Celestia 1.3.0
User's Guide

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CHAPTER 1

1 Introduction to Celestia

1.1 A dream: experience the universe

Many of us have looked up at the stars on a dark night and wondered what it would be like to launch ourselves into space and soar among the stars.

- What do the astronauts of the space shuttle really see when they look down upon our beautiful Earth turning slowly below?
- What wonders might we encounter if we could really visit Saturn and journey right through its rings?
- What might they actually look like up close?

If you have ever wondered about these things and would like to find out the answers, we of the Celestia community are happy to introduce you to Celestia!

Celestia is a free real-time space simulation that lets you visually experience our universe in three dimensions.

1.2 A bit of history

Celestia was the initial inspiration and creation of Mr. Chris Laurel, a gifted Seattle, WA computer programmer who in 2001, decided to write a free software program to be made available to everyone on the internet that would place you in control of a virtual reality world of the solar system.

His vision and dedication gave birth to a program that is unlike any other planetarium program in existence. Celestia doesn't confine you to the surface of the Earth as many other programs do. Instead, Chris created a capability to travel throughout the solar system and anywhere else in space, at any speed and in any direction you choose. If you wish, you can fly via your own "hyperdrive" spacecraft to visit stars circling the center of the Milky Way beyond the confines of our sun. You can even travel completely out of the Milky Way galaxy and view it from far space.

When Celestia version 1.0 first appeared available for download on the Internet, space enthusiasts all over the world discovered and quickly realized the potential of this beautiful program.

Within a year, many talented people worldwide joined Chris in a collaborative volunteer effort to make Celestia into not only a good graphical space simulation program but into a great one, capable of producing a virtual world of space rivaling the visual quality seen only in Hollywood films.

They have succeeded. As of this writing, over 500 members of the public are part of the Celestia forum community. Over 1 million people have downloaded the program for use at home or school. The list grows daily and includes talented graphic artists, computer programmers, astronomers, astrophysicists, animators, engineers, teachers, students, professionals from scores of occupations and ordinary citizens in over 20 countries around the world. We invite you to join us by becoming a member of the Celestia forum at http://www.shatters.net/forum/profile.php?mode=register

1.3 What Celestia offers

Celestia is available free of charge for Windows, Linux, and Mac OS X from http://www.shatters.net/celestia/download.html. Hopefully, you've already downloaded Celestia and are really to install it and experience the beauty of space. Here is just a taste of what you will be able to encounter:

- Hover over each of the nine planets in our solar system as they rotate slowly below you. See clouds actually move and drift by (where applicable). Look carefully and you may be able to see three-dimensional mountains, canyons and craters on the planet surfaces with shadows being cast by them as the Sun sets low on the horizon.
- Take a spin down to the Earth's surface at a lazy speed or at thousands of miles/km per hour in your own spacecraft. Skim over the oceans of Earth as you actually fly below the clouds. See the sky turn a pale blue and eventually, transform into the crimson color of a sunset. Soar back into space in time to see the lights come on in the cities of Earth and glow an eerie white as the dark side of Earth turns below you.
- Position yourself beyond the giant gas world of Jupiter and watch as its large moons drift across the face of the planet, casting eclipse shadows on its banded clouds and Great Red Spot.
- Hover far beyond Saturn, speed up time and count its many moons revolving around its magnificent ringed body like pearls swirling on an invisible necklace.
- Journey to the frozen wasteland of Pluto and its moon Charon and experience their icy coldness as the sun's faint light casts pale shadows across their cratered ice surfaces.
- Take up station behind the comet Halley, set Celestia's clock back in time and follow this famous comet on a trip into the inner solar system, sailing past Earth with its gaseous blue tail streaming out behind it.
- Set your spacecraft speed and journey from the Earth's surface up to the International Space Station or the Hubble Space Telescope. Test your skill at rendezvousing and docking with them as they orbit Earth every 90 minutes.
- Fly out to the very edges of our solar system, locate and follow behind Voyager 1 and 2 as they speed farther and farther away from their creators back on Earth, headed on a one way journey through the blackness of frigid space toward distant stars that will take them millions of years to reach.
- Set your ship at faster-than-light speed and sail to Rigel Kentaurus A and B, located 4.5 light years from Earth. See if you can find their tiny red dwarf companion Proxima Centauri, the closest star to our own Sun, or choose to observe rotating sunspots on any of a whopping 2,000,000 other stars drawn by your computer in the Celestia universe (for large star file, a separate add-on is required).
- Download some of the many stunning add-ons available for Celestia (see User's Guide Part 2) and your experience becomes filled with even more wonders. Visit the massive rotating Space Station from the movie, 2001, a Space Odyssey, as it orbits Earth or Discovery, another spaceship from the film, dark, abandoned and adrift somewhere in Jupiter space with the HAL computer inside.
- Journey to the edges of a massive rotating Black Hole as it spins near its stellar companion.
- Track the spacecraft Cassini as it approaches a precise rendezvous with Saturn in 2004.
- Journey to the heart of a distant solar system dominated by a massive Red Giant star glowing a deep crimson, a star that is swallowing its nearest planetary companion.
- Witness a pulsar spinning rapidly as it sends its twin beacons of light out through its remaining solar system.
- Travel back in time to witness what the Earth and Moon looked like billions of years ago, when both were young, violent worlds orbiting within a few thousand miles of each other.
- Are you a Star Wars fan? The Celestia community has made available for download an entire Star Wars solar system. Orbit the planet Tatooine and you will be amazed as the realism of its arid deserts. Fly via hyperdrive over the ice world, Hoth or to Endor but be careful for tractor beams. Somewhere in that solar system will be the giant imperial

Deathstar, glinting as the light from the system's yellow sun actually reflects off its evil metallic skin.

These are just a few of Celestia's features. Each week, new features are being added by Celestia's programmers and other talented contributors. It is a program undergoing a rapid evolution in computer graphics.

Add-on features, for example, will include entirely new solar systems with dozens of planets and moons drawn in vivid detail, gaseous nebula clouds, new galaxies, stars, globular clusters and spacecraft both real and imaginary. Periodically as new features are added, this User's Guide will also be revised. If this list above excites you, let's get started on our journey into the heart of Celestia.

1.4 Solar System Tutorial

Celestia is a stunning program to observe and explore the solar system. To help you discover some of its beauty and secrets, Celestia has an excellent journey already laid out for you. To see it, launch the program as described below, pull down the Help Menu and select Run Demo. We also suggest you visit:

http://www.shatters.net/celestia/index.html

and download the Celestia Lesson Plan by Frank Gregorio. It is written for use both by the general public and by teachers or students, and provides a good systematic Celestia tour of the nine planets. Celestia developers are also collaborating closely with NASA to use Celestia on the NASA educational website. Exciting lesson plans and new Celestia journeys are under development.

1.5 What is available?

Celestia is a computer program written in the computer language C++. The code is Open Source, and may be examined and freely modified by anyone under the terms of the GNU Public License. For experienced programmers who have an interest, directions on how to locate and access Celestia's source code on the web will be provided in Part 2 of this User's Guide.

In addition to the actual program, Celestia includes many other files (graphics and data) that the program must use. Part 2 gives you a brief tutorial in Celestia's use of these files, and explains how you may create or modify your own files. If you choose to download the entire library of over 100 Celestia **add-on** files designed to date by its many contributors, they can take up over 600 MB (megabytes) of disc space. For many people with limited computer memory and/or internet download speed, that is very large. To offer Celestia in a reasonable fashion, therefore, the program is provided for download with a comprehensive but limited set of files, sufficient to experience its capabilities without overtaxing your computer. "Links" (web addresses) to guide you to the additional add-on files available are listed on the web within the User's forum and Celestia website. To fully experience what Celestia has to offer, we urge you to seek out and download at least some of these other add-on files.

The Celestia package for computers running Microsoft Windows® 95, 98, ME, 2000, XP, or NT 4.0 is offered as a fully "executable" program. It will install itself into your computer. The current Windows version is 11 megabytes in size and is called Celestia-win32-1.3.0.exe. It is available for download at http://www.shatters.net/celestia/download.html. If you have a computer that is less than 3 years old, this is the only file you will need to get started. If you have an older computer, or one with a graphics card with less than 16 megabytes (MB) of memory (see below), the Celestia package with low-resolution textures is only 4.5 MB in size and may run better on your system. You can find it at the same website above. Please note that you do not need both of them. See hardware comments in the next section below for more detail.

Celestia is also provided to Apple computer users in a MAC version (version 1.2.5), also available from the same site above. The comments mentioned above for Windows also apply to the Apple version of Celestia.

Celestia is available for Linux in three different versions. All of them are available in a single tarred, gzipped source archive at http://www.shatters.net/celestia/download.html. Which version you choose to install depends upon which desktop environment you have installed. The most polished version of Celestia for Linux requires KDE3 (Celestia is not compatible with earlier versions of KDE.) If you do have KDE3, it's highly recommended that you choose the KDE version of Celestia, as it's under the most active development.

Celestia also can be compiled to use Gnome/Gtk, although Gnome interface is not up to par with the KDE and Windows UI. It's still possible to build Celestia even if you don't have either KDE3 or Gnome. The last version of Celestia is the GLUT version. GLUT is a cross platform framework for OpenGL applications that should be installed on nearly every Linux computer with OpenGL. However, it provides only a bare minimum of GUI features; if you use the GLUT version of Celestia, you will be missing the helpful menus and dialog boxes of the other versions.

Chapter 2

2 Installation and settings

2.1 Required Libraries:

All version of Celestia for Linux require that you have OpenGL installed. More and more distributions are shipping with OpenGL, so if you've recently installed or re-installed Linux, there's a good chance that you already have a working OpenGL configuration. In order to build Celestia, you need to have the OpenGL developers packages installed. They should be available on your distribution CD or ftp site if they're not already installed.

After you've successfully built Celestia, you will want to be able to run it with hardware 3D acceleration. For this, you'll need a Linux OpenGL driver from your graphics chipset maker. If it's not already installed, you'll have to download it from the chipset maker's web site. NVIDIA and ATI are the two largest graphics hardware makers, and both offer Linux drivers in the drivers section of their web sites. Celestia requires the image format libraries libjpeg and libpng; both should be present on all up to date Linux installations. In order to build the Gnome/Gtk version of Celestia, the gtkglarea library is necessary. It is available at http://www.student.oulu.fi/~jlof/gtkglarea/ if not already installed on your computer.

2.2 Hardware Requirements

Celestia is a sophisticated program that not only positions and graphically depicts the complete solar system in 3D; it also plots and tracks a sky full of hundreds of thousands of stars in real time. This takes computer power and computer memory. Celestia also has available scores of add-on files. Some of them are large graphics files that require lots of RAM memory. Thus, identifying what level of computer performance you need to enjoy the program depends upon what level of detail you wish to achieve.

In general, to run the basic Celestia solar system program, your computer should have a CPU (processor) that has a speed of at least 300 million cycles per second (300 MHz). Typically, computers bought new within the last 2 -3 years have more than adequate CPU speeds. If your computer is more than 3 years old or is a Pentium II or equivalent with a processor speed slower than 300 MHz, Celestia may run slowly and you will be disappointed.

The basic Celestia program also requires a minimum of 64 megabytes of RAM memory. The graphics files that Celestia use are large, and if your computer does not have at least 64 megabytes of RAM, Celestia may run very slowly, not run at all or may lock up. In addition, if you wish to explore Celestia's maximum capabilities, you will need 128 megabytes of RAM memory, with 256 megabytes of RAM recommended. Newer computers usually have adequate RAM memory.

Although it's not absolutely required, the program will be vastly more enjoyable if you also have a 3D video graphics accelerator in your computer. This is a piece of hardware circuitry that helps to draw complex graphic images on your video display monitor. Celestia should run with any 3D accelerator card that has at least 8 megabytes of memory. However, a 16 megabyte or 32 megabyte card is preferred if you intend to use Celestia's most detailed graphic files. If you have such a card, you will know it. Celestia will run smoothly and its graphics will be complete, crisp and sharp. It is runs too slowly, is blurry, locks up, or objects appear to be moving with jerky motions, you may need to locate a faster computer or one with more memory or graphics capability.

READ CAREFULLY

Celestia uses the OpenGL API to render 3D graphics. In order to get the most from Celestia, you should have a modern OpenGL graphics card with the latest drivers from the manufacturer. If you have problems running Celestia, the first thing to do is verify that your graphics card is capable enough to run Celestia, and that the drivers are up to date. If in doubt about the OpenGL driver, download and install a new one. It will be available for free from your card maker's web site. Having a new driver is the best thing you can do to ensure that Celestia runs properly.

NOTE

Please Note: While a graphic video card might use Open GL processing, Celestia does not run well on all such card brands or models. Major improvements have been made in version 1.3.0 to render Celestia more compatible with as many brands of cards as possible, but several graphic cards may handle images in a manner that Celestia still cannot control properly. To date, Celestia's features will work best on the video chipsets manufactured by NVIDIA, Inc.

Those video cards are sold under the brand names "Riva", "GeForce" and "Quadro". If an NVIDIA Open GL card is not present in your computer, Celestia can still offer you a beautiful solar system experience, but some of its advanced features may not function smoothly or may not work at all. These include shadows on mountains and craters (bump mapping), sunlight reflections off water, land or atmosphere (specular highlights), the shadows of moon eclipses, and atmospheric haze near a planet's surface

As development of Celestia continues, better support for graphics hardware will continue to be introduced; if not all the features of your graphics card are supported yet, be patient. Better yet, join the Celestia development team and help out.

2.3 Installation and Uninstallation

If you have a video card incorporating a graphics accelerator with at least 8 MB of memory, install the full Celestia installation (i.e. – celestia-win32-1.3.0.exe). If your computer is an older model, does not have a graphics accelerator or does not support Open GL processing, obtain the Celestia package with low-resolution textures and install that. The views you see in Celestia will be simpler and less detailed, but this version of the program and its files require less RAM and it may run more smoothly.

Also, see the Celestia website for additional answers to troubleshooting questions at http://www.shatters.net/celestia/faq.html. Alternatively, the main Celestia package includes some low-resolution image files. While running Celestia, you can actually switch from one resolution of graphics to another by tapping the "**R**" key on the keyboard (for large resolution), or the "**r**" key (to change to low resolution images). This alone may speed up your program. Note, however, that not every image in Celestia is represented by both a high and low-resolution image. If you tap the "r" key and nothing happens, it just means there is no smaller resolution image of that moon or asteroid or spacecraft to use.

2.3.1 Windows Operating System (95, 98, ME, 2000, NT, XP)

Once you have obtained and downloaded the executable file, simply click twice (double-click) rapidly on its name with your left mouse button. The file will begin running and will install Celestia. In general, just click "Next" whenever it asks a question. Celestia has its preferred choices and unless you have reasons for altering them, we suggest you follow them.

2.3.2 Macintosh OS Operating Systems

To install the Macintosh version, click on it and follow the on-screen menu instructions.

2.3.3 Linux Operating Systems

To install the Linux version, unpack it and its libraries with **gzip** and **tar** via the command:

```
gzip –dc celestia-1.2.5.tar.gz | tar xvf
```

Then change directory (cd) into the newly created directory and configure Celestia. Run **configure** with the appropriate command line for the version that you want to compile:

```
KDE: ./configure –with-kde
Gnome/Gtk: ./configure –with-gtk
GLUT: ./configure
```

Configure may complain if you are missing a required component, or if you have an out of date version of a required component. Check the error output from configure to determine what's missing, install the necessary items, and then try rerunning configure. If neither the **KDE** or **Gnome** versions of Celestia will build, try falling back to the **GLUT** version. There are many options for configure; you can view them all —together with a brief explanation for each— by running **configure –help**.

After running **configure**, compile and install Celestia:

```
make
make –install
```

Note that **make –install** will need to be run as the root unless you've overridden the default install directory by invoking configure with the **–prefix** option.

Hopefully, compilation of Celestia will go smoothly. If it doesn't, it's most likely because some required package is missing. A relatively common problem is that the **OpenGL** developer package necessary for building **OpenGL** applications has not been installed. If the compiler complains that **gl.h** or **glu.h** is not found, it's a symptom of a missing or improperly installed **OpenGL** developer package.

Once **make** completes without errors, you're ready to run Celestia from either your desktop of choice or the command line.

2.3.4 Uninstall

To uninstall Celestia in Windows, click the **Start** button at the bottom left of your screen, select "**Settings**", then select "**Control Panel**", then select **Add/Remove Programs**. Locate Celestia in the pull-down list and click the button that says, "**Add/Remove**". For Apple and UNIX owners, follow your system's standard uninstall procedure.

Chapter 3

3 General Operation and Keyboard commands

3.1 Introduction

To launch Celestia, double-click on its icon either on your desktop or in the **Programs** menu that appears when you click your **Start** button. The program will load and will open far out in space hovering above Io, one of Jupiter's most fascinating moons. Mighty Jupiter will be visible somewhere behind Io. The beauty of Celestia is its accuracy. The image in front of you is exactly what you would see if you were really positioned in space at that very spot right now. In other words, Io, Jupiter, and all of the planets and stars and spacecraft visible on your computer screen really are located in space where Celestia has put them.

In the 1970s, the United States sent two space probes named Voyager 1 and Voyager 2 to explore the outer solar system. The images you see in Celestia have in part, been taken directly from Voyager photographs. The image of Io in front of you is one of these. The Voyagers found Io to be actively volcanic. Those small mountains and black smudges are really there on the moon and are volcanoes. Some of them were erupting when Voyager flew by.

3.2 The Opening Screen

Figure 1: Io and Jupiter

Io orbits Jupiter rapidly and is always changing position. Thus, the screenshot above may or may not be the same scene you see when you open Celestia. However, it will be similar.

In the top left corner will be some information about your target (Io). The **Distance** will be the distance in kilometers (km) from you to the surface of the moon. The **Radius** of Io in km will also be listed.

In the lower left corner will be your **Speed** through space relative to the sun. At the moment, your ship is not moving so your speed is zero. Later, we will begin to fly on our own and your speed will be listed here.

In the top right corner will be the **current time and date**. In Astronomy, times are given in Universal Time (commonly referred to as Greenwich Mean Time), and this is what Celestia uses by default. If you find it more convenient, you can access the **Time** menu to make Celestia use your local time zone instead. The date is listed in the format (year/month/day). Note that the time will be in 24-hour format. Thus, 1:00 PM in the afternoon will be 13:00:00 hours. Celestia can also speed up or slow down time or travel forward or backward in time with the touch of a button. Now, you are experiencing the program in "**Real Time**".

In the lower right of the screen will be a message telling you that you are "**Following**" Io. Wherever it goes, you go. Thus, although Io is actually moving rapidly through space, you are moving with it. Under that will be your "Field of View" or "**FOV**". This is amount of sky your view takes in. Celestia starts you out with an FOV of 45°, which means your monitor is displaying about 45° of the sky (120° being the complete flat plane view). However, you can change the FOV easily by holding down the "**Shift**" key on the keyboard, **left-clicking** your mouse button and **dragging** the mouse forward or backward. Try it. As the FOV gets smaller, the scene enlarges. It is similar to a telescope magnification. You can also press the "**.**" key or the "**,**" keys to change field of view from the keyboard. Enlarging the fov allows you to magnify objects in the distance, while still keeping the planet in the foreground. If you wish to return to an FOV of 45° and have a **mouse wheel**, click/push the wheel button.

Figure 2: The FOV here is 45°. Notice size of the moon behind Earth.

Figure 3: The FOV here is 12°. Earth and moon are now enlarged.

3.3 User input management

General movement in Celestia is one of the highlights of this program. It is easy. Movement keys are very important for enjoying Celestia. For example, if you wish to go into an orbit hovering above a planet, drop down to the surface or fly around in your spaceship, you will need to change direction, orientation and distance in space frequently. There are 15 keyboard or mouse general movement commands. Let's return to our opening scene of the moon Io (select Io from the Solar system Browser and Goto).

3.3.1 Mouse and keyboard control

Right-click on the scene in front of you and while holding down the right mouse button, move your mouse (Right-dragging). Io will rotate left, right, up or down. You can view it from any perspective you wish.

Left-click your mouse and while holding the button down, drag the mouse. The whole scene will shift as a whole.

Tap the "down" arrow on the keypad or # 2 on numeric keypad. Your view of Io will **pitch** upward. Make sure you press the key labeled "**Num Lock**" at the top of the numeric keypad. If so, there should be a little light lit up above the numbers on your keyboard.

Tap the "up" arrow on the keypad or # 8 on numeric keypad. Your view of Io will **pitch** downward.

Tap the "left" arrow on the keypad or # 7 on numeric keypad. Your view will rotate (**roll**) counter-clockwise

Tap the "right" arrow on the keypad or # 9 on numeric keypad. Your view will rotate (**roll**) clockwise.

Tap the # 4 key on the numeric keypad of the keyboard (the one on the right side). The view will move (**yaw**) to the left

Tap the # 6 key on the numeric keypad. The sky will move (**yaw**) to the right as a whole.

Tap the # 5 key on the numeric keypad to instantly stop all pitch, roll and yaw movement.

NOTE

Note. The speed with which the view turns when you press the above keys is initially set at a particular value (120) in one of the files that Celestia uses to operate. That file is called celestia.cfg, and can be found in the main (root) directory of the Celestia folder. If you find that your view is turning too fast or too slowly for your taste when you press a movement key, that document can be opened by you and the Rotate Acceleration (turning speed) of the above keys can be lowered or increased. To do so, double-click on the file. If a menu comes up asking you which program you wish to use to open the document, choose "WordPad" (for Windows systems) or the proper plain text editor for MAC and Linux systems. When open, locate the line "RotateAcceleration 120" and change the number either higher (to turn even faster) or lower (to turn slower). For example, RotateAcceleration 30 will result in your view turning much slower when you hit a movement key. Some users prefer this, particularly if they use the Celestia spaceship. Do not change any other values in this document, or Celestia may not operate properly. After changing, save the change by clicking the File and SAVE menu choices, and close the document

Right-Click + Left-Click + Drag – your position will **advance toward** or **recede away** from the object.

Ctrl + left Drag – same as # 10 above

Roll Center Mouse Wheel (if you have one) forward or backward – same as # 10 above.

Press the "End" key on the keyboard. This is the same as # 10 but using the keyboard only. Your position above Io will rapidly **recede** away. Hold down the key and you can move light years away if you wish.

Press the "Home" key on the keyboard. Your position above Io will rapidly **advance** toward the moon.

The above five keys resemble a "zoom" ability. However, they don't magnify an image; they just reposition you toward or away from it. Because this feature operates exponentially, you can adjust the distance much more finely when your viewpoint is close to the object of interest. Exponential control also makes it possible to move smoothly and rapidly from a distance of one meter to one million light years away from a Celestia object without sacrificing precision at small distances, or experiencing long time delays traveling long distances.

Press the * [Shift+asterick] on the keyboard. This is a **Lookback** command. It will reverse your view so that instead of looking forward, you will look behind you (a rearview window). It

is very useful when flying from one planet to another. You can see forward and then examine your journey from the rear view, watching the planet or moon recede from you.

3.3.2 Joystick control:

You can also control your movement via a joystick (Windows only). The seven commands for joystick control of Celestia are listed in the back of this document, in the **Keyboard and Mouse Command Summary**.

3.4 Selecting objects

In Celestia, you will usually have some object selected. If so, the program will list its name in the upper left-hand corner. Currently, it's Io, but it could also be a star, planet, moon, asteroid, comet, spacecraft, or galaxy. The simplest way to select an object is to point at it with your mouse and **left-click** on it. Try clicking on a star to select it. The information about Io is replaced with details about the star. Note that you have not actually gone there or changed anything yet. You've simply told Celestia that you have selected a new object. (If you see no text on the screen, toggle the "V" key on the keyboard.)

To go to the star you just selected, you have four main ways to make the journey:

- If you **right-click** on the star, and select "**Goto**" from the context menu, Celestia will take you at hyper-light speed directly to that star and position you in space at a convenient distance.
- Alternately, you can press the letter "**G**" on the keyboard. That is the shortcut command for "**Goto**".
- You can select the star and fly to it in your spaceship. It takes longer but sometimes the journey is half the fun of getting there. How to operate your spaceship is explained later below.

You can select an object using keyboard commands, then use the **recede** and **advance** commands to get there. Simply point at a star or planet, left-click on it with the mouse so that it is selected and tap either or both the "**F**" and the "**C**" keys on the keyboard. The "**F**" key tells Celestia to select the object and follow it, keeping it the same distance from you even though it is moving through space. To see that effect in action, swing the sky and locate Io. Left-click on it to select it and press the "**F**" key. The words "**Follow Io**" will appear in the lower right corner of the screen. Io will stay the same distance from you. Now release your hold on Io by pressing the **Esc** key. Io will begin to drift away. The "**C**" key tells Celestia to center the object in the middle of your viewscreen. Let's try it. Point at a star, left-click on it and tap the "**F**" and "**C**" keys on the keyboard. Now, hold down the advance key (**Home** or the **mouse wheel**) and you will go to that star. **Double-clicking** quickly on an object will also center it.

You can select one object such as Io and follow it (F key). Then, select a second object such as Jupiter by left-clicking on it and press the **:** colon [**shift + :**] on the keyboard. This will **Lock** Io and Jupiter together as a pair. When you rotate the scene, Io will stay locked to Jupiter and the display will read distances between them.

To return to our solar system (a useful thing), press the "**H**" key on the keyboard. That will select "**Home**". Tap the "**G**" key and you will be whisked back to our sun (Sol).

NOTE

You will use these two keystrokes constantly as you explore the Celestia universe and wish to return home

To cancel a current selection, hit the "**Backspace**" key on the keyboard. To unselect everything and release your hold on your current object, press the **Esc** key in the upper left of your keyboard. You will now be adrift in space. You can still turn and point at anything you want, but pressing the "Goto" key will have no effect.

NOTE

All of these keyboard shortcut strokes are summarized in a later section

CHAPTER 4

4 Render menu

4.1 Set Program Options

When you use Celestia for the first time, you will need to choose some options that will tell the program how you want things done. During your subsequent use of Celestia, you may have occasion to change these options. To open the Options screen, **left-click** on the word "**Render**" at the top of the Celestia view screen and select "**View Options**". A list of choices will appear. Deciding which ones you want is a personal and a practical choice. If your computer is a newer model and has enough speed and memory, then we recommend the options below. If your computer is slower or older and Celestia appears to be running slowly, deselect some options, as follows:

4.1.1 Atmospheres

Celestia will draw colored atmospheres above all planets and moons that have them. You will be able to see them from space and even fly through them. As you do, the sky will lighten. Atmospheres will even dim and turn color as you view them near the terminator (near the dark side). **Highly Recommended** - but does require computer resources. Try turning off if Celestia is running too slowly on your system.

Figure 4: Earth with Atmospheres selected.

Figure 5: Same scene without Atmospheres selected

4.1.2 Celestial Grid

Celestia places an equatorial coordinate grid on the screen showing you the celestial position and direction in space of each quadrant. The grid follows the standard convention of Right Ascension and Declination used in Astronomy. **Recommended** – **when needed** to locate a direction in space. For example, you can turn the grid on temporarily to identify direction of an object in Celestia then go to a real telescope and swing to that approximate coordinate. You can also use the Celestial Grid to help you decide where to place a fictional add-on (see Part 2 of the User's Manual).

Figure 6 - Sky with Celestial Grid Enabled

4.1.3 Clouds

Some of the planets in our solar system and many fictional planets that Celestia users create in other solar systems have clouds drifting across their surfaces. Celestia has the ability to both place clouds above the surface and put them in motion. **Highly Recommended** - but does require computer resources. Try turning off if Celestia is running too slowly or if you just want clear skies.

Figure 7: Earth with moving clouds selected

Figure 8: Same scene without clouds selected

4.1.4 Comet Tails

Celestia will accurately place a gaseous comet tail behind all comets, properly oriented to always point away from the sun. To see those tails, you do have to be close enough to the comet. **Highly Recommended** - but requires computer resources. Try turning off if Celestia is running too slowly.

Figure 9 : Venus and comet Ikaya-Zhang in Feb, 2002

4.1.5 Constellations

Celestia will display both **constellation shapes** and their official "**borders**" for each of the 88 constellations in the sky. In the second Options row, you can also turn on constellation labels. These 3 options are useful whenever you have an interest in locating a particular constellation in Celestia. **Recommended – only when desired.** Does not use much computer resource.

Figure 10: Constellations with borders and labels enabled.

As viewed from Earth, the sun is "in" Capricorn

4.1.6 Eclipse Shadows

Celestia can compute the actual position of the shadows a moon will cast on a planet below as the moon passes in front of the Sun (a solar eclipse). Turning this feature on will cause shadows to be drawn on all planets whenever an eclipse occurs. It is an elegant feature, particularly when observing moon shadows drifting across the giant gas worlds of Jupiter and Saturn. **Highly Recommended** - but does require significant computer resources.

NOTE

On some older video cards, eclipse shadows have also been known to lock up the program

Figure 11: Io eclipsing Jupiter, an example of Eclipse Shadows

Figure 12: A total solar eclipse over Africa, as seen from space

4.1.7 Galaxies

Celestia comes with a galaxy data file that tells the program the position of numerous galaxies in the night sky and what type they are. When this option is selected, Celestia will create a small, dim sketch of each galaxy and position it in the proper place in space. It will also draw the huge band of starry haze we know as the Milky Way. Selecting the option, therefore, will improve your Celestia experience and you will be able to see dim galaxies in the distance. You can even travel to them in your spaceship. However, the galaxy sketches are simple and appear as dim "blobs". Later versions of Celestia will improve on the graphics of galaxies. **Recommended** - but does require computer resources. Try turning off if Celestia is running too slowly.

Figure 13:Neptune and Milky Way with Galaxies enabled.

Figure 14: Same scene without Galaxies enabled

4.1.8 Night Side Lights

Celestia has the ability to light up the night sky. From space, the thousands of cities across our continents are ablaze with light so bright that they can be seen vividly from hundreds of km up. Turning on this option commands Celestia to add those lights to the nighttime vista you see from space above Earth. **Highly Recommended** - but does require computer resources.

NOTE

On some older video cards, night-side lights may slow down the program

Figure 15: Earth, sun and terminator with night-lights enabled

Figure 16: Same scene without night-lights enabled

4.1.9 Orbits

Celestia will draw the actual path of a planetary orbit through the solar system. The Option also draws orbits of all moons, comets, asteroids and spacecraft. Orbits are excellent for seeing the celestial mechanics of the solar system. Turn them on, zoom out from the sun and view the orbits from above. Speed up time (see later discussion) and you will see the alignment of planets speeding around the sun. **Recommended – when desired.** Does not use much computer resources.

Figure 17: Solar System with orbits enabled.

The inclined orbit is that of Pluto, a large Kuiper Belt Object that may have swung into its current orbit through a past collision with another object.

4.1.10 Planets

Normally selected. Highly Recommended.

4.1.11 Ring Shadows

Celestia can compute and draw the actual position of the shadows a planet's ring will cast on a planet below and conversely, the shadow a planet will cast on its rings. **Highly Recommended** - but does require significant computer resources.

NOTE

On some older video cards, ring shadows have also been known to slow down the program dramatically or lock it up entirely

Figure 18 – Ring Shadows enabled

Figure 19 – Ring Shadows disabled

4.1.12 Stars / As Points

Celestia can display stars either as points or fuzzy disks. Which looks better is a matter of personal taste and the resolution of your monitor. In general, disks make a clearer distinction between brightnesses of a star and look better at high resolutions (see Display Mode below). Points tend to be of similar brightness, but may look better at lower resolutions. Selecting **Stars as Points** may also make Celestia run faster, but this is only noticeable when you adjust the visibility limit so that tens of thousands of faint stars are visible all at once. The slider in the "Filter Stars" section allows you to look at just the stars that are closer than a specified distance. Normally, it is set to one million light years, so that all stars are visible but you can drop it so that you are looking at only close stars to our own. This may also improve performance on slower or older computers.

Figure 20: Voyager 1 against stars – normal windows mode – Stars as Points enabled

Figure 21: Same scene with Stars as Points turned off

Figure 22:Same scene as figure 21 but at a higher screen resolution of 1280x720

4.1.13 Other options

The remaining **Options** in this menu include turning on or off various labels for planets, major stars, moons, etc. Turn them on or off as you desire. They do not use much computer power.

The box regarding **Information Text** allows you to choose how much data you want displayed when you select an object. Pressing the letter "**V**" toggles the information display on or off through two levels of detail.

4.2 Ambient light

Since space is a near vacuum, there is very little light scattered and shadows are completely black. You can set the ambient light level to "**none**" to simulate this and get the most realistic views of space. However, there are times when a bit of extra light is useful or aesthetically pleasing. For example, go to the dark side of any planet and adjust ambient light from **None** to **Low**, then to **Medium**. You'll discover that portions of a planet's dark side become visible with some light scattering. Having a bit of extra light is also good for seeing spacecraft. When they are on the dark side of a planet, they almost disappear in the shadows. Low or medium light allows you to track them better. Use "**{**" to decrease ambient illumination and "**}**" to increase it.

Figure 23: Pluto and its moon Charon with Ambient Light set to None

Figure 24: Same scene with Ambient Light set to Medium

4.3 More or less stars visible

This tells Celestia how many stars to draw in the sky at one time. It controls star numbers by Magnitude (brightness). You can choose to display only bright stars. On the surface of Earth, our view generally includes stars of a magnitude of +6.0 or less (the lower the number, the brighter the star). Setting this option to Magnitude 6.0 – 7.0 results is a realistic sky as seen from Earth on a clear night, with about 3,000 stars visible. However, if you were living on a space station far above earth's atmosphere, you might see stars up to a magnitude of 9.0 with the naked eye. Because there are more stars in the sky, some Celestia users prefer higher star settings of 8.0 to 10.0.

The default download of Celestia actually contains about 100,000 stars up to magnitude 15.0 visible from the vicinity of Earth. A setting of 11.0 or more simulates the view you would see through a telescope. However, millions of stars have been cataloged by Astronomers and if you wish, you can download a star database from the Celestia website that contains over 2,100,000 stars. If this file is loaded, and you select the maximum magnitude limit of 15.0, the sky will be ablaze with stars.

NOTE

this level of star display will dramatically slow down even fast computers

The choice is yours. Experiment by using the keyboard key "`[`" to decrease limiting magnitude (fewer stars visible), and "`]`" to increase limiting magnitude (more stars visible). Celestia also helps you to set realistic star magnitudes with a feature known as **`AutoMag`**. To enable **`AutoMag`**, press the **`Ctrl + Y`** keys. To disable it, press them again. When **`Automag`** is enabled, star magnitudes are restricted to a range of 6.0 – 12.0 when your Field of View (fov) is at the default range of 45°. A screen display will advise you of your changes. Also, note that by turning stars on or off, you are changing the amount of data Celestia must process each second. If you are experiencing slow performance, try turning the stars display down to 6.0 or less.

Figure 25: Stars at Magnitude setting of 7.5

Figure 26: Same scene at Magnitude setting of 15.

4.4 Antialiasing and Pixel Shaders

These are instructions to Celestia to use certain graphical processing techniques when it draws images on the **viewscreen.** Celestia relies on some of these techniques for drawing certain objects properly**.** In general, both choices should be selected. **Ctrl+X** toggles **Antialiasing** (smoothing) of the lines used to render orbit paths and constellation figures. **Ctrl+P** toggles **Pixel Shading**.

New in Celestia 1.3.0 are five possible "render paths" for **Vertex Shading**. **Ctrl + V** toggles among the five choices (the Render menu choice is grayed out). Vertex Shading is a technique that draws (renders) graphical shades (haze, shadows, etc.) on Celestia objects. To see such shading, your must have a graphics accelerator card that renders shading via a process known as Open GL. However, as mentioned earlier, not all graphics cards can handle vertex shading properly. Sometimes, vertex shading must be set in advance to certain parameters.

Celestia gives you five choices for Vertex Shading. They are: **Basic, Multitexture, Nvidia Combiners, Open GL and Open GL/Nividia Combiners.** The number of these available render paths you can cycle through with Ctrl+V depends on the graphics card and driver version you have. By default, Celestia starts up with the highest quality rendering selected. If you have a Nvidia Graphics card, select the last choice (**Open GL/Nividia Combiners**); observe Earth and then cycle through the other choices. You will see surface shadows and a haze appear on Earth. If you have another brand of graphic accelerator card, cycle through the five choices while viewing Earth and choose the one that is most pleasing to you. If you have no graphics card at all, the **Basic** or **Multitexture** settings are your best choices. The **Basic** path will always work well, although rendering will be at a basic level only.

Figure 27: Open GL/Nividia Combiners render path selected

Figure 28: Same scene with Basic render path only

4.5 Display Mode and Toggle Full Screen

These are instructions to Celestia to change the size of the view screen. Many Celestia users adjust their video display modes to use standard Window Mode, 800 x 600 pixel size or Full Screen mode. High-end computers and those with up-to-date video cards can take advantage of smaller pixel sizes and more detailed appearance. However, be advised that the ability of Celestia to redraw complex scenes in different screen sizes varies from system to system. Some users have reported lockups and program crashes when selecting certain display modes. We recommend you experiment with your own system and choose the resolution that works best for you. `Alt+Enter` is a useful keyboard shortcut that toggles between your chosen Display mode and Full screen.

Keyboard shortcuts for turning on and off (toggling) the above options exist and are summarized in a later section below. You can press these keys instead of pulling down the `Render`, `View Options` menu.

Chapter 5

5 Navigation menu

5.1 Select Objects by Navigation Menus:

Right-Click: There is another way to select objects and is one you will use often. To demonstrate it, press **H** to select our Sun, and then **G** to go to our solar system. You'll find yourself in space above the sun, which looks merely like a bright star at this range. Press **G** again and you will advance close enough to see a few planets visible near the sun. **Right click** on the sun to bring up a menu of planets and other objects orbiting the sun. After selecting a planet from the menu, hit **G** again to travel toward it. You can use this right-click feature when the object you visit orbits the sun or planet directly.

5.1.1 Solar System Browser:

Celestia also has a complete menu dedicated to navigation that will be used often as well. At the top of the screen, select the **Navigation** menu and choose **Solar System Browser**. A complete list of all objects being tracked in our solar system by Celestia will appear. Next to planets or moons may be a + sign, which indicates that around them are more objects to choose from. Select any one of them and choose either to **center** it, or **Goto** it. Centering is useful when you want to see where an object is in space without going to it, or when you want to use your spaceship to journey to that planet. **Goto** is used when you just want to get there fast. You should use this navigation menu frequently, since it is the complete list of all objects in the solar system, including all moons and spacecraft. Try it. Go to Neptune, Saturn, or one of their moons.

5.1.2 Star Browser:

Select the **Navigation** menu and choose **Star Browser**. A list of some of the stars being tracked by Celestia will appear. Clicking on the column headers will sort the stars different ways. You have your choice of **nearest**, **brightest** or stars **with planets**. Although extrasolar planets have yet been seen directly or photographed, gravitational evidence strongly points to their existence. To give you an "up-to-date" astronomy experience, Celestia includes some hypothetical planets that have been placed around candidate stars. In addition, as will be discussed in Part 2, Celestia's many users have designed fictional solar systems that they have placed around some of the stars in our sky. When downloaded, their solar systems will appear here in the star browser list also. To practice such a journey, locate the star **51 Peg** in the star browser list (make sure you choose the "**with planets**" option), and select **Goto**. You will fly at great speed to a bright yellow star much like our sun. A planet will be seen near it. Either point to it and left-click to select it, or right-click on the star 51 Peg and select the planet (named "**b**"). Press the "**G**" key on the keyboard and you will zoom to the planet, which will appear as a big gas world similar to Jupiter. Using your movement keys, you can move around this tiny solar system. Notice that the Solar System Browser is no longer listing our solar system. It now lists the one planet system of 51 Peg. To return to Earth, press "**H**" to select the Sun, then "**G**" to go to it.

5.1.3 Select Object

The Navigation menu also provides an option of typing the name of an object you wish to visit and then going there. Select this option from the pull-down menu and in the space provided, type "**Hubble**" and click **OK**. Now, hit the "**G**" key and you will zoom to an orbit above Earth directly next to the Hubble Space Telescope. Try another one. Let's use the keyboard shortcut for this feature. Hit the **Enter** key and the "**Target Name**" window will appear at the bottom of the screen. Type "**Betelgeuse**" and hit **Enter** again. Now, press the "**F**" key and then the "**C**" key. You will begin to follow a small reddish star centered in your viewscreen. Tap the "**G**"

key and you will be taken to one of the largest and brightest stars in our sky. Betelgeuse is a Red Giant, 264 times larger than our sun. Someday, it will blow up in a huge explosion that may become a Supernova. Get closer to it with the **Home** key or your **mouse wheel**.

5.1.4 Goto Object

Choose this option from the Navigation menu and a dialog box appears allowing you to not only enter the name of an object, but a precise position above it. Type **Mars**, enter **30** for the latitude, **5** for the longitude and **5000** (km) for distance. Click **Go To**. You will be taken to a position 5,000 km above Mars, at 30° N latitude and 5° W Longitude. This is an excellent way to position yourself for eclipse events. The Goto Object command can also tell you your current exact position above a planet or space object (see later heading). Position yourself with the mouse anywhere above a planet, and then select **Goto Object** from this menu. It will display your latitude, longitude and distance at the moment.

You can use common names or Bayer and Flamsteed designations and HD or HIP catalog numbers when selecting stars and space objects. Celestia stores star data taken from the HD catalog but if a star isn't in the HD catalog, the HIPPARCOS data set number is used (the prefix is "HIP"). Both the 1st name or number and 2nd name of the object/star can be spelled out or abbreviated (3 letters). Examples:

- Upsilon And
- Ups Andromedae
- Ups And
- 51 Peg
- 51 Pegasi
- HD 173739
- HIP 5643

Planets, moons, asteroids and artificial satellites may also be specified using Celestia's "path" syntax. Type the name of the star, followed by a forward slash, then the planet name/, then the moon or satellite name, etc. For example:

- 51 Peg/b
- Sol/Earth
- Sol/Earth/Moon
- Sol/Earth/ISS
- Sol/Jupiter/Europa

5.1.5 Tour Guide

The tour guide is a list of a few of the more interesting objects you can visit in Celestia. Select the **Tour guide** option in the Navigation menu to bring up the guide window, choose a destination from the list, click the **Goto** button, and you're off. We urge you to visit some of these stops on the tour.

5.1.6 Sync Orbit

This feature lets you hover directly over the same position in space above any object selected. For example, if you are above Earth with Africa below you, selecting **Sync Orbit** will tell Celestia to keep you positioned above Africa all the time. As the Earth turns below, so will you. Many of our satellites (navigation, weather, spy, GPS, TV and radio) are in synchronous orbit around Earth. The keyboard shortcut for Sync Orbit is "**Y**". To cancel it, hit the **Esc** key.

5.1.7 Track Selection

This command tells Celestia to release your hold on an object, but still track it in space. For example, if you are centered on Earth, release your hold on it with the **Esc** key and then hit the **Track Selection** command, Earth will begin to recede from you at the speed it actually travels in space (about 47,100 mph, or 78,500 km/hr), but your view will swing to track it. To see that happen, speed up time. A particular challenge is to try chasing one of our interplanetary spacecraft using the Track Selection Command. The keyboard shortcut for **Track Selection** is "**T**". To cancel it, hit the **Esc** key on the keyboard.

5.1.8 Chase Selection

Although not in the pull-down Navigation Menu, this command is available by pressing the quotation " key on the keyboard [**shift + "**]. It instructs Celestia to chase an object in space. It is similar to the Follow command but locks you above the object at the same position. Try comparing the two commands.

5.1.9 Eclipse Finder

Celestia will calculate and provide you dates of all partial and total solar or lunar eclipses for all planets in its database. Simply select the planet and the date and click "**Compute**". When a list comes up, pick one, click the "**set date and goto the planet**" button and enjoy the show. All eclipse shadows in space are actually composed of an inner shadow (the Umbra) and outer shadow (the Penumbra). Celestia draws both. See figure 11 for an example of a total solar eclipse. The Umbra is the darker inner shadow.

NOTE

To see eclipses, you must have "Eclipse Shadows" selected in the Options menu

5.1.10 Mark

A new feature in Celestia1.3.0 and later is **Mark**. Markers are small symbols used to keep track of the location of an object. To set a marker on an object, turn on the **Mark** feature by pressing **Ctrl + K**, then right click on the object and select **Mark** from the popup menu. If the object is already marked, an **unmark** item will appear on the menu instead. Markers are especially useful for keeping track of the positions of very small or faint objects that would not otherwise be visible. For example, spacecraft are tiny compared to planets and in the vastness of space, can easily be lost. Setting a Mark on a spacecraft will enable you to track or see it from great distances. To turn the Mark off, either unmark it, or turn off the feature by toggling Ctrl+K again.

5.2 Select Objects by Keystroke:

There is yet another way to select planets. The nine (9) planets in our solar system have been given numbers from **1** for Mercury to **9** for Pluto. To go to one of them, you can simply press the number at the top of the keyboard (not on the numeric keypad to the left) and hit the "**G**" key. For example, pressing "**3**" and "**G**" will take you to the 3rd planet, Earth. If you are in another (fictional) solar system, number keys will also work.

Chapter 6

6 Other functions

6.1 Flying your Spaceship

What good is a space simulation program if you cannot fly around in it? The designers of Celestia have created a seamless and easy way to fly through the Celestia universe. You are in command of your own spaceship. The video screen in front of you is its window. You can use this ship to fly through the solar system, chase planets, drift above or move past moons, try your hand at tracking and rendezvousing with spacecraft or visit another star. Start some beautiful music playing and your journey can become ever more stirring. Right now, your ship is stopped. Let's get it moving. Return to our solar system, select the **Earth** from the Solar System Browser and press "**Goto**". Make sure your information text option is selected so that test messages appear on your screen in the four corners (toggle the "**V**" key). Using the **End** or **Home** keys or **mouse wheel**, move in or out so that you are about 10,000 km above the surface (look in upper left corner for distance reading).

Now, press and hold down the letter "**A**" on the keyboard for a second or two. This is the **throttle** for your spaceship. You will begin moving forward. Your speed is shown in the lower left of the screen. You will start slowly (in meters/sec). Hold down the "**A**" key to gain speed. Celestia increases your speed exponentially. Accelerate to about "20 km/s" (20 kilometers/sec or 43,000 mph), which is a bit faster than our fastest spacecraft (the Voyagers) have ever flown. Earth will begin getting bigger as you fly toward it on a collision course. To change course, simply tap the arrow or other movement keys and your view (and forward direction) will change to a new orientation. You will miss and fly by Earth.

To **slow down**, press or hold down the "**Z**" key. Your speed will drop (the **Brake**).

To **reverse course** instantly, simply press the "**Q**" key. Now, you will begin flying away from Earth at the speed you selected. Press "**Q**" again and you move forward again. This command is useful if you overshoot a target. Just reverse course and the target will again come into view in front of you.

To emergency **stop**, press the "**S**" key.

Celestia gives you the opportunity to accelerate to a "hyperspeed" billions of times faster than light (C). Just keep holding down the "A" key to speed up. Much like distance adjustment, the A and Z keys are exponential speed controls. As you gain speed, the stars will wiz by you like a scene from StarTrek. You will quickly be taken out of the Milky Way entirely and into the blackness of the space between the galaxies. You can journey to the very edges of Celestia's universe. There is not much to look at out there. Swing the sky around and you may be able to notice some dim galaxies. Generally, to see the Milky Way from outside of its confines, start your spaceship moving anywhere inside of our solar system, press the "Q" key to reverse course, accelerate to a warp speed of about 10 ly/s (light years/sec) and watch. The stars and then the Milky Way itself will begin to recede from you. Hit the "S" stop key and enjoy the view. Rotate the sky with the right mouse button. To return, press the H and G keys, or hit the "Q" key to reverse course again, start your ship moving forward and you will fly back to your point of origin. Please remember that Celestia only tracks a relative few of the over 200 billion stars in the Milky Way. Thus, your view of stars is actually very limited. Galaxies contain FAR more stars than this program can track.

6.2 Telling where you are

Celestia will provide you a general idea of where you are in space by simply looking at the information view display. The top left corner identifies which object you've selected and how far away from it you are. By changing objects, you can determine a rough estimate of where you are in space. However, if you have taken up position above a star, planet, moon, etc., Celestia will tell you not only how far you are from it, but what latitude and longitude above it

you are positioned. To see that, pull down the **Navigation** menu and select "**Goto Object**". As long as you have an object selected, you will see your distance, Latitude and Longitude from it.

6.3 Adjusting Time

Many events in space take place at certain times. Planets experience seasons, spacecraft are launched and eventually fall back to Earth, moons eclipse the sun on specific dates, comets pass by, space probes fly by target planets and take their measurements, etc. Celestia gives you the opportunity to set a specific date and time, or to speed up or slow down the passage of time. Your time will appear in the upper right corner of the screen. For example, to see a planet turning under you, simply speed up the clock and it will rotate faster. The keyboard commands for selecting date and time are accessed from the **Time** Menu at the top of the screen, or by the following keystrokes:

- Spacebar — stop or pause time
- L — Time 10x faster (repeat for faster time)
- K — Time 10x slower (repeat for slower time)
- J — Reverse time (it flows backward)
- \ — Return to Real Time
- Shift + ! — Set time to the current clock time

NOTE

Celestia has programmed some of its spacecraft to appear in space and then actually fall back to Earth (disappear) on the day that they really did so. For example, the Russian space station Mir was launched on 02/20/1986 and fell back to earth on 03/21/2001. To see Mir in orbit above the Earth, you will have to reset the date to some period between those two dates.

6.3.1 Light Travel Delay

Celestia 1.3.0 and later also has a new feature called **Light Travel Time Delay**. Light travels at a speed of 300,000 kilometers per second. The sunlight we see on Earth actually left the sun eight minutes before it reached your eyes. Pressing the "**?**" key [**Shift + ?**] will display the one-way light travel time from the camera position to the currently selected object. The minus " **–** " [**-**] key controls light time delay adjustment; if it's turned on, a message will appear and the displayed time will have the light time delay subtracted. Most lists of solar system phenonena give times that include light time delay. When observing these events with Celestia, automatic light time adjustment is extremely helpful. For example, if a transit of a moon of Saturn is set to occur at 14:00 hours and you are one light hour away from Saturn, pressing the **–** key will reset the time to 13:00 hours, so that you can witness the event in real time.

6.4 Saving Images and Locations

Celestia gives you the opportunity to capture and save an image on your screen as an individual graphic file (as figures seen in this User's Guide). You can also save a series of images as a movie file and play it back later in your computer. Thirdly, if you like a particular location and would like to return to that exact spot and time quickly, Celestia can save your location internally within the program. You can also save your location as a "hyperlink" and paste it into another software program.

To save a **graphic** file (in .jpg or .png format), simply set up the screen as you want it, pull down the **File** Menu and select **Capture Image**. A menu will appear. Choose the folder you wish to put the file into, type a name for it; decide if it is to be saved as a jpg or png file and click **SAVE**. JPG files are common graphic files that are most useful for viewing in a computer

running typical application software such as word processing or slideshows. PNG files are graphic files that are designed for viewing best on the Internet. If you wish to add your image to a webpage or E-mail it to a friend, save it in png format. Otherwise, use jpg format. To view a jpg or png image, click on it and your default graphic image viewer or browser in your computer will open it. You do not need Celestia running. You can paste and view images anywhere you wish.

To save a **movie** file (in .avi format), set up the screen as you want it, set the time moving forward at the speed you desire, pull down the **File** Menu and select **Capture MovieImage**. Choose the folder you wish to put the movie into, and type a file name for the movie. Then choose the size of the video. Generally, **320x240** or **640x480** are the preferred sizes. Next, choose a frame rate. We recommend 24 frames per second. 24 fps is used in film, 25 fps is used for PAL (Europe) video and 29.97 for NTSC (US/Canada) video. 15 fps is often adequate for displaying video on the web.

Click **SAVE**.

Another menu will appear, asking if you wish to save the file compressed or uncompressed. A compressed file requires less disk space than an uncompressed file, but may not look as good as an uncompressed file, and the process of compressing video can dramatically slow down Celestia. Celestia is set to save movie files uncompressed. To save a compressed file, choose the format you desire. You may wish to try different choices and determine which one works best for your computer. The free DivX video codec available from www.divx.com provides excellent compression and quality, and is quite fast. If you want to create many video files with Celestia and are concerned with file size, we recommend you download and install DivX, and save your videos as a compressed DivX file.

Click **OK**.

A red box will now appear on your screen. You can move what is in that box by clicking on the screen with your standard movement keys. When ready to start taping your movie, press the **F11** key on the keyboard. Recording will begin. To stop, press the **F12** key. The recording will stop and the red box will disappear. Your movie is saved. You can execute any command you wish while taping a movie. For example, you can accelerate in your spaceship, move the screen with your mouse, zoom in or out, etc. In this manner, you can set up your own movie "demo" of a celestial event and show it to someone else.

To save a particular **location**, simply set up your position and time as you would like it, pull down the **Locations** Menu and choose **Add to Locations**. Type a name and click **OK**. To return to that location at any time, simply click on the Location Menu again. All of the locations you've saved will be listed. Select one and you will go there instantly.

6.5 Cel://url's

Celestia 1.3.0 and later also makes it possible to share locations via a web page or other document, through cel:// URLs. A cel:// URL is a string of text (a hyperlink) that contains your current camera location, orientation, time, and field of view. With it, you can take a snapshot of your precise position, time and view in space, and save it as a hyperlink (a URL). If you then paste that address into a document that recognizes hyperlinks (word processors, web browsers, notepads, etc.), a user clicking on that link will automatically launch their own copy of Celestia and be taken to the exact position in space that you were viewing. It can be used anywhere you would use an http hyperlink. Obviously, the user must have Celestia on their computer for this feature to work. For example, below is a cel://url that captures the position of Phobos, one of Mar's moons, orbiting high above the planet in January 2000. Click on this link now, and you will be taken to that exact position, time and place in Celestia.

Click here for a ticket to Mars

Figure 29 – image captured via cel://URL

To save your position in Celestia as a hyperlink, press [**Ctrl and INS**] together. This will save the location to your computer clipboard. To paste that link into a web browser, simply position your cursor in the address field at the top of the browser and press [**Ctrl and V**]. To paste the link into a text document or a PowerPoint presentation, you may be able to simply paste the link by positioning the cursor on the page and pressing [**Ctrl + V**]. If successful, the link will change color when you hit the Enter key and clicking on it will launch Celestia. If that doesn't work, you may have to paste the link by "inserting a hyperlink". See your application software for directions on how to do that.

Cel:// URL addresses may also be dragged onto an open Celestia window to get the same effect.

Cel://url's' are ideal for showing others a particular discovery you've made in the world of Celestia. For example, perhaps you've positioned yourself to witness the passing of a Near-Earth asteroid as it whizzes past Earth, or have assumed a position off the North Pole of the sun with orbits selected and the entire solar system orbiting below you. Saving that location to a cel://url and pasting it on the web or in an e-mail for others to activate is an ideal way to share your Celestia experience. You'll find cel:// URLs used frequently in the Celestia forum.

NOTE

Be careful using cel:// URLs with add-ons. If you save the camera position near a body that is part of an add-on you installed, someone who later clicks on the URL will likely see a very dull view of empty space unless they also have the same add-on installed

6.6 Multiview

Celestia can also show you views from different camera positions simultaneously. This can be very helpful for visualizing phenomena like eclipses, where you want to watch a view from the Sun, the eclipsed planet or moon, and the occluding body all at the same time. Planetary

encounters by spacecraft are another category of events where multiple views can be illuminating.

When multiple views are enabled, one of the views is always designated the active view and is marked as such by a thin highlighting frame around it. All Movement commands will affect just the active view. Other commands such as setting the time or date or Render menu commands are global, affecting all views. New views are created through the keyboard commands of [**Ctrl+U**] and [**Ctrl+R**]. **Ctrl+U** splits the active view horizontally, leaving two identical views side by side. Pressing **Ctrl+R** performs a vertical split that gives two vertically stacked views. A newly created view can be further split by pressing **Ctrl+U** or **Ctrl+R** again; you can continue this until the views become impractically small.

The **TAB** key is used to cycle the active view. A view that is no longer required may be removed by pressing the Delete [**DEL**] key. **DEL** will delete the currently active view.

Views can also be created and deleted with the **View** menu. The **View** menu also contains two additional options which are not available via a keyboard command. The first option changes the visibility of the view frames. **Drawing frames** can be useful to delimit the different views, but it can also clutter the screen; it's entirely an issue of personal taste. The other setting on the view menu is **time synchronization**. Ordinarily, time is synchronized between all views, but if you deselect time synchronization, you can set the current time in each view independently by clicking within the view frame. Turning time synchronization back on resets the time in all views to the time of the active view. Note that the time rate cannot be set per-view; the time rate commands and pause always affect every view.

Figure 30: Four Celestia Multiviews seen at once

6.7 User's Guide Part 2 and 3

This concludes Part 1 of the User's Guide to operating Celestia. In **Part 2**, you will learn what image files are, how Celestia loads and uses them, and how data files of various kinds are used to instruct Celestia in what to do and where to do it. Part 2 will teach you how to modify those data files and locate and download scores of other add-on files designed by Celestia users. These files include exotic spacecraft, fictional solar systems, rotating black holes and much

more. Obtaining and using some of them will significantly boost your viewing pleasure in the Celestia universe.

Part 3 of the User's Guide will teach you how to create scripts, which are a series of lists that Celestia follows one at a time to take a space journey. For example, you can design a script to open Celestia not at Io but orbiting a Red Giant star thousands of light years away. Then as you watch, your spacecraft will accelerate and fly back to Earth at warp speed. You can also insert text messages for the viewer to read. The Run Demo referenced earlier in this Guide is just such a script journey.

6.8 Credits

This User's Guide was written by Frank Gregorio, a high school teacher in Manassas, VA, and edited by Chris Laurel, founding developer of Celestia, with editing assistance by several members of the forum.

The source code for Celestia version 1.3.0 is a joint effort of:

- Chris Laurel
- Clint Weisbrod
- Fridger Schrempp
- Christophe Teyssier
- Deon Ramsey

and many other valued members of the Celestia forum group

Chapeter XX

7 Celestia command reference

NOTE

Print these two pages only as a convenient keystroke summary

This command summary can also be accessed within Celestia. Simply pull down the **Help** menu and click on "**Controls**".

7.1 Mouse Functions:

Left – click on object	select object
Right drag	orbit the selected object in any direction
Left drag	orient scene in any direction
Rotate Mouse Wheel	adjust distance to selection
Right + Left drag	adjust distance to selection
Ctrl + Left drag	adjust distance to selection
Shift + Left drag	change field of view (FOV) (e.g. => telescopic view)
Wheel (middle button) click	toggle field of view between 45 degrees and the previous field (e.g. telescopic view)
Left double click	center selection
Right - click	bring up context/select menu

7.2 Keyboard functions

7.2.1 Render Functions

P	Toggle (turns on or off) planet labels
M	Toggle moon labels
E	Toggle galaxy labels
B	Toggle star labels
W	Toggle asteroid and comet labels
N	Toggle spacecraft labels
=	Toggle constellation labels
V	Toggle info text
U	Toggle galaxy rendering

O	Toggle planet orbits
I	Toggle clouds
;	Toggle Celestial grid (Earth-based equatorial coordinate sphere)
/	Toggle constellation diagrams
Ctrl+A	Toggle atmospheres
Ctrl+B	Toggle constellation boundaries
Ctrl+E	Toggle eclipse shadows
Ctrl+L	Toggle night side lights
Ctrl+S	Toggle stars as points
Ctrl+P	Toggle pixel shading (if supported)
Ctrl+T	Toggle comet tails
Ctrl+V	Toggle vertex shading options on or off
Ctrl+W	Toggle wireframe mode (displays objects as wireframe models)
Ctrl+X	Toggle antialias lines
Ctrl+Y	Toggle autoMag = auto adaptation of star visibility to field of view
[(If autoMag OFF)	Decrease magnitude (fewer stars visible)
[(If autoMag ON)	Decrease magnitude at 45 deg field of view
] (If autoMag OFF)	Increase magnitude (more stars visible)
] (If autoMag ON)	Increase magnitude at 45 deg field of view
{	Decrease ambient illumination
}	Increase ambient illumination
Alt+Enter	Toggle full screen display mode on or off

7.2.2 Navigation Functions:

H	Select the sun (Home)
C	Center on selected object
G	Goto selected object
F	Follow selected object

ENTER	Select a star or planet by typing its name
Y	Orbit the selected object at a rate synchronized to its rotation.
.	Increase Field Of View (FOV)
,	Decrease Field of View (FOV)
:	Lock on selected object. Point at 2nd object and press again to pair the two.
"	Chase selected object (orientation is based on selection's velocity)
T	Track selected object (keep selected object centered in view)
HOME	Move closer to object
END	Move farther from object
Up arrow	Your view pitches downward (also see # 8 key on numerical keypad)
Down arrow	Your view pitches upward (also see # 2 key on numerical keypad)
Left arrow	Your view rolls counter-clockwise (also see # 7 key on numerical keypad)
Right arrow	Your view rolls clockwise (also see # 9 on numerical keypad)
# 4 number key	on numerical keypad - Your view yaws (swings) to the left
# 6 number key	on numerical keypad - Your view yaws to the right
# 5 number key	on numerical keypad – instantly stops yaw, pitch or roll
*	Look back
1-9	Select planets around nearby sun
Esc	Cancel hold on object, cancel command or script action
Backspace	Cancel current selection

7.2.3 Time Functions:

Spacebar	Stop or pause time
L	Time 10x faster (repeat for faster time)
K	Time 10x slower (repeat for slower time)

J	Reverse time (it flows backward)
\	Return to Real Time
Shift + !	Set time to the current clock time
Shift + ?	Display light-travel delay between observer and selected object
-	Subtract light-travel delay from current simulation time

7.2.4 Multiview Function:

Ctrl+R	Split view vertically
Ctrl+U	Split view horizontally
TAB	Cycle active view
DEL	Delete active view
Ctrl+D	Delete all views except active one

7.2.5 Spaceship command:

A	Increase velocity
Z	Decrease velocity
Q	Reverse direction
X	Set movement direction toward center of screen
F1	Stop
F2	Set velocity to 1 km/s
F3	Set velocity to 1,000 km/s
F4	Set velocity to speed of light
F5	Set velocity to 10x the speed of light.
F6	Set velocity to 1 AU/s
F7	Set velocity to 1 ly/s

7.2.6 Other commands:

D	Run demo
F10	Capture image to file
`	Show frames rendered per second
Ctrl+INS	Copy location URL to clipboard (Windows)

7.3 Joystick Functions:

F8	Enable joystick (press again to disable)
X axis	yaw
Y axis	pitch
L trigger	roll left
R trigger	roll right
Button 1	slower
Button 2	faster