Luminos

Version: 9.7 : Download PDF version

Contents

Thanks for choosing to explore the Universe with Luminos!

View Quick Tip and Tutorial videos on YouTube.

Or select a topic to learn more:

Quick Tour

If you are just getting acquainted with Luminos but want to learn quickly, here are some ideas to help you get started:

Explore the sky

Using a single finger, drag across the Sky View to pan across the sky. Tap any object you see to select it. Successfully selecting an object will cause it show a pulsing crosshair, and its name will be displayed underneath it. At the same time, a representation of the object will display in the Selection Bar at the bottom-center of the screen. Tap the Info button in the Selection Bar to view that object's details in the Browser. Pinch to zoom the screen, and discover thousands of deep space images scattered throughout the sky.

Zoom on Mars—Try It Now!

While you can always view a planet by simply locating and tapping it in the Sky View, you can also browse to it using Luminos' Browser. To access it, tap the leftmost icon in the lower area of the screen (a magnifying glass). In this Browser, tap the Solar Sytem, and then Mars. Tap "Center on Screen" and Mars will glide into view. To get an even closer view, tap the "Zoom In" item in the Actions section of the browser, or tap the "Zoom In" button in the row of action buttons of the Selection Bar. You will now see a closer view of Mars, properly oriented to your current location.

Speed up time—Try It Now!

For an even more impressive view, tap the Clock Button in the bottom area of the screen. Here, you can change to a specific date and time to see how the sky would look at that point in time. You can also increase or reverse time itself. To see how Mars rotates over time, tap any of the buttons to change the flow of time (1x, 1 min/s, 10 min/s, etc.) By playing with the flow of time, you can see objects that might not be visible at your current location. To reverse time or stop it altogether, tap the Reverse, Stop, and Forward buttons, or spin the wheel control on the right side of the screen.

See the whole Solar System—Try It Now!

Being on the ground and exploring the sky is fun, but would you like to see the whole Solar System at once? Choose Solar System in the browser and look for the "Fly into orbit" option near the top. Tap it to be whisked away high above our Solar System where you can see the orbits of all the planets. Notice how the orbits aren't concentric rings, but rather some are tilted a little bit and some are off center. Speed up time to see how fast the planets move.

For an exciting (and somewhat frightening) view, turn on Near Earth Asteroids in the Small Bodies section of the browser and see just how many of those giant rocks are orbiting close to our planet! When you're ready to put your feet back on the ground just tap the Home icon in the upper left corner of the screen.

Plan your night viewing

Luminos makes it easy to schedule your night viewing with its "What's Up" display, located in the calendar. From here, you can see exactly which objects will be visible from your location at specific time ranges. Change your date with the calendar control to plan for an upcoming sky party, or create custom observation lists to see which objects will be easily viewable.

Locate surface features—Try It Now!

The notable geological features of all the planets and moons are tracked by the International Astronomical Union, and you can view them right inside Luminos. Select a planet or moon, such as Earth's moon, and tap "Fly into orbit". While the planet or moon is selected, all of the names of its surface features will be displayed in 3D. (If they aren't showing, make sure the "Show surface feature labels" action is highlighted in the planet's detail view.) Rotate the body to see all the features, zoom in for a better view, and tap any feature to find out its details and description. This is a great way to find the locations of lunar landings, for example.

Track satellites—Try It Now!

Luminos supports external satellite tracking data. To try it out, open the Satellites option in the Browser. From here you can toggle the individual types of satellites to display, which will be represented in the Sky View as distinctly-colored moving icons. Satellite passes visible at your location are shown directly in the information display. By speeding up time--as described earlier--you can follow the paths of the satellites around Earth.

For a unique perspective on Earth's satellite traffic, tap the Earth and then "Orbit" to see the satellites in motion around our planet. Also, try switching between the actual and apparent orbit paths of a satellite to see where the satellite appears to move relative to Earth by using the "Orbit style" action button on any selected satellite.

Ride along with the space station—Try It Now!

With satellites enabled, it is easy to see a close up view of the International Space Station. Simply select International Space Station from the satellites browser and tap the "Ride Along" option. While riding along with the space station--or any other detailed satellite model--you can pinch to zoom in and out or pan around for a better

view.

Examine Hubble images

Luminos contains high-resolution images of deep space bodies taken by the Hubble telescope. To view these bodies in the context of the night sky, open the Browser with the magnifying glass icon in the lower left. Select the "Deep Space" category, then tap any of the thumbnail images for detailed information. Tap the image again for an even better view, complete with zooming.

Simulate being on another planet—Try It Now!

Luminos can quickly take you to another planet or moon in the Solar System. Select the Solar System category and then choose a planet from the list. In the Actions section of that objects page will be an item labeled "Land on the surface", and selecting that will quickly launch you into space and set you down on the surface of that planet. Try it with Saturn to see what the rings might look like if you were under them or try it with the Moon to see what it might have felt like to land there!

Find all the Messier Objects

For a real challenge, use Luminos' ability to track your viewing history to complete a Challenge Observation List. From the Browser, select the Deep Space Objects and the Messier list. Individual items in the Messier list will be shaded to represent their visibility at the current moment; faded items are below the horizon, and bright items are in the visible sky.

Select any item in the Messier list, and once you have located it in the night sky, tap the "Mark as seen" action. This will note the date and time you actually found the Messier Object. Take a note if you desire, using the "Notes" section of the object browser. There are more than a hundred Messier Objects. Spot them all!

Exploring the Interface

The primary display of Luminos consists of the Sky View with the Toolbar at the bottom of the display.

Sky View

The Sky View contains the main display area of Luminos. Here, you can see the sky objects and select them for more detail. To select any object in the sky, simply touch it on the screen. To re-orient the Sky View, drag your finger across the display in the direction you wish to point the camera. The currently selected object is represented by an animated crosshair:

When an object is selected, the most common actions you can do with the selection will be visible in the Selection Bar. To clear the selection, push the selection bar off the screen by swiping it down.

If you have changed your elevation or moved away from your location (such as landing on another planet), you can always return to your true location by tapping the "Home" icon in the upper left of the display:

If you have changed to a different time (such as by speeding up the flow of time, or setting time to be at the start of an eclipse), you can always return to your actual time by tapping the "Now" icon in the upper left of the display:

If you have selected a different orientation than horizontal, or have opted to always show the orientation button, the orientation control will also appear in the upper left.

Toolbar

The Toolbar is the main control area of Luminos. In the Toolbar, you will find the menus and controls to navigate through various astral bodies, as well as information on the

current position and selection.

The Toolbar contains buttons to activate the panels:

🔍 Browser, for searching and browsing objects in the database as well as settings and help

Tonight, for viewing "What's Up" in the sky at your location this evening (or any evening you choose).

Observe, for accessing tools to assist with naked eye, binocular and telescope viewing

Settings, to configure Luminos to your preferences.

Time, speeding up of reversing the flow of time in order to observe its effects on the sky.

In the center of the Toolbar is an information display. If no object is selected, this area will be blank (or show the direction coordinates of your Sky View if you choose to turn that on in the Settings.).

If an object is selected the Selection Bar will be shown.

Selection Bar

When an object is selected the Selection Bar will be displayed at the bottom center of the screen. The Selection Bar includes icons for performing the most common actions on the selected object as well as controls for opening the Browser to the selected object.

If you accidentally tap another object you can easily return to your previous selection by either tapping the left arrow next to the icon in the selection bar, or by swiping the entire selection bar to the right. Luminos remembers the last ten objects you selected so this feature can also be used to switch between several objects quickly.

To clear the selection, push the selection bar off the screen by swiping down on it.

Action buttons

Buttons for the most common actions you will take with a selected object are displayed within the Selection Bar. Tapping an icon will perform its action on the selected object. Tapping the "Info" button will display the section in the Browser, where

the full set of available Actions for the selection will be shown.

Center on screen

This action will center the selected object on the screen. While the object is currently centered the icon will be highlighted.

Zoom in

This action will zoom in on the object so that it fills the screen. If the object isn't already centered, the Zoom In button will first center the object.

Fly into orbit

This action will launch you into orbit around the selected object, allowing you to spin the object by dragging your finger on the screen. Tap a second time while flying to complete the journey immediately.

Land on the surface

This action will transport you to the selected object (for example, another planet) and touch down on the surface, where you can see what space would look like from that object. If you're already orbiting the object then this action will land you at the location centered on your screen. Tap a second time while flying to complete the journey immediately. Note that this action is only available for planets and moons.

Ride along

This action will transport you to the same location in space as the selected object. Tap a second time while flying to complete the journey immediately. Note that this action is only available for comets, asteroids and satellites.

Goto

If you are currently connected to a remote telescope mount, this action gives you quick access to slew your mount to the current selection.

Add to a custom list

This action will open a browser containing your custom Observation Lists. Selecting

one more more lists in this browser will add the selected object to those lists.

Add to Things You've Seen

This action will mark the selected object as having been seen at the current date and time. You can see a list of the objects you've already seen in the Browser.

Show surface feature labels

This action will toggle the display of surface feature names on a planet or moon. You can only access this action from a selected feature, or from the body on which it is located.

Set to ... time

This action will temporarily change the current time to one appropriate to the selected item, such as flyover time for a satellite or the greatest time of an eclipse.

Go to ... location

This action will temporarily change your current location to a location appropriate to the selected item, such as the greatest location of an eclipse.

Orbit style

This is a toggle between viewing the actual and apparent orbit paths for a satellite.

Flyover alarm

Turn this button on to receive notifications on your device when this satellite is making a visible pass over your location.

Info

The Info button opens the Browser to the selected object for quick access to additional information about the object.

Gestures

There are two modes of operation for Luminos: panning and motion tracking.

Panning mode

Normally, you can point the Luminos display by sliding your fingers across the display. The camera for Luminos will follow your finger, and you can point the display in any direction.

Tapping anywhere on the screen will always switch Luminos back to panning mode.

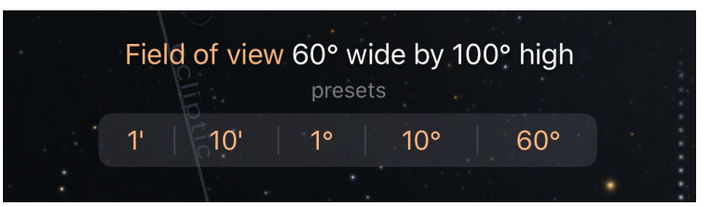
While using panning mode, you can interact with the Sky View using different gestures:

Single finger

With a single finger, you can pan across the Sky View, select any of the astral objects, or raise the Time display. You can also swipe left and right across the current selection to move back and forth in the selection history, or swipe down on the selection to clear it completely.

Two fingers

Using two fingers, you can zoom or expand your field of view. In effect, this allows you to zoom into or out of areas of the sky. Tapping two fingers on the screen will also bring up field of view controls.



You can pinch to a custom zoom level or select one of the preset values. To set the field of view quickly to one of the pre-determined values, simply tap the buttons on the screen representing the values 1 arc-minute, 10 arc-minutes, 1 degree, 10 degrees, or 60 degrees. Alternatively, while pinch zooming a field of view wheel will appear on the side of the screen, similar to the time wheel. Spin this wheel to fine-tune the field of view value.

Three fingers

By dragging three fingers up and down the display, you can change your elevation on the current location. In other words, dragging three fingers down will raise your perspective off of planet Earth.

Motion Tracking

An alternative mode of display -- motion tracking -- will point the camera's field of view based on the orientation of the device itself. This allows you to hold the device in any direction and see the actual sky behind the device represented in the display. When the device itself is moved, the Luminos display will track the movements and adjust accordingly. Luminos uses the compass and accelerometer of the device to find the correct position. As such, you may need to move the device for a few seconds when starting free look mode to calibrate the view.

Motion tracking is not supported on iPod Touch due to hardware limitations.

To switch into motion tracking mode, point the back of your device towards the sky. Luminos will activate the motion sensors in your device and use them to synchronize the display with the direction you're pointing your device.

To switch back to panning mode, simply touch anywhere on the Luminos display.

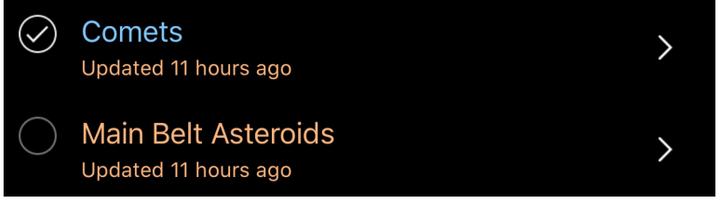
Browse

The Browser display is designed to help you navigate the millions of celestial objects tracked by Luminos. It also contains settings, help, and app information. You access the Browser either by tapping the magnifying glass icon in the lower left area of the Toolbar, or by hitting the "Info" action on a selected object. On a wide screen device, the Browser opens on the side of the screen by default whenever an object is selected. All objects in the Browser are organized in hierarchy, starting with a series of broad categories:

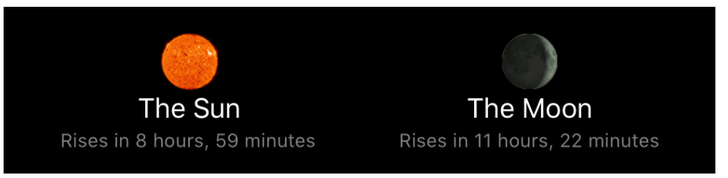
- Solar System
- Stars and Constellations
- Space Stations and Satellites
- Comets and Asteroids
- Deep Space
- Lists and Challenges
- Things you've seen

Special items

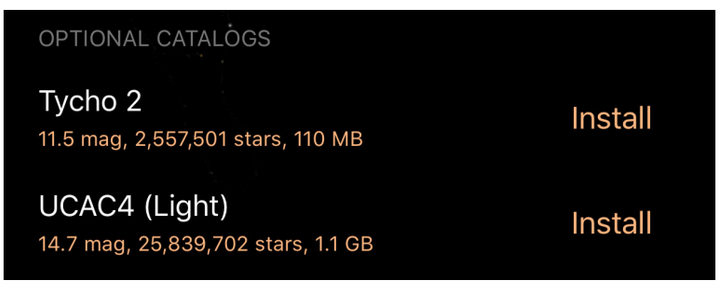
For those items in the Browser which show a display/check mark, tapping the mark will turn the display of the item or category of items on and off. Only items with the check mark are rendered. In the following example, Comets will be drawn in the display, but Main Belt Asteroids will not.



Browser items with dark text descriptions are currently below the horizon. Items with a fully lit description are visible based on your location and the current viewing time.

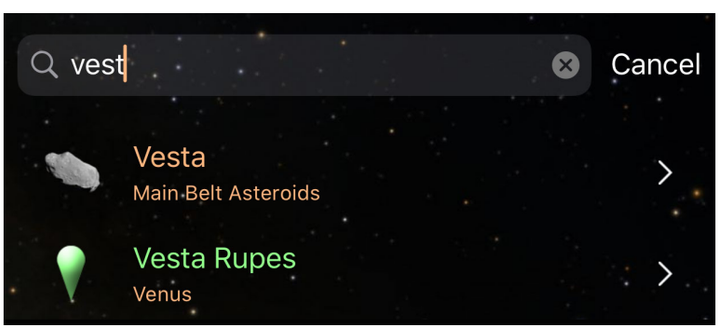


Some categories of Browser items, such as large star catalogs, do not ship with Luminos by default in order to keep the app install size to a minimum. However, these can be downloaded and installed freely from inside the application. If you encounter a Browser item with an "Install" button, tap the button to download and install that data set in the background.

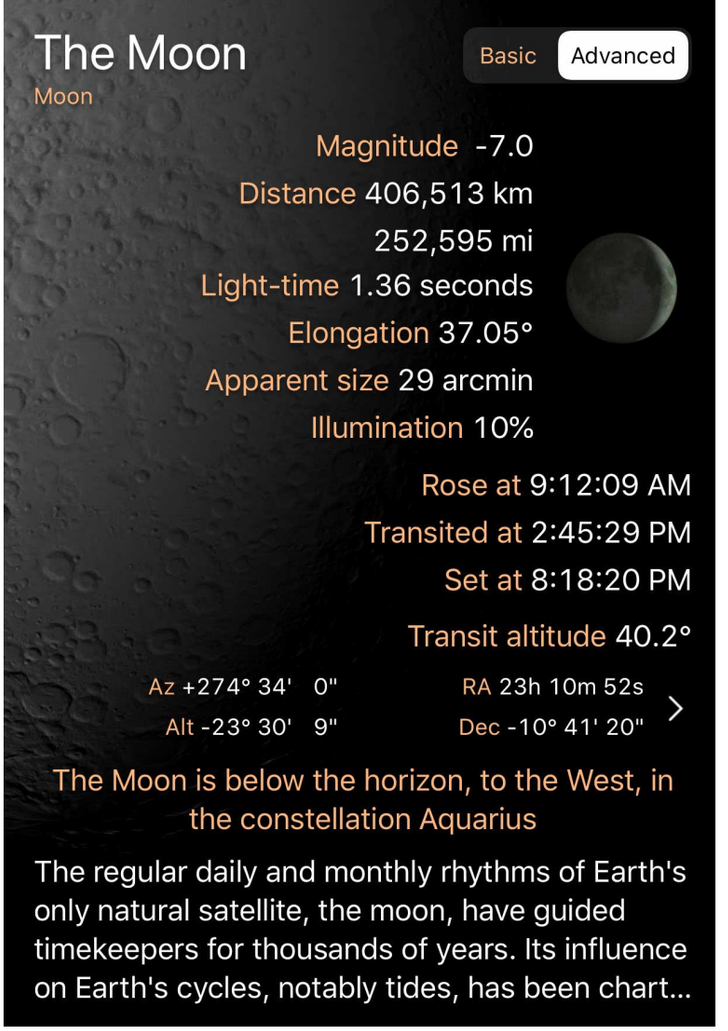


You can continue to use Luminos normally while the install completes. You will be able to see the progress of your download in the Sky View. If you quit Luminos while downloads are in progress, you will need to resume them when the application restarts. However, Luminos will continue its progress where it left off before.

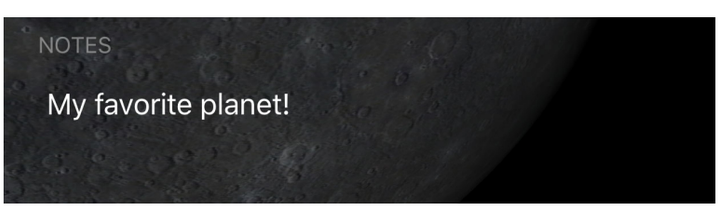
Many Browser categories contain Search bars. If a Search bar is not displayed, pull down on the display to make it appear. Tap the Search bar to bring up a keyboard and enter a search term. The results list will show any browsable items which match your search term in this category or sub-categories.



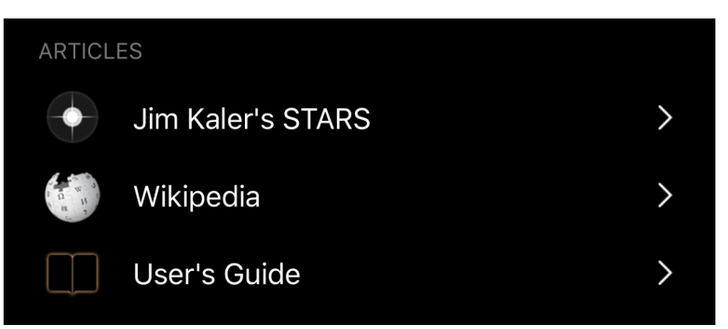
When you have any item selected, you will be shown a Detail View which lists specific characteristics of that item. In many Detail Views, you will be able to toggle between a Basic and an Advanced view by tapping the buttons in the upper right corner of the display. The Advanced view will show extra details.



Article summaries can be tapped to expand or collapse the full text, and you can tap most data fields for more detailed information. Most Browser objects have an Actions section in their display, allowing you to perform activities specific to that item, such as "Land on the surface" or "Fly into orbit".



Most items will allow you to add personal notes to them. If you are signed into iCloud and have an Internet connection, the notes will be synchronized across all device where Luminos is installed.



Certain categories of Browser item will include article links to external resources, such as a Wikipedia page or NASA resource. These require an Internet connection, and will launch Safari for access.

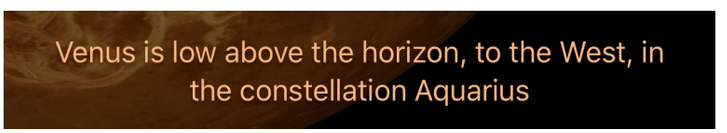
Solar System

The Solar System browser contains all planets, dwarf planets, moons, and Sol itself. Hypothetical bodies such as Planet 9 are also included with theoretical positions. By selecting any Solar System object, you will be presented with a three-dimensional view of that object, as well as details related to the object itself.

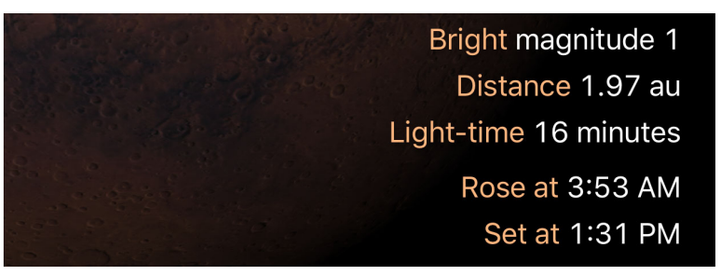
The Actions section of the Solar System browser includes "Fly into orbit." Choosing this action will lift you off of the Earth and into a distant orbit above the Solar System. From there you can view the planets and their orbits all at once.

The descriptive articles on Solar System objects can be tapped to expand or collapse the text in place.

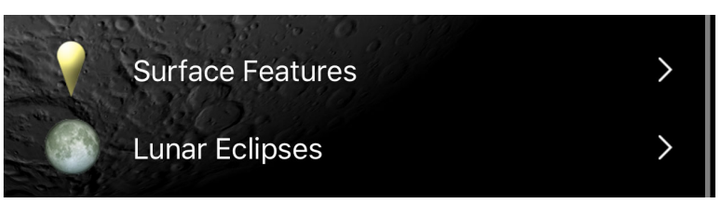
A summary of the object's position will be featured in the display. Tap it for more detailed coordinates, or switch to the Advanced display to see the details at all times.



The highlights of the object's visibility will also be displayed inline. Tap the summary for a full page of characteristics on size, orbit and rotation, and atmosphere.



If the object has moons, transits, surface features, or eclipses associated with it, those menus will appear next.



The following legend describes the actions, and detail displays of Solar System objects:

Actions

Center on screen

Using this action will select the body and center it on the screen for ease of viewing.

As time progresses, the camera will follow the object.

Zoom in

For an even better view, tap this button to enlarge the item in your display view.

Set to...time

Event displays such as moon transits will include an action that will set the Luminos clock to the time of the event, allowing easier simulation.

Fly into orbit

This action launches you off of the Earth and puts you in orbit around the object. From there you can spin the object with one finger to view it from various angles. Use the Home buttton in the upper left corner of the screen when you're ready to return to Earth.

Land on the surface

This action launches you off of the Earth and lands you on the surface of the object, allowing you to look around and view space as if you were standing on that object. Use the Home buttton in the upper left corner of the screen when you're ready to return to Earth.

Show surface feature labels

(Surface features only) Toggle the display of surface feature label names on the planet or moon currently selected, if they exist.

Fly to the best location

(Solar eclipses only) Change the location to that of the greatest location of the current eclipse.

Set to peak location

(Meteor showers only) Change the location to that of the best viewing location for that meteor shower.

Set time to the maximum

(Solar and lunar eclipses only) Change the time to that of the greatest time of the current eclipse.

Set to peak time

(Meteor showers only) Change the time to that of the most visible moment for that meteor shower.

Show Analemma

(The Sun only) Turn on a display of the Sun's motion in the sky over time, from the current location.

Add to custom list

Add the current item to an Observation List. You can define a new Observation List while you add the item.

Add to Things You've Seen

Mark the item as one that you have seen. It's time will be noted in the Things You've Seen list.

Details

Advanced Data

Magnitude

A logarithmic measure of the brightness of an object. Lower numbers are brighter.

Distance

The distance from your current location.

Elongation

The angle between the Sun and the object. Used to determine how visible an object is due to its proximity to the Sun.

Apparent size

The angular diameter of an object, i.e. how many degrees, minutes, or seconds it occupies in the sky.

Illumination

The percentage of the spherical disc which is visible. For example, a half moon would have 50% illumination.

Position

Horizontal Az

Azimuth, a measurement from a viewer to the object projected on a reference plane. Part of the horizontal coordinate system, along with altitude.

Horizontal Alt

Altitude, the vertical elevation in degrees of the object from the horizon, measured in degrees. Part of the horizontal coordinate system, along with azimuth.

Equatorial (now) RA

Right ascension is the celestial equivalent of terrestrial longitude.

Equatorial (now) Dec

Declination is the celestial equivalent of terrestrial latitude.

Equatorial (J2000) RA

Right ascension referenced from the point in time at January 1, 2000.

Equatorial (J2000) Dec

Declination referenced from the point in time at January 1, 2000.

Ecliptic Lon

Longitude relative to the ecliptic plane, the plane formed by the path the Earth travels around the Sun.

Ecliptic Lat

Latitude relative to the ecliptic plane, the plane formed by the path the Earth travels around the Sun.

Galactic Lon

Longitude relative to the galactic plane, the plane formed by the disk containing most mass in our galaxy.

Galactic Lat

Latitude relative to the galactic plane, the plane formed by the disk containing most mass in our galaxy.

Heliocentric X

X dimension of the Cartesian coordinates of the object relative to our Sun.

Heliocentric Y

Heliocentric Y dimension of the Cartesian coordinates of the object relative to our Sun.

Heliocentric Z

Z dimension of the Cartesian coordinates of the object relative to our Sun.

Bulk characteristics

Mass

The property of an object that is a measure of its inertia, the amount of matter it

contains, and its influence in a gravitational field.

Volume

The quantity of space that this object occupies.

Mean radius (volumetric)

The average radius of a sphere with the same volume as this body.

Equatorial radius

The distance between the center of an object and its equator.

Polar radius

The distance between the center of an object and its north or south pole.

Ellipticity

A number indicating how far the object deviates from a perfect sphere (0). It is the ratio of major to minor axes.

Mean density

The average amount of mass per unit of volume in this object.

Surface gravity

The amount of estimated gravity on a negligible mass target at the object's surface.

Surface acceleration

The amount of estimated gravity on a negligble mass target at the object's surface, when rotation of the body is accounted for.

Escape velocity

Speed necessary to escape the gravitational field of the object.

Number of moons

Number of natural bodies orbiting this object.

Has ring system?

Whether or not this body has a ring system.

Has magnetic field?

Whether or not this body has a global magnetic field.

Orbit and rotation

Distance from Sun (now)

Current distance of this body from Sol.

Rotation period (sidereal)

Number of hours for a complete turn of the planet or body.

Length of day

Number of hours for a point to return to the same position facing Sol.

Perihelion

Distance when closest to Sol.

Aphelion

Distance when furthest from Sol.

Sidereal orbital period

Number of days for a full revolution around Sol.

Inclination to ecliptic

Angle between the body's plane and Earth's orbital plane.

Mean velocity

Average speed at which the body revolves around Sol.

Eccentricity

Amount by which the orbit deviates from a perfect circle. Numbers closer to zero are more circular, and numbers closer to one are more parabolic.

Axial tilt

The angle between an object's rotational axis, and a line perpendicular to its orbital plane.

Atmosphere

Mean temperature

Average temperature across the surface of the object.

Surface pressure

Pressure at the surface, relative to the same on Earth.

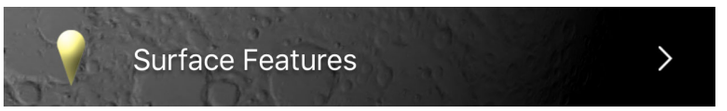
[Chemical composition]

Percentage, or parts-per-million, of various compounds in the object's atmosphere.

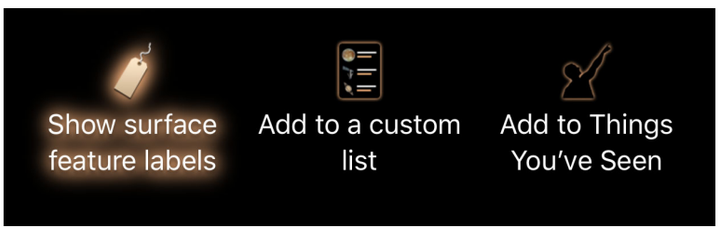
Surface Features

Many planets and moons in the Solar System have notable surface features such as craters or other geological formations. The International Astronomical Union (IAU) names and approves all of these features since its founding in 1919.

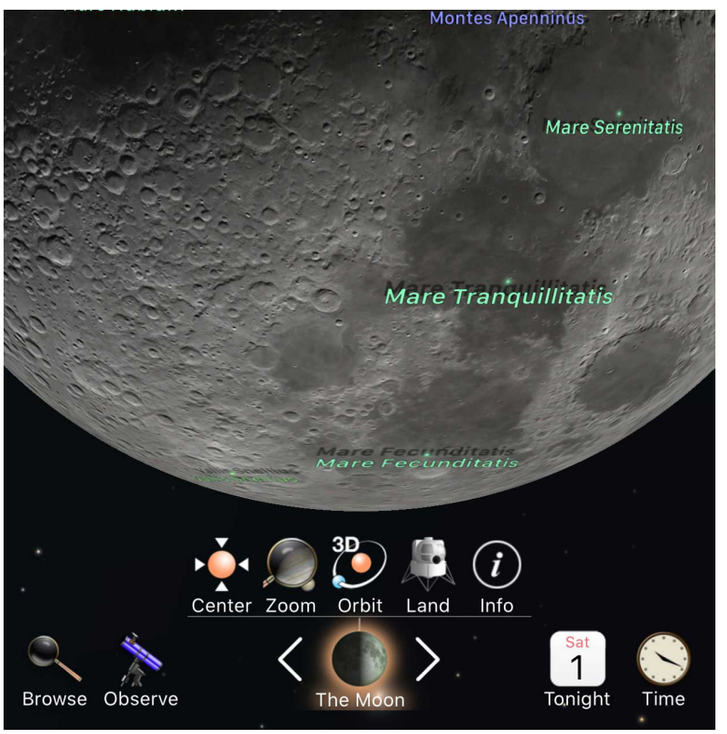
There are two ways to access features in Luminos. If a planet or moon has surface features, they will be accessible in the Browser page for that object in a special navigation menu.



In the surface features page for a planet or moon, the features are grouped by type. Selecting any individual feature brings up an information page containing location and description of the feature, as well as a set of actions. You can mark features as seen, add them to lists, or fly to their position to view them from space or from the ground.



The other way to view a feature is to select the planet or moon on which it is located and view it from space. Any body with surface features present will label them while the planet or moon is selected. Make sure the "Show surface feature labels" action is highlighted so that they will appear, then tap a feature name to select it.

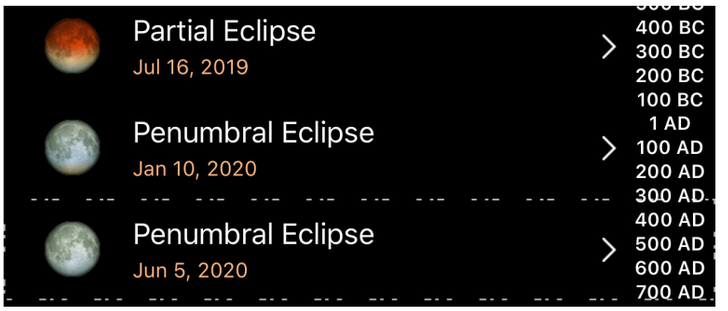


To toggle the display of feature names on a planet or moon, tap the aformentioned "Show surface feature labels" action.

Eclipses

Luminos includes a catalog of 5000 years of solar and lunar eclipses, with the ability to visit them in time and observe their progress. Both eclipse categories can be accessed from the Browser page for Earth.

You can also find solar eclipses listed on the Sun browser page, and lunar eclipses on the Moon page. Each item will indicate the time until the next solar or lunar eclipse occurs.



Eclipse lists are browseable by date, with past eclipses at top and future eclipses at the bottom. The next upcoming eclipse at your location will have its entry highlighted. Tap the date range on the right to jump to a specific time period. Entries and icons reflect the type of eclipse at that date:

Partial solar eclipse

In a partial solar eclipse, the Moon passes betwen the Earth and the Sun in such a way that the Moon only blocks a portion of the Sun from view.

Total solar eclipse

During a total solar eclipse, the Moon passes between the Earth and the Sun, blocking the Sun completely from view, other than its aurora. This generally occurs when the Moon is at its closest orbit to Earth and the Earth is farthest from the Sun.

Annular solar eclipse

An annular solar eclipse is similar to a total solar eclipse, except that the Moon is not close enough to the Earth to fully obscure the Sun. The outer rim of the Sun remains visible.

Hybrid solar eclipse

Hybrid solar eclipses are total during parts of their path, and annular during others. They are rare occurences.

Partial lunar eclipse

During a partial lunar eclipse, a portion of the Moon passes through the Earth's umbral shadow. This allows much of the moon to retain its usual color.

Total lunar eclipse

When the Moon passes through the Earth's umbral shadow--where all sunlight is blocked--a total lunar eclipse occurs. This causes the Moon to take on strong shades of orange and red.

Penumbral lunar eclipse

In a penumbral lunar eclipse, the Moon passes through the part of Earth's shadow which allows some light to reflect on to the Moon. This causes faint shadows across the Moon's surface.

Solar Eclipses

Tapping on any solar eclipse brings up an information display, an interactive map, and a set of actions. To see more fields, switch your detail view to the Advanced option, or tap the location row for a full detail screen.

General information

Apparent size

How large the eclipse will appear in the sky, in angular measurements.

Greatest longitude

The longitude location on Earth of the point of greatest eclipse.

Latitude

The latitude location on Earth of the point of greatest eclipse.

Path width

The width of the Moon's umbra on Earth at its point of greatest eclipse. The path is the

course of the Moon's shadow as it passes along the Earth.

Central duration

The central duration indicates how long the total phase of the eclipse lasts at the point of greatest eclipse. Central duration is not listed for partial solar eclipses.

Gamma

The perpendicular distance of the Moon's shadow axis and Earth's center at greatest eclipse. The absolute value of the gamma can be used to determine the type of eclipse.

Magnitude

The fraction of the eclipsed body which is in eclipse at greatest eclipse. Partial eclipses have magnitudes between 0.0 and 1.0, and total eclipses are greater than 1.0, with larger numbers indicating more coverage.

Catalog

A sequential number given to eclipses by NASA.

Canon plate

A group number of eclipses in the catalog listing. Each plate includes 20 sequential eclipses.

Saros

The number in a series used to track similar eclipses which occur 18 years and 11.3 days apart.

Lunation

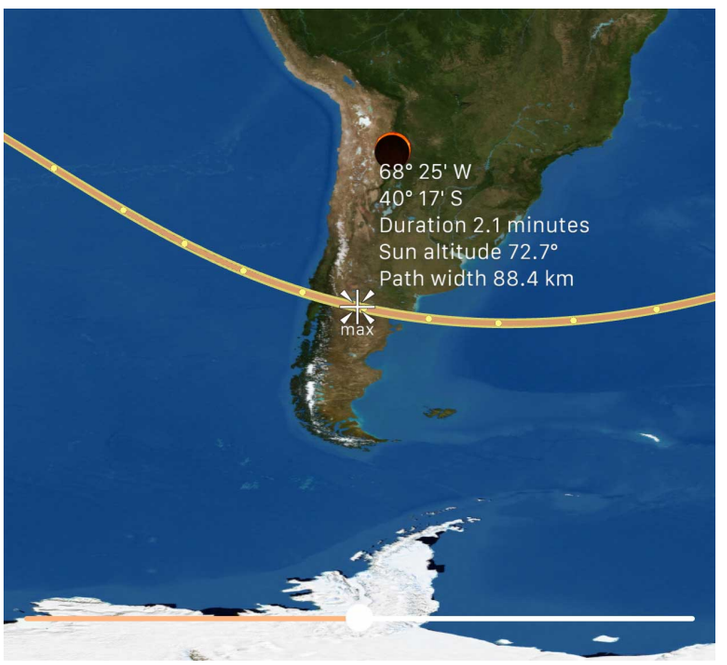
The number of synodic months (time between similar Moon phases) since the new moon of January 6, 2006.

ΔT

The difference between Universal and Terrestrial times when this eclipse occurs; essentially clock error.

Solar eclipse chart

Tapping the solar eclipse chart raises a dialog with a detailed planet map for the eclipse path and duration. The map can be panned with drag gestures to see the effects of the eclipse around the world. The bottom slider updates the crosshair position on the eclipse path to indicate the different positions of the shadow as time progresses. When you are finished, tap the "Done" button in the upper right.



The eclipse chart contains additional data fields such as the saros number of the eclipse. Eclipses in the same saros repeat roughly 18 years apart, and are similar in appearance due to the Sun, Earth, and Moon being in relatively similar positions.

The orange line indicates the umbra path of a non-partial eclipse. Yellow circles on the path indicate 15 minute markers of progress. The greatest eclipse point is designated with a "max" crosshair. Finally, the Sun and Moon icons indicate the positions on earth where the Sun and Moon are directly overhead at the time.

Solar eclipse actions

In addition to the normal actions for "Center on screen", "Zoom in", "Add to a custom list", and "Add to Things You've Seen", solar eclipses include two additional actions:

Set time to the maximum

This will set the clock in Luminos to the time of greatest eclipse at your home location.

Fly to the best location

Tapping this action moves the camera to the location of the greatest eclipse for this entry.

Using these actions together with "Zoom in" and "Center on screen" allow you to simulate seeing an eclipse at its greatest time and location.

Lunar Eclipses

Tapping a lunar eclipse entry brings up an information display, chart, and actions specific to that eclipse. As with solar eclipses, more detailed information can be found by switching to the Advanced view or tapping the date description of any eclipse.

General information

Total phase

The amount of time that the Moon is totally eclipsed by Earth's umbral shadow.

Partial phase

The amount of time that the Moon is partially eclipsed by Earth's umbral shadow.

Penumbral phase

The amount of time that the Moon is partially eclipsed by Earth's penumbral shadow.

Umbra mag.

The fraction of the Moon's diameter that is obscured by the Earth's umbra.

Penumbra mag.

The fraction of the Moon's diameter that is obscured by the Earth's penumbra.

Gamma

The distance of the the axis of the Moon's shadow from the Earth's center at maximum

eclipse. The absolute value of the gamma can be used to determine the type of eclipse, and the positivity or negativity of the number can indicate whether it occurs above or below the center of the Earth.

Catalog

A sequential number given to eclipses by NASA.

Canon plate

A group number of eclipses in the catalog listing. Each plate includes 20 sequential eclipses.

Saros

The number in a series used to track similar eclipses which occur 18 years and 11.3 days apart.

Lunation

The number of synodic months (time between similar Moon phases) since the new moon of January 6, 2006.

ΔT

The difference between Universal and Terrestrial times when this eclipse occurs; essentially clock error.

Quincena Solar Eclipse Param

Indicates which type of eclipse occurs prior to, or after (posterior) this lunar eclipse.

Lunar eclipse chart

Similar to the solar eclipse chart, tapping on a lunar eclipse chart allows you to see the relative positions of the Sun and Moon on the Earth at the time of the eclipse.

You can pan across the globe to see which locations are nearest to the Moon, making the eclipse visible. Adjusting the slider at the bottom of the map shows the closest position on the Earth to the Sun and Moon during the eclipse over time, as indicated by the icons. Tap the "Done" button when you wish to exit the chart.

Lunar eclipse actions

Similar to solar eclipses, a lunar eclipse contains an addtional action:

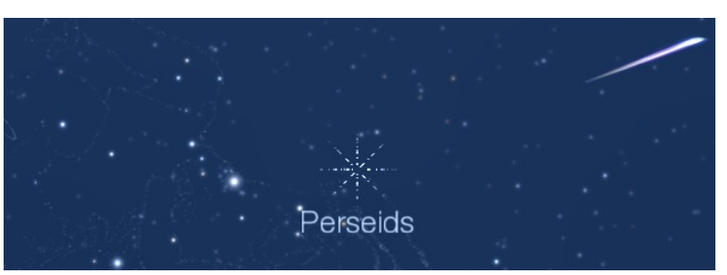
Set time to the maximum

This will set the clock in Luminos to the time of greatest eclipse of this entry.

Note that the "View from space" action will allow you to orbit the Moon and see the effects of the eclipse on its illumination.

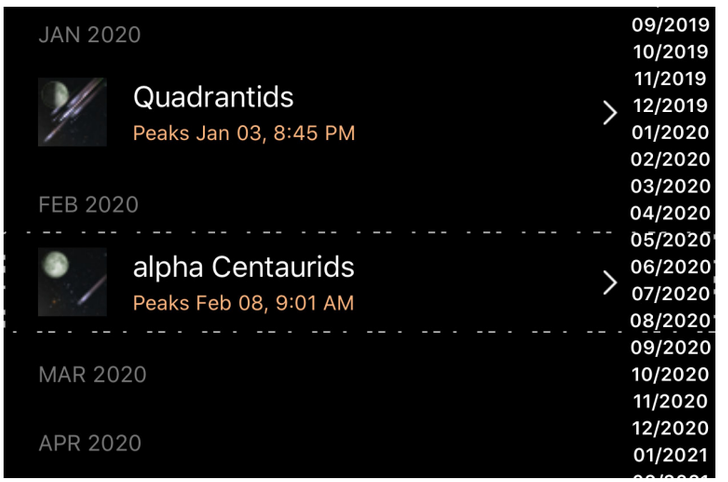
Meteor Showers

The meteor showers feature in Luminos can help you locate the most popular showers and determine when they will be at their peak rates. A meteor shower is represented in the Sky View by its radiant point and by occasional 3D meteor displays in the sky which increase at the shower's peak time.



Meteor showers are accessed as a submenu under the "Earth" item in the Browser.

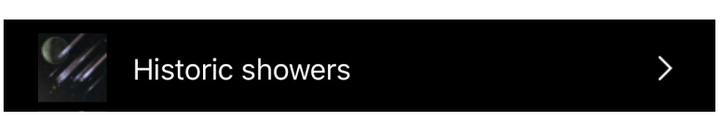
From the meteor showers list, you can identify the next peaking shower by the animated selection lines. The icon preview for each shower contains two helpful pieces of information: the relative strength of the shower as represented by the number of shown meteors, and the phase of the moon during that shower peak. A full moon can hinder the ability to spot meteors.



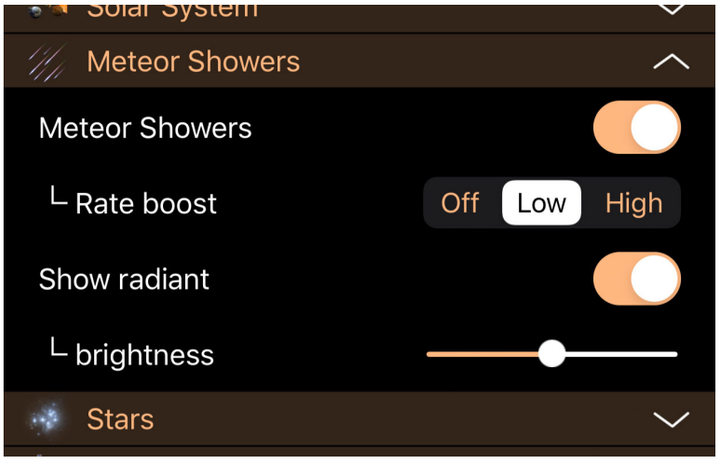
Tapping any particular meteor shower will present a detailed information page, as well as actions you can take related to that shower. The information includes the location of the radiant point where meteors of this shower originate in the sky; the start and end dates of the shower; the time at which the shower reaches its peak, and the zenith hourly rate (ZHR). The ZHR represents the theoretical maximum number of meteors a single person might see in one hour, although the actual number is usually lower. A "variable" rate indicates that this shower's activity changes greatly from year-to-year.

Meteor shower detail pages contain the standard actions available for most objects, such as marking them as seen and adding them to observation lists. There are two special actions for meteors. "Set to peak time" changes the Luminos clock to the moment when the meteor shower is at its peak. "Set to peak location" changes your position to the place on Earth where the shower is most visible at its peak.

For some historic meteor showers, Luminos can simulate the conditions that made them notable. If a shower has a "Historic showers" sub-menu, tap it to access a version of that shower from the past. Set Luminos to peak time and location for that historic shower to experience the show.



There is a section in the Luminos settings to adjust meteor showers. Use the main toggle to turn the display of 3D meteors in the sky view on or off. You can also adjust the quantity of meteors displayed using the "Rate boost": setting it to "Off" displays meteors in the sky at their actual ZHR; choosing "Low" or "High" will increase the number of meteors in the sky for a more noticeable effect. You can also turn the appearance of the radiant point on or off and adjust its brightness.



Tapping the peak and rate display for any shower will list its full detail information.

General information

Name

The common name for the shower.

ID

The IAU designation for this shower.

orbits

The number of orbits used to calculate mean parameters.

Group

IAU numerical code of the main complex group.

Group serial

IAU serial number of the member of the complex group.

Parent body

The comet or asteroid from which this meteor shower originates.

Appearance

Solar longitude

The precise angular distance along the Earth's orbit where this shower is located.

RA / Dec (J2000)

The position of the shower radiant in the equitorial coordinate system.

RA / Dec Δ

Daily motion of the radiant coordinates.

Velocity

The pre-atmospheric speed of meteoroids in this shower.

Zenith hourly rate

The maximum number of meteors an ideal observer would see in perfectly clear skies with the shower radiant overhead.

Orbital Elements

Semimajor axis

A radius of the orbit at the orbit's two most distant points.

Peihelion distance

Distance when closest to our Sun.

Eccentricity

Amount by which the orbit deviates from a perfect circle. Numbers closer to zero are more circular, and numbers closer to one are more parabolic.

Argument of Perihelion

Angle between the ascending node and the perihelion, measured in the orbital plane.

Ascending node

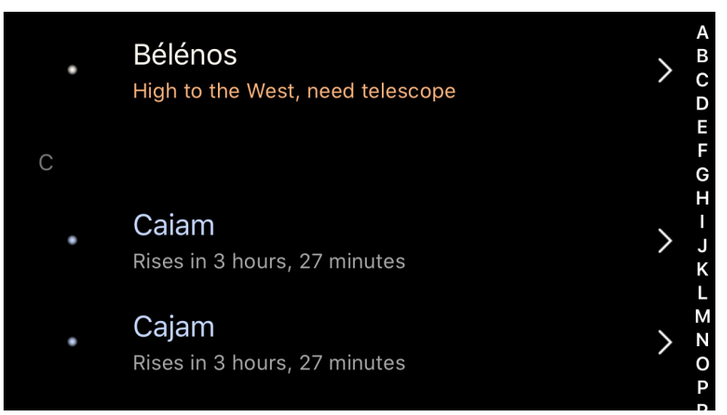
The point on the orbit where the object moves north through the Earth's orbital plane.

Inclination

Angle between the body's plane and Earth's orbital plane.

Stars and Constellations

The stars section allows you to browse hundreds of named stars and find their position in the sky. Stars are also grouped into categories of "Named", "Brightest", "Nearest", and "Variable" to assist your viewing. In addition, you can select choose to view stars from the Hipparcos, Tycho 2, and UCAC4 catalogs. The color of the star in the Browser is indicative of the actual star color.



Star category lists can be sorted by different factors such as name or magnitude. To change the sort criteria, tap the criteria at the top of the list.

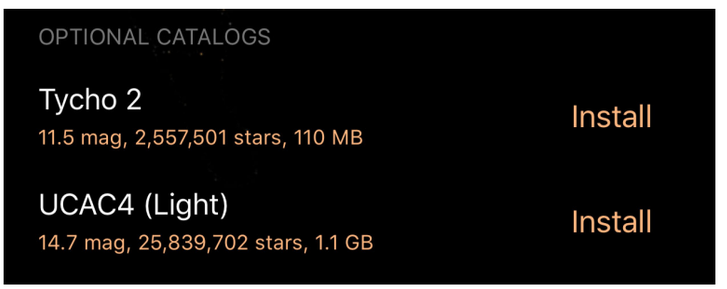
Constellations are the 88 formally recognized areas of the sky noted by the International Astronomical Union (IAU). The names of the constellations are defined by the historical star patterns from which their names derive. Asterisms are informal shapes in the sky which vary in terminology and definition among many cultures. There are no strict asterism lists.

To learn more about the various constellations and asterisms, select the Constellations

or Asterisms categories and browse through the alphabetical list of star groupings. Each contains an information summary and article.

For a more detailed look at the most well-known stars, tap the entry for "Jim Kaler's Stars". This item will take you to a writeup by noted astronomer Jim Kaler with all of the most important facts about your selection.

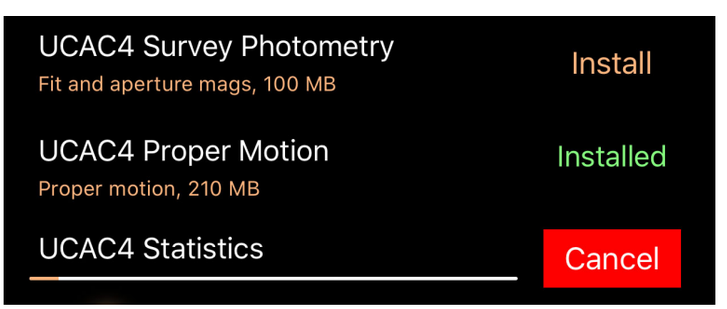
Luminos allows you to choose optional star catalogs tailored to your needs and device storage size. The built-in Hipparcos catalog contains 118,000 stars, but you can install the Tycho-2 catalog or varying sizes of the UCAC4 catalog to scale up to many millions of stars.



Each catalog will list the number of stars, magnitude limit, and size on device.

Note that optional star catalogs will require additional device storage space--up to many additional gigabytes--depending on the chosen catalog. Additional storage above and beyond the listed size of the catalog will be necessary during installation, but will be available again on the device afterwards. Make sure that your device has approximately twice the listed storage during installation to avoid any errors.

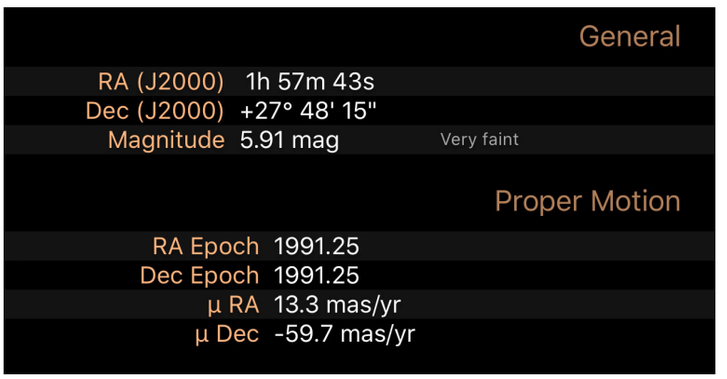
Also note that only one variant of the UCAC4 catalog can be installed on the device at any time. Choosing to install a version of UCAC4 will automatically remove any other installed version from the device.



To install an optional catalog, tap the "Install" button next to the listed catalog. You must keep Luminos active during the install process. The installation will take place in 5 steps:

1. Downloading: The catalog is downloaded from Apple's servers. Note that this can take a long time depending on the size of the catalog chosen and the available network connection.
2. Decompressing: The compressed catalog is expanded on the device to its full size.

3. Indexing: A file is created on the device to list all stars in the catalog.
4. Sorting: The previously created star list is sorted.
5. Finalizing: Final files for displaying the catalog in the sky are created.



After an optional catalog is successfully installed, additional supplemental downloads are also made available for download. These include extra data on its stars, such as proper motion and statistics. A similar, two-step installation process occurs for each supplemental download. The data from supplemental catalogs will only be visible in the detail view page of a star in that catalog.

To delete a catalog or supplemental data set, swipe left across the catalog or data set title. Deleting a catalog automatically deletes any corresponding data sets that were installed.

Details

You can find more details on a particular star, such as which catalog designations it has, by setting its view to Advanced mode, or by tapping the position or magnitude areas of its display.

Position

Horizontal Az

Azimuth, a measurement from a viewer to the object projected on a reference plane. Part of the horizontal coordinate system, along with altitude.

Horizontal Alt

Altitude, the vertical elevation in degrees of the object from the horizon, measured in degrees. Part of the horizontal coordinate system, along with azimuth.

Equatorial (now) RA

Right ascension is the celestial equivalent of terrestrial longitude.

Equatorial (now) Dec

Declination is the celestial equivalent of terrestrial latitude.

Equatorial (J2000) RA

Right ascension referenced from the point in time at January 1, 2000.

Equatorial (J2000) Dec

Declination referenced from the point in time at January 1, 2000.

Ecliptic Lon

Longitude relative to the ecliptic plane, the plane formed by the path the Earth travels around the Sun.

Ecliptic Lat

Latitude relative to the ecliptic plane, the plane formed by the path the Earth travels around the Sun.

Galactic Lon

Longitude relative to the galactic plane, the plane formed by the disk containing most mass in our galaxy.

Galactic Lat

Latitude relative to the galactic plane, the plane formed by the disk containing most mass in our galaxy.

Heliocentric X

X dimension of the Cartesian coordinates of the object relative to our Sun.

Heliocentric Y

Y dimension of the Cartesian coordinates of the object relative to our Sun.

Heliocentric Z

Z dimension of the Cartesian coordinates of the object relative to our Sun.

For Hipparcos catalog stars, the following data applies:

Hipparcos data

Position

RA (J2000)

Right ascension is the celestial equivalent of terrestrial longitude.

Dec

Declination is the celestial equivalent of terrestrial latitude.

Parallax

Difference in a star's position at multiple measurements throughout the year. Used to determine a star's distance.

Reference flag

Reference flag for astrometric parameters of double and multiple systems. Consult the Hipparcos guide for more information.

Motion

pmRA

Change in position of the right ascension per year.

pmDE

Change in position of the declination per year.

Spectrum

Vmag

The magnitude in the Johnson UBV photometric system.

BT magnitude

Blue magnitude (445 nanometers). Refers to the photometric system used to measure the stars.

VT magnitude

Visual magnitude (551 nanometers). Refers to the photometric system used to measure the stars.

Johnson B-V

Difference between blue and visual magnitudes.

Cousins' V-I

Difference between visual and infared magnitudes.

Combined flag

Consult the Hipparcos guide for more information.

Reduction V-I

Difference between visual and infared magnitudes.

Spectral type

A classification of stars based on their spectral characteristics. According to an informal tradition, O stars are "blue", B "blue-white", A stars "white", F stars "yellow-white", G stars "yellow", K stars "orange", and M stars "red", even though the actual star colors perceived by an observer may deviate from these colors depending on visual conditions and individual stars observed.

Variability

Variable type

'C' for constant, 'P' for periodic, 'D' for duplicity-induced, 'M' for micro-variable, 'R' for revised color index.

Period

Cycle duration of brightness of the star.

Hip. magnitude

Median magnitude in the Hipparcos photometric system.

Range

Difference in brightness between brightest and dimmest readings.

observations

Number of Hipparcos magnitude observations.

Scatter

Scatter of the Hipparcos magnitude observations.

Reference

Reference flag for the photometric parameters. Consult the Hipparcos guide for more information.

Additional info

More information on variability.

Designations

Hipparcos

Unique identifier in the Hipparcos catalog.

Henry Draper

Unique identifier in the Henry Draper catalog.

Bonner DM

Unique identifier in the Bonner Durchmusterung.

Cordoba DM

Unique identifier in the Cordoba Durchmusterung.

Cape Photo. DM

Unique identifier in the Cape Photographic Durchmusterung.

Multiple star

CCDM

Identifier in the Catalogue of Components of Double and Multiple Stars.

Historical status

'H': determined multiple by Hipparcos; 'I': determined multiple by an input catalog; 'M': determined by miscellaneous catalogs.

Num. entries

Number of separate catalogue entries with the same CCDM identifier.

Num. components

Number of components into which the entry was resolved.

Add'l info in annex

Double and multiple systems annex flag. 'C': component solutions, 'G': acceleration terms , 'O': orbital solutions, 'V': variability-induced movers, and 'X': stochastic solution.

Measurement

Source

This field qualifies the source of astrometry. 'F': fixed system; 'I': independent system; 'L': linear system; 'P': primary target; 'S': single-star merging.

Solution quality

This provides an indication of the reliability of the double or multiple star solution: 'A','B','C', 'D'.

Component IDs

Letter combinations representing the reference of brightness between two components.

Pos. angle

The position angle between components.

Angular sep

The angular separation between components.

Magnitude diff

This field gives the magnitude difference between the components, expressed in mag.

Is survey star

The 'survey' was the basic list of bright stars added to and merged with the total list of proposed stars, to provide a stellar sample (almost) complete to well-defined limits. A flag 'S' indicates that the entry is contained within this 'survey'.

Chart

Where identification of the star using ground-based telescopes might prove difficult or ambiguous (e.g. for faint stars, for crowded zones, or for components of double or multiple systems), identification charts were constructed. A value of 'D' indicates charts produced directly from the STScI Digitized Sky Survey, while a value of 'G' indicates charts constructed from the Guide Star Catalog.

Notes

Flag indicating that the Hipparcos catalog contains additional notes about this star.

Correlation

DE:RA

Correlation coefficient for declination over right ascension.

pmDE:pmRA

Correlation coefficient for declination over right ascension.

pmRA:DE

Correlation coefficient for proper motion right ascension over declination.

pmRA:RA

Correlation coefficient for proper motion right ascension over right ascension.

pmRA:Plx

Correlation coefficient for proper motion right ascension over parallax.

Plx:RA

Correlation coefficient for parallax over right ascension.

Plx:DE

Correlation coefficient for parallax over declination.

pmDE:DE

Correlation coefficient for proper motion declination over declination.

pmDE:RA

Correlation coefficient for proper motion declination over right ascension.

pmDE:PIx

Correlation coefficient for proper motion declination over parallax.

Goodness of fit

This number indicates the goodness-of-fit of the astrometric solution to the accepted data.

Rejected

This field gives the percentage of data that had to be rejected in order to obtain an acceptable astrometric solution.

Tycho-2 is a catalog of more than 2.5 million stars compiled by the European Space Agency. For Tycho-2 catalog stars, the following data will be present if the supplemental data is installed:

Tycho-2 main entry

Position

Mean RA

The mean right ascension in decimal degrees in the ICRS system and J2000 equinox. Several catalogs are used to determine the Mean RA.

Mean RA epoch

The epoch of the mean right ascension in Julian years.

Dec

The mean declination in decimal degrees in the ICRS system and J2000 equinox. Several catalogs are used to determine the declination.

Mean Dec epoch

The epoch of the mean declination in Julian years.

positions used

The number of positions used in order to compute the mean position and proper motion.

Observed RA

The Right Ascension of the star, in the ICRS system (J2000 equinox), at the epoch specified by the parameter ra_epoch, and given in decimal degrees.

Observed RA epoch

The epoch of the observed right ascension in years.

Observed Dec

The declination of the star, in the ICRS system (J2000 equinox), at the epoch specified by the parameter dec_epoch, and given in decimal degrees.

Observed Dec epoch

The epoch of the observed declination in years.

Motion

μ RA

The proper motion in the RA direction, in milliarcseconds per year.

μ DE

The proper motion in the declination direction, in milliarcseconds per year.

Spectrum

BT magnitude

The Tycho-2 BT (blue) magnitude, blank when no magnitude is available.

VT magnitude

The Tycho-2 VT (visible) magnitude, blank when no magnitude is available.

Designations

Tycho

The TYC identifier is constructed from the Guide Star Catalog region number, the running number within the region and a component identifier which is normally 1. All are separated by hyphens.

Hipparcos

If this star has a Hipparcos designation, it will be listed here.

Measurement

Is Tycho-1 star

A flag which specifies whether or not the star was in the original Tycho Catalog (Tycho-1).

Solution type

A flag describing the type of Tycho-2 solution, where 'D' = double star treatment, 'P' = photocentre treatment, and no value = normal treatment.

Proximity

A proximity indicator, being the angular distance in units of 100 mas to the nearest entry in the Tycho-2 main catalog or first supplement.

Statistics

DE:RA

The correlation coefficient of the observed right ascension and declination.

GoF Mean RA

The goodness-of-fit parameter for the mean right ascension. This goodness of fit is the ratio of the scatter-based error to the model-based error.

GoF Mean Dec

The goodness-of-fit parameter for the mean declination. This goodness of fit is the ratio of the scatter-based error to the model-based error.

GoF Motion RA

The goodness-of-fit parameter for the proper motion in right ascension. This goodness of fit is the ratio of the scatter-based error to the model-based error.

GoF Motion Dec

The goodness-of-fit parameter for the proper motion in declination. This goodness of fit is the ratio of the scatter-based error to the model-based error.

UCAC4 is the fourth version of a catalog created by the United States Naval Observatory and released in 2012. It contains approximately 113 million stars. For UCAC4 catalog stars, the following data will be present if the supplemental data additions are installed. If the "Error Statistics" supplement is installed, error values will be shown next to the listed values.

UCAC4 main entry

General

RA (J2000)

The right ascension in the ICRS system and J2000 epoch.

Dec (J2000)

The declination in the ICRS system and J2000 epoch.

Magnitude

The logarithmic brightness of the star. Higher numbers are less bright.

Proper Motion

RA Epoch

The central epoch for mean RA.

Dec Epoch

The central epoch for mean Dec.

μ RA

The proper motion in the RA direction, in milliarcseconds per year.

μ Dec

The proper motion in the declination direction, in milliarcseconds per year.

UCAC4 Survey Photometry

Model (579-642 nm)

UCAC fit model magnitude.

Aperture (579-642 nm)

UCAC aperture magnitude.

UCAC4 APASS Photometry

B (445 nm)

The UCAC blue magnitude, blank when no magnitude is available.

V (551 nm)

The UCAC visible magnitude, blank when no magnitude is available.

g (475 nm)

The UCAC green magnitude, blank when no magnitude is available.

r (622 nm)

The UCAC red magnitude, blank when no magnitude is available.

i (763 nm)

The UCAC infrared magnitude, blank when no magnitude is available.

UCAC4 2MASS Photometry

J (1220 nm)

The UCAC J spectrum, blank when no magnitude is available.

H (1630 nm)

The UCAC H spectrum, blank when no magnitude is available.

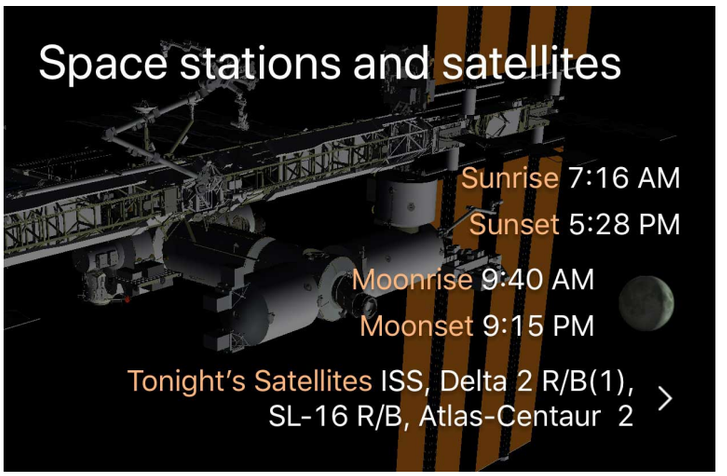
K (2190 nm)

The UCAC K spectrum, blank when no magnitude is available.

Space Stations and Satellites

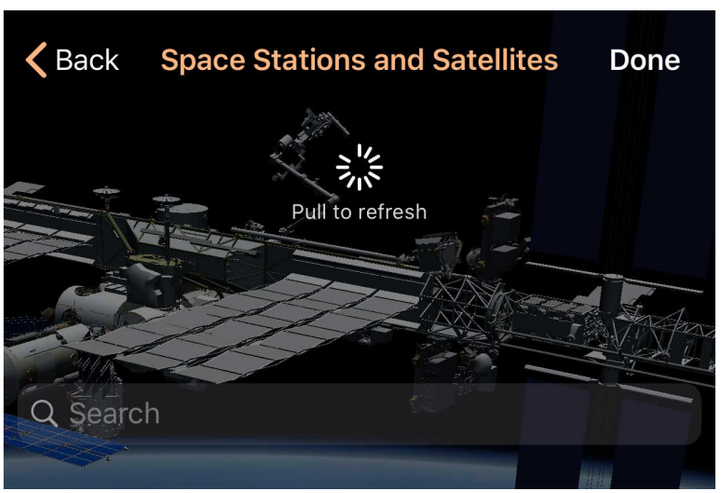
Satellite information for Luminos is currently provided by CelesTrak, a tracking

resource from Dr. T. S. Kelso and the Center for Space Standards and Innovation (CSSI). Luminos also supports custom sources for satellites from two-line element set (TLE) files. From the main satellites page, you can quickly see which satellites will be in prime viewing tonight from your current location.

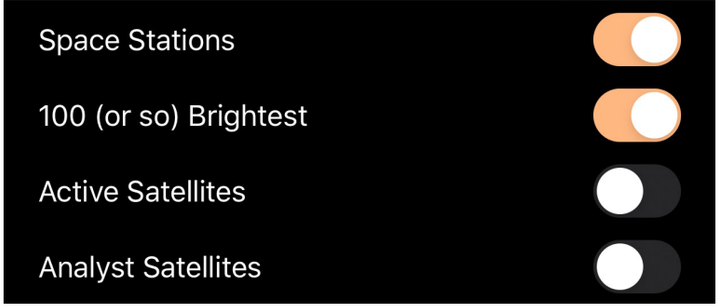


CelesTrak

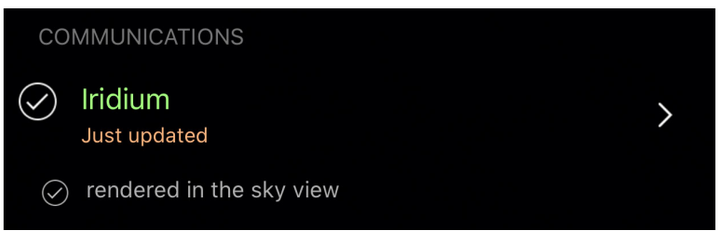
Initially, the satellites list will display Space Stations and objects designated to be in the one hundred (or so) brightest in the sky. Downloading satellite tracking information requires an Internet connection, but it can be retrieved at infrequent intervals. Typically, information about a given category of satellites is accurate for a week or more, after which the errors in position become more pronounced. Luminos will refresh the data occasionally. To manually refresh the satellite data at any time, simply pull down in the "Space stations and satellites" detail page.



To customize which satellite categories are displayed, tap the "CelesTrak" item. The first option to configure is "Automatic Downloads". Turning Automatic Downloads to "On" will cause Luminos to download satellite information for your selected satellite categories approximately every three days. If you do not enable Automatic Downloads, you can choose to update the satellite information manually by pulling down in the satellite detail page until the refresh status appears.



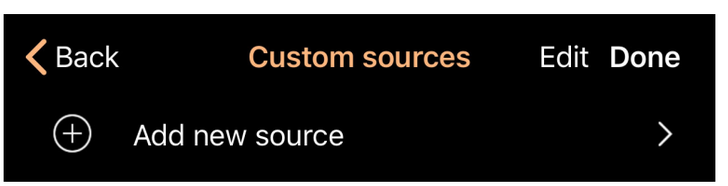
Below the Settings, you can choose which categories of satellites to view. Each category set to "On" will cause Luminos to download an additional information file. Note that the downloads range in size from a few kilobytes typically to a few hundred kilobytes maximum per category.



Once you have chosen the satellite categories you wish to track, navigate back to the satellites list. There, your selected categories will now be available for tracking. Make sure that the categories you want displayed are checked as "rendered in the sky view" if you want to see them in the sky. Any rendered satellites will now appear in the Sky View as colored dots. They will orbit over time according to the downloaded data. You can also browse into any individual satellite from the SkyView or this menu.

Custom sources

Satellite data is generally distributed in the form of TLE (two-line element) files. Luminos can import TLE files from public locations on the Internet and update them at regular intervals by reloading them.

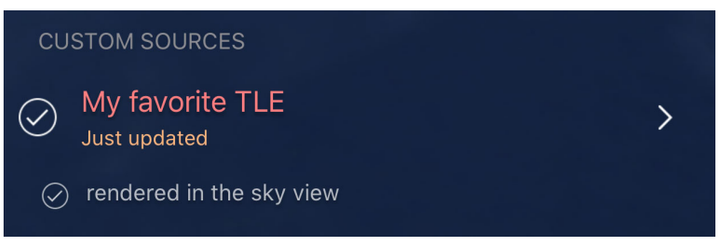


Upon tapping the "Custom sources" option, you will be presented with a list of previously added TLE sources. On first use the list will be empty, and you should tap "Add new source" to continue.

In the next page, you will first be prompted to enter a name for your custom TLE. This name will not affect the display of the satellites, but instead is used only to identify the

satellite in the update lists. Underneath is a field for entering the URL of the TLE file. The file must be publically accessible by your device, and must conform to the TLE format.

Once your TLE information is entered, you will be returned to the TLE list page. From here, you can delete a custom TLE by swiping across it, edit it by tapping its name, or return to the global satellite list.



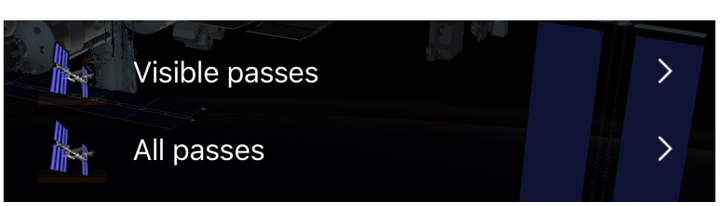
Make sure to set each custom TLE that you would like to track visually to the "rendered in the sky view" state and refresh its data. Your custom satellites will now be updated and displayed in the main satellite list under the "Custom sources" category. Custom TLEs will be updated every three days to ensure that the tracking information is current.

Sky icon

In the Sky View, a satellite will be represented by the following icon, colored appropriate to the satellite's category:

Satellite passes

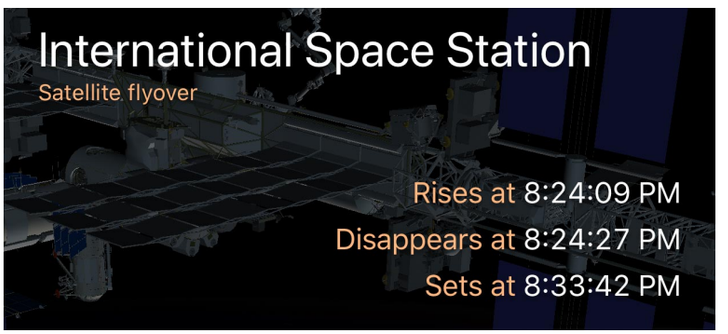
Tapping on the detail view of any satellite offers the ability to view passes of that satellite over your current location. You can choose to view only passes that are visible or the complete list of passes.



In either list, the upcoming satellite flyover passes are chronological by date. Summary information for each pass is shown, and the icon reflects the sky

appearance of the satellite at peak flyover. The next scheduled pass will be highlighted.

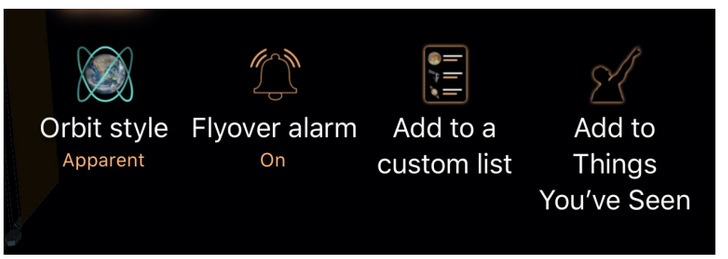
The detail for any particular satellite pass indicates the times and locations of the pass are listed if you tap on any row in the passes list.



From this same display, there are actions to center or zoom in on the satellite. You can also adjust the internal clock of Luminos to the exact moment of rise or set for this pass, which makes it easy to see the path it will take across the sky.

Satellite alarms

Toggling on an alarm for any particular satellite will prompt Luminos to schedule a notification on your device when that satellite becomes visible at your location. Turn off the alarm to disable further notifications. The first time you enable an alarm, Luminos will request permission to send notifications, which is required for this feature.



Any category of satellites with an active alarm will be indicated by a special icon to make them easier to locate and disable.

Satellite alarms will cease scheduling if you have not run Luminos recently. Activating the app will update the list of scheduled alarms for the near future.

The following actions are available for any selected satellite:

Actions

Center on screen

Using this action will select the body and center it on the screen for ease of viewing. As time progresses, the camera will follow the object.

Zoom in

For an even better view, tap this button to enlarge the item in your display view.

Set to...time

When viewing information about a particular satellite flyover event, you can set the Luminos clock to the rise or set time of that flyover to simulate it.

Ride along

This action launches you off of the Earth and puts you in the same position in space as the satellite. From there you can watch the Earth passing beneath you or look around at what space looks like from a satellite. This is especially effective with the International Space Station - search for ISS in the Satellites database to locate the entry for the Space Station.

Orbit style

Switch the appearance of the orbit path between the actual orbit and apparent orbit. The apparent orbit shows the locations above Earth where the satellite travels over time. It is a convenient and interesting way to see a satellite's path relative to locations on Earth.

Flyover alarm

When a satellite has alarms set to "On", Luminos will send notifications to your device when the satellite is appearing overhead at your location. Turn the flyover alarm "Off" to disable these messages.

Add to a custom list

Add the current item to an Observation List. You can define a new Observation List while you add the item.

Add to Things You've Seen

Mark the item as one that you have seen. Its time will be noted in the Things You've Seen list.

Set to rise time (Satellite passes only)

Change the internal clock on Luminos to the time that this satellite is scheduled to rise above the horizon.

Set to set time (Satellite passes only)

Change the internal clock on Luminos to the time that this satellite is scheduled to set below the horizon.

Many satellites include more descriptive information from external sources:

Articles

Wikipedia

If the satellite or satellite group has a Wikipedia article, tapping this option will display the article in the Luminos Browser.

National Space Science

NASA includes helpful web pages with details on many satellites. Tapping this option will open an external browser to the information page of this satellite.

User's Guide

Tapping this option jumps directly to the Luminos User's Guide page for satellite viewing and configuration.

The following additional data can be accessed by tapping on the location description for any satellite detail:

Satellite data

Position

Horizontal Az

Azimuth, a measurement from a viewer to the object projected on a reference plane. Part of the horizontal coordinate system, along with altitude.

Horizontal Alt

Altitude, the vertical elevation in degrees of the object from the horizon, measured in degrees. Part of the horizontal coordinate system, along with azimuth.

Equatorial (now) RA

Right ascension is the celestial equivalent of terrestrial longitude.

Equatorial (now) Dec

Declination is the celestial equivalent of terrestrial latitude.

Equatorial (J2000) RA

Right ascension referenced from the point in time at January 1, 2000.

Equatorial (J2000) Dec

Declination referenced from the point in time at January 1, 2000.

Ecliptic Lon

Longitude relative to the ecliptic plane, the plane formed by the path the Earth travels around the Sun.

Ecliptic Lat

Latitude relative to the ecliptic plane, the plane formed by the path the Earth travels around the Sun.

Galactic Lon

Longitude relative to the galactic plane, the plane formed by the disk containing most mass in our galaxy.

Galactic Lat

Latitude relative to the galactic plane, the plane formed by the disk containing most mass in our galaxy.

Heliocentric X

X dimension of the Cartesian coordinates of the object relative to our Sun.

Heliocentric Y

Y dimension of the Cartesian coordinates of the object relative to our Sun.

HeliocentricZ

Z dimension of the Cartesian coordinates of the object relative to our Sun.

To see details on satellite characteristics, tap the magnitude and velocity information in the detail page.

Designations

Satellite Cat.

The unique satellite catalog number for this object.

Int'l Designation

The international designation for this satellite. The first part of the number represents the year of launch. The second represents the order in which the satellite was launched that year. The final letter represents which item the satellite was in that particular launch.

Elements

Data epoch

The time at which this snapshot position was taken.

Revolution

Number of total revolutions this satellite has orbited around the Earth.

Revolutions / day

Number of times per day that the satellite orbits the Earth.

Inclination

One of the six orbital parameters, indicating the angular distance of this satellite's orbit from the Equator.

Ascending node

Represents the point where the orbit of a satellite crosses the equatorial plane going from south to north.

Eccentricity

Represents how circular this satellite's orbit is. Values closer to zero are more circular, and values closer to 1 represent longer, thinner orbits.

Arg. of Perigree

The argument of perigree defines the angle of the object when it is nearest the Earth. Used to orient the orbit in the orbital plane.

Mean anomaly

An angle that represents how far along the orbit a satellite is at a given point in time.

Time derivative

Acceleration of the mean motion of the object.

Second derivative

Acceleration of the acceleration of the mean motion of the object.

BSTAR drag

The rate at which the satellite is spiraling towards Earth. Represented in revolutions per day.

Ephemeris type

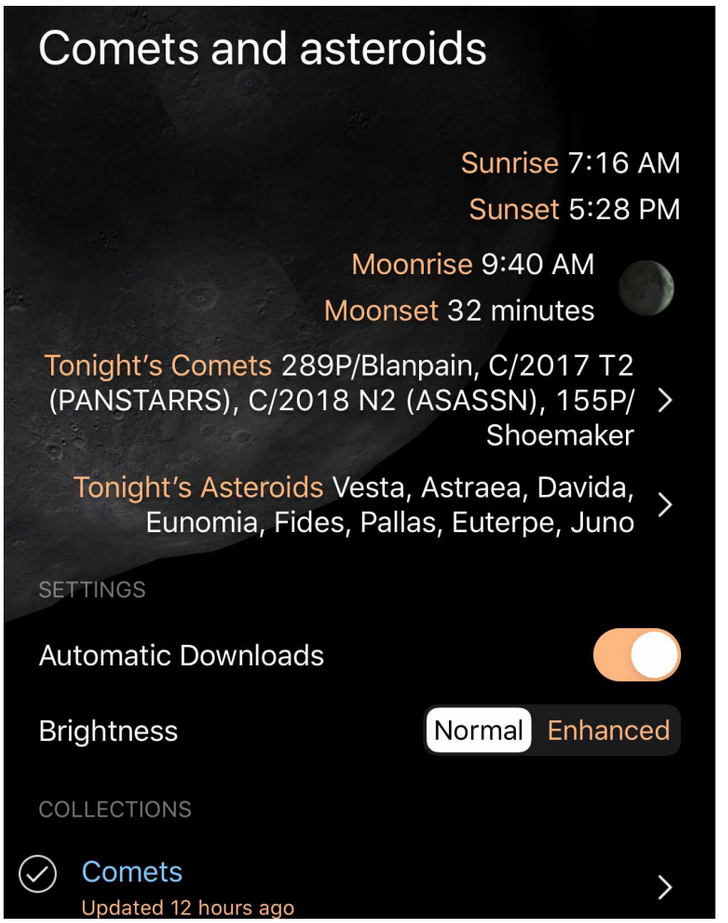
A type indicator which is always zero for publicly-released tracking information.

Comets and Asteroids

Comets and asteroids, or "small bodies", are natural objects that do not orbit the Earth. Comets and asteroids are divided into helpful categories, and the ones visible from your location tonight are summarized at top. To turn categories of small bodies on or off in the display, tap the check next to the category name.

Luminos will update small body locations by contacting the IAU Minor Planet Center once a month, as they will otherwise become inaccurate. They can also be updated immediately by pulling down the detail page to activate the "Refresh" control. If you would prefer to only update small body data at the time of your choosing, you can

switch the Automatic Downloads setting to "Off".



Use the Brightness setting to control how comets and asteroids are shown in the Sky View. When set to "Normal", comets and asteroids will display at their actual brightness, which is generally dim from Earth. Setting the Brightness to "Enhanced" will draw them brighter so that it is easier to track their position from the ground.

In the Sky View, a small body will be represented by the following icon, colored appropriate to the small body's category:

Actions

Center on screen

Using this action will select the body and center it on the screen for ease of viewing. As time progresses, the camera will follow the object.

Zoom in

For an even better view, tap this button to enlarge the item in your display view.

Ride along

Move your location to approximate as if you were riding on the small body. Return home using the Home button in the upper left corner.

Add to a custom list

Add the current item to an Observation List. You can define a new Observation List while you add the item.

Add to Things You've Seen

Mark the item as one that you have seen. It's time will be noted in the Things You've Seen list.

Tapping the location field in any small body display will show the detailed position data.

Position

Horizontal Az

Azimuth, a measurement from a viewer to the object projected on a reference plane. Part of the horizontal coordinate system, along with altitude.

Horizontal Alt

Altitude, the vertical elevation in degrees of the object from the horizon, measured in degrees. Part of the horizontal coordinate system, along with azimuth.

Equatorial (now) RA

Right ascension is the celestial equivalent of terrestrial longitude.

Equatorial (now) Dec

Declination is the celestial equivalent of terrestrial latitude.

Equatorial (J2000) RA

Right ascension referenced from the point in time at January 1, 2000.

Equatorial (J2000) Dec

Declination referenced from the point in time at January 1, 2000.

Ecliptic Lon

Longitude relative to the ecliptic plane, the plane formed by the path the Earth travels around the Sun.

Ecliptic Lat

Latitude relative to the ecliptic plane, the plane formed by the path the Earth travels around the Sun.

Galactic Lon

Longitude relative to the galactic plane, the plane formed by the disk containing most mass in our galaxy.

Galactic Lat

Latitude relative to the galactic plane, the plane formed by the disk containing most mass in our galaxy.

Heliocentric X

X dimension of the Cartesian coordinates of the object relative to our Sun.

Heliocentric Y

Y dimension of the Cartesian coordinates of the object relative to our Sun.

HeliocentricZ

Z dimension of the Cartesian coordinates of the object relative to our Sun.

You can also discover detailed characteristics for small bodies by tapping their information display or switching to the Advanced view. For comets, the following data applies:

MPC Comet entry

General

Name

The unique name of the comet, which contains the family name of the discoverer or team.

Abs. magnitude

The brightness of the object. Lower and negative numbers are brighter.

Number

Some comets are sequentially numbered. In these cases, the numbers are listed here.

Orbit type

Periodic (P) or Non-Periodic (C). Periodic comets as expected to return within 200 years.

Prov. designation

Temporary name given to the comet on initial discovery.

Reference

Designation of the comet from the Minor Planet Center.

Elements (J2000)

Perihelion (Year/Month/Day)

Time when the comet is closest to Sol.

Perihelion distance

Distance when the comet is closest to Sol.

Eccentricity

Amount by which the orbit deviates from a perfect circle. Numbers closer to zero are more circular, and numbers closer to one are more parabolic.

Arg. of perihelion

The orbital element describing the angle of an orbiting body's periapsis (the point of closest approach to the central body).

Ascending node

The point at which the object's orbit passes Sol's ecliptic plane.

Inclination

The angle between the plane of orbit of Sol and Sol's ecliptic. The inclination is measured relative to the equatorial plane of Sol, which is perpendicular to Sol's rotation.

Data epoch (Year/Month/Day)

Time at which the solution was measured.

Slope param

A parameter of visual brightness.

For near-Earth objects, the following data applies:

MPC Minor Planet entry

General

Number

The provisional designation of this object.

Abs. magnitude

The brightness of the object. Lower and negative numbers are brighter.

Slope parameter

A parameter of visual brightness.

Reference

Unique reference number as listed at the Minor Planet Center.

Computer name

Who or what computed this object's orbit.

Readable designation

A code consisting of the year of discovery, a letter representing the half month of discovery, and another letter representing the sequence of discovery in that half month.

Observation

of observations

Number of measurements taken of this object.

of oppositions

Number of times the object has been seen in opposite position from Sol.

Year first observed

Last two numbers of first observation year.

RMS residual

A measure of precision of the solution.

coarse perturbers

Hexidecimal representation of coarse perturbers, as listed in the Minor Planet Center documentation.

precise perturbers

Hexidecimal representation of precise perturbers, as listed in the Minor Planet Center documentation.

Hexdigit flags

A series of bits used to encode the orbit type. For more information, visit the Minor Planet Center documentation.

Last observation in solution

Last time at which the object was observed in this calculated orbit.

Elements

Epoch

The moment in time at which this reference was taken.

Mean anomaly

The mean anomaly is a parameter relating position and time for a body moving in a Kepler orbit.

Arg. of perihelion

The orbital element describing the angle of an orbiting body's periapsis (the point of closest approach to the central body).

Ascending node

The point at which the object's orbit passes Sol's ecliptic plane.

Inclination

The angle between the plane of orbit of Sol and Sol's ecliptic. The inclination is measured relative to the equatorial plane of Sol, which is perpendicular to Sol's rotation.

Eccentricity

Amount by which the orbit deviates from a perfect circle. Numbers closer to zero are more circular, and numbers closer to one are more parabolic.

Mean motion

How fast the object travels around its elliptical orbit.

Semimajor axis

Length of the orbit's longest diameter.

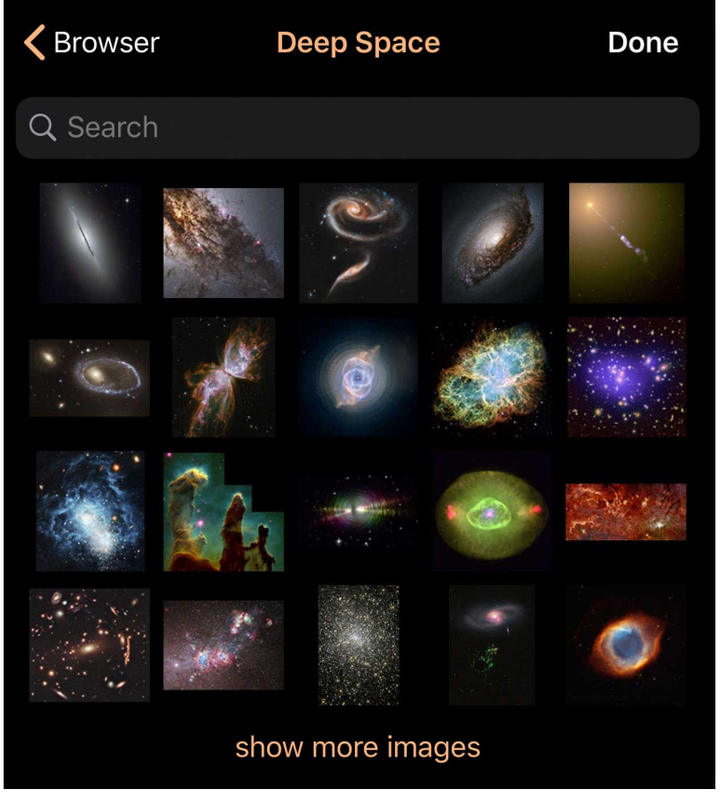
Uncertainty param

Value from zero (least) to nine (greatest) representing uncertainty in the orbit.

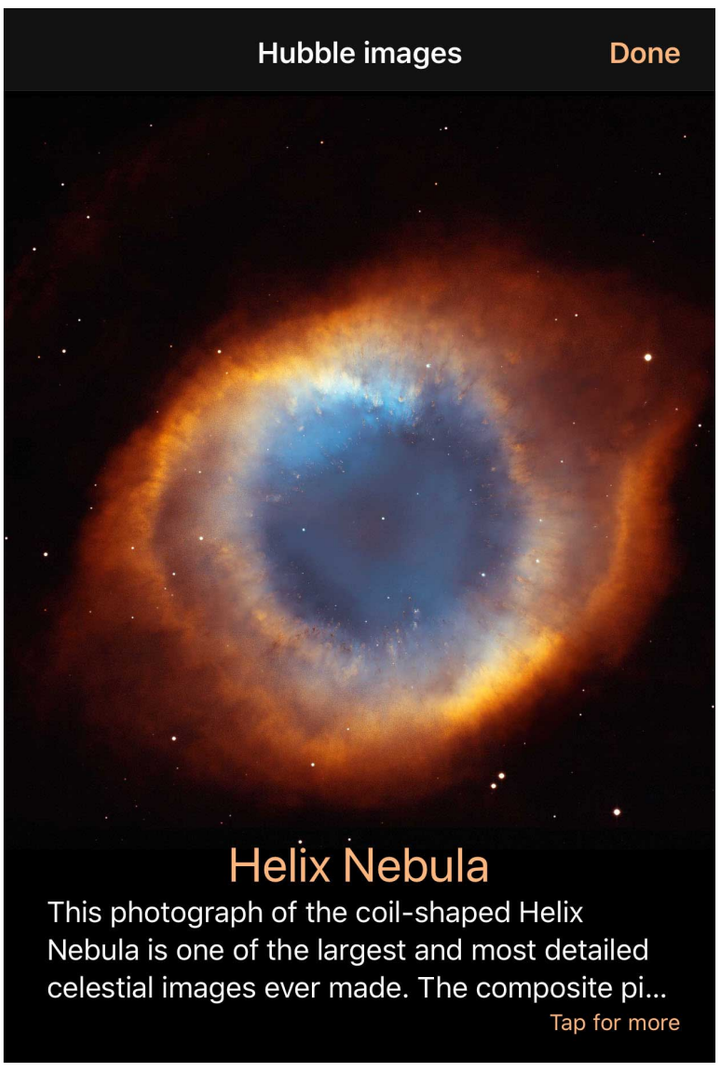
Deep Space

The deep space browser gives you access to thousands of deep space objects and images. Exceptional images are displayed in the main image catalog, but you can also select any object or image through: popular challange lists (Messier, Caldwell, and Herschel 400) that you can mark to completion; categories of object (spiral galaxies, open clusters, etc.); or full catalog lists for the revised New General Catalog (NGC) and Index Catalog (IC), Barnard Catalog, Sharpless Catalog, and RCW Catalog.

To see the detailed description and information of any image in the primary gallery, simply tap it in the grid.



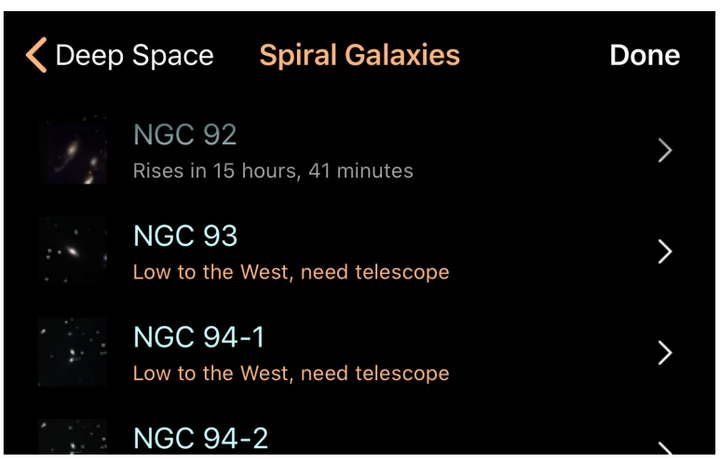
From there, you can tap the image itself for a fullscreen view. Swipe left and right to view other images, or tap the description for more information.



Deep space objects will appear as small dots or star chart symbols in the Sky View from a distance, but will fade into images as you zoom closer in.

If you prefer not to show deep space images in the Sky View, they can be disabled in the Settings.

The Categories section lets you access a list of all deep space objects in any particular category of NGC/IC classification. These categories can be sorted by name/number or by their size.



Alternatively, you can use the full list of catalog entries to find particular items. To control whether or not Luminos displays any particular catalog in the sky, check or uncheck its name in the Catalogs list.

For all deep space objects, you can see detailed position information by selecting the Advanced view or tapping the location description. Detailed data tables can be accessed by tapping the "Catalog data" row.

Position

Horizontal Az

Azimuth, a measurement from a viewer to the object projected on a reference plane. Part of the horizontal coordinate system, along with altitude.

Horizontal Alt

Altitude, the vertical elevation in degrees of the object from the horizon, measured in

degrees. Part of the horizontal coordinate system, along with azimuth.

Equatorial (now) RA

Right ascension is the celestial equivalent of terrestrial longitude.

Equatorial (now) Dec

Declination is the celestial equivalent of terrestrial latitude.

Equatorial (J2000) RA

Right ascension referenced from the point in time at January 1, 2000.

Equatorial (J2000) Dec

Declination referenced from the point in time at January 1, 2000.

Ecliptic Lon

Longitude relative to the ecliptic plane, the plane formed by the path the Earth travels around the Sun.

Ecliptic Lat

Latitude relative to the ecliptic plane, the plane formed by the path the Earth travels around the Sun.

Galactic Lon

Longitude relative to the galactic plane, the plane formed by the disk containing most mass in our galaxy.

Galactic Lat

Latitude relative to the galactic plane, the plane formed by the disk containing most mass in our galaxy.

Heliocentric X

X dimension of the Cartesian coordinates of the object relative to our Sun.

Heliocentric Y

Y dimension of the Cartesian coordinates of the object relative to our Sun.

Heliocentric Z

Z dimension of the Cartesian coordinates of the object relative to our Sun.

For Revised New General Catalog and Index Catalog objects, the following detailed data applies. Not all data will be availble on all object types:

NGC/IC Catalog data

Catalog

ID

The catalog number of the NGC or IC object. Some will have extension letters.

Status

The kind of object, such as galaxy, nebula, cluster, star, or special catalog reference.

Type

Detailed information on the object type, such as the type of galaxy or cluster. This information is coded, and described in detail online.

Dreyer object

Indicates whether or not this object was in Dreyer's original catalog.

Position

High precision

Specifies whether or not this object uses high precision data.

RA (J2000)

The right ascension coordinate in J2000 epoch.

Dec (J2000)

The declination coordinate in J2000 epoch.

Photometrics

Blue magnitude

The magnitude of the object in the blue spectrum.

Visible magnitude

The magnitude of the object in the visible spectrum.

B-V Color

Difference of visual and blue magnitude.

Surface brightness

The magnitude of the object per unit of size.

Small diameter

The diameter of the object on its smallest axis.

Large diameter

The diameter of the object on its largest axis.

Position angle

For galaxies, the angle of rotation for the object.

Redshift

Amount that radiation from the object is shifted towards the red spectrum. Used to measure whether remote objects are moving toward or away from the observer.

Distance

Distance of the object in mega parsecs.

ID

PGC

The catalog number of the object in the *Catalog of Principle Galaxies*.

IDx

A series of identifiers of this object in other catalogs, followed by any remarks on the object.

For Barnard Catalog objects, the following data applies:

Barnard Catalog

Description

E.E. Barnard's description of the object.

Barnard Catalog data

ID

The unique designation in the Barnard Catalog.

RA (1875)

Right ascension value in the 1875 epoch.

Dec (1875)

Declination value in the 1875 epoch.

RA (2000)

Right ascension value in the 2000 epoch.

Dec (2000)

Declination value in the 2000 epoch.

Diameter

Size of the object.

For Sharpless Catalog objects, the following data applies:

Sharpless Catalog data

ID

The unique designation in the Sharpless Catalog.

Galactic Lon

The Galactic longitude.

Galactic Lat

The Galactic latitude.

Galactic Lon (Lund)

The Galactic longitude based on the Lund pole (pre-IAU system).

Galactic Lat (Lund)

The Galactic latitude based on the Lund pole (pre-IAU system).

RA (B1950)

Right ascension value in the B1950 epoch.

Dec (B1950)

Declination value in the B1950 epoch.

RA (B1900)

Right ascension value in the B1900 epoch.

Dec (B1900)

Declination value in the B1900 epoch.

Diameter

Maximun angular diameter of H II region.

Structure

Classification as to structure, from 1=amorphous to 3=filamentary.

Form

Classification as to form: 1=circular; 2=elliptical; 3=irregular.

Brightness

Classification as to brightness, from 1=faintest to 3=brightest.

Number of stars

Number of associated stars with the H II region.

For RCW Catalog objects, the following data applies:

RCW Catalog data

ID

The unique designation in the RCW Catalog.

Galactic Lon

The Galactic longitude.

Galactic Lat

The Galactic latitude.

RA (B1950)

Right ascension value in the B1950 epoch.

Dec (B1950)

Declination value in the B1950 epoch.

Minor axis

The angular diameter of the short axis of the encompassing ellipse.

Major axis

The angular diameter of the long axis of the encompassing ellipse.

Brightness

Classification as to brightness, (v) very bright (b) bright (m) medium or (f) faint.

IDs

Other catalog identifiers for this object.

Has remarks?

Indicates whether this entry has observational or editorial remarks asociated with it. Luminos will display those remarks in the "Description" section above the Details section.

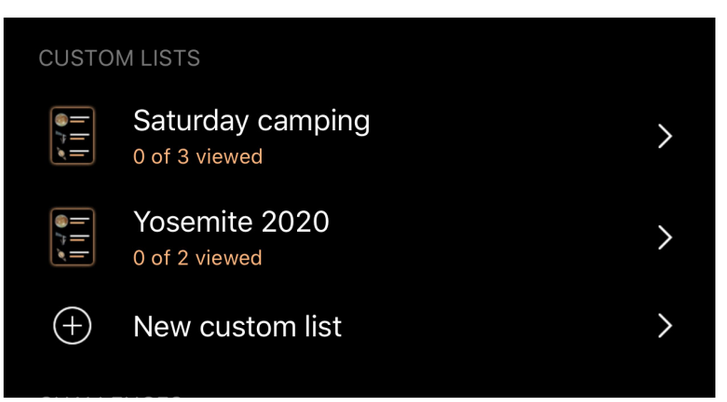
Lists and Challenges

The Observation Lists browser contains custom lists of objects as well as pre-programmed "challenge" lists. The Observation Lists can be accessed through the object browser by tapping the magnifying glass icon

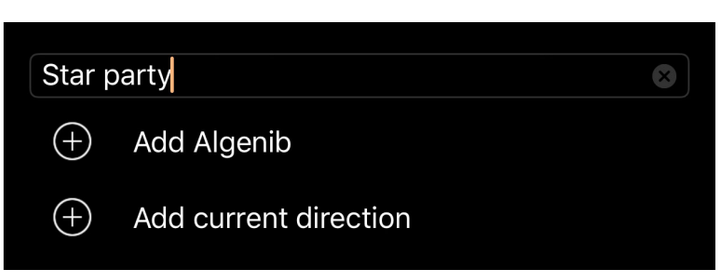
on the toolbar in the lower left corner and then choosing Lists and Challenges in the browser.

Custom Lists

The Custom Lists section is used to manage personal lists of objects. You can create as many lists as you like and each list can have as many objects as you wish. Custom lists are synchronized with iCloud, allowing them to be accessed on all devices with Luminos installed, as long as you are logged into your iCloud account and have suitable Internet connectivity.



To start a new list, tap the "New custom list" item.

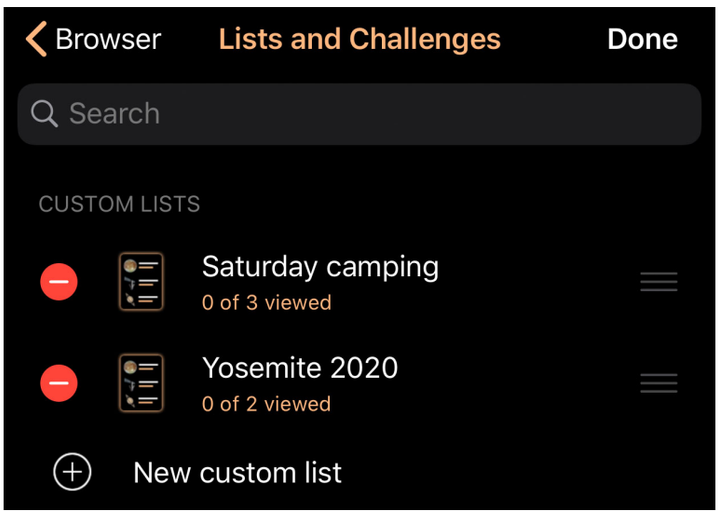


In the editor which opens you can name your list. You can also add the current camera direction to the list or, if you have an object selected, you can add the selected object

to the list.

Editing lists

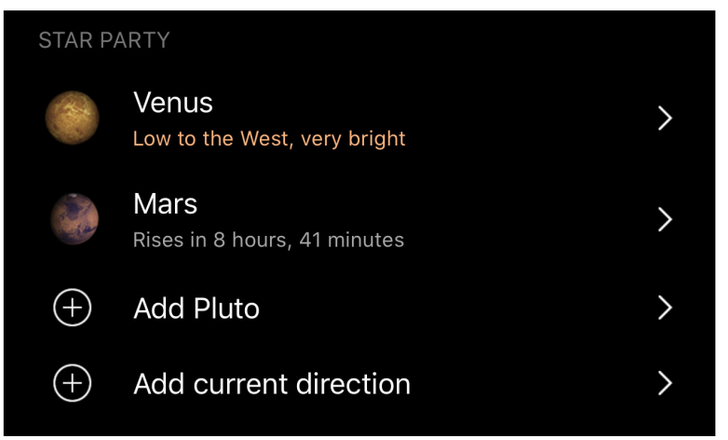
If you wish to delete or rearrange your lists, tap the Edit button in the upper right corner and use the controls which appear. Tap the Done button when you've finished editing your lists.



The list can be rearranged by dragging items around using the stacked-bars icon at the right end of each row.

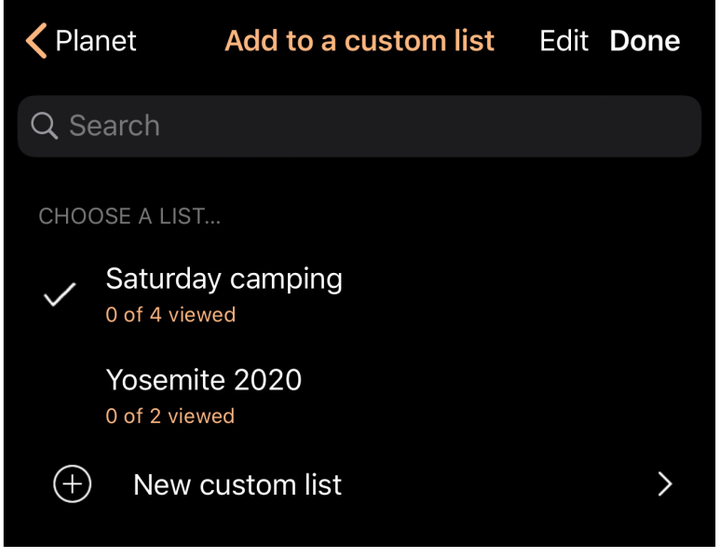
Deleting items can be done either by tapping Edit and then using the Delete control next to the list to reveal the Delete button, or you can simply swipe left on a list and the Delete button will appear without having to use the Edit button.

Adding objects to lists



The current direction or currently selected object can be added to a list by opening the list and then tapping the appropriate row from the "Add new item" section.

Objects can also be added directly to any list. To add an object, browse to it and then use the "Add to list" item in the object's Actions section.



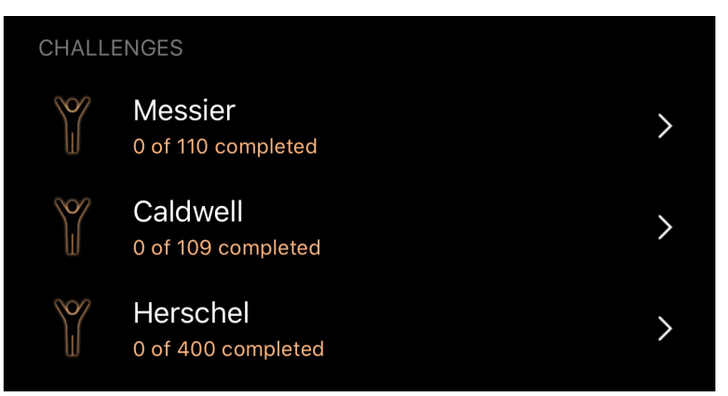
The picker which opens can then be used to add the object to one or more lists at once.

To add an object, tap the list. A checkmark will appear indicating the object is in that list. Tapping a list which already contains the object will remove the object instead and the checkmark will disappear.

The disclosure button at the right can be used if you want to open the list for editing instead of adding the object to it. Once open, the list behaves the same as if you'd opened it through the Observation Lists browser and can be renamed and rearranged if desired.

Challenges

The Challenges section contains popular pre-programmed lists of observation lists.



Just as with Custom Lists, objects in challenge lists can be marked as having been observed and notes can be recorded as well.

Challenge lists can not be renamed, rearranged, or otherwise edited.

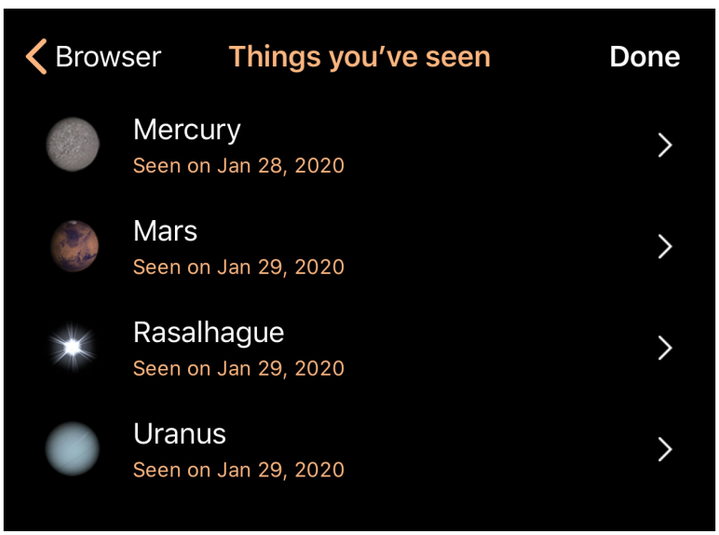
Things You've Seen

Luminos has a built-in utility for tracking any night sky objects you've seen, along with

the date and notes pertaining to the item. For any object you are browsing in Luminos, simply tap

Add to Things You've Seen

to let Luminos know the time when you first saw the object. If you make a mistake, simply tap the icon again to remove the object from the list. If you are logged into iCloud and have a suitable Internet connection, your list of seen objects will be sychronized across any device with Luminos installed.

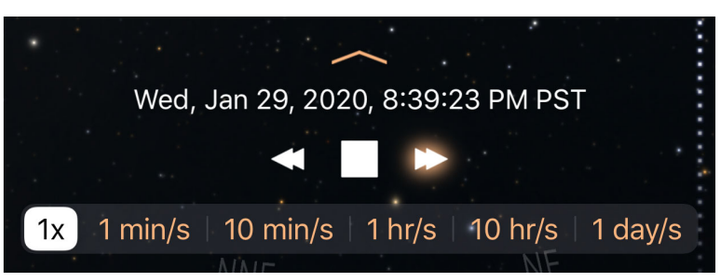


Things you've seen

To see a full list of "Things you've seen", open the Browser and tap the "Things you've seen" row. You will be shown a list with every item you've marked as seen since running Luminos. Marking an item persists between uses of the program.

Time

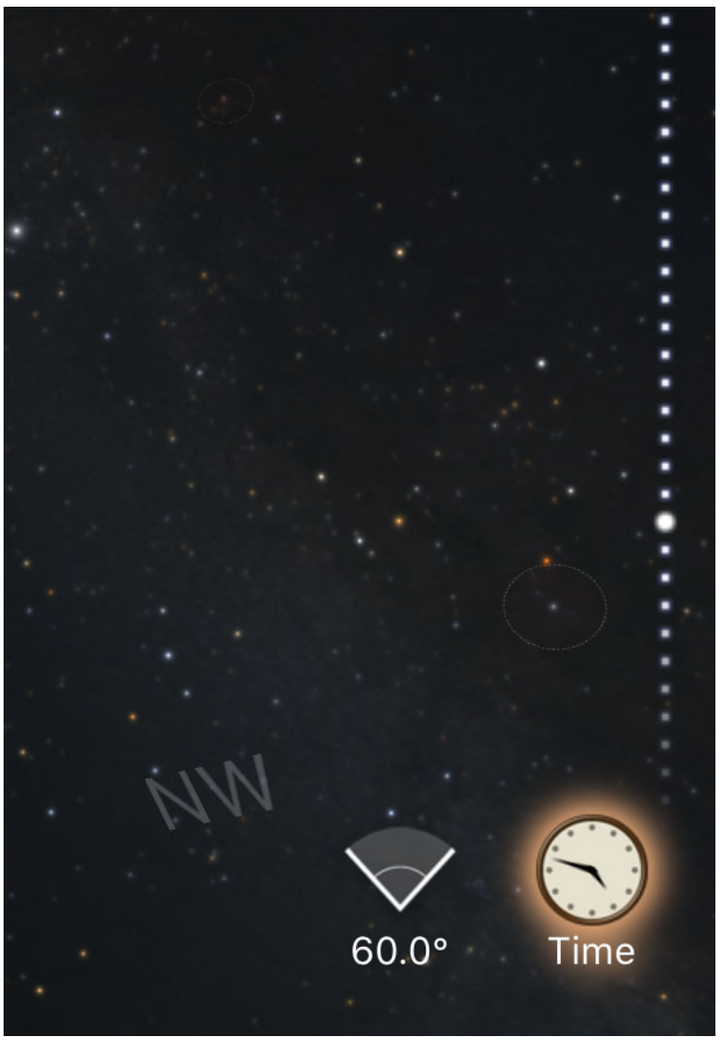
The time controls let you change the date and time as well as control the flow of time. To access the time controls, tap the Clock button in the Toolbar. If at any point you wish to return to the actual date and time, simply tap the "Now" button in the upper left corner of the screen.



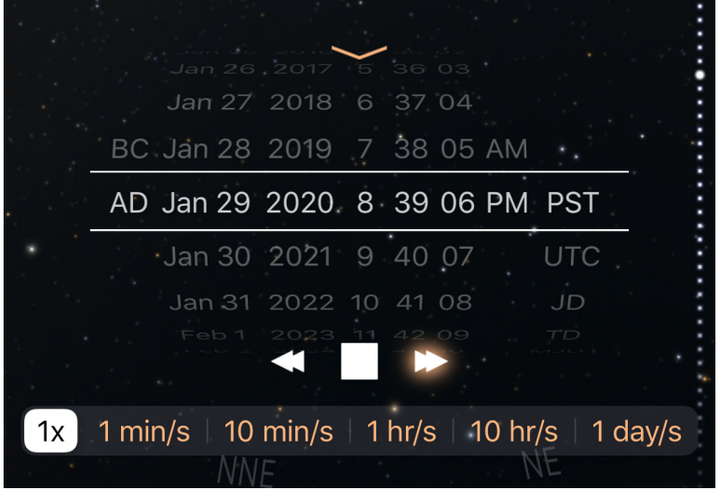
Time Display

Tap the square button to stop time completely. Tap the right button to make time move in the normal (forward) direction. Tapping it again will make time move faster. Tapping the left arrow will slow time, eventually making it flow in reverse.

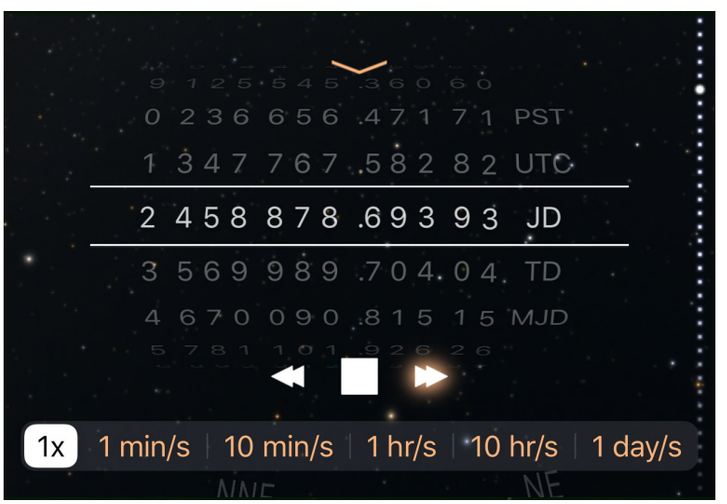
To change the rate of time, you can alternatively use the bar located at the bottom of the screen. Normal time flow is "1x". By setting the choice to "1 min/s", "10 min/s", "1 hr/s", "10 hr/s", or "1 day/s", you can accelerate time. The direction of time flow is toggled with the "Rev", "Stop", and "Fwd" buttons representing reverse, stopped, and forward time flow, respectively.



For a shuttle control of time, a moving wheel will be available on the side of the screen when the time mode is active. Slide up and down on the wheel to jog the time backwards or forwards.



If you want to set to an exact time, tap the disclosure arrow on the time control to open the time setting dials. Slide them to the appropriate time, then close the display using the disclosure arrow again.



This control can also be used to convert from one time system to another. By using the right-most tumbler, you can choose between your local time zone, Coordinated Universal Time (UTC), Julian Date (JD), Dynamical Time (TD), and Modified Julian Date (MJD). This is a convenient way to convert a moment in time between these systems.

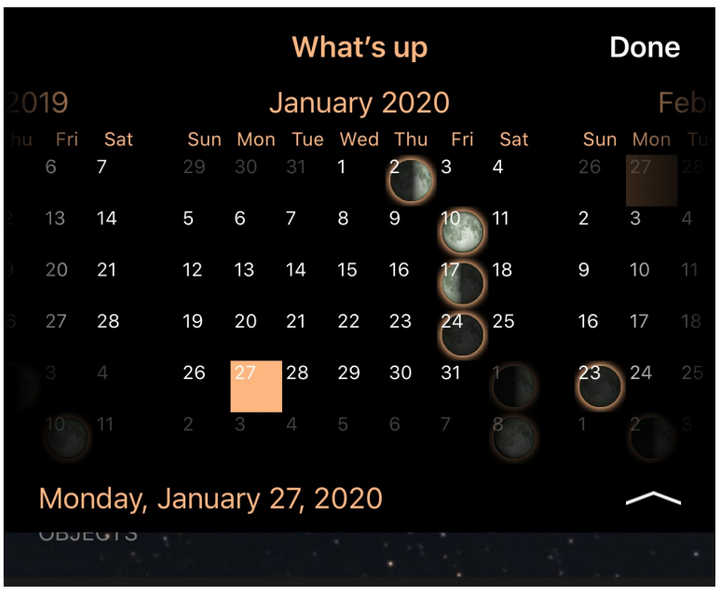
To hide the Time Display, hit the Clock button in the Toolbar again.

Tonight

The Calendar, or "What's Up" display, helps you plan your observation sessions by displaying visibility information for many objects in the sky, including your custom observation lists. To access the calendar, tap the button in the lower left area of the screen.

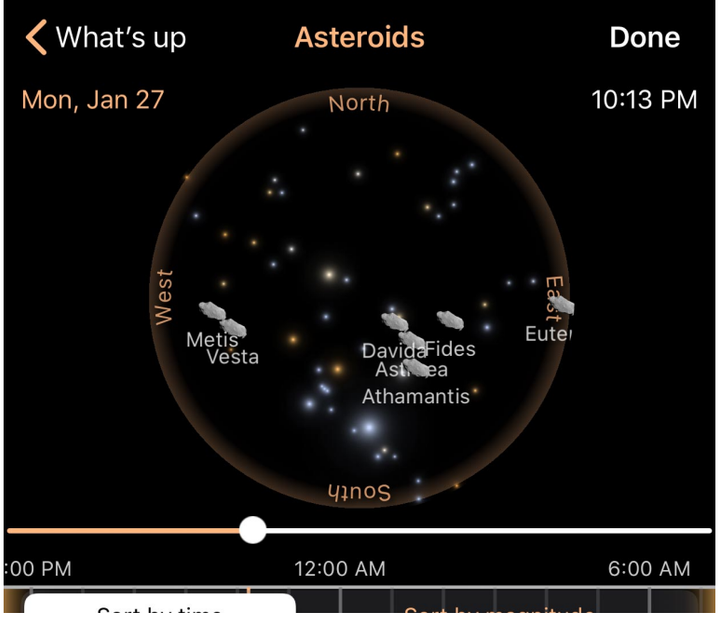
For convenience, Luminos will open to the details for the current date. You can select a different date from the calendar by tapping on that day, or slide across on the month display to move forward or backwards among different months. (The direction to slide

for navigating calendar months may depend on the orientation of your device.) The phases of the moon are shown on each date to indicate the viewing conditions that night.



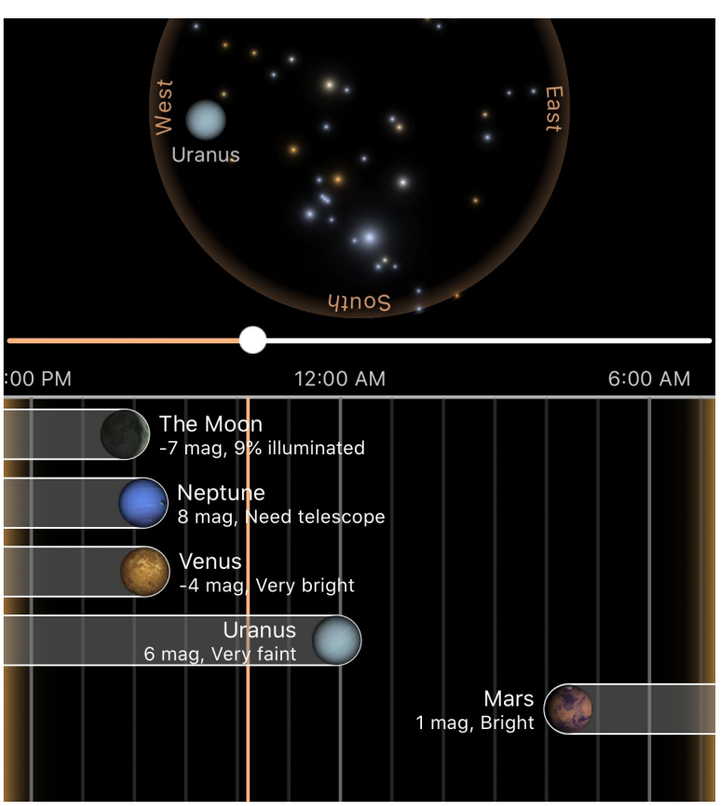
With the month display is a list of categories for which you can see viewing data on the currently selected date. The selected evening will be indicated in the title of the list.

Selecting any category will present an ordered list of objects visible on the selected night at your location. The display will include a sky map indicating where the items will be located above you based on your location. Use the slider to see the movement of those objects over time.



Most lists can be sorted either by time (earliest on top) or by magnitude (brightest on top). You can switch the sort by tapping the selector at the top of the list. Sorting by time is useful when you want to see what is visible as the evening progresses, while sorting by magnitude helps you determine the brightest targets at your location.

In any list, the left side of the display represents earlier times in the evening, and the right side represents the late night and next morning. A time guide is shown across the top, with vertical gray lines representing hour markers and a vertical orange line indicating the current time, if appropriate. Any row in the list will represent an item's visibility for that night, with the circled gray bar showing the time range for that item. Any item which is visible for the entire night will span the full row.



Magnitude values appear on each row, while tapping the row will take the display to details for that item.

Observe

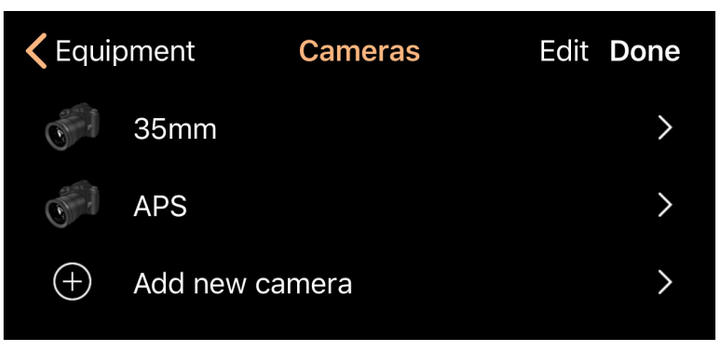
Luminos has tools to assist you with your telescope to simplify tasks like choosing eyepieces and other equipment as well as controlling compatible mounts. If you are logged into an iCloud account and have a suitable Internet connection, your equipment will be synchronized across all devices running Luminos.

To view the observation tools, tap the telescope icon in the Toolbar:

The observation display is divided into a few major sections: Remote control, Equipment, Observation settings, and Calculator.

Equipment

Luminos lets you declare the equipment you are using at your location, and Luminos will then use those choices to augment its display. Once your equipment is declared and chosen, the "Calculator" section of this display will present more data. All equipment you use is declared as part of a "Site", and individual equipment pieces can be swapped out as necessary over time. By default your site is simply named "Home". To rename it, tap the Edit button in the upper right corner of the popover and use the edit field which appears. If this is your first time running Luminos, your equipment will be populated with some default devices. Tap on a category to open a list where you can add, edit, delete and re-arrange your inventory using standard iOS list editing.



Telescope (OTA)

Declaring and choosing a telescope is required for most display capabilities. If you "Add new telescope", you will be presented with a dialog containing options for the name, focal length and aperture of your telescope. The name is optional, and will be defaulted if you skip it. The focal length and aperture of the telescope should be entered in millimeters, and the entries for these fields will be used to calculate other values such as the focal ratio and magnification. Once the telescope is defined, go back to the Site, then select your new telescope in the "Calculators" to make it the active selection.

Eyepiece

You need to declare and select an eyepiece for many of the telescope features to operate. When you "Add new eyepiece", you will be prompted for the focal length of the eyepiece (in millimeters) and the field of view (in degrees). The name is optional, and will be defaulted if left blank. Go back to the Site page when you are finished, then select your eyepiece in the "Calculators" list to make it your active eyepiece. Note that eyepieces and cameras are exclusive; selecting one will deselect the other.

Camera

You can declare a camera and use it as an alternative to an eyepiece. After tapping "Add new camera", you can enter the imaging width and height in millimeters for your camera. Suggested values are shown in the instruction text, or you can consult your camera manual for specifics. The name can be entered at the top, or left blank for a default value. When complete, go back to the Site and select your camera in the "Calculators" to make it active. Cameras are located in the Objective column below the Eyepieces. Note that cameras and eyepieces are exclusive; selecting one will deselect the other.

Barlow

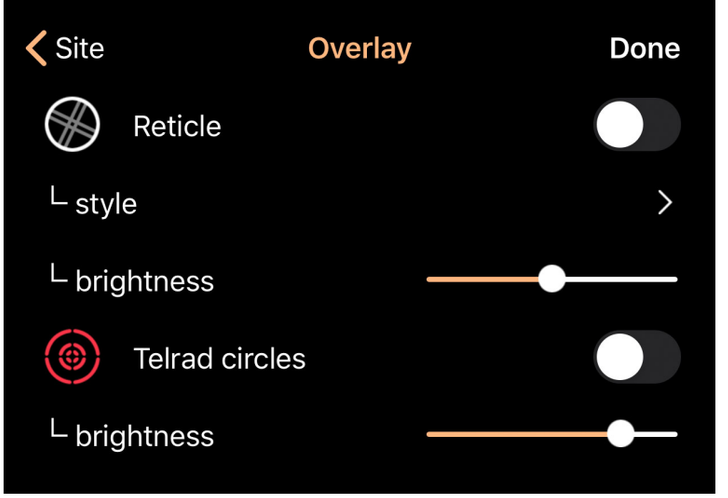
If you use a Barlow lens in your site equipment, you can tap "Add new barlow" and enter the magnification level of that lens. (The name will be defaulted if you do not enter one.) When you are done, navigate back to the Site. There you can select your Barlow in the "Calculators" list if you are currently using it, and it will be included in calculations.

Focal reducer

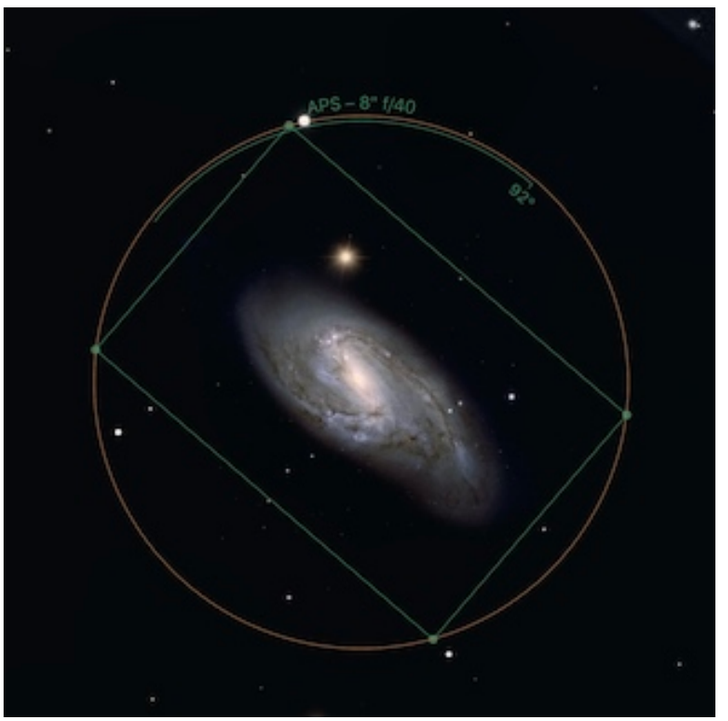
If you use a focal reducer, declare it by tapping "Add new focal reducer" and entering its focal ratio and an optional name. Navigate back to the Site when you are finished, and you can select it in the "Calculators" if it is in use or select "—" if not. It will be included in calculations made by Luminos if chosen.

Observation settings

The first settings option controls overlays, including reticles and telrad circles. The Reticle overlay shows how much you'll be able to see when looking through the selected equipment, but are generally not visible unless you have a tight field of view. Tap on the Reticle row to turn the display on or off, change the brightness, or select a style for the reticle.



When you have a camera selected at your observation site instead of a telescope objective, the reticle will display the dimensions of the camera as a rectangle in the Sky View. To rotate the camera in Luminos to match that of your equipment, tap one of the camera viewfinder corner dots to rotate to your desired angle.

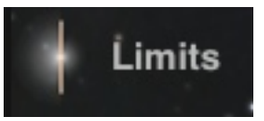


The second overlay is the Telrad Circles display, which shows a series of concentric circles matching those found on a Telrad finder. The circles on Luminos' display can be used to assist in aiming your telescope when using a Telrad device. Tap on the Telrad circles row to turn the display on or off or change the brightness.

The next item in the observation settings allows you to enable or disable flipping controls. Flipping controls provide a simple way to flip the screen display along the horizontal or vertical axis, making it more comfortable to use with a telescope. When the "Enable flipping" option is set to "On", flip buttons will appear in the upper left area of the Sky View, near to where the "Home" and "Now" buttons often appear. Tapping the flip buttons will toggle horizontal or vertical reversal of the display, or both.

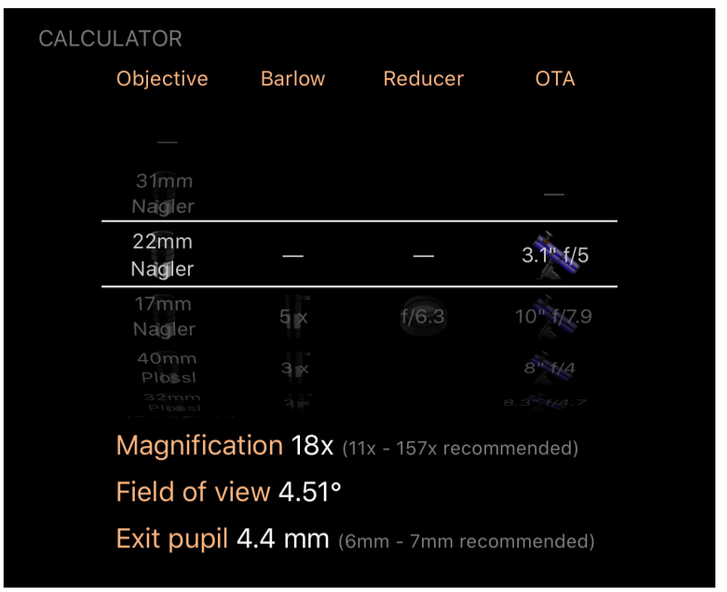
Another item in the settings controls magnitude limits. Turning magnitude limits on will reduce the number of stars shown in the sky view to only reflect those of a brighter magnitude than the number limit you have chosen.

When magnitude limits are in place, you will see a "Limits" indicator at the top of the Sky View. Tap it to return to the limit controls.



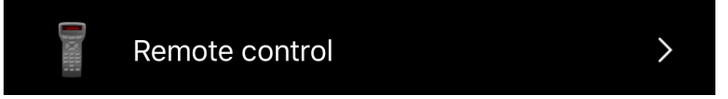
Calculator

The Calculator section in the Site page contains information and tools to assist you with your viewing session. Here you can dial combinations of equipment you have declared above to select them as active and see the effects your choices have on your magnification, field of view, and exit pupil. You must at least select a Telescope and an Objective before any information can be calculated.



Remote Control

The remote control features of Luminos allow you to use Luminos to assist you with using a computer-controllable mount. To access the remote control feature, tap the Observe icon in the main display and then choose the Remote Control item.



Compatibility

If your mount is capable of being controlled by a computer then it's likely that you can use Luminos to control it. Mounts which can be controlled will have either a Serial Port connector, a USB connector, or an Ethernet port designed for the purpose of control by a computer.

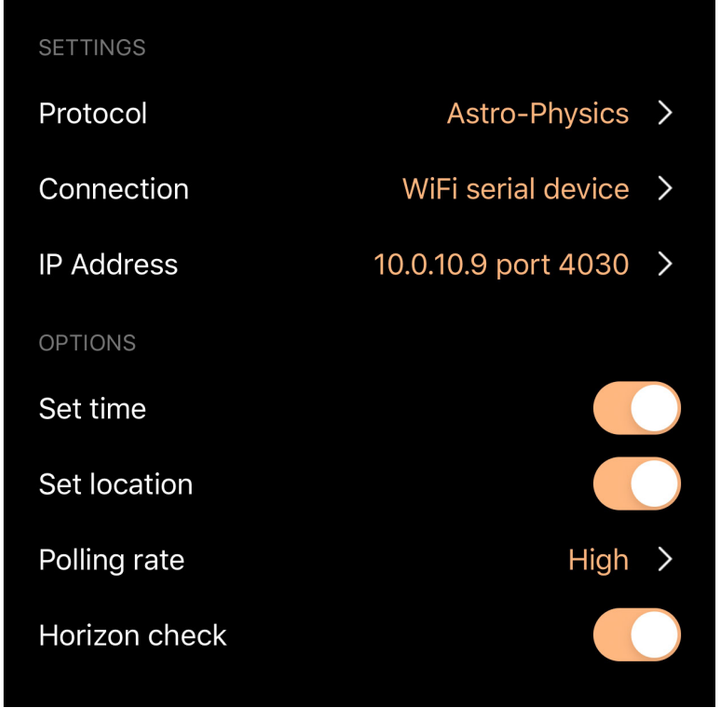
Regardless of which interface your mount has, your iOS device will require an adapter in order to connect. A popular choice is a WiFi adapter which can be connected via Serial or USB cable to your mount. Your iOS device can then connect to the WiFi device wirelessly to control your mount. If your mount has an Ethernet connector then you'll need a router to connect your mount to a network so that this device can communicate with it.

Luminos is compatible with a wide variety of mounts and supports common protocols such as Celestron NexStar, Meade, Astro-Physics and LX200-compatibles. Note that Celestron SkyQ is unsupported because its protocol is proprietary and undocumented.

Configuration

The "Configure…" option is available any time you are not connected to your mount. It is used to configure connection details as well as options supported by your mount.

Configuration consists of selecting the protocol to use when communicating with your mount, selecting how Luminos will be connecting to your mount, and configuring the settings for the connection.



Protocol

Selection of the correct protocol is important and is similar to knowing what language with which to speak to another person. The language in this case isn't a human language but instead specifies the commands the mount understands, how the computer should phrase those commands, and how the mount will reply. If you would like to try out the telescope controls without connecting an actual device, select the Simulator protocol for a demonstration. These are the protocols which Luminos understands:

Astro-Physics

This protocol should be used if you have any Astro-Physics GTO mount. It should not normally used for other manufacturer's mounts unless the manufacturer specifically claims that the Astro-Physics protocol is appropriate for your mount.

Meade

This protocol should be used if you have any Meade mount. This protocol includes features which Meade supports in their mounts but which other manufacturer's often either omit or modify from their Meade-defined behavior. If you have another manufacturer's mount which is Meade-compatible you should probably choose the LX200 Compatible protocol instead, which is the subset of the Meade protocol supported by most manufacturers.

Celestron

This protocol is used by all Celestron NexStar mounts. It may also be appropriate to choose if you have a non-Celestron mount which claims to be compatible with the Celestron protocol.

Orion

This protocol should be chosen for Orion brand mounts, as it has behavior specific to that brand.

Sky-Watcher SynScanLink

The Luminos support for SynScan requires the installation of the separate SynScan or SynScan Pro apps from the App Store. First, you must install, connect, and align your mount using the SynScan app. Then, switch to the Luminos app and select this protocol and connect to the mount with Luminos. Luminos will switch to the SynScan app until it has completed the handoff. Once that is successful, the SynScan app itself will switch back to Luminos where you can continue operating as normal using Luminos controls.

iOptron

This protocol is specific to iOptron brand mounts and should not normally be used with other brands.

LX200 Compatible

This is the most common 'standard' protocol and is understood by a wide variety of computer-controllable mounts. If your mount claims to be Meade-compatible this is the best choice to ensure reliable operation.

Simulator

This protocol choice does not actually connect to remote hardware. Instead, it allows you to experiment with a virtual mount control.

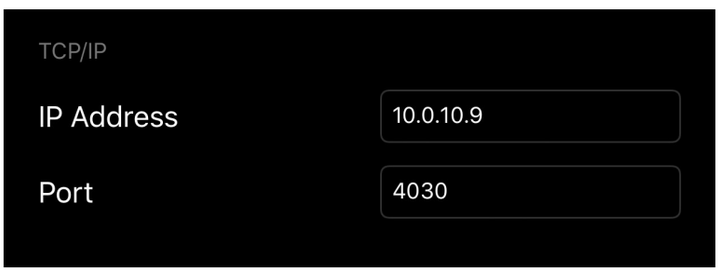
More protocols are being added over time to Luminos. If your mount isn't compatible with one of the available protocols and you'd like to see it supported, contact Wobbleworks at mount-protocols@wobbleworks.com with details. It will be especially helpful if you're willing to beta test a driver for your mount, as it isn't possible or practical to have one of every mount in-house for development.

Connection

The Connection settings tell Luminos how to connect to your mount via a WiFi Serial Device.

IP Address

When connecting via a WiFi serial device you must specify the IP address of your device as well as the port number it is listening on.



For popular devices such as the SkyFi interface using their default "ad hoc" mode, the settings are 10.0.0.1 for the IP address and 4030 for the port number. If you are using another device or have changed the default settings you may need to enter different values for these fields.

Note that there are no serial port settings available when connecting via WiFi. Those settings must be configured on your WiFi Serial Device by following the manufacturer's instructions. Devices designed specifically for connecting to telescopes will usually have the settings configured at the factory to the correct values for most telescopes (9600 baud, 8 data bits, no parity, one stop bit).

Connecting

Once the connection is configured you can connect to your mount by switching the Connection switch from Off to On. Luminos will then establish the connection and configure your mount. You may receive a message if Luminos can't connect to your mount:

Connection failed

If the connection fails you should check your settings and make sure your WiFi device is turned on. You should also make sure that your iOS device is connected to the WiFi network and is using the correct settings for that network. Some WiFi Serial Devices are known to have bugs in certain versions of their firmware. If you're experiencing

dropped connections intermittently check with the manufacturer to see if updates are available.

Mount not responding

This message occurs if Luminos is able to connect to the mount but isn't able to talk to it. The cause may simply be that your mount isn't turned on or that it isn't connected correctly to your WiFi device or cable. This message may also be displayed if the wrong protocol is selected, which would cause the mount to not understand what Luminos is saying to it.

Status display

Once Luminos has successfully connected to your mount the display will change and show status lights, the mounts current direction and various features for controlling the mount.

Status lights

Three lights are shown next to the Connection switch which indicate communication with the mount is occurring. The first light will be green to indicate that the connection is established and working properly. If it is yellow then something has gone wrong while talking to the mount and it may be necessary to re-connect or to change the protocol used. The second and third lights show activity by flashing when data is being sent to the mount (the second light) or being received from the mount (the third light).

Coordinates

The coordinates display shows the direction readings obtained from the mount.

Local Sidereal Time (LST)

Local Sidereal Time is the Right Ascension of the Zenith, which is straight up from wherever you are. Luminos will compare the LST reported by your mount with its own

notion of LST and will warn you if there is a difference by showing a warning icon. Tapping the warning icon will show details about the difference so you can decide if it warrants any action. When there is a difference it means that the calculations used for pointing your mount will be different in Luminos than what your mount will come up with, possibly resulting in pointing errors. LST is determined by time, date and location settings, so if there's a difference you should verify those settings both in Luminos and in your mount.

Follow mount

Selecting this will instruct Luminos to keep the Sky View centered on the mount's current position, updating the view as the mount moves. Even if you're not having Luminos stay centered on the mount, there will be a marker in the sky view showing where the mount is currently pointed.

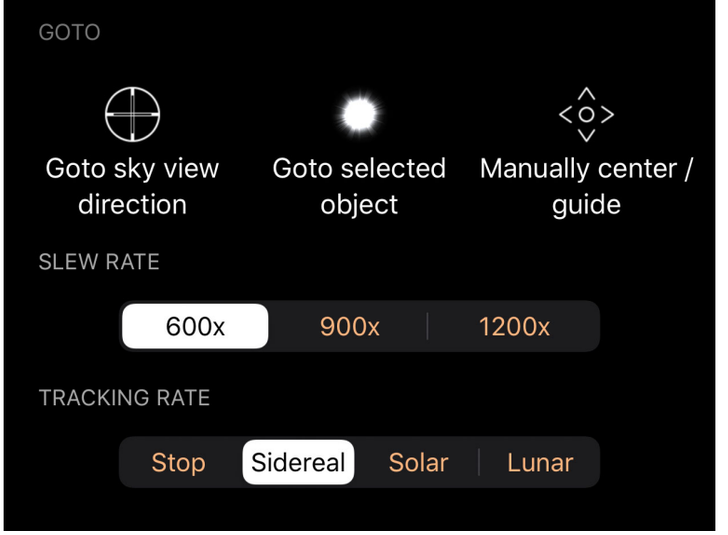
Progress

The progress display is only shown while the mount is slewing (moving) as a result of a Goto command.

The progress bar shows how far along the movement is to its destination and there is also a Stop button which can be used to abort the Goto. Note that the progress bar will sometimes not move initially, or may start to move and then go backwards. This happens because some mount types can't always go directly to a target and must move the telescope out of the way of your tripod or pier before it can go to the destination.

Using Goto

The Goto feature of Luminos makes it simple to aim your telescope at a target using Luminos.



Goto current direction

This option will instruct the mount to aim itself in the same direction that the Sky View in Luminos is currently centered on.

Goto selected object

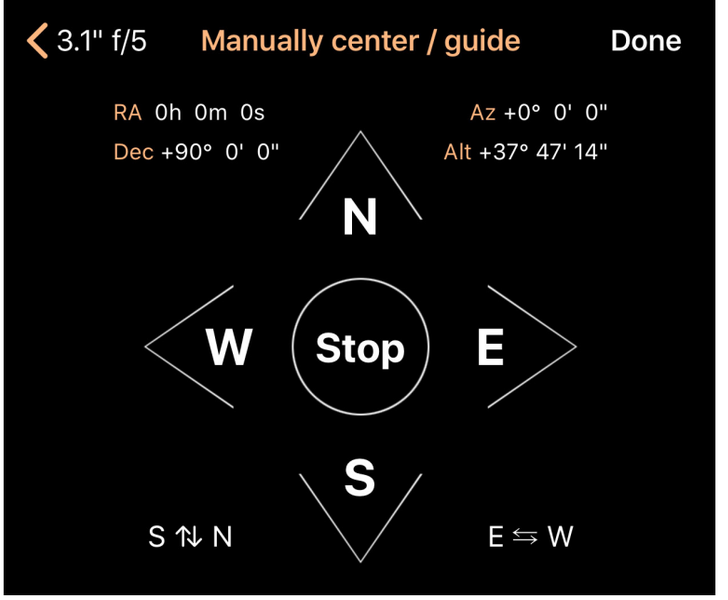
This option is only available if you have selected an object in Luminos and will instruct your mount to aim itself at that object.

Slew rate

Some mounts support changing the speed at which Goto commands will move the scope. If multiple speeds are supported then Luminos will display those in a segmented control. Speed changes only take effect at the start of a slew. To change speed during a slew first stop the slew, then change speed, then start the slew again. Slower speeds will take longer to reach your target but will generally be much quieter and, for some telescopes, may be a safer choice than a fast speed.

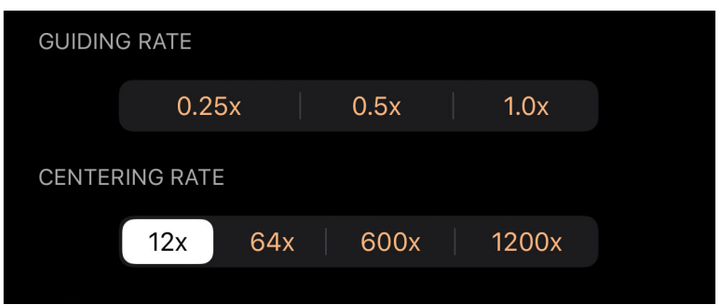
Centering and Guiding

After you've instructed the mount to aim itself at an object using the Goto features, you can use the Centering and Guiding feature to fine-tune the direction.



The four arrow buttons can be used to move the mount in a manner similar to the keypad which came with your mount. You can also use the Swap East/West and Swap North/South buttons to reverse the directions moved on those axis in order to compensate for directional differences caused by aiming your mount at different parts of the sky.

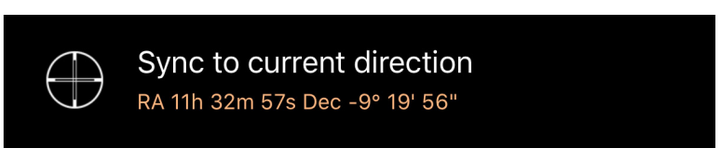
If your mount supports multiple speeds then Luminos will offer those in the form of a segmented control below the arrows.



The actual speeds offered, if any, will vary based on your mount's capabilities.

Syncing

To improve accuracy Luminos also includes syncing options. Syncing instructs the mount to treat whatever direction it's currently aimed as being the same as the direction of the sync option selected. The actual sync options offered will vary based on the capabilities of your mount and some mounts may not offer this feature at all. The Sync options are found below the arrow buttons in the Centering / Guiding section.



Syncing is especially useful for finding dim objects by first having the mount Goto something bright and easy to find which is near the desired dim object. After the Goto the arrow buttons are used to accurately center that bright target. Finally, tapping on

the Sync To Target button will re-calibrate the mount so that it knows it's now pointing exactly at the bright object. Now any Goto commands within a short distance of that target will now be much more accurate which should make it easier to find dim targets nearby.

There are up to three sync options offered, all of which have the same basic behavior and differ in what they sync to.

Sync to target

This option is offered if you recently used one of the Goto features within Luminos to point your telescope at a target. This is the option normally chosen for sync'ing.

Sync to selected object

This option is offered if you have an object selected in Luminos and want the mount to sync to it without having to Goto it first. This option is used if you used your mount's hand controller to perform the Goto but you've switched to Luminos to do the sync. Note that Sync to Selected Object will not be offered if the selected object is the same as the Sync to Target object since that would be redundant.

Sync to current direction

This is similar to the Sync to Selected Object option except that it uses the coordinates of the center of Luminos' Sky View as the sync target.

Mount Features

If Luminos supports additional features of your mount then they will be listed under the Features section while you are connected to the the mount.

Features may include the ability to view Info gleaned from your mount, Park and Unpark your mount, adjusting the brightness of a reticle, or adjusting an attached focuser.

Which features are available and the options available within those features will vary depending on what your mount supports.

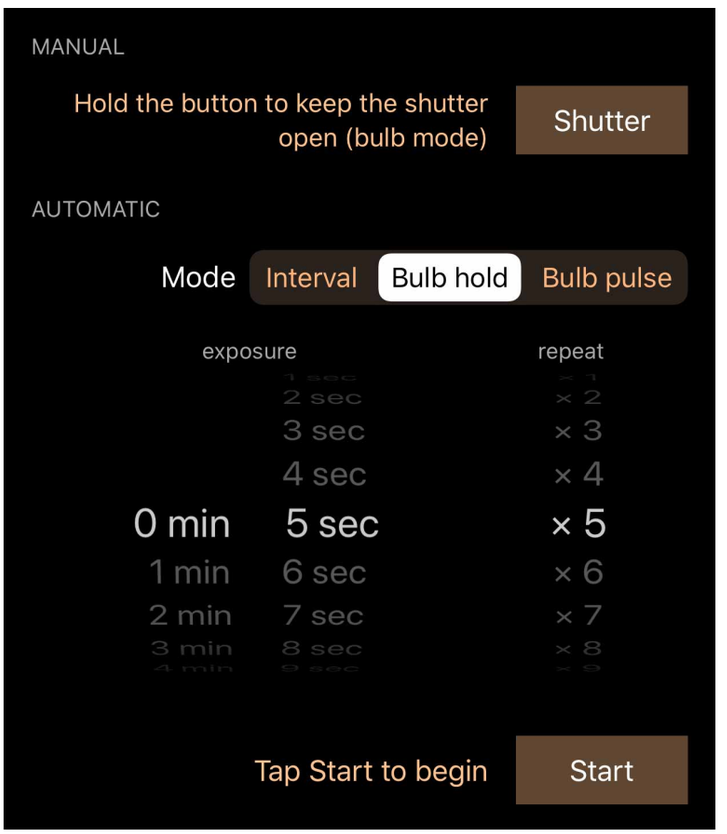
Warn before Goto

By default, Luminos will ask you to confirm when you attempt to slew a mount using the Goto button. This is to prevent unintentional slews. If you do not wish to take that

extra, protective step, you can disable this behavior by turning off the "Warn before Goto" switch.

Shutter Timer

Sky-Watcher mounts with a SNAP shutter control port can use Luminos' shutter timer to operate the shutter.



Manual operation

The shutter timer can be used with your camera in "bulb" mode or in its normal exposure modes.

The Shutter button manually operates the shutter and behaves the same way a tethered shutter button would with your camera.

For cameras set to bulb mode, the shutter works one of two ways: either you hold the button for the duration of the exposure, or you press and release the button once to open the shutter and then press and release a second time to close it. Consult your camera's instructions (or just give it a try) to determine how your camera operates.

If your camera is not set to bulb mode, then the button will take a photo each time you press and release it, like a tethered shutter button would.

Automatic operation

The automatic timer also works with bulb mode and normal exposure modes. Set the Mode to match the mode used by your camera.

Interval mode

This mode is used when your camera is in one of its normal exposure modes (ie, not in bulb mode). Be sure to set an exposure interval that matches or is longer than the exposure for which the camera is set, else Luminos might attempt to operate the shutter while the camera is still taking the previous image. Luminos waits one additional second between exposures for the camera to get ready for the next image, so it's ok to set an interval that's exactly the same as your camera's exposure setting. In interval mode Luminos will press and release the shutter quickly and then wait for the interval (plus one second) before repeating.

Bulb hold

Bulb hold mode is used when your camera is in bulb mode and expects you to hold the button for the duration of the exposure. Luminos will activate the shutter at the start of the exposure and keep it active for the duration of the exposure. After releasing the shutter, Luminos waits one second before beginning the next exposure to give your camera time to get ready.

Bulb pulse

Bulb pulse mode is used when your camera is in bulb mode and expects you to press and release the button to start an exposure, and then press and release it again to end it. Luminos will quickly press and release the shutter at the start of the exposure, and do the same at the end. After ending the exposure, Luminos waits one second before beginning the next exposure to give your camera time to get ready.

Exposure / interval

The exposure / interval tumblers are used to set the duration of each photo. If you are using your camera's built-in exposure timers then set the interval to the same duration as your camera's exposure setting (longer is ok). The actual time between exposures will be one second longer than this setting, as Luminos gives the camera some time to get ready after each image.

Repeat

The repeat tumbler is used to set how many images you want to capture, up to 1,000.

Start

Once you have configured the options, tap the Start button to begin the sequence. You can continue using Luminos while the exposures are taken, but if you turn off your device or switch to another app then the sequence will be interrupted.

Settings

Luminos offers many ways to configure the application to meet your needs. The Settings can be accessed by tapping the settings icon in the toolbar.

To reset all settings back to their default values, tap the "Reset" button in the upper left of the Settings display.

Location

Luminos contains a special display for you to choose your location automatically, through coordinates, or using a list of city names.

Night settings

Night settings make Luminos more useful during evening viewing by helping to preserve your vision in the dark and by prolonging the battery life of your device.

Night vision

In night vision mode, the Luminos display will reduce the amount of light in non-red wavelengths. Using only red wavelengths allows the rods in the eyes to adjust to low light settings, as the rods cannot detect red light. As such, night vision mode will allow you to see the Luminos display and controls with minimal negative effect on your night vision. Night vision can be enabled or disabled without restarting Luminos. To further reduce the effect on your night vision you should also turn down the brightness on your device.

Battery saver

Battery saver disables certain animations which would otherwise increase battery drain due to increased rendering demands. When enabled, battery saver will stop many animations such as twinkle animations on constellation images and update moving objects in the sky less frequently.
To further reduce battery drain you should avoid zooming in to extreme fields of view for long periods, as these also require more updates to the display in order to maintain

smooth motion. For best results, use a field of view of at least one degree. Below a field of view of 10 arcminutes the rendering rate is nearly the same as without the battery saver feature enabled and any savings will be negligible.

Grids

The "Settings" > "Grids" controls allow you to turn off individual grid displays for different coordinate systems. The "Brightness" slider will adjust screen brightness only for any visible grid lines.

Alt / Az

This option displays the local horizontal coordinate grid over the sky view, giving reference lines for altitude and azimuth.

Equatorial

This option displays the equatorial (now) coordinate grid over the sky view, giving reference lines for right ascension and declination.

Ecliptic

This option displays the ecliptic coordinate grid over the sky view, giving reference lines for ecliptic longitude and latitude.

Galactic

This option displays the galactic coordinate grid over the sky view, giving reference lines for galactic longitude and latitude.

Brightness

The brightness slider adjusts the brightness of all grid lines and labels relative to the rest of the sky view.

Horizon

This option draws a horizon line in the Sky View. This has no effect if the alt / az grid is shown.

Meridian

This option draws the meridian (the line extending north and south through the zenith). This has no effect if the alt / az grid is shown.

Direction

This options shows compass direction labels in the Sky View.

Equator

This option draws the equator in the Sky View. This has no effect if the equatorial grid is shown.

Ecliptic path

This option draws the ecliptic path in the sky view. This has no effect if the ecliptic grid is shown.

Coordinates

The "Coordinates" controls allow you to specify your preference for the formatting of coordinates displays.

Degrees

This control will change the format of angles which are displayed in degrees. "Deg" will format those angles as decimal degrees, for example 34.8482°. "DM" will format the angles as degrees and minutes, such as 34° 50.892'. "DMS" will format the angles as degrees, minutes and seconds like this 34° 50' 53.52". The default setting is DMS.

Hours

This control will change the format of angles which are displayed in hours. "Hours" will format those angles as decimal hours, for example 2.3232h. "HM" will format the angles as hours and minutes, such as 2h 19.392m. "HMS" will format the angles as hours, minutes and seconds like this 2h 19m 23.52s. The default setting is HMS.

RA format

Changing this control will change the format of the Right Ascension portion of equatorial coordinates to either be displayed in degrees or in hours. The default format for Right Ascension is hours.

Reckoning

This toggle controls whether Azimuth angles are reckoned from the North or from the South. Users located in the Northern hemisphere normally measure azimuth from the North pole, while those in the Southern hemisphere measure azimuth from the South pole. The default value is North.

Onscreen display

This toggle controls whether or not current direction coordinates will always be displayed at the bottom center of the Sky View.

Orientation

The "Orientation" selector adjusts which plane of motion is used for panning gestures. The chosen orientation will be represented by the horizontal line in the center of the Sky View.

Orientation

Choose which plane is represented by the device orientation:

- Horizontal : (Default) The view is oriented to someone looking across the horizon while standing on the ground.
- Equatorial : The view is oriented to a projection of the Earth's equator onto the celestial sphere.
- Ecliptic : The view is oriented to the plane of the Earth's orbit around the Sun, which is useful for observing many Solar System bodies.
- Galactic : The view is oriented to the plane of the Milky Way galaxy.

Always show button

The orientation indicator will appear in the Sky View if the current setting is not Horizontal. Enabling this options causes the indicator to always appear.

Show matching grid

If this option is turned on, the corresponding grid which matches the orientation setting will always be shown.

Solar System

The "Solar System" settings control the visibiilty of solar body names and orbits.

Show labels

This selector controls whether or not planets and moons of our solar system are displayed in the Sky View. You can also adjust the brightness of their display.

Orbits

This control decides how solar system body orbits are displayed. Setting this to "On" will always display orbits. Setting it to "Auto" will only show them when you are not located on the Earth's surface. You can also adjust the brightness of the orbits.

Meteor Showers

The "Meteor Showers" settings control the display and intensity of meteor events.

Meteor showers

This selector determines whether or not 3D meteors are displayed in the Sky View. Use the "Rate boost" option to adjust the frequency of the meteors: "Off" shows them at their true hourly rate, while "Low" is slightly increased and "High" greatly increases the amount shown in the sky.

Show radiant

This option allows you to turn the display of the radiant point of a meteor shower on or off. You can also control its brightness. The radiant point is the area from which meteors appear to originate in the sky.

Stars

The "Stars" settings allow you to control the overall display of stars. All star catalogs are affected by the settings in this section.

Show stars

This toggle controls whether any stars are shown in Luminos. To disable all visible stars, set this slider to "Off". The "style" option controls the level of visible sharpness of the stars in the sky. To adjust the relative brightness of visible stars, use the "Brightness" slider under "Show stars".

Show labels

This toggle controls whether bright stars are automatically labeled in Luminos. To disable all automatic star labels, set this switch to "Off". To adjust how many labels are shown, use the "Density" slider under "Show labels". To adjust the brightness of the labels, use the "Brightness" slider under "Show labels".

Proper names

If this setting is turned on, you will see specific star names such as Aldebaran. Without this setting, only constellation designations are shown.

Constellations

The "Constelations" settings allow you to control the display of constellations.

Images

This switch controls whether the star-rendered constellation images are shown. To raise or lower the brightness of constellation figures, use the corresponding "Brightness" slider.

Lines

This selector controls when the line-figures of the constellations are shown. Setting this to "Off" never renders them, while "On" renders them all at all times. Setting the control to "Auto" will only show the line drawing you are centered on. To raise or lower the brightness of constellation lines, use the corresponding "Brightness" slider.

Figures

Use this selector to choose which stick figure set you prefer -- the classic figures or the re-imagined modern figures from the 1950’s.

Boundaries

Boundaries between the constellations separate the sky into 88 distinct regions. To view all of the boundaries between the constellations, set this to "On". To see only the boundary of the constellation centered on your screen set this to "Auto". Similarly, the brightness of the constellation boundaries is adjustable using the "Brightness" slider directly underneath the toggle.

Labels

Labels for the constellations make it easy to identify which constellation you're seeing. To have all of the constellation names shown all the time set this to "On". To see only the name of the constellation centered on your screen set this to "Auto". To not show any names set this to "Off". Similarly, the brightness of the constellation names is adjustable using the "Brightness" slider directly underneath the toggle.

Asterisms

The "Asterisms" settings adjust the display of asterisms in the sky.

Asterisms

This selector toggles when the line-figures of the asterisms are shown. Setting this to "Off" never renders them, while "On" renders them all at all times. Setting the control to "Auto" will only show the line drawing of any asterism you are centered on. To raise or lower the brightness of asterism lines, use the corresponding "Brightness" slider.

Labels

To have all of the asterism names shown all the time set this to "On". To see only the name of the asterism centered on your screen set this to "Auto". To not show any names set this to "Off". Similarly, the brightness of the asterism names is adjustable using the "Brightness" slider directly underneath the toggle.

Comets and Asteroids

The "Comets and Asteroids" section adjusts the settings for small bodies. These settings are also found under the Browser section for Comets and Asteroids.

Automatic Downloads

Luminos will automatically contact the IAU Minor Planet Center once a month to update data for comets and asteroids. If you turn off Automatic Downloads, you must refresh the data manually by pulling down in the "Comets and Asteroids" Browser page until the refresh control fully appears.

Brightness

Luminos normally draws comets and asteroids in the Sky View at their actual brightness to keep the sky from becoming too cluttered. Choose "Enhanced" to view these small bodies at brighter-than-normal levels to aid in tracking their positions.

Deep Space

The "Deep Space" settings allow you to control the display of labels on deep space objects.

Show labels

This toggle controls whether deep space objects are automatically labeled in Luminos. To disable all automatic deep space labels, set this switch to "Off". To adjust how many labels are shown, use the "Density" slider under "Show labels". To adjust the brightness of the labels, use the "Brightness" slider under "Show labels".

Show images

If you want to disable or enable the display of images in the Sky View, use this toggle.

Show symbols

Use this toggle to turn off the chart symbols indicating the location of all deep space objects.

Milky Way

Luminos displays a visual representation of our Solar System's galaxy, the Milky Way Galaxy. Normally, the Milky Way forms a glowing strip of light across the night sky. To adjust the visibility of the Milky Way in the Luminos sky, use the following sliders:

Brightness

Use this to control the overall brightness of the Milky Way in the display.

Wavelength

Use this control to choose between the visible and infared representations of the Milky Way. In the infared view, it is possible to see the dust clouds located in our galaxy.

Environment

Luminos gives you detailed control over the realism of the environment while exploring the sky. You have the ability to customize your display to present a more realistic environment, or a more sparse environment which emphasizes only the sky.

Terrain

Setting the terrain to "Off" completely hides the ground and allows you to see the entire sky without obstacles. Choosing "Flat" will show the ground, but with no elevation. The "3D" option will cause Luminos to display terrain features which match your actual environment. Luminos will fetch terrain data based on your current location setting and display the corresponding hills, mountains, and valleys. You must be connected to the Internet to load new terrain data.

Translucent

If terrain is visible, this option will display the ground with a partially transparent appearance, allowing you to see some objects normally obscured by the ground.

Atmosphere

This toggle determines whether or not Sol will light up the atmosphere during daytime. Although the atmosphere can provide a more realistic and appealing display, disabling it will give a clearer view of the sky, even during daytime. The atmosphere will only display if the "Terrain" setting is also enabled.

Lens flare

Lens flare causes visual artifacts when the view is pointed in the direction of a bright light source, such as Sol, providing a more realistic appearance in the atmosphere. To disable lens flare, set this toggle to "Off".

Selection

This toggle adjusts the cursor of the selected object between an animated crosshair and a high-motion flare.

Motion effects

This setting controls whether or not the 3D holographic effect is active in the display. This effect adjusts the view of the 3D display as the device position is adjusted, to create a more striking 3D effect.

Show status bar

Toggles whether or not to show the system status bar at the top of the Luminos display. This also controls whether device functions such as multitasking and the device control panel require more than one tap to activate.

Animations

This setting sets the speed for camera movement animations such as flying to a remote body. The default Luminos speed is Fast, but two slower options are available.

Don't sleep while connected

If enabled, this setting will prevent the device running Luminos from going into sleep mode while a mount is connected via Remote Control.

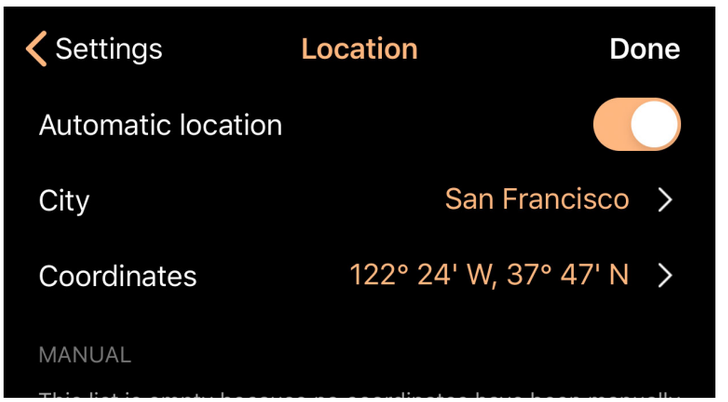
Field of View Button

Turning this option on will show a field of view button on the sky view alongside the clock button. This button will only show up if the display is wide enough, such as with an iPad or with larger iPhones in landscape orientation. The field of view button is intended for people who prefer using a stylus with their device, for whom tapping with two fingers is awkward while holding the stylus.

Location

The celestial objects you see are affected by your viewing location. Luminos will default to using your current position on Earth as its viewing location. When you start Luminos, it will ask you for permission to determine your current location. If you allow this, Luminos will download and display terrain which matches the geographical

features of the area in which you reside. If you don't allow Luminos to detect your location, you can set it manually in the Location Display.



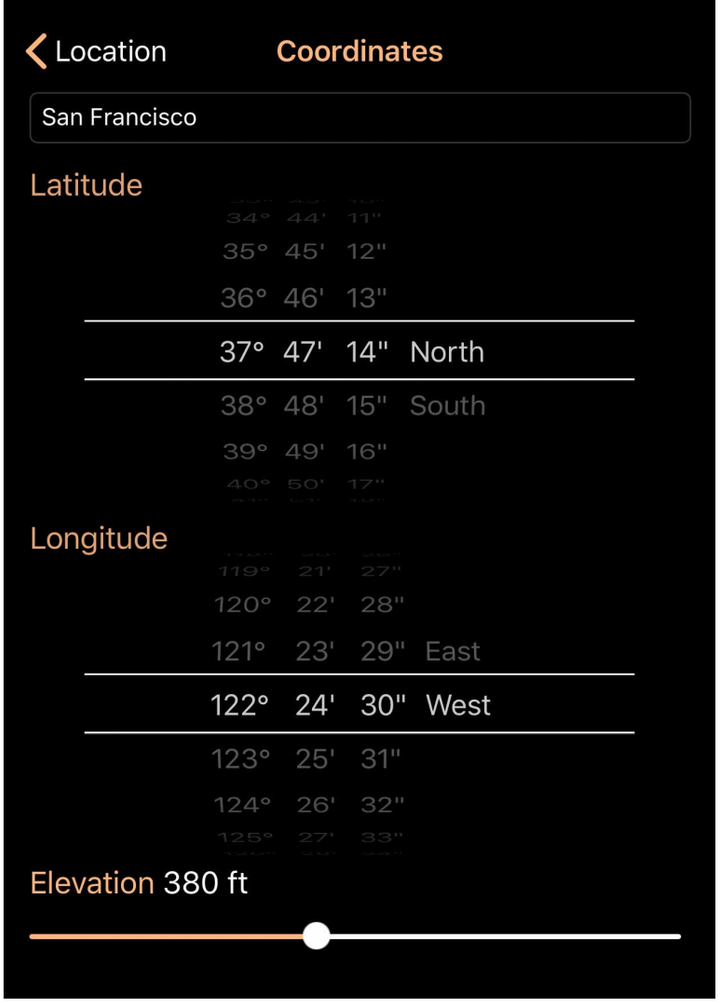
Alternatively, you can set your location to other areas on Earth to see how your position affects the night sky.

To view the Location Display, tap the "Location" indicator at the top of the Settings.

Location detection

In the Location Display, you will be shown your current latitude and longitude, according to Luminos. These values are either determined at startup or set manually here. To request that Luminos retrieve your position at startup, make sure the "Automatic location" slider is set to "On". You must have the device's Location Services enabled for Luminos to find your whereabouts.

Manual location



If you prefer to set your location to a specific latitude and longitude, simply tap the currently displayed coordinate values. You will be presented with dial controls to set the latitude and longitude directly, and a slider to raise or lower your elevation at that location. Your Sky View will update in real time as you change your settings, and terrain will adjust as appropriate.

Location browsing

Another way to set your current location is to navigate the "City" list. After tapping into the countries list, you can choose a specific city or area in which you would like your Sky View to be located. Countries will be divided by state or province, as appropriate. Inside this selector, you can further refine your location by typing into the search bar located at the top of the display.

Recent locations

Luminos includes a set of recently entered cities or coordinates. If you have changed your location to other places, they will appear in the list underneath the main controls so that you may quickly revisit them.

Terrain display

Luminos not only adjusts the sky to match your location; it also alters the terrain which

is displayed in the Sky View landscape to match that of your location. If you are connected to the Internet, Luminos will download terrain appropriate for your chosen location. If the terrain data is not already available to Luminos--or if terrain is turned off in the Settings display--no land will display at all.

Sharing

Luminos makes it easy to share your experiences in the app with those you know, and even those nearby. Using the sharing feature, you can share screen captures of your current view in the app, as well as your current environment so that other Luminos users can re-create it.

To get started with sharing, tap the share button located in the upper left corner of the main Browser display.

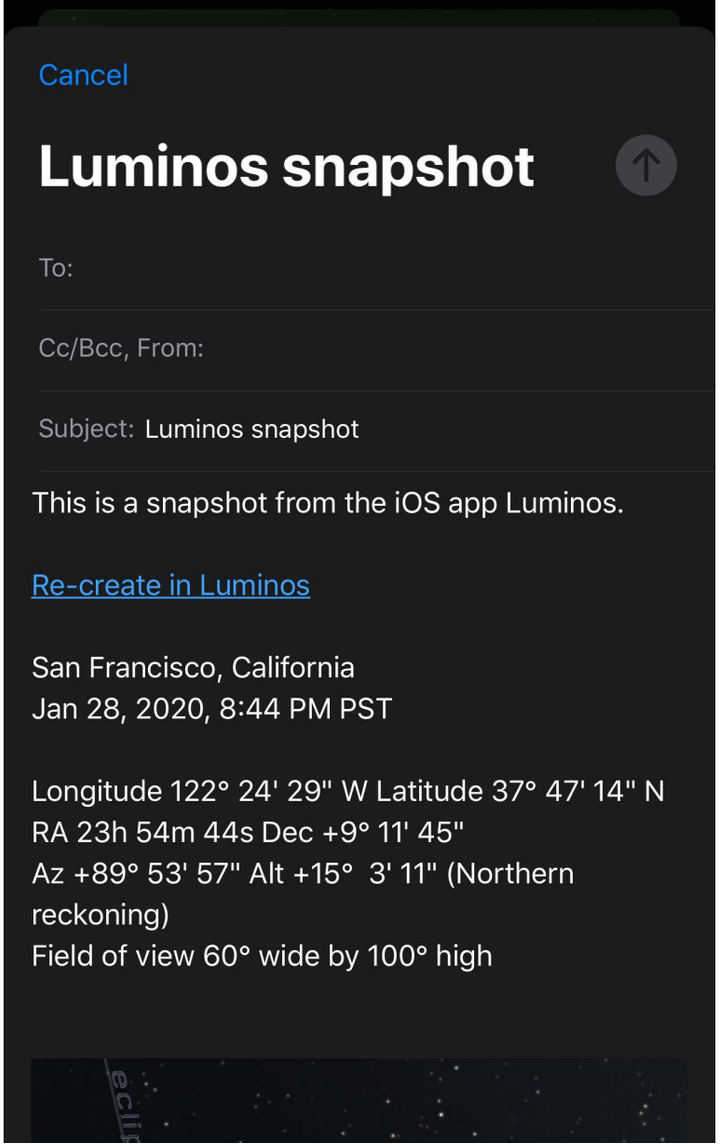
You will then need to choose the account or device with which you would like to share. If you choose a destination that allows images, you will automatically share a screenshot of your current view of Luminos.

In some cases, you will also share information related to your current location and direction in the app. Your location will only be shared if it is not your "Home" location.

For services that support URLs, Luminos will create a link known as a "sequence". A sequence is a special URL beginning with the prefix

luminos://

and a series of commands. Tapping a sequence link on a device with Luminos installed will launch the app and activate the sequence. This allows you to share your current environment in Luminos with others, or save it and recreate it later. You can use the iOS AirDrop feature to share a Luminos sequence with other people nearby, and their copy of Luminos will open to match the state of your own. Your location will only be included in the sequence if you are not at your "Home" location. This allows you to share activities that others can recreate wherever they are.



Sequences can also be created manually to control Luminos as you choose. You can create tours, simulate events, and share them with friends. For more information on creating your own sequences, consult the appendix.

Tips and Tricks

The following tips and tricks can help you get the most out of your Luminos exploration:

Centering your view

In motion tracking mode, you are free to tilt the display in any angle you choose. The user interface will follow you at any angle or rotation. Touching any part of the display will switch to panning mode. Touching the warning notice will re-orient the camera to the horizon, making the sky visible again.

Following the selection

If you lose track of your current selection, an arrow will appear which points toward the selected object. Follow the pointer by panning your view, or press the "Center" button

on the Toolbar to bring the selection back into view.

Clearing the selection

To clear out any selected item completly, just swipe down the Selection Bar as if you were pushing it offscreen.

Selection history

Luminos will also keep an internal list of the objects you have selected recently. If you want to return to a recently selected object, swipe across the Selection Bar.

Returning home

If you ever get overwhelmed or lose your place in the application, simply hit the Home icon in the upper left of the Sky View. The Home button will always return you to your default location on Earth and re-center the view.

Zooming in

To select objects which are close by, try zooming in using the two-finger zoom. Once the objects are separated, they are easier to select.

Appendix I: Greek Alphabet

The Greek alphabet is frequently used in astronomy to identify stars. To help you familiarize yourself with the alphabet the following table summarizes the letters, their abbreviations and their names.

Upper	Lower	Abbrev.	Name
A	α	alf	Alpha
B	β	bet	Beta
Γ	γ	gam	Gamma
Δ	δ	del	Delta
E	ε	eps	Epsilon
Z	ζ	zet	Zeta
H	η	eta	Eta
Θ	θ	the	Theta
I	ι	iot	Iota
K	κ	kap	Kappa
Λ	λ	lam	Lambda
M	μ	mu	Mu

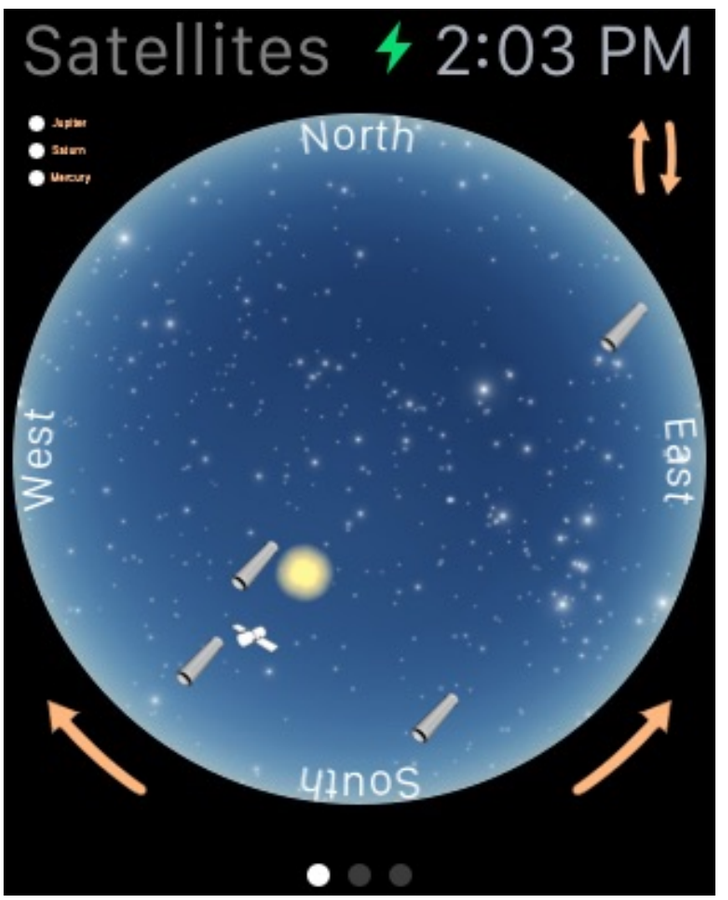
N	ν	nu	Nu
Ξ	ξ	ksi	Xi
O	ο	omi	Omicron
Π	π	pi	Pi
P	ρ	rho	Rho
Σ	σ	sig	Sigma
T	τ	tau	Tau
Y	υ	ups	Upsilon
Φ	φ	phi	Phi
X	χ	chi	Chi
Ψ	ψ	psi	Psi
Ω	ω	ome	Omega

Appendix II: Apple Watch

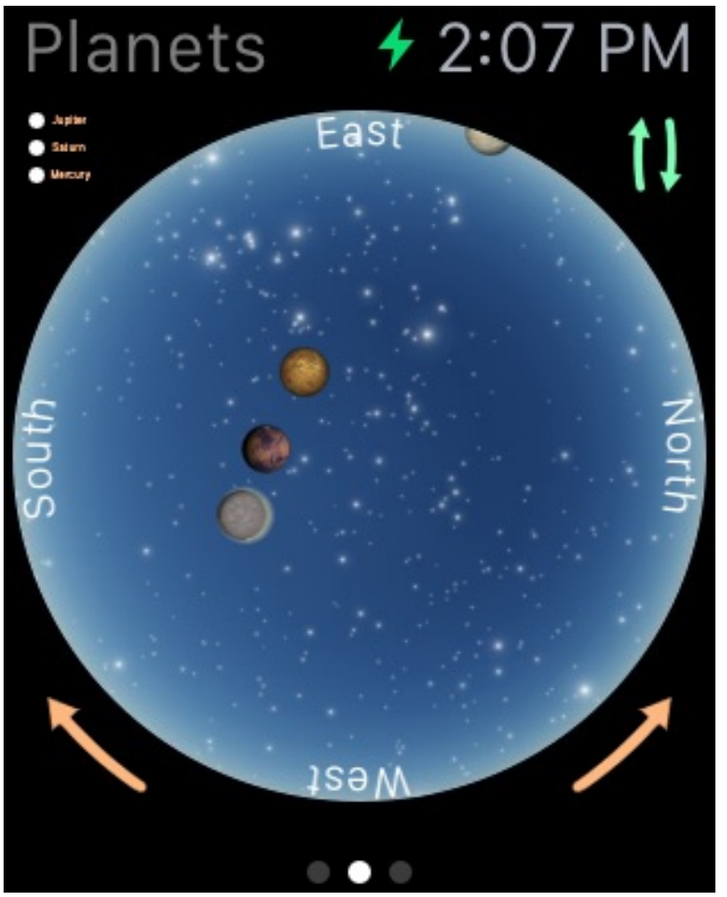
Installing Luminos on an Apple Watch gives you more ways to access astronomy data quickly.

You will receive notifications for any satellites you have configured for flyover alerts if your phone is locked and the Apple Watch is being worn.

Running the Luminos watch app gives you more detailed data and control. At start, the watch will display a live sky view at your location with satellites from the hundred brightest category displayed at their current positions. The satellites will move in real time as long as the watch app is active.

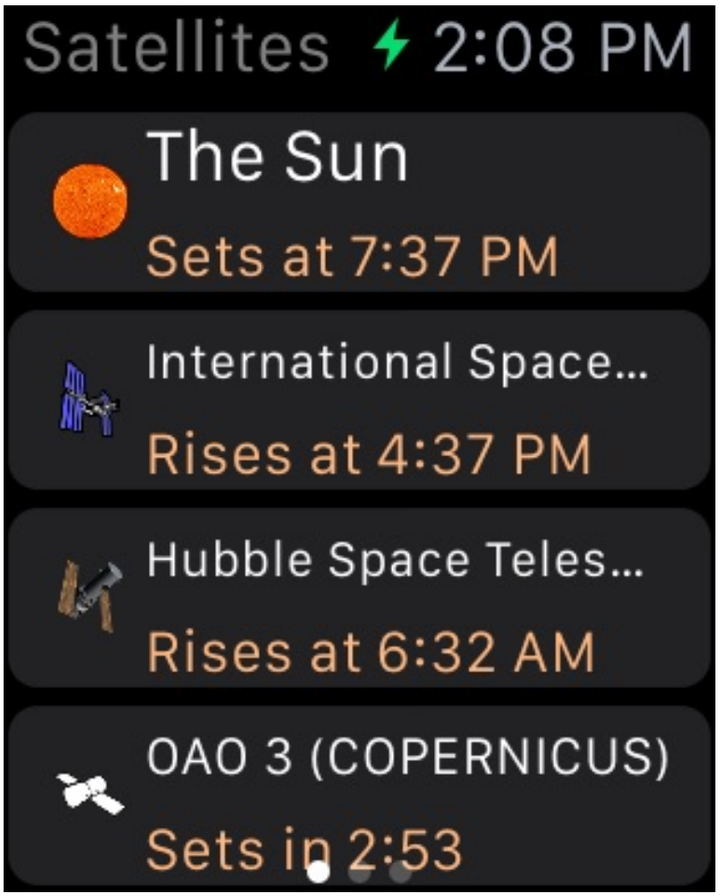


The sky chart is configured by default with North at the top. To flip the view, tap the double arrows in the upper right corner. To rotate the view ninety degrees, tap the directional arrows at the bottom of the watch screen.



Swiping left or right on the display will bring up similar live sky views for Planets and Stars. Tapping on the main sky view will animate a legend pointing to any active satellites, planets, or stars currently being shown.

On any sky chart, swiping down will move to a detail list of any item currently in the sky.



Tapping any item in the detail list brings up its summary, including where it is located in the sky from your position.

Scrolling down in any detail page will present live data related to the object such as

rise and set time, position, and velocity.

Appendix III: Sequence Sharing

Luminos includes a powerful protocol for sharing and scripting state and sequences. Using this protocol, you can create URLs to save your current state, show timed guided tours, and more. Launching one of these URLs on a device with Luminos installed will activate the sequence.

You can also create sequences by using the sharing action in the Browser main view.

This appendix documents how to manually create Luminos sequences using your own URLs.

Syntax

A Luminos sequence consists of the luminos scheme (`luminos://`), followed by the sequence indicator (`sequence/`), followed by a list of commands. Each command is separated by a forward-slash (`/`).

Each command is a verb with zero or more parameters. Parameters are surrounded by parentheses and separated by commas.

```
luminos://sequence/[command_list]
command_list: command[/command_list]
command: verb[(params)]
```

```
params: value[,params]
```

For example, a Luminos sequence with three commands might look like the following:

```
luminos://sequence/command1/command2(parameter1,parameter2)/command3/
```

Commands

The following list includes all commands currently supported by Luminos sequences:

Delay

Syntax

```
delay(seconds)
```

Examples

```
delay(3) // delay 3 seconds
```

The `delay()` command pauses the execution of the sequence for the number of seconds specified in its parameter. This is useful for giving the viewer time to experience a view or text message.

Message

Syntax

```
message("title")
message("title", "subTitle")
message("title", duration_secs)
message("title", "subTitle", duration_secs)
message(location)
```

Examples

```
message("One line message")
message("Two line message","With a subtitle and duration",10)
message(location) // shows current location
```

The `message()` command shows an onscreen message, with an optional subtitle and duration in seconds. Note that commands following this one will continue to execute while the message is displayed, which may overwrite the message contents. To pause on a message, consider following it with a `delay()` command. Messages embedded in HTML files will need to have their quotes escaped with %22 for quote and %20 for space.

Select

Syntax

```
select(objectID)
```

Use the `select()` command to select an object in the Luminos database. A selected object can be centered, or zoomed. The following is a list of the object types that can be selected, and the syntax for doing so.

Planets and moons

```
select(<planet or moon name>)
```

Examples:

```
select(earth)
select(sol)
select(luna)
select(jupiter)
select(ceres)
select(io)
```

Hipparcos Stars

```
select(hp.<hipparcos catalog number>)
```

Example:

```
select(hip.11767) // Polaris
```

Tycho Stars

```
select(tyc.<tycho catalog number>)
```

Example:

```
select(tyc.2540-291-1)
```

The optional Tycho-2 catalog must be installed.

Henry Draper Stars

```
select(hd.<henry draper catalog number>)
```

Example:

```
select(hd.61421) // Procyon
```

Satellites

```
select(satellite.<satellite catalog number>)
```

Example:

```
select(satellite.25544) // ISS
```

Satellite catalog number can be found in the detail view Designations.

Meteor showers

```
select(shower.<IAU meteor shower code>)
```

Example:

```
select(shower.per) // Perseids
```

Shower codes are lower case, and can be found in the detail view as "ID"

Comets

```
select(comet.<IAU comet identifier>)
```

Examples:

```
select(comet.1p) // Halley's Comet
select(comet.c2012s1) // C/2012 S1 (ISON)
```

For numbered comets, the identifier is the number followed by the letter"p". For periodic and non-periodic comets, the identifier is the full name with punctuation and the discovered removed, all lower case.

Asteroids

```
select(asteroid.<IAU asteroid identifier>)
```

Examples:

```
select(asteroid.00001) // (1) Ceres
select(asteroid.F5140) // (155140) 2005 UD
select(asteroid.K10K69E) // 2010 KE69
select(asteroid.01566) // (01566) Icarus
```

The identifier is the packed number designated by the IAU. It can be found in Luminos by viewing the detail for any asteroid in the "Number" field.

New General Catalog deep space

```
select(ngc.<Revised NGC catalog number>)
```

Example:

```
select(ngc.1952)
```

Index Catalog deep space

```
select(ic.<Revised IC catalog number>)
```

Example:

```
select(ic.2764)
```

Barnard deep space

```
select(barnard.<Barnard catalog number>)
```

Example:

```
select(barnard.18)
```

Sharpless deep space

```
select(sh2.<Sharpless catalog number>)
```

Example:

```
select(sh2.49)
```

RCW deep space

```
select(rcw.<RCW catalog number>)
```

Example:

```
select(rcw.131) // War and Peace Nebula
```

Surface features

```
select(<planet or moon name>.feature.<IAU surface feature number>)
```

Examples:

select(luna.feature.3691) // Sea of Tranquility
select(phobos.feature.5707) // Stickney Crater on Phobos

Constellations

select(const.<IAU 3 letter constellation code>)

Example:

select(const.ori) // Orion

Asterisms

select(asterism.<lower case name, no punctuation, underscore separated>)

Examples:

select(asterism.teapot) // Teapot
select(asterism.kembles_cascade) // Kemble's Cascade

Solar eclipses

select(sol.eclipse.<Catalog number of NASA 5 millennium solar eclipses>)

Example:

select(sol.eclipse.9543) // Total Solar Eclipse March 9, 2016

Lunar eclipses

select(luna.eclipse.<Catalog number of NASA 5 millennium lunar eclipses>)

Example:

select(luna.eclipse.9685) // Total Lunar Eclipse September 28 2015

Clear

Syntax

clear

Examples

clear

The `clear` command clears the current selection.

Center

Syntax

```
center
```

Examples

```
center // center on current selection
```

The `center` command only takes action if there is a current selection.

Zoom In

Syntax

```
zoom_in
```

Examples

```
zoom_in // zoom the camera in
```

The `zoom_in` command magnifies the current camera onto the selection. This takes no action if no object is selected.

Zoom Out

Syntax

```
zoom_out
```

Examples

```
zoom_out // zoom the camera out
```

The `zoom_out` command reduces the current camera magnification on the selection. This takes no action if no object is selected.

Equatorial coordinates (JNow)

Syntax

```
eq(ra_deg, dec_deg)
```

Examples

```
eq(269.6380,66.6358) // Location of Cat Eye Nebula
```

Use the `eq()` command to point the camera at a specific equatorial coordinate. This command uses coordinates in the JNow epoch. Both coordinates are in decimal degrees.

Equatorial coordinates (J2000)

Syntax

```
eq2k(ra2k_deg, dec2k_deg)
```

Examples

```
eq2k(85.4250,-1.8567) // Location of Flame Nebula
```

Use the `eq2k()` command to point the camera at a specific equatorial coordinate. This command uses coordinates in the J2000 epoch. Both coordinates are in decimal degrees.

Horizontal coordinates

Syntax

```
horiz(az_deg, alt_deg)
```

Examples

```
horiz(0,30) // Look north, slightly above the horizon
```

The `horiz()` command will direct the camera at a horizontal coordinate specified in decimal degrees.

Location

Syntax

```
location(objectID, longitude_deg, latitude_deg, elevation_meters)
location(objectID, longitude_deg, latitude_deg)
location(longitude_deg, latitude_deg) // Earth
location(longitude_deg, latitude_deg, elevation_meters) // Earth
```

Examples

```
location(mars,137.81,-5.37) // Gale crater on Mars
location(-73.967,40.783) // Manhattan
```

The `location()` command changes the location of the viewer to a specific longitude, latitude, and elevation relative to another object. If the first parameter is a number, the body is assumed to be Earth. Note that the longitude and latitude must be in decimal format.

Orbit

Syntax

```
orbit(objectID)
orbit(objectID, longitude_deg, latitude_deg, distance_au)
orbit(objectID, longitude_deg, latitude_deg)
orbit(longitude_deg, latitude_deg) // Earth
orbit(longitude_deg, latitude_deg, distance_au) // Earth
```

Examples

```
orbit(luna) // Orbit the Moon
orbit(-73.967,40.783,0.0001) // Orbit .0001 AU over Manhattan
orbit(solsys) // Show the solar system orrery
```

The `orbit()` command places the view in orbit over the specified object. If no object ID is specified, the orbit is over Earth. Note that the longitude and latitude must be in decimal format. If no distance value is provided, it will be defaulted. If provided, it must be in astronomical units.

Home

Syntax

```
home
```

Examples

```
home
```

The `home` command returns the viewer to the home location and restores the default camera field of view.

Field of View

Syntax

```
fov(vertical_degrees)
```

Examples

```
fov(62.4) // set the camera field of view to 62.4 degrees
```

The `fov()` command sets the camera field of view to a specific value of vertical degrees.

Home View

Syntax

```
home_view
```

Examples

```
home_view
```

The `home_view` command resets the default camera field of view.

Julian Date

Syntax

```
jd(julianDateUTC)
jd(julianDateUTC, duration)
```

Examples

```
jd(2457193.138579) // change the Luminos clock to June 19, 2015 instantly
jd(2457193.138579,3) // change the Luminos clock to June 19, 2015 over 3 seconds
```

Use the `jd()` command to change the internal clock in Luminos to a specified Julian Date in Coordinated Universal Time. An optional second number specifies how many seconds to take during this transition. Providing no second parameter changes the time instantly. This command also stops the internal clock.

Dynamical Time

Syntax

```
td(julianDateTD)
td(julianDateTD, duration)
```

Examples

```
td(2457193.4236785644) // change the Luminos clock to June 19, 2015 instantly
```

```
td(2457193.4236785644,4) // change the Luminos clock to June 19, 2015 over 4 seconds
```

Use the `td()` command to change the internal clock in Luminos to a specified Julian Date in Dynamical Time. An optional second number specifies how many seconds to take during this transition. Providing no second parameter changes the time instantly. This command also stops the internal clock.

Speed

Syntax

```
speed(multiplier)
```

Examples

```
speed(86400) // change the Luminos clock to one day per second
speed(1) // change the Luminos clock to normal time flow
speed(-60) // change the Luminos clock to 1 minute per second in reverse direction
speed(0) // stop the Luminos clock
```

Use the `speed()` command to change the rate of time flow in Luminos. The parameter is a multiplier on seconds every second. A negative value reverses the flow of time.

Now

Syntax

```
now
```

Examples

```
now // set the Luminos clock to the current time
```

Note that using the `now` command also sets the time flow to normal speed.