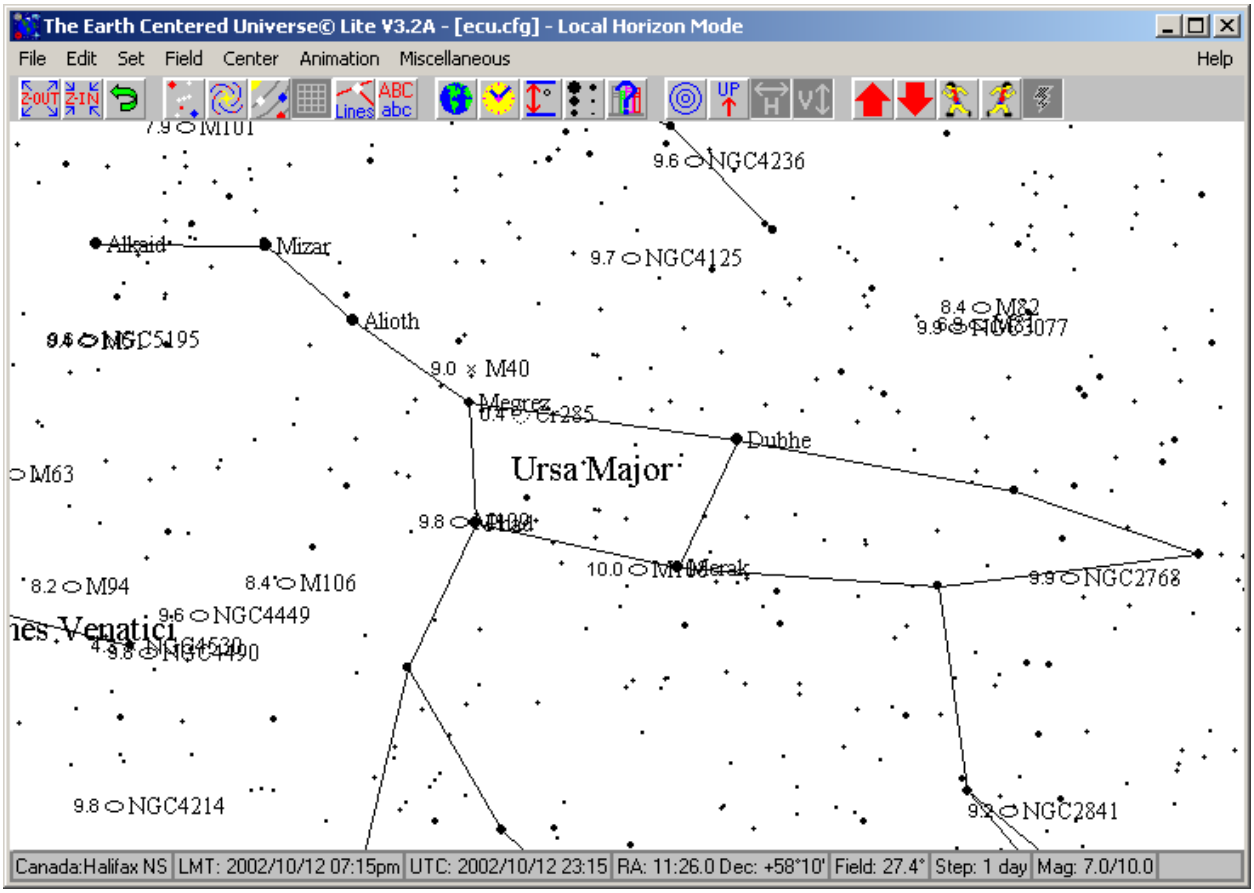
# THE EARTH CENTERED UNIVERSE™ Lite

## *Planetarium and Night Sky Simulator Software*

*(operates with Windows 3.1/95/98/Me/NT/2000/XP)*

# User's Manual

*Version 3.2A — Manual Revision October 2002*





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# 1. Getting Started

Thank you for using ***The Earth Centered Universe Lite***, **ECU** for short (pronounced: eee-see-you). **ECU Lite** is *Planetarium and Night Sky Simulator Software* capable of simulating most of the phenomenon of the Earth's sky. This includes, but is not limited to the stars, planets, Sun and Moon, comets, asteroids, and "deep sky" objects.

**ECU** is designed as an observing tool for the observing amateur astronomer, but is equally useful to the "armchair" astronomer or other person interested in learning about astronomy.

## Important Note

***ECU*** *is available in two versions:* ***ECU Lite*** *and* ***ECU Pro****. This manual documents* ***ECU Lite****. Since this manual was derived from the* ***ECU Pro*** *manual, you will find many places throughout it that refer to features not available in* ***ECU Lite****. Usually these are explicitly stated, however in some places they will just be greyed out. In the* ***ECU Lite*** *program you will find some features that are available only in* ***ECU Pro*** *also greyed out.*

Many of the concepts and terms used in this manual are common in amateur astronomy, but may not be familiar to all users. The author recommends the purchase of a good beginner book in astronomy as a guide to the understanding of the concepts provided by this program. An excellent beginner's book is: **NIGHTWATCH: An Equinox Guide to Viewing the Universe** by Terence Dickinson, which is available in most well stocked bookstores or libraries.

**ECU** is operates on a wide variety of PCs in common use today including those that use Windows 3.1, Windows 95, Windows 98, Windows Me, Windows NT, Windows 2000, and Windows XP. This manual assumes that the user is familiar with the operation of typical Windows programs.

The original version of **ECU** was written way back in 1992 because of the obvious lack of good, reasonably-priced astronomy programs. Many software products suffer from awkward user interfaces and/or slow operation (especially on older computers that one might use in the field at the telescope). **ECU** attempts to fill an obvious need at a reasonable price and has developed a loyal following of thousands of amateur astronomers all over the world.

A large amount of effort in software development has gone into "The Earth Centered Universe". It is written in Borland International's Pascal language and is currently comprised of about 700+ pages of program listing. This release includes a many enhancements over the previous versions (**ECU** was first released as V1.1 in March of 1992).

## Note

*The best way to keep informed and to receive technical support is to join the* ***ECUsers*** *e-mail list on the Internet. Nova Astronomics doesn't run or moderate this list – it is user run and supported, however the author does contribute to the list. Visit* ***www.nova-astro.com*** *and look for the link to the "ECUsers" list home page.*

The author would be most pleased in hearing your comments and suggestions for improvements to **ECU** or this manual. I would also like to hear about any "bugs" which you detect so they can be fixed in a future release. You can also be kept up-to-date by accessing Nova Astronomics'

Internet site shown on the cover of this manual. The author can be reached at any of the addresses (post office and e-mail) listed on the cover page of this manual.

## 1.1 System Requirements

**ECU**'s minimum system requirements are listed below:

| | |
|---|---|
| Hardware: | Pentium/486/386 PC Compatible Computer (Pentium or faster recommended). |
| Math Co-processor: | On 386/486 processors, the math co-processor is supported and recommended, but not required (all Pentium-based and newer computers include the math processor). |
| Software: | Runs within the Microsoft Windows 3.1, 95, 98, Me, NT, 2000, or XP operating systems. |
| Memory: | Minimum ~4 megabytes free from within Windows. |
| Hard Disk Space: | Less than 7 Megabytes |
| Graphics Card: | An SVGA or better graphics |
| Mouse Pointer: | Windows compatible |
| Printer (optional): | Windows compatible printer or plotter |

## 1.2 Installation

**ECU Lite** is usually distributed as a downloaded file from the Internet or on a CD-ROM that may have been included with another product such as a textbook or a telescope. Since a printed user's manual is not available for **ECU Lite**, if you are reading this you have already successfully installed ECU. Proceed to section 1.3: Starting **ECU**.

If your hard disk space is limited, the space occupied by **ECU** can be reduced by deleting several files. If you are not interested in the spectral type or SAO designation of SAO stars you can delete the file "SAO2.ECU". This will reduce **ECU**'s hard disk space requirement by slightly less than two megabytes. The file "YBSC2.ECU" can be deleted if the extended information in the Yale Bright Star catalogue is not desired. This will save an additional 500 kilobytes. **ECU** will automatically detect the absence of these files and adjust its operation accordingly.

When fully installed, **ECU** comprises the following files:

- ECULITE.EXE — the main executable program file
- ECU.CFG — the default configuration file
- ECU.INI — contains information about the installation
- BOUNDS.ECU — constellation boundaries data file
- YBSC1.ECU — the main Yale Bright Star file
- YBSC2.ECU — the secondary Yale Bright Star file
- YBSC3.ECU — the tertiary Yale Bright Star file
- SAO1.ECU — the primary Smithsonian Astrophysical Observatory star file
- SAO2.ECU — the secondary Smithsonian Astrophysical Observatory star file
- MESSIER.ECU — the Messier object file
- SACLITE1.ECU — the main Saguaro Astronomy Club "deep sky" object file
- SACLITE2.ECU — the secondary Saguaro Astronomy Club "deep sky" object file

- CONS.ECU the constellation data file
- LABELS.ECU the text labels data file
- LOCATION.ECU the geographic location data file
- DSNAMES.ECU the deep sky common name data file
- PTERMS.ECU the orbital terms used for high accuracy calculations
- PINDEX.ECU the index file for PTERMS.ECU
- NOTES\ the default directory for user notes

## 1.3 Starting ECU

**ECU** is started by selecting the **ECU** Icon which is accessible from the "Programs" menu of the "Start" menu (usually in the bottom left corner of your screen). The default "programs" menu name for the **ECU** icons is ***Earth Centered Universe Lite*** (In Windows 3.1, this icon is accessible from the ***Earth Centered Universe Lite*** group of the Program Manager).

The first time you start **ECU**, you may be prompted to enter registration information including an unlock code. If you are required to so this, you will have been provided this information either by e-mail from Nova Astronomics or it is included with your CD-ROM.

The loading of **ECU** typically takes less than a few seconds. Before the "main window" appears, several data files, plus the configuration file are loaded into memory. If any problem is encountered while loading **ECU** (due to bad or missing files, not enough memory, etc.), a small dialog box displaying a descriptive message is displayed on the screen. Pressing 'OK' will return control to *Windows*.

If all is successful, the first opening screen will appear greeting the user with a colorful display of the constellation of ORION.

### Note

*Note that **ECU** remembers the size and position of the **ECU** window when it exits, and it restores that size and position when it re-starts, and if it was minimized when it was last exited, it will startup minimized.*

By default, **ECU** always uses the configuration file "ECU.CFG" on your hard disk. If a file name is specified on the command line, **ECU** uses the specified file. This is useful for setting up **ECU** 'icons' to quickly bring up saved astronomical events. You can also "associate" files of type ".cfg" so that when you double-click on an **ECU** configuration file, Windows will launch **ECU** and load that file automatically. For information on how to set this up, search for the word "association" in your windows on-line help.

### Technical Note

*One other seldom-used option available on the command line is "-I file.ini". This option instructs **ECU** to obtain its installation settings from an alternate ini file. Usually it reads the file "ecu.ini" located in the same directory as the "ecu.exe" file, however in certain network server or CD-ROM installations, this option is useful when users don't have write permission to the **ECU** directory. Network administrators are encouraged to contact the author for advise on how to install **ECU** on a network server.*

I suggest you read section 2 next. It introduces the operation of the program. However, if you just want to explore, that's fine, too. I think you will find **ECU's** usage quite intuitive, but there are

some powerful hidden user interface features that you may miss out on if you don't read Section 2.

Section 3 is reference information for all of the menu selections. Section 4 then describes the built-in databases. Section 5 is definitely worth a read since in describes the very important **Identify Object** dialog box.

# 2. Introduction

This section assumes that **ECU** is installed and running. Mouse operations are integral to the operation of **ECU**, and will be described in Section 2.3. The on-screen controls, such as the toolbar and scroll bars will be described in Section 2.4, the keyboard quick-keys are described in Section 2.5, and the menu selections in Section 3. But first, the on-screen status displays and sky display will be described.

## 2.1 The Status Information Displays

**ECU** has two forms of status information displays. First, there is a configurable status line at the bottom of the **ECU** window. This configurable status line is highly configurable (see section 3.2.8) and can be enabled or disabled (see section 3.2.7) by the user. The information that can be displayed includes: location, local mean time, universal time, right ascension and declination, azimuth and altitude, field size, animation step, limited magnitude, and field flip status. The status line is the preferred method to display status information, since it does not cover any of the sky display.

The second method to display status information is using two sizes of status boxes. The size of status box displayed can be configured by the user (see section 3.2.9 to 3.2.11). The small status box the following information: local mean time, right ascension and declination, field size, magnitude limits, and animation step. The large status box add the following information: location, latitude and longitude, universal time, and azimuth and altitude. In both cases, these windows are placed at the top left corner of the sky display, but can be moved around the screen by the user as desired.

Below is a description of all of the status items included in both the status line and status boxes.

a) **Location** — the geographic location in the Earth's surface where the observer is located. In the large status box, the latitude and longitude of the observer is displayed below the place name as degrees and minutes. Positive latitudes are North of the equator and positive longitudes are West of the Greenwich meridian. To set your geographic location, see section 3.3.2, which describes the "Set ⇒ Geographic Location" menu selections.

b) **Local Mean Time (LMT)** — contains the date and time of the local civil time. The date is always in the format year/month/date. The time is either displayed as hh:mm in 24 hour time or hh:mmpm in am/pm format. If daylight savings time is enabled, the title changes from LMT to LDT (Local Daylight Time).

c) **Universal Time (UTC)** — contains the universal date and time (that of the Greenwich meridian). The date is always in the format year/month/date. The time is always displayed as hh:mm in 24 hour time format.

d) **Right Ascension (RA) and Declination (Dec)** — contains the right ascension and declination of the center of the sky display. The RA is formatted in hours and minutes as hh:mm.m. The Dec is formatted in degrees and minutes as +dd° mm'.

e) **Azimuth (Azim) and Altitude (Alt)** — contains the azimuth and altitude of the center of the sky display. The azimuth is the angle, in degrees and minutes, from the Northern horizon towards the East. The altitude is the angle, in degrees and minutes, measured vertically from the horizon.

f) **Field Size (Field)** — contains the number of vertical degrees currently shown in the sky display. The minimum field size is 0.5 degrees and the maximum is 180 degrees.

g) **Animation Time Step (Step)** — contains the value of the time step used by the animation mode in minutes, hours, days, months, or years. In the large status box, if an arbitrary time step has been entered, the word "Manual" will be shown instead of the actual value.

h) **Magnitude (Mag)** — contains the largest magnitude (the faintest) for which stars, deep sky objects, variable stars, and double stars are currently displayed in the sky display. These numbers are usually the same as that set in the "Set ⇒ Magnitude Limits..." menu selection, however to keep the sky drawing speed fast, the largest magnitude for stars automatically changes with the field size; ranging from magnitude 4.0 for fields larger than 120 degrees to magnitude 8.5 for field sizes from 10 to 15 degrees. See section 3.4.3, which describes the "Set ⇒ Magnitude Limits..." menu selection.

## 2.2 The Sky Display

Most of **ECU's** window is occupied by the sky display. There are two modes used to draw the sky. These are the "Star Atlas" mode and the "Local Horizon" mode. The Star Atlas mode depicts the sky similarly to conventional printed star charts — that is, with the lines of declination horizontal and lines of right ascension vertical. The Local Horizon mode depicts the sky as it would appear relative to the Earth's horizon from the current geographic location — that is, "up" in the sky is "up" on the screen. To select the mode desired, see section 3.4.1.

The Local Horizon mode provides a more accurate simulation of the sky, the only penalty is that it draws a bit slower than the Star Atlas mode. This reduction is speed will only be really noticeable when using slower computers.

The sky display shows the positions of celestial objects using one of three "projections". These three projections were selected for the speed of their calculation, however there is some distortion at the limits of their usefulness.

In the Star Atlas mode when displaying the sky from -45 to +45 degrees Declination and a field size of 60 degrees or less, a simple **modified-Mercator** projection is used. This projection causes the objects at high Declinations to be distorted (spread-out), most noticeable in constellations like Ursa Major (the big dipper). This is the same distortion that makes Canada appear much larger than the United States on world maps with similar projections (Canada is only about 10% larger).

In the Star Atlas mode when displaying the sky either North of +45 or South of -45 degrees in Declination and a field size of 60 degrees or less, the **Zenithal Equidistant Projection** is used. This projection is quite good, but does spread out objects a bit at low Declinations.

When displaying the sky with field sizes larger than 60 degrees in the Star Atlas mode or at all times in the Local Horizon mode, an **Orthogonal Projection** is used. This projection is essentially a sphere (like the Earth) viewed from infinity. It can show an entire hemisphere of the sky at once, but suffers from distortion at the edges of the field.

The objects and items displayed in the sky display are listed below. Each will be discussed in detail in sections 3. and 2.4 by the specific menu selection or screen resource which controls their operation.

a) **Grid** — the coordinate grid helps illustrate the sky projections just described. The grid is automatically scaled so that a sufficient number of lines always cross the screen.

b) **Stars** — stars are displayed as varying sized dots according to the star's brightness. The larger the dot, the brighter the star.

c) **Lines** — there are many lines displayed by **ECU**. These include the constellation lines, constellation boundary lines, horizon line, ecliptic line, and telescope field of view lines. Markers are also displayed at the Zenith (the overhead point) and the North and South poles.

d) **Labels** — there are text labels displayed for solar system objects, constellation names, and labels for the coordinate grid, ecliptic and horizon lines, and markers. There are extensive options for labeling stars and deep sky objects. The fonts for all labels are programmable by the user.

e) **Solar System objects** — the planets, sun, moon, comets and asteroids are displayed. The sun and moon are displayed to their correct size. The phase of the moon is also shown. Planets are displayed as a small point (similar in size to a medium brightness star, except with a unique color). Comets are displayed using the special symbol below, which resembles a comet. If a comet tail length is known, its projected length is shown on the sky by a line.

f) **Deep sky objects** — deep sky objects are displayed in six different categories, each using a different symbol. These symbols, shown below in order, are Galaxies, Open Clusters, Globular Clusters, Bright Nebulae, Planetary Nebulae, and Other.

If zoomed in close enough, many objects (those whose sizes are known) will be displayed at their correct size compared to the background stars. Galaxies are displayed according to their correct size, shape, and orientation.

## 2.3 Mouse Operations

The mouse (or other pointing device, such as a touch pad or track ball) forms a vital part of the **ECU** user interface and has many uses from within **ECU**. The cursor (the shape of the mouse pointer) is used to inform the user of how the mouse is currently being used. If it is a "cross-hair", it is used for selecting a window, centering, or measuring an angle. If it is a "target" you are in the process of identifying an object.

The cursor is always a cross-hair while moving about within the sky display. If it is an arrow, it is used for operating the scroll bars or buttons.

If it is the planet Saturn, **ECU** is busy computing solar system positions. If it is an hour-glass, **ECU** is busy performing some other task; usually drawing the sky display.

The specific operation of each mouse button is described separately in the next two sections.

## 2.3.1 Left Mouse Button

The left mouse button, while the cursor is within the sky display, is used for the following functions.

a) **Select an object** — if the left mouse button is pressed (and released) within a few pixels of the center of an object, a dialog box called the "Identify Object" dialog box, will appear identifying and describing the object. Section 5 details the contents of the "Identify Object" dialog box. A cross-hair will appear on the screen identifying the object currently selected. The dialog box is always placed in the diagonally opposite corner from the object selected, so that it doesn't cover the object selected. The dialog box can, of course, be subsequently moved about the screen wherever the user wishes.

   If more than one object is in the vicinity, the "1 more" button can be pressed to update the dialog box with new information for the next object. If another object is selected, the current dialog box will be replaced with a new one. If the left mouse button is pressed while the cursor is not near an object, the dialog box will terminate.

b) **Zoom a window** — the second function performed by the left mouse button is its ability to draw a rectangle on the screen which is used to re-position and re-scale the sky display. The rectangle is drawn by positioning the mouse at one corner, dragging the mouse (with the left mouse button pressed) to another corner, and then releasing the button. The center of the rectangle defines the new display center and the vertical height is used to scale the display.

The left mouse button also interacts with the toolbar, scroll bars, and status line. See section 2.1 and 2.4 for details.

## 2.3.2 Right Mouse Button

The right mouse button, while the cursor is within the sky display, is used for the following functions.

a) **Center the mouse position** — if the right mouse button is pressed (and released), the current mouse position will become the center of the sky display at the current scale. This feature is very useful for quickly "panning" about the sky.

b) **Measure an angle** — the second function performed by the right mouse button is its ability to measure angles on the sky. Angles are measured by positioning the mouse at one location, dragging the mouse (with the right mouse button pressed) to another location, and then releasing the button. A dialog box will appear which displays the angular measure between the two points in both degrees & minutes and in decimal degrees. It also provides: a) the differences in Right Ascension and Declination and b) the differences in Azimuth and Altitude between the two points. This feature is useful for those who find objects with their telescope by offsetting angular distances in each axis from a bright star.

The left mouse button also interacts with the toolbar, scroll bars, and status line. See section 2.1 and 2.4 for details.

## 2.4 On-Screen Controls

The on-screen controls include the scroll bars, toolbar, and speed buttons. Each is described below:

a) **Scroll Bars** — Two scroll bars are used to rapidly move the center of the sky display about the celestial sphere. The scroll bars can be enabled or disabled using the menu selection described in section 3.2.4. They are used in two modes as controlled by the menu selection described in section 3.2.5.

1) **RA/Dec** — The vertical bar is used to change the Declination. +90 degrees is at the top; -90 degrees is at the bottom. Pressing the end arrows will move the pointer (and the sky display) by one degree and pressing along the bar will move the pointer by 10 degrees. The horizontal bar is used to change the Right Ascension. 23 hours 59 minutes is at the left; 0 hours is at the right. Pressing the end arrows will move the pointer by 4 minutes and pressing along the bar will move the pointer by one hour. When sliding the scroll bars by dragging the pointer, observe at the Right Ascension and Declination displays to know when to stop.

2) **Azim/Alt** — The vertical bar is used to change the Altitude with reference to the local horizon. +90 degrees is at the top (the Zenith); -90 degrees is at the bottom (the Nadir). Pressing the end arrows will move the pointer (and the sky display) by one degree and pressing along the bar will move the pointer by 10 degrees. The horizontal bar is used to change the Azimuth with reference to the local horizon. 0 degrees (North) is at the left; 358.5 degrees is at the right. Pressing the end arrows will move the pointer by 1.5 degrees and pressing along the bar will move the pointer by 15 degrees. When sliding the scroll bars by dragging the pointer, observe at the Azimuth and Altitude displays to know when to stop.

b) **Toolbar** — nine graphical buttons are provided for quick access commonly used functions. Many buttons also represent the status of the function they represent. For example, if the grid button ($7^{th}$ from the left) is highlighted the grid is currently being drawn; if the grid button is mostly gray, the grid is not being drawn.

Each button is described below in the order that they appear on the toolbar.


**Zoom Out** — When the left mouse button is pressed over this button, the sky display is zoomed out by a factor of two. When the right mouse button is pressed over this button, the sky display is zoomed out to the maximum field size of 180 degrees.

**Zoom In** — When the left mouse button is pressed over this button, the sky display is zoomed in by a factor of two. When the right mouse button is pressed over this button, the sky display is zoomed in to the minimum field size of 0.5 degrees.

**Undo —** When the left mouse button is pressed over this button, the last operation is nullified and the sky display is re-drawn. This button is equivalent to the Undo menu selection (see section 3.2.1).

**Stars —** When the left mouse button is pressed over this button, the display of stars is "toggled" on or off. When the right mouse button is pressed over this button, the dialog box controlling magnitude limits (see section 3.4.3) is accessed.

**Deep Sky —** When the left mouse button is pressed over this button, the display of deep sky objects is "toggled" on or off. When the right mouse button is pressed over this button, the dialog box controlling deep sky parameters (see section 3.4.4) is accessed.

**Solar System —** When the left mouse button is pressed over this button, the display of solar system objects is "toggled" on or off. When the right mouse button is pressed over this button, the dialog box controlling the planets (see section 3.4.5) is accessed.

**Grid —** When the left or right mouse button is pressed over this button, the display of the coordinate grid is "toggled" on or off.

**Lines —** When the left mouse button is pressed over this button, the display of lines and points is "toggled" on or off. When the right mouse button is pressed over this button, the dialog box controlling the display of lines and points (see section 3.4.11) is accessed.

**Labels —** When the left mouse button is pressed over this button, the display of labels is "toggled" on or off. When the right mouse button is pressed over this button, the dialog box controlling label settings (see section 3.4.12) is accessed.

**Geographic Location —** When the left mouse button is pressed over this button, the dialog box which sets the geographic location on the Earth (see section 3.3.2) is accessed.

**Time —** When the left mouse button is pressed over this button, the dialog box which sets the local time (see section 3.1.1.1) is accessed. When the right mouse button is pressed over this button, the dialog box which sets the Universal time (see section 3.1.1.2) is accessed.

**Field Size —** When the left mouse button is pressed over this button, the dialog box which sets the vertical field size (see section 3.4.16) is accessed.

**Magnitude Limits —** When the left mouse button is pressed over this button, the dialog box which sets the magnitude limits (see section 3.4.3) is accessed.

**Database Search —** When the left mouse button is pressed over this button, the dialog box which sets searches for an object in the **ECU** databases (see section 3.5.1) is accessed. When the right mouse button is pressed over this button, the Object List dialog box (see section 3.5.10) is accessed.

**Place Target —** When the left mouse button is pressed over this button, a Field Target is placed at the center of the sky display (see section 3.4.14.3). When the right mouse button is pressed over this button, the dialog box which controls the default field target parameters (see section 3.4.14.1) is accessed.

**Chart Mode —**When the left mouse button is pressed over this button, the sky display is "toggled" between Sky Atlas or Local Horizon mode (see Section 3.4.1). The icon displayed indicates the current mode — "UP" means Local Horizon mode and "N" means Sky Atlas mode.

**Flip Horizontal —**When the left mouse button is pressed over this button, the sky display is "toggled" between no horizontal flip and horizontal flip (see Section 3.4.15).

**Flip Vertical —**When the left mouse button is pressed over this button, the sky display is "toggled" between no vertical flip and vertical flip (see Section 3.4.15).

**Increase Time Step —** When the left mouse button is pressed over this button, the animation time step in increased by one step. When the right mouse button is pressed over this button, the dialog box which sets a manual animation time step (see section 3.6.15.1) is accessed.

**Decrease Time Step —** When the left mouse button is pressed over this button, the animation time step in decreased by one step. When the right mouse button is pressed over this button, the dialog box which sets a manual animation time step (see section 3.6.15.1) is accessed.

**Reverse One Step —** When the left mouse button is pressed over this button, **ECU's** time is stepped backward by one animation time step in increased by one step. When the right mouse button is pressed over this button the "Center on Previous Object" function (see section 3.5.11) is activated.

**Forward One Step —** When the left mouse button is pressed over this button, **ECU's** time is stepped forward by one animation time step in increased by one step. When the right mouse button is pressed over this button the "Center on Next Object" function (see section 3.5.10) is activated.

**Animation Start/Stop —** When the left mouse button is pressed over this button, the operation of the animation mode is "toggled" on and off.

There are two special mouse operations which relate to the toolbar. If the left mouse button is pressed in an unused region of the toolbar, the state of the status box is cycled

through being disabled, small in size, and large in size. If the right mouse button is pressed in an unused region of toolbar, the status line is "toggled" on and off.

c) **Status Line Speed buttons** — When the left mouse button is pressed while over the boxes on the status line are used to display various status items (see section 2.1), the appropriate dialog box which relates to the items is accessed. For example, if the left mouse button is pressed within the box which display the magnitude limits, the "Magnitude Limits..." dialog box will pop-up. In addition, pressing the right mouse button over the local time display causes the "Julian Date/Sidereal Time" dialog box (see section 3.8.2) to be displayed.

There are two special mouse operations which relate to the status line. If the left mouse button is pressed in an unused region of the status line, the dialog box which controls the status line is accessed. If the right mouse button is pressed in an unused region of the status line, the toolbar is "toggled" on and off.

## 2.5 Keyboard Quick Keys

Most of the functions of **ECU** can be operated from the keyboard, but the mouse interface is usually more efficient. There are, however, many key combinations that speed up access to common functions. These are listed below:

- **Alt-S** equivalent to: **File ⇒ Save**
- **Alt-A** equivalent to: **File ⇒ Save As...**
- **Alt-X** equivalent to: **File ⇒ Exit**
- **Alt-F4** equivalent to: **File ⇒ Exit**
- **Alt-Backspace** equivalent to: **Edit ⇒ Undo**
- **Alt-T** equivalent to: **Set ⇒ Time ⇒ Set Local Time...**
- **Alt-N** equivalent to: **Set ⇒ Time ⇒ Set Time to System Time** (the 'N' stands for Now)
- **Alt-U** equivalent to: **Set ⇒ Time ⇒ Universal Time...**
- **Alt-G** equivalent to: **Set ⇒ Geographic Location…**
- **Alt-M** equivalent to: **Field ⇒ Magnitude Limits...**
- **Alt-P** equivalent to: **Field ⇒ Planets...**
- **Shift-T** toggle the toolbar off and on
- **Ctrl-S** toggle the status box off and on
- **Page Up** zoom out one step
- **Page Down** zoom in one step
- **Alt-Z** zooms the sky display to full zoom out (180 degrees)
- **Shift-Z** zooms the sky display to full zoom in (0.5 degrees)
- **Alt-D, Ctrl-F** equivalent to: **Center ⇒ Database Search...**
- **Shift-M** centers the sky display on the Moon
- **Shift-S** centers the sky display on the Sun
- **N** centers the sky display on the local northern horizon
- **S** centers the sky display on the local southern horizon
- **E** centers the sky display on the local eastern horizon
- **W** centers the sky display on the local western horizon
- **Z** centers the sky display on the local zenith (the overhead point)

- **Escape** stops the execution of animation mode
- **B** silences the system beeper if it is "beeping" while searching for an object with the telescope encoder interface
- + equivalent to: **Animation ⇒ Forward One Step**
- – equivalent to: **Animation ⇒ Reverse One Step**
- **Insert** increases the animation time step by one notch
- **Delete** decreases the animation time step by one notch
- **Ctrl-H** equivalent to: **Field ⇒ Telescope Field ⇒ Flip Horizontal**
- **Ctrl-V** equivalent to: **Field ⇒ Telescope Field ⇒ Flip Vertical**
- **Right-Arrow** moves the mouse pointer to the right by 5 pixels*
- **Shift-Right-Arrow** moves the mouse pointer to the right by 1 pixel*
- **Left-Arrow** moves the mouse pointer to the left by 5 pixels*
- **Shift-Left-Arrow** moves the mouse pointer to the left by 1 pixel*
- **Up-Arrow** moves the mouse pointer up by 5 pixels*
- **Shift-Up-Arrow** moves the mouse pointer up by 1 pixel*
- **Down-Arrow** moves the mouse pointer down by 5 pixels*
- **Shift-Down-Arrow** moves the mouse pointer down by 1 pixel*
- **Spacebar** presses the left mouse button*
- **Shift-Spacebar** presses the right mouse button*
- **Ctrl** causes the coordinate displays to track the mouse position (while key is held down)*

* these keys are active only when the mouse is positioned over the sky display and the **ECU** window is active.

# 3. Menu Selections

The menu selections control most of the features of **ECU** and are divided into eight categories as listed below. Each is described in detail in the identified sections:

- **File** — the file menu handles the loading and saving of the configuration settings of **ECU** including comet and asteroid orbits, and the printing of star charts. (see section 3.1).

- **Edit** — edit includes the undo feature, control of the toolbar, scroll bars, status line, and status box (see section 3.2).

- **Set** — the set menu allows the time, geographic location, solar system calculation settings, comet and asteroid orbits, sky display colors, and sky drawing mode to be adjusted (see section 3.3).

- **Field** — the field menu controls if and how the stars, deep sky objects, planets, sun/moon, comets/asteroids, grid, lines, targets, and labels are displayed. It also allows for various zoom settings (see section 3.4).

- **Center** — the center menu provides many ways to set the center of the sky display. These ways include by a text search of the databases, centering on a specified Right Ascension/Declination, a specified Azimuth/Altitude, a constellation, a bright star, a

Messier object, a named deep sky object, a Solar System object, or a point on the local horizon. (see section 3.5).

- **Animation** — the animation menu controls the various features of the animation mode (see section 3.6).

- **Miscellaneous** — the miscellaneous menu provides access to various functions which didn't seem to fit well anywhere else. These include the display of Sun/Moon data and sidereal time and Julian date, and the settings for various files and directories used by **ECU** (see section 3.8).

- **Help** — the help menu lists the program credits, the version number, etc. (see section 3.9).

Many of the common menu items have "short cut" keyboard keys or on-screen buttons to allow quick access to their features. The keys used are identified by an underline under the key used. The Alt key is to be pressed in conjunction with the identified key. Also, some menu items identify their keyboard equivalent to the right in their menu item. For others, see section 2.5.

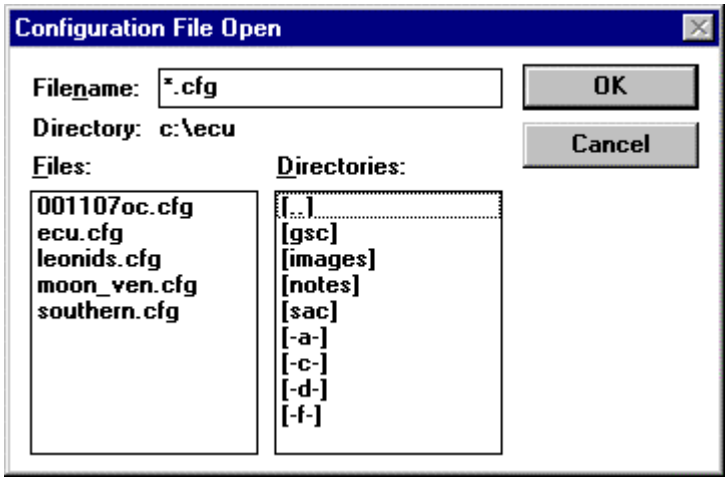
## 3.1 File Menu

The **File** menu allows the configuration settings of **ECU** to be loaded (opened) and saved. Virtually every setting in **ECU** is stored in the configuration file. This allows **ECU** to be "set up" for a particular astronomical event and this event saved to a unique configuration file for later quick retrieval.

The file menu also provides access to setup printers and to print high-quality star charts of the current sky display and the load and save the orbital information for asteroids and comets.

### 3.1.1 Open

The **Open...** menu selection presents a dialog box allowing a new configuration file selected, then subsequently loaded. It defaults to file names with the extension ".cfg".



The operation of this dialog box will not be detailed here, since it is identical to every other Windows application that has an Open... function.

**Note**

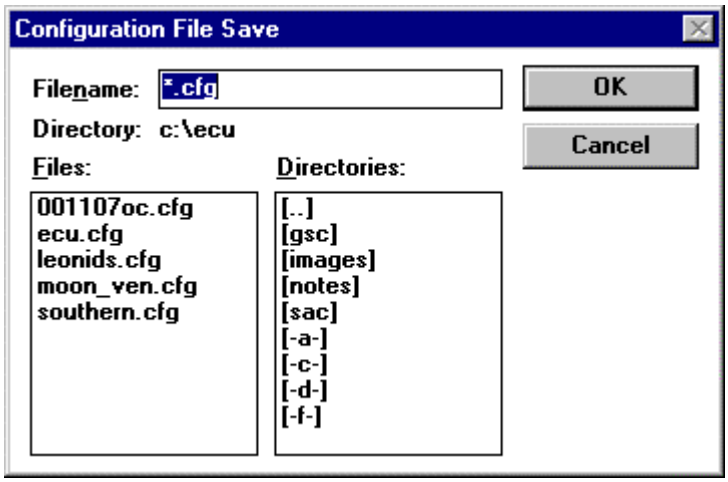
*Please note that configuration files created with V3.0 (and V3.0A through V3.0D), V3.1, and V3.1A of* ***ECU*** *can be read and are automatically converted to V3.2 format. Configuration files from versions older than V3.0 cannot be read.*

## 3.1.2 Save

The **Save** menu selection saves the current configuration settings to the current configuration file name. The current file name is always displayed on the **ECU** Window title. The keyboard equivalent to this menu selection is **Alt-S**.

## 3.1.3 Save As

The **Save As...** menu selection saves the current configuration settings to the file specified by the file name selected in the dialog box presented. I will not detail the operation of this dialog box, since it is identical to every other Windows application that has a **Save As...** function. The keyboard equivalent to this menu selection is **Alt-A**.




## 3.1.4 Revert

The **Revert** menu selection re-loads the configuration settings from the current configuration file name. The current file name is always displayed on the Window main title. This function is commonly found in Macintosh® programs, and is useful, for example, if you have loaded a configuration file (or started ECU), made some changes to these configurations, then subsequently changed your mind and want to start over.

## 3.1.5 Restore Defaults

The **Restore Defaults** menu selection sets all configuration settings to the system defaults. If the special file "default.cfg" exists, those settings will be used instead of the permanent settings programmed into **ECU**. This feature is intended to allow the user to set his/her own "default"

settings which are likely to differ from the author's favorite settings since you probably don't live in Halifax, Nova Scotia!

This selection should be used carefully, since it changes all of the configuration settings at one (and cannot be undone with the Undo feature (see section 3.2.1), including the possible removal of all the comets and asteroids which you may have entered.

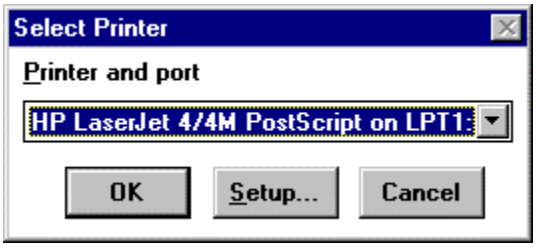
## 3.1.6 Print Chart

The **Print Chart** menu selection prints a high-quality chart of the sky display on the printer selected and setup in **Printer Setup...**. The chart is printed with the same settings used to draw the sky display (except for the fonts — see section 3.1.9). The chart is printed in two formats. In either format, a title box can be printed at the bottom of the page containing the chart title, geographic location, the universal and local date and time, the center of the chart as the right ascension and declination, the center of the chart as the azimuth and altitude, and the height of the field in degrees.

If the printer is set in portrait mode (or, if the height of the paper is larger than its width), a legend box can be drawn above the title box. If the printer is set in landscape mode (or, if the width of the paper is larger than its height), a legend box can be drawn on the right side of the page. This legend box shows the stellar magnitude limit and the star symbols used, the deep sky magnitude limit and the deep sky symbols used, and an area for your notes.

## 3.1.7 Printer Setup

The **Printer Setup...** menu selection presents a dialog box allowing the user to select and setup a printer to be used by **ECU**. The dialog box contains a drop down pick list and three buttons. The printer to be used is selected from the pick list. To change the default settings for the selected printer, press the "Setup..." button. This will activate the printer's setup dialog box where such items as the printer's resolution and the page size and orientation (portrait or landscape) can be set. All changes to the printer's settings remain in effect until **ECU** is terminated.




## 3.1.8 Chart Setup

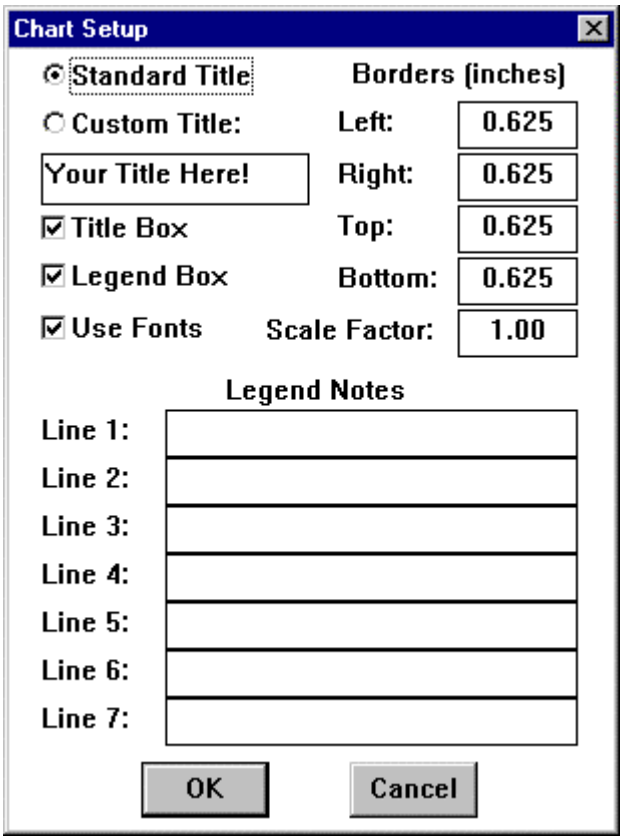
The **Chart Setup...** menu selection presents a dialog box allowing the user to customize the appearance of the printed star charts. The title line of the chart can be customized by selecting the "custom title" radio button and entering new title text below it.

The title box, which shows the chart title, time, geographic location and other data, can be enabled or disabled by using the "title box" check box.

The legend box, which shows the symbols used for stars of different brightness and deep sky objects of different types, can be enabled or disabled by using the “legend box” check box.

The “Use Fonts” check box controls if the printer fonts programmed in **Set Printer Fonts...** (see section 3.1.9) are used to draw the chart. If it is not checked, the default font for the selected printer is used, which may cause the chart to print more quickly.

The four border distances, in inches, can be individually set. This, in effect, allows the chart size to be controlled. This feature is very useful for making charts that can be “pasted” into other documents, such as an astronomy club newsletter. Another project could be to make up a set of small-sized charts of the Messier objects; a project the author plans to undertake.



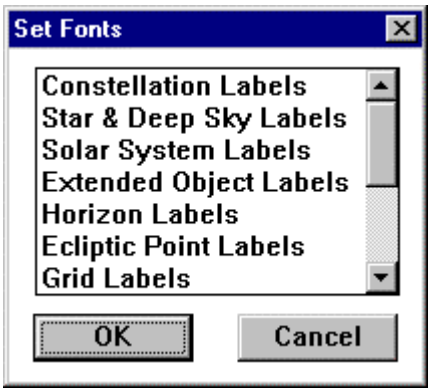

The “symbol scale factor” setting allows the user to increase or decrease the size of the star, deep sky, and other symbols drawn on the chart. Printers of varying resolutions (pixels per inch) may produce higher quality output at values other than the standard setting of one. Experiment with this setting to determine the best setting for your printer.

If the user enters values smaller than one, the symbols will be drawn proportionately smaller. Likewise, if the user enters values larger than one, the symbols will be drawn proportionately larger.

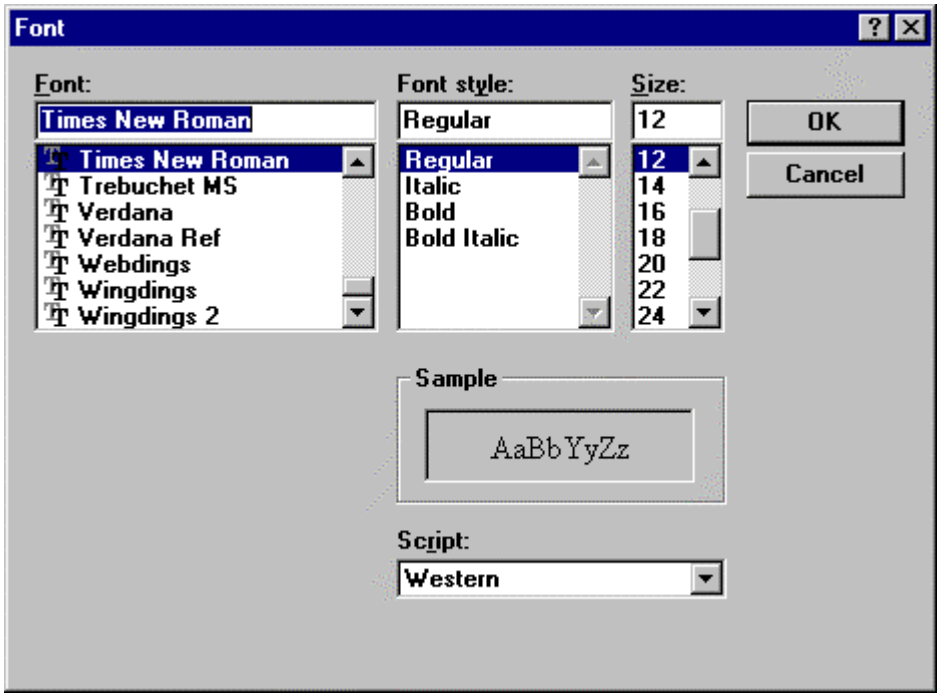
The seven text boxes towards the bottom of the dialog box labeled Line 1-7 can be used to add descriptive text to the “Notes” section of the chart legend box.

## 3.1.9 Set Printer Fonts

The **Set Printer Fonts...** menu selection presents a dialog box allowing the user to customize the fonts used in the printed star charts. A list box is presented containing the 13 text items whose fonts can be customized.




The user is to select the desired item followed by pressing 'OK'. The standard Windows font control dialog box will then be presented as shown below. The font, font style, and size can be selected. Note that only "TrueType" fonts can be used. After exiting the dialog box by pressing 'OK', the **Set Fonts** dialog box will be re-drawn.




## 3.1.10 Load Orbits

The **Load Orbits...** menu selection is used to load orbital information for comets and asteroids. It presents a dialog box allowing an orbital data file to be selected, then subsequently loaded. It defaults to file names with the extension ".orb".

The format of the file loaded is specific to **ECU**, but is in ASCII format, thus can be altered by any text editor, such as the Windows Notepad. **ECU** supports up to 400 comets and asteroids active at any one time; referred to as "Comet/Asteroid 1" to "Comet/Asteroid 400". When the file is loaded, it will replace any orbits currently defined. No more than 400 entries will be loaded even if the file contains more than 400 entries.

A sample comet entry follows:

```
Comet Lane 1995F
E C 2000 1994 12 5.445 0.852 0.9565 45.566 180.765 -34.321 4.0 10.0 0.1
```

Each entry contains two lines. The first line contains the name of the comet (up to 40 characters). The second line contains 13 entries of orbital data separated by a space in the following order: Enable (an 'E' if the comet is enabled, a 'D' if it is disabled), Orbit type (always a 'C' for a comet), Epoch, Year, Month, Date, Perihelion, Eccentricity, Argument of Perihelion, Longitude of Ascending Node, Inclination, Magnitude Parameter 'H', Magnitude Parameter 'G', and the Tail Length (optional). For a description of each entry, see section 3.3.4.

A sample asteroid entry follows:

```
Asteroid Lane 4563
E A 2000 1994 1 3.2 0.4544 4.54 0.045 6.4343 54.3232 5.5845 4.0 5.0
```

Each entry contains two lines. The first line contains the name of the asteroid (up to 25 characters). The second line contains 14 entries of orbital data separated by a space in the following order: Enable (an 'E' if the asteroid is enabled, a 'D' if it is disabled), Orbit type (always a 'A' for a asteroid), Epoch, Year, Month, Date, Mean Anomaly, Semi-Major Axis, Eccentricity, Argument of Perihelion, Longitude of Ascending Node, Inclination, Magnitude Parameter 'H', and Magnitude Parameter 'G'. For a description of each entry, see section 3.3.4.

### 3.1.11 Save Orbits

The **Save Orbits...** menu selection is used to save the orbital information for comets and asteroids. It presents a dialog box allowing an orbital data file to be entered, then subsequently saved. It defaults to file names with the extension ".orb".

The format of the file saved is specific to **ECU**, but is in ASCII format, thus can be altered by any text editor, such as the Windows Notepad. All 400 comets and asteroids are saved in the file format described in section 3.1.10.

### 3.1.12 Exit

The **Exit** menu selection is used to exit **ECU**. If the configuration settings have changed, a message box appears asking to user to specify if the settings are to be saved to the current file name. Pressing "Yes" (or the enter key) will save the configuration settings to the current file name and exit **ECU**. Pressing "No" will exit **ECU** without saving the configuration settings. Pressing "Cancel" will return control to **ECU**.

**ECU** can also be exited by "double-clicking" on the Control-menu box or by selecting "Close" in the window's system menu. The keyboard equivalent to this menu selection is **Alt-X** or **Alt-F4**.

## 3.2 Edit Menu

The **Edit** menu provide several functions which control the operation of toolbar, scroll bars, and status information displays. It also includes the Undo function. Each menu selection is described separately in the following sections.

## 3.2.1 Undo

The **Undo** menu selection nullifies the last operation. This is very useful when you have made a "slip of the mouse" and wish to get back to where you were. Selecting **Undo** a second time restores the **ECU** settings back to what they originally were. The keyboard equivalent to this menu selection is **Alt-Backspace**, or you can press its toolbar button. Depending on the setting described in the next section, you can either undo just the last operation, or up to the last 10 operations.

## 3.2.2 Enable Multiple Undos

The **Enable Multiple Undos** menu selection controls whether or not you can Undo just the last operation or up to the last 10 operations. If a 'check mark' precedes this menu item, up to the last 10 operations can be undone. This feature is provided primarily to allow users with older computers the ability to conserve memory (which is required to store the Undo information). This change to the Undo mode will be effective the next time **ECU** is started.

## 3.2.3 Toolbar On

The **Toolbar On** menu selection controls whether the toolbar (a graphical button bar placed just below the menus) is displayed or not. See section 2.4 for details on how to use the toolbar. If a 'check mark' precedes this menu item, the toolbar line will be displayed. The keyboard equivalent to this menu selection is **Shift-T**.

## 3.2.4 Scroll Bars On

The **Scroll Bars On** menu selection controls whether the scroll bars are displayed or not. If a 'check mark' precedes this menu item, the scroll bars will be displayed. See section 2.4 for details on how to use the scroll bars.

## 3.2.5 Scroll Bar Mode

The **Scroll Bar Mode** menu selection provides a sub-menu allowing the mode of the scroll bars to be set. If 'RA/Dec' is selected, the scroll bars are used to move about the celestial sphere using Right Ascension and Declination coordinates. If 'Azim/Alt' is selected, the scroll bars are used to move about the local sky display using Azimuth and Altitude coordinates. A 'check mark' marks the current setting.

## 3.2.6 Track Coordinates

The **Track Coordinates** menu selection controls whether the coordinate displays (Right Ascension/Declination and Azimuth/Altitude) match the mouse position (checked) or the center

of the sky display (unchecked). Holding down the “control” key also causes the coordinates to match the mouse position.

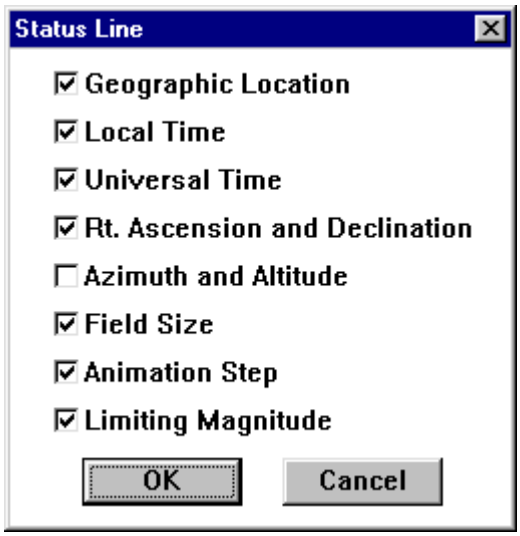
## 3.2.7 Status Line On

The **Status Line On** menu selection controls whether the status line (a line of status text placed just below the sky display) is displayed or not. If a ‘check mark’ precedes this menu item, the status line will be displayed. See section 2.1 for details on the contents of the status line.

## 3.2.8 Status Line

The **Status Line** menu selection presents a dialog box allowing the user to select which text status items are to be included on the status line. For a description of each item, see section 2.1. All those items checked will be included.

This menu selection can also be activated by pressing the left mouse button while the mouse is in an unused part of the status line.




## 3.2.9 No Status Box

The **No Status Box** menu selection turns off the status box. If a ‘check mark’ precedes this menu item, the status box is off. Pressing **Ctrl-S** on the keyboard toggles between turning off the status box and setting it to the large size.

## 3.2.10 Small Status Box

The **Small Status Box** menu selection sets the size of the status box (see section 2.1) to the small (abbreviated) size. If a ‘check mark’ precedes this menu item, the small status box will be displayed. See section 2.1 for details on the contents of the small status box.

## 3.2.11 Large Status Box

The **Large Status Box** menu selection sets the size of the status box (see section 2.1) to the large size. If a 'check mark' precedes this menu item, the large status box will be displayed. See section 2.1 for details on the contents of the large status box. Pressing **Ctrl-S** on the keyboard toggles between turning off the status box and setting it to the large size.

## 3.3 Set Menu

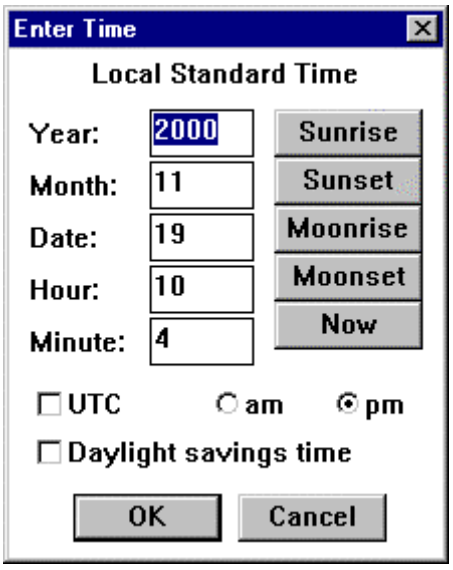
The **Set** menu allows the time, geographic location, Solar System calculation settings, atmospheric refraction setting, comet and asteroid orbits, sky colors, and sky drawing mode to be adjusted. Each is described in the sections below.

### 3.3.1 Time

The time can be set in one of three formats: local civil time, Universal time (UTC), set to your pc's system clock (using local civil time or UTC). The current time format used is identified in the **Time** menu selections sub-menu, by a check mark in front of the current mode. The following sections describe the time settings.

#### 3.3.1.1 Enter Local Time

The **Enter Local Time** menu selection presents a dialog box allowing the user to enter the year, month, date, hour, and minute in local time format. The year can be from 4713BC to 9999 AD. There is a year 0, so, for example, if the year 6 BC is to be entered, -5 should be used for the year. The time is always initialized to the current time.




For you convenience, you are reminded what type of time you are entering. The choices are "Local Standard Time", "Daylight Savings Time", and "Universal Time" (see section 3.3.1.2).

If the **Local Time Format** setting (see section 3.3.1.6) is set to AM/PM, the "am/pm" buttons will be active and the hour must be in 12 hour AM/PM format (using the am and pm radio buttons), otherwise the hour must be entered in 24 hour format (0 to 23 hours).

The “Daylight savings time” check box is used to determine if the time is to be interpreted as local standard time (usually winter time) or daylight savings time (usually summer time).

The “UTC” check box is used to quickly change to entering the Universal Time, rather than the local time.

Five buttons are also provided which make it easy to set the time to: a) when the Sun rises today; b) when the Sun sets today; c) when the Moon rises today; d) when the Moon sets today; and e) the current date and time.

If an error is detected when ending the dialog box (pressing “OK”), a ‘beep’ will sound and the cursor will be placed at the offending field.

This menu selection can also be activated by pressing the left mouse button while the mouse is in box which displays the local mean date and time (LMT) in the **ECU** status line or when the left mouse button is clicked on its button on the toolbar. The keyboard equivalent to this menu selection is **Alt-T**.

## 3.3.1.2 Enter Universal Time

Entering the Universal time is accomplished identically to entering the local time, except that hour must always be entered in 24 hour format. This menu selection can also be activated by pressing the left mouse button while the mouse is in the box which displays the universal date and time (UTC) in the **ECU** status line or when the right mouse button is clicked on the “time” toolbar button. The keyboard equivalent to this menu selection is **Alt-U**.

## 3.3.1.3 Use System Time

Selecting **Use System Time** causes **ECU**’s time to become synched to your pc’s system clock. This will also cause the sky to update automatically once per minute, therefore simulating the actual sky’s movements. See also section 3.3.1.5.

## 3.3.1.4 Set Time to System Time

Selecting **Set Time to System Time** causes **ECU**’s time to be set to your pc’s system clock. Unlike the selection **Use System Time**, the sky will not update automatically thereafter. The keyboard equivalent to this menu selection is **Alt-N** (N stands for NOW!). See also section 3.3.1.5.

## 3.3.1.5 PC Clock is UTC

Feature not present in **ECU Lite**.

## 3.3.1.6 Local Time Format

The local mean time (LMT) display in the status area is displayed in either 24 hour or am/pm format. The **Local Time Format** menu selection is a sub-menu of **AM/PM** and **24 Hour**

selections, each selection setting the respective format. The current format is identified by a 'check mark'.

### 3.3.1.7 Daylight Savings

The **Daylight Savings** menu selection toggles whether the current local time is to be interpreted as a daylight savings time. It is used by **ECU** to convert from local time to Universal time. If a 'check mark' is present, daylight savings mode is enabled. If **ECU** is using the PC's system clock and the daylight savings time 'check mark' is present, the PC's time should be set to the daylight savings time. The daylight savings mode can also be controlled from the Enter Time dialog box (see section 3.3.1.1).

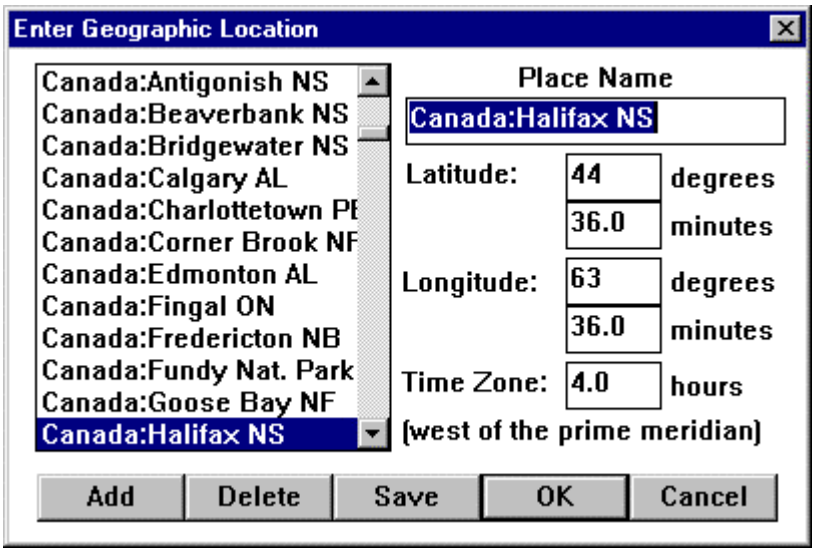
## 3.3.2 Geographic Location

The **Geographic Location** menu selection presents a dialog box allowing the selection of a location on the Earth's surface. The location can be selected from the provided list of hundreds of locations around the world or you can enter the latitude, longitude, and time zone of a location of your choice.

To select a pre-programmed location, use the scroll bar controlled list box on the left side of the dialog box to bring the desired location into view and click on it with the mouse. Its place name, latitude, longitude, and time zone will be displayed on the right side of the dialog box. Press "OK" to use this location.

To add a new location enter a place name, latitude, longitude, and time zone on the right side of the dialog box. The latitude is entered as degrees (North is positive, South is negative) and minutes. The longitude is also entered as degrees (West of the prime meridian is positive, East is negative) and minutes. The time zone is entered in hours West of UTC (the time of the Greenwich meridian; enter a negative for the Eastern hemisphere).

At this point, if you press the "Add" button, the new location will be added to the geographic location database. Pressing "Save" will save the database and use this new location. If an error is detected when adding or saving, a 'beep' will sound and the cursor will be placed at the offending field.



To delete a location from the database, select it in the list box, then press the "Delete" button. To finish, press the "Save" button to save the database.

The database file used to store the geographic locations is user programmable. The default file used is "LOCATION.ECU". See section 3.8.7 for details on how to change this file. The format used for this file is a plain text file and is formatted as shown by the following sample entries below:

```
44.58 63.65 4 Canada:Halifax NS
47.83 71.25 5 Canada:Quebec QUE
43.65 79.38 5 Canada:Toronto ONT
42 83 5 Canada:Windsor ONT
51.50 0.17 0 UK:London
```

The first three entries, which are separated by spaces, are the latitude (decimal degrees North of the Equator), longitude (decimal degrees West of the Prime meridian), and time zone (hours West of UTC). The fourth entry is the name of the location.

This menu selection can also be activated by pressing the left mouse button while the mouse is within the box which displays the geographic location in the status line or by pressing its button on **ECU's** toolbar. The keyboard equivalent to this menu selection is **Alt-G**.

## 3.3.3 Solar System

Feature not present in **ECU Lite**.

## 3.3.4 Define Orbits

The **Define Orbits...** menu selection presents a dialog box allowing the user to select one of the 400 comets or asteroids whose orbit you wish to change or define. If the comet or asteroid has already been named, it name will be shown, otherwise its number will be shown. Select the desired comet or asteroid and press 'OK' or press 'Cancel' to abort the dialog box.

When a comet or asteroid is selected, a second dialog box is presented allowing the orbital elements of a comet or asteroid to be entered or changed. The following items can be entered.

a) **Orbit Type** — select the type of orbit to be used; either comet or asteroid.
b) **Comet or Asteroid Name** — a textual name that is displayed next to the comet or asteroid in the sky display (maximum of 40 characters).
c) **Date of Perihelion or Date of Epoch** — if the orbit type is 'comet', the date of perihelion is to be entered here. If the orbit type is 'asteroid', then the date of the epoch is to be entered here. The date is entered as either decimal years or as year, month, and decimal days. If the month is set to zero, the decimal years are used and the month and date are ignored. If the month is valid (1 to 12), the year, month, and date are used.
d) **Mean Anomaly (M)** — angle of an asteroid at the epoch in degrees. Not used for comet orbits.
e) **Perihelion Distance (*q*) or Semi-major Axis (a)** — the distance of the comet from the Sun in astronomical units (AU) at Perihelion or the semi-major axis of the asteroidal orbit in AU.

f) **Eccentricity (*e*)** — the eccentricity of the orbit from 0 to 2.

g) **Argument of Perihelion (ω)** — the argument, in degrees, of the perihelion.

h) **Longitude of Ascending Node (Ω) —** the longitude, in degrees, of the ascending node.

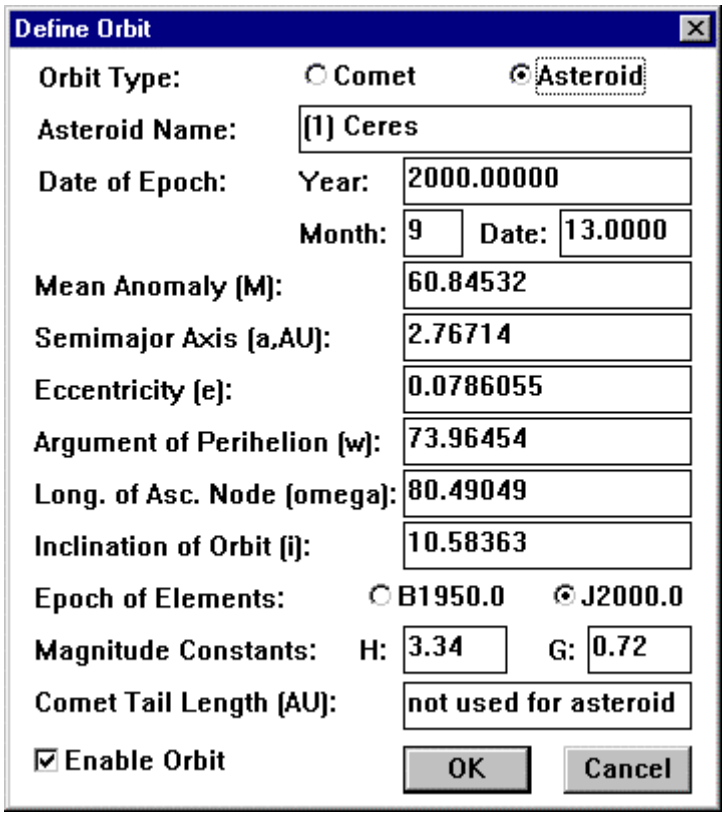
i) **Inclination of Orbit (*i*) —** the inclination of the orbit in degrees.

j) **Epoch of the Elements** — the epoch of the elements, either B1950.0 or J2000.0.

k) **Magnitude Constants** — the magnitude constants H and G, are used to estimate the brightness of the comet or asteroid. Each comet or asteroid has a different set of constants. Comet brightness predictions are notoriously extremely unreliable.

l) **Comet Tail Length** — the estimated length, in astronomical units (AU) of the comet's tail. Normally this value will be set to zero, however if its set to a value greater than zero, **ECU** projects the tail onto sky display in the correct direction (opposite the Sun) and the correct projected length. A good initial guess of a tail length is 0.1 AU. Not used for asteroids.

m) **Enable Orbit** - this flag enables the orbit for display.




If an orbit has a name and is 'enabled', it will be subsequently be referred to by its name instead of just "Comet/Asteroid 1", etc.

## Notes

*As a service to ECU users, you can find a link to orbital elements for current comets and asteroids in ECU format (see section 3.1.10) at the Nova Astronomics Internet web site (**www.nova-astro.com**). These elements are provided by the International Astronomical Union's Minor Planet Center located at Harvard University.*

## 3.3.5 Search Orbits

Feature not present in **ECU Lite**.

## 3.3.6 Enable All Orbits

This menu selection enables all asteroid and comet orbits automatically. This is equivalent the user manually checking the "Enable Orbit" checkbox for all valid orbits. Valid orbits do not include those with names beginning with "Comet/Asteroid".

## 3.3.7 Disable All Orbits

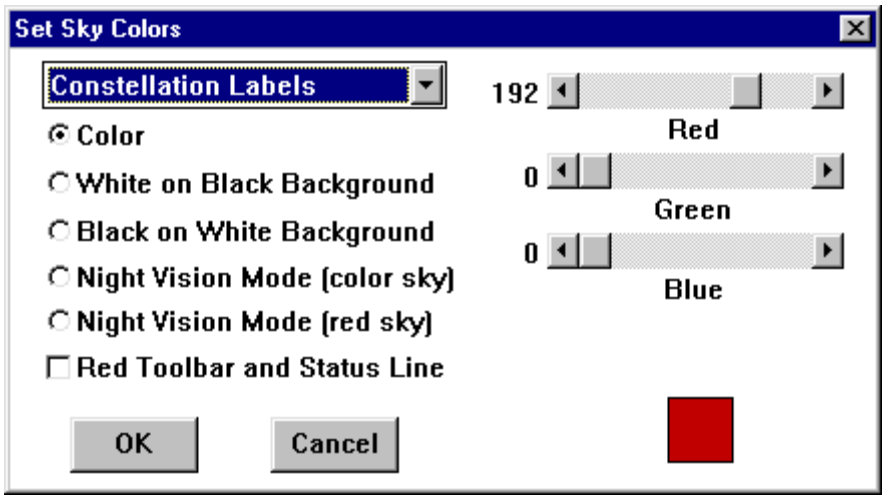
This menu selection disables all asteroid and comet orbits automatically. This is equivalent the user manually un-checking the "Enable Orbit" checkbox for all valid orbits. Valid orbits do not include those with names beginning with "Comet/Asteroid".

## 3.3.8 Atmospheric Refraction

This menu selection controls whether the local horizon, Azimuth and Altitude displays, and Rise/Set calculations are to be corrected for the effects of Atmospheric Refraction. Atmospheric Refraction causes an object to appear higher in the sky that it actually is. The bending (or refraction) of light as it passes through the Earth's atmosphere causes this effect.

## 3.3.9 Set Sky Colors

The **Set Sky Colors...** menu selection presents a dialog box allowing the user to set the colors used to draw the sky display. The dialog box contains five "radio" buttons, one "combo" box, one checkbox, and three scroll bars. When drawing the sky display **ECU** subdivides the drawing into many different elements. These include elements such as constellation lines, the sun, galaxies, etc.




The radio buttons are mutually exclusive, such that only one can be active at any one time. The "Color" radio button is the mode where the color of each sky display drawing element can be individually set as described below. The "White on Black Background" mode causes the entire sky display to be drawn in white with a black background. The "Black on White Background" mode causes the entire sky display to be drawn in black with a white background. This mode is especially useful for "pasting" the display into other Windows program for further manipulation.

Either of these two modes may also be useful when **ECU** is used on laptop computers with black and white LCD screens.

The Night Vision modes, "color sky" and "red sky", are intended to be used in the field or in an observatory, and will help maintain the user's dark adaptation. The "color sky" mode causes the whole screen, except for the sky display, to appear in black and shades of red. The "red sky" mode causes the whole screen, including the sky display, to appear in black and shades of red. In both of these modes, the 'system' colors are changed and thus the colors of all other Windows applications running on your system will be affected. When exiting **ECU**, all of the system colors are restored to their original state. The checkbox "Red Toolbar and Status Line" changes just the toolbar and status line colors to black and shades of red — this feature is useful when ECU is being used at the same time as another program that has a night vision mode.

The colors of individual sky display drawing elements are controlled by first selecting the element from the "drop down pick list" in the top left of the dialog box. Pressing the down arrow will cause a "pick list" to be displayed with a scroll bar on the right hand side. Using the scroll bar, simply select the drawing element whose color you wish to change with the mouse. The three horizontal scroll bars on the right side of the dialog box will be set to the color of the selected drawing element and the actual color is shown in a box beneath the scroll bars.

In Windows, colors are represented by their equivalent red, green, and blue proportions. To change a color drag any or all of the three scroll bars until the desired color is shown. The number of different colors that can be produced varies considerably (ranging from 16 to about 16 million colors) with the graphics card and its associated driver program. **ECU** does not attempt to change the system color palette.

### 3.3.10 Set Drawing Mode

The **Sky Drawing Mode** menu selection provides a sub-menu allowing the mode in which **ECU** uses to draw the sky display. If 'Fast Update' is selected, the sky display will update essentially instantaneously. **ECU** performs all the necessary calculations and drawing functions to the computer's memory in advance, then updates the sky display all at once. This is the best mode to use with the animation functions described in section 3.6.

If 'Continuous Drawing' is selected, the sky display will update sequentially as each element is calculated and drawn. This mode may enable the sky display to update faster than the 'Fast Update' mode on some "accelerated" graphics boards that have become very popular lately. A 'check mark' marks the current setting. This is also the best mode to use if you are using an older computer with limited memory.

## 3.4 Field Menu

The **Field** menu controls various parameters pertaining to the sky display. Each menu selection is described separately in the following sections.

### 3.4.1 Chart Mode

The **Chart Mode** menu selection provides a sub-menu allowing the **ECU** chart mode to be selected to either "Star Atlas" or "Local Horizon". See section 2.2 for a description of the attributes of each mode. The current mode is indicated by a 'check mark' in front of the menu item. You can also change the chart mode using its toolbar button.

When the "Star Atlas" mode is selected, the scroll bars are automatically changed to "RA/Dec" mode and when the "Local Horizon" mode is selected, they are automatically changed to the "Azim/Alt" mode.

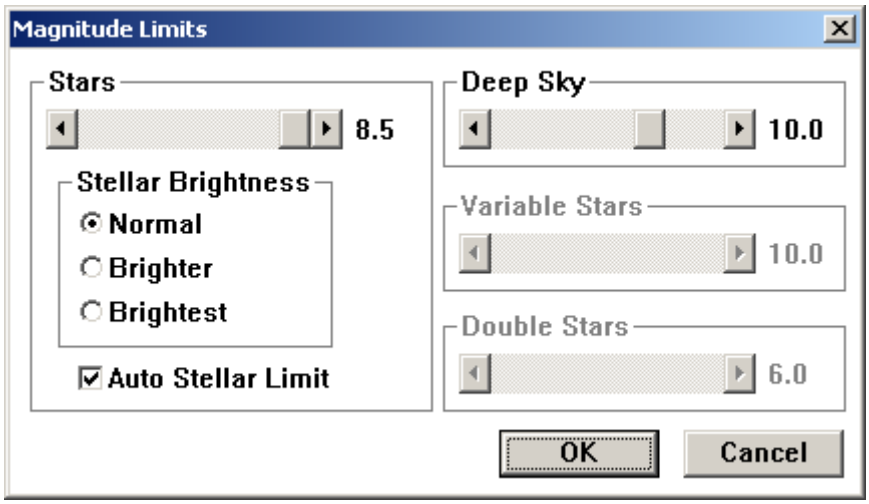
## 3.4.2 Display

The **Display** menu selection provides a sub-menu allowing the user to toggle the display of stars, deep sky objects, solar system objects, the grid lines, lines and labels on the sky display. The current state of each display setting is indicated by a 'check mark' in front of the menu item. Each of these items has an equivalent button on **ECU's** toolbar.

## 3.4.3 Magnitude Limits

The **Magnitude Limits...** menu selection presents a dialog box allowing the user to set the limiting magnitude for stars and deep sky objects. It also allows the size of the stars to be controlled.

The magnitudes are set by dragging the scroll bars to the desired magnitude as displayed immediately to the right of each scroll bar. If the optionally installed variable or double star databases are not present, their magnitude scroll bars will be deactivated.




The actual stellar limiting magnitude which results depends state of the "Auto Stellar Limit" check box. If "checked", the stellar limit depends on the field size, however, the scroll bar sets the upper limit.

If not "checked" all stars in the database are drawn, up to the limit set on the scroll bar. However, if the field size is greater than 45 degrees, then only the Yale stars are shown (to magnitude 6.5). The negative side effect of this mode are that the sky display may take longer to re-draw (due to many more stars being drawn) and the stars cannot be identified with the mouse.

The size of stellar symbols drawn on the sky display is dependent upon the "Stellar Brightness" setting. The "Normal" setting produces the most realistic displays, however the "Brighter" and "Brightest" settings may product displays which are easier to see on notebook computers equipped with LCD displays (especially when used in the dark).

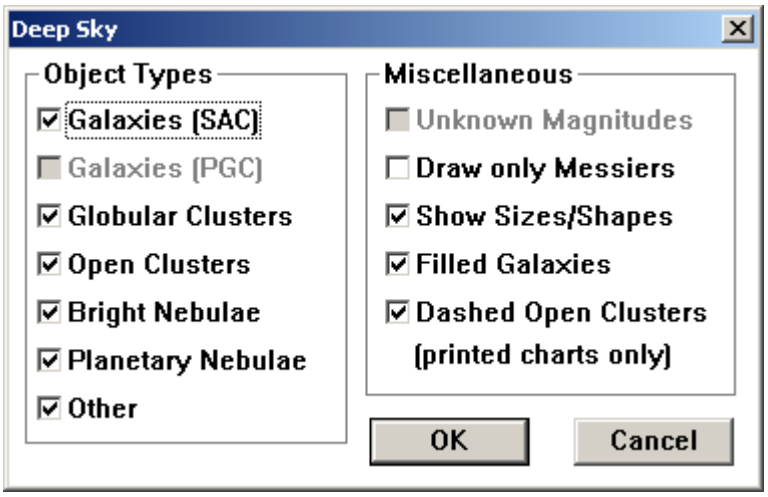
If the deep sky magnitude limit is set to 20, all objects will be displayed, even those whose magnitude is unknown.

This menu selection can also be activated by pressing the left mouse button while the mouse is in the box which displays the current Magnitude Limits in the **ECU** status line, by pressing the left mouse button while over its toolbar button, or by pressing the right mouse button while over the "stars" toolbar button. The keyboard equivalent to this menu selection is **Alt-M**.

## 3.4.4 Deep Sky

The **Deep Sky...** menu selection presents a dialog box which has eleven check boxes in two groups. The first group, "Object Types," provides 7 check boxes which select the types of deep sky objects are displayed; one for each of Galaxies (from the SAC database), Galaxies (from the PGC database), Globular Clusters, Open Clusters, Bright Nebulae, Planetary Nebulae, and Other.

The second group, "Miscellaneous," provides 5 check boxes. When "Unknown Magnitudes" is checked, objects with no known magnitude are plotted regardless of the Deep Sky magnitude limit set (see section 3.4.3). Only the Messier Objects are drawn when "Draw only Messiers" is checked.

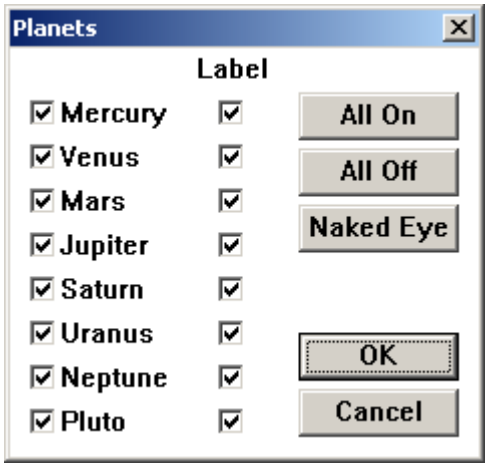



When "Show Sizes/Shapes" is checked, **ECU** will draw objects their correct size, shape, and orientation; if this information is known. Many objects are quite small in angular size, so you may have to zoom in quite close to see this feature in action. When "Filled Galaxies" is checked, the circles or ovals representing galaxy sizes and shapes filled in as a solid color. And lastly, if "Dashed Open Clusters" is checked, open clusters (on printouts only) will be plotted using a dashed line rather than a solid line. This feature is provided because the dashed lines provided by some printers are very thin and not very easy to see.

This menu selection can also be activated by pressing the right mouse button while over the "deep sky" toolbar button.

## 3.4.5 Planets

The **Planets...** menu selection presents a dialog box which allows the user to control various display parameters for the eight planets. The two entries for each planet include one check box indicating if the respective planet is displayed and a second check box indicating if the planet's name is also displayed.




Three buttons are also provided which make it easy to: a) turn all the planets off (All Off); b) turn all the planets on (All On); and c) make only the planets visible to the naked eye visible (Naked Eye).

This menu selection can also be activated by pressing the right mouse button while over the "solar system" toolbar button.

## 3.4.6 User Objects

Feature not present in **ECU Lite**.

## 3.4.7 User Object Labels

Feature not present in **ECU Lite**.

## 3.4.8 Sun

The **Sun** menu selection toggles whether or not the Sun is displayed on the sky display. If marked by a 'check mark', the Sun will be displayed (assuming the Solar System objects are also 'turned on').

## 3.4.9 Moon

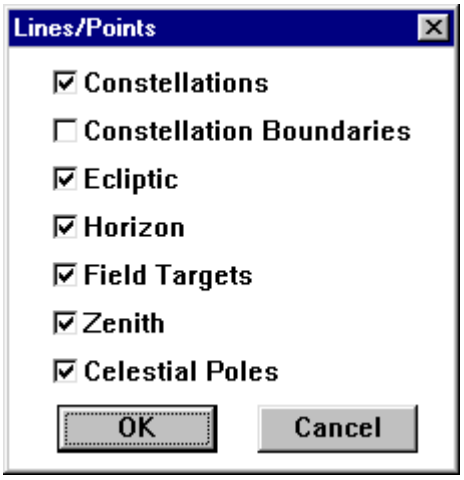
The **Moon** menu selection toggles whether or not the Moon is displayed on the sky display. If marked by a 'check mark', the Moon will be displayed (assuming the Solar System objects are also 'turned on').

## 3.4.10 Comets/Asteroids

The **Comets/Asteroids** menu selection toggles whether or not the Comets and Asteroids are displayed on the sky display. If marked by a 'check mark', they will be displayed (assuming the Solar System objects are also 'turned on').

## 3.4.11 Lines/Points

The **Lines/Points** menu selection presents a dialog box which allows the user to control the display of lines and points on the sky display. Check boxes are included for the constellation lines, constellation boundary lines, ecliptic line, horizon line, field targets, zenith point, and celestial pole points. When the check box is checked, that line or point will be drawn on the sky display.




## 3.4.12 Labels

The **Labels...** menu selection presents a dialog box which allows the user to control most of the text labels shown on the sky display, mostly with check boxes. The labels are divided into five groups which are described separately:

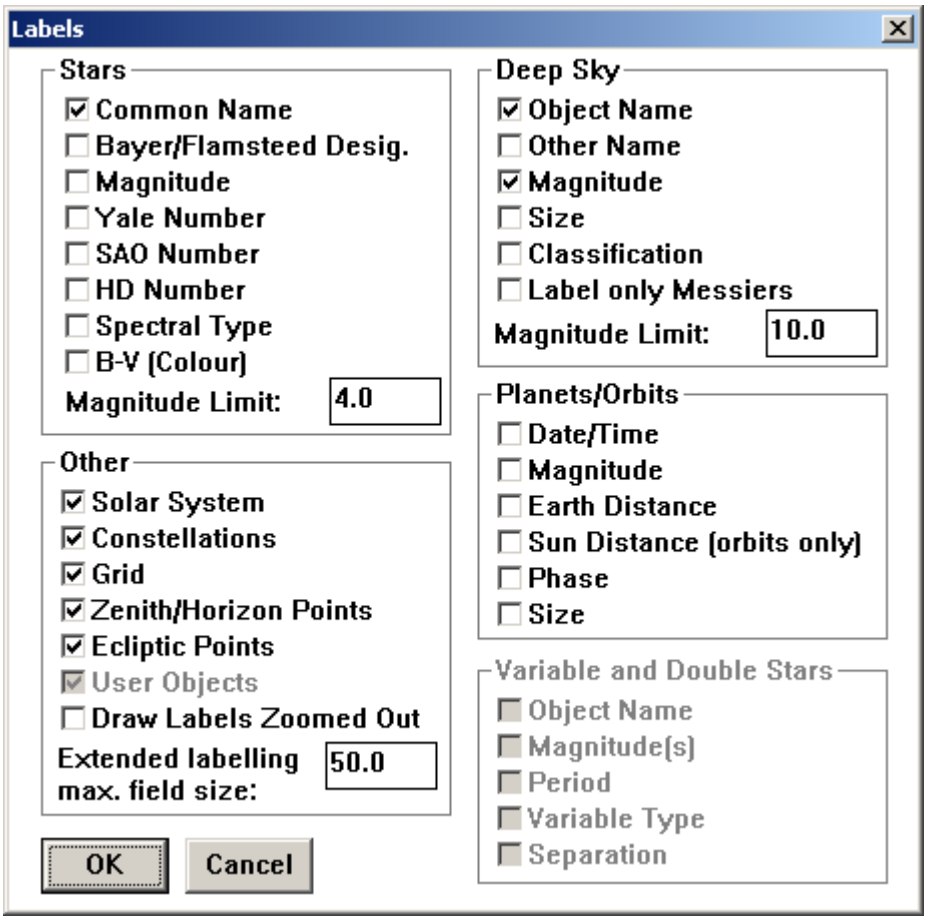
a) **Stars** — support a variety of labeling. The primary designation, which is drawn to the right of the star, can be either (or neither) its common name (for a select group of bright stars) or its Bayer/Flamsteed designation (either a Greek letter or a number). The Greek letters themselves will be drawn if the 'Symbol' font is present on your system and "Use Fonts" (see section 3.4.14) is enabled.

To the left of each star a variety of "extended" information can be provided, separated commas, including the star's magnitude, Yale number, SAO number, HD number, spectral type, and B-V color.

The "Magnitude Limit" field is used to set the faintest stars which will have their labels drawn (except for Bright Star labels).

b) **Other** — The 'Other' check boxes are provided for controlling whether the Solar System, constellation, coordinate grid, zenith/horizon point (N,S,E,W, etc.), ecliptic point (VE -

vernal equinox, SS - summer solstice, etc.), and user object labels are to be drawn. The check box "Draw Labels When Zoomed Out" controls whether the major labels are drawn when the field size is larger than 60 degrees in height. The final item in the 'Other' box is an entry that controls the largest field size for which extended labels are drawn. Extended labels include all labeling immediately to the left or right of an object, as in a) to c) above. The purpose of these final two items is to reduce the text "clutter" when "zoomed out", while maintaining the desired detail when "zoomed in".




c) **Deep Sky** — objects support a variety of labeling. The object's primary and other name, can be drawn to the right of the object.

To the left of each object a variety of "extended" information can be provided, separated by commas, including the object's magnitude, size, and classification.

When the "Label Only Messiers" check box is checked, labels will only be drawn for objects in the Messier Catalog. This dramatically reduces the "clutter", if you are only interested in those objects.

The "Magnitude Limit" field is used to set the faintest objects which will have their labels drawn. If its set at magnitude 20, even labels for objects will unknown magnitudes will be displayed.

These check boxes also control the "User Object" (see section 3.4.6) labels in which only the "Object Name" and "Magnitude" check boxes are relevant.

d) **Planets/Orbits** — Solar System objects support a variety of labeling. The objects name is drawn to the right of the object.

To the left of each object a variety of "extended" information can be provided, separated by commas, including the current date and time, the object's magnitude, distance to the Earth and Sun, phase, and size.

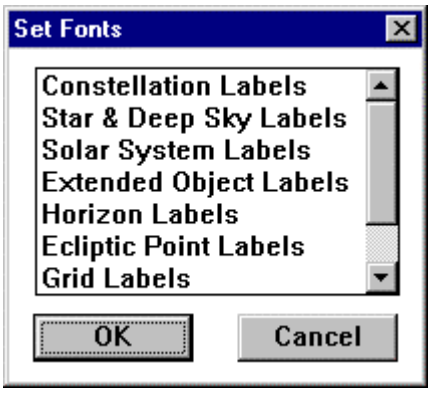
This menu selection can also be activated by pressing the right mouse button while over the "labels" toolbar button.

## 3.4.13 Screen Fonts

The **Screen Fonts** menu selection provides a sub-menu allowing the screen fonts to be controlled.

## 3.4.13.1 Set Screen Fonts

The **Set Screen Fonts...** menu selection presents a dialog box allowing the user to customize the fonts used in the sky display. A list box is presented containing the 9 text items whose fonts can be customized.




The user is to select the desired item followed by pressing 'OK'. The standard Windows font control dialog box will then be presented. The font, font style, and size can be selected. Note that only "TrueType" fonts can be used. After exiting the dialog box by pressing 'OK', the **Set Fonts** dialog box will be re-drawn.

## 3.4.13.2 Use Fonts

The **Use Fonts** menu selection toggles whether or not the font settings programmed in section 3.4.13 are to be used on the sky display. If marked by a 'check mark', the fonts will be used. If it is not checked, the Windows standard system font, which may cause the sky display to draw more quickly.

## 3.4.13.3 Increase Font Size by 20%

The **Increase Font Size by 20%** menu selection increases, by 20%, the size of all screen fonts.

## 3.4.13.4 Decrease Font Size by 20%

The **Decrease Font Size by 20%** menu selection decreases, by 20%, the size of all screen fonts.

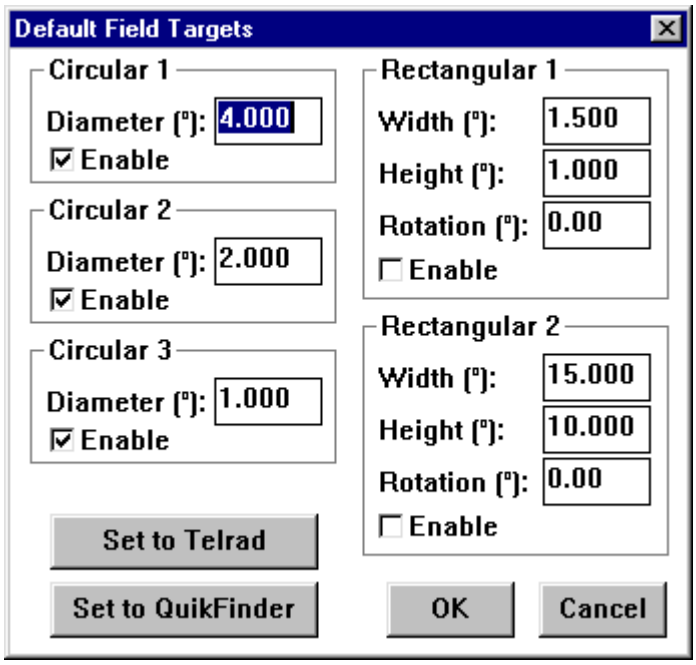
## 3.4.14 Targets

The **Targets** menu selection provides a sub-menu allowing Field Targets comprising of up to three circles and two rectangles to be controlled. Up to 25 Field Targets can be placed at arbitrary locations on the celestial sphere, in addition to one more Target located at the center of the sky display.

These are useful for showing the angular size on the sky observed in a telescope using a particular eyepiece, or viewed by your photographic or CCD camera. They can also be useful on printed charts to aid in "star-hopping" to an object.

## 3.4.14.1 Default Field Target

The **Default Field Target** menu selection presents a dialog box allowing the user to enable and control the angular size of three circular and two rectangular field of view indicators that can be drawn on the sky display.




Angular size values for each field of view indicator can be entered from 0.05 to 90 degrees. Each field of view can be individually enabled by "checking" its "Enable" check box. The rectangular fields of view indicators can also be arbitrarily rotated over a range of 0 to 180 degrees. The "Set to Telrad" and "Set to QuikFinder" buttons automatically set the fields of view to match the popular Telrad and Rigel QuikFinder zero-power telescope finder devices.

It is easy to determine what angular values to enter for your telescope and eyepiece combination without knowing the focal length of your telescope or the parameters of your eyepiece. Simply

position a star located within a few degrees of the celestial equator just off the east side of your eyepiece field and time, in seconds, how long it takes to cross the field. Make sure your clock drive is turned off. The field size, in degrees, is:

```
0.004166 * time(s)
```

This menu selection can also be activated by pressing the right mouse button while over the Place Field Target toolbar button.

## 3.4.14.2 Show Default Field Target

The **Show Default Field Target** menu selection toggles whether or not the default Field Target is displayed at the center of the sky display.

## 3.4.14.3 Place Field Target

The **Place Field Target** menu selection places a Field Target at the celestial location which is at the center of the sky display. The Field Target is placed according to the Default Field Target settings (see section 3.4.14.1). Up to 25 Field Targets can by placed on the sky display. If all 25 Field Targets have already been placed you will hear a "beep." This menu selection can also be activated by pressing the left mouse button while over the Place Field Target toolbar button.

## 3.4.14.4 Clear Last Field Target

The **Clear Last Field Target** menu selection clears the last Field Target placed on the sky display. If there are no Field Targets currently placed, you will hear a "beep."

## 3.4.14.5 Clear All Field Targets

The **Clear All Field Targets** menu selection clears all Field Targets placed on the sky display. If there are no Field Targets currently placed, you will hear a "beep."

## 3.4.15 Flip

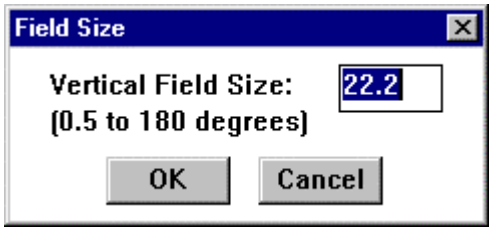
The **Flip** menu selection provides a sub-menu allowing the sky display to flipped from left or right and/or top to bottom.

**Flip Horizontal** toggles whether or not the sky display is drawn as a mirror image (flipped left to right). If marked by a 'check mark', the sky display will be flipped. This selection is useful by itself to simulate what the sky will look like though a telescope which produces an upright, but reversed image such as a refractor or Schmidt-Cassegrain with a star diagonal installed. Used in conjunction with **Flip Vertical**, the sky display is drawn upside-down and reversed left to right, to simulate the view though an Newtonian telescope. This menu selection can also be activated by pressing the left mouse button while over the Flip Horizontal toolbar button and its keyboard equivalent is **Ctrl-H**.

**Flip Vertical** toggles whether or not the sky display is drawn as a upside-down (flipped top to bottom). If marked by a 'check mark', the sky display will be flipped. If this selection is used in conjunction with **Flip Horizontal**, the sky display is drawn upside-down and reversed left to right, to simulate the view though an Newtonian telescope. This menu selection can also be activated by pressing the left mouse button while over the Flip Vertical toolbar button and its keyboard equivalent is **Ctrl-V**.

## 3.4.16 Field Size

The **Field Size...** menu selection presents a dialog box allowing the user to enter the vertical size, in degrees, of the **ECU** sky display. The valid range is 0.5 to 180 degrees.




This menu selection can also be activated by pressing the left mouse button while the mouse is in the box which displays the current Field Size in the status line or but using its toolbar button.

## 3.4.17 Zoom

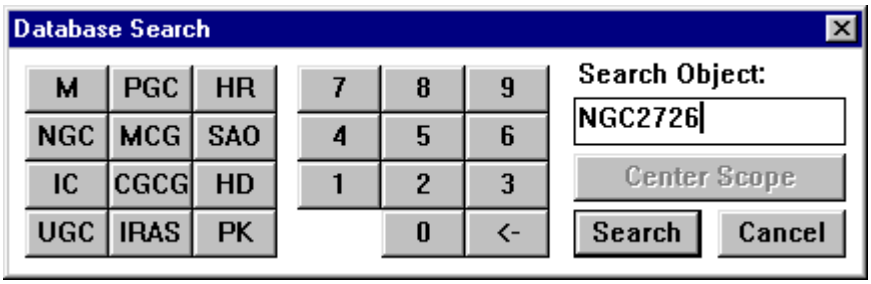
The **Zoom** menu selection presents a sub-menu allowing the sky display to be Zoomed in or out to a variety of field sizes. These include Zoom In Full (keyboard equivalent is **Shift-Z**) which zooms in to the minimum allowable field size (0.5 degrees), 15 degrees, 45 degrees, 90 degrees, and Zoom Out Full (keyboard equivalent is **Alt-Z**) which zooms out to the maximum allowable field size (180 degrees).

# 3.5 Center Menu

The **Center** menu allows the user to quickly center on most objects in **ECU**'s databases. This includes centering on a text search of the databases, a specified Right Ascension/Declination, a specified Azimuth/Altitude, a constellation, a bright star, a Messier object, a named deep sky object, Solar System object, or a point on the local horizon. When an object is centered on the sky display, a cross-hair is used to mark it. Each centering menu selection is described separately below.

## 3.5.1 On Database Search

The **On Database Search...** menu selection is used to search the installed databases for a specified object. If a match is found, the specified object is centered on the sky display. The user is presented with a dialog box which allows the search text to be entered. Several buttons are provided to reduce the requirement for keyboard entry (especially while at the telescope). In addition, there are several keyboard shortcuts for commonly entered objects — specifically "N" is equivalent to "NGC", "U" is equivalent to "UGC", "I" is equivalent to "IC", and "S" is equivalent to "SAO". Therefore typing "N3434" is equivalent to typing "NGC3434".




The line of text entered is converted to upper case to avoid ambiguities and all spaces are removed before any search is started.

The object types which can be searched for are listed below:

a) **Constellations** — the 88 constellations can be searched by entering their complete formal name (eg. 'Ursa Major').

b) **Common Star Names** — bright stars can be searched by entering their common name (eg. 'Deneb').

c) **Stars by catalog number** — any star in the Yale Bright Star (YBSC) database can be searched by entering either its Smithsonian Astrophysical Observatory (SAO) catalogue number with the prefix 'SAO', its Yale number with the prefix 'HR', or its Henry Draper (HD) catalogue number with the prefix 'HD'. For example, to find the SAO star number 49898, enter 'SAO49898'. Note that entering 'sao 49898' would be just as effective because the case of the input and spaces are ignored.

   When searching for SAO stars, if a search of the brighter YBSC database is unsuccessful, the search continues using the SAO database.

d) **Stars by Bayer Letter —** the brightest stars in the Yale Bright Star (YBSC) database can be searched by their Bayer Letter designation.

   A prefix of "B" is used, plus a three letter abbreviation for the Greek Letter and then finally the three letter "standard" abbreviation for the constellation. For example, to search for Beta Bootes, "b bet boo" would be entered. Capitalization and spacing are not important.

e) **Stars by Flamsteed Number —** the brightest stars in the Yale Bright Star (YBSC) database can be searched by their Flamsteed Number.

   A prefix of "F" is used, plus the Flamsteed number and then finally the three letter "standard" abbreviation for the constellation. For example, to search for (4) Corona Borealis, "f 4 crb" would be entered. Capitalization and spacing are not important.

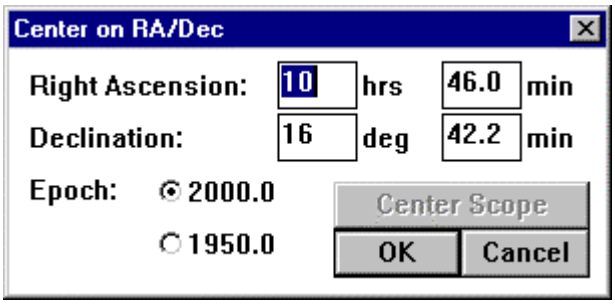
f) **Deep Sky Objects** — deep sky objects can be searched by entering either their primary name or 'Other Names:' as stored in the SAC deep sky database (see Section 4.). For example, the Andromeda Galaxy can be found by entering either its official name 'NGC224' or its common name (other name) 'M31'. Note that for efficiency reasons, if the display of deep sky objects is not currently enabled the SAC database is not searched.

If the 'OK' button is pressed, the search commences and if successful, the screen is redrawn with the object at the center of the sky display. If the 'Center Scope' button is pressed, the telescope (if enabled) is centered on search object. If the search is not successful, a message box will appear informing the user of this.

This menu selection can also be activated by pressing the left mouse button on its toolbar button. The keyboard equivalent to this menu item is **Alt-D** or **Ctrl-F**.

## 3.5.2 On RA/Dec

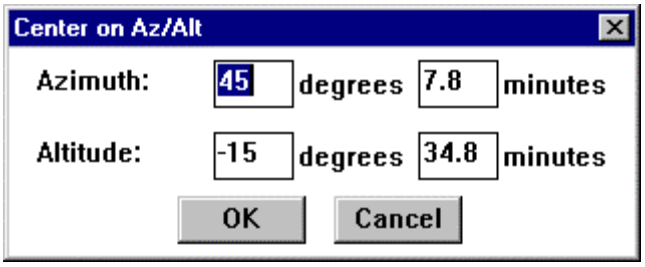
The **On RA/Dec...** menu selection presents a dialog box allowing the user enter a specific Right Ascension and Declination to center the sky display on. The Right Ascension is entered as hours and minutes. The Declination is entered as degrees and minutes.




When the dialog box ends, **ECU** centers the sky display at the coordinates entered (using the selected epoch). This menu selection can also be activated by pressing the left mouse button while the mouse is in the box which displays the current Right Ascension/Declination in the **ECU** status line.

## 3.5.3 On Az/Alt

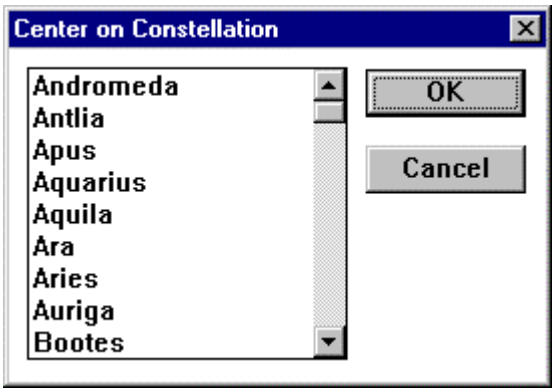
The **On Az/Alt...** menu selection presents a dialog box allowing the user enter a specific Azimuth and Altitude, with reference to the local horizon, to center the sky display on. Both the Azimuth and Altitude are entered as degrees and minutes.




When the dialog box ends, **ECU** centers the sky display at the local horizon coordinates entered. This menu selection can also be activated by pressing the left mouse button while the mouse is in either of the boxes which display the current Azimuth/Altitude in the **ECU** status line.

## 3.5.4 On Constellation

The **On Constellation...** menu selection presents a dialog box allowing the user to select a constellation to center the sky display on. A list box is presented containing the available list of 88 constellations in alphabetical order. The user is to select the desired constellation, then exit the dialog box. **ECU** then centers the sky display on the selected constellation.




## 3.5.5 On Common Star Name

The **On Common Star Name...** menu selection presents a dialog box allowing the user to select the common star name to center the sky display on. A list box is presented containing the available list of bright stars in alphabetical order. The user is to select the desired star, then exit the dialog box. **ECU** then centers the sky display on the selected bright star.

## 3.5.6 On Messier Object

The **On Messier Object...** menu selection presents a dialog box allowing the user to select a Messier Object to center the sky display on. A list box is presented containing the available list of 110 Messier objects in numerical order. The user is to select the desired object, then exit the dialog box. **ECU** then centers the sky display on the selected Messier object.

## 3.5.7 On Named Deep Sky Object

The **On Named Deep Sky Object...** menu selection presents a dialog box allowing the user to select a deep sky object with a common name (as opposed to a catalog number) to center the sky display on. A list box is presented containing the available list of objects in alphabetical order. After the desired object is selected, press the "OK" button and then **ECU** will center the sky display on the object.

**ECU** includes most of the deep sky objects with common names, however you can add you own favorites to the list. The list is stored in a plain text file called "DSNAMES.ECU" and is formatted as shown by the following sample entries below. You can edit this file in any text editor, such as the Windows "Notepad".

```
47 Tucanae                              NGC104
Andromeda Galaxy                        M31
Antennae                                NGC4038
Barbell Nebula                          M76
Barnard's Galaxy                        NGC6822
```

The first entry on each line is the common name. The second entry is another name by which the object is known as, usually an NGC or M catalog number. This other name must begin at column 41 (inline with all the others) and be searchable in **ECU's** databases. You can also enter a position in the sky directly as a right ascension and declination using the same format as described in section 3.5.12.

## 3.5.8 On Solar System Object

The **On Solar System Object** menu selection contains a sub-menu of all the Solar System objects (Sun, Moon, Planets, and Comets/Asteroids). The menu item selected is centered on the sky display. The keyboard equivalent to center on the Moon is **Shift-M**, and to center on the Sun is **Shift-S**.

## 3.5.9 On Point on Horizon

The **On Point on Horizon** menu selection contains a sub-menu of all the cardinal points on the local horizon plus the Zenith (the overhead point). The menu item selected becomes centered on the sky display. There are several keyboard equivalents for these menu selections; see section 2.5.

## 3.5.10 On Object From List

Feature not present in **ECU Lite**.

## 3.5.10 On Next Object

Feature not present in **ECU Lite**.

## 3.5.11 On Previous Object

Feature not present in **ECU Lite**.

## 3.5.12 Select Object List File

Feature not present in **ECU Lite**.

## 3.6 Animation Menu

The **Animation** menu controls all of the functions of **ECU**'s animation mode. The animation mode is used to simulate astronomical events which are affected by changes in the time. The animation mode has the following features.

a) Time can be automatically stepped in any step from 1 minute to 4 years or any arbitrary number of minutes, hours, months, days, or years.

b) Time can be stepped in either forward or reverse.

c) The time between time steps can be set from 0 to 60 seconds.

d) The trail history can be stored as either the objects Right Ascension/Declination or its Azimuth/Altitude.

e) The solar system objects can be trailed with dots and/or lines drawn behind them. Text labels which include the date and/or time can also be displayed.

f) The number of steps used in the trail can be set from 10 to 200.

g) The sky display can be made to 'lock' on any solar system object, or point with reference to the local horizon.

h) The time can be manually stepped, either forward or in reverse.

i) All of the features of **ECU** can be used while the animation mode is running due to the multi-tasking nature of Windows, and thus of **ECU**.

Animation mode is best learned by experimentation, however, the menu items which control the animation mode are described in the sections below. When using the animation mode, the sky display updates may "flicker", unless the 'Sky Drawing Mode' is set to 'Fast Update' (see Section 3.3.10).

## 3.6.1 Start

The **Start** menu selection starts the animation mode. If a 'check mark' precedes the menu selection, animation mode is running.

## 3.6.2 Stop

The **Stop** menu selection stops the animation mode. The ESC key can also be used to stop the animation mode.

## 3.6.3 Forward One Step

The **Forward One Step** menu selection steps the time forward by one time step. The time step is displayed to the left of the time step buttons in the status area. This menu selection can also be executed by using the toolbar button or by pressing the '+' key.

## 3.6.4 Reverse One Step

The **Reverse One Step** menu selection steps the time in reverse by one time step. The time step is displayed to the left of the time step buttons in the status area. This menu selection can also be executed by using the toolbar button or by pressing the '-' key.

## 3.6.5 Restore Date/Time

The **Restore Date/Time** menu selection restore the date and time to what it was prior to the last time the animation mode was started or the last time this menu item was selected. This feature is useful for experimenting with the animation mode without having to keep resetting the time back manually again and again.

## 3.6.6 Trails On

The **Trails On** menu selection enables the drawing of trails (small crosses) behind the Solar System objects. If the trails are enabled, a 'check mark' will precede this menu selection.

## 3.6.7 Trail Lines On

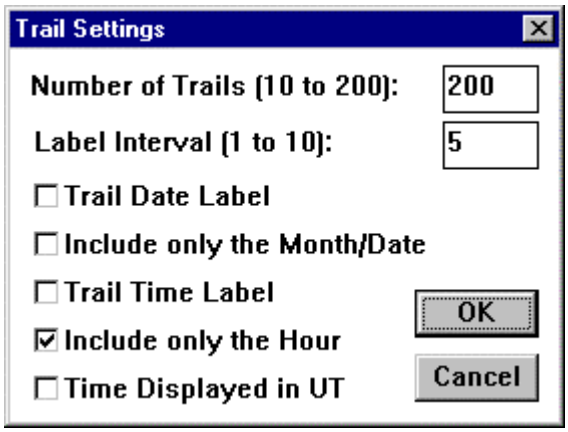
The **Trails Lines On** menu selection enables the drawing of trail lines behind the Solar System objects. If the trail lines are enabled, a 'check mark' will precede this menu selection.

## 3.6.8 Clear Trails

The Clear Trails menu selection clears the current trail history and removes any existing trail crosses or lines drawn behind Solar System objects from the sky display.

## 3.6.9 Trail Settings

The **Trail Settings...** menu selection presents a dialog box allowing the user to control a number of parameters pertaining to the trail crosses and trail lines drawn behind Solar System Objects.




The following items are included in this dialog box:

a) **Number of Trails** — sets the maximum number of trail crosses and/or trail lines.

b) **Label Interval** — set the spacing of the date/time labels that can be drawn next to a trail cross or trail line intersection. Adjusting this setting allows the user to control the amount of clutter caused by the date/time labels.

c) **Trail Date Label** — this check box controls whether or not the date is included in the date/time labels.

d) **Include only the Month/Date** — checking this item eliminates the year from the date labels.

e) **Trail Time Label** — this check box controls whether or not the time is included in the date/time labels.

g) **Include only the Hour** — checking this item eliminates the minutes from the time labels.

h) **Time displayed in UTC** — checking this item causes the date/time labels to be in Universal Time rather than local time.

## 3.6.10 Animation History

The **Animation History** menu selection presents a sub-menu of the selections: **RA/Dec** and **Azim/Alt**. These selections control whether the animation history (the previous positions) is saved as the Right Ascension and Declination of the object or as its Azimuth and Altitude with reference to the local horizon. The latter setting is useful for observing an object's path relative to the local horizon. A good example of this would be to plot the positions of the planet Mercury as it passes through an eastern or western elongation and becomes visible in the evening or morning sky. Beware, however, that the actual positions shown in the object trails (except for the current position) are **not** correct with reference to the background stars for the time shown. Also, this setting operates slowly, because the computational overhead is higher. A 'check mark' will immediately precede current setting. For normal use, ensure that this setting is set to **RA/Dec**.

## 3.6.11 Lock On Current RA/Dec

The **Lock On Current RA/Dec** menu selection causes the animation mode to be locked on the current Right Ascension and Declination. In fact, it turns 'lock mode' off. If locked on the current RA/Dec, a 'check mark' will immediately precede this menu selection.

## 3.6.12 Lock On Current Azim/Alt

The **Lock On Current Azim/Alt** menu selection causes the animation mode to be locked on the current altitude and azimuth, with respect to the local horizon. This feature is very useful for 'watching' a particular horizon as the constellations rise or set, or as a planet such as Mercury crests above the horizon. If locked on the current Azim/Alt, a 'check mark' will immediately precede this menu selection.

## 3.6.13 Lock On Solar System Object

The **Lock On Solar System Object** menu selection presents a sub-menu of all the Solar System objects (Sun, Moon, Planets, and Comets/Asteroids). The menu item selected becomes locked to

the center of the sky display in animation mode. A ‘check mark’ will immediately precede the Solar System object locked.

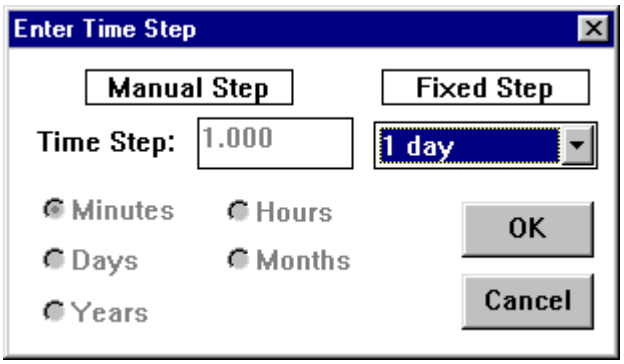
## 3.6.14 Time Direction

The **Time Direction** menu selection presents a sub-menu of the selections: **Forward** and **Reverse**. These selections control the direction in which time is stepped when the animation mode is running. A ‘check mark’ will immediately precede the time direction setting.

## 3.6.15 Enter Time Step

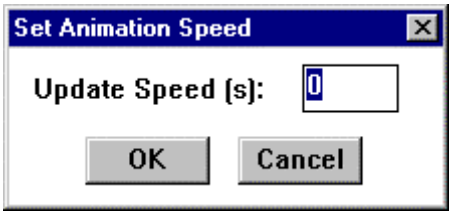
The **Enter Time Step...** menu selection presents a dialog box allowing the user to select one of the preset “fixed” time steps or to enter an arbitrary time step. To set a preset time step, select one from the drop-down list box. To set an arbitrary time step, first start by selecting “Manual” in the drop-down list box, then enter the desired step size as a number (decimals are allowed). The unit of time (minutes, hours, days, months, or years) used is selected by pressing the appropriate ‘radio button’.

This dialog box can also be selected by clicking the mouse over the area where the time step is displayed (to the right of the time step arrows) in the status area.




## 3.6.16 Animation Speed

The **Animation Speed...** menu selection presents a dialog box allowing the user enter the number of seconds between animation mode updates (0 to 60 seconds).




## 3.7 Telescope Menu

Feature not present in **ECU Lite**.

## 3.8 Miscellaneous

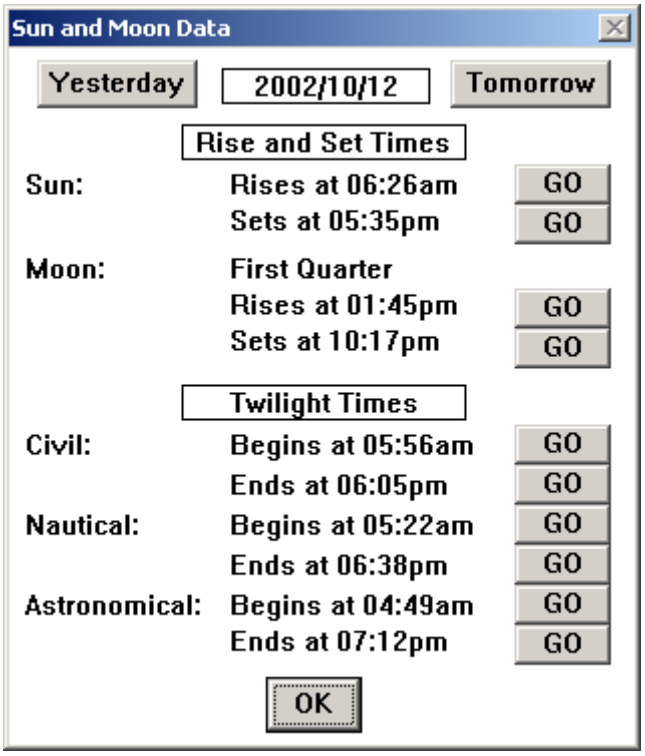
The **Miscellaneous** menu provides access to all of the functions which did not seem belong anywhere else!

## 3.8.1 Sun and Moon Data

The **Sun and Moon Data...** menu selection presents a dialog box which displays various useful data for the Sun and Moon on the current date. An example dialog box is shown below.

Civil, nautical, and astronomical twilight are defined as when the Sun is 6, 12, and 18 degrees below the geometric local horizon, respectively. These twilight times can be used to determine when it is dark enough to begin observing. Usually by the time of nautical twilight in the evening, it is dark enough to begin deep sky observing.

The "GO" button to the right of each time causes that time to be set and the sky redrawn. The "Yesterday" and "Tomorrow" buttons cause the date to be changed to the previous or next day respectively and the data updated.




## 3.8.2 Julian Date/Sidereal Time

The **Julian Date/Sidereal Time...** menu selection presents a dialog box which displays the current Julian Date and Local Sidereal Time.

## 3.8.3 Run Image Viewer

The **Run Image Viewer…** menu selection executes the image viewer program. This image viewer program is usually "Navimage" which is provided with **ECU**, however almost any image

viewer program can be configured for use with **ECU** (see section 3.8.7). Once running, any image can be loaded directly from within "Navimage".

## 3.8.4 Run Text Editor

The **Run Text Viewer…** menu selection executes a text editor program. This is usually the Windows "Notepad", however any text editor can be configured for use with **ECU** (see section 3.8.7). Once running, any text file can be loaded directly from within "Notepad".

## 3.8.5 Hubble GSC Settings

Feature not present in **ECU Lite**.

## 3.8.6 Read GSC Regions from CD-ROM

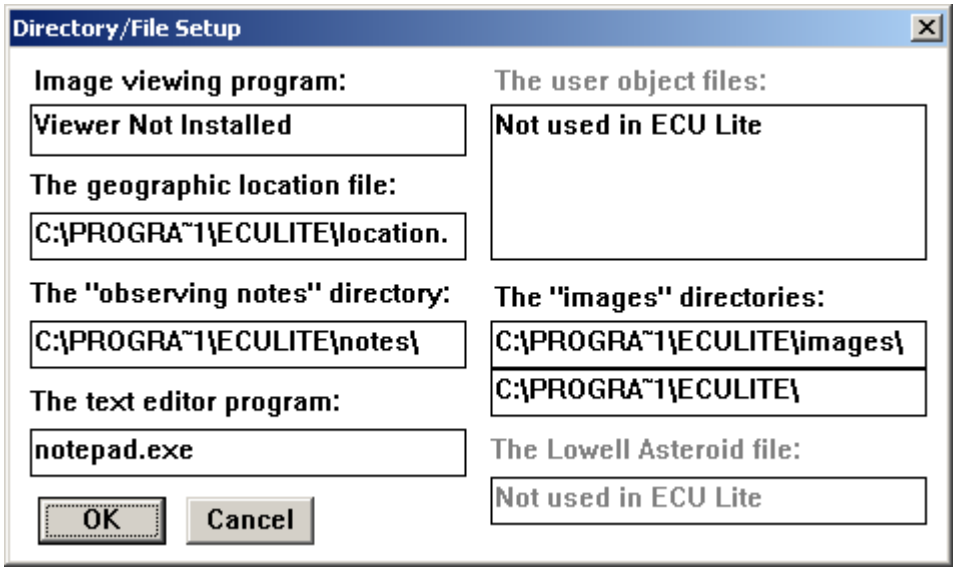
Feature not present in **ECU Lite**.

## 3.8.7 Directory/File Setup

The **Directory Setup...** menu selection controls the location of several files, programs, and directories used by **ECU**. The items in this dialog box, except the "user" filenames, are stored in the **ECU** section of the "ECU.INI" file usually located in the "c:\ecu" directory, not in the normal **ECU** configuration file.

### Important Note

*Because **ECU** is a 16-bit program, it is restricted to filenames and directory names having no more than 8 characters(plus a 3 character extension). Therefore directory and filenames entered in this dialog box must follow this restriction. Long filenames are usually reduced as follows: "c:\Program Files" becomes "C:\PROGRA~1".*




The following items can be configured. In each case, the full directory (include drive letter) and filename should be entered.

a) **The program used to display images** — this item controls which program is used to display image files. This is used by the "image" button in the Identify Object dialog box (see section 5.2).

b) **The "images" directories** — this item provides for the entry of two directories where **ECU** will search for image files. The trailing "\" must be present. In the CD-ROM version of **ECU**, one of these entries will be the location of images on the CD-ROM, while the other will point to a location on your hard disk where you can store your own images.

c) **The geographic location file** — this item specifies the name of the text file used to store the geographic location database. The default file is "location.ecu".

d) **The observing notes directory** — this item controls the directory used to store the observing notes files. The trailing "/" must be present. See section 5.3 for details.

e) **The text editor program** — this item controls which program is used to display or edit text files. This is used by the observing "notes" button in the Identify Object dialog box. The default text editor is "notepad" which is provided as part of Windows.

## 3.9 Help

The **Help** menu has three entries. The first selection, **About ECU Lite...**, presents a message box identifying **ECU**, its version number, its copyright notice, and how to contact the author.

The second selection, **Willman-Bell Credits...**, presents a message box identifying that **ECU** contains source code that which is copyrighted by Jeffrey Sax. The source code referred to, provides high accuracy astronomical calculations based on the algorithms described in the book: **Astronomical Algorithms by Jean Meuss** (distributed by Willman-Bell). The message given in the message box is a requirement of distributing programs containing Jeffrey's source code.

The third selection, **Other Credits...**, presents a dialog box that recognizes the efforts of the Saguaro Astronomy Club for preparing and maintaining the SAC deep sky database and the world's professional astronomers for the preparation and maintenance of most of the other databases used by **ECU**. It also acknowledges the trademarks of other companies' products.

# 4. Databases and Calculations

This section describes the databases built-in to **ECU** and the astronomical calculations used. **ECU** contains several databases. The databases covered in this section include the stellar (see section 4.1) and deep sky objects (see section 4.2). Other databases (not described in this manual) include the user object, label, constellation line, and geographic location databases.

**ECU** uses the algorithms described in the book: "Astronomical Algorithms" by Jean Meuss for all of the solar system calculations and most other astronomical calculations as well. Some methods described in the book: "Practical Astronomy with your Calculator" by Peter Duffett-Smith are also used.

## 4.1 Stellar Databases

The stellar databases are divided into two parts. The first part, the Yale Bright Star Catalog (files YBSC1.ECU and YBSC2.ECU), contains 9110 stars to magnitude 6.5 with a wealth of information about each star. The second star database is the Smithsonian Astrophysical Observatory (SAO) Star Catalogue. The entire SAO catalog contains some 259,000 stars. The Yale stars and those with the magnitude unknown were extracted leaving a database of 245654 stars to about magnitude 9.5. **ECU Lite** displays SAO stars as faint as 8.6 magnitude.

Each database contains the magnitude (visual, if available), Right Ascension, Declination in J2000.0 coordinates and are displayed on the sky display using this epoch. The Yale Catalogue provides several catalogue numbers and names for each star. These include the Bayer/Flamsteed identification, the Yale Catalogue number, the SAO Catalogue number, and the Henry Draper Catalogue number. The full spectral classification, color as B-V, and the proper motion of each star. The SAO Catalogue provides the SAO Catalogue number and the spectral type.

The object positions in each database are stored in integer format obtaining a resolution of about 10 arc-seconds in Declination and 20 arc-seconds in Right Ascension at the celestial equator.

## 4.2 Deep Sky Databases

**ECU** contains two deep sky databases. The first is a general database, containing all types of deep sky objects, called the Saguaro Astronomy Club database (see section 4.2.1). The second is a specialized database, containing only galaxies, called the Principle Galaxy Catalog which is not included in **ECU Lite**.

## 4.2.1 Saguaro Astronomy Club Database

**ECU Lite** contains the 2195 brightest objects from the Saguaro Astronomy Club (SAC) database (files SAC1.ECU, SAC2.ECU, MESSIER1.ECU, and MESSIER2.ECU). This includes all objects brighter than about $12^{th}$ magnitude. The complete SAC database, included with **ECU Pro**, contains 10507 deep sky objects. The members of the Saguaro Astronomy Club (pronounced sa-war-oh) of Phoenix, Arizona have provided much of the effort to compile this database (database version 7.2). The database includes the entire NGC catalog, plus many other interesting deep sky objects. Selected fields of the SAC database were extracted for use in **ECU**. The object positions are stored in integer format obtaining a resolution of about 10 arc-seconds in Declination and 20 arc-seconds in Right Ascension at the celestial equator, however, the source database only reports positions to 1' in Declination and 0.1' in Right Ascension. These fields are described below:

a) **Object Name** — usually the NGC number, but for objects with no NGC value, other catalogs are used. The abbreviations listed below are used to represent the other catalogs.

| | |
|---|---|
| Abell | George Abell (planetary nebulae and galaxy clusters) |
| ADS | Aitken Double Star catalog |
| AM | Arp-Madore (globular clusters) |
| Antalova | (open clusters) |

| | |
|---|---|
| Ap | Apriamasvili (planetary nebulae) |
| Arp | Halton Arp (interacting galaxies) |
| Bark | Barkhatova (open clusters) |
| B | Barnard (dark nebulae) |
| Basel | (open clusters) |
| BD | Bonner Durchmusterung (stars) |
| Berk | Berkeley (open clusters) |
| Be | Bernes (dark nebulae) |
| Biur | Biurakan (open clusters) |
| Blanco | (open clusters) |
| Bochum | (open clusters) |
| Ced | Cederblad (bright nebulae) |
| Cr | Collinder (open clusters) |
| Czernik | (open clusters) |
| DDO | David Dunlap Observatory (dwarf galaxies) |
| Do | Dolidze (open clusters) |
| DoDz | Dolidze-Dzimselejsvili (open clusters) |
| Dun | Dunlop (globular clusters) |
| Fein | Feinstein (open clusters) |
| Frolov | (open clusters) |
| Gum | (bright nebulae) |
| H | William Herschel (globular clusters) |
| Haffner | (open clusters) |
| Harvard | (open clusters) |
| He | Henize (planetary nebulae) |
| Hogg | (open clusters) |
| HP | Haute Provence (globular clusters) |
| Hu | Humason (planetary nebulae) |
| IC | 1st and 2nd Index Catalogs to the NGC (All except dark nebulae) |
| Isk | Iskudarian (open clusters) |
| J | Jonckheere (planetary nebulae) |
| K | Kohoutek (planetary nebulae) |
| King | (open clusters) |
| Kr | Krasnogorskaja (planetary nebulae) |
| Lac | Lacaille (globular clusters) |
| Loden | (open clusters) |
| LDN | Lynds (dark nebulae) |
| Lynga | (open clusters) |
| M | Messier (all types of objects except dark nebula) |
| MCG | Morphological Catalog of Galaxies |
| Me | Merrill (plantary nebulae) |
| Mrk | Markarian (open clusters and galaxies) |
| Mel | Melotte (open clusters) |
| M1 thru M4 | Minkowski (planetary nebulae) |
| NGC | New General Catalog of Nebulae & Clusters of Stars |
| Pal | Palomar (globular clusters) |
| PC | Peimbert and Costero (planetary nebulae) |
| Pismis | (open clusters) |
| PK | Perek & Kohoutek (planetary nebulae) |
| RCW | Rodgers, Campbell, & Whiteoak (bright nebulae) |
| Roslund | (open clusters) |

| | |
|---|---|
| Ru | Ruprecht (open clusters) |
| Sa | Sandqvist (dark nebulae) |
| Sher | (open clusters) |
| Sh | Sharpless (bright nebulae) |
| SL | Sandqvist & Lindroos (dark nebulae) |
| SL | Shapley & Lindsay (clusters in LMC) |
| Steph | Stephenson (open clusters) |
| Stock | (open clusters) |
| Ter | Terzan (globular clusters) |
| Tombaugh | (open clusters) |
| Ton | Tonantzintla (globular clusters) |
| Tr | Trumpler (open clusters) |
| UA | Catalog of selected Non-UGC galaxies |
| UGC | Uppsala General Catalog (galaxies) |
| UKS | United Kingdom Schmidt (globular clusters) |
| Upgren | (open clusters) |
| VV | Vorontsov-Velyaminov (interacting galaxies) |
| vdB | van den Bergh (open clusters, bright nebulae) |
| vdBH | van den Bergh & Herbst (bright nebulae) |
| vdB-Ha | van den Bergh-Hagen (open clusters) |
| Vy | Vyssotsky (planetary nebulae) |
| Waterloo | (open clusters) |
| Westr | Westerlund (open clusters) |
| Zw | Zwicky (galaxies) |

b) **Other Name** — contains other catalog designations that the object is known by. The same abbreviations as in a) are used.

c) **Object Type** — the type of object from the list below.

| | |
|---|---|
| Asterism | Bright Nebula |
| Quasar | Unverified Southern Object |
| Planetary Nebula | Cluster with Nebulosity in the SMC |
| Open cluster in the SMC | Supernova Remnant |
| Nonexistent in RNGC | Open Cluster |
| Multiple Star | |
| Globular Cluster in the LMC | Open cluster in the LMC |
| Globular Cluster in a Galaxy | Cluster with Nebulosity in a Galaxy |
| Globular Cluster | Diffuse Nebula in a Galaxy |
| Galaxy cluster | Galaxy |
| Diffuse Nebula in the SMC | Globular Cluster in the SMC |
| Cluster with Nebulosity in the LMC | Diffuse Nebula in the LMC |
| Cluster with Nebulosity | Dark Nebula |

d) **Position** — the object's position, Right Ascension and Declination, in the J2000.0 epoch.

e) **Magnitude** — the object's brightness to the nearest tenth. There are many objects which have no published magnitude; they are listed as ??.?. Dark nebulae obviously have no magnitude, so they are also listed as ??.?.

f) **Position Angle (PA)** — for elongated objects, the position angle is given in degrees with north as zero degrees progressing clockwise.

g) **Description** — a visual description of the object. Most of these are from the NGC, some are from prominent amateurs. Back issues **of Deep Sky Magazine**, *Astronomy* magazine, *Sky and Telescope* magazine and *Burnham's Celestial Handbook* are used as a source of some of these descriptions. The descriptions use the abbreviations from the NGC and Burnham's. They are given below:

| | | | |
|---|---|---|---|
| ! | remarkable object | !! | very remarkable object |
| Am | Among | N | North |
| Att | Attached | N | Nucleus |
| Bet | Between | Neb | nebula, nebulosity |
| B | Bright | P w | paired with |
| B | Brighter | P | pretty (before F,B,L or S) |
| C | Compressed | P | Preceding |
| C | Considerably | P | Poor |
| Cl | Cluster | R | Round |
| D | Double | Ri | Rich |
| Def | Defined | R | not well resolved, mottled |
| Deg | Degrees | rr | partially resolved |
| Diam | Diameter | Rrr | well resolved |
| Dif | Diffuse | S | small |
| E | Elongated | S | suddenly |
| E | Extremely | S | south |
| Er | easily resolved | Sc | scattered |
| F | Faint | Susp | suspected |
| F | Following | St | star or stellar |
| G | Gradually | V | very |
| IF | irregular figure | Var | variable |
| Inv | Involved | Nf | north following |
| Irr | Irregular | Np | north preceding |
| L | Large | Sf | south following |
| l | Little | Sp | south preceding |
| Mag | Magnitude | 11m | 11th magnitude |
| M | Middle | 8... | 8th magnitude and fainter |
| M | Much | 9...13 | 9th to 13th magnitude |

If you have never dealt with the NGC abbreviations before, perhaps a few examples will help:

| **NGC Number** | **Description** | **Decoded Descriptions** |
|---|---|---|
| 214 | pF, pS, lE, gvlbM | pretty faint, pretty small, little elongated gradually very little brighter in the middle |
| 708 | vF, vS, R | very faint, very small, round |
| 891 | B, vL, vmE | bright, very large, very much elongated |
| 7009 | !, vB, S | remarkable object, very bright, small |
| 2099 | ! B, vRi, mC | remarkable object, bright, very rich, much compressed |
| 6643 | pB,pL,E50,2 st p | pretty bright, pretty large, elongated in |

| | | |
|---|---|---|
| | | position angle 50 degrees, two stars preceding |

h) **Notes** — notes pertaining to the object. Much of this field came from UGC Notes provided by Jim Lucyk. Most of the abbreviations used by the Description field apply here also. Several other common names are included in this field. If there is a position angle (PA) here, that is providing a companion objects' angle in relation to the main object. Another abbreviation that is used often is P w N ( paired with NGC ###) or P w U ( paired with UGC ###). Most of the data on companions to an object have been marked to make recognition easier, but some did not fit into the 71 spaces allotted. So, the data is always in this order: distance in minutes from main object, PA from main object, then the size and magnitude of the companion. Example: P w N4566 @ 4.5,120,0.9X0.7 says that the main object is paired with NGC 4566 and is at 4.5', position angle 120 degrees and 0.9'X0.7'.

j) **Size** — the size of the object in minutes of arc (′), seconds of arc (″), and degrees. For objects that are elongated, often the dimensions of the long and short axis is listed.

k) **Class** — the class of the object. Several professional classification schemes are contained here.

**Trumpler type for open clusters**

Concentration
I. Detached, strong concentration toward the center
II. Detached, weak concentration toward the center
III. Detached, no concentration toward the center
IV. Not well detached from surrounding star field

Range in brightness
1. Small
2. Moderate range
3. Large range

Richness
p Poor (<50 stars)
m Moderately rich (50-100 stars)
r Rich (>100 stars)

An "n" following the Trumpler type denotes nebulosity in cluster

**Shapley-Sawyer concentration rating for globular clusters**

The values range from 1 to 12, smaller numbers are more concentrated clusters.

**Vorontsov-Velyaminov type for planetary nebulae**

1. Stellar
2. Smooth disk (a, brighter center; b, uniform brightness; c, traces of ring structure)
3. Irregular disk (a, very irregular brightness; b, traces of ring structure)
4. Ring structure

5. Irregular form similar to diffuse nebula
6. Anomalous form, no regular structure

Some very complex forms may combine two types.

**Hubble type for galaxies**

E elliptical, E0 is roundest to E7 is flattest subgroups; ‘d’ is dwarf, ‘c’ is supergiant, ‘D’ has diffuse halo
S Spiral, ‘a’ has tightly wound arms, ‘b’ has moderately wound arms and ‘c’ has loosely wound arms
SB Spiral with central bar
Ir Irregular

## 4.2.2 Principle Galaxy Catalog

This database is not present in **ECU Lite**.

## 4.3 General Catalog of Variable Stars

This database is not present in **ECU Lite**.

## 4.4 Washington Visual Double Star Catalog

This database is not present in **ECU Lite**.

# 5. Identify Objects

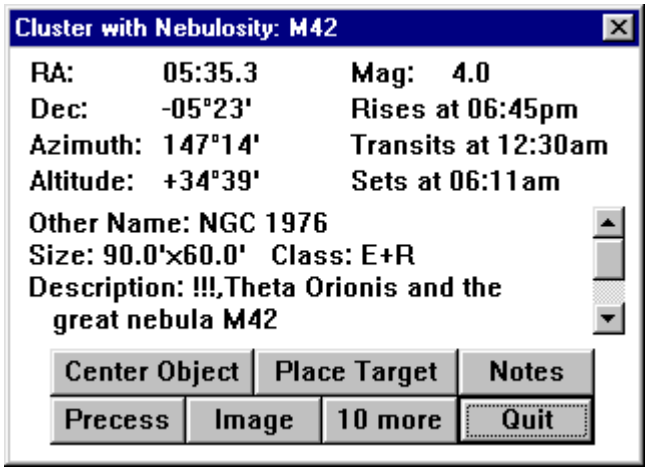
The **Identify Objects** dialog box, obtained by “clicking” near any object on the sky display with the left mouse button, contains various information pertaining to the selected object. Note that if the stars are not drawn with “Auto Stellar Limit”, you will not be able to “click” on stars. See section 3.4.3 for details.

If more than one object is in the vicinity, the “more” button will be highlighted and will indicate the number of remaining objects. It can be pressed to update the dialog box with new information for the next object.

The dialog box can be terminated in four ways. If the “Quit” button is pressed, the dialog box will terminate immediately. If another object is selected, the current dialog box will be replaced with a new one. If the left mouse button is pressed while the cursor is not near an object, the dialog box will terminate. Finally, the <ESC> key can be pressed.

## 5.1 Information Display

The information common to all object types includes the Right Ascension and Declination (in J2000.0 coordinates), the Altitude and Azimuth with reference to the local horizon, and the time the object rises, transits (is highest in the local sky), and sets. Each object type is listed below with each one's specific information that is displayed in the identify objects dialog box.




a) **Sun** — the sun's distance, in astronomical units and in kilometers; its light travel time, in minutes; its size, in minutes of arc, and the solar longitude.

b) **Moon** — the moon's distance from the Earth, in kilometers; its size, in minutes of arc; its phase; its phase angle (and age, in days); and its illuminated fraction (in percent).

c) **Planets** — the planet's magnitude; its distance from the Earth, in astronomical units and in kilometers; its light travel time, in hours and minutes; its size, in seconds of arc; and its phase (0 to 1).

d) **Comets or Asteroids** — its magnitude; its distance from the Earth and the Sun in astronomical units and in kilometers; its light travel time, in hours and minutes; its solar elongation; and for asteroids, its phase angle.

e) **Yale Bright Star Catalogue Stars** — the star's magnitude; its Bayer/Flamsteed identification; its Yale Catalogue number; its SAO Catalogue number; its Henry Draper Catalogue number; its spectral classification; its color as B-V; and its proper motion.

f) **SAO Catalogue Stars** — the star's magnitude; its SAO Catalogue number; and its spectral classification.

g) **SAC Deep Sky Objects** — the object's magnitude; its primary and other names; its description; its size; its position angle; the object class and various notes are displayed. See section 4.2.1 for a detailed description.

If more information is present than can be displayed in the available space, a scroll bar is utilized allowing the user to scroll down to access more information.

## 5.2 Viewing Images

Viewing images of objects from within **ECU** is provided by running an image viewer program and passing to it the name of the image file to view. This is accomplished by pressing the "Image" button. If an image for the identified object or the image viewer program is not present, the "Image" button will be disabled.

The "freeware" image viewer program "Navimage" (written by Dvorak Development) is provided (without any warrantee from Nova Astronomics) with **ECU Pro** to display images, however **ECU** can be configured to use another image viewer program which you might have by using the **Directory/File Setup…** dialog box (see section 3.8.7). The location of the image files is also controlled by the user in the same dialog box.

## Note

*Nova Astronomics recommends that you download and install the excellent "freeware" image viewer program "Irfanview". You can download this from* ***www.irfanview.com****.*

"Navimage" supports images in a number of common formats including GIF, JPG, TIFF, BMP, etc. The name of the image files must be the same as the primary or other object name that appears in the "Identify Objects" dialog box for the object. For example, an image of the Moon would be called "MOON.GIF" if the image was in "GIF" format. Or an image of NGC7009 (the Saturn Nebula) would be called "NGC7009.BMP" if the image was in "BMP" format.

The filename searched for is usually exactly the same as the object's primary name, however, because of the restrictions on the naming of files imposed by Windows on 16-bit programs (such as **ECU**), some names of objects may work directly (for example, if the name is more than 8 characters in length). In these cases, **ECU** creates a "compatible" filename automatically.

Up to 25 images of each object can be accessed. When more than one image of an object exists, the image filenames must all have the same first characters, but with unique file extensions (for example: "SUN.GI1, SUN.GI2, SUN.GI2"). However this feature does not work with "Navimage" since it requires image files to have file extensions which match their file format (e.g. gif files must end with "gif" and jpeg files must end with "jpg").

## Note

*In order for image viewing to be effective, at least a 256 color Windows video driver will have to be installed in your system.*

A growing selection of image files are included with **ECU Pro** including images of the Sun, the Moon, the 8 planets, and a variety of deep sky objects. Most of these images were taken by amateur astronomers. Many images are also available "on-line" from sources on the Internet.

# 5.3 Notes

You can add your own "notes" about any object in **ECU's** database by clicking on the notes button in the Identify Object dialog box. **ECU** then creates a file named after the object, stores it in the "notes" directory (see section 3.8.7), and starts a text editor program (also see section 3.8.7). Below is an sample file, which would be created for Messier Object 101. It includes both known names of the object, a time/date stamp (the current date and time in local and UTC formats), and a section for your own notes.

```
Object Name: M101
Other Name: NGC 5457

LMT: 96/01/01 09:00pm (UTC: 1996/01/02 01:00)
NOTES:
```

After adding your notes, remember to save the file and close the text editor program. If the file was already present, it is not overwritten, but rather a new time/date stamp is appended to the bottom of the existing file allowing the user to add more notes.

The filename created is usually exactly the same as the object's primary name with ".TXT" added to the end. In the example above, the file would have been called "M101.TXT". Because of the restrictions on the naming of files imposed by 16-bit program (such as **ECU**), some names of objects may work directly (for example, if the name is more than 8 characters in length). In these cases, **ECU** creates a "compatible" filename automatically.

## 5.4 Other Buttons

The "Precess" button precesses the object's coordinates to the epoch of the current date. Pressing the "Center Object" button will cause the sky display to be re-drawn centered at the identified object. Pressing the "Place Target" button will cause a default Field Target to be placed at the location of the selected object (see section 3.4.14.1).

# About the Author

**David J. Lane** has been an active amateur astronomer since the early 1980s, is a life member of the *Royal Astronomical Society of Canada (RASC)*, and is a past-president of its Halifax Chapter.

He is employed as the Astronomy Technician and Computer Systems Administrator at the Department of Astronomy and Physics at *Saint Mary's University* in Halifax, Nova Scotia, Canada. Dave often appears in the local and national media covering astronomical topics of interest to the general public.

His primary astronomical interests are in deep sky observing, public education, astrophotography, telescope building, CCD imaging, and of course, using computers and the Internet in Astronomy. He also volunteers his time on projects of the Royal Astronomical Society of Canada, both nationally and locally.

Dave also holds the distinction, along with Paul Gray and Beverly Miskolczi, of being the first Canadians to discover a supernova (1995F in NGC 2726) from within Canada — this occurring in February of 1995. *Earth Centered Universe* was controlling the telescope used to discover the supernova.

For developing ECU, Dave was awarded the **Chant Medal** (1996) of the Royal Astronomical Society of Canada, the highest award for amateur contributions to astronomy in Canada.

**Nova Astronomics** is Dave's part-time business which was primarily formed to support the development and distribution of this software.