The Prairie Astronomer

September 2015 Volume 56, Issue #9

September Program

Dan Delzell:
What You're Missing if You're Not Doing Outreach

Cover: Pluto, colorized by Don Davis, using the low resolution color information available for each region.

Pluto's Majestic Mountains, Frozen Plains and Foggy Hazes

Night Sky Network

The Newsletter of the Prairie Astronomy Club

The Prairie Astronomer

NEXT PAC MEETING: September 29, 7:30pm
At Hyde Memorial Observatory

PROGRAM

The September program will be “What You're Missing if You're not doing Outreach” by Dan Delzell.
Dan will talk about the personal benefits from doing outreach and mentoring new astronomers.

FUTURE PROGRAMS

October Program: “Beginning Astrophotography” by Brett Boller.

November: “How to Buy a Telescope”

December: PAC Holiday Gathering

January: “How to Use Your Telescope”

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

CONTENTS

EVENTS

September 26 Spring Creek Prairie, Twilight on the Tall Grass

Sept 27 Homestead National Monument Star Party, Lunar Eclipse

PAC Meeting
Tuesday Sept 29th, 2015, 7:30pm
Hyde Observatory

October 24, Homestead National Monument, Howling Homestead

PAC Meeting
"Beginning Astrophotography" Brett Boller
Tuesday October 27th, 2015, 7:30pm
Hyde Observatory

PAC Meeting
"How to Buy a Telescope"
Tuesday November 24th, 2015, 7:30pm
Hyde Observatory

2015 STAR PARTY DATES

Photo by Brian Sivill

Dates in underlined are closest to the new moon

Jan 16,23, Feb 13,20
Mar 13,20, Apr 10,17
May 8,15, Jun 12,19
Jul 10,17
NSP Jul 12-17
Aug 7,14, Sep 4,11
Oct 9,16, Nov 6,13
Dec 4,11

Lunar Party Dates
Mar 27, Apr 24, Jul 24, Aug 21

(Lunar party dates are tentative, sites to be determined.)

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

ADDRESS

The Prairie Astronomer
c/o The Prairie Astronomy Club, Inc.
P.O. Box 5585
Lincoln, NE 68505-0585

WEBSITES

www.prairieastronomyclub.org
https://nightsky.jpl.nasa.gov
www.hydeobservatory.info
www.nebraskastarparty.org
www.OmahaAstro.com
Panhandleastronomyclub.com
www.universetoday.com/
www.planetary.org/home/
http://www.darksky.org/

PAC Meeting Minutes

Minutes for the meeting of August 25, 2015

President Jim Kvasnicka called the meeting to order. Present, 15 members and several guests, including two new members and some students from Michael Sibbernsen's UNL Astronomy 103 class. Welcome, everyone to the observatory and club.

We have several events and activities coming up in the next few months. Dan discussed staffing of these events.

Jim discussed dues and benefits of club membership.

Individual membership $30/year

Family membership $35/year

Student membership $10/year with volunteer requirements

To join the club, see club treasurer, John Reinert.

Jim presented his observing report for September. Our last star party had 14 attendance, our best of the year so far.

Club business

Next month is nominations for club officers.

Michael Sibbernsen represents the Nebraska Eclipse Consortium. Jim asked if the club would be interested in becoming a partner in this organization. It is an organization intended to educate groups that wish to organize events to observe the eclipse, publicize these events and coordinate observing campaigns. The motion was made,Lee Taylor seconded. The motion carried unanimously.

Adjourn to Michael Sibbernsen's program.

Respectfully submitted by,

Lee Taylor

Michael Sibbernsen demonstrates how to make a comet using dry ice.

Club members and visitors inspect Michael Sibbernsens's collection of meteorites.

Astrophotography in Hawaii

Mark Dahmke

While in Kailua-Kona the week of September 5-11 I was able to take a few astrophotos.

Right: Mars, Moon and Venus. 112mm, f/5.6, 0.5 seconds, ISO 640.

Below: Orion, 50mm, f/2.2, 9.7 seconds, ISO 500.

All photos were taken between 4 and 5am HT.

Above: 28mm lens, 8 seconds, f/5.0, ISO 1600. Orion is visible in the upper right, next to palm trees.
Below: 8mm fisheye lens, ISO 800, 4 seconds at f/3.5. Moon and Venus visible bottom center.

New Pluto Images: It's Complicated

New close-up images of Pluto from NASA's New Horizons spacecraft reveal a bewildering variety of surface features that have scientists reeling because of their range and complexity.

"Pluto is showing us a diversity of landforms and complexity of processes that rival anything we've seen in the solar system," said New Horizons Principal Investigator Alan Stern, of the Southwest Research Institute (SwRI), Boulder, Colorado. "If an artist had painted this Pluto before our flyby, I probably would have called it over the top — but that's what is actually there."

New Horizons began its yearlong download of new images and other data over the Labor Day weekend. Images downlinked in the past few days have more than doubled the amount of Pluto's surface seen at resolutions as good as 400 meters (440 yards) per pixel. They reveal new features as diverse as possible dunes, nitrogen ice flows that apparently oozed out of mountainous regions onto plains, and even networks of valleys that may have been carved by material flowing over Pluto's surface. They also show large regions that display chaotically jumbled mountains reminiscent of disrupted terrains on Jupiter's icy moon Europa.

"The surface of Pluto is every bit as complex as that of Mars," said Jeff Moore, leader of the New Horizons Geology, Geophysics and Imaging (GGI) team at NASA's Ames Research Center in Moffett Field, California. "The randomly jumbled mountains might be huge blocks of hard water ice floating within a vast, denser, softer deposit of frozen nitrogen within the region informally named Sputnik Planum."

New images also show the most heavily cratered -- and thus oldest -- terrain yet seen by New Horizons on Pluto next to the youngest, most crater-free icy plains. There might even be a field of dark wind-blown dunes, among other possibilities.

"Seeing dunes on Pluto -- if that is what they are -- would be completely wild, because Pluto's atmosphere today is so thin," said William B. McKinnon, a GGI deputy lead from Washington University, St. Louis. "Either Pluto had a thicker atmosphere in the past, or some process we haven't figured out is at work. It's a head-scratcher."

Discoveries being made from the new imagery are not limited to Pluto's surface. Better images of Pluto's moons Charon, Nix, and Hydra will be released Friday at the raw images site for New Horizons' Long Range Reconnaissance Imager (LORRI), revealing that each moon is unique and that big moon Charon's geological past was a tortured one.

Images returned in the past days have also revealed that Pluto's global atmospheric haze has many more layers than scientists realized, and that the haze actually creates a twilight effect that softly illuminates nightside terrain near sunset, making them visible to the cameras aboard New Horizons.

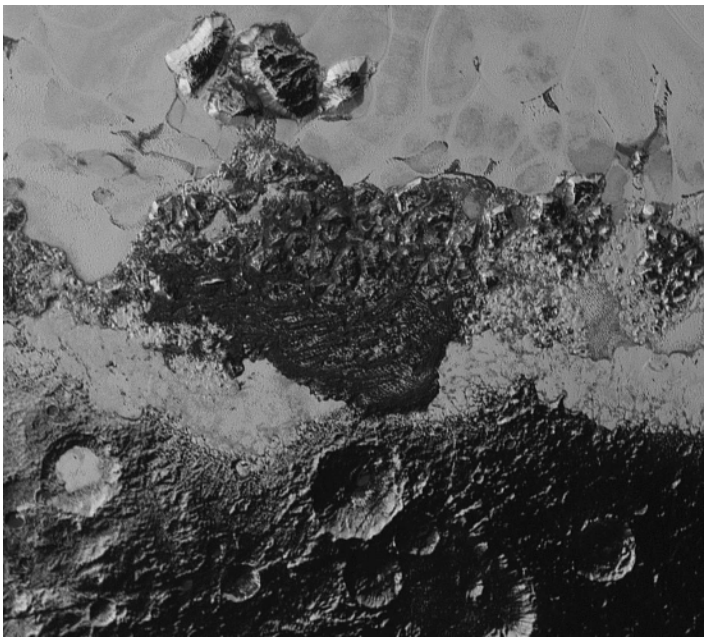
"This bonus twilight view is a wonderful gift that Pluto has handed to us," said John Spencer, a GGI deputy lead from SwRI. "Now we can study geology in terrain that we never expected to see."

The New Horizons spacecraft is now more than 3 billion miles (about 5 billion kilometers) from Earth, and more than 43 million miles (69 million kilometers) beyond Pluto. The spacecraft is healthy and all systems are operating normally.

Follow the mission at www.nasa.gov/newhorizons and http://pluto.jhuapl.edu.

New Horizons is part of NASA's New Frontiers Program, managed by the agency's Marshall Space Flight Center in Huntsville, Alabama. The Johns Hopkins University Applied Physics Laboratory in Laurel, Maryland, designed, built, and operates the New Horizons spacecraft and manages the mission for NASA's Science Mission Directorate. SwRI leads the science mission, payload operations, and encounter science planning.

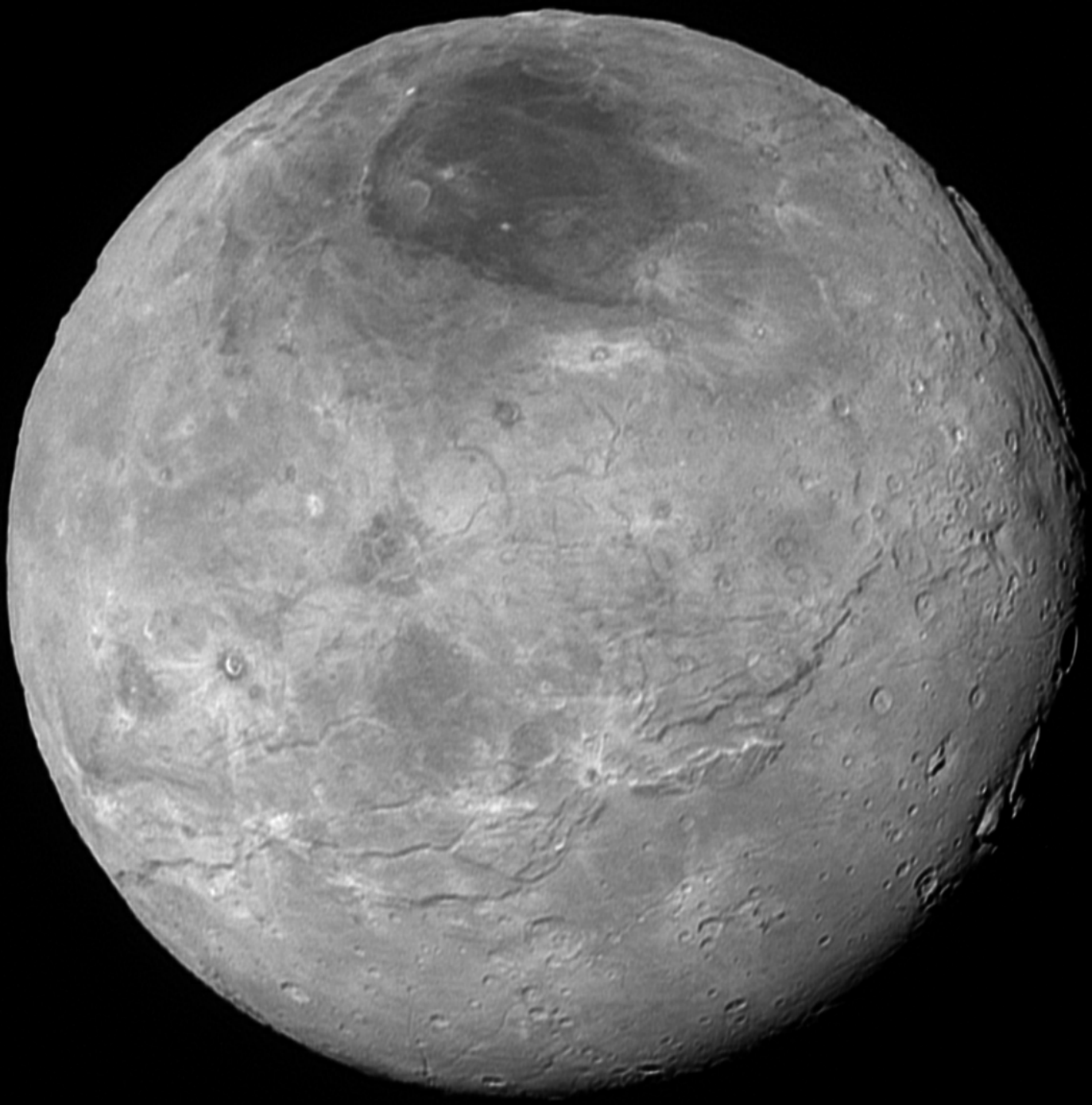
This synthetic perspective view of Pluto, based on the latest high-resolution images to be downlinked from NASA's New Horizons spacecraft, shows what you would see if you were approximately 1,100 miles (1,800 kilometers) above Pluto's equatorial area, looking northeast over the dark, cratered, informally named Cthulhu Regio toward the bright, smooth, expanse of icy plains informally called Sputnik Planum. The entire expanse of terrain seen in this image is 1,100 miles (1,800 kilometers) across. The images were taken as New Horizons flew past Pluto on July 14, 2015, from a distance of 50,000 miles (80,000 kilometers).



This 220-mile (350-kilometer) wide view of Pluto from NASA's New Horizons spacecraft illustrates the incredible diversity of surface reflectivities and geological landforms on the dwarf planet. The image includes dark, ancient heavily cratered terrain; bright, smooth geologically young terrain; assembled masses of mountains; and an enigmatic field of dark, aligned ridges that resemble dunes; its origin is under debate. The smallest visible features are 0.5 miles (0.8 kilometers) in size. This image was taken as New Horizons flew past Pluto on July 14, 2015, from a distance of 50,000 miles (80,000 kilometers).

Credit: NASA/Johns Hopkins University Applied Physics Laboratory/Southwest Research Institute

Charon's Complex Geological History

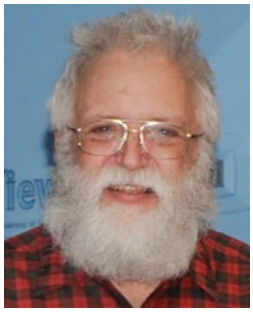


This image of Pluto's largest moon Charon, taken by NASA's New Horizons spacecraft 10 hours before its closest approach to Pluto on July 14, 2015 from a distance of 290,000 miles (470,000 kilometers), is a recently downlinked, much higher quality version of a Charon image released on July 15. Charon, which is 750 miles (1,200 kilometers) in diameter, displays a surprisingly complex geological history, including tectonic fracturing; relatively smooth, fractured plains in the lower right; several enigmatic mountains surrounded by sunken terrain features on the right side; and heavily cratered regions in the center and upper left portion of the disk. There are also complex reflectivity patterns on Charon's surface, including bright and dark crater rays, and the conspicuous dark north polar region at the top of the image. The smallest visible features are 2.9 miles 4.6 kilometers) in size

Credit: NASA/Johns Hopkins University Applied Physics Laboratory/Southwest Research Institute

NGC 4216 and Friends

Rick Johnson



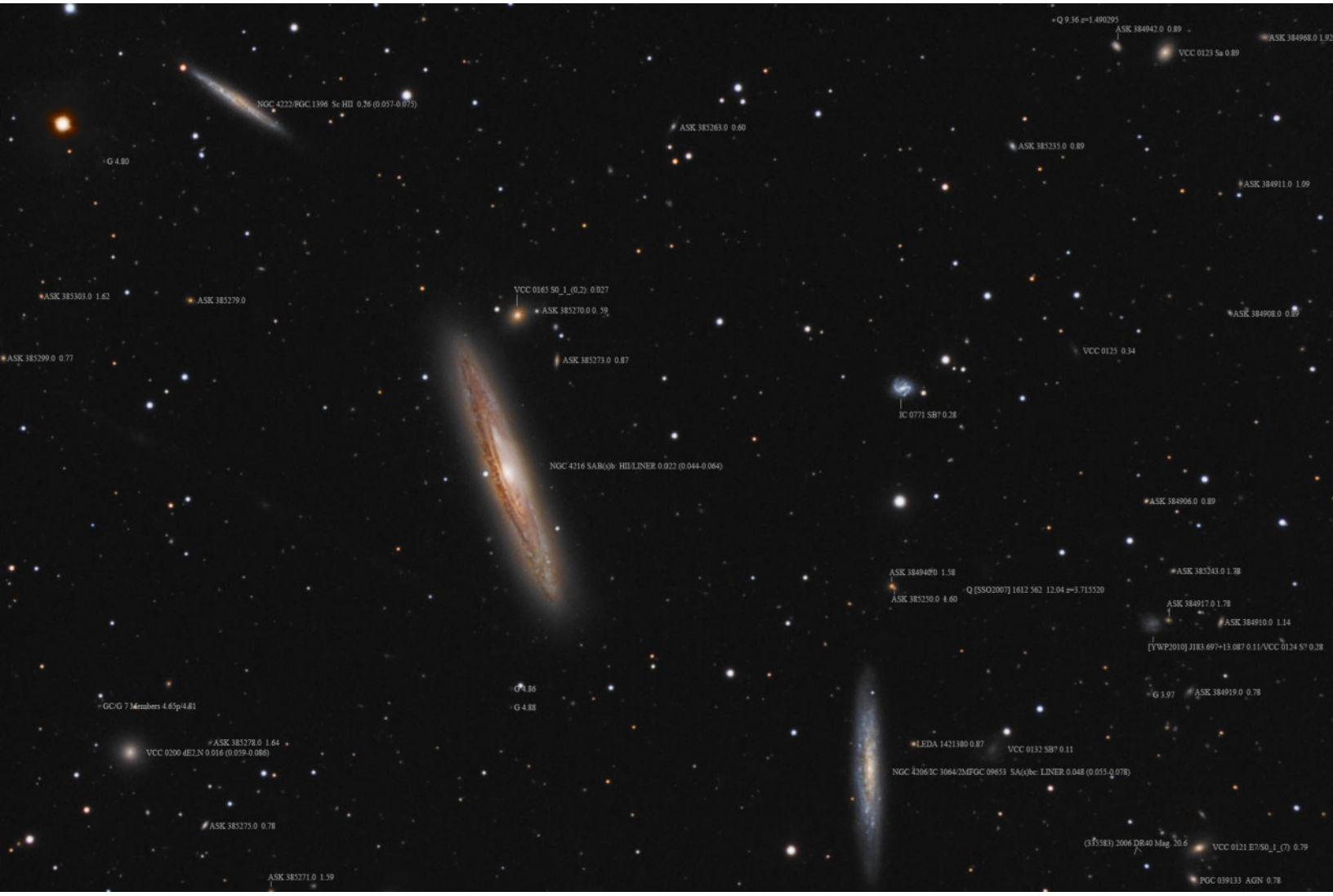
This field was taken not because it is rarely seen but because of the Herschel 400 object, NGC 4216 and it is a great field. NGC 4216 is an Sab(s)b: galaxy with HII emission and LINER properties indicating an active nucleus. It is considered a member of the Virgo Cluster of Galaxies. It's distance however is rather vague. Virgo Cluster galaxies have large orbital velocities making cosmological redshift useless as some of these values range from way too high a redshift for the accepted 50 to 60 million light-year distance to even a few that are blue shifted. NGC 4216 is listed by APOD at 40 million light-years. Several sources say it is near the center of the cluster but that is thought to be some 50 to 60 million light-years distant. Non redshift values at NED are all greater than the 40 million light-year figure. To me its resolution both in my image and others is more akin to a 50 to 60 million light-year distance though this galaxy is considered rather anemic in that star formation is low and its supply of HI is also low. Note its rather red color indicating few young stars even far out in the arms. Still I'll bow to the experts and say it is 40 million light-years distant. That makes it about 100,000 light-years in size. It has a close companion with similar redshift, VCC 0165. It has an odd curving plume to the northwest indicating it is interacting with NGC 4216.

As I stacked the frames an odd faint spike of light came in at an odd angle. Straight as an arrow

it had to be a reflection but those come in perpendicular to the edge not at an angle. Then my sleeping brain (it was 1 a.m.) finally woke up. A quick check turned up Ken Crawford's APOD showing a huge looping star stream.
http://imagingdeepsky.com/Galaxies/NGC4216/NGC4216.htm
Also this version
http://www.cloudynights.com/topic/411099-the-galaxies-star-streams-ngc4216-and-ngc4449
Both of these used many many hours and I'd only used 40 minutes of luminance. Still I picked up some of it. Then I looked at the log entry my system makes and saw I had planned on at least 4 rounds of data over 4 nights but the system got clouded out and never completed it. That's the problem with processing months later, I forget things like this.

NGC 4216 is the only galaxy in this field that is in either Herschel 400 list, being in the original. My comment from April 20, 1985 using my 10" f/5 reads simply "Large, nearly edge on galaxy with bright center." Usually I wrote more than that. Humidity was high and transparency low according to my notes. William Herschel found it the night of April 17, 1784.

The other two NGC galaxies in the image are also Herschel discoveries. NGC 4206 on the same night as NGC 4216 and NGC 5222 a few days earlier earlier on April 8, 1784. You might wonder how he could find 4222 and miss 4216 a much bigger and brighter galaxy. His scope was extremely difficult to use compared to what we are used to. He'd point it to a declination and record what he saw drift by. A clock gave him the RA as it crossed the center and the declination of the center of his field was known making declination easy to estimate. Also his field of view was tiny compared to what we are used to. NGC 4222 was just too far north and likely near the southern edge of his field that pass. The other two would be caught when he could map the



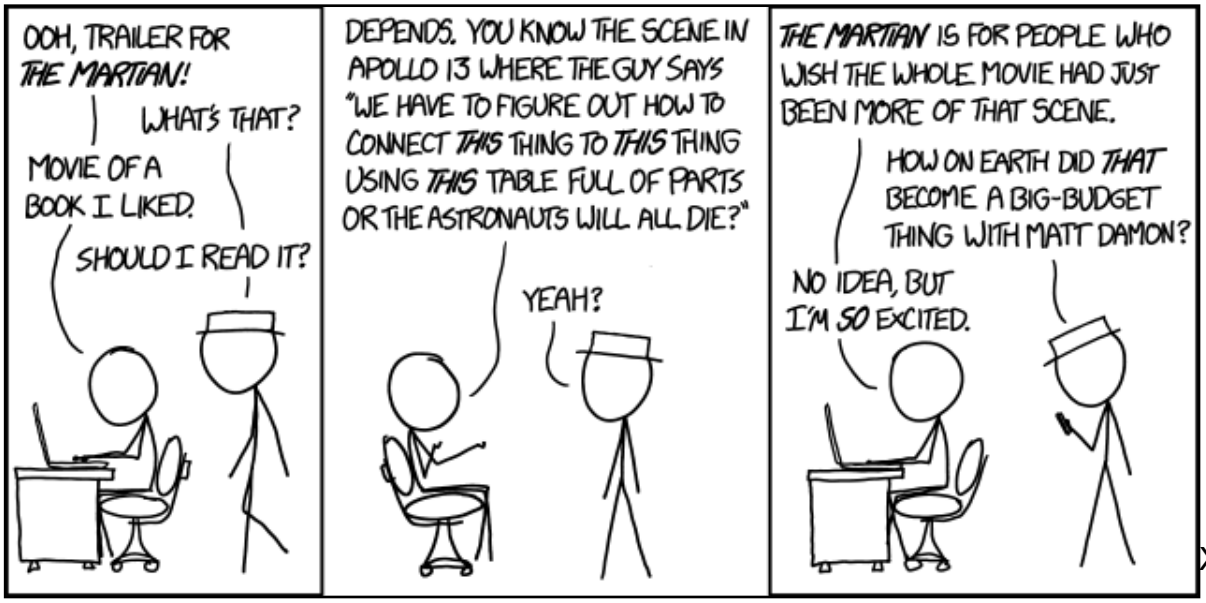
strip one field south a few nights later.

NGC 4206 is a flat galaxy meeting the lesser qualifications of the 2 micron flat galaxy catalog. It is a Sa(s)bc: galaxy with a LINER active core. Redshift puts it about 48 million light-years distant while non redshift measurements place it further away. So is it close to 4216 or not? I have no idea. Assuming it is 50 million light-years away it is about 90,000 light-years in diameter.

NGC 4222 has a similar redshift as NGC 4216 and a wide range of non redshift values putting it more distant than NGC 4216. Still it's similar redshift may indicate it is gravitationally linked to 4216 so I'm going to assume it too is about 40 million light-years distant. That makes it the smallest of the three at 40,000 light-years across. It is flatter than 4222 and thus makes the Flat Galaxy Catalog. Seen nearly edge on it is obvious it has only a slight hint of a central bulge. It is listed as an Sc spiral with HII emission.

There is often a 4th galaxy considered part of this group, IC 771 which is listed as a member of the Virgo Cluster Catalog as VCC 142. But its redshift puts it some 280 million light-years distant (no I didn't leave out a leading zero). While Virgo Cluster Galaxies can have redshifts well beyond their distance this is way too far out of line. No way it is actually a member of the cluster. It is a respectable 60,000 light-years across and is listed as a barred spiral. It was discovered by Rudolf Ferdinand Spitaler on April 1, 1891 using the 68cm refractor at Wien University Observatory. Now known as the University of Vienna and Vienna Observatory. The annotated image shows many other galaxies listed as members of the cluster with even larger redshifts indicating many VCC galaxies are not really members of the cluster but background galaxies. Several of the annotated VCC galaxies carried a second entry in NED without the VCC label. Only one of these is noted. Usually the non VCC entry had very vague coordinates, sometimes over 4 degrees error circle. The one that did agree within a few seconds of arc is listed in the annotated image, otherwise, even though the coordinates match the huge error circle and different redshift value indicated this is only a guess for which galaxy is meant. Most originated from radio galaxy catalogs with a wide beam and thus poor positional information.

One very faint asteroid is marked in the lower right corner. Why I off centered my target galaxy I don't know. Since I was trying for the plume caused by VCC 165 being ripped apart I'd have expected I'd have moved it east rather than west. Maybe I was confused which side of the galaxy it was on. Trying to remember back to April without any note on this fails my memory any more.



Xkcd.com

Ceres' Bright Spots Seen in Striking New Detail

The brightest spots on the dwarf planet Ceres gleam with mystery in new views delivered by NASA's Dawn spacecraft. These closest-yet views of Occator crater, with a resolution of 450 feet (140 meters) per pixel, give scientists a deeper perspective on these very unusual features.

The new up-close view of Occator crater from Dawn's current vantage point reveals better-defined shapes of the brightest, central spot and features on the crater floor. Because these spots are so much brighter than the rest of Ceres' surface, the Dawn team combined two different images into a single composite view -- one properly exposed for the bright spots, and one for the surrounding surface.

Scientists also have produced animations that provide a virtual fly-around of the crater, including a colorful topographic map.

http://www.jpl.nasa.gov/spaceimages/details.php?id=pia19890

http://www.jpl.nasa.gov/spaceimages/details.php?id=pia19891

Dawn scientists note the rim of Occator crater is almost vertical in some places, where it rises steeply for 1 mile (nearly 2 kilometers).

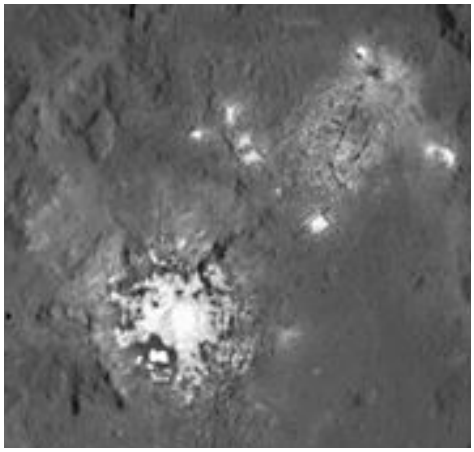
Views from Dawn's current orbit, taken at an altitude of 915 miles (1,470 kilometers), have about three times better resolution than the images the spacecraft delivered from its previous orbit in June, and nearly 10 times better than in the spacecraft's first orbit at Ceres in April and May.

"Dawn has transformed what was so recently a few bright dots into a complex and beautiful, gleaming landscape," said Marc Rayman, Dawn's chief engineer and mission director based at NASA's Jet Propulsion Laboratory, Pasadena, California. "Soon, the scientific analysis will reveal the geological and chemical nature of this mysterious and mesmerizing extraterrestrial scenery."

The spacecraft has already completed two 11-day cycles of mapping the surface of Ceres from its current altitude, and began the third on Sept. 9. Dawn will map all of Ceres six times over the next two months. Each cycle consists of 14 orbits. By imaging Ceres at a slightly different angle in each mapping cycle, Dawn scientists will be able to assemble stereo views and construct 3-D maps.

Dawn is the first mission to visit a dwarf planet, and the first to orbit two distinct solar system targets. It orbited protoplanet Vesta for 14 months in 2011 and 2012, and arrived at Ceres on March 6, 2015.

Dawn's mission is managed by JPL for NASA's Science Mission Directorate in Washington. Dawn is a project of the directorate's Discovery Program, managed by NASA's Marshall Space Flight Center in



See next page for a larger image.

Huntsville, Alabama. UCLA is responsible for overall Dawn mission science. Orbital ATK Inc., in Dulles, Virginia, designed and built the spacecraft. The German Aerospace Center, Max Planck Institute for Solar System Research, Italian Space Agency and Italian National Astrophysical Institute are international partners on the mission team. For a complete list of mission participants, visit:

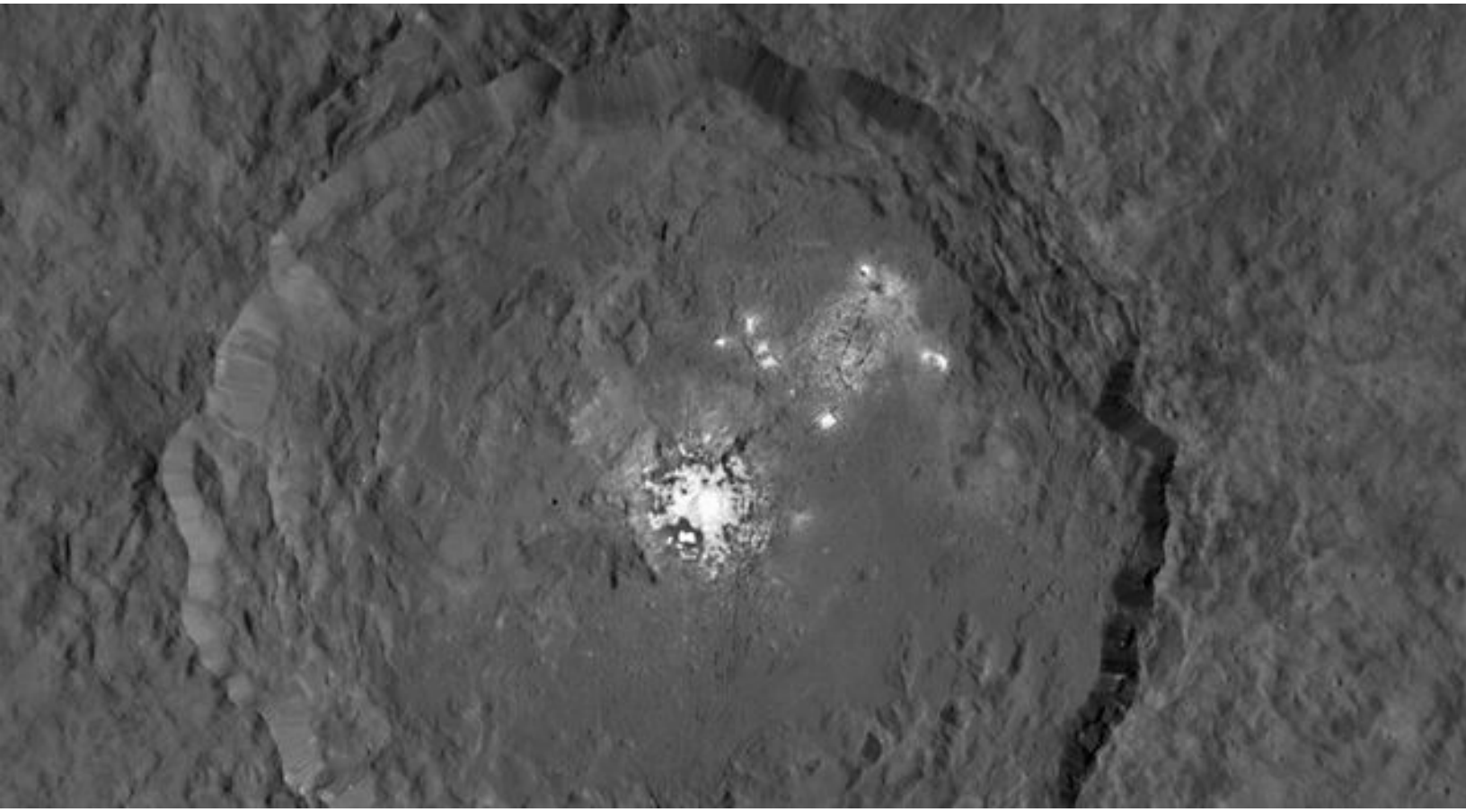
http://dawn.jpl.nasa.gov/mission

More information about Dawn is available at the following sites:

http://dawn.jpl.nasa.gov

http://www.nasa.gov/dawn

Occator Crater on Ceres



This image taken by NASA's Dawn spacecraft, shows Occator crater on Ceres, home to a collection of intriguing bright spots.

The bright spots are much brighter than the rest of Ceres' surface, and tend to appear overexposed in most images. This view is a composite of two images of Occator: one using a short exposure that captures the detail in the bright spots, and one where the background surface is captured at normal exposure.

The images were obtained by Dawn during the mission's High Altitude Mapping Orbit (HAMO) phase, from which the spacecraft imaged the surface at a resolution of about 450 feet (140 meters) per pixel.

Dawn's mission is managed by JPL for NASA's Science Mission Directorate in Washington. Dawn is a project of the directorate's Discovery Program, managed by NASA's Marshall Space Flight Center in Huntsville, Alabama. UCLA is responsible for overall Dawn mission science. Orbital ATK, Inc., in Dulles, Virginia, designed and built the spacecraft. The German Aerospace Center, the Max Planck Institute for Solar System Research, the Italian Space Agency and the Italian National Astrophysical Institute are international partners on the mission team. For a complete list of acknowledgments, see http://dawn.jpl.nasa.gov/mission.

Mars Panorama Shows Petrified Sand Dunes

Some of the dark sandstone in an area being explored by NASA's Curiosity Mars rover shows texture and inclined bedding structures characteristic of deposits that formed as sand dunes, then were cemented into rock.

A panorama from Curiosity's Mast Camera (Mastcam) that includes a ridge made of this sandstone is online at:

http://mars.nasa.gov/msl/multimedia/images/?ImageID=7468

This sandstone outcrop -- part of a geological layer that Curiosity's science team calls the Stimson unit -- has a structure called crossbedding on a large scale that the team has interpreted as deposits of sand dunes formed by wind. Similar-looking petrified sand dunes are common in the U.S. Southwest. Geometry and orientation of the crossbedding give information about the directions of the winds that produced the dunes.

The Stimson unit overlies a layer of mudstone that was deposited in a lake environment. Curiosity has been examining successively higher and younger layers of Mount Sharp, starting with the mudstone at the mountain's base, for evidence about changes in the area's ancient environment.

The dozens of individual Mastcam images combined into this panorama were taken on Aug. 27, 2015. Curiosity has driven about 103 yards (94 meters) in the subsequent two weeks, generally southward. Outcrops of the Stimson unit sandstone are still accessible to the rover, and researchers plan to use the rover to collect and analyze a drilled sample of Stimson unit sandstone this month.

Curiosity has been working on Mars since early August 2012. It reached the base of Mount Sharp last year after fruitfully investigating outcrops closer to its landing site and then trekking to the mountain.

Malin Space Science Systems, San Diego, built and operates the rover's Mastcam. NASA's Jet Propulsion Laboratory, a division of the California Institute of Technology, Pasadena, manages the Mars Science Laboratory Project for NASA's Science Mission Directorate, Washington. JPL designed and built the project's Curiosity rover. For more information about Curiosity, visit:

http://mars.nasa.gov/msl

2015 Wildwood Star Party

Dan Delzell

PAC members participated in the third annual Wildwood House Star Party in Nebraska City on Saturday September 12th.

The Wildwood House Historic Center is the historical home of the Ware family. Jasper Anderson Ware and his wife and three daughters moved to the wooded hills outside Nebraska City in 1869. His wife claimed that she could not live in such a "wild wood" and the home was named. The home is now owned by Nebraska City and is open to the public as a national historic site.

Mrs. Ware was an amateur astronomer and owned a Yeats telescope. This telescope is on display at the Wildwood House. It was recently restored by Prairie Astronomy Club member Eugene Lanning and was available for the public to look through at the party.

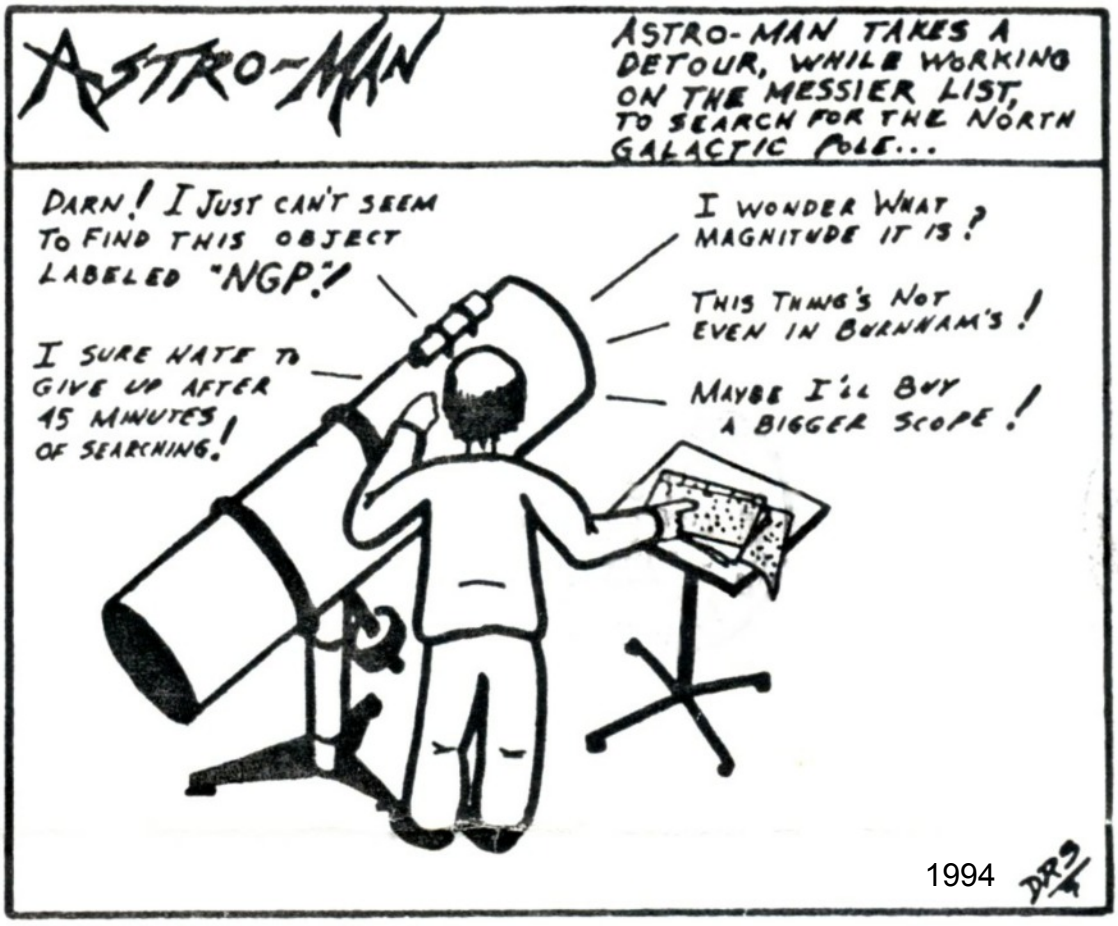
Mrs. Ware's love of astronomy was the inspiration for the Wildwood Star Party.

A total of 6 PAC members attended the party. We were joined with owners of local telescopes. The weather was clear and the temperature was pleasant. The party was held on the 5th fairway of the Wildwood Golf Course which is just south of the Wildwood house.

The employees of the Wildwood House always wear period dress. They're very gracious hosts, providing water and cookies for the astronomers who help with the event.

We had over 50 visitors from Nebraska City attend the party. Not bad considering we were competing with a Husker Football game.

This was my third Wildwood Star Party. It's well organized and the public is very interested and appreciative. It's a lot of fun to work so I encourage more club members to participate in the future!



Cassini Finds Global Ocean in Enceladus

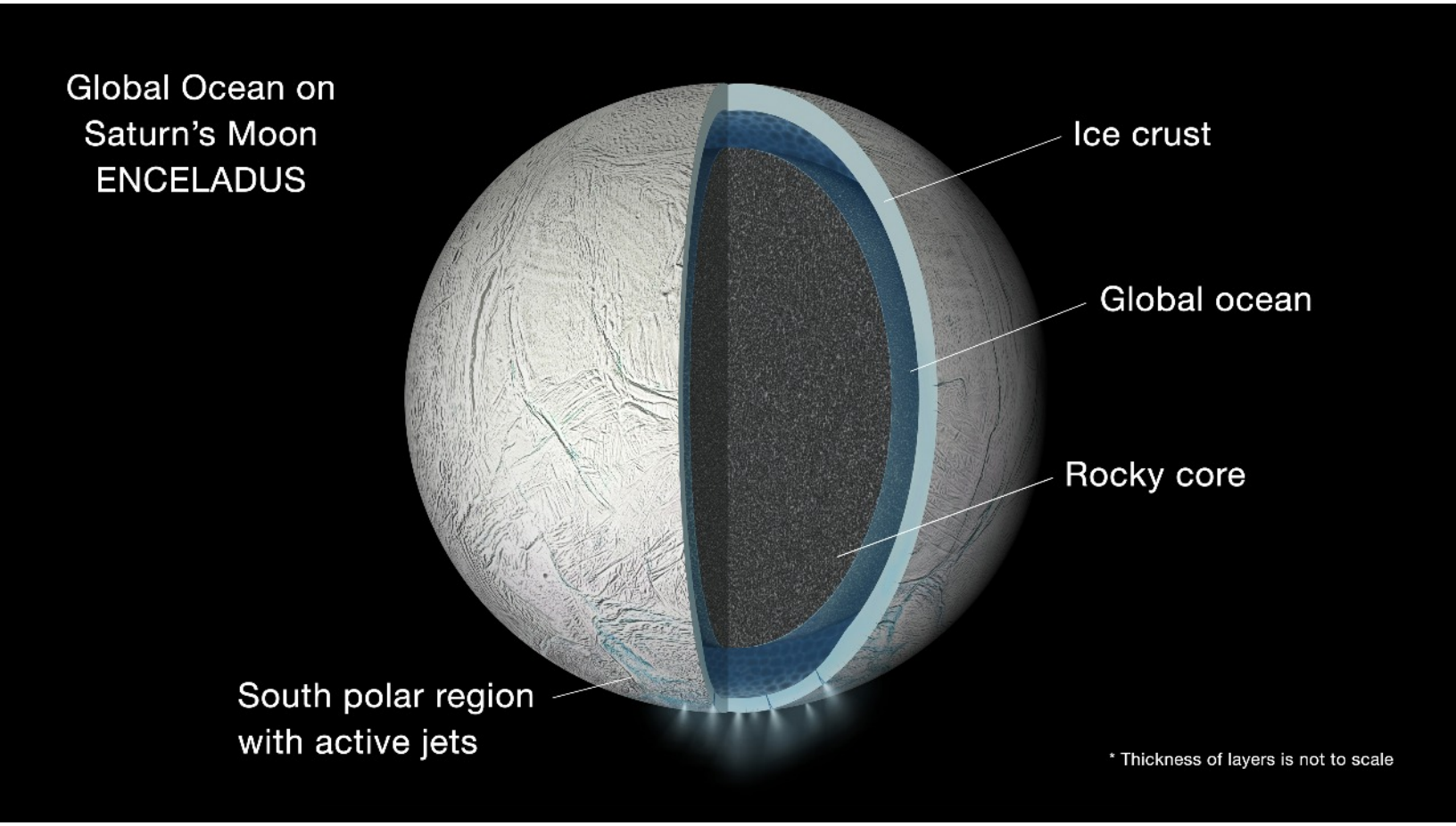
A global ocean lies beneath the icy crust of Saturn's geologically active moon Enceladus, according to new research using data from NASA's Cassini mission.

Researchers found the magnitude of the moon's very slight wobble, as it orbits Saturn, can only be accounted for if its outer ice shell is not frozen solid to its interior, meaning a global ocean must be present.

The finding implies the fine spray of water vapor, icy particles and simple organic molecules Cassini has observed coming from fractures near the moon's south pole is being fed by this vast liquid water reservoir. The research is presented in a paper published online this week in the journal Icarus.

Previous analysis of Cassini data suggested the presence of a lens-shaped body of water, or sea, underlying the moon's south polar region. However, gravity data collected during the spacecraft's several close passes over the south polar region lent support to the possibility the sea might be global. The new results -- derived using an independent line of evidence based on Cassini's images -- confirm this to be the case.

"This was a hard problem that required years of observations,



This illustration is a speculative representation of the interior of Saturn's moon Enceladus with a global liquid water ocean between its rocky core and icy crust. The thickness of layers shown here is not to scale. Scientists on NASA's Cassini mission determined that the slight wobble of Enceladus as it orbits Saturn is much too large for the moon to be frozen from surface to core. The wobble, technically referred to as a libration, reveals that the crust of Enceladus is disconnected from its rocky interior. This graphic is an update to PIA19058, which showed only a regional sea beneath the south polar region of Enceladus.

and calculations involving a diverse collection of disciplines, but we are confident we finally got it right," said Peter Thomas, a Cassini imaging team member at Cornell University, Ithaca, New York, and lead author of the paper.

Cassini scientists analyzed more than seven years' worth of images of Enceladus taken by the spacecraft, which has been orbiting Saturn since mid-2004. They carefully mapped the positions of features on Enceladus -- mostly craters -- across hundreds of images, in order to measure changes in the moon's rotation with extreme precision.

As a result, they found Enceladus has a tiny, but measurable wobble as it orbits Saturn. Because the icy moon is not perfectly spherical -- and because it goes slightly faster and slower during different portions of its orbit around Saturn -- the giant planet subtly rocks Enceladus back and forth as it rotates.

The team plugged their measurement of the wobble, called a libration, into different models for how Enceladus might be arranged on the inside, including ones in which the moon was frozen from surface to core.

"If the surface and core were rigidly connected, the core would provide so much dead weight the wobble would be far smaller than we observe it to be," said Matthew Tiscareno, a Cassini participating scientist at the SETI Institute, Mountain View, California, and a co-author of the paper. "This proves that there must be a global layer of liquid separating the surface from the core."

The mechanisms that might have prevented Enceladus' ocean from freezing remain a mystery. Thomas and colleagues suggest a few ideas for future study that might help resolve the question, including the surprising possibility that tidal forces due to Saturn's gravity could be generating much more heat within Enceladus than previously thought.

"This is a major step beyond what we understood about this moon before, and it demonstrates the kind of deep-dive discoveries we can make with long-lived orbiter missions to other planets," said co-author Carolyn Porco, Cassini imaging team lead at Space Science Institute, Boulder, Colorado, and visiting scholar at the University of California, Berkeley. "Cassini has been exemplary in this regard."

The unfolding story of Enceladus has been one of the great triumphs of Cassini's long mission at Saturn. Scientists first detected signs of the moon's icy plume in early 2005, and followed up with a series of discoveries about the material gushing from warm fractures near its south pole. They announced strong evidence for a regional sea in 2014, and more recently, in 2015, they shared results that suggest hydrothermal activity is taking place on the ocean floor.

Cassini is scheduled to make a close flyby of Enceladus on Oct. 28, in the mission's deepest-ever dive through the moon's active plume of icy material. The spacecraft will pass a mere 30 miles (49 kilometers) above the moon's surface.

The Cassini-Huygens mission is a cooperative project of NASA, ESA (European Space Agency) and the Italian Space Agency. NASA's Jet Propulsion Laboratory in Pasadena, California, manages the mission for the agency's Science Mission Directorate in Washington. JPL is a division of the California Institute of Technology in Pasadena. The Cassini imaging operations center is based at SSI. The California Institute of Technology in Pasadena manages JPL for NASA.

For more information about Cassini, visit:

http://www.nasa.gov/cassini

http://saturn.jpl.nasa.gov

October Observing: What to View

Jim Kvasnicka

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

Planets

Saturn: Low in the southwest about 10° above the horizon.

Neptune and Uranus: In Aquarius and Pisces.

Mars, Venus, and Jupiter: Venus, Regulus, Mars, and Jupiter begin the month aligned in this order almost evenly spaced. On October 17th and 18th Mars is less than ½ ° from brighter Jupiter with Venus to the upper right. On October 25th and 26th Venus is just 1.1° from Jupiter.

Mercury: First visible about 8° above the eastern horizon just 40 minutes before sunrise on 9/11.

Messier List

M11: The Wild Duck Cluster in Scutum.
M16: Open cluster within the Eagle Nebula IC 4703.
M17: The Omega or Swan Nebula in Sagittarius.
M18: Open cluster in Sagittarius.
M24: The Small Sagittarius Star Cloud.
M25: Open cluster in Sagittarius.
M26: Open cluster in Scutum.
M55: Class XI globular cluster in Sagittarius.
M75: Class I globular cluster in Sagittarius.
Last Month: M13, M14, M22, M28, M54, M69, M70, M92
Next Month: M27, M30, M56, M57, M71, M72, M73

NGC and other Deep Sky Objects
NGC 253: The Silver Coin Galaxy in Sculptor.
NGC 288: Class X globular cluster in Sculptor.
NGC 457: The E.T. Cluster in Cassiopeiae.
NGC 869/884: The Double Cluster in Perseus.
NGC 891: Edge on galaxy in Andromeda.

Double Star Program List

8 Lacerta: Four white stars.

Beta Cephei: White primary with a blue secondary.

Struve 2816: White and two blue stars in Cepheus.

Xi Cephei: Yellow pair.

Delta Cephei: Yellow primary with a pale blue secondary.

Eta Persei: Bright yellow and light blue stars.

Struve 331: White primary with a blue-white secondary in Perseus.

Epsilon Pegasi: Bright yellow and white pair.

Challenge Object

NGC 6962 Galaxy Group: NGC 6962 is the brightest member of a galaxy group in Aquarius that includes NGC 6959, NGC 6961, NGC 6964, and NGC 6967. Large aperture telescopes are required to see the galaxy group.

Focus on Constellations: Aquarius

Jim Kvasnicka

Aquarius

Aquarius the Water Carrier is a faint constellation representing a man pouring water from an urn. Aquarius is the 11th sign of the Zodiac and covers 980 square degrees. The most prominent star pattern in the constellation is the Y-shaped asterism centered on Zeta Aquarii. Galaxies are the most numerous type of object in Aquarius but most are faint. Since Aquarius lies far from the plane of the Milky Way it is lacking in star clusters and diffuse nebulae. It does contain three globular clusters, two of which are Messier objects M2 and M72. A third Messier object M73 is an asterism. Aquarius does contain two notable planetary nebulae, the Saturn Nebula and the Helix Nebula. The Helix Nebula requires an OIII filter to see. Aquarius is best seen in the month of October.

Showpiece Objects

Globular Clusters: M2, M72
Planetary Nebulae: NGC 7009 (Saturn Nebula), NGC 7293 (Helix Nebula)

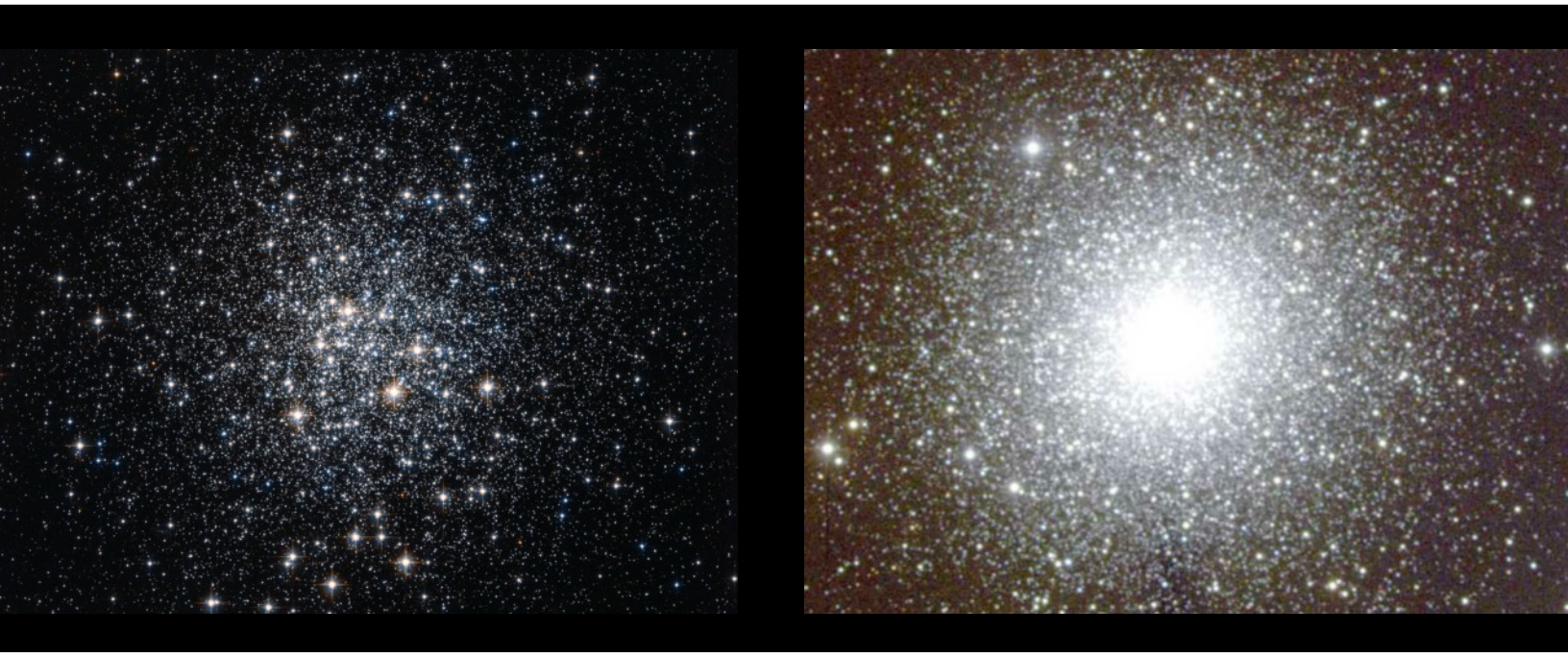
Mythology

In most cultures Aquarius is depicted as a man pouring water. This may arise from the fact that the Sun enters Aquarius in early winter, when the rainy season begins in many parts of the world. The Babylonians knew this area of the sky as a celestial sea, and from them the Greeks inherited not only Aquarius but also Pisces, Capricornus, and Eridinus.

Number of Objects Magnitude 12.0 and Brighter

Galaxies: 13
Open Clusters: 1
Globular Clusters: 3
Planetary Nebulae: 2

Wikipedia: Credit Till Credner



Left: M72: A Globular Cluster of Stars. Image Credit: NASA, ESA, Hubble, HPOW
Right: Globular Cluster M2. Credit & Copyright: D. Williams, N. A. Sharp, AURA, NOAO, NSF

Measure the Moon's Size and Distance during the Next Lunar Eclipse

Ethan Siegel

The moon represents perhaps the first great paradox of the night sky in all of human history. While its angular size is easy to measure with the unaided eye from any location on Earth, ranging from 29.38 arc-minutes (0.4897°) to 33.53 arc-minutes (0.5588°) as it orbits our world in an ellipse, that doesn't tell us its physical size. From its angular size alone, the moon could just as easily be close and small as it could be distant and enormous.

But we know a few other things, even relying only on naked-eye observations. We know its phases are caused by its geometric configuration with the sun and Earth. We know that the sun must be farther away (and hence, larger) than the moon from the phenomenon of solar eclipses, where the moon passes in front of the sun, blocking its disk as seen from Earth. And we know it undergoes lunar eclipses, where the sun's light is blocked from the moon by Earth.

Lunar eclipses provided the first evidence that Earth was round; the shape of the portion of the shadow that falls on the moon during its partial phase is an arc of a circle. In fact, once we measured the radius of Earth (first accomplished in the 3rd century B.C.E.), now known to be 6,371 km, all it takes is one assumption—that the physical size of Earth's shadow as it falls on the moon is approximately the physical size of Earth—and we can use lunar eclipses to measure both the size of and the distance to the moon!

Simply by knowing Earth's physical size and measuring the ratios of the angular size of its shadow and the angular size of the moon, we can determine the moon's physical size relative to Earth. During a lunar eclipse, Earth's shadow is about 3.5 times larger than the moon, with some slight variations dependent on the moon's point in its orbit. Simply divide Earth's radius by your measurement to figure out the moon's radius!

Even with this primitive method, it's straightforward to get a measurement for the moon's radius that's accurate to within 15% of the actual value: 1,738 km. Now that you've determined its physical size and its angular size, geometry alone enables you to determine how far away it is from Earth. A lunar eclipse is coming up on September 28th, and this supermoon eclipse will last for hours. Use the partial phases to measure the size of and distance to the moon, and see how close you can get!

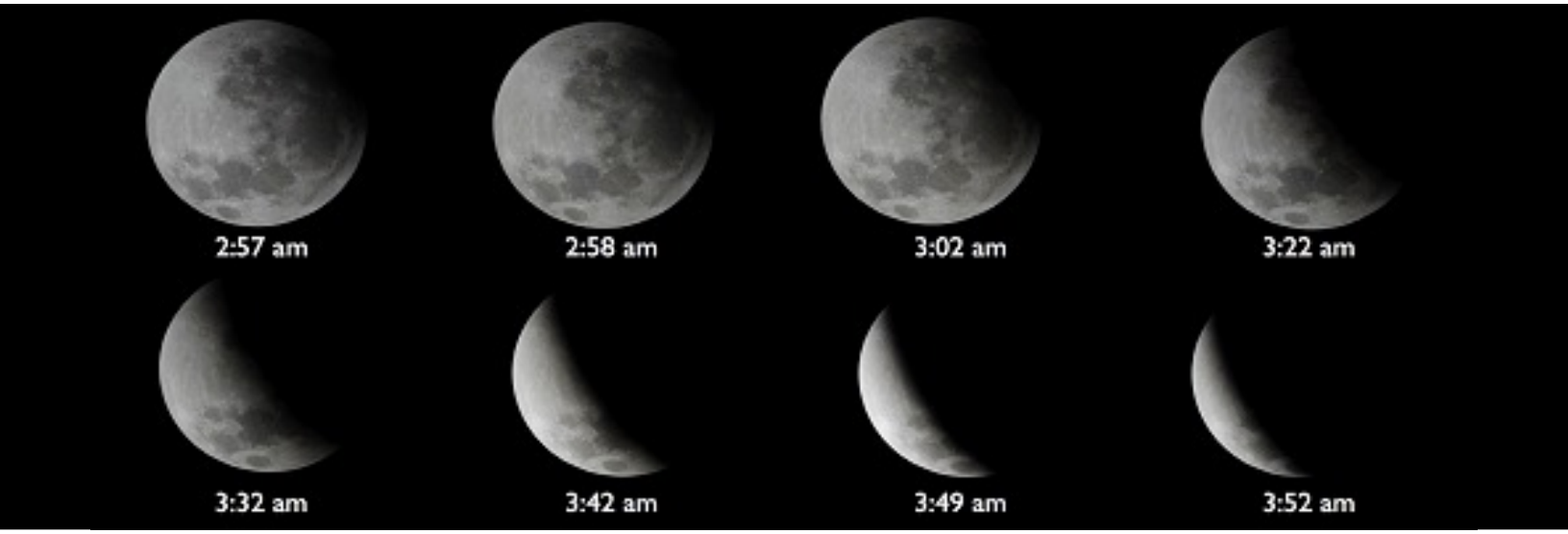


Image credit: Daniel Munizaga (NOAO South/CTIO EPO), using the Cerro Tololo Inter-American Observatory, of an eight-image sequence of the partial phase of a total lunar eclipse.

Amateur Astronomer Chases Down Barnard's Star - You Can Too!

Bob King, Universe Today

Tucked away in northern Ophiuchus and well-placed for observing from spring through fall is one of the most remarkable objects in the sky — Barnard's Star. A magnitude +9.5 red dwarf wouldn't normally catch our attention were it not for the fact that it speeds across

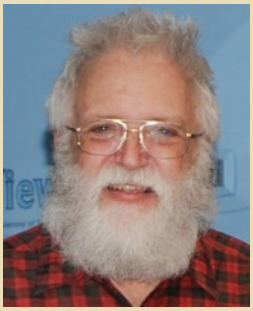
9-year-animation of Barnard's Star from 2007 to July 2015 as it tracked north through Ophiuchus at the rate of 10.3 arc seconds per year. Amateur Rick Johnson photographed it once each year to create the movie. You can watch the same thing in your telescope — if you're patient! Credit: Rick Johnson

the sky faster than any other star known.

Incredibly, you can actually see its motion with a small telescope simply by dropping by once a year for 2-3 years and taking note of its position against the background stars. For one amateur astronomer, recording its wandering ways became a 9-year mission.

Located just 6 light years from Earth, making it the closest star beyond the Sun except for the Alpha Centauri system, Barnard's Star dashes along at 10.3 arc seconds a year. OK, that doesn't sound like much, but over the course of a human lifetime it moves a quarter of a degree or half a Full Moon, a distance large enough to be easily perceived with the naked eye.

"One of the first things I imaged was Barnard's Star on the off chance I could see its motion,"



Rick Johnson is a founding member of the Prairie Astronomy Club.

wrote Johnson, who used a cheap 400mm lens on a homemade tracking mount. "Taking it a couple months later didn't show any obvious motion,

This map shows the sky facing south-southwest around 9 o'clock local time in late September. Barnard's Star is located 1° NW of the 4.8-magnitude star 66 Ophiuchi on the northern fringe of the loose open cluster Melotte 186. Use the more detailed map below to pinpoint the star's location. Source: Stellarium

though I thought I saw it move slightly. So I took another image the following year and the motion was obvious."

Many years later in 2005, Johnson moved to very dark

Barnard's Star is a very low mass red dwarf star 1.9 times Jupiter's diameter only 6 light-years from Earth in the direction of the constellation Ophiuchus the Serpent Bearer. Credit: Wikipedia with additions by the author

skies, upgraded his equipment and purchased a good digital camera. Barnard's Star continued to tug at his mind.

"Again one of my first thoughts was Barnard's Star. The idea of an animation however didn't hit until later, so my exposure times were all over the map. This made the first frames hard to match." Later, he standardized the exposures and then assembled the individual images into a color animation.

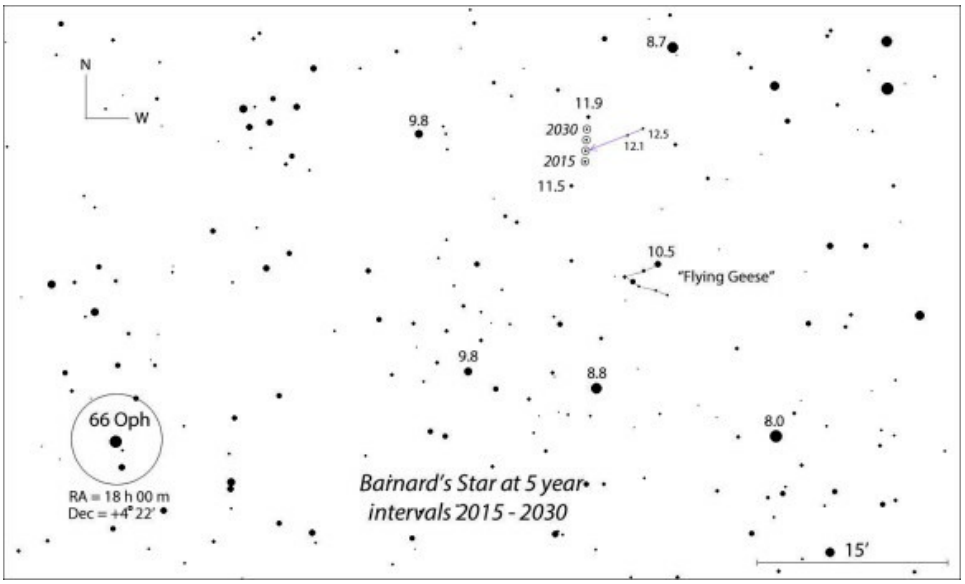
This fleet-footed luminary was first spotted by the American astronomer E.E. Barnard in 1916. With a proper motion even greater than the triple star Alpha Centauri, we've since learned that the star's speed is truly phenomenal; it zips along at 86 miles a second (139 km/sec) relative to the Sun. As the stellar dwarf moves north, it's simultaneously headed in our direction.

Based on its high velocity and low "metal" content, Barnard's Star is believed to be a member of the galactic bulge, a fastness of ancient stars formed early on in the Milky Way galaxy's evolution. Metals in astronomy refer to elements heavier than hydrogen and helium, the fundamental building blocks of stars. That's pretty much all that was around when the first generation of suns formed about 100 million years after the Big Bang.

Generally, the lower a star's metal content, the more ancient it is as earlier generations only had the simplest elements on hand. More complex elements like lithium, carbon, oxygen and all the rest had to be cooked up the earliest stars' interiors and then released in supernovae explosions where they later became incorporated in metal-rich stars like our Sun.

All this to say that Barnard's Star is an interloper, a visitor from another realm of the galaxy here to take us on a journey across the years. It certainly got the attention of Lincoln, Nebraska amateur Rick Johnson, who first learned of the famous dwarf in 1957.

"Now the system is programmed to take it each July," he added. I'm automated, so its all automatic now." Johnson said the Barnard video is his most popular of many he's made over the years including short animations of the eye-catching Comet C/2006 M4 SWAN and Near-Earth asteroid 2005 YU55.



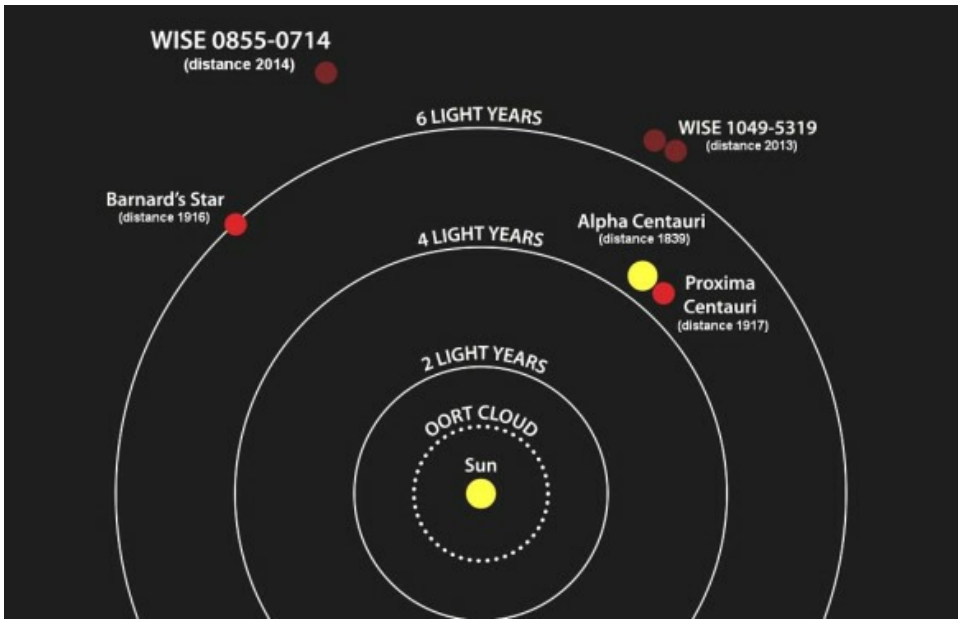
Close-up map showing Barnard's Star's position every 5 years from 2015 to 2030. Your guide star, 66 Ophiuchi, also shown on the first map, is at lower left. Stars are numbered with magnitudes and a 15 arc minute scale bar is at lower right. North is up. The line through the two 12th-magnitude stars will help you gauge Barnard's movement in the coming few years. Click for a larger map.

With Johnson's wonderful animation in your mind's eye, I encourage you to use the maps provided to track down the star yourself the next clear night. To find it, first locate 66 Ophiuchi (mag. 4.8) just above the little triangle of 4th magnitude stars a short distance east or left of Beta Ophiuchi. Then use the detailed map to star hop ~1° to the northwest to Barnard's Star.

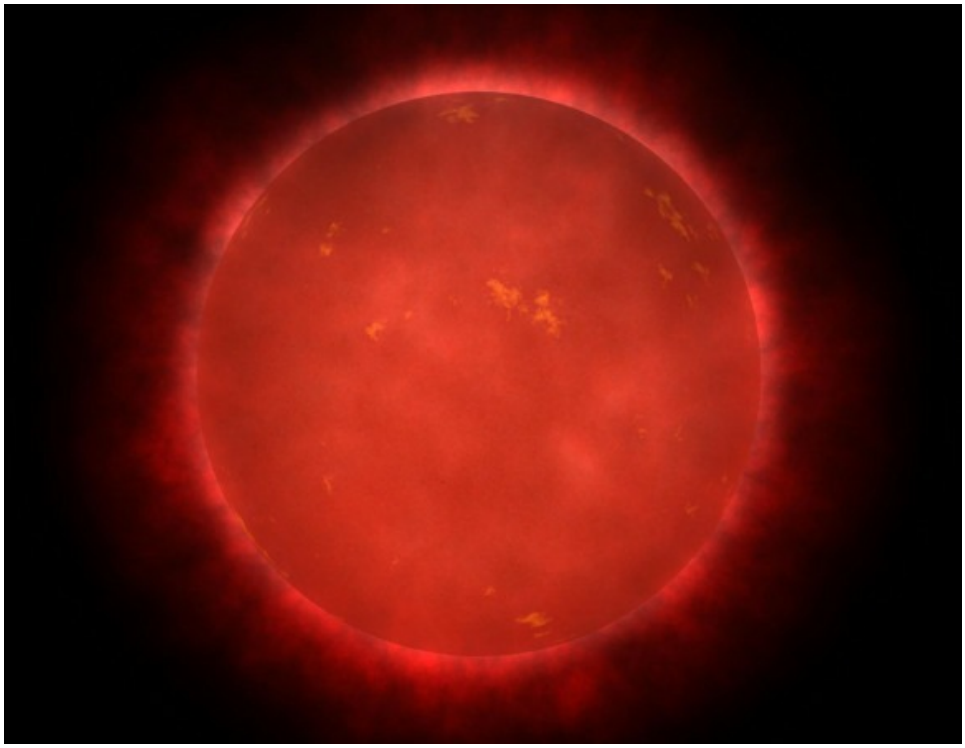
It's easily visible in a 3-inch or larger telescope. Use as high a magnification as conditions will allow to make a sketch of the star's current position, showing it in relation to nearby field stars. Or take a photograph. Next summer, when you return to the field, sketch it again. If you've taken the time to accurately note the star's position, you might see motion in just a year. If not, be patient and return the following year.

Most stars are too far away for us to detect motion either with the naked eye or telescope in our lifetime. Barnard's presents a rare opportunity to witness the grand cycling of stars around the galaxy otherwise denied our short lives. Chase it.

See the original article at Universe Today.



This diagram illustrates the locations of the star systems closest to the Sun along with the dates of discovery. NASA's Wide-field Infrared Survey Explorer, or WISE, found two of the four closest systems: the binary brown dwarf WISE 1049-5319 and the brown dwarf WISE J085510.83-071442.5. The closest system to the Sun is a trio of stars that consists of Alpha Centauri, a close companion to it and Proxima Centauri. Credit: NASA / Penn State



Barnard's Star, a red dwarf low in metals, is very ancient with an age between 7 and 12 billion years. Like people, older stars slow down and Barnard's is no exception with a rotation rate of 150 days. Heading in the Sun's direction, the star will come closest to our Solar System around the year 11,800 A.D. at a distance of just 3.75 light years. Credit: NASA

Club Offices and Duties

Club officer nominations are made in September and elections are held in October. The following is a list of responsibilities of each of the officers and what is required to maintain a functioning club.

As stated in the bylaws, the club has five officers: President, Vice President, Secretary, Treasurer and Second Vice President. The business of the club is managed by a Board of Directors. The Board consists of the five elected officers. Each decision of the Board requires an affirmative vote by at least three Board members. The Board can also create additional non-elected offices as required and can initiate impeachment proceedings against officers who have been negligent in performing their duties.

The Prairie Astronomy Club has a fifty year history of service to club members and the community. Potential club officers should have a good understanding of the history of the club, its formation and mission, its relationship with Hyde Observatory and the types of events, activities and outreach that is part of the tradition of the club. The most complete resource is the book *The Prairie Astronomy Club: Fifty Years of Amateur Astronomy*, which is in the club library or available as a PDF document.

President

The President organizes and directs the regular monthly meetings and all other club activities. The President also prepares the meeting agenda and PowerPoint for the meeting.

The President also officially represents the club at meetings at the regional and national level where he/she is in attendance or delegates this authority. The President has the authority to call meetings of the Board and to appoint non-elected officers.

The President should have good communication skills and be comfortable interacting with the media and public, be a good public speaker, be available to do radio and TV interviews and to deliver prepared introductions and remarks at club-sponsored events.

Another duty of the President is the annual club audit. Within 10 days of assuming office, the President must appoint a committee of three club members to perform the audit. The audit must be completed within 45 days of the close of the fiscal year which is October 31.

When assuming office, the President should hold a meeting of the Board to present his/her direction and ideas for the club for the coming year, and appoint any unfilled non-elected positions.

Vice President

The Vice President is responsible for running club meetings and other events in the absence of the President. The VP is also to be the mediator in cases of procedural dispute and must be available to assume the duties of any officer at the direction of the President. The VP also maintains control of the current inventory of all club property.

Secretary

The Secretary handles all Club correspondence, is responsible for the distribution of information received through official club correspondence and is in charge of Club publicity (often the job of Publicity or Outreach Coordinator is delegated to a non-elected member). The Secretary also sends out membership renewal notices and delivers meeting minutes to the newsletter editor. The Secretary is responsible for maintaining an accurate club membership roster. The master copy of the roster is currently maintained on the Night Sky Network website. The bylaws also require publication of the complete roster in the newsletter on an annual basis.

Treasurer

The Treasurer is responsible for all Club funds and for keeping accurate records of all monetary transactions. The Treasurer

must submit a written report of the club's monetary status at the request of the President or give a verbal report at the request of any member during regular meetings. He/she also prepares an annual financial report in November for publication in the newsletter and presentation at the November meeting. The Treasurer is also responsible for all tax filings and reporting requirements, to maintain the club's 501c3 status.

Second Vice President (and Program Chair)

The Second Vice President is responsible for the formation and presentation of the monthly club programs. Ideally the 2nd VP should try to plan ahead six months to one year to build a list of potential presenters or programs. The 2nd VP also sends out email announcements of upcoming programs to the membership, and sends a program description to the newsletter/website editors.

The club usually has several non-elected officers:

The **Publications Chairperson** (or Newsletter Editor) is responsible for editing and publishing the Prairie Astronomer. The newsletter editor may also be the website manager/editor. The newsletter editor should have a good working knowledge of desktop publishing software (and computers in general), graphics, photo editing, some design and layout experience and some experience with social networking and Internet marketing. The Website editor needs to be familiar with WordPress (or similar CMS software) and HTML, graphics and word processing applications. Ideally the newsletter and website editor(s) should have prior experience with the publication of a newsletter or website, or demonstrated skills. The publications chairperson is also responsible for social networking for the club - posting Facebook and Twitter announcements for club meetings and events.

If the club has an appointed **Outreach Coordinator**, the coordinator takes on some of the roles performed by other officers – organizes outreach events, shares in media communications tasks, puts together flyers, etc.

The **Club Librarian** (often the Vice President) manages the club library. He/she keeps a current bibliographic listing of all Club library material including the archive of all back issues of The Prairie Astronomer. The Club Librarian and Secretary work together to maintain a record of club activities and regularly update the official club history.

The **Observing Chairman** presents a monthly report at Club meetings and/or in the Prairie Astronomer. He/she keeps members informed of upcoming celestial events, sky objects of special interest and star parties.

The **Recording Secretary** (often the Club's elected Secretary) is responsible for keeping the minutes of the club meetings and filing a copy with the Club Secretary. Minutes need to be kept in a systematic fashion as they record the history and life of the club and need to be published in the Prairie Astronomer on a monthly basis.

The **Site Chairperson** (if one is appointed) is responsible for establishing a site committee to oversee the maintenance and security of the club observing site.

While not a requirement of the bylaws, all club officers and appointees should have good computer and social media skills, should be accessible and responsive via email and phone.

From the Archives: August 29, 1972

We had a good turn-out for the picnic on August 5th, even though there was a somewhat smaller response from our own club members than was expected. Our guests included about 15 members of the Omaha Club, 2 from St. Joseph, Mo, and 8 from the Sioux City, Iowa Club. We had a special treat with a surprise visit from Bob Wright, a long-time member and past president of the Astronomical League.

Mr. Wright has been nominated for the League president again and will no doubt be elected at th e Seattle convention since he is unopposed on the ballot. We had only one sailboat at the event this year since my own boat developed a cracked hull, and Philo Prell didn't show up.

The picnic supper turned out very well and there was plenty of food for everyone. Things started to look great for a star party too, as it had been cloudy all day, but cleared up by sunset. But, more clouds moved in with the darkness and the star party turned into a bull session of sorts. A few of the late stayers were treated by a bit of aurora when the skies started to clear at 2 a.m. By 3 a.m. the skies had cleared completely and the splendor of the heavens was on hand for viewing by the few that managed to escape the toll of late hours and heavy eyelids.

On August 11th, a meteor watch was held at the club observatory. Again, only a few of our club members showed up for this annual display of the Perseid meteor shower. There seemed to be quite a few meteors up till midnight, then for some reason they seemed to slack off from midnight until 2 a.m. After two o'clock they seemed to pickup again and were going strong till 3:30 when clouds spoiled the show.

The next day (August 12th) Donn baker and I drove to St. Joe and attended the Midland Empire Astronomy Club's picnic and star party. Their event was held at the farm home of M.E.A.C's members Mr. And Mrs. Mike Hartig, some 12-15 miles east of St. Joe. A total of about 40 people were on hand from Lincoln, St. Joe, Kansas City, Omaha and the Central Missouri Club of Fayette, Mo. I was treated to a special surprise. At the briefing session prior to the meteor watch, I was presented with a Messier Award! And an honorary citation yet! Although I had observed all the Messier objects 10 years ago, I had never applied for a citation because I had not recorded my viewings, according to League rules. But the League officials seemed to think that I was deserving of the award because it was signed by P.A.C. Official Brian Dodson, Messier Award Chairman Bill Scurlock and League president Bud Shewmon. Thanks to all who took part in this award presentation, and especially Bob Allen who first suggested it apparently.

The meteor watch and star party were highly successful since we had perfectly clear skies all night long. The part finally broke up about 4:30 a.m. And a wonderful time was had by all. –Earl Moser.

This silhouette of Brett Boller's DJI Phantom 3 drone was taken at Branched Oak Observatory on September 19th by Mark Dahmke.

Branched Oak Observatory

The founders of Branched Oak Observatory are planning a complex made up of multiple buildings and recreation spaces: a large domed observatory to hold their main optical instrument, a larger roll-off observatory to house four to six more telescopes, six telescope and binocular concrete "pads," a main office and lounge, a classroom, an outdoor pavillion and grilling area, and a play area. Michael Sibbernsen is CEO, Matthew Anderson, COO, Kendra Sibbernsen, CFO and Amelia Squires, Brian Sivill and Brett Boller are Observatory Associates. For more information, visit the website: www.branchedoakobservatory.com

Above: drone view of the observing field. Above right: views of the field and permanent pier. Below: drone view of Branched Oak Lake and surrounding area.

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, contact Dave Churilla. If you keep a scope for more than a week, please check in once a week, to verify the location of the telescope and how long you plan to use it. The checkout time limit will be two weeks, but can be extended if no one else has requested use of a club scope.

100mm Orion refractor: Available

10 inch Meade Dobsonian: Available

13 inch Truss Dobsonian: Available

CLUB APPAREL

Order club apparel from cafepress.com:

Shop through Amazon Smile to automatically donate to PAC:

amazonsmile

CLUB OFFICERS

President	Jim Kvasnicka (402) 423-7390 jim.kvasnicka@yahoo.com
Vice President	Brett Boller proboller86@yahoo.com
2nd VP (Program Chair)	Dave Churilla dchurilla@neb.rr.com
Secretary	Lee Taylor otaylor88@gmail.com
Treasurer	John Reinert jr6@aol.com
Club Observing Chair	Jim Kvasnicka jim.kvasnicka@yahoo.com
Outreach Coordinator	Dan Delzell dan@delzell.net
Website and Newsletter Editor	Mark Dahmke mark@dahmke.com

The Prairie Astronomer is published monthly by the Prairie Astronomy Club, Inc. Membership expiration date is listed on the mailing label. Membership dues are: **Regular $30/yr, Family $35/yr**. Address all new memberships and renewals to: **The Prairie Astronomy Club, Inc., PO Box 5585, Lincoln, NE 68505-0585**. For other club information, please contact one of the club officers listed to the right. Newsletter comments and articles should be submitted to: **Mark Dahmke, P. O. Box 5585, Lincoln, NE 68505 or** mark@dahmke.com**,** no less than ten days prior to the club meeting. The Prairie Astronomy Club meets the last Tuesday of each month at Hyde Memorial Observatory in Lincoln, NE.