# Morning Star

## Winter 2019

## *** Club Info ***

### Announcements

**Associate Members interested in becoming full members** make your interest known to one of the board members.

**Wanted - PR person and Webmaster**
If interested in either position contact Jack St. Louis or Paul Walker.

**Moving or Changing Email?**
Please send changes to Paul Walker, 53 Valley View, Middlebury, VT 05753, paulwaav@together.net (info@vtastro.org will also work)

### Hinesburg Observing Site

We have an observing site in Hinesburg, VT. (Located on town property). A locked gate (required by the town) limits access to the site. The gate lock uses the same key code as the Warming Hut, 115V AC and port-a-potty. There is a separate lock for the observatory buildings which house the two fixed mount VAS telescopes.

**Any Associate Member can request gate access (some training required)** (includes access to the Warming Hut, 115V AC power and the port-a-potty).

**Only Full Member can request observatory access (some training required) .**

**Additionally**, the public and/or VAS members are **welcome to park outside the gate and enter with their equipment on foot** if the gate is locked.

There is some training and other requirements before access can be granted. **Contact Paul Walker or info@vtastro.org or any board member for the *Observatory Access Agreement* which includes the requirements. (Sorry but this is not available on the web site)**

**Email for Observing at HOS**

We have an email List for Member's interested in getting a heads-up when someone will be at the Hinesburg Observing Site (HOS).

If interested in getting on the list contact **info@vtastro.org** (Goes to President and Secretary)

### Observing Certificates

Several certificates (beginner to advanced) are available to members as encouragement to get out under the stars and hone their observing skills. Follow the link on our web site.

### Outreach Acknowledgment Letter

To help record our broad community involvement with public star gazing events, projects and classes, we have developed an Outreach Acknowledgment Letter with a Sample Form. It is posted on the website and can be found under **Members, VAS Club Materials for Members, Outreach Acknowledgement Letter**.

We encourage you to use it any time you interact with the public. Having a folder of proof of what we do helps when we ask for donations for events and projects. Many people have never heard of us and have no clue of the extent of the knowledge and time we freely give to the public.

Please print it out and give it to the event coordinator you are working with or fill it out yourself to record your event. Thank you for helping us document what we do.

**Direct Link:** http://vtastro.org/wp-content/uploads/2018/03/VAS_Outreach_Ack_Letter_V3.pdf

### Dues

**Membership Renewal Time - January 1st**

**Associate Members $15**
**Full Members $25**

Send dues and any address or email updates to VAS, PO Box 782, Williston, VT 05495. Or bring to any monthly meeting or Contact Paul Walker, 802-388-4220, paulwaav@together.net.

### Connect On-line

www.vtastro.org
Twitter@VTAstroSociety
Facebook.com/Vermont-Astronomical-Society-113053818706458/
Email: info@vtastro.org (Goes to President and Secretary)
webmaster@vtatro.org
(Goes to Secretary)

### Board Members

| | | |
|---|---|---|
| Jack St. Louis | Pres | 658-0184 |
| Joe Comeau | VP | 238-1664 |
| Doug Williamson | Treas | 388-3482 |
| Paul Walker | Sec'y | 388-4220 |
| Bob Horton | | 879-7802 |
| Gary Nowak | | 879-4032 |
| Keith Lawrence | | 453-5496 |

Editor and Publisher - Paul Walker

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(My apologies if I missed anyone)

## Contents



**Gary's Astronomical Events for the Month**
can be viewed via WCAX at https://www.wcax.com/weather/astronomy

**Jack on the Radio**
Listen to Jack's astronomy update on radio station WJOY AM (AM 1230) on Ginny McGehee's 'Breakfast Table' morning show. Airs the first Wednesday of the month at 8:40 AM.

## Stargazing and other Events

**All observing events -are weather Permitting unless otherwise stated. Bring extra clothes. Even a summer evening can be chilly after standing still for a couple hours in damp air.**

**Contact: info@vtastro.org**

**We have an mail List for Member's interesting in getting a heads up when the Hinesburg Observing Site (HOS) will be opened.**

If interested in being on this list contact **info@vtastro.org**

## Public Star Gazing at Schools, Libraries, and other, groups.

If you know of a group or institution that would like to schedule a star gazing session have them contact: **info@vtastro.org**

## Public Events

**We have requests from several entities for presentations and/or observing events.** Members interested in helping or for more info, contact: **info@vtastro.org**

## Member & Invited Guest Star Gazing & other events

**No planned events until Spring. We may have impromptu events if there are times this winter when there is not too much snow.**

**Contact info@vtastro.org**

## Green Mountain Astronomers (GMA)

**All events start about sunset.**

**Contact Ron Lewis for info**
**802-779-5913 (cell)**
**802-247-5913 (home)**
**vtpoet@gmail.com**

**No events until Spring**

## New Members

**VAS welcomes** the following new member who joined us since the last newsletter:

Duane Waller
Silas Spaulding

## Meetings/Presentations

Meetings are held the first (non-holiday) Monday of the month, at 7:30 P.M. in the Kolvoord Community Room of the **Brownell Library**, 6 Lincoln St., Essex Jct (2nd building north of Essex 5 corners on the left on Rt. 2A). (see Map on our web site, top of Events page). Extra parking is available in the Bank North parking lot across from the library. **For inclement weather call Jack St. Louis (802-658-0184) or Paul Walker (802-388-4220) to confirm.**

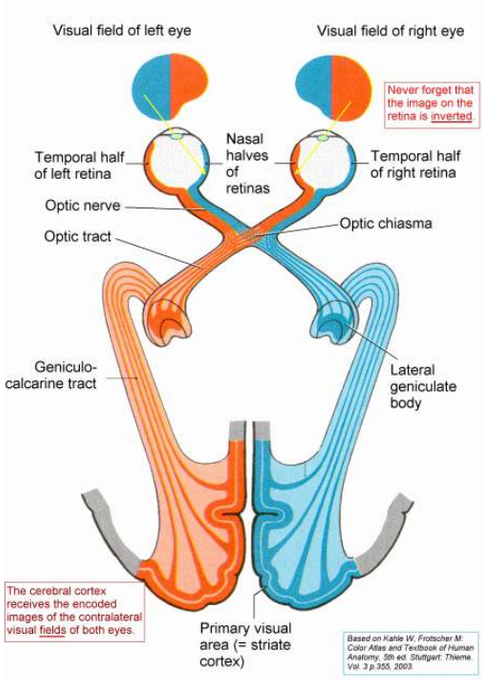
### January 7

**Two Eyes vs. One,**
**The Neurology of the Eye**
**by Jim Bosek**

When stargazing, many people prefer viewing with 2 eyes through binoculars verses only one eye through traditional telescopes. Some amateur astronomers use dual eyepiece setups, called Bino Biewers, on traditional telescopes to get the benefit of using 2 eyes. Because Bino Viewers divides the light from 1 objective lens or mirror (as opposed to the 2 objective lens of binoculars) one may think there would be no benefit to using Bino Viewers.

An examination of the visual pathways, how the eyes hook up to the brain, will give insight to the reasons for this preference. Come learn about

the neurology of the eye/brain and the whys and sometimes the why nots of using both eyes.



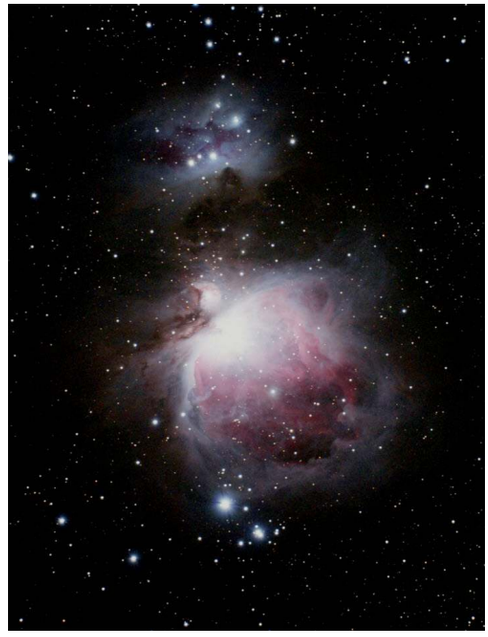

## Feburary 4

**Astro-imaging with a Portable Telescope**
**By Steve Grimsley**

Most amateur astronomers, like me, have to travel to remote sites for optimal weather and sky conditions, and also for gatherings like Stellafane and the Texas Star Party. This requirement for equipment portability in a temporary setup, can present special challenges to the stability of the setup required for consistent results in long exposure astro-photography. Long exposure times allow for the capture of faint nebula and details in small distant galaxies.

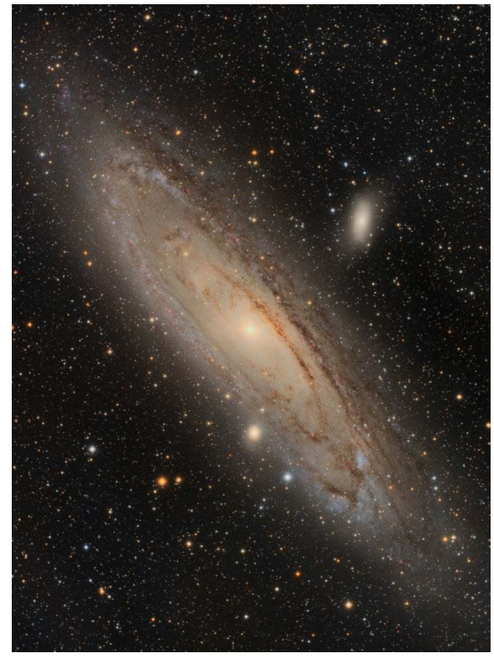
Equipment parameters like f-ratio, image scale, guide scope ratio, polar alignment, and general stability and balance are critical issues that require an understanding and a solution for successful execution of a long astrophoto run. With favorable sampling resolution, sufficient exposure time, alignment, and tracking, the results can be surprisingly good even when compared to similar aperture telescopes located in fixed observatories.

This presentation is divided into three parts. First a discussion of telescope resolution, optical speed, sensor sampling, and camera efficiency and how these parameters play into a quality image capture. Second, a series of astronomy photos will be shown that will demonstrate the advantages of an efficient image acquisition. And lastly, we will look at the complete telescope setup that was used in most of the images shown in this presentation. Comments will be made about general stability, balance, flexure, mount alignment, tracking, and guiding. With the telescope assembled and on display it should be easier for the audience to get a clearer idea of the numerous variables that need to be addressed in order to capture beautiful but very faint and distant deep sky objects.



## March 4

**Astro-Image Processing with PixInsight**
**By Mike Stadtmauer**



PixInsight is the most advanced piece of software on the market for astro-image processing. It is used by NASA and professional observatories around the world. It is non-intuitive, has a non-standard GUI, has no official manual and is entirely algorithm based - in short, its perfect for us astro geeks who like a challenge. Especially when that effort pays off in stunning images that can not be produced any other way.

Astro-image processing typically invokes taking images shot through L, R, G, and B filters and combing them through extensive processing and manipulation of the data in order to produce a pretty color image. This presentation will walk through the steps of a typical LRGB image processing workflow, using the special tools and features of PixInsight. We will start with raw, straight out of the camera subs and calibrate and stack them into master frames for each filter. Then, I will demonstrate how to clean up those frames to prepare for RGB combination. Next, we will see how to prepare the L master and the RGB master for stretching by performing linear noise reduction and deconvolution (what's deconvolution? - you'll just have to come and find out! - but it was invented

by NASA for processing the Hubble images so you know its pretty cool). I will demonstrate a number of different stretching techniques where we take the image from its natural linear state to a non-linear state in order to properly visualize the data. Once stretched, we will see how and why we combine the L with the RGB images to create the LRGB master. That final master image will then be taken through a number of techniques designed to optimize, bring out the most detail and the best colors of our data. Finally, we will see how non-linear noise reduction, sharpening, star reduction and some final touches are applied in order to arrive at the finished image.

If all of this sounds like Greek to you, don't worry - there will be a handout to follow and lots of explanation along the way. If you have used other astro processing software, prepare to be impressed by the raw mathematical power of PixInsight!

## Articles

This article is provided by NASA Space Place. With articles, activities, crafts, games, and lesson plans, NASA Space Place encourages everyone to get excited about science and technology. Visit spaceplace.nasa.gov to explore space and Earth science!

### Observe the Moon
### By Jane Houston Jones and Jessica Stoller-Conrad

This year's International Observe the Moon Night is on Oct. 20. Look for astronomy clubs and science centers in your area inviting you to view the Moon at their star parties that evening!

On Oct. 20, the 11-day-old waxing gibbous Moon will rise in the late afternoon and set before dawn. Sunlight will reveal most of the lunar surface and the Moon will be visible all night long. You can observe the Moon's features whether you're observing with the unaided eye, through binoculars or through a telescope.

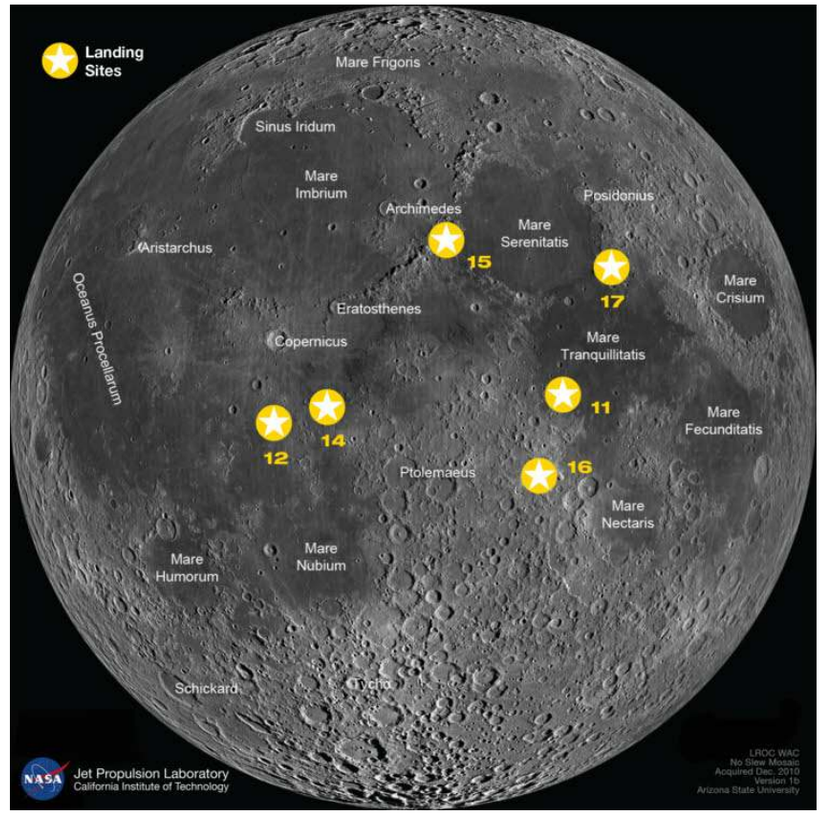
Here are a few of the Moon's features you might spot on the evening of October 20:

Sinus Iridum—Latin for "Bay of Rainbows"—is the little half circle visible on the western side of the Moon near the lunar terminator—the line between light and dark. Another feature, the Jura Mountains, ring the Moon's western edge. You can see them catch the morning Sun.

Just south of the Sinus Iridum you can see a large, flat plain called the Mare Imbrium. This feature is called a mare—Latin for "sea"—because early astronomers mistook it for a sea on Moon's surface. Because the Moon will be approaching full, the large craters Copernicus and Tycho will also take center stage.

Copernicus is 58 miles (93 kilometers) across. Although its impact crater rays—seen as lines leading out from the crater—will be much more visible at Full Moon, you will still be able to see them on October 20. Tycho, on the other hand, lies in a field of craters near the southern edge of the visible surface of the Moon. At 53 miles (85 kilometers) across, it's a little smaller than Copernicus. However, its massive ray system spans more than 932 miles (1500 kilometers)!

And if you're very observant on the 20th, you'll be able to check off all six of the Apollo lunar landing site locations, too!




*Caption: This image shows some of the features you might see if you closely observe the Moon. The stars represent the six Apollo landing sites on the Moon. Credit: NASA/GSFC/Arizona State University (modified by NASA/JPL-Caltech)*

In addition to the Moon, we'll be able to observe two meteor showers this month: the Orionids and the Southern Taurids. Although both will have low rates of meteors, they'll be visible in the same part of the sky.

The Orionids peak on Oct. 21, but they are active from Oct. 16 to Oct. 30. Start looking at about 10 p.m. and you can continue to look until 5 a.m. With the bright moonlight you may see only five to 10 swift and faint Orionids per hour.

If you see a slow, bright meteor, that's from the Taurid meteor shower. The Taurids radiate from the nearby constellation Taurus, the Bull. Taurids are active from Sept. 10 through Nov. 20, so you may see both a slow Taurid and a fast Orionid piercing your sky this month. You'll be lucky to see five Taurids per hour on the peak night of Oct. 10.

You can also still catch the great lineup of bright planets in October, with Jupiter, Saturn and Mars lining up with the Moon again this month. And early birds can even catch Venus just before dawn!

You can find out more about International Observe the Moon Night at https://moon.nasa.gov/observe.

**Walking Quietly at LIGO**
**By Angele Mott-Nickerson**


I recently had the opportunity to join the Rose City Astronomers (Portland, OR) on their third trip to visit one of the LIGO (Laser Interferometer Gravitational-Wave Observatory) facilities. Located in eastern Washington on land surrounding the Hanford Nuclear Reactor (decommissioned), LIGO Hanford rests on acres of flat, dry, semi-desert land full of nothing much but tumbleweeds and wind. This out of the way location might seem a strange spot for such a high-tech scientific operation but it turns out to be a great fit for LIGO's unique requirements.

When choosing a spot to build a LIGO observatory scientists were trying to meet a few specific needs. They needed space and quiet but, also access to the people and things necessary for a successful observatory. The excess land connected to the Hanford Reactor provided all of these things: lots of cheap (government) land and the quiet neighbor of a decommissioned reactor undergoing cleanup, yet access to a number of small and mid-sized cities who have spent decades hosting government workers and scientists.

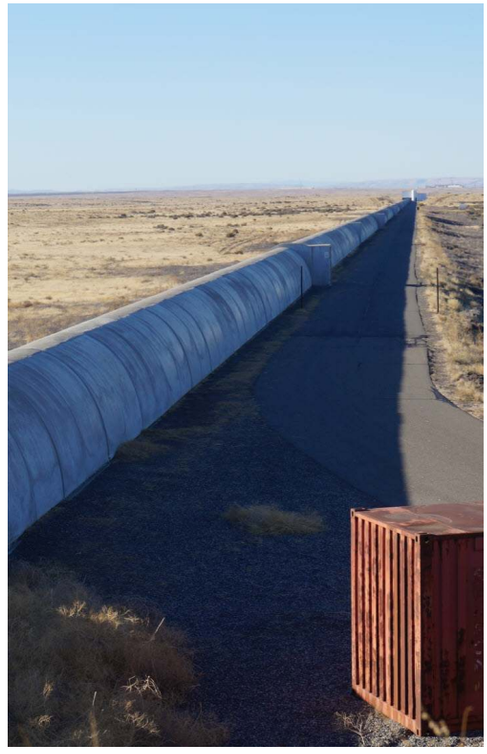
LIGO Hanford was the first of the two LIGO locations to begin construction, breaking ground in late 1994. For all of the upgrades and groundbreaking science in the past 24 years the facility itself still seems a rather quiet and humble place. LIGO Hanford hosts visitors one Saturday a month, offering a short lecture and walking tour. These are given by a member of LIGO's scientific staff. The gentleman who gave the lecture and tour on the day of my visit worked as an engineer, specifically working on the code LIGO uses to block out non-gravitational-wave vibrations. Other scientists hung out in the lobby talking to visitors and answering questions. Multiple employees talked about how surprised they were that people were willing to drive out to visit them and how often tours were full. They all generally seemed happy, and a bit surprised, to have such excitement from the public about the work they do.

The tour itself started with a half an hour lecture about the history of the study of gravitational waves and the methods scientists have created over the years to detect them. It then went on to highlight some of the history of LIGO itself and how the process of detection works. Finally, the discoveries made by LIGO were explained and the floor was opened for questions from the audience. The walking tour of LIGO lasts about an hour as you explore the various buildings and look over the control room and finally stand at one end of the 2.5 mile long detection arms themselves.

Currently LIGO Hanford has just completed an upgrade to improve its sensitivity and is now working on 'commissioning' which helps fine tune all the new upgrades. For the purposes of the tour though it left the site feeling rather quiet and empty. However, even during this process the scientists stay busy. There seemed to be some excitement over the recent purchase of a combine to deal with all the tumbleweeds that pile up against the long detection arms making access difficult. And over the summer months there was a close call as a brush fire came dangerously close to the west detection arm. The real work of the observatory will start up again in February 2019 and run for twelve full months making this the longest LIGO observing run.

In this next observing run LIGO will be joined by the Virgo observatory in Italy. With the addition of a third observatory astronomers can better pinpoint the location of any gravitational waves they detect. The Virgo and LIGO teams previously jointly observed the skies in August 2017 which is when gravitational waves were detected from the merging of two neutron stars. Using data from all three observatories, the location of this merger was determined and various types of observatories around the world were able to detect this event across the electromagnetic spectrum. It is anticipated that a full year of LIGO and Virgo observing will find other such events in the universe.

It was a rather humbling experience to freely walk around LIGO Hanford's grounds, speak with the scientists and engineers, and to see the detection arms heading off into the distance. Since tours are given by the employees of LIGO it is always someone new giving the lecture and showing visitors the grounds. Speaking with other members of the Rose City Astronomers who had previously been to LIGO Hanford they said you learn something a little different with each tour guide. I am sure as well, that visiting next year when LIGO is again operating would be a different experience. I am already looking forward to that trip.



**Modified or Unmodified Camera for Astro-imaging? How About Both!**
**By Paul Walker**

My first foray into astro-imaging with a Digital Single Lens Reflex (DSLR) camera was with a 10 megapixel Canon Rebel XTi. It did and still does fine with many sky objects but not so well for those who's light is primarily from the deep red of glowing hydrogen gas (which emits light at the "H-Alpha" wavelength of 656.3 nm). So after a couple years I bought a used 8 megapixel Rebel XT and had it modified by Hap Griffin with a specialized UV/IR filter that extends much further into the red end of the spectrum.

The regular DSLR produces an image very similar to the results with film. The modified XT does really nice with the glowing clouds of hydrogen gas. Maybe too good in some cases. Having grown up in the days of film, the Orion Nebula looks too red to me using the modified XT.

So why not combine the two. Punch up the DSLR image (top image) by adding in some of the modified DSLR image (bottom image). One can combine the two and get something that reminds one of the film images but with more pizzazz!

A 6" f/4 Newtonian was used for both images. The DSLR image was taken 12/8/18 on the same night as I was imaging comet 46P-Wirtanen. The image using the modified camera was taken a couple years ago on 2/26/16. The DSLR image is a stack of 5, 3 minute exposures (15 minutes total), the other, 16, 4 minute exposures (1hr 4min total). Both were shot at ISO 100 to prevent the central part of the nebula from being blown out (over exposed).

Normally I would have shot both sets of images with the same exposure time and total amount of time. But I took them 2 years apart and did not remember I had done the earlier set. I would also have had the camera oriented the same. I cropped the images but you can see the relative rotation if you look closely in the upper left and lower right of each image.

I like the 2nd image in the sequence best. The 3rd is also nice.

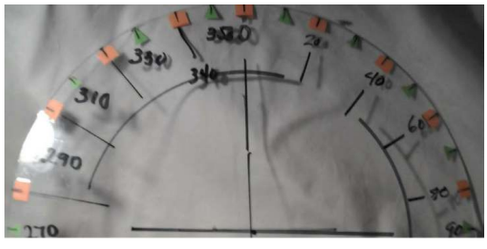
**Creating an Indoor Test-Bed for the Celestron NexStar 8SE**
**By Duane Waller**

As a newcomer to Amateur Astronomy, it took me some time to build a measure of confidence in my understanding of the various designs and models of telescopes available on the used and new market, as well as the challenges and benefits each has to offer. The Celestron Nextar 8SE remained on my list, as I progressed in narrowing it down. And then a recent price-break appeared, and I decided to take the plunge.

Interestingly, since then we've had little to no clear nights to speak of, the thought occurred to me – why not play with the unit inside the house at my work desk. Why not set up a test-bed to simulate taking it through its paces and features. This would allow me to get used to its software flow without having be outside in the dark.

This turned out to be beneficial, as I discovered a few unforeseen quirks with the software, which would perhaps have taken me many nights to discover otherwise. By running through the software options, monitoring the units ALT/AZ movements, and comparing them to object coordinates within Stellarium, I was able to easily become familiar with the star alignment procedure, and then watch the unit track and go-to various sky objects, while confirming its general accuracy. In this way I was able to put the unit into its "Tour" mode – select and watch it skew to various objects while confirming ALT/AZ coordinates in Stellarium.

I started the setup with a makeshift ALT/AZ setting-circle out of a 13" piece of plastic.



I put this on the floor next to my PC. I then I applied degree labels to the Horizontal and Vertical Axes on the NexStar motor-housing assemblies.

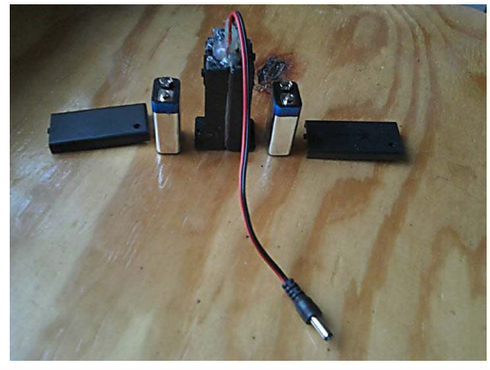
These markers allow me to track the Azimuth and Altitude of the unit. I set the unit down, centered on the plastic setting circle, with a specific Azimuth representing the direction towards Polaris. I turned the unit on and let it boot up.

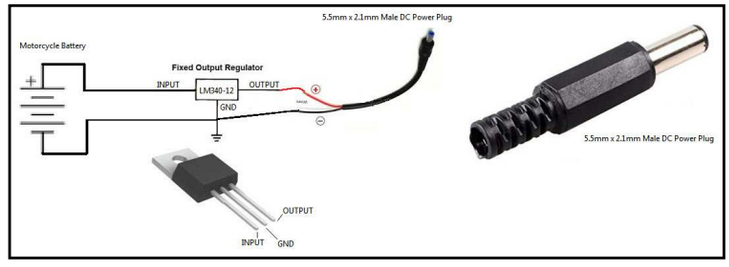
Next is the alignment procedure. I chose the "Auto-Two-Star" procedure because this is said to be the most popular with NexStar users and is said to be the most accurate. I then discovered that the software deviates slightly from the documentation. It presented an option for Universal Time, which I selected. However, this would prove to be wrong. There is another alternate option buried a little deeper containing selectable time zones. My first "Auto-Two-Star" alignments without the proper time setting were successful, but as the software presented a list of possible stars to use for alignment, I confirmed with Stellarium, a few stars on the list were not in fact above the horizon, and a few very desirable stars were missing from the list.

Was there a problem with the software? Did it not accurately know which stars were above my horizon? A little further investigation from an online user-group and I discovered the fault was mine. The software should know exactly which stars are within my horizon. I went digging into the options and there discovered the time zone set option. After this was fixed, every star the software presented as a possible star to use for the alignment was indeed above my horizon, confirmed by Stellarium, and those few desirable stars that were missing before were now on the list.

It was then fun to confirm the alignment was done well, and to see what the "Tour" mode would do, especially looking for Messier objects. The software would present an available object – I would accept it – and then watch the assembly skew to it, following along in Stellarium. I was able to confirm that the ALT/AZ coordinates were correct almost every time, and if they weren't correct, to ascertain which axis was off, and by what amount. It turns out, the test-bed offers me more insight into the NexStars go-to characteristics than I had anticipated.

I added a small battery pack using a pair of rechargeable 9-volt Nicad batteries in series with a 12 volt regulator






The battery cases cost around $5.00 from Amazon, and I have an inventory of voltage regulators. I chose the LM-340 12-volt regulator chip because it can handle up to 1.5 amps of current.

These two 9-volt batteries have enough capacity for about 2 hours of

usage with the NexStar, so I decided a larger battery source would be needed: The Mighty Max Battery. This motorcycle battery is available from Amazon for $20.00


Again, I used the LM340 12 volt regulator to ensure the NexStar would never see more than 12 volts.

All in all, I'm very happy with the little test-bed experiment. It has allowed me to set up the NexStar numerous times during the day, running it along side Stellarium and a cup of coffee. Since this set up has given me the opportunity to become familiar the NexStar's software flow, I now feel it will be much easier for me to take the unit through its paces when the night sky is clear and the stars outside are bright.

And neither the NexStar or Stellarium seem to mind in the least - that we have our fun during the middle of the day.

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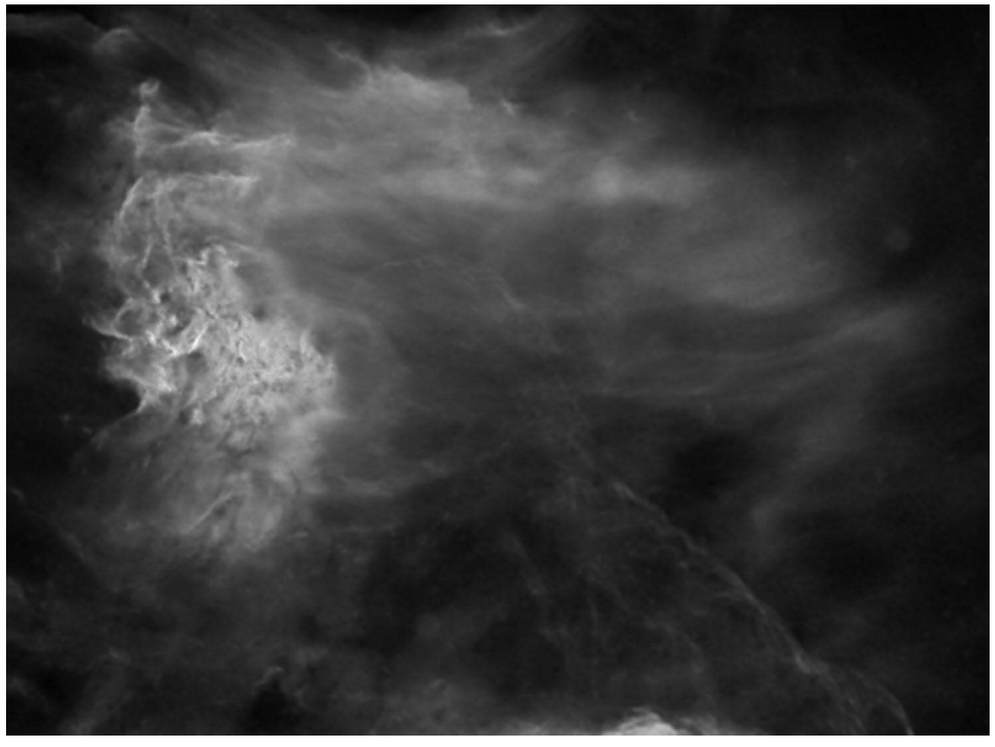
**IC405 - Flaming Star Nebula**
**By Michael Stadtmauer**

This mixed emission/reflection nebula has ties to Orion despite being half a sky away in Auriga. IC405 is only about 1500 light years away. It is illuminated by AE Auriga, a very bright variable star that is not visible in this image, but is located behind the brightest part of the nebula. It's about 30,000 times the luminosity of the sun. This star was born in Orion and had a close encounter with another star within the stellar nursery. This interaction caused both stars to be ejected out of the nursery and into interstellar space. As the star moves further away from Orion (at a velocity of 90km/s from our perspective), it just happens to be currently passing behind an area of heavy interstellar gas and dust, illuminating the nebula and changing the shape and structure as it passes through.

This image was taken through an H-Alpha filter with a 3nm bandwidth . The filter only allows wavelengths of light though that are at approx. 656nm, which puts them deep into the red visual spectrum. This wavelength is fairly specific for stellar activity. Many celestial objects (aside from planets) shine mostly at the H-Alpha wavelength of light. If you were to look at this object with the naked eye, and it was bright enough, it would be a faint red glow. Capturing just the one wavelength allows us to visualize the structure of these dust clouds in a way that is not possible with more broad spectrum photography. The downside is that very, very little light reaches the camera's sensor and so long exposures are needed to have the image signal rise above the background noise. This image was created using 32 x 15 minute exposures (8 hr. total exposure time).



I created both a starred and starless version. The starred version has the stars significantly reduced, but still obviously present to give a 'realistic' look. The starless version has some issues - I'm still working on the technique to remove stars - but allows you to better see the structure of the nebula.

**Telescope**: SV80ST (Triplet 80mm refractor) with .8x reducer
**Camera**: QSI683wsg-8
**Mount**: Paramount MyT

If you like, you can check out a full resolution image at my Astrobin page https://www.astrobin.com/users/drmikevt/

## Board Talk

### October

Jack opened the meeting.

Gary - The objective from the Russel Chmela scope has been sent out to Mystic Coating for re-coating. Coating and return of the objective should take about 2 weeks. Bill Banke has donated 2 finders he would like to have used on Russ's scope. The Grout Observatory at Peoples Academy in Morrisville is still dealing with the issue of the rotating dome sticking in some places.

Keith - The Roll off sheds on the new observatory are virtually done.

Doug - Suggests that we consider using electric heat to warm the Warming Hut just a little. He suggested using a 12v heater that would connect directly to the battery. The YWCA in South Hero sent us a Certificate of Appreciation. Gave financial update on the new observatory.

Paul - We had worked on updates to the Key Sign-out Agreement about a year ago but had not finalized it. We need to do additional updates because of the new observatory and because we are switching from key locks to combination locks. Terri Zittritsch requested a gate key to the HOS. The Board approved her request. Terri Zittritsch also requested Full Membership. The Board discussed Terri's request. For now they have deferred voting on it.

### November

Jack opened the meeting.

The new observatory is essentially done. A little painting of the weather-stripping on the front of the Chmela building, run power to the west end of the deck and into the Chmela building and install the Chmela telescope. The Patterson 14" is also not there yet. The equatorial mount is ready to receive either scope.

Terri Zittrisch has requested to become a Full Member. Maura Kelly has requested access to the HOS. We did not have enough board members at the meeting to consider either of these requests.

We are finalizing the updates to the Key Sign-out Agreement. Among other things, because we won't be using keys, it has been renamed "Observatory Access Agreement".

We will have separate log-in sheets for each building to make it easier for people to sign-in. The intent is to make it easy to sign-in so we can better record and track how much the site and equipment is getting used.

We had a preliminary discussion about having a Dedication for the new observatory. Mostly likely it will be in the Spring, probably a potluck lunch with a grill. Possible dates we threw out are April 27 (Saturday) with rain dates of the 28th, May 4, May 5. The Site Committee will work more on this (the 4 board members present happen to be on that committee).

We briefly discussed options for supplying heat for the Warming Hut. We will hold off doing any insulating or other modifications to the building for this winter.

Jack will change out the locks at the HOS and will send current key holders the access codes.

Bob has the re-figuring of the Patterson mirror almost done and will soon send it out for re-coating.

Jack offered that he would like to bring some of the usable donated telescopes he has stored in his garage up to the site to be stored in the Warming Hut. It was suggested that unless such scopes were likely to get used at the site that it does not make sense to do that (we would rather fill up his garage then the Warming Hut, sorry Jack).

We need to update the VAS Asset List at some point.

Because the price we pay for the Library Loaner Scopes has gone up Keith has determined a new break-even price to charge to libraries for the scopes.

### December

There was no meeting

### VAS Membership Committee

There were no meetings this quarter.

### Site & Russell Chmela Committees

### Septemer

There was no meeting

### October

Only 3 of us were able to attend so we kept it short.

We put out some ideas for the warming hut, such as a storage "shed" on the north side, maybe benches or additional chairs and a table.

Doug has a roll-a-round tool box he will donate for storage in the 18" observatory.

### November

Canceled due to weather

### Chmela Observatory Dedication Committee

Committee members - Terri Zittritsch, Bill Wooden and Paul Walker. They will coordinate with the Board on the details on the planned late Spring or early Summer Dedication / Open House at the Hinesburg Observing Site.

Contact Paul Walker if you want to help or contribute ideas.

### Site Survey Analysis Committee

Committee members - Maura Kelly, Bill Wooden, Terri Zittritsch and Paul Walker. This committee is reviewing the 2018 Site Survey results and will make recommendations based on our findings.

Contact Paul Walker if you want to help or contribute ideas.

There will likely be a joint meeting of these 2 committees in late January.

## Observers Page

Even though it feels like the sky was socked in this Fall it actually started out out pretty good. We opened the Hinesburg Observing Site 3 nights in September (the 7th, 14th and 15th), 2 nights in October (the 5th and 30th) and 1 in November (the 11th). Even on nights that we had some interference from clouds we had a good time. That said, November and into December was pretty well socked in - to many folks buying astronomy gadgets I'm sure : )

### Comet 46P-Wirtanen

Some of us had an opportunity to view and image the close approach of the periodic comet 46P-Wirtanen. By the time you read this it will have made it's closest approach to Earth in many years (7.4 million miles). By happy coincidence this year the comet's closest approach to the Sun (perihelion) occurred at the same time it was going by the Earth. The perihelion of it's 5.4 year

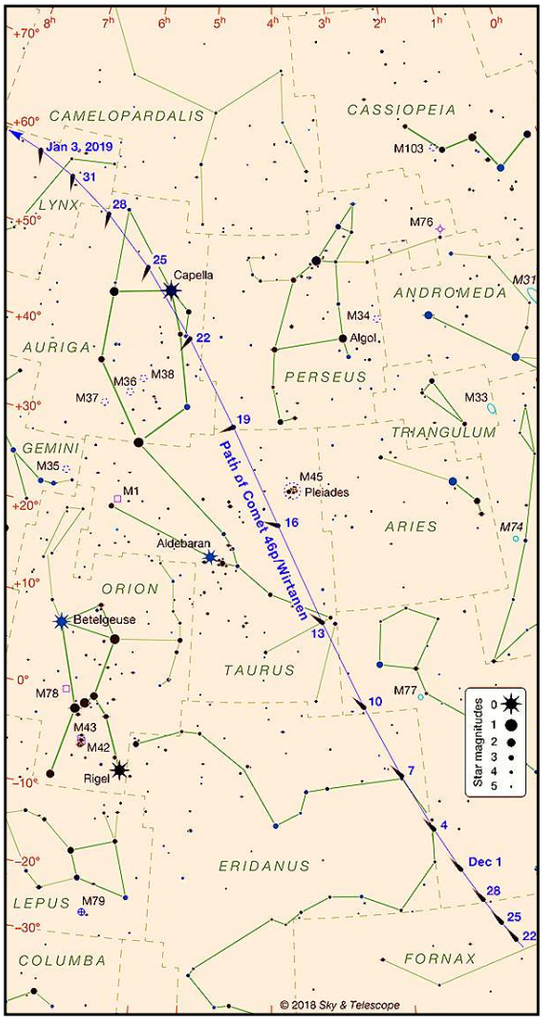
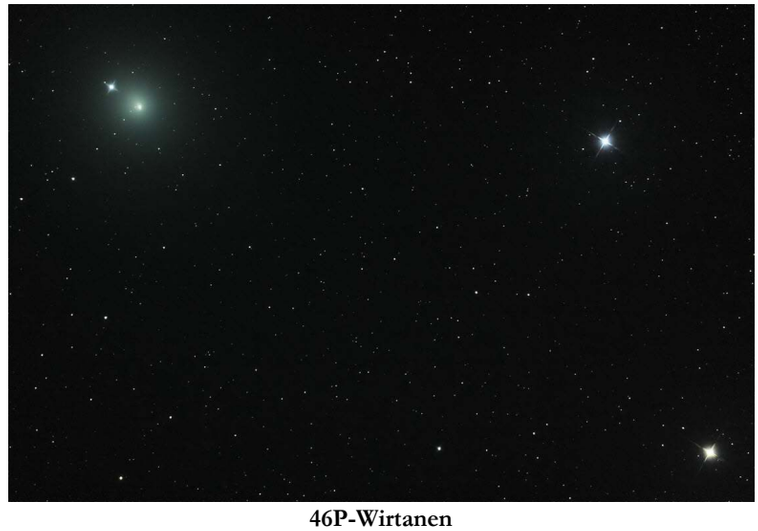



Chart credit: Sky & Telescope

**46P-Wirtanen**
**2018-12-04, by Paul Walker**
**10" f/4 (1000 mm fl), Schmidt-Newtonian, 2 min exp X 15 subs, ISO 1600, Canon XTi, 0.8 x 1.1 deg. field, North to the right.**

**46P-Wirtanen**
**2018-12-10, by Paul Walker**
**6" f/4 (610mm fl) Newtonian, single 3 min exp, ISO 1600, Canon XTi, 1.32 x 2.02 deg. field, North to the right. The 2 bright stars to the left are Kappa Ceti (4.8 mag) and 97 Ceti (5.8 mag)**



**46P-Wirtanen**
**2018-12-12, by Paul Walker**
**6" f/4 (610mm fl) Newtonian, single 3 min exp, ISO 1600, Canon XTi, 1.32 x 2.02 deg. field, The camera was rotated to get 3 bright field stars in, North is to the lower left. Bright stars CW from comet- 6 Tauri (5.75 mag), Xi Tauri (3.7 mag) and Omicron Tauri (3.8 mag)**

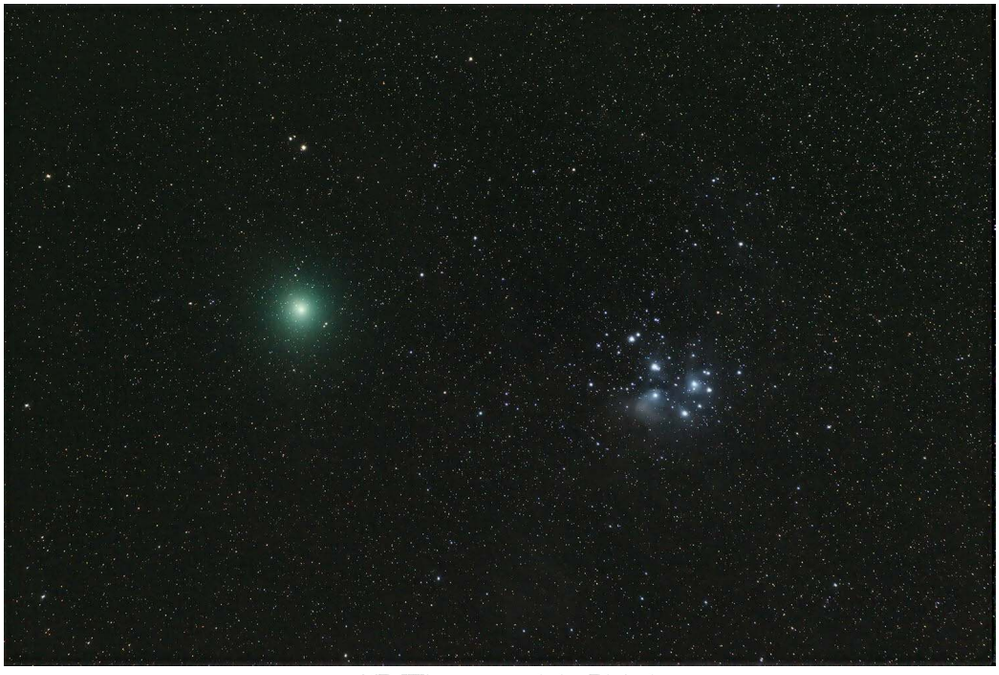
**46P-Wirtanen**
**2018-12-12, by Joe comeau**

**Modified Canon XT at ISO 1600 through an Astrotech 66mm f/6 refractor (400 mm fl), approximately 3.1 x 2.1 degree field. 194, 30 second images. Because the comet moved between each shot, the set of 194 images were processed twice, once to isolate the image of the comet and once to isolate the stars. The resulting 2 images were than combined to show the comet and stars as if the comet held still.**

**Joe used a median stack routine in MaximDL to remove stars from the comet head layer then a median stack for the stars layer to minimize the comet head. The large number of frames made median stacking a good approach.**

**North is to the upper right.**

**The star next to the comet is 6 Tauri (5.75 mag), in the lower left corner is Xi Tauri (3.7 mag).**



**46P-Wirtanen and the Pleiades**
**2018-12-16, by Terri Zittritsch**

**Canon 6D camera at ISO 1600 with 70-200mm f/4 lens at 200mm. This is stack of 80 frames of 30 seconds each.**

**The comet was very large at this time. For comparison the stars in the core of the Pleiades are about ½ degree across. Including the pair of slightly dimmer stars to the upper left of the core, the cluster is 1 degree is size. North is to the upper right**

orbit lays outside of Earth's orbit so we were looking out away from the Sun.

Even though on this passage it was considered a bright comet and it was the brightest comet in 2018, that does not mean it was easy to see. It was visible with the unaided eye in a dark enough sky but a little haze and light pollution was enough to hide it.

I spotted it from the outskirts of Middlebury on the night of November 10th and other members reported spotting it as well. The difficulty was that it had a very low surface brightness with it's maybe 4th magnitude light spread over the area the size of the full Moon or larger. I viewed it through my 10" f/5.6 at up to 470x. Even at low power there was no defined edge to the coma, just faded away into the background sky. The inner coma was slightly non-symmetrical. At 280x and 470x I could see a tiny speck of light (the false nucleus) in the inner coma, slightly offset from the center. As with most short orbit periodic comets this one sheds little gas and even less dust, creating almost no tail.

Brian Johnson spotted it with the naked eye, "with averted vision I definitely saw a somewhat large M33ish hazy patch". And with his 10" f/5 Newtonian "It virtually filled the view through the eye piece. Somewhat bright core, large round coma surrounding it. No discernable tail".

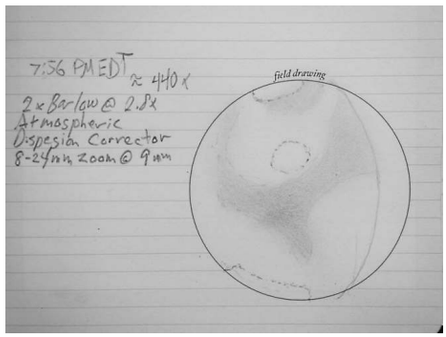
## Mars, A Last View
## By Paul Walker

My last good view of Mars was on 10/26/18. I was surprised by how much detail I could see considering Mars was only 12 arc sec. across.

Uncharacteristically, I decided to sketch what I could see (see next page). It is my first entry in an observer's journal I won at a VAS monthly meeting a few years age.

Using my 10" f/5.6 Newtonian I was able to make out the the South Polar Cap bordered by a dark fringe. Hallas Basin was visible as a slightly lighter area. The main dark feature (middle of the disk) is Syrtis Major one of the only dark regions that I readily recognize when is it visible. I could also make out bluish clouds or limb haze on the lower left limb (Northeast). The crescent shape on the right side depicts the part of Mars in shadow.

As noted on the drawing (next page) I used an 8-24mm zoom eyepiece




at 9mm in conjunction with a 2.8x Barlow (440x magnificaton) and an Atmospheric Dispersion Corrector. The Corrector was very useful this year due to Mars' low altitude. It was low enough that the atmosphere spread the disk of Mars into it's constituent colors with a red fringe at the bottom and blue on the top. This is more noticeable in larger scopes but is present in all scopes. I believe it is less noticeable in smaller scopes due to 2 effects, at lower power the fringes look smaller and at high power the image becomes dim enough that the eye's cones cell (color vision) get less stimulation and therefore the color becomes less noticeable.

I then took a Nikon Coolpix AW110 point & shoot and attached it to the eyepiece. I took a handful of videos and used frames from the best one to create the stacked image below. I was pleased at how well the details on my drawing match up.

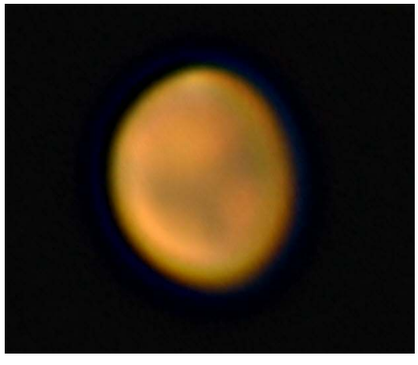


**Image Details:**
Stack of 250 frames from a 1 minute High Def video clip. 10" f/5.6 Newtonian, 2.8x Barlow, 8-24mm zoom at 8mm ( giving 492X), Atmospheric Dispersion Corrector, Nikon Coolpix AW110 point & shoot at 5X optical zoom for approx. 1960X effective focal length. The final image is about a 50% crop so the final magnification is effectively about 4000X. Keep in mind, Mars was only 12 arc seconds across at this time.

**The Pleiades (M45)**
**2018-12-07, by Paul Walker**

**6" f/4 (610mm fl) Newt., single 3 min exp X 27 shots (1hr 21min total time), ISO 1600, Canon Rebel XTi DSLR, 1.32 x 2.02 deg. field, North to the right.**

**Though it looks like the nebulosity is associated with the star cluster, however, the stars are actually just passing through the cloud.**

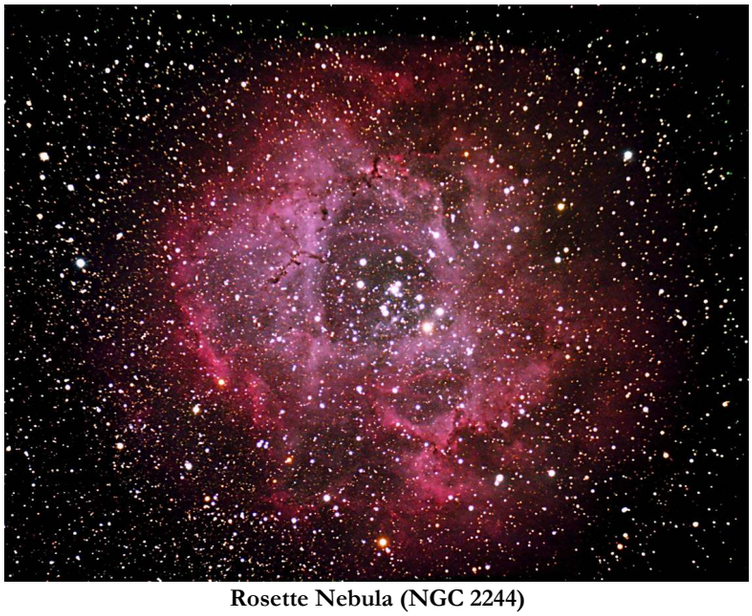
**The Pinwheel Galaxy (M33)**
**2018-10-15, by Terri Zittritsch**

**Explore Scientific 102mm f/7 telescope with an SV reducer/corrector that gives 571mm fl at f/5.6 and ZWO ASI 1600MM Pro monochrome camera with ASI LRGB filters.**

**Flame Nebula (NGC 2024) & the Horsehead Nebula in the Orion Constellation**
**By Maura Kelly**

**Taken with Explore Scientific 80mm f/6 air-spaced triplet ED apochromatic refractor with carbon fiber tube and Explore Scientific EXOS2-GT equatorial mount with PMC-Eight GoTo System, Olympus OM-D E-M1 Mark II Mirrorless Micro Four Thirds DSLR camera.**

**150, 25-sec. subs (62.5 minutes total) at ISO 16,000 + 21 darks, gathered on 12/10/2018 & 12/12/2018**



**Rosette Nebula (NGC 2244)**
**By Maura Kelly**

**Taken with Explore Scientific 80mm f/6 air-spaced triplet ED apochromatic refractor with carbon fiber tube and Explore Scientific EXOS2-GT equatorial mount with PMC-Eight GoTo System and Olympus OM-D E-M1 Mark II Mirrorless Micro Four Thirds DSLR camera.**

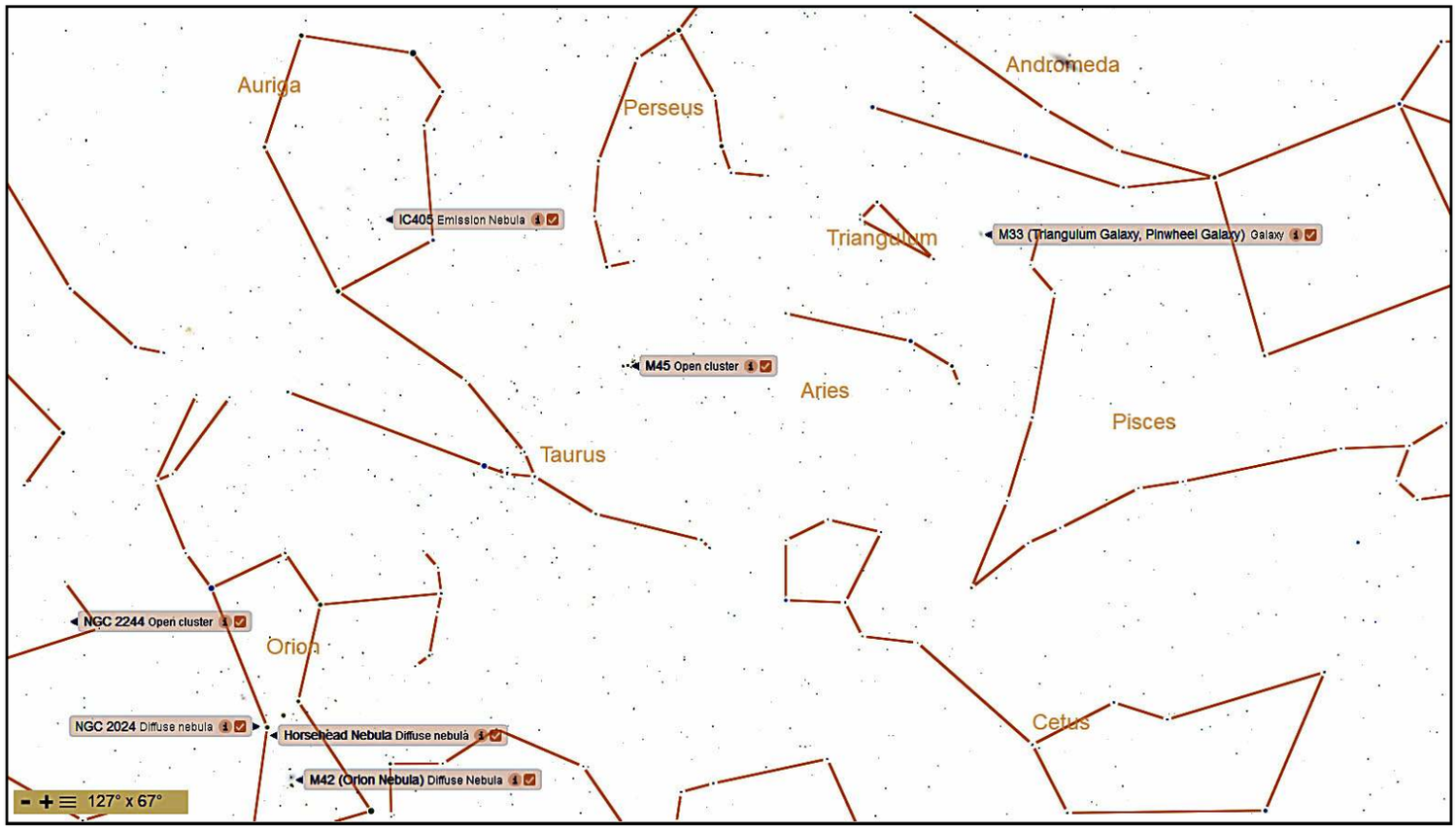
**259 x 25" subs (2hrs 3 min total) + 21 darks) at ISO 16,000**

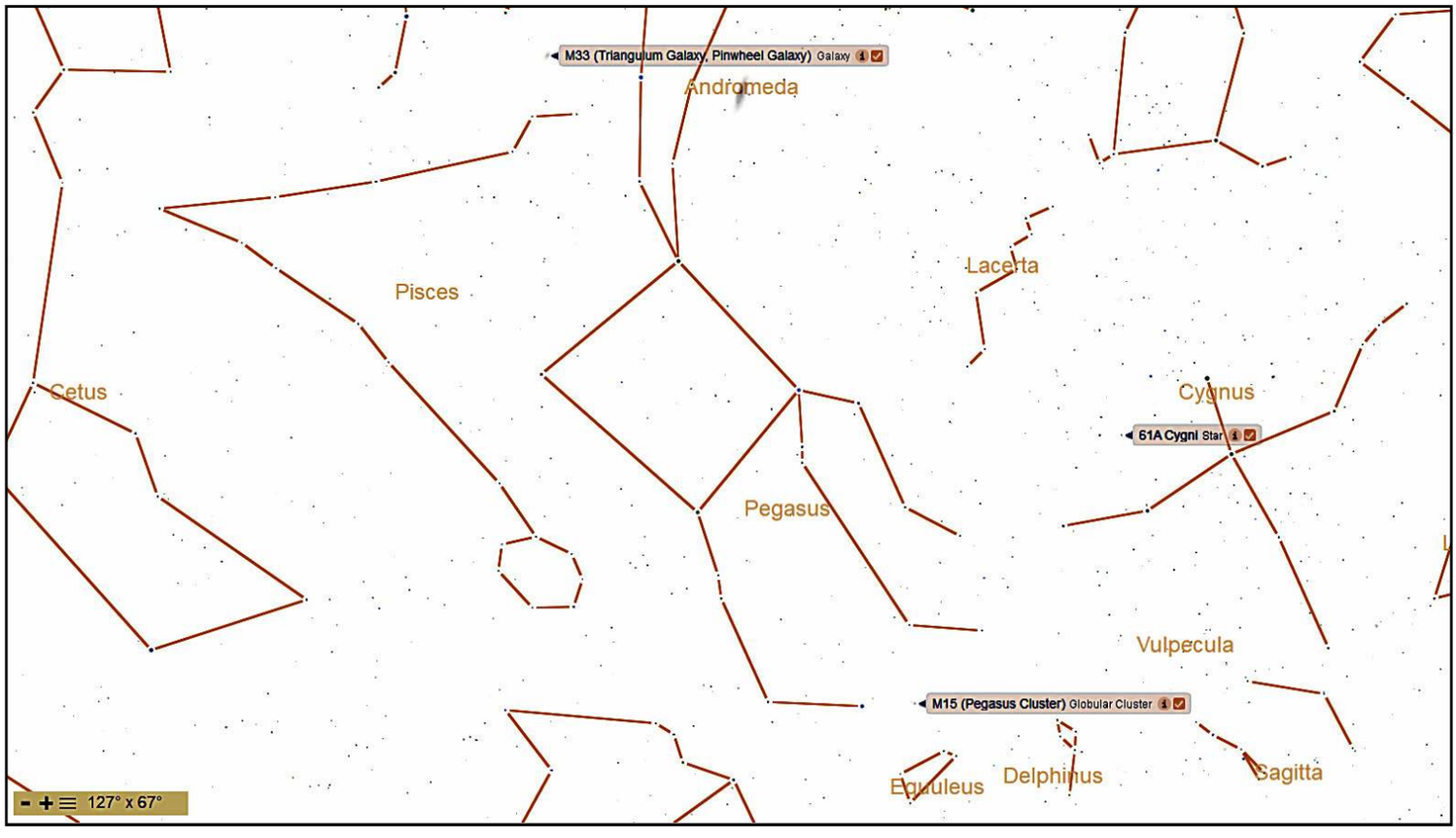
**5.6 Day Old Moon, 2 Image Mosaic**
**by Paul Walker**

**Taken on 12/12/2018 with a 10" f/5.6 & Newtonian, 2 inch 2x Barlow, Canon Rebel XTi DSLR, 1/60 second at ISO 800. The northern half is a stack of 5 images and the bottom half is a stack of 8 images (don't ask why I didn't take the same number of images top and bottom, because I don't know). Used Registax 6 to stack and to sharpen using it's Wavelet function. Picture Window Pro 7 to merge the North and South images**

# Location Charts for the deep sky object images in this issue.

**Created using Starry Night Pro 7 & Picture Window Pro 7.**



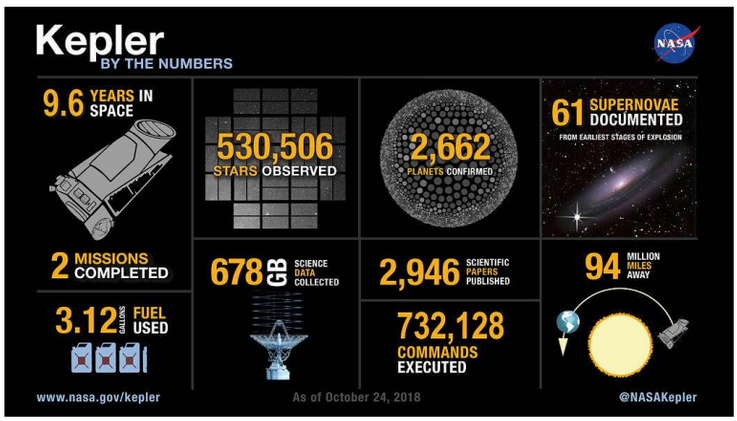



**Kepler and Dawn –**
**Two Metal Emissaries Complete Their Missions**
**By Scott Turnbull, VAS Member and**
**Solar System Ambassador**

When it comes to space exploration, the mind is willing, but the flesh is weak. That is why we send metal. We send our metal emissaries into the void to provide us access to information we otherwise could not clearly observe.

Among the space craft that completed their missions in 2018 were the Kepler Space Telescope. and the Dawn Space Probe. Let's review some of the highlights of both of those long-lasting missions.

**Keeping up with Kepler**




The Kepler Space Telescope, named after renowned astronomer Johannes Kepler, was launched on March 6, 2009 on a United Launch Alliance Delta II rocket. Kepler's mission was to search for signs of the presence of planets orbiting other stars. It was equipped to do this by precisely observing the brightness of stars. By recording the brightness over an extended time, the minuscule dimming that would be caused by a planet passing in front of a star could be detected.

To provide the long duration unwavering view of stars needed to detect planetary occultations, Kepler was placed in a heliocentric orbit. This differs from the Hubble Space Telescope, which is placed in Earth orbit and cannot target the same deep space object for extended periods of time. Kepler's orbit is an Earth-trailing heliocentric orbit with a period of 372.5. As such, Kepler's year is slightly longer than an Earth year, and the Earth moves away from Kepler over time.

Kepler's primary area of study is a single star field in the Cygnus-Lyra region. The area contains about 150,000 stars like the sun. The observatory's orbit allowed it to watch the same stars constantly throughout its mission. Observatories such as the Hubble Space Telescope and ground-based telescopes cannot provide that continuous observation.

**The Kepler Spacecraft**

The Kepler photometer is basically a Schmidt telescope design with a 0.95-meter aperture and about a 12 degree diameter field-of-view. It records data from a single group of stars for the duration of the primary mission. The photometer is an array of 42 CCDs (charge coupled devices). Each 50x25 mm CCD has 2200x1024 pixels. The CCDs are read out every three seconds. Only the information from the CCD pixels where there are stars brighter than about R magnitude of 16 is recorded. The images are intentionally defocused to 10 arc seconds to improve the photometric precision. The data are integrated for 30 minutes. The instrument has the sensitivity to detect an Earth-size transit of a solar-like star in 6.5 hours of integration. The instrument has a spectral bandpass from 400 nm to 850 nm. Data from the individual pixels that make up each star of the 150,000 main-sequence stars are recorded continuously and simultaneously. The data are stored on the spacecraft and transmitted to the ground about once per month.

**The Primary Mission**

Kepler's mission can be divided into two phases. The primary mission began as soon as Kepler achieved its stable heliocentric orbit. First light was on April 8, 2009. The photometer was aimed at the region to be observed. Every 3 months a rotation along the primary axis was executed to adjust the direction of the solar cell power generators and heat radiator. For years Kepler unwaveringly collected information about the stars in the area of study.

The first confirmed planet candidates were announced on January 4, 2010. These were classified as gas giants based on signal characteristics. The first rocky planet candidate was announced on January 10, 2011. By February 2011, Kepler had provided evidence of 1,235 possible planet candidates.

The adjustments to Kepler's orientation are accomplished by gyroscopic reaction wheels. Four of these wheels provided a fault tolerant system to precisely adjust Kepler's direction and rotation. There are additional thruster based attitude controls that are used to de-spin the reaction wheels, and to provide a backup orientation control system in the event the reaction wheels must be taken offline.

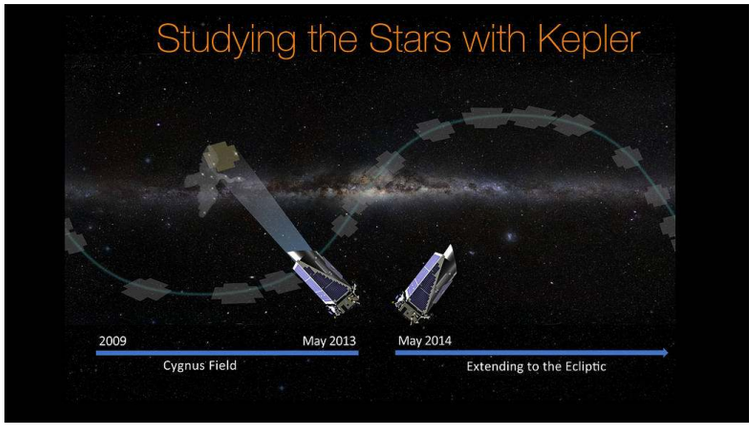
It takes 3 operating reaction wheels to provide long term precision pointing control for Kepler. In July 2012, one of the 4 reaction wheels began malfunctioning. After a period of study while Kepler was in safe mode, it was determined to take one reaction wheel offline. The primary mission continued with 3 reliable reaction wheels until January 2013, when a second reaction wheel began exhibiting excessive friction. Through the use of various wheel rest and momentum management protocols the

primary mission continued with 3 reaction wheels until May 2013. Over the summer of 2013, various attempts to cajole the two malfunctioning reaction wheels into reliable service proved unsuccessful, and the primary mission of Kepler came to end due to an inability to perform accurate targeting with only two reaction wheels.

**K2 – Kepler Continued**

That is not the end of the story for the Kepler Space Telescope. A general call went out to the science community to define an alternate mission for a space telescope with two reaction wheels. There were 42 proposals submitted by September 2013. Based on submitted proposals the Kepler team defined a new mission, dubbed K2, and began testing the spacecraft in that mission mode in February 2014.

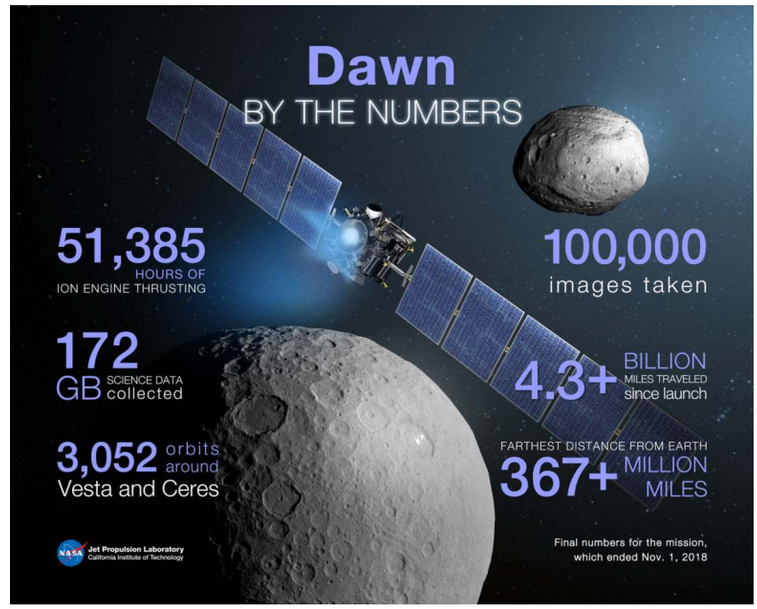
The reduced accuracy control mode, though approximately 40 times worse than the precision control available with 3 reaction wheels, would allow additional planet detection data to be collected. Following a period of testing and validation against previous precision pointing collected data, the K2 mission profile was approved, and data began being collected in May 2014. The K2 mission includes observation of different patches of sky for shorter periods of observation referred to as "campaigns". Operating in the ecliptic plane minimizes the torque exerted on the spacecraft by solar wind pressure, reducing pointing drift to the point where spacecraft attitude can effectively be controlled through a combination of thrusters and the two remaining reaction wheels. Each campaign is therefore limited by sun angle constraints to a duration of approximately 80 days.




Over the next four years, 13 Campaigns were undertaken, relying on citizen science to nominate areas of study and process resulting data. The K2 mission literally ran out of gas in 2018 as the required use of thrusters consumed the remaining onboard propellant. NASA announced the retirement of Kepler on October 30, 2018.

Though only a portion of the sky was assessed, and only those planets on an ecliptic plane that is aligned with our view would be detected, over 2,600 planet candidates were identified. These leads us to extrapolate that there are more planets than stars in our galaxy. We also have evidence that terrestrial sized planets are common, and many of them are in the goldilocks-zone that would permit liquid water to exist upon them. The work that Kepler began continues new science instruments and techniques.

**Staying up for The Dawn**




What has ion engines, and travels through space to visit strange new worlds?

If you answered something from Star Trek or Star Wars, you may be literarily or cinematically correct, but for the purposes of this column the answer we're looking for is NASA's Dawn Space Probe.

The Dawn Space probe was launched on September 27, 2007 onboard a Delta 2 rocket outfitted with nine strap-on solid-fuel boosters. So began a 6.9 billion kilometer journey to visit a pair of asteroids.

The Dawn Spacecraft features a solar electric powered Xenon ion propulsion system. With its solar arrays extended, Dawn is nearly 20 meters wide. The ion thruster is powered by the energy collected by these large solar panels. The power ionizes the fuel (Xenon) and then accelerates it with an electric field between two grids. The main body of the spacecraft is a compact 1.64 x 1.27 x 1.77 meters. At liftoff Dawn weighed 747 kilograms, with 425 kilograms of that being Xenon propellant. The three ion thrusters only produce a force of 91 millinewtons (0.33 ounces) at full thrust. With that amount of thrust over four days the speed of the fully laden spacecraft would only increase velocity by 100 kilometers per hour.

The Dawn science payload includes a framing camera (FC), visible and infrared spectrometer (VIR), and a gamma ray and neutron detector (GRaND). With these instruments Dawn can transmit data to Earth consisting of visual light imagery, surface mapping from the spectrometer in three response bands, neutron and gamma ray spectra producing surface composition maps, and radio tracking to determine mass, gravity field, principle axes, rotational axes, and moments of inertia.

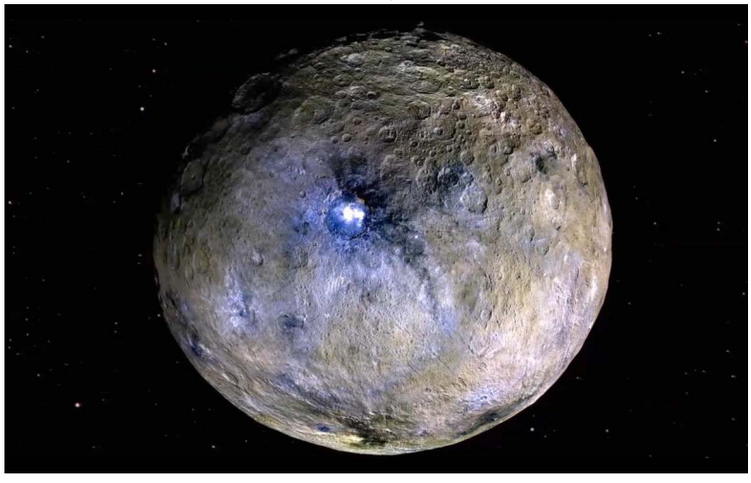
Dawn was slung out towards the asteroid belt by the launch, and used a gravity assist by Mars in February 2009 to speed it on its way to a rendezvous with the asteroid,

Vesta. While cruising towards Vesta, one of Dawn's four attitude control reaction wheels failed.

Dawn entered orbit around the Vesta on July 15, 2011. Dawn orbited Vesta at various altitudes and orbital inclinations until September 2012. Detailed surface maps of Vesta were generated using multiple methods. Surface features as young as a billion years old were identified.

While orbiting Vesta in August 2012, a second attitude control reaction wheel failed. Precision pointing now requires the use of onboard hydrazine thrusters to compliment the two remaining control wheels.

Dawn gently powered out of orbit using its ion engines to place itself on a trajectory to intercept its next target, the asteroid Ceres. After 30 months in transit, Dawn achieved orbit around the asteroid Ceres in March 2015. By doing so Dawn became the first spacecraft to orbit two interplanetary bodies and the first spacecraft to visit a dwarf planet. Dawn once again used its ion engines to achieve orbits of multiple altitudes and inclinations, while mapping Ceres with multiple scientific instruments. By June 2016 Dawn's primary mission had been completed, having met or exceeded all scientific objectives.



Dawn's story does not end there. With functioning hardware in orbit around Ceres, a mission extension was funded to perform additional study of Ceres. Additional orbits are done, finding evidence of a recently formed cryovolcano oozing icy volatiles. As data is studied, evidence of ice and organics on Ceres surface is published. As data continues to be studied, evidence is found for solar activity being the cause of the periodically observed weak atmosphere.

By April 2017 time continues to take its toll on the nearly 10 year old spacecraft. A third reaction wheel fails, relegating more spacecraft pointing to the increasingly limited supply of onboard hydrazine.

The mission is extended again in October of 2017 to continue to make use of the aging scientific platform still orbiting Ceres. In April of 2018 Ceres is at perihelion, providing Dawn with the opportunity to observe Ceres under warmer conditions at its closest approach to the sun.

Dawn is directed to make ever lower orbits, as close as a mere 35 kilometers from the asteroid's surface.

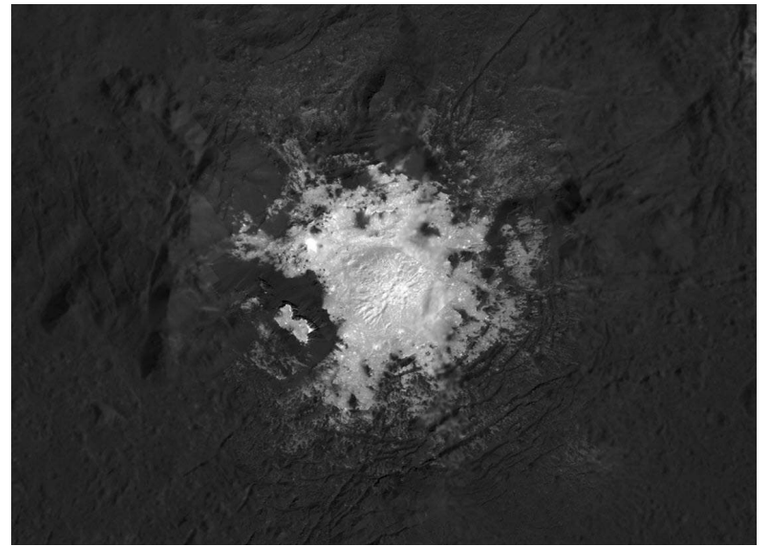
In June of 2018 Dawn's ion engines were used for the last time. The Xenon propellant had been exhausted and Dawn's only remaining maneuvering ability was via the remaining hydrazine onboard. By July 2018 the hydrazine supply was estimated to be at critical levels. With miserly management of onboard resources, the Dawn spacecraft was able to continue communicating with Earth. After having missed its scheduled communication window on October 31 and November 1, Dawn was declared at end of mission.

That'll do, little probe. That'll do.

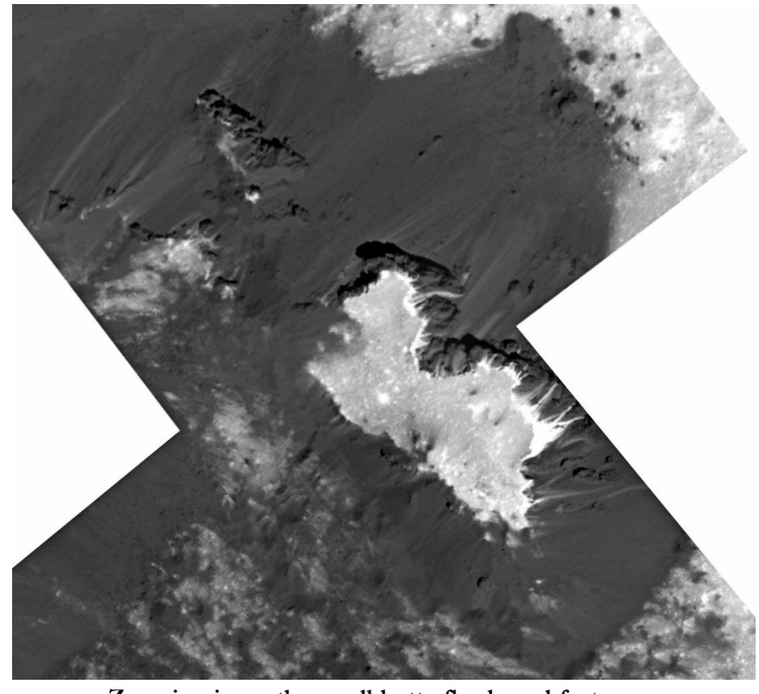
**Resources**

All of the information presented in this article was provided by NASA/JPL from their online mission resources. For more information, please refer to

**Kepler Mission Pages:**
**https://www.nasa.gov/mission_pages/kepler/main/index.html**
**Dawn Mission Pages:**
**https://www.nasa.gov/mission_pages/dawn/main/index.html**



**Close-up image of Ceres' Cryovolcano**



**Zooming in on the small butterfly shaped feature.**

**The Double Star 61 Cyg, 5 Years of Movement 2014 thru 2018, by Paul Walker**
**61 Cyngus A and B are approx. 32 sec of arc apart and move to the Northeast by 6.3 sec of arc per year. Each exposure was 5 sec. North is up.**

**M15, Globular Cluster in Pegasus**
**Taken on 9/29/18 by Paul Walker**
**Stack of 14, 30 sec subs through 10" f/5.6 at f/14.8 (3730 mm effective fl) (2x Barlow at 2.65x), cropped 50%.**

## For Sale

**Celestron Omni XLT 102 achromat refractor f/9.8**
Excellent condition, includes:
2" crayford style focuser
1.25" diagonal
Rings and vixen style dovetail
9x50 right angle finder scope
**$175.00**
Contact Pat Porch 802-236-2463
pcwzard2600@gmail.com

**Meade 6" LXD55 telescope** with the following: 26mm eyepiece, Finder Scope, Anniversary eye piece kit with 15mm; 6.4mm; 9.7mm; 12.4mm; 40mm; 32mm; and 20mm. Solar filter, Dew cap, Autostar Instruction Manual, Martin Preston users guide

**New Price - Asking $350** with the accessories listed.

Contact Bruce Harmon, 802-876-7535 or bdhinvt@yahoo.com.

**Copies of "Mirror Mirror" - A History of the Human Love Affair with Reflection** by Mark Pendergrast of Colchester, Vt. available for **$25.**

Mark will split the profits with VAS.

Contact Mark at markp508@gmail.com or see Jack St. Louis at any monthly meeting.

**Celestron SP-C80 refractor telescope and tripod**, rarely used. Comes with the original manuals, and 3 books on astronomy and a viewing the universe tool.
**Asking $350 or best offer.**

Contact Aimee Green, leftlanegreen@yahoo.com

**Celestron SLT mount** w/handset and Talentcell Lithium-Ion battery pack--**$125**

**AWB OneSky 5" F/5** Collapsible Newtonian--**$150**

**Meade Super Plossls**: 32mm, 26mm, 20mm, 15mm, 12.4mm, 9.7mm, and 6.4mm. All are Japanese made excepting the 32mm and 20mm, which are Chinese. Excellent condition. **$150**

**ETX-125 OTA** only--This one has the USA made optics. Just too heavy for my needs. Needs some TLC but gives the images you expect out of this model. Contact me for more details if interested. **$150**

**Orion Tri-mag 3x Barlow** in very good condition - **$30**

**Celtstron Omni 2x Barlow** in excellent condition - **$25**

**AstroSystem Lightpipe collimation tool** for newts with box and instructions - **$25**

**HoTech Green Laser Pointer** - Bought from Agena Astro a couple years ago for $80 and only been used 2-3 times for a couple minutes total. Like new. **$50**

Contact Paul Marino, paulmarino@gmavt.net or call (802) 482-5128

**Telescope mirrors and a couple mounting cells**
**3.5" f/10** with 3/4" diagonal.
**6", probably f/8**.
**8", probably f/8**, in nice **cast aluminum cell**.
**10" f/9, 1/10 wave** (measured by Bob several years ago), Beral coating that is in good condition though the edge has several chips (edge not beveled) and a note from the coater says there are a few scratches and it is not fully polished (may be saying that because of the scratches). From St. Michael,s College.
**12", probably f/8, plate glass** mirror in **nice 18 point mirror cell**. The cell is worth more than the mirror. If I remember correctly this came from St. Michael,s College, from the old scope they had in their observatory.

Other than the 10" f/9 I cannot vouch for the figure of the mirrors.

The only one that may be Pyrex is the 8" mirror, I'd have to pull it out of the cell and look again. The rest have a slight greenish-yellow tint.

**Make an offer on any of the items.**

Paul Walker 802-388-4220 or paulwaav@together.net

**4 inch, 550mm f.l. brass Televue Renaissance scope** with carrying case
Equatorial mount with oak tripod

2", 20mm Nagler type 2
2" 45deg. righting prism
2" Big Barlow
2", 4.8mm Nagler
1-1/4", 26mm Plossl
2", 45deg. Prism camera adapter

**New Price $1950 - will negotiate.**

Contact Richard Cummings at Rick@vsbmetal.com
Or you can contact Ron Anstey anstyer@myfairpoint.net

## Wanted

**For selling & buying also check out: www.marketplace.skyandtelescope.com**