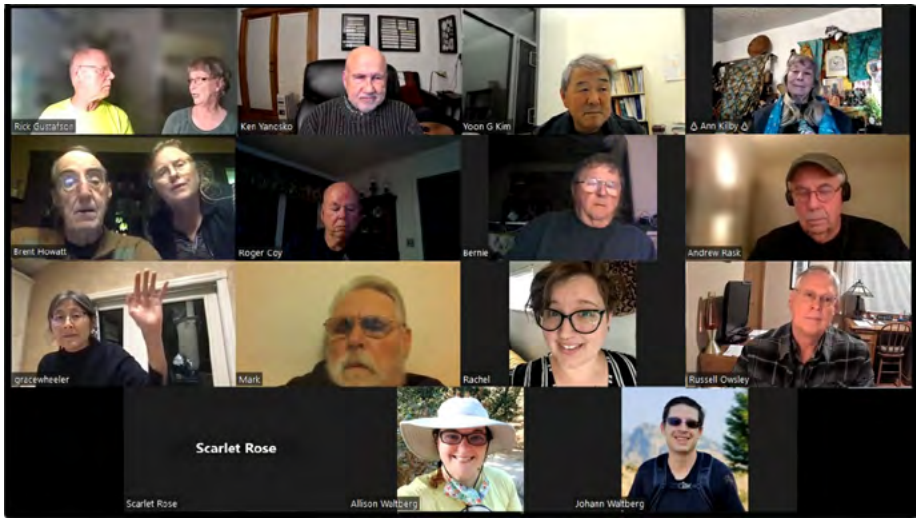
AOH Newsletter

Spring 2024

News and Notes

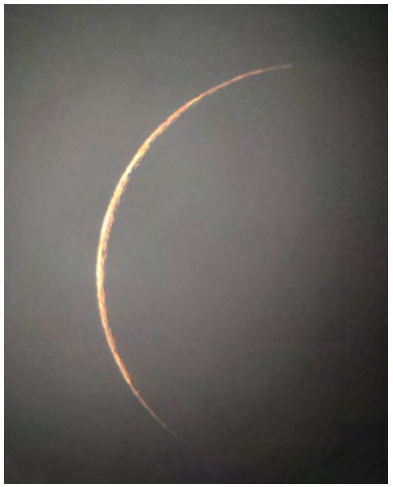
January Zoom Meeting



We began the year with an AOH Zoom meeting; the main focus was planning outreach events at Albee Creek Campground at Humboldt Redwoods State Park. Last year's events were very well received by the Park personnel and by the campers and visitors. Look for calls for volunteers to help out this coming Summer.

February Kneeland Observing

Despite a marginal weather forecast, the clouds held off for our February observing session at Kneeland. We had a good crowd, and the group got in some visual observing and some astrophotography. We saw some planets, Jupiter and Saturn, and looked at the Pleiades, M42 the Orion Nebula, and Andromeda. The sky was beautiful! [Reported by CWH]



Above: dusk at Kneeland and Stormy car-camping, by Johnny Thomas. Right: the New Moon by Allison Waltberg.

Top left: Benjamin, Brent, and Mark, waiting for dark. Top right: Allison and Johann aligning the finderscope. Both photos by Johnny Thomas.

Bottom left: Here is the one picture that we took with the Seestar smart telescope—the Andromeda Galaxy. The live stacking feature wasn't turned on so this is a close approximation as to how M31 would appear in a medium size telescope—the bright core surrounded by fuzzy nebulosity. Photo and description by Grace Wheeler.

Bottom right: The Orion Nebula taken with an Apertura 60mm FPL-53 Doublet APO Refractor, paired with an ASI 533MC Pro camera. The 360mm FL combined with the small camera sensor provides nice framing for many deep-sky objects. Photo and description by Rob Wohleb.

At right: two more photos by Rob Wohleb from Kneeland in February—the Pleiades and the Horsehead Nebula—taken with Apertura 60EDR 60mm FPL-53 Doublet with ZWO ASI533MC Pro Camera.

February Potluck

In February we held our annual potluck dinner at the Eureka Woman's Club. There were 32 AOH members and guests in attendance. Dr. Jon Pedicino of College of the Redwoods gave our feature presentation.

Below: Vice President Mark Wilson welcomes the attendees.

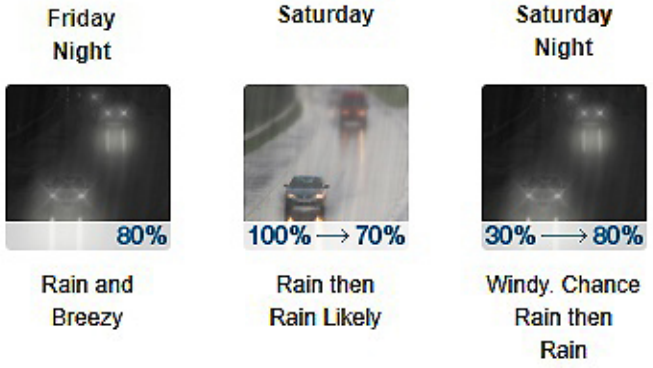
Clockwise from upper left: Speaker Jon Pedicino on "Are We Alone in the Universe?"; the kitchen; Grace presenting a certificate of appreciation to the speaker; the raffle table—everyone got something to take home. Photos by Don Wheeler.

Outreach Awards

Certificates of appreciation and "Night Sky Network Star" pins were awarded at the Potluck dinner to club members who have been supportive of our outreach mission in 2023. The 2023 pin features an image of the Sun and a pivoting lunar disk that partially or annularly eclipses the Sun. The Awardees were: Brent Howatt, Mark Wilson, Ken Yanosko, Catrina Howatt, Bob Zigler, Bernie Christen, Dan Eaton, Rick Gustafson, Mark Mueller, Susie Christian, Yoon Kim, Barry Evans, Don Wheeler, Grace Wheeler, Susan Frances, Stuart Moskowitz, Russ Owsley, Mary Kaufman, Roger Coy, Susan Coy, Allison Waltberg, Johann Waltberg, Susan Parsons, and Jon Pedicino.

Messier Marathon Canceled

We had scheduled the annual Messier Marathon for the weekend of March 8-9, but an unfavorable weather forecast made it necessary to cancel.



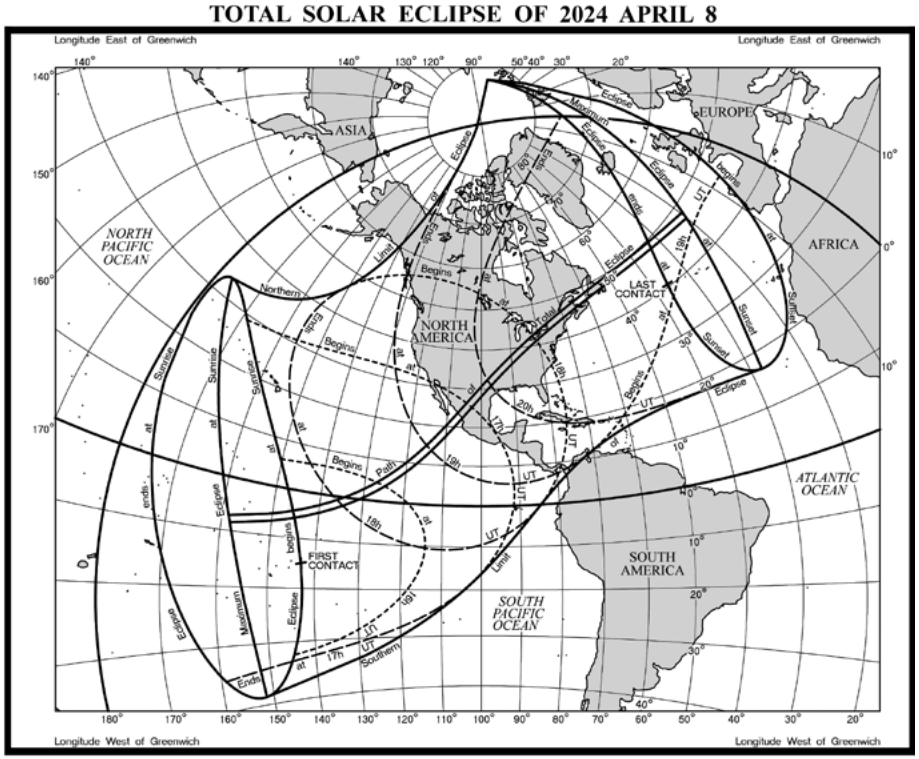
Outreach at the Library

In March AOH Vice President Mark Wilson gave a talk for the general public entitled "Telescopes Big and Small." The talk included a history of telescopes, an exposition of the types of telescopes and mounts, and a survey of modern large-aperture scopes. The event took place at the Arcata Library, and was attended by 15-20 visitors.

The 2024 Solar Eclipse

Americans along a narrow path from Texas to Maine will experience our second "Great American Eclipse" on April 8. (The first was on August 21, 2017, when the path of totality ran from Oregon to South Carolina.) The path of totality is only 115 miles wide, and you want to be as close to the centerline as possible, where the eclipse will last the longest (up to 4 minutes 28 seconds, depending on where you view it from). See the map below.

Those who stay in Humboldt County will get a partial eclipse of magnitude 0.377 (that's the fraction of the Sun's diameter that is covered), and an obscuration of 26.5% (the fraction of the Sun's area that is covered). See the charts at right. Solar glasses are essential.

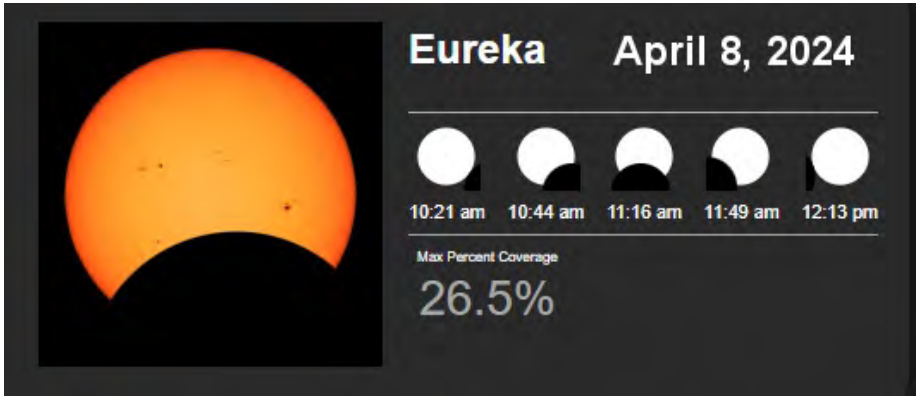


https://aa.usno.navy.mil/downloads/2024_April_TSE.pdf

ASTRONOMICAL APPLICATIONS DEPT.
U.S. NAVAL OBSERVATORY
WASHINGTON, DC 20392-5420 USA

Solar Eclipse of 2024 April 08
Delta T: 72.8s
Sun in Partial Eclipse at this Location
Eureka, CA
40.79° N, 124.15° W
Height 0m

Phenomenon	Time (PDT)	Sun's Altitude (°)	Sun's Azimuth (°)
Eclipse Begins	10:21:23.8	38.6	117.8
Maximum Eclipse	11:16:17.0	47.1	132.3
Eclipse Ends	12:13:48.7	53.8	152.2
Duration		1h 52m 24.8s	
Magnitude		0.377	
Obscuration		26.5%	



https://aa.usno.navy.mil/calculated/eclipse/solar?eclipse=12024&lat=40.79&lon=-124.15&label=Eureka%2C+CA&height=0&submit=Get+Data

https://science.nasa.gov/eclipses/future-eclipses/eclipse-2024/where-when/

Summer Events at Albee Creek

As we discussed at the January Zoom meeting, we have tentative plans to return to Albee Creek Campground in Humboldt Redwoods State Park for our highly successful public observing sessions. Proposed dates are June 29, July 27, and August 24. If you have any interest in participating contact Brent at president@astrohum.org to get more information or to let us know what date or dates you would be interested in.

Barry Evans' Columns

AOH member Barry Evans writes a column entitled "Field Notes" for the general public for the *North Coast Journal*. Frequently he touches on astronomy and cosmology; here are the topics and links from some of his recent endeavors:

The Multiverse: https://www.northcoastjournal.com/life-outdoors/multiverse-29086398;

The Hubble Tension: https://northcoastjournal.com/life-outdoors/cosmic-crisis-28726639;

The Dumbbell Nebula: https://northcoastjournal.com/life-outdoors/the-awesome-dumbbell-nebula-28486259.

Email List

It's happened; the club email list has been pared down to those who have renewed their membership for 2024. If you've stopped getting our meeting notices go to https://www.astrohum.org/membership_renew.html to get fixed up.

Thanks

Thanks to all who helped with the production of the Newsletter: Catrina Howatt, Johnny Thomas, Allison Waltberg, Grace Wheeler, Rob Wohleb, Don Wheeler, Barry Evans, and Susie Christian.

—*Ken*

Book Review: 10 Places to Search for Life Beyond Earth

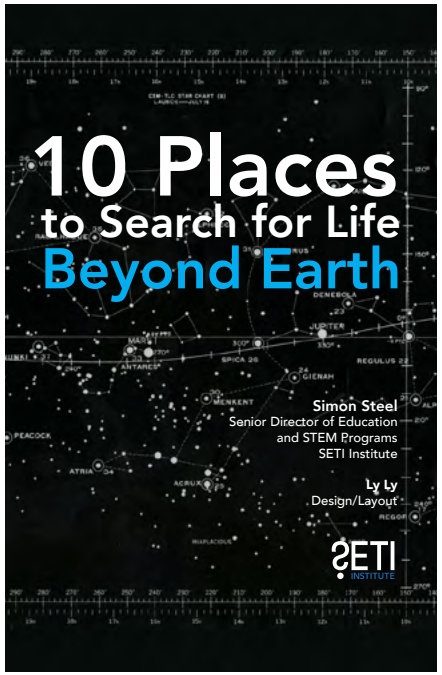
by Ken Yanosko

Here's a brief review for a brief little book by Simon Steel, Senior Director of Education and STEM Programs at the SETI Institute. Only 22 pages long, it lists and describes 5 Solar System locations and 5 neighboring planetary systems that have been of interest to SETI.

These are: Mars, Enceledus, Titan, Europa, Venus, Proxima Centauri b, Trappist 1e, Boyajian's Star, Kepler-452b, and Gliese 1214b.

Each location is represented by a photo or drawing, and a brief description of *why* it is of interest. Of course, you will be left thirsting for more—but that's the whole idea.

SETI—the Search for Extra-Terrestrial Intelligence—is concerned with all the factors of the Drake Equation (https://www.seti.org/drake-equation-index). Scientists affiliated with the SETI Institute, which began as a two-person project in 1984, are currently involved in at least 100 research projects dealing with topics such as the likelihood of a star having a habitable planet, the likelihood of life appearing on such a planet, and the likelihood of such life forms to develop detectable technologies. These are three of the factors in the Drake Equation.



While the Drake Equation cannot be "solved" or even accurately calculated, it retains considerable utility for discussions about extraterrestrial life and intelligence. And that, after all, was the reason for its invention.

And the reason for this

book is to give us a feel for the current scientific projects of the SETI Institute.

You can download the book for free from https://www.seti.org/download-your-free-copy-10-places-search-life-beyond-earth.

Acidalia Planitia Mars: A location on Mars associated with the best-selling novel and Hollywood movie, "The Martian." This area is in the Acidalia Planitia region and in the novel and the movie, it is the landing site of a crewed mission named Ares 3. Credit: REUTERS/NASA/JPL-Caltech/Univ. of Arizona

Some 40 light-years from Earth, a planet called TRAPPIST-1e offers a heart-stopping view: brilliant objects in a red sky, looming like larger and smaller versions of our own moon. But these are no moons. They are other Earth-sized planets in a spectacular planetary system outside our own. Credit: NASA-JPL/Caltech

Solar Cycle 25 and AR3590

by Grace Wheeler

We are in our fifth year of Solar Cycle 25 and solar maximum has been revised by NOAA to occur between now and October 2024; this is several months earlier than the original prediction of July 2025: https://www.weather.gov/news/102523-solar-cycle-25-update. The accelerated timeline for solar maximum is due to the higher-than-predicted solar activity which includes sunspot activity and solar eruptions.

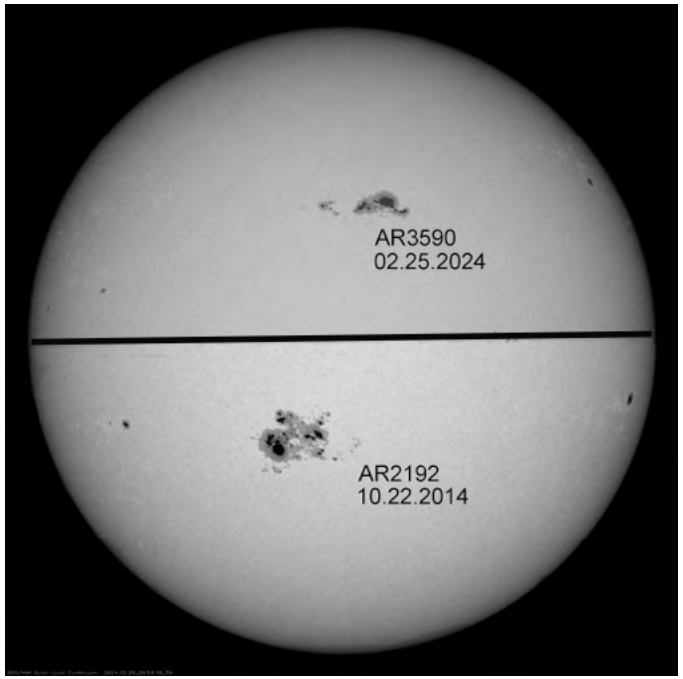


Figure 1. A composite image of the sun showing the size difference between AR3590 (Solar Cycle 25) and AR2192 (Solar Cycle 25).

Visually, AR2192 is about the size of Jupiter. A more accurate way of determining its size is to use micro-hemisphere or MH (MH is a millionth of a solar hemisphere or 600,000 square miles). At the peak of its growth, AR2192 was measured to be 2750 MH (1.65 billion square miles).

The main sunspot of AR3590 is about 9 times the Earth's diameter. At the maximum size, AR3590 had an area of 1450 MH (870 million square miles).

AR3590 is about half the size of AR2192.

Image Credit: Images of the solar disk with sunspots were downloaded from http://sdo.gsfc.nasa.gov.

As we approach the solar maximum and the reversal of the magnetic poles, we can expect to see more sunspots and eruptive events such as solar flares (explosions that happen as magnetic lines reconnect) and CMEs (coronal mass ejections of plasma and magnetic fields).

The Evolution of AR3590

While Solar Cycle 25 has been exceptional for sunspot activity, I have been disappointed that there hasn't yet been a Jupiter-sized sunspot. The last Jupiter-sized sunspot, AR2192 occurred in late October of 2014 during Solar Cycle 24 and was the largest sunspot in two solar cycles. At its maximum size, AR2192 was 2750 MH in area (See Figure 1 for explanation). When AR3590 rotated into view on February 18th and grew rapidly over the next several days (it was visible on the solar disk with just eclipse glasses), my hope was that this would be the long-awaited Jupiter-sized sunspot. AR3590 instead maxed out at a respectable 1450 MH (about nine times the area of the Earth) and about half the size of AR2192. Sunspot measurements are done daily by NOAA/SWPC and can be found here: https://www.swpc.noaa.gov/phenomena/sunspotssolar-cycle.

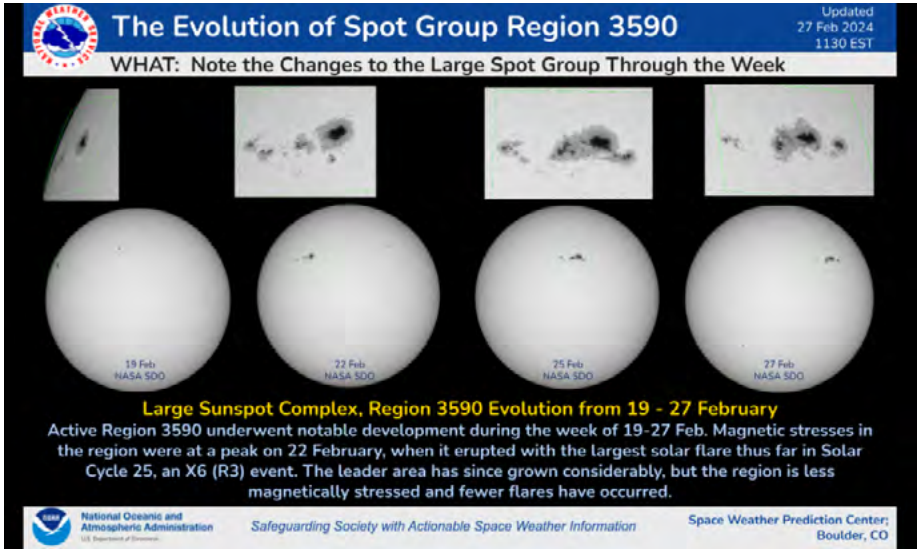


Figure 2. Evolution of Sunspots in AR3590

On February 19, the sunspot complex in AR3590 contained four sunspots and was about three times the area of the Earth (530 MH). At its maximum size on February 25, AR3590 contained 29 sunspots and was eight times the area of the Earth (1450 MH). (Note: The Earth is 175 MH.)

Image credit: https://www.swpc.noaa.gov/news/sunspot-region-3590-evolution-february-19-27th.

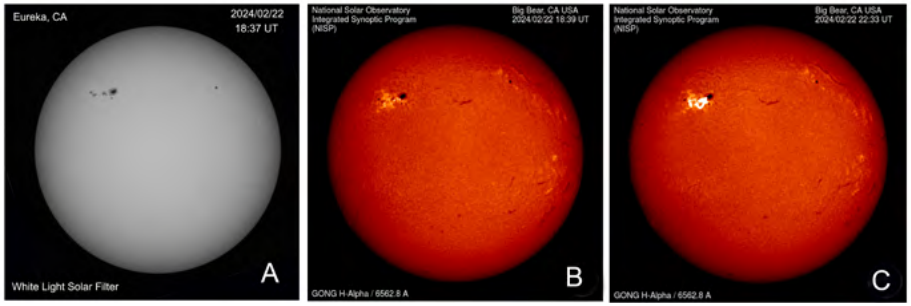


Figure 3. The Sun on February 22, 2024. (A) AR3950 with its complex of sunspots. The sun was imaged through an 80 mm refractor with a white solar filter. (B) Hydrogen-alpha solar image at 10:39 a.m. showing AR 3950. (C) Hydrogen-alpha solar image at 2:30 p.m. showing the brightening of AR3950 during the eruption of the X6.3 solar flare. Image credit: (A) was taken by GDW; (B) and (C) were from the National Solar Observatory/NSO Integrated Synoptic Program.

Although AR3590 fell short of the size goal, it was still interesting to watch it grow from a single Earth-sized sunspot into a complex of sunspots that was about nine times the diameter of Earth (Figures 1, 2). Magnetograms of AR3590 also showed the evolution of its magnetic field from a simple unipolar magnetic field (alpha-class) to a more complex and volatile magnetic field (beta-gamma-delta). The high stresses contained in this complex field made AR3590 a candidate for producing M- and X-class solar flares. If the explosions produced by M- and X-class flares were directed at. Earth, these could affect radio communications as well as cause high altitude radiation storms. M- and X- flares are also capable of launching CMEs which can cause geomagnetic storms and aurorae. X-flares are the most powerful of solar flares and are classified from X1 to X10 in intensity (the most powerful X-flare was in 2003 and was estimated to be X45.) More about solar flares can be found here: https://svs.gsfc.nasa.gov/10109/.

Solar Flares in AR3590

The first few days after AR3590 rotated into view, solar flares were predominantly the weak C-class flares with a few more potent M-class flares. On February 21-22, AR3590 appeared to live up to its potential when it released three X-class flares within a 24-hour period. The first two flares were X1.7 and X1.8, and the third was X6.3 (Figure 3). To date, the X6.3 was the strongest solar flare in the Solar Cycle 25. None of these X-flares triggered CMEs, and only a brief disruption of shortwave radio communication was seen on Earth.

At the time of the X-flares of February 21-22, AR 3950 was still in the northeastern quadrant of the sun, and any flares or CMEs reaching the Earth would have hit with a glancing blow. There was concern that once the sun's rotation brought AR3950 into the center of the disk (Figure 4), and more in direct line with Earth, X- flares and CMEs could cause significant geomagnetic storms. These storms could disrupt telecommunications and affect power grids (https://www.swpc.noaa.gov/phenomena/geomagnetic-storms). That threat never materialized and for the remainder of the time that AR3950 was Earth-facing, it released only the less powerful C- and M-class flares. It is thought that the energy released from the earlier X- flares weakened the magnetic field into a less volatile state.

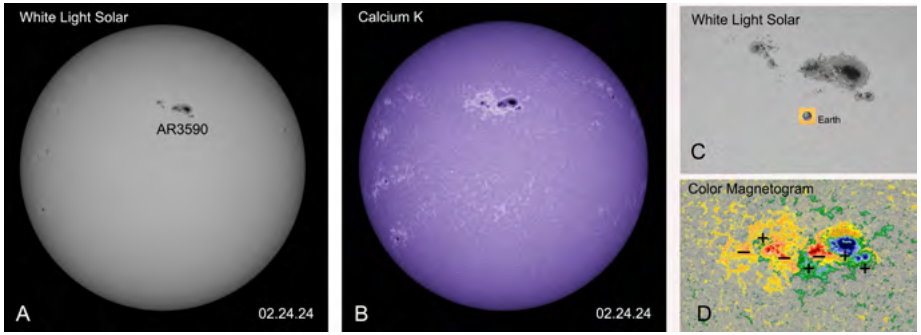


Figure 4. The Sun imaged on February 24, 2024 when AR3590 was in the near center of the disk. All flares produced were C- and M-types. (A) The Sun imaged with a white light solar filter. AR3950 is shown nearly in the center of the disk. (B) The Sun imaged with Calcium-K line (CaK) filter which samples the lower chromosphere. In CaK, the brightest areas of the chromosphere shows where magnetic field is strongest. (C) The sunspot complex in AR3950. By this time, the size of the sunspot is about 8 times the area of the Earth. (D) The color magnetogram of AR3950 where positive polarities are blue/green and negative polarities are red/yellow. The magnetogram shows magnetic fields concentrated in a small area. In this configuration (beta-gamma-delta), the overall magnetic field of the active region is primed to produce flares. https://www.spaceweather.com/archive.php?view=1&day=24&month=02&year=2024.

Image Credit: (A), (B), (C) were taken by GDW; (D) The color magnetogram is from https://sdo.gsfc.nasa.gov.

AR3590 sets the record for Solar Cycle 25 (so far)

Although AR3590 did not grow to Jupiter size, it was still the largest sunspot complex for Solar Cycle 25. Its complex magnetic field made it the most active sunspot region of this cycle, and it produced 3 X-, 10 M-, and 47 C-class flares. Flare X6.3 was the strongest flare of this solar cycle and the largest since the September 9th 2017 solar storm. None of the X-flares from AR3590 triggered a CME, and of the ten M-flares, only one launched a CME (February 27). The reasons for the paucity of X- and M-associated CMEs in AR3590 are unclear. A similar phenomenon was seen in AR2192 which also had no CMEs despite being a producer of X- and M-flares. Dr. C. Alex Young (NASA Goddard and TheSunToday.org) has suggested that both AR2192 and AR3590 have "overlying magnetic field structure that restricts the eruptive nature necessary to produce CMEs": https://earthsky.org/sun/sun-news-activity-solar-flare-cme-aurora-updates/?utm_source=Earthsky.org.

It is unclear when the solar maximum for Solar Cycle 25 will occur or if we are even in it right now (we won't know this until end of the solar cycle). NOAA projects that even if solar maximum were to occur in 2024, we can expect high solar activity through 2025 and perhaps into 2026. I may still get my Jupiter-sized sunspot.

Grace Wheeler is a former President and Newsletter Editor for AOH. She does her daytime observing from her home on Humboldt Hill in Eureka. She writes "I like it when my neighbors (and the Postman) drop by to look at the sun."

12P Pons-Brooks: A Cryovolcanic Comet Swings by Earth

by Grace Wheeler

For comet-watchers, the arrival comet 12P/Pons-Brooks is finally here, and the question that is being asked is how bright will comet become? Pons-Brooks is a periodic Halley-type comet that makes an appearance every 71 years. It is one of the brighter comets and can shine at magnitude 5 at perihelion. The comet bears the name of Jean-Louis Pons, who first identified it in 1812, and William Brooks, who rediscovered it in 1883. The last apparition of Pons-Brooks was in 1954, and the current arrival will be its fourth since the comet's discovery by Pons. Pons-Brooks is unusual in that it undergoes sudden periodic brightening. Pons-Brooks is a cryovolcano that spews out massive amounts of cryomagma made of gas and dust. The gas and dust reflect the sunlight and cause an intense brightening of the coma. More about cryovolcanoes on comets: https://spaceweatherarchive.com/2021/10/14/volcanic-comet-blows-its-top/.

Pons-Brooks made headlines on July 20, 2023 when it suddenly brightened from magnitude 16 to 11, a difference of one hundredfold. Pons-Brooks, which had been nearly undetectable except in large telescopes, was now brighter and visible in moderately-sized telescopes: https://skyandtelescope.org/astronomy-news/see-comet-12p-pons-brooks-in-outburst. The coma of Pons-Brooks had horn-like structures, and the comet was dubbed "The Devil Comet." It has also been compared to a horseshoe crab and the Millennium Falcon from Star Wars. Since its first eruption in July, the comet has undergone a handful of outbursts: October 13th, November 1st and 18th, December 14th, and January 18th. An increase in brightness was seen after each of the eruptions while the horns seemed to be less apparent after the November 18th outburst: https://www.virtualtelescope.eu/2023/10/15/comet-12p-pons-brooks-a-new-image-13-oct-2023/ and https://www.baader-planetarium.com/en/blog/observe-comet-12p-pons-brooks-now/.

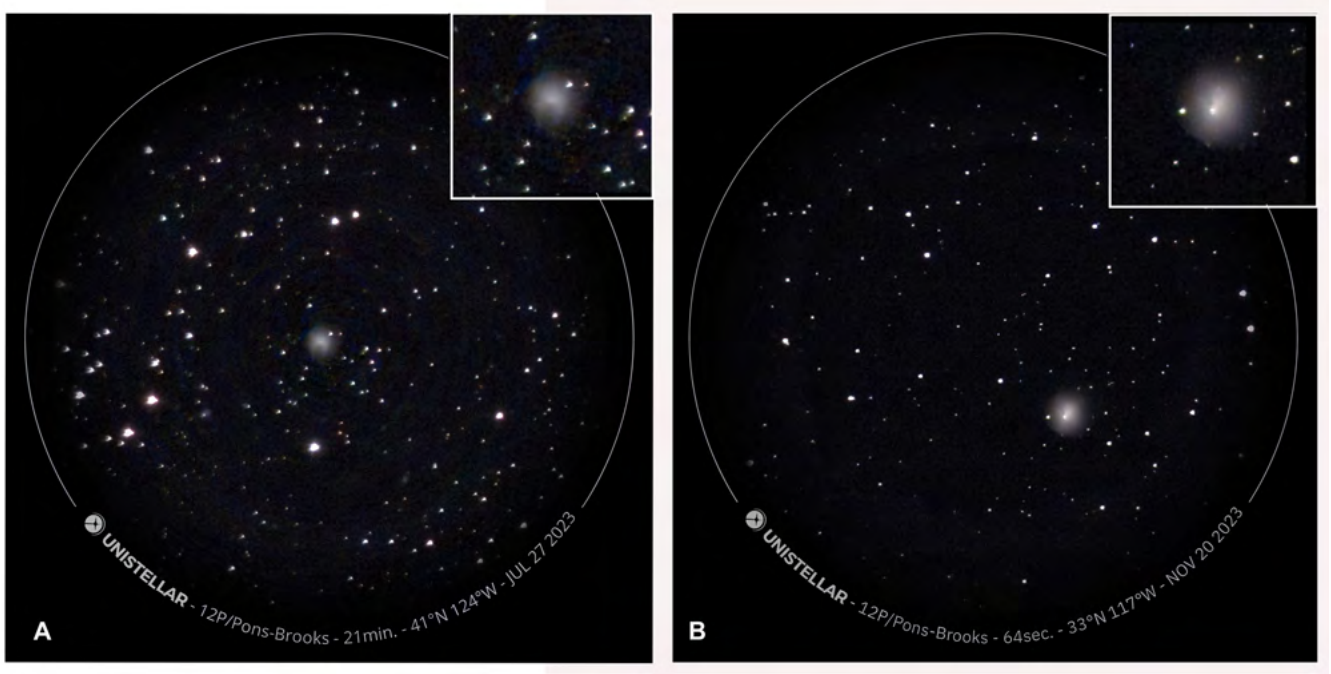


Figure 1. 12P/Pons-Brooks during the eruptions of July 2023 and November 2023.

(A) In the initial outburst, horns could be seen on the coma. The comet was imaged on July 27th with a Unistellar eQuinox telescope. Image credit: GDW.

(B) Pons-Brooks during an outburst on November 20th. The horns in the coma appear to be diminished. Image of Pons-Brook taken was taken with a Unistellar eVScope. Image credit: Scott Kardel .

Approaching Perihelion; Observations from Eureka

12P/Pons-Brooks has been touted to be the brightest comet of 2024 because of its potential of becoming a naked-eye object as it travels closer to the sun. In early March, Pons-Brooks was a magnitude 6.8 and was visible with binoculars under dark rural skies: https://bit.ly/3uS0CjQ. From Eureka, I tried to find the comet

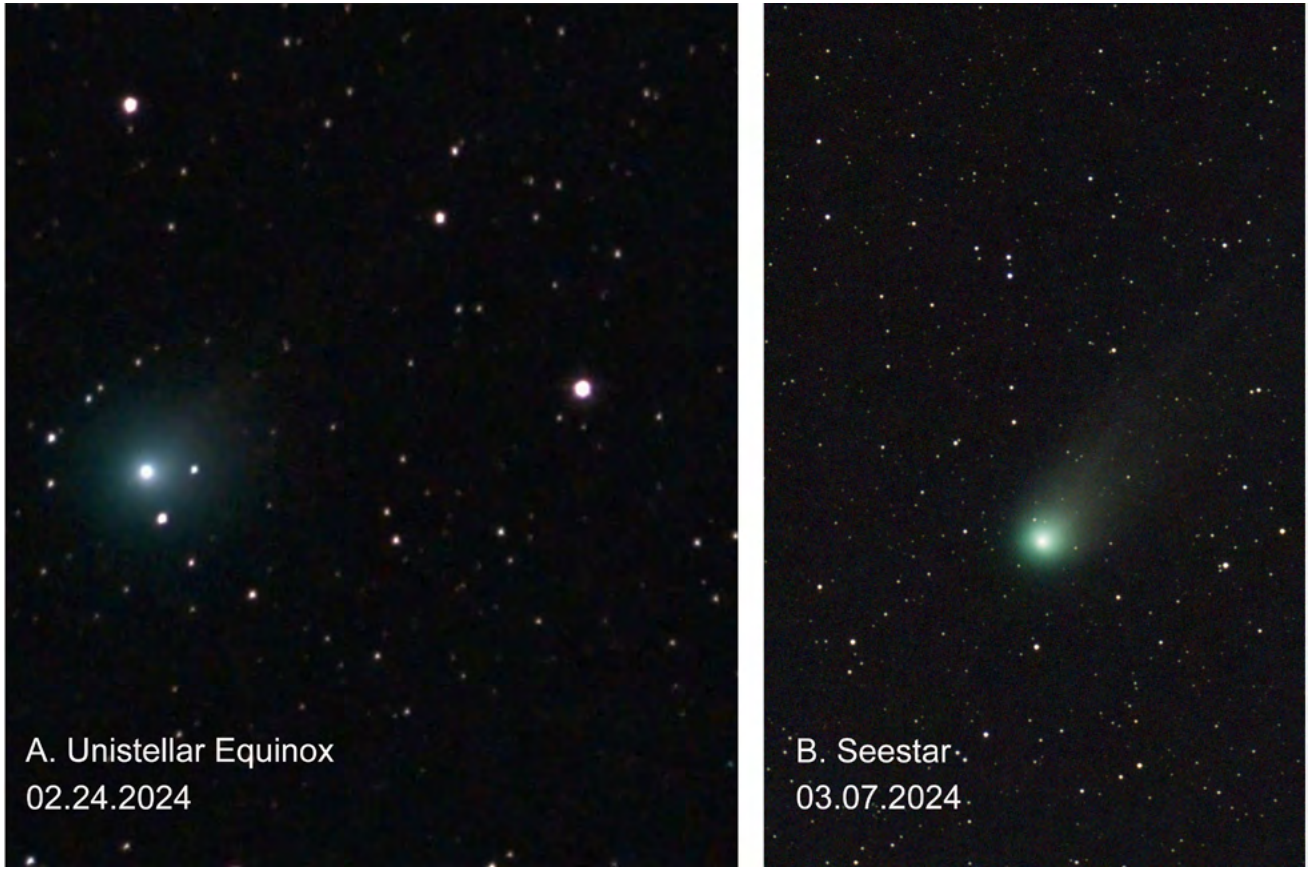


Figure 2. Two images of Pons-Brooks.

(A) The comet was imaged with a Unistellar Equinox smart telescope on February 24th at 6:45 p.m. The image was taken from northwest Pennsylvania, Bortle 2-3. Image credit: Linda Duffy.

(B) Pons-Brooks was imaged with a Seestar smart telescope on March 7th at 7:20 p.m. The photo was taken from Humboldt Hill. Image credit: GDW.

with binoculars on March 7th when it was to the upper right of the star Alpheratz. I started searching 75 minutes after sunset when the comet was in the northwest at 20 degrees above the horizon. While I did see a dim smudge through binoculars, I'm not convinced it was the comet. I was more successful at finding Pons-Brooks with a Seestar smart telescope and could see the bright coma and a hint of a tail (Figure 2). I went out again on March 9th to observe Pons-Brooks with a six-inch Schmidt-Cassegrain. With the telescope, the comet was a small and bright fuzzy patch that was distinct from the pinpoint stars. The greenish coma was present, but not the tail. I still wasn't able to find the comet with binoculars, and I suspect it is because my observing site on Humboldt Hill (Bortle 4.5) is not dark enough.

The best time to search for Pons-Brooks is in March. An unobstructed view of the horizon is needed because the comet is low in the sky. Because the comet is setting in the west, the glow from twilight will make it challenging to see. It will be a race to observe the comet because of the lengthening day, and Pons-Brooks loses altitude throughout the month (Figure 3). By the end of March, Pons-Brooks is predicted to reach magnitude 5.2 and can potentially be seen with the unaided eye. A detailed map for finding Pons-Brooks on a specific date can be found here: https://theskylive.com/12p-info.

Comet Pons-Brooks and Cryovolcanic eruptions near Perihelion

Except for the January 18th eruption, there have been no further outbursts in Pons-Brooks this year. At the time of this writing (March 9th), the comet has a magnitude of 5.5-6 and is possibly on the verge of becoming a naked-eye object: https://www.facebook.com/photo?fbid=803608618481966&set=a.417916517051180.

There has been some speculation that a cryovolcanic eruption could bring brightness to the naked-eye territory. However, comet expert John Bortle thinks that eruptions would have little effect on the current brightness of Pons-Brooks. Comets grow brighter as they approach the sun because of the solar evaporation of gas and dust from the nucleus. The gas and dust form the coma and the tail, and these in

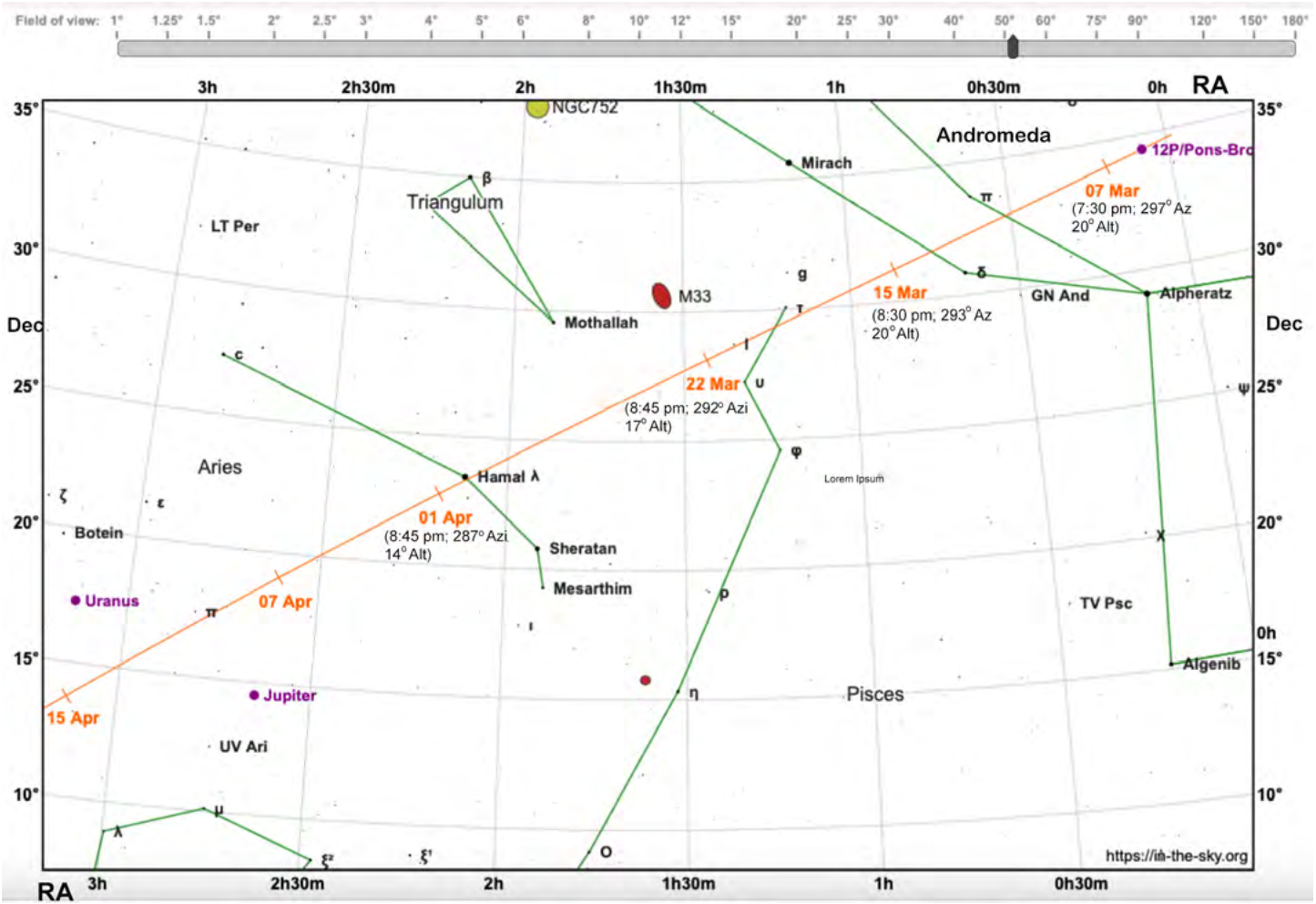


Figure 3. The path that Pons-Brooks travels through the sky in March. Given are specific dates with local time, azimuth and altitude for viewing comet in Eureka, CA. Image credit: Dominic Ford, in-the-sky.org, with chart modifications by GDW.

turn reflect the sunlight. As the comet draws closer to perihelion, the brightness intensifies as more light is reflected, and more gas and dust are evaporated from the nucleus. Cryovolcanic eruptions do not add much to the brightness at this point in the comet's journey. According to John Bortle, "the outburst brightness cannot overwhelm the overall brightness of the comet's coma as easily": https://www.space.com/comet-12p-pons-brooks-march-2024.

Even if Pons-Brooks does not live up to becoming a naked-eye object, it has been an interesting comet to observe from its cryovolcanic activities when it was far from the Earth, to its current state of brightening as it heads to the sun.

Acknowledgment: Many thanks to Scott Kardel and Linda Duffy (the Unistellar eVScopes and eEquinox Users, USA, Facebook group) for sharing their images.

When the Sun goes down, Grace Wheeler removes her solar filters and concentrates on finding the less-bright objects in the sky.

This article is distributed by the NASA Night Sky Network, a coalition of hundreds of astronomy clubs across the US dedicated to astronomy outreach.

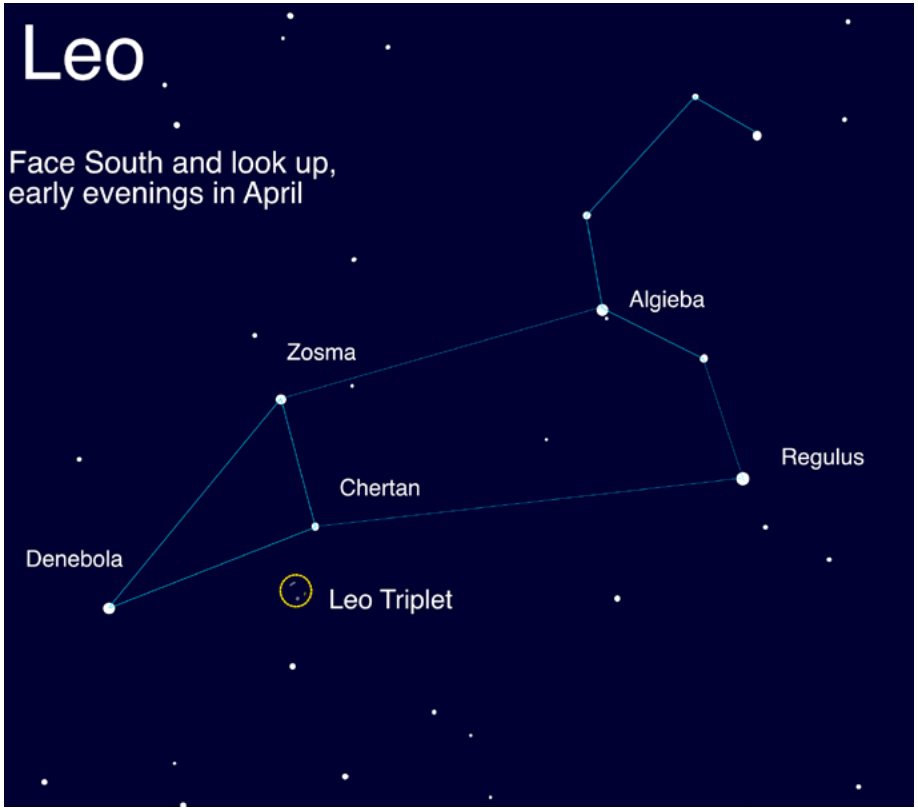
Watch the Lion: Celestial Wonders in Leo

by David Prosper

Leo is a prominent sight for stargazers in April. Its famous sickle, punctuated by the bright star Regulus, draws many a beginning stargazer's eyes, inviting deeper looks into some of Leo's celestial delights, including a great double star and a famous galactic trio.

Leo's distinctive forward sickle, or "reverse question mark," is easy to spot as it climbs the skies in the southeast after sunset. If you are having a difficult time spotting the sickle, look for bright Sirius and Procyon and complete a triangle by drawing two lines to the east, joining at the bright star Regulus, the "period" in the reverse question mark. Trailing them is a trio of bright stars forming an isosceles triangle, the brightest star in that formation named Denebola. Connecting these two patterns together forms the constellation of Leo the Lion, with the forward-facing sickle being the lion's head and mane, and the rear triangle its hindquarters. Can you see this mighty feline? It might help to imagine Leo proudly sitting up and staring straight ahead, like a celestial Sphinx.

If you peer deeper into Leo with a small telescope or binoculars, you'll find a notable double star! Look in the sickle of Leo for its second-brightest star, Algieba - also called Gamma Leonis. This star splits into two bright yellow stars with even a small magnification - you can make this "split" with binoculars, but it's more apparent with a telescope.



The stars of Leo: note that you may see more or less stars, depending on your sky quality. The brightness of the Leo Triplet has been exaggerated for the purposes of the illustration - you can't see them with your unaided eye.

Compare the color and intensity of these two stars - do you notice any differences? There are other multiple star systems in Leo – spend a few minutes scanning with your instrument of choice, and see what you discover.

One of the most famous sights in Leo is the "Leo Triplet": three galaxies that appear to be close together. They are indeed gravitationally bound to one another, around 30 million light years away! You'll need a telescope to spot them, and use an eyepiece with a wide field of view to see all three galaxies at once! Look below the star Chertan to find these galaxies. Compare and contrast the appearance of each galaxy – while

Your view of the three galaxies [M65, M66, and NGC3628 "The Hamburger"] in the Leo Triplet won't look as amazing as this image taken by the VLT Survey Telescope, unless you have a telescope with a mirror 8 feet or more in diameter! Still, even a small telescope will help your eyes pick up these three galaxies as "faint fuzzies": objects that seem blurry against a background of pinpoint stars. Let your eyes relax and experiment with observing these galaxies by looking slightly away from them, instead of looking directly at them; this is called averted vision, a handy technique that can help you see details in fainter, more nebulous objects.

Image Credit: ESO, INAF-VST, OmegaCAM; Acknowledgement: OmegaCen, Astro-WISE, Kapteyn I.

they are all spiral galaxies, each one is tilted at different angles to our point of view! Do they all look like spiral galaxies to you?

April is Citizen Science Month, and there are some fun Leo-related activities you can participate in! If you enjoy comparing the Triplets, the "Galaxy Zoo" project (galaxyzoo.org) could use your eyes to help classify different galaxies from sky survey data! Looking at Leo itself can even help measure light pollution: the Globe at Night project (globeatnight.org) uses Leo as their target constellation for sky quality observations from the Northern Hemisphere for their Spring campaign, running from March 31 to April 9 and April 28 to May 7. Find and participate in many more NASA community science programs at science.nasa.gov/citizenscience. Happy observing!

David Prosper is the former Night Sky Network Coordinator for the Astronomical Society of the Pacific.

Addendum: The *Other* Leo Triplet(s)

While you're looking at the Leo Triplet, swing westward to a point midway between there and Regulus, to find three more relatively bright galaxies: M95 (farthest to the right), M96, and M105. They are about twice as far apart (in angular separation) as the "real" Triplet. But if it's closeness you want, right up against M105 are two other galaxies: NGC3384 and NGC3389. All these are the brightest members of the "Leo I" cluster, which is also sometimes denoted as the "M96 Cluster." This cluster contains 20 to 50 galaxies brighter than magnitude 13. Some catalogs even include the Triplet as an outlying part of this group.

Bottom right: M95; bottom middle M96; upper left: the roundish elliptical M105 with the elongated elliptical NGC3384 and the smaller spiral NGC3389.
Image credit: http://www.messier.seds.org/more/m096gr.html.

What ended the 'dark ages' in the early universe? New Webb data just brought us closer to solving the mystery.

by Themiya Nanayakkara

About 400,000 years after the Big Bang, the cosmos was a very dark place. The glow of the universe's explosive birth had cooled, and space was filled with dense gas – mostly hydrogen – with no sources of light.

Slowly, over hundreds of millions of years, the gas was drawn into clumps by gravity, and eventually the clumps grew big enough to ignite. These were the first stars.

At first their light didn't travel far, as much of it was absorbed by a fog of hydrogen gas. However, as more and more stars formed, they produced enough light to burn away the fog by "reionising" the gas – creating the transparent universe dotted with brilliant points of light we see today.

NASA / ESA / CSA / Ivo Labbe (Swinburne) / Rachel Bezanson (University of Pittsburgh) / Alyssa Pagan (STScI)

But exactly which stars produced the light that ended the dark ages and triggered this so-called "epoch of reionisation"? In research published in Nature, we used a gigantic cluster of galaxies as a magnifying glass to gaze at faint relics of this time – and discovered that stars in small, faint dwarf galaxies were likely responsible for this cosmic-scale transformation.

What ended the dark ages?

Most astronomers already agreed that galaxies were the main force in reionising the universe, but it wasn't clear how they did it. We know that stars in galaxies should make a lot of ionising photons, but these photons need to escape the dust and gas inside their own galaxy to ionise hydrogen out in the space between galaxies.

It hasn't been clear what kind of galaxies would be able to produce and emit enough photons to get the job done. (And indeed, there are those who think more exotic objects like big black holes may have been responsible.)

There are two camps among adherents of the galaxy theory.

The first thinks huge, massive galaxies produced the ionising photons. There were not many of these galaxies in the early universe, but each one produced a lot of light. So if a certain fraction of that light managed to escape, it might have been enough to reionise the universe.

The second camp thinks we are better off ignoring the giant galaxies and focussing on the huge number of much smaller galaxies in the early universe. Each one of these would have produced far less ionising light, but with the weight of their numbers they could have driven the epoch of reionisation.

A magnifying glass 4 million lightyears wide

Trying to look at anything in the early universe is very hard. The massive galaxies are rare, so they are hard to find. Smaller galaxies

are more common but they are very faint, which makes it difficult (and expensive) to get high-quality data.

We wanted a look at some of the faintest galaxies around, so we used a huge group of galaxies called Pandora's Cluster as a magnifying glass. The enormous mass of the cluster distorts space and time, amplifying the light from objects behind it.

As part of the UNCOVER program, we used the James Webb Space Telescope to look at magnified infrared images of faint galaxies behind Pandora's Cluster.

We first looked at many different galaxies, then chose a few particularly distant (and therefore ancient) ones to examine more closely. (This kind of close examination is expensive, so we could only look at eight galaxies in greater detail.)

The bright glow of hydrogen

We selected some sources which were around 0.5% of the brightness of our Milky Way galaxy at that time, and checked them for the telltale glow of ionised hydrogen. These galaxies are so faint they were only visible at all thanks to the magnifying effect of Pandora's Cluster.

Our observations confirmed that these small galaxies did exist in the very early universe. What's more, we confirmed they produced around four times as much ionising light as we would consider "normal". This is at the highest end of what we had predicted, based on our understanding of how early stars formed.

Because these galaxies produced so much ionising light, only a small fraction of it would have needed to escape to reionise the universe.

Previously, we had thought that around 20% of all ionising photons would need to escape from these smaller galaxies if they are to be the dominant contributor to reionisation. Our new data suggests even 5% would be sufficient – which is about the fraction of ionising photons we see escaping from modern galaxies.

So now we can confidently say these smaller galaxies could have played a very large role in the epoch of reionisation. However, our study was only based on eight galaxies, all close to a single line of sight. To confirm our results we will need to look at different parts of the sky.

We have new observations planned which will target other large galaxy clusters elsewhere in the universe, to find yet more magnified, faint galaxies to test. If all goes well, we will have some answers in a few years.

Two of the most distant galaxies ever seen, as magnified by Pandora's Cluster. NASA/ ESA/ CSA/ T. Treu (UCLA), CC BY

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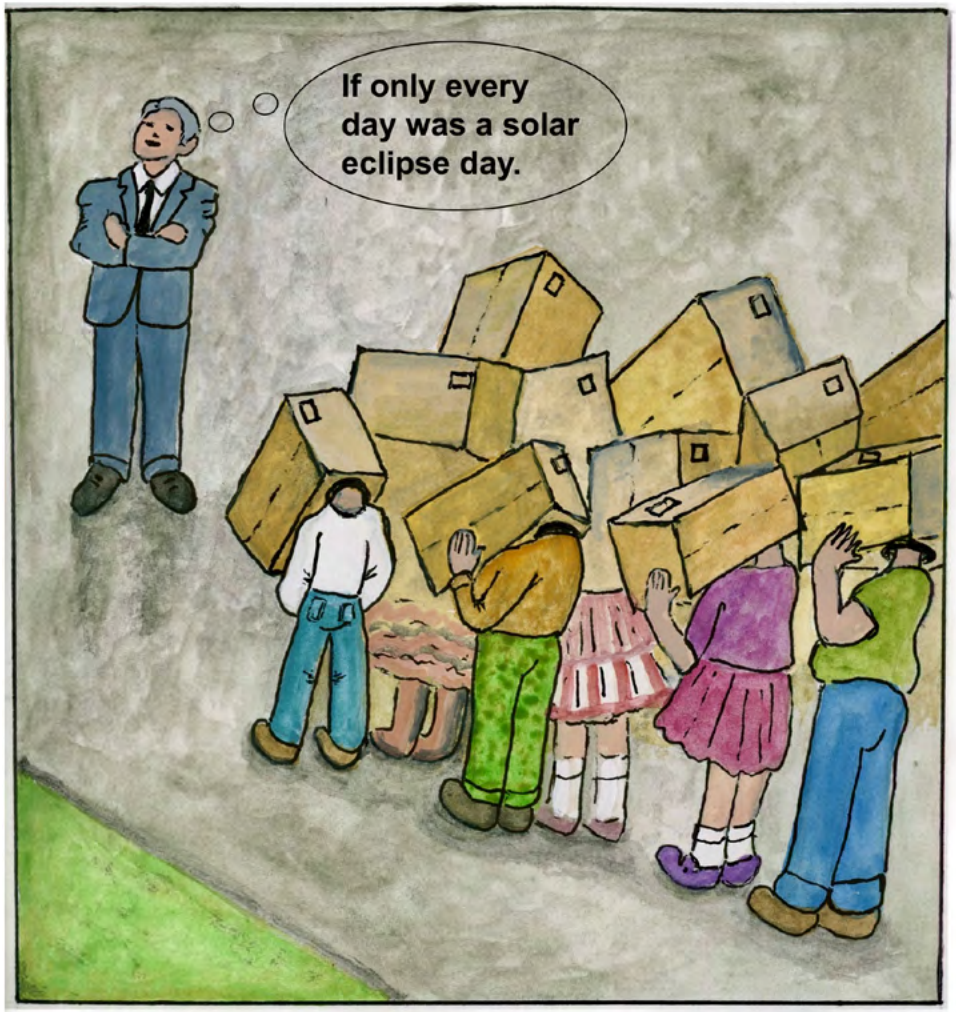
Heavenly Bodies

by Susie Christian



Then: Cardboard Eclipse Viewers (1960's)

https://www.instructables.com/Cardboard-Box-Eclipse-Viewer/

Now: Solar Safe Eclipse Glasses