The Prairie Astronomer

January 2021 Volume 62, Issue #1

Zeroing in on the Target: Jezero Crater

January Program: Herb Schwartz will talk about the history of Drake University Observatory

The Newsletter of the Prairie Astronomy Club

The Prairie Astronomer

NEXT MEETING AND PROGRAM

January 26, 7:30pm: History of the Drake University Observatory, via Zoom

At the time the Observatory was built, it was thought to be the first "research grade Observatory" that was open regularly to the public. Dr. Daniel Morehouse, the 6th President of Drake University, with a handshake agreement with the City of Des Moines, and a over abundance of enthusiasm, promised that ongoing public programs would be open for all at no charge, if the City of Des Moines took care of the structure. That agreement still stands today. This November the Drake Municipal Observatory will celebrate 100 years of public programming and student research. The lecture follows the history of Morehouse and the construction of the Observatory.

Herb Schwartz is Adjunct Assistant Astronomer / Observatory Lecturer at Drake University.

Bob will email the Zoom meeting link to club members on the 26th.

FUTURE PROGRAMS

To be announced

CONTENTS

Cover: Jezero Crater, Mars, the landing target for Perseverance Rover on February 18, 2021. See page 17 for more information.

CALENDAR

PAC Meeting
Tuesday, January 26, 2021, 7:30pm via Zoom

PAC Meeting
Tuesday, February 23, 2021, 7:30pm via Zoom

PAC Meeting
Tuesday, March 30, 2021, 7:30pm

2021 STAR PARTY DATES

	Date	Date
January	8	**15**
February	5	**12**
March	5	**12**
April	2	**9**
May	7	**14**
June	4	**11**
July	2	**9**
August	Jul 30	**6**
September	Aug 27	**3**
October	1	**8**
November	Oct 29	**5**
December	Nov 26	**3**

Dates in **BOLD** are closest to the New Moon.

CLUB OFFICERS

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Night Sky Network

www.prairieastronomyclub.org

The President's Message

Bob Kacvinsky

Happy New Year – Finally we can put 2020 behind us and look forward to 2021 with hope and optimism of returning to some sense of normality. We all will be looking forward to Star Parties and sharing our hobby with the public hopefully by the middle of 2021.

This month your PAC Board will be meeting to begin preparations for 2021 reactivations. We will have a brief update during the Jan 26th Zoom meeting. Your inputs and ideas are greatly appreciated.

Our next PAC meeting is Tuesday, Jan 26th at 7:30 PM via Zoom. Our special program speaker will be Herbert Schwartz, Adjunct Assistant Astronomy, Lecturer at the Drake University Observatory in Des Moines, IA. The Drake Un Observatory is celebrating their 100th year and has a unique designation throughout it's long history as a Research and Education center. Herb Schwartz will share this special mission and the history of the Drake Un Observatory. Jack Dunn is responsible for helping to line up our speaker this month. Thanks Jack.

Our January Star Parties got snow/clouded out this month. Fortunately, we had acceptable skies Dec 21st for the planet conjunction. The media did it's normal over exaggeration of the event by suggesting the view would show a brilliant cross extending from the horizon up over 20 degrees. Yet, it was cool to see Jupiter's bands and 4 moons in the same view as Saturn's rings with 3 moons visible. There is no other time where we can see 7 moons in an eyepiece using our personal telescopes. Dan Delzell set up the club's 5" Mak, Jim Kvasnicka used my 12" Hardin and I set up the 16" Lightbridge in my church's back (unlit) parking lot. We had over 90 visitors during the evening come to view the conjunction along with the quarter moon. We managed to maintain social distancing between families and around the telescopes. It was a great opportunity to do some public viewing.

February will be an exciting month as the Mars 2020 Rover Perseverance arrives at Mars on the 18th. NASA has posted a revised version of the "Seven Minutes of Terror" video highlighting the Sky Crane system for bringing the large Rover safely to the surface. January also notched the 3000th day anniversary of the Curiosity Rover's time on Mars. Hard to believe Curiosity has been successfully roving the planet for 8 years.

February 8-11 from 7-11 PM is the Virtual Winter Star Party from Southern

Cross Astronomical Society in Florida. The event is free for participants. The program has speakers and virtual viewing opportunities. A link to register was sent out to the club members and can be found at https://www.scas.org/winter-star-party/virtualregistration.cfm You might want to check it out.

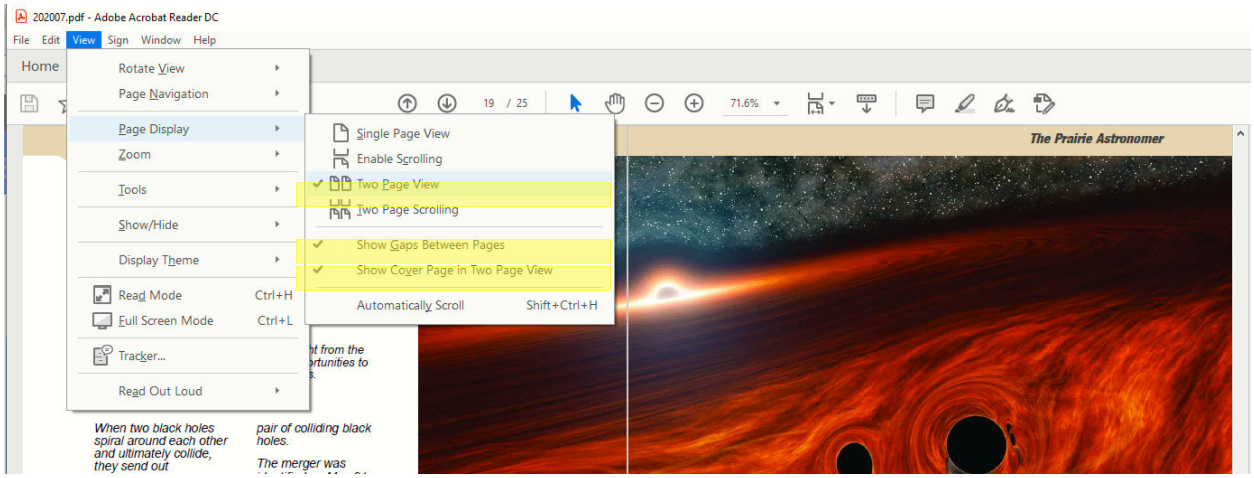
Wishing everyone a safe and healthy 2021. We are all looking forward to getting back out and experiencing the wonders of the skies, especially for our newer PAC Members who have recently purchased telescopes. If you have any suggestions, ideas, or program recommendations please pass them along to one of your PAC Board members or post it on the PAC website comment area.

Clear Dark Skies to you,

Bob Kacvinsky
PAC-President
kacvinskyb@yahoo.com
402-840-0084

New Newsletter Format

How to Adjust Adobe Acrobat Settings for Two Page View



*To view this newsletter in magazine spread format in Acrobat, select **View ->Page Display->Two Page View**. Acrobat will then show two pages side by side. Also make sure the checkboxes "Show Cover Page in Two Page View" and "Show Gaps Between Pages" are checked.*

If you have it setup correctly, the cover page will be displayed by itself and subsequent pages will be side by side with the odd numbered pages on the left.

Meeting Minutes

Bill Lohrberg

PAC meeting minutes December 29, 2020 as recorded by Bill Lohrberg

Bob Kacvinsky hosted the Zoom meeting which began at 7:30pm welcoming 16 in attendance, PAC members and OAS guests

Jim Kvasnicka presented the January observing report (details can be found in newsletter):

- Club star party dates were announced for January 8th & 15th locations to be determined due to snow on ground
- Highlight January 9th Mercury joins Jupiter and Saturn, forming a right triangle low in the Southwest
- Jan 3rd Quadrantids meteor shower

"Observing made easier" presented by Brett Boller:

- Shared tips for those getting started in astro-imaging with suggestions of software programs for image processing such as Registax for planetary imaging, Deep Sky Stacker (free) for deep sky imaging, Backyard EOS, and for more advanced - PHD ("Push Here Dummy")
- Brett also suggested starting off with camera set to widefield rather than attaching to SCT
- Also suggested use of wireless shutter release which have become more widely available

In the News

Bob shared a photo of 3 generations of Mars rovers: Sojourner, Spirit and Opportunity, and Curiosity and the slightly larger Perseverance illustrating the size changes and variations of the rovers over time.

Schedules and other announcements

A number of members were able to view the Geminid meteor shower which peaked December 13, some reported seeing a dozen in a 20 to 30 minute time span, Bob and 2 other members reported seeing a line of Starlink satellites while out observing Geminids.

Hyde observatory remains on hold until further notice

PAC meeting January 26, 2021 - We will continue to have the club meetings via Zoom probably for another 2 or 3 months

Club Treasurer John Reinert gave a summary:

- Membership renewals continued to roll in, 7 of which were collected in December
- Audit will need to be completed for 2 year period, John will be tapping members to help coordinate that after review of statements in January
- CD was rolled over

At approximately 7:54pm the meeting was concluded with no further business.

Jack Dunn provided a recorded video presentation from Dr. Carter Emmert of the Rose Center for Earth and Space at the Museum of Natural History on the New Horizon Open Space video - views of Pluto.

Astrophotos

Jupiter-Saturn Conjunction

by Jim White

Do You Have Copies of these Newsletters?

Mark Dahmke

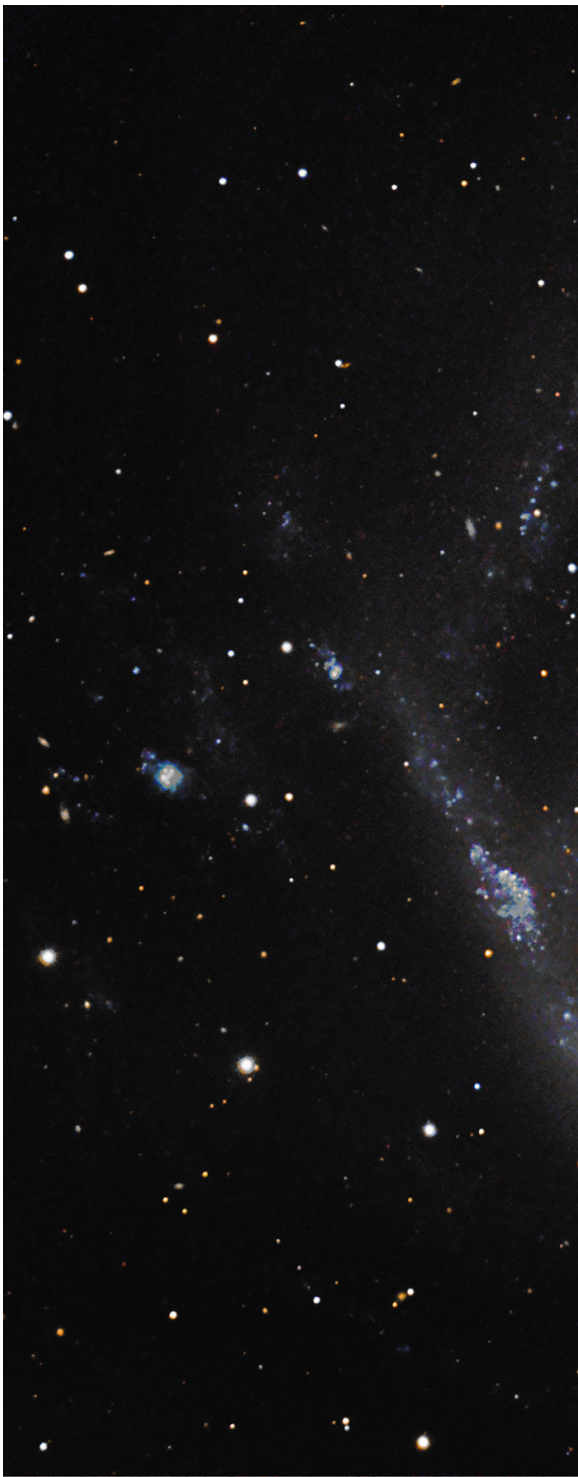
I recently checked my archive of scanned PAC newsletters and have made a list of the missing issues. There are a few cases where a month or two was skipped and no newsletter exists, but if you have copies of any of these, I'd like to borrow them to scan.

1962: June, September
1963: January, March, April, May, June, August, September, October
1964: January, February, March, April, May, July, November
1965: June
1966: February, June, July
1969: March, September
1970: February, November
1972: July
1975: April, August
1976: January
1978: September
1979: March
1984: April, September
1985: January
1986: May
1990: November
1991: January, March, April, May, June, July
1993: August, September, October, November, December
2001: August

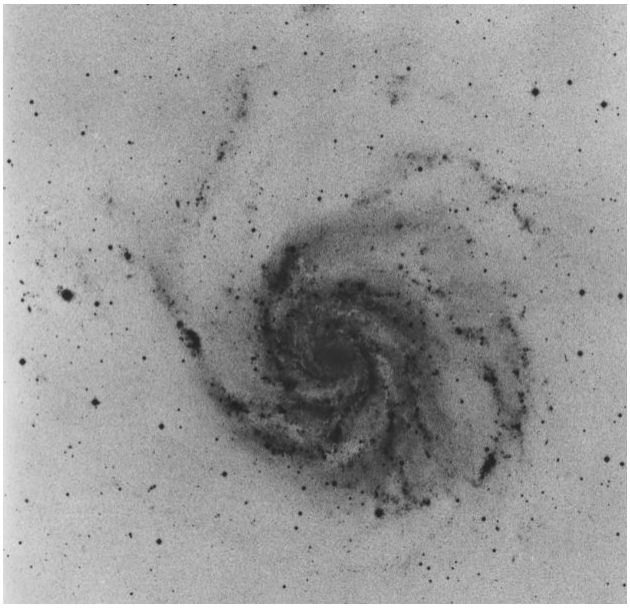
ARP 26

Rick Johnson

Arp 26, more famously known as M101 made Arp\'s atlas under the category of spiral galaxies with one heavy arm. Located in Ursa Major its distance is rather uncertain. An average of many comes to about 20 million light-years. Arp's comment on this entry reads "Note straight arm, bright knot on east appears almost stellar." I took this image while supernova SN 2011fe was near maximum brightness. It is marked at the bottom of my image between tick marks. M101 is classified as SAB(rs)cd HII by NED, SBc by the NGC Project and SAB(rs)cd? by Seligman. While recorded in Messier's list it was actually discovered by his close friend Pierre M'chain on March 27, 1781.



ARP's image:

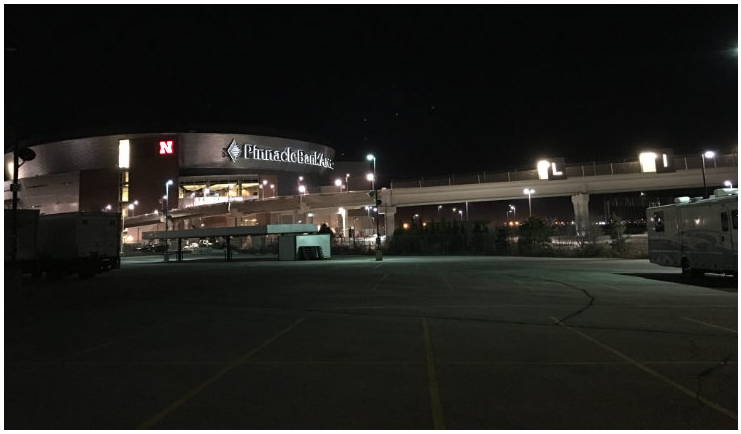


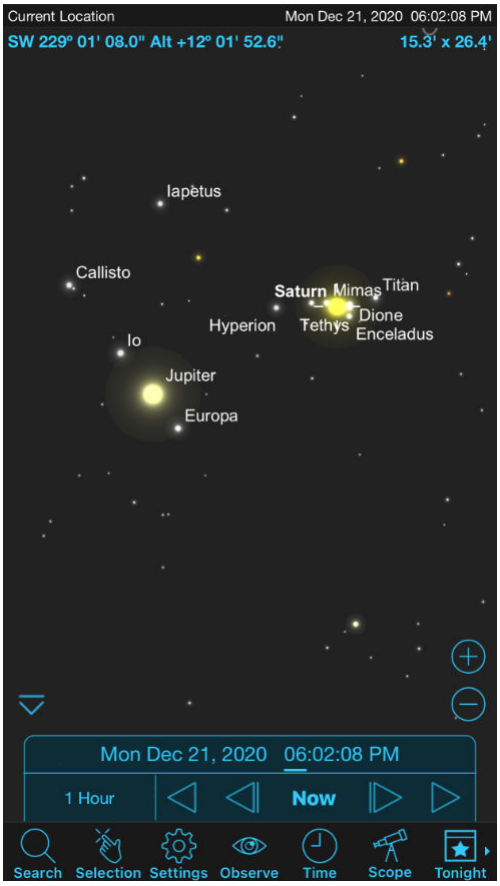
The Mantrap Skies Image Catalog

Rick Johnson, a founding member of the Prairie Astronomy Club, passed away in January, 2019. His legacy lives on through his comprehensive catalog of over 1600 images at www.mantrapskies.com.

Astrophotos

Jupiter-Saturn Conjunction, by John Reinert iPhone 6s Plus

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Mon Dec 21, 2020 06:02:08 PM
SW 229° 01' 08.0" Alt +12° 01' 52.6"
15.3' x 26.4'
Iapètus
Callisto
Saturn
Mimas
Titan
Dione
Tethys
Enceladus
Hyperion
Io
Jupiter
Europa
Mon Dec 21, 2020 06:02:08 PM
1 Hour
Now
Search
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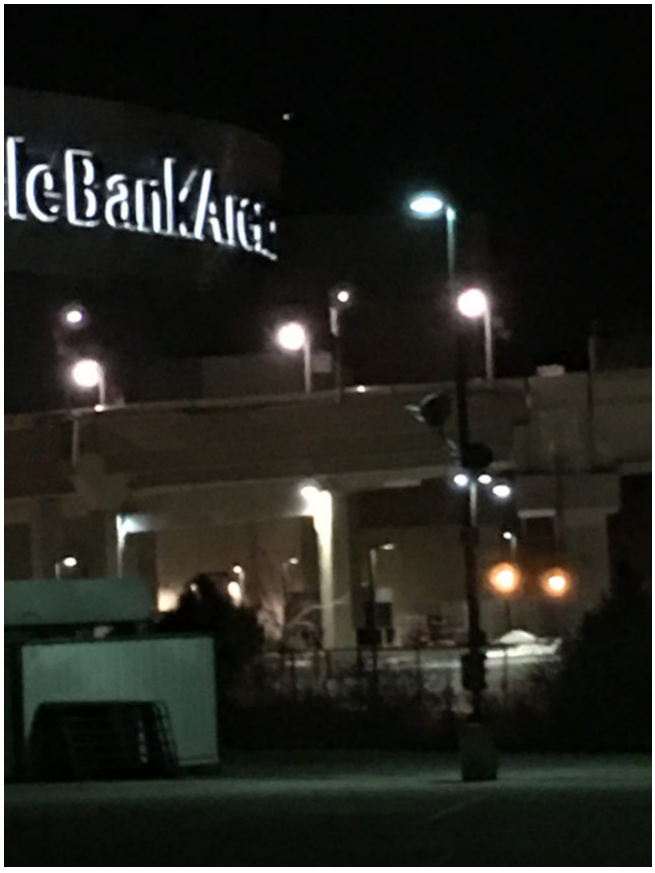


February Observing

Jim Kvasnicka

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

Planets

Mars: In Aries to start February at +0.5 magnitude.
Uranus: Shines at magnitude +5.8 in Aries.
Neptune: Sets by 7:00 pm to end the month in Aquarius.
Jupiter, Saturn, and Mercury: On the morning of February 25th the three planets form a triangle low in the east-southeast.
Venus: After February 7th Venus will not be visible. It returns in the evening sky the middle of April.

Messier List

M1: The Crab Nebula in Taurus.
M35: Open cluster in Gemini.
M36/M37/M38: Open clusters in Auriga.
M42: The Orion Nebula
M43: Emission nebula just north of M42.
M45: The Pleiades.
M78: Emission nebula in Orion.
M79: Class V globular cluster in Lepus.

Last Month: M33, M34, M52, M74, M76, M77, M103
Next Month: M41, M44, M46, M47, M48, M50, M67, M81, M82, M93

NGC and other Deep Sky Objects

NGC 2244: Open cluster embedded in the Rosette Nebula in Monoceros.
NGC 2264: The Christmas Tree cluster in Monoceros.
NGC 2301: Open cluster in Monoceros.
NGC 2362: The Tau Canis Majoris Cluster.
NGC 2392: The Eskimo Nebula in Gemini.
NGC 2403: Galaxy in Camelopardalis.

Double Star Program List

32 Eridani: Yellow and white stars.
55 Eridani: Yellow and pale yellow pair.
Gamma Leporis: Pair of yellow stars.
Epsilon Monocerotis: White primary with a pale yellow secondary.
Beta Monocerotis: Three bluish white stars.
Kappa Puppis: Equal pair of white stars.
Alpha Ursa Minoris: Polaris, yellow-white and white stars.
N Hydrae: Equal yellow stars.

Challenge Object

NGC 2280: Dim elongated 2’ x 1’ galaxy in Canes Major.

Focus on Observing

Herschel II Observing Program

Jim Kvasnicka

The Herschel II observing program was added in August 1997. It includes 400 of the 2,478 deep sky objects catalogued by William Herschel in the late 1700's, and it is the next level observing project after the Ancient City Astronomers' Herschel 400 program. The Herschel II Observing Program is an advanced level program focused on improving the observers' technical skills by taking thorough notes and developing accurate object descriptions.

The 400 objects in this program includes 323 galaxies, 41 open clusters, 21 nebulae, 9 planetary nebulae, 3 cluster-nebula, and 3 globular clusters. Most of the objects are between magnitude 11 and 13. About 80% of the objects on the list can be observed with telescopes between 8" and 13" aperture. A lot will depend on the seeing conditions and how dark your observing site is.

Many of the objects are in fields containing numerous other objects, identifying the correct object can be a challenge.

To qualify for the Astronomical League Herschel II Observing Program certificate and pin you need to:

1. Observe the 400 objects on the list and record your observations.
2. Develop observing logs that include the following:
   a. Date and time
   b. Site (Latitude and Longitude)
   c. Seeing conditions
   d. Telescope used
   e. Eyepiece and magnification
   f. Object description (sketch optional)

When finished complete an index of observations in NGC order showing the page number of your observation next to the NGC number.

When you complete the Herschel II Observing Program you will need to submit a copy of your observing logs to me for review. If your logs are accurate and complete I will submit your name to the Herschel II Program chair for approval. The chair will mail to me your Herschel II certificate and pin which I will present to you at our monthly PAC meeting.

If you have any questions regarding the Herschel II Program or need help getting started please contact me and I will be glad to help.

NASA's Juno Mission Expands Into the Future

The spacecraft, which has been gathering data on the gas giant since July 2016, will become an explorer of the full Jovian system – Jupiter and its rings and moons.

NASA has authorized a mission extension for its Juno spacecraft exploring Jupiter. The agency's most distant planetary orbiter will now continue its investigation of the solar system's largest planet through September 2025, or until the spacecraft's end of life. This expansion tasks Juno with becoming an explorer of the full Jovian system – Jupiter and its rings and moons – with multiple rendezvous planned for three of Jupiter's most intriguing Galilean moons: Ganymede, Europa, and Io.

"Since its first orbit in 2016, Juno has delivered one revelation after another about the inner workings of this massive gas giant," said principal investigator Scott Bolton of the Southwest Research Institute in San Antonio. "With the extended mission, we will answer fundamental questions that arose during Juno's prime mission while reaching beyond the planet to explore Jupiter's ring system and Galilean satellites."

Proposed in 2003 and launched in 2011, Juno arrived at Jupiter on July 4, 2016. The prime mission will be completed in July 2021. The extended mission involves 42 additional orbits, including close passes of Jupiter's north polar cyclones; flybys of Ganymede, Europa, and Io; as well as the first extensive exploration of the faint rings encircling the planet.

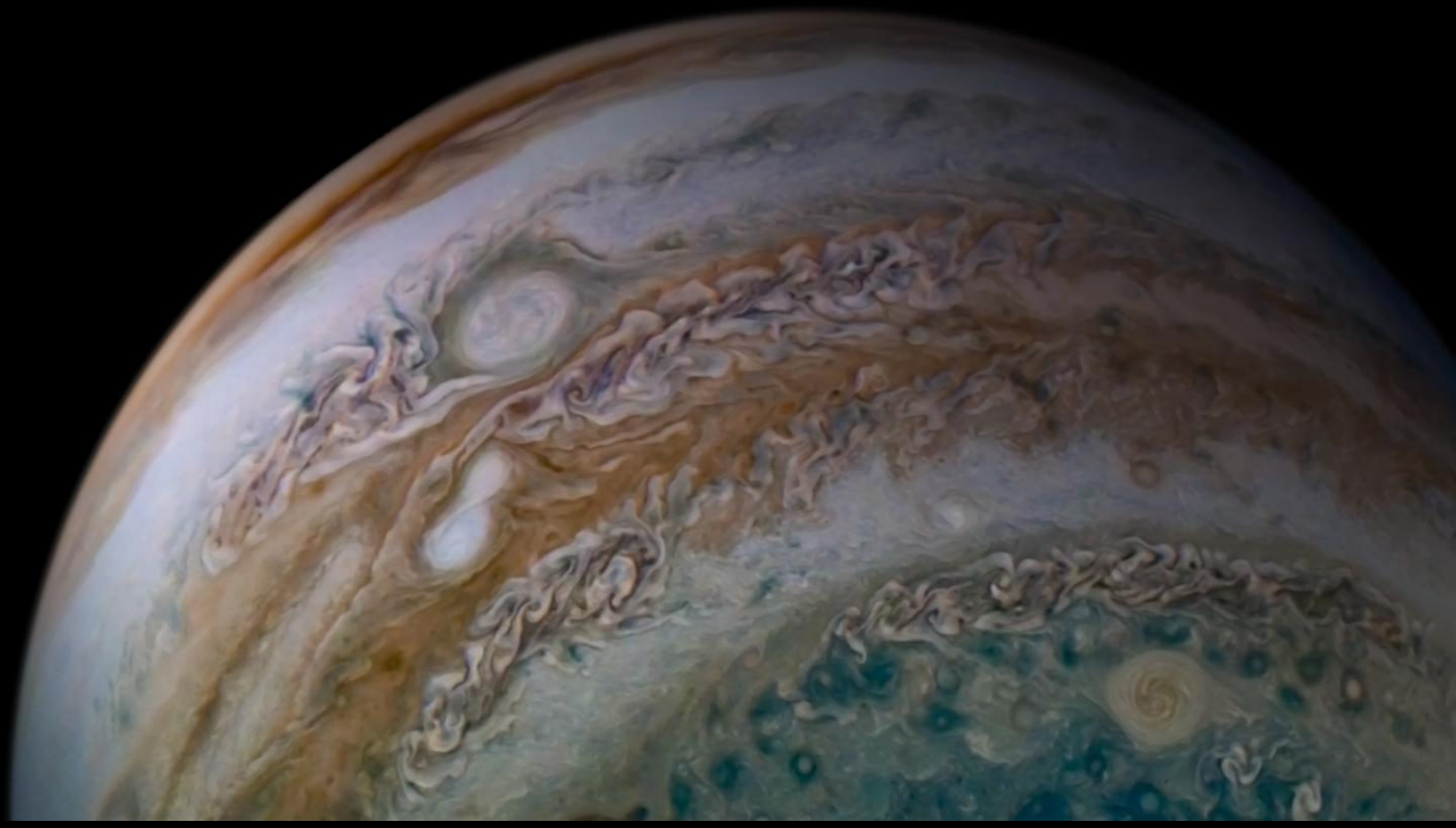
"By extending the science goals of this important orbiting observatory, the Juno team will start tackling a breadth of science historically required of flagships," said Lori Glaze, planetary science division director at NASA Headquarters in Washington. "This represents an efficient and innovative advance for NASA's solar system exploration strategy."

The data Juno collects will contribute to the goals of the next generation of missions to the Jovian system – NASA's Europa Clipper and the ESA (European Space Agency) JUpiter ICy moons Explorer (JUICE) mission. Juno's investigation of Jupiter's volcanic moon Io addresses many science goals identified by the National Academy of Sciences for a future Io explorer mission.

The extended mission's science campaigns will expand on discoveries Juno has already made about Jupiter's interior structure, internal magnetic field, atmosphere (including polar cyclones, deep atmosphere, and aurora), and magnetosphere.

"With this extension, Juno becomes its own follow-on mission," said

This view of Jupiter's atmosphere from NASA's Juno spacecraft includes something remarkable, two storms caught in the act of merging. Credit: Image data: NASA/JPL-Caltech/SwRI/MSSSImage processing by Tanya Oleksuik, © CC BY



Steve Levin, Juno project scientist at NASA's Jet Propulsion Laboratory in Southern California. "Close-up observations of the pole, radio occultations" – a remote sensing technique to measure properties of a planetary atmosphere or ring systems – "satellite flybys, and focused magnetic field studies combine to make a new mission, the next logical step in our exploration of the Jovian system."

Jupiter's enigmatic Great Blue Spot, an isolated patch of intense magnetic field near the planet's equator, will be the target of a high-spatial-resolution magnetic survey during six flybys early in the extended mission. As Juno's orbit evolves, multiple flybys of the moons Ganymede (2), Europa (3), and Io (11) are planned, as well as multiple passages through Jupiter's tenuous rings.

Juno will also fly through the Europa and Io tori – ring-shaped clouds of ions – on multiple occasions, characterizing the radiation environment near these satellites to better prepare the Europa Clipper and JUICE missions for optimizing observation strategies and planning, science priorities, and mission design. The extended

Juno, continued.

mission also adds planetary geology and ring dynamics to Juno's extensive list of science investigations.

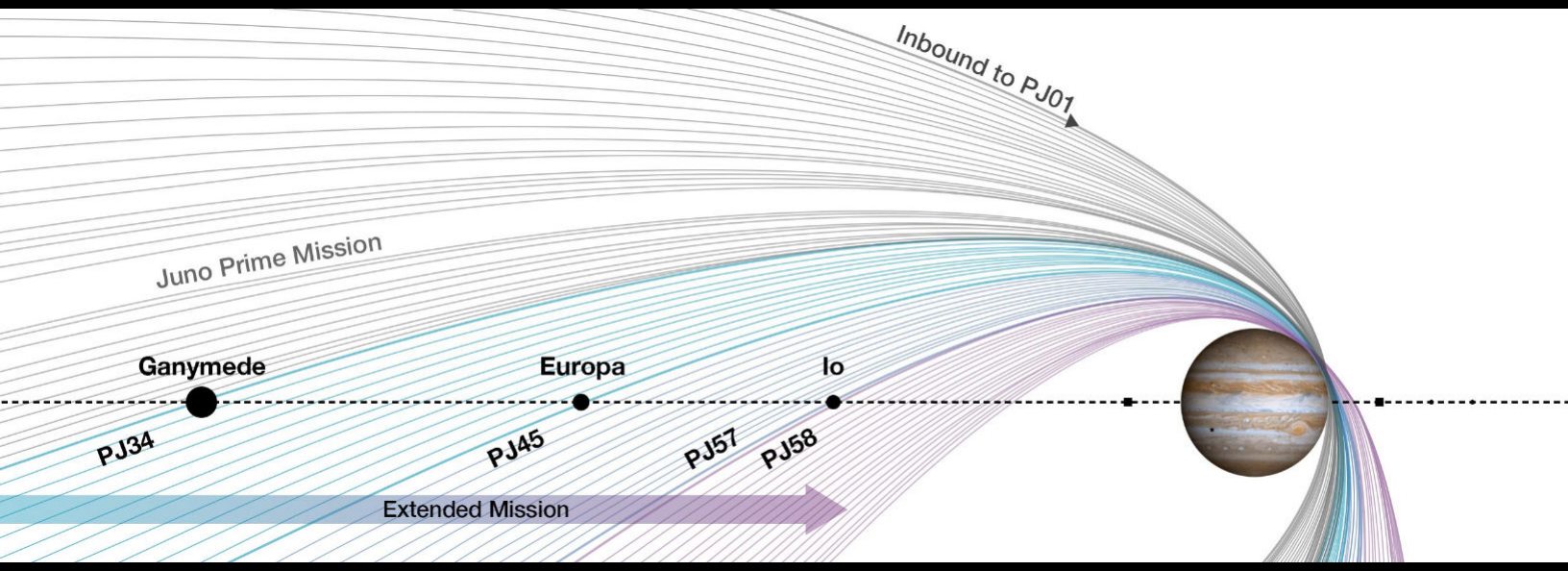
An Evolving Orbit

The natural evolution of Juno's orbit around the gas giant provides the wealth of new science opportunities that the extended mission capitalizes on. Every science pass sends the solar-powered spacecraft zooming low over Jupiter's cloud tops, collecting data from a unique vantage point no other spacecraft has enjoyed.

The point during each orbit where Juno comes closest to the planet is called perijove (or PJ). Over the course of the mission, Juno's perijoves have migrated northward, dramatically improving resolution over the northern hemisphere. The design of the extended mission takes advantage of the continued northward migration of these perijoves to sharpen its view of the multiple cyclones encircling the north pole while incorporating ring and Galilean moon flybys.

"The mission designers have done an amazing job crafting an extended mission that conserves the mission's single most valuable onboard resource – fuel," said Ed Hirst, the Juno project manager at JPL. "Gravity assists from multiple satellite flybys steer our spacecraft through the Jovian system while providing a wealth of science opportunities." The satellite flybys also reduce Juno's orbital period, which increases the total number of science orbits that can be obtained."

The satellite encounters begin with a low-altitude flyby of Ganymede on June 7, 2021 (PJ34), which reduces the orbital period from about 53 days to 43 days. That flyby sets up a close flyby of Europa on Sept. 29, 2022 (PJ45), reducing the orbital period further to 38 days. A pair of close Io flybys, on Dec. 30, 2023 (PJ57), and Feb. 3, 2024 (PJ58), combine to reduce the orbital



NASA has extended the mission of its Juno spacecraft exploring Jupiter. The extended mission involves 42 additional orbits. Credit: NASA/JPL-Caltech/SwRI

period to 33 days.

More About the Mission

JPL, a division of Caltech in Pasadena, California, manages the Juno mission for the principal investigator, Scott J. Bolton, of the Southwest Research Institute in San Antonio. Juno is part of NASA's New Frontiers Program, which is managed at NASA's Marshall Space Flight Center in Huntsville, Alabama, for the agency's Science Mission Directorate in Washington. Lockheed Martin Space in Denver built and operates the spacecraft.

More information about Juno is available at:

https://www.nasa.gov/juno

https://www.missionjuno.swri.edu

Follow the mission on Facebook and Twitter at:

https://www.facebook.com/NASASolarSystem

https://www.twitter.com/NASASolarSystem

2021 Virtual Winter Star Party

Sergio Figuera from the Southern Cross Astronomical Society (SCAS) in South Florida has invited PAC to their 2021 Winter Star Party Virtual Edition. It will take place February 8-11, 7pm to 11pm EST.

The event is free of charge. Please register at:

https://www.scas.org/winter-star-party/virtualregistration.cfm

If you pre-register, rumor has it that there will be prizes from Televue, Celestron, Explore Scientific, and Atlanta Hobby.

The event will be streamed using Explore Scientific's Explore Alliance Live network. The subjects currently planned include Archaeoastronomy presented by Dean Regas of the Cincinnati Observatory, How to Measure Double Stars by David Cottorell, and Hubble's Most Important Photos by Dr. Ata Saradejini from Florida Atlantic University. Also shown will be some classic videos from previous presenters at the Winter Star Parties such as Dr. Mike Reynolds, John Dobson, and Winter Star Party founder, Tippy D'Auria.

This will be the 37th year of the SCAS Winter Star Party, which is normally held on the Florida Keys. SCAS was founded in 1922 as the Southern Cross Observatory, as the constellation Crux, aka The Southern Cross, is visible there, and it is one of the oldest amateur astronomical societies in the Western Hemisphere. SCAS's founder, Mr. S. Lynn Rhorer, established the first observatory with his 5" Clark refractor at the Royal Palm Hotel & Park near the Miami River. He attracted a growing group of amateur astronomers who offered free viewing and instruction to the public. SCAS has grown and moved through the years, and in 1986, SCAS was invited by Florida International University to relocate to their campus, where it is based today.

Here is a recap of the 2020 Winter Star Party:

https://www.youtube.com/watch?v=eV4N7N5c78o

Here is the promo video for the 2021 Winter Star Party Virtual Edition:

https://www.youtube.com/watch?v=mOg0H9uXuYs

Perseverance Targets Jezero Crater

The target landing area of NASA's Perseverance rover is overlaid on this image of its landing site on Mars, Jezero Crater.

As landing technology improves and these landing ellipses shrink, missions can aim for more precise landings, opening up new areas of Mars to explore. Perseverance takes it two steps further than previous missions. First, it uses a new algorithm to time its parachute deployment based on distance to its target rather than vehicle velocity. This shrinks the landing ellipse to 4.8 miles by 4.1 miles (7.7 kilometers by 6.6 kilometers). Second, the rover uses maps stored in its memory to avoid landing hazards within that smaller ellipse during its propulsive descent phase. This allows Perseverance to target safe landing locations within Jezero Crater. The rover is set to land on Feb. 18, 2021.

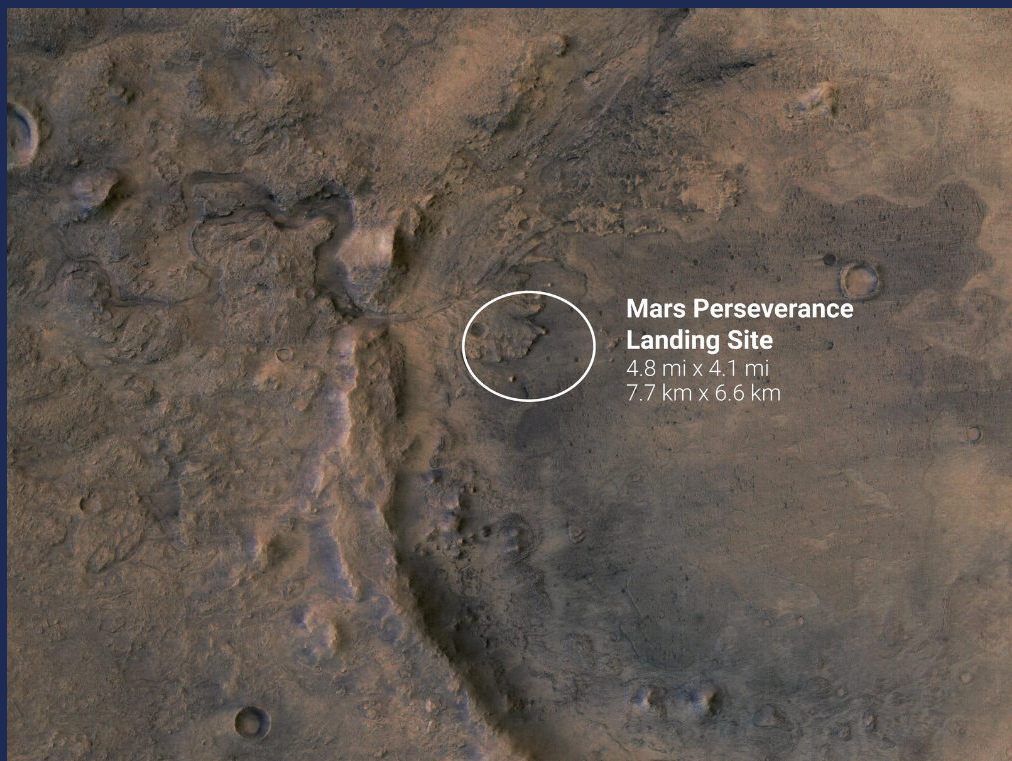
Improvements in interplanetary navigation tightened the landing ellipse of Mars Pathfinder in comparison with missions before it. It landed by bouncing on the surface with airbags, and has the largest ellipse in this image, measuring 124.3 miles by 43.5 miles (200 by 70 kilometers). The Phoenix and InSight landers used retrorockets to land on three legs, but still had large possible landing areas about 80.8 miles (130 kilometers) long.

In 2012, the Curiosity team developed guided entry technology, shrinking its landing ellipse further. The spacecraft used small rockets to steer itself through the atmosphere as it headed toward Gale Crater.

The basemap image featured here was taken by the High Resolution Stereo Camera aboard the ESA (European Space Agency) Mars Express orbiter. Light color processing has been applied to highlight surface features. The original image can be found here. The European Space Operations Centre in Darmstadt, Germany, operates the ESA mission. The High Resolution Stereo Camera was developed by a group with leadership at the Freie Universität Berlin.

NASA's Jet Propulsion Laboratory in Southern California built and will manage operations of the Mars 2020 Perseverance rover for NASA.

For more information about the mission, go to: https://mars.nasa.gov/mars2020.



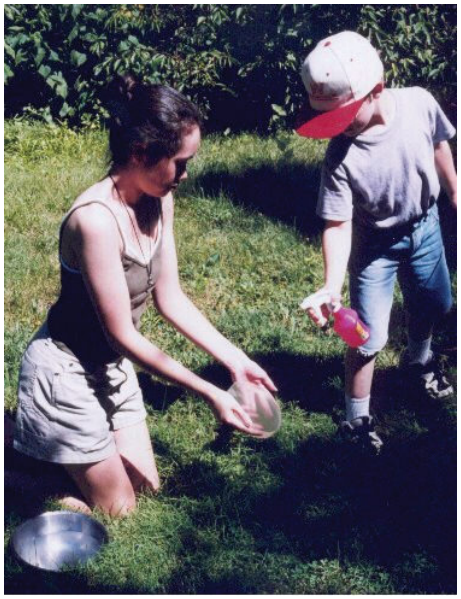
From the Archives

January, 2000

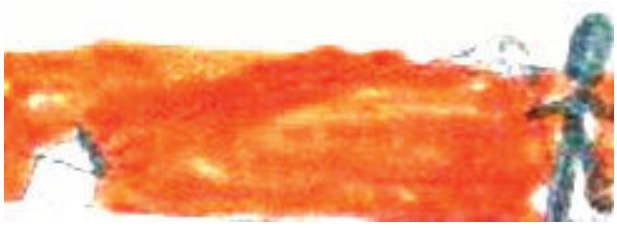
Telescope Making Marathon Part IV: "Are We There Yet?"

Martin Gaskell

"How do you know when you're got to the right focal length?" is a very common question people ask me about making a mirror. There are several ways of checking. You can check the radius of curvature (twice the focal length) or the focal length itself. If you check the radius of curvature you can either do it optically by finding where you need to place a light source so that it reflects back to the same distance or you can do it mechanically by measuring the depth of the curve on the mirror. Since we were working outside on a bright sunny day the obvious thing to do was to use the sun (a convenient source at "infinity") to make an image and measure the focal length. A rough-ground piece of glass does not reflect like a mirror on its own so, you need to wet the surface with water to make it smooth and reflective. The sun is so bright that even with no aluminum coating on the mirror the image is very bright. The quality of the image made by the wet rough-ground surface is very poor but even at this stage you can tell to the nearest inch what the focal length is.



Above Left: Liz Klimek holds the mirror blank while John Dowd wets the surface with water from a squirt bottle. Above Right: Michael and Margaret Fairchild measure the distance from the wet mirror to the image of the sun on a piece of paper held by Martin Gaskell.



Drawing by Daniel Gaskell of how we measured the focal length.

NEW HORIZONS SPACECRAFT ANSWERS QUESTI

NEW MEASUREMENTS OF THE SKY'S BLACKNESS SHOW GALAXIES ONLY NUMBER IN THE HUNDREDS OF BILLIONS

How dark is the sky, and what does that tell us about the number of galaxies in the visible universe? Astronomers can estimate the total number of galaxies by counting everything visible in a Hubble deep field and then multiplying them by the total area of the sky. But other galaxies are too faint and distant to directly detect. Yet while we can't count them, their light suffuses space with a feeble glow.

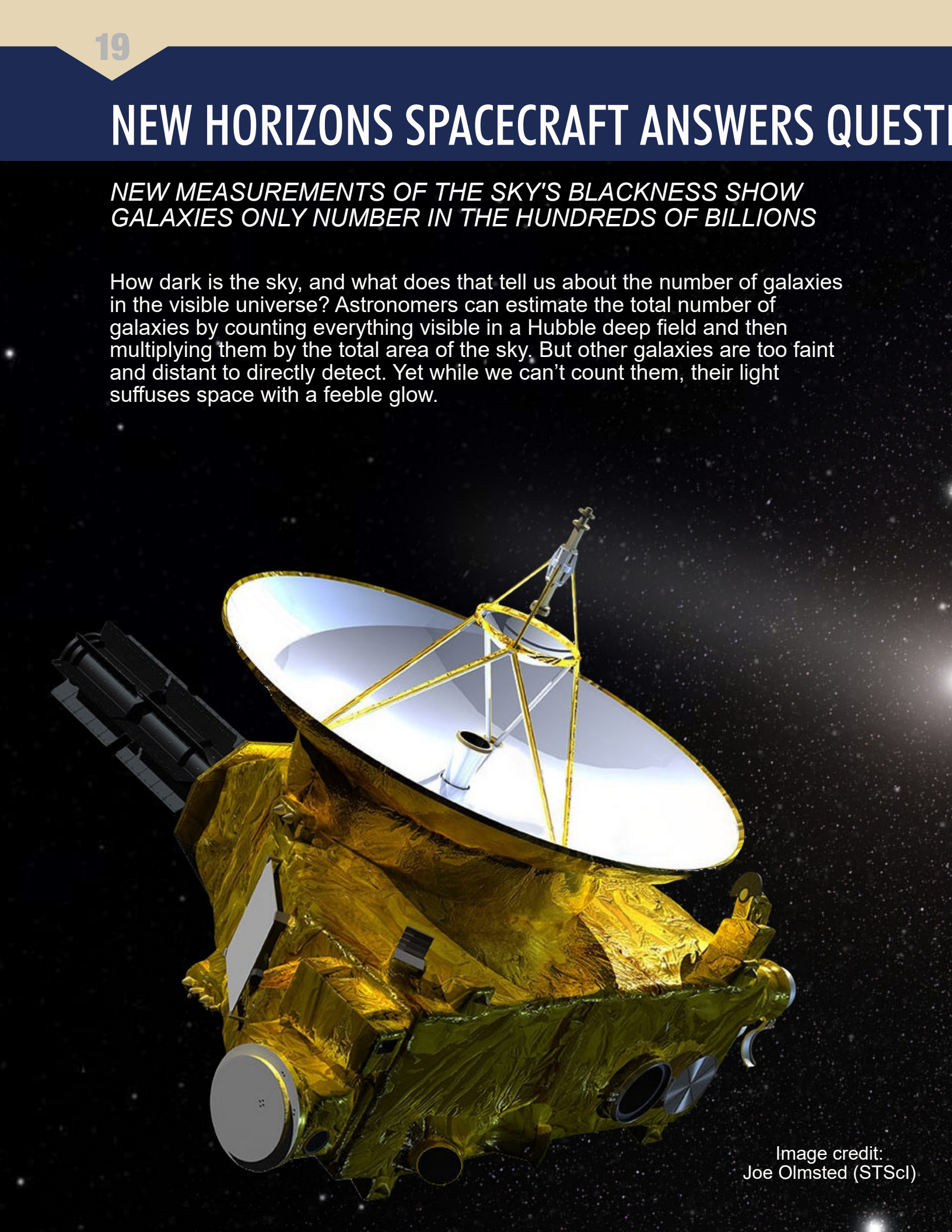


Image credit:
Joe Olmsted (STScI)

ION: HOW DARK IS SPACE?

How dark does space get? If you get away from city lights and look up, the sky between the stars appears very dark indeed. Above the Earth's atmosphere outer space dims even further, fading to an inky pitch-black. And yet even there, space isn't absolutely black. The universe has a suffused feeble glimmer from innumerable distant stars and galaxies.

New measurements of that weak background glow show that the unseen galaxies are less plentiful than some theoretical studies suggested, numbering only in the hundreds of billions rather than the previously reported two trillion galaxies.

"It's an important number to know – how many galaxies are there?" said Marc Postman of the Space Telescope Science Institute in Baltimore, Maryland, a lead author on the study. "We simply don't see the light from two trillion galaxies."

The earlier estimate was extrapolated from very deep sky observations by NASA's Hubble Space Telescope. It relied on mathematical models to estimate how many galaxies were too small and faint for Hubble to see. That team concluded that 90% of the galaxies in the universe were beyond Hubble's ability to detect in visible light. The new findings, which relied on measurements from NASA's distant New Horizons mission, suggest a much more modest number.

"Take all the galaxies Hubble can see, double that number, and that's what we see – but nothing more," said Tod Lauer of NSF's NOIRLab, a lead author on the study.

These results will be presented on Wednesday, Jan. 13th at a meeting of the American Astronomical Society, which is open to registered participants.

The cosmic optical background that the team sought to measure is the visible-light equivalent of the more well-known cosmic microwave background – the weak afterglow of the big bang itself, before stars ever existed.

"While the cosmic microwave background tells us about the first 450,000 years after the big bang, the cosmic optical background tells us something about the sum total of all the stars that have ever formed since then," explained Postman. "It puts a constraint on the total number of galaxies that have been created, and where they might be in time."

As powerful as Hubble is, the team couldn't use it to make these observations. Although located in space, Hubble orbits Earth and still suffers from light pollution. The inner solar system is filled with tiny dust particles from disintegrated asteroids and comets. Sunlight reflects off those particles, creating a glow called the zodiacal light that can be observed even by skywatchers on the ground.

How Dark is Space, continued.

To escape the zodiacal light, the team had to use an observatory that has escaped the inner solar system. Fortunately the New Horizons spacecraft, which has delivered the closest ever images of Pluto and the Kuiper Belt object Arrokoth, is far enough to make these measurements. At its distance (more than 4 billion miles away when these observations were taken), New Horizons experiences an ambient sky 10 times darker than the darkest sky accessible to Hubble.

“These kinds of measurements are exceedingly difficult. A lot of people have tried to do this for a long time,” said Lauer. “New Horizons provided us with a vantage point to measure the cosmic optical background better than anyone has been able to do it.”

The team analyzed existing images from the New Horizons archives. To tease out the feeble background glow, they had to correct for a number of other factors. For example, they subtracted the light from the galaxies expected to exist that are too faint to be identifiable. The most challenging correction was removing light from Milky Way stars that was reflected off interstellar dust and into the camera.

The remaining signal, though extremely faint, was still measurable. Postman compared it to living in a remote area far from city lights, lying in your bedroom at night with the curtains open. If a neighbor a mile down the road opened their refrigerator looking for a midnight snack, and the light from their refrigerator reflected off the bedroom walls, it would be as bright as the background New Horizons detected.

So, what could be the source of this leftover glow? It’s possible that an abundance of dwarf galaxies in the relatively nearby universe lie just beyond detectability. Or the diffuse halos of stars that surround galaxies might be brighter than expected. There might be a population of rogue, intergalactic stars spread throughout the cosmos. Perhaps most intriguing, there may be many more faint, distant galaxies than theories suggest. This would mean that the smooth distribution of galaxy sizes measured to date rises steeply just beyond the faintest systems we can see – just as there are many more pebbles on a beach than rocks.

NASA’s upcoming James Webb Space Telescope may be able to help solve the mystery. If faint, individual galaxies are the cause, then Webb ultra-deep field observations should be able to detect them.

This study is accepted for publication in the Astrophysical Journal.

Background image: Zodiacal light.
CREDITS: Z. Levay

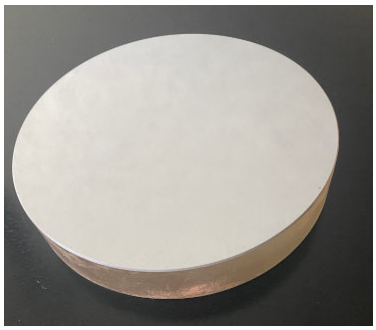
For Sale

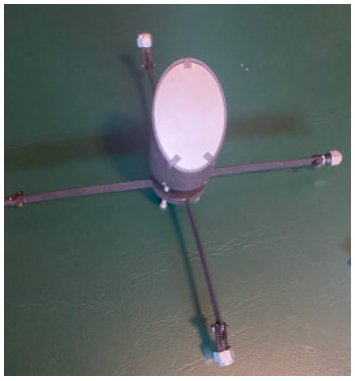
I have some parts for sale if anyone in the club is interested.

Meade 10 inch mirror, Agena Astro 10 inch mirror cell with fan (so brand new it won't be here until the 14th), Meade rack and pinion focuser.

$175 takes all and I will throw in a Meade secondary and spider. Mirror cell is $95 alone.

If anyone in the club is interested. Russ Genzmer, 402.217.4713





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: Available
10 inch Meade Starfinder Dobsonian: Available
13 inch Truss Dobsonian: Needs repair
10 inch Zhumell: Needs mount

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