

# ASTRONOMY

## TECHNOLOGY TODAY

Your Complete Guide to Astronomical Equipment

INDUSTRY NEWS • NEW PRODUCTS • THE UNISTELLAR EVSCOPE 2  
BEGINNER'S REMOTE VIDEO ASTRONOMY  
PORTABLE BASIC+ REMOTE VIDEO ASTRONOMY SETUP

# MALLINCAM SKYRAIDER SOLARCAM



## Cover Article - Page 51

In their cover article Matt Harmston and Jack Huerkamp show how the MallinCam SkyRaider SolarCam is ready for the most demanding applications in video astronomy, excelling at live observing and imaging of solar system objects. The astro image is Lunar composite of two images at f/9 using a SkyWatcher EvoStar 100ED refractor.



## In This Issue

### 49 MALLINCAM SKYRAIDER SOLARCAM

MallinCam recently released the SkyRaider SolarCam for solar system viewing. Though the name implies a dedicated solar observing camera, we wanted to spend some serious time reviewing the camera's performance on the Moon and planets.

*by Matt Harmston and Jack Huerkamp*

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I really enjoy looking through telescopes. I guess that's why I own ten of them. So I had a lot of trepidation about reviewing a telescope that has no optical eyepiece. Some people are fine just looking at pictures on a screen. I wasn't. Then, I tried the Unistellar eVscope!

*by Dr. James Dire*

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Remote video astronomy is a wonderful tool any time, but it really shines when conditions aren't the best. Operating from inside my home means no sweat, no bugs, and an absence of frost-bitten digits make for a happy astronomer.

*by Matt Harmston*

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Through the use of a video astronomy camera and a simple means to extend the camera cable inside, along with a way to control the mount remotely, it doesn't matter to you how cold it is outside since you are toasty warm inside.

*by Jim Meadows*



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**James Dire** has a M.S. degree in physics from the University of Central Florida and M.A. and Ph.D. degrees from The Johns Hopkins University, both in planetary science. He has been a professor of chemistry, physics and astronomy and an administrator at several colleges and universities. He has played a key role in several observatory projects including the Powell Observatory in Louisburg, KS, which houses a 30-inch (0.75-m) Newtonian; the Naval Academy observatory with an 8-inch (0.20-m) Alvin Clark refractor; and he built the Coast Guard Academy Astronomical Observatory in Stonington, CT, which houses a 20-inch (0.51-m) Ritchey Chrétien Cassegrain. Dire is a seasoned visual observer and veteran astro-imager.



**Matt Harmston** is an educational researcher whose appetite for the heavens has been whetted by increasing aperture over the years. More recently, Matt has immersed himself in video astronomy - a means of probing deeper into the night sky while making astronomy accessible to all ages and abilities. With this technology readily available, Matt is considering a career as a sleep-deprivation research subject.



**Jack Huerkamp** is a professional Mechanical and Environmental Engineer by training and is the President of Jack's Astro Accessories which is the sole US distributor and an international distributor for MallinCam products. He has been an amateur astronomer since 1968 and is the former secretary and president of the Pontchartrain Astronomy Society.



**Jim Meadows** enjoyed astronomy as his favorite hobby for many years, but it was gradually set aside due to work, family and life in general. He resumed the hobby looking forward to using the new technology that is now available and then discovered video astronomy, learned how to do it remotely and soon began publishing books on the subject as well as hosting the Remote Video Astronomy website - [www.remotevideoastronomy.com](http://www.remotevideoastronomy.com) - to pass on what he has learned.



**Stuart Parkerson** has been the publisher of Astronomy Technology Today since its inception in 2006. While working primarily in the background of the company's magazine and website business operations, he has recently taken a more active role in contributing content covering industry news and other company centric topics.

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New Products



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# THE UNISTELLAR EVSCOPE 2

By Dr. James R. Dire

I really enjoy looking through telescopes. I guess that's why I own ten of them. So I had a lot of trepidation about reviewing a telescope that has no optical eyepiece. Some people are fine just looking at pictures on a screen. I wasn't. Then, I tried the Unistellar eVscope!

I have a friend who I have spent many nights observing with over the past few years. I would set up my Dob, a 5.2-inch refractor, or my 190mm Mak-Newt, the latter two on a German equatorial GOTO mount, and pull out my arsenal of high-end eyepieces.

My friend James (no relation) would set up his 140mm Apo on a Losmandy mount, and attach his very expensive, astronomy-enhanced Canon camera. With the mount and camera connected to his laptop, he would slew to objects, take 1-3 minute exposures and view objects on his screen. The detail he could see on his screen far surpassed what I could see in

my eyepieces. I would guess his equipment cost close to \$10K new. It's not difficult to spend that much on a fine telescope, mount and high-end camera!

Unistellar has combined everything into a simple device called an eVscope. Unistellar is based in France and their telescopes are made in China. There are two eVscope models. The plain eVscope does not come with a viewing port. The eVscope 2 comes with what looks like an eyepiece, but it really is a port to view what the telescope sees on a miniature TV screen built into the telescope. That is the model I tested (**Image 1**).

The telescope came securely double boxed with Styrofoam padding (**Image 2**). The telescope and mount head were shipped inside a backpack carrying case (**Image 3**). The backpack was quite impressive. It is as nice as any backcountry backpack I had ever used. It has ample padding to protect this delicate instru-



**Image 1 - The Unistellar eVscope 2 is a 114mm f/4 Newtonian with built-in 4.09 megapixel Sony IMX 347 camera at the focal point.**

ment, padded shoulder and waist straps, and several compartments for storing non-telescope items. The tripod secures to the outside of the backpack for transport (**Image 4**). When loaded, the entire backpack weighs about 32 pounds. It's quite easy to carry this from a car, down a trail, to a clear dark spot.

The 4.4 pound tripod is a high end photo-type tripod that is 21.5 inches

## THE UNISTELLAR EVSCOPE 2



Image 2 - The telescope comes delivered inside of its carrying case packed in insulating foam. Also included is a tripod and accessory pack.



Image 3 - The eVscope fits securely inside its padded carrying case.

when completely collapsed. When fully extended (**Image 5**), the tripod is 41 inches tall. The top of the tripod (**Image 6**) has two clamps to secure the telescope/mount assembly. There is a bubble level on top of the tripod head. The tripod should be leveled before attaching the telescope as the telescope will obscure views of the bubble level. It's essential that the tripod is level for the telescope to easily find objects. The OTA and mount weigh just under 20 pounds. The tripod handles this weight nicely and seems very stable.

The fully set up telescope system is shown in **Image 7**. Since the telescope stores in the backpack pointed up, it will start off in that position when powered up (**Image 8**). Notice in Images 7 and 8, the viewing port is located near the primary mirror. The brains and electronics for the telescope are all located below the

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Image 4 - The carrying case is a well-made backpack with comfortable padded shoulder straps and a waist strap. The tripod attaches to the outside of the backpack for transport.



Image 5 - The tripod is lightweight but very sturdy. It adjusts to many lengths that should accommodate astronomers of most heights for comfortable viewing.

primary mirror.

There is only one button on the mount, a power button (Image 9). The power button lights up purple when depressed. After the onboard computer boots and the onboard wifi launches, the power button turns red indicating the scope is ready to be used. The power is shut off by depressing the same switch, or via the software.

The telescope is powered by an onboard rechargeable battery, which can power the telescope for up to 10 hours. Just below the power switch (not visible) is where the power cord plugs in to charge the battery. The telescope will operate plugged in while charging. The user manual states the battery cannot be removed, but no information is provided how to service it when it will no longer hold a charge. I would guess this battery will last as long as a typical laptop battery.

## From Knightware:

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The telescope is a 114mm f/4 Newtonian. Rather than having a secondary mirror (**Image 10**), the spider holds a 4.09 megapixel Sony IMX 347 camera with a resolution of 2688x1520 pixels. The sensor dimensions are 7.79mm x 4.41mm. This is a color sensor that is commonly used in security cameras. It has recently made its way into astronomical cameras. There may be some optics in front of the camera to correct for coma as I didn't notice any coma on images.

The OTA has a tube cover (**Image 11**) and a Bahtinov mask (**Image 12**) to aide in focusing. The focusing knob is on the bottom of the OTA. It's best to drive the telescope to a bright star around 45° elevation for focusing. That makes it easy to reach the focuser. Using the mask makes it easy to focus. One just needs to center the bright star, attach the mask, and turn the focuser until the vertical line perfectly bisects the crossed lines (as seen on the phone screen), all which are formed from the bright star by the mask (**Image 13**).

My eVscope came with several accessories including a tool kit and charging cords that will work in many countries (**Image 14**). The startup guide is not as detailed as the 40-page manual, both included. These documents only cover the eVscope hardware, not the software to use it.

I downloaded from the manual from the Unistellar website to have a copy on my computer in case I misplace the paper copy. The manual includes instructions on how to collimate the mirror. The mirror was in perfect collimation when it arrived and has held its collimation throughout my use of it.

The telescope must be controlled using an Apple iOS device such as an

iPhone or iPad, or an Android phone or tablet. I have an iPhone and iPad, so I only used those devices. I downloaded the Unistellar App onto both my devices from the Apple store. The software version I found was 2.1.

Unistellar's website has a well-made video on setting up and operating the telescope. Other videos produced by end users can be found on YouTube. Unfortunately, the Unistellar video on their website at the time my scope arrived only discussed version 1 of the software. Version 2 looks so different, that the video was not all that useful in explaining the icons and widows found in the new software. This presented all sorts of problems for me, as I could not figure out how to make the telescope work with version 2 of the software. Unistellar's support was not useful troubleshooting the issues I was having because they didn't appear to know version 2 of the software was different than version 1.

So I packed the telescope away for a few months to see if their website would release information about version 2 of the software. Finally, they announced version 2 of the software on their website. They added a couple of pages on the website on how to use version 2 and posted a video on how to use it as well. I would recommend they produce a complete written software manual for downloading. Their website also indicated version 2.2 was now the current version. So I downloaded in to my iPhone and iPad. The first time I connected the software to the telescope, it started a firmware update to the telescope. The new software, firmware update, and new website documentation now had me fully operational with the telescope.

When the software is launched for



**Image 6 - The tripod top has two hand-turn locking bolts to firmly hold the telescope to the tripod and a bubble level to ensure the telescope base is flat before loading on the telescope.**



**Image 7 - This view shows the eVscope attached to the tripod in the home position.**

## THE UNISTELLAR EVSCOPE 2



Image 8 - The viewing port near the bottom of the telescope contains a Nikon OLED microviewing screen.

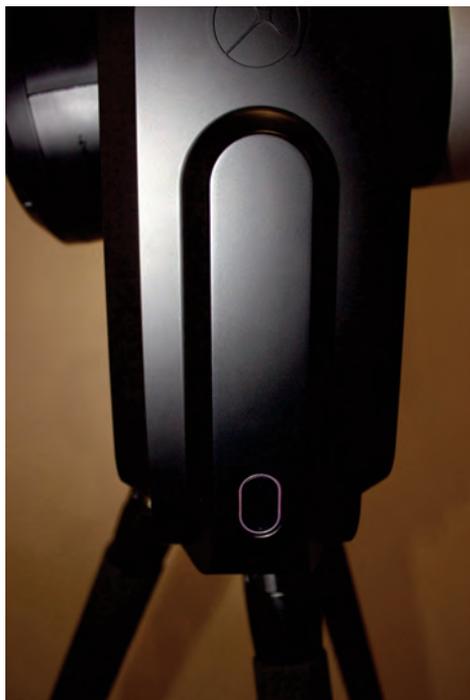


Image 9 - The only button on the telescope turns it on and off. The color displayed on the button depends on the operation occurring with the telescope.



Image 10 - This view shows the 114mm primary mirror. The spider housing contains the Sony camera.



Image 11 - The large spinning knob on the bottom focuses the telescope by moving the primary mirror up or down. It is very easy to focus. There is no image shift during focusing, and the telescope holds the focus quite well!

the first time on an iPhone or iPad, there are some questions it asks to set the software up. If the questions are not answered properly, the telescope won't work with either device. Plus, there are no options in the apps settings to go back and re-address those setup options. So, if the software is not set up properly the first time, the App must be deleted and reinstalled to get it right. These initial settings and their consequences should be thoroughly discussed in the manual and on the setup video. But I don't recall seeing anything about this.

Specifically when setting up the software, it will ask to use geolocator services on the device. This must be selected so the telescope knows where it is located. The telescope gets its location and the current time from the iOS device. This must also be accepted.

The second thing it asked was "Unistellar would like to find and connect to devices on your local network". This didn't make sense to me at first as my iPad could connect to the eVscopes wifi without this setting, and my iPad can only connect to one wifi network at a time. But alas, even when connected to the telescope's wifi, the Unistellar App could not connect to the telescope otherwise.

Finally, it asks to have access to the device's photo library. This is necessary to save images. Unistellar assured me the software will not access my personal images in my photo library. As I stated earlier, if you mishandle these setting the first time you launch the software, you cannot find them anywhere inside the software thereafter. Once the software is configured and the phone or tablet is connected to the telescope's wifi broadcast, the fun begins.

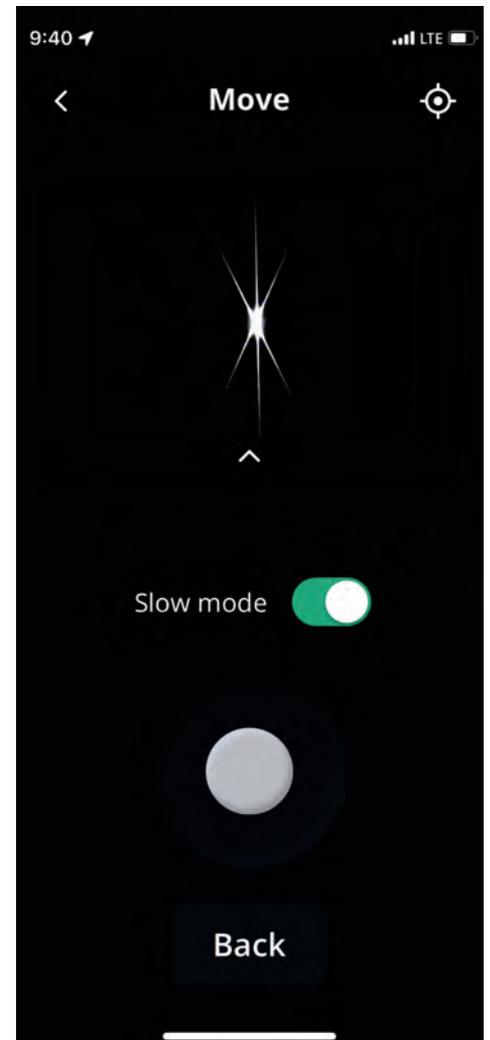
**Image 15** shows the first screen when



**Image 12 - A Bahtinov mask comes with the telescope to aid in focusing.**

launching version 2.1 of the Unistellar software. Scrolling up and down the screen reviews objects of all types currently visible. Pressing the purple button with the telescope icon get to the telescope window. The magnifying glass is the search button. Pressing "Type" allows the selected items to be filtered by object type (**Image 16**). I prefer to search for object I want to see. **Image 17** shows the search window where I have typed in M31. The Andromeda Galaxy appears in the search result list. Selecting it leads to a screen with information about the object (**Image 18**). Finally, selecting "Go To" drives the telescope to the object.

The telescope will slew to any selected object. It probably won't find it immediately, so it will take an image to determine where it is pointed, recalculate how to drive to the object, and continue the process until the object is centered (**Image 19**). As seen in this screen shot, there are three scale options for the image: 0.8x, 1.0x and 3.0x. For something as large M31, even at 0.8x, it won't fit into the field of view. That's because the telescope sensor's field of view is only 47x34



**Image 13 - When a bright star is centered in the telescope's field of view and in perfect focus, the Bahtinov mask shows six symmetric spikes.**

## THE UNISTELLAR EVSCOPE 2



Image 14 - The accessories kit comes with some start up manuals, a tool kit, extra knobs for the tripod and charging cords and plugs for use in any country.

arcminutes. So wide objects, like M31 or the Pleiades, will not completely fit on the sensor.

The button highlighted in purple at the bottom of the screen in Image 19 is

the catalog icon. To the left of that is the enhanced vision icon. To the right is save image button. I'll say more on these buttons later. Below those three icons are buttons called Move and Edit. Move goes

to the screen pictured in Image 13. There is a digital joystick at the bottom of the screen for slewing the telescope. Slow mode is for centering objects already on the screen. With slow mode off, the telescope can be slewed manually to any location in the sky. Finally, the Edit button allows the user to record notes about an object.

Every object I selected always appeared on the screen when the telescope was done finding it. Not all objects were perfectly centered. But that is similar to every other GOTO telescope I own. I found that for an object that was not centered on the screen, if I commanded to software to slew to it again, it would end up in the center of the screen on the second attempt.

After an object is in the field of view, selecting the enhanced vision icon starts the camera taking multiple exposures of the object every four seconds. The software registers and stacks them in real

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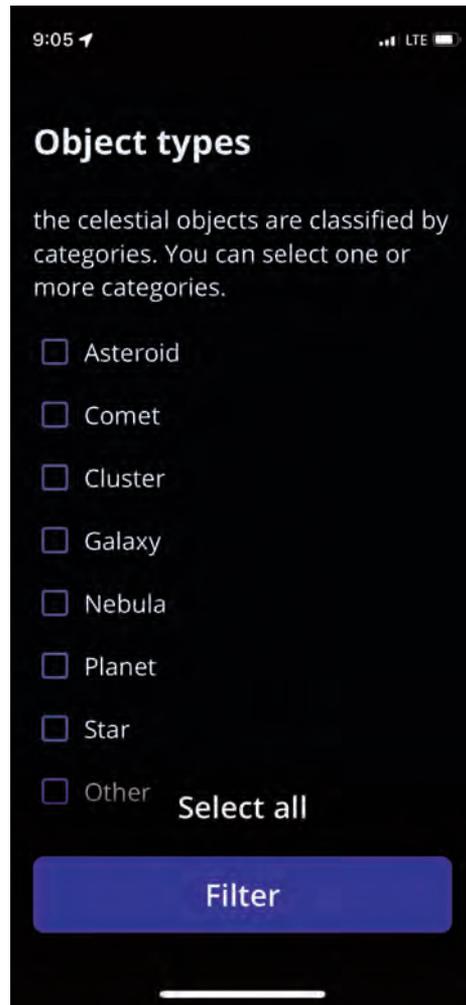
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**Image 15 -** Once connected to the telescope's wifi, the Unistellar app's home screen will appear as in this image on an iPhone or Android phone.

time. The exposures are kept short because there is no guiding. Plus, because the telescope is on an Alt-Az mount, the field will rotate as the telescope tries to keep the object centered. You can actually see the ever so slight rotation on the screen as the camera collects and stacks images. After a couple of minutes you'll typically have an image on the screen with much more detail than the eye can see in the eyepiece of a traditional telescope.

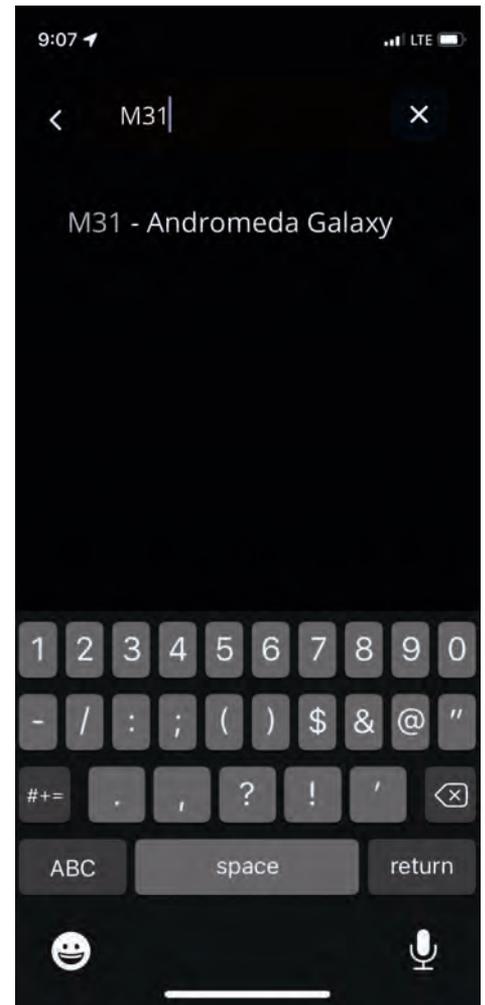
The built-in camera viewing port on the telescope shows the exact same view as seen on my iPhone screen, including



**Image 16 -** Objects to choose for viewing can be filtered by object types.

enhanced view modes. I found the quality of the image in the viewing port to be virtually the same as what I saw on my phone.

If people don't want to stand in line to look through the viewing port or have a phone passed around to see the image, there is a really cool feature of the software to get around that. Up to ten phones or tablets with the Unistellar app can connect to the telescope's wifi simultaneously! Only one of the devices can control the telescope, but every device displays the same image from the telescope. Telescope control can be passed off



**Image 17 -** Objects can be searched by name after pressing the search icon (magnifying glass) from the home screen.

from one device to another, should that be desired. All users can save any image to their own device.

Saved images end up in my iPhone's photo library. The software saves two copies of each image. One is a full sensor rectangular image (**Image 20**). The other is a cropped round image (**Image 21**) that contains the name of the object, exposure, and date acquired.

As I said earlier, the telescope can capture views of objects after a few minutes of image stacking that show more detail than can be seen with the eyepiece of a similar size or even larger telescope.



**Image 18** - Once an object is selected, some information on the object is displayed. The telescope will start searching for the object upon pressing the Go To button.

**Image 22** shows pictures from the camera of the Flame Nebula. These were taken in my back yard in the suburbs where there is significant light pollution. The left image was a 5-minute total exposure while the right image was 15 minutes. The longer exposure had a brighter nebula with a little more detail. But for casual observing, I am not sure the additional 10 minutes was worth the time.

The star clusters M35 and NGC2158 are shown in **Image 23**. This was a 5-minute exposure. **Image 24**



**Image 19** - The telescope will center the object. The user can select viewing it at three different magnifications. The button to the left of the purple button will start camera integration of exposures to achieve a more detailed image of the objects. Pressing the camera icon will save the image to the phone's photo library

shows another cluster, M37 taken with the same exposure.

I tried a few more nebulae to test the telescope. **Image 25** is the Orion Nebula (M42). Not all of it will fit on the camera, but enough to satisfy the visual observer. Unlike looking at this nebula in an eyepiece, here you can see color on the screen. I imported the image of M42 in Adobe Photoshop and performed a few enhancements. There are displayed in

## Image 26.

Next, I tried the Horsehead Nebula (IC434) which is really hard to see in light polluted skies. It barely shows up in a 15-minute exposure as seen in **Image 27**. I processed this in Photoshop to bring out a little more the nebula (**Image 28**). The last nebula I tried was M1, the Crab Nebula. It came out quite well as seen in **Image 29**.

Galaxies the same size and luminosity of these nebulae will come out about the same in the eVscope. **Image 30** is a 3-minute capture of NGC891.

The telescope does not have a long enough focal length to see planets as well as visual telescopes. I did make an attempt to see Saturn (**Image 31**). The detail was much better in my 70mm f/6 refractor with a 5mm Naglar eyepiece. Saturn was past opposition when I attempted it, however Jupiter was not as far past opposition and I was able to see some banding and the Great Red Spot (**Image 32**). Unlike a telescope with an eyepiece, the Unistellar did not allow me to see Jupiter's Galilean moons or any Saturnian moons.

When selecting a planet, the Unistellar software crops and enlarges the image. The exposures are not captured in the same manner as other objects. Good seeing is essential to get views of Jupiter and Saturn like I have shown here.

What I liked most about the Unistellar eVscope is that is very easy and quick to set up. I can set it up out in my yard and control it from inside my house. While the images are no where as good as I can obtain with my traditional CCD cameras, within minutes I can have a view of deep space celestial objects with more detail than I can see in the eyepiece of any of my telescopes. **AT**



Image 20 - A full sensor image of M56 saved after 2 minutes of integration from the telescope's camera.



Image 21 - Besides a full sensor image, the software will save a cropped, round-framed image with name of the object, exposure, telescope location, and date.

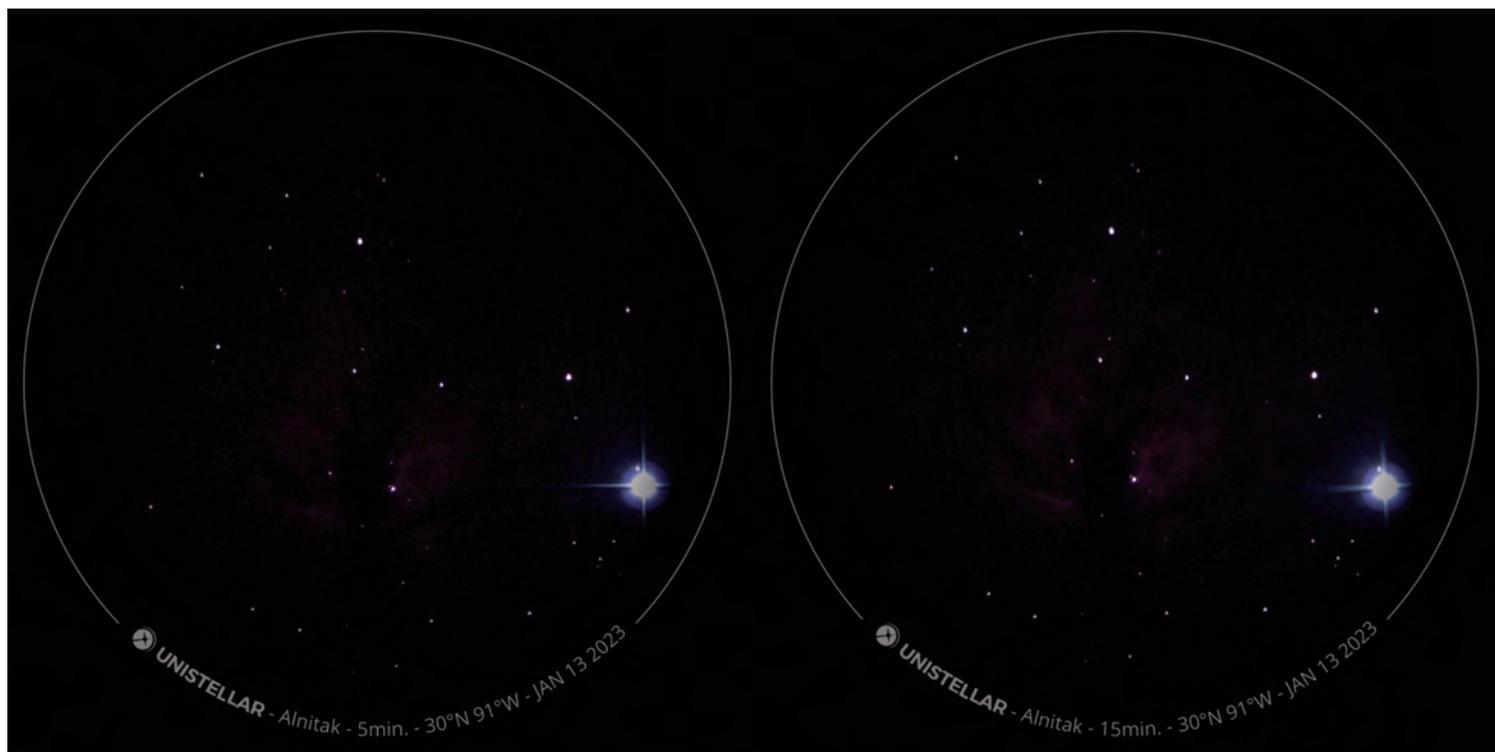


Image 22 - Two different exposure of the Flame Nebula are compared side-by-side.



Image 23 - M35 and NGC2158 barely fit into the field of view of the camera.

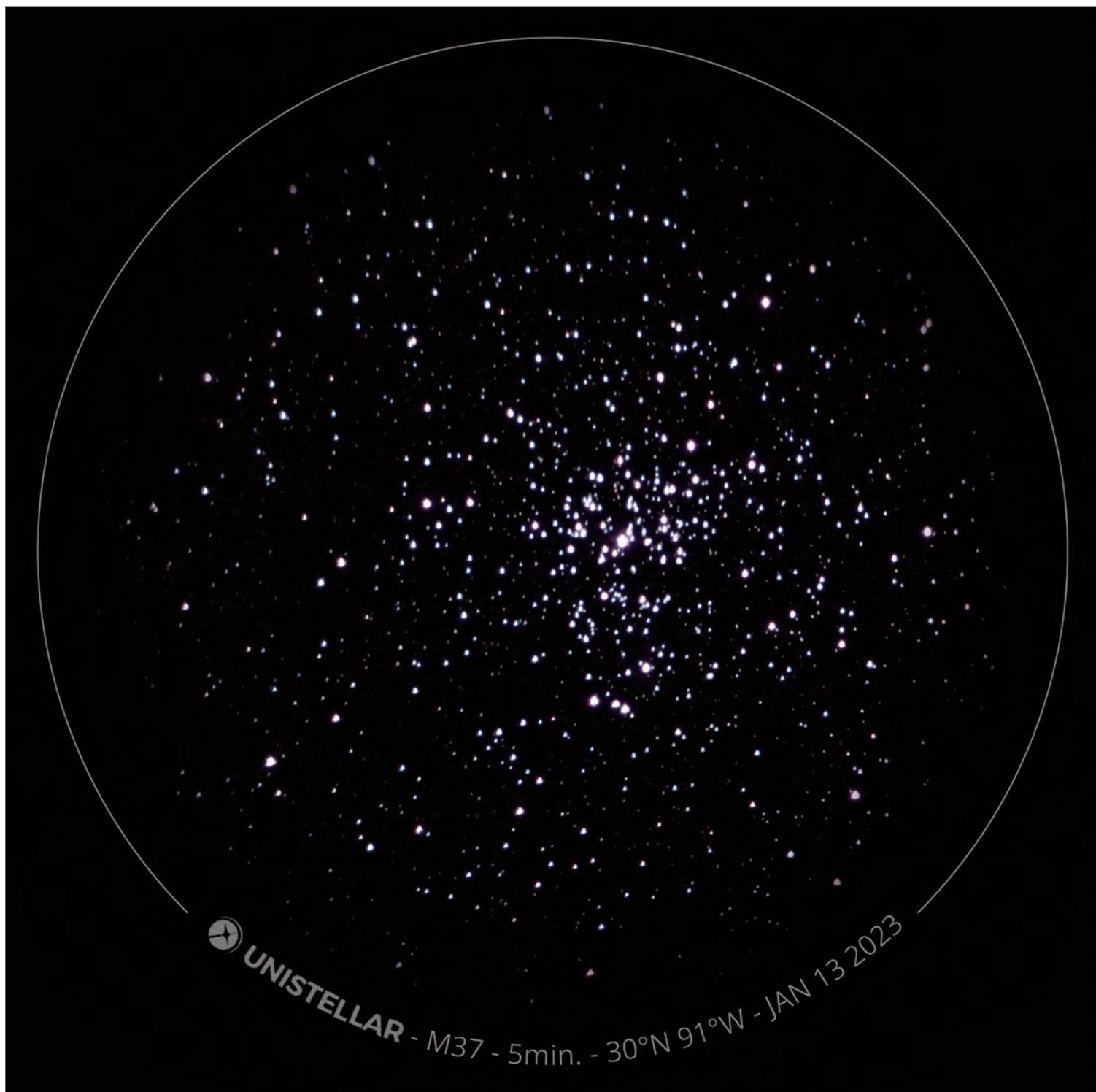


Image 24 - Open star cluster M37.



Image 25 - Five-minute exposure of the Orion Nebula.

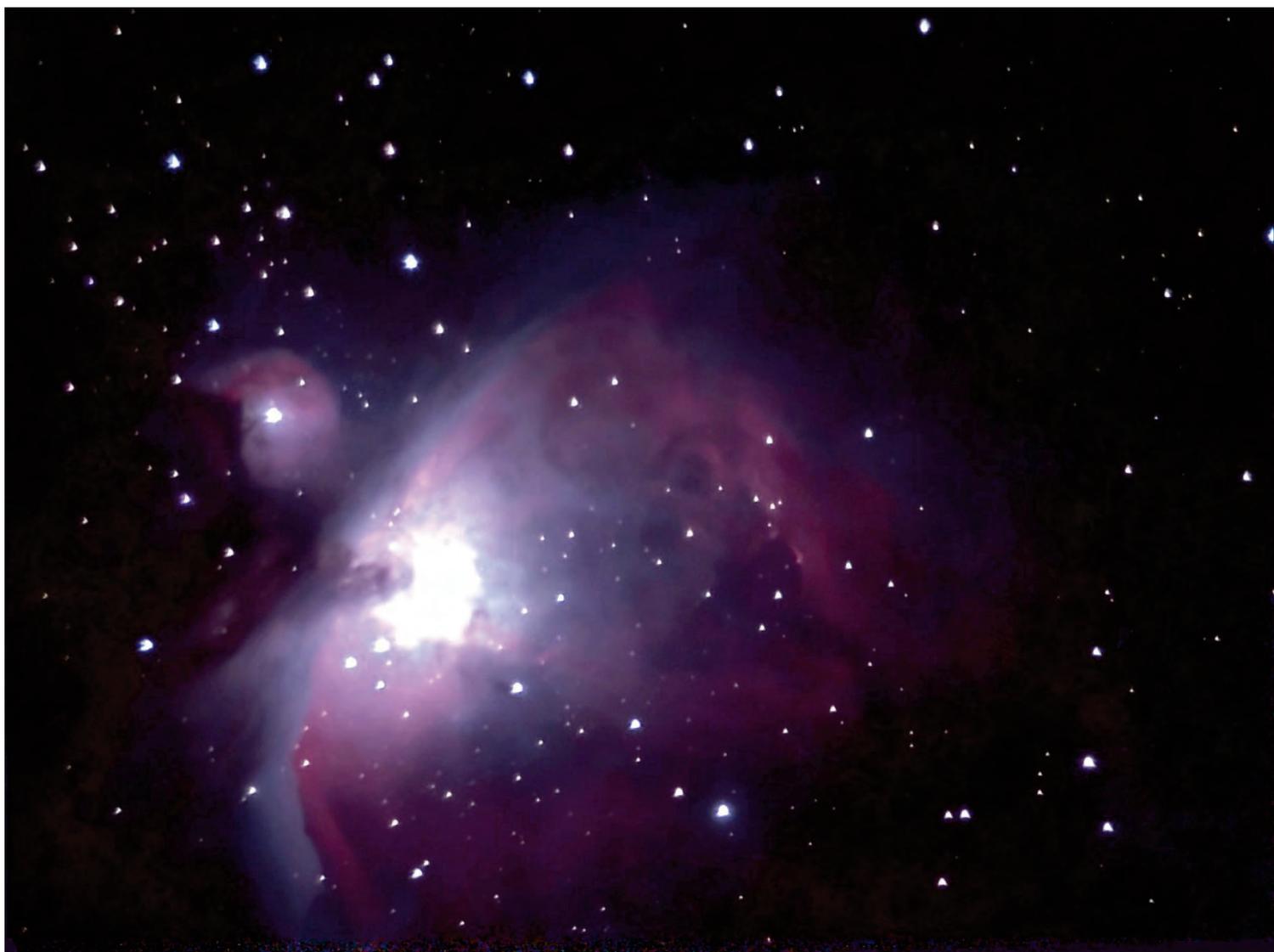


Image 26 - Same picture as Image 25 after some digital darkroom processing in Adobe Photoshop.



Image 27 - With the light pollution at my home in the suburbs, the Horsehead Nebula is barely discernable after a 15-minute exposure.



Image 28 - Same picture as Image 27 after some digital darkroom processing in Adobe Photoshop.



Image 29 - The Crab Nebula comes out well after a 10-minute exposure.



Image 30 - After a mere three minutes of collecting and stacking images, NGC891 shows more detail here than I can see in any other 4- or 5-inch telescope.



Image 31 - The best image I could get of Saturn in the eVscope.



Image 30 - Jupiter with its belts, zones the Great Red Spot.