Halley Manual

Introduction

Halley is a free software for management and working with the regularly updated database of comets, containing Keplerian orbital elements, non-gravitational and physical parameters of the comets and other data. The tasks performed by Halley software, in addition to database management, include calculation of the orbital evolution of small-bodies and visualization of their dynamics, detection of close approaches with the major planets in a given time interval, as well as a number of other tasks.

The core of Halley software has been implemented in Fortran (Intel® Fortran Compiler used). This allows to produce high-precision integration of the equations of motion of asteroids and comets. The gravitational perturbations from all major planets and Pluto are taken into account in the equations of motion. Coordinates of the perturbing planets are computed on a basis of JPL Planetary and Lunar Ephemerides. Equations of motion include relativistic perturbations from the Sun. Perturbations of the Earth and Moon are taken into account separately. Marsden's model was taken as a model of non-gravitational accelerations with perihelion-maximum offset parameter. Numerical integration of the equations of motion is performed by Everhart's method of 11-th order with automatic control of step size. High accuracy of numerical integration is achieved through the use of the modified Encke's method. The modification consists of performing the change of the osculation epoch at each step of integration. The parameters of the unperturbed motion are calculated with quadruple precision by using variables with 32 decimals. Database management is performed using the SQLite library.

Halley is intended for use with a personal computer with Microsoft® Windows XP, Vista or 7.

Features

- The regularly updated database of comets.
- Complete database management with possibility of adding your own objects.
- Fast search on any element of the database.
- Import/Export from ECS Format
- High-precision calculation of small-bodies orbits.
- High-speed integration of the equations of motion.
- Visualization of small-bodies orbits.
- Calculation of orbital evolution of small-bodies.
- Calculation of moments of perihelion passages.
- Detection of close approaches to the planets.

License

Contacts

If you have any questions, please check the this Manual first. Any suggestions, comments, testimonials or bug reports are welcome. If you have found a bug, please report it, so I can correct it in the next version. Please, write down the version of Halley, a description of the problem, and how to reproduce it. Also, please include a brief description of your system (CPU type and speed, RAM size, version of Windows). Your feedback is very important for me because it helps to make a better product for you. A lot of features and significant details in the Halley interface were considerably influenced by users comments. So if you have any ideas about new features or if you know a better way how to do something, please share it with me. I will be grateful for any help you can provide.

Yuri S. Bondarenko

Home page: http://www.ipa.nw.ru/halley

Getting started

When you start Halley first time, the 'Get Started' window appears. You will be prompted to download and install one or more of the planetary numerical ephemerides. Ephemerides were not installed you can download later using Tools/Options… dialog box.
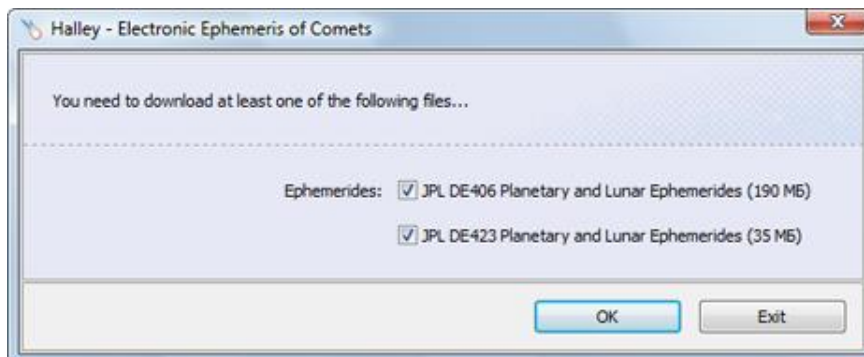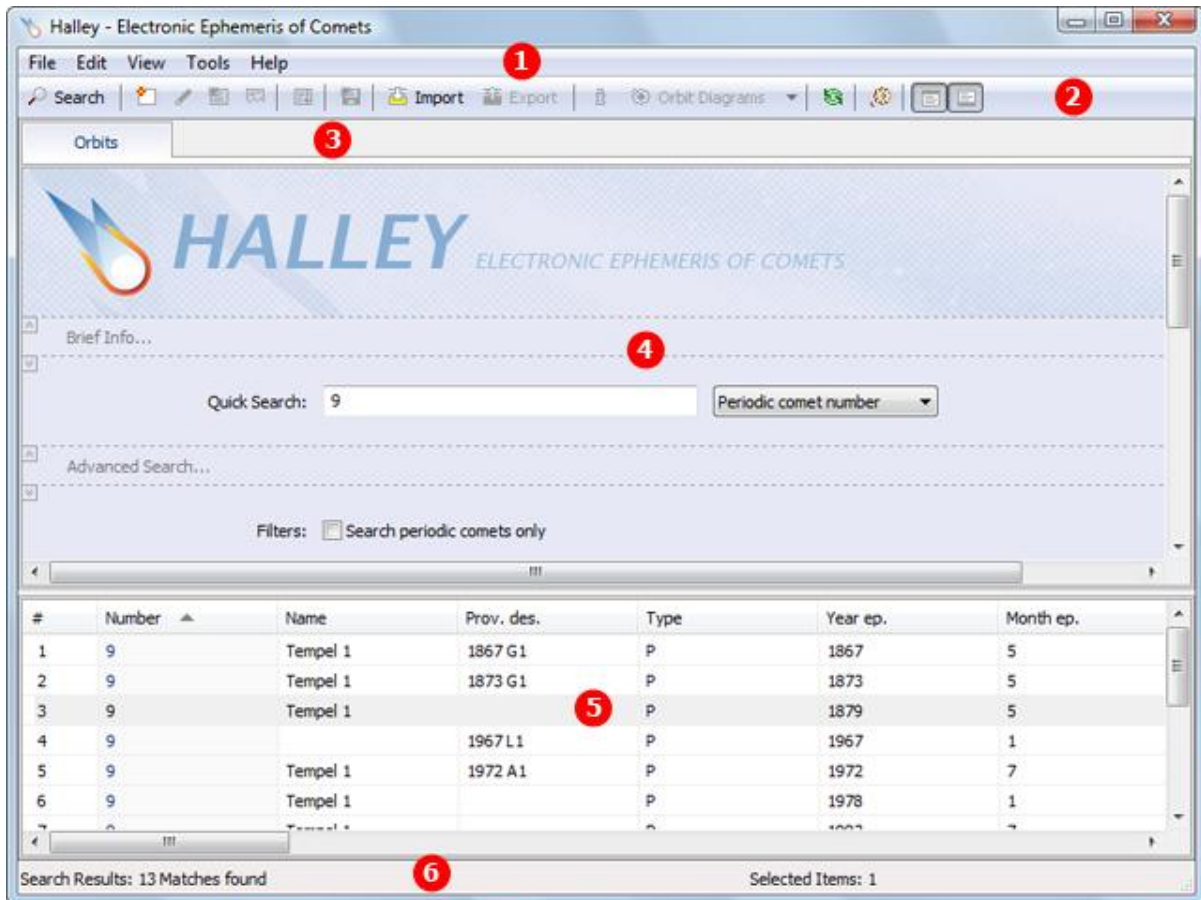

This version of Halley allows to install and use the following planetary numerical ephemerides:

Name	Description
JPL DE406	JPL DE406 Planetary and Lunar Ephemerides: Created May 1997; includes neither nutations nor librations. Referred to the International Celestial Reference Frame. Covers JED 0624976.50 (-3001 FEB 04) to 2816912.50 (+3000 MAY 06) То же что и DE405, но с уменьшенной точностью интерполяционных полиномов для уменьшения размера файла и более длительный промежуток времени, охватываемых файл This is the same integration as DE405, with the accuracy of the interpolating polynomials has been lessened to reduce file size for the longer time span covered by the file.
JPL DE423	JPL DE423 Planetary and Lunar Ephemerides: Created February 2010; includes nutations and librations. Referred to the International Celestial Reference Frame. Covers JED 2378480.5, (1799 DEC 16) to JED 2524624.5, (2200 FEB 02). Intended for the MESSENGER mission to Mercury.

Main Window

Halley Main Window user interface is broken up in to 6 major areas:

Pointer	Area	Description
1	Main Menu	This is where you can access the various menu items. Commands accessible from this location will be referenced using Menu/Command notation. For example, File/Exit means to click on the File menu, and then click on the Exit command.
2	Toolbar	The toolbar contains several buttons for executing various commands and adjusting settings of Halley. All commands that can be found in the toolbar can also be found in the main menu or other dialogs. They are placed on the toolbar for easy access.
3	Sections[1]	Main Window is divided into section tabs. Switching between sections is done by selecting the appropriate tab.
4	Work pane	In the Work pane you can set the necessary conditions for the search.
5	Output pane	This pane creates a table with the found results.
6	Status bar	Here you can see some useful information such as the number of matches found, number of selected items and more.
[1] Each section has its own Work and Output pane.		

Main Menu

There are five top-level menus in Halley:

File		
Menu Item	**Shortcut**	**Description**
Save As...	Ctrl+S	Saves all selected Items in a file.
Import	Ctrl+I	Imports Items from the selected file to the database.
Export	Ctrl+E	Exports all the selected Items in a file.
Exit		Exits Halley.

Edit		
Menu Item	**Shortcut**	**Description**
Select All	Ctrl+A	Selects all found Items.

View		
Menu Item	**Shortcut**	**Description**
Work pane	Alt+Up	Shows/Hides the Work pane.
Output pane	Alt+Down	Shows/Hides the Output pane.
Toolbar		Shows/Hides Toolbar.

Tools		
Menu Item	**Shortcut**	**Description**
Search...		Searches for the requested Records.
Add new Record...	Ctrl+Shift+N	Opens Add new Record Manager.
Edit Record...	Ctrl+Shift+E	Opens Edit Record Manager.
Duplicate Record...	Ctrl+Shift+D	Opens Add new Record Manager.
Delete Record...	Del	Deletes the selected Items from a database.
Additional Info...	Ctrl+Shift+I	Opens Additional Info Viewer.
Tasks		Opens Task Manager on selected Task:
Orbit Diagrams	Ctrl+F1	Orbit Diagrams
Ephemerides	Ctrl+F2	Ephemerides
Close Approaches	Ctrl+F3	Close Approaches
Update Database	Ctrl+U	Opens Update Database dialog.
Options...		Opens Options dialog.

Help		
Menu Item	**Shortcut**	**Description**
Help Topics	F1	Opens Halley Help.
Halley Home Page		Opens Halley Home Page in Internet browser.
Check for Updates...		Opens Check for Updates dialog.
About Halley...		Opens About dialog.

Toolbar

You can access the following commands from the toolbar:

Icon	Title	Description
	Search	Searches for the requested Records.
	Add New Record	Opens Add new Record Manager.
	Edit Record	Opens Edit Record Manager.
	Duplicate Record	Opens Add new Record Manager.
	Delete Record	Deletes the selected Items from a database.
	Select All	Selects all found Items.
	Save As	Saves all selected Items in a file.
	Import	Imports all the selected Items in a file.
	Export	Exports Items from the selected file to the database.
	Additional Info	Opens Additional Info Viewer.
	Orbit Diagrams	Opens Task Manager on Orbit Diagrams Task.
	Ephemerides	Opens Task Manager on Ephemerides Task.
	Close Approaches	Opens Task Manager on Close Approaches Task.
	Update Database	Opens Update Database dialog box.
	Options	Opens Options dialog box.
	Show/Hide Work pane	Shows/Hides the Work pane.
	Show/Hide Output pane	Shows/Hides the Output pane.

Sections

The current version of Halley includes the following sections:

Section	Description
Orbits	In this section you can manage and work with the database of the Orbits.

Orbits

The basis of this section is the database of the Orbits. Each record of Orbits database includes the following elements:

Order	Element	Type	Units	Range	Max. Length
1	Periodic comet number	Integer		>0	10
2	Name of comet	Text			60
3	Provisional designation	Text			30
4	Old designation	Text			30
5	Orbit type	Text		C, P or D	1
6	Year of the epoch[1, 3]	Integer		Depends on ephemerides used	5
7	Month of the epoch[1, 3]	Integer		Depends on ephemerides used; [1;12]	2
8	Day of the epoch[1, 3]	Integer		Depends on ephemerides used; [1; 32)	2
9	Year of perihelion passage[1]	Integer		Depends on ephemerides used	5
10	Month of perihelion passage[1]	Integer		Depends on ephemerides used; [1;12]	2
11	Day of perihelion passage[1]	Real		Depends on ephemerides used; [1; 32)	15
12	Day of perihelion passage error[4]	Real		>=0	17
13	Perihelion distance[1]	Real	AU	(0; 100)	15
14	Perihelion distance error[4]	Real	AU	>=0	17
15	Orbital eccentricity[1]	Real		[0; 10)	14
16	Orbital eccentricity error[4]	Real		>=0	17
17	Orbital period	Real	years	(0; 1000)	6
18	Argument of perihelion[1]	Real	deg	[0; 360]	16
19	Argument of perihelion error[4]	Real	deg	>=0	17
20	Longitude of the ascending node[1]	Real	deg	[0; 360]	16
21	Longitude of the ascending node error[4]	Real	deg	>=0	17
22	Inclination to ecliptic[1]	Real	deg	[0; 180]	16
23	Inclination to ecliptic error[4]	Real	deg	>=0	17
24	Non-grav. radial acceleration parameter[2]	Real	10^{-8}AU/day^2	(-100; 100)	16
25	Non-grav. radial acceleration parameter error[4]	Real	10^{-8}AU/day^2	>=0	17

26	Non-grav. transverse acceleration parameter[2]	Real	10^{-8}AU/day^2	(-100; 100)	16
27	Non-grav. transverse acceleration parameter error[4]	Real	10^{-8}AU/day^2	>=0	17
28	Non-grav. normal acceleration parameter[2]	Real	10^{-8}AU/day^2	(-100; 100)	16
29	Non-grav. normal acceleration parameter error[4]	Real	10^{-8}AU/day^2	>=0	17
30	Non-grav. parameters style	Text		I or II	2
31	Non-grav. perihelion-maximum offset[2]	Real	days	(-1000; 1000)	17
32	Non-grav. perihelion-maximum offset error[4]	Real	days	>=0	17
33	Center-of-light/mass offset	Real	km	(-100000; 100000)	17
34	Center-of-light/mass offset error[4]	Real	km	>=0	17
35	Number of observations used in solution	Integer		>0	10
36	Year of first observation	Integer		[-3000; 3000]	5
37	Month of first observation	Integer		[1; 12]	2
38	Day of first observation	Integer		[1; 31]	2
39	Year of last observation	Integer		[-3000; 3000]	5
40	Month of last observation	Integer		[1; 12]	2
41	Day of last observation	Integer		[1; 31]	2
42	Planetary ephemeris used	Text			60
43	Number of perturbing planets	Integer		>0	10
44	Small-body perturber ephemeris used	Text			60
45	Brief descriptor of perturbers used	Text			3
46	Fuller description of perturbers used	Text			4
47	RMS of orbit fit	Real	sec	[0; 100)	8
48	Source of data	Text			60
49	Person (or institution) who computed the orbit	Text			60
50	Effective body diameter	Real	km	(0; 1000)	16
51	Effective body diameter error[4]	Real	km	>=0	17
52	Axial ratio (a/b)	Real		[0; 1000)	16
53	Axial ratio (a/b) error[4]	Real		>=0	17
54	Rotation period	Real	h	[0; 1000)	16
55	Rotation period error[4]	Real	h	>=0	17
56	Geometric albedo	Real		[0; 1]	14
57	Geometric albedo error[4]	Real		>=0	17

58	Comet total magnitude	Real		[-50; 50]	16
59	Comet total magnitude error[4]	Real		>=0	17
60	Comet total magnitude slope	Real		[-50; 50]	16
61	Comet total magnitude slope error[4]	Real		>=0	17
62	Comet nuclear magnitude	Real		[-50; 50]	16
63	Comet nuclear magnitude error[4]	Real		>=0	17
64	Comet nuclear magnitude slope	Real		[-50; 50]	16
65	Comet nuclear magnitude slope error[4]	Real		>=0	17
66	Additional info	Text			5000

[1] Required element used in calculations.

[2] Not required element used in calculations.

[3] Date of epoch may be empty. In this case, the date of perihelion passage is used as the epoch.

[4] If you set the error, you must set the corresponding element.

Database Records are of two types: 'master record' and 'user record'. 'User record' is any Record that you add, edit or export into a database. 'User record' highlighted in the table in red.

Work with Halley begins with selecting the Records from the database. This selection is done in the Work pane of the Orbits section. The Work pane of Orbits section is divided into several panels:

Panel	Description
Brief Info	This panel contains brief information about Orbits database state. It shows the number of Records, comets, numbered periodic comets, long-period and unnumbered short- and intermediate-period comets, Records added by the user and the last added comets names in the database.
Quick Search	You can choose the comets from the database by the numbers, the names, the preliminary designations, the old designations and the type of orbit by using the Quick Search. To do this you must enter the appropriate request (word) in the search box. If you want to enter several values of selected element, the words entered should be separated by commas. To display the entire database, enter an asterisk '*' in the search box. To search for blank fields, use tilde '~'. Searching comets by the names, preliminary and old designations is made using part of search word.
Advanced Search	Advanced Search differs from the Quick Search presence of conditions and the number of requests. Using the Advanced Search, you can choose the comets from the database by any element. To search for blank fields, use the tilde '~'. Use commas to search for multiple values of the selected element. If you are searching on multiple elements, each of conditions can be combined by logical operations 'and' or 'or'.

Filters	Additional terms to the existing search can be applied using Filters. You can display the records of numbered comets only, the last appearance of the comets only, records created by the user only, the last update only or their combination.
Output Details	By using the Output Details, elements can be displayed together with their errors, if they are given.
Sets of Elements	Predefined Sets of Elements allow you to quickly select the group of elements you need.
Elements	Elements panel gives you the opportunity to make an independent choice of elements to display in the table.
Calculated Elements	Calculated Elements panel adds to the elements contained in the database Record, calculated orbital parameters such as the Mean anomaly, Average motion, Semi-major axis, Aphelion distance, the Orbit classification and the Orbital period.

Each panel can be expanded or collapsed by clicking on the button ⊼ or ⊽ (in the upper left corner of the appropriate panel) or by double clicking on the panel. Switching between the panel elements, as well as between the Work and Output panes can be done by pressing Tab button.

After specifying the necessary conditions index, a user query will be sent to the database. You can use the Search button 🔍 or Tools/Search... command of main menu or if the cursor is in the search box press ENTER. The Output pane creates a table with the found results. The number of results is displayed in the lower left corner on the status bar, as well as in the first column of the table. If you not satisfied with the result, you can make a re-assignment of conditions and further re-searches. If the result is satisfactory, further work is carried out in the Output pane.

The records returned, by default, arranged in ascending order of the first element. Right-clicking on the header of the column will sort the table by the corresponding element (the first click - in ascending order, the second - in descending order of the element). Also, you have the ability to customize a convenient form of the output table: change the width and order of columns, remove unnecessary columns (left-clicking on the header of the table).

To select a row in the table, click on it the left mouse button. Selected row highlighted in blue. To select multiple rows, use the Shift or Ctrl key. To select an element from the table, double click on it the left mouse button.

To manage and work with the database, you can use the main menu, toolbar or secondary menu, which is invoked by pressing the right mouse button on the selected rows. Halley allows you to perform the following operations with the database records:

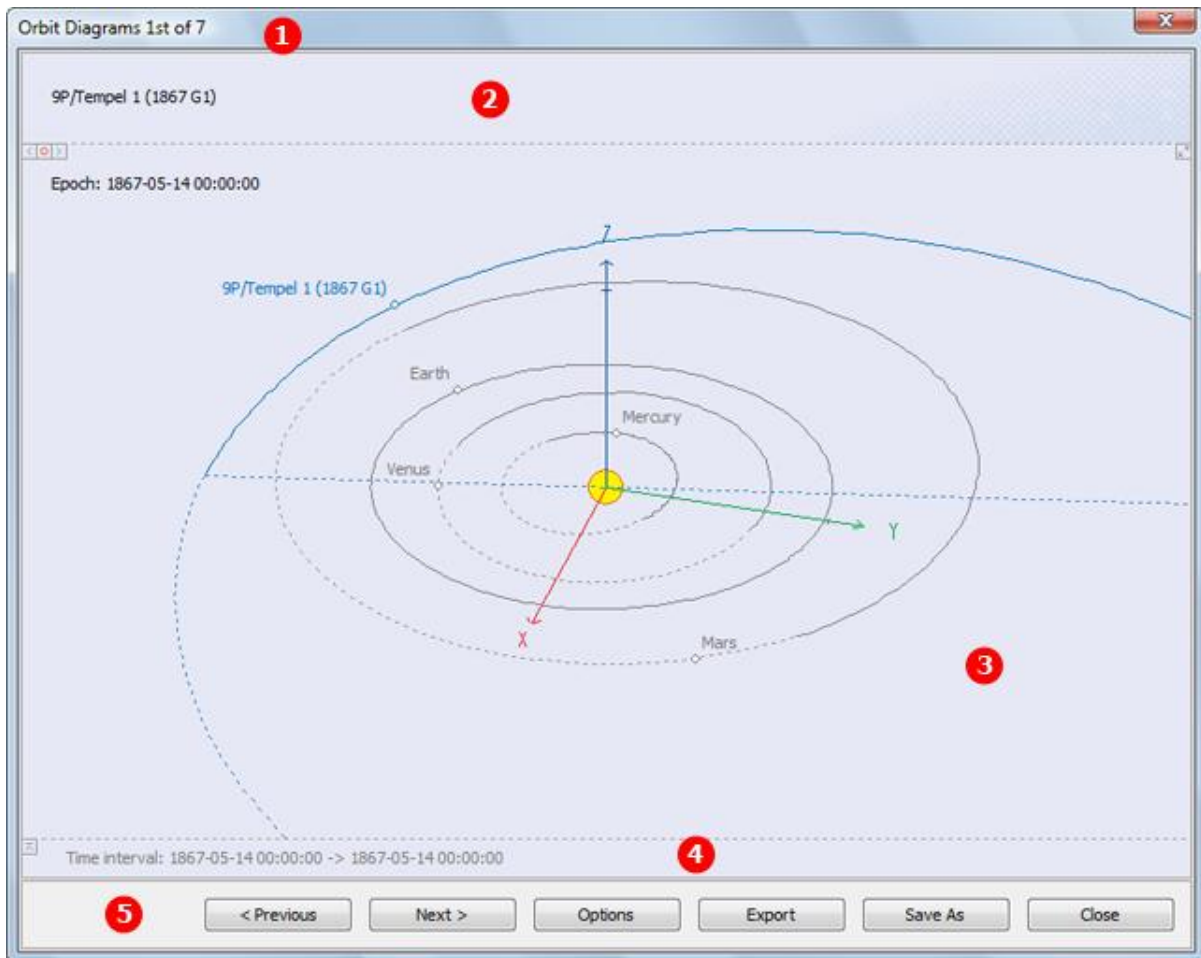| Operation	Description
Save As…[1]	This action saves all the selected Items into a text file as a table.
Import[3]	Importing Items from the selected file to the database.
Export[1]	Exporting all the selected Items in a file.
Add new Record…[3]	Adding new Records into the database.
Edit Record…[1, 3]	Editing existing Records.
Duplicate Record…[1, 3]	Creating copies of existing Records with the possibility of their editing and adding new Records.
Delete Record…[1]	Removing the existing Records.
Additional Info…[1, 2]	Shows Additional Info element of selected Records.
Tasks[1]	Opens Task Manager on selected Task.
Update Database	Updating or Restoring database from the internet server.
[1] Available if selected at least one row (depends on ephemerides used). [2] Additional Info Viewer will not be available for opening, in case the selected Record has no additional information. [3] Record becomes a 'user record'.	

Imports and exports performed with the following formats:

Format	Description
.els[1]	Export Format for Comet Orbits
text file[1]	All elements of the database record listed on the order in quotes, separated by commas.
[1] To see an example, simply export some records to a file.	

Tasks

The current version of Halley has the following Tasks to work with Orbits database:

Task	Description
Orbit Diagrams	Visualization of a three-dimensional projection of the small-bodies orbits.
Ephemerides	Calculating orbital elements, state vector or observer quantities of small-body.
Close Approaches	Calculation the moments of close-approaches of small-bodies with the planets and perihelion passages at a given time interval.

Any work with the Orbits database elements running in a Task Manager. Halley Task Manager user interface is broken up in to 5 major areas:

Pointer	Area	Description
1	Title	Title show the Task name, the number of Record which is currently running and the total number of selected Records.
2	Small-body Name[1]	This area contains the name of small-body which is currently running.
3	Output panel	This area contains the output information, which depends on the selected Task.
4	Status panel	This area shows the current status of the selected task.
5	Command	In this area various actions on selected items are carried.
[1] If you set to Combine all the selected orbits, 'Combined image...' or 'Combined calculation...' appears in this area.		

Switching between Task Manager areas can be done by pressing Tab button.

Using the buttons in the upper left corner of the Output panel you can switch between different Tasks ▣, select previous ◁ or next ▷ Task. If you select the Figures Task you can expand the Output and Status panels on the screen or collapsed them back using ▣ (or ENTER key) and ▣ (or Esc key) buttons.

On the Status panel displays the time remaining until the end of integration, considered time interval, the current status of the computation and speed of integration. Status panel can be expanded or collapsed by clicking on the button ▣ or ▣ (in the upper left corner of the panel) or by double clicking on the panel. In the collapsed state on the panel will be displayed only some of the information.

Command area of Task Manager contains the following buttons:

Button	Description
< Previous[1]	Moves to the previous selected record.
Next >[1]	Moves to the next selected record.
Options[2]	Opens Task Manager Options dialog.
Export[3]	Export of all items being processed in the file.
Save As	Saves data from the Output panel.
Close	Closes Task Manager.
[1] If you select several records and they are not combined. [2] Every Task has its own options dialog. [3] Only if date of the epoch in 'Y-M-D' format.	

The main parameter when working with the Orbits database is the date of the epoch (**6**). This value is set in the Options dialog, regardless of the selected Task.
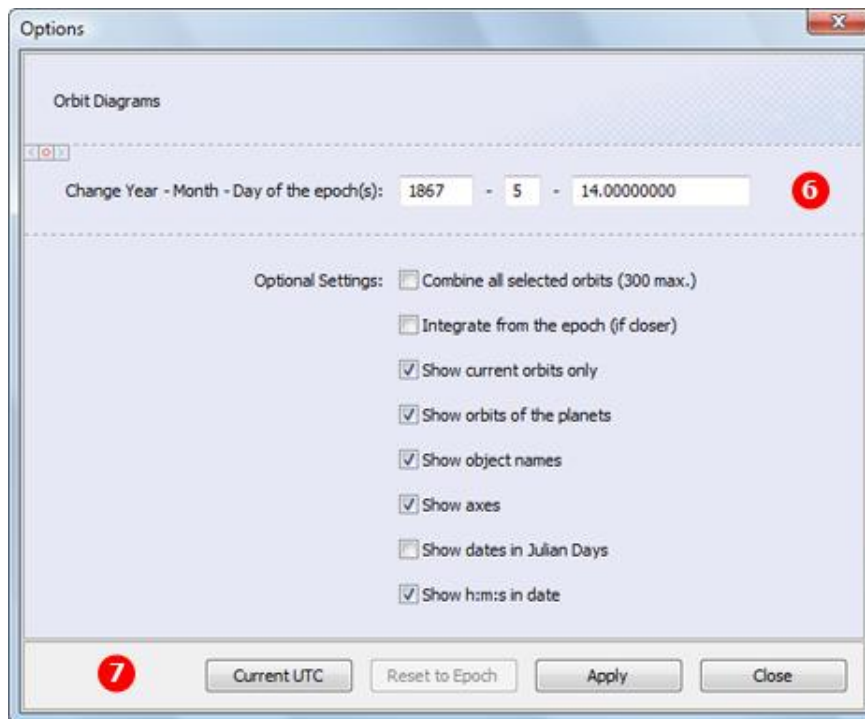
In date of the epoch field (**6**) you can select one of the following Epoch Format:

Date of the Epoch	
Format	**Description**
Y-M-D.0	Year, Month and Day with a fractional part.
Y-M-D h:m:s[1]	Year, Month and Day with hours, minutes and seconds.
JD.0	Julian Day with a fractional part.
[1] In this format, there is a loss of day accuracy (rounding to seconds of day).	

Using the buttons in the upper left corner of the Options dialog you can switch between different epoch formats ⊙, select previous ◁ or next ▷ group of epoch formats.

If you change the format of the epoch, the date automatically converts into the selected date format. You can not specify the date greater than the limits of planetary ephemeris uses. Command area of Options dialog (**7**) contains the following buttons:

Button	Description
Current UTC	Sets the value of the epoch at the current UTC.
Reset to Epoch	Resets the current date at the time of the initial epoch.
Apply	Applies the selected options.
Close	Closes Options dialog.

If this value of the epoch not equal to current epoch of the selected orbital elements, then the orbital elements will be integrated on a new epoch and the corresponding time difference will be the investigated Time interval.
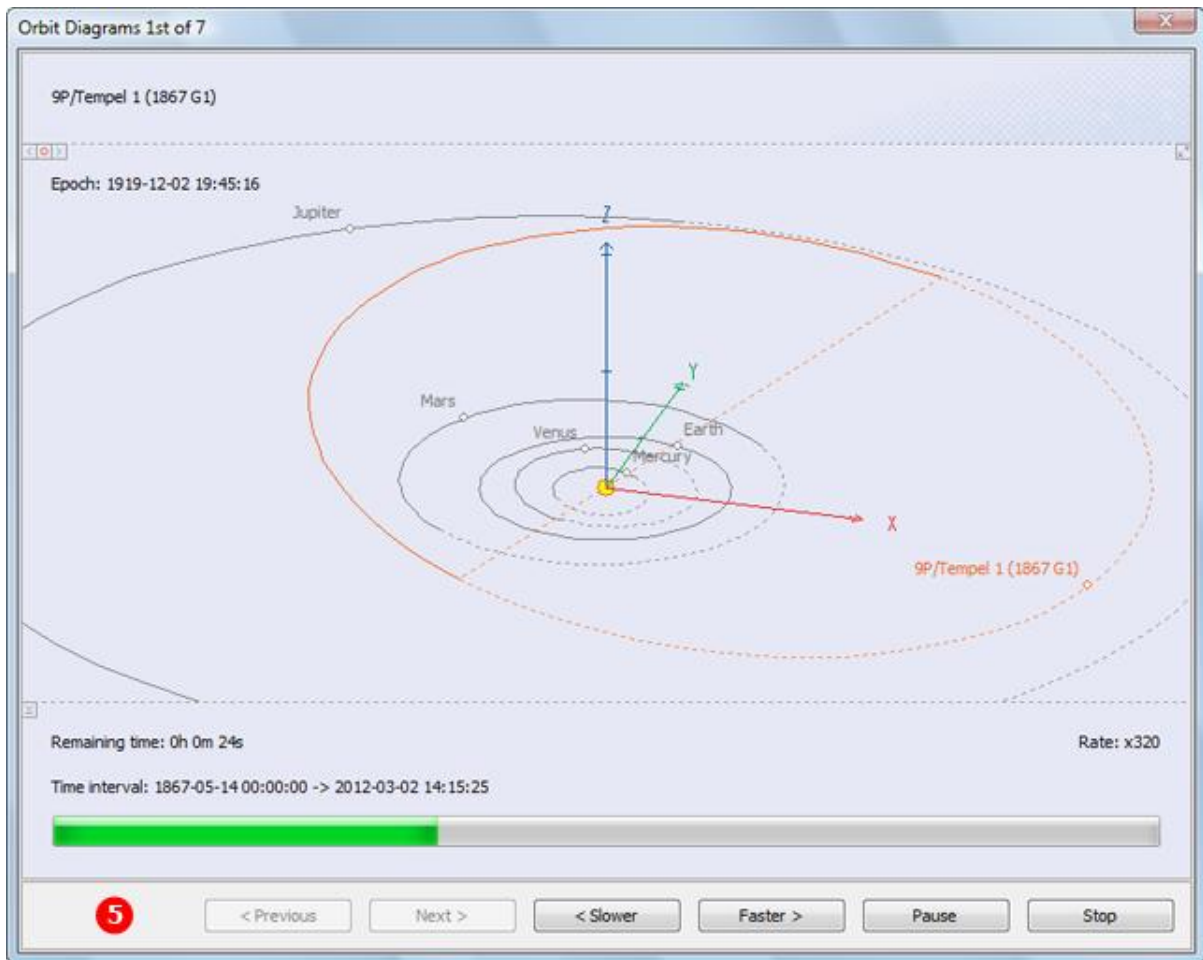
During integration, the buttons in the Command area (**5**) are converted to:

Button	Description
< Slower	Reduces the speed of integration.
Faster >[1]	Increases the speed of integration.
Pause/Run	Pauses/Runs the integration.
Stop[2]	Terminate the integration at the current time.
[1] At a maximum speed of integration to the Output panel nothing is displayed. [2] If you set to show all the selected objects, this setting is removed and integration stops at the current small-body.	

Orbit Diagrams

Orbit Diagrams Task is used to visualize the three-dimensional projection of the small-bodies orbits on a given epoch. You can set the epoch date by changing its value in the Options dialog.
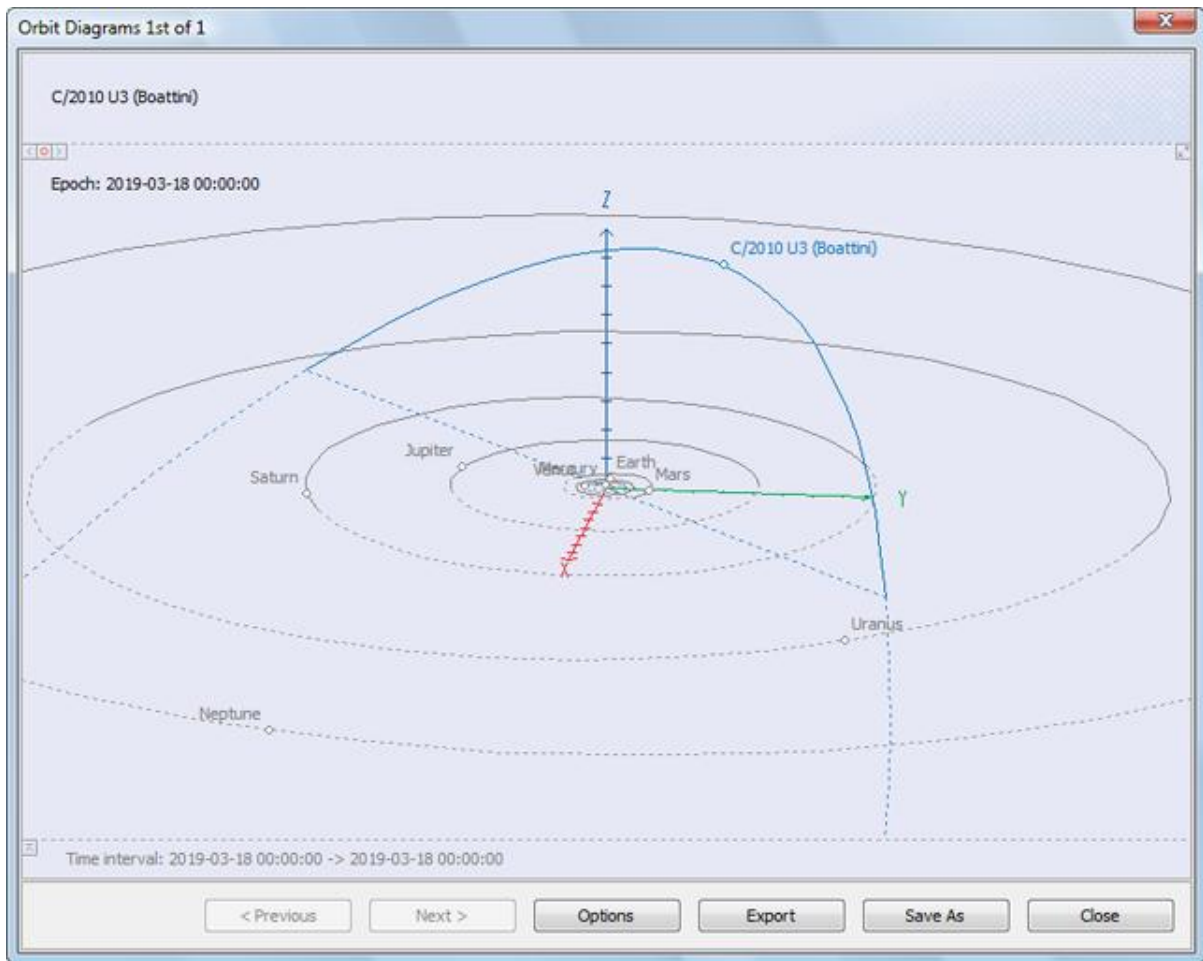
The Output panel of Task Manager displays orbits of the selected objects, where: XY - ecliptic plane; Z axis points to the north pole of the ecliptic plane; The X axis is directed at the vernal equinox 2000.0; Scale of axes is equal to 1 astronomical unit.

To move an image, use the left mouse button or use Shift+[Up; Down; Left; Right] keys. To rotate an image, use the right mouse button or use [Up; Down; Left; Right] keys. For the centering the image, double-click on the image left mouse button or use Home key. To zoom in or out, use the mouse wheel or [+; -] keys. You can expand the Output and Status panels on the screen or collapsed them back using ▣ (or ENTER key) and ▣ (or Esc key) buttons.

In Options dialog of Orbit Diagrams Task you can set the following Settings:

Parameter	Description
Combine all selected objects[1]	Displays all selected small-body orbits on the same date.
Integrate from the Epoch	Integration of the equations of motion will be made from the initial epoch if it closer to a given date.
Show new orbits only[2]	Shows/Hides the initial orbit.
Show the orbits of the planets	Shows/Hides the planets orbits.
Show object names	Shows/Hides object names.
Show axes	Shows/Hides axes.
Show dates in Julian Days	Converts dates to Julian Days.
Show h:m:s in date	Converts day fraction to h:m:s format.
[1] If you select several records. The maximum number of simultaneously displayed orbits is 300. [2] The initial orbit of small-body are drawn in blue.	

Ephemerides

Ephemerides Task is used to calculate orbital elements, state vector or observer quantities of small-body on a given epoch. You can set the epoch date by changing its value in the Options dialog.
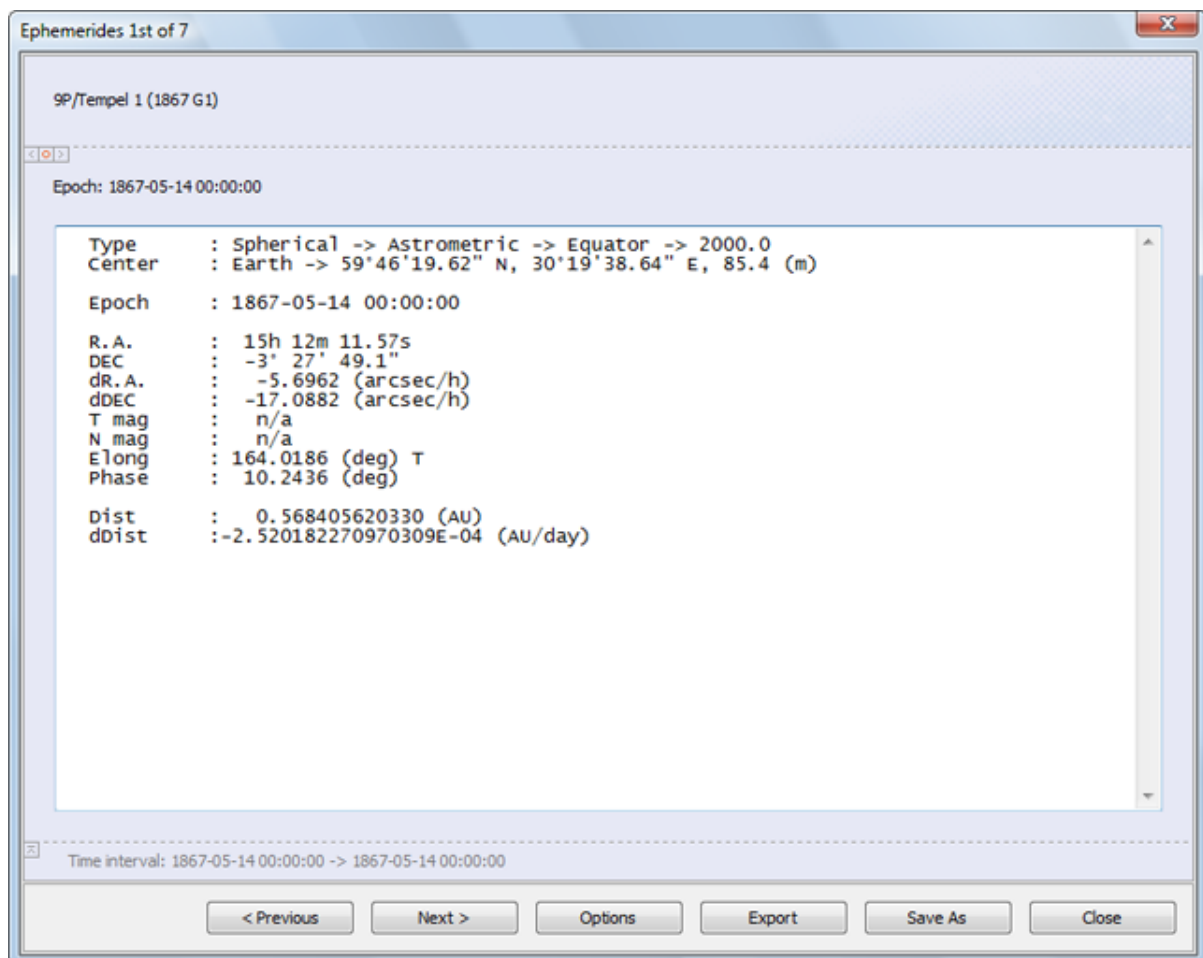
The Output panel of Task Manager displays elements of the selected objects, where:

Designation	Description
Type	Given coordinate system.
Center	Center of a given coordinate system.
Epoch	Date of the epoch.
R.A.	Right ascension of target center in the equatorial plane in hh mm ss.0 format.
DEC	Declination of target center in the equatorial plane in °° ' ' "".0 format.
dR.A.	The rate of change of target center apparent right ascension multiplied by the cosine of the declination in arcsec/h.
dDEC	The rate of change of target center apparent declination in arcsec/h.
Long	Ecliptic longitude of target center in °° ' ' "".0 format.
Lat	Ecliptic latitude of target center in °° ' ' "".0 format.
dLong	The rate of change of target center apparent ecliptic longitude multiplied by the cosine of the latitude in arcsec/h.
dLat	The rate of change of target center apparent ecliptic latitude in arcsec/h.
A	Azimuth of target center in the horizontal coordinate plane in °° ' ' "".0 format.
h	Altitude of target center in the horizontal coordinate plane in °° ' ' "".0 format.
T mag	Small-body approximate apparent visual total magnitude.
N mag	Small-body approximate apparent visual nuclear magnitude.
Elong	Sun-Observer-Target angle; target's apparent solar elongation seen from observer location.
Phase	Sun-Target-Observer angle; phase angle.
Dist	Distance from the center of the given coordinate system to a small-body.
dDist	The rate of distance to target center with respect to the observer at the instant light seen by the observer.
pos(x)	'X' component of position vector in the given coordinate system.
pos(y)	'Y' component of position vector in the given coordinate system.
pos(z)	'Z' component of position vector in the given coordinate system.
vel(x)	'X' component of velocity vector in the given coordinate system.
vel(y)	'Y' component of velocity vector in the given coordinate system.
vel(z)	'Z' component of velocity vector in the given coordinate system.
Vel	The velocity of small-body relative to center of the given coordinate system.
MOID[1]	The minimal distance between the small-body and central body orbits.
T	Date of perihelion passage.
q	Perihelion distance.
e	Orbital eccentricity.
P[2, 3]	Orbital period.
w	Argument of perihelion.
node	Longitude of the ascending node.

i	Inclination to the central plane of a given coordinate system.
M^4	Mean anomaly.
$n^{2, 3}$	Average motion.
a^2	Semi-major axis.
$Q^{2, 3}$	Aphelion distance.
Orbit[5]	Comet Orbit Classes.
Hill Sph.	The object of the Solar System in Hill sphere of which selected object situated.

[1] If the Sun is the central body, then the MOID is equal to perihelion distance of the small-body.

[2] 'n/a' if orbital eccentricity equal to 1.

[3] 'n/a' if orbital eccentricity greater than 1.

[4] M (if e<1), B (if e=1) or H (if e>1)

[5] Comet Orbit Classes:

- Hyperbolic - Comets on hyperbolic orbits (e > 1).
- Parabolic - Comets on parabolic orbits (e = 1).
- Jupiter-family - Jupiter-family comet, as defined by Levison and Duncan ($2 < T_{Jupiter} < 3$).
- Jupiter-family* - Jupiter-family comet, classical definition (P < 20 years).
- Encke-type - Encke-type comet, as defined by Levison and Duncan ($T_{Jupiter} > 3$; $a < a_{Jupiter}$).
- Chiron-type - Chiron-type comet, as defined by Levison and Duncan ($T_{Jupiter} > 3$; $a > a_{Jupiter}$).
- Halley-type - Halley-type comet, classical definition (20 < P < 200 years).
- No class - Comet orbit not matching any defined orbit class.

In Options dialog of Ephemerides Task you can set the following group of settings:

Optional Settings	
Parameter	**Description**
Combine all selected objects[1]	Displays all selected small-body orbits on the same date.
Integrate from the Epoch	Integration of the equations of motion will be made from the initial epoch if it's current epoch is closer to a given date.
Show dates in Julian Days	Converts dates to Julian Days.
Show h:m:s in date	Converts day fraction to h:m:s format.
Time of perihelion passage relative to epoch	The time of perihelion passage is calculated relative to epoch.
Show the distance and velocity in km and km/s	Converts the distance from the AU to km and velocity from the AU/day to km/s.
Show the angles and angular velocity in rad and rad/day	Converts the angles from the degrees to radians and angular velocity from the deg/day to rad/day.

[1] If you select several records. The maximum number of simultaneously displayed orbits is 300.

Ephemerides Settings	
Parameter	Description
Ephemeris Type	Spherical, Rectangular or Orbital.
Position	Astrometric, Geometric or Apparent.
Main Plane	Equator, Ecliptic or Horizon.
Reference System	2000.0, 1950.0 or True.
Central Body	Sets the central body of a given coordinate system.
Center	Geocenter or Topocenter.
Latitude[1]	Sets the value of the latitude.
Longitude[1]	Sets the value of the longitude.
Altitude[1]	Sets the value of the altitude.
[1] Disabled if 'Center' parameter is set to Geocenter.	

Output Settings	
Parameter	Description
Calculate ephemerides	Creates the file with selected ephemerides.
Write to single File[1]	Writes the ephemerides data of selected objects in single File.
Step Size[2]	Sets the step size for ephemeris.
Maximum File Size	Sets the maximum size for ephemeris file.
Save to folder	Sets the directory where the ephemeris files will be stored.
[1] If this option is not set, the ephemeris file is created for each selected object. [2] In Days, Hours or Minutes. [3] If the file size exceeds its maximum value, and the process of integration is not complete yet, you can either stop the integration at the current date, or to continue it but without ephemeris recording.	

Using the buttons in the upper left corner of the Options dialog you can switch between different group of parameters ⊙, select previous ◁ or next ▷ group of parameters.

Close Approaches

Close Approaches Task is used to calculate the moments of close-approaches of small-body with the planets and perihelion passages at a given time interval. You can set the time interval by changing the current date of the epoch value in the Options dialog.
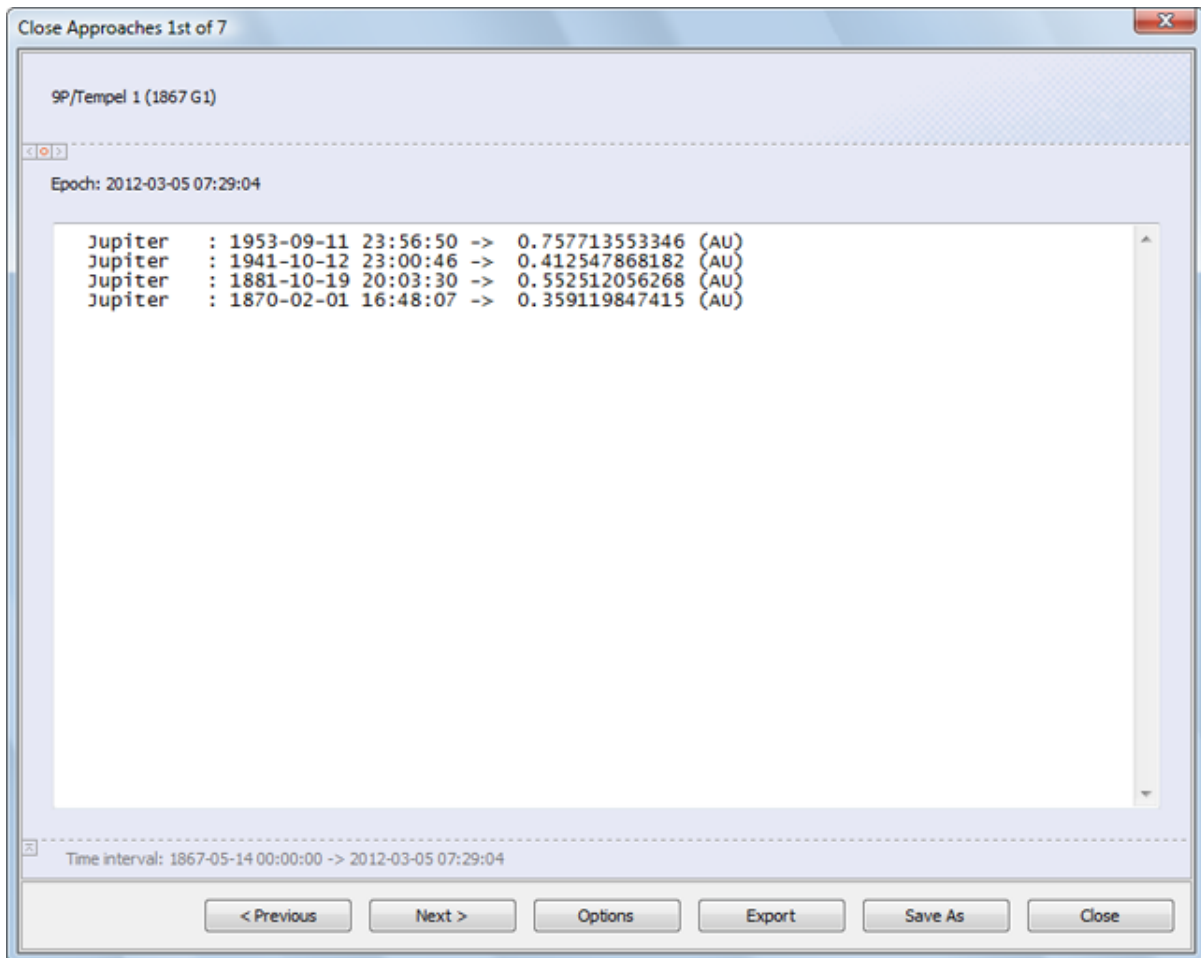
The Output panel of Task Manager displays the moments of close-approaches of the selected objects with the planets, where:

Designation	Description
'Planet name'	The name of the planet which the close approach occured[1].
Date -> Distance	Moment of close-approache and the distance to the relevant Planet.
[1] If small-body enters the sphere of radius 0.1 AU for Mercury, Venus and Mars, 0.5 AU for the Earth and 2 AU for Jupiter, Saturn, Uranus, Neptune and Pluto.	

In Options dialog of Close Approaches Task you can set the following Settings:

Parameter	Description
Combine all selected objects[1]	Displays all selected small-body orbits on the same date.
Integrate from the Epoch	Integration of the equations of motion will be made from the initial epoch if it's current epoch is closer to a given date.
Show Perihelion Passages	Shows/Hides the Perihelion Passages (closest to the Sun).
Minimal distance to Earth at each appearance	Shows/Hides the minimal distance to Earth (only the minimal distance for appearance).
Take into account the size of the planet	The radius of the planet is taken into account when calculating the minimal distance.
Show dates in Julian Days	Converts dates to Julian Days.
Show h:m:s in date	Converts day fraction to h:m:s format.
Show the distance and velocity in km and km/s	Converts the distance from the AU to km and velocity from the AU/day to km/s.
[1] If you select several records. The maximum number of simultaneously displayed orbits is 300.	

Add new Record

Adding new database Records as well as duplicating existing Records is performed by the Add new Record Manager. Add new Record Manager user interface is broken up in to 4 major areas:

Pointer	Area	Description
1	Title	Title show the number of Record which is currently running and the total number of selected Records.
2	Small-body Name	This area contains the name of small-body which is currently running.
3	Edit Page[1]	This area contains the edit fields of each element of the database Record.
4	Command	In this area various actions on selected items are carried.
[2] Fields that used in calculations are highlighted in red. Titles of required fields are highlighted in red too.		

Switching between Add new Record Manager areas can be done by pressing Tab button.

Command area of Add new Record Manager contains the following buttons:

Button	Description
< Previous[1]	Moves to the previous selected record.
Next >[1, 2]	Moves to the next selected record.
Add more >	Creates new empty record.
Remove[1]	Removes selected Record.
Reset	Returns all elements of their original value.
Apply	Applies all changes.
Close	Closes Add new Record Manager.
[1] If you add or select several records. [2] Converts to 'Add more >' button.	

Edit Record

Editing database Records is performed by Edit Record Manager. Edit Record Manager user interface is broken up in to 4 major areas:

Pointer	Area	Description
1	Title	Title show the number of Record which is currently running and the total number of selected Records.
2	Small-body Name	This area contains the name of small-body which is currently running.
3	Edit Page[1]	This area contains the edit fields of each element of the database Record.
4	Command	In this area various actions on selected items are carried.
[2] Fields that used in calculations are highlighted in red. Titles of required fields are highlighted in red too.		

Switching between Edit Record Manager areas can be done by pressing Tab button.

Command area of Edit Record Manager contains the following buttons:

Button	Description
< Previous[1]	Moves to the previous selected record.
Next >[1]	Moves to the next selected record.
Reset	Returns all elements of their original value.
Apply[2]	Applies all changes.
Close	Closes Edit Record Manager.
[1] If you select several records. [2] If changes were made to the 'master record', then it becomes a 'user record'.	

Update Database

Updating or Restoring database Records from the internet server is performed by Update Database dialog. Halley Update Database dialog user interface is broken up in to 3 major areas:
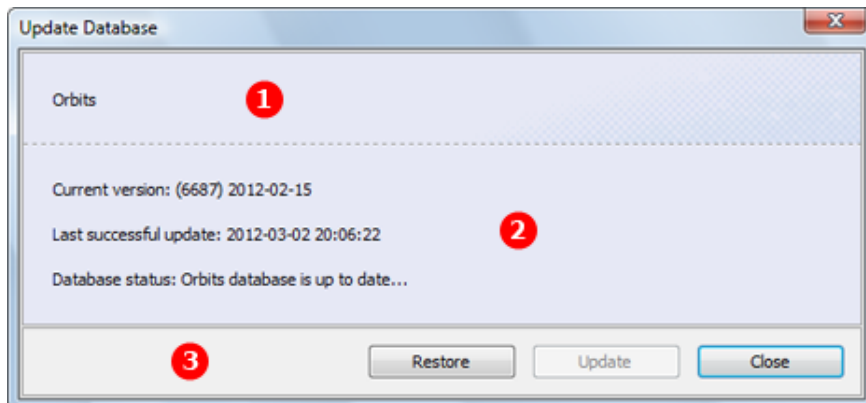
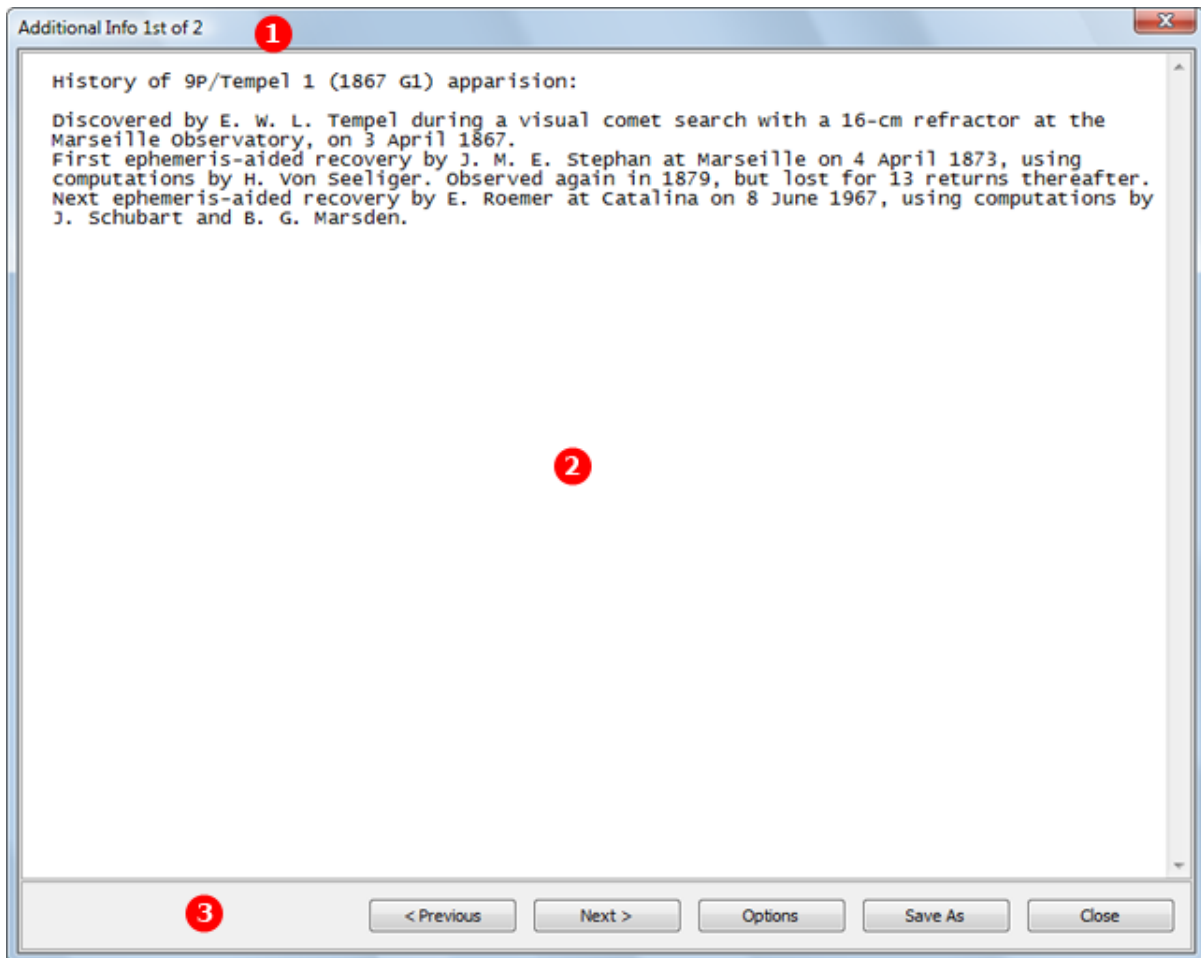| Pointer	Area	Description
1	Database Name	Name of the database to be updated or restored.
2	Database Info	This area contains information about database state. It shows the current version of database, time of last successful update and database status (up to date/out of date).
3	Command	In this area various actions on selected database are carried.

Command area of Update Database dialog contains the following buttons:

Button	Description
Restore[1]	Completely restores all the 'master records' of the database.
Update[1, 2]	Updates the database.
Close	Closes Update Database dialog.
[1] Without affecting the 'user records'. [2] Appears if there are new updates.	

Additional Info

Additional Info element of database Record, is viewed by Additional Info Viewer and possible only if the additional info element of database record is not empty. Halley Additional Info Viewer user interface is broken up in to 3 major areas:

Pointer	Area	Description
1	Title	Title shows the number of Record which is currently running and the total number of selected Records.
2	Output	This area contains the name of small-body which is currently running and it's Additional Info.
3	Command	In this area various actions on selected items are carried.

Switching between Additional Info Viewer areas can be done by pressing Tab button.

Command area of Additional Info Viewer contains the following buttons:

Button	Description
< Previous[1]	Moves to the previous selected record.
Next >[1]	Moves to the next selected record.
Options	Opens Additional Info Viewer Options dialog.
Save As	Saves data from the Output area as a text file.
Close	Closes Additional Info Viewer.
[1] If you select several records.	

In Options dialog of Additional Info Viewer you can set the following parameters:

Parameter	Description
Show horizontal scroll bar	Shows/Hides the horizontal scroll bar of Output area.