The Prairie Astronomer

February 2024 Volume 65, Issue #2

IN THIS ISSUE:

Night Sky Network

The Newsletter of the Prairie Astronomy Club

The Prairie Astronomer

The next regular club meeting is February 27th at 7:30pm at Hyde Observatory

NEXT MEETING AND PROGRAM

A Comparison of Several Smart Telescopes - Jack Dunn. Over the past three to four years a new type of telescope has cause quite a stir in the amateur astronomical community. "Electronically Assisted Astronomy" devices are telescopes that on-board do the job of stacking images of a target (generally combining with "dark" frames) to perform real-time processing. The purpose of this talk is to survey the variety of these scopes and point out both strengths and weaknesses. And different models have variations of both. I'll include examples of imaging from each as well as discussing where I think these things might take us. And make it clear an EAA scope is no replacement for your expensive observatory rig with professional mount and pro CCD. But it can be a lot of fun.

UPCOMING PROGRAMS

March: Beyond the Shadow: Exploring the Great North American Eclipse of 2024 (at BOO)

April: Robert Teeter, founder of Teeterscopes LLC will talk about optimizing Dobsonian telescopes.

CONTENTS

Cover: Face-on spiral galaxy, NGC 3627, is split diagonally in this image: The James Webb Space Telescope's observations appear on bottom right, and the Hubble Space Telescope's at top left. Webb and Hubble's images show a striking contrast, an inverse of darkness and light. Credit: NASA, ESA, CSA, STScI, Janice Lee (STScI), Thomas Williams (Oxford), PHANGS Team

Background photo: Brett Boller

CALENDAR

Most of our club meetings are held at Hyde Memorial Observatory in Holmes Park.

The Observatory is owned and maintained by the City of Lincoln Parks and Recreation Department, but is operated by volunteers, many of whom are also members of the Prairie Astronomy Club.

PAC Meeting
Tuesday, February 27th, 7:30pm at Hyde Observatory
Program: "A Comparison of Smart Telescopes"
presented by Jack Dunn

PAC Meeting
Tuesday, March 26th, 7:30pm at Branched Oak Observatory. Program: "Beyond the Shadow: Exploring the Great North American Eclipse of 2024"
presented by Michael Sibbernsen.

PAC Meeting
Tuesday, April 30th, 7:30pm at Hyde Observatory
Program: "Optimizing Dobsonian Telescopes"
presented by Robert Teeter

https://www.prairieastronomyclub.org/event-calendar/

Night Sky Network

www.prairieastronomyclub.org

2024 STAR PARTY DATES

	Date	Date
January	5	**12**
February	2	**9**
March	1	**8**
April	3/29	**5**
May	4/26	**3**
June	5/31	**7**
July	6/28	**5**
NSP	**7/28**	**8/2**
August	7/26	**2**
September	8/30	**6**
October	9/26	**4**
November	11/22	**29**
December	20	**27**

Dates in BOLD are closest to the New Moon.

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Notices

Newsletter Page View Format

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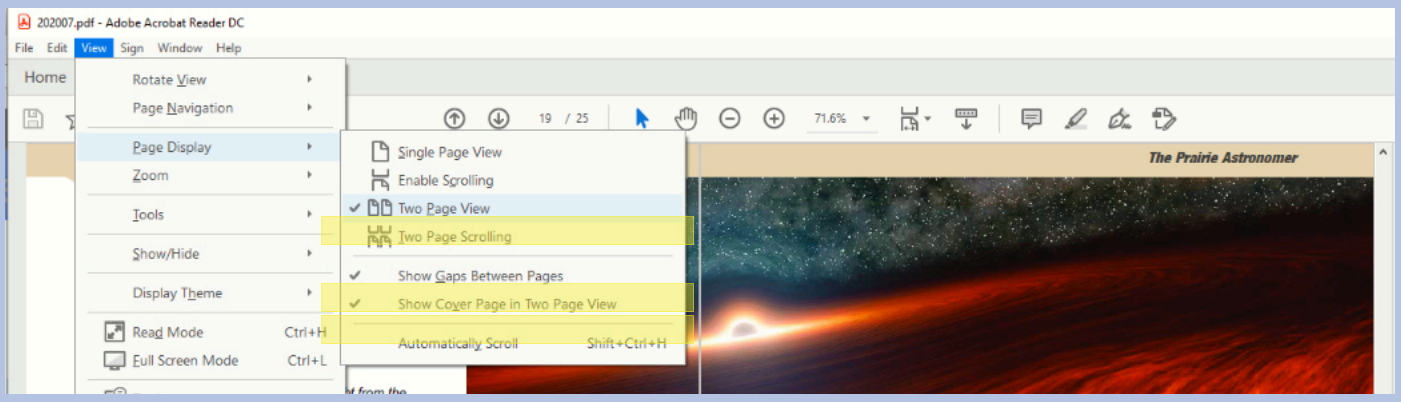


To view this newsletter in magazine spread format in Acrobat, select View ->Page Display->Two Page View. Acrobat will then show two pages side by side. Also make sure the checkboxes "Show Cover Page in Two Page View" and "Show Gaps Between Pages" are checked. If you have it setup correctly, the cover page will be displayed by itself and subsequent pages will be side by side with the odd numbered pages on the left.

PAC Newsletter Archive

Back issues of the Prairie Astronomer from 1962 to present are available online: https://newsletters.prairieastronomyclub.org/

Pay Dues Online

https://www.prairieastronomyclub.org/pay-dues-online/

If you're already a member and are renewing within 30 days of your anniversary date, select the early renewal option for a discount.

PAC-LIST

Subscribe through GoogleGroups or contact Mark Dahmke to be added to the list. You'll need a Google/gmail account, but if you want to use a different email address, just associate that address with your google account to access Google Groups. Once subscribed, you can view message history through the GoogleGroups website.

To post messages to the list, send to this address: pac-list@googlegroups.com

The President's Message

Jason O'Flaherty

Dear PAC Members,

As we welcome the glimmer of spring on the horizon, I hope this letter finds you all in good spirits and eagerly anticipating the celestial wonders that lie ahead in the coming months.

First, I thank everyone who attended and volunteered at our January meeting. Our collective efforts helped about half a dozen scope owners from our community delve into the joys of telescope usage. These events embody the spirit of outreach and education that defines our purpose as a club, "to encourage and participate in the study of astronomy and related subjects for the benefit of its members and the general public."

Speaking of our bylaws, I am glad to announce that the final copy has been completed after starting this process around a year ago. This endeavor was crucial in ensuring that our club's direction remains current and aligned with our collective vision. My gratitude goes to the bylaw committee and all those who contributed to shaping this essential document.

Looking ahead, our next three programs will be focused on terrestrial-based observation. In February, Jack Dunn will be shedding light on the latest advancements in automated imaging telescopes—an increasingly popular option as more companies enter this new market.

March holds a special treat as we gather at the Branched Oak Observatory, where Michael Sibbernsen will share his presentation on the Great North American eclipse, just in time to prepare us for the eagerly anticipated April 8th total Solar eclipse.

The opportunity to witness this astronomical marvel won't happen again in the contiguous US until 2044. I encourage you to capture your eclipse adventures through photos and stories and consider submitting them for the April Newsletter.

Rounding out our program lineup in April, Robert Teeter Jr. will regale us with tales from his years in the telescope business, sharing insights on interesting telescope builds and optimizing Dobsonian telescopes. It promises to be an entertaining session for enthusiasts of all levels.

Clear skies and happy observing!

Jason O'Flaherty

New Members

Welcome to the club!

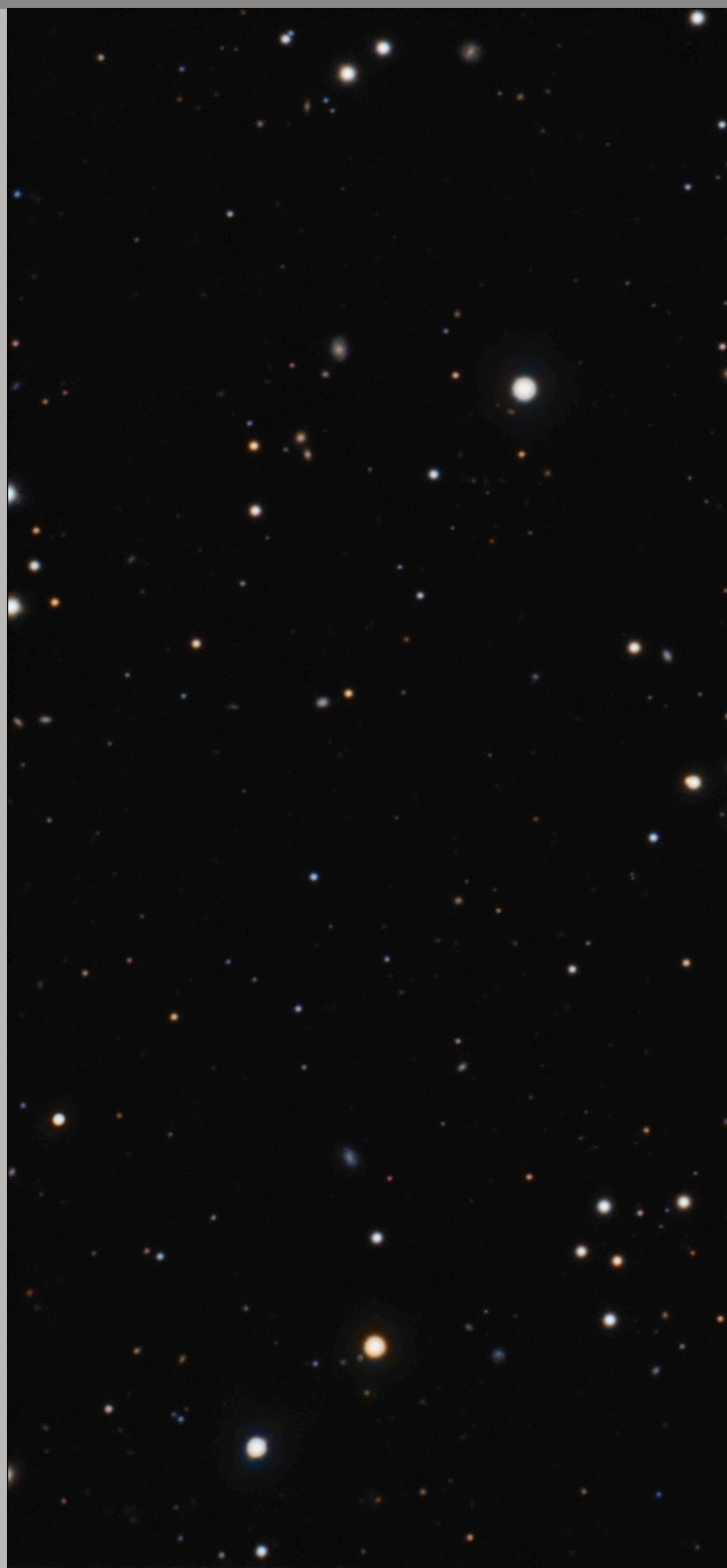
Matt Charron, Eagle, Nebraska
Tim Weismann, Waverly, Nebraska

ARP 64

The Mantrap Skies Image Catalog

Arp 64 consists of three of the four galaxies that make up UGC 9503. They are located in Bootes about 434 million light-years away. Arp put them under his classification of spirals with small high surface brightness companion on the arms. In this case one companion for each arm. Or as Arp put it "Both arms lead toward companions." At least that's how it looked to Arp.

Redshift data indicates the primary galaxy, PGC 052698, is about 430 million light-years away. But there is no redshift data for either companion. (EDIT: Since this was written the companion above the eastern end of PGC 052698 (LEDA 214322) has virtually the same redshift so is likely a true companion.) The western companion is SDSS J144522.63+192758.3. The one to the northeast is LEDA 214322. As mentioned neither have a redshift measurement that I could find. Without this measurement, it is hard to prove either are true companions. The latter isn't actually on an arm. The arm does make a short jog in its direction but ends abruptly. Maybe a longer exposure



Rick Johnson

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.

ARP64, continued.

would show a connection not seen in my image. In Arp's image, this small galaxy does seem a bit distorted on the side toward the arm. I don't see this however in either the SDSS or my images. The other companion is seen virtually on the end of the other arm. Again it doesn't prove anything but is suggestive.

This accounts for three of the 4 galaxies NED refers to as constituting UGC 9503. Arp doesn't include the fourth in his image. It is the very blue disk galaxy to the south-southeast of Arp 64. It shows a small but faint plume to its south and the disk is rather distorted. Unfortunately, it too has never had a redshift measurement taken. How many of these 4 are truly related I have no idea. Apparently, little research has been done on this group.

To the southwest is the large elliptical like golden galaxy (near the right edge of my enlarged and cropped image), ARK 458. This is a catalog of emission line galaxies. It does have a redshift distance that puts it at 439 million light-years. It is a member of the same group as Arp 64. Being an emission line galaxy it is quite active. It is also an IR galaxy. These two pieces of information are suggestive that it may have had an encounter in the past to trigger such activity. Though this isn't necessary. So could it be the cause of Arp 64's drawn-out arms rather than the two companions? It shows no hint of any distortion, however. Sorry, I have lots of questions but no answers.This accounts for three of the 4 galaxies NED refers to as constituting UGC 9503. Arp doesn't include the fourth in his image. It is the very blue disk galaxy to the south-southeast of Arp 64. It shows a small but faint plume to its south and the disk is rather distorted. Unfortunately, it too has never had a redshift measurement taken. How many of these 4 are truly related I have no idea. Apparently, little research has been done on this group.

Toward the lower right corner is an obvious galaxy cluster with two major galaxy. The one on the right, SDSS J144433.71+192121.5 has a spectroscopic redshift measurement putting it at 2.3 billion light years away. The one on the right, SDSS J144431.76+192127.4 marks the center of the cluster, MaxBCG J221.13237+19.35762. The galaxy has no redshift data but the cluster has a photographic redshift distance of 2.5 billion light years. Since a photographic redshift isn't as accurate as a spectroscopic redshift I assume the 2.3 billion light years of the other major member is likely more correct. It is listed as having 26 members but no size is given. This appears to also be the galaxy cluster Abell 1960 though this has a different center as shown on the annotated image. Abell 1960 is described as having a diameter of 16 arm minutes and a distance of 2.3 billion light years, same as one of the galaxies above.

March Observing

Jim Kvasnicka

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

Planets

Jupiter: Getting lower in the west at magnitude -2.2 with a disk 36.4" wide.

Mercury: Low in the evening sky after sunset at magnitude -1.3.

Uranus: Close to Jupiter at magnitude +5.8 with a disk 3.5" wide.

Saturn, Neptune, Venus, Mars: Not visible in March.

Messier List

M41: Open cluster in Canis Major.

M44: The Beehive Cluster in Cancer.

M46/M47: Open clusters in Puppis.

M48: Open cluster in Hydra.

M50: Open cluster in Monoceros.

M67: Open cluster in Cancer

M81/M82: Galaxy pair in Ursa Major.

M93: Open cluster in Puppis.

Last Month: M1, M35, M36, M37, M38, M42, M43, M45, M78, M79

Next Month: M40, M65, M66, M95, M96, M105, M106, M108, M109

NGC and other Deep Sky Objects

NGC 2438: Planetary nebula, foreground object in M46.

NGC 2440: Planetary nebula in Puppis.

NGC 2451: Open cluster in Puppis, bright and irregular.

NGC 2452: Planetary nebula in Puppis, just south of open cluster NGC 2452.

NGC 2477: Bright open cluster in Puppis.

NGC 2537: The Bear Paw Galaxy in Lynx.

NGC 2683: Edge on galaxy in Lynx.

NGC 2775: Galaxy in Cancer.

Double Star Program List

Epsilon Canis Majoris: White and light blue pair.

Delta Geminorum: Wasat, yellow and pale red stars.

Alpha Geminorum: Castor, white primary with a yellow secondary.

12 Lyncis: Close pair of yellow-white stars.

19 Lyncis: White stars.

38 Lyncis: White primary with a yellow secondary.

Zeta Cancri: Yellow and pale-yellow stars.

Iota Cancri: Yellow and pale blue pair.

Challenge Object

NGC 2350: A faint, small, elongated galaxy in Canis Minor.

Focus on Observing Programs

Jim Kvasnicka

Bright Nebula Observing Program

Bright nebulae are interstellar clouds of gas and dust where stars are born or have died. Their complex shapes and colors make them objects of great interest and beauty.

Bright nebulae occur in two main classes depending on their source of illumination: emission and reflection. They can be a combination of the two. There is also a third much less common type of bright nebula, the supernova remnant (SNR).

Emission nebulae are clouds of dust and glowing hydrogen gas. The atoms in the cloud are ionized by nearby stars and when they fall back to their previous energy state they release energy in the form of visible light.

Reflection nebulae have the same composition of emission nebulae but lack stars hot enough to cause the gas to fluoresce. They shine by the dust in the nebula scattering starlight, the gas does not actually reflect any light.

A supernova remnant is the remains of a stellar explosion, where much of the star's material is ejected, often as a highly-structured cloud.

For the program 150 bright nebulae have been selected, some are famous showpieces in the night sky. Some of the 150 are big and bright where others will test your observation skills. You will need a telescope 8" or larger to complete the program. Nebula filters (UHC and OIII) will help your observing. There is the possibility that some of the objects are beyond detection for some observers and the program allows negative observations.

The program offers three levels of accomplishment:

Basic Visual: Observe 60 objects from the list of 150.
Advanced Visual: Observe 100 objects from the list of 150.
Imaging: Image 100 objects from the list of 150.

You can use your own observing logs to record your observations. Your observations should include: object name, date and time, power, seeing, telescope used, filters used, latitude and longitude, and your observing notes. Device aided searches are allowed. Observers who find all objects manually will receive special recognition on their certificate.

Once you complete the Bright Nebula Observing Program you will need to submit your observing logs to me for review. I will contact the Bright Nebula Observing Program chair for approval. Once I receive your certificate and pin I will present them to you at the next PAC meeting.

What is Dark Energy? Inside our accelerating, expanding Universe

Some 13.8 billion years ago, the universe began with a rapid expansion we call the big bang. After this initial expansion, which lasted a fraction of a second, gravity started to slow the universe down. But the cosmos wouldn't stay this way. Nine billion years after the universe began, its expansion started to speed up, driven by an unknown force that scientists have named dark energy.

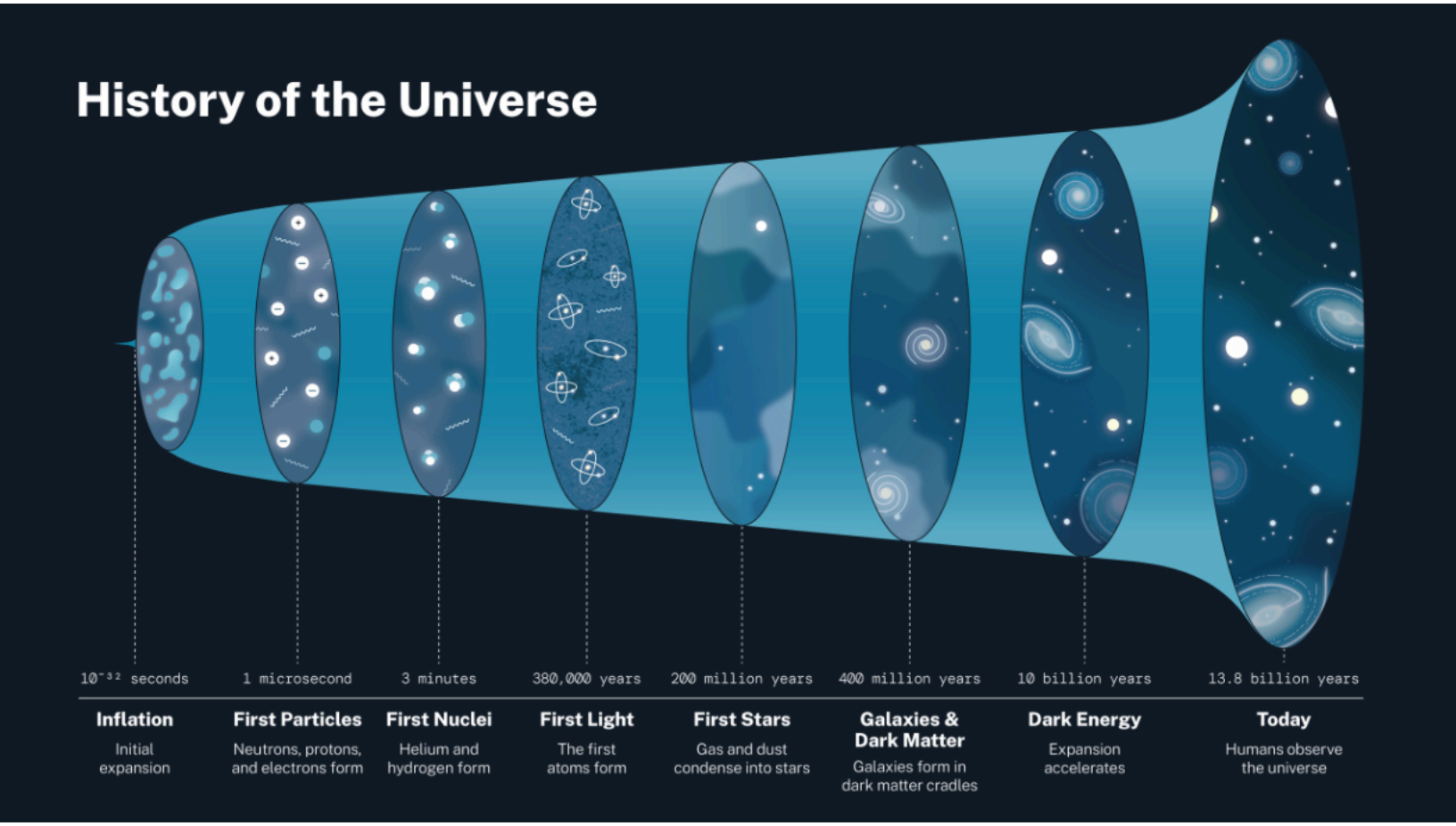
But what exactly is dark energy?

The short answer is: We don't know. But we do know that it exists, it's making the universe expand at an accelerating rate, and approximately 68.3 to 70% of the universe is dark energy.

A Brief History

It All Started With Cepheids

Dark energy wasn't discovered until the late 1990s. But its origin in scientific study stretches all the way back to 1912 when American astronomer Henrietta Swan Leavitt made an important discovery



The history of the universe is outlined in this infographic.
NASA

Dark Energy, continued.

using Cepheid variables, a class of stars whose brightness fluctuates with a regularity that depends on the star's brightness.

All Cepheid stars with a certain period (a Cepheid's period is the time it takes to go from bright, to dim, and bright again) have the same absolute magnitude, or luminosity – the amount of light they put out. Leavitt measured these stars and proved that there is a relationship between their regular period of brightness and luminosity. Leavitt's findings made it possible for astronomers to use a star's period and luminosity to measure the distances between us and Cepheid stars in far-off galaxies (and our own Milky Way).

Around this same time in history, astronomer Vesto Slipher observed spiral galaxies using his telescope's spectrograph, a device that splits light into the colors that make it up, much like the way a prism splits light into a rainbow. He used the spectrograph, a relatively recent invention at the time, to see the different wavelengths of light coming from the galaxies in different spectral lines. With his observations, Silpher was the first astronomer to observe how quickly the galaxy was moving away from us, called redshift, in distant galaxies. These observations would prove to be critical for many future scientific breakthroughs, including the discovery of dark energy.

Redshift is a term used when astronomical objects are moving away from us and the light coming from those objects stretches out. Light behaves like a wave, and red light has the longest wavelength. So, the light coming from objects moving away from us has a longer wavelength, stretching to the "red end" of the electromagnetic.

Discovering an Expanding Universe

The discovery of galactic redshift, the period-luminosity relation of Cepheid variables, and a newfound ability to gauge a star or galaxy's distance eventually played a role in astronomers observing that galaxies were getting farther away from us over time, which showed how the universe was expanding. In the years that followed, different scientists around the world started to put the pieces of an expanding universe together.

In 1922, Russian scientist and mathematician Alexander Friedmann published a paper detailing multiple possibilities for the history of the universe. The paper, which was based on Albert Einstein's theory of general relativity published in 1917, included the possibility that the universe is expanding.

In 1927, Belgian astronomer Georges Lemaître, who is said to have been unaware of Friedmann's work, published a paper also factoring in Einstein's theory of general relativity. And, while Einstein stated in his theory that the universe was static, Lemaître showed how the equations in Einstein's theory actually support the idea that the universe is not static but, in fact, is actually expanding.

Astronomer Edwin Hubble confirmed that the universe was expanding in 1929 using observations made by

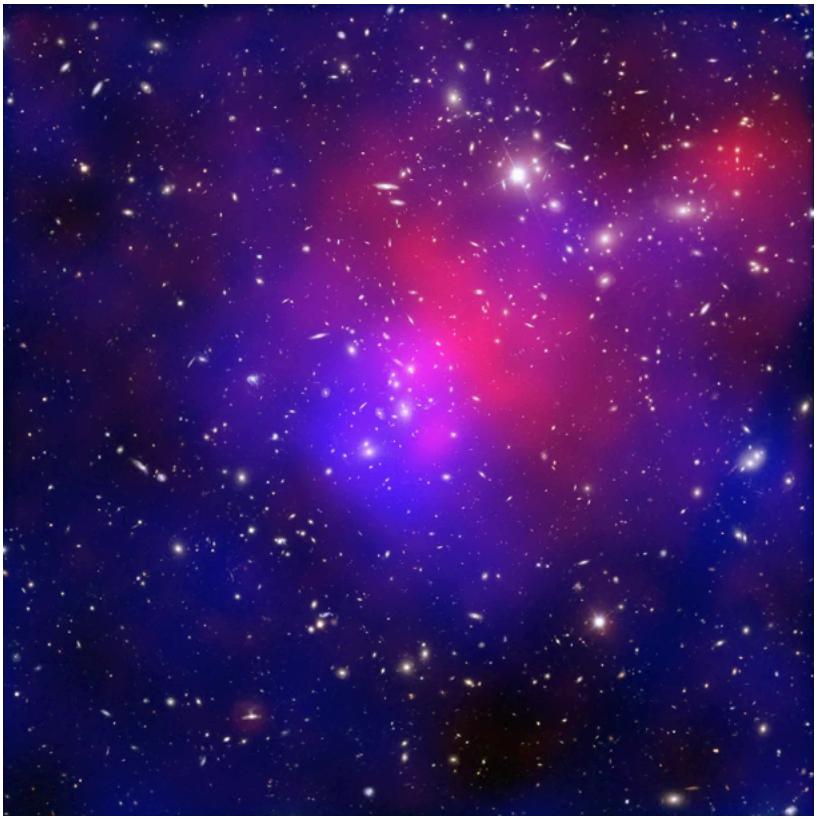
Dark Energy, continued.

his associate, astronomer Milton Humason. Humason measured the redshift of spiral galaxies. Hubble and Humason then studied Cepheid stars in those galaxies, using the stars to determine the distance of their galaxies (or nebulae, as they called them). They compared the distances of these galaxies to their redshift and tracked how the farther away an object is, the bigger its redshift and the faster it is moving away from us. The pair found that objects like galaxies are moving away from Earth faster the farther away they are, at upwards of hundreds of thousands of miles per second – an observation now known as Hubble's Law, or the Hubble- Lemaître law. The universe, they confirmed, is really expanding.

Expansion is Speeding Up, Supernovae Show

Scientists previously thought that the universe's expansion would likely be slowed down by gravity over time, an expectation backed by Einstein's theory of general relativity. But in 1998, everything changed when two different teams of astronomers observing far-off supernovae noticed that (at a certain redshift) the stellar explosions were dimmer than expected. These groups were led by astronomers Adam Riess, Saul Perlmutter, and Brian Schmidt. This trio won the 2011 Nobel Prize in Physics for this work.

While dim supernovae might not seem like a



This composite image features one of the most complicated and dramatic collisions between galaxy clusters ever seen. Known officially as Abell 2744, this system has been dubbed Pandora's Cluster because of the wide variety of different structures found. Data from Chandra (red) show gas with temperatures of millions of degrees. In blue is a map showing the total mass concentration (mostly dark matter) based on data from the Hubble Space Telescope, the Very Large Telescope (VLT), and the Subaru telescope. Optical data from HST and VLT also show the constituent galaxies of the clusters. Astronomers think at least four galaxy clusters coming from a variety of directions are involved with this collision.

Dark Energy, continued.

major find, these astronomers were looking at Type 1a supernovae, which are known to have a certain level of luminosity. So they knew that there must be another factor making these objects appear dimmer. Scientists can determine distance (and speed) using an objects' brightness, and dimmer objects are typically farther away (though surrounding dust and other factors can cause an object to dim).

This led the scientists to conclude that these supernovae were just much farther away than they expected by looking at their redshifts.

Using the objects' brightness, the researchers determined the distance of these supernovae. And using the spectrum, they were able to figure out the objects' redshift and, therefore, how fast they were moving away from us. They found that the supernovae were not as close as expected, meaning they had traveled farther away from us faster than ancitipated. These observations led scientists to ultimately conclude that the universe itself must be expanding faster over time.

While other possible explanations for these observations have been explored, astronomers studying even more distant supernovae or other cosmic phenomena in more recent years continued to gather evidence and build support for the idea that the universe is expanding faster over time, a phenomenon now called cosmic acceleration.

But, as scientists built up a case for cosmic acceleration, they also asked: Why? What could be driving the universe to stretch out faster over time?

Enter dark energy.

What Exactly is Dark Energy?

Right now, dark energy is just the name that astronomers gave to the mysterious "something" that is causing the universe to expand at an accelerated rate.

Dark energy has been described by some as having the effect of a negative pressure that is pushing space outward. However, we don't know if dark energy has the effect of any type of force at all. There are many ideas floating around about what dark energy could possibly be. Here are four leading explanations for dark energy. Keep in mind that it's possible it's something else entirely.

Vacuum Energy:

Some scientists think that dark energy is a fundamental, ever-present background energy in space known as vacuum energy, which could be equal to the cosmological constant, a mathematical term in the equations of Einstein's theory of general relativity. Originally, the constant existed to counterbalance gravity, resulting in a static universe. But when Hubble confirmed that the universe was actually expanding, Einstein removed the constant, calling it “my biggest blunder,” according to physicist George Gamow.

But when it was later discovered that the universe’s expansion was actually accelerating, some scientists suggested that there might actually be a non-zero value to the previously-discredited cosmological constant.

Dark Energy, continued.

They suggested that this additional force would be necessary to accelerate the expansion of the universe. This theorized that this mystery component could be attributed to something called “vacuum energy,” which is a theoretical background energy permeating all of space.

Space is never exactly empty. According to quantum field theory, there are virtual particles, or pairs of particles and antiparticles. It's thought that these virtual particles cancel each other out almost as soon as they crop up in the universe, and that this act of popping in and out of existence could be made possible by “vacuum energy” that fills the cosmos and pushes space outward.

While this theory has been a popular topic of discussion, scientists investigating this option have calculated how much vacuum energy there should theoretically be in space. They showed that there should either be so much vacuum energy that, at the very beginning, the universe would have expanded outwards so quickly and with so much force that no stars or galaxies could have formed, or... there should be absolutely none. This means that the amount of vacuum energy in the cosmos must be much smaller than it is in these predictions. However, this discrepancy has yet to be solved and has even earned the moniker "the cosmological constant problem."

Quintessence:

Some scientists think that dark energy could be a type of energy fluid or field that fills space, behaves in an opposite way to normal matter, and can vary in its amount and distribution throughout both time and space. This hypothesized version of dark energy has been nicknamed quintessence after the theoretical fifth element discussed by ancient Greek philosophers.

It's even been suggested by some scientists that quintessence could be some combination of dark energy and dark matter, though the two are currently considered completely separate from one another. While the two are both major mysteries to scientists, dark matter is thought to make up about 85% of all matter in the universe.

Space Wrinkles:

Some scientists think that dark energy could be a sort of defect in the fabric of the universe itself; defects like cosmic strings, which are hypothetical one-dimensional "wrinkles" thought to have formed in the early universe.

A Flaw in General Relativity:

Some scientists think that dark energy isn't something physical that we can discover. Rather, they think there could be an issue with general relativity and Einstein's theory of gravity and how it works on the scale of the observable universe. Within this explanation, scientists think that it's possible to modify our understanding of gravity in a way that explains observations of the universe made without the need for dark energy. Einstein actually proposed such an idea in 1919 called unimodular gravity, a modified version of general relativity that scientists today think wouldn't require dark energy to

Dark Energy, continued.

make sense of the universe.

The Future

Dark energy is one of the great mysteries of the universe. For decades, scientists have theorized about our expanding universe. Now, for the first time ever, we have tools powerful enough to put these theories to the test and really investigate the big question: “what is dark energy?”

NASA plays a critical role in the ESA (European Space Agency) mission Euclid (launched in 2023), which will make a 3D map of the universe to see how matter has been pulled apart by dark energy over time. This map will include observations of billions of galaxies found up to 10 billion light-years from Earth.

NASA's Nancy Grace Roman Space Telescope, set to launch by May 2027, is designed to investigate dark energy, among many other science topics, and will also create a 3D dark matter map. Roman's resolution will be as sharp as NASA’s Hubble Space Telescope's, but with a field of view 100 times larger, allowing it to capture more expansive images of the universe. This will allow scientists to map how matter is structured and spread across the universe and explore how dark energy behaves and has changed over time. Roman will also conduct an additional survey to detect Type Ia supernovae

In addition to NASA’s missions and efforts, the Vera C. Rubin Observatory, supported by a large collaboration that includes the U.S. National Science Foundation, which is currently under construction in Chile, is also poised to support our growing understanding of dark energy. The ground-based observatory is expected to be operational in 2025.

The combined efforts of Euclid, Roman, and Rubin will usher in a new “golden age” of cosmology, in which scientists will collect more detailed information than ever about the great mysteries of dark energy.

Additionally, NASA's James Webb Space Telescope (launched in 2021), the world’s most powerful and largest space telescope, aims to make contributions to several areas of research, and will contribute to studies of dark energy.

NASA's SPHEREx (the Spectro-Photometer for the History of the Universe, Epoch of Reionization, and Ices Explorer) mission, scheduled to launch no later than April 2025, aims to investigate the origins of the universe. Scientists expect that the data collected with SPHEREx, which will survey the entire sky in near-infrared light, including over 450 million galaxies, could help to further our understanding of dark energy.

NASA also supports a citizen science project called Dark Energy Explorers, which enables anyone in the world, even those who have no scientific training, to help in the search for dark energy answers.

A brief note

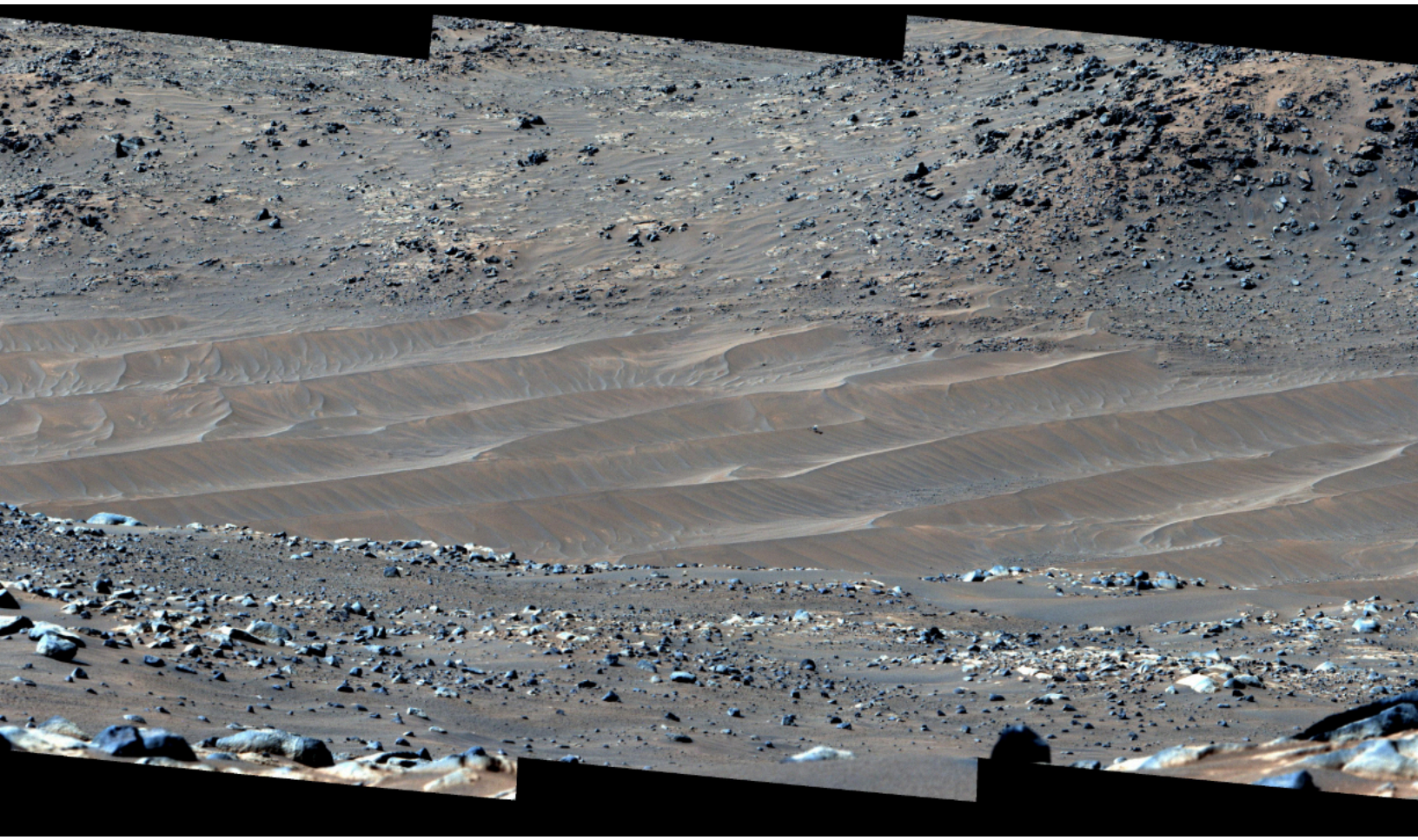
Lastly, to clarify, dark energy is not the same as dark matter. Their main similarity is that we don't yet know what they are!

By Chelsea Gohd

NASA's Jet Propulsion Laboratory

Perseverance Spots Ingenuity at Its Final Airfield

NASA's Perseverance Mars rover captured this mosaic showing the Ingenuity Mars Helicopter at its final airfield on Feb. 4, 2024. The helicopter damaged its rotor blades during landing on its 72nd flight on Jan. 18, 2024. The Ingenuity team has nicknamed the spot where the helicopter completed its final flight "Valinor Hills" after the fictional location in J.R.R. Tolkien's fantasy novels, which include "The Lord of the Rings" trilogy.



The six images that were stitched together to make up this mosaic were captured from about 1,475 feet (450 meters) away by the rover's Mastcam-Z imager. Shown here is an enhanced-color view that exaggerates subtle color differences in the scene to show more detail.

The Ingenuity Mars Helicopter was built by NASA's Jet Propulsion Laboratory, which manages the project for NASA Headquarters. It is supported by NASA's Science Mission Directorate. NASA's Ames Research Center in California's Silicon Valley and NASA's Langley Research Center in Hampton, Virginia, provided significant flight performance analysis and technical assistance during Ingenuity's development. AeroVironment Inc., Qualcomm, and SolAero

Ingenuity, continued.

also provided design assistance and major vehicle components. Lockheed Martin Space designed and manufactured the Mars Helicopter Delivery System.

Arizona State University leads the operations of the Mastcam-Z instrument, working in collaboration with Malin Space Science Systems in San Diego, on the design, fabrication, testing, and operation of the cameras, and in collaboration with the Niels Bohr Institute of the University of Copenhagen on the design, fabrication, and testing of the calibration targets.

A key objective for Perseverance's mission on Mars is astrobiology, including the search for signs of ancient microbial life. The rover will characterize the planet's geology and past climate, pave the way for human exploration of the Red Planet, and be the first mission to collect and cache Martian rock and regolith (broken rock and dust).

Subsequent NASA missions, in cooperation with ESA (European Space Agency), would send spacecraft to Mars to collect these sealed samples from the surface and return them to Earth for in-depth analysis.

The Mars 2020 Perseverance mission is part of NASA's Moon to Mars exploration approach, which includes Artemis missions to the Moon that will help prepare for human exploration of the Red Planet.

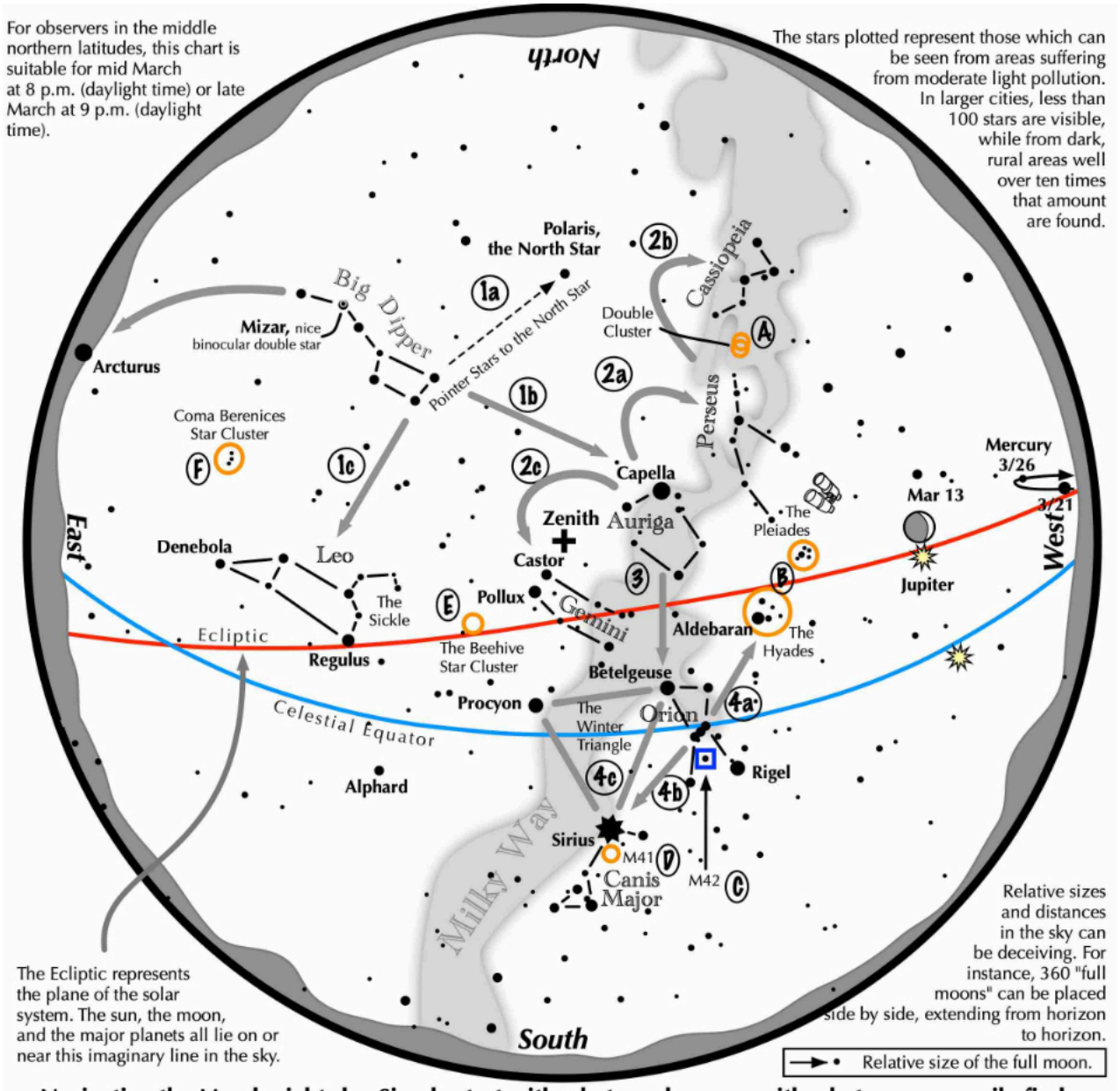
JPL which is managed for the agency by Caltech in Pasadena, California, built and manages operations of the Perseverance rover.

Upscaled and sharpened by Mark Dahmke

Astrophotography

Aurora Borealis, April 24, 2023 at the Strategic Air and Space Museum. Photo by Matthew Charron.

Navigating the mid to late March Night Sky



Navigating the March night sky: Simply start with what you know or with what you can easily find.

1. Above the northeast horizon rises the Big Dipper. Draw a line from its two end bowl stars upwards to the North Star. Its top bowl stars point west to Capella in Auriga, nearly overhead. Leo reclines below the Dipper's bowl.
2. From Capella jump northwestward along the Milky Way to Perseus, then to the "W" of Cassiopeia. Next jump southeastward from Capella to the twin stars of Castor and Pollux in Gemini.
3. Directly south of Capella stands the constellation of Orion with its three Belt Stars, its bright red star Betelgeuse, and its bright blue-white star Rigel.
4. Use Orion's three Belt stars to point northwest to the red star Aldebaran and the Hyades star cluster, then to the Pleiades star cluster. Travel southeast from the Belt stars to the brightest star in the night sky, Sirius. It is a member of the Winter Triangle.

Binocular Highlights

A: Between the "W" of Cassiopeia and Perseus lies the Double Cluster. **B:** Examine the stars of the Pleiades and Hyades, two naked eye star clusters. **C:** M42 in Orion is a star forming nebula. **D:** Look south of Sirius for the star cluster M41. **E:** M44, a star cluster barely visible to the naked eye, lies to the southeast of Pollux. **F:** Look high in the east for the loose star cluster of Coma Berenices.

Said to be one of the eeriest sights encountered in galaxy observing.

NGC 4435 & 4438

"The Eyes"–Two Spiral Lenticular Galaxies

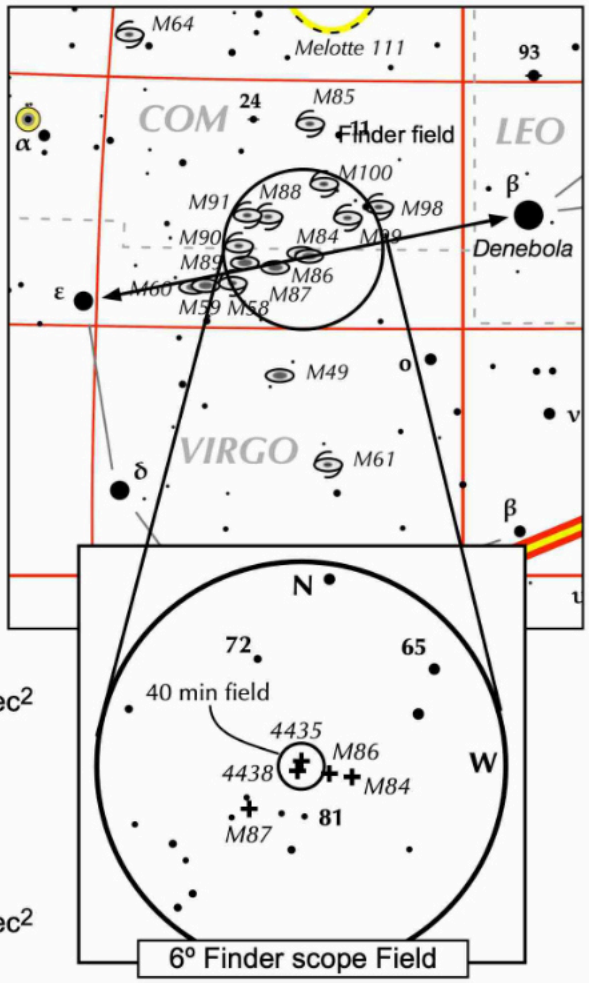
Navigate to NGC 4435 & 4438

1. Find Beta Leonis (Denebola) and Epsilon Virginis (Vindemiatrix).
2. Draw a line from Beta to Epsilon.
3. M84 and M86 lie at the mid point of that line.
4. NGC 4435 & 4438 glow about 40 minutes east of M86.
5. In a 40 minute field, they appear as two eyes staring back in the blackness of space.

Bonus Galaxies:
The region abounds in galaxies: M84, M86, M87, and many fainter ones.

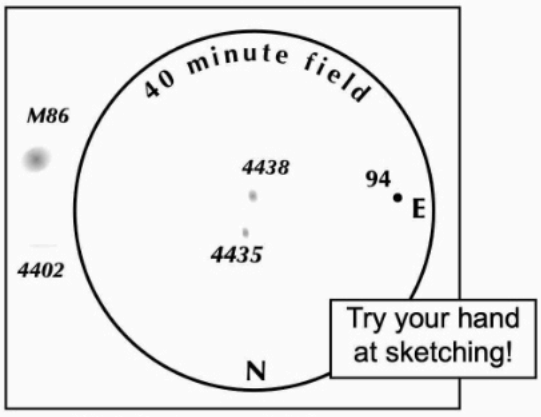
Recommended Aperture:
Not less than 10 inches. The larger, the better.

Yes, they do resemble two eyes staring at you from the blackness of space!



Published Characteristics for NGC 4435
Integrated magnitude: 11.7
Size: 2.8 min x 2.0 min
Surface brightness: 13.7 mag./min^2, 22.6 mag./sec^2
Position Angle: 10°
Distance: 52 million light-years

Published Characteristics for NGC 4438
Integrated magnitude: 10.6
Size: 8.6 min x 3.2 min (bright core, faint tails)
Surface brightness: 15.0 mag./min^2, 24.0 mag./sec^2
Position Angle: 20°
Distance: 52 million light-years

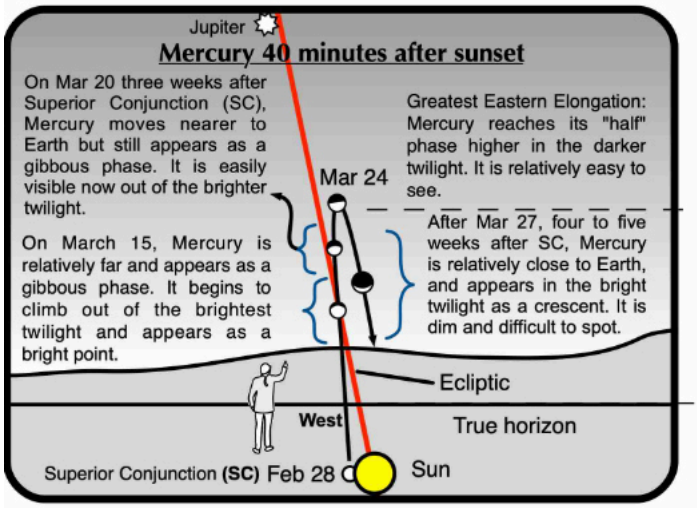


Eyepiece Impressions:

NGC 4435: Very small, elusive. Uniform brightness. Use averted vision. Near NGC 4438 and located 25' east of M86. (6-inch Cass.; ACAC)
10 inch f/10 SCT, 125x: "NGC 4435 is slightly elongated with a bright center." JG

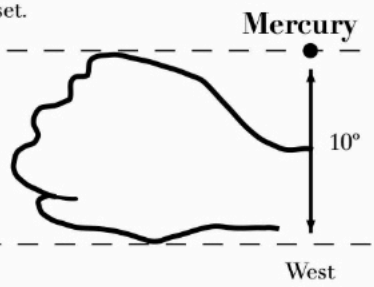
NGC 4438: Extremely elongated, uniform brightness, very large. Use averted vision. Located 4' south of NGC 4435. (6-inch Cass.; ACAC)
10 inch f/10 SCT, 125x:"NGC 4438 is elongated with a brigth center. Under careful observation, wispy outer regions are noticed." JG

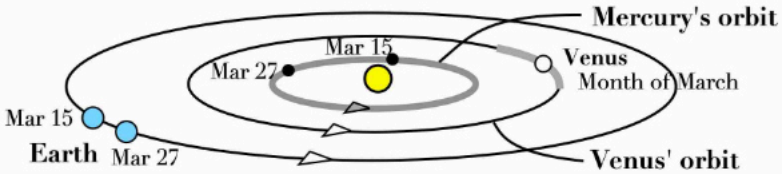
Astronomical League Outreach



Mercury in the Evening!

Mercury appears about "1 fist width on a fully extended arm" above the true horizon forty minutes after sunset.

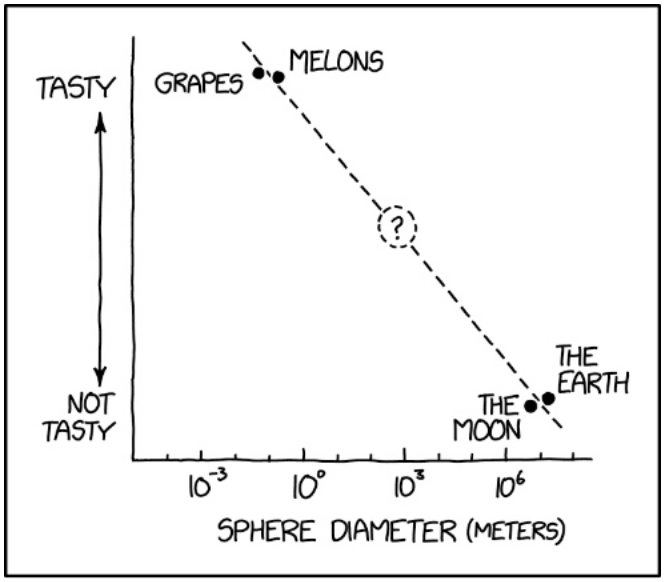




Mercury's best evening apparition of 2024!

From 40 to 60 minutes after sunset after March 15th, look to the west for a point of light shining low above the horizon.

- Outstretch your arm and make a fist. Place one side at the true horizon. At it its other side should be Mercury.
- Over the next week, the little planet rises slightly higher each evening into the darker twilight while brightening, making it easier to spot.
- On the 24th, Mercury appears as far from the set sun as it will be. This point in its orbit is called Greatest Eastern Elongation. Just three nights later as it descends in the twilight, it will become much more difficult to spot.



MY RESEARCH SUGGESTS THE EXISTENCE OF AN 800-METER SPHERE THAT TASTES OKAY.

Xkcd.com

Photos from the January Meeting

Poised for Science: NASA's Europa Clipper Instruments Are All Aboard

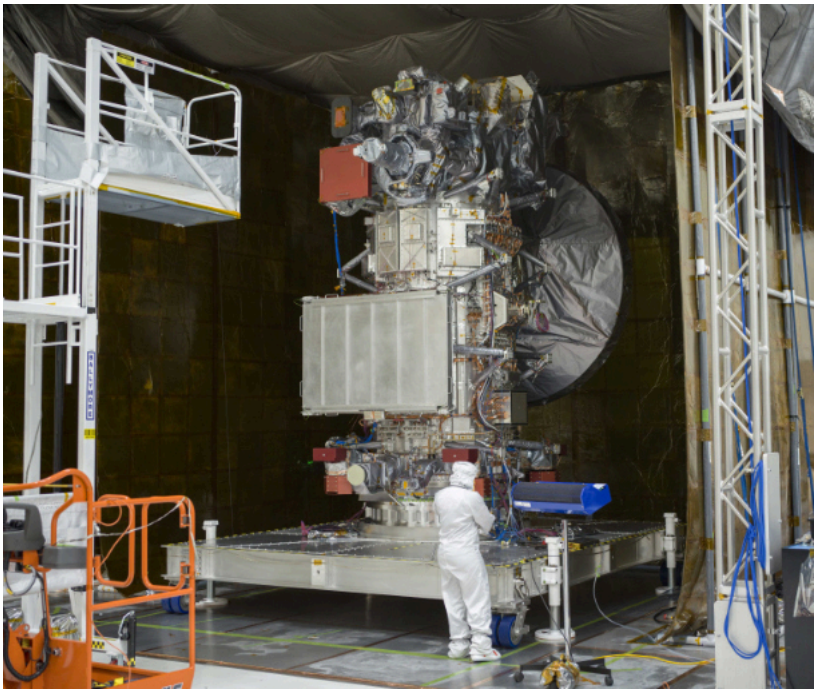
The science performed by the complex suite of instruments recently added to the spacecraft will reveal whether Jupiter's moon Europa has conditions that could support life.

With less than nine months remaining in the countdown to launch, NASA's Europa Clipper mission has passed a major milestone: Its science instruments have been added to the massive spacecraft, which is being assembled at the agency's Jet Propulsion Laboratory in Southern California.

Set to launch from Kennedy Space Center in Florida in October, the spacecraft will head to Jupiter's ice-encased moon Europa, where a salty ocean beneath the frozen surface may hold conditions suitable for life. Europa Clipper won't be landing; rather, after arriving at the Jupiter system in 2030, the spacecraft will orbit Jupiter for four years, performing 49 flybys of Europa and using its powerful suite of nine science instruments to investigate the moon's potential as a habitable environment.

"The instruments work together hand in hand to answer our most pressing questions about Europa," said JPL's Robert Pappalardo, the mission's project scientist. "We will learn what makes Europa tick, from its core and rocky interior to its ocean and ice shell to its very thin atmosphere and the surrounding space environment."

The hallmark of Europa



NASA's Europa Clipper, with all of its instruments installed, is visible in the clean room of High Bay 1 at the agency's Jet Propulsion Laboratory on Jan. 19. The tent around the spacecraft was erected to support electromagnetic testing. Credit: NASA/JPL-Caltech

Europa Clipper, continued.

Clipper's science investigation is how all of the instruments will work in sync while collecting data to accomplish the mission's science objectives. During each flyby, the fully array of instruments will gather measurements and images that will be layered together to paint the full picture of Europa.

"The science is better if we obtain the observations at the same time," Pappalardo said. "What we're striving for is integration, so that at any point we are using all the instruments to study Europa at once and there is no need to have to trade off among them."

From the Inside Out

By studying the environment around Europa, scientists will learn more about the moon's interior. The spacecraft carries a magnetometer to measure the magnetic field around the moon. That data will be key to understanding the ocean, because the field is created, or induced, by the electrical conductivity of the ocean's saltwater as Europa moves through Jupiter's strong magnetic field. Working in tandem with the magnetometer is an instrument that will analyze the plasma (charged particles) around Europa, which can distort magnetic fields. Together, they'll ensure the most accurate measurements possible.

What the mission discovers about Europa's atmosphere will also lend insights into the moon's surface and interior. While the atmosphere is faint, with only 100 billionth the pressure of Earth's atmosphere, scientists expect that it holds a trove of clues about the moon. They have evidence from space- and ground-based telescopes that there may be plumes of water vapor venting from beneath the moon's surface, and observations from past missions suggest that ice and dust particles are being ejected into space by micrometeorite impacts.

Three instruments will help investigate the atmosphere and its associated particles: A mass spectrometer will analyze gases, a surface dust analyzer will examine dust, and a spectrograph will collect ultraviolet light to search for plumes and identify how the properties of the dynamic atmosphere change over time.

All the while, Europa Clipper's cameras will be taking wide- and narrow-angle pictures of the surface, providing the first high-resolution global map of Europa. Stereoscopic, color images will reveal any changes in the surface from geologic activity. A separate imager that measures temperatures will help scientists identify warmer regions where water or recent ice deposits may be near the surface.

An imaging spectrometer will map the ices, salts, and organic molecules on the moon's surface. The sophisticated set of imagers will also support

Europa Clipper, continued.

the full instrument suite by collecting visuals that will provide context for the set of data collected.

Of course, scientists also need a better understanding of the ice shell itself. Estimated to be about 10 to 15 miles (15 to 25 kilometers) thick, this outer casing may be geologically active, which could result in the fracture patterns that are visible at the surface. Using the radar instrument, the mission will study the ice shell, including searching for water within and beneath it. (The instrument's electronics are now aboard the spacecraft, while its antennas will be mounted to the spacecraft's solar arrays at Kennedy later this year.)

Finally, there's Europa's interior structure. To learn more about it, scientists will measure the moon's gravitational field at various points in its orbit around Jupiter. Observing how signals transmitted from the spacecraft are tugged on by Europa's gravity can tell the team more about the moon's interior. Scientists will use the spacecraft's telecommunications equipment for this science investigation.

With all nine instruments and the telecommunications system aboard the spacecraft, the mission team has begun testing the complete spacecraft for the first time. Once Europa Clipper is fully tested, the team will ship the craft to Kennedy in preparation for launch on a SpaceX Falcon Heavy rocket.

More About the Mission

Europa Clipper's main science goal is to determine whether there are places below Jupiter's icy moon, Europa, that could support life. The mission's three main science objectives are to determine the thickness of the moon's icy shell and its surface interactions with the ocean below, to investigate its composition, and to characterize its geology. The mission's detailed exploration of Europa will help scientists better understand the astrobiological potential for habitable worlds beyond our planet.

Find more information about Europa here:

europa.nasa.gov

From the Archives

February, 1971

Observatory Project

I would first like to thank and congratulate those members and guests who were present at the January club meeting. Thanks to their generosity, the "passing of the hat" resulted in an intake of $21.72, an unprecedented total. Apparently the members of the club wish to finance their observatory, which is as it should be. The hat will be passed again at the next meeting and at all future meetings, until we are finished with financing the observatory. Let's try to outdo ourselves.

The total in the observatory fund at the present time (Feb. 1) is $212.21 of which $62.21 is from donations since the end of December, and $150 is from a restructuring of the treasury. I have separated the Treasury into two parts, one of which is to be drawn from for club expenses, which are nominal, and the other which is designated the Observatory fund, and it is funds are reserved for club projects, particularly for the club observatory. For this restructuring, I drew up budget for the next year, and determined that normal operating costs and a large excess would exist if we put about $80.00 into the segment for club expenses, and the remaining club funds into the observatory funds. The actual amount is $81.29. I feel that this procedure will be a great help in the bookkeeping involved with extensive donations and it will give us more or less precise figure for the amount which our club has amassed toward projects such as the observatory.

I have also contacted Olson Construction Company, a prominent construction firm based in Lincoln, and they have promised that they will put in a foundation for the club observatory [FREE]. The only provisos in this agreement are that we have legal title to the land and that we have everything that we are going to on the foundation planned and confirmed and ready to put on it.

I think that this is a small price for a job which would cost us, to do it properly , between $200 and $300. Oh yes. We also have to do the digging. Since we are planning to do this anyway, this is no obstacle.

If anyone has any questions on any of these points please see me at the next meeting and I'll try to clear them up.

–Brian Dodson

Archives, continued.

Notes on the Observatory - February, 1971

At the present time, we are planning on making a roll-off roof type of observatory. There are two possible types of building that could be put up. One possibility is that we could build a cement—block building with a track on top for the sliding roof, or that we could obtain a generous sized metal building, and modify it to be a sliding roof.

This last would be the less expensive method, but would call for some ingenuity on our parts.

As far as the dimensions go, we are considering a building with an internal floor size of from about 12'x12' to 15'x15' The final size will depend on many factors, probably the most important of which will be finances.

If we decide on using the metal building, however, the choice will be limited to what is available and these general sizes would be considered merely as guidelines.

Incidentally, we are now planning, for some time in the future a dedication ceremony for the observatory, at which point of time a plaque will be put up, with names of people. who have been especially helpful towards the completion of the telescope and observatory project. No names have as yet been decided on, but I that the following list of names are obvious choices.

Richard Hartley

Earl Moser

Carl Olsen of Olsen Construction

Mrs. Fred Seacrest

Jess Williams

I realize that this must be an incomplete list, and think that such a list must always slight some people. However, start thinking about this. If you think of people who belong on this list, please submit these names to the Treasurer. I will compile a master list from which the final choices will be made. Would like to emphasize that the final selection will be some time in the future but the time to start working on it is right now.

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.

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

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