

# *Distant Suns (VR)*

## User's Guide





# Distant Suns VR

Originally written for the Commodore Amiga in 1985, Distant Suns is one of the longest-lived consumer programs still on the market. When I first wrote it, I longed to have it run on a small handheld device that I could carry in my pocket. The iPhone and iPod Touch have made that possible, and it took only 24 years of waiting.

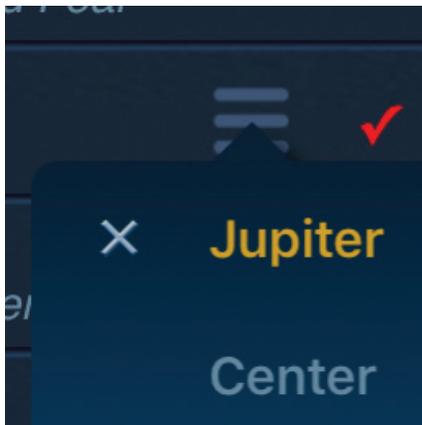
Enjoy this software that I had always wanted to have, as you gaze up into the heavens and deep into the glories of the Universe, and say “duuuude!” or the equivalent.

Mike Smithwick

# what's new

If you have a previous iOS version of Distant Suns this simply spells out the major differences between the old ones and the new.

## ***New UI***



Distant Suns' UI was still rooted in the early days of iOS. It was time for a wholesale upgrade. You will notice the use of floating and tear-off menus, resizable dialogs, a cleaned up main screen as well as What's Up?, a more flexible design resembling that of a desktop experience on the iPad. On the iPhone screen size still limits me to the more traditional design, but it really shines on the iPad.

The toolbar along the bottom is much more simplified indicating various modes you might be in. If you're in spaceship mode, the rocket is lit for example. Tapping it and you go home. Tapping it again, and you go back to where you were. It defaults to Earth. Same for the lock, except it defaults to the moon. The other icons include those for VR mode, clear and clear dialogs, compass and clear all picked objects.

A more refined magnitude limiter has been added to the Star preferences.

## ***Better Visuals***



The planetary graphics have been vastly improved, and are now using shaders to give far more realistic images. And the star images have been refined.

## Virtual and Augmented Reality



Yes, two of the biggest buzz-words of the past couple of years. Virtual Reality will put you inside Distant Suns (VR), making it far easier to learn what is where, without having to go outside. At night. If it's cold. And scary. Or you're too lazy to do so. Like me. This is only for the larger iPhones, such as the 8, 8+ and X. Google Cardboard works quite well for this.

Augmented Reality is supported if you have the Mira headset. Snap in an iPhone 6,7 or 8, and Distant Suns will mark which items you're looking at up against the real sky.

## Chart Mode



Chart mode makes the sky look more like traditional star charts, removing the ambiguity of your own local situation. Celestial Coordinates are used, better known as "Right Ascension" (RA) and "Declination," (Dec).

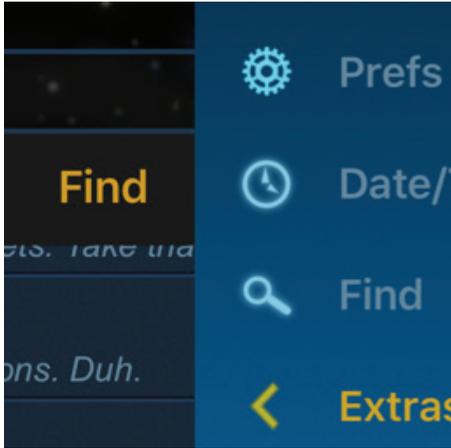
You see both values in the statusbar along the top of the screen when in landscape mode. RA is given in terms of hours and minutes, while Declination is in degrees, analogous to latitude. And as such goes from -90 degrees for the south celestial pole, to +90 degrees where you will find the North Star.

## Lock on Anything



In previous versions, you could lock your eyepoint just on the planets, but you can now lock any object, stars constellations, comets and asteroids (if it had comets and asteroids, but not yet), Santa even. When locked on something, the Lock indicator in the bottom status bar will be on. Tap that to unlock. Tap again, to lock back on the most recent object.

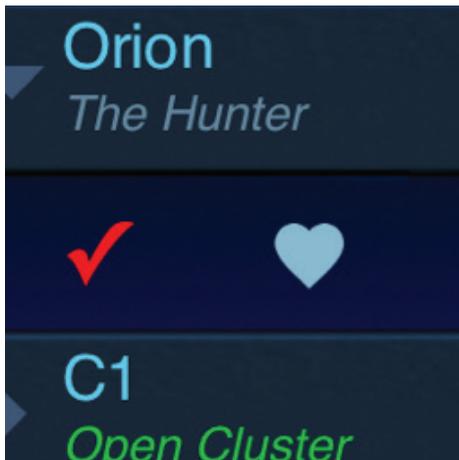
## Improved Find



Find is much improved. You can now center an object by typing in a name, or specific catalog numbers such as SAO for stars. Tap on the > and a tray will expose extra choices for each object. Those include favoriting the object, keeping track of those you've seen and haven't seen.

You may specify an object as a favorite by selecting the little heart, which will populate the new favorites list. Select the check, and that indicates you've actually seen the object if you want to keep track of such things going up against your friends, and the padlock will lock your eyepoint onto that object.

## Cloud Syncing



Favorites use cloud syncing so they'll show up on any device used for Distant Suns (VR), if logged into the same account.

## Improved Picking



You may now pick multiple objects and have each one show their data simultaneously. All may be cleared at the same time using the [ ] in the bottom toolbar. And from the pick tag you may lock on or favorite an object or get more info.

## ***What's Up?***



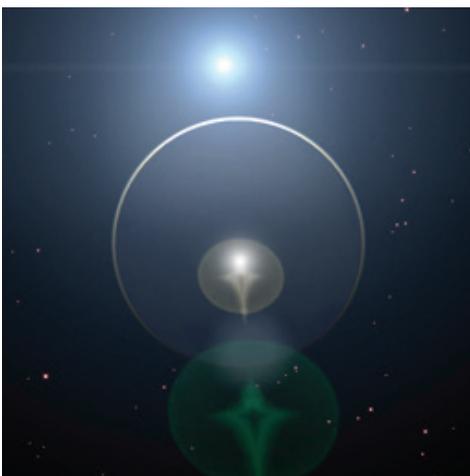
The What's Up? screen is much cleaner compared to previous revs.

## ***More space cats!***



Previous versions had far too few space cats based on the latest data returned from the Hubble Spacecat Telescope.

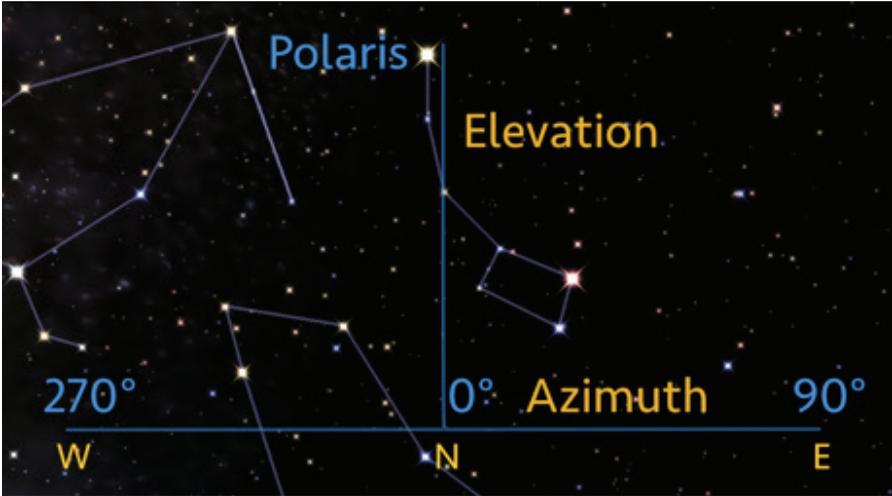
## ***What's not included?***



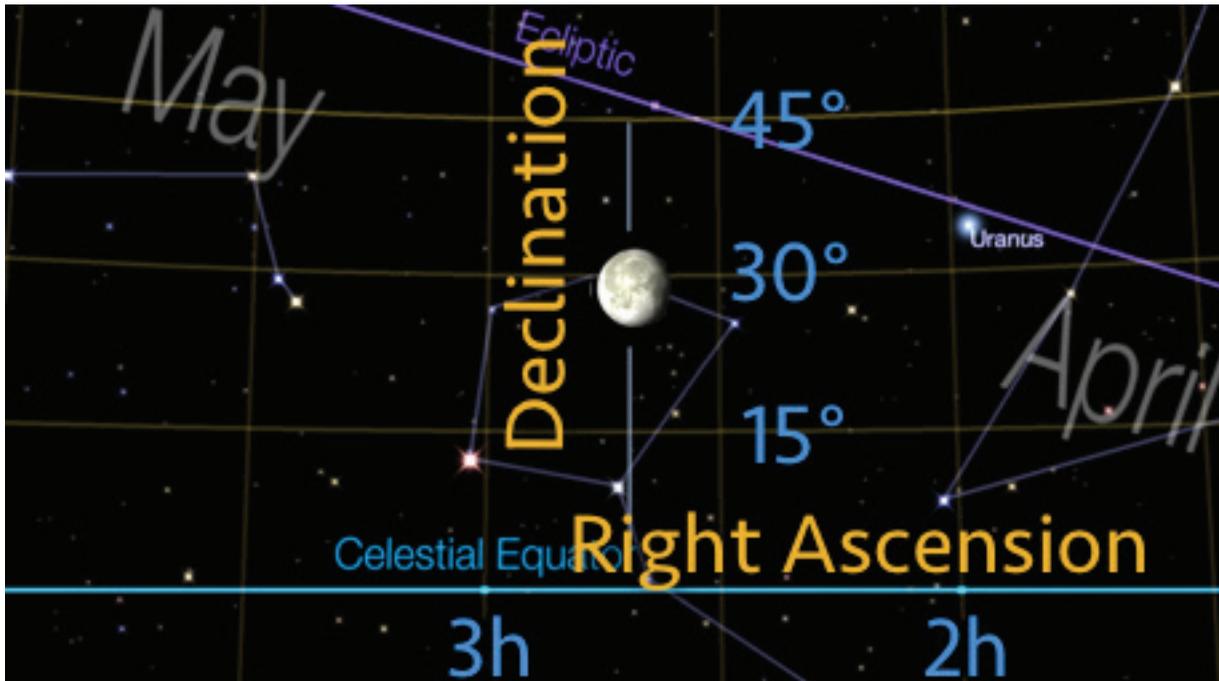
Sadly, I had to drop several features you might miss in order to get this out, such as the Hubble Guide Star Catalog, but they are on the list for future versions.



Pinpointing something in the sky is very similar to finding a location on the earth. On Earth, we use latitude and longitude, however, in the sky you will find two systems are generally used. The first uses azimuth (heading) and elevation and will locate something in your own local sky. The drawback is that they constantly change as the earth rotates.



So, for example, the moon may be at the location of 100 degrees azimuth, 10 degrees elevation, or roughly east and a little above the horizon, at a specific time of the day. As time changes its location changes. Distant Sun VR's own Local mode displays the sky as you will see it at any time during the



The other, known as celestial coordinates is what astronomers use. So, Jupiter or the star Vega, for example, will be at the same celestial coordinates no matter where you are on earth. Right Ascension (“RA”) is like longitude but is expressed in hours, minutes and seconds with an hour the same as 15 degrees. Declination (“Dec”) is like latitude and like latitude goes from -90 to +90 degrees, from the southern celestial pole, to the northern celestial pole. The North Star, Polaris, is almost exactly at 90 degrees Dec. and the star at which the entire sky is seen to spin around.



There are two different interfaces in Distant Suns (VR) depending on whether you're running on an iPad or iPhone. The iPad version looks a lot like a desktop app with floating resizable dialogs, popup menus and so on, while on the iPhone the standard mobile design is used.

Moving the sky around or zooming in and out on any of the devices use the familiar drag and pinch gestures. Tapping any object in the sky will display various basic information about it, whether it is a star, planet or galaxy.

### ***iPad***

The screen layout is similar to previous versions of Distant Suns, except the large scrolling toolbar from the bottom is replaced by a popup menu along the right side of the screen. This can be dragged and repositioned as desired. On the left is the date/time control, letting you change the date and time of the system. After you've dialed in a new date/time, you can go back to real-time by tapping the now button along the top. This can be hidden by using the Clock selection on the menu.

Stretched along the top is the status-bar showing the look-angle, field of view, date/time and view mode. If you've changed either the date or time, this line of text will be gold, reminding you that the sky you see on the display is not current but is sometime in the future or past.

Along the bottom is the state-bar. Each of the buttons indicates a specific mode Distant Suns VR is operating in, such as if you are out in space or if you have the compass on.

If the menu isn't open you'll see a traditional hamburger button as, common on many websites. Tapping the button will open up the menu, giving you access to all other features. The menu may be moved, placed where you want it, and can be minimized to show just icons or enlarged to show both icons and their functions.

You may see the hamburger elsewhere as well, such as in the list of planets in the Find dialog. Tapping it will show a small tear-off context menu that can be dragged to the main screen and used even if the dialog is closed.

Any dialogs such as those for find or preferences may be dragged anywhere on the screen and resized as desired.

If you have a lot of dialogs open and wish to hide them, the second button from the right in the state-bar ("clear UI") along the bottom will do the trick.

You may pick objects to show additional data by simply tapping them, whether they are stars, planets or others. Because the objects can be so dense, it may be hard to determine what you actually meant

to pick. If so, double-tapping the screen will go into Fine Pick, displaying a small crosshair. You can move this to the exact object you were targeting without any ambiguity. Double-tap again turns it off.

## ***iPhone***

The screen layout resembles the iPad, but all other interaction is strictly what you'd expect on an iPhone with a full-screen dialog. On the smallest screens, such as the SE iPhones, the menu might be shortened when in landscape mode.

Along the top of the screen is the Status Bar. This shows you the most important details of the system in one place. The Lookangle is the coordinates of the screen's center. Both Local and Celestial coordinates are shown when in Local or Chart views. When in Spaceship mode, just the Celestial angles are shown. (Note that on the iPhone in portrait, just the AzEl coordinates are shown to save space.)

The Field-of-View ("FOV") is the height of the screen in degrees. The most natural FOV is about 50 degrees. You can go up to 120 degrees, but a lot of distortion comes in at that point.

If you see an asterisk ("\*") right before the date, that means that your location is determined from the GPS. Otherwise, it's fixed from the locations list.

## ***Bottom State Toolbar***

Along the bottom of the screen is a faint toolbar that shows various system states. From left to right are the following controls:

### ***VR***

Tap to turn on virtual reality mode. Tap again to turn off.



### ***Pick***



This glows if any objects have been picked. Tapping it will clear any and all pick windows currently showing.

(Picking an object means touching it, revealing a small data window. Multiple objects can be picked at once.)

### ***Lock***

If your eye point is locked to a specific object (done through the Find dialog). Tapping it will unlock your viewpoint.



Tapping it again will jump back to the previous item.

The moon is the default target at launch

## Spaceship Mode

When in Spaceship mode (ie, off the earth), this will be active. Tapping it off will jump you back to the earth. Tapping it on will either jump out to your previous target, or Earth as a default.

## Compass



This will turn on or off the compass. When on, you aim Distant Suns VR up towards the sky and the view will track what you should be seeing. Unless it's cloudy. Or daytime. Or you're on the moon Zantar, in which case clouds would be the least of your problems my friend.

## Clear Windows



There are two “clear” buttons (iPad only), that look like checkmarks (anyone have a better icon for this?) The first will clear the UI from the screen: the menus and dialogs so you don't have to worry about closing them one at a time. Turning off this mode will bring back them all back.

## Clear Sky



The second clears or dims the on-screen symbology - temporarily removing the clutter.

## Gestures



Distant Suns (VR) supports the usual gamut of gestures. You move around the sky by dragging your fingers, zoom in and out by the pinch gesture, and bring up further information about any of the objects by tapping them (“picking”).

With so many objects on the screen at one time, it might be hard to pick a specific object. In that case, you can go to Fine Pick mode with a double tap. This will display small crosshairs that you can drag around to highlight any of the objects. Leaving it on an object for about a second will bring up the pick data.

The Field of View (“FOV”) in the top statusbar is based on the vertical measurement of the sky. The most natural FOV is about 50 to 65 degrees. A FOV of 6 degrees is what an average pair of binoculars will show, while a telescope's field will usually be 1.5 degrees or smaller in diameter.

## Date/Time Strip

The date/time control will let you change the date and time of the system. After you've dialed in a new date/time, you can go back to real-time by tapping the now button along the top. This can be hidden by using the Clock selection on the menu.



Bring up the main menu using the *hamburger button* along the right side of the screen, similar to the one used in many apps and websites. The menu can then be moved around to another other part of the screen as desired.

## **Main**

### **Minimized/Maximized**

The menu may be toggled between maximized and minimized. The former will show both icons and text, while the latter just the icons. Helpful for small screens.

### **Help**

This will give you a list of various help options. Such as What's New?, the About box that has version and date information as well as various astronomical info such as the Julian date, sidereal time, and the currently used Lat/Long.

### **Prefs**

Displays the preferences dialog.

### **Date/Time**

One tap will open the date/time strip along the left of the screen, another will close it.

### **Find**

The Find dialog. Use it to center any of the objects in Distant Suns (VR).

### **Extras**

Displays a second menu of less commonly used features.

### **Events**

NASA's *Night Sky Network* is displayed, showing any local astronomy related events such as open house at an observatory to star parties sponsored by one of the local astronomy clubs.

### **What's Up?**

What's Up? Is a summary window showing an overview of the entire sky and where all of the most interesting stuff is located in a single view; namely the planets and some of the more prominent constellations.

### **Moonmap**

Puts you over the moon, showing hundreds of lunar features. Zooming in will show more, out, less.



# preferences

## **Constellations**

Over half of the 88 official constellations come from the times of Ptolemy. The others were filled in as the southern skies became more well known, with map-makers gleefully making up constellations to honor their king, their least favorite pest (Musca, the Housefly) or even laboratory equipment such as Fornax (the Furnace). It wasn't until 1922 that the newly formed International Astronomical Union created the official list that we still use today.

## **Names**

Shows the names of the 88 modern constellations.

## **Outlines**

Display's the *stick figure* outlines of the constellations. There are no "official" outlines to go by, so other star charts will likely vary from these.

## **Asterisms**

Huh? Aster-what-erisms? Think of an asterism as a low-calorie constellation. They are informal figures, such as the Summer Triangle made out of stars from three constellations, or the Big Dipper (part of Ursa Major, the Big Bear), known elsewhere as the Plow.

## **Figures**

Toggles on or off the common figures for each of the constellations.

## **Solar System**

### **Names**

Shows the planetary names. But you probably already knew that.

### **Large Sun/Moon Images**

Both the sun and the moon are actually quite small when compared to the entire sky. Most are surprised that they can cover up the moon completely with their little finger. With that in mind, this feature will render the two at five-times their actual size to make them more easily seen.

Note that when tracking solar eclipses, make sure to turn this off.

### **Enhanced Moon**

Brightens up the moon to make it look more like it does to the naked eye which can be quite blinding when full and observed through a telescope.

### ***Lunar Features***

Turns on names of lunar features, down to about 15 miles in size. Craters, Mare (the “seas”) and Apollo landing sites are highlighted.

### ***Use Latin for Lunar Features***

Uses the traditional Latin names for lunar features. For example, the Seas are “Mare,” Bays become “Sinus,” Lakes, “Lacus,” and Marshes (“Palus”).

### ***Show Only Naked-eye Planets***

By the request of a user, this will turn off the planets that are not clearly visible without a telescope, namely Uranus, Neptune, and for the traditionalists, Pluto.

### ***Meteor Showers***

Shows the radiants of the 10 major annual meteor showers.

### ***Sky Light***

Turns on a rough approximation of the daytime sky.

### ***Lens-flare/Lens-flare style***

This will display classic Hollywood-style lens flare from the sun, simulating the optical effects of a bright light going through the layers of glass in a lens. This can give a nice illusion of depth.

You have six different styles to choose from.

### ***Stars***

You can vary both the size of the stars and their style in the Stars preferences. You may also limit the number of stars to show. If you’re in the city, you may only see stars down to third magnitude, or fewer than 150, so showing them all merely adds to the skies clutter.

### ***Galaxies-n-stuff***

Distant Suns (VR) comes with over 7800 known deep-sky objects, from three different catalogs. These include star clusters, galaxies, and nebula.

The first and most well-known collection is the Messier catalog compiled by the 18th-century French astronomer, Charles Messier. Containing just over 100 entries, objects go by names such as “M42” (the Orion Nebula) or “M31” (the Andromeda Galaxy).

The second listing is the very recent, Caldwell Catalog, whose objects start with a “C.” Compiled by the late British astronomer Sir Patrick Caldwell-Moore, it includes major objects that Messier missed.

The third is the New General Catalog, containing over 7800 objects, it must be turned on separately due to its size.

## ***Deep-Sky Objects***



Displays both the Messier and Caldwell catalogs.

## ***Identifiers***

Shows the formal catalog identifiers for each object.

## ***Proper Names***

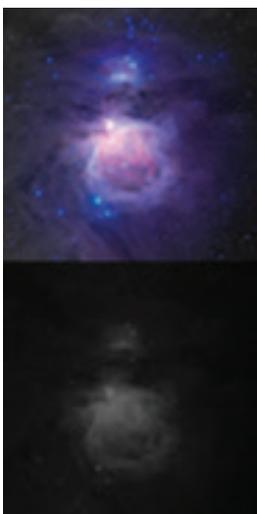


This will display the proper names of objects such as The Dumbbell Nebula, or The Pleiades.

## ***NGC Objects***

Displays the entire NGC catalog. The NGC objects are in the “background” of the other two catalogs. If you don’t see anything, zooming in more closely will reveal their ID numbers and type.

## ***Enhanced Images***



Most of the M and C objects have associated images in the sky. Selecting Enhanced Images will show them the way cameras do, while deselecting this will display them closer to the way the human eye would more likely see them.

## ***Enhanced Milky Way***

This is similar to the above selection, but will show the Milky Way closer to the way it shows up in pictures. Turn off for a more realistic rendering.

## **Markers**

### ***Celestial Equator***

*Celestial Equator* toggles on or off the boundary between the northern and southern skies, where the Declination is 0 degrees.

### ***Ecliptic***

*Ecliptic* toggles on or off a line showing the plane of the solar system and defines the path the sun takes throughout the year. This is also where you will find the planets and asteroids.

### ***Meridian***

*Meridian* will toggle the line that separates the eastern and western skies, running from north to south.

### ***Horizon***

This will indicate where your own local horizon lays. You'll note that if your look angle is at an elevation  $> 0$ , you'll be seeing the objects currently in your sky. An elevation  $< 0$ , means you'll have to wait a while before they rise.

### ***Sky Grid***

This will put up a simple AzEl grid with lines  $5^\circ$  apart.

### ***Celestial Grid***

This will overlay a grid aligned with the celestial coordinate system, marking declination every  $5^\circ$  and right ascension, every 30 minutes ( $7.5^\circ$ ).

### ***Screen Center***

Kinda obvious I think.

### ***Zenith/Nadir***

Highlights the zenith (the point exactly  $90^\circ$  over your head) with a Z and the nadir (the point exactly  $-90^\circ$  below your feet) with an N.

## **Extras**

### ***Compass Dial***

Shows a traditional compass dial, also called a "rose."

### ***Ground***

In Local mode only, this will turn the half of the sky below your horizon a translucent blue color.

### ***Restore Last Position***

When you start up, Restore Last Position will aim your Look-angle and set the Field of View to where you last left it.

### ***High-sensitivity Pick***

Normally picking an object requires touching your finger to the object for about a half-second, but if that feels too sluggish to you, selecting this option makes it almost instantaneous. However, that also makes it easy to accidentally pick something when you didn't want to.

### ***Slew When Centering Objects***

When centering something like an object using Find, this will move the view continuously to the new object. Otherwise, the viewpoint will immediately jump to it.

### ***Auto-zoom While Slewing***

This is similar to the above but will add a zoom effect to the move as well.

## ***Display***

### ***Boing***

Causes a “boing” effect, when the sky coasts to either zenith or nadir. Otherwise, the view will bounce and go the other direction.

### ***Chart Mode***

*Chart Mode* changes the display to show the stars in the Celestial Coordinate system the way astronomers and standard star charts view the sky.

### ***Presentation Mode***

*Presentation Mode* is handy if you use screen sharing for a presentation in front of a classroom for example. It will draw your touch points on the screen so others can follow any gestures you make.

### ***Favorites Menu***

This will put up a pretty little dropdown menu made up of your favorite objects without having to open the Find dialog. The top of the menu will rotate images among the various objects. The menu can be dragged and repositioned as desired.

### ***Fastscroll***

Improves performance on slower devices by turning off high-detailed objects when scrolling the sky around. Mainly hides the massive NGC catalog of over 7500 objects.

### ***Translucency***

This option will make the menus and dialogs somewhat translucent. Looks cool but could make the app run a little slower on older devices.

### ***Observatory First***

When selected, the Observatory screen will show at launch, instead of the default What's Up?

### ***Augmented Reality***

If you have a pair of augmented reality (“AR”) goggles that use a phone as its display, this selection will let you observe the night sky with various graphics overlaying the view. The proper field-of-view will have to be calibrated to your own hardware, but 60° is a good start.

This selection requires the Virtual Reality mode to be active. Besides using the reflection of a phone

as its display, proper AR head-ware must have a completely transparent visor when using at night, such as the Mira brand. The more common partially mirrored visors can blank even bright stars in the sky, making the AR mode useless.

Due to the characteristics of each different AR headset, don't expect the graphics to perfectly match up at this point.

## ***Time***

### ***Set Date/Time***

You can set an arbitrary time, within reason, of course, using Set Date/Time. The dialog should be pretty obvious, except for the Julian Date. The JD is the precise number of days since the beginning of the Julian Calendar, which is January 1, 4713 BC. Astronomical events are frequently recorded based on this date to avoid any eccentricities in the way a local date might generate not to mention errors incurred by calendar changes over the centuries.

### ***Perpetual Motion***

*Perpetual Motion* will remove any damping when you use the date/time strip, so the value will continue to change until you manually stop its spinning.

## ***System***

### ***Select Nearest City***

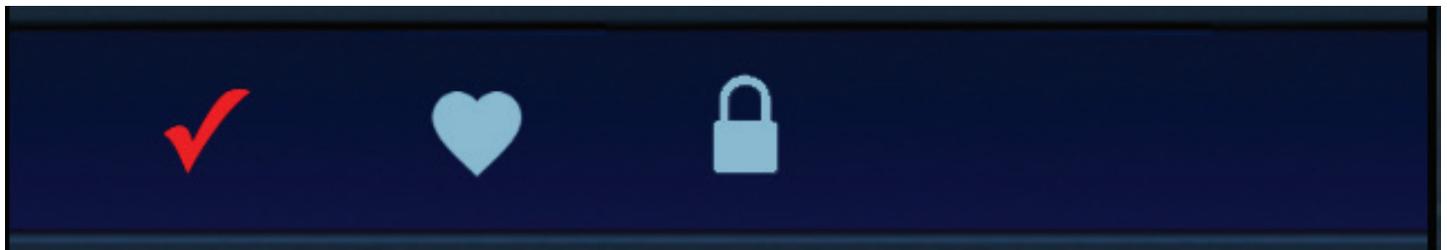
Lets you set your location based on any nearby major city. Useful if for any reason the device's own internal GPS is unable to get your location.

### ***Set Lat/Long***

Reveals a dialog that allows you to manually set your latitude/longitude, in case your device's internal GPS is unable to determine your location. For example, being on the ocean, camping in a remote spot, etc.



The Find dialog will let you center any of the objects in the database. Each item in the list may have several available options. Tapping > will reveal a tray with one or more buttons for each object.



The checkmark is used to show that you've seen a particular object, which would be handy for contests or challenges.

The heart, ♥, when set, will indicate a favorite and put the object both in the Favorites list, at the top of the Find dialog and in the Favorites dropdown menu that can be activated from Preferences > Display.

The padlock locks your viewpoint on that object. It's unlocked with the glowing lock button at the bottom of the screen.

Oh, you actually want to center an object? Then just tap its name.

More information about it? Use the > on the right side of the item.

### **By Name**

*Find By Name* will allow you to center an object based on a name or identifier. For stars, this includes the SAO, HD and SMAP catalog IDs.

For Deep-sky objects, the NGC, M and C identifiers, will do the job.

### **Favorites**

The *Favorites* list will show you all of your favorite objects, done via the the heart, ♥, in the object's tray, or via their Pick data display. They may be unfavorited by tapping a second time on the icon.

Favorites are also synced with iCloud. So, no matter what device you are using, as long as you are logged into the same iCloud account, your favorites will be there.

# virtual reality



The *Virtual Reality* mode in Distant Suns (VR) gives you your own immersive planetarium, and the feel of being out in space without those pesky but otherwise cool looking spacesuits. Simply grab a Google Cardboard viewer or any number of the VR goggles now available made for your iPhone (and a handful for iPad Minis) strap it on and go Wow! In VR mode, you can get a good idea of how the sky is laid out at any time of day or night, on Earth or out among the planets.

VR is toggled on or off via the VR button along the bottom of the screen. If you want to extend that to Augmented Reality, set the AR mode on in the Displays section of Preferences. That will turn off the stars in the view but leave the various selected identifiers on. An appropriate AR headset will be necessary, meaning that it has a non-mirrored visor for an unobstructed direct-view of your surroundings and a place to hold your phone such that its screen will be reflected in the visor. The Mira glasses work that way (but only fit the iPhone 8 sized devices). Some have a partially mirrored reflector, which may be fine for the daytime but it's like wearing a pair of sunglasses at night. All but the brightest objects will be visible.

Because the different shapes of the reflectors and the fickleness of the iPhone's compass, not everything can be expected to line up perfectly at present.

The best field-of-view for the Mira is between 55 to 65 degrees.

# deep sky objects



Using the preference “Galaxies, Nebula and Clusters” selection, you can toggle on the locations of over 7800 *deep-sky objects*, stretched across three different catalogs. The most common and best loved wonders of the “deep sky” comes from the Messier Catalog. Compiled by the 18th century astronomer Charles Messier as a guide to be used by comet hunters of fuzzy things that sort of looked like comets but that really weren’t. This, the most famous of all celestial catalogs, contains the best-known objects in the sky such as the Great Nebula in Orion (“M42”) and the Andromeda Galaxy (“M31”). These objects are color coded: orange for galaxies, blue for “planetary nebula”, red for “diffuse nebula”, green for “open” star clusters, and purple for “globular” clusters.

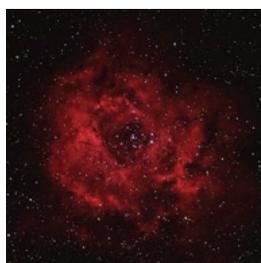
Besides the Messier catalog you will find the relatively recent “Caldwell Catalog.” While the Messier list is good, it was hardly complete. Popular British author and lecturer, the late Sir Patrick Caldwell-Moore submitted a list to Sky and Telescope in 1995 to fill in the blanks. Upon publishing, it quickly became popular as it covered the finest objects in the southern skies and a few in northern skies that Messier missed. The better known “C” objects include the Double Cluster in Perseus (C14), the Helix Nebula (C63) and Omega Centauri (C80).

## Galaxies



The galaxies are cities of stars, typically swirling disks of hundreds of millions of stars hundreds of thousands of light years across. While galaxies lie outside our own home galaxy of the Milky Way, the other objects lie within.

## Nebula



Nebulae are clouds of dust and gas, usually the raw stuff that can eventually condense to form new stars. Diffuse nebulae, shown in red, are formless in their nature while the planetary variety are rounded such as the famous Ring Nebula (M57) in the constellation of Lyra. Planetary nebulae are usually the results of a star having gone supernova, exploding and casting off its material in an ever-expanding sphere of dust and gases.

## Star Clusters



Star clusters come in two major varieties. Open clusters are loose collections of stars typically numbering no more than a few dozen such as M57, otherwise known as The Pleiades. Globular Clusters are spherical condensations of tens of thousands of stars looking much like someone splatted a glob of diamond dust on the black velvet sky. M10 (seen left) in Ophiuchus.





### ***Inspiration***

Sir Arthur C. Clarke, fan of the original Distant Suns and a very generous gentleman.

### ***Planetary Descriptions***

Konrad Kendel Jr.

### ***Lens Flare Support***

By James Grote, of Brain Fever Media. Check out LensFlare HD for the iPad. It's beautiful.

### ***Night Sky Network***

Used with permission by the Astronomical Society of the Pacific and NASA

### ***News***

Brought to you in cooperation with Astronomy Magazine, available in the iTunes store.

### ***Artwork***

#### ***Constellations***

Johan Meuris, used with permission. CopyLeft : The artwork is free work, you can copy, distribute, and modify it under terms of the Free Art License.

#### ***Little Astronaut Graphic on the Launch Screen***

Alexander Skowalsky, The Noun Project (an awesome site for a bazillion icons)

#### ***Observatory Icon on What's Up? page***

Ben Davis, The Noun Project (an awesome site for a bazillion icons)

### ***Photos***

#### ***Mel Martin***

C9, C11, C14, C19, C20, C27, C31, C33, C49

#### ***Roberto Mura***

C1, C8, C10, C58, C64, C71, C16, C89, C28, C76, C82, C85, C88, C91, C95, C97, C98, C102

### ***NASA/Hubble Space Telescope***

C6,C15,C21,C23,C24,C25,C39,C46,C47,, C48,C55,C60,C61,C63,C69,C77,C81,C90,, C93,C109,

M2,M5,M10,M11,M12,M27,M42,M43,, M53,M54,M56,M57,M64,M68,M69,M70,M71,M72,M74,M82,  
M86,M87,M101,M102,M104,M107

### ***NASA/SDSS***

C35,C36,C38,C40,C45,C52,

M21,M23,M35,M38,M77,M85,M88,M89,M90, M96, M97, M98, M99, M100,M103,M105,M106,M108,  
M109,M110

### ***NASA/2MASS***

C16,C17,C78

M13,M19,M22,M25,M28,M29,M34,M36,M37,M39,M44,M47,M48,M50,M52,M55,M59,M60,M61,M62,  
M63,M67,M75,M76,M79,M93

### ***NASA/DSS/DSS2***

C4,C35,C36,C38,C40,C45,C52,C68

### ***NASA/Spitzer Space Telescope***

C56,C67

M58,M81,M95

### ***NASA/University of Massachusetts***

M9

### ***NASA/LIGO***

M1

### ***NASA/JPL***

M51,C51

### ***NASA/GALEX***

C73

### ***NASA/Miscellaneous programs***

M3,M6,M7,M8,M15,M18,M20,M26,M31,M32,M33,M45,M46,M49,M84,M92 and the planets

### ***Nordic Optical Telescope***

M91, M94

### ***Ole Nielson***

C26

### ***Hunter Wilson***

C27, C34

### ***Daniel Verschatse (<http://www.verschatse.cl>)***

C53,C54C57,C59,C62,C70,C72,C79C84,C87,C92,C101,C104,C105,C106

M4,M14,M16,M17,M30,M65,M66,M78,M80,M83