TheSkyX Professional and Serious Astronomer Edition User Guide

Revision 1.2.3

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Welcome to TheSkyX

Many of you have never seen the sky. Not really. If you live in a city or suburb, a pale blue or grey dome looms overhead while the Sun is up, and a darkish brown curtain hangs down at night, with maybe a few sparks of light poking through here and there if the clouds haven't gathered and the glare from buildings and cars and billboards isn't overwhelming. The Sun and the Moon are unmistakable of course, but the spattering of stars you glimpse are probably strangers to you. Some of them might even be planets – for most people, it's hard to tell the difference.

All of this is about to change. You have in your hands an extraordinary tool for revealing not just new worlds, but the entire universe. The night sky is an incredible wonderland of diverse and spectacular objects and phenomena. Some of these breathtaking sights are created by tiny particles that ply the fringes of our atmosphere. Others are immense, ancient structures, incomprehensibly far away.

TheSkyX Professional Edition or *TheSkyX Serious Astronomer Edition* will bring all of these amazing marvels and more to your desktop. It will help you learn the fundamentals of astronomy, the most ancient science, and teach you how to recognize just about everything in the real sky. Whether you're looking up from the streets of a light-polluted city, or taking in the view from a remote, pitch-black mountaintop, or controlling your distant observatory from Internet, *TheSkyX* will help you understand what you see and find what you're looking for.

You'll also enjoy experiences that are only possible through the magic of simulation and virtual-reality programming. Faster-than-light flights through the solar system, out-of-this-world views of the Earth and Moon, and the orbital tracks of hundreds of satellites are just some of the animations built into *TheSkyX*. Trips through space and time that were once possible only in the imagination will be vividly brought to life on your computer screen.

TheSkyX has something to offer everyone, from the absolute beginner to the most knowledgeable amateur astronomer. This User Guide will help you navigate the basic features and tools our unique program has to offer.

The sky is waiting for you. Let's get started!

Getting Started

TheSkyX Professional Edition and *Serious Astronomer Edition* (hereafter referred to simply as *TheSkyX*) are available for either Mac or Windows operating systems. Operating system specific versions are sold separately, so please make sure you have the right product for your computer before proceeding.

Throughout this document, *TheSkyX Professional Edition*-specific features are accompanied by the Professional Edition graphic below.

PROFESSIONAL

Updating Your Computer's Video Driver

If you use Windows, Software Bisque *strongly recommends* updating your computer's video display driver before installing and opening *TheSkyX*. *TheSkyX* takes advantage of software called *OpenGL* to show 2D and 3D planets, animations, and photos at video-quality frame rates. To enjoy *TheSkyX's* entire feature set, and for the best overall performance, make sure that your computer has OpenGL version 1.5 or later installed.

A utility application called *TheSkyX Compatibility Test* can be run on your computer to determine the OpenGL version. This app can be downloaded from TheSkyX Compatibility Test page on the Software Bisque web site.

When you open *TheSkyX Compatibility Test*, and your computer is not running OpenGL 1.5 or later, the following window appears:

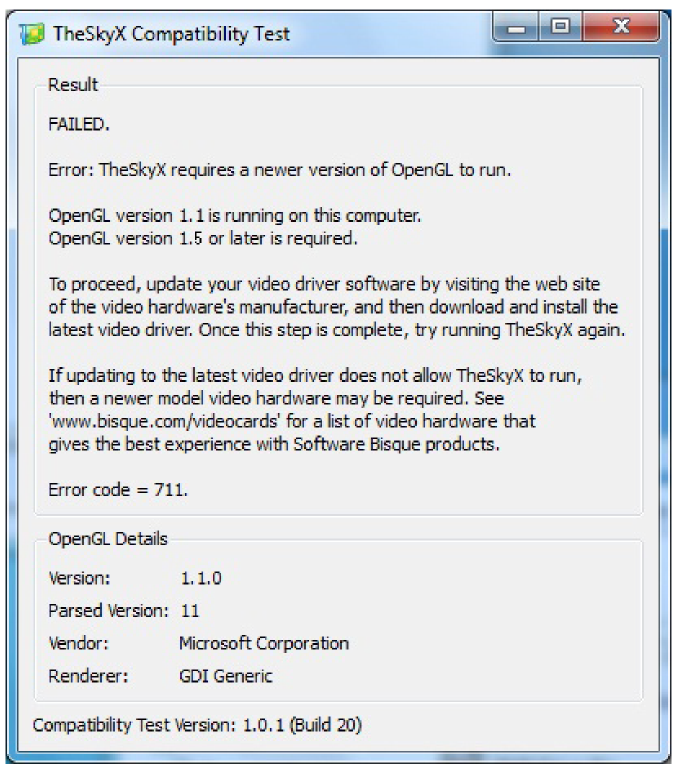


Figure 1: TheSkyX Compatibility Test window that appears when OpenGL version 1.5 or later is not present.

Installing Mac Video Drivers

The latest version of OpenGL is included with the OS X software updates. Click the Apple icon, then click the ***Software Update*** command to make sure your Mac is up to date. That's it.

Windows 7, Windows Vista and Window XP Video Drivers

For all 32- and 64-bit editions of Windows, the latest version of OpenGL is distributed as part of your computer's *video driver* (the video driver is software that communicates with the video display hardware).

In order to obtain the latest version of OpenGL, you must install the latest video driver *directly from the original equipment manufacturer (OEM) of your computer's video display adaptor.*

Video driver software is updated very frequently, so chances are you don't have the latest driver installed on your computer right now.

To Properly Update the Windows Video Driver and OpenGL

To properly update the Windows video driver and OpenGL, first determine the make and model of your computer's video display adaptor. Both are listed in the Windows *Device Manager* (see Windows Help for details about accessing the Device Manager from XP, Vista and Windows 7).

- ***Do not use Windows Update*** to try to obtain latest video drivers. Windows Update installs video drivers from Microsoft, not from the hardware manufacturer.
- In general, ***do not use the video driver that is supplied by Microsoft Windows*** as it often does not include the latest version of OpenGL or the latest video driver for your video hardware.

Next, visit the Downloads page of the ***video driver manufacturer:***

- AMD (ATI)
- Intel
- NVIDIA
- S3 Graphics

From there, download and install the latest video driver according to the video display hardware manufacturer's instructions.

After installing the latest Windows video driver, you're ready to install and run *TheSkyX*.

Running TheSkyX without OpenGL

TheSkyX can be run on a computer that does not have, or cannot support OpenGL 1.5 or later. For example, video driver software that supports OpenGL 1.5 or later for older video hardware simply may not exist. Or, some remote control applications, such as

Windows XP Pro's Remote Desktop, cannot run applications that use OpenGL graphics acceleration.

When *TheSkyX* is launched for the first time, it determines if a suitable version of OpenGL is installed, then configures the display mode accordingly. To manually configure *TheSkyX* to run without OpenGL, click the ***Preferences*** command from the ***Tools*** menu (Windows) or the ***Apple*** menu (Mac) to show the ***Preferences*** dialog. Select the ***No OpenGL*** option from the ***OpenGL Detection Mode*** list and then click ***Close***. Restart TheSkyX for this setting to take effect.

The following features will not be available when the ***No OpenGL*** option is selected.

- Photographic panorama horizons (page 151).
- Solar and Lunar Eclipse Viewer (page 117)
- Satellites From Above Earth (page 121)
- 3D Stars (page 101)
- 3D Solar System (page 115)
- Planets rendered using 2D ellipses instead of 3D-like photographs.

Minimum System Requirements

Please review the minimum system requirements before installing *TheSkyX* on your computer.

Mac

TheSkyX Serious Astronomer Edition for Mac can run on any Mac desktop or laptop computer with OS X 10.4.8 or later with a 1.25 GHz or faster G4 PowerPC processor, or a 2 GHz or faster Core Duo processor. You also need at least 512 MB RAM, 64 MB video RAM, and 1.3 GB of free disk space, a mouse or other pointing device and a DVD ROM drive.

PROFESSIONAL

TheSkyX Professional Edition for Mac has the identical minimum requirements, except that a total of 2.5 GB of free disk space is required.

Windows

TheSkyX for Windows can run on any desktop or laptop computer running Windows 7, Vista or XP with a 1.5 GHz or faster Intel Pentium 4, Pentium M, Pentium D, or AMD K-8 (Athlon) or better processor. You also need at least 512 MB RAM, 64 MB video RAM, and 1.3 GB of free disk space, a mouse or other pointing device and a DVD ROM drive.

PROFESSIONAL

TheSkyX Professional Edition for Windows has the same minimum requirements, except that a total of 2.5 GB of free disk space is required.

Installing TheSkyX

Macintosh

Like all Macintosh software, *TheSkyX* is easy to install. Insert the DVD in the DVD-ROM drive. *TheSkyX* icon appears on your desktop once the media is recognized. Double click it. *TheSkyX* install icon should now appear. Double click that icon and follow the prompts. You'll be asked for the all the usual stuff.

If you're curious about exactly what files are installed to your Mac, turn on the Installer application's logging feature. From the Installer menu, click the Install Log (⌘L) command on the Window menu then click the ***Show All Logs*** command in the pop-up menu on the Install Log window. You might want to print the Installer log for future reference by clicking the ***Print*** button.

To launch *TheSkyX*, click ***Go > Applications*** from Finder (⇧⌘U), then double-click on *TheSkyX* (Serious Astronomer Edition or Professional Edition) icon.

Windows 7 or Windows Vista

To install *TheSkyX* under Windows 7 or Windows Vista:

1. Log on as an administrator. *TheSkyX* requires administrative privileges to be installed under these operating systems.
2. Insert the DVD-ROM in the DVD-ROM drive.
3. Click ***Start > Computer***.
4. On the Computer window, select the removable storage device that holds *TheSkyX* media, and then click the ***AutoPlay*** button (it's located in the tool bar near the top of this window).
5. On the AutoPlay window, click ***Run Readme***.
6. After carefully reading the instructions in the ReadMe file, click the ***Click Here to Begin Installation*** link. Follow the on-screen instructions to complete the installation.

Windows XP

To install *TheSkyX* under Windows XP:

1. Log on as an administrator. *TheSkyX* requires administrative privileges to be installed under XP.
2. Insert the DVD-ROM in the DVD-ROM drive and wait for the ReadMe file to appear in a browser window. If XP's AutoRun is not active, then click ***Start > My Computer***, right-click on the removable storage device that holds *TheSkyX* media and then click ***Open***. Next, double-click the file named ***ReadMe*** on *TheSkyX* media to proceed.
3. After carefully reading the instructions in the ReadMe file, click the ***Click Here to Begin Installation*** link. Follow the on-screen instructions to complete the installation.

You can bypass the ReadMe and just run *setup.exe* on the distribution media to begin the installation process.

Minimum Free Drive Space on Windows

The Microsoft Windows Installer must cache files in the during installation, therefore, ***the drive that holds the Windows operating system*** must have approximately ***three times the amount of free disk space*** as the product's installer requires.

This means, for example, when installing the 2.5 GB *TheSkyX Professional Edition*, the drive where the Windows operating system is installed should have at least 7.5 GB of free disc space. Otherwise, an "out of disk space" error can occur (even if the destination drive has ample free space).

This is limitation of Microsoft Windows Installer.

To open *TheSkyX*, click ***Start > All Programs > Software Bisque > TheSkyX Serious Astronomer Edition > TheSkyX Serious Astronomer Edition***.

Removing TheSkyX

If you wish to remove or uninstall *TheSkyX* from your computer please follow the procedure outlined below.

Macintosh

1. From Finder, click ***Go > Applications*** to open the ***Applications*** folder.
2. Drop *TheSkyX Professional Edition* or *TheSkyX Serious Astronomer Edition* application to the trash. Note that you must empty the trash before re-installing. The files you create with *TheSkyX* are saved to the *Application Support* folder. See "Application Support Files" on page 19 for details.

Windows

1. Log on as an administrator.
2. Click ***Start > Control Panel > Uninstall a Program*** (or double-click the ***Add/Remove Programs*** from XP).
3. Select ***TheSkyX Professional Edition*** or ***TheSkyX Serious Astronomer Edition*** from the list of installed programs, and click the ***Uninstall*** button (or click the ***Remove*** button under Windows XP).

Name and Serial Number Registration

The first time *TheSkyX* is launched, you'll be prompted to enter your name and serial number.

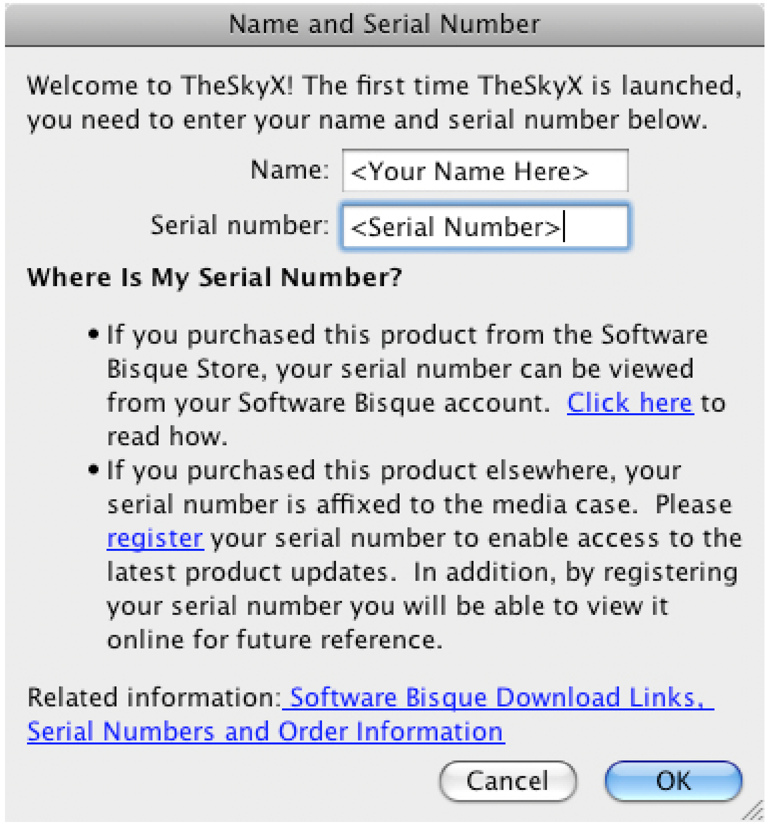


Figure 2: The Serial Number dialog.

If you purchased *TheSkyX* from the Software Bisque store, your serial number has already been registered, and is included as part of your web order information. To access your registered serial number from your Software Bisque account, sign in to www.bisque.com, then click your ***Sign In*** name on the upper right side of the page. On your account profile page, click the ***Subscriptions*** link on the left side of the page (below your account's avatar).

If you did not purchase the product directly from Software Bisque, your serial number is located on the outside of the media case. We urge you to register your software at www.bisque.com/register. After you register your serial number, you will be able to download the full product installer and latest update.

We also recommend that you keep a copy of your serial number for your permanent records. Your registered serial number serves as one form of proof of purchase for future updates, and you'll need it if you ever have to reinstall *TheSkyX*.

Small Computer Screens

When *TheSkyX* is opened on a Netbook computer or a laptop with a small screen, it automatically configures settings to maximize screen real estate.

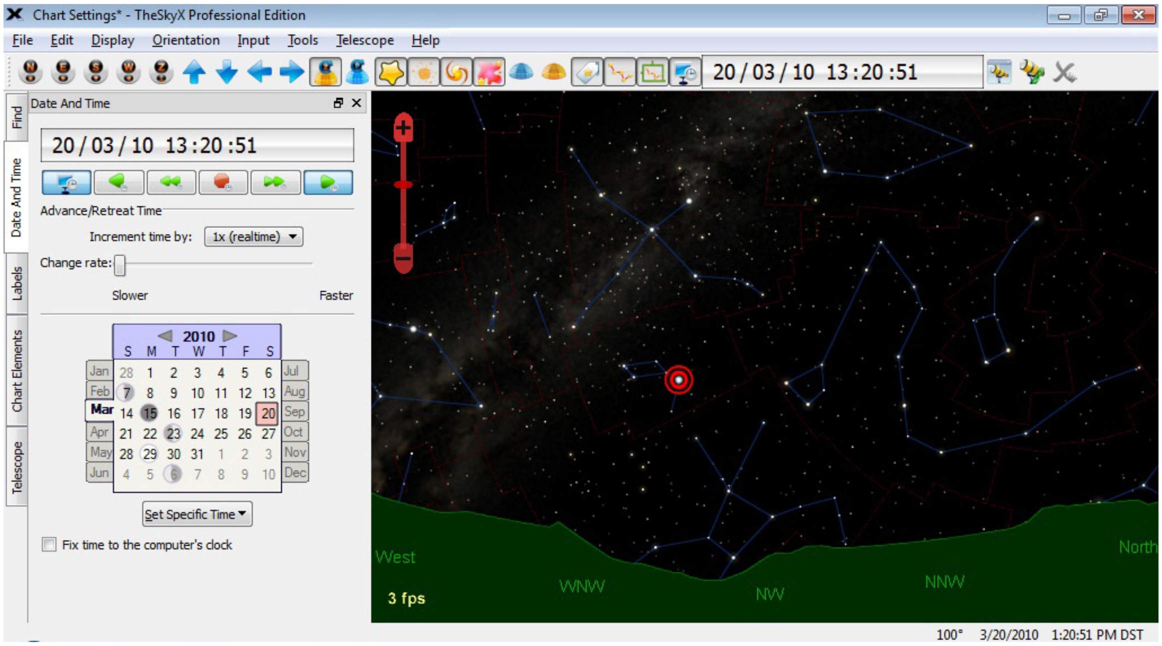


Figure 3: TheSkyX's window optimized for a 1024 x 600 Netbook computer.

The following reminder will be displayed.

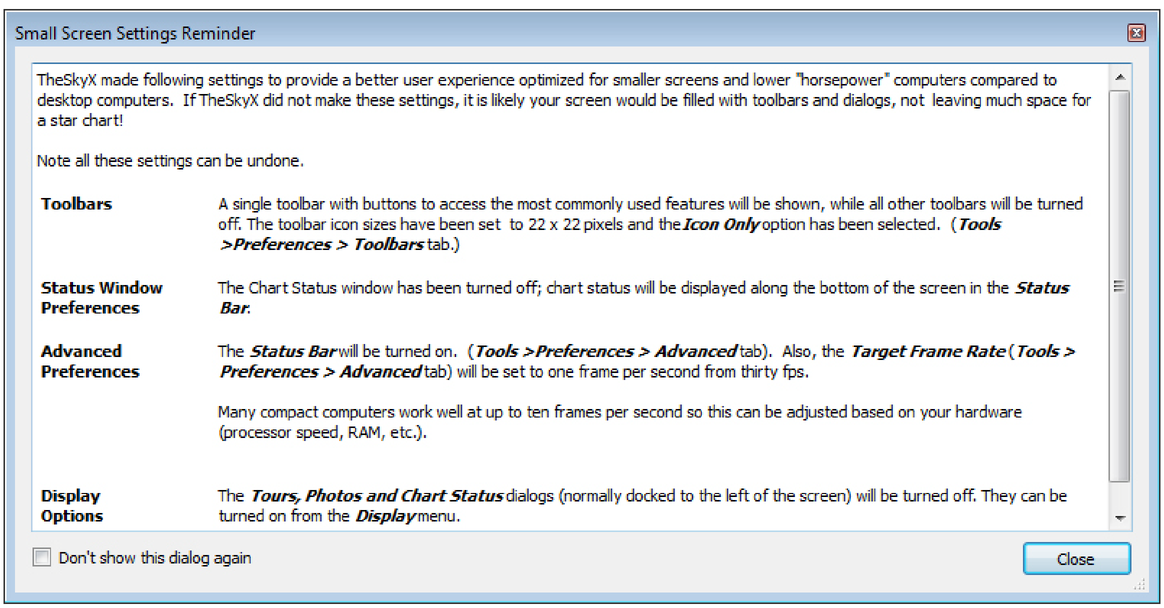


Figure 4: Small Screen Settings Reminder.

Turn on the ***Don't Show this Dialog Again*** checkbox to prevent this window from appearing in the future.

Application Support Files

When *TheSkyX* is launched for the first time, it creates a folder named *TheSkyX Professional Edition* or *TheSkyX Serious Astronomer Edition*. This folder is used to store *TheSkyX's* settings, such as location, time, field of view, etc., as well as tours, movies, exported databases, *TPoint Add On* settings files, and other *TheSkyX-related* files that you create and save.

Mac

TheSkyX's application support files and folders are located in the *Library/Application Support/Software Bisque* folder in your home directory.

Note that *TheSkyX's* support files and folders will remain in your home folder until they are sent to the trash. In other words, if you ever remove *TheSkyX* from your Mac (page 16), you will want to remove these files and folders, too.

Windows

*A*pplication support files and folders are located in the *Software Bisque* folder of your *Documents* (Windows 7 and Windows Vista) or *My Documents* folder.

Note that *TheSkyX's* support files and folders will remain in your *Documents* folder until they are deleted. *TheSkyX's* uninstaller (page 16) *will not delete files or folders in your Documents folder*.

We'll discuss customizing *TheSkyX* for your geographic location in a moment…

About This Documentation

The purpose of the User Guide is to familiarize you with the basic organization and structure of our program, and to introduce those of you who are new to the subject of astronomy to some of its most important terms and concepts. We also hope the Guide will stimulate you to become more interested in astronomy and space science, and excited to start learning about the extraordinary universe we live in.

We urge you join the Software Bisque support community at www.bisque.com/support. If you have questions, our support staff, and other knowledgeable astronomers, are there to help.

Having a Look Around

The star chart display is the heart and soul of *TheSkyX*. We call it the *Sky Chart*, to distinguish it from the real thing. To the left of the Sky Chart you'll find a series of stacked windows with vertical tabs to access the most commonly used commands and options. You can show or hide stacked windows from the ***Display*** menu.

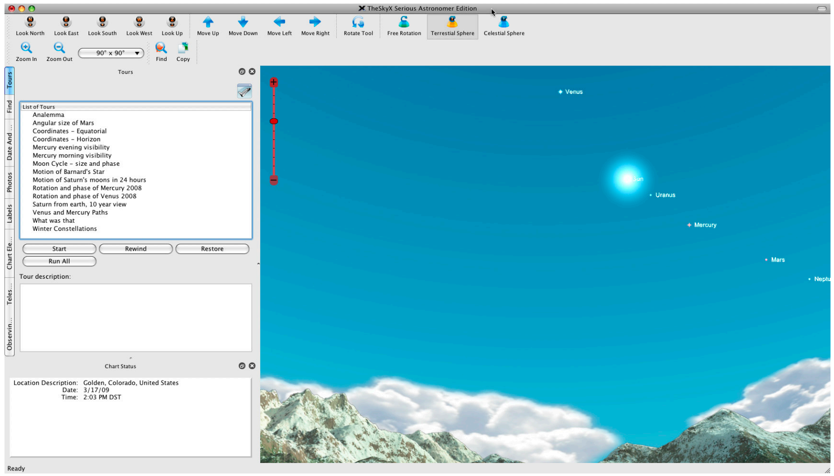


Figure 5: *TheSkyX's* default screen showing the Sky Chart in Daylight mode, with stacked tool windows on the left and toolbars on the top.

Figure 6: The toolbars (click and drag the checkered "gripper" on the left side of each toolbar to move it).

When *TheSkyX* is first launched, it attempts to automatically set your location using the web; the date and time are read from your computer's clock.

You'll also notice that if you are using *TheSkyX* during daytime, the sky it displays is blue (just like the actual sky). In a moment we'll describe how to change that to a night view even during the day.

To help you get started and more easily identify commands, the toolbar buttons are configured with large icons and text description.

The software authors understand that showing both a graphic and text consumes valuable real estate on notebooks, smaller computer screens, or when operating *TheSkyX* from a remote computer. To reduce the size of the toolbar buttons, click the ***Preferences*** command from the Tools menu (***TheSkyX*** menu on the Mac), then click the Toolbars icon. In the ***Appearance*** pop-up, select ***Icon Only***; in the ***Size*** pop-up, select ***Small*** and then click ***Close***. See "*Customizing Toolbars*" on page 130 for more information.

Right now, let's make sure that the program is set to display the Sky Chart from your location.

Entering Your Location

Home is where you hang your hat, and also where most of you probably view the sky. The first time *TheSkyX* is launched, your computer's IP address is used to place your location on Earth, typically within a few miles, which is "close enough" for most astronomy work.

If you know the precise longitude of your location, you can enter it, or choose the name of the city you live in, or the one closest to you, from the list in the ***Location*** window.

1. Highlight the ***Input*** item in the main menu.
2. Select the first command, ***Location***.

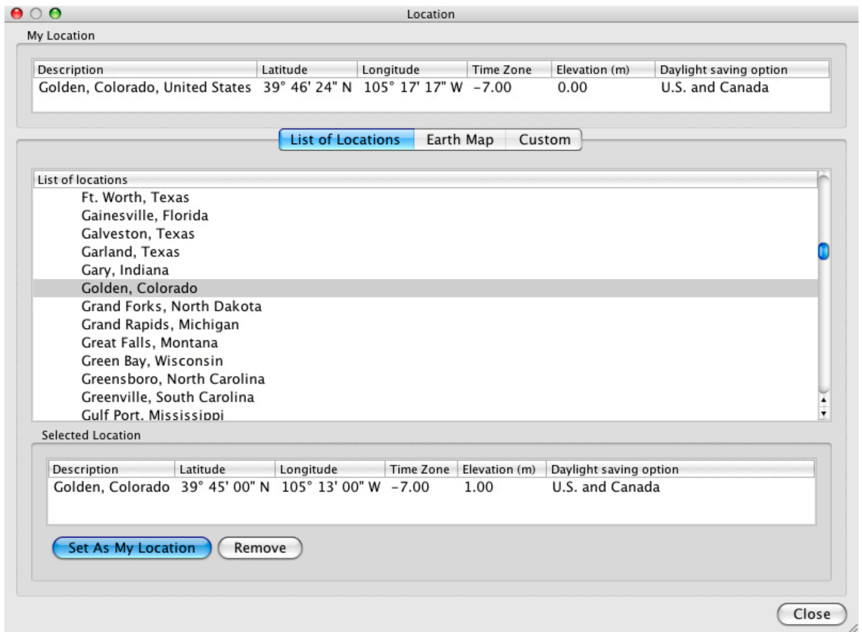


Figure 7: Location window, List of Locations tab.

A window appears displaying options for setting your location. From the ***List of Locations*** tab, if you live in the U.S., *double-click* on United States. A list of the major cities within your country appears. You can choose your city, or the one closest to where you live, by double-clicking on it.

The Location on Earth used by TheSkyX (My Location)

The ***My Location*** table shows your location on Earth as defined by its longitude, latitude, time zone, elevation and Daylight Saving Option.

Location Description (Description)

The location ***Description*** is for reference purposes only. Double-click the description to change it.

Time Zone Offset (Time Zone)

The time zone of a location on Earth is the difference between Universal Time (UT) and local time, in hours. For most locations, this equals your longitude divided by 15 degrees. Regional variations can cause the time zone to differ by plus or minus one hour.

Daylight Saving Option (DSO)

TheSkyX can be configured to automatically "spring forward" when Daylight Saving Time begins, then "fall back" when it ends. Select the DSO for your region.

See Appendix A: International Daylight Saving Time to see the starting and ending dates for each option.

Location Database (List of Locations)

TheSkyX includes a large database of pre-defined locations that can be used to get you "close enough" to your home location.

When a location is highlighted in the list, the ***Selected Location*** table shows the details for this location.

Select a location from the list, then click the ***Set As My Location*** button, or double-click on the location name to use it as your location.

Click the ***Remove*** button to remove the selected location.

Your location settings are saved when you click the ***Close*** button, and will be used the next time *TheSkyX* is started.

Custom Location

Alternatively, you can enter your latitude and longitude or U.S. zip code from the Custom tab.

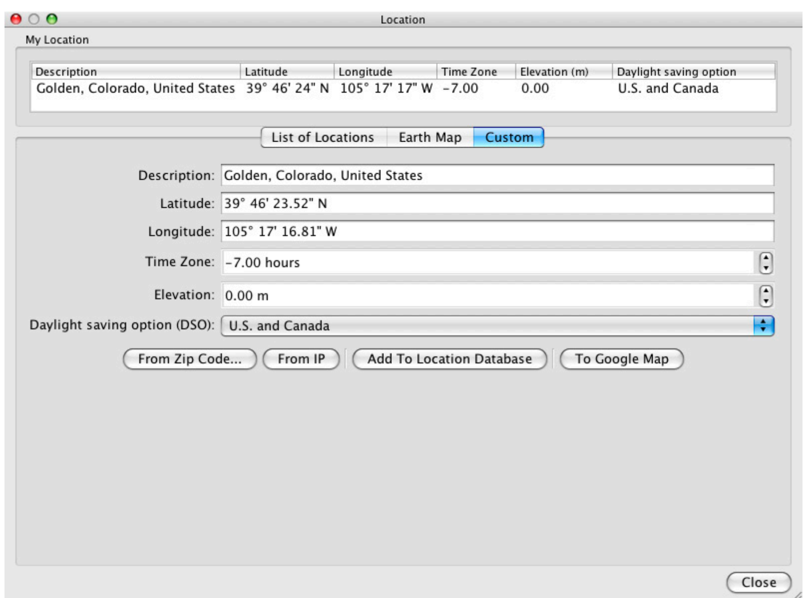


Figure 8: The Custom location tab (Input > Location).

Location from Zip Code (From Zip Code button)

Residents of the U.S. can enter a zip code to retrieve their location information.

Location from Computer's Internet Protocol (From IP button)

If your computer is connected to the Internet, you can obtain reasonably accurate location data using your computer's IP address.

Adding Custom Locations to TheSkyX's Location List (Add to Location Database button)

After manually entering your location details, click this button to permanently save them in *TheSkyX's* Locations List.

Using Google™ Maps (To Google Map button)

Compare your coordinates to a Google map to make sure they're accurate. Or, use the Google map to refine your location. Clicking the ***To Google Map*** button launches a browser and shows this location on a Google Map.

To refine the coordinates, adjust the map accordingly, right-click (⌘+left-click on the Mac) on the map, or click the Satellite button to show the satellite photo of your observatory, for example, then click the Directions To command to show the precise latitude and longitude, in decimal format, of this point in the Driving Directions.

Highlight the latitude (the first coordinate that is shown), then select the Copy command from the Edit menu. From *TheSkyX*, right-click (⌘+left-click on the Mac) and select the Paste command. Repeat this procedure for longitude.

When you're done, click the ***To Google Map*** button again to make sure the values you entered are correct. The coordinates of pointer on the map that appears should match your observing site.

Earth Map

Yet another way to find home is to use the ***Location*** window's ***Earth Map*** tab.

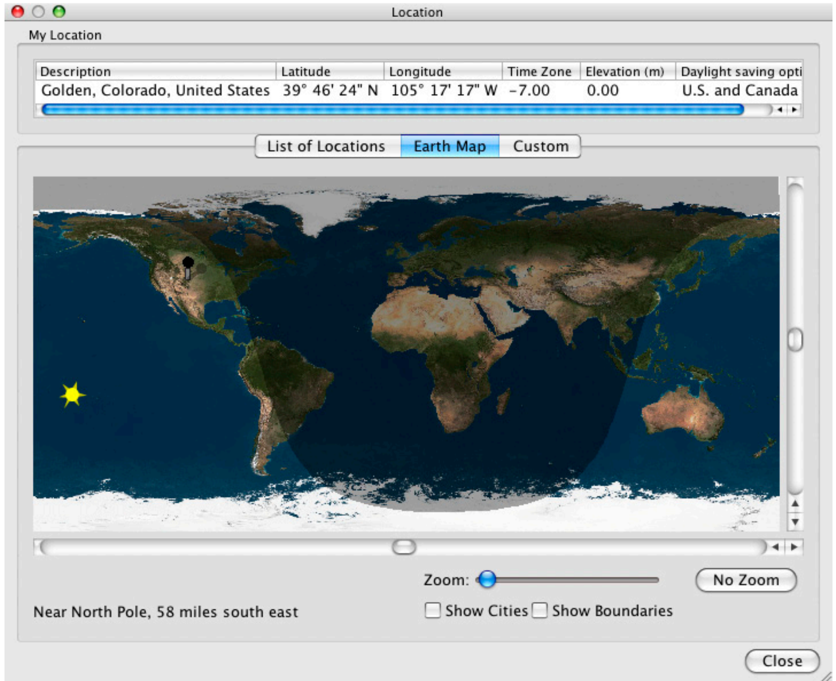


Figure 9: The Earth Map tab (Input > Location).

The default view shows a map of the entire Earth. Use the ***Zoom*** slider to change the magnification, and the scroll bars to center the correct region. Click the ***Show Cities*** option to reveal *TheSkyX's* ***Location*** list. The ***Show Boundaries*** option shows you the approximate country and U.S. state boundaries.

The Basics

What follows is an introductory section, which describes the basic functions of *TheSkyX*, and will help you to quickly get started exploring the marvels of the sky. Included in this section are instructions for zoom, scroll, and pan controls, as well as display options, returning to home position, and moving/adjusting the toolbars and "dockable" windows.

Zoom Control

There are a number of ways to zoom in and out in the Sky Chart. You can use the ***zoom in/zoom out*** buttons on the toolbar, the ***zoom box***, or by using ***Orientation*** menu controls.

Zoom Buttons

To zoom in on objects in the Sky Chart, simply click the ***zoom in*** button in the toolbar. This will reduce your field of view, and increase the angular size of the scene (called the *field of view* or *field width*).

To zoom out, simply click the toolbar's ***zoom out*** button. This will increase the Sky Chart's field of view, giving you a wider field of view.

Zoom Menu Controls

Alternatively, you can zoom in or out using menu commands. Under the ***Orientation*** menu, you will find controls to zoom in and out.

Sky Chart Zoom Tool

On the left side of the Sky Chart window, you will find a red ***zoom tool***. This tool makes it easy to zoom in and out with a simple click and drag. Just click the zoom tool's slider bar, and by dragging it up or down, you will zoom either in (up) or out (down). Or, click the +/– symbols to zoom out or in.

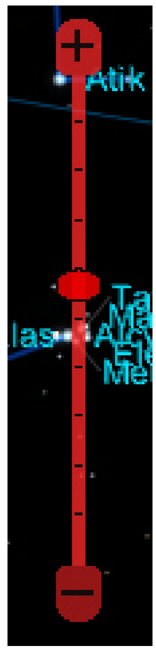


Figure 10: The Sky Chart's zoom tool.

Zooming with Scroll Wheel Mouse

If you are using a mouse with a scroll wheel feature, you can zoom in or out by simply rolling the wheel forward for zoom in, and backward for zooming out. This feature is great for quick, convenient zooming.

Zoom Box

Using the zoom box is another easy way to zoom in on objects in *TheSkyX*. Choose a portion of the Sky Chart into which you would like to zoom. Hold down the ***SHIFT key*** (the cursor changes to the pointing finger) while clicking in one corner of the chosen portion, and drag the mouse to the opposite corner. Release the mouse button, and the box's caption says, "***Click inside to zoom, outside to cancel***."

Notice that the box's diagonal dimensions appear above it in degrees, minutes and seconds of arc. Click anywhere inside the box to ***zoom in***, filling the Sky Chart's field of view with the dimensions of the ***zoom box***.

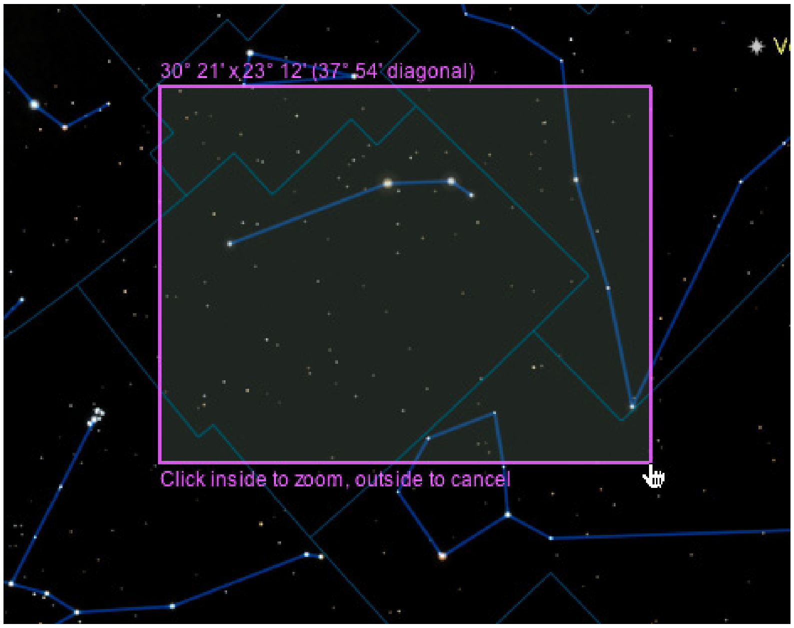


Figure 11: A zoom box on the Sky Chart (SHIFT+drag).

Returning to Naked-Eye View

Regardless of how you zoom, you can always return to the naked-eye field of view by either zooming out manually, or by selecting ***Orientation > Zoom To > Naked Eye 100°***.

Scrolling and Panning Control

Scrolling or panning the Sky Chart's "camera" will allow you to look at the universe in any desired direction, giving you that perfect view.

Toolbar Controls

The toolbar features four easy to use buttons for camera scrolling/panning. By locating and clicking any of the ***four blue arrow buttons***, you can move to camera to look up, down, left, or right. Also, to look specifically in the four cardinal directions or at the zenith (straight up), locate and click the "***look***" buttons (***Look North***, for example). Clicking any of these buttons will orient the Sky Chart in the corresponding direction.

Figure 12: The cardinal direction and move buttons.

Clicking and Dragging

Alternatively, you can adjust the field of view by ***left-clicking*** your mouse anywhere in the Sky Chart and dragging the view.

Chart Navigation

The navigate command lets you explore the digital sky through a celestial sphere map (showing the constellations and their boundaries), by entering specific coordinates, or by selecting a specific position angle.

Using the Navigate Command

To access the Navigate command, select ***Orientation > Navigate***. Three tabs at the top of the window indicate the navigator choices: Celestial Sphere, Sky Chart Center, and Rotation.

Celestial Sphere

This tool lets you select a region of the sky from a model of the Celestial Sphere, in Mercator projection, and with celestial north at the top. The brightest stars (in correct colors) and the constellation borders appear in this map.

If the chart looks too small at first, simply click and drag the window's lower right corner to resize it. After you close the window or quit the application, TheSkyX will remember the window size and position each time you open it.

As you mouse over the map, notice that both the equatorial and altitude-azimuth coordinates of your pointer's current position appear at the bottom of the window. The constellation associated with your pointer's position also appears.

Click on any location to center it on the Sky Chart.

By default, *TheSkyX* attempts to pin the local horizon near the bottom of the screen. If the "clicked on" position happens to be below the horizon, the Sky Chart moves to the closest visible point. Turn on the ***Allow Sky Chart to be Scrolled Below the Horizon*** option on the Horizon tab on the ***Display > Horizon & Atmosphere Options*** window to allow regions below the local horizon to be accessible.

To see more of the map, click and drag at any point to scroll. Because it represents a sphere, the map is a continuous loop.

You can remove the horizon picture altogether by deselecting the Show Horizon checkbox. Click Close to return to the Sky Chart. You will notice that you can now scroll below the horizon either manually or with the Celestial Sphere navigator.

When finished with the Navigate window, click Close to return to the Sky Chart.

Sky Chart Center

Select the Sky Chart Center tab to enter specific coordinates in either equatorial (RA/Dec) or horizon coordinate (Az/Alt) systems.

To enter coordinates, click on the desired field and directly enter the values into it. For convenience, you can simply enter three numbers separated by spaces. For example, enter 10, 30, 29 into the RA field to specify right ascension of 10h 30m 29s.

Because equatorial coordinate systems are based upon the orientation of Earth's axis, their accuracy diminishes over time due to, among other factors, precession. For that reason, many publications reference equatorial coordinates at a specific point in time known as an equinox. If you are using RA/Dec coordinates, it is important to choose the correct equinox (either 2000.0 or 1950.0). The 1950.0 equinox setting can be useful, as many older publications list equatorial coordinates according to the 1950.0 equinox.

Click Center on RA/Dec (for equatorial coordinates) or Center on Az/Alt (for horizon coordinates) to center the Sky Chart on the selected coordinates.

Click the Get Sky Chart Center Coordinates button to display the current coordinates of the Sky Chart's center in the above coordinate fields.

For your reference, example input for each of the coordinate systems appears near the bottom of the window.

Click Close to return to the Sky Chart.

See "Slewing to a Specific Coordinate" on page 216 for details about slewing a telescope using the Navigate commands.

Rotation

The Sky Chart can be rotated to position angle you wish. This parameter is called a position angle, and it helps to match the Sky Chart to the real sky and to any paper charts you may use while observing or planning an observation session.

Click the Rotation tab to view and adjust the Sky Chart's position angle. You will immediately see a graduated circle with a brown indicator showing the Sky Chart's current position angle. Click and drag this indicator to adjust the position angle to whatever you wish in real-time.

Near the bottom of the window, you will see the Sky Chart's current position angle. You can also enter a specific position angle into the field at the bottom of the window (to hundredths of a degree of accuracy). Use the up and down arrows here for an easy way to adjust the position angle in whole-degree increments. For example, if you enter 42.78°, clicking the up arrow once will increase the value to 43.78°.

Once you have entered a position angle, click Set to update the Sky Chart.

Click Close to return to the Sky Chart.

Note: The horizon disappears when you adjust the position angle. Changing the position angle is equivalent to changing the direction of "down" in relation to the horizon, so the horizon as a reference becomes irrelevant. ***TheSkyX*** removes it to avoid confusion.

Mirror Image

Refractors and catadioptric telescopes used with star diagonals produce mirror images of the sky because they have an odd number of image reflections. Selecting *Display >* Show Mirror Image flips the Sky Chart to "reflect" the view through a refractor or catadioptric telescope with star diagonal.

Display Chart Elements

In addition to the huge database of celestial objects in *TheSkyX*, a number of other useful elements, such as coordinate system lines, constellation boundaries, and other reference lines, are all available to you. Each can be toggled on or off with ease.

Chart Element Buttons

On the toolbar, you will find a number of buttons assigned to control chart elements (Constellation Figures, the Ecliptic, etc.). To toggle a given chart element on or off, simply click the appropriate button. For instance, if you want to turn on the constellation figures, locate and click the ***Show Constellation Figures*** button on the toolbar: the constellation figures appear in the Sky Chart. Also, note that the button is now a darker gray than the rest of the toolbar. This change indicates that the constellation figures are turned on. To hide them, click the button again. The button color will lighten and the constellation figures will fade from view. There are several other chart element buttons on the toolbar. Try them all to get a feel for how they work.

Chart Elements Window

A complete list of chart elements is available by selecting ***Chart Elements*** from the ***sidebar*** of the ***stacked tool windows***, which is located on the left side of the screen when you first open *TheSkyX*.

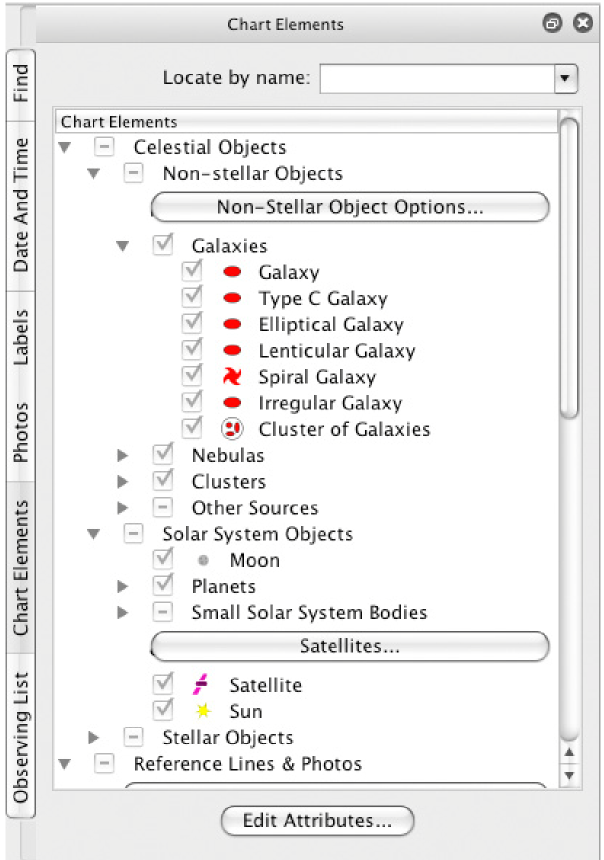


Figure 13: The Chart Elements window (Display menu).

If ***Chart Elements*** does not appear in your stacked tool window, or if you removed it, you can always access it again by selecting ***Chart Elements*** from the ***Display*** menu.

Locating a Chart Element by Name (Locate by Name)

If you know the name of the Chart Element you're after, there's a quick way to find it in the list. For example, suppose you want to turn on the line that represents the galactic equator. Typing the letter "g" into the ***Locate by Name*** text input shows a list of all of the elements that begin with this letter in the pop-up menu. Selecting ***Galactic Equator*** expands the Reference Lines and Photos node to reveal this option. Press the TAB key to place the "focus" on this checkbox.

From here, you can turn the checkbox on or off, or, click the ***Edit Attributes*** button to configure this element's upper and lower magnitude limits, angular size limits and other display properties, such as the font size, line styles, fill colors and symbol. See "Customizing Chart Elements" on page 136 for more information.

Customizable Interface

One of the great features of *TheSkyX* is its customizable interface. All toolbars and "dockable" windows are movable and adjustable, giving you great flexibility in using *TheSkyX* to best suit your needs.

Positioning Toolbars

When you first open *TheSkyX*, you will notice rows of toolbars on the top of the screen, a stacked tool window on the left, and the Sky Chart on the right.

When looking at the toolbars, notice that at the far left of each, you will see a textured area (or "gripper bar").

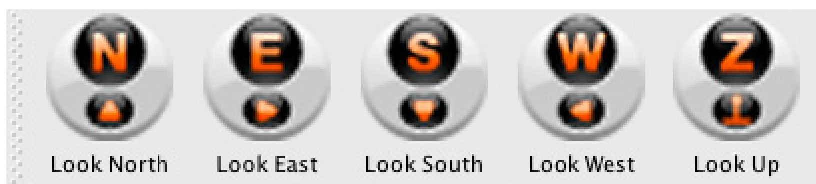


Figure 14: The textured region on the left side of toolbar windows can be used to position the toolbar.

Clicking and dragging on this area will allow you to move that toolbar to almost any new desired location on the screen. As you drag the toolbar, you will notice that portions of the screen move to allow you to drop the toolbar into position. If you drop a toolbar in one of these positions, it will "snap" into place. (You may also drop the toolbar over the Sky Chart in any location, without snapping.) Feel free to experiment with this feature to get a feel for how the toolbars can be moved, as you can always move the toolbar back to its default position later. Be sure to look over each toolbar, and you will see that they are divided into sections, each of which can be moved. Note that the textured section denotes the beginning of a new toolbar section.

Moving Dockable Windows

To the lower left of the screen, you will find a set of tool windows that are stacked together. A ***sidebar*** allows you to choose which window you want to see. All of the windows stacked together on the left side of the screen can be moved and/or made into a new stack. Notice that when you select a stacked window on the sidebar, its name also appears at the top of the window along with a ***window resize button*** and a ***close window button***. By clicking the ***window resize button***, you release that particular window from the stack. Now you are free to move the window to any location that you like by clicking and dragging it. Alternately, you can dock the window on the left or right side of the window by dragging it and releasing it in any area that readjusts as the window is drug over. For instance, try clicking ***Labels*** in the stacked tool window. Now click the ***window resize button*** in the top right of that window. The window will now undock from the stack. Click and drag the window to the far right side of the screen. You will notice that the Sky Chart will move slightly to the left, and a dark gray area will appear, indicating that you may "dock" this window here. Release the mouse button, and you have docked the window. If you would like to move another window, simply repeat the previous steps.

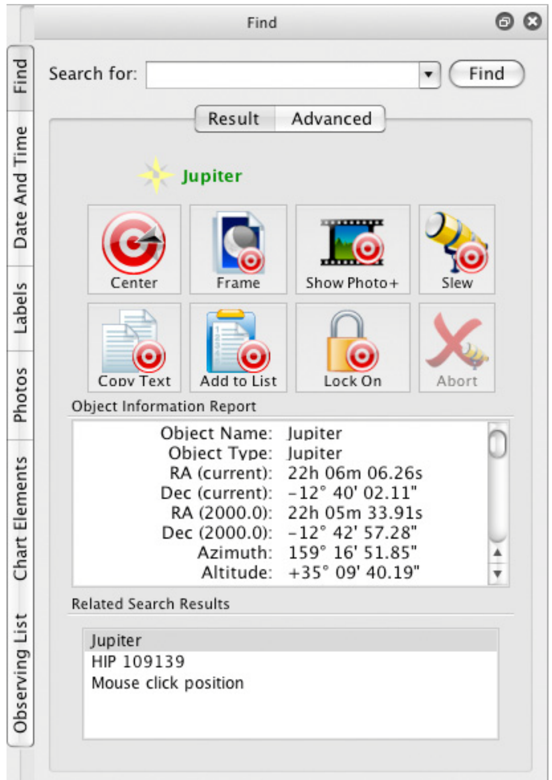


Figure 15: The stacked tool windows, including Tours, Find, Date and Time, Photos, Labels and Telescope and Observing List.

Stacking and "Dockable" Windows

Windows can be stacked by dropping a window on top of docked windows. When the docked window turns a dark gray, drop the window you are moving to stack them.

Closing and Reopening a Docked Window

If you ever wish to remove a window from view completely, simply select it from the stacked tool window sidebar, and click the ***close window*** button.

If you want to view a window again, simply select it from the ***Display*** menu.

The following windows can be stacked on the left or right side of the main window, or, by dragging the window's title (caption), positioned anywhere on your computer's monitor.

- Chart Elements
- Chart Status
- Date and Time
- Find

- Labels
- Observing List
- Photos
- Telescope
- Tours
- Telescope-specific command windows

Full Screen

The Sky Chart can fill your entire screen. For Full Screen Mode, select Display > Full Screen. Select the command once more to return to normal mode.

Heading Home

The universe is a big place, and when you are ready to go home, it is nice to know that *TheSkyX* can get you there in only two clicks (that's one click faster than it takes with a pair of famous red shoes). When you are ready to return to your default space and time, simply click ***Look South***, followed by ***Computer Clock***, both in the toolbar. This action will adjust the Sky Chart's view to the south, and at the current time designated by your computer's internal clock. Welcome back!

Restoring Default Sky Chart Settings

Or, select the ***New*** command from the ***File*** menu whenever you want to restore *TheSkyX's* chart settings to their default values.

This will show the daytime sky (***Display > Show Daylight***), set the date and time to the computer's clock and (turn on the ***Computer Clock*** button on the ***Date and Time*** window, ***Input*** menu), shows the default objects labels, object types, reference lines, object magnitude and size limits; just like when *TheSkyX* was first launched.

Saving & Retrieving Your Sky Chart

Your Sky Chart settings can be saved and opened at any time by creating special TheSkyX files with the extension .skyx.

Saving Your Sky Chart

You can save your current Sky Chart, along with all of its settings, at any time by selecting File > Save. TheSkyX saves the Sky Chart in .skyx files, which are a handy way to save data you wish to quickly recall later, such as when you journey to your favorite hilltop.

Choosing File > Save As allows you to save another .skyx file without overwriting the current one.

Opening An Existing File

To open an existing Sky Chart, select File > Open. You will then be able to search your hard disk for existing .skyx files.

Help Options

As you continue to use *TheSkyX* and read through this User Guide, keep in mind that we have included the complete User Guides for both TheSkyX and the TPoint Add On, as well as an XML-based help guide and all are accessible from TheSkyX's Help menu. Even the most seasoned observer sometimes needs a little help, and with all the features packed into TheSkyX, it is handy to always have a reference guide at your fingertips.

Help Search

You can easily search through TheSkyX's many commands by entering search terms into the Help menu's search field. For more detailed help, continue reading for more help options.

TheSkyX Help - Assistant

TheSkyX includes a slick, XML-based help guide called Assistant, which is designed to help you to get the most out of TheSkyX, no matter how you plan to use it. Whether you use TheSkyX to plan for meteor showers, or you want to use the most advanced telescope controls, TheSkyX Assistant is there for you, regardless of your user experience.

TheSkyX User Guide

This user guide is available, in its entirety, at any time from the Help menu. Simply select *Help* > TheSkyX User Guide to access it.

TPoint User Guide

TPoint is an advanced telescope pointing analysis system, which allows you to analyze the errors inherent in your particular telescope system to drastically improve its pointing performance. Both TheSkyX Serious Astronomer Edition and TheSkyX Professional Edition come with a trial version of TPoint, which can be activated the first time you use the add on, after which time, you will have to purchase a license separately. TPoint can be accessed from the *Tools* menu.

Like all aspects of an imaging system, there is a significant learning curve with TPoint. Fortunately, TheSkyX makes using TPoint smooth, and you should be able to complete a mapping run on the first night and start analyzing your system right away. There is a comprehensive user guide for TPoint available by selecting *Help* > TPoint User Guide.

Finding and Identifying Celestial Objects

TheSkyX's astronomical databases can be quickly searched to locate any one of millions of available objects, either by clicking on the object on the Sky Chart (called "identifying") or through the ***Find*** command from the ***Edit*** menu.

Identifying Objects

The Sky Chart is linked to *TheSkyX'*s astronomical databases. Clicking on an object (or locating it with the ***Find*** command on the ***Edit*** menu) identifies the object and displays the ***Object Information Report*** with a wealth of information…

- the object's common name and/or its catalog designation
- the graphical symbol used to represent this object on the Sky Chart
- cross references to other catalogs (Name 2-Name 10)
- the object's type (variable star, irregular galaxy, and so on)
- the constellation in which the object lies
- the object's magnitude
- a star's Bayer (Greek-letter) brightness designation
- the Dreyer description of the object, in plain English
- the object's distance from Earth, in light years and AU (where known)
- catalog-specific information (such as min/max magnitude of variable stars, spectral class, parallax, proper motion, position error, distance from the Solar System)
- the object's equatorial (RA-Dec) coordinates, for both the date specified in the Site Information dialog and Equinox 2000.0
- the object's horizon (Az-Alt) coordinates at the time displayed in the Status Bar when the object was clicked on (or found using Find)
- the object's rise time, transit time and set time for the site location the object's angular dimensions
- the angular separation from the last object identified
- the object's position angle (the angle between the line connecting the object and the last-identified object, and the line connecting the last identified object and the North or South Celestial Pole)
- Other object-specific information…

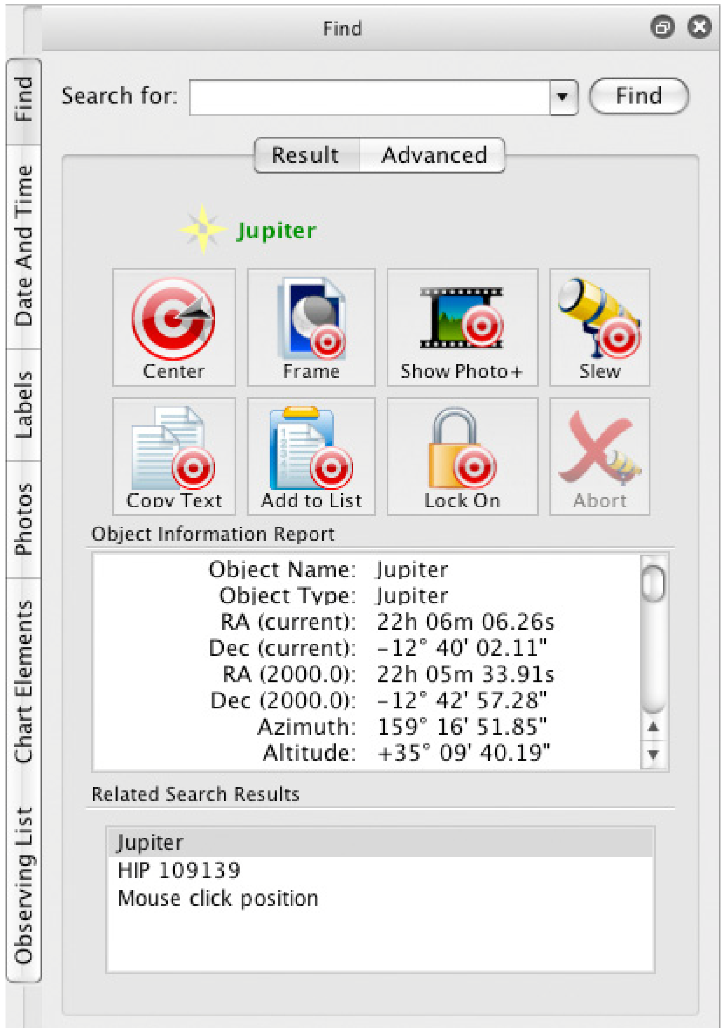


Figure 16: Find window (Edit menu).

The object you clicked on (or located using the Find command), and up to ten "nearby" objects (or objects with names that closely match this object), are listed in the ***Related Search Results*** box. This eliminates any need to click exactly on the object, and makes it easy to study groups of objects without having to click on each one. If you click in an area without any nearby objects, the ***Mouse Click Position*** is the only entry.

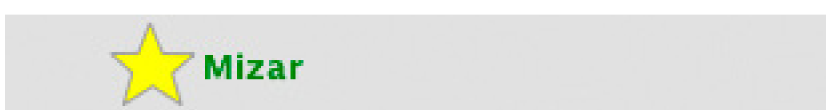


Figure 17: The text color indicates the object's visibility (green means the object is currently above horizon; black text means it is below horizon).

The object's symbol (a yellow star in Figure 16) is displayed next to the object's name. When the object's name is displayed with green text, the object is above the horizon. Black text means the object is currently below the horizon.

Identifying Galaxies, Nebulas, and Open Clusters

At wide fields of view, galaxies, nebulas and open clusters are displayed as their standard symbols. At higher magnifications, the symbols are replaced with circles or ellipses that represent the shape and dimensions of the object. Within these extended objects, there is no marked point on which to click. If the object is displayed as a circle, you can click anywhere within the circle. For objects displayed as ellipses, click within the circular region defined by the ellipse's minor axis, as shown in the drawing below.

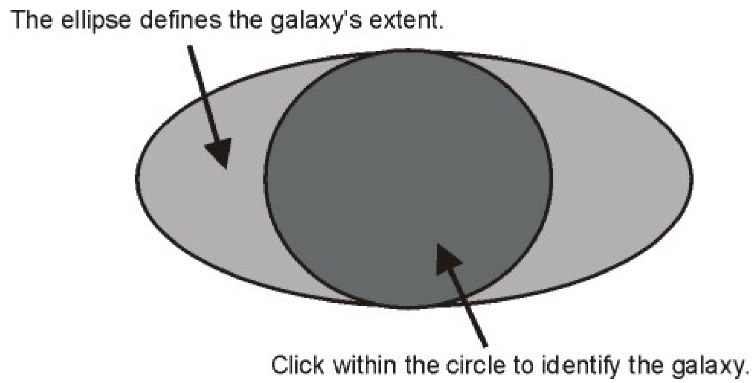


Figure 18: Click inside the shaded circle to identify this extended object (galaxy).

The Andromeda galaxy (M31) is one example of an extended object. You need to click on a point towards the center of M31 – without too many nearby stars – to identify it. Click on the central region of stars to identify them.

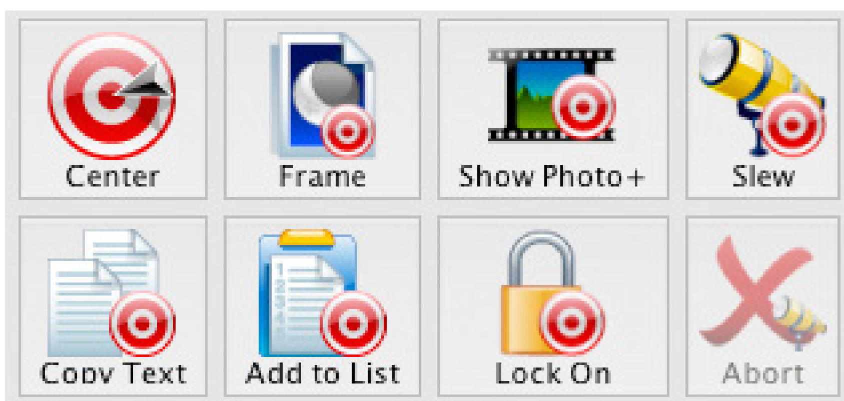


Figure 19: Object-specific buttons on the Find window.

Centering Objects on the Sky Chart (Center button)

The ***Center*** button repositions the Sky Chart with the identified object at the center.

Framing Objects (Frame button)

The ***Frame*** button repositions the Sky Chart with the identified object at the center and adjusts the field of view to show extended objects.

The default field of view for point sources (or cataloged objects that do not have size information) is 10 arcminutes. To use a different framed field width, change the Default ***Frame Size when Object Size is Unknown*** value on the Non-stellar Object Options dialog from the Display menu.

Showing Photographs and Hertzsprung-Russell (HR) Diagrams (Show Photo+ button)

If the identified object has a photograph (not all objects have photographs), the ***Show Photo+*** button shows it in the Photo Viewer window.

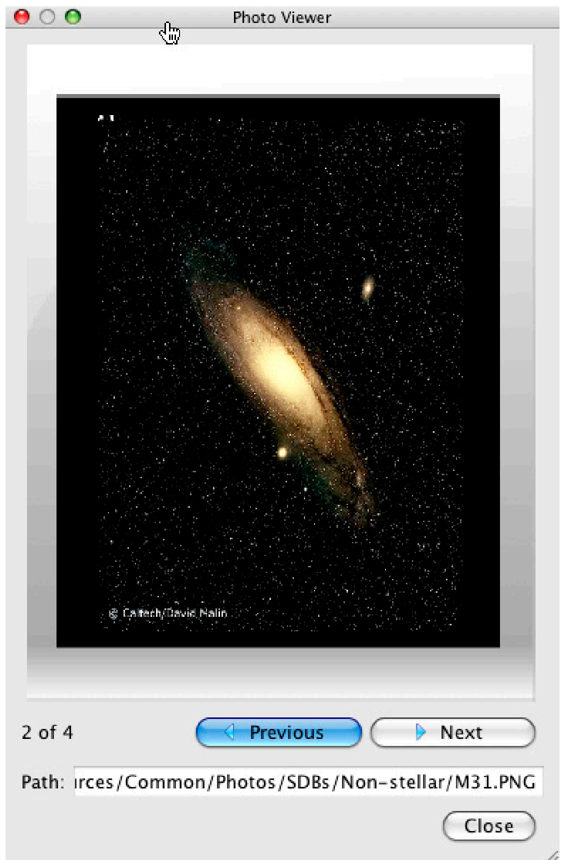


Figure 20: Photo Viewer window showing M31.

If the identified object is a star in the Hipparcos/Tycho catalog, a Hertzsprung-Russell (HR) diagram is displayed. The cross hairs show the position of the star on the diagram.

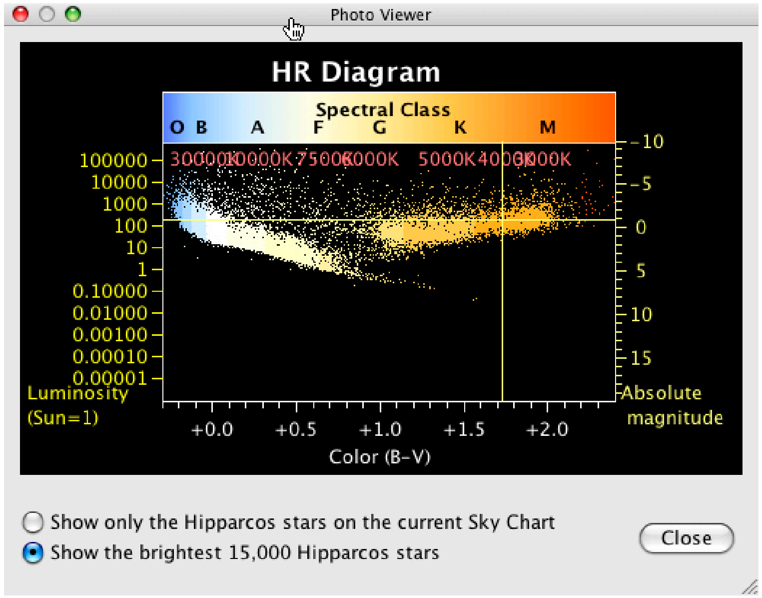


Figure 21: HR Diagram for a Hipparco-Tycho star.

Slew the Telescope (Slew button)

When a telescope connection is established, click the ***Slew*** button to command the telescope to slew to this object.

Aborting Telescope Slews (Abort button)

If you change your mind after clicking the ***Slew To***, click the ***Abort*** button to cancel or terminate the slew. This button is available only while the telescope is slewing.

Copy Object Information Report to Clipboard (Copy Text button)

To copy *all* the information in the Object Information Report to the Clipboard, click the ***Copy*** button. Or, right-click (⌘+click on the Mac) on the report and click the ***Copy Text*** command in the pop-up menu.

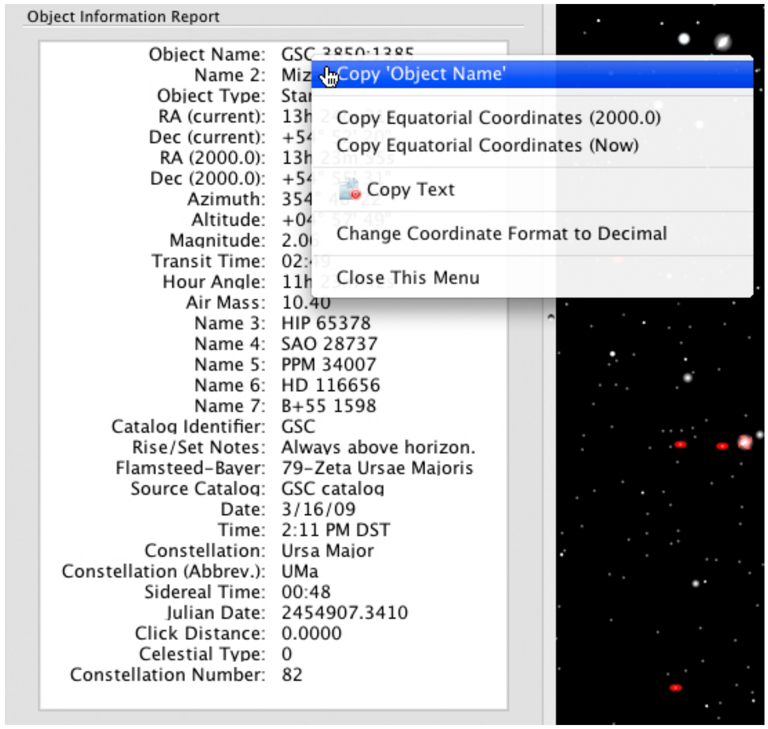


Figure 22: Right-clicking (⌘+click on the Mac) over the Object Information Report to show a context pop-up menu.

To copy the contents of a single field, move the mouse cursor over it, right-click the mouse (⌘+click on the Mac) and then click the ***Copy '<Field Name>'***, where '<Field Name>' is the name of the information field beneath the mouse cursor.

Other pop-up menu commands allow copying just the equatorial coordinates (J2000.0 or current), or toggling the number formatting between sexagesimal and decimal format.

Adding Objects to an Observing List (Add to List button)

TheSkyX can create an *observing list* of the objects. To add this object to the Observing List, click the ***Add to List*** button. See *"Observing Lists"* on page 172.

Locking On a Solar System Object (Lock On button)

If the identified object is a planet, moon or other solar system object, click the Lock On button to pin this object to the center of the Sky Chart.

As a reminder, the text ***Locked on <Solar System Object>*** appears in the lower right corner of the Sky Chart. Left-click and drag the screen to break the lock.

Objects outside the solar system cannot be locked on.

Finding Objects

You don't have to locate an object in the Sky Chart to get information about it. The ***Find*** command in the ***Edit*** menu can locate *every* object in *TheSkyX's* databases.

You can also access it by pressing ⌘F, or by clicking the Find button in the Edit toolbar. Selecting the Find command displays the Find window, which provides several ways to locate any object.

Finding by Name

One way to find an object is to enter its *name* (Aldebaran, Bear Paw) in the ***Search For*** text input. You can enter the names of comets, minor planets, and auxiliary objects that appear in any active Sky Database.

For example, to find the Orion Nebula, type `Orion Nebula`
and click the ***Find*** button. The Object Information report shows details about the Orion Nebula. If the Orion Nebula is within the current field of view, it's marked with a bull's eye.

You can also search for a star by manually entering its Bayer (Greek-letter) magnitude designation, followed by the constellation's three-letter abbreviation. For example, to find the third-brightest star in Orion, type `Gamma Ori`. Clicking the ***Find*** button locates that star, Bellatrix.

```
Great Nebula in Orion
Gamma Ori
```

If You're Not Sure of the Right Spelling…

Star names are Greek, Arabic, or Latin. You don't have to know the correct spelling. The Find command shows you matching names.

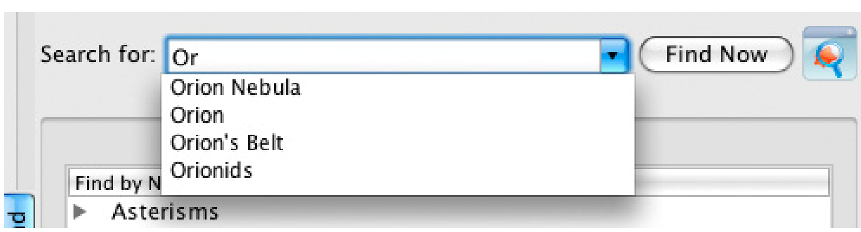


Figure 23: A list of matching names appears as you type.

For example, if you enter 'Or" the Search For text input shows objects that start with these letters.

The Milky Way and the Magellanic Clouds

The Milky Way (our galaxy) is displayed as a photograph or draw as a polygon that can cover a significant portion of the Sky Chart. Keeping track of its boundaries in all cases would consume too many resources. It was therefore decided not to identify the Milky Way when you click inside it. At narrow fields of view, the Milky Way's boundaries are not usually visible and the polygon forms a solid background color. This is potentially confusing ("Is that the Milky Way or a nebula?"), so the Milky Way is not displayed at fields of view below 20°.

The Magellanic Clouds (the two smaller galaxies "attending" our galaxy) are large, complex objects. The Small Magellanic Cloud is shown as a filled ellipse and is easy to spot in the Sky Chart – it's located at a right ascension of about 1h, not far from the south celestial pole. Type the text 'Small Magellanic Cloud' in the ***Search For*** text input and then click the ***Find*** button to locate it.

By default, the Large Magellanic Cloud is not shown as a specific object. To display the region in which it's located, search for Large Magellanic Cloud. To have *TheSkyX* draw a polygon that represents this region, select the Large Magellanic Cloud Sky Database in the ***Database Manager*** window from the ***Input*** menu.

Entering Catalog Numbers with the Mouse

Because it can be difficult to type keyboard keys in the dark, *TheSkyX* includes a method for entering catalog numbers with the mouse.

On the ***Advanced Find*** tab, click the numbers (and the decimal point) on the right to enter numerical keys. Clicking Space enters a space. Clicking Back deletes the last (rightmost) character in the edit box, regardless of the current location of the text cursor.

Advanced Searches

Finding by Object Type

Objects are categorized by type in the ***Find by Name or Catalog Number*** list on the Advanced tab of the Find window.

A simple way to find any object is to first determine its type (is the object a star, galaxy, cluster or other?). Next, determine what catalog you want to search and then select the name of the object from the catalog list. The table below lists each category in the Find tree list.

Object Type	Catalog/Cross Reference	Description
Asterisms		Lists the names of many common asterisms.
Constellations		Lists the names of the 88 constellations.
Non-stellar Objects		Lists databases of non-stellar objects.
	Caldwell	Caldwell Catalog objects.
	Common Names	Names of common non-stellar objects.

	Herschel	Herschel 400 catalog.
	IC	Index Catalog.
	Lorenzin	Tomm Lorenzin Catalog.
	Messier	Messier Catalog.
	NGC	New General Catalogue.
	PGC	Principal Catalog of Galaxies.
	PGC cross reference	Cross references to the Principal Catalog of Galaxies.
	PLN	Planetary Nebulae.
	SAC*	Saguaro Astronomy Club Deep Space Object catalog.
Sky Databases (SDBs)	Additional (non-core) databases	Sky Databases that are loaded from the Sky Database Manager command in the Input menu.
Solar System		Objects within our solar system.
	Meteor Shower Radiants	Locations of meteor showers.
	Moon	Earth's Moon.
	Planets (alphabetical)	Earth Jupiter Mars Mercury Neptune Saturn Uranus Venus
	Satellites	Man-made satellites that have been imported from the Satellites window on the Input menu.
	Small Solar System Bodies	Objects that are classified as Small Solar System Bodies by the IAU.
		Asteroids (Large Database): Names of asteroids that have been imported from the Large Database tab on the Small Solar System Bodies windows (Input menu).
		Asteroids (Small Database): Names of asteroids that have been imported from the Small Database tab on the Small Solar System Bodies windows (Input menu).
		Comets: Names of comets selected in the Comet tab on the Small Solar System Objects dialog (Input menu).
	Dwarf Planets	Pluto
	Sun	The Sun.
Stellar Objects		Lists databases of stars.
	Bayer	Bayer catalog designations.
	Common name	Common star names.
	DM	Bonner Durchmusterung number.
	Flamsteed	Flamsteed designations.
	GCVS	General Catalog of Variable Stars.
	GSC	Guide Star Catalog.
	HD	Henry Draper Number.
	NSV	Catalog of Variable Stars.
	SAO	Smithsonian Astrophysical Observatory.
	Struve	Struve Catalog stars.
	WDS	Washington Double Star catalog.

SAC Cross References

The Saguaro Astronomy Club Database contains cross references to the astronomical catalogs in the table below.

Catalog Name	SAC Cross Reference
Third Cambridge Catalog of Radio Wave Sources	3C
George Abell (planetary nebulae and galaxy clusters)	Abell
Aitken Double Star catalog	ADS
Arp-Madore (globular clusters)	AM
(open clusters)	Antalova
Apriamasvili (planetary nebulae)	Ap
Halton Arp (interacting galaxies)	Arp
Barkhatova (open clusters)	Bark
Barnard (dark nebulae)	B
(open clusters)	Basel
Bonner Durchmusterung (stars)	BD
Berkeley (open clusters)	Berk
Bernes (dark nebulae)	Be
Biurakan (open clusters)	Biur
(open clusters)	Blanco
(open clusters)	Bochum
Cederblad (bright nebulae)	Ced
Catalog of Galaxies and Clusters of Galaxies	CGCG
Collinder (open clusters)	Cr
(open clusters)	Czernik
David Dunlap Observatory (dwarf galaxies)	DDO
Dolidze (open clusters)	Do
Dolidze-Dzimselejsvili (open clusters)	DoDz
Dunlap (Southern objects of all types)	Dun
European Southern Observatory (Southern objects)	ESO
Feinstein (open clusters)	Fein
(open clusters)	Frolov
(bright nebulae)	Gum
William Herschel (globular clusters)	H
(open clusters)	Haffner
(open clusters)	Harvard
Havermeyer and Moffat (open clusters)	Hav-Moffat
Henize (planetary nebulae)	He
(open clusters)	Hogg
Holmberg (galaxies)	Ho
Haute Provence (globular clusters)	HP
Humason (planetary nebulae)	Hu
1st and 2nd Index Catalogs to the NGC (All types of objects except dark nebulae)	IC
Iskudarian (open clusters)	Isk
Jonckheere (planetary nebulae)	J
Kohoutek (planetary nebulae)	K
Father Lucian Kemble (asterisms)	Kemble
(open clusters)	King
Krasnogorskaja (planetary nebulae)	Kr
Lacaille (globular clusters)	Lac
(open clusters))	Loden
Lynds (bright nebula))	LBN
Lynds (dark nebulae)	LDN
Northern Proper Motion, 1st part, Galaxies	NPM1G
(open clusters)	Lynga
Messier (all types of objects except dark nebula)	M
Morphological Catalog of Galaxies	MCG
Merrill (plantary nebulae)	Me
Markarian (open clusters and galaxies)	Mrk
Melotte (open clusters)	Mel
Minkowski (planetary nebulae)	M1 thru M4
New galaxies in the Revised Shapley-Ames Catalog	New
New General Catalogue of Nebulae & Clusters of Stars. (All types of objects except dark nebulae)	NGC

Palomar (globular clusters)	Pal
Peimbert and Costero (planetary nebulae)	PC
(open clusters)	Pismis
Perek & Kohoutek (planetary nebulae)	PK
Rodgers, Campbell, & Whiteoak (bright nebulae)	RCW
(open clusters)	Roslund
Ruprecht (open clusters)	Ru
Sandqvist (dark nebulae)	Sa
(open clusters)	Sher
Sharpless (bright nebulae)	Sh
Sandqvist & Lindroos (dark nebulae)	SL
Shapley & Lindsay (clusters in LMC)	SL
Stephenson (open clusters)	Steph
(open clusters)	Stock
Terzan (globular clusters)	Ter
(open clusters)	Tombaugh
Tonantzintla (globular clusters)	Ton
Trumpler (open clusters)	Tr
Catalog of selected Non-UGC galaxies	UA
Uppsala General Catalog (galaxies)	UGC
United Kingdom Schmidt (globular clusters)	UKS
(open clusters)	Upgren
Vorontsov-Velyaminov (interacting galaxies)	VV
van den Bergh (open clusters, bright nebulae)	vdB
van den Bergh & Herbst (bright nebulae)	vdBH
van den Bergh-Hagen (open clusters)	vdB-Ha
Vyssotsky (planetary nebulae)	Vy
(open clusters)	Waterloo
Double Star (Messier 40)	Winnecke
Zwicky (galaxies)	ZWG

To locate objects in the SAC, in the ***Search For*** text input on the ***Find*** window, enter ***SAC SAC <Cross Reference> <Catalog Number>*** and then click the ***Find*** button.

For example, entering the text ***SAC Cr 33*** locates an open cluster from the Collinder catalog.

Finding by Catalog Designation

Another way to find an object is to enter its *catalog designation*. Leading zeroes are not required; the search routine automatically adds them. Typing *just* the catalog abbreviation (with no number) lists the first 10 items in the catalog.

The Tycho catalog's designers indexed it with the corresponding GSC numbers. We have therefore not included it as a searchable catalog.

Searching Other Catalogs

Other catalog designations can be used to find objects. The table below lists the available catalogs and their prefixes, along with the number of galaxies in the catalog (Count) and an example of the correct format. Catalog numbers requiring leading zeroes are noted in the Comments.

In some cases, the name of the catalog is not known. These entries are marked with a dash (–).

Catalog	Prefix	Count	Example	Comments
—	1SZ	26	1SZ 39	Numbering is not contiguous.
—	2SZ	32	2SZ 4	
Zwicky1	1ZW	238	1ZW 1	
Zwicky2	2ZW	199	2ZW 1	
Zwicky3	3ZW	158	3ZW 1	
Zwicky4	4ZW	203	4ZW 1	
Zwicky5	5ZW	531	5ZW 1	
Zwicky6	6ZW	238	6ZW 1	
Zwicky7	7ZW	1145	7ZW 1	
Zwicky8	8ZW	645	8ZW 1	
Arakelian Catalog of Galaxies	ARAK	595	ARAK 38	
—	ARP	560	ARP 70	
Catalog of Galaxies and Clusters of Galaxies	CGCG	29809	CGCG 502-64	
David Dunlap Observatory Catalog of Galaxies	DDO	242	DDO 11	
–	ESO	16239	ESO 152-5	
Fairall Catalog of Galaxies	FAIR	1185	FAIR 700	
Infrared Astronomical Survey	IRAS	9347	IRAS 01293-2548	5-digit prefix must be padded with zeros.
Karachentseva Catalog of Galaxies	KARA	183	KARA 4	
Kazaryan UV Galaxies	KAZ	581	KAZ 9	
Kiso UV Galaxies	KUG	5455	KUG 0001+311	4-digit prefix must be padded with zeros.
–	LGS	5	LGS 4	
Second Byurakay Survey	SBS	259	SBS 1209+550	
Tololo Galaxies	TOL	111	TOL 29	
Uppsala General Catalog of Galaxies	UGC	13073	UGC 8100	
University of Michigan Catalog of Galaxies	UM	652	UM 533	
–	VV	1161	VV 222	
Virgo Cluster Catalog of Galaxies	VCC	2097	VCC 3	
Weinberger Catalog of Galaxies	WEIN	207	WEIN 1	

More Find Examples

The following tables show a variety of useful search queries for the ***Locate By Name*** text box.

Stars	Type of query
`Polaris`	Common star name.
`SAO 308`	Smithsonian Astrophysical Observatory star.
`GSC 4628:237`	Guide Star Catalog number.
`HIP 11767`	Hipparcos identifier.
`PPM 431`	Positions and Proper Motions (PPM) number.
`HD 8890`	Henry Draper number.
`B+88 8`	Bonner Durchmusterung catalog.
`C-34 12784`	Cordoba Durchmusterung catalog.
`P-42 7856`	Cape Durchmusterung catalog.

Flamsteed/Bayer (use constellation abbreviation)	Type of query
`ALPHA UMI`	(Alpha Ursae Minoris)
`25 PSI 1 ORI`	25 Psi 1 Orionis

Non-stellar Objects	Type of query
`Great Nebula in Andromeda`	Common non-stellar object name.
`M31`	M31 Messier
`NGC 224`	NGC (New General Catalog)
`IC 434`	Index Catalog
`PGC 18508`	Principal Galaxies Catalog
`GCVS GK ORI`	General Catalog of Variable Stars
`NSV`	New Suspected Variable catalog
`PLN 194+2.1`	Planetary Nebula

Solar System Objects	Type of query
`Saturn`	Finds Saturn
`Wild 4`	Finds the comet named "Wild 4"
`Ceres`	Finds small database asteroid named "1 Ceres"
`MPL 835 OLIVIA`	"MPL" prefix finds that asteroid (or *minor planet*) named "835 Olivia" from the large asteroid database.

Uranometria Star Charts	Result
`URA 36`	Centers on Uranometria star chart number 36
`URA 36+`	Centers on Uranometria star chart number 36 and sets Uranometria-like chart attributes.

Satellites	Result
`SAT COSMOS 100`	Searches for the satellite named "Cosmos 100".

Miscellaneous Objects	Result
`Zenith`	Moves to 90 degrees altitude.
`AAVSO A`	Sets field width to AAVSO type A (accepts a-g).
`12.3, 13.4`	Moves to RA 12.3 and Dec 13.4
`Z2.5`	Zooms to 2.5 degree field of view.
`Z2.5m`	Zooms to 2.5 minute field of view.
`Z200s`	Zooms to 200 arcsecond field of view.
`SCALE 2.5`	Sets the screen scale to 2.5 arcseconds/pixel.

Labeling Objects

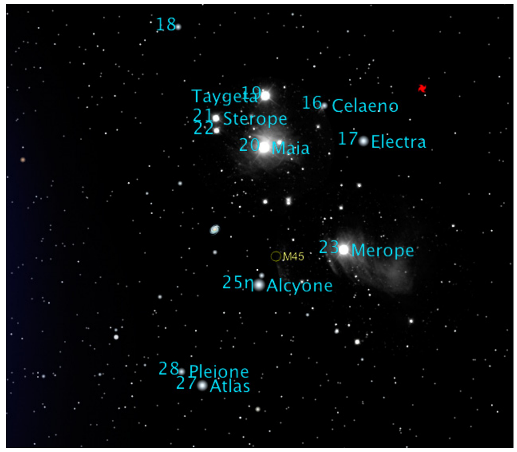


Figure 24: Common star, Bayer and Flamsteed designation labels near the Pleiades Nebula (M45).

The first time *TheSkyX* runs, the common names for the planets are shown. To show the names of other objects, select the ***Labels*** command from the ***Display*** menu to turn on the ***Labels*** window or click the ***Labels*** tab to make it visible.

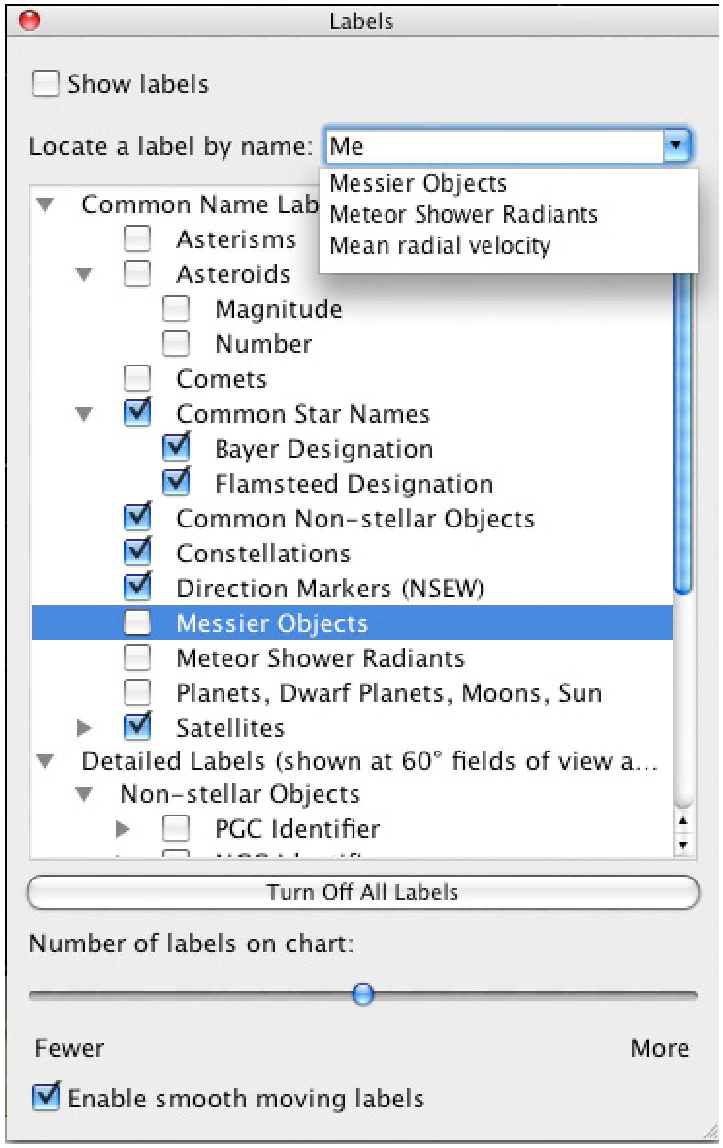


Figure 25: The Labels window (Display > Labels command).

The Labels window allows you to show or hide the names of the following common objects.

- Asterisms
- Asteroids (Name, Magnitude and Number)
- Comets
- Common Star Names
- Bayer Designation
- Flamsteed Designation
- Common Non-stellar Object Names
- Constellations
- Cardinal Directions
- Messier Objects

- Meteor Shower Radiants
- Planets, Dwarf Planets, Moons and the Sun
- Artificial Satellites (Name, Range and Latitude/Longitude Position)

Turn on the checkbox next to the desired common label to show it. Turn off the checkbox to hide the label.

The astronomical catalogs used by *TheSkyX* also contain catalog-specific information that might be useful to show on the sky chart. *Detailed labels* can also be shown for star and non-stellar catalogs and custom Sky Databases (SDBs).

For example, if you're working with double stars, you can show a detailed label that contains the magnitude and angular separation between star systems in Washington Catalog of Double stars by expanding ***WDS*** in ***Stellar Objects*** section under ***Detailed Labels***.

Or, if you're researching galaxies in the New General Catalogue (NGC), you might want to show a detailed label that includes blue magnitude and equatorial coordinates (***Detailed Labels > Non-stellar Objects > NGC Identifier*** group).

Important Note: Detailed labels are shown on the Sky Chart at 60° fields of view and smaller.

Showing Labels (Show Labels)

This checkbox shows or hides the check marked labels.

Finding a Specific Label (Locate a Label by Name)

Use this text input to quickly locate (and turn on or off) a particular common name or detailed label in the labels tree. For example, to turn on satellite labels, type "s"; the labels that begin with this letter appear in the pop-up menu. Select ***Satellites*** to expand the labels list and show the ***Satellites*** checkbox. Pressing the TAB key highlights the checkbox.

Turning Labels Off (Turn Off All Labels)

Press this button to turn off the ***Show Labels*** checkbox and turn off every checkbox in the labels list.

Label Density (Number of Labels on Chart)

Adjust this slider to change the total number of labels that will appear on the Sky Chart.

Anti-aliased Labels (Enable Smooth Moving Labels)

The font used to display labels can be "anti-aliased" that the motion of the label (as the chart is updated, or, particularly during time skip animations or viewing tours) is smooth. When this option is turned off, you might notice a slight "jerky motion" of fonts during animations.

Tours

Before we investigate the various menu and "button" commands arranged across the top of the screen, let's explore some of the tours that have been created to help you appreciate several of the most common yet fascinating things you can see in the sky.

Notice the series of tabs running vertically on the right side of the main. Select the tab labeled ***Tours***. If this window is not visible, click the ***Tours*** command from the ***Display*** menu to show it. A list of available tours is displayed:

- Analemma
- Angular size of Mars
- Coordinates - Equatorial
- Coordinates - Horizon
- Mercury evening visibility
- Mercury morning visibility
- Moon cycle - size and phase
- Motion of Barnard's Star
- 24-Hour Motion of Saturn's Moons
- Rotation and Phase of Mercury 2008
- Rotation and Phase of Venus 2008
- Saturn from Earth Over 10 Years
- Venus and Mercury Paths
- What Was That? (Iridium Flare Example)
- Winter Constellations

Go ahead and take one of the tours. Highlight one that sounds interesting, then click the ***Start*** button. Or, click the ***Run All*** button to watch them consecutively.

Creating Tours

PROFESSIONAL

TheSkyX Professional Edition provides a powerful interface that can be used create *tours* that simulate astronomical events, highlight interesting objects, or demonstrate astronomical concepts.

A tour is based on a timeline that can be as long or as short as you want. Any number of *waypoints* can added to the timeline at which you can "show something" (for example, turn on the constellation lines) or "do something" (for example, perform a 100-year time skip simulation) by executing a *macro command*. One, or any number macro commands can be executed at each waypoint, providing a virtually unlimited set of tools to create educational demonstrations. Tours can be saved later in QuickTime movie format.

To get started, let's look at one of the supplied tours.

1. Highlight the ***Winter Constellations*** tour on the ***Tours*** window. Click the ***Tours*** command from the ***Display*** menu to show this window if necessary. This displays the ***Tour Information*** tab.

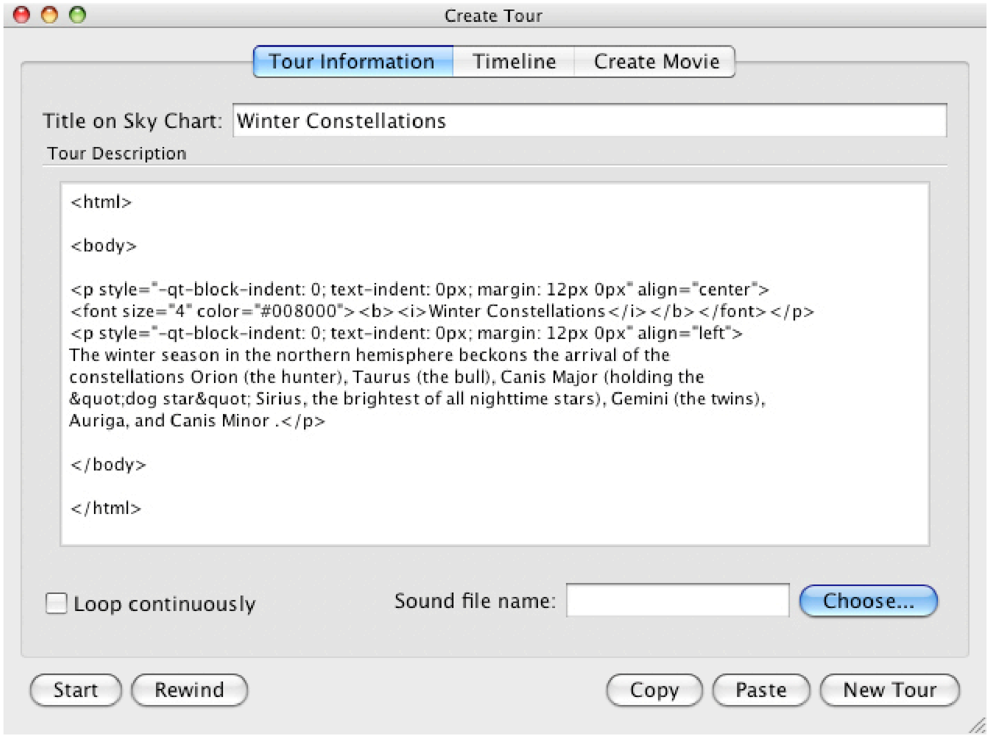


Figure 26: Tour Information tab on the Create Tour dialog.

2. Enter the title of the tour in the ***Title on Sky Chart*** text input. The title appears on the bottom of the Sky Chart while the tour is running.
3. Enter a ***Tour Description*** as plain text or native HTML. This description appears on the ***Tours*** window when the tour name is highlighted.
4. To play a sound at the beginning of the tour, click the ***Choose*** button and select the file. Turn on the ***Loop Continuously*** checkbox to play the tour repeatedly.
5. Click the ***Timeline*** tab.

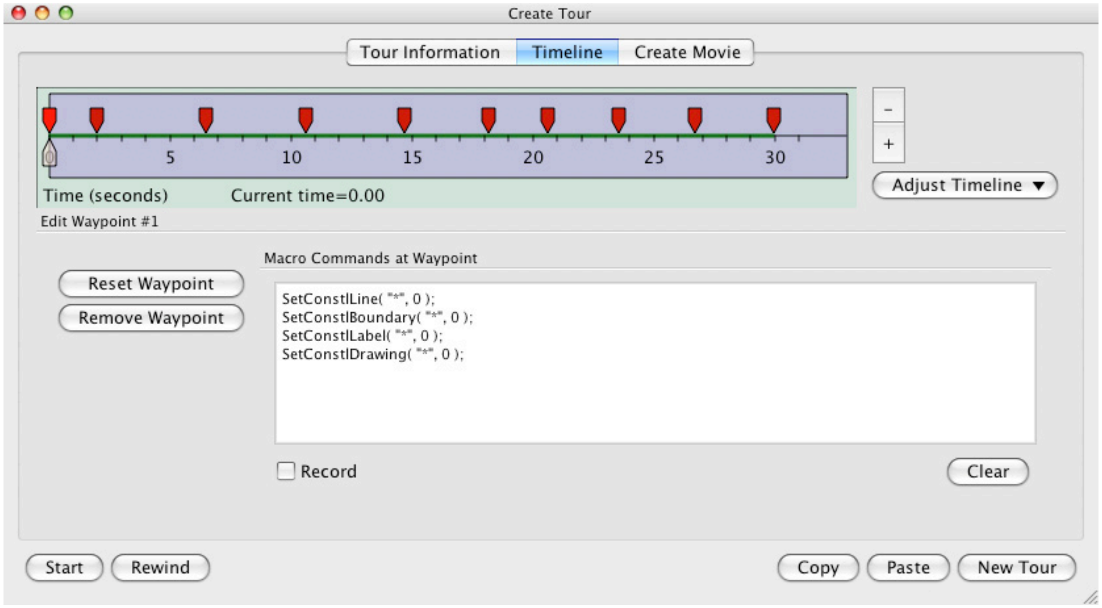


Figure 27: The Timeline tab.

The green line on the timeline graphic indicates the length of the tour, in seconds. A red arrow on the top of the timeline represents the position of a waypoint.

The *Winter Constellations* tour is 30 seconds long. Click the + button to expand the timeline, or the – button to shorten it. This tour also includes ten different waypoints (indicated by a red pointer on the top of the timeline). Each waypoint represents a point of transition in the tour.

Dragging the gray *tour time pointer* (positioned at 0 seconds in Figure 27) lets you advance to a specific point in time in the tour. Defining a new waypoint is easy, just drag the tour time pointer to the desired time and then click the ***Add Waypoint*** button. When the tour time pointer is positioned beneath a waypoint, the button text ***Reset Waypoint*** appears instead.

6. Drag the time pointer to 0 seconds or click the Rewind button to go to the beginning of the tour. The ***Macro Commands at Waypoint*** text input now shows the four macros that will be run when the tour begins:

Macro	Explanation
`SetConstlLine( "*", 0 );`	Show or hide constellation lines. • Argument 1 is either constellation's abbreviation in quotation marks ("Ori"), or an asterisk in quotes "*" to indicate all constellation lines. • Argument 2 defines how to show the constellation lines. A 1 means to turn on the constellation(s), a 0 turns them off.

`SetConstlBoundary( "*", 0 );`	Show or hide constellation boundary lines. • Argument 1 is either constellation's abbreviation in quotation marks ("Ori"), or an asterisk in quotes "*" to indicate all constellation boundary lines. • Argument 2 defines how to show the constellation lines. A 1 means to turn on the constellation boundary lines on, a 0 turns them off.
`SetConstlLabel( "*", 0 );`	Show or hide constellation labels. • Argument 1 is either constellation's abbreviation in quotation marks ("Ori"), or an asterisk in quotes "*" to indicate all constellation lines. • Argument 2 defines how to show the constellation labels. A 1 means to turn on the constellation label(s) on, a 0 turns them off.
`SetConstlDrawing( "*", 0 );`	Show or hide constellation drawings. • Argument 1 is either constellation's abbreviation in quotation marks ("Ori"), or an asterisk in quotes "*" to indicate all constellation lines. • Argument 2 defines how to show the constellation labels. A 1 means to turn on the constellation drawing(s) on, a 0 turns them off.

See "Appendix D: Macro Commands" on page 277 for a complete list of available macro commands.

7. Drag the time pointer under each red arrow to reveal the macro commands for that waypoint.
8. Click the ***Rewind*** button, then the ***Start*** button to watch the entire tour.

Adjust Timeline Pop-up Menu

Use the commands in the ***Adjust Timeline*** pop-up menu to add or remove time from the tour.

- ***Scale Time to Pointer*** adjusts the length of the tour based on the current position of the time slider.
- ***Remove Before Pointer*** resets the start of the tour to the current position of the time slider and removes all waypoints before this position.
- ***Remove After Pointer*** resets the end of the tour to the current position of the time slider and removes all waypoints after this position.
- ***Mirror*** creates a mirror image of the timeline and waypoints.

Clear Button

Click this button to remove all text from the ***Macro Commands at Waypoint*** text input.

Record

When the ***Record*** checkbox is turned on, the macro commands necessary to perform a action are displayed as you perform them. For example, clicking ***Display > Horizon & Atmosphere Options*** and turning off the ***Show Horizon*** checkbox shows:

```
SetVisible("Horizon", 0);
```

Note that you can access any of *TheSkyX's* celestial object types in macro arguments by name. For example, instead of "Horizon" as argument 1, you can turn the *meridian line* on or off by using the text *"Meridian"* as the first argument instead. See "Customizing Chart Elements" on page 136 and the Chart Elements window for the complete list of permitted object type names.

New Tour

Click this button to start a new tour.

Start

Begins the tour from the current time slider position.

Rewind

Resets the time slider to the beginning of the tour.

Create Movies

Once your tour is complete, you can create a QuickTime™ movie from the ***Create Movie*** tab. Windows users will have to install QuickTime (available free from Apple's web site) to use this feature.

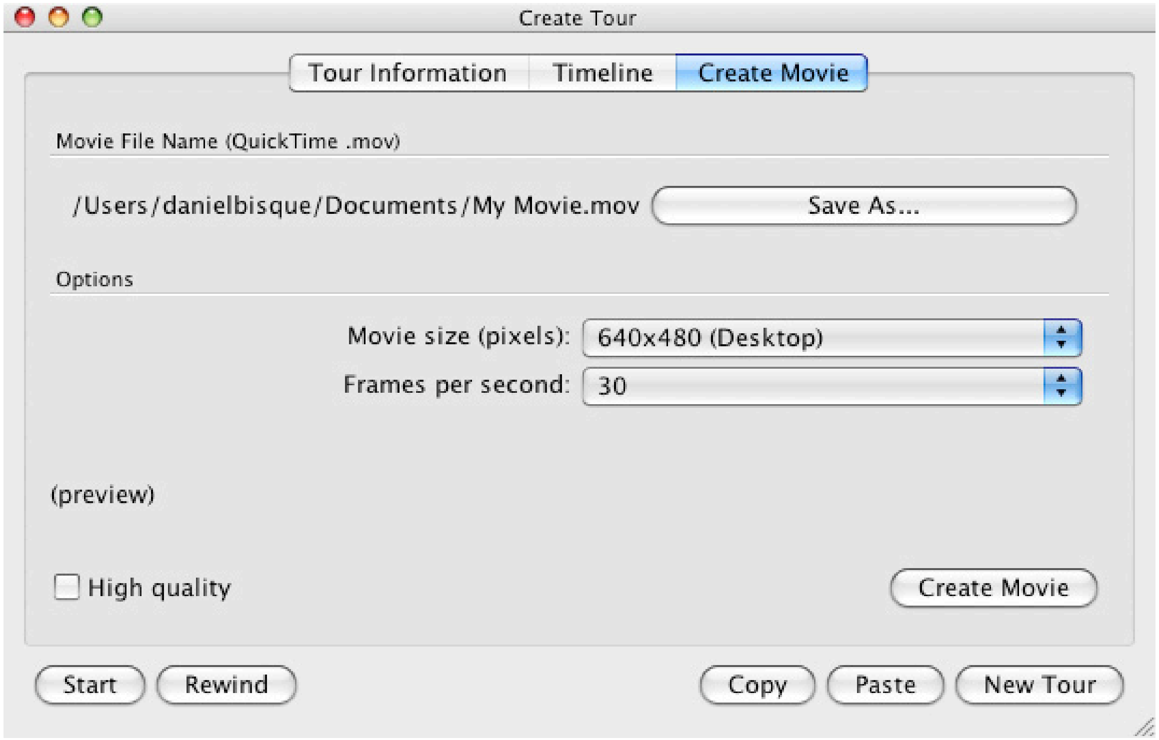


Figure 28: Create Movie tab.

Movie File Name

Displays the file name of the movie that will be created. Click the ***Save As*** button to specify a different file name.

Save As Button

Click this button to enter the name of the movie.

Options

The resolution and frame rate of the movie is configurable to your audience.

Movie Size (Pixels)

Select the resolution of movie from the ***Movie Size*** list.

- ***320x240 (iPod Classic)***
- ***640x480 (Desktop)***
- ***480x272 (PSP)*** Sony PlayStation Portable™ format
- ***480x320 (iPhone/iPod Touch)***
- ***800x600***

Frames Per Second

Select the number of frames, or frequency to capture the Sky Chart when creating the movie. The higher the frames per second, the better the quality at the expense of a larger movie file.

High Quality

Turn this radio button on to configure high quality QuickTime movie settings.

Create Movie

Click this button to create the movie. The length of time it takes create the movie depends on the length of the tour, the resolution and frame rate settings, as well as the speed of your computer.

Photos from the Deep Sky

Since the middle of the 19th century astronomers have been taking pictures of the sky. In recent years, digital imaging sensors have replaced film to capture even more remarkable views of the Moon and planets, as well as star clusters, nebulas, and galaxies. Relatively modest amateur telescopes, equipped with digital cameras, can capture images that rival the best photographs taken by professional observatories just a couple of decades ago.

TheSkyX has a veritable art gallery's worth of fantastic space images you can look at anytime. Browsing these images will give you a taste of the extraordinarily diverse number of objects that populate the night sky.

Viewing Astronomical Photos

In the stacked windows, you'll see a tab called ***Photos***. Select it. (Select the ***Photos*** command from the ***Display*** menu to show this window if necessary.)

In the dialog that opens, you'll see two items, ***Photo Groups***, and ***NGC/IC Digitized Sky Survey Photos***. NGC/IC stands for New General Catalogue/Index Catalog. These are two of the most popular catalogs astronomers use to keep track of the huge number of celestial objects they've been studying over the centuries.

As you scroll through the list of objects, a small picture of each will be displayed below the list. Click the ***Show in Photo Viewer*** option to view them in a separate window.

Placing Photos

PROFESSIONAL

TheSkyX Professional Edition's ***Place Photo*** command lets you create and manage individual or groups of photographs and provides tools to precisely position each photograph on the Sky Chart. In short, there's everything you need to show off your "in-place" photos.

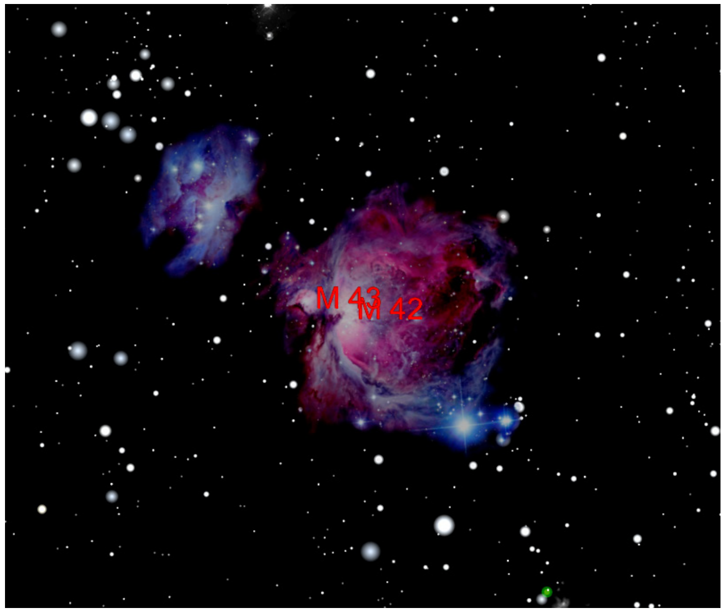


Figure 29: Sky Chart showing in-place photo of the Great Nebula in Orion (M42).

The Bevis constellation drawings are one example of one Photo Overlay Group that is included with *TheSkyX*. The ***Deep Sky Overlays*** is another.

Creating a Photo Group

To create a photo group from your collection, start by copying all the photos to a single folder on your computer. Note that *TheSkyX* can show *GIF*, *JPG*, *TIFF* and *PNG* file formats. The *PNG* format works well since it can have a transparency layer and is compressed.

We'll use the ***Messier Overlay*** photos as a "collection" to demonstrate how to create a photo group. On the Mac, *TheSkyX's* resources are stored inside the *application bundle*, so these photos are not readily accessible or visible from Finder. If you are familiar with accessing files in an application bundle, you'll find the files in this example in the *Resources/Common/Photos/SDBs/Messier Overlays* folder. If you'd like to follow along, you can make a copy of these files in a folder on your desktop. On Windows, these files are located, by default, in the following folder:

C:\Program Files\Software Bisque\TheSkyX <Edition Name Here>\ Resources/Common/Photos/SDBs/Messier Overlays

Where *<Edition Name Here>* is either *TheSkyX Serious Astronomer Edition* or *TheSkyX Professional Edition*.

1. To avoid confusion, first turn off the existing Messier Overlays Photo Group by clicking the ***Database Manager*** command from the ***Input*** menu, and turning off the checkbox next to ***Messier Overlays*** in the ***Photo Databases*** node under ***Sky Databases***, then click ***Close***.

2. Select the ***Place Photo*** command from the ***Input*** menu to show the ***Place Photo*** window.

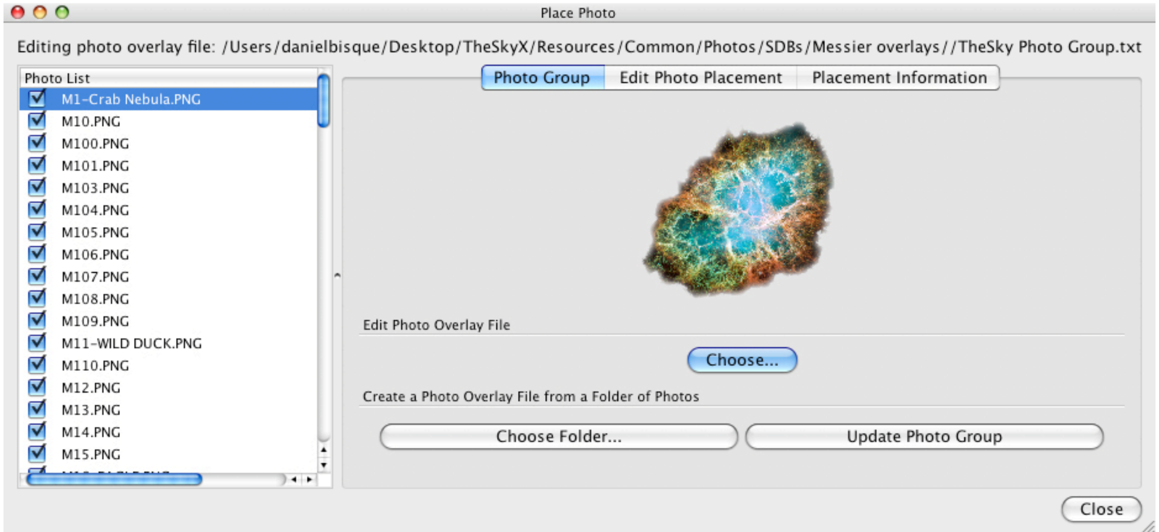


Figure 30: Photo Group tab on the Place Photo window (Input menu).

3. On the ***Photo Group*** tab, click the ***Choose Folder*** button and navigate to the folder that holds your collection of photos then click the ***Choose*** button.
4. Your photos appear in the ***Photo List***. The name of the photo group text file, which stores the photo group information, is listed in the ***Editing Photo Overlay File*** text input box.
5. To overlay and place a single photo in the list on the Sky Chart, highlight its name. A preview of the photo appears on the Photo Group tab.
6. Click the ***Place Photo*** tab. The selected photo is centered on the Sky Chart. From here, you need to adjust the Sky Chart's center coordinates, field width and rotation to align the photo.

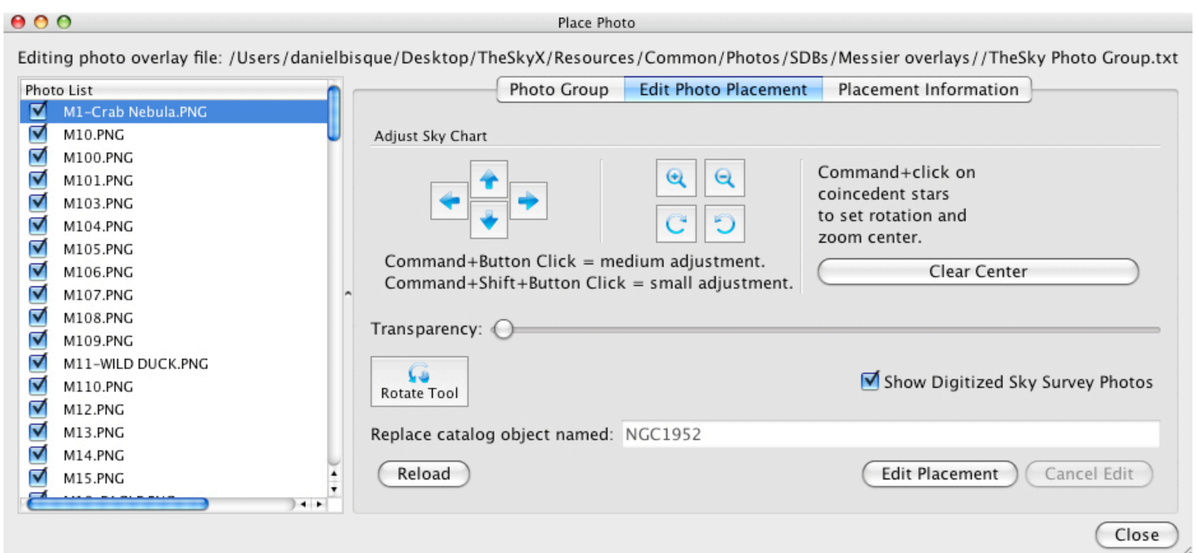


Figure 31: Edit Place Placement tab on the Place Photo window.

7. The ***Edit Photo Placement*** tab has tools to move left, right, up, down, zoom in, out and rotate the Sky Chart so that the photo can be aligned with the Sky Chart. Click the ***Edit Photo Placement*** button to begin this process. The ***Show Digitized Sky Survey Photos*** checkbox allows you to show these photos as another frame of reference to help align your photo. Once you are satisfied with the position of the photo, click the ***Save Placement Changes*** button to save it. Click the ***Cancel Edit*** button to abort the process and not save changes.
8. Repeat steps 5-7 for each photo in the ***Photo List***.

Placement Information

Click on the ***Placement Information*** tab to show the equinox 2000.0 ***RA/Dec*** coordinates of the photo, as well as the photo's ***Scale***, in arcseconds/pixel and ***Position Angle***, in degrees.

Managing Photo Databases

Click the ***Database Manager*** command on the ***Input*** menu to show the ***Database Manger*** window. Next, expand the ***Photo Databases*** branch of the ***Sky Databases*** node in the ***Databases*** tree to show the available photo overlays.

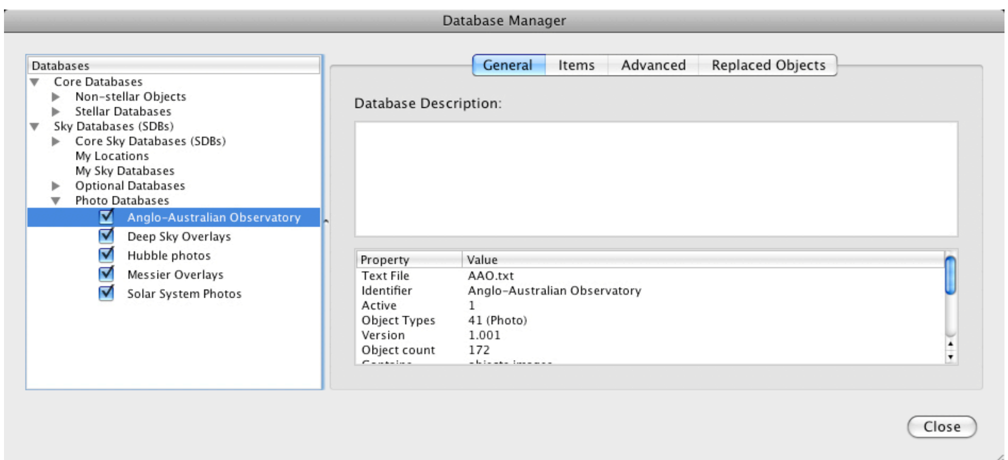


Figure 32: Photo Databases in the Database Manager.

Viewing Photos from the Digitized Sky Survey

PROFESSIONAL

TheSkyX Professional Edition can overlay photos from the Digitized Sky Survey (DSS) on the Sky Chart (see Figure 94) or retrieve the equivalent FITS image for any position on the celestial sphere and for any field of view up to 2° x 2°. This "all-sky photographic reference" can be extremely useful when searching for new objects such as supernovas or asteroids.

Overlaying Digitized Sky Survey Photos on the Sky Chart

1. Adjust the Sky Chart to the desired position and field of view. For example, frame the spiral galaxy M81 by selecting the ***Find*** command from the ***Edit*** menu, entering ***M81*** in the ***Search For*** text input, and then clicking the ***Frame*** button. You should now see the color photo of M81 on the Sky Chart.
2. For convenience, select the ***Celestial Sphere*** command from the ***Orientation*** menu. This command fixes the equatorial center of the Sky Chart to the center of the window with the north celestial pole "up" on the screen.
3. Select the ***Digitized Sky Survey*** command from the ***Tools*** menu.

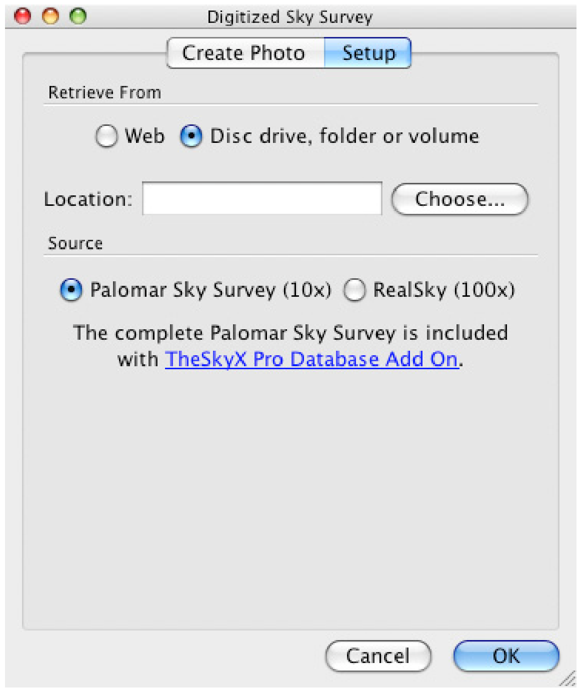


Figure 33: Setup tab of the Digitized Sky Survey window.

4. From the ***Setup*** tab, select the ***Web*** option (internet connection required). If you own the *TheSkyX Pro Database Add On* (page 266), select the ***Disc Drive, Folder or Volume*** option, click the ***Choose*** button to specify the location of the Digitized Sky Survey data, then select the ***Palomar Sky Survey (10x)*** option.
5. Click the ***Create Photo*** tab.
6. Click the ***Fill Sky Chart*** button. The photo is retrieved from the selected source.
7. Click the ***Show Photo in Front of Chart Elements*** option to show the photo on top of everything else on the Sky Chart.

Creating a FITS File of a Digitized Sky Survey Photo

1. Follow steps 1-5 above.
2. Click the ***Create*** button. The FITS file is retrieved from the selected source and displayed in the FITS Viewer window.

Figure 34: M81 in the FITS Viewer window.

Viewing FITS Photos

PROFESSIONAL

TheSkyX Professional Edition uses the High Energy Astrophysics Science Archive Research Center's (HEASARC) *CFITSIO* software library to manage FITS files. It is the "standard" library that handles the all complexities of different FITS file formats so that your FITS (provided it adheres to the FITS standard) will be opened and displayed correctly.

Opening a FITS

1. Click the ***Open FITS*** command from the ***Tools*** menu.
2. Navigate to the location of the FITS file, select it and then click ***Open***.
3. The FITS photo is now displayed on the ***FITS Viewer*** window.

FITS Viewer Window

The ***FITS Viewer*** window contains basic image manipulation commands and shows a table with the FITS header information. Software Bisque plans to implement a more robust feature set in future versions.

Photo Pop-Up Menu

The following commands are available from the ***Photo*** pop-up menu.

Open

Opens a FITS and displays it on the ***FITS Viewer*** window. Note that the FITS file must use the extension FIT or FTS to be recognized as a FITS on the Mac.

Save

Saves the FITS file using its current file name.

Save As

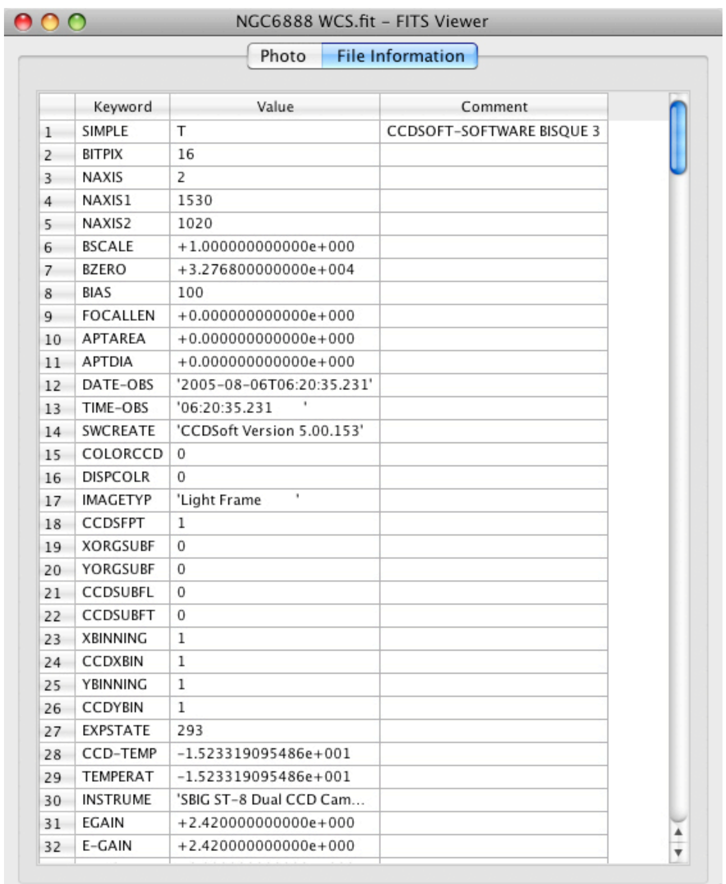
Saves the FITS file using the file name you specify.

Print

Prints the FITS file to the default printer.

File Information

This command shows the ***FITS Information*** tab that displays a table containing the FITS header information. Search the web for the *Flexible Image Transport System specification* for details about FITS headers and keywords.



	Keyword	Value	Comment
1	SIMPLE	T	CCDSOFT-SOFTWARE BISQUE 3
2	BITPIX	16	
3	NAXIS	2	
4	NAXIS1	1530	
5	NAXIS2	1020	
6	BSCALE	+1.000000000000e+000	
7	BZERO	+3.276800000000e+004	
8	BIAS	100	
9	FOCALLEN	+0.000000000000e+000	
10	APTAREA	+0.000000000000e+000	
11	APTDIA	+0.000000000000e+000	
12	DATE-OBS	'2005-08-06T06:20:35.231'	
13	TIME-OBS	'06:20:35.231 '	
14	SWCREATE	'CCDSoft Version 5.00.153'	
15	COLORCCD	0	
16	DISPCOLR	0	
17	IMAGETYP	'Light Frame '	
18	CCDSFPT	1	
19	XORGSUBF	0	
20	YORGSUBF	0	
21	CCDSUBFL	0	
22	CCDSUBFT	0	
23	XBINNING	1	
24	CCDXBIN	1	
25	YBINNING	1	
26	CCDYBIN	1	
27	EXPSTATE	293	
28	CCD-TEMP	-1.523319095486e+001	
29	TEMPERAT	-1.523319095486e+001	
30	INSTRUME	'SBIG ST-8 Dual CCD Cam...	
31	EGAIN	+2.420000000000e+000	
32	E-GAIN	+2.420000000000e+000	

Figure 35: The FITS Header Information tab on the FITS Viewer window.

Zoom In/Zoom Out

These commands can be used to change the scale of the displayed photo by zooming in or out.

Fit To Window

This is the default photo option that scales the photo to match the size of the ***FITS Viewer*** window.

Clear

Click this command to close the FITS image.

To Image Link

Select this command to copy the displayed photo to the ***Image Link*** window. See "Image Link and Automated Astrometry" on page 185 for details.

Close

Click this command to close the ***FITS Viewer*** window.

Your Sky Tonight

This section is intended to help you explore the night sky from your location on any date, at any time. You'll be able to answer the question: "When I head outside tonight at, say, 9 p.m., what am I going to be able to see?" You'll also learn how to plan ahead for special events, like meteor showers and lunar eclipses.

For a given location, what you can see in the sky on any given night depends on the date and time. The stars that are visible at 9 p.m. on a December night are very different from the ones you would see at 9 p.m. in June, for example. And the Moon and planets follow their own unique celestial paths – their positions, and their brightness, vary from month to month and year to year.

Observing Lists

TheSkyX includes a command that will display a select list of objects that will be visible in your night sky on the current date. You can set the parameters of this list to choose the kinds of objects you're most interested in seeing.

To generate a What's Up Observing List:

1. Go to the ***Tools*** menu.
2. Select the ***Manage Observing List*** command.
3. Click the ***What's Up Setup*** tab.
4. Select the ***Viewing Time*** for the list.
5. Select the ***Optical Aid*** that you will be using.
6. Click the ***What's Up?*** button.
7. Click the ***Close*** button.

Clicking the ***What's Up?*** button creates and shows the list of objects that are visible from your location in tonight's sky on the Observing List window. When you highlight an item, observing notes are displayed.

Some of these objects, and the data displayed with them, may be unfamiliar to you. We'll be describing most of the information in the ***What's Up?*** command in more detail on page 172.

Field of View Indicators

A Field of View Indicator (FOVI) is an on-screen element that represents the field of view that is rendered by an eyepiece, CCD sensor, camera body and optical tube, or a Telrad™ finder, binoculars or other optical system. As you zoom in or out in the Sky Chart, the FOVIs shrink or grow in proportion to the field of view. The utility to this feature is endless, particularly helpful during observing sessions and with telescope control. Easy, quick identification of celestial objects can be made when you view the Sky Chart as if you were looking through the eyepiece: no guesswork required!

Choosing Your Telescope and Eyepieces

Select the ***Field of View Indicators*** from the ***Display*** menu to open the ***Field of View Indicators*** dialog.

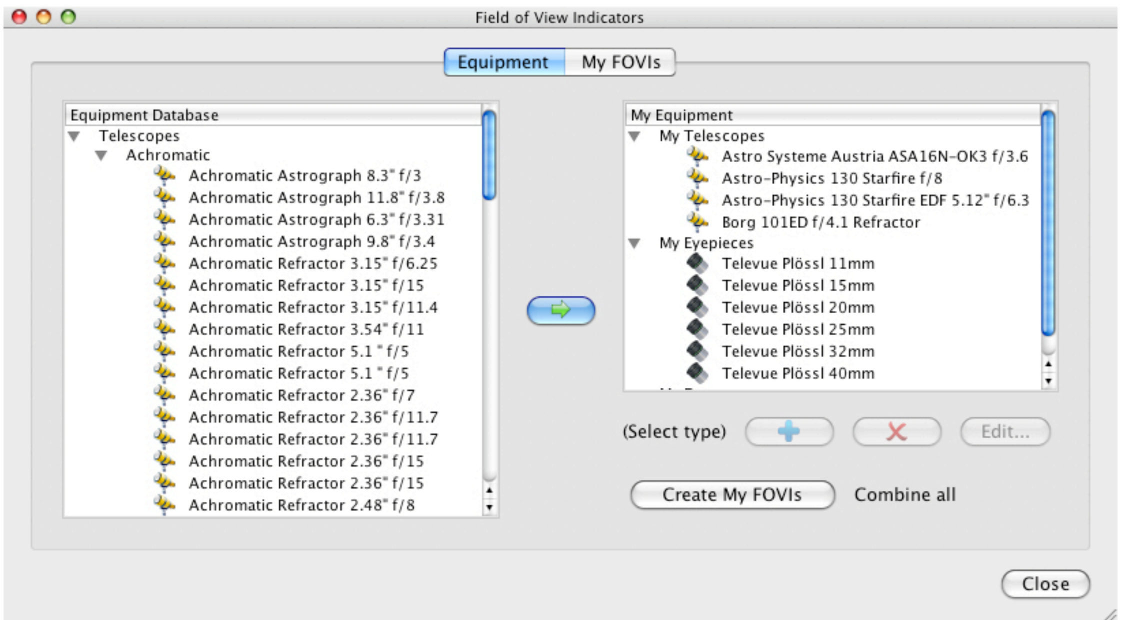


Figure 36: Field of View Indicators dialog.

To the left, you will see the equipment database list, including selections for ***Telescopes***, ***Eyepieces***, and ***Detectors***. To select a telescope, expand the ***Telescopes*** portion of the tree. You will see a large selection of telescope makers. Expanding a telescope maker's menu will produce a list of telescope models by that manufacturer. Choose your telescope from the list. Once you have selected your telescope, click the ***green arrow*** button found in the middle of the window. You will then see the telescope listed on the ***My Equipment*** list to the right of the window.

Now, choose your eyepiece and/or detector from the appropriate menu from the left side ***Equipment Database***.

Once you have chosen your telescope, eyepieces, and detectors, click the ***Create my FOVIs*** button. You will then be taken to the ***My FOVIs*** tab, where each FOVI will appear in a list with a checkbox to toggle each FOVI on or off.

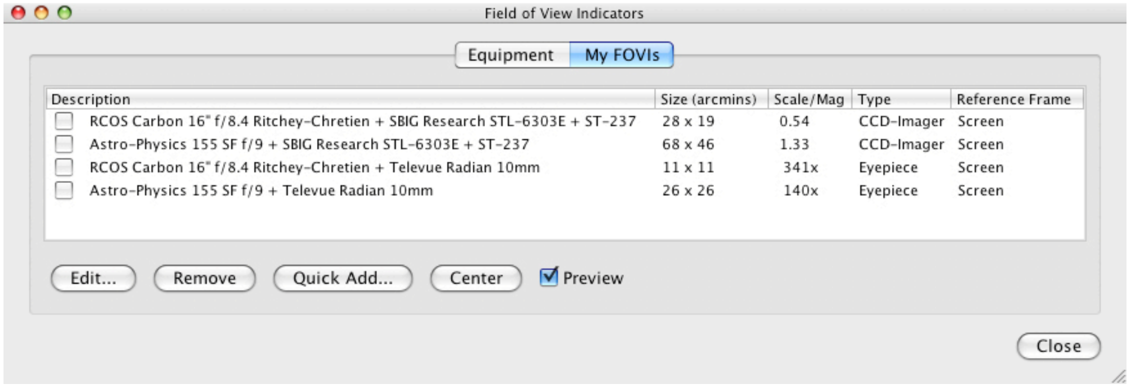


Figure 37: My FOVIs tab.

Selecting a FOVI and clicking the ***Edit*** button will show the ***Add/Edit Equipment*** dialog where you can edit each element and aspect of the telescope and eyepiece or detector combination (page 69).

Clicking the ***Quick Add*** button also opens the ***Add/Edit Equipment*** dialog, in which you can add a FOVI with characteristics of your choosing. Just input the desired ***Shape***, ***Reference Frame***, and ***Width and Height*** in arcminutes, and you've added a brand new FOVI of custom dimension.

Clicking ***Remove*** will remove a FOVI from the list. Clicking ***Center*** will center the FOVI on the screen.

Checking the ***Preview*** checkbox will reveal a preview of each selected FOVI in the Sky Chart. When the ***Preview*** checkbox is turned on, the currently selected FOVI is centered on the Sky Chart. This lets you quickly determine which optical system is best for your needs.

Note that if you turn on both the ***Preview*** checkbox *and* the checkbox next to a FOVI, two identical FOVIs will appear on the Sky Chart (the "preview" FOVI and the actual FOVI). To avoid confusion, make sure to turn off the ***Preview*** checkbox before closing this window.

Note: Remember that FOVIs represent the view through your telescope, and will not appear on the Sky Chart if the chart's field of view is set to 100° (naked eye) or more. To see the indicators, you must zoom to a smaller field of view.

The ***My FOVI*** tab shows the following information for each field of view indicator.

Description

The FOVI description is the combination of the telescope and the eyepiece or detector description. To change a description, highlight the FOVI in the list and click the ***Edit*** button.

Size

The size column shows the angular dimensions of the FOVI, in arcminutes.

Scale/Magnification

For telescope and camera FOVIs, the scale or image scale, in arcseconds per pixel is displayed. The optical system's magnification is displayed when the FOVI consists of a telescope and eyepiece.

Type

The ***Type*** column shows either ***Eyepiece*** for eyepiece plus telescope combinations, or ***CCD*** for a camera plus telescope FOVI.

Reference Frame

This column shows the frame of reference to use when displaying the FOVI. See "FOVI Frame of Reference (Reference Frame List)" on page 70 for details about reference frame options.

Showing Telrad Finders

Telrad™ finder FOVIs are shown at all fields of view (but may not be completely visible at small fields) and can be added to the Sky Chart using the ***My Chart Elements*** command on the ***Input*** menu.

To Add one or more Telrad Finder FOVIs to the Sky Chart:

1. Click ***Input > My Chart Elements***.
2. On the ***Manage*** tab, click the ***Add Telrad*** button.
3. Under ***Command+Click*** (Mac) or ***Ctrl+Click*** (Windows), select ***Cursor Position*** in the ***Snap To*** pop-up menu.
4. Position the mouse cursor over the Sky Chart, press and hold the ⌘ key on the Mac or the CTRL key on Windows, then click the left mouse button. A new Telrad finder is drawn at the current cursor position.

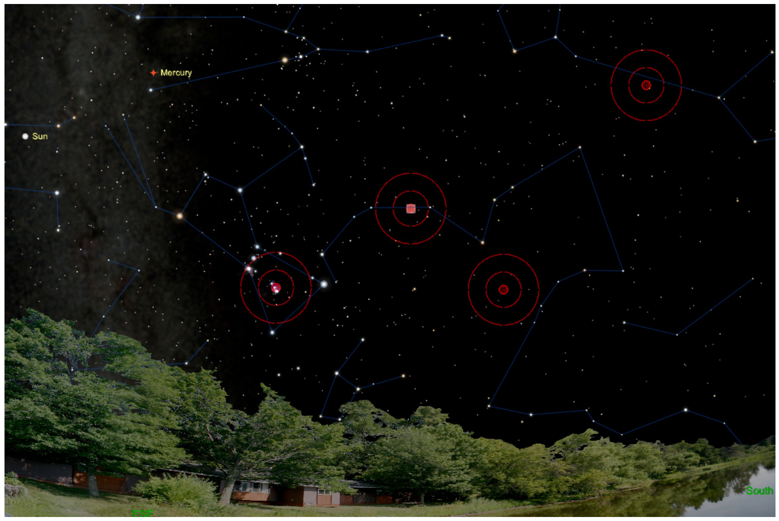


Figure 38: Sky Chart showing multiple Telrad finders.

To position a Telrad finder at a specific coordinate:

1. From the ***Manage*** tab on the ***My Chart Elements*** window, highlight the Telrad you want to move in the ***My Chart Element*** list by clicking on it or click on the center of the Telrad Finder on the Sky Chart. A selected Telrad finder appears as ***My Chart Element*** # in the ***Object Information Report*** on the ***Find*** window.
2. Click the ***Edit*** button (or double-click on the element) to show the ***Add/Edit Chart Element*** window.
3. To enter equatorial coordinates, click the ***Equatorial*** radio button then enter the right ascension (***RA)*** in hours, minutes and seconds and declination (***Dec)*** in degrees, minutes and seconds.

To enter horizon coordinates, click the ***Horizon*** radio button then enter the azimuth (***Azm)*** in hours, minutes and seconds and altitude (***Alt)*** in degrees, minutes and seconds.

To Drag and Move a Telrad Finder:

1. From the ***Manage*** tab on the My Chart Elements window, select the Telrad you want to move in the ***My Chart Element*** list, or click on the center of the Telrad Finder on the Sky Chart. A selected Telrad finder appears as ***My Chart Element*** # in the ***Object Information Report*** on the ***Find*** window.
2. Click and drag the small red rectangle in the center of the Telrad finder to move it.
3. Release the mouse when the Telrad is positioned where you want it.

Adding or Editing Field of View Indicator Properties

Clicking the ***Edit*** button or the ***Quick Add*** button on the ***My FOVIs*** tab (***Field of View Indicators*** dialog) shows the ***Add/Edit Equipment*** dialog. This window lets you define up to twenty different FOVI elements.

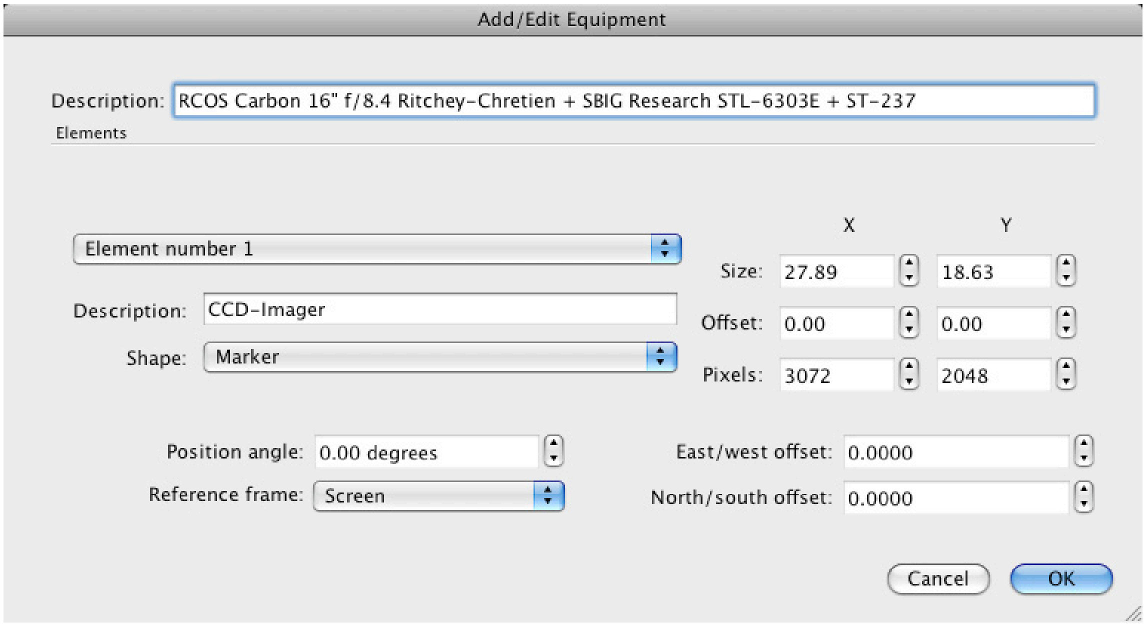


Figure 39: The Add/Edit Equipment dialog (clicking the Edit button).

Field of View Indicator Description (Description)

Enter a description for your detector, such as *Super CCD with 10 Detectors*.

Element Number List

Up to 20 separate FOVI elements can be defined for each FOVI. For example, if your camera has a built-in autoguider, then the FOVI will have two different elements, one for the imaging detector and one for the autoguider.

Element Description (Description)

Enter a text description for the element, such as "ST-237 guider mounted to my guide scope".

Shape

Specify the shape of the element. An element can be:

- Circular (or elliptical)
- Rectangular
- Marker (a small cross offset from the main FOVI)

Position Angle

Enter the position angle, measured counterclockwise from North, of the FOVI element.

FOVI Frame of Reference (Reference Frame List)

Select the frame of reference for the detector or detector/telescope combination.

- **Screen**: The FOVI will remain fixed at on the computer screen.
- **Equatorial**: The FOVI will remain fixed at a specific equatorial coordinate.

- **Telescope**: The FOVI will be included as part of the telescope cross hairs at smaller fields of view.
- **Telescope Mask**: Use this option to simulate the view through a telescope with this field of view indicator.

Figure 40: Sky Chart showing a telescope mask FOVI.

Size, X/Y

Enter the physical size of the detector, in mm.

Offset, X/Y

Enter the offset of the element from the Element Number 1, in mm.

Pixels, X/Y

For CCD cameras, enter the number of pixels in each axis. This value is used to compute the scale of images acquired with the camera, in arcseconds/pixel.

East/West offset

Specify the number of arcminutes to shift the center of the FOVI to the East or West. A number greater than zero shifts the FOVI West, a negative number shifts it East.

North/South Offset

Specify the number of arcminutes to shift the center of the FOVI to the North or South. A number greater than zero shifts the FOVI South, a negative number shifts it North.

Clicking the ***Quick Add*** button shows slightly different options.

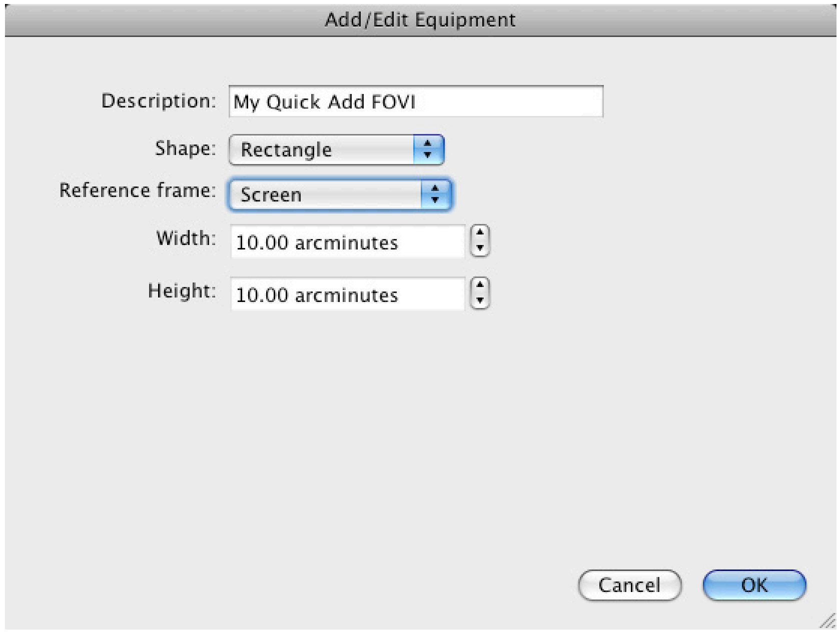


Figure 41: The Add/Edit Equipment dialog (clicking the Quick Add button).

Enter the FOVI's ***Description***, ***Shape*** and ***Reference Frame*** (described above) and the ***Width*** and ***Height,*** in arcminutes.

FOVIs and the Sky Chart

FOVIs that are displayed on the Sky Chart are configurable *and* customizable. They can be:

- Clicked and dragged to any part of the screen
- Copied and "pinned" to a specific equatorial (RA/Dec) coordinate
- Rotated to any angle
- Used as the telescope cross hairs
- Used to create a telescope mask

How to Position a FOVI on the Sky Chart

1. Select the FOVI on the Sky Chart by clicking on it, or click on the center marker (if the FOVI has a visible center marker). Two small reddish squares, and the position angle, appear when the FOVI is selected. The center square can be dragged to move the FOVI; drag the outer square to change the position angle.

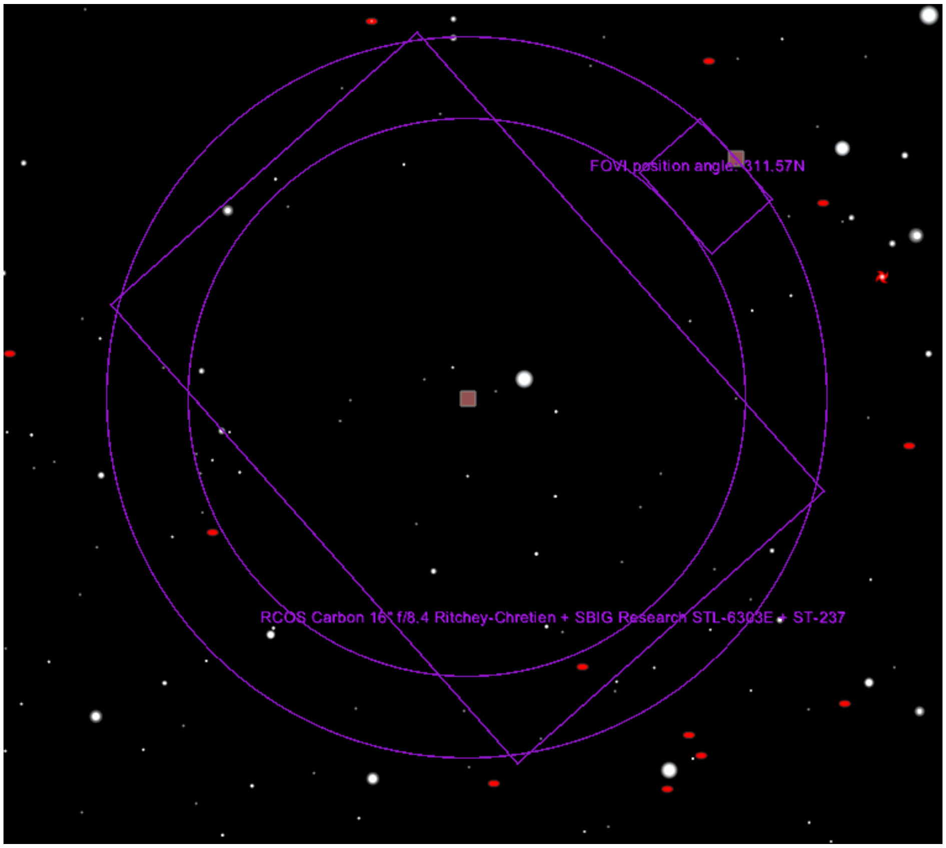


Figure 42: Clicking on a FOVI shows the position angle, and rectangles to position and orient it.

How to Use a FOVI as the Telescope Cross Hair

1. Click the Field of View Indicators command from the Display menu.
2. Click on the My FOVIs tab.
3. Highlight the FOVI that you want use as the telescope cross hair.
4. Click the ***Edit*** button.
5. On the Add/Edit Equipment dialog, select Telescope from the ***Reference Frame*** list.
6. Click ***OK***.

When the Sky Chart's field of view is small enough to resolve the FOVI, and the telescope is connected, the telescope's cross hair will include the FOVI, too.

Object Paths

Sometimes the best way to say something is with a picture. This is certainly true with a complex concept like planetary motion. Tracing out motion paths of solar system objects is the perfect way to demonstrate their motion and to plan for upcoming observation sessions. *TheSkyX* allows you to do so with ease and flexibility.

Generating An Object Path

Selecting the ***Object Paths*** command from the Tools menu will bring up the ***Object Paths*** dialog. In it, you will see a list of solar system objects, along with various drop-down menus and buttons that control the various object path functions. On the left, you will see a list of solar system objects: the eight classical planets, plus Pluto, the Sun, Moon, comets, and asteroids. On the right, you will see information pertaining to the path that *TheSkyX* is currently set to create, including the number of items selected, the chosen time increment, the count of time increments, and the path style.

To get our feet wet, let's try out the object path tool on an observer's favorite, the planet Mars.

Note: This process works the same way with any object. If Mars is not in your sky right now, you can always choose another object, or adjust your Sky Chart to the next time Mars is visible.

1. Choose ***Object Paths*** from the ***Tools*** menu.
2. From the ***Select Solar System Object*** list, select ***Mars***.
3. Looking over to the right side of the window, you will now see that ***Items Selected*** now says ***1***.
4. By default, *TheSkyX* sets the time increment to ***1 day***, which is changeable by using the pop-up menu. Let's leave it at 1 day for now.
5. The ***Count*** is set at ***30*** by default, which means that the system will calculate a path for 30 of the chosen time increments. In this case it is 30 days.
6. The ***Path Style*** may be changed from a connected line to a dotted line, each with various point styles. Experimenting with this feature will allow you to best decide which option is right for you.
7. Then, click the ***Create Path*** button, and a new path appears in the Sky Chart, revealing the path taken by Mars starting with the current system time and ending in the next 30 days.

In this example, the generated path shows the position of Mars in the sky each day at the same time. So, if the clock is set at 12:00 a.m. when you generate the path, it will show the position of Mars each day at 12:00 a.m.

Clicking the ***Show*** button in the ***Object Paths window*** will zoom in and center the path in the Sky Chart.

What if you would like to see the path that an object takes through the sky during a single day? *TheSkyX* makes that easy, as well. Using Mars as our example again, following these easy steps will lead you to success.

1. Select ***Object Paths*** from the Tools menu.
2. Choose ***Mars*** from the ***Select Solar System Objects*** list.

3. Ensuring that the ***Create Paths*** button is highlighted on the right, change the time increment to ***1 hour***.
4. Change the frequency to ***24*** by either typing it into the field or by using the field's arrow buttons.
5. Select the path style that is best for you.
6. Click ***Create Path***.

You will now see a path on the Sky Chart reflecting Mars' motion through the sky over the next 24 hours.

Remember, clicking the ***Show*** button in the ***Object Paths window*** will zoom in and center the path in the Sky Chart.

Once you get the hang of the example path, try out several different paths, changing the variables to achieve different effects.

Updating Object Paths

Should you wish to update object paths based upon new time and date settings, simply click the ***Update All*** button.

Clearing Object Path Data

If you would like to clear paths from the Sky Chart, click ***Clear All Paths***.

Create Paths Options

TheSkyX allows you to create object paths with a great amount of flexibility. The following is a detailed explanation of each option under the ***Create Paths*** menu.

Items selected

This area denotes how many objects are selected for which paths will be drawn. You may select as many objects as you wish from the list on the left.

Time increment

Here, you can select the desired time increment from minutes, hours, 12-hour increments, days, and 30-day increments.

Count

Using this function lets you choose how many time increments you want to include in the object path. Selecting ***1 hour*** as the time increment and ***24*** as the count generates a path that is 24 hours in length, or about one Earth day.

Path style

Using the drop-down menu, the path style can be changed so that is drawn as a smooth connected line, a dotted line with points at each position, a dotted line with a graphical representation of the object at each position, or a continuous line with either dots or graphic objects at each position.

Animating an Object Path

If you would like to animate the path as the object moves, simply turn on the ***Animate Path*** checkbox.

Path Labels

TheSkyX affixes labels to paths so that you can reference an object's position at any given time along the path.

To see the label data, or to adjust how labels are generated, click the ***Path Labels*** button near the top right side of the Object Paths window. You will see a number of options, such as the position of the label, label frequency, and options for the label data (day, month, date, etc.). Let's change the label parameters in our Mars example to show us the date and time of several points along Mars' path.

1. Click the ***Path Labels*** button in the Object Paths window.
2. The label position is set at ***top***, and the frequency at ***6***, by default, so let's just leave those as they are for now.
3. In the ***Label Options*** drop-down menu, select ***Date and time***.
4. Click the ***Update*** button.

You will now notice that the path labels in the Sky Chart now show the date and time of six points along the generated path. If you want to change the label details again, simply follow the previous steps, substituting the new parameters under the Path Labels section.

Label List

In the Path Labels section, you will notice a label list under the label parameters. *TheSkyX* allows you to view and change any label along your generated path. Scrolling in this list will reveal the label and the date and time of each incremental point along the generated path. (In our example above, we generated a path 30 days in length, so the label list contains data for 30 days.) You can change any label to anything you like by double clicking on a label cell and entering text. Clicking ***Update*** will update your path and show the new labels.

Path Labels Options

TheSkyX affixes labels to object paths based upon default parameters or those selected by the user. Understanding these will help you to get the most out of *TheSkyX's* object paths function.

Position

A label's position can be changed here. You can elect Top, Bottom, Left, or Right.

Frequency

This function adjusts the frequency at which labels appear on the object path. The frequency can be changed by directly entering a number into the field, or by using its arrow buttons.

Label option

Here, you can change the data content of labels. Labels can display date, time, date and time, day and month, or day only. Additionally, labels can be turned off completely by selecting ***None***.

Label list

This list shows all labels on a given object path and lists the labels as well as the date and time of each point along the path.

You can change the content of any label by double-clicking in a label's cell and entering text.

The Calendar

Mankind has been using calendars of one kind or another to mark the passage of time for thousands of years. *TheSkyX's* Calendar charts the phases of the Moon, sunrise and sunset, and viewing opportunities for a special kind of satellite event called an *Iridium flare*, on a monthly basis. You can display and print a calendar for a single month or the entire year.

Figure 43: The Calendar window (Tools menu > Calendar command).

Copy Calendar to Clipboard (Copy button)

The current month's calendar can be exported by copying it to the Clipboard using the ***Copy*** button, and then pasted into other applications that accept graphics (in *Portable Network Graphics* or PNG format).

Please include the Software Bisque copyright if you publish a calendar on the web or in a monthly astronomy bulletin.

Create a Calendar as a PDF (Create PDF button)

Calendars created as Portable Document Format (PDF) documents can be emailed and viewed, or printed using free software on Windows, or freely with the Preview application on the Mac.

PDF calendars, by default, are saved to the directory named:

Software Bisque/TheSkyX <Edition Name Here>/Exported Data

In your home folder (the one with the house icon in Finder on the Mac or the current user's *My Documents* folder on Windows).

Print Calendars (Print button)

Clicking the Print button sends the calendar to your printer. Make sure that your printer is turned on and ready to go before doing so.

Show Sun or Moon Rise and Set Times (Sunrise/set, Moonrise/set checkboxes)

Turn on the ***Sunrise/set*** or ***Moonrise/set*** checkbox to show the local sunrise (moonrise) and sunset (moonset) times for each day on the calendar.

Show Times of Iridium Flares (Iridium Flares checkbox)

In order to show the predicted times for flares in the calendar, *TheSkyX* must first generate an Iridium Flare Report. To do so, click the ***Iridium Flares*** command on the ***Tools*** menu, specify the desired search parameters, then click the ***Find Flares*** button to generate a report of upcoming flares.

After an Iridium Flare report is generated, turning on the ***Iridium Flares*** checkbox on the Calendar window shows the magnitude, time, direction and altitude of each flare in the Iridium Flare report.

Show Yearly Moon Phase Calendar (Show Full Year checkbox)

Turn on the Show Full Year checkbox to view the phases of the Moon for the current year.

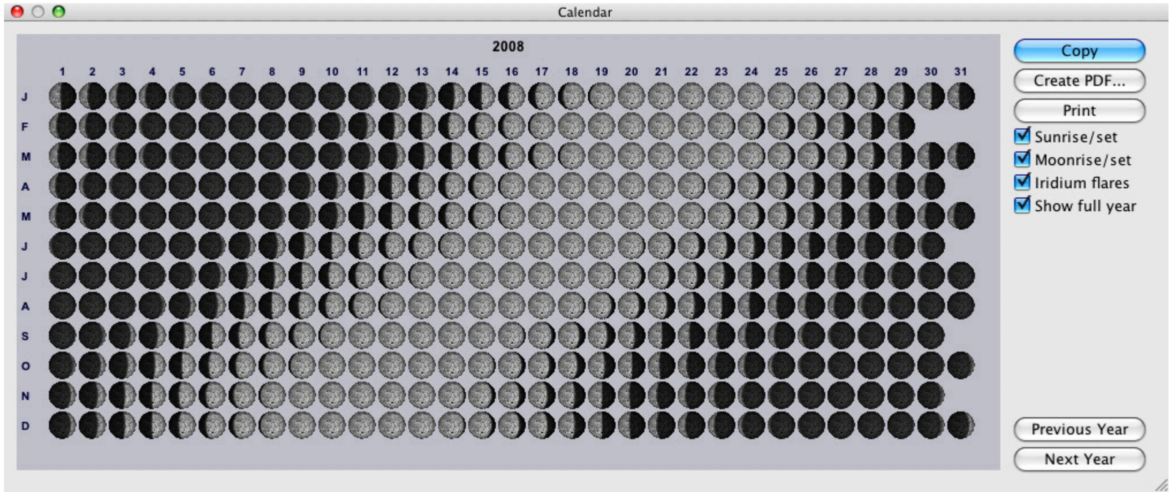


Figure 44: Phases of the Moon for one year.

Future and Past Calendars (Previous/Next Month/Year buttons)

When the ***Show Full Year*** checkbox is off, click the ***Next*** or ***Previous Month*** button to view a future or past month's calendar.

If you select the ***Date & Time*** tab, a small calendar for the current month will be displayed. Here's a very interesting feature: if you click on any date in the calendar, the Sky Chart automatically shifts to show you what the sky will look like on that date, for the current time. Notice also that the four major phases of the Moon are displayed in the calendar.

For a more detailed calendar, go to the ***Tools*** item in the Main Menu. Scroll down to ***Calendar*** and select it. A larger, printable calendar is displayed. Note that you can select various kinds of information to be included in the calendar by checking the appropriate boxes on the right-hand side of the window.

Exploring the Sky Chart

In this section of the User Guide we'll focus on how to adjust and navigate the Sky Chart. The best way to learn our program is simply to use it. Feel free to play around with the various buttons and menu commands you see in the tool bars. *TheSkyX* won't break, and it won't bite you.

Changing the Date and Time

The clock built into your computer is constantly tracking the date and time. *TheSkyX* reads this and displays whatever is above your horizon right now, but it can also show you the sky for different times of day or night.

By default, *TheSkyX* starts up using the computer's clock to show time advancing at ***1x (real time)*** with the ***Go Forward button*** pressed (meaning time is advancing how you'd expect).

From the ***Input*** menu, select the ***Date and Time*** command to show the ***Date and Time*** window (Figure 44).

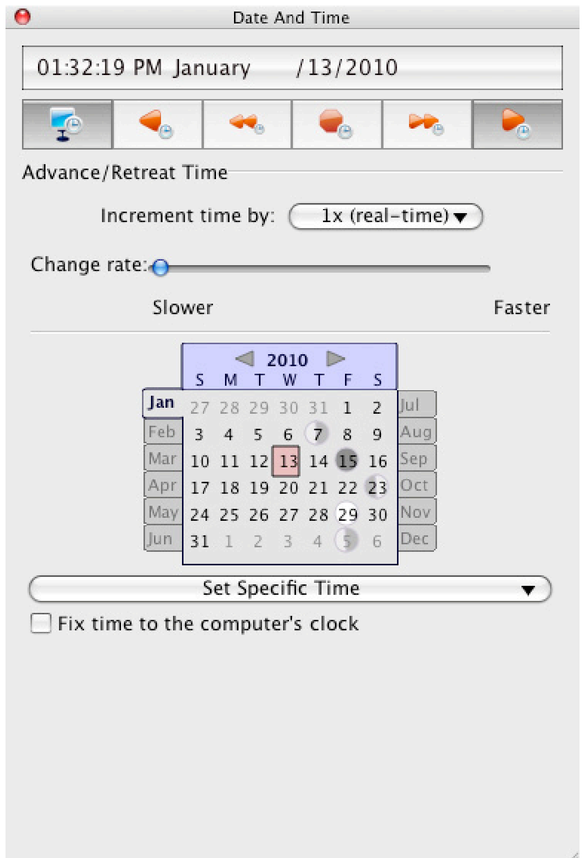


Figure 45: The Date and Time window (*Input > Date and Time* command).

Entering the Date and Time (Date & Time Control)

Use *TheSkyX's* Date & Time control that is located near the top of the Date and Time window to enter any date, after January 1, 4,712 BC and before December 31, 10,000 AD.

Figure 46: The Date & Time control on the Date and Time window and on the Date & Time Toolbar (Display > Date & Time Toolbar).

Do to so, click the mouse on the date or time element you wish to change, then type the desired value for:

- hours
- minutes

- seconds
- AM/PM
- month
- date
- year
- AD/BC

To set a specific month, click the month text to highlight it, then press the key for the first letter in the month. For example, press "D" for December. Pressing the "J" key repeatedly toggles the months January, June and July. If your mouse has a scroll wheel, use it to move up and down through the months. Or, use the up/down arrow keys on the keyboard.

To toggle between ***AM/PM,*** or ***AD/BC***, click the mouse on the text, then press "A" or scroll the mouse wheel or up/down arrow keys.

The current month can also be selected using the calendar on the Date and Time window.

The Daylight Saving Time (DST) or Standard Time (STD) text next to the local time is updated automatically based on the date and your location.

Formatting the Date and Time

The format of the date and time can be changed to suit your preferences. Double-click on the Date & Time control to show the date and time formatting options. See "Have it Your Way with Preferences" on page 130.

Calendar Control

TheSkyX's Calendar control on the Date and Time window provides two mouse click access to any date for the current year. If necessary, click the ***Date and Time*** command from the ***Display*** menu to turn this window on; click the ***Date & Time*** tab on the stacked windows to bring it to the front.

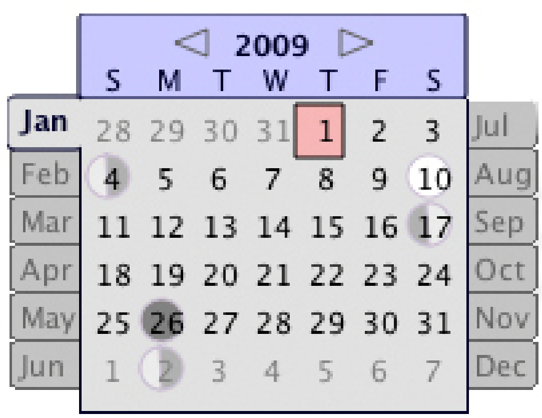


Figure 47: The Calendar control on the Date and Time window (*Display* > *Date and Time* command).

The top of the calendar control shows the year. Click the forward/backward arrows to advance/retreat one year at a time.

The edges of the calendar show the months of the year. Click any tab to bring it forward.

Black numbers for dates indicate the days in the current month, light gray numbers are shown for the prior or next month. The current day is highlighted light red. Click on any day to highlight it; the Sky Chart is adjusted accordingly. Clicking a gray colored number advances or retreats to that month.

Time Controls

Buttons for controlling the flow of time are available by clicking the ***Date and Time*** command on the ***Display*** menu and on the ***Date and Time Toolbar***.

Figure 48: Time Controls on the Date and Time window (*Display* menu) and the Date and Time Toolbar (from left to right: *Computer Clock, Go Backward, Step Backward, Stop, Step Forward, Go Forward*).

Use the Computer's Clock (Computer clock)

When the Computer Clock button is clicked, *TheSkyX* gets the date and time from the computer's clock. It also resets the time skip increment to ***1× (real time)*** and sets the ***Go Forward*** time skip option.

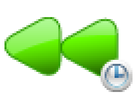
Verifying TheSkyX's Time

Accuracy is of the utmost importance in your observations. Select *Tools* > Verify TheSkyX's Time to check TheSkyX's time against the U.S. Naval Observatory's Master Clock. You can also click the corresponding toolbar button if you have the Orientation Toolbar activated (check *TheSkyX* > Preferences > Toolbars).

Note: This tool requires an internet connection.

Move Backward in Time (Go backward)

Even though time marches on, *TheSkyX* can make time go backward by clicking the Go Backward button. This can be handy to replay an astronomical event and is sort of like having your own DVD player on history.

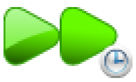


Step Backward in Time (Step backward)

Unlike the Go Backward button, the Step Backward button can be used to incrementally retreat time by the Time Skip Increment amount. Use this to find the first contact of an eclipse, or determine the precise time when a minor planet occults a star, for example.

Stop Time (Stop)

Use the Stop time button to halt the motion of stars and other objects from your earth-based perspective.



Step Forward in Time (Step forward)

Use the Step Forward button to incrementally advance time by the Time Skip Increment amount.

Go Forward in Time (Go forward)

Use the ***Go Forward*** button to advance time. When the Time Skip Increment is set to ***1× (real time)***, *TheSkyX* is showing you how the real sky looks at any instant.

Advancing or Retreating Time (Increment Time By)

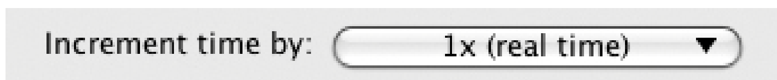


Figure 49: Increment Time control.

Use the Increment Time By control to specify the rate or interval to advance or retreat time.

The default time interval options include:

- ***1× (real time)***: Time advances or retreats based on the computer's clock.
- ***10×, 100×, 1000×***: Time changes by a factor of 10, 100 or 1000 times the normal rate.
- ***1 second***
- ***1 minute***
- ***1 hour***
- ***1 day***
- ***1 lunar month***
- ***1 year***
- ***Sunrise:*** The time skip interval is the length of time between sunrises for each day.
- ***Sunset***: The time skip interval is the length of time between sunrises for each day.
- ***Start Twilight***: The time skip interval is the length of time between morning astronomical twilight for successive days.
- ***End Twilight***: The time skip interval is the length of time between evening astronomical twilight for successive days.
- ***Custom***: Click the ***Custom*** command to show the ***Custom Time Flow Increments and Rates*** dialog.

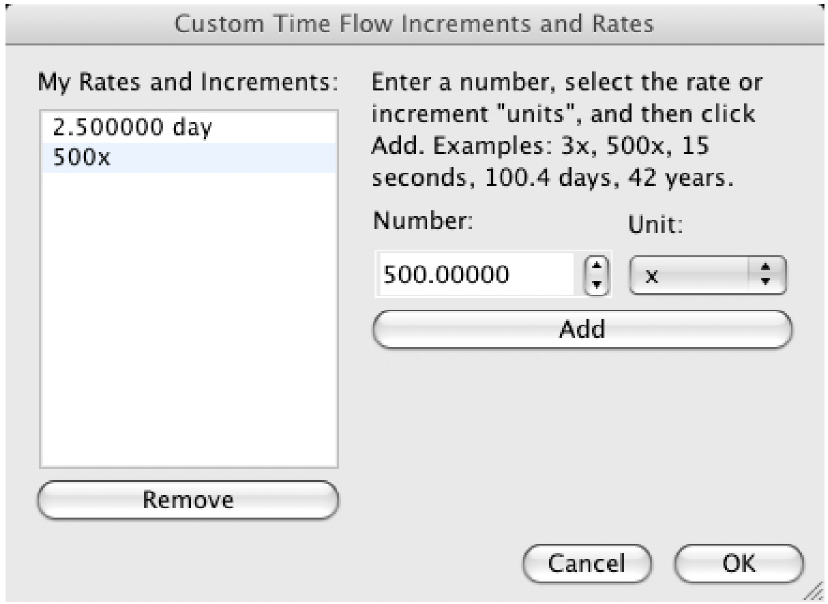


Figure 50: Define custom rates and time skip increments using the Custom Time Flow Increments and Rates dialog.

User-Defined Rates and Time Skip Increments (My rates and increments)

This list shows the rates and increments that you've defined by clicking the Add button to the right.

Define a Numerical Increment or Rate (Number)

Enter any decimal number for the rate or increment you wish to define. For example, 2.56 days, or 500x.

Define the Flow Rate or Time Skip Increment Unit (Unit)

Specify the unit for the rate or time skip increment. The lower case "x" unit means "a rate that is N times greater than actual time. Only whole numbers (integer) values are permitted for time skip rates.

Add Rates and Increments (Add)

Once you've entered a number and a rate, click Add to add it to the list My Rates and Increments list.

Custom rates are saved automatically, and restored when *TheSkyX* is opened.

Remove Rates and Increments (Remove)

Select one or all of the rates and increments, then click the Remove button to remove them from the list.

Quickly Change Time (Change Time)

The ***Change Time*** slider on the ***Date and Time*** dialog allows you to quickly advance or retreat time at the current rate.

This control is useful for reviewing lunar eclipses, occultations and Iridium flares.

Now that you're familiar with the time controls, below the calendar there is an item called ***Set Specific Time***. Click it.

You'll see a list of different "times" – not in hour and minute format, but in terms of astronomical events. The list of common events includes:

- *Now*: *TheSkyX* uses the computer's clock to show time
- ***Sunrise***: The time of day when the rising Sun reaches the "*refracted horizon*" – the line on the refracted sky that corresponds to the observer's horizontal.

  Hint: Refraction in the earth's atmosphere bends light, so, at sea level, the Sun's upper limb is visible about 3 minutes *before* it is actually above the local horizon.

  - ***Noon***: The time of day when the Sun is centered on the meridian. This is not necessarily 12:00 p.m.
  - ***Sunset***: The time when the Sun appears just below the "refracted horizon".
  - ***Midnight***: 12:00:00 a.m. local time.
  - ***Morning (Begin Astronomical Twilight)***: The time when astronomical twilight begins.
  - ***Evening (End Astronomical Twilight)***: The time when astronomical twilight ends.
  - ***New Moon***: The date and time in the current month when the Moon's phase is zero percent.
  - ***First Quarter***: The date and time in the current month when the waxing Moon's phase is approximately 50 percent.
  - ***Last Quarter***: The date and time in the current month when the waning Moon's phase is approximately 50 percent.
  - ***Full Moon***: The date and time in the current month when the Moon's phase is approximately 100 percent.
  - ***Moonrise***: The time of day when the rising Moon intersects the refracted horizon.
  - ***Moonset***: The time of day when the setting Moon is below the refracted horizon.
  - ***Vernal Equinox***: The date and time for the current year when spring begins in the northern hemisphere.
  - ***Summer Solstice***: The date and time for the current year when summer begins in the northern hemisphere.
  - ***Autumnal Equinox***: The date and time for the current year when autumn begins in the northern hemisphere.
  - ***Winter Solstice***: The date and time for the current year when winter begins in the northern hemisphere.

The last item in the list allows you to enter the Julian Date of an event.

The Moon's phase events search the current month. For example, if *TheSkyX's* month is set to any date in July, 1592, the New Moon is July 24, even if the date is later than July 24.

When you select any of these options, the Sky Chart shows you what the sky will look at that time for the current date. Try several of the options and watch how the chart changes.

You can make time speed up and even go backwards. In the ***Tools*** menu, choose the item called ***Time Skip***. Try one of the various options. The Sky Chart will continue moving backward or forward in time until you select ***Stop***, or the ***Use Computer's Clock*** option.

Finally, you can also enter a specific date and time by selecting the ***Input*** item from the Main Menu and choosing ***Date and Time*** (note there is also a shortcut key for this displayed, within the menu – *TheSkyX* will always display shortcut keys in the menu whenever they are available).

Reports

TheSkyX makes generating calendar reports of Sun and Moon activity, equinoxes and solstices, planet ephemerides and meteor showers an absolute snap. Set the Sky Chart to any year you choose, and select Tools > Reports to see a wealth of astronomical data specific to the given year.

Equinox/Solstice Report

This report displays the date and exact time of each equinox and solstice for the Sky Chart's current year. To see a different year's values, simply change the Sky Chart's year in the Date and Time tab or toolbar.

Meteor Radiant Report

Keep on top of meteor shower activity with this handy report. With the Meteor Radiant Report, you can instantly see the Month/Day, RA, Dec, and Hourly Rate of each meteor shower for the Sky Chart's current year. Just as with the other reports, you can obtain values for a different year by changing the date in the Date and Time tab or toolbar.

Planet Report

This is a "catch all" report that lists a variety of solar, planetary and lunar ephemerides and other useful information such as Earth distance, longitude of each visible planet's central meridian, Moon-specific information and more. You can obtain values by changing the date in the Date and Time tab or toolbar.

Sun & Moon Report

This report lists times for moonrise, moonset, sunrise, sunset, and the beginning and ending of (astronomical) twilight for each day of the Sky Chart's current month and year. To see values for a different month or year, simply change the date in the Date and Time tab or toolbar.

Sky Database Reports (All SDBs)

This report shows the name, search prefix, object count, object type and the associated text file for every Sky Database.

Copying Reports

Any of these reports can be copied to the clipboard for pasting into another application by simply clicking the Copy button at the lower left side of the Reports dialog.

The Look Commands

Our eyes can see only a small portion of the sky at a time. *TheSkyX* can show you the entire sky at once, but it's often more useful to focus the display on one part of the sky at a time, to match what you can see in the real night sky with your unaided eyes.

Changing the direction of your view is accomplished with the ***Look*** commands. These can be found in the ***Orientation*** menu, but they are also available to you as buttons in the ***Orientation*** tool bar.

By default, the Sky Chart is displayed looking south. Click the ***East*** button in the ***Orientation*** tool bar. Note that the star field has changed; the compass direction displayed at the bottom of the screen indicates E, for east. Experiment with the other compass direction buttons.

In addition to the compass direction buttons, a set of arrow buttons can be used to shift your viewing direction incrementally. Click the right arrow button. Notice how the view shifts slightly to the left (how far the Sky Chart shifts depends on your field of view, discussed below), just as if you were outside, looking at the real sky, and turning your head to the right. The left, right, up and down buttons function similarly (if your computer's monitor is small, or the screen resolution is low, the entire toolbar may not fit on the screen, so you may need to click the ">>" symbol to display the up and down buttons), mimicking the movement of your head in the indicated directions.

You can also press and hold the CONTROL key then drag the mouse to adjust the position of the Sky Chart.

Orientation Options

A variety of options exist for orienting the Sky Chart. You may choose from a terrestrial sphere or celestial sphere setup, or a free rotation mode.

Terrestrial Sphere

Select Orientation > Terrestrial Sphere to orient the Sky Chart as if from a vantage point on Earth's surface and according to terrestrial coordinates.

Celestial Sphere

To view the Sky Chart from the origin (center) of the celestial sphere, select the Celestial Sphere command from the ***Orientation*** menu.

Free Rotation

Choosing the Free Rotation command from the ***Orientation*** menu allows you to freely rotate the Sky Chart in any direction without being constrained to any coordinate system or convention.

Note: Each of these options is also available as a button on the ***Orientation Toolbar.***

Rotating the Sky Chart

While in Free Rotation mode, you can rotate the Sky Chart freely, in any direction, with commands from the Orientation menu, or by using the Rotate Tool found in the Tools menu.

Rotating Clockwise and Counterclockwise

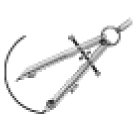
First, select Free Rotation from either the Orientation menu or from the Orientation Toolbar. Then, select either Rotate Clockwise or Rotate Counterclockwise from the Orientation menu. You can also use the keyboard shortcut alt+ (Windows) or ⌥+ (Mac) to rotate clockwise. Similarly, alt- (Windows) or ⌥- (Mac) rotates the Sky Chart counterclockwise.

Rotate Tool

You can also rotate the Sky Chart to any position angle you choose by using the Rotate Tool. Select Tools > Rotate Tool to activate it. A brownish-red position angle indicator will then appears in the Sky Chart with a label indicating its current position angle.

To use the Rotate Tool, first set a central rotation point by clicking and dragging in the Sky Chart to move the desired central point to the center of the view. To change the position angle freely, click and drag the square at the end of the position angle indicator. Notice that the position angle readout changes as you drag the indicator.

You can also set a position angle using the Rotation settings under the Orientation > Navigate command. See the Navigate Command section for more details.



Angular Separation & Position Angle

Determining the angular separation and position angle of two objects is a snap with TheSkyX.

Angular Separation & Position Angle Tool

Select Tools > Angular Separation & Position Angle to bring up the tool. You will notice that a pale green indicator with two square endpoints and a square center point appears in the Sky Chart. To determine the angular separation and relative position angle between two objects, simply click and drag the endpoints so that they overlap the objects for which you wish to determine angular separation and position angle values. You can hold down the Control key (Windows) or Command key (Mac) to snap the endpoints to the nearest object for greater accuracy. It's that simple! The desired values will appear in the label below the indicator. Determining angular separation and position angles has never been so simple or so elegant as it is in TheSkyX.

Once you are finished with this tool, deselect it by returning the Tools > Angular Separation & Position Angle command.

Note: The Angular Separation & Position Angle tool works in terrestrial or celestial sphere mode and in free rotation mode. You can also click and drag the Sky Chart to adjust the view at any time.

Field of View

You probably know that a circle can be divided into 360 degrees. Imagine a pie cut into six equal slices. The angle between the edges of a given slice is 360/6 = 60 degrees. Astronomers measure angles in degrees, and fractions of a degree: each degree is divided into sixty minutes, and each minute is divided into sixty seconds.

When you look up, you can see only a portion of the entire sky. Imagine for a moment that the sky is an immense spherical bowl above your head. You're seeing an area of the sky that spans a particular angle.

Assuming you have normal peripheral vision, that angle is about sixty degrees – one slice of our imaginary pie in the sky. Another way of saying this is your *field of view* is sixty degrees wide. Some people can see a little more, and some a little less, but sixty degrees is about average for adults.

When you look at the sky with binoculars or a telescope, what you see is magnified – in effect, you bring the sky closer, making it easier to see detail and faint objects. The downside of magnification is that it always reduces your field of view, sometimes to just a fraction of a degree. Generally speaking, the greater the magnification, the smaller the field of view.

TheSkyX allows you to set the field of view to any angle, from 235 degrees to a fraction of a degree. This is very useful when you're trying to understand how much of a particular constellation or star field might be visible in a pair of binoculars or a small telescope.

Setting the Field of View

A simple way to change the field of view is to use the ***Zoom In*** and ***Zoom Out*** buttons. The current field of view is displayed next to these buttons. Click on that pop-up menu. A list of preset fields of view is displayed. Some of these correspond to the field of view of a typical pair of binoculars or amateur telescope.

The ***Wide Field*** option shows you the sky from horizon to horizon, 180 degrees. The ***Naked Eye*** option gives you a 100-degree field of view – a bit wider field than what you can actually see with your eyes, but we wouldn't want you to miss anything.

You can also define a ***zoom box*** to zoom in on a particular area of the Sky Chart. Place your cursor on one corner of the area you want to zoom in on. While pressing the shift key, click and hold while you move your cursor to the opposite corner, then click anywhere inside the zoom box to enlarge it (you can click outside the zoom box to cancel this operation).

Stellar Cartography

Just as you would use a map to find your way around a city, state, or country, celestial maps or *star charts* are designed to help you find your way around the sky.

Use your mouse or track pad to move the arrow around the Sky Chart. You'll notice that when the tip of the arrow touches an object, an information box describing that object is automatically displayed. The kind of information displayed depends in part on the nature of the object, but one thing that is always displayed is the location of the object. This is indicated by two different sets of coordinates.

Cosmic Coordinates

Maps of the Earth identify the location of landmarks with two numbers: latitude and longitude. Latitude is measured in degrees north or south of the equator, and longitude is measured in degrees east or west of the Prime Meridian.

A similar system is used for objects in the sky. The *celestial equator* divides the sky into two hemispheres, north and south. The celestial equivalent of longitude is called *right ascension* (*TheSkyX* uses the abbreviation RA) and the equivalent of latitude is called *declination* (dec) . Right ascension is measured in hours, minutes, and seconds, from 0 to 24. This may seem odd at first, but there's a very good reason for this peculiar convention: the Earth is rotating. It turns around once on its axis in 24 hours, but from our terrestrial perspective, it looks like the sky is rotating around the Earth every 24 hours. Right ascension is measured eastward from the constellation Aries, the Ram. Specifically, 0 hours RA, the First Point of Aries, is the position in the sky where the Sun crosses the celestial equator on the first day of spring.

Declination is measured in degrees north or south of the celestial equator. The celestial equator is 0 degrees declination. The north celestial pole is located at 90 degrees declination (Polaris, the North Star, has a declination very close to 90 degrees). The south celestial pole is at *minus* 90 degrees declination. You can also translate right ascension into degrees: a complete circle has 360 degrees; dividing 360 by 24 gives 15, so every hour of right ascension is equal to 15 degrees.

Imagine a line running across the sky from due north to due south, splitting the sky in two. This line is called the *meridian*. Better yet, turn on the ***Meridian*** check box under the ***Reference Lines & Photos*** group on the ***Chart Elements*** window (page 149) to view it on the Sky Chart. When a celestial object crosses the meridian, it is also at its highest altitude in the sky. This is called the *transit time*. Generally speaking, the best time to observe a celestial object with a telescope is when it's crossing the meridian.

This brings us to another way of identifying the location of an object in the sky: altitude and azimuth. Altitude is simply the number of degrees the object is above the horizon, from 0 (on the horizon) to 90 (directly overhead). Be careful not to confuse altitude with declination – they are not the same thing.

Azimuth indicates the compass direction of an object. Specifically, it is the number of degrees east of north that you need to turn to see the object. Due east, for example, is 90 degrees azimuth.

The problem with using altitude and azimuth for astronomical objects of course is that these numbers are constantly changing as the Earth rotates. *TheSkyX*, however, can calculate these numbers instantaneously, making it easier to know what direction to look when you're outside in the dark, trying to find a particular object at a specific time.

Understanding Projections

Ever since we discovered that the Earth isn't flat, but spherical, cartographers have been looking for ways to represent a curved surface on a flat surface.

A sphere cannot be projected onto a plane without introducing distortion. In the most commonly used projection – called the Mercator projection – objects get larger the farther they are from the equator. This causes Greenland to look nearly as large as the rest of the United States on world maps. Navigators adopted the Mercator projection because a straight line on a Mercator projection, called a *rhumb line*, represents a constant compass bearing from true north.

Other projections have their own combinations of strengths and weaknesses. *All* projections are compromises – the "best" projection is the one whose advantages outweigh its disadvantages for a particular application.

By default, *TheSkyX* uses the *stereographic* projection for fields of view greater than 60°. A stereographic projection is said to be "conformal." Although (as with all flat maps) the overall projection is distorted, all lines of declination and right ascension intersect at right angles, as they do on the celestial sphere.

The advantage of stereographic projection is that, over small areas of the display, object shapes are only slightly distorted. Constellations remain easy to identify. Compare this with the *polar* projection of a planisphere. There is almost no distortion near the poles, but constellations near the horizon are badly stretched out of shape. (A planisphere is one of those rotating star charts that approximate what's visible in the sky at a given date and time.)

When the Sky Chart is set to a field of view of 60° or less, the projection automatically switches to an *orthographic* projection, which displays the sky more as it would appear on the surface of a sphere. (This is the only projection used at 60° fields of view and smaller.)

Projections

By default, *TheSkyX* uses a stereographic projection for 60° fields of view and greater. The Projections command from the Display menu changes the projection. In the Projections dialog, click the radio button of the projection you want.

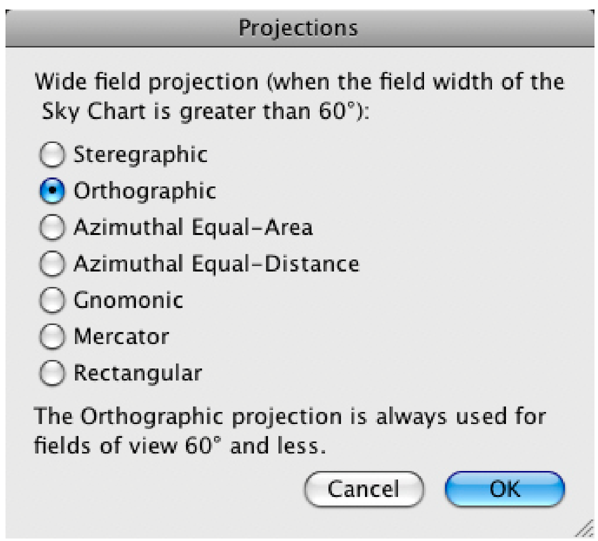


Figure 51: The Projections dialog.

The selected projection is applied to the Sky Chart immediately. It takes effect only when the field of view is greater than 60°– no change occurs if the current field of view is 60° or less.

- **Stereographic –** The default for fields of view equal to and greater than 60°. It keeps lines of right ascension and declination at right angles and minimizes local distortion. Conformal. 235° maximum field of view.
- **Orthographic –** Displays the sky more as it would appear on the surface of a sphere. It's the default (indeed, it's the only available projection) for angles of view 60° and less. Conformal. 180° maximum field of view.

- **Mercator –** Shows the celestial sphere like a conventional map. It allows wider fields of view, including a 360° view that shows the entire celestial sphere. Conformal. 360° maximum field of view.
- **Gnomonic –** This is the "pinhole camera projection." It displays meteor paths as straight lines, as seen when viewing a meteor shower. Non-conformal. 150° maximum field of view.
- **Azimuthal Equal-Distance –** The distance between objects having a particular angular separation on the celestial sphere is the same at any part of the Sky Chart. Non-conformal. 300° maximum field of view.
- **Azimuthal Equal-Area –** The areas of any sections of the celestial sphere subtending a particular solid angle are the same at any part of the Sky Chart. Non-conformal. 235° maximum field of view.

Stars and Constellations

There are some 6,000 stars visible to the naked eye. Most of these stars can only be seen from locations far from the bright lights of a city or town. If you really want to see the stars, you either have to go to Hollywood or get out of Dodge.

Star Names

Some of the brighter stars have proper names, but most don't – there are just too many to give each one a name. Instead, astronomers have devised a system that assigns names to naked-eye stars based on their brightness and the name of the constellation they belong to. Following a centuries-long tradition, the brightest star in a constellation is designated by the first letter of the Greek alphabet, Alpha, followed by the genitive form of the Latin name of its constellation. For example, the brightest star in the constellation Orion is called Alpha Orionis. It also has a proper name: Rigel. (We'll talk more about constellations later. Right now we're going to focus on individual stars.) When the letters run out, stars are identified by various alphanumeric designations.

A funny thing about Rigel: even though it's the brightest star in Orion, its designation is *Beta* Orionis. Astronomers originally thought that Betelgeuse, another star in Orion, was a little bit brighter, but improvements in *photometers* in the 20th century revealed that Rigel is actually the brighter star (it's possible that Betelgeuse might have been brighter in the past, when astronomers first began to designate stars with Greek letters).

Bright Stars and Dim Stars

Long before the invention of the telescope, astronomers also came up with a *numerical* system for classifying stars by their brightness. They decided that the brightest stars would be called First Magnitude. Those half as bright as First would be called Second Magnitude, then Third Magnitude, and so on down to Sixth Magnitude, which denotes the dimmest stars visible to the naked eye.

We use a modified form of this system today. The brightest star in the nighttime sky is called Sirius. It's in the constellation Canis Major, the Big Dog, and it's sometimes called the Dog Star. Its magnitude is *minus* 1.4, which we write as –1.4. This may seem a little confusing, but it isn't that hard to understand. A couple of centuries ago, astronomers decided to make the magnitude scale more precise. They knew the Sun and Moon and some of the planets are brighter than the brightest stars, so these were given negative magnitudes. They also realized that a First Magnitude star is actually a bit more than twice as bright as a Second. In order to keep Sixth Magnitude as the faintest star visible to the naked eye, astronomers recalibrated the magnitude system to follow a *logarithmic* scale. Each stellar magnitude is about 2.5 times brighter than the next lower magnitude so that the difference of five magnitudes is a brightness factor of (exactly) 100.

With a telescope, you can see stars much dimmer than Sixth Magnitude. *TheSkyX* database includes stars down to about 14th Magnitude.

On a clear, moonless night, people who live in cities or suburbs can rarely see stars dimmer than Third Magnitude. If you're just starting to learn the names of the brighter stars and constellations, you should set the magnitude filter in *TheSkyX* to Second or Third magnitude. That way, when you go out at night to compare what you see on your computer to what you can see in the real sky, you won't be confused by a screen display that shows more stars than you can actually see from your location.

Setting the Magnitude Limit

This command tells *TheSkyX* to only display stars, galaxies, clusters, or any other object type, or combination of object types, that has magnitude information, that are brighter or fainter than a selected magnitude. Controls for editing the magnitude limits are found on the ***Chart Elements*** window on the ***Display*** menu.

The following example demonstrates how to change the magnitude limits for all celestial objects.

1. Make sure the Chart Elements window is visible. If it's not, select the ***Chart Elements*** command from the ***Display*** menu to show it.
2. Highlight the ***Celestial Objects*** text by clicking on it. This selects the 40 chart elements in the Chart Elements node.
3. Click the ***Edit Attributes*** button.
4. Near the bottom of the Chart Elements window you'll see a tab labeled ***Magnitude Limits***. You can enter a value between 30.0 and –6.0, or change the magnitude using the sliders.

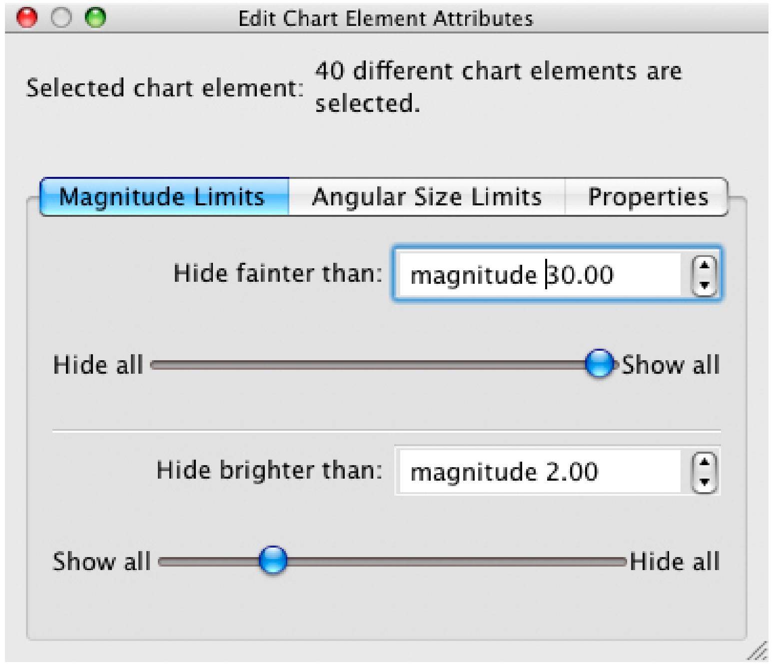


Figure 52: Magnitude Limits tab on the Chart Elements window.

The attributes of chart elements (including lower and upper magnitude, angular size, font properties and colors) can be changed individually or as a group based on the items that are selected in the Chart Elements list.

Number of Selected Chart Elements (Selected)

This text shows the name of the selected chart element or the number of selected chart elements in the Chart Element list.

Show Only Brighter Stars (Hide fainter than)

Specify the magnitude of the *faintest* objects to be displayed on the Sky Chart. For example, if you live in a light polluted city and want to approximate the stars you can see on typical night's sky, enter magnitude 1 or 2.

Show Only Fainter Stars (Hide brighter than)

The ***Hide Brighter Than*** controls provide additional filtering, displaying objects only within a specified brightness range. *Larger* magnitude values represent *dimmer* objects. The brightest objects have negative magnitudes.

As you move the slider the number of stars on the Sky Chart changes to reflect the changing magnitude limits.

Other Chart Elements

Like land maps, star charts can be overlaid with a variety of lines and markings intended to highlight specific celestial features and help you find objects at specific coordinates.

The ***Chart Elements*** menu lets you display or hide various reference lines and symbols, but you should be aware that even though the cosmos mostly consists of empty space, a star chart can get very crowded very quickly. The celestial equator and lines of right ascension and declination can be added to the Sky Chart, for example. Experiment with this feature by clicking on the box next to a listed chart element to see how it affects the display.

A Star to Guide You

For people living in the northern hemisphere, probably the most noteworthy star is Polaris, the North Star. It always stays in the same part of the sky, every night, 365 days a year. The reason for this is fairly simple: Polaris happens to be located almost directly above our North Pole. As the Earth rotates on its axis, other stars rise and set, but because Polaris is right above the pole, it always seems to stay in the same place.

How high Polaris is above your horizon is a direct way to find your latitude. If Polaris is 40 degrees above the local horizon, for example, you must be somewhere on the 40^{th} latitude line. Philadelphia and Denver are both very close this latitude, as are Naples, Italy and Beijing, China. The stars you can see on any given date and (local) time are essentially the same for all of these cities, and any other place along this line of latitude.

More than anything else, latitude determines what you can see in the sky. The North Star is not visible from the Southern Hemisphere, as are most of the stars and constellations near it. And there are all sorts of stars and constellations visible from the Southern Hemisphere that we never get to see in the North (the Moon and planets are visible from both hemispheres). *TheSkyX* can show you what the sky would look like from any place in either hemisphere.

Double Stars

A little more than half of all stars actually travel in pairs, orbiting each other in space. The American astronomer Henrietta Leavitt once quipped that three stars out of every two are double. Most of them appear as single stars to the naked eye. You need good binoculars or a small telescope to resolve them as double stars (there are also triple stars and groups consisting of four or even more stars).

Some double stars are true *binaries*, meaning they are gravitationally bound to each other and orbit a common point in space. Others only appear to be double because they happen to lie along the same line of sight from Earth, but are in fact many light years apart and not tied to each other by gravity.

One of the best-known double stars in the sky is called Mizar. It's located in the handle of the Big Dipper.

Finding Mizar

Mizar is visible only from the Northern Hemisphere, and is easiest to find in the evening sky in Spring.

Select the ***Find*** tab from the vertical tabs on the left side of *TheSkyX's* window.

Type Mizar into the ***Search For*** text input, then click the ***Find*** button. A double red "bull's eye" will encircle the star in the Sky Chart.

The Big Dipper is one of the northern sky's most recognizable *asterisms* (this term is described below). Being able to find it will help you find other nearby constellations, such as Cassiopeia. Once you've mastered these constellations, others will be easier to learn.

Another good thing about being able to find the Big Dipper: it will make it easy for you to find Polaris, and therefore true north. The two stars at the end of the cup of the dipper point to Polaris. Imagine a line connecting these two stars. Extend it in the direction the cup is pouring, about five times the distance between the two stars. The star you see at the end of that line is Polaris.

Variable Stars

Fortunately for us, and everything else that lives on Earth, the Sun radiates energy at a very nearly constant rate. But there are some stars that change in brightness dramatically over the course of a few months, and in some cases, just a few days or even hours. These are called *variable stars*, and *TheSkyX* distinguishes them with a small red "v" to the lower left of the star.

The most notorious variable star is called Algol, a name derived from an Arabic word that means demon. Located in the constellation Perseus, its rhythmic dips in magnitude can easily be observed with the naked eye. Every 2.867 days, over the course of just a few hours, Algol falls from second magnitude (2.1) to third (3.4) and back. During these periodic dimmings, you can gauge its changing brightness by comparing it to other nearby stars. The evening sky in Autumn is the easiest time to find this fascinating object (it is only visible from the Northern Hemisphere). It may have been considered demonic in ancient times, but today we know this innocent star has a companion that orbits it every 2.867 days. Algol dims when that companion passes in front of it from our perspective. Such stars make up a special class called *eclipsing binaries*.

Classifying Stars

Stars differ not only in their brightness, but also in their size, surface temperature, and chemical composition. The one thing they have in common is that they are all spherical – although some spin so fast they tend to bulge in the middle!

All stars are basically immense balls of intensely hot gas that generate heat and light through a process called *nuclear fusion*. The temperature and density in the core of a star are so great that lighter atoms smash into each with enough force to fuse into heavier atoms. In our own Sun, for example, atoms of hydrogen fuse to produce atoms of helium (this process involves several intermediate steps). The fusion process releases energy in the form of electromagnetic radiation – light.

By spreading starlight into a spectrum, astronomers can learn the temperature and chemical makeup of stars. After studying thousands of stars, it became clear that stars fall into various categories, or classes. Some are massive and bright, and have relatively short, tumultuous lives. Others are small and dim, and can shine steadily for tens of billions of years.

A letter and number system is used to define stars in terms of their most important physical characteristics, and these designations are displayed when you point to a star in the Sky Chart. A more complete discussion of *spectral classes* and the physics of stars can be found in any introductory astronomy text.

Giants and Dwarfs

When you see a bright star in the sky, there are two possibilities: the star is close by and relatively average in size, or it is far away and gigantic.

Rigel is the brightest star in the constellation Orion. It is nearly 800 light years away, but is the seventh brightest star in the sky. It is a whopper, with a diameter of about 100 million kilometers. The Sun, by comparison, is about 1.4 million kilometers across.

Astronomers distinguish between *apparent* magnitude and *absolute* magnitude. Apparent magnitude is how bright a star looks in the sky. Absolute magnitude refers to how bright a star would appear if it were located exactly 10 parsecs (32.6 light years) away. The apparent magnitude of Rigel is about 0.2, but its absolute magnitude is nearly –7.0.

More About Constellations

The desire to find order in nature, even where none exists, seems to be built into the human brain. When you look up at the sky on a dark, clear night, the sheer number of stars can be overwhelming. Our distant ancestors must have been in awe of those countless lights randomly scattered across the sky like diamonds.

Because of our instinctive need to find order, cultures all across the globe have organized stars into distinctive patterns called *constellations*. These patterns are purely a product of the human imagination. Nature had nothing to do with creating them.

The constellations we recognize today have mostly come down to us from the ancient Greeks. Many of them represent mythological figures. Orion, for example, one of the most prominent constellations visible in northern wintertime, represents a heroic hunter who first appeared in one of the great epics of classical Greek literature, *The Odyssey*.

Orion is accompanied by two hunting dogs that are also immortalized in constellations: Canis Major and Canis Minor, the big and little dogs, respectively.

When you look at Orion, it isn't hard to imagine the figure of a hunter with a raised arm wielding a club. You can see one classic representation of this figure by going to the ***Display*** menu and selecting ***Constellations & Asterisms Options***. You can display line drawings, mythical figures, and constellation boundaries by checking the appropriate boxes. You can also use the slider labeled ***Transparency*** to adjust how bright these renderings appear.

For many other constellations, the connection between its array of stars and what it is supposed to represent is difficult to see, to say the least. They're a little more like abstract art, intended to represent the idea of a thing rather than the thing itself.

Drawing lines between the stars of a given constellation provides a simple "stick figure" view of that constellation. When astronomers think about constellations at all, this is how they usually think of them. The more fanciful mythological drawings of constellations became popular in the early 17th century, especially in the gorgeous star charts engraved by the great German celestial cartographer Johann Bayer (Bayer is also credited with creating the system that designates stars with Greek letters and the genitive name of their constellations, as described previously).

When the constellations we recognize today were originally created, a number of stars were left over – that is, not all stars fit into the established patterns. To avoid confusion, astronomers designated boundary lines between the constellations. Not unlike borders between countries, any star that falls within the borders of a given constellation is said to belong to it, whether it was included in the original depiction of that constellation or not.

Asterisms

There are familiar patterns of stars that don't quite qualify as constellations. Astronomers call these patterns *asterisms*. The Big Dipper and the Pleiades (the Seven Sisters) are probably the two most familiar examples. In Japan, the Pleiades are called Subaru. You've probably seen them driving around your neighborhood.

Some Tips on Using Star Charts

Learning how to connect what you see on a star chart to what you see in the real sky takes some time. We're going to show you a step-by-step process that will make it easier for you to find common stars and constellations. With a little patience and practice, you'll soon become an expert.

First of all, when you go outside and look at the sky, you need to know what direction you're facing. In particular, you need to know how to find true north. City streets often lie along north/south and east/west lines, but this isn't always the case. If you aren't sure which way is north at your viewing location, use a magnetic compass to find it.

When hundreds of stars are displayed on your chart, finding individual stars and constellations can be very challenging. But if you limit the number of stars in the chart to just a few dozen of the brightest stars, you'll have a much easier time learning the sky.

Printing a Sky Chart

Printing a sky chart to take with you when you go outside is also very helpful. *TheSkyX* can print any chart it displays. You can print an "all sky" chart, or select a particular part of the sky you're interested in learning.

Choose the ***File*** command from the main menu. Near the bottom of the menu, you'll see two items: ***Print*** and ***Print Setup*** (if you have more than one printer connected to your computer, ***Print Setup*** can be used to select the printer you'd like to use). Select the ***Print*** command.

The ***Print Chart*** tab of the ***Export Chart*** window is displayed on the screen. In addition to printing charts, *TheSkyX* allows you export charts as *Portable Document Format* (PDF), *Scalable Vector Graphic* (SVG) and *Postscript* files.

To Export a Sky Chart in PDF, SVG or Postscript Format

1. Select the desired option from the ***Format*** list.
2. Click the ***Export*** button.
3. On the ***Export Chart*** dialog, enter the file name to save the chart in this format.
4. Click ***Save***.

PROFESSIONAL

Click the ***Create Bitmap*** tab (or, from the main menu, click the ***Export*** command from the ***File*** menu) to view the options for saving Sky Charts as *bitmaps* or *pixmaps*. Click the ***Copy Sky Chart*** button to copy the current chart to the Clipboard. Click the ***Save As*** button to save the chart as a *Portable Networks Graphics* (PNG) file.

Turn on the ***Create Custom Size*** checkbox to specify the ***Resolution***, in dots per inch (DPI), ***Width*** and ***Height***, in inches, of the bitmap.

If you want to create high-resolution star charts for publication, individual "layers" of the chart can be exported by turning on the desired checkboxes in the ***Chart Layers*** tab.

Clicking the ***Print*** button on the ***Print Chart*** tab sends the chart to the currently selected printer. *TheSkyX* uses the current ***Map Like*** display settings (page 146) and prints stars in black, leaving the sky white. The size of the star is proportional to its magnitude. Non-stellar objects are also printed using the symbols that appear in the ***Map Like*** Sky Charts.

You can choose the orientation of the printout and other printing parameters by clicking the ***Page Setup*** button. When you're ready to print, simply click the ***Print*** button.

The best time to start learning the sky is a clear, cloudless night, when there is no Moon or at most a crescent Moon. Moonlight can interfere as much as city lights when it comes to seeing the stars, and if the Moon is close to Full, you probably won't be able to find any but the very brightest stars and planets. You also want to be in an open space, a place where there are no tall buildings, trees, or annoying artificial lights to interfere with your viewing. Make sure in particular that you have a clear view to the north.

When you get to your observing site, give your eyes at least a few minutes to adapt to the darkness. You'll need a flashlight to read the chart of course, but you should use one that has a red filter. These can be bought at most stores that sell telescopes, or you can simply tape a piece of transparent red film over a standard flashlight. Using only red light will help preserve your night vision. If you take your computer outside with you, the ***Display > Show Night Vision Mode*** command will help preserve it, too.

An Interstellar Perspective

Our Sun is but one of billions of stars in the Milky Way galaxy. For centuries, astronomers have been charting the positions of other stars in our galaxy, and have accurately determined the distances to many thousands of them. This information allows us to step outside our solar system, in effect, and see what the Sun and other stars in our part of the galaxy would look like from dozens of light years away.

The constellations are only figments of our imagination. A constellation's stars may seem to be close together, but are usually very far apart and often have no mutual relationship at all. (Except for being part of the same galaxy, the Milky Way.) The sky looks flat because there are no reference points to help us perceive the distance to the stars with just our eyes. Since the human mind is pretty good at creating order from random patterns, seeing pictures in the sky is no surprise. *TheSkyX* has a 3D stars tool that can help you to understand the spatial relationship between stars that we see at night.

Viewing the 3D Star Map

Selecting ***3D Stars*** command from the ***Tools*** menu will bring up the ***3D Stars*** window. Immediately upon opening the window, the viewer will pan across a 3D rendering of the heavens, with the position of our Sun marked in the center. Click and drag on the star field to get a feel for the nature of the 3D space.

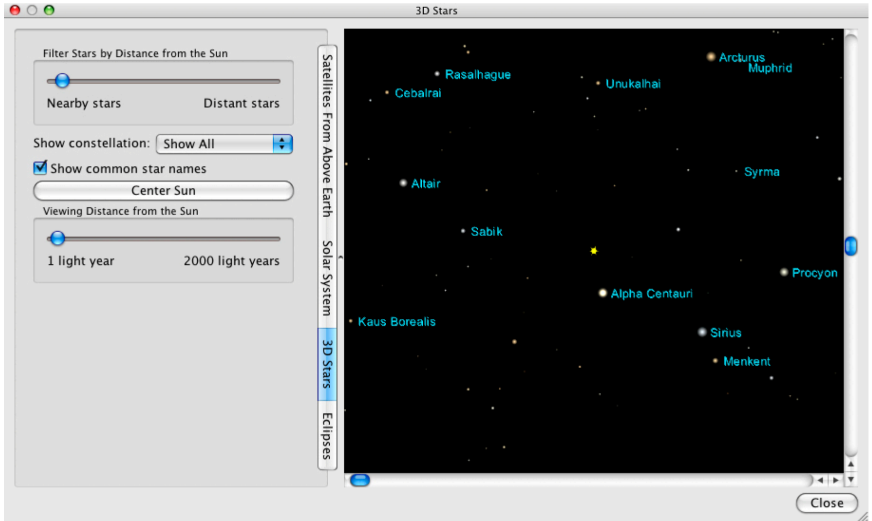


Figure 53: The 3D Stars window.

3D Star Map Controls

On the left, you will see the controls that operate the 3D Stars tool. On the top, you will see a slider that allows you to view visible stars from those relatively nearby to those quite distant.

The bottom slider, labeled ***Viewing Distance from the Sun***, ranges from 1 to 2,000 light years. A light year is a fundamental "cosmic yardstick" used to describe the distance to the stars. One light year is equal to the distance that light travels in one year. Since light travels at approximately 300,000 kilometers per second in a vacuum, then a little math tells us that a light year is equal to about 9.5 trillion kilometers: that's pretty far! Another interesting fact about light years is that the number of light years distant an object is tells us how long it takes light to arrive here from that object. So, if an object is 2,000 light years away, that means it took the light we see from that object 2,000 years to reach us. Also, it means that we see that object, not as it exists today, but as it existed 2,000 years ago. The further we look out into space, the further we see back in time.

Using the ***Filter Stars by Distance from the Sun*** slider will allow you to see the general stellar structure of our galaxy by displaying stars up to 2,000 light years away from our home solar system. Using this can help you to get a feel for the relative distance of many stars, including well-known favorites, such as Betelgeuse and Rigel in the constellation Orion. Notice that the number of stars that disappear grows as you move the slider to the left, meaning that most of the stars we see at night are quite close to us, relatively speaking.

Viewing a Single Constellation

If you would like to focus on a single constellation, you can do that, as well. Using the ***Show constellation*** pop-up menu, select a constellation; you can choose from any of the 88 official astronomical constellations. Let's use the functions of the 3D Stars tool to explore the region around a famous constellation, Orion, the Hunter.

1. Choose ***Tools > 3D Stars***.
2. Select ***Orion*** from the ***Show constellation*** drop-down menu. You will now see the constellation of Orion, the Hunter in the viewer, surrounded by the constellation boundary box. These boxes are used by astronomers to describe regions of the sky found near the 88 constellations.
3. Check ***Show common star names*** to show the names of the more "famous" stars, the A-listers, if you will. In Orion, the stars of his shoulders, knees, and belt are labeled, as well as the brightest star of his head.
4. Use the ***Filter Stars by Distance from the Sun*** slider to hide or reveal stars based upon their distance from the Sun. Move the slider to the left, and take note of when each star in Orion disappears.
5. Now, using the ***Viewing Distance from the Sun*** slider, adjust the distance back and forth and observe the effect on the constellation's appearance.
6. Try sliding the same slider about one-quarter of the way to the right. Then, click and drag on the constellation. You will see an exploded view of Orion's stars through 3D space. This gives you a great view of the relative distance of each of Orion's stars. Experiment with various viewing distances to get a feel for how it works.
7. Use the ***Filter Stars by Distance from the Sun*** slider to see an excellent demonstration of each star's distance, as they appear and disappear, based upon their distance.

Experimenting with the sliders and with different constellations will serve to give you a good grasp on relative stellar distances. The next time you look up at Orion, think about space in 3D and the vast distances over which that light travelled to get to your eyes.

Closer to Home: Atmospheric Phenomena

As we mentioned earlier, some of the most interesting things we can see in the sky are happening right above our heads, in the upper atmosphere.

Meteors and Fireballs

You've probably seen a so-called shooting star (maybe you've even wished on one). A shooting star isn't really a star at all, but a grain of space dust. When one of these particles hits our atmosphere, it's traveling at tens of thousands of kilometers an hour. Friction makes it glow white hot, turning it into a *meteor*. It may seem surprising that a speck of dust at the edge of space could create a streak of light visible from the ground, but even the brightest meteor is rarely bigger than a pea.

The flying dust grains that cause meteors mostly come from the tails of *comets*. Several tons of this material falls to Earth every single day. If you get away from the lights of the city and watch the sky on a moonless night for an hour or two, you'll see at least a few meteors – maybe quite a few. They're falling everywhere, all the time.

Once in a while something much larger than a speck of dust falls to Earth and creates a spectacular *fireball*. Fireballs can blaze across the sky with such intensity that they literally light up the landscape. They can range in size from a few centimeters to several meters. Bits and pieces of them sometimes survive the fiery descent through our atmosphere and crash into the ground. These fragments are called *meteorites*.

Meteorites are chunks of *asteroids* and they fall into three main categories, based on chemical composition. *Iron meteorites* are the most commonly *found* because they are very distinctive, consisting of ninety percent iron with a bit of nickel mixed in. They are extremely dense, and have magnetic properties.

Stony meteorites look more like common rocks. They are the most common *form* of meteorite but aren't found as often as iron meteorites for two reasons: they look like ordinary, everyday Earth rocks, and they can't be located using a metal detector.

The third class is the *stony irons*, which, as the name suggests, are a mixture of the iron and stony types.

A few people around the world make a good living hunting and selling meteorites. A decent-sized specimen can be worth thousands of dollars to a museum or a private collector. A really big meteorite with an unusual composition can be worth millions. Something to think about next time you see a fireball…

Meteor Showers

The dust trails left by comets that have visited the inner solar system follow predictable orbits around the Sun. Several times a year Earth passes near one of these cosmic debris trains, resulting in a meteor shower. Halley's comet, which has a 76-year orbit, is responsible for two annual meteor showers, the Eta Aquarids in early May, and the Orionid shower in mid-October.

Have you ever looked at a set of railroad tracks and noticed, as they stretch into the distance, how they seem to converge to a single point? A similar effect can be seen during a meteor shower. The debris "train" of the shower's parent comet follows the tracks of an imaginary railroad. If you pay attention to the direction most of the meteors in a particular shower seem to be coming from, they all converge back to the same point in the sky – the "vanishing point" of the tracks of the debris train. This is called the *radiant*. *TheSkyX* plots the radiant for all annual meteor showers and estimates the date and time they are expected to peak.

To display meteor shower radiants, select the ***Chart Elements*** tab from Display menu. Within the list of elements, there is an item called ***Reference Objects***. Click it, and a new list of items is displayed. Check the box next to ***Meteor Shower Radiants***.

The radiants for all meteor showers will now be displayed on the Sky Chart. If you move the cursor to the center of any radiant, details on that shower, including when it is expected to peak, will be displayed.

The Northern (and Southern) Lights

The Northern Lights, or *aurora borealis*, can be as stunning as any fireworks display. They appear as curtains of colorful, shifting light, suspended high up in the night sky. Unfortunately, they are generally only visible from high latitudes, and when they might occur is notoriously hard to predict.

Auroral displays are caused by charged particles from the solar wind striking the Earth's upper atmosphere. Our planet's magnetic field guides these particles toward the poles, which is why auroras are only visible from high northern and southern latitudes (the auroral light show is called the *aurora australis* in the southern hemisphere).

Our Celestial Backyard: The Solar System

Our Sun is one of countless stars in the universe. The planets that circle the Sun are its family, figuratively speaking, and it would be hard to deny that Earth is its favorite child. The planet we call home is located at just the right distance to be neither too cold nor too hot for liquid water and life to flourish on its surface. But the rest of the Sun's family – the solar system – is full of diverse and fascinating characters. Some of them may once have harbored some form of primitive life. These bodies are much, much closer than even the next nearest star, and so astronomers like to say they inhabit our celestial backyard.

Finding a planet in *TheSkyX* is simple. Simply go to the ***Edit*** menu and choose ***Find***. Type the name of the planet in the ***Search For*** box. Information about the planet will be displayed. You can center the planet in the Sky Chart by clicking the ***Center*** button near the bottom of the screen. Note that this same procedure applies to every object in *TheSkyX*'s database. If you're unsure of an object's name or catalog number, click the Advanced button to view a comprehensive list of searchable objects.

The Moon

The most familiar object in the night sky is undoubtedly the Moon. It's been Earth's constant companion for more than four billion years. Scientists believe that the Moon was formed shortly after the birth of the solar system, when a molten planet about the size of Mars smashed into the Earth. That planet is no longer around, but much of the fallout from its impact settled into orbit around us and aggregated into the Moon.

The Moon is *tidally locked* to the Earth. Our gravitational pull, over millions of years, slowly put the brakes on the rotation of our satellite. Today the Moon makes one complete rotation for every single orbit it makes around the Earth. Because of this, the same side of the Moon always faces the Earth. We had no way of seeing the far side of the Moon until spacecraft were sent there in the late 1950's. Some people mistakenly call the far side of the Moon the dark side of the Moon. With all due respect to Pink Floyd, the Moon has no "dark" side. Over the course of a lunar day (about 29.5 Earth days) the far side of the Moon gets just as much sunlight as the side facing us.

As the Moon orbits the Earth, it goes through its familiar *phases*, from New to Full and back again. *TheSkyX* can tell you the phase of the Moon on any date, at any time. It is automatically displayed on the star chart in its current phase and proper location whenever it is above the horizon. The orbit of the Moon is not a perfect circle, but an *ellipse*, meaning it has an oval shape (in fact, all orbits, from artificial satellites to planets to stars circling the centers of galaxies, are ellipses). *TheSkyX* will tell you the current distance between the Earth and Moon.

The Moon is one of the most interesting things to look at in binoculars or a telescope. Even a little magnification will reveal the larger lunar craters, and help you see the *mare*, the so-called lunar "seas," which are really cooled lava basins. The Moon has no atmosphere, so liquid water cannot exist there. Our single natural satellite is dry as a bone, but there is some evidence that small amounts of water ice might reside in the permanently shadowed craters near the Moon's poles.

Moon Photo Viewer

TheSkyX includes a detailed map of the Moon based on photographs taken by a spacecraft called Clementine. Clementine was launched into space on a converted intercontinental ballistic missile – a Cold War sword was turned into a lunar plowshare that yielded a rich scientific harvest, giving scientists important new information on the morphology (shape) and mineralogy of the Moon.

To access the Clementine Moon map, go to the ***Tools*** menu and choose ***Moon Photo Viewer***. Your lunar journey begins with a photo showing the region near the feature *Tranquillitatis*, better known as the *Sea of Tranquility*. As you move the mouse cursor over the photo, different features are highlighted in red, and the Moon's longitude and latitude are shown to the left. (To highlight larger features, place the cursor near its center.)

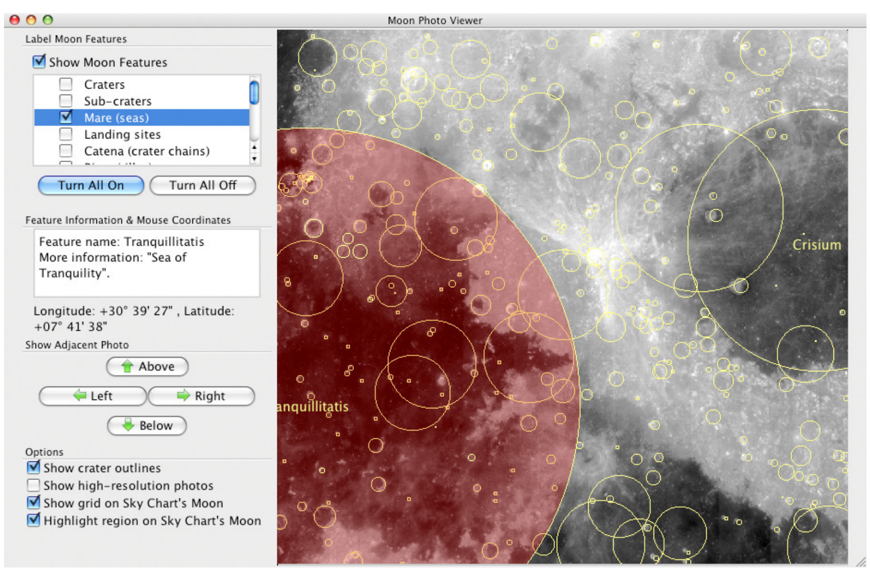


Figure 54: Moon Photo Viewer window.

You can use the Sky Chart's Moon with the Moon Photo Viewer to locate a particular feature in a photo on the Earth-based view of the Moon. Or, you can click on the Sky Chart's Moon to show the photo of that region.

Do to so, first position the Moon Photo Viewer window so that the Sky Chart is also visible on your screen.

Lock On and Frame the Sky Chart's Moon

1. Clicking the ***Find command*** from the ***Edit menu***.
2. On the Find window, type ***Moon*** and then click the ***Lock On*** button.
3. On the ***Find*** window, click the ***Frame*** button.

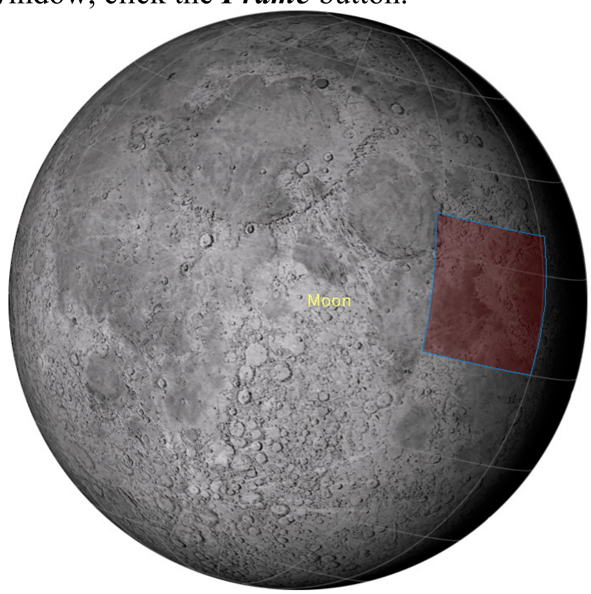


Figure 55: The Sky Chart Moon showing the position of the current Clementine photo (red rectangle) and the Moon grid lines.

The Moon is now fixed to the center of the Sky Chart. Make sure that the ***Highlight Region on Sky Chart's Moon*** checkbox is turned on (page 108). You can now click on the Sky Chart Moon to show the photo of that region on the Moon Viewer window. Or, you can change the Moon Viewer Photo by clicking the ***Left/Right/Above/Below*** buttons and the Sky Chart's Moon will highlight this region in red.

Label Moon Features

A number of interesting lunar features can be labeled on the Clementine photos, including:

- Craters
- Sub-craters
- Mare (lunar "seas")
- Landing Sites
- Catena (crater chains)
- Rima (rilles)

- Lacus (lakes)
- Mons (mountains)
- Dorsum (wrinkle ridges)
- Promontor (promontories)
- Vallis (valleys)

Turn on the ***Show Moon Features*** checkbox to display the selected features. The ***Turn All On*** and ***Turn All Off*** buttons can be used to show or hide all features.

Feature Information & Mouse Coordinates

Placing the mouse cursor over the photo reveals additional information, including the precise lunar latitude and longitude and details about the feature. When the ***Show Crater Outlines*** checkbox is turned on, the crater beneath the mouse cursor is also highlighted in red.

Show Adjacent Photo

Press the Left/Right/Above/Below buttons to navigate the Moon's surface.

As you scroll around, you might notice black rectangular regions on some photos. These show areas where no photographic data was acquired during the survey.

Options

The Moon Viewer window offers the following display options.

Show Crater Outlines

Turn on the **Show Crater Outlines** to display yellow circles around the craters on the photos.

Show Grid on the Sky Chart's Moon

Turn on ***Show Grid on the Sky Chart's Moon*** to show lines of latitude and longitude on the Sky Chart's Moon.

Highlight Region on Sky Chart's Moon

Turn on this checkbox to show the location of the current photo on the Sky Chart's Moon. You can also click anywhere on the Sky Chart Moon to show the Clementine photo for that area.

Show High-Resolution Photos PROFESSIONAL

Turn on this checkbox to show 100-meter resolution Clementine photos in *TheSkyX Professional Edition*.

Setting the Moon's Font

The font used to label Moon features on the Clementine photos is the same font used to label the Sky Chart's Moon. If you wish to change this font, edit the Moon's font attributes from the Chart Elements window (page 136) .

The Classical Planets

Not counting Earth, five planets are visible to the naked eye. It has been known since ancient times that the planets slowly change position relative to the stars, which appear to be fixed, never moving with respect to each other from year to year. In fact, the word planet derives from an ancient Greek term that means "wanderer."

All planets in our solar system orbit the Sun (you probably know that the Sun is a star, not a planet). Their orbits lie more or less in the same plane, so as they circle the Sun, their paths are restricted to a narrow band in our sky, which is called the *ecliptic*. The constellations that lie in this plane received special attention from ancient astronomers. Collectively they are known as the *Zodiac* constellations.

The farther a planet is from the Sun, the longer it takes to complete a single orbit. Planets farther from the Sun therefore move more slowly through the Zodiac.

TheSkyX can locate any planet wherever it happens to be on a given night. Below we describe some general features of the planets, starting from the closest in, then moving out to the edge of the solar system.

Mercury

Mercury is the closest planet to the Sun. It takes only 88 days to travel around the Sun once. This is another way of saying that a year on Mercury is 88 days long.

Because Mercury is so close to the Sun, it can be spotted only shortly after sunset and shortly before sunrise, when it is near the "edge" of its orbit from our perspective. It is hard to see much surface detail on Mercury in even the most powerful telescope, but the Mariner 10 spacecraft made three "fly-bys" of Mercury in 1974 and 1975. Pictures from that spacecraft revealed Mercury strongly resembles our Moon, with a heavily cratered surface. It is comparable to our Moon in size, but much denser. Being so close to the Sun, the surface of Mercury is very hot, as you would expect. The average daytime temperature there is above 400º C.

Venus

Commonly known as both the morning and the evening "star," Venus is the brightest natural object in the sky after the Sun and Moon. Its beautiful radiance has dazzled mankind throughout history. Venus is so bright that, from a very dark location, it can cast shadows.

When astronomers first eyed Venus through telescopes, they discovered that the planet is perpetually enveloped in clouds. They never part, keeping the surface of the planet forever shielded from direct view. This fact led to a great deal of fevered speculation about what might be hidden beneath those relentless clouds. Could Venus harbor steamy, tropical rainforests, inhabited by alien dinosaurs or even more exotic forms of life?

Much to the disappointment of science fiction writers, astronomers discovered in the early 1960's that the surface temperature of this deceptively serene-looking planet is hot enough to melt lead. Venus is a hellish, uninhabitable desert. The reason for this is a runaway greenhouse effect. The Venusian atmosphere is almost entirely carbon dioxide (CO_2), a gas notorious for its effectiveness at trapping heat. The fact that high concentrations of CO_2 have raised the surface temperature of Venus so far above what we would otherwise expect is one reason some worry about rising CO_2 levels on our planet. If Venus had the same mix of nitrogen and oxygen in its atmosphere as we have in ours, it would almost certainly be a lovely place to spend your vacation.

When Galileo began to systematically observe Venus with his telescopes, he discovered it goes through phases like the Moon. This helped convince him that the Sun, not the Earth, is the center of motion in the solar system. Venus, like Mercury, is an "inner" planet, meaning that they lie closer to the Sun than we do. This is why these planets are visible only in the early evening or pre-dawn skies – from our location in the solar system, they never appear to travel very far from the Sun.

Earth

Earth is the third planet from the Sun. Scientists sometimes refer to Earth as the Water Planet because more than 70 percent of our surface is covered by liquid water, and water is essential for life. Our world is the only planet in the solar system that can support life as we know it.

A day is defined as the amount of time it takes for Earth to make one complete *rotation* on its axis. A year is defined as the time it takes Earth to make one complete *orbit* of the Sun. The length of a day and year are different on other planets because they rotate at different rates and have different orbits.

The axis about which our planet turns is tilted relative to the plane of our orbit. This is why we have seasons. In the summer, our northern hemisphere is tilted toward the Sun, so the days are longer, and sunlight strikes the Earth more directly, making the northern hemisphere warmer (the opposite is true in the southern hemisphere) than it is in winter. In the wintertime, our northern hemisphere is tilted *away from* the Sun. The days are thus shorter and colder (again, the opposite is true in the southern hemisphere).

A *solstice* occurs when our axis is tilted directly toward or away from the Sun. The winter solstice is the shortest day of the year, and the summer solstice is the longest (depending on your latitude, this may or may not correspond to the times of earliest sunrise and latest sunset – the explanation is a little more complicated than what we're prepared to discuss here).

An *equinox* occurs when the center of the Sun is directly above the Earth's equator. There are two of these each year, one in spring (the *vernal* equinox) and one in fall (the *autumnal* equinox). Equinox is derived from Latin and means "equal night." During an equinox, night and day are both just about 12 hours long.

Like all planets, the orbit of the Earth is not perfectly circular, but slightly elliptical. The Earth is about a million kilometers closer to the Sun in December than June.

Mars

The next planet out from the Sun is Mars. It is about half the size of our planet and takes a little more than two years to go around the Sun once. Mars is very similar to Earth in two important ways. Its day is just over 24 hours long, and its axis of spin is tilted about 23 degrees, almost exactly the same tilt as Earth. This means that Mars has seasons, just like we do. But they last twice as long, since a Mars' year is about twice as long as one of ours (687 Earth days, to be more precise).

Like Venus, the atmosphere of Mars is almost entirely CO_2. Unfortunately it is an extremely thin atmosphere, about $1/100^{th}$ the pressure of our atmosphere at the equivalent of Martian sea level. During the day, the surface temperature of Mars near the equator can rise above freezing, but that same night it will drop well below –100º C. A little more greenhouse effect on Mars would be a welcome thing. As it is, the air on Mars is too thin to support liquid water on its surface, another blow to all those science fiction writers who imagined alien beings and ancient civilizations on Mars.

Still, Mars is the only other planet in our solar system whose surface is directly accessible to astronauts. Even though liquid water can't exist on Mars today, there is lots of geological evidence to suggest that in the distant past, the atmosphere of Mars was much thicker, and water flowed there freely. This gives scientists hope that Mars may have once harbored simple forms of life. If life did thrive there in the distant past, it may still survive today, perhaps in small "oases" deep underground, where organisms would be protected from the harsh conditions on the surface.

The best time to look at Mars in a telescope is during an *opposition*. About every 26 months, Mars and Earth line up on the same side of the Sun. This is when Mars is at its brightest and closest, and therefore appears at its best in a telescope. *TheSkyX* can calculate the dates of future oppositions and even tell you how large, in arcseconds, the disk of Mars will appear in an Earth-bound telescope.

As Mars approaches opposition, it briefly exhibits *retrograde* motion. This is a fancy way of saying that Mars looks like it turns around and moves backward in the sky for several days. This is simply a trick of perspective. As our two planets orbit the Sun, Earth catches up to and passes Mars. When we pass, Mars appears to move backward with respect to the far more distant stars.

Looking at Mars through a telescope, the first thing an observer usually notices on the disk of the planet are the *albedo* features. These are bright and dark markings that mostly correspond to variations in the coarseness of Martian surface dust. They were first systematically charted and named by the Italian astronomer Giovanni Schiaparelli in the 19^{th} century. He mistakenly believed that the dark features were seas and lakes, and he used the Latin terms *mare* and *lacus* accordingly. Today we know there is no surface water on Mars, but like Earth, the Red Planet does have polar caps. Unlike our polar ice, they are made not just of frozen water but carbon dioxide or "dry ice" as well. During an opposition, you can usually glimpse either the northern or southern cap in a small telescope.

There is a huge difference between seeing Mars in a telescope and looking at images of Mars taken by orbiting spacecraft. Beginning with the Mariner 4 fly-by in 1965, American, Russian, and European spacecraft have revealed Mars to be a world of geological wonders. Huge craters, towering volcanoes, and immense systems of canyons mark and etch its surface.

Mars is orbited by two small moons, named Phobos and Deimos (ancient Greek words for fear and terror, respectively). They are much smaller than our Moon, irregularly shaped, and difficult to see in most amateur telescopes. Some scientists believe these moons are actually wayward *asteroids*.

The Asteroid Belt

A ring of interplanetary debris circles the Sun between the orbits of Mars and Jupiter. These rocky fragments are thought to be remnants from the original disk of material that formed the planets. The gravity of Jupiter prevented these bodies from aggregating into a planet in their own right. There are literally millions of asteroids, but collectively their mass is only about 1/10 the mass of our Moon.

Ceres is the largest asteroid, and the first to be discovered back on New Year's Day in 1801. *TheSkyX* does not include asteroids in its main database, but you can add information on asteroids through the ***Input > Small Solar System Bodies*** menu.

Jupiter

Jupiter is the king of the planets. Ten times wider than Earth, it has more mass than all of the other planets in our solar system combined. Nearly a billion kilometers from the Sun, it takes twelve years to complete a single orbit.

Jupiter has a family of dozens of moons of various sizes and shapes, forming, in effect, a "mini" solar system. At last count, astronomers have charted over 60 moons orbiting this giant world. Many of these bodies are small as a typical asteroid (some of them might even be asteroids that were captured by Jupiter, caught like flies in its gravitational web).

Jupiter is attended by four large moons comparable in size to our own Moon. Because they were discovered by Galileo when he first turned his telescope on Jupiter in 1609, we call them the *Galilean satellites*.

TheSkyX includes telescope and spacecraft images of Jupiter, and can plot the orbits of its Galilean satellites. This is a particularly useful feature if you have a telescope. The moons shift position night to night as they orbit Jupiter, and you can track these motions with a modest telescope, or even a good pair of binoculars. Also, when a Galilean moon passes in front of Jupiter, it casts a shadow on the disk of the planet that can be observed in small telescopes. These *shadow transits* are fascinating to observe, and *TheSkyX* can tell you when they will occur. It also provides timings for another interesting phenomenon involving Jupiter's moons, an *occultation*. These occur when one of the moons enters the giant planet's shadow and passes behind it. Interesting Historical Note: by timing the occultations of the Jovian moon Io, the astronomer Ole Romer was able to make a rough estimate of the speed of light way back in 1676.

Saturn

Author's comment: *I'll never forget the first time I saw Saturn through a telescope. I was 11 years old. The telescope was small enough to fit in a lunchbox, but it was made by an extraordinary man named Max Bray, and was more than a match for Saturn. In the eyepiece, I saw a small white disk nestled inside a perfect set of white rings. It took my breath away. Everyone I know who has ever seen Saturn in a telescope remembers it. The most fun I've ever had in over three decades of being involved in astronomy is showing someone Saturn in a telescope for the first time. The planet is best known of course for its extraordinary rings.*

Saturn takes nearly 30 years to complete one orbit around the Sun. During this period, our view of the rings is slowly changing. Sometimes they are spread relatively wide and are easy to see, but about every 15 years they line up edge-on to our view. These "ring plane crossings" last a few days or so, and during this time all that can be seen of the rings is a dark, thin line crossing the disk of the planet.

Like Jupiter, Saturn is attended by numerous moons of various shapes and sizes. Titan, the largest, has a mostly–nitrogen atmosphere about one-and-a-half times thicker than the Earth's.

Going Farther

Saturn is the farthest planet that was known to man in ancient times. The invention of the telescope revealed innumerable new worlds never before seen by human eyes, including previously unknown planets in our own solar system.

Uranus

The seventh planet out from the Sun, Uranus is the first planet discovered by telescope. The astronomer William Herschel is credited with recognizing it as a planet over two hundred years ago, in 1781 (other astronomers had seen it, but mistook it for a star – Herschel initially thought it was a comet). Like Jupiter and Saturn, it is a giant, much larger than Earth, and its atmosphere is mostly made of hydrogen and helium. But there are also significant amounts of water, ammonia, and methane ice in this frigid world, and so astronomers refer to it as an *Ice Giant*.

At a distance of almost 3 billion kilometers, Uranus takes 84 years to make a complete trip around the Sun. Its axis of rotation is tilted 98 degrees to the plane of its orbit, as if the planet had been flipped on its side. Like all of the giant planets, Uranus has an extensive family of moons, at least 27. They are named after characters taken from the works of Shakespeare and Alexander Pope. The largest, Titania, is about half the size of Earth's Moon.

On a dark, moonless night, Uranus is just barely visible to the naked eye – if you have very sharp vision and know exactly where to look. *TheSkyX*, of course, can tell you where to find it. Uranus is relatively easy to find in a good pair of binoculars.

Neptune

The next planet out, Neptune, is similar in size and composition to Uranus. It is also considered an Ice Giant. The existence of Neptune was predicted by mathematical analysis of the orbit of Uranus. Deviations in the predicted orbit of Uranus led astronomers to believe that some other large body farther out in the solar system periodically tugs at Uranus. This theory was confirmed when Neptune was discovered close to its predicted position.

In a telescope, Neptune appears cool blue in color. It was first spotted by none other than Galileo, when it happened to be near Jupiter in the sky, but Galileo assumed that this faint blue object was a star, not a planet, and so he is not credited with its discovery.

It takes Neptune over 184 years to make a single orbit of the Sun. Discovered in 1846, it has yet to make a single orbit since it was first recognized as a planet. It lies some 4.5 billion kilometers from the Sun, and is attended by 13 diverse moons. The largest, Triton, is 2700 kilometers in diameter, just a little smaller than our own Moon. Triton orbits Neptune in a *retrograde orbit*, which means that it travels backwards relative to the direction of rotation of Neptune itself. This suggests that Triton did not form with Neptune, but came into being somewhere farther out in the solar system and was later captured by Neptune's gravity.

Pluto and the Ice Dwarfs

We all used to be taught that there are nine planets in the solar system. That is no longer the case. Pluto has been demoted. Today it is not considered a full-fledged planet, but an *ice dwarf*, one of perhaps hundreds of such objects that inhabit the outer reaches of the solar system.

Many people, including a lot of astronomers, are unhappy that Pluto has lost its status as a planet. Controversy is still raging over the decision to reclassify it. If you're wondering who gets to decide whether or not Pluto is a planet, the authority rests on a group called the International Astronomical Union (IAU). Founded in 1919, the IAU has some 10,000 members, all professional astronomers. Its main purpose is to promote and protect the science of astronomy internationally, but it also has sole authority for classifying and naming astronomical objects. Despite some groups that claim otherwise, you cannot have a star named after yourself or a loved one without going through the IAU.

During their August, 2006 meeting, the IAU membership voted on a new, more rigorous definition of a planet that had been developed by one of its working groups. This new and improved classification scheme included the category "dwarf planets" to cover objects in our solar system that had recently been discovered beyond the orbit of Pluto. Unfortunately for Pluto fans, it perfectly fits the new category, hence the demotion.

Land of the Comets: The Kuiper Belt and the Oort Cloud

One of the most beautiful things you'll ever see in the sky is a bright comet. Comets are refugees from the outer fringes of the solar system. Mixtures of ice and dust, the astronomer Fred Whipple famously described comets as "dirty snowballs."

Astronomers believe that most comets spend their lives in either the *Kuiper Belt* or the *Oort Cloud*. Named for the astronomers who first theorized their existence, these regions of space, far beyond the orbit of Pluto, are thought to be repositories of matter left over from the formation of the solar system.

A gravitational nudge from a nearby star or a passing cloud of interstellar dust can send an object from this region careening into the inner solar system. When a comet gets close to the Sun, its ice begins to sublimate. The escaping gas and dust form the *coma* and *tail* that give comets their distinctive appearance.

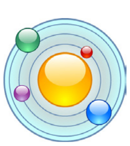
Most comets are unexpected strangers to our part of the solar system, but some have settled into predictable, short-term orbits. Halley's Comet is probably the most famous example. *TheSkyX* charts the orbits of several periodic comets. Most of them can only be seen on rare occasions with a telescope, but you never know when a new comet will be discovered and grace our sky in spectacular fashion, as comets Hyakutake and Hale-Bopp did in the late 1990's.

You can also enter the *orbital elements* of newly discovered comets into *TheSkyX* database using the ***Input*** > ***Small Solar System Bodies*** command. The position of the comet from night to night can then be displayed in the Sky Chart. Orbital elements can be downloaded from Harvard University's Center for Astrophysics website.

A 3D View of the Solar System

Planetary motion is complex. It took humans thousands of years to figure it all out. Fortunately for us, computers make the tough math a breeze, and they allow us to create useful simulations of the motions of solar system objects.

Modeling Planetary Motion



The planets move in predictable orbits about the Sun, and with the easy-to-use Solar System Tool, you can model their positions and motions with ease.

The Planets

For a 3D solar system simulation including the eight classical planets, plus Pluto, select ***Solar System*** from the ***Tools*** menu. A window then opens showing the solar system simulator. On the right, you see the simulation. You can click and drag on the simulated solar system to change the orientation and view it from varying angles. Time can also be moved forward or backward using the ***Time Skip*** item in the ***Tools*** menu, or the corresponding toolbar buttons. Alternately, you can adjust the time using the ***Date and Time*** item in the ***Input*** menu.

On the left are the menus and controls that affect what you see in the simulator. There is a slider that lets you control the viewing distance from 1 to 50 A.U., or astronomical units. An astronomical unit is a basic unit of distance used to describe the distance between objects within the solar system. One A.U. equals the average distance from the Earth to the Sun, about 150 million kilometers. Try out the distance slider to get a feel for how it works.

There are also checkboxes used to toggle on or off the ecliptic grid, orbit depths, and the background stars.

Small Solar System Bodies: Comets

Small solar system bodies include comets and asteroids. *TheSkyX* can display the orbits of these objects in the solar system simulator. By default, there are none available to show, so you will have to download some from the internet. Let's start by downloading some comet data

1. With the ***Solar System window*** open, select ***Input > Small Solar System Bodies***. A new window appears with three tabs at the top, ***Comets, Asteroids (Small Database),*** and ***Asteroids (Large Database)***. Select the ***Comets*** tab.
2. A window opens labeled ***Comets Available for Display***. Here, you will see the total number of comets available for display, as well as a list of their names with checkboxes. It is with these checkboxes that you can toggle comets on or off in the Sky Chart or in the solar system simulator.
3. You have three options for importing comet data into *TheSkyX*. You can import them from an existing file, or you may download comet data directly in *TheSkyX* using internet databases. You may download individual comet data by name, or you can download all the data for all observable comets at once. For our example, let's download all observable comets at once. To do this, simply click ***Observable***.
4. The data will then download, and the observable comets will now appear in the list above, on the Sky Chart, and in the solar system simulator.

Note: Be sure that your computer is connected to an active internet connection before attempting to download comet data.

Small Solar System Bodies: Asteroids

The process is very similar when downloading asteroid data from the ***Asteroids (Small Database)*** tab. There, you can choose to import asteroid data from an existing file, by orbital characteristic, such as distant, critical, or unusual, or you may import by asteroid name.

Should you decide to import asteroids from the ***Asteroids (Large Database)*** tab, you will have to visit one of the websites provided and download a file with the desired data. You can then select the file with the ***Choose*** button to reveal the asteroids in the Sky Chart and solar system simulator. Additionally, the checkboxes you see under the ***Asteroids (Large Database)*** tab toggle important display options such as computing asteroid positions at startup and 24-hour object paths for imported asteroids.

Eclipses

One of the most spectacular phenomena in nature is a total eclipse of the Sun. If you've seen one, you'll never forget it, and chances are you'll want to see as many as you can in your life. *TheSkyX* can predict eclipses literally thousands of years in the future. It can tell you where the eclipse will be visible and how long it will last, so naturally it's a great tool for planning a trip to see one of these extraordinary events.

There are three kinds of solar eclipses: *total*, *annular* and *partial*. In a total eclipse, the Moon passes in front of and completely covers the disk of the Sun, making it possible to see the Sun's *corona*, its extended atmosphere, and eruptions of surface plasma called *prominences*. This is truly a unique coincidence: the Sun is 400 times bigger than the Moon, but the Moon is 400 times closer to the Earth, so in our sky, they have almost exactly the same *angular diameter*, about half a degree. No other moon in our solar system can treat its home planet to a total eclipse.

Similar to a total eclipse, an annular eclipse occurs when the Moon goes right in front of the Sun. Due to differences in orbital positions, the angular size of the Moon is a bit smaller than the Sun. At the peak of an annular eclipse, a ring or "annulus" of light appears around the Moon.

In a partial eclipse, the Moon covers a portion of the Sun, so the corona and prominences aren't visible. Still, a partial eclipse can be fascinating to observe – as long as you use an appropriate filter to protect your eyes.

The Solar and Lunar Eclipse Finder lists *hybrid* eclipses that include both total and partial eclipses during the event. For example, the eclipse in April 2023 near Australia begins as an annular eclipse, becomes a total eclipse, then reverts to an annular eclipse. This type of eclipse is designated as *Hybrid A-T-A*.

NEVER LOOK DIRECTLY AT THE SUN WITHOUT A SAFE FILTER! You can instantly and permanently damage your eyesight by looking at the Sun without proper protection.

Lunar eclipses occur when the Moon passes into the shadow of the Earth. If the Moon orbited the Earth in the same plane as the Earth orbits the Sun, a lunar eclipse would happen every month, when the Moon is in its Full phase. But because the orbit of the Moon is tipped about five degrees relative to the orbit of the Earth around the Sun, lunar eclipses only happen about once every eighteen months when the orbits are aligned.

You might imagine that when the Moon passes into our shadow it completely disappears, but it doesn't. Dust in our atmosphere scatters a little bit of sunlight into our planet's shadow. Because dust mostly scatters red light, the Moon typically takes on a dim red or copper glow during the total phase of a lunar eclipse. How dark the Moon becomes depends mostly on how much dust happens to be in the air at the time of the eclipse. One of the fun things about viewing a lunar eclipse is that you never know exactly what shade of red or how dark the Moon will appear.

Viewing Eclipses

Selecting ***Tools > Solar & Lunar Eclipse Viewer*** from the menu bar will bring up the ***Solar & Lunar Eclipse Viewer Window***.

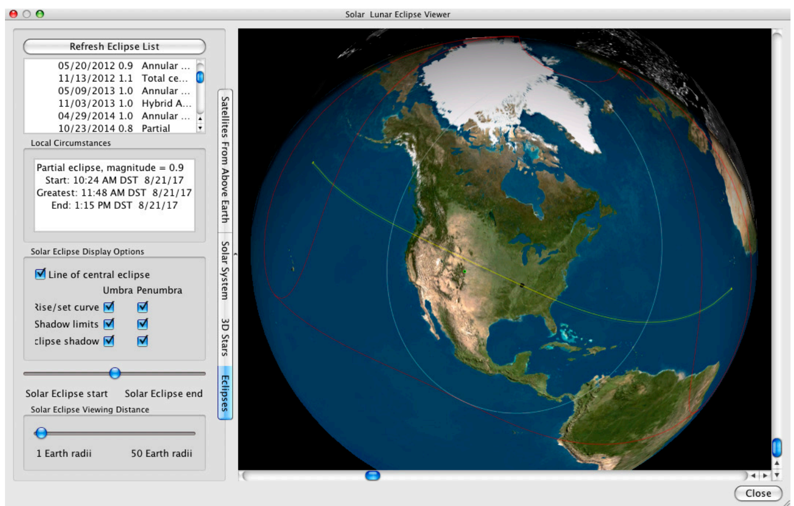


Figure 56: The Solar and Lunar Eclipse Viewer window.

In it, you will see a list of upcoming eclipses, a box displaying local circumstances for a selected eclipse, the eclipse viewer, and several checkboxes and sliders used to control the viewer.

Solar Eclipse Viewing

While using protective eyewear is certainly not necessary when viewing a solar eclipse in *TheSkyX*, the importance of using proper protection when observing the actual Sun at any time can never be overstated. Experienced observers should consider the following guidelines when observing a total eclipse:

i. get a proper eclipse viewing filter – do NOT improvise – and use it right up until the sky darkens rapidly,
ii. enjoy the total phase naked eye as nature intended,
iii. use the filter again as soon as the corona has been outshone by the diamond ring.

In the eclipse viewer, solar eclipse paths are viewed on a three-dimensional Earth globe, showing the eclipse shadow's path, rise and set curves, and umbral and penumbral limits.

To view a solar eclipse, scroll down the list near the top of the window and select a solar eclipse. Immediately, you will notice that the eclipse viewer will update to show the pertinent data on the Earth globe. A ***small green circle*** indicates your home position, as entered in the location section of *TheSkyX*. Additionally, you will notice a black circle along with colored lines representing important data about the selected eclipse. The following is a brief description of these markings.

The ***Black Circle*** marks the umbral (darker) eclipse shadow as projected onto Earth. This is the region where eclipse totality is possible.

The ***Yellow Line*** represents the line of central eclipse. It shows the eclipse's center line path over the globe. ***Yellow Ovals*** at the beginning and end points of the yellow line represent the umbral rise and set curves

The ***Grey Line*** represents the limits of the umbral shadow.

The ***Red Lines*** show both the rise and set curves and the shadow limits of the penumbra (lighter shadow).

The ***White Line*** marks the penumbral shadow on the Earth globe.

All of these markers can be toggled on or off by using the checkboxes under ***Solar Eclipse Display Options*** on the lower left of the window.

Once you have selected an eclipse from the list, you will notice that the ***Local Circumstances*** box now displays the local information regarding the eclipse, such as its local visibility, magnitude, start and end times, and moment of greatest eclipse. Once an eclipse is selected, the Sky Chart automatically updates to display the eclipse from your selected location.

Using the slider immediately below the ***Solar Eclipse Display Options***, you can view the path of the eclipse in progress, ranging between its start and end points. Simply slide it to the left to move toward the start point, and sliding it to the right will move toward the eclipse's end point.

Note: Another way to move time is to click Go Forward in the toolbar. Selecting an eclipse automatically stops time in *TheSkyX*, but by restarting it, you can watch the eclipse progress in the viewer in real time, or at any speed you choose.

Below the eclipse start/end slider is the slider marked ***Solar Eclipse Viewing Distance***. With the slider all the way to the left, the eclipse viewer is set to view the globe from a perspective of one Earth radius away. Slide the slider to the right, and you will gradually increase the viewing distance up to 50 Earth radii. If you have a scroll-wheel mouse, you can adjust the viewing distance by moving the cursor over the viewer and rolling the scroll wheel up (for closer distance) or down (for farther distance). Clicking and dragging the mouse will rotate the globe, adjusting the angle at which the eclipse path is viewed.

Note: In case your view of the globe is cut off, this window is resizable by clicking and dragging on the lower right corner.

Lunar Eclipse Viewing

Also included in the eclipse list are lunar eclipses. These are shown from the perspective of Earth's surface in the Sky Chart.

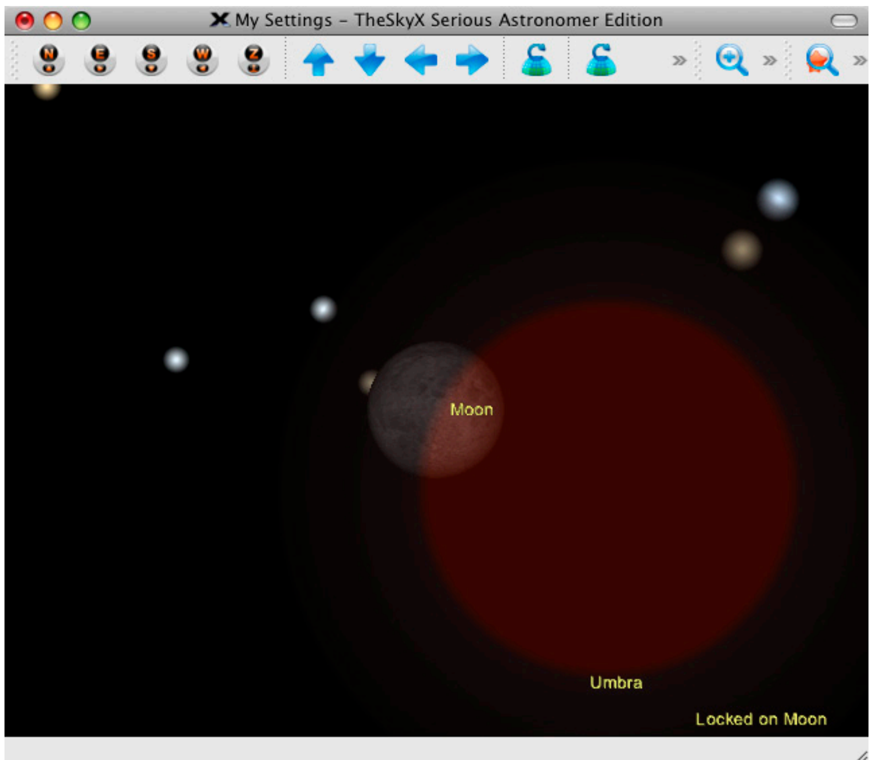
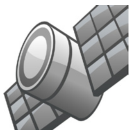


Figure 57: Lunar eclipse showing the umbra and penumbra (the light gray background above).

By selecting a lunar eclipse from the list, the Sky Chart will automatically update to show the chosen eclipse. Note that the Moon and penumbra and umbra of Earth's shadow appear with labels.

Looking at the ***Local Circumstances*** box will show the start date and time for the selected eclipse, as well as the maximum shadow coverage in lunar diameters. As with solar eclipses, time is stopped when an eclipse is selected, but can be started again whenever you wish to view the eclipse in motion. Using this tool, you can take note of shadow contact times when preparing for the exciting spectacle that is a lunar eclipse.

Artificial Satellites



Before 1957, nothing made by human hands existed above our atmosphere. But in that year, the Soviet Union launched the world's first artificial satellite, Sputnik. Since then, thousands of satellites have been launched into Earth orbit.

TheSkyX downloads *orbital elements* or *two line elements* (TLEs) from the web to keep track of thousands of satellites and other orbital debris. Using these numbers, *TheSkyX* can calculate where satellites will appear in the sky for any location on Earth.

To manage which satellites are shown, click the ***Satellites*** command in the ***Input*** menu.

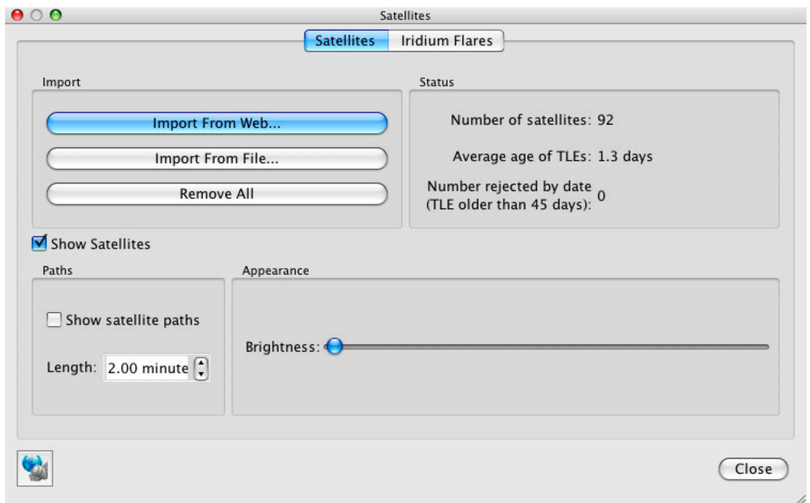


Figure 58: The Satellites dialog (Satellites command from the Input menu).

Satellite TLE data can be imported from the web or from a text file that contains the properly formatted data. *TheSkyX* uses orbital element information from Space Command Center's TLEs to predict and display satellites' positions. Two-line element data must be updated frequently and are available for most satellites on the web.

Gravitational forces, among other things, constantly perturb the orbit of a satellite around earth, so its position is not precisely predictable over long periods of time. *TheSkyX* automatically updates selected TLEs for your each time it is launched.

Download Satellite TLEs from the Web (Import From Web button)

Current satellite TLE data are retrieved from Dr. T.S. Kelso's Celestrak web site.

Clicking the ***Import from Web*** button shows the Import Satellites from Celestrak dialog.

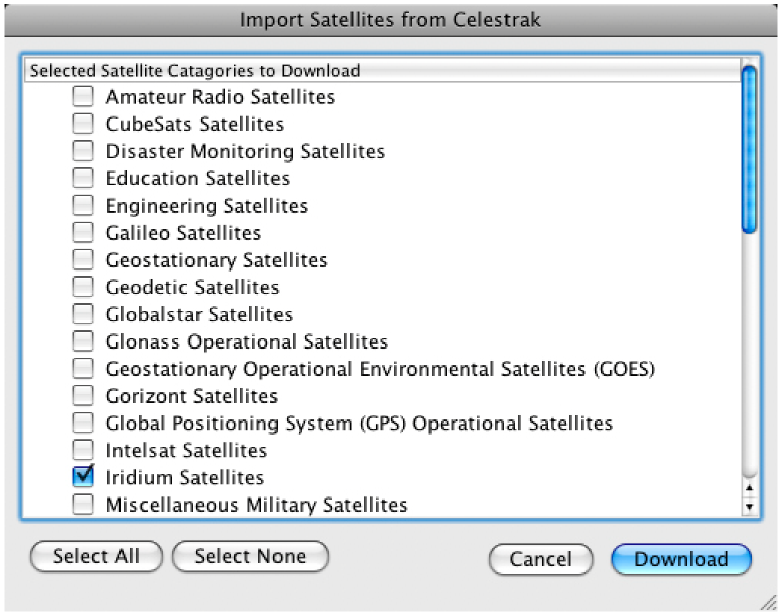


Figure 59: The Import Satellites from Celestrak dialog.

Turn on the desired categories, then click the Download button to retrieve them from the web. Importing all the satellites will most likely sap your computer's processor, so choose wisely.

Import from File

TLE data residing in a text file, rather on the web, can be imported and displayed by clicking the Import From File button. The text file must contain TLE data only. For example, the TLE data for the GOES 2 satellite looks like this:

```
GOES 2
10061U 77048A 98127.50441330 .00000045 00000-0 10000-3 0 97472 10061
13.1659 29.4732 0005723 183.8196 16.8163 1.00281760 21356
```

Status

The Status section shows the total number of satellites that were successfully loaded, the average age of the TLE data (the "newer" the better) and the number of TLEs that have been rejected because they are older than 45 days.

Use the ***Advanced*** tab on the ***Find*** window to locate a particular satellite.

Show Satellites

When this option is turned on, satellite positions are computed and displayed on the Sky Chart.

Show Satellites' Paths

Turn on this checkbox to draw a line on the Sky Chart that represents the upcoming path that the satellite will follow.

Length of Satellite's Path (Length input)

Enter the length of time, in minutes, of the satellites' paths.

Fun Example: Observing the International Space Station (ISS)

Watching the International Space Station fly overhead is a truly exciting event. *TheSkyX* can be used to predict when the ISS will travel overhead, and show you its path.

To find the best passes for the ISS, do the following.

1. Click the ***Satellites*** command on the ***Input*** menu.
2. Click the ***Import From The Web*** button.
3. Turn on the ***International Space Station*** radio button.
4. Click the ***Download*** button.
5. Click the ***Satellites From Above Earth*** button on the Satellites dialog (lower left corner of the window).
6. Select ISS (ZARYA) from the list of satellites, then click the ***Find Best Passes*** button.

A list of the times when this satellite is visible above the horizon is displayed. Double-click the items in the list to show the pass from an above-Earth perspective. Turn on the Update Chart radio button to show the path on the Sky Chart.

Iridium Flares

Beginning in 1998, a network of sixty-six communication satellites called Iridium was launched into orbit. At any given time, at least one of them is above the horizon for any location on Earth (not counting the territory around the north and south poles). Sometimes, as an Iridium satellite moves across the sky, sunlight bounces off its antennas and solar panels, creating a brief but brilliant *Iridium flare*. *TheSkyX* can calculate when the next flare will be visible from your location (they only happen in early evening or shortly before dawn). Click the ***Tools > Iridium Flares*** command to find the next flare that you can observe from your backyard.

Choose the ***Iridium Flares*** command from the ***Tools*** menu.

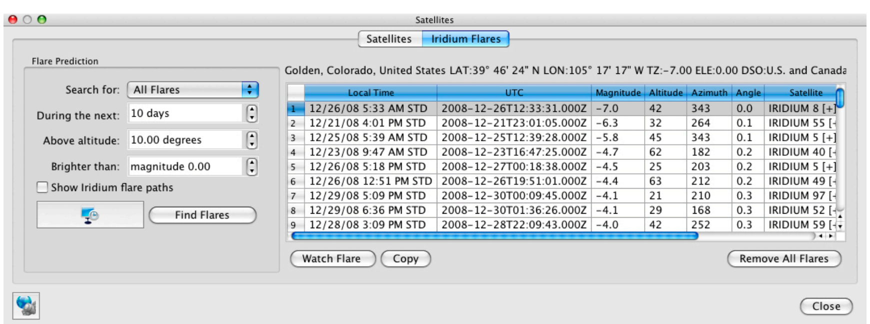


Figure 60: The Iridium Flares tab on the Satellites dialog (Tools > Satellites command).

Specifying the Type of Flare to Find (Search For pop-up menu)

Flares can be located based on what time of day they occur.

- ***Daytime Flares*** occur between sunrise and sunset
- ***Nighttime Flares*** occur between sunset and sunrise
- ***Dawn/Dusk Flares*** occur during the morning and evening hours

Choose the ***All Flares*** item to search for flares that occur any time, day or night.

Length of Time to Search (During the next)

Enter the number of days from now to search for flare events. Flare prediction involves some heavy duty computing, so you may want to limit the length of the search to less than a week so on slower computers.

Minimum Height Above the Horizon (Above altitude)

Mountains, trees or nearby buildings can hide flares that occur at lower altitudes. Enter the lowest altitude that a flare can be seen from where you will be observing.

Limiting Magnitude of Flare (Brighter than)

Enter the magnitude of the faintest flare you want to find. Faint nighttime flares are easy to spot; but if you're looking for a daytime or evening flare, make sure to enter magnitude minus 2 or brighter (the lower the magnitude, the brighter the flare).

Show Iridium Flare Paths

Turn on this option to show a line on the Sky Chart that shows where the flare occurs and how long the flare lasts.

Set Time to Now (Computer clock)

This button resets *TheSkyX's* date and time to the computer's clock.

Begin Searching for Flares (Find flares)

Click this button to begin the search for flares. Even a very fast computer requires a minute or more to locate all the flares for the next month.

Iridium Flare Report

The right side of the window shows a report containing the following information for each flare.

- Local time when the flare begins.
- Coordinated Universal Time when the flare begins.
- Maximum magnitude of the flare.
- The altitude and azimuth position at maximum magnitude.
- The angle, in radians, between observer's line of sight and Sun, subtended at the satellite.
- The name of the Iridium satellite.

- The mirror number on the satellite that is causing the flare and its angle.
- The Julian date of the flare.

Click a column header to sort the column's contents from smallest to biggest (that is, an ascending sort). Clicking a particular header more than once will invert the sort. For example, clicking the Magnitude header once sorts the flares from brightest to faintest. Clicking it twice sorts from faintest to brightest (a descending sort).

Simulating the Flare (Watch flare)

Now the fun begins. Clicking the Watch Flare button orients the Sky Chart so that the selected flare is visible near the center of the window. If no flare is selected, the first flare in the report will be simulated. A green laser pointer momentarily appears, showing you exactly where to look to view the start of flare. They're *really easy* to miss in the actual sky.

The excitement builds as the satellite's mirror begins to reflect the Sun's light and grow brighter for the next few seconds.

Now that you've seen a simulated flare, your goal is to go outside and actually observe the real thing. Take your friends or family along; after viewing the flare, they'll think you are an astronomy wizard.

Satellites from Above Earth

Often people who have not studied or practiced astronomy are amazed that many satellites are visible to the naked eye. Most times, satellites are observed by chance when someone looks up and catches a glimpse of something moving among the stars. *TheSkyX* has a useful tool that aids with satellite observation and can tell you not only when and where to look, but also the name and purpose of many satellites in the sky.

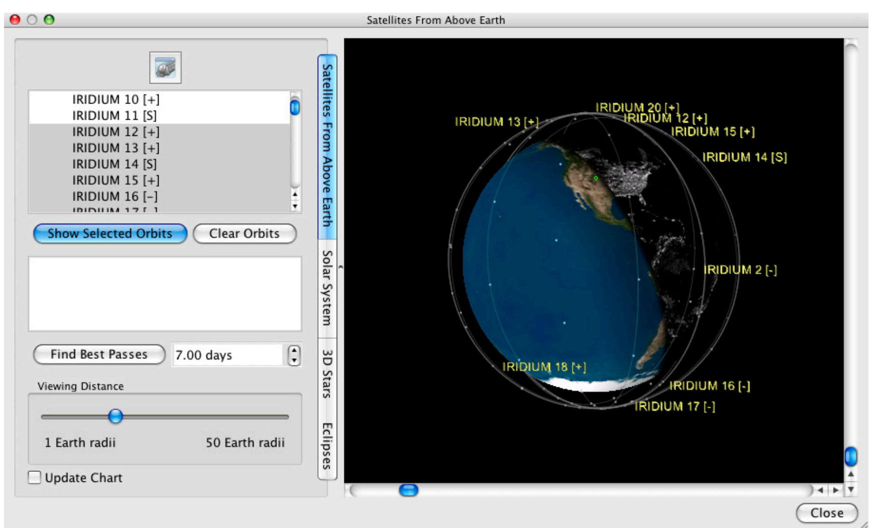


Figure 61: The Satellites Above Earth tab (Tools > Satellites From Above Earth).

Review: Viewing Satellites and their Orbits

To observe satellites, select the ***Satellites from Above Earth*** command from the ***Input*** menu. If this is your first time using the satellites tool, there will not be any satellites listed, and you will have to download some satellite Two-Line Elements (TLE's) before any satellite data can be shown. You can think of a TLE as a big set of numbers that describes a satellite's orbit.

To obtain TLE data, click the ***Satellites*** button, or select ***Satellites*** from the ***Input*** menu. The ***Satellites*** window appears. From here, you can choose to import satellite data from the web or an existing file. Later, you can also choose to clear all satellite data by clicking ***Remove All***.

Note: Ensure that TheSkyX's date is set to within 45 days of the current date to avoid date rejection when downloading satellite for import.

Let's start by downloading some satellite TLEs from the web. To do this, simply click ***Import From Web...*** on the ***Satellites window***. You can then choose the satellite category or categories you wish to download from the internet database, Celestrak. After you have selected the desired satellite categories, click ***Download***.

Return to the ***Satellites From Above Earth window***, and you will see the satellites plotted as points around the Earth globe. Also, note that the satellites are also viewable in the Sky Chart.

On the ***Satellites From Above Earth window***, a list featuring your newly downloaded satellites appears on the left. By selecting a satellite(s) from this list and by clicking ***Show Selected Orbits***. The satellite orbits will appear in the viewer. Sliding the ***Viewing Distance*** slider will change the view from a distance of 1 Earth radius up to 50 Earth radii. If your mouse is equipped with a scroll wheel, you can use it to adjust the viewing distance, too. If need be, the lower right corner of the window can be dragged to resize it.

By clicking ***Update Chart***, the Sky Chart is updated to show the recent satellite data from a ground-based perspective. Now you will be able to amaze your friends and neighbors with your uncanny ability to "predict" satellite appearances in the heavens!

Astronomical Conjunctions

When two or more planets appear near one another – within a few degrees or less –the objects are said to be in conjunction. But don't be fooled. Although the objects appear close by from our earth-bound perspective, the two objects are still hundreds or thousands of astronomical units apart. There's no need to worry about a collision.

Finding out when two or three planets will be in conjunction is easy with *TheSkyX*'s Conjunction Finder. It can locate conjunctions between any two or three planets and/or the Sun and Moon, as viewed from Earth.

Select the ***Conjunction Finder*** command from the Tools menu and then mark two or three objects in the Objects list. Earth is listed for reference only; it cannot be selected as part of the search.

Click the Start button to begin the search. *TheSkyX* uses the value entered in the ***Within (degrees)*** number input to determine how close the objects must fall before a conjunction is reported. Once a conjunction is found, the Sky Chart is updated to show it.

Beyond the Backyard: Our Home Galaxy

Our Sun is but one member of a huge assemblage of hundreds of billions of stars that comprise our home galaxy, the Milky Way. Our galaxy is also peppered with vast, colorful clouds of gas and dust, called nebulae, and other exotic objects.

The invention of the telescope revealed that there is much more in the night sky than stars and planets. In the 18th century, the French astronomer Charles Messier began to catalog some of these mysterious objects to make sure he didn't mistake them for new comets. The Messier Catalog is still in use today. It includes star clusters, and various kinds of *nebulas* and *galaxies*. These so-called "deep sky" objects are favorite viewing targets of amateur astronomers.

There are literally millions of objects in the sky that astronomers want to keep track of. Various catalogs have been developed for this purpose. *TheSkyX* includes several of them in order to chart these objects on the Sky Chart.

The Milky Way

The ancient Greeks believed that the Milky Way was exactly that: spilled milk. History failed to record whether anyone cried over it. It wasn't until Galileo invented the astronomical telescope that the true nature of the Milky Way was revealed: millions of stars too distant to be resolved by the naked eye. We now know that the stars of our particular galaxy form an immense pinwheel shape, with several spiral arms extending out from its center. When you look at the Milky Way, you're looking at a section of one of these spiral arms (galaxies come in a variety of shapes and sizes, from spherical to irregular – more on this later).

An unfortunate fact of modern life is that the Milky Way is too faint to be seen from within cities and most of their suburbs. You need to be far from city lights and any other source of light pollution to appreciate how extraordinarily beautiful it is. *TheSkyX* can display the Milky Way at various levels of brightness, simulating what you might see from the outskirts of a small town or an isolated mountain peak. Astronomers have come up with the very cool-sounding term *isophote* to describe regions of equal brightness in the Milky Way.

In the ***Display*** menu, the item ***Milky Way Options*** allows you to choose to display the Milky Way graphically, with isophotes corresponding to two levels of brightness, or as a wide-angle photograph of the Milky Way superimposed in the proper position on the Sky

Chart. As with constellation figures, you can adjust the transparency of the Milky Way to simulate how much (if any) of it you can see from your location.

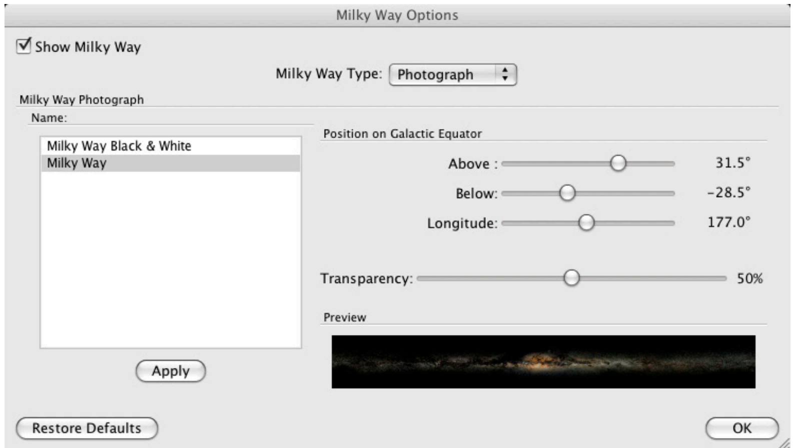


Figure 62: The Milky Way Options window (Click the Milky Way Options command from the Display menu).

Turn Milky Way On/Off (Show Milky Way)

Show or hide the Milky Way photograph or isophote drawings by turning this checkbox on or off.

Displaying the Milky Way (Milky Way Type)

Choose how to show the Milky Way on the Sky Chart.

Milky Way Photograph

Options in this group allow you to configure how the Milky Way Photograph appears on the Sky Chart.

Name of Milky Way Photograph (Name)

A color and black and white Milky Way photos are supplied with *TheSkyX*. Double-click on the name, or highlight it and click the ***Apply*** button to show in on the Sky Chart.

Note that the Milky Way photo shown in the Photo-Like display mode only.

Position on Galactic Equator

The position of the Milky Way photograph with respect to the galactic equator can be configured. Changes to these settings are applied to the Sky Chart immediately.

Degrees Above Galactic Equator (Above)

Use this slider to adjust how far above the galactic equator (in degrees) the top of the photo will appear.

Degrees Below Galactic Equator (Below)

Use this slider to adjust how far below the galactic equator (in degrees) the bottom of the photo will appear.

Longitudinal Position (Longitude)

Use this slider to adjust where the left edge of the photograph appears on the galactic equator.

Transparency of the Photograph (Transparency)

Use the slider to change the transparency of the Milky Way photograph.

Beyond Our Galaxy

About a hundred years ago astronomers believed that our galaxy, the Milky Way, contained pretty much everything in the universe. But as telescopes became larger and more powerful, it became clear that there are other galaxies beyond the Milky Way – lots of them, in fact. According to the latest estimates, there are some fifty to one hundred *billion* galaxies in our universe comparable in size to the Milky Way.

Our galaxy is also surrounded by a halo of some hundred and fifty star clusters. These clusters contain hundreds of thousands to millions of stars arranged in relatively compact, spherical shapes. These *globular clusters* are made up mostly of ancient stars, some of them over ten billion years old.

Just as some planets have moons, the Milky Way and many other galaxies are orbited by smaller "satellite" galaxies. The Milky Way has at least two. They were originally described by Persian astronomers, but today we call them the Magellanic Clouds in honor of Ferdinand Magellan, a 16th century European explorer who observed and charted them on one of his epic voyages into the Southern Hemisphere. Our galactic companions are most easily seen from that hemisphere, although at certain times of year they can be glimpsed from very low Northern latitudes. They are beautiful objects, and to the naked eye look like small shreds of the Milky Way. Even though they lie only 20 degrees apart in the sky, they are separated by 75,000 light years in space. With a telescope you can resolve some of their stars, and also see nebulae and star clusters that reside within them.

The Milky Way is just one of billions of galaxies that populate the Universe. Besides the Magellanic Clouds, only one of these other galaxies is visible to the naked eye. It's called the Andromeda Galaxy because it lies within the boundaries of that constellation. Every other galaxy requires a good pair of binoculars or a telescope to see.

TheSkyX's database includes thousands of galaxies within reach of amateur telescopes. They can be displayed in the ***Non-stellar Objects*** section of the ***Chart Elements*** window.

Galaxies of various shapes and sizes exist right out to the edge of observable space. We live in a truly extraordinary universe. We hope the *TheSkyX* will enrich and expand your appreciation of it.

Have it Your Way with Preferences

Select the ***Preferences*** command from *TheSkyX* menu (or click ***Tools > Preferences*** under Windows) to reveal a host of options that allow you to configure the appearance and contents of the toolbars, what information appears on the status and report windows, as well as advanced options.

The ***Preferences*** window shows four buttons along the top. Click one to view the options associated with it.

Toolbars

The standard set of toolbars and the toolbars you create are listed on the left side of the window. When the check mark next to the toolbar name is on, the toolbar is visible on the main window. Toolbars can also be turned on and off by right-clicking (⌘+click on the Mac) the mouse over the toolbar, and then selecting the desired command from the pop-up menu.

Click the ***Customize*** button to configure the commands or *actions* that appear on each toolbar, or add new toolbars with the commands you want.

Use the ***Toolbar Button Options*** to configure the size and appearance of the buttons on the toolbars.

Customizing Toolbars

The standard set of toolbars contain the most commonly used commands. You can edit the buttons or commands that appear on these toolbars to add additional items, or remove unwanted items or create additional toolbars with any set of commands.

To edit the actions on a toolbar:

1. Highlight the toolbar you wish to edit from the Toolbars list, or click the ***New*** button and enter the name of a new toolbar.
2. Highlight the desired action in the ***Actions*** list then click the green right-pointing arrow to add this action to the ***Current Toolbar Actions*** list.

Once selected in the ***Current Toolbar Actions list***, the action can be positioned on the toolbar by pressing the up/down arrows or removed by clicking the left arrow.

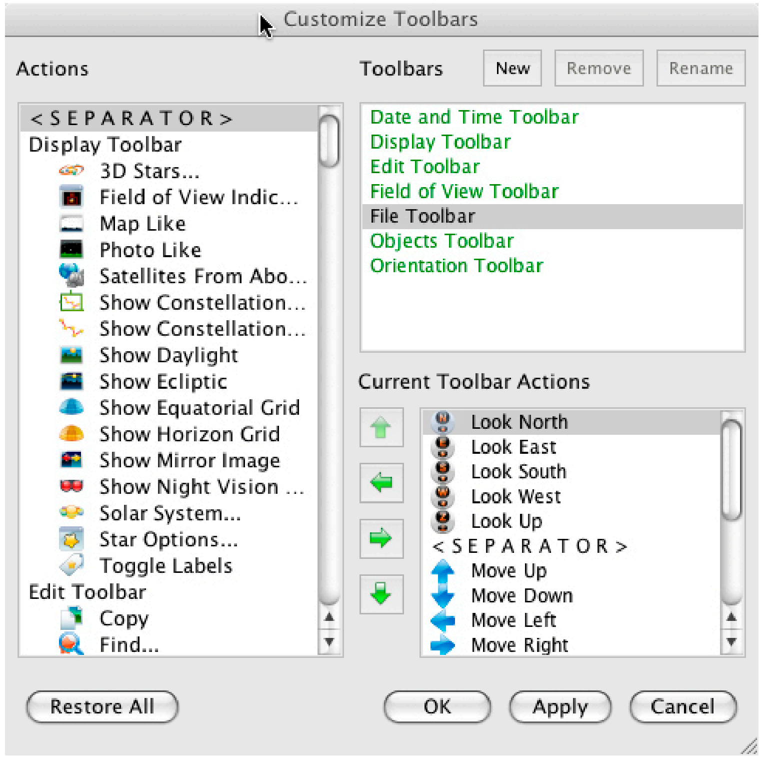


Figure 63: Customize Toolbars window (*TheSkyX* > *Preferences* command on the Mac, *Tools* > *Preferences* command Windows, *Customize* button).

List of All Actions in TheSkyX (Actions List)

Menu commands, dialogs and button actions are listed in the ***Actions*** list on the left side of the window. Each action can be added to (or removed from) a standard or custom toolbar. The <***SEPARATOR***> action places a vertical line between actions on the toolbar.

List of Defined Toolbars (Toolbars)

The currently available toolbars are listed on the top right of the window. The names of the standard toolbars are shown in green text and cannot be removed or renamed. Custom toolbar names appear in black text.

Actions in the Toolbar (Current Toolbar Actions List)

The list of actions that will appear on the toolbar are shown on the bottom right of the window. Selecting an action allows it to be moved up or down by clicking the up/down arrow, or removed by clicking the left arrow.

The right arrow adds the selected action to the toolbar.

Resetting Standard Toolbars (Restore All Button)

The standard toolbar set with the standard "factory" actions will be restored.

Status Windows

TheSkyX offers three different status windows that can be configured to show information about the current time, telescope position, and other report attributes.

Chart Status

The Chart Status window (***Display > Chart Status***) provides helpful information about the sky chart. By default, the current location, date and time are shown, but up to 21 chart status attributes be added.

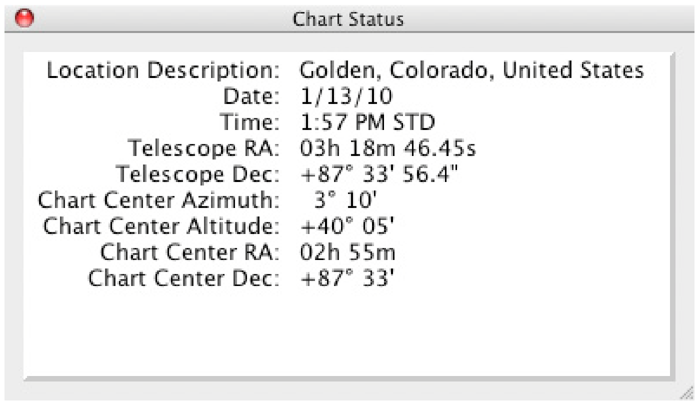


Figure 64: Chart Status window (Display > Chart Status).

To change the contents of the Chart Status report, select the ***Preferences*** command from *TheSkyX* menu on the Mac (***Tools > Preferences*** under Windows) then click the ***Status Windows*** icon. In the ***Status Window*** list, select ***Sky Chart Status***.

Highlight the items in the ***Attribute List*** that interest you, then click the right-arrow button.

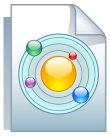
Note that double-clicking the *left* side of the Sky Chart Status report shows the Sky Chart Status report options on the ***Preferences*** dialog. Double-clicking the *right* side of the report shows the attribute-specific dialog. For example, double-clicking on the Location text reveals the Location dialog.

Digital Setting Circles and Status Bar

The contents of the report that appears on the Digital Settings Circles window (page 217) and the Status Bar window can be configured identically as the Chart Status window. Just make sure to select the appropriate option on the ***Status Window*** list.

Figure 65: A Status Bar can be shown at the bottom of Sky Chart.

Report Setup



The object-specific properties (for example, an object's magnitude, or the spectral class of stars or the Moon's ecliptic longitude) , that appear in the Object Information Report and Tool Tips Report is configurable to your needs.

- The Object Information Report appears on the ***Edit*** > ***Find*** dialog.
- The ***Tool Tips Report*** is the small window that appears when you place the mouse over an object on the Sky Chart.

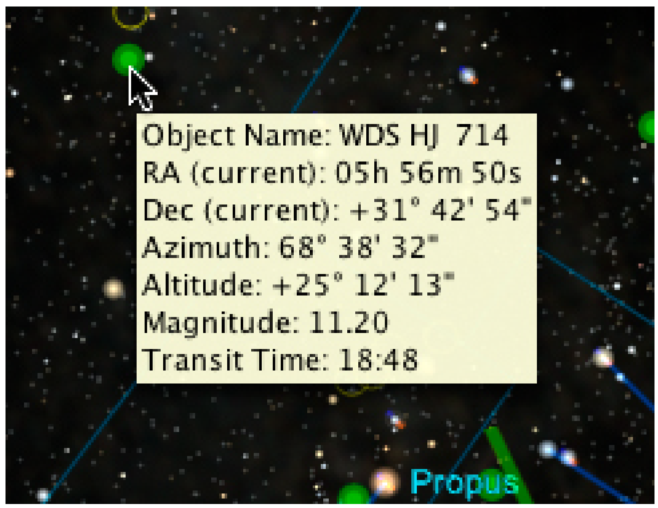


Figure 66: Tool tip on the Sky Chart.

Date & Time Control

The format of the date and time displayed in the Date & Time control (page 80) can be configured to meet your requirements.

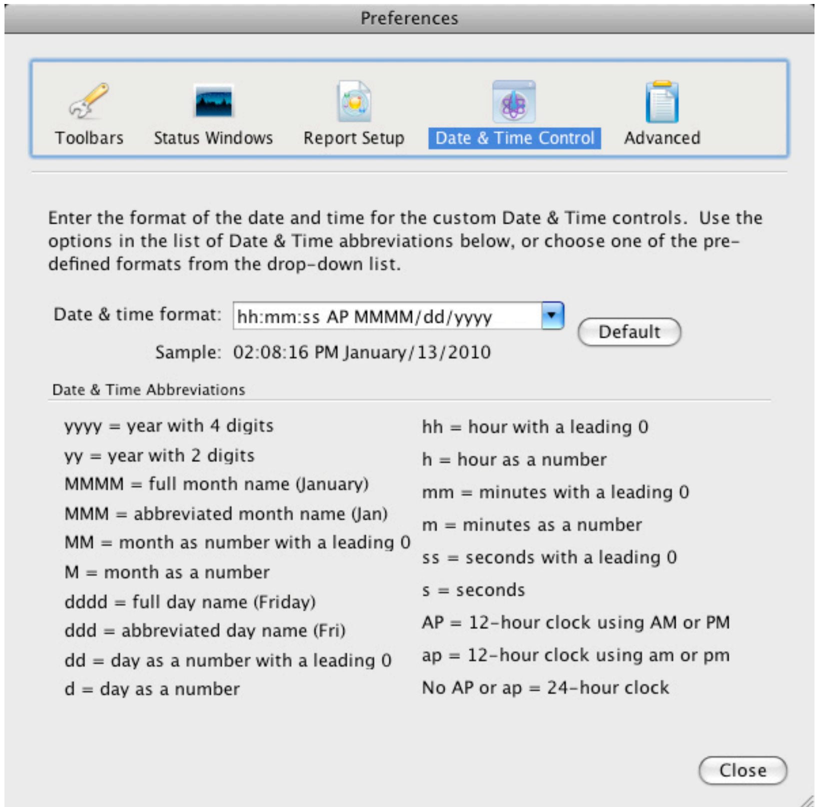


Figure 67: Date & Time Control options on the Preferences window.

To open the Date & Time Control window select the ***Preferences*** command from *TheSkyX* menu (or ***Tools > Preferences*** in Windows) then click the ***Date & Time Control*** icon.

In concept, formatting the date and time is simple. On the ***Date & Time Format*** text box, just type the format of the date and time that you want, or select one of the predefined formats from the drop down list. However, please take a moment to carefully read the text on this window. It should be self-explanatory, but this seemingly simple option is extremely flexible and it might take you a few tries to get the format just the way you want it.

Date & Time Format Configuration

The allowable date and time format abbreviations in the Date and Time format text are shown in the table below.

Abbreviation	**Explanation**
AP	Shows *AM* or *PM* in capital letters. Omitting the AP from the format will the time using a 24-hour time or military time format instead of the standard time format.
ap	Shows *am* or *pm* in lower case letters. Omitting the ap abbreviation from the format will the time using a 24-hour time or military time format instead of the standard time format.

d	A single lower case d shows the day as a number between 1-31.
dd	Two lower case d's in succession indicate the abbreviated name of the day should be displayed. For example, dd shows the text *Fri*.
dddd	Four successive lower case d's indicate the complete name of the current day should be displayed. For example, dddd shows the text *Friday*.
h	A single lower case h shows the hour without a leading zero. For example, 1 a.m. is shown as *1*.
hh	Two successive lower case h's show the hour with a leading zero when appropriate. For example, 1 a.m. is shown as *01*.
M	A single upper case M shows the month as a number between 1 and 12.
m	A single lower case m shows the minutes without a leading zero when appropriate. For example, 5 minutes after the hour is shown as *5*.
MM	Two successive upper case M's indicate the abbreviated name of the current month should be displayed. For example, MM would show *Jan*.
mm	Two successive lower case m's show the minutes with a leading zero. For example, 5 minutes after the hour is shown as *05*.
MMMM	Four successive upper case M's indicate the complete name of the current month should be displayed. For example, MMMM would show *January*.
S	A single lower case s shows the seconds without a leading zero when appropriate. For example, 5 seconds after the minute is shown as *5*.
ss	Two successive lower case s's show the seconds with a leading zero. For example, 5 seconds after the minute is shown as *05*.
yy	Two successive lower case y's indicate the year should omit the century, and show as just the decade and year. For example, yy shows *15*.
yyyy	Four successive lower case y's indicate the year should be shown using four digits. For example, yyyy shows *2015*.

Advanced Settings

The Advanced button shows application-wide options that normally do not need to be changed. We recommend leaving the options alone unless you've contacted technical support and have been instructed to alter one or more settings.

The exceptions are:

- Turning on/off the chart scroll bars
- Showing the frame rate
- Turning on/off the status bar
- Setting the ***Target Frame Rate*** (to conserve power on battery operated computers)

- Turning on/off the zoom tool
- Playing the startup sound
- Showing the splash screen at startup

Customizing Chart Elements

There are over ninety different chart elements that can be displayed in the *TheSkyX*. The universe is made up of vast emptiness, punctuated by an infinite variety of objects with an infinite variety of form. From stars, nebulae, and galaxies, to ecliptic lines, coordinate grids, and reference lines, they are all here. What follows is an introduction to each chart element. To toggle any chart element on or off in the Sky Chart, simply check the box next to its name in the window.

Editing Chart Element Attributes

Before we continue to discuss chart elements, it would be prudent to say a word their customizability. Many of the chart elements have editable attributes, giving you the ultimate flexibility in customizing the Sky Chart. Things such as object color, point style (graphic representation), and label font are all editable. Simply double-click on any object in the ***Chart Elements*** tab, and the ***Edit Chart Element Attributes*** window opens. Here, you can change fonts, line attributes, object fill color, and symbol options. Also, for objects that have them, you can adjust the ***magnitude limits***, and ***angular size limits*** by selecting the appropriate tab in the same window. Experimentation is perhaps the best teacher when exploring the customizable item attributes for chart elements.

Note: Not all attributes of all chart elements are editable, as many are not applicable or do not make sense. These attributes will appear grayed out and are not selectable.

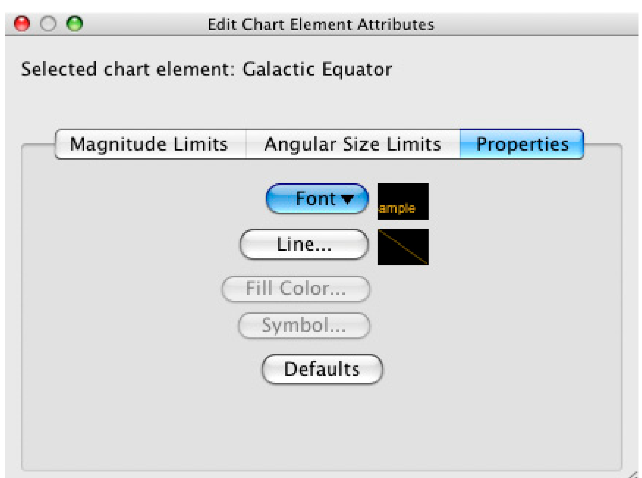


Figure 68: Properties tab on the Edit Chart Element Attributes for the Galactic Equator.

In Figure 67, the Properties tab for the ***Galactic Equator*** chart element is shown. Notice that the ***Fill Color*** and ***Symbol*** buttons are grayed because the galactic equator is a line so it does not have an associated fill color or symbol.

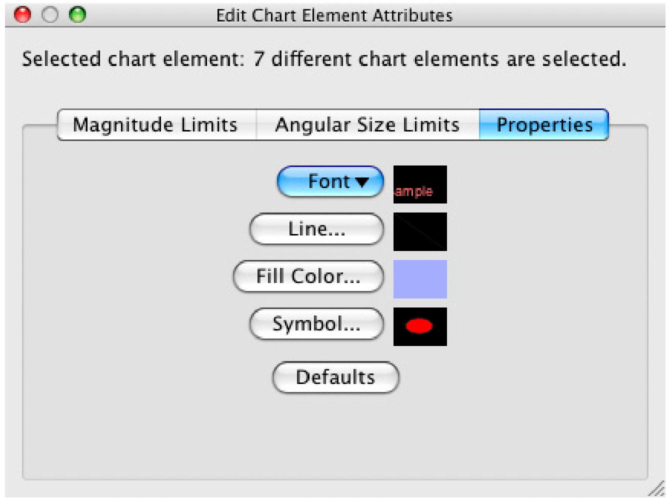


Figure 69: Properties tab on the Edit Chart Element Attributes when more than one element is highlighted.

The ***Edit Chart Elements*** window can be used to set the magnitude limits, angular size limits and properties of multiple object types, too. For example, on the Chart Elements window, highlight the ***Galaxies*** text under the ***Non-stellar Objects*** node of the ***Celestial Objects*** group and then click the ***Edit Attributes*** button.

The ***Selected Chart Element*** text shows that seven different chart elements (that is, all the different classifications of galaxies) have been selected. Any attribute changes will now be applied to each object type.

As another example, you could limit magnitude of *every object on the Sky Chart* to only those between magnitude 8 and 10 by selecting the ***Celestial Objects*** group, then setting the ***Hide Fainter Than*** number input to 10 and the Hide Brighter Than to 8.

Editing Attributes By Right Clicking

The attributes of a chart element can also be edited by right-clicking the mouse (⌘+click on the Mac) over the element on the Sky Chart, and then clicking the ***Edit <Chart Element> Attributes*** where ***<Chart Element>*** is the element beneath the cursor.

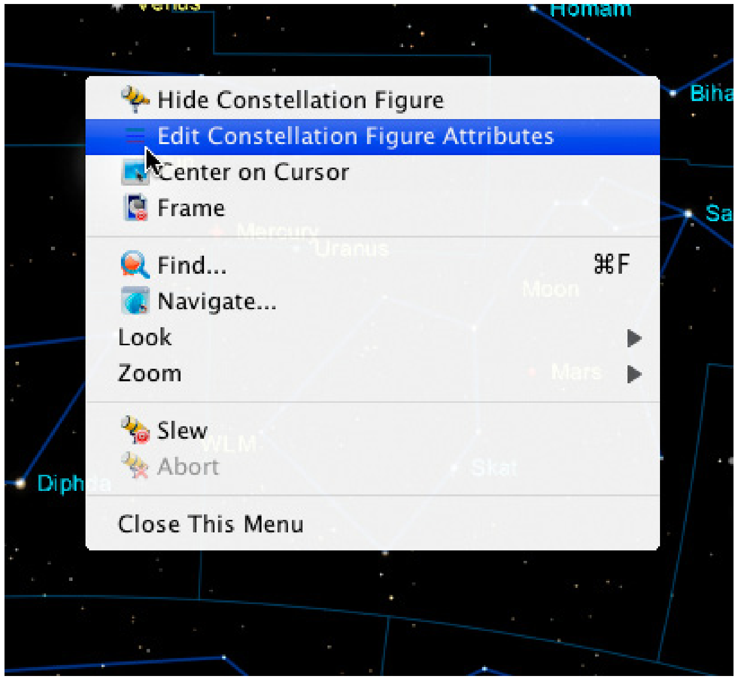


Figure 70: Right-clicking (⌘+click on the Mac) on a constellation line shows a context pop-up menu.

Celestial Objects

Here, you will find all of the real objects of the universe that are included in *TheSkyX's* database.

Non-stellar Objects

Celestial objects other than individual stars and the objects of our solar system, such as galaxies, nebulae, and star clusters, can be found under the heading ***Non-stellar Objects***.

Galaxies

Galaxies, sometimes called "island universes," are the largest building blocks of the observable universe. Galaxies are classified according to their shape. You can choose among galaxy types that you wish to display in the Sky Chart. You can choose to show Type C, elliptical, lenticular, spiral, and irregular galaxies, as well as galaxy clusters. Under ***Non-stellar Objects > Galaxies,*** the list of checkboxes will allow you to toggle on or off galaxies based upon their type. Notice that there are several different graphical points indicating galaxy type; these allow for quick identification in the Sky Chart.

Nebulas

There are many kinds of clouds of gas and dust in the sky, such a cloud is known as a nebula. Each of the different kinds of nebulae can be selected for display in the Sky Chart.

Bright Nebula

Bright nebulae are nebulae that emit or reflect light visible to the naked eye and appear as glowing clouds in the night sky. In some bright nebulae, called emission nebulae, the radiation from nearby stars ionizes the gas in these nebulae, and causes it to glow. A well-known emission nebula is the Orion Nebula in the sword of Orion, the Hunter. In still others, the light from stars bounces off of dust particles in the nebula, thereby illuminating it; these nebulae as known as reflection nebulae. A famous reflection nebula is that around the Pleiades.

Dark Nebula

Not all nebulae emit light. Sometimes they are dark and are only visible by being amongst or in front of regions of ionized gas (bright nebulae). A famous dark nebula is the Horsehead Nebula, also known as Barnard 33, in the constellation of Orion, the Hunter. A dark nebula is a region of cold, dense dust and gas. They are so dense as to block the light from background stars or from a nearby emission nebula. Star formation occurs within the dark nebulae, but such formation has not yet reached a level great enough for nebular ionization to occur. The Great Rift of the Milky Way is a dark nebula that is visible to the naked eye from a dark sky site.

Planetary Nebula

Planetary nebulae are special kinds of nebulae occurring near a dying star or white dwarf. When stars about the eight times the mass of our Sun or smaller begin to decline, they swell and contract, throwing off the outer layers in the process, and eventually leaving a white dwarf at the center. The white dwarf's radiation causes the cloud of gas to glow. These objects are called planetary nebulae because they looked like planets in the telescopes of astronomers during the 18th and 19th centuries. They do not have anything to do with the planets of our solar system, though. They are all quite far away. An interesting fact is that our Sun will end up as a planetary nebula in some 5 billion years from now.

Star Clusters

Visible in the sky are several clusters of stars. These are stars which formed together in the same region of space at about the same time. Star Clusters come in two varieties, open and globular.

Open Clusters

An open star cluster is a group of a few hundred stars up to a few thousand stars. These stars all formed from the same nebula, or cloud of gas and dust. These stars still interact with each other gravitationally, albeit loosely. Some open clusters, such as the Pleiades, in Taurus, the Bull, are still surrounded by remnants of the cloud from which the component stars formed. Others, such as the Hyades, also in Taurus, do not reveal distinct nebulosity.

Globular Clusters

Globular clusters are ancient, high density clusters of stars existing beyond the plane of the Milky Way or other galaxies. They are so-called because they look like globes in the sky. Some people have described them as looking, in telescopes, very much like salt spilled onto a black table cloth. These clusters orbit the galactic core in the region beyond the disk, known as the halo. Globulars are composed of old stars, and are remarkably free of gas and dust, presumably because that material was long ago turned into stars. Some globulars are visible to the naked eye, such as Omega Centauri and M13 in Hercules, though M13 requires very dark skies and good vision.

Cluster + Nebulosity

Some clusters contain nebulosity, either reflection nebulae caused by light from the component stars bouncing off of dust and gas surrounding them, or emission nebulae, which glow due to ionization of the cloud by the component stars' radiation. Use this item to toggle such clusters on or off.

Other Sources

Quasar

Quasars, ***quas***i stell***ar*** radio sources, are among the oldest known objects in the universe. They are all very far away, lying hundreds of millions or even billions of light years away from Earth. The first quasars were discovered in the late 1950's by radio astronomers. For years, the debate raged as to their nature. Today, it is believed that they are supermassive black holes. Tremendous energy emits from such a black hole region rising from the tremendous turmoil of the material orbiting and flowing into the black hole, in what is known as the accretion disk. It is possible that such objects are the precursors to modern galaxies, and would therefore account for the presence of the supermassive black holes found at many galactic cores.

X-ray Source

Many high-energy objects in the universe emit x-rays, such as stars, nebulae, and galaxies. Unusually strong x-ray emissions indicate a very high energy situation, such as a black hole's accretion disk. In fact, it was by observing strong x-ray sources, such as Cygnus X-1, that black holes were eventually brought from the realm of the theoretical to that of the real. Other powerful x-ray sources include quasars, certain double stars, such as those with a neutron star or white dwarf component, and some galaxy clusters.

Radio Source

Some objects emit large quantities of radio waves, these are known as radio sources. Pulsars (short for pulsating star) are perhaps the most well-known examples of astronomical radio sources. Pulsars are rapidly rotating neutron stars with a beam of radio radiation that sweeps by Earth like the beam from a lighthouse. The result is a pulsing radio signal detectable in radio telescopes. The first pulsar was discovered by Jocelyn Bell and Antony Hewish in 1967.

Radio astronomy is a complete subfield of astronomy that has its roots in the 1930s, when the radio emissions of the Milky Way were first discovered. Radio astronomy really took off after World War II. In the 1950s, Cambridge's Ryle and Hewish created important radio maps of the sky. Other milestones occurred in the 1960s with the research of Frank Drake at Green Bank, West Virginia, and the ground-breaking discovery of the cosmic microwave background by Penzias and Wilson in New Jersey.

NGC Probable Star

These are objects that are listed in the New General Catalogue (NGC) as being probable stellar objects. Probable objects are those predicted mathematically or through a combination of mathematics and observations.

Other NGC

NGC stands for New General Catalogue, a catalog of astronomical objects most notable for its size and the fact that it includes all types of deep-sky objects. It was first compiled in the 1880s on commission of the Royal Astronomical Society by J.L.E. Dreyer, using William and John Herschel's observations. Since then, it has continued to grow in size and has been thoroughly revised twice.

Turn the ***Other NGC*** checkbox on or off to toggle those objects belonging to the NGC and not specifically to any other object group.

Mixed Deep Sky

To toggle those objects that do not fall into any other category of non-stellar object, choose the ***Mixed Deep Sky*** checkbox. *TheSkyX* classifies objects in the famous Messier catalog as a mixed-deep sky.

Solar System Objects

The many objects of our solar system are discreetly displayable in *TheSkyX*. Choosing which to show in the Sky Chart is as simple as clicking a checkbox.

Moon, Sun, Planets

Here, you will be able to toggle the Moon and the eight classical planets, (including Earth), a host of small solar system bodies (comets, asteroids), satellites, and the Sun. You will notice that each of the naked eye planets, plus the Moon and Sun, each has a unique graphic point style to instantly distinguish them in the sky chart.

Here, you can select from any of the solar system objects. By clicking the tree arrow next to ***Solar System Objects***, you will see that you can choose among the Moon, the eight classical planets, small solar system objects (you'll find Pluto here), satellites, and the Sun.

Small Solar System Bodies

Under ***Small Solar System Bodies***, you will find a button with the same label. Clicking this button (or, clicking the ***Small Solar System Bodies*** command from the ***Input*** menu) will open a window allowing you to import small solar system bodies, such as comets and asteroids, into *TheSkyX* by using either an existing file, or by downloading orbital data from the internet.

Comets

Getting comet data imported into *TheSkyX*, follow these four, simple steps.

1. With the ***Solar System window*** open, select ***Input > Small Solar System Bodies***. A new window appears with three tabs at the top, ***Comets, Asteroids (Small Database),*** and ***Asteroids (Large Database)***. Select the ***Comets*** tab.
2. A window opens labeled ***Comets Available for Display***. Here, you will see the total number of comets available for display, as well as a list of their names with check-boxes. It is with these check-boxes that you can toggle comets on or off in the Sky Chart or in the solar system simulator.
3. You have three options for importing comet data into *TheSkyX*. You can import them from an existing file, or you may download comet data directly in *TheSkyX* using internet databases. You may download individual comet data by name, or you can download all the data for all observable comets at once. For our example, let's download all observable comets at once. To do this, simply click ***Observable***.
4. The data will then download, and the observable comets will now appear in the list above, on the Sky Chart, and in the solar system simulator.

Note: Be sure that your computer is connected to an active internet connection when attempting to download comet data.

Asteroids

The process is very similar as comet data when downloading asteroid data from the ***Asteroids (Small Database)*** tab. There, you can choose to import asteroid data from an existing file, by orbital characteristic, such as distant, critical, or unusual, or you may import by asteroid name.

Should you decide to import asteroids from the ***Asteroids (Large Database)*** tab, you will have to visit one of the websites provided and download a file with the desired data. You can then select the file with the ***Choose*** button to reveal the asteroids in the Sky Chart and solar system simulator. Additionally, the check-boxes you see under the ***Asteroids (Large Database)*** tab toggle important display options such as computing asteroid positions at start-up and 24-hour object paths for imported asteroids.

Small Database Versus Large Database Asteroids

There are *lots* of asteroids out there; over 430 *thousand* have been cataloged to date.

The sheer number of them presents problems for charting programs. If you want to show them all, there's no easy way to continually update their positions without *really* slowing down the computer. And, if you want to show the path of one *particular* asteroid, "wading through" them all to find the one you want can be frustrating.

For optimal functionality, *TheSkyX* breaks asteroids into separate databases, *Small* and *Large*.

Small Database Asteroids

- Limited to 1000 total on Sky Chart.
- Can be imported by name, orbital characteristic, a text file or by entering the individual orbital elements.
- Can create Object Paths (page 73) for any or all of them.
- Sky Chart coordinates are updated continually.

Large Database Asteroids

- An unlimited number can be shown on the Sky Chart.
- Can be imported from a standard IAU text file.
- Cannot create Object Paths (page 73).
- Can show the 24-hour path vector.
- Sky Chart coordinates are updated only after the text file is imported, or by clicking the ***Compute Asteroid Positions*** button on the ***Asteroids (Large Database)***.

When you click on an asteroid to identify it, its elements are numerically integrated to update them to the current equinox. The coordinates in the Object Information report are computed to an accuracy of ±1 arcsecond.

Asteroid Paths

The position and 24-hour path of any asteroid, over any time period, and for any number of selected small database asteroids, or for all asteroids.

To View a 24-hour path for all Large Database Asteroids:

1. Click the ***Small Solar System Bodies*** command on the ***Input*** menu.
2. Click the ***Asteroids (Large Database)*** tab.
3. Turn on the ***Draw a line for each asteroid showing its path for the next 24 hours*** checkbox.

To Create the 24-hour path for any of the Small Database Asteroids:

1. Click ***Input > Small Solar System Bodies***.
2. Click the ***Asteroids (Small Database)*** tab.
3. Load the desired asteroids and click ***Close***.
4. Click ***Tools > Object Paths***.
5. Select the asteroids in the ***Asteroids*** list.
6. On the ***Create Paths*** tab, enter ***1 hour*** (or any other increment).

7. On the **Count** text input, enter ***24 hours*** or any other number of increments.
8. Click the ***Create Path*** button.

A path for the selected asteroids for the select time increment is drawn.

Satellites

Artificial satellites can be viewed on the Sky Chart as they appear from your backyard, or from a position above Earth.

From the ***Chart Elements*** window, click the ***Satellites*** button, or select the ***Satellites*** command from the ***Input*** menu, to open the ***Satellites*** window. In this window, you can import satellite or Iridium flare data from an existing file or from the internet. Checkboxes allow you to toggle the satellites and orbital paths in the Sky Chart. The ***Brightness*** slider allows you to control the brightness of satellites, making them easier to spot against a starry background.

Viewing Satellites and their Orbits

To observe satellite orbits, select ***Tools > Satellites from Above Earth***. If this is your first time using the satellites tool, there will not be any satellites listed, and you will have to download some satellite two-line elements (TLEs) before any satellite data can be shown. You can think of a TLE as a set of numbers that describes a satellite's orbit.

To obtain TLE data, click the ***Satellites*** button, or select ***Satellites*** from the ***Input*** menu. The ***Satellites*** window appears. From here, you can choose to import satellite data from the web or an existing file. Later, you can also choose to clear all satellite data by clicking ***Remove All***.

Note: Ensure that TheSkyX's date is set to within 45 days of the current date to avoid date rejection when downloading satellite for import.

Let's start by downloading some satellite TLEs from the web. To do this, click the ***Import From Web...*** button. You can then choose the satellite category or categories you wish to download from the internet database, Celestrak. After you have selected the desired satellite categories, click ***Download***.

Return to the ***Satellites From Above Earth*** window, and you will see the satellites plotted as points around the Earth globe. Also, note that the satellites are also viewable in the Sky Chart.

On the ***Satellites From Above Earth*** window, a list featuring your newly downloaded satellites appears on the left. By selecting a satellite(s) from this list and by clicking ***Show Selected Orbits***. The satellite orbits will appear in the viewer. Sliding the ***Viewing Distance*** slider will change the view from a distance of 1 Earth radius up to 50 Earth radii. If your mouse is equipped with a scroll wheel, you can use it to adjust the viewing distance, too. If need be, the lower right corner of the window can be dragged to resize it.

By clicking ***Update Chart***, the Sky Chart is updated to show the recent satellite data from a ground-based perspective. Now you will be able to amaze your friends and neighbors with your uncanny ability to "predict" satellite appearances in the heavens!

Viewing Iridium Flares

Some satellites become incredibly bright for short periods of time. This phenomenon is due to the fact that their orbit brings them into precise alignment as to reflect a large quantity of sunlight down to Earth in a precise location. This is most commonly observed with the Iridium communication satellites, and is therefore referred to as an Iridium Flare.

TheSkyX can predict and display Iridium Flares using the satellite function.

1. Select ***Input > Satellites***, or, if the ***Satellites from Above Earth*** window is open, click the ***Satellites*** button.
2. Choose the ***Iridium Flares*** tab.
3. You can search for all flares, or limit your search to just daytime, nighttime, or dawn/dusk flares. For this example, choose ***All flares***.
4. Leave the next few menus at their default settings.
5. Click ***Find Flares***, and *TheSkyX* will connect to an internet database to retrieve Iridium Flare data. Be sure that your computer is connected to the internet for this.
6. Once the upcoming flares appear in the list, click the ***Watch Flare*** button, and the flare will appear in the Sky Chart, along with a pointer directing you to the flare's position.

Now you know just where to look when it's time for the next Iridium Flare.

The ***Satellites*** window also features a button labeled ***Satellites From Above Earth***, clicking this button opens the tool of the same name. For more on using viewing satellites, please see the section ***Satellites From Above Earth***.

Stellar Objects

From the ***Chart Elements*** window, under the ***Stellar Objects*** heading, you will see the stellar objects displayable by *TheSkyX*; stars, double stars, suspected variables, supernovae, and variable stars. Any of these are selectable via the checkboxes.

Stars

Immense luminous spheres occurring in the night sky, stars make up the better part of the mass of the universe observable to the naked eye. They generate their light from nuclear reactions in their cores. These nuclear reactions fuse hydrogen and helium to form elements up to atomic number 26: iron. Stars occur in a variety of sizes and colors. The color of a star is due to its temperature; red stars are relatively much cooler blue stars. Our Sun is a middle-sized star. The sizes of star points in the Sky Chart does not reflect actual size, but is an expression of relative apparent brightness, with larger points representing stars of greater apparent brightness.

Star Options

You will also see a button labeled ***Star Options***. Clicking this button opens a useful window that contains controls allowing you to adjust the ***Appearance*** of stars as well as options for their ***Proper Motion***. Tabs at the top of this window allow you to select between the two.

Clicking the ***Appearance Tab*** brings up several sliders. The ***Fainter/Brighter*** slider adjusts the apparent brightness of the stars in the Sky Chart. The ***Contrast*** slider adjusts the contrast of the Sky Chart image. Less contrast can be useful those learning to identify constellations. The ***More Fuzzy/More Solid*** slider lets you change the star points from fuzzy, nebulous orbs, to solid balls, and many points in between. You can adjust the number of stars appearing in the Sky Chart by using the ***Less/More Stars*** slider. Additionally, the halos seen around the star points can be controlled by the ***No/Bright Halos*** slider.

Star Color

Star color can be adjusted here in terms of the saturation of the spectral color of stars. Also, the stars may be colored according to the selected 'Star' attribute color via a checkbox.

If you would like the stars to appear red in ***Night Vision Mode***, check the checkbox labeled ***Red in Night Vision Mode***.

Map Like vs. Photo Like Display

You may also choose between a Map Like chart, where the Sky Chart appears similar to a traditional printed chart, or a Photo Like chart, where the Sky Chart appears as photo-realistic view of the sky, by choosing the radio button at the bottom of the window.

Proper Motion

TheSkyX continually calculates stars' proper motion, that is their actual motion in the heavens, not just the rising and setting, called apparent motion. To access the proper motion options from the ***Star Options*** window, click the ***Proper Motion*** tab. From here, you can turn off proper motion at any time by un-checking ***Compute Proper Motion***. You can also choose to ***Show Proper Motion Vectors*** by checking the box labeled as such. Using the field labeled ***Proper motion vector length***, you can enter a value between 0.00 and 99.00 years.

Suspected Variable

Many stars in the heavens are not steady in their energy output. Such stars are known as variable stars. There are many different types of variable star. (Please see ***Variable Stars*** for more information.) Choose ***Suspected Variable*** to toggle on or off those stars which appear, based upon best observations, to exhibit variable star tendencies, but are not yet confirmed.

Supernova

Perhaps the most energetic single event in the cosmos, the supernova is a relentless stellar explosion, whose effects are felt across vast expanses of space and time. There are a few different types of supernovae, all with the same effect: an exploded star. These events release incredible amounts of energy, much more than the Sun will release over its entire lifetime! In addition to an enormous emission of light, there is also a shock wave emanating from the star. Material in this shock wave reaches incredible speed, and matter is slammed together hard enough for it to fuse into heavier elements and to emit light. It is this fusion that is thought by some scientists to produce all elements heavier than iron in the Universe.

Variable Star

A variable star is a star whose energy output is not constant, but varies in a regular pattern. Some variable stars are useful in determining cosmic distances. There are many different types of variables, but two main types of variable star, eclipsing binaries and Cepheids, make up the majority of variables in the night sky.

An eclipsing binary is a binary star with two component stars of unequal brightness. When the brighter one is in "front" as viewed from Earth, the star appears to be brighter, and it appears dimmer when the dimmer one is in "front." A notable eclipsing binary is Algol in the constellation of Perseus.

A Cepheid variable is a star whose energy output varies because the star swells and shrinks at regular intervals. It is believed that these stars do this because of their internal structure and rotation causing a harmonic resonance. The prototype Cepheid variable is δ (delta) Cephei. Cepheids are useful because they can be used to determine distances. Their variation periods are directly related to their brightness. Using this information, an observed Cepheid's apparent brightness can be compared with its brightness as determined by observing its period to calculate its distance. An historic use of this principle was when Edwin Hubble proved that the spiral nebulae were distant, separate galaxies in 1922 by observing Cepheid variables within them.

Non-Stellar Objects

Just as with stars, TheSkyX offers a number of options for displaying non-stellar objects. Select Display > Non-stellar object options to bring up the Non-stellar Object Options dialog. You can also access this dialog from the Chart Elements tab, under Non-stellar Objects.

Non-Stellar Object Options

Many of these options are designed to reduce computer resources while rendering the Sky Chart. Others are designed to reduce the number of non-stellar objects rendered to help you to hone in on just the objects you wish to observe.

Non-Stellar Object Density

The top two sliders are used to adjust the non-stellar object density in fields of view greater than 60° (top slider) and less than 60° (bottom slider). Simply click and drag the slider to the left or right for less or greater object density.

You can also choose to plot objects whose entries overlap in various catalogs, such as NGC, IC, and PGC. Simply select the Plot overlapping catalog entries checkbox to activate this option.

TheSkyX plots small galaxies as either filled ellipses or as a galaxy symbol. If you prefer a symbol, select the Plot small galaxies as a "galaxy symbol..." checkbox. For more on galaxy symbols, see the Galaxies section in the Chart Elements tab.

Non-Stellar Object Drawings

The style and appearance of non-stellar object drawings can be set with the drop-down and slider here. Choose either Filled or Hollow from the drop-down menu to set the non-stellar object drawing style. The slider below the drop-down menu morphs the drawings between More fuzzy and More solid appearance.

In Place Photos

TheSkyX can show NGC, IC, and PGC non-stellar objects as in place photos from the Digitized Sky Survey. It can also clip the photos to the catalogued shape of the object, if you so choose. Select the appropriate checkboxes in this section to activate these options.

You can also set the Default frame size when object size is unknown with this section's value field. The default setting is 10.00 arc-minutes, but you can change that value to suit your needs by using the up/down arrows or by directly entering a value in the field.

Solar System Options

If you want the Sun and Moon to appear as transparent ellipses, select the first checkbox in this section.

You can also choose to Show Earth's shadow by selecting this checkbox.

To exaggerate the angular size of the Sun and Moon in fields of view 90° and wider, set the desired value in the bottom-most field in the Non-Stellar Object Options dialog. You can choose values between 1.0 and 10.0 times.

When you are satisfied with the non-stellar object options settings, click Close to return to the Sky Chart.

Reference Lines and Photos

The Sky Chart can show reference lines that display coordinates, help you visualize your orientation, or indicate what part of the sky you're looking. It can also show in place photographs for many deep space objects.

Constellation & Asterism Options

Here, you will find items such as asterisms, constellation drawings, constellation boundaries, constellation figures, constellation labels, the ecliptic, and the equatorial grid.

Each of the above items is able to be toggled, and there are a number of options available to you by clicking ***Constellation & Asterism Options***. Doing so opens a window of the same name. Two tabs, labeled ***Constellations*** and ***Asterisms*** appear at the top. Under the ***Constellations*** tab, note that there are sections each for constellation figures, boundaries, and drawings, with a number of customizable options for each.

Constellation Figures

Click the ***Show Constellation Figures*** checkbox: dot-to-dot figures appear in the Sky Chart. Today, there are a number of conventions for drawing the constellation figures, such as those from Astronomy and Sky & Telescope magazines, as well as those from H.A. Rey, and *TheSkyX*'s own. Choosing between the many styles is as easy as using the pop-up menu.

You can also choose to affix a label to the constellations, and you can customize that label among many options. This is especially useful, as there is much confusion about constellation pronunciation, especially the genitive forms, such as Cephei or Aurigae. Checking the box labeled ***Label with:*** brings up the labels, and the pop-up menu lets you pick from a number of label options, including pronunciation for the constellation name and the genitive forms (used for describing objects that "belong" to a constellation, such as the star Epsilon Eridani).

Constellation Boundaries

Astronomers use the constellations to map out the sky. But, instead of using just the drawings themselves, astronomers have laid out the entire sky in 88 sections, each attributed to a constellation found within that section. To view these sections, or constellation boundaries, check ***Show Constellation Boundaries***. If you would like to highlight the central constellation region in the Sky Chart, simply click ***Highlight the constellation boundary near the center of the screen***.

Constellation Drawings

To display beautiful constellation drawings from Johannes Bayer's Uranometria, check the box labeled ***Show Constellation Drawings***. Additionally, if you would like see only the drawings for constellations currently at the center of the screen, click the ***Only show constellations that are near the center of the screen***.

Below that is a list of the 88 constellations with checkboxes, along with buttons for selecting ***All, None,*** the ***Zodiac*** constellations, and those constellations at the ***Center*** of the screen. You can select exactly which constellations appear by utilizing the corresponding checkbox (check ***Andromeda*** to display the Andromeda drawing).

Click the button with the color above the ***Transparency*** slider to change the color of the constellation drawing overlay. You can pick from a list of colors, or you can choose your own color from the color wheel by clicking the color square in the lower right (the one with the three black dots). The transparency of the constellation drawing overlay is controlled by the ***Transparency*** slider: move it to the right for increased transparency, and left for increased opacity.

Asterisms

Click the ***Asterisms*** tab, and you will see a list of available asterisms, along with a checkbox enabling asterism labels to be shown in the Sky Chart. To show an asterism, locate it in the list and ensure that it is checked. The chosen asterism will then appear in the Sky Chart.

Also you can choose all asterisms at once by clicking the ***Show All*** button, or no asterisms by clicking the ***Show None*** button.

Highlighting an asterism from the list and clicking the ***Center*** button is a handy way to locate and learn asterisms; they will be centered in the Sky Chart once the button is clicked. *TheSkyX* probably contains more asterisms than you have come across before, so spend some time and have some fun discovering new ones.

Ecliptic

The ecliptic is the apparent path of the Sun through the sky throughout the year. This path also represents the general plane of the solar system, and it is because of this that the Moon and the planets can be found on or very near this line in the sky. That is a handy fact, as it greatly limits the possible areas for planets to appear, therefore making them more easily found.

To turn the ecliptic line on in *TheSkyX*, click the ***Ecliptic*** checkbox in the Chart Elements window. Likewise the ecliptic can be turned off by clicking the ***Ecliptic*** checkbox again. The ecliptic, like most chart elements, is customizable by double-clicking on ***Ecliptic*** in the chart elements window, or by right-clicking on the ecliptic in the Sky Chart.

Equatorial Grid

An equatorial grid can be plotted onto the Sky Chart by turning on the ***Equatorial Grid*** checkbox. This spherical grid is based upon Earth's equator projected into space, or the celestial equator. The grid also displays coordinates of right ascension and declination overlaid onto the Sky Chart.

The grid's attributes are fully customizable (see "Customizing Chart Elements" on page 136).

Horizon Grid

A grid that is based on the local theoretical horizon can be shown by turning on ***Horizon Grid*** checkbox. This grid displays coordinates of azimuth and altitude overlaid onto the Sky Chart.

The grid's attributes are fully customizable (see "Customizing Chart Elements" on page 136).

Horizon

Turning on the ***Horizon*** checkbox displays a line that represents the *local horizon*. The default local horizon is drawn as a featureless line at 0° altitude. You can redefine the line so it represents the horizon at your viewing site (see "Horizon and Atmosphere" on page 151). Adding natural objects and obstructions to the horizon gives a better idea of what is and isn't visible, and the approximate times at which objects rise or set.

Horizon and Atmosphere Options

To best approximate your observing site, *TheSkyX* allows you to show custom horizons and simulate atmospheric conditions including showing clouds, the Sun and Moon's glow and displaying simulated meteor showers.

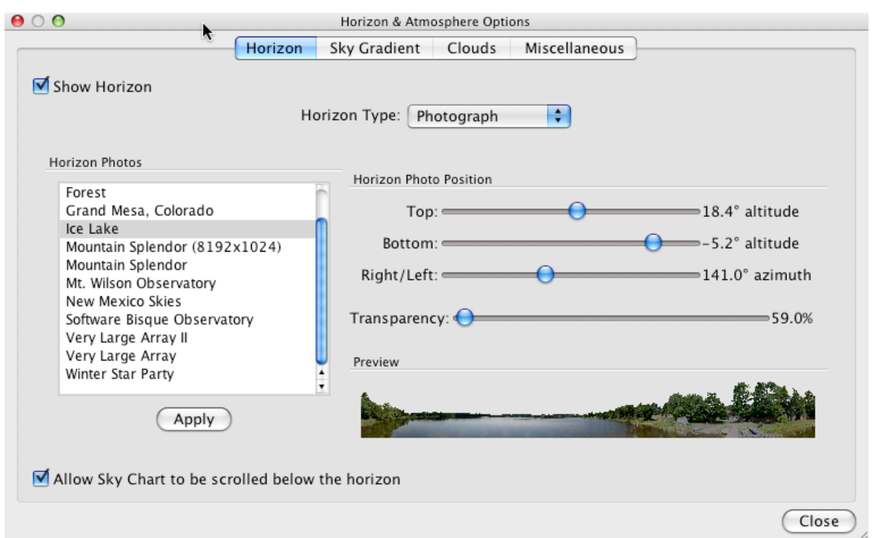


Figure 71: The Horizon and Atmosphere Options dialog.

Horizon and Atmosphere Options

Under this section, you can choose to display the horizon as a panoramic photograph or custom drawn region, as well as show clouds, meteor radiants and other options.

In the ***Horizon & Atmosphere Options*** window, you will notice four tabs at the top: ***Horizon, Sky Gradient, Clouds,*** and ***Miscellaneous***.

Under the ***Horizon*** tab, you can toggle the horizon and change it to one of several available virtual observing spots by choosing from the list at the left.

Using the sliders on the right, under ***Horizon Photo Position***, you can fine-tune the positioning and dimensions of the horizon image to best simulate your actual observing location.

You can also adjust the transparency of the horizon image using the slider.

If you would like to be able to scroll the sky chart below the horizon, click the ***Allow Sky Chart to be scrolled below the local horizon*** checkbox.

Custom Horizon

Near the center of the ***Horizon & Atmosphere*** window is a drop-down menu labeled ***Horizon Type***. This is set to ***Photograph*** by default, but by changing it to ***Custom Drawn***, you can use the mouse to draw out a horizon outline based upon the measurements of your observing location. Simply click and drag in the blue shaded region along the correct coordinates to draw out a custom horizon mask.

Turning on the ***Show Refracted Horizon*** checkbox will draw a line on the refracted sky that corresponds to the observer's horizontal. Near the horizon, the atmosphere refracts (bends) the light so much that objects below the "physical" horizon are visible.

Clicking ***From Photo Horizon*** generates a horizon mask based upon the photo selected when the ***Photograph Horizon Type*** is selected. Once you are satisfied with your custom drawn horizon mask, click ***Apply***.

Creating Your Own Panoramic Horizon

If you own a digital camera and popular image processing software, you can create your own horizon panorama by stitching together a sequence of photos that spans 360 degrees.

Collecting the Photos

If you wish to create a panoramic horizon, the following hardware and software is *recommended*:

- A digital camera
- A tripod

- Panorama or "stitching" software that supports the PNG file format (PhotoShop Elements™, PhotoShop CS4™ or The Panorama Factory™, for example).
- Image processing software to make the "sky" portion of the photo transparent (PhotoShop Elements™ or PhotoShop CS4™, for example).

Photo Taking Tips

- Early morning, late evening, or an overcast day works best for even light distribution.
- Use the widest field settings for your camera or telephoto lens. Don't zoom or magnify the photo.
- If you use a tripod, make sure it is level so that the "ends" of the panorama match. Modern stitching software can account for errors here.
- For best results, expert photographers recommend using up to a *fifty to eighty percent overlap* for adjacent photos.

Figure 72: Panorama before transparency is added.

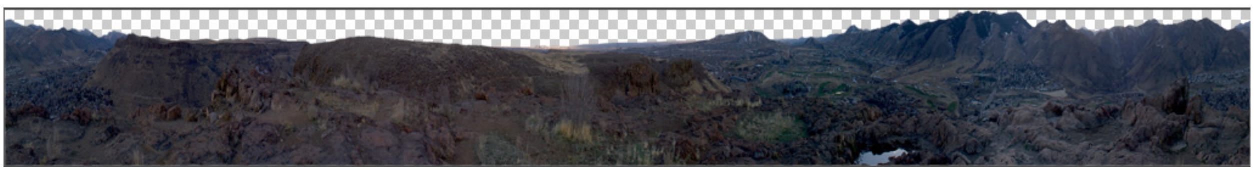


Figure 73: Panorama after transparency is added.

Tips for Creating Panorama Photos

- Use your favorite stitching software to combine the individual images. Search the web for a list of software that can perform this operation. The Panorama Factory software works well.
- After stitching the adjacent photos together, the panorama must have an transparent region that identifies the "sky". Use your favorite image processing software to create an "alpha channel" or "transparency" layer to define a mask of the transparent regions, and then save this as a PNG photo. Your image processing software should have detailed information about how to accomplish this.
- For best performance, the width and the height of the panorama should be multiples of 512 pixels. The supplied panoramic photos are 4096 x 512 pixels or 8192 x 512 pixels, for example.
- Larger images consume more computer *and* video RAM. Generally, the smaller the panorama, the better.
- Consider opening one of the horizon photos that come with *TheSkyX* in your image processing software to use a "template" for creating your own panorama. In Windows, they're located in the Program Files\Software Bisque\Resources

There are many web sites dedicated to creating photographic panoramas. Search the web for “panorama” and “panorama tools” or “image stitching”.

When you have the final panorama, save it to the *Horizon Photos* folder.

Mac

Custom horizon photos on the Mac should be saved in the appropriate *Application Support* folder:

<Home Folder>/Library/Application Support/Software Bisque/TheSkyX <Edition Name>/Horizons

Windows

Custom horizon photos on Windows should be saved in the appropriate *My Documents* folder:

<My Documents>\Software Bisque\TheSkyX <Edition Name>\Horizons

The ***Horizon Photos*** list on the ***Horizon*** tab of the ***Horizon & Atmosphere Options*** dialog will now show your photo. Select its name, then click the ***Apply*** button to update the Sky Chart. You’ll need to fiddle with the ***Horizon Photo Position*** settings to get things “just right” for your panorama.

Sky Gradient

TheSkyX even lets you adjust the color of the sky. While this is best used to match sky conditions at your real-life observing location, you can always use it for fun, too. Click the ***Sky Gradient*** tab to see how.

Hint: Sky Gradients only apply when the Show Daylight command is checked on the Display menu.

On the left, you will see a list of different sky color gradients corresponding to different times of day and sky conditions.

On the right, you will see the controls for editing the sky color gradient. Under ***Edit Sky Gradient***, you will see the name of the selected sky gradient, the selected cloud tint (if any), a color preview of the selected sky gradient, as well as various buttons used to adjust the sky gradient.

Let’s make a change to the default daytime sky gradient to represent a paler day.

1. Click the ***Show Daylight*** command from the ***Display*** menu to turn on daylight simulation.
2. Click the ***Horizon & Atmosphere Options*** command on the ***Display*** menu.
3. After the new window opens, click on the ***Sky Gradient*** tab.
4. In the drop-down menu, ***Sky Gradient Type***, choose ***Selected Sky Gradient***.

5. Select a sky gradient form the list to edit, this time let's choose ***Daytime***. This gradient simulates the color of the sky during sunlight hours. If you would like, you may change the ***Description*** by editing the text in the field to the right.
6. Now, on the right you will see the daytime sky color gradient in a sample box. On the far right, you will also see little gray triangles that correspond to start points for the gradient colors. Double-click the top-most triangle.
7. The color wheel opens, allowing you to select a new color. Choose any color you like from the wheel and click ***OK***. Do this for the remaining triangles until you are satisfied with the sky color gradient in the sample box. If you would like to remove a gradient point, click ***Remove Point***. You can also click ***Paste Photo*** to import a sky photograph.
8. Once you have the sky gradient set to your liking, you can fine-tune it with the ***Darker/Lighter*** slider, located below the sample box.
9. To save your new gradient, click ***Save Gradients***. This action will save all changes made to gradients during the current session. To return to default settings, you can always click ***Defaults***, even after saving changes.
10. Once you have saved and selected your new sky color gradient, it appears in the Sky Chart.

Clouds

Select the Clouds tab in the Horizon & Atmosphere dialog to bring up options for cloud images, position, and transparency. Handily, these options will update live in the Sky Chart as you choose them.

Cloud images

On the top left, notice the checkbox marked Show Clouds. Selecting this option will turn the clouds on or off completely.

Choose a cloud image from those listed in the box to the left labeled Cloud Photo Name. Click the Apply button or double-click on the cloud photo you want to use to apply it to the Sky Chart. You can also see a preview of your cloud choice to the right of the dialog box.

Cloud Transparency

Maybe you have hazy, thin clouds at your observing site and you would like TheSkyX to model similar clouds in the Sky Chart. Simply click and drag the Transparency slider to achieve the level of transparency you desire. The exact transparency percentage appears to the right of the slider.

Cloud Photo Position

You have complete control over the position and orientation of cloud images in TheSkyX. Choose a top and bottom limit for your cloud image by using the sliders to the right. You can also spin the cloud image around your point of view by using the Right/Left slider.

Note that your selections for each slider are marked in degrees or either altitude (***Top/Bottom***) or azimuth (***Right/Left***).

Miscellaneous

Options for the Sun's halo, the Moon's halo, and meteors appear under the Miscellaneous Tab in the Horizon & Atmosphere dialog.

Sun's Halo

Check this box to show the Sun's halo in the Sky Chart. You can also stipulate an angular size (in degrees) for the solar halo. The default size is 10.00°.

Moon's Halo

This box controls the lunar halo. Check it to have the moon's halo appear in the Sky Chart. The default size is 50.00°, but you can change it to whatever you wish (0.00°-99.99°).

Meteors

Several options exist for displaying sporadic meteors and meteor showers.

Checking the Show Meteor Shower Radiants checkbox will show the radiant points for upcoming meteor showers in the Sky Chart. You can select how far into the future you want TheSkyX to look in plotting upcoming meteor shower radiants by entering a value in the Show only those during the next: field. The default value is one week (7 days), but you can change it to whatever you wish. This feature is particularly useful when planning to observe a meteor shower.

You can also choose to show random, or sporadic, meteors in the Sky Chart by selecting the Show meteors (randomly) checkbox, and then choosing an hourly rate. These sporadic meteors will not be based on actual forecasts, but are a great way to add extra realism to the Sky Chart. In the real sky, you can expect to see anywhere from five to 15 sporadic meteors per hour.

Milky Way Options

The Milky Way may be toggled by clicking the ***Milky Way*** checkbox in the Chart Elements window. There are a number of options for Milky Way display available by clicking the ***Milky Way Options*** button.

Once you have clicked the ***Milky Way Options*** button, the corresponding window will open. With the central drop-down menu, you may choose either ***Photograph*** or ***Isophotes*** as your Milky Way type. Choosing ***Photograph*** will display a photo-realistic depiction of the Milky Way in the Sky Chart. Alternately, choosing ***Isophotes*** will give you a view reflecting areas of equal brightness.

Celestial North Arrow

If you would like to have a handy guide orienting you to true north, as a compass does, turn on the ***Celestial North Arrow*** checkbox in the Chart Elements window. A red indicator will appear in the upper left-hand corner of the Sky Chart, pointing North and East to help you stay oriented.

Reference Objects

There are a number of markers for various reference objects available in *TheSkyX*. Many are self-explanatory, but here is a short description of those with a more technical aspect. Remember that each chart element is editable by double-clicking on its name in the list.

Area of Interest, Arrow, Chart Scale

See the "My Chart Elements" on page 169 for an explanation of these object types.

Dome Slit

The graphic that is displayed when TheSkyX is coupled to, and positioning an astronomical dome.

Meteor Shower Radiants

This marks the radiant point (or point of apparent origin) of a meteor shower.

Mosaic Grid

This is the grid produced when setting up to take a photo mosaic of a region in the sky. This grid represents each component frame of the mosaic.

Reference Line

A user-drawn line of reference.

Reference Point

A user-generated reference point.

Telescope Limit

This is a reference line that marks the slewing limit of the telescope currently set up in *TheSkyX*.

Target Object

This object marks the set target of your telescope or the object otherwise currently selected in the Sky Chart.

Telrad

If you have a telescope setup entered into *TheSkyX*, the field of view of your Telrad™ viewfinder will appear on the Sky Chart with this option turned on.

Telescope Cross Hairs

With a telescope set up, these crosshairs show where it points in the Sky Chart.

Pointing Sample

A position on the celestial sphere that has been used by TPoint to calibrate the telescope and improve the telescope's pointing.

Tour Title

When viewing a tour, this object toggles the title of the tour on or off in the Sky Chart.

Zoom Box

This option is a place holder so that the zoom box attributes can be edited (see "Editing Chart Element Attributes" on page 136). To show or hide a zoom box, press and hold down the SHIFT key while dragging the mouse (see "Zoom Box" on page 25).

Managing Databases

TheSkyX includes a host of standard astronomical databases (see "Appendix A: Databases and Cross References"). *TheSkyX* can also be used to create custom databases from text-based data (see "Custom Databases"). The Database Manager on the Input menu provides a means to turn on and off these databases, depending on your needs.

Using the Database Manager

To access the database manager, choose the ***Database Manager*** command from the ***Input*** menu. In the window that opens, you will see an expandable tree list of databases to the left, and a large field to the right with tabs for ***General*** information, database ***Items***, ***Advanced*** options, and ***Replaced Objects***.

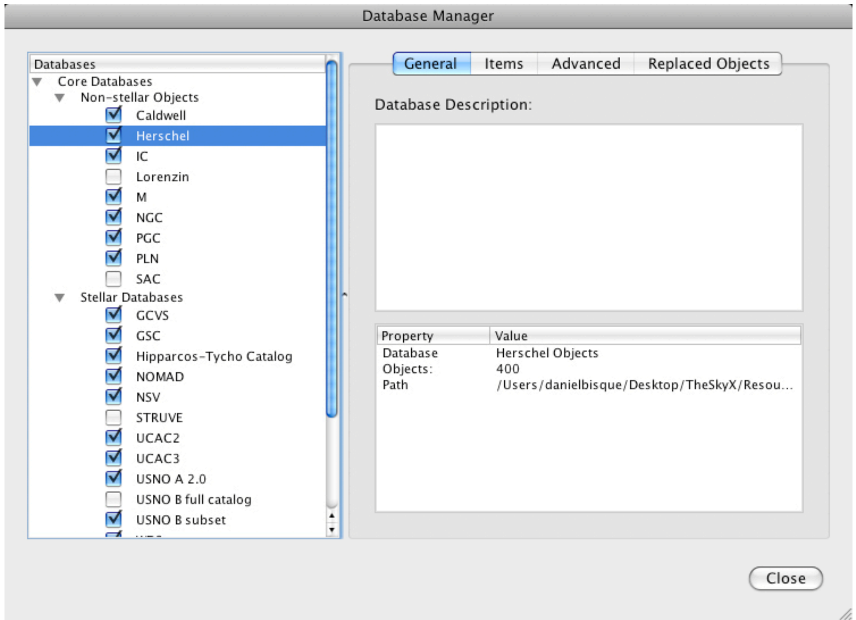


Figure 74: The Database Manager window.

To make a database viewable, turn on the checkbox next to its name in the list.

General Tab

Selecting this tab will let you view the general information about the selected database. Information such as the text file, object types contained within the database, and the file path is found here.

Items Tab

Clicking here will show you a list of the objects contained within the selected database. Clicking the ***Center Item*** button will center the highlighted object in the Sky Chart. Alternately, you can automatically center a selected item by checking the ***Auto center highlighted item*** box.

Advanced Tab

Here, you can remove, then ***Reload*** all the Sky Databases (SDBs). You can also convert your *TheSky6* SDBs to TheSkyX-compatible SDBX format.

1. Copy your *TheSky6* Sky Database (.sdb) and text (.txt) files into *TheSkyX's* ***SDBs*** folder (see "Application Support Files" on page 19 for details).
2. Click the ***Convert*** button, select the folder that holds your existing SDBs and associated text data (only).
3. Click the ***Open*** button to begin the conversion process.

The converted databases will appear on the ***Database Manager*** window's list of ***Databases*** under ***My Sky Databases***.

Replaced Objects

To view replaced objects, click this tab. Clicking ***Refresh*** will update the list.

Optional Star Databases

TheSkyX can show stars from the native NOMAD (*80 GB*) and UCAC 3.0 (*8 GB*) star catalogs. As you can see, these star catalogs are unusually large, so you'll not want

Mac

By default, *TheSkyX* looks to the following folder for the native NOMAD star catalog on the Mac:

<Application Bundle>/Resources/Professional/Core Databases/NOMAD

If the appropriate files are copied to this folder, then turning on the NOMAD checkbox will show stars from this catalog at fields of view of 1 degree and smaller.

The default location for the native UCAC 3 star catalog on the Mac is:

<Application Bundle>/Resources/Professional/Core Databases/UCAC3

Where <Application Bundle> is the Mac "application bundle" folder that holds all *TheSkyX*-related files.

If the appropriate files are copied to this folder, then turning on the UCAC3 checkbox will show stars from this catalog at fields of view of 1 degree and smaller.

Windows

By default, *TheSkyX* looks to the following folder for the native NOMAD star catalog:

<Application Bundle>/Resources/Professional/Core Databases/NOMAD

If the appropriate files are located here, then turning on the NOMAD checkbox will show stars from this catalog at fields of view of 1 degree and smaller.

The default location for the native UCAC 3 star catalog is:

<Application Bundle>/Resources/Professional/Core Databases/UCAC3

If the appropriate files are located here, then turning on the UCAC3 checkbox will show stars from this catalog at fields of view of 1 degree and smaller.

Custom Databases

Creating your own database of celestial objects can be a useful thing to do if you choose to carefully document your observations. *TheSkyX* lets you do this with a great amount of freedom. Let's take an overview look at the ***Create Sky Database*** command.

Creating a Sky Database

To see the ***Create Sky Database*** window, select ***Input > Create Sky Database***. A tabbed window then opens, with sections each for defining fields, behaviors, advanced operations, and compilation operation.

Define Fields Tab

From the ***Define Fields*** tab, you can select values for a number of items. If you wish to open a file containing field data, simply click ***Choose Source Text File***. If you would like to open it in Unicode, be sure to select the ***Open text file in Unicode*** checkbox.

To enter value ranges for field items, highlight a field in the window to the left. You will see its current column start and end points, if any. To enter values, you may either enter them in the ***Starting column*** and ***Ending column*** fields below, or you can click on the starting point on the graph and drag to the desired ending point. When dragging, the selected values appear to the right of the ***Set Columns*** button. You can always change the values by clicking and dragging again. Once you have entered the desired values, click the ***Set Columns*** button. The column will then be set on the graph, and a label featuring its description appears in blue.

Clicking ***Clear All*** will clear any and all data from the graph.

Behavior Tab

This tab includes options that define control the how the database interacts with the Sky Chart.

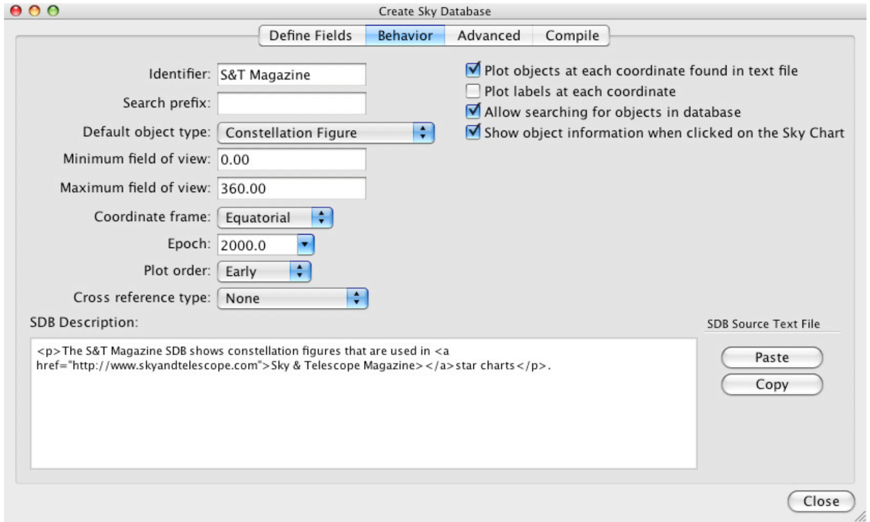


Figure 75: Behavior tab on the Create Sky Database window (Data > Create Sky Database).

Sky Database Identifier (Identifier)

Enter text that uniquely defines the database you are creating.

Search Prefix

Enter the text prefix that can be used to locate objects in the SDB when finding objects (page 35).

Default Object Type

Select the type of object (star, open cluster, etc.) that is in the source text file from this list.

Minimum Field of View

Enter a number for the smallest (most narrow) field of view on the Sky Chart to show the objects in this database.

Maximum Field of View

Enter a number for the largest (widest) field of view on the Sky Chart to show the objects in this database.

Coordinate Frame

Select the coordinate system, equatorial (RA/Dec) or horizon (Azm/Alt) for the objects in the source text file.

Equinox

Enter the equinox of the coordinates in the source text file.

Plot Order

When displaying databases, you may want a specific object to should appear "on top of" other objects. The Plot Order allows you to select when, relative to objects in the core database, this database will be drawn on the sky chart.

- **Early** – Show objects in the Sky Database before stars. Stars will overlay objects in the database.
- **Middle** – Show objects in the Sky Database after stars. Objects in the database will overlay stars.
- **Late** – Show objects in the Sky Database on top of all other objects.

Cross Reference Type

Select how objects in the source text file are cross referenced with objects in the core databases.

- **None** – Objects in the text file do not contain cross references to objects other databases.
- **Database** – Objects in the text file contain cross references to objects in *TheSkyX's* core databases, or other SDBs.
- **Pure** – Objects in the text file reference existing object names or catalog numbers.
- **Common Name** – Objects in the text file reference existing common object names.

SDB Description

Enter a text description for the Sky Database. The ***SDB Description*** text editor accepts text that is formatted with hypertext markup language (HTML) , so that, for example, links to external web sites can be included with the header.

Please note that the ***SDB Description*** text input is a simple *text editor*, not a *web browser*. This means, for example, when HTML is pasted into the ***SDB Description*** text box, a link to an external web page may be formatted as a hyperlink (that is, underlined in blue), but clicking on the underlined text *will not show the external link in a web browser*.

Once the SDB is compiled (see "Compile Tab" on page 164), the web links in the description can be accessed from the Description on General tab of the Sky Database Manager (see "Managing Databases" on page 158).

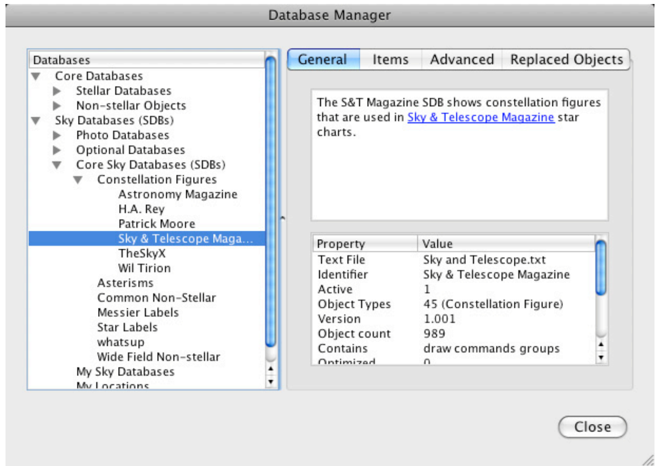


Figure 76: The General tab of the Database Manager window (page 158) showing web accessible hyperlinks in the Sky Database Description field.

Additionally, there are options that control plotting, searching, and how object information is shown in the database and/or Sky Chart.

Advanced Tab

Under ***Advanced***, you will find operators to translate text to object type, multipliers for various measurements and coordinates, folder options, and Unicode control.

To the left is the ***Translate Text to Object Type*** section. Simply type text into the fields, and select the desired object type from the drop-down menu.

Multipliers for right ascension, declination, magnitude, major and minor axes, and position angle may be entered into the fields to the upper right.

Under ***Folder Operations***, you can choose to ***compile*** a new folder from existing text files, or you may choose to ***convert*** a folder of TheSky6 database files for use in *TheSkyX*.

Additionally, you can convert a text file to Unicode and select from a list of codecs to use in the ***To Unicode*** section to the lower right.

Compile Tab

This is where you can finally compile your database, once all the criteria are set. Clicking the ***Compile*** button compiles the database, revealing the corresponding text file in the field with a star chart above. You can add a header by checking the ***Add header to text file*** box.

Once you are finished, click the ***Close*** button.

Defining Search Fields in Sky Databases

Most text-based celestial object databases include catalog numbers or other identifiers to uniquely identify each object.

TheSkyX can use these identifiers to generate a "searchable" Sky Database (SDB) . Objects in these databases can be located by typing the SDB *Search Identifier*, followed by the object's unique identifier in the ***Search For*** text box on the Find window.

Searchable Sky Databases and the objects they contain, are also listed in the Advanced tab of the Find dialog.

The following procedure describes how to configure the Sky Database parameters so that once the SDB is created, the objects in the database can be located using the ***Find*** command on the ***Edit*** menu.

1. Select the ***Create Sky Database*** command from the ***Input*** menu.
2. On the ***Define Fields*** tab, click the ***Choose*** button near the top to the window.
3. Select the file that contains the space separated text-based celestial object database and click ***Open***. The contents of the text file appear on the right side of the ***Define Fields*** tab.
4. Specify the beginning and ending columns that hold the ***RA Hours***, ***RA Minutes***, ***RA Seconds, Dec Sign***, ***Dec Degrees***, ***Dec Minutes*** and ***Magnitude***. These are the minimum required fields for an SDB.

   For example, suppose in columns 66-74 contain right ascension in decimal format. To define ***RA Hours***, select this text on the left side of the window, then enter 66 in the ***Starting Column*** text input and 74 in the ***Ending Column*** text input and then click the ***Set Columns*** button. The text file shows RA Hours in blue above these columns. (You can also drag the mouse to highlight the desired columns in the text file on the right.)

   Repeat this process for each required field.

5. On the ***Behavior*** tab, click
6. Turn on the ***Allow Searching for Objects in Database*** checkbox on the ***Behavior*** tab of the ***Create Sky Database*** window.

Search Prefix

Some astronomical databases do not require a prefix to search for objects that are present in a database. For example, if the database contains common names of objects like "Polaris" or "Andromeda Galaxy", a catalog prefix is not required.

Other catalogs identify each item by a single, unique number. For example, the NGC catalog has 7,840 items and they are numbered from 1 to 7,840. For this catalog, a *prefix* and *a number* are required to uniquely identify and locate each object in the catalog (for example, NGC 555).

In the example below, the ARP catalog of galaxies requires a Search Prefix because the search field contains only numbers from 1 to 338. Entering just the number "338" would not provide enough information to uniquely identify ARP 338.

Search Prefix Hints

- For convenience when searching, limit prefixes to about 3-5 characters.
- Do not use existing prefixes such as NGC, IC, PGC or SAO.
- If a Search Prefix is defined in an SDB, then the prefix is *required* when searching for objects in that SDB. For example, if the Search Prefix is defined as ***ARP-PG*** then the only way to locate objects in the Arp Peculiar Galaxies SDB is to enter ***ARP-PG 338***.

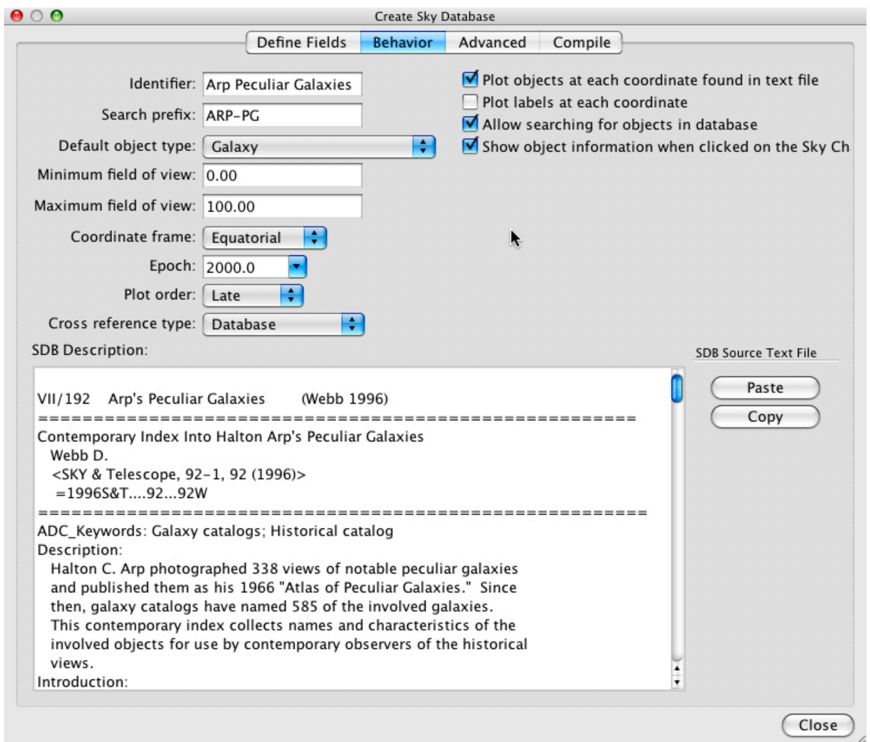


Figure 77: The Behavior tab on the Sky Database window (Sky Database command from the Input menu).

Just like other fields on the Define Fields dialog, the ***Label/Search*** field is specified by dragging over the columns (in this example, columns 1 through 3) then clicking the ***Set columns*** button. Alternatively, you can drag the columns then double-click on the ***Label/Search*** field.

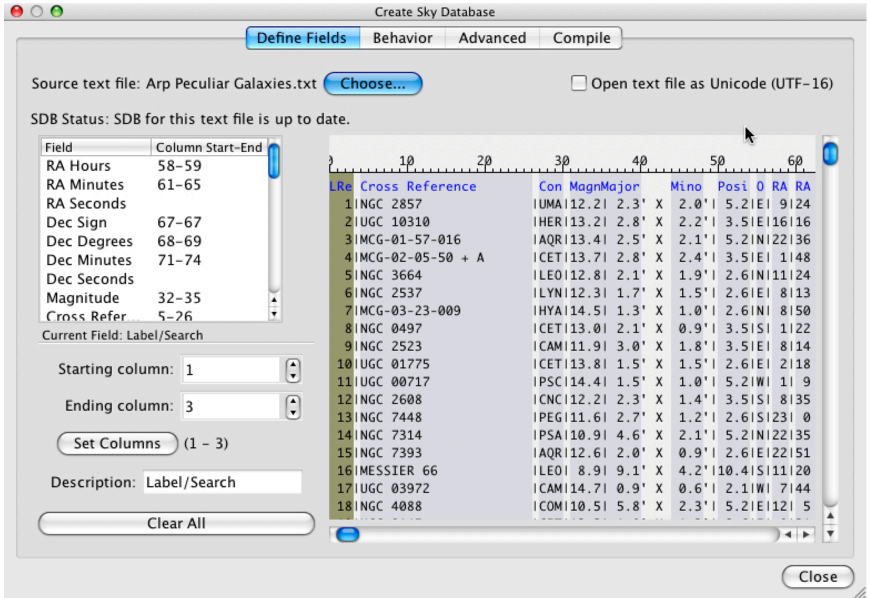


Figure 78: The Define Fields tab on the Sky Database window (Sky Database command from the Input menu).

In the ***Advanced*** tab of the ***Find*** dialog, when the database is expanded the Search Prefix will be added to the search field.

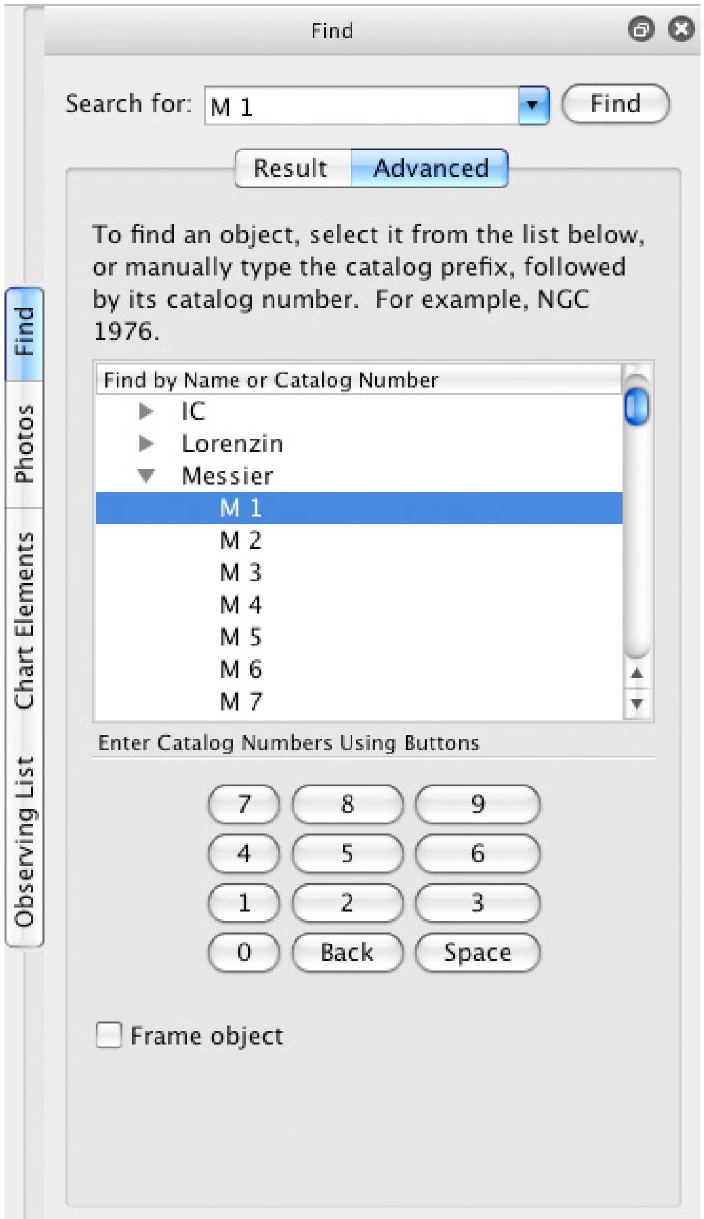


Figure 79: The Advanced tab on the Find dialog (choose the *Find* command on the *Edit* menu).

My Chart Elements

TheSkyX allows you to add your own chart elements to the Sky Chart. In so doing, *TheSkyX* gives you the best of convenience from both electronic and paper star charts.

Adding Chart Elements

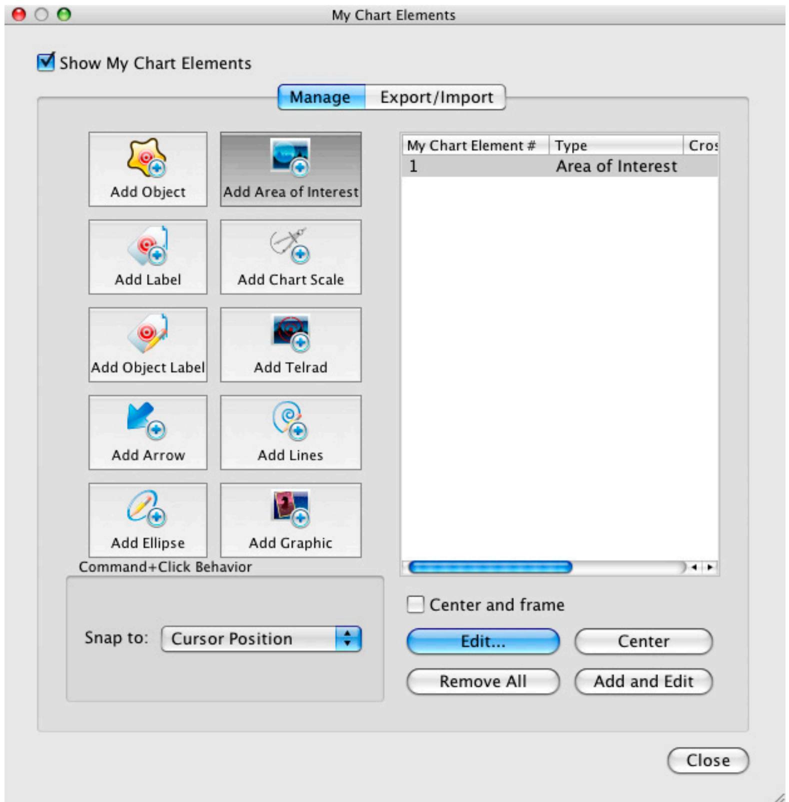


Figure 80: The *My Chart Elements* window (Input menu).

The easiest method to add a chart element to the Sky Chart:

1. Select the ***My Chart Elements*** command from the ***Input*** menu. The ***My Chart Elements*** window opens. At the top left is a checkbox, ***Show My Chart Elements***. Once you have added your own elements, turning this option on will reveal them on the Sky Chart. Notice that there are two tabs in this window, ***Manage*** and ***Import/Export***.
2. On the ***Manage*** tab, select which element to add by clicking one of the buttons on the left side of the window:
   - Add Object – Adds an object to the Sky Chart. The object can be of any type (star, cluster, galaxy, etc.) or one of your own object types (My Object Type).

- Add Label – Adds a text label to the Sky Chart. The ***Enter Label*** window will appear so that you can specify the label's text.
- ***Add Object Label*** – Adds a custom label to an existing object.
- ***Add Arrow*** – Add a reference arrow to the Sky Chart to highlight a particular object or region.
- ***Add Ellipse*** – Adds an ellipse to the Sky Chart.
- ***Add Area of Interest*** – Adds a shaded rectangular region to the Sky Chart for emphasis.
- ***Add Chart Scale*** – Adds a small graphic that shows the angular scale for the chart.
- ***Add Telrad*** – Adds a Telrad™ Finder to the Sky Chart.
- ***Add Graphic*** – Adds a photograph or Scalable Vector Graphic to the Sky Chart.

3. Position the mouse cursor over the Sky Chart, then CTRL+left-click (Windows) or ⌘+left-click (Mac) to add the Chart Element at that position.

Or, click the ***Add and Edit*** button on the My Chart Elements window. This opens a new window where you can input the necessary information about the element.

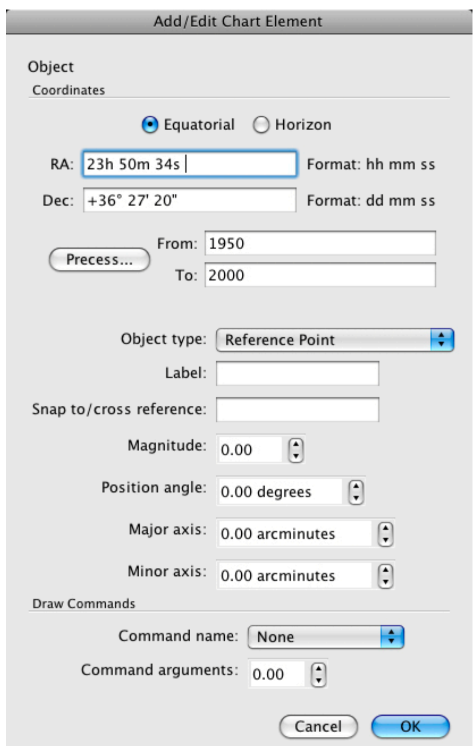


Figure 81: Add/Edit Chart Element window.

Near the top of the ***Add/Edit Chart Element*** window, you will see the coordinates section. You can choose between ***Equatorial*** or ***Horizon*** (azimuth-altitude) coordinates.

Also, you can choose to precess the coordinates you put in from one equinox to the current one to update old data. To do this, simply input equinox dates in the fields ***To*** and ***From***, and then click ***Precess***. The new coordinates will then appear in the coordinate fields above.

Note: This function works forward or backward. If you would like to precess current coordinates to a past time, you can do that, as well.

Once you have your coordinates entered, it is time to choose the object type. Using the pop-up menu, choose the object type for your new chart element. Remember that each of these objects is able to be toggled from various places in the Chart Elements window.

You can then enter ***Label*** text, and a ***Snap to/cross reference*** point in the appropriate fields.

The next four fields control the actual appearance of your object in the Sky Chart. ***Magnitude***, just like the magnitude of a star, controls the apparent brightness of the object in the Sky Chart (remember that the bigger the number, the dimmer the object). ***Position Angle*** controls the angular offset in degrees of your new object and the reference object, relative to the north celestial pole. Imagining your object as an ellipse, input the major and minor axis measurements in arc minutes. Remember that circles are special types of ellipses whose major and minor axes are equal.

Near the bottom of the window are the DRAW commands. You can choose the type of draw command you wish to use from the drop-down menu. You can then enter a command argument into the field below, or use the arrows to choose an appropriate argument value.

Once you click ***OK***, you will be brought back to the ***My Chart Elements*** window, and your new custom chart element appears in the object list to the right.

You can always edit the element data by clicking ***Edit***.

To center the object in the Sky Chart, click ***Center***.

Clicking ***Remove All*** will remove all My Chart Elements.

To change the CTRL+left click (Windows) or ⌘+left-click (Mac) behavior, use the drop-down menu to the lower left. You can choose to snap to the ***Cursor Position***, ***Nearest Star***, or the ***Nearest Non-stellar Object***.

When you are finished managing My Chart Elements, click ***Close***.

Export/Import My Chart Elements

Choose the ***Export/Import*** tab at the top of the ***My Chart Elements*** window. Here, you will be able to export your created chart elements, or you can import other chart elements from a text file.

Exporting Chart Elements

Follow these easy steps to export your chart elements in Sky Database (SDB) format.

1. To export a chart element, choose ***Export/Import*** tab at the top of the My Chart Elements window. The top portion of the window now shows export options.
2. Choose an appropriate identifier and enter it into the first field.
3. Then, from the ***Default Object Type*** drop-down menu, choose the desired object type. You can choose from any of the object types used in *TheSkyX*.
4. Choose the desired maximum and minimum values for the FOV (Field of View).
5. ***Coordinate Frame*** lets you choose between equatorial or horizon (alt.-azimuth) coordinate systems.
6. Choose the appropriate ***equinox***, ***plot order***, and ***cross reference type***.
7. Before exporting, be sure to take note of the checkboxes to the top right of the ***export*** section. These boxes let you toggle options for plotting objects and their labels, make these objects searchable, and to enable click identify for them.
8. Once you are ready, click the ***Export to File...*** button to export your data to a Sky Database file. Simply choose the file's destination, and click ***Save***.

Note: You can also save these data to the clipboard for later pasting.

Importing My Chart Elements

You can import any chart element(s) from a text file by using the bottom portion of the ***My Chart Elements*** window, ***Export/Import*** tab. Simply click the ***From File*** button to import an existing file. If you have chart element data copied to the clipboard, you can paste those data into *TheSkyX* by clicking the button labeled ***From Clipboard***. Additionally, you can change the working directory by clicking the ***Choose*** button.

Observing Lists

The ***Manage Observing List*** command in the ***Tools*** menu can be used to perform advanced searches or database queries to generate observing lists. The ***Advanced Query*** tab offers much more detail regarding your query of celestial objects than the simplified options on the ***What's Up Setup*** tab.

The normal procedure for creating an observing list is to define the type of objects you're after, and specify the astronomical databases to search (in the ***Object Types & Databases*** tab). Next, you can create custom filters based the *attributes* of the object types in the ***Filters*** tab. The ***Constellations*** tab allows you to refine the location further.

Once you've defined the parameters for your query, clicking the ***Run Advanced Query*** button generates an observing list on the ***Observing List*** window (***Display*** menu).

Advanced Query Setup

Defining an advanced query is as simple as turning on the ***Advanced Query*** tab to the left of the ***What's Up Setup*** tab. You will notice that the query setup area changes to a multi-tabbed window that lets you ***Open/Save Query***, choose ***Object Types & Databases***, set ***Filters***, and select ***Constellations*** and ***Other*** criteria for your query. The following is a brief discussion of each tab and the information contained there.

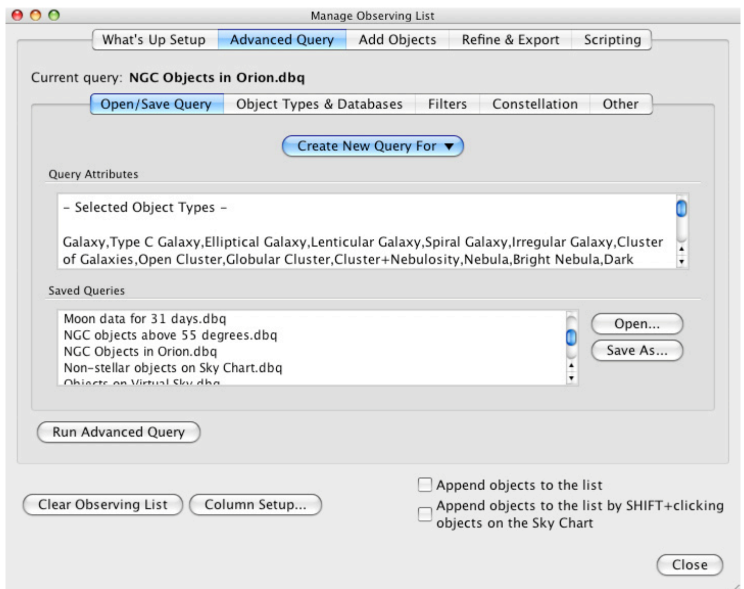


Figure 82: Advanced Query tab on the Manage Observing List window (Tools > Manage Observing List command).

Open/Save Query Tab

Here, you will see advanced (or ***Saved***) queries available to you. You can open queries by double-clicking on the query name in the ***Saved Queries*** list (the ***Current Query*** shows the name of the currently loaded query settings file), save current query settings by clicking the ***Save As*** button, or create new ones by clicking one of the options in the ***Create New Query For*** pop-up menu.

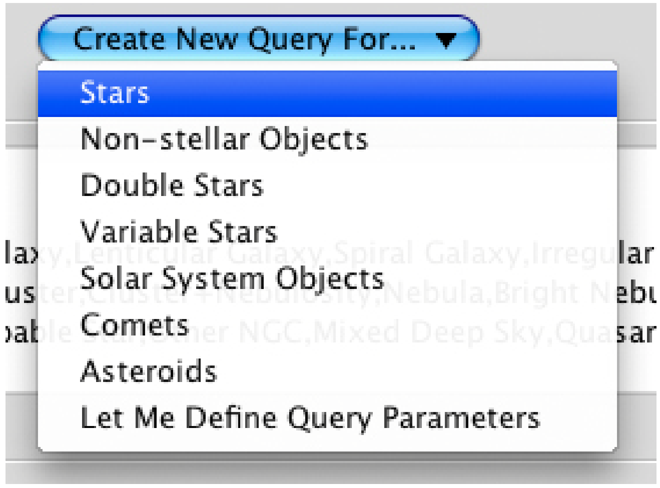


Figure 83: Create New Query For pop-up menu.

To Create a New Query

1. Click the Create New Query pop-up menu.
2. Select from one of the pre-defined queries to setup a query for that object type. Or click the ***Let Me Define Query Parameters*** command to clear any existing query settings and start from scratch.

The ***Query Attributes*** list shows the selected object types and databases and the various filters used in the selected query.

Object Types & Databases Tab

Here is where you select which types of objects you wish to include in your query, along with from which databases you would like to search.

It's best not to mix object types in your query. For example, it's not a good idea to create a single query for asteroids *and* spiral galaxies. These object types are distinct and need separate queries.

Filters Tab

Under this tab, you can select from a thoroughly customizable list of filter options to narrow your query parameters. All current filters can be edited or removed at any time by using the corresponding buttons found in the ***Current Filters*** section.

Constellations Tab

This tab allows you to specify a specific constellation, or group of constellations, to search.

Other Tab

This tab includes options that allow you to name your query, choose among search criteria related to the Sky Chart, set queries to run automatically at given times, and to determine imaging availability of objects sorted by the query.

Observing List Example

Let's go through the steps involved in running an advanced query. Suppose you want to create an observing list that contains all the *double stars* from the *Washington Catalog of Double Stars* that have a *spectral type* of G5 in *Orion*.

TheSkyX makes generating an observing list from this complex query relative simple.

1. Select the ***Manage Observing List*** command in the ***Tools*** menu.
2. Click the ***Advanced Query*** tab.
3. On the ***Advanced Query*** tab, click the ***Create New Query For*** pop-up menu.
4. Select the ***Double Stars*** command. Double stars from the WDS (Washington Catalog of Double Stars) database are automatically selected for you in the ***Object Types & Databases*** tab.
5. Click the ***Filters*** tab to define a filter that limits our search to just the G5 double stars. In the ***Attributes*** list, expand ***Double Stars***, then select ***Spectral Type*** and click the ***Create Attribute Filter*** button.

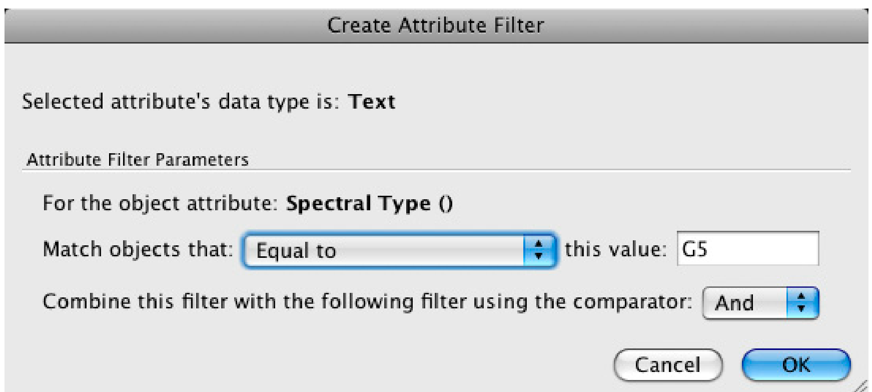


Figure 84: The Create Attribute Filter dialog.

6. On the ***Create Attribute Filter*** dialog, select the ***Equal To*** command from the ***Match Objects That*** pop-up menu.
7. Type the text ***G5*** into the ***This Value*** text input and click ***OK***.
8. On the ***Constellations*** tab, click the ***None*** button, then turn on the check mark next to ***Orion***.
9. On the ***Open/Save Query*** tab, click the ***Save As*** button, and specify the name of this query as ***G5 Double Stars in Orion***. It's always a good idea to save your work.
10. Click the ***Run Advanced Query*** button to run the query and create the observing list on the ***Observing List*** window (***Display*** menu).

The Observing List window now shows forty-three G5 double stars in Orion.

When you highlight any object on Observing List, the green laser pointer will direct you to it in the Sky Chart.

The ***Show on Sky Chart*** pop-up menu affects how the object is shown in the Sky Chart. You can choose among ***Wide-field view***, ***Constellation view***, ***Small-field view***, or ***Do not show*** at all.

Clicking the ***Center*** button centers the object in the Sky Chart's field of view.

Clicking ***Copy Text*** copies the object text to the clipboard.

Print Information lets you print out the data from the list about the object.

If you would like to slew a connected telescope to the object, simply click ***Slew*** to make it so.

Observing List Window

The Observing List window lets you create, edit, and manage objects your observing lists.

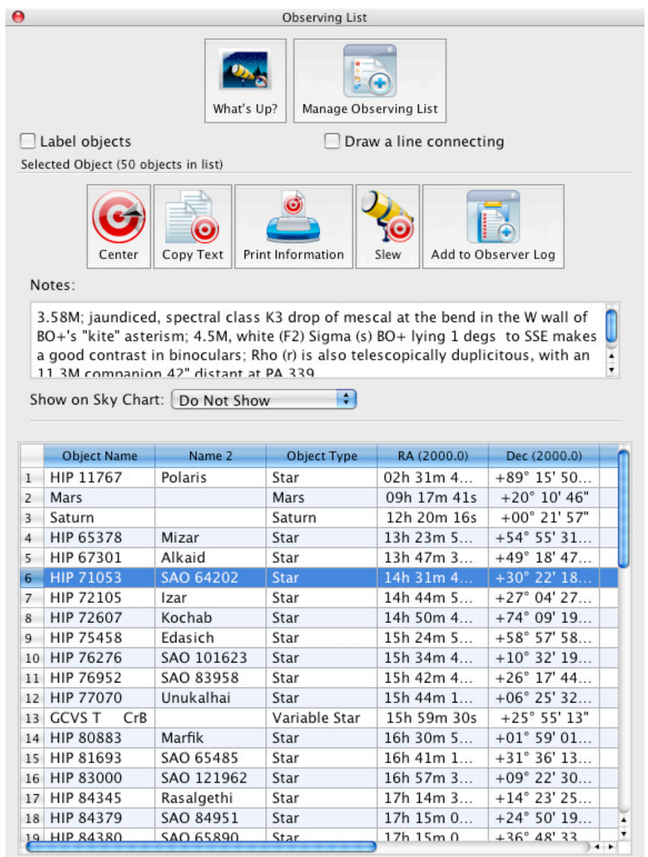


Figure 85: The Observing List window (Observing List command from the Display menu).

Observing lists can be created from *TheSkyX* in several different ways:

- **Manually add items.** For each object in the list, double-click ***<Add>*** on the spreadsheet control, enter the name of the object and the press the Return key (Enter key on Windows).
- **What's Up?** Click the ***What's Up?*** button located on the top left of the window to generate a list of objects (page 60).
- **Manually type or paste a list of object names from the Clipboard**. Click the ***Manage Observing List*** button on the top of the Observing List window, then click the ***Add Objects*** tab. From here, you can type the list of object names, or paste a list of names that have been copied to the Clipboard by clicking the ***Paste Object Names*** button. When the list is complete, click the ***Add Objects to Observing List*** button to update the Observing List spreadsheet.
- **Create an advanced query**. Click the ***Manage Observing List*** button on the top center of the window to define simple or extremely complex database queries that produce exactly the observing list you need. See "*Observing Lists*" on page 172 for details.

Labeling Observing List Objects (Label objects in observing list)

Turn this option on to display a text label next to each object in the observing list.

Draw a Line Between Observing List Objects (Draw a line connecting list objects)

Drawing a line that connects each object in the list helps visualize the path the telescope must take to view each object in the list.

Centering Objects in the List (Center)

Highlight an object in the list, then click the ***Center*** button to center this object in the Sky Chart. The chart's field of view stays the same.

Copying Object Information to the Clipboard (Copy Text)

Highlight an object in the list, then click the ***Copy Text*** button copy the object's information to the Clipboard. This text report can be pasted into any text editor.

Print Information

Click this button to print the ***Object Information Report*** for selected observing list object on the default printer.

Slew the Telescope (Slew)

Slew the telescope to the selected object.

Add Observing Notes (Add to Observer Log)

Use the Observing Log dialog to keep a track of the objects you have observed. You can even rate the object and seeing conditions, as well as add personalized notes.

Select the observed object in the list, then click the Add Observer Log button to show the Edit Observation tab of the Observer Log window.

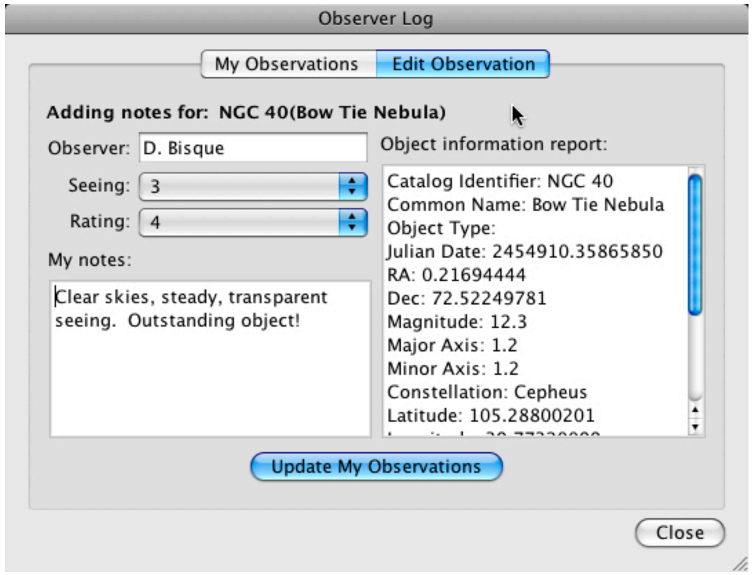


Figure 86: The Edit Observation tab on the Observing Log window (click the Add Observer Log button on the Observing List window to view this window).

Name of the Observer (Observer)

Type your name, or the list of observers' names, here.

Rate the Current Seeing Conditions (Seeing)

Atmospheric turbulence, moisture, light pollution, and many other factors influent local *astronomical seeing* conditions. Seeing conditions are typically rated on a scale from 1-5, the higher the rating, the better the seeing.

Rate the Current Object (Rating)

Similar to rating seeing, the subjective quality or appearance of the object that you're observing can also be rated. Again, a higher the number indicates a better rating.

Enter Personal Comments (My notes)

Critique the observed object by typing your notes here.

Updating the Observations Table (Update My Observations)

Click this button to add notes, ratings, and object information to the My Observations table on the My Observations tab.

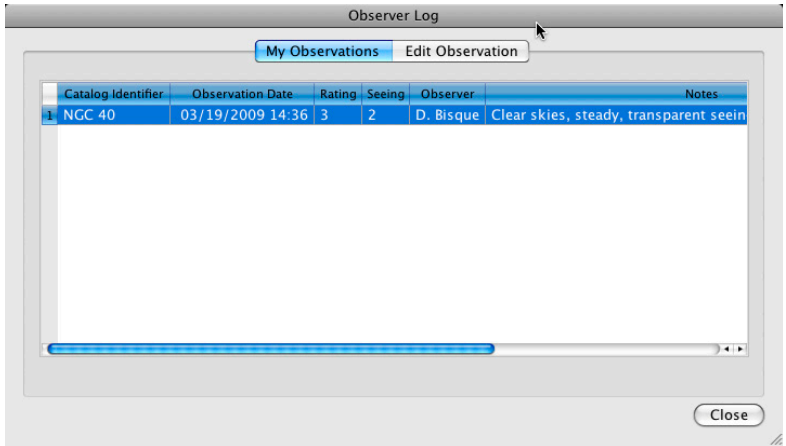
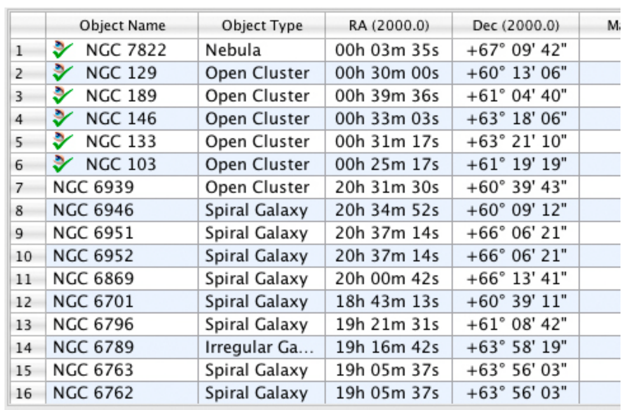


Figure 87: The *My Observations* tab on the *Observer Log* window (click the *Add Observer Log* button on the *Observing List* window to view this window).

The My Observations table shows the list of objects that you have observed. The Observing List table shows an icon next to objects to indicate they have been observed.



	Object Name	Object Type	RA (2000.0)	Dec (2000.0)	M
1	NGC 7822	Nebula	00h 03m 35s	+67° 09' 42"	
2	NGC 129	Open Cluster	00h 30m 00s	+60° 13' 06"	
3	NGC 189	Open Cluster	00h 39m 36s	+61° 04' 40"	
4	NGC 146	Open Cluster	00h 33m 03s	+63° 18' 06"	
5	NGC 133	Open Cluster	00h 31m 17s	+63° 21' 10"	
6	NGC 103	Open Cluster	00h 25m 17s	+61° 19' 19"	
7	NGC 6939	Open Cluster	20h 31m 30s	+60° 39' 43"	
8	NGC 6946	Spiral Galaxy	20h 34m 52s	+60° 09' 12"	
9	NGC 6951	Spiral Galaxy	20h 37m 14s	+66° 06' 21"	
10	NGC 6952	Spiral Galaxy	20h 37m 14s	+66° 06' 21"	
11	NGC 6869	Spiral Galaxy	20h 00m 42s	+66° 13' 41"	
12	NGC 6701	Spiral Galaxy	18h 43m 13s	+60° 39' 11"	
13	NGC 6796	Spiral Galaxy	19h 21m 31s	+61° 08' 42"	
14	NGC 6789	Irregular Ga...	19h 16m 42s	+63° 58' 19"	
15	NGC 6763	Spiral Galaxy	19h 05m 37s	+63° 56' 03"	
16	NGC 6762	Spiral Galaxy	19h 05m 37s	+63° 56' 03"	

Figure 88: Objects that have been observed include a checkmark next to them in the Observing List.

To remove an observation, select it and press the DELETE key.

Manage Observing List Window Orientation

The orientation and position of the controls in the Observing List stacked window changes based on the window's *aspect ratio* (that is, the ratio of the height to the width of the window).

This allows the Observing List window to float in a vertical orientation or be docked to the left or right side of the main window. The window can also float in a horizontal orientation or be docked to the bottom of the main window.

You can choose which orientation works best for your workflow and hardware (screen size, aspect ratio, resolution, number of screens, etc.).

By default, the Observing List window is docked to the left side of *TheSkyX's* main window in the vertical orientation. To undock it, first make sure it's the topmost stacked window by clicking on the ***Observing List*** tab on the left side of the window. (Click the ***Observing List*** command from the ***Display*** menu to turn it on if necessary.)

Once visible, click and drag the topmost portion (the *caption*) of the Observing List window and move it off the stacked windows.

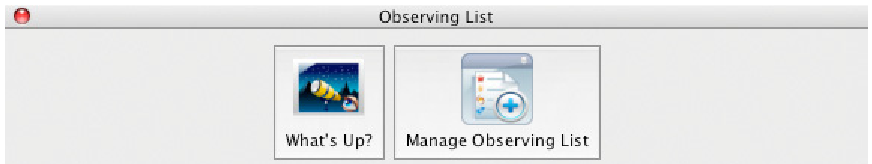


Figure 89: Click and drag the mouse to undock or "tear off" the Observing List window.

The window can now be positioned where you want, even on a second monitor (if you're lucky enough to have two!).

Horizontal Orientation

The controls on the Observing List window automatically switch between the vertical and horizontal orientation as the window is sized.

When the window is taller than it is wide, the controls appear in a vertical orientation. When the window is wider than it is tall *and* the window is wide enough to fit the controls in a horizontal orientation, the controls are automatically repositioned.

To make the Observing List controls appear a horizontal orientation, click the lower right corner of the Observing List window (or the size control in the lower right corner on the Mac) and drag the window wider (while not making it taller). Once the window is wide enough to fit the controls horizontally, they're repositioned automatically.

When the Observing List window is in the horizontal orientation, it can also be "docked" to the bottom of the main window (see Figure 89). To dock it to the bottom of the main window, click and drag the caption to the center of the bottom of the main window. When the top of the caption is near the bottom of the main window, positions of the Sky Chart and stacked windows are adjusted to make room for the Observing List window. At this point, release the mouse to dock the window.

Observing List Orientation Notes

- The Observing List window cannot be docked to the bottom of the window when the Observing List controls are in the vertical orientation.
- The main window will not allow the Observing List window to be docked at the bottom if there's not enough room for it to fit. So, maximize the main window before attempting to dock the horizontal Observing List window.
- The Chart Status Window can be closed or undocked to make room, if necessary.

- If all attempts at "bottom docking" fail, then close all other stacked windows. If the window refuses to be docked it means there is not enough room for it to fit.

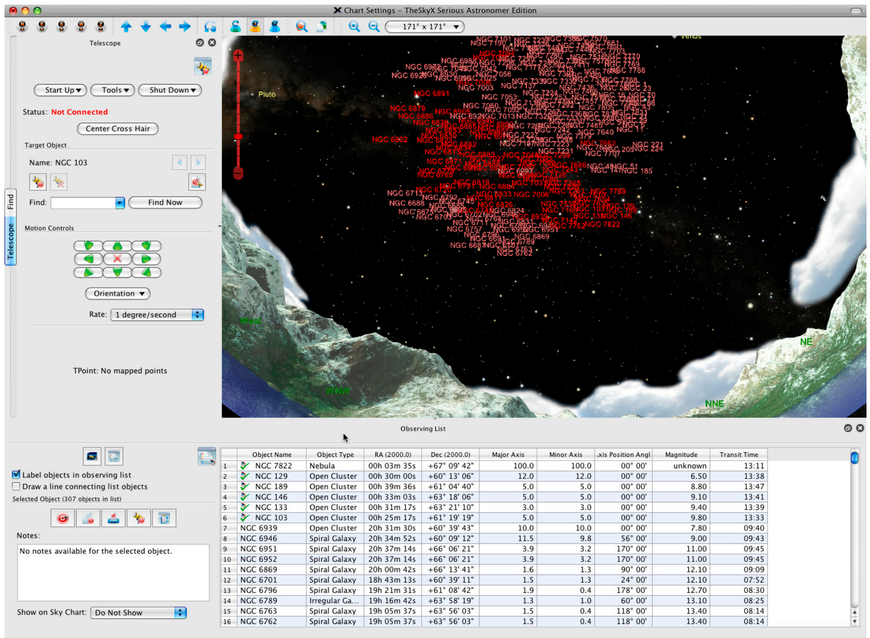


Figure 90: The Observing List controls in a horizontal orientation and docked to the bottom of the main window.

This configuration allows you to access items in the observing list while viewing the Sky Chart and still have access to the controls in the other stacked windows.

Creating Sky Chart Mosaics

PROFESSIONAL

The ***Mosaic Grid*** command on the ***Tools*** menu can be used to divide a rectangular area of the sky into smaller rectangular regions (called *tiles*), each of which has the dimensions of a selected field-of-view indicator (FOVI) or any other custom size. Once the mosaic is created, you can slew the telescope to the center of any rectangle simply by clicking on it.

This provides an easy way to photograph an area of the sky that is larger than a single CCD or film photograph can cover, or to systematically survey sections of the sky (as when searching for comets or asteroids).

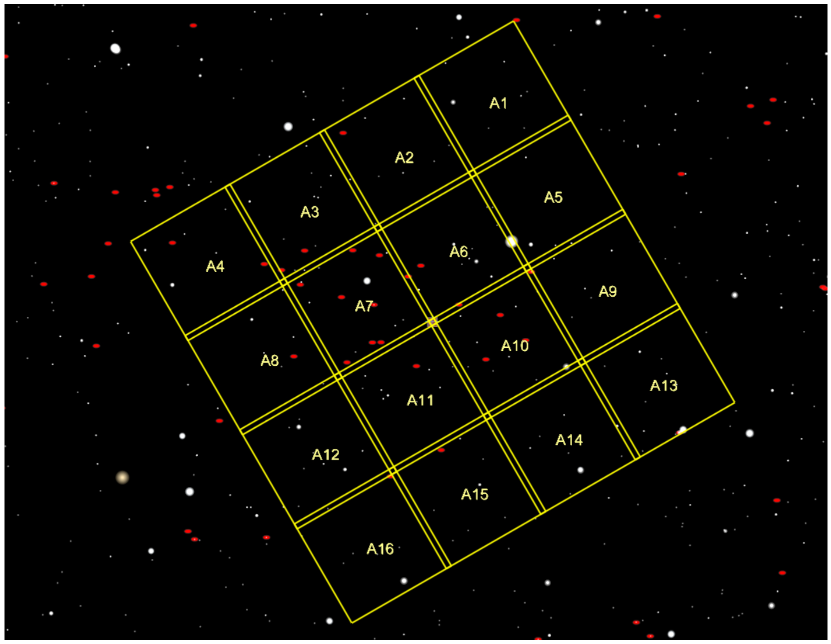


Figure 91: Sample mosaic grid on the Sky Chart.

1. Select the ***Mosaic Grid*** **command** from the ***Tools*** menu to show the ***Mosaic Grid dialog***.

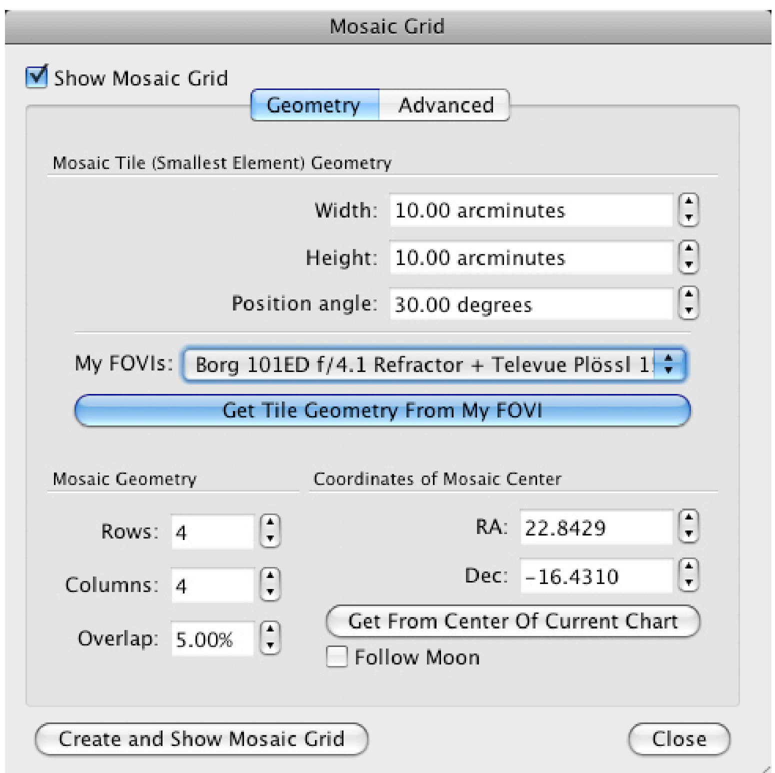


Figure 92: Mosaic Grid dialog.

Mosaic Tile Geometry

Use the options on the ***Geometry*** tab to define the ***Width*** and ***Height***, in arcminutes, of each mosaic tile and each tile's rotation, or ***Position Angle***, in degrees, measured counterclockwise from North. You can optionally select a field of view indicator in the ***My FOVIs*** list.

Next, enter the number of ***Rows*** and ***Columns***, the ***Overlap*** of the *primary* mosaic grid and the grid's position on the celestial sphere, equatorial coordinates.

Turn on the ***Follow Moon*** checkbox so that *TheSkyX* will slew to the current position of the Moon, instead of a fixed equatorial coordinate.

Turn on the ***Show Mosaic Grid*** checkbox to show the mosaic grid then click the ***Create and Show Mosaic Grid*** button to center and frame the mosaic on the Sky Chart.

2. **Click the Advanced tab.** The ***Advanced*** tab can be used to duplicate the primary mosaic grid.

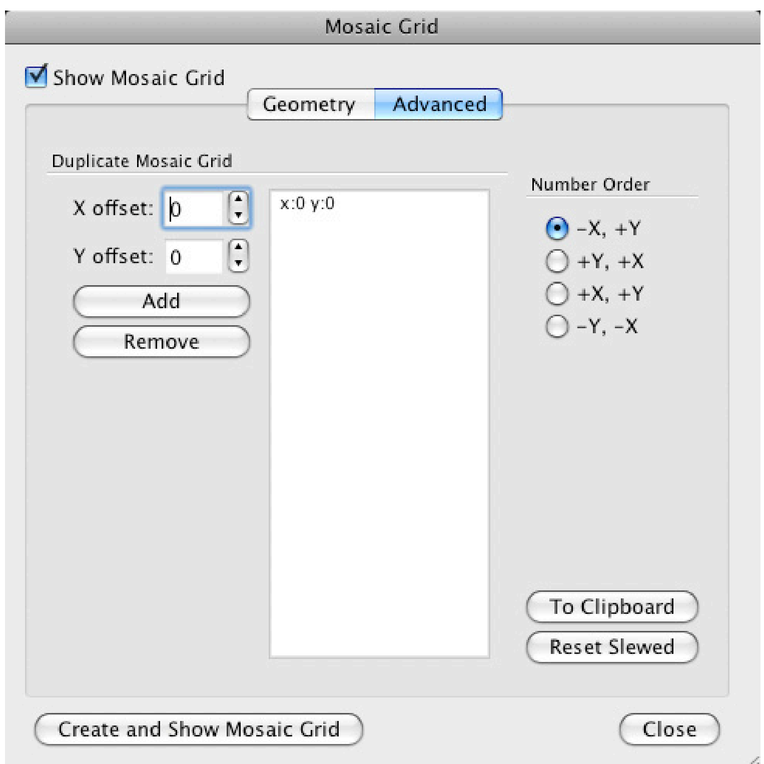


Figure 93: Advanced tab on the Mosaic Grid dialog.

Enter the horizontal (x-axis) and vertical (y-axis) offset for the new mosaic. The offset unit is defined as the "width of the primary mosaic." A value of 1 in the "X offset" will place the replicated mosaic's upper left corner next to the primary mosaic's upper right corner. (The offset is always relative to the upper left corner of the primary mosaic.)

An offset of 0,0 is allowed and will place another mosaic on top of the primary mosaic. The mosaics centers are numbered starting at one through the total number of mosaic regions. Mosaics are ordered alphabetically.

Click the "Add" button to create the new mosaic and add the offset to the mosaic replication list.

3. **Specify the numbering convention for the mosaic centers.**
    - **-X,+Y** – Mosaic center numbers are incremented *right to left* by row, starting in the upper right corner of the mosaic.
    - **+Y,+X** – Mosaic center numbers are incremented *top to bottom* by column, starting in the upper right corner of the mosaic.
    - **+X,+Y** – Mosaic center numbers are incremented *left to right* by row, starting in the upper right corner of the mosaic.
    - **-Y, -X** – Mosaic center numbers are incremented *bottom to top* by column, starting in the lower left corner of the mosaic.

To Clipboard Button

Click the button to copy the equatorial coordinates of the centers of selected mosaic to the Clipboard. These coordinates can be used to generate a script that slews your telescope to each position.

Sample mosaic grid data:

```
 1  A   0   9.32121655 -29.04969590
 2  A   1   9.32119169 -28.89969638
 3  A   2   9.32116702 -28.74969737
 4  A   3   9.32114254 -28.59969785
 5  A   4   9.30977751 -29.04991248
 6  A   5   9.30976922 -28.89991265
 7  A   6   9.30976100 -28.74991333
 8  A   7   9.30975284 -28.59991349
 9  A   8   9.29833849 -29.04991248
10  A   9   9.29834678 -28.89991265
11  A  10   9.29835500 -28.74991333
12  A  11   9.29836316 -28.59991349
13  A  12   9.28689945 -29.04969590
14  A  13   9.28692431 -28.89969638
15  A  14   9.28694898 -28.74969737
16  A  15   9.28697346 -28.59969785
```

Reset Slewed

Once you have slewed your telescope to a given frame, parentheses are placed around the number in the center of the block, indicating that this frame has been imaged. If you wish to start the mosaic process over, click this button to clear all the parentheses.

Using the Mosaic Grid

Once a link with the telescope is established , click anywhere within one of the mosaic tiles, and the telescope will automatically slew to its equatorial center.

If you are viewing or photographing the Moon, turning on the ***Follow Moon*** checkbox. The telescope's drive will automatically be reset to the lunar rate. (The previous rate is restored when you remove the mosaic.)

Although each tile is numbered sequentially, you can slew to them in any order. (If *TheSkyX*'s window is not maximized, or the field of view is too small, the numbers might not be displayed.) A selected frame's border changes color from magenta to red, to remind you it's been "visited." To reset each tile to its original color, click the ***Reset Slewed*** button.

If you're using the Mosaic Grid feature to take pictures, the CCD or film camera has to be aligned with the mosaic frames. You must therefore either position the camera to align it with the Sky Chart, or orient the Sky Chart to the camera. *TheSkyX* can help you. Use Image Link to align one of your CCD images with the Sky Chart, the "Image Link Information" gives the orientation of the image as an angular offset from North. You can then adjust the camera mount or the Sky Chart's orientation accordingly.

The Mosaic feature works best with equatorial telescopes. Alt-az telescopes suffer from field rotation, which causes the field of view to gradually rotate. The severity of this effect varies with the altitude coordinates of the area being photographed, and the length of time needed to complete the photography. A field-rotation corrector might be needed.

Image Link and Automated Astrometry

PROFESSIONAL

TheSkyX Professional Edition's Image Link™ and automated astrometry feature make it possible to overlay *Flexible Image Transport System* (FITS) photos on the Sky Chart.

Star patterns in the photo are compared with known star catalogs to determine the photo's *astrometric solution* (sometimes referred to as a "plate solve"). This means the photo can exactly overlay the Sky Chart – stars and galaxies in the photo match the corresponding objects on the Sky Chart.

Image Link can be used with photos from the Digitized Sky Survey for area of the sky of up to about 3° square.

Your photos become interactive star charts. Objects in the photo can be viewed, labeled and identified, just as if they were part of the Sky Chart.

The astrometric solution can be used to precisely locate the position of variable stars, optical components of gamma ray bursts, supernovae, comets and asteroids. It can also be used to automate calibration runs using the *TPoint Add On*.

Photo Requirements

An astrometric solution can be determined for photos that have the following attributes.

- A FITS photo that adheres to the Flexible Image Transport System standard.
- A minimum of 6 well-defined stars in the photo.
- A field of view of *10 degrees* or smaller. For photos that have small fields of view (5-20 *arcminutes*), Software Bisque recommends using one of the larger star catalogs from *TheSky6 Professional Edition Database Add On* (page 266).
- The approximate equatorial coordinates of the photo must be known. When you use *TheSkyX* or *CCDSoft for Windows* to acquire photos, the FITS header includes this information.
- The approximate scale of the photo, in arcseconds per pixel, must be known. If you know the details of the optical system and detector, the scale can be obtained from the Field of View Indicator Report (page 65).

Let's use a FITS photo from the Digitized Sky Survey to demonstrate how Image Link and automated astrometry work together.

1. On the ***Find*** tab, enter ***M81*** and then click the ***Frame*** button. This sets the field of view to about 40 arcminutes and frames M81 on the Sky Chart.
2. Select the ***Digitized Sky Survey*** command from the ***Tools*** menu.
3. On the ***Setup*** tab, turn on the ***Web*** option to retrieve Digitized Sky Survey photos from the web.
4. On the ***Create Photo*** tab, click the ***Create*** button in the ***Show in FITS Viewer*** section. The photo is downloaded from the web and displayed in the ***FITS Viewer*** window.
5. On the ***FITS Viewer*** window, click the ***To Image Link*** command in the ***Photo*** pop-up menu. The photo is now displayed in the ***Image Link*** window. You'll normally open your FITS photos that are acquired from a CCD or digital camera by clicking the ***Open FITS*** button on the ***Image Link*** window.
6. Click the ***Find Astrometric Solution*** button.

The ***Astrometric Solution*** tab on the ***Image Link*** window shows the equatorial coordinates of the photo, the scale, position angle and the list of stars used in the solution.

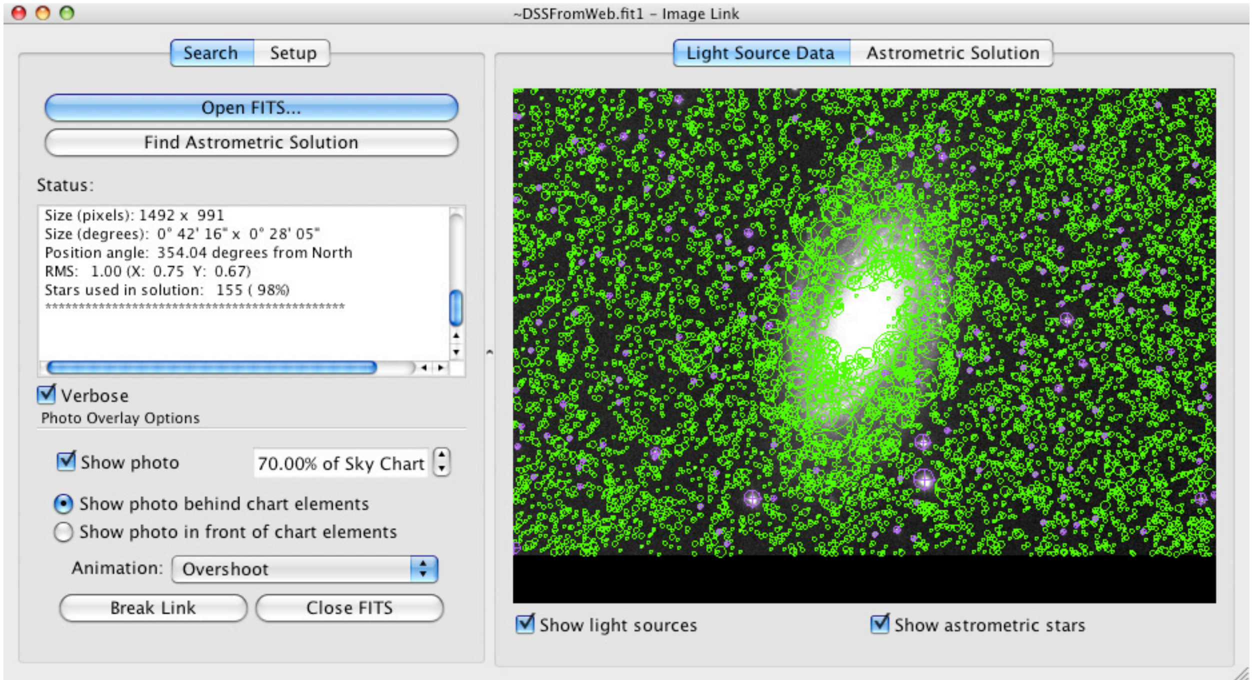


Figure 94: The Astrometric Solution tab of the Image Link window.

The photo of M81 also appears on the Sky Chart at the appropriate location. Turn on the ***Show Photo In Front of Chart Elements*** option to show the photo "on top of" the other chart elements.

Figure 95: M81 "linked" to the Sky Chart.

The default Image Link settings can be used to perform astrometric solutions on photos acquired from a wide range of optical systems. If an Image Link fails, check the following settings on the ***Setup*** tab of the ***Image Link*** window.

Unknown Scale

When the ***Unknown Scale*** option is turned on, *TheSkyX still needs to know the approximate image scale* of the photo. For example, if the image scale is 10 arcseconds per pixel but you use 1 arcsecond per pixel, then the Image Link will fail. Make sure that the ***Approximate Scale*** value is "close to" the actual scale (plus or minus 2 arcseconds per pixel).

Known Scale

When the ***Known Scale*** option is turned on, make sure to use the correct scale of the photo (to plus or minus 0.5 arcseconds per pixel).

If you're sure the scale is correct, the next step is to review and configure the ***Source Extraction Setup*** parameters. *Source Extractor* is a powerful photo analysis tool used by *TheSkyX* to catalog the sources of light (that is, stars, extended objects like nebulas, asteroids, etc.) in photos.

If your wide-field photo contains too many light sources (photos in the Milky Way, for example), or has a poor signal to noise ratio (too short of an exposure), you'll want to try altering two *Source Extractor* parameters accordingly to achieve a successful astrometric solution. In other words, if there are too many light sources, increase the ***Detection Threshold*** so that fewer stars are used on the astrometric solution. If there is an insufficient number light sources, decrease the ***Detection Threshold*** until a sufficient number is found.

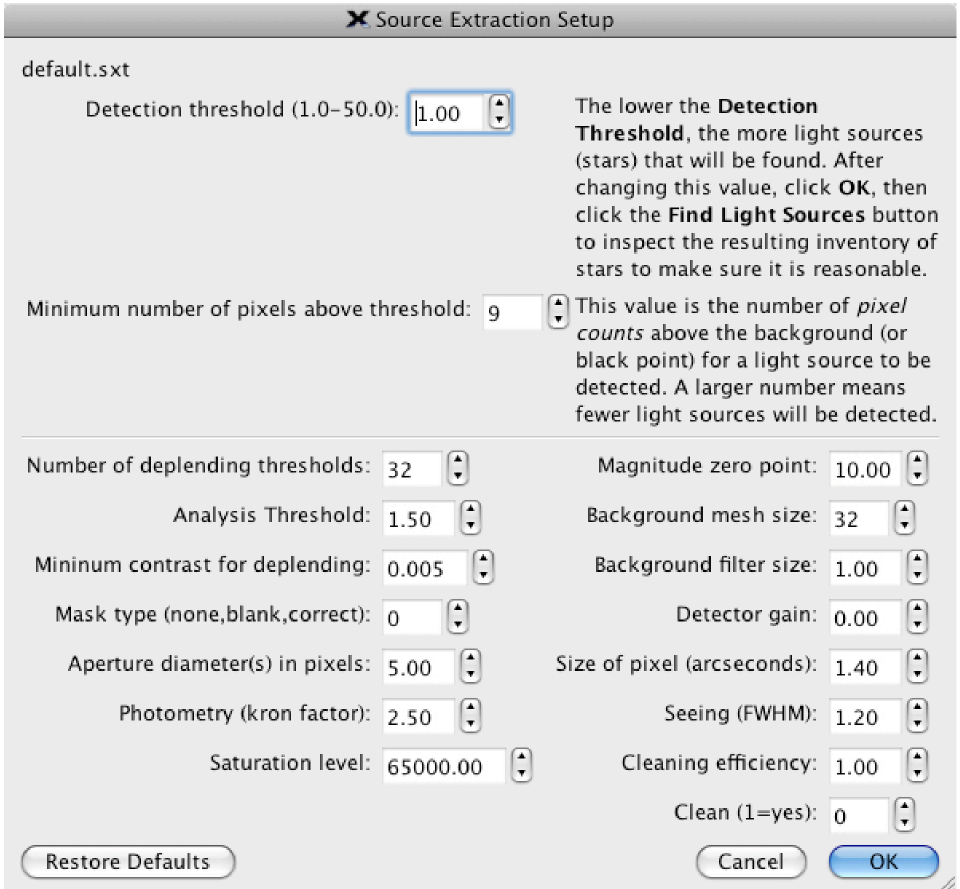


Figure 96: The Source Extraction Setup dialog.

Typically, the ***Detection Threshold*** is the only setting that needs to be adjusted to allow a successful astrometric solution.

The ***Detection Threshold*** can range from 1.0 up to 50.0. The lower the number, the more light sources that will be found in the photo. When the ***Detection Threshold*** too low, then potentially too many light sources, or light sources from noise in the photo can be found. Too many light sources and or light sources from noise will cause the astrometric solution to fail.

If an astrometric solution fails for a particular photo, or for all the photos obtained your imaging system, then altering the ***Detection Threshold*** is usually the solution.

If changing the ***Detection Threshold*** over a range of values fails to find a solution, the next, not normally necessary, step is to change is the ***Minimum Number of Pixels Above Threshold***.

The ***Minimum Number of Pixels Above Threshold*** is the number of "pixel counts" above the background (or black point) that a light source must be to be detected. Increase this value by increments of 5 or so until the astrometric solution is found.

Advanced users can read Source Extractor for Dummies by Dr. Benne W. Holwerda of the Space Telescope Science Institute for a technical explanation of each source extraction parameter (and more).

Here are a few examples of how modifying the ***Detection Threshold*** parameter can affect the astrometric solution.

Example 1

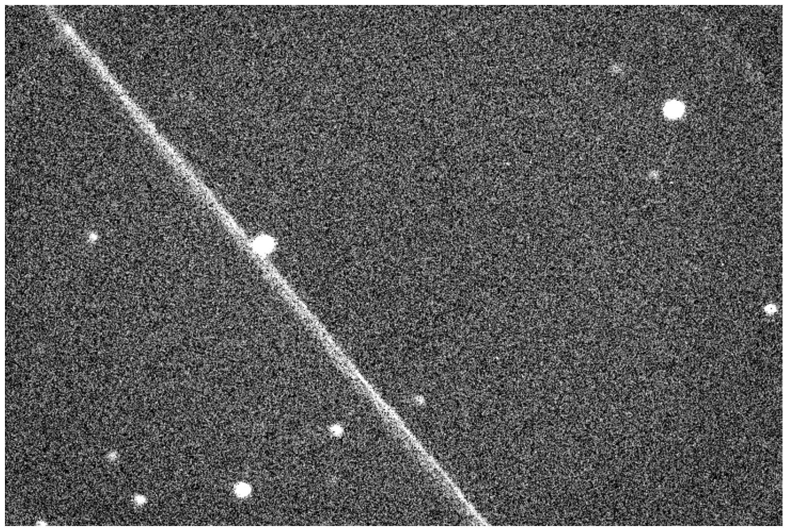


Figure 97: Photo with satellite trail.

The above photo has a satellite passing through it. Setting the ***Detection Threshold*** to 1, and then clicking the ***Light Sources*** button on the ***Image Link Setup*** tab shows the light sources in the photo.

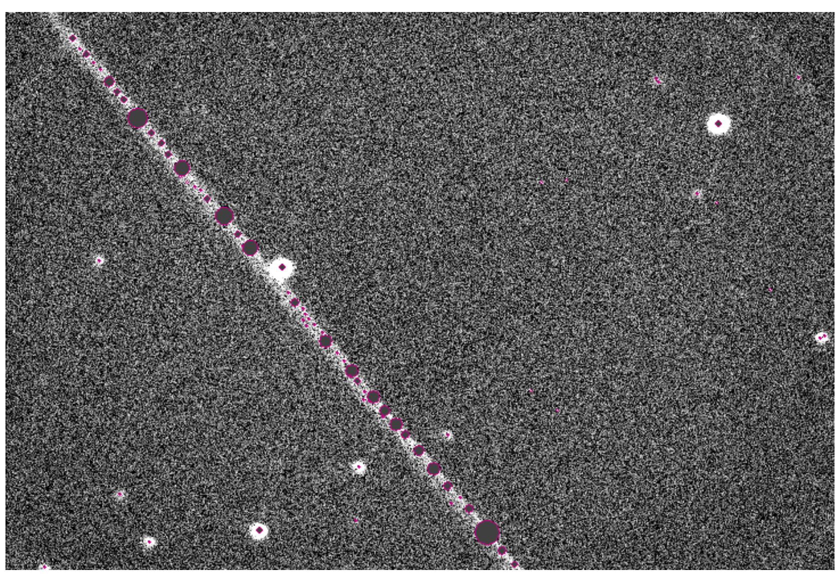


Figure 98: A “poor” inventory of light sources.

What's wrong here? When the ***Detection Threshold*** at set to 1, the streak is *misidentified* as a series of non-existent light sources. These "stars" are then used in the astrometric solution, and, Image Link fails because these light sources do not actually exist.

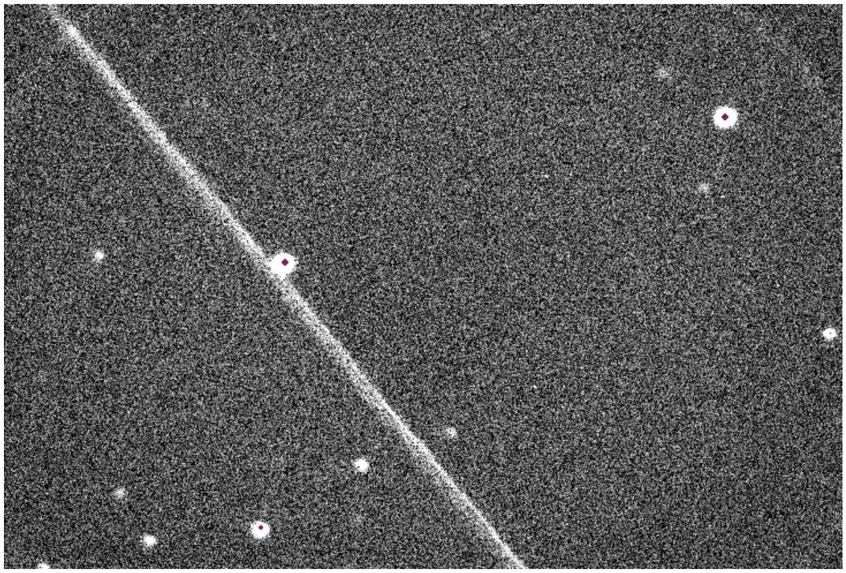


Figure 99: "Correct" inventory.

Changing the ***Detection Threshold*** parameter from 5 to 10, shows no stars detected in the "streak" and only true "stars" are identified.

Note: Even though an astrometric solution can be found using this photo, it is a very poor photo for many reasons. It has very bad signal to noise ratio (the dynamic range is 65 counts out of a possible 65535), and it is also "deficient" in stars (about 6 are "inventoried"). A longer exposure is *highly* recommended for photos like this.

Example 2

This photo also reveals the importance of the ***Detection Threshold*** setting.

Figure 100: Sample image.

The above photo contains relatively good signal and has many “well-defined” stars. However, notice how the nebulosity in the upper left affects the inventory using different ***Detection Threshold*** values.

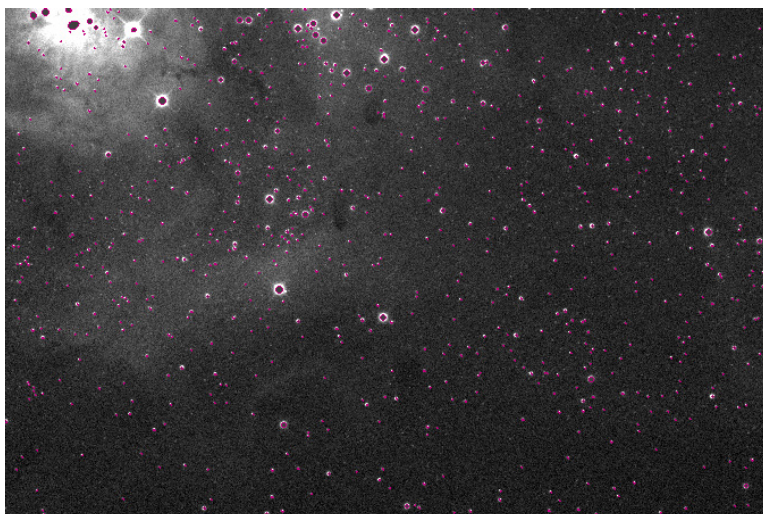


Figure 101: Note the incorrectly identified "stars" in the upper left corner.

A Detection Threshold setting of 6 identifies stars in the nebula that do not exist, and causes the astrometric solution to fail.

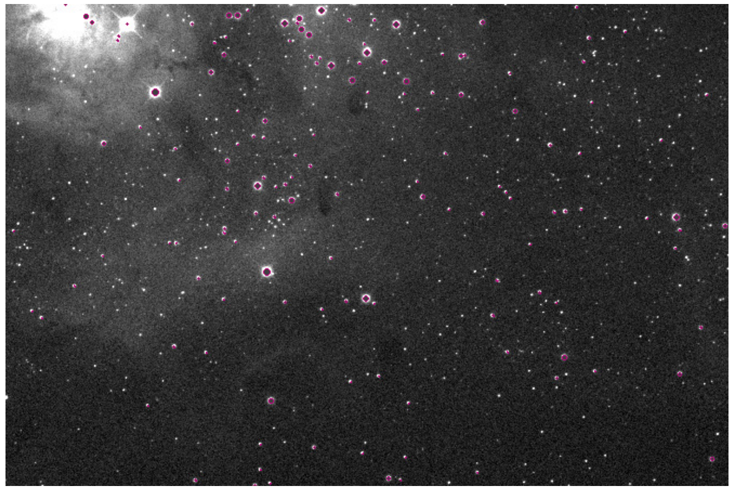


Figure 102: Changing the detection threshold correctly identifies stars in the nebula.

A ***Detection Threshold*** setting of 30 correctly identifies the stars in the nebula; The solution will now succeed.

Example 3

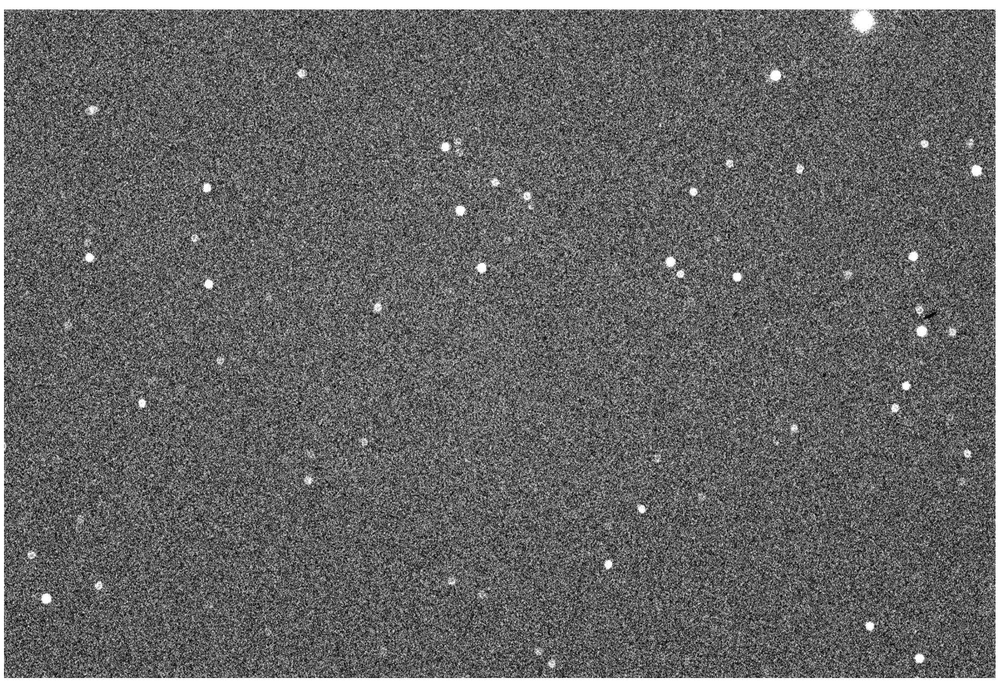


Figure 103: Poor signal-to-noise ratio and poor focus make this a very poor candidate for an astrometric solution.

At first glance, image in Figure 102 may appear to be a good candidate. Upon closer inspection, the image "falls apart"…

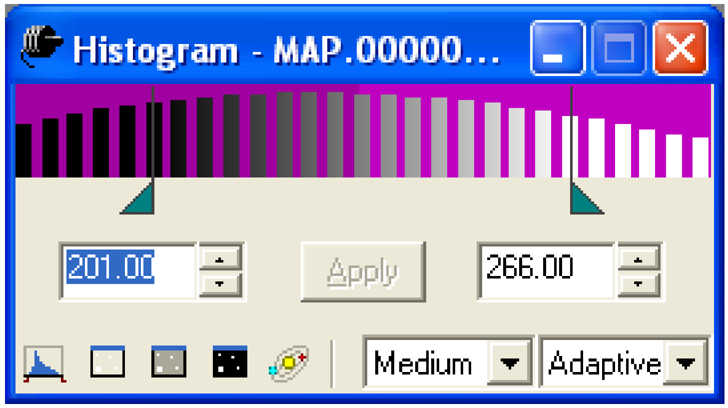


Figure 104: Histogram

The histogram (from CCDSoft for Windows) shows that there is very little actual *signal*. The default background and range settings differ by a mere 65 counts for a 16-bit (65,353) camera. The exposure time should be increased to ensure better a signal-to-noise ratio.

Figure 105: Same image after adjusting the range or "white point"

After increasing the range (that is, increasing the "white point" in the image), another very important deficiency is revealed, specifically that the image is way out of focus. Notice the donut-looking stars.

Figure 106: Multiple light sources (indicated by two red dots) are detected for individual "out of focus" stars.

The ***Show Inventory*** command, using a detection threshold of 10, reveals that several of the out of focus stars are identified as two separate light sources! If multiple light sources are detected for a single star, then the astrometric solution will almost certainly fail.

Telescope Control

TheSkyX Serious Astronomer Edition can control many go to and computer guidable (or "push to") telescope mounts.

SUN OBSERVING WARNING!

NEVER attempt to observe the Sun through your telescope! Without a specially designed solar filter, looking the Sun through a telescope or with the naked eye – for even a fraction of a second – will cause instantaneous, irreversible eye damage.

When observing during the day, *do not* point the telescope near the Sun. Do not use *TheSkyX's* automatic-slew feature to find astronomical objects during the day.

Children should *never* use a telescope during the daytime without strict adult supervision.

Telescopes with Optical Encoders (Push To)

If your telescope is equipped with optical encoders, *TheSkyX* can show and track its position with the aid of a "serial interface box". The encoders read the rotation of the telescope's axes, and return numbers that represent how much they moved. The following serial interface boxes are compatible with *TheSkyX*.

- AB Engineering
- BBox (Software Bisque)
- NGC-MAX (JMI)
- NGC Sky Commander (Lumicon)
- Sky Commander (SkyComm Engineering)
- Sky Wizard 3 (Lumicon)
- Sky Tour (Tele Vue)
- SkyQuest IntelliScope Computerized Object Locator (Orion Telescopes & Binoculars)

Jim's Mobile, Inc. (www.jimsmobile.com) is a good source to purchase software-guided telescope (SGT) hardware.

Telescopes with Go To Control

TheSkyX can send positioning and other commands to the following "go to" telescope systems.

- Astro-Physics GTO mounts (all models)
- Celestron™ Advanced Series (all models)
- Celestron™ NexStar (all models)
- Celestron™ CG Series (all models)

- Celestron™ CGE Series (all models)
- Celestron™ CPS Series (all models)
- Celestron™ GT Series
- Celestron™ SLT Series (all models)
- Celestron™ NexStar i Series (all models)
- Celestron™ *Ultima 2000*™ telescopes
- Gemini Telescope Positioning System (Losmandy and MI-250)
- iOptron™ SmartStar™ Series
- Meade™ *LX200*™ (Classic) Telescopes
- Meade™ *LX200*™ 16-inch (Classic) Telescopes
- Meade™ Autostar (classic) telescopes
- Meade™ Autostar II (LX200 GPS) Telescopes and Mounts
- Meade™ Autostar III Telescopes and Mounts
- Orion® Telescopes & Binoculars Atlas™ EQ-G Equatorial Mounts and Sirius™ EQ-G Equatorial Mounts
- SkyWatcher mounts using the SynScan Controller
- StellarCAT™ Computer Assisted Telescope Innovations
- Takahashi™ Temma mounts (all go to models)
- Vixen™ Sphinx™ and Sphinx Deluxe mounts

In addition, *TheSkyX* can simulate a telescope link. You can experiment without actually having a telescope connected.

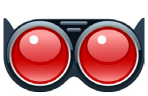
Whether your telescope has optical encoders, or computer control, the Sky Chart tracks the telescope's position. In addition, *TheSkyX* can command "go to" telescope systems. Select an object from *TheSkyX*'s database, and it will point the telescope at it.

All systems using optical encoders are set up the same way and are explained below in a single section. Computer-controlled telescopes are each set up slightly differently.

Setting the Correct Time

Computer-controlled drive systems typically have an internal clock that must be set with high accuracy. (Encoder-based systems do not need as high degree of accuracy.) The best method for keeping accurate time on your computer is to use an Internet time server. Most modern operating systems include time synchronization as part of their Date & Time settings.

Night Vision Mode



Selecting Night Vision Mode command from the Display menu (or clicking the Night Vision button) redraws the display in red to minimize loss of dark adaptation.

On the Mac, turning on Night Vision Mode will show the entire desktop, and all other applications that are running, red. Turning off Night Vision Mode, or exiting *TheSkyX* restores the screen colors.

Under Windows, by default, turning on Night Vision Mode reddens only *TheSkyX's main window*. In order to change the desktop colors, you must configure *TheSkyX* to use a Windows Theme. See the "Night Vision Setup (Display Menu)" below for details.

Night Vision Setup (Display Menu)

TheSkyX on Windows allows you to change screen elements or both screen elements and the Windows theme to red. (You can learn more about Windows Themes by searching Windows help.) Each method has advantages and disadvantages. Together they can provide an effective way to minimize screen brightness that should satisfy even the most discriminating astronomer.

The Night Vision Setup dialog (Figure 106) lets you configure how colors are changed when entering and exiting Night Vision Mode.

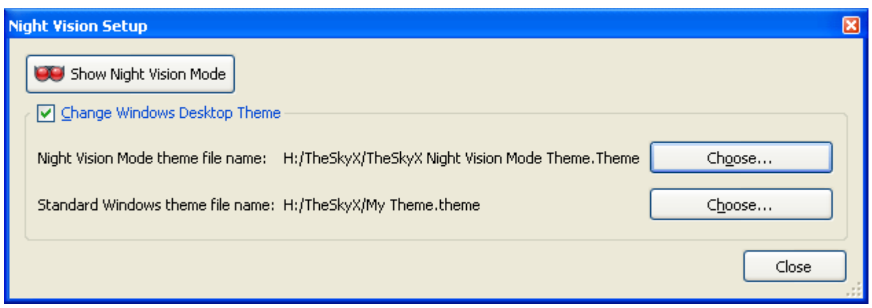


Figure 107: Night Vision Setup dialog (Display menu, Windows OS only).

When the ***Change Windows Desktop Theme*** checkbox is off and the Night Vision Mode button clicked on, the colors of the *TheSkyX's* screen elements change to red.

Note that when the ***Change Windows Desktop Theme*** checkbox is turned off, the options to set theme names are disabled.

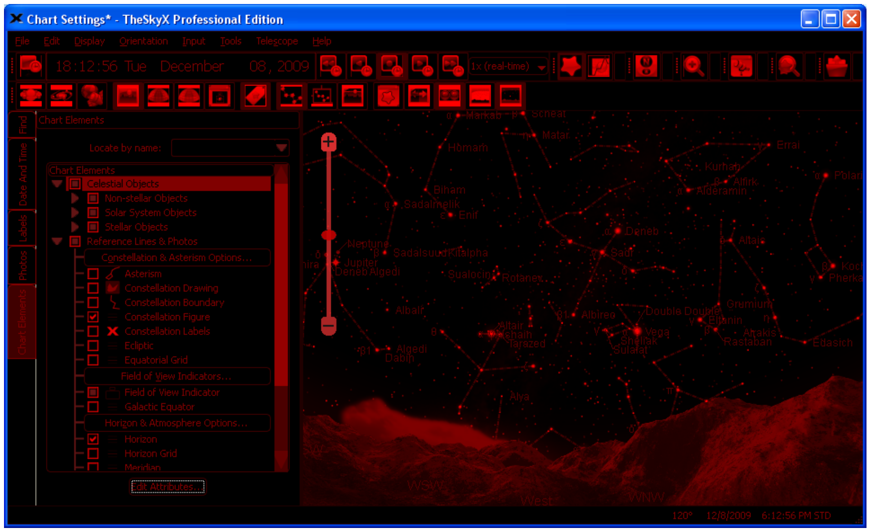


Figure 108: Sample Night Vision Mode Screen that does not use the Windows Desktop Theme.

When the ***Change Windows Desktop Theme*** checkbox is on and the ***Night Vision Mode*** button is clicked on, the selected ***Night Vision Mode Theme File Name*** is loaded.

Themes are changed automatically under Windows 7. Under Windows XP and Windows Vista, the Control Panel's Display Properties application appears, and you must select OK or the Apply button to actually apply the new theme.

Night Vision Mode Theme File Name

Click the ***Choose*** button to select the theme file name to load when Night Vision Mode is turned *on*.

Standard Windows Theme File Name

Click the ***Choose*** button to select the theme file name to load when Night Vision Mode is turned *off*.

Before you can choose a theme file name, you save one to your hard drive.

Saving a Theme File Under Windows 7

1. Click ***Start*** > ***Control Panel***.
2. Click the ***Change the Theme*** link under ***Appearance and Personalization***.
3. Under the ***Change the Visuals and Sounds on your Computer*** window, select the desired theme. The easiest way to save a theme file under Windows 7 is to modify an existing theme, then save it. (There's no other obvious way just save a "supplied" theme.) For example, after selecting a theme to use, click the Window Color icon at the bottom of this window and then modify the color's intensity before clicking the ***Save Changes*** button. The now "modified" theme appears in ***My Themes***.
4. Right-click the modified theme, then click the ***Save Theme for Sharing*** command.

5. Enter a name for the "theme pack file" (.themepack), such as ***My Theme***, and then click ***OK***. The Windows 7 default location to save themes is the ***Libraries > Documents*** folder. Remember this folder name.

Windows 7 Starter Edition and Themes

If you are using a Netbook computer, chances are it runs *Window 7 Starter Edition*. Windows themes on this "streamlined" operating system are very limited and cannot be saved to a file, or restored from a file. These limitations make *TheSkyX's* Night Vision Mode less than ideal. To best preserve dark adaptation when using the Starter Edition, we recommend covering the computer screen with a sheet of red velum, which is available at most hobby stores.

Saving a Theme File Under Windows Vista

1. Click ***Start > Control Panel***.
2. Click the ***Appearance and Personalization*** link.
3. Under ***Personalization***, click ***Change the Theme***.
4. Enter a name for the "theme file" (.theme), such as ***My Theme***, and then click ***OK***. The Windows XP/Vista default location to save themes is the ***Libraries > Documents*** folder. Remember this folder name.

Saving a Theme File Under Windows XP

1. Click ***Start > Control Panel > Display***.
2. On the ***Themes*** tab of the ***Display Properties*** window, click the ***Save As*** button.
3. Enter a name for the "theme file" (.theme), such as ***My Theme***, and then click ***OK***. The Windows XP/Vista default location to save themes is the ***Libraries > Documents*** folder. Remember this folder name.

Once you've saved the theme file, to select it in Night Vision Setup dialog, click the ***Choose*** button next to the ***Standard Windows Theme File Name***, then navigate to the folder where the file resides, and double-click the theme pack name. *TheSkyX* will now load this theme when exiting Night Vision Mode.

Setting Up and Using Push To Telescope Systems

Other than the encoders and their interface box, the extra hardware required includes a standard serial (RS232) cable to connect the interface to your computer and a USB to serial adaptor. The serial cable is usually supplied with the encoder system; USB to serial adaptors can be purchased at almost any computer store. Make the appropriate connections from the encoders to the interface box, and the box to your computer.

Configuring the Hardware

You are now ready to configure the hardware.

Select the ***Telescope Setup*** command from the ***Telescope*** menu. The Telescope Setup dialog is displayed.

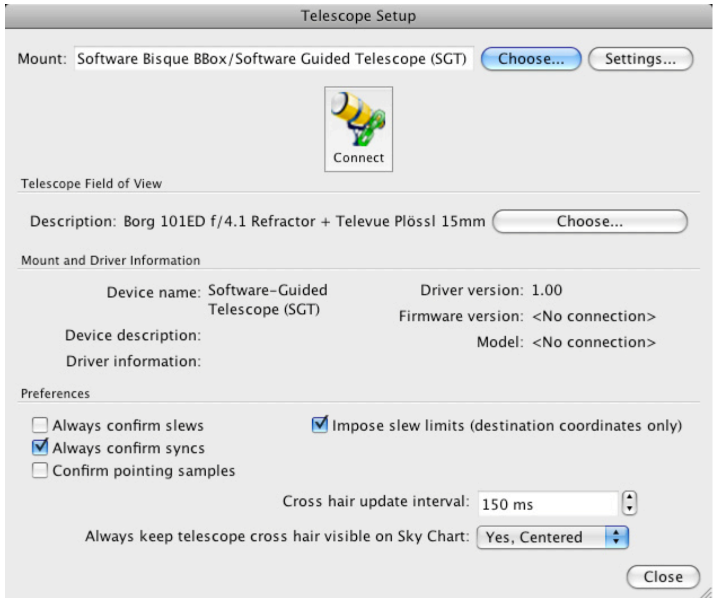


Figure 109: The Telescope Setup dialog.

1. **From the *Mount* pop-up, click the *Select Mount* button.** On the ***Select Mount*** window, select **SGT.** Or select the name of your serial interface box, if it's listed then click ***OK***.
2. **Click *Settings***. The Telescope Settings dialog appears.

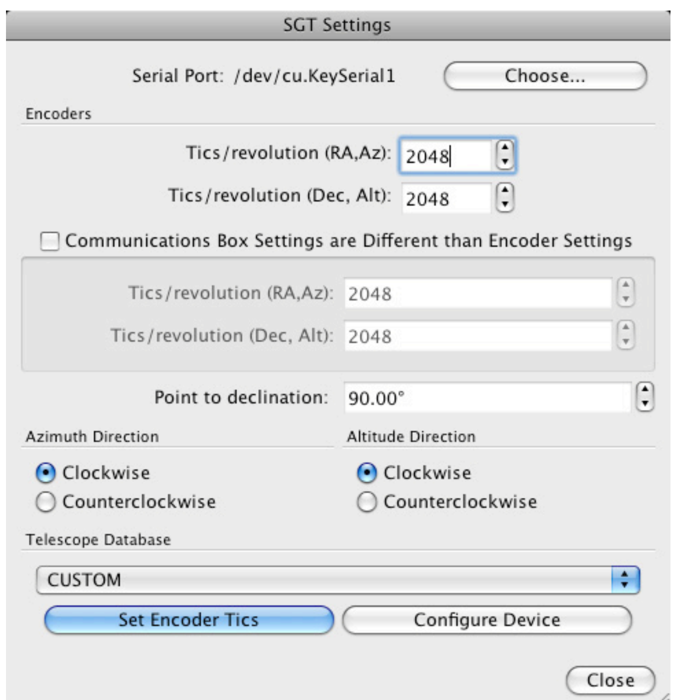


Figure 110: The SGT Settings dialog.

Click the ***Serial Port*** button to select the serial port to which the interface is connected. All telescope serial interface boxes use RS232 serial communication. Since most modern computers are not equipped with a serial port, you'll most likely need to purchase a USB to serial adaptor to convert a USB port into a serial port. Follow the manufacturer's instructions for installing the software drivers for this hardware. On the Mac, choose the port that contains the manufacturer of your USB to serial adaptor's name. On Windows, use the Device Manager to determine the communications port number (COM number) for the adaptor, and enter "COMN", when "N" is the number of the port reported by the Device Manager.

3. Select your telescope model from the Telescope pop-up menu. If it isn't listed, choose the CUSTOM option. The number of encoder tics per revolution for the selected telescope is displayed in the Encoders edit boxes to the right. If your telescope isn't listed, don't worry. Just manually enter the correct values in the Encoders edit boxes. If you don't know these values, contact the manufacturer.
4. Enter the *same values* in the Tics/Rev edit boxes. The RA and Dec values are sometimes different. Don't switch them. If you own version 1.7 through 1.99 of the BBox, or version 2.93 through 3.49 of NGC-MAX, enter 32768 for both axes.
5. Set the Clockwise/Counterclockwise options for Azimuth and Altitude Direction. If you aren't sure which way the encoders are supposed to be mounted, contact the manufacturer. Or continue with the setup, and see which way the cross hairs move when you link the telescope and computer. If the cross hairs move in the wrong direction, you've selected the wrong direction.
6. Click the Configure Device button. This step applies only if you own a BBox, version 1.7 (or later). If not, skip to the next step. The BBox is automatically configured for the selected number of encoder tics. If you get the message "Cannot configure BBox," try again. If you still cannot configure the box, please refer to the "Troubleshooting" section on page 218. This step need be done only once, as the interface box stores the configuration in non-volatile memory.
7. Click ***Close*** to save the configuration.

Aligning the Encoders

TheSkyX is now configured to communicate with the encoders. The next step is to align the encoders by aiming the telescope at specific stars. This gives *TheSkyX* the information it needs to calculate where the telescope is pointing.

Any two stars that are visible from your location can be used during the alignment procedure.

1. After your telescope is setup, select the ***Connect*** command from the ***Telescope*** menu to show the SGT Alignment dialog.

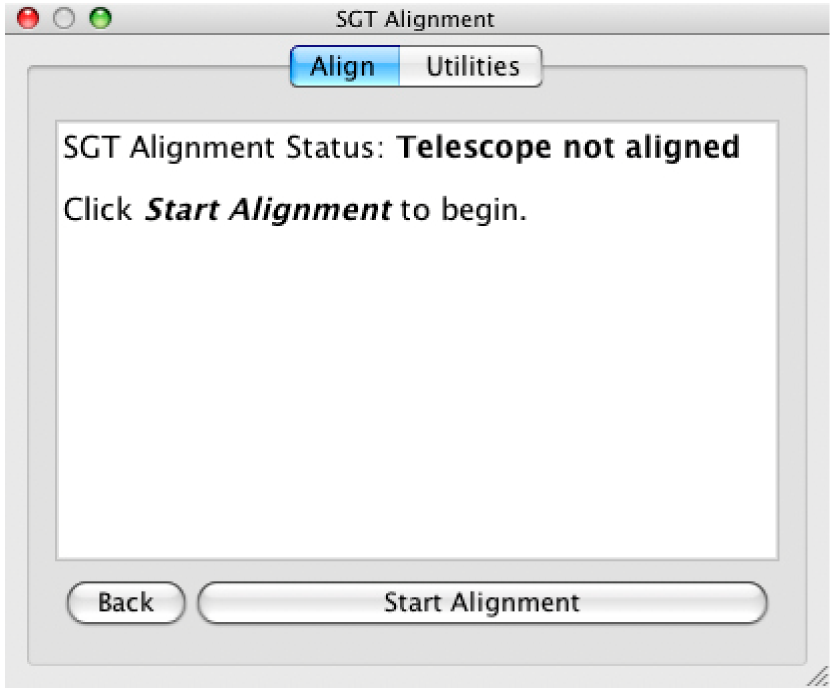


Figure 111: The SGT Alignment dialog.

2. **Click the *Start Alignment* button**. If your telescope is mounted equatorially (that is, the RA axis is pointing to the celestial pole), point it at 90° declination by default. Choose a different declination (or azimuth) from the Point Scope At pop-up menu if your telescope cannot be pointed at 90°.
3. **If your telescope has an az-alt mounting, point it at 90° *altitude***. Specifically, you're looking for the telescope position where rotation in right ascension (or azimuth) causes no rotation in declination (or altitude). The default angle is 90°.
4. **Point the telescope at the first alignment star**. The default first-alignment star is Polaris. To use a different star, use the Find command to locate the star (or just click on it in the Sky Chart). Then click Align On in the Telescope sheet of Object Information dialog.
5. **Point the telescope at the second alignment star.** The default second-alignment star is Capella. To use a different star, use the Find command to locate the star (or just click on it in the Sky Chart). Then click Align On in the Object Information dialog. The difference between the actual angular separation of the alignment stars and the angle measured by the encoders is displayed. A difference of zero indicates a "perfect" alignment. Experience shows that a difference of 1 degree or less is acceptable. If the difference is substantially greater, please refer to "Troubleshooting" below.
6. **Click *Accept Alignment***. The alignment is complete. You should see cross hairs in the Sky Chart, marking the approximate center of the field of view of the telescope.

As you move the telescope, the cross hairs move to show where the telescope is pointing. As the cross hairs reach the edge of the screen, the Sky Chart automatically scrolls to keep the cross hairs visible.

The Connect button on the toolbar is "down" to show the telescope link is active.

Selecting Alignment Stars

If you choose different alignment stars, don't pick closely spaced ones. Generally speaking, the greater the angular separation of the alignment stars (in both right ascension and declination), the more errors inherent to the system are "averaged out" across the sky.

Realignment with Each Use

TheSkyX has no provision for saving alignment settings because you must align the telescope each time you use it, *even when observing from the same location*.

Software Options

The Software Options section of the Telescope Setup dialog provides the following additional controls over encoder/go to interface. Mark or clear the checkboxes to select or deselect them.

Always Confirm Slews

A window appears that requires you to confirm any slewing command.

Always Confirm Syncs

A window appears that requires you to confirm any synchronization command.

Always Ensure Telescope Cross Hairs are Visible on Chart

- ***No*** allows the Sky Chart to be positioned in a different part of the sky as the telescope's cross hairs
- ***Yes*** allows the telescope's cross hairs to move across the Sky Chart; the Sky Chart's position is updated when the telescope's position is outside the chart's field of view.
- ***Yes, Centered*** pins the telescope's cross hairs to the center of the window. The Sky Chart's center coordinates are updated to match the telescope.

Using the Software-Guided Link

The cross hairs in the Sky Chart will now "follow" the telescope. This is true whether you move the telescope by hand, or let its motor drive turn it. Be sure you've clicked the ***Computer Clock*** button. The Sky Chart will then update automatically. If you select a specific date and time, the Sky Chart does not update; however, the Sky Chart may not match what you see through the telescope.

Terminating the Link

On the Telescope menu, click the ***Connect*** command. Or, select ***Disconnect Telescope*** in the ***Shut Down*** pop-up menu on the Telescope window.

Finding a Particular Object

TheSkyX can help you position the telescope on a particular object.

1. Use the ***Find*** command on the ***Edit*** menu to locate the object.
2. **Click the *Guide To Current Object* button**. It is located on the Utilities tab of the SGT Alignment window. This will show the Guide To controls on the Sky Chart. When the telescope is pointing relatively near the target object, its position is represented by cross hairs on the RA/Azimuth and Dec/Altitude axis circles. When an axis is far from the object, a red and green line are shown instead. The red line rotates as the telescope is moved. The green line remains stationary. Your goal is to move the telescope until the red line is drawn on top of the green line. At this point, the lines fade away. Slowing move the telescope axis until the cross hair is over the center green circle.

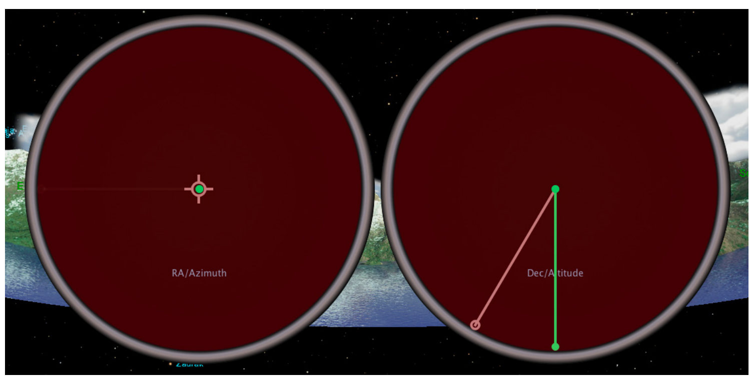


Figure 112: The SGT Guide To controls.

3. **Starting with the RA/Az axis**, move the telescope until the cross hairs are centered in the circle. Lock the RA/Az axis.

Repeat the last step for the Dec/Alt axis.

The Sky Chart's cross hairs are now over the desired object. When you look through the telescope, the object should be near the center of the field. If Impose Slew Limits are enabled, *TheSkyX* warns you if you try to move the telescope into a limit-line region.

Setting Up and Using your Go To Telescope

TheSkyX can drive many popular commercial telescopes. Most telescopes that *TheSkyX* controls are *serial devices* (one exception is Vixen SX mounts; it uses an Ethernet connection). In order for a telescope that uses serial communications to "communicate" with the computer (and *TheSkyX*), the computer must have a *serial port*.

Unfortunately, serial ports have been replaced by USB ports on virtually every newer model computer. This means the physical USB hardware, as well as the USB protocol, is not compatible with older serial devices. Fortunately, there is a solution…

USB to Serial Adaptors

The most common method to connect a personal computer that has a USB port to a telescope that uses serial (RS232) communication, is to use purchase a *USB to serial adaptor*.
This hardware device "converts" one of the computer's USB ports into a virtual serial port that understands serial communication used by the telescope.

The most common way to do this is to use a USB to Serial Adaptor so that one of the computer's USB ports can accept RS232 commands. (Bluetooth or serial to Ethernet hardware devices are other, less common, and typically more expensive alternatives.)

USB to serial adaptors are relatively inexpensive and can be purchased at almost any computer store.

- Before purchasing the USB to serial adaptor, make sure the adaptor is compatible with your computer's operating system. For example, some USB to serial adaptors are not compatible with Mac OS X Snow Leopard.
- Carefully follow the manufacturer's setup instructions for your operating system. Remember, the USB to serial adaptor hardware requires that you install a separate software driver before it can be used to communicate with a telescope.

Mac OS X Snow Leopard and USB to Serial Adaptors

When you plug a USB to Serial Adaptor into a computer that is running Mac OS Snow Leopard, a message appears that a new network device has been connected, and prompts you to set it up (via the Network options in System Preferences).

Configuring the USB to Serial Adaptor as a network device *will not allow TheSkyX to control a telescope that uses RS232 serial communication*.

In order for *TheSkyX* to control a telescope that uses serial communications on Mac OS X, an OS X compatible USB to serial adaptor driver must be installed first.

Contact the manufacturer of your USB to Serial Adaptor hardware device, or visit the manufacturer's Downloads page to obtain this driver.

After installing the Mac OS X-compatible USB to Serial Adaptor driver, you need to select it from *TheSkyX's* ***Telescope > Telescope Setup > Settings*** window.

You'll also need a telescope cable that connects your computer to USB to serial adaptor. Cables for Meade and Celestron products can be purchased from the Software Bisque Store.

We strongly recommend that you read the telescope's owner manual carefully, and become thoroughly familiar with the telescope's operation, before using *TheSkyX* to control it.

Configuring the Telescope Interface

TheSkyX must be configured so your computer can communicate with the telescope. The following general procedure applies to most "go to" telescopes.

1. Turn off the telescope.
2. **Using the appropriate telescope cable, connect the serial port on the telescope to an unused serial port.** If your computer does not have a serial port, you'll need to use a USB to serial adaptor.
3. **Turn on the telescope.**

Select the *Setup* command from the *Telescope* menu. In the Mount list box, select the name of your telescope. If the exact model of your telescope is not listed, use the manufacturer's name instead.

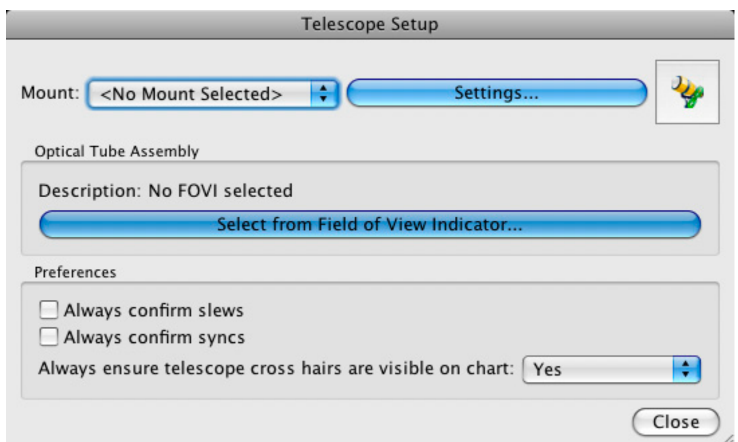


Figure 113: The default Telescope Setup dialog.

4. **Click *Settings***. On the Mac, the Serial Device Settings dialog allows you to specify the USB to serial adaptor that your telescope cable is connected to.

   Under Windows, in the COM Port text input, type the letters "COM" followed by the number of the port that the Device Manager reports for the device.

Windows Serial Port Notes

- Only standard serial ports or USB to serial adaptors that are not being used by any other device should be used.
- Use Windows Device Manager to determine the COM port number for your serial ports, or USB to serial adaptor.

Linking To and Synchronizing the Telescope

Most "go to" drive systems must be properly configured before *TheSkyX* can control them. You can do this "by hand," using the telescope's hand paddle. Or, you can do it from within *TheSkyX* by performing a process called synchronization.

(Note that Celestron telescopes using firmware version 4.1 and earlier cannot be synchronized from *TheSkyX* and must be aligned using the hand paddle before *TheSkyX* can control it.)

Important Notes:

- The local date, time, time zone, Daylight Saving Time and terrestrial coordinates must be entered into the telescope's hand paddle. If the telescope is connected to your computer, you might find it easier to use *TheSkyX* to initialize the telescope's hand paddle with these values.
- The telescope must be aligned with the celestial sphere. Follow the manufacturer's instructions for aligning the telescope with the night sky.

Telescope Limits

Controlling the slewing limits of your telescope is a snap with TheSkyX's telescope limits command. There, you can set lower altitude and upper altitude and declination limits. To open the Telescope Limits dialog, select Telescope > Telescope Limits.

Upper Limits

When you first open the Telescope Limits dialog, you will first be given an opportunity to set the Upper Limits of your telescope's slewing control. Use the data fields to enter maximum values for declination and altitude slewing and to choose whether the telescope limits are plotted on the Sky Chart.

Lower Altitude Limit

Choose the Lower Altitude Limit tab to set minimum altitude limits for your telescope setup. In the top portion of the dialog window, you will see a graph upon which you can click and drag the mouse pointer to draw a set of altitude limit data for given azimuth values.

You can also choose to Open a pre-existing horizon file, and, once you have set altitude limits, you can save a horizon file for later use by clicking Save As.

Clicking Set To allows you to set altitude limits according to a number of values, such as a given set altitude, or to match the current horizon image. For more on horizon images, see Horizon & Atmosphere Options.

You can also import the telescope's current Az/Alt position into the dialog by clicking Get Telescope Az/Alt.

Here, too, you choose to have TheSkyX plot the set limits onto the Sky Chart by clicking Show limits on Sky Chart.

Once you are satisfied with the input limit data, click OK to commit. If you decide not to use these data, click Cancel.

TPoint Add On

The TPoint *Add On* is optional telescope pointing analysis software that allows you to analyze the errors inherent in your particular telescope system to drastically improve its pointing performance. Both TheSkyX Serious Astronomer Edition and TheSkyX Professional Edition supply a 90 day trial version of TPoint. The TPoint *Add On* can be accessed from the Tools menu.

Like many aspects of your imaging system, there is a learning curve to master calibrating telescope pointing. Fortunately, TheSkyX makes using TPoint *Add On* easier and you should be able to complete a calibration run on the first night to start analyzing and improving your telescope's pointing right away. There is a comprehensive user guide for TPoint available by selecting *Help* > TPoint Add On User Guide.

Telescope Controls

The Telescope window holds the most commonly used telescope controls. Select the ***Telescope*** command from the ***Display*** menu to show it.

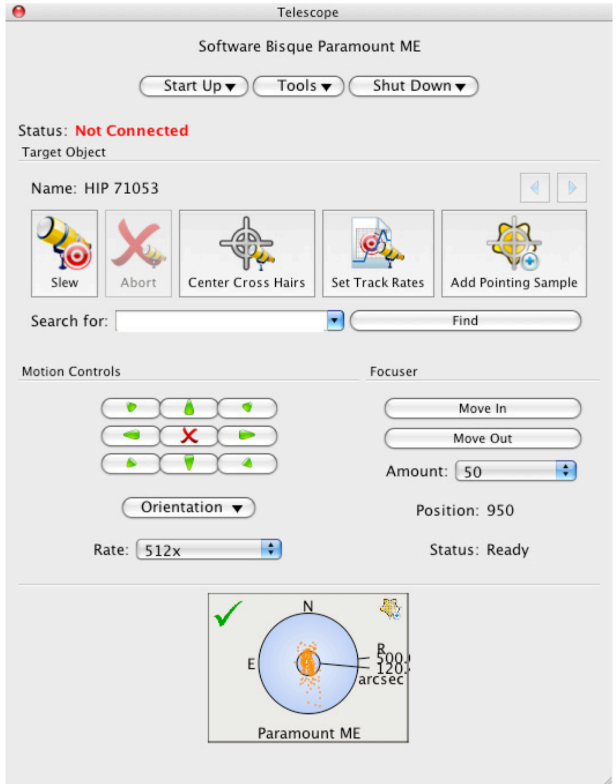


Figure 114: The Telescope window.

Not all telescope mounts have the same feature set; the Telescope window holds commands that are common to most every go to mount.

Manufacturer-specific telescope control features are accessed in the <*Telescope Name*>-*Specific* window from the Display menu. For example, Gemini specific commands are located in the ***Gemini-Specific*** window from the ***Display*** menu.

Telescope Initialization (Start Up pop-up menu)

This pop-up menu contains that commands that are used to connect to and initialize the mount with *TheSkyX*.

- ***Telescope Setup***
  Shows the Telescope Setup dialog. See "Configuring the Telescope Interface" for more information.

- ***Connect Telescope***
  Same selecting the Connect command from the Telescope menu. See "Linking To and Synchronizing the Telescope" for more information about this command.

- ***Find Home***
  Sends the mount to its home position. (Gemini-specific command.)

- ***Synchronize***
  Use this command to tell *TheSkyX* where the telescope is currently pointing. See "Software Synchronization" for more information about this command.

Telescope Tools

Once communication with the telescope is established, the Telescope Tools can be used to help find objects, tracking communications between the mount and the computer and initialize the mount's hand paddle or controller with *TheSkyX's* location, date, time, and time zone values.

Star Search

The Star Search feature slews the telescope in a spiral pattern of increasing size to help locate an object in the eyepiece.

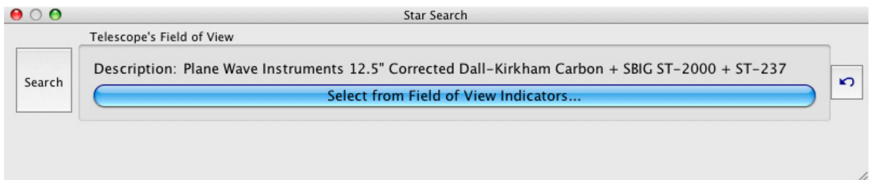


Figure 115: The Star Search dialog.

Spiral Search (Star Search button)

Begins slewing the telescope in a spiral pattern, based on the size of the selected Field of View Indicator.

Defining the Size of the Spiral (Telescope's Field of View group)

The "tightness" of the telescope's outward spiral can be configured to match the telescope's field of view. Click the ***Select From Field of View Indicators*** button to tell *TheSkyX* the specifics of your optical system.

Communications Log

Use this window to track the serial or network communications between *TheSkyX* and the telescope.

Location, Date, Time

Astro-Physics, Gemini, Celestron and Meade mounts allow *TheSkyX* to set their location, date, time and time zone information, rather than having to do it from the hand paddle.

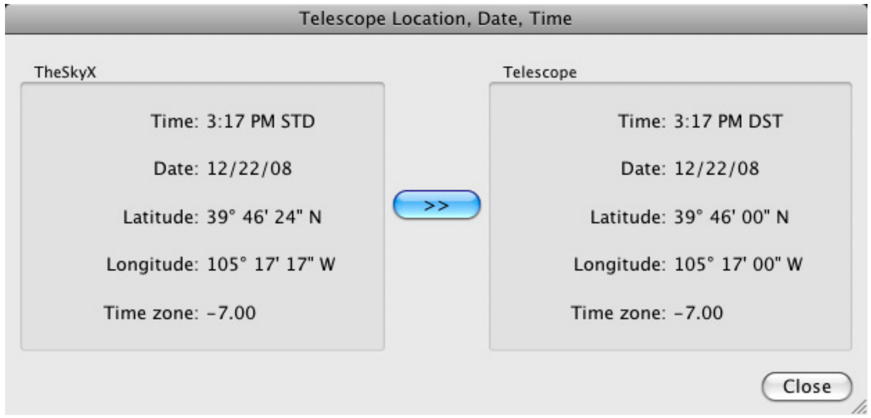


Figure 116: The Telescope Location, Date, Time dialog.

Click the right arrow to send *TheSkyX's* time, date, latitude, longitude and time zone to the telescope.

To ensure accurate slews, *TheSkyX's* values should match the telescope's values for these parameters.

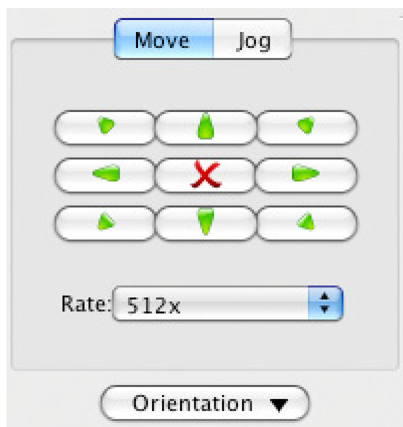


Figure 117: Move and Jog Controls.

Move and Jog Controls

Use the controls on the ***Move*** and ***Jog*** tabs to manually slew or move, by discrete increments, the telescope.

Move Tab

Click and hold the ***Move*** arrow buttons on the ***Telescope*** window to direct the telescope in a specific direction. The ***Rate*** pop-up menu controls the speed of the slew. The ***Rate*** options in this list change depending on the currently selected mount.

The Move controls offer eight directions: North, East, South, West, and the "diagonal" directions in between. Diagonal direction buttons are hidden for mounts that do not support dual-axis moves.

Jog Tab

Use these arrow buttons to slew the telescope by the angular distance shown in the ***Distance*** list, and using and equatorial (***RA/Dec***) or horizon (***Azm/Alt***) coordinates.

Orientation Options

The direction a particular button moves the mount is configurable. This is useful, for example, when the optical tube on a German equatorial mount changes sides from East to West, the relative motion of the telescope in the right ascension axis is reversed. Changing the orientation for the right ascension axis makes the buttons work "as expected" for the opposite side of the mount.

- ***Normal*** sends the standard commands to the mount for moving in this direction.
- ***Swap Axes*** changes the left/right direction buttons to up/down, and up/down to left/right.
- ***Flip Left/Right*** swaps the left and right buttons. Left moves right, and right moves left.
- ***Flip Up/Down*** swaps the up and down buttons. Up moves down and down moves up.

Alice, welcome to Wonderland.

Shut Down Procedure (Shut Down pop-up menu)

At the end of the night, you'll want to make sure to park the telescope so it will be in the correct orientation to close the observatory roof. Note that some telescope control systems do not have the ability to park the telescope. For these telescopes, TheSkyX uses a "built-in" park feature that slews the mount to the park position (a fixed altitude/azimuth coordinate) that you define and turns off the mount's sidereal tracking. When communication with the mount is established again, *TheSkyX* can unpark the mount and initialize the mount's control system.

Set Park Position

Use this command to specify the altitude and azimuth coordinates to slew the mount before parking. The current position of the telescope cross hairs is used as the park position.

Clear Park Position

Use this command to delete the previously defined park position. After clearing the park position, a new one must be defined with the ***Set Park Position*** command before the telescope can be parked.

Park

The Park command slews the telescope to the park position, and then turns the mount's sidereal tracking off (where possible).

Unpark

For mounts that do not support parking (see above), once parked, the ***Unpark*** command must be issued to end the "periodically rewind the mount's position because it is still tracking" loop.

Disconnect Telescope

Terminates communication with the mount, same selecting the Connect command from the Telescope menu when there is a connection. See "Linking To and Synchronizing the Telescope" for more information about this command.

Focuser

Controls the focus and focus speed of a pulse focuser that is connected to the telescope's focuser port. This feature is especially useful when viewing CCD images on a monitor while focusing.

Software Synchronization

The following procedure applies if your telescope can be synchronized through software. If your telescope must be aligned first, do so following the manufacturer's initialization instructions now.

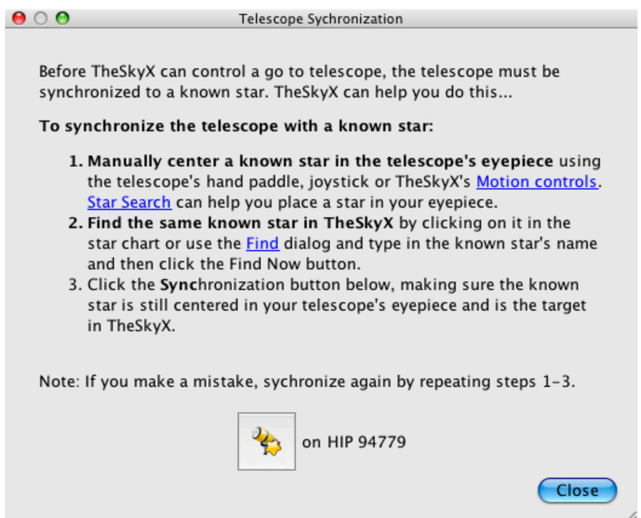


Figure 118: The Telescope Synchronization window (*Synchronize* command in the Start Up pop-up menu on the *Telescope* window).

1. Select the ***Connect*** command from the ***Telescope*** menu. Cross hairs appear on the Sky Chart, showing the position the telescope "thinks" it is pointing. If you receive a "Can't establish link" message, be sure the connections are correct, the telescope is turned on, and the correct port is selected.
2. If you haven't set the telescope's time and coordinates, do so now. Use the ***Telescope*** window's ***Synchronize*** command in the ***Start Up*** pop-up menu to do so.

3. Position the center of the telescope's field on a known star. Don't use a planet, nebula, or galaxy. Star coordinates are more accurate, and a star is a true "point source."
4. Click on that star in the Sky Chart or use the Find command to locate it.
5. Select ***Synchronize*** command in the ***Start Up*** pop-up menu on the Telescope window.

The telescope is now aligned and can be used with *TheSkyX*. The Sky Chart's cross hairs should jump to the object used for synchronization, or be centered on the star used during the hand paddle initialization.

Slewing to a Specific Object

1. Click on the object in the Sky Chart. If the desired object is not visible on the current chart, select the ***Find*** command from the ***Edit*** menu, enter the object's name (***Crab Nebula***, for example) or its catalog number (***M1***) into the ***Search For*** text input and click the ***Find*** button.
2. Click the ***Slew*** button. One is located on the ***Telescope***, ***Find*** and the ***Observing List*** windows and on the ***Telescope*** toolbar.

The ***Search For*** text input and ***Find*** button are also available on the ***Telescope*** window.

There's another way slew the telescope…

1. Right-click an object in the Sky Chart.
2. Select the ***Slew*** command from the Sky Chart's pop-up menu.

Slewing to a Specific Coordinate

Use the ***Slew To Coordinates*** command from the ***Tools*** menu on the ***Telescope*** window to display the Enter Coordinates tab of the Navigate window. From here, enter any right ascension and declination or azimuth and altitude coordinate, then click either the ***Slew To RA/Dec*** or ***Slew To Az/Alt*** button.

Using the Telescope Simulator

The telescope simulator allows you to simulate the process of connecting to, synchronizing and slewing a go to telescope without actually connecting to any hardware. This can be useful to become familiar with how to operate a telescope from *TheSkyX* or practice an observing session during daylight.

1. Select the ***Telescope Setup*** command from the ***Telescope*** menu.
2. In the Telescope Setup dialog, click the ***Select Mount*** button.
3. Choose ***Telescope Mount Simulator*** option from the ***Simulator*** list.
4. Click ***OK***.
5. Click the ***Connect*** button on the Telescope Setup dialog to establish a virtual connection to the simulated telescope mount.

Terminating the Telescope Link

Select the ***Connect*** command ***Telescope*** menu to end the session.

Using the Telescope Simulator

The telescope simulator allows you to simulate the process of connecting to, synchronizing and slewing a go to telescope without actually connecting to any hardware. This can be useful to become familiar with how to operate a telescope from *TheSkyX* or practice an observing session during daylight.

1. Select the ***Telescope Setup*** command from the ***Telescope*** menu.
2. In the Telescope Setup dialog, click the ***Select Mount*** button.
3. Choose ***Telescope Mount Simulator*** option from the ***Simulator*** list.
4. Click ***OK***.
5. Click the ***Connect*** button on the Telescope Setup dialog to establish a virtual connection to the simulated telescope mount.

Digital Setting Circles

TheSkyX's Digital Settings Circles window displays a status report that contains, for example, the telescope's RA/Dec coordinates. The text size is also configurable so that it can be more easily read at a distance.

This feature is available with both encoder-based systems and telescopes having full computer control.

To use it, select the ***Digital Setting Circles*** command from the ***Telescope*** menu.

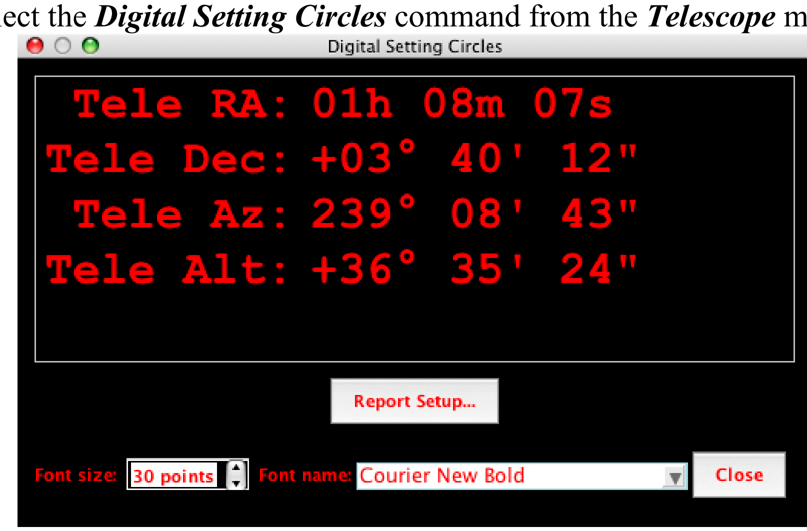


Figure 119: Digital Setting Circles window.

Configuring the Digital Settings Circles Report (Report Setup button)

By default, the report shows universal time (UT) and local sidereal time (LST). Click the Report Setup button to show the Digital Setting Circles report in the Preference dialog.

Select the attributes you wish to display in the report, and then click Close.

Troubleshooting the Telescope Setup

Physically connecting a hardware device to computer software is not always a simple task. Things can, and often do, go wrong. Below is a checklist of items to consider before contacting the Software Bisque support desk.

- Both the software and the hardware must be correctly configured. Communication ports, cables, connectors and telescope control systems all must be plugged in, turned on, connected properly using the correct telescope interface cable and initialized before attempting to be "linked" to the computer.
- Connection cables must be wired correctly. *TheSkyX* uses "bi-directional" serial communication with most devices. This means that the connecting cable must be wired properly to send and receive commands. You can verify that a serial cable is functioning by measuring resistance of pins 2, 3 and 5 on each end of the telescope cable.
- The communication port must be operational. If you are using a USB to serial adaptor, make sure that you have the latest software drivers installed for the device.
- The proper telescope firmware (that is, the software that is run by the telescope's control system) must be correct before *TheSkyX* can control the telescope. Contact the manufacturer to obtain firmware updates.

Astro-Physics GTO German Equatorial Mounts

Figure 120: Astro-Physics GEM (photo copyright Astro-Physics)

AP GTO Minimum System Requirements

TheSkyX can control any mount that employs the Astro-Physics GTO control system running firmware version G or later (including the GTOCP1, GTOCP2 and GTOCP3). If you have and older version of the firmware, contact Astro-Physics for details about upgrading. *TheSkyX* will successfully connect to and control earlier firmware versions (for example, Software Bisque has successfully tested *TheSkyX* using the GTO model controller with firmware version D from May 2001 with the GTO model controller). However, we *strongly recommend* using the latest firmware version.

Hardware Requirements

- Astro-Physics GTO German Equatorial control system with firmware G or later.
- A standard RS232 serial cable. Serial cables can be purchased from most any computer store.
- A USB to serial adaptor.

Step-by-Step AP GTO Setup Procedure

1. Using a standard DB9 M/F RS232 serial cable, connect the male end of the cable to the port labeled COM1 on the GTO Control Panel and the female end to the USB to serial adaptor.
2. Click the ***Telescope Setup*** command from the ***Telescope*** menu.
3. Select ***Mount*** in the ***Imaging System*** list on the left side of the ***Imaging System Setup*** window.
4. On the ***Choose Mount*** window, select your model telescope and click ***OK***. If the *exact* model of your telescope is not listed, don't worry; just select a similar model telescope. The underlying serial communication protocol is the same for similar models.

5. Click the ***Settings*** command on the ***Mount Setup*** pop-up menu and then select the correct ***COM*** port (Windows) or the correct ***Serial Device*** (Mac).
6. On the ***Imaging System Setup*** window, turn on the desired preferences and then click ***Close***.
7. Select the ***Connect*** command from the ***Telescope*** menu.

The telescope cross hair will now display the current coordinates of the telescope. If the mount has not been parked, or has not been initialized with the location, date and time from another application, the coordinates of the telescope will be RA: 0h 0' 0" Dec: 90º 0' 0". Use the ***Synchronize*** command (page 215) to initialize the telescope from *TheSkyX* if necessary.

AP mounts are automatically initialized using *TheSkyX's* time, date, location and Daylight Saving Time adjusted time zone, the mount's tracking is started, and the telescope is put into the long format mode.

Astro-Physics GTO Control System Notes

- *TheSkyX* always places the Astro-Physics control system into the "long format" mode upon establishing a link.
- Click ***Tools > Location, Date, Time*** on the Telescope Setup window (Display menu) to compare *TheSkyX's* date, time, latitude, longitude and time zone settings to the mount. Click the >> button to reset the AP GTO's values to match *TheSkyX's*.

Astro-Physics Specific Commands

Select the ***Astro-Physics Specific*** command from the ***Display*** menu to show commands that are specific to this control system. This command is only available when an Astro-Physics model mount is selected ***Telescope > Telescope Setup*** window.

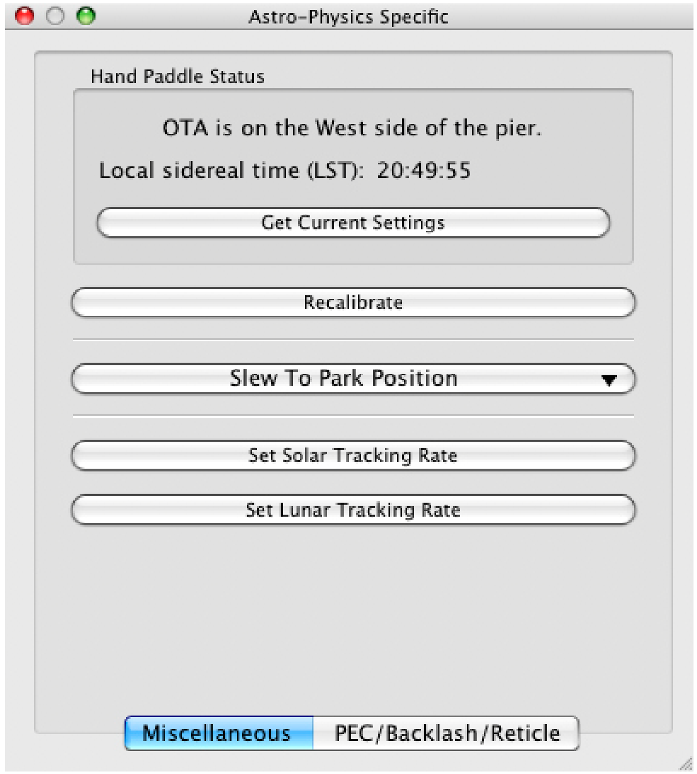


Figure 121: The Astro-Physics Specific window (Display menu).

Most of the AP-specific commands are self-explanatory. Details about each command can be found in AP Protocol documentation; this document is available from Astro-Physics web site.

Celestron and NexStar-Compatible Mounts

Figure 122: The Celestron C11-SGT (XLT) Computerized Telescope (NexStar-compatible). Copyright Celestron International.

TheSkyX controls most NexStar-compatible telescopes manufactured by Celestron International, including:

- Celestron™ Advanced Series (all models)
- Celestron™ NexStar (all models)
- Celestron™ CG Series (all models)
- Celestron™ CGE Series (all models)
- Celestron™ CPS Series (all models)
- Celestron™ GT Series (all models)
- Celestron™ SLT Series (all models)
- Celestron™ NexStar i Series (all models)

The NexStar control system is also used on telescopes from other manufacturers, including:

- Orion Telescopes and Binoculars go to telescopes
- Sky-Watcher SkyScan go to telescopes
- Tasco go to telescopes

Celestron Minimum System Requirements

TheSkyX can control telescopes that employ the NexStar control system using firmware version 1.6 and later and motor controller version 4.2 or later. If you have and older version of the firmware, contact the manufacturer for details about upgrading.

NexStar-Compatible Telescope Hardware Requirements

- A NexStar-compatible telescope.
- A NexStar Telescope Interface Cable. This cable can be purchased from Software Bisque, or the manufacturer.
- A USB to serial adaptor.

Important Notes

- The NexStar firmware version 1.6 and later, and motor controller version 4.2 and later are required to support high precision (24-bit) slewing and variable tracking rates.

  To determine the NexStar firmware version for your mount, when the hand paddle LED reads **NexStar GPS**, press the **Menu** button, then press the button labeled UP or DOWN (6 key or 9 key) until the **Utilities** menu appears. Press the UP or DOWN arrows on the keypad until the **Version** option appears, then press the **Enter** button. The versions for different firmware components are listed in the following order: hand controller, motor controller version for each axis, GPS version and then the bus control version.

  Contact Celestron International for details about obtaining updated firmware for your NexStar.
- NexStar GT Series telescopes using firmware version 1.6 and earlier and motor controller version 4.2 and earlier must use the ***Ultima 2000*** model mount.
- The NexStar command protocol version 4.1 or later supports software synchronization (that is, the telescope's position can be defined by external software like *TheSkyX*). See page 215 for details about synchronizing your mount with *TheSkyX*.

Step-by-Step NexStar Setup Procedure

1. Turn off both the computer and the telescope (always a good idea when connecting devices).
2. Connect the telescope interface cable to the serial port of the computer and the hand paddle of the NexStar (RJ22 end connector).
3. After the telescope interface cable is plugged into the NexStar's hand paddle and into the USB to serial adaptor, turn both the computer and the telescope on (the order does not matter).
4. Click the ***Telescope Setup*** command from the ***Telescope*** menu.
5. Select ***Mount*** in the ***Imaging System*** list on the left side of the ***Imaging System Setup*** window.
6. On the ***Choose Mount*** window, select your model telescope and click ***OK***. If the *exact* model of your telescope is not listed, don't worry; just select a similar

model telescope. The underlying serial communication protocol is the same for similar models.

7. Click the ***Settings*** command on the ***Mount Setup*** pop-up menu and then select the correct ***COM*** port (Windows) or the correct ***Serial Device*** (Mac).
8. On the ***Imaging System Setup*** window, turn on the desired preferences and then click ***Close***.
9. Select the ***Connect*** command from the ***Telescope*** menu.
10. Click the ***Synchronize*** command on the ***Start Up*** pop-up menu (page 215), then follow the on-screen instructions to complete the initialization.

The telescope cross hairs show the current position of the telescope should appear on the Sky Chart.

For NexStar models 4, 5, 8 (non GPS), 60, 80 and 114

Before connecting *TheSkyX* to the NexStar models 4, 5, 8 (non GPS), 60, 80 and 114, make sure that the hand paddle is in the ***RS 232 mode***. That is, the NexStar hand paddle must display the text ***RS-232*** on the top line, and ***Undo to Exit*** on the bottom line, ***at all times*** so that the hardware's serial port is operational; otherwise a connection cannot be established to the device through software. If the hand paddle does not remain in ***RS232*** mode at all times, *TheSkyX* will not be able to communicate with the telescope.

NexStar/TheSkyX Communication Notes

- Make sure so set the correct Daylight Saving Time setting on the NexStar hand paddle, otherwise *TheSkyX's* positions for solar system object, and object rise/set times, will differ from the NexStar hand paddle's values by one hour.
- The NexStar models 4, 5, 8 (non GPS), 60, 80 and 114 hand paddle must be in ***RS232*** mode in order to communicate with *TheSkyX*.
- The NexStar models 4, 5, 8 (non GPS), 60, 80 and 114 must be initialized and aligned in order to communicate with *TheSkyX*.
- The NexStar models 8 GPS and 11 GPS hand paddle *does not need to be in any particular menu* in order to communicate with *TheSkyX*.
- The NexStar firmware version 1.6 and later supports Motion Control buttons.
- The NexStar firmware version 1.6 and later has built-in slew limits. If a slew from *TheSkyX* fails, check the LED readout from the hand paddle to make sure these limits have not been exceeded.

Gemini Astronomical Positioning System

Figure 123: The Losmandy Gemini astronomical positioning system. Copyright Losmandy Instruments.

Gemini Minimum System Requirements

TheSkyX can control any mount that employs the Gemini Astronomical Positioning System firmware version 1.05 or later. If you have and older version of the firmware, contact the manufacturer for details about upgrading.

Hardware Requirements

- Gemini Astronomical Positioning System with firmware version 1.05 or later.
- A Gemini telescope cable. (Contact Losmandy Instruments to purchase this cable.)
- A USB to serial adaptor.

Step-by-Step Gemini Setup Procedure

1. Using the Gemini telescope serial cable, plug the male RJ22 end of the cable into the port labeled RS-232 on the Gemini controller and the female end to the USB to serial adaptor.
2. Click the ***Telescope Setup*** command from the ***Telescope*** menu.
3. Select ***Mount*** in the ***Imaging System*** list on the left side of the ***Imaging System Setup*** window.
4. On the ***Choose Mount*** window, select your model telescope and click ***OK***. If the *exact* model of your telescope is not listed, don't worry; just select a similar model telescope. The underlying serial communication protocol is the same for similar models.
5. Click the ***Settings*** command on the ***Mount Setup*** pop-up menu and then select the correct ***COM*** port (Windows) or the correct ***Serial Device*** (Mac).

6. On the ***Telescope Setup*** window, turn on the desired preferences and then click ***Close***.
7. Select the ***Connect*** command from the ***Telescope*** menu.
8. If the telescope has not been initialized, click ***Tools*** > ***Locate, Date, Time*** command on the ***Telescope*** window (***Display*** menu). This window shows *TheSkyX's* settings, and the Gemini's. Click the >> button to set the Gemini's values to *TheSkyX's*.
9. Click the ***Synchronize*** command on the ***Start Up*** pop-up menu (page 215), then follow the on-screen instructions to complete the initialization.

The Gemini should now be initialized and ready to use.

Gemini Specific Commands

Select the ***Gemini Specific*** command from the ***Display*** menu to show commands that are specific to this control system.

Note that this command is only available when the ***Gemini*** is selected in the Mount pop-up menu on the ***Telescope*** > ***Setup*** window.

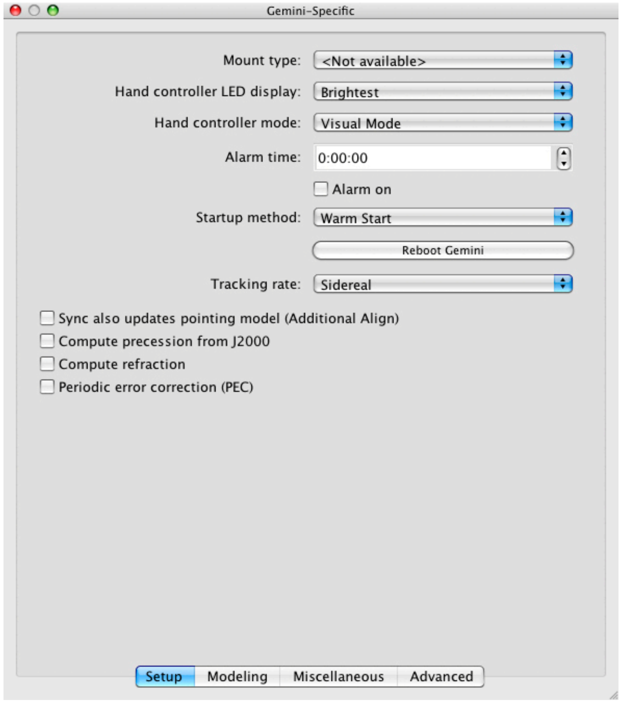


Figure 124: The Gemini Specific window (Display menu).

Details about the Gemini-specific commands can be found in Gemini User Manual; this document is available on the Losmandy web site (http://www.losmandy.com) .

iOptron Mounts

Figure 125: The iOptron SmartStar™-E Go To Alt/Az mount ("The Cube").

iOptron Minimum System Requirements

TheSkyX can control iOptron SmartStar model altitude/azimuth and equatorial mounts.

Hardware Requirements

- Any iOptron model go to mount.
- A standard USB cable (supplied with the mount).
- A Windows computer running *TheSkyX*.

Notes

- *TheSkyX* does not currently support iOptron mounts on the Mac.
- The iOptron firmware used to develop *TheSkyX's* driver contained significant limitations that prevent the mount from being initialized by *TheSkyX*; slews cancelled by *TheSkyX* also report errors. (Representatives from iOptron indicate that these issues will be addressed in future firmware updates.) Make sure to setup the iOptron to run standalone before attempting to control it using *TheSkyX*.

Step-by-Step iOptron Setup Procedure

1. After installing the Windows communication drivers for the iOptron, use Windows Hardware Manager to determine the port number used for this device.
2. Click the ***Telescope Setup*** command from the ***Telescope*** menu.
3. Select ***Mount*** in the ***Imaging System*** list on the left side of the ***Imaging System Setup*** window.
4. On the ***Choose Mount*** window, select your model telescope and click ***OK***. If the *exact* model of your telescope is not listed, don't worry; just select a similar model telescope. The underlying serial communication protocol is the same for similar models.
5. Click the ***Settings*** command on the ***Mount Setup*** pop-up menu and then select the correct ***COM*** port (Windows) or the correct ***Serial Device*** (Mac).

6. On the ***Telescope Setup*** window, turn on the desired preferences and then click ***Close***.
7. Select the ***Connect*** command from the ***Telescope*** menu.
8. Click the ***Synchronize*** command (page 215) on the ***Start Up*** pop-up menu, then follow the on-screen instructions to complete the initialization.

The iOptron should now be initialized and ready to use.

Meade Instruments Mounts

Figure 126: The Meade Autostar ETX-90PE telescope. Copyright Meade Instruments.

Meade Minimum System Requirements

TheSkyX can control LX200 Classic, Autostar, Autostar II and Autostar-compatible mounts, including the RCX400 series and telescopes that use the LX200 protocol, such as the Vixen SkySensor 2000.

LX200 Classic Hardware Requirements

- LX200 by Meade Instruments Corporation telescope (or a control system that uses the LX200 protocol).
- An LX200 telescope cable. This cable can be purchased from Software Bisque or the manufacturer.
- A USB to serial adaptor.

Autostar/Autostar II/Autostar III Hardware Requirements

- Autostar, Autostar II or Autostar III compatible telescope by Meade Instruments Corporation telescope (or a control system that uses the LX200/Autostar serial communications protocol).
- An Autostar telescope cable. This cable can be purchased from Software Bisque or the manufacturer.
- A USB to serial adaptor.

Meade RCX400 (Autostar II) Hardware Requirements

- Meade RCX400 by Meade Instruments Corporation telescope.
- An LX200 telescope cable. This cable can be purchased from Software Bisque or the manufacturer.

Step-by-Step LX200/Autostar Setup Procedure

TheSkyX must be configured correctly before it can communicate with the LX200.

1. Turn off the telescope.
2. Using the appropriate cable, connect the serial port on the telescope to the USB to serial adaptor.
3. Turn on the telescope.
4. Click the ***Telescope Setup*** command from the ***Telescope*** menu.
5. Select ***Mount*** in the ***Imaging System*** list on the left side of the ***Imaging System Setup*** window.
6. On the ***Choose Mount*** window, select your model telescope and click ***OK***. If the *exact* model of your telescope is not listed, don't worry; just select a similar model telescope. The underlying serial communication protocol is the same for similar models.
7. Click the ***Settings*** command on the ***Mount Setup*** pop-up menu and then select the correct ***COM*** port (Windows) or the correct ***Serial Device*** (Mac).
8. Click ***Close.***
9. Click ***Telescope > Connect***.
10. Click the ***Synchronize*** command (page 215) on the ***Start Up*** pop-up menu, then follow the on-screen instructions to complete the initialization.

Troubleshooting the LX200 (Classic) Telescope

TheSkyX will successfully establish communications with the Autostar/LX200 device, provided all of the following are true:

- The device is turned on and functioning.
- The hand paddle is plugged into the telescope's base panel.
- The hand paddle is in Polar or Alt/Az mode and *not* in Land Mode. See the documentation for setting this mode.
- The telescope cable is wired correctly for bi-directional communications.
- The telescope interface cable is plugged into the correct serial communications port or USB to serial adaptor.
- The telescope cable is plugged into the RS232 port on the LX200 base panel.
- The telescope cable is not plugged into a modem port (Windows).
- The COM port or USB to serial adaptor is functional and the software drivers are installed.
- The telescope interface cable (the one sold by Software Bisque) is using the DB9 end connector labeled "LX200" and not "BBox and Compatible".
- The ***Autostar/LX200*** mount is selected in the Control System list on the Telescope Setup window.
- The selected serial device (Mac) or COM port (Windows) is correct. Click ***Telescope > Telescope Setup > Settings*** to check this setting.

Verify that all of the above is true, and *TheSkyX* will successfully communicate and control the telescope.

Software Bisque Paramount Robotic Telescope Systems

PROFESSIONAL

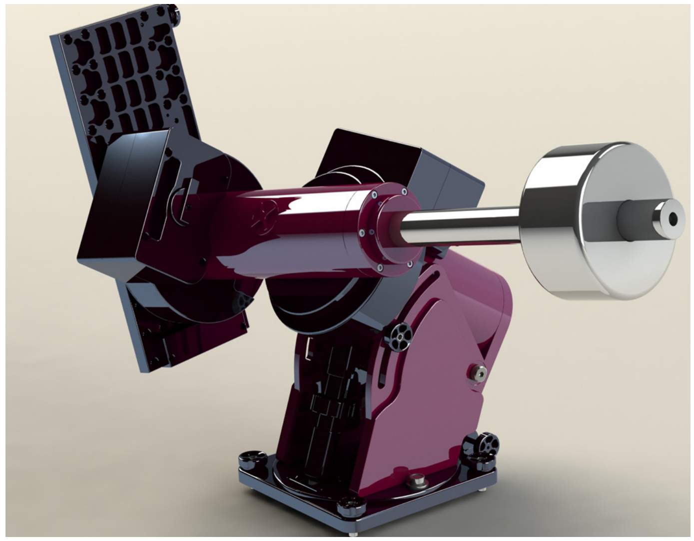


Figure 127: The Software Bisque *Paramount MX* Robotic Telescope Mount.

Please refer to the Paramount User Guide for instructions on setting up and using the Paramount (models GT-1100S, ME and MX) with *TheSkyX Professional Edition*.

StellarCAT

The StellarCAT hardware permits "go to" functionality for Dobsonian-class telescopes.

Computer Assisted Telescope Innovations


Figure 128: ServoCAT and ServoCAT Jr. Track/GOTO. Copyright StellarCAT.

StellarCAT Minimum System Requirements

TheSkyX can show the position of your telescope that uses the StellarCAT and StellarCAT Jr. control system, as well as issue slew commands to point the telescope to any object.

StellarCAT Hardware Requirements

- StellarCAT or StellarCAT Jr. Track/GOTO system
- Sky Commander or Argo Navis DSC. (See the "ServoCAT Quick Start and Troubleshooting Guide" for details about setting up the Digital Setting Circle or DSC.)
- A USB to serial adaptor.

Step-by-Step StellarCAT Setup Procedure

TheSkyX must be configured correctly before it can communicate with the StellarCAT. Please consult the StellarCAT User's Manual for details about setting up and configuring the system before attempting to connect it to *TheSkyX*.

1. Turn off the control system.
2. Using the appropriate cable, connect the serial port from the serial interface box to the computer's USB to serial adaptor (or serial port).
3. Turn on the control system.
4. Select the ***Telescope Setup*** command from the ***Telescope*** menu.
5. Select ***Mount*** in the ***Imaging System*** list on the left side of the ***Imaging System Setup*** window.
6. Select the ***Choose*** command from the ***Mount Setup*** pop-up menu.

7. On the ***Choose Mount*** window, select your model telescope and click ***OK***. If the *exact* model of your telescope is not listed, don't worry; just select a similar model telescope. The underlying serial communication protocol is the same for similar models.
8. Click the ***Settings*** command on the ***Mount Setup*** pop-up menu and then select the correct ***COM*** port (Windows) or the correct ***Serial Device*** (Mac).
9. Click ***Close***
10. Click ***Telescope*** **>** ***Connect***.

Troubleshooting the StellarCAT Connection

TheSkyX will successfully establish communications with the StellarCAT, provided all of the following are true:

- The device is turned on and functioning.
- The DSC serial cable is wired correctly for bi-directional communications. See the ServoCAT User's Manual for details about this cable.
- The ServoCAT serial cable is plugged into the correct serial communications port or USB to serial adaptor (PC side).
- The ServoCAT telescope cable is plugged into the RS232 port on back of the .
- The telescope cable is not plugged into a modem port (Windows).
- The COM port or USB to serial adaptor is functional and the software drivers are installed.
- The telescope interface cable (the one sold by Software Bisque) is using the DB9 end connector labeled "LX200" and *not* "BBox and Compatible".
- Autostar/LX200 is selected as the ***Mount***.
- The selected serial device (Mac) or COM port (Windows) is correct. Click ***Telescope*** **>** ***Telescope Setup*** **>** ***Mount Setup*** **>** ***Settings*** to check it.

Verify that all of the above is true, and *TheSkyX* will successfully communicate and control the telescope.

Takahashi Temma Mounts

Figure 129: Takahashi Temma mounts. Photo copyright Takahashi.

Temma Minimum System Requirements

TheSkyX can control Takahashi Temma model altitude/azimuth and equatorial mounts, including:

- EM-10 Temma PC Jr. (USD2)
- EM-200 Temma PC Jr. (USD2)
- EM-200 Temma PC
- NJP Temma PC
- EM-500 Temma PC
- EM-10 Temma2 Jr. (USD3)
- EM-200 Temma2 Jr. (USD3)
- EM-11 Temma2 Jr. (USD3)
- EM-200 Temma2
- EM-400 Temma2
- EM-500 Temma2

Hardware Requirements

- Any Takahashi Temma or Temma2 mount.
- A Takahashi telescope cable (supplied with the mount).
- A USB to serial adaptor.

Step-by-Step Temma Setup Procedure

TheSkyX must be configured correctly before it can communicate with the Temma mount. Make sure to set *TheSkyX's* location, date, time, time zone and Daylight Saving Time correctly before proceeding.

Figure 130: Temma PC Jr. Control Panel

1. Turn off the Temma telescope mount.
2. Using the gray Temma telescope cable (supplied with your mount), connect the round end to the port labeled RS-232C on the Temma mount, and the DB9 end to the USB to serial adaptor.
3. Turn the MOTOR and COMPUTER STAND BY switches to the ON position. When the Temma control system is powered on, it is initialized with the following default parameters.

    - The control system "thinks" the optical tube assembly end of the declination axis is on the West side of the mount.
    - The control system "thinks" telescope is pointing right ascension 0.0 and declination 0.0.
    - The right ascension and declination correction speeds are set to 90.
    - The control system's tracking is direction is for the Northern Hemisphere.

    These default parameters will not match the actual position of the optical tube assembly. *TheSkyX* allows you to correctly initialize the Temma's control system to match the position of the OTA. See the step below to do so.

1. Select the ***Telescope Setup*** command from the ***Telescope*** menu.

2. Select ***Mount*** in the ***Imaging System*** list on the left side of the ***Imaging System Setup*** window.
3. Select the ***Choose*** command from the ***Mount Setup*** pop-up menu.
4. On the ***Choose Mount*** window, select your model telescope and click ***OK***. If the *exact* model of your telescope is not listed, don't worry; just select a similar model telescope. The underlying serial communication protocol is the same for similar models.
5. Click the ***Settings*** command from the ***Mount Setup*** pop-up menu and then select the correct ***COM*** port (Windows) or the correct ***Serial Device*** (Mac).
6. Click ***Close***.
7. Click ***Telescope*** > ***Connect***. The Temma's local sidereal time and latitude are set according to *TheSkyX*'s values. The telescope cross hairs appear on the Sky Chart at 0,0 right ascension/declination. The Temma's tracking direction is automatically set according to *TheSkyX's* ***North*** or ***South*** latitude setting.
8. Click the ***Synchronize*** command (page 215) on the ***Start Up*** pop-up menu, then follow the on-screen instructions to complete the initialization. See "Temma Synchronization" below for more information.

Temma Synchronization

When the Temma mount is powered off, then on, the Temma control system's right ascension/declination coordinates are always 0.0,0.0.

At this point, you must point the telescope to a known position, and then synchronize *TheSkyX* at that position.

Synchronization Method	Procedure
To synchronize when the optical tube assembly end of the declination axis is on the *West* side of the mount.	1. Loosen the clutches on the mount and orient the telescope so that the optical end of the declination axis is on the West side of the mount. 2. Keeping the OTA end of the declination axis on the West side of the mount, center a known star that is on the *opposite* side of the meridian. 3. Identify this star in *TheSkyX* (either by clicking on it or using *TheSkyX's* **Find** command from the **Edit** menu.) 4. On the Telescope window, select the **Synchronize** command in the **Start Up** pop-up menu and follow the on-screen instructions.
To synchronize when the optical tube assembly end of the declination axis is on the *East* side of the mount.	1. Loosen the clutches on the mount and orient the telescope so that the optical end of the declination axis is on the East side of the mount. 2. Keeping the OTA end of the declination axis on the East side of the mount, center a known star that is on the *opposite* side of the meridian. 3. Identify this star in *TheSkyX* (either by clicking on it or using *TheSkyX's* **Find** command from the **Edit** menu.) 4. On the Telescope window, select the **Synchronize** command in the **Start Up** pop-up menu and follow the on-screen instructions.
To synchronize by pointing the telescope at the zenith.	1. Loosen the clutches on the mount and orient the telescope so that the optical tube assembly is pointing straight up (that is, the OTA is vertical). 2. Select the Temma Specific command from the Display menu to show the Temma Specific window if necessary. 3. Click the **Settings** tab on the Temma Specific window.

	4. Click the **Sync At Zenith** button.
No synchronization.	If the Temma has been initialized using other software, or is still initialized from a previous observing session (that is, you did not turn off the Computer Stand By switch on the mount). 1. Click **Telescope > Connect Telescope**.

Built-in Backlash Compensation

The Temma control system has a built-in "backlash compensation" feature that attempts to minimize the effects of gear slop. When the mount is commanded to slew from *TheSkyX*, it actually slews past the object a small amount, then slews back to it in the direction of sidereal tracking.

Temma Specific Commands

Select the ***Temma Specific*** command from the ***Display*** menu to show commands that are specific to this control system.

Note that this command is only available when the ***Temma*** is selected in the Mount pop-up menu on the ***Telescope*** > ***Setup*** window.

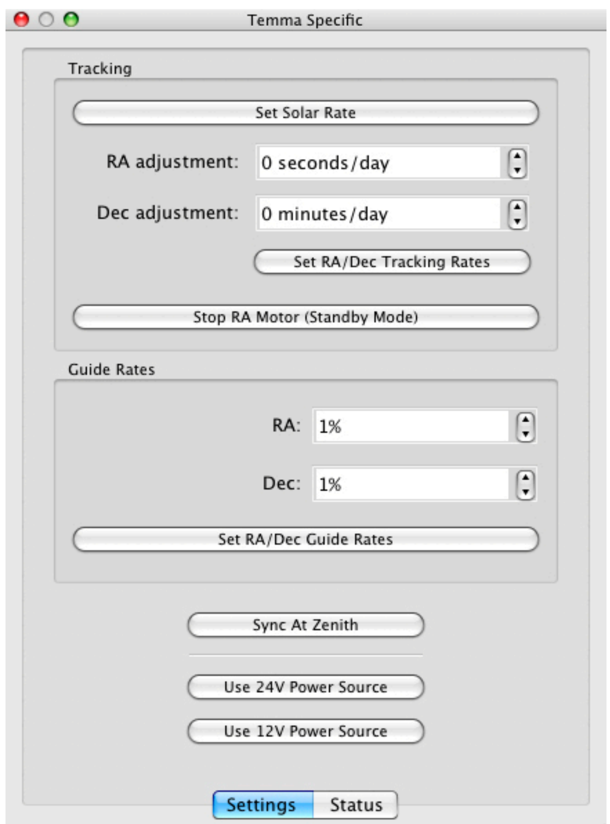


Figure 131: The Temma Specific commands window (Display menu).

Settings Tab

The following Temma-specific settings are available.

Set Solar Rate

Click this button to set the mount's tracking rate to approximate the Sun's rate of motion across the sky.

RA Adjustment (sidereal seconds/day)

Enter the adjusted tracking rate for the right ascension axis in *sidereal* seconds per day. There are 86,164 seconds in one *sidereal* day. (1 "earth day" = 1.002738 “sidereal day”). See the tracking rate example below.

Dec Adjustment (min/day)

Enter the adjusted tracking rate for the declination axis in minutes per day. See the tracking rate example below.

Tracking Rate Example

The following example shows how to set the Temma's tracking rates to match (approximately) the Moon's reported rate. This same procedure can be used for any solar system object.

1. From *TheSkyX*, click the ***Find*** command from the ***Edit*** menu.
2. Type ***Moon*** in the Find text box, and then click the ***Find*** button.
3. On the Object Information dialog report, note the ***RA Rate (arcseconds/sec)*** and the ***Dec Rate (arcseconds/sec)***. For this example, suppose RA = 0.4334 and Dec = 0.2567.
4. Compute the RA adjustment using the following equation: (*TheSkyX's* RA Rate × 5760) × –1. The value is –2496.
5. Compute the Dec adjustment using the following equation: (*TheSkyX's* Dec Rate × 1440) × –1. The value is 370.
6. Enter both values and click the ***Set Tracking Rates*** button.

Stop RA Motor (Standby Mode)

Click this button to turn tracking off. Note that this command is not supported by all Temma models. You may wish to verify that the mount's motor actually stops tracking before relying on this command to enter standby mode.

Guide Rates

RA

Enter the right ascension correction speed (as a percentage of the sidereal rate). This setting is used for the slow speed when using the Motion Controls.

Dec

Enter the declination correction speed (as a percentage of the sidereal rate).

Set RA/Dec Guide Rates

Click this button to set the current tracking rate using the number entered in the ***New*** text box.

Sync At Zenith

Click this button to synchronize the Temma mount when the OTA is pointing at the zenith.

Use 12V Power Source Button

Click this button to configure the Temma control system to use 12-volt power supply.

Use 24V Power Source Button

Click this button to configure the Temma control system to use 24-volt power supply.

- Issuing these commands when the Temma is slewing will cause the mount's motors to stop.
- Even when a 12-volt power supply is used, clicking the 24V Power Source Button results in higher slew rates.

Status Tab

Temma's Local Sidereal Time

Displays the local sidereal time reported by the Temma control system, in hours, minutes and seconds.

OTA is on this Side of Mount (East/West)

For German equatorial mounts, the optical tube assembly (OTA) end of the declination axis can be located on the East or West side of the mount. The Temma reports which side of the mount it "thinks" the optical tube assembly is on. Select the appropriate side from the pop-up menu.

Voltage From Power Supply

The Temma mount can use either 12V or 24V power. The *actual* voltage that is being supplied to the control system is shown here.

Hemisphere Tracking Direction

TheSkyX's North/South latitude setting in the ***Input > Location*** window is used to configure the Temma's direction of tracking.

Standby Mode

Reports whether or not the Temma mount is in "standby mode," which means the mount's MOTOR switch (Figure 129 on page 235) is turned off. When this switch is in the off position, the mount's right ascension axis will not track at the current tracking rate.

Parking the Temma PC Jr.

Temma PC Jr. mounts do not allow the mount's tracking rate to be turned off through software (the Motor Power switch must be turned off to stop the motors from tracking at the current rate). Therefore, when the Park command is issued for this mount, *TheSkyX* still slews the mount to the park position, but it must then periodically slew back to the park position every few minutes (to undo the rotation or the right ascension axis that is the result of the mount tracking at the sidereal rate).

Note that "software-based parking and continuous rewinding" is a *poor workaround* to a *fundamental shortcoming* in the mount's control system. Loss of communication between the mount and *TheSkyX* will prevent *TheSkyX* from correcting the mount's park position, and will most likely result in the mount tracking into itself. This unfortunate event will most likely cause damage to the mount, equipment, cabling or all three. The Temma control system has no built-in software or hardware tracking limits and it will try to rotate the right ascension axis even after the mount has tracked into a fixed object like, such as the pier.

At a minimum, this telescope control system should allow tracking to be turned off through software. Ideally, the telescope's firmware should support a park/unpark mechanism that allows the mount to be shut down and restarted to restore the last session.

Vixen HTTP Equatorial Mounts

Figure 132: The Vixen™ Sphinx HTTP mount. Photo copyright Vixen Optics.

Vixen Minimum System Requirements

TheSkyX can control Vixen Sphinx HTTP mounts using firmware version 1.2 build 35 and later. If you have an older version of the firmware, contact the manufacturer for details about upgrading.

Hardware Requirements

- Any Vixen Sphinx model German equatorial mount that uses the STAR BOOK™ Star-Chart Go To System.
- An Ethernet ***crossover*** cable for direct connection from the computer to the STAR BOOK or an Ethernet straight cable for network connection to the telescope through a router.

Cabling Notes

The Vixen HTTP mount uses standard network protocol rather than serial communications. In the Settings dialog, enter the URL of the mount on your network. The default URL is http://169.254.1.1. Use this address if the Vixen is connected directly to the computer's network port using with an Ethernet *crossover cable*.

If your mount is plugged into a network router, use a standard network cable instead.

Step-by-Step Vixen HTTP Setup Procedure

4. Plug the network cable into the base of the Star Book and into the computer's network port (a network crossover cable is required) or into a network router or hub (using a standard Ethernet cable).
5. Select the ***Telescope Setup*** command from the ***Telescope*** menu.
6. Select ***Mount*** from the ***Imaging System*** list on the left side of the ***Imaging System Setup*** window.

7. Select the ***Choose*** command from the ***Mount Setup*** pop-up menu.
8. On the ***Choose Mount*** window, select your model telescope and click ***OK***. If the *exact* model of your telescope is not listed, don't worry; just select a similar model telescope. The underlying serial communication protocol is the same for similar models.
9. On the ***Imaging System Setup*** window, click the ***Settings*** button from the ***Mount Setup*** pop-up menu and enter the URL of the Vixen Star Book. When the mount is turned on and the network cable is plugged into both the Star Book hand paddle and the network router, the Star Book's About box shows the URL of this device on the network. Enter this address into the URL text input on the HTTP Port Settings dialog.
10. On the ***Imaging System Setup*** dialog, turn on the desired preferences and then click ***Close***.
11. Select the ***Connect*** command from the ***Telescope*** menu. The telescope cross hair displays the current coordinates of the telescope.
12. Click the ***Synchronize*** command (page 215) on the ***Start Up*** pop-up menu, then follow the on-screen instructions to complete the initialization.

The Vixen mount should now be initialized and ready to use.

Camera Control

PROFESSIONAL

TheSkyX Professional Edition for Mac and Windows, stand alone, can acquire photos from SBIG-model cameras using the *Basic Camera Add On*. (Software Bisque plans to add and expand support for additional model cameras and hardware in future updates.)

Additionally, *TheSkyX Professional Edition* for Windows can acquire photos from any camera that is supported by CCDSoft for Windows *Version 5.0.0.196 or later*.

Configuring the Basic Camera Add On

Follow the steps below to configure *TheSkyX Pro* to directly control an SBIG camera.

1. Install the SBIG camera drivers for your operating system. If necessary use SBIG's free CCOPS software for your OS to make sure the driver is functioning and you can take photos.
2. Make sure your camera is plugged in and turned on. Before attempting to connect to the camera, allow 30 seconds or so for the SBIG camera to initialize.
3. From *TheSkyX*, select the ***Telescope Setup*** command from the ***Telescope*** menu.
4. Select ***Camera*** from the ***Imaging System*** list.
5. Click the ***Choose*** command on the ***Camera Setup*** pop-up menu. If you have not purchased the *Basic Camera Add On*, click the ***Run Trial*** button to use begin the 90 day trial period.
6. Expand ***SBIG***, then select your camera model and click ***OK***.
7. Select the ***Connect*** command from the ***Camera Setup*** pop-up menu. If the SBIG drivers are installed properly, after about 15 seconds, the green Ready status text appears on the ***Imaging System Setup*** window and on the ***Camera*** window.

Figure 133: The Camera window.

Take a photo by clicking the ***Take Photo*** button on the ***Camera*** window.

Select Exposure Length (Exposure Length)

The maximum exposure length is determined by how good your polar alignment is, and by how accurately your mount tracks. If you see stars trailing into lines, shorten your exposure until this goes away (or take some time to improve your polar alignment or the accuracy of your mount's tracking). If you see wiggly lines on long exposures, then your mount's tracking error is too large for the current focal length. Use a focal reducer, or switch to a scope with a shorter focal length that better fits the capabilities of your mount.

The following table includes some recommended exposure times for various objects. The table assumes a focal ratio in the range of about f/7. Use longer exposures for longer focal ratios, and shorter exposures for shorter focal ratios. If you get blooming on a particular object, then go to a shorter exposure. If you don't get much detail in the image, or it seems washed out, go to a longer exposure. Generally speaking, unless you run into blooming, saturation, or other problems, longer exposures are generally better. Experiment to find the best exposures for your setup. You might want to keep a written record of successful exposures, which you can use as a guide for future imaging sessions.

Object	**Suggested Exposure range**
Sun	Use a visual solar filter, plus any additional filters needed to cut the light. Polarizing filters, moon filters, or other specialized filters such as h-alpha filters can reduce the light so that your camera's

	shortest exposure will be sufficient for solar images. Do not use so-called photographic solar filters. These are intended for film, which is much less sensitive than your CCD detector. ***Never attempt to photograph or view the sun without a proper solar filter!***
Bright planets	Planets such as Venus, Jupiter, Saturn and Mars require surprisingly short exposures with most setups, as little as 5 to 10 thousandths of a second. However, if you use a Barlow or eyepiece projection to increase the focal ratio to f/20 or even f/30, longer exposures (up to a full second) may be required.
Moon	The moon is also very bright, especially around full moon, and may require some effort on your part to attenuate the light sufficiently for imaging. Polarizing filters and moon filters, or both, will get the job done. As with solar images, the shortest possible exposure of your camera should be tried first. Then add additional filtering if that isn't short enough, or increase the exposure if it's not long enough.
Open clusters, bright globular clusters	These objects require relatively short exposures, and exposure length is usually limited by blooming if you don't have an anti-blooming camera. If you do have an anti-blooming camera, you can even image open clusters long enough to image background galaxies. For clusters with very bright members, or globular clusters with very bright cores such as M13, exposures under a minute should be enough. Dimmer clusters may require exposures longer than a minute. Very bright clusters, such as the Pleiades, may only work well with anti-blooming cameras. For color imaging, be careful not to saturate bright stars so you can get truer star colors.
Galaxies	Galaxies come in a enormous range of brightness levels. M31 will show up in an exposure of a few seconds; M101 may require 5 to 10 minutes or more. Generally speaking, edge-on spirals and elliptical galaxies are brighter and require shorter exposures. Face-on spirals are usually the dimmest galaxies and require longer exposures. When using a scope with a very long focal length, large pixels or binning may be required to get reasonable exposure times.
Nebulas	Nebulas come in an even wider range of brightness than galaxies do. Some, like M42, will yield excellent results in less than 20 seconds. Others, like the Rosette Nebula, may require 20-minute exposures to get good detail. A few trial exposures will help you determine the best exposure for any given nebula.

Generally speaking, longer exposures are better in most cases because they provide better-quality data. However, blooming, the risk of passing satellites or airplanes, and other factors usually limit the longest exposure time you can use. You can take multiple exposures and combine them in various ways to increase the quality of your photos.

Set Frame Type to Light

If you are just getting started, make sure that the ***Frame*** is set to ***Light***. The Frame pop-up also includes settings for taking photo reduction frames. A CCD detector generates a certain amount of noise, and photo reduction removes a great deal of that noise. When you are taking a photo, always set the frame type to ***Light***.

The frame types are:

Light	A normal photo, taken with the shutter open.
Bias	A frame of the shortest possible exposure, taken with the shutter closed. It represents the minimum noise in the CCD detector and camera circuitry. This is subtracted from Dark frames so that the dark frames can be scaled for time and temperature differences.
Dark	A photo taken with the shutter closed. It is in effect a picture of the electronic noise in the camera. This noise can be subtracted from a Light image to create a cleaner image.
Flat Field	A flat-field is an image taken of an evenly illuminated field, with the shutter open. Think of the flat-field as an image of the optical noise in the system, such as dust motes on glass surfaces or reflections off of the inside of the telescope. The Flat Field is applied to the Light frame to remove this source of noise.

Set an Appropriate Reduction Setting (Reduction pop-up)

When you select ***Light*** as the frame type, you can also choose the type of reduction to apply to the photo. Reduction is the process of applying bias, dark, and flat-field frames to your image to reduce system noise.

For your first images, choose the ***AutoDark*** reduction setting. After your exposure is finished, the software will automatically take a dark frame with the same exposure settings, and subtract it from the photo. This will give you a cleaner image with less thermal noise. When you gain more experience, you can explore the other reduction options:

None	The software performs no photo reduction. Use this setting when you wish to manually apply your own bias, dark, and flat-field images; or when you simply want a quick image without any reduction.
AutoDark	This will follow the first exposure with a single dark frame. The dark frame is saved in memory and will be applied to all subsequent exposures with the same duration. If you change the exposure duration, a new AutoDark frame will be taken.

Using CCDSoft for Windows

In addition to the *TheSkyX's* stand alone support for SBIG cameras, any camera that can be controlled by CCDSoft for Windows *version 5.00.200* or later can also be used. Please double-check that you have installed the latest release of CCDSoft for Windows before continuing.

Configuring TheSkyX to use CCDSoft

1. Install the SBIG camera drivers.
2. Make sure that CCDSoft, *standalone*, can connect to and acquire photos from the camera. If CCDSoft does not work to control the camera, *TheSkyX* can't use it to acquire photos either.
3. Make sure your camera is plugged in and turned on. Before attempting to connect to the camera, allow 30 seconds or so for the SBIG camera to initialize.
4. From *TheSkyX*, select the ***Telescope Setup*** command from the ***Telescope*** menu.
5. Select ***Camera*** from the ***Imaging System*** list.
6. Click the ***Choose*** command on the ***Camera Setup*** pop-up menu. If you have not purchased the *Basic Camera Add On*, click the ***Run Trial*** button to use begin the 90 day trial period.
7. Expand ***Software Bisque***, then select ***CCDSoft's Camera*** and click ***OK***.
8. Select the ***Connect*** command from the ***Camera Setup*** pop-up menu. If the SBIG drivers are installed properly, and CCDSoft is configured correctly, then after about 15 seconds, the green Ready status text appears on the ***Imaging System Setup*** window and on the ***Camera*** window.

Temperature Control

CCD detectors have a small but significant amount of noise. Cooling the detector reduces this noise dramatically, so nearly all CCD cameras used in astronomy have some form of cooling. The ***Temperature Setup*** button in the Camera window allows you to set the level of cooling for your camera.

Clicking on the ***Temperature*** button displays the ***Temperature Setup*** dialog. Click the **On** option to turn temperature regulation on. Then set an appropriate temperature for your camera, taking into account the ambient temperature and your camera's cooling capabilities.

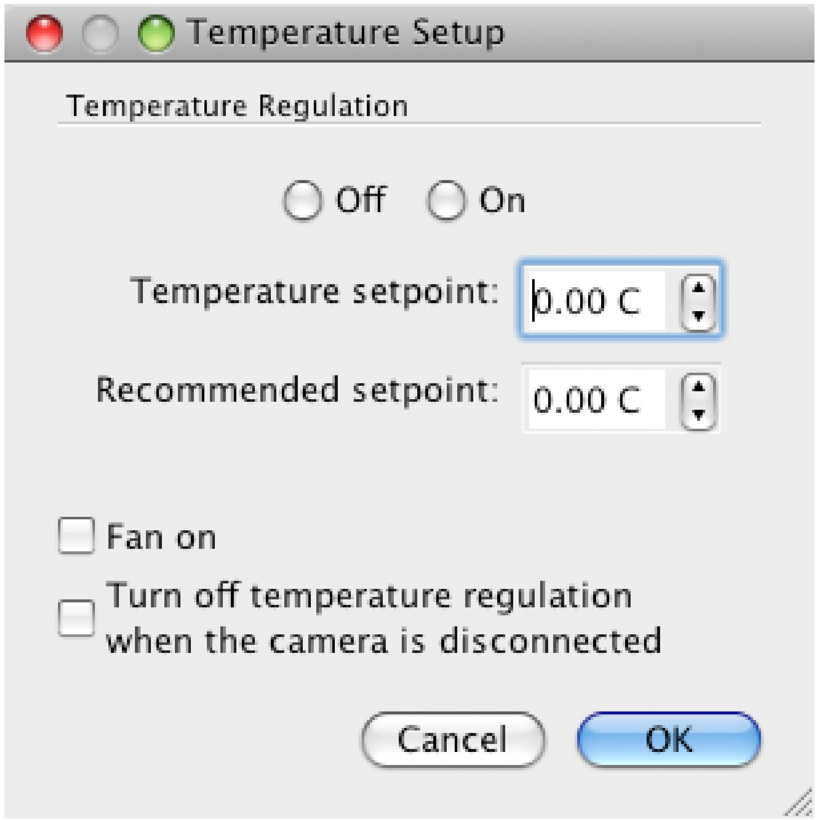


Figure 134: The setpoint you enter in the Temperature dialog will vary with the ambient temperature.

The ***Temperature*** dialog recommends a setpoint on cameras that provide ambient temperature data, but you can also calculate it for yourself.

Generally speaking, you want to set the cooling setpoint so that approximately 75-85% of the camera's cooling capacity is used to maintain that temperature. This leaves a sufficient reserve cooling capacity to quickly respond to changes in ambient temperature.

By keeping some cooling capacity in reserve, the camera can maintain the setpoint more accurately. Your camera documentation will contain information about the maximum cooling capacity of your camera, typically expressed in degrees below ambient temperature. For example, the ST-7E camera has a cooling capacity of 30 degrees below ambient. To calculate an optimal setpoint, take 75% of 30, and subtract it from the ambient temperature. For example, if the ambient temperature is 15 degrees Celsius, and 75% of 30 is 22.5, then your target temperature is 15-22.5, or –7.5 degrees. If you were working with the ST-237 camera, cooling capacity is 25 degrees below ambient, so your target temperature is -2.5ºC. In the real world, cooling capacity will vary somewhat. As long as your values stay in the 75%-85% range, you are going to get good results.

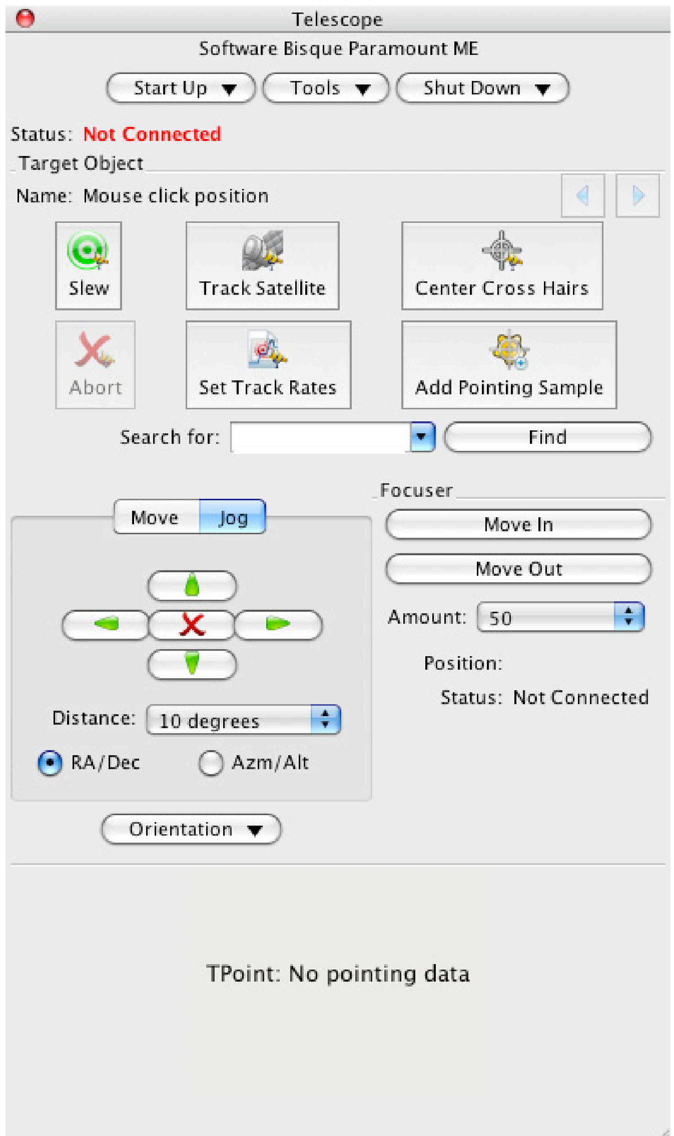
Taking a Photo

To take a photo, click the ***Camera*** tab, enter the ***Exposure Length***, ***Binning*** and click ***Take Photo*** button.

When the photo is ready, it is displayed in the ***FITS Image Viewer*** window (page 62).

Focuser Control

TheSkyX can control focusers that are part of the telescope's control system. Simply plug the focuser into the telescope's focuser port, then use the ***Focuser*** controls on the ***Telescope*** window to adjust focus.



Dome Control

PROFESSIONAL

TheSkyX can control astronomical domes that support the Astronomy Command Language (ACL) and any dome that can be controlled by *AutomaDome for Windows*.

As you slew the telescope using *TheSkyX*, the *Dome Add On* algorithms automatically rotate the dome's aperture to the correct azimuth taking into account the telescope-dome geometry.

The position of the dome's opening is displayed on the Sky Chart for reference.

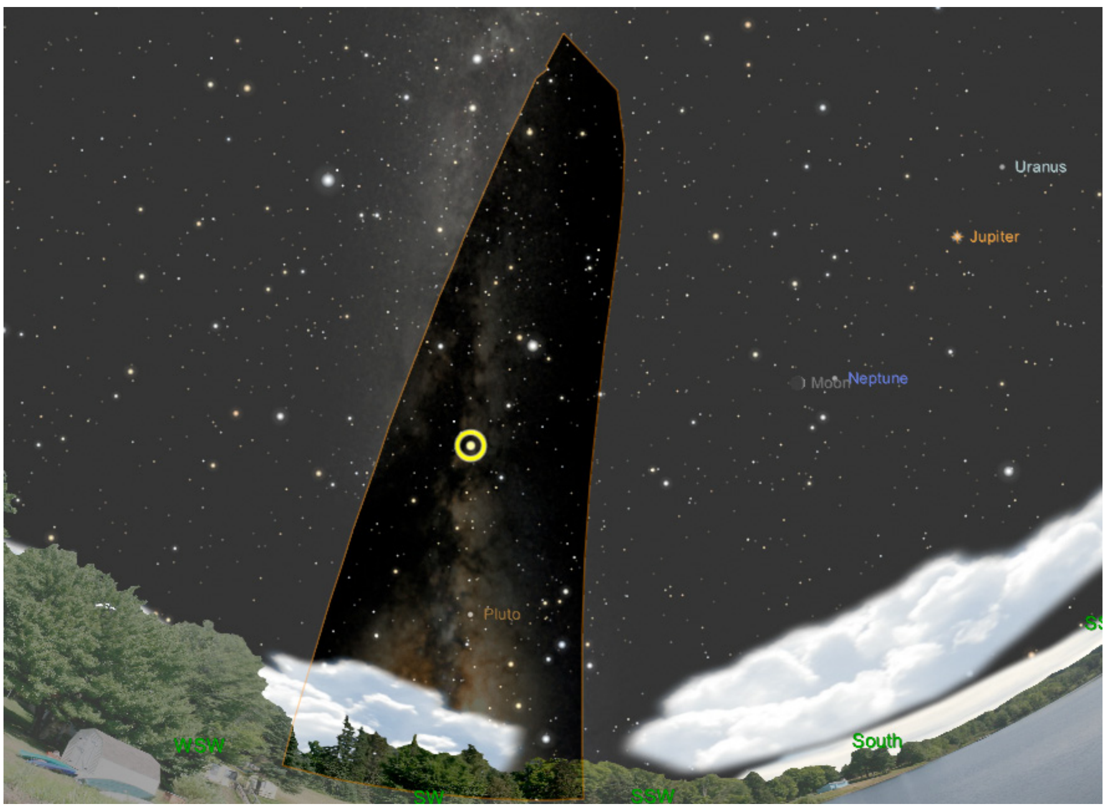


Figure 135: Sky Chart showing dome slit and telescope cross hair.

Minimum Requirements

- Any ACL-compatible dome hardware.
- Any dome controller supported by *AutomaDome for Windows* version 1.00.012 or later.

TheSkyX Professional Edition for Mac and Windows, stand alone, can control astronomical domes with the *Dome Control Add On*. (Software Bisque plans to add and expand support for additional domes controllers in future updates.)

Additionally, *TheSkyX Professional Edition* for Windows can control domes supported by AutomaDome for Windows version 1.00.012 or later.

Configuring the Dome Control Add On

Follow the steps below to configure *TheSkyX Pro* to directly control a dome.

1. Make sure your dome controller is ready.
2. From *TheSkyX*, select the ***Telescope Setup*** command from the ***Telescope*** menu.
3. Select ***Dome*** from the ***Imaging System*** list.
4. Click the ***Choose*** command on the ***Dome Setup*** pop-up menu. If you have not purchased the *Dome Control Add On*, you can click the ***Run Trial*** button to use begin the 90 day trial period.
5. Select your dome controller and click ***OK***.
6. Select the ***Connect*** command from the ***Dome Setup*** pop-up menu. If the dome drivers are installed properly, after about 15 seconds, the green Connected status text appears on the ***Imaging System Setup*** window and on the ***Dome*** window.

Using AutomaDome for Windows

In addition to the *TheSkyX's* stand alone support for domes, any dome that can be controlled by *AutomaDome for Windows* can also be used. Please double-check that you have installed the latest release of AutomaDome for Windows before continuing.

Configuring TheSkyX to Use AutomaDome

- Make sure *AutomaDome*, standalone, can connect to control the dome. If *AutomaDome* does not work to control the dome, *TheSkyX* can't use it to control the dome either.
- From *TheSkyX*, select the ***Telescope Setup*** command from the ***Telescope*** menu.
- Select ***Dome*** from the ***Imaging System*** list.
- Click the ***Choose*** command on the ***Dome Setup*** pop-up menu. If you have not purchased the *Dome Control Add On*, click the ***Run Trial*** button to use begin the 90 day trial period.
- Expand ***Software Bisque***, then select ***AutomaDome Dome*** and click ***OK***.
- Select the ***Connect*** command from the ***Dome Setup*** pop-up menu. The green Connected status text appears on the ***Imaging System Setup*** window and on the ***Dome*** window.

Dome Geometry

The next step is to define the dome geometry so that the dome opening can be coupled to, and follow the telescope.

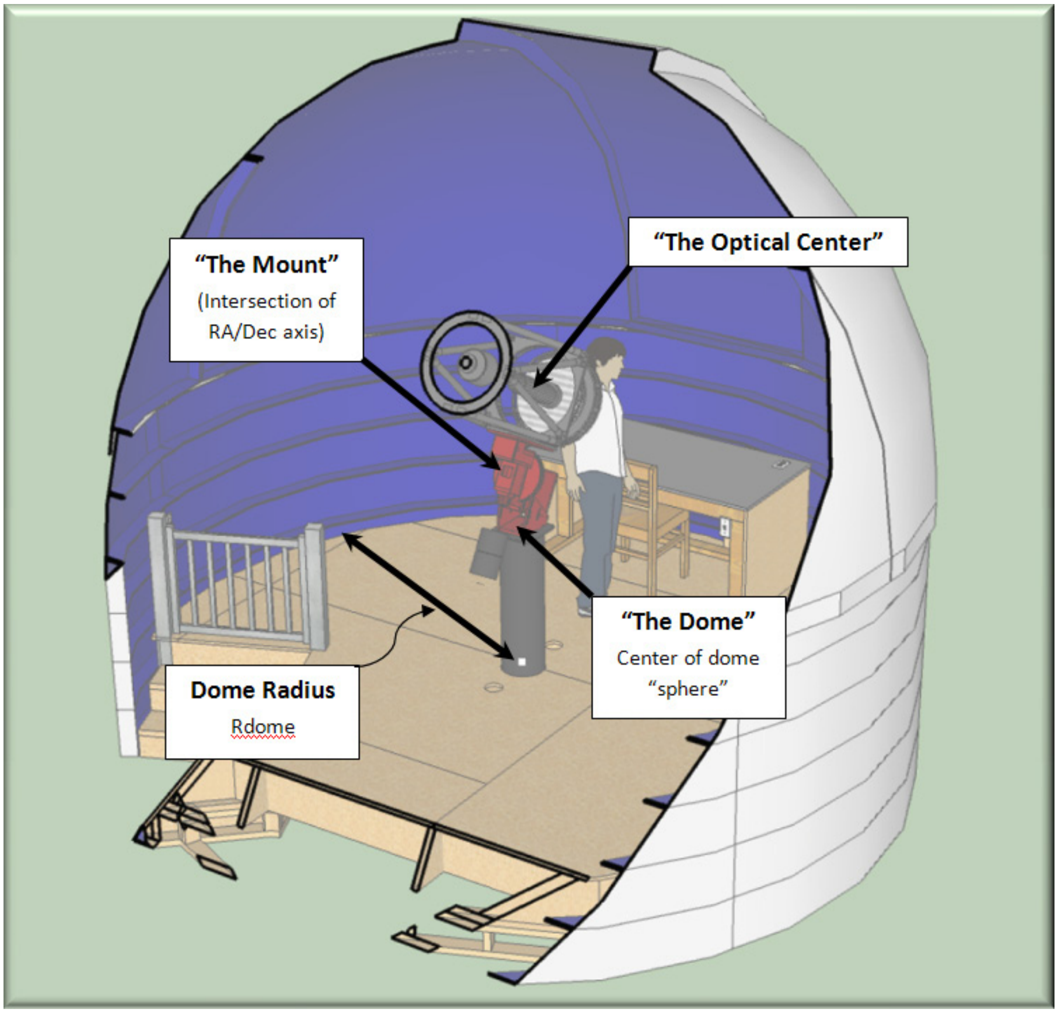


Figure 136: The positions of the dome geometry parameters in an actual dome.

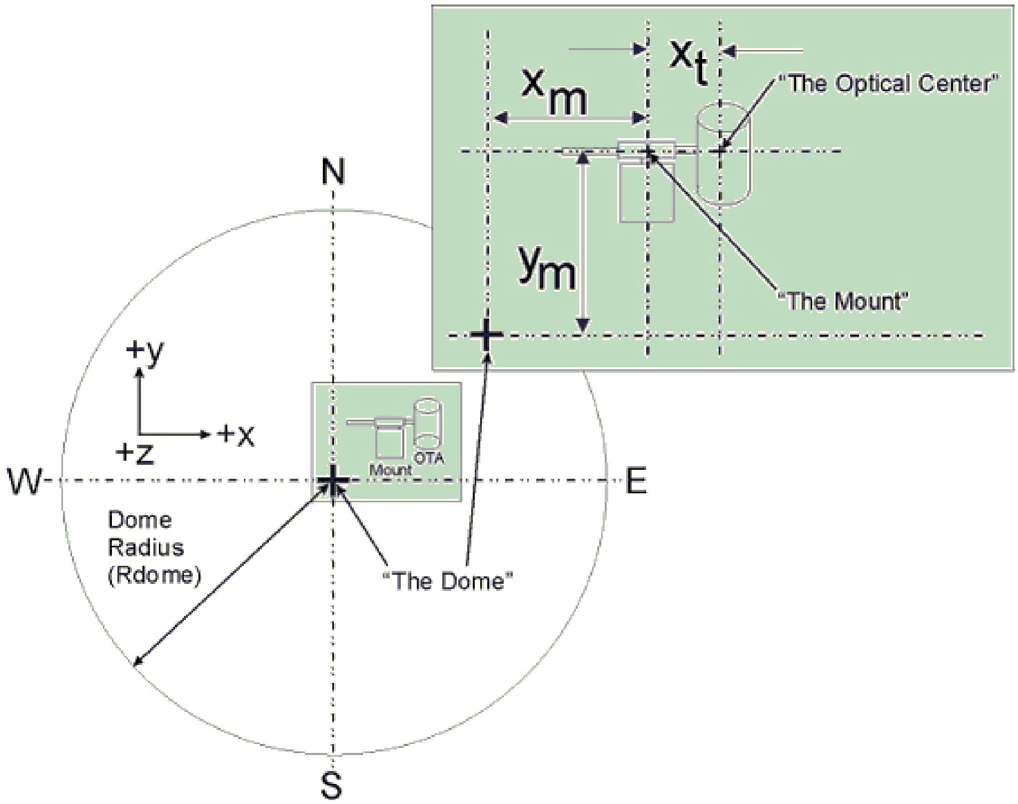


Figure 137: Overhead view of the dome.

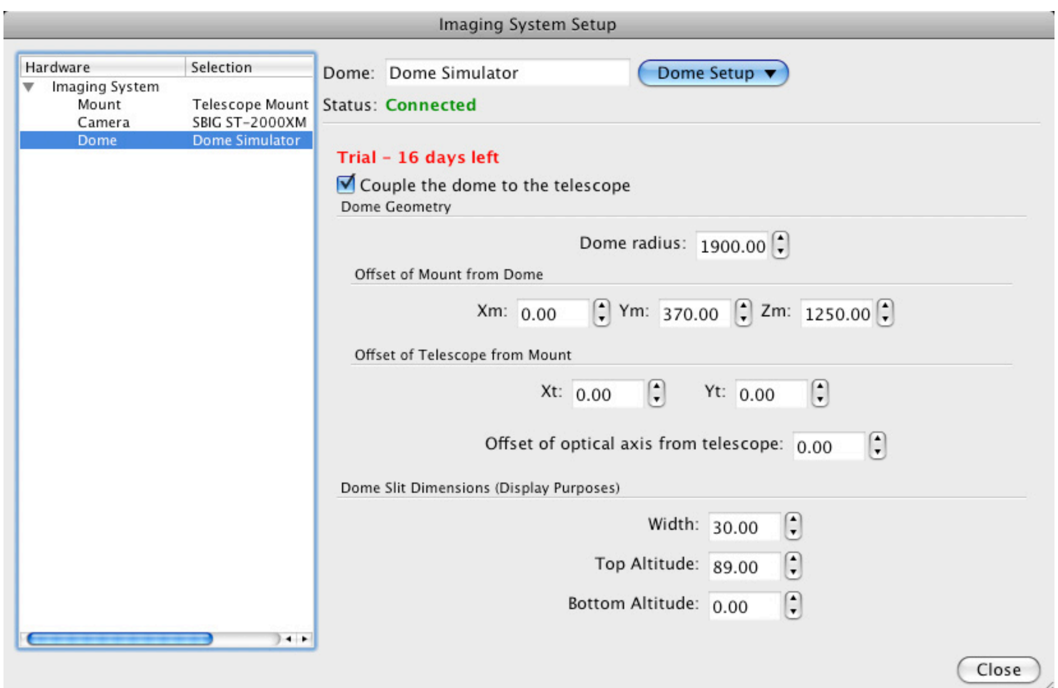


Figure 138: Dome geometry setting on the Imaging System Setup window.

The above dialog allows you to specify the dome geometry for your dome, telescope and optical system.

Use the above figures and the definitions below to determine the geometry for your dome, telescope and optical system.

Dome Radius

Enter the radius of the dome. All measurements should be the same units. See above diagram for details. See Technical Description of Required Parameters below for more information.

Offset of Mount from Dome

The arguments xm, ym, zm specify the offset of "the mount" from "the dome." See Technical Description of Required Parameters below for more information.

Xm

Enter the distance from the N-S centerline of "the dome" to "the mount." See above diagram for details. Also, see Technical Description of Required Parameters below for more information.

Ym

Enter the distance from the E-W centerline of “the dome” to “the mount”. See above diagram for details. Also, see Technical Description of Required Parameters below for more information.

Zm

Enter the distance from “the dome” to “the mount”. This parameter is not defined in the above diagram. See Technical Description of Required Parameters below for more information.

Offset of Telescope from Mount

The arguments xt, yt specify the offset of the telescope from the mount. See Technical Description of Required Parameters below for more information.

Xt

Enter the distance from the N-S centerline of “the mount” to the “optical center”. See Technical Description of Required Parameters below for more information.

Yt

Enter the distance from the E-W centerline of “the mount” to the “optical center”. This parameter is not defined in the above diagram, and is normally zero. See Technical Description of Required Parameters below for more information.

Offset of Optical Axis from Telescope (yo)

Enter the offset of the optical axis within the telescope. This value is typically zero for most amateur telescopes.

Use these dome and telescope mount geometry options to define the position of your telescope mount with respect to the center of the dome. These parameters are required to predict the azimuth and elevation of the dome aperture for any asymmetrically mounted telescope. See Technical Description of Required Parameters below for more information.

Technical Description of Required Parameters

Parameter	**Description** (See notes below)
Rdome	Radius of dome
xm, ym, zm	Offset of mount
xt, yt	Offset of telescope
Yo	Offset of optical center
ta, tb	Telescope roll/pitch in radians.

Notes:

- The dome is presumed to be hemispherical (or some other portion of a sphere). The radius of the sphere is specified through the Rdome argument. Any desired units can be used as long as the other “length” arguments are in the same units.
- The arguments **xm**, **ym**, **zm** specify the offset of the mount from the dome. "The dome" is the center of the sphere. "The mount" is that point along the roll axis (and hence fixed in space) that lies nearest to the telescope (Note 5). The x, y, z coordinate system is oriented east, north, up.
- The arguments xt, yt specify the offset of the telescope from the mount. “The mount” is the fixed point defined in Note 4. “The telescope” is that point along the pitch axis (and hence fixed within the moving part of the mount) that lies nearest to the optical axis (Note 6).
- The argument yo specifies the offset of the optical axis within the telescope. "The telescope" is the point defined in Note 5. “The optical center” is the point along the optical axis that lies nearest to the pitch axis. It is the intersection of the optical axis with the dome that defines the point the azimuth and elevation of which are to be calculated.
- The telescope roll/pitch coordinate system matches hour angle and declination in the equatorial case. This means that it is left-handed, longitude increasing clockwise as seen from the positive pole. It means also that zero roll occurs when a northern-hemisphere telescope is pointing south. Thus the telescope roll/pitch system matches azimuth/elevation in handedness but there is an azimuth zero-point offset of 180 degrees. Note that the roll/pitch are mechanical rather than celestial, so that above/below pole and east/west of the pier cases are distinguished.

- The coordinate systems for the offsets are as follows.
  - ✓ They are all right-handed.
  - ✓ The **xm**, **ym**, **zm** axes point east, north, up.
  - ✓ The orientation of the **xt**, **yt** axes is such that they coincide with xm, ym for the case of an alt-azimuth mount pointing south. Other types of mounting follow suit. For an equatorial mount in the Northern Hemisphere, when the telescope is pointing at the meridian north of the zenith, xt points east (i.e. aligned with xm), and the horizontal component of **yt** points north (i.e. aligned with ym).
  - ✓ The yo axis is coincident with **yt** when the telescope is pointing at the positive pole.
  - ✓ The units of **rdome**, **xm**, **ym**, **zm**, **xt**, **yt**, **xo** and **yo** must all be the same.
- The dome azimuth/elevation coordinate system follows the normal convention. Azimuth increases clockwise from zero in the north, through 90 degrees (pi/2 radians) in the east. The value returned is in the range zero to 2pi. At the zenith, zero is returned.
- Small "pointing corrections", minor non-perpendicularities and misalignments, are ignored.

Dome Commands

Select the ***Dome*** command from the ***Display*** menu to show the Dome window. This window is normally “docked” to the left side of the Sky Chart, but can be positioned elsewhere by dragging the caption.

Figure 139: Dome commands.

Status

Shows the current status of the dome connection.

Azimuth

Shows the current azimuth of the dome opening.

Connect

Click this button to establish communication with the dome controller.

Disconnect

Click this button to terminate communication with the dome controller.

Go To

Click this button to enter the azimuth to position the dome opening.

Find Home

Click this button to locate the dome's home position.

Open Dome

Click this button to open the dome.

Close Dome

Click this button to close the dome.

Park Dome

Click this button to send the dome to its park position.

UnPark Dome

Click this button to perform any necessary initialization when starting up the dome for the night.

Sync Dome

Click this button to synchronize the dome opening to a specific azimuth.

Abort

Click this button to terminate in any dome command that is currently in progress.

Result

Shows the result of the dome command that is reported by the dome controller hardware.

Appendix A: Databases and Cross References

TheSkyX Professional Edition and Serious Astronomer Edition include databases of celestial objects from the standard astronomical catalogs listed in the tables below.

If you want to use a specific set of databases, select the ***Database Manager*** command from the ***Input*** menu to turn any catalog on or off.

Star Catalogs

The Hipparcos-Tycho Catalogs are the primary stellar databases used to display information by *TheSkyX* for stars to about 12th magnitude and brighter.

TheSkyX also cross-references stars from the following catalogs.

- Bayer/Flamsteed Designations
- Smithsonian Astrophysical Observatory Catalog (SAO)
- Positions and Proper Motion Catalog (PPM)
- Henry Draper Catalog (HD)

Star Catalog Name	**Details/Object Count**
Hipparcos/Tycho Stellar Catalog	1.2 million stars, complete to 12th magnitude
Hubble Guide Star Catalog (GSC) Version 1.2	19 million stars, complete to about 14th magnitude
General Catalog of Variable Stars (GCVS)	40,214 variable stars
New Suspected Variable Star Catalog (NSV)	13,490 suspected variable stars
Struve Double Star Catalog	4,307 double stars
Washington Catalog of Double Stars (WDS)	102,139 double stars

Non-Stellar Catalogs

Non-stellar Catalog Name	**Details/Object Count**
Historically Corrected New General Catalogue (HCNGC) from the NGC/IC Project*	7,840 non-stellar objects
Index Catalog (IC) from the NGC/IC Project*	5,382 non-stellar objects
Catalog of Principal Galaxies (PGC)	98,087 galaxies
PK Planetary Nebula Catalog (PLN)	1,455 planetary nebulae
Tomm Lorenzin 2000+ Catalog	2,088 non-stellar objects
Herschel Catalog	400
Caldwell Catalog	109

Messier Catalog (M)	110
Saguaro Astronomy Club (SAC) Database	10,580

*The HCNGC and IC catalog is used with permission of The NGC/IC Project LLC - http://www.ngcic.org – please contact Bob Erdmann at *hcngc at ngcic dot org* for any questions or clarifications regarding this astronomical catalog.

Additional Sky Databases (SDBs)

TheSkyX includes the following additional astronomical catalogs that can be displayed on the Sky Chart. From the ***Input > Database Manager*** dialog, navigate to the ***Sky Databases (SDBs) > Optional Databases*** node in the ***Databases*** list to turn them on or off.

Catalog Name	Search Prefix	Object Count	Object Type
1.4-GHz Northern Sky	1-4ghz	31524	Reference Point
6C Survey of Radio Sources I	6CSRSI	1761	Radio Source
6C Survey of Radio Sources II	6CSRSII	8278	Radio Source
6C Survey of Radio Sources III	6CSRSIII	8749	Radio Source
6C Survey of Radio Sources IV	6CSRS-IV	5421	Radio Source
6C Survey of Radio Sources V - A	6CSRS-VA	2229	Radio Source
6C Survey of Radio Sources V - B	6CSRS-VB	1229	Radio Source
6C Survey of Radio Sources VI	6CSRS-VI	6752	Radio Source
Abell - Zwicky Clusters of Galaxies	AGC	2712	Cluster of Galaxies
Abell Planetary Nebulae	APN	86	Nebula
Ackerman Red Stars	ARS	267	Reference Point
APM Bright Galaxy Catalogue	APM	14681	Galaxy
Arp Globular Clusters	Arp-GC	43	Globular Cluster
Arp Peculiar Galaxies	ARP-PG	338	Galaxy
Barnard's Dark Nebulae	Barnard	349	Dark Nebula
Bright Nebulae Drawings (TMB)	TMB-BN	25743	Bright Nebula
Catalog of Bright Galaxies	CBG	4364	Galaxy
Celestron NexStar Doubles	CND	55	Double Star
Cepheids in the Large Magellanic Cloud	LMC-CV	97	Variable Star
Cluster System of the Large Magellanic Cloud	LMC-CL	1762	Mixed Deep Sky
Cool Galactic Carbon Stars	CCS	5987	Reference Point
Cousins Photometric Standards	CPS	670	Reference Point
Culled Henden CI Labels	HC-L	0	Reference Point
Dark Nebulae Isophotes TMB	DND	650	Dark Nebula
Declination Zero I		51	Reference Line
Declination Zero Label		13	Reference Point
DeepMap 600 I		470	Reference Point
Don Macholtz Messier Marathon I	Macholtz	110	Target Object
Double Stars with common names I		169	Double Star
Einstein Obs Ex M-S Survey	EMSS	835	X-Ray Source
Feitzinger Dark Nebula	FZ-DN	489	Dark Nebula
Feitzinger Globules	FG	331	Reference Point
Florsch - Small Magellanic Cloud Stars	SMC-Florsch	584	Reference Point
G2 V Stars from SIMBAD Query	G2V	688	Reference Point
Galactic Globular Clusters - Monella	GC-Monella	160	Globular Cluster
Galactiglob Galaxies	TJ-GG	2495	Galaxy
Galaxy Isophote M51 Example	BSR-GI	902	Galaxy
Heinz Nebula Small Magellanic CLoud	HN	117	Nebula
Henden 3C	H3C	504	Reference Point
Herbig-Haro Objects	HH	454	Reference Point
HW Clusters Large Magellanic Cloud	HW-SMC	87	Globular Cluster
IRAS 1.2 Jy Redshift	IRAS-1.2	9899	Galaxy
IRAS Small Scale Structure	IRASS	16740	Reference Point

Kron Clusters Small Magellanic Cloud	SMC-KRON	69	Globular Cluster
Landolt Faint Photometric Standards	LFPS	526	Reference Point
Landolt Photometric Standards	LPS	1154	Reference Point
Landolt Photometric Standards South	LPS-S	109	Reference Point
Lindsay Clusters Small Magellanic Cloud	SMC-L	118	Globular Cluster
Lynds' Bright Nebulae	LBN	1053	Bright Nebula
Lynds' Dark Nebulae	LDN	1791	Dark Nebula
Meade Alignment Star Labels	MAS	78	Reference Point
Michael Covington Deep Sky Objects	COV	200	Mixed Deep Sky
Milky Way Globular Clusters	MW-GC	150	Globular Cluster
Molonglo Reference - Radio Sources	Molongo Radio	12141	Radio Source
Molonglo Reference - Radio Sources	Molongo Radio	12141	Radio Source
Navigational Stars	NavStar	58	Reference Point
NB Carbon Stars - Skiff	NBC	211	Reference Point
Nebulae in the Magellanic Clouds- HII	LMC-HII	358	Nebula
NGC and -IC objects UNKNOWN magnitudes		982	Mixed Deep Sky
NGC Max Alignment Stars - JMI	JMI	30	Star
Objects in the Direction of the SMC	SMC-B	965	Reference Point
Open Cluster Data 5th Edition (Lynga 1987)	OC-L	1151	Open Cluster
Palomar Globular Clusters	PAL	15	Globular Cluster
Palomar Sky Survey - 102 CD labels.	DSS-102	0	Reference Point
Palomar Sky Survey Plates Additional Data	POSS	1037	Reference Point
Parkes Radio Sources	PKS90	8264	Radio Source
Planetary Nebulae in LMC	LMC-PLN	169	Planetary Nebula
Pulsars (Taylor+ 1993	PULSARS	558	Radio Source
Query Common Non-Stellar		329	Mixed Deep Sky
RealSky CD's North Labels	RealSky-N	765	Reference Point
RealSky CD's South Labels	RealSky-S	800	Reference Point
RealSky North & South Labels	RealSky-NS	658	Reference Point
Redshift Galaxies	RG	12844	Galaxy
Rich Clusters of Galaxies (North)	RC-GN	2712	Cluster of Galaxies
Rich Clusters of Galaxies (South)	RC-GS	1364	Cluster of Galaxies
Roslund Red Stars in Scorpious	RR	69	Reference Point
Seyfert Galaxies	Seyfert	121	Galaxy
Shapley-Ames Bright Galaxies	SA-BG	1246	Galaxy
Shapley-Ames Bright Galaxies	SA-BG	1246	Galaxy
Sharpless H II Regions		313	Nebula
Skiff North Bright Standards	BK-NBS	119	Reference Point
Star Clusters and Associations	SCA	1039	Open Cluster
Stars in the Double-Double I	DDS	2	Star
Supernova Remnants - Green	SNR-G	231	Supernova
Terzan Globular Clusters	Ter	11	Globular Cluster
Third Catalogue of Nearby Stars	CNS3	3802	Reference Point
Trapezium Circumstellar disks	TCD	149	Reference Point
Trapezium ROSAT PSPC	Trap-XRay	171	X-Ray Source
Trapezium Stars - TMB		14	Star
Trapezium Stars VizieR	Trap-Vzr	292	Reference Point
Trumpler Clusters	Tr	34	Open Cluster
Trumpler Stars	Tr-S	39	Reference Point
UV-Excess Galaxies	UVG	8162	Galaxy
Van Den Berg Reflection Nebulae	Vdb	158	Nebula
Video Calibration Stars	VCS	958	Target Object
W-G Clusters Small Magellanic Cloud	WG	18	Globular Cluster
Yale Bright Star Catalog 1st half	YBSC-1	4991	Star
Yale Bright Star Catalog 2nd half	YBSC-2	4105	Star

Solar System Objects

Group	Objects in Group	Number of Objects
Sun, Planets, Moons	Sun Mercury Venus Earth Earth's Moon Mars Jupiter Io Ganymede Europa Callisto Saturn Enceladus Mimas Tethys Dione Rhea Titan Hyperion Iapetus Uranus Neptune	22
Small Solar System Bodies	Pluto	1
	Comets	Up to 1000 at once.
	Asteroids (Minor Planets)	Every known asteroid (Orbital elements are updated from the web.)
Artificial Satellites	Updated from the web via the ***Input > Satellites*** command.	Up to 10,000 two-line elements (TLEs) can be imported and updated from the web when *TheSkyX* is launched.

Photographs

Photos Database	Details
Anglo-Australian Observatory Photos	172 color photos from the David Malin collection of AAO images.
Deep-sky Overlays	127 photos that appear on the Sky Chart.
Hubble Photos	314 color photographs from the Hubble Space Telescope.
Messier Overlays	104 color photographs.
Non-stellar objects	53 color photographs of non-stellar objects.
Solar System Photos	255 color photographs of the solar system objects.
Digitized Sky Survey thumbnails	100,000 grayscale photos from the Digitized Sky Survey.

Catalog Cross References

TheSkyX also cross-references the following catalogs. Use *TheSkyX* Find command on the Edit menu to locate any object from any of these catalogs.

Cross-Referenced Catalogs	Prefix	Object Count
Arakelian Catalog of Galaxies	ARAK	595
Bayer/Flamsteed Designations	n/a	n/a

Bonner Durchmusterung Number	B+nn nnnnn	-
Caldwell Catalog	Caldwell + Cn	109
Cape Durchmusterung Number	P-nn nnnn	-
Catalog of Galaxies and Clusters of Galaxies	CGCG	29,809
Common Non-Stellar Object Names	name of object	
Common Star Names	name of object	
Constellations	name of constellation	88
Cordoba Durchmusterung	C-nn nnnnn	-
David Dunlap Observatory Catalog of Galaxies	DDO	242
Fairall Catalog of Galaxies	FAIR	1,185
Henry Draper number	HD	359,083
Infrared Astronomical Survey	IRAS	9,347
Karachentseva Catalog of Galaxies	KARA	183
Kazaryan UV Galaxies	KAZ	581
Kiso UV Galaxies	KUG	5,455
Messier Catalog	M	110
Positions and Proper Motions Number	PPM	-
Second Byurakay Survey	SBS	259
Smithsonian Astrophysical Catalog (SAO)	SAO	258,997
Struve Catalog	STRUVE	3,100
Tololo Galaxies	TOL	111
University of Michigan Catalog of Galaxies	UM	652
unnamed	1SZ	26
unnamed	2SZ	32
unnamed	ARP	560
unnamed	ESO	16,239
unnamed	LGS	5
unnamed	VV	1,161
Uppsala General Catalog of Galaxies	UGC	13,073
Virgo Cluster Catalog of Galaxies	VCC	2097
Weinberger Catalog of Galaxies	WEIN	207
Zwicky1	1ZW	238
Zwicky2	2ZW	199
Zwicky3	3ZW	159
Zwicky4	4ZW	203
Zwicky5	5ZW	531
Zwicky6	6ZW	238
Zwicky7	7ZW	1,145
Zwicky8	8ZW	645

Ephemeral Data

TheSkyX can display the positions of comets and minor planets and man-made satellites.

The orbital element data required to *accurately* display these objects changes frequently and can be updated from *TheSkyX* using different sources on the worldwide web.

The table below lists the sites the *TheSkyX* uses to update this information.

Object Type	Object Count	Web Site Address to Obtain Updated Orbital Element Data
Comets	Up to 1000	http://www.minorplanetcenter.org/cfa/ps/Ephemerides
Satellites	Up to 10,000	http://celestrak.com
Asteroids (Large Database)	All known asteroids	http://asteroid.lowell.edu

TheSkyX Professional Edition-Specific Databases

PROFESSIONAL

In addition to the databases listed above, *TheSkyX Professional Edition* includes an optimized version of the UCAC3 star catalog with approximately 30 million stars.

TheSkyX Pro Database Add On

If you need more star data, consider purchasing *TheSkyX Professional Edition Database Add On* from Software Bisque. *TheSkyX Pro Database Add On* includes *210 GB* of native star catalogs , Software Bisque-optimized star catalogs and the complete Digitized Sky Survey (the 10x compression version, distributed with permission).

Catalog Name	Number of Stars	Approximate Size (GB)
Native NOMAD Catalog and related files.	1.1 billion	100
Native UCAC3 Catalog and related files.	100,766,420	8
Software Bisque NOMAD plot files.	800 million	40
Small TheSkyX Pro-specific UCAC3 plot file.	30 million	.8
Large TheSkyX Pro-specific UCAC3 plot file.	90 million	2
Digitized Sky Survey (10x compression).	Photographic data for the entire celestial sphere.	60

The databases and files in *TheSkyX Pro Add On* product are distributed on a USB hard drive that can be purchased from the Software Bisque Store.

Database Add On Copyright Information

The large and small *TheSkyX Professional Edition-specific plot files* included on the *Database Add On* hard drive are copyright Software Bisque and cannot be redistributed. The Digitized Sky Survey is copyright AURA and cannot be redistributed without written permission. Please contact the USNO for details about distributing the native NOMAD and UCAC3 catalogs.

Using the Database Add On

Configuring *TheSkyX Professional Edition* to use the *Database Add On* star catalogs and photos from Digitized Sky Survey is simple.

1. Plug the USB hard drive that contains the *Database Add On* files.
2. From TheSkyX Professional Edition, select the Database Manager command from the Input menu.
3. In the list of databases, expand the ***Database Add On*** node, then highlight the ***Database Add On Root***.
4. Click the ***Choose Folder*** button.
5. Select the volume name (Mac) or drive letter (Windows) for the drive and click the ***Choose*** button. The ***Property*** table should now show the correct location for these files.
6. Click ***Close***.

The Sky Chart will now show stars from the UCAC3 and NOMAD star catalogs at small fields of view.

Additionally, when the ***Digitized Sky Survey Setup***'s ***Disc Or Other Drive*** option is turned on, photos from the Digitized Sky Survey will be retrieved from the hard drive when the ***Show Digitized Sky Survey Photo*** command is selected from the ***Tools*** menu.

Appendix B: Migrating from TheSky6 to TheSkyX

If you are comfortable using *TheSky6*, you'll want to review the table of changes below to ease the transition to *TheSkyX*.

Terminology Changes

This phrase or command in TheSky6…	**Is now this in TheSkyX…**
Chart Mode	Map Like option, Display menu, page 146.
Comets/Minor Planets/Extended Minor Planets	Small Solar System Bodies command, page 142.
Data Menu	Input Menu.
Data Wizard	Advanced Query, page 173.
Data Wizard Results	Observing List, page 172.
Daytime Sky Mode	Show Daylight, page 33.
Display Explorer	Chart Elements, page 136.
Display Properties	Chart Attributes, page 136.
Eclipse Finder	Solar & Lunar Eclipse Viewer, page 117.
Extended Labels	Detailed Labels, page 47.
Extended Minor Planets	Asteroids (Large Database), page 142.
Image Groups	Place Photos, page 57.
Images	Photos, page 54.
Image Manager (Data Menu)	Place Photo, page 57.
Import command	Create Sky Database command, page 161.
Mapping/Map Points	Pointing Calibration/Pointing Samples. See the TPoint Add On User Guide for details about pointing calibration.

Minor Planets	Asteroids, page 143.
Mirror Image	Show Mirror Image, page 29.
Moon Phase Calendar	Calendar, page 77.
Moon Viewer	Moon Photo Viewer, page 105.
Night Vision Mode	Show Night Vision Mode.
N/E Indicator	Celestial North Arrow (Chart Elements window, page 136).
Options command	Preferences (Tools Menu, Windows) page 130.
Pole Up	Celestial Sphere, Orientation menu, page 27.
Print Preview	Export Chart, page 100.
Real Mode Options	Horizon & Atmosphere Options, page 151, and Milky Way Options, page 156.
Sky Database Manager	Database Manager, page 158.
Sky Display	Sky Chart, page 19.
Sky Document	Sky Chart Settings, page 33.
Sky View Preferences	Chart Element Attributes, page 136.
Stellar & Solar System Update Frequency	Target Frame Rate, page 135 . Solar system object updates now occur *30 times per second* by default, rather than *once every 5 minutes* as did TheSky6.
Sync command	Startup pop-up menu on the Telescope window (Display menu), page 215.
Sun & Moon Report	Reports, page 86.
Use Computer's Clock	Computer Clock, page 133.
User-Defined Data	My Chart Elements, page 169.
User-Defined Object Types	My Object Types, page 29.

View Menu	Display Menu.
Virtual Sky Mode	Photo Like, page 146.
Zenith Up	Terrestrial Sphere Orientation, page 87.

TheSky6 Feature	**Equivalent TheSkyX Feature**
Changing Font Colors	Edit the Attributes of Chart Elements (page 136).
Defining Telescope Limit Lines	Click the ***Telescope Limits*** command from the ***Telescope*** menu.
Edit or Draw the Local Horizon	1. Click the ***Horizon & Atmosphere*** command on the ***Display*** menu. 2. Click the ***Horizon*** tab. 3. Select the ***Custom Drawn*** option in the ***Horizon Type*** list.
Object Tips (Tool Tips)	1. Click the ***Preferences*** command from the ***Tools*** menu (Windows) or ***TheSkyX*** menu (Mac). 2. Click the ***Report Setup*** icon. 3. Select ***Tool Tips*** from the ***Report*** list. 4. Turn on the desired ***Object Properties*** to appear in the tool tip.
Right-click to drag the screen	*Left-click* the mouse to drag the Sky Chart.
Setting the Upper and Lower Magnitude Limits	Setting the magnitude limit, page 94.
Showing Labels (common labels and extended labels) on Sky Chart	Labels (for *common names* and *detailed labels*) are located on the Labels window. Click ***Labels*** command on the ***Display*** menu to show this window.
Showing Reference Lines and Reference Photos, including: • Constellation Figures • Constellation Drawings • Constellation Boundaries • Galactic Equator • Milky Way • Equatorial lines (equatorial grid and North/East Indicator) • Horizon • Ecliptic	Reference lines can be turned on or off from the ***Chart Elements*** window (page 149).

• Telescope Limit Lines • Horizon-based lines, including the local horizon, refracted horizon, meridian and horizon grid • Local Horizon Fill Color	
Zoom Box	Press and hold the SHIFT key while dragging the mouse on the Sky Chart to create a zoom box.

TheSky6 and TPoint for Windows Settings

TheSky6 can open and save a variety file formats. The follow section describes each format and how to transition your existing data to *TheSkyX*.

Sky Documents

- By default, *TheSkyX* uses your computer's IP address to determine your location. *TheSkyX* also has a "To Google Map" option that can be used verify and refine your location. If you have the GPS coordinates of your observing site, then you can enter them manually, as well as your time zone, from the ***Input > Location > Custom*** tab (page 22).
- *TheSkyX* uses the computer's local time by default. See "Entering the Date and Time (Date & Time Control)" on 80 for details how to set a specific date and time.

Field of View Indicators

- *TheSky6* stores your custom field of view indicators in a text file named *Field of View Indicators.txt* in the folder named *<My Documents>\Software Bisque\TheSky6\Field of View Indicators*. *TheSkyX* also stores FOVIs in a text file of the same name, but in the folder named *<My Documents>\Software Bisque\TheSkyX Professional Edition\Field of View Indicators*. The format of TheSky6's *Field of View Indicators.txt* text file the same as *TheSkyX*. So, you can copy TheSky6's *Field of View Indicators.txt* to *TheSkyX's* folder to preserve your FOVIs.

Telescope Configuration

- Telescope-configuration is a manual process. You'll need to manually set the telescope and the telescope settings (telescope type, COM port, limit settings, etc.) from *TheSkyX*.
- Use TheSky6 to park the telescope. Then connect to the telescope from TheSkyX and, without slewing the telescope, on the Telescope window, from the Shut

Down pop-up menu, configure *TheSkyX's* park position by clicking the ***Set Park Position*** command (page 214).

TPoint for Windows Settings and Models

Important Note: *TPoint for Windows* is not compatible with *TheSkyX Professional Edition*. *TheSkyX Professional Edition* instead now offers the integrated *TPoint Add On*.

- In *TheSky6*, the *TPoint for Windows* model is saved as part of the Sky Document (.SKY) document. *TPoint for Windows* is a separate application. In *TheSkyX*, the can be purchased as an "Add On" but is an integrated component and is accessed by clicking the Telescope > TPoint Add On command at any time (there's a 90 day free trial period to use the TPoint Add On).

To transfer an existing TPoint for Windows model to TheSkyX Pro and the TPoint Add On

1. From *TheSky6*, open the TPoint document by right-clicking on the TPoint icon, and then click *Open*. This launches *TPoint for Windows* and opens the .TPT document with the model.
2. From *TPoint for Windows*, click the ***Export*** command from the ***File*** menu, then enter a name for the text file that will hold your exported mapping data. This "pointing data" can be imported into the *TPoint Add On*.
3. From *TheSkyX*, click the *TPoint Add On* command from the ***Telescope*** menu.
4. From the *TPoint Add On* ***Setup*** tab, select the ***Import*** command from the ***TPoint Add On Settings*** pop-up menu.
5. Select the text file name that holds the TPoint for Windows pointing data and then click ***Open***.

The *TPoint Add On* now has your pointing data, and you can turn on the desired terms for your model. A *recalibration* will be required to restore the CH, IH and ID terms (the telescope's "synchronization" information). See the TPoint Add On User Guide for more information about recalibration

Comets/Asteroids/Satellites

- The latest orbital elements and two-line elements TLEs for these objects will need to be downloaded from *TheSkyX*. See pages 116 and 121 for details.

Sky Databases

A folder of *TheSky6* SDBs can be converted to TheSkyX-compatible Sky Database format (.SDBX) from the ***Advanced*** tab of TheSkyX's ***Database Manager*** (page 159).

Appendix C: Daylight Saving Time

The following table lists the international Daylight Saving Time (DST) starting and ending dates that *TheSkyX* uses to determine when DST begins and ends.

The Time Zone options are found in the Daylight Saving Option (DSO) pop-up.

Time Zone	**DST Starts**	**DST Ends**	**Adopting Countries**
Australia-NSW	Last Sunday of October	Last Sunday of March	Australia (Australian Capital Territory, Lord Howe Island, New South Wales)
Australia-South	Last Sunday of October	Last Sunday of March	Australia (Broken Hill NSW, South Australia, Victoria)
Brazil	Third Sunday of October	Third Sunday of February	Brazil
Chile	Second Sunday of October	Second Sunday of March	Chile
China	Third Sunday of April	Second Sunday of September	China
Cuba	First Sunday of April	Second Sunday of October	Cuba
Egypt	First Day of May	First Day of October	Egypt
Europe	Last Sunday of March	Last Sunday of October	Albania, Andorra, Austria, Belarus, Belgium, Bosnia Herzegovina, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Faroe Islands, Finland, France, Georgia, Germany, Gibraltar, Greece, Greenland (Scoresbysund), Hungary, Italy, Kazakhstan, Latvia, Lebanon, Lithuania, Luxembourg, Macedonia, Malta, Monaco, Mongolia (Ulan Bator), Netherlands, Norway, Poland, Portugal, Romania, Russian Federation, San Marino, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey, Ukraine, Yugoslavia
Falkland Islands	Second Sunday of September	Third Sunday of April	Falkland Islands
Greenland	Last Sunday of March	Fourth Sunday of September	Greenland (except Scoresbysund and Thule)
Iran	21st Day of March	21st Day September	Iran
Israel	Last Friday of March	Last Sunday of August	Israel
Jordan	First Friday of April	Third Friday of September	Jordan
Kyrgyzstan	Second Sunday of April	Last Sunday of September	Kyrgyzstan
Moldova	First Sunday of March	Last Sunday of September	Moldova
Namibia	First	First Sunday	Namibia

	Sunday of September	of April	
New Zealand	First Sunday of October	Third Sunday of March	New Zealand
U.S. and Canada	Second Sunday of March	First Sunday of November	Begins March 2007 Bahamas, Bermuda, Canada, Greenland (Thule), Mexico, St. Pierre and Miquelon, Turks and Caicos Islands, United States of America
Paraguay	First Sunday of October	Last Sunday of February	Paraguay
Syrian	First Day of April	First Day of October	Iraq, Syria
Tasmania	First Sunday of October	Last Sunday of March	Tasmania
United Kingdom	Last Sunday of March	Last Sunday of October	England, Ireland, Isle of Man, Scotland, Wales
Mexico	First Sunday of April	Last Sunday of October	Mexico

Appendix D: Macro Commands

The table below lists the macro commands that can run at waypoints in tours.

Command Name	Number of Arguments	Argument 1	Argument 2	Argument 3	Argument 4	Argument 5
SetVisible	2	Object type	Visible			
SetMagFaintest	2	Object type	Magnitude			
SetMagBrightest	2	Object type	Magnitude			
SetSizeMin	2	Object type	Size (arcmins)			
SetSizeMax	2	Object type	Size (arcmins)			
SetPenStyleWidth	3	Object type	Pen style (0=none)	Pen width		
SetPenColor	5	Object type	Red	Green	Blue	Alpha
SetFillRgb	5	Object type	Red	Green	Blue	Alpha
SetFontRgb	5	Object type	Red	Green	Blue	Alpha
SetFontFamilySize	3	Object type	Family name	Point size		
SetSymbolSVG	3	Object type	SVG filename	Size(mm)		
ToggleVisible	1	Object type				
SetExtendLabel	4	Dataset/Type	Database	Field	Value	
AddObject	4	RA	Dec	Type	Magnitude	
AddLabel	3	RA	Dec	Label		
AddArrow	4	RA	Dec	Width	Height	
AddAreaOfInterest	3	RA	Dec	Size		
AddChartScale	2	RA	Dec			
AddTelrad	2	RA	Dec			
AddMoveTo	2	RA	Dec			
AddLineTo	2	RA	Dec			
AddPolyPoint	2	RA	Dec			
AddEllipse	5	RA	Dec	Major axis	Minor axis	Position Angle
AddSVG	4	RA	Dec	File name	Size	
ClearUserData	0					
SetRefFrame	1	Frame				
SetDefaultType	1	Object type				
SetConstlLine	2	Constellation	On/Off			
SetConstlBoundary	2	Constellation	On/Off			
SetConstlDrawing	2	Constellation	On/Off			
SetConstlLabel	2	Constellation	On/Off			
ConstlLinesUpdate	0					
LaserPointer	3	RA	Dec	Duration		
Fade	1	Seconds				
Zoom	1	Degrees				
Center	1	Object name				
Frame	1	Object name				
TourIncrement	1	Days				
TourText	3	Text	Height	Position		

Appendix E: Constellation Abbreviations

(And) Andromeda	(Cru) Crux Australis	(Ori) Orion
(Ant) Antlia	(Cyg) Cygnus	(Pav) Pavo
(Aps) Apus	(Del) Delphinus	(Peg) Pegasus
(Aqr) Aquarius	(Dor) Dorado	(Per) Perseus
(Aql)Aquila	(Dra) Draco	(Phe) Phoenix
(Ara) Ara	(Equ) Equuleus	(Pic) Pictor
(Ari) Aries	(Eri) Eridanus	(Psc) Pisces
(Aur) Auriga	(For) Fornax	(PsA) Pisces Australis
(Boo) Bootes	(Gem) Gemini	(Pup) Puppis
(Cae) Caelum	(Gru) Grus	(Pyx) Pyxis
(Cam) Camelopardus	(Her) Hercules	(Ret) Reticulum
(Cnc) Cancer	(Hor) Horologium	(Sge) Sagitta
(CVn) Canes Venatici	(Hya) Hydra	(Sgr) Sagittarius
(CMa) Canis Major	(Hyi) Hydrus	(Sco) Scorpius
(CMi) Canis Minor	(Ind) Indus	(Scl) Sculptor
(Cap) Capricornus	(Lac) Lacerta	(Sct) Scutum
(Car) Carina	(Leo) Leo	(Ser) Serpens
(Cas) Cassiopeia	(LMi) Leo Minor	(Sex) Sextans
(Cen) Centaurus	(Lep) Lepus	(Tau) Taurus
(Cep) Cepheus	(Lib) Libra	(Tel) Telescopium
(Cet) Cetus	(Lup) Lupus	(Tri) Triangulum
(Cha) Chamaeleon	(Lyn) Lynx	(TrA) Triangulum Australis
(Cir) Circinus	(Lyr) Lyra	(Tuc) Tucana
(Col) Columba	(Men) Mensa Berenices	(UMa) Major Ursa
(Com) Coma Berenices	(Mic) Microscopium	(UMi) Ursa Minor
(CrA) Corona Australis	(Mon)	(Vel) Vela
(CrB) Corona Borealis	(Mus) Musca	(Vir) Virgo
(Crv) Corvus	(Nor) Norma	(Vol) Volans
(Crt) Crater	(Oct) Octans	(Vul) Vulpecula
	(Oph) Ophiuchus	

Appendix F: TheSkyX Pro Automation Model

PROFESSIONAL

TheSkyX Professional Edition's automation model is essentially identical to *TheSky6 Professional Edition's* automation model. Please refer to TheSky6 Professional Edition's Automation Model documentation for details about its objects and their methods and properties.

TheSkyX Pro can replace or be exchanged for *TheSky6 Pro* as far as automation is concerned, the only caveat is that controlling programs (clients) need to use *TheSkyX Pro's program ids* in place of *TheSky6 Pro's* program ids.

For example, if your existing script or application source code references *TheSky6 Pro's* StarChart object:

```
TheSky6.StartChart
```

In order to use *TheSkyX Pro*'s StarChart instead, replace the above syntax with:

```
TheSkyXAdaptor.StarChart
```

Your application will now use *TheSkyX Professional Edition's* StarChart Object instead of *TheSky6 Pro's* StarChart object.

The table below includes a complete list of *TheSky6 Pro* and *TheSkyX Pro* program ids.

TheSky6 Pro **Program ID**	**Equivalent** ***TheSkyX Pro*** **Program ID**
TheSky6.DataWizard	TheSkyXAdaptor.DataWizard
TheSky6.MyFOVs	TheSkyXAdaptor.MyFOVs
TheSky6.ObjectInformation	TheSkyXAdaptor.ObjectInformation
TheSky6.RASCOMTele	TheSkyXAdaptor.RASCOMTele
TheSky6.RASCOMTheSky	TheSkyXAdaptor.RASCOMTheSky
TheSky6.RASServerApp	TheSkyXAdaptor.RASServerApp
TheSky6.Raven	TheSkyX.Raven
TheSky6.StarChart	TheSkyXAdaptor.StarChart
TheSky6.Utils	TheSkyXAdaptor.Utils

The Visual Basic (VB) code below shows an example how to use the StartChart object in either *TheSky6 Pro* or *TheSkyX Pro*. Note that both applications can be installed and run on the same computer, and both object models can be accessed on a single computer, without issue.

```
Dim StarChart
'Remove the tic mark below to use TheSky6
'Set StarChart = CreateObject("TheSky6.StarChart")

'The following line will use TheSkyX Pro's StarChart object
Set StarChart = CreateObject("TheSkyXAdaptor.StarChart")
```

Software Bisque plans extend *TheSkyX Professional Edition's* automation model in future updates. For now, the object model version 10.1 of *TheSkyX Professional Edition* it is complete, equivalent to, and backward compatible with *TheSky6 Pro's* automation model.

Appendix G: TheSkyX Change Log

Changes and improvements to *TheSkyX Professional Edition* and *TheSkyX Serious Astronomer Edition* since the initial release are listed below.

Version 10.1.7

- ✓ Fixed a bug that prevented entering FOVIs with multiple elements.
- ✓ Height of Object Information Report now scales to the height of the font.
- ✓ The sky6StartChart is now applying ra dec sets properly.
- ✓ Added camera temperature regulation to the Basic Camera Add On.

Version 10.1.6 (Initial Release of TheSkyX Professional Edition)

- ✓ Added a Planet Report that includes a variety of Sun, Moon and planet ephemerides and other body-specific data.
- ✓ Video driver incompatibility workaround—changed OpenGL calls so that horizon and other graphics items do not disappear when using Intel display adaptors.
- ✓ Bug fix—Added Cepheus constellation line for Wil Trion set.
- ✓ Bug fix—For locales where decimal and separators differed from US (“.” and “,” respectively), custom locations floating point numeric values were being truncated at the decimal level.
- ✓ Bug fix—FOVIs: No longer allow click OK while selecting a root item in the list of telescopes, which isn't a valid selection which was confusing.
- ✓ Bug fix—Julian date displayed in Find tab is now shown to a more appropriate number of significant figures.
- ✓ Bug fix—mirror photos when the Show Mirror Image command is turned on.
- ✓ Added NexStar-specific telescope commands dialog.
- ✓ Added Sky Commander/ServoCAT support.
- ✓ Bug fix—The Edit Chart Element dialog wasn’t in sync with changes that happen outside of it.
- ✓ Added Cross Hair Update Interval option to the Telescope > Telescope Setup dialog.
- ✓ Bug fix—horizon/equatorial lines fonts/widths are now correct.
- ✓ Bug fix—changes to time zone and elevation are now immediately applied.
- ✓ Bug Fix—mounts that cannot report which side of the pier they are on will now point “better” w/r/t TPoint.
- ✓ Bug fix—“Software imposed slew limits” can be over-ridden.
- ✓ Bug fix—Display > Non-Stellar Options dialog, the Hollow Deep Sky option is no longer ignored.
- ✓ Bug fix— Display > Non-Stellar Options dialog, a “fuzzy” value of 0 is now applied correctly.
- ✓ Sky Database pens and brushes can now have an alpha channel.
- ✓ Setting the pen color now works in a drawing Sky Database.
- ✓ The Status Bar can now be configured to show Sky Chart Status information. To save screen space, items placed in the Status Bar do not include a text prefix as

they do in the Chart Status window. For example, the date appears as just: ***12/22/2020***.

- ✓ Added angular separation and position angle from prior object to Object Information Report on the Find dialog.
- ✓ Corrected AP Park Positions (labels were wrong).
- ✓ Moon's Long/Lat are shown separately from the Moon Feature Information text box.
- ✓ Fixed a regression bug that prevented showing Moon Viewer photos.
- ✓ Changed name of TheSkyX supplied Sky Databases from "System" to "Core Sky Databases" in the Database Manager dialog.
- ✓ All negative values for offsets in FOVIs.
- ✓ Added TeleAPI to list of supported telescopes.
- ✓ Corrected spelling of the star Alnair.
- ✓ Updated/added SBIG detectors and corrected the relative position of the autoguider for the SBIG STL-4020M model camera.
- ✓ Corrected misspelling of Sirius in tour description.
- ✓ 1) Enabled the app option to turn off Autosave (was forced to on and disabled) and added an option to turn off being prompted to save modified settings. Sky Chart settings are "dirtied" better now, but not "perfectly" (on the conservative side). These changes allow customers more flexibility w/r/t multiple charts and is more like what TheSky6 Pro offers.
- ✓ The format of the date and time that is displayed in TheSkyX's custom Date & Time control can now be configured. Right-click on the control to edit the format.
- ✓ Bug fix—prevent loading large database asteroids while load in progress.
- ✓ Bug fix—Percent status is now correct while converting large database asteroid text file.
- ✓ Cleaned up Asteroid (Large Database) dialog.
- ✓ Night Vision Mode under Windows no longer requires Windows themes.
- ✓ Fixed printing of ellipses (galaxies, etc.)
- ✓ When FOVI groups are selected (like Telescopes+Eyepieces) the Combine message now correctly displays the number of combinations.
- ✓ Bug fix—Positions of the galactic poles are now precessed to the current equinox.

Version 10.1.3 (Build 2930) July 24, 2009

- ✓ Higher accuracy computations for Jupiter's and Saturn's moons.
- ✓ Shadows of Jupiter's major moons now appear on the planet.
- ✓ Jupiter and Saturn's moons can now be locked on.
- ✓ Jupiter's and Saturn's major moons can be located using the Find command.
- ✓ Added pulse focuser support for mounts that support pulse focusers through the telescope protocol (LX200/Autostar/AP GTO/Gemini).
- ✓ Comet perihelion date now uses full precision from orbital elements.
- ✓ Stereographic spelled correctly in Projections dialog.
- ✓ Double-clicking tree list to add a "My FOVI" now works correctly.
- ✓ Clicking Cancel button when editing a new FOVI no longer creates the FOVI.

- ✓ Press Insert/Delete keys to add/remove My FOVIs.
- ✓ The type Circle no longer appears in the Shape List when editing FOVIs.
- ✓ Can double-click My FOVI list to edit them.
- ✓ Increased the minimum size of the FOVI edit fields for better readability on the Mac.
- ✓ E/W offset option renamed to East/west offset; N/S offset renamed to North/south offset on the Edit Detector dialog.
- ✓ Center telescope cross hair now corrects for coordinate offset caused by TPoint model.
- ✓ Corrected location for observatory in India.
- ✓ Fixed a bug that caused TheSkyX to crash when connecting to the Temma.
- ✓ Fixed a bug that caused the Temma to hang on connection.
- ✓ The "Always keep telescope crosshairs on screen" option is now saved.
- ✓ On the Mac, after a crash, re-starting TheSkyX and clicking cancel when prompted for a serial number would keep incrementing the multi-instance index. It is also possible that this fix might lessen the cases when starting again on the Mac after a crash goes to a new instance. On Mac (Unix OS) shared memory can survive a crash. Restarting the computer is the only way to free it.
- ✓ Turning on/off FOVI's from Chart Elements tab now works.
- ✓ The "Slew button always disabled after slew" issue with Vixen HTTP telescopes is fixed.
- ✓ Set both date and time in Gemini and LX200 driver (date was not always set correctly).
- ✓ Reboot Gemini command now works.
- ✓ Button text "Find Now" changed to "Find" on the Find window and Telescope window.
- ✓ "Find" text on Telescope window changed to "Search For" for consistency with Find window.
- ✓ Increased default width of SDB manager window.
- ✓ Changed the maximum size for FOVI to 50 degrees.
- ✓ TheSkyX Windows installer no longer allows individual features to be selected when there's insufficient space on a drive.
- ✓ Stellar catalogs are now saved and restored when opening an observing list query.
- ✓ FOVI's now drawn after Photo SDBs.
- ✓ Constellation label checkbox in Chart Elements now works.
- ✓ Numerous bug fixes related to changing the magnitude limits of single and multiple chart elements.
- ✓ Fixed bug where clicking on planet moon reverted to Earth's Moon.
- ✓ The Tools > Show Satellites > Find Best Passes option now works (regression bug).
- ✓ NexStar telescope cross hair position is now always correct.
- ✓ Increased NexStar's time out time to 3.5 seconds (per protocol specifiction)
- ✓ Changed ***My Chart Element #*** heading to **Element** #.
- ✓ Jupiter's major moons can now by located from the Display > Find window.
- ✓ Herschel and Caldwell labels are no longer filtered when the corresponding NGC/IC has already been plotted.

- ✓ Renamed “Allow scrolling below the horizon picture” to “Allow Sky Chart to be scrolled below the horizon" (Display > Horizon and Atmosphere dialog).
- ✓ The ***Allow Sky Chart to be scrolled below the horizon*** option can be accessed when either “Photograph” or “Custom Horizon” is selected.
- ✓ FOVIs fill color can now be edited.
- ✓ The default fill for circular FOVIs in Map-Like View is transparent.
- ✓ For object types that cannot be turned on or off, the state of the Visible checkbox in the Chart Elements list is set to “indeterminate”.
- ✓ Telescope can be slewed to any ra/dec or az/alt coordinate from the Telescope windows Tools > Slew To Coordinates command. (Or the Enter Coordinates tab of the Orientation > Navigate window).
- ✓ Disabled diagonal move buttons for telescopes that do not support this feature.
- ✓ Added the native Set Sidereal Tracking Rate and Turn Tracking Off commands to the AP-Specific dialog.
- ✓ Changed the text “Related Find Results” to "Related Search Results" on the Display > Find window.
- ✓ Updated telescopes listed in FOVI telescope database (including RCOS telescopes).
- ✓ Searching for Asterisms now works (recompiled Asterisms.txt).
- ✓ Changed moonlit side of symbol on date calendar for first and last quarter Moon.
- ✓ Add a provision to (externally) abort serial operations that may timeout.
- ✓ For mounts that can set tracking rates, but not get/read them, provide a convention so that an agnostic (non bias) status message may result.
- ✓ Telrad Finder is now the correct size.
- ✓ Added the Telescope Simulator to the list of supported telescopes (under Software Bisque).
- ✓ Improved Telescope Simulator’s cross hair motion (slews now simulate acceleration and deceleration).
- ✓ The automated location look up via IP is now more robust wrt invalid http responses.
- ✓ The LX200 can now automatically synchronize at the home position after a park and reconnection to TheSkyX.
- ✓ Added an abortable progress indicator window that appears when loading observing lists with large numbers of objects.

Version 10.1.2 (Build 2845) May 7, 2009

- ✓ Initial Release of TheSkyX Serious Astronomer Edition for both Mac and Windows.

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