MINOR PLANET SOFTWARE Rel. 8

Sergio Foglia
UAI Minor Planets Section Recorder
Serafino Zani Obs., Lumezzane, MPC 130
F. Bisleri 11, I-20148 Milano, Italy
s.foglia@libero.it

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Introduction

Minor Planet Software (MPS) is a set of computer programs, written by Sergio Foglia, S. Zani Observatory, to help minor planet observers in their researches.

MPS runs under DOS and it works good also with Windows 95/98 operating systems. MPS contains some executable programs and system files, each routine is a single executable program.

Orbital elements database consists of two files: ASTEROID.ELE and ASTEROID.IDX. They should be upgraded anytime using MPCORB.DAT or MPCORBCR.DAT from the *Minor Planet Centre*.

MPS is freely-available on the World Wide Web at the following URL:

http://www.uai.it/sez_ast/

You can distribute it freely but the following acknowledgement is welcome if you use this software in any publication:

Foglia S., Minor Planet Software rel. 8, 2003, http://www.uai.it/sez_ast/

All programs are written using C language.

Perturbations are not used in the ephemeris calculation and highly accurate results cannot be obtained more than one or two years from the epoch of osculation of the elements.

You should be able to obtain accurate ephemeris using *The Minor Planet Ephemeris Service* of the *Minor Planet Centre* at the following URL:

http://cfa-www.harvard.edu/iau/MPEph/MPEph.html

Installation

To install MPS you must have WINZIP program (http://www.winzip.com) and simply extract all file in any directory (i.e.: C:\MPS).

In the MPS.ZIP archive you will find the following files:

ASTEROID.ELE	orbital elements database (first 200 objects)
ASTEROID.IDX	orbital elements database index (first 200 objects)
HELVB.FON	graphical font
LOCATION.DAT	observer's location file
MPCLASS.EXE	ephemeris of groups
MPCORB.EXE	upgrade orbital elements routine
MPCORBCR.EXE	upgrade orbital elements routine
MPEL.EXE	orbital elements
MPELREF.DOC	reference for orbital elements
MPEPH.EXE	ephemeris
MPFILED.EXE	objects in a selected sky region
MPNIGHT.EXE	height and azimuth
MPORBIT.EXE	orbit
MPS.EXE	Minor Planet Software
MPSETUP.EXE	set user's location
MPS_8.DOC	user's guide (this file)
PLANET.DAT	orbital elements of major planets
TMSRB.FON	graphical font
UPGRADE.EXE	upgrade orbital elements

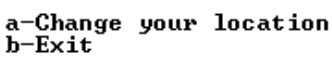
Observer's Location

Computed ephemeris are topocentric and the first step after installation is the observer's location setting. LOCATION.DAT file contains the geographic coordinates of the observer's location and the default values are the following:

Milano
-9.139667
45.191111
126.500000

Using MPSETUP.EXE users should change default data and their information will be permanent stored in the LOCATION.DAT file.

Running MPSETUP.EXE you will find:



press **a** if you want to change location's data, press **b** to exit without changing information.

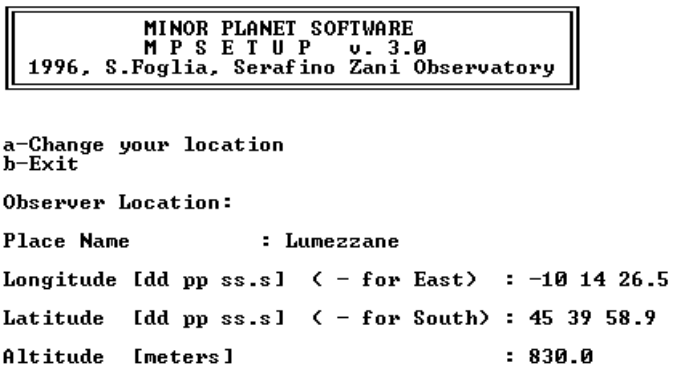
Place name: insert your place name (maximum 50 characters),
Longitude : insert your longitude, i.e. 12 0 32.2 for West, -9 18 34.5 for East,
Latitude : insert your latitude, i.e. 45 28 0.3 for North, -22 1 14.3 for South,
Altitude : insert your altitude, i.e. 234.4

Example:

we want to set the following observer's location:

name:	Lumezzane
longitude:	10° 14' 26.5" E
latitude:	45° 39' 58.9" N
altitude:	830 m a.s.l.

so we type the following values:



pressing enter LOCATION.DAT file is upgraded and now contains the following data:

Lumezzane
-10.240694
45.666361
830.000000

Orbital Elements Database

Orbital elements are stored in two different files: ASTEROID.ELE contains the orbital elements of minor planets, ASTEROID.IDX file is the index file.
Database files will be upgraded from MPCORB.DAT file or MPCORBCR.DAT file, available at the URL: ftp://cfa-ftp.harvard.edu/pub/MPCORB/
or at the mirror URL: http://www.astro.cz/mpcorb
Users should be able to download the preferred file; it is very useful to download the ZIP version of the selected file, in this case the .DAT file must be extracted in the same directory of MPS.

Run UPGRADE.EXE or use the **u** option in MPS.EXE to update ASTEROID.ELE and ASTEROID.IDX files:

```
Update ASTEROID.IDX and ASTEROID.ELE file
2003, S.Foglia, Serafino Zani Observatory


a - Update using MPCORB.DAT
b - Update using MPCORBCR.DAT
x - Exit

Choice: _
```

press **a** if you have MPCORB.DAT file:

```
        M P C O R B     v. 1 . 0
Update ASTEROID.IDX and ASTEROID.ELE file
           from MPCORB.DAT file
2003, S.Foglia, Serafino Zani Observatory


Updating ASTEROID.IDX and ASTEROID.ELE file...OK
```

press **b** if you have MPCORBCR.DAT file:

```
        M P C O R B C R   v. 1 . 0
Update ASTEROID.IDX and ASTEROID.ELE file
           from MPCORBCR.DAT file
2003, S.Foglia, Serafino Zani Observatory


Updating ASTEROID.IDX and ASTEROID.ELE file...OK
```

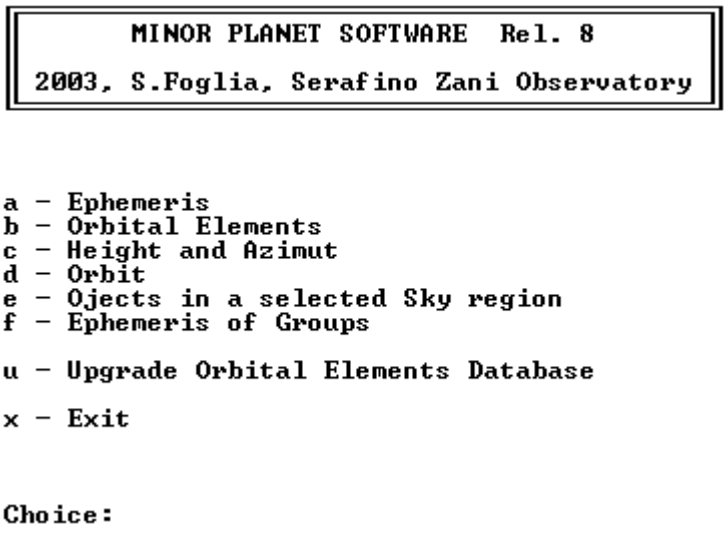
when the upgrading procedure ends an OK will appear and the program will stop.

Press **x** if you want to exit without changes.

MPCORB.EXE and MPCORBCR.EXE are subroutines of the UPGRADE.EXE program.

Minor Planet Software

MPS.EXE is the Minor Planet Software manager. Running this program it will appear:



a choice: Ephemeris

this option runs MPEPH.EXE program; it computes ephemeris for selected minor planets and produces an output file, named by users (8 characters without extension), that contains ephemeris. Ephemeris are referred to J2000.0 equinox and are topocentric.

```
         MINOR  PLANET  EPHEMERIS
            M P E P H   v. 6.1
2000, S.Foglia, Serafino Zani Observatory


a-Minor Planet Ephemeris
b-Exit
```

press **a** to select object, it is possible to search asteroids by catalogue's number, name or designation or users may insert orbital elements of new object:

```
         MINOR  PLANET  EPHEMERIS
            M P E P H   v. 6.1
2000, S.Foglia, Serafino Zani Observatory


a-Minor Planet Ephemeris
b-Exit

Output File Name                : foglia

Minor Planet selection:
        - by catalogue number     [enter 0]
        - by name or designation  [enter 1]
        - new object              [enter 2]
Choice:  _
```

press **0** if you want to select asteroids by catalogue number, in this case we have:

```
         MINOR  PLANET  EPHEMERIS
            M P E P H   v. 6.1
2000, S.Foglia, Serafino Zani Observatory


a-Minor Planet Ephemeris
b-Exit

Output File Name                : foglia

Minor Planet selection:
        - by catalogue number     [enter 0]
        - by name or designation  [enter 1]
        - new object              [enter 2]
Choice:  0


Catalogue number : 13147_
```

and we should be able to insert the catalogue number.

press **1** if you want to select asteroids by name or designation, in this case we have:

```
         MINOR  PLANET  EPHEMERIS
            M P E P H   v. 6.1
 2000, S.Foglia, Serafino Zani Observatory


a-Minor Planet Ephemeris
b-Exit

Minor Planet selection:
        - by catalogue number     [enter 0]
        - by name or designation  [enter 1]
        - new object              [enter 2]
Choice:  1

Minor Planet name or designation : foglia_
```

and we should be able to insert the name or designation

press 2 if you want to insert orbital elements of a new object:

```
         MINOR  PLANET  EPHEMERIS
            M P E P H   v. 6.1
 2000, S.Foglia, Serafino Zani Observatory


a-Minor Planet Ephemeris
b-Exit

Output File Name               : foglia

Minor Planet selection:
        - by catalogue number     [enter 0]
        - by name or designation  [enter 1]
        - new object              [enter 2]
Choice:  2_
```

```
         MINOR  PLANET  EPHEMERIS
            M P E P H   v. 6.1
 2000, S.Foglia, Serafino Zani Observatory


Minor Planet                    : Foglia
Epoch [year month day]          : 2003 12 27
Mean Anomaly                 M : 322.445150
Longitude of perielium       w : 314.146720
Longitude of ascending node  O : 140.856980
Inclination                  i : 2.837530
Eccentricity                 e : 0.03625340
Semi-major axis              a : 2.94293510
Parameter H                  H : 13.2
Parameter g                  g : 0.15
```

now we insert date and step of ephemeris:

```
          MINOR  PLANET  EPHEMERIS
               M P E P H   v. 6.1
 2000, S.Foglia, Serafino Zani Observatory

Minor Planet :  13147 Foglia

Ephemeris begin
year month day                  : 2003 11 1

Ephemeris end
year month day                  : 2005 2 1

Ephemeris step (days)           : 10
```

pressing enter we obtain ephemeris both in the screen and output file:

```
-------------------------------------------------------------------------------
   Date       R.A.2000    Decl.2000    Delta      r         Phase    Mag    Elong.
year mo day   hh mm.mm     dd pp.p     A.U.       A.U.        °       V       °
-------------------------------------------------------------------------------

 13147 Foglia

2003 11  1     2 59.34    +12 32.1     1.890     2.874      3.1     17.2    171.0W
2003 11 11     2 50.96    +11 53.7     1.885     2.872      2.1     17.1    174.0E
2003 11 21     2 42.89    +11 19.6     1.909     2.869      5.7     17.4    163.1E
2003 12  1     2 36.00    +10 53.9     1.961     2.866      9.5     17.6    151.5E
2003 12 11     2 31.00    +10 39.6     2.037     2.864     12.7     17.8    140.2E
2003 12 21     2 28.29    +10 38.2     2.133     2.861     15.4     18.0    129.5E
2003 12 31     2 28.00    +10 49.6     2.246     2.859     17.5     18.2    119.3E
2004  1 10     2 30.10    +11 12.8     2.370     2.857     18.9     18.3    109.7E
2004  1 20     2 34.42    +11 46.3     2.502     2.855     19.8     18.5    100.8E
2004  1 30     2 40.74    +12 28.0     2.638     2.852     20.2     18.6     92.3E
2004  2  9     2 48.83    +13 16.0     2.774     2.851     20.1     18.7     84.3E
2004  2 19     2 58.46    +14  8.3     2.909     2.849     19.7     18.8     76.7E
2004  2 29     3  9.44    +15  3.2     3.040     2.847     19.0     18.9     69.4E
2004  3 10     3 21.59    +15 58.9     3.164     2.845     18.0     18.9     62.5E

Press any key to continue
```

Output file is format as follows:

```
MPEPH: Minor Planet Ephemeris v.6.1
2000, S.Foglia, Serafino Zani Observatory
Ephemeris for Lumezzane
Longitude: -10.240694    Latitude: 45.666361   Altitude: 830.0

-------------------------------------------------------------------------------
   Date       R.A.2000   Decl.2000   Delta     r        Phase   Mag   Elong.
year mo day   hh mm.mm    dd pp.p    A.U.      A.U.       °      V      °
-------------------------------------------------------------------------------

 13147 Foglia
2003 11  1     2 59.34   +12 32.1    1.890     2.874     3.1    17.2  171.0W
2003 11 11     2 50.96   +11 53.7    1.885     2.872     2.1    17.1  174.0E
2003 11 21     2 42.89   +11 19.6    1.909     2.869     5.7    17.4  163.1E
...
```

b choice: Orbital Elements

this option runs MPEL.EXE program; it reads orbital elements of minor planets located in ASTEROID.ELE file. Output file is MPEL.TXT file that contains orbital elements of selected minor planets.

```
       MINOR PLANET ORBITAL ELEMENTS
              M P E L   v. 6.1
 2000, S.Foglia, Serafino Zani Observatory


a-Minor Planet Orbital Elements
b-Exit
_
```

press **a** to search minor planet

```
       MINOR PLANET ORBITAL ELEMENTS
              M P E L   v. 6.1
 2000, S.Foglia, Serafino Zani Observatory


a-Minor Planet Orbital Elements
b-Exit

Minor Planet catalogue number [0], name or designation [1]: 0
```

press **0** if you want to search by catalogue number:

```
       MINOR PLANET ORBITAL ELEMENTS
              M P E L   v. 6.1
 2000, S.Foglia, Serafino Zani Observatory


a-Minor Planet Orbital Elements
b-Exit

Minor Planet catalogue number [0], name or designation [1]: 0

Catalogue number : 13147_
```

press **1** if you want to search by name or designation:

```
       MINOR PLANET ORBITAL ELEMENTS
              M P E L   v. 6.1
 2000, S.Foglia, Serafino Zani Observatory


a-Minor Planet Orbital Elements
b-Exit

Minor Planet catalogue number [0], name or designation [1]: 1

Minor Planet name or designation : foglia
```

press enter to see orbital elements on screen:

```
Minor Planet                    :  13147 Foglia
MPC Designation                 : 13147


Absolute magnitude H            :   13.2
Slope parameter                 :    0.15

Epoch [year month day]          : 2003 12 27
Mean Anomaly [°]             M  : 322.445150
Argument of Perihelion [°]   w  : 314.146720
Long. of Ascending Node [°]  O  : 140.856980
Inclination [°]              i  :   2.837530
Eccentricity                 e  :   0.03625340
Mean daily motion [°/day]    n  :   0.19522393
Semimajor axis [A.U.]        a  :   2.94293510


Press any key to continue

Minor Planet                    :   13147 Foglia

Uncertainty parameter           : 0
Reference                       : MPO 33742
Number of observations          :   256
Number of oppositions           :     7
Years of observations           : 1990-2002
r.m.s. residual              ["] : 0.60
Coarse indicator of perturbers  : M-v
Precise indicator of perturbers: 38h
Computer name                   : MPC
Code                            : 0000

w -> write to MPEL.TXT,
r -> return to Menu
```

press w to save information in MPEL.TXT file.

Output file is as follow:

```
MPEL: Minor Planet Orbital Elements v.6.1
2000, S.Foglia, Serafino Zani Observatory

------------------------------------------------------------
Minor Planet                    :  13147 Foglia
MPC Designation                 : 13147
------------------------------------------------------------
Absolute magnitude H            :   13.2
Slope parameter                 :    0.15

Epoch [year month day]          : 2003 12 27
Mean Anomaly [°]             M  : 322.445150
Argument of Perihelion [°]   w  : 314.146720
Long. of Ascending Node [°]  O  : 140.856980
Inclination [°]              i  :   2.837530
Eccentricity                 e  :   0.03625340
Mean daily motion [°/day]    n  :   0.19522393
Semi-major axis [A.U.]       a  :   2.94293510
Uncertainty parameter           : 0
Reference                       : MPO 33742
Number of observations          :   256
Number of oppositions           :     7
Years of observations           : 1990-2002
r.m.s. residual              ["] : 0.60
Coarse indicator of perturbers  : M-v
Precise indicator of perturbers: 38h
Computer name                   : MPC
Code                            : 0000
------------------------------------------------------------


MPELREF.DOC file contains information about the indicator of perturbers and Code
```

The following is MPELREF.DOC file:

Uncertainty parameter:
If this column contains `E' it indicates that the orbital eccentricity was assumed. For one-opposition orbits this column can also contain `D' if a double (or multiple) designation is involved or `F' if an e-assumed double (or multiple) designation is involved.

Code:
There may sometimes be additional information beyond column 160 as follows:
The bottom 6 bits are used to encode a value representing the orbit type (other values are undefined):

Value	
2	Aten
3	Apollo
4	Amor
8	Hilda
9	Jupiter Trojan
10	Centaur
14	Plutino
15	Other resonant TNO
16	Cubewano
17	Scattered disk

Additional information is conveyed by adding in the following bit values:

64	Unused
128	Unused
256	Unused
512	Unused
1024	Unused
2048	Unused
4096	Unused
8192	1-opposition object seen at earlier opposition
16384	Critical list numbered object
32768	Object is PHA

Coarse And Precise Indication of Perturbers:
The coarse indication of perturbing bodies is given in columns 204-206. Note that minor planets are now indicated by lower-case letters. This allows a distinction to be made between M-P (considering Pluto) and M-p (considering Pallas, and probably Ceres as well).
The precise indicator of perturbers is given in columns 208-209 as a two-digit hexadecimal number as described below.

	Perturber	Bit	Value	
	Pluto	0	1	
Lo-digit	Earth	1	2	Lo-digit bits 1 + 2 must
	Moon	2	4	both be set or both be
	Ceres	3	8	unset!
Hi-digit	Pallas	0	1	
	Vesta	1	2	

Sum the values of the included perturbers and convert to hexadecimal. Since orbits will always include the major planets Mercury to Neptune there is no need to include these bodies in the above scheme (other than allowing the earth and moon to be treated separately). Some examples of coarse and precise indicators are:

Coarse	Precise	Perturbers (Mercury-Neptune+...)	
M-P	01	Pluto, EM barycenter	[NOT RECOMMENDED]
M-P	07	Pluto, Earth, Moon	[NOT RECOMMENDED]
M-c	08	Ceres, EM barycenter	
M-c	0E	Ceres, Earth, Moon	
M-p	11	Pluto, Pallas	[NOT RECOMMENDED]
M-p	16	Pallas, Earth, Moon	[NOT RECOMMENDED]
M-p	18	Ceres, Pallas, EM barycenter	
M-p	1E	Ceres, Pallas, Earth, Moon	
M-v	38	Ceres, Pallas, Vesta, EM barycenter	
M-v	3E	Ceres, Pallas, Vesta, Earth, Moon	

The default for Minor Planet Center orbits will henceforth be h (DE403), M-v (coarse) and 38 or 3E (precise, depending on whether the object is an earth-approacher or not).

c choice: Height and Azimuth

this option runs MPNIGHT.EXE program;

```
NIGHTLY ATEROID AND SUN HEIGHT AND AZIMUT
          M P N I G H T   v. 7.0
2000, S.Foglia, Serafino Zani Observatory


a-Run
b-Exit
```

select minor planet by catalogue's number, name or designation or enter a new object from its orbital elements (see point **a**):

```
NIGHTLY ATEROID AND SUN HEIGHT AND AZIMUT
          M P N I G H T   v. 7.0
2000, S.Foglia, Serafino Zani Observatory


Minor Planet selection:
        - by catalogue number     [enter 0]
        - by name or designation  [enter 1]
        - new object              [enter 2]
Choice:
```

```
NIGHTLY ATEROID AND SUN HEIGHT AND AZIMUT
          M P N I G H T   v. 7.0
2000, S.Foglia, Serafino Zani Observatory


Minor Planet selection:
        - by catalogue number     [enter 0]
        - by name or designation  [enter 1]
        - new object              [enter 2]
Choice:  0

Catalogue number : 13147
```

insert ephemeris period (year month day) and step in hours:

```
NIGHTLY ATEROID AND SUN HEIGHT AND AZIMUT
          M P N I G H T   v. 7.0
2000, S.Foglia, Serafino Zani Observatory


Minor Planet :  13147 Foglia

Ephemeris begin  [year month day] : 2003 11 1

Ephemeris end    [year month day] : 2003 11 3

Ephemeris step (hours)          : 1
```

it will appears:


```
Output file is MPNIGHT.TXT and contains height and azimut
of Sun and Asteroid

Press any key to continue
```

MPNIGHT.TXT is the output file containing height and azimuth of Sun and Minor Planet for the selected period.

```
MPNIGHT: Nightly Asteroid and Sun height and azimuth
2002, S.Foglia, Serafino Zani Observatory

Asteroid:  13147 Foglia


Ephemeris for Lumezzane
Longitude: -10.240694    Latitude: 45.666361   Altitude: 830.0

-----------------------------------------------------------------------
   Date         U.T.      ______SUN______       ________ASTEROID_______
year mo day    hh.hhh    height   azimut      height   azimut   elong
-----------------------------------------------------------------------
2003 11  1      0.000     -56.3    25.6         56.6   189.4   171.0W
2003 11  1      1.000     -50.0    47.7         52.6   214.0   171.0W
2003 11  1      2.000     -41.3    64.5         45.3   233.6   171.1W
2003 11  1      3.000     -31.4    77.8         36.1   248.8   171.1W
2003 11  1      4.000     -20.9    89.2         25.9   261.3   171.2W
2003 11  1      5.000     -10.5    99.8         15.4   272.3   171.2W
2003 11  1      6.000      -0.4   110.3          4.9   282.9   171.3W
2003 11  1      7.000       9.1   121.5         -5.1   293.7   171.3W
2003 11  1      8.000      17.4   133.8        -14.2   305.4   171.3W
2003 11  1      9.000      24.0   147.6        -22.1   318.6   171.4W
2003 11  1     10.000      28.4   163.2        -28.0   333.5   171.4W
...
2003 11  3      0.000     -56.3    29.3         55.7   196.9   173.0W
-----------------------------------------------------------------------
azimut: 0° = N, 90° = E, 180° = S, 270° = W
```

this option runs MPORBIT.EXE program; it shows the orbit of a selected minor planet for a time given by user, also major planets orbit are shown. Bright line in minor planet orbit means positions upper the ecliptic plane; dark line in minor planet orbit means positions under the ecliptic plane. Planet's position at fixed time are given by bright circles. Also vernal equinox direction is shown.
HLEVB.FON and TMSRB.FON are the fonts files of this program. PLANET.DAT contains the orbital elements of major planets. It's an ASCII file:

```
Mercury  1996 11 13  171.11555   29.11796   48.33531   7.00512  0.2056410   4.09235880   0.3870974
Venus    1996 11 13   16.60345   55.04846   76.68990   3.39475  0.0067996   1.60214659   0.7233274
Earth    1996 11 13  309.51249  117.28378  345.63961   0.00046  0.0167357   0.98561288   0.9999975
Mars     1996 11 13  139.61354  286.50997   49.56926   1.84988  0.0933044   0.52400423   1.5237471
Jupiter  1996 11 13  283.53534  275.28402  100.47091   1.30462  0.0484295   0.08310382   5.2022778
Saturn   1996 11 13  281.99057  335.96316  113.63681   2.48525  0.0526327   0.03332765   9.5640305
Uranus   1996 11 13  123.35334  102.37968   74.09917   0.77347  0.0435459   0.01162101  19.3039565
Neptune  1996 11 13  294.92398  231.37914  131.78644   1.76886  0.0094776   0.00591655  30.2759653
Pluto    1996 11 13    9.79961  114.42226  110.39287  17.11879  0.2521571   0.00394230  39.6859010
endfile     0  0  0    0.00000    0.00000    0.00000   0.00000  0.0000000   0.00000000   0.0000000
-------------------------------------------------------------------------------------------------
planet   Epoch         Mean     Longit.of  Longit.of  Inclinat. Eccentric.  Motion       Semi-major
         year mo da    Anomaly  Perielium  Asc.Node                         (°/day)      Axis
-------------------------------------------------------------------------------------------------
```

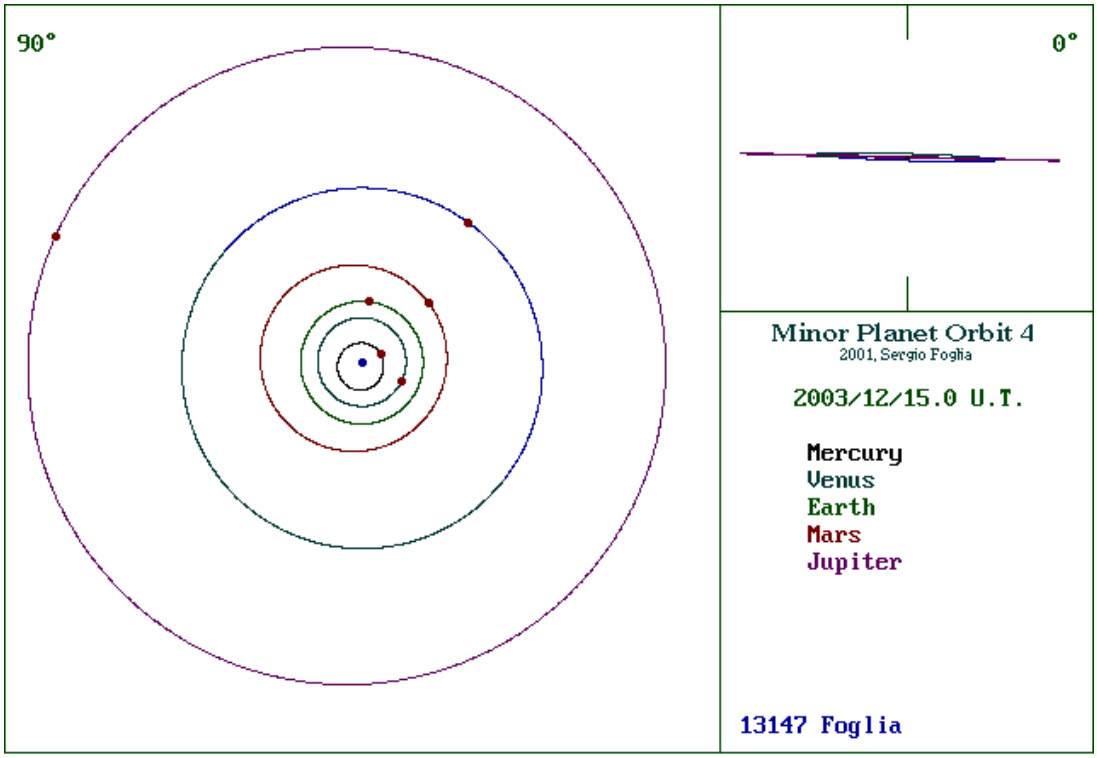
press **a** to run MPORBIT, **b** to exit

it is possible to select asteroid by catalogue number, name or designation and also new object should be shown from their orbital elements (see point **a)**

after object's selection insert the date (year month day)

```
          MINOR  PLANET  ORBIT
           M P O R B I T    8
2003, S.Foglia, Serafino Zani Observatory

Minor Planet selection:
        - by catalogue number     [enter 0]
        - by name or designation  [enter 1]
        - new object              [enter 2]
Choice:  0

Catalogue number : 13147

Minor Planet                    :  13147 Foglia
Epoch                           : 27/12/2003
Mean Anomaly                 M  : 322.44515 °
Longitude of perielium       w  : 314.14672 °
Longitude of ascending node  O  : 140.85698 °
Inclination                  i  :   2.83753 °
Eccentricity                 e  :   0.03625340
Semi-major axis              a  :   2.9429351 A.U.
Parameter H                  H  : 13.2
Parameter g                  g  :   0.15

Date :
year month day                  : 2003 12 15
```

orbits of minor planet and major planets is shown with different colors; also positions for the selected date are shown as red circles.



at this time if you press **x** you will find PCX format file named as catalogue number or MPC's designation of the present screen. Press **c** if you want to continue without PCX file saving.

this option runs MPFIELD.EXE program; it computes ephemeris for all minor planets listed in ASTEROID.ELE file that are in selected sky field at a time given by user. MPFIELD.TXT is the output file that contains ephemeris. Ephemeris are referred to J2000.0 equinox and are topocentric: geographic coordinates of observers are in LOCATION.DAT file.

```
      EPHEMERIDES OF ALL MINOR PLANETS IN A
              SELECTED SKY FIELD
            M  P  F I E L D  v. 6.1
     2000, S. Foglia, Serafino Zani Observatory

a-Ephemeris
b-Exit
```

press **a** to run MPFIELD, **b** to exit

```
      EPHEMERIDES OF ALL MINOR PLANETS IN A
              SELECTED SKY FIELD
            M  P  F I E L D  v. 6.1
     2000, S. Foglia, Serafino Zani Observatory

a-Ephemeris
b-Exit

Date
[year month day]  : 2003 12 15

U.T. [hours minutes] : 20 30

Selection of the sky field :
Right Ascension minima   [hours minutes seconds] : 2 20 0
Right Ascension maxima   [hours minutes seconds] : 2 40 0
Declination minima     [degrees minutes seconds] : 9 30 0
Declination maxima     [degrees minutes seconds] : 10 30 0

Compute.....................................................
Ephemerides are in MPFIELD.TXT file
Press any key to continue
```

insert Date (year month day), U.T. (hours minutes) and the limits of Right Ascension and Declination.
You will find all asteroids in the selected sky region for the given time in MPFIELD.TXT file, which format is as follows:

```
MPFIELD: Ephemeris of Minor Planets in a selected sky field v.6.1
2000, S. Foglia, Serafino Zani Observatory

Date: 2003/12/15 - U.T.: 20:30

Ephemeris for Lumezzane
Longitude: -10.240694    Latitude: 45.666361   Altitude: 830.0

Conditions:   2.333 <= R.A. <=   2.667    9.500 <= Decl. <=  10.500
-------------------------------------------------------------------------
   Date      R.A.2000   Decl.2000   Delta     r       Phase   Mag   Elong.
year mo day  hh mm.mm    dd pp.p    A.U.      A.U.      ø      V      ø
-------------------------------------------------------------------------
  9028 Konradbenes
2003 12 15    2 35.02   + 9 49.8    1.266    2.088    19.2   16.5  135.9E
 13687 1997 RB7
2003 12 15    2 26.44   +10 29.1    2.450    3.214    12.7   17.5  134.2E
...
```

this option runs MPCLASS.EXE program; it is very useful to produce ephemeris of an entire class of objects for a given period.

```
CLASS OF MINOR PLANET EPHEMERIS WITH CONDITIONS
              M P C L A S S  v. 1.1
   2000, S. Foglia, Serafino Zani Observatory
```

```
a-Ephemeris
b-Exit
```

press **a** to run MPCLASS, **b** to exit

```
Minor Planet class:

1  Aten
2  Apollo
3  Amor
4  PHAs
5  NEAs
6  others before Main Belt
7  Main Belt
8  Hilda
9  Thule et al.
A  Jupiter Trojan
B  Jupiter Crosser
C  Centaur
D  TNOs
E  Plutino
F  classeical TNOs
H  Scattered Disk
0  all objects

Choice:
```

now we're able to select the interested class of objects. The following are the definition of each class:

choice	Class	Domain
1	Aten	MPCORB definition
2	Apollo	MPCORB definition
3	Amor	MPCORB definition
4	PHAs	MPCORB definition
5	NEAs	Sum of classes 1, 2 and 3
6	Others before Main Belt	Not NEAs and a < 2.1 AU
7	Main Belt	Not NEAs and 2.1 AU <= a <= 4.0 AU
8	Hilda	MPCORB definition
9	Thule et al.	4 AU <= a < 5.5 and Q < 5.2 AU and q < 5.2 AU
A	Jupiter Trojan	MPCORB definition
B	Jupiter Crosser	4 AU <= a < 5.5 and Q > 5.2 AU and q < 5.2 AU
C	Centaurs	MPCORB definition or 5.5 AU <= a < 29 AU
D	TNOs	MPCORB definition and a >= 28 AU
E	Plutinos	MPCORB definition
F	Calssical TNOs	MPCORB definition and a >= 28 AU
H	Scattered Disk	MPCORB definition and a >= 28 AU
0	All objects	

```
Choice: 5
Output File Name                : neas

Ephemeris begin
[year month day]  : 2003 11 1

Ephemeris end
[year month day]  : 2004 2 1

Ephemeris step [days] : 10
```

insert the output file name, period and step of ephemeris; now it is possible to include conditions in the selected objects:

only numbered minor planets? Insert **y** or **n** (yes or no)

magnitude limit condition? Insert **y** or **n** (yes or no)
if yes you must give the limit of magnitude

minimum elongation condition? Insert **y** or **n** (yes or no)
if yes you must give the minimum value of the elongation from Sun

declination condition? Insert **y** or **n** (yes or no)
if yes you must give the minimum value of the declination

```
CLASS OF MINOR PLANET EPHEMERIS WITH CONDITIONS
            M P C L A S S  v. 1.1
   2000, S. Foglia, Serafino Zani Observatory
```

```
Conditions:
Only numbered minor planets ? (y/n) n

Magnitude limit condititon ? (y/n) y
Magnitude limit : 17

Minimum elongation condititon ? (y/n) y
Minimum elongation : 90

Declination condition ? (y/n) y
Minimum Declination (degrees) : -5
```

at the end of the computation you will find:

```
CLASS OF MINOR PLANET EPHEMERIS WITH CONDITIONS
            M P C L A S S  v. 1.1
   2000, S. Foglia, Serafino Zani Observatory
```

```
Ephemeris are in the output file

Press any key to continue
```

Output file has the following format:

```
MPCLASS 1.1: 2002, S. Foglia, Serafino Zani Observatory

NEAs

Period: 2003/11/01 -2004/02/01  Step: 10.0 days

Ephemeris for Lumezzane
Longitude: -10.240694    Latitude: 45.666361   Altitude: 830.0

Conditions:
All minor planets
Magnitude limit             : 17.0
Mimimum elongation          :  90.0
Declination                 : >=-5.0

-------------------------------------------------------------------------
   Date      R.A.2000   Decl.2000   Delta    r       Phase   Mag   Elong.
year mo day  hh mm.mm    dd pp.p    A.U.     A.U.      °      V      °
-------------------------------------------------------------------------

  1627 Ivar                              0004
2003 11  1    5  2.69   + 7 20.1    1.022    1.895    19.6   15.2  140.2W
2003 11 11    4 50.39   + 6 42.2    1.014    1.943    14.0   15.1  151.7W
2003 11 21    4 35.64   + 6 20.1    1.028    1.990     9.0   15.1  161.6W
2003 12  1    4 20.45   + 6 17.6    1.068    2.036     7.4   15.2  164.5E
2003 12 11    4  6.81   + 6 35.6    1.134    2.079    10.4   15.4  157.7E
2003 12 21    3 56.18   + 7 12.0    1.225    2.121    14.5   15.7  147.4E
2003 12 31    3 49.28   + 8  3.1    1.338    2.162    18.2   16.0  136.8E
2004  1 10    3 46.20   + 9  4.5    1.467    2.200    21.0   16.3  126.6E
2004  1 20    3 46.64   +10 12.5    1.610    2.237    23.0   16.6  117.1E
2004  1 30    3 50.15   +11 23.7    1.762    2.272    24.3   16.8  108.3E

  3122 Florence                          0004
2003 11 11   10 11.89   +45  6.6    0.934    1.367    46.4   16.5   90.5W
2003 11 21   10 23.86   +44 51.2    0.916    1.427    43.4   16.5   97.0W
2003 12  1   10 29.57   +44 59.6    0.893    1.488    39.9   16.4  104.6W
2003 12 11   10 28.14   +45 30.8    0.867    1.548    35.8   16.3  113.3W
2003 12 21   10 18.55   +46 16.5    0.843    1.607    30.9   16.2  123.0W
2003 12 31   10  0.26   +46 57.9    0.828    1.665    25.4   16.1  133.4W
2004  1 10    9 34.34   +47  7.4    0.829    1.722    19.8   16.0  143.6W
2004  1 20    9  4.45   +46 19.7    0.850    1.777    15.4   15.9  151.3W
2004  1 30    8 35.94   +44 28.1    0.896    1.831    14.0   16.1  153.3E

  6239 Minos                             8003
2003 12 31    8 39.69   +35 39.9    0.254    1.212    23.2   16.4  150.9W
2004  1 10    8 28.52   +41  0.8    0.177    1.147    20.0   15.4  156.5W
2004  1 20    7 44.54   +51 11.4    0.110    1.079    28.1   14.5  148.9E
2004  1 30    3 26.48   +63 36.0    0.062    1.008    66.3   14.2  110.4E

...
```

u choice: Upgrade Orbital Elements Database

this option runs UPDATE.EXE program; see the previous section “Orbital Elements Database” for details.

x choice: Exit

exit from Minor Planet Software

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