18987539576723162+003	22
35	6.72296472256373960−056	1.37027155689998357−054	−2.43719100213047022+053	5.08279217401829621+054	1.25987537376869845+003	21
36	7.18326539842856746−058	1.50587247489608916−056	−2.21843349449675398+055	4.75560713760327140+056	1.33187535355501992+003	21
37	7.47048565926475844−060	1.60953583091162457−058	−2.07617957178564854+057	4.57141811165341518+058	1.40587533493816615+003	21
38	7.56746110309944156−062	1.67444348336117782−060	−1.99626946185312712+059	4.51157438249074922+060	1.48187531775423593+003	21
39	7.47168888344118873−064	1.69670761475688936−062	−1.97060875311521923+061	4.56819058299384739+062	1.55987530185983365+003	21
40	7.19503222483238198−066	1.67572826348763488−064	−1.99579403629591196+063	4.74264489081579581+064	1.63987528712906551+003	21
41	6.76171234510115401−068	1.61413168333372601−066	−2.07246315476463213+065	5.04536150311250916+066	1.72187527345103699+003	21
42	6.20501216464882470−070	1.51732359509019621−068	−2.20520509556097600+067	5.49676123550676333+068	1.80587526072775798+003	21
43	5.56327955185746983−072	1.39275204268172984−070	−2.40297978183688257+069	6.12948122648628788+070	1.89187524887238162+003	21
44	4.87585540191460640−074	1.24901153069421782−072	−2.68009271472459303+071	6.99218859402073790+072	1.97987523780771737+003	21
45	4.17947411502253383−076	1.09492884600141626−074	−3.05786724752803280+073	8.15559471452064021+074	2.06987522746497044+003	21
46	3.50552465673575889−078	9.38753755369993981−077	−3.56728062765819432+075	9.72167936270454924+076	2.16187521778266924+003	21
47	2.87836414678292746−080	7.87542133849624045−079	−4.25300628928409688+077	1.18377485775258049+079	2.25587520870574935+003	21
48	2.31468645707490211−082	6.46775063078494001−081	−5.17957422777930934+079	1.47179212910338973+081	2.35187520018476838+003	20
49	1.82379861048932286−084	5.20214853567350904−083	−6.44078696833716511+081	1.86762051883067672+083	2.44987519217523093+003	21
50	1.40856547632949829−086	4.09965231609348956−085	−8.17421487474023595+083	2.41778811112408204+085	2.54987518463700620+003	20
51	1.06675055592967290−088	3.16682080359616485−087	−1.05837163473936180+086	3.19201469078264019+087	2.65187517753382410+003	21

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 0.6 X = 1.40000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	6.60382683461995798−002	5.76352914147855485−002	−3.78035206586641411+000	5.22699002776365913+000	5.94831784129773330+000	23
3	8.08665919571556587−003	1.29684804017434466−002	−1.89270916116588252+001	3.92754830824991392+001	1.18797084952054065+001	22
4	8.18995433972157697−004	1.82686835793204739−003	−1.39227526398708408+002	3.76940685779951186+002	1.98550386572143220+001	22
5	6.86854496733311898−005	1.95168407463375883−004	−1.33110490545679967+003	4.41539569065564846+003	2.98431109116185727+001	22
6	4.90246172707814257−006	1.68745498639834525−005	−1.56068920213670919+004	6.11333248705077464+004	4.18364088775214633+001	24
7	3.04155479509411465−007	1.22792693015330745−006	−2.16546802624009439+005	9.76998385699817662+005	5.58322608728771206+001	22
8	1.66787961068601312−008	7.72035162341343379−008	−3.46892024744524328+006	1.77021303296026254+007	7.18295126736097823+001	22
9	8.19213154078259053−010	4.27484111291637837−009	−6.29966936352428395+007	3.58590686283421746+008	8.98275970101081681+001	22
10	3.64313322283115666−011	2.11520632037428563−010	−1.27880883479898280+009	8.03068655952069009+009	1.09826207950154209+002	22
11	1.48000042107276359−012	9.46107819036987705−012	−2.86937516716121666+010	1.97019697272469986+011	1.31825168437986740+002	21
12	5.53341753628792999−014	3.86141113783179933−013	−7.05162664156197251+011	5.25481340637339569+012	1.55824370140252310+002	22
13	1.91610009828616660−015	1.44922259199542038−014	−1.88367709095309054+013	1.51388919451116015+014	1.81823743713787715+002	21
14	6.17871198886470241−017	5.03435945085033300−016	−5.43432614548241791+014	4.68511158457684154+015	2.09823243083231733+002	22
15	1.86416172419649672−018	1.62778505534892488−017	−1.68389530873031846+016	1.55008601174490558+017	2.39822836654595810+002	22
16	5.28411427293352055−020	4.92253747604757286−019	−5.57754257576525375+017	5.45988267146884726+018	2.71822502173019539+002	21
17	1.41237896003299419−021	1.39813841826090872−020	−1.96660522259028658+019	2.03985219045411281+020	3.05822223593016076+002	21
18	3.57135478779422888−023	3.74362857405312493−022	−7.35427293189758643+020	8.05706565906354355+021	3.41821989108278750+002	21
19	8.56804985222885581−025	9.48086926817242062−024	−2.90730284244579978+022	3.35461961937752204+023	3.79821789874516560+002	22
20	1.95540584031072724−026	2.27769616206943211−025	−1.21142975495499918+024	1.46842239496259128+025	4.19821619159927980+002	21
21	4.25528348109342337−028	5.20458545677419538−027	−5.30664841980825330+025	6.74159577001602906+026	4.61821471767076554+002	21
22	8.84899888624848847−030	1.13385992247578899−028	−2.43793540672162333+027	3.23918379492468581+028	5.05821343631365508+002	23
23	1.76193542007469872−031	2.36026424206194071−030	−1.17209731538963877+029	1.62558242275317928+030	5.51821231537016948+002	22
24	3.36512383504644894−033	4.70383673869386471−032	−5.88554055900311646+030	8.50538815234998782+031	5.99821132912821045+002	21
25	6.17518132533242086−035	8.99134067638751401−034	−3.08108329014644142+032	4.63196710919820191+033	6.49821045683030878+002	21
26	1.09044288323623151−036	1.65121634510766243−035	−1.67876953368315597+034	2.62152101764412100+035	7.01820968157014620+002	22
27	1.85557418022726667−038	2.91783951994661159−037	−9.50563518874329178+035	1.53970607022009341+037	7.55820898946560975+002	21
28	3.04683912294526994−040	4.96841026762804055−039	−5.58540928017277713+037	9.37223802685951020+038	8.11820836903189839+002	21
29	4.83337680749778769−042	8.16297306546028055−041	−3.40124745402865962+039	5.90519135727823516+040	8.69820781070120795+002	21
30	7.41618036347471873−044	1.29565839925069636−042	−2.14385802660634782+041	3.84688995120448654+042	9.29820730645108375+002	21
31	1.10180531954131493−045	1.98904411864784523−044	−1.39710560260940269+043	2.58823033257601913+044	9.91820684951421797+002	20
32	1.58657912601021575−047	2.95650216877483618−046	−9.40309733349356064+044	1.79669757274041995+046	1.05582064341499092+003	21
33	2.21646951611465153−049	4.25922589431743807−048	−6.52955169050776928+046	1.28562429849079978+048	1.12182060554626492+003	21
34	3.00671087565568263−051	5.95269997137714330−050	−4.67364063319858056+048	9.47398268593226898+049	1.18982057092570462+003	22
35	3.96383987601332776−053	8.07822539576129823−052	−3.44508355257676638+050	7.18397961372781045+051	1.25982053919209979+003	21
36	5.08252442421629474−055	1.06537445128001952−053	−2.61307446673672170+052	5.60101165655710619+053	1.33182051003309952+003	21
37	6.34318816711436725−057	1.36652695314050538−055	−2.03782441455889653+054	4.48652722793619193+055	1.40582048317748930+003	21
38	7.71097224899760676−059	1.70604440474370483−057	−1.63274618255099617+056	3.68966850048346343+057	1.48182045838885580+003	21
39	9.13643923838278387−061	2.07456973090428008−059	−1.34307011633723825+058	3.11318003281415641+059	1.55982043546036167+003	21
40	1.05581860976653971−062	2.45880905252490451−061	−1.13347978297905928+060	2.69328486264940015+061	1.63982041421041332+003	21
41	1.19072324430195749−064	2.84223128876138968−063	−9.80811602064804742+061	2.38757177242179726+063	1.72182039447905152+003	21
42	1.31127444454063470−066	3.20624749064250333−065	−8.69659715896354688+063	2.16757549165901728+065	1.80582037612493009+003	21
43	1.41084064357261917−068	3.53175205177028043−067	−7.89683169252703607+065	2.01416473952585707+067	1.89182035902277578+003	20
44	1.48386147890383273−070	3.80084071601540585−069	−7.33931851796544178+067	1.91464810289469575+069	1.97982034306124356+003	21
45	1.52636723421457478−072	3.99848286474912633−071	−6.97795879056356328+069	1.86095829460914737+071	2.06982032814109858+003	20
46	1.53633066579199654−074	4.11392618328594340−073	−6.78346455157191287+071	1.84853654923058036+073	2.16182031417366910+003	21
47	1.51380923374024964−076	4.14165061364309751−075	−6.73931001113742185+073	1.87569465361182071+075	2.25582030107952523+003	20
48	1.46086747242934099−078	4.08175759028101909−077	−6.83941837624854747+075	1.94332880783061255+077	2.35182028878734656+003	21
49	1.38130088098534378−080	3.93976604914626517−079	−7.08712811838496975+077	2.05492372807981463+079	2.44982027723294844+003	21
50	1.28020865867766102−082	3.72587215920413053−081	−7.49521585205844886+079	2.21683317352425312+081	2.54982026635844193+003	21
51	1.16347883830824639−084	3.45379991856930586−083	−8.08692673682545283+081	2.43886510582712476+083	2.65182025611150703+003	21

OBLATE RADIAL FUNCTIONS

H = 0.7 X = 1.40000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	8.75216005800761332−002	7.40187490294933762−002	−2.55192151710913153+000	3.35614799501833239+000	5.92952905718217094+000	22
3	1.25975096235056402−002	1.99418184482733058−002	−1.06000891249985092+001	2.15312738680619647+001	1.18361262204765058+001	22
4	1.49466443885540490−003	3.30851832960830865−003	−6.59970211309918152+001	1.76811009644697476+002	1.98026795724376412+001	22
5	1.46616032859392130−004	4.14492428686093229−004	−5.37617587349050220+002	1.77188713999619814+003	2.97864735502194281+001	23
6	1.22306617526931755−005	4.19459348598580561−005	−5.38379540290764861+003	2.09961780113630193+004	4.17773566645413597+001	22
7	8.86444112894465995−007	3.56896955638143008−006	−6.38769975827564629+004	2.87271830446339213+005	5.57717099309043105+001	22
8	5.67690225591532904−008	2.62216378672113683−007	−8.75584390323174997+005	4.45723571001154759+006	7.17679669941512078+001	22
9	3.25570929270126419−009	1.69600758080904125−008	−1.36117671645620811+007	7.73314989138790817+007	8.97653570914929552+001	22
10	1.69029089862927214−010	9.80012448949841094−010	−2.36601468658432495+008	1.48349078909286761+009	1.09763464197024782+002	22
11	8.01563387865934829−012	5.11810642291846546−011	−4.54673917966914235+009	3.11788857151851264+010	1.31762047395673527+002	22
12	3.49801904200254624−013	2.43862284245457032−012	−9.57118405816844448+010	7.12461535792392063+011	1.55760959216566068+002	21
13	1.41374336772279089−014	1.06836127409848970−013	−2.19025033987387743+012	1.75864745986913345+013	1.81760105233734297+002	22
14	5.32047916791578390−016	4.33187975626296054−015	−5.41352916495864546+013	4.66345042990637545+014	2.09759422689364561+002	22
15	1.87334544679164509−017	1.63474634316879089−016	−1.43722967344142339+015	1.32209939044854110+016	2.39758868541560873+002	22
16	6.19686966273740237−019	5.76953672622561984−018	−4.07899746547008563+016	3.99050228989547176+017	2.71758412466606004+002	22
17	1.93287712916852626−020	1.91241540610965471−019	−1.23238400581528152+018	1.27759009097119080+019	3.05758032598563672+002	23
18	5.70332154497101335−022	5.97571256329278858−021	−3.94913992193490834+019	4.32443147775671820+020	3.41757712846662683+002	22
19	1.59664856881345966−023	1.76602641987558846−022	−1.33782710999425619+021	1.54299252377746956+022	3.79757441155946865+002	21
20	4.25195549504613827−025	4.95092221007960073−024	−4.77711721526346478+022	5.78825732536970065+023	4.19757208350117533+002	22
21	1.07968680775592436−026	1.32010506994872225−025	−1.79330967389371656+024	2.27741750301676687+025	4.61757007343942507+002	23
22	2.61984063880492191−028	3.35587565864757554−027	−7.06045253607017158+025	9.37787859834143487+026	5.05756832596181373+002	21
23	6.08662922850370009−030	8.15125168262199898−029	−2.90908459381164636+027	4.03340940456570834+028	5.51756679722568207+002	21
24	1.35640492626075036−031	1.89551460175002050−030	−1.25189367118719099+029	1.80865761041143454+030	5.99756545217466051+002	21
25	2.90425885932322851−033	4.22771108467828920−032	−5.61666156515359344+030	8.44171511294796175+031	6.49756426250655469+002	22
26	5.98386987111934863−035	9.05912253874288402−034	−2.62279482779638847+032	4.09472950637148609+033	7.01756320516933837+002	21
27	1.18808591971190534−036	1.86784462234812906−035	−1.27279060649693044+034	2.06119750760798602+035	7.55756226123398138+002	22
28	2.27617893347286223−038	3.71099453529293731−037	−6.40969110901089912+035	1.07532053935446490+037	8.11756141503991269+002	21
29	4.21300726860965270−040	7.11396076077221027−039	−3.34526030283306986+037	5.80689663554709352+038	8.69756065354025655+002	21
30	7.54230521017042166−042	1.31747051981518123−040	−1.80717524073444060+039	3.24218478874318011+040	9.29755996579518191+002	21
31	1.30740083802627439−043	2.35982305106287268−042	−1.00936610406641479+041	1.86960980582471632+042	9.91755934257626623+002	21
32	2.19656324442588355−045	4.09256373575034071−044	−5.82248086807754881+042	1.11235923990616350+044	1.05575587760549130+003	21
33	3.58030480679717925−047	6.87904211548084635−046	−3.46529614377519764+044	6.82194155663376712+045	1.12175582595550124+003	21
34	5.66662542134741017−049	1.12173257260640572−047	−2.12585753821696019+046	4.30875697503829139+047	1.18975577873551382+003	21
35	8.71609610621757927−051	1.77610060450724358−049	−1.34308121891379349+048	2.80034482375495549+049	1.25975573545292558+003	21
36	1.30393831935799511−052	2.73292967586669534−051	−8.73131481820448771+049	1.87129088272797880+051	1.33175569568176041+003	21
37	1.89869645583728595−054	4.08994473842299228−053	−5.83608351477366852+051	1.28473875449172818+053	1.40575565905213890+003	21
38	2.69293741234708474−056	5.95746124795996307−055	−4.00775992522804160+053	9.05571503632561403+054	1.48175562524163998+003	21
39	3.72273529937303100−058	8.45219089149813876−057	−2.82560395699129988+055	6.54894916605843214+056	1.55975559396817573+003	22
40	5.01928134309205679−060	1.16878662636506785−058	−2.04388833308355005+057	4.85604474058364914+058	1.63975556498408399+003	21
41	6.60433575769554940−062	1.57629649811912434−060	−1.51586621385396093+059	3.68969766399339544+060	1.72175553807120637+003	21
42	8.48549353477537044−064	2.07463918182456388−062	−1.15201346324348185+061	2.87106760194471050+062	1.80575551303676830+003	21
43	1.06518695814881540−065	2.66625586927380163−064	−8.96592212767211703+062	2.28665076866137716+064	1.89175548970991506+003	21
44	1.30708801780357184−067	3.34777672462114239−066	−7.14220952852841267+064	1.86307464446767676+066	1.97975546793878705+003	21
45	1.56867645626348643−069	4.10900268291760267−068	−5.82023944346255948+066	1.55208352091492228+068	2.06975544758804053+003	21
46	1.84213407534812699−071	4.93243393535997400−070	−4.84953823361133464+068	1.32143048836756326+070	2.16175542853673785+003	22
47	2.11772344087666301−073	5.79350138300474029−072	−4.12953702365467475+070	1.14925628791078219+072	2.25575541067654560+003	21
48	2.38434926837604705−075	6.66157712700107068−074	−3.59205420671976058+072	1.02056365830537082+074	2.35175539391019029+003	21
49	2.63031487104671820−077	7.50173718469065916−076	−3.19030653560350355+074	9.24973179510176399+075	2.44975537815013045+003	21
50	2.84419966343878674−079	8.27714044547827607−078	−2.89191345351168008+076	8.55276609598245870+077	2.54975536331741105+003	21
51	3.01576279650073084−081	8.95179135726890225−080	−2.67438690070333983+078	8.06495615207548534+079	2.65175534934067223+003	21

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OBLATE RADIAL FUNCTIONS

H = 0.8 X = 1.40000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	1.10830689919035941−001	9.02277975155649825−002	−1.84893148912674567+000	2.30506804083638670+000	5.90776576462657717+000	23
3	1.83916814386691534−002	2.86714740645938254−002	−6.49156868907998778+000	1.28413736817584303+001	1.17857439078473119+001	23
4	2.50590378434149095−003	5.49734267063443292−003	−3.48236450042593432+001	9.21263574088192103+001	1.97422582326081293+001	22
5	2.81759840841078429−004	7.91846816758792439−004	−2.46457711966997503+002	8.06149456688149952+002	2.97211342578809802+001	23
6	2.69174831798549491−005	9.19266267514690112−005	−2.15058621244294656+003	8.34406247227789378+003	4.17092343430245908+001	22
7	2.23301416747276248−006	8.96206735262572504−006	−2.22647304924766973+004	9.97572188660905780+004	5.57018576936201080+001	22
8	1.63627952700469049−007	7.53937698252990314−007	−2.66511947866033769+005	1.35284888133679064+006	7.16969654214932356+001	23
9	1.07348122821620426−008	5.58108910575020531−008	−3.61985884884395285+006	2.05191989995906356+007	8.96935528335930372+001	22
10	6.37438902180977495−010	3.68982524013164843−009	−5.49914383808557297+007	3.44171808808405930+008	1.09691077116679776+002	22
11	3.45690629283649200−011	2.20430816107476675−010	−9.23800023843744770+008	6.32540443964116352+009	1.31689223719945683+002	23
12	1.72505035932103364−012	1.20123222376305353−011	−1.70026534275537882+010	1.26405553468359616+011	1.55687800001286355+002	22
13	7.97161792271395429−014	6.01820739009456455−013	−3.40230090791378145+011	2.72892874110446275+012	1.81686682564635689+002	22
14	3.43001513484882257−015	2.79030188185156961−014	−7.35410287837404015+012	6.32929062274515202+013	2.09685789373830341+002	22
15	1.38073609247367273−016	1.20397806790178849−015	−1.70757198825300996+014	1.56952060684559802+015	2.39685064152020047+002	22
16	5.22149235848739751−018	4.85821195450342281−017	−4.23873916041914275+015	4.14384145049819315+016	2.71684467243845685+002	21
17	1.86183396411127697−019	1.84104218570932545−018	−1.12016383666561752+017	1.16052458834423809+018	3.05683970050122037+002	22
18	6.28009582956748453−021	6.57657141666577052−020	−3.13984551241905394+018	3.43630289499810773+019	3.41683551522545248+002	22
19	2.00973430178872130−022	2.22187994700442357−021	−9.30445793932364679+019	1.07259657146791265+021	3.79683195890392996+002	22
20	6.11786130398705870−024	7.12050089851018610−023	−2.90639757481586191+021	3.51997570994151328+022	4.19682891147837915+002	23
21	1.77575188900418275−025	2.17031776082211366−024	−9.54450232339933633+022	1.21160658492181631+024	4.61682628024201013+002	22
22	4.92522347620962706−027	6.30669595084383504−026	−3.28737093032058423+024	4.36473205701097089+025	5.05682399268568786+002	22
23	1.30794161165650429−028	1.75103002956005797−027	−1.18494652026375652+026	1.64234856772228701+027	5.51682199143647363+002	21
24	3.33162342483183785−030	4.65438979708986440−029	−4.46111156454727224+027	6.44309840662883113+028	5.99682023061700137+002	22
25	8.15365107517946860−032	1.18659130865604274−030	−1.75102878303845963+029	2.63098999213153259+030	6.49681867318732490+002	21
26	1.92019320963248742−033	2.90627614037491174−032	−7.15359180168601670+030	1.11652392326767201+032	7.01681728897740806+002	22
27	4.35765473629352914−035	6.84922782296714428−034	−3.03715114839254384+032	4.91722976653916216+033	7.55681605321247692+002	21
28	9.54223542725080109−037	1.55538199573113245−035	−1.33813652985792005+034	2.24440019629536581+035	8.11681494539498228+002	21
29	2.01869921324035548−038	3.40800571856260481−037	−6.11013695848718453+035	1.06040305032089726+037	8.69681394844788775+002	22
30	4.13063099013091069−040	7.21387226808728496−039	−2.88790184428875660+037	5.18002570391281144+038	9.29681304805172030+002	23
31	8.18373236309623580−042	1.47687114433206860−040	−1.41122122357805707+039	2.61345431975045517+040	9.91681223212685903+002	21
32	1.57150017299864002−043	2.92746334216124426−042	−7.12231980319990179+040	1.36044525874394743+042	1.05568114904257961+003	21
33	2.92763334348273011−045	5.62411652801696674−044	−3.70871369509362444+042	7.29992086852213024+043	1.12168108142094552+003	22
34	5.29596650172213800−047	1.04819891921549479−045	−1.99062278144037624+044	4.03402159777014131+045	1.18968101959883262+003	23
35	9.31032864967900555−049	1.89691503663132443−047	−1.10035052303176233+046	2.29390561883388900+047	1.25968096293139943+003	21
36	1.59191804500988189−050	3.33605189015500141−049	−6.25870263978158692+047	1.34117287163710343+049	1.33168091086101529+003	21
37	2.64934403712650902−052	5.70616131565201019−051	−3.66019167605478829+049	8.05636613472982472+050	1.40568086290347783+003	22
38	4.29464093087785097−054	9.49966908861080063−053	−2.19919285402542337+051	4.96854700960739152+052	1.48168081863670667+003	21
39	6.78545943336151986−056	1.54040777632393780−054	−1.35660587204586786+053	3.14385010951276106+054	1.55968077769141756+003	22
40	1.04562018211690327−057	2.43455401423578627−056	−8.58581915895884988+054	2.03965929460220680+056	1.63968073974339021+003	22
41	1.57244613219056573−059	3.75265457797700887−058	−5.57145846036034000+056	1.35597463060602571+058	1.72168070450702587+003	22
42	2.30906909429447617−061	5.64493012609520734−060	−3.70467588251721858+058	9.23189924708738888+059	1.80568067172995448+003	21
43	3.31282042441326734−063	8.29147954565538438−062	−2.52274509573030675+060	6.43332195506917548+061	1.89168064118850054+003	21
44	4.64609652294652088−065	1.18987101359188740−063	−1.75831939857559806+062	4.58621485250635833+063	1.97968061268385471+003	21
45	6.37275581143581279−067	1.66913728566487842−065	−1.25370039795795943+064	3.34294135335535930+065	2.06968058603882844+003	21
46	8.55312575844589041−069	2.28996188131392727−067	−9.13991014191045069+065	2.49028068891511297+067	2.16168056109509227+003	21
47	1.12378143594618586−070	3.07410430133667450−069	−6.80976878443457276+067	1.89501174669795636+069	2.25568053771081714+003	21
48	1.44607487834985404−072	4.03984097374193976−071	−5.18279620543027226+069	1.47240350961459722+071	2.35168051575865287+003	21
49	1.82320834325042089−074	5.19945766253052955−073	−4.02758437719543998+071	1.16763810110036552+073	2.44968049512398977+003	22
50	2.25317892244075949−076	6.55669268289564054−075	−3.19439928807612460+073	9.44666891713016445+074	2.54968047570345910+003	22
51	2.73048152888111384−078	8.10442318483098383−077	−2.58476146097837603+075	7.79413037334836590+076	2.65168045740363533+003	21

OBLATE RADIAL FUNCTIONS

H = 0.9 X = 1.40000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	1.35401084717817934−001	1.05303081457996713−001	−1.41318401048205355+000	1.67327126571114517+000	5.88299107922981127+000	23
3	2.55335165925490625−002	3.91026547012825869−002	−4.26495339832621150+000	8.16982551414154425+000	1.17285205024373784+001	24
4	3.93547471520167699−003	8.54465199839303260−003	−1.99654804806525142+001	5.20336954259905050+001	1.96737724254738626+001	24
5	4.99493342862949995−004	1.39426294287922384−003	−1.24553021190350749+002	4.03840644501572416+002	2.96470982206528057+001	22
6	5.38092455120540827−005	1.82881718746791479−004	−9.61448694620412741+002	3.70835873496190129+003	4.16320483714095437+001	22
7	5.03062148010712247−006	2.01173676835316339−005	−8.81971029108396603+003	3.93482239461189472+004	5.56227103020917555+001	22
8	4.15264338579334921−007	1.90802394667253279−006	−9.36301949628316300+004	4.73738539475117148+005	7.16165134061080049+001	23
9	3.06818088686210626−008	1.59158484264733200−007	−1.12849032684498063+006	6.38054184763302933+006	8.96121889746309836+001	22
10	2.05144383633838892−009	1.18529859140179387−008	−1.52184695801104318+007	9.50506498669027398+007	1.09609050810769229+002	22
11	1.25250627733797866−010	7.97439803887359152−010	−2.27006122217157191+008	1.55170206576818173+009	1.31606700969441106+002	22
12	7.03585211405953368−012	4.89302090012640485−011	−3.71059095414972711+009	2.75468246530273049+010	1.55604895597082240+002	22
13	3.65970298370863181−013	2.75982654231339725−012	−6.59520570959247181+010	5.28346531242077546+011	1.81603478427551888+002	22
14	1.77234916957151769−014	1.44040244640409148−013	−1.26637624877758526+012	1.08875967561910943+013	2.09602345537607983+002	22
15	8.02958244882018613−016	6.99572018915797046−015	−2.61232659888885533+013	2.39893316144311982+014	2.39601425617203788+002	22
16	3.41731864069976844−017	3.17718027941879515−016	−5.76143931429691894+014	5.62792299729678652+015	2.71600668407305389+002	22
17	1.37127078086793828−018	1.35505354183047206−017	−1.35284021453580947+016	1.40058612515661360+017	3.05600037655208152+002	22
18	5.20505793068922158−020	5.44752857766880282−019	−3.36949157758980824+017	3.68528768206480636+018	3.41599506676020433+002	21
19	1.87440177621069644−021	2.07114754906662630−020	−8.87269222517661661+018	1.02223989674595007+020	3.79599055473360420+002	23
20	6.42063341153346342−023	7.46925479103677208−022	−2.46287315728030533+020	2.98128069006731698+021	4.19598668822994883+002	22
21	2.09703472061592010−024	2.56185309807289841−023	−7.18745752662640740+021	9.11969983981252228+022	4.61598334968047338+002	22
22	6.54464999147222465−026	8.37696204907999082−025	−2.19996744994498542+023	2.91971208926921365+024	5.05598044712389952+002	22
23	1.95559551584765731−027	2.61711606207381420−026	−7.04727102101474453+024	9.76378356358430231+025	5.51597790779113558+002	22
24	5.60493580754908563−029	7.82760693459565290−028	−2.35791392110783183+026	3.40426988508862511+027	5.99597567349030360+002	22
25	1.54342484778722167−030	2.24541897782793977−029	−8.22522451597989004+027	1.23546425598879968+029	6.49597369723682674+002	21
26	4.08970601449267581−032	6.18809517275942987−031	−2.98644412119449871+029	4.65978166154862412+030	7.01597194075886115+002	22
27	1.04426194588397854−033	1.64089278927088510−032	−1.12688047082495560+031	1.82393289568220986+032	7.55597037262746767+002	22
28	2.57283749984354460−035	4.19265707686958568−034	−4.41263422929878721+032	7.39917519454246458+033	8.11596896683885799+002	21
29	6.12401073931683287−037	1.03362253971410065−035	−1.79076599064814153+034	3.10707760561283670+035	8.69596770172795203+002	21
30	1.40987194547205284−038	2.46170283185969558−037	−7.52254165307081877+035	1.34900729874602618+037	9.29596655912760811+002	21
31	3.14275669788905588−040	5.67037553814090980−039	−3.26719501494106312+037	6.04924805641156809+038	9.91596552371201468+002	22
32	6.78996037502479588−042	1.26461862714402499−040	−1.46555588476860793+039	2.79881527695644321+040	1.05559645824795350+003	21
33	1.42318243312618468−043	2.73349606948504794−042	−6.78278500761872025+040	1.33481280662809625+042	1.12159637243421487+003	21
34	2.89652994809640747−045	5.73193536207865432−044	−3.23578874549642570+042	6.55619169948191475+043	1.18959629397970947+003	22
35	5.72907767339665755−047	1.16706894987950389−045	−1.58975821834380220+044	3.31361592132755918+045	1.25959622206624272+003	21
36	1.10211133953112415−048	2.30924662730949718−047	−8.03702579292651456+045	1.72197328445023198+047	1.33159615598626502+003	21
37	2.06360463749602330−050	4.44394276147825266−049	−4.17761003023832414+047	9.19385299812186237+048	1.40559609512538764+003	22
38	3.76354230170468097−052	8.32372923179368960−051	−2.23101377423412797+049	5.03971563168546083+050	1.48159603894803953+003	22
39	6.69005299628864925−054	1.51854803161747847−052	−1.22323301936320174+051	2.83438062604615672+052	1.55959598698563629+003	21
40	1.15985385292519096−055	2.70018826815895769−054	−6.88106051004251332+052	1.63446270648820920+054	1.63959593882677060+003	21
41	1.96237884077814713−057	4.68267024404402568−056	−3.96882662107694565+054	9.65808987612978730+055	1.72159589410903882+003	21
42	3.24205669545088923−059	7.92487766098394979−058	−2.34565634964026541+056	5.84459178598447599+057	1.80559585251219909+003	21
43	5.23307656198984332−061	1.30961545970673043−059	−1.41974297573483245+058	3.62011979278406087+059	1.89159581375241863+003	21
44	8.25699318469795000−063	2.11440533636488620−061	−8.79543819550247162+059	2.29386359630287473+061	1.97959577757741651+003	21
45	1.27419100013302326−064	3.33699794205573691−063	−5.57414061194251432+061	1.48616979595516761+063	2.06959574376234599+003	21
46	1.92399874154477674−066	5.15070456769817902−065	−3.61203158752546167+063	9.84045858876119934+064	2.16159571210629052+003	22
47	2.84402636468503426−068	7.77912135906842644−067	−2.39203971807798113+065	6.65590534249265987+066	2.25559568242927097+003	21
48	4.11731033980225392−070	1.15013519195499312−068	−1.61818230591969920+067	4.59675171536262210+068	2.35159565456968070+003	21
49	5.84022317024632674−072	1.66538447421769665−070	−1.11772790410154536+069	3.24012798946404055+070	2.44959562838207989+003	21
50	8.12004532085879491−074	2.36272053217531937−072	−7.87969774983127913+070	2.33003796519136748+072	2.54959560373529271+003	21
51	1.10705957785463102−075	3.28563990179308585−074	−5.66722529723029463+072	1.70876765324282471+074	2.65159558051076078+003	21

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 1.0 X = 1.40000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	1.60636651301904217−001	1.18277185797084562−001	−1.12451566431075195+000	1.27513421139148786+000	5.85516257458899876+000	23
3	3.40461553304634651−002	5.10815017044488211−002	−2.96714440213732329+000	5.47115068337963471+000	1.16644092705727215+001	23
4	5.86691951998932213−003	1.25891866386467710−002	−1.22354375264547748+001	3.13288141392692250+001	1.95972201861103753+001	23
5	8.30518855802389778−004	2.30054583455579345−003	−6.80262677960798888+001	2.18345784147177379+002	2.95643714836989069+001	23
6	9.96735414066038045−005	3.36924850805526582−004	−4.70002925639204803+002	1.80070026313719684+003	4.15458061323492353+001	23
7	1.03740893696013822−005	4.13177118729321061−005	−3.86641236633858104+003	1.71664730617567053+004	5.55342747431752609+001	23
8	9.52941193442086405−007	4.36471599259151625−006	−3.68469233466464767+004	1.85752786685145917+005	7.15266171379765059+001	23
9	7.83255176545563628−008	4.05281742391092596−007	−3.98926160827791877+005	2.24907991121222411+006	8.95212708911589897+001	22
10	5.82461888867825282−009	3.35845412299903398−008	−4.83458425661004600+006	3.01256694893687833+007	1.09517389931433988+002	22
11	3.95459734441084179−010	2.51346556614278603−009	−6.48257890927334852+007	4.42271194569050102+008	1.31514483179371164+002	22
12	2.47001159434981837−011	1.71524633628874942−010	−9.52728065859730399+008	7.06156626115813644+009	1.55512249521578269+002	22
13	1.42838487969281326−012	1.07581665974433660−011	−1.52279030248083256+010	1.21825372587716871+011	1.81510495907148754+002	22
14	7.69009231791915809−014	6.24302621656129824−013	−2.62975033336679818+011	2.25825423045937100+012	2.09509093902326498+002	22
15	3.87284616533254189−015	3.37098839953624188−014	−4.87934867729231831+012	4.47617985721112566+013	2.39507955352854786+002	22
16	1.83212383103184762−016	1.70195062618247904−015	−9.68015150506320655+013	9.44731113423267194+014	2.71507018113466726+002	21
17	8.17156957649447924−018	8.06890622061661991−017	−2.04475963974600225+015	2.11523745165080958+016	3.05506237349175971+002	22
18	3.44750251955001810−019	3.60568988848262811−018	−4.58171094037799548+016	5.00755398327190223+017	3.41505580052648467+002	21
19	1.37982729239571059−020	1.52374302697352914−019	−1.08543906151815119+018	1.24975653597295427+019	3.79505021486509760+002	23
20	5.25304521348375896−022	6.10764669751005046−021	−2.71078432051474306+019	3.27948269638154513+020	4.19504542814879966+002	22
21	1.90677699031577080−023	2.32826943723127648−022	−7.11778511031026332+020	9.02657328994630862+021	4.61504129490418294+002	22
22	6.61352254850867981−025	8.46128426765480724−024	−1.96026290735664053+022	2.60034527124697197+023	5.05503770133392552+002	22
23	2.19618940838340144−026	2.93787522572031906−025	−5.65012109336427948+023	7.82465890039894035+024	5.51503455738369125+002	21
24	6.99517993053370122−028	9.76542605623835141−027	−1.70103148537640507+025	2.45490277084224006+026	5.99503179103453684+002	22
25	2.14064743807549495−029	3.11317601726935263−028	−5.33934025513380845+026	8.01695666844095468+027	6.49502934413467056+002	22
26	6.30344185524024145−031	9.53455793628401667−030	−1.74444202113754382+028	2.72094209174010092+029	7.01502716931361024+002	22
27	1.78861258569491766−032	2.80966820773245175−031	−5.92309097475207296+029	9.58388838232168259+030	7.55502522766895258+002	23
28	4.89706668415088548−034	7.97792684574314313−033	−2.08709543452240346+031	3.49864320666286773+032	8.11502348701228074+002	22
29	1.29530644335453681−035	2.18566574613056503−034	−7.62187624082464302+032	1.32207401969046835+034	8.69502192052488641+002	22
30	3.31379499677493143−037	5.78461086100709458−036	−2.88118194145420200+034	5.16545756432406193+035	9.29502050571740230+002	22
31	8.20848313636303526−039	1.48068678808267362−037	−1.12607700388875279+036	2.08444240906936308+037	9.91501922361726995+002	21
32	1.97070969133596002−040	3.66961318374902428−039	−4.54554445625440806+037	8.67879931528666157+038	1.05550180581287436+003	22
33	4.59004123502851539−042	8.81424879636304327−041	−1.89315114050425711+039	3.72482026779757203+040	1.12150169955247874+003	21
34	1.03808328768834975−043	2.05386249691925257−042	−8.12744486895588989+040	1.64641216888442192+042	1.18950160240406880+003	21
35	2.28157534182178126−045	4.64694111269515449−044	−3.59338919425257279+042	7.48847320091329021+043	1.25950151335467546+003	21
36	4.87718744570884242−047	1.02173698728663315−045	−1.63482131358324767+044	3.50206136979345435+045	1.33150143152829929+003	21
37	1.01475791792406320−048	2.18490805723672428−047	−7.64727694284200700+045	1.68268573950909894+047	1.40550135616426915+003	22
38	2.05647285775221313−050	4.54753986066584983−049	−3.67525287838653853+047	8.30082670770213332+048	1.48150128659948821+003	21
39	4.06204138938644544−052	9.21889932131703188−051	−1.81343554675563234+049	4.20131220157848723+050	1.55950122225378888+003	21
40	7.82537500431698354−054	1.82152361428657678−052	−9.18032412849768940+050	2.18029252112622303+052	1.63950116261778998+003	21
41	1.47119570507466361−055	3.51012787426799745−054	−4.76514476891367838+052	1.15943217116935996+054	1.72150110724277882+003	21
42	2.70080113784868373−057	6.60098932977350003−056	−2.53449360362439095+054	6.31428145926508642+055	1.80550105573224149+003	21
43	4.84409092039491122−059	1.21212096799601755−057	−1.38054568630290589+056	3.51973163335087762+057	1.89150100773474130+003	21
44	8.49296210253690650−061	2.17457717391886585−059	−7.69686874072012058+057	2.00711465608357088+059	1.97950096293790569+003	21
45	1.45630653161035231−062	3.81351724525153939−061	−4.38986615133340886+059	1.17028614109710097+061	2.06950092106332857+003	22
46	2.44344776967702874−064	6.54061343800849501−063	−2.56001666607091738+061	6.97363151675098751+062	2.16150088186223233+003	22
47	4.01338641942445537−066	1.09764877386447127−064	−1.52573319500197091+063	4.24494187600420023+064	2.25550084511176274+003	22
48	6.45608396686486642−068	1.80327415751566190−066	−9.28875710232659063+064	2.63838082545724022+066	2.35150081061181343+003	21
49	1.01756555378414631−069	2.90139237511600371−068	−5.77413766071275308+066	1.67367544418021187+068	2.44950077818229510+003	22
50	1.57205602846800667−071	4.57385637397503180−070	−3.66338326645124098+068	1.08316717546042884+070	2.54950074766077968+003	21
51	2.38153212655969179−073	7.06752777816901335−072	−2.37118728620462559+070	7.14890703401336748+071	2.65150071890046184+003	21

OBLATE RADIAL FUNCTIONS

H = 2.0 X = 1.40000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	3.23744383398499841−001	−1.87405666622846952−002	−1.70694515151015623−001	5.31647310919156622−001	5.39501078349079835+000	23
3	1.70573767732556924−001	1.63356265280488608−001	−4.26117166390302403−001	5.82211505119609079−001	1.06299512876868696+001	23
4	6.54717841858697347−002	1.12482578180420573−001	−7.44493284829913293−001	1.30096339762836390+000	1.83883287402038170+001	24
5	1.97645007682035352−002	4.77822219478711114−002	−1.70911782252212383+000	4.41465599416885169+000	2.82612011298329428+001	23
6	4.95703123215365012−003	1.52658180132624789−002	−5.28122526637582861+000	1.78124145239690476+001	4.01876279172383946+001	25
7	1.06556697957497707−003	3.96423494039832332−003	−2.03335161167652926+001	8.28780222740297119+001	5.41412350355173940+001	23
8	2.00647551130514156−004	8.72247987123396722−004	−9.26887983168615538+001	4.38935340411220224+002	7.01101221891089457+001	22
9	3.36354075520697087−005	1.66985917543177927−004	−4.85807587548564659+002	2.61022236840063825+003	8.80882526859487375+001	23
10	5.08286149048451980−006	2.83382586505628301−005	−2.87179282830224908+003	1.72220531925834530+004	1.08072299830526378+002	23
11	6.99392928605683552−007	4.32289202379459521−006	−1.88792171293887548+004	1.24831261804222496+005	1.30060308435711217+002	23
12	8.83495413623295458−008	5.99254222813467637−007	−1.36530887919875094+005	9.85881833061785749+005	1.54051068532153273+002	23
13	1.03166830092351763−008	7.61539301783725124−008	−1.07671575068661755+006	8.42545833204002754+006	1.80043798930238404+002	22
14	1.12010982992510574−009	8.93637013862306783−009	−9.19326425782313820+006	7.74607135932722144+007	2.08037977084355322+002	23
15	1.13643202306678271−010	9.74227743644605753−010	−8.44716519877394581+007	7.62247897302350410+008	2.38033242783308760+002	23
16	1.08213684181975957−011	9.91851891784006863−011	−8.30965320782876971+008	7.99339446117722915+009	2.70029341210991787+002	23
17	9.70820522712812029−013	9.47264313374855413−012	−8.7125776 73474+009	8.89842949902910788+010	3.04026088007913874+002	22
18	8.23350793924106989−014	8.51997930280332864−013	−9.6985637 75936+010	1.04800234922600870+012	3.40023347130963836+002	22
19	6.62112181811826145−015	7.24190043861168498−014	−1.1422731 - 01165+012	1.30184339222446740+013	3.78021016422358668+002	22
20	5.06239078172731911−016	5.83511979515286600−015	−1.4190728 44713+013	1.70106031615940647+014	4.18019017966603923+002	22
21	3.68908769043293156−017	4.46916653689306068−016	−1.8544754 - 23938+014	2.33226553359114656+015	4.60017291502783003+002	22
22	2.56793815979047621−018	3.26182148963848220−017	−2.54300229718300532+015	3.34785022683014826+016	5.04015789834124268+002	22
23	1.71092094676250309−019	2.27366383468928326−018	−3.65098658341895494+016	5.02114124705314718+017	5.50014475571760051+002	22
24	1.09309548936759311−020	1.51674432519648498−019	−5.47680650780086668+017	7.85382135823518919+018	5.98013318787307725+002	22
25	6.70820952237944599−022	9.70129756907764700−021	−8.56820700781721533+018	1.27897306749887017+020	6.48012295295582078+002	22
26	3.96054899856049086−023	5.95968110589692159−022	−1.39558412147383498+020	2.16501691421342973+021	7.00011385381316757+002	22
27	2.25285464182156772−024	3.52190441530558802−023	−2.36288292024698717+021	3.80408213789349186+022	7.54010572843401867+002	22
28	1.23629796344532302−025	2.00505824401006087−024	−4.15256906683175191+022	6.92854740838417174+023	8.10009844269282110+002	22
29	6.55341647241357519−027	1.10118057173167351−025	−7.56474722710421623+023	1.30645431301124886+025	8.68009188478292615+002	22
30	3.35948592159703838−028	5.84141518269570740−027	−1.42669272868419116+025	2.54740978984254200+026	9.28008596090437148+002	22
31	1.66728988352099753−029	2.99650044978886053−028	−2.78238651505778038+026	5.13076312198895404+027	9.90008059189316435+002	22
32	8.01909850061512253−031	1.48806765107999186−029	−5.60507271852743536+027	1.06634985177502072+029	1.05400757105642888+003	22
33	3.74138077147853783−032	7.16123882835192905−031	−1.16513891841638877+029	2.28473238919395389+030	1.12000712596008232+003	22
34	1.69481104311024016−033	3.34293920109026486−032	−2.49683601533872972+030	5.04193133049240768+031	1.18800671898645690+003	22
35	7.46040150209121040−035	1.51508283736230742−033	−5.51094680266137791+031	1.14502563584124337+033	1.25800634590346781+003	22
36	3.19376184666287438−036	6.67239639509601331−035	−1.25174832183676743+033	2.67387842666597976+034	1.33000600305034774+003	22
37	1.33067248470290313−037	2.85768272043110488−036	−2.92357263268661636+034	6.41574015821343979+035	1.40400568724754219+003	22
38	5.39982400447478258−039	1.19114031922247338−037	−7.01596393171272778+035	1.58058750943464981+037	1.48000539572275727+003	22
39	2.13561606484194646−040	4.83549622745383636−039	−1.72872311379775954+037	3.99540813411237613+038	1.55800512604993347+003	22
40	8.23725268664855882−042	1.91313066943172560−040	−4.37051241382859789+038	1.03560384467640810+040	1.63800487609862695+003	22
41	3.10044439445002363−043	7.38167575585035959−042	−1.13299301213097009+040	2.75073626798898857+041	1.72000464399181801+003	22
42	1.13946707903143972−044	2.77932583381452974−043	−3.00983720458981472+041	7.48294860861359733+042	1.80400442807058097+003	22
43	4.09126808946613561−046	1.02176894431140689−044	−8.18889786133761951+042	2.08364012883628851+044	1.89000422686436930+003	23
44	1.43589733984963496−047	3.66975680810286896−046	−2.28051149609554595+044	5.93563973315175551+045	1.97800403906591864+003	22
45	4.92854572202680876−049	1.28832286796882116−047	−6.49728966377243447+045	1.72896540254315205+047	2.06800386350996559+003	22
46	1.65521776632340475−050	4.42319523831158279−049	−1.89279893145422298+047	5.14716120412744799+048	2.16000369915513332+003	22
47	5.44169775463947583−052	1.48587711581884062−050	−5.63556978996068518+048	1.56534377513468935+050	2.25400354506845668+003	22
48	1.75206470133164507−053	4.88615717091674908−052	−1.71407623304667311+050	4.86091980953665774+051	2.35000340041211633+003	21
49	5.52697998306233075−055	1.57356104112006606−053	−5.32338300063858070+051	1.54066485155029641+053	2.44800326443202865+003	22
50	1.70893598429139884−056	4.96497746486513576−055	−1.68742645954270901+053	4.98196399684064610+054	2.54800313644800061+003	21
51	5.18125485846746284−058	1.53548970766634083−056	−5.45711756607467200+054	1.64295026363110089+056	2.65000301584520909+003	22

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 3.0 X = 1.40000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	1.42234451113232600−001	−4.78149928334120527−001	1.73112214780071514−001	2.09787567556370336−001	4.52646046219492481+000	24
3	2.34626957649756846−001	−7.29851540435877149−002	−5.03306658457647926−002	4.95620815175338431−001	8.80939392076956958+000	24
4	1.71955405253081427−001	1.46337915369312605−001	−2.22209559321825427−001	4.65788957366245861−001	1.63861060190996199+001	23
5	8.87828279137842360−002	1.55351553250137090−001	−3.66111312113597819−001	6.27786396570342913−001	2.61050139380708235+001	24
6	3.63662116921595823−002	9.20160027492044110−002	−6.30358378243284924−001	1.50165639493783419+000	3.79400004790263072+001	24
7	1.24517022863705254−002	4.04847780590099875−002	−1.37987559691296972+000	4.55750177906706466+000	5.18338623574273315+001	24
8	3.67877114895014331−003	1.44828288100594985−002	−3.79017480601673236+000	1.56900653505842923+001	6.77617506037794595+001	23
9	9.58054651585134228−004	4.40632914254276810−003	−1.23955573658073017+001	6.05327753042508144+001	8.57105950232199005+001	26
10	2.23378273911461020−004	1.17175418534866722−003	−4.65846684525802405+001	2.59769365051237748+002	1.05673028613862985+002	23
11	4.71873653278052065−005	2.77478846548954503−004	−1.96885037006388989+002	1.22874373762008069+003	1.27644648702775882+002	23
12	9.11702662469604697−006	5.93192593079105655−005	−9.22181926455221967+002	6.35179276884885011+003	1.51622696238387150+002	24
13	1.62359518947354644−006	1.15693971608180849−005	−4.73505849642125175+003	3.56190019918455062+004	1.77605372590815883+002	24
14	2.68223198676246587−007	2.07601356205108877−006	−2.64254866656381573+004	2.15316736941375162+005	2.05591465473373907+002	22
15	4.13314804458194702−008	3.45106228512655195−007	−1.59179250121478193+005	1.39551889561097660+006	2.35580134131187108+002	24
16	5.96858282469870328−009	5.34552606015955452−008	−1.02895195219686776+006	9.65216024531195628+006	2.67570780880573440+002	22
17	8.11038214840752507−010	7.75322846584140289−009	−7.10244288170974594+006	7.09531921334028440+007	3.01562971549996876+002	23
18	1.04075812667721238−010	1.05749027435971179−009	−5.21289084005284694+007	5.52355033244864714+008	3.37556384678751501+002	23
19	1.26525336613986356−011	1.36139744273811663−010	−4.05319394031613955+008	4.53921210541033092+009	3.75550778194464310+002	23
20	1.46135844260235998−012	1.65970336481601408−011	−3.32770587313840825+009	3.92665923650932083+010	4.15545967027992404+002	24
21	1.60766150736762479−013	1.92166378235251325−012	−2.87647151910309719+010	3.56645356983172901+011	4.57541807751940833+002	23
22	1.68846205338345332−014	2.11864344927475136−013	−2.61104100381077935+011	3.39326331395415991+012	5.01538187835289595+002	22
23	1.69650520425692017−015	2.22942072517774842−014	−2.48306677683086013+012	3.37485597605461994+013	5.47535017995852502+002	22
24	1.63386087028095117−016	2.24390391907056034−015	−2.46866597093089350+013	3.50201912432690976+014	5.95532226671330634+002	23
25	1.51088107085299135−017	2.16439395863529162−016	−2.56091966669176537+014	3.78482616298506915+015	6.45529755964388472+002	22
26	1.34369038818940162−018	2.00427905120545931−017	−2.76707721888589349+015	4.25341016696682572+016	6.97527558629522259+002	23
27	1.15097643021703443−019	1.78474863030755125−018	−3.10908710809600252+016	4.96302283314603445+017	7.51525595806915883+002	24
28	9.50886623574737103−021	1.53054044033112497−019	−3.62727488744603168+017	6.00447016108311409+018	8.07523835299050677+002	23
29	7.58648032319223155−022	1.26579792948771743−020	−4.38795805780041973+018	7.52258332440670098+019	8.65522250246532413+002	23
30	5.85217455783027104−023	1.01086965408721469−021	−5.49693666626242448+019	9.74778646557023168+020	9.25520818100907121+002	23
31	4.36959598213892352−024	7.80472489430628505−023	−7.12255659118154882+020	1.30499520109865663+022	9.87519519820754630+002	23
32	3.16128125649785440−025	5.83226441168049802−024	−9.53506083507594602+021	1.80311753419050235+023	1.05151833923729814+003	23
33	2.21822471667396703−026	4.22267812531364763−025	−1.31743829660830923+023	2.56878545347143453+024	1.11751726254989714+003	22
34	1.51100432555780903−027	2.96507324326422063−026	−1.87685893233931714+024	3.76983504497755275+025	1.18551627792191358+003	22
35	1.00004054861075005−028	2.02105990482305727−027	−2.75440992005246105+025	5.69420291837868042+026	1.25551537515477167+003	22
36	6.43596939703388782−030	1.33842902597615281−028	−4.16050123235511078+026	8.84517202939343401+027	1.32751454542339468+003	23
37	4.03077019371058482−031	8.61863486435036886−030	−6.46292130373708271+027	1.41191511804549551+029	1.40151378106016208+003	22
38	2.45841482628235857−032	5.40061811463184740−031	−1.03167723895728626+029	2.31432320341925200+030	1.47751307537748170+003	22
39	1.46121533891648953−033	3.29554385489314804−032	−1.69111941577287959+030	3.89272060813313171+031	1.55551242252128866+003	22
40	8.46932613692637885−035	1.95969958373227605−033	−2.84459491715205754+031	6.71447727279894521+032	1.63551181734946254+003	23
41	4.78992420834467858−036	1.13635875644377914−034	−4.90679501094404079+032	1.18694608457387862+034	1.71751125533043579+003	23
42	2.64490511865448862−037	6.42947570982263663−036	−8.67434124480666080+033	2.14908073183856439+035	1.80151073245825145+003	22
43	1.42671630145051530−038	3.55162587277904600−037	−1.57064882036066014+035	3.98320553850877855+036	1.88751024518109054+003	22
44	7.52219075593778310−040	1.91652999817940656−038	−2.91125849418304045+036	7.55331419935058507+037	1.97550979034088279+003	22
45	3.87840237980043990−041	1.01082188540669877−039	−5.52087548557649969+037	1.46468543940185315+039	2.06550936512207997+003	22
46	1.95648258534778758−042	5.21347767331431519−041	−1.07062560498581815+039	2.90295380890367379+040	2.15750896700803688+003	21
47	9.66089427365772552−044	2.63079890291647639−042	−2.12205495799118046+040	5.87788381178466801+041	2.25150859374373638+003	22
48	4.67166745840744753−045	1.29944885957424726−043	−4.29695702040566638+041	1.21532309651831005+043	2.34750824330382539+003	22
49	2.21323093380282931−046	6.28546844388618714−045	−8.88495948501370509+042	2.56486927221887779+044	2.44550791386511481+003	22
50	1.02768771324800543−047	2.97858800278668970−046	−1.87522212919951770+044	5.52283252149553877+045	2.54550760378284484+003	22
51	4.67894032958090688−049	1.38343052014748744−047	−4.03806375501891905+045	1.21285595039315694+047	2.64750731157013803+003	22

OBLATE RADIAL FUNCTIONS

H = 4.0 X = 1.40000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	−1.17049010348823693−001	−2.90617449728183676−001	1.13377993960379825−001	−4.40070666517293807−001	3.02762400601350363+000	24
3	8.29412166986288339−002	−4.91366013226334926−001	1.44943486621868599−001	1.59620955924150810−001	6.04607661023357135+000	23
4	1.78011817660426389−001	−1.90740784500547836−001	2.23234808236350930−002	4.50540094856892553−001	1.36731211006644547+001	24
5	1.63775133484151924−001	8.83625414493041401−002	−1.16793161402774214−001	4.52689717399533157−001	2.31287535849864770+001	24
6	1.04818355559005959−001	1.69602059500270082−001	−2.21409803576481895−001	4.47516091329364059−001	3.48313171928388655+001	24
7	5.30463473497684903−002	1.33100406462567558−001	−3.39550272915442296−001	7.40205161743520317−001	4.86356027334451155+001	23
8	2.24885754702584551−002	7.43557213690340959−002	−5.91137790641644824−001	1.80113598842094167+000	6.45011096112973017+001	24
9	8.25405184295274828−003	3.34187075977623243−002	−1.26791802572591061+000	5.09898392941728222+000	8.24048431083834844+001	23
10	2.68026898833166581−003	1.27466087590497659−002	−3.26735068967552995+000	1.59729559704387299+001	1.02333665778257427+002	23
11	7.82017367124248817−004	4.25278682382984329−003	−9.72946920805559153+000	5.50909772848273213+001	1.24279610251660498+002	24
12	2.07425611232120966−004	1.26592479431287270−003	−3.26125588144097273+001	2.08144078225695849+002	1.48237624028012879+002	23
13	5.04795487944493794−005	3.40966526397420704−004	−1.21019799688589238+002	8.55708098941630046+002	1.74204381644195830+002	23
14	1.13558303390681667−005	8.39854859735448297−005	−4.91433367039967560+002	3.80299705222049973+003	2.02177624213072565+002	23
15	2.37609785235002631−006	1.90775669485395325−005	−2.16468887284001836+003	1.81652714859392530+004	2.32155775133397583+002	23
16	4.64865071541190641−007	4.02366805083036857−006	−1.02709891286134189+004	9.27847913142464040+004	2.64137707715648234+002	23
17	8.54198203608580889−008	7.92424938258758948−007	−5.21935975489504741+004	5.04566164646016414+005	2.98122599918766909+002	22
18	1.47997716434129384−008	1.46423876757268328−007	−2.82688403474461511+005	2.90998594749090065+006	3.34109840862470909+002	23
19	2.42607418378062750−009	2.54901883453464695−008	−1.62511376210467001+006	1.77385357251529223+007	3.72098969095361125+002	23
20	3.77418816415447645−010	4.19565561191644244−009	−9.88053849031780240+006	1.13942709858068993+008	4.12089630889050236+002	22
21	5.58713650870706401−011	6.55033191345184083−010	−6.33322412504411384+007	7.69172890105110425+008	4.54081551478298872+002	22
22	7.88964798925487778−012	9.72703563589270216−011	−4.26774557752110809+008	5.44345529743262981+009	4.98074514858691021+002	22
23	1.06508242707012999−012	1.37733649860217066−011	−3.01587264292917846+009	4.02980499031478868+010	5.44068349355935647+002	22
24	1.37731522192017543−013	1.86389828463622832−012	−2.22991633869045150+010	3.11447128377640627+011	5.92062917159580973+002	22
25	1.70922672992327747−014	2.41554325753130460−013	−1.72162352365559361+011	2.50832132233553067+012	6.42058106625535893+002	22
26	2.03895635430282346−015	3.00349033904008194−014	−1.38533380612594551+012	2.10161891590182770+013	6.94053826542087051+002	22
27	2.34167144239649734−016	3.58918512374779892−015	−1.15984213450761273+013	1.82906010353527267+014	7.48050001807980794+002	22
28	2.59280902205250438−017	4.12860010541118955−016	−1.00877277577569588+014	1.65115383398098067+015	8.04046570139215831+002	22
29	2.77148835853926616−018	4.57797358325725007−017	−9.10149227464913360+014	1.54404647329820267+016	8.62043479534282733+002	22
30	2.86341654320714829−019	4.89989249181096764−018	−8.50703461953918507+015	1.49387641491002224+017	9.22040686304828611+002	22
31	2.86272543596411931−020	5.06850948601650047−019	−8.22722377754252040+016	1.49367093198038107+018	9.84038153532221200+002	23
32	2.77243087074841123−021	5.07288279079543342−020	−8.22315115265924900+017	1.54176531296111194+019	1.04803584984801863+003	22
33	2.60351663009485643−022	4.91787223676301429−021	−8.48529176843090857+018	1.64123701599334648+020	1.11403374846300239+003	22
34	2.37292853468492876−023	4.62257955514733899−022	−9.03030821012076804+019	1.80014445130973040+021	1.18203182638857021+003	23
35	2.10094876003430519−024	4.21682851443626928−023	−9.90231131850354519+020	2.03256317074917264+022	1.25203006380817609+003	23
36	1.80847486155208772−025	3.73651572048161672−024	−1.11785219274180861+022	2.36059330729512269+023	1.32402844356668588+003	23
37	1.51466014348143160−026	3.21876624768123495−025	−1.29802798549881247+023	2.81772600675091412+024	1.39802695075304940+003	23
38	1.23522072443423739−027	2.69771256730122142−026	−1.54915251821446220+024	3.45426339154627606+025	1.47402557235731167+003	23
39	9.81532051152905502−029	2.20144859566762805−027	−1.89885641942313555+025	4.34597234295296648+026	1.55202429698721702+003	24
40	7.60471818349478199−030	1.75038582635285286−028	−2.38876017312052794+026	5.60795797221735801+027	1.63202311463286805+003	22
41	5.74849488818502052−031	1.35694171293198608−029	−3.08209474213610595+027	7.41711197464298519+028	1.71402201647035386+003	22
42	4.24206958382527468−032	1.02628000467815330−030	−4.07603253325112663+028	1.00488574607696809+030	1.79802099469714833+003	22
43	3.05774881233797404−033	7.57720994743518284−032	−5.52187154009087298+029	1.39380577389013346+031	1.88402004239354069+003	22
44	2.15408278207883683−034	5.46437459119555992−033	−7.65849284042571916+030	1.97813130163279638+032	1.97201915340550015+003	22
45	1.48383271759342564−035	3.85120383649668401−034	−1.08685525519672963+032	2.87110856021914282+033	2.06201832224526966+003	22
46	9.99965043049899237−037	2.65401744397720110−035	−1.57741292566452398+033	4.25961342797123743+034	2.15401754400668859+003	22
47	6.59580756531440733−038	1.78928056867640701−036	−2.34017531963367402+034	6.45670098324997106+035	2.24801681429280353+003	22
48	4.26021575059257641−039	1.18066647535896740−037	−3.54710620185773678+035	9.99479091706181821+036	2.34401612915377141+003	22
49	2.69565689698543689−040	7.62865515189291616−039	−5.49066707628683240+036	1.57932019569050884+038	2.44201548503341690+003	22
50	1.67166119221397598−041	4.82870037378272221−040	−8.67584452692028241+037	2.54635364795799614+039	2.54201487872309319+003	22
51	1.01638090516017759−042	2.99540695177293789−041	−1.39878998499670715+039	4.18740718091876892+040	2.64401430732172777+003	22

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 5.0 X = 1.40000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	−9.46870717725588704−002	4.10109350393218454−001	−8.63760368245808879−002	−3.39475565292679977−001	4.28957108509711792−001	24
3	−9.70758300096628266−002	−2.87865056742369843−001	8.52866727273596103−002	−4.43122811097844313−001	2.10980581603699983+000	24
4	2.16840411354218867−002	−5.07689601047664402−001	1.33387951593995125−001	−7.01476080049084138−003	1.05123673338162820+001	26
5	1.29012565739825055−001	−2.99461303083059411−001	6.14414238206641555−002	3.81112013740651822−001	1.93843905253782472+001	26
6	1.48637646717055989−001	−2.02163445612089819−003	−4.85280609259616633−002	4.55239133975468627−001	3.09101722480266658+001	23
7	1.13694107884825842−001	1.50907341979132574−001	−1.40038212668578555−001	4.08418465847703743−001	4.45827994265121613+001	24
8	6.80353148122961672−002	1.60717789569132393−001	−2.17576774364927300−001	4.79149827115415599−001	6.03574156276832052+001	23
9	3.40229631120850798−002	1.10728114747779730−001	−3.31475822369935034−001	9.07148344792808180−001	7.81951015168234738+001	23
10	1.47377017963526890−002	5.99231186072923410−002	−5.87553027463501535−001	2.19569904873545943+000	9.80744686145256602+001	24
11	5.65712738525702194−003	2.73027755874768283−002	−1.24818815372884038+000	5.91971229119503273+000	1.19982457348935945+002	23
12	1.95512223447225970−003	1.08541042748390498−002	−3.09095985768459394+000	1.73994067292164388+001	1.43910734702978055+002	22
13	6.15597642416120730−004	3.84863573267520883−003	−8.65821956964498758+000	5.56292487022483038+001	1.69853781372837966+002	23
14	1.78220142264083520−004	1.23565840401212999−003	−2.68872026718986219+001	1.92706442657688172+002	1.97807826657445982+002	23
15	4.77927281396994941−005	3.63239065733023604−004	−9.13490136709354195+001	7.19482618476861731+002	2.27770225429389786+002	22
16	1.19441986205111918−005	9.86093139501419290−005	−3.36353487210180661+002	2.88005767837453737+003	2.59739079076532843+002	22
17	2.79619102429121426−006	2.48921128791370279−005	−1.33248284123685566+003	1.23021832110723355+004	2.93712997091276940+002	22
18	6.15874909045559742−007	5.87601213232593975−006	−5.64617942076485204+003	5.58401524153018987+004	3.29690942758163610+002	23
19	1.28109313932567140−007	1.30330927840492745−006	−2.54659956568484505+004	2.68345041347053587+005	3.67672130729289705+002	23
20	2.52507072201685902−008	2.72723822059787621−007	−1.21754643755028599+005	1.36084013289426163+006	4.07655957504977672+002	23
21	4.72983514136074974−009	5.40307394216498155−008	−6.14868004579046041+005	7.26152045620055867+006	4.49641953295799804+002	22
22	8.44178825277803935−010	1.01658491161146135−008	−3.26962210852877781+006	4.06656522499891116+007	4.93629748083923852+002	23
23	1.43899380585213283−010	1.82146097378969766−009	−1.82573723632404616+007	2.38447699944473156+008	5.39619047301353352+002	22
24	2.34768969659820326−011	3.11551887273018159−010	−1.06792263641332034+008	1.46085048350503978+009	5.87609614138688807+002	22
25	3.67296199955298008−012	5.09834057988136547−011	−6.52899778656933607+008	9.33320660832255720+009	6.37601256500387628+002	23
26	5.52013515653859947−013	7.99793500556586999−012	−4.16384711214581135+009	6.20734601958520469+010	6.89593817265071406+002	22
27	7.98252769044764775−014	1.20493070505635686−012	−2.76502752517895770+010	4.29073386797179779+011	7.43587166929163670+002	22
28	1.11232761808594397−014	1.74621848744657927−013	−1.90872477899988807+011	3.07796570412516121+012	7.99581197991081316+002	22
29	1.49562075761680540−015	2.43806758520959231−014	−1.36762834061924274+012	2.28827155109320241+013	8.57575820621542407+002	22
30	1.94293378794426458−016	3.28405404919593379−015	−1.01570429405045821+013	1.76080573528674016+014	9.17570959294600260+002	22
31	2.44148833527419398−017	4.27320225423705374−016	−7.80872306241619998+013	1.40075682854724764+015	9.79566550143647638+002	22
32	2.97090660349261675−018	5.37769240311210996−017	−6.20705928266765275+014	1.15075687594176475+016	1.04356253886968709+003	22
33	3.50434838627129161−019	6.55273330562603394−018	−5.09566207278164872+015	9.75275549740676549+016	1.10955887907404483+003	22
34	4.01076712646243157−020	7.73900931881982789−019	−4.31590892278496563+016	8.51874644367416117+017	1.17755553092000764+003	22
35	4.45801843544813561−021	8.86763425474969530−020	−3.76771502546116484+017	7.66189042065265840+018	1.24755246005135364+003	22
36	4.81636700036893300−022	9.86703236343218630−021	−3.38704888019999127+018	7.08987638348402816+019	1.31954963671299780+003	22
37	5.06183983397387817−023	1.06707433399188589−021	−3.13278010638799822+019	6.74428196695757292+020	1.39354703503175768+003	22
38	5.17889051598831089−024	1.12249226239007261−022	−2.97887655852803409+020	6.59019699037324386+021	1.46954463242480137+003	22
39	5.16196594221089276−025	1.14943379945154519−023	−2.90976689580012458+021	6.61021861902762327+022	1.54754240911054195+003	22
40	5.01577214705787608−026	1.14659404114644409−024	−2.91765609693354332+022	6.80132502410261645+023	1.62754034770221283+003	21
41	4.75426961363902973−027	1.11495411637349417−025	−3.00112442434829371+023	7.17384793722291449+024	1.70953843286854325+003	21
42	4.39863866328245609−028	1.05756489819817767−026	−3.16465987920920592+024	7.75222475588477170+025	1.[illegible]665104917724+003	21
43	3.97460022739332241−029	9.79099242789010633−028	−3.41897972296553100+025	8.57755775132664541+026	1.[illegible]499021497919+003	21
44	3.50953462962183031−030	8.85258033805988633−029	−3.78215095458818036+026	9.71233396693359382+027	1.[illegible]343966532032+003	21
45	3.02981152152056401−031	7.82128617946576394−030	−4.28166405296753118+027	1.12480421448374054+029	2.[illegible]198985597158+003	21
46	2.55864721827857149−032	6.75588095784709509−031	−4.95778328240976982+028	1.33169487584642137+030	2.1[illegible]063225243754+003	21
47	2.11467174975235419−033	5.70822626504605322−032	−5.86872855849535680+029	1.61100828398204608+031	2.24352935920452569+003	21
48	1.71124924820792161−034	4.72004160184151918−033	−7.09859069343789558+030	1.99047124291019953+032	2.33952816383871117+003	21
49	1.35647835369482100−035	3.82135040492630312−034	−8.76942466005133983+031	2.51065732078550152+033	2.43752703996547086+003	21
50	1.05372033995002648−036	3.03044685136825523−035	−1.10598359714926759+033	3.23153318580935152+034	2.53752598199925578+003	22
51	8.02466519684973219−038	2.35504726007608723−036	−1.42337932656734648+034	4.24270806339926543+035	2.63952498488917062+003	21

OBLATE RADIAL FUNCTIONS

H = 6.0 X = 1.40000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	6.38181647533808198−002	3.89120597802708955−001	−8.39188526921048768−002	3.70611600493948924−001	−3.96828885830739182+000	23
3	−8.16450550766275832−002	3.84541719091434875−001	−6.70732254076677202−002	−3.73737918045322157−001	−3.27797903843184929+000	24
4	−1.04692090591672689−001	−8.75217751898817830−002	3.24515543204109007−002	−5.10698452598918790−001	7.31214012848986341+000	23
5	−1.41017716422922696−002	−4.85492021286285620−001	1.12015772816693277−001	−1.36404303968139157−001	1.49134187085504893+001	25
6	8.49515462354166303−002	−3.94797138116453843−001	8.29967050492268221−002	2.77092598344754276−001	2.62594432274110872+001	24
7	1.27777543378031422−001	−1.11297032256320365−001	−7.11028743988212226−004	4.41278179284947715−001	3.97275520049222553+001	24
8	1.15579814409094802−001	9.95163772671006755−002	−8.35081912631094908−002	4.15261729611297753−001	5.53711820152833167+001	23
9	7.99804031594257046−002	1.66948617013894857−001	−1.48995860539298457−001	3.92991935609805097−001	7.31139413336567528+001	23
10	4.59222648267938456−002	1.42278954889486992−001	−2.16924053925736694−001	5.54035797653364473−001	9.29223857780106065+001	22
11	2.27893192364411462−002	9.09970665245036720−002	−3.35893617283599373−001	1.12951914895436917+000	1.14775928256730038+002	23
12	1.00200743599534008−002	4.82580278491626994−002	−6.06730229405765071−001	2.69725563182743808+000	1.38661500587886042+002	22
13	3.96952256842197437−003	2.21948983685299796−002	−1.28280287215987586+000	7.01208431293155601+000	1.64570445884335911+002	23
14	1.43432897630507041−003	9.08275278356939036−003	−3.09167963843652906+000	1.96784314691198211+001	1.92496839836936458+002	22
15	4.77171527795371630−004	3.36318051508172835−003	−8.29470146585474110+000	5.95377685026230388+001	2.22436516925061995+002	22
16	1.47248933595228271−004	1.14036655465908655−003	−2.43828669306019878+001	1.93555903299718952+002	2.54386479833247715+002	22
17	4.24059996932900277−005	3.57291932952766747−004	−7.76927849911747816+001	6.73190142593026778+002	2.88344528084663583+002	22
18	1.14554038854333681−005	1.04178028253315731−004	−2.66238405317186513+002	2.49402941011834013+003	3.24309017370143473+002	21
19	2.91528507202240460−006	2.84324300591949123−005	−9.75179394834794182+002	9.80335907516297947+003	3.62278699487766851+002	22
20	7.01553080581583225−007	7.29838332700351406−006	−3.79880461943818996+003	4.07398596062910485+004	4.02252613456670412+002	21
21	1.60163805697181534−007	1.76924206499967463−006	−1.56724254405562868+004	1.78429775890408705+005	4.44230009942551298+002	21
22	3.47889082249016743−008	4.06465120383143651−007	−6.82331617688157080+004	8.21293551643294458+005	4.88210297852593307+002	22
23	7.20775691769027306−009	8.87702740687462552−008	−3.12517155903108834+005	3.96296282627072773+006	5.34193005979180715+002	22
24	1.42770163247141044−009	1.84797197955699345−008	−1.50170454352740329+006	2.00008366431264514+007	5.82177755042675641+002	21
25	2.70925826682519558−010	3.67580538621707466−009	−7.55221208897461624+006	1.05364057688197938+008	6.32164237037544274+002	21
26	4.93461633207793071−011	7.00126749728477945−010	−3.96643479590803300+007	5.78286808320103135+008	6.84152199784159090+002	21
27	8.64149922237620821−012	1.27942366026951155−010	−2.17126691593032981+008	3.30111742444216759+009	7.38141435241857910+002	21
28	1.45726288204846464−012	2.24716161738180404−011	−1.23663661016148120+009	1.95689353016250428+010	7.94131770573879329+002	21
29	2.36987641667576555−013	3.79960193931037441−012	−7.31617335389297626+009	1.20292179127684675+011	8.52123061249145688+002	22
30	3.72160588935582071−014	6.19397105128921707−013	−4.48946526375867007+010	7.65763202071605771+011	9.12115185667961168+002	21
31	5.65050609292191687−015	9.74810052542854603−014	−2.85352051997315281+011	5.04200879668506773+012	9.74108040939340376+002	22
32	8.30413058554049204−016	1.48298993665772845−014	−1.87626962904566285+012	3.42978909466897076+013	1.03810153953680501+003	21
33	1.18253655369009701−016	2.18339174265644170−015	−1.27476277402579050+013	2.40781065675462226+014	1.10409560663016700+003	21
34	1.63335986246780395−017	3.11438899724689272−016	−8.93945186179481950+013	1.74274980306584868+015	1.17209017794177189+003	22
35	2.19029177179809804−018	4.30826665722143019−017	−6.46396623002177495+014	1.29927055794653446+016	1.24208519801279037+003	21
36	2.85401267132938935−019	5.78539646531122418−018	−4.81483883101730035+015	9.96861542981286732+016	1.31408061879243974+003	21
37	3.61661373543062278−020	7.54833367899697404−019	−3.69124170482788864+016	7.86470005070890661+017	1.38807639848327282+003	22
38	4.46044877868252704−021	9.57678511189612049−020	−2.91010167856130072+017	6.37534232269692671+018	1.46407250059083246+003	21
39	5.35801915230284142−022	1.18244557063428465−020	−2.35747392118818109+018	5.30615131044073395+019	1.54206889313740978+003	21
40	6.27308346548349730−023	1.42186404654418101−021	−1.96094826178436680+019	4.53115093351791222+020	1.62206554800834199+003	21
41	7.16299965377154192−024	1.66630891623422812−022	−1.67363607324678811+020	3.96738246071525492+021	1.70406244040594744+003	21
42	7.98210056491289875−025	1.90441803051470808−023	−1.46468072703933708+021	3.55954704153809377+022	1.78805954839133221+003	21
43	8.68571742642253091−026	2.12398875990673832−024	−1.31352482761048524+022	3.27056306516013113+023	1.87405685249828975+003	21
44	9.23433798526706672−027	2.31305181287357166−025	−1.20638825576529486+023	3.07568565622648475+024	1.96205433540662923+003	20
45	9.59734566893728260−028	2.46098537234816848−026	−1.13407628027050176+024	2.95882381620244729+025	2.05205198166471445+003	21
46	9.75584204246383934−029	2.55952114907535854−027	−1.09060741423882174+025	2.91025405719969633+026	2.14404977745292834+003	20
47	9.70419566098649047−030	2.60350825489367870−028	−1.07236160766100250+026	2.92525875613433404+027	2.23804771038131333+003	21
48	9.45015720415349820−031	2.59133801944085606−029	−1.07757254181567220+027	3.00341663424465470+028	2.33404576931586368+003	20
49	9.01359449139133530−032	2.52498534613939429−030	−1.10606217470631299+028	3.14839973141511024+029	2.43204394422892970+003	21
50	8.42409179583326614−033	2.40967949551801916−031	−1.15916301851284232+029	3.36821979356980416+030	2.53204222606998652+003	21
51	7.71779389432610017−034	2.25326859085698636−032	−1.23980655798069177+030	3.67593834927351110+031	2.63404060665366240+003	22

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 7.0 X = 1.40000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	7.73232964388663473−002	−3.13507967016362813−001	4.48457034703040043−002	4.42338396232193351−001	−1.05956525716544756+001	23
3	4.56477526898606177−002	4.38875219739997674−001	−7.69042176851225071−002	3.17895010640485835−001	−1.03776727949597438+001	23
4	−3.24019392679880869−002	5.07455220778396993−001	−8.67881586455407082−002	−1.30283685220516686−001	4.08466529086879527+000	23
5	−9.36446945705539386−002	1.12467217228412570−002	8.57564022707830299−003	−5.16409352644561211−001	9.67676377785498349+000	23
6	−4.28303470215781612−002	−4.16940614625360754−001	8.72636959171189445−002	−2.77344688484534520−001	2.10375437832845670+001	23
7	4.60144445205418118−002	−4.58042335458289850−001	9.05363731499074829−002	1.47628783348864952−001	3.41393013273133882+001	23
8	1.02884262075136027−001	−2.25438266232958974−001	3.28506027279275488−002	3.97113849239828406−001	4.95967145043916895+001	25
9	1.10890097248022328−001	2.01251290803310730−002	−4.00701006980069577−002	4.27956449597083979−001	6.72036026037745036+001	22
10	8.78869420413615549−002	1.46982713610045042−001	−1.01521297436610146−001	3.79358658996372062−001	8.69117555614111238+001	23
11	5.70502570814884782−002	1.61699113228280474−001	−1.53675632800879341−001	4.10398408554206503−001	1.08688657886667266+002	23
12	3.18465531794872868−002	1.21976169098174943−001	−2.20708212938547238−001	6.70132363760680223−001	1.32514249999744122+002	23
13	1.57204712959889301−002	7.43174168923147991−002	−3.50234373725374376−001	1.41433636954980049+000	1.58375341738284068+002	22
14	6.98863353809281217−003	3.88586821344334776−002	−6.43815702025272277−001	3.32607489256540943+000	1.86262940807412764+002	22
15	2.83448115786102970−003	1.79932486956233822−002	−1.35785938892233896+000	8.40726935788288101+000	2.16170733681740967+002	21
16	1.05912271387321228−003	7.52248979803338606−003	−3.20891933500679887+000	2.27768557753123272+001	2.48094178410367391+002	22
17	3.67394765704445960−004	2.87740412404123597−003	−8.33745492770810865+000	6.60660502960978869+001	2.82029939032619601+002	21
18	1.19047889791204240−004	1.01684724394979596−003	−2.35139676742706691+001	2.04559989104828296+002	3.17975520785057448+002	21
19	3.62193350826042678−005	3.34494552178883746−004	−7.13466761500179965+001	6.73603579929162610+002	3.55929028089548874+002	21
20	1.03913458497022109−005	1.03041398693543365−004	−2.31359043442116608+002	2.35032008164488197+003	3.95889000090951562+002	21
21	2.82183350941017873−006	2.98724924717218309−005	−7.97578546928573078+002	8.65993299828856272+003	4.37854296531453128+002	21
22	7.27652471312174065−007	8.18414620539505833−006	−2.91038075941272766+003	3.35923639069991346+004	4.81824017076870784+002	22
23	1.78683478799593783−007	2.12647995009830466−006	−1.12001646235091242+004	1.36809641927070862+005	5.27797443338756415+002	21
24	4.18897649007268709−008	5.25622825881194976−007	−4.53136278017765530+004	5.83547585535043808+005	5.75773996580949874+002	21
25	9.39667231455608774−009	1.23933082669479421−007	−1.92206957097389337+005	2.60110672595089729+006	6.25753206446306800+002	21
26	2.02099325364713897−009	2.79409958412561951−008	−8.52690221981867049+005	1.20918435883803469+007	6.77734687543632061+002	22
27	4.17521932063026919−010	6.03627434033912869−009	−3.94780897772764152+006	5.85178606283184491+007	7.31718121718406287+002	21
28	8.29937036674508598−011	1.25200652363814777−009	−1.90379356974798895+007	2.94322671398984933+008	7.87703244485624333+002	21
29	1.58974871949608316−011	2.49754930430533416−010	−9.54595071410128637+007	1.53615885316470330+009	8.45689834546077225+002	21
30	2.93860707622951748−012	4.79935882846477177−011	−4.96889208943805325+008	8.30837587743835469+009	9.05677705611677602+002	21
31	5.24866865915496188−013	8.89707955861548524−012	−2.68105450376281096+009	4.65051132519308867+010	9.67666699977298256+002	20
32	9.06931490737808463−014	1.59326992036574118−012	−1.49752318875980537+010	2.69071721455873853+011	1.03165668342601125+003	21
33	1.51776108944987501−014	2.75960366422260945−013	−8.64817633885642454+010	1.60743408950085145+012	1.09764754116124143+003	20
34	2.46257053149803319−015	4.62826164260108493−014	−5.15774171745482398+011	9.90476000473009756+012	1.16563917453627981+003	21
35	3.87751246840375856−016	7.52430172658145839−015	−3.17332839243452620+012	6.28894636936702621+013	1.23563149840768298+003	20
36	5.93052406583716275−017	1.18692575524170783−015	−2.01214190882077774+013	4.11092130207902970+014	1.30762443898036163+003	21
37	8.81820278575942518−018	1.81841820887671696−016	−1.31367029806843862+014	2.76411520012097266+015	1.38161793204281889+003	21
38	1.27574528640008057−018	2.70804153621178804−017	−8.82307137276438224+014	1.91020141464969604+016	1.45761192151396440+003	21
39	1.79710890613498593−019	3.92341029073061841−018	−6.09120608478637639+015	1.35574686338493757+017	1.53560635824027226+003	21
40	2.46673586040185098−020	5.53418502026663634−019	−4.31918905338750969+016	9.87513794834244618+017	1.61560119899524670+003	22
41	3.30143836428300064−021	7.60572921470243991−020	−3.14340908997076806+017	7.37697549549305858+018	1.69759640564327307+003	20
42	4.31116894350879545−022	1.01911598376314679−020	−2.34639487037923378+018	5.64813474382119013+019	1.78159194443773586+003	21
43	5.49620540716347046−023	1.33224576032628316−021	−1.79523154473386569+019	4.42953825707831607+020	1.86758778542934713+003	21
44	6.84476497570035232−024	1.70016406389944464−022	−1.40699104443377357+020	3.55620568846648823+021	1.95558390196536605+003	20
45	8.33146226546956121−025	2.11932395430441717−023	−1.12891048106732174+021	2.92112923748129486+022	2.04558027026411392+003	20
46	9.91697385813593158−026	2.58193734111882436−024	−9.26794134787756620+021	2.45370258803303084+023	2.13757686905213331+003	20
47	1.15491493145580841−026	3.07585704445060805−025	−7.78094752904960129+022	2.10660242847084840+024	2.23157367925367942+003	20
48	1.31656282654173509−027	3.58490981499750457−026	−6.67709708590348601+023	1.84767159555150119+025	2.32757068372410107+003	20
49	1.46978125303973281−028	4.08970080384985822−027	−5.85382062956695966+024	1.65481586310298922+026	2.42556786702016920+003	20
50	1.60758365993603359−029	4.56884414169958971−028	−5.24067769379601736+025	1.51274918306150635+027	2.52556521520162068+003	20
51	1.72340162460097730−030	5.00050971771843263−029	−4.78894975947340079+026	1.41089332315477861+028	2.62756271565916611+003	20

OBLATE RADIAL FUNCTIONS

H = 8.0 X = 1.40000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	−2.87981596720771627−002	−4.90192772757650227−001	7.19726799150525153−002	−2.41308551605445638−001	−1.94237996138059759+001	23
3	7.19119128967149353−002	−2.42451618914286184−001	2.89699861982088392−002	4.89569923228363165−001	−1.93656429956223289+001	24
4	7.42553181221590438−002	1.56804432662224120−001	−3.06037964679951874−002	5.04084013560848866−001	1.54737735892829929−001	23
5	−2.02265843652862657−002	5.17806423659508235−001	−7.82706855432909875−002	−8.40807296213099761−002	3.49293691839356864+000	24
6	−8.02978561406465563−002	1.77348443561929835−001	−2.05971773423081310−002	−4.80421946991120707−001	1.55694281521800319+001	23
7	−5.95713527260546558−002	−3.13981854264823380−001	6.10180512985157373−002	−3.87286300942181446−001	2.78981769422102452+001	24
8	1.24998985961341750−002	−4.80679676751423525−001	8.78164859186432655−002	1.45038495879927130−003	4.31071642109061111+001	23
9	7.57394019912051454−002	−3.29542833865444593−001	5.48464141354230623−002	3.18928937291973459−001	6.05175976442200780+001	23
10	1.00381949075495955−001	−7.87856849659997172−002	−5.71204015277761362−003	4.25173620544274542−001	8.00852634861732686+001	22
11	9.11349553842661463−002	9.96509810509308837−002	−6.41487126586071941−002	3.93232733028059620−001	1.01755745161226464+002	22
12	6.63520119995807253−002	1.62797525094472491−001	−1.11486281005510998−001	3.62913472770016405−001	1.25498522767600099+002	22
13	4.11921847375502141−002	1.47226098339668185−001	−1.58014160868592476−001	4.60425235113619000−001	1.51293759154720275+002	22
14	2.25284644717295428−002	1.02720816924621076−001	−2.29233394206773110−001	8.29292570465722407−001	1.79128071656414913+002	22
15	1.10777295873004605−002	6.04770094610160591−002	−3.73507240232661748−001	1.77302836954403463+000	2.08992118521659042+002	22
16	4.96672815141426606−003	3.12917372424553879−002	−6.97250203890763482−001	4.10965910254608199+000	2.40879201736298736+002	21
17	2.05154583735160372−003	1.45631908581120993−002	−1.46857237513383683+000	1.01594756316100556+001	2.74784410906611308+002	21
18	7.86954267579851657−004	6.18933603106998320−003	−3.41927476028272341+000	2.67699028058781943+001	3.10704077344826048+002	21
19	2.82127715416802036−004	2.42806348181554706−003	−8.66628790096043357+000	7.50987279757555469+001	3.48635414589267212+002	21
20	9.50265035190654913−005	8.86379383475737918−004	−2.36614953063566220+001	2.23691994557093548+002	3.88576275304251876+002	20
21	3.02032848745677773−005	3.03029459164698633−004	−6.90740763688556896+001	7.05163356033110532+002	4.30524983117590751+002	21
22	9.09288101574436603−006	9.75205271795274281−005	−2.14375241327463956+002	2.34510306956781556+003	4.74480213987036674+002	21
23	2.60132622406521709−006	2.96698843068011391−005	−7.04095840867477342+002	8.20323394769914125+003	5.20440911045442597+002	21
24	7.09196826663271807−007	8.56492181071338243−006	−2.43800425601038471+003	3.01022411553324759+004	5.68406222524577499+002	20
25	1.84717189032176498−007	2.35330793857135431−006	−8.87110952021405249+003	1.15599838779240431+005	6.18375455868031430+002	20
26	4.60668309925661450−008	6.17118664207293655−007	−3.38257121651390385+004	4.63571097954726769+005	6.70348043379323849+002	20
27	1.10225739978852386−008	1.54824623193288835−007	−1.34826670450377431+005	1.93740965449099938+006	7.24323516206342460+002	20
28	2.53501697224048942−009	3.72413000814627422−008	−5.60556991925161359+005	8.42355645524922037+006	7.80301484428584165+002	20
29	5.61306173729171493−010	8.60517012142631479−009	−2.42623956363663258+006	3.80389999765144302+007	8.38281621665298652+002	20
30	1.19838407839166133−010	1.91337289571540969−009	−1.09132889485614372+007	1.78144376559920613+008	8.98263653069435849+002	20
31	2.47042644321416038−011	4.10045669624706276−010	−5.09324280930846619+007	8.64025245735204754+008	9.60247345883060477+002	20
32	4.92360088982132154−012	8.48174114803140731−011	−2.46274240144483431+008	4.33450774016085591+009	1.02423250194889307+003	20
33	9.49822774722047895−013	1.69564246608852531−011	−1.23211395076607627+009	2.24646985919906856+010	1.09021895172884431+003	20
34	1.77553040340940667−013	3.28028357392962231−012	−6.37025809392844239+009	1.20152697478787715+011	1.15820654949308828+003	20
35	3.21946403786455025−014	6.14763500432978369−013	−3.39973044332926171+010	6.62514865834029274+011	1.22819516942535449+003	20
36	5.66791962614342093−015	1.11732881074455450−013	−1.87092206699066657+011	3.76247015753392773+012	1.30018470245057473+003	20
37	9.69698355345484765−016	1.97131282420864243−014	−1.06063176579541352+012	2.19876207847932068+013	1.37417505363593106+003	20
38	1.61356629118209322−016	3.37931842676176509−015	−6.18832938386783528+012	1.32113532170635657+014	1.45016614004999948+003	20
39	2.61346538094266568−017	5.63344307669277173−016	−3.71286819848250849+013	8.15526321401969046+014	1.52815788899010089+003	20
40	4.12334180224269743−018	9.13985656996484922−017	−2.28888133371970437+014	5.16806116394992666+015	1.60815023650731634+003	20
41	6.34146206557235617−019	1.44428979880406778−017	−1.44872408610375996+015	3.35978601164945564+016	1.69014312617345520+003	20
42	9.51316998128739402−020	2.22448169812516811−018	−9.40776811557932077+015	2.23924535967717865+017	1.77413650804571432+003	20
43	1.39293248655344452−020	3.34160989278658652−019	−6.26373105214377912+016	1.52906076107331452+018	1.86013033779366129+003	21
44	1.99187933625697094−021	4.89905435255516730−020	−4.27314831620697956+017	1.06910812740892077+019	1.94812457596012974+003	19
45	2.78336680787944843−022	7.01392502814219262−021	−2.98516571064225784+018	7.64972880269624521+019	2.03811918733308326+003	20
46	3.80265311141563689−023	9.81187028197818782−022	−2.13424899617281248+019	5.59839533244057513+020	2.13011414040982947+003	19
47	5.08200585396312926−024	1.34190413079597893−022	−1.56077652660568374+020	4.18842592046893948+021	2.22410940693840403+003	20
48	6.64704880570204264−025	1.79513054560293293−023	−1.16688903567273960+021	3.20180411475541644+022	2.32010496152369237+003	19
49	8.51277866708450176−026	2.35012385150537596−024	−8.91448635187188971+021	2.49972230718931544+023	2.41810078128806319+003	20
50	1.06796540260549064−026	3.01238969427377025−025	−6.95561521411026498+022	1.99226548814239045+024	2.51809684557806805+003	19
51	1.31302400918839543−027	3.78227981154244565−026	−5.54052447789838398+023	1.62022291311852904+025	2.62009313571020408+003	20

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H=9.0 X=1.40000000 M=2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	−6.66698619441966670−002	1.58691334075239570−001	−1.53581566757060865−002	−5.26479733753048957−001	−3.03400129442213547+001	23
3	−1.53916558773167944−002	−5.26390409080056415−001	6.66634109277071159−002	−1.58953488054229456−001	−3.03260782451631671+001	23
4	3.05318065991180817−002	−4.95822370751122529−001	6.39065695541328765−002	1.91643776323569450−001	−5.47570239238361657+000	23
5	6.56672413863665248−002	1.62812224846081698−001	−2.69649848271649580−002	5.04776927811799914−001	−3.94268498265324982+000	22
6	9.88556243566688432−003	5.06223511659380667−001	−7.19191311751549442−002	1.14346796746795821−001	1.03429643027314422+001	23
7	−6.35465133961549418−002	3.00009181801972003−001	−3.77716017853497077−002	−4.12386278806454801−001	2.10642752188902299+001	23
8	−6.77436278716627985−002	−1.77508259548280469−001	3.44245256236418109−002	−4.63909313623511845−001	3.60087218114355550+001	23
9	−1.46505685458592181−002	−4.57553692736839406−001	7.73483728477054917−002	−1.46513352513591481−001	5.31225937887514519+001	22
10	4.81742478844437471−002	−4.09992618368596445−001	6.69080881382736864−002	2.09774220366254649−001	7.24953715001934651+001	23
11	8.51356433899310203−002	−1.85924561586244806−001	2.09202390494991723−002	3.95227544236301658−001	9.40195383917586998+001	21
12	8.95000787822312560−002	2.75938056658096366−002	−3.29152974119385762−002	4.09265329323847573−001	1.17649553152155955+002	23
13	7.29361113705711601−002	1.41451144998695737−001	−7.89340118161678594−002	3.61579890828137730−001	1.43355622023129345+002	21
14	5.00281448566963466−002	1.60978479333855654−001	−1.17969578682628303−001	3.70730799766401029−001	1.71118045852780665+002	21
15	3.00505009892952517−002	1.29505106937175634−001	−1.63775975259922563−001	5.43342433910748410−001	2.00923214393474121+002	20
16	1.61813133142056492−002	8.55598194407476379−002	−2.42682782112740572−001	1.03660575584229593+000	2.32761434441477130+002	22
17	7.93326520639859415−003	4.91028412573793649−002	−4.05598077628999896−001	2.22121901373092179+000	2.66625630568223562+002	20
18	3.58107393513999737−003	2.52010801177619907−002	−7.67184969148835857−001	5.08329288771395231+000	3.02510531458950150+002	21
19	1.50096299207331162−003	1.17748062438560830−002	−1.61456684332516359+000	1.23429597448226177+001	3.40412140763950843+002	19
20	5.88052782244983221−004	5.06980862569482924−003	−3.71552498644022122+000	3.18007795846250808+001	3.80327382389443445+002	20
21	2.16522359047858951−004	2.02953247487193297−003	−9.23276938823495801+000	8.68239765804321218+001	4.22253856656441001+002	20
22	7.52633439142619892−005	7.60568601102209679−004	−2.45587894193409089+001	2.50572090519778482+002	4.66189669042637353+002	21
23	2.47921471488350465−005	2.68281026521722542−004	−6.94834258564944209+001	7.62195085769291179+002	5.12133307644922485+002	19
24	7.76459640993310759−006	8.94740803870697767−005	−2.08069288836732057+002	2.43679494247432964+003	5.60083554055247771+002	20
25	2.31866883634948497−006	2.83200443415125170−005	−6.56814282589357350+002	8.16698255205857563+003	6.10039417586148371+002	19
26	6.61860752498675346−007	8.53445303796519140−006	−2.17832821432894989+003	2.86264106453577041+004	6.62000086086880184+002	21
27	1.80998127077627646−007	2.45556990538429058−006	−7.56831033118861842+003	1.04713914777322852+005	7.15964888724519746+002	19
28	4.75150760974302930−008	6.76215443889736338−007	−2.74777400080487210+004	3.98961065368751821+005	7.71933267510963955+002	21
29	1.19956503129729425−008	1.78613647234815850−007	−1.04018527487069790+005	1.58044028197238271+006	8.29904755301646416+002	18
30	2.91718331440699152−009	4.53400297216107457−008	−4.09764720678107007+005	6.49900636325921342+006	8.89878958637222575+002	21
31	6.84386328408628433−010	1.10801044090458043−008	−1.67681996736888506+006	2.77010168628004640+007	9.51855544247081590+002	19
32	1.55107437155238541−010	2.61088211047802560−009	−7.11661531488851898+006	1.22217827026361381+008	1.01583422834825821+003	20
33	3.40021477903382599−011	5.94070319120450152−010	−3.12798945718056750+007	5.57467154842406941+008	1.08181476809740673+003	19
34	7.21821271427924426−012	1.30698032378527323−010	−1.42195217765035561+008	2.62570571306634992+009	1.14979695471492488+003	20
35	1.48550109412403176−012	2.78361142639425709−011	−6.67732228674970544+008	1.27569525174929021+010	1.21978060791786068+003	19
36	2.96670180506527859−013	5.74571707443575719−012	−3.23539821685080633+009	6.38684168662577567+010	1.29176557138468893+003	20
37	5.75494014441507642−014	1.15061025369473471−012	−1.61587393035006402+010	3.29197627303474579+011	1.36575170903922844+003	18
38	1.08531498880968617−014	2.23759503309921682−013	−8.31035539544197872+010	1.74532995275244395+012	1.44173890198904054+003	20
39	1.99148583220270094−015	4.22957540509789179−014	−4.39714223397730405+011	9.51023230280364849+012	1.51972704598994832+003	18
40	3.55829491640854681−016	7.77752952325499102−015	−2.39161920517195681+012	5.32183222745407485+013	1.59971604933593877+003	20
41	6.19537066820122977−017	1.39239044499322049−015	−1.33609959632568177+013	3.05612294029261327+014	1.68170583109488515+003	18
42	1.05184757605182685−017	2.42872954099639915−016	−7.66101445341105465+013	1.79978600051505511+015	1.76569631962687162+003	20
43	1.74253581559777313−018	4.13049047671129711−017	−4.50534988776117811+014	1.08624640954047713+016	1.85168745133460183+003	18
44	2.81852751375408300−019	6.85357226541640677−018	−2.71566887957182515+015	6.71467797638851865+016	1.93967916960530128+003	20
45	4.45378271680519356−020	1.11019235583373307−018	−1.67671037734236668+016	4.24870908664027614+017	2.02967142391133170+003	18
46	6.87929265403001780−021	1.75672586756513168−019	−1.05977451979072696+017	2.75031247572028689+018	2.12166416904291097+003	19
47	1.03919406693546380−021	2.71693840105615454−020	−6.85326472319469980+017	1.82041449623299348+019	2.21565736445124221+003	18
48	1.53605539220232744−022	4.10921617625656988−021	−4.53186270605909751+018	1.23140962840577964+020	2.31165097368428027+003	20
49	2.22271397752798289−023	6.08084221514594813−022	−3.06287316916653838+019	8.50882716446753994+020	2.40964496390051540+003	18
50	3.15011579252429098−024	8.80857743525168925−023	−2.11466978365323669+020	6.00305075867945108+021	2.50963930544869712+003	19
51	4.37448252487322323−025	1.24964657952646129−023	−1.49078597290815551+021	4.32233561604602962+022	2.61163397150348277+003	17

OBLATE RADIAL FUNCTIONS

H = 10.0 X = 1.40000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	4.13477112110405560−003	5.48414477592517857−001	−6.10792303924633831−002	6.94233242761187950−002	−4.32902515278834911+001	23
3	−6.10790148365373100−002	6.94779967398518307−002	−4.14085023173708501−003	−5.48405796893201808−001	−4.32871554900663143+001	24
4	−5.43225809151919809−002	−2.42880556268615310−001	3.24154337945102614−002	−4.76978537388278088−001	−1.35081116810601434+001	23
5	3.14538159140611019−002	−4.81007325341389271−001	5.49320205614190488−002	2.34028186533854302−001	−1.29592510494195510+001	24
6	6.44978079064519053−002	−8.47155677734430944−002	5.72330425559818546−003	5.16280039509678134−001	5.48608097389604481+000	22
7	2.30142629009242684−002	4.69119014500072183−001	−6.12644849327137033−002	2.19144493569336165−001	1.36127365278177361+001	24
8	−4.36176277674207679−002	4.11191457834434591−001	−5.06100164951339617−002	−2.97434271054398066−001	2.84823041117450335+001	22
9	−6.77970621435588463−002	−2.46757991719325420−002	9.90577053543268957−003	−4.94702128956404234−001	4.50989397695202586+001	24
10	−3.49338564021217960−002	−3.89129813481617979−001	6.15351512006208867−002	−2.81635722127873747−001	6.42068299418925874+001	23
11	2.19471368379527490−002	−4.55703814740140194−001	7.03781812454239288−002	7.80137349310308649−002	8.55307554583849025+001	23
12	6.64921553624552536−002	−2.88518449939101136−001	4.02728543556724140−002	3.33337401226386917−001	1.09008946769617878+002	22
13	8.31538796572333624−002	−6.29945439247581543−002	−6.56755393960803398−003	4.11255662271867062−001	1.34595911154512659+002	22
14	7.61456798044562713−002	9.63008920789878928−002	−5.14415146913231047−002	3.78615308224325483−001	1.62262825644813053+002	21
15	5.75540112830076685−002	1.58211315726918806−001	−8.84045211161053465−002	3.43975819243054765−001	1.91990052492279498+002	22
16	3.77636553613351136−002	1.49979599125605967−001	−1.23433355472977068−001	4.04391430466607069−001	2.23763749994936617+002	21
17	2.21143835055191126−002	1.11505153516751032−001	−1.71879686760225107−001	6.61031899059066864−001	2.57573884295069009+002	21
18	1.17632551712225540−002	7.07502883562193865−002	−2.61331573276732731−001	1.30017114261433257+000	2.93413015616965658+002	20
19	5.75387389727895202−003	3.98075124311071740−002	−4.46976703504536501−001	2.77912818182786081+000	3.31275522415111205+002	21
20	2.61170155347428595−003	2.02983890489060453−002	−8.54875241486742672−001	6.29137487855392208+000	3.71157087798455616+002	20
21	1.10784830391566978−003	9.51376097020905730−003	−1.79813072910509147+000	1.50533225306626991+001	4.13054349733195029+002	22
22	4.41659194976892799−004	4.13973398550770063−003	−4.09912658581118235+000	3.80711877774508982+001	4.56964657053671964+002	19
23	1.66251999260339120−004	1.68489815674990524−003	−1.00229632980321962+001	1.01629523091023071+002	5.02885895783312384+002	20
24	5.93224177494419381−005	6.45211416777145527−004	−2.60943857630292153+001	2.85682694985063329+002	5.50816363304804023+002	19
25	2.01324196823487987−005	2.33570145032826683−004	−7.19389786949347263+001	8.43464738189548910+002	6.00754675770075220+002	20
26	6.51714468668315170−006	8.02469090729038522−005	−2.09107340787337575+002	2.60905148475373413+003	6.52699699019974594+002	20
27	2.01746951404112337−006	2.62531442361964066−005	−6.38584871176773678+002	8.43577706393046170+003	7.06650496398537976+002	20
28	5.98580279321467719−007	8.20201517135331617−006	−2.04271933425304170+003	2.84495988286275672+004	7.62606288882236158+002	19
29	1.70559789687921019−007	2.45318768345231117−006	−6.82679126807966655+003	9.98851110135806595+004	8.20566424302187410+002	20
30	4.67579129090777439−008	7.03992902913547488−007	−2.37826720686767939+004	3.64450643215229447+005	8.80530353359336931+002	18
31	1.23529000485247869−008	1.94215661346251148−007	−8.61930345794036636+004	1.37973645885202579+006	9.42497610769050021+002	20
32	3.14967411008467024−009	5.15991340855215946−008	−3.24395794492312390+005	5.41174772095308464+006	1.00646780031737304+003	19
33	7.76135973815416619−010	1.32230884498321147−008	−1.26581689633056185+006	2.19623565681632509+007	1.07244058292767951+003	21
34	1.85067561672118977−010	3.27328008142506185−009	−5.11358357049960330+006	9.21047015682000912+007	1.14041566706382333+003	18
35	4.27509683786900709−011	7.83730541653487373−010	−2.13579886192200833+007	3.98701513463487064+008	1.21039280096117563+003	20
36	9.57746643567142460−012	1.81723268525501934−010	−9.21182170591636935+007	1.77956878298953397+009	1.28237176629826689+003	18
37	2.08294291971947485−012	4.08507887618744922−011	−4.09819150434730415+008	8.18186042327984880+009	1.35635237301172275+003	20
38	4.40179546701089561−013	8.91223257275031710−012	−1.87866129341754678+009	3.87131059112894992+010	1.43233445502448834+003	18
39	9.04660319213212186−014	1.88880406803807042−012	−8.86532206698045938+009	1.88346134315057186+011	1.51031786670811535+003	20
40	1.80966498030138629−014	3.89216689005680686−013	−4.30268282968636262+010	9.41446307527330393+011	1.59030247993850143+003	18
41	3.52614481942542135−015	7.80485008423011606−014	−2.14594007741277586+011	4.83106737306714659+012	1.67228818163405542+003	20
42	6.69737114461338142−016	1.52422059704513409−014	−1.09897291889448813+012	2.54323850810408430+013	1.75627487168808744+003	19
43	1.24081230103571162−016	2.90109656616389375−015	−5.77465476354237561+012	1.37256478391399030+014	1.84226246122495042+003	20
44	2.24380126864746717−017	5.38529974053294726−016	−3.11122930800880895+013	7.58930019185265083+014	1.93025087112331543+003	18
45	3.96281243541325591−018	9.75609722481212026−017	−1.71758972700259869+014	4.29664832547955505+015	2.02024003076085724+003	19
46	6.83933862074050511−019	1.72595931141318025−017	−9.70998030127584756+014	2.48923964921550891+016	2.11222987694324117+003	18
47	1.15412869100750177−019	2.98351744811778924−018	−5.61788910919401987+015	1.47494068361236804+017	2.20622035298715102+003	19
48	1.90524308699438359−020	5.04211227890440352−019	−3.32461540158616707+016	8.93361049883796324+017	2.30221140793257089+003	18
49	3.07835233033768505−021	8.33513401647077469−020	−2.01137356464095538+017	5.52851452304291022+018	2.40020299586392935+003	19
50	4.87039084005368658−022	1.34849054456435746−020	−1.24339166191363347+018	3.49392181240001607+019	2.50019507532326085+003	18
51	7.54889494110269886−023	2.13612789432792447−021	−7.85015447862899728+018	2.25395239435080379+020	2.60218760880141368+003	19

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 12.0 X = 1.40000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	1.28724448792995489−002	−5.45004580262580897−001	4.89069962079767422−002	1.16420480100956551−001	−7.52286978492194622+001	23
3	4.89070452927652224−002	1.16418569405551912−001	−1.28722763875560583−002	5.45004937255205656−001	−7.52285673969014027+001	24
4	3.64934168017059447−002	3.65600274190364217−001	−3.70777965026309922−002	4.00003668188569036−001	−3.66661842092831736+001	23
5	−3.70350867689500447−002	4.00432972089442884−001	−3.65393173742859297−002	−3.65102579162440056−001	−3.66217092269358512+001	25
6	−5.32939173169139784−002	4.66941674593671169−002	−1.58109590228880393−003	−5.26876735844876219−001	−6.51224524639420730+000	24
7	−5.28980879568156647−003	−5.21202254815503552−001	5.31705280727120001−002	−8.32835455762187044−002	−3.98717151853308588+000	24
8	4.51303347592738931−002	−3.15606759022140301−001	3.01590464597489247−002	4.12909727884621109−001	1.37164365780463355+001	23
9	4.54698542098324276−002	2.59389094010297375−001	−3.09195826618706135−002	4.42775790008151707−001	2.74902446237123994+001	25
10	−4.39506036305976545−003	5.04021023511784082−001	−5.58326123116405516−002	−2.80832331842024337−003	4.58977645667728861+001	23
11	−4.99746327286922394−002	2.74749811680029434−001	−2.79621997911426019−002	−4.09618698700800799−001	6.65498310735474590+001	23
12	−5.42963174209556357−002	−1.44004000387086136−001	2.26862767661378777−002	−4.58341186419686357−001	8.95576117848965092+001	22
13	−2.05725110467977874−002	−4.18742585716042855−001	5.72577968704923926−002	−2.03031862746253005−001	1.14780769133126801+002	22
14	2.50845996690511968−002	−4.30534777522710408−001	5.82418927913593964−002	1.22704481567678403−001	1.42159811364883728+002	22
15	5.88031755042557634−002	−2.61609595035293031−001	3.17501490326380578−002	3.37515947943629712−001	1.71654125373987273+002	21
16	7.12758905355453854−002	−5.52603167551565772−002	−6.12881908170328482−003	3.99740128434231314−001	2.03236169420520186+002	21
17	6.59200492517485878−002	9.14960778131832504−002	−4.24173659344596984−002	3.68205588656166247−001	2.36886413679515778+002	22
18	5.13222091727261216−002	1.53440632901852894−001	−7.27070440463314028−002	3.31180956007906154−001	2.72590605645570861+002	21
19	3.51319621696076077−002	1.51379434799991958−001	−1.00684293530063902−001	3.67517807374429483−001	3.10338098331930940+002	20
20	2.16684693975223303−002	1.18320184922991384−001	−1.36405541480142039−001	5.54428835756884003−001	3.50120783929988566+002	20
21	1.22324735183579153−002	7.95369761357918954−002	−1.97381678821982442−001	1.01811062630597208+000	3.91932387217646553+002	20
22	6.39076238252034512−003	4.77161620666540049−002	−3.16202899565189952−001	2.04438274646069381+000	4.35767982922972047+002	20
23	3.11538726427867172−003	2.60869598753405510−002	−5.61747407301516369−001	4.33296727940736505+000	4.81623657672317726+002	19
24	1.42615910355387093−003	1.31732894849426836−002	−1.09283739989807612+000	9.64611149628585559+000	5.29496268131497047+002	19
25	6.16242033242015971−004	6.20284448042837094−003	−2.29683960631512986+000	2.25661566860868562+001	5.79383264783595665+002	20
26	2.52407061224847721−004	2.74273706772647185−003	−5.16164266823849942+000	5.54506058931089361+001	6.31282561472110723+002	19
27	9.83482225779503894−005	1.14516903515124899−003	−1.23123242822901375+001	1.42894912240990915+002	6.85192437457944610+002	19
28	3.65654483561368854−005	4.53501774724472301−004	−3.10060012992124772+001	3.85387768245043829+002	7.41111462959183003+002	20
29	1.30065976935740496−005	1.70966483316446539−004	−8.20898493976201228+001	1.08549065776368501+003	7.99038441900708701+002	19
30	4.43663106140348706−006	6.15482699674360020−005	−2.27718299295020443+002	3.18653626951472974+003	8.58972367442615365+002	19
31	1.45423106246464109−006	2.12155000218935849−005	−6.59989476518776042+002	9.73101645596543742+003	9.20912387110147956+002	19
32	4.58883849781462907−007	7.01831653474852941−006	−1.99365178657695753+003	3.08598218517238329+004	9.84857775215940973+002	19
33	1.39630585281776937−007	2.23277095293022830−006	−6.26345162875357825+003	1.01469891161716185+005	1.05080791087555158+003	18
34	4.10316011356435587−008	6.84349279623002641−007	−2.04276071032349181+004	3.45429731118151768+005	1.11876226035222008+003	18
35	1.16603178580607003−008	2.02415196695675439−007	−6.90455821105438181+004	1.21585691246652927+006	1.18872036278069899+003	20
36	3.20848709730637183−009	5.78603035369167774−008	−2.41499994181430323+005	4.41949422129714444+006	1.26068181854916559+003	18
37	8.55832280870271671−010	1.60056349314318295−008	−8.72912402976274134+005	1.65705783960089671+007	1.33464627978731944+003	18
38	2.21532689899189647−010	4.28994729036020864−009	−3.25655298962390645+006	6.40208561808896204+007	1.41061344253474260+003	19
39	5.57027236105873374−011	1.11533858346461315−009	−1.25252406833310771+007	2.54624334906983483+008	1.48858304025831187+003	18
40	1.36176841911345340−011	2.81571192590846746−010	−4.96135054356925925+007	1.04154414656249015+009	1.56855483845926117+003	18
41	3.23959248037892228−012	6.90898331943835968−011	−2.02199095098882243+008	4.37809739546534400+009	1.65052863016536807+003	21
42	7.50560916123996917−013	1.64919776670863301−011	−8.47097872574479355+008	1.88963129469366258+010	1.73450423214598524+003	18
43	1.69479247266878994−013	3.83288700365324848−012	−3.64501545297928129+009	8.36811646500934854+010	1.82048148172038968+003	21
44	3.73240870596240126−014	8.67985614169587142−013	−1.60966937748186875+010	3.79954491539551208+011	1.90846023405547982+003	18
45	8.02219662080907819−015	1.91668049959129966−013	−7.28999127560580866+010	1.76766660096877748+012	1.99844035986891866+003	18
46	1.68384481412843593−015	4.12986647371758862−014	−3.38353837766952072+011	8.42096096130949336+012	2.09042174346967130+003	18
47	3.45361509000883387−016	8.68865428785120810−015	−1.60837445624052805+012	4.10542089026842509+013	2.18440428108047396+003	18
48	6.92554305496036720−017	1.78593093948296963−015	−7.82544832476537974+012	2.04712363523247506+014	2.28038787939682342+003	17
49	1.35854567532659740−017	3.58858720828043311−016	−3.89480558265474906+013	1.04349113305234193+015	2.37837245434514232+003	17
50	2.60829178030345376−018	7.05288763832583356−017	−1.98188550005996512+014	5.43464405180690669+015	2.47835793000928042+003	17
51	4.90354339220424186−019	1.35650337689184261−017	−1.03053187499984317+015	2.89055328670436821+016	2.58034423769978134+003	17

OBLATE RADIAL FUNCTIONS

H = 14.0 X = 1.40000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	−2.38885716197684701−002	4.78336662112550494−001	−3.58481082562690048−002	−2.92349404396441694−001	−1.15189548296244584+002	24
3	−3.58481109148456584−002	−2.92349351988863289−001	2.38885678138746464−002	−4.78336692599459648−001	−1.15189543550979888+002	24
4	−2.05841947055396745−002	−4.72477777380232853−001	3.90546372255242826−002	−2.75882832425735524−001	−6.83141511589437481+001	24
5	3.90534644802373411−002	−2.75910755944328588−001	2.05865539963775907−002	4.72460579398325307−001	−6.83115655792313947+001	24
6	4.47243944879954019−002	5.08865236915371503−002	−6.45360465487565690−003	5.32212294824851826−001	−2.77733452225816203+001	23
7	−6.11551736657175448−003	5.32481965471752815−001	−4.47807641849626872−002	−4.68193916516719794−002	−2.74496570665788272+001	24
8	−3.97206286630576808−002	2.88065451884904802−001	−2.31965340948648231−002	−4.39297026315747761−001	7.54543594508251141−001	25
9	−2.95663986566520917−002	−3.83647476248032968−001	3.55102175894607545−002	−3.55399008654537544−001	7.74331472008800061+000	23
10	1.94581171653848170−002	−4.80982597016471608−001	4.25580979470039365−002	1.88176976504005727−001	2.65196969166217908+001	23
11	4.74108267034376717−002	−4.32634752378219990−002	1.21580296950825291−003	5.07872904647385956−001	4.54335204682938013+001	23
12	2.58022270071922361−002	4.05597219235483011−001	−4.07411858500957370−002	2.94810306102606842−001	6.76634930851798033+001	22
13	−1.93208506732236940−002	4.64660659910526598−001	−4.52357759959293014−002	−1.61068922796121721−001	9.22588661604032645+001	23
14	−4.86225201463982942−002	1.60934383651783201−001	−1.31151072479187749−002	−4.52888956876383986−001	1.19160369906307053+002	22
15	−4.34587012826317962−002	−2.18650081451657927−001	2.81762842360790332−002	−4.13508152744368348−001	1.48274499894155480+002	22
16	−1.18918400734229830−002	−4.28758376304054051−001	5.22368661808895543−002	−1.45837834484480463−001	1.79547467844073955+002	22
17	2.56825537375253624−002	−4.09012145991389101−001	4.95736848222662520−002	1.50103255183131492−001	2.12942043941925500+002	22
18	5.25406328285561730−002	−2.43472023303626521−001	2.63538344857070461−002	3.37164814611863836−001	2.48431804060106030+002	21
19	6.25559886739245327−002	−5.20006446878251439−002	−5.26135867360951683−003	3.90128406433587185−001	2.85997376517853994+002	21
20	5.84464131580181138−002	8.59735848717745766−002	−3.56508481314359190−002	3.60436881844910191−001	3.25624214108506580+002	20
21	4.66321270008215236−002	1.48559318402600238−001	−6.13060012719461142−002	3.22174803822699297−001	3.67301175366009520+002	20
22	3.30284520466510811−002	1.51845783346725154−001	−8.45710807948216003−002	3.41811723527320494−001	4.11019585657602766+002	20
23	2.12315664406996977−002	1.23710041076131515−001	−1.12416216863089254−001	4.81559349569174104−001	4.56772595411761141+002	19
24	1.25662307077471350−002	8.71476464933534277−002	−1.56778916361692225−001	8.33054938591933097−001	5.04554729705274242+002	19
25	6.91759289331657088−003	5.50483896397756413−002	−2.38684173606869438−001	1.58900572948363820+000	5.54361565068337526+002	19
26	3.56875730683089711−003	3.18214714106457620−002	−3.99789436083339684−001	3.19701930944741923+000	6.06189493147895416+002	19
27	1.73560626937636681−003	1.70548971562163784−002	−7.30425822459031343−001	6.72614351248295194+000	6.60035545031999446+002	19
28	7.99499282058145972−004	8.55247250296527815−003	−1.43809629145915341+000	1.47992567441641106+001	7.15897258775238710+002	19
29	3.50201730818395312−004	4.04008699373251938−003	−3.02046675870741696+000	3.40612984308880174+001	7.73772578220321159+002	18
30	1.46347102600191192−004	1.80731020265681467−003	−6.71781514676325881+000	8.19291811312617173+001	8.33659774835653185+002	19
31	5.85115890720221145−005	7.68874518643130506−004	−1.57365944139733862+001	2.05631189768887912+002	8.95557386708233236+002	18
32	2.24365439052460220−005	3.12158864245247037−004	−3.86666513272714272+001	5.37566579760353491+002	9.59464170478681733+002	19
33	8.26914988096954020−006	1.21302975214300643−004	−9.93290228275635544+001	1.46113788129147501+003	1.02537906314713137+003	18
34	2.93484535137003503−006	4.52312353252542627−005	−2.66037775508054212+002	4.12221274153835412+003	1.09330115148280633+003	18
35	1.00477764528077320−006	1.62191891829832628−005	−7.41187311457604554+002	1.20522356001785452+004	1.16322964734449171+003	18
36	3.32339909008551814−007	5.60378340848096275−006	−2.14365114298211919+003	3.64648274076160963+004	1.23516386763471018+003	18
37	1.06347643981519482−007	1.86869914757718645−006	−6.42467342068090442+003	1.14017498955529480+005	1.30910321791472780+003	18
38	3.29653541174486070−008	6.02379559301609981−007	−1.99220142128442658+004	3.67982092536352188+005	1.38504717893273589+003	17
39	9.91009053987992633−009	1.87964525075910598−007	−6.38241683502492752+004	1.22446859492583287+006	1.46299529548591692+003	19
40	2.89236318285377552−009	5.68464479343247944−008	−2.10984193696379272+005	4.19642049840081543+006	1.54294716716411909+003	17
41	8.20376900103843430−010	1.66821598208726381−008	−7.18820294334214544+005	1.47978314566967893+007	1.62490244061951015+003	17
42	2.26338466460763336−010	4.75534034477098226−009	−2.52134249387936756+006	5.36428148383202743+007	1.70886080308070617+003	17
43	6.07937567585090581−011	1.31799746515690606−009	−9.09613370727539947+006	1.99734209724706875+008	1.79482197688714656+003	18
44	1.59096971479018825−011	3.55502909027838669−010	−3.37209604399367942+007	7.63268746524528403+008	1.88278571486405273+003	17
45	4.05967892604796120−012	9.33967296853250392−011	−1.28349493562905931+008	2.99133291005180638+009	1.97275179639321337+003	17
46	1.01077127772229756−012	2.39177224946063785−011	−5.01184547985476504+008	1.20146678696080565+010	2.06472002406234636+003	17
47	2.45715230382587994−013	5.97482710763867027−012	−2.00627776018303770+009	4.94235191093815287+010	2.15869022079759314+003	17
48	5.83578663861269744−014	1.45695519596856001−012	−8.22763447415153080+009	2.08094985057848422+011	2.25466222740108130+003	17
49	1.35490895545499523−014	3.47026404952013443−013	−3.45436499815481552+010	8.96275385542697142+011	2.35263590042941800+003	17
50	3.07684616144666283−015	8.07864074746741576−014	−1.48390428151573449+011	3.94668563200775572+012	2.45261111036019199+003	16
51	6.83778551390026262−016	1.83917393287919189−014	−6.51835430573926550+011	1.77585079002592870+013	2.55458774000263570+003	16

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 16.0 X = 1.40000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	2.98806181898042307−002	−3.55428651052226262−001	2.26879227261395091−002	4.36768978882409704−001	−1.63161980906196654+002	25
3	2.26879228197205830−002	4.36768977756759440−001	−2.98806181215004972−002	3.55428652383625482−001	−1.63161980750329214+002	24
4	6.75569622034267772−003	5.38612863915523310−001	−3.77342813342079742−002	1.17041308825003154−001	−1.08096597142048761+002	24
5	−3.77342664984905885−002	1.17042641303005068−001	−6.75579002761397029−003	−5.38612546152378826−001	−1.08096473874693320+002	24
6	−3.61465238526756394−002	−1.87068614210604036−001	1.50337993469635388−002	−5.06342267635600661−001	−5.86924050483263431+001	24
7	1.50151816330905423−002	−5.06434093858563063−001	3.61547412118300304−002	1.86802353051759694−001	−5.86668926481850273+001	25
8	3.59558943652307186−002	−2.50178163517825600−001	1.72875823273319330−002	4.66957909487728817−001	−1.75883149802601171+001	23
9	1.84312070173415790−002	4.58428934818531733−001	−3.54163712836042043−002	2.64712750369198119−001	−1.60522304864050475+001	23
10	−2.16260500399452254−002	4.54220966294423428−001	−3.41563990988740627−002	−2.58961403062142317−001	9.37595580058753185+000	23
11	−3.90444297000844995−002	−1.22836115895532231−001	1.15014530824040529−002	−5.04606449432273696−001	2.27203387362920798+001	22
12	−6.71598259825756729−003	−5.01818511502536623−001	4.06169950867668934−002	−1.09068902130226523−001	4.42205802592396690+001	23
13	3.30248180761326424−002	−3.30517334251591508−001	2.54695509517790882−002	3.84460460930557272−001	6.75899411642128782+001	22
14	3.96656921685432182−002	1.48021483659088514−001	−1.48338581769312307−002	4.76964705134548915−001	9.37213458690561418+001	23
15	1.08514837925174915−002	4.66399194164431851−001	−4.17213417360159817−002	1.52611820778836903−001	1.22226700059869404+002	22
16	−2.65556625667298098−002	4.02290430848612544−001	−3.50973109312214618−002	−2.63429786816180718−001	1.53015993714770232+002	22
17	−4.49527789241769270−002	7.19558233260589237−002	−3.50132726828736702−003	−4.64107547471788719−001	1.86015755610273190+002	21
18	−3.52021652202739774−002	−2.66319861174871001−001	3.02133458121844745−002	−3.71239971199527656−001	2.21177591210308522+002	21
19	−6.46052315851002700−003	−4.29935472951734468−001	4.75501290553724658−002	−1.03920011437917494−001	2.58466943632419514+002	21
20	2.51809731615895217−002	−3.91401371543897002−001	4.31840360085780752−002	1.67291943614480092−001	2.97858424887299009+002	21
21	4.73998135089078294−002	−2.31097165601988916−001	2.27373278529909865−002	3.34607494641194427−001	3.39332899072483278+002	21
22	5.58569962266008542−002	−5.14702554626331971−002	−4.27469516428046611−003	3.81955456939428508−001	3.82875647561281299+002	21
23	5.27129465336760546−002	8.00532336878633142−002	−3.03723038620108498−002	3.54437855493895571−001	4.28475157541489059+002	20
24	4.29472393562542926−002	1.43590236175119808−001	−5.26299732542948191−002	3.15683028260023865−001	4.76122294757563557+002	19
25	3.12954438549411614−002	1.51616340122221248−001	−7.25496691790259533−002	3.23214765502230690−001	5.25809722654156529+002	19
26	2.08173003223525306−002	1.28009000839302156−001	−9.51577414335392902−002	4.29153508067526385−001	5.77531484971000770+002	19
27	1.28101900748578130−002	9.37985956604166878−002	−1.29017748091354667−001	7.03594655969726791−001	6.31282699841819170+002	18
28	7.36158116424352129−003	6.18483645694735673−002	−1.88582619542472027−001	1.28387340288286386+000	6.87059331784607528+002	19
29	3.97866576542384516−003	3.74424906492193863−002	−3.00966047070422501−001	2.47468549564106579+000	7.44858019222472776+002	17
30	2.03351573468980229−003	2.10792618213317285−002	−5.21944659467303850−001	4.97299163178117592+000	8.04675942300721268+002	18
31	9.87253931363508977−004	1.11341213322252838−002	−9.73350492740275709−001	1.04101508775143956+001	8.66510720403910126+002	17
32	4.56954843971592899−004	5.55414394941161803−003	−1.93290770120574337+000	2.27138794748986207+001	9.30360331867312482+002	18
33	2.02265555648385601−004	2.62993444627523979−003	−4.05721474941674882+000	5.16383326165260340+001	9.96223050480153177+002	17
34	8.58466636465937351−005	1.18687882139948240−003	−8.95285284296674992+000	1.22181957794205641+002	1.06409739483536024+003	17
35	3.50166785109016423−005	5.12218882124358964−004	−2.06839054786055477+001	3.00433346908457078+002	1.13398208760733696+003	17
36	1.37547357175547576−005	2.11989823808445211−004	−4.98696623421664538+001	7.66499927592692509+002	1.20587602257339201+003	17
37	5.21233073900628176−006	8.· - -66561845146−005	−1.25146609661131919+002	2.02597951688906435+003	1.27977823772642217+003	16
38	1.90857262893300547−006	3. 02053970686−005	−3.26140598974394249+002	5.53977929790806910+003	1.35568789321660589+003	18
39	6.76251482887099854−007	1. · 42924951790−005	−8.80950684859556106+002	1.56496450118086490+004	1.43360425314922037+003	16
40	2.32165694918317679−007	4. 04911882030−006	−2.46218699037204345+003	4.56178672789382054+004	1.51352667048248148+003	17
41	7.73206772948286759−008	1.· · 03174328768−006	−7.10981216156526914+003	1.37052964058589147+005	1.59545457443325377+003	16
42	2.50077934153258151−008	4.96307930288638321−007	−2.11824385534523518+004	4.23941946890740647+005	1.67938745992354810+003	17
43	7.86274092131482877−009	1.61594093673199281−007	−6.50345772540688898+004	1.34885040753707481+006	1.76532487869690754+003	16
44	2.40544374559641020−009	5.11169140042078676−008	−2.05532713846271932+005	4.41027433111024018+006	1.85326643180831018+003	17
45	7.16660987181875164−010	1.57254566277400626−008	−6.67950944016108866+005	1.48062074747604931+007	1.94321176324937164+003	16
46	2.08103063882079847−010	4.70914581168083010−009	−2.23012526681534534+006	5.09981910267861432+007	2.03516055451630985+003	16
47	5.89406748040047347−011	1.37389095312804442−009	−7.64293170051032438+006	1.80084639028208047+008	2.12911251996423778+003	17
48	1.62940381020814583−011	3.90821468335312513−010	−2.68651195479482629+007	6.51489785995772801+008	2.22506740282005222+003	16
49	4.39952489271482131−012	1.08478090410615561−010	−9.67813487651450125+007	2.41303532139062124+009	2.32302497174913165+003	16
50	1.16095617549145813−012	2.93997568472846925−011	−3.57080392113923915+008	9.14486557366225123+009	2.42298501788949499+003	16
51	2.99580207035864553−013	7.78512244850647940−012	−1.34842939778253362+009	3.54401814292455619+010	2.52494735228196412+003	16

OBLATE RADIAL FUNCTIONS

H = 18.0 X = 1.40000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	−3.16051059988409029−002	1.90237240979007270−001	−1.02591447970421917−002	−5.32100647547016012−001	−2.19141463599472215+002	25
3	−1.02591447996927698−002	−5.32100647530380393−001	3.16051059980289393−002	−1.90237241023219356−001	−2.19141463594723636+002	23
4	4.71467082820004332−003	−5.51189200997476488−001	3.35415539526563320−002	5.96068009052639447−002	−1.55942778415532475+002	24
5	3.35415544367327354−002	5.96067504280854738−002	−4.71466777718222045−003	5.51189205559783013−001	−1.55942773290723265+002	23
6	2.69587271000865682−002	3.24890625929848187−001	−2.15577344728689543−002	4.36402760359228153−001	−9.80824936483270077+001	23
7	−2.15569898053997236−002	4.36411667451415182−001	−2.69593459252520365−002	−3.24878182127996353−001	−9.80809369916126685+001	23
8	−3.40213373940108421−002	1.53334421679994624−001	−8.82006687669621784−003	−5.11924287788806126−001	−4.68573233895819733+001	24
9	−8.92476635734912637−003	−5.11419592926988720−001	3.39962491856186755−002	−1.54897147316000632−001	−4.66892914132815562+001	22
10	1.99595954031189162−002	−4.47818061409108410−001	2.95644366233668786−002	2.77023655127606077−001	−7.35632030744914201+000	23
11	3.13254080795292985−002	2.34324504228380111−001	−1.72070402292564407−002	4.70440402895843081−001	−2.38419553157480405+000	22
12	−2.12317729515987000−003	5.20544416043340436−001	−3.60199953542771155−002	−8.83643642738728598−003	2.16192953279133818+001	23
13	−3.46494930871359965−002	1.78508699017856666−001	−1.10801252000469652−002	−4.84592083125949408−001	4.14516914328368367+001	21
14	−2.58005132418829176−002	−3.47354114704729957−001	2.61974104848903894−002	−3.74759616275277465−001	6.65177144551926175+001	22
15	1.01413223679818125−002	−4.91768893874689108−001	3.58150098657547117−002	1.13995092654328080−001	9.40075537885043049+001	21
16	3.61367525802383842−002	−1.68339999286677268−001	1.09264396022250345−002	4.68481828751326208−001	1.24051402572242726+002	23
17	3.03683248457066983−002	2.77538060488157661−001	−2.34482205422301881−002	4.03742886045721940−001	1.56452558932280624+002	21
18	4.73944405032948201−004	4.79838268960882194−001	−3.90804298842966117−002	3.47782201155157852−002	1.91125134876101820+002	21
19	−2.96879461818640926−002	3.37607373727061969−001	−2.66904432039136365−002	−3.28681488281769842−001	2.28006822374077204+002	20
20	−4.08219452287522940−002	3.67166316163108797−003	2.72689134670559924−003	−4.60016809342189303−001	2.67053742511488919+002	23
21	−2.89562662777870718−002	−2.97313587926220122−001	3.05590524980999260−002	−3.34405932520419413−001	3.08233583723681287+002	19
22	−2.97897791484259295−003	−4.27067471979102034−001	4.34396196664875413−002	−7.28841301529835392−002	3.51521938517224217+002	20
23	2.41977181281779135−002	−3.77197210327273147−001	3.83357279303361279−002	1.78059729217330661−001	3.96899975650300042+002	20
24	4.31201570744340925−002	−2.22686331760581937−001	2.02079310974141141−002	3.30906464361535287−001	4.44352913253674515+002	19
25	5.05304183737846522−002	−5.27190584068992540−002	−3.28881660896303597−003	3.74866321975547355−001	4.93868978638169730+002	18
26	4.81530369057194508−002	7.38910436889082655−002	−2.61288188794225568−002	3.49678528155506977−001	5.45438678627586113+002	20
27	3.99572896995537845−002	1.38539584193913604−001	−4.57932844090676507−002	3.10946670339396393−001	5.99054275118035813+002	17
28	2.98335755692661609−002	1.50837776659336009−001	−6.32284225767935320−002	3.09434384228432008−001	6.54709400339145986+002	19
29	2.04291247648141176−002	1.31436480341336231−001	−8.21641969881837380−002	3.90099722739746636−001	7.12398769607129342+002	16
30	1.29918671697101518−002	9.96453339164472807−002	−1.08980616534564944−001	6.08793081120933817−001	7.72117963575181278+002	18
31	7.74159565376866394−003	6.81600272982559482−002	−1.54097879043195143−001	1.06766789383498269+000	8.33863260945720814+002	16
32	4.35130799607567843−003	4.29163889784676291−002	−2.36170843200787008−001	1.98403997243521201+000	8.97631508418130433+002	18
33	2.31899187906579105−003	2.51895025626612219−002	−3.91839337323814007−001	3.83724102590814838+000	9.63420018506501546+002	17
34	1.17676491162037293−003	1.39028776836516268−002	−6.97718342062891927−001	7.70627668438986203+000	1.03122648848402661+003	17
35	5.70552390935967220−004	7.26211924013169071−003	−1.32106846820471955+000	1.60809281917770106+001	1.10104893552593277+003	16
36	2.65084445121934122−004	3.60779309904486519−003	−2.64012794201955202+000	3.48709008357814217+001	1.17288564440111838+003	17
37	1.18315466646852249−004	1.71140375381309509−003	−5.53849252247235953+000	7.85203502013231950+001	1.24673512497664331+003	15
38	5.08405160479964160−005	7.77680946006299217−004	−1.21460860835057349+001	1.83377152275020909+002	1.32259607746181655+003	17
39	2.10725620692458175−005	3.39443343127430179−004	−2.77564538593273402+001	4.43563779605038004+002	1.40046736380500945+003	16
40	8.43913348923417429−006	1.42644914240772255−004	−6.59235511723349128+001	1.10972405843455251+003	1.48034798401745137+003	17
41	3.27045461943898714−006	5.78282756057590941−005	−1.62373450695319724+002	2.86779460419804104+003	1.56223705646920543+003	16
42	1.22811711410265335−006	2.26560270962671645−005	−4.13971717300610052+002	7.64569943427483249+003	1.64613380140775919+003	16
43	4.47434369220773414−007	8.59141017053640271−006	−1.09067274427563682+003	2.10049842108460296+004	1.73203752710651539+003	15
44	1.58331061360626516−007	3.15782636355953170−006	−2.96521022616287680+003	5.94017981201645150+004	1.81994761817132789+003	16
45	5.44751813790848686−008	1.12642197344122120−006	−8.30787032133346932+003	1.72750247875845994+005	1.90986352562707023+003	15
46	1.82406405422726158−008	3.90389704038523301−007	−2.39600917678922667+004	5.16154880249201216+005	2.00178475847960942+003	16
47	5.94938746430722937−009	1.31592747935020486−007	−7.10542035003101656+004	1.58311270434720064+006	2.09571087650633002+003	14
48	1.89168861484999682−009	4.31833707593815641−008	−2.16456843232815227+005	4.98043524715501841+006	2.19164148407411935+003	16
49	5.86816534594754885−010	1.38081097240901079−008	−6.76776169350963892+005	1.60591404777460644+007	2.28957622482019505+003	14
50	1.77720952923808959−010	4.30564951481603426−009	−2.16996483788044734+006	5.30362940458790989+007	2.38951477706037906+003	15
51	5.25832351889891043−011	1.31026276528429280−009	−7.12954864034698415+006	1.79281221822063557+008	2.49145684981296268+003	14

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 20.0 X = 1.40000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	2.98112695217852435−002	−1.83334029780111410−003	−6.85558875865102465−004	5.66669887783896258−001	−2.83125583983819548+002	23
3	−6.85558875800898881−004	5.66669887783874265−001	−2.98112695217876720−002	1.83334029902383505−003	−2.83125583983683020+002	23
4	−1.35279354937548862−002	5.05366660682887114−001	−2.71548284755606323−002	−2.34237286631362159−001	−2.11827440117763781+002	23
5	−2.71548285184490872−002	−2.34237285063958542−001	1.35279354109442774−002	−5.05366661379878148−001	−2.11827439925239330+002	23
6	−1.74300455735077187−002	−4.42324749825659014−001	2.54692546733386988−002	−3.22788036699843557−001	−1.45658038523410121+002	23
7	2.54692326692878689−002	−3.22788603292831153−001	1.74300789002113471−002	4.42324321847102493−001	−1.45657958395691428+002	23
8	3.13805088298356419−002	−2.06156487186543424−002	1.81757545892697090−004	5.38173072136964978−001	−8.55094867620428999+001	23
9	1.88424222927563082−004	5.38166672969535981−001	−3.13805864865327033−002	2.07301722735938236−002	−8.54964725458043997+001	23
10	−2.08208131522471974−002	4.13322338005017554−001	−2.41240818108320475−002	−3.32401522697853930−001	−3.35054081775733688+001	23
11	−2.44085847295494459−002	−3.26704029585008536−001	2.04988887856310811−002	−4.17673635590565436−001	−3.26877713381307514+001	22
12	3.59561343730078459−003	−5.22990704697448656−001	3.20273295641591246−002	3.94637065494452168−002	2.78198828989161360+000	24
13	3.22556443198681730−002	−5.79510940833526688−002	2.39297858465762803−003	5.19388668806520961−001	1.39653132821883531+001	22
14	1.53852857034992926−002	4.47316379246306086−001	−2.87534965748868724−002	2.61937411563688865−001	3.89821067359780340+001	22
15	−2.00491740964311535−002	4.19628633646433445−001	−2.60749736547624869−002	−2.96774635012835947−001	6.42719169238528014+001	21
16	−3.27633772571116503−002	−6.38081832998397970−002	5.54088268242911587−003	−5.04781241087065258−001	9.32118599231998912+001	22
17	−1.20549363723700293−002	−4.61143580720803467−001	3.13792585216752794−002	−2.00876071183002473−001	1.24695554166242103+002	21
18	1.98891701190003399−002	−4.16162817901582741−001	2.76473455051831942−002	2.70805400463179784−001	1.58646160082752914+002	21
19	3.45650579317103670−002	−2.53416755520911949−002	6.18574604542510485−005	4.88653146584291222−001	1.94935662125926802+002	20
20	2.18854713164295424−002	3.59870265881785527−001	−2.75014346000691805−002	3.19615840531764919−001	2.33488239084830898+002	21
21	−6.51109916615173932−003	4.68818826074463622−001	−3.52209440654659794−002	−5.83081645967573642−002	2.74249157242637585+002	20
22	−3.06243362206400267−002	2.78006850135173107−001	−2.00372330072267472−002	−3.69686506070225361−001	3.17178267555097611+002	20
23	−3.68948527908358943−002	−4.86501233744934160−002	6.77213793335474086−003	−4.48908866497468318−001	3.62245202021870738+002	20
24	−2.42034201705891700−002	−3.17684573972595632−001	3.00659954742549376−002	−3.03278994326219673−001	4.09426485130933007+002	20
25	−7.16600896592729011−004	−4.22431052823148365−001	3.99029804173064251−002	−4.97262333847158003−002	4.58703641855200242+002	19
26	2.30178873871765336−002	−3.65799588195876825−001	3.45632122188720111−002	1.84581800407486165−001	5.10061914652579049+002	19
27	3.95048615384640753−002	−2.17104528424586460−001	1.83789211680234630−002	3.26586257395021364−001	5.63489365515387323+002	18
28	4.61792774023731232−002	−5.51865182307637546−002	−2.35066119017486774−003	3.68598593481739846−001	6.18976231236431378+002	18
29	4.44237602300672079−002	6.75699115702620448−002	−2.26359570548116358−002	3.45814541493773475−001	6.76514450448788488+002	19
30	3.74694624835616058−002	1.33408012238236020−001	−4.02580492589709325−002	3.07480940478345055−001	7.36097310279150541+002	19
31	2.85767632643355306−002	1.49606745561303185−001	−5.57822971145664517−002	2.99071097786436299−001	7.97719178167803047+002	17
32	2.00665463016791439−002	1.34143988699429035−001	−7.20351204867274944−002	3.60242036406305342−001	8.61375295503614046+002	17
33	1.31287040270226889−002	1.04802951121721227−001	−9.39091205454892329−002	5.36986659686160465−001	9.27061616882379982+002	17
34	8.07105995551020717−003	7.40229582616220451−002	−1.29199553272159289−001	9.07954939376161007−001	9.94774683538040909+002	18
35	4.69193712706271135−003	4.82239876129837434−002	−1.91310905873271782−001	1.63389170170524962+000	1.06451152270739279+003	16
36	2.59201770158529036−003	2.93438777326494422−002	−3.05504580168209053−001	3.05831354462712614+000	1.13626956690747543+003	18
37	1.36622396798917537−003	1.68217762916127576−002	−5.22598655589672144−001	5.92937498321580267+000	1.21004658866495877+003	17
38	6.89344642456804517−004	9.14249928467027949−003	−9.49437248763527636−001	1.19122743813107672+001	1.28584064735148848+003	16
39	3.33878487166602369−004	4.73367337625457856−003	−1.81855220442893229+000	2.48098037365438526+001	1.36365004558672792+003	16
40	1.55600745109018643−004	2.34392397363475811−003	−3.65198931293603117+000	5.35467011035558389+001	1.44347329326382632+003	16
41	6.99203306161959370−005	1.11344325307906832−003	−7.65715961243657090+000	1.19651596466235627+002	1.52530907769250002+003	15
42	3.03495216132352638−005	5.08763485916993369−004	−1.67087088955404436+001	2.76482476921980302+002	1.60915623868559913+003	16
43	1.27454626050656388−005	2.24110175059670409−004	−3.78470173837496874+001	6.59841895200480190+002	1.69501374766575913+003	17
44	5.18608573444463075−006	9.53559358936352062−005	−8.87972404975627204+001	1.62445211106344341+003	1.78288069006057176+003	15
45	2.04723253901218337−006	3.92565716150161835−005	−2.15401535302668585+002	4.12066823604158331+003	1.87275625040272237+003	14
46	7.84962014076711776−007	1.56606076863000496−005	−5.39369191412860275+002	1.07585366370007588+004	1.96463969966663410+003	16
47	2.92650825698477220−007	6.06205387787955902−006	−1.39219425084408808+003	2.88819801366610347+004	2.05853038446330713+003	15
48	1.06193365364697363−007	2.27966499408040186−006	−3.69951124201038001+003	7.96494732907839262+004	2.15442771778612927+003	15
49	3.75391668241785650−008	8.33754688082094563−007	−1.01094761978291544+004	2.25446365326533937+005	2.25233117105685010+003	14
50	1.29382332770282997−008	2.96862669160824029−007	−2.83796740296699144+004	6.54419032972846582+005	2.35224026726594899+003	16
51	4.35116737698250407−009	1.02996108966554100−007	−8.17662465632252561+004	1.94666992032697220+006	2.45415457503778613+003	14

OBLATE RADIAL FUNCTIONS

H = 22.0 X = 1.40000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	−2.53031166972071015−002	−1.87898930175725877−001	9.54698793981936391−003	−5.35997074916455883−001	−3.55112922990008684+002	23
3	9.54698793981801208−003	−5.35997074916465602−001	2.53031166972076323−002	1.87898930175696924−001	−3.55112922990004935+002	24
4	1.94887142326488404−002	−4.03962258089189008−001	1.93616844892645809−002	3.86627638931082784−001	−2.75737554221058966+002	23
5	1.93616844911774418−002	3.86627638891396836−001	−1.94887142308012136−002	4.03962258126120096−001	−2.75737554214372180+002	24
6	8.08376074618708010−003	5.22428620831122264−001	−2.67079281501070916−002	1.73592382507126487−001	−2.01339767966675926+002	23
7	−2.67079277406784457−002	1.73592410240196820−001	−8.08376217495445098−003	−5.22428611159333550−001	−2.01339764325830458+002	23
8	−2.73355962123312412−002	−1.27751868258455641−001	7.46489404054384082−003	−5.26881180288190312−001	−1.32615754045018737+002	23
9	7.46456475072271367−003	−5.26882629607602156−001	2.73356916783824179−002	1.27745457968498007−001	−1.32614935276824586+002	23
10	2.28642514023482935−002	−3.36846129850329625−001	1.74387002802129439−002	4.14713190928345855−001	−7.07656073239279502+001	23
11	1.74667712764582866−002	4.14295168725730489−001	−2.28435337309877011−002	3.37343381992728797−001	−7.06842774868143538+001	23
12	−4.50832459097322606−003	5.23528817078998165−001	−2.87744743130762401−002	−6.47688184775309740−002	−1.97637634294175946+001	22
13	−2.89708054794435963−002	−4.10146546775360062−002	3.20914165621895155−003	−5.25516749274609380−001	−1.67657041439947846+001	22
14	−1.04971686679613665−002	−4.81757973972188988−001	2.74513543419828745−002	−2.03041084038612460−001	1.47635983598552581+001	22
15	2.35056263066297374−002	−3.29079414429461495−001	1.78901586353554677−002	4.02838975867734627−001	3.36025666277675758+001	22
16	2.61656233399443006−002	2.29829503021527725−001	−1.41931109413142730−002	4.62219820455438640−001	6.14353842704671839+001	22
17	−1.20573365767282421−003	5.11848950084539898−001	−2.99976914345716571−002	−1.64090179225549009−003	9.13313541478388749+001	22
18	−2.70929642669178724−002	2.44754152264259292−001	−1.36006944423891569−002	−4.43932188420570751−001	1.24224167755404031+002	21
19	−2.60019253303155433−002	−2.47965795021065434−001	1.62224529814832438−002	−4.35877411443303773−001	1.59652462130857678+002	21
20	−9.73257242307164828−004	−4.94080189584303128−001	1.10080902466355322−002	−3.67654583033646638−002	1.97502234762415273+002	22
21	2.48165696541609517−002	−3.17545541378800270−001	1.93169622324818067−002	3.71616635775114221−001	2.37675439729810337+002	20
22	3.10270405254428992−002	9.06613374880399699−002	−7.54155029828355399−003	4.72895193064185988−001	2.80105610843162434+002	21
23	1.48189396974737814−002	4.09256607719917926−001	−2.89013972805678859−002	2.38085694312929741−001	3.24743733410686937+002	21
24	−1.11262110428620302−002	4.45928555245674877−001	−3.11819729141385520−002	−1.30442719391421351−001	3.71552773982102001+002	20
25	−3.03961242346451622−002	2.25663142264063747−001	−1.48577379561689181−002	−3.94899738844298591−001	4.20504075652124095+002	20
26	−3.33831485031265778−002	−8.89000252570091894−002	9.39262376980403754−003	−4.34987756308850539−001	4.71575047926701646+002	20
27	−2.05513173680188375−002	−3.31099189645937041−001	2.91657131415122706−002	−2.77331193305114385−001	5.24747606732999707+002	19
28	7.56862685313950865−004	−4.17148303338361069−001	3.68712489990458710−002	−3.23884452603239285−002	5.80007086729497536+002	20
29	2.17789043655413469−002	−3.56677454943882190−001	3.15633757149054982−002	1.88178467017822148−001	6.37341462028464191+002	18
30	3.64087340572868057−002	−2.13602277515716536−001	1.70203667902798817−002	3.21919356692462194−001	6.96740775162218073+002	18
31	4.25468245755402202−002	−5.85209050410565606−002	−1.47680776294881037−003	3.62957509454245841−001	7.58196710581200125+002	18
32	4.13049611933672055−002	6.11369888992232303−002	−1.97057824666957190−002	3.42610493836293383−001	8.21702270835066400+002	19
33	3.53571641936126740−002	1.28194590635068649−001	−3.56783896014393980−002	3.04959095354661268−001	8.87251527183380972+002	18
34	2.74791520084894496−002	1.47990351718485042−001	−4.96912636716712539−002	2.91218512335695961−001	9.54839425105034102+002	16
35	1.97275974980285962−002	1.36240448909710418−001	−6.39187278636845862−002	3.36987267661137687−001	1.02446163092467482+003	17
36	1.32322164871491255−002	1.09358806768447169−001	−8.21982973982541702−002	4.81186023564380633−001	1.09611440965402774+003	16
37	8.35975842418901508−003	7.94715314798257857−002	−1.10534806085601467−001	7.86134562908088338−001	1.16979452681872592+003	16
38	5.00490871057105078−003	5.33544524712373956−002	−1.58901601046390471−001	1.37428229631932756+000	1.24549916891678618+003	16
39	2.85299950228753119−003	3.35110554219510349−002	−2.45405360255871975−001	2.49999087702895347+000	1.32322587849267679+003	15
40	1.55443334903458679−003	1.98602159443923156−002	−4.05220918247404967−001	4.70170716501034756+000	1.40297250077939983+003	15
41	8.12044690484868418−004	1.11754881741062700−002	−7.09871889637375249−001	9.14124620907267426+000	1.48473713957150839+003	16
42	4.07832152889683627−004	5.99935961208794367−003	−1.30987711104296042+000	1.83846257985056547+001	1.56851812051956694+003	15
43	1.97363467172805259−004	3.08417576581255910−003	−2.53164565765345686+000	3.82453008119125561+001	1.65431396043267977+003	17
44	9.22136406280359848−005	1.52302393704792633−003	−5.10340257881929799+000	8.22401221411680858+001	1.74212334147614286+003	15
45	4.16697722649053102−005	7.24308872415015541−004	−1.06952898972676155+001	1.82616116600008004+002	1.83194508938126480+003	15
46	1.82395267543276641−005	3.32459746455735096−004	−2.32423547466857726+001	4.18273900025273625+002	1.92377815496198635+003	16
47	7.74409421566363880−006	1.47560941484612519−004	−5.22634605857664579+001	9.87103164566894658+002	2.01762159837114507+003	14
48	3.19323687711527453−006	6.34361472824735574−005	−1.21384412189922209+002	2.39760036646744566+003	2.11347457563760579+003	14
49	1.28021715225577088−006	2.64525769280352758−005	−2.90734133155264479+002	5.98773287786620587+003	2.21133632711104230+003	14
50	4.99543912182770739−007	1.07134527370767811−005	−7.17135416856301831+002	1.53605494423160591+004	2.31120616750914805+003	14
51	1.89893282008847083−007	4.21918752791199248−006	−1.81948250683178836+003	4.04412803599279097+004	2.41308347731641019+003	15

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 24.0 X = 1.40000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	1.89352830650896197−002	3.56848069801618801−001	−1.59252649974238028−002	4.43282335538028774−001	−4.35102588928034513+002	24
3	−1.59252649974237785−002	4.43282335538029231−001	−1.89352830650896407−002	−3.56848069801618219−001	−4.35102588928034413+002	24
4	−2.25700280392263611−002	2.56857455635399510−001	−1.09813201650609831−002	−4.98711946653262999−001	−3.47665453233606837+002	24
5	−1.09813201651265770−002	−4.98711946652501876−001	2.25700280391954759−002	−2.56857455636832224−001	−3.47665453233388706+002	24
6	4.92864188582968113−004	−5.52985094418522398−001	2.54579976224039023−002	−2.67141006683710628−003	−2.65091117839041123+002	24
7	2.54579976240782667−002	−2.67141117885949870−003	−4.92864137467764342−004	5.52985094398317655−001	−2.65091117688817543+002	23
8	2.19630870848780858−002	2.74861175844362952−001	−1.35887590463718077−002	4.70860687610049694−001	−1.87951459571433092+002	23
9	−1.35887459967293657−002	4.70860848655175567−001	−2.19630954142933865−002	−2.74860890887707171−001	−1.87951415156566172+002	25
10	−2.40560555596568809−002	2.25802105885692420−001	−1.03434736753857656−002	−4.88068312337598931−001	−1.17118004623077558+002	22
11	−1.03455258035644281−002	−4.88048529891944883−001	2.40552086038085235−002	−2.25843270376722717−001	−1.17111778712758791+002	23
12	8.00813943978274275−003	−5.10543315688620853−001	2.52872691502295581−002	1.45643110822186951−001	−5.43592809764411137+001	24
13	2.53332237498684521−002	1.42805868153329253−001	−7.86913026177500127−003	5.11297682672519030−001	−5.39572991578885675+001	22
14	9.16650990400005686−003	4.88186955766181535−001	−2.51813374093067952−002	1.94553449817122102−001	−6.74288910700460606+000	22
15	−2.40492170609568717−002	2.47275540020340998−001	−1.19294161555130242−002	−4.62664698247436524−001	1.31253416277216785+000	22
16	−2.07296157388607987−002	−3.21689790782542593−001	1.73393554806161799−002	−4.09977833008306004−001	3.11611279751431629+001	22
17	8.96608973468073591−003	−4.94292001960003347−001	2.56654627369626651−002	1.55066886484037779−001	5.70658483824468937+001	22
18	2.72409986176958646−002	−7.03365687671251009−002	2.84419888013222240−003	5.09398556976634786−001	8.85635541318365802+001	21
19	1.52033583456706095−002	4.15851495768666315−001	−2.30557045528302115−002	2.95252354790410235−001	1.22675093430107332+002	21
20	−1.25666629128358246−002	4.58944433220397589−001	−2.48810736013977573−002	−2.11475900412162615−001	1.59524948298918153+002	21
21	−2.80464904191023564−002	6.41512355347707391−002	−2.55886533408984584−003	−4.96048596310357675−001	1.98875163785883544+002	21
22	−1.80757660809618121−002	−3.69489351798964571−001	2.20161164895375559−002	−3.28719454495766705−001	2.40617796816841549+002	21
23	7.12288525944010427−003	−4.77924368083320588−001	2.79541529620435825−002	1.00606097218494558−001	2.84671500596579978+002	20
24	2.66884785967766151−002	−2.16729541782196078−001	1.19777841742117698−002	4.30172025704014086−001	3.30977462375901238+002	20
25	2.68834022027785665−002	1.81006636250125658−001	−1.26478634577420005−002	4.38457501302477646−001	3.79491225881403260+002	20
26	9.16094400615442282−003	4.36393795548648893−001	−2.88056885686628669−002	1.64388387014891178−001	4.30178400253214758+002	20
27	−1.41182798119805500−002	4.18054773858475591−001	−2.73924647327764870−002	−1.85931003085933927−001	4.83011851880371242+002	21
28	−2.95679877433542361−002	1.80701950324872695−001	−1.08446956684464009−002	−4.09798564034241304−001	5.37969828794363350+002	19
29	−3.03231675572689772−002	−1.20026499917357273−001	1.10686706104786599−002	−4.20406039718195038−001	5.95034658808493941+002	18
30	−1.77156925667225140−002	−3.39845382330593076−001	2.80834828712361137−002	−2.55848569620172508−001	6.54191819891996405+002	18
31	1.70525344070340950−003	−4.11779233209800574−001	3.42652635751279056−002	−1.94383915786905340−002	7.15429260372228334+002	18
32	2.05481468359593566−002	−3.49395919174561044−001	2.91326668649903820−002	1.89688232734249184−001	7.78736891780180800+002	17
33	3.37243113175339304−002	−2.11665439642349148−001	1.59885522443191045−002	3.17051771224129980−001	8.44106203964779227+002	17
34	3.94595547258087677−002	−6.24903799903221278−002	−6.70729506461546767−004	3.57796503696271891−001	9.11529968638335523+002	17
35	3.86485871448686077−002	5.46207456153975577−002	−1.72089587446095473−002	3.39898852432579589−001	9.81002008054022946+002	16
36	3.35336001325232080−002	1.22898281953776726−001	−3.18216084727159820−002	3.03151332576861747−001	1.05251701242429592+003	16
37	2.65078160720692699−002	1.46037234951771411−001	−4.46113448270708696−002	2.85261490799262682−001	1.12607039432997234+003	16
38	1.94098672506872468−002	1.37806801220617156−001	−5.72683760913551753−002	3.18632001777790004−001	1.20165817155532666+003	15
39	1.33102660787041429−002	1.13380689412102549−001	−7.28568296787489914−002	4.36957380478310930−001	1.27927687201345015+003	16
40	8.61498025122194848−003	8.45351894062976247−002	−9.61130101969236934−002	6.90848368958946522−001	1.35892345601243085+003	16
41	5.29381109774604998−003	5.83018745880221293−002	−1.34672150365623022−001	1.17588966446331245+000	1.44059525225924094+003	15
42	3.10253175342162459−003	3.76670062483415037−002	−2.01933819623071965−001	2.08550134062191654+000	1.52428990483811390+003	15
43	1.74059922015913312−003	2.29926360672503405−002	−3.23109368722941161−001	3.81905287249482219+000	1.61000532902330705+003	15
44	9.37644331495507906−004	1.33430756843400592−002	−5.47939531847262013−001	7.21529230801853103+000	1.69773967425372164+003	14
45	4.86236626564089966−004	7.39621021366457669−003	−9.78017511486857469−001	1.40732990793582492+001	1.78749129295139192+003	16
46	2.43265451354907705−004	3.93065432881896115−003	−1.82700459107712735+000	2.83445636586817895+001	1.87925871413726652+003	15
47	1.17642261643288614−004	2.00880100606437791−003	−3.55667658100465485+000	5.89237318764542480+001	1.97304062100732188+003	15
48	5.50835956565432307−005	9.89735564648619524−004	−7.19174095294257026+000	1.26328985985185574+002	2.06883583179526474+003	13
49	2.50092434852594806−005	4.71128432970418942−004	−1.50654934827547052+001	2.79048594342075136+002	2.16664328337613405+003	14
50	1.10248666565485766−005	2.17068379691188026−004	−3.26266635142288258+001	6.34416706406049592+002	2.26646201716628988+003	14
51	4.72453062292258089−006	9.69590932348012873−005	−7.29167876048857528+001	1.48303218415335732+003	2.36829116695574542+003	14

OBLATE RADIAL FUNCTIONS

H = 26.0 X = 1.40000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	−1.15764285942523756−002	−4.85268754265845025−001	1.96432618766743829−002	−2.99012924838500267−001	−5.23093992571517991+002	24
3	1.96432618766743825−002	−2.99012924838500282−001	1.15764285942523762−002	4.85268754265845016−001	−5.23093992571517989+002	24
4	2.29346090530563570−002	−7.97289807819555019−002	2.79861204315379343−003	5.56828000791945943−001	−4.27606293979691762+002	24
5	2.79861204315568750−003	5.56828000791938826−001	−2.29346090530561483−002	7.97289807820013919−002	−4.27606293979685002+002	24
6	−7.75757458802352592−003	5.27665573236341669−001	−2.20908098994093217−002	−1.72373866311328023−001	−3.36891085775943616+002	23
7	−2.20908098999762699−002	−1.72373866273869479−001	7.75757458646995863−003	−5.27665573248076086−001	−3.36891085770205822+002	26
8	−1.56217795917406522−002	−4.03825745994916773−001	1.78544503181249103−002	−3.70231588581296733−001	−2.51433061176805418+002	22
9	1.78544499069879260−002	−3.70231599254148383−001	1.56217800739039377−002	4.03825735957457095−001	−2.51433059026004808+002	23
10	2.37988813997916882−002	−8.82957015092124825−002	3.34053864815428266−003	5.33588431198986008−001	−1.71923659369882540+002	23
11	3.34065810010646322−003	5.33587952739439141−001	−2.37988662505920743−002	8.82983725812696309−002	−1.71923259302121940+002	22
12	−1.21032515455593385−002	4.70150817011774545−001	−2.11074920875453628−002	−2.53655667006307389−001	−9.94861533697383131+001	22
13	−2.11133845040525854−002	−2.53430049878395149−001	1.20932925342037060−002	−4.70268481195893613−001	−9.94484802389692937+001	22
14	−6.54759616830366720−003	−5.05244419205065985−001	2.37172770140479601−002	−1.54368277715045845−001	−3.71210916948662483+001	21
15	2.35862340967247434−002	−1.64572526060375467−001	7.03024244903231170−003	5.01851130051853299−001	−3.55226862387832984+001	23
16	1.81585980154001246−002	3.46062652298010906−001	−1.68960763498226290−002	3.93569040553277722−001	6.19437459526073208+000	21
17	−1.29160261444138372−002	4.54120625485163713−001	−2.12631667530535858−002	−2.58416975217607554−001	2.21086187651388953+001	23
18	−2.47539870358223180−002	−6.16221791717314421−002	3.69591366367797814−003	−5.15715416724685901−001	5.31152246858471422+001	20
19	−6.42931019399619887−003	−4.94860872827274399−001	2.43510835081561402−002	−1.46728735457176928−001	8.46793045170295981+001	22
20	1.91306863600617012−002	−3.48400796614200314−001	1.66600328845053013−002	3.75804303613045365−001	1.20135391654894641+002	20
21	2.39458061284748690−002	1.62971576886926995−001	−8.97416767536461856−003	4.81555253333021484−001	1.58308022598621204+002	21
22	4.46445799775324541−003	4.93117590678132923−001	−2.54104344107472694−002	1.03804493016576976−001	1.99101649055948690+002	21
23	−1.92083263427251324−002	3.49849380346547169−001	−1.75999378773017773−002	−3.55910010652252398−001	2.42361026461283413+002	21
24	−2.56597721317704964−002	−9.30957421753440298−002	5.91386828631568263−003	−4.84930535338414854−001	2.87991718104578867+002	20
25	−1.06340210123845340−002	−4.39583615200383047−001	2.44294811858211637−002	−2.12051803734807674−001	3.35923575719240953+002	21
26	1.26677632272795348−002	−4.34451456518292953−001	2.38322758554109165−002	2.08386910054434629−001	3.86103945327489922+002	19
27	2.67280077048976636−002	−1.23156882407929469−001	5.92196494830975285−003	4.58860697303405225−001	4.38492117628645458+002	19
28	2.27824961580441215−002	2.49711193222261326−001	−1.59472626707042183−002	3.95547219282676697−001	4.93055975105300498+002	19
29	4.71746898977349025−003	4.48796026764546356−001	−2.79014568881227490−002	9.99900587484029147−002	5.49769751435326596+002	20
30	−1.60044127727038087−002	3.88928630356343230−001	−2.40054703983134440−002	−2.28521241149501240−001	6.08612487446534139+002	19
31	−2.84525521922958899−002	1.42496709390732325−001	−7.73542458234670958−003	−4.17941081863941605−001	6.69566933201726787+002	19
32	−2.76858549934464209−002	−1.44210546101051296−001	1.21091469978163819−002	−4.06254251315424678−001	7.32618747545934139+002	17
33	−1.54922097433479924−002	−3.45390303476977311−001	2.69389243284417804−002	−2.38140317342609644−001	7.97755902115597091+002	18
34	2.29607009608599942−003	−4.06598229438300253−001	3.20129307872209833−002	−9.85944788467014486−003	8.64968229568632236+002	17
35	1.93581454735004728−002	−3.43607324069980691−001	2.71304481894324543−002	1.89663947695757343−001	9.34247075808805956+002	17
36	3.13711173876107615−002	−2.10929744257223154−001	1.51899215885765872−002	3.12062735822839401−001	1.00558502863728653+003	16
37	3.67959383135326100−002	−6.69357975138393796−002	6.97444178019092942−005	3.53003488723597149−001	1.07897570351085353+003	16
38	3.63512689099561956−002	4.80393844687003023−002	−1.50534565590615384−002	3.37556420298125600−001	1.15441357259761282+003	15
39	3.19371378356526993−002	1.17518468489475775−001	−2.85253028322239406−002	3.01890330352594202−001	1.23189382708805854+003	15
40	2.56384372818506610−002	1.43783963777910176−001	−4.03059613381965459−002	2.80766414487110858−001	1.31141226534565871+003	14
41	1.91109344063503981−002	1.38904889353561174−001	−5.17177571620883421−002	3.04009920918266766−001	1.39296520134485822+003	16
42	1.33683716988001083−002	1.16922226571541166−001	−6.52423405131041459−002	4.01356529809369115−001	1.47654938918803973+003	16
43	8.84226226378928770−003	8.92390521030679346−002	−8.46884825259499541−002	6.14802290061266817−001	1.56216196047560154+003	15
44	5.56160250099118629−003	6.30632906256475962−002	−1.16041813897264461−001	1.02053038817875263+000	1.64980037203124937+003	14
45	3.34127458556252060−003	4.17929236990508049−002	−1.69487109813777476−001	1.76890614464362702+000	1.73946236203023970+003	14
46	1.92419790764622913−003	2.61974667001654991−002	−2.63628297973203940−001	3.16358801358174219+000	1.83114591299172320+003	15
47	1.06534847228045039−003	1.56289417762068044−002	−4.34170383092182496−001	5.82733210493358667+000	1.92484922041266224+003	14
48	5.68479396766996699−004	8.91549963555459974−003	−7.52097800413840065−001	1.10618526617406456+001	2.02057066606503975+003	13
49	2.92981460372666609−004	4.88097411006606664−003	−1.36266058368430926+000	2.16486461495708637+001	2.11830879516825019+003	15
50	1.46105645811094366−004	2.57221985517516266−003	−2.57101154392917438+000	4.36708384344904204+001	2.21806229679778926+003	13
51	7.06149141473901933−005	1.30805592018838944−003	−5.03470013166628533+000	9.07470292577098769+001	2.31982998700930349+003	13

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 28.0 X = 1.40000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	4.05831724504466288−003	5.58091423177007357−001	−2.07487964630661815−002	1.19732314901630177−001	−6.19086728618735091+002	23
3	−2.07487964630661815−002	1.19732314901630177−001	−4.05831724504466289−003	−5.58091423177007357−001	−6.19086728618735091+002	25
4	−2.09261620516306937−002	−1.07842892406571725−001	4.49471701303119624−003	−5.53417953747533926−001	−5.15556857122093756+002	24
5	4.49471701303114885−003	−5.53417953747534158−001	2.09261620516307044−002	1.07842892406570465−001	−5.15556857122093555+002	24
6	1.32836635644914428−002	−4.46789845590635752−001	1.71196660868416802−002	3.32494426457790252−001	−4.16726482444936697+002	24
7	1.71196660868732936−002	3.32494426456732377−001	−1.32836635644516295−002	4.46789845591404786−001	−4.16726482444731002+002	24
8	8.80945765161423249−003	4.99045736844674040−001	−2.00898128101347609−002	2.31558140058486303−001	−3.23015743758797240+002	23
9	−2.00898128007544461−002	2.31558140602021293−001	−8.80945767370341893−003	−4.99045736584742633−001	−3.23015743663663544+002	23
10	−2.19818482882465319−002	−6.45974390603089073−002	3.12968635300637556−003	−5.39693804933845611−001	−2.34997053607513293+002	23
11	3.12968061826273659−003	−5.39693820124536123−001	2.19818491759691864−002	6.45972976530402248−002	−2.34997031060060739+002	23
12	1.55461989621860534−002	−3.96427131130613271−001	1.62183070646922321−002	3.62549079546400897−001	−1.53517411535571647+002	21
13	1.62188331839261118−002	3.62535668107694083−001	−1.55456637858272410−002	3.96439089418400300−001	−1.53514551533449524+002	22
14	2.17950780662020334−003	5.27443396857347137−001	−2.26113575529760067−002	6.39712461299131224−002	−8.01126548436684260+001	22
15	−2.26071354231524201−002	6.51380010234830778−002	−2.22960298306562527−003	−5.27285078853300908−001	−7.99245236641393532+001	23
16	−1.64697482506396042−002	−3.56422607312536868−001	1.59549175049552197−002	−3.87312767140612729−001	−2.03367735248305959+001	20
17	1.49655705026916181−002	−4.07406339437710864−001	1.73979107339426020−002	3.32604623309362510−001	−1.53399042848566641+001	22
18	2.22451141094771114−002	1.26586590911226381−001	−6.18010813487824315−003	5.07226808990521035−001	2.17069566529501212+001	20
19	5.00576892781469128−004	5.20050388552256306−001	−2.31766079874004072−002	2.52370348059033258−002	4.62974136118358733+001	21
20	−2.12194158748761171−002	2.27449337720794699−001	−9.66223655097322310−003	−4.65044269804819097−001	8.02913722649942752+001	20
21	−1.78109970046183271−002	−3.23670900364773271−001	1.52731653965035350−002	−3.99874182702064200−001	1.16577476995090491+002	21
22	5.47868377336417430−003	−5.00198217994383566−001	2.29841818228989281−002	1.03855287018095601−001	1.56056382794577208+002	21
23	2.29136836243103548−002	−1.52609566780928361−001	6.47640201862471998−003	4.83434978892836826−001	1.98224602049158264+002	20
24	1.75315991663494669−002	3.31800406216845761−001	−1.64103124162212994−002	3.77643173162285442−001	2.42947924524825354+002	19
25	−4.26284043927231755−003	4.92946124693001176−001	−2.38587065845793741−002	−7.14500387523925743−002	2.90108121240223999+002	21
26	−2.22436328433845996−002	2.21292883656019690−001	−1.02269479117057925−002	−4.40687289719004017−001	3.39623244688258942+002	18
27	−2.17219323875630974−002	−2.18215252699460446−001	1.18680569816596722−002	−4.36234025742479732−001	3.91431476186741774+002	19
28	−4.28502093903391899−003	−4.71378231198900392−001	2.46822954552123245−002	−1.00569004950435534−001	4.45485170717582506+002	18
29	1.62456737941436045−002	−3.77639178310086831−001	1.95024697561474649−002	2.89353367023951033−001	5.01746763382887056+002	20
30	2.57268476138330980−002	−4.04247828978574259−002	1.09853977652531540−003	4.67263965414972207−001	5.60186116151554335+002	18
31	1.90085861418165903−002	3.01096436668513381−001	−1.79742847202365613−002	3.50033607711165752−001	6.20778698010439135+002	19
32	1.26331936073326082−003	4.51601162576435584−001	−2.65924060175244691−002	4.47041295920884037−002	6.83504298180208709+002	17
33	−1.71367849499272400−002	3.60526424271302017−001	−2.10507438449397754−002	−2.61209303381543236−001	7.48346091552609687+002	18
34	−2.72237070205774805−002	1.10205088580874449−001	−5.32228237664598683−003	−4.21658022406342663−001	8.15289944755555467+002	16
35	−2.54213877677003423−002	−1.63059144814963627−001	1.27162009282275099−002	−3.93060532662216097−001	8.84323891127911972+002	17
36	−1.37332216279026909−002	−3.48697598829182000−001	2.57956056712826109−002	−2.23601671255148288−001	9.55437727035278204+002	16
37	2.63884772577289922−003	−4.01730277925792677−001	3.00533264575274686−002	−2.91571380374709878−003	1.02862269710555110+003	17
38	1.82235295946740262−002	−3.39035114565465898−001	2.54570471734304930−002	1.88481827455557503−001	1.10387124576263028+003	15
39	2.92880226734542204−002	−2.11129861346813486−001	1.45614824481437059−002	3.06994889877145823−001	1.18117681894792329+003	15
40	3.44682751654169560−002	−7.17440856948786012−002	7.49056736599957708−004	3.48491376992023194−001	1.26053370434804228+003	16
41	3.43385660102059453−002	4.14052472216014515−002	−1.31719429656698495−002	3.35490116486829132−001	1.34193690152209730+003	15
42	3.05227245046608297−002	1.12055107221166719−001	−2.56726308798348733−002	3.01050702677102460−001	1.42538201549658042+003	14
43	2.48526251168273906−002	1.41258918596973594−001	−3.66070715161240367−002	2.77417846117153255−001	1.51086516895909473+003	15
44	1.88285425108616755−002	1.39583110333525627−001	−4.70125248972136139−002	2.92294669790647471−001	1.59838292932268214+003	13
45	1.34105007289379018−002	1.20026573778665081−001	−5.89218550400769233−002	3.72353634321674135−001	1.68793224777575593+003	14
46	9.04588333845112819−003	9.36045712332770212−002	−7.54473890952862491−002	5.53115309085968716−001	1.77951040806372958+003	13
47	5.81073122189851471−003	6.76375068905312868−002	−1.01376279737504491−001	8.96410115602208123−001	1.87311498322599213+003	13
48	3.56989040926231112−003	4.58738052928611360−002	−1.44627553459606420−001	1.52134105409987418+000	1.96874379887694627+003	14
49	2.10488815380532249−003	2.94563112610533516−002	−2.19272683696713565−001	2.66364397247644373+000	2.06639490190151150+003	13
50	1.19452519723173910−003	1.80182983647053780−002	−3.51636027003984364−001	4.79667924006860994+000	2.16606653365472399+003	13
51	6.54031794013337053−004	1.05486167655095582−002	−5.92779065314458909−001	8.88739344512467061+000	2.26775710692704885+003	13

OBLATE RADIAL FUNCTIONS

H = 30.0 X = 1.40000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	2.87775862961909987−003	−5.66684239136256902−001	1.94969700050694487−002	7.38893270226079707−002	−7.23080508972632228+002	25
3	1.94969700050694487−002	7.38893270226079707−002	−2.87775862961909987−003	5.66684239136256902−001	−7.23080508972632228+002	26
4	1.70388013840338222−002	2.84701536315788865−001	−1.03489448727226064−002	4.87997985852525507−001	−6.11514915258733847+002	25
5	−1.03489448727226053−002	4.87997985852525524−001	−1.70388013840338228−002	−2.84701536315788836−001	−6.11514915258733841+002	24
6	−1.68039137208110248−002	3.17365312526890693−001	−1.11489194796631736−002	−4.59594179937748236−001	−5.04588552263729785+002	25
7	−1.11489194796644307−002	−4.59594179937724285−001	1.68039137208102094−002	−3.17365312526924621−001	−5.04588552263722792+002	24
8	−2.07612360207097436−003	−5.48092861408698812−001	2.02929314869114398−002	−6.68796289829676630−002	−4.02671891900056997+002	25
9	2.02929314868337436−002	−6.68796290058811795−002	2.07612360292063879−003	5.48092861405652835−001	−4.02671891896150555+002	23
10	1.87307065281076952−002	2.18738251243148278−001	−8.65105227205686834−003	5.00191768089433224−001	−3.06252328489318816+002	22
11	−8.65105204179580533−003	5.00191770726039667−001	−1.87307066375964644−002	−2.18738245026103194−001	−3.06252327343771551+002	23
12	−1.78482321299109532−002	2.89387000381472007−001	−1.08026880951577064−002	−4.55793251574407998−001	−2.16011477327802496+002	22
13	−1.08027245462790449−002	−4.55792653355909482−001	1.78482106414921717−002	−2.89387918939131376−001	−2.16011290678724179+002	22
14	2.55703970285516345−003	−5.31550294901325015−001	2.09313777145277011−002	5.28663142234738769−002	−1.33008878987799469+002	22
15	2.09318977134562888−002	5.27676027605210368−002	−2.55316747071497759−003	5.31558910075921060−001	−1.32991945155235469+002	22
16	1.34605403586791690−002	4.01946630724254944−001	−1.65021302474179810−002	3.43840996364944150−001	−5.95867223891883919+001	21
17	−1.63866057005018424−002	3.47279042550986854−001	−1.36045330790194072−002	−3.98904578452509240−001	−5.87994530771537448+001	22
18	−2.06111416401520658 9−002	−1.33780988949935060−001	5.96916902491877244−003	−5.07616736379475425−001	−4.79462299800932247+000	21
19	3.24387283980374384−003	−5.19849297799252854−001	2.12479717861308741−002	6.64385008987679243−002	6.98657136135910497+000	22
20	2.09772277033680644−002	−1.37236854528363522−001	5.16450462398981511−003	5.03045542561061130−001	4.24096831077116137+001	21
21	1.22101867528949897−002	4.21519581413654747−001	−1.79448008610822188−002	3.02794411630920095−001	7.44159832424490523+001	21
22	−1.14385543064356125−002	4.46462435196768305−001	−1.85905161327218604−002	−2.58887100393041354−001	1.12203725883143840+002	22
23	−2.18604004370279406−002	−3.59147541375382613−002	2.12530827501589704−003	−5.11652628199442616−001	1.52793956003048568+002	20
24	−8.45267496479936156−003	−4.65184795745159912−001	2.04345434727552249−002	−2.07676544650347758−001	1.96287720178026379+002	20
25	1.36164169394539643−002	−4.08917283453643046−001	1.76335726903739863−002	2.97478304104693248−001	2.42418444331190136+002	20
26	2.23347942637083355−002	3.80374290302759241−002	−2.36723999816962712−003	5.00171051764971642−001	2.91060012959114621+002	20
27	1.03957649143731409−002	4.34559927031118940−001	−2.01323733391501562−002	2.41688667715359720−001	3.42115069428159448+002	22
28	−1.06015482963558449−002	4.43606856458798972−001	−2.02697585734631759−002	−2.14068484703179734−001	3.95511847023206956+002	19
29	−2.28161330433744891−002	9.40500850286030641−002	−3.68797641260124530−003	−4.78363566048806622−001	4.51195066002262908+002	19
30	−1.72854223435741181−002	−3.11579678811499414−001	1.57322662806563443−002	−3.67905779804188245−001	5.09121221627751093+002	19
31	8.51401484649678798−004	−4.76312467556242992−001	2.36441375181217356−002	−8.64719227907574985−004	5.69255429562935315+002	19
32	1.83833294625670785−002	−3.16029313143460336−001	1.53911802716398536−002	3.47989037816788705−001	6.31569293082606945+002	18
33	2.41801668393093509−002	3.07561106283374422−002	−2.66046522784514495−003	4.62339063774223532−001	6.96039403355749116+002	18
34	1.56634734529672680−002	3.38982326770672360−001	−1.91191623117641337−002	3.05181551797360289−001	7.62646255400242138+002	18
35	−1.40542693837942551−003	4.48284063177160011−001	−2.51135619103712829−002	−2.31366507931840190−003	8.31373445934623471+002	17
36	−1.77546968420613908−002	3.33844004530845333−001	−1.85054506080868768−002	−2.86308888843836599−001	9.02207068013530489+002	17
37	−2.59776009041666239−002	8.29860871884857325−002	−3.44590040156068724−003	−4.22490880146447527−001	9.75135246403698975+002	17
38	−2.34771824970107293−002	−1.77761605293408144−001	1.30244704448961561−002	−3.81051281942330017−001	1.05014777573624252+003	17
39	−1.23309409136613531−002	−3.50413503707363410−001	2.46865724769136025−002	−2.11723738146191929−001	1.12723583507923487+003	16
40	2.80705959554264632−003	−3.97221006221665374−001	2.83364369278977529−002	1.93557416222616026−003	1.20639176023893749+003	15
41	1.71495728373209613−002	−3.35458614578905064−001	2.40402126991240292−002	1.86404923630173778−001	1.28760886028288803+003	15
42	2.74279151975408428−002	−2.12067829547173458−001	1.40595983839784814−002	3.01870291199103887−001	1.37088126836155015+003	14
43	3.24116630759885165−002	−7.68324701223139032−002	1.37236465457784151−003	3.44191505038999716−001	1.45620381942946533+003	14
44	3.25554592444216290−002	3.47272346202831383−002	−1.15139778102538261−002	3.33627996794208822−001	1.54357194927541212+003	14
45	2.92566139462239133−002	1.06508737420822963−001	−2.31773502422332905−002	3.00536178464207987−001	1.63298161058681534+003	15
46	2.41361893726561623−002	1.38484752464192332−001	−3.33920407245758390−002	2.74980141428748029−001	1.72442920274414864+003	14
47	1.85606593721275163−002	1.39880140576969305−001	−4.29707410067936572−002	2.82883698432555078−001	1.81791151276594635+003	13
48	1.34395641034187122−002	1.22728994236751279−001	−5.35937824001439369−002	3.48504625142969008−001	1.91342566537266947+003	12
49	9.22920132765850558−003	9.76501281150894334−002	−6.78385768177013485−002	5.02407020851434545−001	2.01096908055574098+003	13
50	6.04323455942069416−003	7.20243868388313650−002	−8.95993991338384367−002	7.95587103271236763−001	2.11053943736030738+003	13
51	3.78901219453229618−003	4.98974666637450161−002	−1.25154925247537828−001	1.32391961106839214+000	2.21213464284087018+003	13

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 35.0 X = 1.40000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	−9.15040117010502271−003	−4.76543166528906503−001	1.41504413009813435−002	−3.17932896391819460−001	−1.01806827407736223+003	24
3	1.41504413009813435−002	−3.17932896391819460−001	9.15040117010502271−003	4.76543166528906503−001	−1.01806827407736223+003	24
4	1.67257412498614711−002	−1.12873813315839078−001	3.13691744176243445−003	5.55935529546588741−001	−8.86433410489711463+002	24
5	3.13691744176243445−003	5.55935529546588741−001	−1.67257412498614711−002	1.12873813315839078−001	−8.86433410489711463+002	26
6	−4.02112706016906469−003	5.48105708338595740−001	−1.67087808817262633−002	−1.22933561775068344−001	−7.59324741722267464+002	24
7	−1.67087808817262633−002	−1.22933561775068338−001	4.02112706016906450−003	−5.48105708338595742−001	−7.59324741722267463+002	24
8	−1.33433828243214765−002	−3.48729211679082217−001	1.10990246146974501−002	−4.33320067657842930−001	−6.37027656521040913+002	25
9	1.10990246146973248−002	−4.33320067657846196−001	1.33433828243215827−002	3.48729211679078083−001	−6.37027656521039876+002	24
10	1.62813573089106554−002	−2.12558288526418537−001	6.49051574126270749−003	5.08120826656471882−001	−5.19895762714263522+002	24
11	6.49051574133384963−003	5.08120826655525367−001	−1.62813573088830589−002	2.12558288528623455−001	−5.19895762713789927+002	24
12	−2.87429238974280543−003	5.39698401419743510−001	−1.74636596314293630−002	−7.91152867050753210−002	−4.08382770826656287+002	23
13	−1.74636596350107073−002	−7.91152860683586372−002	2.87429236921599803−003	−5.39698401506852879−001	−4.08382770699403414+002	23
14	−1.29897929415810988−002	−3.63750770713915489−001	1.22694362480399055−002	−3.99505425867721934−001	−3.03099932316189017+002	22
15	1.22694337557349330−002	−3.99505495607752089−001	1.29897953428944620−002	3.63750692579210889−001	−3.03099911510684225+002	22
16	1.78045901679577830−002	−9.51599193904092097−002	2.86716888771056163−003	5.26811906581070744−001	−2.04934494439546174+002	21
17	2.86751536579753221−003	5.26809951607926285−001	−1.78045379998615258−002	9.51701440404369661−002	−2.04932419854586278+002	21
18	−9.82241260148917330−003	4.52269152528014283−001	−1.53124510514495479−002	−2.77646694655282571−001	−1.15402824368908533+002	21
19	−1.53238214491070041−002	−2.77127192767656304−001	9.80506964125135039−003	−4.52580203376256852−001	−1.15281782660834263+002	21
20	−2.71845508186595604−003	−5.19114855357111241−001	1.81295174431017155−002	−8.87297454163246479−002	−3.92177248198125719+001	20
21	1.80370883153003358−002	−1.05672638686190868−001	3.31227787227649547−003	5.15742471682265941−001	−3.57545315190426002+001	21
22	1.11960235542812627−002	4.09325355339579546−001	−1.46435527113705681−002	3.26770680479234977−001	1.39421067166020134+001	20
23	−1.17757783740089962−002	4.09600478992123931−001	−1.42417170232065546−002	−3.24317885139831587−001	3.78427624814586937+001	21
24	−1.76594366217093542−002	−1.49198402067983074−001	5.70459224274040301−003	−4.98396058378414860−001	7.75819348001275458+001	20
25	−1.44844253588331282−003	−5.15378066101436142−001	1.85839557427749388−002	−5.16047267543431952−002	1.18448708567825046+002	21
26	1.63608557481716914−002	−2.61098404802479883−001	9.12430917007025769−003	4.44363497556789026−001	1.63447906582629480+002	20
27	1.55306340935778763−002	2.80193188048703000−001	−1.06556864368566815−002	4.29271519678407020−001	2.11403574932213464+002	20
28	−2.11246204268221921−003	5.07663744469187736−001	−1.88270755826586964−002	−4.48225638613133666−002	2.62190262318690378+002	19
29	−1.75206574922097478−002	2.10955704261240349−001	−7.51699463104202042−003	−4.60414043238786105−001	3.15623221354916617+002	19
30	−1.56013118108454228−002	−2.82683890908268243−001	1.11821852182166637−002	−4.16085910266508218−001	3.71585738675545032+002	19
31	1.00782875186758229−003	−4.99220479702022850−001	1.93087720202822451−002	1.30728777710881503−002	4.29988647975368956+002	19
32	1.66798950374083138−002	−2.67519032997287318−001	1.00750214093281937−002	4.17103923739091452−001	4.90763395878593413+002	20
33	1.80508288827604026−002	1.81489011862309116−001	−7.76525611474545967−003	4.56666064861956810−001	5.53855767923505703+002	20
34	4.72349138268349639−003	4.69429198688083393−001	−1.92564308560735415−002	1.29772385824132166−001	6.19222082617918303+002	18
35	−1.22379778191308513−002	3.90575303127629517−001	−1.58428123514622580−002	−2.83110368979994859−001	6.86826592589418579+002	18
36	−2.02103758797946402−002	3.47050221888810744−002	−8.23417386013689277−004	−4.76187726101565550−001	7.56639664925755623+002	17
37	−1.41699247478585380−002	−3.29280114781952136−001	1.47498056615792201−002	−3.38441596309685362−001	8.28636466848116313+002	18
38	1.12293850800693197−003	−4.66517155703974461−001	2.06697853420175944−002	8.63821631437156829−003	9.02795993090560426+002	16
39	1.57118730809217247−002	−3.17983160117339714−001	1.38885960098809803−002	3.33261984534020140−001	9.79100331183253855+002	16
40	2.12490005071422772−002	2.33373069491256835−004	−8.77208774164667039−004	4.54247480127880769−001	1.05753409662786782+003	15
41	1.53779881668248347−002	2.99826191085949948−001	−1.51606435349372193−002	3.32094913301786620−001	1.13808399205225158+003	17
42	1.84928715379784841−003	4.36260554477087502−001	−2.18800653478962816−002	5.79143220789485423−002	1.22073845855298427+003	15
43	−1.25209919298820784−002	3.70245384284017708−001	−1.85302894768749416−002	−2.22966001406590961−001	1.30548739672056516+003	15
44	−2.15996135801557285−002	1.59634840347380086−001	−7.36452485871320416−003	−3.92454933093926213−001	1.39232194110373400+003	14
45	−2.23794887008646081−002	−9.16992937056616388−002	6.62248774737190424−003	−4.04175105356709838−001	1.48123427618606388+003	16
46	−1.54123580444329904−002	−2.89475606324779380−001	1.83095972152798789−002	−2.82392083320832520−001	1.57221748498264471+003	15
47	−3.69495864074578299−003	−3.82595707297455813−001	2.43434121298803329−002	−9.16991781472848302−002	1.66526542353579248+003	14
48	9.01762539827802100−003	−3.68306508180093222−001	2.37814364074206291−002	9.91005736339517021−002	1.76037261616665395+003	13
49	1.96206954855084750−002	−2.77410916989385892−001	1.76712697325753822−002	2.42106938316117198−001	1.85753416750281818+003	13
50	2.63763297734014492−002	−1.52922317911304339−001	8.10242128963520092−003	3.18977988237415503−001	1.95674568817071985+003	12
51	2.89488477427854680−002	−3.26519018289718633−002	−2.74688442573012395−003	3.36531551779663204−001	2.05800323169799590+003	12

OBLATE RADIAL FUNCTIONS

H = 40.0 X = 1.40000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	−1.41559145597744297−002	−1.50172495022848018−001	4.02764620500552253−003	−5.53910115320440806−001	−1.36305927072589725+003	23
3	4.02764620500552253−003	−5.53910115320440806−001	1.41559145597744297−002	1.50172495022848018−001	−1.36305927072589725+003	24
4	9.07805484137169161−003	−4.54653954072396145−001	1.17450208260979330−002	3.42146620721291042−001	−1.21137424430981044+003	23
5	1.17450208260979330−002	3.42146620721291042−001	−9.07805484137169161−003	4.54653954072396145−001	−1.21137424430981044+003	24
6	7.22962331074996959−003	4.90335880069329921−001	−1.31116823987463601−002	2.78965795461048827−001	−1.06413650947451040+003	23
7	−1.31116823987463601−002	2.78965795461048827−001	−7.22962331074996959−003	−4.90335880069329921−001	−1.06413650947451040+003	23
8	−1.50708775311048831−002	4.38952837360917490−002	−9.76875750125675619−004	−5.57569769270311530−001	−9.21577771344244604+002	23
9	−9.76875750125675644−004	−5.57569769270311530−001	1.50708775311048831−002	−4.38952837360917499−002	−9.21577771344244604+002	23
10	6.03598918790467509−003	−5.12210446145878968−001	1.39863738470463033−002	2.12389240251825212−001	−7.83974360303797126+002	23
11	1.39863738470463100−002	2.12389240251824647−001	−6.03598918790465978−003	5.12210446145879197−001	−7.83974360303796989+002	23
12	9.36024199599945597−003	4.30940715681195528−001	−1.21841316398334778−002	3.41370184498207952−001	−6.51663421527715605+002	23
13	−1.21841316398294168−002	3.41370184498395808−001	−9.36024199600483278−003	−4.30940715681044201−001	−6.51663421527661150+002	23
14	−1.54075258123936987−002	6.63549705541012335−002	−1.64891067713732226−003	−5.41068866476427468−001	−5.25068638051493288+002	23
15	−1.64891067885343730−003	−5.41068866468532555−001	1.54075258122246512−002	−6.63549706142831767−002	−5.25068638037752172+002	23
16	7.31363474160964394−003	−4.81703029590168992−001	1.38081029867477798−002	2.45369227167820286−001	−4.04744152201091400+002	23
17	1.38081031231794284−002	2.45369218282320663−001	−7.31363448933562160−003	4.81703034019889670−001	−4.04744149947013533+002	22
18	6.67806860684185913−003	4.81833028303254746−001	−1.42672578321696806−002	2.35324012316711681−001	−2.91457619080057121+002	21
19	−1.42672449151367220−002	2.35324958844933007−001	−6.67809685539254810−003	−4.81832555561925807−001	−2.91457378199954325+002	21
20	−1.52973922572966077−002	−1.33521857619086079−001	4.24623251969145781−003	−5.15053870588696186−001	−1.86380622956493572+002	20
21	4.24417746477736711−003	−5.15071227724405180−001	1.52979828221149677−002	1.33452278268962452−001	−1.86364251580315460+002	22
22	1.39700682769093768−002	−2.65141952617022681−001	7.78043220089818528−003	4.56907356032448132−001	−9.19128960405979765+001	20
23	7.85616614265819842−003	4.55444659885172971−001	−1.39285477656569089−002	2.67594041157921730−001	−9.12593849007389399+001	20
24	−6.93207460343836981−003	4.77937387551221961−001	−1.45135962189929797−002	−2.17735060773652787−001	−1.73844779372964364+001	20
25	−1.50893996541085429−002	−1.73842007504754938−001	5.60824308466766767−003	−4.95115636194211044−001	−6.56815315497912029+000	19
26	−5.69645866067631814−004	−5.22022734358127686−001	1.61486237893889944−002	−2.80827093485733259−002	4.05019585185363204+001	20
27	1.52769479877837161−002	−1.83181207220594195−001	5.41059414438821666−003	4.87978802098267407−001	7.71462663006720323+001	20
28	1.07823342554918555−002	3.82204078973413305−001	−1.21818393880902254−002	3.51500626173639717−001	1.23184337474188895+002	21
29	−6.92700148727267282−003	4.72513795590842837−001	−1.47932351460740072−002	−2.10183043945021352−001	1.72001827698425130+002	19
30	−1.64074779021348667−002	1.05896093962455668−002	−1.29182073094249543−005	−5.14753650594739426−001	2.24313669728313076+002	19
31	−7.40304900005873068−003	−4.53099086165210345−001	1.47305220967637126−002	−2.39301380438224201−001	2.79591652607638695+002	19
32	9.56292436948311626−003	−4.22333972919902586−001	1.35330963030993320−002	2.85525589542850519−001	3.37668901293314178+002	19
33	1.65765878492605403−002	4.05226733056807833−002	−1.68344584542669065−003	5.05395217405832646−001	3.98397520692535385+002	18
34	7.07954433242870546−003	4.52148888855958816−001	−1.51906354960754573−002	2.22827474665782464−001	4.61671354434069849+002	19
35	−9.16284739855005236−003	4.26550519196796838−001	−1.41572105059281005−002	−2.62710961948889924−001	5.27407900597712077+002	18
36	−1.69747632877959949−002	1.57093950196104914−002	−1.44123833734545034−004	−4.97425602027726297−001	5.95541866590887259+002	18
37	−9.84750026571020604−003	−3.97068515252876349−001	1.39735993931769152−002	−2.94234019190425229−001	6.66020480324958888+002	18
38	5.56608055262070909−003	−4.67988966000914187−001	1.62985758897177093−002	1.47032056092719853−001	7.38800405010956611+002	17
39	1.64722029442583747−002	−1.65404246264399606−001	5.48004517629445045−003	4.57711893763069115−001	8.13845577573775151+002	17
40	1.46739122613412911−002	2.52344069071523830−001	−9.54806792481746489−003	4.11379564393989810−001	8.91125652373745731+002	16
41	2.08985448704054108−003	4.73195603391834855−001	−1.75406471594241301−002	6.97602777432715021−002	9.70614851194045134+002	16
42	−1.19450980855001217−002	3.60883124208607267−001	−1.32433419406639796−002	−3.06958327607799818−001	1.05229109509473048+003	16
43	−1.80171766320589616−002	1.78463962155882329−002	−1.35787926556430030−004	−4.68637389377828444−001	1.13613533698067874+003	16
44	−1.27121471954351525−002	−3.21674460690083065−001	1.30464539960002976−002	−3.34265708816716932−001	1.22213104034853483+003	16
45	1.78307120785837673−004	−4.58397615835889258−001	1.84292804667058978−002	−1.11733146392460202−002	1.31026376658501212+003	15
46	1.29590328403186458−002	−3.37040907854541217−001	1.34308179523374138−002	3.02430815505574034−001	1.40052084425562288+003	14
47	1.88715007570494308−002	−4.85353409809136830−002	1.32633931615378262−003	4.44139113411480876−001	1.49289110125587682+003	15
48	1.54250318650988704−002	2.47198465892215558−001	−1.14280446871151930−002	3.64404487478661652−001	1.58736464580404355+003	15
49	4.85001909643957267−003	4.14572266320574031−001	−1.88920686534806280−002	1.26559961225545814−001	1.68393268583492835+003	14
50	−7.79953093583761535−003	3.99554778518394375−001	−1.82484840101860411−002	−1.48044410421395812−001	1.78258737890970295+003	14
51	−1.73561857607760150−002	2.33761622024066609−001	−1.03840792590788210−002	−3.46766669709135667−001	1.88332170661068463+003	13

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 0.1 X = 1.60000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	2.36754600405816735−003	2.12271676806335319−003	−5.03421810290029621+002	7.35093148327575729+002	5.99857123417190307+000	21
3	5.41504474021920206−005	8.24222902339575914−005	−1.46783496937626250+004	2.95318994052371150+004	1.19966664421869860+001	21
4	1.01677072552924938−006	2.11624553114216245−006	−5.95868015022987309+005	1.52245309707971643+006	1.99959740046062577+001	21
5	1.58353541064304580−008	4.16251554317359192−008	−3.09984811019978730+007	9.59038970533565671+007	2.99956410515004519+001	21
6	2.10017492554830812−010	6.65667534701919543−010	−1.96698542426074836+009	7.14050247738846145+009	4.19954545802252094+001	21
7	2.42223959733429802−012	8.97978015742152633−012	−1.47311601497842151+011	6.13549117763648474+011	5.59953394001596214+001	20
8	2.47007883810687886−014	1.04801800309367015−013	−1.27181730599984898+013	5.97592800658268225+013	7.19952631879514903+001	21
9	2.25671053657372339−016	1.07807039444514706−015	−1.24361668461538062+015	6.50629493914762770+015	8.99952101102423571+001	20
10	1.86710871631956016−018	9.91547095311904125−018	−1.35844805655755035+017	7.83041462264254498+017	1.09995171647438028+002	21
11	1.41135651635704409−020	8.24709694449433991−020	−1.63947753896561049+019	1.03226628207903538+020	1.31995142876876673+002	20
12	9.81974472371521763−023	6.26076154853108741−022	−2.16646717601261197+021	1.47928012972002170+022	1.55995120790161862+002	20
13	6.32846626629046422−025	4.37146767197275739−024	−3.11108788647718511+023	2.28963336618081534+024	1.81995103463378979+002	20
14	3.79827055921503312−027	2.82564008810103334−026	−4.82410360535642403+025	3.80665539186594913+026	2.09995089619064503+002	20
15	2.13308192211722198−029	1.70021767209981293−028	−8.03322792704240007+027	6.76563398960404388+028	2.39995078381740073+002	20
16	1.12552699379045962−031	9.56918101063467559−031	−1.42979340309687375+030	1.28010574938609088+031	2.71995069134989622+002	20
17	5.60034576382148853−034	5.05882182255559834−033	−2.70871631195343571+032	2.56894396474011455+033	3.05995061434544711+002	20
18	2.63629296969858421−036	2.52135719487470420−035	−5.44213868598449546+034	5.45019551096372913+035	3.41995054953608932+002	18
19	1.17748267767210712−038	1.18865617691428072−037	−1.15578408114631465+037	1.21883650946653541+038	3.79995049447434870+002	20
20	5.00304191169377857−041	5.31606864470569524−040	−2.58713203844991394+039	2.86555987021078096+040	4.19995044729773045+002	20
21	2.02703669380655542−043	2.26143855234010091−042	−6.08772990880165125+041	7.06591083043233730+042	4.61995040656851186+002	20
22	7.84825224469749233−046	9.17226501803669975−045	−1.50229600692683126+044	1.82339074779952284+045	5.05995037116251116+002	21
23	2.90953216690553551−048	3.55474964442466905−047	−3.87954743169995622+046	4.91455909982026747+047	5.51995034019043052+002	19
24	1.03465670259317696−050	1.31899402515851832−049	−1.04634647361305714+049	1.38100300662282574+050	5.99995031294130486+002	20
25	3.53519873160730601−053	4.69425678090426613−052	−2.94207405764060012+051	4.03910434165477472+052	6.49995028884122796+002	20
26	1.16236375264378161−055	1.60511668541448394−054	−8.60979454995021802+053	1.22768476889238430+055	7.01995026742281287+002	19
27	3.68296825668604215−058	5.28118924887550174−057	−2.61834002066983894+056	3.87240331151276529+057	7.55995024830230942+002	20
28	1.12604217492741716−060	1.67441110970489140−059	−8.26296049405509583+058	1.26587574671168743+060	8.11995023116226001+002	20
29	3.32618003596505522−063	5.12239696368336602−062	−2.70239021442737862+061	4.28334367272014799+062	8.69995021573821253+002	18
30	9.50319015935020495−066	1.51391290559968347−064	−9.14806160233003107+063	1.49849880731364865+065	9.29995020180844063+002	19
31	2.62900701850031029−068	4.32757949579582465−067	−3.20169673316556041+066	5.41432198776155657+067	9.91995018918591754+002	20
32	7.04936090471210393−071	1.19776988764204417−069	−1.15727076101680070+069	2.01840239687449582+070	1.05599501777119960+003	19
33	1.83380857348471828−073	3.21310039945555671−072	−4.31574870352723149+071	7.75596426085463180+072	1.12199501672513917+003	19
34	4.63223916586162776−076	8.36198840609022620−075	−1.65894840585321343+074	3.06931049872905281+075	1.18999501576881722+003	18
35	1.13716921154573410−078	2.11308380189682275−077	−6.56717362534095896+076	1.24984912396441685+078	1.25999501489225267+003	18
36	2.71519209515793721−081	5.18932820772881740−080	−2.67502846613778988+079	5.23288462351559195+080	1.33199501408681479+003	19
37	6.31019825786118655−084	1.23947524831739426−082	−1.12031009240764775+082	2.25094692119376812+083	1.40599501334500976+003	18
38	1.42843648929924841−086	2.88153069562548871−085	−4.82039092052984261+084	9.94078724843714499+085	1.48199501266030551+003	19
39	3.15171591477405196−089	6.52493952793695569−088	−2.12937334915020510+087	4.50416715488187404+088	1.55999501202698728+003	18
40	6.78233885058554330−092	1.44009415326018042−090	−9.65059520412485343+089	2.09251148079740122+091	1.63999501144003789+003	18
41	1.42436972571606153−094	3.09988131505460900−093	−4.48446804427182746+092	9.96129634454201425+093	1.72199501089503800+003	18
42	2.92098128852326033−097	6.51184497838594494−096	−2.13529407894798502+095	4.85630759457766418+096	1.80599501038808257+003	19
43	5.85245194254346437−100	1.33573480263277258−098	−1.04121965553990472+098	2.42325002730161800+099	1.89199500991571068+003	19
44	1.14624992126691780−102	2.67691312950992439−101	−5.19666363303464832+100	1.23697897539314443+102	1.97999500947484627+003	18
45	2.19569655292472374−105	5.24415912250844524−104	−2.65323090258300834+103	6.45623029268992066+104	2.06999500906274787+003	18
46	4.11553686826731527−108	1.00476494471779441−106	−1.38507876639564023+106	3.44380385661407070+107	2.16199500867696586+003	19
47	7.55166249310361020−111	1.88369269265486799−109	−7.38946845762631590+108	1.87646096699315087+110	2.25599500831530599+003	18
48	1.35710331730049778−113	3.45711313207704156−112	−4.02708196023950891+111	1.04397428929265212+113	2.35199500797579802+003	19
49	2.38958254999548645−116	6.21394931328172956−115	−2.24085562350133608+114	5.92794937243602027+115	2.44999500765666890+003	19
50	4.12427005664040727−119	1.09435227737231403−117	−1.27262036836647166+117	3.43404710710530519+118	2.54999500735631947+003	20
51	6.98004601804150519−122	1.88911878145937349−120	−7.37340816570100251+119	2.02873215372167812+121	2.65199500707330447+003	19

OBLATE RADIAL FUNCTIONS

H = 0.2 X = 1.60000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	9.40100149587289001−003	8.36419926917103090−003	−6.40368080710852065+001	9.24239570790090066+001	5.99428260216102775+000	21
3	4.30878382451011508−004	6.53537372945344547−004	−9.26310367858844197+002	1.85462063131195082+003	1.19866630743779954+001	22
4	1.61989728621457709−005	3.36441270555638264−005	−1.87465305609948925+004	4.77674561567758259+004	1.99838957634995984+001	21
5	5.04927156020877667−007	1.32537463595846485−006	−4.86859316043212331+005	1.50362955171957498+006	2.99825645168181086+001	21
6	1.33999400235310339−008	4.24287404980666672−008	−1.54316806561575146+007	5.59515644619850098+007	4.19818187383378792+001	22
7	3.09212112999201904−010	1.14543273151610449−009	−5.77473147481203259+008	2.40300333036368739+009	5.59813580044443829+001	21
8	6.30821461915818135−012	2.67486617349909677−011	−2.49161493218151887+010	1.16993599081636860+011	7.19810531125249704+001	21
9	1.15292970831495660−013	5.50507558083400561−013	−1.21773904247758159+012	6.36742925497391809+012	8.99808407554937990+001	21
10	1.90813804992836148−015	1.01293222798086964−014	−6.64899781221568671+013	3.83093857005346046+014	1.09980686862451590+002	21
11	2.88520396065489659−017	1.68537334647916484−016	−4.01132795441469720+015	2.52472917034744453+016	1.31980571744318647+002	21
12	4.01540252843208855−019	2.55937077229580862−018	−2.64985468143202729+017	1.80878084981740939+018	1.55980483367231199+002	21
13	5.17616591111961217−021	3.57463271467421848−020	−1.90231688156489457+019	1.39965754307491520+020	1.81980414034755664+002	21
14	6.21397931433234828−023	4.62177773604897290−022	−1.47468147865753871+021	1.16339199548466291+022	2.09980358636216366+002	21
15	6.98007701206514027−025	5.56258697556550062−024	−1.22769620789140153+023	1.03376751743344718+024	2.39980313668970715+002	21
16	7.36669849150176624−027	6.26210998666697078−026	−1.09244591160252526+025	9.77904467733477035+025	2.71980276666747091+002	20
17	7.33149230918632648−029	6.62161097495569148−028	−1.03471656121735294+027	9.81171769557217982+027	3.05980245851978774+002	20
18	6.90285290675323642−031	6.60104415037813051−030	−1.03935321903362363+029	1.04074756199972386+030	3.41980219917083926+002	20
19	6.16657742970371561−033	6.22436182069050665−032	−1.10359489890105979+031	1.16365519573812208+032	3.79980197882755149+002	20
20	5.24054199861728752−035	5.56783519015291238−034	−1.23507729967871216+033	1.36784267169424162+034	4.19980179003739211+002	21
21	4.24672438778114624−037	4.73734643145347720−036	−1.45303535213196646+035	1.68633782795787654+036	4.61980162704741063+002	20
22	3.28862289063924688−039	3.84307825567098080−038	−1.79276716405185048+037	2.17574332859590518+038	5.05980148535920975+002	20
23	2.43843628797714441−041	2.97894136602697571−040	−2.31472294232096948+039	2.93201012948513117+040	5.51980136141423603+002	20
24	1.73432427947189552−043	2.21077395838708656−042	−3.12136664127998726+041	4.11936096361414568+042	5.99980125236751170+002	20
25	1.18520218889593696−045	1.57367634061517783−044	−4.38809196120125754+043	6.02387287783308993+044	6.49980115592248967+002	19
26	7.79406799180178614−048	1.07621962387399414−046	−6.42050381659131847+045	9.15448983144144112+046	7.01980107020885664+002	19
27	4.93926895565303808−050	7.08223880002993667−049	−9.76242613272319732+047	1.44372792214593355+049	7.55980099369097288+002	20
28	3.02037641114977033−052	4.49101405614236969−051	−1.54036575732659899+050	2.35968587430381892+051	8.11980092509847162+002	20
29	1.78440367333374460−054	2.74788203603236560−053	−2.51879982291499463+052	3.99213425803273858+053	8.69980086337309181+002	20
30	1.01966384918946510−056	1.62430443955858202−055	−4.26317289396332136+054	6.98294165044117831+055	9.29980080762754417+002	20
31	5.64181657843663768−059	9.28650966467882010−058	−7.46007340160638595+056	1.26149784328397767+058	9.91980075711339461+002	20
32	3.02563128379938238−061	5.14068601347593445−060	−1.34821026142876087+059	2.35131697116100766+060	1.05598007111957740+003	21
33	1.57419587183109455−063	2.75810999545077717−062	−2.51384889670575179+061	4.51752680744592356+062	1.12198006693333047+003	20
34	7.95305119189291887−066	1.43560800811409659−064	−4.83144287876927391+063	8.93856403183257703+064	1.18998006310620487+003	21
35	3.90486018788140908−068	7.25573702792881696−067	−9.56277513298953037+065	1.81989759327629919+067	1.25998005959825826+003	20
36	1.86473938257650733−070	3.56380534946712456−069	−1.94758225801759069+068	3.80972259016624060+069	1.33198005637495213+003	20
37	8.66757083026617756−073	1.70246 - 9022888−071	−4.07819556901595318+070	8.19371121210042059+071	1.40598005340629747+003	20
38	3.92420600054808183−075	7.91591 -0940460−074	−8.77354008366982734+072	1.80925477367756408+074	1.48198005066615398+003	20
39	1.73170564843862556−077	3.58501- • 9859404−076	−1.93779396227439947+075	4.09880554164560050+076	1.55998004813165212+003	20
40	7.45319257513938322−080	1.58249 ~0998798−078	−4.39110082483873350+077	9.52083037294069942+078	1.63998004578271391+003	19
41	3.13055377149385260−082	6.81290 - 1603246−081	−1.02022060189594068+080	2.26614281381821497+081	1.72198004360165372+003	20
42	1.28399261541169087−084	2.86237747990718944−083	−2.42887404785268436+082	5.52385532361185534+083	1.80598004157284413+003	20
43	5.14525241853657090−087	1.17429893111767309−085	−5.92180464042332135+084	1.37815881202282669+086	1.89198003968243500+003	19
44	2.01550092957087598−089	4.70682461631477086−088	−1.47775011397559625+087	3.51745469475513895+088	1.97998003791811628+003	20
45	7.72165954897367772−092	1.84418580422184911−090	−3.77238802671930472+089	9.17932126944731449+090	2.06998003626891693+003	20
46	2.89467143562088915−094	7.06688689468621999−093	−9.84647817170021315+091	2.44813590170536272+093	2.16198003472503389+003	20
47	1.06230595615686491−096	2.64977111994061958−095	−2.62654593388849382+094	6.66963996421694904+095	2.25598003327768593+003	18
48	3.81815935252266853−099	9.72627061644498368−098	−7.15694722979292015+096	1.85531891461946031+098	2.35198003191898844+003	20
49	1.34461238357421754−101	3.49650962170922947−100	−1.99120948612058347+099	5.26743675700683623+100	2.44998003064184575+003	19
50	4.64147420730133346−104	1.23156761143678175−102	−5.65415681252142163+101	1.52569358433557745+103	2.54998002943985828+003	19
51	1.57108892005626417−106	4.25201030424022022−105	−1.63796010693780929+104	4.50663261461813315+105	2.65198002830724213+003	20

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 0.3 X = 1.60000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	2.08948002289102698−002	1.83498919793484211−002	−1.95545041795625086+001	2.76387686067104753+001	5.98712708737664133+000	22
3	1.44121289161794793−003	2.17310294178638739−003	−1.85975335166354942+002	3.69262614260838509+002	1.19699818088618035+001	22
4	8.14249111901354832−005	1.68514237788345701−004	−2.49660866484698293+003	6.33240459542532024+003	1.99637645230817575+001	23
5	3.81155029921883229−006	9.98109142230252435−006	−4.31123612466153001+004	1.32759934739648932+005	2.99607713321740383+001	21
6	1.51854733250705117−007	4.80001783152255845−007	−9.09525780003068380+005	3.29101096220352118+006	4.19590937280665220+001	21
7	5.25948958492623530−009	1.94579237801669171−008	−2.26653260709582181+007	9.41744237488765577+007	5.59580570248754014+001	21
8	1.61025794017859917−010	6.82108105471327523−010	−6.51435269381519254+008	3.05528883481476314+009	7.19573708561621501+001	22
9	4.41623428082736466−012	2.10698192463847213−011	−2.12123444623513119+010	1.10815978791212140+011	8.99568928794732675+001	21
10	1.09670321207090004−013	5.81796180033153521−013	−7.71776448827691475+011	4.44343549725988962+012	1.09956546463218970+002	21
11	2.48807335545977805−015	1.45258418900039694−014	−3.10287750776831632+013	1.95175317532518121+014	1.31956287312807962+002	21
12	5.19523946720519605−017	3.30982324727090574−016	−1.36605821502176650+015	9.31984882219507659+015	1.55956088350987227+002	21
13	1.00475618590633546−018	6.93598078294031487−018	−6.53616575351266892+016	4.80696107359164552+017	1.81955932257866896+002	20
14	1.80961940011047865−020	1.34546868809145645−019	−3.37713785943230114+018	2.66324655594497560+019	2.09955807531342102+002	21
15	3.04953459830691285−022	2.42949561683758347−021	−1.87398255365542528+020	1.57744184397337283+021	2.39955706287730863+002	21
16	4.82830501169256204−024	4.10321255264359179−023	−1.11150048294772991+022	9.94670621391777208+022	2.71955622975643487+002	22
17	7.20869088408149790−026	6.50911889079347037−025	−7.01738317072861617+023	6.65252238057127719+024	3.05955553593705667+002	21
18	1.01819179195122620−027	9.73462224626332568−027	−4.69860000954733805+025	4.70381543053725242+026	3.41955495198372220+002	23
19	1.36451284440181555−029	1.37702905812534120−028	−3.32562087551265400+027	3.50588073823358809+028	3.79955445585009771+002	21
20	1.73955536772089489−031	1.84786942217392448−030	−2.48096247993902854+029	2.74713944987604098+030	4.19955403075841025+002	21
21	2.11466414116852713−033	2.35858897928857156−032	−1.94567243609640730+031	2.25768916307868536+032	4.61955366375679668+002	21
22	2.45653958133226106−035	2.87028324689953745−034	−1.60025347637179119+033	1.94180267738251854+034	5.05955334471759936+002	21
23	2.73237887930099472−037	3.33758698569573339−036	−1.37733184750908335+035	1.74438876944421876+036	5.51955306562896473+002	21
24	2.91526057171703432−039	3.71567063828608539−038	−1.23811775556793740+037	1.63376753874187115+038	5.99955282008550218+002	21
25	2.98851262894491765−041	3.96760101160735603−040	−1.16030732386647390+039	1.59265158263097098+040	6.49955260291652243+002	21
26	2.94808935211354911−043	4.07034255946857402−042	−1.13174560878788081+041	1.61348690425500390+042	7.01955240991094979+002	21
27	2.80253691931373354−045	4.01805725376995942−044	−1.14715436471131955+043	1.69630734605692348+044	7.55955223761119846+002	21
28	2.57075404423231840−047	3.82211462629040888−046	−1.20663001564245021+045	1.84825835808833779+046	8.11955208315693158+002	21
29	2.27825364212601570−049	3.50808041830850162−048	−1.31532077426770623+047	2.08451102209813324+048	8.69955194416536449+002	21
30	1.95287449035048666−051	3.11063914501856388−050	−1.48408971152138022+049	2.43068786664327607+050	9.29955181863865691+002	21
31	1.62085275950174234−053	2.66774420847446550−052	−1.73125395255468598+051	2.92731905906251551+052	9.91955170489160556+002	21
32	1.30390796083207169−055	2.21524141810722009−054	−2.08577250127523789+053	3.63737808882557317+054	1.05595516014947050+003	20
33	1.01764232494259481−057	1.78286652596302080−056	−2.59263372307160781+055	4.65878421622253298+056	1.12195515072289528+003	20
34	7.71213860795640580−060	1.39203267840681561−058	−3.32179244738147938+057	6.14518551004838257+058	1.18995514210497094+003	20
35	5.68002775884717545−062	1.05535975746784208−060	−4.38302665749952627+059	8.34084995894030597+060	1.25995513420575964+003	20
36	4.06880013371449984−064	7.77566622801211057−063	−5.95088153912531039+061	1.16400139191855296+063	1.33195512694749098+003	21
37	2.83692748268307309−066	5.57193214470979960−065	−8.30710323045069221+063	1.66893033295122075+065	1.40595512026263839+003	20
38	1.92665821160221111−068	3.88625793108548238−067	−1.19138784321435203+066	2.45671774939418521+067	1.48195511409234127+003	20
39	1.27534729575986330−070	2.64012371445820677−069	−1.75421678974016900+068	3.71031996459969024+069	1.55995510838510360+003	21
40	8.23375143022178242−073	1.74814386710845414−071	−2.65000697026217140+070	5.74550068384067930+071	1.63995510309571512+003	20
41	5.18772724890895110−075	1.12893515106333934−073	−4.10455588063902152+072	9.11674465535435109+073	1.72195509818435236+003	20
42	3.19167470824817113−077	7.11483508983555606−076	−6.51442441832812534+074	1.48147626817046555+076	1.80595509361582630+003	21
43	1.91850312989018978−079	4.37841727592440071−078	−1.05882591748977033+077	2.46406384079585924+078	1.89195508935894983+003	21
44	1.12729657391078857−081	2.63248935302800324−080	−1.76145417577829087+079	4.19258483166539949+080	1.97995508538600365+003	20
45	6.47835649393654654−084	1.54718771268848085−082	−2.99769170455827203+081	7.29398592505945133+082	2.06995508167228361+003	21
46	3.64294111628409471−086	8.89335906745876664−085	−5.21617513333057576+083	1.29685435130583691+085	2.16195507819571545+003	20
47	2.00539934397537065−088	5.00201574785220903−087	−9.27592492500171884+085	2.35537307781850066+087	2.25595507493652581+003	20
48	1.08119341088853047−090	2.75411278115750042−089	−1.68500560394362493+088	4.36795152693874096+089	2.35195507187696031+003	21
49	5.71142219384687520−093	1.48514368537616554−091	−3.12530281924029083+090	8.26724408213720486+091	2.44995506900104106+003	20
50	2.95733594795742771−095	7.84675495839036900−094	−5.91622803330387845+092	1.59636131900434416+094	2.54995506629435757+003	20
51	1.50156041044763771−097	4.06372167682091112−096	−1.14256930310618852+095	3.14353801752129729+096	2.65195506374388570+003	20

OBLATE RADIAL FUNCTIONS

H = 0.4 X = 1.60000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	3.65128778910073444−002	3.14734822904953652−002	−8.61909438296424223+000	1.18033499817620857+001	5.97709295201319849+000	22
3	3.37344585035973319−003	5.04425398436009595−003	−6.02195682817200511+001	1.18123844711256196+002	1.19466091507941440+001	22
4	2.54784691708573056−004	5.24660195634560015−004	−6.01915861145062878+002	1.51675477422068125+003	1.99355790647381016+001	22
5	1.59285095563227737−005	4.15716838792557420−005	−7.76657500458605719+003	2.38175196966537516+004	2.99302630704997057+001	22
6	8.47125086384814731−007	2.67127457244217073−006	−1.22605182280645228+005	4.42360982053462579+005	4.19272816436791530+001	22
7	3.91544164948919294−008	1.44593001422929838−007	−2.28792164087316915+006	9.48627938269406779+006	5.59254384834979519+001	22
8	1.59943526324018711−009	6.76565967699873498−009	−4.92631259320877818+007	2.30674948095222644+008	7.19242182238810373+001	23
9	5.85192821425418683−011	2.78878087657721005−010	−1.20206832834479090+009	6.27172208767948009+009	8.99233680555316056+001	21
10	1.93851535675857216−012	1.02741530120441679−011	−3.27794518652463795+010	1.88528858243279918+011	1.09922751813636743+002	21
11	5.86603568333301504−014	3.42203436724762906−013	−9.87872791965418843+011	6.20851536223271194+012	1.31922290766635277+002	22
12	1.63366844233139813−015	1.04010219802115257−014	−3.26041839774865759+013	2.22279103522570679+014	1.55921936774488503+002	22
13	4.21382519443913582−017	2.90721416083276597−016	−1.16957020851793887+015	8.59618202150648503+015	1.81921659038999403+002	21
14	1.01215032717208104−018	7.52171966672674552−018	−4.53080576448244031+016	3.57113635256987557+017	2.09921437104290732+002	22
15	2.27468171314978589−020	1.81140431875188563−019	−1.88510185969535149+018	1.58606377292989593+019	2.39921256948110966+002	21
16	4.80286756048853238−022	4.08003564445867341−021	−8.38372464559483365+019	7.49944137749788277+020	2.71921108695648153+002	21
17	9.56252148848387865−024	8.63158350733270023−023	−3.96892802544175422+021	3.76120309462775916+022	3.05920985228743512+002	21
18	1.80114362177713219−025	1.72149387554365865−024	−1.99272614092856062+023	1.99429185959305820+024	3.41920881310728035+002	21
19	3.21879136167265306−027	3.24742418768574117−026	−1.05764936730264078+025	1.11465310096359129+026	3.79920793019286720+002	22
20	5.47197999564561687−029	5.81124894299167954−028	−5.91679301691684088+026	6.54987078976635516+027	4.19920717369320786+002	21
21	8.87021234694103624−031	9.89114476680634042−030	−3.47968071002015474+028	4.03673464123990176+029	4.61920652056353970+002	21
22	1.37403779672884517−032	1.60512852086899857−031	−2.14618590894159001+030	2.60368943641880099+031	5.05920595278354645+002	22
23	2.03795485297480405−034	2.48887904232697005−033	−1.38525816081795879+032	1.75407806518485916+033	5.51920545609721790+002	21
24	2.89938972243279869−036	3.69479646066909248−035	−9.33838391246247981+033	1.23202793320986436+035	5.99920501910676208+002	22
25	3.96330137731057607−038	5.26089790130190218−037	−6.56302450929584120+035	9.00696511205002170+036	6.49920463261123456+002	21
26	5.21330275875033389−040	7.19678109211814252−039	−4.80069575367530203+037	6.84310202628878564+038	7.01920428911713336+002	22
27	6.60833008016348394−042	9.47318751993647619−041	−3.64925652811208084+039	5.39540659583448871+040	7.55920398247167440+002	21
28	8.08289612989680425−044	1.20158344250729973−042	−2.87863307297692276+041	4.40875895879522857+042	8.11920370758480771+002	21
29	9.55152750540323030−046	1.47057701849631003−044	−2.35329160411244608+043	3.72901125738203568+044	8.69920346021624705+002	21
30	1.09171116264417457−047	1.73873697781996607−046	−1.99130643794287740+045	3.26104000225422266+046	9.29920323681069369+002	21
31	1.20819815667383290−049	1.98834928689215655−048	−1.74210529086221740+047	2.94534309432495735+048	9.91920303436917797+002	21
32	1.29598920323040389−051	2.20156834094719082−050	−1.57404761711623015+049	2.74469764119903141+050	1.05592028503477437+003	20
33	1.34867784955763545−053	2.36260482787022796−052	−1.46734041457160448+051	2.63645344489246157+052	1.12192026825770286+003	22
34	1.36284160833235890−055	2.45969635020845082−054	−1.40994553637033251+053	2.60810500543708760+054	1.18992025291979561+003	21
35	1.33837396921014919−057	2.48651557971353200−056	−1.39522841844891711+055	2.65487434164384611+056	1.25992023886099506+003	21
36	1.27834741695635674−059	2.44278776295771667−058	−1.42067581813051202+057	2.77863619806138421+058	1.33192022594289644+003	21
37	1.18846233002204320−061	2.33405125618391543−060	−1.48732816934786294+059	2.98787066143055163+060	1.40592021404532481+003	21
38	1.07620672720872622−063	2.17065944224325472−062	−1.59975995597681899+061	3.29856501227772655+062	1.48192020306352724+003	20
39	9.49888395211766025−066	1.96625109798787697−064	−1.76656758198758410+063	3.73618256655118618+064	1.55992019290585695+003	21
40	8.17700507364297691−068	1.73598391211326850−066	−2.00142883776627511+065	4.33902585917052881+066	1.63992018349185340+003	21
41	6.86950438567796873−070	1.49482585528817858−068	−2.32491029729035780+067	5.16359796478524428+068	1.72192017475064266+003	21
42	5.63531307866572468−072	1.25614227751359816−070	−2.76734728191693725+069	6.29297776934482066+070	1.80592016661959848+003	20
43	4.51660942278288908−074	1.03072518985368386−072	−3.37334225881643372+071	7.84987750339457582+072	1.89192015904321664+003	21
44	3.53865551728284712−076	8.26310959984599634−075	−4.20877804426371829+073	1.00171165762880034+075	1.97992015197216448+003	21
45	2.71153072532047907−078	6.47545796291160501−077	−5.37181477668832552+075	1.30700190852317505+077	2.06992014536247530+003	20
46	2.03306361772511966−080	4.96298974457652622−079	−7.01029251877382159+077	1.74282343725253034+079	2.16192013917486281+003	21
47	1.49227336261308564−082	3.72196416771094999−081	−9.34956923395499360+079	2.37395897537008986+081	2.25592013337413560+003	20
48	1.07275168853175201−084	2.73248621474886864−083	−1.27375700559834029+082	3.30174120371031259+083	2.35192012792869543+003	20
49	7.55593129925922806−087	1.96468726224369612−085	−1.77185683588872982+084	4.68681783074118117+085	2.44992012281010570+003	21
50	5.21665313316096838−089	1.38408684857301503−087	−2.51555097271027633+086	6.78736117101875866+087	2.54992011799271929+003	20
51	3.53167989751848963−091	9.55751798011873304−090	−3.64353411690104636+088	1.00240048064776445+090	2.65192011345335643+003	21

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OBLATE RADIAL FUNCTIONS

H = 0.5 X = 1.60000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	5.57982890221471702−002	4.69230828596159020−002	−4.67652096970572138+000	6.13568942439915558+000	5.96416367140576943+000	22
3	6.48265129881389212−003	9.58826172189745459−003	−2.54258105717935103+001	4.90553034394168784+001	1.19165261752530774+001	23
4	6.14080250072225341−004	1.25634210650081572−003	−2.01326087828544227+002	5.02968971069465544+002	1.98993377613406211+001	22
5	4.80910956490080679−005	1.24970017710565636−004	−2.06804690204304888+003	6.30790150942725629+003	2.98910419602430505+001	22
6	3.20184983782216216−006	1.00652357437760783−005	−2.60397236589441431+004	9.36027017690448827+004	4.18863854270495889+001	22
7	1.85196575586847008−007	6.82314754983267097−007	−3.87957102750673612+005	1.60418137516979286+006	5.58835052153919181+001	22
8	9.46475423757066633−009	3.99632484879840884−008	−6.67301097667542679+006	3.11812171322488422+007	7.18815977446971031+001	22
9	4.33168441972779115−010	2.06127765650450116−009	−1.30118699183145465+008	6.77766330696338980+008	8.98802684873799165+001	21
10	1.79468200306727570−011	9.50041599850784373−011	−2.83613121868983399+009	1.62899883249648373+010	1.09879304823718740+002	22
11	6.79176026565210165−013	3.95809434158535275−012	−6.83302172363313791+010	4.28961410902501794+011	1.31878583764130687+002	21
12	2.36531675504131775−014	1.50463693166785759−013	−1.80312501359504960+012	1.22813531592724224+013	1.55878030084212708+002	21
13	7.62894911776147541−016	5.25953909112366896−015	−5.17201769848144576+013	3.79834044878974387+014	1.81877595647077788+002	21
14	2.29126879614617996−017	1.70165863376863546−016	−1.60221828375283646+015	1.26198591680878938+016	2.09877248474931037+002	21
15	6.43840336447406996−019	5.12426140354573413−018	−5.33111866808474054+016	4.48274642305945523+017	2.39876966644291330+002	22
16	1.69969589473917259−020	1.44318167903487299−019	−1.89617197980543191+018	1.69527788791746190+019	2.71876734714355031+002	21
17	4.23101791192992308−022	3.81744523992590665−021	−7.17938716377427219+019	6.80045760284651344+020	3.05876541553743558+002	21
18	9.96352734425322252−024	9.51918896998425297−023	−2.88302646921774022+021	2.88408919071446490+022	3.41876378972725810+002	22
19	2.22608551477915154−025	2.24509428201527115−024	−1.22388557702855340+023	1.28936601860368163+024	3.79876240836722682+002	22
20	4.73119460878961504−027	5.02292627903853712−026	−5.47637348463925759+024	6.06027808236993498+025	4.19876122476727720+002	22
21	9.58807909110203729−029	1.06885224354285865−027	−2.57609423460955965+026	2.98757801081133373+027	4.61876020288133236+002	22
22	1.85678795115266013−030	2.16849217105382859−029	−1.27090271984327038+028	1.54139029616281139+029	5.05875931452132127+002	21
23	3.44286213738940931−032	4.20361394909063592−031	−6.56151802643930037+029	8.30636994353584700+030	5.51875853738668134+002	21
24	6.12334969215685308−034	7.80145042040568823−033	−3.53817425585072668+031	4.66687118681570612+032	5.99875785364740575+002	21
25	1.04638948809631481−035	1.38869206982517636−034	−1.98906971431476973+033	2.72916750596091481+034	6.49875724890972471+002	22
26	1.72067886403611220−037	2.37487964927486146−036	−1.16383845493269870+035	1.65864841259933443+036	7.01875671145068614+002	21
27	2.72663090999321729−039	3.90798705345950900−038	−7.07683465280796018+036	1.04611141074178989+038	7.55875623164458140+002	22
28	4.16914315050128202−041	6.19671342872494592−040	−4.46550214010095217+038	6.83793699909478676+039	8.11875580152814879+002	21
29	6.15879162295239853−043	9.48075463120898082−042	−2.92019555002141506+040	4.62657604615270166+041	8.69875541446745375+002	21
30	8.79976773922683823−045	1.40130969348117203−043	−1.97664671799560186+042	3.23654374294331465+043	9.29875506490014452+002	21
31	1.21742021390864588−046	2.00325260867482782−045	−1.38331931928381466+044	2.33841976712727981+045	9.91875474813419798+002	21
32	1.63245371624715611−048	2.77278331622452255−047	−9.99827524547550474+045	1.74318721602979648+047	1.05587544601894327+003	21
33	2.12365172775475123−050	3.71974938290647643−049	−7.45588467750449236+047	1.33947353424114419+049	1.12187541976717067+003	21
34	2.68259177678754035−052	4.84106821399442658−051	−5.73104013987093266+049	1.05999799420452782+051	1.18987539576723162+003	22
35	3.29321053305527715−054	6.11767542559532027−053	−4.53670788827231636+051	8.63159783876282064+052	1.25987537376869845+003	21
36	3.93208144627390959−056	7.51302936285948383−055	−3.69535636642279865+053	7.22682243030913154+054	1.33187535355501992+003	21
37	4.56971901385288494−058	8.97372017767525901−057	−3.09481934638917812+055	6.21651624089574606+056	1.40587533493816615+003	21
38	5.17284196326798137−060	1.04324279772534826−058	−2.66288065492566320+057	5.49010869422033107+058	1.48187531775423593+003	21
39	5.70735072682473381−062	1.18130796226513071−060	−2.35232131253534999+059	4.97457010735605187+060	1.55987530185983365+003	21
40	6.14163252742392400−064	1.30376483817917858−062	−2.13195034226096077+061	4.62159795857493365+062	1.63987528712906551+003	21
41	6.44973273672862766−066	1.40337141442008793−064	−1.98113759518533670+063	4.39972596509967060+064	1.72187527345103699+003	21
42	6.61394143702017328−068	1.47417290918853689−066	−1.88644653300742072+065	4.28946821122125954+066	1.80587526072775798+003	21
43	6.62643735253260548−070	1.51209551471110945−068	−1.83956217921739069+067	4.28040537767857910+068	1.89187524887238162+003	21
44	6.48978695149830363−072	1.51532511552757480−070	−1.83604824189341131+069	4.36958491090968256+070	1.97987523780771737+003	21
45	6.21628114612382653−074	1.48442429062647425−072	−1.87466561476503854+071	4.56089144954187390+072	2.06987522746497044+003	21
46	5.82626808560945175−076	1.42218314576289201−074	−1.95710585230663829+073	4.86523196120481034+074	2.16187521778266924+003	21
47	5.34577539606010742−078	1.33323988198664838−076	−2.08807357527498475+075	5.30152195152001842+076	2.25587520870574935+003	21
48	4.80378802541332181−080	1.22353799490872626−078	−2.27571247363131000+077	5.89858843921502032+078	2.35187520018476838+003	20
49	4.22955278259356770−082	1.09970381320547111−080	−2.53242501099140704+079	6.69824974996172956+080	2.44987519217523093+003	21
50	3.65022613514968888−084	9.68429358832809253−083	−2.87619791875673122+081	7.76002065865403472+082	2.54987518463700620+003	20
51	3.08908651575963532−086	8.35933144827241686−085	−3.33262658495260565+083	9.16816182372004339+084	2.65187517753382410+003	21

OBLATE RADIAL FUNCTIONS

H = 0.6 X = 1.60000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	7.81862725222313932−002	6.37164403697499140−002	−2.90733766387065118+000	3.61853274220616219+000	5.94831784129773330+000	23
3	1.09812399422006788−002	1.60228430822553607−002	−1.27376475636227437+001	2.40475089560396460+001	1.18797084952054065+001	22
4	1.25344467516574328−003	2.54388835297376298−003	−8.29856722426857937+001	2.05081655392275887+002	1.98550386572143220+001	22
5	1.18104239803653186−004	3.05273186791544671−004	−7.06019558019892812+002	2.13909300812235179+003	2.98431109116185727+001	22
6	9.45334111302201509−006	2.96040429457772592−005	−7.38089208450755280+003	2.64097682263547232+004	4.18364088775214633+001	24
7	6.57049070527725654−007	2.41381405393058051−006	−9.14105318440562353+004	3.76709714186551473+005	5.58322608728771206+001	22
8	4.03386747939420633−008	1.69942326307548439−007	−1.30790194948863360+006	6.09580992398249435+006	7.18295126736097823+001	22
9	2.21729794056037452−009	1.05323310632086957−008	−2.12238122691855816+007	1.10327336840989836+008	8.98275970101081681+001	22
10	1.10317043010454725−010	5.83120890771846413−010	−3.85094873266759831+008	2.20825288485496900+009	1.09826207950154209+002	22
11	5.01273765879435888−012	2.91772905383053704−011	−7.72505935139039934+009	4.84303207969414667+010	1.31825168437986740+002	21
12	2.09594886033841082−013	1.33189649013829750−012	−1.69757233647829361+011	1.15492193019096852+012	1.55824370140252310+002	22
13	8.11566854791161530−015	5.59008725430897968−014	−4.05532399885332751+012	2.97533890894046018+013	1.81823743713787715+002	21
14	2.92603383860025892−016	2.17139239640711730−015	−1.04637840971803427+014	8.23486654754910009+014	2.09823243083231733+002	22
15	9.86972963612196955−018	7.84987318161338342−017	−2.90012897701337646+015	2.43682812068619105+016	2.39822836654595810+002	22
16	3.12755963217038426−019	2.65395828240106426−018	−8.59276528725942042+016	7.67743596346253469+017	2.71822502173019539+002	21
17	9.34485947821893834−021	8.42690642671089506−020	−2.71030867125815050+018	2.56579158803181080+019	3.05822223593016076+002	21
18	2.64133173288118631−022	2.52232740517853848−021	−9.06718777560019123+019	9.06590523573966493+020	3.41821989108278750+002	21
19	7.08310531071179037−024	7.14050201593107383−023	−3.20679461770643291+021	3.37681778247283689+022	3.79821789874516560+002	22
20	1.80682540475111026−025	1.91748596160731809−024	−1.19547734708229282+023	1.32239501577861702+024	4.19821619159927980+002	21
21	4.39473959089109098−027	4.89738825255959552−026	−4.68530535345615627+024	5.43165744167294325+025	4.61821471767076554+002	21
22	1.02144173477587930−028	1.19252584710961419−027	−1.92586053397468515+026	2.33494422068536330+027	5.05821343631365508+002	23
23	2.27308173544303613−030	2.77452455834875466−029	−8.28439093721650375+027	1.04841075104741799+029	5.51821231537016948+002	22
24	4.85203200914527750−032	6.18002970715118905−031	−3.72207936487993845+029	4.90802993643308992+030	5.99821132912821045+002	21
25	9.95090886578709565−034	1.32027700125275683−032	−1.74346083422453317+031	2.39153702456813032+032	6.49821045683030878+002	21
26	1.96381277670068211−035	2.70981528403548846−034	−8.49993559182741999+032	1.21107390189481625+034	7.01820968157014620+002	22
27	3.73468512735265204−037	5.35162680678259530−036	−4.30652644714136551+034	6.36454110897383136+035	7.55820898946560975+002	21
28	6.85328336173400031−039	1.01841516307236960−037	−2.26426589173805262+036	3.46649204083136481+037	8.11820836903189839+002	21
29	1.21497910007876427−040	1.86996560456275216−039	−1.23379103667801821+038	1.95435554250707518+039	8.69820781070120795+002	21
30	2.08335540708802656−042	3.31702683210134376−041	−6.95880117479586859+039	1.13921749039769096+041	9.29820730645108375+002	21
31	3.45898915266870706−044	5.69078147442026179−043	−4.05794675026347470+041	6.85853298842014634+042	9.91820684951421797+002	20
32	5.56626647436240960−046	9.45302731286261569−045	−2.44393741825244881+043	4.26028332353564421+044	1.05582064341499092+003	21
33	8.68998264586527773−048	1.52189657228011399−046	−1.51861466587988677+045	2.72782303723687547+046	1.12182060554626492+003	21
34	1.31734927165143851−049	2.37698825173676500−048	−9.72674182941379677+046	1.79877340463021344+048	1.18982057092570462+003	22
35	1.94077395965683842−051	3.60482941928366375−050	−6.41596841181621326+048	1.22054439151830606+050	1.25982053919209979+003	21
36	2.78090139782087538−053	5.31280736039890637−052	−4.35478738490230632+050	8.51534432246457275+051	1.33182051003309952+003	21
37	3.87845569134567775−055	7.61536261668694600−054	−3.03904256961742260+052	6.10373563848827851+053	1.40582048317748930+003	21
38	5.26870074455167184−057	1.06245625360502977−055	−2.17894127380299378+054	4.49184395210168311+055	1.48182045838885580+003	21
39	6.97609992732873726−059	1.44376005379756515−057	−1.60392546812139729+056	3.39152885506134001+057	1.55982043546036167+003	21
40	9.00875300496539411−061	1.91221234582215758−059	−1.21132202080878187+058	2.62560535938147340+059	1.63982041421041332+003	21
41	1.13533566237708319−062	2.47009281099082812−061	−9.37979464963398553+059	2.08286560985906796+061	1.72182039447905152+003	21
42	1.39715205221841377−064	3.11380761922681948−063	−7.44252746378132041+061	1.69214801210670570+063	1.80582037612493009+003	21
43	1.67982218529066759−066	3.83287160834129733−065	−6.04767835363437737+063	1.40708373479623275+065	1.89182035902277578+003	20
44	1.97429808414483304−068	4.60947669118607701−067	−5.02987870713371786+065	1.19695049752119656+067	1.97982034306124356+003	21
45	2.26940095345064269−070	5.41880761573557580−069	−4.27954235547285317+067	1.04108807468004156+069	2.06982032814109858+003	20
46	2.55251692541447331−072	6.23017530347341993−071	−3.72296320289078992+069	9.25430337529413224+070	2.16182031417366910+003	21
47	2.81051418571584117−074	7.00892364713145913−073	−3.30995360791825374+071	8.40318380434980088+072	2.25582030107952523+003	20
48	3.03078537634490523−076	7.71894715827121284−075	−3.00604792722934777+073	7.79103478574652176+074	2.35182028878734656+003	21
49	3.20229601744734505−078	8.32555588779336026−077	−2.78752121337596162+075	7.37246513805968953+076	2.44982027723294844+003	21
50	3.31651460180903228−080	8.79835995620446601−079	−2.63817782415993639+077	7.11736389233387099+078	2.54982026635844193+003	21
51	3.36811416333243741−082	9.11383157133578555−081	−2.54727750003485593+079	7.00719160796707487+080	2.65182025611150703+003	21

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 0.7 X = 1.60000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	1.03020382035892099−001	8.07437897609619201−002	−1.99010167097959398+000	2.33541900612384886+000	5.92952905718217094+000	22
3	1.70308440700557355−002	2.44449865326473395−002	−7.20212201537189686+000	1.32247311143570155+001	1.18361262204765058+001	22
4	2.27919555704696596−003	4.58132146630468283−003	−3.95780740320570682+001	9.65095901100363739+001	1.98026795724376412+001	22
5	2.51329539817845113−004	6.45506241949863239−004	−2.86458257517992545+002	8.60915577294066359+002	2.97864735502194281+001	23
6	2.35213813989122949−005	7.33256483488893315−005	−2.55552323769166052+003	9.09379883975586717+003	4.17773566645413597+001	22
7	1.91043794313398048−006	6.99453096674933445−006	−2.70478037911932876+004	1.11020307522410654+005	5.57717099309043105+001	22
8	1.37011229830532661−007	5.75682468223670530−007	−3.31007667403798064+005	1.53804033755442536+006	7.17679669941512078+001	22
9	8.79524915674969489−009	4.16892864497524763−008	−4.59663823163585697+006	2.38371349655095767+007	8.97653570914929552+001	22
10	5.10947896815719295−010	2.69609438083352083−009	−7.13987788270686527+007	4.08625349192002448+008	1.09763464197024782+002	22
11	2.71056097950942758−011	1.57542149130174564−010	−1.22641659057625005+009	7.67633730854680332+009	1.31762047395673527+002	22
12	1.32302824002797413−012	8.39697550790517159−012	−2.30810675070158214+010	1.56816721154926479+011	1.55760959216566068+002	21
13	5.97971896732199427−014	4.11447930350322385−013	−4.72284367942826802+011	3.46109381650555640+012	1.81760105233734297+002	22
14	2.51637199953901910−015	1.86566818418362117−014	−1.04390937626593994+013	8.20726260426035293+013	2.09759422689364561+002	22
15	9.90640677139917115−017	7.87269787132758508−016	−2.47869644701388560+014	2.08091421527028092+015	2.39758868541560873+002	22
16	3.66363666885835159−018	3.10664563680835578−017	−6.29216192854735182+015	5.61761314610049150+016	2.71758412466606004+002	22
17	1.27749491404190152−019	1.15127596528940802−018	−1.70047471621954141+017	1.60871514910742303+018	3.05758032598563672+002	23
18	4.21381252942353502−021	4.02167785965403436−020	−4.87447666222357486+018	4.87084698280841498+019	3.41757712846662683+002	22
19	1.31865171318647315−022	1.32865778180185171−021	−1.47722542940135030+020	1.55470470992606994+021	3.79757441155946865+002	21
20	3.92524415151560404−024	4.16372103737811103−023	−4.71901082958916122+021	5.21745029293137281+022	4.19757208350117533+002	22
21	1.11408675015109928−025	1.24098766539942636−024	−1.58486850546791003+023	1.83651661295637965+024	4.61757007343942507+002	23
22	3.02153238032426887−027	3.52625972108846125−026	−5.58259277359415964+024	6.76568585241150612+025	5.05756832596181373+002	21
23	7.84602791326158126−029	9.57348426227342047−028	−2.05795652740716413+026	2.60343153416862118+027	5.51756679722568207+002	21
24	1.95422126709952615−030	2.48828125818736135−029	−7.92379681708082950+027	1.04449665679855309+029	5.99756545217466051+002	21
25	4.67652128480031301−032	6.20290068080076020−031	−3.18081671560821083+029	4.36181501204268711+030	6.49756426250655469+002	22
26	1.07687603782650438−033	1.48554054183594732−032	−1.32900526491308743+031	1.89302186931880945+032	7.01756320516933837+002	21
27	2.38957659697779535−035	3.42326514733825220−034	−5.77069343670528909+032	8.52611179020107877+033	7.55756226123398138+002	22
28	5.11638566978600471−037	7.60124762640380017−036	−2.60029582004906614+034	3.97994205266464414+035	8.11756141503991269+002	21
29	1.05834599074481609−038	1.62852653882564902−037	−1.21432666929877119+036	1.92307421347496570+037	8.69756065354025655+002	21
30	2.11745153115425073−040	3.37060386609509380−039	−5.86989938023542705+037	9.60744794910495049+038	9.29755996579518191+002	21
31	4.10192600917818580−042	6.74721920914932758−041	−2.93364952558014149+039	4.95728943855220769+040	9.91755934257626623+002	21
32	7.70173597966528116−044	1.30772068983340830−042	−1.51426070136158658+041	2.63915959711841467+042	1.05575587760549130+003	21
33	1.40290180455255039−045	2.45650504382943495−044	−8.06435421056027147+042	1.44830408340231281+044	1.12175582595550124+003	21
34	2.48136667789047502−047	4.47657132391171902−046	−4.42693688542658263+044	8.18537315820139851+045	1.18975577873551382+003	21
35	4.26525202589839606−049	7.92112510926285405−048	−2.50273218138807576+046	4.76031804636393913+047	1.25975573545292558+003	21
36	7.13071867465647496−051	1.36209633667801824−049	−1.45591971250323629+048	2.84647070961972655+049	1.33175569568176041+003	21
37	1.16033366989131250−052	2.27800166752671403−051	−8.70818165680848809+049	1.74873479121683557+051	1.40575565905213890+003	21
38	1.83908770370226367−054	3.70810860577305650−053	−5.35128660829040587+051	1.10300661300338154+053	1.48175562524163998+003	21
39	2.84109046235654200−056	5.87912548591125126−055	−3.37614029571740918+053	7.13798406881512699+054	1.55975559396817573+003	22
40	4.28064509485338849−058	9.08507780010071512−057	−2.18535014826377818+055	4.73628024473823018+056	1.63975556498408399+003	21
41	6.29418927921705578−060	1.36923894851473142−058	−1.45037818060451393+057	3.22031433535992369+058	1.72175553807120637+003	21
42	9.03709931605303775−062	2.01386291558693741−060	−9.86361631298571385+058	2.24236108290087885+060	1.80575551303676830+003	21
43	1.26770300377531391−063	2.89223355539569242−062	−6.86963092306371558+060	1.59815302052008342+062	1.89175548970991506+003	21
44	1.73834024797601685−065	4.05817304098378329−064	−4.89702524613567512+062	1.16521694205877077+064	1.97975546793878705+003	21
45	2.33131115676353790−067	5.56610614001969447−066	−3.57111067980131326+064	8.68662673991133481+065	2.06975544758804053+003	21
46	3.05931176897585510−069	7.46647925321924770−068	−2.66272825967362131+066	6.61822237682303966+067	2.16175542853673785+003	22
47	3.93012342260611583−071	9.80017573707301703−070	−2.02905136522703578+068	5.15081812436599341+069	2.25575541067654560+003	21
48	4.94470222063331884−073	1.25923472892219655−071	−1.57943194207645537+070	4.09320005078454064+071	2.35175539391019029+003	21
49	6.09551329186575346−075	1.58462739444877825−073	−1.25532991254063419+072	3.31983678176920087+073	2.44975537815013045+003	21
50	7.36535876041493846−077	1.95380038677466507−075	−1.01830808459617432+074	2.74700856776597693+075	2.54975536331741105+003	21
51	8.72692724313814411−079	2.36125726333598687−077	−8.42728188461340195+075	2.31804732537568664+077	2.65175534934067223+003	21

OBLATE RADIAL FUNCTIONS

H = 0.8 X = 1.60000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	1.29571208030890724−001	9.68166694053978110−002	−1.46162236822907750+000	1.61775280998595924+000	5.90776576462657717+000	23
3	2.47357875289686095−002	3.48190839969772379−002	−4.46187299066940213+000	7.91425236938145361+000	1.17857439078473119+001	23
4	3.80506352222596780−003	7.56243476452336411−003	−2.10360211916631020+001	5.04696062015256480+001	1.97422582326081293+001	22
5	4.81271536042591165−004	1.22692614454743182−003	−1.32024003542064448+002	3.93000374398410338+002	2.97211342578809802+001	23
6	5.16067760190283441−005	1.60031186202129680−004	−1.02520057443406265+003	3.62470872845957252+003	4.17092343430245908+001	22
7	4.79946243794349976−006	1.75024658895790794−005	−9.46157620841005877+003	3.86548875118943009+004	5.57018576936201080+001	22
8	3.93955960988897519−007	1.65020275048856548−006	−1.01064754068121580+005	4.67936212723402757+005	7.16969654214932356+001	23
9	2.89363656705846450−008	1.36820014438043720−007	−1.22573961308599863+006	6.33866346706986626+006	8.96935528335930372+001	22
10	1.92302270244228884−009	1.01266518310594144−008	−1.66349847783336974+007	9.49894643513401294+007	1.09691077116679776+002	22
11	1.16683579505626761−010	6.77041921009200186−010	−2.49728423259709488+008	1.56017654637075044+009	1.31689223719945683+002	23
12	6.51342168768942497−012	4.12803131258514916−011	−4.10842286574470301+009	2.78696239639081882+010	1.55687800001286355+002	22
13	3.36642145762952731−013	2.31350535981909084−012	−7.34988568006292367+010	5.37911246811909271+011	1.81686682564635689+002	22
14	1.61985678044845982−014	1.19970504090432605−013	−1.42053014358139924+012	1.11554231389811705+013	2.09685789373830341+002	22
15	7.29129488119806253−016	5.78905460752635959−015	−2.94960145594588728+013	2.47376576390613272+014	2.39685064152020047+002	22
16	3.08294006112429005−017	2.61208410304536363−016	−6.54825670658508658+014	5.84110036121286574+015	2.71684467243845685+002	21
17	1.22901506798069439−018	1.10677564782501405−017	−1.54777945927318147+016	1.46311578122742816+017	3.05683970050122037+002	22
18	4.63449787968528058−020	4.42028304518962836−019	−3.88063257458075611+017	3.87504011065627155+018	3.41683551522545248+002	22
19	1.65795788336207255−021	1.66955253886811552−020	−1.02866926941176092+019	1.08194459138888896+020	3.79683195890392996+002	22
20	5.64175670014838697−023	5.98132083854060629−022	−2.87442065678571560+020	3.17623186000319894+021	4.19682891147837915+002	23
21	1.83046283540906350−024	2.03797153602887543−023	−8.44454965275537760+021	9.78037214268981371+022	4.61682628024201013+002	22
22	5.67485311430283917−026	6.61985752109613510−025	−2.60204469519703027+023	3.15201011278172871+024	5.05682399268568786+002	22
23	1.68443790741374644−027	2.05446205629431446−026	−8.39113320867703009+024	1.06107174894120517+026	5.51682199143647363+002	21
24	4.79567682374162028−029	6.10397354482968523−028	−2.82639034403196304+026	3.72421835741925825+027	5.99682023061700137+002	22
25	1.31178936934427595−030	1.73934393994897667−029	−9.92566327119260947+027	1.36060084850059299+029	6.49681867318732490+002	21
26	3.45276153178384899−032	4.76152317463306689−031	−3.62807667808965343+029	5.16606438188526763+030	7.01681728897740806+002	22
27	8.75743118127107521−034	1.25419981417568784−032	−1.37820121924796386+031	2.03563831114220888+032	7.55681605321247692+002	21
28	2.14323440046866877−035	3.18324870663867099−034	−5.43309880446619816+032	8.31334864926974667+033	8.11681494539498228+002	21
29	5.06734910842097576−037	7.79534397655009678−036	−2.21975671772931382+034	3.51438040098904291+035	8.69681394844788775+002	22
30	1.15880377574590654−038	1.84416021871049497−037	−9.38749667245184744+035	1.53609368613690715+037	9.29681304805172030+002	23
31	2.56580912118784054−040	4.21951373362603339−039	−4.10469157485900082+037	6.93448196563745688+038	9.91681223212685903+002	21
32	5.50633163673796499−042	9.34750602738689374−041	−1.85365801300531464+039	3.22996892933548003+040	1.05568114904257961+003	21
33	1.14639846501817678−043	2.00695871623898843−042	−8.63690992602181299+040	1.55080789408413911+042	1.12168108142094552+003	22
34	2.31756243885924106−045	4.18026135530862239−044	−4.14815377889707236+042	7.66839862209224136+043	1.18968101959883262+003	23
35	4.55318358732943964−047	8.45433253297427554−046	−2.05178218333120842+044	3.90186566096008022+045	1.25968096293139943+003	21
36	8.70024935986380806−049	1.66162265202736360−047	−1.04429229475327243+046	2.04133944821129512+047	1.33168091086101529+003	21
37	1.61810743054198933−050	3.17620510992672450−049	−5.46489864949576169+047	1.09725227136833019+049	1.40568086290347783+003	22
38	2.93123898323665635−052	5.90928375854652283−051	−2.93822374635061497+049	6.05531032740204348+050	1.48168081863670667+003	21
39	5.17555081027473932−054	1.07083154852062359−052	−1.62188865156552589+051	3.42855569159806135+052	1.55968077769141756+003	22
40	8.91254996999029129−056	1.89130417159492765−054	−9.18538178449570923+052	1.99045264526829092+054	1.63968073974339021+003	22
41	1.49779513173242403−057	3.25787695399944530−056	−5.33377478149837862+054	1.18411238201722259+056	1.72168070450702587+003	22
42	2.45787756621006090−059	5.47654371213396220−058	−3.17371782033142907+056	7.21409211805418598+057	1.80568067172995448+003	21
43	3.94063387236692796−061	8.98938242832877230−060	−1.93395182871577934+058	4.49859782421806632+059	1.89168064118850054+003	21
44	6.17589080921898359−063	1.44160279962316987−061	−1.20621850094936443+060	2.86978517250444679+061	1.97968061268385471+003	21
45	9.46630024986854778−065	2.25987231639765402−063	−7.69625676379914449+061	1.87188251824253893+063	2.06968058603882844+003	21
46	1.41977001392590830−066	3.46469114665980028−065	−5.02096046467624274+063	1.24782761342314695+065	2.16168056109509227+003	21
47	2.08455692945677651−068	5.19753864290993619−067	−3.34763238570864679+065	8.49720658298365968+066	2.25568053771081714+003	21
48	2.99750667164887503−070	7.63281570579002352−069	−2.27998181767512831+067	5.90813648262994985+068	2.35168051575865287+003	21
49	4.22320273607518576−072	1.09778816596129048−070	−1.58553200534131753+069	4.19268927753433036+070	2.44968049512398977+003	22
50	5.83225387382083019−074	1.54697756325410761−072	−1.12534027324538265+071	3.03546422981674280+072	2.54968047570345910+003	22
51	7.89794335998245640−076	2.13677481931302361−074	−8.14855382804379196+072	2.24118281306848923+074	2.65168045740363533+003	21

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 0.9 X = 1.60000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	1.57057143177261943−001	1.10720772684148564−001	−1.13035945352863161+000	1.19036668300487104+000	5.88299107922981127+000	23
3	3.41383469625051026−002	4.69709511088145940−002	−2.97145950313457453+000	5.05406966006894363+000	1.17285205024373784+001	24
4	5.94695906871499554−003	1.16659649094987480−002	−1.21643246623905355+001	2.86198838844940818+001	1.96737724254738626+001	23
5	8.49717682860387744−004	2.14780543818287759−003	−6.71343284151831962+001	1.97616679515853244+002	2.96470982206528057+001	22
6	1.02802676747922161−004	3.16866213932658128−004	−4.60583382396211604+002	1.61636404175471722+003	4.16320483714095437+001	22
7	1.07790672373826758−005	3.91313886967230486−005	−3.76338337797321998+003	1.52929229647731836+004	5.56227103020917555+001	22
8	9.97050058773705640−007	4.16181049994538884−006	−3.56310203068128318+004	1.64304998323239360+005	7.16165134061080049+001	22
9	8.24989532528381262−008	3.88986894700315523−007	−3.83307588094775686+005	1.97588245470251703+006	8.96121889746309836+001	22
10	6.17474087993249521−009	3.24416106673496711−008	−4.61632264174135139+006	2.62924265115382866+007	1.09609050810769229+002	22
11	4.21886019123768972−010	2.44325564648960122−009	−6.15189571688442038+007	3.83523785734320689+008	1.31606700969441106+002	22
12	2.65145980356282035−011	1.67769971976926831−010	−8.98643224015203869+008	6.08512012682872252+009	1.55604895597082240+002	22
13	1.54272014286199432−012	1.05872872886852173−011	−1.42771676343920551+010	1.04330904086750932+011	1.81603478427551888+002	22
14	8.35602874345770931−014	6.18120918378742950−013	−2.45087690221072506+011	1.92215751572945894+012	2.09602345537607983+002	22
15	4.23351937294368304−015	3.35772652170904263−014	−4.52055163855669193+012	3.78696982942618003+013	2.39601425617203788+002	22
16	2.01469786403763381−016	1.70540079825449508−015	−8.91556624502307644+013	7.94480043967221061+014	2.71600668407305389+002	22
17	9.03917124887712943−018	8.13336426376059617−017	−1.87222690705975992+015	1.76824649158192152+016	3.05600037655208152+002	22
18	3.83603540787201065−019	3.65600634927301340−018	−4.17064971936882639+016	4.16134438691617765+017	3.41599506676020433+002	21
19	1.54435292873597828−020	1.55411152615230351−019	−9.82313574350905479+017	1.03245427185289756+019	3.79599055473360420+002	23
20	5.91380990084319284−022	6.26594614785914669−021	−2.43902333703247347+019	2.69339015812425875+020	4.19598668822994883+002	22
21	2.15914818451504685−023	2.40259178865671244−022	−6.36720395116325234+020	7.37012607635024510+021	4.61598334968047338+002	23
22	7.53242369560983492−025	8.78233095387260612−024	−1.74343946073955602+022	2.11081115022471250+023	5.05598044712389952+002	22
23	2.51585142018296258−026	3.06709532211969014−025	−4.99624838758954624+023	6.31476727202226216+024	5.51597790779113558+002	22
24	8.05975939199080128−028	1.02541564247393144−026	−1.49553572970366979+025	1.96972740548233938+026	5.99597567349030360+002	22
25	2.48068520333075691−029	3.28792780901865168−028	−4.66739081496401518+026	6.39538712521288436+027	6.49597369723682674+002	21
26	7.34688864514257449−031	1.01280211139872070−029	−1.51617300044567408+028	2.15807736744147068+029	7.01597194075886115+002	22
27	2.09670588879435663−032	3.00179177735838917−031	−5.11857911275654907+029	7.55760627154379397+030	7.55597037262746767+002	22
28	5.77363734007801891−034	8.57261899530530153−033	−1.79330826632988806+031	2.74309535322743567+032	8.11596896683885799+002	21
29	1.53594379191436115−035	2.36212008126286327−034	−6.51161490341949839+032	1.03062169499174732+034	8.69596770172795203+002	21
30	3.95198335001843486−037	6.28759038040072325−036	−2.44745084295326371+034	4.00366511929653076+035	9.29596655912760811+002	21
31	9.84547476169605977−039	1.61868574340636159−037	−9.51108257134776261+035	1.60637581095583356+037	9.91596552371201468+002	22
32	2.37727009532088458−040	4.03465583237387342−039	−3.81740504815732506+037	6.65009447441465880+038	1.05559645824795350+003	21
33	5.56868456425603527−042	9.74666871181814685−041	−1.58084696335686740+039	2.83783260640732338+040	1.12159637243421487+003	21
34	1.26662073834524341−043	2.28415183443285354−042	−6.74811338641549138+040	1.24719817214285440+042	1.18959629397970947+003	22
35	2.79979307758375570−045	5.19758565254675601−044	−2.96659220784831475+042	5.64037010346677115+043	1.25959622206624272+003	21
36	6.01915867528297537−047	1.14935133907272219−045	−1.34199371253469771+044	2.62275251634475011+045	1.33159615598626502+003	21
37	1.25951295284433005−048	2.47186368507851115−047	−6.24187173308246591+045	1.25301849160037965+047	1.40559609512538764+003	22
38	2.56705837792804827−050	5.17421057318182954−049	−2.98280059595658043+047	6.14608067410170243+048	1.48159603894803953+003	22
39	5.09951071489453840−052	1.05492496541423977−050	−1.46342054889487065+049	3.09304135822335409+050	1.55959598698563629+003	21
40	9.88006131177645799−054	2.09628821926957844−052	−7.36641274602615071+050	1.59602876052991614+052	1.63959593882677060+003	21
41	1.86807470806154762−055	4.06267123243691175−054	−3.80194695495922948+052	8.43913023283791359+053	1.72159589410903882+003	21
42	3.44893316223003942−057	7.68367994639333212−056	−2.01073075414085102+054	4.56986956621294879+055	1.80559585251219909+003	21
43	6.22116852673824392−059	1.41898142041387302−057	−1.08904809903535834+056	2.53289973013245684+057	1.89159581375241863+003	21
44	1.09694680528675088−060	2.56020746048666786−059	−6.03732635631140596+057	1.43618434480298422+059	1.97959577757741651+003	21
45	1.89166890622690684−062	4.51538490262932728−061	−3.42386660065133666+059	8.32646276423960501+060	2.06959574376234599+003	21
46	3.19198343655314090−064	7.78852945196698019−063	−1.98538154153495336+061	4.93354178383039394+062	2.16159571210629052+003	22
47	5.27270078094317079−066	1.31452105738616455−064	−1.17656525342372157+063	2.98609553455561971+064	2.25559568242927097+003	21
48	8.53012276076351270−068	2.17186270138932574−066	−7.12248978312251070+064	1.84545015443209037+066	2.35159565456968070+003	21
49	1.35210957648381115−069	3.51433261994639453−068	−4.40249328671771354+066	1.16404474713425063+068	2.44959562838207989+003	21
50	2.10077889864633784−071	5.57165328978424908−070	−2.77735740073320390+068	7.49079961656329846+069	2.54959560373529271+003	21
51	3.20059771618820962−073	8.65832044797717103−072	−1.78753102830799847+070	4.91594733502209727+071	2.65159558051076078+003	21

OBLATE RADIAL FUNCTIONS

H = 1.0 X = 1.60000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	1.84666583932903732−001	1.21270744135876103−001	−9.07073958868135802−001	9.25437286955900313−001	5.85516257458899876+000	23
3	4.52159558403858666−002	6.05880869532758314−002	−2.09924060152297127+000	3.39946157162254074+000	1.16644092705727215+001	23
4	8.81745757706369821−003	1.70405583269145731−002	−7.52952285247291821+000	1.73056237276400893+001	1.95972201861103753+001	23
5	1.40640338573063054−003	3.52065106673669496−003	−3.69255976700761462+001	1.07292639585803828+002	2.95643714836989069+001	23
6	1.89677745710753155−004	5.80657797887203269−004	−2.26407955206459626+002	7.87827434105230126+002	4.15458061323492353+001	23
7	2.21516146631934252−005	8.00087921656835327−005	−1.65742843997531855+003	6.69432143325475405+003	5.55342747431752609+001	23
8	2.28095261495578692−006	9.48345962601597349−006	−1.40777104412710993+004	6.46192633908852222+004	7.15266171379765059+001	23
9	2.10019146014989194−007	9.87132954415417225−007	−1.35971903441424300+005	6.98395991155991954+005	8.95212708911589897+001	22
10	1.74872643948529285−008	9.16400840083005549−008	−1.47104958741595626+006	8.35418081036847854+006	1.09517389931433988+002	22
11	1.32893086594199277−009	7.67967460166642202−009	−1.76169566776229950+007	1.09566558637709486+008	1.31514483179371164+002	22
12	9.28813161393638882−011	5.86634471167464046−010	−2.31322160329391915+008	1.56325652182280361+009	1.55512249521578269+002	24
13	6.00914998861604944−012	4.11749588751101372−011	−3.30421272101262243+009	2.41045828073170527+010	1.81510495907148754+002	22
14	3.61880836750183044−013	2.67332452271418742−012	−5.10048203445137708+010	3.99431041165241022+011	2.09509093902326498+002	22
15	2.03831899177320875−014	1.61473633181652744−013	−8.46054405351143697+011	7.07854846495763764+012	2.39507955352854786+002	22
16	1.07834255014058010−015	9.11841167132112816−015	−1.50077534345182203+013	1.33586495597427824+014	2.71507018113466726+002	21
17	5.37808516749797502−017	4.83465401219507198−016	−2.83478387098193126+014	2.67468587366995860+015	3.05506237349175971+002	22
18	2.53696043423275715−018	2.41588596914605791−017	−5.68052708632494123+015	5.66283248307246177+016	3.41505580052648467+002	21
19	1.13525246833474200−019	1.14156973020625746−018	−1.20360090051312080+017	1.26403108453497561+018	3.79505021486509760+002	23
20	4.83184831927866624−021	5.11608549794871614−020	−2.68853686959627863+018	2.96679494139160558+019	4.19504542814879966+002	22
21	1.96072024338943143−022	2.18044442579234548−021	−6.31442374066898454+019	7.30427384595140643+020	4.61504129490418294+002	22
22	7.60228317991305817−024	8.85878445458787533−023	−1.55557715089616674+021	1.88224571744274654+022	5.05503770133392552+002	22
23	2.82202368645964699−025	3.43857316479545267−024	−4.01089444159956147+022	5.06662425100888598+023	5.51503455738369125+002	21
24	1.00474420437522582−026	1.27769316566032952−025	−1.08023360726679668+024	1.42203524091189373+025	5.99503179103453684+002	22
25	3.43680777023426360−028	4.55318059450246460−027	−3.03339182535131742+025	4.15452588573615693+026	6.49502934413467056+002	22
26	1.13117661456972013−029	1.55874345375288241−028	−8.86635610037363855+026	1.26147525740513729+028	7.01502716931361024+002	21
27	3.58758163736510105−031	5.13429112547852218−030	−2.69336695607291929+028	3.97520085165264715+029	7.55502522766895258+002	23
28	1.09785670118333531−032	1.62950838190073859−031	−8.49097465891146329+029	1.29832729971797581+031	8.11502348701228074+002	22
29	3.24562587980613324−034	4.98978893620526625−033	−2.77430280085008861+031	4.38950844819346945+032	8.69502192052488641+002	22
30	9.28027379107579856−036	1.47603332856570569−034	−9.38311709550895499+032	1.53444762538550301+034	9.29502050571740230+002	22
31	2.56921752173294081−037	4.22280773581446548−036	−3.28122511035411168+034	5.54017117705807699+035	9.91501922361726995+002	21
32	6.89378303208723761−039	1.16968169793787730−037	−1.18509092657348186+036	2.06390249042827185+037	1.05550180581287436+003	22
33	1.79449906093066123−040	3.14004474386372600−039	−4.41626007382319889+037	7.92568450870603672+038	1.12150169955247874+003	21
34	4.53571429925710452−042	8.17747809559247516−041	−1.69641549141671396+039	3.13456407972922119+040	1.18950160240406880+003	21
35	1.11411676322817864−043	2.06779526908478759−042	−6.71113694437688924+040	1.27568589628840604+042	1.25950151335467546+003	21
36	2.66160537666160517−045	5.08120956039847929−044	−2.73199676904409769+042	5.33814654237949191+043	1.33150143152829929+003	21
37	6.18886821585331286−047	1.21435157883837298−045	−1.14350692442373766+044	2.29503889147286896+045	1.40550135616426915+003	22
38	1.40166061834464863−048	2.82466584037423087−047	−4.91750738253160562+045	1.01305354030663369+047	1.48150128659948821+003	21
39	3.09408423331384020−050	6.39948807151311345−049	−2.17114669986984223+047	4.58800057228028997+048	1.55950122225378888+003	21
40	6.66128288861601391−052	1.41310083439797810−050	−9.83507073684227884+048	2.13051167667840559+050	1.63950116261778998+003	21
41	1.39954008343120708−053	3.04319867872891615−052	−4.56805102129507550+050	1.01379024266977376+052	1.72150110724277882+003	21
42	2.87122424304067163−055	6.39561750979086834−054	−2.17412322060551817+052	4.94041074523657008+053	1.80550105573224149+003	22
43	5.75498259081223397−057	1.31244999752595410−055	−1.05970355259987940+054	2.46426608018084598+055	1.89150100773474130+003	21
44	1.12757622573995271−058	2.63131251067886792−057	−5.28677355866951097+055	1.25745239308247750+057	1.97950096293790569+003	21
45	2.16068986925676968−060	5.15681730918043793−059	−2.69819380722762746+057	6.56077270204941918+058	2.06950092106332857+003	22
46	4.05129309497067582−062	9.88395402370218003−061	−1.40803015555314672+059	3.49838483336849133+060	2.16150088186223233+003	21
47	7.43619413484886715−064	1.85365861083753444−062	−7.50925746246623221+060	1.90558337063115009+062	2.25550084511176274+003	22
48	1.33676891225012855−065	3.40314368822024410−064	−4.09097717392127715+062	1.05984694606027555+064	2.35150081061181343+003	21
49	2.35448201436827277−067	6.11892784821158401−066	−2.27567027537139034+064	6.01628100477665463+065	2.44950077818229510+003	22
50	4.06485724210449594−069	1.07795345116110134−067	−1.29198929261534044+066	3.48421694257040016+067	2.54950074766077968+003	21
51	6.88139663267269607−071	1.86136697899119841−069	−7.48338820789320926+067	2.05780260827735723+069	2.65150071890046184+003	21

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 2.0 X = 1.60000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	3.11736962473944047−001	−1.02439744520455039−001	−7.00897016710352758−002	4.73570436317067420−001	5.39501078349079835+000	24
3	2.01180390579595289−001	1.39526975853047192−001	−3.21710602665262166−001	4.75007183539061494−001	1.06299512876868696+001	24
4	8.97033726986978815−002	1.28644095264428756−001	−5.41285873978953531−001	7.89448652088831331−001	1.83883287402038170+001	24
5	3.10226186515099559−002	6.50232499698934051−002	−1.06462416077197780+000	2.29587695585834180+000	2.82612011298329428+001	23
6	8.84316083182937020−003	2.40147738977806453−002	−2.81335128682414475+000	8.24223878093338083+000	4.01876279172383946+001	24
7	2.15073870239788431−003	7.12130537454495932−003	−9.43285035185917172+000	3.40697966761739722+001	5.41412350355173940+001	26
8	4.56873887168446634−004	1.77776987783025652−003	−3.78257743713767362+001	1.60227839618726299+002	7.01101221891089457+001	22
9	8.62289084753123362−005	3.84647354473915441−004	−1.75290299430865838+002	8.46867826027640708+002	8.80882526859487375+001	23
10	1.46501757623348217−005	7.35868626404770515−005	−9.18891209575319793+002	4.97134765911362088+003	1.08072299830526378+002	23
11	2.26401169530242250−006	1.26322690086294697−005	−5.36726604247770761+003	3.20884781043864813+004	1.30060308435711217+002	23
12	3.20950126151433737−007	1.96808869004500893−006	−3.45340741066854751+004	2.25839816300628419+005	1.54051068532153273+002	23
13	4.20318412136962500−008	2.80826580592921620−007	−2.42548456437385892+005	1.72096635465196128+006	1.80043798930238404+002	22
14	5.11550578826163693−009	3.69743596192154517−008	−1.84576427033572353+006	1.41146328998860734+007	2.08037977084355322+002	23
15	5.81549598423570421−010	4.52004657077179085−009	−1.51245495546181820+007	1.23954637831120541+008	2.38033242783308760+002	24
16	6.20294181342982481−011	5.15787961618358288−010	−1.32746469478262230+008	1.16042370641262233+009	2.70029341210991787+002	23
17	6.23171737438020394−012	5.51917142942408259−011	−1.24228223300800712+009	1.15354641115134633+010	3.04026088007913874+002	22
18	5.91707414229372704−013	5.56012436830733304−012	−1.23466776020400940+010	1.21344389934712944+011	3.40023347130963836+002	22
19	5.32625723180383760−014	5.29211090471704359−013	−1.29865725986706921+011	1.34659391419651919+012	3.78021016422358668+002	22
20	4.55766126685939919−015	4.77376822060680340−014	−1.44113994699018590+012	1.57213871770980833+013	4.18019017966603923+002	22
21	3.71653737283842153−016	4.09253207909432727−015	−1.68259735943421840+013	1.92621772159749718+014	4.60017291502783003+002	22
22	2.89456148402170736−017	3.34279706042683490−016	−2.06173437851570347+014	2.47118060536171889+015	5.04015789834124268+002	22
23	2.15754187327537216−018	2.60735389420641724−017	−2.64534840242007364+015	3.31283691416437807+016	5.50014475571760051+002	22
24	1.54197231814694151−019	1.94606529612465090−018	−3.54681700157674897+016	4.63212358464055481+017	5.98013318787307725+002	22
25	1.05846679544375530−020	1.39251547743712196−019	−4.96004560092344883+017	6.74371986241887240+018	6.48012295295582078+002	22
26	6.98948599501530720−022	9.56924623549388496−021	−7.22231177220277033+018	1.02063812010508837+020	7.00011385381316757+002	22
27	4.44644438352758664−023	6.32529415972538129−022	−1.09325750912092653+020	1.60347636622181315+021	7.54010572843401867+002	23
28	2.72876635411706702−024	4.02760162008879887−023	−1.71786417898858549+021	2.61146259703994491+022	8.10009844269282110+002	22
29	1.61752412246585552−025	2.47380631199993289−024	−2.79824896646039945+022	4.40340750751186803+023	8.68009188478292615+002	22
30	9.27201687956355905−027	1.46753031334773420−025	−4.71919289674160598+023	7.67835658864355253+024	9.28008596090437148+002	22
31	5.14530935728690516−028	8.41825276163178655−027	−8.23043814765097784+024	1.38307581905762999+026	9.90008059189316435+002	22
32	2.76698799028672579−029	4.67463677978912125−028	−1.48277628803641958+026	2.57084717134365154+027	1.05400757105642888+003	22
33	1.44337408250001886−030	2.51542777681190890−029	−2.75663792492107714+027	4.92652618574714311+028	1.12000712596008232+003	21
34	7.31002461796990668−032	1.31290498924259858−030	−5.28343948674484382+028	9.72402984832919507+029	1.18800671898645690+003	22
35	3.59746714257869776−033	6.65283059332649952−032	−1.04302137300390241+030	1.97525065241245607+031	1.25800634590346781+003	22
36	1.72171734812074086−034	3.27568906727033543−033	−2.11903694355116333+031	4.12590236071319499+032	1.33000600305034774+003	22
37	8.01943522451262514−036	1.56845571607739123−034	−4.42693345364578022+032	8.85535519814782967+033	1.40400568724754219+003	22
38	3.63793518373087661−037	7.30880439204716777−036	−9.50289811283891482+033	1.95150851107646766+035	1.48000539572275727+003	22
39	1.60839061274722227−038	3.31694537189824090−037	−2.09452171538432999+035	4.41281468182490722+036	1.55800512604993347+003	22
40	6.93481218901960287−040	1.46705134954996725−038	−4.73688378388367472+036	1.02319888109615265+038	1.63800487609862695+003	22
41	2.91777525497416205−041	6.32775105440023317−040	−1.09849484946122658+038	2.43128454331758894+039	1.72000464399181801+003	21
42	1.19866394311737058−042	2.66329117554531563−041	−2.61055600092789783+039	5.91681521781799353+040	1.80400442807058097+003	22
43	4.81076444890730382−044	1.09448121006692697−042	−6.35393614953441244+040	1.47391961712131864+042	1.89000422686436930+003	23
44	1.88726658334412839−045	4.39401521685082485−044	−1.58301360593367490+042	3.75630979207435241+043	1.97800403906591864+003	22
45	7.24062417223637090−047	1.72429038117510514−045	−4.03484348115314235+043	9.78879976025069731+044	2.06800386350996559+003	22
46	2.71802700964346601−048	6.61723338841233400−047	−1.05159291257011230+045	2.60715146060212908+046	2.16000369915513332+003	22
47	9.98777810305054002−050	2.48468627679664797−048	−2.80114700447348390+046	7.09364207516331491+047	2.25400354506845668+003	23
48	3.59430739330901945−051	9.13268533800521058−050	−7.62235034400527308+047	1.97080837065515502+049	2.35000340041211633+003	21
49	1.26729772732551936−052	3.28739195539337413−051	−2.11793503773827360+049	5.58863245976527198+050	2.44800326443202865+003	22
50	4.37963196277291443−054	1.15935591036891958−052	−6.00649388130604682+050	1.61686637108529318+052	2.54800313644800061+003	21
51	1.48410104498285021−055	4.00749600046581094−054	−1.73794315334201105+052	4.77066141022189368+053	2.65000301584520909+003	22

OBLATE RADIAL FUNCTIONS

H = 3.0 X = 1.60000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	4.45301586763434642−002	−4.84407114162099680−001	1.93708943961469465−001	−4.51450738647331402−003	4.52646046219492481+000	23
3	2.05295682066726970−001	−2.18695136557609740−001	4.12916106117566912−002	4.12101625949337101−001	8.80939392076956958+000	24
4	1.94049014281011158−001	6.80506471584679278−002	−1.32491167245014457−001	4.36059154648199333−001	1.63861060190996199+001	23
5	1.20325031743108147−001	1.55374462186943377−001	−2.62499575931416035−001	4.39203942864370645−001	2.61050139380708235+001	26
6	5.75587556091610578−002	1.18917662610640120−001	−4.13293063787918076−001	7.72864409799166407−001	3.79400004790263072+001	23
7	2.27043531026874978−002	6.27232958821733367−002	−7.60793315954967439−001	2.02223310798668705+000	5.18338623574273315+001	24
8	7.66642508785022914−003	2.61781950006906024−002	−1.76602655400640926+000	6.18300847541611390+000	6.77617506037794595+001	23
9	2.27023848306854482−003	9.16839960097867430−003	−4.97935003257906952+000	2.11344703684235711+001	8.57105950232199005+001	23
10	5.99779896537260019−004	2.78492642460340899−003	−1.63326962577230445+001	8.02754505216280555+001	1.05673028613862985+002	22
11	1.43203091738947360−004	7.49569418275816616−004	−6.06519959464773870+001	3.36375960167408379+002	1.27644648702775882+002	23
12	3.12132921349094870−005	1.81512550871925483−004	−2.50630384524357174+002	1.54230441865596882+003	1.51622696238387150+002	22
13	6.26177505170216969−006	4.00027305010407574−005	−1.13846309967314930+003	7.68014274591686709+003	1.77605372590815883+002	24
14	1.16401155780883966−006	8.09627783037138955−006	−5.63185371302557669+003	4.12675510982538507+004	2.05591465473373907+002	23
15	2.01645703140467185−007	1.51591946845225669−006	−3.01158191268775013+004	2.37941109239777665+005	2.35580134131187108+002	24
16	3.27118663133925834−008	2.64182164345301901−007	−1.73014785140005880+005	1.46508114029106237+006	2.67570780880573440+002	23
17	4.99041281533190159−009	4.30726516631953092−008	−1.06236243019935292+006	9.59323279997463478+006	3.01562971549996876+002	23
18	7.18595523259894236−010	6.59915790475774638−009	−6.94131245833858864+006	6.65550233401083103+007	3.37556384678751501+002	23
19	9.79861321199516067−011	9.53743247716417816−010	−4.80753428328519868+007	4.87634567864369961+008	3.75550778194464310+002	23
20	1.26892722447235836−011	1.30465266627611931−010	−3.51764463800892268+008	3.76222633740456195+009	4.15545967027992404+002	22
21	1.56469685759099755−012	1.69424641210695051−011	−2.71103136824608214+009	3.04860375238024382+010	4.57541807751940833+002	23
22	1.84146578592416462−013	2.09428319308193638−012	−2.19489341162607571+010	2.58846378467079872+011	5.01538187835289595+002	22
23	2.07281526337289035−014	2.47009297030940480−013	−1.86229720898418037+011	2.29796100008468375+012	5.47535017995852502+002	22
24	2.23595217586057330−015	2.78581631633554197−014	−1.65234653762881340+012	2.12891938690541698+013	5.95532226671330634+002	22
25	2.31547141284505504−016	3.01029816046046956−015	−1.53008403338252588+013	2.05456508887022216+014	6.45529755964388472+002	22
26	2.30567872125827696−017	3.12224352148017564−016	−1.47608338880208455+014	2.06212775373286750+015	6.97527558629522259+002	23
27	2.21102128870149874−018	3.11344985263055209−017	−1.48105775997725223+015	2.14927682510110061+016	7.51525595806915883+002	23
28	2.04467964972665639−019	2.98947944683594797−018	−1.54326080266781838+016	2.32297975387087835+017	8.07523835299050677+002	22
29	1.82581090164465305−020	2.76782344473568781−019	−1.66764535008770969+017	2.60024079076102684+018	8.65522250246532413+002	25
30	1.57617899005344806−021	2.47420807124335880−020	−1.86638140109014526+018	3.01074940314562122+019	9.25520818100907121+002	22
31	1.31692363136836577−022	2.13803680278702993−021	−2.16074941975787529+019	3.60198115222363140+020	9.87519519820754630+002	23
32	1.06604505282143005−023	1.78799239466899821−022	−2.58479598326388882+020	4.44793614280509407+021	1.05151833923729814+003	23
33	8.36905689733986162−025	1.44859166609400011−023	−3.19160081540314484+021	5.66368420671703192+022	1.11751726254989714+003	22
34	6.37769388182359633−026	1.13811302347913567−024	−4.06371090354847217+022	7.42954062231077557+023	1.18551627792191358+003	22
35	4.72186565171971291−027	8.67934312946493042−026	−5.33048496889226385+023	1.00315964501818276+025	1.25551537515477167+003	22
36	3.39923720459815866−028	6.43027285791677933−027	−7.19717283691591539+024	1.39305293524344301+026	1.32751454542339468+003	22
37	2.38123667387990190−029	4.63201769779696357−028	−9.99428702549517144+025	1.98801089122355268+027	1.40151378106016208+003	22
38	1.62440434404740911−030	3.24673232968405555−029	−1.42626325851223815+027	2.91343769514043969+028	1.47751307537748170+003	22
39	1.07983345438213732−031	2.21603746035015217−030	−2.09019672739420910+028	4.38154755582206422+029	1.55551242252128866+003	22
40	6.99963918318495360−033	1.47388653702034708−031	−3.14349406772315363+029	6.75769446215516942+030	1.63551181734946254+003	22
41	4.42712440206222918−034	9.55858942328163513−033	−4.84830652569454227+030	1.06818745147840144+032	1.71751125533043579+003	25
42	2.73371207997768243−035	6.04837148467407814−034	−7.66386239362241171+031	1.72948250050650123+033	1.80151073245825145+003	22
43	1.64897599330544657−036	3.73642949678147029−035	−1.24087222765748382+033	2.86654524152182851+034	1.88751024518109054+003	22
44	9.72166318313861824−038	2.25473372181345080−036	−2.05675241664606704+034	4.86117113902199677+035	1.97550979034088279+003	23
45	5.60473447983325730−039	1.32980768392203678−037	−3.48801102651025522+035	8.43021561947793090+036	2.06550936512207997+003	22
46	3.16134151959210053−040	7.66940756853607676−039	−6.04909661207027796+036	1.49430142771084235+038	2.15750896700803688+003	21
47	1.74539650787437316−041	4.32741479105977935−040	−1.07227439312365407+038	2.70604403639142339+039	2.25150859374373638+003	22
48	9.43667207544708861−043	2.38997839337204790−041	−1.94186613638690517+039	5.00417703784680896+040	2.34750824330382539+003	22
49	4.99842683036874884−044	1.29257117557756338−042	−3.59115769268135138+040	9.44590992299861571+041	2.44550791386511481+003	22
50	2.59488162450382153−045	6.84854219523317754−044	−6.77896738040792493+041	1.81923191450753640+043	2.54550760378284484+003	22
51	1.32082219079291901−046	3.55635782950235351−045	−1.30564824509143247+043	3.57348896319602394+044	2.64750731157013803+003	22

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 4.0 X = 1.60000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	−1.44383257864901964−001	2.12117861923895286−002	1.72185510674360921−002	−4.88906791332822934−001	3.02762400601350363+000	26
3	−1.53330140149537031−002	−4.62706301240725326−001	1.47378735568450478−001	−1.32501638799100964−001	6.04607661023357135+000	23
4	1.22002526281722723−001	−3.58866770085937026−001	9.77632825003094722−002	2.88032770699298054−001	1.36731211006644547+001	24
5	1.67328967694605122−001	−6.03456130725821962−002	−2.79105462366081170−002	4.29746260409642105−001	2.31287535849864770+001	23
6	1.35089721654541492−001	1.23030115533020947−001	−1.39019550744162733−001	3.93228493338410416−001	3.48313171928388655+001	24
7	8.20669685684066195−002	1.52256390904875056−001	−2.27880449661602862−001	4.32920392913663758−001	4.86356027334451155+001	23
8	4.08148427296926076−002	1.08534968489771767−001	−3.48419176457979053−001	7.94050707916783759−001	6.45011096112973017+001	23
9	1.73482966250614235−002	5.87625720270264774−002	−6.19361205543096279−001	1.95001632614358603+000	8.24048431083834844+001	23
10	6.47093979815453044−003	2.63276530212013185−002	−1.33730290930043703+000	5.41137349644408014+000	1.02333665778257427+002	23
11	2.15678066718510518−003	1.01774927676357744−002	−3.40666029361307976+000	1.64845035668307692+001	1.24279610251660498+002	22
12	6.50933055094678048−004	3.48057634537127566−003	−9.90032131474899748+000	5.49455810263484723+001	1.48237624028012879+002	23
13	1.79720071725306631−004	1.07095883969908996−003	−3.21003283190090182+001	1.99457903541389757+002	1.74204381644195830+002	23
14	4.57643456642974307−005	3.00151950550097669−004	−1.14452306198245095+002	7.83833694769685598+002	2.02177624213072565+002	23
15	1.08200550210754086−005	7.73478494803042854−005	−4.44146496449109066+002	3.31522738809586772+003	2.32155775133397583+002	22
16	2.38853063910224123−006	1.84651354530896770−005	−1.86118778197735988+003	1.50124239631917146+004	2.64137707715648234+002	24
17	4.94649027383693983−007	4.10887667667956648−006	−8.36885841069914683+003	7.24515969565811049+004	2.98122599918766909+002	22
18	9.64963685271667212−008	8.56633197006074558−007	−4.01677163642894812+004	3.71161323086120523+005	3.34109840862470909+002	23
19	1.77962312718733512−008	1.68062931187745160−007	−2.04878257128665804+005	2.01122800241490338+006	3.72098969095361125+002	22
20	3.11257377378930171−009	3.11458079432408301−008	−1.10627795244955468+006	1.14917110603108673+007	4.12089630889050236+002	22
21	5.17731569971281654−010	5.47036850399374138−009	−6.30284420192324143+006	6.90431891092249458+007	4.54081551478298872+002	22
22	8.21058871624581608−011	9.13257667825491515−010	−3.77779673442454475+007	4.35093048546519013+008	4.98074514858691021+002	23
23	1.24426227732856424−011	1.45298538688553584−010	−2.37594846920230408+008	2.86937374010381534+009	5.44068349355935647+002	22
24	1.80554638984788354−012	2.20818431784364085−011	−1.56428591990079769+009	1.97626618359245093+010	5.92062917159580973+002	23
25	2.51348351109148109−013	3.21241696613481263−012	−1.07586926890250087+010	1.41887989382441909+011	6.42058106625535893+002	21
26	3.36245625571716349−014	4.48211506884324487−013	−7.71499117357450614+010	1.06009530519379366+012	6.94053826542087051+002	23
27	4.32944877683404869−015	6.00824675485968630−014	−5.75818062223731075+011	8.22925755683008052+012	7.48050001807980794+002	22
28	5.37319899300691104−016	7.75036242028232239−015	−4.46595005253063874+012	6.62770682594864119+013	8.04046570139215831+002	22
29	6.43634853949154733−017	9.63487525220111353−016	−3.59402842191137531+013	5.53057426656299420+014	8.62043479534282733+002	22
30	7.45062313117721783−018	1.15587654550416202−016	−2.99707405984009544+014	4.77574054754537984+015	9.22040686304828611+002	22
31	8.34439293730994204−019	1.33988079403812127−017	−2.58651115985324138+015	4.26256926079800877+016	9.84038153532221200+002	21
32	9.05138663739822567−020	1.50251800065756520−018	−2.30740243069354498+016	3.92819174085829906+017	1.04803584984801863+003	23
33	9.51902674422413386−021	1.63172470826408827−019	−2.12544652668947681+017	3.73391985538407634+018	1.11403374846300239+003	21
34	9.71490358648740651−022	1.71787500009099297−020	−2.01953630672394693+018	3.65743308246243047+019	1.18203182638857021+003	23
35	9.63029424873448641−023	1.75496881095099261−021	−1.97748236029707952+019	3.68841486235169343+020	1.25203006380817609+003	22
36	9.28025029707797732−024	1.74128836227820194−022	−1.99362403718693956+020	3.82640280350923292+021	1.32402844356668588+003	23
37	8.70045908548605049−025	1.67943268644380264−023	−2.06764938952819332+021	4.08023749822026452+022	1.39802695075304940+003	22
38	7.94166068944572462−026	1.57576404221601307−024	−2.20428568811967594+022	4.46888619746569965+023	1.47402557235731167+003	22
39	7.06275434271787353−027	1.43940575304989778−025	−2.41373629318576384+023	5.02371430632267224+024	1.55202429698721702+003	23
40	6.12380574981863737−028	1.28099618932269611−026	−2.71290125728939050+024	5.79256737139474856+025	1.63202311463286805+003	22
41	5.17999547758679586−029	1.11141900642162365−027	−3.12757613897362297+025	6.84638502209366801+026	1.71402201647035386+003	21
42	4.27720918558933151−030	9.40699695647419478−029	−3.69601748346637438+026	8.28958611669928995+027	1.79802099469714833+003	22
43	3.44956660792005388−031	7.77197432934291706−030	−4.47454295089133634+027	1.02762724076309162+029	1.88402004239354069+003	23
44	2.71881431716882901−032	6.27147965062113799−031	−5.54627003319103535+028	1.30356086575350357+030	1.97201915340550015+003	22
45	2.09523442438506053−033	4.94545454440536701−032	−7.03480423175857294+029	1.69119092984408438+031	2.06201832224526966+003	21
46	1.57957643162846881−034	3.81301147520024180−033	−9.12585910129013798+030	2.24286162527250623+032	2.15401754400668859+003	22
47	1.16549655034042675−035	2.87589858771111688−034	−1.21017615296578015+032	3.03915787642768160+033	2.24801681429280353+003	21
48	8.42058244418503869−037	2.12290627589378844−035	−1.63971535119372158+033	4.20577783527250444+034	2.34401612915377141+003	22
49	5.95969725206149854−038	1.53440189951618843−036	−2.26899896872209499+034	5.94143533260867967+035	2.44201548503341690+003	22
50	4.13370525949280428−039	1.08639893695836581−037	−3.20520210580693965+035	8.56457712241771316+036	2.54201487872309319+003	23
51	2.81101416775047390−040	7.53814342441511729−039	−4.62007491419609810+036	1.25925839052950728+038	2.64401430732172777+003	22

OBLATE RADIAL FUNCTIONS

H = 5.0 X = 1.60000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	8.55077443635409332−004	4.89169683778660786−001	−1.14734759043347722−001	6.43327474640829006−002	4.28957108509711792−001	24
3	−1.14824254447930509−001	1.13009722072973546−001	−1.22013374556402565−002	−4.77258971021397229−001	2.10980581603699983+000	24
4	−6.77985719865325693−002	−3.47841178646921948−001	9.83915677276196886−002	−3.23828891233377885−001	1.05123673338162820+001	23
5	5.20864446882161588−002	−4.43066873862233644−001	1.13092517825442906−001	1.16579793209512571−001	1.93843905253782472+001	24
6	1.27425820924088847−001	−2.12210828162974290−001	3.69131795858957914−002	3.79408180541749435−001	3.09101722480266658+001	23
7	1.33502667667386299−001	3.24882408035523869−002	−5.88180623339776116−002	4.06500340827659264−001	4.45827994265121613+001	26
8	9.97141738331698552−002	1.44616764878355887−001	−1.36552486777688046−001	3.65364270760232515−001	6.03574156276832052+001	23
9	5.99146693002876909−002	1.44047482021742362−001	−2.05655003508232511−001	4.43225176246410152−001	7.81951015168234738+001	24
10	3.05611311914514115−002	9.87884502981782989−002	−3.10121790564330088−001	8.35810822162809749−001	9.80744686145256602+001	22
11	1.36451437555598425−002	5.44056174092821370−002	−5.40070690655871131−001	1.96384123107461865+000	1.19982457348935945+002	23
12	5.44063601194506457−003	2.55393051565271433−002	−1.11355209118738697+000	5.09874738090737812+000	1.43910734702978055+002	22
13	1.96498553240871177−003	1.05482142287699207−002	−2.65239671178528549+000	1.43521293567656118+001	1.69853781372837966+002	23
14	6.49763537397550858−004	3.91020944015607637−003	−7.10187779054137655+000	4.37235148886276870+001	1.97807826657445982+002	21
15	1.98373660293163153−004	1.31908379417383132−003	−2.09792555185775228+001	1.43700425098693439+002	2.27770225429389786+002	22
16	5.62983668577791937−005	4.09115789395716588−004	−6.75314505851658180+001	5.07147794141842589+002	2.59739079076532843+002	21
17	1.49360520789548745−005	1.17592744535016072−004	−2.34782455679963190+002	1.91289249647691671+003	2.93712997091276940+002	22
18	3.72193937038946079−006	3.15252025814875933−005	−8.75591460303711457+002	7.67787281640044288+003	3.29690942758163610+002	21
19	8.74717260893502349−007	7.92458165856661792−006	−3.48353906828284743+003	3.26667675956188915+004	3.67672130729289705+002	22
20	1.94567390990644146−007	1.87617382090043058−006	−1.47174760967606253+004	1.46824356193389087+005	4.07655957504977672+002	21
21	4.10892179467564928−008	4.19960218516965523−007	−6.57731633996876876+004	6.95015983122848545+005	4.49641953295799804+002	23
22	8.26111910636357454−009	8.91709769736168913−008	−3.09889201873721269+005	3.45554301163085219+006	4.93629748083923852+002	22
23	1.58515934478212147−009	1.80129884042273628−008	−1.53471770511538481+006	1.80012963042621539+007	5.39619047301353352+002	22
24	2.90932474632141078−010	3.47070767186970482−009	−7.96864791129062894+006	9.80396838710383363+007	5.87609614138688807+002	21
25	5.11761180210974373−011	6.39328988103702205−010	−4.32779122930123085+007	5.57114382837964713+008	6.37601256500387628+002	23
26	8.64351395959298341−012	1.12825897860424032−010	−2.45339092586918465+008	3.29717427573404457+009	6.89593817265071406+002	21
27	1.40405821753058244−012	1.91112925030808924−011	−1.44899025543868660+009	2.02895423561564207+010	7.43587166929163670+002	22
28	2.19692996614190640−013	3.11253263717293926−012	−8.90052640790015548+009	1.29619955060736912+011	7.99581197991081316+002	21
29	3.31585882025750335−014	4.88160698566689477−013	−5.67720331319764063+010	8.58477440421646958+011	8.57575820621542407+002	22
30	4.83382496287898567−015	7.38352901736291973−014	−3.75486441004823640+011	5.88677189835531205+012	9.17570959294600260+002	21
31	6.81437965274956845−016	1.07844043315738208−014	−2.57167668255777599+012	4.17437471577294262+013	9.79566550143647638+002	22
32	9.30017642604866124−017	1.52298347022180640−015	−1.82165033603078863+013	3.05761315433363663+014	1.04356253886968709+003	21
33	1.23010365330606793−017	2.08189493617379466−016	−1.33303837360259931+014	2.31096922663473429+015	1.10955887907404483+003	21
34	1.57835474127451045−018	2.75772347444182558−017	−1.00666692741288545+015	1.80052584954657222+016	1.17755553092000764+003	22
35	1.96643687153388466−019	3.54326843143598408−018	−7.83721176756961904+015	1.44476696128209686+017	1.24755246005135364+003	21
36	2.38091449671673772−020	4.42002203203796169−019	−6.28441216464088887+016	1.19292545338968034+018	1.31954963671299780+003	21
37	2.80381863318959143−021	5.35787465039626751−020	−5.18578634570525641+017	1.01272535037588316+019	1.39354703503175768+003	22
38	2.21389889122242832−022	6.31635415772522028−021	−4.40000998379497500+018	8.83280864972249687+019	1.46954463242480137+003	21
39	1.58844369529167020−023	7.24742400959979649−022	−3.83569963747619670+019	7.90895330805346442+020	1.54754240911054195+003	22
40	3.90544276724412716−024	8.09958507294032767−023	−3.43296233123520372+020	7.26529782098996894+021	1.62754034770221283+003	21
41	4.14579361981306708−025	8.82277377495321418−024	−3.15228794991353710+021	6.84256246855331653+022	1.70953843286854325+003	21
42	4.29523619374749954−026	9.37338146442024515−025	−2.96776736060076320+022	6.60307336616738519+023	1. - 665104917724+003	21
43	4.34574110594907805−027	9.71867601952129744−026	−2.86292709727726117+023	6.52498933177012564+024	1. - 499021497919+003	21
44	4.29616796976413256−028	9.83999720617223085−027	−2.82819926586364726+024	6.59897438969517670+025	1. - 343966532032+003	21
45	4.15213085218908977−029	9.73430170480916288−028	−2.85946181182121302+025	6.82659393460755647+026	2. 198985597158+003	21
46	3.92513276264430827−030	9.41390693606909597−029	−2.95733177398191175+026	7.22006894932668349+027	2. - 063225243754+003	21
47	3.63113578347202510−031	8.90456717577686054−030	−3.12705039636063963+027	7.80327331559403773+028	2.24352935920452569+003	22
48	3.28880025668401511−032	8.24225532667615977−031	−3.37890855955124319+028	8.61406774400768581+029	2.33952816383871117+003	21
49	2.91764734321781265−033	7.46917812146689344−032	−3.72925182745444986+029	9.70827718013248715+030	2.43752703996547086+003	21
50	2.53637655139629604−034	6.62960269830806689−033	−4.20219702819626249+030	1.11658809132090105+032	2.53752598199925578+003	22
51	2.16151401688040800−035	5.76602307609319498−034	−4.83230592625653809+031	1.31003489120230275+033	2.63952498488917062+003	22

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 6.0 X = 1.60000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	9.40586101828264492−002	−1.02780581057802537−001	1.03399382048197050−002	4.86438556289765379−001	−3.96828885830739182+000	23
3	1.35083656233956399−002	4.81828995153004447−001	−9.38231614368851196−002	1.19167621636520326−001	−3.27797903843184929+000	23
4	−7.69449298580800161−002	3.37583285356858207−001	−5.99030339212443191−002	−3.45626624857848476−001	7.31214012848986341+000	23
5	−8.59516716639976561−002	−1.87832234297748267−001	5.05495465395858617−002	−4.34216629053806505−001	1.49134187085504893+001	23
6	−4.26222542872932604−003	−4.49334572500812868−001	1.03388729110829172−001	−8.45448018547718755−002	2.62594432274110872+001	23
7	8.06841699068932458−002	−3.46932519838748510−001	7.31481394664759619−002	2.65715208805745040−001	3.97275520049222553+001	23
8	1.17077391293505704−001	−9.88140718522754804−002	−4.90661474085536514−004	4.00290467195472094−001	5.53711820152833167+001	26
9	1.07243186023709536−001	8.67679243902626028−002	−7.36740829627803962−002	3.76937068353933435−001	7.31139413336567528+001	22
10	7.64168947351063985−002	1.51447206509600609−001	−1.32224313661471839−001	3.50596246509893336−001	9.29223857780106065+001	22
11	4.56141403494381281−002	1.34330987381437132−001	−1.90590255005839179−001	4.65081707076303852−001	1.14775928256730038+002	22
12	2.36901449255182211−002	8.98680781035159247−002	−2.85761929259605729−001	8.92168624948717269−001	1.38661500587886042+002	22
13	1.09567799181629696−002	5.00819934875229801−002	−4.91349588969519500−001	2.02693790071162089+000	1.64570445884335911+002	22
14	4.58481537748070977−003	2.43006550391990773−002	−9.81434243399265767−001	5.00935861475543000+000	1.92496839836936458+002	22
15	1.75594980788187055−003	1.05274621903122229−002	−2.22844758354184680+000	1.33013948445905233+001	2.22436516925061995+002	21
16	6.21033210000132533−004	4.13904967327300601−003	−5.62195661173224921+000	3.79157206807002425+001	2.54386479833247715+002	22
17	2.04270021588702231−004	1.49414081193229280−003	−1.55088882885472793+001	1.15748832242936956+002	2.88344528084663583+002	21
18	6.28489947397508969−005	4.99568930241144411−004	−4.62809313054001493+001	3.77030120466813680+002	3.24309017370143473+002	22
19	1.81761233925218488−005	1.55775369105259166−004	−1.48241811181129136+002	1.30523192623886229+003	3.62278699487766851+002	21
20	4.96141415148472360−006	4.55538485973159758−005	−5.06608037662641387+002	4.78463051663967509+003	4.02252613456670412+002	22
21	1.28279815254736472−006	1.25513237382696335−005	−1.83818519115158789+003	1.85101778705872478+004	4.44230009942551298+002	21
22	3.15146003302073664−007	3.27115189924283746−006	−7.05270093116887441+003	7.53492765453326718+004	4.88210297852593307+002	22
23	7.37665021240922806−008	8.09151693943444828−007	−2.85143964243479880+004	3.21880617197628309+005	5.34193005979180715+002	20
24	1.64915991807309210−008	1.90528825973675566−007	−1.21118338504149981+005	1.43951743560499085+006	5.82177755042675641+002	22
25	3.52919204367672921−009	4.28178253432698149−008	−5.39071969344020766+005	6.72521916523348864+006	6.32164237037544274+002	21
26	7.24363964568298894−010	9.20510310624009563−009	−2.50817821514540102+006	3.27576211437462867+007	6.84152199784159090+002	22
27	1.42852653780683262−010	1.89703737735321578−009	−1.21740624125591952+007	1.66058013919102317+008	7.38141435241857910+002	21
28	2.71132985677465330−011	3.75475545932640670−010	−6.15259822019855573+007	8.74662209954324478+008	7.94131770573879329+002	21
29	4.96012108795777720−012	7.14967896730169355−011	−3.23209437608417947+008	4.77973053466063477+009	8.52123061249145688+002	21
30	8.75829285877631851−013	1.31179728636584303−011	−1.76211323608995140+009	2.70613533586945937+010	9.12115185667961168+002	22
31	1.49458132481568344−013	2.32242929490813171−012	−9.95603206950706593+009	1.58534691074124575+011	9.74108040939340376+002	21
32	2.46778692566569386−014	3.97269519043884174−013	−5.82195957589679598+010	9.59872521743938289+011	1.03810153953680501+003	21
33	3.94696072263286629−015	6.57390287294643324−014	−3.51927828934589655+011	5.99982807224980956+012	1.10409560663016700+003	20
34	6.12113138025122153−016	1.05352972768684045−014	−2.19659011974966088+012	3.86770811195736291+013	1.17209017794177189+003	21
35	9.21365656725288821−017	1.63686166737442587−015	−1.41416156463273132+013	2.56886184782014502+014	1.24208519801279037+003	20
36	1.34727180707746190−017	2.46799694450743845−016	−9.38161795660599358+013	1.75634009596319407+015	1.31408061879243974+003	22
37	1.91544205261822076−018	3.61445769265274569−017	−6.40747200572672872+014	1.23506440128826965+016	1.38807639848327282+003	21
38	2.64983925880803325−019	5.14613646867883287−018	−4.50144814346324249+015	8.92560289051090088+016	1.46407250059083246+003	21
39	3.56971207556496414−020	7.12870148262593164−019	−3.25029715595619846+016	6.62408640964884863+017	1.54206889313740978+003	21
40	4.68617397816220472−021	9.61527090202369382−020	−2.41028432403443644+017	5.04482820834753992+018	1.62206554800834199+003	21
41	5.99883723372186878−022	1.26370875134034289−020	−1.83432204357647566+018	3.94009543640236503+019	1.70406244040594744+003	20
42	7.49300266888360652−023	1.61943018779973035−021	−1.43169241228443890+019	3.15377176868102402+020	1.78805954839133221+003	21
43	9.13792325611925596−024	2.02482278512576576−022	−1.14527832009805537+020	2.58555717312206033+021	1.87405685249828975+003	20
44	1.08865846289826797−024	2.47164883914973133−023	−9.38413523121143352+020	2.16984419403798407+022	1.96205433540662923+003	21
45	1.26772789311929599−025	2.94722726217503573−024	−7.87131624095472361+021	1.86301190613494541+023	2.05205198166471445+003	20
46	1.44370103455258930−026	3.43484762581882799−025	−6.75508155671803278+022	1.63564359852118694+024	2.14404977745292834+003	21
47	1.60864992933404442−027	3.91468511846323296−026	−5.92810074388068037+023	1.46767989774522535+025	2.23804771038131333+003	20
48	1.75462960638391230−028	4.36515491292199585−027	−5.31721795254760906+024	1.34535512487778280+026	2.33404576931586368+003	21
49	1.87433220214127713−029	4.76457411130481447−028	−4.87224639511685536+025	1.25923784138763207+027	2.43204394422892970+003	23
50	1.96170653690258402−030	5.09294616325309073−029	−4.55880544368970853+026	1.20296936689384866+028	2.53204222606998652+003	21
51	2.01246873809283639−031	5.33365689549266528−030	−4.35371101904032744+027	1.17245441662973839+029	2.63404060665366240+003	20

OBLATE RADIAL FUNCTIONS

H = 7.0 X = 1.60000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	−1.44144091848955852−002	−4.83677334980799456−001	7.90995668491897927−002	−1.29713483167614248−001	−1.05956525716544756+001	24
3	7.89972374375818063−002	−1.34088016787422497−001	1.51337881544604662−002	4.82284602735867971−001	−1.03776727949597438+001	24
4	5.89163533863564835−002	3.08607427229137850−001	−5.79973153937673755−002	3.77314741109015192−001	4.08466529086879527+000	24
5	−4.30817936382543350−002	4.35237813012696809−001	−7.16719293279322580−002	−2.07374772156769822−001	9.67676377785498349+000	24
6	−8.55925899902413822−002	2.42055418903125909−002	4.80610705520941201−003	−4.70189596379433871−001	2.10375437832845670+001	23
7	−4.33776422517701371−002	−3.67638256968141321−001	7.71357622857082369−002	−2.71346092302210832−001	3.41393013273133882+001	25
8	3.38090893616002152−002	−4.28200870644119714−001	8.59562894405452130−002	9.82532508823280664−002	4.95967145043916895+001	23
9	8.92309890790391017−002	−2.41168134962158013−001	4.01791885655649362−002	3.41119954608099139−001	6.72036026037745036+001	24
10	1.03263671896454834−001	−1.65644634664575705−002	−2.40191523568595564−002	3.92454331154086756−001	8.69117555614111238+001	23
11	8.70912281216992724−002	1.18196498445737086−001	−8.10527673209914916−002	3.50761589738544944−001	1.08688657886667266+002	24
12	6.01196387355298136−002	1.50848253566913449−001	−1.27908477079333411−001	3.46536355994341221−001	1.32514249999744122+002	22
13	3.57317900290291371−002	1.24364584419636220−001	−1.80115230140246144−001	4.96153569594078862−001	1.58375341738284068+002	23
14	1.88120384416647142−002	8.17594273827559561−002	−2.69769108905077403−001	9.60674362926352897−001	1.86262940807412764+002	22
15	8.93571852830390879−003	4.59567774802279180−002	−4.60120719912769238−001	2.12436697907688889+000	2.16170733681740967+002	22
16	3.87927918849231298−003	2.28571098631936015−002	−8.98124839410845055−001	5.05245223076313039+000	2.48094178410367391+002	21
17	1.55417596352358821−003	1.02670662234868279−002	−1.96745434941841673+000	1.28225035552476753+001	2.82029939032619601+002	22
18	5.78969426480315825−004	4.22270638133268684−003	−4.74346741070342155+000	3.47136478903348505+001	3.17975520785057448+002	21
19	2.01771984254787142−004	1.60610740015829759−003	−1.24139730017264810+001	1.00064620398411576+002	3.55929028089548874+002	21
20	6.61151663130053223−005	5.69241012153221194−004	−3.49329671656753719+001	3.06179874556883775+002	3.95889000090951562+002	20
21	2.04559117210464267−005	1.89136220029533918−004	−1.04971241012079926+002	9.91133881225834523+002	4.37854296531453128+002	21
22	5.99781231446211819−006	5.92040851738260126−005	−3.35029911197007919+002	3.38344557193111177+003	4.81824017076870784+002	21
23	1.67183747481149179−006	1.75314882071629635−005	−1.13078393399413997+003	1.21447724537635157+004	5.27797443338756415+002	21
24	4.44248617352274552−007	4.92836307386847840−006	−4.02134030264171441+003	4.57171616672118067+004	5.75773996580949874+002	21
25	1.12812162094516284−007	1.31923974293310696−006	−1.50210101049186531+004	1.80052372265513373+005	6.25753206446306800+002	22
26	2.74370286679959270−008	3.37161419399076602−007	−5.87738754117157681+004	7.40318053507827027+005	6.77734687543632061+002	20
27	6.40365191286207806−009	8.24646402847654972−008	−2.40318783846738977+005	3.17172281187538935+006	7.31718121718406287+002	21
28	1.43682876158413325−009	1.93430988276433496−008	−1.02467419258555663+006	1.41339297239704921+007	7.87703244485624333+002	21
29	3.10439270290371761−010	4.35946680388425099−009	−4.54726655321695228+006	6.54065231785047693+007	8.45689834546077225+002	21
30	6.46830083261231749−011	9.45654625211899406−010	−2.09668649774260698+007	3.13853647166137840+008	9.05677705611677602+002	22
31	1.30149000482672535−011	1.97742404820650297−010	−1.00289416133357550+008	1.55951567168285463+009	9.67666699977298256+002	21
32	2.53208148043448566−012	3.99166350378190188−011	−4.96928382062944254+008	8.01423737940110086+009	1.03165668342601125+003	20
33	4.76880129016144222−013	7.78867612334134068−012	−2.54729316123914732+009	4.25439607489849910+010	1.09764754116124143+003	21
34	8.70377945474606236−014	1.47080093672844869−012	−1.34922441258193817+010	2.33048248999957113+011	1.16563917453627981+003	20
35	1.54103955961115404−014	2.69098280644464185−013	−7.37602459341080931+010	1.31597241794776225+012	1.23563149840768298+003	21
36	2.64934303410133263−015	4.77514572691221063−014	−4.15758186426190939+011	7.65297335246256140+012	1.30762443898036163+003	19
37	4.42655927860253925−016	8.22625736256166736−015	−2.41389166589667497+012	4.57942965406724906+013	1.38161793204281889+003	21
38	7.19382194043562169−017	1.37705635617375231−015	−1.44231161660293214+013	2.81727394568198406+014	1.45761192151396440+003	20
39	1.13804288572505866−017	2.24183659992656306−016	−8.86126023224013420+013	1.78050525678637956+015	1.53560635824027226+003	21
40	1.75381536237033886−018	3.55226779454678898−017	−5.59345447597863596+014	1.15513657562359491+016	1.61560119899524670+003	20
41	2.63474361470369708−019	5.48255899158013982−018	−3.62482039522343162+015	7.68770029508558304+016	1.69759640564327307+003	21
42	3.86107945310091217−020	8.24792424814832809−019	−2.40994281753998337+016	5.24500605581284658+017	1.78159194443773586+003	20
43	5.52289327873567162−021	1.21026563313853858−019	−1.64266832040917931+017	3.66615100902269038+018	1.86758778542934713+003	20
44	7.71560410812222530−022	1.73327261691225924−020	−1.14720357097525336+018	2.62380563793611017+019	1.95558390196536605+003	20
45	1.05332811179944706−022	2.42417734220345803−021	−8.20384408102920982+018	1.92160806760853354+020	2.04558027026411392+003	20
46	1.40598649042030835−023	3.31299899617817933−022	−6.00388803453263478+019	1.43938338108107421+021	2.13757686905213331+003	20
47	1.83588165613489116−024	4.42663343985527104−023	−4.49417700039313054+020	1.10215909902159654+022	2.23157367925367942+003	20
48	2.34620756555454177−025	5.78556605904551404−024	−3.43910571363266757+021	8.62295302499517707+022	2.32757068372410107+003	20
49	2.93595279044853707−026	7.40035354260633415−025	−2.68908441428246711+022	6.88983678795280869+023	2.42556786702016920+003	20
50	3.59903796445700620−027	9.26825503536722480−026	−2.14744669064904312+023	5.61964822568592326+024	2.52556521520162068+003	20
51	4.32378492915188527−028	1.13704572444105716−026	−1.75066848905450515+024	4.67703876172289790+025	2.62756271565916611+003	21

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 8.0 X = 1.60000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	−6.79656528839406933−002	1.50070364783492856−001	−1.61206072685958595−002	−4.81024352007028366−001	−1.94237996138059759+001	24
3	−1.62645234006515018−002	−4.80667998398009803−001	6.79369726944543803−002	−1.51079180604808599−001	−1.93656429956223289+001	24
4	4.20269137865847269−002	−4.18865489234757510−001	5.82360421071813156−002	2.55057778847968301−001	1.54737735892829929−001	24
5	6.32632161496013969−002	2.00090444673425153−001	−3.47526004807161962−002	4.45103774051405464−001	3.49293691839356864+000	24
6	−4.03812568019812595−003	4.78809517333902328−001	−7.34610284053313934−002	1.52248859782885510−002	1.55694281521800319+001	24
7	−6.89902281135212957−002	2.25998026764997113−001	−2.97613384463834490−002	−4.11454731546691210−001	2.78981769422102452+001	26
8	−6.44341007557474936−002	−2.10018940673539679−001	4.27099970361950267−002	−4.05723846693370726−001	4.31071642109061111+001	24
9	−7.06302666118240603−003	−4.31246501861201066−001	7.98784731593334718−002	−9.41589857278072521−002	6.05175976442200780+001	23
10	5.47912503081670951−002	−3.59758000273835277−001	6.38197933415732701−002	2.21799616759183754−001	8.00852634861732686+001	23
11	8.83621482236415128−002	−1.47227528339378982−001	1.50494859828100796−002	3.72293584842168385−001	1.01755745161226464+002	22
12	8.96607859379897254−002	4.14142955073889655−002	−3.91065307601758306−002	3.73550039507293857−001	1.25498522767600099+002	23
13	7.14746624915521932−002	1.35491152189098884−001	−8.46781813460715539−002	3.30735597352405729−001	1.51293759154720275+002	22
14	4.82239933218917407−002	1.46302779648148347−001	−1.24163247529354137−001	3.51421152407612397−001	1.79128071656414913+002	22
15	2.85762682373090284−002	1.14662624000584434−001	−1.72820357050746550−001	5.35280667278818914−001	2.08992118521659042+002	21
16	1.52065728888021990−002	7.44017997017022360−002	−2.59299208989968094−001	1.04034169014702209+000	2.40879201736298736+002	21
17	7.37612145928090274−003	4.20930108458355242−002	−4.40002884234851680−001	2.24932757193002604+000	2.74784410906611308+002	21
18	3.29677931097017024−003	2.13405924390362093−002	−8.44069868045456934−001	5.18670098712207875+000	3.10704077344826048+002	21
19	1.36897005825886226−003	9.86239167902840794−003	−1.79822969370734651+000	1.26938597944665198+001	3.48635414589267212+002	20
20	5.31584040026093065−004	4.20374135190495217−003	−4.18315517377538016+000	3.29721282908846212+001	3.88576275304251876+002	21
21	1.94057905046269166−004	1.66694940716311132−003	−1.04980810906970085+001	9.07594539674886529+001	4.30524983117590751+002	20
22	6.68953353847182686−005	6.19075177014451309−004	−2.81848103283040225+001	2.64051940331304779+002	4.74480213987036674+002	22
23	2.18574086351530273−005	2.16482797371666101−004	−8.04515752009306833+001	8.09610040855763628+002	5.20440911045442597+002	22
24	6.79121391407964051−006	7.15939296185359453−005	−2.42979259748516126+002	2.60874119907082178+003	5.68406222524577499+002	20
25	2.01219609818647797−006	2.24756255112059504−005	−7.73402758525137404+002	8.81109390709795983+003	6.18375455868031430+002	20
26	5.69967959280143753−007	6.71905498892761357−006	−2.58585512356109645+003	3.11207963415295864+004	6.70348043379323849+002	21
27	1.54686184685084566−007	1.91805822238961261−006	−9.05585164349362387+003	1.14701315318750542+005	7.24323516206342460+002	20
28	4.03030290366229519−008	5.24111273487046238−007	−3.31363450599833900+004	4.40295133309776846+005	7.80301484428584165+002	21
29	1.00992475731258435−008	1.37380710677738413−007	−1.26409727263694025+005	1.75717064603098813+006	8.38281621665298652+002	21
30	2.43788912657173364−009	3.46101006664075148−008	−5.01777051521338395+005	7.27916831487330752+006	8.98263653069435849+002	21
31	5.67752713907737507−010	8.39473150934859214−009	−2.06887929204285331+006	3.12542290577133941+007	9.60247345883060477+002	20
32	1.27737383219266394−010	1.96344955376124140−009	−8.84637701668897228+006	1.38901738062722406+008	1.02423250194889307+003	20
33	2.77994825225394403−011	4.43469675692630541−010	−3.91719401491332339+007	6.38169863125709530+008	1.09021895172884431+003	19
34	5.85895918523955868−012	9.68522683019034866−011	−1.79386785524204701+008	3.02755863427818530+009	1.15820654949308828+003	20
35	1.19712078651631988−012	2.04777678362185304−011	−8.48562686273843061+008	1.48152885375750805+010	1.22819516942535449+003	20
36	2.37369762863001008−013	4.19631387649472894−012	−4.14160048737661836+009	7.47058249568230996+010	1.30018470245057473+003	20
37	4.57182778608942824−014	8.34288684037029541−013	−2.08349015550535641+010	3.87810691472276884+011	1.37417505363593106+003	19
38	8.56076080323728980−015	1.61082032253931728−013	−1.07927813389651877+011	2.07074212683643457+012	1.45016614004999948+003	20
39	1.55973314839889055−015	3.02309404095651826−014	−5.75177374082585312+011	1.13636147618811403+013	1.52815788899010089+003	19
40	2.76719471802007241−016	5.51945816225916536−015	−3.15086449170931571+012	6.40406498979725716+013	1.60815023650731634+003	20
41	4.78406667690502914−017	9.81127189346133534−016	−1.77285378114694429+013	3.70362920774355811+014	1.69014312617345520+003	19
42	8.06532168668695913−018	1.69926711914915093−016	−1.02378241218620880+014	2.19651023689380574+015	1.77413650804571432+003	20
43	1.32677044062574047−018	2.86952682804050521−017	−6.06357741198594898+014	1.33502834782887455+016	1.86013033779366129+003	19
44	2.13101875233013697−019	4.72779984871159577−018	−3.68085474244268330+015	8.31058620988065718+016	1.94812457596012974+003	20
45	3.34387637229954052−020	7.60467024397995609−019	−2.28872944506233485+016	5.29544901535890295+017	2.03811918733308326+003	19
46	5.12892131647769057−021	1.19490209399898729−019	−1.45682728147123835+017	3.45193438656068743+018	2.13011414040982947+003	20
47	7.69386355226492214−022	1.83510073480460159−020	−9.48733945518616958+017	2.30081230642539907+019	2.22410940693840403+003	19
48	1.12933931360226929−022	2.75610705207861429−021	−6.31786907093474044+018	1.56725581380784680+020	2.32010496152369237+003	20
49	1.62283654683422237−023	4.05007065083910456−022	−4.29996427784988106+019	1.09051034521674794+021	2.41810078128806319+003	19
50	2.28399400487511312−024	5.82600504701827083−023	−2.98961820356370591+020	7.74731841247082842+021	2.51809684557806805+003	20
51	3.14974749758253093−025	8.20772177534874474−024	−2.12237201986396628+021	5.61712344285141755+022	2.62009313571020408+003	20

OBLATE RADIAL FUNCTIONS

H = 9.0 X = 1.60000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	1.68962332440431734−002	4.77902248207467391−001	−5.93766671334897523−002	1.67773699147071751−001	−3.03400129442213547+001	26
3	−5.93699915250270280−002	1.67986018817860402−001	−1.69229402049358439−002	−4.77819992672354502−001	−3.03260782451631671+001	24
4	−5.59310453574150385−002	−2.02758129334461374−001	2.99397534966156122−002	−4.49490219515884208−001	−5.47570239238361657+000	24
5	2.71602192916006384−002	−4.58338904752942628−001	5.74573137172118313−002	1.79529626606545082−001	−3.94268498265324982+000	24
6	6.46335297931551063−002	−4.81854011028041489−002	1.69712118972344295−003	4.81626330815307432−001	1.03429643027314422+001	23
7	2.43532142175579267−002	4.28254874428743546−001	−6.08556640020730015−002	2.11440324701287543−001	2.10642752188902299+001	24
8	−4.26412035070237293−002	3.84894878216944613−001	−5.15452403226497279−002	−2.66678384643706312−001	3.60087218114355550+001	23
9	−6.81887809344567803−002	−7.67289467641438643−003	7.68169457071168101−003	−4.56850012668975682−001	5.31225937887514519+001	23
10	−3.72507574748896994−002	−3.49108412622065778−001	6.02702736065615348−002	−2.73017984317159759−001	7.24953715001934651+001	23
11	1.92164101175559049−002	−4.23058223885357778−001	7.12378222595727522−002	5.58501667067299388−002	9.40195383917586998+001	23
12	6.49184491888340079−002	−2.77510016334053716−001	4.27679830156987961−002	2.97949856221023890−001	1.17649553152155955+002	22
13	8.32203973179862091−002	−7.01262717327593844−002	−3.64445721001228624−003	3.78111129938008507−001	1.43355622023129345+002	22
14	7.73857523074554982−002	8.13678488619832583−002	−4.89323263820939160−002	3.51866684986911308−001	1.71118045852780665+002	22
15	5.92078030914516847−002	1.43776796275870848−001	−8.63562464988779964−002	3.17440621434939850−001	2.00923214393474121+002	21
16	3.92633316101038027−002	1.39650764127283088−001	−1.21139951867673831−001	3.64047034124451084−001	2.32761434441477130+002	21
17	2.32162518815860876−002	1.05446810954353448−001	−1.67868140194471741−001	5.81912459070792749−001	2.66625630568223562+002	21
18	1.24616372714501505−002	6.77267251928266152−002	−2.52749673313009098−001	1.13091709324638145+000	3.02510531458950150+002	21
19	6.14806339638111496−003	3.85095519986716935−002	−4.27523615452794652−001	2.39868108320208226+000	3.40412140763950843+002	21
20	2.81370169541710705−003	1.98247057545499045−002	−8.09149360343114966−001	5.39141669196482427+000	3.80327382389443445+002	20
21	1.20306283640854320−003	9.37462751019320797−003	−1.68587582418149651+000	1.28060878623905038+001	4.22253856656441001+002	21
22	4.83334489847652569−004	4.11364766878566808−003	−3.80983394649029905+000	3.21488990773729478+001	4.66189669042637353+002	20
23	1.83313820732381683−004	1.68782598858619522−003	−9.23943547967514834+000	8.51895775360181909+001	5.12133307644922485+002	21
24	6.58935473243641042−005	6.51381025445043391−004	−2.38663369463067069+001	2.37730519444530846+002	5.60083554055247771+002	20
25	2.25244162280190858−005	2.37592261251384252−004	−6.52989985726329083+001	6.96863766853934773+002	6.10039417586148371+002	20
26	7.34335071458847800−006	8.22327658968662687−005	−1.88410141057437530+002	2.14037159001128279+003	6.62000086086880184+002	20
27	2.28915716895943086−006	2.70976712276506207−005	−5.71240315276228921+002	6.87226907140778620+003	7.15964888724519746+002	20
28	6.83881117421441254−007	8.52604382285880175−006	−1.81440688891091912+003	2.30175584890642559+004	7.71933267510963955+002	20
29	1.96194532424913880−007	2.56793612186489404−006	−6.02171098634803866+003	8.02653209304853880+004	8.29904755301646416+002	20
30	5.41481710388358469−008	7.42001166054488171−007	−2.08346277831260274+004	2.90899357366622250+005	8.89878958637222575+002	20
31	1.44007722182715370−008	2.06093848280441006−007	−7.49994341511687552+004	1.09397357484118557+006	9.51855544247081590+002	21
32	3.69609665915393230−009	5.51230956640109883−008	−2.80385829640956352+005	4.26267297907761633+006	1.01583422834825821+003	19
33	9.16751359265827695−010	1.42201464408153860−008	−1.08686915978684067+006	1.71862822931714914+007	1.08181476809740673+003	20
34	2.20017652939362780−010	3.54329239356850237−009	−4.36198893173308874+006	7.16087270909500426+007	1.14979695471492488+003	19
35	5.11524028227122472−011	8.53922776327465490−010	−1.81007652663205685+007	3.07988083998719329+008	1.21978060791786068+003	20
36	1.15330637537425272−011	1.99281975083006784−010	−7.75678412844201246+007	1.36590883302536633+009	1.29176557138468893+003	19
37	2.52422490346616256−012	4.50861593855195036−011	−3.42884774933035444+008	6.24018431639658202+009	1.36575170903922844+003	19
38	5.36810727470222639−013	9.89910773064367169−012	−1.56186182395394507+009	2.93398529602595970+010	1.44173890198904054+003	19
39	1.11020395833972992−013	2.11128166669648079−012	−7.32392089394562629+009	1.41848947998655107+011	1.51972704598994832+003	19
40	2.23474344923067914−014	4.37809127947886036−013	−3.53231089772075724+010	7.04609145844788389+011	1.59971604933593877+003	18
41	4.38156490211510130−015	8.83441112892675845−014	−1.75074086411389019+011	3.59328734027682084+012	1.68170583109488515+003	20
42	8.37377594947132272−016	1.73607002630694994−014	−8.91023370247664856+011	1.87994002990971079+013	1.76569631962687162+003	19
43	1.56098954161362666−016	3.32487747093342584−015	−4.65305421320585870+012	1.00834443300466387+014	1.85168745133460183+003	19
44	2.84017456234845907−017	6.21020520355580669−016	−2.49152567626783150+013	5.54124410388397748+014	1.93967916960530128+003	19
45	5.04686148103931165−018	1.13199410167553533−016	−1.36705037668106896+014	3.11798861437397567+015	2.02967142391133170+003	19
46	8.76355459444890089−019	2.01493324594457935−017	−7.68112679339132695+014	1.79539345082788492+016	2.12166416904291097+003	19
47	1.48785432455594338−019	3.50438253934845906−018	−4.41703007167299578+015	1.05736314023306109+017	2.21565736445124221+003	20
48	2.47109095631529510−020	5.95853654329184993−019	−2.59811115526813200+016	6.36562809020277157+017	2.31165097368428027+003	18
49	4.01681173910657743−021	9.91004788146025865−020	−1.56234213462085051+017	3.91556834808216372+018	2.40964496390051540+003	19
50	6.39359130691596380−022	1.61301923880343812−020	−9.59988265947995129+017	2.45968034118138050+019	2.50963930544869712+003	19
51	9.96955644611538540−023	2.57063392782316828−021	−6.02445496923649368+018	1.57723345181828770+020	2.61163397150348277+003	20

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 10.0 X = 1.60000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	5.25389081945310635−002	−1.84301446337291639−001	1.72608262493160400−002	4.74099924297943929−001	−4.32902515278834911+001	24
3	1.72655402013246159−002	4.74082235326505133−001	−5.25375085554034439−002	1.84343386242511067−001	−4.32871554900663143+001	24
4	−2.16464995188235170−002	4.68757097140031750−001	−5.24651692105378490−002	−1.61525756962074262−001	−1.35081116810601434+001	24
5	−5.28318841988559184−002	−1.53857830221390854−001	2.08135555368167014−002	−4.71070822548883238−001	−1.29592510494195510+001	25
6	−9.56182211122357490−003	−4.74209779374380136−001	5.69916882576148094−002	−1.11262446974798453−001	5.48608097389604481+000	25
7	5.35068515756117171−002	−2.20237749207119438−001	2.30472517447824404−002	4.30113380120059690−001	1.36127365278177361+001	23
8	4.44514516864540541−002	2.87911249535741855−001	−3.90570960096887145−002	3.78950735824804782−001	2.84823041117450335+001	24
9	−1.31901403767863067−002	4.62582091640548508−001	−5.88199288077113039−002	−6.67803311616309097−002	4.50989397695202586+001	23
10	−5.76986354986273025−002	1.97646500661370342−001	−2.18267103393356609−002	−4.12070658438639194−001	6.42068299418925874+001	23
11	−5.41050803548765255−002	−1.94539998833047005−001	3.31731298755242994−002	−3.99895663240177092−001	8.55307554583849025+001	22
12	−1.22860120887756939−002	−4.10649598416678535−001	6.45748873391365787−002	−1.27969602786498395−001	1.09008946769617878+002	23
13	3.66344456505648269−002	−3.76532083098481042−001	5.81100853833600940−002	1.69501026472514072−001	1.34595911154512659+002	22
14	6.84024972960392334−002	−1.96965255951849593−001	2.45819476708471247−002	3.39872065270520690−001	1.62262825644813053+002	24
15	7.63403547916180836−002	−9.40211151180629109−003	−1.74476974398127541−002	3.70104814347876236−001	1.91990052492279498+002	21
16	6.66786969970530772−002	1.08114429914417765−001	−5.54089806497915537−002	3.31430850940817280−001	2.23763749994936617+002	21
17	4.94436906413043663−002	1.46216785471720926−001	−8.70330743425149986−002	3.10741190252707712−001	2.57573884295069009+002	20
18	3.23481292338436731−002	1.31932117431483151−001	−1.18852788171297840−001	3.83619947375240232−001	2.93413015616965658+002	23
19	1.90964633860431442−002	9.68078179598000586−002	−1.64730834802839771−001	6.35858835587578991−001	3.31275522415111205+002	20
20	1.03239228677286632−002	6.16685821029261981−002	−2.49152682384983003−001	1.23257362086689145+000	3.71157087798455616+002	20
21	5.16540642730588829−003	3.52048594323872930−002	−4.20642917020551593−001	2.57118448711084779+000	4.13054349733195029+002	20
22	2.41092775784195765−003	1.83510307144644806−002	−7.87642683564474555−001	5.65584452623337412+000	4.56964657053671964+002	20
23	1.05631515291126298−003	8.84367167402532976−003	−1.61148190246084230+000	1.31007027100884116+001	5.02885895783312384+002	20
24	4.36642516281094721−004	3.97546397070688097−003	−3.55553262581787151+000	3.19597732000379375+001	5.50816363304804023+002	20
25	1.71001885589351230−004	1.67825188678082062−003	−8.38030604815351220+000	8.20202838991881789+001	6.00754675770075220+002	19
26	6.36731365781396015−005	6.68887145662011083−004	−2.09586655125439587+001	2.20986532862430603+002	6.52699699019974594+002	22
27	2.26106580211401562−005	2.52787756421470955−004	−5.53376802666022077+001	6.23652774152005764+002	7.06650496398537976+002	19
28	7.67753024668749519−006	9.09147248557482213−005	−1.53636854437096066+002	1.83939819679528120+003	7.62606288882236158+002	20
29	2.49857831749377939−006	3.12118108574798783−005	−4.47051612103592950+002	5.65785638215273920+003	8.20566424302187410+002	19
30	7.80955265695479087−007	1.02555540652814830−005	−1.35956036757311100+003	1.81147927508894799+004	8.80530353359336931+002	20
31	2.34869080781619323−007	3.23265151936090622−006	−4.31096626306844778+003	6.02635134140453303+004	9.42497610769050021+002	19
32	6.80797217095412094−008	9.79502436008299107−007	−1.42223871593488215+004	2.07977124707161677+005	1.00646780031737304+003	19
33	1.90484864926768526−008	2.85818445158561958−007	−4.87284608466631463+004	7.43491863867032932+005	1.07244058292767951+003	19
34	5.15175036755565821−009	8.04496736402587701−008	−1.73093647975089840+005	2.74946554880768723+006	1.14041566706382333+003	19
35	1.34850224851133437−009	2.18751627779292204−008	−6.36524069203020923+005	1.05048545749194617+007	1.21039280096117563+003	19
36	3.42025400173557105−010	5.75383410962809211−009	−2.41986363466216172+006	4.14191276773394498+007	1.28237176629826689+003	19
37	8.41480090239857952−011	1.46581399994679377−009	−9.49877885764589712+006	1.68351512683745429+008	1.35635237301172275+003	18
38	2.01021835227262284−011	3.62083914965943963−010	−3.84545992242246780+007	7.04704331690164086+008	1.43233445502448834+003	19
39	4.66725473920631035−012	8.68168589180817881−011	−1.60388739110954258+008	3.03506919946126590+009	1.51031786670811535+003	19
40	1.05408762616294617−012	2.02248711498367734−011	−6.88525277122278372+008	1.34377373148824661+010	1.59030247993850143+003	20
41	2.31762271741527615−013	4.58191712424016027−012	−3.03942672901764944+009	6.11121307901486710+010	1.67228818163405542+003	18
42	4.96468440072186248−014	1.01031103891411916−012	−1.37854596082964035+010	2.85260541830688851+011	1.75627487168808744+003	19
43	1.03689733473667208−014	2.16996358949934961−013	−6.41895688120186941+010	1.36570752486998808+012	1.84226246122495042+003	19
44	2.11285381911809427−015	4.54319257676366281−014	−3.06618666231164392+011	6.70165206373512920+012	1.93025087112331543+003	18
45	4.20310977564798810−016	9.27863076516431647−015	−1.50148252710833802+012	3.36850247240630273+013	2.02024003076085724+003	18
46	8.16775384379190269−017	1.84971993967132030−015	−7.53257935222528019+012	1.73324584533629388+014	2.11222987694324117+003	18
47	1.55136672442627486−017	3.60161128401787224−016	−3.86900269760683569+013	9.12436991459124637+014	2.20622035298715102+003	19
48	2.88166096950561532−018	6.85348420122422215−017	−2.03343809973480622+014	4.91166445308026340+015	2.30221140793257089+003	19
49	5.23736540648428998−019	1.27523835369370661−017	−1.09294313517927200+015	2.70217112960253764+016	2.40020299586392935+003	18
50	9.31834232330758322−020	2.32148629676597140−018	−6.00439445818338869+015	1.51859286710302885+017	2.50019507532326085+003	19
51	1.62376981688016716−020	4.13669843592464379−019	−3.36998187607294516+016	8.71385139538426017+017	2.60218760880141368+003	18

OBLATE RADIAL FUNCTIONS

H = 12.0 X = 1.60000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	−4.23036115647525935−002	2.15478716466986823−001	−1.74472807407037387−002	−4.64469139010813054−001	−7.52286978492194622+001	23
3	−1.74474134846411886−002	−4.64468432863592295−001	4.23035604344750866−002	−2.15480150346247012−001	−7.52285673969014027+001	24
4	1.17710721893718544−002	−4.90019016745545650−001	4.53010466365100973−002	1.02782936893390058−001	−3.66661842092831736+001	23
5	4.53149117956957662−002	1.02250551352966502−001	−1.17226743239244968−002	4.90116584305733209−001	−3.66217092269358512+001	24
6	2.19992763874494431−002	4.23695837294056254−001	−4.23369175325889128−002	2.48656541315860749−001	−6.51224524639420730+000	23
7	−4.09651749391442910−002	2.74058630103455725−001	−2.46143678857926406−002	−4.06746944971785931−001	−3.98717151853308588+000	24
8	−4.00742217955057005−002	−2.49089523378935788−001	2.70883183036105811−002	−4.15749143926227681−001	1.37164365780463355+001	23
9	1.22458225659864034−002	−4.70773665029626894−001	4.72862730149906248−002	9.36733846448191024−002	2.74902446237123994+001	23
10	4.84766660198944580−002	−1.24528917850981170−001	1.01080900414204070−002	4.56910344801480066−001	4.58977645667728861+001	23
11	3.33816697714951862−002	3.27983122124548598−001	−3.76688736839096988−002	3.31124385876263782−001	6.65498310735474590+001	25
12	−1.32320261133966446−002	4.49069192474329184−001	−4.95834355796051260−002	−8.62941408029934095−002	8.95576117848965092+001	23
13	−4.86101078987283701−002	2.01265991902313252−001	−1.98777779640334800−002	−3.99248630389011852−001	1.14780769133126801+002	22
14	−4.81715447705708923−002	−1.61077688028612190−001	2.43709770167928782−002	−4.04442480728030796−001	1.42159811364883728+002	22
15	−1.72048099557989190−002	−3.85475819457779481−001	5.30922921914674425−002	−1.71024548863731865−001	1.71654125373987273+002	21
16	2.29003614186824566−002	−3.90217002812651739−001	5.34252999762370004−002	1.11822657401003873−001	2.03236169420520186+002	22
17	5.29930268817471565−002	−2.44266319487540262−001	3.05164370654713800−002	3.01060401213162113−001	2.36886413679515778+002	22
18	6.52002624275293499−002	−6.31282542949017795−002	−2.64960886863905568−003	3.61586042832578791−001	2.72590605645570861+002	21
19	6.17923164524037912−002	7.18027084573832800−002	−3.51519662054697714−002	3.37974598108904135−001	3.10338098331930940+002	21
20	4.96030301144287244−002	1.35285484802614923−001	−6.26325698809606197−002	3.01089713373191213−001	3.50120783929988566+002	21
21	3.51755313837299412−002	1.40980330440675131−001	−8.72587808558346856−002	3.15744141014048091−001	3.91932387217646553+002	20
22	2.25624038203719877−002	1.15507844116960340−001	−1.16351211117824214−001	4.41830676514901334−001	4.35767982922972047+002	20
23	1.32900658644366995−002	8.13362175006021563−002	−1.62624396074579823−001	7.66059894224606821−001	4.81623657672317726+002	19
24	7.26570656281334218−003	5.11691549396054315−002	−2.48571016612117372−001	1.47116742817025699+000	5.29496268131497047+002	20
25	3.71592896324073680−003	2.93827951163339999−002	−4.19062660299504504−001	2.98579642443221965+000	5.79383264783595665+002	20
26	1.78879471671638601−003	1.56118444863358830−002	−7.72348775394805414−001	6.34530649248249391+000	6.31282561472110723+002	19
27	8.14511034510526278−004	7.74829897715719335−003	−1.53667917134497554+000	1.41208523414729189+001	6.85192437457944610+002	18
28	3.52241020458171118−004	3.61740603105881111−003	−3.26626301717230043+000	3.29116698218507503+001	7.41111462959183003+002	19
29	1.45168464008426067−004	1.59731236290364670−003	−7.36073267874199975+000	8.02574475949184429+001	7.99038441900708701+002	19
30	5.71823887389940473−005	6.70008884312568891−004	−1.74901416696331521+001	2.04428140405113439+002	8.58972367442615365+002	19
31	2.15829002249298056−005	2.67936970684529952−004	−4.36351965398304303+001	5.42872236917195386+002	9.20912387110147956+002	18
32	7.82311569731786657−006	1.02461903533522007−004	−1.13916273270734678+002	1.50019019936441616+003	9.84857775215940973+002	18
33	2.72852014531437184−006	3.75662227322591039−005	−3.10329256641465127+002	4.30648890213380347+003	1.05080791087555158+003	18
34	9.17310020505513817−007	1.32348114030763774−005	−8.80058132510476571+002	1.28210049274002041+004	1.11876226035222008+003	18
35	2.97738220252812145−007	4.48936137727660206−006	−2.59270253116386841+003	3.95268739237015035+004	1.18872036278069899+003	18
36	9.34341987721234591−008	1.46880117589398855−006	−7.92056035757746977+003	1.26019289383989620+005	1.26068181854916559+003	18
37	2.83855981969294074−008	4.64235536189830998−007	−2.50505669289224359+004	4.14959594951962247+005	1.33464627978731944+003	19
38	8.35856046179846316−009	1.41947934962377417−007	−8.19041939495465418+004	1.40958584415662230+006	1.41061344253474260+003	18
39	2.38827847618726328−009	4.20432970127082140−008	−2.76471492603388899+005	4.93429335766432553+006	1.48858304025831187+003	18
40	6.62827972895636534−010	1.20768723717048835−008	−9.62343188423842179+005	1.77816029467060454+007	1.56855483845926117+003	18
41	1.78850134201038315−010	3.36800857974311453−009	−3.45039302224321256+006	6.59059410306284567+007	1.65052863016536807+003	18
42	4.69604160658503019−011	9.12824343276467655−010	−1.27299774151265892+007	2.51020059318844004+008	1.73450423214598524+003	18
43	1.20083958601186082−011	2.40657088436999903−010	−4.82838421946703522+007	9.81679064928591236+008	1.82048148172038968+003	17
44	2.99282811770786053−012	6.17705073173860555−011	−1.88111327342570047+008	3.93891901393443767+009	1.90846023405547982+003	18
45	7.27503386602379541−013	1.54483848084712771−011	−7.52171147322291520+008	1.62039250837926954+010	1.99844035986891866+003	18
46	1.72599231797161438−013	3.76729908734586365−012	−3.08446384005287049+009	6.82977656855706951+010	2.09042174346967130+003	18
47	3.99917603698823768−014	8.96453192338174730−013	−1.29627553353802970+010	2.94754124085806723+011	2.18440428108047396+003	17
48	9.05507051857198400−015	2.08287245854395508−013	−5.57932317612075137+010	1.30172604347376412+012	2.28038787939682342+003	17
49	2.00470537382209040−015	4.72830743035249595−014	−2.45788186050253387+011	5.87947675022185046+012	2.37837245434514232+003	17
50	4.34191698332168068−016	1.04932982969467266−014	−1.10759195042544813+012	2.71445700563503505+013	2.47835793000928042+003	17
51	9.20465871015965376−017	2.27783958266870784−015	−5.10265027347999390+012	1.28035392750831077+014	2.58034423769978134+003	17

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 14.0 X = 1.60000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	3.49695383738237779−002	−2.44936061355272210−001	1.73222043014101296−002	4.52432994475217873−001	−1.15189548296244584+002	24
3	1.73222077124397598−002	4.52432969883809175−001	−3.49695367675980992−002	2.44936104720154673−001	−1.15189543550979888+002	24
4	−5.96811599515459163−003	5.01402564530869182−001	−3.93500075857875550−002	−5.59658592279415329−002	−6.83141511589437481+001	23
5	−3.93503701559841437−002	−5.59389685358328002−002	5.96602458941051695−003	−5.01404996127396408−001	−6.83115655792313947+001	24
6	−2.58169044896281582−002	−3.68184314984155507−001	3.12526134632158982−002	−3.31468220037110917−001	−2.77733452225816203+001	24
7	3.10822333771821918−002	−3.33907410309121729−001	2.60313781474155281−002	3.65872530956263648−001	−2.74496570665788272+001	24
8	3.94696197150763362−002	1.14909574001942952−001	−1.14551594318766669−002	4.74995657479349961−001	7.54543594508251141−001	24
9	−5.55860710678233184−003	4.85066701950743165−001	−4.08655455462098748−002	−4.34803272300143889−002	7.74331472008800061+000	23
10	−4.02180982260169355−002	1.47084741693213396−001	−1.07892219318715106−002	−4.59426883705578372−001	2.65196969166217908+001	24
11	−2.59453996956217555−002	−3.60765519350133486−001	3.31057302019443408−002	−3.12995737316176581−001	4.54335204682938013+001	24
12	1.77366985894109282−002	−4.38697309216466793−001	3.87147891114975903−002	1.73658679028678345−001	6.76634930851798033+001	23
13	4.29785916957501981−002	−7.31729733575135152−002	4.39051570961968702−003	4.59366805412806405−001	9.22588661604032645+001	23
14	2.79087810048750928−002	3.35124088906031006−001	−3.39276346292422266−002	3.11523380834285482−001	1.19160369906307053+002	23
15	−1.06910826264504620−002	4.42062638345779342−001	−4.34989085146846853−002	−7.80990310780061965−002	1.48274499894155480+002	23
16	−4.11344046647981783−002	2.21780298182569650−001	−2.01809653130030896−002	−3.78964156155010379−001	1.79547467844073955+002	22
17	−4.40268937207400873−002	−1.17183153131831834−001	1.65906921223739341−002	−4.11567892044782383−001	2.12942043941925500+002	22
18	−2.12625826425113999−002	−3.54079796697694438−001	4.36452175290877413−002	−2.16827644385974105−001	2.48431804060106030+002	21
19	1.20563718493992659−002	−3.97427391236373233−001	4.89493409068885478−002	5.06285477690948362−002	2.85997376517853994+002	21
20	4.03604654453431124−002	−2.86669233890167401−001	3.40207048563425374−002	2.55485558605777653−001	3.25624214108506580+002	20
21	5.53491766411078617−002	−1.17511335383393372−001	7.90104373120899635−003	3.45727694953185628−001	3.67301175366009520+002	20
22	5.67236229897000687−002	2.86935858270096582−002	−2.01413196515330500−002	3.43530221560631313−001	4.11019585657602766+002	20
23	4.88788480264315634−002	1.14645573065669693−001	−4.48924927239648135−002	3.05192951656958128−001	4.56772595411761141+002	19
24	3.71534973659335992−002	1.41468512228520052−001	−6.60615864047191858−002	2.88494270344530088−001	5.04554729705274242+002	19
25	2.55590926362873481−002	1.29145189955023446−001	−8.74426060258932038−002	3.43181724676504131−001	5.54361565068337526+002	19
26	1.61696927831968284−002	9.95769213570547822−002	−1.16340388418384741−001	5.24400052800555625−001	6.06189493147895416+002	19
27	9.51107979988119524−003	6.81630657425371825−002	−1.64848029885253277−001	9.28144705396951788−001	6.60035545031999446+002	18
28	5.24343112821439278−003	4.24933025707911601−002	−2.54738384217989415−001	1.76211530094815116+000	7.15897258775238710+002	18
29	2.72605853414116526−003	2.44999330935825518−002	−4.29566699671732425−001	3.49950301389286377+000	7.73772578220321159+002	18
30	1.34312874172801930−003	1.32001153479611469−002	−7.82993830268450533−001	7.24323460509226844+000	8.33659774835653185+002	18
31	6.29657032653105455−004	6.69583053011334663−003	−1.52638774347107407+000	1.56335453960738007+001	8.95557386708233236+002	17
32	2.81805771222294089−004	3.21597715043904083−003	−3.15551711855053988+000	3.51878333200069876+001	9.59464170478681733+002	18
33	1.20751812523702290−004	1.46910895111408771−003	−6.87511349075246154+000	8.25156532231631020+001	1.02537906314713137+003	18
34	4.96597974584976694−005	6.40643415169652218−004	−1.57142272342069996+001	2.01309505213837562+002	1.09330115148280633+003	18
35	1.96434975182575466−005	2.67500632406952909−004	−3.75455645439595172+001	5.10130295715664556+002	1.16322964734449171+003	18
36	7.48792293823703464−006	1.07227244663899237−004	−9.35017795914904280+001	1.34059436021126858+003	1.23516386763471018+003	18
37	2.75530051411417087−006	4.13550990187603595−005	−2.42116617413415445+002	3.64804082848883392+003	1.30910321791472780+003	17
38	9.80173974448060222−007	1.53760990271111404−005	−6.50535655784625387+002	1.02650193289599132+004	1.38504717893273589+003	17
39	3.37568786825669602−007	5.52086881679460818−006	−1.81039454951518482+003	2.98287490903317316+004	1.46299529548591692+003	18
40	1.12691392257464483−007	1.91726805358665101−006	−5.20998450862538006+003	8.94058401228753050+004	1.54294716716411909+003	17
41	3.65078748774106778−008	6.44874087237931450−007	−1.54824815289430024+004	2.76103562509622403+005	1.62490244061951015+003	19
42	1.14896661204746171−008	2.10343621571726597−007	−4.74490062866485203+004	8.77624252038237330+005	1.70886080308070617+003	17
43	3.51621771434027086−009	6.66105850354800176−008	−1.49792247033213582+005	2.86855282244513964+006	1.79482197688714656+003	17
44	1.04732870583466019−009	2.05008576516407900−008	−4.86591528863435831+005	9.63275591849671283+006	1.88278571486405273+003	17
45	3.03873666539340340−010	6.13811255136171403−009	−1.62490514587238133+006	3.32057558712678324+007	1.97275179639321337+003	17
46	8.59498944260380631−011	1.78944824815602795−009	−5.57298624199360375+006	1.17413000412872846+008	2.06472002406234636+003	17
47	2.37168678491103253−011	5.08375276704906647−010	−1.96146926569869832+007	4.25544414831531899+008	2.15869022079759314+003	16
48	6.38891015104017016−012	1.40852781010114392−010	−7.07898817351372050+007	1.57980837248891937+009	2.25466222740108130+003	17
49	1.68125514346512303−012	3.80868294682734912−011	−2.61783451205844725+008	6.00367162176665322+009	2.35263590042941800+003	16
50	4.32455723361543344−013	1.00578577994470465−011	−9.91288106064922954+008	2.33410499690413550+010	2.45261111036019199+003	19
51	1.08792741984952354−013	2.59556858892065398−012	−3.84120800204525331+009	9.27827209763747216+010	2.55458774000263570+003	17

OBLATE RADIAL FUNCTIONS

H = 16.0 X = 1.60000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	−2.94220348341500655−002	2.72988338165037907−001	−1.70729265236310805−002	−4.38292932785645406−001	−1.63161980906196654+002	24
3	−1.70729266059277037−002	−4.38292932007201512−001	2.94220347882624958−002	−2.72988339368673517−001	−1.63161980750329214+002	24
4	2.10796733123820794−003	−5.07318359183686925−001	3.45481598539217967−002	1.38825706356551921−002	−1.08096597142048761+002	23
5	3.45481659144136928−002	1.38814431347740893−002	−2.10789086605057277−003	5.07318369707642773−001	−1.08096473874693320+002	24
6	2.60161846482341313−002	3.22663057000708070−001	−2.37017684530494960−002	3.80858870886340814−001	−5.86924050483263431+001	24
7	−2.36899154200193942−002	3.81005484369203105−001	−2.60274016213743407−002	−3.22483085237251205−001	−5.86668926481850273+001	24
8	−3.57147046173105112−002	2.45439581632799196−002	−4.13131905901172339−004	−4.91283354323534805−001	−1.75883149802601171+001	24
9	−1.42020540781704390−003	−4.90116094592604664−001	3.57091725181088409−002	−3.84026136442182310−002	−1.60522304864050475+001	23
10	3.15293405327134882−002	−2.53633212665045877−001	1.75448785744990833−002	4.15683158454079298−001	9.37595580058753185+000	24
11	2.48436714645585246−002	3.39067800983831526−001	−2.64252323178487800−002	3.46013043001484237−001	2.27203387362920798+001	23
12	−1.48147601576924617−002	4.47063383103488977−001	−3.34487088549731718−002	−1.75668509407601875−001	4.42205802592396690+001	23
13	−3.69314063609115663−002	3.03783309200037886−002	−7.20784437589469987−004	−4.74779741008515006−001	6.75899411642128782+001	24
14	−1.82590571960497103−002	−3.99269676990948727−001	3.25910580510311646−002	−2.48838617770221535−001	9.37213458690561418+001	24
15	1.88175058175369135−002	−4.13915386492531569−001	3.28320078536967066−002	2.10788113666776271−001	1.22226700059869404+002	23
16	3.83160499113671922−002	−5.48242007682375730−002	2.58043952774388773−003	4.54501684824644824−001	1.53015993714770232+002	23
17	2.52435048634173704−002	3.26433030448686769−001	−2.97959978790835080−002	3.10170158016205813−001	1.86015755610273190+002	22
18	−7.27339731977267373−003	4.38637065866760288−001	−3.91361228190185248−002	−5.35685973714450479−002	2.21177591210308522+002	23
19	−3.46882733812636123−002	2.50927872469362663−001	−2.12700761856109910−002	−3.52249438202483677−001	2.58466943632419514+002	22
20	−4.05819104581781205−002	−6.64308602495719126−002	9.74869281091250267−003	−4.16652777916120196−001	2.97858424887299009+002	21
21	−2.43612825561070783−002	−3.15743505361928817−001	3.54232697298289607−002	−2.61542568817105924−001	3.39332899072483278+002	22
22	3.31067830563333981−003	−3.96321543425915905−001	4.44009380058398944−002	−1.23444505865871375−002	3.82875647561281299+002	21
23	2.96458632700317941−002	−3.22291758283673020−001	3.57432173146034251−002	2.03618136036672805−001	4.28475157541489059+002	20
24	4.63659919492366734−002	−1.70448071599597190−001	1.55215074130519703−002	3.21584164202332176−001	4.76122294757563557+002	20
25	5.14540288416772898−002	−1.91654266949237622−002	−8.57803866171576711−003	3.44396385382454763−001	5.25809722654156529+002	20
26	4.73899055464639223−002	8.55265594625123822−002	−3.11389215402836966−002	3.14264710571439028−001	5.77531484971000770+002	19
27	3.83443968761962067−002	1.33378867056959877−001	−5.04141801596763451−002	2.82492213320016767−001	6.31282699841819170+002	19
28	2.80512259124273274−002	1.36714243080128182−001	−6.80352654992212808−002	2.94275550579136850−001	6.87059331784607528+002	19
29	1.88772728410173878−002	1.15043273052705267−001	−8.83539661965764133−002	3.91563462534575289−001	7.44858019222472776+002	18
30	1.18218150208315514−002	8.50645617454156457−002	−1.18565465065115948−001	6.31921615945733715−001	8.04675942300721268+002	18
31	6.94699390679212039−003	5.70384598307432610−002	−1.70614586372411308−001	1.12632696226911780+000	8.66510720403910126+002	18
32	3.85488918831904454−003	3.53116875998899236−002	−2.66395585119340339−001	2.11401721228475487+000	9.30360331867312482+002	19
33	2.02993206274159313−003	2.04189757273975353−002	−4.49660677490379707−001	4.12554167193612759+000	9.96223050480153177+002	18
34	1.01847686417007059−003	1.11184499617209209−002	−8.12984242067046278−001	8.36254161466019700+000	1.06409739483536024+003	17
35	4.88506100448312503−004	5.73555900967435127−003	−1.56038178937449151+000	1.76180357559585485+001	1.13398208760733696+003	17
36	2.24628122892571226−004	2.81624103950687744−003	−3.15722509373089005+000	3.85734109504129757+001	1.20587602257339201+003	17
37	9.92630077177869510−005	1.32119494650313268−003	−6.69990199837548321+000	8.76892944621226263+001	1.27977823772642217+003	16
38	4.22432734719826981−005	5.94046139509819975−004	−1.48535369692351313+001	2.06719147521370242+002	1.35568789321660589+003	17
39	1.73453266876076600−005	2.56666660826013094−004	−3.42972096969730372+001	5.04644832833445751+002	1.43360425314922037+003	17
40	6.88304013022592609−006	1.06804941836305168−004	−8.22743949659652135+001	1.27398179298948239+003	1.51352667048248148+003	17
41	2.64359254953822857−006	4.28878698937541399−005	−2.04610207671263824+002	3.32157230934681218+003	1.59545457443325377+003	17
42	9.84024478971408737−007	1.66473484883399972−005	−5.26566215074148914+002	8.93295713531813127+003	1.67938745992354810+003	17
43	3.55420022983764390−007	6.25584424122482785−006	−1.40005930795548887+003	2.47527608106541937+004	1.76532487869690754+003	17
44	1.24705083898716921−007	2.27903418246003667−006	−3.84052649477991988+003	7.05944644741513364+004	1.85326643180831018+003	16
45	4.25475704291078295−008	8.05890005216796911−007	−1.08550862346981540+004	2.07019441630569245+005	1.94321176324937164+003	16
46	1.41293184319396994−008	2.76915743913173247−007	−3.15772735897238551+004	6.23663173201129430+005	2.03516055451630985+003	16
47	4.57088870132729243−009	9.25574546709500143−008	−9.44409908441884242+004	1.92850069693900871+006	2.12911251996423778+003	16
48	1.44166176896964715−009	3.01214350327682961−008	−2.90118355257956168+005	6.11613540384479930+006	2.22506740282005222+003	16
49	4.43645294693879669−010	9.55250782739166640−009	−9.14610333200269258+005	1.98792988764988181+007	2.32302497174913165+003	15
50	1.33297893355331120−010	2.95451264085227567−009	−2.95658010988465477+006	6.61745376832055682+007	2.42298501788949499+003	16
51	3.91301582463801954−011	8.91878493613424672−010	−9.79281866359893404+006	2.25457187313495317+008	2.52494735228196412+003	15

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 18.0 X = 1.60000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	2.50535509439838834−002	−2.99736837898081743−001	1.67689951946906547−002	4.22263796571268273−001	−2.19141463599472215+002	23
3	1.67689951965850795−002	4.22263796548316700−001	−2.50535509427568822−002	2.99736837929407871−001	−2.19141463594723636+002	24
4	6.27300948571596264−004	5.09258857033870238−001	−3.06123018594954273−002	2.53582869223795221−002	−1.55942778415532475+002	23
5	−3.06123018479898255−002	2.53583285420800395−002	−6.27303448354948413−004	−5.09258854301665520−001	−1.55942773290723265+002	23
6	−2.52245390223303667−002	−2.80671733302936044−001	1.81644683452507129−002	−4.16548358298778485−001	−9.80824936483270077+001	23
7	1.81638442315457415−002	−4.16555228981683515−001	2.52250044646827546−002	2.80661161687317430−001	−9.80809369916126685+001	24
8	3.08750415700313814−002	−1.16214088187747614−001	6.37993680058524337−003	4.81426221302167579−001	−4.68573233895819733+001	24
9	6.46445497768319436−003	4.81083708838325456−001	−3.08589950368091226−002	1.17524733774801987−001	−4.66892914132815562+001	23
10	−2.11089913943864628−002	3.78062276086947049−001	−2.39056637133405182−002	−3.11131089877411783−001	−7.35632030744914201+000	23
11	−2.55800146970186072−002	−2.78875767448989132−001	1.91247346942783354−002	−4.01566151940290650−001	−2.38419553157480405+000	23
12	7.90160225170167039−003	−4.74503316231344581−001	3.11870843913151375−002	1.02146139555855882−001	2.16192953279133818+001	23
13	3.22719970868207987−002	−5.57081043374660997−002	2.54343765718303155−003	4.79170935768208741−001	4.14516914328368367+001	23
14	1.54589150202776177−002	4.12439326231304397−001	−2.87394776971826854−002	2.42720935524620742−002	6.65177144551926175+001	23
15	−1.91325363954419701−002	3.96707890540744352−001	−2.68045600385340072−002	−2.59866886494356446−001	9.40075537885043049+001	24
16	−3.30474298928719826−002	−3.52657235932227354−002	3.88672521953061339−003	−4.68067411186025068−001	1.24051402572242726+002	23
17	−1.39980860407143827−002	−4.13064938610914211−001	3.06174601190950665−002	−2.11349883152734129−001	1.56452558932280624+002	23
18	1.79310182861737737−002	−4.00457258783541363−001	2.90164200518801690−002	2.22277231347678732−001	1.91125134876101820+002	23
19	3.45116334914347154−002	−5.74227564201430888−002	2.68033807696854165−003	4.47720932621183495−001	2.28006822374077204+002	22
20	2.40297817939181179−002	3.07599140644692608−001	−2.57132062768401609−002	3.20274775926394190−001	2.67053742511488919+002	22
21	−3.62733037838706615−003	4.35563578899957116−001	−3.56743603572024465−002	−1.84822043871784390−002	3.08233583723681287+002	22
22	−2.89011354661090349−002	2.83657004482573324−001	−2.25018341105333378−002	−3.19111693214972407−001	3.51521938517224217+002	21
23	−3.73410296918165680−002	−1.12076931010508823−002	3.74402969984132934−003	−4.16794376753804097−001	3.96899975650300042+002	20
24	−2.65235270690118465−002	−2.70467831151183485−001	2.80366241640997004−002	−3.02466869592581540−001	4.44352913253674515+002	20
25	−3.78295493505149234−003	−3.85925267262571267−001	3.96982578635168087−002	−7.53200507642174771−002	4.93868978638169730+002	20
26	2.03964996213639379−002	−3.49647733018712236−001	3.60885569269344000−002	1.46457042709169806−001	5.45438678627586113+002	21
27	3.80470621962219818−002	−2.19970124458903942−001	2.09552663544035556−002	2.89009451737045595−001	5.99054275118035813+002	20
28	4.60060652885031516−002	−6.97448651933212474−002	4.97689342830067698−004	3.38450631668131400−001	6.54709400339145986+002	19
29	4.52320199764125651−002	4.93063248104454722−002	−2.00443020263709182−002	3.23160059508609681−001	7.12398769607129342+002	18
30	3.87977030851133735−002	1.17000221064433811−001	−3.80687596297427488−002	2.87425258572410660−001	7.72117963575181278+002	18
31	3.00120818144986864−002	1.37531833544524304−001	−5.37763709790382940−002	2.73540845390450593−001	8.33863260945720814+002	17
32	2.13408908368855128−002	1.26573721302526025−001	−6.96776193056684275−002	3.17987548806289989−001	8.97631508418130433+002	17
33	1.41237529529654649−002	1.00752170167258811−001	−9.03117258994298288−002	4.60670105129439504−001	9.63420018506501546+002	18
34	8.77628164519682421−003	7.22451560980485889−002	−1.22880927062804580−001	7.66604998386750677−001	1.03122648848402661+003	17
35	5.15382396715491314−003	4.76847734588559915−002	−1.79573188413166700−001	1.36647785599562335+000	1.10104893552593277+003	17
36	2.87483653356559262−003	2.93588901293933022−002	−2.83029187542704641−001	2.53790788725512630+000	1.17288564440111838+003	18
37	1.52944344100705544−003	1.70139564491124795−002	−4.78321483407914484−001	4.88239842415424071+000	1.24673512497664331+003	17
38	7.78664716686684895−004	9.34158401335880004−003	−8.59442025037300520−001	9.73068779118013235+000	1.32259607746181655+003	16
39	3.80445217517254873−004	4.88376133161813968−003	−1.62945462077333022+000	2.01017789497560885+001	1.40046736380500945+003	16
40	1.78816680503178896−004	2.44075755010250503−003	−3.24101330731323585+000	4.30327048467872373+001	1.48034798401745137+003	16
41	8.10229800645127489−005	1.16985291902228156−003	−6.73365331309299284+000	9.53816947170270776+001	1.56223705646920543+003	16
42	3.54560933095593717−005	5.39190540577939539−004	−1.45649045330543767+001	2.18643219298197691+002	1.64613380140775919+003	16
43	1.50093948166193817−005	2.30952473117398978 0−004	−3.27112623333926333+001	5.17698209138416886+002	1.73203752710651539+003	15
44	6.15541033391223652−006	1.02757236413375473−004	−7.61139289087464462+001	1.26461693438536810+003	1.81994761817132789+003	16
45	2.44873204493415364−006	4.26459315736680899−005	−1.83145146752033618+002	3.18332001791400576+003	1.90986352562707023+003	15
46	9.46087945542689951−007	1.71477887979989385−005	−4.54973538681541974+002	8.24839067061299614+003	2.00178475847960942+003	16
47	3.55383849488685490−007	6.68951689915638350−006	−1.16524075150927744+003	2.19779133070162223+004	2.09571087650633002+003	15
48	1.29918315736041057−007	2.53494656062568500−006	−3.07277829587615555+003	6.01621435484650102+004	2.19164148407411935+003	15
49	4.62642936892088448−008	9.34138932772156493−007	−8.33366179991047902+003	1.69043868826095009+005	2.28957622482019505+003	15
50	1.60616699796773473−008	3.35089808859241364−007	−2.32209143727696238+004	4.87147437643468433+005	2.38951477706037906+003	15
51	5.44057201054035723−009	1.17116953786429695−007	−6.64126556968129600+004	1.43871732427044579+006	2.49145684981296268+003	15

OBLATE RADIAL FUNCTIONS

H = 20.0 X = 1.60000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	−2.15051043047295263−002	3.25200821845678336−001	−1.64389714756508686−002	−4.04507537502725065−001	−2.83125583983819548+002	23
3	−1.64389714756928899−002	−4.04507537502084732−001	2.15051043046982925−002	−3.25200821846453285−001	−2.83125583983683020+002	24
4	−2.64857773523672288−003	−5.07985248476359126−001	2.73220884310935741−002	−6.25716728860822386−002	−2.11827440117763781+002	23
5	2.73220884248636877−002	−6.25716742843332573−002	2.64857781056147659−003	5.07985248284138021−001	−2.11827439925239330+002	25
6	2.41006650745542038−002	2.40354814077351332−001	−1.39156382306264509−002	4.43981655586437861−001	−1.45658038523410121+002	23
7	−1.39156106004972288−002	4.43981926421214638−001	−2.41006815771709150−002	−2.40354295729472889−001	−1.45657958395691428+002	23
8	−2.65073718850863173−002	1.83476331234126099−001	−9.61821214189418520−003	−4.63276012297077236−001	−8.55094867620428999+001	24
9	−9.62326130812025574−003	−4.63239832784911600−001	2.65056269818264886−002	−1.83563716368544524−001	−8.54964725458043997+001	24
10	1.27429289682386705−002	−4.47073469204766789−001	2.55348376567561509−002	2.06310132465692369−001	−3.35054081775733688+001	23
11	2.56907831030340559−002	2.00883475311788173−001	−1.24381616385278662−002	4.49434438704356449−001	−3.26877713381307514+001	24
12	2.03764732245496496−003	4.85569210572906143−001	−2.87150312310043101−002	4.99638836847150569−002	2.78198828989161360+000	23
13	−2.80666468925641133−002	1.28907136946045497−001	−6.74737632516629451−003	−4.69424042946169902−001	1.39653132821883531+001	23
14	−1.65511452419849997−002	−3.88267062511084847−001	2.38704455559412626−002	−2.88610605100081488−001	3.89821067359780340+001	23
15	1.62331632342049632−002	−4.08587509187803491−001	2.43150500652315447−002	2.53192678407531640−001	6.42719169238528014+001	23
16	2.90987714184540787−002	5.78692437675277962−002	−4.59618925396131698−003	4.73523972051517311−001	9.32118599231998912+001	23
17	9.22415887708098170−003	4.43991678796918773−001	−2.82447064540047827−002	1.63107466451302350−001	1.24695554166242103+002	24
18	−2.02938328367361493−002	3.56832335599997512−001	−2.20921702835961277−002	−3.03626384874038641−001	1.58646160082752914+002	23
19	−2.97608201441548747−002	−7.03805279144194865−002	5.79278882328245787−003	−4.58228107246021295−001	1.94935662125926802+002	23
20	−1.18558488106108214−002	−4.14789274332776080−001	2.82964103654528880−002	−1.94663101342059718−001	2.33488239084830898+002	23
21	1.61610394105289881−002	−3.96448155192244505−001	2.65536745688428821−002	2.17670932820068820−001	2.74249157242637585+002	23
22	3.13180410372120805−002	−7.40664438381561147−002	3.75109973023759469−003	4.39590496301019492−001	3.17178267555097611+002	22
23	2.35360736631643282−002	2.80897087239398073−001	−2.17680460940717243−002	3.36945031316697996−001	3.62245202021870738+002	21
24	−3.50397894028596995−005	4.30212691026637071−001	−3.26484405085953746−002	2.36767633397009768−002	4.09426485130933007+002	23
25	−2.35622373145193472−002	3.16469357477341063−001	−2.35658148839273802−002	−2.79561123061060730−001	4.58703641855200242+002	20
26	−3.40749225006692031−002	4.64789672167034191−002	−1.49414253128179558−003	−4.10140261308641953−001	5.10061914652579049+002	20
27	−2.78070041900812655−002	−2.18794204389957873−001	2.12965243815367952−002	−3.37518836899474274−001	5.63489365515387323+002	19
28	−9.49598975663719707−003	−3.65868816033813149−001	3.48453987804352694−002	−1.36489092492426652−001	6.18976231236431378+002	19
29	1.23603172517754210−002	−3.67602228910218495−001	3.53367394172415025−002	8.53602400760075164−002	6.76514450448788488+002	19
30	3.02997680596753208−002	−2.64270008885671818−001	2.46634924881561212−002	2.48421784166906861−001	7.36097310279150541+002	19
31	4.04268616335167587−002	−1.21031103939328037−001	7.64337191941758443−003	3.24533182860809750−001	7.97719178167803047+002	18
32	4.24927380715122843−002	7.51597991694181510−003	−1.08925335925454504−002	3.28599106346116381−001	8.61375295503614046+002	18
33	3.85598869254912087−002	9.29132495996438077−002	−2.78835322245560949−002	2.97049476650635017−001	9.27061616882379982+002	17
34	3.14238493817987190−002	1.31226947870001585−001	−4.25509946107869659−002	2.69257485479137086−001	9.94774683538040909+002	17
35	2.34999668865757070−002	1.33212925263407806−001	−5.61435095199237815−002	2.79400507848053265−001	1.06451152270739279+003	17
36	1.63479342986053518−002	1.14150908293154578−001	−7.15700717221265225−002	3.59382110254686442−001	1.13626956690747543+003	17
37	1.06785277793741643−002	8.72571006861564398−002	−9.34742807871917158−002	5.51447653803433643−001	1.21004658866495877+003	17
38	6.59467537436236580−003	6.11157140010636395−002	−1.29239000236331797−001	9.32026171885975668−001	1.28584064735148848+003	16
39	3.87077060686304835−003	3.98401350723231406−002	−1.91627424258493259−001	1.65612535727095461+000	1.36365004558672792+003	16
40	2.16841716108058550−003	2.44195309414694848−002	−3.04545130641631653−001	3.04742772657015950+000	1.44347329326382632+003	16
41	1.16336552072385200−003	1.41753252594957378−002	−5.15323231465930044−001	5.79359563297616058+000	1.52530907769250002+003	15
42	5.99458207813772333−004	7.83513358300413471−003	−9.21384173891559276−001	1.13865748229757113+001	1.60915623868559913+003	16
43	2.97389980487778738−004	4.14094103908178257−003	−1.72967145932032338+000	2.31429326533062409+001	1.69501374766575913+003	15
44	1.42340644780197794−004	2.09969688924540363−003	−3.39261784528108399+000	4.86261299067298269+001	1.78288069006057176+003	16
45	6.58509455764439356−005	1.02430389035157189−003	−6.92715802847559514+000	1.05532712427184507+002	1.87275625040272237+003	15
46	2.94935934132464928−005	4.81875633452555710−004	−1.46817105530802707+001	2.36328790108076703+002	1.96463969966663410+003	15
47	1.28071178934923403−005	2.19052598182546205−004	−3.22247555017768707+001	5.45480057251055221+002	2.05853038446330713+003	14
48	5.39876926803685463−006	9.63891301442614209−005	−7.31054084518146645+001	1.29629119957893004+003	2.15442771778612927+003	15
49	2.21190013455081990−006	4.11188723603327219−005	−1.71132607668051772+002	3.16839076925794451+003	2.25233117105685010+003	14
50	8.81709489723501915−007	1.70286583796494176−005	−4.12770136801954506+002	7.95729461129341694+003	2.35224026726594899+003	15
51	3.42292331876583856−007	6.85451377421016815−006	−1.02451389761773469+003	2.05157946677759510+004	2.45415457503778613+003	15

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 22.0 X = 1.60000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	1.85511710492588899−002	−3.49361190403015417−001	1.60951730728394592−002	3.85156381891833495−001	−3.55112922990008684+002	23
3	1.60951730728403632−002	3.85156381891816405−001	−1.85511710492581247−002	3.49361190403033805−001	−3.55112922990004935+002	24
4	4.18759785522902256−003	5.03949968021094275−001	−2.45202862122750403−002	9.81787906404076000−002	−2.75737554221058966+002	24
5	−2.45202862119387860−002	9.81787906840704809−002	−4.18759785736076646−003	−5.03949968012012845−001	−2.75737554214372180+002	24
6	−2.28711354961450494−002	−2.01143582137536715−001	1.05567181789176555−002	−4.65421344617063784−001	−2.01339767966675926+002	23
7	1.05567170962091699−002	−4.6542135391779[illegible]−001	2.28711360133954598−002	2.01143559812619955−001	−2.01339764325830458+002	23
8	2.27316389743132925−002	−2.3838723269618[illegible]−001	1.15532061331518370−002	4.40531099324777875−001	−1.32615754045018737+002	23
9	1.15534532979919515−002	4.4052845602901[illegible]−001	−2.27315176122873369−002	2.38391961059845260−001	−1.32614935276824586+002	24
10	−7.17536471774827808−003	4.7919133778466[illegible]−001	−2.47761578868970939−002	−1.24817418751880308−001	−7.07656073239279502+001	23
11	−2.47842807048187797−002	−1.2429677051824[illegible]−001	7.14869889368668912−003	−4.79318754546566655−001	−7.06842774868143538+001	23
12	−1.00935116211059907−002	−4.46470215118167623−001	2.40161359852422028−002	−2.02668944447743426−001	−1.97637634294175946+001	23
13	2.36062881605003790−002	−2.20303021368150254−001	1.10546053166324159−002	4.37712516432878910−001	−1.67657041439947846+001	24
14	1.98890008136564586−002	3.06620303788320434−001	−1.71043016426749971−002	3.78279665750166752−001	1.47635983598552581+001	23
15	−1.16190070754388867−002	4.41445607935017408−001	−2.36319256622465723−002	−2.01043078797249412−001	3.36025666277675758+001	23
16	−2.63994376296021280−002	−2.46896835490324811−002	2.15854913911136737−003	−4.81632867672596995−001	6.14353842704671839+001	23
17	−8.46547201786383413−003	−4.49421067828402265−001	2.52778948822520919−002	−1.66288688008470422−001	9.13313541478388749+001	23
18	1.92703816790330785−002	−3.42145017966586978−001	1.86990800438247266−002	3.30576413804867508−001	1.24224167755404031+002	24
19	2.57236756322925606−002	1.31837431460507047−001	−8.42510702186303755−003	4.53177315821937777−001	1.59652462130857678+002	23
20	5.51011712958806858−003	4.54635334215630418−001	−2.67480790965288302−002	1.10253348829945820−001	1.97502234762415273+002	23
21	−2.00307926899246070−002	3.30446634742698703−001	−1.89557960843211714−002	−3.24712647243245976−001	2.37675439729810337+002	23
22	−2.71828143528439270−002	−8.45013604492207314−002	6.17992432722727150−003	−4.50502239156619942−001	2.80105610843162434+002	23
23	−1.10019228920493886−002	−4.09681926825721915−001	2.59743281897020001−002	−1.93322380620853642−001	3.24743733410686937+002	24
24	1.39728481673002346−002	−3.99073701626902905−001	2.49294635069208715−002	2.01779725265839561−001	3.71552773982102001+002	23
25	2.85030463871903715−002	−1.00351373625449935−001	5.30333713828807119−003	4.29285116152768419−001	4.20504075652124095+002	21
26	2.33469092342502185−002	2.47386773612812728−001	−1.79627873640669276−002	3.56551466879279755−001	4.71575047926701646+002	21
27	3.36084078378272254−003	4.20601345634704292−001	−2.97943153435149938−002	7.03995324781230462−002	5.24747606732999707+002	21
28	−1.85619437132550513−002	3.46726004216534975−001	−2.43045059085311026−002	−2.33872410917650313−001	5.80007086729497536+002	20
29	−3.06865556960651678−002	1.04743496844043860−001	−6.00982272497767233−003	−3.95568698496467954−001	6.37341462028464191+002	19
30	−2.82809021784176728−002	−1.61678572406515948−001	1.51172016216419475−002	−3.65052115507438508−001	6.96740775162218073+002	19
31	−1.40069185799316203−002	−3.36264377455351270−001	2.98871081833321777−002	−1.94058450681961202−001	7.58196710581200125+002	19
32	5.39098273441934233−003	−3.75367148223299949−001	3.37000685263721367−002	2.19314610729271652−002	8.21702270835066400+002	18
33	2.30914152594616246−002	−3.01739590365759459−001	2.69580849733785018−002	2.00672378746797868−001	8.87251527183380972+002	18
34	3.47785596163535554−002	−1.71054420420352426−001	1.32078528231939749−002	3.02165163017521860−001	9.54839425105034102+002	17
35	3.92577369225022243−002	−3.81818459176391189−002	−3.27248620987869895−003	3.28421384435479553−001	1.02446163092467482+003	17
36	3.76795134398526935−002	6.19693312152422309−002	−1.92419890103791528−002	3.07215154832420086−001	1.09611440965402774+003	17
37	3.22782306592506775−002	1.17734068979579628−001	−3.32535039562995212−002	2.74273410786161824−001	1.16979452681872592+003	16
38	2.53044707242702351−002	1.34232398717050326−001	−4.56389572551431501−002	2.62479468973267450−001	1.24549916891678618+003	16
39	1.84308429895580840−002	1.24274228241757390−001	−5.81978550854434054−002	3.00346393419221939−001	1.32322587849267679+003	16
40	1.25998364385830839−002	1.01178482905528267−001	−7.40398803792514772−002	4.18806069435992911−001	1.40297250077939983+003	15
41	8.14384200107628522−003	7.49878937591334397−002	−9.79495021412777700−002	6.65914673272390790−001	1.48473713957150839+003	15
42	5.00425225135201003−003	5.15560407391026882−002	−1.37674369021563770−001	1.13307345090785784+000	1.56851812051956694+003	15
43	2.93617145184436448−003	3.32715751628734972−002	−2.06851183834547004−001	2.00460570225935445+000	1.65431396043267977+003	16
44	1.65075885223799040−003	2.03177960694759097−002	−3.31123752231364524−001	3.65918127040365880+000	1.74212334147614286+003	15
45	8.91891535468609717−004	1.18098907464583927−002	−5.60944539282362873−001	6.88809880753477952+000	1.83194508938126480+003	15
46	4.64233333065399924−004	6.56352204843959058−003	−9.98952642140502936−001	1.33800884408866717+001	1.92377815496198635+003	15
47	2.33278386636581841−004	3.50026493186223281−003	−1.86001246864600974+000	2.68245782176953833+001	2.01762159837114507+003	14
48	1.13376992406212105−004	1.79640104860081970−003	−3.60612988476458709+000	5.54792917485467917+001	2.11347457563760579+003	14
49	5.33813652051569519−005	8.89406384766040818−004	−7.25684551450594806+000	1.18278091756007373+002	2.21133632711104230+003	14
50	2.43832781716834869−005	4.25686194821080705−004	−1.51198806004966818+001	2.59678221365559299+002	2.31120616750914805+003	14
51	1.08190784501793485−005	1.97308697628534483−004	−3.25500657386629046+001	5.86530516093533598+002	2.41308347731641019+003	14

OBLATE RADIAL FUNCTIONS

H = 24.0 X = 1.60000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	−1.60430638201114756−002	3.72179788033302106−001	−1.57429703549716762−002	−3.64325950828183839−001	−4.35102588928034513+002	23
3	−1.57429703549716952−002	−3.64325950828183399−001	1.60430638201114574−002	−3.72179788033302527−001	−4.35102588928034413+002	25
4	−5.38467825801667167−003	−4.97449140707911928−001	2.20950528057635956−002	−1.32404348765459591−001	−3.47665453233606837+002	23
5	2.20950528057503122−002	−1.32404348766745095−001	5.38467825807404859−003	4.97449140707553878−001	−3.47665453233388706+002	24
6	2.16298970335334439−002	1.62754220782353681−001	−7.83895935938834281−003	4.82124168771501501−001	−2.65091117839041123+002	23
7	−7.83895932068343792−003	4.82124169053959108−001	−2.16298970480881294−002	−1.62754219911407977−001	−2.65091117688817543+002	23
8	−1.94807726689058430−002	2.84848686854007709−001	−1.27248815928220685−002	−4.14739916912800578−001	−1.87951459571433092+002	23
9	−1.27248921067229021−002	−4.14739761474284777−001	1.94807659865148471−002	−2.84848907260182344−001	−1.87951415156566172+002	23
10	3.17460941309220165−003	−4.94645933447879057−001	2.33075019235406236−002	5.51749151114201392−002	−1.17118004623077558+002	23
11	2.33077645332358232−002	5.51374276287233005−002	−3.17285098959570663−003	4.94649625961838683−001	−1.17111778712758791+002	23
12	1.39773035819837977−002	3.90998877516441199−001	−1.92138402816325934−002	2.99881149658326012−001	−5.43592809764411137+001	23
13	−1.91462157547219250−002	3.01780933077206319−001	−1.40724256321004761−002	−3.89493684172718536−001	−5.39572991578885675+001	23
14	−2.24244690035457293−002	−1.59542498596167174−001	8.40600229175798926−003	−4.62129348066904207−001	−6.74288910700460606+000	23
15	6.15775814724858200−003	−4.75003813711659584−001	2.31767492431204722−002	1.12878023729593294−001	1.31253416277216785+000	23
16	2.39637607567641645−002	−6.52398333698538644−002	2.59202151095482696−003	4.81352527084695940−001	3.11611279751431629+001	23
17	1.00406379998659876−002	4.34352631096768439−001	−2.20326218993175123−002	2.12555472897928396−001	5.70658483824468937+001	23
18	−1.66513024224779121−002	3.59979741141065132−001	−1.77648516689186787−002	−3.18841914602043414−001	8.85635541318365802+001	23
19	−2.31864462596734675−002	−1.41240132825994362−001	7.91545974218036324−003	−4.56565837915171046−001	1.22675093430107332+002	23
20	−3.22244296861892358−003	−4.68518948520089600−001	2.44582430194043117−002	−7.60198242366801498−002	1.59524948298918153+002	23
21	2.01673466923476948−002	−2.87053831603096968−001	1.45309497695631215−002	3.73522365481044666−001	1.98875163785883544+002	23
22	2.28798588589261827−002	1.76983892249460461−001	−1.02324913943640199−002	4.32394874321699635−001	2.40617796816841549+002	23
23	3.46299039753718651−003	4.56294472385389610−001	−2.50533418823315263−002	7.86656626861446659−002	2.84671500596579978+002	23
24	−1.90831959571701776−002	3.16527773068760720−001	−1.69779182774450379−002	−3.31712633496578415−001	3.30977462375901238+002	23
25	−2.51849047734398661−002	−8.36452389306586491−002	5.68766542348602550−003	−4.45837449769658603−001	3.79491225881403260+002	23
26	−1.09284831162877309−002	−3.99671111463605490−001	2.37291757569387903−002	−2.03162120275159462−001	4.30178400253214758+002	23
27	1.15824198443248584−002	−4.05619604067476580−001	2.37940745116051864−002	1.77232115156294510−001	4.83011851880371242+002	22
28	2.58944664996447332−002	−1.33185624358393934−001	7.06050171302259759−003	4.15678095604036406−001	5.37969828794363350+002	21
29	2.32156624102792839−002	2.07760720030193100−001	−1.42881012204029575−002	3.76281042444180574−001	5.95034658808493941+002	21
30	6.47643904394446750−003	4.05314556993620258−001	−2.69654727538186517−002	1.19606036835010445−001	6.54191819891996405+002	21
31	−1.38525953205877606−002	3.72341505212266653−001	−2.46390663568661191−002	−1.82635292325818845−001	7.15429260372228334+002	20
32	−2.71501083572943132−002	1.61752129760228187−001	−9.83009336261156594−003	−3.72524528445414160−001	7.78736891780180800+002	20
33	−2.80194766902237139−002	−1.00395931377937196−001	9.46751329880737715−003	−3.83790894941037292−001	8.44106203964779227+002	18
34	−1.74436956760371154−002	−2.97635071372408542−001	2.48880775183091440−002	−2.46309910554423587−001	9.11529968638335523+002	18
35	−6.00501469258606974−004	−3.72506528673716170−001	3.13520868221559741−002	−4.20695413454570748−002	9.81002008054022946+002	18
36	1.64220560831728648−002	−3.31010406747504377−001	2.80680480261232099−002	1.46955036825417198−001	1.05251701242429592+003	17
37	2.91320866839487494−002	−2.17930744416034622−001	1.74260525766422094−002	2.71399962718186604−001	1.12607039432997234+003	18
38	3.56134323781586576−002	−8.60301238209892531−002	3.06490133044160494−003	3.21239634746539199−001	1.20165817155532666+003	17
39	3.62097753541317713−002	2.52616704600811308−002	−1.17976723720122785−002	3.15000323171431589−001	1.27927687201345015+003	16
40	3.25768936122363697−002	9.72837150871373301−002	−2.52777166372139291−002	2.83790399933239522−001	1.35892345601243085+003	16
41	2.67147772820056994−002	1.29147881808508177−001	−3.70232839810870686−002	2.59131531337822112−001	1.44059525225924094+003	16
42	2.03149700458727933−002	1.30261973277802398−001	−4.80183301359898042−002	2.68233593299111158−001	1.52428990483811390+003	17
43	1.44864395145758949−002	1.13116124985560186−001	−6.03571529173215061−002	3.36642595450185800−001	1.61000532902330705+003	16
44	9.76354282539844938−003	8.86023245787793911−002	−7.72939938816175985−002	4.97328890180738676−001	1.69773967425372164+003	15
45	6.25603225576094904−003	6.40854468282294019−002	−1.03840710833676265−001	8.07131627686270058−001	1.78749129295139192+003	14
46	3.82835228557105690−003	4.34021351389400231−002	−1.48293689821885909−001	1.37601158183381147+000	1.87925871413726652+003	15
47	2.24558545902547551−003	2.77772964531831394−002	−2.25448455259703298−001	2.42331960765716840+000	1.97304062100732188+003	14
48	1.26635002325003962−003	1.69095092017180800−002	−3.63153214005456406−001	4.39323815231625461+000	2.06883583179526474+003	13
49	6.88298311424525040−004	9.83919162089575725−003	−6.15835585567430782−001	8.20108871855287482+000	2.16664328337613405+003	14
50	3.61352058409065865−004	5.49331157532538958−003	−1.09306556299167097+000	1.57729007149128949+001	2.26646201716628988+003	14
51	1.83578555175211709−004	2.95183358520450174−003	−2.02131429842145568+000	3.12538488625597822+001	2.36829116695574542+003	13

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 26.0 X = 1.60000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	1.38788587314401261−002	−3.93609127961896699−001	1.53846267391481270−002	3.42122757764126815−001	−5.23093992571517991+002	23
3	1.53846267391481274−002	3.42122757764126804−001	−1.38788587314401256−002	3.93609127961896708−001	−5.23093992571517989+002	24
4	6.32950312387107189−003	4.88693020411276685−001	−1.99657766682729387−002	1.65363254156823489−001	−4.27606293979691762+002	24
5	−1.99657766682724861−002	1.65363254156859536−001	−6.32950312387255358−003	−4.88693020411264062−001	−4.27606293979685002+002	23
6	−2.04171531825256624−002	−1.25029824667314878−001	5.59867995550989291−003	−4.94868254898341169−001	−3.36891085775943616+002	23
7	5.59867995422267177−003	−4.94868254905912447−001	2.04171531828938503−002	1.25029824635906158−001	−3.36891085770205822+002	24
8	1.66702075281083078−002	−3.24816360896988703−001	1.34111160524978477−002	3.86777010185578833−001	−2.51433061176805418+002	24
9	1.34111164540512458−002	3.86777002319810424−001	−1.66702072124996464−002	3.24816370050816475−001	−2.51433059026004808+002	23
10	−1.71989945924641148−004	4.99901024116652442−001	−2.16142983363317706−002	7.01747566825043316−003	−1.71923659369882540+002	23
11	−2.16143002394471480−002	7.01971224577755606−003	1.71893341325498747−004	−4.99900966523440908−001	−1.71923259302121940+002	23
12	−1.57159430474394797−002	−3.35315144658204207−001	1.51445806430050611−002	−3.64317665968518557−001	−9.94861533697383131+001	23
13	1.51380002847964982−002	−3.64457962218924370−001	1.57224371737291398−002	3.35158900101065618−001	−9.94484802389692937+001	23
14	2.19703481444225984−002	1.96189014315555765−002	−1.40273727664205283−003	4.90492126179860366−001	−3.71210916948662483+001	23
15	−1.00569665350584361−003	4.90656324585273990−001	−2.19970746157262677−002	−1.07379854715384562−002	−3.55226862387832984+001	23
16	−2.01635693532016149−002	2.12793901300297111−001	−9.17232665164746716−003	−4.39008967676851610−001	6.19437459526073208+000	23
17	−1.26772175698352298−002	−3.92621711904775591−001	1.82281246935998250−002	−2.87685006313804620−001	2.21086187651388953+001	23
18	1.27804664441700577−002	−4.03958521480350298−001	1.82800772971984632−002	2.67549698287529201−001	5.31152246858471422+001	23
19	2.17151110624767322−002	1.07169920110897474−001	−5.54003683541130553−003	4.70183072248465069−001	8.46793045170295981+001	24
20	3.50721838447561624−003	4.71664485532664656−001	−2.22580818309593871−002	8.70935851166450441−002	1.20135391654894641+002	23
21	−1.87719745491216604−002	2.77821498618342541−001	−1.27061225004916391−002	−3.87480226168318002−001	1.58308022598621204+002	23
22	−1.99678912126805067−002	−2.17591330513894984−001	1.10405752090616117−002	−4.20748961408636327−001	1.99101649055948690+002	23
23	8.84219273291923056−005	−4.70179497609087388−001	2.29802372667930970−002	−1.16879877562374268−002	2.42361026461283413+002	24
24	2.00141442139928771−002	−2.46707089660588115−001	1.16529375732073058−002	3.96166857756945425−001	2.87991718104578867+002	24
25	2.06840703038679487−002	2.02170862138234998−001	−1.08456993336774681−002	4.16316441945300005−001	3.35923575719240953+002	23
26	2.51788068965138250−003	4.54190021259064787−001	−2.34342022336222164−002	6.36337252256718993−002	3.86103945327489922+002	23
27	−1.77943671097379779−002	3.12885085756287837−001	−1.58100068038981551−002	−3.29154027668898446−001	4.38492117628645458+002	23
28	−2.36021054843827850−002	−7.16073718723186154−002	4.67147692796499597−003	−4.43574441271269238−001	4.93055975105300498+002	22
29	−1.13158860854724259−002	−3.85259765990535766−001	2.15518421292809775−002	−2.20994207996945956−001	5.49769751435326596+002	22
30	9.10011929221656440−003	−4.13697954111953703−001	2.29116088611234472−002	1.45637346590376953−001	6.08612487446534139+002	21
31	2.33759397933585394−002	−1.70171648737334235−001	8.85317776673504854−003	3.97727028889160377−001	6.69566933201726787+002	21
32	2.29919370733380468−002	1.62688281191610892−001	−1.07429633641088202−002	3.93879326702084691−001	7.32618747545934139+002	20
33	9.25583312032272410−003	3.83430275916660835−001	−2.40870961632634954−002	1.69415436767129208−001	7.97755902115597091+002	20
34	−9.42405896989967337−003	3.91648773965748175−001	−2.45357810679204402−002	−1.26738846701429196−001	8.64968229568632236+002	19
35	−2.34803781890916978−002	2.15725067671773131−001	−1.29736204865910947−002	−3.40925845263240065−001	9.34247075808805956+002	18
36	−2.71004685336500281−002	−3.64600963122431875−002	4.34505923013311561−003	−3.92811720114846697−001	1.00558502863728653+003	17
37	−1.99070855695358518−002	−2.50861984687380378−001	1.99222020659644190−002	−2.91658955739290997−001	1.07897570351085353+003	18
38	−5.67238531154674332−003	−3.58940061205799992−001	2.84429221447282505−002	−1.04805772260158650−001	1.15441357259761282+003	17
39	1.03087839481411100−002	−3.50990598992457414−001	2.81747897441066819−002	8.87317664688075670−002	1.23189382708805854+003	17
40	2.35626975356158652−002	−2.59908742774570928−001	2.04688850055496999−002	2.32730601517751061−001	1.31141226534565871+003	16
41	3.16476714884169725−002	−1.34223787165672520−001	8.27923225553975166−003	3.06263702023674070−001	1.39296520134485822+003	16
42	3.42095373418733651−002	−1.59110889181722487−002	−5.35080752787211358−003	3.18301297213571245−001	1.47654938918803973+003	17
43	3.23316554316031985−002	7.03872691004851914−002	−1.82825492268547417−002	2.94353756382618801−001	1.56216196047560154+003	15
44	2.77017544952043569−002	1.17731192311697682−001	−2.96542999967615928−002	2.63974862823681903−001	1.64980037203124937+003	16
45	2.19495179548606129−002	1.31413611157542495−001	−3.98204588993870572−002	2.53802960419084687−001	1.73946236203023970+003	14
46	1.62859336154634405−002	1.22219837590372161−001	−5.01425548571798228−002	2.87081363464743393−001	1.83114591299172320+003	14
47	1.14130330890976598−002	1.01210574077655660−001	−6.28929018971640450−002	3.88886652440572911−001	1.92484922041266224+003	14
48	7.60181859112284979−003	7.69101346379005231−002	−8.14855367600806676−002	5.96796579791172854−001	2.02057066606503975+003	14
49	4.83558823384350563−003	5.45407628444731993−002	−1.11267936764895431−001	9.79232423928426485−001	2.11830879516825019+003	14
50	2.94883952414686210−003	3.64808761858135448−002	−1.61270188467569433−001	1.66863103956463074+000	2.21806229679778926+003	13
51	1.72930328451361870−003	2.31849226975251968−002	−2.47735302258179484−001	2.92607962504041594+000	2.31982998700930349+003	13

OBLATE RADIAL FUNCTIONS

H = 28.0 X = 1.60000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	−1.19864097649958844−002	4.13597756637873837−001	−1.50209955764515964−002	−3.18648597096867802−001	−6.19086728618735091+002	23
3	−1.50209955764515964−002	−3.18648597096867802−001	1.19864097649958843−002	−4.13597756637873837−001	−6.19086728618735091+002	25
4	−7.08195538298700032−003	−4.77842281580588616−001	1.80733545567307360−002	−1.97105132133725252−001	−5.15556857122093756+002	24
5	1.80733545567307219−002	−1.97105132133726222−001	7.08195538298703726−003	4.77842281580588205−001	−5.15556857122093555+002	24
6	1.92491352818236116−002	8.78904796344944599−002	−3.72414670059896282−003	5.04167358528100796−001	−4.16726482444936697+002	24
7	−3.72414670055859311−003	5.04167358528274955−001	−1.92491352818318452−002	−8.78904796334323623−002	−4.16726482444731002+002	24
8	−1.42237234294483797−002	3.59494067831264327−001	−1.37742430203281136−002	−3.57173991694719879−001	−3.23015743758797240+002	24
9	−1.37742430343829453−002	−3.57173991339112596−001	1.42237234161187159−002	−3.59494068177304414−001	−3.23015743663663544+002	24
10	−2.12498197377907544−003	−4.97906308836579887−001	1.98781491448787262−002	−6.33637664525230496−002	−2.34997053607513293+002	24
11	1.98781486989785989−002	−6.33638825740045326−002	2.12498661720431195−003	4.97906292790567520−001	−2.34997031060060739+002	24
12	1.64380615002749766−002	2.79864587719546665−001	−1.17005407148204629−002	4.11090792267074995−001	−1.53517411535571647+002	25
13	−1.17000551380466519−002	4.11098997571217123−001	−1.64384153051577580−002	−2.79852243129589518−001	−1.53514551533449524+002	24
14	−2.01302328169191901−002	8.31175366971532515−002	−2.99544347370305976−003	−4.85991837991043582−001	−8.01126548436684260+001	24
15	−3.03515294306551634−003	−4.85816108906474995−001	2.01247469709556554−002	−8.40736751529784672−002	−7.99245236641393532+001	24
16	1.46463569775016999−002	−3.50220137699253996−001	1.43434614260947331−002	3.41978124710126427−001	−2.03367735248305959+001	24
17	1.51024754575485691−002	3.22884692467780675−001	−1.38810605676384649−002	3.67497419335270614−001	−1.53399042848566641+001	24
18	−7.12275409037872808−003	4.60662259725227407−001	−1.93374141134630132−002	−1.57816180611929020−001	2.17069566529501212+001	24
19	−2.05820242712150173−002	−3.39526704262338138−002	1.92330903334778295−003	−4.84247862098479446−001	4.62974136118358733+001	24
20	−5.47267993688918321−003	−4.63096091112708046−001	2.00278374051974457−002	−1.38376357045756105−001	8.02913722649942752+001	24
21	1.65813276098414515−002	−3.01033146255068608−001	1.26583049346721942−002	3.75213222631152174−001	1.16577476995090491+002	24
22	1.84210328268088912−002	2.18251313075286767−001	−1.00222038450029172−002	4.25857966456424086−001	1.56056382794577208+002	23
23	−1.00354398767338617−003	4.75674559236180748−001	−2.10678958298367287−002	−1.06030886251983208−002	1.98224602049158264+002	24
24	−1.92726679918388849−002	2.09142598377212322−001	−8.88913576531629625−003	−4.24072358892229427−001	2.42947924524825354+002	23
25	−1.72564216191013740−002	−2.66712169366481115−001	1.26014060538166899−002	−3.86589672546374902−001	2.90108121240223999+002	23
26	2.04586677137043482−003	−4.65203813045698002−001	2.14266801843436414−002	3.14435949421522897−002	3.39623244688258942+002	23
27	1.93641910005991641−002	−2.20337458131306403−001	9.78062361258322272−003	4.06785131522023748−001	3.91431476186741774+002	23
28	1.90632293706320892−002	2.13092851378632344−001	−1.07364450049619967−002	4.06239829484774020−001	4.45485170717582506+002	23
29	2.30404450829458497−003	4.50407481013855916−001	−2.19589386826321603−002	6.14712391362201591−002	5.01746763382887056+002	23
30	−1.63233890058157064−002	3.17219772299116997−001	−1.51905074077992102−002	−3.19380578742833556−001	5.60186116151554335+002	22
31	−2.22878617441047193−002	−5.08932167285990548−002	3.33869653825096814−003	−4.42491336111608954−001	6.20778698010439135+002	22
32	−1.19549531892942533−002	−3.66369084639044368−001	1.94112264278864103−002	−2.44286148543119073−001	6.83504298180208709+002	21
33	6.59110523342694802−003	−4.21259072268682792−001	2.21222888923107750−002	1.08159073213076788−001	7.48346091552609687+002	22
34	2.08747871876515376−002	−2.09287614810801173−001	1.05695536337710465−002	3.74615845843501259−001	8.15289944755555467+002	20
35	2.25840346406122833−002	1.12955260937406780−001	−7.33784116087467027−003	4.07511550178820812−001	8.84323891127911972+002	20
36	1.16589394657054284−002	3.54463294122005130−001	−2.11299138797053984−002	2.18057899510971071−001	9.55437727035278204+002	19
37	−5.28831906748842098−003	4.03342583046667572−001	−2.39896045118260899−002	−6.73321095266527470−002	1.02862269710555110+003	20
38	−1.97160659482603217−002	2.64967884293923116−001	−1.54567795352329510−002	−3.01102287487909323−001	1.10387124576263028+003	18
39	−2.56047029464492468−002	2.84493614702555596−002	−2.38657537561723984−004	−3.91541862256539717−001	1.18117681894792329+003	17
40	−2.14840251643250961−002	−1.97135552217746666−001	1.50662931416067685−002	−3.28709385525833330−001	1.26053370434804228+003	16
41	−9.86762679201410245−003	−3.34940015348009024−001	2.51075227873837743−002	−1.64435552253384767−001	1.34193690152209730+003	17
42	4.77602751398756149−003	−3.60895453848443716−001	2.74317052683755136−002	2.76642053836293843−002	1.42538201549658042+003	17
43	1.81465323375635877−002	−2.95417299860108547−001	2.24710295268650240−002	1.87020406857763663−001	1.51086516895909473+003	15
44	2.74493858190974200−002	−1.80961298034701582−001	1.24801116418440941−002	2.83200709029978872−001	1.59838292932268214+003	15
45	3.17434500121584938−002	−6.00878477467557352−002	2.16076704212893844−004	3.15627921375591196−001	1.68793224777575593+003	15
46	3.15643712865983889−002	3.78149141150936604−002	−1.20750346141788014−002	3.03363759249833433−001	1.77951040806372958+003	15
47	2.82468731042986057−002	1.00015164629211076−001	−2.31623618581407225−002	2.73145819213331209−001	1.87311498322599213+003	14
48	2.32911262619998322−002	1.27215829242572025−001	−3.29030063070248464−002	2.51010596526992066−001	1.96874379887694627+003	13
49	1.79484856735244225−002	1.27720231074346865−001	−4.20933095369395109−002	2.59405478137803774−001	2.06639490190151150+003	13
50	1.30498203893643409−002	1.12049018510637847−001	−5.23202234099889041−002	3.19519573678096599−001	2.16606653365472399+003	14
51	9.01308519597443454−003	8.94364977986034808−002	−6.59968748159800774−002	4.58175340601637587−001	2.26775710692704885+003	13

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 30.0 X = 1.60000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	1.03132582654469368−002	−4.32093436258561051−001	1.46523062561135958−002	2.94003160086816324−001	−7.23080508972632228+002	23
3	1.46523062561135958−002	2.94003160086816324−001	−1.03132582654469368−002	4.32093436258561051−001	−7.23080508972632228+002	25
4	7.68350006656988426−003	4.65028136572133663−001	−1.63736975693178712−002	2.27639200304592118−001	−6.11514915258733847+002	23
5	−1.63736975693178707−002	2.27639200304592143−001	−7.68350006656988516−003	−4.65028136572133650−001	−6.11514915258733841+002	24
6	−1.81309886231856386−002	−5.13068379158448453−002	2.13670805275614261−003	−5.10378575527873846−001	−5.04588552263729785+002	24
7	2.13670805275493693−003	−5.10378575527876947−001	1.81309886231857921−002	5.13068379158108144−002	−5.04588552263722792+002	24
8	1.20784273932062579−002	−3.89679161899264510−001	1.39147874164072886−002	3.26283633905393615−001	−4.02671891900056997+002	23
9	1.39147874168642732−002	3.26283633890684149−001	−1.20784273926899276−002	3.89679161911342307−001	−4.02671891896150555+002	24
10	3.90300790271797475−003	4.90407212184394395−001	−1.81792105089404768−002	1.14803747754400961−001	−3.06252328489318816+002	23
11	−1.81792104678476263−002	1.14803753159612724−001	−3.90300810382605380−003	−4.90407210862427399−001	−3.06252327343771551+002	23
12	−1.65749238217022778−002	−2.25240698401085993−001	8.78167113696823352−003	−4.45571045729967235−001	−2.16011477327802496+002	23
13	8.78164131524749074−003	−4.45571445301051042−001	1.65749400143153678−002	2.25239887532043419−001	−2.16011290678724179+002	23
14	1.79582919979042979−002	−1.64781111603487435−001	5.93967928582670398−003	4.66890109919225207−001	−1.33008878987799469+002	23
15	5.94265290499111051−003	4.66862079347924659−001	−1.79573427702818096−002	1.64857936432700139−001	−1.32991945155235469+002	23
16	−9.70359902194002558−003	4.27955765773724543−001	−1.64050934761413010−002	−2.41419862226527664−001	−5.95867223891883919+001	23
17	−1.64807870158486080−002	−2.38090415954550440−001	9.57763098756996599−003	−4.29770357911234815−001	−5.87994530771537448+001	23
18	−6.54387304001788476−005	−4.88345713261375075−001	1.91718976361835980−002	−1.19478851267667815−002	−4.79462299800932247+000	23
19	1.90601516550816830−002	−6.82841322501218819−002	2.28396269822336533−003	4.83067377208155003−001	6.98657136135910497+000	23
20	8.69588019781733473−003	4.28874159268338305−001	−1.71976041167492350−002	2.28578111465723774−001	4.24096831077116137+001	23
21	−1.36925673345053857−002	3.49404234072911722−001	−1.36580048706767657−002	−3.35300972942978363−001	7.44159832424490523+001	23
22	−1.77918972062504328−002	−1.83514502659751729−001	7.78977365869242279−003	−4.45919811101181854−001	1.12203725883143840+002	23
23	1.92166559382196271−004	−4.79926609486294150−001	1.95123246414458467−002	−6.18176346072804520−003	1.52793956003048568+002	23
24	1.78833596823896186−002	−2.06143972766131969−001	8.05319149998976235−003	4.30745627650774842−001	1.96287720178026379+002	23
25	1.52483623859115033−002	2.92349799196931654−001	−1.25070602258668116−002	3.74260474019589616−001	2.42418444331190136+002	23
26	−3.93038469751374399−003	4.64888586370516945−001	−1.94461176731572464−002	−8.21847604091646647−002	2.91060012959114621+002	23
27	−1.89892549174122754−002	1.56160694092523837−001	−6.17116573079443546−003	−4.42334488256667021−001	3.42115069428159448+002	23
28	−1.51517597044785306−002	−2.97004246554986131−001	1.32144899120639868−002	−3.58937599743036472−001	3.95511847023206956+002	23
29	3.07324495167348952−003	−4.58831633629844560−001	2.00191006075664374−002	5.78864514144953307−002	4.51195066002262908+002	23
30	1.84875208924958141−002	−2.06081137137584427−001	8.65827662616565641−003	4.09951579308515029−001	5.09121221627751093+002	23
31	1.78976709924412379−002	2.13358940129263193−001	−1.01765854910519069−002	4.01841691507323282−001	5.69255429562935315+002	23
32	2.57778637510266049−003	4.45489829714335742−001	−2.06164243268858383−002	6.93961761822980759−002	6.31569293082606945+002	22
33	−1.47434749228295464−002	3.27409265346736559−001	−1.49278575457228386−002	−3.03576804744547672−001	6.96039403355749116+002	22
34	−2.11250320990650829−002	−2.32849625094884300−002	1.81797495945456222−003	−4.41228413649995660−001	7.62646255400242138+002	21
35	−1.27028725519759651−002	−3.42739898360492170−001	1.72776470298307041−002	−2.70927451972415057−001	8.31373445934623471+002	21
36	4.10151371318279325−003	−4.26561562254741523−001	2.13178940348014631−002	6.58053868785972073−002	9.02207068013530489+002	21
37	1.83510389057148052−002	−2.48727520780715298−001	1.21312839916169825−002	3.45806671852890198−001	9.75135246403698975+002	20
38	2.19386037286057724−002	5.95122698322386211−002	−4.09291095382282385−003	4.15692701863946468−001	1.05014777573624252+003	19
39	1.36568092971895398−002	3.18322980801109216−001	−1.80945088156457420−002	2.63853570728490855−001	1.12723583507923487+003	18
40	−1.46946966888688002−003	4.06459311333456623−001	−2.30153670225685550−002	−5.77463437967910960−003	1.20639176023893749+003	18
41	−1.59098341770208723−002	3.07914267073396324−001	−1.72977988589318797−002	−2.53746002478745728−001	1.28760886028288803+003	17
42	−2.36157529814946324−002	9.25566882298310973−002	−4.26722625953050061−003	−3.79760728216792914−001	1.37088126836155015+003	16
43	−2.22554022111551036−002	−1.37905594198064930−001	1.03959698126895282−002	−3.56301513251966186−001	1.45620381942946533+003	16
44	−1.32232240911230957−002	−3.01119520960396736−001	2.14699677380269392−002	−2.19180243779246730−001	1.54357194927541212+003	16
45	−1.50763072569944546−004	−3.60269661896144281−001	2.59752696366542680−002	−3.44532013221612160−002	1.63298161058681534+003	15
46	1.29578224544546265−002	−3.23110068646654095−001	2.35469562834203715−002	1.35442295583447833−001	1.72442920274414864+003	14
47	2.31076585874411719−002	−2.24498373740417499−001	1.57497248710144970−002	2.52189473792694880−001	1.81791151276594635+003	14
48	2.88814496493412487−002	−1.05693344423060514−001	4.97392315808080437−003	3.05995211942919158−001	1.91342566537266947+003	14
49	3.03065365608823471−002	5.66461480566644665−004	−6.54776222916628406−003	3.08830631512803019−001	2.01096908055574098+003	14
50	2.83422250998421124−002	7.62908933357557698−002	−1.73344388990993162−002	2.83705179206566260−001	2.11053943736030738+003	13
51	2.43045371887257714−002	1.17363625224632993−001	−2.68502726936119583−002	2.55592216807915481−001	2.21213464284087018+003	13

OBLATE RADIAL FUNCTIONS

H = 35.0 X = 1.60000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	−1.37081822001984199−002	−2.27917047013746257−001	6.85621460654894051−003	−4.71472723500483932−001	−1.01806827407736223+003	24
3	6.85621460654894051−003	−4.71472723500483932−001	1.37081822001984199−002	2.27917047013746257−001	−1.01806827407736223+003	24
4	1.27669888092029077−002	−2.98543899386283628−001	8.70270118641907744−003	4.25123254724402633−001	−8.86433410489711463+002	24
5	8.70270118641907744−003	4.25123254724402633−001	−1.27669888092029077−002	2.98543899386283628−001	−8.86433410489711463+002	24
6	9.13677983045879511−004	5.13955268840119708−001	−1.55486285951480994−002	3.76309749266586203−002	−7.59324741722267464+002	24
7	−1.55486285951480994−002	3.76309749266586255−002	−9.13677983045879667−004	−5.13955268840119708−001	−7.59324741722267463+002	24
8	−1.36668683674026976−002	−2.44974015256951380−001	7.72717892249599841−003	−4.48729289758888018−001	−6.37027656521040913+002	24
9	7.72717892249588309−003	−4.48729289758890065−001	1.36668683674027641−002	2.44974015256947558−001	−6.37027656521039876+002	24
10	1.42771726869693003−002	−2.25752756421918178−001	6.82421043934967822−003	4.54228439207578475−001	−5.19895762714263522+002	24
11	6.82421043940548928−003	4.54228439206684320−001	−1.42771726869431913−002	2.25752756423680425−001	−5.19895762713789927+002	24
12	−3.25852787681491707−003	4.94280479560159143−001	−1.56107405999510694−002	−9.5011564[illegible]401729−002	−4.08382770826656287+002	24
13	−1.56107406035176299−002	−9.50115644116251532−002	3.25852786042843797−003	−4.94280470[illegible]698483−001	−4.08382770699403414+002	24
14	−9.93212561240416231−003	−3.87572320389089585−001	1.26303715537642218−002	−3.1518930[illegible]483600−001	−3.03099932316189017+002	24
15	1.26303698567949086−002	−3.15189371888430471−001	9.93212780966611937−003	3.8757226[illegible]177571−001	−3.03099911510684225+002	24
16	1.61227839651540913−002	3.48874798606028052−002	−1.41112774734288974−003	4.9473164[illegible]082304−001	−2.04934494439546174+002	24
17	−1.41084888978658238−003	4.94732176224343320−001	−1.61228108891016551−002	−3.48789054043882308−002	−2.04932419854586278+002	24
18	−1.28591834309860529−002	3.09267228365051942−001	−1.00077560599212612−002	−3.83431127695024197−001	−1.15402824368908533+002	24
19	−1.00208877646286914−002	−3.83113453727599503−001	1.28491449347900482−002	−3.09653392239806618−001	−1.15281782660834263+002	26
20	4.36902153865684830−003	−4.74244515967960213−001	1.57983695214495979−002	1.22085018689720787−001	−3.92177248198125719+001	24
21	1.59232759729258330−002	1.08178713416895189−001	−3.90801620129849829−003	4.77471974438165622−001	−3.57545315190426002+001	24
22	2.91407624452677200−003	4.78298609269798407−001	−1.62006215017388418−002	9.50378185600450391−002	1.39421067166020134+001	23
23	−1.53176827918424336−002	1.88643738271314569−001	−6.11248344761202561−003	−4.48671026074946007−001	3.78427624814586937+001	24
24	−1.08552112523055895−002	−3.60160389020370414−001	1.24866907400349985−002	−3.25048560222912590−001	7.75819348001275458+001	24
25	8.08977392671215363−003	−4.26600153736535648−001	1.44966803236049408−002	2.27620220904572914−001	1.18448708567825046+002	24
26	1.65294294012172686−002	5.18231658396701744−002	−2.10987283402521802−003	4.78924087520182079−001	1.63447906582629480+002	24
27	4.64277810901026490−003	4.58244277752882136−001	−1.60742750709473480−002	1.42099750883586626−001	2.11403574932213464+002	24
28	−1.26940595104838770−002	3.20128455952007769−001	−1.10117042618871767−002	−3.54537671460460633−001	2.62190262318690378+002	24
29	−1.55572600038103441−002	−1.75784985495022631−001	6.55947711248554822−003	−4.41763176306694046−001	3.15623221354916617+002	24
30	−1.37786653737285625−003	−4.70623109570134959−001	1.69122027474105777−002	−4.81967843164461161−002	3.71585738675545032+002	24
31	1.42303477121594584−002	−2.67798850603868719−001	9.40761629346867494−003	3.86942994229677021−001	4.29988647975368956+002	24
32	1.53600375033549598−002	1.99235748270894863−001	−7.64152219192324694−003	4.23385541196018273−001	4.90763395878593413+002	24
33	1.47100396982262128−003	4.62420885103937414−001	−1.71966976059182242−002	5.00134987405631110−002	5.53855767923505703+002	24
34	−1.37845646344545201−002	2.89594350618087177−001	−1.05693442104119430−002	−3.60175307786116104−001	6.19222082617918303+002	23
35	−1.65671422050742255−002	−1.36654422410085061−001	5.60186140589727550−003	−4.38226639107235629−001	6.86826592589418579+002	22
36	−4.97561630156319184−003	−4.33895339947437713−001	1.68978381821903769−002	−1.39437789913442327−001	7.56639664925755623+002	22
37	1.07438201256810728−002	−3.66879414421997391−001	1.41298884340978996−002	2.64497818764014389−001	8.28636466848116313+002	22
38	1.78953257863678809−002	−1.46809352225897500−002	1.12690359022004127−004	4.48386795463483742−001	9.02795993090560426+002	21
39	1.14198577331139013−002	3.36582148579781970−001	−1.39798945642489109−002	2.90747863172064260−001	9.79100331183253855+002	20
40	−3.34591529250008239−003	4.35353660877420989−001	−1.79087124305946947−002	−6.84591941818179293−002	1.05753409662786782+003	21
41	−1.57879953656472365−002	2.35249414801079407−001	−9.44726355376201092−003	−3.67571615400811156−001	1.13808399205225158+003	19
42	−1.78455704506680627−002	−1.08052858891025312−001	5.21888155411437775−003	−4.18129929299655478−001	1.22073845855298427+003	18
43	−8.78372544084690791−003	−3.70734050806884103−001	1.66256446552457925−002	−2.11981761635178112−001	1.30548739672056516+003	18
44	5.44647899188339386−003	−4.08334258343202717−001	1.82356349910810709−002	1.06389411278117391−001	1.39232194110373400+003	19
45	1.66476819099116328−002	−2.23512004918952248−001	9.72538237424775752−003	3.51516956029168872−001	1.48123427618606388+003	17
46	1.91696439671964048−002	6.45672775346378656−002	−3.84868646366932439−003	4.05703047445770573−001	1.57221748498264471+003	16
47	1.23494776541876122−002	3.05607464391094009−001	−1.55418725666771142−002	2.65271941674634391−001	1.66526542353579248+003	16
48	−6.98983954932107813−005	3.97749436526298045−001	−2.01807864328259594−002	1.73716337830715573−002	1.76037261616665395+003	16
49	−1.24555313302191354−002	3.22857462548508392−001	−1.63420902908076742−002	−2.20746614982694693−001	1.85753416750281818+003	15
50	−2.00233641372806248−002	1.33918856224190025−001	−6.18893008385893173−003	−3.59423506238102443−001	1.95674568817071985+003	15
51	−2.05205401147583666−002	−8.46700288459636186−002	6.14577650396490561−003	−3.65746664909476932−001	2.05800323169799590+003	15

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 40.0 X = 1.60000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	−4.15055098701374240−003	5.00499310311560820−001	−1.27314454273322120−002	−1.56700220404052892−001	−1.36305927072589725+003	24
3	−1.27314454273322120−002	−1.56700220404052892−001	4.15055098701374240−003	−5.00499310311560820−001	−1.36305927072589725+003	26
4	−9.23438032065715782−003	−3.75197272171383426−001	9.82783969066545955−003	−3.61160484085377912−001	−1.21137424430981044+003	24
5	9.82783969066545955−003	−3.61160484085377912−001	9.23438032065715782−003	3.75197272171383426−001	−1.21137424430981044+003	24
6	1.32337074989544087−002	−1.22397971255076447−001	3.05032264137209214−003	5.02438081517241803−001	−1.06413650947451040+003	24
7	3.05032264137209214−003	5.02438081517241803−001	−1.32337074989544087−002	1.22397971255076447−001	−1.06413650947451040+003	25
8	−4.42559056123463793−003	4.87979035968108670−001	−1.29402548957224136−002	−1.59955782425261257−001	−9.21577771344244604+002	24
9	−1.29402548957224136−002	−1.59955782425261256−001	4.42559056123463791−003	−4.87979035968108670−001	−9.21577771344244604+002	24
10	−8.38383206633836891−003	−4.00463335830748486−001	1.09254190764725090−002	−3.15755625882361431−001	−7.83974360303797126+002	24
11	1.09254190764725008−002	−3.15755625882361823−001	8.38383206633837971−003	4.00463335830748173−001	−7.83974360303796989+002	24
12	1.38582216089327362−002	−2.42213925535262797−002	4.75660351857966393−004	5.05905516007099987−001	−6.51663421527715605+002	24
13	4.75660351863401914−004	5.05905516007089036−001	−1.38582216089325894−002	2.42213925537246706−002	−6.51663421527661150+002	24
14	−8.14390715411866120−003	4.12652884849808180−001	−1.13387717810118316−002	−2.87760528168477665−001	−5.25068638051493288+002	23
15	−1.13387717818296839−002	−2.87760528127232264−001	8.14390715299774396−003	−4.12652884878115070−001	−5.25068638037752172+002	24
16	−3.46760483649968473−003	−4.82507509653033643−001	1.36181134283340235−002	−1.30242612676207889−001	−4.04744152201091400+002	24
17	1.36181133732576767−002	−1.30242620564402300−001	3.46760505992337676−003	4.82507507459067673−001	−4.04744149947013533+002	23
18	1.24327743080591897−002	2.30246699176987416−001	−6.74054318685228119−003	4.40005099033576580−001	−2.91457619080057121+002	24
19	−6.74052143351168734−003	4.40005497770455398−001	−1.24327863224571425−002	−2.30245922505336991−001	−2.91457378199954325+002	24
20	−1.37083692495655155−002	1.39385177319625039−001	−3.81137082650625529−003	−4.73522648351092349−001	−1.86380622956493572+002	24
21	−3.81301793796466611−003	−4.73505473684692895−001	1.37079252967319893−002	−1.39441843153957268−001	−1.86364251580315460+002	24
22	8.15630526971133328−003	−4.07578077847393552−001	1.17553981272361626−002	2.73558831272331942−001	−9.19128960405979765+001	24
23	1.17948966639750758−002	2.71586461798730954−001	−8.10006634293332512−003	4.08872047724648255−001	−9.12593849007389399+001	23
24	−8.33900212626240436−004	4.88239432434618757−001	−1.43479608404130894−002	−2.06639266113972820−002	−1.73844779372964364+001	24
25	−1.43782479759446044−002	1.83016145556119021−002	−3.11820744140830358−004	−4.88012524111559652−001	−6.56815315497912029+000	24
26	−5.20319014515962859−003	−4.51292283357066410−001	1.34519075211166906−002	−1.82912755991606207−001	4.05019585185363204+001	24
27	1.15953151286049184−002	−2.96391744442380808−001	8.63255740983510067−003	3.84970404935376581−001	7.71462663006720323+001	24
28	1.20470053044745084−002	2.62889369223412912−001	−8.06524727858235007−003	4.06923049879808497−001	1.23184337474188895+002	24
29	−3.28423501223154094−003	4.72230070277282814−001	−1.41666651568898288−002	−1.01255429724435672−001	1.72001827698425130+002	24
30	−1.44023825586928415−002	8.51697212268535846−002	−2.33974446769068537−003	−4.73754706782093936−001	2.24313669728313076+002	24
31	−7.93722493922513894−003	−3.98557547780124555−001	1.23060209624348966−002	−2.66820505732101340−001	2.79591652607638695+002	24
32	7.86189695566647737−003	−4.08099943189019490−001	1.24208245465123004−002	2.48481267222905730−001	3.37668901293314178+002	24
33	1.46709983258918704−002	4.37383361261631775−002	−1.61655405856518130−003	4.73844135955220675−001	3.98397520692535385+002	24
34	5.29253870789057985−003	4.39462323294626459−001	−1.38465267608873207−002	1.77125788199522046−001	4.61671354434069849+002	23
35	−9.71834112649173688−003	3.62978435211022473−001	−1.12828656014239435−002	−3.01186691361580835−001	5.27407900597712077+002	24
36	−1.46740710661133757−002	−8.31377028917987562−002	2.92668566125508020−003	−4.61981815176311317−001	5.95541866590887259+002	23
37	−4.96727570429667983−003	−4.37770305931397802−001	1.41952499492404312−002	−1.62707497061541165−001	6.66020480324958888+002	23
38	9.52564758296028649−003	−3.66456593310665647−001	1.17420409845828460−002	2.85494875671515121−001	7.38800405010956611+002	23
39	1.51138759371047500−002	4.13446735575019840−002	−1.66689096384602433−003	4.60077539096714018−001	8.13845577573775151+002	22
40	7.07612772490284026−003	4.02607880958308209−001	−1.35610462441508571−002	2.20839402414632830−001	8.91125652373745731+002	21
41	−7.10779008650970130−003	4.09180438375388174−001	−1.36529692878021387−002	−2.02023967270661643−001	9.70614851194045134+002	22
42	−1.53226141206932335−002	7.71716826207157039−002	−2.30056690160627881−003	−4.46720986211469936−001	1.05229109509473048+003	20
43	−1.11633880819919343−002	−3.07113776954950551−001	1.09005653124107815−002	−3.29179465864995715−001	1.13613533698067874+003	20
44	1.66004027582332093−003	−4.45396660639696188−001	1.56298998039075845−002	3.67260555100940598−002	1.22213104034853483+003	20
45	1.32374624334753520−002	−2.52527515769763269−001	8.69973413223442071−003	3.64537364022183552−001	1.31026376658501212+003	19
46	1.53383757412146364−002	1.11803231735847932−001	−4.45004979569410886−003	4.25399799278329733−001	1.40052084425562288+003	18
47	6.92926123315798247−003	3.88565102779205276−001	−1.45438664752476603−002	1.97890206792763774−001	1.49289110125587682+003	18
48	−6.01456439589332519−003	4.05681904545162452−001	−1.51058326793789320−002	−1.48690558473691606−001	1.58736464580404355+003	18
49	−1.51928222720879154−002	1.73621021319163290−001	−6.22539972653620622−003	−3.91080178854390117−001	1.68393268583492835+003	17
50	−1.53241911282382610−002	−1.50292402926108596−001	6.35652735905769898−003	−3.95918720164875168−001	1.78258737890970295+003	16
51	−6.79048837628585692−003	−3.77361393854785726−001	1.53389910327847116−002	−1.81743757630829438−001	1.88332170661068463+003	16

OBLATE RADIAL FUNCTIONS

H = 0.1 X = 1.80000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	2.81840380338643217−003	2.38573231908925953−003	−3.79914050356495308+002	5.15226858508124266+002	5.99857123417190307+000	21
3	7.25281006373352583−005	1.01728738568243855−004	−9.96979730995897161+003	1.85345493691661159+004	1.19966664421869860+001	21
4	1.51517976408364050−006	2.89641609553333433−006	−3.64829368854945784+005	8.59167302006774921+005	1.99959740046062577+001	21
5	2.61972998289589254−008	6.31532870969292455−008	−1.71214554696763351+007	4.87536647510566323+007	2.99956410515004519+001	21
6	3.85291279389216780−010	1.11922632194578739−009	−9.80508183068778684+008	3.27305616847349284+009	4.19954545802252094+001	21
7	4.92493253889192582−012	1.67274815293095237−011	−6.62912281637508414+010	2.53730434174536429+011	5.59953394001596214+001	20
8	5.56402410193018155−014	2.16247256177850362−013	−5.16764875453160598+012	2.23040137721344940+013	7.19952631879514903+001	21
9	5.63052171533213261−016	2.46365896520487123−015	−4.56310453103589303+014	2.19215427936516272+015	8.99952101102423571+001	20
10	5.15902896649224437−018	2.50927876611185432−017	−4.50156856476967752+016	2.38207913280237746+017	1.09995171647438028+002	21
11	4.31828376048662143−020	2.31100366189616957−019	−4.90686861485927716+018	2.83564374232190305+019	1.31995142876876673+002	20
12	3.32670287900155464−022	1.94249897084660934−021	−5.85670420546357186+020	3.66977882087727502+021	1.55995120790161862+002	20
13	2.37368819021617146−024	1.50165865368827232−023	−7.59686983303268585+022	5.12999154010682741+023	1.81995103463378979+002	20
14	1.57725042040892277−026	1.07461252205370507−025	−1.06408304782158468+025	7.70336518933107230+025	2.09995089619064503+002	20
15	9.80605873608479728−029	7.15838325290791804−028	−1.60065569195463859+027	1.23666389196637916+028	2.39995078381740073+002	20
16	5.72797409571146065−031	4.46013002742109049−030	−2.57359578365034786+029	2.11354549182374143+030	2.71995069134989622+002	20
17	3.15505291926598847−033	2.61019855855202941−032	−4.40451781881454200+031	3.83139044190840294+032	3.05995061434544711+002	20
18	1.64407873465911804−035	1.44012675388728533−034	−7.99428271105474037+033	7.34279021773970758+034	3.41995054953608932+002	18
19	8.12854084654969202−038	7.51548310208007144−037	−1.53379681014695987+036	1.48337590710535334+037	3.79995049447434870+002	20
20	3.82309021032988353−040	3.72064960881792352−039	−3.10167466667416848+038	3.15050400657335022+039	4.19995044729773045+002	20
21	1.71458315947395806−042	1.75200227812813973−041	−6.59362342136578194+040	7.01795205355754612+041	4.61995040656851186+002	20
22	7.34820794541642647−045	7.86580267933772632−044	−1.47000694969623609+043	1.636061628374 - -+044	5.05995037116251116+002	21
23	3.01535780908712828−047	3.37433017904883974−046	−3.42960066132401990+045	3.983706547390- +046	5.51995034019043052+002	19
24	1.18690343447259284−049	1.38589250148041802−048	−8.35679411322057024+047	1.011311199700 - -+049	5.99995031294130486+002	20
25	4.48882876305026474−052	5.45956732204533014−051	−2.12286423788886757+050	2.672186013598 - - -+051	6.49995028884122796+002	20
26	1.63364776238000490−054	2.06632937844322068−053	−5.61265404897152455+052	7.337759083687 +053	7.01995026742281287+002	19
27	5.72939666988761371−057	7.52529363257770951−056	−1.54209301391586010+055	2.09100601898956452+056	7.55995024830230942+002	20
28	1.93891066963047257−059	2.64088872324001249−058	−4.39674414350220598+057	6.17542304572123672+058	8.11995023116226001+002	20
29	6.33926699411136458−062	8.94242436529545842−061	−1.29914111284969166+060	1.88782623132768180+061	8.69995021573821253+002	18
30	2.00470737376831280−064	2.92533053188827003−063	−3.97330301459254267+062	5.96679654889547949+063	9.29995020180844063+002	19
31	6.13846669166036702−067	9.25570010029916026−066	−1.25637295776953535+065	1.94776561472270720+066	9.91995018918591754+002	20
32	1.82180951575411855−069	2.83547682864361949−068	−4.10289554384215207+067	6.56009330949217630+068	1.05599501777119960+003	19
33	5.24554835186169446−072	8.41906712567220109−071	−1.38238788127023897+070	2.27745289775234314+071	1.12199501672513917+003	19
34	1.46659527524467076−074	2.42512876705692539−073	−4.80093728844962642+072	8.14267898915031072+073	1.18999501576881722+003	18
35	3.98497551561904087−077	6.78306919322274504−076	−1.71708597556913267+075	2.99570038274754386+076	1.25999501489225267+003	18
36	1.05312840115093088−079	1.84375737797100424−078	−6.31921691256041869+077	1.13317643335825515+079	1.33199501408681479+003	19
37	2.70896253114233733−082	4.87430285954725845−081	−2.39108639017284847+080	4.40390972344034637+081	1.40599501334500976+003	18
38	6.78733468957496449−085	1.25423500813854832−083	−9.29527470311078890+082	1.75716201763110817+084	1.48199501266030551+003	19
39	1.65753575630203808−087	3.14349119508762719−086	−3.70984240618314901+085	7.19323771812817609+086	1.55999501202698728+003	18
40	3.94795391447203461−090	7.67902131106586522−089	−1.51908508256524860+088	3.01923963558491009+089	1.63999501144003789+003	18
41	9.17680216330929448−093	1.82952556053234693−091	−6.37769744397157298+090	1.29857274431992228+092	1.72199501089503800+003	18
42	2.08292100126861937−095	4.25378126434468939−094	−2.74369756358179087+093	5.71976390949477252+094	1.80599501038808257+003	19
43	4.61909251048936878−098	9.65758046752255037−097	−1.20877927838127201+096	2.57864991551651598+097	1.89199500991571068+003	19
44	1.00131872161300432−100	2.14219359903184937−099	−5.45074506372598976+098	1.18926713521606417+100	1.97999500947484627+003	18
45	2.12294636306740187−103	4.64489649956672442−102	−2.51439439406723091+101	5.60815108095422131+102	2.06999500906274787+003	18
46	4.40419346598951496−106	9.85008161990746358−105	−1.18593355884006409+104	2.70273397432167550+105	2.16199500867696586+003	19
47	8.94448192995539236−109	2.04390191627003105−107	−5.71645828147083483+106	1.33054387250137617+108	2.25599500831530599+003	18
48	1.77908961880431070−111	4.15181251836295272−110	−2.81470348345730551+109	6.68813103989468165+110	2.35199500797579802+003	19
49	3.46719956213940905−114	8.25972378328489601−113	−1.41509230685560184+112	3.43119392601616751+113	2.44999500765666890+003	19
50	6.62331486598934084−117	1.61000860740503217−115	−7.26103988171206086+114	1.79586342983454145+116	2.54999500735631947+003	20
51	1.24067416303899528−119	3.07611902481655532−118	−3.80099775725442721+117	9.58558217805665990+118	2.65199500707330447+003	19

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 0.2 X = 1.80000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	1.11749139498059854−002	9.37289223868043795−003	−4.85007029920138497+001	6.48464429909151447+001	5.99428260216102775+000	21
3	5.76455611979639164−004	8.05077618529724646−004	−6.30474958357740822+002	1.16516170723881216+003	1.19866630743779954+001	22
4	2.41169463868059251−005	4.59826540893668889−005	−1.14947926072283089+004	2.69803730661215844+004	1.99838957634995984+001	21
5	8.34666852493717941−007	2.00861677185611741−006	−2.69216211566332279+005	7.64967583537736833+005	2.99825645168181086+001	21
6	2.45661979886918442−008	7.12726888107976898−008	−7.69963500670907109+006	2.56641908332409756+007	4.19818187383378792+001	22
7	6.28313103020366417−010	2.13204408769760043−009	−2.60072902674736015+008	9.94342447256893124+008	5.59813580044443829+001	21
8	1.42019764881335727−011	5.51556036931695320−011	−1.01308872199362921+010	4.36889951884019834+010	7.19810531125249704+001	21
9	2.87516121367796478−013	1.25729269841239326−012	−4.47086257585738884+011	2.14640832263577504+012	8.99808407554937990+001	21
10	5.27003250931492408−015	2.56202009168980232−014	−2.20451236797420912+013	1.16592219121981052+014	1.09980686862451590+002	21
11	8.82412587315556337−017	4.72045804170075202−016	−1.20115824338504319+015	6.93829148502069266+015	1.31980571744318647+002	21
12	1.35980588217192782−018	7.93731269758843944−018	−7.16667667933208320+016	4.48890354835188320+017	1.55980483367231199+002	21
13	1.94079135457462453−020	1.22743167997425279−019	−4.64712427619812059+018	3.13708387996200915+019	1.81980414034755664+002	21
14	2.57952648713088655−022	1.75702978436917905−021	−3.25404002077097538+020	2.35508634025378175+021	2.09980358636216366+002	21
15	3.20783016898003112−024	2.34117313167034604−023	−2.44710772875196363+022	1.89017175035162576+023	2.39980313668970715+002	21
16	3.74791718335246979−026	2.91776008957770258−025	−1.96703179287850681+024	1.61506396056031451+025	2.71980276666747091+002	20
17	4.12917295667372653−028	3.41548688649796039−027	−1.68303012884886749+026	1.46375207794474161+027	3.05980245851978774+002	20
18	4.30370660690163998−030	3.76921974251324103−029	−1.52721773322340570+028	1.40251976966250716+029	3.41980219917083926+002	20
19	4.25591513081974100−032	3.93436649433238988−031	−1.46494659070900332+030	1.41657337197781202+031	3.79980197882755149+002	20
20	4.00361585195534105−034	3.89583048905747691−033	−1.48110746974636556+032	1.50421754101077290+033	4.19980179003739211+002	21
21	3.59129798865917769−036	3.66923956812819429−035	−1.57417906303959291+034	1.67527527477915702+035	4.61980162704741063+002	20
22	3.07841539182957558−038	3.29489648709962052−037	−1.75465555389495430+036	1.95264239697614318+037	5.05980148535920975+002	20
23	2.52659514817261767−040	2.82710022986032649−039	−2.04673205099301101+038	2.37716603813944295+039	5.51980136141423603+002	20
24	1.98912262176838951−042	2.32239432336645929−041	−2.49347045485217876+040	3.01722535085462274+041	5.99980125236751170+002	20
25	1.50462096435417911−044	1.82985034163991129−043	−3.16690990907545780+042	3.98604153019920290+043	6.49980115592248967+002	19
26	1.09521425332977091−046	1.38517991796342611−045	−4.18631959753850087+044	5.47257942934834883+045	7.01980107020885664+002	19
27	7.68236581702524672−049	1.00896923288040796−047	−5.75078010572794471+046	7.79719786992376979+047	7.55980099369097288+002	20
28	5.19981953782394187−051	7.08192161802007274−050	−8.19786528601055922+048	1.15134551258535126+050	8.11980092509847162+002	20
29	3.40026643444499392−053	4.79624843615738209−052	−1.21110130007039172+051	1.75977683780376389+052	8.69980086337309181+002	20
30	2.15063877510999960−055	3.13809204959579285−054	−1.85195930643458578+053	2.78095704574351999+054	9.29980080762754417+002	20
31	1.31709830518803443−057	1.98583613554973062−056	−2.92789088682679983+055	4.53887252199281289+056	9.91980075711339461+002	20
32	7.81812033679476382−060	1.21675401347777005−058	−4.78061950145675067+057	7.64328842158873211+058	1.05598007111957740+003	21
33	4.50226166624208293−062	7.22574174297523474−061	−8.05344733912384410+059	1.32671981587831236+061	1.12198006693333047+003	20
34	2.51761885233768745−064	4.16288431228843413−063	−1.39841744156640438+062	2.37168656213274877+063	1.18998006310620487+003	21
35	1.36818454195602557−066	2.32876797271535921−065	−2.50070451786384458+064	4.36263680572602067+065	1.25998005959825826+003	20
36	7.23167950482903711−069	1.26602881334987842−067	−4.60143964524895083+066	8.25105378692266439+067	1.33198005637495213+003	20
37	3.72048200441027437−071	6.69409136638446429−070	−8.70535338215896418+068	1.60328950158450460+070	1.40598005340629747+003	20
38	1.86437562184456780−073	3.44506051394617456−072	−1.69205523703467051+071	3.19850789497281472+072	1.48198005066615398+003	20
39	9.10614588710440531−076	1.72690536052965051−074	−3.37652055395487159+073	6.54670094190762599+074	1.55998004813165212+003	20
40	4.33791417862221371−078	8.43723396885858038−077	−6.91286521470766927+075	1.37391070076780392+077	1.63998004578271391+003	19
41	2.01668048240678075−080	4.02040902986047181−079	−1.45111673150289950+078	2.95454340509205015+079	1.72198004360165372+003	20
42	9.15493055850275913−083	1.86958014745563720−081	−3.12131418473829553+080	6.50677332653029472+081	1.80598004157284413+003	20
43	4.06045920625284269−085	8.48934350404055008−084	−6.87561270043666131+082	1.46670825298343491+084	1.89198003968243500+003	19
44	1.76046254173087727−087	3.76617947293043798−086	−1.55018572935745248+085	3.38216520710450867+086	1.97998003791811628+003	20
45	7.46498911390548311−090	1.63325714208784896−088	−3.57540319614515046+087	7.97442559313591750+088	2.06998003626891693+003	20
46	3.09736230885852778−092	6.92714550536111256−091	−8.43171692282831335+089	1.92153168995503020+091	2.16198003472503389+003	20
47	1.25810257213272290−094	2.87481718122221350−093	−2.03210895166841902+092	4.72975036664109243+093	2.25598003327768593+003	18
48	5.00488048457136588−097	1.16794764362993262−095	−5.00284599034465672+094	1.18871782506345020+096	2.35198003191898844+003	20
49	1.95078564735655717−099	4.64714688366483430−098	−1.25757533577098269+097	3.04918971269199059+098	2.44998003064184575+003	19
50	7.45316529886358635−102	1.81169087256640504−100	−3.22636155315789936+099	7.97953998637350572+100	2.54998002943985828+003	19
51	2.79227091239431109−104	6.92299245321804118−103	−8.44455939925031678+101	2.12955365635124689+103	2.65198002830724213+003	20

OBLATE RADIAL FUNCTIONS

H = 0.3 X = 1.80000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	2.47768056903892252−002	2.04601159876251817−002	−1.49052653388779404+001	1.94213923443513634+001	5.98712708737664133+000	22
3	1.92448754270979461−003	2.66839406641875505−003	−1.27029087582553971+002	2.32373475286319002+002	1.19699818088618035+001	22
4	1.21035747833595179−004	2.29773366420494189−004	−1.53464210203104581+003	3.58194705067080642+003	1.99637645230817575+001	23
5	6.29232903773703696−006	1.50984115642554167−005	−2.38853890570605749+004	6.76271194822566240+004	2.99607713321740383+001	21
6	2.78077081136353493−007	8.05085309323630137−007	−4.54518817084657584+005	1.51122522521194676+006	4.19590937280665220+001	21
7	1.06763687686423067−008	3.61708279852999358−008	−1.02211566139797353+007	3.90072536217261783+007	5.59580570248754014+001	21
8	3.62196635896231331−010	1.40491404191074300−009	−2.65176897385374305+008	1.14195642447667947+009	7.19573708561621501+001	22
9	1.10041269595167598−011	4.80728177422014415−011	−7.79587591016921481+009	3.73854101970722181+010	8.99568928794732675+001	21
10	3.02668833127051360−013	1.47022458080829058−012	−2.56118370354577871+011	1.35333391974579005+012	1.09956546463218970+002	21
11	7.60430369717595315−015	4.06515017410556674−014	−9.29891100806841509+012	5.36733988056973476+013	1.31956287312807962+002	21
12	1.75823392102218805−016	1.02570546710548775−015	−3.69734042079727183+014	2.31439792402490445+015	1.55956088350987227+002	21
13	3.76507565246212460−018	2.37999971503693052−017	−1.59780210263223686+016	1.07803057516823292+017	1.81955932257866896+002	20
14	7.50786448024894181−020	5.11173795850147513−019	−7.45675443807088501+017	5.39426059160883050+018	2.09955807531342102+002	21
15	1.40074257425881932−021	1.02191925077153535−020	−3.73753303831838628+019	2.88573955854269306+020	2.39955706287730863+002	21
16	2.45526484048188392−023	1.91079046186288707−022	−2.00245059981015618+021	1.64355862843086130+022	2.71955622975643487+002	22
17	4.05812290808601082−025	3.35572042306670882−024	−1.14201500758610347+023	9.92910325040114662+023	3.05955553593705667+002	21
18	6.34529901670780007−027	5.55578379403721661−026	−6.90747745797715523+024	6.34168709411413924+025	3.41955495198372220+002	23
19	9.41335008607897384−029	8.70005370116717479−028	−4.41658434634677764+026	4.26966285592040816+027	3.79955445585009771+002	21
20	1.32843632441621384−030	1.29239143877356191−029	−2.97648687182894133+028	3.02223674222134966+029	4.19955403075841025+002	21
21	1.78761003405069392−032	1.82604540678625350−031	−2.10877229464224055+030	2.24373391351330440+031	4.61955366375679668+002	21
22	2.29867724396456021−034	2.45988101947457272−033	−1.56686042213975471+032	1.74332652313848290+033	5.05955334471759936+002	21
23	2.83017140480919580−036	3.16625808440589891−035	−1.21833409229857447+034	1.41478181995413399+035	5.51955306562896473+002	21
24	3.34242896394020487−038	3.90184775026358833−037	−9.89418829883674040+035	1.19705568251152777+037	5.99955282008550218+002	21
25	3.79270306719257267−040	4.61185968229156684−039	−8.37693836138936133+037	1.05421086763116648+039	6.49955260291652243+002	21
26	4.14132915383899609−042	5.23709103704305192−041	−7.38173443305618697+039	9.64848131596271414+040	7.01955240991094979+002	21
27	4.35765283470594637−044	5.72246122867562155−043	−6.75976609401302236+041	9.16407394717276136+042	7.55955223761119846+002	21
28	4.42446893404703699−046	6.02524748638912856−045	−6.42372192593796954+043	9.02070698397473976+044	8.11955208315693158+002	21
29	4.34009749654769451−048	6.12128148524505120−047	−6.32629474583227247+045	9.19134220720226822+046	8.69955194416536449+002	21
30	4.11780942015636399−050	6.00788384899582200−049	−6.44889249345092683+047	9.68285587739259520+048	9.29955181863865691+002	21
31	3.78292649543110028−052	5.70312461475876595−051	−6.79665002796699599+049	1.05352853609482220+051	9.91955170489160556+002	21
32	3.36838578920277887−054	5.24184801930311450−053	−7.39795946512126436+051	1.18268439321363612+053	1.05595516014947050+003	20
33	2.90977157548851809−056	4.66954937335501122−055	−8.30804107065666398+053	1.36854537178849677+055	1.12195515072289528+003	20
34	2.44076435909729449−058	4.03549306963808708−057	−9.61709408051204868+055	1.63090859389704951+057	1.18995514210497094+003	20
35	1.98969887270569070−060	3.38639131212293117−059	−1.14646475429128970+058	1.99992923106370454+059	1.25995513420575964+003	20
36	1.57756702078890857−062	2.76160900182255113−061	−1.40632060462178686+060	2.52155853065719366+061	1.33195512694749098+003	21
37	1.21745541138320027−064	2.19036764026570988−063	−1.77365929579356825+062	3.26637777168778011+063	1.40595512026263839+003	20
38	9.15148922684420518−067	1.69093995432258849−065	−2.29822394619900170+064	4.34407605906986183+065	1.48195511409234127+003	20
39	6.70496951238038565−069	1.27146689784540335−067	−3.05732767660237994+066	5.92746063367005431+067	1.55995510838510360+003	21
40	4.79122315149850715−071	9.31839459836356384−070	−4.17278653267062392+068	8.29280529391933391+069	1.63995510309571512+003	20
41	3.34122108251879756−073	6.66062642626288924−072	−5.83937777439707282+070	1.18885991986593021+072	1.72195509818435236+003	20
42	2.27523008635033067−075	4.64613848244043249−074	−8.37333488535282775+072	1.74543572548136325+074	1.80595509361582630+003	21
43	1.51372533212909040−077	3.16464378422517335−076	−1.22961654091870903+075	2.62289121590015449+076	1.89195508935894983+003	21
44	9.84464178559839437−080	2.10597822666745278−078	−1.84816128601357272+077	4.03208961672769011+078	1.97995508538600365+003	20
45	6.26185608864112964−082	1.36996376750004922−080	−2.84170826951787549+079	6.33773404706630376+080	2.06995508167228361+003	21
46	3.89732197350247437−084	8.71585545320079207−083	−4.46754849592736688+081	1.01807973655644218+083	2.16195507819571545+003	20
47	2.37459923911056098−086	5.42583655856013481−085	−7.17793408988084516+083	1.67060000475306611+085	2.25595507493652581+003	20
48	1.41699275272036497−088	3.30658900319778843−087	−1.17806494022686756+086	2.79906769890267980+087	2.35195507187696031+003	21
49	8.28481435450878095−091	1.97352772961106344−089	−1.97417708215210759+088	4.78651884719397111+089	2.44995506900104106+003	20
50	4.74802483089782590−093	1.15409236563195625−091	−3.37649008826143153+090	8.35053296442336721+091	2.54995506629435757+003	20
51	2.66826207936906463−095	6.61530141284764750−094	−5.89155753860681384+092	1.48568326922416477+094	2.65195506374388570+003	20

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 0.4 X = 1.80000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	4.31473493718142626−002	3.48405467245639769−002	−6.63180873405450294+000	8.31028567600651050+000	5.97709295201319849+000	22
3	4.49264162696910019−003	6.16573715158502398−003	−4.13440211042052928+001	7.45009957131001246+001	1.19466091507941440+001	22
4	3.77900110675593738−004	7.13018189171256667−004	−3.71295022629452878+002	8.59704794066002073+002	1.99355790647381016+001	22
5	2.62469387628353456−005	6.27217833166734328−005	−4.31453398070221687+003	1.21540793363341556+004	2.99302630704997057+001	22
6	1.54876582215073746−006	4.47079856794965755−006	−6.14047026970250829+004	2.03448823650198286+005	4.19272816436791530+001	22
7	7.93678160079156279−008	2.68297667615571118−007	−1.03368024064785704+006	3.93470123774309244+006	5.59254384834979519+001	22
8	3.59305904273820033−009	1.39129113972307674−008	−2.00856023180268473+007	8.63257275790092173+007	7.19242182238810373+001	23
9	1.45647763761137150−010	6.35395655537036060−010	−4.42406203572098032+008	2.11825883082601014+009	8.99233680555316056+001	21
10	5.34432215464882145−012	2.59306362710233762−011	−1.08918485183374521+010	5.74797084405040414+010	1.09922751813636743+002	21
11	1.79110999965733632−013	9.56588945970377301−013	−2.96392055432811030+011	1.70898089825598755+012	1.31922290766635277+002	22
12	5.52391977070281082−015	3.21989828202606497−014	−8.83381331887881522+012	5.52475146065774101+013	1.55921936774488503+002	22
13	1.57771542626524285−016	9.96621259073038815−016	−2.86183395945881422+014	1.92941122364912070+015	1.81921659038999403+002	21
14	4.19601138256268331−018	2.85513601323802359−017	−1.00129874488522653+016	7.23873705677947429+016	2.09921437104290732+002	22
15	1.04406693896171872−019	7.61301920813008696−019	−3.76283138087968275+017	2.90362192691394625+018	2.39921256948110966+002	21
16	2.44064910278517193−021	1.89852836526895910−020	−1.51156323530235738+019	1.24003107760201839+020	2.71921108695648153+002	21
17	5.37970524933527790−023	4.44670556201149572−022	−6.46377976424710603+020	5.61735956173108524+021	3.05920985228743512+002	21
18	1.12176691286425418−024	9.81824792148258849−024	−2.93154938966669950+022	2.69036152725043214+023	3.41920881310728035+002	21
19	2.21924008722920664−026	2.05038845987839288−025	−1.40552298223446144+024	1.35828400431900127+025	3.79920793019286720+002	22
20	4.17641593987079315−028	4.06186008257792409−027	−7.10293934901187162+025	7.20979873023653012+026	4.19920717369320786+002	21
21	7.49433286318184912−030	7.65334941655239034−029	−3.77358584598030267+027	4.01392541103758546+028	4.61920652056353970+002	21
22	1.28508066150139506−031	1.37485412232739085−030	−2.10257690370060922+029	2.33875583188669192+030	5.05920595278354645+002	22
23	2.10985663898794989−033	2.35985716190872752−032	−1.22600076117170981+031	1.42333828888877422+032	5.51920545609721790+002	21
24	3.32266340294127936−035	3.87794520986553335−034	−7.46641757234582806+032	9.03128070837555452+033	5.99920501910676208+002	22
25	5.02751685691586852−037	6.11216460550992195−036	−4.74055911888263758+034	5.96461182480793980+035	6.49920463261123456+002	21
26	7.32018276910112156−039	9.25535024998417210−038	−3.13269902729383160+036	4.09389196565568409+037	7.01920428911713336+002	22
27	1.02709250248445091−040	1.34854665793041347−039	−2.15135142075734595+038	2.91602619954234894+039	7.55920398247167440+002	21
28	1.39056210303305145−042	1.89336945237465192−041	−1.53316503524753934+040	2.15263925672839533+041	8.11920370758480771+002	21
29	1.81885813504256749−044	2.56494157201879107−043	−1.13233989453034169+042	1.64490054959018211+043	8.69920346021624705+002	21
30	2.30109045120819235−046	3.35682631425864372−045	−8.65645720868476314+043	1.29955955398777465+045	9.29920323681069369+002	21
31	2.81878301305305094−048	4.24903421446778181−047	−6.84194893712728435+045	1.06040759026262568+047	9.91920303436917797+002	21
32	3.34672645301165026−050	5.20750662352538035−049	−5.58507149499506759+047	8.92752000122603854+048	1.05592028503477437+003	20
33	3.85496491376200561−052	6.18566811810180435−051	−4.70380279360198720+049	7.74743787423358862+050	1.12192026825770286+003	22
34	4.31170610644468349−054	7.12808459937460636−053	−4.08347279698923581+051	6.92415574200089468+052	1.18992025291979561+003	21
35	4.68674315221810043−056	7.97584084674230700−055	−3.65076053633963344+053	6.36782903910712732+054	1.25992023886099506+003	21
36	4.95485509008589269−058	8.67287834261297193−057	−3.35849878266153171+055	6.02124830144911181+056	1.33192022594289644+003	21
37	5.09864143336659728−060	9.17230625996249170−059	−3.17665854520694553+057	5.84959336340017201+058	1.40592021404532481+003	21
38	5.11034778139567986−062	9.44167458177087074−061	−3.08697651912542893+059	5.83444369957347563+060	1.48192020306352724+003	20
39	4.99242848253837212−064	9.46638451603556795−063	−3.07981539516501113+061	5.97055070216046268+062	1.55992019290585695+003	21
40	4.75682258588652111−066	9.25076044110138006−065	−3.15247444046474936+063	6.26457635689921489+064	1.63992018349185340+003	21
41	4.42313799343637446−068	8.81673430956113843−067	−3.30853401814391369+065	6.73544411298781800+066	1.72192017475064266+003	21
42	4.01610059427147952−070	8.20049975310575905−069	−3.55804936816699172+067	7.41626871304870347+068	1.80592016661959848+003	20
43	3.56270315284595470−072	7.44779486109929025−071	−3.91857779711859706+069	8.35812002663171667+070	1.89192015904321664+003	21
44	3.08947820338910971−074	6.60861909081816224−073	−4.41717544880389994+071	9.63620138825595712+072	1.97992015197216448+003	21
45	2.62023569446692831−076	5.73217196575455840−075	−5.09367184898518707+073	1.13594594708750911+075	2.06992014536247530+003	20
46	2.17447820879040637−078	4.86264757990138081−077	−6.00576146995827500+075	1.36852889825644513+077	2.16192013917486281+003	21
47	1.76656681879682239−080	4.03628228627629183−079	−7.23679386070304895+077	1.68420016525718402+079	2.25592013337413560+003	20
48	1.40558738189141307−082	3.27979371785202550−081	−8.90767700503481700+079	2.11633381548620931+081	2.35192012792869543+003	20
49	1.09577910033140953−084	2.61012020166577663−083	−1.11951613324679591+082	2.71419188294119972+083	2.44992012281010570+003	21
50	8.37341827707982046−087	2.03520570707653042−085	−1.43601589093553303+084	3.55128405151974928+085	2.54992011799271929+003	20
51	6.27433132404543848−089	1.55549057676115317−087	−1.87920375631105495+086	4.73858093681506041+087	2.65192011345335643+003	21

OBLATE RADIAL FUNCTIONS

H = 0.5 X = 1.80000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	6.56421171817692555−002	5.14435477559220201−002	−3.64221569499904726+000	4.33151196779895545+000	5.96416367140576943+000	22
3	8.60363277599793737−003	1.16502705571890527−002	−1.75773126769769250+001	3.10238328159580437+001	1.19165261752530774+001	23
4	9.08236789419975145−004	1.70004452856988735−003	−1.24762223543691809+002	2.85824997097581050+002	1.98993377613406211+001	22
5	7.90548682621444635−005	1.87915085213030727−004	−1.15289056171391829+003	3.22627297557473318+003	2.98910419602430505+001	22
6	5.84169619261293830−006	1.67991196742381502−005	−1.30787218667070533+004	4.31359473471605573+004	4.18863854270495889+001	22
7	3.74716575378386472−007	1.26308481671073125−006	−1.75699445553450548+005	6.66569956165587086+005	5.58835052153919181+001	22
8	2.12274230672124185−008	8.20127027871789456−008	−2.72637329168047078+006	1.16877526756070138+007	7.18815977446971031+001	22
9	1.07651426092393291−009	4.68793944678303856−009	−4.79761311125843792+007	2.29248161978846346+008	8.98802684873799165+001	21
10	4.94111631234662364−011	2.39390625587959551−010	−9.43920599881854331+008	4.97321566145779211+009	1.09879304823718740+002	22
11	2.07119565312872080−012	1.10481823577011424−011	−2.05314485766167914+010	1.18222981443319756+011	1.31878583764130687+002	21
12	7.98866132082729571−014	4.65175101678275147−013	−4.89199415749376832+011	3.05601546292734464+012	1.55878030084212708+002	21
13	2.85333412379121360−015	1.80080052973103139−014	−1.26711588951493443+013	8.53443046400323367+013	1.81877595647077788+002	21
14	9.48928443563845888−017	6.45188036361804006−016	−3.54493362474139818+014	2.56060652852814672+015	2.09877248474931037+002	21
15	2.95241942972407418−018	2.15134972706926215−017	−1.06527571537044977+016	8.21428177901672606+016	2.39876966644291330+002	22
16	8.62961619161476099−020	6.70875604772031309−019	−3.42216378032368052+017	2.80561137663857383+018	2.71876734714355031+002	21
17	2.37830346086053701−021	1.96478325088082879−020	−1.17032939117877006+019	1.01649666918414764+020	3.05876541553743558+002	21
18	6.20043885055926655−023	5.42432253138539358−022	−4.24504517633665297+020	3.89380779423786312+021	3.41876378972725810+002	22
19	1.53364623314981590−024	1.41634606260742502−023	−1.62779740141536916+022	1.57236828137708452+023	3.79876240836722682+002	22
20	3.60842122343718976−026	3.50807176548074488−025	−6.57944756580956717+023	6.67567215440873817+024	4.19876122476727720+002	22
21	8.09527611846601043−028	8.26409995530150200−027	−2.79578902179783650+025	2.97273756182178685+026	4.61876020288133236+002	22
22	1.73543300206539284−029	1.85606312024999211−028	−1.24597522857210344+027	1.38545968569009448+028	5.05875931452132127+002	21
23	3.56207902438687843−031	3.98296647307700779−030	−5.81116215447191490+028	6.74441727019637803+029	5.51875853738668134+002	21
24	7.01302070334460864−033	8.18278341263581162−032	−2.83077724544290520+030	3.42308617746254977+031	5.99875785364740575+002	21
25	1.32658802880958473−034	1.61237962135795294−033	−1.43763882987954239+032	1.80836968810695171+033	6.49875724890972471+002	22
26	2.41470625393582237−036	3.05234108963656282−035	−7.59924906951840153+033	9.92845862572502705+034	7.01875671145068614+002	21
27	4.23553503186652191−038	5.55993556774891826−037	−4.17445276716052844+035	5.65692946096876422+036	7.55875623164458140+002	22
28	7.16873119976113561−040	9.75885425305413993−039	−2.37967261108797112+037	3.34047022713870750+038	8.11875580152814879+002	21
29	1.17219828961619589−041	1.65271185999550254−040	−1.40588156617956579+039	2.04185931262971328+040	8.69875541446745375+002	21
30	1.85388900776628111−043	2.70396838661127475−042	−8.59723679133194671+040	1.29043080381637179+042	9.29875506490014452+002	21
31	2.83894604134620366−045	4.27871359345758226−044	−5.43560820699512057+042	8.42298523766096150+043	9.91875474813419798+002	21
32	4.21365566086610686−047	6.55541991757 14−046	−3.54935336276695235+044	5.67258255436913818+045	1.05587544601894327+003	21
33	6.06737242583429323−049	9.73425410837· ·37−048	−2.39124526718792315+046	3.93791918108763647+047	1.12187541976717067+003	21
34	8.48338157369052734−051	1.40227172837 73−049	−1.66058581181509915+048	2.81537329763471253+049	1.18987539576723162+003	22
35	1.15273374174592748−052	1.96144960134 52−051	−1.18760927059511607+050	2.07120284177388907+051	1.25987537376869845+003	21
36	1.52343986572706958−054	2.66626619317· · 73−053	−8.73968491690507416+051	1.56668375462124660+053	1.33187535355501992+003	21
37	1.95967457251372311−056	3.52498080933389751−055	−6.61276503866491000+053	1.21754610676103444+055	1.40587533493816615+003	21
38	2.45535220718665332−058	4.53590244883511313−057	−5.14054724095680524+055	9.71461056883432912+056	1.48187531775423593+003	21
39	2.99852634897777045−060	5.68504508971755886−059	−4.10266036815406529+057	7.95257381951336588+058	1.55987530185983365+003	21
40	3.57144982795718107−062	6.94482060750778002−061	−3.35937573797453874+059	6.67503412219103468+060	1.63987528712906551+003	21
41	4.15134334855409103−064	8.27416163211117109−063	−2.82039488517598647+061	5.74113152619142703+062	1.72187527345103699+003	21
42	4.71185989215203593−066	9.62028914990319811−065	−2.42635691219492871+063	5.05693224967487683+064	1.80587526072775798+003	21
43	5.22511871241423990−068	1.09220976978827916−066	−2.13766972947755327+065	4.55912583057608257+066	1.89187524887238162+003	21
44	5.66408253900106019−070	1.21148676205071063−068	−1.92764541312080155+067	4.20485438860127742+068	1.97987523780771737+003	21
45	6.00498517900154600−072	1.31357805519051174−070	−1.77821680821912463+069	3.96529630706570931+070	2.06987522746497044+003	21
46	6.22949816995945652−074	1.39295590286976126−072	−1.67723493913372062+071	3.82160289345625559+072	2.16187521778266924+003	21
47	6.32635875062613602−076	1.44535069250104143−074	−1.61675743944170458+073	3.76235326069141898+074	2.25587520870574935+003	21
48	6.29226065752455297−078	1.46813043573396756−076	−1.59197665285844267+075	3.78202983722598121+076	2.35187520018476838+003	20
49	6.13191855719909815−080	1.46050939135129346−078	−1.60057796954428874+077	3.88022436007836702+078	2.44987519217523093+003	21
50	5.85733546060367299−082	1.42356485039246535−080	−1.64240631438843226+079	4.06141879503054077+080	2.54987518463700620+003	20
51	5.48640893796041764−084	1.36006864961118958−082	−1.71937541577407257+081	4.33528116307926454+082	2.65187517753382410+003	21

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 0.6 X = 1.80000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	9.14710064985280876−002	6.89903442933528030−002	−2.29618655968964395+000	2.56548023985400924+000	5.94831784129773330+000	23
3	1.45122601273582024−002	1.93240093525183854−002	−8.88477044568774046+000	1.52555406171004542+001	1.18797084952054065+001	22
4	1.84743265932837486−003	3.42402255678447003−003	−5.17240558262066866+001	1.16906792806995177+002	1.98550386572143220+001	22
5	1.93577238019960313−004	4.57130300519763635−004	−3.95301971075724382+002	1.09711892960519290+003	2.98431109116185727+001	22
6	1.72036301023365810−005	4.92418261920122840−005	−3.72014324823193618+003	1.22006293159579465+004	4.18364088775214633+001	24
7	1.32646436963241841−006	4.45551309933190995−006	−4.15204729649603292+004	1.56873229755968376+005	5.58322608728771206+001	22
8	9.02901963145297319−008	3.47883569383514494−007	−5.35726728088941467+005	2.28940951578474228+006	7.18295126736097823+001	22
9	5.50049074007317060−009	2.39006169021167133−008	−7.84298369258108140+006	3.73838666616180434+007	8.98275970101081681+001	22
10	3.03223837301687224−010	1.46643473342919777−009	−1.28423816031565124+008	6.75265567509990238+008	1.09826207950154209+002	22
11	1.52635158960893831−011	8.12962949245840198−011	−2.32537883898325374+009	1.33676328894311715+010	1.31825168437986740+002	21
12	7.06895607859937681−013	4.11096432001203984−012	−4.61322510722318309+010	2.87784675112615599+011	1.55824370140252310+002	22
13	3.03140788724204923−014	1.91109229035732602−013	−9.95039840505322384+011	6.69393469224275977+012	1.81823743713787715+002	21
14	1.21033533168842191−015	8.22139729676699183−015	−2.31838049891151495+013	1.67291232469886455+014	2.09823243083231733+002	22
15	4.52070713485517934−017	3.29137611292891100−016	−5.80267538590213749+014	4.47040437292947795+015	2.39822836654595810+002	22
16	1.58619176579601306−018	1.23221512727004768−017	−1.55269643320539736+016	1.27195312730454377+017	2.71822502173019539+002	21
17	5.24747653915172459−020	4.33224876890321753−019	−4.42321212804403008+017	3.83912546421199174+018	3.05822223593016076+002	21
18	1.64214103220293634−021	1.43574957187431619−020	−1.33652169878641871+019	1.22517318170326706+020	3.41821989108278750+002	21
19	4.87535076324182951−023	4.50008243313071705−022	−4.26947958326884062+020	4.12178877074034980+021	3.79821789874516560+002	22
20	1.37682938590514282−024	1.33789937587684323−023	−1.43766979510339419+022	1.45795848710580233+023	4.19821619159927980+002	21
21	3.70738563035478229−026	3.78305344526380486−025	−5.08957333943889492+023	5.40921558840446737+024	4.61821471767076554+002	21
22	9.53914126662731060−028	1.01981477453658041−026	−1.88974881914530067+025	2.10042370495669038+026	5.05821343631365508+002	23
23	2.34997593735807906−029	2.62668462318542417−028	−7.34318367081980128+026	8.51921423917529630+027	5.51821231537016948+002	22
24	5.55286792317334969−031	6.47690129114079505−030	−2.98031168167315957+028	3.60264133748126476+029	5.99821132912821045+002	21
25	1.26065214367916896−032	1.53176321132377270−031	−1.26109346766629448+030	1.58578323153964827+031	6.49821045683030878+002	21
26	2.75401101491286186−034	3.48024231392712696−033	−5.55412612721572453+031	7.25431787586248749+032	7.01820968157014620+002	22
27	5.79759038306913645−036	7.60839269639493224−035	−2.54212896822822776+033	3.44395849071650340+034	7.55820898946560975+002	21
28	1.17764821595625504−037	1.60274331053699987−036	−1.20746071748305514+035	1.69453661572468056+036	8.11820836903189839+002	21
29	2.31102650777782428−039	3.25761685748122136−038	−5.94383300606181222+036	8.63055678284162238+037	8.69820781070120795+002	21
30	4.38646829938815108−041	6.39644045553164797−040	−3.02860524936301040+038	4.54485969100668611+039	9.29820730645108375+002	21
31	8.06144652603733421−043	1.21473182240133439−041	−1.59551658150978074+040	2.47188000180594558+041	9.91820684951421797+002	20
32	1.43594188213252989−044	2.23354664227031409−043	−8.68110384690818600+041	1.38714010643564959+043	1.05582064341499092+003	21
33	2.48140748954625892−046	3.98035375820379853−045	−4.87332330853220039+043	8.02392409890380456+044	1.12182060554626492+003	21
34	4.16374271236038928−048	6.88134090885432388−047	−2.81994350338702320+045	4.78011848595488409+046	1.18982057092570462+003	22
35	6.78983703936635229−050	1.15514790644610448−048	−1.68047871486017855+047	2.93028555653022645+048	1.25982053919209979+003	21
36	1.07688491890575029−051	1.88443575848642558−050	−1.03047564853261418+049	1.84694985954448069+050	1.33182051003309952+003	21
37	1.66241666782555862−053	2.98985410242911053−052	−6.49695052488324429+050	1.19604442769062734+052	1.40582048317748930+003	21
38	2.49965525645013085−055	4.61711330456361461−054	−4.20844990972265495+052	7.95201097414029658+053	1.48182045838885580+003	21
39	3.66338984860501651−057	6.94468653085953608−056	−2.79876478640199476+054	5.42438364648140219+055	1.55982043546036167+003	21
40	5.23633513675635664−059	1.01809925764990989−057	−1.90962900283558732+056	3.79392397164223066+057	1.63982041421041332+003	21
41	7.30428829138586581−061	1.45566690087203521−059	−1.33595357856535452+058	2.71910708533510895+059	1.72182039447905152+003	21
42	9.94916958576121943−063	2.03111127309116264−061	−9.57697825267746063+059	1.99577134938821284+061	1.80582037612493009+003	21
43	1.32402066247381938−064	2.76731115147877959−063	−7.03085326498999655+061	1.49934347844089357+063	1.89182035902277578+003	20
44	1.72238923467604682−066	3.68362829649520527−065	−5.28310624288058696+063	1.15230495241085611+065	1.97982034306124356+003	21
45	2.19137072134132855−068	4.79310703264422754−067	−4.06109130814410068+065	9.05503144589215097+066	2.06982032814109858+003	20
46	2.72808740739733205−070	6.09960512732108937−069	−3.19189649679368653+067	7.27207926297154278+068	2.16182031417366910+003	21
47	3.32475394312430891−072	7.59520949634634365−071	−2.56387924457275770+069	5.96584783538161029+070	2.25582030107952523+003	20
48	3.96836944125489832−074	9.25832567063956727−073	−2.10372067734608374+071	4.99732830908739347+072	2.35182028878734656+003	21
49	4.64088424365786937−076	1.10528080454141778−074	−1.76249432659078040+073	4.27238939535834394+074	2.44982027723294844+003	21
50	5.31989099065337936−078	1.29284129628158915−076	−1.50706432225936758+075	3.72643466111676876+076	2.54982026635844193+003	21
51	5.97982451500464653−080	1.48227145633162213−078	−1.31468866101300957+077	3.31463260988174491+078	2.65182025611150703+003	21

OBLATE RADIAL FUNCTIONS

H=0.7 X=1.80000000 M=2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	1.19725208647144881−001	8.60609860947544741−002	−1.59436647306456376+000	1.66810711886019368+000	5.92952905718217094+000	22
3	2.23933485190746347−002	2.92155677963282085−002	−5.07997167855110214+000	8.41825717047025977+000	1.18361262204765058+001	22
4	3.34540793060605409−003	6.12708070492404129−003	−2.48430371535692084+001	5.52135745343525755+001	1.98026795724376412+001	22
5	4.10505336112057961−004	9.61831552961801413−004	−1.61226018616818872+002	4.43002650289474861+002	2.97864735502194281+001	23
6	4.26765684394680062−005	1.21472852386839305−004	−1.29343744044398035+003	4.21331177786831274+003	4.17773566645413597+001	22
7	3.84661609734016149−006	1.28665968928982641−005	−1.23287529991169107+004	4.63519426363388419+004	5.57717099309043105+001	22
8	3.05946900424030202−007	1.17496505483226442−006	−1.35993243031736736+005	5.78989083460449105+005	7.17679669941512078+001	22
9	2.17718595545621159−008	9.43561646696146029−008	−1.70314339215594762+006	8.09417059263168964+006	8.97653570914929552+001	22
10	1.40168026931469360−009	6.76425724579581350−009	−2.38670029175844886+007	1.25195938146987993+008	1.09763464197024782+002	22
11	8.23870259994950056−011	4.38026443653960576−010	−3.69964175872744913+008	2.12258094476964833+009	1.31762047395673527+002	22
12	4.45473565038871415−012	2.58674689498418525−011	−6.28463681305254547+009	3.91402744811114429+010	1.55760959216566068+002	21
13	2.23012476259796535−013	1.40411611622088414−012	−1.16090828635882020+011	7.79876638309636267+011	1.81760105233734297+002	22
14	1.03937699319236210−014	7.05219149742549065−014	−2.31675419501312546+012	1.66970485684585239+013	2.09759422689364561+002	22
15	4.53134803630801510−016	3.29587120480320865−015	−4.96712895936487655+013	3.82263841255635587+014	2.39758868541560873+002	22
16	1.85569455593219046−017	1.44031995256887930−016	−1.13862592393273091+015	9.31881054948500146+015	2.71758412466606004+002	22
17	7.16491580876887392−019	5.91067797769787804−018	−2.77893591566582179+016	2.40998324539628997+017	3.05758032598563672+002	23
18	2.61676041384746407−020	2.28628662300243886−019	−7.19427295602592812+017	6.59003868261000840+018	3.41757712846662683+002	22
19	9.06646378600649782−022	8.36336231505880332−021	−1.96913701289108902+019	1.89976119595284465+020	3.79757441155946865+002	21
20	2.98798494514427345−023	2.90185540486155468−022	−5.68155350177547384+020	5.75828725736576872+021	4.19757208350117533+002	22
21	9.38904830188799796−025	9.57574363256269732−024	−1.72349749628714556+022	1.83074488952217098+023	4.61757007343942507+002	23
22	2.81909244147887474−026	3.01242932761552869−025	−5.48361604105274658+023	6.09193098311746010+024	5.05756832596181373+002	21
23	8.10403893752330850−028	9.05437496753620093−027	−1.82596189653213953+025	2.11743536977332916+026	5.51756679722568207+002	21
24	2.23453067949286016−029	2.60533509772227844−028	−6.35071586606592889+026	7.67363795351244027+027	5.99756545217466051+002	21
25	5.91955071529596089−031	7.18994606855469610−030	−2.30287368854569719+028	2.89467656799587986+029	6.49756426250655469+002	22
26	1.50896087336713175−032	1.90622445602295718−031	−8.69175794126456326+029	1.13483928713710520+031	7.01756320516933837+002	21
27	3.70658178372156810−034	4.86274736520683486−033	−3.40929740664906676+031	4.61723803471430348+032	7.55756226123398138+002	22
28	8.78518346558702377−036	1.19528469963768247−034	−1.38778255093729847+033	1.94700201121293974+034	8.11756141503991269+002	21
29	2.01161690507069656−037	2.83479038685335575−036	−5.85465345802435779+034	8.49863957083897356+035	8.69756065354025655+002	21
30	4.45509249290038845−039	6.49483828352055603−038	−2.55663075139179691+036	3.83556999506370393+037	9.29755996579518191+002	21
31	9.55328466492148088−041	1.43918074665572743−039	−1.15430748643842002+038	1.78788258374174859+039	9.91755934257626623+002	21
32	1.98550758188254300−042	3.08767239772333559−041	−5.38261988410462972+039	8.59878636786338792+040	1.05575587760549130+003	21
33	4.00336255867780771−044	6.42030658424340972−043	−2.58967894863360276+041	4.26296377528575433+042	1.12175582595550124+003	21
34	7.83791061290891136−046	1.29509617989789184−044	−1.28429892978914578+043	2.17657700327708258+044	1.18975577873551382+003	21
35	1.49129309875293646−047	2.53663868273791658−046	−6.55943664840740619+044	1.14355800659907651+046	1.25975573545292558+003	21
36	2.75967555667558378−049	4.82827355990441615−048	−3.44732029373784106+046	6.17758015211330103+047	1.33175569568176041+003	21
37	4.97063300076761347−051	8.93815131564804672−050	−1.86279983839954803+048	3.42868514793907759+049	1.40575565905213890+003	21
38	8.72033506221789560−053	1.61047229946883383−051	−1.03417417279579688+050	1.95378201287796727+051	1.48175562524163998+003	21
39	1.49113076507397698−054	2.82630097732986146−053	−5.89460643868215725+051	1.14227342311593716+053	1.55975559396817573+003	22
40	2.48678354058704052−056	4.83433877654808079−055	−3.44711796527690685+053	6.84747427637961551+054	1.63975556498408399+003	21
41	4.04729577215144462−058	8.06470465460789884−057	−2.06689753951042693+055	4.20621697124716402+056	1.72175553807120637+003	21
42	6.43204377314784334−060	1.31291950414121782−058	−1.26992508225879337+057	2.64606847827485221+058	1.80575551303676830+003	21
43	9.98690148425758811−062	2.08707874242123851−060	−7.99063187940537929+058	1.70379616388216900+060	1.89175548970991506+003	21
44	1.51579321955604051−063	3.24139334249407571−062	−5.14620748523401504+060	1.12230609497115468+062	1.97975546793878705+003	21
45	2.25007012378886045−065	4.92092656567772172−064	−3.39052410668277510+062	7.55896540467894220+063	2.06975544758804053+003	21
46	3.26820264139937396−067	7.30641121439124001−066	−2.28402161323543966+064	5.20308044174127829+065	2.16175542853673785+003	22
47	4.64707545402258362−069	1.06148453085300860−067	−1.57245207300457048+066	3.65851319397665612+067	2.25575541067654560+003	21
48	6.47143972224710555−071	1.50965199724030473−069	−1.10585303054541090+068	2.62664735195803822+069	2.35175539391019029+003	21
49	8.82993048229210432−073	2.10274458594040687−071	−7.94085983350796356+069	1.92471757092876800+071	2.44975537815013045+003	21
50	1.18093556537525798−074	2.86964184973741269−073	−5.81973188383073509+071	1.43887411829080929+073	2.54975536331741105+003	21
51	1.54873838022584438−076	3.83864499100401544−075	−4.35137344506203220+073	1.09697962612735999+075	2.65175534934067223+003	21

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 0.8 X = 1.80000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	1.49408179934140169−001	1.01169483897090725−001	−1.18596758998258579+000	1.17013400360386627+000	5.90776576462657717+000	23
3	3.23327025503334470−002	4.11671791546407687−002	−3.18972203272798515+000	5.05678305503147376+000	1.17857439078473119+001	24
4	5.55830478869590117−003	1.00383868826544506−002	−1.33165257435187571+001	2.89899329983042766+001	1.97422582326081293+001	22
5	7.82906964706527591−004	1.81762826296649036−003	−7.47629269264739044+001	2.02987224427912349+002	2.97211342578809802+001	23
6	9.33078634140686272−005	2.63865007055498795−004	−5.21424179979766778+002	1.68502117691553756+003	4.17092343430245908+001	22
7	9.63397297705317351−006	3.20683716212943781−005	−4.33030316671057396+003	1.61870445291071228+004	5.57018576936201080+001	22
8	8.77298323424328580−007	3.35647979410810464−006	−4.16677078903470401+004	1.76626920417606282+005	7.16969654214932356+001	23
9	7.14522882258508756−008	3.08728783255646314−007	−4.55558962690831996+005	2.15762378406512082+006	8.96935528335930372+001	22
10	5.26351932855677843−009	2.53379737577848578−008	−5.57597360966215762+006	2.91682120223338319+007	1.09691077116679776+002	22
11	3.53922486923155636−010	1.87781453316590217−009	−7.55205315350488539+007	4.32291743923599882+008	1.31689223719945683+002	23
12	2.18891140774284384−011	1.26882146071974307−010	−1.12119143102784738+009	6.96931567393602658+009	1.55687800001286355+002	22
13	1.25325956413943997−012	7.87885524990502859−012	−1.81040510040614712+010	1.21421074940137383+011	1.81686682564635689+002	22
14	6.67958462247023001−014	4.52621357714526248−013	−3.15864605912157725+011	2.27325893083210394+012	2.09685789373830341+002	22
15	3.32992740988832726−015	2.41925908091365896−014	−5.92135028215944286+012	4.55140601235961393+013	2.39685064152020047+002	22
16	1.55925510490318223−016	1.20901676647206150−015	−1.18694818515368438+014	9.70381912494511778+014	2.71684467243845685+002	21
17	6.88338414280185281−018	5.67334426985662422−017	−2.53336678017501617+015	2.19491893177573033+016	3.05683970050122037+002	22
18	2.87419092578345642−019	2.50919216577207833−018	−5.73591811799179619+016	5.24968996838080831+017	3.41683551522545248+002	22
19	1.13850177597317018−020	1.04945274041595495−019	−1.37312970183287717+018	1.32373836459226517+019	3.79683195890392996+002	22
20	4.28947409074694025−022	4.16310423509703848−021	−3.46530787355673743+019	3.50968297573537932+020	4.19682891147837915+002	23
21	1.54086551382150767−023	1.57056963576379939−022	−9.19477484947877248+020	9.76081154019383747+021	4.61682628024201013+002	22
22	5.28882555508364841−025	5.64846757381149744−024	−2.55898343829804599+022	2.84123515624006353+023	5.05682399268568786+002	22
23	1.73799603388551142−026	1.94083730930073480−025	−7.45374443452561200+023	8.63904548124000742+024	5.51682199143647363+002	21
24	5.47800735283418820−028	6.38411184089443274−027	−2.26776780816340718+025	2.73885151892212325+026	5.99682023061700137+002	22
25	1.65884840460041184−029	2.01399983831327017−028	−7.19363791319115856+026	9.03828610247968176+027	6.49681867318732490+002	21
26	4.83360373117440668−031	6.10374665464548159−030	−2.37518231657318648+028	3.09988608703644785+029	7.01681728897740806+002	22
27	1.35717515829062088−032	1.77985871020266730−031	−8.15027868792669517+029	1.10337913796234934+031	7.55681605321247692+002	21
28	3.67686038620551811−034	5.00092144935397845−033	−2.90237682991631195+031	4.07047642841847446+032	8.11681494539498228+002	21
29	9.62345077597072857−036	1.35571578954106465−034	−1.07118440564230802+033	1.55442328342645865+034	8.69681394844788775+002	22
30	2.43611193068851125−037	3.55042093536494244−036	−4.09229558748921906+034	6.13755056144839196+035	9.29681304805172030+002	23
31	5.97096195555142030−039	8.99261355920255390−038	−1.61644594248023231+036	2.50295655652453885+037	9.91681223212685903+002	21
32	1.41843900865182433−040	2.20524388974219217−039	−6.59444670985431085+037	1.05318372317846384+039	1.05568114904257961+003	21
33	3.26895046725128182−042	5.24121686174665307−041	−2.77574426502463430+039	4.56808831437706111+040	1.12168108142094552+003	22
34	7.31518083287773392−044	1.20844200000512251−042	−1.20434818597063995+041	2.04058971485882054+042	1.18968101959883262+003	22
35	1.59083961939071959−045	2.70536961638982956−044	−5.38155937790944706+042	9.37996807710431446+043	1.25968096293139943+003	21
36	3.36478680317874144−047	5.88574074825254997−046	−2.47446800840341635+044	4.43328381877630829+045	1.33168091086101529+003	22
37	6.92699793807503682−049	1.24536174992908571−047	−1.16984339702933528+046	2.15278682166626164+047	1.40568086290347783+003	22
38	1.38898719160578367−050	2.56470342658132915−049	−5.68223317807045929+047	1.07329205504087671+049	1.48168081863670667+003	21
39	2.71462935686042241−052	5.14441601067710858−051	−2.83365066259624033+049	5.49012490433776018+050	1.55968077769141756+003	22
40	5.17440850551497196−054	1.00574160137020206−052	−1.44982604875512621+051	2.87948435840720534+052	1.63968073974339021+003	22
41	9.62529154206162359−056	1.91764185288096801−054	−7.60587052924596830+052	1.54756833659556948+054	1.72168070450702587+003	22
42	1.74832667542252027−057	3.56816567866035966−056	−4.08865188417030957+054	8.51794173236313755+055	1.80568067172995448+003	21
43	3.10261244237078552−059	6.48293897867651785−058	−2.25090367285054713+056	4.79874982584867823+057	1.89168064118850054+003	21
44	5.38218375292601083−061	1.15077242789423211−059	−1.26834794693554216+058	2.76566804399469607+059	1.97968061268385471+003	21
45	9.13135285616765262−063	1.99676860888790254−061	−7.31130261749850926+059	1.62978761628263670+061	2.06968058603882844+003	21
46	1.51588883962019151−064	3.38849415050409895−063	−4.30929587583373533+061	9.81543489108715488+062	2.16168056109509227+003	21
47	2.46352106525091853−066	5.62648011150385299−065	−2.59575076128232997+063	6.03858933967771407+064	2.25568053771081714+003	21
48	3.92097959756075074−068	9.14574844453322057−067	−1.59721602482270082+065	3.79328576718907638+066	2.35168051575865287+003	21
49	6.11458624046650298−070	1.45595210646174879−068	−1.00349585075114585+067	2.43200643729404741+068	2.44968049512398977+003	22
50	9.34654649595041719−072	2.27093844863745948−070	−6.43478283463491700+068	1.59076257033641789+070	2.54968047570345910+003	22
51	1.40093285980593851−073	3.47193606474905488−072	−4.20960299958627422+070	1.06112577050919831+072	2.65168045740363533+003	21

OBLATE RADIAL FUNCTIONS

H = 0.9 X = 1.80000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	1.79469533747567560−001	1.12843574753489260−001	−9.25744917631240412−001	8.78088543673382495−001	5.88299107922981127+000	23
3	4.43214209531799277−002	5.48318208193511346−002	−2.15745988608645797+000	3.24351183574545795+000	1.17285205024373784+001	24
4	8.63953838319288706−003	1.53514437675862220−002	−7.77829100921130082+000	1.65108949083666220+001	1.96737724254738626+001	23
5	1.37592130762929022−003	3.16080266474611190−003	−3.82880902674846812+001	1.02501072415995394+002	2.96470982206528057+001	22
6	1.85136123287797531−004	5.19653072564487109−004	−2.35570320880228385+002	7.54254025671915606+002	4.16320483714095437+001	22
7	2.15614496383662640−005	7.13727747271505615−005	−1.73042745822765854+003	6.42577843807100441+003	5.56227103020917555+001	22
8	2.21342018672911708−006	8.43191495022452160−006	−1.47489716893592337+004	6.22079952442536151+004	7.16165134061080049+001	23
9	2.03141769810474644−007	8.74707151629231991−007	−1.42959850320706751+005	6.74437876533135132+005	8.96121889746309836+001	22
10	1.68576547327598455−008	8.09222804606708954−008	−1.55220534327140726+006	8.09403878414984889+006	1.09609050810769229+002	22
11	1.27664602139329180−009	6.75762994970755376−009	−1.86564162175839502+007	1.06514529534949214+008	1.31606700969441106+002	22
12	8.89114526726225229−011	5.14358762228803564−010	−2.45869994249945557+008	1.52499050853627040+009	1.55604895597082240+002	22
13	5.73164566653808494−012	3.59716683991884867−011	−3.52500832342345907+009	2.35977736049848424+010	1.81603478427551888+002	22
14	3.43913916008434113−013	2.32698129938453890−012	−5.46157633611092706+010	3.92437296260218219+011	2.09602345537607983+002	22
15	1.93000728269838961−014	1.40037409927041978−013	−9.09345193401414751+011	6.97987841453337449+012	2.39601425617203788+002	22
16	1.01726430562423095−015	7.87865924920016402−015	−1.61911439007338868+013	1.32207530476900311+014	2.71600668407305389+002	23
17	5.05457722513605539−017	4.16179061610714288−016	−3.06986790761934925+014	2.65685984900002460+015	3.05600037655208152+002	22
18	2.37543138099326794−018	2.07188337547253365−017	−6.17492739436757890+015	5.64601504717197871+016	3.41599506676020433+002	21
19	1.05897514997038689−019	9.75346161950848975−019	−1.31333052357081802+017	1.26499020102126664+018	3.79599055473360420+002	23
20	4.49019380136614748−021	4.35467639255684941−020	−2.94482869621819397+018	2.98019981367750608+019	4.19598668822994883+002	22
21	1.81518434059241162−022	1.84892760860047616−021	−6.94278840331118229+019	7.36494761178706373+020	4.61598334968047338+002	23
22	7.01129109198538944−024	7.48344312116829896−023	−1.71692428345507217+021	1.90506218325926897+022	5.05598044712389952+002	22
23	2.59274372051447141−025	2.89370468791658576−024	−4.44388730997201496+022	5.14750188640523739+023	5.51597790779113558+002	22
24	9.19593820509227814−027	1.07114368436658616−025	−1.20144590420552256+024	1.45023145135850945+025	5.99597567349030360+002	22
25	3.13353392609041710−028	3.80257898777131936−027	−3.38674126680200353+025	4.25305736907115043+026	6.49597369723682674+002	21
26	1.02741422855080773−029	1.29681351654578911−028	−9.93728282588774589+026	1.29632700008343537+028	7.01597194075886115+002	22
27	3.24601570313858318−031	4.25520495769722631−030	−3.03032199751320286+028	4.10066086052671053+029	7.55597037262746767+002	22
28	9.89523397174573272−033	1.34533837181376814−031	−9.59010108560422761+029	1.34443710898625177+031	8.11596896683885799+002	21
29	2.91412778591156696−034	4.10383683955270932−033	−3.14552653733602263+031	4.56284831239239508+032	8.69596770172795203+002	21
30	8.30039906151285519−036	1.20930341564284349−034	−1.06797677782076897+033	1.60117254397059524+034	9.29596655912760811+002	21
31	2.28910438296554052−037	3.44643441272515465−036	−3.74910054157714145+034	5.80332714809826365+035	9.91596552371201468+002	22
32	6.11853576232885418−039	9.50964992148776367−038	−1.35931535434770139+036	2.17026394824056109+037	1.05559645824795350+003	21
33	1.58656202601469173−040	2.54307667857599922−039	−5.08512562604071827+037	8.36625743519237438+038	1.12159637243421487+003	21
34	3.99468286746398900−042	6.59733538227099594−041	−1.96091466473604371+039	3.32157507234084961+040	1.18959629397970947+003	22
35	9.77437702710586435−044	1.66180911159929786−042	−7.78758560605605681+040	1.35701436311143697+042	1.25959622206624272+003	21
36	2.32607042149026691−045	4.06784214498351731−044	−3.18249671640986999+042	5.70041059030954063+043	1.33159615598626502+003	21
37	5.38778646051907021−047	9.68420233652505711−046	−1.33723690430402769+044	2.46026416929058684+045	1.40559609512538764+003	22
38	1.21551733435852191−048	2.24392342781581207−047	−5.77293961669553466+045	1.09018735528578777+047	1.48159603894803953+003	22
39	2.67281454304954273−050	5.06415407169824334−049	−2.55872858978888524+047	4.95644374648143232+048	1.55959598698563629+003	21
40	5.73208069743218429−052	1.11392201927709219−050	−1.16357980224893432+049	2.31051860637165856+050	1.63959593882677060+003	21
41	1.19965633940394512−053	2.38963293080601980−052	−5.42542544750183996+050	1.10370570186357944+052	1.72159589410903882+003	21
42	2.45163115400867937−055	5.00267123762638483−054	−2.59221891173943911+052	5.39943854144533217+053	1.80559585251219909+003	21
43	4.89494701970980442−057	1.02263399136157903−055	−1.26840236033595393+054	2.70367319532483334+055	1.89159581375241863+003	21
44	9.55356244095132290−059	2.04233646390357086−057	−6.35256220071606935+055	1.38496831876017186+057	1.97959577757741651+003	21
45	1.82358853369183532−060	3.98706643324068176−059	−3.25474771294537043+057	7.25413388733048698+058	2.06959574376234599+003	21
46	3.40598412734431311−062	7.61235098821677510−061	−1.70507112300369948+059	3.88312170317947950+060	2.16159571210629052+003	23
47	6.22750091654739332−064	1.42211176712985908−062	−9.12881171694379447+060	2.12336543155501673+062	2.25559568242927097+003	21
48	1.11514965695542638−065	2.60075659566677588−064	−4.99265273420518757+062	1.18556071132999181+064	2.35159565456968070+003	21
49	1.95652575244300668−067	4.65811044955525577−066	−2.78805287015509222+064	6.75605343239953734+065	2.44959562838207989+003	21
50	3.36471683088638876−069	8.17427212165271929−068	−1.58905250044937689+066	3.92785005209639935+067	2.54959560373529271+003	21
51	5.67404170141013412−071	1.40603247780603185−069	−9.23986341781014684+067	2.32883425487263181+069	2.65159558051076078+003	21

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 1.0 X = 1.80000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	2.08840673168924068−001	1.19705333424916245−001	−7.46002544143162885−001	7.01724291047186725−001	5.85516257458899876+000	23
3	5.82537958535394102−002	6.96807984861370237−002	−1.55035563038339045+000	2.19417527164308443+000	1.16644092705727215+001	23
4	1.27305865276876595−002	2.22019189945961183−002	−4.87193535743594664+000	1.00296040699598365+001	1.95972201861103753+001	23
5	2.26556965228958427−003	5.14225067505174925−003	−2.12321925761368219+001	5.59099120471952025+001	2.95643714836989069+001	23
6	3.40067988304891511−004	9.46490689407001266−004	−1.16536337175658276+002	3.69186465080789120+002	4.15458061323492353+001	24
7	4.41368280143384036−005	1.45186671520069634−004	−7.66106865986837893+002	2.82350491208810907+003	5.55342747431752609+001	23
8	5.04599193235438511−006	1.91292112464032414−005	−5.85350826832194939+003	2.45493972378739521+004	7.15266171379765059+001	24
9	5.15514763042497727−007	2.21115868998901616−006	−5.09124062026168600+004	2.39127287981167402+005	8.95212708911589897+001	22
10	4.76050723249529313−008	2.27797016530400607−007	−4.96364145676383112+005	2.57911140787566824+006	1.09517389931433988+002	22
11	4.01081147260409256−009	2.11743602232878908−008	−5.35945271449048594+006	3.05090565994680173+007	1.31514483179371164+002	22
12	3.10700313837586272−010	1.79341533955088089−009	−6.34721630113152480+007	3.92716390652213245+008	1.55512249521578269+002	22
13	2.22751149969565432−011	1.39530916126895966−010	−8.17959520769470895+008	5.46432264581902057+009	1.81510495907148754+002	22
14	1.48625889810590118−012	1.00396253970731521−011	−1.13937573511102859+010	8.17219672079119705+010	2.09509093902326498+002	22
15	9.27395570922618515−014	6.71923564030090201−013	−1.70577062719980643+011	1.30725563589407844+012	2.39507955352854786+002	22
16	5.43457977167127119−015	4.20366561366768844−014	−2.73127137678333151+012	2.22713707420220881+013	2.71507018113466726+002	21
17	3.00202053694494922−016	2.46896165471957997−015	−4.65741844672580035+013	4.02592785648533391+014	3.05506237349175971+002	22
18	1.56835057207440079−017	1.36654249767547752−016	−8.42618468567964822+014	7.69608938782676604+015	3.41505580052648467+002	21
19	7.77207750519551848−019	7.15173507471762750−018	−1.61204133591893033+016	1.55119568588090087+017	3.79505021486509760+002	23
20	3.66310180349146103−020	3.54959567870774148−019	−3.25154711111668653+017	3.28771318180783428+018	4.19504542814879966+002	22
21	1.64596838583441545−021	1.67529935992199516−020	−6.89624990683167435+018	7.30975315756187183+019	4.61504129490418294+002	22
22	7.06646041679226867−023	7.53712240977400261−022	−1.53425457748591223+020	1.70114037199500040+021	5.05503770133392552+002	22
23	2.90438859111322856−024	3.23947313244396197−023	−3.57266476758253272+021	4.13558783811388592+022	5.51503455738369125+002	21
24	1.14491123337682250−025	1.33281674286380016−024	−8.69020635169660229+022	1.04833045444881578+024	5.99503179103453684+002	22
25	4.33592201634511465−027	5.25886006967581910−026	−2.20402504078738105+024	2.76625048504108248+025	6.49502934413467056+002	22
26	1.57999460161669030−028	1.99329277391133113−027	−5.81863836636529460+025	7.58651696558528480+026	7.01502716931361024+002	22
27	5.54774088193613734−030	7.26917223427714713−029	−1.59650789866346643+027	2.15936811515751647+028	7.55502522766895258+002	23
28	1.87949192837105020−031	2.55422205883878311−030	−4.54613566466024843+028	6.37037354749666723+029	8.11502348701228074+002	22
29	6.15128454464759568−033	8.65909412323926102−032	−1.34170465357671424+030	1.94544061368145428+031	8.69502192052488641+002	22
30	1.94712388414449313−034	2.83573907230207290−033	−4.09898601803148448+031	6.14303535056322201+032	9.29502050571740230+002	22
31	5.96750316918102048−036	8.98139162021884256−035	−1.29478838918007641+033	2.00350192247649762+034	9.91501922361726995+002	21
32	1.77256643882349896−037	2.75407243784150881−036	−4.22429717048202221+034	6.74213670762777087+035	1.05550180581287436+003	22
33	5.10782410648166923−039	8.18469660136130457−038	−1.42201245486722032+036	2.33879728528099947+037	1.12150169955247874+003	21
34	1.42916144740167303−040	2.35960615669805766−039	−4.93437759818397600+037	8.35575149465474925+038	1.18950160240406880+003	21
35	3.88601737356000182−042	6.60504589179269317−041	−1.76340714801572564+039	3.07191640547972957+040	1.25950151335467546+003	21
36	1.02766605115669208−043	1.79671338515613110−042	−6.48481455261917202+040	1.16122864426623652+042	1.33150143152829929+003	21
37	2.64514880244016679−045	4.75329912162489231−044	−2.45200431508613546+042	4.51006600923648297+043	1.40550135616426915+003	22
38	6.63145424717679263−047	1.22391919717176427−045	−9.52568773753800782+043	1.79843411831096820+045	1.48150128659948821+003	21
39	1.62039852440254611−048	3.06946113694426984−047	−3.79938162592894653+045	7.35797474239516256+046	1.55950122225378888+003	21
40	3.86160979690362544−050	7.50270456150094699−049	−1.55480861952759291+047	3.08670128917330801+048	1.63950116261778998+003	21
41	8.98077618783268195−052	1.78854384208757666−050	−6.52392760023772254+048	1.32689812946143674+050	1.72150110724277882+003	21
42	2.03944068307639872−053	4.16076694276084230−052	−2.80507121317729190+050	5.84163010150805041+051	1.80550105573224149+003	21
43	4.52481683188566738−055	9.45132152562671174−054	−1.23517443593471909+052	2.63234410776358228+053	1.89150100773474130+003	21
44	9.81326828633448556−057	2.09748321654560378−055	−5.56699997581949780+053	1.21348120698677165+055	1.97950096293790569+003	21
45	2.08146382136406311−058	4.55010797353444434−057	−2.56680296468656806+055	5.71985681522098651+056	2.06950092106332857+003	22
46	4.31993084841896308−060	9.65344492406185934−059	−1.21010304589880286+057	2.75542432784779238+058	2.16150088186223233+003	22
47	8.77685057144394007−062	2.00396858932195548−060	−5.83042736684039257+058	1.35594337148982503+060	2.25550084511176274+003	22
48	1.74641496195615411−063	4.07238684494552913−062	−2.86962609234513586+060	6.81320211473160406+061	2.35150081061181343+003	21
49	3.40477153808739008−065	8.10494005050207890−064	−1.44212931456913067+062	3.49407702914648615+063	2.44950077818229510+003	22
50	6.50635649757570625−067	1.58044170268726938−065	−7.39693903645463175+063	1.82813141876886059+065	2.54950074766077968+003	21
51	1.21917953209496359−068	3.02073650157277821−067	−3.87071508272393025+065	9.75450703504638858+066	2.65150071890046184+003	21

OBLATE RADIAL FUNCTIONS

H = 2.0 X = 1.80000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	2.82692659241225715−001	−1.87259707619616847−001	1.80299424136750536−002	4.05204177797053462−001	5.39501078349079835+000	23
3	2.25131810809104390−001	9.70028387978366749−002	−2.32441715338395800−001	4.23649690891069190−001	1.06299512876868696+001	24
4	1.16329270287765570−001	1.35824084878182224−001	−4.12018642124102162−001	5.32647313349011791−001	1.83883287402038170+001	25
5	4.57975674282524672−002	8.25993638652882161−002	−7.19099836049982622−001	1.27795738016468814+000	2.82612011298329428+001	24
6	1.47260751160293969−002	3.51955033767298369−002	−1.63314771905829761+000	4.10462881418261431+000	4.01876279172383946+001	24
7	4.01910998974985301−003	1.18506966022513724−002	−4.78240477756105884+000	1.52396178283404895+001	5.41412350355173940+001	23
8	9.54942493930521980−004	3.33245248667264156−003	−1.69708334056474595+001	6.42656837541411516+001	7.01101221891089457+001	22
9	2.01145440173917089−004	8.08412248770858496−004	−7.00595356560146101+001	3.04692671538438137+002	8.80882526859487375+001	23
10	3.80796962796621797−005	1.72885119996392644−004	−3.28363765896379371+002	1.60598232673105753+003	1.08072299830526378+002	23
11	6.54966460449116887−006	3.31086729551209691−005	−1.71880945417682027+003	9.31605385862605813+003	1.30060308435711217+002	23
12	1.03248834929402757−006	5.74612321202182218−006	−9.92645584846028762+003	5.89700503444620871+004	1.54051068532153273+002	23
13	1.50257262269178115−007	9.12363654081563184−007	−6.26492009732855034+004	4.04410898075270683+005	1.80043798930238404+002	22
14	2.03104038966769087−008	1.33558113146351199−007	−4.28784599384609198+005	2.98649236964650779+006	2.08037977084355322+002	23
15	2.56329467195265886−009	1.81414013864532721−008	−3.16214524583916115+006	2.36253688729128148+007	2.38033242783308760+002	23
16	3.03413253210909092−010	2.29896667896483728−009	−2.49912956328911554+007	1.99300365879786776+008	2.70029341210991787+002	22
17	3.38173429272836247−011	2.73077858950703064−010	−2.10687135574645527+008	1.78578596611099725+009	3.04026088007913874+002	22
18	3.56142914467944306−012	3.05279795336145816−011	−1.88699957947726177+009	1.69365278120940251+010	3.40023347130963836+002	22
19	3.55493991281579562−013	3.22343021936393992−012	−1.78914853153285075+010	1.69489711063571460+011	3.78021016422358668+002	23
20	3.37260631961964959−014	3.22493514460970436−013	−1.79016952468262193+011	1.78475388017101090+012	4.18019017966603923+002	22
21	3.04864703929659305−015	3.06571910726058924−014	−1.88492597631606900+012	1.97261249705450813+013	4.60017291502783003+002	23
22	2.63170380558028448−016	2.77622033132837487−015	−2.08329081868575222+013	2.28322750096059438+014	5.04015789834124268+002	22
23	2.17393761206567823−017	2.40038562358354921−016	−2.41140191979253420+014	2.76188161790519398+015	5.50014475571760051+002	22
24	1.72167957950718186−018	1.98571831913759407−017	−2.91710993063004808+015	3.48490757131232411+016	5.98013318787307725+002	22
25	1.30948487709430474−019	1.57466701465843632−018	−3.68109900368602666+016	4.57885979156707065+017	6.48012295295582078+002	22
26	9.58032141852631971−021	1.19908562850848941−019	−4.83715870709221550+017	6.25478528320759970+018	7.00011385381316757+002	22
27	6.75191940275837457−022	8.78207982090452687−021	−6.60842836354160983+018	8.86989007867428287+019	7.54010572843401867+002	22
28	4.59019943341086287−023	6.19543949171163117−022	−9.37262258123829923+019	1.30401768135587461+021	8.10009844269282110+002	22
29	3.01398397901930170−024	4.21569109830907201−023	−1.37811824770640819+021	1.98499130803679824+022	8.68009188478292615+002	22
30	1.91366543463928581−025	2.77038025899501973−024	−2.09808802324193977+022	3.12486763920283133+023	9.28008596090437148+002	22
31	1.17620700585278414−026	1.76034592877748604−025	−3.30339115923130550+023	5.08187897379727361+024	9.90008059189316435+002	22
32	7.00552658720050244−028	1.08274120900194584−026	−5.37299637703102297+024	8.52882101379144996+025	1.05400757105642888+003	22
33	4.04721356330257064−029	6.45310155882582305−028	−9.01872576508228272+025	1.47572580676654021+027	1.12000712596008232+003	22
34	2.26998890891709272−030	3.73036044137315755−029	−1.56072193077006431+027	2.63014389903283601+028	1.18800671898645690+003	22
35	1.23712821711701540−031	2.09347351680444361−030	−2.78203439845115240+028	4.82434836714074193+029	1.25800634590346781+003	22
36	6.55660782991088552−033	1.14154047765082612−031	−5.10368660557931779+029	9.09980913828215632+030	1.33000600305034774+003	22
37	3.38180196718905127−034	6.05304612053218106−033	−9.62806551341880633+030	1.76371663025657812+032	1.40400568724754219+003	22
38	1.69877123209367871−035	3.12354485073945013−034	−1.86636215669593840+032	3.51005880802276754+033	1.48000539572275727+003	22
39	8.31641970552050075−037	1.56973762411225652−035	−3.71484511557354834+033	7.16789303041812643+034	1.55800512604993347+003	22
40	3.97040357987624293−038	7.68794028265173570−037	−7.58710041169915979+034	1.50098981676111713+036	1.63800487609862695+003	22
41	1.84968477712761873−039	3.67180366688886685−038	−1.58898137709305155+036	3.22110299918915222+037	1.72000464399181801+003	22
42	8.41357856489500089−041	1.71121392269078606−039	−3.41036718843428720+037	7.07972828673102432+038	1.80400442807058097+003	22
43	3.73875411506790518−042	7.78646713136051616−041	−7.49665107448607541+038	1.59283278017979135+040	1.89000422686436930+003	22
44	1.62393318992486651−043	3.46124005433676831−042	−1.68683956699526007+040	3.66634304453132072+041	1.97800403906591864+003	22
45	6.89804606973107972−045	1.50387136999448340−043	−3.88318691542923801+041	8.62945701371565718+042	2.06800386350996559+003	22
46	2.86690004039242113−046	6.38997978008438527−045	−9.14090089280829933+042	2.07591320194547602+044	2.16000369915513332+003	22
47	1.16635375213502966−047	2.65650378413471887−046	−2.19919531409691110+044	5.10161016359471065+045	2.25400354506845668+003	22
48	4.64700929491504110−049	1.08105242421242371−047	−5.40517462656651035+045	1.28021600975864563+047	2.35000340041211633+003	21
49	1.81396347435441375−050	4.30827154698909666−049	−1.35653923130509846+047	3.27907013656897656+048	2.44800326443202865+003	22
50	6.94023231086867191−052	1.68215490546147940−050	−3.47492371926617754+048	8.56901121365527324+049	2.54800313644800061+003	21
51	2.60364407308263448−053	6.43746043435106645−052	−9.08175111584580892+049	2.28376510575063428+051	2.65000301584520909+003	22

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 3.0 X = 1.80000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	−4.55998187214525883−002	−4.02585933813724254−001	1.72457460743847539−001	−2.01478965972951604−001	4.52646046219492481+000	25
3	1.49010058239281915−001	−3.36593559274044488−001	1.11005779931062775−001	2.76843872968805994−001	8.80939392076956958+000	24
4	1.97004348125903771−001	−4.24008558330151602−002	−4.76446000639600897−002	4.09313422708098781−001	1.63861060190996199+001	26
5	1.48799710142147117−001	1.23639509334369173−001	−1.82168500524117568−001	3.76970681775474539−001	2.61050139380708235+001	24
6	8.32265591240077778−002	1.35197591553270856−001	−2.93721481133870001−001	4.67469949184481412−001	3.79400004790263072+001	23
7	3.76900437550942202−002	8.71107022222487497−002	−4.74223122191242520−001	9.89822226250641566−001	5.18338623574273315+001	23
8	1.44640815970675667−002	4.25362947574088169−002	−9.32836962264416004−001	2.69197348981126112+000	6.77617506037794595+001	23
9	4.83754894536162302−003	1.71032856085082091−002	−2.26379742639166352+000	8.24756063628683211+000	8.57105950232199005+001	24
10	1.43738843928513612−003	5.90352892205652100−003	−6.49824734995450452+000	2.80047897478178647+001	1.05673028613862985+002	23
11	3.84829850556457423−004	1.79426519413364316−003	−2.13202155053417702+001	1.04883317991656834+002	1.27644648702775882+002	23
12	9.38502904748743768−005	4.88581495732417281−004	−7.82614817226464079+001	4.30251629469195761+002	1.51622696238387150+002	23
13	2.10303663438429657−005	1.20723497293983069−004	−3.16889852785588200+002	1.91914397762369207+003	1.77605372590815883+002	23
14	4.36107028426887800−006	2.73347683476381403−005	−1.40076986350760060+003	9.24695770654967945+003	2.05591465473373907+002	23
15	8.41897924386925975−007	5.71632290352503913−006	−6.70518322264762873+003	4.78530218525515839+004	2.35580134131187108+002	23
16	1.52070224548146426−007	1.11120834295791049−006	−3.45296399813810788+004	2.64658833076634282+005	2.67570780880573440+002	22
17	2.58132291962257006−008	2.01882896524562483−007	−1.90256708669792147+005	1.55760352438389405+006	3.01562971549996876+002	23
18	4.13338807297150156−009	3.44374668577320756−008	−1.11645497666631614+006	9.71804975362121314+006	3.37556384678751501+002	23
19	6.26455771100191977−010	5.53760117588193363−009	−6.94960166607930097+006	6.40623515572139982+007	3.75550778194464310+002	23
20	9.01335538087064812−011	8.42334943313760514−010	−4.57278475463977555+007	4.44875261609060480+008	4.15545967027992404+002	23
21	1.23438128824272331−011	1.21578638708834761−010	−3.17078884934140859+008	3.24586360707788800+009	4.57541807751940833+002	23
22	1.61294044573084773−012	1.66966375116102116−011	−2.31063153174760890+009	2.48221037538867067+010	5.01538187835289595+002	22
23	2.01527486840432128−013	2.18709195383107429−012	−1.76524639961917861+010	1.98527708835930250+011	5.47535017995852502+002	23
24	2.41242066120803519−014	2.73863473368526575−013	−1.41068508751800267+011	1.65737431512254526+012	5.95532226671330634+002	22
25	2.77176686049584415−015	3.28476096524529724−014	−1.17688217287078454+012	1.44162867914220680+013	6.45529755964388472+002	22
26	3.06170225712985813−016	3.78070285544882697−015	−1.02310236090830313+013	1.30436889920414794+014	6.97527558629522259+002	22
27	3.25636327833244858−017	4.18282756042129522−016	−9.25252596032082908+013	1.22574259071470289+015	7.51525595806915883+002	23
28	3.33946832078380647−018	4.45519649688151691−017	−8.69134842870903329+014	1.19464187997246878+016	8.07523835299050677+002	23
29	3.30645651912999866−019	4.57490821692606888−018	−8.46801721127665074+015	1.20600257253070352+017	8.65522250246532413+002	24
30	3.16457924518627833−020	4.53513096315756623−019	−8.54617621200062769+016	1.25951416467900687+018	9.25520818100907121+002	24
31	2.93108091482734762−021	4.34531928031851102−020	−8.92331093187744922+017	1.35928411130337828+019	9.87519519820754630+002	23
32	2.63000879302029969−022	4.02878345522603211−021	−9.62829180397285475+018	1.51429339647140188+020	1.05151833923729814+003	23
33	2.28841094421095904−023	3.61834242753233128−022	−1.07245529558231469+020	1.73968960101318520+021	1.11751726254989714+003	24
34	1.93268818145377256−024	3.15110176775711564−023	−1.23192176373012059+021	2.05916526570974397+022	1.18551627792191358+003	22
35	1.58569664674906224−025	2.66341547092124003−024	−1.45799159365587010+022	2.50892745549156244+023	1.25551537515477167+003	22
36	1.26493057077781679−026	2.18686242343983699−025	−1.77628711367824587+023	3.14415650144090238+024	1.32751454542339468+003	22
37	9.81836670568525172−028	1.74570229494167776−026	−2.22586082808520665+024	4.04949721628793571+025	1.40151378106016208+003	22
38	7.42090963325752215−029	1.35589137309818602−027	−2.86662074627893546+025	5.35622865219703572+026	1.47751307537748170+003	23
39	5.46541116721553552−030	1.02543187271666835−028	−3.79148310540915787+026	7.27068371874564782+027	1.55551242252128866+003	22
40	3.92485154090372479−031	7.55648853444953882−030	−5.14648827383598995+027	1.01219045238561531+029	1.63551181734946254+003	22
41	2.74998820286707173−032	5.42941310586262021−031	−7.16453275506735463+028	1.44426598347240176+030	1.71751125533043579+003	22
42	1.88106935996106443−033	3.80609112168041790−032	−1.02227171177912756+030	2.11091415260753348+031	1.80151073245825145+003	22
43	1.25687470201628995−034	2.60470916525470736−033	−1.49412316055713506+031	3.15853197095523486+032	1.88751024518109054+003	22
44	8.20781725379033581−036	1.74116888613946281−034	−2.23563290682673009+032	4.83565927359881440+033	1.97550979034088279+003	24
45	5.24126968460583500−037	1.13752356344939541−035	−3.42273016762683293+033	7.57106434491662596+034	2.06550936512207997+003	22
46	3.27441032573120919−038	7.26679977021139472−037	−5.35892541858224697+034	1.21164149432202738+036	2.15750896700803688+003	21
47	2.00227057224463182−039	4.54155577046304519−038	−8.57631054629236415+035	1.98107888615636880+037	2.25150859374373638+003	22
48	1.19895274939713979−040	2.77811840349102543−039	−1.40228166878371811+037	3.30782902928725988+038	2.34750824330382539+003	22
49	7.03330418681724980−042	1.66409714209596311−040	−2.34145062417966519+038	5.63779672078134047+039	2.44550791386511481+003	22
50	4.04366783715153384−043	9.76511506217280910−042	−3.99080933199942155+039	9.80437599716843626+040	2.54550760378284484+003	22
51	2.27941698941380307−044	5.61601212051967580−043	−6.94036221888614019+040	1.73900580908587796+042	2.64750731157013803+003	22

OBLATE RADIAL FUNCTIONS

H = 4.0 X = 1.80000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	−1.11256533017962311−001	2.92998866331400917−001	−6.93002310534816834−002	−3.47461618362023772−001	3.02762400601350363+000	24
3	−9.13828434554210240−002	−2.75271357696649013−001	9.66960550555445801−002	−3.53946195684666749−001	6.04607661023357135+000	25
4	4.10608180704559562−002	−4.29182439027750200−001	1.32468842317864381−001	5.13619408693016391−002	1.36731211006644547+001	24
5	1.38383154688084623−001	−2.27085956533167112−001	5.07242318218502087−002	3.42841609263829817−001	2.31287535849864770+001	24
6	1.50044449844432503−001	1.76182164357225177−002	−6.11112998006372464−002	3.85789625037139124−001	3.48313171928388655+001	24
7	1.11342972905278036−001	1.32606213235386945−001	−1.51902113850552100−001	3.48644364685639739−001	4.86356027334451155+001	24
8	6.52477193983742158−002	1.32736646424544639−001	−2.32098331092350539−001	4.31498760425834763−001	6.45011096112973017+001	23
9	3.20845067847847664−002	8.87862617690403105−002	−3.57685280168073919−001	8.47908475498504093−001	8.24048431083834844+001	23
10	1.36952493645546291−002	4.70677267273931907−002	−6.47065334777485976−001	2.08147869674036614+000	1.02333665778257427+002	23
11	5.18663928519675912−003	2.10880455044705974−002	−1.40167405509312751+000	5.66912335288576838+000	1.24279610251660498+002	23
12	1.76988223307451047−003	8.26025731680293801−003	−3.52906955508403305+000	1.68436300336594182+001	1.48237624028012879+002	23
13	5.50508752219829400−004	2.88927278767397810−003	−1.00304110658874541+001	5.44617506773417103+001	1.74204381644195830+002	23
14	1.57495788582678193−004	9.15773958233666097−004	−3.15688439455932770+001	1.90813603617409819+002	2.02177624213072565+002	22
15	4.17468562409559242−005	2.65894828550344336−004	−1.08627643370995767+002	7.20503009073906306+002	2.32155775133397583+002	23
16	1.03144328624679608−005	7.13208878626335183−005	−4.04911523824135648+002	2.91665234212363410+003	2.64137707715648234+002	22
17	2.38747537041867727−006	1.77931895638698930−005	−1.62336763310507032+003	1.25979838351084644+004	2.98122599918766909+002	23
18	5.19986644906522616−007	4.15194278963330231−006	−6.95987208497604066+003	5.78193184872311952+004	3.34109840862470909+002	22
19	1.06965135203660621−007	9.10450746665548080−007	−3.17558272341522660+004	2.80934039651444540+005	3.72098969095361125+002	23
20	2.08508672714563771−008	1.88374404389824930−007	−1.53570027915062954+005	1.44040059434021124+006	4.12089630889050236+002	22
21	3.86284709050169587−009	3.69036065596474118−008	−7.84359672934160581+005	7.77058026799319704+006	4.54081551478298872+002	22
22	6.81906432931025622−010	6.86644854672680089−009	−4.21800129481308056+006	4.39936827713088779+007	4.98074514858691021+002	22
23	1.14972205146778069−010	1.21673123921558786−009	−2.38173480008807477+007	2.60784358834602114+008	5.44068349355935647+002	22
24	1.85537025849053681−011	2.05831857835930032−010	−1.40869299760043243+008	1.61514254807917128+009	5.92062917159580973+002	22
25	2.87126133390022686−012	3.33147124490745044−011	−8.70811335023001079+008	1.04314555326708594+010	6.42058106625535893+002	24
26	4.26855885955762561−013	5.16921862441682934−012	−5.61508214868994496+009	7.01329837897734137+010	6.94053826542087051+002	22
27	6.10597333613413776−014	7.70302732078854210−013	−3.76990134182085313+010	4.90054729540709407+011	7.48050001807980794+002	22
28	8.41660024333653189−015	1.10423368088994902−013	−2.63105864515715651+011	3.55359973890058554+012	8.04046570139215831+002	22
29	1.11949131281930836−015	1.52503706277286067−014	−1.90590490452927400+012	2.67054399023208065+013	8.62043479534282733+002	22
30	1.43865796322555884−016	2.03200690230234900−015	−1.43099130230651696+013	2.07724301957958115+014	9.22040686304828611+002	22
31	1.78837654938739394−017	2.61550469416301695−016	−1.11218781332205145+014	1.67039428557867554+015	9.84038153532221200+002	24
32	2.15279173654643902−018	3.25605154767868926−017	−8.93727744804257253+014	1.38713037481813847+016	1.04803584984801863+003	22
33	2.51207451018258021−019	3.92479002096542343−018	−7.41711260678431455+015	1.18832679868599241+017	1.11403374846300239+003	22
34	2.84425192097134479−020	4.58545744196221692−019	−6.35061545064856982+016	1.04919634761239292+018	1.18203182638857021+003	22
35	3.12752418507552379−021	5.19771724217035720−020	−5.60435812079412249+017	9.53866174962094767+018	1.25203006380817609+003	22
36	3.34271344488084474−022	5.72140609879579505−021	−5.09294641324298631+018	8.92192823978003281+019	1.32402844356668588+003	22
37	3.47545004670532704−023	6.12104557893073735−022	−4.76182404055445818+019	8.57872268603760123+020	1.39802695075304940+003	22
38	3.51774668945814418−024	6.36989167200775383−023	−4.57707575237345999+020	8.47326145542968453+021	1.47402557235731167+003	22
39	3.46872659837210123−025	6.45287338941370162−024	−4.51941969477211716+021	8.59076673293914439+022	1.55202429698721702+003	22
40	3.33442993062834279−026	6.36798204454240732−025	−4.58083322049605379+022	8.93454085813319255+023	1.63202311463286805+003	21
41	3.12678540743936103−027	6.12596295868271198−026	−4.76296703096287288+023	9.52559919045723182+024	1.71402201647035386+003	22
42	2.86196629183614970−028	5.74846209156849285−027	−5.07693186797189423+024	1.04046346916708368+026	1.79802099469714833+003	21
43	2.55842686256233775−029	5.26502582095144444−028	−5.54433258724170151+025	1.16365296013803544+027	1.88402004239354069+003	22
44	2.23492872365580209−030	4.70949705770715566−029	−6.19966159823153630+026	1.33180874093396777+028	1.97201915340550015+003	22
45	1.90882239776400637−031	4.11637818258072236−030	−7.09440830582949510+027	1.55902385771285331+029	2.06201832224526966+003	22
46	1.59476675316882741−032	3.51765275679015733−031	−8.30355051881367733+028	1.86568077859485841+030	2.15401754400668859+003	22
47	1.30396997919706425−033	2.94040654255658400−032	−9.93553803752816231+029	2.28132116353578385+031	2.24801681429280353+003	22
48	1.04394281776665962−034	2.40540652948599464−033	−1.21475604511312340+031	2.84904904926645831+032	2.34401612915377141+003	21
49	8.18683431376469760−036	1.92662469881442742−034	−1.51689738430671401+032	3.63233740289848224+033	2.44201548503341690+003	22
50	6.29171460706303777−037	1.51156070959560459−035	−1.93375146098463027+033	4.72564931856433990+034	2.54201487872309319+003	22
51	4.74036589082773555−038	1.16213932655336353−036	−2.51558085131446041+034	6.27118464506993453+035	2.64401430732172777+003	23

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 5.0 X = 1.80000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	7.94791209983564191−002	2.53592432009970606−001	−6.65833999299020605−002	3.81040512534916157−001	4.28957108509711792−001	24
3	−5.95896252719143185−002	4.00569983166142551−001	−8.54933623184939042−002	−2.16878971080052782−001	2.10980581603699983+000	23
4	−1.05659713064465619−001	−1.58408926032385052−002	1.72261545900237428−002	−4.43848769751195342−001	1.05123673338162820+001	24
5	−3.45699974958909721−002	−3.86112414178316857−001	1.04941952253917709−001	−1.92375506772870508−001	1.93843905253782472+001	24
6	6.69499020435561813−002	−3.74243313346993572−001	9.44920634292143552−002	1.76352586898932456−001	3.09101722480266658+001	23
7	1.22291678383918061−001	−1.49769465874928189−001	1.95448737940236353−002	3.61779203595009512−001	4.45827994265121613+001	23
8	1.20653027747577374−001	5.14732879375986978−002	−6.41877153795196154−002	3.63570308875641676−001	6.03574156276832052+001	23
9	8.88733058355850800−002	1.36002585089373743−001	−1.31659252631447018−001	3.29275616978632641−001	7.81951015168234738+001	23
10	5.37646671113373711−002	1.29937365994983942−001	−1.93972879208371025−001	4.08548727298339981−001	9.80744686145256602+001	24
11	2.79557858897766943−002	8.91910140740942647−002	−2.89554737215706106−001	7.63495999099544553−001	1.19982457348935945+002	22
12	1.28339574920673560−002	5.00032046342348528−002	−4.95405942661106591−001	1.74520810176436229+000	1.43910734702978055+002	23
13	5.29588245774970546−003	2.41336221873442222−002	−9.93271048610844855−001	4.38049433480265961+000	1.69853781372837966+002	22
14	1.98977967729438915−003	1.03198032385082355−002	−2.28344772540496440+000	1.18631627202331281+001	1.97807826657445982+002	23
15	6.87410223367027991−004	3.98184672584698133−003	−5.87001021566926197+000	3.46173646447184008+001	2.27770225429389786+002	22
16	2.20055943375739133−004	1.40416772501082131−003	−1.65796807530400309+001	1.08559479693592057+002	2.59739079076532843+002	22
17	6.56887815207227630−005	4.56899139508210198−004	−5.08515918421526685+001	3.64381287205052726+002	2.93712997091276940+002	21
18	1.83808920559635486−005	1.38205178032378395−004	−1.67947091629676517+002	1.30345434536632803+003	3.29690942758163610+002	22
19	4.84271303232287113−006	3.90969067064294076−005	−5.93433593040346848+002	4.94937307604583059+003	3.67672130729289705+002	22
20	1.20591784789452341−006	1.03952971466057563−005	−2.23171579802785894+003	1.98773593867376964+004	4.07655957504977672+002	22
21	2.84773498616676966−007	2.60876300523421749−006	−8.89382417938080245+003	8.41648957608616868+004	4.49641953295799804+002	22
22	6.39597920775090786−008	6.20160407258643176−007	−3.74212760968117564+004	3.74651272589800388+005	4.93629748083923852+002	22
23	1.36984181590387092−008	1.40090866200901231−007	−1.65707999482855677+005	1.74878835341846988+006	5.39619047301353352+002	22
24	2.80414966254958630−009	3.01545293448219534−008	−7.70104100730969643+005	8.54008790490921236+006	5.87609614138688807+002	22
25	5.49807459877765247−010	6.20009527721258518−009	−3.74681189881591563+006	4.35410981284693287+007	6.37601256500387628+002	21
26	1.03448593267570061−010	1.22039831457705621−009	−1.90423695217393143+007	2.31327801519486687+008	6.89593817265071406+002	21
27	1.87109328564651290−011	2.30421238956950934−010	−1.00893431407298058+008	1.27849434535281986+009	7.43587166929163670+002	21
28	3.25845567923943077−012	4.18062514715429349−011	−5.56294958801964237+008	7.33881529618038577+009	7.99581197991081316+002	22
29	5.47150355940772919−013	7.30077653105022704−012	−3.18665381239282838+009	4.36895703257899884+010	8.57575820621542407+002	21
30	8.87082582596483482−014	1.22901618703580393−012	−1.89364959248034180+010	2.69383615147631124+011	9.17570959294600260+002	22
31	1.39035154192773674−014	1.99713013169228816−013	−1.16573347827003504+011	1.71816954565875399+012	9.79566550143647638+002	21
32	2.10906806908720172−015	3.13667122039237081−014	−7.42471649118487481+011	1.13229710948201321+013	1.04356253886968709+003	21
33	3.09977205736215324−016	4.76714782591210142−015	−4.88684091943419199+012	7.70170122651264283+013	1.10955887907404483+003	21
34	4.41854216802303029−017	7.01862861739114512−016	−3.32022264738178470+013	5.40141990823393622+014	1.17755553092000764+003	22
35	6.11430895113003748−018	1.00206228304606138−016	−2.32622749368578179+014	3.90225014460090535+015	1.24755246005135364+003	21
36	8.22088811175896011−019	1.38867876857455148−017	−1.67906475792386469+015	2.90151078479338132+016	1.31954963671299780+003	21
37	1.07486531895812509−019	1.86966238149599092−018	−1.24745093007552837+016	2.21857474912535818+017	1.39354703503175768+003	20
38	1.36770819022803284−020	2.44762526175743415−019	−9.53134998764823019+016	1.74310854337727121+018	1.46954463242480137+003	21
39	1.69495436984056002−021	3.11811073792526317−020	−7.48369281464320797+017	1.40622242227816875+019	1.54754240911054195+003	20
40	2.04715802004908254−022	3.86836940732072615−021	−6.03369500356602959+018	1.16401615910845220+020	1.62754034770221283+003	21
41	2.41135473051400080−023	4.67693292824001311−022	−4.99171545498924888+019	9.87987899060900680+020	1.70953843286854325+003	20
42	2.77178814066620216−024	5.51418963110355625−023	−4.23472289001356357+020	8.59327807944231223+021	1.79353665104917724+003	21
43	3.11105238144627530−025	6.34402730440436498−024	−3.68157485038402722+021	7.65458019566980200+022	1.87953499021497919+003	20
44	3.41153257244353616−026	7.12644072699803487−025	−3.27804132273187959+022	6.97898777985353724+023	1.96753343966532032+003	21
45	3.65697057616952650−027	7.82083662233545623−026	−2.98757576082153254+023	6.50934124371703880+024	2.05753198985597158+003	20
46	3.83395591301827828−028	8.38964020569298445−027	−2.78554789110931809+024	6.20770485591841295+025	2.14953063225243754+003	21
47	3.93314810777958246−029	8.80174245765679304−028	−2.65560868683106723+025	6.05007158105347717+026	2.24352935920452569+003	21
48	3.95007565115853249−030	9.03533979098128492−029	−2.58740324435128634+026	6.02311093074268016+027	2.33952816383871117+003	21
49	3.88542043132527642−031	9.07980572943012826−030	−2.57516562013127281+027	6.12232528996650268+028	2.43752703996547086+003	21
50	3.74477244710339061−032	8.93637995713539997−031	−2.61692086771311795+028	6.35125697624456219+029	2.53752598199925578+003	22
51	3.53791366878445370−033	8.61763501568068236−032	−2.71413923141787751+029	6.72157442745790513+030	2.63952498488917062+003	21

OBLATE RADIAL FUNCTIONS

H = 6.0 X = 1.80000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	3.35485167500552505−002	−4.38183511911239979−001	7.88293515846437231−002	1.42076444603948820−001	−3.96828885830739182+000	24
3	7.99182464099141585−002	1.28378482933808472−001	−3.11970436012028249−002	4.41740760802118241−001	−3.27797903843184929+000	25
4	8.26977528672672139−003	4.41834798606310182−001	−8.73531980606610170−002	8.61563226540414071−002	7.31214012848986341+000	24
5	−8.10343083095543545−002	2.27245275153094560−001	−3.74860758836562710−002	−3.79958108045051638−001	1.49134187085504893+001	25
6	−7.44789495505211140−002	−2.08807468129907325−001	5.37428950058769967−002	−3.77103308169359116−001	2.62594432274110872+001	24
7	5.52650756964956487−004	−4.12447515164950415−001	9.53796623076584499−002	−5.59641239011970515−002	3.97275520049222553+001	24
8	7.48254313691639407−002	−3.12885125269563287−001	6.69256670118145371−002	2.45479779505259079−001	5.53711820152833167+001	24
9	1.07718701030922572−001	−9.44395453879938608−002	1.73958921626520943−003	3.63389919403558690−001	7.31139413336567528+001	23
10	1.00545679196970217−001	7.28665222323813434−002	−6.39497801156164914−002	3.44603351459806310−001	9.29223857780106065+001	23
11	7.38233896443060218−002	1.37048723995581110−001	−1.17088656755683572−001	3.15094243301249703−001	1.14775928256730038+002	23
12	4.57264026580588103−002	1.27143619459298475−001	−1.67923808002521745−001	3.92721366954833897−001	1.38661500587886042+002	22
13	2.47712672957054468−002	8.89390097830423036−002	−2.44828654857507556−001	7.07810293344487372−001	1.64570445884335911+002	23
14	1.19995933180167928−002	5.19463921735863225−002	−4.02380853080263608−001	1.53388052541278461+000	1.92496839836936458+002	22
15	5.27711695162996817−003	2.64876123049838294−002	−7.62384645970110833−001	3.62213446207522817+000	2.22436516925061995+002	22
16	2.13034930853609930−003	1.20897903860673240−002	−1.63822726006071666+000	9.15453247202675473+000	2.54386479833247715+002	21
17	7.96208933427103105−004	5.01995278663745855−003	−3.90643064561709664+000	2.47398363273462034+001	2.88344528084663583+002	23
18	2.77377911013309669−004	1.91795753409109861−003	−1.01712979999770918+001	7.13829677271491926+001	3.24309017370143473+002	22
19	9.05729161570214348−005	6.80069347472248380−004	−2.86028745539152474+001	2.19229309482467257+002	3.62278699487766851+002	21
20	2.78500445131968444−005	2.25296633882024659−004	−8.61971502741759387+001	7.14119084592842733+002	4.02252613456670412+002	21
21	8.09606828185086376−006	7.01134578340834341−005	−2.76719213300553730+002	2.45877807770279253+003	4.44230009942551298+002	21
22	2.23269095535995775−006	2.05897277671803258−005	−9.41826087481932017+002	8.92028218573423824+003	4.88210297852593307+002	21
23	5.85851788087061944−007	5.72742854326196293−006	−3.38501633087204871+003	3.40030317443088662+004	5.34193005979180715+002	22
24	1.46655443158808037−007	1.51409969485189713−006	−1.28038876772798788+004	1.35840942868849859+005	5.82177755042675641+002	20
25	3.51059790822129847−008	3.81485392435594582−007	−5.08211769107434437+004	5.67442925780363888+005	6.32164237037544274+002	21
26	8.05290919256844689−009	9.18386335950672583−008	−2.11133340976990825+005	2.47338919173729089+006	6.84152199784159090+002	20
27	1.77353980033367034−009	2.11724626182829471−008	−9.15993414970320266+005	1.12285835140715988+007	7.38141435241857910+002	21
28	3.75662026680354196−010	4.68370439386447407−009	−4.14161656249726754+006	5.29999494095787623+007	7.94131770573879329+002	20
29	7.66493174053603884−011	9.96021031142722694−010	−1.94802853057732791+007	2.59694448916594490+008	8.52123061249145688+002	21
30	1.50870214415955075−011	2.03950566302914810−010	−9.51586933707332135+007	1.31904808222489776+009	9.12115185667961168+002	20
31	2.86855234161717151−012	4.02729000484139971−011	−4.82028321462025357+008	6.93572761467122155+009	9.74108040939340376+002	21
32	5.27499562348435501−013	7.67949522016079933−012	−2.52851507163582884+009	3.77070581923223746+010	1.03810153953680501+003	22
33	9.39244439926886390−014	1.41591507950197455−012	−1.37174435468559327+010	2.11717419716282883+011	1.10409560663016700+003	21
34	1.62104438500703931−014	2.52719014079671551−013	−7.68746499949166677+010	1.22640012389959531+012	1.17209017794177189+003	21
35	2.71457896180543229−015	4.37128793877728270−014	−4.44549613069604208+011	7.32181040311946216+012	1.24208519801279037+003	21
36	4.41473911560138231−016	7.33488853537131724−015	−2.64997758253146403+012	4.50103287899970395+013	1.31408061879243974+003	20
37	6.97880623596833136−017	1.19509578002184624−015	−1.62680797117778723+013	2.84665629282479662+014	1.38807639848327282+003	20
38	1.07321443726927132−017	1.89244427045170246−016	−1.02758143448244156+014	1.85068048190607773+015	1.46407250059083246+003	20
39	1.60677900342872442−018	2.91485501530248255−017	−6.67297822573495831+014	1.23585209975778644+016	1.54206889313740978+003	20
40	2.34372231062164369−019	4.37043815179433744−018	−4.45149561912763840+015	8.47079439585243742+016	1.62206554800834199+003	19
41	3.33299991335144760−020	6.38363739655762079−019	−3.04827357541590690+016	5.95532656036182601+017	1.70406244040594744+003	20
42	4.62409217448291390−021	9.08970472299553106−020	−2.14121659164778320+017	4.29168554296624794+018	1.78805954839133221+003	20
43	6.26250328446698601−022	1.26257267801441829−020	−1.54183988613286104+018	3.16827410035850290+019	1.87405685249828975+003	20
44	8.28427568389338805−023	1.71182628588342695−021	−1.13741355916368927+019	2.39461270636270006+020	1.96205433540662923+003	19
45	1.07099768744780362−023	2.26682223525247614−022	−8.59093205031503206+019	1.85192372867736086+021	2.05205198166471445+003	20
46	1.35388166909777478−024	2.93342293897457072−023	−6.63987707647949161+020	1.46472242184412432+022	2.14404977745292834+003	19
47	1.67436876754853361−025	3.71162839260073703−024	−5.24861388042510191+021	1.18416397776423976+023	2.23804771038131333+003	20
48	2.02679498593338342−026	4.59419092404782217−025	−4.24103614823671591+022	9.78098251546229747+023	2.33404576931586368+003	20
49	2.40246793266453713−027	5.56570653489768694−026	−3.50130721284524456+023	8.25023609927175438+024	2.43204394422892970+003	21
50	2.78988652374138903−028	6.60238362634544987−027	−2.95200424274101591+024	7.10348304664250464+025	2.53204222606998652+003	21
51	3.17526963983537665−029	7.67262583036773396−028	−2.54061418666552914+025	6.24041304033870897+026	2.63404060665366240+003	21

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H=7.0 X=1.80000000 M=2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	−7.22430621394856410−002	−2.84546746192488163−002	9.84709761496065077−003	−4.62501525044406990−001	−1.05956525716544756+001	23
3	9.26151640101134905−003	−4.62576966642746767−001	7.23437701702962022−002	2.46353406087036820−002	−1.03776727949597438+001	23
4	6.81767025994027834−002	−2.16526288651840079−001	3.01666009660109391−002	3.98389173837724109−001	4.08466529086879527+000	23
5	4.42537106152162817−002	3.39888850616610918−001	−6.08336133660680681−002	2.94123481741303166−001	9.67676377785498349+000	23
6	−3.72293073018874170−002	4.03691621160574587−001	−6.70514301649246570−002	−1.77941044506576629−001	2.10375437832845670+001	23
7	−7.85690280624537455−002	4.43265836620 -26−002	−9.55494441690977976−005	−4.28775661635500721−001	3.41393013273133882+001	23
8	−4.64549682852328677−002	−3.12601841759 -42−001	6.64651704397671438−002	−2.78023818686379383−001	4.95967145043916895+001	23
9	2.12268156917472425−002	−4.00153259472 21−001	8.17725572178938427−002	4.57518960898662767−002	6.72036026037745036+001	23
10	7.57569501268705184−002	−2.57024233547 73−001	4.70301899370268013−002	2.85186029976668418−001	8.69117555614111238+001	23
11	9.54808363831684897−002	−5.34298853902 ·97−002	−9.19123329198703775−003	3.58017485060271828−001	1.08688657886667266+002	23
12	8.59274904277819922−002	8.72938358055666547−002	−6.25152099335733194−002	3.28597166751965239−001	1.32514249999744122+002	23
13	6.30099688332667641−002	1.36932226478533392−001	−1.06046704069131712−001	3.04261554608951106−001	1.58375341738284068+002	23
14	3.97539688462125371−002	1.24450920891706230−001	−1.48932119588048680−001	3.81294833668548718−001	1.86262940807412764+002	23
15	2.22299187955766977−002	8.83185740874157214−002	−2.13192425268161673−001	6.68642629904850902−001	2.16170733681740967+002	22
16	1.12267853560843849−002	5.32327759852204773−002	−3.39844035411135540−001	1.38970154591562245+000	2.48094178410367391+002	22
17	5.18827691112941879−003	2.83237263063806345−002	−6.16536212010356957−001	3.12822922195965803+000	2.82029939032619601+002	21
18	2.21544047470956747−003	1.36018715045098743−002	−1.25708620962548624+000	7.49015713488118542+000	3.17975520785057448+002	22
19	8.80722616210090439−004	5.98169283249640766−003	−2.82625215141858881+000	1.90604281371095354+001	3.55929028089548874+002	20
20	3.27933981444005306−004	2.43393247094670124−003	−6.90272581775452505+000	5.15102271247150221+001	3.95889000090951562+002	21
21	1.14938243562961862−004	9.23487469218972007−004	−1.81270948094550392+001	1.47492922604174199+002	4.37854296531453128+002	20
22	3.80795361388093597−005	3.28737230336838738−004	−5.08107940078367780+001	4.46153614284729023+002	4.81824017076870784+002	21
23	1.19680076356926910−005	1.10336500457386748−004	−1.51178897546521869+002	1.42147067344296365+003	5.27797443338756415+002	20
24	3.57933305646241528−006	3.50619728847268140−005	−4.75338666233555383+002	4.75686690141440668+003	5.75773996580949874+002	22
25	1.02144095136957466−006	1.05857688586687605−005	−1.57358891364064992+003	1.66774925469387009+004	6.25753206446306800+002	19
26	2.78805116710700860−007	3.04571302569319484−006	−5.46758998721873823+003	6.11180043242435947+004	6.77734687543632061+002	20
27	7.29453892523617387−008	8.37299977576991153−007	−1.98857211047663404+004	2.33632429842612974+005	7.31718121718406287+002	19
28	1.83292161578856564−008	2.20449542800853105−007	−7.55260314428843314+004	9.29829356804689838+005	7.87703244485624333+002	21
29	4.43096656293630700−009	5.57023344847868105−008	−2.98915231601644159+005	3.84621411979279074+006	8.45689834546077225+002	19
30	1.03217397596807149−009	1.35326140032302114−008	−1.23048940331492347+006	1.65097983853536603+007	9.05677705611677602+002	20
31	2.32027532009557971−010	3.16639073123450120−009	−5.25955493995587705+006	7.34348902998754642+007	9.67666699977298256+002	19
32	5.04010150216969871−011	7.14637899022704084−010	−2.33073207267729640+007	3.38017550809330668+008	1.03165668342601125+003	21
33	1.05922472264230333−011	1.55795004150922226−010	−1.06929425487171442+008	1.60812448201232734+009	1.09764754116124143+003	19
34	2.15616584674703898−012	3.28491908998897641−011	−5.07228168439030456+008	7.89859808919909151+009	1.16563917453627981+003	21
35	4.25581091090543883−013	6.70677769533778414−012	−2.48481723135402928+009	4.00102493841973387+010	1.23563149840768298+003	19
36	8.15301027309954219−014	1.32738681570954636−012	−1.25572007926330176+010	2.08811948315341786+011	1.30762443898036163+003	21
37	1.51736595190001821−014	2.54928212893654177−013	−6.53965814826568300+010	1.12176556379994965+012	1.38161793204281889+003	19
38	2.74583932686537827−015	4.75540427782412033−014	−3.50645274119828395+011	6.19778507794661613+012	1.45761192151396440+003	20
39	4.83531904497816058−016	8.62365683180524567−015	−1.93395236518295665+012	3.51889517264492899+013	1.53560635824027226+003	18
40	8.29224866323485412−017	1.52156678782507689−015	−1.09629374105654447+013	2.05154013126395948+014	1.61560119899524670+003	20
41	1.38589275207319993−017	2.61411816767322162−016	−6.38222443091480564+013	1.22728353341204305+015	1.69759640564327307+003	18
42	2.25887745768576302−018	4.37636216626732777−017	−3.81295582278003603+014	7.52845034140409439+015	1.78159194443773586+003	20
43	3.59286741300974546−019	7.14424303949282305−018	−2.33611820558790934+015	4.73241124364798550+016	1.86758778542934713+003	18
44	5.58007859327067662−020	1.13799051472607347−018	−1.46685291887041168+016	3.04656556463938502+017	1.95558390196536605+003	20
45	8.46723739301437727−021	1.76982321235882681−019	−9.43338626874575866+016	2.00741937345673852+018	2.04558027026411392+003	18
46	1.25598579177264853−021	2.68896647988619739−020	−6.20986985847358445+017	1.35308779680469561+019	2.13757686905213331+003	20
47	1.82220432160153587−022	3.99344535244077258−021	−4.18204410139925791+018	9.32494648931476860+019	2.23157367925367942+003	18
48	2.58699686214280110−023	5.80026323801398936−022	−2.87975282996700480+019	6.56722787196232750+020	2.32757068372410107+003	19
49	3.59574131142282630−024	8.24337458126678534−023	−2.02657447084945975+020	4.72417463346420566+021	2.42556786702016920+003	18
50	4.89522532744412368−025	1.14690997466565003−023	−1.45680395389508418+021	3.46960382358726587+022	2.52556521520162068+003	20
51	6.53037381910982004−026	1.56286230521111368−024	−1.06922907245914420+022	2.60048577808064368+023	2.62756271565916611+003	19

OBLATE RADIAL FUNCTIONS

H = 8.0 X = 1.80000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	7.28396548844917933−003	4.58354074158322460−001	−6.30063005067822252−002	8.26387139668677795−002	−1.94237996138059759+001	24
3	−6.29963806849808723−002	8.35094294074487474−002	−7.40380070895635968−003	−4.58166716706338535−001	−1.93656429956223289+001	25
4	−4.45580370740816254−002	−3.08570132211401847−001	4.71249794694796651−002	−3.35287905642613636−001	1.54737735892829929−001	24
5	4.20952907164499048−002	−3.66134770622820536−001	4.96784284486064251−002	2.68251670872206804−001	3.49293691839356864+000	24
6	6.31252464715935451−002	1.00147694122762441−001	−1.96046813738688441−002	4.35923342560734393−001	1.55694281521800319+001	24
7	7.57545720042308308−003	4.32011489549631341−001	−6.67550698458912610−002	8.47704500690295575−002	2.78981769422102452+001	25
8	−5.54866621447865709−002	2.83735873478863565−001	−4.04199710121056584−002	−3.24628218712449265−001	4.31071642109061111+001	24
9	−6.64531302678257945−002	−1.00559375095774830−001	2.36307182381964769−002	−4.07879082702858268−001	6.05175976442200780+001	24
10	−2.45714905647000393−002	−3.64534055204821314−001	6.87075946173566855−002	−1.80488602209951110−001	8.00852634861732686+001	24
11	3.33833112003445931−002	−3.71910248853964877−001	6.84891494132411319−002	1.20099394854379238−001	1.01755745161226464+002	25
12	7.37715503414535087−002	−2.08653735074836135−001	3.24300849642230423−002	3.07902892290561251−001	1.25498522767600099+002	23
13	8.53162692542735472−002	−2.21178054272023914−002	−1.62377481166702919−002	3.49760669210197737−001	1.51293759154720275+002	24
14	7.48215066813922737−002	9.74360609226944152−002	−6.06616963572749911−002	3.15022997784567788−001	1.79128071656414913+002	23
15	5.48513719441696041−002	1.36183387686630796−001	−9.73576417545652748−002	2.95756296135415032−001	2.08992118521659042+002	23
16	3.51259480833189472−002	1.21882963334948178−001	−1.34436230553662189−001	3.72819713931937252−001	2.40879201736298736+002	23
17	2.01484315826851993−002	8.74812804725235931−002	−1.89618758613697540−001	6.39902923332993633−001	2.74784410906611308+002	22
18	1.05222725652809597−002	5.40641808428633567−002	−2.95063888221598709−001	1.28572459784969746+000	3.10704077344826048+002	22
19	5.06107588398770063−003	2.97643291487262721−002	−5.17139746250037825−001	2.78375878472226991+000	3.48635414589267212+002	21
20	2.26150177142215155−003	1.48911846486580910−002	−1.01088935676378385+000	6.37973942220970783+000	3.88576275304251876+002	21
21	9.45167268158429782−004	6.86014481030199568−003	−2.16708339524149435+000	1.54624759663856826+001	4.30524983117590751+002	20
22	3.71491464662410356−004	2.93770517702971605−003	−5.02487590656544199+000	3.96227895146898055+001	4.74480213987036674+002	21
23	1.37936491133954552−004	1.17776625928579778−003	−1.24806036868425830+001	1.07164522136752031+002	5.20440911045442597+002	21
24	4.85685697703008719−005	4.44565233613983687−004	−3.29762857333528739+001	3.05156647082597164+002	5.68406222524577499+002	20
25	1.62703607699485447−005	1.58719521097263421−004	−9.22046107283033900+001	9.12485016628352196+002	6.18375455868031430+002	21
26	5.20042504583616065−006	5.38027701275215035−005	−2.71692724403756373+002	2.85809539567481935+003	6.70348043379323849+002	20
27	1.58988191950886509−006	1.73727851146132357−005	−8.40775901453615659+002	9.35573442747731038+003	7.24323516206342460+002	20
28	4.65948137591673019−007	5.35848905936189583−006	−2.72451042574672466+003	3.19389038529261584+004	7.80301484428584165+002	20
29	1.31164952353160641−007	1.58265967559513239−006	−9.22155239011010785+003	1.13494898554718992+005	8.38281621665298652+002	20
30	3.55288460237810055−008	4.48585512688414633−007	−3.25284751179271665+004	4.19077202162938933+005	8.98263653069435849+002	19
31	9.27535535183578791−009	1.22251390652919368−007	−1.19347499343407868+005	1.60540849864523148+006	9.60247345883060477+002	20
32	2.33726030505962190−009	3.20897712622457681−008	−4.54661726021070841+005	6.37119504982899940+006	1.02423250194889307+003	20
33	5.69243108490759034−010	8.12578571375611099−009	−1.79555739369373554+006	2.61589771320133937+007	1.09021895172884431+003	21
34	1.34166108251099223−010	1.98779012000306187−009	−7.34040029640877215+006	1.10981507054936883+008	1.15820654949308828+003	19
35	3.06366420549600946−011	4.70381113591429641−010	−3.10225670682459534+007	4.85976968518155929+008	1.22819516942535449+003	20
36	6.78508571386094694−012	1.07801640663259910−010	−1.35378010745410010+008	2.19410056633120460+009	1.30018470245057473+003	20
37	1.45886639213710323−012	2.39540455290718185−011	−6.09321768579379475+008	1.02034091465092573+010	1.37417505363593106+003	20
38	3.04805614598575585−013	5.16602960417320482−012	−2.82569390024951125+009	4.88295261688418706+010	1.45016614004999948+003	19
39	6.19374003799486833−014	1.08236714606509241−012	−1.34885990803792488+010	2.40267035638180434+011	1.52815788899010089+003	20
40	1.22506029931708362−014	2.20505397818462293−013	−6.62191527197455759+010	1.21458931206058346+012	1.60815023650731634+003	19
41	2.36029987916846343−015	4.37172602572248824−014	−3.34050752319407456+011	6.30316025879037967+012	1.69014312617345520+003	19
42	4.43295826252697472−016	8.44141713212173360−015	−1.73026693025772068+012	3.35559829042265377+013	1.77413650804571432+003	19
43	8.12139862030443225−017	1.58864088173809586−015	−9.19529926691438652+012	1.83134758378325227+014	1.86013033779366129+003	19
44	1.45230121420627099−017	2.91598165438825528−016	−5.01036818556411291+013	1.02396047177882769+015	1.94812457596012974+003	19
45	2.53649801209045452−018	5.22367797664702809−017	−2.79730790163316637+014	5.86197833585354029+015	2.03811918733308326+003	19
46	4.32926385004053225−019	9.13837620611771869−018	−1.59922318988884909+015	3.43403161453894115+016	2.13011414040982947+003	18
47	7.22491225362861615−020	1.56212955425596402−018	−9.35667515539893792+015	2.05743582258523036+017	2.22410940693840403+003	19
48	1.17954867582556534−020	2.61072912342140012−019	−5.59933183024328223+016	1.26004070024093330+018	2.32010496152369237+003	18
49	1.88485972722508845−021	4.26808177110480154−020	−3.42549669272607018+017	7.88431726224319908+018	2.41810078128806319+003	19
50	2.94935661870583346−022	6.82885903102047016−021	−2.14123921624286187+018	5.03801785847669773+019	2.51809684557806805+003	18
51	4.52123024305934268−023	1.06983343557744804−021	−1.36695108070538132+019	3.28605967123786204+020	2.62009313571020408+003	19

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H=9.0 X=1.80000000 M=2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	5.25524775912310875−002	−1.87885355482026431−001	1.96717144391769384−002	4.28322787147962636−001	−3.03400129442213547+001	24
3	1.96930964785561530−002	4.28241636548237563−001	−5.25451759287549998−002	1.88056693133057046−001	−3.03260782451631671+001	24
4	−2.69668803163140930−002	4.16230336490756561−001	−5.06260521486801198−002	−1.90357651774921574−001	−5.47570239238361657+000	23
5	−5.18595687319774875−002	−1.71079758069425746−001	2.47010880916765736−002	−4.23829104182735503−001	−3.94268498265324982+000	24
6	1.39252474137972509−003	−4.50607442241580459−001	5.82123448803421472−002	−1.82869997971342571−002	1.03429643027314422+001	24
7	5.63284529728210495−002	−1.57886449075126709−001	1.70625955902707512−002	4.17400032543843355−001	2.10642752188902299+001	23
8	4.03587109494180270−002	3.01967442258115730−001	−4.41108375201475671−002	3.19272188055752137−001	3.60087218114355550+001	24
9	−1.87501153755049347−002	4.19518757795955029−001	−5.79934271379788271−002	−1.00059129393330051−001	5.31225937887514519+001	23
10	−5.99776521986488253−002	1.51294990306289381−001	−1.72399309476298935−002	−3.93432131521171032−001	7.24953715001934651+001	23
11	−5.21780756008789506−002	−2.04947656665794014−001	3.74732480089752660−002	−3.55041770960693392−001	9.40195383917586998+001	23
12	−8.18632559817690712−003	−3.84920183699641975−001	6.60767431693154248−002	−9.42032668377379806−002	1.17649553152155955+002	23
13	4.04387018030498299−002	−3.37853817364098109−001	5.66996225024319757−002	1.74319810327615776−001	1.43355622023129345+002	24
14	7.05787460448009880−002	−1.67339694001026252−001	2.14987551825154418−002	3.20321015702897459−001	1.71118045852780665+002	23
15	7.68313222973517571−002	2.36531033415598668−003	−2.09344392584884722−002	3.40433217939505732−001	2.00923214393474121+002	23
16	6.60981573958709081−002	1.04761036802257519−001	−5.87061499026823301−002	3.03417438449376636−001	2.32761434441477130+002	23
17	4.84698705459013100−002	1.35069782654716261−001	−9.03214685399155446−002	2.88957850542387803−001	2.66625630568223562+002	23
18	3.14256803306597570−002	1.19439882720995038−001	−1.22987939546163257−001	3.66445070944953783−001	3.02510531458950150+002	22
19	1.84083807546268293−002	8.65132436708784404−002	−1.71365088342291991−001	6.18202178725251929−001	3.40412140763950843+002	22
20	9.88321146632489722−003	5.45694142084946604−002	−2.61487944277768457−001	1.20772552854925586+000	3.80327382389443445+002	21
21	4.91362944108152959−003	3.08972705922523623−002	−4.45567884212868113−001	2.53145244206132570+000	4.22253856656441001+002	21
22	2.27987911311642179−003	1.59900676904255625−002	−8.41257916205843944−001	5.59401576826654964+000	4.66189669042637353+002	21
23	9.93322916400614426−004	7.65575759082232283−003	−1.73366856861649133+000	1.30198389829364519+001	5.12133307644922485+002	20
24	4.08413752825191710−004	3.42071230775675492−003	−3.84990325502803283+000	3.19187079167363165+001	5.60083554055247771+002	20
25	1.59124885632909171−004	1.43586030916810576−003	−9.12818322692186407+000	8.23168211012526704+001	6.10039417586148371+002	19
26	5.89556114195189382−005	5.69181889272393842−004	−2.29568747533552508+001	2.22859420392647803+002	6.62000086086880184+002	20
27	2.08338762344265152−005	2.13987766194221705−004	−6.09372019860351385+001	6.31934012398498602+002	7.15964888724519746+002	20
28	7.04065412018067507−006	7.65728847947529864−005	−1.70052834797235027+002	1.87255535931148069+003	7.71933267510963955+002	20
29	2.28064717213245242−006	2.61593634280902535−005	−4.97285260541072001+002	5.78642108129636763+003	8.29904755301646416+002	19
30	7.09574544325839129−007	8.55428938974329869−006	−1.51967708334023609+003	1.86107200286416919+004	8.89878958637222575+002	19
31	2.12438242411636292−007	2.68374612859681673−006	−4.84158304943734158+003	6.21915848039491467+004	9.51855544247081590+002	20
32	6.13033109707380781−008	8.09432356923384151−007	−1.60475082950032127+004	2.15585064860347356+005	1.01583422834825821+003	19
33	1.70768216500473256−008	2.35118861438577221−007	−5.52342336775435949+004	7.74080848880893401+005	1.08181476809740673+003	19
34	4.59833083344206483−009	6.58823720820314778−008	−1.97092490902256135+005	2.87507149711966145+006	1.14979695471492488+003	19
35	1.19842842312883965−009	1.78347126076995420−008	−7.28020480835733076+005	1.10322939863273688+007	1.21978060791786068+003	19
36	3.02655177886711893−010	4.67047864091931966−009	−2.77996321646382028+006	4.36856623469565842+007	1.29176557138468893+003	19
37	7.41439321001094167−011	1.18464753329536242−009	−1.09601735462648463+007	1.78322187712261543+008	1.36575170903922844+003	19
38	1.76371477263372832−011	2.91367281684952690−010	−4.45639495003414932+007	7.49609523707165852+008	1.44173890198904054+003	20
39	4.07765167858057347−012	6.95617061006146631−011	−1.86672787870355899+008	3.24210456630627827+009	1.51972704598994832+003	19
40	9.17060457803010937−013	1.61360947935688466−011	−8.04796980714732661+008	1.44147206990373123+010	1.59971604933593877+003	19
41	2.00791291392566920−013	3.64013168360806015−012	−3.56784762776126713+009	6.58296256275898060+010	1.68170583109488515+003	18
42	4.28333592966873093−014	7.99266780187622052−013	−1.62507732268880512+010	3.08562012369661736+011	1.76569631962687162+003	19
43	8.90884497712641364−015	1.70948222491824605−013	−7.59882363383634184+010	1.48340181419156344+012	1.85168745133460183+003	18
44	1.80782525031950001−015	3.56415542035375182−014	−3.64503281816623149+011	7.30932774347675742+012	1.93967916960530128+003	18
45	3.58149834852533537−016	7.24886280703484776−015	−1.79240706957569603+012	3.68910900028174899+013	2.02967142391133170+003	19
46	6.93120734099614021−017	1.43909343635139533−015	−9.02956477313749260+012	1.90602627878132549+014	2.12166416904291097+003	19
47	1.31110578582381016−017	2.79050528918238480−016	−4.65717627407410892+013	1.00751410382908991+015	2.21565736445124221+003	18
48	2.42542343303765600−018	5.28817601904487694−017	−2.45781653615809370+014	5.44568180884083226+015	2.31165097368428027+003	19
49	4.39018739838725421−019	9.79939726281648420−018	−1.32649529055031332+015	3.00820790001957500+016	2.40964496390051540+003	19
50	7.77925696286936127−020	1.77661071741339162−018	−7.31749089654094946+015	1.69747805547644030+017	2.50963930544869712+003	19
51	1.35007127163591826−020	3.15284383781195752−019	−4.12383164225497671+016	9.77996779110470548+017	2.61163397150348277+003	18

OBLATE RADIAL FUNCTIONS

H = 10.0 X = 1.80000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	−2.83024237354800002−002	−3.74667570622167366−001	4.15930199748750960−002	−2.82708999990029482−001	−4.32902515278834911+001	24
3	4.15908341488672589−002	−2.82738658202048848−001	2.83058229658279743−002	3.74643970831222025−001	−4.32871554900663143+001	24
4	5.03960576553573798−002	6.51699793261186481−002	−9.98647806420114214−003	4.55077007178449648−001	−1.35081116810601434+001	24
5	−9.26187928420688082−003	4.55793706480556690−001	−5.05553224266089503−002	−5.85310877629383514−002	−1.29592510494195510+001	24
6	−4.96971408492198892−002	1.60828196186000146−001	−1.57009826490888962−002	−4.23761701029673748−001	5.48608097389604481+000	24
7	−2.61556030974351522−002	−3.76666626316064591−001	4.54660988143911866−002	−2.46958312685254678−001	1.36127365278177361+001	24
8	3.21820264979933413−002	−3.69866637337689237−001	4.22273124548604482−002	2.47542882341077414−001	2.84823041117450335+001	24
9	5.27455432338353412−002	6.03948297134014626−002	−1.08773052697511169−002	4.34690236466503258−001	4.50989397695202586+001	24
10	1.70570376974583598−002	3.99523630309409187−001	−5.20808455396918206−002	1.62828811780719310−001	6.42068299418925874+001	25
11	−3.46476613171307505−002	3.51180385444589529−001	−4.39477173358957045−002	−2.35263479180841443−001	8.55307554583849025+001	24
12	−5.73847005056309765−002	3.02486733664116534−002	7.58840013979953331−004	−4.11396406290924841−001	1.09008946769617878+002	24
13	−3.85987602325059191−002	−2.76165547631253515−001	4.48378949793263336−002	−2.90222374275770754−001	1.34595911154512659+002	24
14	3.89514656123176850−003	−3.86182337162083875−001	6.12842934323312973−002	−2.10533820379164690−002	1.62262825644813053+002	24
15	4.43617463355461398−002	−3.02663781358511902−001	4.65762114599587320−002	2.13877364222473760−001	1.91990052492279498+002	24
16	6.69569964162789138−002	−1.32108089550565758−001	1.31582875296352084−002	3.26277918699602355−001	2.23763749994936617+002	23
17	6.96814016689192155−002	2.18758622337262193−002	−2.41350070522448013−002	3.30890754474831190−001	2.57573884295069009+002	23
18	5.90655014307080356−002	1.10140311915666731−001	−5.67837273897493667−002	2.93415408218746860−001	2.93413015616965658+002	23
19	4.33381251747018229−002	1.33738389969739193−001	−8.44943337009063433−002	2.83463335345742528−001	3.31275522415111205+002	23
20	2.83945887804238521−002	1.17114009336934874−001	−1.13704953981247180−001	3.61634489499676657−001	3.71157087798455616+002	22
21	1.69295771264536685−002	8.54662170211653954−002	−1.56807944857314177−001	6.01499006058890480−001	4.13054349733195029+002	21
22	9.30371274913329103−003	5.48345279920020393−002	−2.35416127841874643−001	1.14749602619211323+000	4.56964657053671964+002	21
23	4.75660824906045909−003	3.17869771258579727−002	−3.91840850868051251−001	2.33979106836393719+000	5.02885895783312384+002	20
24	2.27848531444620989−003	1.69264982909832210−002	−7.18555060654183165−001	5.01310435569482264+000	5.50816363304804023+002	21
25	1.02834948549809240−003	8.37248961004164638−003	−1.43225728580599237+000	1.12737416409022401+001	6.00754675770075220+002	20
26	4.39307675841785731−004	3.87815907105970579−003	−3.06616831826288603+000	2.66187408656199504+001	6.52699699019974594+002	20
27	1.78315258586788028−004	1.69263297062721772−003	−6.98857508723380156+000	6.59271289691664625+001	7.06650496398537976+002	19
28	6.89935343502438938−005	6.99510716299512985−004	−1.68527759255861962+001	1.70975561871525872+002	7.62606288882236158+002	19
29	2.55177874211077218−005	2.74826818772306507−004	−4.27950436513959796+001	4.63350515439357242+002	8.20566424302187410+002	19
30	9.04384038442833881−006	1.02993734876350704−004	−1.14006804312490102+002	1.30950111672778575+003	8.80530353359336931+002	19
31	3.07803720820174655−006	3.69222158551437765−005	−3.17647715850128650+002	3.85201585551736529+003	9.42497610769050021+002	21
32	1.00795070723180266−006	1.26928987991808602−005	−9.23221297892128288+002	1.17729478950156314+004	1.00646780031737304+003	19
33	3.18124469319831031−007	4.19341441277401766−006	−2.79275588553546023+003	3.73241420378640412+004	1.07244058292767951+003	18
34	9.69221452400334208−008	1.33394729393919664−006	−8.77546169052038909+003	1.22561281075875839+005	1.14041566706382333+003	19
35	2.85450930090925092−008	4.09274569653782001−007	−2.85927915472420069+004	4.16274811257213558+005	1.21039280096117563+003	18
36	8.13736590409875315−009	1.21300684954364664−007	−9.64521683111173800+004	1.46056988452720786+006	1.28237176629826689+003	19
37	2.24799680964041366−009	3.47767293476214069−008	−3. [illegible] 63374368491+005	5.28778921581894298+006	1.35635237301172275+003	18
38	6.02479649738886564−010	9.65700169505118024−009	−1. [illegible] 17775389163+006	1.97318279793484227+007	1.43233445502448834+003	19
39	1.56806466221537586−010	2.60033287123935001−009	−4. [illegible] 05202180050+006	7.58171123768465438+007	1.51031786670811535+003	18
40	3.96706396595101521−011	6.79694124736358456−010	−1. [illegible] 93907871597+007	2.99687911294805179+008	1.59030247993850143+003	19
41	9.76425198402352218−012	1.72633763656368304−010	−6. [illegible] 19980171218+007	1.21757444579752215+009	1.67228818163405542+003	18
42	2.34007212832646790−012	4.26446285883816784−011	−2.74279512576409221+008	5.08033815421584234+009	1.75627487168808744+003	18
43	5.46479058654369824−013	1.02541701096093593−011	−1.14071449022265082+009	2.17534872432442765+010	1.84226246122495042+003	18
44	1.24447190296827407−013	2.40204390893148005−012	−4.86991865732280560+009	9.55196110431300472+010	1.93025087112331543+003	18
45	2.76540586145123906−014	5.48567719622109383−013	−2.13256250990880285+010	4.29832205915129434+011	2.02024003076085724+003	18
46	6.00030179299893939−015	1.22223083424879553−013	−9.57219166455510156+010	1.98081334350325583+012	2.11222987694324117+003	18
47	1.27201056202326785−015	2.65850054889708963−014	−4.40111722379490618+011	9.34310882313316130+012	2.20622035298715102+003	18
48	2.63609322206625410−016	5.64873690120851485−015	−2.07150153039210632+012	4.50801148656907453+013	2.30221140793257089+003	18
49	5.34342147297063572−017	1.17314770407196457−015	−9.97521290759369574+012	2.22376385623176303+014	2.40020299586392935+003	18
50	1.05996398332011087−017	2.38277417082725555−016	−4.91169276558699012+013	1.12092969105247142+015	2.50019507532326085+003	18
51	2.05868209469457025−018	4.73556201124559239−017	−2.47162383907535182+014	5.77086560988705109+015	2.60218760880141368+003	18

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 12.0 X = 1.80000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	3.65641762791065960−002	2.09883947868087365−001	−2.00096994500266819−002	4.22664337249677511−001	−7.52286978492194622+001	23
3	−2.00095979076275169−002	4.22664903887952822−001	−3.65642346961373566−002	−2.09882743577477665−001	−7.52285673969014027+001	24
4	−4.00959174823712335−002	1.70948152446252869−001	−1.39524104774621218−002	−4.30690961607578258−001	−3.66661842092831736+001	23
5	−1.39915876184909210−002	−4.30514945874587104−001	4.00832516559061556−002	−1.71363622097173713−001	−3.66217092269358512+001	23
6	2.34573005004566244−002	−3.93879383626896831−001	3.61707919327005281−002	2.30510702561890795−001	−6.51224524639420730+000	23
7	3.74685737950347890−002	2.07880345918336996−001	−2.14388620430350508−002	4.05603108243387131−001	−3.98717151853308588+000	24
8	−5.58255976313563505−003	4.50033902933070071−001	−4.32224132108131294−002	−3.62802634382515572−002	1.37164365780463355+001	23
9	−4.32257451092121679−002	1.00940118956802223−001	−7.75927384204503436−003	−4.36565430578507755−001	2.74902446237123994+001	23
10	−2.46558785015250014−002	−3.55416473318643757−001	3.69071159342923717−002	−2.65116940131808531−001	4.58977645667728861+001	23
11	2.22159332341085093−002	−3.92020261318777816−001	3.90665979779109619−002	1.95318830699227118−001	6.65498310735474590+001	23
12	4.56034085077928688−002	−2.73653551205931330−002	2.26190123217965341−004	4.30842757595856766−001	8.95576117848965092+001	24
13	2.55235254036253501−002	3.39063026876015600−001	−3.87355833343176212−002	2.55461728505829749−001	1.14780769133126801+002	23
14	−1.64233896435079042−002	3.99484414803683160−001	−4.43786415408416003−002	−1.17242082565463679−001	1.42159811364883728+002	23
15	−4.57168469801305440−002	1.63427005603649300−001	−1.59935304011598001−002	−3.72735969198139326−001	1.71654125373987273+002	23
16	−4.40572880854341132−002	−1.53317452482424095−001	2.31723529197850076−002	−3.65464208813902837−001	2.03236169420520186+002	23
17	−1.65424935887713043−002	−3.49351383164808782−001	4.86983986804182585−002	−1.59663662508043084−001	2.36886413679515778+002	23
18	1.91899582785933688−002	−3.59025620560776430−001	4.99413860042200929−002	8.98308856881178532−002	2.72590605645570861+002	23
19	4.70288066654481582−002	−2.36357474330723254−001	3.07084318933625070−002	2.63581441381745661−001	3.10338098331930940+002	23
20	5.97003252326401229−002	−7.60817714177908346−002	1.59504627177487865−003	3.27179693382730589−001	3.50120783929988566+002	23
21	5.83602710179383269−002	5.05930010914888921−002	−2.78767902531775258−002	3.12605086515116349−001	3.91932387217646553+002	23
22	4.84275830287870322−002	1.17075394942687264−001	−5.32300612748542286−002	2.77159353498167939−001	4.35767982922972047+002	23
23	3.55895422349513023−002	1.30732636481891326−001	−7.53749415902502764−002	2.75365250467540721−001	4.81623657672317726+002	22
24	2.37153789899449002−002	1.12774638446756805−001	−9.95433426364197604−002	3.55386417323713929−001	5.29496268131497047+002	21
25	1.45455844345040100−002	8.32534809583230596−002	−1.35039371433737455−001	5.78291669881514538−001	5.79383264783595665+002	21
26	8.29780234442476670−003	5.48658060813664329−002	−1.97628577629828595−001	1.06185185766205788+000	6.31282561472110723+002	20
27	4.43696147795568203−003	3.30180730921138924−002	−3.17013614015102799−001	2.07054071062196008+000	6.85192437457944610+002	20
28	2.23717741735946159−003	1.84027313090688257−002	−5.54988016766733633−001	4.21995708733116068+000	7.41111462959183003+002	20
29	1.06878631320567392−003	9.59172005769674516−003	−1.04866386384161316+000	8.97803210535364407+000	7.99038441900708701+002	19
30	4.85702181620964410−004	4.70840931186686383−003	−2.11632146369177178+000	1.99496331917364892+001	8.58972367442615365+002	19
31	2.10657145707081216−004	2.18868744029659522−003	−4.52557030652812675+000	4.62791287117939402+001	9.20912387110147956+002	18
32	8.74455344849992316−005	9.67639386386840411−004	−1.01953953679198274+001	1.11939643232536583+002	9.84857775215940973+002	19
33	3.48271815338082886−005	4.08330899258170521−004	−2.40929782445230503+001	2.81854004418698888+002	1.05080791087555158+003	18
34	1.33367752039931806−005	1.64959925087151274−004	−5.95180111865176994+001	7.37509722793053053+002	1.11876226035222008+003	18
35	4.91995130241384009−006	6.39618160197387134−005	−1.53271068291824196+002	2.00217269919949685+003	1.18872036278069899+003	17
36	1.75140113956805830−006	2.38561193794294257−005	−4.10484948076420604+002	5.63064046422659897+003	1.26068181854916559+003	19
37	6.02544050717143034−007	8.57547234437038684−006	−1.14096520431664934+003	1.63801675297618622+004	1.33464627978731944+003	17
38	2.00618643823731768−007	2.97606444748237112−006	−3.28555302768081562+003	4.92280792357108832+004	1.41061344253474260+003	18
39	6.47262689087792682−008	9.98666452464067092−007	−9.78625006095686417+003	1.52656542476407145+005	1.48858304025831187+003	18
40	2.02589992576093483−008	3.24484706783892208−007	−3.01077793568666114+004	4.87910284614616442+005	1.56855483845926117+003	20
41	6.15807158708816759−009	1.02213810100591903−007	−9.55517216399065808+004	1.60559720360504386+006	1.65052863016536807+003	17
42	1.81964569775398974−009	3.12510530871968567−008	−3.12456162132527563+005	5.43485138469306980+006	1.73450423214598524+003	19
43	5.23165750995591116−010	9.28359972699670144−009	−1.05164008557972948+006	1.89062116931485764+007	1.82048148172038968+003	17
44	1.46477068409783402−010	2.68216744287417990−009	−3.63954140581498649+006	6.75343157262715256+007	1.90846023405547982+003	17
45	3.99687706334316291−011	7.54332287208421380−010	−1.29400000557141366+007	2.47518951797220373+008	1.99844035986891866+003	17
46	1.06368665747952609−011	2.06684865090178870−010	−4.72242580850679416+007	9.30118712070884537+008	2.09042174346967130+003	17
47	2.76280064284715668−012	5.52154996024080626−011	−1.76766396665776789+008	3.58109195142658995+009	2.18440428108047396+003	16
48	7.00828146172158463−013	1.43924542675229094−011	−6.78142422835924918+008	1.41175183913786226+010	2.28038787939682342+003	17
49	1.73726732194560222−013	3.66290494131013200−012	−2.66459875658698865+009	5.69510286253620829+010	2.37837245434514232+003	16
50	4.21082375475962773−014	9.10774756385251406−013	−1.07165153950716428+010	2.34960115366644514+011	2.47835793000928042+003	17
51	9.98507687729597370−015	2.21387123179262323−013	−4.40883390810402551+010	9.90828374882812901+011	2.58034423769978134+003	16

OBLATE RADIAL FUNCTIONS

H = 14.0 X = 1.80000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	−3.55585352959858224−002	3.92389142169764226−004	1.16453563916572758−003	−4.73777055125949777−001	−1.15189548296244584+002	23
3	1.16453253372864687−003	−4.73777054348020228−001	3.55585354538132025−002	−3.92430645085563268−004	−1.15189543550979888+002	23
4	2.42646458535958796−002	−3.56649541009375895−001	2.68021477962302507−002	3.00329438985523229−001	−6.83141511589437481+001	23
5	2.68033399860191265−002	3.00311953545116674−001	−2.42633782571468798−002	3.56663709334822076−001	−6.83115655792313947+001	23
6	8.21826166355848721−004	4.58612839047753186−001	−3.66834691020960978−002	2.78054847685491516−002	−2.77733452225816203+001	23
7	−3.66822513503569048−002	3.05998586062191451−002	−1.04507439122550497−003	−4.58379228057269957−001	−2.74496570665788272+001	23
8	−1.97161601294617649−002	−3.75021786708533140−001	3.14233699653911478−002	−2.56739284116261037−001	7.54543594508251141−001	23
9	2.86251131021119914−002	−3.03317028028293148−001	2.37563398752053320−002	3.36790242323801179−001	7.74331472008800061+000	23
10	3.25025559949891466−002	2.07548608544187721−001	−1.86658670642333331−002	3.99115886502320869−001	2.65196969166217908+001	23
11	−6.02471622381217470−003	4.43316723284904288−001	−3.72927944398935356−002	−5.20923710086618085−002	4.54335204682938013+001	23
12	−3.67914332155240259−002	1.35558665229005601−001	−1.00468505421631279−002	−4.20870354411724312−001	6.76634930851798033+001	24
13	−2.60493197655492877−002	−3.08169538590222152−001	2.84309420322968421−002	−3.10365528580821919−001	9.22588661604032645+001	23
14	1.17515581602898918−002	−4.17906110482257531−001	3.72386244264925529−002	1.09271679098515368−001	1.19160369906307053+002	23
15	3.82277746466413066−002	−1.33381324886909462−001	1.03877835423698643−002	4.04439572990485071−001	1.48274499894155480+002	23
16	3.11440982316554664−002	2.46632473846713705−001	−2.55264113630445817−002	3.38771061040493482−001	1.79547467844073955+002	23
17	−7.82813489791042937−004	4.11002256785120717−001	−4.10224229484833058−002	1.78167913793361357−002	2.12942043941925500+002	23
18	−3.21101356216180427−002	2.79587814170006945−001	−2.69516044538712591−002	−2.89971400870780635−001	2.48431804060106030+002	23
19	−4.27468182558793753−002	−1.03555642099587439−002	4.44781976566645193−003	−3.93018759951693951−001	2.85997376517853994+002	23
20	−2.91312799936970304−002	−2.64303110892475699−001	3.32994476637962988−002	−2.76170960533899666−001	3.25624214108506580+002	23
21	−1.21337712442664674−003	−3.66774625814627858−001	4.57715843077524574−002	−4.82170607863347168−002	3.67301175366009520+002	23
22	2.71922580435503402−002	−3.15739644890900229−001	3.92060908474534819−002	1.64291026405146693−001	4.11019585657602766+002	23
23	4.63239138860221786−002	−1.79204946577496874−001	1.92941746435143993−002	2.89024577730593457−001	4.56772595411761141+002	23
24	5.31498529665144568−002	−3.43126057872530461−002	−5.73029981623444104−003	3.20659075300894845−001	5.04554729705274242+002	23
25	4.98441667970045943−002	7.02069561452430342−002	−2.96525512766159212−002	2.96214116268448982−001	5.54361565068337526+002	23
26	4.07665837207509177−002	1.20810758237811405−001	−5.01317024962317590−002	2.64675408407338002−001	6.06189493147895416+002	22
27	3.00130036338322821−002	1.27532186594807577−001	−6.85396144429393477−002	2.70061416931090634−001	6.60035545031999446+002	21
28	2.02639151841186783−002	1.08790181217272102−001	−8.92290016463711264−002	3.52307136215904855−001	7.15897258775238710+002	21
29	1.27026072989380049−002	8.09895307611012648−002	−1.19535352754930105−001	5.64077034609923899−001	7.73772578220321159+002	20
30	7.45814292791776347−003	5.44619057826575899−002	−1.71619998523437354−001	1.00555983821489474+000	8.33659774835653185+002	20
31	4.12863976228925855−003	3.37238608978656193−002	−2.67733100971085022−001	1.89344863712356250+000	8.95557386708233236+002	19
32	2.16606214698791879−003	1.94665742758434761−002	−4.52427703831709875−001	3.71140952537931567+000	9.59464170478681733+002	18
33	1.08153397956857081−003	1.05646692426887042−002	−8.20416143416115959−001	7.56234768758067124+000	1.02537906314713137+003	18
34	5.15726966947135303−004	5.42473521748549995−003	−1.58169660838214950+000	1.60280078818587857+001	1.09330115148280633+003	18
35	2.35548721096814579−004	2.64837868901370608−003	−3.21860879994408981+000	3.53314006256876537+001	1.16322964734449171+003	17
36	1.03303075806511023−004	1.23413053271003925−003	−6.87617088804897321+000	8.09295239240470954+001	1.23516386763471018+003	17
37	4.35978865062784268−005	5.50707623568185958−004	−1.53606827415794239+001	1.92374373371882761+002	1.30910321791472780+003	17
38	1.77407114828013994−005	2.35959101770555507−004	−3.57673145217944135+001	4.73867002844058480+002	1.38504717893273589+003	17
39	6.97220747159958477−006	9.73004238276203550−005	−8.65866532339609521+001	1.20785894034391948+003	1.46299529548591692+003	16
40	2.65048893313506779−006	3.86926815188897629−005	−2.17449149221482258+002	3.18155280830736950+003	1.54294716716411909+003	17
41	9.75968457783475174−007	1.48643719151567267−005	−5.65445934355227219+002	8.64921653204411532+003	1.62490244061951015+003	16
42	3.48531531271562325−007	5.52521383679695227−006	−1.51997717054028460+003	2.42393055827040337+004	1.70886080308070617+003	18
43	1.20848122998970730−007	1.98996855270653041−006	−4.21757342309131216+003	6.99516260204826007+004	1.79482197688714656+003	16
44	4.07270872650068314−008	6.95325243989856250−007	−1.20642683468750133+004	2.07669426470398984+005	1.88278571486405273+003	17
45	1.33533659353057528−008	2.35979299266393475−007	−3.55336812621090757+004	6.33634098128399162+005	1.97275179639321337+003	15
46	4.26333156916588373−009	7.78681940786779830−008	−1.07650191293758388+005	1.98526318218561147+006	2.06472002406234636+003	16
47	1.32653202673026988−009	2.50072153401199787−008	−3.35118904906474510+005	6.38203254489826487+006	2.15869022079759314+003	15
48	4.02560672628421115−010	7.82304402043563669−009	−1.07102815889937354+006	2.10344957357617197+007	2.25466222740108130+003	16
49	1.19234697775284571−010	2.38588230488327981−009	−3.51122602798857214+006	7.10278911707509164+007	2.35263590042941800+003	16
50	3.44925001673343531−011	7.09933081202975321−010	−1.17987734526622136+007	2.45561253989378623+008	2.45261111036019199+003	16
51	9.75152701453352330−012	2.06248546296706242−010	−4.06090160964932592+007	8.68665044655857523+008	2.55458774000263570+003	15

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 16.0 X = 1.80000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	2.81736634265073164−002	−2.11649193907649048−001	1.30099482119289611−002	4.25469020639423924−001	−1.63161980906196654+002	23
3	1.30099482830578840−002	4.25469020091318559−001	−2.81736633950006282−002	2.11649194967828254−001	−1.63161980750329214+002	24
4	−7.74138109144104494−003	4.57450262654857445−001	−3.05105919776348499−002	−1.01207745046660097−001	−1.08096597142048761+002	23
5	−3.05106084697669834−002	−1.01206824393201674−001	7.74132028808695158−003	−4.57450450671870757−001	−1.08096473874693320+002	24
6	−1.68690348116021678−002	−3.84205381892206107−001	2.70807829488890927−002	−2.57038030411542773−001	−5.86924050483263431+001	23
7	2.70739255563639826−002	−2.57197092882348875−001	1.68804701221468500−002	3.84094954172168690−001	−5.86668926481850273+001	23
8	3.04583114704336722−002	1.36636691114996690−001	−1.07027422505214510−002	4.35945990100509907−001	−1.75883149802601171+001	23
9	−9.93160219624961897−003	4.39080561279583419−001	−3.07337543906100161−002	−1.25455277512871693−001	−1.60522304864050475+001	23
10	−3.23547081479969205−002	6.48664629168722958−002	−3.51597004070496547−003	−4.48543607041378766−001	9.37595580058753185+000	23
11	−1.05861265820258449−002	−4.21492611445242333−001	3.09162039723949315−002	−1.61495753540306649−001	2.27203387362920798+001	23
12	2.54097925314559378−002	−2.97426832235021129−001	2.08968223019924348−002	3.35512002552647859−001	4.42205802592396690+001	24
13	2.92263069699926452−002	1.94787073785719025−001	−1.56381725179519475−002	4.00134446874000054−001	6.75899411642128782+001	23
14	−1.72537608023580011−003	4.41176229047987420−001	−3.33914713017698489−002	−5.24097126447917249−003	9.37213458690561418+001	23
15	−3.06817500229467777−002	1.98745507537931491−001	−1.40985743640176271−002	−3.89108760460831076−001	1.22226700059869404+002	23
16	−2.78708922485135365−002	−2.34001310460539855−001	1.97188628116945281−002	−3.63329821259949094−001	1.53015993714770232+002	23
17	1.72193318515633773−003	−4.26880332051049443−001	3.45243813446236930−002	1.61833543243846877−003	1.86015755610273190+002	23
18	2.97378487241421728−002	−2.40117128623598093−001	1.85548619906837018−002	3.45863143966290053−001	2.21177591210308522+002	23
19	3.32841579698378122−002	1.26615344435243282−001	−1.26418123736608634−002	3.94779961736345734−001	2.58466943632419514+002	23
20	1.17461640673706948−002	3.77286451096697914−001	−3.42804520519492457−002	1.53838813309704730−001	2.97858424887299009+002	23
21	−1.78311982821786234−002	3.61347680763637454−001	−3.23824764683414185−002	−1.70444701495758218−001	3.39332899072483278+002	23
22	−3.63477158725609150−002	1.33728823600359013−001	−1.04395560566190008−002	−3.67134389796636956−001	3.82875647561281299+002	23
23	−3.47713442868231117−002	−1.41955897103302778−001	1.72563131164756056−002	−3.53478730278737415−001	4.28475157541489059+002	24
24	−1.62907602826818028−002	−3.22787980564095560−001	3.65464787337243647−002	−1.80703780515250773−001	4.76122294757563557+002	23
25	9.02488512500053179−003	−3.55350750682193935−001	4.04719350391307336−002	3.97604551248771426−002	5.25809722654156529+002	23
26	3.11314507307983826−002	−2.69223018452862372−001	3.00559762304877252−002	2.13571974268413646−001	5.77531484971000770+002	23
27	4.42434216354842311−002	−1.31377301140195153−001	1.09689761664293902−002	3.00598169424869634−001	6.31282699841819170+002	23
28	4.74802041680558831−002	−2.56970752129703379−003	−1.05582361545151705−002	3.11028519682088232−001	6.87059331784607528+002	22
29	4.32301583657097923−002	8.39934499307168108−002	−3.04138269181110985−002	2.81886633081454278−001	7.44858019222472776+002	21
30	3.49904108591220075−002	1.22613158059064463−001	−4.74558272947496898−002	2.54980063559188238−001	8.04675942300721268+002	21
31	2.58062829784517919−002	1.24289776333297386−001	−6.32095079932649541−002	2.66767222263800263−001	8.66510720403910126+002	20
32	1.76088836350000210−002	1.05099402111726190−001	−8.13708253160668788−002	3.51444252569137921−001	9.30360331867312482+002	20
33	1.12322528242340676−002	7.87399490366133079−002	−1.07933590319841925−001	5.55710482508519664−001	9.96223050480153177+002	19
34	6.74841605931992652−003	5.37903358781519884−002	−1.52667014777059050−001	9.67420499562525028−001	1.06409739483536024+003	19
35	3.84090716057940461−003	3.40677642903582864−002	−2.33034173476634554−001	1.77083497720089915+000	1.13398208760733696+003	18
36	2.08036626330654712−003	2.02212684166746671−002	−3.82946240719738670−001	3.36330550941764215+000	1.20587602257339201+003	17
37	1.07629230971415181−003	1.13346461135561695−002	−6.72031976134588672−001	6.61838921170803088+000	1.27977823772642217+003	17
38	5.33515238037087250−004	6.03409916599185442−003	−1.24901734116814582+000	1.35026537715929317+001	1.35568789321660589+003	18
39	2.54055207864631948−004	3.06440170301273982−003	−2.44221028245187584+000	2.85632904362332672+001	1.43360425314922037+003	17
40	1.16480949498908135−004	1.48989597918913566−003	−4.99885925135869798+000	6.26092573075434344+001	1.51352667048248148+003	16
41	5.15208490215510328−005	6.95539168391722467−004	−1.06708234976590762+001	1.42051042929394603+002	1.59545457443325377+003	16
42	2.20225281449617183−005	3.12550522945132871−004	−2.36854698845581601+001	3.33188814236784131+002	1.67938745992354810+003	17
43	9.11127590053951468−006	1.35480151005983427−004	−5.45352403589409350+001	8.06925782844922994+002	1.76532487869690754+003	16
44	3.65360732722244146−006	5.67532901253688978−005	−1.29988152081310674+002	2.01535361365787853+003	1.85326643180831018+003	16
45	1.42180433992271661−006	2.30129774946381298−005	−3.20187611356916429+002	5.18502830278173675+003	1.94321176324937164+003	16
46	5.37561610393904395−007	9.04583513775809980−006	−8.13798778741576294+002	1.37269408887356463+004	2.03516055451630985+003	15
47	1.97669523513492200−007	3.45128733285361564−006	−2.13134690503834740+003	3.73586951149613574+004	2.12911251996423778+003	15
48	7.07603529361764277−008	1.27961116896522589−006	−5.74500046842488410+003	1.04425698375101856+005	2.22506740282005222+003	16
49	2.46809927962506573−008	4.61531027946438691−007	−1.59202538191376880+004	2.99537177797162250+005	2.32302497174913165+003	15
50	8.39484859253650135−009	1.62095732286274473−007	−4.53108312622501849+004	8.81001435851616705+005	2.42298501788949499+003	15
51	2.78657619491751110−009	5.54852508589694075−008	−1.32327767983437418+005	2.65498809939640936+006	2.52494735228196412+003	15

OBLATE RADIAL FUNCTIONS

H = 18.0 X = 1.80000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	−1.71850290694615104−002	3.79483647424865103−001	−2.14906119785736913−002	−2.87889507073711019−001	−2.19141463599472215+002	23
3	−2.14906119797584456−002	−2.87889507047687217−001	1.71850290680210784−002	−3.79483647444050697−001	−2.19141463594723636+002	24
4	−6.38872687724746032−003	−4.54721801644414866−001	2.71276839774903938−002	−1.20082772191082418−001	−1.55942778415532475+002	23
5	2.71276835349723201−002	−1.20082805661886296−001	6.38872888519995752−003	4.54721792291099542−001	−1.55942773290723265+002	23
6	2.47154894486658863−002	2.12468846483386295−001	−1.36075915175521578−002	4.13163417820807037−001	−9.80824936483270077+001	24
7	−1.36070378135901455−002	4.13168086408065256−001	−2.47158051877192291−002	−2.12459425264804498−001	−9.80809369916126685+001	23
8	−2.76998188188583566−002	1.23627499589318358−001	−6.86120957730031540−003	−4.42403297393894475−001	−4.68573233895819733+001	23
9	−6.92949903442969387−003	−4.42080842765094834−001	2.76839382342570613−002	−1.24711269447523756−001	−4.66892914132815562+001	24
10	1.96056294191396022−002	−3.42822813071886953−001	2.10952182174166948−002	2.99444776278641099−001	−7.35632030744914201+000	24
11	2.24980064965450277−002	2.73214548645513364−001	−1.80327531160880575−002	3.63406191774542128−001	−2.38419553157480405+000	24
12	−9.17112890093178260−003	4.33181505210934182−001	−2.75108870926840969−002	−1.29266298531569452−001	2.16192953279133818+001	23
13	−2.91286181765683549−002	1.82311638535513433−003	8.27314559134917705−004	−4.49874881745891419−001	4.14516914328368367+001	23
14	−9.88161562171526576−003	−4.15674728619454445−001	2.76085349544451243−002	−1.64604165388925667−001	6.65177144551926175+001	24
15	2.15371403237709640−002	−3.14696320155627492−001	2.02054151644670652−002	3.13140717199031076−001	9.40075537885043049+001	23
16	2.77813516859601088−002	1.43455378546209704−001	−1.06902419628462925−002	4.16435916802145178−001	1.24051402572242726+002	23
17	3.60834987996991958−003	4.31188555326440202−001	−2.98146455881091339−002	6.84499608923089571−002	1.56452558932280624+002	24
18	−2.42290887138619950−002	2.73201779835006948−001	−1.82432212380619461−002	−3.35078423732425899−001	1.91125134876101820+002	23
19	−2.86580147889023955−002	−1.35739294041787659−001	1.09026991353705716−002	−4.05568940092526712−001	2.28006822374077204+002	23
20	−7.23811440754748906−003	−4.06334513280147310−001	3.01787285748332595−002	−1.16061495122513012−001	2.67053742511488919+002	24
21	2.02397790736933106−002	−3.31080530025180574−001	2.40759572594107206−002	2.53542524248047718−001	3.08233583723681287+002	23
22	3.19150966430778563−002	−9.88005291518880558−003	−7.87624639960798613−004	4.10793277132062190−001	3.51521938517224217+002	24
23	2.06244585402726038−002	2.98201903810160493−001	−2.50641674749913710−002	2.72906214600811768−001	3.96899975650300042+002	23
24	−4.26121346497131205−003	3.95870909541095461−001	−3.27917866467015999−002	−2.84921097164083348−002	4.44352913253674515+002	23
25	−2.65735759253814172−002	2.58775247624707628−001	−2.08331145474468491−002	−2.90199219432157252−001	4.93868978638169730+002	23
26	−3.44943042163339568−002	6.34030594039727431−004	2.39178944979022802−003	−3.79895815621547655−001	5.45438678627586113+002	23
27	−2.57761871384487518−002	−2.32153971578608586−001	2.44516757654885070−002	−2.88102025574161658−001	5.99054275118035813+002	23
28	−6.14360183125681971−003	−3.46686018459566878−001	3.61444206079402849−002	−9.30984970203655200−002	6.54709400339145986+002	23
29	1.57239754653364836−002	−3.29703881833134635−001	3.46372326200617993−002	1.07014623610559658−001	7.12398769607129342+002	23
30	3.27613364013663563−002	−2.24579664950411080−001	2.25078212726497991−002	2.45653178127533085−001	7.72117963575181278+002	23
31	4.16548933162169641−002	−9.16546969772849924−002	4.79120117533038979−003	3.04012044368003201−001	8.33863260945720814+002	22
32	4.26220492887274179−002	2.19470955881097575−002	−1.38315705004212566−002	3.00294396458196088−001	8.97631508418130433+002	21
33	3.79579389862896135−002	9.38457106741137255−002	−3.06219594263019490−002	2.69482118772987965−001	9.63420018506501546+002	21
34	3.04834062874573766−002	1.23176868520662001−001	−4.51400166436953237−002	2.47430336380707640−001	1.03122648848402661+003	20
35	2.25203165771406661−002	1.21074814621873781−001	−5.89288356003967556−002	2.65001937261093599−001	1.10104893552593277+003	20
36	1.55015368542583485−002	1.01654977327535060−001	−7.51814434228379938−002	3.52233297356992188−001	1.17288564440111838+003	19
37	1.00304889043044844−002	7.65353759376380119−002	−9.89308432438577463−002	5.51420388392687577−001	1.24673512497664331+003	18
38	6.14141752856575524−003	5.29501238485207285−002	−1.38269602704028003−001	9.41367811636546192−001	1.32259607746181655+003	18
39	3.57616640523420185−003	3.41553143117417763−002	−2.07392542880066994−001	1.68313417129761468+000	1.40046736380500945+003	17
40	1.98851894497968501−003	2.07405269512530516−002	−3.33176728856840901−001	3.11410884876127453+000	1.48034798401745137+003	16
41	1.05937220992024698−003	1.19381053838014508−002	−5.69237912213842915−001	5.95362340389045482+000	1.56223705646920543+003	16
42	5.42230439964307608−004	6.54712203521483163−003	−1.02658796797959967+000	1.17690343261634693+001	1.64613380140775919+003	16
43	2.67280168260689167−004	3.43497643245113794−003	−1.94229714417058963+000	2.40608216228028978+001	1.73203752710651539+003	15
44	1.27141877884808850−004	1.72972418229352124−003	−3.83734066181986741+000	5.08501568168259130+001	1.81994761817132789+003	17
45	5.84695566319579920−005	8.38276328722365227−004	−7.88868997781938720+000	1.10994912013644089+002	1.90986352562707023+003	17
46	2.60363564251826815−005	3.91877020661231064−004	−1.68280868595950603+001	2.49965268512570849+002	2.00178475847960942+003	15
47	1.12423047826137806−005	1.77059529717918062−004	−3.71654206739709693+001	5.80150919823936684+002	2.09571087650633002+003	15
48	4.71312116819468596−006	7.74532992494608844−005	−8.48191608488046957+001	1.38617304465952490+003	2.19164148407411935+003	16
49	1.92061723892053555−006	3.28524023205034929−005	−1.99706095391403695+002	3.40614477609182010+003	2.28957622482019505+003	15
50	7.61566907744031041−007	1.35295695695040209−005	−4.84408522373270195+002	8.59922680039515783+003	2.38951477706037906+003	14
51	2.94122191980311223−007	5.41643406591778614−006	−1.20894499170244112+003	2.22851410356594341+004	2.49145684981296268+003	14

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 20.0 X = 1.80000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	5.20072721736704519−003	−4.68717249427260788−001	2.41630509582022721−002	8.97593793672771186−002	−2.83125583983819548+002	24
3	2.41630509582119027−002	8.97593793664532959−002	−5.20072721732483624−003	4.68717249427408083−001	−2.83125583983683020+002	25
4	1.62256919859395782−002	3.51525007178151082−001	−1.90232467825239954−002	3.14643336804014912−001	−2.11827440117763781+002	25
5	−1.90232467427437701−002	3.14643337670074060−001	−1.62256920338065434−002	−3.51525006382824875−001	−2.11827439925239330+002	24
6	−2.52843211694827940−002	8.89297590119828544−003	1.50740609413952189−004	−4.66446905326854721−001	−1.45658038523410121+002	24
7	1.50714223559774871−004	−4.66446889579[illegible]7−001	2.52843216775053796−002	−8.89346325781026622−003	−1.45657958395691428+002	25
8	1.81641974829622379−002	−3.33172159577[illegible]2−001	1.79756704247251267−002	3.19499933887680633−001	−8.55094867620428999+001	24
9	1.79788129059306160−002	3.19442224687[illegible]1−001	−1.81611715975763386−002	3.33225992364794908−001	−8.54964725458043997+001	26
10	−2.74083537838400227−003	4.55792858087[illegible]7−001	−2.56548874983847281−002	−3.61708456362815661−002	−3.35054081775733688+001	24
11	−2.56869112294571662−002	−3.12374476920[illegible]3−002	2.46421337733874671−003	−4.56087420907072339−001	−3.26877713381307514+001	24
12	−9.47989814736438142−003	−4.17966997322079376−001	2.41882128451064813−002	−1.77489052158220292−001	2.78198828989161360+000	24
13	2.25702160862421133−002	−2.36905484905993701−001	1.29789605545025307−002	3.86246452100315833−001	1.39653132821883531+001	24
14	1.97335272290397612−002	2.86115506153416404−001	−1.71799383300674040−002	3.48493505462966417−001	3.89821067359780340+001	25
15	−9.73068772160110152−003	4.21507201799510265−001	−2.44304782154356927−002	−1.53620212850744506−001	6.42719169238528014+001	24
16	−2.64524374913135089−002	1.72022603765275418−002	−2.18696527179397487−004	−4.45656123729840959−001	9.32118599231998912+001	24
17	−1.11315509886489572−002	−3.96520153385332834−001	2.41904788994359623−002	−1.97675995803594914−001	1.24695554166242103+002	24
18	1.68962546650258053−002	−3.50366916823234865−001	2.08344582948648381−002	2.65902000342970868−001	1.58646160082752914+002	24
19	2.65585246312575384−002	6.77970531453281908−002	−5.09089823997245901−003	4.31021869271425043−001	1.94935662125926802+002	24
20	8.99571806372651832−003	4.03108119691981534−001	−2.57573127648308037−002	1.56682424154985121−001	2.33488239084830898+002	24
21	−1.72411810394992728−002	3.43573063291479864−001	−2.14879397320532277−002	−2.55769923331918203−001	2.74249157242637585+002	23
22	−2.77464532710780619−002	−1.95944034[illegible]−002	2.34397472357268952−003	−4.23352272413761466−001	3.17178267555097611+002	24
23	−1.45136923246880654−002	−3.50103182[illegible]−001	2.41470418900909608−002	−2.30023935261687841−001	3.62245202021870738+002	24
24	1.03228556799147586−002	−3.91600011[illegible]−001	2.66054292248447621−002	1.33080077900484553−001	4.09426485130933007+002	24
25	2.74392196898172240−002	−1.47237597[illegible]−001	9.21426405929848198−003	3.80323013636623720−001	4.58703641855200242+002	23
26	2.55535133188966834−002	1.81342149[illegible]−001	−1.45420328188066991−002	3.58282214342219417−001	5.10061914652579049+002	24
27	7.35307642474201525−003	3.76949647725431597−001	−2.89987984825899216−002	1.17143615537200027−001	5.63489365515387323+002	24
28	−1.51403010904531202−002	3.46783666057718684−001	−2.64783882362315184−002	−1.72399496597502861−001	6.18976231236431378+002	24
29	−2.95671223645403909−002	1.42952541367619606−001	−9.87100707864344539−003	−3.51111858450219877−001	6.76514450448788488+002	25
30	−2.98210405139864643−002	−1.07359049440122793−001	1.14586244872676558−002	−3.54188372212916792−001	7.36097310279150541+002	24
31	−1.73606403476881948−002	−2.88919742288459846−001	2.78944219594157685−002	−2.15038359854384466−001	7.97719178167803047+002	25
32	1.58283470695750621−003	−3.48681929621316308−001	3.39003717167089931−002	−1.76861138754770475−002	8.61375295503614046+002	24
33	2.00118091554259668−002	−2.97737647124987243−001	2.90175743670043547−002	1.57548399967006943−001	9.27061616882379982+002	23
34	3.30585601163793446−002	−1.83688179383924663−001	1.63398552557833082−002	2.65922488333100589−001	9.94774683538040909+002	22
35	3.89514661223895225−002	−5.86603306520100935−002	1.31425293457156188−004	3.02549417318197119−001	1.06451152270739279+003	21
36	3.84559944074668000−002	4.11249834774567936−002	−1.60944942463243767−002	2.89436463462492122−001	1.13626956690747543+003	20
37	3.36648459046980009−002	1.00931700966399520−001	−3.05188114486583578−002	2.58790350737561714−001	1.21004658866495877+003	20
38	2.68719406662741473−002	1.22912752293126341−001	−4.31244496659707950−002	2.41586869785163641−001	1.28584064735148848+003	19
39	1.98836910098933782−002	1.17920123834075809−001	−5.54119776521435362−002	2.64451180665629766−001	1.36365004558672792+003	19
40	1.37878237067576773−002	9.84204814110463434−002	−7.01806210001168713−002	3.54315694016064111−001	1.44347329326382632+003	18
41	9.02928635066197333−003	7.43899964021205819−002	−9.17485967094179387−002	5.50129307917152897−001	1.52530907769250002+003	17
42	5.61679670187844727−003	5.20029395688270328−002	−1.26983083771029502−001	9.23828914235967896−001	1.60915623868559913+003	17
43	3.33401778376917512−003	3.40574696416424782−002	−1.87741340082206245−001	1.61920487231312767+000	1.69501374766575913+003	16
44	1.89528551648425955−003	2.10779834642924769−002	−2.96002738606973507−001	2.93006618377317331+000	1.78288069006057176+003	16
45	1.03494189956175103−003	1.24047940899443518−002	−4.94553515807639662−001	5.46660474615300504+000	1.87275625040272237+003	15
46	5.44242390133175072−004	6.97508801019412742−003	−8.69668300606583072−001	1.05218556981210673+001	1.96463969966663410+003	14
47	2.76213967100961345−004	3.76121968813161698−003	−1.60046911730316521+000	2.08995111164357885+001	2.05853038446330713+003	14
48	1.35547924394231495−004	1.95092462660714853−003	−3.06900718141097506+000	4.28265587000528611+001	2.15442771778612927+003	14
49	6.44245216076139220−005	9.75835886139943824−004	−6.11163523504602360+000	9.04702076071702395+001	2.25233117105685010+003	14
50	2.96999879478839680−005	4.71696140562299794−004	−1.26063348555616380+001	1.96838239208798871+002	2.35224026726594899+003	13
51	1.32976941149256097−005	2.20746044149914220−004	−2.68761599364493164+001	4.40651348394307037+002	2.45415457503778613+003	14

OBLATE RADIAL FUNCTIONS

H = 22.0 X = 1.80000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	5.54413324290800561−003	4.606[illegible] 4104180896−001	−2.17374129793403691−002	1.27636068780904034−001	−3.55112922990008684+002	24
3	−2.17374129793401376−002	1.276[illegible] 8780924109−001	−5.54413324290895772−003	−4.60624284104175092−001	−3.55112922990004935+002	25
4	−2.09418887618053995−002	−1.717[illegible] 0528076746−001	8.68305756953384400−003	−4.40709630782889360−001	−2.75737554221058966+002	23
5	8.68305756789866156−003	−4.407[illegible] 0795978039−001	2.09418887625056126−002	1.71727480493309437−001	−2.75737554214372180+002	25
6	2.02863551831111745−002	−2.266[illegible] 7484408551−001	1.06349160807696167−002	4.09657072917361521−001	−2.01339767966675926+002	24
7	1.06349169587906451−002	4.09657062949649773−001	−2.02863547361021866−002	2.26608555007993322−001	−2.01339764325830458+002	23
8	−6.24643601819875548−003	4.49141987743577871−001	−2.22732756279122651−002	−1.14713153651002159−001	−1.32615754045018737+002	24
9	−2.22733391178722331−002	−1.14708761826327354−001	6.24621991848703478−003	−4.49143052055275797−001	−1.32614935276824586+002	25
10	−1.04536669996099242−002	−4.05576714642699152−001	2.08764098255173936−002	−2.15563204120053516−001	−7.07656073239279502+001	23
11	2.08664877049287574−002	−2.15955545171438918−001	1.04741029911716626−002	4.05361513723734455−001	−7.06842774868143538+001	24
12	2.07089882758009709−002	2.06291283571267078−001	−1.11763110156432663−002	4.06337383880414834−001	−1.97637634294175946+001	24
13	−1.04275000364239591−002	4.13324408692919700−001	−2.11083359910841094−002	−1.91399776056584800−001	−1.67657041439947846+001	24
14	−2.35879609402660203−002	−2.41491185001712004−002	1.86768018359749270−003	−4.52574466303715138−001	1.47635983598552581+001	24
15	−3.51192631222816086−003	−4.44978252756039952−001	2.34726501755598648−002	−7.84734008153649991−002	3.36025666277675758+001	24
16	2.10875002275697510−002	−2.20379574734385302−001	1.11258002527747935−002	3.92104917429303916−001	6.14353842704671839+001	24
17	1.79788574640452521−002	2.86655170230246275−001	−1.58410202733433235−002	3.43709343771697409−001	9.13313541478388749+001	24
18	−7.61441888295993143−003	4.26001082557384256−001	−2.28622836813225687−002	−1.28841620208986115−001	1.24224167755404031+002	23
19	−2.40954051531188337−002	6.18615303597753666−002	−2.70404139333868752−003	−4.37972943720924109−001	1.59652462130857678+002	24
20	−1.33064861321062045−002	−3.61128722365317850−001	2.04664385301320101−002	−2.50208269335641190−001	1.97502234762415273+002	23
21	1.17667180426401630−002	−3.89116722118934523−001	2.15958819411809651−002	1.96919214278050426−001	2.37675439729810337+002	25
22	2.47838596400757467−002	−2.52261321331247535−002	6.65345609000216113−004	4.31878961671215428−001	2.80105610843162434+002	24
23	1.37642302767288264−002	3.50148200185183146−001	−2.08834645152323293−002	2.47605865467844648−001	3.24743733410686937+002	24
24	−9.87788101439808938−003	3.96397640773351142−001	−2.32392377671202701−002	−1.52708120026121930−001	3.71552773982102001+002	24
25	−2.49294689892320820−002	1.04221905781200487−001	−5.43519003131117356−003	−4.07306942833299207−001	4.20504075652124095+002	24
26	−1.95902976773556034−002	−2.58501374739098190−001	1.67968928518131755−002	−3.25589323619192712−001	4.71575047926701646+002	24
27	7.88825066159412886−004	−4.10647533940785138−001	2.61138010969324795−002	−4.00134149256921643−003	5.24747606732999707+002	24
28	2.05875821240747480−002	−2.68008639830428923−001	1.66544786412180672−002	3.03914634481211746−001	5.80007086729497536+002	23
29	2.65824192677482096−002	4.07357003563713495−002	−3.95668576258502030−003	3.97226196450454838−001	6.37341462028464191+002	23
30	1.60576846234545681−002	3.06122725947753272−001	−2.20985910824361156−002	2.46332570031311415−001	6.96740775162218073+002	23
31	−3.66190515311335707−003	3.84812341005562392−001	−2.75710311017249659−002	−3.02407181468875292−002	7.58196710581200125+002	24
32	−2.14516409247743008−002	2.64187383033326466−001	−1.85748400900151838−002	−2.70989678157938994−001	8.21702270835066400+002	23
33	−2.90105902847179315−002	3.36272419378025043−002	−7.29416643352224508−004	−3.68688926660784100−001	8.87251527183380972+002	23
34	−2.41321152551315718−002	−1.89042509449163750−001	1.74222927676800697−002	−3.07758256585831189−001	9.54839425105034102+002	23
35	−1.00667303341140748−002	−3.20612657874261816−001	2.89344038811376522−002	−1.43410569624247507−001	1.02446163092467482+003	25
36	7.34644006763096858−003	−3.37204898670260807−001	3.08085792149595315−002	4.51385743843266489−002	1.09611440965402774+003	23
37	2.26590915492915375−002	−2.63730487651843805−001	2.38934205613962683−002	1.95020537247373695−001	1.16979452681872592+003	21
38	3.25833369215652196−002	−1.47053295507902285−001	1.13021714185117990−002	2.78006826990308326−001	1.24549916891678618+003	21
39	3.63128204680892580−002	−3.11778031308148689−002	−3.43409994085593972−003	2.98172359407067840−001	1.32322587849267679+003	20
40	3.48663331546645883−002	5.62690515459576300−002	−1.76777635444451924−002	2.78942458117569536−001	1.40297250077939983+003	19
41	3.01069115581063908−002	1.06009822086144608−001	−3.02387083801150832−002	2.49604199813503987−001	1.48473713957150839+003	18
42	2.39160422457778297−002	1.22078531308833336−001	−4.13586995037109920−002	2.37137997720033094−001	1.56851812051956694+003	18
43	1.77224903147211751−002	1.14841117129430413−001	−5.24702549525457025−002	2.64898943975829923−001	1.65431396043267977+003	17
44	1.23669923076527754−002	9.53675735309248680−002	−6.60582248451736121−002	3.57451427040019451−001	1.74212334147614286+003	17
45	8.18213243722249143−003	7.23097881948459042−002	−8.58927570991476568−002	5.51142947770224575−001	1.83194508938126480+003	16
46	5.15916400703011675−003	5.09887476394660389−002	−1.17915318763973742−001	9.12562040305177383−001	1.92377815496198635+003	16
47	3.11296101476392212−003	3.38235301543722616−002	−1.72248915267389282−001	1.57224753570343497+000	2.01762159837114507+003	15
48	1.80337564254120541−003	2.12734013194879133−002	−2.67320750099658294−001	2.79120442084839606+000	2.11347457563760579+003	15
49	1.00579488364642580−003	1.27587618475676044−002	−4.38254950162717242−001	5.09927166962440761+000	2.21133632711104230+003	16
50	5.41317285038044970−004	7.32870685896422636−003	−7.54275067759603907−001	9.59243487081210946+000	2.31120616750914805+003	14
51	2.81695605945061076−004	4.04568975629861094−003	−1.35564269233303983+000	1.85870911712279701+001	2.41308347731641019+003	13

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 24.0 X = 1.80000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	−1.33996798744184047−002	−3.56762188365734298−001	1.55623308668460974−002	−3.19036935889123589−001	−4.35102588928034513+002	23
3	1.55623308668460834−002	−3.19036935889123964−001	1.33996798744184213−002	3.56762188365733956−001	−4.35102588928034413+002	24
4	2.06759263286525752−002	−4.52439153456213069−002	1.57591145811867326−003	4.71840703312744230−001	−3.47665453233606837+002	23
5	1.57591145816715020−003	4.71840703312626554−001	−2.06759263286493921−002	4.52439153467265200−002	−3.47665453233388706+002	24
6	−1.19074846020377834−002	3.91515874830604894−001	−1.72171636864810493−002	−2.59185816777350082−001	−2.65091117839041123+002	23
7	−1.72171637061178467−002	−2.59185816136527511−001	1.19074845742924837−002	−3.91515875244938826−001	−2.65091117688817543+002	24
8	−4.84143074951167730−003	−4.50509796134380671−001	2.05650673239777995−002	−1.16139167662140825−001	−1.87951459571433092+002	24
9	2.05650650966872177−002	−1.16139384837077228−001	4.84144070815141606−003	4.50509737558758536−001	−1.87951415156566172+002	24
10	1.79766231605685266−002	2.39183873990579257−001	−1.14495679514474920−002	3.94317216514843005−001	−1.17118004623077558+002	24
11	−1.14483528409419402−002	3.94333210825412776−001	−1.79774168256875388−002	−2.39156808317919920−001	−1.17111778712758791+002	24
12	−2.13277461315620883−002	6.55058924003344210−002	−2.59419779038115509−003	−4.52795561437416304−001	−5.43592809764411137+001	24
13	−2.68856853778126233−003	−4.52477714913470010−001	2.13171868491493202−002	−6.75050788998857561−002	−5.39572991578885675+001	25
14	1.72689730285045607−002	−2.81916923065984968−001	1.30079358969096199−002	3.56702552693391185−001	−6.74288910700460606+000	24
15	1.45061291799157782−002	3.29861851996986353−001	−1.60626433337045416−002	3.12188735264941179−001	1.31253416277216785+000	24
16	−1.05351001603466398−002	4.00732244262082776−001	−1.90060439907647966−002	−2.09842272835253616−001	3.11611279751431629+001	24
17	−2.12872117881119966−002	−8.72620393667946229−002	4.73656888106596085−003	−4.42224254575758198−001	5.70658483824468937+001	24
18	−2.86433261479547035−003	−4.43355130725085680−001	2.17154918447348229−002	−6.96041020325181181−002	8.85635541318365802+001	24
19	1.91939237095695105−002	−2.28278773283973726−001	1.07713002364127103−002	3.83881114252944992−001	1.22675093430107332+002	23
20	1.76508895766652763−002	2.58726185225611211−001	−1.33440547644495202−002	3.61148236343671916−001	1.59524948298918153+002	24
21	−4.54719211063039179−003	4.34600911756379204−001	−2.17869399585363037−002	−7.88222811079287437−002	1.98875163785883544+002	23
22	−2.16190894499000537−002	1.26141951004039613−001	−5.85368412241368699−003	−4.20399245326986615−001	2.40617796816841549+002	23
23	−1.55794896283279331−002	−3.06653452363589195−001	1.63048764540463047−002	−3.09836681773265815−001	2.84671500596579978+002	24
24	6.32579949449580184−003	−4.18914585324493363−001	2.18206919297166801−002	1.08450783892753064−001	3.30977462375901238+002	24
25	2.20629159736649410−002	−1.27418915263205880−001	6.14091936233343883−003	4.09944666973567998−001	3.79491225881403260+002	24
26	1.73972048333869711−002	2.69913360145075016−001	−1.51973953550514771−002	3.29079529398605712−001	4.30178400253214758+002	23
27	−2.53283815524896223−003	4.20447015699079323−001	−2.31788719510711590−002	−3.21996436642637516−002	4.83011851880371242+002	23
28	−2.03404959688419682−002	2.22588338147516861−001	−1.18751133762877144−002	−3.53176357372026841−001	5.37969828794363350+002	23
29	−2.21428151781001123−002	−1.38088390663017364−001	8.75759005068595341−003	−3.89188205729808681−001	5.95034658808493941+002	23
30	−7.53408464482588688−003	−3.82584458130106958−001	2.28871211807491497−002	−1.42125715404272774−001	6.54191819891996405+002	23
31	1.23116392836470627−002	−3.55780443066384461−001	2.10745596953932480−002	1.89180968158717833−001	7.15429260372228334+002	24
32	2.41257111564360023−002	−1.05280073303632737−001	5.53203989925607558−003	3.83185821926693637−001	7.78736891780180800+002	24
33	2.12885005871472070−002	1.92621143131807831−001	−1.33615621958431247−002	3.40715618334638794−001	8.44106203964779227+002	24
34	6.47248703982963412−003	3.67071580904717097−001	−2.47280313119315719−002	1.15888448166735686−001	9.11529968638335523+002	23
35	−1.16942106350765781−002	3.46422410336995202−001	−2.32670508053328436−002	−1.51084691295107146−001	9.81002008054022946+002	24
36	−2.43056023081753048−002	1.70096141093583242−001	−1.07664018386483571−002	−3.28966158400892172−001	1.05251701242429592+003	23
37	−2.64485362883938739−002	−6.08120765914959368−002	6.36548159118939847−003	−3.56917515894234770−001	1.12607039432997234+003	23
38	−1.83644118817684016−002	−2.47340764024420645−001	2.10310089517959329−002	−2.51857681726653322−001	1.20165817155532666+003	23
39	−3.98630625258999614−003	−3.34185152418365188−001	2.84820390877631816−002	−7.74575338326412235−002	1.27927687201345015+003	23
40	1.15804677046743022−002	−3.17742580686453858−001	2.74119422313356747−002	9.64643905093523441−002	1.35892345601243085+003	22
41	2.41856083950254665−002	−2.29982622298679163−001	1.93403844018754951−002	2.22408781962078520−001	1.44059525225924094+003	20
42	3.16656439618441857−002	−1.14596270383861337−001	7.17445028399046160−003	2.84373777189183458−001	1.52428990483811390+003	20
43	3.38178753494764117−002	−8.20567428607141753−003	−6.19576233167226228−003	2.92090627537243581−001	1.61000532902330705+003	19
44	3.17541864380812859−002	6.83054445758936649−002	−1.87911019782124387−002	2.69051435694118509−001	1.69773967425372164+003	18
45	2.71144109626759052−002	1.09593238320145650−001	−2.98595351531457556−002	2.41740116796654525−001	1.78749129295139192+003	17
46	2.14544911097040717−002	1.20843414395862803−001	−3.98018461699260808−002	2.33855606691837078−001	1.87925871413726652+003	17
47	1.59200152864398126−002	1.11844451103503965−001	−4.99736865254030032−002	2.66190980966868853−001	1.97304062100732188+003	16
48	1.11702432894719534−002	9.24738721641106166−002	−6.26047155398643586−002	3.61473197925681063−001	2.06883583179526474+003	16
49	7.45606326223449042−003	7.02964882324435548−002	−8.10344203126470158−002	5.53993267754070382−001	2.16664328337613405+003	15
50	4.75671467515472024−003	4.99342602159684051−002	−1.10485966183144976−001	9.06089461717651251−001	2.26646201716628988+003	15
51	2.91113788959314716−003	3.34886811028861383−002	−1.59757153087121937−001	1.53788238184186548+000	2.36829116695574542+003	14

OBLATE RADIAL FUNCTIONS

H = 26.0 X = 1.80000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	1.74459048058924045−002	1.78608008998124688−001	−7.36034539534254317−003	4.44602960487504916−001	−5.23093992571517991+002	23
3	−7.36034539534254273−003	4.44602960487504921−001	−1.74459048058924047−002	−1.78608008998124677−001	−5.23093992571517989+002	24
4	−1.63533187637568205−002	2.52759537665698706−001	−9.87818545505103911−003	−4.02016989215622891−001	−4.27606293979691762+002	23
5	−9.87818545505214004−003	−4.02016989215605702−001	1.63533187637561699−002	−2.52759537665725470−001	−4.27606293979685002+002	24
6	2.43214731398254047−003	−4.67972986408827758−001	1.91202016764041770−002	5.07287045189843692−002	−3.36891085775943616+002	23
7	1.91202016765540180−002	5.07287044921905513−002	−2.43214731289119436−003	4.67972986411464107−001	−3.36891085770205822+002	23
8	1.29220734008436867−002	3.42648354284494476−001	−1.45243391839829634−002	3.16851368678552490−001	−2.51433061176805418+002	23
9	−1.45243389087706603−002	3.16851375997373437−001	−1.29220737166149799−002	−3.42648347377063570−001	−2.51433059026004808+002	23
10	−1.95820572629998997−002	−1.16604403821890582−002	8.83460038220949771−004	−4.62710118088470630−001	−1.71923659369882540+002	23
11	8.83381171379526768−004	−4.62710145573639837−001	1.95820616508472004−002	1.16585738091043825−002	−1.71923259302121940+002	23
12	1.52819385037407281−002	−2.98287274308114262−001	1.25189068062049548−002	3.49228402655661450−001	−9.94861533697383131+001	23
13	1.25247853408860255−002	3.49113083071237371−001	−1.52777225883414469 9−002	2.98419336621114396−001	−9.94484802389692937+001	23
14	−4.95473238333703887−003	4.44056178319038575−001	−1.92647317845113675−002	−1.04242641005023896−001	−3.71210916948662483+001	23
15	−1.93461836715427555−002	−9.69870623746569648−002	4.64179861180550433−003	−4.45613630913199636−001	−3.55226862387832984+001	23
16	−3.76330774938876734−003	−4.43834490281251321−001	1.96320039123914499−002	−9.50645378619155204−002	6.19437459526073208+000	23
17	1.87993368319112105−002	−1.65355747711100388−001	6.90105677093583765−003	4.21822760570355708−001	2.21086187651388953+001	23
18	1.24621091981853635−002	3.47911412118064037−001	−1.57679974096222827−002	2.87692176309126865−001	5.31152246858471422+001	23
19	−1.10301721741984455−002	3.82021599900837888−001	−1.68902534441674947−002	−2.37410248621290707−001	8.46793045170295981+001	23
20	−1.97953348107104740−002	−8.51929945465964270−002	4.30747145597091556−003	−4.39707196299401662−001	1.20135391654894641+002	23
21	−3.62379583690004071−003	−4.36717744245428442−001	2.00276755491282288−002	−8.95956306596841222−002	1.58308022598621204+002	23
22	1.68768438361604796−002	−2.59319686858552634−001	1.15596478489466985−002	3.59870207976121738−001	1.99101649055948690+002	23
23	1.78318274955872154−002	2.10456951097258422−001	−1.02513734905001820−002	3.87713752503750304−001	2.42361026461283413+002	23
24	−9.72126323451429661−004	4.38451743966786203−001	−2.06676665296613045−002	−9.61102256387073709−003	2.87991718104578867+002	23
25	−1.87171469665047815−002	2.00994035677556939−001	−9.12414562877084447−003	−3.86662493092486361−001	3.35923575719240953+002	23
26	−1.74089684392708076−002	−2.31537788401448706−001	1.16825486608967517−002	−3.65683130741198171−001	3.86103945327489922+002	23
27	8.30870831030817993−004	−4.29633211926298097−001	2.11037664027629511−002	5.10141668711148296−003	4.38492117628645458+002	23
28	1.82814395685906544−002	−2.28733748453663350−001	1.09059092513691247−002	3.59740163439954541−001	4.93055975105300498+002	23
29	1.95138474802753272−002	1.64785432055068903−001	−8.94976026061076831−003	3.89278816390666433−001	5.49769751435326596+002	23
30	4.27769270967928437−003	4.07917015415354299−001	−2.12379533306999000−002	9.53306030073598157−002	6.08612487446534139+002	23
31	−1.43781694816834123−002	3.21297522668828631−001	−1.64890675176356722−002	−2.62427078909799665−001	6.69566933201726787+002	23
32	−2.20949630794420836−002	−7.64648613763149994−004	7.89105719714030799−004	−4.10524070145581145−001	7.32618747545934139+002	23
33	−1.39324759883225517−002	−3.08276127731411596−001	1.74908742722472859−002	−2.64066385148042303−001	7.97755902115597091+002	23
34	3.66056010024797187−003	−3.97878299796031758−001	2.23401244694499612−002	4.98466943719247445−002	8.64968229568632236+002	23
35	1.89174546923211762−002	−2.36811884450159427−001	1.29784859451341496−002	3.17043595201049692−001	9.34247075808805956+002	23
36	2.29118011999307448−002	5.21323186822443372−002	−4.10171112421800009−003	3.86581821870911343−001	1.00558502863728653+003	23
37	1.42080806798219745−002	2.95919089008161354−001	−1.89024597093036791−002	2.44756415933904529−001	1.07897570351085353+003	23
38	−1.78689740349919975−003	3.77394309595282811−001	−2.39936827393352462−002	−8.97546193335623119−003	1.15441357259761282+003	23
39	−1.69319996474885551−002	2.81763528932510727−001	−1.77407444419530623−002	−2.40516352859310532−001	1.23189382708805854+003	23
40	−2.47553943979592487−002	7.73336768757032995−002	−3.82297590962751074−003	−3.54487294240332847−001	1.31141226534565871+003	23
41	−2.28812447141515031−002	−1.37923225335378326−001	1.15882076220348244−002	−3.26592136221276986−001	1.39296520134485822+003	22
42	−1.29715199909765754−002	−2.86300115238016841−001	2.29255794474343709−002	−1.93309768302338099−001	1.47654938918803973+003	21
43	9.67692843818682402−004	−3.34974592961917875−001	2.71344422416725432−002	−1.88398452936654852−002	1.56216196047560154+003	21
44	1.46420573052927778−002	−2.93843483376120782−001	2.40027889742621321−002	1.37825880384649747−001	1.64980037203124937+003	20
45	2.49429874575273429−002	−1.97697849212707225−001	1.53463497934131532−002	2.42039059055776184−001	1.73946236203023970+003	19
46	3.05040189193426756−002	−8.60049746776021429−002	3.77656262946505338−003	2.86726624825885446−001	1.83114591299172320+003	18
47	3.14965635801739791−002	1.10613739795563105−002	−8.35660140263681852−003	2.85068624883977034−001	1.92484922041266224+003	18
48	2.90385164186595582−002	7.79071903615782393−002	−1.95722398122751024−002	2.59872069221040667−001	2.02057066606503975+003	17
49	2.45658024486059828−002	1.12041104806599745−001	−2.94279141294144035−002	2.35041438705289045−001	2.11830879516825019+003	16
50	1.93749368332299837−002	1.19322638291698470−001	−3.84210100916314167−002	2.31568304471741916−001	2.21806229679778926+003	16
51	1.43949815588179443−002	1.08932216510464241−001	−4.78296147900543196−002	2.68213723788774687−001	2.31982998700930349+003	15

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 28.0 X = 1.80000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	−1.75325846258626061−002	3.69224106516467598−002	−1.07278313480377328−003	−4.78170847735808652−001	−6.19086728618735091+002	23
3	−1.07278313480377329−003	−4.78170847735808652−001	1.75325846258626061−002	−3.69224106516467601−002	−6.19086728618735091+002	24
4	9.43054510169276336−003	−4.06725169509839597−001	1.49929011200450515−002	2.46559484995194960−001	−5.15556857122093756+002	23
5	1.49929011200450691−002	2.46559484995194206−001	−9.43054510169273588−003	4.06725169509840045−001	−5.15556857122093555+002	24
6	6.10277724854789080−003	4.40521168320063628−001	−1.67831573279188272−002	1.68750140608969202−001	−4.16726482444936697+002	24
7	−1.67831573279075254−002	1.68750140609803668−001	−6.10277724857987981−003	−4.40521168319735202−001	−4.16726482444731002+002	23
8	−1.68846751338374507−002	−1.54563383128251544−001	6.24490252206222298−003	−4.41699190109370329−001	−3.23015743758797240+002	23
9	6.24490250719935438−003	−4.41699190242333075−001	1.68846751394938808−002	1.54563382736537163−001	−3.23015743663663544+002	23
10	1.62161542207379697−002	−2.15789467313504532−001	8.13770313430155674−003	4.11142486543405226−001	−2.34997053607513293+002	24
11	8.13770656326866782−003	4.11142440267148633−001	−1.62161525411832991−002	2.15789553458676731−001	−2.34997031060060739+002	23
12	−6.15422036782891690−003	4.36825800996498168−001	−1.72118590518485064−002	−1.46987989048641360−001	−1.53517411535571647+002	23
13	−1.72120286821963320−002	−1.46976224088724654−001	6.15376032938976134−003	−4.36829630873691830−001	−1.53514551533449524+002	23
14	−6.25201307994447372−003	−4.27422452918565139−001	1.73111957458772406−002	−1.63785141080467500−001	−8.01126548436684260+001	23
15	1.73003981552039173−002	−1.64540096800619814−001	6.28279695009213851−003	4.27123613477207656−001	−7.99245236641393532+001	23
16	1.46237342312487371−002	2.71863095799620465−001	−1.13506987740852931−002	3.64978219679007890−001	−2.03367735248305959+001	23
17	−1.06524174066209303−002	3.77239943079937581−001	−1.51509877673928107−002	−2.54179190193290453−001	−1.53399042848566641+001	23
18	−1.79544063736331205−002	−1.08518206992374042−001	4.81417569381147583−003	−4.40045452583486666−001	2.17069566529501212+001	23
19	5.33853483877148900−004	−4.52106250187096235−001	1.86265704592049757−002	3.73074054054754481−003	4.62974136118358733+001	23
20	1.78932205970299548−002	−1.39679765273098989−001	5.42720335307448029−003	4.28380685353949337−001	8.02913722649942752+001	23
21	1.12110831519251906−002	3.54295010869648694−001	−1.50511554505003735−002	2.75676423693760764−001	1.16577476995090491+002	23
22	−9.90649483013343742−003	3.85264803384415396−001	−1.[illegible]114104038171−002	−2.26828280375711549−001	1.56056382794577208+002	23
23	−1.87172269547577399−002	−5.67554309123006361−002	2.[illegible]083467718157−003	−4.41463162637511289−001	1.98224602049158264+002	24
24	−5.25377262659666898−003	−4.22897534640515267−001	1.[illegible]138497103562−002	−1.31814464094273091−001	2.42947924524825354+002	23
25	1.41929450506833981−002	−3.02643766256396072−001	1.[illegible]922890500727−002	3.20324395610629383−001	2.90108121240223999+002	23
26	1.80069173772033432−002	1.43904567453156256−001	−6.[illegible]371597037967−003	4.13947957750121017−001	3.39623244688258942+002	23
27	2.78769563976313372−003	4.29478022552843622−001	−1.91380071802042812−002	7.31167028165869562−002	3.91431476186741774+002	23
28	−1.52438934007427435−002	2.77441145910104108−001	−1.21013443680094620−002	−3.32314692270923349−001	4.45485170717582506+002	23
29	−1.84091712801633177−002	−1.37042110166583839−001	6.71568660642976344−003	−4.07560373850938103−001	5.01746763382887056+002	23
30	−4.38308925119462506−003	−4.13594955481980016−001	1.92456946810522399−002	−1.05692202830702214−001	5.60186116155543335+002	23
31	1.35496186844951624−002	−3.17866806895664080−001	1.45636361237188014−002	2.79999324696599455−001	6.20778698010439135+002	23
32	1.98936600220462320−002	4.17792536474930187−002	−2.55737371494172318−003	4.18039486885155194−001	6.83504298180208709+002	23
33	1.00166736891806159−002	3.55618533433710291−001	−1.75827016276764860−002	2.16683311616656831−001	7.48346091552609687+002	23
34	−7.63052312194524213−003	3.87213790016998061−001	−1.89498683444549631−002	−1.42261576783694715−001	8.15289944755555467+002	24
35	−1.96397799159238160−002	1.37861938732312789−001	−6.33802307626838757−003	−3.84393739455624016−001	8.84323891127911972+002	23
36	−1.79113808902412524−002	−1.95291108318052315−001	1.06992002128623201−002	−3.53614384291058405−001	9.55437727035278204+002	23
37	−4.34624179251947020−003	−3.87520934907477819−001	2.06578725295309410−002	−9.61342090694803579−002	1.02862269710555110+003	23
38	1.19199784900737872−002	−3.35420540400100838−001	1.77479792443244533−002	2.07227203128580611−001	1.10387124576263028+003	23
39	2.12103366875512194−002	−9.54395571394126243−002	4.46168017091627829−003	3.77050111518304160−001	1.18117681894792329+003	24
40	1.88998210226766244−002	1.81612370374573992−001	−1.12596463145681572−002	3.37478832660424340−001	1.26053370434804228+003	23
41	6.97069385630757289−003	3.52397751994771072−001	−2.12451793022210952−002	1.34337726697897614−001	1.34193690152209730+003	23
42	−8.23961656085689254−003	3.51876679713644617−001	−2.12166255728850524−002	−1.16212304857295076−001	1.42538201549658042+003	23
43	−1.98734992072946061−002	2.05089702556780832−001	−1.19897436250347216−002	−3.00108580627427184−001	1.51086516895909473+003	22
44	−2.36358406578041611−002	−7.32649887404329969−003	1.98189242111095988−003	−3.55758882543649647−001	1.59838292932268214+003	21
45	−1.89267620603484324−002	−1.98158428969001390−001	1.52399188908759394−002	−2.85482651006680434−001	1.68793224777575593+003	20
46	−8.14571498166046720−003	−3.09878641570599903−001	2.36049505271584099−002	−1.36085118591871568−001	1.77951040806372958+003	20
47	4.94162771262069307−003	−3.26939241280973823−001	2.52784147823476012−002	3.21098335392987257−002	1.87311498322599213+003	21
48	1.68108367714988575−002	−2.67794229934965284−001	2.07334580422524549−002	1.70775565886482428−001	1.96874379887694627+003	18
49	2.51711757887804112−002	−1.67464657642296409−001	1.18644135891786774−002	2.55701628210088005−001	2.06639490190151150+003	18
50	2.92197475666036383−002	−6.08917938156512898−002	9.65242051745068290−004	2.86258642513217809−001	2.16606653365472399+003	17
51	2.93547732109428270−002	2.72671651236311406−002	−1.00614084884889694−002	2.77598278406125489−001	2.26775710692704885+003	16

OBLATE RADIAL FUNCTIONS

H = 30.0 X = 1.80000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	1.42056244811192826−002	−2.45143273833332163−001	8.15605630036288417−003	4.12669846712994305−001	−7.23080508972632228+002	23
3	8.15605630036288417−003	4.12669846712994305−001	−1.42056244811192826−002	2.45143273833332163−001	−7.23080508972632228+002	24
4	−1.59255656391835968−003	4.74701484754043352−001	−1.64314488625512040−002	−3.86812310521805666−002	−6.11514915258733847+002	24
5	−1.64314488625512041−002	−3.86812310521805432−002	1.59255656391835887−003	−4.74701484754043353−001	−6.11514915258733841+002	24
6	−1.21805411974782664−002	−3.16402397469320219−001	1.13308130590872833−002	−3.51095959828062313−001	−5.04588552263729785+002	23
7	1.13308130590865558−002	−3.51095959828081192−001	1.21805411974789547−002	3.16402397469298910−001	−5.04588552263722792+002	24
8	1.66199154608215583−002	−6.85377961051918934−002	2.17849156310860193−003	4.64041241830440158−001	−4.02671891900056997+002	24
9	2.17849156367100376−003	4.64041241827985879−001	−1.66199154607528116−002	6.85377961208657844−002	−4.02671891896150555+002	23
10	−9.59248981619460750−003	3.87600976059817563−001	−1.38968014716795458−002	−2.58037428553165645−001	−3.06252328489318816+002	24
11	−1.38968015684574526−002	−2.58037424667256716−001	9.59248967863062305−003	−3.87600978597163065−001	−3.06252327343771551+002	24
12	−3.08282561045371511−003	−4.53169375650122277−001	1.67244819313450546−002	−9.16731015429715169−002	−2.16011477327802496+002	24
13	1.67244771538915085−002	−9.16738395385014722−002	3.08285292472102234−003	4.53169219345108158−001	−2.16011290678724179+002	24
14	1.35055411418506803−002	2.75762850635156102−001	−1.05223111420748178−002	3.67254644017729336−001	−1.33008878987799469+002	24
15	−1.05203190859883579−002	3.67295130293474051−001	−1.35071230406456704−002	−2.75707863926386907−001	−1.32991945155235469+002	24
16	−1.72229296454373223−002	8.43417067059817678−004	2.82973185555770501−004	−4.56477152632552402−001	−5.95867223891883919+001	24
17	1.63543930483126324−004	−4.56430186527904146−001	1.72256161322623669−002	−4.01093564807292869−003	−5.87994530771537448+001	23
18	1.54530592317074121−002	−2.12052160738337748−001	7.78970332929801937−003	4.01849996465159108−001	−4.79462299800932247+000	24
19	9.36296311717339416−003	3.77235210876796484−001	−1.45745181866355856−002	2.52442923141211966−001	6.98657136135910497+000	24
20	−1.10109320327011852−002	3.55443900943916558−001	−1.34418317948617043−002	−2.80068760934096588−001	4.24096831077116137+001	24
21	−1.60317047624091276−002	−1.68791678181301499−001	6.82652947802038472−003	−4.18506575115369424−001	7.44159832424490523+001	24
22	1.16871350022809309−003	−4.49253889930060792−001	1.74438466485230160−002	2.13219560897550127−002	1.12203725883143840+002	24
23	1.67915180812400718−002	−1.38512224663850344−001	5.09239437376249621−003	4.26184000274844063−001	1.52793956003048568+002	24
24	1.11124738823439550−002	3.40613308311443188−001	−1.36692817730976022−002	2.88477252418389854−001	1.96287720178026379+002	24
25	−8.09861466875626465−003	3.99245963333611504−001	−1.57292981484090480−002	−1.95314444877217939−001	2.42418444331190136+002	24
26	−1.77594664659509720−002	−8.03490754913037622−003	6.94292547126362505−004	−4.42358820787745142−001	2.91060012959114621+002	24
27	−7.28820628836458044−003	−3.98017723183795594−001	1.63056793402147932−002	−1.88206233453943022−001	3.42115069428159448+002	24
28	1.11277349568406148−002	−3.49564570006056296−001	1.40897857545196548−002	2.63876281449765260−001	3.95511847023206956+002	24
29	1.78116670255439810−002	6.15404100967611878−002	−2.95078552902977394−003	4.31180453662626868−001	4.51195066002262908+002	24
30	6.43677635650166931−003	4.01237455149498394−001	−1.69829867760254366−002	1.62725061003210276−001	5.09121221627751093+002	23
31	−1.12051646802971116−002	3.46061444765652642−001	−1.44391316347996775−002	−2.55668573123515015−001	5.69255429562935315+002	23
32	−1.83266917087400260−002	−2.77152633108681886−002	1.64048869873977716−003	−4.26490976554932034−001	6.31569293082606945+002	23
33	−8.94300426791677443−003	−3.66402739600834018−001	1.62311343972117573−002	−2.14078295481350589−001	6.96039403355749116+002	23
34	8.15584761210327503−003	−3.83526911682496786−001	1.67977701969882046−002	1.74014812539712640−001	7.62646255400242138+002	23
35	1.85009680869476387−002	−8.82085926348423040−002	3.47566742573159042−003	4.08359792445958374−001	8.31373445934623471+002	23
36	1.42164709574674602−002	2.65737006079106870−001	−1.25862892452205466−002	3.17729513320785414−001	9.02207068013530489+002	23
37	−7.89108903368949352−004	4.10406238088079807−001	−1.91463931614785926−002	−4.86121719276343019−003	9.75135246403698975+002	23
38	−1.52208296803614423−002	2.60693941296136067−001	−1.19502884828941388−002	−3.11827115575580313−001	1.05014777573624252+003	24
39	−1.92581113263489818−002	−5.70927057009913471−002	3.39878772736304231−003	−3.98148556872059290−001	1.12723583507923487+003	23
40	−1.08372486960687013−002	−3.25106051104766896−001	1.65433554916503000−002	−2.29143974993748282−001	1.20639176023893749+003	23
41	4.20487042142074180−003	−3.86950089530993718−001	1.95708348962268237−002	6.86582167583121371−002	1.28760886028288803+003	24
42	1.68207092375150259−002	−2.28884744102617839−001	1.13284439742704900−002	3.13228600863230128−001	1.37088126836155015+003	24
43	2.03421894434385527−002	4.08550495438896451−002	−3.03353492305989294−003	3.80376951166723014−001	1.45620381942946533+003	23
44	1.35870718763380976−002	2.75050001758784066−001	−1.58589371924130530−002	2.57570913682641786−001	1.54357194927541212+003	22
45	4.49059672355311886−004	3.69792907005005921−001	−2.12284864849139608−002	2.55901214480028697−002	1.63298161058681534+003	22
46	−1.28808125125140335−002	3.03396774728918728−001	−1.73674969024902828−002	−2.01260027057856274−001	1.72442920274414864+003	21
47	−2.10596867590398540−002	1.25808537175644745−001	−6.56653809415862990−003	−3.34074706271286595−001	1.81791151276594635+003	20
48	−2.15585159093286637−002	−8.08263662989757702−002	6.62610282233040905−003	−3.39822622164048890−001	1.91342566537266947+003	19
49	−1.49519756737191042−002	−2.43232049961877003−001	1.76321259864148270−002	−2.38960867060807942−001	2.01096908055574098+003	19
50	−3.94178205603179021−003	−3.21523420845173128−001	2.34414104794098503−002	−8.23669925771824100−002	2.11053943736030738+003	19
51	8.08991862340003627−003	−3.12966550655686646−001	2.31625840052662536−002	7.57141361043255003−002	2.21213464284087018+003	18

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 35.0 X = 1.80000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	−1.39471022514193331−002	5.39030543034754953−002	−1.39541001672263995−003	−4.77757134949549853−001	−1.01806827407736223+003	23
3	−1.39541001672263995−003	−4.77757134949549853−001	1.39471022514193331−002	−5.39030543034754953−002	−1.01806827407736223+003	23
4	6.87280544188557836−003	−4.20092963692274678−001	1.23238679337333084−002	2.27181502977472263−001	−8.86433410489711463+002	23
5	1.23238679337333084−002	2.27181502977472263−001	−6.87280544188557836−003	4.20092963692274678−001	−8.86433410489711463+002	24
6	5.85354584143632909−003	4.29632320856297010−001	−1.29424333664663327−002	2.01255242812201934−001	−7.59324741722267464+002	23
7	−1.29424333664663326−002	2.01255242812201938−001	−5.85354584143632921−003	−4.29632320856297008−001	−7.59324741722267463+002	23
8	−1.38746467874223161−002	−1.07561254619317844−001	3.45320065100906034−003	−4.58902772623421688−001	−6.37027656521040913+002	23
9	3.45320065100895423−003	−4.58902772623422487−001	1.38746467874223433−002	1.07561254619314320−001	−6.37027656521039876+002	22
10	1.16796462708498774−002	−2.78893637309118341−001	8.40624157844106222−003	3.76218344510121833−001	−5.19895762714263522+002	22
11	8.40624157848235180−003	3.76218344509130849−001	−1.16796462708206273−002	2.78893637310434432−001	−5.19895762713789927+002	23
12	−1.69478187560055064−003	4.62926314989550098−001	−1.43814576784624059−002	−4.77874281586004273−002	−4.08382770826656287+002	23
13	−1.43814576801747409−002	−4.77874277188627590−002	1.69478186196885223−003	−4.62926315031548503−001	−4.08382770699403414+002	23
14	−9.03807250397797735−003	−3.58513091986992206−001	1.14270943665337050−002	−2.92294793990383492−001	−3.03099932316189017+002	23
15	1.14270929728978327−002	−2.92294849495000944−001	9.03807429456764397−003	3.58513046008702757−001	−3.03099911510684225+002	23
16	1.44541349662229910−002	6.88377065570419261−002	−2.41312345750276932−003	4.54709369000549905−001	−2.04934494439546174+002	23
17	−2.41289844924257146−003	4.54710386109853838−001	−1.44541743744737577−002	−6.88306064971560731−002	−2.04932419854586278+002	22
18	−1.28698391094054541−002	2.28861503169413583−001	−7.17297959494250894−003	−3.96036464695705032−001	−1.15402824368908533+002	22
19	−7.18477572691783558−003	−3.95824385397099510−001	1.28633824121420381−002	−2.29221356320059734−001	−1.15281782660834263+002	22
20	6.92776373637098951−003	−4.05657163821829871−001	1.30821362005014684−002	2.06658636328897413−001	−3.92177248198125719+001	23
21	1.32619571398476615−002	1.95914911436008608−001	−6.58417397902553949−003	4.10844836471553966−001	−3.57545315190426002+001	23
22	−1.25407898750848725−003	4.52686928687743627−001	−1.47996650957276481−002	−3.10423322527100715−002	1.39421067166020134+001	23
23	−1.48057127078570884−002	5.10308540256321799−002	−1.43621388603560401−003	−4.50181182408635338−001	3.78427624814586937+001	23
24	−5.78583325241975553−003	−4.13596889502023769−001	1.37448883009638774−002	−1.82117489494090616−001	7.75819348001275458+001	23
25	1.13467857727748403−002	−2.99153396224785337−001	9.73777680192808692−003	3.37140010309924563−001	1.18448708567825046+002	23
26	1.30236164201088114−002	2.16237979718692256−001	−7.43478333436738145−003	3.93965990782831886−001	1.63447906582629480+002	23
27	−2.28760844360634513−003	4.43872013972309301−001	−1.48689805306880723−002	−6.05960958525881066−002	2.11403574932213464+002	23
28	−1.46773145710454376−002	1.11781307594019079−001	−3.52700272078377647−003	−4.32251517651077058−001	2.62190262318690378+002	23
29	−9.11375366803552410−003	−3.50623814993780939−001	1.21021214208669052−002	−2.73789766892950633−001	3.15623221354916617+002	23
30	7.22855503975104127−003	−3.93579151984428704−001	1.33808166328264686−002	2.03655364466485762−001	3.71585738675545032+002	23
31	1.52550426525279541−002	1.20420753850943679−002	−6.93134592958885730−004	4.41178556407236545−001	4.29988647975368956+002	23
32	6.30959197357524371−003	3.97125062540352675−001	−1.39789774649252831−002	1.88148802546453636−001	4.90763395878593413+002	23
33	−9.42422538926174564−003	3.51041606286321924−001	−1.21887969458140765−002	−2.61004964783618239−001	5.53855767923505703+002	23
34	−1.53068173229661195−002	−5.69634059775226797−002	2.32074595191108548−003	−4.31595069123354832−001	6.19222082617918303+002	22
35	−5.71707073207082176−003	−3.99628940224680809−001	1.44724518678227643−002	−1.67032019849949248−001	6.86826592589418579+002	23
36	9.45486083286798593−003	−3.48416800490612427−001	1.24641575330308177−002	2.53395859365307321−001	7.56639664925755623+002	23
37	1.56772329218081736−002	2.72784418986912079−002	−1.32625033114879046−003	4.27522284399352679−001	8.28636466848116313+002	22
38	7.57630019086841688−003	3.69476892013239492−001	−1.38961991784334114−002	2.11741872778821598−001	9.02795993090560426+002	23
39	−7.19924396897003894−003	3.81576457474466518−001	−1.42072388650148549−002	−1.82990964532637699−001	9.79100331183253855+002	22
40	−1.58463564582418976−002	7.33227887165380580−002	−2.44021206748898107−003	−4.13951392411960096−001	1.05753409662786782+003	22
41	−1.15137859965436210−002	−2.85665766517199819−001	1.13188918131136669−002	−3.04428497240384523−001	1.13808399205225158+003	22
42	1.88600240451034110−003	−4.12646482794113078−001	1.61555745461951172−002	3.81378007249618656−002	1.22073845855298427+003	23
43	1.38527782654555215−002	−2.28457650170858570−001	8.76528077095417875−003	3.41884417379562526−001	1.30548739672056516+003	22
44	1.57594230075980622−002	1.12870862869037221−001	−4.98462819604030515−003	3.91887773165777812−001	1.39232194110373400+003	22
45	6.71031912471903898−003	3.65569482482566922−001	−1.52643271793985604−002	1.72625513846142132−001	1.48123427618606388+003	22
46	−6.79473957829639038−003	3.70873579433329155−001	−1.53969689337203253−002	−1.51325224708421236−001	1.57221748498264471+003	23
47	−1.59875723486377256−002	1.45571603787349072−001	−5.76805782281530995−003	−3.68966527109462935−001	1.66526542353579248+003	22
48	−1.55284398606936019−002	−1.56628655396823009−001	7.33914877405080278−003	−3.59921764214313628−001	1.76037261616665395+003	22
49	−6.16910126852360592−003	−3.58159195252087222−001	1.62360477644589522−002	−1.49690308653575529−001	1.85753416750281818+003	22
50	6.53661864975853646−003	−3.60820821561551366−001	1.63167679756204388−002	1.30207205560690502−001	1.95674568817071985+003	22
51	1.58884482370610461−002	−1.83263572863234105−001	8.03351064046626094−003	3.31454307759447050−001	2.05800323169799590+003	21

OBLATE RADIAL FUNCTIONS

H = 40.0 X = 1.80000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	1.16171961883678314−002	1.47590971489851195−001	−3.88349059795530199−003	4.58205076221432172−001	−1.36305927072589725+003	22
3	−3.88349059795530199−003	4.58205076221432172−001	−1.16171961883678314−002	−1.47590971489851195−001	−1.36305927072589725+003	24
4	−9.83374076336976377−003	2.92623400217472745−001	−7.42338590058905479−003	−3.78693122113727343−001	−1.21137424430981044+003	22
5	−7.42338590058905479−003	−3.78693122113727343−001	9.83374076336976377−003	−2.92623400217472745−001	−1.21137424430981044+003	24
6	−2.52573348223366865−004	−4.75559511703023108−001	1.23904408980750824−002	−1.51813001948064604−002	−1.06413650947451040+003	22
7	1.23904408980750824−002	−1.51813001948064604−002	2.52573348223366865−004	4.75559511703023108−001	−1.06413650947451040+003	23
8	1.00549735982168444−002	2.75055183453636919−001	−7.36657306091964734−003	3.84885377628915593−001	−9.21577771344244604+002	22
9	−7.36657306091964733−003	3.84885377628915593−001	−1.00549735982168444−002	−2.75055183453636919−001	−9.21577771344244604+002	22
10	−1.21231323801372577−002	1.25202388558163002−001	−3.19042968431596950−003	−4.53412272153121533−001	−7.83974360303797126+002	23
11	−3.19042968431598029−003	−4.53412272153121419−001	1.21231323801372549−002	−1.25202388558163405−001	−7.83974360303796989+002	22
12	5.53802846366321504−003	−4.22711374035170704−001	1.13247614508311691−002	2.00273607994300118−001	−6.51663421527715605+002	23
13	1.13247614508331562−002	2.00273607994149940−001	−5.53802846365921844−003	4.22711374035240649−001	−6.51663421527661150+002	22
14	4.58065046037103608−003	4.31599799599268531−001	−1.18190171339042423−002	1.73586916425956786−001	−5.25068638051493288+002	22
15	−1.18190171335006294−002	1.73586916464565306−001	−4.58065046143353667−003	−4.31599799583439034−001	−5.25068638037752172+002	22
16	−1.16639729798023179−002	−1.80875710090551592−001	5.13252867536323021−003	−4.25916336996014992−001	−4.04744152201091400+002	22
17	5.13252850372037772−003	−4.25916339623832570−001	1.16639730567339079−002	1.80875703783486452−001	−4.04744149947013533+002	22
18	1.21236629988652193−002	−1.54282758271719831−001	4.13260138530530625−003	4.33749872049735920−001	−2.91457619080057121+002	22
19	4.13262061758407793−003	4.33749623023068527−001	−1.21236565918819504−002	1.54283443292972935−001	−2.91457378199954325+002	22
20	−6.73653246886955240−003	3.93584795960731529−001	−1.09670921527451211−002	−2.34504278747832718−001	−1.86380622956493572+002	22
21	−1.09678273134593955−002	−2.34461614099925759−001	6.73535421299888704−003	−3.93609807247980220−001	−1.86364251580315460+002	22
22	−9.38701402234592644−004	−4.54422010307260706−001	1.28938933878526167−002	−3.93708382781568002−002	−9.19128960405979765+001	22
23	1.28901173011127823−002	−4.13329021373106244−002	9.94418943000256533−004	4.54233585115192011−001	−9.12593849007389399+001	22
24	6.95577560738103706−003	3.80226926220600366−001	−1.09518604696055658−002	2.49006619837101613−001	−1.73844779372964364+001	22
25	−1.04310894515807528−002	2.75462244280596455−001	−7.72616449683406252−003	−3.61223994924552933−001	−6.56815315497912029+000	22
26	−1.05803932452156437−002	−2.58527894429207190−001	7.57134681033531415−003	−3.72275583235637860−001	4.05019585185363204+001	22
27	4.80760985227456991−003	−4.22860473596763588−001	1.21145665702506670−002	1.60881411251099466−001	7.71462663006720323+001	22
28	1.30296256568175192−002	2.58511033395933475−002	−9.35471146540964545−004	4.50668623065272737−001	1.23184337474188895+002	22
29	3.28288402046563460−003	4.34251917968856992−001	−1.26766477721442181−002	1.19214630850578886−001	1.72001827698425130+002	22
30	−1.08188592374961190−002	2.59867779078543756−001	−7.43829994264580756−003	−3.66328079687277280−001	2.24313669728313076+002	22
31	−1.08725758766421500−002	−2.47060756253688470−001	7.42503282599815762−003	−3.73581406649074908−001	2.79591652607638695+002	22
32	2.75837141072150697−003	−4.38060968277774760−001	1.29139528076671743−002	8.66916409243165163−002	3.37668901293314178+002	22
33	1.29911399806642411−002	−9.37093392664731596−002	2.59058427838594196−003	4.35178474134462863−001	3.98397520692535385+002	22
34	7.74444938831502433−003	3.56529360858507161−001	−1.08016241702140955−002	2.64076908623076245−001	4.61671354434069849+002	22
35	−6.46549422554676466−003	3.90030469211577414−001	−1.16657789969916708−002	−2.08215661822088835−001	5.27407900597712077+002	22
36	−1.33725501807348537−002	−1.33187694254817364−002	6.18559165347787593−004	−4.40304047366939470−001	5.95541866590887259+002	22
37	−5.60924051487430847−003	−3.95725568099926673−001	1.22120912874077540−002	−1.89613843420756604−001	6.66020480324958888+002	22
38	8.12991218987568736−003	−3.53110071876754148−001	1.07691334359972203−002	2.57510399197929908−001	7.38800405010956611+002	22
39	1.34249358735384436−002	5.19010635717970700−002	−1.84275798766169428−003	4.32075457958995714−001	8.13845577573775151+002	22
40	5.18015433543731618−003	3.97751844016236329−001	−1.25870659374828727−002	1.71751200851327716−001	8.91125652373745731+002	22
41	−8.13348471797818120−003	3.51118423863074090−001	−1.09932717328581800−002	−2.50358393943213739−001	9.70614851194045134+002	22
42	−1.37012644293433553−002	−2.53331141202463331−002	1.05732201376109926−003	−4.28386824159642833−001	1.05229109509473048+003	22
43	−6.61651725150526748−003	−3.70956136181610630−001	1.21246592569128917−002	−2.11366435160910675−001	1.13613533698067874+003	22
44	6.38854055093518782−003	−3.80670373603045660−001	1.23299904775648610−002	1.88237724076384079−001	1.22213104034853483+003	22
45	1.38436770024350805−002	−6.36035270972996701−002	1.83648153588620060−003	4.17477214395158203−001	1.31026376658501212+003	22
46	9.66375641287951175−003	2.98907329705234576−001	−1.01951163406648098−002	2.94795449301184500−001	1.40052084425562288+003	22
47	−2.36962585708418784−003	4.12679895493649694−001	−1.39342305702582203−002	−6.15496320398974908−002	1.49289110125587682+003	22
48	−1.25364027389936154−002	2.03586900842564336−001	−6.72444186917538346−003	−3.61125773422334571−001	1.58736464580404355+003	22
49	−1.31898462359788037−002	−1.52257126933507403−001	5.58339605426003957−003	−3.82575693685966453−001	1.68393268583492835+003	22
50	−4.19401893760577311−003	−3.88418980452303582−001	1.38022937229877445−002	−1.27599223386843344−001	1.78258737890970295+003	22
51	7.75408527559443039−003	−3.48148075628000925−001	1.22927049771442628−002	2.08476535346703500−001	1.88332170661068463+003	23

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 0.1 X = 2.00000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	3.32178436319400340−003	2.64792935171309892−003	−2.92461221895082023+002	3.68953313130686348+002	5.99857123417190307+000	21
3	9.49914450494974676−005	1.23277686880906317−004	−6.97010097467339095+003	1.20088927368301851+004	1.19966664421869860+001	21
4	2.18742809895596026−006	3.85794738430870694−006	−2.31935555159933353+005	5.05253101653970534+005	1.99959740046062577+001	21
5	4.16139509810495757−008	9.24466408964057275−008	−9.90394081560264885+006	2.60589036704194117+007	2.99956410515004519+001	21
6	6.72834581398427089−010	1.80018948143291799−009	−5.16248923095397518+008	1.59125905303103508+009	4.19954545802252094+001	21
7	9.45050305386839073−012	2.95561737752434339−011	−3.17759951720801397+010	1.12250444105033587+011	5.59953394001596214+001	20
8	1.17289119453651262−013	4.19680195598766159−013	−2.25545749396798373+012	8.98147383724790957+012	7.19952631879514903+001	21
9	1.30362443674983231−015	5.25107355393827364−015	−1.81361574767042627+014	8.03649426557374870+014	8.99952101102423571+001	20
10	1.31175488603294049−017	5.87323843563160632−017	−1.62938819537597410+016	7.95134421484555200+016	1.09995171647438028+002	21
11	1.20569610140913740−019	5.93965061769990065−019	−1.61757920522439483+018	8.61920732957895566+018	1.31995142876876673+002	20
12	1.01989106157808061−021	5.48187756810664493−021	−1.75846547027531253+020	1.01582492233799225+021	1.55995120790161862+002	20
13	7.99014256971517643−024	4.65296162793102899−023	−2.07754123944491596+022	1.29325356115477739+023	1.81995103463378979+002	20
14	5.82915278356069716−026	3.65582040321210597−025	−2.65055570122946063+024	1.76870374999801404+025	2.09995089619064503+002	20
15	3.97886826642574731−028	2.67368546162106139−027	−3.63174694892214245+026	2.58612507209837455+027	2.39995078381740073+002	20
16	2.55161633087328302−030	1.82892168247256048−029	−5.31890624288925129+028	4.02573730268671587+029	2.71995069134989622+002	20
17	1.54298318857323336−032	1.17507291398969462−031	−8.29185071475120906+030	6.64716951824583676+031	3.05995061434544711+002	20
18	8.82693389712149217−035	7.11751593563512980−034	−1.37091149631908807+033	1.16037071286368489+034	3.41995054953608932+002	18
19	4.79100114887566600−037	4.07769680331625653−036	−2.39595920999204760+035	2.13525408795613060+036	3.79995049447434870+002	20
20	2.47371301445889112−039	2.21616352107007116−038	−4.41360722494612345+037	4.13092570238119317+038	4.19995044729773045+002	20
21	1.21789499992149443−041	1.14561346942772895−040	−8.54694756603054685+039	8.38208691760858056+040	4.61995040656851186+002	20
22	5.72987738747204158−044	5.64628648895732228−043	−1.73579684305966251+042	1.78000209214899541+043	5.05995037116251116+002	21
23	2.58114221376404162−046	2.65901233950998429−045	−3.68908297300121089+044	3.94812916505390050+045	5.51995034019043052+002	19
24	1.11530764446979917−048	1.19887014913398549−047	−8.18865102578247705+046	9.13010035751596168+047	5.99995031294130486+002	20
25	4.63037249149701228−051	5.18451238536590860−050	−1.89493721289978136+049	2.19759308110015662+050	6.49995028884122796+002	20
26	1.84987593559378750−053	2.15404064834759683−052	−4.56396951856132060+051	5.49713845319868517+052	7.01995026742281287+002	19
27	7.12184164277932276−056	8.61152905199587168−055	−1.14232215375100315+054	1.42699881519250563+055	7.55995024830230942+002	20
28	2.64568805162495287−058	3.31747336987791675−057	−2.96697801207812030+056	3.83912587490392802+057	8.11995023116226001+002	20
29	9.49545232044591647−061	1.23313714960884699−059	−7.98630603965678155+058	1.06912119525834008+060	8.69995021573821253+002	18
30	3.29626341104581577−063	4.42821013548562231−062	−2.22509750650889680+061	3.07827360981876465+062	9.29995020180844063+002	19
31	1.10795929997575801−065	1.53800688929991200−064	−6.40950975958858008+063	9.15388302886184490+064	9.91995018918591754+002	20
32	3.60959644762295342−068	5.17213110896576153−067	−1.90680638860670473+066	2.80855422643954276+067	1.05599501777119960+003	19
33	1.14087291326349315−070	1.68577889959318354−069	−5.85270861119704144+068	8.88234543915082396+069	1.12199501672513917+003	19
34	3.50143729252497143−073	5.33044624285993492−072	−1.85167484086617553+071	2.89302533651882722+072	1.18999501576881722+003	18
35	1.04436069374965910−075	1.63661350413111444−074	−6.03313762255329226+073	9.69596572836462217+074	1.25999501489225267+003	18
36	3.02966175041260944−078	4.88330498721874547−077	−2.02268232434142982+076	3.34117342195236547+077	1.33199501408681479+003	19
37	8.55466509163333836−081	1.41713730801971192−079	−6.97226007344486705+078	1.18290430078928306+080	1.40599501334500976+003	18
38	2.35280411703685854−083	4.00282771126056294−082	−2.46919309179043669+081	4.29965477979041389+082	1.48199501266030551+003	19
39	6.30718045222686657−086	1.10125541691611245−084	−8.97766449319779128+083	1.60345790360886220+085	1.55999501202698728+003	18
40	1.64903423065397234−088	2.95303665872828867−087	−3.34892657374725766+086	6.13116263591775876+087	1.63999501144003789+003	18
41	4.20759234557769914−091	7.72303452882444876−090	−1.28086556152402196+089	2.40228382680453441+090	1.72199501089503800+003	18
42	1.04833301214829857−093	1.97110879600505489−092	−5.01986968098890494+091	9.6[illegible]96473591238+092	1.80599501038808257+003	19
43	2.55191862025235496−096	4.91234862642733379−095	−2.01474556376747669+094	3.9[illegible]08383912180+095	1.89199500991571068+003	19
44	6.07247517680250743−099	1.19609165158225014−097	−8.27649520899710494+096	1.6[illegible]79422335813+098	1.97999500947484627+003	18
45	1.41323787882651468−101	2.84686062191317790−100	−3.47809762061918735+099	7.1[illegible]08364387778+100	2.06999500906274787+003	18
46	3.21828931136407857−104	6.62695423404997702−103	−1.49446877626214425+102	3.1[illegible]90219691905+103	2.16199500867696586+003	19
47	7.17457151738171347−107	1.50944660444714177−105	−6.56254014778504340+104	1.40694061421267928+106	2.25599500831530599+003	18
48	1.56646373963509357−109	3.36572484636374083−108	−2.94371893558952796+107	6.44269751186572825+108	2.35199500797579802+003	19
49	3.35106446838551353−112	7.35003153037758349−111	−1.34824092751222567+110	3.01109894107796794+111	2.44999500765666890+003	19
50	7.02684652169560351−115	1.57265816131686246−113	−6.30232619130870715+112	1.43572159272420387+114	2.54999500735631947+003	20
51	1.44485293529793559−117	3.29830947214464559−116	−3.00551738375825501+115	6.98124584034207750+116	2.65199500707330447+003	19

OBLATE RADIAL FUNCTIONS

H = 0.2 X = 2.00000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	1.31492990566411836−002	1.03686957608261183−002	−3.74881095346339364+001	4.64889569363101692+001	5.99428260216102775+000	21
3	7.54037180162057579−004	9.73533103631879523−004	−4.41804079001664386+002	7.55783824412749887+002	1.19866630743779954+001	22
4	3.47807498937085410−005	6.11517045918192222−005	−7.31970649990841899+003	1.58819885168347738+004	1.99838957634995984+001	21
5	1.32468282379360933−006	2.93666939025712542−006	−1.55927762476031404+005	4.09223780295512417+005	2.99825645168181086+001	21
6	4.28671308524092304−008	1.14519699664485874−007	−4.05818358329554622+006	1.24864441406291187+007	4.19818187383378792+001	22
7	1.20486167991774433−009	3.76388854329803075−009	−1.24773364422510349+008	4.40189087246571932+008	5.59813580044443829+001	21
8	2.99195346230481470−011	1.06962000143106556−010	−4.42508490521475824+009	1.76033509334545514+010	7.19810531125249704+001	21
9	6.65316649775095880−013	2.67801955751649958−012	−1.77815456417414562+011	7.87304406499535288+011	8.99808407554937990+001	21
10	1.33930972587181610−014	5.99309466315427874−014	−7.98427846990088564+012	3.89375678422352925+013	1.09980686862451590+002	21
11	2.46262759463233674−016	1.21257532017329344−015	−3.96185697118765443+014	2.10992113708409728+015	1.31980571744318647+002	21
12	4.16708007688055433−018	2.23885822547447396−017	−2.15285688015592308+016	1.24309074220415554+017	1.55980483367231199+002	21
13	6.53036745637502904−020	3.80151931855418579−019	−1.27144829892060742+018	7.91159879382711696+018	1.81980414034755664+002	21
14	9.52980019694131866−022	5.97486733244746598−021	−8.10903132720714155+019	5.40930686477794964+020	2.09980358636216366+002	21
15	1.30114355479017085−023	8.74093041084229124−023	−5.55447080380651314+021	3.95411844031067861+022	2.39980313668970715+002	21
16	1.66902074531627714−025	1.19601575437273491−024	−4.06681324505685127+023	3.07726989208095784+024	2.71980276666747091+002	20
17	2.01875098408068186−027	1.53706868926201097−026	−3.16953898718926720+025	2.54028401909682806+026	3.05980245851978774+002	20
18	2.30994675085648509−029	1.86224633165075889−028	−2.61983141418226002+027	2.21703316645581137+028	3.41980219917083926+002	20
19	2.50775401545071010−031	2.13401968088214228−030	−2.28911785634584008+029	2.03966474031542493+030	3.79980197882755149+002	20
20	2.58982920410038318−033	2.31982658776530065−032	−2.10820031087666724+031	1.97284857951396944+032	4.19980179003739211+002	21
21	2.55030340497562162−035	2.39860176045042924−034	−2.04109236229105982+033	2.00142157854960399+034	4.61980162704741063+002	20
22	2.39985469662156929−037	2.36453580926959902−036	−2.07246570037975815+035	2.12495391706342547+036	5.05980148535920975+002	20
23	2.16225498408874068−039	2.22722126832237486−038	−2.20214887769514724+037	2.35648765806059231+038	5.51980136141423603+002	20
24	1.86871474642962208−041	2.00850370285579423−040	−2.44389751360083547+039	2.72455857923760541+040	5.99980125236751170+002	20
25	1.55172892711553225−043	1.73725530103615562−042	−2.82754864315266418+041	3.27881116465558845+042	6.49980115592248967+002	19
26	1.23991681256388180−045	1.44365323152231700−044	−3.40490205789847875+043	4.10068005335310752+044	7.01980107020885664+002	19
27	9.54752644362808994−048	1.15435868528374007−046	−4.26087588969430188+045	5.32223811038154460+046	7.55980099369097288+002	20
28	7.09389147247219201−050	8.89442542794602207−049	−5.53317726001483103+047	7.15905616519008109+048	8.11980092509847162+002	20
29	5.09222715670686820−052	6.61257157224630730−051	−7.44659240947375028+049	9.96791249898490291+050	8.69980086337309181+002	20
30	3.53556802306014406−054	4.74935377602787401−053	−1.03732137198321162+052	1.43495862388356451+053	9.29980080762754417+002	20
31	2.37686948776981197−056	3.29921594744502773−055	−1.49397343818327597+054	2.13350334706200938+055	9.91980075711339461+002	20
32	1.54875801932930623−058	2.21905018891250235−057	−2.22218123987719085+056	3.27286008310567962+057	1.05598007111957740+003	21
33	9.79049835002453657−061	1.44657987936927997−059	−3.41024462123377656+058	5.17523068392449033+059	1.12198006693333047+003	20
34	6.00974137069328867−063	9.14847559876360462−062	−5.39448462485913794+060	8.42776517614565247+061	1.18998006310620487+003	21
35	3.58509934628442892−065	5.61789842061966580−064	−8.78791499958217230+062	1.41224499833680787+064	1.25998005959825826+003	20
36	2.08010600266760639−067	3.35261341361143739−066	−1.47308697083116584+065	2.43319756574154385+066	1.33198005637495213+003	20
37	1.17472017605312696−069	1.94591016944047488−068	−2.53882656773149136+067	4.30712919259233844+068	1.40598005340629747+003	20
38	6.46184845210692148−072	1.09930545333434354−070	−4.49545709628440719+069	7.82766655131744884+070	1.48198005066615398+003	20
39	3.46453825242268009−074	6.04894476750971837−073	−8.17225815838782743+071	1.45954404569559193+073	1.55998004813165212+003	20
40	1.81166728859211566−076	3.24414282772845773−075	−1.52420978707286817+074	2.79038308145563064+075	1.63998004578271391+003	19
41	9.24529317904982657−079	1.69690761678629269−077	−2.91476507794496621+076	5.46647125214465540+077	1.72198004360165372+003	20
42	4.60706322652135031−081	8.66202583749314054−080	−5.71154732031843695+078	1.09671665126002447+080	1.80598004157284413+003	20
43	2.24299990835387725−083	4.31753939349295278−082	−1.14615481014524193+081	2.25208723252409482+082	1.89198003968243500+003	19
44	1.06749383768604140−085	2.10256512701589204−084	−2.35413659387726256+083	4.73096360390140323+084	1.97998003791811628+003	20
45	4.96880303387614022−088	1.00089546002440424−086	−4.94640223164991171+085	1.01617400175916994+087	2.06998003626891693+003	20
46	2.26307104724637648−090	4.65986860848667940−089	−1.06266728614042925+088	2.23064586425196014+089	2.16198003472503389+003	20
47	1.00903306054135809−092	2.12282567464748679−091	−2.33316553149394888+090	5.00191371711276676+091	2.25598003327768593+003	18
48	4.40621656366041795−095	9.46698682833909883−094	−5.23279020950424290+092	1.14522841267795954+094	2.35198003191898844+003	20
49	1.88522895048605201−097	4.13483974195856209−096	−1.19830718836920705+095	2.67616928604646156+096	2.44998003064184575+003	19
50	7.90637454017347236−100	1.76945642943284464−098	−2.80069274982389068+097	6.38003699587888124+098	2.54998002943985828+003	19
51	3.25144150697749613−102	7.42220187476658871−101	−6.67802447647658884+099	1.55113829059288568+101	2.65198002830724213+003	20

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 0.3 X = 2.00000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	2.90746107858730389−002	2.25068087860581602−002	−1.16044692782760923+001	1.39464324576217895+001	5.98712708737664133+000	22
3	2.51200182126349003−003	3.21514766485942111−003	−8.93700596068355068+001	1.51006549837056624+002	1.19699818088618035+001	22
4	1.74250282071825131−004	3.04770570931959832−004	−9.79948765813769925+002	2.11194563044577359+003	1.99637645230817575+001	23
5	9.97170899707482169−006	2.20287878119161402−005	−1.38638664708759841+004	3.62287441433536111+004	2.99607713321740383+001	21
6	4.84614623849940381−007	1.29139270335186473−006	−2.39978319988867768+005	7.36173441148308783+005	4.19590937280665220+001	21
7	2.04500730801213807−008	6.37630941789081365−008	−4.91097574343161085+006	1.72873542526140015+007	5.59580570248754014+001	21
8	7.62276089469157587−010	2.72108547775332800−009	−1.15975129805994447+008	4.60579086791916760+008	7.19573708561621501+001	22
9	2.54404861414599333−011	1.02280486465516890−010	−3.10407795086349078+009	1.37253691570150897+010	8.99568928794732675+001	21
10	7.68552543342063943−013	3.43572479562660912−012	−9.28542340752925971+010	4.52337416988467844+011	1.09956546463218970+002	21
11	2.12057490335302806−014	1.04329728887202039−013	−3.06991760948509742+012	1.63343909340501181+013	1.31956287312807962+002	21
12	5.38422732598973181−016	2.89078968634658163−015	−1.11159952838878707+014	6.41367090498515574+014	1.55956088350987227+002	21
13	1.26603454843898076−017	7.36556352907705328−017	−4.37491896909788696+015	2.72053579483118986+016	1.81955932257866896+002	20
14	2.77199113717690670−019	1.73704565079977069−018	−1.85953293637300098+017	1.23974893748071125+018	2.09955807531342102+002	21
15	5.67832264865430121−021	3.81289814777280024−020	−8.48909377810033594+018	6.04027260268605561+019	2.39955706287730863+002	21
16	1.09277915511776042−022	7.82768210799898734−022	−4.14259850542507793+020	3.13327009439868811+021	2.71955622975643487+002	22
17	1.98298779079548241−024	1.50929912536595488−023	−2.15192900977481119+022	1.72404596247789833+023	3.05955553593705667+002	21
18	3.40406708138405981−026	2.74343185302944705−025	−1.18557595705998058+024	1.00295315581568882+025	3.41955495198372220+002	23
19	5.54412870182317198−028	4.71651751863764059−027	−6.90490276406900985+025	6.15057363373115075+026	3.79955445585009771+002	21
20	8.58946325238556864−030	7.69195784179420847−029	−4.23879510006035830+027	3.96556018183539129+028	4.19955403075841025+002	21
21	1.26890279744918870−031	1.19313981364167012−030	−2.73552673918505156+029	2.68168752539917759+030	4.61955366375679668+002	21
22	1.79126052326867468−033	1.76451470816221764−032	−1.85148034631014836+031	1.89793852963687826+032	5.05955334471759936+002	21
23	2.49335477728310009−034	2.49335477728310009−034	−1.31140492121842864+033	1.40302220211700972+034	5.51955306562896473+002	21
24	3.13892227616523319−037	3.37310937876944824−036	−9.70143098736115090+034	1.08134817715784289+036	5.99955282008550218+002	21
25	3.91003520260418575−039	4.37678058107897807−038	−7.48220048066753622+036	8.67478555603551742+037	6.49955260291652243+002	21
26	4.68686017658308336−041	5.45612189414778676−040	−6.00611511233902029+038	7.23225554558230038+039	7.01955240991094979+002	21
27	5.41380499656675412−043	6.54468995176673600−042	−5.01026424673753531+040	6.25734407072851452+041	7.55955223761119846+002	21
28	6.03415498865320844−045	7.56468279326436406−044	−4.33722223712470314+042	5.61088608141345527+043	8.11955208315693158+002	21
29	6.49767480120696524−047	8.43656000229237670−046	−3.89109979136506025+044	5.20788910451816492+045	8.69955194416536449+002	21
30	6.76746415377871197−049	9.08970170936284371−048	−3.61333238483939377+046	4.99781784478468119+047	9.29955181863865691+002	21
31	6.82475564294958442−051	9.47205173346278412−050	−3.46911875511575445+048	4.95358311965484780+049	9.91955170489160556+002	21
32	6.67081540735727583−053	9.55689781892092556−052	−3.43984750834024912+050	5.06570688187824187+051	1.05595516014947050+003	20
33	6.32575608533612851−055	9.34559993051974462−054	−3.51908882698027139+052	5.33986292137474229+053	1.12195515072289528+003	20
34	5.82471295604386905−057	8.86598586750779512−056	−3.71091545353608808+054	5.79697968894127970+055	1.18995514210497094+003	20
35	5.21230659858093739−059	8.16703521259020450−058	−4.02999630723049729+056	6.47574049617422436+057	1.25995513420575964+003	20
36	4.53652426810855473−061	7.31113979506234690−060	−4.50335388454674046+058	7.43785657828668146+059	1.33195512694749098+003	21
37	3.84308763648407022−063	6.36552718690311280−062	−5.17405092526230126+060	8.77708447636335841+061	1.40595512026263839+003	20
38	3.17109946649978603−065	5.39434792624612073−064	−6.10748628410873840+062	1.06337757776575070+064	1.48195511409234127+003	20
39	2.55038005404248397−067	4.45254434269284994−066	−7.40154907231467316+064	1.32180069257265700+066	1.55995510838510360+003	21
40	2.00052369131150229−069	3.58208438784501275−068	−9.20275896541136169+066	1.68463925710731393+068	1.63995510309571512+003	20
41	1.53140823000499843−071	2.81060924607216269−070	−1.17319554475342138+069	2.20011382668423800+070	1.72195509818435236+003	20
42	1.14471891921695476−073	2.15212474535541961−072	−1.53255089450589007+071	2.94257909652452499+072	1.80595509361582630+003	21
43	8.36002838714110310−076	1.60912317937215567−074	−2.05021481935690626+073	4.02823808986945748+074	1.89195508935894983+003	21
44	5.96825168140958802−078	1.17545720628647618−076	−2.80726453921529485+075	5.64126232239988036+076	1.97995508538600365+003	20
45	4.16712255843129256−080	8.39363112680324714−079	−3.93221537400372108+077	8.07778049100778927+078	2.06995508167228361+003	21
46	2.84698341202708342−082	5.86189554077240909−081	−5.63173118557090059+079	1.18209493602836419+081	2.16195507819571545+003	20
47	1.90411838569980223−084	4.00572806968006500−083	−8.24304009744224848+081	1.76707970583866248+083	2.25595507493652581+003	20
48	1.24725646962642268−086	2.67966899174809631−085	−1.23246025567566370+084	2.69718475541623525+085	2.35195507187696031+003	21
49	8.00488324944349639−089	1.75561730369196721−087	−1.88150751382220603+086	4.20175961792794171+087	2.44995506900104106+003	20
50	5.03580475155720562−091	1.12697014610627828−089	−2.93158087002629455+088	6.67790494500581261+089	2.54995506629435757+003	20
51	3.10647373925630077−093	7.09098012731010531−092	−4.65997341453371409+090	1.08234901089053165+092	2.65195506374388570+003	20

OBLATE RADIAL FUNCTIONS

H = 0.4 X = 2.00000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	5.04362057919798979−002	3.80142837768874052−002	−5.21798832406945445+000	5.98066223197749263+000	5.97709295201319849+000	22
3	5.84667494873711266−003	7.39120770229351148−003	−2.92566203627833107+001	4.85332680060845276+001	1.19466091507941440+001	22
4	5.42717164592183647−004	9.42241853029357425−004	−2.38027905211161542+002	5.08036530829690104+002	1.99355790647381016+001	22
5	4.15085648396292735−005	9.12457522932293852−005	−2.51187778264603923+003	6.52399867593764395+003	2.99302630704997057+001	22
6	2.69425279089490992−006	7.15419300252420943−006	−3.25004426317519612+004	9.92800533227373641+004	4.19272816436791530+001	22
7	1.51785044837179583−007	4.72002011582472180−007	−4.97684913201483109+005	1.74649432767909936+006	5.59254384834979519+001	22
8	7.55123615556750936−009	2.68993871613929071−008	−8.80021157077178744+006	3.48657751435206463+007	7.19242182238810373+001	23
9	3.36293240112916150−010	1.34976604816005639−009	−1.76431272666519812+008	7.78662866470757979+008	8.99233680555316056+001	21
10	1.35547478226441332−011	6.05117276061085139−011	−3.95436271194706934+009	1.92341963222188975+010	1.09922751813636743+002	21
11	4.98941979430427882−013	2.45191770040136058−012	−9.79752459582563657+010	5.20647231428232398+011	1.31922290766635277+002	22
12	1.68990522019057172−014	9.06426344541748279−014	−2.65897250093361430+012	1. - 404084381488+013	1.55921936774488503+002	22
13	5.30027756956130663−016	3.08102863308538902−015	−7.84435984661042294+013	4. 546191792782+014	1.81921659038999403+002	21
14	1.54787591186040304−017	9.69259502089682272−017	−2.49947699775891188+015	1.-- -353231670756+016	2.09921437104290732+002	21
15	4.22899309791885157−019	2.83789028754805028−018	−8.55446135497010735+016	6. - 454204147148+017	2.39921256948110966+002	21
16	1.08544171305364545−020	7.77074975241041910−020	−3.12977427202367329+018	2. - -330255593380+019	2.71921108695648153+002	21
17	2.62686922060151557−022	1.99837144513817999−021	−1.21897707948322336+020	9.76078668848107453+020	3.05920985228743512+002	21
18	6.01381326890178495−024	4.84452428015201223−023	−5.03546744118841877+021	4.25779028618288808+022	3.41920881310728035+002	21
19	1.30619875839450677−025	1.11076408303421240−024	−2.19899203556505803+023	1.95792455901541106+024	3.79920793019286720+002	22
20	2.69872196294341152−027	2.41585007417153838−026	−1.01222036893496590+025	9.46606349860609070+025	4.19920717369320786+002	21
21	5.31654773035554853−029	4.99744452661222995−028	−4.89834591012310701+026	4.80025560502118411+027	4.61920652056353970+002	21
22	1.00083696994972855−030	9.85593008021671465−030	−2.48605886524021147+028	2.54762547891993801+029	5.05920595278354645+002	22
23	1.80391791989544931−032	1.85722820170993399−031	−1.32044353326888443+030	1.41227879780426655+031	5.51920545609721790+002	21
24	3.11871989290319944−034	3.35053777644160571−033	−7.32513393756341592+031	8.16259968797700320+032	5.99920501910676208+002	22
25	5.18042786468997093−036	5.79744375042988663−035	−4.23653834079629326+033	4.91058034918054999+034	6.49920463261123456+002	21
26	8.28042140769183020−038	9.63737796235767249−037	−2.55024638106929808+035	3.07017124815472602+036	7.01920428911713336+002	22
27	1.27542592855201322−039	1.54153315324609294−038	−1.59536455009691385+037	1.99203465888176653+038	7.55920398247167440+002	21
28	1.89560712554352710−041	2.37596386207285483−040	−1.03567973113869310+039	1.33955098180223000+040	8.11920370758480771+002	21
29	2.72186399451465735−043	3.53343056174815825−042	−6.96793281864697638+040	9.32423268669242763+041	8.69920346021624705+002	21
30	3.78014608141648218−045	5.07644765077921969−044	−4.85244071494468397+042	6.71054456249168419+043	9.29920323681069369+002	21
31	5.08325283279331789−047	7.05392464466215890−046	−3.49377467827938649+044	4.98798260248161001+045	9.91920303436917797+002	21
32	6.62526914687670974−049	9.49025272086001361−048	−2.59800944845352329+046	3.82538930889196079+047	1.05592028503477437+003	20
33	8.37732235769730819−051	1.23748495702250883−049	−1.99324076494728842+048	3.02411012669930434+049	1.12192026825770286+003	22
34	1.02856995631233608−052	1.56541577670901626−051	−1.57630617288108603+050	2.46208382084916764+051	1.18992025291979561+003	21
35	1.22730995674755079−054	1.92280490915706414−053	−1.28379584504762290+052	2.06265013403431832+053	1.25992023886099506+003	21
36	1.42433168886168561−056	2.29520959353170729−055	−1.07587262517421691+054	1.77672577888403736+055	1.33192022594289644+003	21
37	1.60890532107560630−058	2.66462801557194095−057	−9.27022913852210764+055	1.57239132690604270+057	1.40592021404532481+003	21
38	1.77019525266457351−060	3.01095815242515175−059	−8.20651301624118238+057	1.42868605554653363+059	1.48192020306352724+003	20
39	1.89834967246306408−062	3.31387622455272489−061	−7.45858547545804687+059	1.33185004274165029+061	1.55992019290585695+003	21
40	1.98551870549577417−064	3.55487976975372459−063	−6.95489818794926599+061	1.27302619013357429+063	1.63992018349185340+003	21
41	2.02665247262390139−066	3.71920011393323717−065	−6.64941015506947969+063	1.24685970263862742+065	1.72192017475064266+003	21
42	2.01996712571834992−068	3.79730486726592490−067	−6.51431323649119210+065	1.25067216780535245+067	1.80592016661959848+003	20
43	1.96702328102646306−070	3.78577949063392680−069	−6.53574453121265244+067	1.28402712064151207+069	1.89192015904321664+003	21
44	1.87242491449035583−072	3.68748242698073530−071	−6.71153556522543014+069	1.34858975384057090+071	1.97992015197216448+003	21
45	1.74320461449916347−074	3.51098766541425235−073	−7.05049383843233141+071	1.44824095164744717+073	2.06992014536247530+003	20
46	1.58800243426485088−076	3.26943732222261520−075	−7.57301148113157707+073	1.58945056237605123+075	2.16192013917486281+003	21
47	1.41616439760792287−078	2.97900477952520569−077	−8.31302893579789408+075	1.78195745568470270+077	2.25592013337413560+003	20
48	1.23688235048029495−080	2.65720466677663267−079	−9.32160427054187225+077	2.03985363851896134+079	2.35192012792869543+003	20
49	1.05847345138372313−082	2.32127820543326657−081	−1.06725989675739085+080	2.38323678201505249+081	2.44992012281010570+003	21
50	8.87862395499673197−085	1.98683884526946820−083	−1.24713424547212316+082	2.84069383793503132+083	2.54992011799271929+003	20
51	7.30290714790707099−087	1.66689724404366230−085	−1.48676530723681494+084	3.45302898661380185+085	2.65192011345335643+003	21

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 0.5 X = 2.00000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	7.63457528967087778−002	5.55148094888103083−002	−2.90419605502361059+000	3.12753624435738867+000	5.96416367140576943+000	22
3	1.11534375797995357−002	1.38723839202797949−002	−1.25370327632604044+001	2.02701155289012552+001	1.19165261752530774+001	23
4	1.30023536999037786−003	2.23576242740728221−003	−8.03980057264809470+001	1.69391761400774918+002	1.98993377613406211+001	22
5	1.24688865637289762−004	2.72343597973265360−004	−6.73844522071976787+002	1.73618355799365414+003	2.98910419602430505+001	22
6	1.01388265554103236−005	2.67988941203863467−005	−6.94440541083257833+003	2.10968807383255543+004	4.18863854270495889+001	22
7	7.15159117604103523−007	2.21624935374688431−006	−8.48207218858274677+004	2.96460081004739662+005	5.58835052153919181+001	22
8	4.45307483003527339−008	1.58203153619924606−007	−1.19728817088575905+006	4.72898488374096432+006	7.18815977446971031+001	22
9	2.48152648822065622−009	9.93851151368430248−009	−1.91718816994310360+007	8.44077361194728401+007	8.98802684873799165+001	21
10	1.25132816923720972−010	5.57634941923142925−010	−3.43321763673575544+008	1.66664343838806604+009	1.09879304823718740+002	22
11	5.76167423763719859−012	2.82723516293606509−011	−6.79805038092890090+009	3.60664488594007792+010	1.31878583764130687+002	21
12	2.44080690525392351−013	1.30755122621642220−012	−1.47470088037203071+011	8.48798424450370041+011	1.55878030084212708+002	21
13	9.57426523460506313−015	5.55948613306450477−014	−3.47799783543188439+012	2.15829818338435312+013	1.81877595647077788+002	21
14	3.49662695792673049−016	2.18749465832481972−015	−8.86030821762859528+013	5.89657499953930823+014	2.09877248474931037+002	21
15	1.19462730616248558−017	8.01004702430278390−017	−2.42469290694302505+015	1.72255361063160347+016	2.39876966644291330+002	22
16	3.83410867946393382−019	2.74287665813964748−018	−7.09366760943378043+016	5.35794532990520851+017	2.71876734714355031+002	21
17	1.16022499234428138−020	8.82063835285554836−020	−2.20938331351474852+018	1.76791820069379457+019	3.05876541553743558+002	21
18	3.32112740013462685−022	2.67384326682003233−021	−7.29882338489173906+019	6.16781224224288208+020	3.41876378972725810+002	22
19	9.01913200987704312−024	7.66569180082207748−023	−2.54912324257406285+021	2.26842304089902515+022	3.79876240836722682+002	22
20	2.32982461188479424−025	2.08463694563889290−024	−9.38448348720050129+022	8.77180149209200758+023	4.19876122476727720+002	22
21	5.73846209755114398−027	5.39172312178547897−026	−3.63215878841064419+024	3.55781830244075034+025	4.61876020288133236+002	21
22	1.35058556422935981−028	1.32949352181022933−027	−1.47440613014288807+026	1.51029794444873747+027	5.05875931452132127+002	21
23	3.04341869215842089−030	3.13223332166568753−029	−6.26361120810035683+027	6.69671521455204684+028	5.51875853738668134+002	21
24	6.57811519806184668−032	7.06473556930150467−031	−2.77924939505588111+029	3.09592297027412968+030	5.99875785364740575+002	21
25	1.36604685759486380−033	1.52828292906870701−032	−1.28569182134709510+031	1.48977256971630290+032	6.49875724890972471+002	22
26	2.72974787803029812−035	3.17618651074337783−034	−6.19052762785059720+032	7.45040588463129802+033	7.01875671145068614+002	21
27	5.25643430281570567−037	6.35147500855421945−036	−3.09763729278475587+034	3.86677222207921081+035	7.55875623164458140+002	22
28	9.76666822165783461−039	1.22385926482526510−037	−1.60851804141208336+036	2.07993170882425456+037	8.11875580152814879+002	21
29	1.75316665750160487−040	2.27537998978347298−039	−8.65642318572271339+037	1.15809571287664350+039	8.69875541446745375+002	21
30	3.04383388867834088−042	4.08676095991195198−041	−4.82206021164019314+039	6.66704995177501665+040	9.29875506490014452+002	21
31	5.11689905274851637−044	7.09918816597201757−043	−2.77720907438840204+041	3.96413335412123680+042	9.91875474813419798+002	21
32	8.33717426394918407−046	1.19401866973121737−044	−1.65195723101937614+043	2.43191777018820532+044	1.05587544601894327+003	21
33	1.31785752741793696−047	1.94637241649079122−046	−1.01382976109230524+045	1.53788226407402116+046	1.12187541976717067+003	21
34	2.02275280910124948−049	3.07798038091425356−048	−6.41350758872815399+046	1.00157317186234461+048	1.18987539576723162+003	22
35	3.01722028469950570−051	4.72627695237062552−050	−4.17833349250849906+048	6.71215118688484570+049	1.25987537376869845+003	21
36	4.37729561776034236−053	7.05264414736456206−052	−2.80105881319401604+050	4.62503123448212145+051	1.33187535355501992+003	21
37	6.18109680444019532−055	1.02355205279041897−053	−1.93066995263641282+052	3.27427133201405011+053	1.40587533493816615+003	21
38	8.50148923495866500−057	1.44583918121728538−055	−1.36720687769401711+054	2.37986389382292529+055	1.48187531775423593+003	21
39	1.13969175679154581−058	1.98926124842240229−057	−9.94012189220580143+055	1.77473431695087217+057	1.55987530185983365+003	21
40	1.49011990775341467−060	2.66759069722260545−059	−7.41459135091350467+057	1.35699851960786657+059	1.63987528712906551+003	21
41	1.90134676163143304−062	3.48884073032239869−061	−5.67077209552549474+059	1.06322422341357462+061	1.72187527345103699+003	21
42	2.36897249872322256−064	4.45290129009357556−063	−4.44418016667769728+061	8.53133770581347806+062	1.80587526072775798+003	21
43	2.88375144014802967−066	5.54954910030116393−065	−3.56683699566286287+063	7.00672834644897451+064	1.89187524887238162+003	21
44	3.43150272588530626−068	6.75718776643801165−067	−2.93005928309385479+065	5.88693667790350707+066	1.97987523780771737+003	21
45	3.99354871698760905−070	8.04262674189792727−069	−2.46230264184896997+067	5.05731126807291298+068	2.06987522746497044+003	21
46	4.54769777791074748−072	9.36209871794155140−071	−2.11572338239281657+069	4.44013428778413921+070	2.16187521778266924+003	21
47	5.06970977861253275−074	1.06635562165563237−072	−1.85788517831725154+071	3.98214845399539201+072	2.25587520870574935+003	21
48	5.53510732177841113−076	1.18901042593166921−074	−1.66655794642900492+073	3.64662346895221777+074	2.35187520018476838+003	20
49	5.92113725393885326−078	1.29842487818755897−076	−1.52640909162449748+075	3.40825144662981607+076	2.44987519217523093+003	21
50	6.20865669700983149−080	1.38925026628197716−078	−1.42687432307053503+077	3.24984060995851232+078	2.54987518463700620+003	20
51	6.38372173112065986−082	1.45698193246974407−080	−1.36077845154532979+079	3.16017907260840272+080	2.65187517753382410+003	21

OBLATE RADIAL FUNCTIONS

H = 0.6 X = 2.00000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	1.05724007569073988−001	7.33885604146472826−002	−1.85793289654494730+000	1.86317485723558985+000	5.94831784129773330+000	23
3	1.87236168892006978−002	2.28166474891841227−002	−6.40249451760784309+000	1.00007319088889367+001	1.18797084952054065+001	22
4	2.63452565419301987−003	4.47611384684247386−003	−3.35503961872558568+001	6.95221699970917390+001	1.98550386572143220+001	22
5	3.04319216826279285−004	6.59437423335219457−004	−2.32176648337269895+002	5.92231290796465055+002	2.98431109116185727+001	22
6	2.97740446599295777−005	7.82545527346133925−005	−1.98305089112717608+003	5.98341860613777348+003	4.18364088775214633+001	24
7	2.52528948533133431−006	7.79260787311223243−006	−2.01105652100905370+004	6.99403318195304749+004	5.58322608728771206+001	22
8	1.88988136958474266−007	6.69195657162252558−007	−2.35933995041649289+005	9.28351013445207190+005	7.18295126736097823+001	22
9	1.26539159369463710−008	5.05447547844611630−008	−3.14200059311452515+006	1.37919111120508602+007	8.98275970101081681+001	22
10	7.66497300119372323−010	3.40836211118826044−009	−4.68145308405743632+007	2.26709813767383774+008	1.09826207950154209+002	22
11	4.23884626251938251−011	2.07621890141956736−010	−7.71496918645186044+008	4.08492486213947992+009	1.31825168437986740+002	21
12	2.15642793782255335−012	1.15343352990058369−011	−1.39322539571950004+010	8.00555593313551643+010	1.55824370140252310+002	22
13	1.01569798003548249−013	5.89007220531731240−013	−2.73582114417187817+011	1.69530210670750873+012	1.81823743713787715+002	21
14	4.45379217927439728−015	2.78310887048202725−014	−5.80369934170700158+012	3.85761291103101480+013	2.09823243083231733+002	22
15	1.82685957612196970−016	1.22369152096756586−015	−1.32268158220591084+014	9.38648552226495331+014	2.39822836654595810+002	22
16	7.03890188849143564−018	5.03108595233513369−017	−3.22290794146552625+015	2.43199958381940294+016	2.71822502173019539+002	21
17	2.55699657131465009−019	1.94242969780208619−018	−8.36095763756558755+016	6.68470232139291456+017	3.05822223593016076+002	21
18	8.78625358668587209−021	7.06882545137456686−020	−2.30075295962411757+018	1.94277482280768249+019	3.41821989108278750+002	21
19	2.86416859109113945−022	2.43281299099216238−021	−6.69361092176305077+019	5.95252310888798903+020	3.79821789874516560+002	22
20	8.88096433194434562−024	7.94176391359007736−023	−2.05281431136175129+021	1.91762584304071677+022	4.19821619159927980+002	21
21	2.62557599272178480−025	2.46563549832411403−024	−6.61893949391690405+022	6.47988906168947139+023	4.61821471767076554+002	21
22	7.41709550435037918−027	7.29776471854348147−026	−2.23839939765382744+024	2.29173551468446542+025	5.05821343631365508+002	23
23	2.00607814591319553−028	2.06371309924300784−027	−7.92233131034309700+025	8.46622773207269051+026	5.51821231537016948+002	22
24	5.20420817041946104−030	5.58693122714714735−029	−2.92868709067186962+027	3.26100713426074779+028	5.99821132912821045+002	21
25	1.29711752135464116−031	1.45062493843973312−030	−1.12877634731828275+029	1.30743913799068240+030	6.49821045683030878+002	21
26	3.11093562025868370−033	3.61846244325788589−032	−4.52826243866166278+030	5.44787415575365206+031	7.01820968157014620+002	22
27	7.18967584472491602−035	8.68466189547748836−034	−1.88787785708326050+032	2.35584368619816408+033	7.55820898946560975+002	21
28	1.60328024235287542−036	2.00846518709057981−035	−8.16797614726695375+033	1.05585019670164325+035	8.11820836903189839+002	21
29	3.45403677673904532−038	4.48163136638016802−037	−3.66249784701672203+035	4.89843310783069489+036	8.69820781070120795+002	21
30	7.19716840280647144−040	9.66064635258707701−039	−1.69991243559862822+037	2.34968525344713437+038	9.29820730645108375+002	21
31	1.45204839476671077−041	2.01407771715664647−040	−8.15758695113463235+038	1.16410164359576796+040	9.91820684951421797+002	20
32	2.83937999625371892−043	4.06551415442996168−042	−4.04310424738042130+040	5.95060746010219884+041	1.05582064341499092+003	21
33	5.38642531866394804−045	7.95359925431204173−044	−2.06751000099457648+042	3.13550942080626204+043	1.12182060554626492+003	21
34	9.92201600520537891−047	1.50950272794838639−045	−1.08980242371087813+044	1.70154291318546755+045	1.18982057092570462+003	22
35	1.77617871038125946−048	2.78172805601004876−047	−5.91599348620415404+045	9.50166116446916680+046	1.25982053919209979+003	21
36	3.09247248594809801−050	4.98163979227549542−049	−3.30462253724211271+047	5.45547107695132592+048	1.33182051003309952+003	21
37	5.24063369044250072−052	8.67666324969097092−051	−1.89795152304876158+049	3.21820758706321235+050	1.40582048317748930+003	21
38	8.65027037414187845−054	1.47089969978090659−052	−1.11993022295927037+051	1.94910474665277228+052	1.48182045838885580+003	21
39	1.39167156730075033−055	2.42869582870845498−054	−6.78469185474810266+052	1.21116080278385220+054	1.55982043546036167+003	21
40	2.18365299431304219−057	3.90856070068395087−056	−4.21705441713568443+054	7.71675729145427670+055	1.63982041421041332+003	21
41	3.34376155546733221−059	6.13470154893441578−058	−2.68750627049458883+056	5.03812373385719687+057	1.72182039447905152+003	21
42	4.99970242576241665−061	9.39654901875170972−060	−1.75503536188358520+058	3.36861198757909940+059	1.80582037612493009+003	21
43	7.30383287745728351−063	1.40538249305063525−061	−1.17372376799234023+060	2.30536832697308735+061	1.89182035902277578+003	20
44	1.04300166362232896−064	2.05358631489561171−063	−8.03431514046222976+061	1.61401216301579558+063	1.97982034306124356+003	21
45	1.45668669263966785−066	2.93328136619834322−065	−5.62606838969610337+063	1.15539544954458478+065	2.06982032814109858+003	20
46	1.99069263538279877−068	4.09766687415121604−067	−4.02823500224385389+065	8.45282084449290908+066	2.16182031417366910+003	21
47	2.66317779976676310−070	5.60108268771184074−069	−2.94759803081937526+067	6.31711222361901688+068	2.25582030107952523+003	20
48	3.48936676592322084−072	7.49481660014232953−071	−2.20325288808879871+069	4.82046118860359729+070	2.35182028878734656+003	21
49	4.47948752059895662−074	9.82192479212217852−073	−1.68155242603157764+071	3.75428032637803489+072	2.44982027723294844+003	21
50	5.63667047779272208−076	1.26114132661399951−074	−1.30985031680750327+073	2.98301448302400201+074	2.54982026635844193+003	21
51	6.95504527441735585−078	1.58723066919837806−076	−1.04092809892270492+075	2.41715224554549991+076	2.65182025611150703+003	21

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 0.7 X = 2.00000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	1.37344372731075829−001	8.98729523510583787−002	−1.30806448868069385+000	1.22432877960151871+000	5.92952905718217094+000	22
3	2.87275050161290538−002	3.41424759162152034−002	−3.70790579484119840+000	5.53884513552391606+000	1.18361262204765058+001	22
4	4.74867074592026257−003	7.95220251486447329−003	−1.62446552437922977+001	3.29636451560633611+001	1.98026795724376412+001	22
5	6.42838896921206635−004	1.37979725354397194−003	−9.52524895074042139+001	2.40005953338654695+002	2.97864735502194281+001	23
6	7.36116628567297182−005	1.92169018760690661−004	−6.92717877307330680+002	2.07297818079648114+003	4.17773566645413597+001	22
7	7.30144983989235929−006	2.24173099798515328−005	−5.99492993281171920+003	2.07252102556642037+004	5.57717099309043105+001	22
8	6.38693086527580271−007	2.25269384157504964−006	−6.00939059517960898+004	2.35388666374725755+005	7.17679669941512078+001	22
9	4.99668609269917565−008	1.98959907938639460−007	−6.84327636891411509+005	2.99319427524237803+006	8.97653570914929552+001	22
10	3.53549733719458174−009	1.56807059081549840−008	−8.72332464724483289+006	4.21231818824258584+007	1.09763464197024782+002	22
11	2.28340314464355469−010	1.11602450789470858−009	−1.23037548478530980+008	6.49913120112338619+008	1.31762047395673527+002	22
12	1.35642956991557772−011	7.24208117236989613−011	−1.90214151551727061+009	1.09080232714468806+010	1.55760959216566068+002	21
13	7.45934882465695883−013	4.31894598694250105−012	−3.19826475521302450+010	1.97849654019904942+011	1.81760105233734297+002	22
14	3.81854134098136164−014	2.38291464766767449−013	−5.81037739730160405+011	3.85639275523383077+012	2.09759422689364561+002	22
15	1.82839087502995070−015	1.22326259073550103−014	−1.13417663251889582+013	8.03847268857131300+013	2.39758868541560873+002	22
16	8.22311385533880020−017	5.87134049488332619−016	−2.36723838237871259+014	1.78430777611090400+015	2.71758412466606004+002	22
17	3.48662280839438680−018	2.64615052116295229−017	−5.26082291322740021+015	4.20191689292382581+016	3.05758032598563672+002	23
18	1.39830416146929784−019	1.12404051537364584−018	−1.24022369304995698+017	1.04632541212708220+018	3.41757712846662683+002	22
19	5.31988522445901177−021	4.51528591090892241−020	−3.09134129018768613+018	2.74688986349684578+019	3.79757441155946865+002	21
20	1.92510619671659644−022	1.72034406490617527−021	−8.12293447615010160+019	7.58253569629484178+020	4.19757208350117533+002	22
21	6.64197375714649623−024	6.23349975866134404−023	−2.24411867836821510+021	2.19553943821630941+022	4.61757007343942507+002	23
22	2.18964244437419495−025	2.15319303810750283−024	−6.50285409046454692+022	6.65383905643801022+023	5.05756832596181373+002	21
23	6.91105111010577345−027	7.10591047108919495−026	−1.97215634779624867+024	2.10640348292481117+025	5.51756679722568207+002	21
24	2.09218058157731558−028	2.24496682773556639−027	−6.24733019473699505+025	6.95273613110708753+026	5.99756545217466051+002	21
25	6.08505337321741332−030	6.80218103014561222−029	−2.06334753999697668+027	2.38883115475085219+028	6.49756426250655469+002	22
26	1.70298100201388487−031	1.97999894289872725−030	−7.09329060664497796+028	8.53017188766008504+029	7.01756320516933837+002	21
27	4.59256890846733254−033	5.54541457790231611−032	−2.53424986604562300+030	3.16118553897914795+031	7.55756226123398138+002	22
28	1.19502752180670568−034	1.49650727651357707−033	−9.39628599849039723+031	1.21418276464029388+033	8.11756141503991269+002	21
29	3.00408741675745852−036	3.89652974492972255−035	−3.61070076252707253+033	4.82749788481680234+034	8.69756065354025655+002	21
30	7.30398606388898085−038	9.80098959189691280−037	−1.43621191259675159+035	1.98455068746278123+036	9.29755996579518191+002	21
31	1.71944369976239505−039	2.38427817483502964−038	−5.90658552424678878+036	8.42626345961345116+037	9.91755934257626623+002	21
32	3.92315336505226217−041	5.61576176866603527−040	−2.50886341865903339+038	3.69148181438108971+039	1.05575587760549130+003	21
33	8.68388238050557737−043	1.28193309448765592−041	−1.09951475434825172+040	1.66704066480237862+041	1.12175582595550124+003	21
34	1.86642973381504734−044	2.83883617531612565−043	−4.96702421149837616+041	7.75323083102463428+042	1.18975577873551382+003	21
35	3.89846803379590367−046	6.10411225946266373−045	−2.31086534102602879+043	3.71059785225919830+044	1.25975573545292558+003	21
36	7.91965292959945919−048	1.27549422999773920−046	−1.10629347104378711+045	1.82592839736408954+046	1.33175569568176041+003	21
37	1.56593846889493201−049	2.59211598132650383−048	−5.44550272322550906+046	9.23155936414298113+047	1.40575565905213890+003	21
38	3.01584441528517397−051	5.12716930825228281−050	−2.75391679111612322+048	4.79190201234928289+049	1.48175562524163998+003	21
39	5.66111935191082494−053	9.87775483131935537−052	−1.42987926483615439+050	2.55204507393283768+051	1.55975559396817573+003	22
40	1.03641473914076359−054	1.85477092301830670−053	−7.61710706890930462+051	1.39359653206714145+053	1.63975556498408399+003	21
41	1.85168829468293985−056	3.39666807453441752−055	−4.16048550854087616+053	7.79809448030082823+054	1.72175553807120637+003	21
42	3.23041050230162830−058	6.07033143631951370−057	−2.32860582801115631+055	4.46878791428214145+056	1.80575551303676830+003	21
43	5.50609653881741068−060	1.05930529253802253−058	−1.33472981830351180+057	2.62119722444171655+058	1.89175548970991506+003	21
44	9.17394212287621804−062	1.80601145855922384−060	−7.83060527390033403+058	1.57285336293209679+060	1.97975546793878705+003	21
45	1.49490572108599149−063	3.00982098276657451−062	−4.69972041756733793+060	9.65018144088571384+061	2.06975544758804053+003	21
46	2.38356641942036632−065	4.90570647950359170−064	−2.88405672775568586+062	6.05105554320108803+063	2.16175542853673785+003	22
47	3.72046674285976069−067	7.82372402340390258−066	−1.80875850474614080+064	3.87591186858073821+065	2.25575541067654560+003	21
48	5.68744214956765798−069	1.22145626045022890−067	−1.15878072829679448+066	2.53495832425347608+067	2.35175539391019029+003	21
49	8.51864983280503553−071	1.86761651961793417−069	−7.58006796537100141+067	1.69214238199628716+069	2.44975537815013045+003	21
50	1.25065108200650265−072	2.79787266462870137−071	−5.06070751500541035+069	1.15237683466370321+071	2.54975536331741105+003	21
51	1.80046064535410719−074	4.10843365634282768−073	−3.44697572671860049+071	8.00337264819639770+072	2.65175534934067223+003	21

OBLATE RADIAL FUNCTIONS

H = 0.8 X = 2.00000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	1.69882318211235931−001	1.03173736056926410−001	−9.83523242617898608−001	8.74288943806425416−001	5.90776576462657717+000	23
3	4.12028147476019212−002	4.75174456499992944−002	−2.36394368664653577+000	3.34131139324958380+000	1.17857439078473119+001	23
4	7.84738546169951540−003	1.29182869896469987−002	−8.79310671940350684+000	1.73826205599195893+001	1.97422582326081293+001	22
5	1.22047628337931896−003	2.59055915305762932−003	−4.44778753409950610+001	1.10430194148181373+002	2.97211342578809802+001	23
6	1.60317958696765781−004	4.15231154825345957−004	−2.80791593332204142+002	8.32137481788628069+002	4.17092343430245908+001	22
7	1.82241460928920761−005	5.56239885744339923−005	−2.11526886098422424+003	7.26181124592575055+003	5.57018576936201080+001	22
8	1.82585036216044451−006	6.41045520048678067−006	−1.84847999354146250+004	7.20234367774043496+004	7.16969654214932356+001	23
9	1.63532202954267410−007	6.48782554365502149−007	−1.83675203670173914+005	8.00054850516807957+005	8.96935528335930372+001	22
10	1.32429375245246458−008	5.85599413109698554−008	−2.04425732999604235+006	9.83833160049499786+006	1.09691077116679776+002	22
11	9.78649421824044586−010	4.77128825574787022−009	−2.51851018503709666+007	1.32667139453799783+008	1.31689223719945683+002	23
12	6.65080199350754008−011	3.54342811741816059−010	−3.40201708544300133+008	1.94641142769568037+009	1.55687800001286355+002	22
13	4.18357991029050797−012	2.41790277023186947−011	−4.99916312216017221+009	3.08647376528569110+010	1.81686682564635689+002	22
14	2.44943225974842030−013	1.52614104728625820−012	−7.93880006440473945+010	5.26010519549394379+011	2.09685789373830341+002	22
15	1.34127355633339651−014	8.96130078649857461−014	−1.35475460546074099+012	9.58763141780423855+012	2.39685064152020047+002	22
16	6.89813425239115325−016	4.91932485547156279−015	−2.47229868531204336+013	1.86107709091696455+014	2.71684467243845685+002	21
17	3.34440958657757401−017	2.53547990323739453−016	−4.80432123178657625+014	3.83288581624542573+015	3.05683970050122037+002	22
18	1.53359884767770581−018	1.23160740893404949−017	−9.90446815925447545+015	8.34741344054604019+016	3.41683551522545248+002	22
19	6.67095447531583897−020	5.65708762643924926−019	−2.15903038971701921+017	1.91669362226013002+018	3.79683195890392996+002	22
20	2.75993455404782167−021	2.46443366714149773−020	−4.96168231414188561+018	4.62774127764585167+019	4.19682891147837915+002	23
21	1.08864110580925994−022	1.02095870775916549−021	−1.19890861954944926+020	1.17207020592425622+021	4.61682628024201013+002	22
22	4.10290328971044209−024	4.03196369245523689−023	−3.03868552803578683+021	3.10709987002160683+022	5.05682399268568786+002	22
23	1.48040761481685579−025	1.52123415090257327−024	−8.06082485221170794+022	8.60411539557445180+023	5.51682199143647363+002	21
24	5.12324910832143507−027	5.49434732348962605−026	−2.23358244769668211+024	2.48434577113008324+025	5.99682023061700137+002	22
25	1.70337753060138062−028	1.90314967850971423−027	−6.45298540496066226+025	7.46693124255946345+026	6.49681867318732490+002	21
26	5.44939930550384130−030	6.33283767499349070−029	−1.94055903441131434+027	2.33250564396947346+028	7.01681728897740806+002	22
27	1.67988574556073945−031	2.02752977797400337−030	−6.06496416790879603+028	7.56188602754013185+029	7.55681605321247692+002	21
28	4.99667217291949734−033	6.25466460987648947−032	−1.96717344031234792+030	2.54088910819443609+031	8.11681494539498228+002	21
29	1.43578258050976858−034	1.86160757684337196−033	−6.61291011037091564+031	8.83793730736311172+032	8.69681394844788775+002	22
30	3.99028614501552553−036	5.35252505612245091−035	−2.30112758105741342+033	3.17850813303174790+034	9.29681304805172030+002	22
31	1.07373067578311001−037	1.48839655180101979−036	−8.27914422427848970+034	1.18068250918457966+036	9.91681223212685903+002	21
32	2.80028162606414402−039	4.00717410936660065−038	−3.07650714156811021+036	4.52522350505061506+037	1.05568114904257961+003	21
33	7.08492866973473422−041	1.04558183733429163−039	−1.17955616657663548+038	1.78784791655387717+039	1.12168108142094552+003	22
34	1.74054297443478791−042	2.64662179252284032−041	−4.66181218076423828+039	7.27471052178570583+040	1.18968101959883262+003	22
35	4.15542421003982275−044	6.50472687226491489−043	−1.89748332708073318+041	3.04599207514893364+042	1.25968096293139943+003	21
36	9.64878897932791704−046	1.55359029034916684−044	−7.94734533426179424+042	1.31136471962935069+044	1.33168091086101529+003	21
37	2.18063935951551425−047	3.60878172232231991−046	−3.42248377434028732+044	5.80059378228703020+045	1.40568086290347783+003	22
38	4.80018545180294441−049	8.15885148993837478−048	−1.51428956370983462+046	2.63430162519624840+047	1.48168081863670667+003	21
39	1.02988551587326137−050	1.79660262376151813−049	−6.87883605513314553+047	1.22746314032812650+049	1.55968077769141756+003	22
40	2.15504118082891372−052	3.85588370782582882−051	−3.20601605537988067+049	5.86437745944679583+050	1.63968073974339021+003	22
41	4.40071437188761486−054	8.07094247886743805−053	−1.53208219158369389+051	2.87104585554172554+052	1.72168070450702587+003	22
42	8.77494527278684350−056	1.64861347600287001−054	−7.50237300896646268+052	1.43949464785733560+054	1.80568067172995448+003	21
43	1.70946475521793129−057	3.28821981243372780−056	−3.76238042011687645+054	7.38738024408640890+055	1.89168064118850054+003	21
44	3.25536952241998872−059	6.40754344090068316−058	−1.93122667505644380+056	3.87838649296071219+057	1.97968061268385471+003	21
45	6.06295740976602622−061	1.22050990901721214−059	−1.01409886221761825+058	2.08195803570559597+059	2.06968058603882844+003	21
46	1.10489990102669982−062	2.27368415568905944−061	−5.44482699119142590+059	1.14220149064480324+061	2.16168056109509227+003	21
47	1.97113651252849534−064	4.14446505010007344−063	−2.98768246830480149+061	6.40120780530243727+062	2.25568053771081714+003	21
48	3.44396387431197752−066	7.39533431992822364−065	−1.67467345720140645+063	3.66299716480208843+064	2.35168051575865287+003	21
49	5.89567420371676557−068	1.29238280553160839−066	−9.58469633056513729+064	2.13934875475043343+066	2.44968049512398977+003	22
50	9.89279144644859559−070	2.21285880635105948−068	−5.59878979494703671+066	1.27473309890406110+068	2.54968047570345910+003	21
51	1.62774074603215007−071	3.71383948783357276−070	−3.33656831364170085+068	7.74602520314014610+069	2.65168045740363533+003	21

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H=0.9 X=2.00000000 M=2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	2.01968623025695208−001	1.11580218161860880−001	−7.71976699813008559−001	6.73792253482364477−001	5.88299107922981127+000	23
3	5.60491081958872973−002	6.23632414626325976−002	−1.62648996379812588+000	2.15505723036988937+000	1.17285205024373784+001	24
4	1.21225515434576278−002	1.95611554585491580−002	−5.19662627700085201+000	9.94594309008296849+000	1.96737724254738626+001	24
5	2.13388370624801476−003	4.47125113001672010−003	−2.29638623313366684+001	5.60222782870766246+001	2.96470982206528057+001	22
6	3.16683734287147160−004	8.12813670982449802−004	−1.27660667840259883+002	3.74057374375596766+002	4.16320483714095437+001	22
7	4.06280185675580493−005	1.23170861880640685−004	−8.49709775811183368+002	2.89363697596190483+003	5.56227103020917555+001	22
8	4.59061922500023673−006	1.60333547093838704−005	−6.57233923719788869+003	2.54531186828768255+004	7.16165134061080049+001	23
9	4.63471762213500755−007	1.83107984794460807−006	−5.78657269183600523+004	2.50857690272377322+005	8.96121889746309836+001	22
10	4.22924787582467230−008	1.86379867095049738−007	−5.71055835183859026+005	2.73781331708357153+006	1.09609050810769229+002	22
11	3.52085776076829306−009	1.71168592542533662−008	−6.24126037788612259+006	3.27736746569442488+007	1.31606700969441106+002	22
12	2.69493529551883068−010	1.43236906997050354−009	−7.48179279957193585+007	4.26931720673178750+008	1.55604895597082240+002	22
13	1.90899555780935601−011	1.10103623088155370−010	−9.75940631177476260+008	6.01193765701273151+009	1.81603478427551888+002	22
14	1.25848583060564334−012	7.82712962403195630−012	−1.37602856413510921+010	9.09971968365743739+010	2.09602345537607983+002	22
15	7.75854575426451169−014	5.17553944804802733−013	−2.08521209024532299+011	1.47323031321021237+012	2.39601425617203788+002	22
16	4.49196874375348717−015	3.19898173008419678−014	−3.37959051720329218+012	2.54030572193787891+013	2.71600668407305389+002	23
17	2.45151737259725030−016	1.85627861974994267−015	−5.83330604058621507+013	4.64772596106571016+014	3.05600037655208152+002	22
18	1.26535091309144369−017	1.01506724105260335−016	−1.06824644078743375+015	8.99260626467518833+015	3.41599506676020433+002	21
19	6.19509695352566834−019	5.24836239380001609−018	−2.06865633051773158+016	1.83454177016045527+017	3.79599055473360420+002	23
20	2.88469751122599720−020	2.57353515420867200−019	−4.22352057269613763+017	3.93554038497443966+018	4.19598668822994883+002	22
21	1.28059166472436454−021	1.19999863982286295−020	−9.06714607685127265+018	8.85657745192857693+019	4.61598334968047338+002	23
22	5.43158937861801258−023	5.33371099504744799−022	−2.04187305317176098+020	2.08621467459162400+021	5.05598044712389952+002	22
23	2.20553397453855633−024	2.26481376154166515−023	−4.81280045787132254+021	5.13350764231598314+022	5.51597790779113558+002	22
24	8.58940978368198639−026	9.20579951221543682−025	−1.18497859634431001+023	1.31715066843164505+024	5.99597567349030360+002	22
25	3.21369077327877290−027	3.58851301897252934−026	−3.04209154912289727+024	3.51796046691629953+025	6.49597369723682674+002	21
26	1.15693284036007632−028	1.34376964649714731−027	−8.12929591156372666+025	9.76575366756216525+026	7.01597194075886115+002	22
27	4.01326263065464071−030	4.84137358154256710−029	−2.25776577998958208+027	2.81355487064845894+028	7.55597037262746767+002	22
28	1.34322822062866643−031	1.68062706382389280−030	−6.50769005181304039+028	8.40156722800681781+029	8.11596896683885799+002	21
29	4.34312424500184016−033	5.62876948030120255−032	−1.94409920804940934+030	2.59705578219560928+031	8.69596770172795203+002	21
30	1.35817698272173515−034	1.82110452206678534−033	−6.01194931352491473+031	8.30071064695365275+032	9.29596655912760811+002	21
31	4.11226518832971539−036	5.69821987140005038−035	−1.92227433777197763+033	2.74026111555917988+034	9.91596552371201468+002	22
32	1.20674648752268156−037	1.72622461520306524−036	−6.34817706305114109+034	9.33405883570399069+035	1.05559645824795350+003	21
33	3.43537358183545828−039	5.06816060186503348−038	−2.16309824317122801+036	3.27745808716462712+037	1.12159637243421487+003	21
34	9.49605778982927731−041	1.44348622404327857−039	−7.59772828771018177+037	1.18522931873301005+039	1.18959629397970947+003	22
35	2.55088194021433885−042	3.99184658674824981−041	−2.74841777465826722+039	4.41061576865804754+040	1.25959622206624272+003	21
36	6.66439578668193795−044	1.07275676219348364−042	−1.02307320613802442+041	1.68764514911660104+042	1.33159615598626502+003	21
37	1.69465637674414674−045	2.80376534273870530−044	−3.91570158949501318+042	6.63468651662044268+043	1.40559609512538764+003	22
38	4.19722974521259382−047	7.13219090712914102−046	−1.53979924028971092+044	2.67797589461099789+045	1.48159603894803953+003	22
39	1.01320635609616216−048	1.76707794205683555−047	−6.21670507163396318+045	1.10903566191194654+047	1.55959598698563629+003	21
40	2.38542771643905763−050	4.26711599625222161−049	−2.57515896501458521+047	4.70931067510431818+048	1.63959593882677060+003	21
41	5.48066530044462144−052	1.00493722706937215−050	−1.09374518625797038+049	2.04916174598830800+050	1.72159589410903882+003	21
42	1.22956577918296270−053	2.30959163925675453−052	−4.76026337852605223+050	9.13164461195336367+051	1.80559585251219909+003	21
43	2.69502463767540213−055	5.18294441744597652−054	−2.12175677008314534+052	4.16518448796963753+053	1.89159581375241863+003	21
44	5.77425871573479650−057	1.13632999549276151−055	−9.67985531433167368+053	1.94357628035185722+055	1.97959577757741651+003	21
45	1.20996291702726933−058	2.43528287055500971−057	−4.51773392236502698+055	9.27322815390754760+056	2.06959574376234599+003	21
46	2.48084954690949796−060	5.10424551434608739−059	−2.15591214844694467+057	4.52180476771044649+058	2.16159571210629052+003	22
47	4.97946402035267541−062	1.04679457356789725−060	−1.05145283411775683+059	2.25238518949220536+060	2.25559568242927097+003	21
48	9.78839383917727962−064	2.10155475105810405−062	−5.23836222168461379+060	1.14559317817765082+062	2.35159565456968070+003	21
49	1.88526285324649595−065	4.13202025579620191−064	−2.66474296761921654+062	5.94688973170111715+063	2.44959562838207989+003	21
50	3.55911145442218207−067	7.95997857713029707−066	−1.38351591893471720+064	3.14951225605914080+065	2.54959560373529271+003	21
51	6.58856838410196612−069	1.50302735723156240−067	−7.32831986503790457+065	1.70106103923429959+067	2.65159558051076078+003	21

OBLATE RADIAL FUNCTIONS

H = 1.0 X = 2.00000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	2.32244252926980083−001	1.13578123715406126−001	−6.21129431845530746−001	5.57401455213919974−001	5.85516257458899876+000	23
3	7.30284745930564006−002	7.78771811802543807−002	−1.18989174308773726+000	1.46976348248787106+000	1.16644092705727215+001	23
4	1.77387512660058143−002	2.79695851189316138−002	−3.30023606952394256+000	6.07110189020260644+000	1.95972201861103753+001	23
5	3.49323850858419824−003	7.21235021891824458−003	−1.28546903917996689+001	3.07128959774523884+001	2.95643714836989069+001	23
6	5.78803016326237342−004	1.47033667785040377−003	−6.36098303513521052+001	1.83952277993231918+002	4.15458061323492353+001	24
7	8.28030560223514384−005	2.49120865768377497−004	−3.78420135002397537+002	1.27685683865915342+003	5.55342747431752609+001	23
8	1.04245975858469844−005	3.61951064516151727−005	−2.62158781452151675+003	1.00830127125330540+004	7.15266171379765059+001	23
9	1.17202505676371020−006	4.60871497862494184−006	−2.06987625239121437+004	8.92517634442817026+004	8.95212708911589897+001	22
10	1.19049426679021761−007	5.22634126013623710−007	−1.83328811004908460+005	8.75150011165001037+005	1.09517389931433988+002	22
11	1.10288987291497883−008	5.34468667272120908−008	−1.79927053747006548+006	9.41477747938689214+006	1.31514483179371164+002	22
12	9.39184094060297207−010	4.97835849466052218−009	−1.93765992502132101+007	1.10240732546329891+008	1.55512249521578269+002	22
13	7.40025675053612462−011	4.25833880476003282−010	−2.27129981468934669+008	1.39563209899654504+009	1.81510495907148754+002	22
14	5.42583053677907087−012	3.36783779644135066−011	−2.87845054783424905+009	1.89940422576012675+010	2.09509093902326498+002	22
15	3.71982589994777343−013	2.47706483896674423−012	−3.92140101231342940+010	2.76530023436156765+011	2.39507955352854786+002	22
16	2.39475351744462066−014	1.70280436322869718−013	−5.71450235390741158+011	4.28825780326817277+012	2.71507018113466726+002	21
17	1.45313287406286040−015	1.09879555256375664−014	−8.86960246176862070+012	7.05656065252331082+013	3.05506237349175971+002	22
18	8.33868579836907596−017	6.68109281906160841−016	−1.46075904897735130+014	1.22807519735316700+015	3.41505580052648467+002	21
19	4.53863732996920454−018	3.84078966890778556−017	−2.54418585633945260+015	2.25360972987447841+016	3.79505021486509760+002	23
20	2.34934329980130214−019	2.09382942526351142−018	−4.67216852327678985+016	4.34899236183882778+017	4.19504542814879966+002	22
21	1.15932912527897196−020	1.08537858255648238−019	−9.02242893841908651+017	8.80444443690303276+018	4.61504129490418294+002	22
22	5.46583314238589332−022	5.36287437112059016−021	−1.82773202808686431+019	1.86579108502480158+020	5.05503770133392552+002	22
23	2.46695989032806655−023	2.53133450836187199−022	−3.87553404023463229+020	4.13047937486648620+021	5.51503455738369125+002	21
24	1.06786857886039868−024	1.14369734632633980−023	−8.58441405231778024+021	9.53490778749535557+022	5.99503179103453684+002	22
25	4.44072038701715639−026	4.95544145057179855−025	−1.98268339697663993+023	2.29127880715227482+024	6.49502934413467056+002	22
26	1.77681535494630084−027	2.06252029373105381−026	−4.76680875884143076+024	5.72280072335480337+025	7.01502716931361024+002	22
27	6.85026786573162721−029	8.25916941451665456−028	−1.19112872064077837+026	1.48348448570426423+027	7.55502522766895258+002	23
28	2.54816496174968588−030	3.18657047288558054−029	−3.08902731063997655+027	3.98584743705270786+028	8.11502348701228074+002	22
29	9.15673149631682865−032	1.18615408405702789−030	−8.30304486432663819+028	1.10861713354306107+030	8.69502192052488641+002	22
30	3.18235420886709882−033	4.26510742309749703−032	−2.31028957922766025+030	3.18832100394737829+031	9.29502050571740230+002	22
31	1.07083172466386382−034	1.48318230377176505−033	−6.64669727055125198+031	9.47089631003769732+032	9.91501922361726995+002	21
32	3.49219673357686408−036	4.99351470980715484−035	−1.97508395683519183+033	2.90286887647826831+034	1.05550180581287436+003	22
33	1.10482685903289655−037	1.62932290459625390−036	−6.05570540439005534+034	9.17184479929288241+035	1.12150169955247874+003	21
34	3.39388143415599625−039	5.15717424983714475−038	−1.91394585381777134+036	2.98462038925866377+037	1.18950160240406880+003	21
35	1.01314728889296070−040	1.58493130792244334−039	−6.23004216611284705+037	9.99441170327267997+038	1.25950151335467546+003	21
36	2.94149488934801928−042	4.73337368919532611−041	−2.08680481473997839+039	3.44123426223843545+040	1.33150143152829929+003	21
37	8.31209569823482874−044	1.37480146147063842−042	−7.18713408706809208+040	1.21739666152571582+042	1.40550135616426915+003	22
38	2.28775725127776051−045	3.88638896569573342−044	−2.54322700530982241+042	4.42181119681928056+043	1.48150128659948821+003	21
39	6.13706052787896462−047	1.07004115995555803−045	−9.23973851321631689+043	1.64787351170661619+045	1.55950122225378888+003	21
40	1.60561446271132109−048	2.87142485959667785−047	−3.44417418388476260+045	6.29684950055781896+046	1.63950116261778998+003	21
41	4.09938025836618840−050	7.51479553487381388−049	−1.31638183369871895+047	2.46565554715343242+048	1.72150110724277882+003	21
42	1.02198422033718880−051	1.91922492103031910−050	−5.15565876811460360+048	9.88775658842554037+049	1.80550105573224149+003	21
43	2.48920353108878556−053	4.78604833242897970−052	−2.06794429061182350+050	4.05861495461654412+051	1.89150100773474130+003	21
44	5.92648308884134552−055	1.16603729910965288−053	−8.48993914359608822+051	1.70428467271144697+053	1.97950096293790569+003	21
45	1.37998398435339393−056	2.77691497380228644−055	−3.56575161525256102+053	7.31762908935287199+054	2.06950092106332857+003	22
46	3.14413905321295099−058	6.46766953671207416−057	−1.53129311862819120+055	3.21108639726177383+056	2.16150088186223233+003	22
47	7.01263960782034827−060	1.47393680286990660−058	−6.72072102922410728+056	1.43941261746121435+058	2.25550084511176274+003	22
48	1.53181506602530113−061	3.28819378851114040−060	−3.01316035155479623+058	6.58835721887512891+059	2.35150081061181343+003	21
49	3.27839489819657869−063	7.18417177020635848−062	−1.37938156974312750+060	3.07781282598355782+061	2.44950077818229510+003	22
50	6.87739484100824993−065	1.53787881453726115−063	−6.44491591014053509+061	1.46690725100810574+063	2.54950074766077968+003	21
51	1.41470239326334198−066	3.22679612079241359−065	−3.07215441186324971+063	7.12996889618376920+064	2.65150071890046184+003	21

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 2.0 X = 2.00000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	2.37498189736538421−001	−2.62137974091731624−001	9.09031403978128181−002	3.20721749593287258−001	5.39501078349079835+000	23
3	2.38903218050111253−001	3.83928321248979287−002	−1.50809156592385349−001	3.94343827332999936−001	1.06299512876868696+001	24
4	1.43219555427400943−001	1.30844291842005617−001	−3.19663409427984258−001	4.06186622992857032−001	1.83883287402038170+001	24
5	6.39267312172257353−002	9.81288090583142677−002	−5.20424650645928815−001	7.65428607029115101−001	2.82612011298329428+001	24
6	2.30531268651404861−002	4.83351001430733961−002	−1.02759478816923073+000	2.18326578002949887+000	4.01876279172383946+001	23
7	7.01385655206923854−003	1.84163810081855119−002	−2.63127133377762885+000	7.34852562190323991+000	5.41412350355173940+001	23
8	1.85081059024927575−003	5.80169105863869899−003	−8.29289089406936111+000	2.80348563613001001+001	7.01101221891089457+001	22
9	4.31882817760601469−004	1.56786923075981085−003	−3.06728593810936997+001	1.20192249893429706+002	8.80882526859487375+001	23
10	9.04179379266005222−005	3.72214606844433907−004	−1.29398492445036215+002	5.73293222528341858+002	1.08072299830526378+002	23
11	1.71760890098712375−005	7.89423462924615442−005	−6.11356873046142290+002	3.01221389746994834+003	1.30060308435711217+002	23
12	2.98751335329937430−006	1.51477823836718582−005	−3.19272500988155964+003	1.72843734011698840+004	1.54051068532153273+002	23
13	4.79347156158191748−007	2.65590728095265061−006	−1.82456381234309668+004	1.07523902458165506+005	1.80043798930238404+002	22
14	7.13940714609876736−008	4.28923287277663467−007	−1.13184734219390930+005	7.20682133348924973+005	2.08037977084355322+002	23
15	9.92339932532910236−009	6.42285510614605078−008	−7.57120907387888716+005	5.17677657181592740+006	2.38033242783308760+002	22
16	1.29313071083194068−009	8.96780844455847358−009	−5.43083325275977505+006	3.96690970721046370+007	2.70029341210991787+002	23
17	1.58617208787253090−010	1.17309447088499526−009	−4.15736758984476010+007	3.22979776663951268+008	3.04026088007913874+002	22
18	1.83788398554986789−011	1.44367804857652025−010	−3.38240113238219895+008	2.78412662275228045+009	3.40023347130963836+002	22
19	2.01793574666393393−012	1.67755762327890896−011	−2.91416083503916269+009	2.53294847676359618+010	3.78021016422358668+002	23
20	2.10540213445724301−013	1.84650394837360124−012	−2.65028865896128938+010	2.42529978718530869+011	4.18019017966603923+002	22
21	2.09264690384727581−014	1.93077876547238777−013	−2.53702772763125179+011	2.43785070796981104+012	4.60017291502783003+002	23
22	1.98600416600502507−015	1.92282613301201175−014	−2.54975338846629052+012	2.56659459188072593+013	5.04015789834124268+002	22
23	1.80338189974285483−016	1.82801467025062299−015	−2.68416306225219539+013	2.82431056094352973+014	5.50014475571760051+002	22
24	1.56978604159003267−017	1.66251315443598679−016	−2.95356846886217646+014	3.24225941188391316+015	5.98013318787307725+002	22
25	1.31217558694322417−018	1.44920274305786919−017	−3.39064697881054361+015	3.87620768758210269+016	6.48012295295582078+002	22
26	1.05495914349016185−019	1.21292640851331145−018	−4.05373512404563756+016	4.81830755844286871+017	7.00011385381316757+002	22
27	8.16980878544820406−021	9.76297085690066718−020	−5.03925804820466099+017	6.21824474343418979+018	7.54010572843401867+002	22
28	6.10258592635505742−022	7.56865010037037051−021	−6.50386478252899430+018	8.32016521744301498+019	8.10009844269282110+002	22
29	4.40243310198562839−023	5.65903328166078626−022	−8.70308566073934989+019	1.15274775146139025+021	8.68009188478292615+002	22
30	3.07087279784079258−024	4.08610037055712650−023	−1.20591792051179046+021	1.65180998109133467+022	9.28008596090437148+002	22
31	2.07348296628464075−025	2.85256762689965459−024	−1.72818048191575142+022	2.44528090478234339+023	9.90008059189316435+002	22
32	1.35661745390539559−026	1.92755006414346575−025	−2.55861995247249246+023	3.73585931089334536+024	1.05400757105642888+003	22
33	8.60901580024396924−028	1.26203009550955800−026	−3.90946471178102288+024	5.88468878899743771+025	1.12000712596008232+003	22
34	5.30376645624629402−029	8.01403851697467968−028	−6.15887239816495470+025	9.54841428214314271+026	1.18800671898645690+003	22
35	3.17484558949750056−030	4.94024567069395957−029	−9.99448869152115000+026	1.59455850950299443+028	1.25800634590346781+003	22
36	1.84807506110911213−031	2.95893539470012652−030	−1.66925135764174390+028	2.73841316390330879+029	1.33000600305034774+003	22
37	1.04690555004653825−032	1.72331760737470512−031	−2.86703001546739360+029	4.83252447486630500+030	1.40400568724754219+003	22
38	5.77564685114165700−034	9.76723481550734992−033	−5.06010020306262955+030	8.75690886756580127+031	1.48000539572275727+003	22
39	3.10525268355629359−035	5.39100833507656038−034	−9.17037911145338429+031	1.62828648509325739+033	1.55800512604993347+003	22
40	1.62809324063596266−036	2.89974316492381701−035	−1.70536817323925273+033	3.10477936386268473+034	1.63800487609862695+003	22
41	8.32945218084901859−038	1.52098192003981702−036	−3.25213308524050120+034	6.06710293313765115+035	1.72000464399181801+003	22
42	4.16067974833910618−039	7.78454588859783197−038	−6.35577373802479890+035	1.21430128572066218+037	1.80400442807058097+003	22
43	2.03032989025237442−040	3.88994873778638775−039	−1.27221999965584013+037	2.48783680051338833+038	1.89000422686436930+003	22
44	9.68402629102955371−042	1.89889235465622498−040	−2.60678672115852319+038	5.21476550476797974+039	1.97800403906591864+003	22
45	4.51704527393645176−043	9.06016068875255435−042	−5.46468784389064941+039	1.11774505143444108+041	2.06800386350996559+003	22
46	2.06145751726417528−044	4.22739889010336625−043	−1.17143820181338103+041	2.44868662271954420+042	2.16000369915513332+003	22
47	9.20913819497456875−046	1.92985728792149175−044	−2.56658091982000618+042	5.48027947891931079+043	2.25400354506845668+003	22
48	4.02886654300614878−047	8.62373637452362618−046	−5.74471716252984346+043	1.25243844901576391+045	2.35000340041211633+003	21
49	1.72684227459640433−048	3.77380221854999928−047	−1.31300261877686620+045	2.92151048101773648+046	2.44800326443202865+003	22
50	7.25449910742970558−050	1.61794291187523155−048	−3.06308446653225677+046	6.95307025916246064+047	2.54800313644800061+003	21
51	2.98826522364653055−051	6.79871884112278909−050	−7.29070524337549160+047	1.68768637059759831+049	2.65000301584520909+003	22

OBLATE RADIAL FUNCTIONS

H = 3.0 X = 2.00000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	−1.11484629026641756−001	−2.46221446884744318−001	1.17079861928995649−001	−3.39410858625190067−001	4.52646046219492481+000	24
3	7.46761750207068208−002	−3.94685809016674356−001	1.49417698259109706−001	1.03026454498068044−001	8.80939392076956958+000	24
4	1.76340313178596724−001	−1.63834336349035697−001	2.90834765975130075−002	3.51035979599835100−001	1.63861060190996199+001	24
5	1.67500774123018185−001	5.80291328922621647−002	−1.08740342399413637−001	3.60335999656294853−001	2.61050139380708235+001	23
6	1.10311590495693744−001	1.31667328878783862−001	−2.14117295745079711−001	3.48779435563168327−001	3.79400004790263072+001	23
7	5.73344843692174002−002	1.08223817658364721−001	−3.26731426481278080−001	5.46033415811231353−001	5.18338623574273315+001	23
8	2.49227275845177527−002	6.24563649750311460−002	−5.55334556289465131−001	1.28326599997316087+000	6.77617506037794595+001	23
9	9.36791896458439706−003	2.88576516892109674−002	−1.15761336680764900+000	3.55048580824613396+000	8.57105950232199005+001	23
10	3.11232372790460872−003	1.12875212705804832−002	−2.90528791305186509+000	1.08835617732280949+001	1.05673028613862985+002	23
11	9.28388385365695252−004	3.85610774942618335−003	−8.44539444437464858+000	3.67306573846467513+001	1.27644648702775882+002	23
12	2.51608322156712361−004	1.17409806428473685−003	−2.76743403182732043+001	1.35823318464561185+002	1.51622696238387150+002	23
13	6.25344986968659335−005	3.23222195070274878−004	−1.00483916576556994+002	5.46706782559479441+002	1.77605372590815883+002	22
14	1.43613457160093722−005	8.13274967829313701−005	−3.99501580312456905+002	2.37973542694757770+003	2.05591465473373907+002	22
15	3.06670968273065496−006	1.88627291218983273−005	−1.72369860080824928+003	1.11366938527467769+004	2.35580134131187108+002	24
16	6.12139896772020631−007	4.06064774436828604−006	−8.01391691351046928+003	5.57470166676208208+004	2.67570780880573440+002	22
17	1.14735986462446099−007	8.16008807295429252−007	−3.99154381572262527+004	2.97163240884965455+005	3.01562971549996876+002	22
18	2.02735538590506661−008	1.53817555739591162−007	−2.11945815913321399+005	1.68030132015746113+006	3.37556384678751501+002	24
19	3.38876532878951048−009	2.73108433262317054−008	−1.19475521736831286+006	1.00440398816524052+007	3.75550778194464310+002	23
20	5.37479678539250245−010	4.58410143474868364−009	−7.12403420760219076+006	6.32756410936849551+007	4.15545967027992404+002	23
21	8.11102127388749851−011	7.29701306271973983−010	−4.47900793436707070+007	4.18976675242735255+008	4.57541807751940833+002	22
22	1.16746830338458668−011	1.10467293274917604−010	−2.96087423020134275+008	2.90874624813691865+009	5.01538187835289595+002	23
23	1.60631623429683094−012	1.59446833310033850−011	−2.05279133960761163+009	2.11263249959323550+010	5.47535017995852502+002	22
24	2.11692506165494383−013	2.19926721653960281−012	−1.48926122377458447+010	1.60203275108108905+011	5.95532226671330634+002	22
25	2.67709730821043697−014	2.90477812809040839−013	−1.12825251073603351+011	1.26605164486278127+012	6.45529755964388472+002	22
26	3.25414040500294875−015	3.68072570108666196−014	−8.90921814284725277+011	1.04095933966532426+013	6.97527558629522259+002	23
27	3.80796311886358731−016	4.48211014023656532−015	−7.32029949740203828+012	8.89091543247301915+013	7.51525595806915883+002	22
28	4.29588710117840451−017	5.25342415020005137−016	−6.24874686544283301+013	7.87715044140241658+014	8.07523835299050677+002	23
29	4.67832453288080251−018	5.93529290771645833−017	−5.53355259843734752+014	7.22981292489724640+015	8.65522250246532413+002	22
30	4.92422792234328474−019	6.47236875634153150−018	−5.07670037375632766+015	6.86572399073081284+016	9.25520818100907121+002	23
31	5.01525185780680925−020	6.82095910093199094−019	−4.81932976869650265+016	6.73828879957030569+017	9.87519519820754630+002	22
32	4.94786495629693829−021	6.95490081470889386−020	−4.72844161913712390+017	6.82735371636103718+018	1.05151833923729814+003	23
33	4.73311985898974434−022	6.86860145186656520−021	−4.78969545662055770+018	7.13443954629359863+019	1.11751726254989714+003	23
34	4.39429296208706703−023	6.57681855662653597−022	−5.00401595444127879+019	7.68181866140509824+020	1.18551627792191358+003	22
35	3.96301067326761727−024	6.11145282223863740−023	−5.38691534115819616+020	8.51493737561933944+021	1.25551537515477167+003	21
36	3.47469644664338061−025	5.51620201149460958−024	−5.97017220055836968+021	9.70847131051261504+022	1.32751454542339468+003	22
37	2.96417768466467192−026	4.84023405617592596−025	−6.80606275319374444+022	1.13770946035587871+024	1.40151378106016208+003	22
38	2.46211900534007493−027	4.13205227346938155−026	−7.97489883124309262+023	1.36930699723361512+025	1.47751307537748170+003	22
39	1.99267224851054684−028	3.43449043273844435−027	−9.59734700601386164+024	1.69143070166376703+026	1.55551242252128866+003	23
40	1.57243799497675226−029	2.78139272745340918−028	−1.18540832410039011+026	2.14290203220440842+027	1.63551181734946254+003	23
41	1.21058764178528674−030	2.19612099111399322−029	−1.50170782973813344+027	2.78272672128929729+028	1.71751125533043579+003	22
42	9.09839382102953258−032	1.69168633702746702−030	−1.94997157206996188+028	3.70167137942468434+029	1.80151073245825145+003	23
43	6.67924300590633434−033	1.27208194612646444−031	−2.59378969619830545+029	5.04122041840136971+030	1.88751024518109054+003	23
44	4.79203944637474866−034	9.34310858926071175−033	−3.53228544193885212+030	7.02501316841927225+031	1.97550979034088279+003	22
45	3.36178505920231346−035	6.70635305735927877−034	−4.92214037289442933+031	1.00116619401422225+033	2.06550936512207997+003	22
46	2.30723390384069358−036	4.70681214575866676−035	−7.01459976310352932+032	1.45846778898488920+034	2.15750896700803688+003	21
47	1.54985731065612980−037	3.23168706582450780−036	−1.02184771783247622+034	2.17076410232943251+035	2.25150859374373638+003	22
48	1.01945413212910102−038	2.17170465407080379−037	−1.52088722846075492+035	3.29955874255618100+036	2.34750824330382539+003	22
49	6.56914376865208282−040	1.42902363744468021−038	−2.31173172795594602+036	5.11961300045784535+037	2.44550791386511481+003	22
50	4.14855086407244196−041	9.21160047493142604−040	−3.58688772009454418+037	8.10540623520504871+038	2.54550760378284484+003	22
51	2.56864949767095688−042	5.81928792865759068−041	−5.67879495121833384+038	1.30886381299605678+040	2.64750731157013803+003	22

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 4.0 X = 2.00000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	−3.72974753450591661−002	4.15398595140530450−001	−1.13208481154946612−001	−7.97200331318362171−002	3.02762400601350363+000	23
3	−1.19518880805177956−001	−5.70399448888327976−004	1.64284686039242204−002	−4.18265539919584673−001	6.04607661023357135+000	24
4	−4.01878130445364761−002	−3.59356129431761887−001	1.18044481407928230−001	−1.88614196350200036−001	1.36731211006644547+001	23
5	7.95600112305539468−002	−3.48065019260828311−001	1.03696084975687325−001	1.74799122958445471−001	2.31287535849864770+001	25
6	1.39591248404404304−001	−1.25085433172402073−001	1.30818929970536053−002	3.46466173922566583−001	3.48313171928388655+001	22
7	1.31689557758134940−001	6.23240015606183780−002	−8.34950450901154950−002	3.40165579124913671−001	4.86356027334451155+001	24
8	9.20936516446459695−002	1.29801675583279246−001	−1.59675317449258425−001	3.17870729664959699−001	6.45011096112973017+001	23
9	5.25683475480216552−002	1.14225843259203832−001	−2.35673309988765073−001	4.39047801754882283−001	8.24048431083834844+001	25
10	2.56567364541676870−002	7.30309549668956751−002	−3.67829453245470492−001	9.01792938702996872−001	1.02333665778257427+002	23
11	1.10065758340086787−002	3.81481277757652189−002	−6.75168431422295074−001	2.20264583405042615+000	1.24279610251660498+002	23
12	4.22775714466451227−003	1.71214140468976037−002	−1.46426682958453055+000	5.89666825281267635+000	1.48237624028012879+002	22
13	1.47361101748602414−003	6.79123436896662669−003	−3.64506829970574784+000	1.71317169770325846+001	1.74204381644195830+002	23
14	4.70864769896302096−004	2.42448054552933095−003	−1.01529530502151884+001	5.39100915442685569+001	2.02177624213072565+002	22
15	1.39044214751153387−004	7.89139167063768550−004	−3.11145732903453419+001	1.83008488311817496+002	2.32155775133397583+002	22
16	3.81949966895688977−005	2.36465263554326526−004	−1.03725480384603748+002	6.66907426398917009+002	2.64137707715648234+002	22
17	9.81372494401644203−006	6.57306797570057388−005	−3.73026419358480425+002	2.59643713611324813+003	2.98122599918766909+002	22
18	2.36946905481976634−006	1.70544317995511995−005	−1.43779781162306147+003	1.07531158629411215+004	3.34109840862470909+002	22
19	5.39750137544766908−007	4.15146994678979201−006	−5.90821388595149592+003	4.71926282948905500+004	3.72098969095361125+002	22
20	1.16404613728493074−007	9.52243437102888717−007	−2.57683185758023998+004	2.18739506411704603+005	4.12089630889050236+002	21
21	2.38403835499792637−008	2.06584415755547399−007	−1.18833957994704490+005	1.06754810225219086+006	4.54081551478298872+002	22
22	4.64946086421713479−009	4.25268899516620658−008	−5.77552934803027845+005	5.47127304504270695+006	4.98074514858691021+002	21
23	8.65554664144495354−010	8.33087022540656282−009	−2.94975940450081643+006	2.93753107206254497+007	5.44068349355935647+002	23
24	1.54148792117208660−010	1.55698092945370662−009	−1.57911576628236153+007	1.64863235812211016+008	5.92062917159580973+002	21
25	2.63148600682373848−011	2.78248195475140883−010	−8.84057751014779975+007	9.65281690366747503+008	6.42058106625535893+002	22
26	4.31381817225764744−012	4.76463983888389616−011	−5.16525915365222648+008	5.88559819735315363+009	6.94053826542087051+002	21
27	6.80205449544172096−013	7.83223865899814565−012	−3.14367659953331633+009	3.73092785756920034+010	7.48050001807980794+002	22
28	1.03322558573556674−013	1.23804903448905675−012	−1.98966223230254018+010	2.45512754364535856+011	8.04046570139215831+002	21
29	1.51403146558520538−014	1.88478516319376165−013	−1.30749622737498184+011	1.67476737924448241+012	8.62043479534282733+002	23
30	2.14299855772436335−015	2.76744959102934837−014	−8.90839361797599527+011	1.18275719943176869+013	9.22040686304828611+002	21
31	2.93344696587758319−016	3.92433015056857885−015	−6.28466763456176073+012	8.63724131034592387+013	9.84038153532221200+002	23
32	3.88767612659247333−017	5.38085393149998821−016	−4.58519260168209628+013	6.51488126526472370+014	1.04803584984801863+003	21
33	4.99356967320758180−018	7.14218433044033832−017	−3.45566151403216352+014	5.07032646786126836+015	1.11403374846300239+003	22
34	6.22251440438839086−019	9.18683350066518156−018	−2.68746463892611590+015	4.06760164434658064+016	1.18203182638857021+003	21
35	7.52926618407554116−020	1.14626797544607593−018	−2.15457716142679172+016	3.36058938197790784+017	1.25203006380817609+003	22
36	8.85412349461516829−021	1.38865821062698416−019	−1.77904146134657513+017	2.85688297570463454+018	1.32402844356668588+003	21
37	1.01273802921122233−021	1.63482848621929514−020	−1.51159844434775309+018	2.49698908356891722+019	1.39802695075304940+003	21
38	1.12756036349396735−022	1.87185838717460540−021	−1.32055700503966379+019	2.24210106724619138+020	1.47402557235731167+003	21
39	1.22289142251974323−023	2.08609304288119305−022	−1.18525724145524182+020	2.06677538589362238+021	1.55202429698721702+003	21
40	1.29282258974378373−024	2.26449578359655104−023	−1.09215900760532501+021	1.95449132178415947+022	1.63202311463286805+003	21
41	1.33313764444269498−025	2.39599917857358235−024	−1.03246908826518661+022	1.89493179728643278+023	1.71402201647035386+003	22
42	1.34172629377682760−026	2.47265505237507216−025	−1.00069570156829460+023	1.88236954835084410+024	1.79802099469714833+003	21
43	1.31874379442962844−027	2.49041678827743386−026	−9.93782047957279887+023	1.91475289934583607+025	1.88402004239354069+003	22
44	1.26650514667981015−028	2.44945056177834765−027	−1.01062055287474460+025	1.99330806166431597+026	1.97201915340550015+003	22
45	1.18914456140074410−029	2.35395180666168466−028	−1.05183857015544738+026	2.12255328695527775+027	2.06201832224526966+003	22
46	1.09210424842845350−030	2.21152215253610011−029	−1.11980309192810417+027	2.31070491608649898+028	2.15401754400668859+003	21
47	9.81535551741763301−032	2.03222481361938049−030	−1.21883282594066215+028	2.57052093833210218+029	2.24801681429280353+003	21
48	8.63698236207829524−033	1.82747253410028349−031	−1.35564129970410411+029	2.92069921292710785+030	2.34401612915377141+003	21
49	7.44432058138282332−034	1.60890812373448556−032	−1.54007246312725016+030	3.38803907671891571+031	2.44201548503341690+003	21
50	6.28753000083078796−035	1.38741645783260563−033	−1.78623856547904227+031	4.01070566073779017+032	2.54201487872309319+003	21
51	5.20600316652353174−036	1.17236663320249639−034	−2.11423890357088662+032	4.84313354061703775+033	2.64401430732172777+003	21

OBLATE RADIAL FUNCTIONS

H = 5.0 X = 2.00000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	9.27618726185748815−002	−1.21470990952876914−001	1.78469675748152185−002	4.07841175422839959−001	4.28957108509711792−001	24
3	2.53552883232601042−002	3.94914249748480925−001	−9.14033422666091881−002	1.53952801266213893−001	2.10980581603699983+000	24
4	−7.56058717322137011−002	2.94027235319689643−001	−6.06674766245458756−002	−2.93126830846660009−001	1.05123673338162820+001	24
5	−8.90372594412660788−002	−1.34252869242989816−001	4.41669960259477532−002	−3.82653894240169747−001	1.93843905253782472+001	23
6	−1.16202361924933776−002	−3.79325503685264070−001	1.02400546825792285−001	−9.95557214583297263−002	3.09101722480266658+001	24
7	7.48208899408381074−002	−3.12914632292336445−001	7.83391671061181514−002	2.06981343621367617−001	4.45827994265121613+001	23
8	1.15940214657415188−001	−1.05259311574635712−001	7.19221225041994218−003	3.38475763614711180−001	6.03574156276832052+001	23
9	1.09824812249782731−001	6.16644573035089676−002	−6.67198492300888981−002	3.26754546360953340−001	7.81951015168234738+001	23
10	8.02548271111046734−002	1.26943496924513053−001	−1.26254297113257576−001	2.98708985934374581−001	9.80744686145256602+001	24
11	4.89469480092128582−002	1.18015222221110077−001	−1.82921213480980622−001	3.76172837959607381−001	1.19982457348935945+002	22
12	2.59196268151104077−002	8.13254402562717892−002	−2.70363831290439550−001	6.94938338403537948−001	1.43910734702978055+002	23
13	1.22064538869695406−002	4.63947642069956402−002	−4.54707388307484602−001	1.54868548321601647+000	1.69853781372837966+002	23
14	5.19587665741989634−003	2.29743352695999558−002	−8.88299200987949837−001	3.77066617022310028+000	1.97807826657445982+002	22
15	2.02288159590139762−003	1.01392222372642912−002	−1.97714417710102425+000	9.86379817468678031+000	2.27770225429389786+002	22
16	7.26867891970352982−004	4.05625113963908682−003	−4.89877434823973981+000	2.76932592421331677+001	2.59739079076532843+002	22
17	2.42793621912044215−004	1.48866557077206133−003	−1.32884408951254178+001	8.32721856157802566+001	2.93712997091276940+002	22
18	7.58347271713519353−005	5.05724040864836315−004	−3.90239769014497437+001	2.67221067005277864+002	3.29690942758163610+002	22
19	2.22572888753135124−005	1.60148189431589079−004	−1.23076886278233112+002	9.11570811117180206+002	3.67672130729289705+002	21
20	6.16432800628503852−006	4.75432153681194454−005	−4.14318810327983090+002	3.29345738072571126+003	4.07655957504977672+002	21
21	1.61677167439745007−006	1.32941111937209687−005	−1.48132523411745799+003	1.25602754830214107+004	4.49641953295799804+002	21
22	4.02841238111781192−007	3.51532896903503637−006	−5.60183182074576418+003	5.04112201026328538+004	4.93629748083923852+002	22
23	9.56192355521927636−008	8.82059008062725729−007	−2.23278702702893552+004	2.12357908740567178+005	5.39619047301353352+002	21
24	2.16747304535841016−008	2.10645262389606263−007	−9.35150612634588496+004	9.36643499500663024+005	5.87609614138688807+002	22
25	4.70239616239501047−009	4.80032836275529028−008	−4.10464116774866732+005	4.31617708984897344+006	6.37601256500387628+002	21
26	9.78380871041193561−010	1.04633655108390531−008	−1.88365979684828353+006	2.07389367965773139+007	6.89593817265071406+002	22
27	1.95571681459531196−010	2.18606729378543163−009	−9.01875173053530529+006	1.03718501879850997+008	7.43587166929163670+002	21
28	3.76209961598148148−011	4.38600256596691959−010	−4.49656831361642935+007	5.39008583193577319+008	7.99581197991081316+002	21
29	6.97490017989570520−012	8.46512222372156960−011	−2.33054801284162218+008	2.90636793361928245+009	8.57575820621542407+002	22
30	1.24805500999850001−012	1.57411759735879136−011	−1.25370233822558433+009	1.62374660677150760+010	9.17570959294600260+002	22
31	2.15812183275311062−013	2.82426049675005201−012	−6.98980349490890554+009	9.38731715782653579+010	9.79566550143647638+002	21
32	3.61062409598694528−014	4.89565254839051649−013	−4.03361228603323577+010	5.60923408093693711+011	1.04356253886968709+003	21
33	5.85105082760634500−015	8.20891597189291124−014	−2.40630295589750373+011	3.46038033656986958+012	1.10955887907404483+003	22
34	9.19346800053945818−016	1.33297817262514569−014	−1.48231489224430014+012	2.20167906557392887+013	1.17755553092000764+003	21
35	1.40196811264663863−016	2.09836294184973688−015	−9.41902904931929805+012	1.44336082341428453+014	1.24755246005135364+003	21
36	2.07684046418820421−017	3.20542916024779939−016	−6.16764777536818854+013	9.74077803256056162+014	1.31954963671299780+003	21
37	2.99118604146989983−018	4.75597824542914804−017	−4.15796343911471730+014	6.76147055311275664+015	1.39354703503175768+003	20
38	4.19185570190945191−019	6.85988517997308828−018	−2.88346239533834677+015	4.82358661296436473+016	1.46954463242480137+003	21
39	5.72030704490976159−020	9.62653090702042024−019	−2.05526521437084553+016	3.53388825687660240+017	1.54754240911054195+003	21
40	7.60662243642624066−021	1.31531844786889842−019	−1.50455948266675074+017	2.65692845073280504+018	1.62754034770221283+003	21
41	9.86317291319944171−022	1.75111073941499571−020	−1.13038253335776105+018	2.04860547814796001+019	1.70953843286854325+003	20
42	1.24787528000136814−022	2.27307755679913233−021	−8.71003498087428019+018	1.61886490499412454+020	1. [illegible] 665104917724+003	20
43	1.54141242199860106−023	2.87881313176584943−022	−6.87879324962981660+019	1.31030731126946462+021	1. [illegible] 499021497919+003	20
44	1.85998754929572949−024	3.55940542152561936−023	−5.56463233859941601+020	1.08566412139900963+022	1. [illegible] 343966532032+003	21
45	2.19372934011001474−025	4.29891691431987342−024	−4.60829054587772752+021	9.20320545341905591+022	2. [illegible] 198985597158+003	20
46	2.53025913471607694−026	5.07456452091608657−025	−3.90464910045002690+022	7.97768336502594197+023	2. [illegible] 063225243754+003	21
47	2.85543733977738714−027	5.85768127089754796−026	−3.38324923239480409+023	7.06792057926785410+024	2.24352935920452569+003	20
48	3.15437249427272975−028	6.61543514447402195−027	−2.99624581513676907+024	6.39700294423007084+025	2.33952816383871117+003	20
49	3.41258927804853195−029	7.31316606389272880−028	−2.71083988391546115+025	5.91198533209938337+026	2.43752703996547086+003	21
50	3.61722321636285180−030	7.91710151745812282−029	−2.50445928255597478+026	5.57663721785659291+027	2.53752598199925578+003	20
51	3.75810117882994040−031	8.39714358917577141−030	−2.36165827388588264+027	5.36675714832527959+028	2.63952498488917062+003	20

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 6.0 X = 2.00000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	−4.90987005873781197−002	−3.10178103655766705−001	6.08202185751089848−002	−2.94676500573136606−001	−3.96828885830739182+000	26
3	5.95178440532191567−002	−3.02857377353235849−001	5.08080668344549727−002	3.01518573949281702−001	−3.27797903843184929+000	24
4	7.20909839097738322−002	1.45177630416659466−001	−3.39827736690916828−002	3.93943780995040821−001	7.31214012848986341+000	24
5	−1.07483006979314541−002	4.13879551272384255−001	−8.01013261678845080−002	−1.68428859346336300−002	1.49134187085504893+001	24
6	−7.81846286968127075−002	1.69717517759997172−001	−2.67740484095944264−002	−3.68222101667979128−001	2.62594432274110872+001	24
7	−6.60082101063473367−002	−2.11900082005294992−001	5.36855913237542381−002	−3.32645773820424230−001	3.97275520049222553+001	23
8	2.01155190361986805−003	−3.78172683566073999−001	8.83731250198939740−002	−4.32345346911626459−002	5.53711820152833167+001	24
9	6.84960515341878168−002	−2.87892218417532732−001	6.28724291142496050−002	2.22390194721368820−001	7.31139413336567528+001	23
10	9.94395755051107143−002	−9.44969014516382024−002	4.90707268480917137−003	3.30548778013755248−001	9.29223857780106065+001	23
11	9.49386395944655010−002	5.88452528009056877−002	−5.47246873299164861−002	3.17184292945243902−001	1.14775928256730038+002	23
12	7.18255258973674034−002	1.23578773722962390−001	−1.03560679908549253−001	2.85907151360951830−001	1.38661500587886042+002	23
13	4.60793616764658699−002	1.20402703710567562−001	−1.48529744394597837−001	3.35290029303400614−001	1.64570445884335911+002	23
14	2.59599885224793480−002	8.80172817448123232−002	−2.11547382349901047−001	5.66776359162246632−001	1.92496839836936458+002	24
15	1.31218510806952466−002	5.37502433111786095−002	−3.33771271906664335−001	1.17308496822637225+000	2.22436516925061995+002	23
16	6.03862564577891206−003	2.87030706669963614−002	−6.02168706796641454−001	2.65776408907119080+000	2.54386479833247715+002	23
17	2.55731815027890320−003	1.37461790352087165−002	−1.22936580023763753+000	6.42636151536788668+000	2.88344528084663583+002	22
18	1.00486482253211912−003	6.00002189336724662−003	−2.78304929341644096+000	1.65544422190007824+001	3.24309017370143473+002	23
19	3.68766867212564211−004	2.41409683796137881−003	−6.87299798579126648+000	4.53979251310279381+001	3.62278699487766851+002	22
20	1.27071127535012819−004	9.02930357725772423−004	−1.83098691736200652+001	1.32215688460427258+002	4.02252613456670412+002	22
21	4.12992010346131177−005	3.16019224436018492−004	−5.22043445694807617+001	4.07653330537440582+002	4.44230009942551298+002	23
22	1.27085440034530798−005	1.04050078263100569−004	−1.58352969862099389+002	1.32640642558323746+003	4.88210297852593307+002	22
23	3.71486398118672630−006	3.23708496495220740−005	−5.08613014838089729+002	4.54097323230405294+003	5.34193005979180715+002	21
24	1.03451380077941363−006	9.55136705559675998−006	−1.72302719799546186+003	1.63130430022177328+004	5.82177755042675641+002	22
25	2.75158359675108752−007	2.68142685668593789−006	−6.13623350055798826+003	6.13445727979026054+004	6.32164237037544274+002	22
26	7.00596780704805936−008	7.18232557151110245−007	−2.29074084707702295+004	2.40944395329437904+005	6.84152199784159090+002	21
27	1.71110822299438262−008	1.84004410282052920−007	−8.94187953264775318+004	9.86488195446458338+005	7.38141435241857910+002	21
28	4.01615241381266393−009	4.51858482625143139−008	−3.64166333480514387+005	4.20257174212759282+006	7.94131770573879329+002	21
29	9.07387276175420749−010	1.06570375680084089−008	−1.54429687830784910+006	1.85981266523578386+007	8.52123061249145688+002	20
30	1.97646184652513012−010	2.41822376084305724−009	−6.80689804011789931+006	8.53683605618220553+007	9.12115185667961168+002	21
31	4.15629312395727087−011	5.28783732080760861−010	−3.11354312392524005+007	4.05876662198355753+008	9.74108040939340376+002	21
32	8.44902720530076508−012	1.11587739109443992−010	−1.47573803653327700+008	1.99619504376742074+009	1.03810153953680501+003	20
33	1.66229716309658974−012	2.27559190247305560−011	−7.23814603438400794+008	1.01439545244485410+010	1.10409560663016700+003	20
34	3.16878833405237980−013	4.49002411569787536−012	−3.66919269289014074+009	5.32019430769448879+010	1.17209017794177189+003	21
35	5.85879456644014037−014	8.58175125884539401−013	−1.92017594334978784+010	2.87684792889535029+011	1.24208519801279037+003	21
36	1.05165138277919041−014	1.59051216540965267−013	−1.03627997300187111+011	1.60235364788873762+012	1.31408061879243974+003	20
37	1.8343 [illegible] 46227875−015	2.86128413905025526−014	−5.76167870355186986+011	9.18462316734817036+012	1.38807639848327282+003	21
38	3.1116 [illegible] 10129257−016	5.00090454318243619−015	−3.29727907286734444+012	5.41326536519832072+013	1.46407250059083246+003	20
39	5.1374 [illegible] 19885320−017	8.49913715809116435−016	−1.94053595646678632+013	3.27799012181005133+014	1.54206889313740978+003	20
40	8.2619 [illegible] 16623327−018	1.40569741678065222−016	−1.17353150211338358+014	2.03789376790076930+015	1.62206554800834199+003	20
41	1.2951 [illegible] 12633286−018	2.26428309014127858−017	−7.28691352968894258+014	1.29979365526257478+016	1.70406244040594744+003	20
42	1.98015683922605874−019	3.55470513440046825−018	−4.64254471804781492+015	8.49955693104751703+016	1.78805954839133221+003	20
43	2.95489527654760242−020	5.44258449128997120−019	−3.03275550302975570+016	5.69472136634558228+017	1.87405685249828975+003	20
44	4.30619064881337118−021	8.13231866029663334−020	−2.03005897846372604+017	3.90699070091246437+018	1.96205433540662923+003	20
45	6.13197921395002537−022	1.18657580384047434−020	−1.39157174585425071+018	2.74320559757908957+019	2.05205198166471445+003	21
46	8.53689473837403717−023	1.69160645687625590−021	−9.76286815675521053+018	1.97008432658007825+020	2.14404977745292834+003	20
47	1.16256014250780896−023	2.35756885811353956−022	−7.00625131708302824+019	1.44642954813397662+021	2.23804771038131333+003	20
48	1.54939176497790344−024	3.21379106586565262−023	−5.14047826834672702+020	1.08512969929744383+022	2.33404576931586368+003	20
49	2.02181675248993642−025	4.28721692401531653−024	−3.85402538794536184+021	8.31444810408600830+022	2.43204394422892970+003	20
50	2.58435701350040471−026	5.59943662524429579−025	−2.95129363593543306+022	6.50364929018094916+023	2.53204222606998652+003	20
51	3.23728133409397451−027	7.16343889459749317−026	−2.30727761273032241+023	5.19117413883036079+024	2.63404060665366240+003	20

OBLATE RADIAL FUNCTIONS

H = 7.0 X = 2.00000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	−2.76438273840912495−002	4.02320726487571560−001	−6.05958849515223559−002	−1.51659466589908779−001	−1.05956525716544756+001	24
3	−6.08148397853201905−002	−1.48607883025960778−001	2.72013206019265167−002	−4.03340664677485227−001	−1.03776727949597438+001	24
4	−4.99100867118605411−003	−4.17845933772051896−001	6.76416122220569262−002	−6.16420388993325717−002	4.08466529086879527+000	24
5	6.59129621224246209−002	−1.40391183984762146−001	1.79780159635328249−002	3.95179836952730208−001	9.67676377785498349+000	25
6	4.25580859837718078−002	3.04939828711914018−001	−5.47988916369543560−002	2.78702946052973752−001	2.10375437832845670+001	24
7	−3.08438123248162734−002	3.78937620306209581−001	−6.36347295340865237−002	−1.44529332042585150−001	3.41393013273133882+001	25
8	−7.21165090812628218−002	7.63212302069490874−002	−7.03278849863152153−003	−3.88741466532129317−001	4.95967145043916895+001	24
9	−4.99221077472076693−002	−2.56132847972845077−001	5.55939765780819048−002	−2.87086937372960792−001	6.72036026037745036+001	25
10	8.96984778100662981−003	−3.70916133312107381−001	7.71713423451307517−002	−5.87159726876807996−003	8.69117555614111238+001	23
11	6.24225253653770647−002	−2.69999812880275555−001	5.27130530139877896−002	2.29707369853654884−001	1.08688657886667266+002	25
12	8.72349734262437957−002	−8.88074731068740543−002	4.15409674421463910−003	3.23293658825703546−001	1.32514249999744122+002	23
13	8.40690702683877901−002	5.49049357171966310−002	−4.56891698661268014−002	3.10017317352885423−001	1.58375341738284068+002	24
14	6.54538570050439858−002	1.19895393509974729−001	−8.70960360102210947−002	2.76973976635588200−001	1.86262940807412764+002	23
15	4.37344884825701897−002	1.21806630349280744−001	−1.24330220232716438−001	3.07015901183996777−001	2.16170733681740967+002	23
16	2.58867417125799687−002	9.35079369061199165−002	−1.72518594620056268−001	4.80538294416508755−001	2.48094178410367391+002	23
17	1.38429612518995958−002	6.03461504975589970−002	−2.59312855800427959−001	9.33535514127859827−001	2.82029939032619601+002	23
18	6.77841931786094024−003	3.42430368384733871−002	−4.39263842464433681−001	1.99599641120743677+000	3.17975520785057448+002	23
19	3.06948800219670432−003	1.75102335887853990−002	−8.36466204693415719−001	4.53649270762965921+000	3.55929028089548874+002	23
20	1.29521857976002640−003	8.19560658168843447−003	−1.76049765893820191+000	1.09194560607738844+001	3.95889000090951562+002	22
21	5.12380657777026238−004	3.54942443288979707−003	−4.03131984775734433+000	2.78358739552806187+001	4.37854296531453128+002	22
22	1.90973422282589576−004	1.43392542394904004−003	−9.93085493979484687+000	7.50435480519394093+001	4.81824017076870784+002	23
23	6.73427840261246797−005	5.43765828382274081−004	−2.61109239367509133+001	2.13433415249936539+002	5.27797443338756415+002	22
24	2.25469336729327572−005	1.94539121615070995−004	−7.28474994194445845+001	6.38656246184025075+002	5.75773996580949874+002	22
25	7.18942080621316869−006	6.59361829058435841−005	−2.14670141702788536+002	2.00529350448243609+003	6.25753206446306800+002	22
26	2.18914991078282198−006	2.12466968708304562−005	−6.65675955076058763+002	6.59069224481189579+003	6.77734687543632061+002	22
27	6.38060911553903885−007	6.52862479181368167−006	−2.16528634212904112+003	2.26233674801905878+004	7.31718121718406287+002	21
28	1.78390610585971036−007	1.91803246411463945−006	−7.36799003503143926+003	8.09425139671597208+004	7.87703244485624333+002	21
29	4.79324725431650061−008	5.40005887042228921−007	−2.61658058785238427+004	3.01293436194350348+005	8.45689834546077225+002	21
30	1.23988500495425849−008	1.45996278166313742−007	−9.67744822944575755+004	1.16484305215859563+006	9.05677705611677602+002	20
31	3.09246588392141533−009	3.79739229110898820−008	−3.72063971662812441+005	4.67028595807720618+006	9.67666699977298256+002	20
32	7.44766781431032176−010	9.51811993512947475−009	−1.48447972211552964+006	1.93912683743973607+007	1.03165668342601125+003	19
33	1.73419060712620849−010	2.30247139946018875−009	−6.13718723897314681+006	8.32707224985558411+007	1.09764754116124143+003	20
34	3.90894383077137162−011	5.38285999091931806−010	−2.62542777241898192+007	3.69386695775995861+008	1.16563917453627981+003	19
35	8.53874238259454653−012	1.21774620639282341−010	−1.16068401522459219+008	1.69079266722605570+009	1.23563149840768298+003	20
36	1.80947010527879156−012	2.66889439913069120−011	−5.29666712543483719+008	7.97757492880590902+009	1.30762443898036163+003	20
37	3.72350693388691203−013	5.67289949522048114−012	−2.49227573904086649+009	3.87618421174980901+010	1.38161793204281889+003	19
38	7.44712633190501836−014	1.17061095188435063−012	−1.20797559137394332+010	1.93775872189668814+011	1.45761192151396440+003	19
39	1.44886763457256111−014	2.34724687468599697−013	−6.02535931742419071+010	9.95841331565191663+011	1.53560635824027226+003	19
40	2.74420951371952532−015	4.57743188150867732−014	−3.09023451508247596+011	5.25692025649976354+012	1.61560119899524670+003	19
41	5.06382982432049521−016	8.68872851625614614−015	−1.62827871465828762+012	2.84838894105208150+013	1.69759640564327307+003	19
42	9.11004163364768885−017	1.60655071254847435−015	−8.80768482258744235+012	1.58302638162850474+014	1.78159194443773586+003	19
43	1.59893284045332462−017	2.89567344056329091−016	−4.88739119386128224+013	9.01797707377970382+014	1.86758778542934713+003	20
44	2.73956953985837319−018	5.09116169584948784−017	−2.78022070098213974+014	5.26246011383445096+015	1.95558390196536605+003	18
45	4.58496533884142810−019	8.73726130218889359−018	−1.62027649169007068+015	3.14389497334367217+016	2.04558027026411392+003	19
46	7.49959212518200384−020	1.46449856188809089−018	−9.66812992771031565+015	1.92176667151746377+017	2.13757686905213331+003	19
47	1.19955785775916814−020	2.39887795759111117−019	−5.90321817298419298+016	1.20130334057622762+018	2.23157367925367942+003	19
48	1.87719595177899559−021	3.84211827625103761−020	−3.68629718978607970+017	7.67540477231698885+018	2.32757068372410107+003	18
49	2.87551309146771172−022	6.02008807344296725−021	−2.35299393094940119+018	5.00995732329746530+019	2.42556786702016920+003	20
50	4.31361347166479199−023	9.23251256787730416−022	−1.53449258047710722+019	3.33924368316200972+020	2.52556521520162068+003	18
51	6.33988008586243883−024	1.38652386708364695−022	−1.02191992620889407+020	2.27169358047873319+021	2.62756271565916611+003	19

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 8.0 X = 2.00000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	5.79838054365584043−002	−3.39653708311229712−002	1.20629961078851152−003	4.30448250135884109−001	−1.94237996138059759+001	24
3	1.30636610021492295−003	4.30366385591222277−001	−5.79846735492703537−002	3.47112688442447490−002	−1.93656429956223289+001	24
4	−4.85892435627990181−002	2.62443442108186987−001	−3.35817393087984953−002	−3.33133252484136199−001	1.54737735892829929−001	24
5	−3.84006245928010700−002	−3.03969740835300188−001	4.51305408066287744−002	−2.93789002832185141−001	3.49293691839356864+000	25
6	2.88276515642454258−002	−3.78894907700390007−001	5.25961102267685502−002	1.75928367211127080−001	1.55694281521800319+001	24
7	6.02757642382929860−002	2.30879041457874901−002	−7.66394760860426615−003	4.11824815926003731−001	2.78981769422102452+001	24
8	2.06220432629781538−002	3.71095890482505421−001	−5.82572271168790607−002	1.63949924016013096−001	4.31071642109061111+001	24
9	−4.01841469296951893−002	3.26454699966531167−001	−4.86523496158655610−002	−2.26885787060180542−001	6.05175976442200780+001	24
10	−6.45543681813564091−002	6.90081557494031316−003	4.85860257316502023−003	−3.87789843283434651−001	8.00852634861732686+001	23
11	−3.86522468048868460−002	−2.81974051833009645−001	5.44926451822530785−002	−2.49260750390413739−001	1.01755745161226464+002	24
12	1.25486630805962454−002	−3.62224541188600609−001	6.83400140156150291−002	1.95693976955227061−002	1.25498522767600099+002	24
13	5.69899227801534500−002	−2.57105143666600713−001	4.56656097563716069−002	2.32657568147865693−001	1.51293759154720275+002	24
14	7.78086550747437623−002	−8.62375783039135860−002	4.11420187761094385−003	3.16741128216995839−001	1.79128071656414913+002	23
15	7.57331733927654609−002	5.03108876663284565−002	−3.86169224964294917−002	3.04452425764392920−001	2.08992118521659042+002	23
16	6.04283809515732366−002	1.15980028610867963−001	−7.45761058619344671−002	2.70579169108452465−001	2.40879201736298736+002	24
17	4.17677491917137853−002	1.22469336897204726−001	−1.06366271079221505−001	2.86665993365876505−001	2.74784410906611308+002	26
18	2.57527845595810207−002	9.80538595303016265−002	−1.44860296958967332−001	4.19212484206922542−001	3.10704077344826048+002	23
19	1.44254567819188700−002	6.62869368184014977−002	−2.09675927360328976−001	7.69557957058289397−001	3.48635414589267212+002	22
20	7.43389499906254524−003	3.95655305640131782−002	−3.37441112354426962−001	1.56700671142857319+000	3.88576275304251876+002	22
21	3.55709816969405995−003	2.13621601817770401−002	−6.06472524217922234−001	3.38602878448137174+000	4.30524983117590751+002	22
22	1.59168801796726841−003	1.05932502795490627−002	−1.20117015073448423+000	7.71238070926935488+000	4.74480213987036674+002	24
23	6.69836537587049029−004	4.87584487810522872−003	−2.58296335538703766+000	1.85207444759467215+001	5.20440911045442597+002	22
24	2.66348927483835294−004	2.09938526633719371−003	−5.96272871635147266+000	4.68630953525561259+001	5.68406222524577499+002	22
25	1.00461341733274419−004	8.50702821532872553−004	−1.46596279874699643+001	1.24714769803708721+002	6.18375455868031430+002	22
26	3.60626669088333977−005	3.25994604550414645−004	−3.81613927183878089+001	3.48271299608173860+002	6.70348043379323849+002	22
27	1.23559839688613699−005	1.18610584055820534−004	−1.04711563824569189+002	1.01813827932060699+003	7.24323516206342460+002	22
28	4.05089947971849455−006	4.11127779398888845−005	−3.01752851966228615+002	3.10896433432593356+003	7.80301484428584165+002	22
29	1.27364277915601521−006	1.36151107476720877−005	−9.10479545946496783+002	9.89580465945102584+003	8.38281621665298652+002	21
30	3.84794428030183418−007	4.31860176055302189−006	−2.86891629060067365+003	3.27715063887139492+004	8.98263653069435849+002	21
31	1.11910393023990356−007	1.31491628770572182−006	−9.41907793782755761+003	1.12721443143146631+005	9.60247345883060477+002	20
32	3.13815352051809754−008	3.85065245547969704−007	−3.21567785811945475+004	4.02068989840800369+005	1.02423250194889307+003	20
33	8.49725162138669706−009	1.08645436467831517−007	−1.13955695696769152+005	1.48509591869303118+006	1.09021895172884431+003	21
34	2.22467818416950219−009	2.95811411816042023−008	−4.18507421757995213+005	5.67276335122546579+006	1.15820654949308828+003	20
35	5.63867196678119046−010	7.78335487418959694−009	−1.59053839105039203+006	2.23816447131193503+007	1.22819516942535449+003	19
36	1.38516769422964769−010	1.98168806104835686−009	−6.24719934840166525+006	9.11080996824855858+007	1.30018470245057473+003	20
37	3.30143034218429489−011	4.88811658004145246−010	−2.53280284413367119+007	3.82239305865978732+008	1.37417505363593106+003	20
38	7.64191305477082687−012	1.16940788860723873−010	−1.05878720165450258+008	1.65121728680369407+009	1.45016614004999948+003	19
39	1.71948813421308618−012	2.71614655833951097−011	−4.55890304565388789+008	7.33785301084263424+009	1.52815788899010089+003	19
40	3.76412855972899859−013	6.13078213114479307−012	−2.01995543244577623+009	3.35166377259996866+010	1.60815023650731634+003	19
41	8.02316242842476626−014	1.34598008589747636−012	−9.20167723439540432+009	1.57228845834601193+011	1.69014312617345520+003	18
42	1.66636141186689800−014	2.87660870953671294−013	−4.30601506593208139+010	7.56935408376521364+011	1.77413650804571432+003	19
43	3.37475902245911515−015	5.98934076024558085−014	−2.06837799541247847+011	3.73709034646600045+012	1.86013033779366129+003	18
44	6.66893276639715126−016	1.21576474630573219−014	−1.01909154925402881+012	1.89089388861858410+013	1.94812457596012974+003	19
45	1.28672002138409240−016	2.40763165843960013−015	−5.14668050583933162+012	9.79909294075057595+013	2.03811918733308326+003	18
46	2.42541183241778220−017	4.65458914433628942−016	−2.66250659287061529+013	5.19793197493110522+014	2.13011414040982947+003	19
47	4.46896354982962465−018	8.79000087865471408−017	−1.41006091268535226+014	2.82069056907382064+015	2.22410940693840403+003	19
48	8.05344794876994801−019	1.62242307835743040−017	−7.64041821914746009+014	1.56504508790892084+016	2.32010496152369237+003	19
49	1.42014622953016020−019	2.92850106120057910−018	−4.23340506514551280+015	8.87406417182746569+016	2.41810078128806319+003	18
50	2.45172827023116572−020	5.17200895330114428−019	−2.39733797129405040+016	5.13961791825742019+017	2.51809684557806805+003	19
51	4.14573727378409735−021	8.94172503972750864−020	−1.38681900166779820+017	3.03913272239674976+018	2.62009313571020408+003	18

OBLATE RADIAL FUNCTIONS

H = 9.0 X = 2.00000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	−2.29249985599196674−002	−3.77429847582482033−001	4.59492690729227226−002	−2.12850464821125920−001	−3.03400129442213547+001	25
3	4.59413125914386643−002	−2.12987490958286969−001	2.29420617708147901−002	3.77347730623546585−001	−3.03260782451631671+001	25
4	4.70751205693377850−002	1.64032343423318550−001	−2.27548126471089435−002	3.92770039798933094−001	−5.47570239238361657+000	24
5	−2.08394749363045569−002	3.98718574075802681−001	−4.80197244714895136−002	−1.47598063906999573−001	−3.94268498265324982+000	25
6	−5.29071633953218440−002	1.25292980544135586−002	1.46694657101794050−003	−4.20370335617104053−001	1.03429643027314422+001	24
7	−1.37520864256415197−002	−3.95811484851199101−001	5.15832364871759509−002	−1.31251705300300060−001	2.10642752188902299+001	26
8	4.25388040298200202−002	−2.74041884094164528−001	3.33547104271568655−002	3.07522386482200009−001	3.60087218114355550+001	24
9	4.96800089411725935−002	1.47377037088397869−001	−2.33146954110237746−002	3.78143480492772697−001	5.31225937887514519+001	24
10	5.31068142745601484−003	3.93067381341369377−001	−5.56353579783563268−002	6.66162631881892826−002	7.24953715001934651+001	24
11	−4.38616146703537900−002	2.73198756051325121−001	−3.65962745847380469−002	−2.78698484345160617−001	9.40195383917586998+001	24
12	−5.73864100588223716−002	−4.46118950179963509−002	1.20884277605688379−002	−3.77840930105395910−001	1.17649553152155955+002	24
13	−3.06245387069965475−002	−2.97231578726518520−001	5.22287745705958483−002	−2.18719412094272396−001	1.43355622023129345+002	24
14	1.42928607798201427−002	−3.53748317821824800−001	6.13187654301930292−002	3.71382684374719447−002	1.71118045852780665+002	24
15	5.22192827317597618−002	−2.47789858558169056−001	4.05679149193119883−002	2.33053839227943550−001	2.00923214393474121+002	24
16	7.02824260223106975−002	−8.57157990744767243−002	4.42003378795014883−003	3.10793988346643845−001	2.32761434441477130+002	23
17	6.91029673675670881−002	4.53016093898288577−002	−3.29167165213285084−002	3.00002196399270934−001	2.66625630568223562+002	24
18	5.63360878519935125−002	1.11878079650721157−001	−6.47155877292951904−002	2.65939065257097885−001	3.02510531458950150+002	23
19	4.00839752481613697−002	1.22543214474243811−001	−9.24917001432765880−002	2.71629545399857981−001	3.40412140763950843+002	23
20	2.55856710543484323−002	1.01828448486248993−001	−1.24291530322958438−001	3.73873661907649281−001	3.80327382389443445+002	23
21	1.49053824138764926−002	7.16543257093272469−002	−1.74607398104762872−001	6.51499342822955587−001	4.22253856656441001+002	23
22	8.01978026231107466−003	4.46590803072823666−002	−2.69328814199050502−001	1.27113770532460953+000	4.66189669042637353+002	23
23	4.02017210898177523−003	2.52535138198966387−002	−4.60894389096241006−001	2.63247918516302946+000	5.12133307644922485+002	22
24	1.89021316064586610−003	1.31522700161635791−002	−8.66672427843500669−001	5.72608034956341861+000	5.60083554055247771+002	23
25	8.38094202797006525−004	6.37429496454855115−003	−1.76639261708444740+000	1.30805279658763538+001	6.10039417586148371+002	23
26	3.51968321192952722−004	2.89676836438955371−003	−3.85850901813633746+000	3.13807087164474896+001	6.62000086086880184+002	22
27	1.40522546494753818−004	1.24162118465508601−003	−8.96076911801476155+000	7.89648475015807357+001	7.15964888724519746+002	22
28	5.35041082058564928−005	5.04303441682219549−004	−2.19950177346004645+001	2.08022513635382297+002	7.71933267510963955+002	22
29	1.94809211819316834−005	1.94847135617232422−004	−5.68093504275011440+001	5.72513122505334836+002	8.29904755301646416+002	22
30	6.79905333577827174−006	7.18455846531260951−005	−1.53843971266727453+002	1.64275989753313838+003	8.89878958637222575+002	21
31	2.27939587022167301−006	2.53519497837236849−005	−4.35530006582376241+002	4.90510995132830670+003	9.51855544247081590+002	21
32	7.35428530799164587−007	8.58163711120356749−006	−1.28568820100821666+003	1.52141400209955905+004	1.01583422834825821+003	20
33	2.28741587086823030−007	2.79249056860259222−006	−3.94895262913732426+003	4.89408567636135209+004	1.08181476809740673+003	20
34	6.86907785044830945−008	8.75161241433546875−007	−1.25956433116665551+004	1.63035033650100017+005	1.14979695471492488+003	20
35	1.99436866245539780−008	2.64597587526547831−007	−4.16492440493454267+004	5.61678135810134605+005	1.21978060791786068+003	19
36	5.60556915903050004−009	7.72930231277342660−008	−1.42552478252847090+005	1.99871055121311283+006	1.29176557138468893+003	19
37	1.52703884780177400−009	2.18446904610505625−008	−5.04335745896093772+005	7.33783818323235775+006	1.36575170903922844+003	19
38	4.03613966727022784−010	5.98060854079382403−009	−1.84201310914777938+006	2.77638134781835113+007	1.44173890198904054+003	19
39	1.03610339688047792−010	1.58794914635536242−009	−6.93730549102863984+006	1.08156521091201813+008	1.51972704598994832+003	19
40	2.58562333182277795−011	4.09334467220256554−010	−2.69123410668793093+007	4.33399300355997423+008	1.59971604933593877+003	19
41	6.27812248676526463−012	1.02540407149808466−010	−1.07435370236920668+008	1.78488961301097648+009	1.68170583109488515+003	18
42	1.48439441899110407−012	2.49850915538769477−011	−4.40942323517938645+008	7.54869309382282812+009	1.76569631962687162+003	18
43	3.42022315735163747−013	5.92656836589496477−012	−1.85902808608868007+009	3.27597488830955664+010	1.85168745133460183+003	18
44	7.68521212773790984−014	1.36963642530663595−012	−8.04479878416248485+009	1.45783520180704498+011	1.93967916960530128+003	18
45	1.68517953007005927−014	3.08608964126987387−013	−3.57064597883698879+010	6.64789030153108702+011	2.02967142391133170+003	19
46	3.60829095567212892−015	6.78445746781942857−014	−1.62434317090545548+011	3.10449883440305634+012	2.12166416904291097+003	19
47	7.54889025606873371−016	1.45616141069670750−014	−7.56872992160471347+011	1.48378495413828894+013	2.21565736445124221+003	18
48	1.54396771807462327−016	3.05323427899906920−015	−3.61005221440359449+012	7.25396452342623118+013	2.31165097368428027+003	18
49	3.08888371169656280−017	6.25778636162540087−016	−1.76155005244498993+013	3.62552280175045098+014	2.40964496390051540+003	18
50	6.04778264615783980−018	1.25438744702388384−016	−8.78874339335025244+013	1.85154353085150973+015	2.50963930544869712+003	19
51	1.15940274452035409−018	2.46048715060763210−017	−4.48105742643810147+014	9.65724641955063480+015	2.61163397150348277+003	18

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 10.0 X = 2.00000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	−2.85888295353244509−002	3.52574923118797273−001	−3.61242986709267061−002	−2.54067000693497046−001	−4.32902515278834911+001	24
3	−3.61264526779764716−002	−2.54040657357948130−001	2.85862365378936695−002	−3.52592981992085773−001	−4.32871554900663143+001	24
4	−1.78730894548174851−003	−4.25599022075861008−001	4.68375346940212842−002	−3.69220094528998695−002	−1.35081116810601434+001	24
5	4.68255106447665042−002	−4.25152910582028779−002	2.40225533443252681−003	4.24936474611289346−001	−1.29592510494195510+001	24
6	2.24719018194913804−002	3.61220820778699694−001	−4.17595821941725019−002	2.18742921001098105−001	5.48608097389604481+000	24
7	−3.67745564134326970−002	2.83782371240847054−001	−3.03286131496971477−002	−3.09814049579425250−001	1.36127365278177361+001	26
8	−4.17483321096496664−002	−1.87275728976825211−001	2.39563527095526744−002	−3.71597038701979512−001	2.84823041117450335+001	24
9	5.62392346926915366−003	−4.10780243679982054−001	4.83558460160744207−002	2.42488701900814199−002	4.50989397695202586+001	24
10	4.62971015374347532−002	−1.63312191542872294−001	1.70942684786654539−002	3.71692762191876665−001	6.42068299418925874+001	24
11	3.87325984248056245−002	2.33393940157279030−001	−3.18668324991602552−002	3.24338539462499289−001	8.55307554583849025+001	24
12	−5.12244097503203048−003	3.92015362039972017−001	−5.08647538073940304−002	−1.17590659246214999−002	1.09008946769617878+002	23
13	−4.46241714966835459−002	2.24802287964711311−001	−2.72469475150126405−002	−3.10926195225874963−001	1.34595911154512659+002	24
14	−5.11098264174959184−002	−8.30447882917393402−002	1.64742784625381925−002	−3.64546278843187047−001	1.62262825644813053+002	24
15	−2.48049370234872302−002	−3.06140763120086369−001	4.95866483395694753−002	−1.94296225472911180−001	1.91990052492279498+002	24
16	1.49929269292326074−002	−3.46053857275329603−001	5.56587859481169108−002	4.92940727904993235−002	2.23763749994936617+002	23
17	4.80382794520353584−002	−2.41100107770909111−001	3.67556808892413507−002	2.31860955543420192−001	2.57573884295069009+002	24
18	6.41134942384250996−002	−8.66050350899378176−002	4.89247236001654658−003	3.05338018027592892−001	2.93413015616965658+002	23
19	6.36783903990598285−002	4.00104407420278760−002	−2.82151179444036894−002	2.96350152338880865−001	3.31275522415111205+002	24
20	5.29194837301557843−002	1.07615949037442185−001	−5.67349426649579113−002	2.62557650266872374−001	3.71157087798455616+002	23
21	3.86178120541683442−002	1.22130240668162334−001	−8.14426039675820406−002	2.60330522161527418−001	4.13054349733195029+002	23
22	2.54004562451959616−002	1.04954282133934256−001	−1.08420347371146908−001	3.39396276575936029−001	4.56964657053671964+002	23
23	1.53070314173349626−002	7.65125394998375978−002	−1.48710187327917729−001	5.63257870385004375−001	5.02885895783312384+002	23
24	8.54758565076308975−003	4.95207164721110859−002	−2.21357657626395869−001	1.05739919633864347+000	5.50816363304804023+002	22
25	4.45974435010117599−003	2.91494083195524629−002	−3.63140382537533848−001	2.11103416990289162+000	6.00754675770075220+002	22
26	2.18813481785292870−003	1.58393043207523877−002	−6.52724175901375840−001	4.41531438627981384+000	6.52699699019974594+002	24
27	1.01474721067588444−003	8.02655431953003439−003	−1.26974918024909643+000	9.66574643355655756+000	7.06650496398537976+002	23
28	4.46666917926241273−004	3.82158216516471159−003	−2.64388287810577840+000	2.21556241330610045+001	7.62606288882236158+002	22
29	1.87274658082986490−004	1.71934221249872488−003	−5.84454917460490735+000	5.31370340917538686+001	8.20566424302187410+002	22
30	7.50145935803211006−005	7.34286999245175813−004	−1.36356137011322071+001	1.33141374975726081+002	8.80530353359336931+002	22
31	2.87813070396701230−005	2.98797003504719335−004	−3.34254555297512976+001	3.47884619455587461+002	9.42497610769050021+002	22
32	1.06013099073462410−005	1.16212717606874978−004	−8.57879227772535187+001	9.46142735555353064+002	1.00646780031737304+003	21
33	3.75634242458581641−006	4.33170698870884977−005	−2.29857542743065537+002	2.67367657729755337+003	1.07244058292767951+003	21
34	1.28264317038285038−006	1.55095160456183865−005	−6.41366229524051879+002	7.83750337132217475+003	1.14041566706382333+003	20
35	4.22747869015596448−007	5.34506877357195332−006	−1.85970704761549536+003	2.37960701143773048+004	1.21039280096117563+003	19
36	1.34686892610875266−007	1.77625774880971626−006	−5.59324859335021132+003	7.47284954752155985+004	1.28237176629826689+003	19
37	4.15350030541366235−008	5.70105604598279766−007	−1.74199168703332871+004	2.42417407492740713+005	1.35635237301172275+003	18
38	1.24129754806642759−008	1.76982805910958548−007	−5.60978769643676551+004	8.11380022854883347+005	1.43233445502448834+003	18
39	3.59911287164368146−009	5.32113812217649096−008	−1.86544971009319359+005	2.79893540210631576+006	1.51031786670811535+003	19
40	1.01349328450385769−009	1.55130379199531225−008	−6.39776890947675610+005	9.94098035425181493+006	1.59030247993850143+003	18
41	2.77438801995864892−010	4.39021707743343435−009	−2.26046434941708555+006	3.63181744506301347+007	1.67228818163405542+003	18
42	7.38959089002752829−011	1.20729190134920810−009	−8.21951328930371755+006	1.36362734050543533+008	1.75627487168808744+003	17
43	1.91663955474509756−011	3.22911177277172496−010	−3.07300370894985284+007	5.25760178574579733+008	1.84226246122495042+003	17
44	4.84466862421623916−012	8.40768814600318821−011	−1.18023284969973613+008	2.08001228601805521+009	1.93025087112331543+003	18
45	1.19428249352780240−012	2.13277581168212989−011	−4.65270441073743209+008	8.43755529238850312+009	2.02024003076085724+003	17
46	2.87320272509365754−013	5.27494812564551076−012	−1.88124527706008186+009	3.50707197368538898+010	2.11222987694324117+003	17
47	6.75027347880142089−014	1.27292879888445363−012	−7.79610506590944046+009	1.49269705503309583+011	2.20622035298715102+003	17
48	1.54965993561734506−014	2.99911308676543528−013	−3.30911067111460100+010	6.50181543003574149+011	2.30221140793257089+003	17
49	3.47825275612305515−015	6.90330958074716511−014	−1.43771370925704685+011	2.89657419483917628+012	2.40020299586392935+003	18
50	7.63716602019037433−016	1.55329961797055133−014	−6.39002777473501530+011	1.31912443333682579+013	2.50019507532326085+003	17
51	1.64124841052611548−016	3.41845668903278639−015	−2.90374270307733654+012	6.13781635298335768+013	2.60218760880141368+003	19

OBLATE RADIAL FUNCTIONS

H = 12.0 X = 2.00000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	−7.66679682642325500−003	−4.24150538855643760−001	3.74271873706997712−002	−1.03290199735559792−001	−7.52286978492194622+001	24
3	3.74271696028608142−002	−1.03291284112215466−001	7.66689306592572475−003	4.24150252481896009−001	−7.52285673969014027+001	24
4	3.18407550313664338−002	2.31564448801764747−001	−2.21541303805933614−002	3.62320480938263960−001	−3.66661842092831736+001	24
5	−2.21264401123861648−002	3.62518734502088741−001	−3.18608571116649963−002	−2.31293959723752515−001	−3.66217092269358512+001	24
6	−3.92789051117966293−002	1.43473472804853639−002	2.95383378781786940−004	−4.24423862812208611−001	−6.51224524639420730+000	24
7	−1.68945608938319093−003	−4.22698119475638984−001	3.92861825633994393−002	−3.57932805244811619−002	−3.98717151853308588+000	26
8	3.65293476687828004−002	−1.79646342189415471−001	1.53588248119608248−002	3.80721552844890474−001	1.37164365780463355+001	24
9	2.49300760926083504−002	3.14711751860702192−001	−3.11168859457988299−002	2.75723866733511819−001	2.74902446237123994+001	24
10	−2.00795886262803695−002	3.68551079645710702−001	−3.48392615600350394−002	−1.90572589701769464−001	4.58977645667728861+001	24
11	−4.03968002391511124−002	−2.25634367210652115−002	4.15704237618787872−003	−4.10252034961990414−001	6.65498310735474590+001	24
12	−1.48077476842018078−002	−3.71129686158973563−001	3.83164315794426324−002	−1.65204154745712325−001	8.95576117848965092+001	24
13	2.62191434340559336−002	−3.24368390533157629−001	3.23274457217341780−002	2.35731008658036459−001	1.14780769133126801+002	24
14	4.19948930697085909−002	2.16903489648200481−002	−4.70592746759696646−003	3.94443044067174735−001	1.42159811364883728+002	24
15	2.09197098650054324−002	3.27086578632250306−001	−3.75653275958286717−002	2.09350522373808850−001	1.71654125373987273+002	24
16	−1.67589751935222206−002	3.60872893619953661−001	−4.05372726868122484−002	−1.21598352475830644−001	2.03236169420520186+002	24
17	−4.24521968249347783−002	1.46898185238316138−001	−1.45934241012643256−002	−3.42100532739630370−001	2.36886413679515778+002	24
18	−4.12800206470338018−002	−1.33767013711618193−001	2.05608326609860396−002	−3.37119634730178449−001	2.72590605645570861+002	24
19	−1.73214116526253825−002	−3.13589474286335081−001	4.43438778275772204−002	−1.59391935615177808−001	3.10338098331930940+002	24
20	1.47997869751403081−002	−3.33428704964757362−001	4.71859051760935897−002	6.30773546119294461−002	3.50120783929988566+002	24
21	4.11024986329110318−002	−2.33158950299151617−001	3.15217041799606337−002	2.26679630638474250−001	3.91932387217646553+002	23
22	5.45470334585077479−002	−9.11406276378525448−002	6.01052030979336489−003	2.95503954132779082−001	4.35767982922972047+002	24
23	5.52692744492190341−002	2.88738116906608157−002	−2.08932846021875776−002	2.90638841590414589−001	4.81623657672317726+002	23
24	4.74883378091251578−002	9.86735197121681353−002	−4.45746242831647425−002	2.58344093830167528−001	5.29496268131497047+002	23
25	3.61648381166493055−002	1.20111316350744877−001	−6.49224834860976462−002	2.45231063548133381−001	5.79383264783595665+002	23
26	2.50060274873569308−002	1.09596989818926640−001	−8.55563228450872795−002	2.91527761718835230−001	6.31282561472110723+002	24
27	1.59384489753276334−002	8.48954213635087482−002	−1.13332671339561388−001	4.42028066215754722−001	6.85192437457944610+002	23
28	9.46314241374079836−003	5.85551479211515067−002	−1.59524167074499311−001	7.74130320176065834−001	7.41111462959183003+002	23
29	5.27418844794477233−003	3.68578204027721104−002	−2.44231002024337473−001	1.45327462848836480+000	7.99038441900708701+002	23
30	2.77576080877677285−003	2.14915611917480943−002	−4.07177528246457991−001	2.85175360838872823+000	8.58972367442615365+002	23
31	1.38601713006473863−003	1.17260340862760708−002	−7.32682875054496894−001	5.82619227726983786+000	9.20912387110147956+002	23
32	6.59171807605390329−004	6.03031878860822109−003	−1.40847695917674770+000	1.23990460485745381+001	9.84857775215940973+002	23
33	2.99558519836247232−004	2.93928516480769047−003	−2.86868914272993667+000	2.74896912679939315+001	1.05080791087555158+003	22
34	1.30442447490043732−004	1.36382685690112797−003	−6.15265307261174951+000	6.34418728280543890+001	1.11876226035222008+003	21
35	5.45568094949779178−005	6.04566711440342764−004	−1.38329667706940832+001	1.52203098266019079+002	1.18872036278069899+003	21
36	2.19624437480406700−005	2.56797605486195110−004	−3.24874277183067699+001	3.79009417881480039+002	1.26068181854916559+003	20
37	8.52545817375175827−006	1.04785162891141861−004	−7.94744435026516694+001	9.78120353018961499+002	1.33464627978731944+003	20
38	3.19651795453431328−006	4.11643020964499527−005	−2.02031576853102974+002	2.61227308053080874+003	1.41061344253474260+003	19
39	1.15932041262143963−006	1.55985705150541923−005	−5.32606269598723816+002	7.21006041347126045+003	1.48858304025831187+003	19
40	4.07267810935575499−007	5.71119090095930160−006	−1.45350935072058554+003	2.05402888249321236+004	1.56855483845926117+003	18
41	1.38751616785639195−007	2.02349360304136437−006	−4.09989882480492289+003	6.03275681788195941+004	1.65052863016536807+003	18
42	4.58947956343789226−008	6.94704689956379734−007	−1.19361541233522674+004	1.82473073501572331+005	1.73450423214598524+003	17
43	1.47537759299255067−008	2.31396087633643285−007	−3.58215409308340815+004	5.67834450113242534+005	1.82048148172038968+003	17
44	4.61391905683254962−009	7.48610671557592719−008	−1.10691942240792866+005	1.81627584744198116+006	1.90846023405547982+003	17
45	1.40490294703122807−009	2.35475800762278131−008	−3.51824561524224838+005	5.96628375583080612+006	1.99844035986891866+003	17
46	4.16857882194164657−010	7.20837619003934496−009	−1.14910141842223024+006	2.01111978932583558+007	2.09042174346967130+003	16
47	1.20622131610251029−010	2.14935983426010501−009	−3.85326207715086895+006	6.95114554454479808+007	2.18440428108047396+003	17
48	3.40622917477822914−011	6.24760642176462150−010	−1.32550357298538699+007	2.46179619800748322+008	2.28038787939682342+003	16
49	9.39333914168579180−012	1.77165501877665266−010	−4.67395516704549686+007	8.92763522208826695+008	2.37837245434514232+003	16
50	2.53127566545321331−012	4.90469658189702482−011	−1.68822654646826931+008	3.31312302693605530+009	2.47835793000928042+003	16
51	6.66945693460701911−013	1.32647725551800626−011	−6.24209657191423164+008	1.25747382725542471+010	2.58034423769978134+003	16

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 14.0 X = 2.00000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	2.86148462268308484−002	1.98485131245776938−001	−1.56859172485090963−002	3.90436937992621717−001	−1.15189548296244584+002	23
3	−1.56859149890465133−002	3.90436953329739086−001	−2.86148475143922066−002	−1.98485099809226249−001	−1.15189543550979888+002	24
4	−3.16977715900664359−002	1.36792327516660872−001	−9.42999362160720316−003	−4.09989814988130910−001	−6.83141511589437481+001	24
5	−9.43138918582735092−003	−4.09983500021331283−001	3.16973824752092052−002	−1.36810225046398259−001	−6.83115655792313947+001	23
6	1.86830907744567342−002	−3.62345819625946964−001	2.77760677526783911−002	2.25935435460996005−001	−2.77733452225816203+001	24
7	2.78816826464325566−002	2.23901801076738404−001	−1.85311180296989807−002	3.63556378983319030−001	−2.74496570665788272+001	23
8	−3.49246002883328278−003	4.22275696051480236−001	−3.35935101402596293−002	−2.86306522045136084−002	7.54543594508251141−001	24
9	−3.38454239687854493−002	2.22678758145235431−002	−5.59224070440482149−004	−4.21719094632260975−001	7.74331472008800061+000	23
10	−1.13600302637108034−002	−3.90236779881529271−001	3.21065899871771862−002	−1.54624763787198601−001	2.65196969166217908+001	24
11	2.69209492097064908−002	−2.70467804216303438−001	2.12094198525598982−002	3.17568634110726631−001	4.54335204682938013+001	23
12	3.00160231546872583−002	1.90367811351063137−001	−1.70767369136941133−002	3.67632087620949281−001	6.76634930851798033+001	24
13	−3.05172244769531646−003	4.09991466362246369−001	−3.47011214834026147−002	−1.91860843582992335−002	9.22588661604032645+001	23
14	−3.26076922743189447−002	1.68523106338743071−001	−1.32052917411556246−002	−3.69861117429761031−001	1.19160369906307053+002	24
15	−2.78530887436527358−002	−2.35686459619296265−001	2.21286035836279387−002	−3.25647978730442191−001	1.48274499894155480+002	23
16	4.11974219906734758−003	−3.96141686177051799−001	3.57848974243032084−002	2.66581439010522711−002	1.79547467844073955+002	23
17	3.23258969622590971−002	−1.99654289017380865−001	1.70178452473074459−002	3.36820614907212558−001	2.12942043941925500+002	23
18	3.35189893518329348−002	1.46417368381773988−001	−1.59389095834542866−002	3.56573432575057511−001	2.48431804060106030+002	23
19	9.07713785970779991−003	3.61639075309051271−001	−3.66803996581071595−002	1.12441662467251281−001	2.85997376517853994+002	23
20	−2.16589870249986694−002	3.19964870667728321−001	−3.19071432467742208−002	−1.88215142226105171−001	3.25624214108506580+002	23
21	−3.88171839704345134−002	9.13349892365355037−002	−7.16019855971058608−003	−3.51177912280149126−001	3.67301175366009520+002	23
22	−3.43358479419665708−002	−1.62951433634712793−001	2.15644461570376978−002	−3.13717514333489685−001	4.11019585657602766+002	23
23	−1.30776420476192719−002	−3.14214483676503978−001	3.97387263988509443−002	−1.37580680201062711−001	4.56772595411761141+002	23
24	1.36686267822989608−002	−3.24089673753130518−001	4.12048502586143640−002	6.81595761733619179−002	5.04554729705274242+002	23
25	3.55939869221287487−002	−2.29963183632087942−001	2.81648854654729405−002	2.19386144477854668−001	5.54361565068337526+002	23
26	4.74068548442455955−002	−9.79527097030918037−002	7.13223455092826226−003	2.86606074793466194−001	6.06189493147895416+002	23
27	4.89810292991974523−002	1.72618368780232394−002	−1.54346694718539660−002	2.86218638922204960−001	6.60035545031999446+002	24
28	4.33067108190059942−002	8.92388762553245274−002	−3.57121434396140564−002	2.56283668895566212−001	7.15897258775238710+002	23
29	3.41640204123683114−002	1.16792164507356032−001	−5.31240688257764104−002	2.36542397603429395−001	7.73772578220321159+002	23
30	2.46024426060516143−002	1.12474454786089291−001	−6.98784366649770021−002	2.61200699597853746−001	8.33659774835653185+002	23
31	1.64065645316156660−002	9.17370935309957477−002	−9.05040052325703023−002	3.64679630597537097−001	8.95557386708233236+002	23
32	1.02325806602313709−002	6.66962066854511393−002	−1.22272368747336771−001	5.99126585109527551−001	9.59464170478681733+002	24
33	6.01225328364911339−003	4.43451760719470747−002	−1.77370042197242075−001	1.06785396950079643+000	1.02537906314713137+003	22
34	3.34658274165016762−003	2.73779287392495178−002	−2.78308100941128931−001	1.99194684405297267+000	1.09330115148280633+003	22
35	1.77260320410480542−003	1.58546374755511320−002	−4.69993360780309914−001	3.85542569188681837+000	1.16322964734449171+003	22
36	8.96704823584046930−004	8.67468334227075599−003	−8.46700782283752760−001	7.74039899329173269+000	1.23516386763471018+003	23
37	4.34549169250874330−004	4.50880113035338599−003	−1.61395291127389539+000	1.61287193049013205+001	1.30910321791472780+003	21
38	2.02258320606326062−004	2.23582887787690425−003	−3.23470265969894239+000	3.48735846647465400+001	1.38504717893273589+003	21
39	9.06202219506605954−005	1.06143287706415133−003	−6.78456607530072643+000	7.81762905042670245+001	1.46299529548591692+003	20
40	3.91603131590895652−005	4.83808430000929617−004	−1.48388708363437963+001	1.81473101466929935+002	1.54294716716411909+003	20
41	1.63501430216489316−005	2.12246152025304731−004	−3.37471929929492364+001	4.35653830175922227+002	1.62490244061951015+003	19
42	6.60574607347010231−006	8.98054042095010881−005	−7.96189432556140188+001	1.08019636609527534+003	1.70886080308070617+003	19
43	2.58612591886012569−006	3.67160152806813220−005	−1.94480429524578572+002	2.76288475026990691+003	1.79482197688714656+003	18
44	9.82313412071762406−007	1.45277856939707828−005	−4.90988176871289393+002	7.28152867094543069+003	1.88278571486405273+003	18
45	3.62425931715608849−007	5.57131590567295769−006	−1.27922567505165721+003	1.97522950454084489+004	1.97275179639321337+003	17
46	1.30020322789301219−007	2.07343578801682495−006	−3.43496449486993589+003	5.50955098234326180+004	2.06472002406234636+003	17
47	4.53986980317435598−008	7.49728904123629258−007	−9.49453606932478347+003	1.57876469459225100+005	2.15869022079759314+003	16
48	1.54419137165334721−008	2.63669352034860817−007	−2.69853942889939348+004	4.64352604914030927+005	2.25466222740108130+003	16
49	5.12084470637223235−009	9.02772982307132298−008	−7.87873402363137401+004	1.40074665132298061+006	2.35263590042941800+003	15
50	1.65690297645383419−009	3.01195758783091281−008	−2.36081455889513027+005	4.33039294608830940+006	2.45261111036019199+003	16
51	5.23452797972674082−010	9.80006288078950228−009	−7.25406286244422847+005	1.37102850423078783+007	2.55458774000263570+003	15

OBLATE RADIAL FUNCTIONS

H = 16.0 X = 2.00000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	−2.66178514030932220−002	1.67087548244529400−001	−1.01230918155498166−002	−4.06064232766340880−001	−1.63161980906196654+002	24
3	−1.01230918767402166−002	−4.06064232370447438−001	2.66178513808201183−002	−1.67087549168949507−001	−1.63161980750329214+002	24
4	1.11279556144455149−002	−4.04859804233892108−001	2.65820997397783715−002	1.56181095921286551−001	−1.08096597142048761+002	23
5	2.65821207425299254−002	1.56180352556059228−001	−1.11279074709435632−002	4.04860078404435202−001	−1.08096473874693320+002	23
6	9.62540522698352841−003	4.00689552022061642−001	−2.75042768737373121−002	1.53689490040830864−001	−5.86924050483263431+001	23
7	−2.75007791799449232−002	1.53841116926974177−001	−9.63591187978770960−003	−4.00628668799253446−001	−5.86668926481850273+001	23
8	−2.39452431960126414−002	−2.36207141417031356−001	1.70970614745584344−002	−3.53370893467154834−001	−1.75883149802601171+001	24
9	1.65473508748852097−002	−3.58594610203638845−001	2.43414602804003020−002	2.27908598027396208−001	−1.60522304864050475+001	23
10	2.89330219209473417−002	7.70171678195567131−002	−6.32138153217739241−003	4.15205336328432364−001	9.37595580058753185+000	23
11	−4.17655201956810704−004	4.20833886759771103−001	−2.97104851977334487−002	7.61145381625691262−003	2.27203387362920798+001	23
12	−2.84435871722339407−002	1.41052733365685177−001	−9.13528592919825706−003	−3.94164170704667251−001	4.42205802592396690+001	23
13	−1.85481255540731031−002	−3.18592540185052544−001	2.36486522750600105−002	−2.67720626823401872−001	6.75899411642128782+001	23
14	1.47169852081630872−002	−3.67900157439795548−001	2.64434015039255243−002	1.88317674052211429−001	9.37213458690561418+001	24
15	3.04195135944963483−002	1.47425107305998028−002	−2.19069183296558695−003	4.09858746209564221−001	1.22226700059869404+002	24
16	1.20192156425737528−002	3.68108207433842726−001	−2.83179520853833317−002	1.72717545086624393−001	1.53015993714770232+002	23
17	−1.90261751283570809−002	3.27701589008124433−001	−2.45505607660700689−002	−2.34137560274995262−001	1.86015755610273190+002	23
18	−3.11944653290474386−002	−2.85265813098232529−002	3.52215777792398772−003	−3.97491181495453435−001	2.21177591210308522+002	23
19	−1.44262897503404602−002	−3.42898426837807717−001	2.83007856031125417−002	−1.93792387841971189−001	2.58466943632419514+002	23
20	1.48075136949896081−002	−3.52992272596657010−001	2.85758166196803999−002	1.62954942998307850−001	2.97858424887299009+002	23
21	3.21213043706797056−002	−8.73719830384995287−002	5.88831821416917538−003	3.73133227173884603−001	3.39332899072483278+002	23
22	2.55739957027418722−002	2.24820176428349601−001	−2.11569908377323925−002	3.02787318695678962−001	3.82875647561281299+002	23
23	1.59360376032746276−003	3.68415369886015879−001	−3.37623641260466956−002	3.85454237780734267−002	4.28475157541489059+002	23
24	−2.33655323276095775−002	2.82009439840876875−001	−2.53815271938030282−002	−2.28634625518765479−001	4.76122294757563557+002	24
25	−3.52007130327204992−002	5.24449246804704817−002	−2.75944910542614848−003	−3.50995188308304897−001	5.25809722654156529+002	23
26	−2.93877838083822882−002	−1.79656091046337542−001	2.12372331599987417−002	−2.95517408269413470−001	5.77531484971000770+002	23
27	−1.06055786364792675−002	−3.11836812630275017−001	3.58521390192056340−002	−1.24461218714945616−001	6.31282699841819170+002	23
28	1.22186521144191586−002	−3.17262343637998897−001	3.67795097924845305−002	6.80309511716663334−002	6.87059331784607528+002	23
29	3.11019566263983721−002	−2.29705345402474462−001	2.58625705020917528−002	2.10894426630828010−001	7.44858019222472776+002	23
30	4.18168117213605064−002	−1.06095087943266858−001	8.15972067370515059−003	2.78220486895413618−001	8.04675942300721268+002	23
31	4.40398842995659756−002	5.34969613490966028−003	−1.11957569103609275−002	2.82473632716874656−001	8.66510720403910126+002	23
32	3.99383149852690621−002	7.93670032092794560−002	−2.89396183311799777−002	2.55472701409592985−001	9.30360331867312482+002	23
33	3.24731364750108971−002	1.12400963314763495−001	−4.42423883592786373−002	2.31795069591246698−001	9.96223050480153177+002	23
34	2.42000071976577359−002	1.13892286147634017−001	−5.84401171584319422−002	2.41492550244210342−001	1.06409739483536024+003	24
35	1.67597596285487247−002	9.72412856928061095−002	−7.46439111080884027−002	3.12744945684154254−001	1.13398208760733696+003	23
36	1.08895399916697749−002	7.39775654719760870−002	−9.78332720225110848−002	4.83264923738077592−001	1.20587602257339201+003	23
37	6.68444360648783717−003	5.1522653236221[illegible]−002	−1.35972490749320613−001	8.21958689893761690−001	1.27977823772642217+003	23
38	3.89722910464051345−003	3.3372688427119[illegible]−002	−2.02938913714717970−001	1.46960384136536530+000	1.35568789321660589+003	22
39	2.16733661560627165−003	2.0311900550272[illegible]−002	−3.24939338116006471−001	2.72217265967510666+000	1.43360425314922037+003	21
40	1.15367561228281783−003	1.1701312571940[illegible]−002	−5.54282031571469400−001	5.21305350615102235+000	1.51352667048248148+003	21
41	5.89503752890877841−004	6.4150927309649[illegible]−003	−9.99512858206444630−001	1.03273851929841619+001	1.59545457443325377+003	20
42	2.89871120829099987−004	3.36120019457940174−003	−1.89314962563355538+000	2.11705984797658669+001	1.67938745992354810+003	20
43	1.37455477917901844−004	1.68884143253416199−003	−3.74802537015153534+000	4.48885672521844994+001	1.76532487869690754+003	19
44	6.29744544084959759−005	8.16034365562419617−004	−7.72749540239032698+000	9.83589020358108918+001	1.85326643180831018+003	19
45	2.79205597051925449−005	3.80087074488179778−004	−1.65440587568853967+001	2.22481826027994361+002	1.94321176324937164+003	18
46	1.19970815003508138−005	1.70999846043922266−004	−3.66941664081109207+001	5.18901467271096783+002	2.03516055451630985+003	18
47	5.00251742905904973−006	7.44412654527584899−005	−8.41498081938838941+001	1.24652874854916781+003	2.12911251996423778+003	17
48	2.02664781684614090−006	3.14059674229419634−005	−1.99196065448560483+002	3.08097677644913212+003	2.22506740282005222+003	17
49	7.98570556276409047−007	1.28585103355512816−005	−4.86007328367734634+002	7.82732307859629531+003	2.32302497174913165+003	16
50	3.06353112595785621−007	5.11548158165127794−006	−1.22060594531692707+003	2.04209211888492930+004	2.42298501788949499+003	16
51	1.14524727382632451−007	1.97963385951365870−006	−3.15191416916171046+003	5.46638628313905778+004	2.52494735228196412+003	15

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 18.0 X = 2.00000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	8.52129212567102652−003	−4.17588715101764611−001	2.37809049177247315−002	1.38532227877147964−001	−2.19141463599472215+002	24
3	2.37809049182702579−002	1.38532227851186487−001	−8.52129212420719115−003	4.17588715110015267−001	−2.19141463594723636+002	26
4	1.18309464473836848−002	3.80643158351174863−001	−2.26250565902538449−002	2.11228926091155275−001	−1.55942778415532475+002	25
5	−2.26250558150234149−002	2.11228951522905974−001	−1.18309479784499498−002	−3.80643143800888410−001	−1.55942773290723265+002	23
6	−2.44201797187758168−002	−1.28075266911154451−001	8.29983231239683499−003	−4.11467400653789033−001	−9.80824936483270077+001	23
7	8.29933272884307508−003	−4.11469922309004668−001	2.44203571006219543−002	1.28066762339363242−001	−9.80809369916126685+001	26
8	2.44490504078931770−002	−1.57429295976793760−001	8.94550082815368158−003	3.96859062078033618−001	−4.68573233895819733+001	24
9	9.00033267451528696−003	3.96493774982765522−001	−2.44297848427952422−002	1.58311203407957815−001	−4.66892914132815562+001	24
10	−1.67775764521947425−002	3.33140785983791310−001	−2.01609415164866970−002	−2.61937665470187598−001	−7.35632030744914201+000	24
11	−2.12497907419193450−002	−2.38994086926223896−001	1.54178498068520841−002	−3.49478084953888389−001	−2.38419553157480405+000	24
12	7.96083430489466323−003	−4.05221882690719291−001	2.51462694770922036−002	1.15728127941211998−001	2.16192953279133818+001	24
13	2.64578756760402377−002	4.91286025382547340−003	−1.07452779154291842−003	4.19755245742939405−001	4.14516914328368367+001	26
14	7.77760521972222803−003	3.95673828598658351−001	−2.54514367461505637−002	1.33800014403701511−001	6.65177144551926175+001	26
15	−2.10179549314166439−002	2.66880891697308595−001	−1.65693422683867987−002	−3.18255048767262833−001	9.40075537885043049+001	23
16	−2.36850732500787483−002	−1.85130255423807441−001	1.28222636096826129−002	−3.68895721017460981−001	1.24051402572242726+002	24
17	1.50214938887813255−003	−4.09770314839568875−001	2.70803072172340208−002	9.58965656780345593−003	1.56452558932280624+002	23
18	2.49737577215869043−002	−1.77479197522795330−001	1.11050357372636419−002	3.65992109873755982−001	1.91125134876101820+002	23
19	2.20115915402610430−002	2.31565381877837717−001	−1.65902669109840788−002	3.30252340232532668−001	2.28006822374077204+002	24
20	−2.96341742083171725−003	3.98641038075262081−001	−2.76619043693690781−002	−2.83256883006495177−002	2.67053742511488919+002	23
21	−2.51176624320067909−002	1.90590696296652926−001	−1.26075669366473251−002	−3.46697316026994988−001	3.08233583723681287+002	24
22	−2.49319996738527016−002	−1.74138933319346570−001	1.36393982424300456−002	−3.50391503462851550−001	3.51521938517224217+002	24
23	−3.95675498762006995−003	−3.80343845451606885−001	2.84951024841106528−002	−6.90399725587102464−002	3.96899975650300042+002	24
24	2.00899079647019115−002	−2.87798761288607029−001	2.11324142534250133−002	2.50336063001088580−001	4.44352913253674515+002	25
25	2.95526839346697188−002	1.94908145876687925−003	−1.55378185393723657−003	3.75873903306534912−001	4.93868978638169730+002	24
26	1.91678878148754908−002	2.72630568606092834−001	−2.31861372340853137−002	2.49889887684249524−001	5.45438678627586113+002	24
27	−3.05475400663640244−003	3.62871042761806661−001	−3.04848748660845061−002	−1.60513022931837694−002	5.99054275118035813+002	24
28	−2.35452355756722277−002	2.50253898343980267−001	−2.05769044328128886−002	−2.53200293613029578−001	6.54709400339145986+002	24
29	−3.19967649061537978−002	2.55097869735237560−002	−1.56966872838513714−004	−3.47132185150596870−001	7.12398769607129342+002	24
30	−2.57970776705380277−002	−1.88716780472092944−001	2.03287147285135550−002	−2.81998667031911639−001	7.72117963575181278+002	24
31	−9.15868340477577869−003	−3.08053696184734106−001	3.25815659149023902−002	−1.17291891865016509−001	8.33863260945720814+002	24
32	1.06966303594920422−002	−3.12249877239906078−001	3.33727931168493080−002	6.45493519002857747−002	8.97631508418130433+002	26
33	2.73519964142411493−002	−2.31317713036932753−001	2.41941080335075550−002	2.01615461201231557−001	9.63420018506501546+002	23
34	3.72795401918801020−002	−1.15035307533946381−001	9.06925234562252967−003	2.70063064796661397−001	1.03122648848402661+003	24
35	4.00099957597732634−002	−6.75982871496279340−003	−7.80319607921627704−003	2.79026757389967491−001	1.10104893552593277+003	23
36	3.71301054667865476−002	6.91018662695428429−002	−2.35786347551990492−002	2.55366456039844891−001	1.17288564440111838+003	24
37	3.10034741660141948−002	1.07090146073144990−001	−3.72895091790112638−002	2.29579823474666239−001	1.24673512497664331+003	23
38	2.38009741750930473−002	1.14055419240103428−001	−4.97032917150639349−002	2.28653722192237077−001	1.32259607746181655+003	23
39	1.70270280654472504−002	1.01552085561311333−001	−6.30082989691451338−002	2.76765089304503742−001	1.40046736380500945+003	23
40	1.14566324679834512−002	8.04300402731060121−002	−8.07622126873289261−002	4.02858615306219763−001	1.48034798401745137+003	22
41	7.29929088555539821−003	5.83301114742425153−002	−1.08470642806981669−001	6.55407011380272788−001	1.56223705646920543+003	22
42	4.42642743588802741−003	3.93798361263396147−002	−1.55257277783228113−001	1.12892508167446856+000	1.64613380140775919+003	21
43	2.56539326756621337−003	2.50127822962453659−002	−2.37519000452295649−001	2.01532456132190033+000	1.73203752710651539+003	21
44	1.42571530706117441−003	1.50579431115387091−002	−3.86544076702704680−001	3.71080563406795378+000	1.81994761817132789+003	20
45	7.61901662176154564−004	8.63890179754430171−003	−6.64546522612888356−001	7.04836231360946127+000	1.90986352562707023+003	20
46	3.92444717858822774−004	4.74324630769344822−003	−1.19922235623097126+000	1.38182624228005118+001	2.00178475847960942+003	19
47	1.95234132561887126−004	2.50083175277402591−003	−2.26011553317087621+000	2.79610043038409815+001	2.09571087650633002+003	19
48	9.39728205265272603−005	1.26966767015789046−003	−4.43151674173122779+000	5.83632325138450057+001	2.19164148407411935+003	18
49	4.38327319343582486−005	6.22162185217339767−004	−9.01318970935486365+000	1.25555607941620879+002	2.28957622482019505+003	18
50	1.98403958178835329−005	2.94841464886723131−004	−1.89705886589932070+001	2.78109116964114392+002	2.38951477706037906+003	17
51	8.72571812314375604−006	1.35360824513207516−004	−4.12390971018264893+001	6.33638727173969901+002	2.49145684981296268+003	17

OBLATE RADIAL FUNCTIONS

H = 20.0 X = 2.00000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	1.12422365275240368−002	3.78098865953100313−001	−1.97180841149255086−002	2.26344175480467617−001	−2.83125583983819548+002	24
3	−1.97180841149078964−002	2.26344175481068458−001	−1.12422365275557571−002	−3.78098865952731345−001	−2.83125583983683020+002	25
4	−2.23889277381308621−002	−8.37693088054301226−002	4.89431174802349170−003	−4.28337033374622728−001	−2.11827440117763781+002	24
5	4.89431169736305551−003	−4.28337033553515757−001	2.23889277498278826−002	8.37693078304819083−002	−2.11827439925239330+002	24
6	1.95135308178506509−002	−2.40515528012651267−001	1.24213321864358857−002	3.59364832331826732−001	−1.45658038523410121+002	24
7	1.24213508664702449−002	3.59364599473297400−001	−1.95135192412982848−002	2.40515867046377205−001	−1.45657958395691428+002	24
8	−6.64516991640221864−003	4.13703491821863818−001	−2.23687013721166708−002	−1.12260505633346646−001	−8.55094867620428999+001	24
9	−2.23697754523470905−002	−1.12196008673961982−001	6.64171133678023159−003	−4.13720133980049179−001	−8.54964725458043997+001	24
10	−7.68574691312637954−003	−3.98439887526896512−001	2.22268329303465961−002	−1.48839559783039182−001	−3.35054081775733688+001	24
11	2.21532153172736109−002	−1.52723100374633595−001	7.90418249109333008−003	3.96910724610582849−001	−3.26877713381307514+001	23
12	1.64402674039057043−002	2.96559088918278388−001	−1.70016778439092246−002	3.01576476021936974−001	2.78198828989161360+000	24
13	−1.46674917641814488−002	3.38099712593389345−001	−1.86056172010601951−002	−2.52902556983705294−001	1.39653132821883531+001	24
14	−2.22110284023970257−002	−1.40312565051102202−001	8.51150344027162707−003	−3.96457514722906225−001	3.89821067359780340+001	24
15	1.43770132506652883−003	−4.18607245154855623−001	2.38398505039110428−002	1.42351233162108428−002	6.42719169238528014+001	24
16	2.29907145856234944−002	−1.30091605920007068−001	6.87548676829860779−003	3.96053669881324280−001	9.32118599231998912+001	25
17	1.50456861958330297−002	3.16945033391405771−001	−1.88565733863050445−002	2.67419024035233529−001	1.24695554166242103+002	24
18	−1.12696707480022921−002	3.70359774948154241−001	−2.14880040798481769−002	−1.81168349152022075−001	1.58646160082752914+002	24
19	−2.44006308721592761−002	−3.94285166598414461−003	9.39608622503179265−004	−4.09673639790313822−001	1.94935662125926802+002	24
20	−1.03779830230823439−002	−3.63585075192536681−001	2.22912294228211303−002	−1.82621388949486967−001	2.33488239084830898+002	24
21	1.46253282582944118−002	−3.33127647281791891−001	1.99973745298143228−002	2.28256187629626330−001	2.74249157242637585+002	23
22	2.48577448016442837−002	2.66718632361736802−002	−2.45688936346234536−003	3.99652915507209638−001	3.17178267555097611+002	24
23	1.12756779196469349−002	3.48971210449621410−001	−2.25391727835211403−002	1.89299269313316810−001	3.62245202021870738+002	23
24	−1.25313004671057345−002	3.48723604513331720−001	−2.21478487025960374−002	−1.81666888779068963−001	4.09426485130933007+002	23
25	−2.55687009852854103−002	5.56241951624447150−002	−2.74977453319616886−003	−3.85121090444902728−001	4.58703641855200242+002	23
26	−1.79124089196982545−002	−2.68634696521335969−001	1.88619481081177287−002	−2.75397145983517815−001	5.10061914652579049+002	23
27	3.35709265594346717−003	−3.78534155588126709−001	2.61238304466508434−002	3.31351894481345545−002	5.63489365515387323+002	24
28	2.22280930306619179−002	−2.20951811878806199−001	1.47926570053229541−002	3.02839097482926243−001	6.18976231236431378+002	23
29	2.63498081006729442−002	6.97701393521834072−002	−6.34442368013103243−003	3.62710371142470740−001	6.76514450448788488+002	23
30	1.42659285625267660−002	3.01103375201713805−001	−2.35722473824148138−002	2.03443942631875970−001	7.36097310279150541+002	25
31	−5.90074211415471933−003	3.52500823949172471−001	−2.74322819453065376−002	−5.59417790317589840−002	7.97719178167803047+002	23
32	−2.29996776444926893−002	2.24895632321695842−001	−1.70573498269170745−002	−2.67998387639100924−001	8.61375295503614046+002	24
33	−2.92615728429101252−002	7.17176150222784632−003	1.34844900564247343−003	−3.42075622810947343−001	9.27061616882379982+002	24
34	−2.31392195180898149−002	−1.92844084325760493−001	1.91790635157898198−002	−2.72326862759807820−001	9.94774683538040909+002	23
35	−8.33097572886805422−003	−3.03558809761052351−001	2.98051399794736016−002	−1.14318804191119627−001	1.06451152270739279+003	24
36	9.20473375256547741−003	−3.08508531797273720−001	3.06601220736884536−002	5.87839658230617407−002	1.13626956690747543+003	24
37	2.41585295902238979−002	−2.34126566813458622−001	2.29260067063861615−002	1.91750608901547280−001	1.21004658866495877+003	23
38	3.34915134870426246−002	−1.24444868248397184−001	9.86171446862880523−003	2.61939796947134933−001	1.28584064735148848+003	24
39	3.66265620374425485−002	−1.89957481557032583−002	−5.02500427997131684−003	2.75632031897050572−001	1.36365004558672792+003	23
40	3.47246611512290228−002	5.84833274730304096−002	−1.92184897066056317−002	2.55611962181447113−001	1.44347329326382632+003	23
41	2.96966478646568240−002	1.00970572407640163−001	−3.16796773972931564−002	2.29025338836320740−001	1.52530907769250002+003	23
42	2.34046744322422564−002	1.13110272000922651−001	−4.27901766503264034−002	2.20468415189986665−001	1.60915623868559913+003	23
43	1.72267695612411064−002	1.04775760544242600−001	−5.41064761317968151−002	2.51408297854426912−001	1.69501374766575913+003	22
44	1.19495944454065397−002	8.60797766512800278−002	−6.82483374545684771−002	3.45216599101846083−001	1.78288069006057176+003	21
45	7.86354680821114945−003	6.47239744130854776−002	−8.91884543380462948−002	5.37590589410291610−001	1.87275625040272237+003	21
46	4.93386772158319480−003	4.53231492449044148−002	−1.23237445855510346−001	8.94732306992888333−001	1.96463969966663410+003	20
47	2.96340022853514513−003	2.98842015123238196−002	−1.81235520629105366−001	1.54684511939678098+000	2.05853038446330713+003	20
48	1.70936230403426087−003	1.86946391581411672−002	−2.83033393970109571−001	2.75470730746289748+000	2.15442771778612927+003	19
49	9.49488345701761143−004	1.11571523183656169−002	−4.66628749874644822−001	5.04877388250302708+000	2.25233117105685010+003	19
50	5.09036410222335934−004	6.37963777424990812−003	−8.07161987699722203−001	9.52898220230175160+000	2.35224026726594899+003	18
51	2.63915686905442044−004	3.50680017921535683−003	−1.45734986059992719+000	1.85262395918909639+001	2.45415457503778613+003	18

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 22.0 X = 2.00000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	−2.02312902305211924−002	−7.54809488829631434−002	3.91413828594535555−003	−4.34745689415193290−001	−3.55112922990008684+002	22
3	3.91413828594455063−003	−4.34745689415196124−001	2.02312902305213567−002	7.54809488829457677−002	−3.55112922990004935+002	23
4	1.64809362307728462−002	−2.73436965754374691−001	1.26708261522322153−002	3.41378472403548785−001	−2.75737554221058966+002	22
5	1.26708261534206173−002	3.41378472383716468−001	−1.64809362298789832−002	2.73436965778607343−001	−2.75737554214372180+002	22
6	−2.45350861839947445−003	4.31646189661251814−001	−2.08230894572165455−002	−4.18591844169602007−002	−2.01339767966675926+002	22
7	−2.08230895621724315−002	−4.18591674771070607−002	2.45350780385587318−003	−4.31646191118979032−001	−2.01339764325830458+002	22
8	−1.23515033255538864−002	−3.43647419193011379−001	1.71550500142705157−002	−2.58723196938028749−001	−1.32615754045018737+002	22
9	1.71549423282872702−002	−2.58726217638917265−001	1.23516564651818480−002	3.43645091850675069−001	−1.32614935276824586+002	22
10	2.04927020268090489−002	1.07338980414660908−001	−5.80773433839048534−003	4.13196502707629073−001	−7.07656073239279502+001	22
11	−5.78967465264475591−003	4.13287157433180726−001	−2.04980355955878470−002	−1.06972198577949210−001	−7.06842774868143538+001	22
12	−2.06060552899445809−002	1.26149479144624807−001	−5.91102842982999678−003	−4.04989495362040814−001	−1.97637634294175946+001	22
13	−6.58465352662575794−003	−4.00486618599991804−001	2.04094152298245655−002	−1.39295316633537774−001	−1.67657041439947846+001	22
14	1.70532814247750244−002	−2.65474456815593051−001	1.31468688056913269−002	3.28426599924372579−001	1.47635983598552581+001	22
15	1.64026944731678589−002	2.66323575184511402−001	−1.40318438114115315−002	3.26403585056188050−001	3.36025666277675758+001	22
16	−8.47969261433649682−003	3.90016179601486880−001	−1.99368120981212303−002	−1.55103476362280421−001	6.14353842704671839+001	22
17	−2.16940838182778479−002	−2.05357960324281943−002	1.59062572507033091−003	−4.17544451350524395−001	9.13313541478388749+001	22
18	−6.24233010026703228−003	−3.95801810026813496−001	2.09395472049195076−002	−1.28637606977192065−001	1.24224167755404031+002	22
19	1.70494832270401461−002	−2.68948781595575679−001	1.38374384552728852−002	3.14927250665521916−001	1.59652462130857678+002	22
20	1.96945156919648811−002	1.76643830542101589−001	−9.97472158388604590−003	3.72130809224752674−001	1.97502234762415273+002	22
21	−4.71746618577199471−004	4.09534212274477849−001	−2.22005415171771166−002	2.06083383875234847−003	2.37675439729810337+002	22
22	−2.00898139066086799−002	1.88023975367869669−001	−9.78508583021167304−003	−3.60933077205438404−001	2.80105610843162434+002	23
23	−1.83590509253407751−002	−2.24391334244646355−001	1.30055757681485588−002	−3.36214035070542244−001	3.24743733410686937+002	22
24	2.00281817897838938−003	−4.00551937563802680−001	2.25761666235731625−002	2.39571457745018242−002	3.71552773982102001+002	22
25	2.04082163917794704−002	−1.89418957059632196−001	1.02665816074642786−002	3.50164060056426050−001	4.20504075652124095+002	22
26	1.99581007905131366−002	1.86585172492128675−001	−1.15135442838003131−002	3.47861378073637185−001	4.71575047926701646+002	22
27	1.98176375467673452−003	3.88440583462071426−001	−2.31695532932869967−002	4.58754434753305623−002	5.24747606732999707+002	22
28	−1.76363319519123629−002	2.65423755989624167−001	−1.55104153144192322−002	−2.82035766550515402−001	5.80007086729497536+002	22
29	−2.33325243643206964−002	−5.73245742815280614−002	4.38033296104673132−003	−3.78862065273283350−001	6.37341462028464191+002	22
30	−1.16540734522323323−002	−3.24098005746789017−001	2.10010259921963786−002	−1.96027462634892269−001	6.96740775162218073+002	22
31	8.18266253974977484−003	−3.56953703717322723−001	2.29053695550955878−002	1.11791557914068555−001	7.58196710581200125+002	22
32	2.26406191565944416−002	−1.60395411874023395−001	9.77227759028883047−003	3.32300126150750225−001	8.21702270835066400+002	22
33	2.32232386735026729−002	1.20273072548058520−001	−9.34348230077856350−003	3.43067557385371201−001	8.87251527183380972+002	22
34	1.05933736367438678−002	3.17521348330263223−001	−2.31378326741929850−002	1.64645685365953205−001	9.54839425105034102+002	22
35	−7.59780333460763763−003	3.40910670255220187−001	−2.47740794078690723−002	−8.49141582906889165−002	1.02446163092467482+003	22
36	−2.21241439754812115−002	2.05226413964867314−001	−1.44747478887047959−002	−2.76634815586420964−001	1.09611440965402774+003	22
37	−2.69504258823581884−002	−4.88423715285165345−003	2.16633919160636324−003	−3.36927075519343554−001	1.16979452681872592+003	22
38	−2.11336254721983742−002	−1.93627320106006177−001	1.79484909325166242−002	−2.65718293299289598−001	1.24549916891678618+003	22
39	−7.88914843693903334−003	−2.98651442357089528−001	2.74183940141632769−002	−1.14380681093427863−001	1.32322587849267679+003	22
40	7.78439794205157985−003	−3.05626830236556980−001	2.84361852423338399−002	5.13909918600084834−002	1.40297250077939983+003	22
41	2.13930194808368639−002	−2.37683046469924127−001	2.19202519257309405−002	1.81406689097322658−001	1.48473713957150839+003	22
42	3.02569101343609479−002	−1.34105121991985692−001	1.05458278989834381−002	2.53715912164193909−001	1.56851812051956694+003	22
43	3.37191839054622999−002	−3.13022813091302320−002	−2.70920117606548851−003	2.72121451514694290−001	1.65431396043267977+003	22
44	3.26186861105949793−002	4.75497945216016767−002	−1.55958812138899206−002	2.55967641231672590−001	1.74212334147614286+003	22
45	2.85125948131156209−002	9.41287052488146183−002	−2.70438166699869937−002	2.29558540205751569−001	1.83194508938126480+003	22
46	2.30094752059009532−002	1.11167298282009254−001	−3.71648820854997005−002	2.15536839241895041−001	1.92377815496198635+003	22
47	1.73712189575262520−002	1.06993818919918604−001	−4.70655765743552361−002	2.33442645761713553−001	2.01762159837114507+003	21
48	1.23797141972758646−002	9.09485968100474432−002	−5.87159714915499926−002	3.02977420451210589−001	2.11347457563760579+003	20
49	8.38252858396405860−003	7.06709100579048726−002	−7.50789025492961915−002	4.51536154477585943−001	2.21133632711104230+003	20
50	5.41966770139535541−003	5.11401063261657771−002	−1.00701082996877248−001	7.27174656533661035−001	2.31120616750914805+003	19
51	3.35890628323192308−003	3.48623333074158404−002	−1.43077920785756788−001	1.22149252809644542+000	2.41308347731641019+003	19

OBLATE RADIAL FUNCTIONS

H = 24.0 X = 2.00000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	1.47908152498291830−002	−2.80284664830786204−001	1.17145071067868122−002	3.41423819441463828−001	−4.35102588928034513+002	23
3	1.17145071067868265−002	3.41423819441463554−001	−1.47908152498291718−002	2.80284664830786531−001	−4.35102588928034413+002	24
4	−8.92815621054949460−004	4.37991569047981367−001	−1.90004797639433153−002	−1.26379832445691625−002	−3.47665453233606837+002	23
5	−1.90004797639456131−002	−1.26379832436325547−002	8.92815621014376989−004	−4.37991569047999396−001	−3.47665453233388706+002	24
6	−1.32620630496050517−002	−3.08264259588216011−001	1.38454639401783179−002	−3.06533879981816653−001	−2.65091117839041123+002	23
7	1.38454639207656784−002	−3.06533880433621317−001	1.32620630702764743−002	3.08264259130005985−001	−2.65091117688817543+002	24
8	1.92988780019615173−002	1.13156172072132707−002	−8.79317224172439421−004	4.31288457047860963−001	−1.87951459571433092+002	23
9	−8.79308746352370057−004	4.31288460108064991−001	−1.92988784743231274−002	−1.13154274549224524−002	−1.87951415156566172+002	23
10	−1.54074268086184056−002	2.68313617630738992−001	−1.18846842917824541−002	−3.33898110340416905−001	−1.17118004623077558+002	23
11	−1.18856455982118718−002	−3.33881273144031065−001	1.54067010291433049−002	−2.68334130646914869−001	−1.17111778712758791+002	23
12	5.57231669087776850−003	−4.10354714018114248−001	1.87771947474428390−002	1.12704102714065600−001	−5.43592809764411137+001	23
13	1.88002092737529860−002	1.11049940810325024−001	−5.49713999850164891−003	4.10786717818911717−001	−5.39572991578885675+001	23
14	3.67415785077882232−003	4.14212683411809750−001	−1.93406838129784863−002	8.76872484049288576−002	−6.74288910700460606+000	23
15	−1.89980173875703756−002	1.20726252323873903−001	−5.22621000211795439−003	−4.05431389433270415−001	1.31253416277216785+000	23
16	−1.06332463124067411−002	−3.50555640666208169−001	1.66646240399336881−002	−2.34308065792276961−001	3.11611279751431629+001	23
17	1.34029277705486186−002	−3.15843179681657030−001	1.46075409464619897−002	2.77524524279408365−001	5.70658483824468937+001	23
18	1.81239349628586670−002	1.64418651360496364−001	−8.20498282093958770−003	3.85362292338351165−001	8.85635541318365802+001	23
19	−1.60913630218873246−003	4.16642696778751974−001	−1.99069732097729389−002	−2.43847152399683179−002	1.22675093430107332+002	24
20	−1.92056567896695212−002	1.28760716877650571−001	−5.78158641566716569−003	−3.95138380575659953−001	1.59524948298918153+002	23
21	−1.28557245518328072−002	−3.12374724978077095−001	1.55161374244357726−002	−2.71200908093204316−001	1.98875163785883544+002	23
22	8.87817573360342212−003	−3.74101319942180161−001	1.82010226901817569−002	1.71691433733322886−001	2.40617796816841549+002	23
23	2.03601087060455835−002	−8.32986112068600301−003	−7.67578134719367594−005	4.09328497975300715−001	2.84671500596579978+002	23
24	9.29156153284082684−003	3.58066938126035301−001	−1.82491947608986266−002	1.93605782588266056−001	3.30977462375901238+002	23
25	−1.16464124742516124−002	3.39433611393030685−001	−1.69990700873152151−002	−2.20091602365938206−001	3.79491225881403260+002	23
26	−2.06820589918905046−002	−2.04432148714650391−002	1.59696871554244799−003	−4.01347185113107680−001	4.30178400253214758+002	23
27	−9.48047174378209610−003	−3.50552754429366278−001	1.86171831972421951−002	−1.90605334065694742−001	4.83011851880371242+002	23
28	1.05906805867309555−002	−3.47669882990854813−001	1.81943906303046330−002	1.89571544091401425−001	5.37969828794363350+002	24
29	2.11729073595676337−002	−3.89224699571008122−002	1.49029381238499822−003	3.90845115253104913−001	5.95034658808493941+002	24
30	1.36742815892018586−002	2.91988796476810886−001	−1.64773611796912379−002	2.57573200492146935−001	6.54191819891996405+002	23
31	−4.93507066717724906−003	3.78123686930739905−001	−2.10440424591695486−002	−7.62060841897163431−002	7.15429260372228334+002	23
32	−1.97262885808185019−002	1.74997090394594262−001	−9.36121451216033846−003	−3.39402316037080986−001	7.78736891780180800+002	23
33	−2.00812787555805385−002	−1.44837785275366323−001	9.16520599952324326−003	−3.48875451610519264−001	8.44106203964779227+002	24
34	−6.55699715943595786−003	−3.52657070643677324−001	2.13506170911726170−002	−1.22599908765969144−001	9.11529968638335523+002	24
35	1.12307973915245818−002	−3.26896985534267706−001	1.96353658939857832−002	1.70476890106830009−001	9.81002008054022946+002	23
36	2.21544497976073244−002	−1.08497050543205820−001	5.92881147282544282−003	3.47111972789122439−001	1.05251701242429592+003	23
37	2.04325474066446251−002	1.57554452656027992−001	−1.11573746439063538−002	3.21812016258731515−001	1.12607039432997234+003	23
38	7.86812790312128264−003	3.26463124631488620−001	−2.23184359808387839−002	1.33092267822113427−001	1.20165817155532666+003	24
39	−8.55470756729526079−003	3.29792469444322295−001	−2.25241416291866223−002	−1.05794503927895569−001	1.27927687201345015+003	23
40	−2.11168127179142690−002	1.90359869726937197−001	−1.25738452843549804−002	−2.81281927456689313−001	1.35892345601243085+003	23
41	−2.49956347034136497−002	−1.22575661825316170−002	2.54342137726363272−003	−3.32144283431123852−001	1.44059525225924094+003	23
42	−1.95922482399338636−002	−1.92036248829997830−001	1.67134932143766337−002	−2.61518572491102622−001	1.52428990483811390+003	23
43	−7.69289625922977490−003	−2.93450723420197675−001	2.53388833232098818−002	−1.16681632148680775−001	1.61000532902330705+003	23
44	6.45028571531265507−003	−3.03293542845058855−001	2.65659655369740869−002	4.27961703881431398−002	1.69773967425372164+003	23
45	1.89641737511627851−002	−2.41674139897339455−001	2.10911188592251961−002	1.70645732633571997−001	1.78749129295139192+003	23
46	2.74437123570567353−002	−1.43860853734257787−001	1.11321298214519130−002	2.45296829589006956−001	1.87925871413726652+003	24
47	3.11731536333390948−002	−4.36314299932859940−002	−7.51927983855846107−004	2.68376473067951126−001	1.97304062100732188+003	23
48	3.07415049312649912−002	3.63392989969170646−002	−1.25341817452090583−002	2.56261037734703825−001	2.06883583179526474+003	22
49	2.74229005474342842−002	8.66359666905310100−002	−2.31379757142833047−002	2.30783480730541989−001	2.16664328337613405+003	21
50	2.26135572170428081−002	1.08313911120211272−001	−3.24825234032786369−002	2.12926437634569234−001	2.26646201716628988+003	20
51	1.74688393769336253−002	1.08271162755661202−001	−4.13436879182117201−002	2.20793384528698081−001	2.36829116695574542+003	20

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 26.0 X = 2.00000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	−7.02748983875711497−004	4.42017006760384275−001	−1.73856700679352524−002	−1.07376154622514256−002	−5.23093992571517991+002	24
3	−1.73856700679352524−002	−1.07376154622514155−002	7.02748983875711100−004	−4.42017006760384275−001	−5.23093992571517989+002	24
4	−1.28149581094206912−002	−2.94092900681548924−001	1.19628781031759098−002	−3.25721717917780734−001	−4.27606293979691762+002	23
5	1.19628781031751340−002	−3.25721717917798522−001	1.28149581094214284−002	2.94092900681528870−001	−4.27606293979685002+002	23
6	1.76166001180299355−002	−3.80086900442561038−002	1.23948305480529627−003	4.33976846487984680−001	−3.36891085775943616+002	24
7	1.23948305572324255−003	4.33976846485799846−001	−1.76166001179736951−002	3.80086900668513683−002	−3.36891085770205822+002	23
8	−1.17700349266100776−002	3.29290315651739447−001	−1.33349444441423053−002	−2.80478320385788617−001	−2.51433061176805418+002	24
9	−1.33349446774027521−002	−2.80478313872398949−001	1.17700346672221678−002	−3.29290321096464047−001	−2.51433059026004808+002	24
10	−6.25075284037722411−005	−4.29517696983036500−001	1.79078235344905932−002	−9.28799793397304391−003	−1.71923659369882540+002	24
11	1.79078239275556802−002	−9.28957268083600966−003	6.25731528167325630−005	4.29517648016467332−001	−1.71923259302121940+002	24
12	1.11685626645988362−002	3.30057551512612286−001	−1.41446155616319813−002	2.70739449986052269−001	−9.94861533697383131+001	24
13	−1.41407921503185933−002	2.70852980608149150−001	−1.11735007516789205−002	−3.29962541015280948−001	−9.94484802389692937+001	24
14	−1.71591124476670820−002	−1.28973623618574599−001	5.83457781131734020−003	−4.04438229008813573−001	−3.71210916948662483+001	24
15	5.58156038201877140−003	−4.06239642241521776−001	1.72458498159771525−002	1.22969167390046773−001	−3.55226862387832984+001	24
16	1.81482338279902759−002	−3.88440676446109201−002	1.32012713090704491−003	4.21034281195472984−001	6.19437459526073208+000	24
17	3.97633433519668478−003	4.10150237580342608−001	−1.77839739192490366−002	1.00144135436585826−001	2.21086187651388953+001	24
18	−1.59727335152464490−002	2.11812000673548388−001	−8.88183673890328213−003	−3.63809242634516154−001	5.31152246858471422+001	24
19	−1.31589478138583197−002	−2.86121555873942484−001	1.27617182120225145−002	−3.07084204529127470−001	8.46793045170295981+001	23
20	7.83456182722345093−003	−3.81991894403645850−001	1.66413265731464800−002	1.70456990281359316−001	1.20135391654894641+002	24
21	1.83969404119682507−002	2.63331874054349573−002	−1.54611775464984548−003	4.15916631373433873−001	1.58308022598621204+002	24
22	5.43727985001083422−003	3.94175601177880414−001	−1.77210116754755649−002	1.30049819239203707−001	1.99101649055948690+002	23
23	−1.41984080806616998−002	2.73986703895902665−001	−1.20418048058508327−002	−3.09401818826301223−001	2.42361026461283413+002	23
24	−1.69366142772614324−002	−1.66401941140191427−001	7.93748713037227744−003	−3.76196465346242572−001	2.87991718104578867+002	23
25	−2.60968391981429154−004	−4.09039935137704056−001	1.87963193048330919−002	−1.48005013245613978−002	3.35923575719240953+002	24
26	1.66861059887253031−002	−1.99309720226709991−001	8.87363858523957187−003	3.55008248928375799−001	3.86103945327489922+002	26
27	1.58508692471968943−002	2.15440804659000015−001	−1.04888390493779183−002	3.42730968431380123−001	4.38492117628645458+002	24
28	−1.23391808703589138−003	4.02040517852013162−001	−1.90831022710895322−002	−1.63117578284942221−002	4.93055975105300498+002	24
29	−1.70901061636679788−002	1.92613208952587554−001	−8.85366057096018364−003	−3.50318228653595034−001	5.49769751435326596+002	23
30	−1.67452821251571782−002	−1.91083327082869364−001	9.75743387247539898−003	−3.48027863645761335−001	6.08612487446534139+002	24
31	−1.17849640660705745−003	−3.92649543077308794−001	1.94882911907388982−002	−3.41444069586701706−002	6.69566933201726787+002	24
32	1.54069183912964541−002	−2.51530120011504520−001	1.22408743858439836−002	2.99434252315942894−001	7.32618747545934139+002	23
33	1.91493933453827750−002	9.10020552009491584−002	−5.20107234990506737−003	3.76983191530614061−001	7.97755902115597091+002	23
34	7.65836393527924423−003	3.50647028322321262−001	−1.84987607358636286−002	1.57445144004834812−001	8.64968229568632236+002	24
35	−9.63280476464932108−003	3.40155132642442984−001	−1.77708130920054905−002	−1.71027488678940134−001	9.34247075808805956+002	23
36	−1.99770464975564825−002	9.00938511571640439−002	−4.23822657135019958−003	−3.65943461127365299−001	1.00558502863728653+003	23
37	−1.66675142265229808−002	−2.09646204631785596−001	1.21861168650924875−002	−3.08236397612687260−001	1.07897570351085353+003	23
38	−2.58897988610718788−003	−3.63705342479361478−001	2.07314569371676760−002	−5.87745187575738627−002	1.15441357259761282+003	25
39	1.30627580978751194−002	−2.94568092416998051−001	1.66468058286802820−002	2.13484000363660197−001	1.23189382708805854+003	25
40	2.12370405687116709−002	−6.52814107422362008−002	3.03904191634630592−003	3.52870011452750602−001	1.31141226534565871+003	25
41	1.80430194212661608−002	1.84940336702996471−001	−1.21921515394262224−002	3.01362369264172569−001	1.39296520134485822+003	24
42	5.85767831699962630−003	3.30788887497038678−001	−2.13439696456484247−002	1.07885698779168274−001	1.47654938918803973+003	24
43	−9.02894269209072556−003	3.19885103961554687−001	−2.06423755763486093−002	−1.20625334792302865−001	1.56216196047560154+003	23
44	−2.00772434701451214−002	1.79467890897098816−001	−1.11718475279148370−002	−2.83271943556688880−001	1.64980037203124937+003	23
45	−2.33317704063420814−002	−1.60682626009725820−002	2.63278457373788492−003	−3.27879251560166451−001	1.73946236203023970+003	24
46	−1.83865992920118213−002	−1.88683919973887425−001	1.55099896678644536−002	−2.59200843360472733−001	1.83114591299172320+003	24
47	−7.65460621459230793−003	−2.87991829965202201−001	2.35031588457678207−002	−1.20658063976107412−001	1.92484922041266224+003	23
48	5.20502863036879972−003	−3.01271069624369139−001	2.49577001157004823−002	3.32898616686550854−002	2.02057066606503975+003	23
49	1.68056142644745179−002	−2.45872936964107300−001	2.03831958641130227−002	1.59508091658998760−001	2.11830879516825019+003	23
50	2.49596878670232273−002	−1.53595641184639846−001	1.16308142200262057−002	2.36616153060398546−001	2.21806229679778926+003	22
51	2.89084039294081968−002	−5.59394295620025017−002	9.20279597829548627−004	2.64311644296440365−001	2.31982998700930349+003	21

OBLATE RADIAL FUNCTIONS

H = 28.0 X = 2.00000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	−1.18015255438505556−002	−2.97083772173305707−001	1.10156708178427084−002	−3.27947441107706797−001	−6.19086728618735091+002	24
3	1.10156708178427084−002	−3.27947441107706797−001	1.18015255438505556−002	2.97083772173305707−001	−6.19086728618735091+002	24
4	1.61506334320328760−002	−5.68592369912849154−002	1.85603707680497406−003	4.35730543972645348−001	−5.15556857122093756+002	24
5	1.85603707680500124−003	4.35730543972645247−001	−1.61506334320328731−002	5.68592369912856476−002	−5.15556857122093555+002	24
6	−9.59610653043265902−003	3.57555073920830274−001	−1.32608908963027870−002	−2.50242982459393843−001	−4.16726482444936697+002	24
7	−1.32608908963195933−002	−2.50242982458770832−001	9.59610653040983831−003	−3.57555073921258605−001	−4.16726482444731002+002	24
8	−2.69226634922029491−003	−4.26493648973006491−001	1.62570309435830682−002	−7.77548233004312868−002	−3.23015743758797240+002	24
9	1.62570309415293116−002	−7.77548236431337445−002	2.69226636231475851−003	4.26493648907503149−001	−3.23015743663663544+002	24
10	1.30925043239655927−002	2.58713271179905879−001	−1.01806381615736296−002	3.44394840727592467−001	−2.34997053607513293+002	23
11	−1.01806356720959550−002	3.44394889711894020−001	−1.30925062948700675−002	−2.58713204775830713−001	−2.34997031060060739+002	24
12	−1.66778939371632418−002	2.11237140286883344−002	−5.38540065792350403−004	−4.27600823184474238−001	−1.53517411535571647+002	24
13	−5.38946808298097645−004	−4.27600214955253180−001	1.66778844241881829−002	−2.11341414403680796−002	−1.53514551533449524+002	24
14	1.32650982726552921−002	−2.66588801380945742−001	1.02779562707846690−002	3.31913794340971349−001	−8.01126548436684260+001	24
15	1.02994463136327296−002	3.31479111890970973−001	−1.32487302224522024−002	2.67119195659484796−001	−7.99245236641393532+001	24
16	−6.55572607982705056−003	3.93262248043764321−001	−1.55329753844114172−002	−1.57774182719107997−001	−2.03367735248305959+001	24
17	−1.58060330637969078−002	−1.40699746696281487−001	5.88602164694425635−003	−3.99511715722448783−001	−1.53399042848566641+001	24
18	6.45217997497623665−004	−4.22231017401590205−001	1.69039955898933063−002	8.47137991453544593−003	2.17069566529501212+001	24
19	1.66954087074274319−002	−8.03142646117368031−002	2.92576458319280112−003	4.13759053940247727−001	4.62974136118358733+001	24
20	7.64435624929459147−003	3.71857241665740025−001	−1.51806660014306743−002	1.95937565972866498−001	8.02913722649942752+001	24
21	−1.21213211690799705−002	3.00191594121430906−001	−1.19871287689286551−002	−2.92412171852601125−001	1.16577476995090491+002	24
22	−1.54056094190299977−002	−1.74282361920159052−001	7.42977383599614448−003	−3.79600602035472598−001	1.56056382794577208+002	24
23	1.43515916416598856−003	−4.15351164834119265−001	1.71045105179743957−002	2.68115037410460486−002	1.98224602049158264+002	23
24	1.64351687909088508−002	−1.32229713434352295−001	5.17445742321884771−003	3.92976804970769050−001	2.42947924524825354+002	24
25	1.13554463208460827−002	3.06086321312549378−001	−1.30533650598935220−002	2.77171021023333877−001	2.90108121240223999+002	23
26	−7.12139088721923340−003	3.78362338204320035−001	−1.58510971746599334−002	−1.60839219597476090−001	3.39623244688258942+002	23
27	−1.74498865817461625−002	2.14267592751258254−002	−5.52882994679982771−004	−4.08656561669711633−001	3.91431476186741774+002	23
28	−8.51452532421385101−003	−3.51772722026657939−001	1.53410900490164483−002	−2.05094244360567008−001	4.45485170717582506+002	24
29	9.49044966801801289−003	−3.46065485379256057−001	1.48674910403544010−002	2.10499155412765923−001	5.01746763382887056+002	24
30	1.77140945060721068−002	1.16931492189074602−002	−9.08308922425297339−004	4.02630580335085314−001	5.60186116151554335+002	24
31	8.34387816882171394−003	3.49583382239852575−001	−1.57719292375856590−002	1.95263250801324293−001	6.20778698010439135+002	23
32	−9.00523756044813476−003	3.48832325054253401−001	−1.55343850979377546−002	−1.91439865887289165−001	6.83504298180208709+002	24
33	−1.80493051323621323−002	3.10890691427398751−002	−9.86306410658929750−004	−3.94042526429905794−001	7.48346091552609687+002	23
34	−1.11012789358746257−002	−3.05002755442643228−001	1.44284291096964286−002	−2.47011765358803286−001	8.15289944755555467+002	23
35	5.28588728439474978−003	−3.75790458219256736−001	1.75643328681795119−002	1.02603104612078902−001	8.84323891127911972+002	24
36	1.73558904849400650−002	−1.42901886227567889−001	6.37536625856505204−003	3.59059956302675695−001	9.55437727035278204+002	24
37	1.58735968527474773−002	1.91947616478952841−001	−9.78606416533078102−003	3.31647924566045106−001	1.02862269710555110+003	24
38	2.55293859415828998−003	3.74585598598183520−001	−1.86434015551095611−002	6.24015837257716865−002	1.10387124576263028+003	24
39	−1.25791436955740253−002	2.89294674036652327−001	−1.42394970246295755−002	−2.40353919618141377−001	1.18117681894792329+003	23
40	−1.91958081759154864−002	1.57589723721764768−002	−2.02371144122394461−004	−3.71938910628725705−001	1.26053370434804228+003	23
41	−1.34845487887245893−002	−2.56127488487274146−001	1.39609804662727493−002	−2.64529895297163613−001	1.34193690152209730+003	24
42	4.20249912136192460−004	−3.63865867849240936−001	1.96363618728957373−002	−5.10341909391209181−003	1.42538201549658042+003	23
43	1.40808992887676815−002	−2.63206986579285647−001	1.40510606882394417−002	2.44623566309480376−001	1.51086516895909473+003	24
44	2.01473605114221027−002	−2.98942708839414432−002	8.91757764073434848−004	3.53207492895195944−001	1.59838292932268214+003	24
45	1.60403258379223143−002	2.04956636563643705−001	−1.27151731280259662−002	2.82837024076324041−001	1.68793224777575593+003	24
46	4.38362192111259618−003	3.32286490652161478−001	−2.03343455173717198−002	8.80616161996028655−002	1.77951040806372958+003	24
47	−9.18484545885234748−003	3.11450567297418183−001	−1.90746761531435578−002	−1.30871928039630067−001	1.87311498322599213+003	24
48	−1.90544252160902230−002	1.71843355181638206−001	−1.01381217039158464−002	−2.83434857402884390−001	1.96874379887694627+003	23
49	−2.19027284881910252−002	−1.71148860506469686−002	2.53201043561836925−003	−3.24138706125140130−001	2.06639490190151150+003	23
50	−1.74271002742978469−002	−1.83970589159437274−001	1.43537018483640140−002	−2.58344652083899766−001	2.16606653365472399+003	24
51	−7.71782141801752704−003	−2.82271324422179794−001	2.18626349775939351−002	−1.25898509403787181−001	2.26775710692704885+003	23

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H=30.0 X=2.00000000 M=2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	1.49674292074862307-002	-5.42752718643404012-002	1.63795797946835502-003	4.39472000224238055-001	-7.23080508972632228+002	23
3	1.63795797946835502-003	4.39472000224238055-001	-1.49674292074862307-002	5.42752718643404013-002	-7.23080508972632228+002	24
4	-8.45639935194101341-003	3.68539310341823085-001	-1.25768821675889244-002	-2.40243051660841497-001	-6.11514915258733847+002	23
5	-1.25768821675889248-002	-2.40243051660841480-001	8.45639935194101284-003	-3.68539310341823096-001	-6.11514915258733841+002	23
6	-3.70540236084971793-003	-4.22421400291076803-001	1.47962723602216886-002	-1.12377695219629444-001	-5.04588552263729785+002	23
7	1.47962723602214916-002	-1.12377695219652588-001	3.70540236085053149-003	4.22421400291070453-001	-5.04588552263722792+002	23
8	1.32904468708547648-002	2.11639583370988003-001	-7.67889903617170927-003	3.79333194955179420-001	-4.02671891900056997+002	23
9	-7.67889903576442502-003	3.79333194961605682-001	-1.32904468710944066-002	-2.11639583359252660-001	-4.02671891896150555+002	23
10	-1.50097100433672134-002	1.08013322570033323-001	-3.63295400974884894-003	-4.18013353702469531-001	-3.06252328489318816+002	22
11	-3.63295414606751091-003	-4.18013352692302629-001	1.50097100115367972-002	-1.08013326353075756-001	-3.06252327343771551+002	22
12	8.99910563639423677-003	-3.53740746949099764-001	1.26612583465927958-002	2.43120124402055672-001	-2.16011477327802496+002	23
13	1.26612718431191676-002	2.43119596704137859-001	-8.99908697512624357-003	3.53741103268590485-001	-2.16011290678724179+002	23
14	6.64704926396641826-004	4.26147139755768099-001	-1.56049818225865309-002	2.50461465975793548-002	-1.33008878987799469+002	23
15	-1.56049096352734193-002	2.51036766980207642-002	-6.66812212295129054-004	-4.26143270540919217-001	-1.32991945155235469+002	23
16	-9.23262535013211138-003	-3.39361780457349452-001	1.26944554991286560-002	-2.55469442016514279-001	-5.95867223891883919+001	23
17	1.26367524359331285-002	-2.57588501440854374-001	9.31286988243074680-003	3.37727473191771981-001	-5.87994530771537448+001	23
18	1.38026212285104186-002	1.97855210736475289-001	-7.59883022869151115-003	3.74073766492498493-001	-4.79462299800932247+000	23
19	-6.26801123062906521-003	3.90760164025814187-001	-1.44697252070984091-002	-1.61530417556514333-001	6.98657136135910497+000	23
20	-1.56858668965618610-002	-4.52312396305585946-002	1.96172369297011701-003	-4.19354283419476755-001	4.24096831077116137+001	23
21	-2.09957244035630868-003	-4.16108307850359698-001	1.57040551185046625-002	-6.29075055369354691-002	7.44159832424490523+001	22
22	1.43922329850176257-002	-1.84268482036957795-001	6.72637706406135443-003	3.77092795893008227-001	1.12203725883143840+002	23
23	1.10300822094557645-002	2.96859324410753662-001	-1.14977367934177528-002	2.94962107093899555-001	1.52793956003048568+002	23
24	-7.01851331870173768-003	3.77990096184788121-001	-1.43602361683222836-002	-1.76481764715860520-001	1.96287720178026379+002	23
25	-1.59856459161606802-002	-2.61369044938279403-002	1.29703831926974292-003	-4.14920118635036633-001	2.42418444331190136+002	23
26	-4.97020741931329643-003	-3.91580125619563195-001	1.53101901839235846-002	-1.35105120276699282-001	2.91060012959114621+002	23
27	1.20486707436445160-002	-2.80654620260231196-001	1.07682178130112729-002	3.02482876577813009-001	3.42115069428159448+002	22
28	1.49079394641257479-002	1.55049797529966562-001	-6.40643111638780865-003	3.80559019094042438-001	3.95511847023206956+002	22
29	8.07566750898909575-004	4.08169551660628966-001	-1.62773385478763889-002	2.81743760826723698-002	4.51195066002262908+002	23
30	-1.41705563828191874-002	2.10928216781470536-001	-8.20202702587243004-003	-3.48372187989123981-001	5.09121221627751093+002	23
31	-1.40148696842920470-002	-2.05311232613471579-001	8.61998000484966226-003	-3.49406598639726648-001	5.69255429562935315+002	23
32	6.15290427656567054-004	-4.03114686336632980-001	1.65276893411168635-002	6.68361129668902138-003	6.31569293082606945+002	23
33	1.46218273399801007-002	-1.98421166680559931-001	7.92212795215922596-003	3.48434479312726695-001	6.96039403355749116+002	22
34	1.45077513451524636-002	1.90870761140974065-001	-8.32494445759465750-003	3.49997602025752048-001	7.62646255400242138+002	23
35	8.75254167244493532-004	3.95139935699318128-001	-1.68064926912280081-002	2.94202830302873543-002	8.31373445934623471+002	23
36	-1.35374925796183111-002	2.43777303235430160-001	-1.01807181724085794-002	-3.09129524613557156-001	9.02207068013530489+002	23
37	-1.62245650040642794-002	-1.11666287683630184-001	5.25582345419179648-003	-3.74726124940392728-001	9.75135246403698975+002	23
38	-5.39672949921961839-003	-3.65454958807952391-001	1.63086566522915609-002	-1.30928782273150795-001	1.05014777573624252+003	22
39	9.74614725836782710-003	-3.23773640580897237-001	1.43059989550368190-002	2.08775965405292127-001	1.12723583507923487+003	23
40	1.74012944695000556-002	-3.89134987427064320-002	1.32037657867158264-003	3.80160579773390283-001	1.20639176023893749+003	23
41	1.22580358026208547-002	2.64595915590936186-001	-1.26322275128071141-002	2.71187889763848601-001	1.28760886028288803+003	22
42	-1.50158289712708409-003	3.74861357050225669-001	-1.77000051692345102-002	-2.10569187967601937-002	1.37088126836155015+003	22
43	-1.42503300773719100-002	2.34534071682879082-001	-1.08933185031509875-002	-2.88541549680548387-001	1.45620381942946533+003	22
44	-1.78951967531257456-002	-4.68375961429737117-002	2.86856410873407253-003	-3.65031472386049923-001	1.54357194927541212+003	23
45	-1.06851404457372219-002	-2.88548542197322417-001	1.48874221302988027-002	-2.21889709913795060-001	1.63298161058681534+003	23
46	2.66193833362828680-003	-3.57603754173721190-001	1.83509769257621355-002	3.91776262963411618-002	1.72442920274414864+003	22
47	1.45622490569863603-002	-2.34381905299507672-001	1.18583751242054702-002	2.66942152691321301-001	1.81791151276594635+003	23
48	1.90254792510338959-002	-1.24360345683846141-003	-6.87393306570796871-004	3.50452223746037547-001	1.91342566537266947+003	23
49	1.43813588296810874-002	2.19469693430523875-001	-1.29019433060505448-002	2.66670289647087433-001	2.01096908055574098+003	23
50	3.31267750269241437-003	3.32074888155983861-001	-1.93501336551639505-002	7.27427276361508430-002	2.11053943736030738+003	23
51	-9.12886637225430399-003	3.04514327711917503-001	-1.77680979479987458-002	-1.37588416140016469-001	2.21213464284087018+003	22

OBLATE RADIAL FUNCTIONS

H = 35.0 X = 2.00000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	−9.96133102048716768−003	2.85376836896498376−001	−8.17667846416555087−003	−3.39397523374048816−001	−1.01806827407736223+003	24
3	−8.17667846416555087−003	−3.39397523374048816−001	9.96133102048716768−003	−2.85376836896498376−001	−1.01806827407736223+003	24
4	6.30113663297585632−005	−4.40934571543556732−001	1.29599427508659591−002	−3.19132575762679264−003	−8.86433410489711463+002	23
5	1.29599427508659591−002	−3.19132575762679265−003	−6.30113663297585631−005	4.40934571543556732−001	−8.86433410489711463+002	24
6	9.76285041431875682−003	2.86388965629024373−001	−8.63284094001913832−003	3.32068523991613185−001	−7.59324741722267464+002	24
7	−8.63284094001913824−003	3.32068523991613187−001	−9.76285041431875689−003	−2.86388965629024370−001	−7.59324741722267463+002	23
8	−1.30402440632080194−002	4.83175138920253640−002	−1.28681864383253022−003	−4.33435893468649392−001	−6.37027656521040913+002	24
9	−1.28681864383262133−003	−4.33435893468649034−001	1.30402440632080110−002	−4.83175138920283892−002	−6.37027656521039876+002	24
10	8.30316359092486646−003	−3.40295883036166210−001	1.02277100876704164−002	2.69034573882842645−001	−5.19895762714263522+002	24
11	1.02277100876972263−002	2.69034573881746755−001	−8.30316359089229875−003	3.40295883037020543−001	−5.19895762713789927+002	24
12	9.70115334503919510−004	4.29937032020348114−001	−1.32068181684810797−002	3.73002128814436329−002	−4.08382770826656287+002	24
13	−1.32068181677226686−002	3.73002132525362552−002	−9.70115345911493023−004	−4.29937031985560132−001	−4.08382770699403414+002	23
14	−9.44247465920665375−003	−2.98466282915334914−001	9.37898219064585073−003	−3.08708878500653049−001	−3.03099932316189017+002	24
15	9.37898086280133349−003	−3.08708920477097909−001	9.44247599686542467−003	2.98466238881564007−001	−3.03099911510684225+002	24
16	1.32873628219058091−002	4.22550999101184798−002	−1.50521698030196967−003	4.25267428618779087−001	−2.04934494439546174+002	24
17	−1.50502891506973776−003	4.25267984224798001−001	−1.32873854915023213−002	−4.22490691441293062−002	−2.04932419854586278+002	24
18	−1.17912178484762971−002	2.08977003787079182−001	−6.43234334083866499−003	−3.70621078479369748−001	−1.15402824368908533+002	24
19	−6.44215317100953134−003	−3.70445433536001869−001	1.17859533998851546−002	−2.09282993067807674−001	−1.15281782660834263+002	24
20	7.03665969112551739−003	−3.64669344058015042−001	1.15012399127297410−002	2.16030924640829250−001	−3.92177248198125719+001	24
21	1.16673148901544039−002	2.07260488264291916−001	−6.76243979680867181−003	3.69639388389233419−001	−3.57545315190426002+001	23
22	−2.47120371188372368−003	4.16660395120095511−001	−1.32917995510554347−002	−7.12686132021056127−002	1.39421067166020134+001	23
23	−1.35335972504736982−002	−2.07348119527702007−003	2.62568877650091508−004	−4.22189398495322556−001	3.78427624814586937+001	23
24	−3.41186450010568064−003	−4.06191162730748892−001	1.31278064102274129−002	−1.11929053571568871−001	7.75819348001275458+001	24
25	1.16859412017099928−002	−2.20054099612574008−001	6.94283366344241633−003	3.58249851805211891−001	1.18448708567825046+002	24
26	1.02076918485217199−002	2.73109810615462472−001	−9.02453331402463531−003	3.18347886889838035−001	1.63447906582629480+002	23
27	−5.22180466347444200−003	3.88968064019504265−001	−1.26221329190812143−002	−1.54099810470204262−001	2.11403574932213464+002	24
28	−1.36856709318320523−002	−1.04987983422450194−002	5.53171672966311774−004	−4.17113498116124387−001	2.62190262318690378+002	23
29	−4.45724730443967023−003	−3.91400920954078524−001	1.29933007573548563−002	−1.41050246639328492−001	3.15623221354916617+002	24
30	1.03624542418283596−002	−2.78212182470183508−001	9.08151575294360643−003	3.07619924984052991−001	3.71585738675545032+002	23
31	1.24817182953914228−002	1.71744702716037947−001	−5.94107304670291799−003	3.76065040003232613−001	4.29988647975368956+002	24
32	−2.76041022372405376−004	4.12013375831436066−001	−1.38681208619661182−002	−1.57375706319062577−003	4.90763395878593413+002	23
33	−1.27019273340237410−002	1.74095912587337401−001	−5.69669108613432492−003	−3.71795158067638013−001	5.53855767923505703+002	23
34	−1.07706457555777497−002	−2.55296184294706580−001	8.90264217347316050−003	−3.19523565750425008−001	6.19222082617918303+002	24
35	2.99887343828897883−003	−3.99366336254585323−001	1.37050884552017883−002	8.03417532765997747−002	6.86826592589418579+002	23
36	1.35522976070860920−002	−1.17505267267676610−001	3.84804669102131190−003	3.88282497327047404−001	7.56639664925755623+002	23
37	1.00061277784602392−002	2.80529405737012345−001	−1.00047441382253589−002	2.90588012767305746−001	8.28636466848116313+002	24
38	−3.65155952687422220−003	3.90350798136618433−001	−1.37379122972352989−002	−9.63097223914333686−002	9.02795993090560426+002	23
39	−1.37173621000396100−002	1.18542627250008143−001	−3.98150529129590948−003	−3.82165869677709433−001	9.79100331183253855+002	22
40	−1.07050069944841526−002	−2.59663815561497087−001	9.56505238309952083−003	−3.01782868344606443−001	1.05753409662786782+003	22
41	2.20315353538974464−003	−3.92465462976504463−001	1.42627168235434568−002	5.29522572789347313−002	1.13808399205225158+003	24
42	1.31319052595623573−002	−1.74594960014118303−001	6.17697332091709932−003	3.53019399141356137−001	1.22073845855298427+003	23
43	1.26592914313647567−002	1.88052747398264752−001	−7.26694416649935739−003	3.43440778334151903−001	1.30548739672056516+003	23
44	1.55550503693644251−003	3.86051469036593375−001	−1.46035287175738544−002	4.92264556719516294−002	1.39232194110373400+003	23
45	−1.08075669664618923−002	2.69758398621876980−001	−1.00826788190143430−002	−2.77064988960227844−001	1.48123427618606388+003	24
46	−1.46950932143970026−002	−5.20617928963465748−002	2.34056175594804741−003	−3.80564572901616480−001	1.57221748498264471+003	23
47	−7.47112959388926374−003	−3.26224747719503874−001	1.29908049348931768−002	−1.97609161127982465−001	1.66526542353579248+003	23
48	5.19231484994951520−003	−3.58456830991219669−001	1.41769620802116981−002	1.21806329586598344−001	1.76037261616665395+003	23
49	1.42148510477808107−002	−1.42561927346192710−001	5.43004905184539031−003	3.47535646997969530−001	1.85753416750281818+003	23
50	1.36687138128959853−002	1.60764948331303290−001	−6.96934878488850909−003	3.36085661011215700−001	1.95674568817071985+003	23
51	4.30045665623179758−003	3.51955998590401443−001	−1.48678894323547855−002	1.11951562514169141−001	2.05800323169799590+003	24

UNCLASSIFIED

OBLATE RADIAL FUNCTIONS

H = 40.0 X = 2.00000000 M = 2

L	R_1	R_1D	R_2	R_2D	EIGENVALUE	ACC
2	3.39291359458775394−003	−4.24637865673351330−001	1.07413320716492678−002	1.29335352160494859−001	−1.36305927072589725+003	24
3	1.07413320716492678−002	1.29335352160494859−001	−3.39291359458775394−003	4.24637865673351330−001	−1.36305927072589725+003	24
4	6.19515673177977034−003	3.67134734834220733−001	−9.47448805656374463−003	2.45609014515820111−001	−1.21137424430981044+003	24
5	−9.47448805656374463−003	2.45609014515820111−001	−6.19515673177977034−003	−3.67134734834220733−001	−1.21137424430981044+003	24
6	−1.12799554702529290−002	−5.21912966403078516−002	1.47169894159673692−003	−4.36454748155446888−001	−1.06413650947451040+003	24
7	1.47169894159673692−003	−4.36454748155446888−001	1.12799554702529290−002	5.21912966403078516−002	−1.06413650947451040+003	24
8	8.68658797486302752−003	−2.87955267103177497−001	7.42966121815231670−003	3.29311109001453140−001	−9.21577771344244604+002	24
9	7.42966121815231671−003	3.29311109001453140−001	−8.68658797486302751−003	2.87955267103177498−001	−9.21577771344244604+002	25
10	−6.02003347265030861−004	4.35012261442753115−001	−1.14690572089963563−002	−1.79724696670522405−002	−7.83974360303797126+002	26
11	−1.14690572089963569−002	−1.79724696670518882−002	6.02003347265021580−004	−4.35012261442753127−001	−7.83974360303796989+002	24
12	−7.69119341376644902−003	−3.19742785940580877−001	8.60107678089034553−003	−2.92525181327808608−001	−6.51663421527715605+002	26
13	8.60107678088788276−003	−2.92525181327911147−001	7.69119341376923655−003	3.19742785940485934−001	−6.51663421527661150+002	26
14	1.15430990197688676−002	3.40736099231449912−002	−1.04918941125794510−003	4.30062180075165287−001	−5.25068638051493288+002	25
15	−1.04918941031667046−003	4.30062180077732998−001	−1.15430990198601945−002	−3.40736098880293426−002	−5.25068638037752172+002	26
16	−9.44207008175676627−003	2.55343841228848802−001	−6.80980011483463964−003	−3.45386070262116169−001	−4.04744152201091400+002	24
17	−6.80980024213461250−003	−3.45386066805149624−001	9.44206999113381414−003	−2.55343845845072511−001	−4.04744149947013533+002	24
18	3.12329217468123711−003	−4.13522188275001715−001	1.12655708823863221−002	1.09319435933204747−001	−2.91457619080057121+002	24
19	1.12655754760590344−002	1.09318839980516802−001	−3.12327599911436446−003	4.13522336318988062−001	−2.91457378199954325+002	24
20	4.11031502930756350−003	3.97210617615269229−001	−1.09935788657506353−002	1.54059663168858304−001	−1.86380622956493572+002	24
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51	1.11074061313745430−002	−2.03162196664087479−001	6.55337369610047264−003	3.30284331098424318−001	1.88332170661068463+003	23

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13. FOREWORD:

This volume is one of a series of six volumes published by the Naval Research Laboratory containing tabulation of explicit values of radial spheroidal wave functions of both oblate and prolate kinds over extended ranges of parameters. It is designed to provide the mathematical physicist and research engineer with accurate values of important but not easily calculated functions needed to solve boundary value problems of radiation, scattering, and propagation of scalar or vector waves in spheroidal coordinates.

This series vastly extends the scope and accuracy of existing tabulations of radial spheroidal wave functions. The presence of many of the entries was made possible only through adoption of calculation techniques involving extreme precision. This was particularly true in the calculation of the characteristic values for the radial equation resulting from separation of the Helmholtz wave equation in spheroidal coordinates, a knowledge of which is essential in the calculation of spheroidal angle functions.

The authors express the hope that the availability of these tables will result in an ever-increasing use of the versatile prolate and oblate spheroidal wave functions in theoretical and practical problems where these functions appear naturally.

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