LMSC-D420943
27 APRIL 1974
NASA CR-132455

STUDY OF EPHEMERIS ACCURACY OF THE MINOR PLANETS

STUDY PERFORMED UNDER CONTRACT NAS1-11609

For
NASA-LANGLEY RESEARCH CENTER
HAMPTON, VIRGINIA

Prepared by
SPACE SYSTEMS DIVISION
LOCKHEED MISSILES & SPACE COMPANY, INC.
(A SUBSIDIARY OF LOCKHEED AIRCRAFT CORPORATION)
SUNNYVALE, CALIFORNIA 94088

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FOREWORD

The study described in this report was conducted by Lockheed Missiles & Space Company, Inc. (LMSC) for Langley Research Center, National Aeronautics and Space Administration, Hampton, Virginia, under Contract NAS1-11609. The study was conducted under the direction of D. R. Brooks of the Space Technology Division.

L. E. Cunningham, Professor of Astronomy at the University of California, Berkeley, contributed significantly to the effort under a consulting agreement with LMSC.

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Section 1

INTRODUCTION AND SUMMARY

The objective of this study has been to assess the current state of minor planet ephemerides and to develop the means for providing and updating these ephemerides for use by both the mission planner and the astronomer.

Mission modes for studying asteroids and comets proposed by mission analysts include flybys of single targets, multiflybys, and surface sample return missions. Of particular interest as a background to this study are the multiple asteroid flyby missions proposed by Brooks, Hampshire, and Drewry[1,2] and others. These missions demonstrate the need for readily available estimates of ephemeris accuracies, inasmuch as their analysis involves a large number of constantly changing targets. Velocity increments to effect close flyby of several asteroids on a single mission are highly dependent on the relative positions of the asteroids. From a systems point of view, these ephemeris uncertainties impact spacecraft propulsion and acquisition and guidance subsystems and thus could tend to restrict the number of suitable targets. It is usually assumed that ephemeris accuracies for asteroids being approached at flyby velocities should be on the order of 1000 km, but a better estimate of the worst tolerable position uncertainty must await further design studies of possible spacecraft configurations. The resulting criteria for ephemeris accuracy, in conjunction with a great deal of recent work to define physical characteristics of asteroids from ground-based observations,[3] will aid mission planners in more sharply defining desirable multiple flyby missions.

An immediate source of partial answers to questions about ephemeris accuracies for the numbered asteroids is contained in Ephemerides of the Minor Planets, published annually by the Institute for Theoretical Astronomy, Leningrad, U.S.S.R. In addition, current observations are published in astronomical journals and released from time to time by various observatories. While these and other sources contain the raw data

necessary for determining ephemeris accuracies, the mission analyst needs an easily accessible means of interpreting such data. Also, the computational means required to reduce the raw data to quantities suitable for use by the mission planner are not always available. Thus, the results of this study are needed to facilitate determination of ephemeris accuracies.

The study began with a consolidation of the data contained in the Ephemerides of Minor Planets. This is published in Appendix A in the form of a computer listing. Second, a thorough search of other available astronomical literature was made to establish a complete base of existing minor planet ephemeris accuracy data. Next, a new computerized method was developed for the systematic ephemeris determination of all numbered minor planets. Examples of how data generated by the new method can be used by the mission planner and astronomer are provided in Appendixes B, C, D, and E. It should be noted that the osculating element data presented in these appendixes are shown as examples of output only and are in most cases not as accurate as data provided by the Ephemerides of the Minor Planets. On the other hand, the perturbation data shown are sufficiently accurate to be used directly with current observational or other more recently published data. Appendix F is a short description of the main computer programs and subroutines developed during the contract period.

The accuracy of the existing ephemerides for all of the numbered minor planets was examined on the basis of data contained in the annual volumes of Ephemerides of Minor Planets and elsewhere. An empirical formula was developed and used to estimate the present ephemeris accuracy in terms of angular errors and distance errors in kilometers. These are listed in Appendix A and are summarized in Table 3-1. Discussion of the methods used and results obtained are given in Section 3. Results from this survey show accuracies ranging from 1.0 arc-sec (1,000 km) to 4,000 arc-sec (4,000,000 km) and thus indicate the need for developing a new system for keeping track of the minor planets.

A new system of providing data for all of the numbered minor planets was planned, and computer programs for its initial mechanization were developed. Essentially, this new system furnishes the osculating elements for all of the numbered minor planets

at an adopted date of 10 October 1972 (JD = 2441600.5 days) and at every 400-day date over the years of interest. It also furnishes the perturbations in the rectangular coordinates relative to these osculating elements at every 4-day date. The overall ephemeris accuracy depends on the accuracy of the adopted elements at the initial date, which must be improved in stages to meet future standards. Details are given in Section 4; samples of listings are contained in Appendixes B, C, D, and E.

A new computer program was designed and developed to integrate the perturbed motion of a group of 50 minor planets simultaneously. This mass production approach secures great economy in both machine time and supervision. On the CDC 6400 computer, the numerical integration of 50 minor planets at a step interval of 4 days over one 400-day interval requires about 100 seconds of central processor time. At this rate, more extensive integrations than originally planned become practical. Appendixes B, C, D, and E came directly from listings made by the program. Details are contained in Section 6.

The data furnished by this new system and program are so extensive that only samples are listed in this report. However, all data computed during the study by the new system for all the minor planets are available on magnetic tapes. The osculating elements at each 400-day date and the perturbations in these elements are listed in full whenever a run is made. However, the perturbations in the rectangular coordinates relative to these osculating elements at each 4-day step are listed for only one of the 50 minor planets in each group during any given run. Again, data for all 50 minor planets are placed on magnetic tape. Details are given in par. 4.3, and examples of some typical uses of the data are given in par. 4.4. The listings in Appendixes B, C, D, and E show that the perturbations in the position of a minor planet after 10 years can exceed 3 degrees (roughly 10,000,000 kilometers). This error, of course, is often small in comparison to the error resulting from the propagation of velocity errors in the initial conditions; that is, in the osculating elements at the adopted date. Thus, improving the initial elements is of paramount importance for obtaining accurate ephemerides at future dates.

A method to improve the initial elements on the basis of observed or ephemeris positions without the extensive computation of perturbations was developed and tested. Theory and discussions are contained in Section 5. However, this method was found to be less important than originally anticipated because of the high speed of the numerical integration program, so its use is now planned for only those minor planets having low ephemeris accuracy as reflected in the Appendix A tabulation. For the other minor planets, the numerical integration program can be used economically to reduce the published elements from their epoch of osculation to the adopted standard date.

Section 7 contains recommendations with regard to work needed to establish and implement the new system on a permanent basis.

Section 2
HISTORICAL PROCEDURES

2.1 ASTRONOMICAL POSITION OBSERVATIONS OF MINOR PLANETS

Following the discovery of the first minor planet in 1801, an attempt was made by astronomers to secure as many accurate position observations as possible for every known minor planet. After 1845, new minor planets were discovered at an ever increasing pace and the number of known ones soon became so large that this practice could no longer be continued. In an attempt to provide some observational material for all known minor planets, the measurement and publication of approximate positions was eventually introduced. For much the same reason, many apparently accurate positions were published, although made with small telescopes equipped with inferior micrometers. As a result of these policies, it is often found that old position observations are good and that modern ones are excellent but that position observations made over the many intermediate years are only approximate and essentially useless.

With the exception of a few of the very brightest objects, all modern position observations of minor planets are made photographically. The first four minor planets and occasionally a few others are observed with meridian circles. During the last century and the first part of this one, most of the accurate position observations were made visually with the aid of filar micrometers attached to refracting telescopes of large apertures.

With the possible exception of the relatively few meridian circle observations, all position observations of minor planets are relative. This means that the position of the minor planet is compared, either on a photograph or visually at the telescope, with neighboring stars, called comparison stars, the positions of which are assumed to be known. The positions of these comparison stars are taken from one or more catalogs, which are based on meridian circle observations, either directly or indirectly. The relative positions of all stars change slowly with time because of the space motions

of the stars and the sun. These changes are called "proper motions." They vary enormously from star to star and must be determined by direct measurement. As a result, a catalog position may be accurate for some year (called the epoch of the catalog) but may be quite poor a few decades later (or earlier) unless the proper motion of the star is known. Good proper motions are known for most stars visible to the naked eye, for a considerable number of stars brighter than the 9th magnitude, and for a few fainter stars of special interest. The proper motions of faint stars that must necessarily be used as comparison stars on photographs made with large telescopes are totally unknown.

The older published positions of minor planets were based on comparison star positions taken from various catalogs. An intercomparison of these catalogs shows that each differs systematically from the others and that these differences depend on various factors, including the right ascension of the star, its declination, its brightness, and its color. Tables of these "systematic corrections" have been published for the important catalogs. An application of these systematic corrections and of proper motion reduces the position of a comparison star to a given adopted astronomical "system" and to the date of observation. This procedure is necessary in obtaining the most accurate results, but it involves a great deal of work so is often avoided.

Modern photographic positions of minor planets brighter than magnitude 12, say, are based on comparison star positions taken from special catalogs. The included stars are chosen to provide (1) a quite uniform distribution over the entire sky, (2) a spacing between stars suitable to secure an adequate number of comparison stars on photographs taken with telescopes of moderate apertures, and (3) magnitudes sufficiently large to eliminate some of the difficulties inherent in the use of comparison stars very much brighter than the minor planet. Positions obtained in this way can have a probable error of about 0.1 second of arc. For fainter minor planets and for larger telescopes, the same catalog positions of the comparison stars are often used; but the resulting positions for the minor planets are somewhat less accurate unless special procedures are used (such as a coarse objective grating, or field plates, or both). For the faintest minor planets and for the largest telescopes, comparison star positions must necessarily be taken from the Astrographic Catalog. About this catalog, suffice it to say that the epoch of the catalog is about 1900 and no proper motions are known

for comparison stars taken from it. As a result, minor planet positions based on this catalog are never known to better than 1.0 second of arc and can quite easily be in error by 4 seconds of arc.

Modern positions of minor planets are all referred to the standard mean equator and equinox of 1950.0. Somewhat earlier positions were often referred to the mean equator and equinox of the beginning of the year of observation (e.g., 1934.0). Still earlier positions, especially those from the last century, were referred either to a mean equinox or to a true equinox of date or they were apparent positions (true equinox and stellar aberration). Thus, for a particular position, reductions for precession, nutation, and stellar aberration may or may not be required. In the last century, the measurement of positions was practiced by most astronomers, all of whom were so familiar with the then current but changing practices that published positions often do not contain precise statements about the system to which they refer.

The ultimate accuracy inherent in a particular photograph or in a particular instrument was, and is, not always attempted. Often quality has been intentionally sacrificed for quantity. The purpose for which the observations were made governed this, and correctly so. The fact that such observations are now available for general use is an added feature. However, their correct usage depends on a knowledge of the intended usage, the standards attempted, the inherent advantages and defects of the instruments used, the actual accuracy attained, the systematic errors introduced, and on many other factors, sometimes including the habits of the observer!

2.2 DETERMINATION OF ORBITS OF MINOR PLANETS

Ceres was observed for several weeks following its discovery in 1801, after which it remained too close to the Sun to be observed for several months. For the first time there was need to provide a finding ephemeris for a star-like object on the basis of observations extending over only a small part of an elliptic orbit. The finding ephemeris needed to be good, since the only way to distinguish Ceres from the many stars of similar brightness nearby in the sky was to watch each star for several hours until one was found to be moving relative to its neighbors. The problem of furnishing a good finding ephemeris was that of determining a good orbit on the basis of observed

positions extending over only a short interval of time. The problem was solved by Gauss, who invented a complicated and ingenious method, the principles of which are still in use.

An elliptical orbit is defined by six constants, and as each observed position provides two independent measures (right ascension and declination) a total of three observations is necessary to find the orbit. A basic quantity in the orbit determination process depends on the geocentric distance of the minor planet, the radial velocity of the minor planet with respect to the Sun, and the energy of the orbit. In this basic quantity, the geocentric distance is multiplied by the square of the smallest time interval between any two of the three dates of observation, the radial velocity is multiplied by the cube of this interval, and the energy is multiplied by the fourth power of the interval. Thus, the geocentric distance is the easiest quantity to determine, whereas the energy is the most difficult to determine. The mean daily motion in the orbit depends solely upon the energy of the orbit, and so is much more difficult to determine than are the other elements. In the computation of an ephemeris, the mean daily motion is multiplied by the time, whereas none of the better determined elements is so multiplied. Thus, the accuracy of the ephemeris depends almost completely upon the accuracy of the mean daily motion, which is the most difficult element to determine. For best accuracy, the time interval between the first and last observations should be as long as possible, and the second observation should lie near the middle of this interval.

Geometrical considerations, as well as the above dynamical ones, affect the accuracy of an orbit determined from three observations. The determinant of the problem is very nearly the determinant of the 3 by 3 matrix formed by the direction cosines of the three observed positions. This determinant will be zero if the three observed positions lie along a great circle. A minor planet often moves many degrees across the sky in a path that approximates a great circle. Even if the motion does not lie on a great circle, nevertheless the three basic positions may, accidentally, lie on a great circle. If a minor planet should move in the ecliptic – that is, if the inclination of its orbit should be zero – it would permanently move in the great circle that is the ecliptic.

The determination of an orbit from observations extending over several weeks or months is essentially the problem of determining an orbit from three observations. The above dynamical and geometrical considerations still hold. The value of additional positions lies in the resulting opportunity to select three accurate ones at times that maximize the geometrical determinant or keep it as large as possible while keeping the time intervals as nearly equal as possible. If enough additional positions are available and distributed in a suitable manner, the three basic positions may be chosen as "normal positions," which are a general average of several nearby positions.

In principle, the determination of an orbit is the same as the solution of any set of transcendental equations. Methods peculiar to the problem at hand must first be used to find a good approximation for each constant needed to define the solution and to select the particular solution of interest if there is more than one solution.

When the constants that define the solution have been determined with sufficient accuracy, the problem can be "linearized"; that is, the problem of determining the constants themselves can be replaced by the problem of determining the corrections to an assumed set of constants. The equations that determine these corrections are linear, provided that the corrections are sufficiently small. If the corrections are not sufficiently small, the solution can be iterated through successive sets of linear equations, but the convergence of the process depends upon the accuracy of the initial set of constants and upon the degree of nonlinearity of the equations that define the original problem.

In the determination of the orbit of a minor planet, the direct solution based on three observations should ordinarily be employed throughout the discovery apparition and may continue to be used through the second or even a third apparition. For a numbered minor planet, an "apparition" covers the interval between successive conjunctions with the Sun. After two apparitions the problem must ordinarily be linearized – partly because the methods based on three observations become less satisfactory and partly because all or many of the accurate observations should be used through the application of least squares to the solution of the many linear equations, which number two for each observation.

In the last century, each new discovery was assigned a permanent number at its first apparition, even though only a few observations of questionable quality were obtained. In some cases the orbital elements determined from the observations of the first apparition were not accurate enough to provide a sufficiently good ephemeris for the next apparition; as a consequence, the minor planet was lost. The brighter minor planets so lost were rediscovered later, but 14 (mostly from this century) remain lost at this date. Over the years the requirements for assigning a permanent number have gradually been tightened, and as a result no additional numbered minor planets should be lost.

The enormous amount of research that was done on the orbits of the minor planets during the last century and early part of this century was collected, discussed, and condensed by Professor Leuschner in his Research Surveys, which was published in 1935[5]. This thick volume is the most authoritative reference on the orbital work done during the time interval it covers. No comparable publication exists for more recent work.

Section 3

SURVEY OF ACCURACY OF EXISTING MINOR PLANET EPHEMERIDES

3.1 OBJECTIVE OF THE SURVEY

The principal objective of the survey was to assess the ephemeris accuracy that has been achieved for each of the 1779 numbered minor planets. The data used to accomplish this have been taken from annual volumes of Ephemerides of Minor Planets and, to a much smaller degree, from other publications.

3.2 MINOR PLANET IDENTIFICATION

All of the lower-numbered minor planets have been assigned permanent names, but many of the higher numbered ones have not. By international agreement, the discoverer of a minor planet has the privilege of naming it when or after its permanent number has been assigned. Until the discoverer assigns a name, the temporary designation assigned at discovery continues to be used.

This temporary designation consists of the year of discovery followed by two letters, which may or may not be followed by an integer. The first of the two letters denotes the half-month of discovery. The second of the two letters is assigned in alphabetical order beginning with A and continuing through Z, after which A is again assigned, followed by the digit one, etc. Thus, a given numbered minor planet will often have two names associated with it: first, the temporary designation; later, the permanent name assigned by the discoverer. Sometimes the permanent name is not directly assigned, and the temporary designation continues to be used for many years.

3.3 LAST KNOWN OBSERVATION

The year of the last known observation for a numbered minor planet is a crude (but very effective) indicator of the gross accuracy of the orbital elements of that minor planet. If a minor planet has been observed in recent years, then its orbital elements

must at least be good enough to provide a satisfactory finding ephemeris. If, on the other hand, it has not been observed for many years, it is hopelessly lost and will probably be rediscovered only by accident. Several minor planets have not been observed since their discovery many, many years ago. Their orbital elements were not determined with suitable accuracy at that time, and they would not have been assigned permanent numbers under present rules. A few numbered minor planets that have not been observed recently, but which are deemed not to be hopelessly lost, are placed on a "critical list" to encourage observers to search for them.

The year of the last known observation for each minor planet is given in the annual volumes of Ephemerides of Minor Planets. Since this publication is the principal source (and almost the sole source) for much of the information about the orbits and ephemerides of the numbered minor planets, it seems desirable to digress with a discussion about some of its contents.

3.4 OPPOSITION VIEWING

The principal purpose of the annual volumes of Ephemerides of Minor Planets is to provide observers with "opposition ephemerides" for all numbered minor planets. A planet is said to be in opposition when its right ascension differs by 12 hours from that of the Sun. An object in opposition crosses the meridian of an observer at midnight, and so is observable all night, or nearly so. It is then closest to the Earth, and as a consequence is then at its brightest for the year. Each of these factors makes the neighborhood of opposition the most favorable location for observation of an ordinary minor planet.

The opposition ephemerides given in Ephemerides of Minor Planets are tabulated at an interval of ten days, and run for about one month before and one month after opposition. During that time the apparent motion of an ordinary minor planet is "retrograde"; that is, it moves westward relative to the stars with its right ascension decreasing. Just outside these opposition ephemerides (both before and after) the motion in right ascension halts, and the minor planet is said to pass through a "stationary" point, although its motion in declination does not necessarily vanish at the same time. Before the first stationary point, and after the second one, the apparent motion of an ordinary

minor planet is "direct"; that is, its motion relative to the stars is eastward and its right ascention increases. When the motion of an ordinary minor planet is direct, the planet is not close to the Earth and so is relatively faint; its position in the sky is also relatively unfavorable for observation. While the brightness and location in the sky are not unfavorable near the stationary points, the problem of identifying the minor planet there is acute. On a short photographic exposure, a minor planet and a star appear exactly alike. In order to easily distinguish a minor planet from a star, it is necessary on most photographs to continue the exposure until the motion of the minor planet relative to the stars produces a "trail" on the photographic plate. Thus the neighborhood of opposition is the only favorable location for observing the ordinary minor planets, and most minor planets are actually observed only in that neighborhood.

The needs of the professional minor planet observer are satisfactorily met by the opposition ephemerides. The needs of observers of things other than minor planets are not fully satisfied by the opposition ephemerides. For example, an observer may find a bright trail on a photograph he has taken for another purpose. He is curious to know whether this minor planet is new, or which one it is, if it is not new. If his photograph was taken in the opposition region, he can turn to the opposition ephemerides for a positive identification. If his photograph was not taken in the opposition region, his curiosity will probably never be satisfied. No ephemerides for most minor planets exist outside the opposition region. The identification of a minor planet without an ephemeris is a most time-consuming process, and may be entirely unsuccessful. Once or more each year some enthusiastic observer becomes convinced that his "bright trail" comes from a really new and unusual minor planet, or even from a comet (fuzzy appearance due to poor seeing and/or guiding), and announces his "discovery" by the usual astronomical telegraphic system. Then the professional must spend considerable time and effort to identify the minor planet and prove his identification.

The opposition ephemerides of minor planets are given with an accuracy of about one minute of arc. This accuracy is sufficient to properly point even large telescopes. The aim of the makers of the opposition ephemerides is to attain this accuracy, and their principal efforts are expended in this direction. The effort needed to maintain this accuracy for all of the numbered minor planets taxes to the limit the resources of those doing this work. In order to cover all of the numbered minor planets as well as possible,

approximations have often been found necessary, especially for the lower-numbered planets that are relatively bright and can be found quite far from their predicted positions. It should be noted that an observer searching for a stray minor planet need not look in all directions from the predicted position, but instead only along a narrow band through it. The constants that define this band are given with each opposition ephemeris and are computed on the basis that at any instant the orbit of the minor planet traces a line on the sky, and, of course, the minor planet itself must be somewhere on this line. For the higher-numbered minor planets that are relatively faint, efforts to obtain higher accuracy are often made to prevent their loss. The procedures that have been employed to provide the opposition ephemerides were adopted by necessity in view of the very small budgets available. The results have been adequate for the intended purpose. In fact, the results are somewhat remarkable when one realizes that some outstanding astronomers consider the minor planets to be the "vermin of the sky."

3.5 BASIS FOR ORBITAL ELEMENTS

Data about the orbital elements themselves – their observational basis, their likely accuracy, the perturbations that were included, etc. – are given in condensed form in the annual volumes of Ephemerides of Minor Planets for those planets for which new elements were computed since the previous volume was issued. Data were found in each of the annual volumes from 1948 through 1972. The data published vary slightly over the years, but usually consist of:

a. The years of the first and last oppositions from which observed positions were used in the orbit computations
b. The total number of oppositions that had usable observed positions
c. The major planets included in the computation of the perturbations
d. The largest residual in right ascension (see below)
e. Reference to publication of the orbit work (Given only in recent years, and then for only a small number of the minor planets)

Item d. above needs some discussion. By "residual" is here meant the difference between an observed right ascension and the right ascension computed from the orbit elements and associated perturbations. This residual may be due to an incorrect observed position, to insufficient perturbations, to the employment of approximate

methods, or to other possible causes; nevertheless, when properly evaluated, it is a good measure of the accuracy of the orbit elements. It is given by the orbit computer solely for this purpose, and presumably the value he has quoted is based on his best judgment of the accuracy of his work. In any case, it is the only estimate of orbital accuracy that is consistently published for all of the numbered minor planets, and it must necessarily be used as a principal datum in the estimate of ephemeris accuracy.

New sets of elements for each numbered minor planet appeared at least twice in the annual volumes mentioned, and many minor planets had three or more sets of new elements in that time interval. Each set of new elements was keypunched into cards, and a computer program then selected the latest set for each numbered minor planet.

The orbital elements themselves were taken from the table of elements in the 1972 volume of Ephemerides of Minor Planets. For each minor planet, these are:

- Brightness (in astronomical magnitudes) of the minor planet itself
- Epoch and date of osculation (here identical, but not necessarily so, in general) to which the elements refer
- Mean anomaly at Epoch
- Argument of perihelion
- Longitude of the ascending node on the ecliptic of 1950.0
- Inclination to the ecliptic of 1950.0
- Eccentric angle (The eccentricity is the sine of this)
- Mean daily motion in seconds of arc
- Semi-major axis (Not used, since the value obtained from the mean daily motion is more accurate)

The date of osculation is the instant at which the elliptical orbit osculates – not in the ordinary mathematical sense, but in an astronomical sense, which defines the osculating orbit to be the ellipse that represents the instantaneous orbit at the instant of osculation. Stated another way, the instant of osculation is the instant at which a numerical integration of the perturbed motion must be started with the stated elements. On the other hand, the epoch is the instant for which the position of the minor planet in the ellipse is stated. That the epoch and date of osculation are here identical is simply a matter of convenience – a single date serves two purposes.

3.6 EPHEMERIS ACCURACY, A GENERAL DESCRIPTION

The principal part of the inaccuracy of an ephemeris computed from a given set of elements arises from the failure of those elements to fit exactly the actual positions of the minor planet at the times of observation. This may be due to errors in the observed positions themselves, to failure to fully compute the perturbations, to a distribution of observations that leads to a poorly conditioned determining matrix, or to other causes. Whatever the causes, the sizes of the residuals will usually be good indicators of the quality of the resulting orbital elements. A visual inspection of all the residuals is the best way to judge the quality of the elements, since it will reveal systematic trends that are often meaningful. A single number like the probable error (or mean error) of the mean daily motion lumps together the errors of observations, the blunders of computation, and the systematic trends, but usually provides a good and meaningful measure of the accuracy of the elements. In the present case, neither the residuals nor the probable errors are available for most of the minor planets. The only datum here available is the largest residual in right ascension, described earlier. This must necessarily be taken as the only available measure of the accuracy of the elements, or more particularly of the accuracy of the mean daily motion, since by far the largest part of the ephemeris error arises from this element, with the other elements playing only minor roles.

3.7 EMPIRICAL FORMULA DEVELOPMENT

In order to predict the ephemeris uncertainty, it was necessary to devise an empirical formula that utilized as well as possible the available data of somewhat doubtful quality. It is well known that the error in the mean daily motion is the most important source of error after a long time. During the computation of a predicted position, the mean daily motion is multiplied by the time interval since the epoch, while all the other elements are not so used. The problem of using the largest residual found during the orbit computations as a measure of the ephemeris accuracy is then the problem of converting this residual into an error in the mean daily motion. No rigorous theoretical basis exists for doing this. The method used was simply to assume that the error in the mean daily motion was equal to the quoted residual divided by the time interval covered by

the observations used in the orbit determination. In many cases, this will turn out to be a good assumption; in some cases it may be quite far from the truth. However, there is no apparent better way of proceeding.

A small error in the mean daily motion also arises from the limited precision with which the mean daily motion is quoted in Ephemerides of Minor Planets. This can give rise to an error as large as 0.0005 second of arc per day, which amounts to nearly 0.2 second of arc per year. After 20 years, which is often the interval since the epoch of the elements, this amounts to nearly four seconds of arc.

The epochs for current elements fall in the range of years from 1892 through 1969, with major clustering in 1951 (with 348 minor planets), 1957 (with 237 minor planets, and 1962 (with 395 minor planets).

Another small error arises from the limited precision with which the other elements are quoted in Ephemerides of Minor Planets. This error does not build up with the time.

Each of the above errors applies to the position as seen from the Sun. At opposition, the minor planet is one astronomical unit closer to the Earth than it is to the Sun; thus, the error computed from the empirical formula derived as outlined above must be multiplied by the factor A/(A-1), where A is the semi-major axis of the elliptical orbit.

To compute the ephemeris uncertainty, the sum of the two errors in the mean daily motion was multiplied by the interval between the year of interest and the earlier of (1) the year of the epoch or (2) a year near the middle of the interval covered by the observations on which the orbit determination was based. To this was added the constant error of 1.8 seconds or arc. This sum was then multiplied by the factor A/(A-1) to give the predicted ephemeris uncertainty in seconds of arc. The result was also reduced to kilometers in the orbit. Usually, 1 second of arc here corresponds to roughly 1000 kilometers; but the conversion factor depends, of course, upon the distance of the minor planet from the Earth.

This empirical formula, or procedure, has been used to estimate the ephemeris uncertainty for each of the numbered minor planets. A computer program provided a listing of the basic data, of the predicted uncertainties expressed in seconds of arc and in thousands of kilometers, and of brief remarks concerning a few special cases among the minor planets. The final computer listing of these results is shown in Appendix A. The computer program also writes all of this on a magnetic tape from which additional copies of the listing can be made directly.

The remark "LOST" appearing in Appendix A after 14 minor planets is self-explanatory.

The remark "ESTIMATED" appears after 46 minor planets. It indicates that for those minor planets the predicted uncertainty in seconds of arc was not computed from the empirical formula used for other minor planets. Instead, the uncertainty was estimated directly in seconds of arc, usually because the data needed by the empirical formula were either missing or inadequate. However, for the first four minor planets (Ceres, Pallas, Juno, and Vesta) it was estimated to be 1.0 second of arc because excellent orbit determinations and perturbations exist for these large and bright minor planets.

3.8 DISCUSSION OF SURVEY RESULTS

Results from the survey of published minor planet ephemeris data, primarily from Ephemerides of Minor Planets, can be summarized as follows:

a. The details of how the orbit determination was computed are not often published.

b. The only accuracy indicator provided by the published data is the maximum residual in right ascension.

c. Using an empirical relationship to estimate current ephemeris accuracies resulted in a wide range of ephemeris uncertainties. An attempt to improve this empirical relationship, based on data from a few selected minor planets, showed no significant change.

d. The survey showed that the published data provide ephemerides of acceptable accuracy for only a very few minor planets.

The distribution of the predicted uncertainties according to size, as taken directly from the computer listing of Appendix A, is shown in Table 3-1. It is hoped that the

accuracy of these estimated uncertainties is a little better than order-of-magnitude. At first sight, this may seem to be very low accuracy, but it should be noted that the estimated uncertainties range from 1 second of arc through 3000 seconds of arc. Thus, the presumed accuracy of the estimates is significant in that the numbered minor planets are separated into at least several groups between which the ephemeris uncertainties differ widely.

Table 3-1

DISTRIBUTION OF PREDICTED UNCERTAINTIES

Range (Seconds of Arc)	Number of Planets	Range (Seconds of Arc)	Number of Planets	Range (Seconds of Arc)	Number of Planets
0 - 10	49	0 - 100	1209	0 - 1000	1654
10 - 20	480	100 - 200	141	1000 - 2000	48
20 - 30	327	200 - 300	89	2000 - 3000	16
30 - 40	140	300 - 400	82	3000 - 4000	1
40 - 50	80	400 - 500	53		
50 - 60	49	500 - 600	26		
60 - 70	28	600 - 700	14	LOST	14
70 - 80	22	700 - 800	18		
80 - 90	21	800 - 900	13		
90 - 100	13	900 - 1000	9	ESTIMATED	46
	1209		1654		1779

Attempts were made to locate additional data in the literature with which to improve the accuracy of the predicted uncertainties. In the last century and during the early part of this one, all orbit determinations were published in considerable detail. This rarely happens now, presumably because of high cost and the desire to devote available space to other things. As a result, most orbit determinations for the numbered minor planets are not published outside of Ephemerides of Minor Planets, and a very condensed form is adopted for those that are published elsewhere. The additional data that were located in the literature added little that was new and helpful.

Accurate residuals with accurate perturbations included were computed for 21 numbered minor planets in an effort to calibrate or improve the empirical formula used. These residuals showed nothing unexpected and agreed with the estimated uncertainties within the (admittedly large) uncertainties of the uncertainties. No basis was found for attempting to make a significant improvement to the procedure adopted to estimate the ephemeris uncertainties or to the estimated uncertainties themselves. In a positive sense, the correctness of the early procedures was confirmed.

It is believed that the value of the results contained in the final listing would be lessened if any attempt were made to improve or change the predicted uncertainties for only a small portion of the planets. If this were done, the systematic and uniform basis for the results would be destroyed without any real gain. The final listing should remain as it now exists, and all effort in the future should be expended on an improved system for keeping track of the numbered minor planets.

Section 4
NEW SYSTEM FOR DETERMINING MINOR PLANET EPHEMERIDES

In the course of a survey of the accuracies with which the ephemerides of the numbered minor planets are currently known (the results of which are discussed in Section 3), it became increasingly apparent that not only were the uncertainties in most cases very large, but also that there exists at present no efficient method for using the available data. In this section a new system is described for determining the minor planet ephemerides. Numerical examples (based on the inadequate, low-quality orbit elements currently available) are included purely to illustrate the advantages of the new system. When fully implemented, this system will directly provide the information required by those involved with the ephemerides of the minor planets.

4.1 NEED FOR MORE DATA AND EPHEMERIDES

As a result of the perturbing influences of the major planets, the orbital elements and ephemerides of the minor planets are continually changing. Astronomers and mission analysts need a simple method for obtaining accurate data for specific dates. The astronomer may need data accurate for the date of his photograph or for an earlier date for which accurate position measurements have been made or published. The mission analyst may be planning a possible mission and thus requires the minor planet position several years in the future. The need for accurate orbit elements and positional coordinates of the minor planets at remote times is common to both the astronomer and the mission analyst.

The present system of publishing elements and opposition ephemerides of the numbered minor planets in the annual volumes of Ephemerides of Minor Planets provides the bare minimum of information needed by the astronomer, and almost none of the information needed by the mission analyst. For example, the opposition ephemeris gives an astronmer the means to point his photographic telescope at the minor planet, and auxiliary data given with the ephemeris permits him to identify the trail of the minor planet on his photograph with more or less certainty. No means whatever is provided for him

to compare an accurately measured position of the minor planet on his photograph with the position predicted by the published elements, and thus no monitoring of the accuracy of those elements is practicable. Similarly, the mission analyst wishes to find the position in space of the minor planet at some future date, with an accuracy of a very few thousands of kilometers. He cannot do this from the published orbital elements, because the perturbations since the epoch of those published elements may well amount to ten million kilometers or more.

The essential shortcoming of Ephemerides of Minor Planets is that the influences of the major planets are not available, and their computation is beyond the means of most astronomers and mission analysts. Thus, there is a need for a simple way to provide the perturbations in the osculating elements and in the rectangular coordinates relative to the published elements at the dates of osculation. These perturbations, added to the position derived through two-body formulae, will provide an accurate minor planet position. The astronomer will have a position as accurate as his measurement for comparison. The mission analyst will have a position for accurate planning of his mission.

A system developed to satisfy the needs of all those involved with the minor planets is described in the following paragraph.

4.2 THE NEW SYSTEM

The new system is characterized by the attempt to provide all of the data needed to satisfy the requirements of all users and to provide these data in a systematic and uniform manner for all of the numbered minor planets.

Elements of the new system are summarized as follows:

a. Orbit elements for all numbered minor planets are defined at a single date.
b. Orbit elements are advanced in 400-day intervals.
c. Integration and processing is done in groups of 50 minor planets.
d. The processing is highly efficient: 100 seconds of CDC6400 CPU time per 50 minor planets per 400 days at 4-day step intervals.

e. Perturbations in rectangular coordinates are computed only once for each minor planet in intervals of 4 days.

f. The new system provides:

- The osculating elements and their perturbations at intervals of 400 days over the years of interest, the angular elements being referred to mean ecliptic and equinox of 1950.0
- The rectangular coordinates and their perturbations at intervals of 4 days over the years of interest, referred to the mean equator and equinox of 1950.0

A standard date of 1972 October 10 was adopted. This corresponds to Julian Date 2441600.5 and is one of the standard 400-day dates recommended by the International Astronomical Union (i.e., the integral part is exactly divisible by 400). Nearby standard 400-day dates are given in Table 4-1. The data in the new system are then provided at the standard 400-day dates forward and backward from the adopted standard date.

A new observation is now never more than 200 days from a date of osculation, and the representation of the observation by means of the osculating two-body elements alone immediately gives an accuracy of a very few second of arc, since the perturbations over 200 days are very small. These perturbations are computed and tabulated between the 400-day dates at intervals of 4 days. When these perturbations in the rectangular coordinates are added to the rectangular coordinates computed from the osculating two-body elements, a perfect gravitational representation is achieved.

Perturbations in rectangular coordinates over an interval of 200 days are essentially independent of small errors in the osculating elements, and thus need to be computed only once. Since the dates of osculation of their orbit elements are all the same, perturbations for 50 minor planets are computed by numerical integration in a single computer run and output on tape for recovery as needed.

A significant benefit of the standardized nature of the new system lies in the efficiencies with which the data are computed for the approximately 1800 numbered minor planets. Thus, the data can be further and continually monitored and economically upgraded through the utilization of all past and current observations.

Table 4-1

STANDARD 400-DAY DATES

Julian Date	Calendar Date
243,0000.5	1941 Jan 6.0
0400.5	1942 Feb 10.0
0800.5	1943 Mar 17.0
1200.5	1944 Apr 20.0
1600.5	1945 May 25.0
2000.5	1946 Jun 29.0
2400.5	1947 Aug 3.0
2800.5	1948 Sep 6.0
3200.5	1949 Oct 11.0
3600.5	1950 Nov 15.0
4000.5	1951 Dec 20.0
4400.5	1953 Jan 23.0
4800.5	1954 Feb 27.0
5200.5	1955 Apr 3.0
5600.5	1956 May 7.0
6000.5	1957 Jun 11.0
6400.5	1958 Jul 16.0
6800.5	1959 Aug 20.0
7200.5	1960 Sep 23.0
7600.5	1961 Oct 28.0
8000.5	1962 Dec 2.0
8400.5	1964 Jan 6.0
8800.5	1965 Feb 9.0
9200.5	1966 Mar 16.0
9600.5	1967 Apr 20.0

Julian Date	Calendar Date
244,0000.5	1968 May 24.0
0400.5	1969 Jun 28.0
0800.5	1970 Aug 2.0
1200.5	1971 Sep 6.0
1600.5	1972 Oct 10.0
2000.5	1973 Nov 14.0
2400.5	1974 Dec 19.0
2800.5	1976 Jan 23.0
3200.5	1977 Feb 26.0
3600.5	1978 Apr 2.0
4000.5	1979 May 7.0
4400.5	1980 Jun 10.0
4800.5	1981 Jul 15.0
5200.5	1982 Aug 19.0
5600.5	1983 Sep 23.0
6000.5	1984 Oct 27.0
6400.5	1985 Dec 1.0
6800.5	1987 Jan 5.0
7200.5	1988 Feb 9.0
7600.5	1989 Mar 15.0
8000.5	1990 Apr 19.0
8400.5	1991 May 24.0
8800.5	1992 Jun 27.0
9200.5	1993 Aug 1.0
9600.5	1994 Sep 5.0
245,0000.5	1995 Oct 10.0

4.3 DATA FURNISHED BY THE NEW SYSTEM

Data furnished by the new system are written on two series of tapes; complete listings are impracticable because of the large volume of material involved. In one series the osculating elements, perturbations in the elements, and some associated data for all of the 50 minor planets in a group are written onto tape at each 400-day date. The most important of these data are listed. Samples of these listings are shown in Appendixes B, D, and E. In the other series, the rectangular coordinates for all of the 50 minor planets in a group are written onto tape at each 4-day date, but are listed for only one of the minor planets in the group. Samples of this listing are given in Appendix C.

In the first series, a tape (or file) contains one record for each group of 50 minor planets (the last record may contain fewer minor planets, but is of the same size with unused words containing hash). Each record has 2804 words, consisting of an initial four words that describe the record and 56 words of data for each of the 50 minor planets contained therein. Contents of the initial descriptive four words are:

1 Total number of minor planets in this record. Integer.
2 Number of words (56) occupied by each planet. Integer.
3 Relative address (2749) of last minor planet. Integer.
4 Dimension (2804) assigned to the array that holds this record. Integer.

These first four words of each record define a fixed table, which may be operated upon by several useful subroutines.

The beginning of the array ELM of dimensions (56, 50) immediately follows the fourth word. The array holds the osculating elements and associated data for the 50 minor planets contained in the record.

The quantities shown in Table 4-2 are given for each minor planet at 400-day intervals. Quantities marked with an asterisk are listed in Appendixes B and D. The data given in these appendixes are for ten 400-day intervals, starting with the initial date of osculation at October 10, 1972. All quantities are generated in single-precision floating-point arithmetic unless otherwise specified. At a rate of 556 bytes per inch, each record occupies about 5 feet of tape, and a complete file occupies about 200 feet.

In the second series, a tape contains one file for each group of 50 minor planets (the last file may contain fewer minor planets, but has the same number of records). Since the step interval for the numerical integration is 4 days, there are 115 records in a file. These records correspond to seven steps before the initial date of osculation, the initial date of osculation, the 100 steps through the final date of osculation, and seven steps after the final data of osculation. The complete data in 4-day steps for a single minor planet are contained in Appendix C for ten 400-day intervals starting with the initial date of osculation at October 10, 1972. Appendix E contains the same data in 400-day steps for 50 minor planets.

Each record (including the last one, wherein unused words contain hash) has 401 words and contains the quantities shown in Table 4-3. Each word is generated in single-precision floating-point arithmetic unless otherwise specified. At 800 bpi, each record occupies about 6 inches of tape, and each file occupies about 60 feet of tape. Thus, one 2400-foot tape can accommodate about 2000 minor planets over one 400-day interval.

Table 4-2

CONTENTS OF ELM FOR ONE MINOR PLANET – FIRST SERIES OF DATA TAPES

Word	Contents
1*	Number of the minor planet. Integer.
2	Reserved for the future
3-6*	Name of the minor planet. 4A4 format.
7-8*	Source from which the elements were taken. A4, I4 format. At present this is always EMP and year, where EMP stands for Ephemerides of Minor Planets.
9-11*	Author of the elements. 3A4 format.
12-15*	Reference, if any, to a known publication of the elements where more complete details are given (such as the observations used, their residuals, etc.). 4A4 format.
16*	Absolute magnitude of the minor planet, which is defined as the astronomical magnitude the minor planet would have if it were placed one astronomical unit from both Earth and Sun. Here expressed as an integer with unit of 0.1 astronomical magnitudes.
17*	Quality of the elements. Indicates the stage of improvement of the elements for this planet. Integer. -1 denotes a "lost" minor planet. 0 refers only to the minor planet, number 864, which is identical with minor planet 1078. 1 denotes the initial adopted elements. 2 denotes that the initial adopted elements have been improved by the method of Section 5.2 applied to one or two positions taken from an opposition ephemeris. 3 denotes that elements of lower quality have been improved by the method of Section 5 applied to one or more accurate observed positions.

*Quantities listed in Appendixes B and D

Table 4-2 (Cont.)

Word	Contents
18*	Integral part of the present Julian Date of osculation. Date of osculation is this number +0.5.
19-24	Double-precision equatorial coordinates at date of osculation. Mean equator and equinox of 1950.0.
25-30	Double-precision equatorial velocities at date of osculation. Mean equator and equinox of 1950.0. Unit of time is the mean solar day.
31*	Argument of perihelion in degrees at the date of osculation. Equinox 1950.0.
32*	Longitude of ascending node on the ecliptic in degrees at the date of osculation. Equinox 1950.0.
33*	Inclination to the ecliptic in degrees at the date of osculation. Equinox 1950.0.
34-42	Equatorial PQR matrix. This matrix rotates from orbital coordinates to equatorial coordinates at the date of osculation. Equinox 1950.0.
43*	Mean anomaly in degrees at the date of osculation.
44*	Semimajor axis at the date of osculation.
45*	Eccentricity at the date of osculation.
46*	Mean daily motion in seconds of arc per mean solar day at the date of osculation.
47*	Semiminor axis at the date of osculation.
48*	Integral part of the initial Julian Date. This initial Julian Date is defined as Julian Ephemeris Date 2441600.5 = 1972 October 10.0 Ephemeris Time.
49*	Perturbation in the mean anomaly at the present Julian Date of osculation and since the initial Julian Date. Expressed in degrees. See par. 4.4, Example 6.
50*	Perturbation in the argument of perihelion at the present Julian Date of osculation and since the initial Julian Date. Expressed in degrees. Equinox 1950.0.
51*	Perturbation in the longitude of the ascending node at the present Julian Date of osculation and since the initial Julian Date. Expressed in degrees. Equinox 1950.0 .
52*	Perturbation in the inclination at the present Julian Date of osculation and since the initial Julian Date. Expressed in degrees. Equinox 1950.0.

*Quantities listed in Appendixes B and D

Table 4-2 (Cont.)

Word	Contents
53*	Perturbation in the semimajor axis at the present Julian Date of osculation and since the initial Julian Date.
54*	Perturbation in the eccentricity at the present Julian Date of osculation and since the initial Julian Date.
55*	Perturbation in the mean daily motion at the present Julian Date of osculation and since the initial Julian Date. Expressed in seconds of arc per mean solar day.
56	Available for future use.

*Quantities listed in Appendix B and D

Table 4-3

CONTENTS OF SECOND SERIES OF DATA TAPES

Word	Contents	
1	Integral part of current Julian Date. Integer.	
2	Number of first minor planet in record. Integer.	
3	Quality of elements for first minor planet. Integer.	
4	Perturbed X-Coordinate	For first minor planet in record
5	Perturbed Y-Coordinate	
6	Perturbed Z-Coordinate	
7	Perturbation in X-Coordinate	For first minor planet
8	Perturbation in Y-Coordinate	
9	Perturbation in Z-Coordinate	
10	Number of second minor planet in record. Integer.	

Etc.

4.4 USE OF DATA FURNISHED BY THE NEW SYSTEM

The space ephemeris described in the previous section provides precisely the data required by the mission analyst. These same data are needed by the astronomer to

compute his opposition ephemeris or to represent his observed positions. He needs only to add the equatorial rectangular coordinates of the Sun to the perturbed equatorial rectangular coordinates taken from the space ephemeris. He obtains the equatorial rectangular coordinates of the minor planet referred to the observer as origin. From these, the astronomer easily computes the right ascension, declination, and other quantities in his opposition ephemeris, or the theoretical right ascension and declination at the date of his observation to compare with the observed right ascension and declination.

The data provided by the new system can be used in two basically different situations. In the first situation, the most accurate elements available to define the orbit of the minor planet are assumed to be those used to compute the data on the tapes and listings. In this case, all of the data are correct and may be used directly. In the second situation, it is assumed that a more accurate set of elements is available, differing only small amounts from the elements used to compute the taped and listed data. In this case, only the perturbations in the elements and in the rectangular coordinates should be used. Results will not be exactly correct, since the perturbations were computed about a different orbit, but they will be sufficiently accurate for most purposes.

Typical uses of the data on the tapes and in the listings include the following examples:

1. Obtain the perturbed equatorial rectangular space coordinates of a minor planet at a tabulated 4-day Julian Ephemeris Date. Assume the given orbital data.
2. Obtain the perturbations in the equatorial rectangular space coordinates of a minor planet at a tabulated Julian Ephemeris Date. Orbital data may be as given, or improved.
3. Same as example 1, except that coordinates are required at an untabulated Julian Ephemeris Date.
4. Same as example 2, except that perturbations are required at an untabulated Julian Ephemeris Date.
5. Determine the perturbed coordinates at a specified Julian Ephemeris Date from a set of improved elements.
6. Determine the mean anomaly at a specified Julian Ephemeris Date for a set of improved elements.

These uses of the data are best explained by specific numerical examples, which will also help to define the exact meaning of the various kinds of data provided.

Example 1: Rectangular Coordinates at a 4-Day Point. Suppose that the most accurate orbit available for the minor planet 1 Ceres is that used in computing the tabulated data, and that the perturbed equatorial rectangular space coordinates are wanted for Julian Ephemeris Date 2442164.5. This date is 164 days later than the immediately preceeding 400-day date (Julian Ephemeris Date 24420000.5). Also, 164 is exactly divisible by 4, thus the required date is a tabulated 4-day point. Referring to the format description for the second series of tapes (par. 4.3) the required coordinates appear in words 4, 5, and 6 under Julian Ephemeris Date 2442164 and minor planet number 1. Line 42 of the listing in Appendix C contains these quantities, expressed in astronomical units. They are:

X = 2.0544716593
Y = -1.7549533520
Z = -1.2457539671

Example 2: Perturbations at a 4-Day Point. Suppose that the perturbations in the equatorial rectangular space coordinates with respect to elements osculating at the immediately preceding 400-day date are wanted for the minor planet 1 Ceres at Julian Ephemeris Date 2442164.5 This example will provide the perturbations either in the given elements, or in improved elements when differences are small. Proceeding as in the previous example, the required perturbations appear on the second series of tapes in words 7, 8, and 9 under Julian Date 2442164 and minor planet number 1. Line 42 of the listing in Appendix C also contains these quantities, expressed in astronomical units. They are:

del X = 0.0003656068
del Y = -0.0000453460
del Z = 0.0000252780

These perturbations for minor planet 1 Ceres correspond to about 55,000 kilometers in 164 days, or to about 30 seconds of arc as seen from the Earth at opposition. These amounts can be much larger or smaller for other minor planets.

Example 3: Interpolation for Rectangular Coordinates Between 4-Day Points. If the date in the first example were not a tabular date, then the coordinates would have to be interpolated from the given table. This can be done easily with the Zig-Zag interpolation formula, which is

$$X_n = X_O + C_1D_1 + C_2D_2 + C_3D_3 + C_4D_4 + \cdots\cdots$$

where

- X is the function being interpolated
- X_n is the required interpolated value
- X_O is the preceding tabular value
- D_1 is the 1-st difference on the half-line below X_O
- D_2 is the 2-nd difference on the line through X_O
- D_3 is the 3-rd difference on the half-line below X_O
- D_4 is the 4-th difference on the line through X_O; etc.
- n is the fractional way from the preceding tabular point to the following tabular point

$C_1 = n$

$C_2 = n(n-1)/2!$

$C_3 = (n+1)n(n-1)/3!$

$C_4 = (n+1)n(n-1)(n-2)/4!$

$C_5 = (n+2)(n+1)n(n-1)(n-2)/5!$

etc.

As many differences as necessary to attain the required accuracy must first be computed from the tabular values for each of the coordinates. Then the corresponding number of C's must be computed.

Suppose that the perturbed equatorial rectangular space coordinates of the minor planet 1 Ceres are wanted for Julian Ephemeris Date 2442166.1, assuming the given orbit. For this date n = 0.4. Details of the interpolation are shown only for the X coordinate. The coordinate and differences to be used in the formula are underlined in the following table.

2442156.5	1.9987483181			
		+280436849		
60.5	2.0267920030		-3640286	
		+276796563		-46323
64.5	2.0544716593		-3686609	+609
		+273109954		-45714
68.5	2.0817826547		-3732323	+615
		+269377631		-45099
72.5	2.1087204178		-3777422	
		+265600209		
76.5	2.1352804387			

C_1 = +.4

C_2 = -.12

C_3 = -.156

C_4 = +.0224

X_n = 2.0654405541

Example 4: Interpolation for Perturbations Between 4-Day Points. If the date in the second example were not a tabular date, then the perturbations would have to be interpolated from the given table, just as were the coordinates in the previous example. Suppose the required date is the same; viz., 2442166.1. Then the values of the C's are the same, and the difference table is:

2442156.5	3262537			
		+193477		
60.5	3456014		+6577	
		+200054		+74
64.5	3656068		+6651	+11
		+206705		+85
68.5	3862773		+6736	+15
		+213441		+100
72.5	4076214		+6836	
		+220277		
76.5	4296491			

The interpolated value is del X_n = .0003737947

It is to be noted that the differences of the perturbations are appreciably smaller than those of the coordinates, and this fact makes the interpolations a little easier.

Example 5: Rectangular Coordinates for an Improved Orbit. Suppose that an improved set of orbit elements is available, osculating at the 400-day date preceding the date at which perturbed coordinates are wanted. The basic steps in the procedure for obtaining the required coordinates at a future date are as follows:

- Compute the unperturbed rectangular coordinates at the desired Julian Date from the improved set of osculating elements, using two-body formulae.
- Determine the perturbations at the desired future Julian Date, interpolating as in the previous example, if required.
- Add the perturbations to the unperturbed coordinates to obtain the perturbed rectangular coordinates at the desired Julian Date.

Purely as an illustration of the procedure, suppose that the improved osculating elements are in fact those used to compute the data and listings provided, and that the perturbed rectangular coordinates are wanted at Julian Ephemeris Date 2442164.5, as in the first example. The values obtained in the first example should result from the procedure and will serve as an informative check on the procedure computations, which were performed on an HP-45 calculator.

The orbital values required for this numerical example are contained on the appropriate tape in the first series. With the exception of the PQR matrix, the required values are listed in Appendix B. The first requirement, then, is to compute the PQR matrix (which rotates coordinates from the orbit plane to the equatorial system) according to the following formulae:

$$
\begin{aligned}
P_x &= +\cos\Omega\cos\omega - \sin\Omega\sin\omega\cos i \\
P_y &= (+\sin\Omega\cos\omega + \cos\Omega\sin\omega\cos i)\cos\epsilon - \sin\omega\sin i\sin\epsilon \\
P_z &= (+\sin\Omega\cos\omega + \cos\Omega\sin\omega\cos i)\sin\epsilon + \sin\omega\sin i\cos\epsilon \\
Q_x &= -\cos\Omega\sin\omega - \sin\Omega\cos\omega\cos i \\
Q_y &= (-\sin\Omega\sin\omega + \cos\Omega\cos\omega\cos i)\cos\epsilon - \cos\omega\sin i\sin\epsilon \\
Q_z &= (-\sin\Omega\sin\omega + \cos\Omega\cos\omega\cos i)\sin\epsilon + \cos\omega\sin i\cos\epsilon \\
R_x &= +\sin\Omega\sin i
\end{aligned}
$$

$$R_y = -\cos \Omega \sin i \cos \epsilon - \cos i \sin \epsilon$$
$$R_z = -\cos \Omega \sin i \sin \epsilon + \sin i \cos \epsilon$$

where

- ω denotes the argument of perihelion
- Ω denotes the longitude of the ascending node
- i denotes the inclination
- ϵ denotes the obliquity of the ecliptic for 1950.0

From the listings of Appendix B, we have

ω	(=ARGPER)	=	$70^{\circ}.19002182$
Ω	(=NODE)	=	$80^{\circ}.41833167$
i	(=INCLINATION)	=	$10^{\circ}.60075242$

and for the equinox of 1950.0

$$\epsilon = 23^{\circ}.44578785$$

Substituting these values in the formulae, the components of the PQR matrix are

$$P_x = -0.8554523125$$
$$P_y = 0.3789403134$$
$$P_z = 0.3529951552$$
$$Q_x = -0.4850733612$$
$$Q_y = -0.8250389098$$
$$Q_z = -0.2898527754$$
$$R_x = 0.1813978365$$
$$R_y = -0.4191837735$$
$$R_z = 0.8895952949$$

(Useful checks on the PQR components, which are direction cosines, are that the sum of the squares of any row (or column) of components should equal unity, and that the dot product of any two rows (or columns) should equal zero.)

We are now in a position to compute the required rectangular coordinates X, Y, Z:

(a) Compute

$$M = Mo + n\,(JD - JDo)$$

where

- JDo denotes the Julian Date at osculation
- JD denotes the Julian Date for which the coordinates are required
- n denotes the mean daily motion
- Mo denotes the mean anomaly at JDo
- M denotes the mean anomaly at JD

From Appendix B

JDo	(=IJDOSC + 0.5)	=	2442000.5
n	(=MEAN MOTION)	=	770".4945317
Mo	(=MEAN ANOMALY)	=	$126^{\circ}.4530634$

and

$$JD = 2442164.5$$

Therefore

$$M = 161^{\circ}.5533699 = 2.819638223 \text{ rads}$$

(b) Compute E from

$$E - e \sin E = M$$

where

- E denotes the eccentric anomaly
- e denotes the eccentricity

From Appendix B

$$e \text{ (=ECCENTRICITY)} = 0.07829883826$$

Then E is obtained iteratively in the following manner:

- Assume first approximation $E_1 = M$ radians
- Compute $M_1 = E_1 - e \sin E_1$
- Compute $E_2 = E_1 + \dfrac{M - M_1}{1 - e \cos E_1}$

- Compute $M_2 = E_2 - e \sin E_2$
- Continue iterating until change in E is negligible

Thus

$$E = 2.842694665 \text{ rads} = 162^{\circ}.8744067$$

(c) Compute

$$\overline{X} = a(\cos E - e)$$
$$\overline{Y} = b \sin E$$

where

$$b = a(1 - e^2)^{1/2}$$

and a denotes the semi-major axis.

From Appendix B

$$a \quad (=\text{SEMI-MAJOR AXIS}) = 2.767948524$$

therefore

$$\overline{X} = -2.861949202$$
$$\overline{Y} = 0.812567832$$

(d) Compute the unperturbed coordinates.

$$\begin{pmatrix} X' \\ Y' \\ Z' \end{pmatrix} = \begin{pmatrix} P_x & Q_x & R_x \\ P_y & Q_y & R_y \\ P_z & Q_z & R_z \end{pmatrix} \begin{pmatrix} \overline{X} \\ \overline{Y} \\ O \end{pmatrix}$$

Thus

$$X' = 2.054106054$$
$$Y' = -1.754908006$$
$$Z' = -1.245779244$$

(e) Compute the perturbed coordinates by addition of the perturbations obtained in the second example above.

Thus

X = 2.054471661

Y = -1.754953352

Z = -1.245753966

Comparison with the values in the first example validates the computations.

Example 6: The Mean Anomaly for an Improved Orbit. Perturbations in the orbital elements contained in Appendix D are, except for the case of the mean anomaly, simply the differences between the elements contained in Appendix B at the corresponding date and at the initial date. The perturbation in the mean daily motion for 1 Ceres at 2443600.5, for example, is obtained as follows:

From Appendix B, the mean daily motion, n,

at JD 2443600.5 = 770.58375366239

at JD 2441660.0 = 771.16700000000

Difference in n = -0.58324633761

This is precisely the value for the perturbation in n, DEL MDM, tabulated in Appendix D for JD 2443600.5.

The mean daily motion is constant in an unperturbed orbit. Any change in its value with time is due solely to the perturbations of the major planets. The same is true for any element.

The mean anomaly is not an element in the usual sense, since it changes linearly with time in an unperturbed orbit. It is therefore given by the formula

$$M = M_o + n\ (JD - JD_o)$$

Thus the total perturbation in M consists of perturbations in the individual quantities M_o and n. The quantity called DEL MO in Appendix D is the perturbation in M_o only. To this must be added the effect of the perturbation in n, and this effect is in fact

an integral. For a tabular 400-day date this integral is the sum of all preceding values of DEL MDM multiplied by 400. M is expressed in degrees, while n is expressed in seconds of arc; thus in practice the sum of the tabular values is multiplied by 400/3600, or divided by 9.

The total perturbation of M could have been computed directly instead of that for M_o, but this quantity would be tied to the initial standard date rather than to the preceding 400-day date. A considerable loss in flexibility would result.

As an illustration, find the value of M for 1 Ceres at 2443600.5 from the perturbations in Appendix D. Proceed as follows:

(a) From Appendix B, obtain the mean anomaly and mean daily motion for 1 Ceres at Julian Date JD_o = 2441600.5

$M_o = 41^o.19588888888$

$n_o = 771''.16700000000$

(b) Compute the unperturbed mean anomaly at JD = 2443600.5

$JD - JD_o = 2000.0$

Thus

$$M = M_o + 2000 \times \frac{771.16700000000}{3600}$$

$$= 469^o.62199999999$$

Subtracting 360^o, the unperturbed mean anomaly at 2443600.5 is $109^o.62199999999$.

(c) Compute the perturbation in n. From Appendix D, obtain the values of DEL MDM preceding 2443600.5. These are

JD =	2442000.5	DEL MDM = - 0.67246831416
	2442400.5	- 1.93973984903
	2442800.5	- 0.15878519331
	2443200.5	- 0.21417159313

The sum of the DEL MDM values is - 2.98516494963. Dividing by 9, the effect of the perturbation in n is

- 0.331684994403

(d) From Appendix D, obtain the perturbation in M_o at JD 2443600.5. This is

DEL MO = -3.422076800154

(e) The total perturbation is then the sum of the values obtained in (c) and (d) above. This is

- 3.753761794557

(f) Obtain the perturbed mean anomaly by adding the total perturbation in (e) to the unperturbed value in (b)

M = 105.868238205442

This value compares closely with the perturbed mean anomaly at 2443600.5 tabulated in Appendix B for 1 Ceres, which is

M = 105.868238205548

The computations using the perturbations are thus confirmed.

Section 5
IMPROVED EPHEMERIS ACCURACY

It has been noted in the preceding sections that the elements initially adopted were obtained from published elements without the inclusion of perturbations over the often long intervals of time from the dates of osculation in the published elements to the initial 400-day date. The required numerical integration of these perturbations planet-by-planet was not practical within the contract period. In this section, provisional improvement of the initial elements is discussed and the theory of a method to do this for a minor planet orbit is developed.

The basic idea behind the theory depends on the known fact that by far the largest part of the error in the position of a minor planet usually lies in its mean anomaly. A change in the mean anomaly coupled with a small rotation of the orbit plane and no changes in the other elements can always be made to fit an observed or ephemeris position, and thus to produce better osculating elements at and near that date.

A suggested procedure to find suitable initial elements for all of the numbered minor planets is outlined in Figure 5-1. The reduction of published elements for all of the planets to the initial 400-day date with two-body formulas has been done. The basic program for numerical integration from the published epochs to the initial 400-day date is now available for use with those minor planets that possess good elements and thus deserve this relatively expensive treatment. For those minor planets that do not have good elements, the appropriate improvement method discussed below may be used.

5.1 IMPROVEMENT OF ELEMENTS FROM CURRENT OBSERVATIONS

The direct and efficient method developed in par. 5.3, of improving the accuracy of the minor planet elements at the adopted standard date (October 10, 1972), uses recent observations taken less than about 200 days from the standard date. During the time

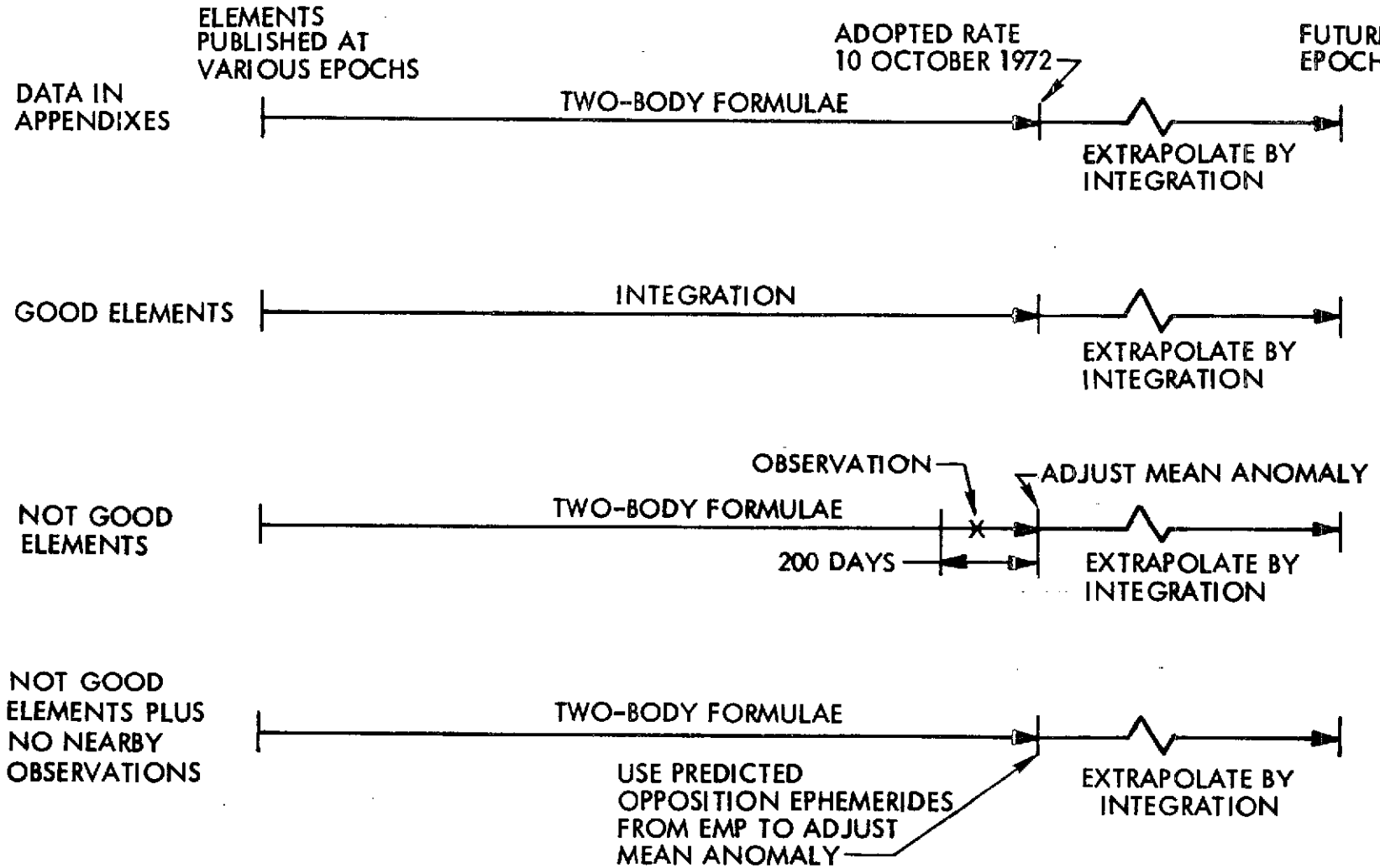

Figure 5-1 Minor Planet Accuracy Initial Improvement

within the 200-day interval, the effect of perturbations is negligible, and therefore orbit element improvements can be made using only two-body formulae. Unfortunately, only a few minor planets have available observations within 200 days from the adopted date.

An alternative is to make use of positions observed earlier. However, to attempt an improvement with observations several hundreds of days earlier than the standard date would increase the accuracy of the elements only if the perturbations are included. The means for improving orbital elements, using recent observations including effects of perturbations, is included in the new system. The theory is presented in par. 5.3.

5.2 IMPROVEMENT OF INITIAL ELEMENTS FROM PUBLISHED EPHEMERIDES

Instead of using current or recent observations to improve initial orbital elements, predicted opposition ephemerides from the published Ephemerides of Minor Planets can be used. These predicted positions are close (within 200 days) to the adopted date and therefore perturbation effects can be neglected. Furthermore, these predicted positions have been computed including perturbations from epoch to the date of tabulated ephemeris position. Therefore, the theory described in par. 5.3 can be applied directly to improving orbit elements at the adopted date.

5.3 THEORY OF ORBIT IMPROVEMENT METHOD

Suppose we have one perfect observation of a minor planet. How can we use this to improve the orbit of the minor planet?

An observation of a minor planet consists of two independent quantities; e.g., right ascension and declination. Thus, one observation imposes two conditions on the orbit; or, in other words, two orbital elements can be determined from one observation, provided the other four elements are otherwise known.

Here we propose to determine from the one observation the corresponding eccentric anomaly, E, and an angle θ, through which the assumed orbit plane must be rotated about a line in itself in order to obtain the actual orbit plane. The location in the orbit

plane of the axis of this rotation is arbitrary, but it should be nearly perpendicular to the radius vector in order to minimize the size of the rotation.

The assumed orbit plane is defined by a set of published or otherwise given angular elements ω^o, Ω^o, and i^o. The small rotation θ will, in general, cause small changes in each of these angular elements. The value found for the eccentric anomaly determines the mean anomaly at Epoch, since both a and e are not changed. Thus, four of the six elements are here modified by the two conditions provided by a single observation; these are M_o, ω, Ω, and i.

5.3.1 Rotation of Orbit Plane. Given a rectangular coordinate system $\bar{x}^o$, $\bar{y}^o$, $\bar{z}^o$ based on the assumed orbit plane as the $\bar{x}^o\,\bar{y}^o$-plane and let γ be the angle in this plane from the positive $\bar{x}^o$-axis to the positive axis of rotation. Given also a rectangular coordinate system $\bar{x}$, $\bar{y}$, $\bar{z}$ based on the actual orbit plane as the $\bar{x}\,\bar{y}$-plane, then the rotation matrix connecting the rectangular coordinate systems based on the assumed and actual orbit planes is obtained by three successive rotations; (1) about the $\bar{z}^o$ -axis through the angle γ, (2) about the resulting x-like axis through the angle θ, and (3) about the $\bar{z}$-axis through the angle $-\gamma$. Denote this rotation matrix by A, then

$$\begin{pmatrix} \bar{x} \\ \bar{y} \\ \bar{z} \end{pmatrix} = A \begin{pmatrix} \bar{x}^o \\ \bar{y}^o \\ \bar{z}^o \end{pmatrix}$$

$$A = \begin{pmatrix} \cos\gamma & -\sin\gamma & 0 \\ \sin\gamma & \cos\gamma & 0 \\ 0 & 0 & 1 \end{pmatrix} \begin{pmatrix} 1 & 0 & 0 \\ 0 & \cos\theta & \sin\theta \\ 0 & -\sin\theta & \cos\theta \end{pmatrix} \begin{pmatrix} \cos\gamma & \sin\gamma & 0 \\ -\sin\gamma & \cos\gamma & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

$$A = \begin{pmatrix} 1 - \sin\gamma\sin\gamma\,(1-\cos\theta) & \sin\gamma\cos\gamma\,(1-\cos\theta) & -\sin\gamma\sin\theta \\ \cos\gamma\sin\gamma\,(1-\cos\theta) & 1 - \cos\gamma\cos\gamma\,(1-\cos\theta) & \cos\gamma\sin\theta \\ \sin\gamma\sin\theta & -\cos\gamma\sin\theta & \cos\theta \end{pmatrix}$$

Let $\gamma = f + 90^o$, where f is the true anomaly of the radius vector.

Then

$$\left.\begin{aligned} \sin\gamma &= \cos f \\ \cos\gamma &= -\sin f \end{aligned}\right\}, \quad \left.\begin{aligned} \sin\gamma\cos\gamma &= -\sin f \cos f \\ \sin\gamma\sin\gamma &= \cos f \cos f \\ \cos\gamma\cos\gamma &= \sin f \sin f \end{aligned}\right\}$$

$$A = \begin{pmatrix} 1 - \cos f \cos f\ (1 - \cos\theta) & -\cos f \sin f\ (1 - \cos\theta) & -\cos f \sin\theta \\ -\sin f \cos f\ (1 - \cos\theta) & 1 - \sin f \sin f\ (1 - \cos\theta) & -\sin f \sin\theta \\ \cos f \sin\theta & \sin f \sin\theta & \cos\theta \end{pmatrix}$$

The expected size of the angle θ is of the order of a few seconds of arc, or at most a few minutes of arc. Even for the extreme angle of one degree:

$$\sin\theta = .00175 \qquad \cos\theta = .99985 \qquad 1 - \cos\theta = .00015$$

Thus, to the accuracy needed in practice, the matrix A reduces to

$$A = \begin{pmatrix} 1 & 0 & -\cos f \sin\theta \\ 0 & 1 & -\sin f \sin\theta \\ \cos f \sin\theta & \sin f \sin\theta & 1 \end{pmatrix}$$

The complete matrix A may be written

$$A = I + B$$

where

$$B = \begin{pmatrix} -\cos f \cos f\ (1 - \cos\theta) & -\cos f \sin f\ (1 - \cos\theta) & -\cos f \sin\theta \\ -\sin f \cos f\ (1 - \cos\theta) & -\sin f \sin f\ (1 - \cos\theta) & -\sin f \sin\theta \\ \cos f \sin\theta & \sin f \cos\theta & -(1 - \cos\theta) \end{pmatrix}$$

Now

$$A^{-1} = I + \tilde{B}$$

thus

$$\begin{pmatrix} \bar{x}^o \\ \bar{y}^o \\ \bar{z}^o \end{pmatrix} = A^{-1} \begin{pmatrix} \bar{x} \\ \bar{y} \\ \bar{z} \end{pmatrix} = \begin{pmatrix} \bar{x} \\ \bar{y} \\ \bar{z} \end{pmatrix} + \tilde{B} \begin{pmatrix} \bar{x} \\ \bar{y} \\ \bar{z} \end{pmatrix}$$

Since

$$\begin{aligned} \bar{x} &= r \cos f \\ \bar{y} &= r \sin f \\ \bar{z} &= 0 \end{aligned}$$

$$\tilde{B} \begin{pmatrix} \bar{x} \\ \bar{y} \\ \bar{z} \end{pmatrix} = r \begin{pmatrix} -\cos f & (1 - \cos\theta) \\ -\sin f & (1 - \cos\theta) \\ & -\sin\theta \end{pmatrix}$$

Hence

$$\begin{pmatrix} \bar{x}^o \\ \bar{y}^o \\ \bar{z}^o \end{pmatrix} = \begin{pmatrix} \bar{x} \\ \bar{y} \\ \bar{z} \end{pmatrix} - r \begin{pmatrix} \cos f & (1 - \cos\theta) \\ \sin f & (1 - \cos\theta) \\ & -\sin\theta \end{pmatrix}$$

5.3.2 Basic Equations in the Assumed Orbit Plane. The equations connecting the observer, the Sun, and the minor planet may be written

$$\begin{aligned} \rho\bar{\lambda}^o &= \bar{x}^o + \bar{X}^o \\ \rho\bar{\mu}^o &= \bar{y}^o + \bar{Y}^o \\ \rho\bar{\nu}^o &= \bar{z}^o + \bar{Z}^o \end{aligned}$$

where $\bar{X}^o$, $\bar{Y}^o$, $\bar{Z}^o$ are the coordinates of the Sun with respect to the observer; $\bar{\lambda}^o$, $\bar{\mu}^o$, $\bar{\nu}^o$ are the direction cosines of the right ascension and declination measured by the observer; and ρ is the distance between the observer and the minor planet.

Substitute for the coordinates $(\bar{x}^o, \bar{y}^o, \bar{z}^o)$ relative to the assumed orbit plane the coordinates $(\bar{x}, \bar{y}, \bar{z})$ relative to the actual orbit plane. Then

$$\rho \begin{pmatrix} \bar{\lambda}^o \\ \bar{\mu}^o \\ \bar{\nu}^o \end{pmatrix} = \begin{pmatrix} \bar{x} \\ \bar{y} \\ \bar{z} \end{pmatrix} + \begin{pmatrix} \bar{X}^o \\ \bar{Y}^o \\ \bar{Z}^o \end{pmatrix} - r \begin{pmatrix} \cos f \ (1 - \cos\theta) \\ \sin f \ (1 - \cos\theta) \\ -\sin\theta \end{pmatrix}$$

Explicitly, the basic equations become:

$$\left.\begin{aligned} \rho\bar{\lambda}^o &= a\ (\cos E - e) + \bar{X}^o - r \cos f\ (1 - \cos\theta) \\ \rho\bar{\mu}^o &= b \sin E + \bar{Y}^o - r \sin f\ (1 - \cos\theta) \\ \rho\bar{\nu}^o &= 0 + \bar{Z}^o + r \sin\theta \end{aligned}\right\} \quad (1)$$

5.3.3 Solution of Basic Equations. Since θ is so small, $(1 - \cos\theta)$ is negligible in the first approximation. To exploit this fact, let

$$\left.\begin{aligned} \bar{X}' &\equiv \bar{X}^o - r \cos f\ (1 - \cos\theta) \\ \bar{Y}' &\equiv \bar{Y}^o - r \sin f\ (1 - \cos\theta) \end{aligned}\right\} \quad (2)$$

Thus, the basic equations (1) may be written:

$$\left.\begin{aligned} \rho\bar{\lambda}^o &= a\ (\cos E - e) + \bar{X}' \\ \rho\bar{\mu}^o &= b \sin E + \bar{Y}' \\ \rho\bar{\nu}^o &= + \bar{Z}^o + r \sin\theta \end{aligned}\right\} \quad (3)$$

In the first approximation the terms in $(1 - \cos\theta)$ are set to zero, and in subsequent approximations they are computed from the previous approximation. In this way the first two of the above equations are used to determine ρ and E, while the last is used to determine $\sin\theta$.

To solve for ρ and E, write

$$\left.\begin{aligned} \cos E &= \left[\bar{\lambda}^o \rho - (\bar{X}' - ae) \right]/a \\ \sin E &= \left[\bar{\mu}^o \rho - \bar{Y}' \right]/b \end{aligned}\right\} \quad (4)$$

$$\therefore 1 = (\bar{\lambda}^o \rho - \bar{X}' + ae)^2/a^2 + (\bar{\mu}^o \rho - \bar{Y}')^2/b^2$$

or

$$b^2(\bar{\lambda}^o \rho - \bar{X}' + ae)^2 + a^2(\bar{\mu}^o \rho - \bar{Y}')^2 = a^2 b^2$$

$$\left[a^2 \bar{\mu}^{o2} + b^2 \bar{\lambda}^{o2}\right]\rho^2 - 2\left[a^2 \bar{\mu}^o \bar{Y}' + b^2 \bar{\lambda}^o (\bar{X}' - ae)\right]\rho + \left[a^2 \bar{Y}'^2 + b^2 (\bar{X}' - ae)^2 - a^2 b^2\right] = 0$$

But

$$b^2 = a^2 (1 - e^2)$$

$$\left.\begin{aligned} \therefore \left[\bar{\mu}^{o2} + (1 - e^2)\, \bar{\lambda}^{o2}\right]\rho^2 - 2\left[\bar{\mu}^o \bar{Y}' + (1 - e^2)\, \bar{\lambda}^o (\bar{X}' - ae)\right]\rho \\ + \left[\bar{Y}'^2 + (1 - e^2)\, (\bar{X}' - ae)^2 - b^2\right] = 0 \end{aligned}\right\} \quad (5)$$

The solution (or solutions) to this quadratic is the required distance ρ. Then cos E and sin E follow from (4), $r = a\ (1 - e \cos E)$, θ is obtained from the third of (3), and a new iteration can be started with the computation of $\bar{X}'$ and $\bar{Y}'$ from equation (2).

When the iterations have converged, the mean anomaly (M_o) at Epoch is obtained from

$$M_o = E - e \sin E + n(t - t_o)$$

Finally, the rotation matrix, A, is computed with θ and applied to the given PQR matrix to obtain the improved PQR matrix, from which the improved values of ω, Ω, and i may be computed by standard formula, if desired.

To examine the values of the roots of the quadratic (5), suppose e = 0 and $(1 - \cos\theta) = 0$. Then

$$(\bar{\lambda}^{o2} + \bar{\mu}^{o2})\rho^2 - 2(\bar{\lambda}^o \bar{X}^o + \bar{\mu}^o \bar{Y}^o) + (\bar{X}^{o2} + \bar{Y}^{o2} - a^2) = 0$$

Neglecting the small effect of all Z - terms, we have

$$\bar{\lambda}^{o2} + \bar{\mu}^{o2} = 1, \quad \bar{\lambda}^o \bar{X}^o + \bar{\mu}^o \bar{Y}^o = R\cos\psi, \quad \bar{X}^{o2} + \bar{Y}^{o2} = R^2$$

$$\rho^2 - 2\rho R\cos\psi + (R^2 - a^2) = 0$$

$$(\rho - R\cos\psi)^2 - (a^2 - R^2\sin^2\psi) = 0$$

$$\rho = R\cos\psi \pm \sqrt{a^2 - R^2\sin^2\psi}$$

In the neighborhood of opposition $\cos\psi = -1$, and there

$$(\rho + 1)^2 = a^2$$

$$\rho = a - 1 \quad \text{or} \quad -a - 1$$

Hence, only one positive root is possible there, and its value agrees with the value seen from the geometrical relations.

Roots of the general equation represent the distance from the observer to a point on the minor planet orbit in the direction observed. So long as the minor planet orbit lies outside that of the Earth, only one positive root is possible. If, however, the minor planet orbit penetrates that of the Earth, then a second positive root may be possible.

As soon as the distance ρ is obtained from the quadratic equation, sin E, cos E, sin f, cos f, r, etc., follow immediately. Then

$$r \sin \theta = \bar{\nu}^{o} \rho - Z^{o}$$

and the solution is complete to the accuracy of the approximation.

The value for ρ obtained from the first approximation will probably always be sufficient. However, the solution of the basic equations can always be obtained to any desired accuracy in a practical case by easy iterations. In each iteration the values from the previous iteration are used to compute the terms neglected in the first approximation, and the iteration then proceeds exactly as in the first approximation.

Section 6
COMPUTER PROGRAM

Described in this section are the computer programs that were developed to provide the new system discussed in Section 4. A general overview of the program capabilities is given, and the numerical integration techniques employed are described. In addition, two data tapes, which were received to assist the contract work, are reviewed. The computer programs developed during the study are listed and briefly described in Appendix F.

Almost all programs were written in FORTRAN IV, and features peculiar to local installations were usually avoided. Advantage was taken of the 60-bit word length of the CDC6400, and conversion to a machine with a shorter word length would be difficult. Compilation and runs were done under a local version (CALIDOSCOPE) of the SCOPE operating system. Active programs and subroutines were maintained in a library kept in a permanent file on disk. The Berkeley machine has four tape drives, but no program requires more than two. Extended core storage was not directly used. The largest programs required about 70,000 (octal) words of central memory.

6.1 GENERAL PROGRAM LAYOUT

An overview of the computer programs is shown in Figure 6-1. The published minor planet elements at Epoch are reduced to the standard date with no perturbations and output on tape. Two subprograms are available for improving the taped elements at the standard date according to the data available. The taped elements are then input to a subprogram whose primary function is to integrate, forward or backward, the rectangular coordinates of 50 minor planets for one 400-day interval. Two series of tapes are produced (see par. 4.3). The first series is designated Tape B in Figure 6-1 (Tape A is an initial version to start the process) and contains the elements of the minor planets and associated data. The second series is designated Tape C and contains the rectangular coordinates and perturbations with respect to the preceding

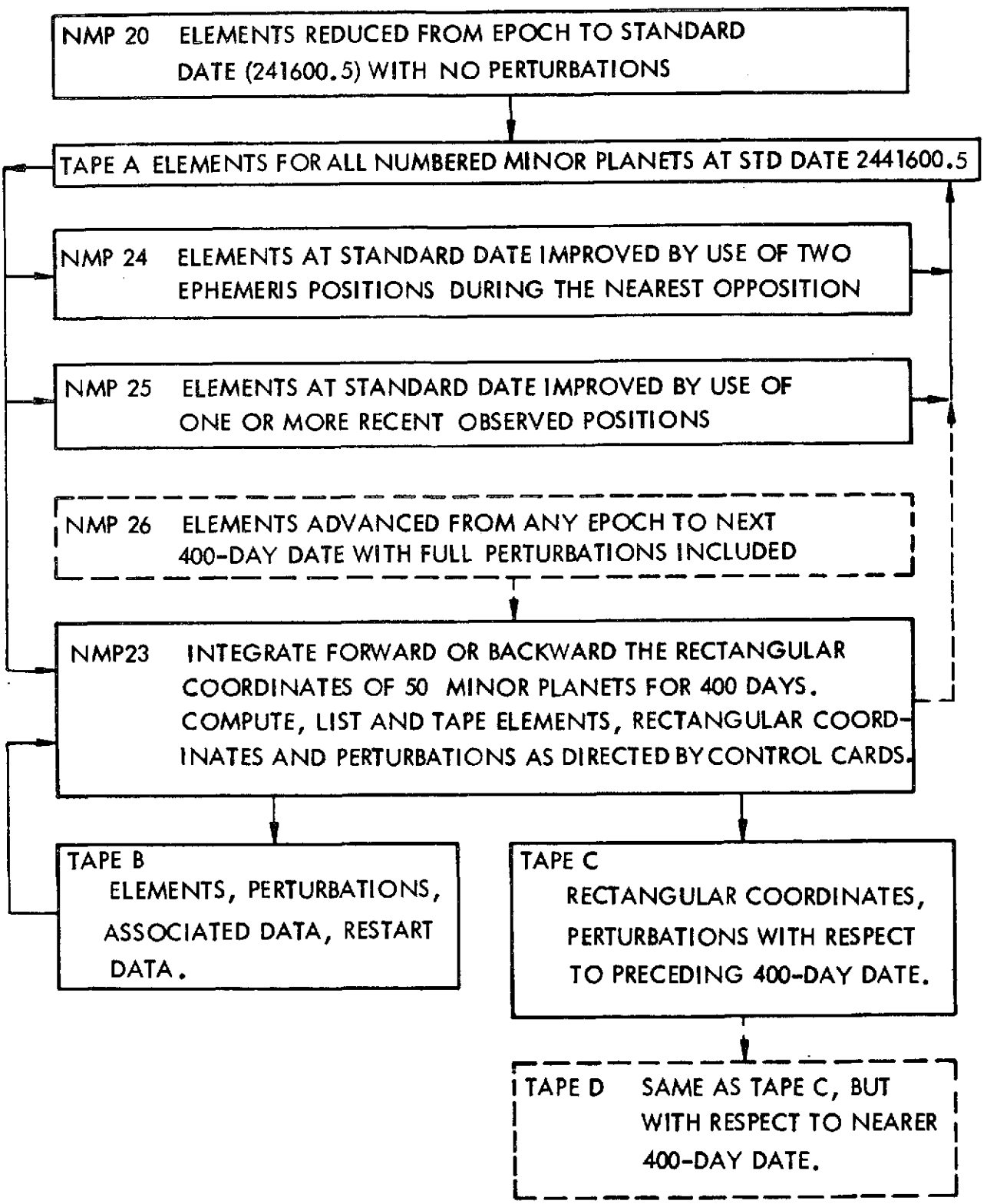

Figure 6-1 General Program Layout

400-day date. Existing capabilities are indicated by solid lines in Figure 6-1, future extensions are indicated by broken lines. A description of the program functions is given in the following paragraphs.

NMP 20. The taped elements described in par. 3.5 were reduced with Program NMP 20 to the standard data (Julian Ephemeris Date 244 1600.5 = 1972 October 10.0 Ephemeris Time) adopted in par. 4.2. The program uses two-body formulae; that is, all elements except the mean anomaly were adopted without change, while the mean anomaly at the standard date was computed from

$$M_{1600} = M_{Epoch} + n_{Epoch} (2441600.5 - JD_{Epoch})$$

This simple approximate method is intended only to provide a uniform set of elements for all of the numbered minor planets so that systematic methods and programs can be used henceforth. The adopted elements were output to magnetic tape, designated Tape A.

NMP 24. This program uses for each numbered minor planet two predicted positions taken from the opposition ephemeris nearest to the standard date, improves the initial adopted elements, and produces a new Tape A.

NMP 25. This program is similar to NMP 24 but uses a single observed position for each further improvement of the initial elements.

NMP 23. Tape A provides the initial input to NMP 23, which performs the prime function of integrating the rectangular coordinates of a set of up to 50 minor planets for an interval of 400 days either forward or backward. Two tapes are produced. Tape B contains the elements of the minor planets, the perturbations and associated data, and also restart data for a following 400 day interval. Tape C contains the rectangular coordinates and their perturbations with respect to the preceding 400-day date (see par. 4.3).

The methods employed in NMP 24 and NMP 25 are relatively inexpensive and satisfy an immediate need. However, they do not fully utilize the accuracy inherent in published elements that have been determined by the best methods from adequate data. For those minor planets that have excellent elements, perhaps osculating at a distant epoch, there is no alternative to reducing such elements from their epoch of osculation to the standard date 2441600.5 by means of accurate numerical integration. Since the epoch of osculation will usually not be a 400-day date, this reduction should be done in two steps:

a. Use of NMP 26 to integrate one or more minor planets from a common osculating date to the following 400-day date
b. Use of the principal program NMP 23 to reduce from that 400-day date to the standard date 2441600.5

Once initial elements at 2441600.5 have been obtained, the elements can be accurately extended to any earlier or later 400-day date by means of the principal program NMP 23.

NMP 26 is indicated on Figure 6-1 as a future extension of the new system that should be considered for implementation. An envisaged additional extension is Tape D. This tape is the same as Tape C except that the perturbations are with respect to the nearer (instead of preceding) 400-day date. This procedure will minimize the magnitude of the largest perturbation.

The principal Program NMP 23 will be discussed in more detail because of its importance in computing the data provided by the new system. A flow diagram of the program is shown in Figure 6-2.

NMP 23 has many options that may be exercised during test or production runs. They are specified by the numbers punched in two initial control cards. During production runs, they control the flow of the program from group to group of 50 minor planets or over successive 400-day intervals, as well as the type and quantity of listings to be produced.

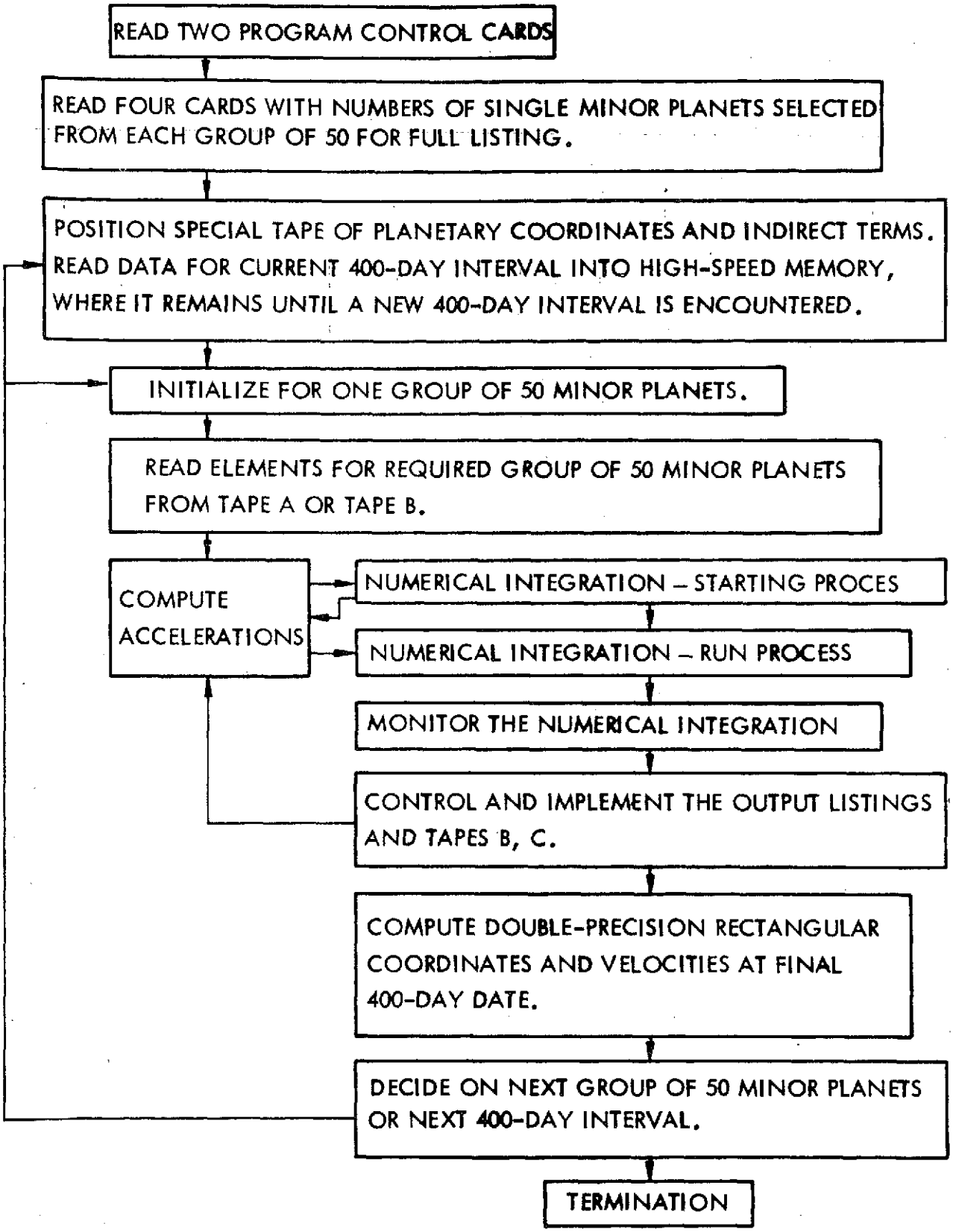

Figure 6-2 NMP 23 Flow Diagram

While the rectangular coordinates of each minor planet at each 4-day step are computed and output to Tape C, their complete listing would produce too much output for practical storage or use. Accordingly, a single minor planet among each group of 50 is chosen to receive such listings, and the extent of these is limited as specified in the initial control cards. The numbers of those planets selected in the groups of 50 are read from four further initial cards.

Options in the initial control cards specify the major planets that are to be included in the perturbations. In the current production runs, all major planets from Mercury through Pluto, both inclusive, have been used. These same options direct the prior preparation by Program JP18 of the special tape of planetary coordinates and indirect terms required by NMP 23. On this tape, each 400-day interval must be complete; that is, it must include data for dates before the starting osculating date and after the final one. Thus, each 400-day interval overlaps both the preceding and following ones. Indirect terms are those parts of the planetary accelerations that are due to the use of an origin at the center of the accelerated Sun.

The tapes (A and B) output by NMP 20, NMP 23, NMP 24, and NMP 25 all have the format required for input to NMP 23. The contents of these tapes are described in par. 4.3.

The numerical integration process and programs are described in par. 6.2.

Options contained in the initial control cards direct the program to start with a given group of 50 minor planets, to continue over one or more groups, and to end with a given minor planet. Or, a single group of 50 or fewer minor planets can be integrated over successive 400-day intervals, either forward or backward.

Numerous checks are provided in the program to ensure that a run is set up in a consistent and logical manner, and with the correct data. Failure of any check causes immediate termination with a diagnostic. Numbers that appear on the page and column headings are set by the program and are those actually used.

6.2 NUMERICAL INTEGRATION TECHNIQUES

The numerical integration is carried out with a predictor-corrector formula, and the process is started by an iterative method. The single and double sums are carried to double precision, but all other quantities are computed to single precision, which on the CDC 6400 amounts to about 14 significant places. The differential equations of motion in rectangular coordinates are integrated directly; that is, the so-called "Cowell method" is used. At the same time, the unperturbed coordinates are computed from the starting elements and are subtracted from the integrated ones to give the perturbations in the coordinates. This procedure is much to be preferred to the so-called "Encke method" when used on a modern electronic computer, since the sizes of the numbers are not as important as they were when the computations were done by hand. Each method, when properly done, will yield exactly the same accuracy – no more, no less.

To test the accuracy of the integration process and programs, integrations of several minor planets were made with only two-body accelerations. After 100 steps, it was found that the integrated coordinates agreed with the coordinates computed from two-body formulae within the accuracy of the latter (14 significant places). Of course, this agreement would not continue if the integrations were continued over a large number of steps.

The accelerations produced by all the major planets from Mercury through Pluto are included in production runs. The step interval of the integration is four days. This short interval is necessary because of the short period and high eccentricity of Mercury's orbit ($e = 0.206$). It should be remarked here that no other integration process (Encke method; integration of the elements; etc.) can use a step interval longer than can be used in the present process to attain the same accuracy. The limitation on the length of the step interval is inherent in all methods, so long as the attraction of Mercury is included. Even this short step interval may produce an appreciable error when the integrations are extended over a very large number of steps (1000's).

At each and every step of a numerical integration, a short test of the computer's central processor is made to prove that it is still functioning correctly. Any failure of

this test causes an immediate abort with listing of the central processor registers and storage areas. No error isolated from a general machine malfunction has been detected.

At each step of the integration the difference between the predicted and corrected values for each coordinate is monitored, as is the size of a specified difference of the accelerations at successive dates. These values are stored in memory for each of the 150 coordinates. Whenever a value larger than the stored one is encountered, the larger value replaces the one in storage. These monitor variables are not used to modify the step interval or to cause termination, since with the short step interval used here difficulties are not anticipated (except for the very few extraordinary minor planets moving in orbits of very high eccentricity, and these always require special treatment). The function of the monitor variables here is mainly to prove that nothing unexpected did actually happen, and they are ordinarily printed out at the end of each 400-day interval to give visual proof.

About 100 seconds of central processor time on the CDC 6400 are required to integrate 50 minor planets through one 400-day interval. Thus, the integration of the numbered minor planets would require about 1 hour of central processor time on this machine. This high speed demonstrates the economy of the mass production approach and makes practicable the integration of all of the numbered planets over long periods of time.

6.3 JPL PLANETARY POSITION DATA TAPE

The easy inclusion of the accelerations by all of the major planets was made possible through the generosity of Dr. J. H. Lieske, Jet Propulsion Laboratory, who kindly provided tapes containing the coordinates of the major planets at an interval of 4 days for the 19th and the 20th centuries. These tapes were translated to the system of the CDC 6400, and work tapes needed by the various programs can now easily be made.

6.4 MINOR PLANET OBSERVATION DATA TAPE

Dr. Paul Herget, Director, Minor Planet Center, Cincinnati Observatory, very kindly provided a tape containing all observations published since approximately 1940

for all of the numbered minor planets. An examination of the observations contained on this tape shows that for most minor planets the latest accurate observations lie several years prior to the adopted initial 400-day date of 1972 October 10. At the beginning of the work, only a very few more recent observations were available from other sources. For most minor planets, the perturbations from the adopted initial date backward to the latest accurate observations are large compared to the accuracy of the observations themselves. Thus perturbations must be included even in the first use of these observations, and the computation of the perturbations should be based on better initial elements than those furnished by the adopted initial ones derived solely from the two-body reduction from the published epoch to the adopted initial epoch. Accordingly, less use has actually been made of the observations on this tape than was originally anticipated.

Section 7
CONCLUSIONS AND RECOMMENDATIONS

Conclusions from the study are summarized as follows:

a. The survey of the accuracy of minor planet ephemerides showed that the present system does not provide accurate ephemerides nor does it provide the means for comparing these data with current observations without prohibitive computation. The orbit elements for most numbered minor planets are not sufficiently good to provide the accuracy needed for mission planners, and are totally inadequate unless brought up to the date of the mission with the inclusion of perturbations by the major planets. The current system of providing approximate opposition ephemerides is barely sufficient for the simplest needs of astronomers and is not organized so as to provide extension to other research work.

b. The new system is designed to satisfy the needs of mission analysts and astronomers alike. The best possible initial elements will be provided for all of the numbered minor planets, and perturbations relative to these elements will be computed over the time intervals of interest. Means will be provided to monitor the accuracy of the initial elements and to improve them, on the basis of recent observed positions, as the need arises. Results in formats easy to use will be made available to all who need them.

c. Methods for quickly improving the accuracy of the initial approximate elements at the adopted standard date on the basis of published ephemerides or recent observations have been developed and tested. These are designed to give initial elements of a quality sufficient to provide good perturbations without extensive numerical integrations. They will serve to get the new system started in an economical and systematic manner.

d. Computer programs to do the work required to set up the new system have been completed. Basic programs for the numerical integration of perturbations in groups of 50 minor planets have been designed, programmed, and tested. These programs possess the efficiencies of mass production, so that rather extensive numerical integrations are now practicable.

The following recommendations are suggested for continued development and use of the new system:

a. Improve the accuracy of the osculating elements of all of the numbered minor planets at the standard date 1972 October 10, using techniques and computer programs now available. These programs are diagrammatically shown and described in par. 6.1.

b. Continuously monitor the accuracy of the elements by representing all observed positions as soon after they are made as may be possible. Mass production methods will be used to do this economically.

c. Plan how results that flow from the new system can best be distributed to all who need them. The needs of mission planners may be mostly satisfied by the listings and tapes described herein. But, for example, should not each mission that enters the belt of minor planets be examined for possible passes near some minor planet? Should astronomers be provided with improved opposition ephemerides? Etc., etc.

d. Implement the plans derived from the above task to systematically distribute minor planet ephemeris data to all who need them in formats compatible with individual requirements.

Section 8
REFERENCES

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4. Herget, Paul, Minor Planet Circulars, Published by the Minor Planet Center, Cincinnati, Ohio.

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Appendix A

RESULTS FROM ACCURACY SURVEY

Appendix A
RESULTS FROM ACCURACY SURVEY

The computer listing contained in Appendix A represents the final estimates of ephemeris accuracy for all of the 1779 numbered minor planets. An explanation of the headings on the computer listing table is given on page 37 of this listing (page A-38 of this Appendix). Comments on the method used to estimate the ephemeris uncertainties are given on page 38 of this listing (page A-39 of this Appendix).

NUMBER	NAME	NOTE	ABMAG	EPOCH	A	PLANETS			OPPOSITIONS		RESIDUAL	LAST	ERROR SEC	ERROR KM3	
1	CERES		4.1	1968 MAY 24	2.7663							1969	1.0	1.3	ESTIMATED
2	PALLAS		5.2	1968 MAY 24	2.7687							1968	1.0	1.3	ESTIMATED
3	JUNO		6.4	1968 MAY 24	2.6680							1969	1.0	1.2	ESTIMATED
4	VESTA		4.3	1968 MAY 24	2.3619							1969	1.0	1.0	ESTIMATED
5	ASTRAEA		8.0	1956 NOV 23	2.5790	2	8	28	1918	1958	50.5	1969	101.1	115.7	
6	HEBE		6.7	1941 JAN 6	2.4259	2	8	0	-0	-0	1.6	1968	222.3	229.7	
7	IRIS		6.8	1935 AUG 20	2.3859	2	8	0	-0	-0	2.4	1969	340.8	342.3	
8	FLORA		7.5	1951 DEC 20	2.2016	5	6	4	1954	1960	-180.0	1967	1000.3	871.7	
9	METIS		7.3	1957 JUN 11	2.3863	5	6	4	1955	1960	3.6	1967	22.9	23.0	
10	HYGIEA		6.6	1948 JUL 28	3.1508	5	6	10	1949	1962	-5.1	1969	26.7	41.6	
11	PARTHENOPE		7.8	1962 DEC 2	2.4525	5	6	7	1955	1964	-3.0	1969	13.5	14.2	
12	VICTORIA		8.8	1941 JAN 6	2.3332	2	8	0	-0	-0	9.3	1968	1100.4	1063.3	
13	EGERIA		8.0	1947 JAN 15	2.5763	5	6	7	1953	1961	-38.1	1969	215.2	245.8	
14	IRENE		7.4	1949 DEC 30	2.5878	2	9	18	1930	1957	21.6	1969	54.6	62.8	
15	EUNOMIA		6.3	1962 DEC 2	2.6424	2	8	19	1944	1968	3.6	1968	11.8	14.1	
16	PSYCHE		6.9	1951 DEC 20	2.9228	5	6	5	1950	1955	36.0	1969	210.2	292.9	
17	THETIS		8.7	1957 JUN 11	2.4692	5	6	4	1953	1957	-1.8	1969	17.1	19.2	
18	MELPOMENE		7.8	1962 DEC 2	2.2958	5	6	7	1955	1963	6.0	1967	22.2	20.8	
19	FORTUNA		8.4	1951 DEC 20	2.4418	5	6	6	1953	1961	90.0	1969	403.3	421.4	
20	MASSALIA		7.5	1956 NOV 23	2.4088	2	8	30	1916	1959	14.3	1968	34.0	34.7	
21	LUTETIA		8.7	1962 DEC 2	2.4349	5	6	10	1947	1965	-5.4	1969	16.4	17.0	
22	KALLIOPE		7.5	1947 JAN 15	2.9092	5	6	9	1951	1961	-6.3	1968	37.4	51.8	
23	THALIA		8.3	1956 NOV 23	2.6247	2	8	21	1920	1957	19.4	1967	44.9	52.8	
24	THEMIS		8.2	1957 JUN 11	3.1380	5	6	5	1954	1960	-2.4	1968	15.5	24.0	
25	PHOCAEA		9.1	1937 JAN 7	2.4007	2	8	0	-0	-0	3.4	1969	473.0	480.2	
26	PROSERPINA		8.6	1951 DEC 20	2.6556	5	6	5	1953	1958	-360.0	1969	2241.0	2689.2	
27	EUTERPE		8.6	1941 MAR 27	2.3472	2	8	0	-0	-0	2.1	1968	288.1	291.3	
28	BELLONA		8.2	1960 MAR 7	2.7761	2	8	39	1906	1963	10.4	1968	23.6	30.3	
29	AMPHITRITE		7.3	1951 DEC 20	2.5544	5	6	5	1953	1958	108.0	1969	678.9	764.8	
30	URANIA		8.8	1962 DEC 2	2.3652	5	6	10	1927	1966	10.5	1967	23.8	23.5	
31	EUPHROSYNE		7.8	1962 DEC 2	3.1556	5	6	8	1949	1965	6.2	1969	17.3	27.1	
32	POMONA		8.7	1951 DEC 20	2.5876	5	6	5	1953	1958	-324.0	1968	2018.0	2322.1	
33	POLYHYMNIA		9.8	1956 NOV 23	2.8622	2	8	18	1921	1958	-73.9	1965	147.1	198.5	
34	CIRCE		9.6	1951 DEC 20	2.6868	5	6	4	1952	1958	-216.0	1969	1125.0	1375.4	
35	LEUKOTHEA		9.8	1962 DEC 2	2.9925	5	6	7	1948	1966	-4.5	1966	13.7	19.8	
36	ATALANTE		10.0	1956 NOV 23	2.7488	2	8	10	1928	1958	7.8	1969	22.8	28.8	
37	FIDES		8.5	1951 DEC 20	2.6428	5	6	5	1952	1958	-72.0	1967	381.1	453.7	
38	LEDA		9.7	1960 MAR 7	2.7398	2	8	20	1906	1963	8.1	1968	19.8	24.9	
39	LAETITIA		7.4	1962 DEC 2	2.7690	5	6	9	1953	1963	-1.5	1969	9.3	11.9	
40	HARMONIA		8.4	1962 DEC 2	2.2668	5	6	8	1955	1965	-3.0	1969	13.1	12.0	
41	DAPHNE		8.3	1951 DEC 20	2.7624	5	5	5	1948	1953	36.0	1968	203.2	259.6	
42	ISIS		8.8	1951 DEC 20	2.4410	5	6	6	1952	1959	90.0	1967	433.8	453.1	
43	ARIADNE		9.2	1956 NOV 23	2.2032	2	8	26	1917	1959	22.1	1969	48.6	42.4	
44	NYSA		8.0	1966 APR 25	2.4217	2	8	14	1943	1966	6.0	1968	15.6	16.1	
45	EUGENIA		8.5	1956 NOV 23	2.7214	2	8	23	1921	1959	11.9	1968	29.4	36.7	
46	HESTIA		9.3	1956 NOV 23	2.5245	2	8	29	1924	1958	-68.8	1969	139.3	154.0	
47	AGLAJA		9.2	1951 DEC 20	2.8773	5	5	6	1946	1953	72.0	1969	317.2	431.6	
48	DORIS		8.1	1968 MAY 24	3.1143							1968	300.0	459.7	ESTIMATED
49	PALES		8.7	1957 JUN 11	3.0989	5	6	5	1950	1960	-3.6	1966	16.4	25.0	
50	VIRGINIA		10.4	1956 NOV 23	2.6495	2	8	14	1924	1959	62.6	1969	125.6	150.2	

STATUS OF NUMBERED MINOR PLANET EPHEMERIDES

NUMBER	NAME	NOTE	ABMAG	EPOCH			A	PLANETS			OPPOSITIONS		RESIDUAL	LAST	ERROR SEC	ERROR KM	
51	NEMAUSA		9.7	1949	MAR	25	2.3657	2	8	8	1943	1954	.8	1969	12.9	12.8	
52	EUROPA		7.6	1951	DEC	20	3.0956							1969	300.0	455.7	ESTIMATED
53	KALYPSO		9.8	1956	NOV	23	2.6164	2	9	23	1923	1958	35.3	1969	75.2	88.1	
54	ALEXANDRA		9.8	1960	MAR	7	2.7085	2	8	20	1909	1951	17.2	1969	36.8	45.6	
55	PANDORA		9.0	1951	DEC	20	2.7598	5	6	5	1954	1959	72.0	1968	469.6	599.0	
56	MELETE		9.6	1951	DEC	20	2.5973	5	6	5	1952	1958	180.0	1965	939.2	1087.3	
57	MNEMOSYNE		8.4	1938	APR	12	3.1578	2	8	0	-0	-0	2.4	1969	333.3	521.3	
58	CONCORDIA		9.9	1951	DEC	20	2.6993	5	6	5	1953	1959	36.0	1967	200.9	247.5	
59	ELPIS		8.7	1951	DEC	20	2.7141	5	6	5	1952	1961	90.0	1969	368.9	458.3	
60	ECHO		10.0	1956	NOV	23	2.3933	2	8	23	1915	1959	73.8	1968	140.6	142.0	
61	DANAE		8.8	1947	JAN	15	2.9891	5	6	7	1947	1962	-10.1	1968	41.9	60.4	
62	ERATO		9.8	1947	JAN	15	3.1344	5	6	6	1952	1960	7.5	1968	48.7	75.4	
63	AUSONIA		8.2	1956	NOV	23	2.3946	2	8	22	1924	1958	-43.0	1969	90.3	91.3	
64	ANGELINA		8.8	1956	NOV	23	2.6818	2	8	26	1915	1957	129.2	1969	245.6	299.4	
65	CYBELE		7.9	1962	DEC	2	3.4230	5	6	10	1947	1965	9.0	1968	22.1	38.8	
66	MAJA		10.6	1951	DEC	20	2.6467	5	6	4	1952	1958	90.0	1968	474.1	565.8	
67	ASIA		9.9	1951	DEC	20	2.4214	5	6	5	1952	1959	108.0	1967	518.7	534.4	
68	LETO		8.3	1939	MAR	18	2.7839	5	6	10	1949	1962	23.6	1969	116.9	151.1	
69	HESPERIA		8.3	1962	DEC	2	2.9791	5	6	11	1948	1962	4.2	1969	14.8	21.2	
70	PANOPAEA		9.2	1956	NOV	23	2.6144	2	8	17	1920	1958	23.1	1968	50.8	59.4	
71	NIOBE		8.5	1956	NOV	23	2.7559	2	8	17	1921	1957	84.6	1969	169.6	215.8	
72	FERONIA		10.3	1964	JUL	4	2.2662	2	8	10	1946	1964	2.8	1968	11.3	10.4	
73	KLYTIA		10.3	1951	DEC	20	2.6657	5	6	5	1953	1958	252.0	1968	1571.4	1807.2	
74	GALATEA		10.1	1951	DEC	20	2.7786	5	6	4	1953	1957	144.0	1967	1052.8	1357.2	
75	EURYDIKE		10.0	1951	DEC	20	2.6716	5	6	4	1952	1958	360.0	1967	1869.0	2264.4	
76	FREIA		9.0	1957	JUN	11	3.3664	5	6	6	1950	1961	-45.0	1967	121.0	207.5	
77	FRIGGA		9.6	1951	DEC	20	2.6694	5	6	4	1953	1957	108.0	1967	792.0	958.3	
78	DIANA		9.1	1956	NOV	23	2.6186	2	8	16	1922	1957	-38.9	1967	83.2	97.6	
79	EURYNOME		9.3	1957	JUN	11	2.4440	5	6	5	1953	1961	56.6	1969	177.5	185.8	
80	SAPPHO		9.3	1957	JUN	11	2.2969	5	6	11	1945	1965	5.1	1969	17.5	16.4	
81	TERPSICHORE		9.7	1951	DEC	20	2.8535	5	6	5	1953	1959	36.0	1969	200.7	269.6	
82	ALKMENE		9.4	1962	DEC	2	2.7631	5	6	10	1953	1967	-7.0	1969	18.7	23.9	
83	BEATRIX		9.8	1951	DEC	20	2.4309	5	6	5	1953	1958	72.0	1969	456.0	472.9	
84	KLIO		10.3	1951	DEC	20	2.3625	5	6	5	1954	1959	180.0	1969	1161.8	1147.3	
85	IO		8.9	1951	DEC	20	2.6544	5	6	6	1952	1959	108.0	1969	518.2	621.4	
86	SEMELE		9.8	1957	JUN	11	3.1007	5	6	4	1953	1960	-9.0	1969	36.3	55.2	
87	SYLVIA		8.3	1962	DEC	2	3.4812	5	6	10	1942	1964	5.0	1969	14.4	25.9	
88	THISBE		8.2	1962	DEC	2	2.7680	5	6	10	1949	1964	3.8	1968	13.5	17.3	
89	JULIA		8.2	1962	DEC	2	2.5530	5	6	10	1948	1964	-9.0	1968	24.0	27.0	
90	ANTIOPE		9.3	1962	DEC	2	3.1377	5	6	7	1952	1965	4.1	1969	13.8	21.4	
91	AEGINA		9.7	1951	DEC	20	2.5901	5	6	5	1953	1958	108.0	1969	678.9	782.3	
92	UNDINA		8.0	1947	JAN	15	3.1999	5	6	9	1948	1962	-12.3	1968	50.5	80.6	
93	MINERVA		8.8	1951	DEC	20	2.7541	5	6	4	1953	1958	108.0	1968	678.4	862.5	
94	AURORA		8.8	1947	JAN	15	3.1534	5	6	7	1951	1961	33.3	1967	155.8	243.2	
95	ARETHUSA		8.9	1948	JUL	28	3.0689	5	6	6	1952	1961	-24.6	1969	124.0	185.9	
96	AEGLE		9.1	1947	JAN	15	3.0550	5	6	5	1953	1960	8.0	1966	57.5	85.6	
97	KLOTHO		8.7	1951	DEC	20	2.6688	5	6	4	1953	1958	270.0	1966	1683.0	2035.7	
98	IANTHE		10.4	1962	DEC	2	2.6919	5	6	10	1949	1967	-6.3	1967	17.0	20.8	
99	DIKE		11.5	1962	DEC	2	2.6638	5	6	5	1938	1965	-8.4	1969	20.7	25.0	
100	HEKATE		9.1	1951	DEC	20	3.0871	5	5	9	1942	1956	144.0	1967	388.9	588.3	

STATUS OF NUMBERED MINOR PLANET EPHEMERIDES

NUMBER	NAME	NOTE	ABMAG	EPOCH			A	PLANETS			OPPOSITIONS		RESIDUAL	LAST	ERROR SEC	ERROR KMS
101	HELENA		9.3	1956	NOV	23	2.5830	2	8	17	1921	1958	-41.0	1967	85.3	97.8
102	MIRIAM		10.4	1951	DEC	20	2.6591	5	6	5	1953	1959	-109.0	1968	595.0	703.5
103	HERA		8.6	1951	DEC	20	2.7017	5	6	5	1952	1957	72.0	1968	440.9	543.9
104	KLYMENE		9.5	1948	JUL	28	3.1399	5	6	8	1949	1962	-4.8	1969	25.7	39.8
105	ARTEMIS		9.8	1962	DEC	2	2.3736	5	6	9	1951	1966	-7.6	1967	21.0	20.9
106	DIONE		8.8	1962	DEC	2	3.1619	5	6	10	1951	1968	-5.7	1969	15.4	24.1
107	CAMILLA		8.2	1947	JAN	15	3.4895	5	6	6	1952	1962	-3.6	1965	25.1	45.3
108	HECUBA		9.3	1962	DEC	2	3.2192	5	6	6	1949	1962	-3.0	1969	12.2	19.6
109	FELICITAS		10.1	1951	DEC	20	2.6960	5	6	5	1953	1959	-252.0	1966	1352.0	1663.1
110	LYDIA		8.6	1947	JAN	15	2.7325	5	6	9	1951	1962	21.8	1967	101.2	127.1
111	ATE		9.1	1951	DEC	20	2.5931	5	6	4	1954	1958	36.0	1967	279.2	322.3
112	IPHIGENIA		10.7	1962	DEC	2	2.4343	5	6	8	1953	1967	4.4	1968	14.3	14.9
113	AMALTHEA		9.7	1964	NOV	1	2.3766	2	8	14	1938	1964	7.2	1968	18.6	18.6
114	KASSANDRA		9.5	1956	NOV	23	2.6752	2	8	22	1919	1957	58.9	1967	119.1	144.7
115	THYRA		9.1	1951	DEC	20	2.3793	5	6	5	1954	1959	103.0	1969	700.9	700.7
116	SIDONA		8.8	1962	DEC	2	2.7671	5	6	7	1955	1964	6.6	1968	21.9	27.9
117	LOMIA		9.2	1962	DEC	2	2.9905	5	6	9	1948	1965	7.0	1968	19.0	27.5
118	PEITHO		10.0	1957	JUN	11	2.4380	5	6	5	1953	1960	1.7	1969	13.3	13.8
119	ALTHAEA		9.4	1951	DEC	20	2.5807	5	6	5	1952	1958	36.0	1969	195.2	223.6
120	LACHESIS		8.9	1956	NOV	23	3.1209	5	7	19	1921	1958	-7.3	1968	20.8	31.9
121	HERMIONE		8.3	1948	JUL	28	3.4538	5	6	6	1951	1962	18.0	1969	80.7	143.5
122	GERDA		9.1	1947	JAN	15	3.2119	5	6	7	1950	1960	9.9	1968	51.8	83.1
123	BRUNHILD		10.1	1951	DEC	20	2.6936	2	8	10	1921	1955	28.9	1969	66.8	81.9
124	ALKESTE		9.1	1951	DEC	20	2.6304	5	6	5	1952	1957	36.0	1965	225.1	266.0
125	LIBERATRIX		9.6	1951	DEC	20	2.7429	5	5	60	1944	1953	108.0	1968	404.9	511.4
126	VELLEDA		10.4	1962	DEC	2	2.4381	5	6	6	1948	1966	-10.8	1966	25.9	27.0
127	JOHANNA		9.5	1957	JUN	11	2.7550	5	6	9	1950	1962	5.0	1968	18.8	23.9
128	NEMESIS		8.8	1951	DEC	20	2.7515	5	6	5	1952	1957	72.0	1967	440.8	559.6
129	ANTIGONE		7.8	1956	NOV	23	2.8741	2	8	23	1922	1957	-9.5	1968	25.7	34.9
130	ELEKTRA		8.0	1957	JUN	11	3.1173	5	6	10	1947	1959	-5.1	1969	19.9	30.5
131	VALA		11.0	1957	FEB	11	2.4309	5	6	4	1952	1957	21.6	1969	107.1	111.0
132	AETHRA		10.3	1925	JAN	10	2.6123	2	8	21	1873	1961	-6.5	1967	27.4	32.0
133	CYRENE		9.0	1951	DEC	20	3.0616	5	6	5	1952	1958	180.0	1968	938.4	1402.1
134	SOPHROSYNE		9.7	1960	JAN	7	2.5642	5	6	5	1947	1953	28.8	1968	140.9	159.8
135	HERTHA		9.2	1951	DEC	20	2.4281	5	6	5	1953	1958	72.0	1969	456.0	472.0
136	AUSTRIA		10.9	1957	JUN	11	2.2872	5	6	5	1948	1964	3.2	1968	14.5	13.5
137	METHODEA		9.0	1962	DEC	2	3.1248	5	6	9	1924	1968	-7.1	1969*	16.6	25.6
138	TOLOSA		10.7	1951	DEC	20	2.4480	5	6	5	1954	1959	144.0	1966	931.1	977.2
139	JUEWA		9.2	1951	DEC	20	2.7829	5	6	4	1952	1957	-144.0	1969	872.8	1127.9
140	SIWA		9.5	1960	MAR	7	2.7324	2	8	23	1902	1960	7.1	1969	19.4	23.1
141	LUMEN		9.6	1956	NOV	23	2.6653	2	8	20	1922	1956	-23.8	1968	54.5	65.7
142	POLANA		11.4	1951	DEC	20	2.4187	5	6	5	1952	1959	180.0	1966	858.2	892.4
143	ADRIA		10.6	1952	JUL	7	2.7559	2	8	10	1921	1954	6.6	1969	22.1	28.2
144	VIBILIA		9.0	1956	NOV	23	2.6544	2	8	18	1919	1958	-61.5	1966	122.7	147.1
145	ADEONA		8.9	1957	JUN	11	2.6737	5	6	5	1953	1960	15.9	1967	59.5	72.2
146	LUCINA		9.2	1960	MAR	7	2.7190	2	8	23	1910	1962	8.5	1968	20.7	25.8
147	PROTOGENEIA		9.8	1957	JUN	11	3.1386	5	6	4	1952	1959	11.1	1968	44.7	69.3
148	GALLIA		8.8	1956	NOV	23	2.7702	2	8	18	1918	1957	14.7	1967	35.3	45.3
149	MEDUSA		12.2	1967	APR	20	2.1744	2	8	13	1936	1967	10.5	1968	22.6	19.3
150	NUWA		9.2	1947	JAN	15	2.9825	5	6	6	1954	1961	16.2	1968	109.1	156.7

STATUS OF NUMBERED MINOR PLANET EPHEMERIDES

NUMBER	NAME	NOTE	ARMAG	EPOCH			A	PLANETS			OPPOSITIONS		RESIDUAL	LAST	ERROR SEC	ERROR KM3
151	ABUNDANTIA		10.4	1947	JAN	15	2.5922	5	6	5	1950	1957	13.5	1966	55.6	98.8
152	ATALA		9.7	1952	JAN	29	3.1331	5	6	6	1952	1962	-6.5	1969	30.8	47.5
153	HILDA		8.8	1947	JAN	15	3.9754	5	6	6	1951	1961	13.1	1968	66.1	142.6
154	BERTHA		8.5	1957	JUN	11	3.1906	5	6	6	1947	1961	-8.7	1969	26.5	41.9
155	SCYLLA		12.0	1941	JAN	6	2.7596	2	9	6	1875	1950	-3.3	1950*	17.6	27.5
156	XANTHIPPE		9.6	1956	NOV	23	2.7284	2	8	22	1923	1959	-23.7	1969	51.6	64.6
157	DEJANIRA		12.4	1956	NOV	23	2.5778	2	8	7	1922	1958	-8.7	1968	24.1	27.6
158	KORONIS		10.7	1947	JAN	15	2.8677	5	6	5	1949	1960	8.7	1969	44.6	60.3
159	AEMILIA		9.4	1957	JUN	11	3.1092	5	6	5	1951	1965	8.1	1968	24.0	36.8
160	UNA		10.1	1956	NOV	23	2.7278	2	8	14	1921	1956	-8.5	1968	23.5	29.5
161	ATHOR		10.3	1942	AUG	29	2.3789	5	6	7	1947	1961	14.7	1968	71.4	71.3
162	LAURENTIA		10.1	1956	NOV	23	3.0261	2	8	14	1922	1956	-15.3	1968	37.2	54.6
163	ERIGONE		10.5	1957	JUN	11	2.3672	5	6	5	1952	1961	46.1	1968	135.9	134.7
164	EVA		9.8	1957	JUN	11	2.6321	5	6	6	1949	1962	-1.8	1966	11.5	13.6
165	LORELEY		8.8	1951	DEC	20	3.1282	2	8	16	1920	1956	28.1	1965	62.9	97.1
166	RHODOPE		10.8	1957	JUN	11	2.6858	5	6	6	1950	1964	-7.7	1964	23.7	29.0
167	URDA		10.7	1954	SEP	15	2.9523	2	8	10	1925	1956	18.0	1968	44.4	59.6
168	SIBYLLA		9.2	1948	JUL	28	3.3780	5	6	8	1951	1963	9.8	1969	45.5	78.5
169	ZELIA		10.6	1962	DEC	2	2.3576	5	6	9	1951	1963	2.6	1969	12.1	12.0
170	MARIA		10.7	1951	DEC	20	2.5539	5	6	5	1948	1956	396.0	1969	1494.3	1682.9
171	OPHELIA		9.8	1957	JUN	11	3.1336	5	6	9	1951	1962	-3.0	1969	14.0	21.7
172	BAUCIS		9.6	1946	JUN	29	2.3794	5	6	11	1947	1962	-7.2	1966	35.3	35.3
173	INO		9.0	1957	MAR	23	2.7473	2	8	25	1930	1959	-5.0	1968	17.0	21.5
174	PHAEDRA		9.6	1951	DEC	20	2.8576	5	6	5	1953	1958	108.0	1969	678.3	913.2
175	ANDROMACHE		10.0	1947	JAN	15	3.2286	5	6	6	1947	1959	27.6	1969	108.1	174.6
176	IDUNA		9.5	1951	DEC	20	3.1681	5	5	6	1945	1954	10.8	1966	46.6	73.3
177	IRMA		10.6	1939	FEB	26	2.7722	2	8	4	1937	1951	-4.0	1969	27.1	34.8
178	BELISANA		10.7	1956	NOV	23	2.4597	2	8	12	1923	1957	18.6	1969	44.1	46.6
179	KLYTAEMNESTRA		9.7	1951	DEC	20	2.9745	5	6	5	1952	1958	216.0	1969	1124.5	1609.3
180	GARUMNA		11.5	1956	NOV	23	2.7232	2	8	11	1925	1959	-8.2	1966	22.9	28.6
181	EUCHARIS		9.0	1947	JAN	15	3.1219	5	6	7	1952	1959	-10.2	1969	69.1	106.3
182	ELSA		10.0	1956	NOV	23	2.4163	2	8	14	1921	1958	28.2	1969	61.4	63.0
183	ISTRIA		11.0	1968	MAY	24	2.7908	2	8	8	1937	1968	-2.5	1968	8.1	10.5
184	DEJOPEJA		9.5	1957	JUN	11	3.1753	5	6	8	1938	1963	-8.3	1969	22.2	35.0
185	EUNIKE		8.5	1941	JAN	6	2.7372	2	8	0	-0	-0	1.8	1966	247.6	311.7
186	CELUTA		10.4	1925	JAN	1	2.3620	5	6	7	1926	1955	450.0	1969	1445.6	1427.0
187	LAMBERTA		9.6	1969	FEB	14	2.7342	2	8	15	1941	1968	-5.9	1966	13.8	17.4
188	MENIPPE		10.4	1951	DEC	20	2.7625	5	6	4	1952	1957	10.8	1966	73.6	94.1
189	PHTHIA		10.4	1951	DEC	20	2.4501	5	6	4	1954	1958	21.6	1969	171.5	180.3
190	ISMENE		8.6	1957	JUN	11	3.9526	5	6	8	1932	1959	-7.2	1969	20.5	43.8
191	KOLGA		10.0	1951	DEC	20	2.9936	2	8	26	1902	1961	14.3	1969	32.8	45.1
192	NAUSIKAA		8.4	1941	JAN	6	2.4025	2	6	7	1942	1955	79.3	1969	330.0	335.4
193	AMBROSIA		11.0	1956	NOV	23	2.5992	2	8	13	1916	1957	-91.8	1969	180.1	208.7
194	PROKNE		8.9	1962	DEC	2	2.6163	5	6	10	1952	1968	4.8	1969	14.3	16.7
195	EURYKLEIA		10.3	1941	JAN	6	2.8807	2	6	7	1940	1958	-4.3	1969	25.0	34.1
196	PHILOMELA		9.7	1962	DEC	2	3.1127	5	6	9	1953	1964	-5.9	1969	18.7	28.7
197	ARETE		10.9	1956	NOV	23	2.7386	2	8	15	1914	1957	-24.1	1968	52.3	65.9
198	AMPELLA		9.7	1951	DEC	20	2.4594	5	6	5	1952	1957	21.6	1968	139.1	147.1
199	BYBLIS		10.0	1962	DEC	2	3.1716	5	6	5	1945	1958	-6.2	1967	21.5	33.9
200	DYNAMENE		9.4	1956	NOV	23	2.7375	2	8	21	1920	1959	-78.8	1969	152.0	192.6

STATUS OF NUMBERED MINOR PLANET EPHEMERIDES

NUMBER	NAME	NOTE	ABMAG	EPOCH	A	PLANETS		OPPOSITIONS			RESIDUAL	LAST	ERROR SEC	ERROR KM3
201	PENELOPE		9.5	1951 DEC 20	2.6781	5	6	5	1952	1958	36.0	1966	195.0	237.2
202	CHRYSEIS		8.9	1957 JUN 11	3.0721	5	6	6	1953	1959	-2.4	1968	15.5	23.3
203	POMPEJA		10.2	1951 DEC 20	2.7382	5	6	4	1954	1958	36.0	1969	278.9	351.3
204	KALLISTO		10.3	1951 DEC 20	2.6711	5	6	5	1952	1958	144.0	1967	753.0	912.0
205	MARTHA		10.5	1955 NOV 23	2.7764	2	8	14	1925	1957	15.0	1967	36.9	47.5
206	HERSILIA		10.0	1951 DEC 20	2.7408	5	6	5	1952	1958	90.0	1968	472.9	597.9
207	HEDDA		11.0	1957 JUN 11	2.2842	5	6	6	1948	1962	4.5	1969	18.0	16.8
208	LACRIMOSA		10.5	1947 JAN 15	2.8919	5	6	6	1950	1961	-30.3	1969	133.7	183.3
209	DIDO		9.1	1942 AUG 29	3.1567	5	6	6	1946	1961	21.2	1969	91.2	142.6
210	ISABELLA		10.6	1956 NOV 23	2.7222	2	8	9	1935	1959	-5.8	1969	19.3	24.1
211	ISOLDA		9.0	1957 JUN 11	3.0395	5	6	6	1952	1960	5.3	1969	22.7	33.5
212	MEDEA		9.5	1957 JUN 11	3.1202	5	6	5	1952	1961	60.2	1965	173.9	267.2
213	LILAEA		10.0	1957 JUN 11	2.7522	5	6	5	1953	1958	-8.4	1969	44.1	56.0
214	ASCHERA		10.4	1962 DEC 2	2.6115	5	6	9	1948	1966	3.0	1966	11.4	13.3
215	OENONE		10.9	1964 SEP 2	2.7656	2	8	10	1942	1964	-4.9	1969	14.2	18.2
216	KLEOPATRA		8.1	1933 AUG 16	2.7929	2	8	0	-0	-0	2.3	1966	333.6	433.5
217	EUDORA		11.1	1957 JUN 11	2.8713	5	6	4	1948	1953	22.1	1968	126.3	171.3
218	BIANCA		9.9	1951 DEC 20	2.6655	5	6	5	1953	1958	-180.0	1967	1125.0	1358.1
219	THUSNELDA		10.4	1951 DEC 20	2.3541	5	6	4	1952	1959	360.0	1966	1706.9	1675.3
220	STEPHANIA		12.4	1962 DEC 2	2.3493	5	6	5	1932	1966	-6.0	1968	16.4	16.0
221	EOS		9.0	1947 JAN 15	3.0135	5	6	10	1947	1962	30.5	1964	107.1	156.3
222	LUCIA		10.4	1951 DEC 20	3.1469	2	8	22	1899	1961	178.2	1968	307.2	478.0
223	ROSA		11.1	1957 JUN 11	3.0931	5	6	4	1931	1953	-6.6	1966	22.3	33.8
224	OCEANA		9.9	1951 DEC 20	2.6446	5	6	5	1953	1959	36.0	1969	201.1	239.7
225	HENRIETTA		9.6	1957 JUN 11	3.3475	5	6	5	1946	1955	1.2	1965	10.6	18.0
226	WERINGIA		11.1	1956 NOV 23	2.7153	2	8	10	1921	1957	4.7	1966	16.5	20.5
227	PHILOSOPHIA		10.2	1951 DEC 20	3.1349	5	5	6	1940	1953	144.0	1967	440.3	681.3
228	AGATHE		14.0	1957 JUN 11	2.2012	5	6	5	1944	1959	3.0	1967	15.5	13.5
229	ADELINDA		10.5	1962 DEC 2	3.3986	5	6	10	1930	1963	4.1	1968	12.5	21.7
230	ATHAMANTIS		8.6	1966 JUN 4	2.3825	2	8	14	1941	1966	7.0	1967	17.3	17.3
231	VINDOBONA		10.6	1962 DEC 2	2.9215	5	6	9	1942	1965	5.1	1966	14.9	20.6
232	RUSSIA		11.6	1951 DEC 20	2.5523	5	6	4	1953	1958	270.0	1966	1683.3	1893.8
233	ASTERope		9.6	1956 NOV 23	2.6603	2	8	21	1921	1958	18.6	1967	42.9	51.4
234	BARBARA		10.4	1960 JAN 7	2.3853	5	5	5	1948	1955	270.0	1968	1086.9	1091.3
235	CAROLINA		9.9	1957 JUN 11	2.8809	5	6	4	1954	1960	-10.7	1968	46.2	63.0
236	HONORIA		9.6	1957 JUN 11	2.7982	5	6	5	1953	1959	-11.6	1969	49.6	64.6
237	COELESTINA		10.8	1939 JAN 24	2.7627	5	6	7	1939	1961	-9.5	1968	51.1	65.3
238	HYPATIA		9.3	1957 JUN 11	2.9065	5	6	8	1951	1963	-4.5	1969	17.4	24.1
239	ADRASTEA		11.8	1957 JUN 11	2.9687	5	6	4	1949	1956	21.0	1966	87.8	125.3
240	VANADIS		9.8	1951 DEC 20	2.6658	5	6	5	1953	1958	72.0	1966	455.4	549.9
241	GERMANIA		8.8	1939 DEC 8	3.0481	2	8	59	1884	1964	10.7	1969	20.0	43.1
242	KRIEMHILD		10.6	1957 JUN 11	2.8651	5	6	5	1954	1961	-38.3	1966	132.8	179.5
243	IDA		11.2	1947 JAN 15	2.8608	5	6	5	1952	1957	-48.3	1966	376.9	508.3
244	SITA		13.4	1962 DEC 2	2.1748	5	6	4	1942	1953	4.5	1969	21.4	18.3
245	VERA		9.7	1957 JUN 11	3.1009	5	6	9	1951	1964	7.5	1969	23.4	35.7
246	ASPORINA		9.9	1951 DEC 20	2.6951	5	6	5	1952	1957	36.0	1966	225.0	276.4
247	EUKRATE		9.2	1947 JAN 15	2.7402	5	6	7	1950	1960	14.1	1969	70.6	89.1
248	LAMETA		11.5	1962 DEC 2	2.4717	5	6	6	1940	1963	-6.0	1967	17.6	18.7
249	ILSE		12.5	1962 DEC 2	2.3777	5	6	6	1950	1962	8.1	1969	25.2	25.1
250	BETTINA		8.8	1948 JUL 28	3.1403	5	6	7	1952	1962	14.6	1969	71.8	111.5

STATUS OF NUMBERED MINOR PLANET EPHEMERIDES

NUMBER	NAME	NOTE	ABMAG	EPOCH	A	PLANETS			OPPOSITIONS		RESIDUAL	LAST	ERROR SEC	ERROR KMS	
251	SOPHIA		11.3	1962 DEC 2	3.0956	5	6	4	1949	1956	-1.5	1966	11.1	16.9	
252	CLEMENTINA		10.6	1956 NOV 23	3.1544	2	8	15	1922	1958	40.3	1969	83.0	129.7	
253	MATHILDE		11.5	1951 DEC 20	2.6474	5	6	4	1951	1957	144.0	1963	729.1	870.5	
254	AUGUSTA		13.2	1957 JUN 11	2.1950	5	6	4	1951	1961	-5.7	1963	23.2	20.1	
255	OPPAVIA		11.5	1957 JUN 11	2.7462	5	6	4	1951	1956	-6.8	1969	39.8	50.3	
256	WALPURGA		11.1	1965 JUN 29	2.9995	2	8	8	1935	1966	7.5	1966	17.4	25.3	
257	SILESIA		10.2	1957 JUN 11	3.1217	5	6	9	1938	1962	4.5	1968	15.3	23.5	
258	TYCHE		9.6	1951 DEC 20	2.6143	5	6	5	1953	1959	360.0	1969	1929.1	2257.1	
259	ALETHEIA		9.2	1957 JUN 11	3.1357	5	6	8	1948	1959	5.4	1969	21.4	33.1	
260	HUBERTA		10.4	1947 JAN 15	3.4499	5	6	6	1950	1958	26.6	1969	142.0	252.1	
261	PRYMNO		10.6	1964 SEP 22	2.3309	2	8	13	1934	1964	5.6	1967	15.6	15.1	
262	VALDA		12.8	1956 NOV 23	2.5553	2	8	6	1924	1957	6.3	1961*	20.2	22.7	
263	DRESDA		11.7	1956 NOV 23	2.8884	2	8	13	1923	1958	6.3	1969	19.3	26.4	
264	LIBUSSA		10.0	1962 DEC 2	2.7993	5	6	7	1947	1961	-7.7	1969	23.2	30.3	
265	ANNA		12.8	1932 FEB 5	2.4204							1967	300.0	308.9	ESTIMATED
266	ALINE		9.6	1947 JAN 15	2.8024	5	6	6	1949	1962	-6.3	1967	32.7	42.7	
267	TIRZA		12.1	1947 JAN 15	2.7742	5	6	5	1951	1961	1.8	1966	17.9	23.0	
268	ADORA		9.6	1947 JAN 15	3.0950	5	6	8	1951	1953	22.7	1968	98.3	149.3	
269	JUSTITIA		11.3	1951 DEC 20	2.6461	5	6	4	1949	1959	180.0	1967	621.1	727.5	
270	ANAHITA		10.1	1957 JUN 11	2.1983	5	6	8	1952	1962	4.2	1968	19.2	16.7	
271	PENTHESILEA		11.0	1962 DEC 2	3.0081	5	6	7	1941	1960	-1.5	1968	8.7	12.6	
272	ANTONIA		11.8	1962 DEC 2	2.7779	5	6	9	1948	1964	7.4	1969	20.5	26.4	
273	ATROPOS		11.6	1957 JUN 11	2.3949	5	6	4	1952	1950	20.1	1966	68.1	68.8	
274	PHILAGORIA		11.3	1967 FEB 19	3.0486	2	8	12	1935	1967	7.2	1968	16.0	23.7	
275	SAPIENTIA		10.0	1949 JAN 4	2.7739	5	6	5	1949	1960	-2.9	1969*	19.9	25.6	
276	ADELHEID		9.4	1951 DEC 20	3.1192	5	5	5	1943	1951	216.0	1967	899.3	1381.3	
277	ELVIRA		11.2	1951 DEC 20	2.8872	5	5	6	1947	1953	-180.0	1968	848.6	1160.8	
278	PAULINA		10.7	1929 MAY 9	2.7546	2	8	7	1929	1957	-5.6	1969	32.1	40.9	
279	THULE		9.8	1948 SEP 16	4.2829							1968	300.0	713.8	ESTIMATED
280	PHILTA		12.0	1968 AUG 12	2.5444	2	8	4	1948	1968	7.1	1968	15.9	22.4	
281	LUCRETIA		12.9	1957 JUN 11	2.1876	5	6	5	1948	1962	8.7	1965	27.6	23.8	
282	CLORINDE		12.0	1968 MAR 25	2.3396	2	8	9	1950	1968	5.9	1968	14.6	14.2	
283	EMMA		9.5	1947 JAN 15	3.0422	5	6	7	1950	1960	-18.2	1969	87.7	129.9	
284	AMALIA		11.6	1966 OCT 22	2.3575	2	8	8	1940	1966	7.9	1969	18.7	18.4	
285	REGINA		11.9	1938 AUG 30	3.0838	2	8	4	1889	1954	-4.1	1968	19.2	28.9	
286	ICELA		10.4	1957 JUN 11	3.1914	5	6	6	1951	1958	-7.1	1969	32.0	50.8	
287	NEPHTHYS		9.5	1941 JAN 6	2.3541	2	8	0	-0	-0	1.5	1967	209.5	205.6	
288	GLAUKE		11.0	1956 NOV 23	2.7612	2	8	22	1916	1956	15.2	1968	36.3	46.3	
289	NENETTA		10.8	1957 JUN 11	2.8724	5	6	4	1951	1960	-17.4	1968	57.2	77.7	
290	BRUNA		13.2	1963 MAR 12	2.3365	2	8	6	1915	1942	-7.2	1960*	25.0	24.2	
291	ALICE		12.8	1957 JUN 11	2.2220	5	6	6	1949	1960	-4.1	1966	19.1	16.9	
292	LUDOVICA		11.0	1959 FEB 1	2.5298	2	8	10	1918	1959	-7.7	1968	21.0	23.3	
293	BRASILIA		11.0	1956 NOV 23	2.8616	2	8	8	1918	1958	5.8	1968	18.0	24.3	
294	FELICIA		11.1	1940 AUG 1	3.1594							1968	300.0	469.5	ESTIMATED
295	THERESIA		11.6	1957 JUN 11	2.7970	5	6	4	1951	1959	6.9	1969	28.6	37.3	
296	PHAETUSA		13.6	1957 JUN 11	2.2288	5	6	4	1932	1960	6.9	1967	21.5	19.2	
297	CAECILIA		10.4	1962 DEC 2	3.1742	5	6	10	1948	1964	-3.5	1968	12.3	19.4	
298	BAPTISTINA		12.5	1957 JUN 11	2.2638	5	6	5	1948	1961	-3.0	1968	15.3	14.0	
299	THORA		13.1	1951 DEC 20	2.4337	5	6	5	1949	1958	180.0	1969	669.6	695.8	
300	GERALDINA		10.6	1935 JUL 17	3.2096	2	8	25	1890	1964	-6.0	1968	22.1	35.3	

STATUS OF NUMBERED MINOR PLANET EPHEMERIDES

NUMBER	NAME	NOTE	ABMAG	EPOCH		A	PLANETS			OPPOSITIONS		RESIDUAL	LAST	ERROR SEC	ERROR KMS	
301	BAVARIA		11.4	1951 DEC	20	2.7248	2	8	9	1921	1955	14.8	1966	39.5	48.1	
302	CLARISSA		12.3	1951 DEC	20	2.4060	5	6	5	1956	1961	180.0	1968	1233.6	1257.2	
303	JOSEPHINA		10.0	1947 JAN	15	3.1248	5	6	5	1952	1960	4.4	1968	32.5	50.0	
304	OLGA		11.0	1962 DEC	2	2.4030	5	6	6	1937	1963	-3.9	1963	13.4	13.6	
305	GORDONIA		10.3	1947 JAN	15	3.0964	5	6	7	1948	1960	9.3	1968	43.5	66.1	
306	UNITAS		10.2	1962 DEC	2	2.3581	5	6	12	1931	1956	180.0	1968	395.1	398.9	
307	NIKE		11.0	1947 JAN	15	2.9136	5	6	6	1949	1956	-15.0	1968	91.1	126.4	
308	POLYXO		9.1	1947 JAN	15	2.7491	5	6	7	1954	1961	-9.6	1965	69.0	87.4	
309	FRATERNITAS		11.5	1962 DEC	2	2.6641	5	6	7	1930	1961	5.4	1966	15.9	19.2	
310	MARGARITA		11.7	1956 NOV	23	2.7631	2	8	13	1913	1957	21.0	1968	46.1	58.9	
311	CLAUDIA		11.2	1957 JUN	11	2.8980	5	6	4	1954	1959	6.2	1969	33.0	45.4	
312	PIERRETTA		10.3	1957 JUN	11	2.7809	5	6	8	1938	1960	3.9	1968	15.1	19.4	
313	CHALDAEA		9.7	1957 JUN	11	2.3759	5	6	4	1950	1956	2.0	1970	16.2	16.1	
314	ROSELIA		11.2	1962 DEC	2	3.1476	5	6	4	1941	1952	-7.9	1967	31.5	49.1	
315	CONSTANTIA		13.9	1962 DEC	2	2.2411	5	6	5	1928	1955	-90.0	1968	199.9	179.8	
316	GOBERTA		11.0	1957 JUN	11	3.1659	5	6	4	1948	1959	-15.0	1969	47.5	74.6	
317	ROXANE		11.2	1957 JUN	11	2.2866	5	6	6	1949	1963	1.1	1967	10.4	9.7	
318	MAGDALENA		10.4	1947 JAN	15	3.2096	5	6	5	1948	1960	-3.9	1969	23.5	37.7	
319	LEONA		11.4	1962 DEC	2	3.3768	5	6	6	1938	1960	6.9	1966	19.3	33.2	
320	KATHARINA		11.7	1957 JUN	11	3.0157	5	5	4	1949	1954	.3	1969	8.3	12.2	
321	FLORENTINA		11.4	1951 DEC	20	2.8855	5	6	5	1950	1958	14.4	1969	66.2	90.5	
322	PHAEO		10.4	1930 MAR	5	2.7799	5	6	7	1948	1959	-24.2	1969	184.2	237.6	
323	BRUCIA		11.4	1967 MAY	30	2.3820	2	8	11	1946	1967	6.3	1967	15.8	15.8	
324	BAMBERGA		8.1	1951 DEC	20	2.6815	5	6	5	1953	1959	72.0	1969	393.0	478.9	
325	HEIDELBERGA		10.1	1947 JAN	15	3.1897	5	6	60	1928	1955	8.2	1969	26.9	42.7	
326	TAMARA		10.1	1957 JUN	11	2.3180	5	6	5	1950	1960	3.5	1967	17.4	16.7	
327	COLUMBIA		11.4	1951 DEC	20	2.7761	5	5	6	1942	1953	-72.0	1968	244.4	314.7	
328	GUDRUN		10.0	1947 JAN	15	3.1107	5	6	6	1953	1963	-2.3	1969	20.0	30.5	
329	SVEA		10.7	1957 JUN	11	2.4755	5	6	4	1948	1956	1.1	1967	11.5	12.3	
330	ADALBERTA	L	13.5	1892 MAR	21	2.0893							1892*	640000.0	505293.3	LOST
331	ETHERIDGEA		10.4	1947 JAN	15	3.0251	5	6	7	1951	1961	8.9	1966	48.7	71.4	
332	SIRI		10.8	1949 DEC	30	2.7718	2	8	15	1921	1957	-86.9	1968	175.9	225.9	
333	BADENIA		10.5	1947 JAN	15	3.1284	5	6	7	1951	1961	-32.9	1969	154.1	237.7	
334	CHICAGO		8.6	1947 JAN	15	3.8854	5	6	7	1950	1960	-4.7	1968	28.8	60.2	
335	ROBERTA		10.0	1957 JUN	11	2.4729	5	6	4	1955	1961	4.2	1969	23.0	24.6	
336	LACADIERA		11.0	1957 JUN	11	2.2518	5	6	5	1952	1963	2.0	1969	13.1	11.9	
337	DEVOSA		10.0	1965 JUL	19	2.3834	2	8	15	1936	1965	6.0	1969	15.9	15.9	
338	RUDOSA		9.8	1959 FEB	1	2.9116	5	7	19	1914	1959	-93.7	1969	179.0	242.5	
339	DOROTHEA		10.5	1947 JAN	15	3.0087	5	6	4	1948	1960	-6.6	1968	33.7	49.1	
340	EDUARDA		11.1	1951 DEC	20	2.7488	5	6	6	1954	1960	270.0	1969	1493.9	1893.5	
341	CALIFORNIA		12.6	1957 JUN	11	2.1993	5	6	5	1941	1960	3.5	1969	15.9	13.8	
342	ENDYMION		11.2	1951 DEC	20	2.5675	5	6	5	1952	1958	144.0	1966	753.2	855.8	
343	OSTARA		12.7	1951 DEC	20	2.4106	5	6	5	1951	1959	-684.0	1969	2831.1	2894.5	
344	DESIDERATA		9.3	1962 DEC	2	2.5964	5	6	5	1930	1963	-6.0	1968	16.6	19.2	
345	TERCIDINA		10.1	1957 JUN	11	2.3252	5	6	7	1949	1961	6.5	1969	23.7	22.7	
346	HERMENTARIA		9.1	1962 DEC	2	2.7953	5	6	10	1947	1966	4.1	1967	13.2	17.2	
347	PARIANA		10.2	1962 DEC	2	2.6115	5	6	10	1947	1964	-7.4	1968	20.7	24.1	
348	MAY		10.8	1947 JAN	15	2.9682	5	6	8	1950	1958	-4.4	1967	31.6	45.1	
349	DEMBOWSKA		7.3	1947 JAN	15	2.9244	5	6	7	1955	1962	13.5	1969	94.5	131.8	
350	ORNAMENTA		10.0	1947 JAN	15	3.1097	5	6	6	1950	1962	-13.1	1968	59.6	91.1	

STATUS OF NUMBERED MINOR PLANET EPHEMERIDES

NUMBER	NAME	NOTE	ABMAG	EPOCH	A	PLANETS		OPPOSITIONS		RESIDUAL	LAST	ERROR SEC	ERROR KM	
351	YRSA		10.3	1940 MAY 11	2.7652	5	6	6	1949 1961	4.8	1965	35.6	45.5	
352	GISELA		11.6	1951 DEC 20	2.1943	5	6	6	1952 1959	72.0	1969	349.8	302.9	
353	RUPERTO-CAROLA		12.3	1930 JAN 24	2.7354	2	8	6	1920 1952	-8.3	1968	35.7	44.9	
354	ELEONORA		7.6	1962 DEC 2	2.7954	5	6	9	1947 1965	3.0	1966	11.3	14.7	
355	GABRIELLA		11.6	1942 MAY 1	2.5396	2	8	17	1893 1960	-6.9	1966	23.5	26.4	
356	LIGURIA		9.1	1951 DEC 20	2.7576	5	6	5	1953 1959	72.0	1969	392.8	500.4	
357	NININA		9.5	1957 JUN 11	3.1440	5	6	7	1949 1962	3.6	1969	15.0	23.2	
358	APOLLONIA		10.3	1956 NOV 23	2.8803	2	8	13	1922 1957	-11.4	1969	29.4	40.0	
359	GEORGIA		10.5	1951 DEC 20	2.7300	5	6	5	1952 1961	90.0	1966	368.9	462.5	
360	CARLOVA		9.6	1948 MAR 30	3.0004	5	6	10	1934 1961	6.3	1968	21.4	31.0	
361	BONONIA		9.6	1957 JUN 11	3.9333	5	6	6	1932 1959	3.9	1968	13.9	29.5	
362	HAVNIA		9.9	1951 DEC 20	2.5788	5	6	5	1952 1959	36.0	1969	178.9	204.7	
363	PADUA		10.1	1962 DEC 2	2.7463	5	6	10	1932 1964	-6.5	1968	17.1	21.6	
364	ISARA		11.1	1957 JUN 11	2.2204	5	6	6	1950 1963	-6.9	1967	23.6	20.9	
365	CORDULA		10.4	1951 DEC 20	2.8018	2	8	9	1921 1956	14.4	1968	37.1	48.5	
366	VINCENTINA		9.8	1947 JAN 15	3.1422	5	6	6	1955 1962	12.7	1968	86.0	133.6	
367	AMICITIA		12.1	1957 JUN 11	2.2196	5	6	5	1949 1959	-6.3	1966	25.9	22.9	
368	HAIDEA		11.1	1956 NOV 23	3.0798	2	8	10	1921 1958	-18.2	1969	41.4	62.4	
369	AERIA		9.6	1951 DEC 20	2.6484	5	6	5	1952 1958	180.0	1967	939.0	1121.9	
370	MODESTIA		11.7	1957 JUN 11	2.3244	5	6	6	1939 1960	2.7	1967	13.6	13.1	
371	BOHEMIA		10.0	1957 JUN 11	2.7272	5	6	5	1951 1961	12.3	1966	39.1	49.0	
372	PALMA		8.5	1957 JUN 11	3.1603	5	6	4	1955 1960	8.4	1969	41.9	65.6	
373	MELUSINA		10.3	1947 JAN 15	3.1252	5	6	4	1950 1969	11.3	1968	43.3	66.6	
374	BURGUNDIA		10.0	1951 DEC 20	2.7800	5	5	6	1944 1953	-36.0	1967	140.8	181.6	
375	URSULA		8.4	1957 JUN 11	3.1363	5	6	10	1938 1963	3.5	1965	13.2	20.5	
376	GEOMETRIA		10.6	1957 JUN 11	2.2882	5	6	6	1947 1962	-8.6	1966	27.0	25.2	
377	CAMPANIA		9.9	1951 DEC 20	2.6901	5	5	6	1942 1953	-432.0	1968	1422.8	1742.9	
378	HOLMIA		11.1	1957 JUN 11	2.7757	5	6	4	1951 1957	2.6	1966	17.5	22.5	
379	HUENNA		10.1	1947 JAN 15	3.1454	5	6	6	1952 1959	2.7	1969	25.1	39.1	
380	FIDUCIA		10.6	1951 DEC 20	2.6788	5	6	5	1952 1957	36.0	1967	225.0	273.8	
381	MYRRHA		9.6	1951 DEC 20	3.2003	5	5	4	1948 1953	288.0	1969	1563.4	2493.3	
382	DODONA		9.8	1951 DEC 20	3.1298	5	6	5	1956 1962	9.8	1969	65.4	101.0	
383	JANINA		10.8	1962 DEC 2	3.1260	5	6	10	1936 1961	2.1	1969	9.4	14.6	
384	BURDIGALA		10.7	1962 DEC 2	2.6516	5	6	10	1931 1965	6.0	1968	16.1	19.2	
385	ILMATAR		8.9	1957 JUN 11	2.8451	5	6	8	1952 1962	-6.0	1967	22.6	30.2	
386	SIEGENA		9.4	1957 JUN 11	2.8955	5	6	5	1953 1959	2.4	1968	15.7	21.6	
387	AQUITANIA		9.0	1951 DEC 20	2.7384	2	8	18	1924 1954	69.8	1968	155.5	195.9	
388	CHARYBDIS		9.4	1957 JUN 11	3.0081	5	6	8	1948 1964	-3.0	1969	12.8	18.6	
389	INDUSTRIA		9.3	1951 DEC 20	2.6085	5	6	5	1953 1958	36.0	1968	232.3	270.9	
390	ALMA		11.5	1951 DEC 20	2.6518	5	6	5	1951 1960	450.0	1969	1759.0	2106.0	
391	INGEBORG		12.3	1957 JUN 11	2.3197	5	6	5	1932 1964	8.4	1967	22.7	21.7	
392	WILHELMINA		10.6	1925 JAN 10	2.8847	2	8	7	1933 1955	-8.8	1964	51.1	69.8	
393	LAMPETIA		9.2	1942 JAN 1	2.7808	2	8	12	1921 1957	11.1	1968	32.6	42.1	
394	ARDUINA		10.9	1949 OCT 27	2.7620						1969	300.0	383.1	ESTIMATED
395	DELIA		11.5	1956 NOV 23	2.7878	2	8	7	1926 1957	15.7	1968	38.8	50.2	
396	AEOLIA		11.2	1956 NOV 23	2.7423	2	8	7	1925 1959	-6.3	1966	19.3	24.4	
397	VIENNA		10.3	1962 AUG 24	2.6355	2	8	6	1936 1962	-6.8	1962	18.7	22.1	
398	ADMETE		12.0	1951 DEC 20	2.7361	2	8	6	1930 1957	96.1	1969	208.2	262.0	
399	PERSEPHONE		10.6	1951 DEC 20	3.0593	5	5	10	1938 1956	180.0	1968	438.4	654.3	
400	DIONOSA		11.4	1957 JUN 11	3.1299	5	6	7	1938 1963	7.5	1969	20.8	32.1	

STATUS OF NUMBERED MINOR PLANET EPHEMERIDES

NUMBER	NAME	NOTE	APMAG	EPOCH			A	PLANETS			OPPOSITIONS		RESIDUAL	LAST	ERROR SEC	ERROR KM3
401	OTTILIA		10.2	1962	DEC	2	3.3366	5	6	10	1932	1963	6.9	1969	17.6	29.9
402	CHLOE		10.0	1951	DEC	20	2.5556	5	6	4	1949	1958	108.0	1965	405.3	456.9
403	CYANE		10.3	1949	SEP	6	2.8095	5	5	4	1938	1953	-72.0	1965	211.2	277.0
404	ARSINOE		9.9	1951	DEC	20	2.5915	5	6	4	1950	1958	25.2	1966	110.0	126.9
405	THIA		9.7	1951	DEC	20	2.5831	5	6	4	1950	1959	90.0	1967	349.2	400.7
406	ERNA		11.4	1962	DEC	2	2.9192	5	6	10	1933	1965	3.6	1969	11.7	16.3
407	ARACHNE		10.3	1951	DEC	20	2.6239	5	6	4	1953	1958	7.2	1969	53.7	63.3
408	FAMA		10.8	1962	DEC	2	3.1650	5	6	10	1938	1965	-3.8	1969	12.1	18.9
409	ASPASIA		8.6	1936	APR	22	2.5749	2	8	0	-0	-0	1.0	1969	149.7	170.9
410	CHLORIS		9.7	1959	FEB	1	2.7261	2	8	21	1919	1959	-16.8	1965	37.2	46.6
411	XANTHE		10.2	1962	DEC	2	2.9363	5	6	6	1923	1956	10.4	1969	26.3	36.9
412	ELISABETHA		10.3	1931	NOV	15	2.7618	5	6	7	1948	1962	-5.3	1968	44.5	56.8
413	EDBURGA		11.1	1962	DEC	2	2.5841	5	6	5	1929	1965	4.6	1969	13.7	15.7
414	LIRIOPE		10.7	1962	DEC	2	3.5072	5	6	6	1949	1960	-90.0	1966	242.3	440.4
415	PALATIA		10.4	1960	JAN	7	2.7869	5	5	6	1941	1951	144.0	1968	524.6	679.5
416	VATICANA		9.4	1960	JAN	7	2.7887	5	6	7	1948	1958	2.9	1967	14.6	19.0
417	SUEVIA		10.7	1947	JAN	15	2.7998	5	6	6	1952	1962	2.6	1968	21.6	28.2
418	ALEMANNIA		10.8	1951	DEC	20	2.5923	5	6	4	1954	1958	-36.0	1967	270.2	322.2
419	AURELIA		9.6	1951	DEC	20	2.5955	5	6	4	1954	1959	360.0	1967	2313.2	2675.0
420	BERTHOLDA		9.4	1962	DEC	2	3.4213	5	6	11	1948	1965	-6.3	1965	17.4	30.5
421	ZAHRINGIA		13.0	1956	NOV	23	2.5376	2	8	7	1904	1957	31.3	1969*	63.9	71.2
422	BEROLINA		12.1	1957	JUN	11	2.2278	5	6	7	1941	1962	9.0	1968	26.2	23.3
423	DICTINA		8.5	1947	JAN	15	3.0661	5	6	7	1954	1961	9.2	1966	66.0	98.8
424	GRATIA		10.8	1951	DEC	20	2.7743	5	5	6	1948	1954	-252.0	1969	1184.8	1523.7
425	CORNELIA		10.8	1947	JAN	15	2.8862	5	6	5	1953	1962	-21.8	1969	118.7	162.3
426	HIPPO		9.6	1962	DEC	2	2.8872	5	6	10	1946	1966	4.4	1969	13.8	18.9
427	GALENE		10.7	1957	JUN	11	2.9777	5	6	4	1951	1964	7.4	1969	23.3	33.5
428	MONACHIA		12.9	1962	DEC	2	2.3075	5	6	5	1932	1965	8.4	1969	20.9	19.8
429	LOTIS		10.9	1951	DEC	20	2.6074	5	6	4	1954	1958	216.0	1967	1629.1	1898.0
430	HYBRIS		11.8	1951	DEC	20	2.8434	5	6	6	1940	1957	90.0	1966	225.7	301.6
431	NEPHELE		10.1	1951	DEC	20	3.1312	5	5	6	1943	1954	72.0	1968	237.4	366.7
432	PYTHIA		10.0	1951	DEC	20	2.3713	5	6	5	1953	1961	180.0	1969	797.2	792.4
433	EROS		12.4	1941	JAN	6	1.4581	2	8	15	1926	1965	-1.2	1968	26.0	8.6
434	HUNGARIA		12.1	1957	JUN	11	1.9443	5	6	6	1938	1963	8.3	1968	24.9	17.1
435	ELLA		11.3	1942	FEB	10	2.4490	2	8	28	1898	1966	6.9	1966	23.3	24.4
436	PATRICIA		11.1	1962	DEC	2	3.1991	5	6	5	1949	1960	4.7	1969	17.7	28.2
437	RHODIA		11.6	1962	DEC	2	2.3864	5	6	6	1950	1964	-2.3	1968	11.0	11.1
438	ZEUXO		10.6	1951	DEC	20	2.5543	5	6	4	1953	1958	108.0	1969	678.9	764.8
439	OHIO		10.7	1951	DEC	20	3.1304	5	5	6	1937	1952	-36.0	1964	111.5	172.1
440	THEODORA		12.9	1964	NOV	1	2.2109	2	8	5	1941	1965	9.9	1969	23.7	20.8
441	PATHILDE		9.8	1962	DEC	2	2.8050	5	6	10	1939	1966	-4.7	1968	13.8	18.1
442	EICHSFELDIA		11.2	1951	DEC	20	2.3455	5	6	5	1953	1958	324.0	1969	2018.6	1968.6
443	PHOTOGRAPHICA		11.6	1966	AUG	23	2.2156	2	8	12	1942	1966	7.2	1966	17.9	15.8
444	GYPTIS		9.4	1957	JUN	11	2.7694	5	6	5	1953	1959	70.1	1969	264.1	338.7
445	EDNA		10.2	1947	JAN	15	3.1786	5	6	8	1950	1961	-12.9	1969	62.1	98.0
446	AETERNITAS		10.0	1953	JAN	23	2.7869	2	8	23	1899	1963	9.2	1969	23.3	30.2
447	VALENTINE		10.4	1957	JUN	11	2.9854	5	6	5	1954	1960	6.3	1969	29.9	43.1
448	NATALIE		11.0	1945	DEC	11	3.1355	5	5	11	1927	1954	108.0	1969	245.9	380.6
449	HAMBURGA		10.7	1948	MAR	30	2.5541	5	6	6	1948	1960	2.6	1968	19.3	21.7
450	BRIGITTA		11.3	1962	DEC	2	3.0137	5	6	4	1951	1956	4.5	1969	27.0	39.4

STATUS OF NUMBERED MINOR PLANET EPHEMERIDES

NUMBER	NAME	NOTE	ARMAG	EPOCH			A	PLANETS			OPPOSITIONS		RESIDUAL	LAST	ERROR SEC	ERROR KMS	
451	PATIENTIA		8.3	1947	JAN	15	3.0606	5	6	9	1950	1962	7.5	1967	38.2	57.1	
452	HAMILTONIA	E	13.4	1900	JAN	1	2.8652	0	0	2	1900	1940	144.0	1969*	498.1	673.4	
453	TEA		12.0	1966	NOV	11	2.1827	2	8	12	1936	1966	38.0	1969	69.9	60.0	
454	MATHESIS		10.1	1951	DEC	20	2.6272	5	6	4	1953	1960	450.0	1969	2194.8	2588.5	
455	BRUCHSALIA		10.0	1951	DEC	20	2.6589	5	6	4	1952	1957	360.0	1969	2169.0	2608.0	
456	ABNOBA		11.0	1951	DEC	20	2.7833	5	6	4	1952	1960	90.0	1966	391.3	505.8	
457	ALLEGHENIA		13.0	1939	OCT	9	3.0897	2	8	3	1900	1940	7.4	1969*	28.9	43.7	
458	HERCYNIA		10.6	1947	JAN	15	2.9899	5	6	7	1951	1962	-18.2	1969	85.7	123.6	
459	SIGNE		11.9	1947	DEC	1	2.6208	5	5	6	1947	1955	252.0	1968	1175.9	1381.3	
460	SCANIA		12.0	1951	DEC	20	2.7186	5	6	5	1952	1958	72.0	1967	380.9	474.5	
461	SASKIA		11.6	1951	DEC	20	3.1163	5	5	6	1935	1949	-144.0	1966	460.9	706.9	
462	EOSTRYLA		10.8	1962	DEC	2	2.8722	5	6	7	1929	1963	3.3	1967	11.4	15.4	
463	LOLA		12.9	1962	DEC	2	2.3978	5	6	5	1926	1967	-3.8	1967	12.4	12.6	
464	MEGAIRA		10.4	1947	JAN	15	2.8021	5	6	5	1950	1960	8.3	1968	45.6	59.5	
465	ALEKTO		11.0	1962	DEC	2	3.0981	5	6	4	1950	1962	-2.4	1968	11.0	16.7	
466	TISIPHONE		9.2	1957	JUN	11	3.3753	5	6	7	1951	1958	6.3	1965	28.9	49.8	
467	LAURA		12.1	1952	JUL	7	2.9458	2	8	4	1924	1952	22.2	1969	57.4	81.0	
468	LINA		10.6	1957	JUN	11	3.1520	5	6	6	1949	1959	.9	1966	9.2	14.3	
469	ARGENTINA		10.0	1957	JUN	11	3.1525	5	6	9	1942	1964	-9.9	1969	25.1	39.2	
470	KILIA		11.5	1951	DEC	20	2.4046	5	6	5	1953	1958	36.0	1969	232.8	237.0	
471	PAPAGENA		7.9	1951	DEC	20	2.8872	2	8	10	1938	1956	16.9	1965	49.0	67.0	
472	ROMA		10.6	1951	DEC	20	2.5420	5	6	4	1954	1958	-72.0	1966	549.3	613.9	
473	NOLLI	L	11.2	1901	FEB	14	2.9792							1901*	640000.0	918091.0	LOST
474	PRUDENTIA		11.9	1962	DEC	2	2.4547	5	6	6	1933	1961	9.0	1968	23.2	24.4	
475	OCLLO		12.4	1968	OCT	11	2.5946	2	8	7	1930	1968	4.1	1968	10.7	12.4	
476	HEDWIG		9.8	1962	DEC	2	2.6487	5	6	9	1952	1968	-2.7	1968	10.5	12.6	
477	ITALIA		11.5	1957	JUN	11	2.4155	5	6	6	1950	1961	10.1	1968	33.5	34.3	
478	TERGESTE		8.9	1957	JUN	11	3.0134	5	6	9	1948	1964	2.7	1969	12.2	17.8	
479	CAPRERA		11.0	1951	DEC	20	2.7212	5	6	5	1954	1959	-108.0	1968	700.1	873.4	
480	HANSA		10.0	1951	DEC	20	2.6448	5	6	5	1952	1957	270.0	1967	1629.1	1942.1	
481	EMITA		9.8	1956	NOV	23	2.7431	2	8	18	1921	1958	12.4	1969	30.9	39.0	
482	PETRINA		10.1	1962	DEC	2	2.9954	5	6	6	1938	1959	-8.3	1966	23.2	33.6	
483	SEPPINA		9.7	1962	DEC	2	3.4288	5	6	7	1941	1962	2.2	1969	9.5	16.8	
484	PITTSBURGHIA		11.5	1951	DEC	20	2.6702	5	6	4	1953	1956	360.0	1968	3369.0	4078.4	
485	GENUA		9.7	1956	NOV	23	2.7483	2	8	22	1918	1958	42.7	1963	86.4	109.5	
486	CREMONA		12.3	1967	MAY	30	2.3523	2	8	6	1952	1967	-2.1	1967	8.6	8.5	
487	VENETIA		9.6	1951	DEC	20	2.6695	5	6	5	1953	1959	-36.0	1967	201.0	243.2	
488	KREUSA		9.0	1957	JUN	11	3.1477	5	6	7	1950	1961	2.7	1969	13.5	21.1	
489	COMACINA		9.8	1957	JUN	11	3.1500	5	6	8	1939	1958	9.0	1969	27.0	42.1	
490	VERITAS		9.5	1962	DEC	2	3.1746	5	6	10	1939	1964	7.2	1968	18.5	29.2	
491	CARINA		10.0	1962	DEC	2	3.1953	5	6	7	1941	1963	-4.4	1968	13.7	21.8	
492	GISMONDA		11.0	1962	DEC	2	3.1077	5	6	10	1933	1966	6.0	1968	15.5	23.7	
493	GRISELDIS		11.8	1951	DEC	20	3.1134	5	6	4	1943	1960	180.0	1960*	421.2	645.2	
494	VIRTUS		10.1	1957	JUN	11	2.9863	5	6	6	1951	1959	-9.0	1969	34.9	50.3	
495	EULALIA		11.6	1957	JUN	11	2.4878	5	6	4	1953	1961	-3.8	1968	19.0	20.5	
496	GRYPHIA		13.0	1969	APR	29	2.1993	2	8	11	1936	1969	3.8	1969	10.4	9.0	
497	IVA		10.7	1960	JAN	7	2.8517	5	5	6	1938	1952	180.0	1969	533.3	715.7	
498	TOKIO		10.0	1962	DEC	2	2.6499	5	6	10	1931	1966	6.3	1967	16.4	19.7	
499	VENUSIA		10.2	1948	SEP	6	3.9634	5	6	5	1949	1958	-3.2	1967	22.1	47.5	
500	SELINUP		10.6	1951	DEC	20	2.6125	5	6	5	1952	1959	72.0	1969	348.6	407.4	

NUMBER	NAME	NOTE	ABMAG	EPOCH			A	PLANETS			OPPOSITIONS		RESIDUAL	LAST	ERROR SEC	ERROR KM	
501	URHIXIDUR		10.2	1951	DEC	20	3.1518	5	5	6	1931	1951	-288.0	1968	742.7	1158.2	
502	SIGUNE		12.3	1941	JUL	25	2.3876							1962	300.0	300.8	ESTIMATED
503	EVELYN		10.3	1947	JAN	15	2.7230	5	6	7	1950	1960	-10.1	1969	53.5	66.8	
504	CORA		11.1	1960	JAN	7	2.7213	5	5	4	1951	1956	-7.2	1969	40.9	51.0	
505	CAVA		10.1	1955	NOV	23	2.6864	2	8	13	1916	1959	-89.8	1969	170.4	208.3	
506	MARION		9.8	1947	JAN	15	3.0449	5	6	7	1951	1962	-7.5	1969	40.8	60.5	
507	LADDIA		10.4	1962	DEC	2	3.1530	5	6	10	1938	1965	-3.0	1968	10.6	14.6	
508	PRINCETONIA		9.5	1947	JAN	15	3.1597	5	6	8	1948	1960	9.0	1969	42.3	66.2	
509	IOLANDA		9.8	1962	DEC	2	3.0619	5	6	7	1942	1964	5.7	1969	16.0	23.9	
510	MARELLA		11.0	1951	DEC	20	2.6088	5	6	5	1953	1958	360.0	1969	2241.1	2613.3	
511	DAVIDA		7.1	1957	JUN	11	3.1908	5	6	9	1950	1961	2.0	1969	11.7	18.6	
512	TAURINENSIS		12.2	1962	DEC	2	2.1893	5	6	5	1932	1958	4.8	1968	16.5	14.2	
513	CENTESIMA		10.6	1951	DEC	20	3.0131	5	5	6	1943	1953	61.2	1969	216.5	315.9	
514	ARMIDA		10.3	1951	DEC	20	3.0508	5	5	6	1939	1952	-180.0	1967	562.2	835.7	
515	ATHALIA		11.9	1903	SEP	3	3.1239	2	8	8	1903	1964	3.7	1969	30.9	47.6	
516	AMPHERSTIA		9.5	1941	JAN	6	2.6788	2	6	10	1937	1959	-32.6	1969	100.8	122.7	
517	EDITH		10.5	1962	DEC	2	3.1377	5	6	10	1931	1963	6.9	1969	17.6	27.3	
518	HALAWE		12.3	1951	DEC	20	2.5375	5	6	4	1943	1959	360.0	1963	864.3	963.1	
519	SYLVANIA		10.3	1967	APR	20	2.7886	2	8	13	1956	1967	5.2	1968	14.6	19.0	
520	FRANZISKA		11.9	1962	DEC	2	3.0079	5	6	4	1942	1969	-9.0	1968	20.3	29.6	
521	BRIXIA		10.0	1951	DEC	20	2.7403	5	6	4	1952	1959	360.0	1966	1706.0	2151.9	
522	HELGA		10.0	1962	DEC	2	3.6283	5	6	9	1939	1963	-3.6	1968	11.8	22.4	
523	ADA		10.7	1957	JUN	11	2.9622	5	6	8	1949	1964	4.7	1969	16.6	23.6	
524	FIDELIO		10.9	1951	DEC	20	2.6361	5	6	5	1952	1958	72.0	1967	381.1	451.9	
525	ADELAIDE		13.2	1957	JUN	11	2.2453	2	6	3	1908	1957	-3.6	1968	14.7	13.3	
526	JENA		10.9	1962	DEC	2	3.1246	5	6	7	1934	1963	-2.7	1968	10.3	15.8	
527	EUPHANTHE		11.4	1951	DEC	20	2.7236	5	6	5	1953	1961	90.0	1968	402.7	503.0	
528	REZIA		9.9	1948	JUL	28	3.3943	5	6	8	1951	1962	11.3	1969	54.0	93.6	
529	PREZIOSA		11.1	1950	AUG	27	3.0194	5	6	5	1951	1961	-15.2	1967	66.5	97.3	
530	TURANDOT		10.0	1949	SEP	1	3.2174	5	6	5	1950	1957	4.7	1968	32.2	51.8	
531	ZERLINA		12.3	1904	APR	30	2.7848	2	8	2	1904	1955	4.1	1955*	33.8	43.8	
532	HERCULINA		8.0	1935	DEC	24	2.7728	2	8	0	-0	-0	1.6	1968	232.6	298.8	
533	SARA		11.2	1957	JUN	11	2.9822	5	6	4	1948	1958	-2.6	1967	14.4	20.6	
534	NASSOVIA		11.0	1962	DEC	2	2.8843	5	6	10	1928	1968	-7.4	1969	17.4	23.7	
535	MONTAGUE		10.5	1951	DEC	20	2.5687	5	5	6	1943	1953	144.0	1966	498.8	567.2	
536	MERAPI		9.4	1947	JAN	15	3.5047	5	6	5	1951	1959	-5.6	1969	37.6	68.3	
537	PAULY		10.1	1951	DEC	20	3.0689	5	5	6	1946	1952	-108.0	1968	530.4	795.3	
538	FRIEDERIKE		10.6	1951	DEC	20	3.1645	5	5	6	1938	1953	-108.0	1968	310.6	487.3	
539	PAMINA		11.1	1951	DEC	20	2.7390	0	0	5	1941	1956	144.0	1968	383.3	483.1	
540	ROSAMUNDE		12.2	1957	JUN	11	2.2188	5	6	7	1948	1964	9.8	1967	27.9	24.6	
541	DEBORAH		11.3	1951	DEC	20	2.8152	5	6	5	1955	1961	360.0	1966	2048.7	2605.4	
542	SUSANNA		10.3	1962	DEC	2	2.9041	5	6	6	1942	1964	4.1	1967	13.2	18.2	
543	CHARLOTTE		10.6	1966	APR	5	3.0591	2	8	16	1935	1966	-5.1	1966	13.0	19.4	
544	JETTA		11.3	1951	DEC	20	2.5913	5	6	5	1952	1957	7.2	1967	52.4	60.4	
545	MESSALINA		9.5	1957	JUN	11	3.1715	5	6	7	1950	1960	-3.6	1966	16.3	25.7	
546	HERODIAS		10.8	1951	DEC	20	2.5966	5	6	5	1953	1958	270.0	1967	1683.2	1947.8	
547	PRAXEDIS		10.9	1956	NOV	23	2.7766	2	8	12	1904	1957	-25.0	1968	52.2	67.2	
548	KRESSIDA		12.6	1928	OCT	1	2.2821	2	8	20	1904	1962	-24.8	1969	63.2	58.8	
549	JESSONDA		11.8	1962	DEC	2	2.6825	5	6	6	1936	1958	180.0	1969*	390.3	476.0	
550	SENTA		10.4	1951	DEC	20	2.5889	5	6	5	1952	1958	-72.0	1969	381.2	439.0	

NUMBER	NAME	NOTE	ARMAG	EPOCH			A	PLANETS			OPPOSITIONS		RESIDUAL	LAST	ERROR SEC	ERROR KM3
551	ORTRUD		10.5	1957	JUN	11	2.9705	5	6	8	1931	1958	8.4	1969	24.0	34.2
552	SIGELINDE		10.4	1951	DEC	20	3.1531	5	5	6	1939	1953	-144.0	1968	419.7	654.9
553	KUNDRY		13.5	1967	SEP	7	2.2309	2	8	6	1932	1967	-6.8	1967	16.2	14.4
554	PERAGA		9.5	1965	JUN	9	2.3751	2	8	14	1938	1965	3.9	1969	12.2	12.2
555	NORMA		11.7	1968	MAY	4	3.1564	2	8	6	1931	1968	-6.8	1968	14.7	23.0
556	PHYLLIS		10.6	1951	DEC	20	2.4668	5	6	6	1952	1960	90.0	1969	392.0	416.7
557	VIOLETTA		13.1	1951	DEC	20	2.4414	5	6	4	1949	1955	252.0	1967	1185.5	1238.6
558	CARMEN		10.1	1957	JUN	11	2.9080	5	6	7	1951	1962	-3.2	1969	14.8	20.4
559	NANON		10.6	1951	DEC	20	2.7146	5	6	5	1954	1959	180.0	1969	1160.9	1442.7
560	DELILA		11.8	1957	JUN	11	2.7502	5	6	4	1947	1957	7.7	1969	30.2	38.3
561	INGWELDE		12.0	1951	DEC	20	3.1613	5	5	5	1927	1953	-684.0	1965*	1534.1	2403.1
562	SALOME		10.9	1947	JAN	15	3.0185	5	6	4	1951	1959	-9.0	1969	55.6	81.4
563	SULEIKA		9.6	1951	DEC	20	2.7126	5	6	5	1954	1959	-72.0	1969	469.7	583.1
564	DUDU		11.8	1962	DEC	2	2.7469	5	6	6	1948	1965	3.6	1969	12.7	16.1
565	MARBACHIA		12.1	1951	DEC	20	2.4413	5	6	4	1954	1959	36.0	1968	239.9	250.7
566	STEREOSKOPIA		9.2	1947	JAN	15	3.3855	5	6	8	1950	1962	3.0	1969	20.5	35.5
567	ELEUTHERIA		10.5	1951	DEC	20	3.1520	5	5	6	1944	1952	72.0	1968	296.2	462.1
568	CHERUSKIA		10.4	1957	JUN	11	2.8846	5	6	4	1952	1962	-107.9	1969	287.5	392.7
569	MISA		10.9	1962	DEC	2	2.6570	5	6	9	1949	1962	8.8	1969	26.1	31.4
570	KYTHERA		10.1	1962	DEC	2	3.4444	5	6	10	1931	1962	3.3	1969	11.2	19.8
571	DULCINEA		12.9	1951	DEC	20	2.4110	5	6	4	1950	1959	72.0	1970	291.6	288.0
572	PEREKKA		11.9	1951	DEC	20	2.4009	5	6	4	1949	1956	72.0	1963	318.2	323.1
573	RECHA		10.8	1951	DEC	20	3.0119	5	5	6	1939	1952	-144.0	1967	451.5	658.4
574	REGINHILD		13.8	1962	DEC	2	2.2527	5	5	5	1947	1966	3.9	1966	13.7	12.4
575	RENATE		12.4	1951	DEC	20	2.5535	5	6	4	1953	1958	36.0	1966	232.5	261.7
576	EMANUELA		10.7	1947	JAN	15	2.9889	5	6	6	1951	1961	10.5	1967	55.8	80.4
577	RHEA		10.8	1934	DEC	29	3.1115	2	8	9	1905	1954	-43.9	1966	95.3	145.8
578	HAPPELIA		10.5	1967	MAR	11	2.7489	2	8	9	1941	1967	6.3	1969	14.9	18.9
579	SIDONIA		9.4	1947	JAN	15	3.0145	5	6	8	1950	1962	-3.2	1969	21.8	31.8
580	SELENE		11.0	1957	JUN	11	3.2234	5	6	5	1942	1961	-8.1	1965	23.6	38.1
581	TAUNTONIA		11.0	1951	DEC	20	3.2170	5	5	4	1941	1951	10.8	1961*	47.1	75.6
582	OLYMPIA		10.5	1957	JUN	11	2.6111	5	6	5	1940	1959	7.8	1966	24.6	28.7
583	KLOTILDE		10.4	1957	JUN	11	3.1883	5	6	4	1945	1955	2.1	1967	13.3	21.1
584	SEMIRAMIS		10.0	1957	JUN	11	2.3734	5	6	4	1954	1962	4.5	1969	21.3	21.2
585	BILKIS		11.5	1951	DEC	20	2.4314	5	6	4	1952	1959	216.0	1968	1027.9	1066.4
586	THEKLA		10.4	1962	DEC	2	3.0415	5	6	10	1930	1966	-2.8	1969	10.1	14.9
587	HYPSIPYLE		13.6	1962	DEC	2	2.3346	5	6	5	1938	1957	90.0	1968*	214.8	207.7
588	ACHILLES		9.4	1948	AUG	7	5.2112	5	6	9	1906	1931	-4.7	1967	22.5	68.7
589	CROATIA		10.1	1962	DEC	2	3.1300	5	6	5	1951	1964	3.2	1968	12.2	16.9
590	TOMYRIS		11.2	1951	DEC	20	3.0003	5	5	6	1944	1954	144.0	1965	483.6	701.2
591	IRMGARD		11.9	1951	DEC	20	2.6784	5	6	5	1951	1959	180.0	1969	751.5	914.2
592	BATHSEBA		10.6	1962	DEC	2	3.0240	5	6	4	1951	1965	7.1	1966	19.6	28.8
593	TITANIA		10.5	1951	DEC	20	2.6980	5	6	5	1952	1957	108.0	1966	656.9	808.5
594	MIREILLE		13.8	1949	SEP	1	2.6307	2	8	3	1906	1936	-49.5	1965	143.3	169.4
595	POLYXENA		9.3	1957	JUN	11	3.2092	5	6	9	1942	1960	5.9	1969	19.4	31.0
596	SCHEILA		9.8	1947	JAN	15	2.9301	5	6	6	1951	1962	9.9	1968	51.1	71.4
597	BANDUSIA		10.8	1947	JAN	15	2.6721	5	6	6	1951	1962	-6.6	1969	37.8	45.8
598	OCTAVIA		9.9	1951	DEC	20	2.7635	5	6	5	1951	1958	180.0	1967	831.7	1063.0
599	LUISA		10.1	1951	DEC	20	2.7750	5	6	4	1952	1958	108.0	1967	566.8	729.2
600	MUSA		11.4	1951	DEC	20	2.6586	5	6	5	1953	1959	72.0	1968	393.0	472.5

NUMBER	NAME	NOTE	ABMAG	EPOCH	A	PLANETS		OPPOSITIONS		RESIDUAL	LAST	ERROR SEC	ERROR KM3	
601	NERTHUS		10.4	1923 JUN 30	3.1345	5	5	10	1923 1955	649.0	1967	1980.0	3063.3	
602	MARIANNA		9.7	1947 JAN 15	3.0884	5	6	8	1951 1963	-3.0	1969	21.2	32.0	
603	TIMANDRA		13.6	1906 MAR 11	2.5518	2	8	2	1906 1951	-6.1	1951*	40.9	46.0	
604	TEKMESSA		10.3	1957 JUN 11	3.1667	5	6	7	1951 1960	2.1	1968	12.7	19.9	
605	JUVISIA		10.6	1962 DEC 2	2.9996	5	6	6	1939 1961	-8.6	1967	22.6	32.8	
606	BRANGANE		11.6	1951 DEC 20	2.5862	5	6	4	1952 1956	-36.0	1968	261.2	300.3	
607	JENNY		10.9	1947 JAN 15	2.8515	5	6	5	1950 1962	-9.0	1969	44.3	59.4	
608	ADELEINE		11.9	1942 JUL 20	3.0259						1969	300.0	440.5	ESTIMATED
609	FULVIA		11.3	1962 DEC 2	3.0873	5	6	5	1948 1965	2.7	1969	10.6	16.0	
610	VALESKA		13.3	1942 MAY 1	3.0797						1957*	300.0	452.2	ESTIMATED
611	VALERIA		10.6	1957 JUN 11	2.9780						1967	300.0	430.1	ESTIMATED
612	VERONIKA	L	12.4	1906 OCT 17	3.1389	2	8	1	1906 1906	7.2	1912*	6400000.0	992171.0	LOST
613	GINEVRA		11.0	1947 JAN 15	2.9199	5	6	8	1951 1960	12.5	1966	69.4	96.6	
614	PIA		12.1	1962 DEC 2	2.6927	5	6	4	1949 1957	1.4	1968	10.5	12.9	
615	ROSWITHA		11.3	1951 DEC 20	2.6313	5	6	5	1952 1957	144.0	1969	873.1	1032.3	
616	ELLY		11.7	1951 DEC 20	2.5519	5	6	5	1955 1961	450.0	1962	2559.3	2878.7	
617	PATROCLUS		9.2	1948 AUG 7	5.2068						1965	300.0	914.7	ESTIMATED
618	ELPIDE		9.6	1957 JUN 11	3.1843	5	6	8	1951 1962	4.4	1969	17.4	27.6	
619	TRIBERGA		11.2	1962 DEC 2	2.5195	5	6	7	1946 1958	4.5	1969*	18.0	19.8	
620	DRAKONIA		12.5	1951 DEC 20	2.4352	5	6	5	1950 1959	72.0	1962	281.6	292.9	
621	WERDANDI		11.8	1962 DEC 2	3.1191	5	6	5	1950 1958	-4.2	1969	68.3	105.0	
622	ESTHER		11.8	1951 DEC 20	2.4143	0	0	6	1945 1955	-252.0	1969	816.0	836.5	
623	CHIMAERA		11.5	1951 DEC 20	2.4591	5	6	4	1954 1959	36.0	1966	239.9	253.7	
624	HEKTOR		8.7	1948 AUG 7	5.1211						1969	300.0	896.1	ESTIMATED
625	XENIA		11.1	1951 DEC 20	2.6470	5	6	4	1951 1956	90.0	1969	531.1	633.9	
626	NOTBURGA		10.1	1962 DEC 2	2.5719	5	6	9	1953 1967	-9.0	1967	22.6	25.8	
627	CHARIS		11.1	1951 DEC 20	2.9003	5	5	6	1940 1949	-72.0	1969	304.6	419.5	
628	CHRISTINE		10.5	1951 DEC 20	2.5810	5	6	4	1953 1958	-72.0	1966	455.6	522.1	
629	BERNARDINA		10.9	1966 OCT 22	3.1200	2	8	5	1935 1966	-6.8	1969	15.9	24.4	
630	EUPHEMIA		12.5	1968 JUL 23	2.6245	2	8	6	1930 1968	-6.6	1968	14.7	17.3	
631	PHILIPPINA		10.2	1956 NOV 23	2.7913	5	5	6	1920 1930	72.0	1969	417.8	542.4	
632	PYRRHA		13.3	1951 DEC 20	2.6630	5	6	4	1951 1959	72.0	1969	306.0	368.9	
633	ZELIMA		11.1	1962 DEC 2	3.0170	5	6	7	1949 1959	6.0	1969	22.2	32.5	
634	UTE		11.1	1962 DEC 2	3.0444	5	6	6	1932 1959	3.5	1969	12.4	18.4	
635	VUNDTIA		10.1	1962 DEC 2	3.1341	5	6	8	1939 1964	11.6	1967	26.7	41.2	
636	ERIKA		10.7	1951 DEC 20	2.9101	5	6	4	1953 1957	-36.0	1969	269.6	373.2	
637	CHRYSOTHEMIS		12.0	1957 JUN 11	3.1532						1969*	300.0	468.2	ESTIMATED
638	MOIRA		11.1	1956 NOV 23	2.7357	2	8	9	1925 1957	-4.1	1968	15.5	19.5	
639	LATONA		9.4	1962 DEC 2	3.0192	5	6	10	1941 1965	-2.1	1967	9.2	13.4	
640	BRAMBILLA		10.4	1962 DEC 2	3.1665	5	6	5	1950 1964	-8.6	1968	23.1	36.3	
641	AGNES		13.7	1962 DEC 2	2.2194	5	6	4	1932 1960	.8	1966	8.1	7.2	
642	CLARA		10.8	1962 DEC 2	3.1715	5	6	5	1930 1963	-6.6	1969	17.1	26.9	
643	SCHEHEREZADE		10.6	1962 DEC 2	3.3454	5	6	6	1930 1957	-4.5	1967	14.5	24.7	
644	COSIMA		11.8	1962 DEC 2	2.5993	5	6	7	1926 1965	-3.3	1969	11.5	13.3	
645	AGRIPPINA		11.1	1962 DEC 2	3.1798	5	6	8	1930 1964	9.5	1968	21.8	34.4	
646	KASTALIA		14.3	1953 AUG 11	2.3251	2	8	4	1937 1964	-34.5	1964	71.9	69.0	
647	ADELGUNDE		12.7	1951 DEC 20	2.4444	5	6	4	1940 1962	270.0	1964	819.5	858.0	
648	PIPPA		10.8	1957 JUN 11	3.1718	5	6	7	1941 1963	-5.9	1969	17.9	28.2	
649	JOSEFA		14.2	1951 DEC 20	2.5505	5	6	2	1952 1956	9.6	1967	76.5	85.9	
650	AMALASUNTHA		13.6	1907 SEP 22	2.4577	2	6	7	1907 1953	51.5	1968	173.1	182.8	

NUMBER	NAME	NOTE	ABMAG	EPOCH	A	PLANETS		OPPOSITIONS			RESIDUAL	LAST	ERROR SEC	ERROR KM3
651	ANTIKLEIA		11.2	1962 DEC 2	3.0244	5	6	8	1928	1964	-6.0	1964	15.7	23.1
652	JURTLATRIX		12.4	1962 DEC 2	2.5554	5	6	7	1937	1955	3.0	1967	13.3	15.0
653	BERENIKE		10.6	1962 DEC 2	3.0121	5	6	9	1927	1968	2.4	1968	9.3	13.5
654	ZELINDA		9.9	1957 JUN 11	2.2969	5	6	8	1950	1964	8.1	1965	25.4	23.9
655	BRISEIS		10.6	1957 JUN 11	2.9867	5	6	7	1941	1964	8.3	1969	22.3	32.2
656	BEAGLE		11.2	1947 JAN 15	3.1683	5	6	6	1950	1960	-4.4	1967	28.2	44.3
657	GUNLOD		12.0	1957 JUN 11	2.6120	5	6	4	1951	1961	9.0	1968	30.8	35.9
658	ASTERIA		11.7	1951 DEC 20	2.8548	5	6	6	1952	1959	36.0	1969	178.4	239.8
659	NESTOR		9.7	1963 DEC 17	5.2582	2	8	14	1931	1964	-6.0	1967	14.8	45.7
660	CRESCENTIA		10.0	1962 DEC 2	2.5367	5	6	10	1948	1966	-7.5	1966	19.7	22.0
661	CLORIS		10.7	1951 DEC 20	3.0129	5	6	5	1952	1960	180.0	1967	773.4	1128.4
662	NEWTONIA		11.9	1951 DEC 20	2.5531	5	6	4	1953	1957	-144.0	1969	1053.3	1185.6
663	GERLINDE		10.6	1962 DEC 2	3.0700	5	6	6	1948	1966	-3.9	1969	12.5	18.8
664	JUDITH		11.4	1962 DEC 2	3.1694	5	6	5	1930	1964	7.8	1964	18.8	29.6
665	SABINE		9.8	1957 JUN 11	3.1517	5	6	5	1951	1957	3.9	1967	22.2	34.7
666	DESDEMONA		12.0	1957 JUN 11	2.5932	5	6	4	1950	1962	-58.1	1962	143.0	165.1
667	DENISE		10.6	1965 JUL 19	3.1908	2	8	6	1936	1965	6.2	1965	15.4	24.4
668	DORA		13.4	1964 MAY 25	2.7981	2	8	5	1936	1959	-2.6	1969	10.5	13.7
669	KYPRIA		11.4	1962 DEC 2	3.0102	5	6	6	1943	1966	7.5	1966	18.8	27.4
670	OTTEGEBE		11.2	1962 DEC 2	2.8049	5	6	10	1927	1968	-3.0	1969	10.5	13.7
671	CARNEGIA		11.2	1951 DEC 20	3.0974	5	6	4	1952	1960	270.0	1970	1155.8	1757.1
672	ASTARTE		12.4	1951 DEC 20	2.5549	5	6	4	1948	1956	72.0	1969	279.3	314.7
673	EDDA		11.2	1947 JAN 15	2.8154	5	6	6	1950	1959	4.5	1969	30.9	40.6
674	RACHELE		8.5	1951 DEC 20	2.9207	5	6	4	1953	1957	25.2	1967	191.3	266.3
675	LUDMILLA		9.3	1951 DEC 20	2.7714	5	6	5	1952	1957	21.6	1968	138.4	177.7
676	MELITTA		10.6	1962 DEC 2	3.0635	5	6	7	1931	1965	-3.5	1968	11.4	17.0
677	AALTJE		11.0	1941 JUN 15	2.9557	2	8	14	1906	1961	-24.4	1968	53.0	75.1
678	FREDEGUNDIS		10.7	1962 DEC 2	2.5739	5	6	8	1934	1967	7.1	1969	17.8	20.3
679	PAX		9.2	1954 SEP 15	2.5869	0	0	6	1939	1953	720.0	1969	2065.4	2375.6
680	GENOVEVA		10.9	1962 DEC 2	3.1305	5	6	10	1933	1966	-7.5	1966	19.1	27.9
681	GORGO		12.0	1962 DEC 2	3.1120	5	6	5	1932	1966	1.0	1966	7.0	10.7
682	HAGAR		13.6	1909 JUN 23	2.6321	2	8	2	1909	1951	-11.8	1951*	56.8	67.2
683	LANZIA		9.6	1947 JAN 15	3.1168	5	6	7	1947	1963	-3.0	1968	18.6	28.5
684	HILDBURG		12.2	1957 JUN 11	2.4326	5	6	4	1954	1962	35.7	1969	114.8	119.2
685	JERMIA		13.0	1924 DEC 21	2.2357	2	8	10	1909	1959	-18.8	1966	59.7	53.5
686	GERSUIND		11.5	1938 JUL 1	2.5884	2	8	7	1922	1955	-3.2	1968	19.6	22.6
687	TINETTE		13.0	1957 JUN 11	2.7222	5	6	4	1951	1963	9.6	1969	29.6	36.9
688	MELANIE		11.7	1951 DEC 20	2.6987	5	6	5	1940	1956	540.0	1967	2323.2	2860.4
689	ZITA		13.4	1968 APR 14	2.3155	2	8	10	1934	1968	-48.0	1969	82.1	78.3
690	WRATISLAVIA		8.9	1951 DEC 20	3.1589	5	5	6	1946	1953	-36.0	1968	162.5	254.3
691	LEHIGH		10.5	1962 DEC 2	3.0142	5	6	10	1938	1966	6.8	1968	17.1	24.9
692	HIPPODAMIA		10.2	1961 JUL 20	3.3617	5	6	5	1949	1956	-21.6	1969	88.7	151.9
693	ZERLINETTA		10.5	1951 DEC 20	2.9434	5	5	6	1944	1953	-108.0	1969	404.5	569.8
694	EKARD		10.2	1962 DEC 2	2.6700	5	6	8	1948	1965	-11.0	1969	27.1	32.9
695	BELLA		9.8	1951 DEC 20	2.5391	5	6	5	1953	1960	360.0	1969	1757.9	1961.0
696	LEONORA		10.3	1962 DEC 2	3.1885	5	6	8	1951	1965	6.2	1968	17.7	28.0
697	GALILEA		10.4	1947 JAN 15	2.8813	5	6	5	1951	1960	5.0	1966	33.6	45.9
698	ERNESTINA		11.9	1962 DEC 2	2.8681	5	6	7	1937	1966	90.0	1968	160.7	217.6
699	HELA		13.2	1943 MAR 17	2.6134	2	8	9	1902	1957	5.7	1969	21.6	25.3
700	AURAVICTRIX		12.5	1957 JUN 11	2.2293	5	6	5	1938	1960	2.6	1967	13.5	12.1

NUMBER	NAME	NOTE	ABMAG	EPOCH			A	PLANETS			OPPOSITIONS		RESIDUAL	LAST	ERROR SEC	ERROR KMS	
701	ORICLA		10.6	1951	DEC	20	3.0119	5	5	5	1948	1955	75.6	1969	321.6	469.0	
702	ALAUDA		8.7	1962	DEC	2	3.1935	5	6	7	1953	1961	-1.4	1967	9.3	14.8	
703	NOEMI		13.7	1962	DEC	2	2.1750	5	6	5	1934	1958	14.2	1966	36.3	30.9	
704	INTERAMNIA		7.6	1962	DEC	2	3.0569	5	6	10	1939	1966	-3.8	1970	12.0	17.9	
705	ERMINIA		9.8	1951	DEC	20	2.9228	5	6	4	1953	1958	-216.0	1969	1347.8	1878.3	
706	HIPPONOE		12.1	1962	DEC	2	2.7296	5	6	6	1930	1959	6.8	1968*	19.1	23.9	
707	STETNA		13.5	1962	DEC	2	2.1806	5	6	8	1932	1957	-1.5	1968*	9.9	8.5	
708	RAPHAELA		11.8	1957	JUN	11	2.6717	5	6	5	1952	1960	-3.8	1969	18.7	22.6	
709	FRINGILLA		9.9	1949	JUN	13	2.9139	5	6	7	1951	1963	3.0	1968	19.9	27.6	
710	GERTRUD		12.2	1962	DEC	2	3.1430	5	6	5	1938	1967	-8.0	1969	18.8	29.3	
711	MARMULLA		12.6	1962	DEC	2	2.2373	5	6	6	1942	1968	3.4	1969	12.2	10.9	
712	BOLIVIANA		9.6	1954	SEP	15	2.5764	0	0	6	1950	1957	360.0	1967	1345.5	1537.3	
713	LUSCINIA		10.0	1957	JUN	11	3.4096	5	6	8	1930	1962	8.0	1964	20.9	36.5	
714	ULULA		10.3	1962	DEC	2	2.5352	5	6	9	1949	1965	9.0	1969	23.4	26.1	
715	TRANSVAALIA		11.1	1957	JUN	11	2.7679	5	6	6	1951	1962	2.7	1968	13.7	17.6	
716	BERKELEY		11.9	1962	DEC	2	2.7101	5	6	5	1950	1963	4.4	1968	15.4	20.3	
717	WISTARIA		12.0	1957	JUN	11	3.1385	5	6	4	1950	1956	10.8	1967	51.7	80.1	
718	ERIDA		10.8	1957	JUN	11	3.0522	5	6	8	1941	1963	-5.4	1968	17.1	25.4	
719	ALBERT	L	16.9	1911	OCT	11	2.5939	2	8	1	1911	1911	-8.4	1911*	640000.0	734723.3	LOST
720	BOHLINIA		10.9	1951	DEC	20	2.8858	5	5	6	1946	1954	-72.0	1969	278.6	380.8	
721	TABORA		10.5	1962	DEC	2	3.5539	5	6	5	1931	1964	-11.4	1968	25.1	46.4	
722	FRIEDA		13.2	1962	DEC	2	2.1718	5	6	6	1952	1965	9.0	1968	25.4	21.6	
723	HAMMONIA		11.4	1962	DEC	2	2.9975	5	6	6	1934	1967	3.2	1967	10.8	15.6	
724	HAPAG	L	14.8	1911	OCT	31	2.4506	2	8	1	1911	1911	-4.6	1911*	640000.0	672889.5	LOST
725	AMANDA		12.4	1927	MAR	21	2.5712	2	8	11	1911	1960	-15.6	1964	49.2	56.0	
726	JOSELLA		12.1	1926	MAY	5	2.5656	2	8	9	1927	1963	2.7	1964	24.3	27.6	
727	NIPPONIA		11.3	1962	DEC	2	2.5672	5	6	5	1951	1967	8.7	1967	21.7	24.7	
728	LEONTISIS		13.9	1912	FEB	28	2.2556	2	8	1	1912	1912	4.4	1960*	295.7	269.1	
729	WATSONIA		11.0	1957	JUN	11	2.7585	5	5	6	1940	1953	-72.0	1969	223.1	284.4	
730	ATHANASIA		14.8	1912	MAY	18	2.2436	2	8	2	1912	1966	-11.7	1969*	53.6	48.3	
731	SORGA		10.6	1947	JAN	15	2.9852	5	6	6	1950	1959	-7.5	1968	44.6	64.1	
732	TJILAKI		12.0	1932	AUG	21	2.4569	2	8	9	1912	1954	6.1	1967	27.4	28.9	
733	MOCTA		10.2	1957	JUN	11	3.3911	5	6	4	1949	1960	3.6	1969	15.9	27.6	
734	BENDA		11.0	1951	DEC	20	3.1533	5	5	6	1944	1953	216.0	1967	800.2	1249.0	
735	MARGHANNA		11.0	1957	JUN	11	2.7280	5	6	5	1951	1961	-2.9	1969	14.7	18.4	
736	HARVARD		12.2	1962	DEC	2	2.2024	5	6	5	1933	1964	9.0	1967	22.6	19.7	
737	AREQUIPA		9.8	1951	DEC	20	2.5908	5	6	5	1953	1961	90.0	1969	402.9	464.6	
738	ALAGASTA		11.1	1951	DEC	20	3.0334	5	5	5	1948	1956	43.2	1969	170.4	251.1	
739	MANDEVILLE		10.1	1960	JAN	7	2.7378	5	6	7	1941	1956	19.5	1965	57.0	71.8	
740	CANTABIA		10.4	1957	JUN	11	3.0487	5	6	7	1948	1963	4.7	1968	16.8	24.9	
741	BOTOLPHIA		11.4	1951	DEC	20	2.7235	5	5	6	1941	1954	-36.0	1969	114.1	142.6	
742	EDISONA		10.5	1951	DEC	20	3.0129	5	5	6	1945	1953	-108.0	1968	426.9	622.9	
743	EUGENISIS		11.3	1947	JAN	15	2.7950	5	6	7	1951	1962	17.7	1969	83.9	109.2	
744	AGUNTINA		11.2	1951	DEC	20	3.1730	5	5	6	1941	1953	144.0	1967	452.2	712.2	
745	MAURITIA		11.1	1962	DEC	2	3.2595	5	6	6	1924	1957	3.4	1969*	11.9	19.5	
746	MARLU		10.6	1947	JAN	15	3.1129	5	6	5	1951	1958	5.7	1968	41.9	64.2	
747	WINCHESTER		8.8	1947	JAN	15	2.9944	5	6	4	1952	1958	2.3	1968	24.5	35.4	
748	SIMEISA		9.8	1942	DEC	27	3.9511	2	8	19	1913	1962	16.4	1969	37.9	81.0	
749	MALZOVIA		13.0	1964	SEP	2	2.2430	2	8	8	1934	1964	-2.3	1964	9.9	9.0	
750	OSKAR		13.0	1962	DEC	2	2.4420	5	6	6	1932	1966	4.2	1968	13.2	13.8	

NUMBER	NAME	NOTE	APMAG	EPOCH			A	PLANETS			OPPOSITIONS		RESIDUAL	LAST	ERROR SEC	ERROR KM3
751	FAINA		10.1	1951	DEC	20	2.5520	5	6	4	1953	1959	180.0	1967	969.3	1090.3
752	SULAMITIS		11.5	1957	JUN	11	2.4633	5	6	5	1952	1960	-3.5	1968	18.1	18.2
753	TIFLIS		11.9	1930	JAN	24	2.3295	2	8	5	1938	1956	-2.6	1967	27.7	26.7
754	MALABAR		10.5	1947	JAN	15	2.9856	5	6	4	1953	1963	-8.3	1968	47.7	68.7
755	QUINTILLA		10.7	1962	DEC	2	3.1618	5	6	10	1927	1967	10.5	1968	22.4	35.0
756	LILLIANA		11.3	1908	APR	29	3.2288	2	8	4	1908	1950	6.3	1967*	38.6	62.3
757	PORTLANDIA		11.5	1962	DEC	2	2.3729	5	6	10	1939	1966	-8.6	1969	21.2	21.1
758	MANCUNIA		9.3	1962	DEC	2	3.2017	5	6	10	1939	1976	-2.4	1969	8.6	13.8
759	VINIFERA		12.1	1962	DEC	2	2.6192	5	6	5	1926	1968	-4.5	1968	13.0	15.3
760	MASSINGA		9.6	1951	DEC	20	3.1461	5	5	5	1939	1953	-90.0	1969	327.3	509.2
761	BRENDELIA		11.9	1957	JUN	11	2.8632	5	6	4	1951	1957	9.2	1962	43.8	59.1
762	PULCOVA		9.3	1947	JAN	15	3.1505	5	6	5	1956	1962	4.4	1969	40.9	63.7
763	CUPIDO		13.9	1963	JUN	20	2.2403	2	8	6	1940	1963	-75.0	1963	149.7	134.6
764	GEDANIA		10.7	1947	JAN	15	3.1810	5	6	5	1951	1957	-11.1	1968	70.6	125.9
765	MATTIACA		14.1	1925	JAN	10	2.5488	2	8	3	1913	1939	3.9	1969*	28.2	31.6
766	MOGUNTIA		10.9	1962	DEC	2	3.0224	5	6	8	1942	1965	5.4	1968	15.3	22.4
767	BONDIA		11.2	1951	DEC	20	3.1157	5	5	6	1939	1951	-180.0	1968	593.3	909.8
768	STRUVEANA		11.4	1957	JUN	11	3.1319	5	6	4	1951	1962	-9.3	1968	29.5	45.6
769	TATJANA		10.2	1957	JUN	11	3.1959	5	6	5	1939	1957	12.0	1968	34.6	55.1
770	BALT		12.2	1957	JUN	11	2.2208	5	6	6	1951	1964	-9.3	1969	29.0	25.7
771	LIBERA		11.7	1951	DEC	20	2.6531	5	6	4	1951	1960	90.0	1969	359.0	430.2
772	TANETE		9.8	1947	JAN	15	2.9997	5	6	5	1952	1958	8.9	1968	67.4	97.7
773	IRMINTRAUD		10.6	1957	JUN	11	2.8568	5	6	7	1951	1960	-6.0	1965	24.3	32.7
774	ARMOR		10.0	1957	JUN	11	3.0430	5	6	5	1952	1960	9.6	1968	35.6	52.7
775	LUMIERE		11.4	1951	DEC	20	3.0119	5	5	5	1943	1951	108.0	1968	453.9	661.9
776	BERBERICIA		8.9	1962	DEC	2	2.9327	5	6	10	1947	1966	-1.6	1969	8.4	11.8
777	GUTEMBERGA		11.3	1957	JUN	11	3.2178	5	6	5	1950	1962	1.7	1969	10.6	17.0
778	THEOBALDA		11.6	1957	JUN	11	3.1710	5	6	5	1934	1960	-10.5	1969*	27.2	42.8
779	NINA		9.7	1957	JUN	11	2.6650	5	6	5	1953	1958	-3.3	1968	21.8	26.3
780	ARMENIA		10.2	1962	DEC	2	3.1152	5	6	6	1943	1963	3.3	1969	11.8	18.1
781	KARTVELIA		10.6	1962	DEC	2	3.2369	5	6	5	1950	1961	-5.1	1969	18.2	29.6
782	MONTEFIORE		12.6	1948	FEB	19	2.1797	5	6	6	1951	1960	14.1	1966	75.7	64.7
783	NORA		12.2	1962	DEC	2	2.3418	5	8	6	1943	1965	-7.1	1967	19.2	18.7
784	PICKERINGIA		10.4	1957	JUN	11	3.0999	5	6	6	1950	1959	7.7	1968	29.8	45.4
785	ZHETANA		10.5	1957	JUN	11	2.5757	5	6	5	1952	1961	-8.6	1969	31.3	35.8
786	BREDICHINA		10.1	1962	DEC	2	3.1624	5	6	9	1933	1966	-9.4	1966	21.3	33.3
787	MOSKVA		11.4	1951	DEC	20	2.5406	5	6	5	1950	1956	324.0	1968*	1575.3	1759.0
788	HOHENSTEINA		9.6	1951	DEC	20	3.1229	5	5	6	1942	1953	36.0	1963	126.1	194.0
789	LENA		12.4	1962	DEC	2	2.6961	5	6	7	1949	1962	-1.6	1968	9.5	11.6
790	PRETORIA		9.1	1962	DEC	2	3.3973	5	6	9	1939	1966	7.7	1966	18.5	32.2
791	ANI		10.7	1957	JUN	11	3.1361	5	6	4	1948	1953	1.5	1968	14.8	22.9
792	METCALFIA		11.2	1962	DEC	2	2.6220	5	6	8	1947	1967	5.0	1968	14.6	17.2
793	ARIZONA		11.0	1947	JAN	15	2.7960	5	6	5	1949	1959	-8.0	1969	43.5	56.6
794	IRENAEA		12.4	1957	JUN	11	3.1567	5	6	5	1936	1958	10.1	1969	29.2	46.1
795	FINI		10.8	1925	JAN	10	2.7499	2	8	16	1914	1955	33.0	1969	95.2	120.7
796	SARITA		10.4	1951	DEC	20	2.6362	5	6	4	1951	1956	108.0	1969	635.5	753.6
797	MONTANA		11.7	1951	DEC	20	2.5359	5	6	5	1952	1958	180.0	1965	939.3	1045.6
798	RUTH		10.7	1962	DEC	2	3.0145	5	6	5	1945	1964	-1.2	1966	7.8	11.3
799	GUDULA		11.5	1957	JUN	11	2.5414	5	6	4	1952	1961	-7.5	1969	28.3	31.6
800	KRESSMANNIA		12.7	1968	OCT	11	2.1926	2	8	7	1951	1968	3.0	1968	9.9	8.6

NUMBER	NAME	NOTE	APMAG	EPOCH			A	PLANETS			OPPOSITIONS		RESIDUAL	LAST	ERROR SEC	ERROR KMS	
801	HELWERTHIA		12.5	1963	MAY	31	2.6060	2	8	7	1915	1957	18.8	1967	40.5	47.1	
														1970	300.0	260.1	ESTIMATED
802	EPYAXA		13.6	1915	MAR	20	2.1963										
803	PICKA		10.7	1957	JUN	11	3.2064	5	6	9	1930	1962	8.7	1968	22.4	35.8	
804	HISPANIA		9.2	1947	JAN	15	2.8390	5	6	6	1951	1960	6.8	1969	42.3	56.4	
805	HORMUTHIA		10.6	1951	DEC	20	3.2205	5	5	5	1938	1952	144.0	1969*	429.9	691.9	
806	GYLDENIA		11.2	1951	DEC	20	3.1986	5	5	6	1938	1952	684.0	1969	2011.3	3205.1	
807	CERASKIA		11.9	1957	JUN	11	3.0187							1969	300.0	438.9	ESTIMATED
808	MERXIA		11.0	1956	NOV	23	2.7459	2	8	13	1921	1958	-32.5	1969	68.9	87.2	
809	LUNDIA		13.2	1951	DEC	20	2.2836	5	6	4	1950	1960	144.0	1967	514.0	478.2	
810	ATOSSA		14.2	1915	SEP	20	2.1790	2	8	7	1915	1962	-5.1	1969	36.4	31.1	
811	NAUHEIMA		11.8	1962	DEC	2	2.8980	5	6	7	1934	1964	4.5	1969	13.5	18.6	
812	ADELE		12.5	1951	DEC	20	2.6589							1969*	300.0	360.7	ESTIMATED
813	BAUMEIA		13.2	1957	JUN	11	2.2230	5	6	8	1947	1960	90.0	1968*	229.8	203.7	
814	TAURIS		10.0	1957	JUN	11	3.1794							1965	300.0	473.9	ESTIMATED
815	COPPELIA		12.0	1963	MAY	31	2.6580	2	8	8	1916	1957	-7.9	1966	20.4	24.5	
816	JULIANA		11.4	1957	JUN	11	3.0022	5	6	6	1950	1951	1.5	1965	10.6	15.4	
817	ANNIKA		12.0	1951	DEC	20	2.5884	5	6	4	1951	1959	72.0	1968	306.2	352.5	
818	KAPTEYNIA		10.4	1951	DEC	20	3.1763	5	5	6	1946	1953	180.0	1964	779.6	1229.8	
819	BARNARDIANA		13.2	1962	NOV	12	2.1975	2	8	10	1916	1959	15.2	1969	34.2	29.7	
820	ADRIANA		11.2	1957	JUN	11	3.1278	5	6	6	1951	1962	10.8	1968	33.2	51.2	
821	FANNY		12.5	1951	DEC	20	2.7746	5	6	7	1930	1962	360.0	1968	661.3	850.6	
822	LALAGE		12.6	1962	DEC	22	2.2556	2	8	7	1936	1962	180.0	1967	345.7	314.6	
823	SISIGAMBIS		12.8	1967	SEP	7	2.2214	2	8	9	1937	1967	-6.2	1969	15.3	13.5	
824	ANASTASIA		11.5	1957	JUN	11	2.7924	5	6	5	1934	1959	-4.8	1969	16.9	21.9	
825	TANINA		13.1	1962	DEC	22	2.2258	2	8	20	1916	1963	13.7	1969	29.9	26.6	
826	HENRIKA		12.5	1951	DEC	20	2.7135	5	6	7	1934	1956	90.0	1966*	209.4	260.0	
827	WOLFIANA		13.9	1924	DEC	21	2.2743	2	8	7	1916	1961	8.8	1964	42.4	39.1	
828	LINDEMANNIA		11.2	1957	JUN	11	3.1860	5	6	6	1950	1961	3.3	1968	15.0	23.8	
829	ACADEMIA		12.0	1962	DEC	2	2.5792	5	6	9	1929	1966	7.5	1969	18.5	21.2	
830	PETROPOLITANA		10.6	1947	JAN	15	3.2004	5	6	6	1950	1960	2.4	1968	19.6	31.2	
831	STATEIRA	L	13.6	1916	OCT	24	2.2143	2	8	1	1916	1916	-5.5	1916*	640000.0	563277.0	LOST
832	KARIN		12.1	1952	JUL	7	2.8637	2	8	6	1916	1958	-39.6	1969	81.0	109.4	
833	MONICA		12.3	1951	DEC	20	3.0091	5	6	4	1942	1953	180.0	1963*	597.5	870.1	
834	BURNHAMIA		10.5	1962	DEC	2	3.1519	5	6	7	1950	1961	-3.0	1966	12.9	20.2	
835	OLIVIA		12.0	1962	DEC	2	3.2023	5	6	5	1930	1951	-5.7	1969	19.7	31.4	
836	JOLE		14.4	1925	JAN	0	2.1902	5	5	5	1903	1955	-46.2	1968*	110.6	95.4	
837	SCHWARZSCHILDA		13.0	1962	DEC	2	2.2980	5	6	5	1923	1967	-3.3	1967	11.7	11.0	
838	SERAPHINA		11.3	1957	JUN	11	2.8968	5	6	4	1940	1959	4.5	1965	16.9	23.2	
839	VALBORG		11.8	1957	JUN	11	2.6158	5	6	4	1953	1962	3.0	1966	15.7	18.4	
840	ZENOBIA		10.6	1951	DEC	20	3.1280	5	6	7	1927	1956	-90.0	1970*	194.5	300.0	
841	ARABELLA		13.6	1962	DEC	2	2.2546	5	6	5	1933	1960	-7.8	1969*	21.8	19.8	
842	KERSTIN		11.8	1968	OCT	11	3.2163	2	8	5	1939	1968	5.1	1968*	12.1	19.5	
843	NICOLAIA	L	14.3	1916	OCT	4	2.2790	2	8	1	1916	1916	-4.3	1916*	640000.0	593289.4	LOST
844	LEONTINA		10.7	1957	JUN	11	3.1889	5	6	8	1950	1961	4.4	1967	17.8	28.3	
845	NAEMA		11.2	1957	JUN	11	2.9381	5	6	7	1939	1960	3.8	1966	14.8	20.8	
846	LIPPERTA		11.5	1957	JUN	11	3.1430	5	6	4	1951	1954	-4.5	1966	41.2	63.9	
847	AGNIA		11.4	1962	DEC	2	2.7820	5	6	6	1939	1957	9.0	1967	26.7	34.4	
848	INNA		11.9	1951	DEC	20	3.1122	5	6	9	1934	1959	90.0	1968	191.9	293.8	
849	ARA		9.0	1962	DEC	2	3.1570	5	6	10	1926	1966	-8.0	1966	18.5	28.9	
850	ALTONA		10.7	1962	DEC	2	2.9990	5	6	4	1950	1964	-9.0	1964	24.1	34.9	

NUMBER	NAME	NOTE	ABMAG	EPOCH		A	PLANETS		OPPOSITIONS			RESIDUAL	LAST	ERROR SEC	ERROR KM3
851	ZEISSIA		13.0	1959 FEB	21	2.2281	2	8	8	1934	1959	5.6	1962	19.0	16.9
852	WLADILENA		11.4	1961 NOV	17	2.3631	2	8	9	1923	1960	-6.8	1967	19.1	18.9
853	NANSENIA		12.6	1966 AUG	23	2.3122	2	8	11	1939	1966	-180.0	1966	313.7	298.3
854	FROSTIA		13.4	1961 DEC	27	2.3680	2	8	7	1942	1960	-24.0	1968	58.6	58.1
855	NEWCOMBIA		12.9	1967 APR	20	2.3619	2	8	5	1938	1967	1.3	1967	6.9	6.8
856	BACKLUNDA		12.0	1957 JUN	11	2.4363	5	6	4	1950	1962	15.0	1966	42.7	44.4
857	GLASENAPPIA		12.8	1962 NOV	12	2.1908	2	8	14	1920	1962	-6.7	1968	18.3	15.8
858	EL DJEZAIR		11.5	1962 DEC	2	2.8081	5	6	5	1941	1964	3.8	1969	12.7	16.7
859	BOUZAREAH		11.0	1947 JAN	15	3.2056	5	6	7	1948	1961	2.6	1968	18.4	29.5
860	URSINA		10.8	1957 JUN	11	2.7958	5	6	4	1956	1961	5.0	1965	29.1	37.8
861	ADA		10.9	1957 JUN	11	3.1501	5	6	5	1951	1958	-3.0	1968	17.4	27.1
862	FRANZIA		11.3	1957 JUN	11	2.8026	5	6	5	1950	1960	26.7	1969	79.1	103.4
863	BENKOELA		10.3	1962 DEC	2	3.1951	5	6	6	1948	1960	10.4	1966	31.3	49.8
864	(=1078)		12.9	1951 DEC	20	2.2697	5	6	6	1950	1965	-180.0	1969	526.1	484.1
865	ZUBAIDA		13.2	1962 DEC	2	2.4154	5	6	4	1934	1966	4.5	1968	13.8	14.1
866	FATME		10.4	1957 JUN	11	3.1236	5	6	4	1951	1958	-1.4	1969	11.7	18.0
867	KOVACIA		12.2	1962 DEC	2	3.0726	5	6	5	1928	1958	-90.0	1958*	182.4	274.0
868	LOVA		11.2	1962 DEC	2	2.7022	5	6	10	1930	1963	7.4	1966	19.0	23.4
869	MELLENA		13.3	1964 NOV	1	2.6908	2	8	7	1917	1962	-10.7	1966	23.7	29.1
870	MANTO		13.0	1924 DEC	21	2.3217	2	8	8	1917	1960	-18.3	1964	63.7	61.0
871	AMNERIS		13.8	1967 JUN	19	2.2223	2	8	6	1930	1967	-6.6	1967	15.8	14.0
872	HOLDA		11.2	1962 DEC	2	2.7300	5	6	7	1939	1962	-6.2	1968	17.9	22.4
873	MECHTHILD		12.4	1962 DEC	2	2.6270	5	6	9	1930	1965	6.0	1966	16.1	19.0
874	BOTRAUT		11.0	1962 DEC	2	3.1579	5	6	4	1933	1962	3.0	1969	10.9	17.0
875	NYMPHE		12.8	1949 DEC	30	2.5539	2	6	5	1917	1950	37.1	1966	90.8	102.3
876	SCOTT		12.0	1962 DEC	2	3.0134	5	6	4	1942	1965	.8	1965	6.9	10.0
877	WALKURE		11.8	1957 JUN	11	2.4858	5	6	4	1954	1958	6.9	1969	42.1	45.3
878	MILDRED		16.6	1916 OCT	4	2.3633	2	8	2	1916	1938	17.6	1938*	92.0	90.9
879	RICARDA		12.8	1917 JUL	31	2.5298	2	8	3	1917	1949	-5.3	1949*	36.6	40.6
880	HERBA		13.1	1951 DEC	20	3.0093	5	6	5	1917	1943	90.0	1969*	243.8	355.1
881	ATHENE		13.6	1936 NOV	8	2.6121	2	8	4	1917	1959	6.2	1964*	25.4	29.6
882	SWETLANA		11.6	1962 DEC	2	3.1329	5	6	7	1934	1967	90.0	1967	155.3	240.1
883	MATTERANIA		13.7	1924 DEC	21	2.2384	2	8	9	1917	1961	5.8	1964	33.2	29.8
884	PRIAMUS		9.9	1965 AUG	28	5.1855	2	8	13	1930	1965	3.0	1965	9.0	27.2
885	ULRIKE		11.8	1966 OCT	2	3.1009	2	8	10	1937	1966	90.0	1966	159.4	242.8
886	WASHINGTONIA		10.3	1943 APR	26	3.1485	2	8	5	1928	1951	3.2	1969	18.2	28.3
887	ALINDA		16.3	1958 FEB	6	2.5158	2	8	8	1918	1957	4.4	1970*	15.6	17.1
888	PARYSATIS		11.0	1962 DEC	2	2.7097	5	6	8	1927	1965	-8.6	1965	20.2	25.1
889	ERYNIA		12.3	1962 DEC	2	2.4460	5	6	4	1933	1965	2.7	1968	10.8	11.3
890	WALTRAUT		11.4	1967 JUL	29	3.2031	2	8	12	1934	1967	-90.0	1967	153.9	245.8
891	GUNHILD		11.3	1956 NOV	23	2.8596	5	7	12	1918	1958	-7.4	1967	20.9	28.2
892	SEELIGERIA		10.7	1962 DEC	2	3.2365	5	6	5	1936	1961	1.8	1966	8.8	14.2
893	LEOPOLDINA		10.8	1947 JAN	15	3.0506	5	6	6	1949	1962	-6.2	1967	31.9	47.4
894	ERDA		11.0	1951 DEC	20	3.1169	5	5	6	1936	1952	-108.0	1969	305.3	468.4
895	HELIO		9.8	1964 JUN	14	3.2033	2	8	9	1937	1964	3.4	1968	10.9	17.4
896	SPHINX		13.0	1959 FEB	1	2.2853	2	8	8	1918	1959	9.8	1967	25.3	23.6
897	LYSISTRATA		12.2	1962 DEC	2	2.5433	5	6	8	1950	1962	-90.0	1969	216.0	241.6
898	HILDEGARD		13.5	1949 DEC	30	2.7314	2	8	6	1918	1951	-97.2	1967	218.6	274.3
899	JOKASTE		11.5	1951 DEC	20	2.9095	5	6	4	1952	1957	45.0	1968	278.6	385.6
900	ROSALINDE		13.0	1962 DEC	2	2.4730	5	6	6	1937	1968	5.9	1969	15.8	16.9

NUMBER	NAME	NOTE	ABMAG	EPOCH			A	PLANETS			OPPOSITIONS		RESIDUAL	LAST	ERROR SEC	ERROR KMS	
901	BRUNSIA		12.8	1963	JAN	31	2.2245	2	8	10	1905	1961	-10.2	1968	23.6	20.9	
902	PROBITAS		13.6	1951	DEC	20	2.4468	5	6	5	1918	1958	180.0	1968	342.5	359.2	
903	NEALLEY		10.8	1947	AUG	3	3.2445	2	8	4	1918	1947	5.7	1969*	22.8	37.0	
904	ROCKEFELLIA		11.4	1968	MAY	24	2.9909	2	8	6	1933	1968	-1.3	1969	5.9	8.5	
905	UNIVERSITAS		12.3	1962	DEC	2	2.2163	5	6	4	1951	1959	.8	1967	9.1	8.0	
906	REPSOLDIA		10.7	1947	JAN	15	2.8945	5	6	3	1950	1962	-3.2	1969	22.0	30.2	
907	AGNIA		10.7	1944	MAY	30	2.9002							1968	300.0	391.4	ESTIMATED
908	BUDA		12.1	1962	DEC	2	2.4741	5	6	6	1931	1964	-6.2	1967	17.0	18.1	
909	ULLA		9.6	1962	DEC	2	3.5513	5	6	9	1926	1963	4.6	1969	13.1	24.3	
910	ANNELIESE		11.3	1951	DEC	20	2.9319	5	5	5	1939	1950	216.0	1966	774.4	1084.3	
911	AGAMEMNON		8.9	1963	DEC	17	5.1536	2	8	10	1935	1964	-4.6	1969	12.5	37.7	
912	MARITIMA		9.4	1957	JUN	11	3.1254	5	6	4	1950	1958	12.2	1969	46.3	71.4	
913	OTILA		13.8	1919	MAY	22	2.1973	2	8	9	1909	1962	7.8	1968	39.2	34.0	
914	PALISANA		10.5	1962	FEB	5	2.4545	2	8	16	1919	1962	8.2	1969	22.2	23.4	
915	COSETTE		13.1	1962	DEC	2	2.2281	5	6	5	1951	1964	-5.3	1964	18.0	16.0	
916	AMERICA		12.7	1962	DEC	2	2.3650	5	6	7	1951	1964	3.0	1969	12.7	12.6	
917	LYKA		12.6	1963	APR	21	2.3812	2	8	17	1919	1963	12.0	1966	26.4	26.4	
918	ITHA		12.1	1962	DEC	2	2.8636	5	6	8	1936	1963	180.0	1968	338.9	457.8	
919	ILSEBILL		12.4	1951	DEC	20	2.7715	2	8	5	1918	1953	4.9	1969	18.9	24.3	
920	ROGERIA		12.0	1969	JUN	8	2.6208	2	8	8	1940	1969	3.9	1969	10.1	11.9	
921	JOVITA		11.2	1964	SEP	2	3.1789	2	8	6	1935	1964	6.9	1964	17.1	27.1	
922	SCHLUTIA		13.1	1951	DEC	20	2.6879	5	6	5	1937	1963	90.0	1963*	175.1	214.2	
923	HERLUGA		12.8	1949	JUN	13	2.6148	2	8	7	1919	1961	4.1	1969	16.9	19.8	
924	TONI		10.5	1947	JAN	15	2.9355	5	6	6	1951	1961	14.1	1969	71.7	100.6	
925	ALPHONSINA		8.7	1951	DEC	20	2.7001	5	5	9	1940	1954	180.0	1969	510.4	628.9	
926	IMHILDE		11.7	1947	JAN	15	2.9789	5	6	5	1951	1962	29.6	1968	133.4	191.3	
927	RATISBONA		10.2	1957	JUN	11	3.2176	5	6	8	1943	1964	8.7	1969	23.2	37.2	
928	HILDRUN		10.8	1966	JUN	24	3.1424	2	8	9	1946	1966	-3.9	1966	11.3	17.5	
929	ALGUNDE		13.7	1967	MAR	11	2.2388	2	8	7	1944	1967	4.5	1967	12.7	11.4	
930	WESTPHALIA		12.6	1962	DEC	2	2.4301	5	6	7	1940	1962	90.0	1966	182.1	188.7	
931	WHITTEMORA		10.5	1957	JUN	11	3.1607	5	6	6	1942	1962	3.0	1968	12.6	19.8	
932	HOOVERIA		10.8	1941	JAN	6	2.4194	2	6	8	1942	1958	45.1	1967	170.6	175.5	
933	SUSI		13.5	1950	APR	29	2.3699	2	8	6	1927	1956	-29.8	1967	71.7	71.2	
934	THURINGIA		11.5	1957	JUN	11	2.7476	5	6	4	1952	1961	2.0	1969	12.7	16.1	
935	CLIVIA		14.3	1920	OCT	23	2.2189	2	8	6	1920	1963	5.0	1963*	34.2	30.2	
936	KUNIGUNDE		11.2	1951	DEC	20	3.1423	5	5	6	1946	1953	72.0	1968	316.9	492.0	
937	BETHGEA		13.2	1950	APR	29	2.2314	2	8	8	1916	1953	-7.5	1969	25.7	23.0	
938	CHLOSINDE		12.4	1962	DEC	2	3.1742	5	6	4	1934	1965	4.8	1965	13.7	21.5	
939	ISARGA		13.4	1962	DEC	2	2.2474	5	6	9	1937	1957	90.0	1967	209.0	189.0	
940	KORDULA		10.5	1957	JUN	11	3.3899	5	6	8	1949	1963	5.4	1969	18.0	31.2	
941	MURRAY		12.1	1957	JUN	11	2.7798	5	6	3	1948	1957	-102.8	1966	338.3	436.4	
942	ROMILDA		11.6	1962	DEC	2	3.1629	5	6	5	1931	1968	8.0	1968	18.3	28.6	
943	BEGONIA		11.0	1951	DEC	20	3.1131	5	5	5	1949	1956	-126.0	1968	548.3	839.8	
944	HIDALGO		12.0	1964	MAY	5	5.8201	2	8	11	1920	1964	-4.5	1964*	11.5	40.2	
945	BARCELONA		11.4	1961	NOV	17	2.6396	2	8	12	1921	1962	-13.9	1968	30.5	36.3	
946	POESIA		11.4	1957	JUN	11	3.1235	5	6	5	1947	1963	-4.8	1963*	16.6	25.5	
947	MONTEROSA		11.0	1951	DEC	20	2.7511	5	6	5	1953	1959	90.0	1969	488.8	620.4	
948	JUCUNDA		12.4	1962	DEC	2	3.0333	5	6	5	1932	1953	270.0	1966	661.1	974.3	
949	HEL		11.0	1957	JUN	11	2.9927	5	6	7	1947	1963	7.5	1968	22.3	32.2	
950	AHRENSA		12.5	1928	FEB	4	2.3710	2	8	8	1921	1959	-3.3	1969	25.2	25.0	

NUMBER	NAME	NOTE	ABMAG	EPOCH			A	PLANETS			OPPOSITIONS		RESIDUAL	LAST	ERROR SEC	ERROR KM	
951	GASPRA		13.1	1962	DEC	22	2.2098	2	8	12	1926	1962	-5.6	1968	16.6	14.5	
952	CALA		10.4	1951	DEC	20	2.9845	5	5	6	1941	1952	-252.0	1967	956.1	1231.4	
953	PAINLEVA		11.6	1957	JUN	11	2.7893	5	6	4	1952	1959	-2.6	1969	16.0	20.7	
954	LI		11.8	1957	JUN	11	3.1312	5	6	4	1949	1951	5.9	1969	20.9	32.3	
955	ALSTEDE		12.7	1962	DEC	2	2.5941	5	6	9	1933	1967	180.0	1967*	302.4	349.4	
956	ELISA		13.6	1925	JAN	10	2.2981	2	8	8	1921	1955	-51.0	1963*	152.6	143.6	
957	CAMELIA		11.1	1962	DEC	2	2.9192	5	6	8	1926	1966	-3.9	1966	11.9	16.6	
958	ASPLINDA		11.1	1957	JUN	11	3.9442							1961*	300.0	640.2	ESTIMATED
959	ARNE		11.9	1951	DEC	20	3.1917	5	6	4	1927	1957	-180.0	1969	368.2	584.9	
960	BIRGIT		14.2	1921	OCT	19	2.2484	2	8	7	1921	1959	12.2	1968*	55.3	50.0	
961	GUNNIE		12.5	1962	DEC	2	2.6932	5	6	4	1934	1956	2.7	1965	11.8	14.5	
962	ESLOG		12.7	1921	NOV	7	2.9048	2	8	11	1916	1963	-7.5	1963	35.6	49.2	
963	TOURBERGA		13.6	1921	OCT	19	2.2478	2	8	6	1921	1960	9.8	1968*	47.7	43.1	
964	SURAVARA		12.0	1962	DEC	2	3.0477	5	6	4	1950	1963	90.0	1968	206.2	306.0	
965	ANGELICA		11.8	1925	JAN	10	3.1676	2	8	7	1921	1938	74.3	1969	316.7	497.6	
966	MUSCHI		11.2	1961	NOV	17	2.7177	2	8	16	1921	1960	-10.1	1969	24.4	30.4	
967	HELIONAPE		13.3	1957	JUN	11	2.2255	5	6	4	1950	1954	3.2	1967	27.4	24.4	
968	PETUNIA		11.4	1962	DEC	2	2.8663	5	6	4	1935	1957	2.7	1969	11.5	15.5	
969	LEOCADIA		13.4	1921	DEC	17	2.4622	2	8	6	1921	1963	-8.3	1966	41.2	43.7	
970	PRIMULA		13.5	1962	DEC	2	2.5625	5	6	6	1929	1966	-180.0	1969	307.6	348.3	
971	ALSATIA		11.3	1951	DEC	20	2.6411	5	6	5	1953	1959	450.0	1964	2409.1	2865.5	
972	COHNIA		10.8	1951	DEC	20	3.0611	5	5	6	1942	1953	-108.0	1968	361.8	540.5	
973	ARALIA		11.0	1962	DEC	2	3.2275	5	6	9	1931	1968	-3.4	1969	10.8	17.4	
974	LIDIA		11.8	1951	DEC	20	2.5333	5	6	5	1952	1959	72.0	1968	348.7	387.6	
975	PERSEVERANTIA		11.4	1949	DEC	30	2.8345	2	8	9	1922	1953	-33.8	1969	81.2	109.0	
976	BENJAMINA		10.6	1962	DEC	2	3.1827	5	6	6	1950	1963	-4.5	1968	15.3	24.2	
977	PHILIPPA		10.8	1947	JAN	15	3.1188	5	6	5	1951	1958	15.0	1967	95.1	146.0	
978	AIDAMINA		10.8	1962	DEC	2	3.1953	5	6	5	1950	1958	5.1	1969	21.9	34.8	
979	ILSEWA		11.0	1962	DEC	2	3.1444	5	6	4	1951	1960	-3.9	1968	16.6	25.8	
980	ANACOSTIA		9.3	1962	DEC	2	2.7399	5	6	10	1938	1966	8.1	1966	19.6	24.7	
981	MARTINA		12.2	1966	OCT	2	3.1026	2	8	8	1906	1966	-5.7	1969	13.4	20.4	
982	FRANKLINA		11.4	1947	JAN	15	3.0692	5	6	5	1950	1960	-11.1	1966	57.2	85.7	
983	GUNILA		10.8	1947	JAN	15	3.1688	5	6	5	1955	1961	-1.8	1968	21.9	34.4	
984	GRETIA		10.8	1954	SEP	15	2.8042	2	8	12	1922	1955	-16.9	1969	42.2	55.2	
985	ROSINA		14.2	1963	JAN	31	2.3001	2	8	4	1922	1950	-10.6	1965	30.3	28.6	
986	AMELIA		10.8	1951	DEC	20	3.1377	5	5	4	1942	1953	-10.8	1967	43.6	67.6	
987	WALLIA		10.7	1947	JAN	15	3.1348	5	6	7	1950	1960	10.5	1966	54.5	84.3	
988	APPELLA		12.5	1962	DEC	2	3.1609							1966*	300.0	469.9	ESTIMATED
989	SCHWASSMANNIA		13.4	1941	JAN	6	2.6591	2	8	6	1922	1961	55.6	1965	113.2	136.1	
990	YERKES		13.0	1962	DEC	2	2.6701	5	6	7	1933	1965	-4.5	1965	13.5	16.4	
991	MCDONALDA		11.9	1951	DEC	20	3.1344	5	6	5	1922	1954	90.0	1966	193.9	300.0	
992	SWASEY		12.2	1962	DEC	2	3.0227	5	6	8	1935	1967	-180.0	1969	303.5	445.0	
993	MOULTONA		13.4	1951	DEC	20	2.8601	5	6	5	1923	1943	90.0	1969	274.2	369.6	
994	OTTHILD		11.5	1962	DEC	2	2.5308	5	6	9	1943	1967	12.9	1969	28.0	31.1	
995	STERNBERGA		14.6	1951	DEC	20	2.6164	5	6	5	1949	1957	324.0	1969	1264.6	1481.6	
996	HILARITAS		11.7	1963	JUL	23	3.0949	2	8	8	1931	1968	4.0	1969	10.2	15.5	
997	PRISKA		13.1	1962	DEC	2	2.6709	5	6	3	1923	1958	8.8	1968	22.6	27.4	
998	RODEA		12.2	1951	DEC	20	3.1176	5	6	4	1923	1946	-90.0	1938*	247.0	379.1	
999	ZACHIA		12.4	1962	DEC	2	2.6117	5	6	8	1940	1965	90.0	1969	167.9	196.1	
1000	PIAZZIA		11.4	1962	DEC	2	3.2007	5	6	4	1944	1962	3.2	1969	11.8	18.9	

NUMBER	NAME	NOTE	ABMAG	EPOCH			A	PLANETS			OPPOSITIONS		RESIDUAL	LAST	ERROR SEC	ERROR KMS	
1001	GAUSSIA		10.6	1962	DEC	2	3.1843	5	6	10	1933	1965	-4.5	1969	13.0	20.6	
1002	OLBERSIA		12.1	1956	NOV	23	2.7874	2	8	7	1923	1958	-5.1	1969	17.1	22.2	
1003	LILOFEE		11.3	1962	DEC	2	3.1609	5	6	6	1946	1965	4.2	1968	13.3	20.8	
1004	BELOROLSKYA		10.8	1962	DEC	2	3.3993	5	6	9	1929	1967	-3.4	1968	10.7	18.5	
1005	ARAGO		11.0	1962	DEC	2	3.1664	5	6	5	1923	1962	-3.0	1968	10.6	16.7	
1006	LAGRANGEA		12.9	1956	MAY	7	3.1364	2	8	5	1923	1967	-2.4	1969	10.8	16.7	
1007	PAWLOWIA		12.6	1951	DEC	20	2.7081	2	8	7	1923	1957	-6.6	1967	21.7	26.9	
1008	LA PAZ		12.0	1951	DEC	20	3.0909	5	6	5	1950	1956	-90.0	1969	443.3	671.9	
1009	STRENE		16.9	1923	DEC	7	2.6277	2	8	1	1923	1923	-4.6	1967*	251.9	297.2	
1010	MARLENE		11.8	1951	DEC	20	2.9316	5	5	6	1941	1953	72.0	1968	230.5	322.8	
1011	LACADEMIA		13.7	1939	APR	7	2.3936	2	8	3	1924	1950	-9.2	1965	35.0	35.4	
1012	SAREMA		13.2	1951	DEC	20	2.4830	5	6	4	1938	1954	180.0	1968	481.9	518.0	
1013	TOMPEDIA		10.7	1949	DEC	30	2.6831	2	8	6	1924	1957	-3.1	1965	15.7	19.1	
1014	SEMPHYRA		13.0	1962	DEC	2	2.8050	5	6	4	1932	1957	1.1	1969	8.0	10.4	
1015	CHRISTA		10.3	1962	DEC	2	3.2048	5	6	5	1930	1961	3.0	1966	10.9	17.4	
1016	ANITRA		13.3	1967	FEB	19	2.2196	2	8	6	1934	1967	3.4	1967	10.6	9.4	
1017	JACQUELINE		12.3	1951	DEC	20	2.6085	5	6	5	1949	1959	648.0	1967	2212.3	2579.2	
1018	ARNOLDA		11.7	1951	DEC	20	2.5358	5	6	9	1936	1962	-180.0	1969	348.5	388.0	
1019	STRACKEA		13.9	1962	DEC	2	1.9114	5	6	5	1932	1964	-4.2	1969	15.0	9.9	
1020	ARCADIA	F	12.2	1924	APR	8	2.7963	0	0	4	1924	1948	72.0	1966*	268.5	347.6	
1021	FLAMMARIA		10.0	1962	DEC	2	2.7375	5	6	10	1951	1967	-3.3	1969	11.7	14.7	
1022	OLYMPIADA		11.3	1962	DEC	2	2.8090	5	6	5	1930	1966	.3	1967	6.1	8.0	
1023	THOMANA		11.1	1967	MAR	11	3.1641	2	8	6	1933	1967	5.1	1969	12.4	19.4	
1024	HALE		12.0	1945	MAR	6	2.8724	2	8	6	1924	1952	-13.9	1962*	41.1	55.8	
1025	RIEMA		14.1	1962	DEC	2	1.9794	5	6	7	1936	1958	90.0	1967*	109.6	141.7	
1026	INGRID	L	14.6	1923	AUG	29	2.2504	2	8	1	1923	1923	1.7	1923*	640000.0	580022.7	LOST
1027	AESCULAPIA		12.0	1957	JUN	11	3.1682							1968	300.0	471.5	ESTIMATED
1028	LYDINA		10.4	1957	JUN	11	3.4092	5	6	7	1951	1960	-9.0	1967	32.4	56.6	
1029	LA PLATA		12.0	1957	JUN	11	2.8892	5	6	7	1949	1960	-1.8	1969	11.7	16.0	
1030	VITJA		11.6	1962	DEC	2	3.1204	5	6	8	1940	1964	-180.0	1968	335.3	515.4	
1031	ARCTICA		10.8	1966	JUN	24	3.0472	2	8	5	1940	1966	-3.7	1966	10.7	15.9	
1032	PAFURI		11.0	1957	JUN	11	3.1374	5	6	4	1948	1958	-2.4	1965	13.6	21.1	
1033	SIMONA		12.2	1924	FEB	5	3.0024	5	6	4	1924	1953	-45.0	1966*	158.6	230.2	
1034	MOZARTIA		13.8	1974	OCT	2	2.2924	2	8	8	1924	1962	-5.6	1969*	34.2	32.0	
1035	AMATA		11.8	1962	DEC	2	3.1371	5	6	4	1943	1961	-3.3	1969	12.3	19.0	
1036	GANYMED		10.9	1950	JUN	28	2.6584	2	6	11	1927	1938	-6.5	1967	39.5	47.4	
1037	DAVIDWEILLA	L	15.2	1924	NOV	11	2.1807							1924*	640000.0	547691.0	LOST
1038	TUCKIA		11.7	1924	DEC	21	3.9269	2	8	4	1924	1948	-4.1	1948*	28.5	60.5	
1039	SONNEBERGA		12.3	1962	DEC	2	2.6797	5	6	8	1924	1965	7.5	1965	18.4	22.4	
1040	KLUMPKEA		11.6	1951	DEC	20	3.1222	5	6	5	1950	1958	180.0	1967	728.3	1120.2	
1041	ASTA		11.0	1962	DEC	2	3.0740	5	6	5	1930	1965	450.0	1968	776.8	1167.7	
1042	AMAZONE		11.0	1925	MAY	10	3.2079	2	8	8	1925	1961	-184.5	1967	532.7	852.5	
1043	BEATE		11.0	1962	DEC	2	3.0947	5	6	10	1943	1963	-180.0	1968	356.4	541.0	
1044	TEUTONIA		12.2	1951	DEC	20	2.5765	5	6	4	1950	1957	36.0	1966	168.6	192.7	
1045	MICHELA		14.1	1951	DEC	20	2.3591	5	6	4	1924	1964	180.0	1964	315.8	311.1	
1046	EDWIN		11.6	1967	JAN	30	2.9840	2	8	7	1934	1967	-5.7	1968	13.6	19.5	
1047	GEISHA		13.5	1962	DEC	2	2.2415	5	6	7	1941	1961	90.0	1961	191.0	171.9	
1048	FEODOSIA		10.7	1957	JUN	11	2.7289	5	6	9	1939	1963	-6.3	1968	19.0	23.8	
1049	GOTHO		11.8	1962	DEC	2	3.0891	5	6	5	1937	1957	-180.0	1969	410.4	621.4	
1050	METIS		13.9	1949	DEC	30	2.6239	2	8	5	1908	1948	360.1	1959*	765.9	901.5	

NUMBER	NAME	NOTE	ABMAG	EPOCH			A	PLANETS			OPPOSITIONS		RESIDUAL	LAST	ERROR SEC	ERROR KM	
1051	MEROPE		11.3	1962	DEC	2	3.2221	5	6	7	1942	1965	2.9	1965	10.6	17.0	
1052	BELGICA		13.1	1968	JUL	23	2.2361	2	8	9	1933	1968	4.3	1968	11.6	10.4	
1053	VICOIS		13.5	1929	SEP	26	2.6139	2	8	5	1925	1963	7.9	1969	35.6	41.6	
1054	FORSYTIA		11.7	1951	DEC	20	2.9215	5	5	6	1930	1950	72.0	1969	195.8	272.6	
1055	TYNKA		12.7	1962	DEC	2	2.1989	5	6	11	1941	1967	130.0	1969	311.3	270.5	
1056	AZALEA		12.9	1950	JAN	19	2.2302	2	8	8	1924	1959	-10.3	1965	30.0	26.7	
1057	WANDA		12.0	1962	DEC	2	2.8953	5	6	6	1940	1964	-6.0	1969	16.5	22.7	
1058	GRUBBA		13.2	1962	DEC	2	2.1964	5	6	4	1945	1954	1.6	1967	12.3	10.7	
1059	MUSSORGSKIA		12.4	1941	FEB	26	2.6425							1967	300.0	357.1	ESTIMATED
1060	MAGNOLIA		14.4	1962	DEC	2	2.2373	5	6	6	1942	1965	90.0	1965	170.9	153.3	
1061	PAEONIA		12.1	1941	JAN	6	3.1261	2	8	3	1925	1953	6.0	1969	24.0	37.0	
1062	LJUBA		11.3	1957	JUN	11	3.0075	5	6	6	1950	1960	-1.2	1969	10.0	14.6	
1063	AQUILEGIA		12.5	1966	MAY	15	2.3143	2	8	9	1941	1966	-6.7	1966	16.9	16.1	
1064	ASTHUSA		12.4	1962	DEC	2	2.5471	5	6	9	1934	1966	-14.1	1966	29.8	33.4	
1065	AMUNDSENIA		13.9	1926	SEP	2	2.3606	2	8	6	1926	1961	17.0	1966	65.8	64.9	
1066	LOPELIA		14.2	1951	DEC	20	2.4025	5	6	4	1930	1956	90.0	1967	200.0	203.3	
1067	LUNARIA		12.2	1950	JUL	18	2.8735							1967	300.0	407.4	ESTIMATED
1068	MOPPETETE		12.1	1957	JUN	11	2.9072	5	6	7	1931	1959	-8.1	1966	22.8	31.6	
1069	PLANCKIA		10.8	1951	DEC	20	3.1271	5	5	6	1934	1952	-36.0	1969	102.3	157.7	
1070	TUNICA		12.2	1962	DEC	2	3.2178	5	6	6	1934	1966	90.0	1966	157.1	252.6	
1071	BRITA		11.4	1955	OCT	20	2.8004	5	5	6	1941	1949	-18.0	1968	86.4	112.7	
1072	MALVA		11.8	1962	DEC	2	3.1782	5	6	7	1926	1968	-3.4	1968*	10.7	16.9	
1073	GELLIVARA		12.6	1951	DEC	20	3.1733	5	5	6	1933	1951	-144.0	1968	392.2	617.8	
1074	BELJAWSKYA		11.4	1951	DEC	20	3.1535	5	5	6	1934	1953	792.0	1968	2009.1	3135.9	
1075	HELINA		11.6	1947	JAN	15	3.0143	5	6	5	1951	1962	1.5	1967	15.8	23.1	
1076	VIOLA		13.1	1962	DEC	2	2.4769	5	6	5	1951	1961	.5	1969	7.4	7.9	
1077	CAMPANULA		14.0	1926	SEP	22	2.3923	2	8	4	1926	1948	10.2	1966*	54.1	54.6	
1078	MENTHA		12.9	1951	DEC	20	2.2697	5	6	6	1950	1965	-180.0	1969	526.1	484.1	
1079	MIMOSA		12.1	1962	DEC	2	2.8724	5	6	8	1932	1964	3.6	1969	11.9	16.1	
1080	ORCHIS		13.6	1962	DEC	2	2.4203	5	6	4	1933	1951	3.3	1961*	15.0	15.4	
1081	RESEDA		12.3	1962	DEC	2	3.0944	5	6	8	1927	1965	90.0	1965	156.9	238.2	
1082	PIPOLA		11.7	1962	DEC	2	3.1352	5	6	6	1929	1965	-5.7	1969	15.0	23.2	
1083	SALVIA		14.0	1950	JAN	19	2.3281	2	8	11	1910	1962	-7.7	1969	23.2	22.4	
1084	TAMARIWA		11.8	1951	DEC	20	2.6874	5	6	6	1953	1963	-180.0	1968	693.0	847.5	
1085	AMARYLLIS		10.8	1962	DEC	2	3.1751	5	6	7	1931	1964	7.2	1968	17.9	28.3	
1086	NATA		10.7	1962	DEC	2	3.1638	5	6	7	1949	1960	-8.7	1969	28.2	44.3	
1087	ARABIS		11.0	1967	MAR	31	3.0120	2	8	10	1937	1967	-6.3	1969	14.6	21.2	
1088	MITAKA		12.8	1962	NOV	12	2.2011	2	8	11	1932	1961	-5.2	1969	16.5	14.4	
1089	TAMA		12.9	1962	DEC	22	2.2133	2	8	16	1919	1963	-9.1	1969	22.1	19.5	
1090	SUMIDA		14.1	1963	APR	21	2.3612	2	8	2	1928	1957	-6.4	1964	19.0	18.7	
1091	SPIRAEA		12.0	1928	APR	4	3.4235	2	8	2	1928	1932	3.5	1969*	57.6	101.2	
1092	LILIUM		11.8	1956	NOV	23	2.9009	2	8	7	1924	1956	-12.6	1965	32.4	44.6	
1093	FREDA		10.0	1962	DEC	2	3.1460	5	6	6	1932	1959	7.7	1964	20.7	32.2	
1094	SIBERIA		13.0	1926	FEB	14	2.5482	2	8	9	1918	1959	9.6	1959*	40.2	45.1	
1095	TULIPA		12.7	1942	JUN	10	3.0252	2	8	3	1926	1952	-8.0	1968	29.0	42.6	
1096	REUNERTA		11.4	1944	APR	20	2.6004	2	8	8	1928	1957	-5.8	1966	23.0	26.7	
1097	VICIA		13.2	1950	OCT	6	2.5385	2	8	5	1928	1954	-9.3	1967	29.8	35.3	
1098	HAKONE		12.0	1951	DEC	20	2.6883	5	5	6	1936	1950	36.0	1968	119.5	146.3	
1099	FIGNERIA		11.8	1968	DEC	30	3.1610	2	8	9	1928	1969	-3.8	1969	9.7	15.2	
1100	ARNICA		12.4	1956	NOV	23	2.8976	2	8	11	1918	1958	25.8	1967	54.9	75.6	

NUMBER	NAME	NOTE	ABMAG	EPOCH			A	PLANETS			OPPOSITIONS		RESIDUAL	LAST	ERROR SEC	ERROR KMS	
1101	CLEMATIS		12.1	1928	OCT	1	3.2733	2	8	2	1928	1961	-4.1	1969*	25.8	42.6	
1102	PERITA		11.0	1962	DEC	2	3.0704	5	6	5	1951	1965	3.0	1965	11.4	17.1	
1103	SEQUOIA		13.6	1928	NOV	30	1.9338	2	8	8	1928	1965	-8.6	1965	43.6	29.5	
1104	SYRINGA		13.6	1962	DEC	2	2.6310	5	6	9	1928	1966	-180.0	1968	304.3	359.7	
1105	FRAGARIA		11.3	1962	DEC	2	3.0126	5	6	10	1930	1962	-90.0	1969	168.6	245.9	
1106	CYDONIA		13.0	1951	DEC	20	2.5974	5	6	6	1929	1954	180.0	1969	412.4	477.4	
1107	LICTORIA		10.3	1962	DEC	2	3.1877	5	6	8	1946	1965	-4.7	1966	14.2	22.5	
1108	DEMETER		12.4	1951	DEC	20	2.4284	5	6	6	1929	1948	90.0	1967*	260.6	269.8	
1109	TATA		11.0	1962	DEC	2	3.2019	5	6	10	1931	1964	-8.0	1966	19.3	30.9	
1110	JAROSLAWA		13.4	1964	APR	15	2.2188	2	8	7	1934	1957	-3.8	1961	14.2	12.5	
1111	RETNMUTHIA		11.5	1962	DEC	2	2.9959	5	6	10	1932	1966	-10.0	1966	22.2	32.1	
1112	POLONIA		11.0	1947	JAN	15	3.0188	5	6	4	1950	1959	13.8	1968	73.9	108.2	
1113	KATJA		10.7	1957	JUN	11	3.1174	5	6	6	1950	1959	7.8	1967	30.1	46.2	
1114	LORRAINE		10.8	1966	OCT	22	3.0922	2	8	7	1933	1966	-1.6	1966	7.0	10.6	
1115	SARAUDA		10.6	1957	JUN	11	3.0994	5	6	7	1951	1960	-3.0	1966	15.4	23.4	
1116	CATRICNA		10.9	1949	MAR	25	2.9215	2	8	9	1908	1956	-10.4	1969	28.2	39.3	
1117	REGINITA		13.2	1962	DEC	2	2.2476	5	6	7	1948	1968	6.0	1968	16.7	15.1	
1118	HANSKYA		11.1	1951	DEC	20	3.2014	5	5	6	1940	1953	288.0	1968	872.2	1391.6	
1119	EUROPA		12.4	1965	OCT	7	2.6114	2	8	7	1930	1964	7.2	1969	17.5	20.4	
1120	CANNONIA		13.4	1957	JUN	11	2.2159	5	6	4	1946	1953	-.6	1968	10.8	9.6	
1121	NATASCHA		12.6	1949	DEC	30	2.5468	2	8	6	1928	1956	-3.9	1967*	18.0	20.1	
1122	NETTH		12.8	1928	SEP	11	2.6045	2	8	3	1924	1932	-2.4	1968	31.9	37.0	
1123	SHAPLEYA		13.0	1962	DEC	2	2.2254	5	6	8	1940	1964	6.0	1964	17.6	15.6	
1124	STROOBANTIA		12.2	1961	MAR	2	2.9269	2	8	7	1931	1961	9.4	1961*	23.3	32.6	
1125	CHINA	E	14.3	1958	JAN	0	3.1546							1967*	300.0	468.5	ESTIMATED
1126	OTERO		13.8	1962	DEC	2	2.2717	5	6	6	1929	1955	-6.6	1967	20.7	19.1	
1127	MIMI		11.7	1951	DEC	20	2.5935	5	6	5	1946	1961	450.0	1965	1179.2	1361.9	
1128	ASTRID		11.8	1957	JUN	11	2.7907	5	6	4	1950	1958	2.4	1967	14.9	10.3	
1129	NEUJMINA		11.1	1962	DEC	2	3.0232	5	6	4	1940	1966	-4.5	1969	13.2	19.4	
1130	SKULD		13.5	1962	DEC	2	2.2290	5	6	7	1939	1965	-13.6	1969	30.6	27.3	
1131	PORZIA		15.4	1929	OCT	16	2.2287	2	8	4	1929	1952	-6.9	1969	40.9	36.4	
1132	HOLLANDIA		11.9	1959	FEB	1	2.6841	2	8	9	1929	1959	5.7	1969	17.7	21.6	
1133	LUGDUNA		13.2	1962	DEC	2	2.1860	5	6	4	1939	1968	-2.6	1968*	11.0	9.4	
1134	KEPLER		15.4	1969	OCT	6	2.6824	2	8	4	1929	1969	-2.5	1969*	7.7	9.4	
1135	COLCHIS		11.8	1962	DEC	2	2.6659	5	6	6	1950	1963	2.9	1967	12.3	14.8	
1136	MERCEDES		12.3	1962	DEC	2	2.5641	5	6	7	1933	1962	-90.0	1962*	173.5	196.7	
1137	PAISSA		12.1	1962	DEC	2	2.4232	5	6	7	1939	1966	4.5	1969	14.0	14.4	
1138	ATTICA		12.3	1951	DEC	20	3.1453	5	6	4	1929	1964	90.0	1964	165.1	256.7	
1139	ATAMI		14.4	1941	JUL	5	1.9473	2	8	6	1929	1955	.3	1969	16.0	11.0	
1140	CRIMEA		11.3	1965	AUG	28	2.7719	2	8	6	1935	1965	-1.8	1969	7.9	10.2	
1141	BOHMIA		14.6	1930	JAN	24	2.2707	2	6	3	1930	1956	-3.6	1961*	28.1	25.9	
1142	AETOLIA		11.6	1957	JUN	11	3.1711	5	6	7	1941	1960	6.0	1967	19.6	30.8	
1143	ODYSSEUS		9.4	1965	JAN	20	5.2117	2	8	15	1930	1965	-5.2	1968	12.7	38.8	
1144	ODA		11.0	1952	FEB	18	3.7525	2	8	9	1930	1952	5.7	1968*	21.2	42.2	
1145	ROBELMONTE		12.3	1962	DEC	2	2.4244	5	6	6	1933	1956	-7.5	1967	22.8	23.5	
1146	BIARMIA		11.0	1957	JUN	11	3.0489	5	6	6	1940	1961	-6.9	1967	20.9	31.0	
1147	STAVROPOLIS		13.6	1962	DEC	2	2.2719	5	6	4	1950	1967	4.8	1967	15.2	14.0	
1148	RAPAHU		11.3	1966	AUG	23	3.0152	2	8	7	1934	1966	4.0	1966	11.1	16.2	
1149	VOLGA		11.5	1957	JUN	11	2.9009	5	6	8	1948	1953	11.1	1969	30.6	42.2	
1150	ACHAIA		14.7	1962	DEC	2	2.0908	5	6	6	1929	1958	3.6	1968*	14.1	11.2	

NUMBER	NAME	NOTE	ABMAG	EPOCH			A	PLANETS			OPPOSITIONS		RESIDUAL	LAST	ERROR SEC	ERROR KMS	
1151	ITHAKA		14.9	1979	SEP	6	2.4063	2	8	2	1929	1966	5.4	1966*	31.0	31.6	
1152	PAWONA		12.3	1962	DEC	2	2.4275	5	6	5	1938	1961	5.6	1969	17.4	18.0	
1153	WALLENBERGIA		13.4	1962	DEC	2	2.1958	5	6	4	1950	1966	-1.5	1969	12.9	11.2	
1154	ASTRONOMYA		11.4	1962	DEC	2	3.3981	5	6	9	1927	1966	-2.1	1968	8.6	15.0	
1155	AENNA		13.1	1962	DEC	2	2.4621	5	6	5	1948	1961	180.0	1968	435.3	461.3	
1156	KITT		14.0	1933	SEP	28	2.2603							1966	300.0	274.0	ESTIMATED
1157	ARABIA		11.3	1951	DEC	20	3.2062	5	5	6	1930	1952	324.0	1969	788.7	1261.2	
1158	LUDA		12.3	1951	DEC	20	2.5639	5	6	4	1952	1960	180.0	1969	774.2	877.6	
1159	GRANADA		13.0	1959	APR	27	2.3794	2	8	8	1929	1962	-7.4	1969	21.0	21.0	
1160	ILLYRIA		12.0	1954	SEP	15	2.5602	5	6	7	1937	1953	-180.0	1968	492.1	556.5	
1161	THESSALIA		12.8	1929	DEC	15	3.1645	2	8	4	1929	1938	-7.4	1968	61.0	95.7	
1162	LARISSA		10.3	1968	DEC	30	3.9429	2	8	9	1930	1969	7.6	1969	15.5	33.0	
1163	SAGA		11.7	1957	JUN	11	3.2099	5	6	5	1931	1951	2.1	1966	11.9	19.1	
1164	KORCULA		14.1	1962	DEC	2	2.3059	5	6	5	1930	1965	90.0	1965	160.7	152.1	
1165	IMPERIATTA		11.6	1962	DEC	2	3.1407	5	6	7	1935	1957	180.0	1968*	398.0	617.6	
1166	SAKUNTALA		12.7	1956	NOV	23	2.5412	2	8	8	1930	1958	-9.1	1963	26.0	29.0	
1167	DUBIAGO		11.0	1962	DEC	2	3.4215	5	6	7	1934	1966	7.5	1969	17.8	31.2	
1168	BRANDIA		13.1	1950	JUN	8	2.5506	2	8	4	1930	1956	7.6	1967*	25.6	28.8	
1169	ALWINE		14.4	1951	DEC	20	2.3185	5	6	6	1937	1962	180.0	1969	355.5	339.7	
1170	SIVA		13.2	1942	FEB	10	2.3254	2	8	4	1930	1955	5.2	1969	24.4	23.5	
1171	RUSTHAWELIA		10.8	1962	DEC	2	3.1485	5	6	6	1938	1964	-3.8	1969	12.2	19.0	
1172	ANEAS		9.4	1966	OCT	22	5.1654	2	8	14	1934	1966	5.2	1966	12.4	37.3	
1173	ANCHISES		10.1	1964	SEP	2	5.1663	2	8	11	1930	1964	-2.3	1964	8.0	24.3	
1174	MARMARA		12.9	1962	DEC	2	3.0201	5	6	5	1930	1955	-3.2	1970*	12.5	18.2	
1175	MARGO		11.7	1934	JUN	12	3.2201	2	8	11	1907	1964	-8.1	1968	26.5	42.6	
1176	LUCIDOR		12.3	1945	MAR	6	2.6941	5	5	9	1927	1952	-180.0	1969	428.3	525.9	
1177	GONNESSIA		10.5	1966	OCT	2	3.3531	2	8	15	1946	1966	2.8	1966	9.2	15.6	
1178	IRMELA		13.0	1940	FEB	1	2.6792	2	8	4	1931	1953	-4.9	1962*	24.7	30.0	
1179	MALLY		15.1	1931	APR	9	2.6166	2	8	2	1931	1936	1.1	1936*	25.8	30.2	
1180	RITA		10.2	1962	DEC	2	3.9810	5	6	8	1931	1965	6.9	1966	16.6	35.9	
1181	LILITH		12.7	1951	DEC	20	2.6644	5	6	7	1934	1954	-90.0	1969	225.0	271.4	
1182	ILONA		12.7	1962	DEC	2	2.2596	5	6	5	1927	1962	7.0	1969	19.1	17.4	
1183	JUTTA		13.1	1962	DEC	2	2.3833	5	6	7	1935	1964	90.0	1967	167.6	168.1	
1184	GAEA		12.2	1962	DEC	2	2.6677	5	6	6	1931	1965	7.1	1968	17.9	21.6	
1185	NIKKO		13.4	1962	DEC	22	2.2371	2	8	9	1927	1962	-29.2	1969	59.1	53.0	
1186	TURNERA		10.8	1957	JUN	11	3.0180	2	8	9	1929	1956	7.0	1966	21.6	31.5	
1187	AERA		12.9	1935	JUL	17	2.6395	2	8	7	1929	1963	5.0	1969	25.8	30.7	
1188	GOTHLANDIA		13.1	1949	JUN	21	2.1910							1969	300.0	259.0	ESTIMATED
1189	TERENTIA		11.2	1962	DEC	2	2.9335	5	6	8	1950	1965	-3.0	1968	11.5	16.1	
1190	PELAGIA		13.3	1930	OCT	31	2.4313	2	8	4	1909	1955	-7.4	1968	30.6	31.7	
1191	ALFATERNA		11.7	1931	FEB	12	2.8939							1966	300.0	411.8	ESTIMATED
1192	PRISMA		13.7	1931	FEB	28	2.3649	2	8	4	1931	1953	6.3	1969*	37.3	36.9	
1193	AFRICA		13.3	1931	JUN	8	2.6461	2	8	7	1931	1958	49.6	1969	165.6	197.5	
1194	ALETTA		11.6	1931	JUN	8	2.9146	2	8	9	1931	1956	-10.4	1965	47.0	65.2	
1195	ORANGIA		14.6	1931	JUL	18	2.2588	2	8	2	1931	1935	2.4	1935*	44.9	40.9	
1196	SHEBA		11.6	1931	JUN	8	2.6525	2	8	11	1931	1958	-34.9	1966	120.9	144.8	
1197	RHODESIA		11.2	1957	JUN	11	2.8862	5	6	4	1948	1960	8.6	1965	28.4	38.9	
1198	ATLANTIS		16.8	1931	OCT	6	2.2491	2	8	1	1931	1931	-1.3	1938*	72.6	65.7	
1199	CELOONIA		11.4	1962	DEC	2	3.0239	5	6	5	1951	1958	2.9	1967	15.8	23.1	
1200	IMPERATRIX		11.8	1951	DEC	20	3.0590	5	6	5	1937	1953	72.0	1969	201.9	301.3	

NUMBER	NAME	NOTE	ABMAG	EPOCH			A	PLANETS			OPPOSITIONS		RESIDUAL	LAST	ERROR SEC	ERROR KM3	
1201	STRENUA		12.7	1951	DEC	20	2.6992	5	5	4	1940	1949	36.0	1958*	156.9	193.3	
1202	MARINA		11.4	1962	DEC	2	3.9504	5	6	4	1931	1954	2.4	1962	10.4	22.2	
1203	NANNA		13.2	1951	DEC	20	2.8837	5	6	6	1926	1952	180.0	1952*	417.1	569.4	
1204	RENZIA		13.6	1931	OCT	6	2.2628	2	8	5	1931	1955	5.0	1967	32.7	29.9	
1205	EBELLA		15.3	1931	SEP	16	2.5322	2	8	2	1931	1935	-3.9	1935*	61.2	67.9	
1206	NUMERORIA	L	11.5	1931	OCT	29	2.8705	5	5	2	1931	1950	180.0	1932*	640000.0	867668.4	LOST
1207	OSTENIA		12.3	1941	NOV	22	3.0186	2	8	3	1932	1938	-2.0	1968	25.5	37.3	
1208	TROILUS		9.8	1965	OCT	7	5.1660	2	8	8	1931	1965	4.1	1965	10.8	32.6	
1209	PUMMA		11.6	1957	JUN	11	3.1818	5	6	4	1951	1961	-60.6	1969	164.2	259.6	
1210	MORDOVIA		11.4	1962	DEC	2	3.0107	5	6	5	1951	1968	-5.8	1968	15.7	22.8	
1211	BRESSOLE		12.2	1957	JUN	11	2.9275	5	6	7	1938	1965	-7.8	1965	20.8	29.0	
1212	FRANCETTE		10.9	1962	DEC	2	3.9544	5	6	7	1941	1965	6.9	1969	17.2	36.9	
1213	ALGERIA		12.2	1930	JAN	24	3.1379	5	6	5	1931	1956	5.7	1969	32.4	50.1	
1214	RICHILDE		12.1	1962	DEC	2	2.7094	5	6	9	1932	1966	-5.6	1966	15.1	18.8	
1215	1932 BA		11.9	1963	JUL	30	2.5786	2	8	14	1932	1963	-2.9	1969	10.9	12.4	
1216	ASKANIA		13.4	1966	JUN	24	2.2322	2	8	8	1932	1966	3.1	1969	10.4	9.3	
1217	MAXIMILIANA		14.6	1956	NOV	23	2.3525	2	8	8	1925	1957	5.6	1969	13.2	18.9	
1218	ASTER		14.4	1931	DEC	5	2.2634	2	8	3	1932	1951	-3.1	1951*	28.2	25.8	
1219	BRITTA		13.3	1962	DEC	2	2.2125	5	6	6	1932	1965	7.6	1968	19.7	17.3	
1220	CROCUS		12.3	1956	NOV	23	3.0056							1966	300.0	436.1	ESTIMATED
1221	AMOR		19.2	1964	JUN	14	1.9206	2	9	5	1932	1964	4.0	1964	13.8	9.2	
1222	TINA		13.3	1962	DEC	2	2.7902	5	6	6	1932	1965	180.0	1965	316.6	410.7	
1223	NECKAR		11.7	1951	DEC	20	2.8687	5	5	6	1941	1954	-144.0	1969	429.6	581.8	
1224	FANTASIA		12.9	1962	DEC	2	2.3039	5	6	5	1939	1962	-4.2	1969	14.6	13.8	
1225	ARIANE		13.6	1968	SEP	21	2.2334	2	8	12	1930	1968	-107.0	1968	176.3	157.6	
1226	SOLIA		13.3	1969	SEP	16	2.5849	2	8	3	1930	1969	-4.9	1969*	11.6	13.3	
1227	GERANIUM		11.6	1962	DEC	2	3.2021	5	6	6	1931	1959	12.7	1969	30.2	48.2	
1228	SCABIOSA		12.8	1962	DEC	2	2.7677	5	6	5	1931	1962	-2.3	1962*	9.9	12.7	
1229	TILIA		13.0	1951	DEC	20	3.1953	5	5	4	1931	1952	-144.0	1933*	364.8	590.4	
1230	PICETA		14.7	1962	DEC	2	2.5722	5	6	5	1931	1964	90.0	1964*	164.1	187.0	
1231	AURICULA		12.8	1931	OCT	26	2.6679	2	8	4	1931	1956	12.7	1966	55.0	66.5	
1232	CORTUSA		11.4	1954	NOV	4	3.1689							1969	300.0	471.6	ESTIMATED
1233	KORRESIA		12.4	1962	DEC	2	2.5543	5	6	5	1931	1963	-5.7	1967	16.1	18.1	
1234	ELYNA		12.1	1959	JAN	12	3.0107	2	8	6	1931	1959	-7.0	1963*	20.0	29.1	
1235	SCHORRIA		15.4	1931	SEP	16	1.9102	2	8	7	1931	1960	-4.7	1960*	33.3	21.9	
1236	THAIS		12.9	1951	DEC	20	2.4305	5	6	5	1931	1957	90.0	1969	196.5	203.7	
1237	GENEVIEVE		12.1	1957	JUN	11	2.6117	5	6	4	1951	1960	6.3	1969	25.6	29.8	
1238	PREDAPPIA		13.1	1962	DEC	2	2.6672	5	5	5	1932	1952	30.2	1969	81.3	98.2	
1239	QUETELETA		13.6	1951	DEC	20	2.6618	5	6	4	1939	1958	90.0	1967	212.7	256.2	
1240	CENTENARIA		11.1	1964	NOV	1	2.8702	2	8	10	1932	1964	-3.9	1968	11.8	16.0	
1241	DYSONA		10.5	1951	DEC	20	3.1940	5	5	6	1939	1954	-432.0	1967	1189.0	1890.8	
1242	ZAMBESIA		11.3	1941	JUN	15	2.7378							1969	300.0	377.9	ESTIMATED
1243	PAMELA		11.3	1957	JUN	11	3.0962	5	6	5	1947	1961	-1.5	1965	10.1	15.4	
1244	DEIPA		12.7	1947	AUG	3	2.3430	2	8	8	1921	1957	-12.7	1968	35.4	34.5	
1245	CALVINIA		11.0	1924	DEC	21	2.8942	2	8	20	1906	1963	-28.5	1968	74.1	101.8	
1246	CHAKA		12.8	1951	DEC	20	2.6212	5	6	7	1932	1954	90.0	1968	217.7	255.9	
1247	MEMORIA		11.7	1962	DEC	2	3.1378	5	6	4	1932	1965	-3.6	1966	11.5	17.9	
1248	JUGURTHA		11.0	1947	JAN	15	2.7219	5	6	6	1950	1961	9.5	1967	48.9	61.1	
1249	RUTHERFORDIA		13.0	1968	AUG	12	2.2245	2	8	10	1932	1968	5.6	1968	13.6	12.1	
1250	GALANTHUS		14.2	1951	DEC	20	2.5528	5	6	3	1933	1952	180.0	1970*	473.5	532.9	

NUMBER	NAME	NOTE	ABMAG	EPOCH			A	PLANETS			OPPOSITIONS		RESIDUAL	LAST	ERROR SEC	ERROR KM3	
1251	HEDERA		11.9	1956	MAR	8	2.7205	2	8	7	1933	1956	2.4	1963*	12.8	15.9	
1252	CELESTIA		11.8	1962	DEC	2	2.6934	5	6	7	1933	1956	6.4	1965	20.0	24.5	
1253	FRISIA		13.3	1957	JUN	11	3.1528							1933*	320000.0	499309.4	LOST
1254	FREDEGUNDA		11.6	1962	DEC	2	3.1325	5	6	4	1933	1956	-12.0	1967*	31.9	49.4	
1255	SCHILOWA		11.7	1951	DEC	20	3.1541	5	5	4	1932	1949	324.0	1966	942.1	1470.9	
1256	NORMANNIA		10.9	1966	JAN	15	3.9341	2	8	4	1932	1964	10.5	1967	22.3	47.3	
1257	MORA		13.0	1962	DEC	2	2.4875	5	6	8	1932	1960	-90.0	1968	179.6	193.7	
1258	SICILIA		11.8	1969	JAN	19	3.1852	2	8	6	1932	1969	5.9	1969	12.8	20.3	
1259	OGYALLA		11.8	1951	DEC	20	3.1018	5	5	6	1939	1953	-360.0	1969	1036.9	1579.6	
1260	WALHALLA		13.0	1933	FEB	17	2.6144	2	6	6	1933	1956	4.4	1967	28.6	33.5	
1261	LEGIA		11.9	1962	DEC	2	3.1519	5	6	6	1938	1955	4.2	1969	15.9	24.9	
1262	SNIADECKIA		11.4	1951	DEC	20	3.0060	5	5	5	1940	1954	-180.0	1967	509.9	741.3	
1263	VARSAVIA		11.5	1962	DEC	2	2.6653	5	6	7	1946	1961	90.0	1961*	209.8	253.2	
1264	LETARA		10.9	1957	JUN	11	2.8640	5	6	4	1952	1957	5.1	1967	30.4	41.1	
1265	SCHWEIKARDA	E	11.1	1935	MAY	28	3.0144							1966*	300.0	438.0	ESTIMATED
1266	TONE		10.4	1951	AUG	22	3.3662	5	6	5	1952	1956	-6.3	1967	52.1	89.4	
1267	GEERTRUIDA		13.5	1951	DEC	20	2.4633	5	6	7	1938	1961	-180.0	1969	369.5	391.9	
1268	LIBYA		10.0	1962	DEC	2	3.9309	5	6	10	1938	1958	-3.9	1969	11.2	23.9	
1269	HOLLANDIA		9.8	1957	JUN	11	3.9382	5	6	5	1950	1955	-5.0	1968	31.1	66.2	
1270	DATURA		14.2	1930	MAR	5	2.2347	2	8	4	1930	1953	-5.1	1968	34.2	30.6	
1271	ISERGINA		11.8	1951	DEC	20	3.1357	5	5	9	1930	1953	360.0	1967	853.5	1321.2	
1272	GEFION		13.6	1962	DEC	2	2.7814	5	6	3	1931	1959	90.0	1954*	182.4	235.6	
1273	HELMA		14.1	1951	DEC	20	2.3929	5	6	5	1932	1958	180.0	1969*	376.6	380.2	
1274	DELPORTIA		13.2	1932	OCT	20	2.2291	2	8	15	1918	1965	-6.4	1969	29.7	26.5	
1275	CIMBRIA		11.9	1932	OCT	20	2.6798	2	6	6	1932	1958	6.4	1965	34.0	41.4	
1276	UCCLIA		11.9	1951	DEC	20	3.1676	5	5	6	1933	1952	-720.0	1961	1865.1	2930.2	
1277	DOLORES		12.5	1943	OCT	31	2.6980							1968	300.0	369.2	ESTIMATED
1278	KENYA		12.5	1957	JUN	11	2.4037	5	6	5	1951	1959	12.3	1963	46.2	47.0	
1279	UGANDA		13.8	1933	MAY	8	2.3700	2	8	9	1933	1959	3.7	1966	26.5	26.3	
1280	BAILLAUDA		11.1	1962	DEC	2	3.4120	5	6	5	1939	1968	-4.4	1969	12.4	21.7	
1281	JEANNE		12.6	1962	DEC	2	2.5593	5	6	10	1933	1961	90.0	1969	176.3	199.3	
1282	UTOPIA		11.5	1962	DEC	2	3.1218	5	6	6	1933	1961	-9.6	1969	23.5	36.1	
1283	KOMSOMOLIA		12.0	1962	DEC	2	3.2155	5	6	6	1931	1966	-90.0	1966	157.0	252.1	
1284	LATVIA		11.5	1966	APR	5	2.6450	2	8	11	1933	1966	6.6	1966	15.9	18.9	
1285	JULIETTA		11.4	1962	DEC	2	2.9925	5	6	6	1936	1964	-7.8	1969	19.4	28.0	
1286	BANACHIEWICZA		11.6	1951	DEC	20	3.0219	5	5	6	1938	1955	108.0	1968*	281.6	412.7	
1287	LORELIA		12.1	1930	JAN	24	3.0124	5	6	4	1937	1957	6.3	1967	39.1	57.0	
1288	SANTA		12.8	1962	DEC	2	2.8869	5	6	6	1933	1962	90.0	1967	173.1	236.8	
1289	KUTAISSI		11.6	1951	DEC	20	2.8603	5	5	6	1941	1955	144.0	1967	399.5	538.7	
1290	ALBERTINE		13.8	1951	DEC	20	2.3665	5	6	7	1933	1955	-180.0	1966	418.8	414.8	
1291	PHRYNE		11.5	1957	JUN	11	3.0177	5	6	5	1949	1957	12.2	1969	48.0	70.1	
1292	LUCE		12.6	1962	DEC	2	2.5419	5	6	7	1948	1965	-3.0	1969	11.8	13.2	
1293	SONJA		15.2	1962	DEC	2	2.2271	5	6	4	1933	1953	180.0	1953*	447.6	398.1	
1294	ANTWERPIA		12.0	1957	JUN	11	2.6907	5	6	4	1952	1962	3.0	1968	15.0	18.4	
1295	DEFLOTTE		11.7	1962	DEC	2	3.3863	5	6	7	1935	1968	1.2	1969	7.1	12.3	
1296	ANDREE		12.7	1962	DEC	2	2.4191	5	6	8	1935	1959	-2.1	1963*	10.5	10.8	
1297	QUADEA		12.5	1934	FEB	12	3.0212	2	8	8	1927	1955	-6.1	1960	20.0	42.4	
1298	NOCTURNA		11.6	1957	JUN	11	3.1413	5	6	6	1934	1956	9.0	1966	26.7	41.4	
1299	MERTONA		13.0	1962	DEC	2	2.8037	5	6	10	1934	1958	90.0	1969*	193.1	252.5	
1300	MARCELLE		12.4	1957	JUN	11	2.7822							1967	300.0	387.5	ESTIMATED

NUMBER	NAME	NOTE	ABMAG	EPOCH		A	PLANETS			OPPOSITIONS		RESIDUAL	LAST	ERROR SEC	ERROR KM3	
1301	YVONNE		11.9	1963 APR	6	2.7646	2	8	9	1934	1957	-6.5	1969	26.7	34.1	
1302	WERRA		12.0	1966 APR	25	3.1262	2	8	6	1937	1963	-9.3	1966	21.4	33.0	
1303	LUTHERA		10.5	1966 NOV	11	3.2046	2	8	9	1935	1964	5.8	1969	14.1	22.6	
1304	AROSA		10.5	1953 SEP	5	3.1955	2	8	13	1928	1963	-18.2	1963	40.2	63.9	
1305	BONGOLA		11.6	1962 DEC	2	3.0128	5	6	8	1935	1964	-4.1	1969	12.8	18.6	
1306	SCYTHIA		10.9	1930 AUG	12	3.1446	5	5	7	1930	1956	-6.5	1968	34.1	53.0	
1307	CIMMERIA		13.3	1930 OCT	11	2.2502	2	8	7	1933	1957	2.7	1967	26.1	23.7	
1308	HALLERIA		12.0	1962 DEC	2	2.9109	5	6	6	1931	1963	2.6	1966	10.2	14.1	
1309	HYPERBOREA		11.3	1951 DEC	20	3.2175	5	6	4	1931	1951	90.0	1968	237.7	382.0	
1310	VILLIGERA		12.8	1951 DEC	20	2.3924	5	6	5	1938	1960	180.0	1960*	377.9	391.3	
1311	KNOPFIA		13.9	1962 DEC	2	2.4265	5	6	5	1929	1967	90.0	1967	153.0	158.2	
1312	VASSAR		12.8	1962 DEC	2	3.0997	5	6	8	1933	1957	90.0	1968	196.6	299.2	
1313	BERNA		13.0	1951 DEC	20	2.6563	5	6	5	1933	1957	180.0	1968*	391.5	470.0	
1314	PAULA		14.2	1951 DEC	20	2.2951	5	6	4	1933	1959	90.0	1966*	190.0	178.3	
1315	BRONISLAWA		11.2	1951 DEC	20	3.2097	5	5	6	1939	1955	72.0	1967	213.9	342.6	
1316	KASAN	L	14.9	1933 NOV	24	2.4107	2	8	1	1933	1933	-3.7	1933*	640000.0	654381.0	LOST
1317	SILVRETTA		9.8	1951 DEC	20	3.1675	5	5	6	1935	1954	396.0	1969	987.8	1551.8	
1318	NERINA		13.2	1957 JUN	11	2.3076	5	6	4	1934	1955	180.0	1967*	428.0	405.6	
1319	DISA		11.8	1941 OCT	13	2.9820	2	8	6	1908	1949	7.3	1965	26.4	37.9	
1320	IMPALA		12.0	1962 DEC	2	2.9809	5	6	4	1934	1965	-3.4	1969	11.4	16.3	
1321	MAJUBA		11.2	1962 DEC	2	2.9417	5	6	6	1935	1960	5.3	1964	16.1	22.6	
1322	COPPERNICUS		14.2	1934 JUN	12	2.4223	2	8	3	1934	1953	-9.5	1968*	48.4	49.9	
1323	TUGELA		11.2	1951 DEC	20	3.1849	5	5	4	1948	1956	86.4	1968	332.2	526.1	
1324	KNYSNA		13.7	1934 JUL	2	2.1847	2	8	2	1934	1937	-1.6	1969*	39.0	33.5	
1325	INANDA		13.3	1962 DEC	2	2.5377	5	6	4	1934	1954	2.0	1954	10.8	12.0	
1326	LOSAKA		12.0	1962 DEC	2	2.6680	5	6	7	1934	1965	90.0	1969	162.6	196.5	
1327	NAMAQUA		13.0	1962 DEC	2	2.7804	5	6	6	1934	1967	270.0	1967	455.7	588.0	
1328	DEVOTA		11.4	1957 JUN	11	3.5058							1964	300.0	544.9	ESTIMATED
1329	ELYANE		11.5	1962 DEC	2	2.6175	5	6	4	1951	1968	5.0	1968	14.7	17.2	
1330	SPIRIDONIA		11.6	1951 DEC	20	3.1851	5	6	4	1925	1950	-90.0	1970*	224.2	355.1	
1331	SOLVEJG		11.6	1933 OCT	15	3.1047	2	8	8	1926	1960	2.9	1967	20.2	30.9	
1332	MARCONIA		11.3	1962 DEC	2	3.0618	5	6	7	1939	1964	9.0	1969	21.9	32.8	
1333	CEVENOLA		12.9	1951 DEC	20	2.6333	5	6	7	1934	1957	270.0	1968*	596.0	705.6	
1334	LUNDMARKA		11.5	1948 MAY	9	2.9137							1969	300.0	416.1	ESTIMATED
1335	DEMOULINA		15.0	1962 DEC	2	2.2424	5	6	5	1934	1954	90.0	1954*	222.5	200.4	
1336	ZEELANDIA		12.1	1957 JUN	11	2.8506	5	6	6	1951	1962	-1.5	1968	10.7	14.3	
1337	GERARDA		12.3	1962 DEC	2	2.9096	5	6	6	1934	1954	-90.0	1969	221.5	306.6	
1338	DUPONTA		14.1	1934 DEC	29	2.2640	2	8	6	1935	1951	-5.0	1966	35.3	32.4	
1339	DESAGNEAUXA		11.6	1957 JUN	11	3.0234	5	6	6	1934	1962	-7.4	1969	20.5	30.1	
1340	YVETTE		12.6	1962 DEC	2	3.1698	5	6	9	1935	1953	2.1	1968	10.7	16.8	
1341	EDMEE		12.1	1962 DEC	2	2.7426	5	6	6	1949	1964	3.0	1969	11.9	15.0	
1342	BRABANTIA		13.4	1962 DEC	2	2.2888	5	6	6	1935	1964	90.0	1967	167.8	156.8	
1343	NICOLE		12.6	1935 APR	28	2.5680	2	8	12	1935	1960	-7.1	1968	35.3	40.1	
1344	CAUBETA		14.1	1935 APR	28	2.2481	2	8	6	1935	1962	9.0	1962*	41.4	37.5	
1345	POTOMAC		10.8	1969 SEP	1	3.9827	2	8	6	1932	1964	-224.0	1968	395.4	854.7	
1346	GOTHA		12.5	1947 MAY	15	2.6304	2	8	6	1929	1961	-3.4	1969	16.5	19.5	
1347	PATRIA		12.2	1951 DEC	20	2.5743	5	5	4	1931	1951	-36.0	1966	101.0	115.3	
1348	MICHEL		12.2	1951 DEC	20	2.7921	5	5	4	1933	1952	7.2	1966	27.3	35.5	
1349	BECHUANA		11.7	1951 DEC	20	3.0185	5	5	6	1938	1950	-396.0	1969	1328.4	1943.5	
1350	ROSSELIA		12.2	1962 DEC	2	2.8580	5	6	5	1934	1962	6.5	1968	17.6	23.8	

NUMBER	NAME	NOTE	ABMAG	EPOCH			a	PLANETS			OPPOSITIONS		RESIDUAL	LAST	ERROR SEC	ERROR KM3	
1351	UZBEKISTANIA		11.1	1951	DEC	20	3.1949	5	5	5	1935	1953	72.0	1966	192.2	305.8	
1352	MAWEL		12.4	1962	DEC	2	2.7788	5	6	4	1935	1951	1.5	1968	9.9	12.7	
1353	MAARTJE		11.2	1957	JUN	11	3.0128	5	6	8	1950	1964	3.0	1969	13.2	19.3	
1354	BOTHA		12.2	1939	JAN	17	3.1278	2	8	6	1930	1952	-72.3	1968	198.8	306.6	
1355	MAGDEBA		13.9	1951	DEC	20	1.8531	5	6	6	1935	1955	180.0	1966	435.2	269.1	
1356	NYANZA		11.4	1963	JUL	30	3.0813	2	8	7	1935	1963	4.2	1969	12.7	19.2	
1357	KHAMA		10.7	1948	NOV	25	3.1972	2	8	3	1935	1947	-4.3	1968	24.4	38.9	
1358	GAIKA		12.9	1962	DEC	2	2.4749	5	6	6	1951	1966	3.0	1966	11.9	12.7	
1359	PRIESKA		11.0	1957	JUN	11	3.1166	5	6	6	1939	1963	-7.7	1969	21.1	32.4	
1360	TARKA		12.5	1951	DEC	20	2.6334	5	6	4	1935	1957	90.0	1969	205.4	243.2	
1361	LEUSCHNERIA		12.0	1935	SEP	15	3.0872	2	8	8	1935	1961	-6.4	1961*	31.4	47.4	
1362	GRIQUA		11.5	1941	JAN	6	3.2807	2	8	6	1935	1956	2.7	1965	18.1	29.8	
1363	HERBERTA		12.7	1951	DEC	20	2.9006	5	5	5	1935	1954	72.0	1968	186.7	257.2	
1364	SAFARA		12.0	1962	DEC	2	3.0118	5	6	7	1937	1960	4.4	1966	14.4	21.0	
1365	1928 RK		13.3	1928	SEP	11	2.2487	2	8	11	1928	1962	-3.9	1969	28.6	25.9	
1366	PICCOLO		11.3	1962	DEC	2	2.8740	5	6	8	1939	1966	-3.2	1966	11.1	15.1	
1367	1934 NA		14.3	1962	DEC	2	2.3443							1955*	320000.0	311790.0	LOST
1368	NUMIDIA		12.0	1951	DEC	20	2.5220	5	6	6	1948	1963	180.0	1968	501.3	553.0	
1369	CONSTANTIA		11.5	1962	DEC	2	3.1089	5	6	8	1939	1967	-90.0	1968	156.4	239.1	
1370	HELLA	L	15.0	1935	SEP	15	2.2511	2	8	1	1935	1935	-4.0	1935*	640000.0	580347.4	LOST
1371	REST		12.4	1962	DEC	2	3.2137	5	6	5	1933	1968	10.6	1968	22.5	36.1	
1372	HAREMARI		12.8	1968	DEC	30	2.7674	2	8	8	1935	1969	6.0	1969	13.5	17.3	
1373	CINCINNATI		14.3	1941	JAN	6	3.4111	2	8	10	1935	1949	-5.8	1949*	29.6	51.7	
1374	ISORA		14.8	1951	DEC	20	2.2506	5	6	4	1935	1955	90.0	1967*	221.6	200.9	
1375	ALFREDA		12.9	1962	DEC	2	2.4476	5	6	7	1939	1968	5.0	1969	14.4	15.1	
1376	MICHELLE		13.8	1962	DEC	2	2.2277	5	6	10	1935	1958	-90.0	1968*	198.3	176.5	
1377	ROBERRAUXA		14.3	1950	AUG	29	2.2602	2	8	5	1936	1953	1.3	1967	13.9	12.7	
1378	LEONCE		13.3	1962	DEC	2	2.3755	5	6	5	1940	1962	9.2	1969	24.2	24.2	
1379	LOMONOSSOVA		12.2	1962	DEC	2	2.5267	5	6	6	1948	1965	-9.9	1968	25.2	27.9	
1380	VOLODIA		13.2	1936	MAR	13	3.1454	2	8	2	1936	1938	6.5	1966*	139.0	216.2	
1381	DANUBIA		13.0	1951	DEC	20	2.4917	5	6	6	1934	1952	270.0	1969	714.4	772.4	
1382	GERTI		13.6	1962	DEC	2	2.2202	5	6	6	1936	1968	5.8	1969	16.0	14.2	
1383	LIMPURGIA		12.9	1951	DEC	20	3.0756	5	6	5	1934	1962	-180.0	1962*	342.6	515.5	
1384	KNIERTJE		12.9	1951	DEC	20	2.6768	5	6	5	1941	1963	-180.0	1969	369.0	448.4	
1385	GELRIA		12.0	1951	DEC	20	2.7409	5	5	5	1941	1956	72.0	1966	196.1	247.4	
1386	STORERIA		14.8	1935	AUG	6	2.3642	2	8	1	1935	1935	-9.9	1949*	400.9	396.4	
1387	KAMA		14.4	1935	AUG	26	2.2583	2	8	3	1935	1962	6.2	1969*	33.3	30.3	
1388	APHRODITE		12.0	1951	DEC	20	3.0173	5	5	5	1943	1953	-108.0	1966	375.6	549.2	
1389	DENNIE		12.6	1951	DEC	20	2.8658	5	6	6	1935	1952	90.0	1969*	252.2	341.0	
1390	ABASTUMANI		10.1	1966	AUG	3	3.4345	2	8	9	1935	1966	2.8	1966	8.9	15.7	
1391	CARELIA		13.0	1940	JAN	12	2.5490	2	8	4	1936	1957	8.0	1965	35.4	39.8	
1392	PIERRE		13.0	1939	SEP	19	2.6085	2	8	5	1936	1959	4.0	1969*	24.6	28.7	
1393	SOFALA		13.2	1951	DEC	20	2.4342	5	6	4	1936	1959	180.0	1963	385.2	400.4	
1394	ALGOA		12.9	1951	DEC	20	2.4388	5	6	6	1948	1959	90.0	1966	295.9	308.6	
1395	ARTEDA		12.8	1936	AUG	23	3.2007							1966	300.0	478.5	ESTIMATED
1396	OUTENIQUA		13.1	1962	DEC	2	2.2482	5	6	9	1936	1963	-90.0	1969	173.2	156.7	
1397	UMTATA		12.8	1951	DEC	20	2.6829	5	6	8	1949	1962	90.0	1962*	279.0	340.3	
1398	DONNERA		11.5	1962	DEC	2	3.1582	5	6	7	1936	1958	-4.1	1969	14.1	22.0	
1399	TENERIFFA		15.3	1936	SEP	9	2.2160	2	8	2	1936	1956	-5.6	1969*	33.7	29.7	
1400	TIRELA		13.0	1962	DEC	2	3.1141	5	6	2	1936	1968	3.3	1969*	10.7	16.4	

NUMBER	NAME	NOTE	ABMAG	EPOCH			A	PLANETS			OPPOSITIONS		RESIDUAL	LAST	ERROR SEC	ERROR KM3
1401	LAVONNE		12.9	1962	DEC	2	2.2266	5	6	4	1935	1964	90.0	1965	168.0	149.3
1402	ERA		14.6	1936	AUG	20	2.6829	2	8	2	1936	1949	-3.4	1949*	28.0	34.1
1403	IDELSONIA		13.7	1936	SEP	9	2.7197	2	8	1	1936	1936	-2.9	1966	123.4	153.9
1404	AJAX		10.3	1964	JAN	6	5.2088	2	8	6	1936	1964	2.6	1964	8.7	26.5
1405	1936 BF		14.4	1936	OCT	19	2.2515	2	8	2	1936	1951	6.1	1968*	39.1	35.4
1406	KOMPPA		12.6	1942	JAN	1	2.6971	2	8	4	1936	1958	8.6	1969*	33.8	41.6
1407	LINDELOF		12.4	1957	JUN	11	2.7653	5	6	4	1949	1954	-9.0	1968	53.9	69.0
1408	TRUSANDA		12.1	1962	DEC	2	3.1109	5	6	4	1936	1962	-1.6	1968	8.4	12.8
1409	ISKO		11.8	1966	NOV	11	2.6759	2	8	8	1937	1966	5.4	1969	13.9	16.9
1410	MARGRET		12.5	1962	DEC	2	3.0209	5	6	7	1937	1958	90.0	1969*	202.6	296.7
1411	ARUNA		12.0	1962	DEC	2	3.0042	5	6	6	1937	1956	90.0	1966	218.6	317.5
1412	LAGRULA		13.7	1937	JAN	27	2.2147	2	8	9	1937	1960	-5.8	1970*	32.6	28.7
1413	ROUCARIE		12.5	1953	FEB	12	3.0219	2	8	4	1937	1964	-3.5	1969	14.	20.8
1414	JEROME		13.8	1937	MAR	8	2.7844	2	8	2	1937	1951	2.0	1951*	20.8	26.9
1415	MALAUTRA		13.5	1962	DEC	2	2.2232	5	6	8	1938	1957	6.6	1967	21.9	19.4
1416	PENAUXA		11.8	1962	DEC	2	3.0189	5	6	9	1940	1961	-6.9	1969	19.5	28.6
1417	MALINSKIA		12.4	1962	DEC	2	2.9737	5	6	4	1937	1963	-4.4	1968	13.6	19.4
1418	FAYETA		13.1	1962	DEC	2	2.2418	5	6	6	1937	1967	9.8	1969	22.9	20.6
1419	DANZIG		13.8	1964	NOV	1	2.2932	2	8	6	1938	1964	-2.7	1964	10.7	10.0
1420	RADCLIFFE		12.9	1962	DEC	2	2.7484	5	6	8	1931	1967	180.0	1967	300.7	381.1
1421	ESPERANTO		11.5	1962	DEC	2	3.0906	5	6	4	1936	1955	4.5	1969	16.3	24.6
1422	STROMGRENIA		13.8	1943	OCT	3	2.2472	2	8	4	1936	1963	6.9	1963	28.9	26.1
1423	JOSE		12.6	1951	DEC	20	2.8590	5	5	6	1939	1954	-180.0	1968	500.7	674.6
1424	SUNDMANIA		10.8	1957	JUN	11	3.1843	5	6	6	1937	1962	-2.9	1968	12.2	19.3
1425	TUORLA		12.9	1937	MAY	27	2.6113	2	8	5	1937	1958	3.8	1968	25.4	29.7
1426	1937 GF		14.2	1937	APR	17	2.5808	2	8	14	1920	1959	-35.3	1967	83.1	95.2
1427	RUVUMA		12.0	1942	NOV	17	2.7499	2	8	5	1937	1957	45.6	1969	136.8	173.5
1428	MOMPASA		11.6	1957	JUN	11	2.8092	5	6	4	1949	1956	11.6	1961	51.8	67.9
1429	PEMPA		13.4	1962	DEC	2	2.5483	5	6	6	1937	1957	180.0	1966	411.0	461.2
1430	1937 NK		13.3	1951	DEC	20	2.5581	5	6	5	1937	1962	270.0	1966	527.6	595.9
1431	1937 OB		12.6	1962	DEC	2	2.6190	5	6	6	1937	1953	90.0	1967	247.7	290.7
1432	ETHIOPIA		13.4	1962	DEC	2	2.3809	5	6	4	1939	1959	2.0	1969	10.6	10.6
1433	GERAMTINA		12.9	1957	JUN	11	2.7871	5	6	4	1950	1955	47.6	1967*	245.1	317.4
1434	MARGOT		11.5	1962	DEC	2	3.0183	5	6	6	1951	1964	90.0	1969	199.3	291.5
1435	GARLENA		14.8	1937	JAN	7	2.6471	2	8	2	1936	1933	-2.8	1938*	66.4	79.2
1436	1936 YB		11.5	1951	DEC	20	3.1494	5	5	6	1940	1952	-108.0	1967	350.3	545.7
1437	DIOMEDES		9.2	1964	JAN	26	5.0826	2	8	9	1937	1963	2.4	1968	8.5	25.1
1438	WENDELINE		12.8	1951	DEC	20	3.1901	5	6	3	1931	1939	180.0	1939*	1020.7	1620.2
1439	VOGTIA		11.2	1962	DEC	2	3.9810	5	6	4	1937	1950	.5	1969*	6.5	13.9
1440	ROSTIA		12.9	1962	DEC	2	3.1527	5	6	2	1937	1954	45.0	1954*	121.8	190.0
1441	BOLYAI		14.2	1941	OCT	13	2.6320	2	8	4	1937	1954	-3.9	1954*	24.2	28.6
1442	CORVINA		12.6	1965	AUG	28	2.8745	2	8	9	1937	1966	-90.0	1968	159.9	217.2
1443	RUPPINA		12.4	1938	FEB	11	2.9395	2	8	7	1937	1956	29.2	1969	107.4	151.0
1444	1938 AF		12.2	1951	DEC	20	3.1638	5	6	3	1938	1950	90.0	1965	308.2	483.4
1445	KONKOLYA		12.0	1951	DEC	20	3.1143	5	6	6	1938	1964	90.0	1969	174.5	267.3
1446	1938 BA		14.0	1938	FEB	11	2.2460	2	8	3	1938	1958	2.3	1969*	21.8	19.7
1447	UTA		12.9	1951	DEC	20	2.5348	5	6	6	1938	1959	90.0	1968*	202.2	224.9
1448	LINDBLADIA		14.4	1942	MAR	22	2.3722	2	8	3	1938	1949	-3.1	1966	24.7	24.6
1449	VIRTANEN		13.8	1939	MAR	23	2.2228	2	8	5	1938	1956	5.6	1969	33.5	29.7
1450	RAIMONDA		12.6	1962	DEC	2	2.6112	5	6	8	1934	1966	-9.6	1968	22.1	25.8

NUMBER	NAME	NOTE	ARMAG	EPOCH			A	PLANETS			OPPOSITIONS		RESIDUAL	LAST	ERROR SEC	ERROR KMS	
1451	GRAND		13.9	1938	MAR	23	2.2034	2	8	3	1939	1962	-6.1	1964	32.4	28.3	
1452	1938 D71		13.1	1949	MAR	25	3.1108	2	8	3	1938	1954	-9.7	1969*	34.3	52.5	
1453	FENNIA		13.8	1965	OCT	7	1.8969	2	8	10	1938	1965	4.8	1965	15.0	8.8	
1454	1936 DC		14.3	1940	APR	21	2.3649	2	8	4	1936	1951	3.8	1965	26.2	25.9	
1455	MITCHELLA		14.5	1962	DEC	2	2.2462	5	6	5	1937	1947	-90.0	1968	366.5	331.1	
1456	1937 NG		11.9	1962	DEC	2	3.1940	5	6	6	1937	1960	-90.0	1966	189.2	300.9	
1457	ANKARA		12.5	1951	DEC	20	2.6970	5	6	7	1947	1963	90.0	1969	239.6	294.7	
1458	MINEURA		12.5	1951	DEC	20	2.6252	5	6	5	1950	1962	-180.0	1967	579.1	682.1	
1459	MAGNYA		12.0	1962	DEC	2	3.1563	5	6	7	1937	1965	180.0	1968	320.3	500.6	
1460	1937 MC		13.8	1941	OCT	13	2.5410	2	8	3	1937	1953	-3.7	1969*	24.1	26.9	
1461	JEAN-JACQUES		10.8	1957	JUN	11	3.1242	5	6	8	1951	1963	-7.1	1968	23.2	35.8	
1462	ZAMENHOF		12.2	1938	FEB	11	3.1450	2	8	2	1938	1961	-20.7	1969	73.8	114.8	
1463	NORDENMARKIA		12.1	1957	JUN	11	3.1354	5	6	7	1938	1958	8.9	1969	26.2	40.6	
1464	ARMISTICIA		12.4	1939	DEC	3	3.0018							1968*	300.0	435.3	ESTIMATED
1465	AUTONOMA		12.2	1957	JUN	11	3.0239							1966	300.0	440.1	ESTIMATED
1466	MUNDLERIA		14.1	1938	MAY	22	2.3774	2	8	4	1923	1953	-4.0	1967	22.5	22.4	
1467	MASHONA		9.9	1957	JUN	11	3.3810	5	6	9	1948	1963	5.9	1968	19.0	32.8	
1468	ZOMBA		14.6	1951	SEP	11	2.1956	2	8	2	1938	1951	-3.0	1951*	19.8	17.2	
1469	LINZIA		11.0	1951	DEC	20	3.1249	5	5	4	1942	1953	180.0	1966	597.4	920.0	
1470	CARLA		12.3	1962	DEC	2	3.1599	5	6	7	1938	1955	-180.0	1966	460.6	721.1	
1471	1938 SL1		12.4	1939	OCT	29	2.7164	2	8	9	1931	1963	-7.4	1969	30.0	37.3	
1472	1938 UO		14.0	1939	NOV	18	2.2339	2	8	5	1931	1954	-3.3	1968*	23.4	20.9	
1473	1938 UT		13.6	1942	NOV	17	2.5742	2	8	3	1938	1954	2.5	1966	19.7	22.5	
1474	BEIRA		13.0	1941	JAN	6	2.7329	2	8	4	1935	1950	45.5	1968*	157.4	197.6	
1475	YALTA		14.2	1941	JAN	6	2.3495	2	8	3	1935	1953	-6.3	1966	31.2	30.5	
1476	1936 RA		14.9	1962	DEC	2	2.2816	5	6	5	1936	1957	90.0	1967*	207.9	193.1	
1477	BONSDORFFIA		12.4	1942	OCT	8	3.1756	2	8	4	1938	1955	-4.1	1967*	23.2	36.5	
1478	VIHURI		13.6	1938	FEB	11	2.4640	2	8	4	1938	1961	6.9	1969	34.2	36.3	
1479	INKERI		12.5	1939	MAR	3	2.6754	2	8	9	1923	1960	-8.2	1969*	31.4	38.2	
1480	AUNUS		14.4	1938	MAR	3	2.2023	2	6	4	1938	1951	-14.4	1969	74.5	64.9	
1481	TURINGIA		11.9	1951	DEC	20	3.0183	5	6	5	1933	1959	180.0	1967	368.4	539.0	
1482	SEBASTIANA		12.2	1962	DEC	2	2.8728	5	6	7	1938	1964	-11.9	1969	27.1	36.7	
1483	HAKOILA		12.7	1951	DEC	20	2.7178	5	6	5	1938	1956	90.0	1969	223.9	278.8	
1484	POSTREMA		12.3	1968	DEC	10	2.7347	2	8	P	1938	1968	-2.6	1969	8.2	10.4	
1485	ISA		12.6	1962	DEC	2	3.0288	5	6	4	1938	1954	-2.1	1965	10.9	16.1	
1486	MARILYN		14.6	1938	AUG	30	2.1988	2	8	9	1938	1964	4.7	1964	27.9	24.2	
1487	RODA		11.8	1951	FEB	3	3.1360	2	8	5	1938	1951	7.2	1962	31.0	48.0	
1488	1938 XF		12.1	1939	MAY	17	3.0389	2	8	6	1938	1955	-4.8	1969	28.0	41.4	
1489	1939 GC		13.1	1939	MAY	17	3.1740	2	8	4	1939	1950	14.5	1967	77.3	121.8	
1490	LIMPOPO		12.8	1962	DEC	2	2.3521	5	6	5	1937	1954	7.2	1969	24.9	24.4	
1491	BALDUINUS		12.7	1962	DEC	2	3.1917	5	6	4	1950	1961	-13.8	1961*	40.4	64.2	
1492	OPPOLZER		14.4	1941	FEB	15	2.1727	2	8	5	1938	1957	-5.6	1964	30.6	26.0	
1493	SIGRID		12.7	1962	DEC	2	2.4305	5	6	4	1949	1957	3.4	1968	17.6	18.3	
1494	SAVO		14.0	1940	APR	21	2.1905	2	8	4	1938	1951	-28.2	1969	122.5	105.7	
1495	1938 SW		13.5	1941	MAR	27	2.6394	2	8	6	1938	1963	-17.2	1968	57.4	68.2	
1496	TURKU		13.9	1938	OCT	29	2.2055	2	8	8	1938	1957	-4.1	1967	28.2	24.7	
1497	1938 SR1		13.0	1938	OCT	9	2.8941	2	8	6	1933	1962	5.5	1968	26.1	35.8	
1498	1938 SK1		13.1	1938	OCT	9	3.0944	2	8	2	1938	1954	1.5	1954*	17.3	26.2	
1499	1938 UF		12.7	1942	AUG	29	2.6706	2	8	5	1938	1955	-6.6	1967	31.8	38.5	
1500	1938 UH		14.5	1943	MAR	17	2.2422	2	8	5	1938	1958	-3.9	1958*	23.3	21.0	

NUMBER	NAME	NOTE	ARMAG	EPOCH		A	PLANETS		OPPOSITIONS		RESIDUAL	LAST	ERROR SEC	ERROR KMS	
1501	1938 UJ		13.7	1938 OCT	29	2.5471	2	8	4	1930	1950	-3.3	1950*	22.4	25.1	
1502	ARENDA		12.8	1957 JUN	11	2.7321	5	6	6	1951	1960	-5.1	1969	21.9	27.5	
1503	1938 XD		11.9	1938 DEC	28	2.6263	2	8	10	1935	1961	-3.7	1962	22.9	27.0	
1504	1939 EM		13.0	1939 APR	7	2.3988	2	8	6	1939	1955	-6.0	1965	34.8	35.3	
1505	KORANNA		12.5	1939 MAY	17	2.6586	2	8	5	1939	1956	4.4	1967	27.8	33.4	
1506	XOSA		13.3	1962 DEC	2	2.5667	5	6	5	1939	1968	-4.4	1968*	13.2	15.0	
1507	1939 RD		14.7	1939 OCT	4	2.3315	2	8	2	1939	1957	-1.9	1964*	20.0	19.3	
1508	1938 UO		13.2	1962 DEC	2	2.7682	5	6	4	1935	1958	1.6	1967	9.1	11.6	
1509	ESCLANGONA		14.1	1957 JUN	11	1.8864	5	6	5	1948	1957	-23.1	1965	84.2	52.9	
1510	1939 OC		12.6	1951 DEC	20	2.6695	5	6	4	1950	1954	180.0	1967	1179.0	1426.7	
1511	DALERA		14.2	1950 MAR	20	2.3579	2	8	5	1928	1955	4.4	1968	19.5	19.2	
1512	OULU		10.5	1942 NOV	17	3.9332	2	8	9	1939	1965	4.3	1966	20.7	43.9	
1513	1940 EB		14.5	1940 MAY	31	2.1928	2	8	4	1940	1953	16.0	1963	78.0	67.5	
1514	PICCOLA		13.6	1951 DEC	20	2.2405	0	0	4	1939	1953	-90.0	1966	267.3	240.3	
1515	1936 VG		14.0	1936 NOV	28	2.5659	2	8	1	1936	1936	-2.5	1950*	108.7	123.4	
1516	1938 PG		13.0	1953 OCT	30	2.6228							1966	300.0	352.9	ESTIMATED
1517	BEOGRAD		12.2	1951 DEC	20	2.7174	5	6	9	1934	1958	-180.0	1967	393.9	477.9	
1518	1938 UA		13.8	1938 OCT	29	2.2255	2	8	8	1928	1960	7.4	1960*	31.2	27.7	
1519	1938 UB		12.4	1960 OCT	13	3.1432	2	8	4	1938	1960	5.0	1966	16.1	25.0	
1520	1939 UY		11.7	1939 DEC	8	3.1072	2	9	7	1938	1960	30.1	1965	103.5	158.0	
1521	1938 UB1		13.3	1938 NOV	18	2.8503	2	8	3	1933	1959	2.9	1969	19.9	26.7	
1522	1938 WO		13.7	1938 DEC	8	2.3679	2	8	4	1938	1956	-4.4	1967	29.8	29.5	
1523	1939 PC		13.4	1949 JAN	24	2.2422	2	8	6	1939	1957	13.8	1964	43.0	38.7	
1524	1939 SB		12.0	1962 DEC	2	3.1100	5	6	5	1931	1966	-6.9	1969	17.0	26.0	
1525	1939 SC		13.7	1939 DEC	3	2.6955	2	8	4	1930	1957	-3.4	1961*	20.6	25.3	
1526	1939 TF		14.8	1939 OCT	24	2.3152	2	8	2	1939	1953	3.3	1967*	26.5	25.3	
1527	MALMQUISTA		13.7	1962 DEC	2	2.2274	5	6	4	1932	1965	-8.1	1969	20.6	18.3	
1528	CONRADA		13.6	1962 DEC	2	2.4146	5	6	5	1929	1955	90.0	1967*	200.0	205.1	
1529	1938 BC		11.3	1938 FEB	11	3.9976	2	8	4	1938	1952	-3.9	1968*	26.0	56.5	
1530	1938 SG		14.6	1938 OCT	9	2.2487	2	8	3	1938	1965	3.9	1965	25.2	22.9	
1531	1938 SH		13.1	1957 JUN	11	2.6294	5	6	4	1951	1961	-13.4	1967	42.2	49.8	
1532	1938 SM		11.9	1951 DEC	20	3.0056	5	6	5	1936	1961	180.0	1969	361.2	525.1	
1533	1939 BD		11.9	1962 DEC	2	3.0191	5	6	5	1936	1960	90.0	1967	185.4	271.4	
1534	1939 BK		13.0	1957 JUN	11	2.7321	5	6	5	1933	1962	180.0	1967	342.3	429.8	
1535	1939 PC		12.9	1939 OCT	4	3.1519	2	8	3	1933	1956	-4.1	1966	22.5	35.1	
1536	1939 SF		14.6	1939 OCT	24	2.2044	2	8	6	1903	1957	-4.6	1967	22.5	19.6	
1537	1940 QA		13.2	1957 JUN	11	3.0458							1967	300.0	444.8	ESTIMATED
1538	1940 PF		15.6	1940 NOV	27	2.3610							1969*	300.0	295.9	ESTIMATED
1539	1940 UB		12.1	1957 JUN	11	3.1412	5	6	4	1951	1959	5.4	1966	23.5	36.5	
1540	1938 WK		11.9	1957 JUN	11	2.8513	5	6	4	1938	1960	6.9	1964	21.1	28.3	
1541	ESTONIA		12.6	1939 MAR	18	2.7691	2	8	8	1939	1960	102.8	1969	330.4	423.7	
1542	1941 QE		11.8	1962 DEC	2	3.0918	5	6	4	1951	1963	7.4	1968	22.0	33.4	
1543	1941 SJ		13.7	1941 SEP	3	2.6279	2	8	4	1911	1958	-11.7	1958*	33.2	39.2	
1544	VINTERHANSENIA		13.0	1941 NOV	2	2.3735	2	8	6	1919	1952	18.6	1968	52.3	52.1	
1545	1941 UW		12.9	1941 OCT	13	2.7718	2	8	3	1941	1952	-33.3	1955*	157.0	201.6	
1546	1941 SG1		11.8	1962 DEC	2	3.1674	5	6	6	1935	1952	180.0	1959	492.4	773.5	
1547	1929 CZ		12.8	1944 AUG	5	2.6455	5	5	6	1929	1953	-19.8	1968	56.5	67.4	
1548	PALOMAA		12.8	1935 JUL	17	2.7886	2	8	8	1935	1959	3.8	1968*	24.9	32.3	
1549	MIKKO		13.7	1937 MAR	28	2.2305	2	8	6	1937	1962	2.5	1965	22.1	19.7	
1550	TITO		13.6	1937 DEC	13	2.5483	2	8	8	1935	1959	10.9	1965	44.8	50.3	

NUMBER	NAME	NOTE	ABMAG	EPOCH			A	PLANETS			OPPOSITIONS		RESIDUAL	LAST	ERROR SEC	ERROR KM	
1551	ARGELANDER		13.7	1962	DEC	2	2.3940	5	6	7	1938	1968	-5.1	1969	14.6	14.7	
1552	BESSEL		12.6	1939	MAR	23	3.0096	2	8	7	1933	1962	5.7	1969	26.3	38.4	
1553	BAUERSFELDA		12.7	1968	OCT	31	2.9076	2	8	6	1940	1968	4.9	1968	11.9	16.5	
1554	YUGOSLAVIA		12.7	1951	DEC	20	2.6206	5	6	5	1952	1961	90.0	1969	369.1	422.6	
1555	DEJAN		12.5	1941	SEP	3	2.6906	2	8	7	1932	1963	-7.0	1967	27.4	33.6	
1556	WINGOLFIA		11.3	1962	DEC	2	3.4149	5	6	7	1942	1958	5.6	1958*	19.4	32.3	
1557	ROEHLA		12.2	1957	JUN	11	3.0083	5	6	6	1930	1958	-90.0	1966	186.8	271.9	
1558	1942 PD		11.5	1951	DEC	20	3.2197	5	6	6	1937	1960	90.0	1969	192.1	309.0	
1559	1942 PF		13.1	1942	FEB	10	2.3904	2	8	8	1935	1961	33.9	1969	93.3	94.1	
1560	STRATTONIA		12.8	1951	DEC	20	2.6834	5	6	4	1950	1959	180.0	1968	689.0	840.6	
1561	1941 CG		12.0	1957	JUN	11	3.1742	5	6	4	1948	1958	26.6	1969	83.8	132.0	
1562	1943 EE		13.4	1960	MAY	26	2.2266	2	8	7	1936	1960	-15.0	1961	37.2	33.1	
1563	NOEL		13.8	1943	MAR	17	2.1913	5	5	4	1930	1953	-72.0	1969	182.1	157.2	
1564	SRBIJA		12.1	1962	DEC	2	3.1447	5	6	6	1933	1953	-5.0	1969*	17.6	27.3	
1565	1948 WA		13.7	1949	MAR	25	2.3936	2	8	4	1948	1955	6.7	1964	41.9	42.3	
1566	ICARUS		17.7	1949	JUN	23	1.0777							1968	10.0	.6	ESTIMATED
1567	1941 HN		10.9	1941	APR	16	3.2179	2	6	5	1941	1954	12.2	1968	58.7	94.3	
1568	ATSLEEN		13.1	1947	JAN	15	2.3521	2	8	7	1946	1957	-4.3	1964	27.1	26.6	
1569	EVITA		12.4	1957	JUN	11	3.1639	5	6	7	1948	1959	-7.8	1959*	27.9	43.8	
1570	ARUNONIA		12.5	1948	SEP	6	2.8432	2	8	6	1948	1958	-11.9	1969	55.9	74.7	
1571	1950 GJ		13.1	1950	APR	29	3.1380	2	8	3	1950	1953	2.0	1967	26.5	41.1	
1572	POSNANIA		11.3	1947	JAN	15	3.1075	5	6	7	1952	1960	5.7	1965	39.2	60.0	
1573	VAISALA		13.9	1949	SEP	1	2.3703	2	8	4	1949	1956	-7.0	1967*	44.4	44.1	
1574	MEYER		11.5	1947	JAN	15	3.5336	5	6	6	1950	1956	11.7	1966	81.0	148.8	
1575	WINIFRED		13.9	1950	APR	29	2.3752	2	8	7	1939	1958	8.8	1966	30.0	29.9	
1576	FABIOLA		11.8	1948	SEP	6	3.1366	2	8	9	1939	1959	7.1	1965	25.0	38.8	
1577	1940 BA		15.2	1954	MAR	8	2.2312	2	8	5	1949	1956	-2.6	1968	18.6	16.6	
1578	KIRKWOOD		11.7	1950	DEC	25	3.9584	2	8	5	1949	1957	3.6	1968	22.6	48.5	
1579	1948 SP		11.0	1948	SEP	6	3.4317	2	8	7	1948	1957	4.5	1967	27.7	48.9	
1580	BETULIA		15.6	1963	MAY	24	2.1956	2	8	7	1950	1963	12.4	1963	32.3	28.0	
1581	ABANDEBADA		11.3	1950	JUL	18	3.1695	2	8	4	1943	1955	3.3	1969	18.1	28.5	
1582	MARTIR		13.1	1950	JUL	18	3.1706	2	8	5	1950	1956	-3.1	1967*	24.5	38.6	
1583	ANTILOCHUS		9.8	1950	NOV	15	5.2765	2	8	7	1950	1955	-5.5	1969	40.2	124.5	
1584	FUJI		12.4	1949	MAR	25	2.3755	2	8	8	1927	1962	6.4	1965	21.9	21.8	
1585	UNION		11.8	1948	SEP	6	2.9294	2	8	7	1947	1957	9.5	1969	45.5	63.6	
1586	1939 CJ		13.5	1943	MAR	17	2.4291	2	8	5	1939	1959	6.8	1964	30.8	31.9	
1587	1933 FS1		12.9	1962	DEC	2	2.5452	5	6	7	1933	1959	5.0	1969*	16.0	17.9	
1588	DESCAMISADA		12.2	1957	JUN	11	3.0295	5	6	4	1951	1958	-16.0	1968*	66.8	98.2	
1589	FANATICA		13.3	1950	OCT	6	2.4177	2	8	8	1935	1958	28.8	1969	71.3	73.2	
1590	TSIOLKOVSKAJA		13.1	1951	DEC	20	2.2295	5	6	7	1936	1956	90.0	1966	217.2	193.6	
1591	RATZE		13.3	1951	JUL	13	2.3925	2	8	3	1951	1954	-4.8	1966	51.3	51.8	
1592	1951 LA		13.0	1951	JUL	13	2.3697	2	8	3	1951	1957	-3.1	1965*	24.3	31.2	
1593	1951 LB		14.6	1951	JUL	13	2.2248	2	8	5	1951	1961	5.1	1961	28.6	25.4	
1594	DANJON		13.5	1952	SEP	25	2.2693	5	6	3	1949	1952	-2.6	1969	31.4	28.9	
1595	1930 ME		12.6	1935	OCT	5	2.6420	5	5	4	1930	1950	-72.0	1968	237.0	282.0	
1596	1951 EV		11.9	1951	DEC	20	2.8917	2	8	7	1934	1962	6.4	1965	20.5	28.1	
1597	1949 FB		13.4	1951	DEC	20	2.8490	5	6	4	1949	1954	180.0	1954*	980.7	1314.3	
1598	PALOQUE		14.4	1969	JUL	18	2.3318	2	8	9	1950	1969	-3.9	1969	10.7	10.3	
1599	STOMUS		12.3	1957	JUN	11	3.1379	5	6	5	1950	1955	-10.7	1955*	60.2	93.2	
1600	1947 UC		14.3	1948	FEB	19	1.8491	2	8	5	1947	1961	-2.6	1969	21.6	13.3	

NUMBER	NAME	NOTE	APMAG	EPOCH			A	PLANETS			OPPOSITIONS		RESIDUAL	LAST	ERROR SEC	ERROR KMS
1601	PATRY		13.7	1949	SEP	1	2.2342	2	8	6	1942	1956	-43.8	1969	129.7	116.1
1602	INDIANA		13.2	1967	MAY	10	2.2443	2	8	6	1950	1967	5.0	1968	14.0	12.6
1603	NEVA		12.1	1935	OCT	5	2.7552	2	8	11	1907	1962	31.5	1969	66.7	84.8
1604	1931 EH		11.8	1962	DEC	2	3.0262	5	6	8	1951	1964	2.7	1969	11.2	16.5
1605	1936 GA		11.4	1936	JUN	1	3.0145	5	5	4	1931	1952	396.0	1967	1200.5	1752.9
1606	1950 BH		12.8	1950	AUG	27	2.6889	5	5	5	1928	1954	180.0	1963	403.9	494.4
1607	1950 RA		12.9	1962	DEC	2	2.5456	5	6	5	1950	1966	-8.4	1966	21.7	24.3
1608	1951 PZ		13.7	1957	JUN	11	2.2140	5	6	3	1951	1961	9.5	1967	33.0	29.0
1609	1951 NL		12.0	1951	NOV	10	2.5849	2	8	6	1934	1957	-7.3	1969*	25.1	28.8
1610	MIRNAYA		14.8	1929	SEP	11	2.2024	5	5	2	1928	1954	6.4	1964	38.4	33.5
1611	BEYER		11.9	1953	FEB	28	3.2006	5	5	2	1950	1953	-5.4	1963	57.1	91.0
1612	HIROSE		12.2	1950	FEB	9	3.1023	2	8	8	1939	1961	7.9	1969	24.7	37.7
1613	1950 SO		13.0	1950	OCT	6	2.7377	2	8	6	1929	1959	-32.7	1970	72.4	91.2
1614	1952 HA		11.8	1952	APR	18	2.9960	2	8	9	1928	1957	-19.9	1969	48.7	70.4
1615	1950 RW		11.5	1949	DEC	30	3.1174	2	8	6	1926	1961	-5.5	1964	18.9	29.0
1616	1950 EB		12.4	1954	JAN	18	2.9116	5	6	3	1950	1954	-2.6	1962	23.3	32.3
1617	1952 FR		12.1	1954	SEP	15	3.1910	2	8	4	1952	1958	-23.4	1969	104.9	166.6
1618	1948 NF		12.7	1948	JUL	28	2.8692	2	8	5	1948	1958	2.4	1958*	19.8	25.5
1619	UETA		12.9	1953	OCT	30	2.2410	2	8	5	1926	1962	-29.4	1969	61.8	55.6
1620	GEOGRAPHOS		16.0	1969	MAY	24	1.2439	2	8	6	1951	1955	6.5	1969	25.9	4.6
1621	DRUZHBA		12.9	1926	OCT	12	2.2300	2	8	8	1926	1962	25.9	1969	90.4	80.6
1622	1952 EA		13.5	1952	APR	18	2.2344	2	8	7	1942	1960	-5.6	1969	22.0	19.7
1623	1948 PL		11.9	1948	SEP	6	3.1347	2	8	5	1948	1960	8.7	1968	39.5	61.2
1624	1931 TT1		11.9	1931	OCT	26	3.1742	2	8	4	1928	1954	-6.2	1968	31.9	50.3
1625	THE MORC		11.1	1953	SEP	20	3.1663	2	8	6	1929	1957	5.9	1969	19.7	30.9
1626	SADEYA		13.7	1927	JAN	20	2.3645	2	6	2	1927	1956	8.8	1964	44.4	43.9
1627	IVAR		14.2	1957	JUL	1	1.9642	2	6	2	1929	1957	-1.3	1964	12.4	7.8
1628	1923 CG		11.7	1957	MAR	3	3.0143	2	6	2	1923	1957	-2.6	1968	13.8	20.1
1629	PECKER		14.1	1942	FEB	10	2.2380	2	6	4	1942	1953	-3.6	1967	28.5	25.6
1630	1952 DA		12.6	1952	MAR	9	3.0299	2	8	7	1924	1963	5.1	1968	17.0	25.1
1631	1926 TH		13.7	1936	NOV	8	2.2353	2	8	6	1926	1966	-7.0	1966	30.2	27.0
1632	1941 DF		12.7	1941	MAR	7	2.6551	2	6	3	1941	1956	7.2	1969	37.9	45.4
1633	1929 EC		11.6	1929	MAR	10	3.1686	2	6	5	1929	1957	21.6	1968	79.7	125.2
1634	1935 QP		14.6	1935	AUG	26	2.2456	2	6	4	1928	1955	-2.3	1969	22.0	19.9
1635	1924 QW		12.8	1924	APR	5	2.8536	2	6	5	1924	1955	5.0	1969	31.6	42.4
1636	1935 US		13.5	1950	FEB	8	2.2350	2	6	3	1950	1955	-4.7	1967	38.7	34.7
1637	1907 YT		11.4	1936	NOV	8	3.0679	2	8	7	1907	1962	6.4	1967	23.2	34.8
1638	1912 CX		12.9	1954	SEP	15	2.7482	2	6	4	1912	1954	19.2	1967	45.0	57.0
1639	1951 RB		12.3	1951	OCT	1	2.5753	2	6	4	1935	1959	-3.1	1969	15.5	17.7
1640	1951 QA		14.7	1951	SEP	11	2.2890	2	6	2	1951	1958	-4.9	1965	32.4	30.3
1641	1935 CJ		12.5	1957	JUN	11	3.0174	2	6	4	1930	1956	7.5	1969	22.7	33.1
1642	1951 PU		12.5	1951	OCT	21	2.7543	2	6	4	1940	1955	4.7	1967	21.4	27.2
1643	1951 PO		13.8	1951	OCT	21	2.4899	2	6	3	1933	1955	4.8	1967	20.3	21.9
1644	RAFITA		12.2	1935	DEC	24	2.5456	2	6	5	1935	1957	-28.4	1967	104.4	117.0
1645	1933 QJ		12.7	1933	SEP	5	3.0562	2	6	4	1933	1958	9.3	1966	41.9	62.4
1646	1939 PG		13.8	1939	JAN	17	2.3607	2	6	6	1937	1959	-11.6	1968*	47.3	46.7
1647	MENELAUS		11.5	1959	JUN	6	5.2224	2	6	3	1957	1959	6.2	1969	58.1	177.8
1648	SHAJNA		13.0	1952	NOV	4	2.2370	2	8	6	1934	1955	-95.8	1968	233.4	209.3
1649	1951 OF		12.7	1951	FEB	23	3.0205	2	8	4	1930	1956	-3.2	1967*	15.2	22.2
1650	1937 TG		12.3	1937	NOV	3	2.4358	2	8	3	1906	1955	4.2	1967	21.7	22.6

NUMBER	NAME	NOTE	APMAG	EPOCH			A	PLANETS			OPPOSITIONS		RESIDUAL	LAST	ERROR SEC	ERROR KMS
1651	1936 HD		13.5	1936	MAY	12	2.1799	5	7	5	1936	1952	19.9	1969	90.1	77.0
1652	1933 UE1		14.3	1953	SEP	20	2.2510	2	8	3	1933	1956	7.2	1966	25.4	23.1
1653	YAKHONTOVIA		12.8	1937	SEP	24	2.6111	2	8	4	1937	1962	6.3	1968	31.7	37.0
1654	BOJEVA		12.1	1957	OCT	29	3.0153	2	8	7	1931	1962	-23.4	1963	49.8	72.8
1655	1929 WC		12.9	1929	DEC	15	2.7819	2	8	3	1901	1954	4.8	1969	23.9	30.9
1656	1942 EF		14.2	1942	MAR	22	1.8775	2	8	3	1942	1955	-4.4	1968*	32.5	20.7
1657	ROEMERA		11.8	1961	MAR	2	2.3487	2	8	2	1961	1962	-10.5	1968	143.1	139.9
1658	1953 NA		12.4	1953	AUG	11	2.5599	2	8	3	1948	1957	3.9	1969	21.2	24.0
1659	1940 YL		11.3	1953	JUL	2	2.7847	2	8	6	1940	1953	-3.8	1969	19.6	25.4
1660	1953 GA		14.2	1953	JUN	12	2.3955	2	8	4	1931	1955	-18.4	1968	49.7	50.2
1661	1916 ZE		14.1	1916	APR	7	2.1838	2	8	4	1916	1961	5.6	1968	37.6	32.3
1662	HOFFMANN		13.1	1923	SEP	18	2.7424	2	8	5	1923	1955	7.4	1968	39.3	49.7
1663	1926 PE		14.9	1926	SEP	2	2.2400	2	8	5	1926	1963	-6.7	1969	36.9	33.2
1664	1929 CD		13.7	1929	JAN	29	2.3292	2	8	5	1929	1961	-3.2	1965	26.0	25.2
1665	GARY		12.4	1930	APR	14	2.4137	2	8	4	1930	1957	6.2	1957*	35.2	36.1
1666	VAN GENT		13.4	1930	AUG	12	2.1856	2	8	5	1930	1959	2.0	1969	23.4	20.1
1667	PELS		13.5	1930	SEP	21	2.1897	2	8	8	1930	1963	-3.6	1969	27.5	23.7
1668	HANNA		13.6	1933	JUL	27	2.8043	2	8	4	1933	1962	-3.6	1966	24.2	31.6
1669	DAGMAR		11.7	1934	AUG	31	3.1444	2	8	6	1934	1963	-5.8	1967	29.2	45.4
1670	1934 PZ		12.3	1934	OCT	10	2.9008	2	8	5	1934	1957	10.5	1969	46.7	64.3
1671	CHAIKA		12.9	1934	OCT	10	2.5871	2	8	4	1934	1963	-3.5	1963	24.1	27.8
1672	1935 RD		13.2	1935	MAR	19	3.1715	2	8	5	1929	1962	13.1	1962	44.6	70.3
1673	VAN HOUTEN		12.1	1950	FEB	8	3.1021	2	8	6	1937	1959	6.7	1966	22.6	34.4
1674	GROENEVELD		11.9	1938	MAR	3	3.1756	2	8	3	1938	1955	-7.4	1969	37.8	59.6
1675	1938 FP		13.2	1953	NOV	19	2.2334	2	8	7	1931	1958	-4.5	1969*	18.7	16.7
1676	1939 LC		14.2	1939	MAY	17	2.2359	2	8	6	1939	1959	8.6	1969*	41.2	36.9
1677	1940 PO		13.4	1940	SEP	8	2.5318	2	8	4	1916	1952	6.0	1968	25.0	27.7
1678	1940 YH		12.1	1941	JAN	6	3.1705	2	8	4	1919	1962	5.8	1967*	21.0	33.1
1679	1941 FP		11.6	1941	MAY	6	3.1179	2	8	5	1941	1963	-4.9	1964	25.2	38.7
1680	1942 CH		12.4	1942	MAR	22	2.7226	2	8	8	1902	1960	-8.7	1967	26.3	32.9
1681	1948 WE		11.9	1949	FEB	13	2.6974	2	8	6	1939	1957	3.9	1957*	18.6	22.9
1682	KAREL		14.5	1949	AUG	12	2.2390	2	8	5	1929	1959	3.9	1969	18.4	16.5
1683	1950 SL		12.9	1950	AUG	27	2.7344	2	8	5	1936	1959	3.5	1968*	16.5	20.7
1684	1951 QF		12.7	1951	AUG	22	3.0975	2	8	7	1922	1951	7.5	1968*	25.1	38.2
1685	TOBO		16.2	1968	MAY	24	1.3677	2	8	3	1948	1965	-6.4	1965	21.8	5.8
1686	DE SITTER		12.0	1935	OCT	5	3.1775	2	8	4	1935	1963	-4.5	1969*	25.2	39.7
1687	GLADONA		11.4	1965	SEP	17	3.1544	2	8	2	1954	1965	4.5	1968	14.3	22.4
1688	1951 EQ1		13.3	1951	APR	4	2.6194	2	8	3	1951	1964	1.5	1969	13.8	16.2
1689	1930 SC		11.6	1930	OCT	11	2.4493	2	8	4	1930	1951	-9.7	1968	50.2	52.7
1690	1948 VR		11.8	1956	APR	17	3.0380	2	8	2	1948	1956	-5.6	1969	26.6	39.3
1691	OORT		11.8	1956	SEP	24	3.1644	2	8	3	1950	1956	-1.4	1964	12.7	20.0
1692	SUBBOTINA		12.5	1936	AUG	20	2.7873	2	8	5	1936	1950	6.9	1969	41.1	53.3
1693	HERTZSPRUNG		12.0	1935	JUN	7	2.8061	2	8	3	1935	1950	-3.6	1969	27.7	36.2
1694	KAISER		13.8	1960	OCT	13	2.3958	2	8	2	1934	1960	-1.5	1969*	9.8	9.9
1695	1941 UO		13.0	1964	SEP	22	2.7843	2	8	2	1941	1964	3.0	1964*	10.7	13.8
1696	1939 FF		14.4	1939	MAR	18	2.2618	2	9	3	1939	1951	7.1	1951*	44.2	40.4
1697	1940 PM		13.2	1940	SEP	28	2.3739	2	8	2	1940	1962	1.9	1969	18.8	19.7
1698	1934 CS		12.4	1934	FEB	12	3.1552	2	8	2	1934	1940	2.2	1968	30.0	46.9
1699	1941 QD		14.4	1941	OCT	13	2.2113	2	8	3	1931	1941	1.7	1964	21.4	18.8
1700	1940 QC		13.7	1940	SEP	8	2.3607	2	8	3	1929	1951	6.4	1969	29.3	28.9

NUMBER	NAME	NOTE	ABMAG	EPOCH			A	PLANETS		OPPOSITIONS			RESIDUAL	LAST	ERROR SEC	ERROR KM3
1701	1953 NJ		11.5	1953	JUL	2	3.1772	2	8	2	1931	1953	2.8	1965*	14.3	22.6
1702	1924 SH		12.0	1948	JUL	28	2.8586	2	8	4	1924	1965	3.2	1967	14.9	20.1
1703	1930 FB		14.4	1930	SEP	21	2.2147	2	8	2	1930	1963	-2.4	1969	23.9	21.1
1704	1924 OT		13.9	1924	APR	5	2.2226	2	8	3	1924	1957	6.4	1964	38.2	33.9
1705	1941 SL1		14.2	1941	OCT	13	2.2994	2	8	3	1941	1955	2.4	1969*	22.1	20.8
1706	1931 TS		14.0	1962	OCT	3	2.1258	2	8	4	1931	1962	-4.6	1968	15.3	12.5
1707	1932 FL		13.6	1932	OCT	20	2.2192	2	8	4	1932	1965	-5.3	1967*	31.0	27.4
1708	1929 XA		12.9	1929	DEC	15	2.9128	2	8	2	1929	1934	10.3	1968*	119.8	166.0
1709	UKRAINA		13.9	1925	SEP	7	2.3784	2	8	3	1925	1960	4.3	1969*	30.2	30.2
1710	1941 UF		14.6	1941	NOV	22	2.3227	2	8	3	1941	1962	6.2	1969	31.7	30.4
1711	1935 BB		12.1	1935	FEB	7	3.0123	2	8	5	1935	1959	-8.7	1969*	39.3	57.3
1712	1935 KC		11.0	1935	JUN	7	3.1647	2	8	4	1929	1965	-2.9	1968	19.4	30.4
1713	1951 SC		14.4	1951	OCT	1	2.2286	2	8	4	1931	1958	2.8	1968*	15.9	14.2
1714	1951 OA		12.8	1951	AUG	2	2.5644	2	8	3	1951	1963	-1.2	1966	13.1	14.9
1715	1938 GK		13.4	1953	JUN	12	2.3983	2	8	2	1938	1953	7.1	1969*	28.9	29.3
1716	1934 GF		13.0	1934	MAY	3	2.7335	2	8	3	1934	1957	-2.9	1968	23.0	28.9
1717	1954 AC		13.6	1954	JAN	18	2.1955	2	8	5	1941	1959	8.6	1967	28.4	24.7
1718	1942 RX		14.9	1953	OCT	30	2.3661	2	8	2	1942	1953	-2.3	1964*	16.7	16.5
1719	1950 DP		12.5	1950	MAR	20	2.6581	2	8	3	1950	1957	6.6	1965	40.4	48.6
1720	1935 CO		14.4	1935	FEB	27	2.1883	2	8	3	1927	1951	-4.4	1969*	27.7	23.8
1721	1953 TD3		11.9	1953	OCT	30	3.1442	2	8	4	1944	1958	4.0	1969*	17.7	27.5
1722	1938 EG		13.0	1938	MAR	3	2.5141	2	8	4	1938	1960	-6.9	1964	34.3	37.6
1723	1936 FX		11.5	1942	MAY	1	3.0139	2	8	6	1931	1965	-12.7	1968	37.0	54.1
1724	1932 OC		12.0	1932	MAR	14	2.7113	2	8	4	1932	1956	7.1	1969	36.9	45.8
1725	CRAO		12.3	1930	OCT	11	2.9028	2	8	3	1930	1950	3.3	1969	26.3	36.3
1726	1933 OE		13.0	1933	SEP	5	2.7876	2	8	4	1933	1962	-5.0	1962	28.2	36.6
1727	1965 BA		14.2	1965	JAN	20	1.8540	2	8	2	1965	1966	2.6	1968*	30.1	18.6
1728	GOETHE LINK		12.7	1964	NOV	1	2.5631	2	8	4	1943	1964	2.9	1964	10.9	12.3
1729	BERYL		13.6	1963	SEP	28	2.2304	2	8	5	1937	1963	5.0	1969	15.2	13.6
1730	1936 UA		12.8	1936	NOV	8	2.7843	2	8	5	1931	1959	-5.3	1968*	26.9	34.8
1731	1948 PH		11.0	1948	AUG	17	3.1778	2	8	5	1931	1960	8.7	1968	25.8	40.8
1732	1943 FY		12.0	1943	MAR	17	3.0087	2	8	5	1924	1966	3.2	1966	16.2	23.6
1733	1938 DL1		14.2	1938	MAR	3	2.1930	2	8	3	1938	1965	5.8	1969	30.8	26.7
1734	1928 TJ		12.6	1951	OCT	1	2.7768	2	8	4	1928	1965	-5.7	1969	18.5	23.8
1735	1948 RJ1		10.8	1948	OCT	16	3.1428	2	8	5	1931	1959	-8.8	1968*	26.3	40.9
1736	FLORAC		13.3	1967	SEP	27	2.2288	2	8	6	1927	1957	7.7	1967	17.4	15.5
1737	SEVERNY		12.1	1966	OCT	22	3.0098	2	8	4	1950	1966	.7	1966	5.6	8.2
1738	1930 SP		13.7	1930	SEP	21	2.1834	2	8	4	1927	1952	2.5	1959*	25.2	21.6
1739	1939 PF		13.7	1939	AUG	25	2.2617	2	8	4	1936	1963	2.2	1969	19.8	18.1
1740	1939 UA		14.4	1939	OCT	24	2.4673	2	8	4	1939	1966	3.5	1966	22.7	24.2
1741	1960 RC		12.6	1960	FEB	16	2.8836	2	8	4	1951	1963	-3.9	1969	14.9	20.3
1742	1934 RC		12.3	1934	SEP	20	2.8888	2	8	5	1934	1964	5.0	1968	27.2	27.2
1743	SCHMIDT		13.1	1960	SEP	23	2.4685	2	8	5	1939	1960	3.4	1970	13.8	14.7
1744	HARRIET		14.5	1960	SEP	23	2.2289	2	8	4	1949	1960	2.3	1969	13.3	11.8
1745	1941 SYL		12.8	1960	SEP	23	2.8450	2	8	5	1941	1960	-2.5	1960*	11.5	15.4
1746	BOOWER		10.9	1948	MAR	30	3.0731	2	8	4	1940	1963	3.2	1968	15.4	33.1
1747	1947 NH		14.5	1969	SEP	16	1.7091	2	8	4	1947	1968	-3.3	1969*	11.3	5.8
1748	MAUDERLI		11.7	1966	NOV	11	3.9191	2	8	3	1966	1969	2.7	1969*	13.8	29.2
1749	TELAMON		11.2	1949	OCT	11	5.2670	2	8	3	1941	1969	-1.5	1969*	10.5	32.3
1750	1950 NA1		14.7	1950	NOV	15	1.9265	2	8	3	1950	1969	2.0	1969*	17.5	11.7

NUMBER	NAME	NOTE	ABMAG	EPOCH		A	PLANETS		OPPOSITIONS		RESIDUAL	LAST	ERROR SEC	ERROR KM3
1751	1955 CC		13.5	1956 JAN	8	2.7899	2	8	3	1955 1969	-2.2	1969*	13.0	16.9
1752	1930 DK		14.6	1930 JAN	24	2.2383	2	9	4	1930 1967	7.5	1967	37.0	33.2
1753	1934 JM		12.2	1934 JUN	12	3.0156	2	9	4	1934 1967	-1.8	1967	17.9	26.1
1754	1935 FE		10.6	1934 JUN	12	3.0937	2	9	7	1935 1969	5.4	1969	25.0	56.3
1755	1936 VD		11.4	1936 AUG	20	3.0907	2	9	5	1936 1968	4.2	1968	23.4	35.5
1756	1937 YA		13.9	1961 OCT	28	2.5485	2	9	3	1937 1969	-3.4	1969*	11.7	13.1
1757	1939 FC		14.0	1968 MAY	24	2.3512	2	9	3	1939 1968	-7.6	1968*	17.0	16.6
1758	1942 DK		12.0	1968 MAY	24	3.0084	2	9	5	1942 1969	5.8	1969	13.2	19.3
1759	1942 RF		14.1	1943 MAR	17	2.6492	2	9	3	1942 1968	-4.3	1969*	22.5	26.9
1760	1950 GB		12.6	1968 MAY	24	3.1655	2	9	5	1935 1968	3.7	1968	9.8	15.3
1761	1952 FN		12.6	1951 DEC	20	3.1685	2	9	4	1950 1969	-3.2	1969	16.5	25.9
1762	1953 TZ		12.9	1954 FEB	27	2.8750	2	0	4	1947 1963	-2.5	1963	13.3	18.0
1763	1953 TN2		14.2	1954 FEB	27	2.1894	2	9	3	1953 1969	-4.0	1969*	19.6	16.9
1764	1953 VM1		12.5	1954 FEB	27	3.0973	2	9	10	1935 1969	-6.0	1969	17.0	25.0
1765	1957 XB		11.0	1957 JUN	11	3.1560	2	9	4	1945 1956	-4.6	1966	15.0	23.4
1766	1962 RF		13.5	1962 DEC	2	2.7491	2	0	3	1953 1969	-5.0	1969*	14.1	17.9
1767	1962 PJ		12.4	1962 DEC	2	3.0182	2	0	3	1941 1967	-2.7	1967*	10.0	14.6
1768	1965 SA		14.2	1966 MAR	16	2.4505	2	9	3	1965 1969	6.5	1969*	22.3	23.9
1769	1966 QP		14.0	1967 APR	20	2.1785	2	9	3	1937 1969	-4.6	1969*	12.3	10.5
1770	1967 JC		14.1	1968 MAY	24	2.4577	2	9	3	1943 1968	1.5	1968*	6.8	7.2
1771	1968 BD		11.2	1968 MAY	24	3.1334	2.	9	5	1938 1968	6.8	1968	14.8	22.9
1772	1968 CR		13.2	1968 MAY	24	2.5302	2	0	4	1940 1969	6.0	1969	13.9	15.4
1773	1968 HF		13.3	1968 MAY	24	2.4350	2	9	9	1941 1969	4.8	1969	12.0	12.5
1774	1968 UG1		13.5	1968 MAY	24	2.8777	2	9	3	1931 1968	2.2	1968*	7.4	10.1
1775	1969 JA		13.3	1968 MAY	24	2.6058	2	9	3	1952 1969	1.5	1969*	6.7	7.8
1776	1930 EB		11.8	1960 SEP	23	3.1019	2	9	5	1930 1963	-3.1	1963	11.4	17.4
1777	1905 RN		12.6	1960 SEP	23	2.6255	2	0	6	1905 1964	-6.4	1964	17.0	20.0
1778	1936 HK		12.6	1960 SEP	23	3.1360	2	9	4	1952 1960	-.7	1960	8.0	12.2
1779	1950 LZ		15.1	1960 SEP	23	2.1753	2	9	3	1950 1969	1.0	1969*	9.1	7.7

EXPLANATION OF HEADINGS IN ABOVE TABLE

NUMBER =PERMANENT NUMBER ASSIGNED TO THE MINOR PLANET.
NAME =PERMANENT NAME, IF ASSIGNED.
OTHERWISE THE TEMPORARY DESIGNATION.
NOTE = L DENOTES THE MINOR PLANET IS LOST.
E DENOTES NO PERTURBATIONS IN EPHEMERIS CALCULATIONS.
ABMAG =BRIGHTNESS OF THE MINOR PLANET AT ONE ASTRONOMICAL UNIT FROM SUN AND EARTH. IN ASTRONOMICAL MAGNITUDES.
EPOCH =YEAR, MONTH AND DAY OF THE EPOCH FOR THE ORBIT.
A =SEMI-MAJOR AXIS OF THE ORBIT IN ASTRONOMICAL UNITS.
PLANETS =NUMBERS OF INNERMOST AND OUTERMOST MAJOR PLANETS USED IN PERTURBATION CALCULATIONS OF THE ORBIT DETERMINATION.

1 MERCURY	4 MARS	7 URANUS
2 VENUS	5 JUPITER	8 NEPTUNE
3 EARTH	6 SATURN	9 PLUTO

OPPOSITIONS=THE NUMBER OF OPPOSITIONS, THE YEAR OF THE FIRST OPPOSITION AND THE YEAR OF THE LAST OPPOSITION USED IN THE ORBIT DETERMINATION.
RESIDUAL =MAXIMUM RESIDUAL IN SECONDS OF ARC IN RIGHT ASCENSION FROM THE ORBIT DETERMINATION AS REPORTED IN *EPHEMERIDES OF MINOR PLANETS*.
LAST =YEAR OF LAST KNOWN OBSERVATION.
AN ASTERISK INDICATES THE MINOR PLANET IS ON THE CRITICAL LIST OF THOSE NEEDING OBSERVATION.
ERROR SEC =ESTIMATED EPHEMERIS UNCERTAINTY IN SECONDS OF ARC AS SEEN FROM THE EARTH.
METHOD OF ESTIMATION IS OUTLINED BELOW.
ERROR KM3 =ESTIMATED EPHEMERIS UNCERTAINTY IN SPACE.
EXPRESSED IN THOUSANDS OF KILOMETERS.

A SHORT REMARK PERTAINING TO AN INDIVIDUAL MINOR PLANET MAY APPEAR TO THE RIGHT OF THE LAST HEADED COLUMN.

METHOD USED TO ESTIMATE THE EPHEMERIS UNCERTAINTY

THE PRINCIPAL PART OF THE EPHEMERIS UNCERTAINTY ARISES FROM THE UNCERTAINTY OF THE ORBIT DETERMINATION AS EVIDENCED BY THE MAXIMUM RESIDUAL IN RIGHT ASCENSION QUOTED IN *EPHEMERIDES OF MINOR PLANETS*. THE EFFECT OF THIS UNCERTAINTY BUILDS UP IN PROPORTION TO THE TIME AND INVERSELY AS THE TIME INTERVAL COVERED BY THE OBSERVATIONS ON WHICH THE ORBIT DETERMINATION WAS BASED. IT IS ASSUMED HERE THAT THE MAXIMUM RESIDUAL APPLIES TO THE LAST OPPOSITION AND THAT THE RESIDUAL AT THE FIRST OPPOSITION IS NEGLIGIBLE. LET

RESID DENOTE THE QUOTED MAXIMUM RESIDUAL.
INTVOP DENOTE THE INTERVAL BETWEEN THE FIRST AND LAST OPPOSITIONS USED IN THE ORBIT DETERMINATION.
INTVEP DENOTE THE INTERVAL BETWEEN THE EPOCH OF THE ORBIT ELEMENTS AND THE MEAN OF THE OPPOSITIONS USED.
INTVNW DENOTE THE INTERVAL BETWEEN THE EPOCH OF THE ORBIT ELEMENTS AND THE CURRENT YEAR.

THEN THE UNCERTAINTY IN SECONDS OF ARC DUE TO THIS CAUSE IS

= RESID + RESID*(INTVEP + INTVNW)/INTVOP.

A LESSER PART OF THE EPHEMERIS UNCERTAINTY ARISES FROM THE POSSIBLE ROUNDING ERRORS IN THE ORBITAL ELEMENTS GIVEN IN *EPHEMERIDES OF MINOR PLANETS*. THE MEAN ANOMALY (M) AT EPOCH HAS A POSSIBLE ROUNDING ERROR OF 1.8 SECONDS OF ARC AND THE EFFECT OF THE ROUNDING ERROR IN THE MEAN DAILY MOTION (MU) CAN REACH 0.1825 SECONDS OF ARC PER YEAR.

THE ESTIMATED EPHEMERIS UNCERTAINTY IN SECONDS OF ARC AS SEEN FROM THE EARTH AND LISTED UNDER THE COLUMN HEADING *ERROR SEC* IS THE SUM OF THE PRINCIPAL AND LESSER PARTS ABOVE.

Appendix B

OSCULATING ELEMENTS AT FUTURE DATES

Appendix B
OSCULATING ELEMENTS AT FUTURE DATES

Appendix B contains osculating elements for the first 50 minor planets at the initial standard date 1972 October 10 (244 1600.5) and at ten following 400-day dates through 1983 September 23 (244 5600.5). The elements osculating at 1972 October 10 are those that were obtained as described in par. 6.1, and do not contain the effects of perturbations from the individual published epochs of osculation to the standard date. Elements osculating at the other dates are accurately consistent with the elements osculating at the initial standard date 1972 October 10.

Page B-3 of this Appendix contains the names of the first 50 minor planets and some reference information.

SOURCE	shows that the elements were taken from the 1972 or 1973 volumes of Ephemerides of Minor Planets
REFERENCE	is to a more detailed publication, if any, of the orbital work
MAGABS	is the absolute brightness of the minor planet expressed in units of 0.1 astronomical magnitudes
QUAL	1 denotes the elements were obtained as stated above
IJDOSC	is the integral part of the Julian Date of osculation (here, the same as the initial standard date)
B	is the semi-minor axis of the orbit
IJDOO	is the integral part of the initial standard Julian Date

Page B-4 and succeeding pages of this Appendix contain the elements osculating at the dates stated in the page headings. These elements are:

ARGPER	Argument of perihelion in degrees Ecliptic and equinox of 1950.0
NODE	Longitude of ascending node in degrees Ecliptic and equinox of 1950.0

INCLINATION	Inclination in degrees Ecliptic and equinox of 1950.0
MEAN ANOMALY	in degrees at date of osculation
SEMI-MAJOR AXIS	in astronomical units at date of osculation
ECCENTRICITY	at date of osculation
MEAN MOTION	in seconds of arc per mean solar day at date of osculation

NUM	NAME	SOURCE		AUTHOR	REFERENCE	MAGABS	QUAL	EPOCH	M	EQUIN
1	CERES	EMP	1972	HERGET	ASP 16,3	41	1	2441600	2.75777354002807	2441600
2	PALLAS	EMP	1972	HERGET	ASP 16,3	52	1	2441600	2.69002987325280	2441600
3	JUNO	EMP	1972	HERGET	ASP 16,3	64	1	2441600	2.57838550016058	2441600
4	VESTA	EMP	1972	HERGET	ASP 16,3	43	1	2441600	2.35267393781440	2441600
5	ASTRAEA	EMP	1973	ITA		80	1	2441600	2.53244088189615	2441600
6	HEBE	EMP	1973	ITA		67	1	2441600	2.37545528855064	2441600
7	IRIS	EMP	1973	ITA		68	1	2441600	2.32198655345842	2441600
8	FLORA	EMP	1973	ITA		75	1	2441600	2.17479743797047	2441600
9	METIS	EMP	1973	ITA		73	1	2441600	2.36730310173369	2441600
10	HYGIEA	EMP	1972	ITA		66	1	2441600	2.13516019508158	2441600
11	PARTHENOPE	EMP	1972	ITA		78	1	2441600	2.43962533059167	2441600
12	VICTORIA	EMP	1973	ITA		88	1	2441600	2.27847998964013	2441600
13	EGERIA	EMP	1972	ITA		80	1	2441600	2.56693652739531	2441600
14	IRENE	EMP	1972	HERGET	MPC 2041	74	1	2441600	2.55257049286710	2441600
15	EUNOMIA	EMP	1972	ITA		63	1	2441600	2.59508879072925	2441600
16	PSYCHE	EMP	1972	SOCHILINA		69	1	2441600	2.89594559506521	2441600
17	THETIS	EMP	1972	ITA		87	1	2441600	2.44568248609573	2441600
18	MELPOMENE	EMP	1973	ITA		78	1	2441600	2.24072454691806	2441600
19	FORTUNA	EMP	1972	ITA		84	1	2441600	2.41131539770018	2441600
20	MASSALIA	EMP	1973	ITA		75	1	2441600	2.38286748557697	2441600
21	LUTETIA	EMP	1972	ITA		87	1	2441600	2.40268129708221	2441600
22	KALLIOPE	EMP	1972	ITA		75	1	2441600	2.89366789908145	2441600
23	THALIA	EMP	1972	HERGET	MPC 2081	83	1	2441600	2.55066260569133	2441600
24	THEMIS	EMP	1972	ITA		82	1	2441600	3.11501318477470	2441600
25	PHOCAEA	EMP	1972	HERGET	MPC 2082	91	1	2441600	2.32110374553504	2441600
26	PROSERPINA	EMP	1972	ORLOVSKAYA		86	1	2441600	2.64523683739209	2441600
27	EUTERPE	EMP	1972	HERGET	MPC 2082	86	1	2441600	2.31210868954633	2441600
28	BELLONA	EMP	1972	CINCINNATI	MPC 2427	82	1	2441600	2.74335928653456	2441600
29	AMPHITRITE	EMP	1972	MAKOVER		73	1	2441600	2.54746537586327	2441600
30	URANIA	EMP	1972	ITA		88	1	2441600	2.34596314196558	2441600
31	EUPHROSYNE	EMP	1972	ITA		78	1	2441600	3.07636091746421	2441600
32	POMONA	EMP	1972	ORLOVSKAYA		87	1	2441600	2.57892415575797	2441600
33	POLYHYMNIA	EMP	1972	HERGET	MPC 2082	98	1	2441600	2.69162341437261	2441600
34	CIRCE	EMP	1972	ORLOVSKAYA		96	1	2441600	2.67106254902779	2441600
35	LEUKOTHEA	EMP	1972	ITA		98	1	2441600	2.91583609794044	2441600
36	ATALANTE	EMP	1972	HERGET	MPC 2083	100	1	2441600	2.62168135817936	2441600
37	FIDES	EMP	1972	KHANINA		85	1	2441600	2.60183719926952	2441600
38	LEDA	EMP	1972	CINCINNATI	MPC 2428	97	1	2441600	2.70663824637055	2441600
39	LAETITIA	EMP	1972	ITA		74	1	2441600	2.75146511010045	2441600
40	HARMONIA	EMP	1972	ITA		84	1	2441600	2.26430307830856	2441600
41	DAPHNE	EMP	1972	IZVEKOV		83	1	2441600	2.65956619550621	2441600
42	ISIS	EMP	1973	ITA		88	1	2441600	2.37703358492392	2441600
43	ARIADNE	EMP	1972	HERGET	MPC 2083	92	1	2441600	2.17185674075536	2441600
44	NYSA	EMP	1972	DIRIKIS		80	1	2441600	2.39363734683127	2441600
45	EUGENIA	EMP	1972	HERGET	MPC 2084	85	1	2441600	2.71251195148999	2441600
46	HESTIA	EMP	1972	HERGET	MPC 2085	93	1	2441600	2.48762662914925	2441600
47	AGLAJA	EMP	1972	IZVEKOV		92	1	2441600	2.85098544171242	2441600
48	DORIS	EMP	1972	ZIELENBACH	AJ 74,4	81	1	2441600	3.10871612460124	2441600
49	PALES	EMP	1972	ITA		87	1	2441600	3.02010712414803	2441600
50	VIRGINIA	EMP	1972	HERGET	MPC 2085	104	1	2441600	2.53823044561685	2441600

NUM	ARGPER	NODE	INCLINATION	MEAN ANOMALY	SEMI-MAJOR AXIS	ECCENTRICITY	MEAN MOTION
1	69.762000000000	80.420000000000	10.604000000000	41.195388888888	2.76633916386105	.07963308943040	771.16700000000
2	310.109999999999	172.802000000000	34.848000000000	29.061555555554	2.76865174229971	.23661770246840	770.20100000000
3	247.085999999999	170.023000000000	13.033000000000	154.189333333332	2.66797353630162	.25696412479523	814.20600000000
4	149.932000000000	103.631000000000	7.137000000000	159.524777777777	2.36194427397865	.08951183900910	877.46700000000
5	356.151000000000	141.460000000000	5.338000000000	190.543999999998	2.57789190614648	.18695269309381	857.25400000000
6	239.114000000000	139.740000000000	14.770000000000	331.118999999999	2.42581805005707	.20270184127368	939.11600000000
7	144.013000000000	259.603999999999	5.502000000000	212.599399999995	2.38613887054499	.23032149102335	962.63800000000
8	284.492999999999	110.703000000000	5.887000000000	105.476999999999	2.20178496653779	.15508968724616	1086.03600000000
9	5.192000000000	68.764000000000	5.593000000000	53.708999999995	2.38552433547812	.12334168061387	963.01000000000
10	310.263999999999	285.374000000000	3.813000000000	15.159088888886	3.15093225385771	.09961498429844	634.40800000000
11	193.566000000000	125.208000000000	4.629000000000	238.323999999997	2.45244532280394	.10211544029619	923.86300000000
12	68.603000000000	235.414000000000	8.372000000000	115.483999999997	2.33504494520296	.21877341541424	994.40600000000
13	77.407000000000	43.500000000000	16.530000000000	98.341333333330	2.57632536907330	.08529513595985	858.03600000000
14	95.659000000000	86.561000000000	9.129000000000	101.207133333330	2.58779265581171	.16442787180234	852.33900000000
15	96.787000000000	293.335999999999	11.734000000000	347.353999999999	2.64237773927113	.18834129714867	826.06500000000
16	225.364000000000	150.424000000000	3.038000000000	177.578999999998	2.92282210775284	.13530055705518	710.07300000000
17	136.817999999999	125.196000000000	5.593000000000	305.330111111107	2.46923547211901	.13779029068464	914.45600000000
18	227.009000000000	150.281999999999	10.142000000000	130.776999999995	2.29582327001356	.21776850018893	1019.99700000000
19	180.764000000000	211.955000000000	1.555000000000	126.894333333330	2.44183346933613	.15760656671193	929.89200000000
20	255.915000000000	206.277000000000	.699000000000	316.180999999997	2.40820082045349	.14466706256711	949.44000000000
21	248.342000000000	80.704000000000	3.076000000000	258.292999999998	2.43487163235196	.16206884794311	933.88300000000
22	353.862999999999	66.507000000000	13.724000000000	63.879999999990	2.39914610218744	.10301822504950	715.08600000000
23	58.291000000000	67.285000000000	10.165000000000	6.605166666661	2.62466548292423	.23578669028676	834.44100000000
24	112.122000000000	36.259000000000	.769000000000	202.366222222219	3.13800462710465	.12082988487333	638.30200000000
25	89.497000000000	214.415000000000	21.571000000000	346.587244444439	2.40067510626764	.25532763626975	953.90800000000
26	193.012000000000	45.481000000000	3.562000000000	195.134555555553	2.65555726049658	.08807720983400	819.92300000000
27	355.165999999999	94.448000000000	1.587000000000	356.932599999986	2.34715912933017	.17216980276177	986.71800000000
28	340.755999999999	144.437000000000	9.407000000000	259.120722222222	2.77605274694041	.15302033186886	767.12300000000
29	62.680000000000	356.409000000000	6.085000000000	140.681777777776	2.55439399834728	.07360372704759	869.11000000000
30	85.863000000000	307.766000000000	2.099000000000	105.440999999999	2.36516031968374	.12715116723669	975.47400000000
31	64.250000000000	30.831000000000	26.291000000000	324.080999999998	3.15559922790246	.22268865686824	632.97100000000
32	335.576999999999	220.550000000000	5.449000000000	328.282111111097	2.58763276651037	.08197329778781	852.41800000000
33	335.750000000000	8.667000000000	1.904000000000	134.614999999998	2.86217218506873	.34003483375969	732.76200000000
34	328.279999999999	184.146000000000	5.511000000000	285.029222222220	2.68681838864504	.10913816431348	805.65500000000
35	210.969999999999	354.359999999999	8.044000000000	224.315999999999	2.99252250732400	.22493404834384	685.41000000000
36	45.481000000000	358.798999999999	18.543000000000	222.026383888888	2.74877315626456	.30055598628679	778.57100000000
37	61.430000000000	7.534000000000	3.073000000000	41.077555555552	2.64275099299375	.17528081131441	825.89000000000
38	167.578000000000	296.057999999999	6.968000000000	274.284833333331	2.73981865940576	.15515869232091	782.39100000000
39	208.357000000000	157.134000000000	10.366000000000	265.143999999997	2.76899209411305	.11233611576153	770.05900000000
40	269.347000000000	93.988000000000	4.259000000000	240.353999999999	2.26679719217692	.04689724267182	1039.65100000000
41	43.915000000000	178.558000000000	15.873000000000	93.302333333333	2.76240501940586	.27031479767781	772.81500000000
42	235.916000000000	84.415000000000	8.532000000000	130.721999999994	2.44040775401956	.22641331344861	930.70700000000
43	15.179000000000	264.806999999999	3.467000000000	55.677777777775	2.20323233776013	.16816243865817	1084.96600000000
44	342.154999999999	131.275000000000	3.711000000000	321.932499999999	2.42166131348976	.15169211765858	941.53500000000
45	86.248000000000	147.853999999999	6.602000000000	266.349222222219	2.72136179064043	.08058165402095	790.36400000000
46	174.703000000000	181.016000000000	2.315000000000	217.612777777773	2.52454000803696	.17038148269576	884.57200000000
47	312.215999999999	3.551000000000	4.994000000000	228.941555555553	2.87732823678139	.13500657346062	726.98000000000
48	255.501999999999	183.786999999999	6.548000000000	253.728999999999	3.11432104634686	.05996841820938	645.59700000000
49	106.616000000000	288.079000000000	3.155000000000	33.009333333328	3.09891274892028	.22408366108899	650.41800000000
50	199.777999999999	173.650000000000	2.824000000000	236.961833333327	2.64951579298670	.28677536580444	822.72900000000

NUM	ARGPER	NODE	INCLINATION	MEAN ANOMALY	SEMI-MAJOR AXIS	ECCENTRICITY	MEAN MOTION
1	70.190021817526	80.418331672823	10.603752416025	126.453063416526	2.767948524137 30	.078293838258 28	770.49453168584
2	310.075194988299	172.802280039139	34.847415670039	114.711013332888	2.768097171445 45	.236413685597 49	770.43246897992
3	247.007962463152	169.995335832838	12.993428538579	244.761277137747	2.669595[illegible]114864	.255366911227589	813.46309575840
4	150.038994524572	103.629676929544	7.135729818851	267.990362271401	2.362095023325 39	.093309137329 60	977.37963183920
5	356.143581086515	141.462196872938	5.338820999844	285.859427695744	2.577299088911 77	.187426519310 58	857.54979036237
6	238.176948840695	138.737712667357	14.771514095068	75.400476244433	2.426271035398 34	.202832575831 92	938.85301253297
7	143.985400322836	259.569503771172	5.496522460401	319.493052015345	2.386918685334 03	.229309110389 97	962.22797023224
8	284.421746580269	110.702902820388	5.887025554721	226.254419815658	2.201431568759 08	.156245236932 67	1086.29751004793
9	5.058649493453	69.761398092095	5.583277459494	160.881676760297	2.396544020050 74	.123390369595 50	963.42210252423
10	309.826901632939	285.333527241521	3.807149744581	85.890664403926	3.152241690329 79	.101511428551 73	633.98256095589
11	193.379937585653	125.207099906345	4.627070721810	341.1[illegible]	2.453515229715 15	.102465132903 74	923.25876102838
12	68.675547284512	235.397492053710	8.371009049528	225.[illegible]	2.334995356317 67	.218445307630 31	994.46431311608
13	78.010725867056	43.424351090731	16.519255240967	193.042794157163	2.578727830307 66	.186452922348 84	856.83720072837
14	95.474094214466	86.537279193139	9.127750440108	196.195312471[illegible]	2.585391332553 30	.166373F2059520	853.53172711403
15	96.810018919784	293.334893231302	11.733712753759	79.073407584563	2.643211067270 87	.189630236298 83	825.67437918865
16	225.259715217478	150.424387620067	3.084055330554	256.614758366822	2.922920969627 57	.125456441670 51	710.03333134598
17	136.775475751518	125.183850439039	5.593179227329	46.329081052493	2.470598287234 76	.138383195492 61	913.70912597063
18	226.978582829553	150.285363744379	10.142681160025	244.172679391065	2.295363236127 70	.214030561321 68	1020.30365518504
19	180.692200724635	211.953908160403	1.555175496321	230.325211168854	2.441504391414 78	.157769363288 77	930.08000943296
20	255.734299462269	206.262406123000	.699906583882[illegible]	61.743981813511	2.408190176422 58	.144721854324 81	949.44629469381
21	248.127240826055	80.695077466454	3.075111139486	2.216896269309	2.436009747332 22	.162165709485 20	933.23377662351
22	353.665026465644	66.496597291296	13.725021173489	143.560633791717	2.[illegible]2622525882	.103220534920 14	715.53601574513
23	58.257545209781	67.282134329438	10.165242777475	99.393220729685	2.623945024157 05	.235556977675 92	834.78469332818
24	111.958409504173	36.259591245621	.747961507472	273.478399721347	3.138650774665 78	.120961702063 13	638.10490127070
25	89.511526635622	214.404497717502	21.573094403419	92.602546196414	2.400325340331 53	.255078636301 33	954.11650715922
26	193.123738929262	45.446221911097	3.561569652544	286.108774343598	2.655479651352 64	.087852400906 89	819.95894491132
27	355.073135179855	94.446899875046	1.595972336614	106.669364725584	2.346547332479 76	.172169798120 76	997.10328317052
28	340.627075311613	144.430698383948	9.409996049969	344.466805710970	2.777193693548 69	.153180954[illegible]506	766.65445690769
29	67.410995961624	356.397515421204	6.034883661815	237.521965464814	2.556043425591 14	.072972214262 40	868.26887437233
30	85.779329944712	307.765015249968	2.093050310139	213.946556530892	2.364566563046 40	.127334427662 59	975.84200732035
31	64.207827800168	30.819195916391	26.283819543275	34.433029427379	3.156235380452 91	.222852859420 69	632.77964268169
32	335.748302867722	220.545595480818	5.449916564695	62.958256090189	2.587561985617 26	.081849866324 09	852.45297615918
33	335.778769085726	8.657857158021	1.904523791075	216.011288030963	2.861245205850 03	.340452064530 24	733.11812649542
34	328.184982682944	184.133023514233	5.511493936719	14.629334661691	2.686647359069 08	.107966232364 63	805.73193214300
35	210.948225392051	354.338255484528	8.043850037667	300.472072261429	2.993132032243 96	.224591283486 29	685.20064411401
36	45.421144026064	358.605645358133	18.543341582273	308.564819487332	2.750984403149 85	.299543269983 15	777.64094352592
37	61.315962815596	7.530828039566	3.078512[illegible]0842	132.979507765224	2.641768022348 07	.175399672349 79	826.35099873230
38	167.498674785600	296.057325920432	6.967874058355	1.287145204554	2.740861845992 35	.155425458089 63	781.94436881666
39	208.185016174791	157.080246187447	10.376231817539	350.821535977938	2.768241436146 97	.111214804788 17	770.37224405121
40	268.894544713360	93.979020305702	4.257784670959	356.247495938116	2.266856696584 28	.046217420804 21	1039.61006441015
41	43.975656120586	178.554892441254	15.872119440302	179.251921929053	2.762491679736 19	.270070445923 70	772.77863506987
42	235.975695649868	84.406197733236	8.531365211028	234.072449956472	2.439863397592 92	.226655255370 59	931.01846157472
43	15.249040186693	264.807813601174	3.466575578564	176.143834164150	2.203768312885 95	.167925054555 40	1084.57021468113
44	342.060430314177	131.274201752477	3.711238634787	66.630721543841	2.421306196623 25	.151641445505 43	941.74214060357
45	86.456428139433	147.856128735361	6.602699895000	353.982074452721	2.720287940505 13	.080359388341 32	790.83204764530
46	174.523240899738	180.990658402453	2.314929830314	316.083615244528	2.526000879973 75	.170449437968 34	883.80474399924
47	312.279823792389	3.551538080699	4.994437979688	309.687326773139	2.876913245249 24	.135255418301 72	727.13730475566
48	255.851190052671	193.781069928959	6.549186130844	325.176623427344	3.113538989387 75	.060293853772 85	645.84025630661
49	106.582672321991	288.074848800970	3.154831443857	105.287202572354	3.098712468108 36	.224341671692 54	650.48105926316
50	198.647155694978	173.597734430909	2.824414965854	328.477925513427	2.651577090312 57	.286443026484 43	821.76982020023

NUM	ARGPER	NODE	INCLINATION	MEAN ANOMALY	SEMI-MAJOR AXIS	ECCENTRICITY	MEAN MOTION
1	71.572999074920	80.233297769380	10.587514579935	210.618190537669	2.77098774727591	.07725704363678	769.22726015197
2	310.049750424145	172.791891512534	34.852374487717	200.357442370711	2.76989627244227	.23554949505886	769.68197477912
3	246.845494700496	169.970063084911	13.005982296258	335.194155219160	2.67078309322251	.25543559542200	812.92156975317
4	150.162159373020	103.624353813608	7.136833985884	16.492591568964	2.36144458975343	.08809998196243	977.77726602097
5	356.078666588613	141.461109872977	5.338808180247	21.180536984616	2.57808530389842	.18763572081996	857.15754010771
6	238.215889086340	138.735306820231	14.769883818283	179.652196697306	2.42621799325575	.20302858126487	938.88380059797
7	144.065793361478	259.558774499244	5.496172381778	66.368891433361	2.38663772846327	.22923083753268	962.33619813736
8	284.226402335817	110.690423471647	5.885249847715	347.088274272206	2.20216703360022	.15593584356229	1085.75337798734
9	4.826924562234	68.741866267820	5.581840347805	268.156507017811	2.38628583558854	.12295638862749	962.54907188253
10	308.968160072782	285.205641620123	3.804814003175	157.406470991878	3.14565722396232	.10294130087496	635.97417363530
11	192.938845431888	125.198533636995	4.628567620240	84.167148451062	2.45236087968975	.10226448472607	923.91071802205
12	68.762443826786	235.389019884796	8.372326051292	336.322228498158	2.33430409112373	.21882551616676	994.87937581583
13	78.900781891254	43.334906115851	16.531893510853	287.438120695537	2.57633046116277	.08465841207485	858.03345615286
14	95.390285708152	86.535670016900	9.126888586754	291.145876914212	2.58564251009494	.16555767773456	853.40239177911
15	96.845334473278	293.322616088670	11.732404895674	170.779091438785	2.64291567630400	.18889849714711	825.81280787755
16	224.719676497789	150.416183873948	3.088746691720	335.961481494847	2.92666956577945	.13574365540149	708.67324615304
17	136.425511444404	125.174743827939	5.592765618407	148.863222761152	2.46867202945982	.13864879150320	914.76908710462
18	226.838250963116	150.282917444714	10.142366973588	357.628524872638	2.29620001470117	.21800467118571	1019.74597917049
19	180.465048437081	211.883619315825	1.556639079479	333.886981896492	2.44311488385540	.15759518356462	929.16050297213
20	255.614666710258	206.268087584160	.699297202327	167.383309019164	2.40753357315657	.14482129971506	949.83473291649
21	248.087516205977	80.686229938683	3.075051190453	106.013115756292	2.43514292665526	.16176643170006	933.72694134830
22	353.582405641042	66.495421925219	13.727036546676	223.185376148565	2.90716712275783	.13352637284212	715.81628891742
23	58.282334343176	67.258774233263	10.161146020779	192.148188134716	2.62545369559474	.23480364971976	834.06525488435
24	111.764296823471	36.259072455480	.767935581271	344.545990567569	3.14021019160249	.12119769166198	637.62963943362
25	89.574028203479	214.386979976282	21.567716794926	198.537957207853	2.40100301690033	.25479891074628	953.71259048143
26	193.207913078943	45.462761997822	3.561966814291	17.152549076925	2.65453683736230	.08753791922652	820.39582191714
27	354.991614541890	94.446535401763	1.586970995450	216.461269719519	2.34655561722498	.17212090808486	987.09805557740
28	340.535820708359	144.429132252410	9.406991182292	69.721897372008	2.77698801502528	.15325042421860	766.73549099244
29	62.381497255884	356.367017051272	6.087301707933	333.921847513824	2.55552503597248	.07170687141040	868.53308097728
30	85.466085135904	307.758660815653	2.097627152920	322.642599651568	2.36605454045626	.12731423523202	974.92104992463
31	64.139492481857	30.814292155784	26.294223756187	104.805575331328	3.15547702091915	.22302035090951	633.00753068243
32	336.903712862135	220.402358353732	5.453078773557	156.382399529654	2.59026831662054	.08210836077804	851.11735165996
33	335.844064946377	8.657015180111	1.904525899131	297.421891234897	2.86011497404317	.34065121774979	733.55272892909
34	328.022691603435	184.135960233439	5.512025510536	104.341704947507	2.68570748640848	.10780378053330	806.15492217549
35	210.925225153265	354.336417128299	8.044305263244	16.624186518510	2.99229343605172	.22431469937071	685.48870756106
36	45.484904128322	358.689002786936	18.554231047424	34.960596266309	2.74945692635715	.29913046561598	778.28058057596
37	61.249795748305	7.531358117990	3.078545442968	224.899883120495	2.64133482736013	.17560457206283	826.55429695723
38	167.420779652834	296.048800576318	6.967174558039	88.223709655758	2.74070118158497	.15557267831825	782.01312854825
39	208.290860396965	157.080870597338	10.376813614838	76.362722003105	2.76765432133885	.11087784299774	770.61739078151
40	269.161551090621	93.976416836621	4.257543190134	111.522440184505	2.26688398530781	.04603250244115	1039.59129224552
41	43.813949168250	178.545021202813	15.871191583934	265.181662005192	2.76351298103005	.25977393426645	772.35028522946
42	236.049843365432	84.399946703460	8.531956214740	337.478103045742	2.43931830378115	.22674219108967	931.33057923942
43	15.304088805259	264.792340999360	3.466053608479	296.584233687609	2.20376654445981	.16773910861014	1084.57152016154
44	341.966951623979	131.273576840901	3.711252582654	171.398455236548	2.42092611855557	.15159777859779	941.96392530323
45	86.935151637112	147.855908345250	6.602383707890	81.361488281770	2.72213093883073	.08060573249051	790.02904324535
46	174.398212723867	180.972006983614	2.316419969568	54.420383998282	2.52488221761112	.16993614771353	884.39217057181
47	312.039875320543	3.540271158496	4.994883242743	30.621189209950	2.88000009499883	.13625258119691	725.96857455671
48	255.921346955683	183.770773600528	6.549012840742	36.857120423182	3.11500891759334	.06075099438897	645.38316605558
49	106.608441161459	288.050249295971	3.154679902548	177.548413990948	3.09786566780546	.22474104289478	650.74779058280
50	198.673860776969	173.592418712201	2.825155859213	59.806300584896	2.65059739074930	.28607497183660	822.22546951455

GROUP OF MINOR PLANETS OSCULATION IS JULIAN DATE 2442800.5

NUM	ARGPER	NODE	INCLINATION	MEAN ANOMALY	SEMI-MAJOR AXIS	ECCENTRICITY	MEAN MOTION
1	72.906809833869	80.137235738551	10.598430985410	294.899929383964	2.766718995974808	.07759082796682	771.00821480e68
2	309.822673759234	172.78E188467081	34.822589331405	285.929574744852	2.773761741454246	.2338482161595B	768.07361109173
3	246.904474929481	169.969970702850	13.005682690221	65.502281430609	2.670307335213329	.25520881723655	813.13883192108
4	150.741945350248	103.576796507007	7.135360104987	124.522463216876	2.363221226276641	.0383838718821S	976.67485445888
5	355.999409305063	141.453199559884	5.338887019034	116.502481143508	2.577473149030863	.18778563717569	857.46292311445
6	238.315393421569	138.723346391166	14.770266732467	283.893867128167	2.425435390712B1	.2032019539437B	939.33825433491
7	144.142524502648	259.537922709827	5.496606501680	173.197567058383	2.386956822040B9	.22932823246022	962.14323379382
8	284.295855868761	110.683428074026	5.885007256377	107.698402381068	2.202030056639B3	.15570413542891	1085.85468825900
9	4.779256782026	66.702634973756	5.583678410680	15.146863767670	2.385468328583A4	.12216135709236	963.04391989312
10	308.799740390547	285.180466638132	3.806208405957	228.347645240541	3.144043553982B1	.10356994235456	636.46385392262
11	192.936333519132	125.197971621992	4.628213694370	186.836894132230	2.452816101112S9	.10195402685935	923.65352521621
12	68.738659595066	235.365787445745	8.376334907202	46.841275453079	2.334816746455IO	.21937841774108	994.55172555011
13	79.058636235115	43.332726365227	16.532458276512	22.646419176753	2.576485549895G9	.08486403311453	857.95598473895
14	95.310385864944	86.527229283486	9.126319646516	26.019673455089	2.586365270596I6	.16571598932738	853.04469146451
15	96.951803527260	293.305165544152	11.734646518582	262.454212323646	2.641979990599G1	.18916714749167	826.25155248538
16	224.321655267854	150.404043778629	3.088492494758	55.106347180091	2.923535267007O7	.13484914131820	709.81319592644
17	136.314902575036	125.174783878176	5.592357195096	250.625104939042	2.469188698422B7	.1384792878245B	914.43198385229
18	226.865823852476	150.281247376836	10.141739865752	110.944400464331	2.295973514609I4	.21773394066478	1019.89688133838
19	180.458424164058	211.877054879890	1.557460910479	77.191929278054	2.442029519585I3	.15710431165276	929.73059398258
20	255.441719144426	206.233378088372	.699660473812	273.124870481355	2.406659298529B7	.1445891085268S	949.16893008766
21	248.155404082741	80.678473222722	3.074738680149	209.666605352176	2.435982570560741	.16141922286454	933.24422196253
22	353.303835324097	66.482984618064	13.726721701843	303.021737141264	2.909624508319A3	.10377027414998	715.27833080839
23	58.171734519142	67.157269876740	10.164619906964	284.867555054824	2.628796567736B7	.23323177503614	832.47481975933
24	111.674248721601	36.271668902026	.767736443930	55.430942077828	3.140917987297O9	.12146787655012	637.41411991559
25	89.581606780003	214.379115597093	21.569772452465	304.471541513352	2.401170257707Z9	.25454722932665	953.61295351145
26	193.571979432798	45.460668171672	3.561963472359	107.952015813332	2.655746923973I7	.08735905594109	819.83516783376
27	354.765584462617	94.436647212491	1.586881185639	326.276085417181	2.347836521447I4	.17154636296882	986.29037225565
28	340.419120912984	144.419659063050	9.407640775956	155.059480814879	2.775858171489A6	.15352885104407	767.20365933673
29	62.609979794537	356.365519153094	6.087068261191	70.245165459975	2.555151289215J5	.07147496214367	868.72365088244
30	85.432302442733	307.715382962508	2.097101070863	71.078259560530	2.364943730970K5	.12678161837561	975.60800836539
31	64.095407026514	30.816356828817	26.296234866747	175.188471524675	3.154126914282G7	.22351465598916	633.41424812941
32	337.575287835987	220.367514194686	5.462423312974	250.353610716390	2.586814063176L2	.08343823770980	852.82270593727
33	335.854356755344	8.656435906038	1.904066768835	18.915034283565	2.861169526136M2	.34099964901113	733.14721383716
34	327.920049550074	184.135304105898	5.512068645250	194.043279814761	2.686366079783N0	.10740874227708	805.85848319470
35	210.886530112384	354.333662949473	8.044366806505	92.871268820585	2.991344389192O1	.22404070868379	685.81495510276
36	45.551461053070	358.688750194642	18.552768467649	121.325711969176	2.750523186112P2	.29922089988910	777.82806548558
37	60.984783977518	7.537895964271	3.077548797580	316.966052446754	2.643331128727Q4	.17566263753824	825.61812599625
38	167.359740629526	296.033428588307	6.968776833604	175.203463427682	2.739653595840R7	.15595168998308	782.46170941020
39	208.490490897220	157.081014231186	10.375870723259	161.751040603773	2.768809736734S1	.11069087981499	770.13507687035
40	269.463920964841	93.966755336326	4.257427582513	226.702089143889	2.267172319561T3	.04594031124109	1039.39297896820
41	43.742115065314	178.542768274987	15.870983908354	351.036186044124	2.764405167301U6	.26975298970295	771.97641200268
42	235.958130461352	84.367362381920	8.534058381477	81.015022144167	2.439451341299W7	.22718867357540	931.25439394037
43	15.398255164017	264.780952137660	3.466252533234	57.031851715719	2.203753920298X0	.16769486927574	1084.58083959528
44	341.729933285185	131.257840149447	3.709753793334	276.260085738695	2.422869266151Y1	.15093093736995	940.83096617779
45	88.074041193337	147.765050876800	6.593078619698	167.843103630646	2.723126459001Z6	.08189187751794	789.59585479032
46	174.499788906785	180.965925262071	2.316509645512	152.578479534753	2.525662698012a2	.16970778901389	883.98225988038
47	311.427006371114	3.523698912319	4.993084016719	111.954704665183	2.876195152236b2	.13630713761443	727.40963579382
48	256.173464564870	183.767652011533	6.549220440665	108.273192754208	3.116106899533c5	.06103148426467	645.04208823400
49	106.723407432864	288.023652906884	3.155836077737	249.766466076841	3.096550381840d0	.22509067627776	651.16245054959
50	198.753815176320	173.588427968133	2.825329029830	151.047169430301	2.651612435974e6	.28595700531429	821.75338912163

NUM	ARGPER	NODE	INCLINATION	MEAN ANOMALY	SEMI-MAJOR AXIS	ECCENTRICITY	MEAN MOTION
1	73.083015339759	80.135013932030	10.599666685724	20.420122093370	2.76685146830293	.07776197433776	770.95282840687
2	309.930017801020	172.758014950043	34.811193821952	11.214896450728	2.77224120538153	.23341899956843	768.70561444611
3	246.987715582926	169.963086942034	13.002875915637	155.733153179192	2.67116693011030	.25513064666014	812.74635527732
4	151.054754159447	103.526583569010	7.141099392294	232.783980358752	2.36132913582345	.08945528402208	977.84807750297
5	355.951153297063	141.450460736377	5.339856446028	211.863456385016	2.57659083401775	.18914807419619	857.90339884599
6	238.350534567892	138.709664286672	14.769701734262	28.240754947734	2.42614100728034	.20353608966365	938.92848975146
7	144.221726531534	259.535269675996	5.497847088467	280.020690194153	2.38632074574944	.22941997210979	962.52794985599
8	284.385232416609	110.672438691438	5.885137698671	228.233016567817	2.20232409779541	.15557728209425	1085.63723027312
9	4.912962842851	68.700466032723	5.583646249341	122.913204849427	2.38601621777943	.12211130748009	962.71222733465
10	308.660384001516	285.175677291889	3.805756919723	299.225361340887	3.14477296880628	.10375126150549	636.24242971176
11	192.868975679168	125.189054123178	4.627860737602	289.505988721051	2.45341251932740	.10167581358869	923.31673956926
12	68.599060023414	235.367499115132	8.377871756609	197.557483966973	2.33355965440346	.21979019519296	995.35548350972
13	79.168710570063	43.331423932124	16.531868130042	117.827366768052	2.57706390901976	.08509978903312	857.66718000927
14	95.192520221777	86.527219108830	9.127351374119	120.929583695539	2.58551445790079	.16582613729043	852.46579196713
15	97.016083003097	293.202375367575	11.735650104768	354.227451407436	2.64190817345900	.18935444942918	826.28524371722
16	224.320721684655	150.401326834944	3.083496522538	134.010117214983	2.92354372076791	.13456130567981	709.91011716968
17	136.207933194851	125.166045479791	5.592024115035	352.316168310252	2.46972934802423	.13843772390467	914.18171577152
18	226.920791796362	150.270896138841	10.139879303256	224.183045501810	2.29650530506136	.21748212219169	1019.54264308200
19	180.563052866807	211.869934131701	1.557605333771	180.372558188772	2.44280038885207	.15687983028624	929.33994399871
20	255.263981726964	206.244263259496	.700604061230	18.689690672620	2.40827374602610	.14392356918768	949.39687496181
21	248.157115146411	80.675303663842	3.074837739184	313.331097763919	2.43604372166288	.16117529689263	933.20908191893
22	352.516630238473	66.463401670128	13.732453704854	23.134204499057	2.91002212398119	.10386341495126	714.76312422099
23	58.259471587039	67.146299840105	10.168488761436	17.310634143304	2.62685116758718	.23251082513076	833.39976544984
24	111.595768410425	36.253312221186	.767401317273	126.332294331917	3.14020353398335	.12176845885948	637.63166721501
25	80.622660438527	214.378943403621	21.569446397738	50.412388320699	2.40089092603623	.25441242352897	953.77938051026
26	194.831731366284	45.454049086915	3.557020530280	197.534194632703	2.65821210083719	.08702880083521	818.69498226704
27	354.823866040733	94.435215991451	1.586922723341	75.851495246342	2.34726413237665	.17123771409209	986.65116010007
28	340.382790596559	144.418226939720	9.409066661344	240.383619902016	2.77513511009919	.15387492776926	767.50352121103
29	62.874988291803	356.361570220923	6.085720261931	166.472486399416	2.55593949641907	.07139556809625	868.32183301005
30	85.558709409421	307.701168102454	2.096606731868	179.340832977397	2.36564598507864	.12656690681629	975.17361926747
31	64.156221430500	30.808485608405	26.294318548335	245.540792020045	3.15265022971036	.22402046944005	633.85933202707
32	337.615669673603	220.366029758084	5.462446159960	345.098619676583	2.58694887771490	.08371450252833	852.75604165044
33	335.747882200867	8.599374762818	1.903156956980	100.558103242286	2.85888576601965	.34112995807481	734.02587785296
34	327.481663957644	184.098227526770	5.506422670812	283.896875109684	2.68979742900400	.10600342912066	804.31693598633
35	210.886945208084	354.331412932253	8.041166223796	169.106426302834	2.99249840911838	.22341102150681	685.42171499158
36	45.612471071481	358.675386237707	18.547754602953	207.659844653886	2.75080139018712	.29915394900297	777.71006925377
37	60.846890952199	7.505067923369	3.075718110458	48.852207904590	2.64210656274435	.17510881391405	826.19217987336
38	167.379849166608	296.035630572447	6.970234628308	262.160346926757	2.73884614536679	.15632556732398	782.80775603406
39	208.572927260377	157.068394513816	10.374154402697	247.211889721301	2.76926303046993	.11042478133634	769.94599238322
40	269.829098219845	93.966387950780	4.257780926717	341.848444981319	2.26649270280278	.04585643673598	1039.86051312598
41	43.685417561843	178.535902119842	15.871607633016	76.889162578232	2.76337901203627	.26961323731570	772.40645138193
42	235.849998412292	84.365909624323	8.535121876643	184.659555695840	2.43865313731283	.22726175368106	931.71164949322
43	15.588518140769	264.728935535781	3.470636103461	177.286749096937	2.20365917994643	.16863268729719	1084.65078326597
44	341.760007408591	131.216898087232	3.709967433998	20.788280395864	2.42181135151576	.15019625648481	941.44750524237
45	88.553444258812	147.696515809674	6.594760695016	255.252301469549	2.71962651430682	.08319326957604	791.12056640024
46	174.524104622861	180.963144819610	2.316396446279	250.737550389432	2.52625642078094	.16938697083564	883.67064688362
47	311.291328337342	3.515203670927	4.993097433330	192.970391894996	2.87581091771995	.13627755536123	727.55542348630
48	256.409815721745	183.758758043682	6.548442122014	179.681128806236	3.11611483684418	.06119066162246	645.03962367645
49	106.841314273106	288.024022352267	3.156809389992	322.030111316288	3.09509482611894	.22513543037195	651.62184583853
50	198.790780227646	173.582487342824	2.824965716254	242.278721214752	2.65204596787645	.28568837369918	821.55189841173

GROUP OF MINOR PLANETS OSCULATION IS JULIAN DATE 2443600.5

NUM	ARGPER	NODE	INCLINATION	MEAN ANOMALY	SEMI-MAJOR AXIS	ECCENTRICITY	MEAN MOTION
1	73.261270494812	80.134691373477	10.599394798934	105.868238205543	2.76773486221919	.07799585593883	770.58375366239
2	309.997689997592	172.751538784711	34.807205554803	96.556618047843	2.77289474560786	.23344111787120	768.43386750754
3	247.050152049698	169.942063234407	13.002095767724	245.958209166185	2.67137313113551	.25494865738276	812.65225429130
4	151.020575915706	103.525499079811	7.141222907201	341.485794182790	2.36152481103765	.08968861817947	977.72744362564
5	355.942052817736	141.442020163956	5.339803648965	307.312350260641	2.57749686047944	.18931289380057	857.45109090199
6	238.191409106988	139.689128791946	14.776312054109	132.764761754490	2.42491488851729	.20373050538289	939.64071063670
7	144.261346561940	259.535535877085	5.497635986529	26.937232269929	2.38674690005845	.22965306655787	962.27017192206
8	284.471193132125	110.672309435620	5.885563158806	348.787421055937	2.20180429262957	.15547819089609	1086.02170119144
9	5.019905004558	68.699300522983	5.583154169065	228.839920217620	2.38623813460116	.12201720181478	962.57793411337
10	308.553215417645	285.168593534912	3.805774366699	10.008345545867	3.14611700670176	.10409052526605	835.83476404080
11	192.830690080527	125.186028110261	4.628341653452	32.138267983450	2.45281246033989	.10141005603533	923.65558172104
12	68.536446774173	235.366828066536	8.377649854215	308.218572953325	2.33400013395688	.21981958807178	995.07372706537
13	79.272339104240	43.321065688031	16.530832856076	213.021294289904	2.57650115382178	.08537301890055	857.94319076136
14	95.117832235004	86.527128863730	9.127385450209	215.871538153526	2.58496068756109	.16605043597530	853.74006075303
15	96.838817022323	293.283812461521	11.741417340139	86.143554002570	2.64193850372537	.18993985110252	826.27101474506
16	224.316890205416	150.394017590972	3.088080239974	212.876305647173	2.92456182804570	.13416100620178	709.43949757378
17	136.096837514325	125.166183650945	5.592566122208	94.018750044340	2.46899572952255	.13830483420780	914.58919547835
18	226.961890275966	150.261092071185	10.140838914988	337.423640206605	2.29613875155678	.21728888587073	1019.78679111739
19	180.609210726397	211.863310853158	1.557452071747	283.560975579016	2.44208468857908	.15666218911010	929.29183954219
20	255.360380249938	206.242593515935	.700594310039	124.085496453508	2.40867246136227	.14381555804060	949.16114979586
21	248.193665594417	80.674763437887	3.074806332665	57.012127358719	2.43558629194210	.16095920062072	933.47199455744
22	352.168485716717	66.456027181445	13.731541570730	102.980813872794	2.90761325311040	.10335297804368	715.65154806533
23	58.333109269018	67.146831459057	10.167800490061	109.910779747109	2.62767987909722	.23259332408203	833.00554304455
24	111.621402866897	36.229807122808	.767437971599	197.183367292599	3.13888535839389	.12225214956391	638.03336971755
25	89.868736033202	214.304926927999	21.545836834920	156.068104412952	2.40226319385035	.25485263512781	952.96224243659
26	195.674833106094	45.402492137713	3.554809506701	287.769829755029	2.65493744041548	.08767960429033	820.21014484535
27	354.914394458440	94.435322316062	1.586898287956	185.351230715868	2.34778644334808	.17115033639814	986.32192866732
28	340.159156877975	144.396336320997	9.408784603305	325.885569351142	2.77710886768368	.15414379855111	766.68544199256
29	63.083607875801	356.344824383461	6.085834445060	262.736711042375	2.55574045526481	.07131892682019	868.42327238619
30	85.626204918857	307.690169252030	2.096878517648	287.607881942733	2.36565813744399	.12636940039698	975.16610508948
31	64.220171310868	30.803103781182	26.298421081055	315.945422831230	3.15208025913513	.22425582991446	634.03126491104
32	337.609355957295	220.362370619106	5.461828157504	79.824477981735	2.58751632751542	.08398871747857	852.47553923797
33	335.696300952328	8.586987782439	1.903428108767	182.239864238097	2.85807503603473	.34125204624791	734.33822391514
34	327.732340689801	184.036166569717	5.506295041077	13.100879333032	2.68731018776032	.10504194136879	805.43384821989
35	210.757478053287	354.259727969905	8.033646010705	245.424680690489	2.99629016198502	.22213737738459	684.11761371297
36	45.670290756800	358.654302560297	18.547630756385	294.012283223718	2.75041147713108	.29902093026227	777.87545362950
37	60.910656158578	7.502972709565	3.075221546392	140.594948143789	2.64260119888840	.17488666498416	825.96022353970
38	167.185983663979	296.022467721672	6.970936746596	349.310338933105	2.74086372664992	.15677286256446	781.94356444208
39	208.658194363085	157.057115340742	10.375581052506	332.677039035712	2.76860888916879	.11016591748571	770.21888207724
40	270.221592595004	93.964284517118	4.257780009276	96.929618483615	2.26768871536396	.04643863605507	1039.03796488903
41	43.625397544939	178.535693846385	15.872965760371	162.816173920266	2.76284203175440	.26957623000336	772.63164731163
42	235.784794345291	84.364302188664	8.535031815295	288.248080208503	2.43921469061088	.22717239749603	931.38992157961
43	15.608236620608	264.729745579911	3.470982856503	297.941820574640	2.20300382554166	.16908213799286	1085.13481569645
44	341.874205576421	131.210891104867	3.709931380011	125.270533650814	2.42241056369382	.15018125417558	941.09820942235
45	88.563853175134	147.693151780097	6.594798955020	343.167300094994	2.71988088848347	.08345173949375	791.00958583950
46	174.554631180982	180.952819854866	2.316450819438	348.892749469715	2.52577007003465	.16913685214693	883.92589254425
47	311.160664957355	3.514691003266	4.992259070157	273.940800724478	2.87663163446547	.13617304826137	727.24408313943
48	256.761712453850	183.741834064705	6.549118468340	251.005542350967	3.11516637473362	.06131700526767	645.33423500759
49	106.897343793017	288.015031254308	3.157160994269	34.352476480938	3.09790687128039	.22588170279816	650.73480779366
50	198.823475975814	173.569278477247	2.825013030996	333.527262364811	2.65156428492959	.28546135580585	821.77577315224

GROUP OF MINOR PLANETS OSCULATION IS JULIAN DATE 2444000.5

NUM	ARGPER	NODE	INCLINATION	MEAN ANOMALY	SEMI-MAJOR AXIS	ECCENTRICITY	MEAN MOTION
1	73.407359724401	80.126833676302	10.597212116421	191.322445124870	2.76759331929698	.07817464909565	770.64286932259
2	310.073790309463	172.735729614132	34.809111323024	181.839516398775	2.77354871749895	.23330135012112	768.16210131022
3	247.099564127085	169.934798788120	13.004204599582	336.206308301056	2.67066275002388	.25475240648734	812.97651717250
4	150.922206800188	103.523769409111	7.141005587448	90.194607203850	2.36161029132050	.08985029636696	977.67435972197
5	355.686855245207	141.430343371618	5.341511472877	42.707949158309	2.57705053026341	.18801029969678	857.67385888595
6	238.126897343415	138.687850654451	14.776284292597	237.259065552812	2.42510519537076	.20364481096587	939.53010725391
7	144.133350254281	259.512145500952	5.496587379632	134.011275483142	2.38568662418699	.22997418980071	962.91173891589
8	284.473334737833	110.669686245945	5.885137261884	109.389541383244	2.20225808135969	.15600638118987	1085.68604637565
9	5.154474618926	68.692013442193	5.583150444180	335.678058808709	2.38557489733411	.12191317472737	962.97938572794
10	308.521783491244	285.166793066428	3.805381734887	80.651913639821	3.14665069408959	.10437536418561	635.67300985902
11	192.997636862241	125.184772013917	4.623478101884	134.610190414196	2.45350195196363	.10110357665378	923.26625573646
12	68.488050450621	235.360299345548	8.377415151556	58.822332397461	2.33385239333830	.21977862325612	995.16821577529
13	79.432751210491	43.315699961738	16.532477536417	308.223803420375	2.57587868184383	.08555567592867	858.25919976201
14	94.983798227386	86.525971128387	9.124923193831	310.935597307026	2.58657016989516	.16598552691108	952.94333101450
15	96.688906750525	293.282483052273	11.741458289053	178.167406153845	2.64080208350344	.19309450382657	826.80442774178
16	224.208178277078	150.382959500930	3.088186339874	291.786276979614	2.92557063446608	.13387713507251	709.07258176004
17	136.051077138162	125.164679125294	5.592683707608	195.702202554801	2.46963476901787	.13789934737711	914.23423156891
18	227.068625254661	150.251403461260	10.142788051719	90.605764485243	2.29703321620346	.21753106399957	1019.19119170212
19	180.675141980476	211.855290158744	1.557592486009	26.779598854146	2.44231325907360	.15647647933176	929.61799907609
20	255.470685164391	206.216070320934	.700515220690	229.425399433703	2.40903606860368	.14365614644092	948.94626563524
21	248.620378058827	80.649498127848	3.072416415483	160.192463268636	2.43768607610855	.16093654621375	932.26613734615
22	352.153214664375	66.458361844678	13.730271378345	192.521460664226	2.90925360683100	.10303078046840	715.41519750941
23	58.406377799326	67.135950992960	10.165904815275	202.263839213217	2.62795625803899	.23257261298266	832.87413724021
24	111.760902579890	36.226979621531	.767492234525	267.968546857546	3.13755939010890	.12261116821058	638.43787268550
25	90.040216400626	214.218083965856	21.551332026218	261.903020464377	2.40056450377230	.25564715978793	953.97392741963
26	195.745783314698	45.400262227123	3.554601811743	18.847008332842	2.65537782882893	.08793017844407	820.00610830662
27	354.996970648415	94.434022943210	1.596874847301	294.848137360650	2.34740419043575	.17108503101469	986.56285848646
28	339.909576364318	144.380498553135	9.413480217780	51.302963756024	2.77584423145532	.15372423669499	767.20943858318
29	63.300747919288	356.343645966506	6.086571556886	359.037988165286	2.55499457304599	.07117605012258	868.80357970022
30	85.709216950638	307.690033240744	2.096894919518	35.901813186326	2.36526862575886	.12623531685542	975.40699945397
31	64.211793943174	30.773842061412	26.294059682184	26.393188618708	3.15394341912548	.22475377493997	633.46952661197
32	337.570190895607	220.347700355469	5.462394420184	174.593015383488	2.58690450962762	.08429431988407	852.77798021635
33	335.657788821552	8.586425873085	1.903357881729	263.907918897159	2.85825433948580	.34137133712409	734.26912545652
34	327.903595236961	184.030254703713	5.505899972310	102.428869735828	2.68795293345008	.10501467807964	805.14497140638
35	210.627033626256	354.131123363293	8.033898587600	321.512532586125	2.99826872305532	.22082488095110	683.44055041090
36	45.710792443003	358.650713274570	18.549358557070	20.427742448634	2.74983267054625	.29890187458270	778.12106664327
37	60.947635892953	7.490676256429	3.074894766771	232.307052738512	2.64343314937450	.17451303964131	825.57033060410
38	166.923142514125	296.018652647492	6.971344798607	76.461411258178	2.73915301512029	.15643293920946	782.67621174263
39	208.723915211796	157.057386512184	10.376256551929	58.222571960687	2.76809098809160	.10993100157741	770.43505046617
40	269.840985880552	93.958466110651	4.257412787395	212.811094239602	2.26650580851165	.04699035016292	1039.85149389732
41	43.552340383088	178.523723456788	15.871706363692	248.774502849456	2.76362616306375	.26939578864029	772.30283926038
42	235.732538365769	84.361805693888	8.534569997413	31.767009303118	2.43927025043765	.22711414888911	931.35810005016
43	15.551794676589	264.726280299861	3.470733813768	58.445982191857	2.20322428876145	.16918325283069	1084.97194553485
44	341.964798910445	131.208058251617	3.710260993951	229.713990612127	2.42256576413000	.15011856955700	941.00777440788
45	88.559201218395	147.686817999999	6.595140907111	71.031528249615	2.72063690155312	.08375463803476	790.67989904518
46	174.692351440924	180.937730145921	2.316497823340	86.996742902726	2.52632466299509	.16905653158339	883.63484196403
47	311.029749437655	3.504848057574	4.991962797546	354.851868593742	2.87757288655580	.13625457868535	726.88729073128
48	257.162150730543	183.739995940635	6.550653425090	322.333211155163	3.11377383672334	.06121179049698	645.76719174984
49	106.602319307045	287.987517914702	3.155284576278	106.874354090694	3.09549253570363	.22709722228835	651.49626908795
50	198.916242170325	173.553254179902	2.825270826345	64.764764030847	2.65232732483452	.28552179169568	821.42117743469

GROUP OF MINOR PLANETS   OSCULATION IS JULIAN DATE 2444400.5

NUM	ARGPER	NODE	INCLINATION	MEAN ANOMALY	SEMI-MAJOR AXIS	ECCENTRICITY	MEAN MOTION
1	73.664910413399	90.116973387940	10.598316647813	276.718422793067	2.76652786736275	.07837611633756	771.08809996424
2	310.128311478975	172.731653390965	34.813783374439	267.111022796720	2.77335746443264	.23318367187774	768.24156233822
3	247.198398440710	169.930330474079	13.005595614933	66.428739761458	2.67193391341719	.25501005921342	812.39642999608
4	150.782302328081	103.520055248815	7.141240368489	199.001059961700	2.36100770139871	.09003436209481	978.04867508617
5	355.745256665117	141.429985701707	5.341493159079	137.952238720176	2.57752221030502	.18779492364381	857.43844143344
6	238.055102648076	138.687094409564	14.775988674766	341.694015995521	2.42561944883238	.20355669681567	939.23133965403
7	144.076211063597	259.510216254726	5.496255970691	241.085721737138	2.38584089339651	.22792077974771	962.81834716966
8	284.371728063984	110.763331491402	5.884705556899	230.182106306370	2.20161728715418	.15631779665148	1086.16007423087
9	5.283304126372	68.665356634366	5.582275187035	82.523698846218	2.38665005331465	.12239815072195	962.32874377556
10	308.458385455715	285.149067874779	3.805158636972	151.352162238103	3.14574199527672	.10472634750035	635.94846650317
11	193.599868406642	125.172241382465	4.626956321108	236.658432630133	2.45406875671537	.10071022762959	922.94641049075
12	68.471195093851	235.353617993173	8.376903938835	169.441468973334	2.33395341126781	.21951425979029	995.10360732313
13	79.390315582311	43.280683240000	16.533039777265	43.631226466406	2.57719698092194	.08610940536769	857.60574472816
14	94.823635553644	86.501984215853	9.127269940675	45.789386373115	2.58561485751825	.16550980084207	853.41608223930
15	96.599674032519	293.285528296530	11.763499835534	270.127089935265	2.66148814301795	.18995965825040	826.48233645428
16	224.145579918402	150.382742487159	3.088471405942	10.917305303549	2.92511733158649	.13365190226844	709.23741468422
17	136.030619834034	125.156459553289	5.590797342853	297.183620270563	2.47060677638946	.13687136366635	913.69475579467
18	227.055349810361	150.251761735403	10.145466078712	203.856915227333	2.29568149765788	.21850046543200	1020.09148802697
19	181.012774526579	211.750323559706	1.558820884721	179.727495655902	2.44375317455996	.15702455748396	928.79649171075
20	255.587874147378	206.207044206230	.700816915263	334.766820769695	2.40831520570673	.14354130047363	949.37235895054
21	249.986325673426	80.589273612224	3.071855638568	263.476778693439	2.43561680937829	.16172408385769	933.45445049056
22	352.051199370771	66.451247487342	13.727409737648	262.091265098341	2.90931208041376	.10268143620823	715.02480666124
23	58.496708012587	67.121362859507	10.166614947477	294.723721848299	2.62722980585207	.23256251851302	833.21960667351
24	111.746948267172	36.230774364889	.767506729859	338.938035563504	3.13834627058534	.12298571976695	638.19777355561
25	90.060377694414	214.213340760554	21.552745619572	7.899997527633	2.40074600517033	.25585610219696	953.86574405267
26	195.782454006211	45.391265789897	3.554590329576	109.896426022579	2.65573950638469	.08817767664890	819.83860258562
27	355.069468990805	94.432555091985	1.586827744808	44.402261366978	2.34783872616046	.17129389795935	986.28898300754
28	339.935380885203	144.380705087327	9.413429298507	136.544103140372	2.77607357488925	.15345900793469	767.11436681636
29	63.729826398869	356.335743504947	6.087169940998	95.079582706886	2.55680597693657	.07177119893315	867.88046971720
30	85.946331397898	307.661970194687	2.094694996306	143.961241093293	2.36607329408962	.12689258054763	974.90945902693
31	64.035497279230	30.745504057164	26.309354504879	97.006370667187	3.15155808429587	.22470387488047	634.18884834044
32	337.580852941255	220.347677286721	5.463181283638	269.370267697519	2.58637193343044	.08458472531602	853.04139513394
33	335.611954249485	8.585699585099	1.903300530483	345.925890333405	2.85927942218824	.34149728036483	733.97429567458
34	328.066543503604	184.019163879814	5.506508368331	191.698358388151	2.68850388761850	.10492127191969	804.89748696745
35	210.693086992355	354.129063550012	8.040429075339	37.439279355330	2.99649170129196	.22032220489884	684.04859586554
36	45.783613970494	358.623206472537	18.561492727333	106.691409498741	2.75138665786987	.29985315700123	777.46193381139
37	60.966083255441	7.486625701527	3.075029605133	324.000201894487	2.64319443204624	.17427757562573	825.68217390489
38	166.924688174891	296.021076665003	6.970827268349	163.438150424159	2.73953072462730	.15614706884306	782.51435150861
39	209.420702489994	157.048359344588	10.378390993797	143.026630360489	2.77143296705763	.10974291768081	769.04190760571
40	269.525155520709	93.957186354299	4.257071357739	328.647016304614	2.26703591024426	.04698647502665	1039.48679200744
41	43.405100392300	178.496299198372	15.877052679516	334.670076045909	2.76525181000456	.26398133527222	771.62190278768
42	235.713197856669	84.359550370617	6.534293810233	135.307784536839	2.43905083232355	.22688851374641	931.48378095223
43	15.475502514091	264.721708183959	3.470963230506	179.114192234428	2.20282723219380	.16918376140222	1085.26530579640
44	342.079400345514	131.208095666516	3.710313439173	334.174814408949	2.42181404141199	.15006864919714	941.44593675154
45	88.468664494593	147.687129295176	6.595423502004	158.768447149274	2.71994959769265	.08405507502338	790.97961324373
46	175.200311922253	190.850202317355	2.321637740233	184.570035646182	2.52737526641300	.16949070198985	883.08392260840
47	310.898493019979	3.503324819839	4.992346143238	75.746010320928	2.87677175969253	.13619012551577	727.19094857932
48	257.471707327093	183.736500773438	6.550889518956	33.604932010336	3.11432530527911	.06137255032359	645.59567569087
49	106.466002888826	287.924044377056	3.154580832238	179.547679620897	3.09223398374824	.22805645219006	652.52634651774
50	199.180703099587	173.483264099539	2.833960974389	155.603307082913	2.65323738981517	.28681344970362	820.99859036537

GROUP OF MINOR PLANETS OSCULATION IS JULIAN DATE 2444800.5

NUM	ARGPER	NODE	INCLINATION	MEAN ANOMALY	SEMI-MAJOR AXIS	ECCENTRICITY	MEAN MOTION
1	73.733095061363	80.110846476080	10.597946530470	2.347856970589	2.767147619437 42	.07869673854034	770.82906606537
2	310.191865940242	172.731335667167	34.813906103467	352.426001724136	2.772473997513 32	.23304033882401	758.60879936556
3	247.186445969173	169.920346473316	13.004479750876	156.605400178711	2.670611720819 65	.25647233375405	812.99981843112
4	150.451394384147	103.497184512803	7.139266933670	307.973370480362	2.362225339628 55	.08974058990790	977.29255163930
5	355.780179867730	141.429334135461	5.340938015632	233.154108014444	2.578109394674 24	.18750184031534	857.14552575606
6	238.031235202653	139.684590493093	14.775912611676	86.102710249019	2.425110015785 18	.20336719873184	939.52730598582
7	144.027419579852	259.500753555378	5.495709302633	348.098888125280	2.386272534904 35	.22986333901497	962.55711952517
8	294.294841785102	110.660551085735	5.884442446058	350.925208179528	2.201987749484 66	.15630372442243	1085.88598246912
9	5.102593749575	68.641672552362	5.584257986435	189.691293809800	2.385271775731 67	.12298220231731	963.16295545635
10	308.518155353071	285.134251637297	3.806129623156	221.985630132700	3.144451911640 52	.10514766082159	636.33987534506
11	193.884216203955	125.163669097449	4.626818277325	338.789499880355	2.453051726196 25	.10089861221973	923.52044768432
12	68.510916948839	235.280762424259	8.379397721637	279.943552571609	2.335250550166 29	.21859620874991	994.27461169240
13	78.877765671351	43.271335111265	16.539094776671	139.457691930429	2.575693905613 06	.08612815417688	858.35155666654
14	94.920699771486	86.496684092535	9.122077245641	140.510838025235	2.586254343339 77	.14536569316556	853.09957407260
15	96.536106267823	293.278862260322	11.738945003165	1.996744559538	2.641857510518 36	.18992587143695	826.30901235773
16	224.064275987599	150.382650769051	3.088479374712	89.533161544148	2.924206160102 32	.13340895667447	709.56993601511
17	136.175816369213	125.149747010994	5.590551728027	38.612430271862	2.469899024722 99	.13668647936842	914.08751394181
18	227.036643566807	150.251081411742	10.145284744978	317.249095663950	2.295671030660 43	.21874312927964	1020.09846461914
19	181.066448039064	211.729446845919	1.561391319211	232.937745815102	2.441850602366 02	.15801044087041	929.88221325906
20	255.722410115329	206.163508527388	.701522004258	80.113721724453	2.409437057283 03	.14400031663607	948.70938403060
21	249.006702590038	80.596466123730	3.071861612429	7.190779449780	2.435818415585 47	.16194634109491	933.33856357792
22	351.978905778911	66.440024135645	13.728051435630	341.594847845497	2.909376694577 56	.10250014236313	715.00098588214
23	58.551874479737	67.116027535577	10.166976926199	27.267232402896	2.627588627350 87	.23272363246390	833.04893674953
24	111.286822421705	36.308269826465	.766198624589	50.082194995336	3.140550908686 41	.12395772023944	637.52587797972
25	90.016282554018	214.213030147894	21.555075920215	113.925957673649	2.400380150547 93	.25596610182376	954.08382793942
26	195.784578656294	45.390336173404	3.554907285083	200.992642028959	2.654976075839 23	.08851438322687	820.19224124525
27	354.924207594549	94.424850998674	1.596861038529	154.131206778718	2.346904692940 48	.17184054458498	986.87783414194
28	339.953669701707	144.382298372849	9.412380450953	221.731931081027	2.776962490108 33	.15308272265562	766.74606238373
29	63.529836032730	356.328547306244	6.086131787036	191.728888084775	2.554917021621 21	.07272101131294	868.84313722763
30	85.976816701153	307.620016001953	2.094453071943	252.355872261159	2.364862159665 14	.12753231849539	975.65848634229
31	63.924193369835	30.747057029062	26.311957692256	167.640593419243	3.150627841599 70	.22471621192492	634.46974144410
32	337.144219976136	220.315401337310	5.465063024162	4.546051651425	2.587861943122 06	.09483065542011	852.30476949457
33	335.574168986877	8.582856144447	1.903199016725	67.109343982229	2.859606757149 29	.34144211319110	734.13334527272
34	328.217627706777	184.019954100455	5.506996620901	280.969135753130	2.687941037161 64	.10488880094828	805.15031652777
35	210.797669648214	354.131022557058	8.040008613113	113.324185349533	2.997599447586 38	.22033430945952	683.66945133651
36	45.709069201230	358.622880084396	18.561444157389	193.197945751649	2.747818025835 97	.30158161848696	778.97697746838
37	61.017699688455	7.487285767976	3.074965124995	55.716582115386	2.642905832703 93	.17411691451011	825.81742153715
38	166.892798215651	296.017983404361	6.968931620520	250.392410362364	2.740374798584 80	.15579228309075	782.15284122046
39	210.118206363893	157.025129908920	10.373357241567	227.702203227410	2.769107689942 86	.11072435221596	770.01078157185
40	269.279568138909	93.951554449717	4.257275827106	84.399881717949	2.266594237921 62	.04687475514247	1039.79064099587
41	43.437709146773	178.497027257869	15.877804140462	60.410640252011	2.764529883133 21	.26871004229778	771.92417350383
42	235.770532491080	84.299329802412	8.530875465200	238.724053062621	2.441092598031 83	.22580752938524	930.31536528079
43	15.416040584290	264.667970132943	3.469995903816	299.745334149324	2.203765592456 85	.16863928874390	1084.57222294642
44	342.097542019603	131.195722383305	3.709599236844	78.711577988805	2.422786323693 37	.15060064083103	940.87927966310
45	88.482063159027	147.684589208322	6.595514359646	246.874505390337	2.719212835759 92	.08437815770770	791.30110507419
46	175.415280051307	180.663703846790	2.323431702296	282.523183715100	2.525207017838 81	.17024577015311	884.22154602140
47	310.765219191222	3.502301889856	4.992343473005	156.713244390343	2.875951628074 25	.13624816996817	727.50202898818
48	258.554230780787	183.722511259527	6.554034301372	104.194840057525	3.118989506065 30	.06257193676696	644.14806173279
49	106.444843162342	287.905494173947	3.155191152157	252.149889871475	3.091482574792 41	.22850609828741	652.76426340129
50	199.305293153409	173.509665412756	2.837453861804	246.719295124517	2.649491831705 96	.28849495850818	822.74016082991

GROUP OF MINOR PLANETS OSCULATION IS JULIAN DATE 2445200.5

NUM	ARGPER	NODE	INCLINATION	MEAN ANOMALY	SEMI-MAJOR AXIS	ECCENTRICITY	MEAN MOTION
1	73.379884733053	80.064989047814	10.604297242593	88.282273966320	2.767486483472938	.07949990258455	770.68734777921
2	310.248544220536	172.713618936006	34.801047332617	77.729636393635	2.773480361599981	.23347738997105	768.05621343417
3	247.224474090809	169.894516186316	13.003007579462	247.006160308739	2.668517238899235	.25748133870060	813.95717453511
4	150.506863392357	103.479702967581	7.140350432273	56.559137638089	2.361320425599976	.08923590225859	977.85438800832
5	355.820368425666	141.420717542534	5.340751478027	328.346302256496	2.577744944068995	.18729801983176	857.32731153421
6	238.160031011071	139.653739040151	14.767641342150	190.352309164185	2.426675646860690	.20266340947409	938.61921299990
7	144.014037962119	259.493493754658	5.496091892195	95.089248951102	2.385999868264758	.22969346840812	952.78941949736
8	284.260684745714	110.657767675788	5.864697341285	111.638612842193	2.201662106458l4	.15614582238949	1036.12690790806
9	4.982786193577	68.639624243473	5.584221331751	296.833402093556	2.385742937952l4	.12298843490117	962.87764584689
10	308.594351144396	285.134105480112	3.806707572507	292.647531777888	3.143976237164l2	.10543511420829	636.51466342459
11	193.900271031069	125.157684309812	4.626535271197	81.362612608933	2.453592650549l7	.10114336710649	923.21506253812
12	68.603939583379	235.275457797886	8.381648811307	30.369505554996	2.334536170820l1	.21842287805480	934.73102585549
13	78.766371854060	43.270483406185	16.539056895232	234.941911504433	2.576306229420l5	.08587462622253	858.04556167859
14	54.992046601826	86.484975695243	9.122388702988	235.202948880196	2.586653436899l9	.16516033812542	852.90214518151
15	96.476566908140	293.275002513317	11.740302266549	93.894476655395	2.641122014882l8	.19076973168619	826.65420029935
16	224.144688737119	150.378635413172	3.087866497117	168.303025885279	2.925701397506l9	.13278410017029	709.02504472306
17	136.272296701378	125.140970972650	5.590169378082	140.055081901254	2.470394748697l2	.13682017185892	913.81238846097
18	226.990834454515	150.246432605017	10.145086016199	70.629181592053	2.295577568048l3	.21876006302168	1020.16076399768
19	181.019282591329	211.728013208213	1.561453349719	336.316111874818	2.442232116929l5	.15821293578472	929.66432871696
20	255.505049041193	206.200147941934	.702585037745	185.740340342505	2.407917689323l1	.14467355096814	949.60746219041
21	248.952719339237	80.583352516992	3.072029944675	110.934896061058	2.435651330061l7	.16209921695654	933.43460567258
22	351.878606361115	66.440757711538	13.729328697206	61.155128155912	2.908347209735l0	.10221765235132	715.38066016047
23	58.424677105409	67.099308541066	10.172425027445	119.919094323836	2.626686875808l5	.23340384419731	833.47795584315
24	110.739873124577	36.275684924975	.765025630926	121.560906677122	3.136769229421l0	.12402824165671	638.67912422785
25	89.976199232744	214.214125818983	21.555362229069	220.007602232221	2.399960618738l6	.25615997550456	954.33401079908
26	195.802249462699	45.390683598366	3.554896462888	292.136704873434	2.654705623974l8	.08875675121674	820.31758181273
27	354.844089394519	94.424191509922	1.586863859895	263.889207422279	2.347049938755l9	.17186921263790	986.78622702153
28	339.941065155714	144.373425030256	9.411158255051	306.915733377307	2.777184732276l5	.15283850760168	766.65402678958
29	63.356895038252	356.329529529681	6.085817935345	288.459229465043	2.555157359938l0	.07285850621709	869.72055492170
30	85.888438899116	307.613935980607	2.094099351780	.839248912757	2.365430626728l1	.12766706130479	975.30679791098
31	63.846040338749	30.747839153346	26.311914427625	238.245869959802	3.151321488125l9	.22455483117799	634.26027050543
32	336.858515370621	220.317236164274	5.466565234487	99.579041313898	2.586430871846l8	.08440885291314	853.01223722012
33	335.532161435527	8.574279324897	1.903272068443	148.767338096091	2.857873454128l6	.34145998689510	734.41592079960
34	328.350372918025	184.019385254770	5.506994959556	10.325624618363	2.687519458812l9	.10495265536302	805.33977408727
35	210.867017908376	354.127181799924	8.037903400249	189.169369606512	2.998274560271l7	.22019343033592	683.43855456899
36	45.749611427162	358.609151326880	18.960003677406	279.793664698976	2.746634006216l3	.30222750061234	779.48073411073
37	61.458670348452	7.458320695697	3.069616185073	146.909425998129	2.645548638581l3	.17428232901656	824.58028874001
38	166.871012137671	296.002523786849	6.968673858196	337.309391517771	2.740404782512l3	.15558711349603	782.14000445785
39	210.345865327899	157.013419610978	10.373229044917	313.104867848708	2.767902821466l9	.11110585982429	770.51351498047
40	269.316918343496	93.941697467876	4.257239155128	199.898671490976	2.267316407906l1	.04645842623577	1039.29390014042
41	43.510169281687	178.496868367995	15.875721862963	146.070539115036	2.765425452592l4	.26865335282536	771.54922808204
42	235.930624711720	84.254542044272	8.534899453810	341.951791399428	2.439900198046l0	.22523970219555	930.99742914766
43	15.507966774427	264.655034751986	3.470664966110	60.208532087492	2.203396744931l1	.16847672777311	1084.84456962423
44	341.913901610529	131.177595708117	3.709959048806	183.510345798030	2.421439952231l7	.15100030295195	941.66411168969
45	88.115250639513	147.672918404241	6.593594502529	335.148295340139	2.720887917074l6	.08469580421051	790.57048530474
46	175.401462432732	180.863396923214	2.323420422865	20.777820322478	2.525781811156l9	.17048329505927	883.91972914387
47	310.599493695127	3.506125652231	4.991350747219	237.723704676292	2.876964471050l0	.13596766690142	727.11788427330
48	258.471634320907	183.696682700782	6.551544666016	175.925034321624	3.114259387371l3	.06465302513831	645.61617328082
49	106.385649377044	287.902610829882	3.154774909874	324.746525961606	3.092438417231l9	.22870480103035	652.46164222402
50	199.355725952466	173.510391986315	2.837454033685	338.130472602867	2.649023678253l6	.28880665667234	822.95827080763

Appendix C

RECTANGULAR COORDINATES AND PERTURBATIONS AT FUTURE DATES

Appendix C

RECTANGULAR COORDINATES AND PERTURBATIONS AT FUTURE DATES

Appendix C contains the perturbed equatorial rectangular coordinates and the perturbations in these rectangular coordinates for the minor planet 1 Ceres at each 4-day date from 1972 October 10 (244 1600.5) through 1983 September 23 (244 5600.5). The perturbations are always with respect to the elements osculating at the preceding 400-day date and contained in Appendix B.

Note that the perturbations are listed in terms of the 10th decimal of an astronomical unit.

L	STEP	JULIAN DATE	X	Y	Z	PERTURBATIONS IN		10-TH DEC
1	0	2441600.5	-2.447144476828598	-.906908685772876	.071811498992186	-0	-0	-0
2	1	2441604.5	-2.436077983692783	-.944279503833705	.051944598131843	252	133	-9
3	2	2441608.5	-2.424765123325614	-.981399774466468	.032063911181796	1029	530	-41
4	3	2441612.5	-2.412910815723320	-1.018260385002229	.012174736203938	2362	1192	-100
5	4	2441616.5	-2.399020151476108	-1.054852354635436	-.007717656078118	4283	2085	-190
6	5	2441620.5	-2.385398387934245	-1.091166836724383	-.027608024153929	6822	3239	-312
7	6	2441624.5	-2.371150945337163	-1.127195120992575	-.047491157563151	10010	4641	-469
8	7	2441628.5	-2.356283402902463	-1.162928635640355	-.067361878699261	13876	6294	-661
9	8	2441632.5	-2.340801494859093	-1.198358949378964	-.087215044587720	18446	8198	-890
10	9	2441636.5	-2.324711106382239	-1.233477773393162	-.107045548645631	23747	10353	-1157
11	10	2441640.5	-2.308018269348537	-1.268276963200208	-.126848322413482	29805	12755	-1467
12	11	2441644.5	-2.290729[illegible]825950	-1.302748520267016	-.146618337193281	36652	15395	-1826
13	12	2441648.5	-2.272850083393649	-1.336884593110504	-.166350605435444	44332	18265	-2244
14	13	2441652.5	-2.254387490828705	-1.370677477747563	-.186040181747431	52902	21365	-2726
15	14	2441656.5	-2.235347954766041	-1.404119618036084	-.205682163751168	62426	24710	-3270
16	15	2441660.5	-2.215738174998428	-1.437203606761230	-.225271693280544	72961	28336	-3864
17	16	2441664.5	-2.195564993293465	-1.469922187558900	-.244803958092982	84549	32283	-4490
18	17	2441668.5	-2.174835319062439	-1.502268256647518	-.264274193541958	97217	36593	-5129
19	18	2441672.5	-2.153556245041386	-1.534234863785699	-.283677683989021	110985	41303	-5763
20	19	2441676.5	-2.131734932944738	-1.565815213367657	-.303009764097501	125863	46447	-6375
21	20	2441680.5	-2.109378660821463	-1.597002664684915	-.322265819865239	141860	52053	-6951
22	21	2441684.5	-2.086494909404044	-1.627790732222756	-.341441289518421	158984	58147	-7479
23	22	2441688.5	-2.063090957951167	-1.658173086261534	-.360531664635189	177239	64754	-7945
24	23	2441692.5	-2.039174380203221	-1.688143552914056	-.379532490959408	196627	71894	-8339
25	24	2441696.5	-2.014753040623461	-1.717696114331766	-.398439369278535	217151	79598	-8650
26	25	2441700.5	-1.989834590486559	-1.746824908838320	-.417247956281191	238810	87855	-8866
27	26	2441704.5	-1.964426964051461	-1.775524230928376	-.435953965335447	261602	96711	-8980
28	27	2441708.5	-1.938537774788941	-1.803788531220619	-.454553167238691	285522	106171	-8982
29	28	2441712.5	-1.912175311639828	-1.831612416348918	-.473041390931957	310565	116247	-8864
30	29	2441716.5	-1.885347535310842	-1.858990648798996	-.491414524181758	336723	126948	-8619
31	30	2441720.5	-1.858062574589120	-1.885918146707475	-.509668514240118	363986	138281	-8243
32	31	2441724.5	-1.830329622631491	-1.912389983631201	-.527799368491042	392344	150244	-7733
33	32	2441728.5	-1.802153933144141	-1.938401388254967	-.545803155075006	421790	162831	-7092
34	33	2441732.5	-1.773546816364501	-1.963947743900512	-.563676003426504	452321	176026	-6326
35	34	2441736.5	-1.744515634943127	-1.989024587562255	-.581414104567731	483952	189811	-5445
36	35	2441740.5	-1.715069800259502	-2.013627608341096	-.599013711033944	516710	204172	-4456
37	36	2441744.5	-1.685214769775655	-2.037752645924256	-.616471136662170	550634	219110	-3362
38	37	2441748.5	-1.654962045080545	-2.061395689264657	-.633782756735457	585758	234640	-2155
39	38	2441752.5	-1.624319169497674	-2.084552877645322	-.650945008643927	622104	250786	-822
40	39	2441756.5	-1.593294724598223	-2.107220499594661	-.667954392576220	659685	267566	647
41	40	2441760.5	-1.561897326786045	-2.129394992586910	-.684807471818083	698506	284998	2266
42	41	2441764.5	-1.530135623893010	-2.151072942337251	-.701500873151392	738570	303090	4041
43	42	2441768.5	-1.498018291533127	-2.172251081414075	-.718031286855691	779882	321848	5979
44	43	2441772.5	-1.465554030491099	-2.192926287957704	-.734395466657361	822449	341278	8086
45	44	2441776.5	-1.432751563636124	-2.213095584752566	-.750590229913236	866279	361390	10364
46	45	2441780.5	-1.399619633000782	-2.232756137795477	-.766612457504408	911382	382154	12818
47	46	2441784.5	-1.366166997173053	-2.251905255093590	-.782459093816630	957771	403602	15452
48	47	2441788.5	-1.332402428571712	-2.270540385443383	-.798127146719153	1005459	425724	18268
49	48	2441792.5	-1.298334710835939	-2.288659117132838	-.813613687486381	1054463	448519	21269
50	49	2441796.5	-1.263972636295925	-2.306259176654805	-.828915850712971	1104798	471988	24460
51	50	2441800.5	-1.229325003499326	-2.323338427414114	-.844030834215694	1156480	496132	27844

L	STEP	JULIAN DATE	X	Y	Z	PERTURBATIONS IN	10-TH DEC	
1	51	2441804.5	-1.194490614794276	-2.339894868437355	-.858955899925977	1209529	520948	31424
2	52	2441808.5	-1.159208273951073	-2.355926633100908	-.873688368783849	1263958	546436	35204
3	53	2441812.5	-1.123756783773167	-2.371431987984748	-.888225630642122	1319787	572591	39184
4	54	2441816.5	-1.088054943611482	-2.386409331121143	-.902565134172239	1377036	599403	43365
5	55	2441820.5	-1.052111546692288	-2.400857191596003	-.916704391706421	1435732	626858	47740
6	56	2441824.5	-1.015935377354801	-2.414774226730700	-.930640977858680	1495917	654941	52306
7	57	2441828.5	-.979535208736966	-2.428159220216187	-.944372528801757	1557645	683645	57058
8	58	2441832.5	-.942919801503366	-2.441011079652910	-.957896741434951	1620983	712981	62003
9	59	2441836.5	-.906097903262502	-2.453328635046406	-.971211372934626	1685983	742976	67155
10	60	2441840.5	-.869078247529742	-2.465111638234404	-.984314240844210	1752705	773667	72537
11	61	2441844.5	-.831869551604367	-2.476359762203859	-.997203223212402	1821164	805088	78171
12	62	2441848.5	-.794480514515616	-2.487069599746107	-1.009876258363612	1891389	837274	84081
13	63	2441852.5	-.756919814963940	-2.497243662354890	-1.022331344793592	1963393	870255	90288
14	64	2441856.5	-.719196109022427	-2.506880578380958	-1.034566540685873	2037193	904056	96817
15	65	2441860.5	-.681318078855920	-2.515980091351878	-1.046579963406373	2112799	938704	103673
16	66	2441864.5	-.643294180947642	-2.524542058678776	-1.058369789250037	2190219	974221	110891
17	67	2441868.5	-.605133144481467	-2.532566449903200	-1.069934252919595	2269460	1010630	118484
18	68	2441872.5	-.566843470017591	-2.540053345216805	-1.081271647114413	2350525	1047953	126472
19	69	2441876.5	-.528433678034482	-2.547002933997220	-1.092380322136407	2433415	1086209	134874
20	70	2441880.5	-.489912257566125	-2.553415513304088	-1.103258685459068	2518129	1125418	143708
21	71	2441884.5	-.451287664900825	-2.559291486420761	-1.113905201309336	2604659	1165596	152994
22	72	2441888.5	-.412568322312961	-2.564631361421505	-1.124318390254302	2692996	1206758	162748
23	73	2441892.5	-.373762616831279	-2.569435749771998	-1.134496828796685	2783129	1248914	172988
24	74	2441896.5	-.334878899021694	-2.573705364976746	-1.144439148988774	2875036	1292070	183728
25	75	2441900.5	-.295925481736445	-2.577441021279554	-1.154144038073056	2968700	1336226	194980
26	76	2441904.5	-.256910639742625	-2.580643632382348	-1.163610238140109	3064102	1381372	206751
27	77	2441908.5	-.217842603140942	-2.583314210040825	-1.172836545736999	3161227	1427489	219045
28	78	2441912.5	-.178729565673653	-2.585453862259172	-1.181821811267753	3260070	1474553	231860
29	79	2441916.5	-.139570673464111	-2.587063790960414	-1.190564938063773	3360645	1522544	245196
30	80	2441920.5	-.100401029779121	-2.588145289689052	-1.199064881362091	3462971	1571451	259060
31	81	2441924.5	-.061201694449845	-2.588699742192560	-1.207320647682160	3567061	1621278	273465
32	82	2441928.5	-.021989683816960	-2.588728621947197	-1.215331294752993	3672914	1672032	288428
33	83	2441932.5	.017227030437051	-2.588233491578848	-1.223095931494093	3780520	1723711	303966
34	84	2441936.5	.056440522387243	-2.587216001641409	-1.230613717641305	3889860	1776310	320092
35	85	2441940.5	.095642913001665	-2.585677889651322	-1.237883863509332	4000913	1829810	336815
36	86	2441944.5	.134826371521109	-2.583620978384332	-1.244905629380327	4113660	1884188	354142
37	87	2441948.5	.173983115842584	-2.581047174361899	-1.251678324087799	4228081	1939412	372075
38	88	2441952.5	.213105413419113	-2.577958466724510	-1.258201308656638	4344160	1995444	390614
39	89	2441956.5	.252185582010755	-2.574356925657938	-1.264473987684838	4461883	2052243	409758
40	90	2441960.5	.291215990165377	-2.570244701104542	-1.270495816846029	4581239	2109760	429501
41	91	2441964.5	.330189057847514	-2.565624021498408	-1.276266298416374	4702219	2167944	449838
42	92	2441968.5	.369097256987356	-2.560497192471189	-1.281784981573871	4824819	2226739	470761
43	93	2441972.5	.407933111983910	-2.554866595614541	-1.287051461919546	4949035	2286084	492259
44	94	2441976.5	.446589200189910	-2.548734687277076	-1.292065381011980	5074867	2345914	514320
45	95	2441980.5	.485358152375390	-2.542103997405064	-1.296826425919441	5202320	2406160	536931
46	96	2441984.5	.523932653191363	-2.534977128439436	-1.301334328798966	5331398	2466748	560075
47	97	2441988.5	.562405441682525	-2.527356754275303	-1.305588866510647	5462113	2527594	583731
48	98	2441992.5	.600769311935888	-2.519245619248551	-1.309589860257226	5594482	2588609	607875
49	99	2441996.5	.639017113954242	-2.510646537006622	-1.313337175181580	5728533	2649695	632477
50	100	2442000.5	.677141754652769	-2.501562388985278	-1.316830719762791	5864313	2710749	657505

L	STEP	JULIAN DATE	X	Y	Z	PERTURBATIONS IN		10-TH DEC
1	0	2442000.5	.677141754652325	-2.501562388986116	-1.316830719763189	0	-0	-0
2	1	2442004.5	.715136198436099	-2.491996122371845	-1.320070444891172	1555	-125	92
3	2	2442008.5	.752903466749764	-2.481950748105135	-1.323056342854677	6334	-526	369
4	3	2442012.5	.790706637018882	-2.471429339822350	-1.325783446766630	14410	-1225	833
5	4	2442016.5	.828268842141771	-2.460435033630887	-1.328266830489483	25887	-2239	1494
6	5	2442020.5	.865673270839821	-2.448971027865340	-1.330491608635917	40849	-3583	2363
7	6	2442024.5	.902913168412454	-2.437040582395525	-1.332462936368273	59378	-5277	3450
8	7	2442028.5	.939981837134553	-2.424647017643693	-1.334181009032990	81553	-7343	4764
9	8	2442032.5	.976872637082099	-2.411793713543531	-1.335646061625134	107458	-9805	6312
10	9	2442036.5	1.013578985978995	-2.398484108260547	-1.336858368472036	137176	-12689	8102
11	10	2442040.5	1.050094359557107	-2.384721697458502	-1.337818242659523	170794	-16019	10142
12	11	2442044.5	1.086412291780825	-2.370510033107180	-1.338526035646083	208402	-19821	12440
13	12	2442048.5	1.122526374023941	-2.355852722582995	-1.338982136825926	250089	-24117	15003
14	13	2442052.5	1.158430259210341	-2.340753427800408	-1.339186973152870	295949	-28930	17842
15	14	2442056.5	1.194117653890565	-2.325215864319517	-1.339141008742608	346074	-34279	20966
16	15	2442060.5	1.229582326291393	-2.309243800517834	-1.338844744504065	400556	-40186	24386
17	16	2442064.5	1.264818102364487	-2.292841056801208	-1.338298717789399	459487	-46668	28114
18	17	2442068.5	1.299818866632897	-2.276011504863348	-1.337503502067506	522958	-53745	32160
19	18	2442072.5	1.334578562256922	-2.258759067005911	-1.336459706629711	591057	-61438	36536
20	19	2442076.5	1.369091191169566	-2.241087715524003	-1.335167976335498	663874	-69771	41251
21	20	2442080.5	1.403350814369333	-2.223001472120970	-1.333628991337975	741496	-78771	46312
22	21	2442084.5	1.437351552459361	-2.204504407207310	-1.331843467070577	824019	-88474	51721
23	22	2442088.5	1.471087586328991	-2.185600638804829	-1.329812153285005	911549	-98914	57481
24	23	2442092.5	1.504553157429378	-2.166294330938030	-1.327535833771108	1004207	-110121	63593
25	24	2442096.5	1.537742567059865	-2.146589692080312	-1.325015325252650	1102121	-122107	70070
26	25	2442100.5	1.570650175046922	-2.126490974494786	-1.322251476998268	1205410	-134872	76930
27	26	2442104.5	1.603270398953590	-2.106002474517368	-1.319245170939951	1314179	-148408	84198
28	27	2442108.5	1.635597714433992	-2.085128532718954	-1.315997321842914	1428520	-162709	91899
29	28	2442112.5	1.667626655536615	-2.063873533439661	-1.312508877132721	1548515	-177775	100055
30	29	2442116.5	1.699351815101373	-2.042241904581701	-1.308780816869294	1674239	-193614	108686
31	30	2442120.5	1.730767845412835	-2.020238116655264	-1.304814153346094	1805768	-210240	117807
32	31	2442124.5	1.761869457901639	-1.997866682041682	-1.300609930706962	1943176	-227671	127433
33	32	2442128.5	1.792651423410959	-1.975132154621811	-1.296169224815806	2086532	-245928	137575
34	33	2442132.5	1.823108572328842	-1.952039128963150	-1.291493142875339	2235910	-265041	148242
35	34	2442136.5	1.853235794496236	-1.928592239792316	-1.286582823175081	2391379	-285039	159441
36	35	2442140.5	1.883028039293286	-1.904796161483155	-1.281439434865455	2553010	-305960	171177
37	36	2442144.5	1.912480315676063	-1.880655607511848	-1.276064177708768	2720872	-327842	183451
38	37	2442148.5	1.941587692200649	-1.856175329963044	-1.270458281855873	2895034	-350732	196264
39	38	2442152.5	1.970345297058735	-1.831360119063760	-1.264623007638633	3075566	-374679	209611
40	39	2442156.5	1.998748318122686	-1.806214802753118	-1.258559645382476	3262537	-399739	223488
41	40	2442160.5	2.026792003020134	-1.780744246300735	-1.252269515247939	3456014	-425975	237882
42	41	2442164.5	2.054471659287444	-1.754953351977882	-1.245753967108584	3656068	-453460	252780
43	42	2442168.5	2.081782654689079	-1.728847058745053	-1.239014380454854	3862773	-482274	268159
44	43	2442172.5	2.108720417790323	-1.702430341809766	-1.232052164254647	4076214	-512509	283991
45	44	2442176.5	2.135280439676062	-1.675708211775621	-1.224868756610221	4296491	-544264	300243
46	45	2442180.5	2.161458269262980	-1.648685713268833	-1.217465624093855	4523723	-577632	316881
47	46	2442184.5	2.187249522624754	-1.621367923615992	-1.209844261009863	4758040	-612696	333876
48	47	2442188.5	2.212649871719847	-1.593759952411460	-1.202006189072065	4999574	-649527	351204
49	48	2442192.5	2.237655048660656	-1.565866942013812	-1.193952957634608	5248442	-688190	368844
50	49	2442196.5	2.262260845126505	-1.537694067902095	-1.185686143965455	5504760	-728757	386774
51	50	2442200.5	2.286463112715836	-1.509246538401001	-1.177207353175923	5768638	-771304	404967

L	STEP	JULIAN DATE	X	Y	Z	PERTURBATIONS IN		10-TH DEC
1	51	2442204.5	2.310257763402831	-1.480529594656069	-1.168518218295020	6040189	-815917	423389
2	52	2442208.5	2.333640770238489	-1.451548509848500	-1.159620349962002	6319530	-862684	442005
3	53	2442212.5	2.356608167104284	-1.422308589632987	-1.150515586141324	6606784	-911699	460775
4	54	2442216.5	2.379156049039040	-1.392815166923278	-1.141205492083216	6902080	-963060	479654
5	55	2442220.5	2.401280572423033	-1.363073611233631	-1.131691860032163	7205553	-1016863	498597
6	56	2442224.5	2.422977954945068	-1.333089318301617	-1.121976459064406	7517342	-1073209	517554
7	57	2442228.5	2.444244475748732	-1.302867714719198	-1.112061084949005	7837596	-1132197	536475
8	58	2442232.5	2.465076475529415	-1.272414256527249	-1.101947559984815	8166467	-1193925	555306
9	59	2442236.5	2.485470356621747	-1.241734428857157	-1.091637732862637	8504111	-1258494	573991
10	60	2442240.5	2.505422583100071	-1.210833745596929	-1.081133478542334	8850692	-1326000	592474
11	61	2442244.5	2.524929680890622	-1.179717749090074	-1.070436698149635	9206377	-1396542	610696
12	62	2442248.5	2.543988237915698	-1.148392009880894	-1.059549318901603	9571337	-1470217	628593
13	63	2442252.5	2.562594904319042	-1.116862126510249	-1.048473294068252	9945751	-1547123	646102
14	64	2442256.5	2.580746392860050	-1.085133725325058	-1.037210602959306	10329802	-1627361	663152
15	65	2442260.5	2.598439479563766	-1.053212460154114	-1.025763250866291	10723689	-1711032	679670
16	66	2442264.5	2.615671004517196	-1.021104011570735	-1.014133268798908	11127627	-1798236	695578
17	67	2442268.5	2.632437872256816	-.988814085632182	-1.002322712899726	11541852	-1889061	710802
18	68	2442272.5	2.648737051171949	-.956348412675553	-.990333663788633	11966614	-1983571	725273
19	69	2442276.5	2.664565572322815	-.923712747006423	-.978168226325632	12402161	-2081811	738933
20	70	2442280.5	2.679920528814677	-.890912867511418	-.965828529925947	12848729	-2183810	751727
21	71	2442284.5	2.694799076318930	-.857954578119553	-.953316728912142	13306550	-2289594	763602
22	72	2442288.5	2.709198433529764	-.824843707637704	-.940635002524562	13775850	-2399184	774505
23	73	2442292.5	2.723115882742576	-.791586109835031	-.927785555077751	14256854	-2512598	784379
24	74	2442296.5	2.736548770671419	-.758187662761067	-.914770615731058	14749791	-2629853	793165
25	75	2442300.5	2.749494508331097	-.724654268299457	-.901592438289384	15254889	-2750955	800807
26	76	2442304.5	2.761950571506830	-.690991852056740	-.888253301243843	15772381	-2875909	807245
27	77	2442308.5	2.773914501079801	-.657206362809177	-.874755507560913	16302500	-3004709	812421
28	78	2442312.5	2.785383903149821	-.623303772229473	-.861101384600833	16845482	-3137344	816277
29	79	2442316.5	2.796356449345183	-.589290074615782	-.847293284056633	17401562	-3273793	818754
30	80	2442320.5	2.806829877091232	-.555171286580752	-.833333581867734	17970975	-3414027	819797
31	81	2442324.5	2.816801989879693	-.520953446782062	-.819224678156345	18553957	-3558011	819348
32	82	2442328.5	2.826270657560698	-.486642615671492	-.804968997176438	19150743	-3705701	817352
33	83	2442332.5	2.835233816656540	-.452244875269578	-.790568987279315	19761565	-3857044	813753
34	84	2442336.5	2.843689470717933	-.417766328979301	-.776027120905070	20386655	-4011984	808495
35	85	2442340.5	2.851635690771914	-.383213101441829	-.761345894606634	21026245	-4170459	801521
36	86	2442344.5	2.859070615948852	-.348591338396410	-.746527829095204	21680566	-4332403	792773
37	87	2442348.5	2.865992454373981	-.313907206395296	-.731575469235899	22349858	-4497747	782188
38	88	2442352.5	2.872399484210959	-.279166892092512	-.716491383831645	23034372	-4666416	769704
39	89	2442356.5	2.878290054297878	-.244376600999296	-.701278165080520	23734376	-4838318	755261
40	90	2442360.5	2.883662583804949	-.209542556290784	-.685938427961155	24450142	-5013334	738812
41	91	2442364.5	2.888515561320816	-.174670998497082	-.670474810034268	25181938	-5191322	720316
42	92	2442368.5	2.892847544509593	-.139768186101200	-.654889971789618	25930017	-5372121	699741
43	93	2442372.5	2.896657160916902	-.104840395962372	-.639186597018622	26694620	-5555563	677060
44	94	2442376.5	2.899943108704562	-.069893923106444	-.623367392841878	27475981	-5741472	652243
45	95	2442380.5	2.902704157520517	-.034935080751088	-.607435089877534	28274327	-5929669	625263
46	96	2442384.5	2.904939149596132	.000029800453728	-.591392442014090	29089887	-6119966	596091
47	97	2442388.5	2.906646999913846	.034994372949165	-.575242226215412	29922888	-6312166	564703
48	98	2442392.5	2.907826696968101	.069952272480534	-.558987242554501	30773554	-6506064	531074
49	99	2442396.5	2.908477303371882	.104897118760598	-.542630313991552	31642114	-6701442	495185
50	100	2442400.5	2.908597956263520	.139822515863865	-.526174286277168	32528791	-6898075	457017

L	STEP	JULIAN DATE	X	Y	Z	PERTURBATIONS IN		10-TH DEC
1	0	2442400.5	2.908597956263293	.139822515864371	-.526174286276877	0	0	-0
2	1	2442404.5	2.908187867897027	.174722052633326	-.509622027869391	3618	-1553	431
3	2	2442408.5	2.907246326187149	.209589303137395	-.492976429820699	14423	-6228	1704
4	3	2442412.5	2.905772695248771	.244417827096588	-.476240405682480	32341	-14043	3785
5	4	2442416.5	2.903766415957875	.279201170302512	-.459416894417550	57330	-25020	6638
6	5	2442420.5	2.901227006526227	.313932865021643	-.442508845324090	89227	-39176	10224
7	6	2442424.5	2.898154063114589	.348606430369818	-.425519247981155	128052	-56533	14503
8	7	2442428.5	2.894547260532576	.383215372654067	-.408451102222541	173706	-77111	19432
9	8	2442432.5	2.890406353112965	.417753185719668	-.391307433127709	226123	-100936	24962
10	9	2442436.5	2.885731175844981	.452213351451727	-.374091287958416	285249	-128035	31041
11	10	2442440.5	2.880521645650518	.486589340712291	-.356805735878501	351046	-158436	37613
12	11	2442444.5	2.874777762240129	.520874614816357	-.339453867343666	423492	-192154	44626
13	12	2442448.5	2.868499607982216	.555062626956971	-.322038793418944	502578	-229185	52033
14	13	2442452.5	2.861687347201283	.589146822749015	-.304563645511362	588290	-269504	59799
15	14	2442456.5	2.854341226048859	.623120634877413	-.287031575642835	680604	-313077	67892
16	15	2442460.5	2.846461573513253	.656977507936563	-.269445756739312	779487	-359865	76282
17	16	2442464.5	2.838048802341831	.690710848903180	-.251809382573388	884900	-409830	84939
18	17	2442468.5	2.829103410101553	.724314077382253	-.234125667844457	996803	-462932	93832
19	18	2442472.5	2.819625980447796	.757780601649202	-.216397847855745	1115159	-519129	102928
20	19	2442476.5	2.809617183463047	.791103624449763	-.198629178227494	1239930	-578378	112195
21	20	2442480.5	2.799077776588419	.824277143507725	-.180822934829756	1371081	-640629	121601
22	21	2442484.5	2.788008605387418	.857293952485247	-.162982413457603	1508579	-705831	131117
23	22	2442488.5	2.776410604110239	.890147641679157	-.145110929629381	1652389	-773925	140713
24	23	2442492.5	2.764284796436385	.922831598738828	-.127211818393997	1802479	-844847	150362
25	24	2442496.5	2.751632296165297	.955339209438371	-.109288434105620	1958814	-918530	160040
26	25	2442500.5	2.738454307900497	.987663858425545	-.091344150212439	2121359	-994899	169724
27	26	2442504.5	2.724752127746953	1.019798929968040	-.073382359049985	2290078	-1073875	179391
28	27	2442508.5	2.710527144020645	1.051737808690667	-.055406471642567	2464930	-1155377	189022
29	28	2442512.5	2.695780837991947	1.083473860289283	-.037419917522523	2645872	-1239318	198599
30	29	2442516.5	2.680514784712443	1.115000532218637	-.019426144573860	2832858	-1325611	208103
31	30	2442520.5	2.664730654013681	1.146311154392862	-.001428618888630	3025843	-1414171	217515
32	31	2442524.5	2.648430211762687	1.177399140049324	.016569175436100	3224784	-1504912	226814
33	32	2442528.5	2.631615321255268	1.208257887057435	.034563736723832	3429648	-1597747	235980
34	33	2442532.5	2.614287944180830	1.238880799772382	.052551546478601	3640416	-1692575	244996
35	34	2442536.5	2.596450140596076	1.269261290839651	.070529070218853	3857070	-1789277	253857
36	35	2442540.5	2.578104068333204	1.299392782124023	.088492757898746	4079583	-1887714	262567
37	36	2442544.5	2.559251982988513	1.329268704757773	.106439043796318	4307906	-1987738	271138
38	37	2442548.5	2.539896239046158	1.358882499400863	.124264346396876	4541979	-2089198	279586
39	38	2442552.5	2.520039290903711	1.388227617139350	.142265068626657	4781726	-2191945	287924
40	39	2442556.5	2.499683694044890	1.417297520169122	.160137597954779	5027062	-2295835	296167
41	40	2442560.5	2.478832106404909	1.446085683292246	.177978306909015	5277898	-2400723	304329
42	41	2442564.5	2.457487288807926	1.474585595170183	.195783553555227	5534135	-2506469	312424
43	42	2442568.5	2.435652105997974	1.502790759309256	.213549681770667	5795674	-2612930	320467
44	43	2442572.5	2.413329527488486	1.530694695508480	.231273021782045	6062406	-2719969	328471
45	44	2442576.5	2.390522628210846	1.558290941056008	.248949890588166	6334218	-2827445	336451
46	45	2442580.5	2.367234589332725	1.585573051965639	.266576592384778	6610993	-2935224	344424
47	46	2442584.5	2.343468699014849	1.612534604281613	.284149419031102	6892605	-3043170	352404
48	47	2442588.5	2.319228353151360	1.639169195376844	.301664650512850	7178925	-3151151	360406
49	48	2442592.5	2.294517056112355	1.665470445265008	.319118555411107	7469814	-3259040	368447
50	49	2442596.5	2.269338421485585	1.691431997920041	.336507391373912	7765130	-3366712	376539
51	50	2442600.5	2.243696172838170	1.717047522589326	.353827405580985	8064725	-3474048	384695

1 CERES RECTANGULAR SPACE COORDINATES

L	STEP	JULIAN DATE	X	Y	Z	PERTURBATIONS IN		10-TH DEC
1	51	2442604.5	2.217594144546638	1.742310715097453	.371074835195197	8368443	-3580939	392925
2	52	2442608.5	2.191036282782704	1.767215299180201	.388245907812916	8676128	-3687284	401236
3	53	2442612.5	2.164026646738193	1.791755028000274	.405336841985942	8987628	-3792992	409628
4	54	2442616.5	2.136569409966256	1.815923686125956	.422343847978487	9302799	-3897978	418100
5	55	2442620.5	2.108668861267788	1.839715092067884	.439263128866985	9621510	-4002155	426652
6	56	2442624.5	2.080329404562534	1.863123100772953	.456090881732797	9943632	-4105423	435291
7	57	2442628.5	2.051555558176830	1.886141605251758	.472823298420145	10269031	-4207673	444032
8	58	2442632.5	2.022351954695353	1.908764537342989	.489456365813207	10597551	-4308794	452892
9	59	2442636.5	1.992723341918783	1.930985868712263	.505986866094588	10929028	-4408682	461891
10	60	2442640.5	1.962674583686599	1.952799612493990	.522410377373731	11263285	-4507240	471042
11	61	2442644.5	1.932210660829170	1.974199824729929	.538723274190911	11600138	-4604384	480359
12	62	2442648.5	1.901336672270844	1.995180606633518	.554921728448033	11939436	-4700038	489849
13	63	2442652.5	1.870057835180020	2.015736106605459	.571001910304378	12280900	-4794134	499519
14	64	2442656.5	1.838379485687284	2.035860521999652	.586959988880484	12624435	-4886609	509372
15	65	2442660.5	1.806307079382194	2.055548101353153	.602792133233670	12969822	-4977410	519410
16	66	2442664.5	1.773846191582329	2.074793146367284	.618494513224526	13316872	-5066487	529634
17	67	2442668.5	1.741002517737925	2.093590013935639	.634063300395063	13665396	-5153800	540041
18	68	2442672.5	1.707781873741453	2.111933118241353	.649494668894860	14015202	-5239313	550628
19	69	2442676.5	1.674190196186906	2.129816932949621	.664784796410796	14366098	-5322995	561389
20	70	2442680.5	1.640233542597642	2.147235992814657	.679929865109102	14717891	-5404823	572316
21	71	2442684.5	1.605918091618513	2.164184896793202	.694926062586081	15070385	-5484783	583401
22	72	2442688.5	1.571250143193737	2.180658309149962	.709769582817657	15423385	-5562866	594631
23	73	2442692.5	1.536236118778305	2.196650962050597	.724456627100803	15776693	-5639074	605988
24	74	2442696.5	1.500882561670508	2.212157657581130	.738983404998919	16130116	-5713421	617451
25	75	2442700.5	1.465196137548020	2.227173270045284	.753346135364122	16483465	-5785932	628994
26	76	2442704.5	1.429183635081863	2.241692748720283	.767541047599870	16836567	-5856637	640585
27	77	2442708.5	1.392851966054465	2.255711121160260	.781564383271174	17189265	-5925566	652194
28	78	2442712.5	1.356208164424608	2.269223496438187	.795412397793999	17541408	-5992736	663797
29	79	2442716.5	1.319259384778576	2.282225067503987	.809081361718473	17892841	-6058155	675378
30	80	2442720.5	1.282012901314857	2.294711112670242	.822567561494377	18243392	-6121831	686923
31	81	2442724.5	1.244476107892829	2.306676997329703	.835867300255536	18592884	-6183775	698417
32	82	2442728.5	1.206656517899368	2.318118176293993	.848976898960302	18941126	-6244009	709842
33	83	2442732.5	1.168561764217068	2.329030195914996	.861892697409903	19287928	-6302567	721174
34	84	2442736.5	1.130199599293903	2.339408697020090	.874611055697354	19633099	-6359490	732388
35	85	2442740.5	1.091577894229481	2.349249417566028	.887128355612415	19976447	-6414828	743453
36	86	2442744.5	1.052704638398154	2.358548195035283	.899441001859191	20317779	-6468638	754337
37	87	2442748.5	1.013587938807028	2.367300969271497	.911545423542229	20656905	-6520985	765003
38	88	2442752.5	.974236019197054	2.375503785041033	.923438075539103	20993633	-6571940	775411
39	89	2442756.5	.934657219242830	2.383152794620941	.935115439883571	21327773	-6621582	785519
40	90	2442760.5	.894859993622681	2.390244260429597	.946574027192142	21659133	-6669999	795280
41	91	2442764.5	.854852911003647	2.396774557626387	.957810378090119	21987521	-6717285	804646
42	92	2442768.5	.814644652960652	2.402740176699226	.968821064645436	22312745	-6763545	813561
43	93	2442772.5	.774244012825438	2.408137726030390	.979602691805859	22634613	-6808891	821969
44	94	2442776.5	.733659894486983	2.412963934425903	.990151898829712	22952933	-6853450	829804
45	95	2442780.5	.692901311191761	2.417215653603392	1.000465360702584	23267514	-6897359	836997
46	96	2442784.5	.651977384431518	2.420889860677661	1.010539789552283	23578168	-6940772	843470
47	97	2442788.5	.610897343000541	2.423983660796225	1.020371936135412	23884718	-6983859	849134
48	98	2442792.5	.569670522094288	2.426494290205810	1.029958591559385	24187003	-7026799	853896
49	99	2442796.5	.528306361873504	2.428419119835553	1.039296589345234	24484880	-7069777	857659
50	100	2442800.5	.486814404942892	2.429755658781247	1.048382807558689	24778220	-7112970	860328

L	STEP	JULIAN DATE	X	Y	Z	PERTURBATIONS IN		10-TH DEC
1	0	2442800.5	.486814404942633	2.429755658788068	1.048382807562369	0	0	0
2	1	2442804.5	.445204293179151	2.430501556852893	1.057214170521796	779	-515	-254
3	2	2442808.5	.403485765169014	2.430654606302483	1.065787650001276	3100	-2020	-1003
4	3	2442812.5	.361668654370149	2.430212743520302	1.074100266449925	6926	-4459	-2222
5	4	2442816.5	.319762887520929	2.429174051873773	1.082149090416642	12211	-7731	-3893
6	5	2442820.5	.277778482861342	2.427536763238265	1.089931244169954	18907	-11942	-5997
7	6	2442824.5	.235725548074596	2.425299261634734	1.097443903386640	26958	-16907	-8519
8	7	2442828.5	.193614278069125	2.422460085458496	1.104684298922400	36312	-22641	-11447
9	8	2442832.5	.151454952429141	2.419017929989806	1.111649718458267	46912	-29118	-14770
10	9	2442836.5	.109257933024947	2.414971650064899	1.118337508281896	58702	-36314	-18480
11	10	2442840.5	.067033661199300	2.410320262501187	1.124745074993868	71625	-44211	-22570
12	11	2442844.5	.024792655038958	2.405062948486687	1.130869887197306	85625	-52792	-27033
13	12	2442848.5	-.017454493516684	2.399199055962640	1.136709477215064	100643	-62046	-31867
14	13	2442852.5	-.059697121676067	2.392728101920724	1.142261442784466	116624	-71965	-37069
15	14	2442856.5	-.101924498893343	2.385649774634672	1.147523448740472	133507	-82546	-42639
16	15	2442860.5	-.144125830060484	2.377963935812133	1.152493228679383	151236	-93789	-48580
17	16	2442864.5	-.186290258773377	2.369670622651014	1.157168586592640	169752	-105704	-54896
18	17	2442868.5	-.228406870620132	2.360770049792336	1.161547398461458	188998	-118305	-61596
19	18	2442872.5	-.270466696402652	2.351262611207261	1.165627613823361	208923	-131616	-68694
20	19	2442876.5	-.312452715208021	2.341148982160435	1.169407257393206	229482	-145670	-76208
21	20	2442880.5	-.354359857459029	2.330429621591790	1.172884430831658	250650	-160503	-84162
22	21	2442884.5	-.396175008520602	2.319105774808833	1.176057314973576	272418	-176148	-92577
23	22	2442888.5	-.437887013405371	2.307178476182855	1.178924171989754	294788	-192624	-101468
24	23	2442892.5	-.479484682117389	2.294649050713602	1.181483346645138	317757	-209933	-110840
25	24	2442896.5	-.520956794482139	2.281519014674444	1.183733268437983	341315	-228076	-120699
26	25	2442900.5	-.562292103956427	2.267790076386348	1.185672451732891	365441	-247058	-131046
27	26	2442904.5	-.603479341671427	2.253464137486731	1.187299497697730	390113	-266885	-141890
28	27	2442908.5	-.644507220382778	2.238543293866869	1.188613095468341	415306	-287571	-153237
29	28	2442912.5	-.685366438373757	2.223029837311941	1.189612023799668	441003	-309137	-165101
30	29	2442916.5	-.726039684349018	2.206926256714709	1.190295152605202	467186	-331600	-177493
31	30	2442920.5	-.766521641801841	2.190235238927372	1.190661444263583	493843	-354986	-190429
32	31	2442924.5	-.806798993678903	2.172959669919152	1.190709955134224	520967	-379317	-203923
33	32	2442928.5	-.846860427299424	2.155102635528948	1.190439836897177	548552	-404617	-217992
34	33	2442932.5	-.886694639180231	2.136667422118649	1.189850337845300	576597	-430909	-232651
35	34	2442936.5	-.926290340005771	2.117657517135797	1.188940804156012	605105	-458219	-247918
36	35	2442940.5	-.965636259658162	2.098076609510514	1.187710681097087	634079	-486568	-263807
37	36	2442944.5	-1.004721152317920	2.077928589906165	1.186159514174179	663524	-515980	-280337
38	37	2442948.5	-1.043533901611815	2.057217550810066	1.184286950212559	693449	-546477	-297523
39	38	2442952.5	-1.082063025787605	2.035947786449654	1.182092738362080	723861	-578085	-315385
40	39	2442956.5	-1.120297682958073	2.014123792527187	1.179576731015651	754772	-610830	-333942
41	40	2442960.5	-1.158226675619744	1.991750265812215	1.176738884652266	786195	-644743	-353216
42	41	2442964.5	-1.195838956458402	1.968832103744710	1.173579260677144	818153	-679858	-373233
43	42	2442968.5	-1.233123532068440	1.945374404329819	1.170098026421812	850686	-716212	-394021
44	43	2442972.5	-1.270069468661987	1.921382466401944	1.166295456404789	883847	-753826	-415604
45	44	2442976.5	-1.306665898202027	1.896861789634613	1.162171933573035	917700	-792709	-437996
46	45	2442980.5	-1.342902025187804	1.871818073481755	1.157727950039195	952301	-832848	-461203
47	46	2442984.5	-1.378767132830177	1.846257215085181	1.152964107213592	987694	-874224	-485226
48	47	2442988.5	-1.414250588121604	1.820185307265966	1.147881115877816	1023911	-916818	-510062
49	48	2442992.5	-1.449341847054725	1.793608636942999	1.142479796512475	1060979	-960611	-535712
50	49	2442996.5	-1.484030459642725	1.766533683166394	1.136761079407641	1098919	-1005591	-562177
51	50	2443000.5	-1.518306074805921	1.738967115805359	1.130726005119179	1137755	-1051745	-589460

L	STEP	JULIAN DATE	X	Y	Z	PERTURBATIONS IN	10-TH DEC	
1	51	2443004.5	-1.552158446140020	1.710915793750758	1.124375724754079	1177506	-1099063	-617564
2	52	2443008.5	-1.585577437045494	1.692386762725592	1.117711500348031	1218195	-1147534	-646493
3	53	2443012.5	-1.618553026052119	1.653387253358041	1.110734703460921	1259843	-1197150	-676252
4	54	2443016.5	-1.651075312276518	1.623924678816230	1.103446818257645	1302473	-1247900	-706846
5	55	2443020.5	-1.683134529676945	1.594006632316187	1.095844938355984	1346104	-1299778	-738279
6	56	2443024.5	-1.714721007316946	1.563640884514797	1.087944268178980	1390759	-1352773	-770558
7	57	2443028.5	-1.745825264589726	1.532835380716705	1.079733122397549	1436457	-1406879	-803687
8	58	2443032.5	-1.776437926372097	1.501598237920284	1.071217925583554	1483218	-1462090	-837673
9	59	2443036.5	-1.806549773107989	1.469937741693492	1.062400711767026	1531059	-1518402	-872525
10	60	2443040.5	-1.836151736790896	1.437862342869451	1.053283623988518	1579998	-1575813	-908250
11	61	2443044.5	-1.865234005789990	1.405380654060501	1.043868913139200	1630053	-1634327	-944861
12	62	2443048.5	-1.893790529421430	1.372501446035329	1.034158938201955	1681245	-1693954	-982372
13	63	2443052.5	-1.921810022180935	1.339233644118828	1.024156164469318	1733603	-1754712	-1020804
14	64	2443056.5	-1.949284967765443	1.305586324900872	1.013863163403883	1787171	-1816617	-1060177
15	65	2443060.5	-1.976207123463659	1.271568713333131	1.003282612142478	1842010	-1879681	-1100513
16	66	2443064.5	-2.002568425446597	1.237190179589845	.992417293063522	1898190	-1943899	-1141821
17	67	2443068.5	-2.028360994476599	1.202460234887383	.981270092835311	1955776	-2009250	-1184105
18	68	2443072.5	-2.053577140875447	1.167388526312216	.969844000858838	2014819	-2075707	-1227363
19	69	2443076.5	-2.078209368262151	1.131984831785410	.958142107637194	2075365	-2143246	-1271593
20	70	2443080.5	-2.102250377323770	1.096259055492539	.946167603411347	2137452	-2211842	-1316793
21	71	2443084.5	-2.125693069250929	1.060221222978470	.933923776560306	2201116	-2281481	-1362965
22	72	2443088.5	-2.148530548931433	1.023881476952212	.921414012355076	2266399	-2352145	-1410110
23	73	2443092.5	-2.170756128897423	.987250072650010	.908641791544312	2333340	-2423821	-1458232
24	74	2443096.5	-2.192363332511093	.950337372878252	.895610688681124	2401985	-2496494	-1507333
25	75	2443100.5	-2.213345897238014	.913153843378996	.882324370622193	2472380	-2570151	-1557417
26	76	2443104.5	-2.233697777933287	.875710047825919	.868786594819632	2544575	-2644776	-1608486
27	77	2443108.5	-2.253413149813881	.838016642768086	.855001207541573	2618622	-2720352	-1660541
28	78	2443112.5	-2.272486411334725	.800094372535444	.840972142050607	2694575	-2796859	-1713584
29	79	2443116.5	-2.290912186914769	.761924064039430	.826703416697924	2772488	-2874278	-1767614
30	80	2443120.5	-2.308685329491340	.723546621497338	.812199122946294	2852417	-2952596	-1822631
31	81	2443124.5	-2.325800922908982	.684963021075703	.797463473318036	2934421	-3031759	-1878631
32	82	2443128.5	-2.342254284102310	.646184305445196	.782500699261131	3018556	-3111772	-1935614
33	83	2443132.5	-2.358040965035158	.607221578250158	.767315148928876	3104882	-3192601	-1993576
34	84	2443136.5	-2.373156754294286	.568085998540713	.751911234898826	3193461	-3274226	-2052520
35	85	2443140.5	-2.387597678258231	.528788775331734	.736293441839972	3284364	-3356627	-2112444
36	86	2443144.5	-2.401360001977466	.489341162577857	.720466324506503	3377678	-3439781	-2173353
37	87	2443148.5	-2.414440230352156	.449754454642212	.704434505809612	3473503	-3523653	-2235241
38	88	2443152.5	-2.426835110138086	.410039981631305	.688202675035335	3571949	-3608187	-2298095
39	89	2443156.5	-2.438541632296321	.370209103796020	.671775585520013	3673117	-3693307	-2361891
40	90	2443160.5	-2.449557033531590	.330273205059333	.655158051766950	3777095	-3778927	-2426595
41	91	2443164.5	-2.459878796549887	.290243686806802	.638354946553971	3883958	-3864958	-2492173
42	92	2443168.5	-2.469504650303333	.250131962254315	.621371198330237	3993772	-3951307	-2558587
43	93	2443172.5	-2.478432569845282	.209946450602985	.604211788439592	4106598	-4037894	-2625801
44	94	2443176.5	-2.486660775905804	.169707572026814	.586881748742826	4222494	-4124597	-2693776
45	95	2443180.5	-2.494187735186017	.129417742326963	.569386159114959	4341516	-4211349	-2762473
46	96	2443184.5	-2.501012159846766	.089091367398527	.551730144740624	4463714	-4298044	-2831850
47	97	2443188.5	-2.507133007069939	.048739838135726	.533918873632313	4589136	-4384580	-2901864
48	98	2443192.5	-2.512549478605536	.008374525089948	.515957553995207	4717826	-4470851	-2972469
49	99	2443196.5	-2.517261019989661	-.031993226800116	.497851431577333	4849822	-4556750	-3043616
50	100	2443200.5	-2.521267319657468	-.072352103395404	.479605787033915	4985156	-4642167	-3115256

L	STEP	JULIAN DATE	X	Y	Z	PERTURBATIONS IN	10-TH DEC	
1	0	2443200.5	-2.521267319657454	-.072352103395441	.479605787033892	-0	-0	0
2	1	2443204.5	-2.524568307899145	-.112690826525050	.461225933265691	179	-410	-235
3	2	2443208.5	-2.527164155647881	-.152998159109537	.442717212744826	726	-1627	-935
4	3	2443212.5	-2.529055273100255	-.193262910242541	.424084994825956	1652	-3630	-2090
5	4	2443216.5	-2.530242308150704	-.233473940239708	.405334673036132	2962	-6398	-3691
6	5	2443220.5	-2.530726144590290	-.273620165651723	.386471662339749	4658	-9915	-5730
7	6	2443224.5	-2.530507899982339	-.313690564193526	.367501396395072	6742	-14169	-8204
8	7	2443228.5	-2.529588923137567	-.353674179425582	.348429324882432	9220	-19155	-11111
9	8	2443232.5	-2.527970791332820	-.393560124897693	.329260911072602	12105	-24868	-14451
10	9	2443236.5	-2.525655307866188	-.433337587686177	.310001629735099	15426	-31295	-18222
11	10	2443240.5	-2.522644500478473	-.472995831956634	.290656965100483	19210	-38409	-22412
12	11	2443244.5	-2.518940620155348	-.512524203354258	.271232408399602	23477	-46164	-27003
13	12	2443248.5	-2.514546139152642	-.551912134155536	.251733454890299	28227	-54515	-31969
14	13	2443252.5	-2.509463747807416	-.591149148043812	.232165600956151	33449	-63415	-37286
15	14	2443256.5	-2.503696351401032	-.630224864214103	.212534341532105	39118	-72825	-42931
16	15	2443260.5	-2.497247066688701	-.669129001589358	.192845167432965	45203	-82712	-48885
17	16	2443264.5	-2.490119218241105	-.707851382105748	.173102563137811	51672	-93047	-55131
18	17	2443268.5	-2.482316335563468	-.746381934251751	.153315004502576	58489	-103806	-61651
19	18	2443272.5	-2.473842149492981	-.784710696694411	.133484956335108	65617	-114970	-68432
20	19	2443276.5	-2.464700588757637	-.822827821388831	.113618870247825	73015	-126522	-75463
21	20	2443280.5	-2.454895776605284	-.860723576855069	.093722182412291	80644	-138450	-82732
22	21	2443284.5	-2.444432027196143	-.898388351304114	.073800311354925	88461	-150743	-90229
23	22	2443288.5	-2.433313841987086	-.935812655611191	.053858655819062	96424	-163395	-97948
24	23	2443292.5	-2.421545906056508	-.972987126202444	.033902592652465	104487	-176403	-105881
25	24	2443296.5	-2.409133084361741	-1.009902527934775	.013937474731270	112607	-189769	-114025
26	25	2443300.5	-2.396080417932879	-1.046549756276718	-.006031371083423	120735	-203498	-122377
27	26	2443304.5	-2.382393119985181	-1.082919840904935	-.025998645965368	128824	-217604	-130938
28	27	2443308.5	-2.368076571903373	-1.119003947218424	-.045959081124817	136827	-232104	-139712
29	28	2443312.5	-2.353136319011597	-1.154793379227307	-.065907439777355	144701	-247027	-148708
30	29	2443316.5	-2.337578066054633	-1.190279581556247	-.085838519001354	152410	-262411	-157940
31	30	2443320.5	-2.321407672538641	-1.225454140978911	-.105747151316510	159935	-278295	-167426
32	31	2443324.5	-2.304631148528528	-1.260308787320135	-.125628205887743	167272	-294715	-177191
33	32	2443328.5	-2.287254651428967	-1.294835394370288	-.145476589645046	174428	-311692	-187216
34	33	2443332.5	-2.269284483249564	-1.329025981612752	-.165287248798604	181404	-329234	-197530
35	34	2443336.5	-2.250727087208574	-1.362872716694994	-.185055170829604	188189	-347345	-208123
36	35	2443340.5	-2.231589043229832	-1.396367917505678	-.204775386391905	194763	-366034	-218992
37	36	2443344.5	-2.211877063618473	-1.429504053583159	-.224442970945336	201104	-385313	-230138
38	37	2443348.5	-2.191597988504157	-1.462273747632445	-.244053045878646	207186	-405201	-241564
39	38	2443352.5	-2.170758781217842	-1.494669776111728	-.263600780648014	212987	-425723	-253276
40	39	2443356.5	-2.149366524546636	-1.526685070091908	-.283081392978076	218487	-446903	-265282
41	40	2443360.5	-2.127428416369114	-1.558312716202771	-.302490150679740	223670	-468772	-277590
42	41	2443364.5	-2.104951765561054	-1.589545957084283	-.321822372579904	228520	-491358	-290209
43	42	2443368.5	-2.081943988067451	-1.620378192024191	-.341073429640012	233027	-514693	-303149
44	43	2443372.5	-2.058412602837961	-1.650802977466924	-.360238746023674	237181	-538808	-316421
45	44	2443376.5	-2.034365227851026	-1.680814027398590	-.379313800092829	240975	-563734	-330034
46	45	2443380.5	-2.009809576173978	-1.710405213675308	-.398294125373656	244403	-589501	-343999
47	46	2443384.5	-1.984753452047443	-1.739570566278786	-.417175311483806	247461	-616142	-358327
48	47	2443388.5	-1.959204746996946	-1.768304273509692	-.435953005026199	250143	-643688	-373028
49	48	2443392.5	-1.933171435949589	-1.796600682135889	-.454622910460174	252448	-672174	-388115
50	49	2443396.5	-1.906661573308234	-1.824454297500317	-.473180790957150	254371	-701635	-403601
51	50	2443400.5	-1.879683288890533	-1.851859783546907	-.491622469227327	255915	-732114	-419503

L	STEP	JULIAN DATE	X	Y	Z	PERTURBATIONS IN	10-TH DEC	
1	51	2443404.5	-1.852244783659252	-1.878811962605660	-.509943828239763	257088	-763657	-435840
2	52	2443408.5	-1.824354325390075	-1.905305814654945	-.528140811669296	257916	-796309	-452635
3	53	2443412.5	-1.796020244874470	-1.931336476003445	-.546209423977750	258438	-830136	-469905
4	54	2443416.5	-1.767250933175120	-1.956899238042496	-.564145730424492	258701	-865066	-487659
5	55	2443420.5	-1.738054839425380	-1.981988546867545	-.581945857485874	258744	-901190	-505896
6	56	2443424.5	-1.708440468018040	-2.006603003691652	-.599605993760623	258593	-938473	-524612
7	57	2443428.5	-1.678416374749929	-2.030735364909972	-.617122390793728	258261	-976910	-543801
8	58	2443432.5	-1.647991163211650	-2.054382541558539	-.634491362549397	257753	-1016497	-563455
9	59	2443436.5	-1.617173480982366	-2.077540598934917	-.651709290988268	257071	-1057237	-583573
10	60	2443440.5	-1.585972015823558	-2.100205755342571	-.668772616173243	256216	-1099133	-604151
11	61	2443444.5	-1.554395492787584	-2.122374381176769	-.685677846461612	255184	-1142190	-625189
12	62	2443448.5	-1.522452670747349	-2.144042398142950	-.702421553824912	253972	-1186415	-646685
13	63	2443452.5	-1.490152339242925	-2.165208278039287	-.719000374899920	252576	-1231816	-668639
14	64	2443456.5	-1.457503315525685	-2.185867041784491	-.735411011147305	250991	-1278402	-691052
15	65	2443460.5	-1.424514441501451	-2.206016258367384	-.751650228975224	249207	-1326182	-713924
16	66	2443464.5	-1.391194580793176	-2.225653043729665	-.767714859815623	247215	-1375167	-737257
17	67	2443468.5	-1.357552615868698	-2.244774659645685	-.783601800175582	245003	-1425370	-761053
18	68	2443472.5	-1.323597445218994	-2.263378512583046	-.799308011687735	242556	-1476805	-785315
19	69	2443476.5	-1.289337980588755	-2.281462152554298	-.814830521132059	239858	-1529491	-810047
20	70	2443480.5	-1.254783144235368	-2.299023271975187	-.830166420460067	236890	-1583451	-835257
21	71	2443484.5	-1.219941866164937	-2.316059704533586	-.845312866821786	233630	-1638713	-860955
22	72	2443488.5	-1.184823081254258	-2.332569424025252	-.860267082582514	230061	-1695315	-887156
23	73	2443492.5	-1.149435726180712	-2.348550542995440	-.875026355251020	226170	-1753302	-913879
24	74	2443496.5	-1.113788736309644	-2.364001310902751	-.889588037152055	221962	-1812724	-941149
25	75	2443500.5	-1.077891043137463	-2.378920111750887	-.903949544752464	217452	-1873624	-968985
26	76	2443504.5	-1.041751572801019	-2.393305461843084	-.918108357939190	212665	-1936030	-997405
27	77	2443508.5	-1.005379245134932	-2.407156008453541	-.932062019727649	207619	-1999961	-1026414
28	78	2443512.5	-.968782972118142	-2.420470529329819	-.945808136473115	202318	-2065429	-1056018
29	79	2443516.5	-.931971655292234	-2.433247931880260	-.959344378014130	196757	-2132454	-1086222
30	80	2443520.5	-.894954183436063	-2.445487251807307	-.972668477487776	190924	-2201058	-1117033
31	81	2443524.5	-.857739430044600	-2.457187651943769	-.985778231268405	184806	-2271273	-1148466
32	82	2443528.5	-.820336250825530	-2.468348420254046	-.998671498452218	178391	-2343136	-1180533
33	83	2443532.5	-.782753482105720	-2.478968968232834	-1.011346200455606	171670	-2416687	-1213254
34	84	2443536.5	-.744999938666595	-2.489048829468075	-1.023800320755569	164633	-2491970	-1246646
35	85	2443540.5	-.707084411891778	-2.498587657815563	-1.036031904383222	157278	-2569033	-1280732
36	86	2443544.5	-.669015668128093	-2.507585225961774	-1.048039057546376	149602	-2647925	-1315535
37	87	2443548.5	-.630802446933803	-2.516041423346550	-1.059819947235752	141606	-2728696	-1351078
38	88	2443552.5	-.592453459451079	-2.523956255560122	-1.071372800799779	133292	-2811399	-1387387
39	89	2443556.5	-.553977386840476	-2.531329841776596	-1.082695905527430	124669	-2896088	-1424498
40	90	2443560.5	-.515382878761681	-2.538162413705933	-1.093787608230976	115740	-2982820	-1462411
41	91	2443564.5	-.476678551901168	-2.544454313975621	-1.104646314834540	106520	-3071654	-1501183
42	92	2443568.5	-.437872988521262	-2.550205994656054	-1.115270489978705	97020	-3162650	-1540838
43	93	2443572.5	-.398974734977365	-2.555418015833695	-1.125658656648675	87257	-3255875	-1581410
44	94	2443576.5	-.359992300111202	-2.560091044186890	-1.135809395811506	77253	-3351401	-1622937
45	95	2443580.5	-.320934153441469	-2.564225851402171	-1.145721345983411	67042	-3449305	-1665461
46	96	2443584.5	-.281808723303955	-2.567823312146913	-1.155393202559544	56675	-3549665	-1709030
47	97	2443588.5	-.242624395541472	-2.570884401547502	-1.164823716817509	46223	-3652550	-1753683
48	98	2443592.5	-.203389513248675	-2.573410192832569	-1.174011694895682	35768	-3758010	-1799457
49	99	2443596.5	-.164112377044550	-2.575401855930295	-1.182955997223452	25384	-3866079	-1846375
50	100	2443600.5	-.124801244712538	-2.576860656923643	-1.191655538470769	15139	-3976785	-1894459

L	STEP	JULIAN DATE	X	Y	Z	PERTURBATIONS IN		10-TH DEC
1	0	2443600.5	-.124801244692320	-2.576860656934045	-1.191655528478422	-0	-0	-0
2	1	2443604.5	-.085464329801276	-2.577787957185407	-1.200109287428063	163	-504	-216
3	2	2443608.5	-.046109800514307	-2.578185212168933	-1.208316266646877	663	-2012	-860
4	3	2443612.5	-.006745778161066	-2.578053969964998	-1.216275552115903	1515	-4513	-1928
5	4	2443616.5	.032619663806655	-2.577395869677332	-1.223986272473709	2734	-8001	-3415
6	5	2443620.5	.071978500726142	-2.576212639970988	-1.231447608653554	4334	-12469	-5320
7	6	2443624.5	.111322757537574	-2.574506097047077	-1.238658793224403	6332	-17910	-7638
8	7	2443628.5	.150644509541286	-2.572278144190250	-1.245619109880636	8742	-24316	-10367
9	8	2443632.5	.189935883081238	-2.569530769290395	-1.252327892885425	11581	-31678	-13502
10	9	2443636.5	.229189056205474	-2.566266043985166	-1.258784526571823	14863	-39985	-17040
11	10	2443640.5	.268396259290757	-2.562486122170682	-1.264988444818322	18601	-49225	-20975
12	11	2443644.5	.307549775619474	-2.558193238673553	-1.270939130547838	22806	-59386	-25302
13	12	2443648.5	.346641941934410	-2.553389707961756	-1.276636115240599	27488	-70455	-30015
14	13	2443652.5	.385665148972750	-2.548077922904284	-1.282078978466572	32651	-82419	-35109
15	14	2443656.5	.424611842004934	-2.542260353593477	-1.287267347447568	38299	-95266	-40580
16	15	2443660.5	.463474521432987	-2.535939546231432	-1.292200896655402	44432	-108990	-46425
17	16	2443664.5	.502245743541078	-2.529118122034745	-1.296879347431314	51050	-123589	-52644
18	17	2443668.5	.540918121476537	-2.521798775991996	-1.301302467546058	58160	-139064	-59242
19	18	2443672.5	.579484326306620	-2.513984275188989	-1.305470070532294	65779	-155422	-66223
20	19	2443676.5	.617937087547908	-2.505677456653387	-1.309382014701612	73938	-172657	-73592
21	20	2443680.5	.656269192668244	-2.496881225381642	-1.313038202149876	82671	-190750	-81343
22	21	2443684.5	.694473486096321	-2.487598553332049	-1.316438578225913	92003	-209667	-89462
23	22	2443688.5	.732542868899223	-2.477832479277268	-1.319583131525533	101941	-229368	-97933
24	23	2443692.5	.770470299519289	-2.467586108359029	-1.322471893831569	112483	-249820	-106738
25	24	2443696.5	.808248794281560	-2.456862611137225	-1.325104939756237	123614	-270991	-115863
26	25	2443700.5	.845871428159281	-2.445665222865671	-1.327482386528189	135313	-292859	-125294
27	26	2443704.5	.883331335535981	-2.433997241957383	-1.329604393342386	147563	-315406	-135024
28	27	2443708.5	.920621710118589	-2.421862028898914	-1.331471160858577	160337	-338618	-145045
29	28	2443712.5	.957735805476137	-2.409263005324377	-1.333082930850622	173614	-362487	-155352
30	29	2443716.5	.994666935280360	-2.396203652744276	-1.334439985632258	187367	-387007	-165942
31	30	2443720.5	1.031408473410153	-2.382687511577927	-1.335542647632550	201573	-412175	-176813
32	31	2443724.5	1.067953854192659	-2.368718180165729	-1.336391278971064	216203	-437993	-187965
33	32	2443728.5	1.104296572570000	-2.354299313775797	-1.336986281018703	231232	-464464	-199399
34	33	2443732.5	1.140430184246327	-2.339434623665852	-1.337328093985711	246633	-491598	-211120
35	34	2443736.5	1.176348305830480	-2.324127876179219	-1.337417196523873	262377	-519406	-223131
36	35	2443740.5	1.212044614974104	-2.308382891385927	-1.337254105350887	278437	-547905	-235441
37	36	2443744.5	1.247512850529532	-2.292203544781231	-1.336839374905338	294784	-577117	-248060
38	37	2443748.5	1.282746812781619	-2.275593761543192	-1.336173597039107	311391	-607073	-261002
39	38	2443752.5	1.317740363845203	-2.258557520802555	-1.335257400731294	328235	-637811	-274286
40	39	2443756.5	1.352487428305196	-2.241098852258105	-1.334091451742644	345305	-669378	-287937
41	40	2443760.5	1.386981993940957	-2.223221835352533	-1.332676452041326	362605	-701823	-301981
42	41	2443764.5	1.421218111928859	-2.204930597464696	-1.331013138914464	380155	-735190	-316446
43	42	2443768.5	1.455189996027449	-2.186229312286528	-1.329102284072306	397986	-769510	-331350
44	43	2443772.5	1.488891521288288	-2.167122199165277	-1.326944693219112	416126	-804798	-346704
45	44	2443776.5	1.522317223452823	-2.147613523296371	-1.324541206148488	434590	-841066	-362516
46	45	2443780.5	1.555461299413693	-2.127707595605969	-1.321892696780488	453388	-878329	-378794
47	46	2443784.5	1.588318107448742	-2.107408772132871	-1.319000072905830	472523	-916606	-395548
48	47	2443788.5	1.620882067732239	-2.086721453631412	-1.315864276075814	492002	-955924	-412792
49	48	2443792.5	1.653147662837540	-2.065650084361607	-1.312486281054802	511835	-996311	-430542
50	49	2443796.5	1.685109437408144	-2.044199151334780	-1.308867095430223	532034	-1037797	-448813
51	50	2443800.5	1.716761998465152	-2.022373183714947	-1.305007759370213	552616	-1080413	-467624

L	STEP	JULIAN DATE	X	Y	Z	PERTURBATIONS IN	10-TH DEC	
1	51	2443804.5	1.748100015417073	-2.000176751869631	-1.300909345141969	573602	-1124192	-486992
2	52	2443808.5	1.779118219947598	-1.977614466730998	-1.296572056902786	595018	-1169164	-506935
3	53	2443812.5	1.809811406045739	-1.954690979131939	-1.291999730191328	616892	-1215361	-527472
4	54	2443816.5	1.840174429969039	-1.931410979136949	-1.287190831806388	639256	-1262810	-548620
5	55	2443820.5	1.870202210195707	-1.907779195428049	-1.282147459424951	662145	-1311539	-570397
6	56	2443824.5	1.899889727379086	-1.883800394724226	-1.276870841328034	685596	-1361575	-592819
7	57	2443828.5	1.929237024311567	-1.859479381245961	-1.271362236169523	709648	-1412943	-615903
8	58	2443832.5	1.958324205903456	-1.834820996237013	-1.265622932748578	734341	-1465669	-639667
9	59	2443836.5	1.986361439263357	-1.809830117545168	-1.259654249832757	759720	-1519778	-664130
10	60	2443840.5	2.013138953940991	-1.784511659214701	-1.253457536002834	785833	-1575300	-689311
11	61	2443844.5	2.043052042428243	-1.758870570922980	-1.247034169438296	812736	-1632267	-715233
12	62	2443848.5	2.070596060751257	-1.732911836976271	-1.240385557481439	840505	-1690708	-741921
13	63	2443852.5	2.097766428545965	-1.706640474825612	-1.233513135875533	869230	-1750638	-769394
14	64	2443856.5	2.124558628127218	-1.680061533775984	-1.226418268022550	899007	-1812054	-797660
15	65	2443860.5	2.150968203102224	-1.653180094665792	-1.219102744697850	929927	-1874933	-826718
16	66	2443864.5	2.176990757690305	-1.626001270392635	-1.211567784295930	962067	-1939243	-856562
17	67	2443868.5	2.202621957113024	-1.598530206110769	-1.203815033013356	995493	-2004949	-887181
18	68	2443872.5	2.227857527761657	-1.570772078980506	-1.195846064744053	1030262	-2072018	-918568
19	69	2443876.5	2.252693257664561	-1.542732098052987	-1.187662481120611	1066427	-2140416	-950713
20	70	2443880.5	2.277124996944664	-1.514415503384228	-1.179265911117120	1104041	-2210113	-983608
21	71	2443884.5	2.301148657468474	-1.485827565658738	-1.170658010817171	1143154	-2281071	-1017244
22	72	2443888.5	2.324760213148352	-1.456973585873392	-1.161840463324161	1183813	-2353257	-1051612
23	73	2443892.5	2.347955699954468	-1.427858894718334	-1.152814978454906	1226064	-2426634	-1086703
24	74	2443896.5	2.370731215826225	-1.398488852254332	-1.143583292586229	1269951	-2501162	-1122504
25	75	2443900.5	2.393082920739772	-1.368868847558659	-1.134147168500412	1315514	-2576801	-1159005
26	76	2443904.5	2.415007036723608	-1.339004298360351	-1.124508395219387	1362790	-2653508	-1196194
27	77	2443908.5	2.436499847879702	-1.308900650723828	-1.114668787865391	1411813	-2731242	-1234057
28	78	2443912.5	2.457557700422740	-1.278563378758449	-1.104630187537225	1462610	-2809959	-1272582
29	79	2443916.5	2.478177002738974	-1.247997984364602	-1.094394461208253	1515207	-2889618	-1311757
30	80	2443920.5	2.498354225488214	-1.217209997028228	-1.083963501654829	1569624	-2970191	-1351569
31	81	2443924.5	2.518085901803659	-1.186204973664090	-1.073339227421101	1625878	-3051611	-1392011
32	82	2443928.5	2.537368627681261	-1.154988498459041	-1.062523582803529	1683985	-3133880	-1433076
33	83	2443932.5	2.556199062633937	-1.123566182545523	-1.051518537772068	1743969	-3216965	-1474763
34	84	2443936.5	2.574573930446164	-1.091943663220050	-1.040326087658137	1805862	-3301846	-1517072
35	85	2443940.5	2.592490019416672	-1.060126602669349	-1.028946252527769	1869709	-3365494	-1560001
36	86	2443944.5	2.609944181604604	-1.028120686885600	-1.017387076553234	1935562	-3470863	-1603539
37	87	2443948.5	2.626933331637034	-.995931625540102	-1.005644627854522	2003460	-3556897	-1647669
38	88	2443952.5	2.643454446238408	-.963565152684382	-.993722998858455	2073427	-3643532	-1692367
39	89	2443956.5	2.659504564831167	-.931027027108609	-.981624306585161	2145477	-3730710	-1737613
40	90	2443960.5	2.675080789911689	-.898323032201077	-.969350692645115	2219613	-3818378	-1783386
41	91	2443964.5	2.690180287740091	-.865458976005694	-.956904323375429	2295834	-3906488	-1829670
42	92	2443968.5	2.704800289008574	-.832440690449282	-.944287389530292	2374141	-3995000	-1876451
43	93	2443972.5	2.718938088713259	-.799274031030833	-.931502106138115	2454532	-4083873	-1923715
44	94	2443976.5	2.732591046682685	-.765964876627386	-.918550712489782	2537003	-4173072	-1971452
45	95	2443980.5	2.745756587809723	-.732519128945792	-.905435471907889	2621555	-4262565	-2019652
46	96	2443984.5	2.758432202188857	-.698942712267552	-.892158671664653	2708185	-4352320	-2068306
47	97	2443988.5	2.770615445407643	-.665241573149597	-.878722622893228	2796892	-4442308	-2117405
48	98	2443992.5	2.782303938784381	-.631421680104811	-.865129660484058	2887677	-4532501	-2166943
49	99	2443996.5	2.793495369610682	-.597489023321074	-.851382143003747	2980538	-4622874	-2216914
50	100	2444000.5	2.804187491409536	-.563449614397353	-.837482452625849	3075476	-4713403	-2267311

L	STEP	JULIAN DATE	X	Y	Z	PERTURBATIONS IN		10-TH DEC
1	0	2444000.5	2.804187491409536	-.563449614397353	-.837482452625849	0	-0	-0
2	1	2444004.5	2.814378124210904	-.529309496107834	-.823432885070862	192	-267	-81
3	2	2444008.5	2.824065154867654	-.495074692204991	-.809236199627414	751	-1092	-331
4	3	2444012.5	2.833246537466479	-.460751307276038	-.794894519071555	1653	-2469	-760
5	4	2444016.5	2.841920293025639	-.426345426561797	-.780410429782204	2878	-4462	-1383
6	5	2444020.5	2.850084514853236	-.391863165637883	-.765786431654252	4419	-7097	-2219
7	6	2444024.5	2.857737360500949	-.357310659599710	-.751025047826996	6284	-10415	-3291
8	7	2444028.5	2.864877061190796	-.322694061767475	-.736128824087320	8499	-14448	-4617
9	8	2444032.5	2.871501916752294	-.288019542573956	-.721100328271607	11093	-19211	-6209
10	9	2444036.5	2.877610295519432	-.253293289411431	-.705942150137940	14114	-24703	-8069
11	10	2444040.5	2.883200634060330	-.218521507294140	-.690656901751758	17563	-30920	-10196
12	11	2444044.5	2.888271437970090	-.183710419164370	-.675247217791526	21456	-37857	-12588
13	12	2444048.5	2.892821282431015	-.148866265703771	-.659715755567088	25800	-45512	-15245
14	13	2444052.5	2.896849813095232	-.113995305334270	-.644065195174353	30599	-53888	-18167
15	14	2444056.5	2.900352746930409	-.079103813394807	-.628298239200948	35860	-62989	-21358
16	15	2444060.5	2.903331872278031	-.044198081727429	-.612417612603956	41592	-72818	-24819
17	16	2444064.5	2.905785049569459	-.009284418515063	-.596426062711277	47803	-83379	-28555
18	17	2444068.5	2.907711211738516	.025630852431252	-.580326359005490	54507	-94676	-32567
19	18	2444072.5	2.909109364545415	.060541391945671	-.564121293055170	61714	-106709	-36859
20	19	2444076.5	2.909978587053971	.095440845389791	-.547813678437272	69438	-119479	-41430
21	20	2444080.5	2.910318032055741	.130322845546977	-.531406350643547	77691	-132983	-46282
22	21	2444084.5	2.910126926501832	.165181007982275	-.514902167007804	86485	-147217	-51415
23	22	2444088.5	2.909404571952820	.200008936388660	-.498304006643596	95831	-162176	-56828
24	23	2444092.5	2.908150345049933	.234800220409570	-.481614770398936	105737	-177855	-62520
25	24	2444096.5	2.906363698031911	.269548436424662	-.464837380835409	116209	-194250	-68491
26	25	2444100.5	2.904044159352594	.304247147798966	-.447974782240799	127254	-211358	-74741
27	26	2444104.5	2.901191334493760	.338889905144931	-.431029940654764	138876	-229181	-81274
28	27	2444108.5	2.897804907043522	.373470246769312	-.414005843825009	151089	-247726	-88096
29	28	2444112.5	2.893884639872581	.407981699591531	-.396905500922259	163918	-266998	-95216
30	29	2444116.5	2.889430375789743	.442417780561046	-.379731941936125	177400	-286993	-102635
31	30	2444120.5	2.884442037204494	.476771997886910	-.362488217071347	191577	-307688	-110351
32	31	2444124.5	2.878919625372333	.511037851315251	-.345177396612957	206480	-329046	-118347
33	32	2444128.5	2.872863220383351	.545208831605159	-.327802571298950	222126	-351023	-126605
34	33	2444132.5	2.866272982215463	.579278420379808	-.310366852603138	238515	-373578	-135107
35	34	2444136.5	2.859149151553765	.613240090474758	-.292873372729508	255641	-396673	-143833
36	35	2444140.5	2.851492050946646	.647087306112862	-.275325284735855	273491	-420277	-152768
37	36	2444144.5	2.843302085914956	.680813523926240	-.257725762200721	292050	-444360	-161899
38	37	2444148.5	2.834579745287172	.714412193511766	-.240077999062450	311302	-468897	-171213
39	38	2444152.5	2.825325602196315	.747876757910706	-.222385209568833	331226	-493864	-180699
40	39	2444156.5	2.815540314769194	.781200654447304	-.204650628004568	351802	-519242	-190346
41	40	2444160.5	2.805224626733050	.814377315293903	-.186877508558661	373008	-545011	-200146
42	41	2444164.5	2.794379368174290	.847400168102979	-.169069125173590	394821	-571154	-210089
43	42	2444168.5	2.783005456242208	.880262636676360	-.151228771370706	417214	-597658	-220170
44	43	2444172.5	2.771103895858673	.912958141617590	-.133359760087525	440161	-624512	-230380
45	44	2444176.5	2.758675780442545	.945480100987499	-.115465423516768	463631	-651707	-240717
46	45	2444180.5	2.745722292650626	.977821930953578	-.097549112952728	487595	-679239	-251176
47	46	2444184.5	2.732244705159133	1.009977046419991	-.079614198654462	512020	-707109	-261758
48	47	2444188.5	2.718244381540330	1.041938861638542	-.061664069731320	536874	-735324	-272464
49	48	2444192.5	2.703722777326760	1.073700790850481	-.043702134033647	562126	-763902	-283302
50	49	2444196.5	2.688681441334651	1.105256249131564	-.025731817963587	587755	-792864	-294284
51	50	2444200.5	2.673122017071464	1.136598653726338	-.007756566034777	613754	-822238	-305424

1 CERES RECTANGULAR SPACE COORDINATES

L	STEP	JULIAN DATE	X	Y	Z	PERTURBATIONS IN		10-TH DEC
1	51	2444204.5	2.657046243606345	1.167721425894108	.010220159899003	640133	-852043	-316736
2	52	2444208.5	2.640455955435257	1.198617992575002	.028194881395822	666908	-882285	-328223
3	53	2444212.5	2.623353091924122	1.229281787115909	.046164103774923	694083	-912955	-339884
4	54	2444216.5	2.605739647491134	1.259706249214886	.064124315889170	721669	-944042	-351711
5	55	2444220.5	2.587617772835159	1.289884825263725	.082071990061012	749638	-975536	-363699
6	56	2444224.5	2.568989675909535	1.319810969192631	.100003582287264	777978	-1007436	-375843
7	57	2444228.5	2.549857673228459	1.349478143158322	.117915532327733	806668	-1039744	-388144
8	58	2444232.5	2.530224191097239	1.378879819091715	.135804264259948	835690	-1072466	-400601
9	59	2444236.5	2.510091716063840	1.408009479779693	.153666186862353	865029	-1105612	-413217
10	60	2444240.5	2.489462896018779	1.436860619893579	.171497693000154	894667	-1139193	-425996
11	61	2444244.5	2.468340440966585	1.465426747380512	.189295164637482	924594	-1173220	-438941
12	62	2444248.5	2.446727173705914	1.493701384590399	.207054964215820	954798	-1207707	-452057
13	63	2444252.5	2.424626020640261	1.521678069483684	.224773444058285	985269	-1242666	-465348
14	64	2444256.5	2.402040017531415	1.549350356874925	.242446942303054	1015999	-1278109	-478819
15	65	2444260.5	2.378972285225771	1.576711819677179	.260071784231235	1046981	-1314049	-492475
16	66	2444264.5	2.355426080392476	1.603756050147929	.277644282698747	1078207	-1350499	-506320
17	67	2444268.5	2.331404746255572	1.630476661137500	.295160738566903	1109670	-1387472	-520360
18	68	2444272.5	2.306911738350920	1.656867287322918	.312617441122178	1141364	-1424982	-534600
19	69	2444276.5	2.281950620358359	1.682921586428002	.330010668475838	1173283	-1463047	-549049
20	70	2444280.5	2.256525065107425	1.708633240480744	.347336687989136	1205424	-1501688	-563718
21	71	2444284.5	2.230638855820771	1.733995957281451	.364591756725755	1237793	-1540934	-578621
22	72	2444288.5	2.204295887422930	1.759003472367297	.381772122242829	1270411	-1580807	-593773
23	73	2444292.5	2.177500167287775	1.783649551490470	.398874023654068	1303313	-1621324	-609184
24	74	2444296.5	2.150255814962136	1.807927992913129	.415893692723428	1336539	-1662479	-624858
25	75	2444300.5	2.122567061456792	1.831832628763607	.432827354495858	1370123	-1704253	-640787
26	76	2444304.5	2.094438249267128	1.855357325621966	.449671227439733	1404081	-1746618	-656958
27	77	2444308.5	2.065873833416404	1.878495985517283	.466421523704286	1438417	-1789548	-673358
28	78	2444312.5	2.036878382220280	1.901242547422122	.483074449671905	1473129	-1833018	-689975
29	79	2444316.5	2.007456578376093	1.923590588599180	.499626206397785	1508207	-1877008	-706798
30	80	2444320.5	1.977613219943208	1.945535326810301	.516072990522954	1543640	-1921499	-723818
31	81	2444324.5	1.947353220536769	1.967069622051980	.532410995015039	1579413	-1966472	-741023
32	82	2444328.5	1.916681610151997	1.988187978252490	.548636409824013	1615509	-2011913	-758407
33	83	2444332.5	1.885603535635376	2.008884545328641	.564745422767686	1651909	-2057803	-775960
34	84	2444336.5	1.854124261049748	2.029153520981879	.580734220289393	1688588	-2104129	-793673
35	85	2444340.5	1.822249168154364	2.048989152578556	.596598988249674	1725520	-2150874	-811539
36	86	2444344.5	1.789983756794598	2.068385739076220	.612335912753095	1762673	-2198026	-829550
37	87	2444348.5	1.757333645262563	2.087337632944752	.627941180976876	1800012	-2245572	-847698
38	88	2444352.5	1.724304570636590	2.105839242103286	.643410982010870	1837497	-2293502	-865977
39	89	2444356.5	1.690902389099286	2.123885031860297	.658741507703425	1875082	-2341812	-884382
40	90	2444360.5	1.657133076258553	2.141469526845611	.673928953504070	1912718	-2390500	-902911
41	91	2444364.5	1.623002727524707	2.158587312933761	.688969519297615	1950352	-2439572	-921565
42	92	2444368.5	1.588517558635616	2.175233039210511	.703859410247979	1987930	-2489043	-940349
43	93	2444372.5	1.553683906399257	2.191401420157078	.718594837738259	2025403	-2539939	-959275
44	94	2444376.5	1.518508229471507	2.207087238337593	.733172020578809	2062735	-2589286	-978356
45	95	2444380.5	1.482997108541639	2.222285347601215	.747587186554291	2099900	-2640107	-997607
46	96	2444384.5	1.447157245465939	2.236990676095900	.761836573980769	2136878	-2691413	-1017031
47	97	2444388.5	1.410995461945461	2.251198228341948	.775916432808923	2173639	-2743203	-1036630
48	98	2444392.5	1.374518698909760	2.264903086542787	.789823025249465	2210135	-2795477	-1056401
49	99	2444396.5	1.337734016881335	2.278100412319219	.803552626527217	2246310	-2848241	-1076344
50	100	2444400.5	1.300648596021382	2.290785448932596	.817101525933492	2282099	-2901508	-1096461

L	STEP	JULIAN DATE	X	Y	Z	PERTURBATIONS IN		10-TH DEC
1	0	2444400.5	1.300648595995760	2.290785448916836	.817101525927693	0	0	0
2	1	2444404.5	1.263269736493790	2.302953523355924	.830466027767688	287	-123	-47
3	2	2444408.5	1.225604658539171	2.314600049280358	.843642452813587	1119	-485	-185
4	3	2444412.5	1.187661502043149	2.325720529393919	.856627139482089	2450	-1081	-410
5	4	2444416.5	1.149447326333352	2.336310558064497	.869416445151273	4235	-1910	-719
6	5	2444420.5	1.110970109733081	2.346365823901806	.882006747471337	6428	-2973	-1113
7	6	2444424.5	1.072237749062445	2.355882112338875	.894394445650327	8985	-4278	-1591
8	7	2444428.5	1.033253259062578	2.364855308223710	.906575961993428	11863	-5834	-2159
9	8	2444432.5	.994031771750352	2.373281398411933	.918547742885384	15016	-7654	-2821
10	9	2444436.5	.954590535693193	2.381156474371650	.930306260518503	18403	-9757	-3583
11	10	2444440.5	.914918915212212	2.388476734778877	.941848014128979	21981	-12162	-4455
12	11	2444444.5	.875033389518752	2.395238488100730	.953169531404917	25707	-14895	-5446
13	12	2444448.5	.834942551306897	2.401438155150302	.964267369880375	29541	-17987	-6571
14	13	2444452.5	.794655108355659	2.407072271611611	.975138118314337	33443	-21476	-7846
15	14	2444456.5	.754173877732298	2.412137490584342	.985778398077201	37380	-25407	-9293
16	15	2444460.5	.713525790155203	2.416630585322508	.996184864631182	41329	-29833	-10939
17	16	2444464.5	.672701886901187	2.420548452450760	1.006354209275855	45284	-34811	-12813
18	17	2444468.5	.631717318918401	2.423888115663686	1.016283161226696	49258	-40388	-14942
19	18	2444472.5	.590591344542386	2.426646729197785	1.025968489693149	53270	-46596	-17345
20	19	2444476.5	.549303326569664	2.428821580324879	1.035407005492324	57335	-53454	-20033
21	20	2444480.5	.507892730057339	2.430410091051328	1.044595562178174	61460	-60977	-23014
22	21	2444484.5	.466359121042538	2.431409820210717	1.053531057295316	65641	-69180	-26296
23	22	2444488.5	.424712164891988	2.431818465997409	1.062210433916611	69872	-78085	-29889
24	23	2444492.5	.382961624913467	2.431633868320276	1.070630682067666	74146	-87718	-33805
25	24	2444496.5	.341117360749172	2.430854011974120	1.078788840621883	78461	-98107	-38059
26	25	2444500.5	.299189325924948	2.429477029266991	1.086681999001947	82814	-109280	-42664
27	26	2444504.5	.257187565947850	2.427501202579606	1.094307298799613	87207	-121268	-47637
28	27	2444508.5	.215122215960296	2.424924967216455	1.101661935608774	91645	-134101	-52994
29	28	2444512.5	.173003498220033	2.421746913935024	1.108743160716180	96134	-147808	-58750
30	29	2444516.5	.130841719611577	2.417965791499384	1.115548282813954	100682	-162415	-64920
31	30	2444520.5	.088647268991103	2.413580509207208	1.122074669727980	105298	-177950	-71519
32	31	2444524.5	.046430614425250	2.408590139339452	1.128319750128014	109993	-194437	-78563
33	32	2444528.5	.004202300334246	2.402993919546475	1.134281015228268	114777	-211899	-86064
34	33	2444532.5	-.038027055460712	2.396791255155279	1.139956020467132	119661	-230361	-94037
35	34	2444536.5	-.080246764759345	2.389981721382156	1.145342387158529	124653	-249847	-102497
36	35	2444540.5	-.122446072017589	2.382565065447167	1.150437804105160	129763	-270383	-111461
37	36	2444544.5	-.164614157304378	2.374541208639982	1.155240029191859	135005	-291999	-120947
38	37	2444548.5	-.206740139103655	2.365910248511796	1.159746891044918	140400	-314732	-130979
39	38	2444552.5	-.248813077157941	2.356672461476009	1.163956290928503	145983	-338613	-141579
40	39	2444556.5	-.290821975971239	2.346828305819187	1.167866204943330	151803	-363665	-152768
41	40	2444560.5	-.332755789419990	2.336378424407144	1.171474686190535	157913	-389893	-164555
42	41	2444564.5	-.374603425853035	2.325323646338120	1.174779866436872	164359	-417285	-176943
43	42	2444568.5	-.416353752519539	2.313664987733191	1.177779957264185	171170	-445824	-189928
44	43	2444572.5	-.457995599074129	2.301403652853637	1.180473251314467	178362	-475495	-203510
45	44	2444576.5	-.499517761455975	2.288541035576529	1.182858123780463	185946	-506285	-217684
46	45	2444580.5	-.540909005490420	2.275078720620641	1.184933033749509	193924	-538188	-232454
47	46	2444584.5	-.582158070716186	2.261018485514327	1.186696525983237	202300	-571198	-247822
48	47	2444588.5	-.623253675032714	2.246362301935974	1.188147232461141	211075	-605312	-263790
49	48	2444592.5	-.664184518784108	2.231112336920461	1.189283873810140	220246	-640532	-280366
50	49	2444596.5	-.704939289275710	2.215270954277102	1.190105260907202	229811	-676857	-297555
51	50	2444600.5	-.745506665437222	2.198840715610871	1.190610296300257	239765	-714291	-315364

L	STEP	JULIAN DATE	X	Y	Z	PERTURBATIONS IN		10-TH DEC
1	51	2444604.5	-.7858763322434023	2.191824381294916	1.190797975e13037	250104	-752837	-333800
2	52	2444508.5	-.826033936417751	2.154224911342401	1.190667388925547	260818	-792500	-352374
3	53	2444612.5	-.865971189353321	2.146045466127518	1.190217722096818	271898	-833289	-372594
4	54	2444616.5	-.905675773908555	2.127289406971457	1.189448258036528	283333	-875212	-393971
5	55	2444620.5	-.945136398402713	2.107960296577318	1.188358377916508	295108	-918282	-416017
6	56	2444624.5	-.984341791784257	2.088061899299589	1.186947562310920	307209	-962517	-439749
7	57	2444628.5	-1.023280708578127	2.067598181244321	1.185215392256708	319618	-1007938	-464183
8	58	2444632.5	-1.061941933705455	2.046573310250821	1.183161550251320	332324	-1054577	-489343
9	59	2444636.5	-1.100314287103380	2.024991655930350	1.180785821273720	345323	-1102471	-515256
10	60	2444640.5	-1.138386628331581	2.002857790045027	1.178088093999382	358626	-1151658	-529951
11	61	2444644.5	-1.176147861794078	1.980176487224490	1.175068362274345	372259	-1202171	-555456
12	62	2444648.5	-1.213596943010355	1.956952725302962	1.171726726500019	386258	-1254024	-581791
13	63	2444652.5	-1.250692885306847	1.933191664535309	1.168063394482324	400647	-1307221	-608968
14	64	2444656.5	-1.287454765762206	1.908898745892458	1.164078681716020	415441	-1361760	-636996
15	65	2444660.5	-1.323861730166591	1.884079489628327	1.159773011727786	430646	-1417643	-665885
16	66	2444664.5	-1.359902998289456	1.858739694133021	1.155146916615024	446263	-1474875	-695647
17	67	2444668.5	-1.395567868785939	1.832885334482256	1.150201037395632	462292	-1533470	-726297
18	68	2444672.5	-1.430845724265097	1.806522581669263	1.144936124750309	478736	-1593442	-757852
19	69	2444676.5	-1.465726037085794	1.779657301144950	1.139353039478870	495600	-1654809	-790332
20	70	2444680.5	-1.500198374502162	1.752297551182615	1.133452752805191	512891	-1717591	-823756
21	71	2444684.5	-1.534252404158615	1.724448581396750	1.127236346809262	530618	-1781805	-858145
22	72	2444688.5	-1.567877899631895	1.696117830816942	1.120705014635021	548796	-1847473	-893520
23	73	2444692.5	-1.601064745827358	1.667312425881441	1.113860060641294	567440	-1914613	-929904
24	74	2444696.5	-1.633802944414420	1.638039678258579	1.106702900487562	586566	-1983244	-967318
25	75	2444700.5	-1.666082619234942	1.608307082519275	1.099235061121938	606195	-2053383	-1005784
26	76	2444704.5	-1.697894021668610	1.578122313610962	1.091458180680078	626346	-2125049	-1045323
27	77	2444708.5	-1.729227535947238	1.547493224162530	1.083374008286768	647042	-2198258	-1085958
28	78	2444712.5	-1.760073684386242	1.516427841595643	1.074984403750555	668305	-2273028	-1127712
29	79	2444716.5	-1.790423132465435	1.484934365045440	1.066291337144783	690161	-2349378	-1170609
30	80	2444720.5	-1.820256693687444	1.453021162145895	1.057296898293493	712638	-2427332	-1214676
31	81	2444724.5	-1.849595334055330	1.420696765860832	1.048003246250886	735776	-2506915	-1259944
32	82	2444728.5	-1.878460176496783	1.387969871647648	1.038412708946566	759631	-2588150	-1306441
33	83	2444732.5	-1.906672505724124	1.354849334950408	1.028527683058641	784273	-2671045	-1354193
34	84	2444736.5	-1.934403774041066	1.321344168304478	1.018350683773484	809779	-2755591	-1403216
35	85	2444740.5	-1.961585607430692	1.287463537321678	1.007884333974481	836217	-2841757	-1453513
36	86	2444744.5	-1.988209810760509	1.253216755771412	.997131362854347	863643	-2929505	-1505094
37	87	2444748.5	-2.014268371876824	1.218613280957399	.986094604569352	892100	-3018797	-1557927
38	88	2444752.5	-2.039753465880267	1.183662709390326	.974776997067302	921624	-3109589	-1612037
39	89	2444756.5	-2.064657458898552	1.148374772185363	.963181580712725	952245	-3201846	-1667411
40	90	2444760.5	-2.088972911904321	1.112759331169691	.951311497292480	983994	-3295524	-1724048
41	91	2444764.5	-2.112692585117372	1.076826374322820	.939169988718739	1016896	-3390580	-1781940
42	92	2444768.5	-2.135809441625099	1.040586011093083	.926760395579443	1050975	-3486971	-1841083
43	93	2444772.5	-2.158316651227167	1.004048467907523	.914096155803715	1086249	-3584647	-1901468
44	94	2444776.5	-2.180207594189142	.967224083291807	.901150803131266	1122737	-3683558	-1963087
45	95	2444780.5	-2.201475864721573	.930123302955636	.887957965451761	1160448	-3783649	-2025928
46	96	2444784.5	-2.222115274367994	.892756674798651	.874511363182748	1199388	-3884864	-2089978
47	97	2444788.5	-2.242119855234918	.855134843794776	.860814807480747	1239556	-3987144	-2155221
48	98	2444792.5	-2.261483863051708	.817268546780923	.846872198402469	1280945	-4090428	-2221642
49	99	2444796.5	-2.280201780052920	.779168607142498	.832687522975224	1323541	-4194655	-2289223
50	100	2444800.5	-2.298268317655157	.740845929389341	.818264853174771	1367320	-4299766	-2357946

L	STEP	JULIAN DATE	X	Y	Z	PERTURBATIONS IN		10-TH DEC
1	0	2444900.5	-2.298268317655157	.740845929389341	.818264853174771	-0	0	0
2	1	2444804.5	-2.315678418867620	.702311493628862	.803508343807309	-487	-625	-456
3	2	2444808.5	-2.332427260340850	.663576349996966	.788722230317738	-1984	-2514	-1834
4	3	2444812.5	-2.348510253984401	.624651613234118	.773610826616949	-4542	-5685	-4154
5	4	2444816.5	-2.363923048346905	.585548457697929	.758278523103545	-8199	-10160	-7435
6	5	2444820.5	-2.378661530397139	.546278112817788	.742729784948004	-12983	-15951	-11694
7	6	2444824.5	-2.392721828146136	.506851858238026	.726969150290557	-18918	-23057	-16939
8	7	2444828.5	-2.406100313405602	.467281017999200	.711001227861587	-26041	-31460	-23171
9	8	2444832.5	-2.418793603642612	.427576953896484	.694830694201588	-34406	-41141	-30396
10	9	2444836.5	-2.430798562597388	.387751059292929	.678462290780278	-44079	-52086	-38582
11	10	2444840.5	-2.442112301034683	.347814753338836	.661900821478575	-55135	-64285	-47756
12	11	2444844.5	-2.452732176909933	.307779475052843	.645151149857643	-67656	-77736	-57913
13	12	2444848.5	-2.462655795532143	.267656678241735	.628218196867643	-81724	-92443	-69055
14	13	2444852.5	-2.471881010243052	.227457825876630	.611106938298953	-97426	-108411	-81188
15	14	2444856.5	-2.480405922264993	.187194384489612	.593822402139100	-114849	-125651	-94320
16	15	2444860.5	-2.488228880737040	.146877818890763	.576369666100884	-134082	-144179	-109459
17	16	2444864.5	-2.495348482619093	.106519586632309	.558753954980989	-155214	-164011	-123614
18	17	2444868.5	-2.501763572294834	.066131132574092	.540980138021570	-178338	-185167	-139794
19	18	2444872.5	-2.507473241064346	.025723883504221	.523053726265413	-203546	-207671	-157011
20	19	2444876.5	-2.512476826463754	-.014690757226091	.504979869903909	-230934	-231547	-175276
21	20	2444880.5	-2.516773911409487	-.055101415028705	.486763855547171	-260597	-256826	-194600
22	21	2444884.5	-2.520364323164742	-.095496749372832	.468411003551768	-292635	-283541	-214999
23	22	2444888.5	-2.523248132106517	-.135865459055373	.449926665259854	-327145	-311729	-236487
24	23	2444892.5	-2.525425650238091	-.176196287441125	.431316220231164	-364230	-341436	-259092
25	24	2444896.5	-2.526897429356069	-.216478027613444	.412585073462450	-403984	-372715	-282805
26	25	2444900.5	-2.527664258809523	-.256699527249021	.393738652691768	-446495	-405624	-307643
27	26	2444904.5	-2.527727163054209	-.296849692927506	.374782405963410	-491837	-440227	-333742
28	27	2444908.5	-2.527087399645367	-.336917493887084	.355721799513727	-540068	-476576	-361006
29	28	2444912.5	-2.525746458093565	-.376891965951875	.336562315632930	-591239	-514708	-389489
30	29	2444916.5	-2.523706058942395	-.416762216352902	.317309450050757	-645409	-554649	-419197
31	30	2444920.5	-2.520968151913280	-.456517429208766	.297969706853062	-702653	-596417	-450132
32	31	2444924.5	-2.517534912930486	-.496146870460684	.278545605555879	-763051	-640037	-482294
33	32	2444928.5	-2.513409741324326	-.535639892295247	.259045658452520	-826692	-685536	-515685
34	33	2444932.5	-2.508592256509402	-.574985937597070	.239474387871259	-893665	-732946	-550309
35	34	2444936.5	-2.503098294742682	-.614174543465101	.219837313923454	-964059	-782302	-586170
36	35	2444940.5	-2.496899906459163	-.653195345186099	.200139954047396	-1037962	-833642	-623271
37	36	2444944.5	-2.490030352853395	-.692038080085304	.180387820521832	-1115461	-887004	-661616
38	37	2444948.5	-2.482483102734335	-.730692590978169	.160586418203612	-1196641	-942427	-701210
39	38	2444952.5	-2.474261829328043	-.769148829791259	.140741242151734	-1281588	-999949	-742054
40	39	2444956.5	-2.465370406867549	-.807396861002925	.120857775309044	-1370386	-1059609	-784149
41	40	2444960.5	-2.455812907163505	-.845426864957112	.100941486233585	-1463119	-1121443	-827496
42	41	2444964.5	-2.445593596094170	-.883229141093210	.080997826850211	-1559871	-1185491	-872095
43	42	2444968.5	-2.434716930015071	-.920794111073594	.061032230233484	-1660729	-1251790	-917943
44	43	2444972.5	-2.423187552088422	-.958112321819151	.041050108416279	-1765777	-1320380	-965039
45	44	2444976.5	-2.411010288511306	-.995174448466187	.021056850215622	-1875105	-1391300	-1013382
46	45	2444980.5	-2.398190144589577	-1.031971297242599	.001057819071839	-1988798	-1464597	-1062970
47	46	2444984.5	-2.384732300566895	-1.068493808207648	-.018941649077938	-2106942	-1540321	-1113806
48	47	2444988.5	-2.370642107148853	-1.104733057672384	-.038936247799588	-2229613	-1618527	-1165894
49	48	2444992.5	-2.355925080928827	-1.140680260015785	-.058920701860775	-2356872	-1699271	-1219241
50	49	2444996.5	-2.340586900361657	-1.176326768916404	-.078889768572527	-2488769	-1782598	-1273846
51	50	2445000.5	-2.324633402703483	-1.211664078733904	-.098838239123285	-2625346	-1868539	-1329701

L	STEP	JULIAN DATE	X	Y	Z	PERTURBATIONS IN		10-TH DEC
1	51	2445004.5	-2.308070541268453	-1.246683826761711	-.118760940357857	-2766655	-1957107	-1386789
2	52	2445008.5	-2.290904581848110	-1.281377796112551	-.138652736991427	-2912765	-2048315	-1445099
3	53	2445012.5	-2.273141698121208	-1.315737918033520	-.158508533631307	-3063751	-2142179	-1504579
4	54	2445016.5	-2.254788367353756	-1.349756273705140	-.178323276501640	-3219699	-2238716	-1565238
5	55	2445020.5	-2.235851165651709	-1.383425096054580	-.198091955229605	-3380696	-2337958	-1627050
6	56	2445024.5	-2.216336803456329	-1.416736770627729	-.217809604112430	-3546829	-2439936	-1690000
7	57	2445028.5	-2.196252121648200	-1.449693836923676	-.237471303574956	-3718187	-2544688	-1754074
8	58	2445032.5	-2.175604087044988	-1.482258989593880	-.257072181626169	-3894855	-2652255	-1819260
9	59	2445036.5	-2.154399788256758	-1.514455079251597	-.276607415075874	-4076930	-2762684	-1885549
10	60	2445040.5	-2.132646431595454	-1.546265113454353	-.296072230845901	-4264466	-2876026	-1952932
11	61	2445044.5	-2.110351336865151	-1.577682257511640	-.315461907205352	-4457578	-2992338	-2021404
12	62	2445048.5	-2.087521933210525	-1.608699835177511	-.334771774941434	-4656338	-3111680	-2090961
13	63	2445052.5	-2.064165755030388	-1.639311329270264	-.353997218495325	-4860827	-3234119	-2161601
14	64	2445056.5	-2.040290437856683	-1.669510382205047	-.373133677054570	-5071125	-3359727	-2233326
15	65	2445060.5	-2.015903714268120	-1.699290796451642	-.392176445608589	-5287310	-3488584	-2306141
16	66	2445064.5	-1.991013409789048	-1.728646534933802	-.411121675978459	-5509458	-3620779	-2380054
17	67	2445068.5	-1.965627439723288	-1.757571721371065	-.429964377824371	-5737641	-3756410	-2455079
18	68	2445072.5	-1.939753799831230	-1.786060640509476	-.448700419614422	-5971923	-3895586	-2531238
19	69	2445076.5	-1.913400571789673	-1.814107738059960	-.467325529459847	-6212354	-4038429	-2608557
20	70	2445080.5	-1.886575908643935	-1.841707620062088	-.485835495645595	-6458966	-4185066	-2687069
21	71	2445084.5	-1.859288035898551	-1.868855051700031	-.504226166803136	-6711768	-4335619	-2766805
22	72	2445088.5	-1.831545247650093	-1.895544956311170	-.522493452079718	-6970760	-4490199	-2847793
23	73	2445092.5	-1.803355904162231	-1.921772415306037	-.540633321756221	-7235940	-4648908	-2930052
24	74	2445096.5	-1.774728428541550	-1.947532668753823	-.558641808300443	-7507318	-4811850	-3013604
25	75	2445100.5	-1.745671302667503	-1.972821115430364	-.576515007227503	-7784900	-4979133	-3098472
26	76	2445104.5	-1.716193063353963	-1.997633312402847	-.594249077674029	-8068695	-5150875	-3184685
27	77	2445108.5	-1.686302298199256	-2.021964974667952	-.611840243037843	-8358705	-5327206	-3272278
28	78	2445112.5	-1.656007641705117	-2.045811973898083	-.629284791110049	-8654921	-5508260	-3361289
29	79	2445116.5	-1.625317772142537	-2.069170337708755	-.646579074410432	-8957329	-5694176	-3451761
30	80	2445120.5	-1.594241407772060	-2.092036248830041	-.663719510530193	-9265902	-5885100	-3543741
31	81	2445124.5	-1.562787303586099	-2.114406043947810	-.680702582250184	-9580603	-6081181	-3637278
32	82	2445128.5	-1.530964248086867	-2.136276212772188	-.697524837768608	-9901386	-6282569	-3732426
33	83	2445132.5	-1.498781060031057	-2.157643396985421	-.714182890867406	-10228196	-6489420	-3929241
34	84	2445136.5	-1.466246585300269	-2.178504389134787	-.730673421032524	-10560966	-6701889	-3927780
35	85	2445140.5	-1.433369693835672	-2.198856131511917	-.746993173557094	-10899619	-6920134	-4028104
36	86	2445144.5	-1.400159276632586	-2.218695715006035	-.763138959620701	-11244072	-7144314	-4130277
37	87	2445148.5	-1.366624242792639	-2.238020377944210	-.779107656351865	-11594228	-7374590	-4234364
38	88	2445152.5	-1.332773516606352	-2.256827504934591	-.794896206884989	-11949984	-7611126	-4340433
39	89	2445156.5	-1.298616034609218	-2.275114625713684	-.810501620417831	-12311225	-7854088	-4448559
40	90	2445160.5	-1.264160742515763	-2.292879413942714	-.825920972249850	-12677821	-8103648	-4558817
41	91	2445164.5	-1.229416591968793	-2.310119685770474	-.841151403709954	-13049625	-8359982	-4671290
42	92	2445168.5	-1.194392537313156	-2.326833397880634	-.856190121800800	-13426464	-8623260	-4786062
43	93	2445172.5	-1.159097533039727	-2.343018645054642	-.871034398510151	-13808141	-8893642	-4903215
44	94	2445176.5	-1.123540532300865	-2.358673657995155	-.885681570146733	-14194445	-9171267	-5022820
45	95	2445180.5	-1.087730485826953	-2.373796802123323	-.900129037151473	-14585154	-9456256	-5144943
46	96	2445184.5	-1.051676340085884	-2.388386577095375	-.914374264366398	-14980089	-9748720	-5269642
47	97	2445188.5	-1.015387034538193	-2.402441615833240	-.928414781130758	-15379015	-10049768	-5396977
48	98	2445192.5	-.978871499274472	-2.415960683160748	-.942248181121137	-15781734	-10356508	-5527010
49	99	2445196.5	-.942138652287806	-2.428942674546221	-.955872122280201	-16188033	-10672046	-5659802
50	100	2445200.5	-.905197397049630	-2.441386614013993	-.969284326263640	-16597692	-10995487	-5795415

L	STEP	JULIAN DATE	X	Y	Z	PERTURBATIONS IN	10-TH DEC	
1	0	2445200.5	-.905197397050667	-2.441386613999754	-.9492543262555913	-0	-0	-0
2	1	2445204.5	-.869056620808176	-2.453291652647195	-.9824825781234455	-1543	-235	-103
3	2	2445208.5	-.830725192255244	-2.466657067021548	-.9954647260134427	-6159	-928	-400
4	3	2445212.5	-.793211959772638	-2.475482257408558	-1.009228680705692	-13783	-2059	-874
5	4	2445216.5	-.755525749575433	-2.485766746230794	-1.020772415246718	-24368	-3610	-1507
6	5	2445220.5	-.717675363948484	-2.495510176437762	-1.033093964555412	-37864	-5560	-2282
7	6	2445224.5	-.679669579542491	-2.504712309909024	-1.045191425023631	-54222	-7889	-3180
8	7	2445228.5	-.641517145727857	-2.513373025873975	-1.057062954113661	-73392	-10575	-4185
9	8	2445232.5	-.603226783001595	-2.521492319354564	-1.068706769956485	-95329	-13598	-5279
10	9	2445236.5	-.564807181435981	-2.529070299643195	-1.080121150958576	-119989	-16938	-6445
11	10	2445240.5	-.526266999140972	-2.536107189926875	-1.091304435426025	-147329	-20578	-7669
12	11	2445244.5	-.487614860681395	-2.542603320357387	-1.102255021211981	-177309	-24505	-8938
13	12	2445248.5	-.448859355352356	-2.548559137610255	-1.112971369366711	-209888	-28712	-10241
14	13	2445252.5	-.410009035249447	-2.553975192246796	-1.123451993697429	-245017	-33196	-11575
15	14	2445256.5	-.371072413345534	-2.558852142095176	-1.133695450064067	-282634	-37955	-12936
16	15	2445260.5	-.332057962221281	-2.563190748585072	-1.143700395363254	-322665	-42978	-14315
17	16	2445264.5	-.292974113843545	-2.566991874482781	-1.153465506559940	-365031	-48235	-15699
18	17	2445268.5	-.253829259713360	-2.570256482632956	-1.162989526214858	-409667	-53686	-17063
19	18	2445272.5	-.214631750225912	-2.572985635441711	-1.172271252484514	-456520	-59284	-18380
20	19	2445276.5	-.175389893109186	-2.575180493892233	-1.181309538960129	-505550	-64986	-19624
21	20	2445280.5	-.136111952226938	-2.576842316200313	-1.190103294271253	-556726	-70756	-20771
22	21	2445284.5	-.096806145982415	-2.577972456593045	-1.198651481790890	-610021	-76561	-21799
23	22	2445288.5	-.057480646020090	-2.578572363281268	-1.206953118873656	-665405	-82374	-22690
24	23	2445292.5	-.018143576603914	-2.578643577048396	-1.215007276349226	-722856	-88169	-23427
25	24	2445296.5	.021196986604605	-2.578187729798557	-1.222813078051090	-782346	-93926	-23992
26	25	2445300.5	.060533017338182	-2.577206542860679	-1.230369700165788	-843852	-99624	-24372
27	26	2445304.5	.099856539456142	-2.575701825589562	-1.237676370730348	-907349	-105244	-24553
28	27	2445308.5	.139159627752136	-2.573675473910697	-1.244732369103104	-972813	-110773	-24523
29	28	2445312.5	.178434409661540	-2.571129468876990	-1.251537025426110	-1040220	-116194	-24270
30	29	2445316.5	.217673060932982	-2.568065875273987	-1.258089720105602	-1109547	-121496	-23783
31	30	2445320.5	.256867816272175	-2.564486840257530	-1.264389883302755	-1180773	-126670	-23053
32	31	2445324.5	.296010959961533	-2.560394592036701	-1.270436994441951	-1253878	-131707	-22073
33	32	2445328.5	.335094831485073	-2.555791438614790	-1.276230581746432	-1328839	-136606	-20836
34	33	2445332.5	.374111825218042	-2.550679766587663	-1.281770221807271	-1405639	-141368	-19340
35	34	2445336.5	.413054391277711	-2.545062039941627	-1.287055539164356	-1484249	-146002	-17587
36	35	2445340.5	.451915036597496	-2.538940798664072	-1.292086205806150	-1564639	-150524	-15582
37	36	2445344.5	.490686326009119	-2.532318656983334	-1.296861940414104	-1646756	-154948	-13331
38	37	2445348.5	.529360882683243	-2.525198300576818	-1.301382507306180	-1730538	-159276	-10839
39	38	2445352.5	.567931387540167	-2.517582485587927	-1.305647715441644	-1815912	-163503	-8101
40	39	2445356.5	.606390578315740	-2.509474036723176	-1.309657417933124	-1902817	-167595	-5102
41	40	2445360.5	.644731249439253	-2.500875847444405	-1.313411512037682	-1991202	-171524	-1925
42	41	2445364.5	.682946252841543	-2.491790879295948	-1.316909938990818	-2081026	-175258	1746
43	42	2445368.5	.721028498413761	-2.482222160839555	-1.320152683617899	-2172255	-178770	5630
44	43	2445372.5	.758970954894433	-2.472172786775047	-1.323139774052855	-2264955	-182036	9840
45	44	2445376.5	.796766650411957	-2.461645916255918	-1.325871280997873	-2358791	-185034	14390
46	45	2445380.5	.834408672517399	-2.450644771836764	-1.328347317251570	-2454030	-187741	19294
47	46	2445384.5	.871890168644669	-2.439172638378395	-1.330568037274752	-2550535	-190134	24565
48	47	2445388.5	.909204346294529	-2.427232861722572	-1.332533636587144	-2648270	-192189	30217
49	48	2445392.5	.946344473132527	-2.414828847670947	-1.334244351320116	-2747199	-193879	36266
50	49	2445396.5	.983303877180504	-2.401964060914437	-1.335700457749503	-2847285	-195178	42725
51	50	2445400.5	1.020075946931442	-2.388642023983437	-1.336902271828357	-2948493	-196054	49613

L	STEP	JULIAN DATE	X	Y	Z	PERTURBATIONS IN		10-TH DEC
1	51	2445404.5	1.056654131444844	-2.374866316254810	-1.377852148745491	-3050790	-196477	56946
2	52	2445408.5	1.093031940432923	-2.360640572999003	-1.338544482501553	-3154142	-196412	64743
3	53	2445412.5	1.129202944340570	-2.346568484480181	-1.338955705510929	-3258520	-195824	73023
4	54	2445416.5	1.165160774448367	-2.330853795120973	-1.339174289236272	-3363338	-194679	81805
5	55	2445420.5	1.200899123058310	-2.315200302730762	-1.339110738859052	-3470243	-192944	91108
6	56	2445424.5	1.236411743863215	-2.299311857737820	-1.338795603002566	-3577545	-190590	100946
7	57	2445428.5	1.271692452548763	-2.282892362236993	-1.338229463289018	-3685758	-187538	111334
8	58	2445432.5	1.306735127431295	-2.266045768569043	-1.337412938765610	-3794941	-183910	122285
9	59	2445436.5	1.341533709459283	-2.248776077475185	-1.336346683946246	-3904738	-179513	133820
10	60	2445440.5	1.376082201207552	-2.231087336580856	-1.335031387959567	-4015394	-174334	145966
11	61	2445444.5	1.410374665559075	-2.212983639904706	-1.333467774205232	-4126765	-168294	158764
12	62	2445448.5	1.444405225220898	-2.194469129108096	-1.331656600490538	-4238627	-161310	172257
13	63	2445452.5	1.478169063187773	-2.175547988272612	-1.329598659010699	-4351567	-153298	186491
14	64	2445456.5	1.511657422871373	-2.156224453345361	-1.327294776110328	-4464989	-144175	201510
15	65	2445460.5	1.544867608680413	-2.136502801700800	-1.324745812158554	-4579100	-133865	217358
16	66	2445464.5	1.577792986315394	-2.116387355914156	-1.321952660963724	-4693914	-122291	234077
17	67	2445468.5	1.610427982448527	-2.095882482166232	-1.318916249466348	-4809451	-109380	251712
18	68	2445472.5	1.642767085040099	-2.074992589597201	-1.315637537465612	-4925738	-95058	270303
19	69	2445476.5	1.674804843255899	-2.053722129431478	-1.312117517181650	-5042803	-79254	289893
20	70	2445480.5	1.706535867374626	-2.032075594400709	-1.308357212975039	-5160684	-61897	310524
21	71	2445484.5	1.737954828806224	-2.010057518111182	-1.304357681045886	-5279423	-42919	332240
22	72	2445488.5	1.769056460049399	-1.987672474425914	-1.300120009134091	-5399068	-22253	355091
23	73	2445492.5	1.799835554652091	-1.964925076896840	-1.295645316244986	-5519675	165	379089
24	74	2445496.5	1.830286967181017	-1.941819978228672	-1.290934752392005	-5641304	24398	404305
25	75	2445500.5	1.860405613203739	-1.918361869787283	-1.285989498363556	-5764025	50501	430767
26	76	2445504.5	1.890186469311189	-1.894555481163181	-1.280810765522673	-5887910	78525	458514
27	77	2445508.5	1.919624573240625	-1.870405579787700	-1.275399795644439	-6013039	108513	487577
28	78	2445512.5	1.948715024194804	-1.845916970541118	-1.269757860768635	-6139491	140499	517987
29	79	2445516.5	1.977452983417386	-1.821094495162527	-1.263886262972015	-6267344	174507	549768
30	80	2445520.5	2.005833674802290	-1.795943031177750	-1.257786333885520	-6396661	210558	582941
31	81	2445524.5	2.033852384882763	-1.770467490393749	-1.251459433915336	-6527498	248680	617530
32	82	2445528.5	2.061504461823944	-1.744672817717706	-1.244906951535356	-6659907	288911	653568
33	83	2445532.5	2.088785314118283	-1.718563990992003	-1.238130303092959	-6793954	331303	691093
34	84	2445536.5	2.115690410137304	-1.692146021551423	-1.231130933089545	-6929720	375905	730145
35	85	2445540.5	2.142215278626850	-1.665423954289089	-1.223910314294749	-7067303	422758	770763
36	86	2445544.5	2.168355508872381	-1.638402867387832	-1.216469947647674	-7206795	471898	812993
37	87	2445548.5	2.194106751328675	-1.611087872152183	-1.208811362259809	-7348314	523349	856837
38	88	2445552.5	2.219464717953642	-1.583484112040473	-1.200936114959148	-7491962	577130	902353
39	89	2445556.5	2.244425181944024	-1.555596762331730	-1.192845790113033	-7637850	633251	949557
40	90	2445560.5	2.268983978108011	-1.527431029717462	-1.184541999476117	-7786086	691718	998473
41	91	2445564.5	2.293137002835962	-1.498992151664133	-1.176026381874230	-7936780	752531	1049120
42	92	2445568.5	2.316880214068240	-1.470285396063105	-1.167300603041852	-8090041	815687	1101520
43	93	2445572.5	2.340209631372403	-1.441316060815659	-1.158366355435923	-8245978	881175	1155687
44	94	2445576.5	2.363121335960457	-1.412089473425148	-1.149225358047239	-8404700	948992	1211638
45	95	2445580.5	2.385611470710785	-1.382610990631321	-1.139879356234978	-8566318	1019090	1269386
46	96	2445584.5	2.407676240199848	-1.352885998969034	-1.130330121575305	-8730940	1091476	1328942
47	97	2445588.5	2.429311910748539	-1.322913009964699	-1.120579451731984	-8898677	1166111	1390315
48	98	2445592.5	2.450514810510754	-1.292718168882011	-1.110629170358060	-9069639	1242961	1453510
49	99	2445596.5	2.471281329664720	-1.262286245514758	-1.100481127033689	-9243937	1321982	1518530
50	100	2445600.5	2.491607920803077	-1.231629638465513	-1.090137197217494	-9421674	1403125	1585372

Appendix D
PERTURBATIONS IN OSCULATING ELEMENTS AT FUTURE DATES

Appendix D

PERTURBATIONS IN OSCULATING ELEMENTS AT FUTURE DATES

Appendix D contains the perturbations in the orbital elements for the first 50 minor planets at successive 400-day dates from 1973 November 14 (244 2000.5) through 1983 September 23 (244 5600.5). The dates of osculation are contained in the page headings. All of the perturbations are with respect to elements osculating at the initial standard date 1972 October 10 (244 1600.5). However, to find the mean anomaly at an osculating date see par. 4.4, Example 6.

NUM	Number of the minor planet
DEL ARGPER	Perturbation in degrees of the argument of perihelion
DEL NODE	Perturbation in degrees of the longitude of the ascending node
DEL INCL	Perturbation in degrees of the inclination
DEL MO	Perturbation in degrees of the mean anomaly at the initial standard date 244 1600.5 (Also see par. 4.4, Example 6.)
DEL A	Perturbation in astronomical units of the semi-major axis
DEL E	Perturbation in the eccentricity
DEL MDM	Perturbation in the mean daily motion, which is expressed in seconds of arc per mean solar day

NUM	DEL ARGPER	DEL NODE	DEL INCL	DEL MO	DEL A	DEL E	DEL MOM
1	.428021917534	-.001668327179	-.003247583975	-.428047694582	.001609360276?5	-.00333425117211	-.67246831416
2	-.034805011710	.000823039138	.001415670039	.071573888446	-.00055457085426	-.00020401647091	.23146897992
3	-.078037536849	-.027664167163	-.000571461421	.104510471080	.00162215484683	-.00059721451934	-.74200424160
4	.106994524569	-.001323070457	-.001270181149	-.141259950728	.00014075435044	-.00020270067949	-.08736816080
5	-.007418913497	.002196872938	.003820989844	.054983250802	-.00059282032871	.00047382621678	.29579036237
6	.062948840685	-.002287332645	.001514095068	-.064745975786	.00045298533126	.00013073555824	-.26298746701
7	-.027599677167	-.034490228827	-.005477539199	-.065725762426	.00067781476903	-.00102058063338	-.41002976776
8	-.071253419730	-.000007179613	.003025554721	.106753149993	-.00035337894171	.00015554378651	.26151004793
9	-.133350506549	-.004671907907	.003277459494	.171565649191	-.00068031841738	.00004868898163	.41210252423
10	-.435308367061	-.042472758480	-.005850255419	.232797737262	.00140943643707	.00189644425329	-.42543904411
11	-.185062414348	-.000909093655	.000070721810	.179708514119	.00106990695122	.00034969250755	-.60423897161
12	.076547284512	-.016507946289	-.000991950472	-.090351462211	-.00009128202329	.00007189221607	.05831311609
13	.603725867055	-.075648509271	-.011744759033	-.635872509600	.00240246123435	-.00376597247601	-1.19879927163
14	-.184905785536	-.023720806861	-.001749559802	.283845804697	-.00241135325841	.00394594879286	1.19272711403
15	.032018919781	-.001110769699	-.000287246241	-.065592413430	.00093332799974	.00028893915015	-.39062091135
16	-.104284782523	.000087520064	.000055330554	.138998366827	.00010886187474	.00015588461533	-.03966865402
17	-.042524248482	-.002149561064	.000178227329	-.008252280837	.00134540022275	.00059290480797	-.74687402937
18	-.030417170449	.003363744378	.000681150025	.062679391071	-.00046003388586	.00026206113276	.30665518604
19	-.071799275367	-.001091839596	.000175496321	.109544502193	-.00032907792135	.00016279657684	.18800943296
20	-.080710537732	-.014593876003	.000065836826	.069648480181	-.00001064403091	.00005479175769	.00629469391
21	-.214759173945	-.009922533547	-.000888870514	.159108491534	.00112911498026	.00009686154209	-.64922337648
22	-.197973534356	-.010402718704	.001021173989	.226636751726	-.00121987692862	.00020230897064	.45001574513
23	-.033454790220	-.002965670365	.000242777475	.072387396358	-.00072045876718	-.00022071261084	.34369332818
24	-.163590495828	.000591245618	-.000038492528	.190233054687	.00064614756113	.00013181718980	-.19709872930
25	.014526635619	-.010512282501	-.000905596581	.025523974196	-.00034976593611	-.00024894996842	.20850715922
26	.111739929259	-.014778098906	-.000430347456	-.128336767510	-.00007760914394	-.00022480892711	.03594491132
27	-.092864820144	-.001111124955	-.000027613386	.101431392264	-.00061079685041	-.00000030464101	.38528317052
28	-.128924688396	-.006311616053	-.000003950031	.110194599758	.00113094660828	.00016062286620	-.46854309231
29	-.269004038379	-.021484578796	-.000116338185	.272409909263	.00164942724386	-.00063151278518	-.84112562767
30	-.083670055290	-.000994750033	.000050310139	.119556530892	-.00059466663734	.00023326042590	.36800732035
31	-.042172199832	-.011804093621	-.002180456725	.021918316270	.00063615255046	.00016420255245	-.19135731831
32	.171302867722	-.004404519183	-.000083435305	-.136966142018	-.00007078089311	-.00012343146371	.03497615919
33	.028769085726	-.009142841980	.001523791075	-.021711969035	-.00092697920870	.00041717077054	.35612649542
34	-.095017317057	-.012977485?07	.000493936719	.082890217247	-.00017102957595	-.00017193154885	.07693214301
35	-.021774607951	-.021744515470	-.000149962333	-.000594405235	.00060952491997	-.00034276485755	-.20935588599
36	-.959855973937	-.103354641866	.006341582273	.030541709559	.00219124688529	-.00101271630362	-.93005647408
37	-.114037184405	-.003171360437	.000512440842	.136396654118	-.00098297064568	.00011885103538	.46099873230
38	-.089325214401	-.000674079569	-.000125941645	.069378537889	.00104318758659	.00026676576873	-.44663118334
39	-.171983825210	-.053753812554	.010231837539	.115474866889	-.00075065795608	-.00112131147336	.31324405121
40	-.452455286631	-.009979694300	-.001215329141	.376708160340	.00005950440736	-.00067982186761	-.04093558985
41	-.039343879416	-.003107558747	-.000980559698	.081255262387	.00098666033033	-.00024435175411	-.03636493013
42	.059695649867	-.008802266756	-.001634788972	-.061439032412	-.00054435647664	.00024194192197	.31149157472
43	.070040186692	.000813601175	-.000424421436	-.085721391402	.00053597512583	-.00023744410277	-.39578531887
44	-.094569685822	-.000798247525	.000238634787	.083221543842	-.00035511686652	-.00005066915316	.20714060357
45	.208428139431	.002128735359	.000699895000	-.185369991719	-.00107385013530	-.00022177060963	.46804764531
46	-.179759110262	-.025341597549	-.000070169686	.185059689978	.00146087193679	.00006795527258	-.76725600076
47	.063823792389	.000538080698	.001437979688	-.029784332968	-.00041499153215	.00024884484110	.15730475566
48	.349199952670	-.005930071042	.001186130844	-.285376572654	-.00078205695911	.00032543556347	.24325630661
49	-.033327678011	-.004151199031	-.000168556143	.009202572361	-.00020028081192	.00025801060354	.06305926316
50	-.130844305022	-.052265569091	.000414965854	.101758846769	.00206129732587	-.00033233932001	-.95917979977

NUM	DEL ARGPER	DEL NODE	DEL INCL	DEL MO	DEL A	DEL E	DEL MDM
1	1.810999074914	-.186702230621	-.016485420065	-1.873424094087	.004648358341486	-.00137604579362	-1.93973984803
2	-.060249575854	-.010108487470	.004374487718	.114390261835	.001244530142 56	-.00106820740954	-.51902522088
3	-.240505299505	-.052936915090	.005982296258	.152600134898	.002809556920 70	-.00152852937322	-1.28443024683
4	.230159373015	-.006646186393	-.000166014116	-.237367524274	-.000499684225 52	-.00041185604667	.31026602097
5	-.072334411390	.001109872974	.000808180247	.102782499911	.000193397751 94	.00068302772616	-.09645989229
6	.101889086338	-.004693179773	-.000116181717	-.130026917464	.000399943198 67	.00032673999119	-.23219940203
7	.052793361476	-.045225500755	-.005827618222	-.104105259103	.000498857898 28	-.00109065349067	-.30180186264
8	-.266597664184	-.012576528356	-.001750152285	.240884266885	.000382067062 43	-.00015384368387	-.28262201266
9	-.365075437770	-.024133732182	-.001159652195	.399495626236	.000761497110 42	-.00038529198638	-.46092811747
10	-1.295839927217	-.170358379877	-.008185996825	1.316097552339	-.005175029895 40	.00332631657652	1.56617363530
11	-.627154568116	-.009466363008	-.000432379760	.607397225693	-.000084443114 19	.00014904442989	.04771802205
12	.159443826786	-.024960115206	.000326051292	-.147361848067	-.000740754079 23	.00005210075252	.47337561583
13	1.493781891251	-.165093884152	.001853510853	-1.444679385389	.000005092089 47	-.00063678388401	-.00254384714
14	-.268714291851	-.025329983102	-.002111413246	.397551679325	-.002150145716 77	.00112980593222	1.06339177911
15	.058334473273	-.013383911333	-.001595104326	-.101506248840	.000537937032 87	.00055719999844	-.25219212245
16	-.644323502213	-.007816126057	.000746691720	.592889123080	.003847458026 61	.00044309834631	-1.39975384696
17	-.392488555597	-.011256172063	-.000234381593	.403653208861	-.000563442659 19	.00095850081856	.31308710462
18	-.170749036886	.000917444711	.000366973588	.151452074198	.000376744687 61	.00023617099678	-.25102082951
19	-.298951562923	-.071380684178	.000639079479	.329091959506	.001281414519 27	-.00001138314731	-.73149702787
20	-.200333289744	-.008912415844	.000297202327	.214942942079	-.000667247296 92	.00015423714795	.39473291649
21	-.254383794025	-.017770061320	-.000948809547	.262696131460	.000271294303 30	-.00030241624305	-.15605865170
22	-.280594358959	-.011578074784	.003036546676	.347374399120	-.001978979429 61	.00050814779262	.73028891742
23	-.008665656827	-.026225766742	-.003853979221	.073499987146	.000788212670 51	-.00098304056700	-.37574511565
24	-.357703176531	.000072455474	-.000064418729	.356779315276	.002205564497 84	.00036780678865	-.67236056638
25	.077028203475	-.028020023721	-.003283205074	-.052010254276	.000327910632 69	-.00052872552347	-.19540951857
26	.195913078940	-.018239002183	-.000033185709	-.191111468772	-.001020423134 28	-.00053929060748	.47282191714
27	-.174385458111	-.001464598241	-.000029004550	.215193811699	-.000602512105 19	-.00004889467691	.38005557740
28	-.220179291642	-.007867747594	-.000008817708	.181457715596	.000935268084 87	.00023009234974	-.38750900756
29	-.298502744121	-.041982948729	.002301707933	.197972583570	.001131037625 20	-.00189685563719	-.57691902272
30	-.396914864101	-.007339184351	-.001372847080	.388709949308	.000894220772 52	.00016306799533	-.55295007537
31	-.110507518144	-.016707844221	.003223756187	.085615033364	-.000121406983 31	.00033169404127	.03653068244
32	1.326712862134	-.147641646268	.004078773557	-1.329820043575	.002635550110 17	.00013506299023	-1.30064834003
33	.094064946377	-.009984819892	.000525899131	-.068678375705	-.002057211025 56	.00061632399009	.79072892909
34	-.257308396565	-.010039766563	.001025510536	.269490264953	-.001110902236 56	-.00033438378018	.49992217549
35	-.044774846738	-.023582871701	.000305263244	.018114950290	-.000229071272 27	-.00061934897313	.07870756106
36	.003904128320	-.109997213065	.011231047424	.021769207880	.000683770092 59	-.00142552067080	-.29041942404
37	-.180204251697	-.002641882016	.000545442968	.239994372467	-.001416165633 63	.00032376074842	.66429695723
38	-.157220347170	-.009199423683	-.000825441961	.123835342798	.000882522179 21	.00041398599734	-.37787145175
39	-.066139603037	-.053129402666	.010813614838	.059694886309	-.001337772774 19	-.00145827275379	.55839078152
40	-.185448909378	-.012583163381	-.001456809866	.139433027824	.000086793130 89	-.00086474023067	-.05970775448
41	-.101050831756	-.012978797189	-.001808416066	.146702552986	.001107961624 19	-.00054086341136	-.46471477054
42	.133843365431	-.015053296545	-.000043785260	-.102284907000	-.001089450238 41	.00032887764106	.62357923943
43	.125088805256	-.014659000641	-.000946391521	-.153123499178	.000534206699 68	-.00042339004804	-.39447983846
44	-.188048376021	-.001423159101	.000252582654	.212939613932	-.000735194934 19	-.00009433906080	.42892530323
45	.687151637107	.001908345246	.000383707890	-.676183678814	.000769148190 30	.00002407846956	-.33495675464
46	-.304787271136	-.043993016388	.001419969568	.321301331707	.000342209574 16	-.00044533498222	-.17982942819
47	-.176124679459	-.010728841506	.000883242743	.111044237103	.002671858217 44	.00124600773629	-1.01142544329
48	.419346955681	-.016226399475	.001012840742	-.364908055326	.000687871246 48	.00078257617959	-.21383394442
49	-.007558838544	-.028750704030	-.000320097452	-.005259260510	-.001047081114 82	.00065738180579	.32979058280
50	-.104139223033	-.057581287801	.001155859213	.122376118215	.001081597762 59	-.00070039396784	-.50353048545

NUM	DEL ARGPER	DEL NODE	DEL INCL	DEL MO	DEL A	DEL E	DEL MOM
1	3.144809833862	-.282764261454	-.005569014590	-3.061380820232	.000379795888703	-.00104226146358	-.15878519331
2	-.287326240767	-.015311532925	-.025410668595	.166303216076	.00510999924275	-.00276943630882	-2.12738890827
3	-.181525070522	-.053029297153	.005682690221	.136107484883	.00233379891148	-.00175530755868	-1.06716807892
4	.809945350244	-.054203492997	-.001639895013	-.849414323136	.00127695229746	-.00012796612695	-.79214554112
5	-.151590694943	-.006800440122	.000887019034	.184999980167	-.00041875713785	.00083294408189	.20892311445
6	.201393421565	-.016653608840	.000266732467	-.208778775268	-.00038265934427	.00050011267009	.22225433491
7	.129524502645	-.006077290172	-.005393498320	-.201673871565	.00081795147590	-.00099325856313	-.49476620617
8	-.197144131242	-.019171925978	-.001992743623	.211748154932	.00024509010214	-.00038555181725	-.18131174010
9	-.412743217981	-.063365026246	.000678410680	.439955500260	-.00005601489468	-.00118032352151	.03391989313
10	-1.464259609453	-.195533361868	-.006791594043	1.593474730416	-.00678869937480	.00395495805612	2.05585392262
11	-.629666480872	-.010028378012	-.000786305630	.620396459970	.00037077830865	-.00016141343683	-.20947478379
12	.135659595064	-.048212554258	.004334907202	-.170467721549	-.00022809874785	.00060500232683	.14572555011
13	1.651636235110	-.167273634779	.002458276512	-1.573431587825	.00016018092239	-.00043116284433	-.08001526105
14	-.348114135060	-.033770716516	-.002680463484	.448860244745	-.00142738521495	.00128811752505	.70569146451
15	.164803527252	-.030834455851	.000664618582	-.183364016997	-.00039774867152	.00082585034299	.18655248538
16	-1.042344732148	-.019956221378	.000492494758	.996283013541	.00071315925423	-.00045141573698	-.25980407356
17	-.503097424968	-.011216121823	-.000642804904	.524525708461	-.00004677369614	.00068899713994	.02598385229
18	-.143176147529	-.000752623168	-.000260134248	.162218869173	.00015024459618	-.00003455952415	-.10011866162
19	-.305575835948	-.077945120112	.001460910479	.393983455273	.00019504924890	-.00050225505917	-.11140601741
20	-.373280855576	-.043621911635	.000660477312	.419311857997	.00045847807638	-.00007795404023	-.27106991234
21	-.186595917261	-.025526777285	-.001261319811	.168747799755	.00111093831545	-.00064962507857	-.63877803747
22	-.559164675906	-.024015331939	.002721701843	.648592178772	-.00052151586800	.00075204910048	.19233080839
23	-.119265480862	-.127730123266	-.000380093036	.118950497883	.00413108481264	-.00255491525062	-1.96618024067
24	-.447751278403	.012668902018	-.000263556070	.393993110691	.00291336019244	.00063799167679	-.83788008441
25	.084606779998	-.035884402911	-.001227547534	-.086491557824	.00049515143965	-.00078040694310	-.29506648855
26	.559979432794	-.020331828335	-.000036527641	-.546736056494	.00018966347659	-.00071815389291	-.08783216624
27	-.400415537384	-.011352787515	-.000118814361	.352447778539	.00067839211697	-.00062343989295	-.42762774435
28	-.336879087019	-.017340936956	.000640775956	.326208825976	-.00019457545095	.00050851917521	.08065933673
29	-.070020205469	-.043480846907	.002068261191	.017614865577	.00075729086807	-.00212876490392	-.38634911756
30	-.430697557273	-.050617037497	-.001898929137	.499808755532	-.00021658871329	-.00036954886108	.13400836539
31	-.154592973489	-.014643171191	.005234866747	.134341150886	-.00147231361979	.00082599912092	.44324812941
32	1.998287835984	-.182485805315	.013423312974	-1.927203485724	-.00081870333365	.00146493992199	.40470593728
33	.104356755342	-.010564093966	.000066768835	-.081394096935	-.00100265893201	.00096475525143	.38521383716
34	-.359950449929	-.010695894103	.001068645250	.398296001596	-.00045230886204	-.00072942203640	.20348319470
35	-.083469887621	-.026337050527	.000366806505	.099785301136	-.00117811813159	-.00089333966005	.40495510276
36	.070461053067	-.110249805359	.009768467649	-.088735153247	.00175002984805	-.00133508639768	-.74293451442
37	-.445216022486	.003895964262	-.000451202420	.466797370147	.00058013573378	.00038182622382	-.27187400375
38	-.218259370478	-.024571411694	.000776833604	.213241498252	-.00016506356549	.00079299766217	.07070941020
39	.133490897217	-.052985768820	.009870723259	-.176141044300	-.00018235737883	-.00164523594654	.07607687035
40	.116920964840	-.022244663676	-.001572417487	-.191061595626	.00037512738440	-.00095693143072	-.25802103180
41	-.172884934695	-.015231725018	-.002016091646	.184528233091	.00200014789610	-.00056180797486	-.83858799732
42	.042130461348	-.047637618089	.002058381477	-.046541279622	-.00095641271979	.00077536012679	.54739394037
43	.219255164011	-.026047862342	-.000747466766	-.213452155684	.00052158253807	-.00046762938243	-.38516040472
44	-.425066714815	-.017159850555	-.001246206666	.411911749052	.00120795266184	-.00076118028864	-.70403382221
45	1.826041193330	-.088949123205	-.008921380302	-1.975573134980	.00176466836103	.00131022349699	-.76814520968
46	-.203211093220	-.050074737934	.001509645512	.213600137977	.00112268997596	-.00067369368186	-.58974011962
47	-.788993628088	-.027301087684	-.000915983281	.781384741589	-.00113308454517	.00130056415381	.42963579382
48	.671464564868	-.019347988473	.001220440665	-.658076397143	.00178585318659	.00106306605529	-.55491176600
49	.107407432861	-.055347093119	.000836077737	-.092517239373	-.00236236707978	.00100701518877	.74445054960
50	-.024184823684	-.061572031871	.001329029830	.004859462002	.00209664298795	-.00081836049015	-.97561087837

NUM	DEL ARGPER	DEL NODE	DEL INCL	DEL MO	DEL A	DEL E	DEL MDM
1	3.321015339749	-.284986067978	-.005333814276	-3.208767533790	.000512304441 88	-.000871115092 64	-.21417159313
2	-.179982198981	-.043985049964	-.036806178048	.110112578426	.003589463081 92	-.003198702899 97	-1.49538555388
3	-.098284417079	-.059913057969	.002875915637	.018420133124	.003103393308 49	-.001833478135 09	-1.45964472268
4	1.122754159442	-.104416430997	.004099322294	-1.107325454468	-.000615133155 50	.000943446012 98	.38197750297
5	-.199846702944	-.009539263629	.001855446028	.272317097846	-.001301072128 73	.001195381102 38	.64939884600
6	.236534567888	-.030335713334	-.000298265738	-.232808104025	.000322957223 25	.000834248389 97	-.18751024854
7	.208726531531	-.068731324005	-.004152911533	-.283354490661	.000181875184 45	-.000901518913 56	-.11005014401
8	-.107767583395	-.030561309569	-.001862301329	.095841423514	.000539131257 63	-.000512405151 90	-.39876972688
9	-.279037157157	-.065533967281	.001646249341	.301416593891	.000491879301 31	-.001230373133 78	-.29777266535
10	-1.603615998483	-.200322708111	-.007243080277	1.752784839261	-.006059285051 44	.004136277207 05	1.83442971176
11	-.697024320838	-.019945876829	-.001139262398	.661221580325	.000967195523 46	-.000439626707 50	-.54626041074
12	-.003939976588	-.046510884873	.005871756609	.039993468981	-.001485190799 50	.001016779773 71	.94948350972
13	1.761710579056	-.168576067885	.001868130042	-1.720926745300	.000739539946 45	-.000195406925 73	-.36881999073
14	-.466479778228	-.033780891172	-.001648625881	.575026989140	-.002278197910 93	.001398265488 09	1.12679196713
15	.229093003087	-.033624632430	.001650104768	-.215152987178	-.000469564812 12	.001013152280 51	.22024371722
16	-1.043278315348	-.022673165044	.000496522538	1.031920167716	.000721613015 07	-.000739251375 37	-.26288283032
17	-.610066805155	-.019954520216	-.000975884965	.606479762751	.000493875905 22	.000647433220 03	-.27428422948
18	-.088208203644	-.011103861165	-.002120696744	.078988202389	.000682035047 80	-.003286377997 24	-.45435691800
19	-.200947133198	-.085065868305	.001605333771	.265557479038	.000966919516 84	-.000726736425 69	-.55205600129
20	-.551018273040	-.032736740512	.001604061230	.520917595077	.000072925572 61	-.000743493379 43	-.04312503819
21	-.184884853592	-.028696336165	-.001162260816	.139437771220	.001172089310 93	-.000893551050 47	-.67391808107
22	-1.346369761530	-.043598329878	.008453704854	1.285689436743	.000876021793 76	.000845189901 76	-.32287577901
23	-.031528412968	-.138700159903	.003488761436	.064926590882	.002185684652 95	-.003275865156 00	-1.04123455016
24	-.526231589582	-.005687778823	-.000598682727	.471554263047	.002198906878 70	.000938573986 16	-.67033278499
25	.125660438520	-.036056596386	-.001553602262	-.102139585084	.000215819768 58	-.000915212740 78	-.12861948974
26	1.819731366279	-.026950913092	-.004979469720	-2.057353663095	.002654840340 61	-.001048408998 79	-1.22801773296
27	-.342133959268	-.012784008555	-.000077276659	.340038468185	.000106003046 48	-.000932088669 68	-.06683989993
28	-.373209403446	-.018773060288	.002066661344	.405496875701	-.000917636841 22	.000854595900 40	.38052121103
29	.194988291794	-.047429779079	.000720261931	-.279914293027	.001545498071 79	-.002208158951 33	-.78816698995
30	-.304290590586	-.064831897551	-.002393268132	.361492354023	.000485665394 90	-.000584260420 40	-.30038073253
31	-.093778569506	-.022514391603	.005318548335	.107300742991	-.002948998192 10	.001331812571 82	.88833202707
32	2.038669673599	-.183970241920	.013446159960	-1.940272963006	-.000683888795 46	.001741204740 52	.33804165044
33	-.002117799137	-.067625237180	-.000843043020	.100873324325	-.003286419049 08	.001095064315 11	1.26387785296
34	-.798336042360	-.047772473234	-.004577329188	.712059830443	.002979040358 97	-.002134735192 83	-1.33806401367
35	-.083054791921	-.028587167748	-.002833776204	.133281105300	-.000034098205 62	-.001523026837 03	.01171499158
36	.131471071476	-.123613712294	.004754602953	-.179943078045	.002028233922 56	-.001402037283 81	-.86093074623
37	-.583109047806	-.028932076642	-.002281899542	.617605495067	-.000644430249 41	-.000171997400 37	.30217987336
38	-.198150833399	-.022369427556	.002234628308	.229935062864	-.000972514038 96	.001166875003 07	.41675603406
39	.215927260371	-.065605486190	.008154402697	-.285856023474	.000270936356 88	-.001911334425 19	-.11300761678
40	.482098218843	-.022612049223	-.001219173283	-.532814532438	-.000304489374 14	-.001040835935 84	.20951312598
41	-.229582438165	-.022097880163	-.001392366984	.262347878011	.000973992630 41	-.000701550362 11	-.40854861807
42	-.066001587715	-.049090375687	.003121876643	.125281834233	-.001754616706 73	.000848440232 45	1.00464949322
43	.405184140761	-.078064464222	.003636103461	-.467536951717	.000426842186 30	.000470189639 01	-.31521673403
44	-.394992591409	-.058101912771	-.001032566002	.403332386468	.001500380259 99	-.001495861173 78	-.08749475763
45	2.305444258804	-.157484190331	-.007239304984	-2.299248053556	-.001735276333 60	.002611614555 09	.75656640024
46	-.178895377147	-.052855180398	.001396446279	.152419894835	.001716412743 97	-.000994511860 12	-.90135311638
47	-.924671662662	-.035796329077	-.000902566670	.973779105425	-.001517319061 45	.001270981900 61	.57542348630
48	.907815721741	-.028241956326	.000442122014	-.921483482227	.001793790497 32	.001222243413 08	-.55737632354
49	.225314273102	-.054977647738	.001809389992	-.180255394323	-.003817922801 35	.001051769282 96	1.20384583854
50	.012780227640	-.067512657180	.000965716254	-.069520878169	.002530174889 74	-.001086992105 25	-1.17710158827

NUM	DEL ARGPER	DEL NODE	DEL INCL	DEL MO	DEL A	DEL E	DEL MDM
1	3.499270494802	-.285309626531	-.005605201066	-3.422076900154	.001395698358l4	-.00063723349157	-.58324633761
2	-.112310002409	-.050461215298	-.040794445197	.040099237085	.004243003308l5	-.00317658459720	-1.76713249246
3	-.035847950308	-.080939765598	.002095767724	-.061374468254	.003399594833l0	-.00201546741247	-1.55374570900
4	1.088575915699	-.105510920199	.004222907201	-1.055398019645	-.000419462941l0	.00117678017037	.26044362564
5	-.308947182271	-.017979836051	.001803648965	.399111101699	-.000395045667l3	.00136020070677	.19709090199
6	.077409106983	-.050871208063	.006312054109	-.034189047430	-.000903161539l8	.00102866410921	.52471063670
7	.248346561937	-.068464122916	-.004364013471	-.314362398884	.000608029493l6	-.00066842446548	-.36732807794
8	-.021806867881	-.030690564388	-.001436841194	.023886992800	.000019326091l9	-.00061149635007	-.01429880856
9	-.172094995454	-.066699477022	.000154169065	.160106702679	.000713796123l4	-.00132947879909	-.43206588662
10	-1.710784587356	-.207406465190	-.007225633301	1.842365743036	-.004715247155l6	.00447554096761	1.42676404080
11	-.735309919481	-.021971889746	-.000658346548	.702951999475	.000367137535l5	-.00070538426086	-.20741827895
12	-.066553225832	-.047171933471	.005649854215	.106028732029	-.001044711246l8	.00104617265753	.66772706537
13	1.865339104232	-.178934311978	.000832856076	-1.823352557811	.000175784748l8	.00007782294170	-.08780923864
14	-.541167765001	-.033871136275	-.001614549791	.688449006335	-.002831968250l2	.00162255417296	1.40106075303
15	.051817022311	-.052187538484	.007417340139	-.109121916179	-.000439235545l6	.00159855395385	.20601474506
16	-1.047109794588	-.029982409036	.000080239974	1.030317803277	.001739720292l6	-.00113955085340	-.63350242622
17	-.721162485683	-.019 .6349064	-.000433877792	.733315300004	-.000239742596l6	.00051454352316	.13319547805
18	-.047100724041	-.020907928822	-.001161085012	.037067009187	.000315481543l3	-.00047961431820	-.21020888261
19	-.154789273609	-.091689146848	.001452071747	.194381091646	.001051219242l5	-.00094437760183	-.60016045781
20	-.454619750068	-.034406484072	.001594310039	.428171713542	.000471640608l8	-.00085150452651	-.27885020414
21	-.148334405589	-.029235562121	-.001193667335	.130569375029	.000714659590l4	-.00110964732239	-.41100544255
22	-1.694514283288	-.050972818561	.007541570730	1.714173907036	-.001532849077l4	.00033475299418	.56554806533
23	.042109269009	-.138169541951	.002800490061	-.035301744185	.003014396172l9	-.00319336620473	-1.43545695545
24	-.500597133112	-.029192877202	-.000562028401	.474664199839	.000880731289l4	.00142276469058	-.26863028245
25	.371736033194	-.110073072010	-.025163165080	-.422410216190	.001588087582l0	-.00047500114193	-.94575756341
26	2.662833106089	-.078507862298	-.007190493299	-2.787827681550	-.000619820081l0	-.00039760554367	.29714484535
27	-.251645541561	-.012677683946	-.000101712044	.211867259928	.000628314017l2	-.00101941636363	-.39607133268
28	-.596843122032	-.040663679014	.001784603305	.629377301379	.001056120743l7	.00112346668225	-.43755800744
29	.403607875789	-.064175616542	.000934445060	-.495893317853	.001346456917l3	-.00228480022739	-.68672761381
30	-.236795081153	-.075830747977	-.002121482352	.275916956307	.000497817760l5	-.00078176683971	-.30789491052
31	-.029828689138	-.027896218828	.007421081055	.083116884503	-.003518968767l2	.00156717304622	1.06026491104
32	2.032355957290	-.187629380900	.012828157504	-1.965085952346	-.000116439994l5	.00201541969076	.05753923797
33	-.053699047676	-.080012217568	-.000571891233	.224203447586	-.004097149034l0	.00121715248821	1.57622391514
34	-.547659110203	-.109833430288	-.004704958923	.547515610866	.000491799115l8	-.00309622294470	-.22115178010
35	-.212521946720	-.100272130097	-.010353989295	.293567160559	.003767654661l2	-.00279667095925	-1.29238628703
36	.189290756793	-.144697439704	.004630756385	-.239734425297	.001638320866l2	-.00153505602450	-.69554637050
37	-.519343841428	-.031027290450	-.002778453608	.561214637226	-.000149794105l5	-.00039414633026	.07022353970
38	-.392016336031	-.035532278333	.002936746596	.401287509874	.001045067244l6	.00161417024355	-.44743555792
39	.301194363077	-.076884659265	.009581052506	-.370261418309	-.000383204944l6	-.00217019827583	.15988207724
40	.874592595002	-.024715482887	-.001219990724	-.991698044141	.000891523187l4	-.00045860661674	-.61303511097
41	-.289602455072	-.022306153620	-.000034239629	.366420177612	.000437012348l4	-.00073856767446	-.18335268837
42	-.131205654718	-.050697811348	.003031815295	.190289736540	-.001193063408l8	.00075908404742	.68292157961
43	.429736670599	-.077254420092	.003982856503	-.429219170233	-.000228512218l7	.00091960933469	.16881569645
44	-.280794423579	-.064108895138	-.001068619989	.280307281155	.000749250204l5	-.00151086348300	-.43679057765
45	2.315853175125	-.160848219908	-.007201044980	-2.286534580693	-.001480902156l6	.00287008547280	.64558583950
46	-.148368819027	-.063181145142	.001450819438	.121991543605	.001230061997l9	-.00124463054883	-.64610745575
47	-1.055335042649	-.036308966740	-.001740929843	1.104696436432	-.000696602315l3	.00116647480075	.26408313943
48	1.259712453844	-.045165935306	.001118468340	-1.268139234879	.000845328386l6	.00134858705829	-.26276499241
49	.281343793013	-.063968745697	.002160994269	-.260317545064	-.001005877639l0	.00179804170916	.31680779366
50	.045475975807	-.080721522758	.001013030996	-.104523996080	.002048491942l9	-.00131400999359	-.95322684776

NUM	DEL ARGPER	DEL NODE	DEL INCL	DEL MO	DEL A	DEL E	DEL MOM
1	3.645359724389	-.293166323707	-.006787883579	-3.588286954429	.001254155435 93	-.00045844033475	-.52413067740
2	-.036209690537	-.066271385876	-.033889676976	-.059543246152	.004906975199 24	-.00331635234728	-2.038898689 78
3	.013564127075	-.088201211885	.004204599582	-.108470254607	.002689213722 06	-.00221171830789	-1.22948282749
4	.990206800179	-.107231590900	.004005587448	-.982367623659	-.000333982658 45	.00133845935787	.20735972197
5	-.464144754802	-.029656628391	.003511472877	.521866565810	-.000841375883 07	.00105750660298	.41985888595
6	.012897343408	-.052149345560	.006784292597	.055591346816	-.000712854588 31	.00094296969219	.41410725391
7	.120350254278	-.071854499049	-.005412620368	-.159227177013	-.000452246378 00	-.00034730122264	.27373891599
8	-.019665262174	-.033313754066	-.001862738116	-.043070591051	.000473114821 90	-.00008330605629	-.34995362635
9	-.037525381089	-.073986557814	.000150444180	.045141503397	.000050558855 99	-.00142850588650	-.03061427206
10	-1.742216508759	-.209206933574	-.007618265113	1.837626721343	-.004181559768 13	.00476037988717	1.26500985902
11	-.568363137769	-.023227986090	-.000521898116	.546376461218	.001056629159 69	-.00101186364241	-.59674426354
12	-.114949549385	-.053700654462	.005415151556	.146040724459	-.001192451864 65	.00100520784187	.76221577529
13	2.025751210480	-.184300038272	.002477536417	-1.948420178604	-.000446687229 47	.00026047996982	.22319976201
14	-.775201772620	-.035029871618	-.004176806169	.892601409499	-.001222486916 55	.00155765510875	.60433101450
15	-.098093249489	-.053516947733	.007458289053	.106739707866	-.001575655757 68	.00175320667829	.73942774178
16	-1.155821722929	-.041040499080	.000186339874	1.113678294187	.002748526713 25	-.00142342198267	-1.00041823996
17	-.766922861847	-.021320874715	-.000316292392	.795746090680	.000395296898 86	.00010905669247	-.22176843109
18	.059625254653	-.030596538749	.000788051719	-.090452169665	.001209946189 90	-.00023743618936	-.80580829788
19	-.088858019531	-.099709841263	.001592486009	.158055528755	.000479789737 47	-.00113008738017	-.27400092391
20	-.344314835616	-.060929679075	.001515220690	.305734716421	.000835248150 20	-.00101091612620	-.49373436476
21	.278378858820	-.054501872160	-.003583584517	-.408205221436	.002814443756 59	-.00113230172336	-1.61686265385
22	-1.709785335632	-.048638155331	.006271378345	1.737382024544	-.000892495356 44	.00001255541890	.32919750941
23	.115377799313	-.149049007050	.000904815276	-.138113727473	.003290775114 76	-.00321407730411	-1.56686275979
24	-.361097420122	-.032020378480	-.000507765475	.367247129503	-.000445236995 74	.00178128333725	.13587268550
25	.543216400616	-.196916034154	-.019667973782	-.472187768832	-.000110605495 34	.00031952351818	.06592741963
26	2.733783314692	-.080737772889	-.007398188257	-2.845109642109	-.000179431667 65	-.00014703138993	.08310830662
27	-.169029351586	-.013977056798	-.000125152699	.117448497229	.000246061105 59	-.00109477174708	-.15514151354
28	-.846423635689	-.056501446878	.006480217780	.859400373753	-.000208515485 08	.00070390482613	.08643858318
29	.620747919274	-.065354033497	.001571556886	-.586090904517	.000600574698 71	-.00242767692500	-.30642029978
30	-.153783049373	-.075966759265	-.002115080482	.218058745511	.000108307075 12	-.00091615038127	-.06700054603
31	-.038206056834	-.057157938598	.003059682184	.082964348530	-.001655808776 97	.00206506807173	.49852661198
32	1.993190895602	-.202299644538	.013394420184	-1.916052910368	-.000729256882 75	.00232102209627	.35998021635
33	-.092211178453	-.080574126925	-.000642116271	.299122116077	-.003917845582 93	.00133644336440	1.50712545652
34	-.376404763043	-.115745296294	-.005100027690	.382956211450	.001134544805 04	-.00312348623384	-.51002859362
35	-.342966373752	-.229976636709	-.005101412400	.368350865865	.005746215731 32	-.00410916739274	-1.96944958910
36	.229792442995	-.148286725431	.006358557070	-.254881159213	.001059514281 69	-.00165411170408	-.44993335673
37	-.482364107054	-.043323743586	-.003105233229	.499961060872	.000682156380 75	-.00076777167310	-.31966939590
38	-.654857485896	-.039347352515	.003344798607	.669741563608	-.000665644285 46	.00127424688855	.28521174263
39	.366915211787	-.076613487825	.010256551929	-.404604279698	-.000901106021 44	-.00240511418412	.37605046618
40	.493985880548	-.030535989357	-.001587212605	-.558385053601	-.000291383665 27	.00009310749111	.20049389732
41	-.362659616923	-.034276543218	-.001293636308	.476788294400	.001221143657 89	-.00091900903752	-.51216073962
42	-.183461634242	-.053194306125	.002569997413	.221449766752	-.001137503611 91	.00070083544050	.65110005016
43	.372794676579	-.080719700141	.003733813768	-.395592630401	-.000008048998 68	.00102075417252	.00594553485
44	-.190201089557	-.066941748388	-.000739006049	.157296528872	.000904450640 23	-.00157354810158	-.52722559212
45	2.311201218385	-.167182000008	-.006859092889	-2.312260408239	-.000724889087 31	.00317258401381	.31589904518
46	-.010648559088	-.078269854090	.001497823340	.011996916146	.001784654958 13	-.00132495111237	-.93715803597
47	-1.186250562350	-.046151942432	-.002037202454	1.210366179095	.000244649874 40	.00124800522473	-.09270926872
48	1.660150730535	-.047004059375	.002653425090	-1.644274320413	-.000547209623 52	.00124337228761	.17019174985
49	-.013680692962	-.091482085303	.000284576278	-.042307467938	-.003420213216 66	.00301356119936	1.07826908796
50	.138242170317	-.096745820105	.001270826345	-.175441569183	.002811531847 81	-.00125357410876	-1.30782256531

NUM	DEL ARGPER	DEL NODE	DEL INCL	DEL MO	DEL A	DEL E	DEL MOM
1	3.902910413384	-.303020612071	-.005683352187	-3.819294766519	.00018870350171	-.00025707309284	-.07890003576
2	.018311478972	-.070346609045	-.034216625561	-.138381438232	.00470572213293	-.00343403059066	-1.95943766178
3	.112398440699	-.092669525930	.005595614933	-.216762924483	.00396037711536	-.00195406558181	-1.80957000392
4	.850302328072	-.110944751199	.004240369489	-.905999279361	-.00093657259024	.00152252498572	.58167508617
5	-.405743334393	-.030014298303	.003483159079	.469060695905	-.00036969584146	.00084223055600	.18144143845
6	-.058897351933	-.052905590448	.005988674766	.098307650202	-.00019860122470	.00085485554199	.11533965403
7	.063211063592	-.093783745277	-.005744029309	-.074974085883	-.00029797716849	-.00040071127564	.18034716967
8	-.121271936925	-.039668518610	-.002094444101	.117712002448	-.00016767938361	.00022810940532	.12407423087
9	.091304126356	-.100624565643	-.000724812965	-.106927986420	.00112571483653	-.00094352999192	-.68125622443
10	-1.805614544290	-.226982125223	-.007841363128	1.907540890847	-.00509025858099	.00511136320191	1.54046650317
11	.033868406630	-.034758617545	-.002043678892	-.190520799119	.00162343391143	-.00139621266659	-.91658950925
12	-.131804906156	-.060382006839	.004803938835	.198931103679	-.00109143393514	.00074084437604	.69760732313
13	1.893315582300	-.219316760013	.003035706265	-1.842430441458	.00086161184863	.00031420940384	-.43025527184
14	-.835364446364	-.059015784154	-.005854059374	.973807251754	-.00217779829346	.00108192903973	1.07708223930
15	-.187325967498	-.050471703478	.006499835534	.194255351311	-.00088959525327	.00161836110173	.41733645428
16	-1.218420081605	-.041257512854	.000471405942	1.158864205328	.00229522383366	-.00164865478674	-.83558531578
17	-.787390165977	-.029540446722	-.002202657147	.695582521006	.00137130427045	-.00091892701828	-.76124420533
18	.046349810353	-.030238264608	.003466078712	-.082767172255	-.00014177235568	.00073196524307	.09448802687
19	.248774526572	-.204676440302	.002820884721	-.184936454723	.00191970522383	-.00058200923097	-1.09550828925
20	-.227125852631	-.069955793781	.001816915263	.208682092943	.00011438525324	-.00112576209348	-.06764104946
21	.644325673416	-.114726387787	-.004144361432	-.709016168425	.00074517702633	-.00034476408542	-.42854950944
22	-1.811800629235	-.055752512668	.003409737648	1.817208957615	.00016597822632	-.00033678884127	-.06119333876
23	.205708012574	-.163637140504	.001614947477	-.219801896856	.00256432292784	-.00322417177374	-1.22139332649
24	-.375051732841	-.028225635124	-.003493270141	.399194425961	.00034164348070	.00215583489362	-.10422644439
25	.563377694401	-.201659239458	-.018254380428	-.472313752201	.00007089890269	.00052846592721	-.04225594733
26	2.770454006204	-.089734210116	-.007409670424	-2.907481764218	.00018224588811	.00010046681490	-.08439741438
27	-.096531009196	-.015444908026	-.000172255192	.053477116173	.00068059683029	-.00087590480242	-.42901699246
28	-.820619114806	-.056294912687	.006429298507	.855046582190	.00002082794884	.00043867606583	-.00863318364
29	1.049826398852	-.073256495056	.002169940998	-1.178227440720	.00241197858929	-.00183252811444	-1.22953028290
30	.083331397887	-.104029805323	-.004305003694	-.101068842407	.00091297443588	-.00025858668906	-.56454097307
31	-.214502720781	-.085495942847	.018354504879	.310643440123	-.00404114360659	.00201521801223	1.21784834045
32	2.003852941249	-.202322713289	.014181283638	-1.891909509264	-.00126093307993	.00261142752821	.62339513395
33	-.138045750522	-.081300414913	-.000699469517	.331625168266	-.00289276288049	.00146238660513	1.11229567459
34	-.213456496400	-.126836120195	-.004491631669	.191792485286	.00168549897346	-.00321689239379	-.75751303255
35	-.276913007652	-.230936449992	-.003570924661	.357258700526	.00396919396796	-.00461184344500	-1.36140413446
36	.302613970485	-.169793527464	.019482727333	-.449110407802	.00261350160531	-.00070282928555	-1.10906618861
37	-.463916744568	-.047374298490	-.002970394867	.453073483061	.00044343905249	-.00100323569868	-.20782609511
38	-.653311825121	-.036923335003	.002827268349	.682457202631	-.00028793477846	.00098837652215	.12335150861
39	1.063702489984	-.085640655473	.012390993797	-1.204440376136	.00244087294459	-.00259319808072	-1.01709239429
40	.178155520705	-.031814645710	-.001928642261	-.262017866065	.00023871806734	.00030923235483	-.16420799256
41	-.509899607714	-.061700801634	.004052679516	.560934907364	.00284679059870	-.00133446240559	-1.19309721232
42	-.202802143343	-.055449629395	.002293810233	.277991661565	-.00135692169601	.00047520029779	.77678095223
43	.296502514080	-.085291816045	.003963230506	-.279820980591	-.00040510556633	.00102126274405	.29930579640
44	-.075599654490	-.066904333489	-.003686560827	.061700947041	.00015272792223	-.00162346846145	-.08906324846
45	2.220664494580	-.166870704934	-.006576497996	-2.228663624712	-.00141219294778	.00347342100244	.61561324374
46	.497311922241	-.165797182657	.006637740233	-.596359447511	.00283525837604	-.00089078070591	-1.48807739160
47	-1.317506980027	-.047675180169	-.001653856762	1.339753380584	-.00055647708886	.00118355205515	.21094857932
48	1.969707327084	-.050499226574	.002889518956	-1.924463659667	.00000425893225	.00140413211421	-.00132430913
49	-.149997111181	-.154955622951	-.000419167762	.242543719160	-.00667876517204	.00397279110107	2.10834651775
50	.402703099579	-.166735900468	.009960974389	-.605918232082	.00372159682847	.00003808389919	-1.73040963463

NUM	DEL ARGPER	DEL NODE	DEL INCL	DEL MO	DEL A	DEL E	DEL MOM
1	3.971095061348	-.309153523933	-.006053469530	-3.866316140578	.000808455557638	.00006364910994	-.33793393463
2	.081865990240	-.070664332907	-.034093896533	-.183576103947	.003922255213 61	-.00357736364440	-1.59220063444
3	.100445969161	-.102653526694	.004479750876	-.306372506795	-.002638184517 83	-.00043179104118	-1.20618156888
4	.519394384137	-.133815487214	.002266933670	-.505763770270	.000281065650 00	.00122875189881	-.17444836070
5	-.370820132281	-.030665864550	.002938015632	.393992052568	.000217498527 77	.00054914722153	-.10847424394
6	-.092764797357	-.055419506920	.005912611676	.147964164364	-.000708034271 90	.00066535745815	.41130598582
7	.014419573845	-.103244444625	-.006290697367	-.041624099933	.000133664339 36	-.00045815200837	-.08088047483
8	-.198158214509	-.042448914279	-.002557553942	.176360583289	.000202782946 87	.00021403717628	-.15001753088
9	-.089409250442	-.124327347647	.001257986435	.135251004100	-.000255627464 5	-.00035947829656	.15295545635
10	-1.745844646935	-.241748362707	-.006870376844	1.880068062870	-.006390342217 20	.00555267652315	1.93187534506
11	.318216203941	-.044330902561	-.002181722675	-.409054764536	.000606403392 31	-.00121682807646	-.34255231568
12	-.092083051120	-.133237575756	.007397721638	.125947221004	.000205704963 34	-.00017720666434	-.13138830760
13	1.470765671336	-.228654888728	.009094778671	-1.366192167454	-.000631463460 24	.00083295821802	.31555666654
14	-.738300228524	-.064315907475	-.006922754358	.872251766174	-.001538312471 94	.00093782136323	.76057407260
15	-.250893732195	-.057137739688	.004945003165	.237548758440	-.000520228752 76	.00159457428826	.24401235773
16	-1.299724012009	-.041349230964	.000479374712	1.270563253798	.001384052349 48	-.00189160038070	-.50406598489
17	-.642183630900	-.036252589019	-.002448271973	.602752989565	.000663552603 98	-.00110381131622	-.36848605819
18	.027643566798	-.030918588269	.003284744978	-.034085405288	-.000152239353 13	.00097462909071	.10146461914
19	.302448339056	-.225531500089	.005391319211	-.174296486606	.000017133029 89	.00040387415848	-.00978674093
20	-.092589883679	-.113491472624	.002522004258	.069765386532	.001236236829 54	-.00066674593104	-.73061596940
21	.664702590027	-.117535876281	-.004138387571	-.712176577701	.000946783233 52	-.00012250684819	-.54443642208
22	-1.884094221095	-.066975864367	.004051435630	1.873590964635	.000230592390 12	-.00051808268637	-.08501311786
23	.260874479722	-.168972464435	.001976926199	-.256247639314	.002923144426 65	-.00306305782286	-1.39206325047
24	-.835177578309	.049269828451	-.001801375411	.632490129396	.002546281581 76	.00312783536611	-.77612202028
25	.519282554003	-.201969852118	-.015924079785	-.431436278704	-.000224955719 71	.00063846555401	.17582793942
26	2.772578656284	-.090663826613	-.007092714917	-2.904443822903	-.000581184657 35	.00043717339287	.26924126525
27	-.241792405453	-.023149101336	-.000138961471	.194757749297	-.000253436389 68	-.00032925817679	.15983414194
28	-.802330238302	-.054701627167	.005380450953	.807944876586	.000909743167 92	.00006239078676	-.37693761627
29	.849836032681	-.080452693761	.001131787036	-.960085364743	.000523023273 93	-.00388271573464	-.26686277237
30	.113816701141	-.145983998060	-.004546928057	-.029710899755	-.000298160018 60	.00038115125870	.18448634229
31	-.325806630179	-.084942970952	.020957692256	.479438598795	-.004971386302 76	.00202755505668	1.49874144410
32	1.567239976128	-.234598662701	.016063024162	-1.498502792463	.000229176611 70	.00285735763230	-.11323050543
33	-.175831013130	-.084143855565	-.000809983275	.373500408805	-.003568427919 44	.00140721943140	1.37134527272
34	-.062372293229	-.126045839557	-.004003379099	.029515742772	.001122648516 60	-.00324936336520	-.50468347223
35	-.182330351796	-.228977442948	-.003991386887	.236765154114	.005076940262 38	-.00459973888432	-1.74054866349
36	.227069201268	-.176119915606	.018444157389	-.327233462271	-.000955130428 59	.00102563220018	.40597746838
37	-.412300311556	-.045714232045	-.003034875005	.436989936748	.000154839710 18	-.00116389680430	-.07257845285
38	-.695201784363	-.040016595645	.000931620520	.690678084324	.000556139179 04	.00063359076984	-.23815877954
39	1.761206363881	-.108870091091	.007357241567	-1.977968354295	.000115595829 81	-.00141176354557	-.04921842815
40	-.067431861095	-.037445550293	-.001724172894	-.007684897999	-.000202954255 30	-.00002248752935	.13964099587
41	-.477290853243	-.060372742140	.004804140462	.565732136056	.002124863727 35	-.00160475538003	-.89082649617
42	-.145467508934	-.115670197603	-.001124534800	.196062303767	.000684844012 27	-.00060578406337	-.39153471921
43	.237040584278	-.139029867063	.002995903816	-.233713043071	.000533254696 72	.00047679008572	-.39377705358
44	-.057457380402	-.079277616700	-.001400763156	-.006395566606	.001125010203 61	-.00109147682756	-.65572033690
45	2.234063159012	-.169410791688	-.006485640354	-2.209229077394	-.002148954880 51	.00379650368675	.93710507419
46	.712280351295	-.152296153225	.008431702296	-.763647223968	.000667009801 84	-.00013571254264	-.35045397860
47	-1.450780808784	-.048698110153	-.001656526995	1.507993163410	-.001376608707 15	.00124159650755	.52202898818
48	3.152230780775	-.064488740485	.006034301372	-3.267408467022	.004668459718 45	.00260351855758	-1.44893826721
49	-.171156837667	-.173505926060	.000191152157	.341826578879	-.007430174127 88	.00442243719842	2.34626340129
50	.527293153398	-.140334587253	.013453861804	-.711995786631	-.000023961280 75	.00171959270375	.01116082991

NUM	DEL ARGPER	DEL NODE	DEL INCL	DEL MO	DEL A	DEL E	DEL MOM
1	3.617884739037	-.355010952200	.000297242593	-3.579573152110	.001147670868 33	.00086681325415	-.47965222079
2	.138544220532	-.083381064007	-.046952667383	-.720919141733	.005151873700 10	-.00314031249735	-2.14478156583
3	.138474090796	-.128483613696	.003007579462	-.238925535778	.000543702590 53	.00051721390537	-.24852546489
4	.574863392347	-.161297032437	.003350932273	-.510057905798	-.000623348379 19	.00078406424950	.38738800832
5	-.330631574347	-.039282457477	.002751478027	.353794543946	-.000146962077 52	.00034532673795	.07331153421
6	.046031011061	-.086260959863	-.002358657850	.005440192216	.000357596811 83	-.00003843179959	-.49778700010
7	.001037962109	-.105506245345	-.005908117805	-.002054332464	-.000250187917 42	-.00063802261523	.15141949736
8	-.232315254299	-.045232324228	-.002302658715	.235767193830	-.000122960079 64	.00005613514233	.09090790806
9	-.209213806043	-.126375756539	.001221331751	.259253126038	.000218599477 22	-.00035324571270	-.13235415311
10	-1.669648815612	-.241894515892	-.006292427493	1.937539114164	-.006956016693 20	.00582012990985	2.10666342459
11	.334271031054	-.090315690198	-.002466728803	-.449325111993	.001147327745 83	-.00097207318969	-.64793746188
12	.000939583369	-.138532202131	.009649811307	.076943351680	-.000508674388 35	-.00035053735944	.32502585549
13	1.359371854043	-.229516593830	.009056895232	-1.254367778620	-.090001913965 55	.00057943026368	.00956167859
14	-.666953398188	-.076024304770	-.006611297012	.775521057516	-.001139218911 92	.00073246632309	.56314518151
15	-.310433091880	-.060997486693	.006302266549	.323168370105	-.001255724388 24	.00142743453751	.58920029935
16	-1.219311262892	-.045364586844	-.000133502883	1.199434926584	.002979289753 25	-.00251645688489	-1.04795527694
17	-.545703298638	-.045029127366	-.002830621918	.480125192091	.001159276578 01	-.00097011882571	-.64341153902
18	-.018165545494	-.035567394996	.003086016199	.001726676244	-.000245701954 93	.00099156283275	.16376399768
19	.255282591319	-.226986791797	.005453349719	-.116176344563	.000398547592 92	.00060636907279	-.22767128304
20	-.309950918818	-.076952059079	.003585037745	.284230223409	-.000283130629 88	.00000648840102	.16746219041
21	.610719339224	-.120047483022	-.003970055325	-.672344809416	.000779697709 92	.00003036901344	-.44839432762
22	-1.984393638893	-.066242298474	.005328697206	1.989317177035	-.000798892451 94	-.00080057269818	.29466016047
23	.133677105390	-.185691458948	.007425027445	-.165378690544	.002021392883 92	-.00239284608945	-.96304315685
24	-1.382126875436	.016684924958	-.002974369074	1.274993146766	-.001235397683 35	.00319835678338	.37712422785
25	.479199232726	-.200874181031	-.015637770931	-.359105935622	-.000714487529 58	.00083233923481	.42601079908
26	2.790249462687	-.090316401653	-.007103537112	-2.892852230121	-.000851636522 40	.00067954138274	.39458181273
27	-.321910605486	-.023808490088	-.000136130105	.299665710423	-.000108190574 78	-.00030059012387	.06822702153
28	-.814934844297	-.063574969761	.004158255051	.797740241342	.001131985335 75	-.00018182426718	-.46897321042
29	.676895038232	-.079471470326	.000817935346	-.767870343097	.000763361591 52	-.00074522083049	-.38944507830
30	.025438899102	-.152064019407	-.004900648220	.047167269367	.000270307045 07	.00051589406810	-.16720209902
31	-.403959661267	-.083160846669	.020914427625	.578077201120	-.004277739776 57	.00186617430975	1.28927050544
32	1.281515370611	-.232763835738	.017565234487	-1.166043073834	-.001201894667 69	.00243555512533	.59423722012
33	-.217938564480	-.090720675118	-.000727931557	.461122825698	-.004298730939 87	.00142509313540	1.65392079960
34	.070372918017	-.126614735243	-.004005040444	-.075141672856	.000701070167 95	-.00328550895046	-.31522591273
35	-.102982191635	-.232818200082	-.006090599751	.118677040369	.005752052947 07	-.00474061795792	-1.97144543101
36	.268611427149	-.190849673123	.017000877406	-.284512011429	-.002139150048 44	.00167151432556	.90973411073
37	.028670388438	-.075679304326	-.008383814927	-.127657562414	.002797645587 68	-.00099848229785	-1.30971125999
38	-.706987862344	-.055476213158	.000673858196	.701787993014	.000598612310 717	.00042842117512	-.25099554214
39	1.988865327387	-.120580389033	.007229044917	-2.132057240979	-.001089272646 65	-.00123025593724	.45461498047
40	-.033081656518	-.047312332137	-.001760844872	-.041188568957	.000519215729 28	-.00043881643605	-.35709985958
41	-.404830718333	-.061131632014	.002721862963	.456278387544	.003020433186 18	-.00166144485245	-1.26577191796
42	.014624711705	-.160457955746	.002899453810	.055426720486	-.000507555973 46	-.00117361125306	.29042814766
43	.328568774411	-.151965248020	.003664966110	-.278539876726	.000164407170 89	.00031422911494	-.12143037577
44	-.241098389477	-.097404291890	-.001040951194	.249986067833	-.000221361258 60	-.00069181480663	.12911168969
45	1.867250639898	-.181081595769	-.008405497471	-1.857783135831	-.000473873565 87	.00411415018956	.20648530474
46	.698462432720	-.152613076800	.008420422865	-.755849063411	.001241803119 73	.00010181236351	-.65227085613
47	-1.616506304879	-.044874347779	-.002649252781	1.684894672893	-.000363765731 00	.00096109334080	.13788427330
48	2.969634320896	-.090317299233	.003544666016	-3.109221062121	-.000061658975 33	.00468460692894	.01917328082
49	-.230350622965	-.176389170127	-.000225090126	.409100068864	-.006474331688 99	.00462113994135	2.04364222402
50	.577725952455	-.139608013695	.013454033685	-.716391733826	-.000492114733 15	.00203129086790	.22927080763

NUM	DEL ARGPER	DEL NODE	DEL INCL	DEL MO	DEL A	DEL E	DEL MOM
1	3.154898902831	-.353350168785	.002255222376	-3.050871156520	-.000522422132947	.001129271603 82	.21850335880
2	.054750620737	-.133121591003	-.043400183812	-.117091841661	.003637557 82425	-.002714249210 37	-1.51540580516
3	.119111722688	-.139862799746	.002507429440	-.203298904311	.001022 23225419	.000756491470 83	-.46954902751
4	.764061275189	-.157870154384	.003396116858	-.723430140811	.000007449295 04	.000721498117 04	-.00462419987
5	-.235081410046	-.046607473552	.002632534829	.283350976562	.000131793946 18	.000332294482 03	-.06573607735
6	.324717885847	-.187810653904	.000963566329	-.261507172603	.000343520651 12	-.000599475600 22	-.19945314843
7	.131660764131	-.129721409572	-.003969349579	-.192335993421	.001705365062 49	-.001572536539 77	-1.03106980947
8	-.072112811638	-.080149802427	-.000964098989	.022253486080	.001091457337 27	-.000667553573 47	-.80704307828
9	-.304989821117	-.127590145199	.001237437442	.337239673393	.000067859440 30	-.000428233934 84	-.05319939881
10	-1.986499101179	-.279201595149	-.005624361240	2.046431694798	-.000759978830 63	.000659303108 11	1.14031149049
11	.282738022281	-.054484194785	-.001777579868	-.388957155424	.000496544027 13	-.000676546018 45	-.28073528071
12	.029032995935	-.140333108348	.003686156251	.017714914618	-.000275873189 94	-.000167395687 20	.17625173565
13	1.237069985018	-.239367290334	.007913854482	-1.164463777444	.000334264981 70	.001400748623 48	-.16696156643
14	-.584091652614	-.077273998981	-.005805793140	.694137312039	-.001870930530 76	.000563368784 92	.92517616908
15	-.304631708292	-.077752269535	.005809033247	.347593453254	-.000445436087 60	.000962155516 31	.20892359951
16	-1.141741753261	-.168084820696	-.001984026410	1.061536945872	.007262318000 56	-.004485223922 59	-2.63827515526
17	-.454372843851	-.051827713469	-.001915765177	.392357130382	.000584053839 64	-.000743899850 14	-.31324787397
18	-.060391369389	-.038348120088	.002935567148	.077801369360	-.000335972668 81	.000659266602 94	.22394176627
19	.177437028869	-.228979233230	.005528406131	-.052974839247	.000210199417 95	.000661901617 02	-.12005838908
20	-.411085119187	-.079770165812	.003599066689	.397880535136	.000146438991 98	.000047502285 42	-.08553007759
21	.553277285861	-.119390479435	-.003926332132	-.583686813894	.000164562079 29	.000282623971 08	-.09466746252
22	-1.955196684470	-.066213987195	.005380586030	1.986245308522	-.000430274481 69	-.001127194256 12	.15867550555
23	.039097588658	-.184189661759	.007682232266	-.007703954452	.001112580068 21	-.002043027579 03	-.53029086231
24	-1.529500643794	.014865506750	-.003008196119	1.467722125486	-.001381913989 58	.003115059383 00	.42187522636
25	.369535161983	-.200914464610	-.019516860103	-.280183368937	.000300117834 84	.000750643235 67	-.17884973632
26	2.330653938036	-.095157208838	-.008955522219	-2.519523487776	.000543328244 06	.001052170067 72	-.25157059727
27	-.393954867246	-.023853087982	-.000110409066	.343829934550	.000146751528 29	-.000348277668 67	-.09253172379
28	-.801568563082	-.068827167550	.005176133433	.807109790036	.000149711940 04	-.000486916761 46	-.06205198968
29	.495586535904	-.087398095700	-.000117383054	-.611770649368	.001209398814 25	-.000660301604 14	-.61686580983
30	-.085432827324	-.159622909854	-.004537460799	.173078138312	-.000302510612 24	.000505272055 16	.18717870008
31	-.517416039274	-.079081252665	.018585650538	.669035356914	-.002855911673 11	.001809532530 99	.87232231710
32	1.358704670933	-.232381928232	.017343779411	-1.258554534710	-.000387161918 30	.002102996877 77	.19134410755
33	-.262216494473	-.090230832313	-.000923684011	.543135276537	-.004179265701 52	.001416583205 47	1.60787296535
34	.327124345564	-.173166542088	-.007397281643	-.401337714167	.002601458906 82	-.002398513181 69	-1.16867479613
35	-.027861684674	-.252233582240	-.007414640531	.031359711859	.005558249105 85	-.004878686647 08	-1.90517545612
36	.246569042036	-.192167048950	.015519658408	-.270100655696	-.001330447268 17	.001896539860 3	.56560217723
37	.533721579959	-.237187621424	-.012603655696	-.501422168858	-.000279532690 94	.000320046387 05	.13105308586
38	-.719937045178	-.056738481984	.001439448123	.744016633609	-.000238941542 86	.000155511060 28	.10236047575
39	1.971702506675	-.125978095308	.005966272599	-2.134484591206	-.000115604609 85	-.000908620664 06	.04822712377
40	.656329716698	-.060373736662	-.000458598375	-.749756688507	-.000132581110 07	-.000829174302 58	.09121779545
41	-.344996551405	-.075275496449	-.000296410924	.371962903886	.003186424724 28	-.001776134803 57	-1.33523376217
42	.056254857060	-.162724076992	.003028949089	-.003544192859	.000060109681 80	-.001005647746 99	-.03438530658
43	.388393216246	-.157868108101	.004104976823	-.362945776749	.000279169606 50	.000444411705 13	-.20617995635
44	-.345977739016	-.101057702104	-.001289915389	.355412336350	.000383037823 85	-.000765804804 76	-.22334185889
45	1.383553263324	-.235291225740	-.007406006509	-1.351732317376	-.001867950470 57	.003749892589 28	.81446091556
46	.634682786007	-.158772267947	.003480354554	-.695381755109	.000833862801 19	.000267478703 69	-.43808412028
47	-1.985636280795	-.112822699597	-.009132294843	1.989801257081	.002003721922 15	.000234733541 47	-.75872407126
48	3.015089299934	-.109813881747	.003712529856	-3.060958314702	-.002100522497 66	.005467922460 05	.65370679993
49	-.269590706324	-.187583304418	-.000075429313	.426773564392	-.005780397909 48	.004807301702 69	1.82408819579
50	.553326942321	-.145642209896	.013438294409	-.712372302667	-.000287120797 84	.002185004918 59	.13375346359

Appendix E

PERTURBATIONS IN RECTANGULAR COORDINATES AT FUTURE DATES

Appendix E

PERTURBATIONS IN RECTANGULAR COORDINATES AT FUTURE DATES

Appendix E contains the perturbed equatorial rectangular coordinates and the perturbations in these rectangular coordinates for the first 50 minor planets at successive 400-day dates from 1973 November 14 (244 2000.5) through 1983 September 23 (244 5600.6). The date of the perturbations themselves is contained in the column heading, while the date of osculation is contained in the page heading. Orbital elements at the date of osculation are contained in Appendix B.

Note that the perturbations are listed in terms of the 10th decimal of an astronomical unit.

These pages illustrate the variations between individual minor planets of the perturbations over 400-day intervals.

GROUP OF MINOR PLANETS OSCULATION IS JULIAN DATE 2441600.5

L	NUM	QUAL	X,Y,Z COORDINATES AT JULIAN DATE 2442000.5			PERTURBATIONS IN 10-TH DEC		
1	1	1	.677141754652769	-2.501562388985278	-1.316830719762791	5864313	2710749	657505
2	2	1	-.531181387821960	-3.038286057101516	.639986250252360	2910246	4145432	-257018
3	3	1	.494824143179542	-2.935335754911318	-.580401376154327	7690620	3217127	-1086924
4	4	1	-2.087629941389813	.955868540748167	.654853515286124	-2967531	5494293	2536205
5	5	1	1.878629697259321	1.637763255935255	.456857539493655	-9129773	-4831310	-1491160
6	6	1	-1.060322512122874	2.058981623389599	.631573367273628	-3822658	-2782980	209345
7	7	1	1.928770394690822	-.659959163208654	-.075199626574640	18058146	-17520208	-7315098
8	8	1	-.832039433828026	-2.187101167915344	-.769160126392091	2919719	3922511	1239191
9	9	1	-1.381572622407269	-2.109590086624593	-.865691834640376	1994125	3449335	1235487
10	10	1	2.803872455631478	-1.394340073287424	-.436439104051740	22925828	-28279515	-12694285
11	11	1	.953878580798285	-1.849701755673841	-.769062295458134	4584535	3541574	994359
12	12	1	-2.457074768784679	1.201890542106359	.093049688593948	-2544727	5214551	2138183
13	13	1	1.806886243736656	-1.495997207739109	-1.513918800684138	11223098	-6991066	-805774
14	14	1	2.877504144057937	.839680124384795	-.131234780724714	-5189638	-12559941	-3062340
15	15	1	-1.714980366425785	1.902548970372408	.648263761149053	-2485754	3040253	1022379
16	16	1	-.638818698289025	-2.806697136068091	-1.045721175273080	4054215	4288091	1541091
17	17	1	1.780781614993792	-1.259256472138730	-.615367443866894	5436207	-223345	-651673
18	18	1	-1.206193781824169	-2.241165580674476	-.475149573390149	2517404	3974431	1134642
19	19	1	-.898335262324483	-2.371849720603578	-.978268726427682	3175420	3959857	1726961
20	20	1	-2.286083324229736	.022957954048754	-.003730237577375	-3749278	4601766	1970219
21	21	1	1.798655373271636	-.839358832381436	-.477045777464109	6876051	-3107194	-1510233
22	22	1	-2.684736581721850	-1.648965313314399	-.230042511726405	154437	3738468	1142464
23	23	1	-.998215810442822	-2.445553267990647	-1.082504370325530	2619768	3599740	1086589
24	24	1	2.120816601176344	2.147538177422675	.940655278085309	-6937042	-7[illegible]732	-307163
25	25	1	1.171870405941291	2.246327249079130	.461549580399549	-2294245	-3324656	-2143350
26	26	1	-2.357947017352089	.956700889028145	.581715657502357	-2798828	5534932	2471131
27	27	1	-2.096104214567021	-1.307862669949763	-.500810953499509	-1344140	2754269	1209143
28	28	1	-.577486857520086	2.179646784891002	.678536474064533	-3204799	1521370	1087168
29	29	1	.895462193025885	-2.197477745214011	-1.231683529931146	6282621	1633716	1510000
30	30	1	-1.298645663529570	-2.055696455685322	-.988307864408785	2265837	3532245	1682809
31	31	1	-2.112206154126497	.684780816311068	1.433993600532254	-2555152	4204071	2317827
32	32	1	-.098423797389954	-2.360778496781464	-.833179619853123	3506478	4021077	1741100
33	33	1	-3.720714158304560	-.221688158331210	-.084332899221282	-790621	4346772	1876820
34	34	1	-2.375372902201661	.392557758520466	.106636391026420	-3296358	5210309	2147686
35	35	1	-1.425102161986395	2.049047616839374	1.230190613025674	-2442485	5922955	2486407
36	36	1	1.858619846595843	-1.175311158081058	-1.039798810516800	15538781	-12604436	1112567
37	37	1	-2.467539232018754	-1.525435750706478	-.741074202683141	266947	3247921	1392698
38	38	1	-.614838508231397	2.026239171091262	.935741846272791	-3494458	862533	-44918
39	39	1	2.446123442914867	-.206003723632959	-.228047136762442	19611104	-22401972	-12371595
40	40	1	2.155894756869429	.020069556142127	-.165556683577983	15056234	-14781937	-7066115
41	41	1	2.605673771657649	2.331284708750431	.292037168861471	-6565776	-1014990	-96780
42	42	1	-2.795731957269529	-.020952159976772	.448450655527296	-1807695	4275849	1848647
43	43	1	-.324597285432267	2.355067059932580	.984767192538843	-3503270	354940	-9907
44	44	1	-2.221970719840201	-.674303503221353	-.142866052517713	-3437691	3754891	1724329
45	45	1	-1.691307743950404	-1.785462971561266	-.466001664962839	615985	3314279	1323097
46	46	1	.983601709804162	-1.896462666191503	-.732234474881626	5573017	2572943	790237
47	47	1	-.811529941634817	-2.233282157278936	-1.204100304397414	2984256	4063560	1974844
48	48	1	2.250536470129916	1.839564233805334	.576971383976410	-8820998	-3866948	-1922185
49	49	1	-3.248897339336764	1.005939259648407	.269912134750703	-2144810	4731427	2027979
50	50	1	1.529114684792852	-1.334225235898352	-.511516199665994	9644663	-3353046	-2028346

L	NUM	QUAL	X,Y,Z COORDINATES AT JULIAN DATE 2442400.5			PERTURBATIONS IN		10-TH DEC
1	1	1	2.908599795626352D	.139822515863865	-.526174286277168	32528791	-6898075	457017
2	2	1	2.483013620969089	-2.299752003593596	.273137716083808	3802395	7191011	-3650161
3	3	1	2.020535274139604	.559813705108414	.024447776075376	25671035	-2895914	-4520409
4	4	1	.134202376933809	-1.999550194515585	-.815574378689877	-1927246	2128303	842621
5	5	1	-2.097777923003406	.356065105626680	.253491057859291	-3623373	40398	270408
6	6	1	-2.741530882469533	-.964846289400533	.269245010506040	-5005782	2175975	1234936
7	7	1	-1.640605443202553	1.521979364898463	.468081967817014S	-1c51819	-8910227	-3968652
8	8	1	1.779039042141323	.577483023577837	.041761781738561	10948944	-555802	-754836
9	9	1	2.047819605938244	-1.090795527707130	-.726178331212257	3749702	4378130	2204617
10	10	1	2.796531025649315	1.756049575274695	.995359181495004	5961936	-21211741	-12633660
11	11	1	1.434190675597151	1.891573770386238	.616188259154757	20183455	-5534396	-3205186
12	12	1	-.100483225761824	-1.785678401952573	-.616084460261018	-2514979	1742961	880351
13	13	1	1.928318178383208	1.515685291473147	.613901198516192	20281853	-14217924	-1515942
14	14	1	-.182996605254767	2.263449952006781	1.039969091334143	-5118065	-6467738	-1882832
15	15	1	-2.811552711757088	-.881930524766663	-1.077878641176810	-4645507	2223793	1026964
16	16	1	2.469967238484188	-.653781262530831	-.318105927353258	10439585	3402112	717374
17	17	1	1.475723885890403	2.240328967498669	.699363880065082	6794903	-9811846	-3819463
18	18	1	1.738369308971976	.450824696373139	-.039868028893786	6458909	1389644	-255153
19	19	1	2.108281336334130	-.126290337261212	-.018684227108309	8725901	-1481958	224184
20	20	1	.112323356657888	-2.532670418931545	-1.064951118014392	-1069483	3293639	1475011
21	21	1	-.063998300444118	2.372499018300871	1.057235579012563	-1365866	-7740338	-3131699
22	22	1	.280594619435426	-2.703878227409263	-1.570940217984507	-895030	4305251	1824881
23	23	1	2.174414953222552	-1.934705435248752	-1.407150205984451	4854259	5261928	3158830
24	24	1	-1.719102067076108	1.986155092945694	.901920164360760	-4459401	319075	167328
25	25	1	-2.014468339563265	2.201681800246817	-.222110911494297	-4240775	1078004	1107402
26	26	1	-.461242065859460	-2.158358541028178	-1.027432709572636	-2551207	2043175	931126
27	27	1	1.177974511056782	-2.209249898130665	-.987924713753358	395252	4842679	2071575
28	28	1	-2.261112166831253	-1.447072838340425	-.184278204108986	-5219478	1783970	1067083
29	29	1	2.098270768600756	.995470239867625	.579093656621131	33293959	-9472676	-3605075
30	30	1	2.076891124983959	-.502230429005259	-.165128389704261	5050997	-3075239	1291857
31	31	1	-2.603180252630565	-1.961037849191570	-1.181999333466990	-3747673	2273546	773268
32	32	1	2.778551542177425	-.194219075997362	.113696276466528	20562174	-1972469	-2978864
33	33	1	-1.262180972863781	-2.183407350264957	-1.026441605647314	-3050139	2725102	1297101
34	34	1	-.097923897247277	-2.648005470411334	-.858447550475297	-1554990	2925778	1191119
35	35	1	-1.460619263142611	-1.578214695275101	-.988935859951699	-5025552	1585558	635559
36	36	1	-.613695245000780	1.569328035664356	1.406794073584301	3949800	-6290967	-3547138
37	37	1	.597596350004540	-2.632570754172534	-1.317127017114615	-415648	4466896	2209731
38	38	1	-2.416461050268452	-1.112635780138632	-.851233847839932	-5063193	1957268	771514
39	39	1	-.224493703775067	2.636074060034758	.667274013413060	-4185523	-8764767	-2141075
40	40	1	-1.132988066457109	1.815447119146839	.867736996494713	-3347613	-7630193	-2960971
41	41	1	-.464919986423910	2.948591351384309	.395606961566298	-5126765	-1670131	552864
42	42	1	.486458055048928	-1.694376194180983	-.844161925946544	-1210848	3305884	1283225
43	43	1	-1.986548225976186	-.549256058925355	-.364923938534822	-6058677	2483684	1001408
44	44	1	.807868206831238	-2.473751515699291	-.991517249856191	-247647	4298186	1646283
45	45	1	2.227984303307352	-1.415375957042983	-.599204136189620	2975843	4859312	1353679
46	46	1	.889941757381216	2.009139661080383	.777113449285622	18334157	-3260401	-1973384
47	47	1	2.550909587187519	-.171829305456062	-.108624553286735	11671291	509946	665985
48	48	1	-1.527072097806659	2.438318489021142	.729349145555055	-4380640	-837587	85135
49	49	1	-3.173968796035680	-1.817136524893272	-1.007859423705469	-4179132	2523578	1267431
50	50	1	-.623871737736657	2.228709269376267	.843082376415854	2248741	-5802619	-2473111

L	NUM	QUAL	X,Y,Z COORDINATES AT JULIAN DATE 2442800.5			PERTURBATIONS IN		10-TH DEC
1	1	1	.486814404942892	2.429755658781247	1.048382807558689	24778220	-7112970	860328
2	2	1	2.522980851048445	1.010785882701107	-.384353965554576	18450847	17244313	859424
3	3	1	-2.246779153994022	1.163801613985477	.308228142487469	3304605	-8669558	-1707760
4	4	1	2.209688558034770	1.142608544044933	.166748371230958	4546931	5668929	2983020
5	5	1	.062015166475851	-2.695238312010503	-.945855861407111	-4637507	-1059673	-301582
6	6	1	.350105447966197	-2.312900958930356	-.562795695202080	-4498149	-377094	-186940
7	7	1	-2.260289816987012	-1.632778750510496	-.905859358409227	-6302338	-973176	-355506
8	8	1	-2.179060802489460	.721586700743355	.507696687119541	2969821	-7567013	-3145353
9	9	1	-.103136471763355	1.895840908385537	.913833815482192	24346951	11644549	4825317
10	10	1	-.248235792135260	3.072964782461582	1.379290227936941	662281	10957532	-5825840
11	11	1	-2.175906973625160	1.439842575242871	.699986364714007	-923509	-5339107	-1995225
12	12	1	1.364190209653714	1.831301459637082	.792253702423895	7616472	4558890	984656
13	13	1	-1.977180255156867	.795486603091295	1.054466976958359	1100760	-7019315	-5085582
14	14	1	-1.726856262330443	-1.359646692353685	-.302347682187751	-5819696	-1069418	-18322
15	15	1	.131762709314170	-2.473755522547634	-1.294882698122834	-4743797	-222026	271912
16	16	1	.297984009961615	2.547818506400475	.957288434460771	26141695	3464156	820763
17	17	1	-1.949012136448786	1.585019798089405	.749688580925525	-1335683	-5510995	-1962315
18	18	1	-2.189757083243435	1.216964613722524	.515643684218176	2403756	-7321016	-1983338
19	19	1	-1.473070473577614	1.782336411717253	.701743614373566	6138126	-4246514	-1995597
20	20	1	2.438693302244687	-.071036607749335	-.015606555905782	-1918965	6102910	2462175
21	21	1	-2.750087246429601	.351789404767837	.315710053860494	-4440143	-956882	-334356
22	22	1	2.672264962508578	-.067570504558501	-.718665022279129	-2394446	5481170	4272307
23	23	1	2.373159170721181	1.085810830329656	.122778153325290	15832332	11712527	8597867
24	24	1	-2.399613990981678	-1.588778561569505	-.688669448704565	-6517623	-821140	-215533
25	25	1	-1.673154978157257	-1.318361861984890	-.480703480438367	-6903075	-1007532	-357523
26	26	1	2.735773822983134	-.114691855339071	-.190664293726377	-2105264	5479269	2816359
27	27	1	1.506932668403586	1.277933976115328	.505647974496039	10731330	7205363	2876427
28	28	1	.900275904762687	-2.902368984519413	-.909092866800115	-4199342	922212	206559
29	29	1	-1.837154843180208	1.488362957456573	.828593389190328	1914794	-8535006	-4954225
30	30	1	-1.101478574326833	1.850745649316003	.817265314169035	10024042	1025940	62474
31	31	1	-.059104256836283	-2.667818579244681	-2.785542894576807	-5144388	264665	699180
32	32	1	.486419220882491	2.472481939743702	.896648962570126	24860198	-3258796	-3716196
33	33	1	1.830103245724601	.734604490240379	.337562592006602	-4133924	4455468	2092424
34	34	1	2.844676355988497	-.810835328592230	-.241929950101412	-2734275	5988277	1895981
35	35	1	2.518416662350091	-1.657010680852295	-.972690012293285	-3484523	3226616	2108595
36	36	1	-3.274122114581544	-.389313344683300	-.382542380564404	-5377425	-553284	-400694
37	37	1	2.318760513162985	.349285161982896	.155874928267141	-260167	6585997	3109954
38	38	1	.547244133508691	-2.816396671863728	-1.338148325493052	-4403809	391121	490468
39	39	1	-3.018959315755481	.405722279190996	.318850063048830	-4760173	-946189	-26450
40	40	1	-1.608201072828400	-1.607297362227676	-.557362177838844	-6745413	-1277478	-255213
41	41	1	-1.825764800106441	-.893976457963412	-.106149523057738	-6062368	-626235	129224
42	42	1	.947429197646148	2.141356526871874	.811183783323294	12455620	5035555	2153571
43	43	1	2.040990474164985	-.209949385985725	.044191239309878	-3382558	3323459	1273987
44	44	1	2.381770907605429	.515614639784069	.073663742092674	2232387	7257965	3037939
45	45	1	2.052643688227604	2.040864809890238	.525359701727020	39613496	11752864	4941450
46	46	1	-2.656946255555283	1.127330912380458	.433729304108120	-2349305	-3011429	-1065301
47	47	1	.511944344052910	2.658860664412600	1.436294931905351	20205794	-4146455	-3234918
48	48	1	-3.082059786340452	-.764801080702419	-.256662726298378	-5162218	-497883	26345
49	49	1	-.420876037864780	-3.116176614224941	-1.439308983027743	-5445960	-78716	206016
50	50	1	-3.340457781190779	.246242185139172	.112391508213501	-5178489	-643954	-85846

L	NUM	QUAL	X,Y,Z COORDINATES AT JULIAN DATE 2443200.5			PERTURBATIONS IN		10-TH DEC
1	1	1	-2.521267319657468	-.072352103395404	.479605787033915	4995156	-4642167	-3115256
2	2	1	-1.696069621352535	1.308018593148795	-.133094553056318	8317982	7163413	5506676
3	3	1	-2.453363077879885	-2.205271036567510	-.316149576974301	-3489296	-3318553	-1223898
4	4	1	-1.235060976518355	1.958174650618275	.943841013155975	17558446	13618649	6730739
5	5	1	2.821540091951718	-.919625921489654	-.495054610913035	-4815059	46210	7339
6	6	1	.987624902702844	1.751252840545526	.207471790947261	-5789599	1284719	1728092
7	7	1	1.108502389224256	-2.021733850277528	-.721623853518651	-3404801	-3605633	-1396450
8	8	1	-.767426206664705	-2.198574627035029	-.780501612998105	-3973738	-3911551	-1499831
9	9	1	-2.285957970947550	-1.120088829127890	-.303261206249761	1762904	-2880755	-1639139
10	10	1	-2.861227387358184	.919703760537729	.216288059170259	1928258	-4860321	-1954927
11	11	1	-1.326672092322984	-1.892165985590196	-.624055419599987	-3643253	-3353739	-1290613
12	12	1	-1.[illegible]4896706699351	1.965421952332299	.409511842628374	9364641	-4211333	-1001989
13	13	1	-1.018897580306479	-2.137759525634237	-1.282557821904931	-3741253	-3564145	-1687666
14	14	1	2.065100268897410	-1.636163991658718	-1.091093850275030	-3029114	-2138555	-861671
15	15	1	1.952236573772019	.538073547286608	.708830990243225	-5986283	1598233	4659
16	16	1	-2.998535844986819	1.068363230410137	.490339922295151	3511924	-5073256	-1935558
17	17	1	-.692618679135246	-1.913430008122894	-.646564001372216	-3601160	-3608590	-1328454
18	18	1	-1.818885107932658	-1.960658982331985	-.346632130468509	-3547784	-3272918	-1212032
19	19	1	-2.377924009397375	-1.401414887440644	-.606551959831677	-2151990	-2917162	-1115084
20	20	1	-1.242221597199986	1.547624852363015	.643827594272921	11593481	23901229	9747816
21	21	1	-.124259081447089	-2.015722056569814	-.887910665784631	-4293136	-4546160	-1845566
22	22	1	.143790278211707	2.318515505847614	1.249537670006518	15190976	22357544	11973248
23	23	1	-1.816574239486613	.686360077921304	.693699748571781	10092099	14970985	7531773
24	24	1	.845884932591428	-2.998334767083932	-1.346337488025426	-3865505	-3534156	-1402227
25	25	1	1.961616450896152	.669704241492958	.481140149706528	-3792555	692122	-794588
26	26	1	.742621879100376	2.516814521168627	1.187861288912949	18124259	28633766	11870414
27	27	1	-2.307692545172131	-.202915727420032	-.018073165228377	7484783	-2454700	-1765268
28	28	1	2.984848890036346	-.343905049104682	-.393502673150976	-5571605	792535	305494
29	29	1	-1.847386784380504	-1.747645414443973	-1.003932035285612	-3073031	-3069925	-1330917
30	30	1	-2.240132655475250	-1.282850984757431	-.662232982508311	-1350554	-2829966	-1117184
31	31	1	2.547602452276453	-1.231290342962801	-2.156266840753119	-4743152	-2023919	463416
32	32	1	-2.374486303270217	.040205753114331	-.141325375765910	5428137	-5384694	-1486997
33	33	1	-1.583319600239122	2.628444881302983	1.252706255181749	12899477	6564447	2074947
34	34	1	1.188091769197165	2.251626209254056	.738136682157009	4881975	17513504	7184162
35	35	1	3.470508491985029	.946739236924727	.635198143230827	-5339236	5314257	2398370
36	36	1	-1.749796807163669	-2.258929304869952	-2.050470092090237	-4325600	-3850539	-1552758
37	37	1	-1.678163463200050	1.520391104347621	.771016626900906	10955747	17922600	7671556
38	38	1	2.787905112456954	-.637450348422593	.023704314691750	-5300361	469480	142460
39	39	1	-1.356615887329305	-2.525409950180020	-.525551534064203	-4243124	-3861909	-1435518
40	40	1	2.077716212499880	-.491390000465774	-.377936640210747	-3036761	-1035867	-338452
41	41	1	2.422773516970352	-1.376316096964224	-.200207906597160	-2733948	-1547835	-852704
42	42	1	-2.368204861121285	1.499214924434670	1.060098434053195	5741555	-5130346	-2827910
43	43	1	-.373229210412600	2.351791529593541	.979903761152332	15956009	20159217	7655463
44	44	1	-1.627163600096509	1.194453636436535	.543425409637091	10102457	20921160	8538271
45	45	1	-1.507887356321646	2.208815450218992	.809341819026258	17961368	-1219258	1738234
46	46	1	-1.776100955333987	-1.928655931269518	-.746649570942918	-3934180	-3456579	-1343801
47	47	1	-2.662541680876885	1.647350231340639	.507974076290678	4553359	-5559389	-3405026
48	48	1	-.582072379361318	-3.113122959431848	-.951058854612100	-4253644	-4054826	-1575142
49	49	1	2.412352583755265	-.985562817295957	-.308625241578863	-4504990	-810531	-264398
50	50	1	-1.996577891578518	-2.273362678138412	-.844491486141322	-4323928	-3777174	-1482002

L	NUM	QUAL	X,Y,Z COORDINATES AT JULIAN DATE 2443600.5			PERTURBATIONS IN		10-TH DEC
1	1	1	-.1248012447 12538	-2.576860656923643	-1.191655538470769	15139	-3976785	-1894459
2	2	1	-1.234599842295339	-2.648487287910484	.612696170656232	2466546	-1903350	-1194072
3	3	1	.544236851461967	-2.965948098267248	-.578813078071761	-663456	-5421107	-2274992
4	4	1	-1.307421313681019	-1.652320282369928	-.488376011755975	7129329	-74753	-960116
5	5	1	.987700804374256	2.032589141438677	.649634176250039	-6217137	-996605	136774
6	6	1	-2.671023169292098	.610388514381821	.599242274229049	4054272	9341879	5162977
7	7	1	.120002029450637	1.779959754745207	.747543859790706	-5094418	-2026986	-1340240
8	8	1	1.750402453552290	.649816934671388	.073040893064688	-41541	-3041100	-1334895
9	9	1	1.007854023266809	-2.118369336764758	-1.111098407556398	-384104	-5293574	-2351422
10	10	1	-1.140443814717834	-2.321521417375024	-1.135606001456235	1046910	-3253508	-1212872
11	11	1	2.242661899978657	-.052141292183791	-.178310523372467	472190	-4073184	-1780355
12	12	1	-1.377033478438591	-1.442040379760016	-.662530774585658	4817673	-1641368	106647
13	13	1	2.337932437065547	-.869151174535816	-1.195479891401824	-323596	-4525593	-2032158
14	14	1	2.574983607109630	1.433475818895936	.186307691582734	-4337327	-2366516	-304755
15	15	1	-1.981019633137159	1.764420074644477	.516318958425359	-281514	19157988	7013118
16	16	1	-2.489815353129728	-2.000807182172291	-.687556695357493	1750015	-3115419	-1386671
17	17	1	2.485441149082320	.516777338544340	-.021361373696505	-881774	-2824839	-1196338
18	18	1	1.764393477143422	-.503405716020129	-.291161262562806	1014776	-5583722	-2181741
19	19	1	1.133625764698166	-1.978429934298232	-.786720337684340	-369484	-5672712	-2375865
20	20	1	-1.395707762563795	-2.055008827134145	-.872767319311469	4531867	-1066460	-415997
21	21	1	1.660384672971752	1.451309978066483	.548184481845194	-2758445	-1941297	-683777
22	22	1	-2.903882038353342	.045278610024226	.765517755363092	10302712	4153551	-1162279
23	23	1	-.642599820711574	-2.597414114107735	-1.228743951575780	1269282	-2594740	-1455454
24	24	1	3.326072460848593	-1.009870493863659	-.479830619575912	-1545590	-4185376	-1754117
25	25	1	-.874969949867786	2.848122084015330	.082390048840313	-1273181	18448706	9894474
26	26	1	-2.426872891188211	.794133051376743	.505622487077190	11462577	14806515	4967553
27	27	1	.153188486456932	-2.518158085830763	-1.090298302025197	-176029	-4323265	-1857396
28	28	1	.459928289898304	2.325492117263380	.611151909991616	-6330039	887319	1651760
29	29	1	1.806407549482458	-1.622769429354889	-.904810991515369	-108006	-5368148	-2396417
30	30	1	1.377483121700045	-1.702020336189825	-.739926896326473	-135740	-5680920	-2444248
31	31	1	2.389347381278270	1.246865745360914	.503642555084941	-4470438	-2923966	93734
32	32	1	.760843968280642	-2.329383501001345	-.764989326444432	-79324	-4524290	-1793669
33	33	1	-3.709994690544406	.862561504831046	.428600999115540	7534542	-1823769	-1105692
34	34	1	-2.361140706457263	.483393021263577	.139862726584492	3936230	17692926	8311476
35	35	1	1.145324859555345	2.703034203027428	1.671275233678010	-11555373	7299952	933757
36	36	1	1.474484800999377	-1.644042008804121	-1.464892888864810	-490948	-5410673	-2413463
37	37	1	-2.324820213998251	-1.741485995803579	-.849875749291542	3931842	-1873308	-863976
38	38	1	.057470960703947	2.073937395273518	1.041812387534108	-5642685	2312720	-34235
39	39	1	2.210114217838736	-1.099290919969235	-.431762195808071	926	-5001443	-2090059
40	40	1	-.642088894731081	1.997274216669865	.905871683037731	-3431528	5352667	2632158
41	41	1	2.959869993087707	1.829731202611164	.222545018287325	-5109860	-1678123	-674498
42	42	1	-1.750867444105606	-1.568578940397259	-.421056402441561	3562589	-1755283	-1485593
43	43	1	-1.960587741555685	-.593491129341110	-.382231681685560	10847081	-108605	533053
44	44	1	-.866985190815363	-2.366877907006767	-.863283418078844	2547371	-1751939	-917143
45	45	1	-2.008819328032288	-1.456513663839750	-.339661255875047	6538867	-1215670	-733171
46	46	1	1.979128303766004	-.683111028096455	-.262570820892183	680640	-5347086	-2211758
47	47	1	-2.433295113644931	-1.398229130317645	-.742163840046537	3176572	-2480637	-1146404
48	48	1	2.611485656335006	-1.754145417371355	-.512984410998229	-706362	-4864541	-2114386
49	49	1	.093659570197360	2.352769156657644	1.073801634076375	-5440605	1817153	340989
50	50	1	1.674468570271145	-1.087280453083572	-.419393612497220	297789	-5962575	-2456791

L	NUM	QUAL	X,Y,Z COORDINATES AT JULIAN DATE 2444000.5			PERTURBATIONS IN	10-TH DEC	
1	1	1	2.804187491409536	-.563449614397353	-.837482452625849	3075476	-4713403	-2267311
2	2	1	1.970137185418039	-2.767262053805666	.399963634538084	2538709	-3982135	-2157631
3	3	1	1.994779937108781	.622331213617286	.036979018655512	3547212	-4080073	-1804681
4	4	1	2.354760690077640	-.087198290249865	-.343542901706525	3764387	-4380095	-2180568
5	5	1	-2.166209985787305	-.679698327490083	-.104149776453560	-13876047	12742836	6159584
6	6	1	-1.436431992608689	-2.333735731812368	-.255184452470276	5807072	1841451	-652906
7	7	1	-2.731922810354192	-.496417502903379	-.484674053895061	-4680489	10641612	4911853
8	8	1	-2.211254450813101	.664208091136718	.488633129366352	-6384604	5828778	2874253
9	9	1	1.555432738996572	1.365295743856198	.493809945877074	1982593	-3002665	-1356432
10	10	1	2.597680682945381	-1.646924169955206	-.565405827295642	2980506	-4900261	-2118254
11	11	1	-.476857213470748	2.415582461473932	.950093165325296	-4188256	-3394476	-974567
12	12	1	1.919484650377967	.847550141545995	.530850285428809	4594478	-3654676	-1029662
13	13	1	1.145722890916318	1.895149749701370	1.070683949946599	-1428061	-3754665	-1274571
14	14	1	-1.015489681898245	1.867111518568116	1.009635563960103	-6123956	-1697738	-181493
15	15	1	-2.696380311846241	-1.107554598053774	-1.174280105046158	7410437	3683816	3559925
16	16	1	1.031762150740839	-2.452696519870400	-.959142414846376	2632301	-3969493	-1788810
17	17	1	-.164767027435145	2.618666918763657	.978447026799891	-4668907	-3526378	-868503
18	18	1	-1.618225576519258	1.683414841212240	.585726048933328	-3710649	-1722405	327921
19	19	1	.757551331337698	1.826486971733530	.754235276909039	146863	-2750524	-1218981
20	20	1	2.036502735861191	-1.580133333942278	-.652855715764918	2903201	-4868627	-2133528
21	21	1	-1.975367828737625	1.784958703940276	.907146546807560	-10718089	8867163	3946537
22	22	1	-1.562614137224770	-2.599587242616835	-1.043758806121062	4851309	295539	-795290
23	23	1	2.409632443469860	-1.664479346360146	-1.311418530294240	2870463	-4934292	-2300819
24	24	1	2.371533391321648	1.965953620627040	.857408395812971	-497620	-4220373	-1854009
25	25	1	-2.568422987924620	.164657630207629	-.529184012215616	1380196	9609855	12043877
26	26	1	-.272790731117775	-2.182756008483253	-1.048522310808231	5620901	2248786	827222
27	27	1	2.231015854471664	.207664484950143	.022428975066309	3631933	-4374765	-1985233
28	28	1	-2.493404573133105	-.550128989021250	.092567584404176	-12291243	15566243	8034602
29	29	1	1.238088288893792	1.757647279214076	1.004862492629414	-360408	-3187417	-1469495
30	30	1	.408261897608401	1.931793248689202	.888879601736981	-1026322	-3018315	-1422400
31	31	1	-1.726179896991417	.984391239512696	1.618465206546290	-5641766	1520197	-1622790
32	32	1	2.724797957493365	.549138316851927	.370305616421465	2446465	-3843196	-1696789
33	33	1	-2.723135823520906	-1.616756084408998	-.750258133375603	6494158	865417	381689
34	34	1	-.208210437684357	-2.632830563707032	-.854568726945146	4454392	784333	128457
35	35	1	-2.134571290953474	1.212257666706620	.705436940199029	-21342362	22093407	6097403
36	36	1	.256160084133073	1.494292340148341	1.347593230709116	-451717	-2723693	-1580839
37	37	1	.863515453909223	-2.539084518321985	-1.272383336732098	2612947	-3809957	-1670431
38	38	1	-2.563713843889449	-.603519256528518	-.615492646186013	-7369732	13457145	5559557
39	39	1	.644357018771423	2.490049267188624	.568335279316610	-2095540	-3853674	-1120622
40	40	1	-1.952622016148979	-1.264145068446673	-.382832302444742	477129	8400101	3313775
41	41	1	.218898660871917	3.145099078718573	.416921379740055	-5655494	-4560530	56669
42	42	1	1.966467183769765	.423837640928987	-.130879496365170	4590890	-4304844	-2483146
43	43	1	2.053310665098039	-.149114121296458	.071155942396466	3507606	-3581194	-1399792
44	44	1	2.353147004297668	-1.161699032283725	-.568775358976570	3165553	-4990983	-2224430
45	45	1	1.938609143994912	-1.699209214662403	-.672967141635478	2688521	-4083157	-1807118
46	46	1	-.527685402291180	2.351551756944033	.908410097037603	-3582185	-3473480	-1311730
47	47	1	1.520844472445972	-1.727309758541615	-.944261754491837	2595705	-3857415	-1745305
48	48	1	2.317420660230340	1.768453945796892	.555624234243847	232373	-3843392	-1735608
49	49	1	-3.290289652052650	.936435179905256	.235762410170365	-10374396	27444112	12328328
50	50	1	-.872965712938758	2.223313565592719	.842550246995653	-3224249	-3312616	-1170538

L	NUM	QUAL	X,Y,Z COORDINATES AT JULIAN DATE 2444000.5			PERTURBATIONS IN 10-TH DEC		
1	1	1	1.300648596021382	2.290785448932596	.817101525933492	2282099	-2901508	-1096461
2	2	1	2.926012776914561	.252399820624085	-.265731611935491	4719253	-2769565	-1502441
3	3	1	-2.285031151789800	1.122253350185632	.302265844084458	-2065439	-4842337	-574507
4	4	1	-.016505378234429	2.380180212340207	.952629897318487	278960	-3912398	-1406198
5	5	1	.887891587729847	-2.658205262168795	-.983777507900900	3115505	2614457	697995
6	6	1	1.911812308757035	-.271299733473763	-.393003550158367	3949690	-1850753	-1098293
7	7	1	-.247397943354806	-2.505731988701029	-1.060267580708008	3887776	3819506	2054966
8	8	1	-.705317445972831	-2.208264489168073	-.790759667447848	1895778	7155031	2299080
9	9	1	-2.341408500303686	.266314324633244	.362910250251055	-4774833	-1795616	-1016938
10	10	1	2.970264941163939	1.494569844056983	.888702016482004	3848985	-2732978	-1314597
11	11	1	-2.584831367031086	-.330693687594604	.057229568963981	-24629909	8848142	4667429
12	12	1	-1.262945620380748	2.454938884346640	.669139693796149	-1581470	-5269731	-1942534
13	13	1	-2.359403620834030	-.013865440029726	.567544170571729	-7066605	7296	-1465715
14	14	1	-1.054106351356715	-1.951111391124462	-.688483559928439	-14478074	3763225	2342008
15	15	1	.428005284522614	-2.418015473775142	-1.201055946479599	3682239	1590714	1447790
16	16	1	2.233025191669356	1.157572596683487	.375191659953927	4996493	-2237244	-1108283
17	17	1	-2.344058689513147	-.201330053188297	.125449721133895	-20906062	5613099	3327906
18	18	1	-2.299841281103312	-1.528689706793500	-.190081390777793	-13616504	10877599	5251061
19	19	1	-2.707699894797301	.248171036330917	.059029385644552	-12105626	2425495	1585122
20	20	1	.781253622757099	1.801749828149127	.762593519144065	2982437	-1788100	-848082
21	21	1	-2.069900530651395	-1.387041405524343	-.496152948673606	-17007929	13533690	5698710
22	22	1	1.814546609571089	-1.840059904312312	-1.483291491927012	3834802	-1418350	-685073
23	23	1	2.060520144271862	1.382081585261105	.334797077142296	4248104	-2387438	-1149283
24	24	1	-1.435340737206438	2.175094959849673	.983814270756667	-1540789	-5616516	-2489675
25	25	1	1.267043643601880	-1.265392116809551	.149989758459767	2219293	7389365	1472063
26	26	1	2.750138274836175	.058939132562712	-.106447979722450	4714607	-2435944	-1202251
27	27	1	-1.816797045195592	.948161236488656	.463440585854823	-549842	-5434748	-2332918
28	28	1	.096175754961415	-2.990534931467323	-.854120096312258	3540350	3849760	723667
29	29	1	-2.476389300810510	.656171089891362	.352268410225864	-7264005	-1080653	-1021360
30	30	1	-2.608570675598031	-.191854690117683	-.166876109638121	-15166867	4846923	2400214
31	31	1	-2.761091057767885	-1.738615075717092	-.897503204514980	-4935316	10640581	672135
32	32	1	-.341226631557706	2.446700138433471	.833387729198723	-47111	-4610463	-1936044
33	33	1	1.345611837992507	-1.275438120690559	-.611035003990594	2942489	1405692	672084
34	34	1	2.814202209235745	-.896082903282263	-.270441176225669	4510258	-2619185	-1225926
35	35	1	-.374713544959059	-2.143056500931920	-1.316702207073547	-878051	7289741	3640105
36	36	1	-3.180613848668926	.029272568868564	-.006234940016679	-15874794	7240892	1092592
37	37	1	2.187652106855424	.656802791733238	.310307971350207	5383964	-2537057	-1199328
38	38	1	.046009676662410	-2.824142922128516	-1.403417634607628	3695636	2651327	1748583
39	39	1	-2.770048444024283	1.118094732492096	.477083042446264	-12022286	-1385842	1400297
40	40	1	1.865113068896669	-.970959702822903	-.565911632984538	2631514	442614	70511
41	41	1	-2.146965436231071	.066284096786626	.024362601102549	-12988336	176397	2938664
42	42	1	-.991222512592724	2.401685056387990	1.246322871599347	-1069756	-4942425	-1955267
43	43	1	-.426467165505688	2.345817727390937	.973931606582969	-397592	-4229942	-1992422
44	44	1	.417467041365001	1.935758513152244	.721253460448072	1988419	-2290435	-1000045
45	45	1	2.294920153065775	1.790381938205231	.425518847122031	3762107	-2292851	-1119484
46	46	1	-2.954551309722845	.032215427607834	.010542785307828	-25930639	9864600	5674458
47	47	1	1.977277069157232	1.788456622273586	.956222632141472	3696543	-2051846	-933089
48	48	1	-1.442101427107751	2.475670073929621	.741370448851423	-1509109	-5694133	-1765308
49	49	1	-3.139310672587570	-1.871693286649432	-1.030493398798257	2730237	12102555	6853185
50	50	1	-3.371302911219345	.079176357675179	.050021910586219	-29819981	14695421	8344906

L	NUM	QUAL	X,Y,Z COORDINATES AT JULIAN DATE 2444800.5			PERTURBATIONS IN 10-TH DEC		
1	1	1	-2.298268317655157	.740845920389341	.818264453174771	1367330	-4290766	-2357946
2	2	1	-.738713174503926	1.957727024547040	-.327707067058130	2942404	-783873	-71926
3	3	1	-2.423433273841463	-2.239854147900331	-.323220319592547	-28892325	3370702	2068664
4	4	1	-2.157944723111788	-.579256720469107	.052850249692288	-4408460	-3777621	-1763654
5	5	1	2.903411627159755	-.156341478364682	-.233439369107431	4425448	324582	-21437
6	6	1	-1.470535155091660	1.855990474430832	.668353139591769	1995166	-1805526	-433191
7	7	1	1.698119176093416	.639823813003364	.437015740957634	3540556	766926	339208
8	8	1	1.714138691330149	.724174065490477	.105878273834842	2264247	1415168	484668
9	9	1	-.403714572924244	-2.402900444479101	-1.104663153140322	-9516631	4466684	1692815
10	10	1	.097946548789458	3.095195784006179	1.413613856863423	3610804	-1526744	-868590
11	11	1	.874827430373369	-1.892601414462604	-.779910244521300	-3103866	8017143	2934564
12	12	1	-2.221636264054242	-.618887910461222	-.491783271343937	-13299367	-5103838	-368832
13	13	1	-.173270330615312	-2.251513083221582	-1.572261664746073	-7036820	5331896	1849573
14	14	1	2.568336270196355	-1.084543721100566	-.933636231124964	1869986	2645337	1208177
15	15	1	1.758688613046345	.876980753278172	.848490376475375	4598744	341136	416636
16	16	1	-1.447224683182256	2.413940616139328	.956276935261421	2312432	-2649652	-1070225
17	17	1	1.464281427009958	-1.530592787976417	-.688459876696150	-2667422	7391367	2689866
18	18	1	1.332187168538039	-1.351828318438621	-.477828002368087	-453263	8329251	2153009
19	19	1	-.795139349319779	-2.393840311972909	-.985198516072479	-12134351	6192609	3411582
20	20	1	-2.274972229124424	-.658441361090229	-.307153673826562	-3118628	-3196479	-1165777
21	21	1	1.915619119541041	-.608438510568014	-.381209325117235	-1196535	6684387	3024879
22	22	1	2.097998896517808	1.551982628088055	.326359849991881	5207282	293986	-107724
23	23	1	-2.057667272499145	.210776582228389	.491536103026988	2097210	-3715148	-2250878
24	24	1	-2.539242681338038	-1.329476234334251	-.571659675409080	-20717117	-4253996	-1228399
25	25	1	.499304806139483	2.690677728262472	.358113131035569	3173740	273743	-183061
26	26	1	.557148582528299	2.548535225341482	1.212541247783683	3762720	-453394	-280852
27	27	1	-.900711248007429	-2.366961907600583	-.993425699376242	-15060281	276260	478033
28	28	1	2.842090157260657	-1.133621096267710	-.602717131280475	3699229	1084995	202739
29	29	1	-.933825208168365	-2.235974113339807	-1.273345092350809	-16970938	2971437	1979895
30	30	1	.121693008754488	-2.259588804853578	-1.036592600020128	-4518567	7093256	3790624
31	31	1	-.395119516060701	-2.701872792417177	-2.710752519458197	917660	6462420	4721650
32	32	1	-2.130878124856179	-.819957060765926	-.429351193392598	-7794205	-3878448	-827543
33	33	1	-.049269810433920	2.531675190752239	1.198462780018808	3002424	270411	63893
34	34	1	1.284089694242958	2.217190180099934	.727448021925920	4753669	204052	-80683
35	35	1	3.136288680676628	-1.063359180384282	-.597623353840238	3162166	1265460	721967
36	36	1	-2.201292352708592	-2.071161905358181	-1.887691429638892	-16813968	11811039	9478273
37	37	1	-1.944986448209391	1.322105817206818	.674212750611119	1899115	-3018526	-1529163
38	38	1	2.705225641656185	-1.122277334434180	-.228299510881257	3644483	1019429	390254
39	39	1	-2.045538498999567	-2.146229322930338	-.381573029568385	-35904991	2949529	1593559
40	40	1	-.118432184592187	2.072755987423065	.895889398440008	3418322	511250	120953
41	41	1	1.754007047567178	-1.868517780229432	-.261120614844097	-2509444	6039164	1128028
42	42	1	-2.772255922268798	-.161113005954587	.381215317481487	-8608399	-5678434	-3446187
43	43	1	-1.925745203442162	-.650284226568591	-.404097863822248	-7358453	-3623330	-1113731
44	44	1	-2.094162109186954	-1.138010948911287	-.327519120175321	-6030634	-2660571	-946804
45	45	1	-1.178463066397988	2.420306975104854	.856263342936458	2549095	-2752358	-950876
46	46	1	-.468098735927228	-2.254815982891365	-.886843477919381	-10280478	7808868	3782072
47	47	1	-1.436488026603463	2.553106637057610	1.390805512444402	2420621	-2919794	-1619055
48	48	1	-3.092054418147427	-.695520092818175	-.235336760280997	-17890213	-7419576	-1176260
49	49	1	-.347775872761774	-3.105848674169764	-1.430000556426876	929778	7931806	4108711
50	50	1	-1.831806942275179	-2.349711163760560	-.873486193968127	-19915749	13789533	6694007

L	NUM	QUAL	X,Y,Z COORDINATES AT JULIAN DATE 2445200.5			PERTURBATIONS IN 10-TH DEC		
1	1	1	-.90519739704963O	-2.441386614013993	-.969284326263640	-16597692	-10995487	-5795415
2	2	1	-1.829306465807292	-2.032344707617156	.535353880492131	-3013746	-5299887	-1879207
3	3	1	.579853083890921	-2.951898384811003	-.577759298380119	-9900752	8688430	157639
4	4	1	1.710507243049562	-1.279597987736871	-.736395291617987	-6795162	-955553	-514902
5	5	1	-.069535001809260	2.073354899789887	.728985395827699	4642088	3358110	1156921
6	6	1	-2.606873537469824	-1.287772439189908	.176063292268799	-956568	-6199106	-3395916
7	7	1	-2.433734304737357	.764544776944948	.066685406424241	2721246	-985068	-282358
8	8	1	-2.243995243175220	.603910263845243	.468455909106638	2636443	-584905	-333158
9	9	1	2.271758391804738	-.019817167947201	-.238457533346921	-1489575	4189838	2190651
10	10	1	-2.750715276699225	1.256890708349211	.377196262766892	4241450	-2003837	-872842
11	11	1	1.496059440246938	1.836368274646865	.591005913549349	3151696	2395275	873655
12	12	1	1.891415516773279	-.384001214892017	.111301777945743	-6223923	1631236	370418
13	13	1	2.606808356923224	-.148669416979967	-.744821131615961	-250309	3490665	2667844
14	14	1	2.078172869735788	1.920122681409886	.490683180959534	4794379	2501186	900831
15	15	1	-2.225006951933742	1.599676758895733	.375494611818693	2944384	-186222	-230914
16	16	1	-3.291420940653154	-.328225284811811	-.030672437160633	2480616	-5475833	-2254711
17	17	1	1.742626614334377	2.035120322326449	.601234709018769	4030255	2467077	869284
18	18	1	-.834567504048512	1.965079037020061	.592649360355214	3208169	3789647	1009795
19	19	1	2.100615215048975	-.004054058376021	.030848521356216	-3040023	5195122	2064005
20	20	1	.761194668901865	-2.442135433593137	-1.022879953963262	-11669730	-1155713	-49908
21	21	1	-.293659035879848	2.379791685881813	1.074018646286405	3809762	2884795	1148772
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25	25	1	-2.405003474831616	1.617189706318939	-.358416304684530	3767607	-2044933	382444
26	26	1	-2.475743744907717	.612605873531688	.419696230814331	3956858	-2075958	-1204113
27	27	1	2.212796265771402	-.951637480091865	-.476856798105779	-2522323	5741123	2545741
28	28	1	1.430923760212441	2.087010456173502	.447229069280482	5076214	2777254	866470
29	29	1	2.358045237791174	-.753151660125635	-.408054199025889	-2488104	5316610	2985084
30	30	1	1.697517450272592	1.044162337546624	.534913475996927	289907	2625213	1082607
31	31	1	2.332712332804633	-1.475486711074176	-2.341275465315931	565698	4058526	4045451
32	32	1	1.547361813018718	-2.048912345255104	-.615178914912757	-7815123	1652215	793033
33	33	1	-3.167360691755796	1.813120930416815	.875490479671644	3985739	-2060184	-1081611
34	34	1	-2.330775401800992	.592904039766207	.175618856757975	3647085	-1730249	-511712
35	35	1	3.128597626950182	1.564776731671404	1.021420082257031	4867233	2443865	955523
36	36	1	.972927233068514	-1.998302416747663	-1.789200582414644	-5659509	6070295	7448077
37	37	1	-2.157015000950283	-1.937471956649517	-.948784461501273	-10706691	-11121818	-4253886
38	38	1	.724161791091845	1.972718853313410	1.072903367899535	5025311	2956489	1384926
39	39	1	1.673343336344395	-1.872325973586463	-.584176250383749	-6084672	7876969	1486347
40	40	1	-2.196900920363390	-.959999321344127	-.190315540957447	2854369	-3492949	-1839057
41	41	1	3.190395183356910	1.244987889213476	.142474140297759	3810687	2407651	757070
42	42	1	.694300526164405	-1.600129949592770	-.836449467025460	-17588687	-15342879	-6949472
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45	45	1	-2.245101C00357266	-1.114552735422365	-.214167833487330	1493423	-4850455	-2097144
46	46	1	1.924893874686120	.861471764125440	.334065846063341	-1904587	3537579	1362623
47	47	1	-3.119792364948552	.000288708216581	.019032572645400	3364363	-4547735	-2315912
48	48	1	-.657721874566274	-3.1C7393764502802	-.949615093321054	-33450575	-7609691	-3560385
49	49	1	2.424557936866876	-.866850714845835	-.253887593556511	-697242	4927734	2083018
50	50	1	1.770451368360256	-.842207015381884	-.327593416215365	-5908327	8615212	3290624

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3	3	1	1.957478458368215	.679200246636292	.048872164477855	-5595839	3844375	862600
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5	5	1	-1.814614228278359	-1.576588481577133	-.439289332569564	5242751	-698168	-568555
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7	7	1	-1.543948110060498	-2.217644032033988	-1.073842474862943	1992594	-8718284	-2602726
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9	9	1	-1.352439551837016	1.502718387591543	.852628105672927	1931358	5022593	2230707
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13	13	1	.174345560539830	1.956061110627311	1.360734833438549	3065729	4429864	2104952
14	14	1	-1.692568232227444	1.295494474438545	.833955140355737	2121886	3741057	1625775
15	15	1	-2.551776858707854	-1.327107822482162	-1.260355795244293	5126560	-3314148	32823
16	16	1	-1.137429606916129	-2.726426210392489	-1.001303927945905	-800801	-19715275	-9070043
17	17	1	-1.723507156123368	1.853690953243387	.829619630656250	2501916	3413626	1413442
18	19	1	-2.613677772396883	-.994280027120496	-.022248746748979	5125354	-948937	-609573
19	19	1	-1.580928136668923	1.722354427864403	.675532158970015	1739401	4527576	1836785
20	20	1	2.230420208127185	.610579345338380	.269955634956167	-4117787	3347343	1369433
21	21	1	-2.763375475643571	.154649185234605	.228775574971157	4201102	396372	-42676
22	22	1	-2.783130729427906	-1.468760695528772	-.105498837765527	5239846	-1013326	-1873375
23	23	1	2.604671085593509	-1.366411258282326	-1.193433866375358	-7779855	3331459	2921406
24	24	1	3.234904195487843	-1.251453146147398	-.586806181907786	-4907230	4568434	2110327
25	25	1	-.758942890633318	-1.776420885495448	-.327547889068024	3518531	-3822108	-376512
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27	27	1	-.624650008268112	1.699366239671889	.751472431916937	2448514	4881976	2033984
28	28	1	-2.372967500193569	.434734793267697	.356876290067458	2469953	1788706	788240
29	29	1	.061551890511859	2.078501440597705	1.177313682578635	2723083	4247362	1962899
30	30	1	-2.275211240496574	.959642221416146	.369324707647639	1804231	2520494	1019050
31	31	1	2.633035093917676	1.014213932076061	.178031613526820	456757	3243751	2283185
32	32	1	2.437833739416178	1.240808097649520	.593340671562295	-565312	3188092	1074450
33	33	1	-3.551769186179087	-.656305160411172	-.291159537484214	5979884	-1517465	-732779
34	34	1	-.305283721985607	-2.613224696179032	-.848968719920578	-2631642	-11832186	-5139267
35	35	1	.206218742800720	2.715577899106705	1.663698735071056	3384495	4460701	1854613
36	36	1	1.051523505905713	1.134727051937617	1.086656166335352	-2991511	2035806	1331800
37	37	1	1.113354208910323	-2.430343715208579	-1.219453567185120	-21089964	-21058279	-6720675
38	38	1	-2.589774673641969	-.057396677185964	-.346159173491541	3610605	404334	250471
39	39	1	1.444124421639920	2.054653916050341	.402916876722395	457768	2971768	1174316
40	40	1	1.540292239529954	-1.390066120732833	-.718894672977669	-6310460	-17686925	-7715980
41	41	1	.903099917290887	3.169494301175050	.415085098995162	3356632	4420242	1714148
42	42	1	.811793401576850	2.219522014017869	.869479176517718	-862536	1991819	1186137
43	43	1	-.476558547600526	2.338418112579888	.967173063885109	2540103	4447298	1838061
44	44	1	2.152065258549968	.937277813611050	.247416379236509	-2458806	3061398	1377990
45	45	1	1.616596615322976	-1.945779554327643	-.731995051768877	-9107536	-16840382	-7507843
46	46	1	-1.809844304081174	1.973655179610930	.761286605073085	2065258	3628941	1462331
47	47	1	-.414399900540012	-2.269927088597569	-1.226002257546320	-2540063	-16171632	-6125097
48	48	1	2.561489537809280	-1.841179318441071	-.540057591001620	-10174081	4240730	337512
49	49	1	-.072076134058882	2.376048218461918	1.074467676945076	2664683	4329417	1843936
50	50	1	-1.132777124440523	2.184935603906965	.829196629229717	1872665	4437095	1742783

Appendix F

LIST OF COMPUTER PROGRAMS

Appendix F
LIST OF COMPUTER PROGRAMS

The following list of 119 computer programs developed for this study is divided into two categories: main programs and subroutines. All but three of the 32 main programs are new developments. Fifty-five of the 87 subroutines are new developments; the remaining 32 are modified subroutines taken from previously existing computer programs. A few subroutines have both single and double precision versions, and sometimes both are used. Any skipped numbers appearing in the sequence of computer programs is simply the result of omitting programs when they become obsolete in the development cycle.

MAIN PROGRAMS

CIN1	List Observations on Cincinnati Tape
CIN3	Reduce Observations on Cards and Cincinnati Tape
CIN4	Copy Cincinnati Observation Tape (Needed because of the frequent parity errors that occurred during the reading of the original tape.)
CIN5	Last Accurate Observation Each Minor Planet
CIN6	Copy Cincinnati Tape with Long Blocks
CIN7	Cincinnati Observation Tape to Binary Form
JPL1	Translate JPL Ephemeris Tape (Translates the JPL tape written with a UNIVAC to the CDC 6400 form.)
JPL2	Prepare Working Tape from JPL Ephermeris Tape (Prepares from the translated JPL ephemeris tape a working tape containing only the necessary data and covering only the specified interval of time.)
JPL8	Prepare Tape of Planetary Coordinates for 400-Day Integrations
LECPY	List, Punch or Tape BCD Cards

NMP1 Status of Numbered Minor Planet Ephemerides

(The program computes the estimated ephemeris uncertainties for all of the numbered minor planets, and provides the listings of the results. It uses data from tapes prepared by other main programs of the NMP series.)

NMP3 Prepare Tape of Data from Opposition Ephemerides

NMP4 Prepare Tape of Numbered Minor Planet Names and Synonyms

NMP6 Consolidate Numbered Minor Planet Tapes

NMP7 Prepare Multi-Record Tape of Orbit Data

(Data selected by groups of 200 minor planets; costly large storage is avoided in this way.)

NMP8 Prepare Tape of Orbit Information

NMP9 Distribution of Ephemeris Uncertainties

(Computes and lists several statistics relating to the orbital elements and the ephemeris uncertainties.)

NMP12 Integrate Coordinates of One Minor Planet

(Numerical integration of the rectangular coordinates with perturbations by specified major planets included. Any number of minor planets can be integrated in succession.)

NMP13 Integrate Elliptic Motion

(The same as NMP12, but without perturbations by the major planets. Used in the development of NMP12, and to study the maximum size of step interval.)

NMP15 Residuals for Minor Planets

(Computes the residuals of observed right ascensions and declinations. Rectangular coordinates of the minor planets are taken from a tape prepared during a numerical integration. Reduced observed positions are taken from another tape.)

NMP16 Prepare Tape of Numbered Minor Planet Elements

(Consolidates elements and other data from earlier tapes.)

NMP17 Consolidate Numbered Minor Planet Basic Data

(Forms the basic tape for initializing the new system.)

NMP18 Prepare Tape of Ephemeris Positions Near Standard Date

NMP20	Prepare Elements Tape for Integrations
NMP22	Integrate Elliptic Motion for Group of Minor Planets (Used to prove the accuracy of the procedures and processes of NMP23. Elliptic motion permits essentially exact checks.)
NMP23	Integrate Perturbed Motion for Group of Minor Planets (This is NMP22 with perturbed accelerations.)
NMP24	Improve Elements from Nearby Ephemeris Positions (Provides provisional improvement of initial elements during initialization of new system. Intended for use only when more accurate and expensive procedures are not justified.)
NMP25	Improve Elements from Recent Observed Positions (Provides provisional improvement of initial elements during initialization of the new system. Intended for use when expensive numerical integrations are not justified.)
NMP26	Integrate Perturbed Motion of Group from any Epoch (The Epoch must be the same for all members of the group, but it need not be a 400-day date.)
SUN01	Check and Tape Solar Coordinates (Basic program to provide solar coordinates in coded form.)
SUN21	Solar Coordinates to Blocked Tape (Basic program to provide solar coordinates in binary form and ready to be interpolated for the date of an observation.)
SUN30	List Solar Coordinates from Tape in SUN01 Form

SUBROUTINES

PRNTA	General Page Handling Routine (This subroutine is used in all main programs. It is machine dependent, and may be installation dependent. It prints page headings, column headings, page numbers; dates each page; prints elapsed times on each page; limits the number of lines on each page; provides vertical spacing where needed. Several entries provide for various other features, including automatic input of the headings and control parameters.)
SUB09	Solve Kepler's Equation
SUB42	Calendar Date to Julian Date

SUB43	Observatory Topocentric Constants
SUB46	Matrix for Rotating About N Axes
SUB86	Mean Obliquity of the Ecliptic
SUB100	Check Arithmetic Unit (Used at each step of the numerical integration to ensure the continued accuracy of the arithmetic unit.)
SB217	Julian Date to 3Q
SB138	Space Coordinates in Elliptic Orbit
SB155	4-Point Lagrange Interpolation of Q Quantities (Required in the interpolation of the solar coordinates.)
SB191	Space Coordinates and Velocities in Elliptic Orbit
SB236	Apply Constant Term of Stellar Aberration
SB245	Extended Gregorian Calendar Date to Julian Date
SB253	Ecliptic Angles to Equatorial PQR Matrix
SB282	Perturbed Two-Body Space Accelerations for One Point (The principal subroutine for the computation of the accelerations in the rectangular coordinates as required in the numerical integrations.)
SB332	Convert Alphanumeric Array to Floating Point Number (Provides for the printing of input data in its original form and for its conversion to binary numbers.)
SB339	Logical Sum of N Words
SB380	Mean Obliquity from Julian Date
SB381	Greenwich Mean Sidereal Time from Julian Date
SB384	Precession Matrix from Reference Equinox to Julian Date
SB385	Besselian Year to Julian Date
SB386	General Precession Matrix
SB396	Rotate Array with Direct or Transposed Matrix

SB400	Initialize Fixed Table
SB403	Place One Item at End of Fixed Table
SB405	Search of General Table with Argument in N Integer Cells
SB406	M Alphanumerical Characters to N Collating Integers
SB407	Place One Item in Sequential Table with Integer Arguments
SB408	Redimension Fixed Table
SB409	Convert Integer Representation to Decimal Fraction for Printing
SB410	Sort with M-Word Argument and N-Word Function
SB411	N Collating Integers to M Alphanumerical Characters
SB412	Rotate String of Words
SB413	Search Table with Sequential Integer Arguments in N Cells
SB416	Collect N Words for L Lines
SB424	Orbit Coordinates to Equatorial Coordinates
SB425	Julian Date to Precessed Space Coordinates in Ellipse
SB426	Reduce Least Squares Matrix
SB427	Solve Least Squares Equations
SB428	N-Point Lagrange Interpolation of M Functions
SB429	Topocentric Coordinates of Date from Sidereal Time
SB430	Topocentric Coordinates of Date from UT Julian Date
SB431	Topocentric Coordinates to Mean Equinox from Julian Date
SB432	Lagrange Interpolation Coefficients
SB434	Set Integer in Heading
SB435	Angle to Sexagesimal
SB436	Roots of Real Quadratic
SB437	Difference of Two Nearby Angles

SB438	Equatorial PQR Matrix to Ecliptic Angles
SB439	Julian Date to Besselian Year
SB440	Angle to Sexagesimal for Printing
SB441	Residuals from Perturbed Elliptic Orbit
SB442	Coordinates and Velocities to Elliptic Elements
SB447	I8 Integer to 2A4 Format
BFILL BMOVE	Bit Manipulation Package
CIN2	Table of Observatory Numbers – Cincinnati to LEC (Converts the observatory numbers on the Cincinnati tape to those adopted in comet work.)
CMT6	Reduce One Observation with Solar Coordinates on Disk (This is the principal subroutine for reducing observed positions. It does much of the actual computing and controls the subroutines that do the remainder.)
CONV1	Convert UNIVAC Fieldata to CDC Display Code
CONV2	Convert UNIVAC Integer to CDC Integer
CONV3	Convert UNIVAC Single-Precision Floating-Point Numbers to CDC
CONV4	Convert UNIVAC Double-Precision Floating-Point Numbers to CDC
CONV5	Logical Checksum of N UNIVAC Cells
DMPBC	Dump Blank Common
EFT3	Set Table of Reductions to Ephemeris Time
EFT4	Look Up Reduction to Ephemeris Time
INTG2	Integration Setup (Reads the controls and options that govern the numerical integration programs. Sets default values and initializes other parameters.)
INTG3	Integration, Initial Start (Controls and carries out the repetitive processes that start the numerical integration from the coordinates and velocities at the date of osculation.)

INTG4	Integration, Run (Controls and carries out the full numerical integration processes at each step of the integration.)
INTG5	Monitor Differences During Numerical Integration
INTG6	Coordinates and Velocities for Restart
INTG7	Setup for Coordinate Integration
INTG8	Start Coordinate Integration
INTG9	Coordinate Integration – Run
JPL3	Planetary Coordinates in Numerical Integration (Positions the tape containing the coordinates of the major planets and loads the coordinates required during the starting process of the numerical integration and then the coordinates required at each step of the integration that follows.)
JPL4	Indirect Terms in Numerical Integration (Computes and stores the indirect terms needed during the starting process and later at each step of the integration. These terms do not depend upon the coordinates being integrated, and so do not need recomputation during the predictor-corrector processes.)
JPL5	Planetary Accelerations in Numerical Integration (Computes and recomputes as needed all of the accelerations by the specified major planets at each step of the starting and running processes.)
JPL6	Indirect Terms for One Date
JPL7	Planetary Masses and Gravitation Factors
NMP14	Interpolate Minor Planet Coordinates (Positions the tape written by the numerical integration program and reads two adjacent records of 50 points each. The coordinates for the given Julian Date are interpolated with a Lagrange formula of specified order.)
NMP19	Improve Orbit from One Observed Position (Uses an observed or ephemeris position to improve the given orbit in the neighborhood of the date of the position. Adjusts the mean anomaly, and then rotates the orbit plane slightly to give exact fit.)

NMP21	Perturbed Accelerations in 400-Day Block (Computes the complete perturbed accelerations during one step of the numerical integration of a group of minor planets.)
NTG10	Monitor Differences and Integration Convergence (Monitors the accuracy and convergence during the numerical integration of a group of minor planets.)
OBSY3	Set Table of Observatory Constants (Reads punch-cards containing the latitude, longitude, and height of each observatory. For each observatory, it computes and sets in the table three constants needed to compute the topocentric coordinates.)
OBSY4	Set Earth Constants (Reads a punch-card with the constants that define the size and shape of the Earth and the units used. Required by OBSY3.)
SET50	Input Elliptic Elements in Various Forms (Needed to input the elements that define the initial osculating orbit.)
SUN22	Interpolate Solar Coordinates from Tape
TAN2	Arctangent with Range 0 to 360 Degrees