The Prairie Astronomer

July 2016 Volume 57, Issue #7

In This Issue:

Cover: NGC 5894
by Rick Johnson

Night Sky Network

The Newsletter of the Prairie Astronomy Club

The Prairie Astronomer

NEXT PAC MEETING: July 26, 6:30pm

at Dino's, 84th & Van Dorn

PROGRAM

July: Club dinner at Dinos; informal talk about Apollo space program by Don Eret.

FUTURE PROGRAMS

August: NSP Review and "Adventures in Astrophotography" by Mark Dahmke

September: Rick Johnson's Astrophotography

October: Club viewing night

November: How to Buy a Telescope

December: PAC Holiday Gathering, "The Thirty Meter Telescope" by Larry Stepp

Buy the book! The Prairie Astronomy Club: Fifty Years of Amateur Astronomy.
Order online from Amazon or lulu.com.

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Cover: NGC 5894 is a barred(?) spiral in Draco below the bowl of the Little Dipper about 120 million light-years distant. That makes it about 120,000 light-years across, a rather large spiral. Image by Rick Johnson.

EVENTS

PAC Meeting
Tuesday July 26th, 2016, 6:30pm
Dino's, 84th & Van Dorn

PAC Meeting
Tuesday August 30, 2016, 7:30pm
Hyde Observatory

PAC Meeting
Tuesday September 27th, 2016, 7:30pm
Hyde Observatory

Newsletter submission deadline August 20

2016 STAR PARTY DATES

Photo by Brian Sivill

	Star Party Date	Star Party Date	Lunar Party Date
January	Jan 1st	**Jan 8th**	
February	Jan 29th	**Feb 5th**	
March	Mar 4th	**Mar 11th**	
April	Apr 1st	**Apr 8th**	Apr 15th
May	Apr 29th	**May 6th**	May 13th
June	May 27th	**Jun 3rd**	
July	**Jul 1st**	Jul 8th	
NSP	**July 31st - Aug 5th**		
August	Jul 29th	**Aug 5th**	Aug 12th
August	Aug 26th	**Sep 2nd**	Sep 9th
September	Sep 23rd	**Sep 30th**	
October	Oct 21st	**Oct 28th**	
November	Nov 25th	**Dec 2nd**	
December	Dec 23rd	**Dec 30th**	

PAC E-MAIL:

info@prairieastronomyclub.org

PAC-LIST:

Subscribe through GoogleGroups.
To post messages to the list, send to the address:

pac-list@googlegroups.com

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Night Sky Network

PAC Meeting Minutes

Minutes for the meeting of June 28, 2016

President Jim Kvasnicka called the meeting to order. Jim thanked Dave Churilla for his presentation of solar observing before the meeting. 5 visitors, 20 members.

Jim reviewed dues and benefits of joining the club. Also, he discussed upcoming events. Including Hyde, the club star party, Branched Oak Observatory's Star Party on Saturday July 2, Platte River State Park and the Nebraska Star Party.

Jim referred members to the online newsletter to view his monthly observing report.

Club business

The July meeting will NOT be at Hyde. The club will meet at Dino's on 84th & Van Dorn St. for an informal meeting, dinner and presentation. Brett has a speaker who worked at Teledyne for the meeting. He will speak and answer questions during dinner. Jim asked the club if we'd like to start at a different time that night. Dave Churilla suggested 6:30. Beth will make arrangements.

Jim discussed the upcoming programs for this year. August will be a review of NSP. In September, Dan Delzell will present some of Rick Johnson's best work. Including his apparent discovery of a new galaxy. Congratulations Rick!

The October meeting has been recommended as a public star party at Hyde to provide people new to the hobby a chance to look through and use different telescope sizes and designs. Members are welcome to bring their scopes out and set up as well.

The November meeting will be our annual 'How to Buy a Telescope' to help people plan for the holidays.

In December, Larry Stepp will be back in town and will make his presentation on current projects.

At the last board meeting, Beth Jenckes asked if we could provide outside speakers a token of appreciation. She has been looking into space pens. She presented her ideas to the club. After some discussion, Lee Taylor moved we order 10 pens, the motion was seconded. The motion passed without objection.

Beth asked about our weather policies, considering the weather for the Space Law presentation. The discussion of this centered around common sense and the frequency of such circumstances. Dave asked if someone was responsible for letting a speaker know if we are canceling the meeting. Eugene Lanning suggested contacting other clubs about their policies on weather.

Meeting adjourned.

Respectfully submitted by,

Lee Taylor

PAC Space Pens that will be given to presenters.

Boller-Sivill Observatory - Construction Update

Brian Sivill and Brett Boller

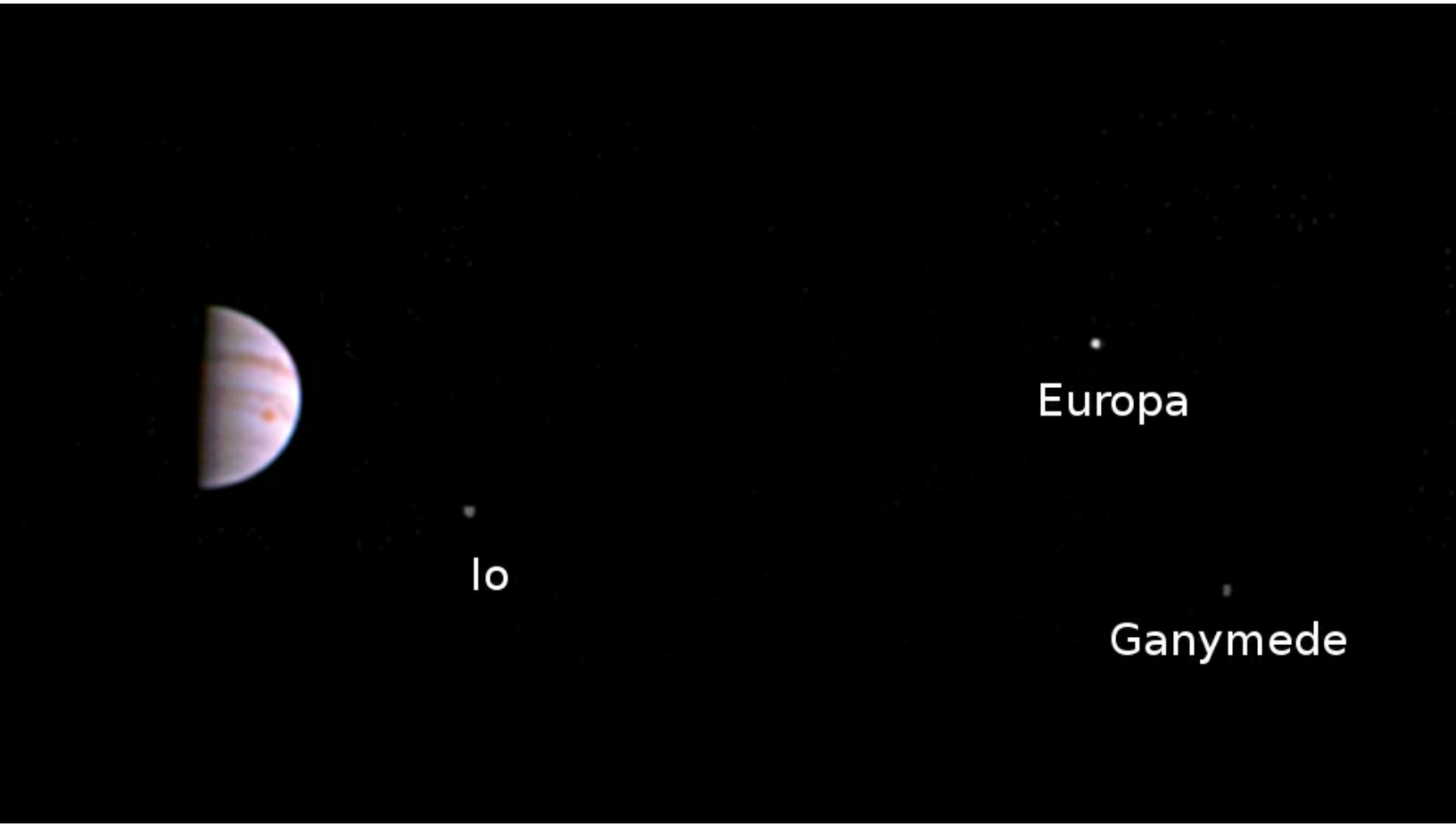
The four telescope piers are poured, dry and very solid. We intend to operate four separate mounted instruments. The spacing is slightly tight, but there's ample space for each mount.

A steel support system is in place to support the displaced roof. We spent most of last Sunday putting up the lower walls, which will support the roller rails.

We are refining a few elements tomorrow (Sunday Jul 17th) in effort to perfect building and support structure alignment. Brett and his dad, Bill have put a ton of labor into the project so far and continue to come to the rescue for any issue. Each month brings considerable forward progress!

Roof designs are now our dominant focus. We will have to power the observatory using solar charged batteries, so our solar charger and sun tracker designs continue to evolve. We welcome any donations: labor, materials, solar panels etc.

NASA's Juno Spacecraft Sends First In-orbit View



This view from NASA's Juno spacecraft is made from some of the first images taken by JunoCam after the spacecraft entered orbit around Jupiter on July 5th (UTC). The view shows that JunoCam survived its first pass through Jupiter's extreme radiation environment, and is ready to collect images of the giant planet as Juno begins its mission.

The image was taken on July 10, 2016 at 5:30 UTC, when the spacecraft was 2.7 million miles (4.3 million kilometers) from Jupiter on the outbound leg of its initial 53.5-day capture orbit. The image shows atmospheric features on Jupiter, including the Great Red Spot, and three of Jupiter's four largest moons.

JunoCam will continue to image Jupiter during Juno's capture orbits. The first high-resolution images of the planet will be taken on August 27 when the Juno spacecraft makes its next close pass to Jupiter.

NASA's Jet Propulsion Laboratory, Pasadena, Calif., manages the Juno mission for the principal investigator, Scott Bolton, of Southwest Research Institute in San Antonio. The Juno mission is part of the New Frontiers Program managed at NASA's Marshall Space Flight Center in Huntsville, Ala. Lockheed Martin Space Systems, Denver, built the spacecraft. JPL is a division of the California Institute of Technology in Pasadena.

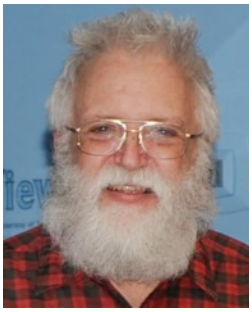
More information about Juno is online at http://www.nasa.gov/juno and http://missionjuno.swri.edu.

Observatory Update: Barnard's Star 10 Year Animation

Rick Johnson

This is my annual update to my movie of the proper motion of Barnard's Star [Editor's note: the movie is available on the PAC website]. It now spans 10 years (10 animation frames) from 2007 to 2016 (July). Nothing much has changed but for its location keeps moving north. For those looking to find it visually the arrowhead asterism to the south seen in the full frame image which is about a half degree wide and a third of a degree high (field the asterism is much smaller). The field fits a medium power telescope field of view. The galaxy near the bottom of the image is CGCG 056-003, a 15.6 magnitude galaxy some 360 million light-years distant and 85,000 light-years across.

Barnard's Star is the second closest star system to us after the Alpha Centauri system at a distance of 5.96 or 5.98 light-years depending on who you believe. It has the highest proper motion of any known star by quite a margin. It moves about 10.3 seconds of arc per year. That means it is moving at about 90.5 km/s across our line of sight. But it is moving even faster toward us at a speed of about 106.8 to 110.8 km/s depending again on who you believe. This gives it a velocity of about 140 km/s relative to the sun. That sucker is really moving so is sometimes called Barnard's Runaway Star. This means it will be closer to us than Proxima Centauri is now but then Proxima is moving



toward us as well. In the year 11,800 Barnard's Star will be as close to us as it will get at 3.75 light-years but Proxima will be very slightly closer. Proxima will be slow to give up its place as our closest star after the sun but some 33,000 years from now it will have to give the honor to ROSS 248 at about 3 light-years. In about 40,000 years it will give up closest honors to Gliese 245. Then about 50,000 years from now Alpha Centauri itself will be the closest star. Actually for about 5,000 prior to Ross 248 being closest it will be so close to the same distance as Proxima that it depends on who you believe as to which of these two stars is closest.

Barnard's star is a very typical old red dwarf at least 8 billion years old and it could be as much as 12 billion years old. Being old it rotates slowly having lost much of its rotational speed of its youth, now taking 150 days to rotate. Young red stars usually have severe flares likely frying any habitable planets. Old stars like Barnard's are thought to rotate so slowly they no longer flare but Barnard's star did send up a strong flare in 1998 surprising many.

The number of frames and exposure times of the frames varied greatly over the years. Some was due to weather but mostly just because I was trying to find a way to match previous years more closely. That seemed to always fail so this year I just used my standard four 10 minute luminance exposure times and 2 10 minute frames for each color. I just added this frame to the animation from 2015 (and this text is mostly from 2015). The animation is at 1" per pixel but doesn't begin to go as deep as I usually do because some of the years used only 2 minute subs and less than 10 minutes of total time and most of the others were adjusted to match. In 2014 I didn't try to fully match past years and this year I sort of matched 2014 but left it slightly brighter.

Note that below Barnard's star in this year's image there is a tight trio of stars. Some years it was hidden behind the glare of Barnard's star but for all years the bottom star was seen it was the dimmest. Not this year, it is the brightest! I don't know if it is processing or real. Short of reprocessing all 10 years I just can't tell if processing is involved somehow. Looking at the FITS from prior years it seems always the dimmest until this year. It may have flared during one or more of the years it was hidden from view. This image was taken July 9 UT. At least the luminance was. Color had been taken previous nights under less suitable conditions including moonlight. But with prior years available for color balance that wasn't a problem.

I've been asked in the past for an annotated image of the background galaxies. Many have no redshift. Still I gave in this time and made one but you won't find it very useful. Only 5 galaxies have redshift information, one of which I've already mentioned. The other 4 seem to be part of a galaxy group but I found none listed at NED. I've identified all NED lists in my image, most don't even have a magnitude estimate let alone a redshift measurement.

The Moon, July 15, 9:30pm, By Mark Dahmke.

This photo is a stack of two shots taken with a Panasonic Lumix GX8 at prime focus on a Astro-Tech RC-6 (6" f/9, 1350mm) telescope. The exposures were 1/40 sec at ISO 100. Processed with Registax. I like the Lumix mirrorless cameras for a couple of reasons - they're light so they don't put a huge load on the scope mount, you get a live preview, and it has a manual focus zoom preview mode for fine focus adjustments.

One Year Later: New Horizons' Top 10 Discoveries at Pluto

Where were you at 7:49 a.m. Eastern Time on July 14, 2015?

Three billion miles from Earth, NASA's New Horizons spacecraft, moving at speeds that would get it from New York to Los Angeles in about four minutes, was pointing cameras, spectrometers, and other sensors at Pluto and its moons – distant worlds that humankind had never seen up close – recording hundreds of pictures and other data that would forever change our view of the outer solar system.

"New Horizons not only completed the era of first reconnaissance of the planets, the mission has intrigued and inspired. Who knew that Pluto would have a heart?" said NASA's Director of Planetary Science Jim Green. "Even today, New Horizons captures our imagination, rekindles our curiosity, and reminds us of what's possible."

To say that New Horizons shook the foundation of planetary science is an understatement—discoveries already culled from the pictures and compositional and space environment readings have not only introduced us to the Pluto system, but hint at what awaits as scientists examine other worlds in the Kuiper Belt. New Horizons Principal Investigator Alan Stern of the Southwest Research Institute, Boulder, Colorado, lists the mission's most surprising and amazing findings from Pluto (so far):

The complexity of Pluto and its satellites is far beyond what we expected.

The degree of current activity on Pluto's surface and the youth of some surfaces on Pluto are simply astounding.

Pluto's atmospheric hazes and lower-than-predicted atmospheric escape rate upended all of the pre-flyby models.

Charon's enormous equatorial extensional tectonic belt hints at the freezing of a former water ice ocean inside Charon in the distant past. Other evidence found by New Horizons indicates Pluto could well have an internal water-ice ocean today.

All of Pluto's moons that can be age-dated by surface craters have the same, ancient age—adding weight to the theory that they were formed together in a single collision between Pluto and

NASA's New Horizons spacecraft captured this high-resolution enhanced color view of Pluto's moon Charon just before closest approach on July 14, 2015. Charon's striking reddish north polar region is informally named Mordor Macula. Credits: NASA/JHUAPL/SwRI

another planet in the Kuiper Belt long ago.

Charon's dark, red polar cap is unprecedented in the solar system and may be the result of atmospheric gases that escaped Pluto and then accreted on Charon's surface.

Pluto's vast 1,000-kilometer-wide heart-shaped nitrogen glacier (informally called Sputnik Planum) that New Horizons discovered is the largest known glacier in the solar system.

Pluto shows evidence of vast changes in atmospheric pressure and, possibly, past presence of running or standing liquid volatiles on its surface – something only seen elsewhere on Earth, Mars and Saturn's moon Titan in our solar system.

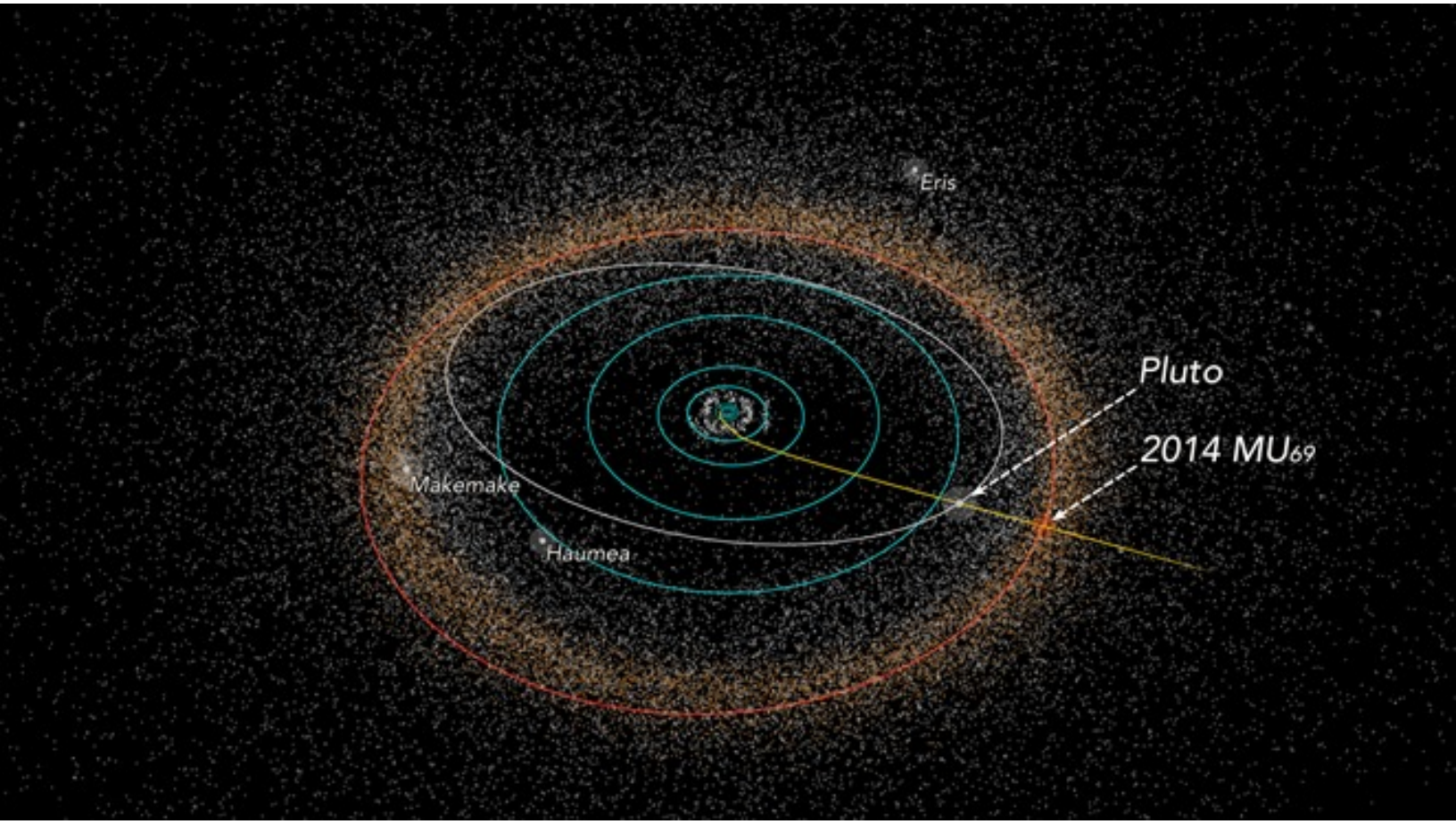
The lack of additional Pluto satellites beyond what was discovered before New Horizons was unexpected.

Pluto's atmosphere is blue. Who knew?

"It's strange to think that only a year ago, we still had no real idea of what the Pluto system was like," said Hal Weaver, New Horizons project scientist from the Johns Hopkins University Applied Physics Laboratory in Laurel, Maryland. "But it didn't take long for us to realize Pluto was something special, and like nothing we ever could have expected. We've been astounded by the beauty and complexity of Pluto and its moons and we're excited about the discoveries still to come."

New Horizons is now nearly 300 million miles beyond Pluto, speeding to its next destination deeper into the Kuiper Belt, following NASA approval of an extended mission. About 80 percent of the data stored on the spacecraft's recorders has been sent to Earth; transmission of the remainder will be complete by October.

"Our entire team is proud to have accomplished the first exploration of Pluto and the Kuiper Belt—something many of us had worked to achieve since the 1990s," said Stern. "The data that New Horizons sent back about Pluto and its system of moons has revolutionized planetary science and inspired people of all ages across the world about space exploration. It's been a real privilege to be able to do that, for which I'll be forever indebted to our team and our nation."



August Observing: What to View

Jim Kvasnicka

This is a partial list of objects visible for the upcoming month.

Planets

Jupiter/Mercury/Venus: On August 1st the three planets form a line nearly 27° long in the west after sunset. Venus at magnitude -3.9 is only 4° high with Mercury 8° to the upper left. Jupiter is to the upper left of Mercury.
Mars: Dims to magnitude -0.3 with a disk 10½" wide.
Saturn: Dims to magnitude 0.5 in Ophiuchus with the rings open 26° from edge on.
Uranus / Neptune: In Pisces and Aquarius.

Meteor Showers

Perseids: Peaks the night of August 11-12. Expect 60-90 Perseids per hour. The waxing gibbous Moon sets around 1:00 am.

Messier List

M6/M7: Open clusters in Scorpius.
M8: The Lagoon Nebula in Sagittarius.
M9/M10/M12/M19: Globular clusters in Ophiuchus.
M20: The Trifid Nebula in Sagittarius.
M21/M23: Open clusters in Sagittarius.
M62/M107: Globular clusters in Ophiuchus.

Last Month: M3, M4, M5, M53, M68, M80, M83
Next Month: M13, M14, M22, M28, M54, M69, M70, M92

NGC and other Deep Sky Objects

NGC 6520/B86: Open cluster and the Ink Spot in Sagittarius.
NGC 6703: Galaxy in Lyra.
NGC 6712: Class IX globular cluster in Scutum.
NGC 6781: Planetary nebula in Aquila.
NGC 6818: Little Gem, planetary nebular in Sagittarius.

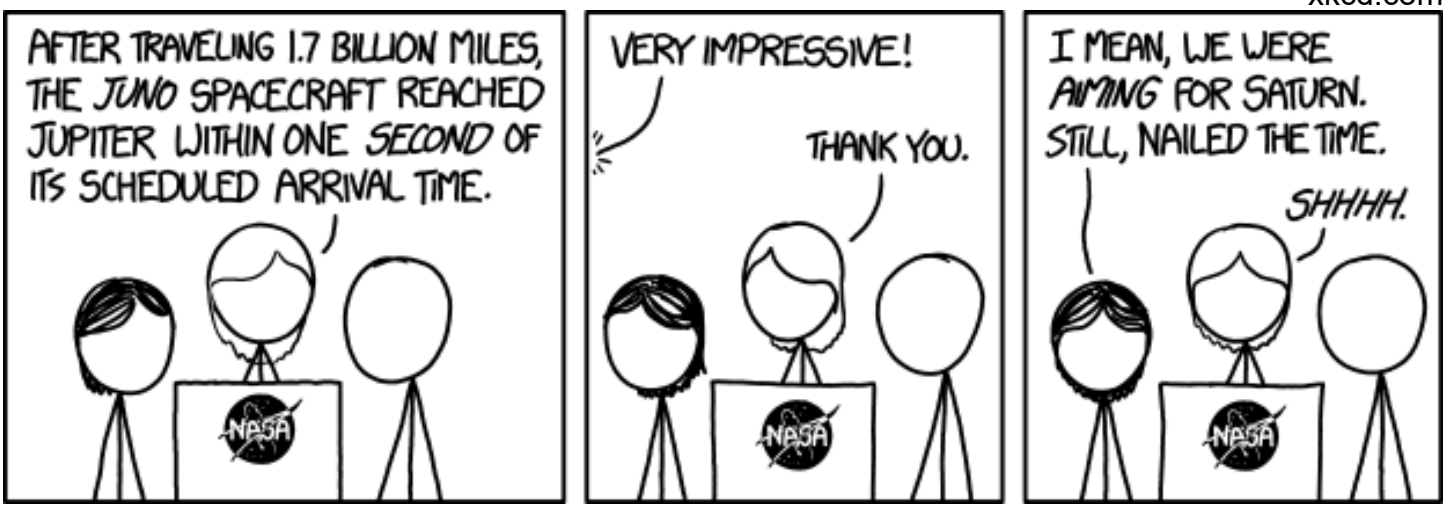
Double Star Program List

Struve 2404: Close orange pair.
57 Aquilae: Two white stars.
Beta Cygni: Albireo, gold and blue stars.
31 Cygni: Yellow primary with a blue secondary.
61 Cygni: Two orange stars.
Epsilon Lyrae: The Double Double.
Zeta Lyrae: Yellow pair.
Beta Lyrae: Shellak, yellow and multiple white stars.

Challenge Object

NGC 6822: Barnard's Galaxy in Sagittarius. NGC 6822 is a member of our Local Galaxy Group 2.2 million light years distant. Low surface brightness makes it difficult to see.

xkcd.com



Focus on Constellations: Sagittarius

Jim Kvasnicka

Sagittarius

Sagittarius, the Archer, covers 867 square degrees. Toward Sagittarius lies the center of our Galaxy and the bulk of the cool dust that lies along the spiral arms of our Milky Way. Because most of the 150+ globular clusters are congregated around the central hub of our Milky Way, Sagittarius is rich in globular clusters. Sagittarius contains 15 Messier objects, more than any other constellation. Most of these Messier objects are famous and well known. They include M8, The Lagoon Nebula; M17, The Swan or Omega Nebula; M20, The Trifid Nebula; and M22, one of the best globular clusters in the sky. Sagittarius contains a large variety of objects, enough to keep any observer busy for a while. The constellation Sagittarius is best seen in August.

Showpiece Objects

Globular Clusters: M22, M28, M55, M75
Planetary Nebulae: NGC 6818 (Little Gem)
Open Clusters: M21, M23
Dark Nebulae: B86 (Ink Spot)
Bright Nebulae: M8 (Lagoon), M17 (Swan), M20 (Trifid)

Mythology

Two Centaurs are immortalized among the stars. The Centaur represented by Centaurus, and the Centaur Sagittarius, one of the zodiac signs. In Greek-Roman mythology, Sagittarius was the Archer-Centaur who slew the scorpion that had killed Orion.

Number of Objects Magnitude 12.0 and Brighter

Galaxies: 3
Globular Clusters: 20
Open Clusters: 23
Planetary Nebulae: 16
Dark Nebulae: 9
Bright Nebulae: 3

The Great American Total Eclipse August 21, 2017

Planning your eclipse trip? Take a look at Fred Espanak's presentation on YouTube:

https://www.youtube.com/watch?v=K4KnxE6yAuI

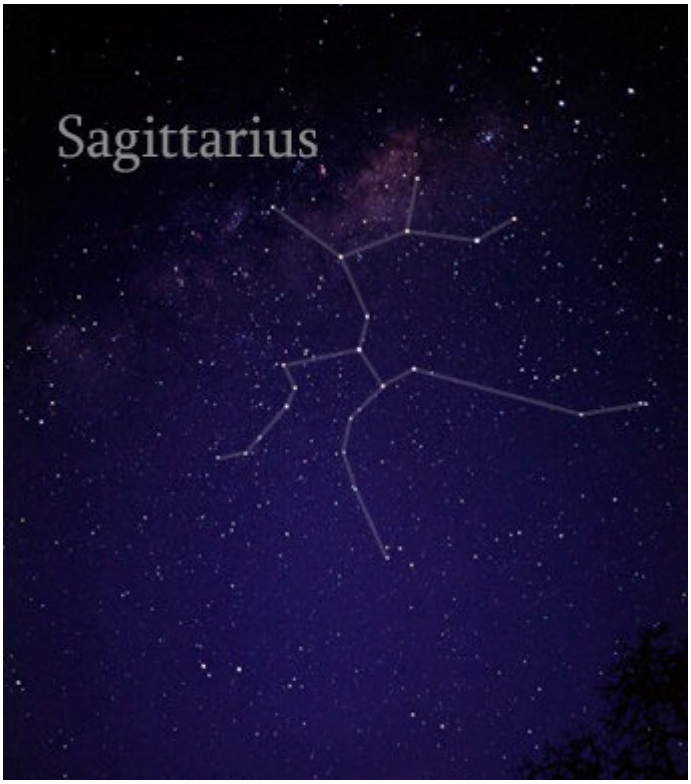


Photo: Till Credner - Own work: AlltheSky.com

Ricoh Theta S in Astronomy

Editor's Note: I recently bought a Theta S and plan to test it at NSP.

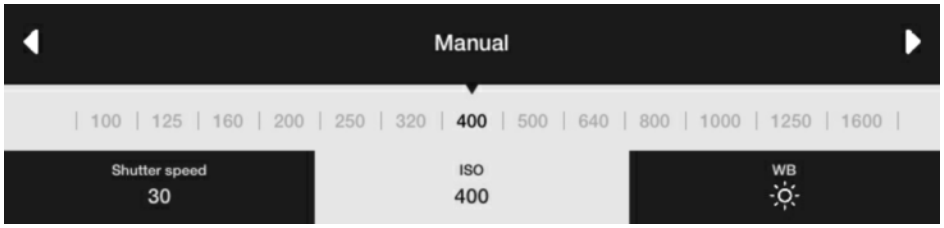
Erwin Matys, Karoline Mrazek, Project Nightflight. Reprinted with permission.

The Theta S camera is a valuable tool for a multitude of applications in astronomy and astrophotography.

The Ricoh Theta S is a completely new type of camera. With two fisheye lenses it records a 360° full-sphere panorama in only one single shot. The recorded images can be further processed and viewed either with the player provided by the manufacturer or with any third-party panorama viewer or web service that supports full-sphere panoramas. When used stand-alone, the camera works only in automatic mode. Controlling the camera with the provided app on a mobile device gives the user much more options: Long exposures, timed exposure series, HDR shooting, image download, immediate viewing as a sphere on the mobile device, etc. For a more thorough introduction to the camera system and to view some terrestrial sample shots, visit the manufacturer's Theta S website theta360.com.

Night Sky Suitability of the Theta S

Before we discuss some astronomical applications in more detail, here are the basic facts about the camera's suitability for night sky photography: First of all, to use the manual mode and to set exposure time, ISO and white balance individually (as it is required for night sky photography) the camera must be controlled by the provided app running on a smartphone or tablet. This procedure is straightforward, the camera connects with the mobile device via Wi-Fi and the app is easy to understand and simple to use. For night sky photography the camera must be mounted on a tripod - for this, the camera provides a standard 1/4" thread in the base. The extremely fast focal ratio of f/2 of the two f=1.31mm fisheye lenses is a great benefit for astronomical applications. One would believe that this fast focal ratio must result in catastrophic aberrations. Luckily, this is not the case. Although star images show some chromatic aberration and distortions especially in the field edges of the fisheyes, the images are surprisingly nice. Noise, on the other hand, is as strong as the small pixel size of the

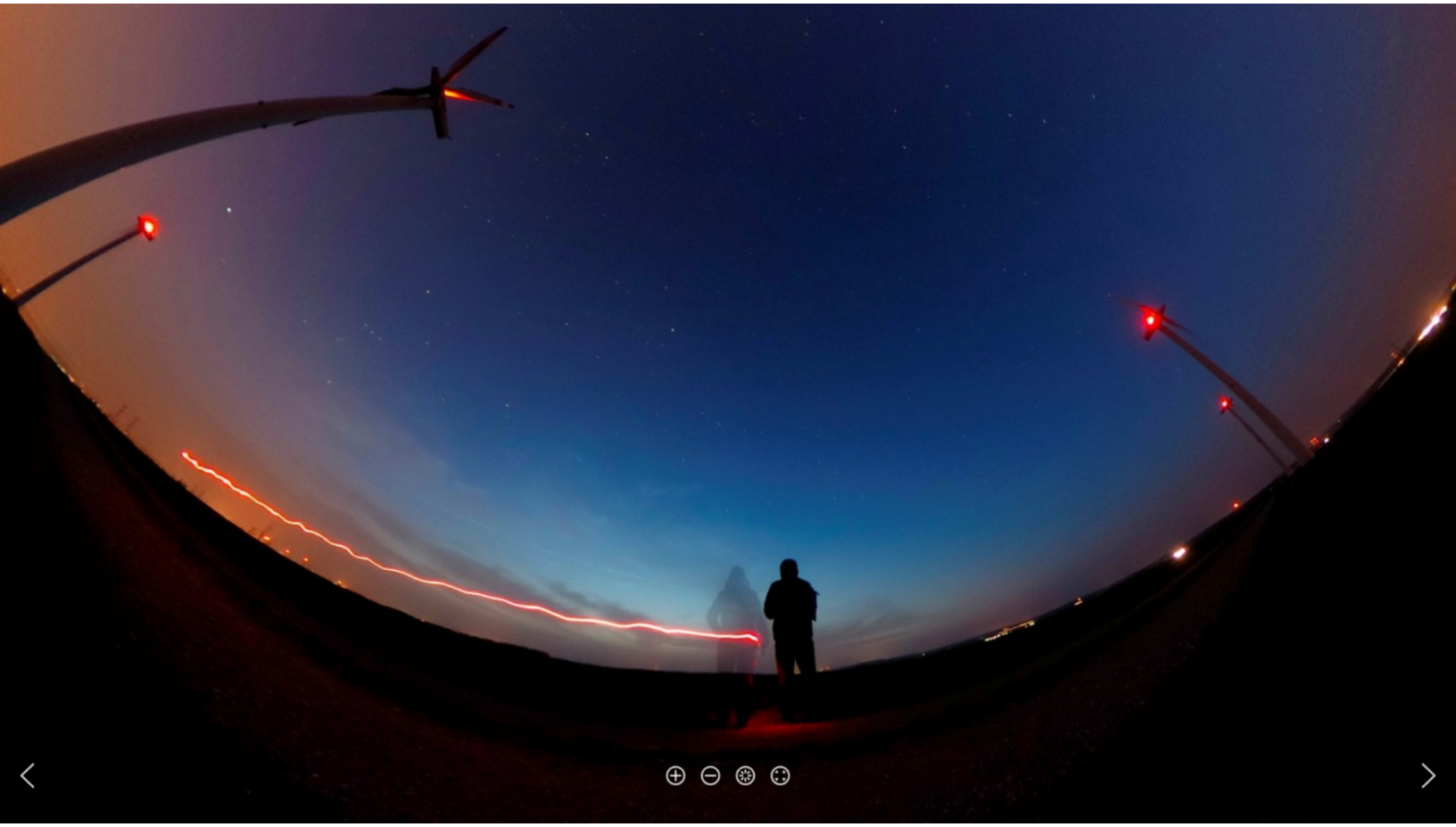


The exposure values can be set manually when operating the camera via the provided app.

The camera's performance at different ISO settings. With values higher than ISO 400, noise increases considerably. The 100% crops were somewhat stretched to make the noise better visible.

tiny chips would imply. The camera allows ISO settings from 100 up to 1600. Above ISO 400, noise increases considerably. ISO 800 might be of use in some cases, but in our opinion it is best to avoid the ISO 1600 setting. With the highest ISO setting too much detail, like small stars, gets lost in the noise.

To keep the ISO setting as low as possible, it comes in handy that the maximum exposure time of the camera can be used to its full 60 seconds duration for night sky photography. Experiments revealed that 30 second exposures show no significant signs of star trailing. In 60 second exposures some trailing begins to show in areas near the celestial equator but is still tolerable. After each shot the camera automatically stitches the two fisheye shots to one full-sphere image. This is done remarkably well. Stitching is seamless and the camera even retouches itself out of the picture. The images are EXIF time stamped by the camera's internal clock, which is updated every time the cam is connected to a mobile device. The reliable time stamp is of great value when analyzing the images later. When you download the resulting image to your smartphone, tablet or desktop computer you get a 5376 x 2688 pixel wide equirectangular panorama image in JPEG format. The term equirectangular refers to the projection that is used to store the spherical 360° data in a flat image, see explanation equirectangular. The images downloaded via Wi-Fi onto a mobile device are somewhat compressed and tend to show banding. However, downloads via USB to a computer retrieve the uncompressed original images. Once downloaded, the images may be further enhanced and labeled with any image processing software such as Photoshop. Whether the original images are modified or not, they can be dragged and dropped into the desktop software,



Fun shot during a short observing session at a wind farm. The picture was exposed 30 seconds at ISO 100. This is a screen shot of the panorama displayed with the Theta S desktop player. To experience the 360° scene yourself, explore the panorama on our website.

explored interactively as a 360° sphere and uploaded for sharing on the Theta S website.

Simple Astronomical Applications for the Theta S

Many possible shooting scenarios for the Theta S in an astronomical context require no additional accessories. We expect a lot of these images to appear in the near future. For example, the Theta S will be a wonderful tool to capture twilight phenomena, auroras, noctilucent clouds, total solar eclipses, solar and lunar halos, constellations, planetary conjunctions, fireballs and the brighter parts of the Milky Way. Even the social aspects of stargazing might be captured with this little gadget: Imagine using the Theta S on a star party, during observing sessions or inside an observatory dome. All you have to do is put the tiny cam on a tripod, connect via the app and shoot away.

Aligning the Images

Besides the fun images mentioned above, there are some more advanced astronomical applications of the Theta S. Two of these applications are described later in the text. With these applications it is possible to measure azimuth and elevation angles of objects directly on the images. To do so, the images must be recorded with the camera aligned in the horizontal system. Meaning, the mathematical horizon of the imaged scene must appear as a straight horizontal line crossing the equirectangular image exactly in its middle. This is never the case when the vertical alignment of the camera is done by simple eyeballing.

The obvious solution would be to transform such non-aligned images later on by using the

A simple leveling plate turns the Theta S into a powerful full-sphere surveying tool. With a two-way bubble level the camera is vertically aligned for the exposures. On images shot with this setup, the horizontal coordinates of celestial objects, light pollution domes, horizon lines etc. can be measured directly.

data that is provided by the camera's internal alignment sensor. This sensor monitors the orientation of the camera during the exposure and determines how much it deviates from the vertical position. The sensor's value is stored with the image in the JPEG data. Sadly, the precision of the sensor is not high enough. During our tests transformations performed with the Theta S desktop software based on the values provided by the sensor worked only to an accuracy of ±2°, even if the camera had been steadily mounted on a tripod for the shot.

For accurate vertical alignment the internal sensor is a dead end.

So, obviously some means is needed to put the camera in a reliable vertical position during shooting. At first, we tried to align the camera with the tiny bull's eye spirit levels that can be found on many tripod heads and ball heads. Still no luck, again the accuracy was too low.

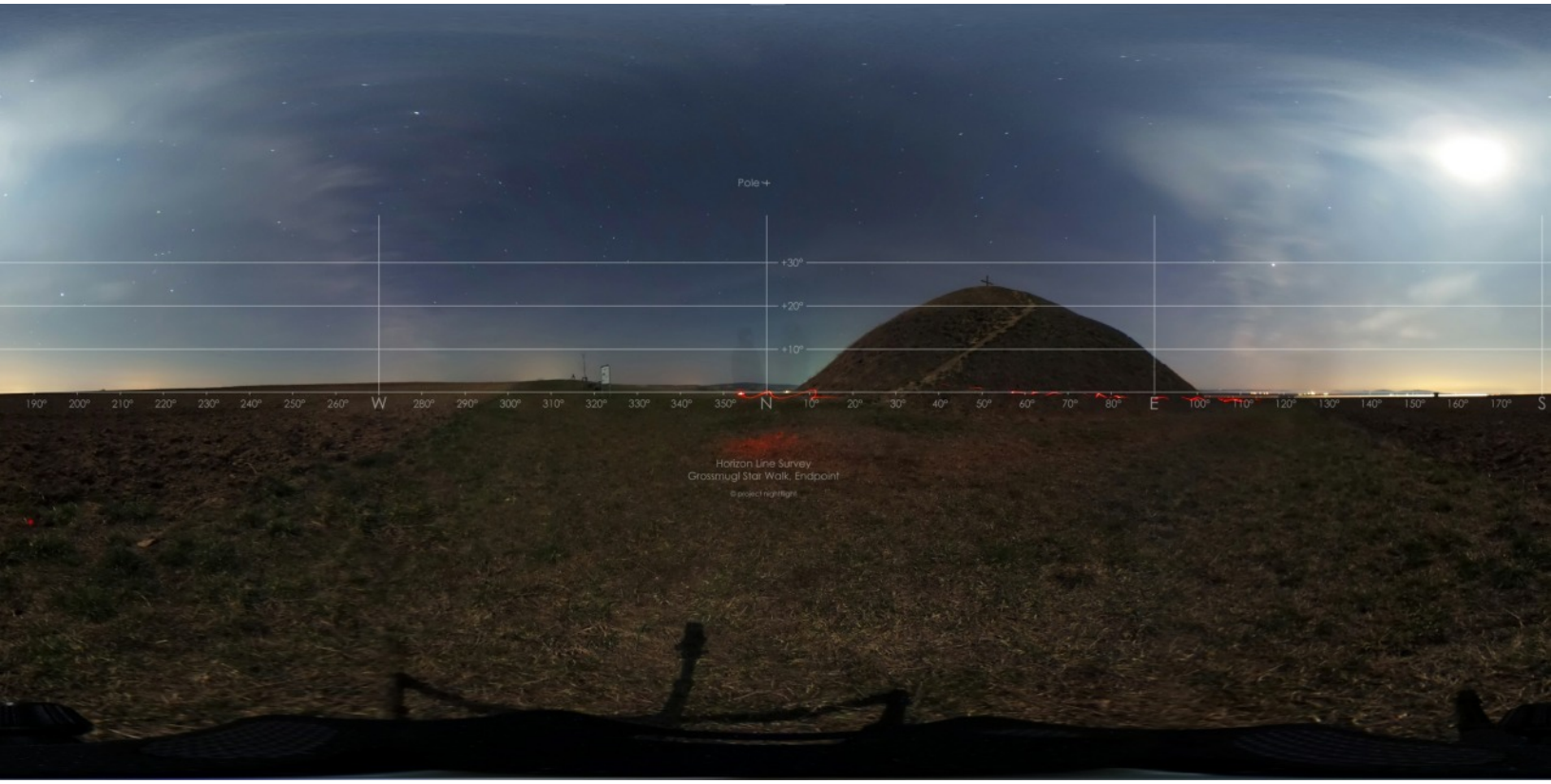
Finally we came up with a solution that really works. It consists of a quick release plate with a two-axis spirit level and a compass mounted on it. The compass is for pointing the camera roughly in a north-south direction. This is only for convenience and the compass could have been left out, but the two-way bubble level is the indicator that really matters. The Theta S is mounted on the quick release plate and the whole contraption goes onto the tripod. Before shooting, we orient the camera roughly north-south with the compass and then adjust the tripod head until the bubble levels indicate sufficient vertical alignment of the camera. This simple solution allows alignment to a repeatable accuracy better than ±0.5°. This means that horizontal coordinates of objects on the images can be measured to the same accuracy.

In Theta S images shot with this setup it is possible to measure horizontal coordinates of objects on the images to an accuracy of ±0.5°. This can be used for

many purposes, including two typical applications we describe on the following pages. It may also be used as an educational tool, for example with students who are in the process of familiarizing themselves with the apparent motions of celestial objects and the usage of spherical coordinate systems.

Surveying an Observing Site's Horizon

A question that often arises is: "Can I watch or photograph a certain celestial object or event from my observing site or will it be obstructed by the local horizon?" For example, a conjunction of Venus and the crescent moon low in the western sky might be hidden behind a nearby group of trees. Or there may be some hills on the horizon that just block a star cluster with a southern declination from view. Or the long awaited partially eclipsed sun may hide itself behind a group of buildings in the east, etc. To avoid such disappointments, astrophotographers and visual observers alike often prepare for an upcoming event by driving to their preferred observing site to check out the visibility of objects. Other amateurs even make panoramas of their favorite observing locations by carefully photographing the horizon in several images and stitching them together. This has never been done frequently, because until now the process to produce such a panorama took hours. With the Theta S this changed dramatically. To demonstrate how the Theta S can be used to survey an observing site's horizon, we did an exposure at Star Meadow, the endpoint of the Grossmugl Star Walk. For the shot, we aligned the camera vertically as described above. Since the Theta S delivers equirectangular images, azimuth circles and elevation parallels are simple parallel lines on the image. To add a grid of horizontal coordinates to the image, we prepared an overlay image that includes lines for the horizon, parallels for different height angles, verticals at the cardinal points, azimuth labels every 10 degrees and a mark for the celestial pole. We used Photoshop to insert the overlay image as a layer in the original Theta S image. Since the horizon line is exactly in the middle of the

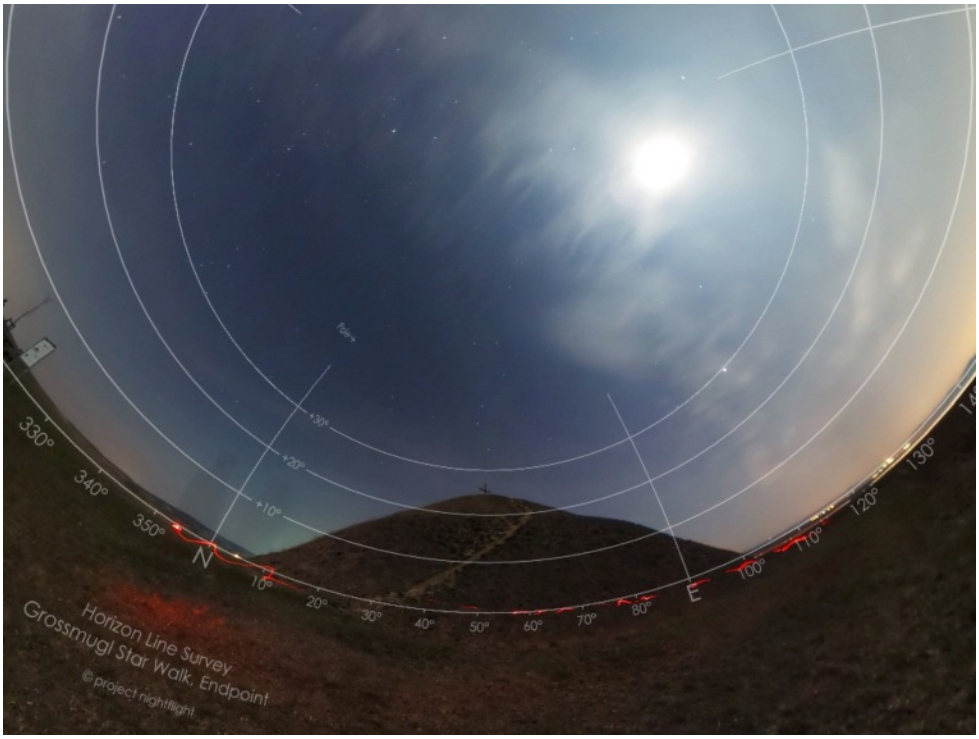


Equirectangular image of an observing location in moonlight at the endpoint of the Grossmugl Star Walk. In the image, coordinate lines of the horizontal system (azimuth, height) were added in Photoshop. Exposure of the original Theta S image was 60 seconds at ISO 100.

equirectangular image, the layer with the grid only has to be oriented left-right until it matches north on the image. It is easy to use the celestial pole to do so. Once we had the overlay oriented, we flattened the layers and saved the image again as a JPEG. It is now possible to open the image in the Theta app or the Theta desktop viewer and simply read off the height of the horizon at any azimuth to an accuracy of ±0.5°.

Our experiments showed that it is best to do the shots to survey a horizon line with the Theta S under a gibbous moon. During this lunar phase, the surroundings of the observing site are plainly visible on the image. With a gibbous moon the night sky is not too bright from moonlight, so major light pollution sources can be identified on the picture, too.

With the labeled image in the Theta S player, we now have a 360° full-sphere model of the observing site on our hands. It can be viewed interactively and will be of great help for planning images and observing events at Star Meadow. The panorama is available in the tests section of our *website*.



Screenshot of the spherical display of the image in the Theta iPad app. To view the interactive 360° scene yourself explore the panorama on our website.

When comparing this technique to the conventional way of generating panoramas from several images the Ricoh Theta S clearly wins. To survey the horizon line of an observing site with this little cam it takes only one shot and the grid overlay can be inserted and aligned within minutes. The whole process takes 15 minutes max. We are planning to make similar surveys of all our favorite observing and astro shooting locations.

Documenting Light Pollution at an Observing Site

The same technique can be used to document the light pollution at an observing site. To do so, the exposure has to be made after the end of astronomical twilight and with no moon in the sky.

Again, we shot our example image at Star Meadow, the endpoint of the Grossmugl Star Walk. The image was made on an evening with average sky conditions, on March 26, 2016. We inserted the grid with the horizontal coordinate lines as explained above and additionally labeled the sources responsible for the light pollution. As the result shows, the sky at Grossmugl is still rather nice for being so close to a major city (Vienna with its 1.800.000 inhabitants is only 33 kilometers away). We will also use this data to plan our imaging sessions at the Star Walk. As can be seen on the sphere, in the directions facing away from Vienna's awful light dome the Grossmugl sky will allow long exposures down to a height above horizon of about 30 degrees.

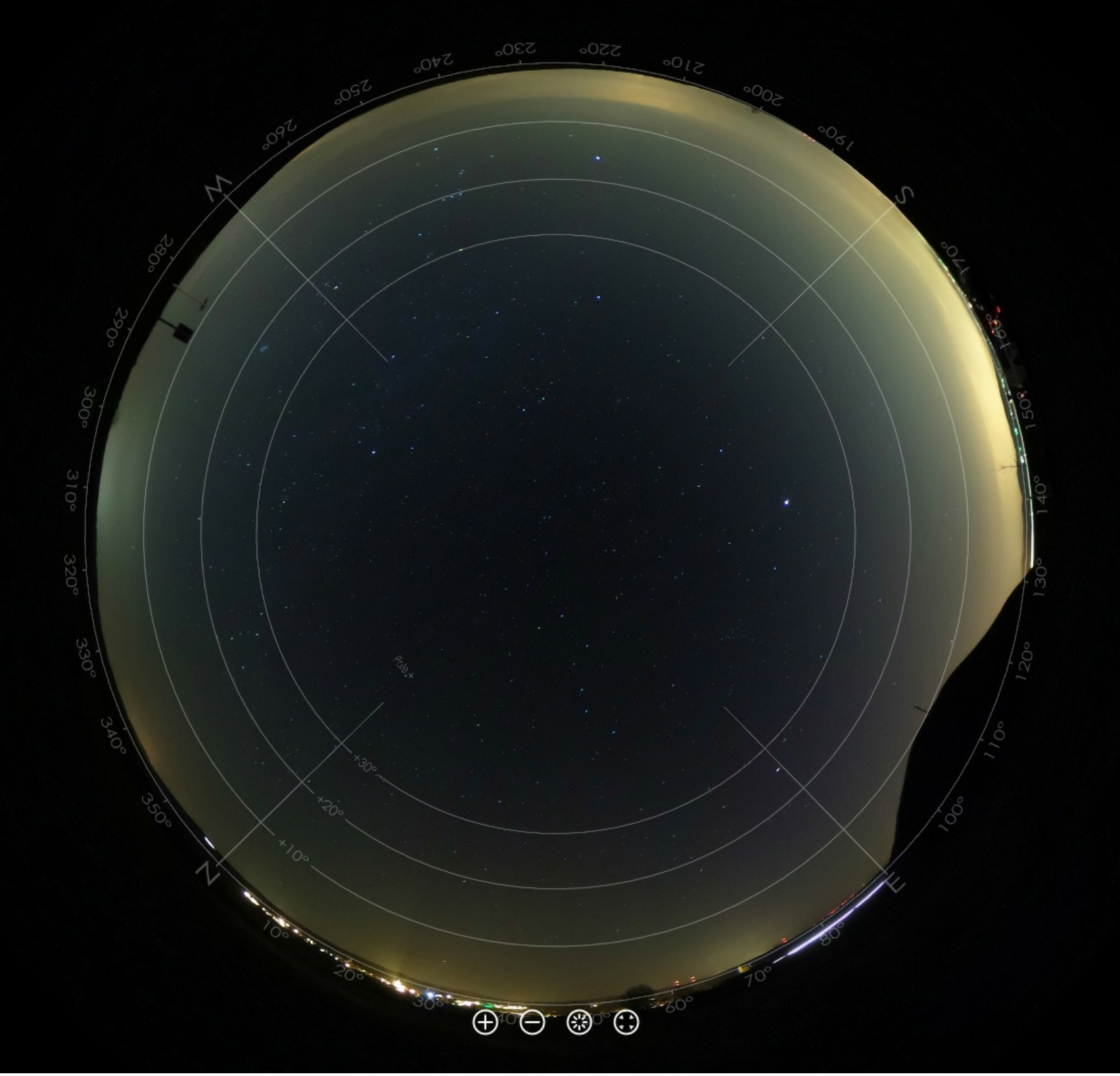
We want to emphasize how useful this technique is to document and visualize light pollution. With the Theta S, it takes only one shot to capture the light pollution situation at a site and the horizontal grid is added in no time. Since it is so easy to do this kind of documentation a larger

Equirectangular image of the light pollution at Star Meadow, the endpoint of the Grossmugl Star Walk. In the image, coordinate lines of the horizontal system (azimuth, height) were added in Photoshop. Exposure of the original Theta S image was 60 seconds at ISO 200.

number of sites can be covered, and with high frequency. For example, the increase of light pollution (or hopefully the decrease at some sites) may be documented over several consecutive years. The Ricoh Theta S even provides a website where it is possible to share the results among fellow stargazers and with the general public. Given all this, we can all turn the Theta S into a new and highly valuable tool in the struggle against light pollution.

For those of you interested in doing sky brightness measurements, here's some additional information: It is obvious that the Theta S cannot be used to make absolute measurements of the sky brightness. At present (April 2016), accessing the RAW image data of the camera is not possible. Therefore, the images cannot be calibrated and analyzed for sky brightness values. There is a chance that this will change over time, since a lot of third-party developers are asking Ricoh to give them access to the RAW data. We are not sure this will ever happen - what's sure is that at the moment sky brightness measurements cannot be done with this cam. For this purpose, the SQM (Sky Quality Meters) from Unihedron are a much better choice. They are highly recommended by the International Dark Sky Association (IDA) and are widely used in IDA campaigns for data acquisition on a global scale.

Although measured sky brightness values are very useful, a typical SQM result like "20.7 magnitudes per square arcsecond" will mean absolutely nothing to someone outside the astronomical community. Numbers are not easy to comprehend for everyone and that's where the Theta S can come in. It will doubtlessly excel in the visualization of light pollution. The camera is a very easy-to-use tool to demonstrate the impact of light pollution on the night sky at a given location. The presence of light pollution domes on the horizon can be proven and the sources can easily be identified. Even some quantitative analysis of the images is possible, since the horizontal and vertical extension of light pollution domes can be measured



Screenshot of an all-sky view of the image in the Theta desktop viewer. To view the interactive 360° scene yourself explore the panorama on our website.

directly from the image. Changes over time might be documented as well. But the greatest strength of the Theta S spherical images is the fact that they are extremely instructive - they can be viewed full screen, panned, zoomed, auto rotated, played with etc. This will be very useful to demonstrate the effects of light pollution to people not involved in astronomy, such as politicians, local government officials or media people.

Conclusion

The Theta S has tremendous potential for astronomical usage and is a definite "Buy!" for every astronomy and nature enthusiast. Besides, the app that comes with the cam will not be the end of the story. Ricoh provides a programming interface and information for third-party developers, so there are new interesting apps for the Theta S to be expected. But already today the camera opens up a whole new world for astronomy aficionados. Whether you want to shoot fun pictures at a star party, record an observing event, capture extended celestial scenes, survey observing sites or document light pollution, the Ricoh Theta S is a great investment.

*The authors **Karoline Mrazek** and **Erwin Matys** are founding members of the astrophotography group project nightflight. Check out their images, tests and tools at their website.*

Venus and Jupiter Prepare for their Close-up this August

Ethan Siegel

This article is provided by NASA Space Place.
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As Earth speeds along in its annual journey around the Sun, it consistently overtakes the slower-orbiting outer planets, while the inner worlds catch up to and pass Earth periodically. Sometime after an outer world—particularly a slow-moving gas giant—gets passed by Earth, it appears to migrate closer and closer to the Sun, eventually appearing to slip behind it from our perspective. If you've been watching Jupiter this year, it's been doing exactly that, moving consistently from east to west and closer to the Sun ever since May 9th.

On the other hand, the inner worlds pass by Earth. They speed away from us, then slip behind the Sun from west to east, re-emerging in Earth's evening skies to the east of the Sun. Of all the planets visible from Earth, the two brightest are Venus and Jupiter, which experience a conjunction from our perspective only about once per year. Normally, Venus and Jupiter will appear separated by approximately 0.5º to 3º at closest approach. This is due to the fact that the Solar System's planets don't all orbit in the same perfect, two-dimensional plane.

But this summer, as Venus emerges from behind the Sun and begins catching up to Earth, Jupiter falls back toward the Sun, from Earth's perspective, at the same time. On August 27th, all three planets—Earth, Venus and Jupiter—will make nearly a perfectly straight line.

As a result, Venus and Jupiter, at 9:48 PM Universal time, will appear separated by only 4 arc-minutes, the closest conjunction of naked eye planets since the Venus/Saturn conjunction in 2006. Seen right next to one another, it's startling how much brighter Venus appears than Jupiter; at magnitude -3.80,

Venus appears some *eight times brighter than* Jupiter, which is at magnitude -1.53.

Look to the western skies immediately [see next page] after sunset on August 27th, and the two brightest planets of all—brighter than all the stars—will make a dazzling duo in the twilight sky. As soon as the sun is below the horizon, the pair will be about two fists (at arm's length) to the left of the sun's disappearance and about one fist above a flat horizon. You may need binoculars to find them initially and to separate them. Through a telescope, a large, gibbous Venus will appear no more distant from Jupiter than Callisto, its farthest Galilean satellite.

As a bonus, Mercury is nearby as well. At just 5º below and left of the Venus/Jupiter pair, Mercury achieved a distant conjunction with Venus less than 24 hours prior. In 2065, Venus will actually occult Jupiter, passing in front of the planet's disk. Until then, the only comparably close conjunctions between these two worlds occur in 2039 and 2056, meaning this one is worth some special effort—including traveling to get clear skies and a good horizon—to see!

To teach kids more about Venus and Jupiter, visit the NASA Space Place webpages titled "All About Venus" [http://spaceplace.nasa.gov/all-about-venus/en/] and "All About Jupiter" [http://spaceplace.nasa.gov/all-about-jupiter/en/].

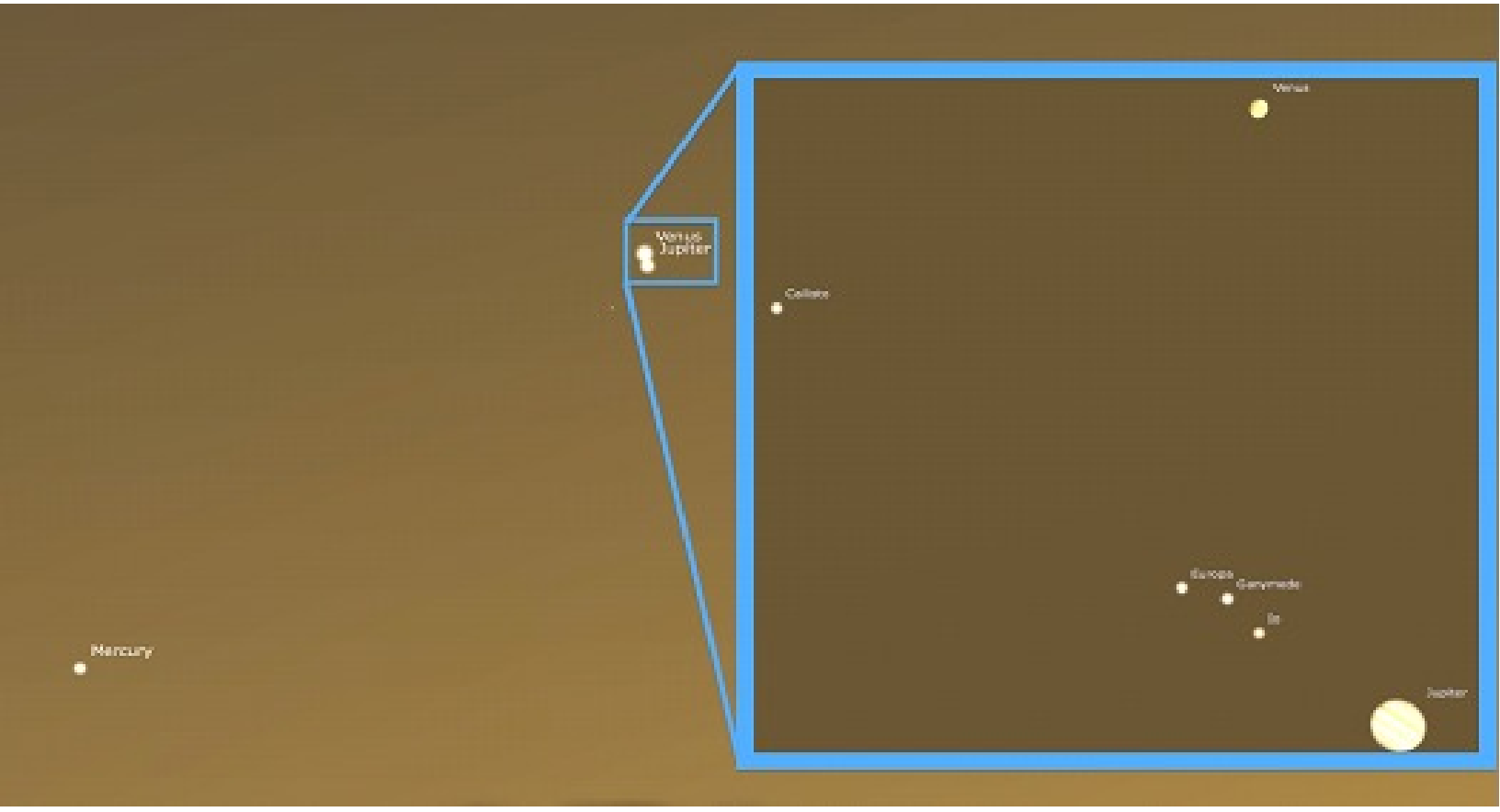

Image credit: E. Siegel, created with Stellarium, of a small section of the western skies as they will appear this August 27th just after sunset from the United States, with Venus and Jupiter separated by less than 6 arc-minutes as shown. Inset shows Venus and Jupiter as they'll appear through a very good amateur telescope, in the same field of view.

From the Archives: July, 1994

The Prairie Astronomer

July 1994 Volume 35 Issue 7

1st Annual Nebraska Star Party Is Huge Success!

by Dave Scherping

The 1st Annual Nebraska Star Party turned out to be a huge success. We attracted 73 attendees from Lincoln, Omaha, Chadron, & Amarillo. Thanks to the star party's designated "Clear Skies Coordinator", Jason Stahl, attendees enjoyed 2-1/2 out of 3 nights of fantastic observing with the Milky Way straight overhead. He got off to a slow start though.... Thursday night was cloudy until midnight. Friday and Saturday nights were crystal clear.

On Friday, about one-third of the attendees went canoeing and tubing down the Niabrara River. Friday evening featured the star party barbecue . On Saturday evening, we gave away a substantial number of door prizes and several awards. Bill Canady of Amarillo, who failed to show up, was awarded the "1,000,000 B.C." award, including a tee-shirt showing the cave man at Morrill Hall using the Canady Star Pointer. Alan Scruggs, also from Amarillo, received the "Gaseous Nebula Award" for his notorious reactions to the food at the Prude Ranch. Tom Miller received by far the most awards, including the "Big Dob Award" for largest telescope, the "Al Nagler Award" for most eyepieces, the "Largest Telescope Without Optics Award" for his innovative 30" mirrorless telescope, and the "Obsessed telescope Buyer Award". His wife, Jennifer, received the "Wife Of The Man With The Most Toys Award".

Saturday night ended with a spectacular fireball, which cast shadows on the ground as the last of the die -hard observers finished packing up their equipment and were raising a toast to next year's NSP.

There are still a few tee-shirts that were ordered and were not picked up. Please make arrangements to pick them up at the July meeting or contact me asap. We sold all of the extra tee-shirts. Several people have requested additional tee-shirts. If there are a minimum of 24 additional shirts requested, we will place another order. Cost is $8.50 per shirt. Contact Jason Stahl at the July meeting or call me at 477-2596.

At the July meeting, we will discuss hosting the 2nd annual NSP next year. We will be seeking several volunteers to help coordinate registrations, reservations, programs, tee-shirts, publicity, and door prizes, etc.

LAST MONTH.....

At the June meeting, there was an excellent demonstration of Dance Of The Planets by David Knisley and a humorous video tour of Car-Henge by Ron Veys. Both presentations were great and well appreciated.

THIS MONTH....

At the July meeting, we will see a video tape of the Nebraska Star Party, by Earl Moser.

Welcome!

David Nolte

Lincoln, NE 68506

CLUB MEMBERSHIP INFO

REGULAR MEMBER - $30.00 per year. Includes club newsletter, and 1 vote at club meetings, plus all other standard club privileges.

FAMILY MEMBER - $35.00 per year. Same as regular member except gets 2 votes at club meetings.

STUDENT MEMBER - $10.00 per year with volunteer requirement.

If you renew your membership prior to your annual renewal date, you will receive a 10% discount.

Club members are also eligible for special subscription discounts on Sky & Telescope Magazine.

CLUB TELESCOPES

To check out one of the club telescopes, please contact a club officer. Scopes can be checked out at a regular club meeting and kept for one month. Checkout can be extended for another month if there are no other requests for the telescope, but you must notify a club officer in advance.

100mm Orion refractor: David Pennington
10 inch Meade Dobsonian: Lee Taylor
13 inch Truss Dobsonian: Available

CLUB APPAREL

Order club apparel from cafepress.com:

Shop through Amazon Smile to automatically donate to PAC:

amazonsmile

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