Solar System Simulator

Educational Edition

Instruction Manual

Nov 24, 2003

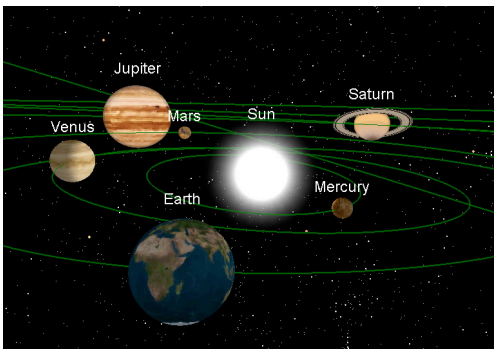
Solar System Simulator Project

Contents

1 Solar System Simulator Educational Edition

[About Solar System Simulator]

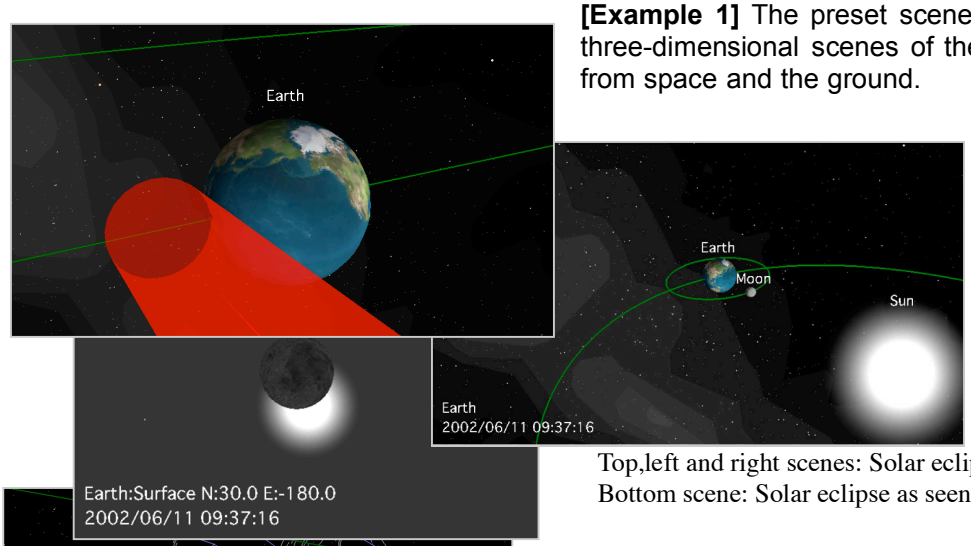
The Solar System Simulator Educational Edition software was designed to simulate astronomical phenomena of the solar system. Based on accurate astronomical data, it reproduces the motions of the solar system (the sun, planets, satellites, comets, asteroids, etc.) three-dimensionally on your PC.



While traveling across time between the past, present, and future, you can move freely to any cosmic location in space or any celestial body in the solar system and experience the various astronomical phenomena that take place in the solar system.

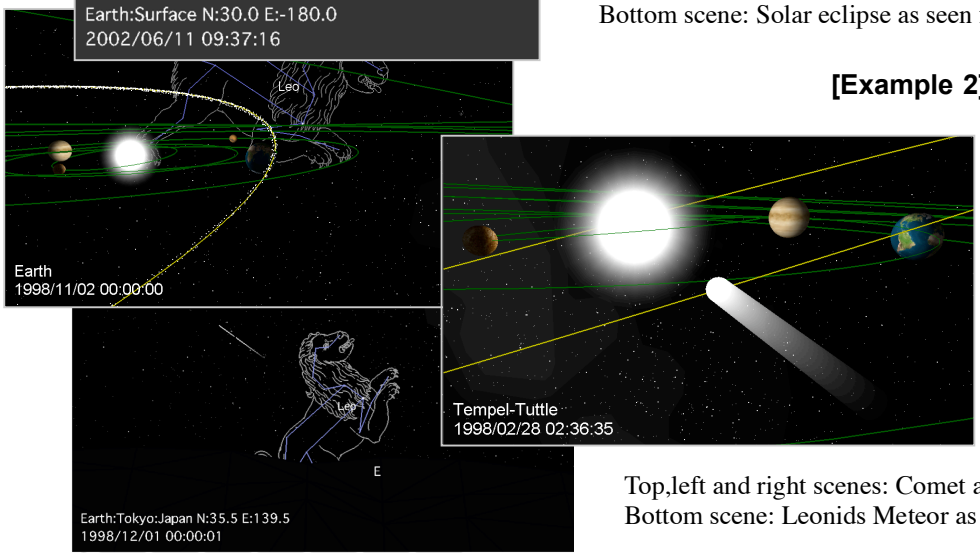
The menu list will allow easy selection of various astronomical phenomena. The operation panel will allow you to perform operations and settings freely so that you can enjoy your own special voyage through the solar system.

[Example 1] The preset scene “Solar Eclipse” shows three-dimensional scenes of the solar eclipse as seen from space and the ground.



Top,left and right scenes: Solar eclipse as seen from space
Bottom scene: Solar eclipse as seen from ground

[Example 2] The preset scene “Shooting Stars” shows three-dimensional scenes of the Tempel-Tuttle comet and Leonids Meteor as seen from space and the ground.



Top,left and right scenes: Comet as seen from space
Bottom scene: Leonids Meteor as seen from ground

[About This Educational Edition]
The Solar System Simulator Educational Edition is specially designed as a teaching aid for classroom teachers.
The Simulator is arranged on the computer screen to allow the widest view possible. The buttons required for simulation are minimized for each screen to maintain a wide screen view, and to maximize display of the desired motions. Simple operations are performed using controls similar to a projector.
If more detailed settings are required, these can be performed on the setting/operation panel to allow full use of the functions of the Solar System Simulator.
By using the preset scenes provided, the software allows easy simulation of Solar System phenomena utilizing three-dimensional Computer Graphics to enhance classroom teaching and individual learning.
The simulations of various motions of the solar system as seen from ground will appear the same as those provided by general planetarium software.
Additionally, the Solar System Simulator also allows you to move to a viewpoint anywhere in space and thus provide three-dimensional pictures of Solar System phenomena.

[System Requirements]
Applicable OS: MAC OS 9.2.x and later / MAC OS X 10.2.x and later
CPU: PowerPC G3 and later (G4 recommended)
VRAM: 16MB and over is recommended (Those mounted with OpenGL graphic board are recommended)
* If the simulator runs too slowly, run “ScreenSizeSetup” program and select “small screen” setting in it.

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- The copyrights for the Solar System Simulator Educational Edition belong to the Solar System Simulator Project.
- Use of this software is restricted to non-commercial and educational purposes.
- The Solar System Simulator Project assumes no responsibility whatsoever for any damages resulting from the use of the Solar System Simulator Educational Edition.
- This software may not be re-distributed, reproduced, nor copied.

Information on Solar System Simulator
Visit the following webpage for more information on the Solar System Simulator such as software updates, etc.
Solar System Simulator Project site **http://www.sssim.com/**

2 Starting and Ending the Solar System Simulator

To start the Solar System Simulator:
Double-click the SssimEdu-E icon.

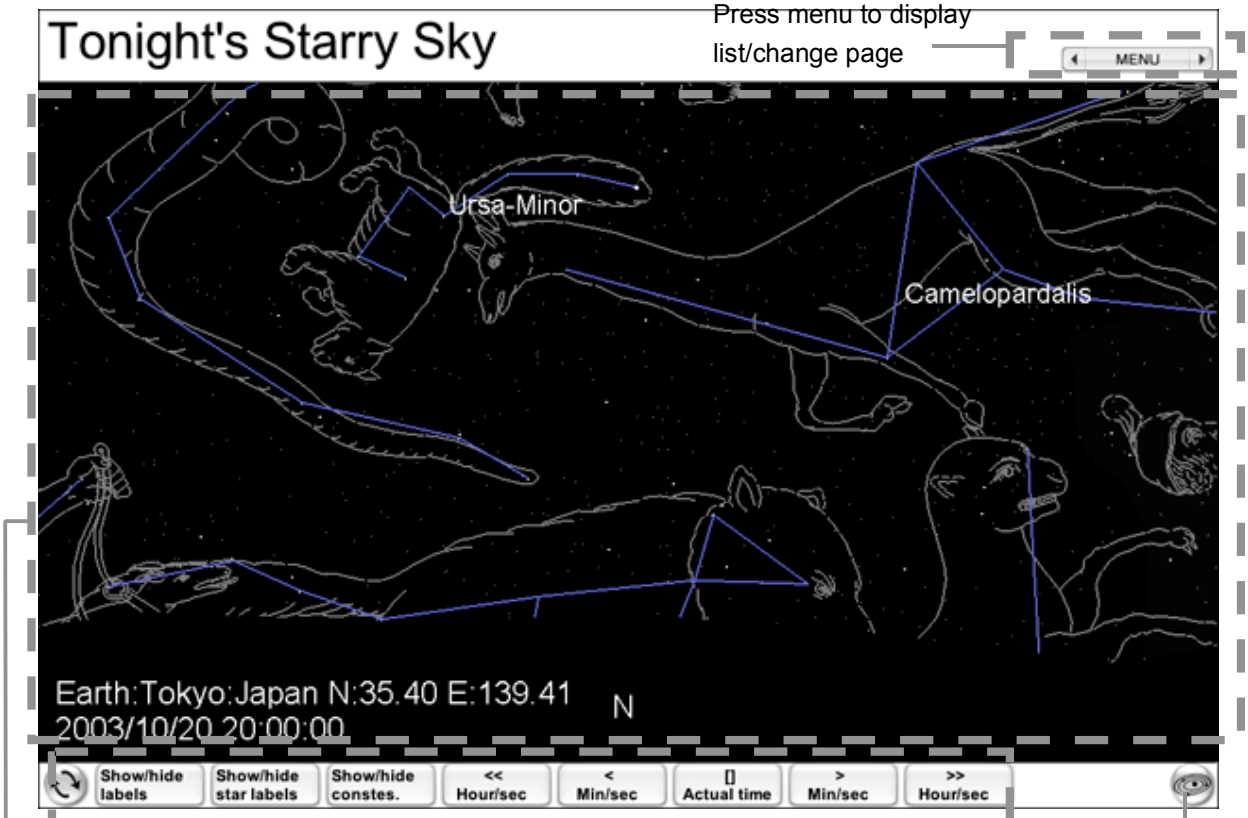
To end the Solar System Simulator:
Press Command + Q or ESC.

* No installation/uninstallation procedures are required in the use of the Solar System Simulator.
* You can change the size of the simulation screen by “ScreenSizeSetup” program in the same folder.

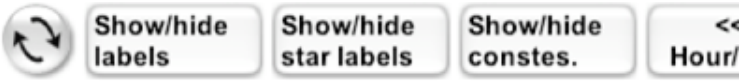
3 Using the Solar System Simulator

3.1 Solar System Simulator Screen

The following shows the main functions of the Solar System Simulator screen.



Simulation Screen : You can move the viewpoint freely using the mouse. The bottom left of the screen shows the current observation point, latitude, longitude, and current time within the simulator.



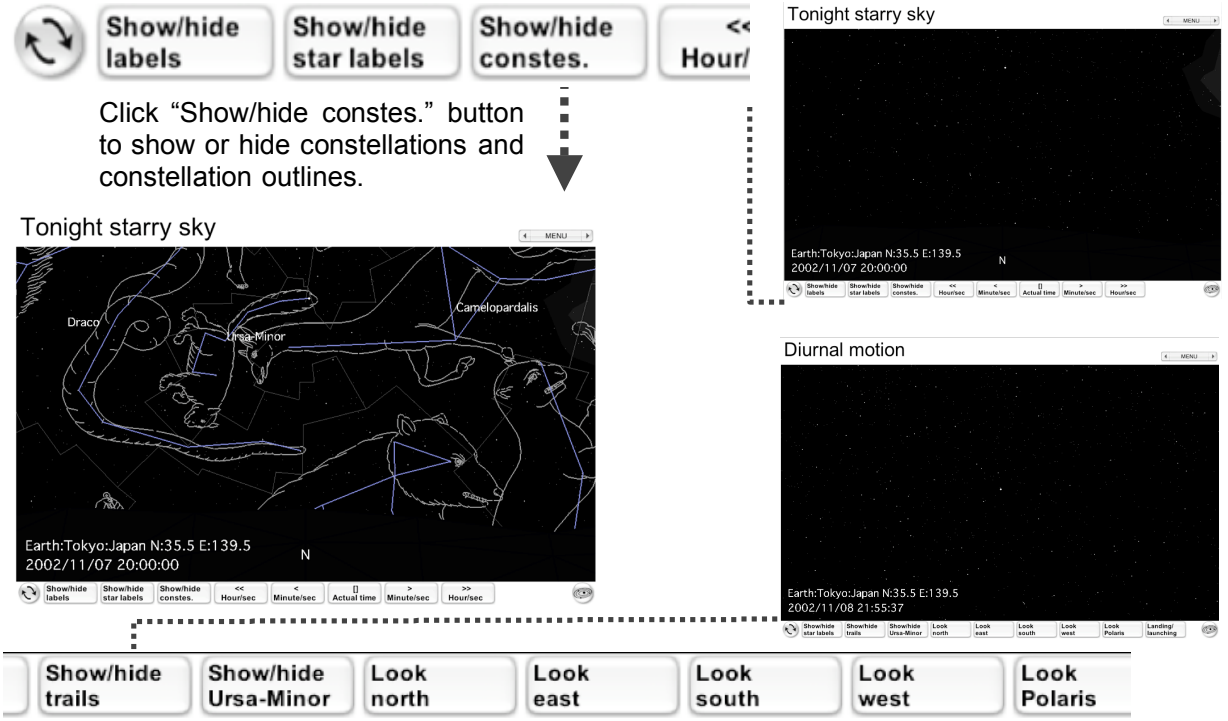
Preset buttons: Shortcut buttons preset with a series of operations

Button for displaying operation panels

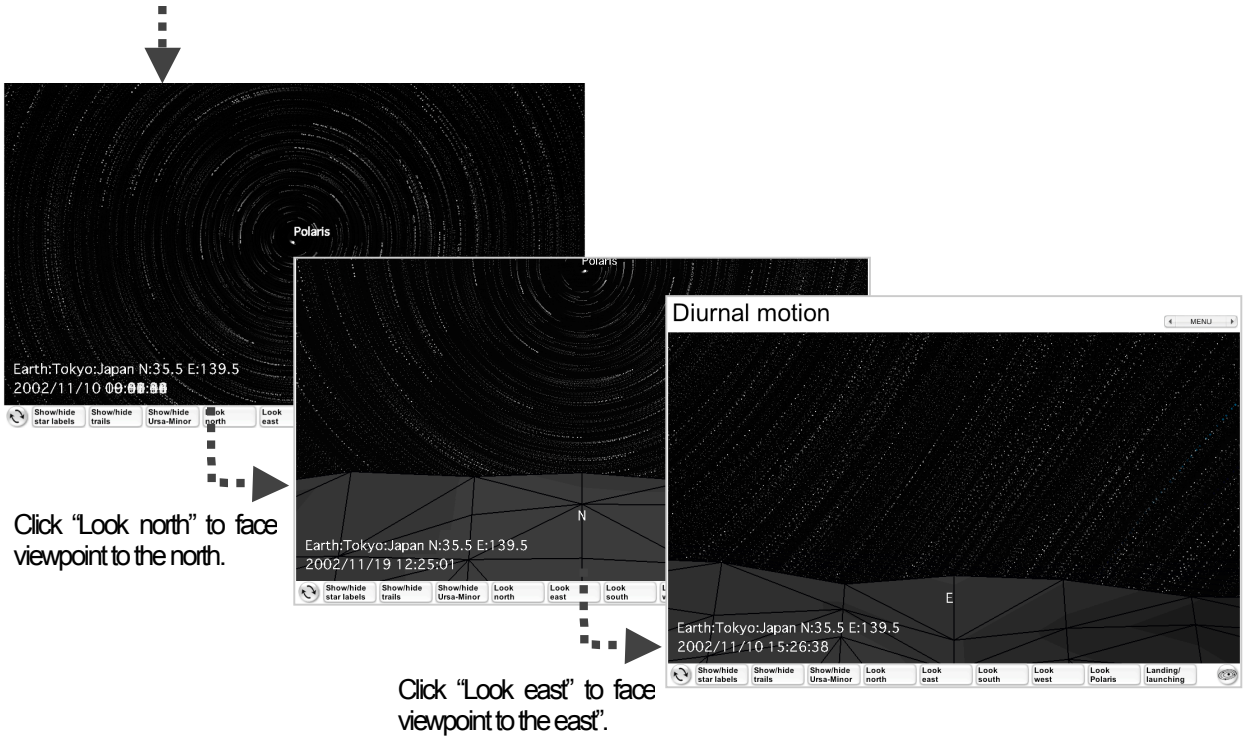
3.2 Main Operations

3.2.1 Preset Buttons

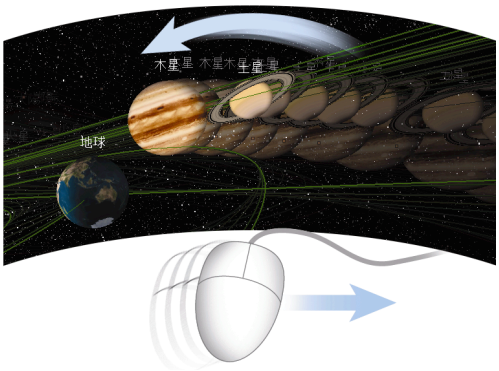
The following are preset buttons for reproducing preset scenes. To display the first screen of a preset scene, click the button at the bottom left. The following shows an example of using the preset button.



Click “Show/hide trails”.

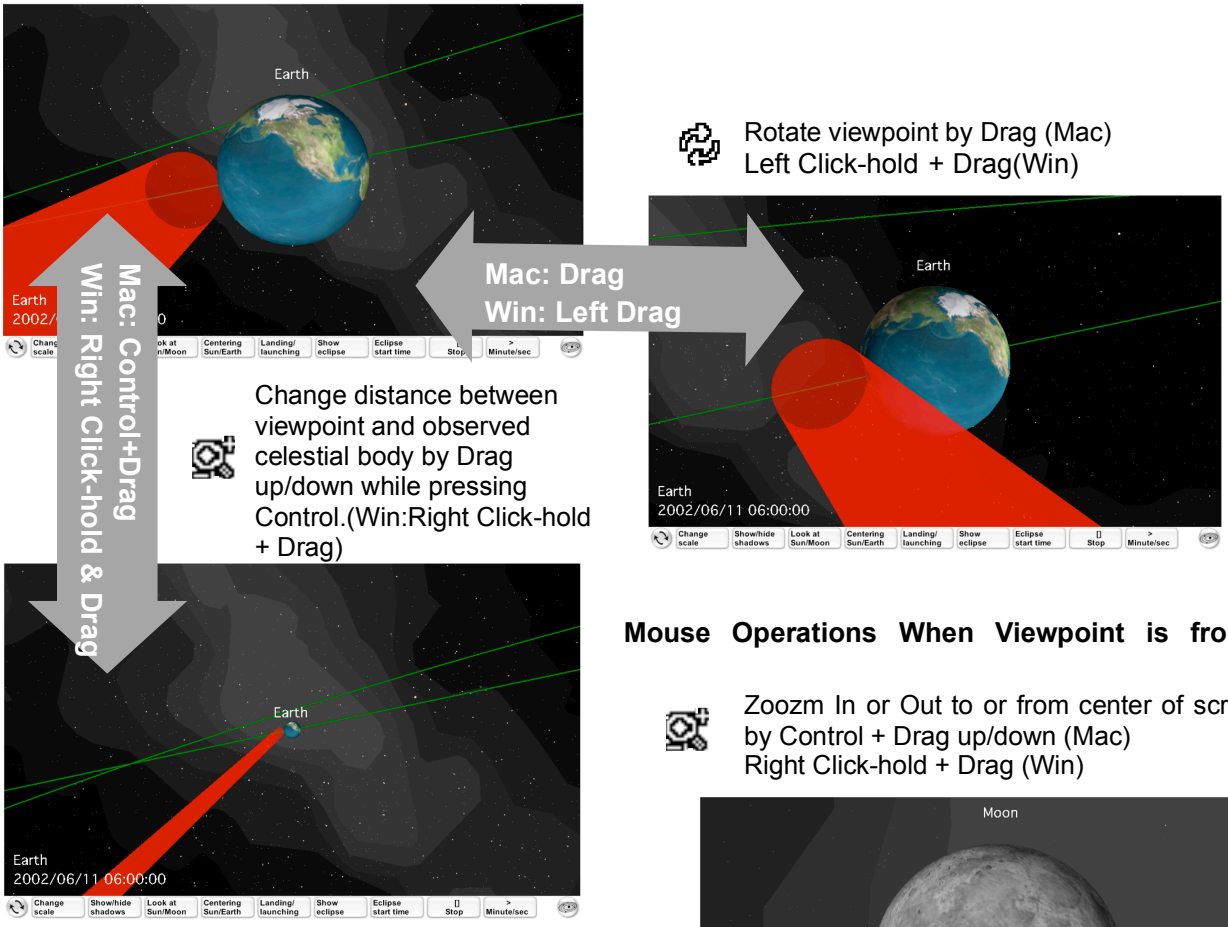


3.2.2 Using the Mouse



You can move the viewpoint using the mouse.
When the viewpoint is in space, a celestial body will always be at the center of the display.
You can rotate the viewpoint by dragging. Also, by dragging while pressing the Control key, you can change the distance between the viewpoint and observed celestial body.

Mouse Operations When Viewpoint is in Space

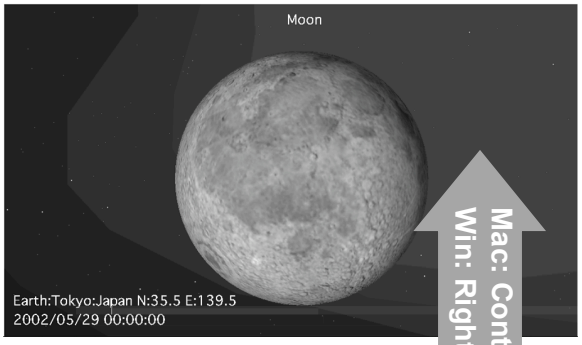


Rotate viewpoint by Drag (Mac)
Left Click-hold + Drag(Win)

Change distance between viewpoint and observed celestial body by Drag up/down while pressing Control.(Win:Right Click-hold + Drag)

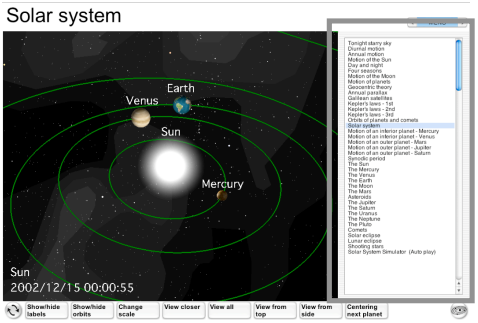
Mouse Operations When Viewpoint is from

Zoozm In or Out to or from center of screen by Control + Drag up/down (Mac)
Right Click-hold + Drag (Win)



Rotate viewpoint by Drag (Mac)
Left Drag (Win)

3.2.3 Menu List

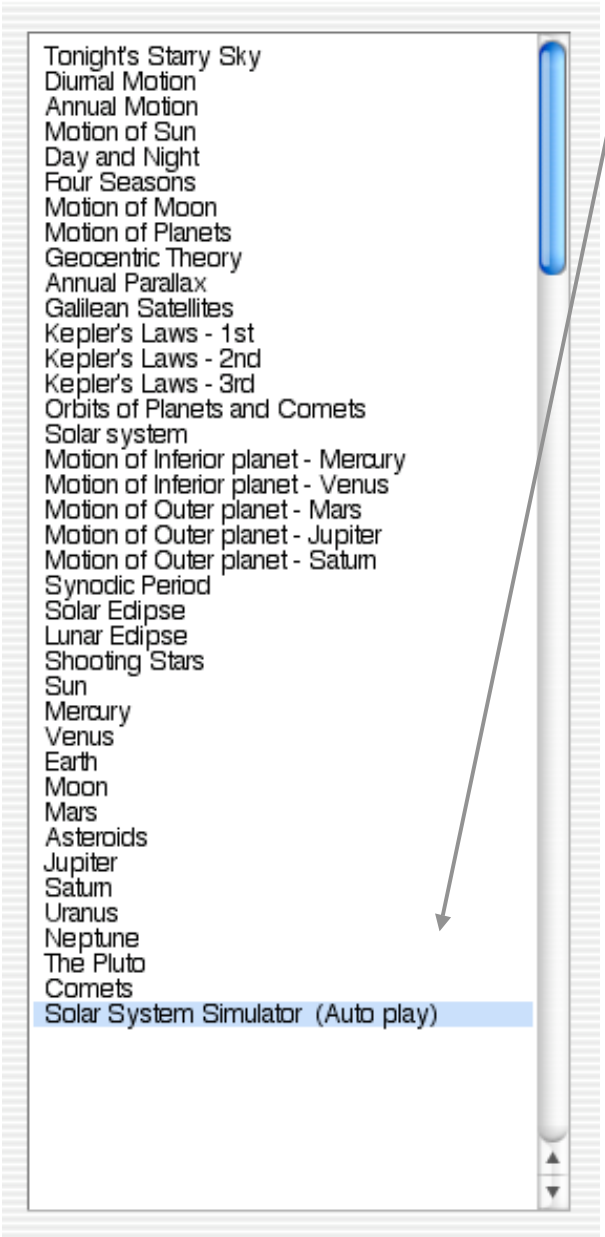


The Menu List allows you to view a variety of preset scenes.

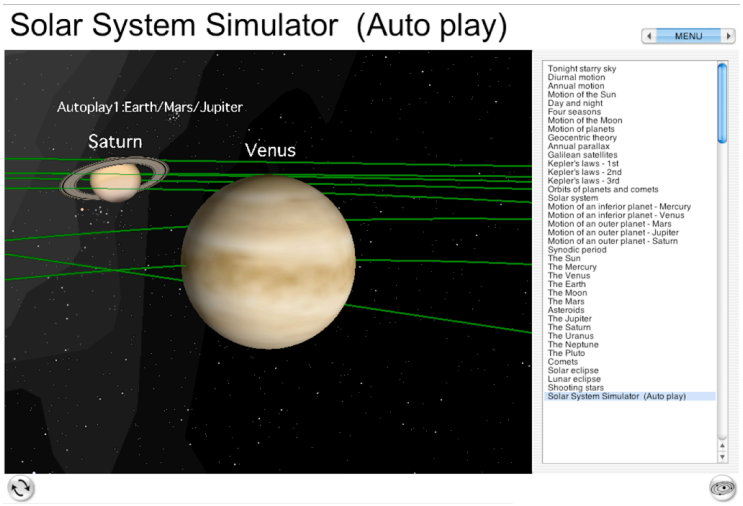
In order to view these scenes click the top right 

button to open the menu list (right side of screen). Select and double-click the desired preset scene to display it.

MENU Panel



Double-click a title to display the corresponding preset scene.



* is the “Solar System Simulator (Auto play) screen. If no operations are carried out for five minutes, the screen switches to this automatically.

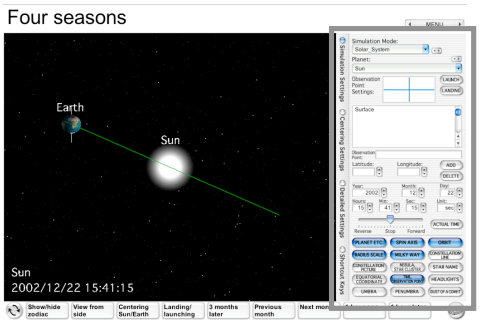
- To close the menu list, click 

again. (You can not close the menu list in the lighter version.)

- You can also switch the preset scene without opening the menu list. Simply click the arrow buttons on either side of the 

button. The preset scenes will switch preset scenes in the order listed on the menu.

3.2.4 Simulation Settings



Click the  button at the bottom right to open the operations panel. This will appear on the right side of the screen. Next click the “Simulation Settings” tab on the left side of this panel to display the “Simulation Settings” panel. The simulation mode allows you to set the celestial body to be observed, select your observation point, select whether to launch or land, set the time, adjust the time speed, and activate various display functions.

Simulation Settings Panel

・**Hide/show buttons**: These buttons hide/show the corresponding items on the simulator screen. “UMBRA” and “PENUMBRA” are effective only in the “Eclipse” and “Comets” modes.

・**Simulation Mode**: The following ten modes are available.
SolarSystem/Eclipse/Mars_System/Jupiter_System/Saturn_System/Uranus_System/Neptune_System/Pluto_System/Asteroids/Comets

・**Planet**: Planet: Select the celestial body you want to observe. If the viewpoint is in space, the celestial body selected becomes the center of the display. If the viewpoint is from the ground, the viewpoint default is from the surface of the celestial body looking South.

・**Observation Point Settings**: A red observation point marker is displayed at the observation point currently selected on the map. You can click and select any location. Selecting a location also updates the latitude and longitude display as well as the simulator screen. The list below shows pre-selected observation points. Click the desired observation point to select it.

・**LAUNCH/LANDING**: Press these buttons to launch from or land at the selected observation point.

・**Observation Point**: Shows the selected observation point. You can change the observation point by manually entering it or add new observation points.

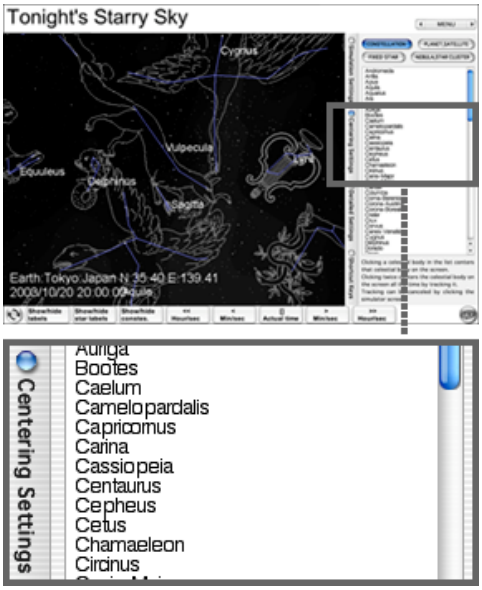
・**Latitude/Longitude**: Click the  buttons to change the values.

・**Year/Month/Day/Hours/Min/Sec**: Click the  buttons to change or enter the values.

・**Unit**: Set the unit to forward and reverse time.

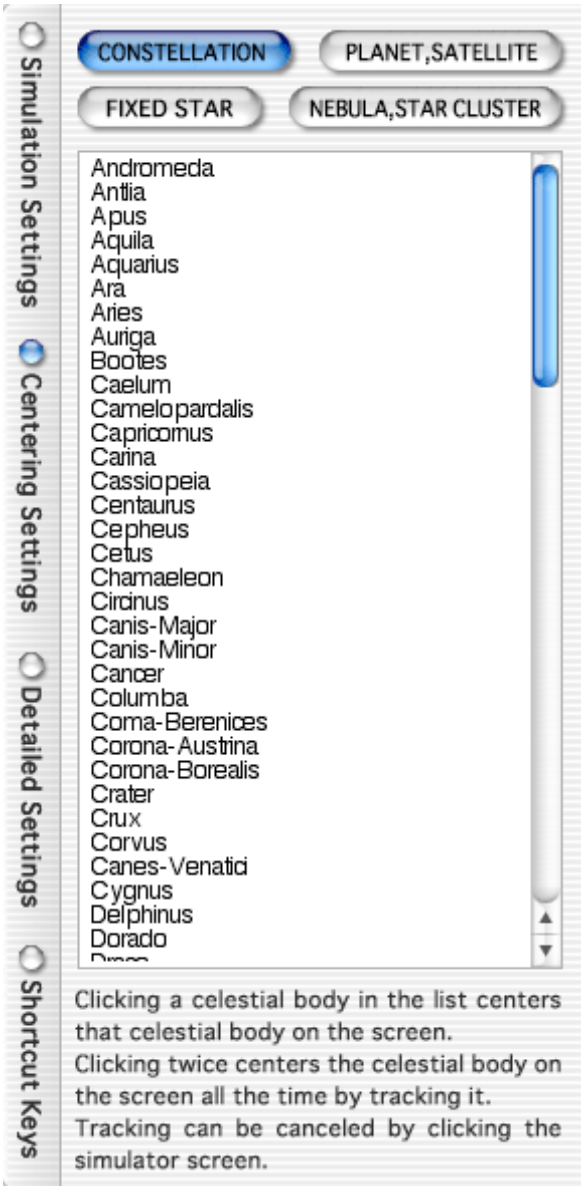
・**Slider function**: Adjust the time speed using the slider. The default is the stop position. Dragging the slider knob to the right advances the simulation forward in the time. Dragging it to the left sends the simulation backwards in the time. Time will advance until the slider is returned to the STOP position.

3.2.5 Centering Settings



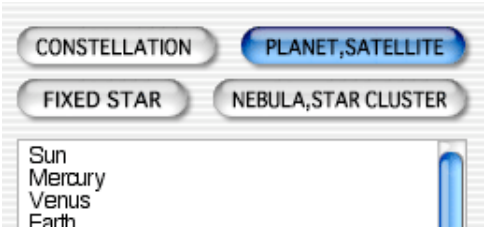
Click the button at the bottom right to open the operations panel. This will appear on the right side of the screen. Next click the “Centering Settings” tab to display the Centering Settings panel. Selecting the name of a celestial body on the list centers that celestial body on the screen. Double clicking it will center the celestial body on the screen all the time by tracking it. Tracking can be canceled by clicking the Simulation screen.

Centering Settings Panel : CONSTELLATION List

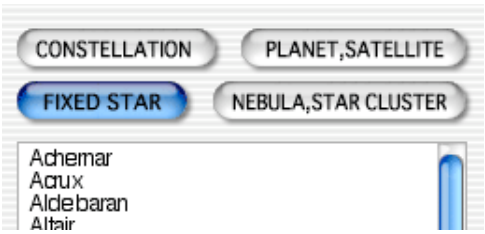


Clicking the “CONSTELLATION”, “PLANET, SATELLITE”, “FIXED STAR”, or “NEBULA, STAR CLUSTER” button above the panel displays the corresponding list.
For the “PLANET, SATELLITE” list, the celestial body displayed depends on the simulation mode selected. For example, if “Mars_System” is selected, Sun, Earth, Mars, Phobos, and Deimos will be listed.

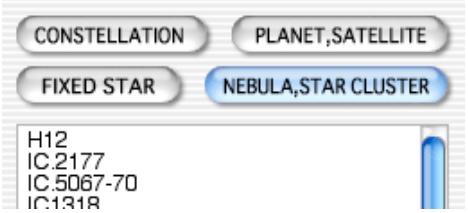
PLANET, SATELLITE List



FIXED STAR List

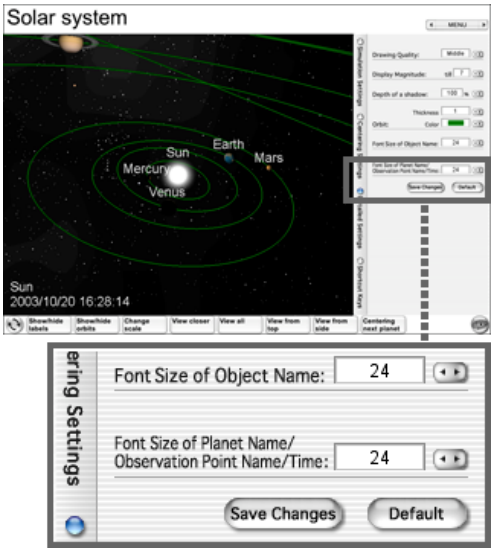


NEBULA, STAR CLUSTER List

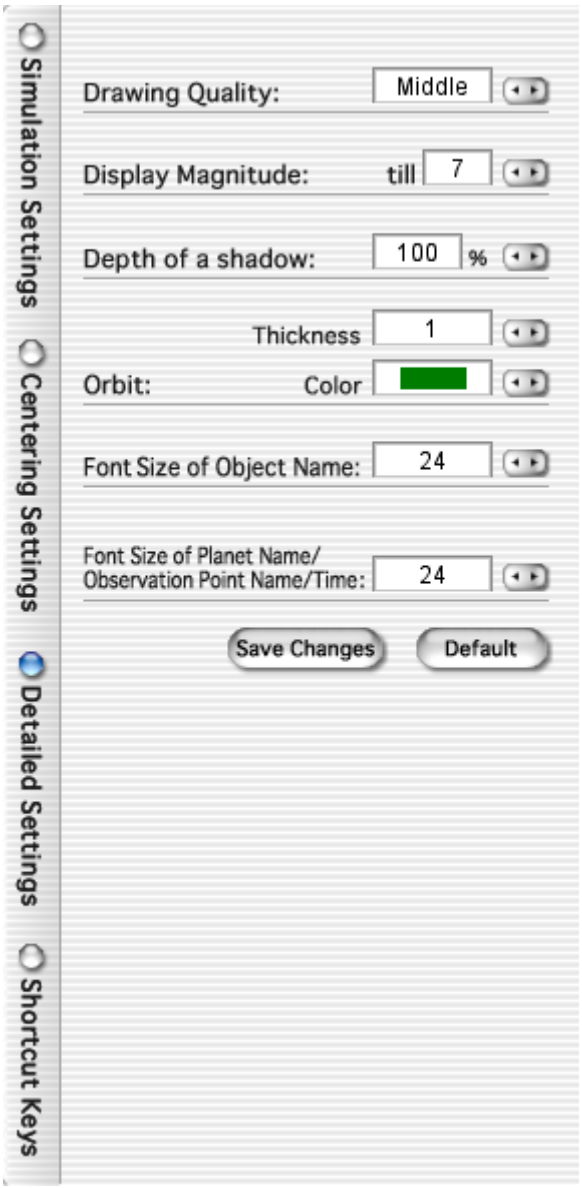


3.2.6 Detailed Settings

Click the button at the bottom right to open the operations panel. This will appear on the right side of the screen. Next click the “Detailed Settings” tab on the left side of the panel to display the Detailed Settings panel.



Detailed Settings Panel



・**Drawing Quality**: Select from three modes Low, Middle or High according to the drawing capacity of your PC.

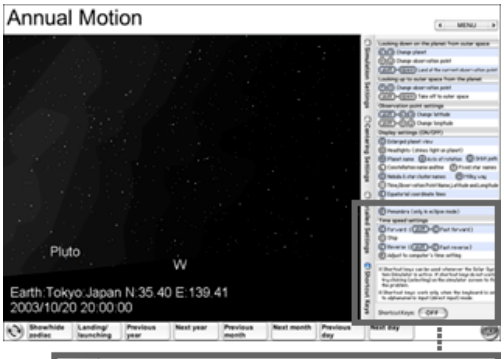
・**Display Magnitude**: The number of fixed stars shown on the Simulation Screen can be set to a display magnitude between 0 and 7.

・**Depth of a shadow**: Adjust the contrast of light and shadow from the sun. This is useful for adjusting simulation of “Solar eclipse” and “Motion of the moon”. Adjust according to the environment of the monitor or projector used.

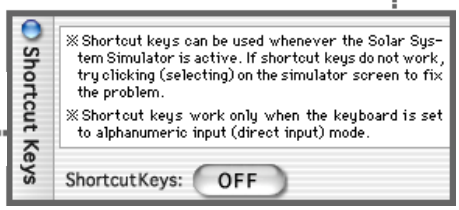
・**Orbit**: Adjust the thickness and color of the orbit.

・**Font Size of Object Name**: Adjust the font size of the names of planets displayed on the Simulation Screen.

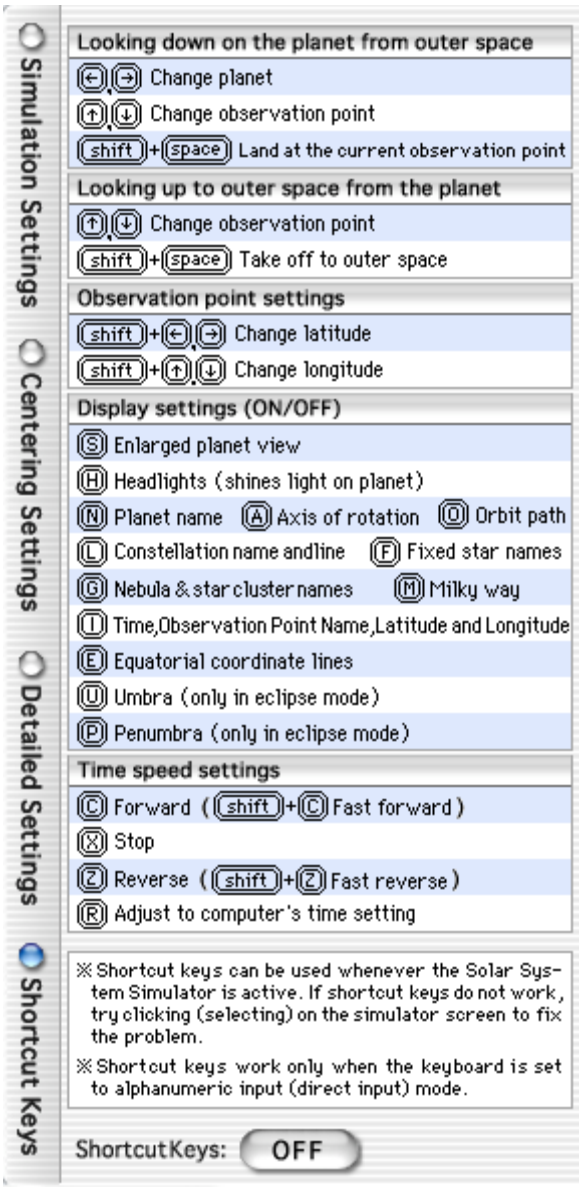
3.2.7 Shortcut Keys



Click the  button at the bottom right to open the operations panel. This will appear on the right side of the screen. Next click the “Shortcut Keys” tab at the bottom left side of the panel to display the Shortcut Keys list.
The default setting for the Shortcut Keys button at the bottom of the panel is “OFF”. Click the button to switch it to “ON”. This will activate all the shortcut keys on the list.



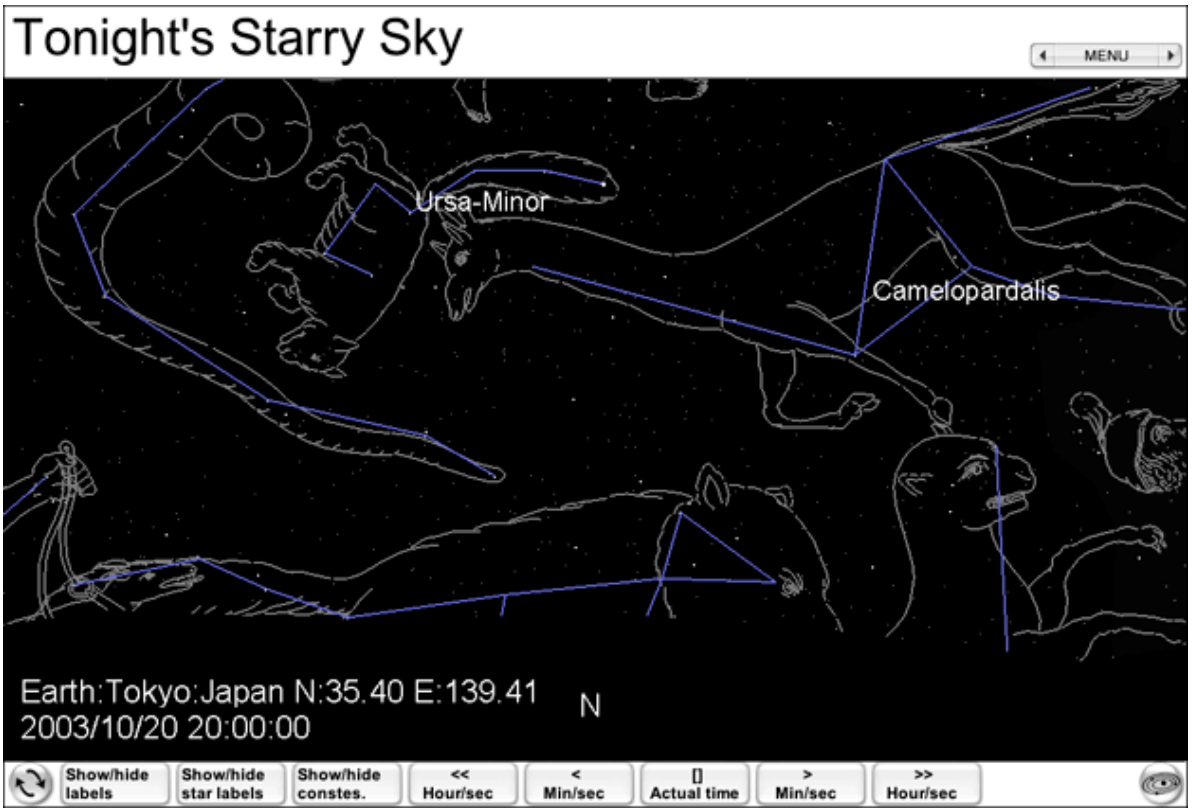
List of Shortcut Keys



4 Preset Scenes

The menu panel consists of 39 preset screens. The following demonstrates how to use the nine main screens. These scenes are listed in bold type on the menu panel.

4.1.1 Tonight's Starry Sky



1) Select Tonight's Starry Sky from the Menu Panel.

2) Button functions:

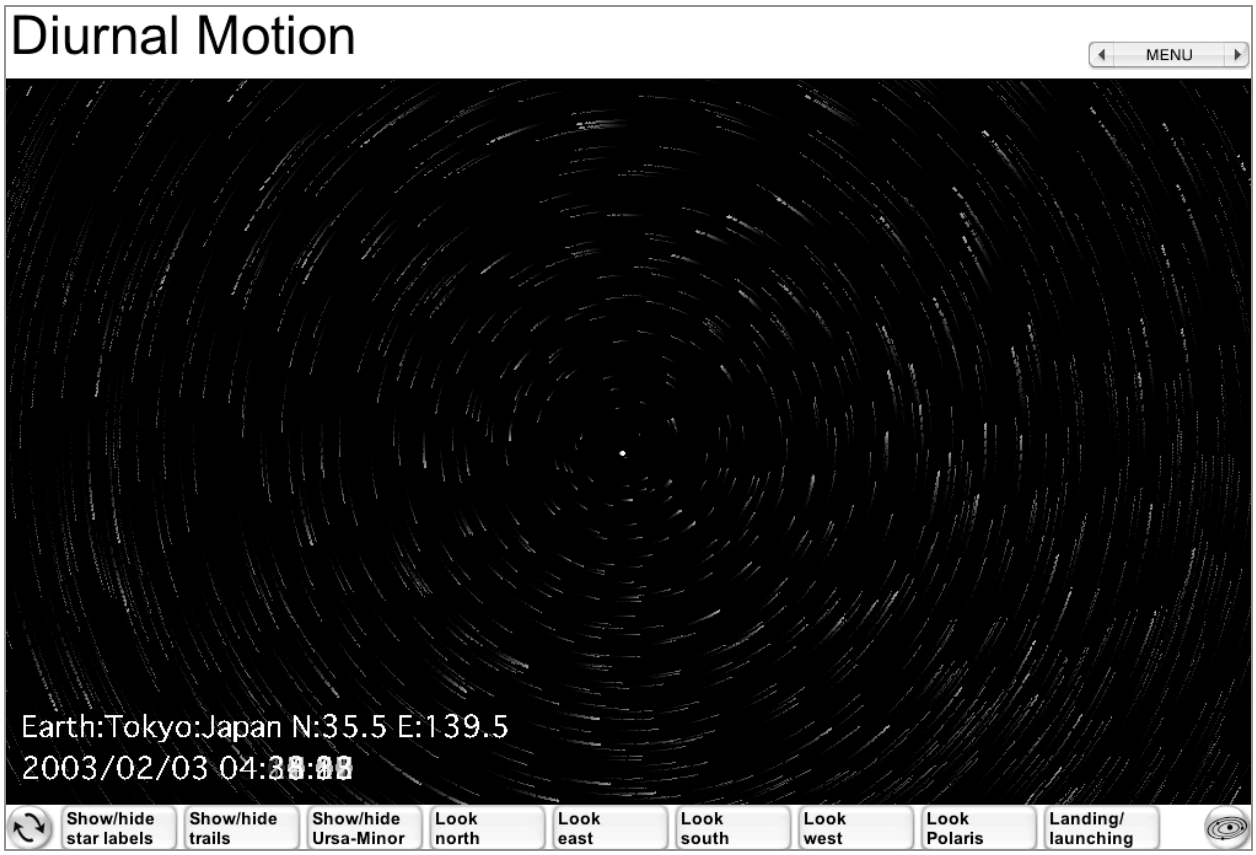
- Show/hide labels :Switches the names of solar system objects on and off.
- Show/hide star labels :Switches star names on and off.
- Show/hide constes :Switches between displaying constellation names, constellation outlines, and/or constellation pictures.
- << Hour sec :Reverses time by one hour per second.
- < Min/sec :Reverses time by one minute per second.
- [] Actual time :Shows the actual time.
- > Min/sec :Forwards time by one minute per second.
- >> Hour/sec :Forwards time by one hour per second.

* In this screen example, the "Show/hide constes" button is turned on.

3) Scene Location

The observation point is initially set to Tokyo. You may change the observation point at the Simulation Settings panel. Select from the list of observation points or click on the desired observation point on the map.

4.1.2 Diurnal Motion



1) Select Diurnal Motion from the Menu Panel. This scene demonstrates the motion of celestial bodies on the same day.

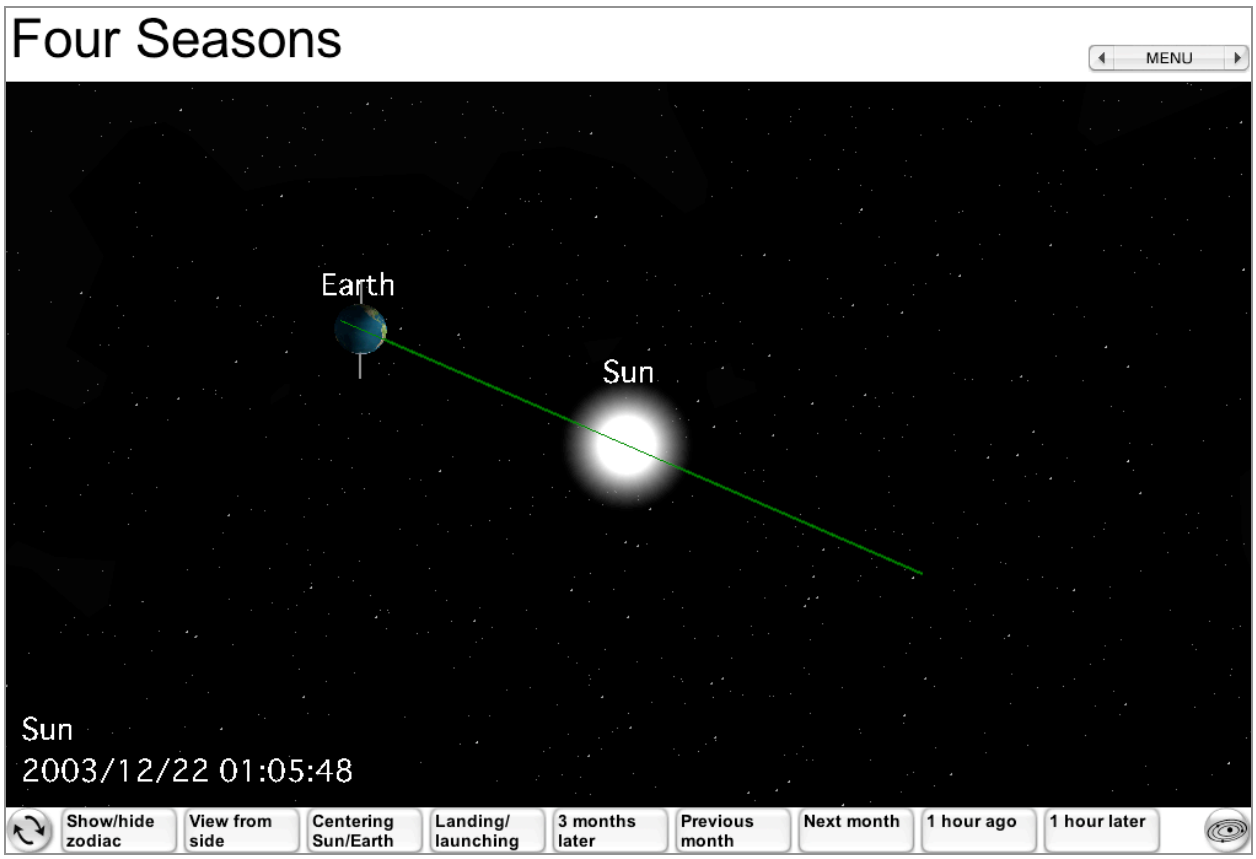
2) Button functions

- Show/hide star labels :Switches star names on and off.
- Show/hide trails :Switches star trails on and off.
- Show/hide Ursa-Minor :Switches the Ursa-Minor constellation on and off.
- Look north :Faces the viewpoint towards the north.
- Look east :Faces the viewpoint towards the east.
- Look south :Faces the viewpoint towards the south.
- Look west: :Faces the viewpoint towards the west.
- Look Polaris :Faces the viewpoint towards Polaris.
- Landing/launching :Switches between landing or launching.

3) Scene Location

The observation point is initially set to Tokyo. You may change the observation point at the Simulation Settings panel. Select from the list of observation points or click on the desired observation point on the map.

4.1.3 Four Seasons

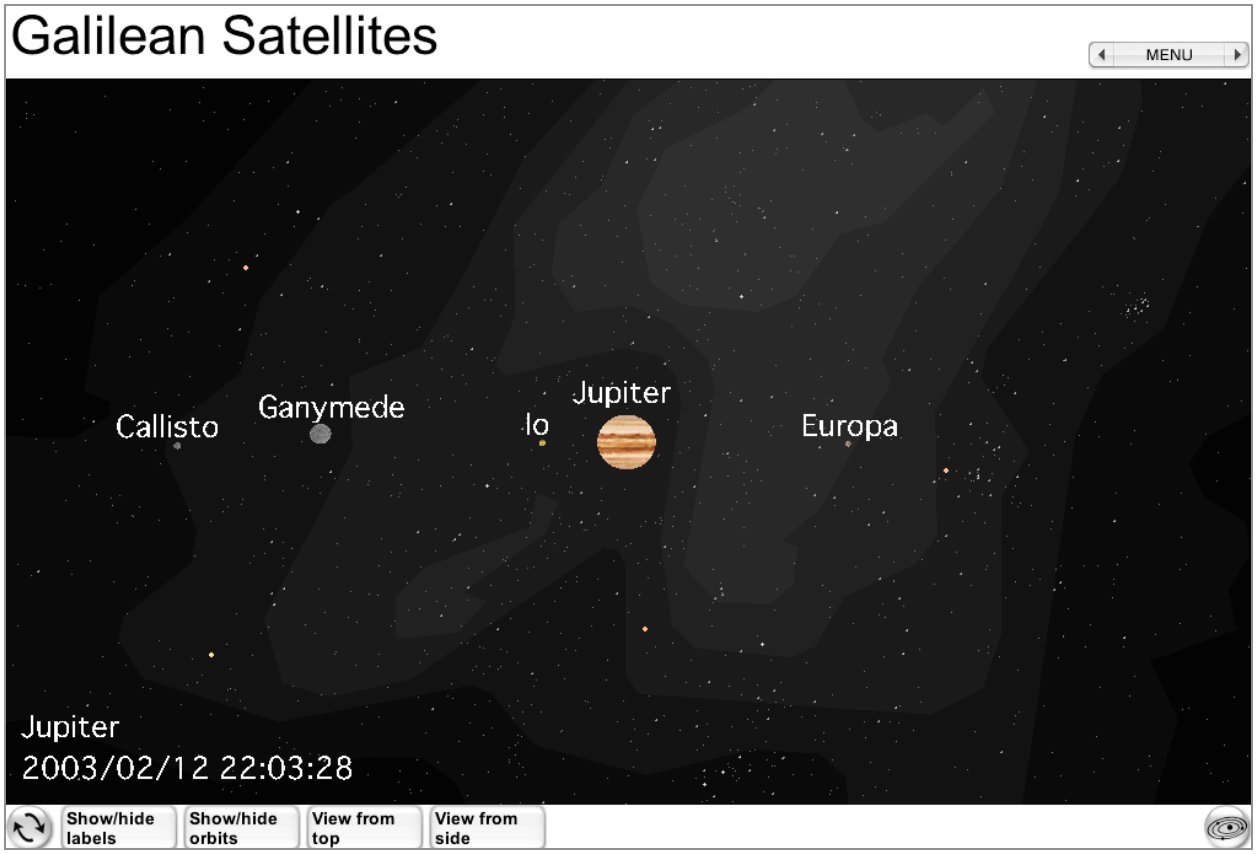


1) Select Four Seasons from the Menu Panel. This scene uses a simulation to explain why we have the four seasons.

2) Button functions

- Show/hide zodiac :Switches the zodiac on and off.
- View from side :Moves the viewpoint to the side.
- Centering Sun/Earth :Switches the center of viewpoint to the sun and earth.
- Landing/launching :Toggle button to switch between launching and landing.
- 3 months later :Forwards time by three months.
- Previous month :Reverses time by one month.
- Next month :Forwards time by one month.
- 1 hour ago :Reverses time by one hour.
- 1 hour later :Forwards time by one hour.

4.1.4 Galilean Satellites



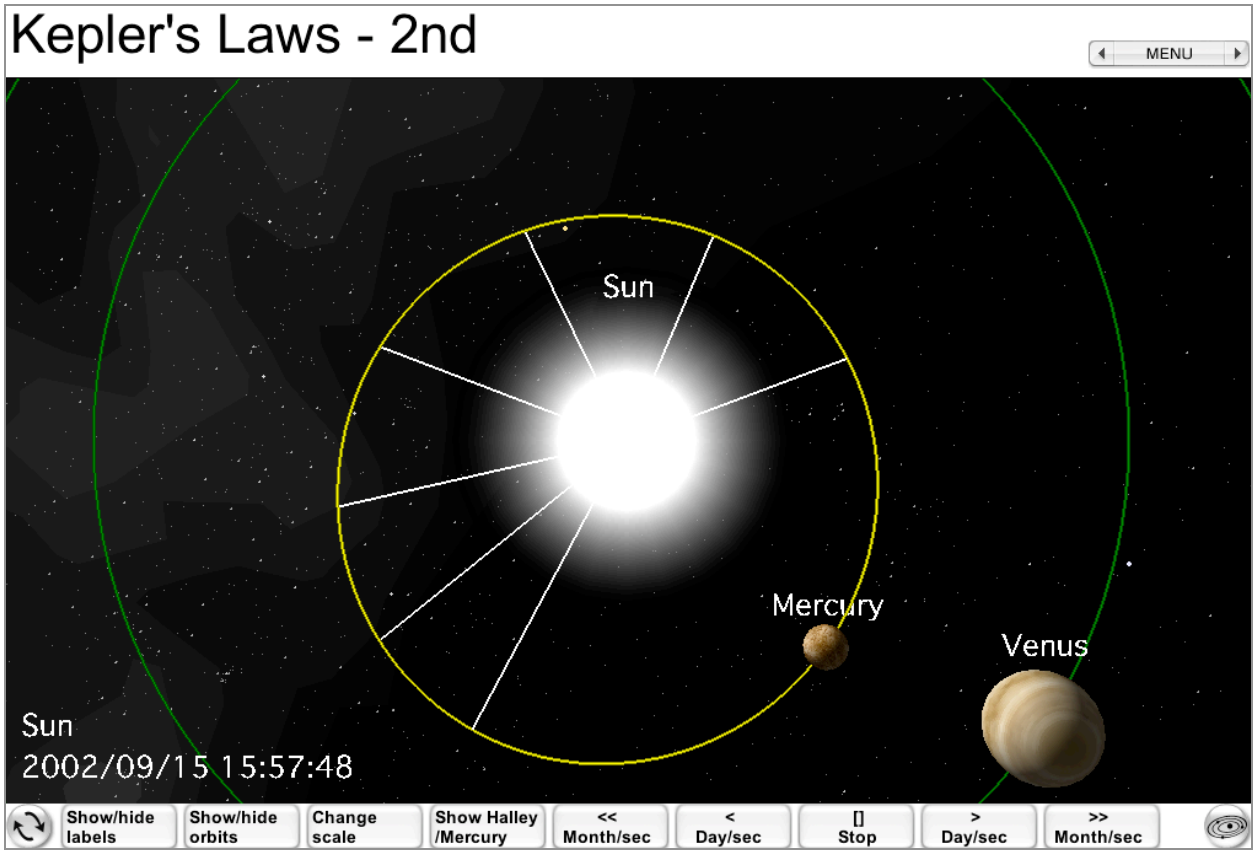
1) Select Galilean Satellites from the Menu Panel. This scene demonstrates the motion of Jupiter's four large moons as first seen by Galileo Galilei.

2) Button functions

- Show/hide labels :Switches the names of solar system objects on and off.
- Show/hide orbits :Switches the orbits of the moons or planets on and off.
- View from top :Moves to a viewing position above the planet.
- View from side :Moves to a viewing position from the side of the planet.

* Click the button (initialization button) to reproduce 20:00 LT for the current date.
* This screen example is set to "show orbits" and "view from side".

4.1.5 Kepler's Laws - 2nd



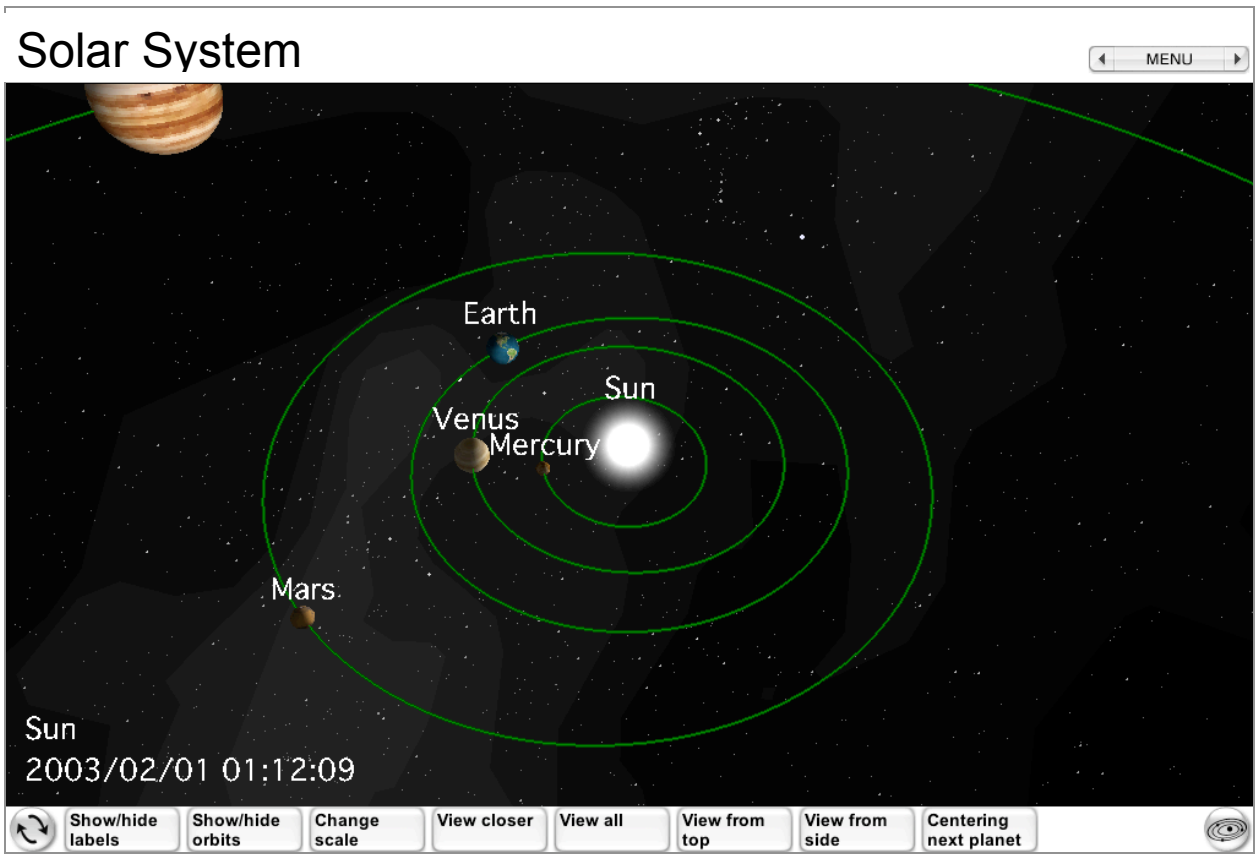
1) Select Kepler's Laws-2nd from the Menu Panel. This scene demonstrates Kepler's Second Law of Planetary Motion.

2) Button functions

- Show/hide labels :Switches the names of solar system objects on and off.
- Show/hide orbits :Switches the orbits (orbital paths) of planets satellites, and comets on and off.
- Change scale :Switches display of the celestial body between actual size and magnified size.
- Show Halley/Mercury :Switches the displayed celestial body between Mercury and Halley's comet.
- << Month/sec :Reverses time one month per second. Clicking continuously accelerates the speed.
- < Day/sec :Reverses time one day per second. Clicking continuously accelerates the speed.
- [] Stop :Stops time.
- > Day/sec :Forwards time one day per second. Clicking continuously accelerates the speed.
- >> Month/sec :Forwards time one month per second. Clicking continuously accelerates the speed.

* Click the button (initialization button) to show the view of the orbit of Mercury from the top at 20:00 LT for the current date.
* Pressing a button to forward or reverse time (e.g. >>Month/sec) continuously more than two times accelerates the speed.

4.1.6 Solar System



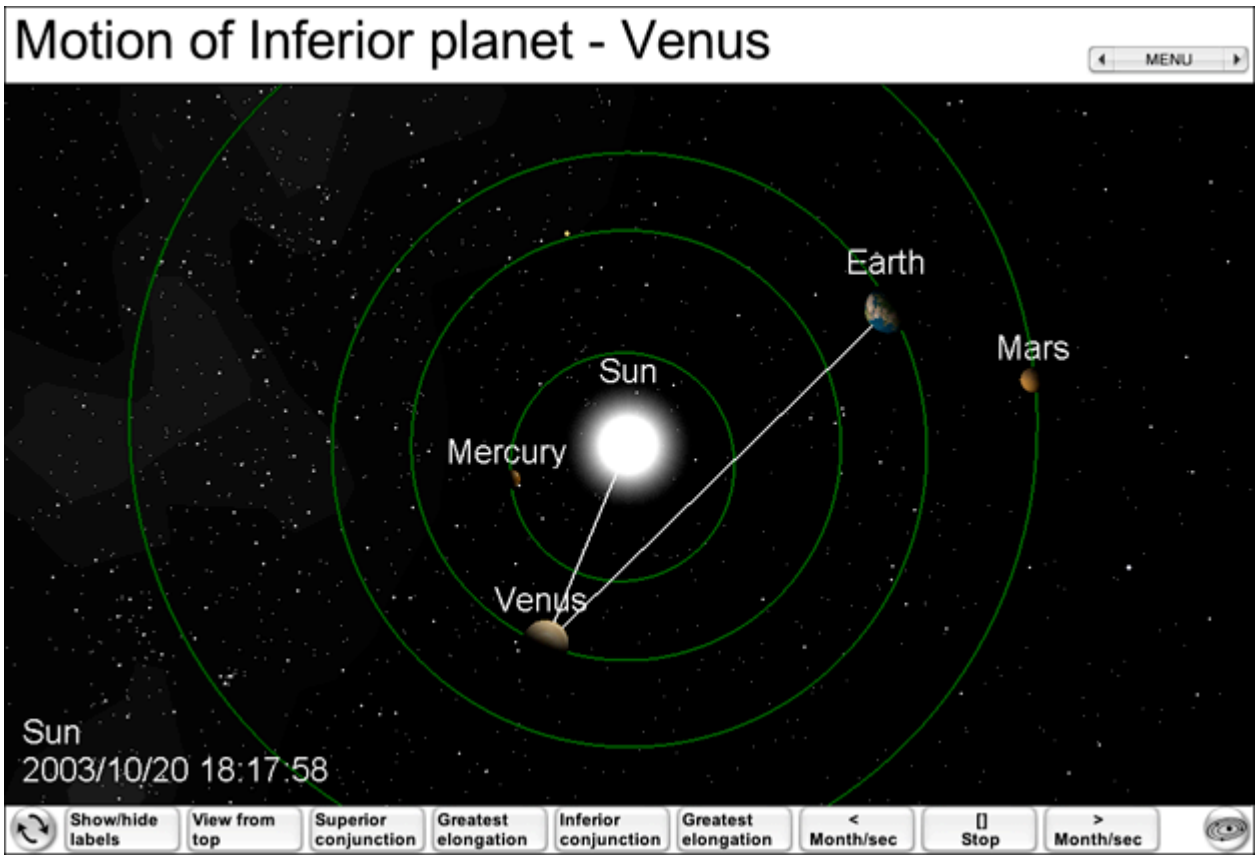
1) Select Solar System from the Menu Panel. This scene allows for exploration of the motions of Solar System objects.

2) Button functions:

- Show/hide labels :Switches the names of solar system objects on and off.
- Show/hide orbits :Switches the orbits (orbital paths) of planets satellites, and comets on and off.
- Change scale :Switches displayed scale of the celestial body between actual size and magnified size.
- View closer :Zooms in closer to the displayed celestial body.
- View all :Moves the viewpoint to a position which displays the entire Solar System.
- View from top :Moves to a viewing position above the plane of the Solar System.
- View from side :Moves to a viewing position to the side of the plane of the Solar System.
- Centering next planet :Switches the celestial body serving as the viewpoint in the order from the Sun to Mercury, then Venus, Earth, Mars, Jupiter, Saturn, Uranus, Neptune, and finally Pluto.

* Click the button (initialization button) to set the simulation for 20:00 LT on the current date.

4.1.7 Motion of Inferior Planet - Venus



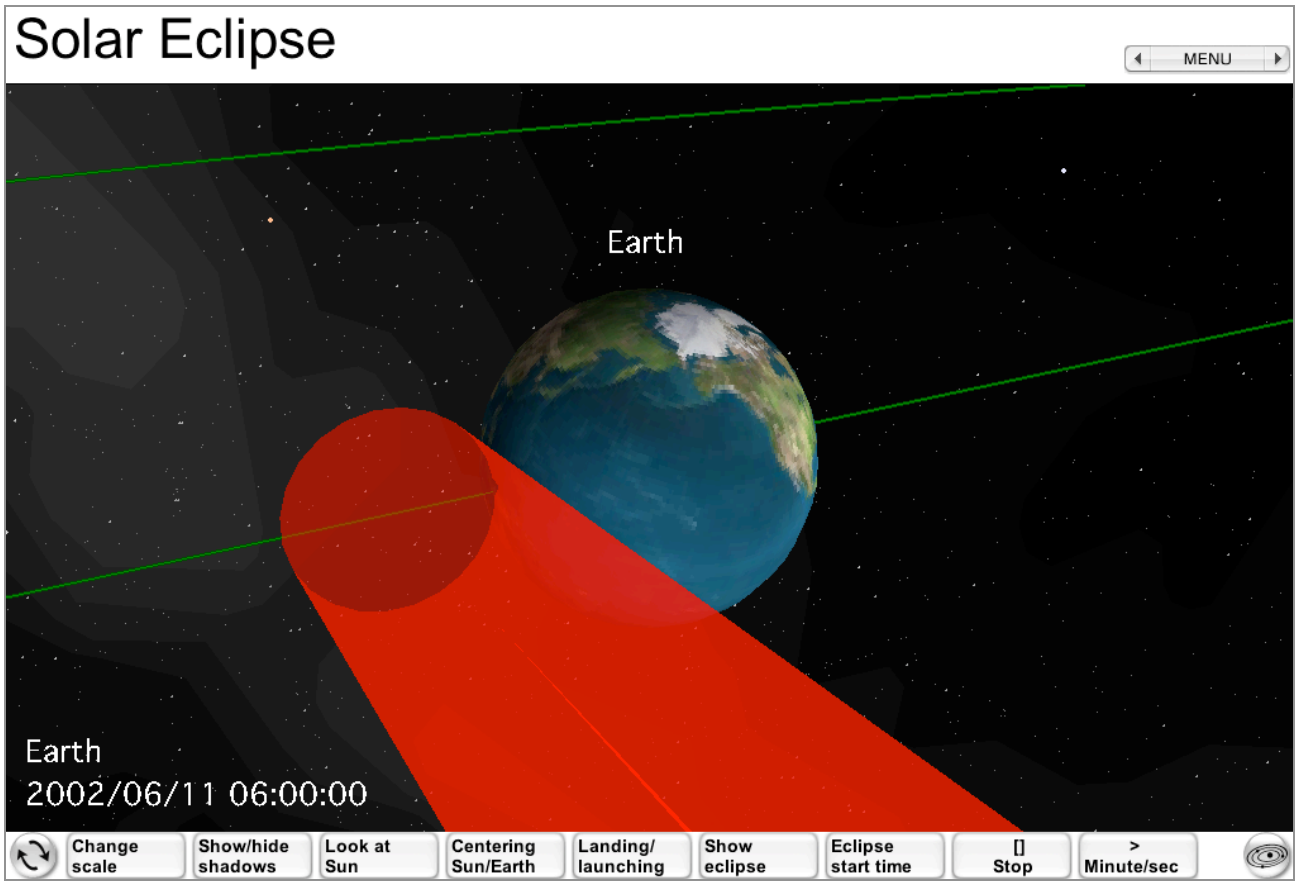
1) Select Motion of Inferior Planet-Venus from the Menu Panel. This scene allows for exploration of the motions of inferior planets such as Venus.

2) Button functions:

- ・Show/hide labels :Switches the names of solar system objects on and off.
- ・View from top :Moves to a viewing position above the plane of the Solar System.
- ・Superior conjunction :Sets the simulation to the nearest date Venus is at superior conjunction.
- ・Greatest elongation :Sets the simulation to the nearest date Venus is at greatest eastern elongation.
- ・Inferior conjunction :Sets the simulation to the nearest date Venus is at inferior conjunction.
- ・Greatest elongation :Sets the simulation to the nearest date Venus is at greatest western elongation.
- ・<< Month/sec :Reverses time one month per second. Clicking continuously accelerates the speed.
- ・[] Stop :Stops time.
- ・>> Month/sec :Forwards time one month per second. Clicking continuously accelerates the speed.

* Click the button (initialization button) shows the orbit of Venus from above the plane of the Solar System for the current time.

4.1.8 Solar Eclipse



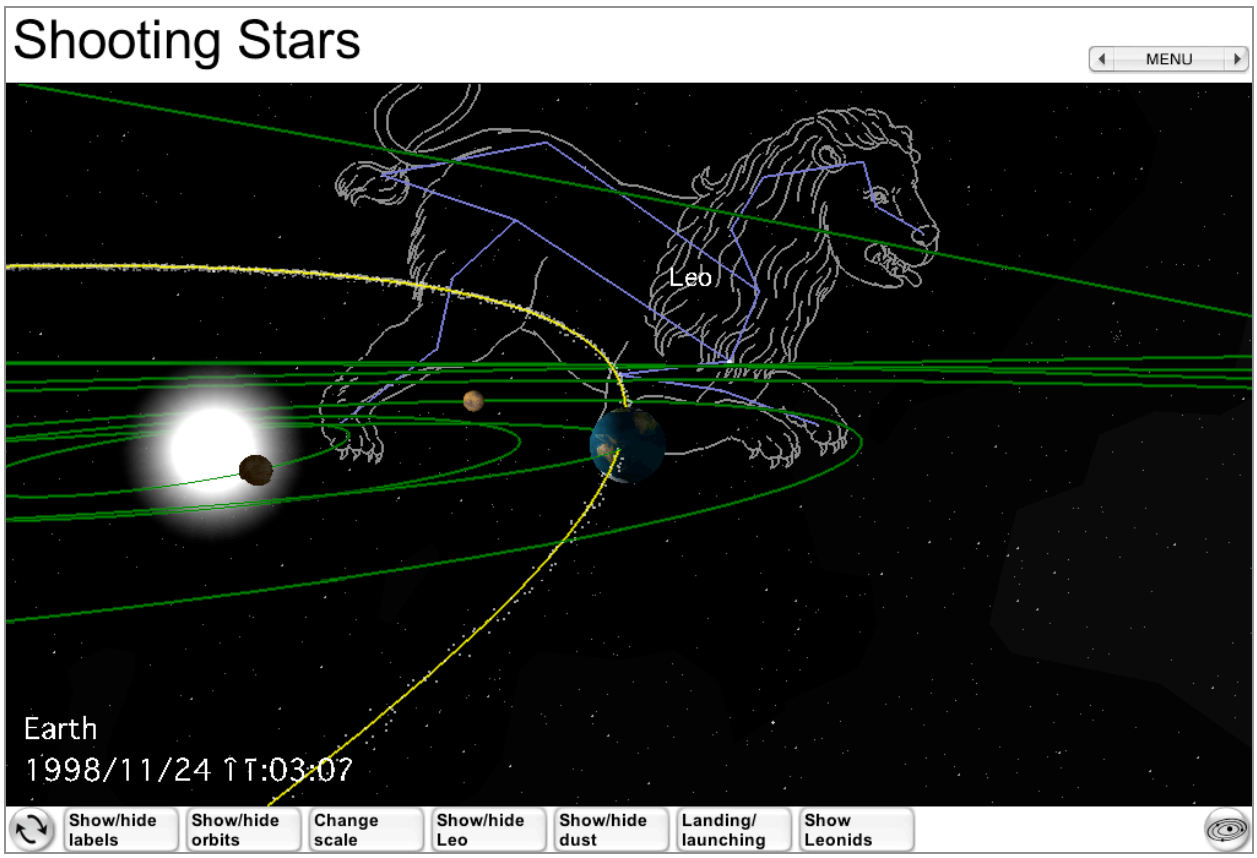
1) Select Solar Eclipse from the Menu Panel. This scene allows for exploration of the arrangement of the Earth, Moon and Sun during a solar eclipse.

2) Button functions:

- ・Change scale :Switches displayed scale of the celestial body between actual size and magnified size.
- ・Show/hide shadows :This button is effective only when the viewpoint is from the ground.
- ・Look at Sun :Faces the viewpoint towards the center of the Sun.
- ・Centernig Sun/Earth :Switches the center of the viewpoint between the sun and earth.
- ・Landing/Launching :Toggle button for switching between landing and launching.
- ・Show eclipse :Simulation of a solar eclipse in South-East Asia on June 11, 2002 as seen from the ground.
- ・Eclipse start time :Sets the time to the beginning of the solar eclipse.
- ・[] Stop :Stops time.
- ・> Min/sec :Forwards time one minute per second. Clicking continuously accelerates the speed.

* If the viewpoint is not from the ground, the simulation shows the penumbra and umbra.
* The default is a simulation of a solar eclipse that took place in South-East Asia on June 11, 2002 (eclipse is partial in Japan).

4.1.9 Shooting Stars



1) Select Shooting Stars from the Menu Panel. This scene demonstrates the relationship between comet orbits, dust and debris left by a comet, and meteor showers.

2) Button functions:

- Show/hide labels :Switches the names of solar system objects on and off.
- Show/hide orbits :Switches the orbits (orbital paths) of planets satellites, and comets on and off.
- Change scale :Switches displayed scale of the celestial body between actual size and magnified size.
- Show/hide Leo :Switches Leo picture and constellation outline on and off.
- Show/hide dust :Switches display of the comet and cometary dust on and off.
- Landing/Launching :Toggle button for switching between landing and launching.
- Show Leonids :Simulates the motions of comet Tempel-Tuttle between 1997 and 1998 and the 33 year peak of the Leonid meteor shower in November 1998.

* Click the button (initialization button) to show a scene of Leonids as seen from ground on November 17, 1997-1998.

5 Appendix :

The following preset scenes come with this Solar System Simulator Educational Edition.

A. Motion of Celestial Bodies
Tonight Starry Sky
Diurnal Motion
Annual Motion
Motion of Sun
Day and Night
Four Seasons
Motion of the Moon
Motion of Planets

B. Changes in Understanding of the Universe
Geocentric Theory
Annual Parallax
Galilean Satellites
Kepler's Laws - 1st
Kepler's Laws - 2nd
Kepler's Laws - 3rd
Orbits of Planets and Comets

C. Motions of Planets in Solar System
Solar System
Motion of Inner planet - Mercury
Motion of Inner planet - Venus
Motion of Outer planet - Mars
Motion of Outer planet - Jupiter
Motion of Outer planet - Saturn
Synodic Period

D. Astronomical Phenomena
Solar Eclipse
Lunar Eclipse
Shooting Stars

E. Solar System
Sun
Mercury
Venus
Earth
Moon
Mars
Asteroids
Jupiter
Saturn
Uranus
Neptune
Pluto
Comets

Solar System Simulator (Auto play)

Special Thanks: Roy Morris