Perseus

ASTRONOMY SIMULATION SOFTWARE

version 1.9

User's manual

www.perseus.it

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Contents

1 Warning

This manual refers to Perseus version 1.9. If you are running an older version, you can download a free patch from *www.perseus.it* by clicking on the "Patch" link.

The program version appears at the top of the splash screen when the program is started (see figure 1).

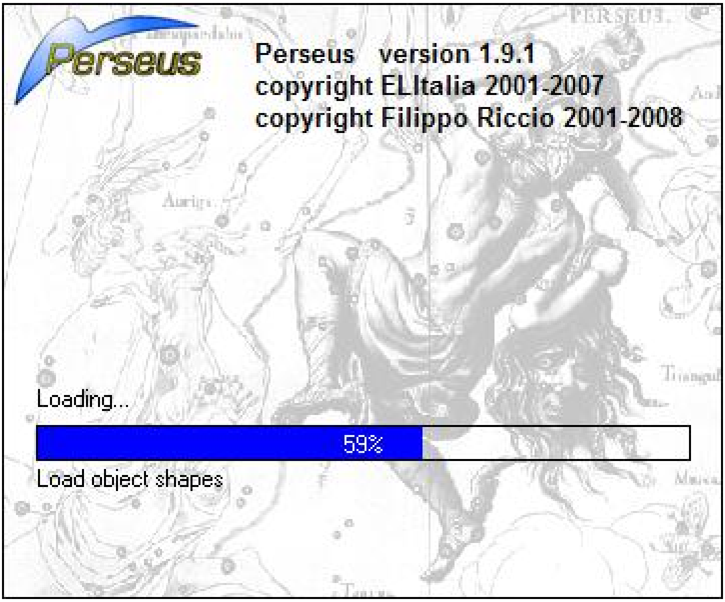


Fig. 1

2 Introduction

Perseus is a planetarium simulator running under the Windows environment. Perseus displays the sky as it would be seen from any location on Earth or from space, in different times, with great details and accuracy.

Perseus reconstructs or predicts the position of the Sun, the Moon, and all other celestial bodies of the solar system: planets, major satellites, comets, and asteroids. It also incorporates custom-designed tools and functions for amateur astronomers. Perseus can drive the most common electronically driven telescopes (with the support of the ASCOM platform* version 1.2 or newer), can realistically simulate the appearance of nebulae and galaxies (*RealDeep* technology), includes a wide catalog of stars and objects created by merging numerous other catalogs, maps for SN research, and lots more. The comets and asteroids databases are constantly updated on Perseus' website, on which you can also find free updates for the program.

These are Perseus' primary characteristics:

- Its vector graphics engine allows high execution speed. This produces very smooth animations.
- Great amount of detailed data obtained by cross-referencing different databases, which were carefully controlled and edited.
- Simplicity of use to support telescope observation on the field.
- Planets and satellites are rendered in 3D by pasting on the virtual bodies images taken by real telescopes and space probes.
- The *RealDeep* function allows the simulation of deep-sky objects like galaxies and nebulae with great realism.
- Particular care has been taken in achieving the maximum realism possible.
- Hand-optimized assembly loops for graphics visualization of the sky.

And lots more!

Have fun exploring the sky with Perseus!

* The ASCOM platform contains drivers to control the most common electronically driven telescopes and can be downloaded for free from *www.ascom-standards.org*. ASCOM is a non-profit organization devoted to unifying astronomy computer software.

NOTE

It is assumed that the user has a basic knowledge of astronomy. This manual won't therefore explain terms like ecliptic, celestial equator or Julian day.

2.1 The levels of Perseus

Perseus has three levels. Your copy's level is printed on the label on the CD jewel case and at page 9 of this manual. These are the differences between the levels:

- Level III has all functionalities described in this manual.
- Level II has all functionalities described in this manual besides the SCRIPT menu. The commands to create, edit, and run scripts and to create AVI movie files are missing.
- Level I is missing the SCRIPT menu and can't read the USNO-A or UCAC-2 catalog disks: the checkbox in the Star Settings menu will not be available.

You can upgrade Perseus from version I to II or III. For more information please email technical support at *info@perseus.it*.

3 Installation

To install Perseus, insert the CD in the CD-ROM drive; then click on the Start button, select Run... and type X:\SETUP (where X is the letter identifying the CD-ROM drive). Follow the step-by-step instructions that will appear on the screen. If you are not sure about what to enter, accept all defaults.

The installation program will prompt you whether you want to install all data (full installation) or just part of them (medium or minimum installation). Your choice depends on how much free space you have on your hard drive. Minimum installation requires about 90MB, medium installation requires about 250MB, and the full installation requires over 650MB. The installation process can take a few minutes.

NOTE

The choice among minimum, medium, and maximum installation has nothing to do with the level of your copy of Perseus (level I, II, or III): it only affects the amount of data that is copied from the CD-ROM to your hard disk. If you perform a minimum or medium installation Perseus will require less disk space but will prompt you to insert the CD-ROM in the drive for stars over magnitude 11 (with medium installation) of for stars over magnitude 9 and RealDeep objects (with minimum installation).

There's no functional difference between full, medium, and minimum installations, but performance will vary when using weak stars and RealDeep object that need to be read from the CD-ROM. The program will prompt you to insert the original CD only if you want to use data that were not installed on the hard disk, but this function can be deactivated. In this case Perseus won't use data that were not installed on the hard disk. You could also click on "Cancel" when prompted: Perseus will continue without those data.

If after a minimum or medium installation you wish to upgrade to a higher one, just run SETUP again and perform the new installation directly over the older one. You will have to select the same destination folder you chose the previous time. User defined data and settings will be saved. If you did run a patch you downloaded from Perseus' website, you will need to reinstall it as well. You must uninstall and then reinstall Perseus from scratch if you change operating system. If you have updated the software with a patch downloaded from the website, you will have to reinstall also the patch.

3.1 Activation

Perseus is protected against illegal copying through an activation code; all installed copies of Perseus need such code, which can be obtained via Internet (even automatically) or by e-mailing the technical support.

Each copy of Perseus, i.e. each original CD, allows three *simultaneous* installations. In other words, you can have the program installed on a maximum of three computers. In order to install Perseus on a fourth computer (e.g. if you change computer) you will have to uninstall one of the previous three copies.

Each copy has a serial number printed on the CD case and on this page. The serial number consists of four groups of characters separated by dashes (each character can be a number between 0 and 9 or a letter from A to F; the dashes are part of the serial number and facilitate reading). This code is not case sensitive. **Do not disclose your serial number to anyone except the technical support.**

label here

The first time it is launched after installation, Perseus will prompt you to enter the serial number. Type it as XXXX-XXXX-XXXX-XXXX (the "-" are part of the code and must be typed).

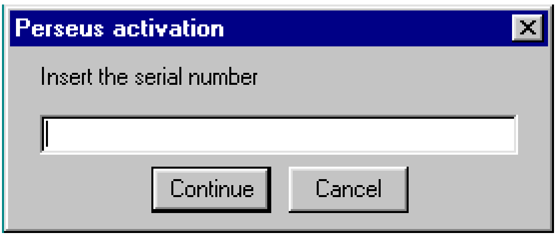


Fig. 2

You won't be able to proceed if you don't enter a valid serial number. This prompt only appears the first time the program is executed; Perseus will check for the serial number's validity. After entering the serial number, you can run Perseus TWENTY times without having to complete the activation procedure.

After you entered the serial number (or every time you run Perseus, from the second time on) Perseus displays the message shown below.

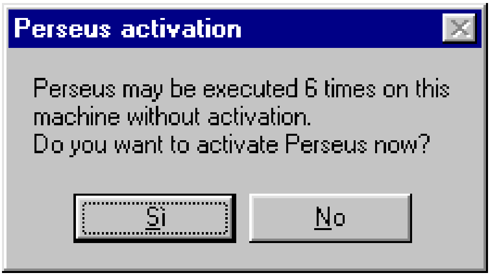


Fig. 3

Perseus informs you that it can be launched X more times (this number starts from 20 and decreases by one every time you run the program). If you click on "No" when prompted whether you want to want to activate your copy now, Perseus starts normally.

If you run Perseus twenty times without activate your installation, the program won't run anymore on that PC, even if you uninstall and install Perseus again. You will have to activate your installation.

When you decide to complete the activation and click on "Yes", Perseus asks:

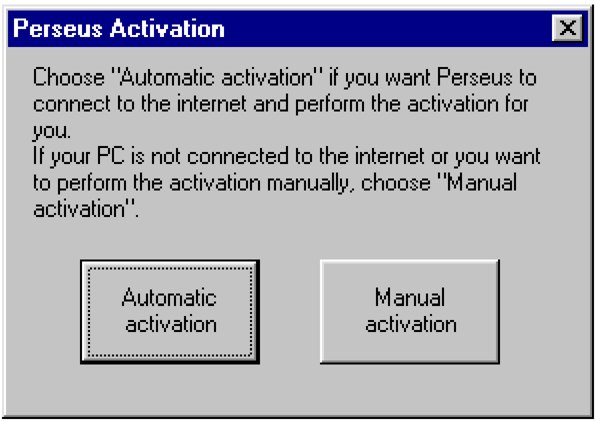


Fig. 4

If you choose "automatic activation", Perseus will ask you some data for our database. There is no obligation to insert any information – registering the software with your name is completely optional; if you don't want to insert your data, leave all fields blank and choose "Continue".

At this point Perseus tries to establish an Internet connection. If Perseus fails to do the connection automatically, try to connect your computer to the Internet as you do normally, and then minimize your browser and try again. If the connection is successful, the activation procedure is completed automatically and you can start using Perseus. Otherwise, the software reverts to the manual activation.

If you choose "manual activation", Perseus displays the window shown in figure 5.

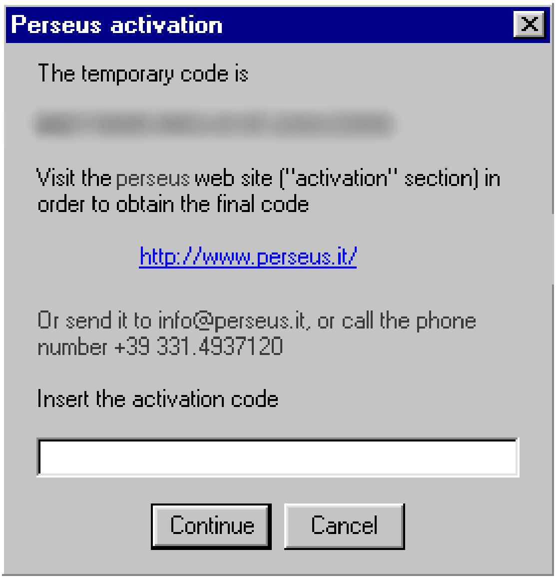


Fig. 5

Perseus presents a temporary code, and waits for the final code, which allows the program to run indefinitely on that computer. The temporary code identifies the installation of your copy on that particular computer. This means that two identical computers on which you installed the same copy of Perseus will display different temporary codes. Also if you install Perseus twice on the same machine, you'll get different temporary codes. The temporary code is made of 24 characters in groups of four, separated by dashes. Like the serial number, each character can be a number between 0 and 9 or a letter from A to F; the dashes are part of the code and the code is not case sensitive.

To obtain the final code visit *www.perseus.it* and find the activation page and enter your temporary code. To avoid typos you can cut and paste it from your web browser. You will then receive the final code. The final code consists of twenty-four characters separated by dashes into groups of four to facilitate reading. You can still cut and paste it from your web browser.

If you are registering from a computer other than the one on which you installed Perseus, you can write down the codes on a sheet of paper. In this case, you can obtain the temporary code by choosing the manual activation, then click "Cancel" to abort the activation procedure and continue to use Perseus (provided that you haven't run out of the twenty executions). Once you have the final code, choose again the manual activation and complete the procedure.

You can also send the temporary code to our technical support *info@perseus.it* in order to obtain the final code. If you don't have any mean of connecting to the Internet, you can obtain the final code by calling the phone number +39.331.49.37.120. The number is normally active from Monday to Friday from 16:00 to 18:00 CET (Central European Time) or CEST (Central European Summer Time). You may also send a SMS with the temporary code to the same number, and we will respond with the final code; in this case pay attention to insert the temporary code correctly.

The activation can be made anonymously. You haven't to give any personal data, only the temporary code.

The Perseus' website keeps track of how many times an original serial number has been registered and **will not release more than three final codes for each serial number**. In order to install your copy of Perseus on a fourth computer, you will have to uninstall one of the previous copies.

3.2 Uninstallation

To uninstall Perseus, click on Start... Programs... Perseus... Uninstall Perseus, or uninstall the application "Perseus" using Windows' control panel. The uninstaller will remove Perseus from the computer, and it will give you an *uninstallation code*. If you choose the automatic uninstallation, the uninstaller will send the uninstallation code to the Perseus' website.

If you don't have Internet access, choose the manual uninstallation to obtain the uninstallation code. You can send this code to us with the same methods used for the activation procedure.

After communicating the uninstallation code to us, you will have the right to make an additional activation of Perseus. **The uninstallation code is given only if the activation procedure has been completed**.

NOTE

When you uninstall Perseus, do not just delete Perseus' folder, but use the uninstallation program. In this way the uninstallation will be registered on the website and you will obtain an additional activation.

To summarize:

1. Each CD and manual contain a sticker with a serial number.
2. Enter the serial number the first time you run Perseus.
3. Choose whether you want to activate your copy or not. If you do, Perseus will give you the temporary code.
4. You can run Perseus twenty times before you have to activate it.
5. To obtain the final code, provide your temporary code to Perseus' website.
6. Once you enter the final code, Perseus will be fully functional on that computer.
7. You can install the same copy of Perseus on up to three different computers (you will have different temporary codes and different final codes each time).
8. Every time you uninstall a copy of Perseus you receive an uninstallation code that has to be inserted in the Perseus' website to obtain the right to make an additional activation.

WARNING

If you have to reinstall or change the operating system on your computer, or format your hard disk, the registration data might be lost. Please uninstall Perseus before reinstalling the operating system or changing the hard disk and provide your uninstallation code to the Perseus' website. After reinstalling the operating system on your computer you will be able to run Perseus' installation again without losing an activation.

If you lose an activation (because of a virus, or an hard disk crash, for example) contact the technical support writing to *info@perseus.it*.

4 Using Perseus

You can start Perseus by double-clicking with your mouse on the desktop icon, if you have installed it, or selecting:

– with Windows XP/Vista: Start → All Programs → Perseus → Perseus

– with Windows 95/98/ME/NT/2000: Start → Programs → Perseus → Perseus

When you run it, Perseus calculates the first "sky" and displays a splash screen listing some functions as they are executed and the program version number. In the same window you will find the exact version of the software. After startup, you find this screen.

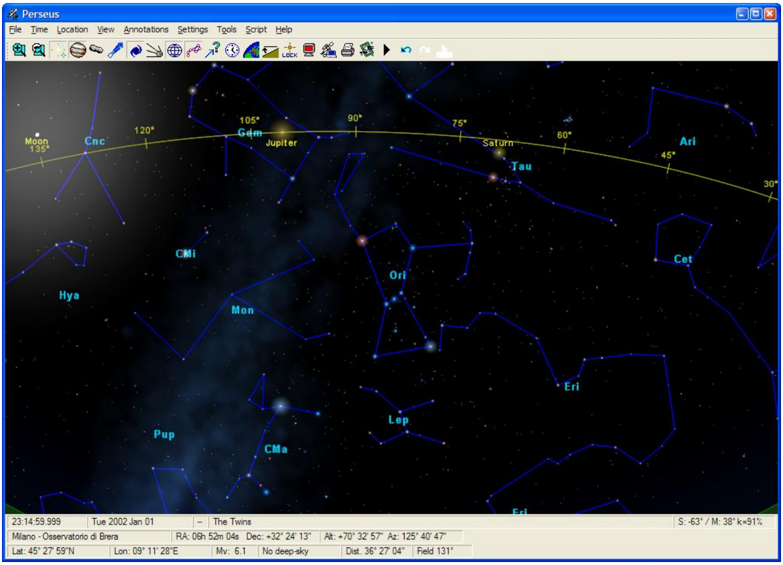


Fig. 6

After startup, this is the initial screen: the simulation places you in Milan, on January 1, 2002. You are looking about 45° over cardinal South; local time is 23:15:00. Your visual field is about 130° on the screen diagonal and you can see stars up to magnitude 6.1, i.e. almost all those observable by naked eye on a clear night, far from any light pollution. Orion is visible in the center of the visual field. Perseus displays lines and constellations names, and the ecliptic, represented by a yellow line, can be seen in the upper part of the screen. The Milky Way is also visible, together with the Moon and its halo, Jupiter and Saturn. On this scale the Moon doesn't appear as a disk, but as a large dot.

4.1 The main window

Perseus has a *status bar* in the lower part of the application window, which displays information about the status of the simulated sky, and a *toolbar*, which at startup is right underneath the menu bar. These buttons control Perseus' main functions. The rest of the screen is used to display the sky.

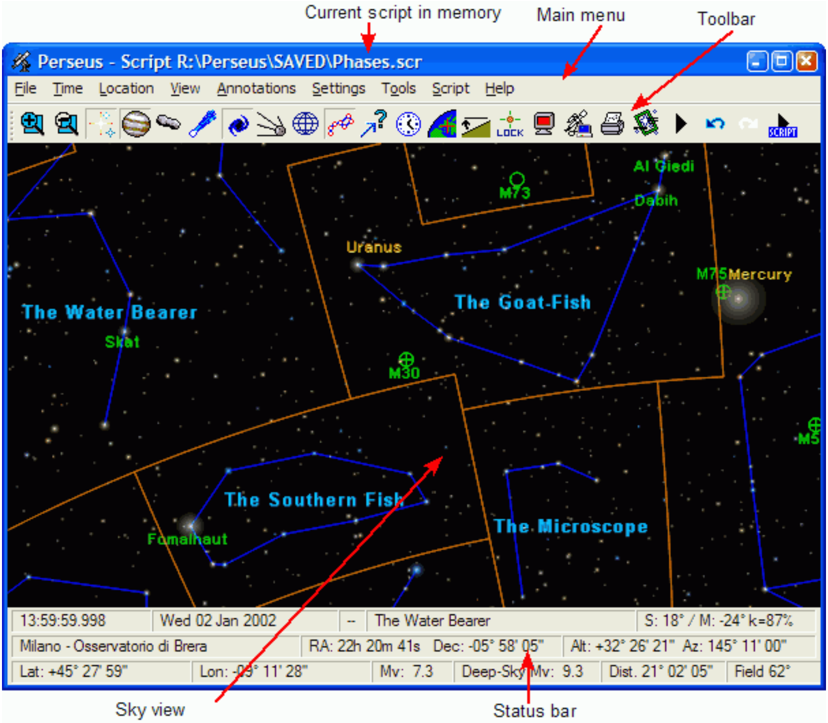


Fig. 7

4.2 Using the mouse

You can identify all objects present in the screen by left clicking on them. When you hover the mouse over an object recognized by Perseus, the pointer changes to a crosshair (figures 8 and 9).

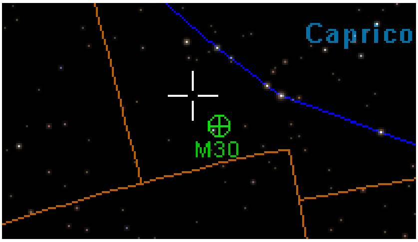


Fig. 8

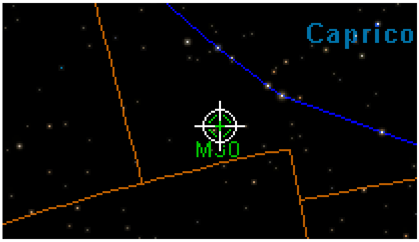


Fig. 9

If more objects are present but can't be distinguished because of the current zoom factor, a list will appear (see figure 10).

Fig. 10

Keeping the button pressed, choose the desired object with the mouse, then release the button.

Try left clicking on any bright star, for example Betelgeuse, the red star in the upper part of Orion; a window will pop up containing lots of information; we will describe it more in detail later. For now, just click on Close to return to the sky screen.

If you put the mouse cursor in a point of the sky and click the right button, the sky is recalculated with that point at center, without changing the other parameters.

If you keep the right button pressed, you can scroll around the sky.

If you press the left button where there are no objects, i.e. when the cursor is a simple cross (and not a crosshair), and drag the mouse keeping the button pressed, you can draw a rectangle that marks a zone that will be magnified as soon as you release the button. If your mouse has a middle button, you can use it to draw this rectangle even when the cursor is a crosshair. Perseus changes automatically the limiting magnitude of the stars so that the field of view is always filled in a pleasant way. You can change this automatic choice (see page 23).

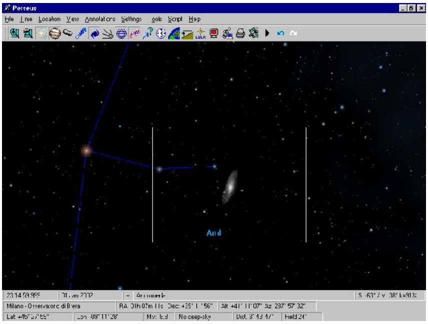


Fig. 11

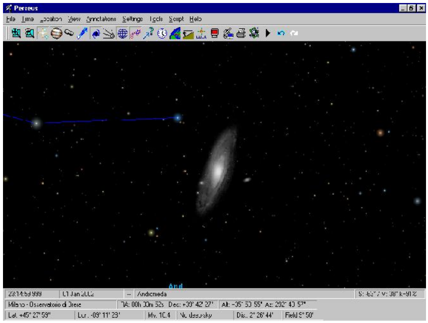


Fig. 12

The figures show the effect of the magnification. On the left (figure 11) the zone to enlarge is chosen, on the right (figure 12) the result. If you choose a rectangle with different proportions than the window, Perseus will put the center of the rectangle in the center of the window, and its diagonal as the new diagonal of the window.

Also the mouse wheel can be used to change the magnification.

In these conditions, hit [F11] to display the sky at full screen, maintaining the toolbar and the status bar. Hit [F11] again to hide the toolbar and the status bar, and again to return to the normal window. When Perseus is displayed in full screen, hit [Ctrl]+[F11] to toggle the mouse cursor on and off.

To return to the start situation press [F12]. This key loads the default situation, which after installation is the one described here. If you replace the default situation of the manual, you can still load it as the situation called "Example – Handbook Start".

You can use the keys [F4], [Ctrl]+[F4] and [F8] as an alternative to [F11], [Ctrl]+[F11] and [F12], respectively.

4.3 The status bar

In the status bar you will find information about your virtual sky. At startup, the first line displays, from left to right:

– The local time (hours, minutes, seconds, and fractions of second). Perseus uses the 24 hours system, the standard for astronomy.

– The current date and day of week. The day of week and the month are given in the three letters format. The date format (year-month-day, day-month-year, month-day-year) depends on the settings in the advanced configuration window.

- The next field just contains two dashes (--). When you run an animation, the letter "A" appears, and if the animation is a real-time animation, the letter "T" appears (see page 58).
- The long field on the right shows a short description of objects as you hover the mouse over them, or the name of the constellation on which the cursor is resting. For instance, when the cursor turns into a crosshair on Sirius, this field displays "Sirius Sp: A0 Mv -1.44". Perseus displays the name of each star (or the catalog code in which it is listed, like a SAO number), the spectral type and magnitude. The string "var" means that the star is a variable.
- The three digits in the rightmost field are the height of the Sun ("S") and the Moon ("M") over the horizon, expressed in degrees, and the illuminated fraction of the Moon disk ("k%"). At startup the Sun is 63° below the horizon, the Moon is 38° above it and 91% of its visible surface is illuminated (97% or more practically corresponds to a full Moon). The Moon appears at startup in the top left corner of the screen as a bright "star" with a halo. Please note that if the letter "k" is capitalized, the Moon is waxing. If it is not, our satellite is waning.

The second line displays (from left to right):

- The name of the current location.
- The current position of the cursor, expressed in right ascension (RA) and declination (Dec). As you move the mouse, both these values are updated.
- The altazimuth coordinates of the cursor, expressed in azimuth (Az) and altitude (Alt). As you move the mouse, both these values are updated.

The third line displays (from left to right):

- The current latitude.
- The current longitude.
- The limiting magnitude of displayed stars; at startup this value is 6.1.
- The limiting magnitude of deep-sky objects (at startup they are disabled, even though the Milky Way is displayed).
- The angular distance (in degrees, minutes of arc and arcseconds) between the cursor and the center of the screen. This value is updated as you move the mouse. Aim at an object (this will cause it to be displayed in the center of the screen), then hover the mouse over the second object: this field will show the relative angular distance. A different method to measure the angular distance between two objects using the information window will be described later (page 91).

– Your visual field, on the screen diagonal, expressed in degrees. At startup this value is about 130°, which is reasonably close to what you would see in reality. Even at the same magnification factor, this value changes slightly depending on the shape of Perseus' window and the screen resolution.

You can click on each of the Status Bar fields:

Click on this field...	to open this dialog window...
Date, time	Date and time settings (page 40)
"—"	Animation settings (page 58)
Short Description	Aim at object (page 39)
Sun and Moon height and k%	Night Duration Chart (page 71)
Place, latitude and longitude	Location (page 43)
Cursor equatorial coordinates	Aim at equatorial coordinates (page 39)
Cursor altazimuth coordinates	Aim at altazimuth coordinates (page 39)
Magnitude of displayed stars	Stars settings (page 23)
Magnitude of deep-sky objects	Deep-sky settings (page 34)
Field	Zoom settings (page 22)

These dialog windows will be described later.

4.4 Quick aiming

Let's see another fundamental function of Perseus, which can be used whenever a sky is displayed as at startup. If you press [Enter], the Quick aiming window appears, where you can enter the name of any object known to Perseus. The text field is case insensitive. You can enter the Latin names of stars, planets, and satellites, international codes, constellation names in Latin, designations by Flamsteed, Bayer or any other star and deep-sky object catalog. "Io", "JupitER", "M 34", "ngc4565", "beta cas", "61 cygni", "Sirius" are all valid entries. You can quick aim at an object by entering any of its designations; e.g. "M32", "Ngc 221", "PGC 2555", "UGC 452", "MGC 7-2-15", "ZWG 535.16", "IRAS 399+4035", "CGCG 536-16", "Arak 12" and "Arp 130" all refer to the same object. Don't blame Perseus if astronomers created so many different catalogs along the centuries… If a satellite is not visible in the current simulation conditions, Perseus will aim at the corresponding planet (e.g. if you aimed at Titan, Perseus will center the screen on Saturn).

Perseus remembers the last objects that have been entered in the quick aiming window. When you begin to type the name of an object, or when you click on the arrow on the right, or when you press the cursor key ↓, a list of these objects appears, containing only the objects whose names begin with the letters already entered. You can aim to one of these objects by selecting it with the keyboard or the mouse.

4.5 The buttons

The buttons toolbar can be undocked and dragged around, or can be docked at either side of the screen. Click (and hold) on the two small vertical bars on the leftmost side of the button toolbar to drag and move it.

Some of Perseus buttons perform different functions depending on whether you click them with the left or the right mouse button:

– If you right click on a multifunction button, a menu appears from which you can select an option with the left button.

– If you left click on a multifunction button, you toggle on and off all options currently activated in that button's menu.

Let's clarify this with an example.

The constellation figures and the international three-letter acronyms are visible at startup; these parameters are controlled by the "Constellations" button (figure 13).

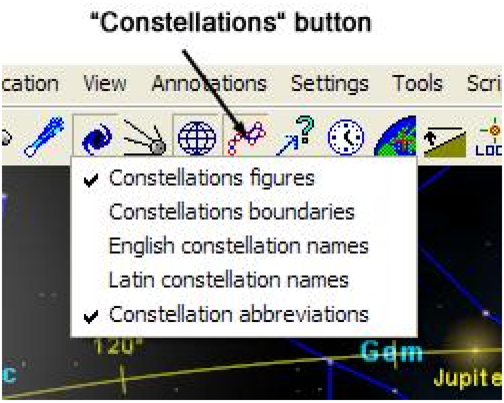


Fig. 13

If you left click on it you will see the constellation figures and the three-letter acronyms appear and disappear. Try a couple times, and then leave them on. If you right click on the same button, you will see the menu shown in figure following menu 13. The constellation figures and the three-letter acronyms are checked and displayed in the sky. Left click on "Constellations boundaries" to show the constellations boundaries. From now on, left clicking on the button will toggle on and off all three parameters (figures, acronyms, and boundaries). Given the high number of commands and functions, we chose this method to avoid filling Perseus' screen with too many hard to read buttons.

In the next chapter we will describe each button and its functions in detail.

5 Perseus' buttons

We will now describe Perseus' buttons individually, from left to right. At the end of each description, if necessary, you will find further explanations. Perseus includes several custom simulations that were specially created to highlight a certain functions. We recommend loading these simulations in order to get familiar with the different commands. If you try out all examples while reading this chapter, you will end up with a pretty good knowledge of Perseus' capabilities.

5.1  "Zoom In" button

Left clicking increases the zoom factor; every time you click the screen diagonal is reduced by approximately 1.5.

Right clicking lets you access the following commands:

Fine Zoom In: this works as left clicking, but increases the zoom factor by approximately 1.1 only.

Set Zoom factor: opens a window where you can input a custom zoom factor. You can also use the checkboxes to pick some other typical values, or use the vertical slider.

5.2  "Zoom Out" button

Left clicking decreases the zoom factor; every time you click the screen diagonal is increased by approximately 1.5.

Right clicking lets you access the following commands:

Fine Zoom Out: this works as left clicking, but decreases the zoom factor by approximately 1.1 only.

Set Zoom factor: is the same function that you find under the "Zoom In" button.

Please note: Perseus' zoom factor expresses the angle under which you are seeing the screen diagonal. This number can vary between 275° and 1" approximately. The exact limits depend on the screen resolution and on the size of the application window. At minimum zoom, if you resize Perseus' window to a square, you obtain a "fish-eye" visual, and if you aim at the zenith you can see the entire horizon circle. At maximum zoom Perseus yields an extremely high magnification, well beyond the capabilities of any telescope. Select File - Load Simulation from the menu bar and click on the "Example – Zoom" sample simulation. Your visual field is now apparently centered on Saturn. Click multiple times on the "Zoom In"  button, or hit [Z] several times on the keyboard, and you will see the magnification increase to the point where you can clearly see some details on Dione's surface (one of Saturn's satellites). You can decrease the magnification by clicking multiple times on the "Zoom Out"  button, or hitting [Shift]+[Z] several times on the keyboard. The complete list of keyboards shortcuts is given later on in this manual. In the same simulation, try reducing the zoom factor further and resizing the application window to a square: you will obtain a result similar to the one depicted in figure 14.

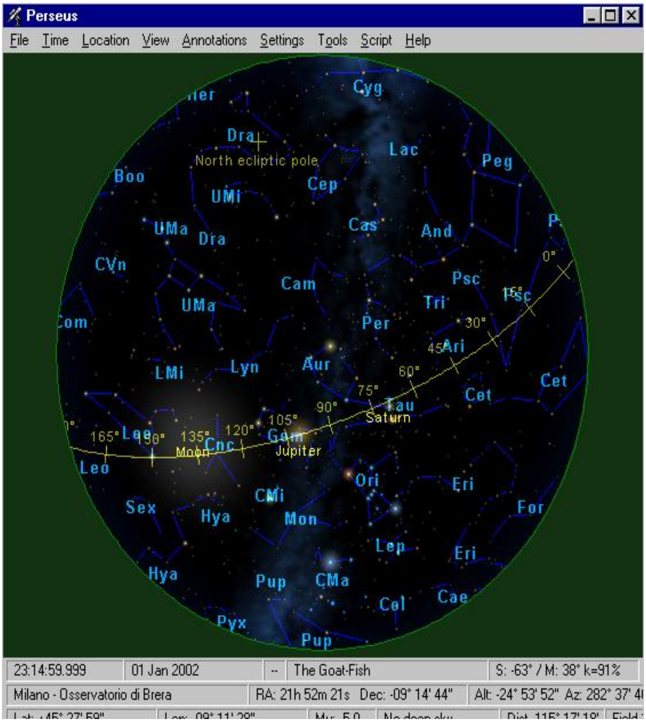


Fig. 14

5.3 "Stars" button

Left clicking toggles stars on and off.

Right clicking lets you access the following commands:

Increase stars: this command increases the maximum magnitude of the visualized stars by half a magnitude each time. Perseus automatically selects the maximum magnitude according to the zoom factor so that the number of stars in the current screen is kept to a reasonable level. You can vary this value by ±5 magnitudes or more (please see the explanations for the Settings command below).

Decrease stars: this command decreases the maximum magnitude of the visualized stars by half a magnitude each time.

Star Names: toggles on and off stars names; this only works if a star has a name associated with it. You can add or edit a star's name in the Information window, which we will describe later.

Bayer's letters: toggles on and off stars Bayer's letter; this only works if a star has a Bayer's letter associated with it.

Flamsteed's numbers: toggles on and off stars Flamsteed 's numbers; this only works if a star has a Flamsteed's number associated with it.

Use external catalog: this option is not available in Perseus level I copies. If this option is checked, Perseus attempts to retrieve data from the external catalog every time it has to display skies with high magnitude and magnification. Perseus will first search the Data folder, then the CD drive (and will prompt to insert the required disk).

Stars colors: When this option is active, Perseus displays stars in different colors, according to their spectral type (the color index B-V). Otherwise, all stars are white. This setting is useful when comparing to a black and white picture.

Search for guide star: This command was designed for people taking astronomical pictures. According to user-defined settings, it searches for stars closest to the center of the visual field. You can constrain the search by entering the maximum or minimum magnitude, or the maximum and minimum distances from the center of the field. Load the "Image of M27" sample simulation and try using this option; in the simulation you will also see a field boundary and a comment: we will see later how to create them. You will obtain different lists, depending on the settings you chose. The magnitude and distance parameters are selected accordingly to the driving method you are using (for instance, a CCD drive might not detect bright stars; or maybe you know that your off-axis drive allows you to aim at stars between 30 and 40 minutes of arc from your object, and so on).

Settings: clicking on this entry displays the "Stars Settings" window shown in figure 15, where you can find again some of the parameters we described earlier (show stars, stars names, Bayer's letters, Flamsteed's numbers, USNO Catalog). In this window you find the following controls as well:

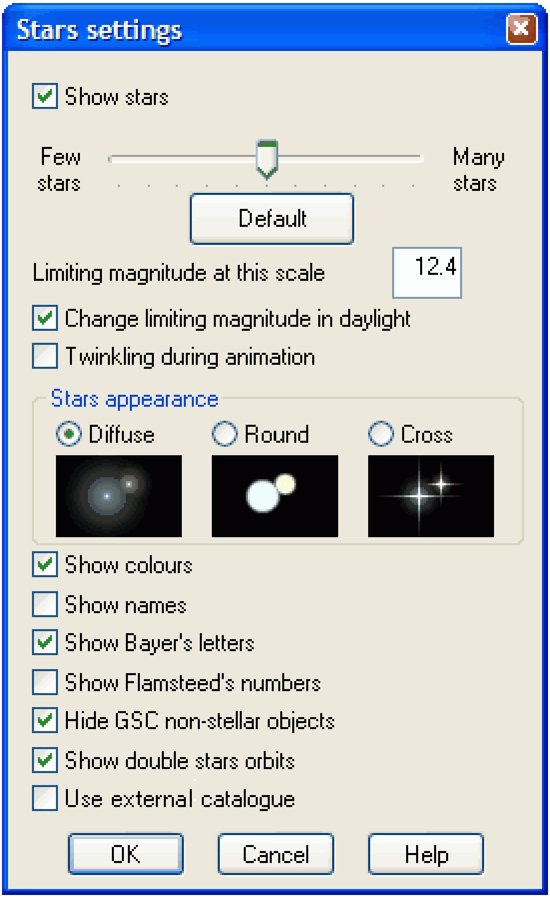


Fig. 15

The "Show stars" checkbox toggles stars on and off (it's not unusual to turn off stars, for instance when you want to see an animation involving planets and satellites).

The horizontal slider allows you to set the maximum magnitude of stars displayed in the simulation within ±5 magnitudes from Perseus' default value (to which you can revert by clicking on the "Default" button beneath the slider). If you prefer, you can type the desired value directly in the provided text field. Perseus warns you if you are about to display an unrealistic sky with too many stars, which would make the screen unreadable and would require a very long time to compute.

The "Change limiting magnitude in daylight" checkbox causes atmospheric events to influence the limiting magnitude (if these were enabled through the

 "Local conditions" button). If this option is unchecked, all stars are displayed, by day, even with a blue sky. Enabling this parameter obviously allows more realism.

"Twinkling during animations" simulates the corresponding atmospheric effect during an animation. This yields a very realistic effect if Perseus is running full screen on a high-resolution, fast computer.

"Stars appearance" You can choose among three different ways of representing stars: as shaded dots, flat circles, or crosses. You can choose the rendering method that better suits your personal taste and situation.

The checkboxes controlling the color of the stars, Bayer's letters, Flamsteed's numbers, and the external catalog have the same functions of the commands shown above.

The "Hide GSC non-stellar objects" checkbox excludes from Perseus' simulation all objects marked as non-stellar in the GSC catalog. This directory has been created through an automated method and contains thousands of "false stars", only a small number of which has been recognized as such (they are usually small, compact galaxies). We recommend you leave this option always active, unless you are comparing catalogs.

When the "Show double stars orbits" option is enabled, about hundred double stars with a known orbit are displayed with the primary star in the focal point of an ellipse, two mutually perpendicular axes representing the orientation of the major and minor axes (as) seen from the Earth, and the secondary star on the elliptical orbit. For some stars (like Sirius) Perseus shows the orbits of both stars around the common center of mass.

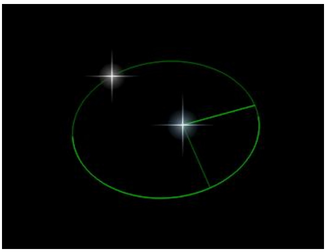


Fig. 16

Figure 16 shows ε_1 Lyrae; load the sample simulation called "Example – Epsilon 1 Lyrae" to recreate this image. If you lock on a double star and run an animation at high speed, you can see the two objects revolve about each other. Half of the ellipse is displayed with a lighter color: this is the side of the orbit that's closer to the Earth.

The USNO–A and UCAC–2 catalogs

The USNO–A and UCAC–2 catalogs can be downloaded from the Internet for free and are among the biggest star catalogs available today. The USNO–A2.0 catalog, for example, needs 11 CD–ROMs, or 2 DVD–ROMs, to fit about 528 million stars. Since they are made with automated systems from photographic plates, they are not very reliable for photometry, and also for supernovae or asteroid research, since they lack some stars and at the same time show some artifacts. Instead, they are very useful for astrometry. As a rule, the USNO–A2.0 catalog is almost complete up to magnitude 14, even though it includes millions of weaker stars.

When needed, Perseus tells you what disk and what file it needs. If you want to be always able to display the stars of a certain zone of the sky, even without the CDs from the catalog, you can copy the corresponding files in a folder of the PC and configure Perseus to find them (see the description of the "Advanced configuration" window at page 63).

Remember that level I copies of Perseus cannot visualize stars from the external catalog; therefore this command is not available.

The USNO–A and the UCAC–2 catalogs are not provided with Perseus. The institution that created these catalogs (the United States Naval Observatory) allows the free download from the Internet. You can obtain the USNO CDs from amateurs who already own them, but the disks must be sold at cost price. Or you can borrow them and make copies. This doesn't break USNO's distribution policy.

Perseus supports the USNO–A1.0, USNO–SA1.0, USNO–A2.0, USNO–SA2.0 and UCAC–2 catalogs. The USNO "SA" catalogs are versions that fit on a single CD and are not suitable for making charts, since they contain only a fraction of stars; they were created as astrometric references only.

5.4 "Planets" button

<u>Left clicking</u> toggles on and off planets and their satellites.

<u>Right clicking</u> lets you access the following commands:

Edge: Shows (or hides) the planet's edge, regardless of its phase. The edge also reflects the planet's polar flattening.

Coordinates grid: Shows (or hides) the coordinate grid on the planet surface. Longitude 0° was established by the International Astronomical Union.

Terminator: Shows (or hides) the terminator on the planet. This is the line that separates the illuminated hemisphere of a planet from the dark one. This might not always be visible. Only Mercury, Venus, and Mars show a phase visible from Earth - besides the Moon, of course.

Name: Shows (or hides) the names of planets and satellites.

Surface details names: Shows (or hides) the names of surface details on Mars and on the Moon.

Limit to stellar limiting magnitude: When enabled, this command prevents planets from being displayed if their magnitude is lower than the current limiting magnitude of stars. This magnitude obviously depends on the distance between the observer and the object. For instance, Jupiter's satellites are much more brilliant if seen from each other, or from Jupiter, than from Earth.

Inner (outer) planets orbits: Displays the approximate orbits of outer planets (up to Mars), or inner planets (from Jupiter on). These visualizations are truly spectacular when seen from outside the solar system. If you run an animation, you can see planets traveling on their orbits.

Note: commands affecting names, grids, and limiting magnitude apply both to planets as well as their satellites.

Load the simulation called "Example – Mars" and notice the phase (both the terminator and the planet edge are on). Try activating one by one the options we just described. When you enable the names, you will notice that one of Mars' satellites is also visible. If you zoom in, you will see that the grid coordinate, the terminator, and the edge are displayed as well. You will not be able to zoom in further because this satellite is very small. After all, you are observing from Earth - but with Perseus this is not a problem…

Now load the "Example – View from Mars" simulation file. You are now on the Red Planet. Zoom in on the Earth and you will see our planet's phase, and next to it the Moon in the same phase: like Venus and Mercury, Earth is an inner planet. If you zoom on Phobos (which you can see close to the center of the screen), you will see that it is almost completely hidden (turn planet edges on). Why? Look for its position with respect to the Sun and you will see that it is only 30° away from it…

Satellites orbits: shows the approximate orbits of the planets' satellites.

Earth umbra & penumbra: displays the Earth umbra and penumbra projected at the Moon distance. Use this option to show the limits of umbra and penumbra during the lunar eclipses.

Set Red Spot longitude: sets the longitude of the Jupiter Red Spot. Since the Red Spot longitude slowly changes in time in the Jupiter reference system, the above value should be regularly updated in order to correctly display the Red Spot.

Enlarge Moon – enlarge planets: when the Moon or the planets appear too small they are enlarged to a minimum size of 15 pixels on the screen so that you can recognize them immediately.

Zodiacal light: shows the zodiacal light as it would appear from a perfectly dark site.

Meteor showers: opens the Meteor showers window – see page 69.

5.5  "Asteroids" button

Left clicking toggles on and off asteroids. Please note: you first have to have created the list of asteroids you want to visualize. Please see below.

Right clicking lets you access the following commands:

Asteroid database: Due to the complex orbits of these lesser celestial bodies of the solar system (please see the note further on) and to their extremely high number (more than 400,000), managing asteroids is a complex task.

You will have a generic file listing the orbital data of all known asteroids for a given time frame. The file on the CD-ROM is updated to the epoch of the generation of the master CD. It is called ASTEROID.PSA, and is located in the MINOR folder on the CD. This file is not copied to the hard drive during installation, and is periodically updated on Perseus' website, from which you can download it for free. In order to have accurate position data, e.g., in March of 2008, you will need to have the updated general file, i.e. the ASTEROID.PSA, which will be available in 2008.

In addition to its own, Perseus can read general files in MPC (Minor Planet Center), ASTORB (Lowell Observatory), and arbitrary ASCII format. Both MPC and Lowell Observatory update their database rather frequently, and the data can be downloaded for free from the Internet.

Perseus creates an extended list by filtering the general file according to the parameters you defined in the window shown in figure 17. Please note that the following parameters refer to the current time in the simulation and thus do change with time: distance from observer, distance from Sun, apparent magnitude, right ascension, declination, and distance from screen center. The user will typically generate such a list for each planned night of observation.

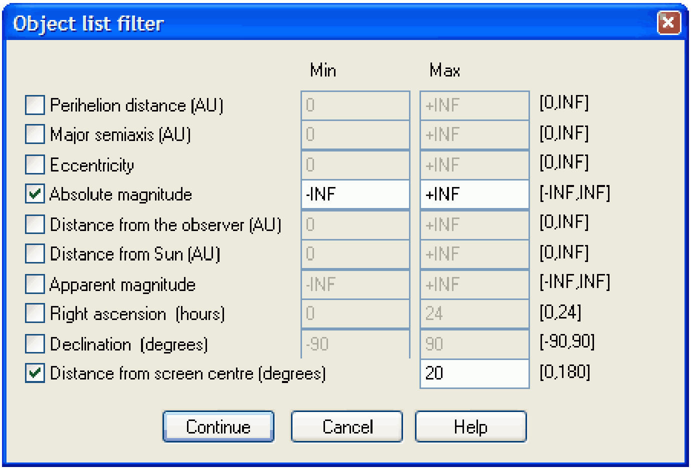


Fig. 17

Perseus uses this extensive list and its parameters in the Asteroids window to select which bodies to visualize. Four buttons (Add, Add all, Remove, and Remove all) are also available to assist you in this task. As an alternate option, you can generate the list of visible asteroids automatically starting from the general one by using the button labeled "Add to the list of visible asteroids with filter". We will clarify this further on with an example. We strongly discourage keeping more than 10,000 objects in the extended list (and thus in the list of visible asteroids). Perseus will warn you that the program might start running very slowly.

Finding an asteroid in a list

Since lists are in alphabetical order and can contain up to 20,000 entries, finding a certain asteroid might result rather difficult. Perseus has an "incremental search" algorithm implemented, which works as follows: by entering the name of an asteroid, or part of it, the focus in the list will jump to the first available asteroids whose name most closely matches the string you entered.

For instance, let's assume you want to add Ceres to the list of visible asteroids and the current list starts with "1992 QB1 (15760)". Highlight the first asteroid in the list, then type "ceres" on the keyboard (without the quotes, case insensitive); after you entered "C", the first asteroid in the list is selected with its name containing that letter, e.g. "1993 SC (15789)". After you hit "e", Perseus highlights the first asteroid whose name contains the string "ce" (e.g. "2000 CE 105"), and so on. By the time you entered the "r" and the second "e", Ceres should already be highlighted. You can now add it to the list of visible asteroids by clicking on the Add button. If you now want to add Vesta, you still have to go to the top of the list, highlight the first asteroid, then type "vesta". Please note: the asteroids names highlighted in each search depend on the list you are using. The names shown in the previous examples are just for illustration purpose.

You can enter directly data of objects of exceptional interest (e.g. NEO that were recently discovered and are not yet in the updated files). In the top right corner of the Asteroids window you can find four buttons: Add, Modify, Delete, and Save; in this order, they let you:

- add a new object;
- modify the data of the currently selected asteroid;
- remove from the list one or more selected asteroids;
- save the extended list.

You can decide how many lists to keep: an example could be the list of asteroids whose orbital data are updated to a given year, or the list of asteroids in a particular group, and so forth. We remind that in order to find the exact position of an asteroid on a given date you need a recent data file.

Limit to deep-sky limiting magnitude: When enabled, this command prevents asteroids from being displayed if their magnitude is lower than the current limiting magnitude of deep-sky objects. This option lets you exclude from the simulation all asteroids that are too dim to be seen with the tools you are currently using.

Show asteroids symbols: Toggles on and off the names and placeholders for asteroids (a small diamond with a cross on top). When this option is disabled, asteroids appear as small stars, without any particular feature - unless you identify them by left clicking on them.

To summarize:

1. Perseus reads a general file to access data for all asteroids. This file must be updated periodically, resides on the CD, and is not installed - this was done on purpose to remind you to update it. You can download smaller data files for minor asteroids (up to a certain magnitude) from Perseus' website.
2. You create the extended list by filtering the general file in the Asteroids window with the button labeled "Add to the list of visible asteroids with filter". Perseus will calculate the position of all asteroids satisfying the criteria you entered.
3. From the extended list Perseus creates the list of visible asteroids; this is done in the Filter window or by manually selecting the asteroids you want to appear in the simulation.

4. All elements in the list of visible asteroids are displayed, unless you enabled the Limit to deep-sky limiting magnitude option; in this case only those asteroids will appear that are brighter than the magnitude dictated by the current limiting magnitude of deep-sky objects.
5. Asteroids appear as small stars or as small diamonds with a cross on top, depending on the corresponding option being disabled or not.

Example:

This example illustrates how to use asteroids lists in Perseus. Let's assume we want to see all asteroids around M1 on the evening of the default simulation at startup (January 1st, 2002). To follow this procedure you need to have the original CD in your CD-ROM reader.

Load the sample simulation "Example – Asteroids around M1"; the nebula is clearly identified by its symbol.

Right click on the Asteroids button and select "Asteroid database". Under "Create list from file", click on "Perseus". Navigate to the MINOR folder on the CD, select the file ASTEROID.PSA, and click on Open.

Enable the checkbox labeled "Distance from screen center", and enter a value of 2°. While Perseus is reading the file, a status window appears with some scrolling numbers: the program is calculating the position of over 100,000 asteroids and is selecting those that are 2° or less from M1.

The completed list contains about a hundred objects; click on "Add all" to include them in the list of visible asteroids.

The resulting view is shown in figures 18-20 and will vary depending on your choices: displaying asteroids that are brighter than the magnitude of the current limiting magnitude of deep-sky objects, enabling or disabling the names.

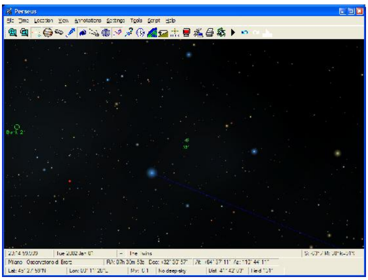


Fig. 18

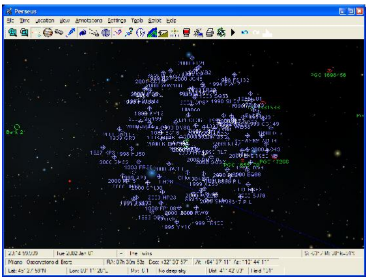


Fig. 19

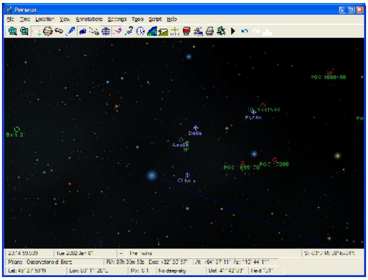


Fig. 20

An image of M1 without asteroids (figure 18), with all asteroids within 2° from the screen center (figure 19) and with asteroids within 2° AND brighter than magnitude 15 (figure 20). Compare the last two images and notice the high number of weak asteroids close to the ecliptic at any time (M1 is very close to the ecliptic).

If you were to run the same simulation for a different date, the procedure is the same but you need an updated data file.

NOTE

In order to obtain realistic results, the calculations to determine asteroids' positions must be based on a recent data file. Otherwise, predicting the location of an asteroid might become very difficult. Generally speaking, the orbital parameters of the most famous asteroids, like Ceres, Pallas, and Vesta, i.e. those on the principal band between Mars and Jupiter, vary very slowly in time and can therefore be calculated even with slightly outdated figures, specially if they are very bright. In this case it won't be too difficult finding them even if their position is off by some arcminutes. There are exceptions, though. Computations for asteroids that orbit close to planets (like NEOs, which pass close to Earth) can yield useless results if they are based on old data. The file that comes with Perseus becomes obsolete very soon and is practically useless after a couple years, but for some asteroids with a very stable orbit.

With these limitations, it is kind of dangerous using Perseus with a data file referring to a different age: if you want to calculate the position of Ceres when Giuseppe Piazzi discovered it in 1801, you will need data referring to 1801.

Data files for asteroids are frequently updated on Perseus' website *www.perseus.it*. Some files are also already filtered by magnitude, i.e. they contain only asteroids up to a given magnitude. Please visit the updates section of the website for more details.

5.6 "Comets" button

This button works similarly to the asteroids button, but it doesn't support importing data files in ASTORB format. Perseus can also simulate comets' tails orientation in space. Furthermore, there is the "RealDeep Comets" to simulate the tails.

Left clicking toggles on and off comets. Please note: you first have to have created the list of comets you want to visualize.

Right clicking lets you access the following commands:

Comet database: opens a window for managing the comet database.

Show comets symbols: displays both a name and a symbol for the comet (a small diamond).

Limit to deep-sky limiting magnitude: when enabled, this command prevents comets from being displayed if their magnitude is lower than the current limiting magnitude of deep-sky objects.

RealDeep Comets: this command simulates a comet's tail's direction and length. The tail is always oriented as to point away from the Sun, but its length can only be roughly estimated by means of the distance between the comet and the Sun, and the comet's magnitude parameters.

A data file with comet data is frequently updated on Perseus' website *www.perseus.it*. Please visit the updates section of the website for more details.

NOTE

The same considerations we made about asteroids hold for comets. Periodic comes (like Halley) must be considered as different bodies every time; and the orbits of comets that are visible for a long period (like Hale-Bopp) can be estimated more exactly if calculations are performed with orbital data calculated for different moments (e.g. once every 30 or 60 days). Comets travel often on unstable orbits and feel non-gravitational effects due to gas and dust emissions from the surface, which makes calculating their precise position extremely difficult. If you want to simulate comets' transits in the past, you will need to enter data manually.

5.7 "Deep-sky objects" button

Left clicking toggles on and off deep-sky objects and the Milky Way.

Right clicking lets you access the following commands:

Object Symbols: toggles on and off the symbols of deep-sky objects that are visible in the current simulation settings. Which deep-sky objects are displayed also depends on the parameters entered in the "Select Catalogs" and "Select Types" commands, which are described later on. Perseus uses standard international symbols; you can see them by selecting Settings... Show... Symbols' Key from the menu bar. Instead of being displayed with a symbol, the largest and brightest nebulae are represented by an outline. When their data are available, galaxies are shown with the correct shape and orientation.

RealDeep Images: toggles on and off the RealDeep images of the most relevant objects. Perseus is capable of displaying over 250 objects in detail, and can use a standard representation for many others. Load the "Example – RealDeep" sample simulation: it is a view centered on the great nebula of Orion. Turn on and off object symbols, RealDeep images, and so on. Displaying RealDeep objects can become very slow if they are read from CD (minimum installation). You can still copy the to your hard drive; please refer to the chapter "Installing and removing Perseus' components".

Increase Objects: increases by 0.5 the limiting magnitude of all displayed objects with respect to the default value chosen by the program according to the current zoom factor.

Decrease Objects: decreases by 0.5 the limiting magnitude of all displayed objects with respect to the default value chosen by the program according to the current zoom factor.

Milky Way: toggles on and off the Milky Way. Try using this command in the default startup simulation. The Milky Way in Perseus is created from an isophotes map taken in the optical band. You can modify the contrast of the Milky Way by changing its color. To do so, select Settings - Colors from the menu bar, highlight the Milky Way in the list and select a different color.

Show all dark nebulae: if this option is disabled, Perseus displays only the largest among all dark nebulae. Most dark nebulae can be seen only with instruments normally unavailable to amateurs. In addition to that, their high number clutters maps, specially in the region close to the center of the Milky Way.

Show clusters larger than 2°: if this option is enabled, all open clusters are displayed. Otherwise, giant clusters do not have a symbol associated, since they are plainly visible in the sky (e.g. Berenice's Hair, easily visible with the naked eye).

Show large objects: if this option is enabled, all objects larger than 6 pixels are shown in the sky, regardless of their magnitude. This selection is useful to display large objects for which magnitude is not defined, like for example in the case of Barnard's Loop nebula in Orion (Sh2-276).

Catalog numbers: displays the catalog number under each object. If only a number appears, the catalog is implicitly NGC. The numbers of objects on the IC catalog are preceded by an "I", all others by the applicable conventional code.

Object names: this option shows the name of an object (if there is one). You can add or modify objects' names in the information window, as described later on.

Select catalogs: when activated, this command allows you to select the objects you want to visualize according to the catalogs in which they are listed. For instance, you can display objects from Messier's catalog only, or exclude them all but MCG and PGC if you are dealing with weak galaxies, and so on. In the default simulation only Messier's objects are activated, even though deep-sky objects are turned off as a whole. If you enable the Object Symbols option, you will only see objects from the Messier catalog.

Select types: this parameter lets you select which objects to display according to their type (i.e. nebula, open cluster, globular cluster, and so on). Among the possible options, selections like asterisms, single stars, and star groups were implemented to include objects that were erroneously added to some catalogs.

Settings: displays the "Deep-sky Settings" window, which contains some of the commands we just described. There is also a horizontal slider to control the limiting magnitude of displayed objects within ±5 magnitudes from Perseus' default value (to which you can revert by clicking on the "Default" button beneath the slider). You can also type the desired value directly in the provided text field. The checkbox labeled "Show all unknown magnitude objects" forces all objects with undefined magnitude to be displayed, regardless of their size.

5.8 "Artificial Satellites" button

NOTE

Since the orbital data of artificial satellites are extremely variable, they **are not provided** with Perseus. Therefore it is impossible to show artificial satellites in Perseus without loading the orbital parameters.

Left clicking toggles on and off the visualization of artificial satellites. Perseus displays artificial satellites with the symbol + if they are currently illuminated by the Sun, and with the symbol -¦- if they are in Earth's shadow and are thus invisible.

Right clicking lets you access the option "Load TLE Elements", where you can enter artificial satellites data in standard TLE (Two Line Elements) format. You can find these data on the Internet. Usually they are valid only for a very short amount of time, since artificial satellites can use engines to maneuver. It is also rather difficult to account for atmospheric resistance in lower orbits. This is why Perseus cannot provide these data and you will have to download them directly from the Internet. Here are some of the many websites you can visit:

www.celestrak.com

www.io.com/~mmccants/tles/index.html

space-track.org (registration is required)

www.satobs.org/satintro.html

5.9  "Reference lines" button

Left clicking toggles on and off the reference lines and the screen center cross (if activated; see below).

Right clicking lets you access the following commands:

Show tick marks: toggles on and off the tick marks (and graduated scales) on the reference lines.

Celestial equator: toggles on and off the celestial equator.

Equatorial coordinates: toggles on and off the equatorial coordinates.

When the celestial equator and the equatorial coordinates are both active, the celestial equator is marked with a double line.

Meridian: toggles on and off the local meridian.

Altazimuth coordinates: toggles on and off the altazimuth coordinates. According to the most common conventions, used in computer-driven telescopes and GPS devices, azimuth is calculated starting from North (0°) towards East (90°) and increases clockwise until it reaches North again (360°).

Ecliptic: toggles on and off the ecliptic.

Ecliptic Coordinates: toggles on and off the ecliptic coordinates.

When the ecliptic and the ecliptic coordinates are both active, the ecliptic is marked with a double line.

Galactic Equator: toggles on and off the galactic equator, which coincides with the Milky Way plane in the sky.

Galactic coordinates: toggles on and off the galactic coordinates.

Screen center cross: toggles on and off the screen center cross, which shows the exact direction at which Perseus is aiming. When enabled, this cross is used as the starting point to calculate the angular distance displayed in the status bar.

Compass: displays or hides a compass in the upper left corner of the screen. This compass shows the cardinal points North, East, South, and West *with respect to the center of the visual field*. The compass is never displayed when equatorial coordinates are on.

Zenith direction: displays or hides the indication of Zenith as a small circle with a dot, or with an arrow if it is outside of the current visual field. The Zenith is never displayed when altazimuth coordinates are on.

Scale: toggles an angular scale in the top left corner of the display.

Screen polar coordinates: toggles the display of a polar coordinates grid with the pole at the center of the screen.

Screen rectangular coordinates: toggles the display of a rectangular coordinates grid centered on the screen.

Perseus sets the spacing between circles according to the current zoom factor. Numbers on the coordinate lines are placed so that they are always visible, if possible.

NOTE

Some reference lines are meaningful only when the observer is on Earth. Otherwise, they cannot be activated.

5.10  "Constellations" button

Left clicking toggles on and off constellations nametags, lines, and boundaries (if activated; see below).

Right clicking lets you access the following commands:

Constellations figures: toggles on and off the visualization of the lines joining the principal stars forming the traditional constellation figure.

Constellations boundaries: toggles on and off the boundaries of the 88 constellations in the sky. These boundaries were defined in 1930 by the International Astronomical Union.

English constellations Names: toggles on and off English constellations names. They are automatically deactivated when Latin names or abbreviations are enabled.

Latin Constellations Names: toggles on and off Latin constellations names. They are automatically deactivated when English names or abbreviations are enabled.

Constellations Abbreviations: toggles on and off the international three-letter acronyms set by the International Astronomical Union. They are automatically deactivated when English or Latin names are enabled.

NOTE

The names of some very large constellations appear in multiple locations.

5.11 "Aim at Object" button

Left clicking opens the window displayed in figure 21. The appearance of this window changes according to the object you wish to find, depending on the radio button you select on the left. After you click on OK Perseus will center that object in the screen.

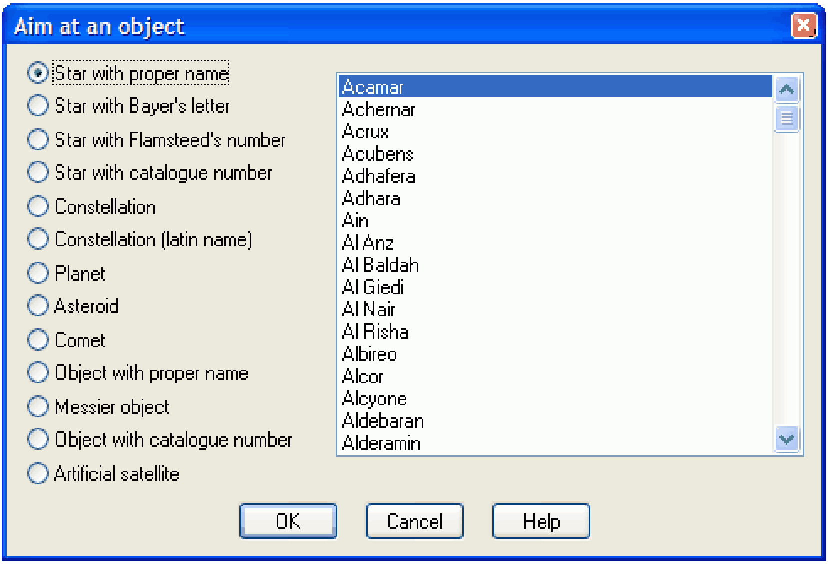


Fig. 21

Planets' natural satellites are listed beneath the planet itself, in the planets' list. Please be careful when aiming at objects listed in certain catalogs that do not list entries in a continuous way. The same precautions hold when using the Quick Aiming window, which appears when you hit [Enter] at any time while looking at the sky.

Right clicking lets you access the following commands:

Northern / Eastern / Southern / Western Horizon: Lets you look at the corresponding cardinal point and sets a very wide visual field. These options are useful when you want to get a quick glance at what is visible above the horizon in a given condition.

Aim at Equatorial Coordinates: Allows you to directly enter equatorial coordinates at which Perseus will aim. You can choose the reference system to use among "Equatorial J2000.0 (ICRS)", "Mean Equatorial" and "Apparent Equatorial". If you change the reference system after typing the coordinates, the coordinates will be converted to the new reference system.

Aim at Altazimuth Coordinates: Allows you to directly enter altazimuth coordinates at which Perseus will aim. Azimuth is calculated starting from North (0°) towards East (90°) and ranges from 0° (included) to 360° (excluded).

Quick Aiming: Opens the previously described window (see page 19).

5.12 Date/Time of Simulation" button

Left clicking opens the Date and Time window (see figure 22).

In this window you can set the simulation time. You can click on a field to edit it directly, or you can click on a value and use the up and down arrow buttons on the side to change the values. You can move from one field to the other by hitting the TAB key. You can set the simulation time as Julian day, local time, universal time, or dynamic time. If the option "Use system time zone data" is enabled, Perseus refers to your computer's settings to automatically adjust for daylight saving changes. If the option is disabled, the "Daylight saving time" checkbox becomes available. You can use UT1 instead of UTC, as well as set DeltaT manually. These parameters are to be used when reproducing events in remote epochs. This is because of the lack of a satisfactory model to simulate Earth's rotational deceleration, which is namely expressed by DeltaT. In the same window you find other buttons to switch directly to midnight, to the system time, and to the three standard epochs: J2000.0, B1950.0, and B1875.0. In normal conditions, we recommend using just the local time fields, that corresponds to the time shown by your watch. Perseus' website periodically publishes a file containing updated values of DeltaT (see on page 97).

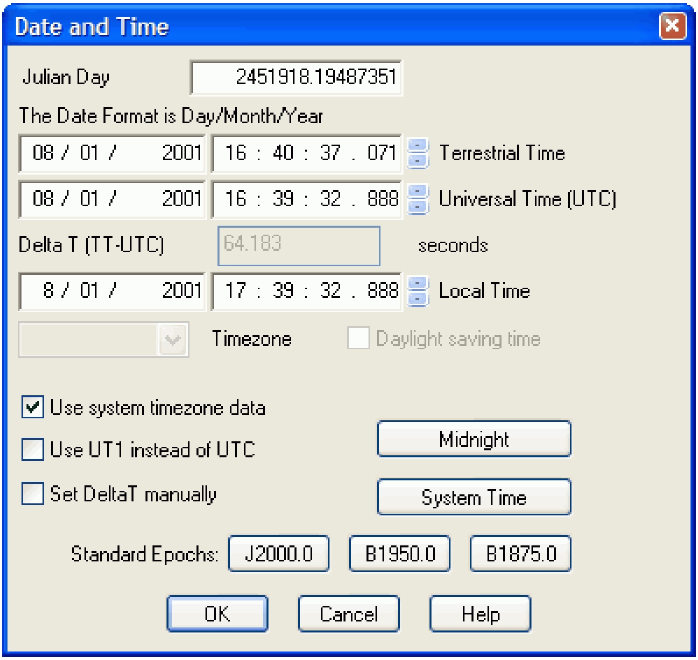


Fig. 22

The Date and Time window appears in simplified form (figure 23) when the option "Simplified Dialog Windows" is enabled in the File menu.

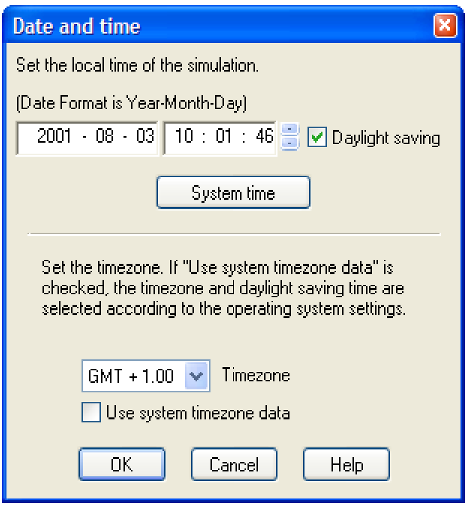


Fig. 23

In this case only have the date and time fields will be available, and you will be able to enable and disable the daylight savings checkbox. If you choose not to rely on the system settings to switch to daylight savings, you can enable the "Summer time" option manually and then select the time zone in which you are from the list.

The date can be displayed in three different formats, in which year, month, and day are shown in different orders. The default format is the one commonly used in Europe, i.e. day/month/year. This setting can be changed in the Advanced Configuration dialog window (page 63).

Time measurement

Time measurement in astronomy is a complex matter. The accuracy we can attain in predicting astronomical phenomena is strictly dependent on the accuracy of the time.

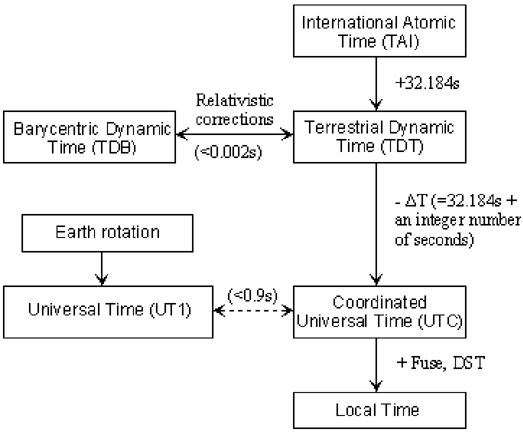


Fig. 24

Figure 24 shows graphically the relation between the different time scales. The International Atomic Time (TAI) is maintained by a network of atomic clocks, and it is the main reference. Terrestrial Dynamic Time (TDT), or simply Terrestrial Time (TT) is TAI plus 32.184 seconds and is equally uniform. By applying the relativistic corrections, we can obtain the time in the solar system's barycenter, the Barycentric Dynamical Time (TDB), which differs from TDT by no more than 0.002 seconds. Perseus doesn't consider the difference between TDB and TDT, since it is not relevant in the majority of observations.

The Universal Time (UT1) is a measure of the Earth's rotation, which is not uniform, so the UT1 is not an uniform time. The difference between TDT and UT1 is now (2008) slightly greater than 1 minute, and its variation is not entirely predictable.

To overcome the difficulties of the non-uniform UT1, Coordinated Universal Time (UTC) has been introduced. UTC is an uniform time scale, obtained by adding an integer number of seconds to TAI, called ΔT1. This number is modified always at the beginning of the year, or between June and July, keeping the difference between UTC and UT1 smaller than 0.9 seconds.

The ΔT is the difference between TDT and UTC, which is ΔT1+32.184s.

To obtain the local time, we add the timezone offset and the daylight saving time offset to UTC.

Right clicking lets you access the following command:

Make screen center rise/culminate/set: when you select Make screen center rise, Perseus shifts the simulation time to the instant in which the center of the screen rises (or will rise). At the same time, the program will center the point of the rise again. For instance, starting from the default simulation, turn on the Screen center cross using the "Reference Lines" button: right now, that point is slightly under the Orion's feet. By selecting the Make screen center rise command, you will see in the status bar that that point rose at 17:59. If an object is circumpolar or anti circumpolar (i.e. it does never rise or set), Perseus will display a notification message. The calculation takes into account atmospheric refraction, if it is enabled, and always refers to the ideal horizon.

NOTE

These commands might have an approximation of the order of a few seconds due to the finite screen resolution. Also, if a moving body (like the Moon) is in the center of the screen, Perseus ignores its proper motion in the time between the current simulation and the instant in which that body rises/culminates/sets. This might cause the object to appear slightly off the screen center. To obtain a precise estimate of the time, aim again at that object, and select the Make screen center rise (or culminate, or set) command again. This procedure can be simplified if you first "lock" the object to the center of the screen with the "Lock" button. Perseus will aim at the rising or setting that's closer in time; in some cases, this instant might belong to the previous or following day.

5.13 "Local Conditions" button

Left clicking opens the Location window, in which you can set the location of the current simulation. You can change the location from Earth to a different planet of the solar system, or in space. You can choose among some positions listed in Perseus' database, and you can create new ones.

By editing longitude, latitude, elevation, a new location is automatically created, and you can add it to the database by clicking on the "Add to database" button.

The database supplied with Perseus contains the biggest cities in the world, divided by nation. If you select a location in a timezone that is different from the current one, you will be asked if you want to change the timezone setting to match the location. If you answer "yes", check that the daylight saving time is correctly set with the Time → Change date and time window. The automatic setting of the DST is enabled only if "Use system timezone data" is selected and you move between locations in the same timezone.

The two checkboxes "Planetocentric view" and "Heliocentric view" allow you to directly place yourself in the center of a planet or the Sun.

To bring your observation point into space, you can use very high elevations from a planet (usually the Sun). In the Elevation field Perseus accepts the following suffixes: m, km, au, ly (meters, kilometers, astronomical units, and light years). Load the sample simulation "Example – Earth form North Pole". You'll be 200,000 km over the North Pole and Earth will appear to be in the Octant (which is logic, since the Octant contains the South Pole and you are above the North Pole).

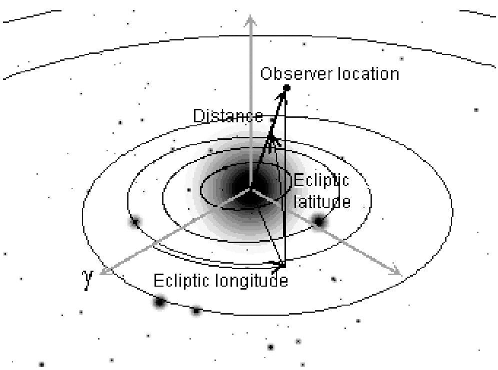


Fig. 25

The checkbox labeled "Absolute position" allows you to set a fixed observation position in space. When you enable it, the values in the latitude and longitude fields are converted into ecliptic coordinates. Load the sample simulation "Example – View of the solar System". You will be 100 astronomical units over the North Pole of the Ecliptic and you are looking over the Sun. Try zooming in and changing the date, but remember that the orbits of the planets are approximated, and therefore a planet might appear not to be on the proper path at high magnification. Stars were turned off for ease of representation.

Right clicking lets you access the following commands:

Horizon: shows or hides the local horizon line. The horizon might not appear to be actually horizontal depending on the current orientation, which you can set with the "Orientation" button. You can set the horizon to appear half-transparent by selecting Settings - Colors from the menu bar, scrolling down the list and highlighting Horizon, and then checking the checkbox labeled "Transparent horizon".

Azimuth on Horizon: toggles on and off the azimuth references along the horizon. Perseus sets the scale on this line according to the current zoom factor. The convention for the angles is the usual one: 0° for North, 90° for East, 180° for South, and 270° for West.

Cardinal Points: toggles on and off the cardinal points along the horizon.

Show landscape: toggles on and off the .PNG landscape (see the command below).

Modify horizon: opens a window (figure 26) where you can edit the horizon's appearance.

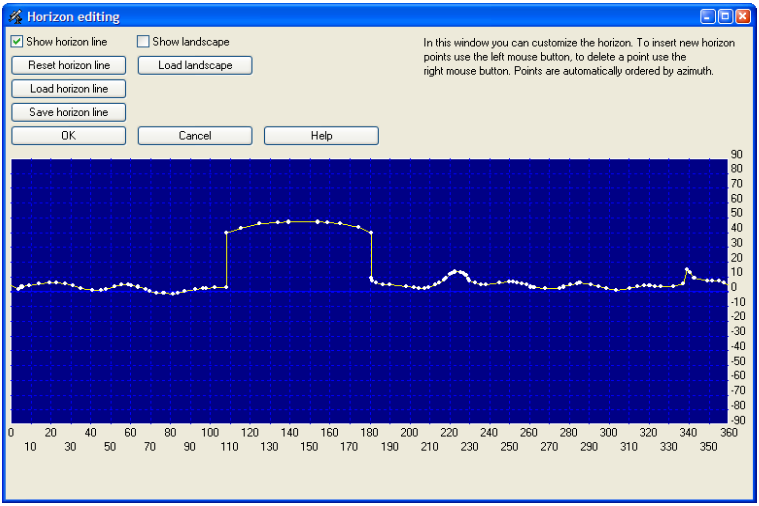


Fig. 26

With this window you can modify the horizon line and the landscape. The two checkboxes on the top toggle the visualization of the horizon line and of the landscape, respectively.

The horizon is defined as a series of points with different heights above the mathematical horizon (which is a plane perpendicular to the plumb line, the local vertical). You can add points by left clicking and remove them by right clicking on an exiting point. The points are ordered by increasing azimuth. The "Load horizon" and "Save horizon" allow you to load or save the horizon line to an external file.

This function is intended to give you the ability to reproduce a realistic horizon, as you would see in a real location. The visible horizon corresponds to the mathematical one only in the middle of the sea. If you are in the mountains, high peaks block the view of objects close to the mathematical horizon, and at the same time you are able to see a couple degrees below it if you are looking into a valley from a high place. Starting from the default simulation, click on the Load button and retrieve the file called "Example – Horizon with building", click on "OK", and then look around by using the right/left arrows on your keyboard. Your view is now similar to what you would see in reality if you were close to a building: there are mountains profiles and, between 110° and 180°, the silhouette of a building. The sky in this simulation might appear rather strange, but Perseus gives you here a sense of when an object truly becomes visible because the building does not hide it anymore. The functionality of the other buttons in the window is self-explanatory. If you click on the "Reset horizon" button you reset the current horizon to a flat line.

A landscape is an image in .PNG format that covers an area of 360° azimuth by 180° altitude. The image must have the origin oriented to the North, and the sky in the image must be transparent. Some example landscapes are supplied with Perseus, and you can find others on the Perseus' website or make them yourself. To load a landscape select "Load landscape" and activate it with the "Show landscape" checkbox. Additional details about making a landscape image are found on page 104.

Atmospheric Effects: Toggles on and off atmospheric effects i.e. dusk simulation, limiting magnitude reduction, halos, and so on. To achieve better realism, we recommend you keep this option always active. Load the sample simulation called "Example – Sunrise": the Sun is a few degrees below the horizon. If you uncheck the atmospheric effects option, you will immediately notice how much less realistic the simulation becomes. If you enable the option again and advance a couple minutes in time, you will see the sky change color. Disabling atmospheric effects increases Perseus' speed, but penalizes its realism.

Setup Refraction: Opens the dialog window where you can enter and edit the data Perseus uses to calculate refraction, i.e. local pressure, pressure at sea level, and temperature. You can tell Perseus not to perform the calculation by disabling the corresponding checkbox.

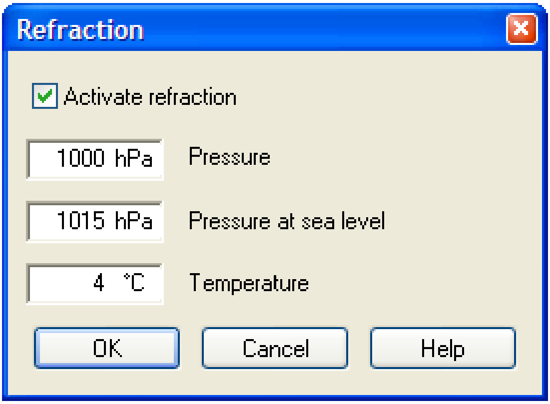


Fig. 27

Atmospheric refraction allows you to see stars that are slightly below the mathematical horizon and is also the cause of the apparent deformation of the Sun and the Moon when they are really close to the horizon. Because of refraction stars seem to rise a little earlier and set later with respect to calculated time. All these effects can be usually neglected during observation, because we typically do not aim at stars that are very low on the horizon, but in rare occasions. The color of the sky during the day is calculated and rendered accordingly to the pressure in order to simulate the darkening you can experience at higher altitudes. When you change the elevation in the location window, the pressure value is adjusted based on the sea level pressure.

5.14  "Orientation" button

Left clicking opens a window similar to the one you get when you right click.

Right clicking lets you access the following commands:

Align with horizon: if selected, this option will keep the local horizon parallel to the lower side of the screen. When the horizon happens to be passing through the center of the screen, it will appear as a straight line. This is the natural orientation when you look at the sky with naked eye or with a telescope mounted in altazimuth mode. If you observe in these conditions, it is like moving your head to the right and to the left, without tilting it to the side. Coherently with the laws of perspective, the horizon bends when you look at a point located at non-zero height. If you are anywhere else on Earth but at the poles, constellations seem to rotate as time passes: from Italy, for example, Orion seems to rise "lying down" and to set "standing".

Align with celestial equator: If selected, this option will keep the celestial equator parallel to the lower side of the screen. This will display the sky as you would see it through a telescope that is mounted on an equatorial mount, and is perfect to reproduce charts, as in this representation constellations do not seem to rotate as time passes. This mode is also the one used to track the motion of objects with respect to fixed stars. Astronomical charts follow this orientation.

Align with ecliptic: If selected, this option will keep the ecliptic parallel to the lower side of the screen. This orientation is useful when you wish to follow the motion of planets at high magnification. This will display the sky as you would see it if the axis your telescope was lying on the ecliptic plane.

Free orientation: If you select this option, there won't be any orientation at all. You will be able to look in any direction you like, as well as rotate your visual field. You can use this option when you are simulating a view from an arbitrary point in space where you don't have a body to refer to. You can rotate the visual field with the [Del] and [Ins] keys; hold down the [Ctrl] key to rotate in smaller increments.

Align with ICRS equator: This option allows you to switch to the ICRS reference (an inertial reference based on far quasars), which represents Earth orientation on J2000.0.

Align with galactic equator: This option allows you to switch to the ICRS reference (an inertial reference based on far quasars), which represents Earth orientation on J2000.0.

Swap left-right: Inverts left and right sides of the visual fields, as if you were looking through a prism. Using this option together with Free Orientation reproduces all orientations a telescope would offer in any situation.

Using the correct orientation is very important in order to run good animations; otherwise the results might be completely different. Load the sample simulation "Example – Rotation of Jupiter". Start the animation by clicking on the button . Jupiter will appear to be rotating about its axis, but its orientation will also change. If you wait, the sky will light up and then Jupiter will abruptly disappear beneath the horizon (the note "Object under the horizon" will appear in the lower left corner of the screen). This is correct, because since the simulation keeps the horizon horizontal, Jupiter does seem to tilt. If you let the animation run longer, you will notice that this oscillation has a period of about 24 hours, because Jupiter is in the same position once a day. While the animation is running, select now the option

"Align with ecliptic" from the orientation button , and when prompted whether you want to hide the horizon and atmospheric effects, click on "Yes". Jupiter will now rotate while keeping its equatorial bands practically parallel to the lower side of the screen. If you were to select the option "Align with celestial equator", the result will be similar but you will notice that Jupiter's bands are slightly inclined over the celestial equator.

Whenever you are selecting an orientation other than "Align with horizon", Perseus prompts whether you want to hide the horizon and atmospheric effects. You usually do so, but make sure that the event you are simulating and wish to observer later on is actually visible!

5.15 "Lock" button

Left clicking allows you to keep any object (star, planet, asteroid, satellite, and so on) locked to the center of the screen. After you locked it, that object will remain fixed at the center of the screen, independently of all other parameters in the simulation. If you click on the button again, the object will be unlocked. When the function is active, the icon on the button changes to .

Right clicking has no effect.

If an object is locked and you try to change the visual field with the mouse or the cursor arrows, the lock function is automatically deactivated. Perseus will however prompt before releasing the object. If you want to aim at a different object, this will be automatically blocked. During animations at high magnification an object might leave the visual field if it is not locked.

5.16 "Night Vision" button

Left clicking toggles on and off a visualization mode in shades of red only. It might take a couple seconds to switch from normal mode to this one or vice versa. Red light blinds less than any other light and is used in order not to lose adaptation to darkness when observing at night. The Color command in the Settings menu (page 69) has no effect on night vision.

Right clicking has no effect.

5.17 "Telescope Control" button

Left clicking opens a dialog window (figure 28) from which you can set up the connection with an electronically driven telescope connected to the serial port of your computer. Perseus can control directly the following models: Meade LX200 (not LX200 GPS), Meade Autostar, LX200 clones, and Celestron NexStar 5" and 8". Perseus also supports ASCOM drivers, which are included in the program CD or can be downloaded from the Internet – see the website www.ascom-standards.org for more details. These drivers allow you to control many electronically driven telescopes. Some manufacturers of astronomical equipment provide an ASCOM driver themselves.

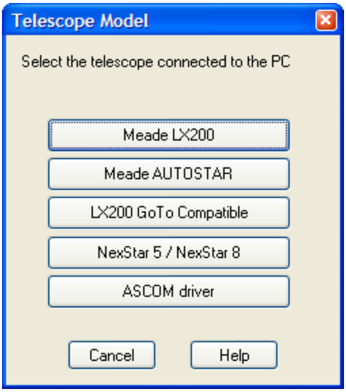


Fig. 28

If your telescope is not supported directly by Perseus, choose the "ASCOM driver" button. A window similar to figure 29 will appear.

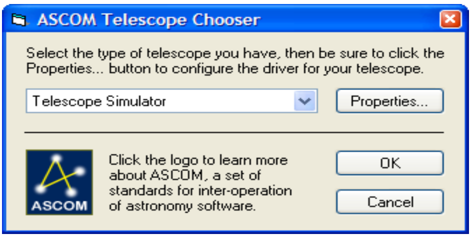


Fig. 29

In this window you have to select the telescope/mount driver to use and click on "Properties...". A new window will appear, allowing you to setup the driver accordingly to your system.

Please refer to the documentation available on the ASCOM website and on the Internet, or from the manufacturer of the driver. Also ASCOM drivers are frequently updated.

Also the telescopes directly supported by Perseus (like the LX200) can be controlled with an ASCOM driver.

Once you established a connection between your computer and the telescope, you can control the instrument from the PC. It is worth reminding that the telescope can be controlled successfully only if it has been setup correctly. In other words, you have to align the mount and the telescope as you would normally do, and then connect it to the computer. After the connection is made you can (at minimum) aim the telescope at the same spot currently aimed at by Perseus, or vice versa. Other functions can be available depending on the telescope and its driver. See page 95 for a more detailed description.

Right clicking has no effect with this button.

5.18  "Print" button

Left clicking allows you to print the current screen on the default system printer, using the default settings. You can change these settings from the Windows Control Panel or with the File... Print setup menu command. Perseus will print the current screen at the printer's resolution, which is much higher than that of the screen. The printout might take several minutes. You can customize the printout colors by selecting Settings... Colors from the menu bar (see page 69), and then clicking on the "Printer" radio button. Default settings are black and white, with green horizon (printed in gray with a B/W printer). Color printing is also supported.

The quality of the printouts is strictly dependent on your printer driver. The printer driver is a piece of software that allows your operating system (Windows) to communicate with the printer. The printer driver should have been installed when you installed your printer. If you cannot print anything at all from Perseus you are likely to have some problems with your printer driver.

Since all printers and printer drivers are different, we cannot give specific directions on how to solve problems, but here are some troubleshooting hints:

- If you get memory errors, increase the spooler size in the printer properties window.
- If possible, specify in the driver that you are printing files with complex graphics content.
- Update your printer driver to the latest version and make sure you are using the correct driver for your operating system. Usually you can download updated drivers from the manufacturer's website.
- If you cannot print directly from Perseus, you can print the current screen to file ("Create image file" command from the "File" menu) and then import it into any graphic program or into a word processor. This is also the best method to embed an image generated by Perseus in a text document.

If the quality of your printout is not satisfactory, you will have to change the printer driver settings (halftoning, screening, print density, and so on). There is no standard method to do this: it depends on your printer model. If you experience print problems, please try the solutions we described before contacting our customer support.

Note that if there is no system printer installed, the printing command has no effect.

Right clicking allows you to see a print preview according to the default printer settings. You can always change the default printer by selecting File... Print setup from the menu bar (see page 62); in the printer properties window you can also change the page orientation, the print quality, and so on.

5.19  "Annotations" button

Left clicking allows you to add a text note to the screen (see below).

Right clicking lets you access the following options:

Add text to the map: lets you add a text note to the screen; you can customize the font and the color, but the background of the note is always transparent. In the Text window you can decide whether you want the string to be fixed with respect to the map, the horizon, or the screen. Once you entered the note, left click where you want to place it. If a note is fixed with respect to the map, it will rise and set with the stars; if a note is fixed on the horizon, it will not move as time goes by, but it will do so if you change the direction in which you are looking. Notes fixed to the screen will never move. You will find some of these notes Perseus' sample simulations.

Add Eyepiece/Camera/CCD Field: this function is very interesting for those who want to take images of the sky. When you select this option, a window (figure 30) appears presenting on the left a list of telescopes, which you can customize with your instruments clicking on the "Add to database" button. On the right side there is a list of eyepieces, CCDs and films, which is also customizable.

Select the telescope/camera or CCD you are using, and whether you want the field of view to be fixed with respect to the map, the horizon, or the screen. A field of view fixed with respect to the map will remain always in the same position in the sky. A field of view fixed with respect to the horizon will be tied to the local horizon, and if you change the local time you will see the stars and objects moving inside it. This option is useful if you are planning an exposure with a fixed camera, like star trails or an eclipse sequence. A field of view fixed with respect to the screen will stay in the same position in the Perseus window, except for zooming in and out which will change the apparent size of the field; it can be used as a maker of the field of view of an eyepiece or camera, leaving it active while looking at the various objects.

Pressing OK, Perseus displays the corresponding visual field; this will be rectangular if you selected a CCD/film, or circular if you chose an eyepiece. The field of view can be rotated (if it is not round) with the [Page↑] and [Page↓] keys. Hold down the [Ctrl] key to rotate in smaller increments, and place by clicking with the left mouse button. When they are created, rectangular visual fields are aligned with celestial meridians and parallels: they coincide with what you would see in a telescope that is mounted equatorially.

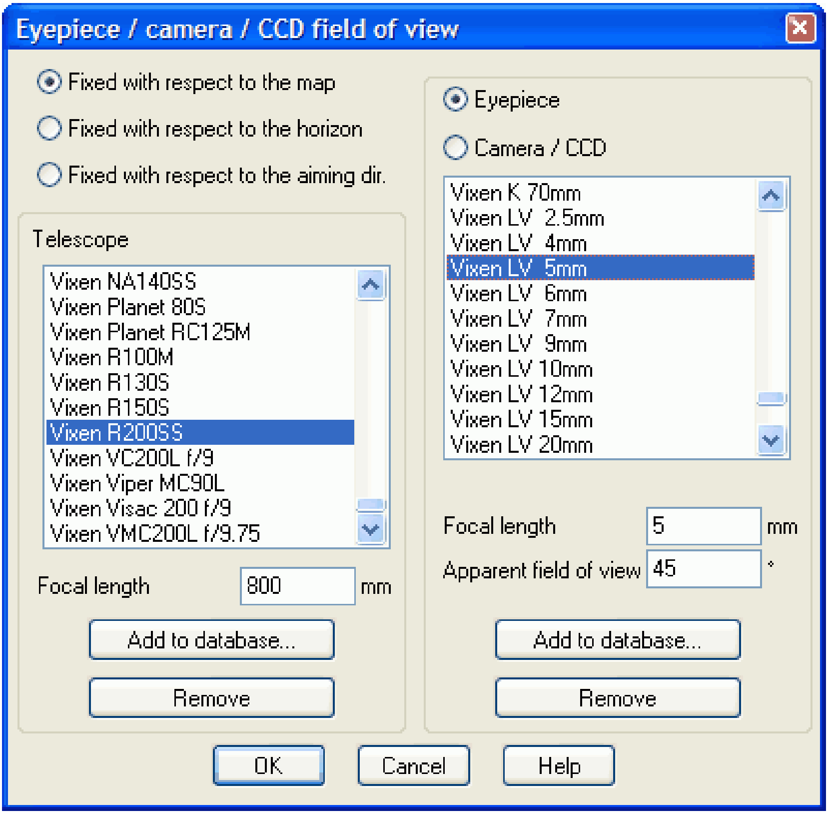


Fig. 30

Please note that when you add a telescope to the database the only relevant parameter used to determine the size of the available visual field is the focal length. Optical scheme, aperture, and focal ratio don't influence the result.

Due to the same reason, size (expressed in millimeters) is the critical factor for CCDs, while focal length and apparent field are for an eyepiece. Perseus will prompt you to enter a name for each telescope, CCD, or eyepiece, so that the list can be sorted easily and the installer will populate it with some sample telescopes, CCDs, and eyepieces.

Track Object: this command tracks an object by joining its different positions in time with a line. When you click on this button, a window appears prompting you to click on the object you wish to track; after that, the Track Parameters window appears (see figure 31).

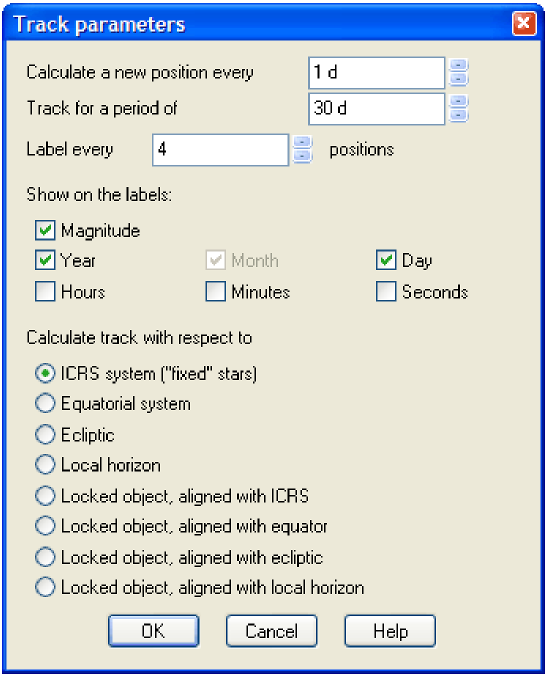


Fig. 31

Here you must enter the tracking step (i.e. the time interval you want Perseus to use between two positions), the tracking period (i.e. for how long you want to track the desired object), and how often to display a label; if you enter "0" in this last field, no labels will be displayed. Labels can include different parameters, which you have to choose according to the object's speed and the frequency of labeling you chose previously. Perseus will check for valid entries: for example, it will automatically enable the Minutes checkbox if you chose to display hours and seconds. In the lower part of this window you can specify the tracking reference; you can choose among the

ICRS and the equatorial system, the Ecliptic and the local horizon. If you locked an object (see the description of the "Lock"  button on page 49), you have four more selections: the previous four become orientations, and the locked body becomes the reference. Please note that when you select a different orientation with respect to the current one, the new orientation instantly applies to the simulation, as if you had selected it through the "Orientation"  button. Load the "Example – Track of Mars" sample simulation to see this functionality at work. Here we tracked Mars for 160 days starting from 2003 May 5 with respect to the equatorial system; this is the usual method of tracking moving objects in the solar System with respect to the stars. You can back track by entering a negative tracking step. The period of time for which you want Perseus to track an object must always be positive.

A little practice is useful to learn to use this function correctly, since it can easily yield results that differ from your expectations – maybe because figures on books are rarely drawn to scale. Load the sample simulation "Example – Track of Saturn – beginning", and track Saturn's motion with respect to the horizon every 30 minutes for 4 hours. You will obtain something similar to what you see in the sample situation "Example – Track of Saturn 1", i.e. the path followed by the planet that day when it is about to set. If you change the simulation current time in one-hour increments, Saturn follows the track.

Notice that this line seems to imply that Saturn will intersect the Ecliptic, but this is not true! The Ecliptic itself "moves" with time. Try setting up the simulation in 15-30 minutes intervals and see the result.

If you track Saturn's motion with respect to the fixed stars (equatorial system) for a couple years, the outcome is different. First Perseus changes the orientation of the horizon, and then it erases the previous track. Tracks created with different orientations cannot be displayed at the same time on the screen. You can find the result of this in the sample simulation "Example – Track of Saturn 2".

In order to learn how to use this command, nothing is as useful as trying. If you do not obtain what you were expecting, these are the most common causes:

1. Wrong temporal or spatial scale. You should estimate in advance how much the object will move in the time you will track it. Pluto's motion in the span of a day can only be appreciated at very high magnification. At the same zoom factor, Mercury will quickly disappear from the screen.

2. Wrong reference with respect to the moving body. If you choose to track a locked planet and set the motion reference to be the planet itself, you will obtain no track - the planet is obviously fixed with respect to itself.
3. Wrong reference frame. To recognize diurnal motions during a period of time of the order of hours, the correct reference is usually the horizon. Otherwise, the most used reference will be the equatorial system.

Let's see another example. We want to follow Sirius' motion during a time interval of several years. We also know this stars has a conspicuous proper motion (well over 1" per year, according to Perseus itself), and its companion star makes its motion rather wavy. Starting from the default sky, follow these steps:

1. Center Sirius by clicking on the "Aim at object"  button, then select Sirius from the list.
2. Zoom in with the [Z] key until your visual field is about 2'. You will now be able to see Sirius' companion star, and the two stars' orbit about the common center of mass.
3. Track Sirius A once a month for 50 years (this may take several seconds on a slow PC), setting the reference to the ICRS system. Label the tracks every 12 points (i.e. every year).
4. What a mess! You can find the same result in the sample simulation called "Example – Track of Sirius – wrong".

What happened? Since we set up this simulation from Earth, no matter whether from its center or surface, those ellipses are given by Sirius' light's aberration caused by its orbiting around the Sun. Their amplitude of about 20" is much larger than the star's proper motion and hides therefore the desired effect.

Delete the track: right clicking on the "Annotations"  button and select the "Delete all annotations" option. Aim at Sirius once again and track it again over 100 years, calculating a new position once a year. You will have to type "100y" directly in the text field, as Perseus' default values do not go beyond 50 years. Label the trajectory with the year value once every 10 years. The result is now much better. You can change the zoom factor, or vary the orientation slightly to better appreciate the result. If you track once a year, the light aberration is always the same and you are actually able to observe Sirius' proper motion.

In order to avoid light aberration completely, the correct tracking should be performed from the Sun. Try setting up this situation by moving the observation point to the Sun with the "Local Conditions" button, and enabling the Heliocentric View option. If you prefer, you can load the sample situation "Example – Track of Sirius – correct". In the sample simulation "Example – Track of Sirius A and B" we tracked both stars. When describing animations, we will use this simulation again.

Another example of use of this function are Moon occultations:

1. Load the default simulation and set the time two hours ahead by pressing twice on the [+] key on the numeric keypad.
2. Aim at the Moon ("Aim at object"  button → Planet → Moon).
3. Zoom in with [Z] until the visual field is about 2°. If you want, you can turn off the surface details names by right clicking on the "Planets" button and deselecting the Surface details names option.
4. It seems like the Moon will end up covering SAO 98510; you can find this star with the "Aim at object" button (or just type [Enter], SAO 98510 and than [Enter] again).
5. Track the Moon every 10 minutes for 2 hours, set its trajectory to be labeled every 3 positions (30 minutes), display hours and minutes, and set the reference to the equatorial system. Clearly, it seems like the Moon will hide the star. Notice how the orientation of the simulation changed: since we chose the equatorial reference, the image is now rotated with respect to the previous one, where the horizon was the reference.
6. We can track the star with respect to the Moon. Lock the Moon with the "Lock" button; this will erase the previous track due to the change of reference system: now the Moon will be kept in the center of the screen. Track SAO 98510 imposing the same tracking parameters you used before. Notice that Perseus will have automatically set the reference to "Locked object, align with equator"; change this to "Locked object, aligned with ICRS".
7. You now have the correct reconstruction of this occultation, as well as the entry and exit times. The same result is saved in the sample simulation "Example – Occultation of a star".

Move field of view: this option displays a list of the visual fields you created with the "Add Eyepiece/Camera/CCD Field" command, together with their dimensions and the name of the constellation in which their center is located. After you selected the desired field, you can change its position by moving it with the mouse. You can rotate the field (if it is not round) with the [Page↑]

and [Page↓] keys. Hold down the [Ctrl] key to rotate it in smaller increments, and place it by clicking with the left mouse button.

Delete Annotation: lets you remove tracks, visual fields, and annotations from the current simulation. Simply select from the list the item you wish to remove.

Delete All Annotations: this command is similar to the previous one, but it will remove all the items you added from the current simulation. Perseus will prompt you for confirmation before performing this action.

Delete all object marks: this command deletes all the object marks. To mark an object, see the object information window (page 91).

Load fields of view: this command loads a set of fields of view from a file (with extension .PFOV). As an example, you will find in the SAVED folder the file named "TELRAD.PFOV" with contains the field of view of a Telrad finder.

Save fields of view: this command saves a set of fields of view to a file. Use it together with the load fields of view command to save and recall quickly the fields of view corresponding to your observing instruments.

5.20  "Animation Controls" button

Left clicking starts or stops (the button changes to ) the animation according to its current settings. When an animation is running, the button changes to .

Right clicking lets you access the following options:

Start [Stop] animation at xxx/s: starts or stops the animation. The animation parameter xxx shows how much time passes in the simulation for each second of real time: e.g. if that value is 1 min/s, for each second of real time a minute will pass in the simulation. This setting expresses how much the simulation time is accelerated (or slowed down, even though this option is rarely used) with respect to real time. See the description of the "Setup Animation" command below for more details.

Speed up to xxx/s: changes the animation parameter to the next value suggested by Perseus.

Slow down to xxx/s: has the opposite effect of the previous command.

Invert: inverts time in the animation. E.g., if the current animation parameter is set to 5 min/s, it will be changed to -5 min/s. This option is useful when you wish to observe a phenomenon many times, e.g. a star's exit from occultation.

Setup Animation: allows you to set up the animation with the Animation Controls window (figure 32). Perseus has two different animation modes, called "fixed step" and "movie". In "fixed step" mode the simulation time is incremented by a fixed amount for each frame; you can specify this amount in the first text field. The pause between frames is entered in the second text field. For example, if you set up a fixed step of 4 hours and a pause of 10 seconds between frames, the screen will be updated every 10 seconds and the simulation time will increase by 4 hours every time.

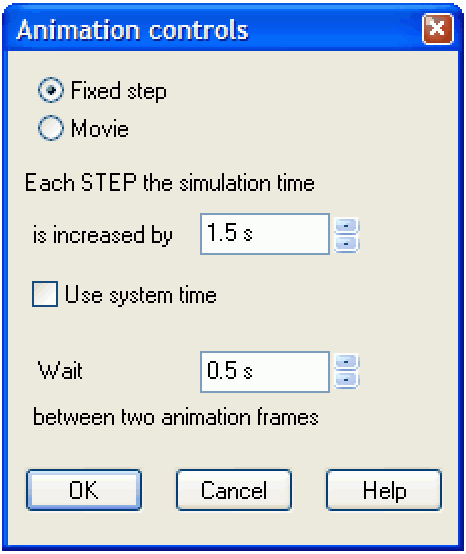


Fig. 32

In "movie" mode the simulation time changes so as to obtain a user defined animation speed, while frames are calculated at the maximum possible speed. This makes the animation speed independent from the computer's calculation power. A more powerful PC will display a smoother animation, and reducing Perseus' window size will also increase the simulation speed. For example, if you set the animation parameter to 1 day/s, and your computer can calculate 8 frames per second, the simulation time will increase by 3 hours per frame since there are 24 hours in a day. If you enter the same settings into a computer that can calculate 12 frames per second, the simulation time will increase by 2 hours per frame, which will yield a smoother animation. For a slower computer that takes 2 seconds to calculate a frame, there will be 2 days in simulation time between frames. The only parameter that remains fixed is the user defined animation speed, in our example 1 day per second. The "fixed step" animation mode is useful when you want to simulate a periodical phenomenon: to see the Sun's position at midday changing during an entire year, you would set up a 1-day step.

When you set up the animation parameters, you can choose among those suggested by Perseus or you can enter customizes values directly in the text fields. Perseus recognizes the following suffixes: **s**, **sec**, **m**, **min**, **h**, **hour**, **d** (for day), **month**, **y (**for year). You can enter an animation parameter of 29.54 days by typing "29.54 d".

If you enable the "Use system time" checkbox, the simulation time will coincide with the PC internal clock for every frame: this will basically yield real time animations.

Forward xxx: even if an animation is not currently running, this command allows you to advance by one step and is helpful in order to find manually the parameters you need to eventually set up an animation.

Backward xxx: this command is exactly as the previous one, except for the fact that time runs in the opposite direction.

Here is a list of the keyboard shortcuts you can use to control animations, even when the simulation is not being animated.

Keyboard shortcut	Effect on simulation time
[+] on the numeric keypad	Forward 1 hour
[−] on the numeric keypad	Backward 1 hour
[*] on the numeric keypad	Forward 1 day
[/] on the numeric keypad	Backward 1 day
[T	Forward one animation step
[Alt]+[T]	Forward 10 animation steps
[Ctrl]+[T]	Forward 1/10 of an animation step
[Shift]+[T]	Backward one animation step
[Shift]+[Alt]+[T]	Backward 10 animation steps
[Shift]+[Ctrl]+[T]	Backward 1/10 of an animation step
[Ctrl]+[+] on the numeric keypad	Increase the animation step
[Ctrl]+[−] on the numeric keypad	Reduce the animation step
[Ctrl]+[I]	Invert the animation step

Choosing the reference system ("Orientation" button) and the animation speed is very important in order to meet the expected results when making animations. Here are some examples.

Load the sample simulation "Example – Rotation of Jupiter" and start the animation. Set the orientation to the equatorial system and change the animation speed. Try using both the fixed step and movie modes (in fixed step mode you can also enter no wait time between frames). If you set up movie mode to run at 30 days per second, Jupiter will seem to rotate chaotically, but also become larger and smaller. This happens because in a month the distance between Jupiter and Earth changes considerably, and hence the planet's apparent diameter seems to change.

Load the sample simulation "Example – Track of Sirius A and B", and run an animation in movie mode in 2 years/second increments. Both stars will revolve about each other while moving on the pre-marked tracks.

You can now animate the sample simulation "Star Occultation"; set the animation speed to 5 minutes per second. Try locking the Moon, the reload the simulation and run the animation after locking the star (Perseus will remove the star track because the reference changed). What happens if you do not lock any of the two?

5.21 "Undo" and "Redo" buttons.

Left clicking cancels or repeats the last commands you issued. It might take Perseus some time to restore complicated simulations. You can undo and redo up to 100 actions.

Right clicking has no effect.

5.22 "Script" button (only with Perseus level III)

Left clicking starts or stops the execution of the script in memory.

Right clicking lets you access the "**execute from slide**" command which shows a window where you can choose a slide to start the execution from. If the script is already running the command becomes "**jump to slide**". See the description of the "Script" menu (page 75) for details.

6 Perseus' menus

Menu items are activated by clicking on them or by hitting the [Alt] key and then the underscored letter (e.g. [Alt]+[F] to open the File menu). Perseus' menus let you access all previously described commands as well as some others that can be accessed via menu only. For commands accessible also with buttons, see the description in the previous chapter.

6.1 File menu

The "**Load simulation**" and "**Save simulation**" commands allow you to save a simulation to a file and load a simulation from the same file later on. Simulation files have the ".PSIT" extension and by default appear in the "SAVED" folder. If a simulation is very complex, Perseus might take some time to retrieve it, especially if your computer is slow.

You can use at any time the combination of the [Ctrl] key with any number ([0] to [9]) to quickly save the current simulation. Then you can reload the saved simulation by hitting the corresponding number ([0] to [9]) without [Ctrl]. With this command you can quickly access up to ten different simulations with only a key. This functionality allows you to compare photographic fields or different views in general. Simulations saved in this way are overwritten without prompting.

Load Default Simulation: loads Perseus' default simulation at startup. After installation the default simulation is the one described in this manual. You can replace the default simulation; anyway the original default is always available by loading the "Example – Handbook start" simulation.

Save as Default: selecting this option will make the current simulation the default one used by Perseus at startup. You just have to set up all the parameters you need (location, time, orientation, and so on), and then select Save as Default. This command is often used together with "Use system time at startup".

Use System Time At Startup: if you select this option, Perseus will use all default parameters to create the startup simulation except for time and date, which are synchronized with the computer internal clock. For example, if your customized default simulation is set to place you in your backyard at sunset and you check this option, at startup Perseus will display the sky you would see from your backyard at the time read from your PC's clock.

Print: prints the current screen on the default printer. You can also set up the number of copies, the print quality, and other print options. If you have a color printer, you can use Settings... Colors to change them. If you do not have a printer connected to your computer, this command has no effect.

Print Preview: shows a print preview according to the current print settings. To achieve the best match between the screen and the printout, set the page orientation to landscape with the "Print Setup" command.

Print Setup: lets you select a printer and set the print options through the printer control panel.

Create Image File: creates an image file (in JPG, BMP, PNG or TGA format) representing the current view, up to a resolution of 8192 x 8192. In this way you can create high-resolution images, suitable for publication. If you select a resolution with an aspect ratio different from the aspect ratio of the Perseus' window, the field of view will not be the same.

Simplified Dialog Windows: if you check this item, the Date/Time of Simulation window and the Location window will appear with fewer options.

Search data on CD: if Perseus was installed at minimum or medium level and this option is enabled, the program will attempt to retrieve data from the CD that were not copied to your hard disk when the Perseus was installed. This will require the CD to be in the reader while Perseus is running. If you are already using the CD-ROM for other reasons, unselect this option; otherwise the program will prompt you to insert the data CD in the reader every time it needs to access data. Just click on Cancel once and Perseus will automatically disable this option.

If the option is disabled, Perseus will work only with the data it copied to your hard disk when it was installed.

Advanced Configuration: this window allows you to set up options that control the program's behavior and is divided into the following subsections:

- **Stars**: the two parameters "contrast" and "offset" control the way stars are displayed in the simulation. Usually the contrast is set to 1, and the offset to 0. If you increase the contrast, brighter stars will be rendered with proportionally larger images with respect to the fainter ones. If you increase the offset, all stars will be displayed with larger images - even weaker ones. "maximum number of stars" shows the highest number of stars you can have at the same time on the screen before Perseus displays a warning message. You can increase this number above the default value of 50,000 if you use a fast PC with high-resolution graphics. Conversely, you might need to decrease this number on a slower computer in order to keep a reasonable execution speed.
- **Calendar**: allows you to select among three date formats: year-month-day is a widespread standard format; day-month-year is used for example in Italy (where 10/2/2002 means 10th February 2002), while month-day-year is common in the USA (where 10/2/2002 means 2nd

October 2002). In the lower part of this window you can enter the day in which the Gregorian Calendar starts. Historically, that day is October 15, 1582 in those lands that first applied this reformed system, but the Gregorian reform was adopted in different times in different countries. For example, the first day calculated with the Gregorian calendar was September 14, 1752 in Great Britain and in the USA, and February 14, 1918 in Russia. A table of the dates for different countries may be found at *http://www.polysyllabic.com/GregConv.html*. When "Always use the Gregorian calendar" is selected, the dates preceding the Gregorian reform will be calculated with a backwards projection of the Gregorian calendar (the so-called "proleptic" Gregorian calendar).

– **Map**: this section controls some aspects of the appearance of the Perseus map. The characters used for stars' names, Bayer letters, Flamsteed numbers, constellation names etc. may be made smaller or larger. It is possible to change the way of laying the lines and symbols on the map: "See-through" is the default implementation, where the lines does not cover the objects behind them; "Solid" makes the lines opaque, which allows for a better readability in some conditions (for example, with lines drawn above the Sun's disc). The "Solid" lines and symbols may be made thicker. The last option detaches from stars the constellation lines. "Use DirectDraw if available" is normally checked. If you uncheck it, Perseus will not use DirectDraw for visualization. To reactivate the usage of DirectDraw, you must recheck this option and restart Perseus.
– **Telescope**: these options influence the telescope control. **Set current time when connected** - when a telescope is connected, the date and time of Perseus are set to the system date and time. **Keep telescope view centered** - if checked, Perseus will keep the aiming direction of the telescope at the center of the field of view. **Close the information window when the telescope is moved to the object** - when checked, clicking the "Move tel" button in the object information window will cause the window to close. **Close the information window when the coordinates are matched** - when checked, clicking the "Sync tel" button in the object information window will cause the window to close. If you select the checkbox in the upper part of this window, pressing the "move telescope here" button in the object information window will cause the window to close.
– **External Catalog**: this tab, available only with Perseus level II or III, lets you select what external catalog you want to use. Perseus supports the following catalogs: USNO–A1.0, USNO–A2.0, USNO–SA1.0, USNO–SA2.0 and UCAC–2. You can also enter a folder where Perseus

will search for the catalog's files; in this case, you can copy the entire catalog on the hard disk and avoid using the CD–ROMs.

Exit Perseus asks for confirmation and terminate the program. You will be asked if you want to use the current situation at the next execution of Perseus. If you answer "yes", Perseus will save the situation and recover it at the next startup, ignoring the default situation and the "use system time at startup" option.

6.2 Time menu

Change Date and Time: opens the Date and Time window described when illustrating the "Date / Time" button (page 40).

Make Screen Center... [Rise – Culminate – Set]: these options are equivalent to those described in the "Date / Time" button paragraph.

Animation Setup: opens the Animation Setup window, previously described when illustrating the "Animation control" button (page 58).

Start animation at xxx/step: has the same effect as clicking on the "Animation control" button.

6.3 Location menu

Location database: opens the window, described at page 43, that allows you to change the location from which you are observing; this can be Earth, any other body in the solar system, or space.

Now that you are familiar with animations, it is worth reviewing some examples: if you practice with animations, orientations, and location choice, you will master Perseus.

Load the sample simulation "Example – Earth form North Pole". You are now 200,000 km over the North Pole and the Earth will appear to be in the Octant (which is logic, since the Octant contains the South Pole and you are above the North Pole). Turn on the equatorial coordinates and animate the simulation in movie mode, with two hours increments per step. You will see our planet rotate slowly. If you animate it in fixed step mode, one day per step with a 0.5s pause, what happens? Can you interpret the meaning of what you see? Since the increment is set to one day per step, Earth seems not to be rotating. Only its orientation with respect to the stars in the background changes, and they would return to the same position after a year.

Load the sample simulation "Example – View of the Solar System". You are 100 astronomical units over the North Pole of the Ecliptic, looking towards the Sun. Zoom in and animate the planets; remember that their orbits are approximated, so if you zoom in at high magnification, a planet might not lay on its "orbit" any longer. Stars were turned off for clarity of vision. What would be the best step at which to animate this simulation? What happens if you set the increment to 1 year/step and look at the Earth, in movie mode or in fixed step mode?

A very interesting exercise consists in looking at the sky from a different star. Perseus is actually capable of placing in space stars correctly if it knows their distance from the Sun. Load the sample simulation "Example – Sun from Alpha Cen"; you are now close to Alpha Centauri, about 4.3 light years form the Sun, looking towards our star. The Sun is between Cassiopeia and Perseus. Aim at Sirius (α Cma): it will be very close to Betelgeuse, in the constellation of Orion. Also Gemini, the Lion, and the Lyre appear with a different shape. This happens because the position of some of the stars forming these constellations change radically when you move 4 light ears away from Earth. Again, aim at Alpha Centauri (Rigil Kentaurus) and you will see it shine with a magnitude of about –8. That occurs because you are now very close to that star.

How did we calculate this position? How can you go near a star? Just follow these steps:

1. Aim at the desired star and left click on it; in the information window activate the coordinate pull down menu, select mean ecliptic coordinates, and write them down; close the information window.
2. Click on the Location button, select Sun as observation point, and enable the Absolute position checkbox.
3. Enter the ecliptic latitude, longitude, and distance. E.g., to move to Sirius starting from the default startup simulation, you would have to enter:

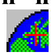
   Ecliptic latitude 39° 36' 19.73" S

   Ecliptic longitude 104° 06' 31.45"

   Distance 8.601 ly ("ly", of course, means "light years").

Now look around with the quick aiming. Our Sun is now between Hercules and the Eagle, which appear both very distorted; Sirius is very bright and close, even though very off-center. Epsilon Eridani and Alpha Centauri also appear to be rather far from their usual position.

However, to position yourself near an object, it is easier to use the position window described later.

Show local horizon and Show azimuth on horizon are the same commands described with the "Local conditions"  button (page 43).

Show cardinal points on horizon toggles on and off the cardinal points along the horizon.

Show landscape toggles the display of the panoramic landscape.

Quick position window shows the window of figure 33.

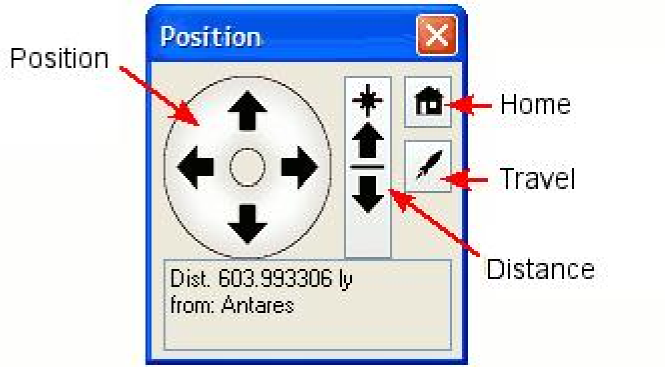


Fig. 33

This window has four different controls, working in different modes if an object is currently locked or not.

If no object is locked, or an object without distance data is locked, the controls work as follows:

- the Position control modifies your current coordinates (latitude and longitude), as reported in the Status Bar or in the Location window;
- the Distance control modifies your current elevation (or your distance from the planet if in "absolute position" mode) as reported in the Location window;
- the Home control returns you to the last location selected via the Location window;
- the Travel control has no effect.

If an object with distance data is locked, the controls work as follows:

- the Position control makes you go around the object;
- the Distance control modifies your distance from the object;
- the Home control returns you to the last location selected via the Location window;
- the Travel control performs a "voyage" towards the object which completes in 15 seconds.

To try this command, lock Jupiter and travel towards it. After 15 seconds Jupiter will be in front of you as shown in figure 34.

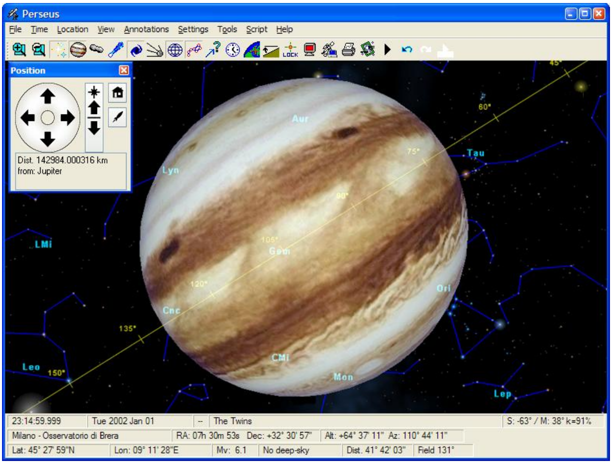


Fig. 34

These commands work with every object that can be locked, but due to the limits of the database, when used with far objects (like galaxies) you can obtain results that are difficult to understand.

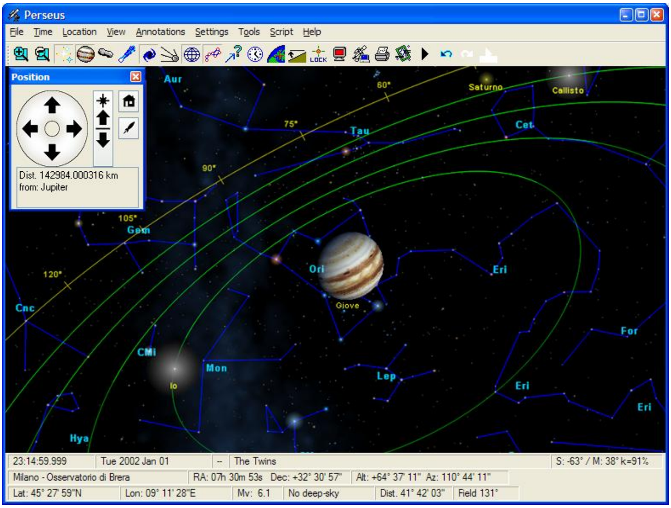


Fig. 35

Figure 35 shows Jupiter as it appears after moving the point of view and with the satellites' orbits on.

6.4 View menu

Zoom Factor opens a window where you can input a custom zoom factor; this parameter is expressed as the length (in degrees) of the visual field's diagonal. You can use the checkboxes to choose among typical values, or utilize the vertical slider.

Aim at Equatorial Coordinates and **Aim at Altazimuth Coordinates** allows you to enter altazimuth coordinates at which Perseus will aim. Click directly on the numbers to edit them. In the Aim at Altazimuth Coordinates window you can also aim to the primary eight directions by choosing any of the provided radio buttons.

Aim at an object does the same as clicking on the "aim at an object"  button (page 39).

Quick Aiming opens the Quick Aiming window; another way to make it appear is hitting the [Enter] key.

Lock Object at Center does the same as clicking on the "Lock" 

button (page 49).

Night Vision does the same as clicking on the "night vision" button (page 49).

6.5 Annotations menu

All commands in this menu are equivalent to the ones described in the paragraph about the "annotations"  button (page 52).

6.6 Settings menu

Stars – Deep–sky – Planets – Asteroids – Comets have the same effect as if you clicked on the corresponding buttons (page 23).

Meteor showers... opens a window where you can control the appearance of meteor showers (Fig. 36). **Show radiants** – activates the display of the radiants of the meteor showers active at the time of the simulation. The radiants are shown with the symbol  . **No name** – if selected, the radiants are shown without name. **Complete names** – if selected, the radiants are shown with their complete name (for example, "Geminids"). **Abbreviations** – if selected, the radiants are shown with their standard abbreviation (for example, "GEM"). **Show meteors during animations** – activates the display of random meteors during animations. The meteors are generated proportionally to the maximum hour rate of the shower. **Storm mode** – together with "Show meteors during animations", shows a great number of meteors to simulate a meteor storm.

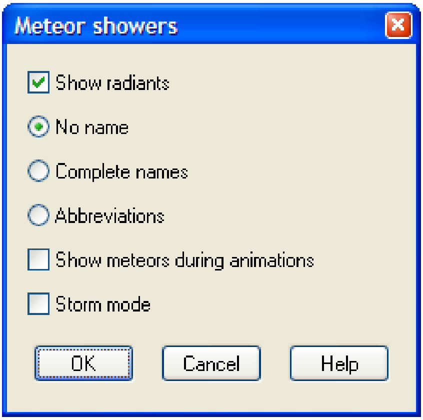


Fig. 36

Satellites... shows a submenu where you can control the visualization of artificial satellites and load the orbital elements in TLE format. See page 36 for details.

Colors... lets you change the color of all objects in Perseus, as well as save and retrieve color palettes through the usual Window interface. You can set the horizon to appear semitransparent by scrolling down the list, highlighting Horizon, and then checking the checkbox labeled "Transparent horizon". Other options apply to various objects. Choose "screen" to set the colors used for the simulation. Choose "printer" to change the colors used when printing maps. When "printer" is set, the screen changes its colors temporarily to show the colors used by the printer. It is possible to load and save the color set by clicking on "load" and "save".

Show... allows you to toggle on and off the status bar and the toolbar. The toolbar can be repositioned, as illustrated before. **Position in the Sky** displays a small map of the entire sky showing the current position of the screen center. If you click on the map, the point clicked will become the new screen center. **Symbols' Key** option displays a list of symbols with the corresponding explanations, similar to the one Perseus includes when printing.

Reference lines – Constellations – Orientation – Horizon – Refraction – Atmospheric effects have the same effect of the corresponding buttons (page 37).

Light pollution shows a window where you can control the simulation of the effect of artificial lights.

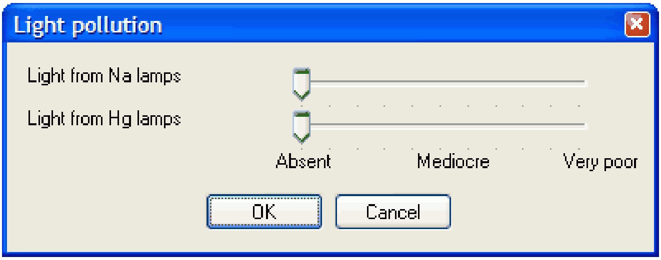


Fig. 37

Move the cursors to change the amount of light pollution. Na (sodium) lamps provide a yellow-orange light, while Hg (mercury) lamps provide a bluish light. Even a small amount of light pollution will cancel out most of the deep-sky wonders, so be careful, and avoid it!

6.7 Tools menu

Night Duration Chart shows what period of a given month is favorable for astronomical observation.

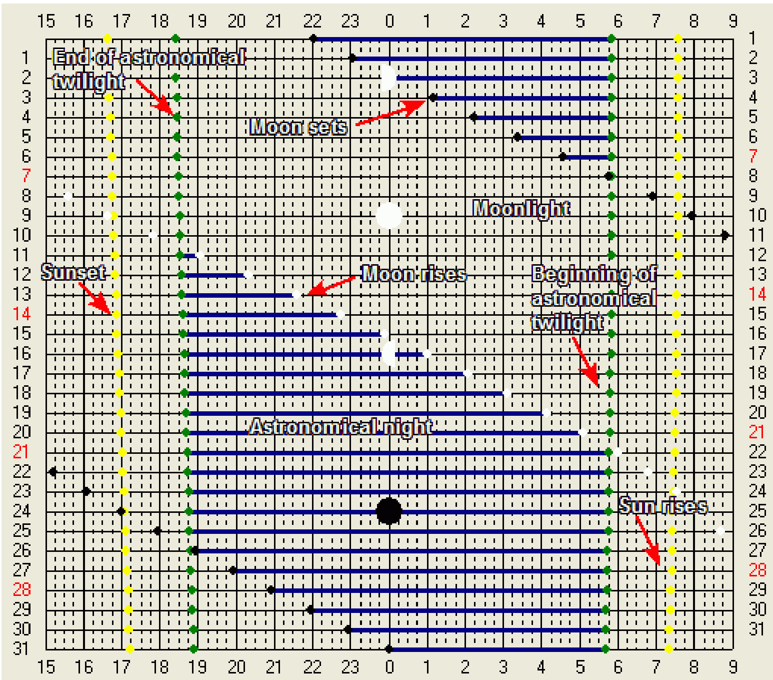


Fig. 38

It lists the nights in a given month, one per line, and the times at which the Sun and the Moon set and rise (if they do on that particular day), and the beginning and end of astronomical twilight. Astronomical nights, i.e. nights in which the Moon is under horizon, are marked with a blue line. On the left and right side of each line Perseus displays the number of the corresponding evening and day, i.e. the first line represents the night between the last day of the previous month and the first day of the month in the current chart, and so on. On the horizontal scale you find the local time, expressed in hours. If the switch to (or from) daylight saving time occurs in the month you are considering, the top horizontal time scale shows the scale used at the beginning of the month, and the bottom horizontal time scale shows the scale used at its end. Sundays are marked in red. Astronomical twilight is calculated when the Sun is 18° below the horizon: it is difficult to notice the twilight until the Sun is about 14° below the horizon, so the chart tends to be conservative. Figure 38 shows a sample chart. Moon phases are displayed approximately, on the line of the day when they occur.

Monthly Lunar Calendar shows the Moon phase at local 0:00 time for all days of a given month. The Moon is shown as it would appear to an observer placed in the center of the Earth, and the illuminated part is drawn with the orientation the Moon would have with respect to the celestial equator. The chart also displays the times at which the phases occur. The positions of surface details account for libration. To calculate the times in which the Moon is visible, or when it is not and will not disturb observation, use the Night Duration Chart.

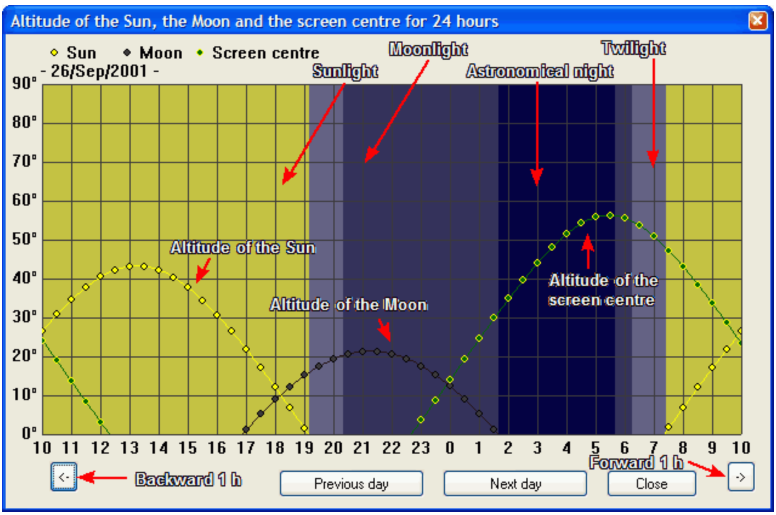


Fig. 39

Today's Altitudes shows a diagram (figure 39) displaying the variation of the altitude of the screen center, the Sun, and the Moon above the horizon in the current simulation. The vertical bands represent the periods of daylight, twilight, and Moon interference. This functionality is useful when you are simulating a situation and found something you wish to observe: you can have an immediate idea of the length of time in which you can observe the object on that date. The arrow buttons allow you to move the chart back and forward by one hour. On the top, the current date is displayed.

Inner Planets generates a visibility map of Mercury and Venus at sunrise or sunset for your current location. You can determine for how long to track the planets and set other parameters as well. The planets' positions are calculated at the time the Sun is on the horizon. If you enable the labels , you can easily find the best moments of morning or evening visibility and then simulate them with Perseus.

Current Visibility displays a map of the Earth showing a blue dot in the point where the center of the screen is at the zenith. The red dot marks the observer's current position. The blue lines join the points where the center of the screen is at 80°, 70°, and so on above the horizon, until the red line, which is where the center of the screen is on the horizon itself. This function is useful to determine whether a phenomenon like a Moon eclipse or the transition of one of Jupiter's satellites is visible from a given location.

Supernovae Charts lets you retrieve and print a map to find supernovae; select an object on the list by clicking on it and then click on Show Chart. You can also directly double-click on an object to see the map. These charts have been prepared by Stefano Pesci, member of the Amateur astronomers Club of Milan and discoverer of several supernovae. These maps can be used with telescopes with a diameter of 10" or higher. The stars' brightness was corrected to compensate for naked eye vision and might not be an accurate comparison to photographs or CCD frames.

Search Guide Star and **Telescope Control** have been described earlier in the corresponding paragraphs.

Lunar Eclipses and **Solar Eclipses** allow you to calculate the occurrence of eclipses. When you select either option, a window appears prompting you for the period of time in which you want to search for eclipses. If you are working on Moon eclipses, you have a choice of excluding penumbral eclipses, which are generally not very interesting. After Perseus completes the calculation, it displays a list of the eclipses that will occur in the specified time frame. For each eclipse Perseus shows the date, time, and type. Selecting an occurrence and clicking on Show Eclipse Data will open a window displaying a visibility map of the eclipse and other data. For Moon eclipses, the map will look like figure 40. In the top left part you can see the eclipse magnitude, and the times (expressed in local time) in which the Moon enters and exits the zones of Earth shadow and penumbra. On the right side there is a chart representing the Moon's path with respect to the zones of darkness and the times of entrance and exit. The map gives a quick glance of the visibility zones from different regions of Earth. The eclipse will be invisible if observed from the dark area.

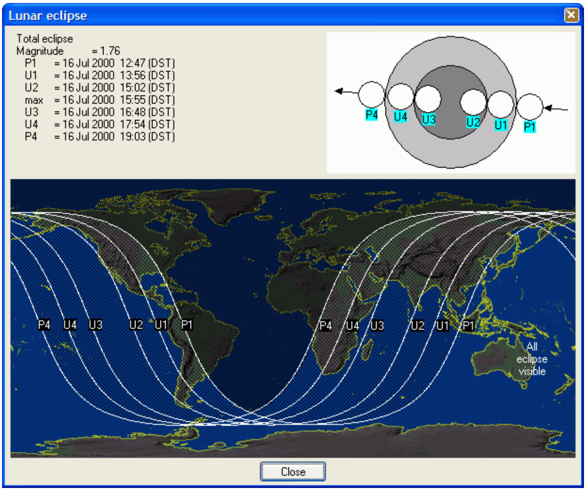


Fig. 40

The window for Sun eclipses might take a few seconds to appear, and will look like figure 41. In the left top part you can see the eclipse magnitude , and the instant of its maximum, both referred to the current location of the simulation. On the right side there is a sketch of the Moon's trajectory with respect to the Sun as viewed from the current location of the simulation. If the eclipse is not visible from this location, you might see in this sketch just a part of the Moon disk, or even only the Sun disk, as represented below , where the eclipse's totality is very far from the current location (Italy. The image is taken with the Italian version of the program). The green line on the map indicates the central part of the eclipse; in the red zone the eclipse is either total of annular, and in the white zones the eclipse is less and less visible the farther away you move from its totality. The outmost white line marks the zone from which the eclipse is visible; the lines found moving towards the interior indicate areas in which the Sun is covered by 20%, 40%, 60%, and 80%.

Click the map to simulate the situation in that location, at the time of maximum eclipse.

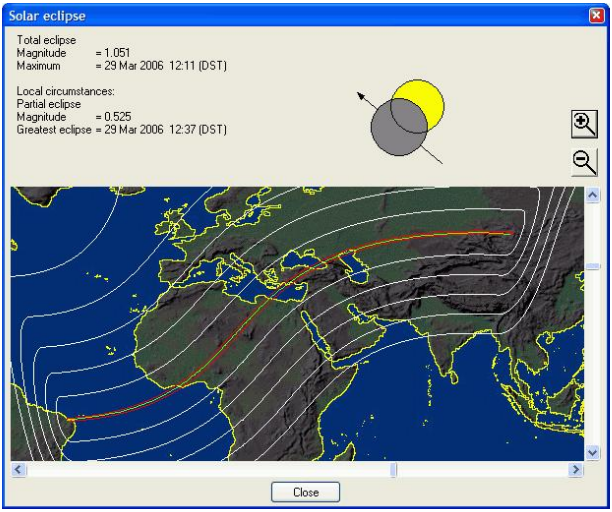


Fig. 41

Satellites → Satellites of Mars/Jupiter/Saturn shows a chart of the movement of the satellites of one of these planets in the current month.

6.8 Script menu (Perseus Level III only)

A script is a series of simulations generated by Perseus and tied to each other. While describing scripts, we will call Perseus' simulations "slides" in order to distinguish them from normal .PSIT files. These slides are not static: in any of them we could have text, animations, and so on. Everything that happens in a slide is an action, and a slide can consist of many actions. A script is made of several slides.

Scripts are useful because they let you perform actions and go from one slide to the next one by simply hitting a key while the script is running, instead of having to give the sequence commands manually. In a script you can generate animations, visualize JPG files, and even play WAV files. Perseus can interpolate two slides for you and much more.

Scripts are valid assistants for presentations and lectures. Perseus' scripts are in a proprietary .PSCR format and can be exported or imported on other PCs with Perseus installed by simply copying such files. Please note that their size can become considerable if the script includes images or sound files.

Since using scripts is a rather complex task, what follows here is a synthetic description of the menu commands, which will be explained in detail later.

Create New Script opens the window where you can create a new script.

Open Script retrieves a previously saved script without executing it. To run the script, see the Run Script command.

Modify Script allows you to modify the current script.

Run Script prepares Perseus to execute the script. The program calculates and displays the first slide, but does not start until you hit the [Page Down] key. At that moment Perseus executes all actions in the first slide, then proceeds to the second one and so on. Unless they are separated by a pause or user input is required, actions are performed at the maximum speed allowed by the computer. This option turns to "Stop Script" when a script is running.

Execute from Slide is similar to the previous one, but lets you choose the slide from which you want to start running the script using the window of figure 42.

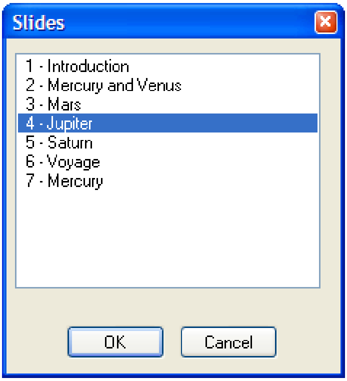


Fig. 42

Create AVI File generates a video clip file of the script's execution. Once you loaded a script, you do not need to run it before creating an AVI file. However, this can take a very long time, depending on the length of the script, the frame rate, and your computer speed. An AVI file generated by Perseus can be viewed on any computer, as it does not need Perseus to be installed – but make attention that a CODEC may be necessary to view the file.

For illustration purposes we will now create and describe a script step by step. You can also refer to the scripts already provided with Perseus to familiarize yourself with this functionality. If you created interesting scripts, please feel free to send them to us via email and we will publish the most remarkable ones on Perseus' website.

The first thing to do is to become familiar with the windows you will encounter.

Fig. 43

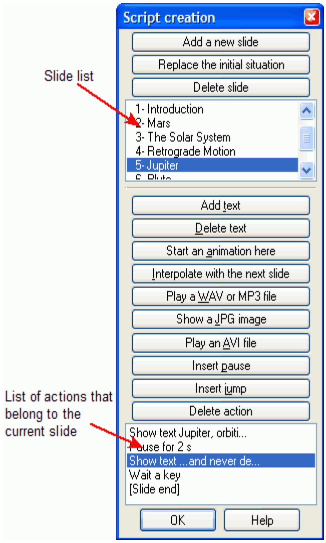


Fig. 44

The figures show the script creation window as it appears on the beginning, empty (figure 43) and while editing a script (figure 44). In this example the action "Show text Note how..." is selected from the slide "5 – Jupiter". If you add a new action, it will be insert above the selected one.

6.9 The script window

The upper part of the window shows a list of slides; the current slide is highlighted, and you can change it by clicking on a different one. You can edit the name of a slide by double-clicking on the slide itself.

The lower part of the window lists the actions that will be performed in a given slide. If you click on an action or select a different slide, Perseus' displays the screen as it will appear up to completion of the previous action. You can double click on an action to edit it. The following buttons allow you to edit a slide as well.

Add New Slide appends a new slide after the current one. The simulation in which Perseus is at the moment you add the action is considered the starting point for the new slide. If the current simulation contains text, Perseus will prompt whether you want to keep it.

Replace Initial Simulation sets the current simulation to be the one used at the beginning of the current slide (if the slide if the first, the situation will be used at the beginning of the script).

Delete Slide removes from the script the current slide and all its actions. Perseus will prompt for confirmation.

You can add actions to a script by clicking on the buttons located in the center of the window. These are:

Add Text allows you to add a comment to a slide; you can enter the text in the Insert Text window described below.

Remove Text removes a text comment from the current slide. Perseus will prompt you which comment you want to remove. Please note this command will not delete the action of creating a comment: the text will still appear in the slide, and will be removed from the simulation when the script performs the next action. If you want Perseus not to show the comment at all, you need to delete the action where you inserted it in the slide in the first place: select the action and click on Delete Action at the bottom of the list.

Start Animation Here starts an animation according to the parameters you can enter in the Script Animation window described below.

Interpolate with Next Slide: this action should be entered at the end of a slide. As the simulation moves from one slide to the next, the action changes the visualization parameters according to what you set in the Interpolation window, as described below.

Play WAV or MP3 File inserts a WAV sound file.

Play an AVI file inserts an .AVI movie in the slide. After selecting the AVI file, position it with the mouse in the place you want it to be reproduced.

Show JPG Image inserts a JPG picture in the slide.

Insert pause inserts a pause between two actions. You can set the pause length or tell Perseus to wait for the user to press a key. See the script pause window.

Insert Jump allows you to specify a slide to jump to while the script is running. You can use this function to create self-repeating scripts.

Delete Action removes from the slide the selected action.

The key combinations [Ctrl]+[C] and [Ctrl]+[V] allow you to respectively copy and paste actions (if used in the actions list) or whole slides (if used in the slides list). This is an easy way to move and reorder actions and slides in the script.

Here are the detailed descriptions of the actions windows.

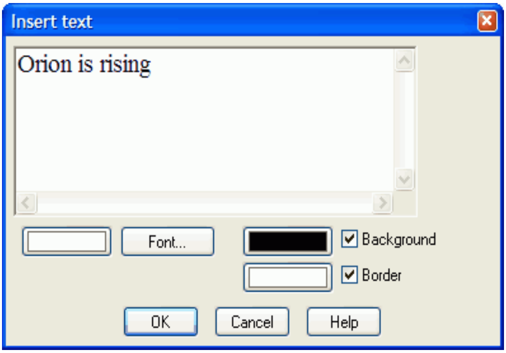


Fig. 45

Add Text allows you to insert text in the slide, with, if you want, a background, a border, and a leader (figure 45).

Enter the desired text in the top field, and then select a color, a font, a background and a border color.

After clicking OK, place the text on the slide by left clicking; an additional click is required if you want to add a leader. If you do not want to add one, click inside the text you just placed on the screen. You can use this function to draw just a line: just do not enter any text, click on OK, click on the screen where you want the line to start, then click where you want it to end.

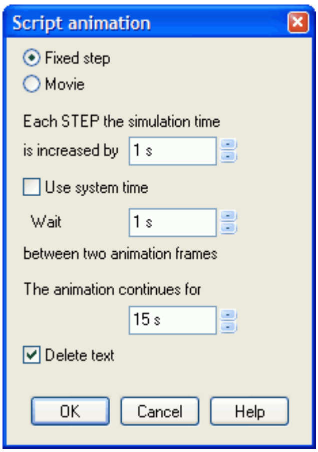


Fig. 46

Start Animation Here: the parameters you set in a script animation (figure 46) are the same ones you would have in a normal animation (page 58). You have to specify the animation duration, but you can choose whether you want to keep or remove the text that is already on the slide when the animation is started. To do so, use the "Delete text" checkbox.

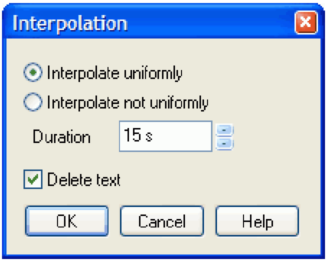


Fig. 47

Interpolate with Next Slide: you can specify how long an interpolation you want and whether parameters are to be interpolated uniformly or not. The interpolation is basically an animation between two simulations. It is difficult to decide a priori which method is better between uniform and non uniform. The second one is slower at the beginning and the end, and faster in between. You will have to try out both options and see which one works better for your case. Some parameters cannot be varied uniformly: if you are interpolating between a slide where the stars are displayed and one where they are not, they will be turned off abruptly when the script is executed.

Insert Pause: You can enter the duration of the pause directly, or you can use the checkbox to have Perseus wait for the user to hit the [Page Down] key in order to continue running the script.

To control the execution of a script use the following keys:

[Page Down]	This key has different functions, depending on when you use it: – Starts a script; remember to first load it, and then select the "Run Script" option from the Script menu. You can use this key to start a script when using Perseus in full screen mode: load a script, hit the [F11] key, and then hit [Page Down]. – Moves on to the next action in the current slide while a script is running. – If the last action was performed, lets you move on to the next slide. – If that the last action of the last slide was completed, ends the execution of the script. – If pressed while an animation is running in a slide, jumps to the end of the animation.
[Page Up]	Goes back to the beginning of the current slide and suspends script execution. Press [Page Down] to resume the script.
[Esc]	Terminates at any time the script.

After a script has been loaded or is been executed, Perseus displays its name on the main window bar.

Remember to hit [F11] to display the sky at full screen; hit [F11] again to return to the previous view. When Perseus is in full screen mode, hitting [Ctrl]+[F11] toggles the cursor on and off.

6.10 Building a script

First of all, you must know the characteristics of the phenomenon you want to observe; after that, you can jot down on a sheet of paper the sequence of steps you want the script to execute. Once the outline of the script is complete, you can go back and add pauses, comments, and anything else you deem necessary.

We now want to write a script explaining some of the observations on the principal satellites of Jupiter. The left column on the following tables describes what we want to achieve, while the one on the right explains the steps you need to perform that particular task. At the end we pasted a series of screenshots obtained from running the very same script on Perseus. This sample script is also available among those provided with Perseus and is called "Satellites of Jupiter".

Try creating the script step by step; once you feel more confident, you can load other scripts and examine them. The two scripts "Satellites of Jupiter - corrected" and " Satellites of Jupiter - extended" are variations of the first one, and use the entire series of script functions. Studying them can prove a very effective learning tool.

Why did Galileo observe Jupiter?
Because it is one of the brightest bodies in the sky.

Starting from the default simulation:

Modify the stars so that they appear as crosses (Stars button... Settings).

Turn off the Ecliptic (deactivate the Reference Lines  button).

Create a new script.

Add a new slide (will become the slide number 1).

Add the following text: "Jupiter attracted Galileo's attention because it is very bright…" and place in on the screen. Draw a leader connecting the text box with Jupiter.

Insert a pause (see figure 48).

Add the following text: "What could Galileo see with his simple telescope?" and place it wherever you want.

Insert another pause (wait for a key).

What did he see with his instrument?
We now want to go from this generic visual field to a more specific view of Jupiter.

Lock Jupiter.

Add a new slide (number 2).

Answer no when prompted whether you want to keep the already existing text in the next slide.

Set the visual field to 1° (select View... Zoom Factor from the menu bar).

Deactivate the planets' names (right click on the Planets button and uncheck the Names option).

Orient the visual field to be parallel to the Ecliptic (Orientation  button). See figure 49.

Click on Yes when prompted whether you want to hide atmospheric effects.

Create a new slide (number 3).

Try running the script at this point (select Scripts → Run Script from the menu bar, hit [Page Down] to start the script, [Page Down] twice more to show the text notes, [Page Down] again to move on to the next slide). Slide 2 is not shown, since there is no action associated with it. This yields an unpleasant effect. Now hit [Esc] to interrupt the script execution, select Script → Modify Script from the menu bar and select the first slide in the list. Highlight the "Slide end" entry at the bottom of the list and add a new action "Interpolate with next slide". Set this to happen uniformly in 7 seconds. Do the same in the second slide and run the script again - it looks much better.

What did Galileo see while observing Jupiter over many nights?
The satellites seem to be orbiting around the planet while this moves with respect to the fixed stars.

Insert an action to wait for the user to hit a key before displaying a text box.

Insert the following text: "Galileo immediately noticed four small stars close to Jupiter".

Insert another action to wait for the user to hit a key.

Insert the following text: "While observing Jupiter over many hours for many nights, Galileo noticed that while the planet was moving with respect to the fixed stars, the four stars seemed to be orbiting around it".

Insert a 5 seconds pause.

Insert an animation by adding a Start Animation Here action: set it up to run for 15 seconds in movie mode, with 3 hours/second speed.

As the script is running, we want to talk about what is known about Jupiter today, while we look at it and its satellites; after that, we want to animate this view. Which is the best viewpoint in order to see the Medicean satellites orbit and track their path around Jupiter? The best solution is to take the planet as reference, and nothing is better than being on Jupiter itself: change the current location to Jupiter, enable the Absolute Position checkbox, enter 270° as ecliptic longitude, 10° as ecliptic latitude, and 2 au as distance (about 300 millions Km).

We chose these parameters both by trial and error and by reasoning. We selected 10° as ecliptic latitude because it yields a rather natural perspective (had we entered 90°, we would have been looking at Jupiter from above). The distance has been set so to obtain a larger image than the previous one (the planet is about 4 au from Earth, as shown in Jupiter's information window). The ecliptic longitude was chosen by trial and error: if we entered 100°, for instance, Jupiter would be almost completely hidden by its phase.

We want to see Jupiter close up and animate its satellites once again.
Turn off the stars (click on the Stars button) and lower the limiting magnitude of the stars to the minimum allowed value with the slider. This way the satellites will not be too bright. Create a new slide (number 4, see figure 50). Enter the following text: "Here is a close up view of Jupiter". Insert an animation: set it up to run for 15 seconds in movie mode, with 3 hours/second speed. Remove the text "Here is a close up view of Jupiter". Insert an action to wait for the user to hit a key in order to proceed to the next slide. To give the impression of zooming in onto Jupiter, return to slide 3 and add an "Interpolate with next slide" action at the end, to be made in 15 seconds.

We will now look at the satellites as they move on their orbits and are eclipsed by Jupiter.
Starting from the final simulation at the end of the fourth slide (select slide 4 from the slide list and "slide end" from the action list), track Io and Europa and visualize their orbits around Jupiter. Track Io once every two hours for two days, and Europa once every four hours for four days. We set these parameters knowing that that is the approximate period of their revolutions. Create a new slide (number 5, see figure 51). Animate the slide for 15 seconds at a speed of 1.5 hours/second; again, these values have been found by trial and error. You can use the + and – keys on the numeric keypad to move forward and back by one hour. We also chose those values so that Jupiter eclipses Io at the end of the animation. Insert the following text: "The satellites disappear periodically due to Jupiter's shadow", and draw a leader from the text box up to eclipsed Io. Insert an action to wait for the user to hit a key.

Let's end the script with a view of Europa.
Zoom in very close so that Europa fills the entire screen. As you see, Perseus reproduces the surface appearance of the satellite accurately. Enter a new slide (number 6). Insert the following text: "Satellites are very interesting…" and draw a leader from the text box up to Europa Insert a 2 seconds pause. Insert the following text: "Hit Esc or Page Down to quit" and format it with a small font non bold, set the color to white. Go back to the fifth slide and add a 10 seconds interpolation at its end.

Congratulations! You just created your first script!

Important note
You can always insert a new slide between two preexisting ones by simply clicking on the Enter New Slide button. In the sample script we just created, the brightness of the satellites changes abruptly between the third and fourth slide because during the interpolation Perseus zooms in onto Jupiter, thus increasing the limiting magnitude, while in the fourth slide we turned off the stars and corrected the limiting magnitude of the satellites. You can fix this by inserting a new slide. Highlight the Slide End action at the end of the third slide: Perseus will have turned off the stars and adjusted the satellites' magnitude, which is to be expected, since we are interpolating with the next slide and the end of the third slide is therefore the beginning of the fourth one. At this point, turn on the stars and reset the magnitude to its default value: Jupiter's satellites will turn bright again, as they were at the end of the animation. Insert a new slide. Slide number 4 will turn into 5; now insert a text command into the new slide number 4 displaying a warning message like "Let's change the limiting magnitude…" and add insert an action to wait for the user to hit a key to move on to the last slide. The fixed script, as we just described it, is named "Corrected Medicean Satellites" and is provided with Perseus. As an exercise, try making in the initial zoom smoother (hint: create and intermediate slide without names and constellation names and insert an explanation before changing the orientation). Remember: first create the simulation you want to have at the beginning of a slide, and then insert a new slide. If you prefer, you can use the Replace Initial Simulation command.

The "Satellites of Jupiter - extended" script is a further elaboration on the previous one and contains a JPG image and some audio files; you will need a sound card to be able to listen to them. This script is designed to run automatically without user intervention and will give you an idea of Perseus' capabilities as an educational tool.

Other sample scripts have been installed. Use them freely, and study them to create other scripts.

While you are checking a script, remember that by pressing [Page Down] while an animation is in progress, you can jump to the end of the animation.

Another note

Perseus lets you control the simulation even when it is running a script: you can still give other commands on top of those being executed by the script. To resume script execution, simply hit the [Page Down] key. Perseus will regenerate the last slide that was displayed before you gave a manual command.

You can write a wide variety of scripts and adjust them depending on the use you want to make of them: if you are going to show them at exhibitions, for instance, they might contain more text, no pauses requiring user intervention, and restart automatically. Conversely, if you are going to use the script for a presentation and will describe what is happening on the screen, you might want to have less text and pauses requiring user intervention.

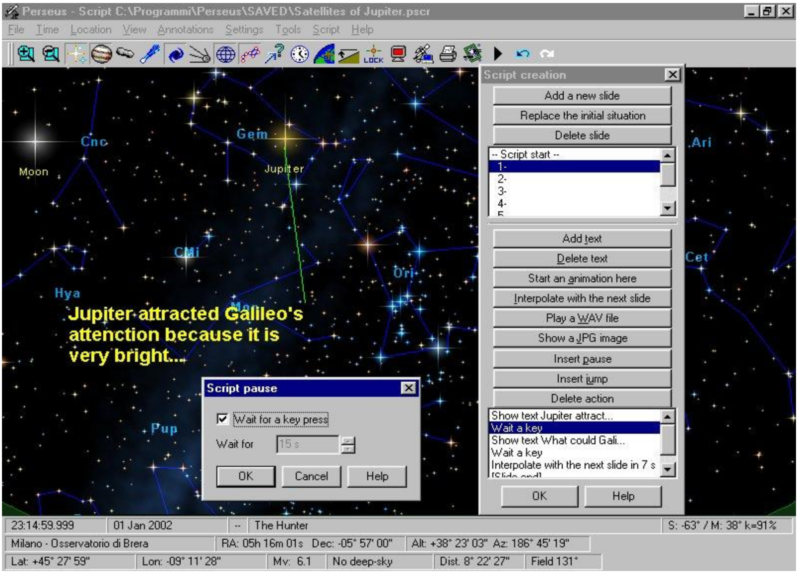


Fig. 48 - while creating slide 1.

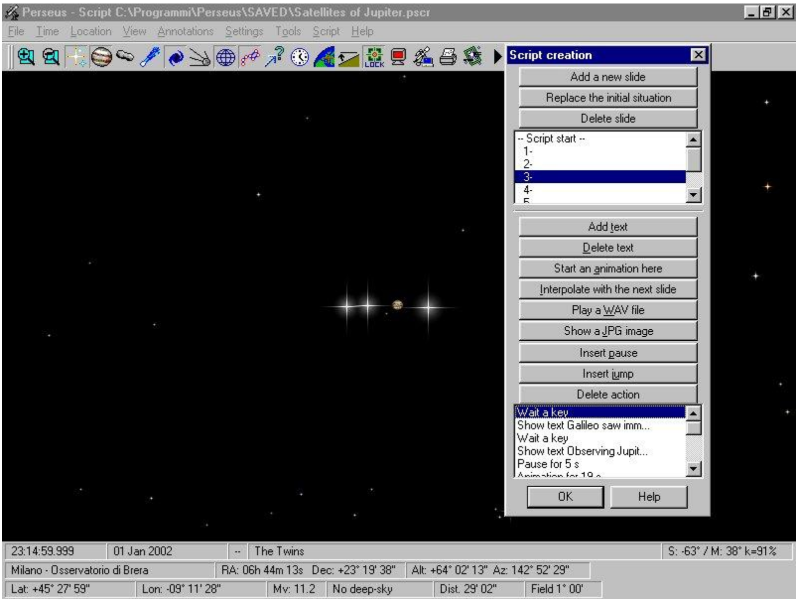


Fig. 49 - while creating slide 3.

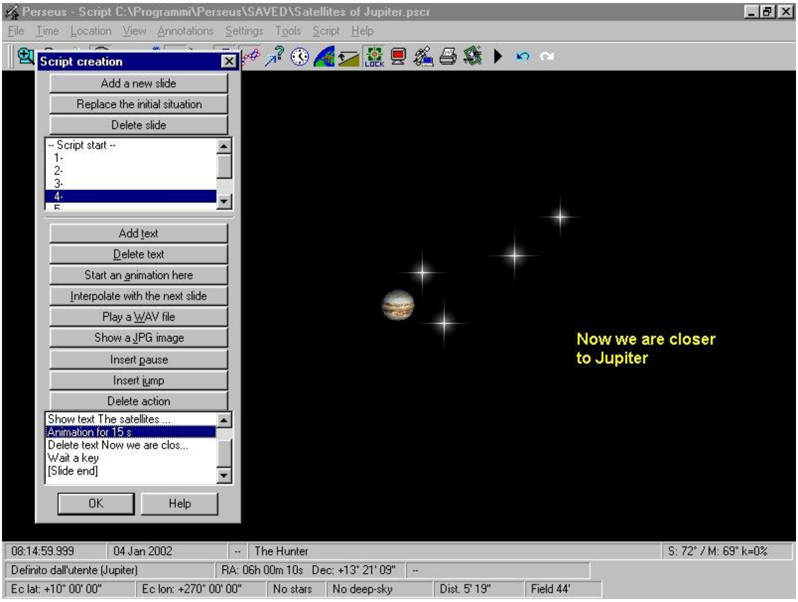


Fig. 50 - we found a good point of view for slide 4.

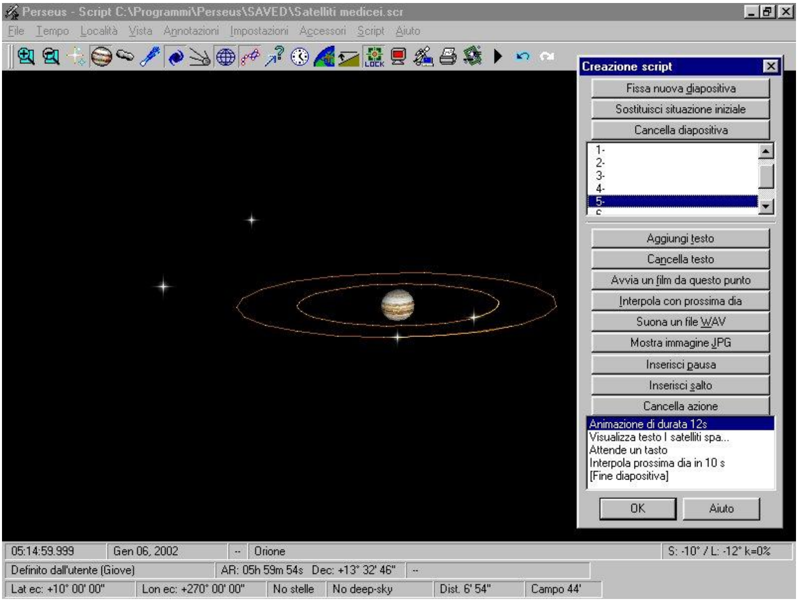


Fig. 51 - the tracks that must appear at the beginning of slide 5.

Note about the "Create AVI file" command

When you create video files, Perseus prompts for the video quality attributes (resolution and frame rate, figure 52) you want the AVI file to have. As you enter them, think of the capabilities of the computer that will eventually run the file; otherwise the result might not be smooth. A good beginning set of parameters could be a resolution of 320 x 200 and a rate of 15 fps. After you selected the desired values, enter a file name and then the compression program (CODEC) you wish to use (see figure 53). After pressing OK, a progress bar will display the status of the conversion while the .AVI file is created.

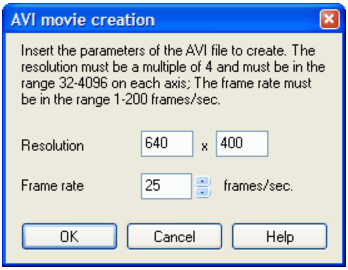


Fig. 52

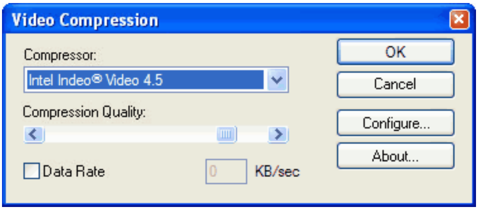


Fig. 53

WARNING

Please keep in mind that if you select a specific CODEC from the list, that CODEC must be already installed on the computer where you intend to play the AVI file, or you will not be able to run it. There are many CODECs; some are freely available on the Internet, others can be bought for a fee, and others are already installed together with the operating system.

If a script contains pause actions requiring user intervention or jumps to a different slide, these commands are ignored while creating the .AVI file.

.AVI files generated by Perseus do not include audio files. You can add it later on with a common video editing program.

Perseus can generate huge .AVI files: remember this if you want to move or upload them to a website. The sample .AVI files in the Info section of Perseus' website were generated with a freely downloadable CODEC.

6.11 Help menu

Contents and **Index** let you access Perseus' Help and the Help Index respectively. These are standard functions of all Windows programs.

About Perseus displays the version of the program you are running, the serial number and level of your copy, the activation code and other information on the program. If you need to contact our customer support, please have your serial number ready: without it you will not receive any assistance via mail nor over the phone. The serial number is also on a label glued on the CD case or on this manual.

7 The information window

This window shows the information relative to an object clicked in the main window of Perseus.

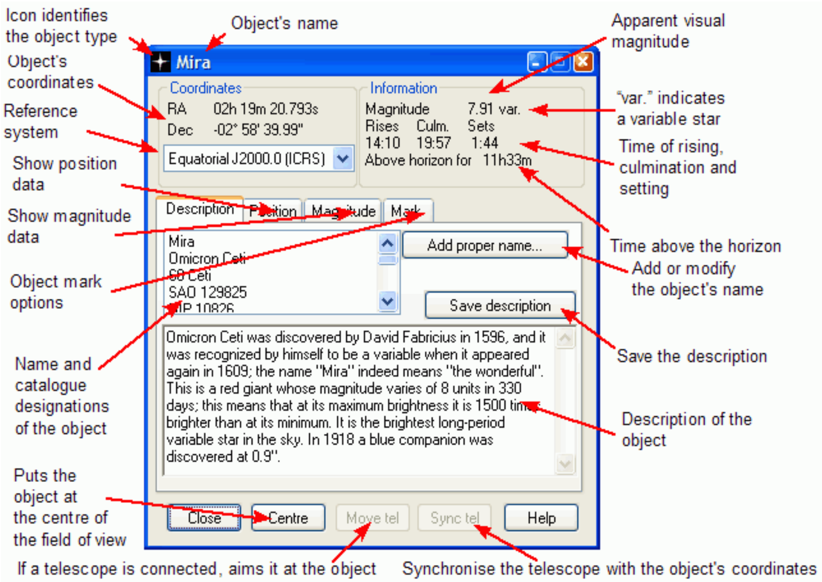


Fig. 54

Some information is available for all object types, other is relative only to some objects. Figure 54 shows the aspect of the information window for a star.

The icon of the window (top left) has a different aspect for each object type. The title of the window is the object's name or catalog designation.

The coordinates can be shown relative to various coordinate systems:

– **Apparent Altazimuth** - shows the apparent altazimuth coordinates. The effects of refraction (if active) and light aberration are computed.

– **Equatorial J2000.0 (ICRS)** - shows the equatorial coordinates with respect to the ICRS, a reference system "fixed" with respect to the extragalactic radio sources. The effects of refraction and light aberration are not computed, but the effect of parallax are computed.

– **Equatorial B1950.0**, **Equatorial B1875.0** - shows the equatorial coordinates with respect to the equinoxes of 1950 and 1875. These coordinate systems aren't used anymore today. The effects of refraction and light aberration are not computed, but the effect of parallax is computed.

– **Mean Equatorial** - shows the equatorial coordinates with respect to the mean equinox of the date. The effects of refraction, light aberration and nutation are not computed, but the effects of parallax and precession are computed.
– **Apparent Equatorial** - shows the equatorial coordinates with respect to the true equinox of the date. The effect of refraction is not computed, but the effects of parallax, light aberration, nutation and precession are computed.
– **Mean Ecliptic** - shows the ecliptic coordinates with respect to the ecliptic of the date. The effect of ecliptic's obliquity change is computed, but the effect of light aberration is not computed.
– **Apparent Ecliptic** - shows the ecliptic coordinates with respect to the ecliptic of the date. The effect of ecliptic's obliquity change is computed, and also the effect of light aberration.
– **Galactic** - shows the galactic coordinates of the object.

The effect of parallax is always computed.

NOTE

The coordinates of an object depend on the position of the observer. If you choose "Equatorial J2000.0 (ICRS)", for example, but you are on Earth, the coordinates will be affected by parallax and light aberration. To obtain heliocentric coordinates (the coordinates used in star catalogs), choose "Heliocentric view" in the location window.

To the right of the coordinates panel there are the visual apparent magnitude ("var." indicates a star marked as variable in the GCVS), the time of rise, culmination and setting, and the amount of time that the object remains above the horizon.

The "Centre" button brings the object to the center of the field of view; The "Move tel" button is active only when a telescope is connected to the PC, and aims the telescope at the object. The "Sync tel" button is available when a scope is connected and the scope coordinates can be set. This commands sets the coordinates of the telescopes equal to the coordinates of the object.

In this window there are various pages of information.

The "**Description**" page contains a list of designations of the selected object. To add a proper name to a star or a deep-sky object simply click on the "Add proper name..." button. If the object already has a name, the existing name will be deleted.

The description can be modified or added to each object. It is saved with the "Save description" button.

NOTE

Objects' descriptions are saved in the file called "DESC.DAT" in the DATI folder of Perseus. You can move descriptions from a PC to another by copying this file.

The "**Position**" page shows various positional data, many with an error estimate

- Distance (if available): the distance of the object from the observer.
- Parallax (stars only, if available): the parallax, referred to the earth's orbit, computed for the current position.
- Proper motion (stars only, if available): the proper motion of the star in AR and Dec.
- Position error (stars only, if available): the position error at the epoch of the measure.
- Current position error (stars only, if available): the position error at the epoch of the simulation, calculated by combining the position error at the epoch of the measure with the proper motion error.
- Position epoch (stars only, if available): the epoch of the measure.
- From screen centre: the angular distance of the object from the center of the field of view.
- Sun elongation: the angular distance of the Sun.
- Moon elongation: the angular distance of the Moon.
- Sky Atlas, Uranometria, Millennium Star Atlas: the page where the object is situated in these atlases.
- Distance from Sun (planets, asteroids and comets): the distance from Sun of the object.
- Apparent size (planets and deep-sky objects, if available): for planets, the equatorial and polar apparent diameters; for deep-sky objects, the angular apparent size.

- Central meridian and parallel (Moon and planets): the coordinates of the point which appears to be at the center of the planet.

The "**Magnitude**" page contains the available information about the star's brightness.

If the star is variable, some GCVS data are shown: the amplitude of the variation, the classification, the period and the epoch of maximum (if available).

Some other data that can be found are:

- the spectrum;
- the Tycho photometry in the BT and VT bands, from the Tycho-II o Tycho-I catalog (the measure with the minimum error is used);
- the Hipparcos photometry if the Hp band, from the Hipparcos catalog;
- the color index B-V;
- the effective temperature of the star, computed from the color index data.

Click on the "H-R diag." button to see the position of the star in the H-R diagram.

For the Moon, this window shows the age, that is the time elapsed from the last New Moon.

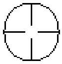
For galaxies, when available, the morphological classification by Hubble and the luminosity class by Van den Bergh and Corwin are shown.

The "**Orbit**" page is available for asteroids and comets and shows the orbital parameters.

Use the "**Mark**" page to attach a symbol to the object. A text can be also attached. The symbol is displayed even if the object is too faint to be displayed, or beyond the horizon.

8 Telescope control

Once connected the telescope with the procedure described at page 49, a window appears to allow you control the telescope using Perseus (figure 55).

When Perseus is connected to a telescope, the symbol  appears in the sky to mark the direction where the telescope is looking. The position of this mark is correct only if the telescope and driver have been correctly initialized before the connection.

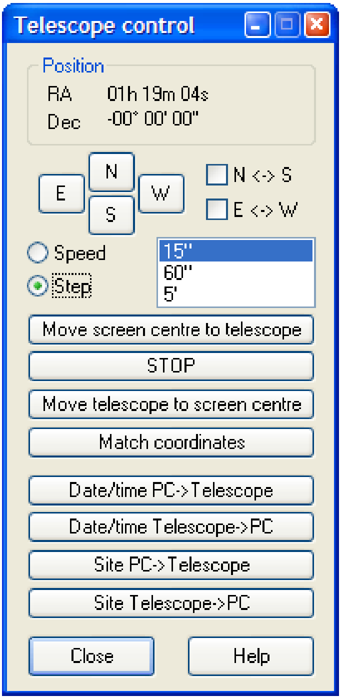


Fig. 55

Available commands change based on the possibilities of the telescope and driver you hare using. Not every combination of driver/telescope allow you to use every command.

In the top part of the window the coordinates of the telescope are shown. They are updated every 0.5 seconds.

The N/E/S/W buttons allow you to move the telescope manually. The movement can happen in two ways:

– if you selected the "Speed" mode, the telescope begins to move when you press a button and stops when you release it. The speed can be set in the window below the N/E/S/W buttons;
– if you selected the "Step" mode, the telescope moves by a certain angle in the selected direction; the angle can be set in the window below the N/E/S/W buttons.

The buttons have the following functions:

Move screen center to telescope – The main window of Perseus is centered on the point where the telescope is aiming.

STOP - Interrupts any slew of the telescope.

Move telescope to screen centre – The telescope is aimed at the center of the main window of Perseus.

Match coordinates – The coordinates of the telescope are matched to the coordinates of the center of the main window of Perseus.

Date/time PC–>Telescope – Set the date and time of the telescope to the date and time of the simulation (NOT the PC clock. Use the "System time" command in the Time window to match the simulation time to the PC clock).

Date/time Telescope–>PC – Set the date and time of the simulation matching them to the date and time of the telescope

Site PC–>Telescope – Set the geographic coordinates of the telescope matching them to the coordinates of the current location in the simulation (Location window)

Site Telescope–>PC – Set the location of the simulation matching its coordinates to the geographical coordinates of the telescope

Warning: many telescopes require a special procedure before they can be connected to the PC. Refer to your telescope instruction manual for further information.

The telescope can be moved using the command of the information window (page 91). Furthermore, the way Perseus interacts with the telescope can be modified in the advanced configuration window (page 63).

9 Updating

In order to update the data of asteroids, comets, UTC and ΔT, you can use the dedicated utility provided by Perseus. You will find it by choosing:

- with Windows XP/Vista: Start → All programs → Perseus → Update
- with Windows 95/98/ME/NT/2000: Start → Programs → Perseus → Update

The window of figure 56 appears.

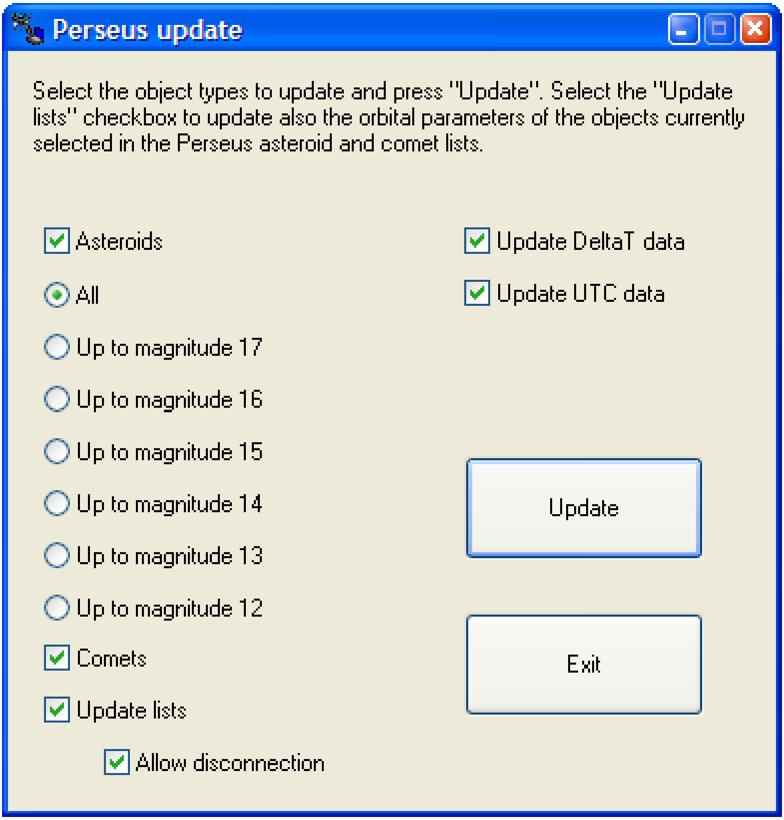


Fig. 56

Here you can select what data to update. Usually the biggest amount of data is relative to asteroids, especially if you select "All", since the complete asteroid database contains more than 200,000 objects at the moment these words are written. If you are not interested in very faint asteroids, you can select one of the buttons "**Up to magnitude...**" to limit the number of asteroids that will be downloaded.

If the "**Update lists**" option is selected, also the orbital parameters of the objects currently inserted in the asteroids and comets lists of Perseus will be updated. Usually this option should be selected.

Updating DeltaT and UTC data is very important when you want to simulate phenomena with better than 1 second accuracy.

Click on "**Update**" to make the utility connect to the Internet and begin to download data from the Perseus' website. You will see a window like in figure 57, showing the progress in downloading the data.

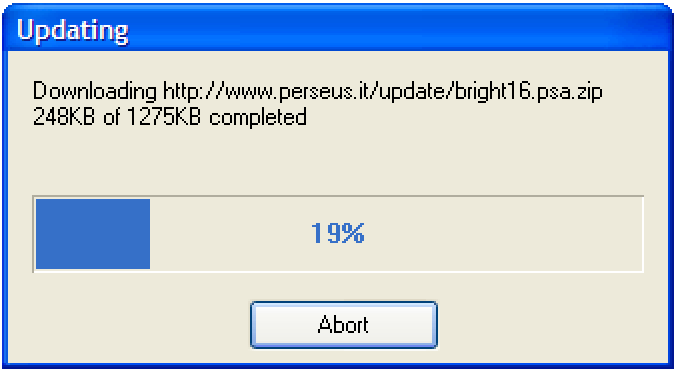


Fig. 57

The asteroid and comet files are saved in the DATI folder of Perseus, and can be loaded to create new lists with the command described in the section about the management of the comets and asteroids databases.

If the "**Allow disconnection**" option is checked, you are allowing the update program to disconnect from the Internet after the update is complete. It is advisable to uncheck this option if you are using the updater on a remote, Internet-controlled computer.

10 Keyboard shortcuts

This table lists Perseus' keyboard shortcut combinations.

[F1]	Open the online help.
[F9]	Load a simulation.
[Shift]+[F9]	Save the current simulation.
[F10]	Activate the menu.
[F11] o [F4]	Toggle the sky view between normal and fill screen.
[Ctrl]+[F11] o [Ctrl]+[F4]	Toggle the mouse cursor on and off when Perseus is at full screen.
[F12] o [F8]	Load the default simulation.
[Ctrl]+[0]...[9]	Quick save the current simulation.
[0]...[9]	Recall a quick saved simulation.
[Q]	Toggle on and off the equatorial coordinates.
[E]	Toggle on and off the ecliptic.
[Shift]+[E]	Toggle on and off the ecliptic coordinates.
[R]	Toggle on and off the RealDeep images.
[T]	Go forward 1 time step
[Shift]+[T]	Go backward 1 time step
[Control]+[T]	Go forward 1/10 time step
[Control]+[Shift]+[T]	Go backward 1/10 time step
[Alt]+[T]	Go forward 10 time steps
[Alt]+[Shift]+[T]	Go backward 10 time steps
[I]	Toggle on and off the altazimuth coordinates
[O]	Increase limit magnitude of deep-sky objects by 0.5
[Shift]+[O]	Decrease limit magnitude of deep-sky objects by 0.5
[Control]+[O]	Increase limit magnitude of deep-sky objects by 0.1
[Control]+[Shift]+[O]	Decrease limit magnitude of deep-sky objects by 0.1
[P]	Open the aim at object window
[A]	Activate/stop animation
[Shift]+[A]	Open the animation controls window
[S]	Increase limit magnitude of stars by 0.5
[Shift]+[S]	Decrease limit magnitude of stars by 0.5

[Control]+[S]	Increase limit magnitude of stars by 0.1
[Control]+[Shift]+[S]	Decrease limit magnitude of stars by 0.1
[D]	Open the date and time window
[F]	Print the current map
[Shift]+[F]	Display print preview window
[G]	Open the night duration chart
[H]	Toggle on and off the Horizon
[L]	Show Lunar calendar of the current month
[Shift]+[L]	Lock an object
[Z]	Zoom in by 50%
[Shift]+[Z]	Zoom out by 33%
[Control]+[Z]	Zoom in by 4%
[Control]+[Shift]+[Z]	Zoom out by 4%
[C]	Toggle on and off the constellation figures
[Shift]+[C]	Toggle on and off the constellation boundaries
[V]	Toggle on and off the night vision
[N]	Toggle on and off the stars names
[M]	Cycle among English, Latin and abbreviated constellation names
Arrow keys	Change viewpoint
[Ctrl]+Arrow keys	Change viewpoint slowly
[Ins]/[Del]	Rotate viewpoint (only in free orientation mode)
[Ctrl][Ins]/[Del]	Rotate viewpoint slowly (only in free orientation mode)
[/] (num. keypad)	Backward 1 day
[*] (num. keypad)	Forward 1 day
[−] (num. keypad)	Backward 1 hour
[+] (num. keypad)	Forward 1 hour
[Enter]	Open the quick aim window
[Ctrl]+[+] (num. kpad)	Accelerate animation speed
[Ctrl]+[−] (num. kpad)	Decelerate animation speed
[Ctrl]+[I]	Invert animation speed

11 Examples

We will now present examples to illustrate the use of Perseus in solving some typical practical problems. We strongly encourage you to follow the descriptions step by step while running the program: you will learn a great deal on how to take advantage of Perseus when planning your observations. All examples start from the default startup simulation. Remember to set the time zone correctly in the Date/Time menu.

Example 1: Two observers claim they saw Mercury on April 9th, 1999, from Milan and Siracusa (in Sicily, not Syracuse, NY) with no instrument. Is this possible?

1. From the startup simulation (which is already located in Milan), set the local date to 04/09/1999.
2. Aim at Mercury.
3. Mercury is below the horizon at the moment. If you make the horizon semitransparent, you will see that the two are about 26° apart. It seems thus like there are good chances of seeing the planet. Mercury is ahead of the Sun on the Ecliptic, so it will be visible at dawn (as you can see in the sample simulation "Example – Mercury from Milan").
4. Let Mercury rise (right click on the Date/Time button and select Make screen center rise). Whoops! Mercury rises at 6:06AM, and the Sun is just 8° below the horizon. How come? Activate the Equatorial coordinates (hit the [Q] key) and you will see that Mercury is 4° South of the celestial equator, while the Sun is 7° above it. If you are in Milan, you basically have no chances to see the planet.
5. Advance time to 6:30AM. Mercury is now 3° above the horizon, while the Sun is 5° below it. The observation is very difficult - if not impossible. How are things in Siracusa?
6. Lock Mercury, and then change your location to Siracusa. At the same moment in time, the Sun has almost risen, but Mercury is definitely higher in the sky. Let's advance in time.
7. Set up an animation with 1-minute increments: you will see that the observation is still somehow possible around 6:00AM.
8. At 6:00AM Mercury is 5° above the horizon, and the Sun is still 8° below it. Observation is difficult, but not impossible.

Example 2: From Aosta (Northern Italy), on April 9th, 2002, we want to take a picture of the M96 galaxy group with a 24x36 film on a telescope with a 2m focal length. What are the conditions?

1. From the startup simulation, change the local time and date. You will be looking at the Virgo and the Leo.
2. Aim to M96 and turn on the RealDeep objects.
3. Zoom in until your visual field is about 5°.
4. With the Today's Altitudes command you can see that the current screen center (M96) is close to culminating and the Moon is not interfering: photographic conditions are optimal.
5. Use the Add Eyepiece/Camera/CCD Field command to display the field a telescope with a 2m focal length would have with a 24x36 film.
6. You can now increase the number of stars and objects, or find other galaxies in that region.

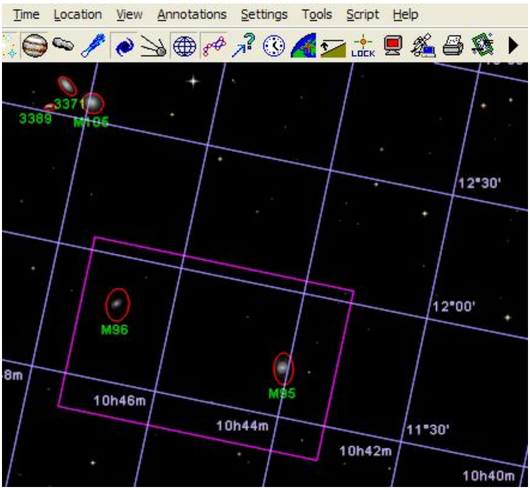


Fig. 58

Example 3: Will you be able to show Saturn to a friend during a 2010 Star Party? All you know is that the event will take place in at the beginning of March.

1. From the startup simulation, set the date to March 10th, 2010. Since the location on the earth is irrelevant (if you don not live very close to a pole...), you will not need to change the location.
2. Aim to Saturn. Notice it just rose.

3. Look for the moment in time when it culminates. Saturn will culminate late at night, but at that moment it will be well above the horizon. Perfect position for observing.

Example 4: Solar eclipse on August 11th, 1999 from Milan and Vienna (Austria).

1. Set the date and the time to 12 UT.
2. Set the visual field to 5°.
3. Aim at the Moon and lock it.
4. Deactivate the surface details names.
5. Zoom in again.
6. Set up an animation with 10-minutes increments and go back in time (Shift + t). When you are close to the critical point, use Ctrl + Shift + t.
7. You will see that the eclipse is at its maximum around 12:36.
8. Now move to Vienna (in the location database, "[Austria] Wien").
9. Here the eclipse is not yet at the maximum.
10. Go ahead at one minute steps; you will find the maximum around 12:47. As you can see, Vienna was right at the edge of the totality "strip". Move to Munich (Germany): the eclipse is even more visible.
11. What would we see from Palermo (Sicily)? Not too well - try: over one third of the Sun is uncovered.

12 Making a panoramic image

Perseus is able to read 360° panoramic images in .PNG format and integrate them perfectly in the simulation to achieve maximum realism.

To obtain good results it is necessary to follow these guidelines.

- The image can have whatever size in pixel, but it must cover all 360° on the horizon.
- The height of the image can be up to half the width; in this case it will cover 180° in height (from the nadir to the zenith). In any case, the image will be divided so that it will be half above and half below the horizon. For example, if you use a 2000x500 pixel image, the 2000 pixels of width will cover 360° on the horizon, and the 500 pixels of height will cover 90°, 45° above and 45° below the mathematical horizon.
- The origin of the image must correspond to the north direction.
- The sky must be transparent. Perseus uses transparency to show (or hide) the sky behind the panoramic image. It is possible to use the transparency to simulate effects such as half-transparent clouds or haze at the horizon. This is *very important* because a "normal" panoramic image has the sky blue and not transparent! If you use a normal panoramic image you will not see the sky in Perseus. If you have a panoramic image made with a camera and a dedicated software (the usual case), you will have to use an image editor to make the sky transparent. This is also the reason why Perseus needs a .PNG image file and not, for example, the usual .JPG: the .PNG format is the only widespread format allowing transparency.

In the pictures you see an example on how to use a panoramic image (figure 59) and the result in Perseus (figure 60).

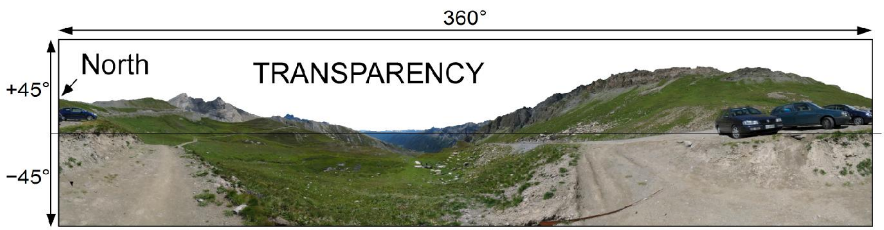


Fig. 59

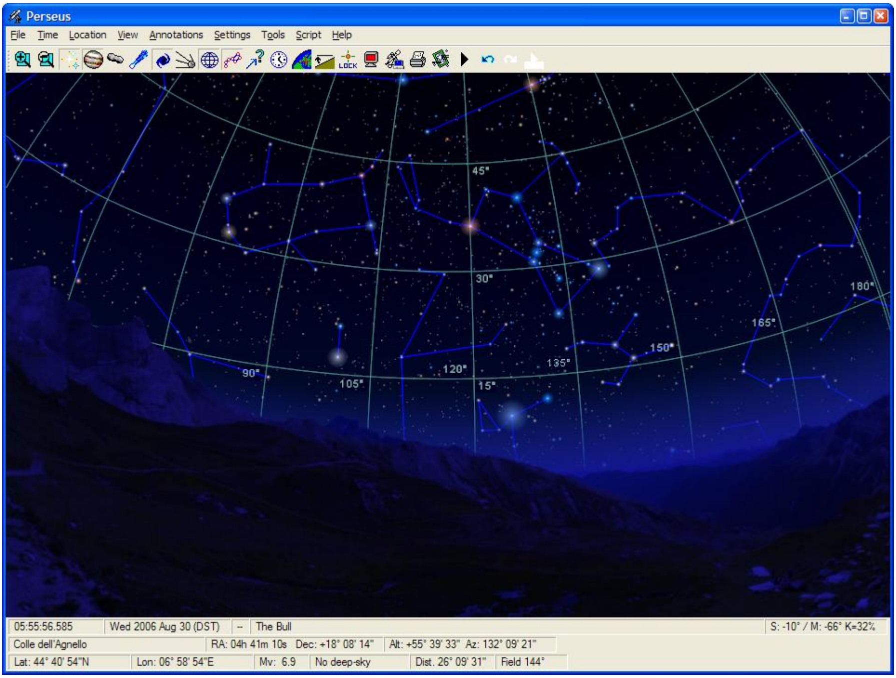


Fig. 60

12.1 Creating the panoramic image

Many programs are available to make panoramic images, free or not. One of the free ones is **hugin** (*hugin.sourceforge.net*) which allows you to compose a panoramic image from images taken with a digital camera. If you use hugin, make sure that the horizontal angle is 360°.

You will find software for making panoramic images also included with many digital cameras.

When you have the panoramic image, you will have to use a photo editing software such as *Photoshop Elements* (commercial, but often included with digital cameras or scanners) or *GIMP* (free).

Using Photoshop Elements

Open the panoramic image. Open the layers palette and double click on the "Background" layer. You can use safely the defaults in the dialog window that appears and click OK. Now use the magic wand to select the sky and delete it with [Ctrl]+[X]. The sky will be made transparent (it should appear as a checkerboard). Save the file as a .PNG image.

Using the GIMP

Open the panoramic image. Select Image → Alpha → Add Alpha Channel. Now use the magic wand to select the sky (if the entire sky is not selected at once, hold down [Shift] and add the other parts of the sky to the selection) and delete it with [Ctrl]+[X]. The sky will be made transparent (it should appear as a checkerboard). Save the file as a .PNG image.

13 Command line

Perseus can be started from the command line, where it can accept arguments that can be useful to automate some procedures.

--force_new_instance	Execute a new instance of Perseus even if Perseus is already running. Normally, if Perseus is running, starting it again will not create a new instance.
--execute_script <file>	Load and execute the script specified in <file> (only level III)
--load_situation <file>	Load the situation specified in <file>
--associate_files	Associate the files with .PSIT and .PSCR extension to Perseus. Normally this is done during the installation process.
--full_screen=yes	Execute Perseus full–screen.
--full_screen=no	Execute Perseus not full–screen.

14 Installing and removing components of Perseus

Please use Perseus' installer and uninstaller to setup and remove Perseus' components; otherwise you could have undesired results. You cannot copy an installed copy of Perseus to another computer. The only allowed manual operations are:

– If you made a minimal installation of Perseus and want to copy the RealDeep images to your hard drive, copy the contents of the SFONDO folder from the CD to the same folder on your disk.

– The same holds if you want to copy the supernovae charts; in this case the folder is labeled CARTINE.

When you uninstall Perseus, all files you created (scripts, horizons, color settings, and simulations) are left on your hard disk (in ...\PERSEUS\SAVED) and can be copied, moved, or deleted as ordinary files and directories.

15 Further information – customer service – upgrades

If you have any question on Perseus, wish to report a bug, or have any suggestion, please contact the email address *info@perseus.it*.

Perseus' website is *www.perseus.it*; check it for availability of upgrades.

WARNING

If you contact the customer service, you will need the serial number of your copy, without it no assistance will be available. You can see the serial number (and the activation code, if needed) selecting from the menu Help → About Perseus.

16 Printout Samples

Here are some sample printouts obtained from Perseus' simulations. Remember to set the print parameters in order to optimize the quality of the result.

M104 with RealDeep and USNO stars, together with track of 2000QJ1 asteroid.

M84 and M86 chart, without USNO stars, with coordinate grid.

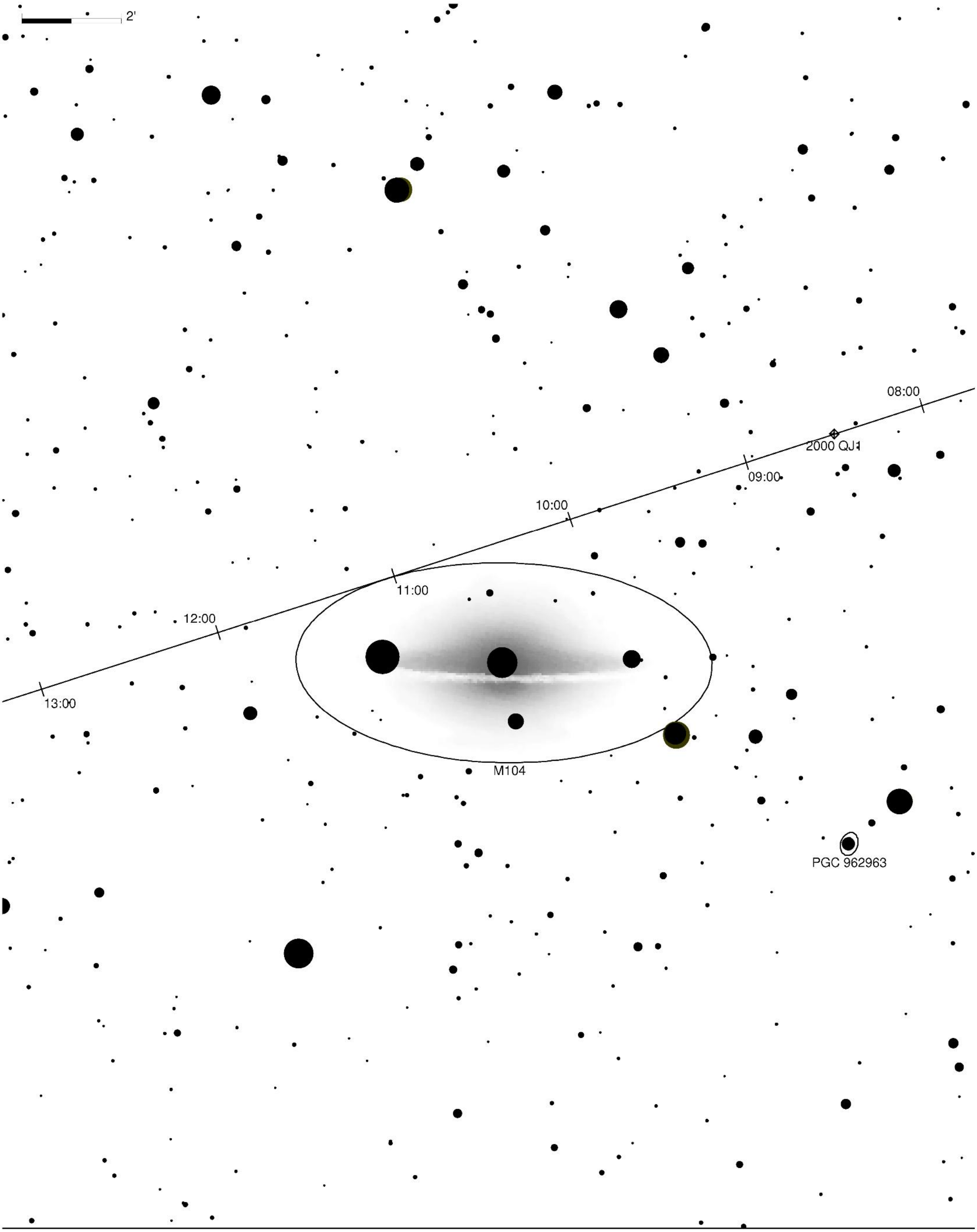
Same as above, at higher magnification, without coordinates.

Wide field view of Orion rising.

Wide field view of Orion.

Moon in its first quarter with track of an occultation.

Europa's transit in front of Jupiter.

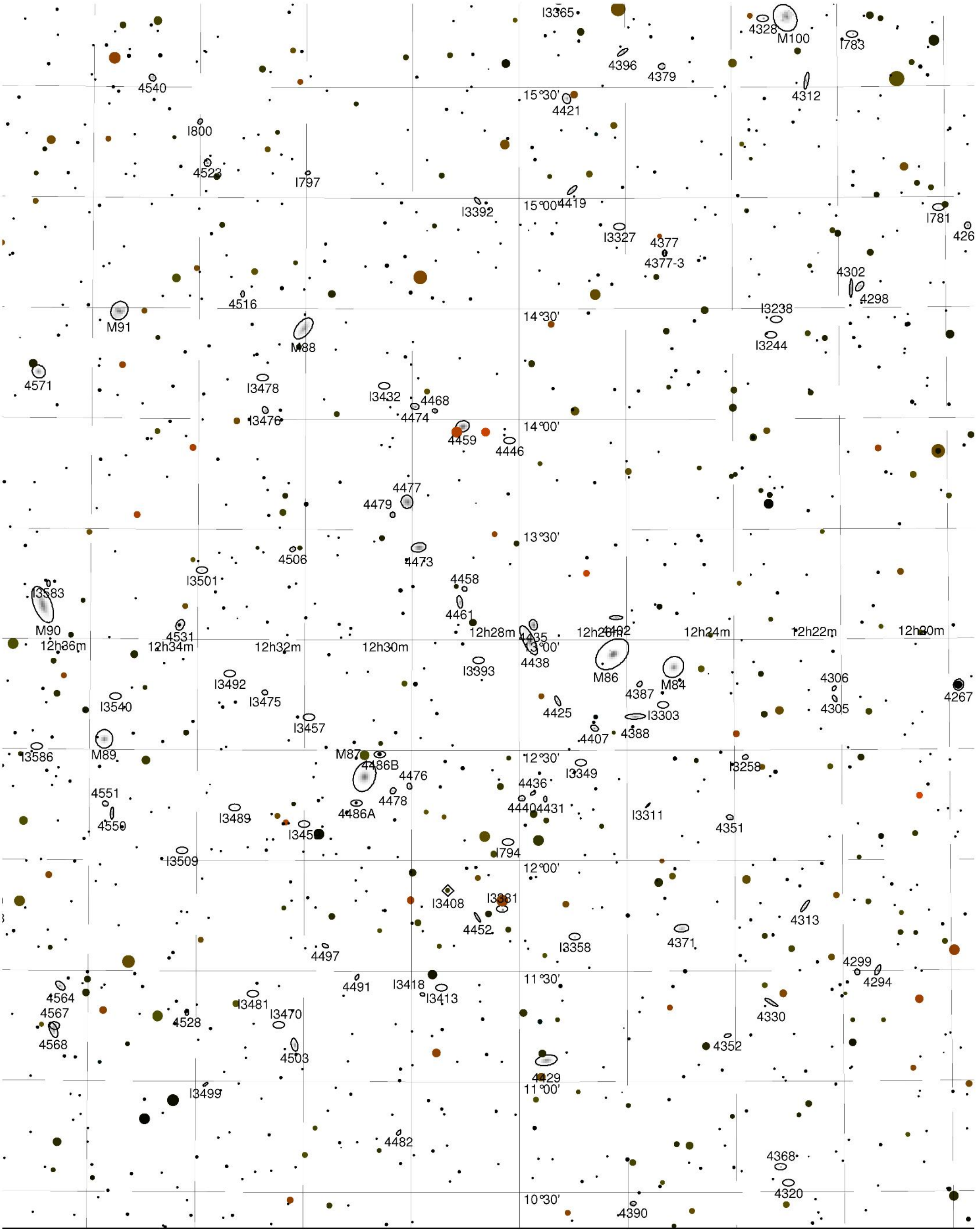


Date 30/Nov/2001 Time 08:30:00.000
Location: [Italy] Milano, Earth
elev. 0 m
lon. -09° 12' 00", lat. +45° 28' 12"
Centre(ICRS) R.A. 12h 40m 00s, Dec. -11° 36' 19"
Limit mag. 19.5

Stars: 12 13 14 15 16 17 18 19

Galaxies
Dark nebulae
Globular clusters
Quasar
Comets
Asteroids
Nebulae
Open clusters
Planetary nebulae

Perseus

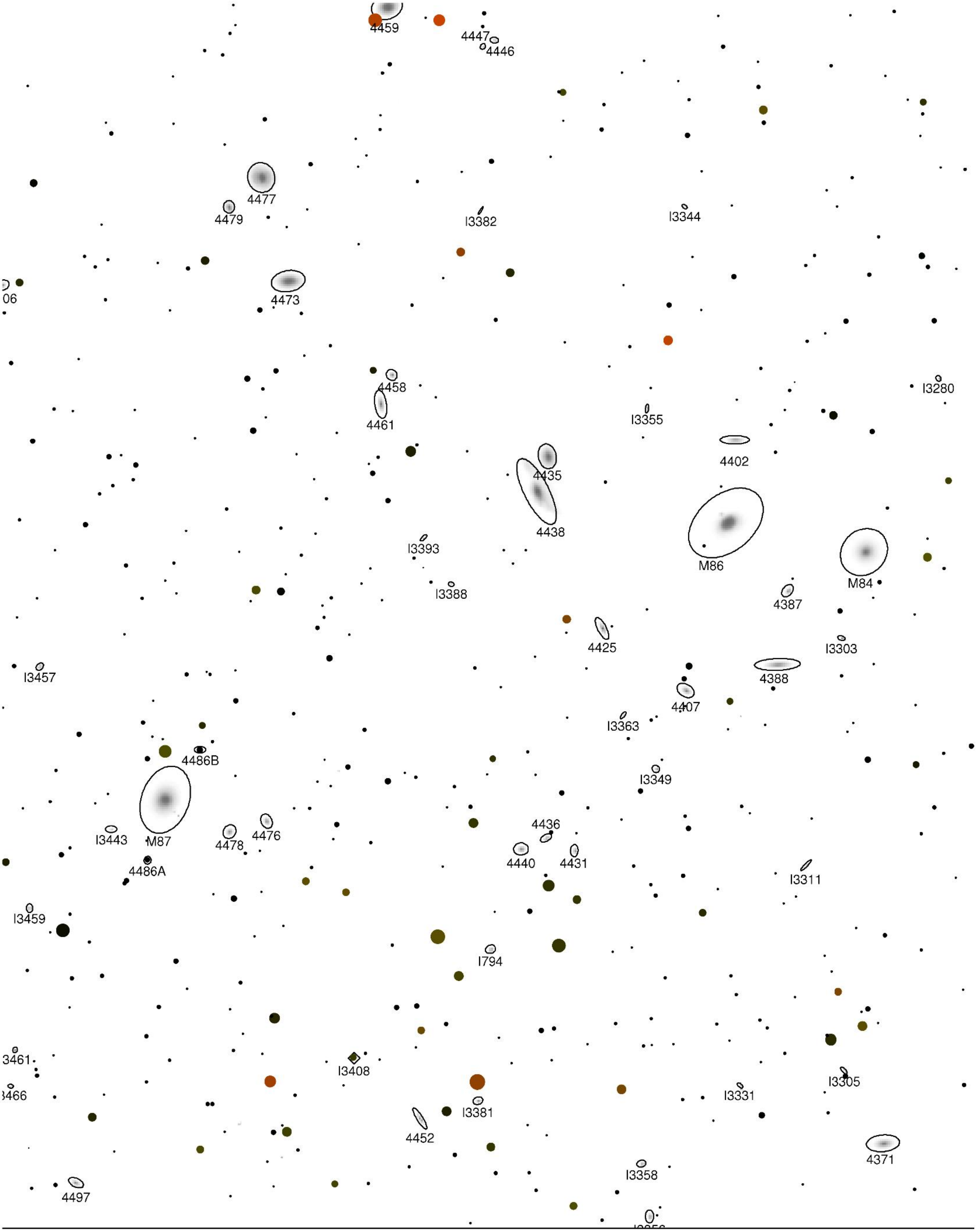


Date 30/Nov/2001 Time 08:30:00.000
Location: [Italy] Milano, Earth
elev. 0 m
lon. -09° 12' 00", lat. +45° 28' 12"
Centre(ICRS) R.A. 12h 28m 31s, Dec. +13° 07' 15"
Limit mag. 13.1

6 7 8 9
10 11 12 13
Stars

Galaxies
Dark nebulae
Globular clusters
Quasar
Comets
Nebulae
Open clusters
Planetary nebulae
Asteroids

Perseus

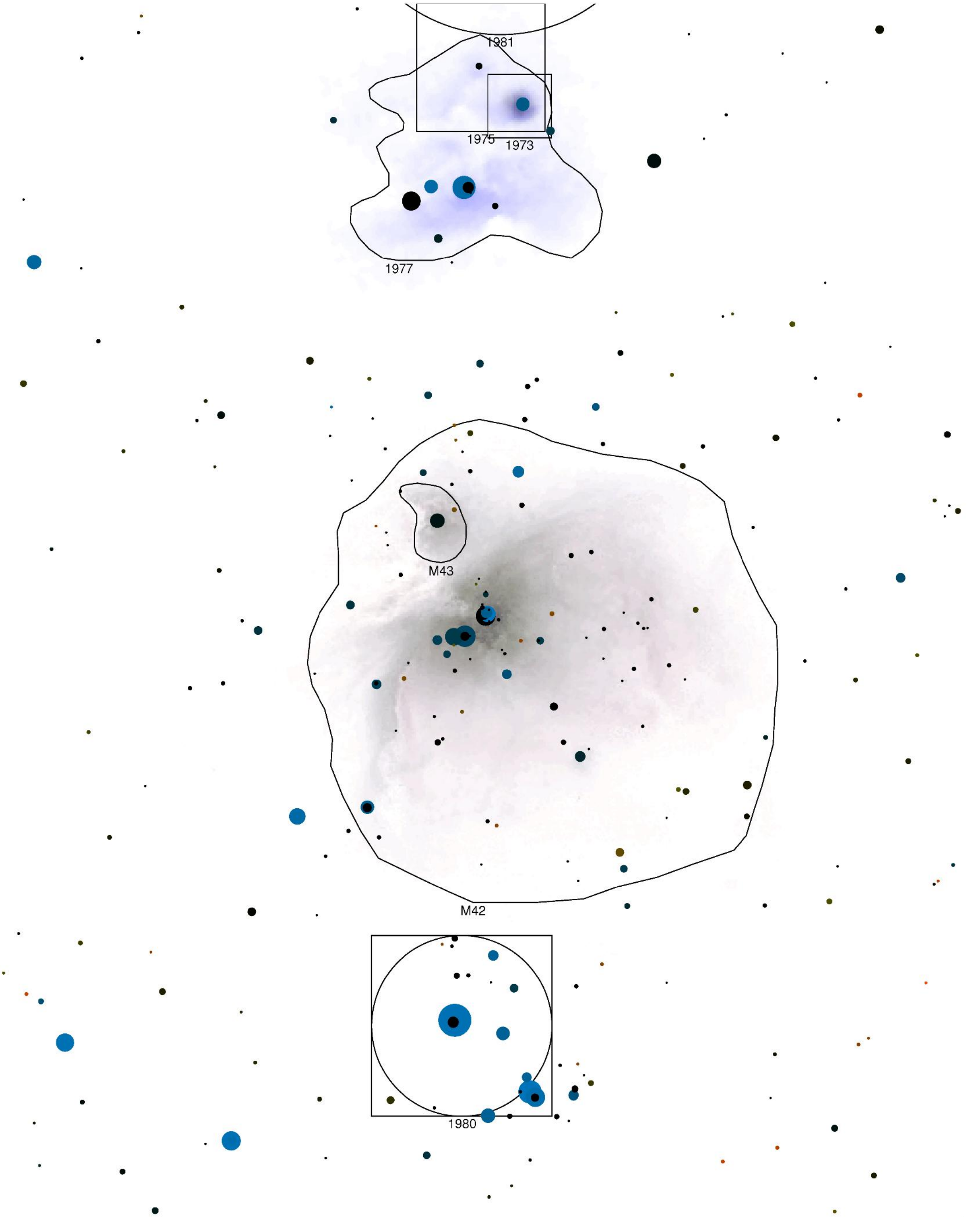


Date 30/Nov/2001 Time 08:30:00.000
Location: [Italy] Milano, Earth
elev. 0 m
lon. -09° 12' 00", lat. +45° 28' 12"
Centre(ICRS) R.A. 12h 28m 09s, Dec. +12° 45' 41"
Limit mag. 14.5

Stars: 7 8 9 10 11 12 13 14

Galaxies
Dark nebulae
Globular clusters
Quasar
Comets
Nebulae
Open clusters
Planetary nebulae
Asteroids

Perseus

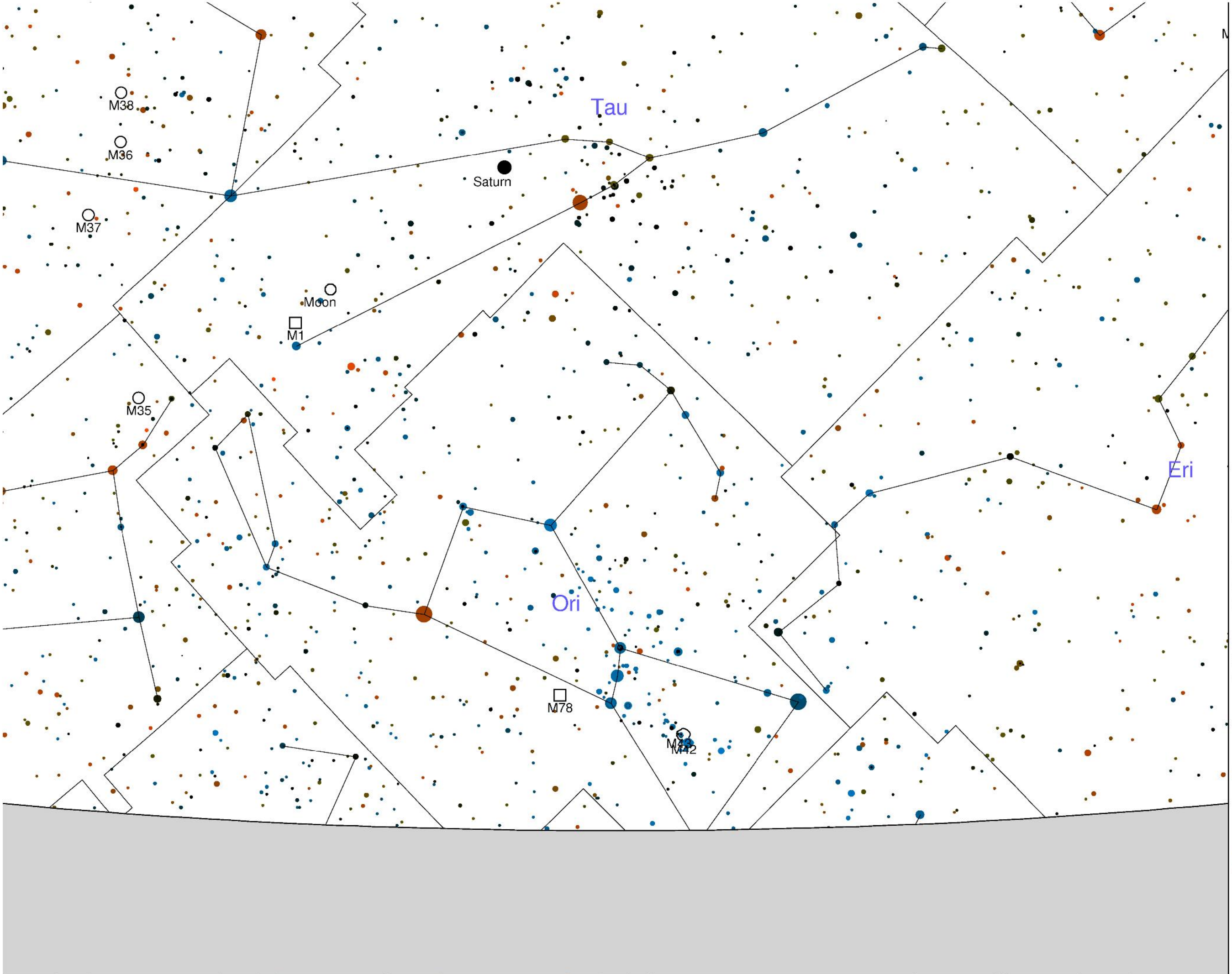


Date 30/Nov/2001 Time 08:30:00.000
Location: [Italy] Milano, Earth
elev. 0 m
lon. -09° 12' 00", lat. +45° 28' 12"
Centre(ICRS) R.A. 05h 35m 19s, Dec. -05° 22' 57"
Limit mag. 13.2

6 7 8 9
10 11 12 13
Stars

Galaxies
Dark nebulae
Globular clusters
Quasar
Comets
Nebulae
Open clusters
Planetary nebulae
Asteroids

Perseus

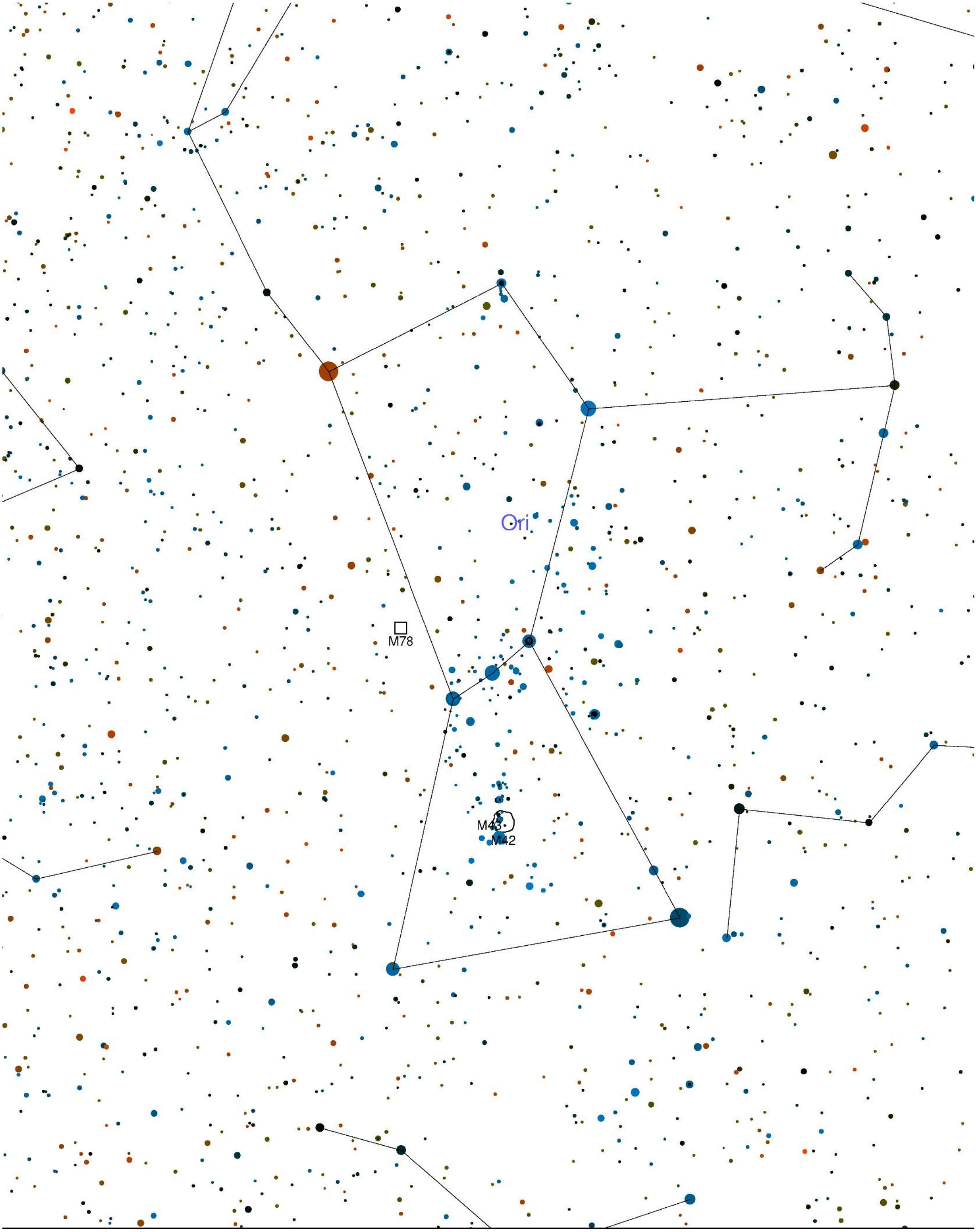


Date 01/Dec/2001
Time 19:59:59.998
Location:
[Italy] Milano, Earth
elev. 0 m
lon. -09° 12' 00''
lat. +45° 28' 12''
Centre (ICRS):
R.A. 05h 11m 06s
Dec. +05° 29' 20''
Limit mag. 7.2

Stars 0 1 2 3 4 5 6 7

Galaxies
Nebulae
Dark nebulae
Open clusters
Globular clusters
Planetary nebulae
Quasar
Comets
Asteroids

Perseus



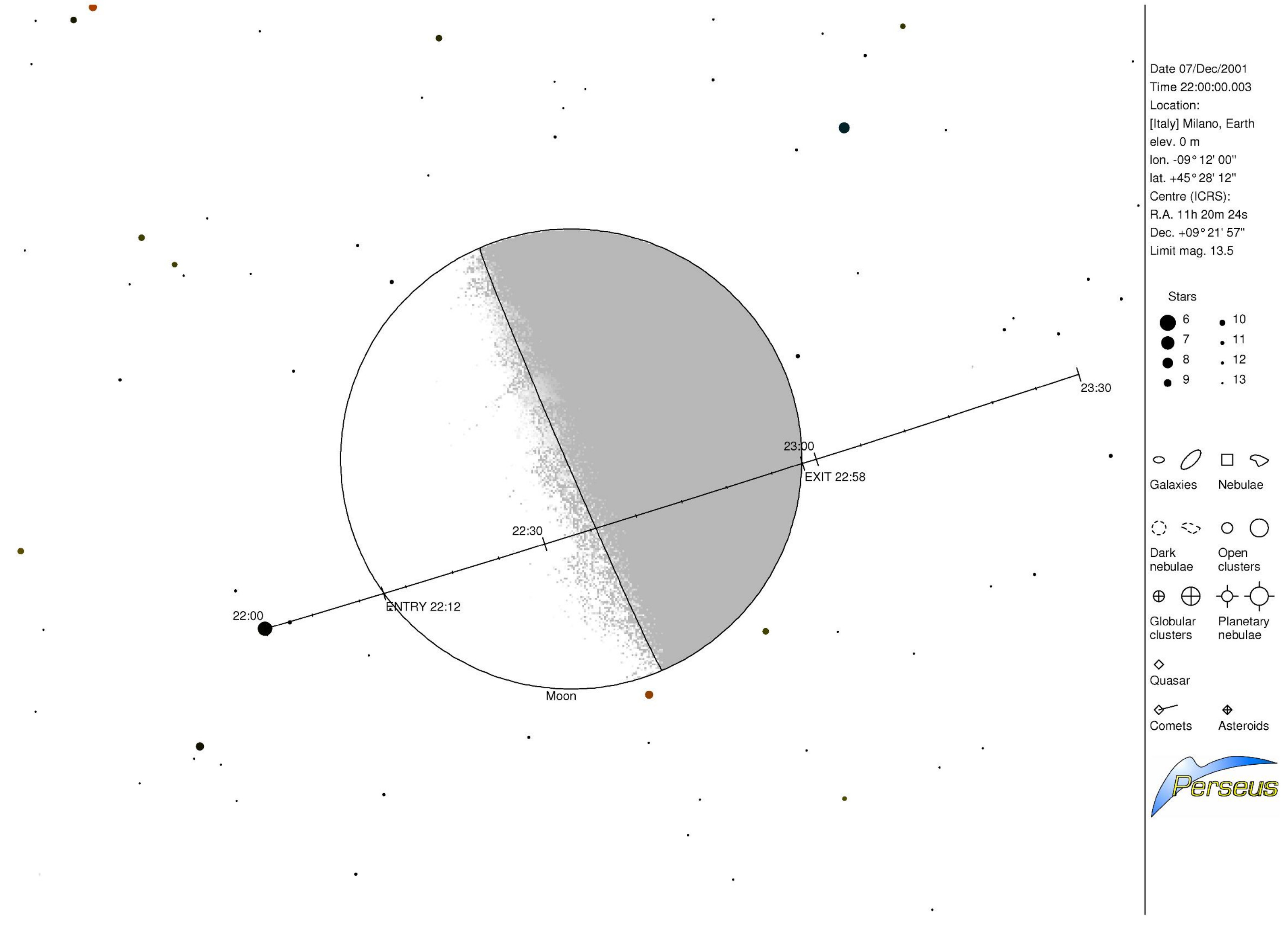
Date 30/Nov/2001 Time 9:59:59.998
Location: [Italy] Milano, Earth
elev. 0 m
lon. -09° 12' 00", lat. +45° 28' 12"
Centre(ICRS) R.A. 05h 36m 51s, Dec. +00° 27' 41"
Limit mag. 8.1

Stars: 1 2 3 4 5 6 7 8

Galaxies | Dark nebulae | Globular clusters | Quasar

Nebulae | Open clusters | Planetary nebulae | Comets | Asteroids

Perseus


22:00
ENTRY 22:12
22:30
23:00
EXIT 22:58
23:30
Moon
Date 07/Dec/2001
Time 22:00:00.003
Location:
[Italy] Milano, Earth
elev. 0 m
lon. -09° 12' 00"
lat. +45° 28' 12"
Centre (ICRS):
R.A. 11h 20m 24s
Dec. +09° 21' 57"
Limit mag. 13.5
Stars
6 7 8 9 10 11 12 13
Galaxies
Nebulae
Dark nebulae
Open clusters
Globular clusters
Planetary nebulae
Quasar
Comets
Asteroids
Perseus

Date 01/Dec/2001 Time 20:00:00.003
Location: [Italy] Milano, Earth
elev. 0 m
lon. -09° 12' 00'', lat. +45° 28' 12''
Centre(ICRS) R.A. 07h 01m 59s, Dec. +22° 36' 23''
Limit mag. 19.8

12 13 14 15
16 17 18 19
Stars

Galaxies
Nebulae
Dark nebulae
Open clusters
Globular clusters
Planetary nebulae
Quasar
Comets
Asteroids

Perseus