

DESCRIPTION OF AMPLE PACKAGE

Adaptable Minor Planet Ephemerides (AMPLE) is integrated software package to deal with a number of problems concerning minor planets with the aid of IBM-type personal computer.

Among these problems are the following:

- obtaining selections of orbital elements and/or photometric parameters of minor planets in conformity with imposed restrictions and their sorting; drawing frequency distribution graphs (histograms) and plots of scattering elements in two- or three-dimensional phase space for found selections;
- ephemeris computations in various coordinate systems (spherical, rectangular), referred to different main planes and centers;
- comparison of observed positions with computed ones (computation of $O-C$);
- identification of minor planets, that is finding among numbered minor planets that (or those) whose computed positions are sufficiently close to the observed position of unknown object;
- compiling a list of all numbered minor planets which can be seen at certain moment within specified sky region and visualization of their mutual positions;
- drawing the picture of apparent motion of minor planets in the sky with respect to fixed stars;
- visualization of orbital motion of minor planets.

AMPLE is organized on the pattern after a yearbook. Yearly issue of the package is destined for operating basically within the time interval covering 16 months (from November of the year preceding to the title year of the package to February of the subsequent one (basic interval).

The package computes positions of minor planets by the formulae of elliptic motion using sets of osculating elements obtained in advance for a number of non-uniformly distributed moments of time. The space between the moments is determined in such a way as to assure precision of spherical coordinates not worse than 0.2 arcsec within 120 day intervals centered at oppositions of each planet which fall within basic interval. For minor planets with perihelion distances less than 1.4 a.u. the created net of osculating elements assures precision not worse than 0.2 arcsec during the whole basic interval. Beyond the limits of 120 day intervals the precision of computations is not ensured for the ordinary minor planets. The computed positions whose precision can not be ensured within 0.2 arcsec are marked by asterisk.

In a number of the package sections, such as “Ephemerides”, “ $O-C$ ”, “Tracks”, “Orbits” computations can be fulfilled for the moments of time lying outside of the basic interval. In this case positions are computed on the base of the fundamental set of osculating elements for standard epoch lying within title year.

It is worth noting that the employing method of computations enables the time-consuming problems to be effectively solved with good precision in a matter of seconds (e. g. the opposition ephemerides for all minor planets at oppositions during 2021, covering 80 day intervals with 10 day step, can be calculated for the time on the order of 1000 seconds). In so doing AMPLE enables one to display only those lines of ephemerides which fit combination of restrictions imposed on several ephemeris data.

The special option is also introduced to calculate positions of minor planets at any moment (within time interval from 1800 till 2100) by numerical integration. Such option is provided in sections “Ephemerides” and “ $O-C$ ”, only. In addition one more opportunity is introduced in AMPLE: performing the ephemeris and ($O-C$) calculations for objects which are absent in the data base of the package. Such objects can be specified by orbital elements or by initial values of coordinates and velocities.

In AMPLE there are opportunities performing the calculation of value of MOID (Minimum Orbit Intersection Distance) between orbit of some ordered body (major planet or minor planet) and orbits of any set of selected minor planets; calculation of criteria of Tisserand for orbits of minor planets with respect to the orbit of some ordered body (major planet or minor planet); calculation of photometric diameters of minor planets, calculating near commensurability of minor planets with respect to the orbit of some ordered body (major or minor planet); calculating the time of perihelion passage which is the nearest to the epoch of elements, calculating the times of ascending and descending nodes passages the nearest to the epoch of perihelion passage, and so on. All operations of the package section "Elements" can be done for objects from user text file; calculation of ephemeris in rectangular coordinates can be fulfilled for any set of major planets and minor planets with respect to the center of some ordered minor planet (section "Ephemerides").

The orbital elements of all minor planets used in AMPLE for 2021 have been determined in IAA RAS on the ground of available observations in the catalogue of observations of the Minor Planet Center. In so doing coordinates and masses of perturbing planets are taken from *DE 405*.

As AMPLE is able to reproduce virtually any table of the Ephemerides of Minor Planets, it may be considered as computer version of the EMP.

Access to the package is open via FTP server of IAA RAS for anonymous user at the address: <ftp://ftp.iaaras.ru/pub/WINAMPLE> (for Windows modification).

The package with data base for 2021 is also supplied on CD on request which should be sent at one of the addresses: mvasilev@iaaras.ru, cya@iaaras.ru or by FAX: +7-812-275-1119 or by mail: Institute of Applied Astronomy of the Russian Academy of Sciences, nab. Kutuzova, 10, St. Petersburg 191187, Russia.