# NWASNEWS

Volume30 Issue1

September 2023

**Newsletter for the Wiltshire, Swindon, Beckington, Bath Astronomical Societies**




## Welcome to our new season

It is a very important summer for the members of Wiltshire Astronomical Society to decide how it goes forward. We need several roles to be filled by volunteers going forward, many of these roles can be done by the same person but a full list of roles and the duties or on the web site.

Our speaker secretary has resigned with plenty of notice but no one hs yet stood in.

The hall coordinator has been ansent with family issues and other duties for tea/ coffee supplies and projector etc has also stood down for the past 12 months.

Now I am sorry to say again I have to retire due to health problems, and these may mean if the last ditch medication attempts don't work I shall have to have invasive operations that will mean I can't drive for 3 months plus recovery period for EACH HAND. Thank heavens I'm not an octopus. But seriously I had stood back five years ago but stood back to see us through COVID period.

Individully the tasks I do are not onerous, but when all are added together they are too much for one person.

On the good news side the increase in the Hall hire fee is much less than we initially feared and with the accounts nearly complete for the year we can certainly keep Seend as our meeting base, and Lacock for our observing sessions.

It is now up to the members to attend those meetings. One meeting we only had 8 persons there and 4 were committee.

We have had some ideas to change what we do at meetings. Some more practical sessions on equipment and computer use. Still maintaining some speakers and possibly going to 3-4 meetings on Zoom to keep these costs down.

Here is a list of vacant roles…

Chair Person

Outreach coordinator

Newsletter/Publicity

Hall Coordinator

Live Meeting Supplies and Equipment

Zoom Session Coordinator

Speaker Secretary.

A list of other roles and expectations are on the web site.

But the society is healthy and should go forward in some form or other. It is up to you, the members how this goes forward.

Clear skies

Andy Burns

Note we have a very full observing year from Lacock planned. See the web page and back page of the newsletter.

Perhaps the best Noctilucent clouds of this summer were on the 5th July.
These clouds were not recouded before 1883 and the eruption of Krakatoa, but they exist at a height of nearly 60 miles were the atmosphere should be too dry for droplets to form around minute dust particles, but space rockets and incoming meteorites are bringing the water to the upper levels.
When the Sun is about 18 degrees below the horizon it can light up these high clouds that can by hundreds of miles to the north of us here in Wiltshire.

Photo Andy Burns,

## Wiltshire Society Page

**Wiltshire Astronomical Society**

**Web site: www.wasnet.org.uk**

**Facebook members page: [https://www.facebook.com/groups/wiltshire.astro.society/](https://www.facebook.com/groups/wiltshire.astro.society/)**

**Meetings 2023**

**HALL VENUE the Pavilion, Rusty Lane, Seend**

**Some Speakers have requested Zoom Meetings we will try to hold these at the hall**

**Meet 7.30 for 8.00pm start**

**SEASON 2022/23**
**2023**

September 5th Jonathan Gale The Lunar 100 (Hall)
October 3rd:
November 7th:
December 5th
**2024**
January 2nd
February 6th
March 5th
April 2nd
May 7th
June 4th

AWAITING A SPEAKER SECRETARY FOR 23/24 SEASON

Jonathan Gale

The Lunar 100.

Some may see it as an annoying light source, other a romantic interlude to our observing sessions, but it has plenty of interesting objects on its surface, a certainly a lot of excitement from recent Earthly approaches to its southerly regions, some good, some failures.

What can we see through even the humblest telescope of even binoculars?

One of our long term members and eye to the eyepiece astronomers Jonathan Gale pus forward his views of the Lunar 100.

**Membership Meeting nights £1.00 for members £3 for visitors**

Members can renew or new members sign up online via [https://wasnet.org.uk/membership/](https://wasnet.org.uk/membership/) and also remind them they can pay in cash too on the door.

**Wiltshire AS Contacts**

Chairperson:

Outreach coordinator:

Newsletter/Publicity

Treasurer and Membership: Sam Franklin

Hall coordinator:

Live Meeting Supplies

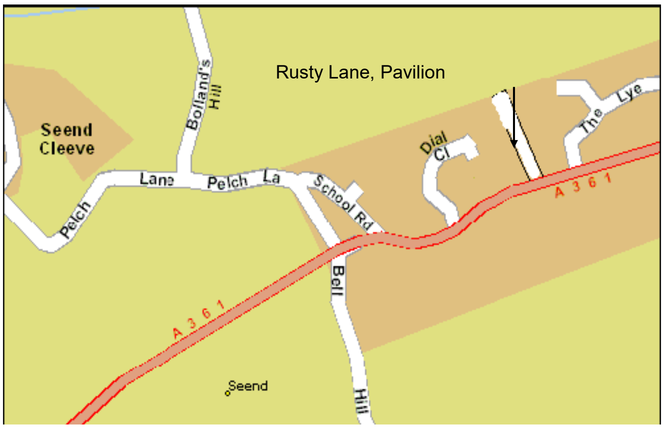
Speaker secretary

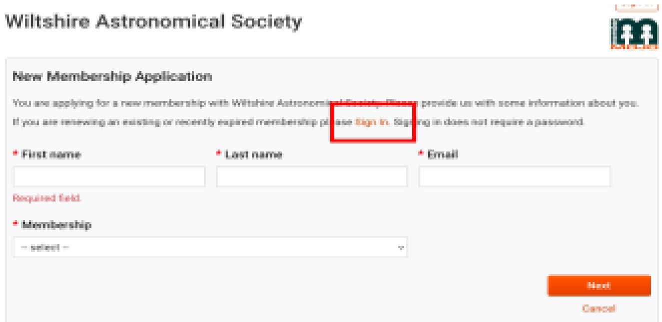
Zoom session coordinator

Observing Sessions coordinators: Chris Brooks, Jon Gale,

Web coordinator: Sam Franklin

Contact via the web site details.



Wiltshire Astronomical Society

New Membership Application

You are applying for a new membership with Wiltshire Astronomical Society. Please provide us with some information about you.

If you are renewing an existing or recently expired membership please Sign In. Signing in does not require a password.

* First name | * Last name | * Email

Required field.

* Membership

-- select --

Next

Cancel

## Observing Sessions see back page

Swindon Stargazers

## Swindon's own astronomy group

### Physical meetings

The club meets in person once per month

### Online Meetings

Once per month to discuss equipment and techniques

### Friday, 15 September

### – Talk by Grant Bowskill

Our in-person speaker at our September meet is Grant from First Light Optics in Exeter.

Grant will inform us about the latest updates and new products from FLO.

### Ad-hoc viewing sessions

Regular stargazing evenings are organised near Swindon. The club runs a WhatsApp group to notify members in advance of viewing sessions, usually at short notice. Anyone can call a viewing. To join these events please visit our website on the link below.

Information about our evenings and viewing spots can be found here:

http://www.swindonstargazers.com/noticeboard/noticeboard06.htm

### Meetings at Liddington Village Hall

Church Road, Liddington, SN4 0HB

**7.30pm onwards**

The hall has easy access from Junction 15 of the M4, a map and directions can be found on our website at:

*http://www.swindonstargazers.com/clubdiary/directions01.htm*

**Next Meeting Dates**

**Friday, 15 September** @ 19.30

First Light Optics: Product trends / changes / news and upcoming products

**Friday, 20 October** @ 19.30

Damian OHara: Telescope Tweaks!

**Friday, 17 November** @ 19.30

Dr Lillian Hobbs: Eisa Esinga - The Planetarium in the Bedroom

**Friday, 8 December** @ 19.30

Christmas Social

**Friday 19 January 2024** @ 19:30

Bernard Henin: Imaging our Solar System

**Friday 16 February 2024** @ 19:30

John Gale: The Lunar 100

**Website:**
**http://www.swindonstargazers.co**

Chairman: Damian OHara
Email: damian@cog2.com

Secretary: Hilary Wilkey
Email: hilary@wilkey.org.uk
Address: 61 Northern Road
Swindon, SN2 1PD

## BECKINGTON ASTRONOMICAL SOCIETY

Sadly the Beckington Astronomical Society is closing its regular society.

## STAR QUEST ASTRONOMY CLUB

This young astronomy club meets at the
Sutton Veny Village Hall.
Second Thursday of the Month.
Meet at Sutton Veny near Warminster.

## BATH ASTRONOMERS

A friendly bunch of stargazers and enthusiastic astronomers who share experiences and know-how as well as offer an extensive outreach programme of public and young people's observing and activities. As a partner to Bath Preservation Trust, they are the resident astronomers at the Herschel Museum of Astronomy, 19 New King Street, Bath, BA1 2BL and partner with Bath Abbey to showcase the skies above the city both day and night.

Gatherings and talks are held on the last Wednesday of each month at 7:30pm at the Herschel Museum of Astronomy (excluding December, July, and August) and are of 90 minutes duration or so.

Public stargazing is scheduled twice a month on Saturday evenings as well as during school holidays to promote astronomy in Bath and Somerset area. Locations vary to bring telescopes to local communities.

Member's observing is conducted from the Monkton Combe Community Observatory using the 1860s Refractor and more modern telescopes. We try to avoid school nights but will run member's sessions when the clouds look like they'll recede long enough to align a Celestron Goto telescope.

Get in touch by email hello@bathastronomers.org.uk whether you'd like to find out more, pop in for a visit, share the stars , or have Bath Astronomers visit your school, young persons' group (rainbows, beavers, brownies, cubs, guides, scouts, rangers etc) or your community. The Coordination Team of Annie, Jade, Jonathan, Meyrick, Mike, Prim and Simon will be happy to help you.

### Fordingbridge Astronomers

Hi everyone

I hope you've all had a great summer and have managed to enjoy the night skies in between the clouds.

Our September meeting will be on Wednesday 20th September, starting at 7.30pm. For our first meeting after the summer break, Hugh Allen will tell us about "The Lives of Stars": How are they born? What factors determine how they develop and, ultimately, how do they die?

After this, there will be a short 10-15 minute break to charge glasses and to catch up with everyone. After the break we will have our Chairman's **Pick of the Month**, followed by the Fordingbridge Astronomers' **What to look out for in the sky this month**.

We will be holding the meeting in our usual venue at The Elm Tree, Hightown, near Ringwood. The postcode for the Elm Tree is BH24 3DY. We'll be meeting in The Barn at the rear of the pub and, if you've not been before, just look out for the signs or ask the bar staff where the meeting is. There is plenty of parking for those who want to come along. Meetings are free to members and £2 each for guests. The Zoom link is included below for those of you who are unable to join us in The Elm Tree.

Fordingbridge Astronomers September Meeting

Time: Sep 20, 2023 19:00 London

Join Zoom Meeting

https://us06web.zoom.us/j/81176115897?pwd=TUZyUmhkdEdZSDdrUHBBY29PQStXUT09

Meeting ID: 811 7611 5897

Passcode: 131318

***Please note:*** If you are joining us as a Guest on Zoom, there is a £2 voluntary donation which can be made by BACS (Lloyds Bank - Sort Code: 30-93-94, Account: 34541260) or by PayPal. Our account name for both services is Fordingbridge Astronomers. Please use the reference 'Zoom Meeting'. Do please take a moment to add your Astronomical Society to your screen name so we know where you are from. Thank you.

Clear Skies and Best Regards

Martin Davies

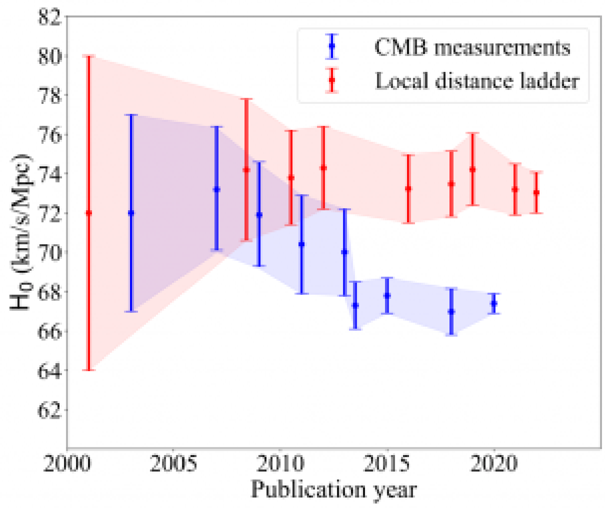
Membership Secretary

Fordingbridge Astronomers

# SPACE NEWS TO SEPT 23

## It's Going to Take More Than Early Dark Energy to Resolve the Hubble Tension

Our best understanding of the Universe is rooted in a cosmological model known as LCDM. The CDM stands for Cold Dark Matter, where most of the matter in the universe isn't stars and planets, but a strange form of matter that is dark and nearly invisible. The L, or Lambda, represents dark energy. It is the symbol used in the equations of general relativity to describe the Hubble parameter, or the rate of cosmic expansion. Although the LCDM model matches our observations incredibly well, it isn't perfect. And the more data we gather on the early Universe, the less perfect it seems to be.
A central difficulty is the fact that increasingly our various measures of the Hubble parameter aren't lining up. For example, if we use fluctuations in the cosmic microwave background to calculate the parameter, we get a value of about 68 km/s per megaparsec. If we look at distant supernova to measure it, we get a value of around 73 km/s per megaparsec. In the past, the uncertainty of these values was large enough that they overlapped, but we've now measured them with such precision that they truly disagree. This is known as the Hubble Tension problem, and it's one of the deepest mysteries of cosmology at the moment.

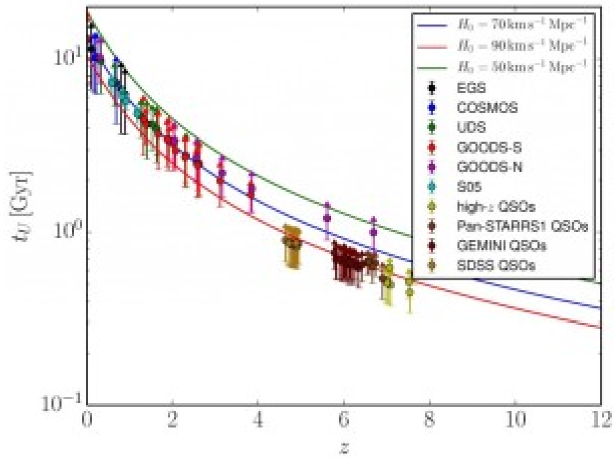



Hubble tension has gotten worse lately. Credit: Perivolaropoulos and Skara

Much of the effort to solve this mystery has focused on better understanding the nature of dark energy. In Einstein's early model, cosmic expansion is an inherent part of the structure of space and time. A cosmological constant that expands the Universe at a steady rate. But perhaps dark energy is an exotic scalar field, one that would allow a variable expansion rate or even an expansion that varies slightly depending on which direction you look. Maybe the rate was greater in the period of early galaxies, then slowed down, hence the different observations. We know so little about dark energy that there are lots of theoretical possibilities.
Perhaps tweaking dark energy will solve Hubble Tension, but Sunny Vagnozzi doesn't think so. In a recent article, he outlines seven reasons to suspect dark energy won't be enough to solve the problem. It's an alphabetical list of data that shows just how deep this cosmological mystery is.

**Ages of Distant Objects**

The idea behind this one is simple. If you know the age of a star or galaxy a billion light-years away, then you know the Universe must have been at least that old a billion years ago. If this age disagrees with LCDM, then LCDM must be wrong. For example, there are a few stars that appear to be older than the Universe, which big bang skeptics often point to as disproving the big bang. This doesn't work because the age of these stars is uncertain enough to be younger than the Universe. But you can expand upon the idea as a cosmological test. Determine the age of thousands of stars at various distances, then use statistics to gauge a minimum cosmological age at different epochs, and from that calculate a minimum Hubble parameter.

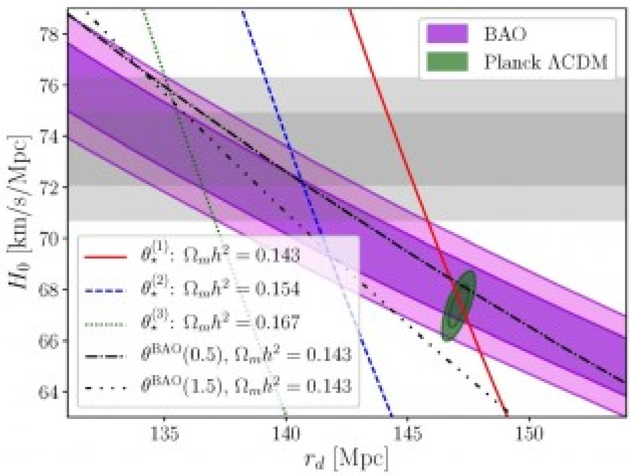



Ages of objects vs Hubble parameter. Credit: Vagnozzi, Pacucci & Loeb

Several studies have looked at this, drawing upon a range of sky surveys. Determining the age of stars and globular clusters is particularly difficult, so the resulting data is a bit fuzzy. While it's possible to fit the data to the range of Hubble parameters we have from direct measures, the age-distance data suggests the Universe is a bit older than the LCDM allows. In other words, IF the age data is truly accurate, there is a discrepancy between cosmic age and stellar ages. That's a big IF, and this is far from conclusive, but it's worth exploring further.

**Baryon Acoustic Oscillation**

Regular matter is made of baryons and leptons. The protons and neutrons in an atom are baryons, and the electrons are leptons. So Baryonic matter is the usual type of matter we see every day, as opposed to dark matter. Baryon Acoustic Oscillation (BAO) refers to the fluctuations of matter density in the early Universe. Back when the Universe was in a hot dense state, these fluctuations rippled through the cosmos like sound waves. As the Universe expanded, the more dense regions formed the seeds for galaxies and galactic clusters. The scale of those clusters is driven by cosmic expansion. So by looking at BAO across the Universe, we can study the evolution of dark energy over time.




BAO and CMB agree, but barely. Credit: Jedamzik, Pogosian & Zhao

What's nice about BAO is that it connects the distribution of galaxies we see today to the inflationary state of the Universe during the period of the cosmic microwave background (CMB). It's a way to compare the value of the early Hubble parameter with the more recent value. This is because early inflation put a limit on how far acoustic waves could propagate. The higher the rate of expansion back then, the smaller the acoustic range. It's known as the acoustic horizon, and it depends not only on the expansion rate but also on the density of matter at the time. When we compare BAO and CMB observations, they do agree, but only for a level of matter on the edge of observed limits. In other words, if we get a better measure of the density of matter in the Universe, we could have a CMB/BAO tension just as we currently have a Hubble Tension.

**Cosmic Chronometers**

Both the supernovae and cosmic microwave background measures of the Hubble parameter depend on a scaffold of interlocking models. The supernova measure depends on the cosmic distance ladder, where we use various observational models to determine ever greater distances. The CMB measure depends on the LCDM model, which has some uncertainty in its parameters such as matter density. Cosmic chronometers are observational measures of the Hubble parameter that aren't model dependent.

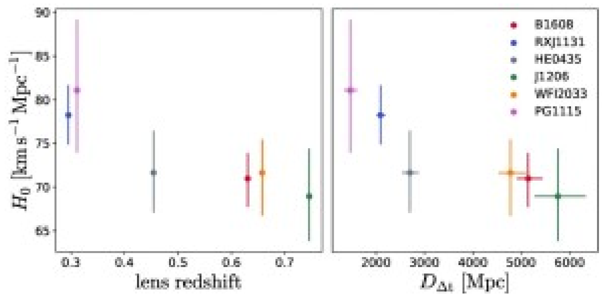
One of these measures uses astrophysical masers. Under certain conditions, hot matter in the accretion disk of a black hole can emit microwave laser light. Since this light has a very specific wavelength, any shift in that wavelength is due to the relative motion or cosmic expansion, so we can measure the expansion rate directly from the overall redshift of the maser, and we can measure the distance from the scale of the accretion disk. Neither of these require cosmological model assumptions.

Another approach uses gravitational lensing. If a nearby galaxy happens to be between us and a distant supernova, the light from the supernova can be gravitationally lensed around the galaxy, creating multiple images of the supernova. Since the light of each image travels a different path, each image takes a different amount of time to reach us. When we are lucky we can see the supernova multiple times. By combining these observations we can get a direct measure of the Hubble parameter, again without any model assumptions.

The maser method gives a Hubble parameter of about 72 – 77 (km/s)/Mpc, while the gravitational lensing approach gives a value of about 63 – 70 (km/s)/Mpc. These results are tentative and fuzzy, but it looks as if even model-independent measures of the Hubble parameter won't eliminate the tension problem.

**Descending Redshift**

Within general relativity the Hubble parameter is constant. The Lambda is a cosmological constant, driving expansion at a steady pace. This means that the density of dark energy is uniform throughout time and space. Some exotic unknown energy might drive additional expansion, but in the simplest model, it should be constant. So the redshifts of distant galaxies should be directly proportional to distance. There may be some small variation in redshift due to the actual motion of galaxies through space, but overall there should be a simple redshift relation.

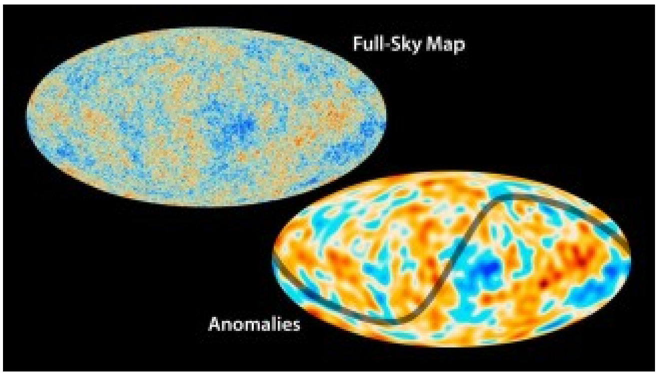



HOLiCOW measures of the Hubble constant vs redshift. Credit: Wong et al

But there's some evidence that the Hubble parameter isn't constant. A survey of distant quasars gravitationally lensed by closer galaxies calculated the Hubble value at six different redshift distances. The uncertainties of these values are fairly large, but the results don't seem to cluster around a single value. Instead, the Hubble parameter for closer lensings seems higher than those of more distant lensings. The best fit puts the Hubble parameter at about 73 (km/s)/Mpc, but that assumes a constant value.

**Early Integrated Sachs-Wolfe Effect**

When we look at light from the cosmic microwave background, we don't have a perfectly clear view. The CMB light has to travel across billions of light-years to reach us, and that means it often has to pass through dense regions of galaxy clusters and the vast voids between galaxies. As it does so, the light can be red-shifted or blue-shifted by the gravitational variations of the clusters and voids. As a result, regions of the CMB can appear warmer or cooler than it actually is. This is known as the Integrated Sachs-Wolfe (ISW) effect.

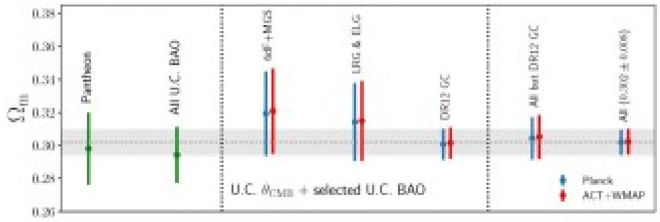



Anomalies in the cosmic microwave background. Credit: ESA and the Planck Collaboration

When we look at fluctuations within the CMB, most of them are on a scale predicted by the LCDM model, but there are some larger scale fluctuations that are not, which we call anomalies. Most of these anomalies can be accounted for by the Integrated Sachs-Wolfe effect. How this pertains to cosmic inflation is that since most of the ISW happens in the early period of the Universe, it puts limits on how much you can tweak dark energy to address the tension problem. You can't simply shift the early expansion rate without also accounting for the CMB anomalies on some level.

**Fractional Matter Density Constraints**

In general, our cosmological model depends on two parameters: the fraction of dark energy and the fraction of matter. Just as dark energy drives cosmic expansion, working to move galaxies away from each other, dark matter and regular matter work against cosmic expansion. We mostly see the effect of matter density through the clustering of galaxies, but the overall density of matter in the Universe also dampens the observed expansion rate.

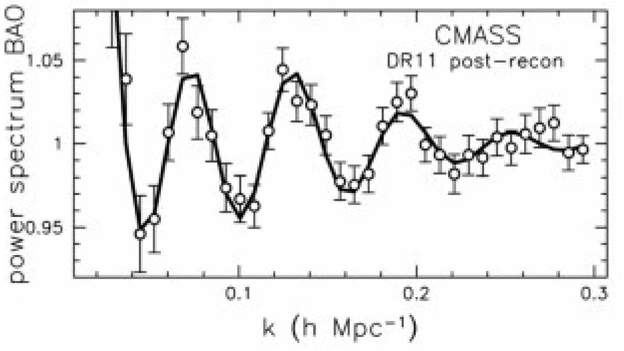



Observations of the matter density of the Universe. Credit: Lin, Chen & Mack

The cosmic matter density can be determined by many of the same observational tests used to determine cosmic expansion. All of them are in general agreement that the matter density is about 30% of the total mass-energy of the Universe, but the early Universe observations trend a bit lower. Not a problem per se, but increasing the expansion rate of the early universe would tend to make this problem worse, not better.

**Galaxy Power Spectrum**

Power spectrum in this case is a bit of a misnomer. It doesn't have to do with the amount of energy a galaxy has, but rather the scale at which galaxies cluster. If you look at the distribution of galaxies across the entire Universe, you see small galaxy clusters, big galaxy clusters, and everything in between. At some scales clusters are more common and at others more rare. So one useful tool for astronomers is to create a "power spectrum" plotting the number of clusters at each scale.




A galactic power spectrum. Credit: Sloan Digital Sky Survey

The galaxy power spectrum depends upon both the matter and energy of the Universe. It's also affected by the initial hot dense state of the Big Bang, which we can see through the cosmic microwave background. Several galactic surveys have measured the galactic power spectrum, such as the Baryon Oscillation Spectroscopic Survey (BOSS). Generally, they point to a lower rate of cosmic expansion closer to those of the cosmic microwave background results.

**So What Does All This Mean?**

As is often said, it's complicated. One thing that should be emphasized is that none of these results in any way disprove the big bang. On the whole, our standard model of cosmology is on very solid ground. What it does show is that the Hubble Tension problem isn't the only one hovering at the edge of our understanding. There are lots of little mysteries, and they are all interconnected in non-trivial ways. Simply tweaking dark energy isn't likely to solve all of them. It will likely take a combination of adjustments all coming together. Or it might mean a radical new understanding of some basic physics.

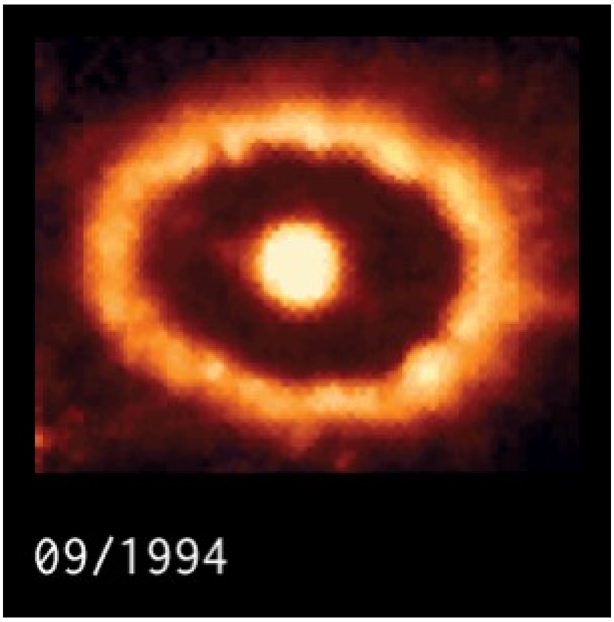
We have come a tremendous way in our early understanding of the cosmos. We know vastly more than we did even a decade or two ago. But the power of science is rooted in not resting on our success. No matter how successful our models are, they are, in the end, never enough.

**Reference:** Vagnozzi, Sunny. "Seven Hints That Early-Time New Physics Alone Is Not Sufficient to Solve the Hubble Tension." *Universe* 9.9 (2023): 393.

## The Closest Supernova Seen in the Modern Era, Examined by JWST

In November of 1572, Tycho Brahe noticed a new star in the constellation Cassiopeia. It was the first supernova to be observed in detail by Western astronomers and became known as Tycho's Supernova. Earlier supernovae had been observed by Chinese and Japanese astronomers, but Tycho's observations demonstrated to the Catholic world that the stars were not constant and unchanging as Aristotle presumed. Just three decades later, in 1604, Johannes Kepler watched a supernova in the constellation Ophiuchus brighten and fade. There have been no observed supernovae in the Milky Way since then.

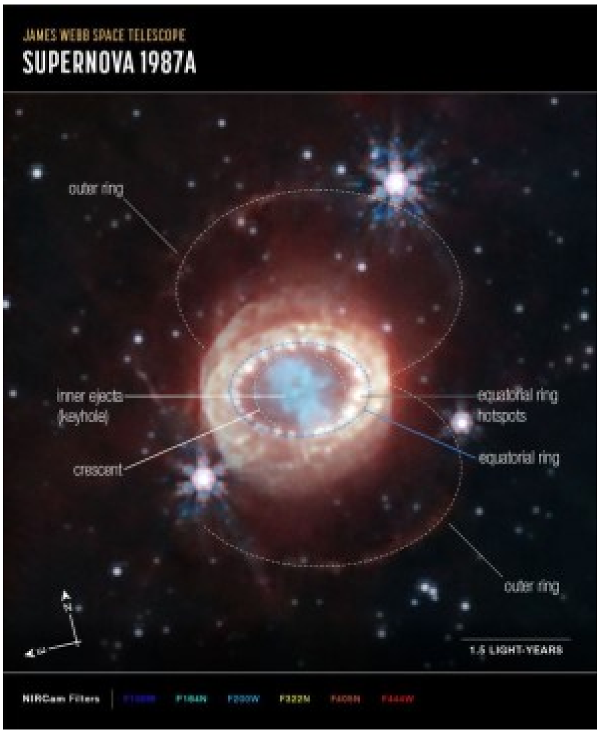
More than three centuries passed. Galileo pointed his first telescopes to the heavens. Astrophotography revolutionized our view of the heavens, as did radio astronomy. We launched telescopes into space, landed on the Moon, and sent robotic probes to the outer solar system. But there were no nearby supernovae to observe with our clever tools. Until February 1987, when a supernova appeared in the Large Magellanic Cloud. Known as SN 1987a, it reached a maximum apparent magnitude of about 3. It is the only naked-eye supernova to occur within the era of modern astronomy.




Hubble's observations of SN 1987a over time. Credit: Mark McDonald/Larsson, J., et al

In cosmological terms, SN 1987a is right in our backyard, only 168,000 light-years away. It has been studied over the years by both land-based and space-based telescopes, and recently the James Webb Space Telescope has taken a closer look. The results tell us much about the rare supernova but also raise a few questions.

Most prominent in the image is the bright equatorial ring of ionized gas. This ring was ejected from the star for thousands of years before it exploded. It's now heated by shockwaves from the supernova. The equatorial ring girdles the hourglass shape of the fainter outer rights that stem from the polar regions of the star. These structures have been observed before by telescopes such as Hubble and Spitzer. But JWST's real power is to peer into the center of SN 1987a. There it reveals a turbulent keyhole structure where clumps of gas expand into space. Rich chemical interactions have begun to occur in this region.



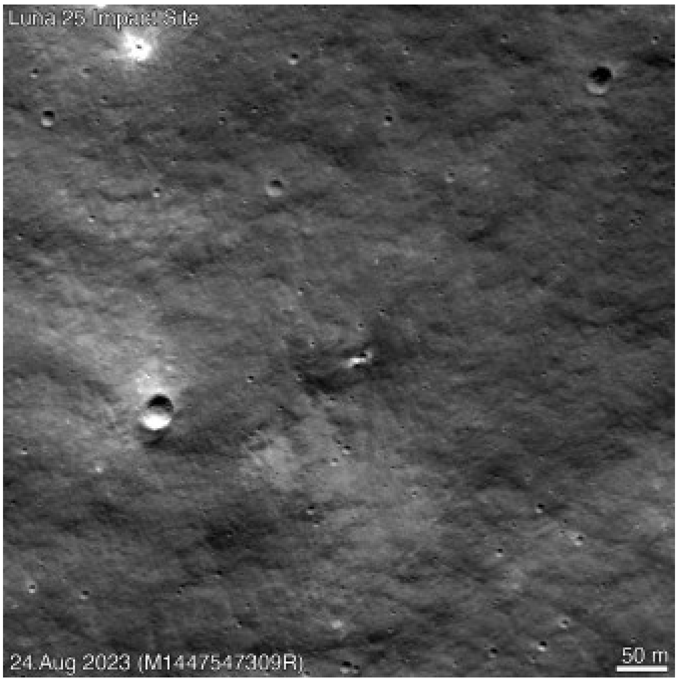
The structures seen in the new JWST image. Credit: NASA, ESA, CSA, M. Matsuura, R. Arendt, C. Fransson
But even JWST wasn't able to observe the ultimate jewel of the supernova, the remnant star. Supernovae not only cast off new material into interstellar space, they also trigger the collapse of the star's core to become a neutron star or black hole. Based on the scale of SN 1987a, a neutron star should have formed in its center. However, the gas and dust of the inner keyhole region are too dense for JWST to observe it. How a neutron star forms, and how it interacts with surrounding gas and dust, is a mystery that will require further study. We have observed the neutron stars of some supernovae, but only from a much greater distance.
Tycho's supernova was just 8,000 light-years from Earth, and Kepler's about 20,000 light-years distant. Unless Betelgeuse happens to explode in the near future, SN 1987a is likely the closest new supernova we'll be able to study for quite some time.
For more information on these results, check out NASA's website.

## NASA Satellite Spots the Crash Site for Luna 25

Poor Russia. They can't seem to get much right. Their most recent failure is their Luna 25 spacecraft. It was supposed to land near the Moon's south pole but instead crashed into the surface on August 19th.
Now NASA's Lunar Reconnaissance Orbiter (LRO) has spotted Luna 25's final resting place.
Luna 25 was Russia's first mission to the Moon in over 40 years. Roscosmos launched it into orbit on August 10th on a Soyuz 2.1b rocket from the Vostochny Cosmodrome. The launch and the travel to the Moon went well, and the spacecraft entered lunar orbit on August 16th. But, perhaps sadly, it crashed while executing a failed orbital maneuver.

The Luna-25 mission lifting off from the Vostochny Cosmodrome on Aug. 11th. Credit: Roscosmos/Reuters
Initially, Roscosmos announced that they'd lost contact with the spacecraft. "The measures taken on August 19 and 20 to search for the device and get into contact with it did not yield any results," Roscosmos reported.
Later, on Telegram, they said, "During the operation, an emergency situation occurred on board the automatic station, which did not allow the maneuver to be performed with the specified parameters."
Luna 25 was in a sort of race with India's Chandrayaan-3 lunar lander. C3 was launched before L25, but Roscosmos planned for L25 to pass the Indian lander and reach the Moon's surface first. It did reach the surface first, but only as a wreck. And as everybody knows, C3 landed successfully and is going about its business. That must sting.

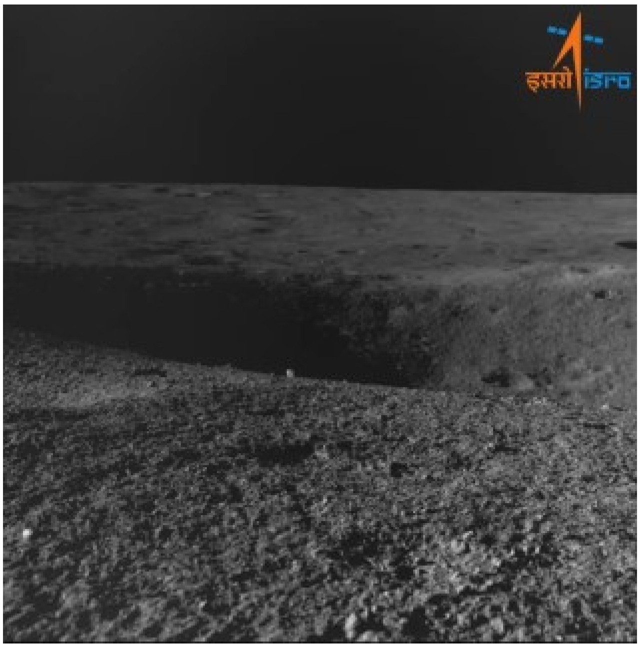
Artistic rendering of the Luna-25 lander on the surface of the Moon. Credit: NASA
On August 21, Roscosmos revealed the likely location of L25's impact, and NASA instructed the LRO to image the region. On August 24, the LRO captured these images and compared them to previous images of the same region pre-impact. The most recent pre-impact image is from June 2022, and a small new crater appeared sometime between the dates of the two images. The new crater is so close to the impact site that NASA confidently concluded that the new crater is indeed the impact crater created by L25's crash. The crater is about 10 meters (33 feet) in diameter.




Russia is a political pariah right now for obvious reasons. But Luna 25 was predominantly a scientific endeavour, so it's unfortunate that the mission failed.
Luna 25 carried eight science instruments, including an instrument for the spectrometry of minerals, an important part of modern lunar exploration. It was also going to measure the regolith's thermal properties, measure plasma in the exosphere, and measure dust and micrometeorites, among other things. But that's all gone now.
Luna 25 was also going to carry a demonstration navigation camera provided by the ESA, but they pulled it after Russia invaded Ukraine. The ESA announced that they were discontinuing their participation in Luna 25, 26 and 27, saying, "As with ExoMars, the Russian aggression against Ukraine and the resulting sanctions put in place represent a fundamental change of circumstances and make it impossible for ESA to implement the planned lunar cooperation."

There's significant schadenfreude involved in Russia's failures right now, and that's not likely to dissipate any time soon. That's what happens when you invade your neighbour and do all the terrible things Russia's done. It's just the way it is.
But Russia is a dictatorship, and while leadership might deserve to fail, this latest disappointment must be difficult for the dedicated scientists and other personnel who have no way of voicing discontent and do their work while suffering under crude leadership. There must be some people in Russia like that, right?
Luna 25's failure might not be restricted to this single mission. It was intended as a sort of test bed for subsequent landers in the Luna series. Will this failure affect future Luna missions?
Russia is not exactly open about its failures. For example, when their Phobos-Grunt mission to Mars' largest moon failed, they quickly blamed foreign sabotage. So far, they haven't placed blame for Luna 25's crash on anyone, but they still might.

Poster art for the Russian Phobos-Grunt mission. Russia blamed foreign sabotage for the mission's failure, with no evidence. Russian Federal Space Agency)/IKI
The real problem might lie with the nature of Russian society. Rampant corruption is well-documented in Russia, and corruption tends to eat into everything. It may have played a role in Luna 25's failure, but that's only speculation at this point. We may never know exactly what role it might have played.
For its part, NASA has avoided criticizing or condemning Russia's latest failure. Thomas Zurbuchen, NASA's former Associate Administrator for the Science Mission Directorate, had a conciliatory message for Roscosmos. He said on X, "Too bad to read this. None of us ever wishes bad onto other explorers. Hope this can be fixed. We are reminded that landing on any celestial object is anything but easy & straightforward. Just because others managed to do it decades ago does not guarantee success today."
Classy, diplomatic words.
This latest Russian failure is just another chapter in their decline. If there's a new space race happening between nations, Russia isn't really participating.
Prior to Luna 25's launch, NASA Administrator Bill Nelson wished Russia well, emphasizing the cooperation between NASA and Roscosmos over the decades, pointing out that the two built the ISS together. But he also said, "I don't think a lot of people at this point would say that Russia is actually ready to be landing cosmonauts on the Moon in the timeframe that we're talking about going to the Moon or that China would be," he said.
So Much to Do, So Little Time. Chandrayaan-3 Makes the Most of Its Time at the Moon's South Pole
India's Chandrayaan-3 lunar lander and rover are quickly checking all the boxes of planned tasks for the mission. Time is short, as the duo are expected to last just 14 days on the Moon's surface, or one lunar day, the amount of time the solar-powered equipment is built to last. Therefore, we likely only have until about September 6 or 7 to follow any action.
But what a joy to watch the updates coming in from ISRO, the Indian Space Resource Organization.
Last week, India became only the fourth country to land on the Moon, and the first to ever make a soft landing near the Moon's south pole. Shortly after touchdown, the Vikram lander began sending back images from its surroundings. Then, the six-wheeled rover named Pragyan rolled down a ramp to begin its explorations, looking for evidence of ice and other minerals.
One video shows the rover "doing a donut" – or spinning around in a circle on the lunar surface (although ISRO phrased it, "It feels as though a child is playfully frolicking in the yards of Chandamama, while the mother watches affectionately.") The frame rate from the rover is quite low, so thankfully video and image editing expert Simeon Schmauss was able to upscale the data and provide an improved version.
The 57-lb (26 kg) rover also came upon a 13-foot (4-meter) shadowed crater of unknown depth that could have posed an extreme hazard for Pragyan if it had entered it. Thankfully, a team on the ground saw the danger via the rover's navigation camera. The rover moves at just 10 centimeters per second to allow ground control to monitor the terrain, as well as to minimize any vibrations on the vehicle from the rough lunar terrain.
"On August 27, 2023, the Rover came across a 4-meter diameter crater positioned 3 meters ahead of its location," ISRO wrote in a post on X, formerly Twitter. "The Rover was commanded to retrace the path. It's now safely heading on a new path."



*The lunar crater the Chandrayaan-3 rover encountered on August 27, 2023, as seen by the navigation camera. Credit: ISRO.*
Pragyan is studying the composition of the lunar surface, measuring the presence of water in the regolith, and gathering data on the history of impacts in the region as well as the Moon's tenuous atmosphere. And the rover hit paydirt.
This week, ISRO announced the rover had confirmed the presence of sulfur and several other elements. Pragyan's laser-induced spectroscope detected the sulfur, as well as aluminum, iron, calcium, chromium, titanium, manganese, oxygen and silicon on the lunar surface.
The rover "unambiguously confirms the presence of sulfur," ISRO said. It is also searching for signs of frozen water. Water ice could be a source of oxygen, fuel, and water for future missions, or perhaps even for a future lunar base

or colony at the Moon's south pole.

*The tracks made on the lunar surface by the Chandrayaan-3 rover on August 27, 2023, as see by the navigation camera. Credit: ISRO.*

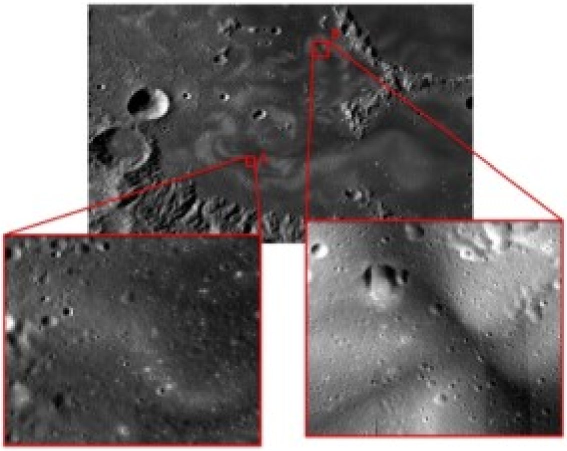
Meanwhile, the Vikram lander is using its suite of instruments to measure the thermal conductivity and temperature of the lunar surface, search for seismic activity around the landing site, and estimate the near-surface plasma density over time. We'll keep you updated the mission's status and its findings. Meanwhile, follow ISRO on X for their posts, and here is a gallery of images from the mission.

## There's No Wind on the Moon, So How Does Dust Shift and Swirl So Quickly?

The last place to look for windstorms is on the Moon. Yet, it has swirls on its surface that look like the wind put them there. Since there's no atmosphere on the Moon, planetary scientists had to look for another cause. It turns out there's a connection to local magnetic anomalies and an interplay with lunar topography.

Swirls are albedo patterns on the Moon's surface and they've kept planetary scientists debating their cause for years. They're visible from Earth, although it wasn't until 1966 that the NASA Lunar Orbiter II managed to get a clear image of one. One of the largest, Reiner Gamma, is visible through an amateur telescope.

A new study by scientists at the Planetary Science Institute, led by planetary scientist Deborah Domingue, examined the texture of the surface where these swirls appear. They looked at a spot in Mare Ingenii using photometric analysis to determine the cause. That technique takes into account how material scatters light and how those scattering properties change as the illumination (angle of the sunlight to the surface) and viewing (position of your spacecraft) geometries change.

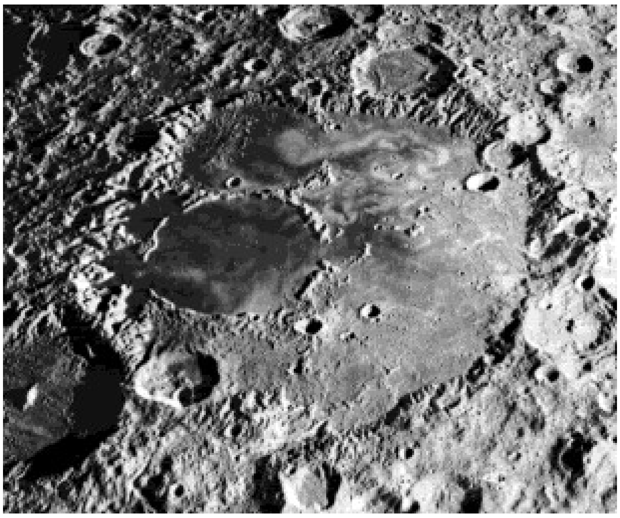


Closeups in Mare Ingenii of topology where lunar swirls are created by highly mobile regolith, deposited by more than one process. Courtesy PSI.

**Changing Ideas about Lunar Swirls**

Over the years, lunar observers have come up with several explanations for these weird markings. Cometary impacts might send swirls of dust across the surface. Such collisions might also explain the magnetic anomalies associated with the swirls.

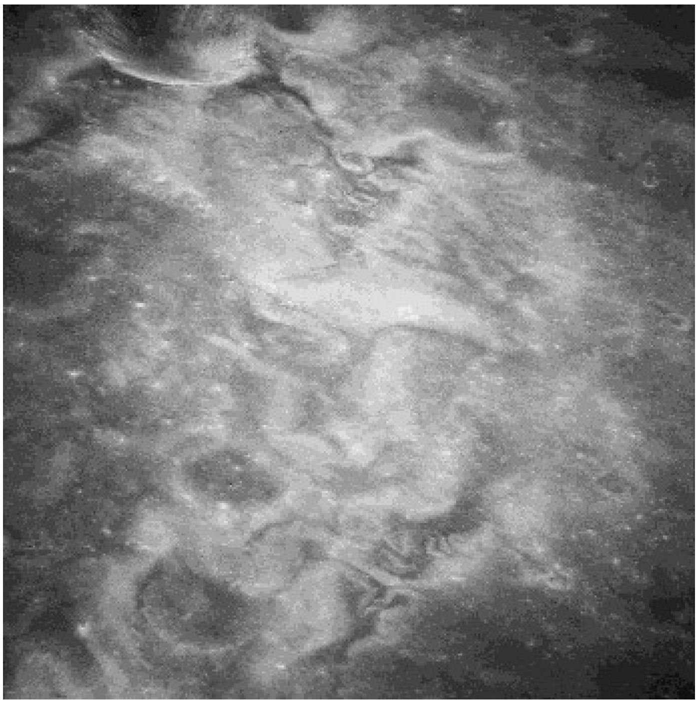
It's also highly likely that the solar wind plays a role. It's a frequent occurrence and could explain why some swirls seem to change more quickly over time. In this case, a magnetic anomaly protects light-colored regolith (lunar surface materials), which could be exposed silicates. This explains the swirling pattern, as shielded material would be brighter than materials outside the magnetic field. However, the spectral properties don't always match those of shielded materials.



A reprocessed Lunar Orbiter II image of Mare Ingenii. Courtesy James Stuby, CC0.

It could be that magnetic fields segregate and trap electrostatically levitated dust. It's the smallest size of all lunar dust and made of minerals brighter than the larger sizes of dust grains. Those bigger ones are more difficult to move electrostatically. The darker dust includes small inclusions of nanometer-scale iron. It's more likely to get magnetically separated and deposited in the dark areas of the swirls. Ironically, one way to produce this nanometer-scale iron is by solar wind radiation.

Related to that is an idea that says weak electric fields created by interactions with the magnetic anomalies and solar wind plasma could attract or repel fine dust particles. Another theory, proposed by scientists in 2022 says that topography may also play a role in the placement of the swirls.



Lunar swirl region near Firsov Crater, as seen from Apollo 10. Courtesy NASA.

**Using Photometric Analysis**

What the team found with their photometric analysis study is that the grain-to-grain roughness was similar across the swirl region. However, the soil in the dark lanes has grains with a more complicated structure. In addition, they found that the composition between the bright and dark areas is different, following the expectations from dust collection and segregation.

Domingue thinks they may have a better feel for the origins of these strange swirls now. “The evidence, which includes recent correlation of topographic lows with the bright areas of the swirls, tells a story that more than one process is involved in their formation”, she said. “We definitely see evidence that the bright areas are less radiated, but this doesn’t explain all the properties of the swirls. Something else is operating, and the textures suggest dust collection and segregation are part of the tale.”

## Is the Solar Wind Coming From These Tiny Jets on the Sun?

Ever since the first direct observations of the solar wind in 1959, astronomers have worked to figure out what powers this plasma flow. Now, scientists using the ESA/NASA Solar Orbiter spacecraft think they have an answer: tiny little outbursts called “picoflares” They flash out from the corona at 100 kilometers per second.

The discovery comes from highly detailed extreme ultraviolet studies of a coronal hole at the Sun’s south pole. The observations revealed a collection of short-lived, faint features associated with tiny plasma jets ejected from the Sun. “We could only detect these tiny jets because of the unprecedented high-resolution, high-cadence images produced by EUI,” said Lakshmi Pradeep Chitta, Max Planck Institute for Solar System Research, Germany. In a paper describing the observations, Chitta and colleagues outline the observations and findings.

This movie was created from observations taken by the ESA/NASA Solar Orbiter spacecraft on 30 March 2022 between 04:30 and 04:55 UTC and shows a ‘coronal hole’ near the Sun’s south pole. Tiny jets show up as little flashes of bright light across the image. Each one expels charged particles, known as plasma, into space. These jets could be the source of the solar wind.

**Creating the Solar Wind**

The solar wind is responsible for a number of phenomena in the Solar System. It impacts magnetic fields around various worlds, including Earth, and plays a role in space weather events like aurorae. It also affects comets, shaping their plasma tails as these icy bodies whip around the Sun.

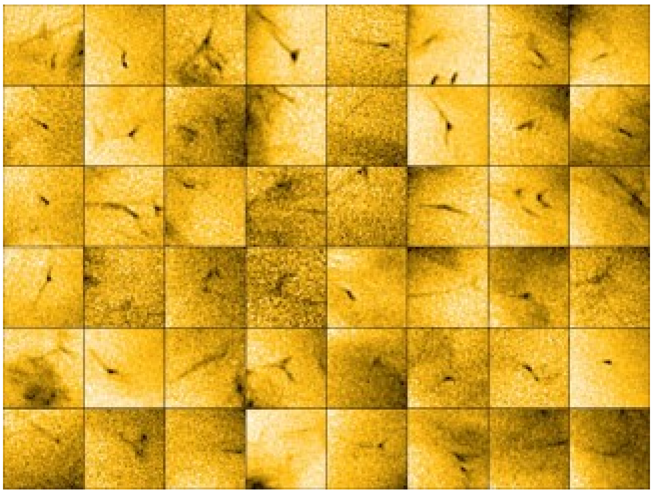
Although this wind is a fundamental feature of the Sun, solar physicists haven’t always had a definitive explanation for what generates it. They’ve known for quite some time that it’s mostly associated with coronal holes. These are magnetic structures in the corona and appear as dark regions on the solar surface. Essentially, they’re places in the solar atmosphere where the magnetic field doesn’t duck back down into the Sun. Rather, their magnetic field lines extend out from the Sun and through the Solar System. Naturally, plasma can flow along those “exit lines” and that’s what the solar wind is: an escape of plasma from the Sun. But, the big question remains: what launches it in the first place?

Coronal holes can appear nearly anywhere on the Sun, although they occur quite often around the polar regions. They seem to be more common and last longer during the quiet part of the solar cycle (solar minimum). However, they also show up during solar maximum.

**Jets and the Solar Wind**

The idea of jets and outbursts from the Sun is not new and solar physicists observe a range of them. The largest are coronal mass ejections. These carry huge amounts of energetic particles out through space. There are also events called X-class solar flares. Then, there are the solar nanoflares These are less energetic but still influential. They have about a billion times less energy than the huge solar flares, but they happen nearly constantly. They could well be responsible for heating the corona to its incredibly high 2-million-degree temperatures.

Picoflares carry less power than nanoflares. Those tiny jets discovered by Solar Orbiter show about a thousand times less energy than a nanoflare. However, they seem to pack a mighty punch. Most of their energy gets channeled into ejecting plasma away from the Sun. That contributes to the near-constant flow of the solar wind. They’re ubiquitous enough that they probably eject a larger fraction of the solar wind than expected.



A sequence of Solar Orbiter images showing tiny jets called “picoflares” escaping the Sun and helping to create the solar wind. Courtesy: ESA.

There’s still quite a bit to learn about this process, but ongoing Solar Orbiter studies should help explain the mechanism further. “One of the results here is that to a large extent, this flow is not actually uniform, the ubiquity of the jets suggests that the solar wind from coronal holes might originate as a highly intermittent outflow,” said Andrei Zhukov, Royal Observatory of Belgium, a collaborator on the work who led the Solar Orbiter observing campaign.

**Next Steps**

Solar Orbiter isn’t done measuring these constant little ejections. It’s actually circling the Sun in the equatorial regions at the moment. Eventually, its orbit will cover the polar areas. Luckily, that change in orbit will also help the spacecraft study changes in the Sun as the current solar cycle progresses. That means it will be able to study these tiny structures in coronal holes that show up at different solar latitudes.

## The Early Universe Should Be Awash in Active Galaxies, but JWST Isn't Finding Them

For decades the most distant objects we could see were quasars. We now know they are powerful active black holes. Active galactic nuclei so distant that they resemble star-like points of light. It tells us that supermassive black holes in the early Universe can be powerful monsters that drive the evolution of their galaxies. We had thought most early supermassive black holes went through such an active phase, but a new study suggests most supermassive black holes don't.
Most galaxies contain a supermassive black hole. They contain millions or billions of solar masses. They can power tremendous jets of ionized gas streaming away from a galaxy at nearly the speed of light, rip stars apart to seed a galaxy with gas and dust, and even strip galaxies of dust to winnow star formation. They can also remain quiet for billions of years, hiding in a galaxy's central bulge, as does the central black hole in the Milky Way. But the sheer mass of these black holes suggests they must have grown quickly in their youth, suggesting a period of extreme activity similar to distant quasars.
This new study looks at a period of cosmic history known as cosmic noon. It's the time when the Universe was about 3 – 6 billion years old and marks the age when star production in the Universe was at its peak. This is also around the time when we would expect supermassive black holes to be active since their churning of gas and dust can trigger star formation. Using the James Webb Space Telescope, the team gathered data from a patch of sky known as the Extended Groth Strip (ESG).

The Extended Groth Strip as seen by Hubble. Credit: NASA, ESA, and M. Davis (University of California, Berkeley)
The ESG is a small, barren region of sky between the constellations of Ursa Major and Boötes. It was observed in detail by the Hubble Space Telescope in 2004 and 2005, which found more than 50,000 galaxies. In 2011, the Spitzer Space Telescope observed the region at infrared wavelengths as part of the All-Wavelength Extended Groth Strip International Survey (AEGIS). Spitzer saw the glow of lots of active black holes, but not as many as anticipated. This wasn't too unexpected, since it was quite possible Spitzer wasn't sensitive enough to see smaller AGNs, or those deeply shrouded in dust.
This new survey made by JWST expected to see more, but that wasn't the case. The Cosmic Evolution Early Release Science program (CEERS) found about the same number of active black holes as before. And with the higher resolution and sensitivity of JWST we can just discount the conclusions. What this team discovered is that active black holes are rare during cosmic noon, meaning that most galactic black holes grow at a slower pace. The team also found that within smaller galaxies there wasn't a tremendous amount of dust. Many of the galaxies observed resembled the Milky Way. Spiral galaxies with limited dust and a quite central black hole. This suggests the possibility that our galaxy never had an AGN period.
It should be noted that this initial result only focuses on about 400 galaxies. The team plans to complete a larger survey of 5,000 galaxies next year.
**Reference:** Kirkpatrick, Allison, et al. "CEERS Key Paper VII: JWST/MIRI Reveals a Faint Population of Galaxies at Cosmic Noon Unseen by Spitzer." *arXiv preprint* arXiv:2308.09750 (2023).

## 40th Rocket Lab Electron Mission, "We Love The Nightlife", Launches From New Zealand with Reused Engine

Private space company, Rocket Lab, launched its 40th Electron mission on their lauded Electron rocket, dubbed "We Love The Nightlife", on August 24th at 11:45am New Zealand Standard Time (August 23rd at 7:45pm EST), which also marks the 7th launch of 2023, all successful. The purpose of the mission was to deliver the next-generation Acadia satellite for Capella Space to a circular orbit above the Earth at 640 km (400 miles), which was executed flawlessly. Acadia is part of Capella's synthetic aperture radar (SAR) constellation and is the first of four Acadia satellites that Rocket is currently contracted to launch for Capella.

"We've been a trusted launch partner to Capella since 2020 and we're delighted to deliver mission success once again," Rocket Lab CEO and Founder, Peter Beck, said in an official statement. "Electron has played a crucial role in helping constellation operators like Capella deploy their spacecraft on time and on target, and we look forward to continuing building out Capella's constellation with more dedicated launches this year."
After the successful launch, Rocket Lab crews successfully recovered the Electron first stage booster from the Pacific Ocean once it parachuted down upon stage separation. This marked the sixth time Rocket lab successfully recovered a booster from the ocean, and the third successful recovery in 2023. Rocket Lab has only attempted booster recoveries a handful of times, but this looks to be increasing since they've had three booster recoveries out of three attempts this year. The goal of booster recoveries is to enhance rocket reusability with the goal of decreasing launch costs.
Along with increasing reusability of the Electron rocket, this latest mission also marked the first time Rocket Lab attempted to reuse one of its 3D-printed Rutherford engines, which performed flawlessly with the rest of Electron's nine first stage Rutherford engines. Rocket Lab posted an image of the nine engines prior to launch on their X account (previously known as Twitter), with the reused engine standing out from the rest due to its darker color.
Previous Rocket Lab launches for Capella Space include the "I Can't Believe It's Not Optical" mission in August 2020 that delivered a Sequoia Earth-imaging satellite to a 500-km (310-mile) low Earth orbit, and the "Stronger Together" mission in March 2023 that delivered the Capella 9 and Capella 10 satellites to a 600-km (375-mile) low Earth orbit. As noted, this latest mission was the first of four Acadia satellite launches, with the remaining three missions scheduled for launch by the end of 2023.

Founded in New Zealand in 2006, Rocket Lab's goal is to deliver payloads to space with low-cost launch vehicles, which follows in the footsteps of private space company, SpaceX, founded in 2002. To accomplish this, Rocket Lab built the expendable, and now partially reusable, Electron rocket, with its first successful launch occurring in January 2018 after a failed first launch attempt in May 2017. All of their launches occurred in New Zealand until January 2023 when Rocket Lab conducted their first launch from American soil at NASA's Wallops Flight Facility in Virginia.

This latest launch not only marks the 40th Electron, but also continues a streak of 20 successful missions, including one suborbital launch, with the last launch failure occurring in May 2021. Going forward, Rocket Lab has a full plate of contracted launches through the rest of 2023 and 2024 with several customers, both returning and new. The private rocket company is even slated to launch the first private mission to Venus sometime in 2025.

As this latest launch demonstrates, Electron has proven to be both a successful and reliable launch vehicle for Rocket Lab. However, Peter Beck's private rocket company is currently working on the upgraded, and fully-reusable, Neutron rocket capable of listing up to 15,000 kilograms (33,000 pounds) to low Earth orbit depending on the launch configuration. For context, Electron can only launch a maximum 300 kilograms (660 pounds) to low Earth orbit and is only partially-reusable, as previously noted. Like Electron, Neutron will use nine first stage engines but called Archimedes, and they'll be capable of much greater lift-off thrust. Neutron is currently in development and is slated to have its maiden launch sometime in 2024.

## Chandrayaan-3 Lands Successfully on the Moon's South Pole

India's space agency successfully landed their Chandrayaan-3 lander on the lunar surface, becoming the fourth country to touch down on the Moon and the first to land at one of the lunar poles.
The Indian Space Resource Organization's (ISRO) Chandrayaan-3 launched last month and made a soft landing on the Moon's south pole at approximately 8:34 a.m. ET on August 23. The mission is set to begin exploring an area of the Moon that is of extreme interest, but Chandrayaan-3 is the first to visit this area in-situ. The lunar south pole is thought to contain water ice that could be a source of oxygen, fuel, and water for future missions, or perhaps even for a future lunar base or colony.

*The Chandrayaan-3 team celebrates after the mission successfully landed on the Moon's south pole. Via ISRO webcast.*

The landing comes just days after a Russian lunar mission failed, and four years after the ISRO's Chandrayaan-2 lander crashed on the Moon on September 6, 2019, due to a last-minute guidance software glitch.

Shortly after landing, the spacecraft sent back its first images from the lunar surface, as well as images captured during the descent:
"The entire mission operations right from launch until landing happened flawlessly, as per the timeline," said the mission's project director P. Veeramuthuvel following Chandrayaan-3's successful landing. "I take this opportunity to thank navigation guidance and control team, propulsion team, sensors team, and all the mainframe subsystems team who have brought success to this mission. I also take the opportunity to thank the critical operations review committee for thoroughly reviewing the mission operations right from launch till this date. The target was on spot because of the review process."
A team from the Jet Propulsion Laboratory has been providing navigation and tracking support for ISRO through NASA's Deep Space Network since the launch on July 14, 2023, as well as mission support during the years leading up to launch. NASA and ESA also are providing deep space communication support to the Chandrayaan-3 mission.
Chandrayaan-3's Vikram lander will deploy a rover named Pragyan to help gain insights into the lunar surface composition and look for the presence of water ice in the lunar regolith, while studying the history of impacts on the Moon and the Moon's atmospheric evolution. The mission is expected to last for one lunar day (14 days on Earth), and the rover will carry out a number of scientific experiments including a spectral analysis of the minerals on the lunar surface.

*The Chandrayaan-3 Integrated Module with the Vikram lander plus Pragyan rover (top) and the Propulsion Module (bottom). (Credit: Indian Space Resource Organization)*

"This will remain the most memorable and happiest moment for all of us, for our team," said associate project director Kalpana Kalahasti, during a livestream following the landing. "We have achieved our goal flawlessly, from the day we started rebuilding our spacecraft after the Chandrayaan 2 experience. It has been breath in breath out for our team! This has been possible only because of the immense effort from our Chandrayaan-3 team. Thank you for all the help that has been provided from all the departments."
India's Prime Minister Narendra Modi tuned in to the livestream of the landing, and addressed the team.
"All the people of the world, the people of every country and region: India's successful Moon mission is not just India's alone … this success belongs to all of humanity," Modi said,

speaking on the ISRO webcast of the event. "We can all aspire for the Moon, and beyond."

## India's Rover Rolls Out Onto the Lunar Surface

On July 14th, 2023, the Indian Space Research Organization (ISRO) launched the third mission in its Chandrayaan ("Moon vehicle" in Hindi) lunar exploration program. Earlier this week (Wednesday, August 23rd), the Chandrayaan-3 mission's *Vikram* lander touched down on the far side of the Moon, making India the fourth nation in the world to send missions to the lunar surface and the first to land one near the Moon's south pole region. Shortly after that, the ISRO announced that they had deployed *Pragyan,* the rover element of the mission, to the surface.

The ISRO shared the news via its official Twitter account on the evening of August 23rd, stating, "Chandrayaan-3 ROVER: Made in India. Made for the MOON! The Ch-3 Rover ramped down from the Lander, and India took a walk on the Moon!" Multiple updates followed, including how communications were established between the lander and the ISRO's Telemetry, Tracking, and Command center and the Mission Control /Mission Analysis Room (ISTRAC-MOX) in Bengaluru, India, and how the rover had completed its first maneuvers and systems' checks:

*"All planned Rover movements have been verified. The Rover has successfully traversed a distance of about 8 meters. Rover payloads LIBS and APXS are turned ON. All payloads on the propulsion module, lander module, and rover are performing nominally."*
They also shared images of the lunar surface taken by *Vikram's* Lander Horizontal Velocity Camera (LHVC) as it slowly descended. These and other images were stitched together to create animations of the lander's descent and the rover's deployment onto the surface (see above). The lander and rover will conduct science experiments on the surface, including characterizing the local environment, atmosphere, and surface composition while also scouting for resources (the most important being water ice).

This research will enable future missions, which could include sending crews (*vyomanauts*) to the Moon. As noted, this mission is the first to land near the Moon's South Pole-Aitken Basin, a highly significant accomplishment given that this is where multiple space agencies plan to establish habitats that will enable lunar research, exploration, and development. This includes NASA's Artemis Program – which will lead to the Lunar Gateway and the Artemis Base Camp – and the Russian-Chinese International Lunar Research Station (ILRS).

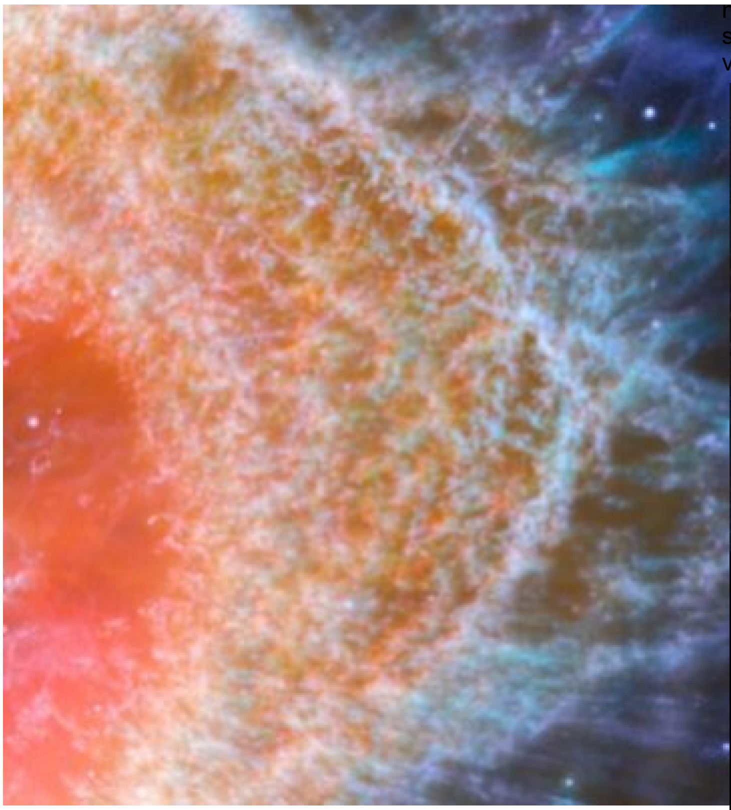
Under the circumstances, this successful landing and deployment show that India will likely be a crucial partner in any future lunar settlement. This is all the more poignant given the current competition between India and its Russian counterparts. *Chandrayaan-3* launched on July 14th and established orbit around the Moon by August 4th, almost three weeks before making its descent. Meanwhile, Roscosmos launched its comparatively smaller and lighter Luna-25 mission on August 10th, reaching lunar orbit on the 16th. Roscosmos has reportedly scheduled a landing date for Monday, August 21st, but the mission controllers reported an "abnormal situation" that was later revealed to be due to an engine failure. This caused the mission to crash into the surface (in the southern Pontecoulant crater) two days before its scheduled landing. A day later, RussianSpaceWeb creator/publisher Anatoly Zak posted that according to rumors on Russian social media, "mission managers were pressured not to postpone the transfer to a lower orbit in order to beat an Indian lander to the lunar surface."

*The Vikram lander with its ramp deployed to show how the rover will roll onto the surface. Credit: ISRO*

The fact that Chandrayaan-3 made it to the surface safely indicates that a slow and measured approach is better than a hasty one. It was also a welcome relief after the failure of *Chandrayaan-2*, which crashed on the lunar surface in September 2019 during an attempted landing. The lessons learned from that mission helped inform the design of *Chandrayaan-3*, which included improvements like autonomous attitude control, a Laser Doppler Velocimeter (LDV), greater systems redundancy, and stronger landing legs.
The *Pragyan* rover will spend the next two weeks studying the composition of the lunar surface, measuring the presence of water in the regolith, and gathering data on the history of impacts in the region and the evolution of the Moon's tenuous atmosphere. Similarly, the *Vikram* lander will rely on its suite of instruments to measure the thermal conductivity and temperature of the lunar surface, search for seismic activity around the landing site, and estimate the near-surface plasma density over time.
*Further Reading: ISRO*

## When the Sun Dies, it Could Produce a Fantastic Ring in Space, Like This New Image From JWST

Planetary nebulae were first discovered in the 1700s. Legend tells us that through the small telescopes of the time, they looked rather planet-like, hence the name. Real history is a bit more fuzzy, and early objects categorized as planetary nebulae included things such as galaxies. But the term stuck when applied to circular emission nebulae centered around a dying star. As new observations show, planetary nebulae have a structure that is both simple and complex.
Planetary nebulae are the remnants of stars like our Sun. When stars of about 1 – 8 solar masses near their end of life, they heat up and cast off their outer atmosphere in an expanding sphere. The exposed underlayer of the star then bathes the nebula in ultraviolet radiation, causing the nebula to ionize and glow. While most planetary nebulae are spherical, many have dual lobes or some other asymmetry. While the process can be simple, stellar rotation and magnetic fields can craft an menagerie of structures.
The Ring Nebula is perhaps the most archetypal planetary nebula. It's just 2,200 light-years away, and bright enough to be seen with a pair of binoculars. Also known as M57, it is a popular target for amateur astronomers. Recently the James Webb Space Telescope (JWST) captured images of the Ring Nebula using both its Near-Infrared Camera (NIRCam) and its Mid-InfraRed Instrument (MIRI), and the results show incredible details.



Details show dense globules within the nebula. Credit: ESA/Webb, NASA, CSA, M. Barlow, N. Cox, R. Wesson

Both high-resolution images show how the ring portion of the nebula is filled with clumps of hydrogen gas. Astronomers have identified more than 20,000 clumps within the ring, each about as massive as the Earth. Both images also show spikes of gas radiating away from the ring. These are thought to be trails of complex molecules that can only form in dark regions of space. The spikes indicate where the inner globules cast shadows that allow molecules to form without the disruption of ultraviolet light.

The MIRI image in particular also shows concentric arcs of gas in the outermost region of the nebula. This indicates that the star went through cycles of heating and cooling before a final heating period cast off the bulk of its atmosphere. Based on the spacing of these arcs, the cycles occurred every 280 years. This cycling behavior is unusual because there is no nuclear process that would produce it. Instead, astronomers speculate that the central star has an unseen companion orbiting it at a distance roughly that of Pluto from the Sun.

We still have much to learn from these new observations, but it is clear that these nebulae are the result of a complex stellar dance of heat and light. When the time comes for our Sun to become a planetary nebula, we can be sure it will not go quietly into the cosmic night.

**Reference:** “Webb Reveals Intricate Details in the Remains of a Dying Star.”

## Comet P1 Nishimura Could Be Bright Over the Next Few Weeks

*New Comet P1 Nishimura graces the August dawn sky… but how bright will it get?*

Hello. In a predictable clockwork Universe, a new comet is always the one wildcard that can over- or under-perform expectations. The most dramatic ones often crop up with scant warning: witness Comet IRAS-Araki-Alcock in 1983, and Comet B2 Hyakutake in 1996.

Now, we have a new comet that could reach naked eye visibility over the next few weeks: C/2023 P1 Nishimura. The comet was discovered by Hideo Nishimura while shooting wide-field images from Kakegawa, Japan on the night of August 11th. At the time, the comet displayed respectable a 5’ coma. Score one for the human observers, versus robotic all-sky surveys…

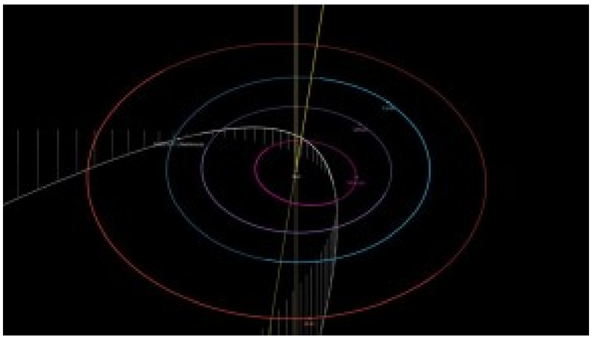
Getting brighter… Comet C/2023 P1 Nishimura from August 15th, just before confirmation. Image credit and copyright: Dan Bartlett.

Currently at +9th magnitude (with a bullet) in the constellation Gemini, the comet is now well-placed in the predawn sky. With binoculars, I could just make out the smudge of the comet this morning near Delta Geminorum. I was observing from Jimena de la Frontera in southern Spain.

The comet was initially listed as simply HN00003 on the IAU’s Minor Planet Center PCCP site, before receiving a formal name. P1 Nishimura is expected to brighten to +3 or +2 magnitude in early September, though it will also be near the Sun at that time. The comet passes 0.85 Astronomical Units (AU) or 127 million kilometers (79 million miles) from the Earth on September 13th, and reaches perihelion 0.22 AU (33 million kilometers or 20.5 million miles) from the Sun interior to the orbit of Mercury on September 18th.

### An Intriguing Orbit

At its closest approach to Earth in mid-September, the comet will cross four degrees of sky per day.



The orbital path of Comet Nishimura. Credit: NASA/JPL.

Unfortunately, the comet also ‘takes the plunge’ sunward in early September, and passes only 12 degrees from the Sun in mid-September before heading southward. It’ll also juuuust miss the joint NASA/ESA SOHO's LASCO C3 field of view. Too bad it didn't come by in December, as it would've passed just 0.06 AU (9 million kilometers or 5.6 million miles) from the Earth, and would've been a truly spectacular comet.

Keep in mind, as of writing this, the NASA/JPL ephemeris for the orbital solution for the comet is only from 63 observations over a four day span; expect the final orbit for the comet to get tweaked a bit as its path and position through space is better known (it's *that* new!) P1 Nishimura crept up on us from south and sunward, which is most likely how it evaded detection earlier this summer.

On a steep orbit inclined 129° relative to the ecliptic plane, Comet P1 Nishimura is on a retrograde path. This means its moving opposite to the planets in the inner solar system. The comet also looks to has an orbital eccentricity of slightly greater than 1.0, meaning it's most likely a dynamically new visitor to the inner solar system from the distant Oort Cloud, due to get ejected towards galactic space in the direction of the southern constellation Pyxis after perihelion.

**How Bright?**

As a first time newcomer approaching the Sun, P1 Nishimura could prove to be an active one, another plus. Late August sees the comet 20° above the eastern horizon one hour before sunrise as seen from latitude 35° north. Also, watch for a brilliant crescent Venus entering the dawn view. Venus is fresh off of inferior conjunction on August 13th. We're seeing the comet approaching the Sun on a nearly perpendicular path from our Earthbound perspective. This is an ideal geometry to spy a dust tail, should the comet sprout one towards perihelion.


The apparent path of Comet P1 Nishimura through the dawn sky from August 17th through September 7th as seen from latitude 35 degrees north. Note that the background celestial view is for the end of the path. Credit: Starry Night.

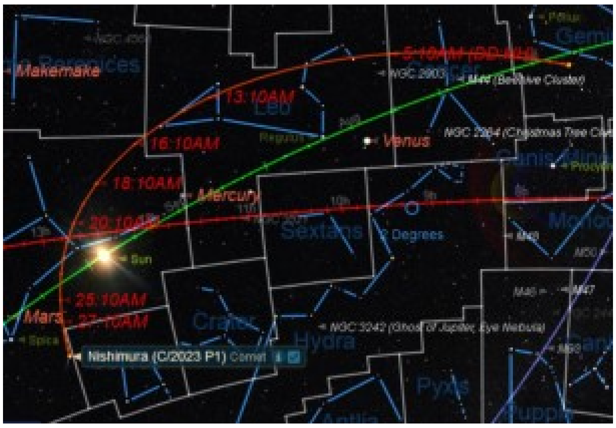
The comet then begins its dramatic plunge towards the eastern horizon in early September, becoming increasingly difficult to observe. The following evening apparition will be a brief and bashful one for northern observers. The comet only climbs 5° above the western horizon, 30 minutes after sunset around September 16$^{th}$ as seen from 35° north.

**The Comet Month by Month**

Here's a look at celestial dates with destiny for Comet P1 Nishimura over the next few months. Unless otherwise noted, 'near' denotes a pass or conjunction of less than one degree, or the diameter of two full Moons.

**August**

19- Passes 16' from the 'Clown Face' Nebula NGC 2392.
22- Crosses the ecliptic plane northward.
26- Crosses into the constellation Cancer.
31- Passes 4 degrees from the open cluster Messier 44.




The celestial path of Comet P1 Nishimura, through October 1st. Credit: Starry Night.

**September**

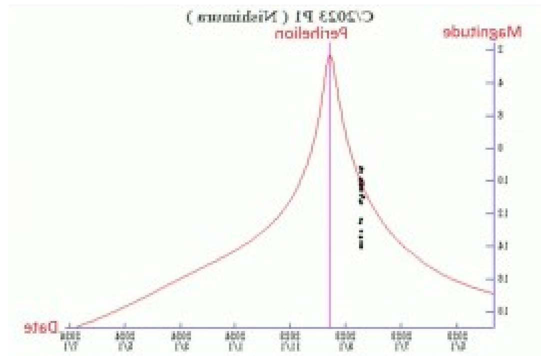
5-Crosses into the constellation Leo.
7-Passes near the +3$^{rd}$ magnitude star Epsilon Leonis.
9-Passes near the +3.4 magnitude star Zeta Leonis.
13-Earth closest approach at 0.85 AU distant.
15-Passes in front of (transits) the +2nd magnitude star Denebola (Beta Leonis).
16-Crosses into the constellation Virgo, and reaches a minimum elongation of 12 degrees from the Sun.
18-May top out at +2$^{nd}$ magnitude, as the comet reaches perihelion at 0.22 AU from the Sun.
21-Crosses the celestial equator southward.
24-Crosses the ecliptic southward.

**October**

1-Drops below +10$^{th}$ magnitude.

**Farewell For Comet Nishimura**

From there, the comet begins its long journey out of the solar system. Southern observers may still see Comet P1 Nishimura as it departs, never to be seen by human eyes again.



The projected light curve for Comet P1 Nishimura. Adapted from Seiichi Yoshida's *Weekly Information About Bright Comets*.

Your best bet at spotting Comet P1 Nishimura is to sweep the suspect area of sky with binoculars, or a low power telescopic field of view. Watch for a fuzzy blob that refuses to snap into focus. COBS (The Comet Observer's Database) is an excellent source to see what the comet is currently doing, and Heavens Above will generate wide and narrow field of view finder charts for the comet. Gideon van Buitenen's comet page will also produce inverted finder charts (black stars on a white background) for a given comet.

Though +6$^{th}$ magnitude is usually quoted as the cut off for naked eye visibility, comets are diffuse objects. In past experience, comets like F3 NEOWISE in 2020 only became conspicuous objects able to be captured along with foreground objects when they hit brighter than

+3rd magnitude or so.
The hunt is now on, to nab Comet C/2023 P1 Nishimura in the dawn sky.

## The Largest Impact Crater on Earth, 520 km Across, Might Be Hiding Under Australia

Asteroid impacts have arguably killed off more species than almost any other type of disaster since life began on Earth. The most famous of these, the Chicxulub impactor, killed the dinosaurs about 65 million years ago, along with 76% of all species on the planet at the time. But that was by no means the worst disaster; as far as we can tell, it wasn't even the biggest asteroid. That title currently goes to the Vredefort crater in South Africa. Coming in at over 300 kilometers wide, it was the largest asteroid crater so far found, at least when it was formed about 2 billion years ago. But that might be about to change if a theory from Andrew Glikson and Tony Yeates of New South Wales is correct. They have found what they believe to be the biggest impact crater on Earth since the Late Heavy Bombardment in their own Australian province of New South Wales, and they think it might have caused one of the other five mass extinction events.
They named the crater, which they estimate is around 520 kilometers in size, the Deniliquin structure. Trying to research a structure that massive is a difficult task, and made much more difficult the older the structure is. Drs. Glikson and Yeates estimate the Denliquin structure to be around 445 million years ago. That is a lot of time for erosion, sedimentation, and tectonic activity to take its toll on any structure on Earth, no matter how massive. However, there are some tell-tale clues that researchers can find to point out the size of this impact crater.
First is an assessment of the geophysical data of the region. Updates of that data, which culminated in 2020, point to a structure with a defined dome from a seismic event that is around 520 km wide. Other magnetic evidence abounds, such as "radial faults" that point away from what is thought to be the center of the impact structure. And there are some magnetic irregularities that could have been caused by magma swirling around closer to the surface after the impact.
Video describing the asteroid impact that created the largest confirmed crater on Earth – though it is smaller than the newly described one in NSW.
Credit – GeologyHub YouTube Channel
If it does exist, it would have been created by an impact of epic proportions. The authors of a new paper on the crater suggest a specific time in history. Four hundred forty-five million years ago coincided with the geologic event called the Hirnantian glaciation stage, which was part of the first of the five big extinctions – the End Ordovician extinction. The end of the Ordovician period was caused by massive global cooling, which caused massive changes in ocean chemistry and other problems. A full 86% of all species on Earth died off during this period, as it was the second-most catastrophic of all the extinction events (after the one that ended the Permian 250 million years ago).
Lots of geological processes can cause global cooling, but one of the more dramatic ones is an asteroid impact, which flings ejects into the upper atmosphere to block out the Sun. An impact as big as the one that created the Denliquin structure was undoubtedly big enough to do just that.
A description of Chicxulub, probably the best known massive asteroid crater.
Credit – GeologyHub YouTube Channel
So, could this massive crater be a clue to how a different asteroid caused another global catastrophe? Maybe, but to get a better timestamp on when the impact happened, researchers will need to collect samples from deep within the magnetic core of the impact crater. Currently, there aren't any plans to do so, but there if the theory garners enough attention, there will undoubtedly be some multi-millionaire who would be willing to fund an effort to try to research the world's largest impact crater – and discover if it was responsible for one of the deadliest events in Earth's history.
Learn More:
The Conversation – New evidence suggests the world's largest known asteroid impact structure is buried deep in southeast Australia
Glikson & Yeates – Geophysics and origin of the Deniliquin multiple-ring feature, Southeast Australia
UT – Scientists Have Been Underestimating the Asteroid That Created the Biggest Known Crater on Earth
UT – Recreating the Extreme Forces of an Asteroid Impact in the Lab

## Virgin Galactic Flies Its First Privately Funded Space Tourists

Virgin Galactic sent its first privately funded adventurers — and its first space sweepstakes winners — past the 50-mile space boundary today.
The tourists on the suborbital space trip known as Galactic 02 included Keisha Schahaff, who won two tickets in an online contest organized by the Omaze charity sweepstakes platform and a nonprofit group called Space for Humanity in 2021. She and her daughter, Anastatia Mayers, became the first mother-and-daughter duo to share a spaceflight, and the first spacefliers from the Caribbean island nation of Antigua and Barbuda.

"I kind of feel like I was born in this life for this," Schahaff, a wellness coach, told NBC's "Today" show. Her daughter is a college student who aims to become an astrobiologist.
Jon Goodwin — an 80-year-old British adventurer who competed as a canoeist in the 1972 Olympics — also broke barriers on today's Galactic 02 flight. In 2005, he was one of the first customers to reserve a spot with Virgin Galactic, back when the price was $200,000. Then, almost a decade ago, he was diagnosed with Parkinson's disease. Today he became only the second person with Parkinson's to take a space trip. (The first was NASA shuttle astronaut Rich Clifford.)
"When I was diagnosed with Parkinson's, I thought, 'Well, that's it. They're not going to accept me any longer,'" Goodwin said before the flight. "The fact that I am now one of three [on] the first commercial trip to go into space, with suffering with Parkinson's for nine years, just shows you this attitude of 'Space for All' is a wonderful attitude."
Rounding out the crew were Virgin Galactic pilots C.J. Sturckow and Kelly Latimer, and chief astronaut instructor Beth Moses. This was the first spaceflight for Latimer.
Today's flight profile followed the routine that was set during Virgin Galactic's test flights, plus a research mission known as Galactic 01 that was flown for the Italian Air Force in June.
The SpaceShipTwo rocket plane known as VSS Unity was slung underneath its twin-fuselage carrier airplane, VMS Eve, for takeoff from Spaceport America in New Mexico at 8:30 a.m. MT (14:30 UTC). About 47 minutes later, Unity was released from Eve at an altitude of 44,300 feet and fired up its rocket motor for the climb to a maximum height of a little more than 290,000 feet (55 miles, or 88.4 kilometers).
That altitude exceeded the 50-mile space boundary as defined by NASA and the Federal Aviation Administration — but stayed below the internationally recognized 100-kilometer (62-mile) space boundary known as the Karman Line.
At the top of the ride, the riders in Unity's passenger cabin unstrapped themselves from their seats and experienced a few minutes of weightlessness. They also marveled at views of a curving Earth beneath the black sky of space.

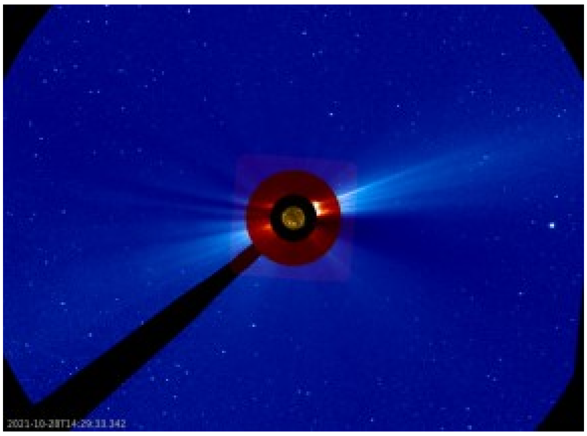
They returned to their seats for the high-G descent — and then unfurled an Antiguan flag to celebrate their milestone. Virgin Galactic's webcast showed a crowd of well-wishers on Antigua cheering on the spacefliers — and one of those well-wishers was the company's billionaire founder, Richard Branson.
Unity glided to a landing back at Spaceport America a little bit after 9:30 a.m. MT (15:30 UTC). The carrier aircraft, piloted by Nicola Pecile and Mike Masucci, touched down minutes later.
Afterward, Goodwin said the experience was "far more dramatic than I imagined it might be."
"It was, without a doubt, the most exciting day of my life," he said.
Schahaff said she wasn't yet ready to come down to Earth. "I'm still up there," she said. "I'm not here yet."
Her daughter sounded as if she had experienced what astronauts call the Overview Effect. "I was shocked at the things that you feel," Mayers said. "You are so much more connected to everything than you would expect to be. You felt like a part of the team, a part of the ship, a part of the universe, a part of Earth. It was incredible."
Although this was the first Virgin Galactic mission to carry crew members who could be considered space tourists, the first crewed flight of Blue Origin's New Shepard suborbital spaceship set an earlier precedent. That flight carried an 18-year-old Dutch student named Oliver Daemen, whose family paid an undisclosed fare for the trip. Mayers is also 18, and is now the youngest woman to take a suborbital spaceflight.

## A Massive Solar Storm was Detected on Earth, Mars, and the Moon

A coronal mass ejection erupted from the Sun on October 28th, 2021, spreading solar energetic particles (SEPs) across a volume of space measuring more than 250 million km (155.34 million mi) wide. This means that the event was felt on Earth, Mars, and the Moon, which was on the opposite side of the Sun at the time. It was also the first time that a solar event was measured simultaneously by robotic probes on Earth, Mars, and the Moon, which included ESA's *ExoMars Trace Gas Orbiter* (TGO) and *Eu:CROPIS* orbiter, NASA's *Curiosity* rover and *Lunar Reconnaissance Orbiter* (LRO), and China's *Chang'e-4* lander.

The ESA's Solar Orbiter, Solar and Heliospheric Observatory (SOHO), and BepiColombo missions were also caught by the outburst and provided additional measurements of this solar event. The study of Solar Particle Events (SPE) – aka. solar flares – and "space weather" phenomena are vital to missions operating in Low Earth Orbit (LEO) – for example, crews living and working on the International Space Station (ISS). But it is especially vital for missions destined for locations beyond LEO and cislunar space, including Project Artemis and the many proposals for sending astronauts to the Moon and Mars in the coming years.

The event was described in a paper, "The First Ground Level Enhancement Seen on Three Planetary Surfaces: Earth, Moon, and Mars," that recently appeared in the *Geophysical Research Letters*. The international team behind it consisted of scientists from the Deep Space Exploration Laboratory (DSEL), the CAS Center for Excellence in Comparative Planetology (CECP), the Institute of Experimental and Applied Physics (IEAP), the German Aerospace Center (DLR), the Space Research and Technology Institute (SRTI-BAS), the Southwest Research Institute (SwRI), the Leidos Corporation, and the Institute for the Study of Earth, Oceans, and Space (UNH-EOS).



*A coronal mass ejection, as seen by the ESA/NASA SOHO mission on October 28th, 2021. Credit: ESA/NASA*

The 2021 solar event was an example of what scientists describe as a "ground level enhancement," a rare occurrence where solar particles are energetic enough to pass through the Earth's magnetic field and reach the surface. Only seventy-three ground-level enhancements have been detected since scientists began recording them in the 1940s, and no such events have been detected since. While Mars' thin atmosphere does filter out the lower energy particles (and slows down the highly energetic ones), neither the Moon nor Mars generates similar magnetic fields.
This means solar particles reach the surface regularly and even produce secondary radiation (through interaction with surface regolith). According to measurements made by NASA's LRO mission from lunar orbit, the solar event was rather weak, equivalent to an absorbed radiation dose of only 31 milligray (mGy) or 31 millisieverts (mSV). Meanwhile, the *Exomars TGO* and *Curiosity* rover, obtaining measurements from orbit and the surface, recorded doses of 9 and 0.3 three mGy (respectively) – a difference of a factor of 30.
Compare this to the solar outburst recorded in August 1972, which fell between the Apollo 16 and 17 missions. The measured outburst of radiation from this event would have delivered a fatal dose to any astronauts operating on the lunar surface. Jingnan Guo, a researcher with the DSEL with the School of Earth and Space Sciences at the University of Science and Technology of China (USTC), explained in an ESA press release:
*"Our calculations of the past ground-level enhancement events show that, on average, one event every 5.5 years may have exceeded the safe dose level on the Moon if no radiation protection had been provided. Understanding these events is crucial for future crewed missions to the surface of the Moon."*
Astronauts are exposed to radiation regularly when they go to space, but the hazard of prolonged exposure increases dramatically beyond Low Earth Orbit (LEO). This includes the risk of exposure to solar radiation and cosmic rays, which becomes elevated beyond Earth's magnetic field. But there is also the risk of huge outbursts of SEPs caused by "coronal mass ejections" (CMEs), also known as "solar flares."

*Artist's impression of the Lunar Gateway with the Orion spacecraft docked on the left side. Credit: ESA*

**Impact on Astronaut Health**

Given how much of our future planned exploration efforts are centered on the Moon and Mars, it is crucial to understand intense radiation events and their effect on the space radiation environment. According to ESA health guidelines, if astronauts absorb more than 700 milligray (mGy) of radiation during a mission – equivalent to 700 millisieverts (mSv) – they may experience radiation sickness caused by the destruction of bone marrow and damage to their central nervous system. This can lead to serious health problems, including nausea, infection, internal bleeding, and elevated cancer risks.

If an astronaut absorbed as much as 10 gray (10,000 sieverts), they would likely die within two weeks. This is why the ESA, NASA, and other space agencies are dedicated to limiting astronaut exposure to 1,000 mSv, or 3% Risk of Exposure-Induced Death (REID), during the entirety of their career. While radiation shielding is important, dedicated instruments that measure the radiation environment in space are used to predict major events. The advanced warning allows astronauts to seek protection within shielded environments, protective suits, and (in the future) lunar or Martian caves.

On the ISS, astronauts and cosmonauts will retreat to designated areas where the wall shield against incoming energetic particles. This includes the sleeping quarters (located in the Russian *Zvezda* and NASA *Harmony* modules) or one of the ISS' galleys in the Nauka and Unity modules.

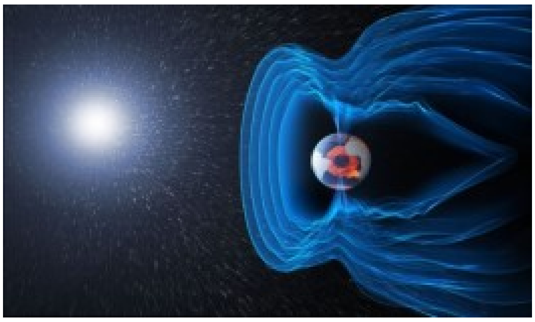
For astronauts bound for the Moon, the Lunar Gateway will serve as the stopover point and a potential fallback position in the event of solar activity. The Gateway will rely on three instrument suites to monitor the radiation environment around the Moon and inside the Gateway. This includes the:

European Radiation Sensors Array (ERSA) provided by the ESA

Heliophysics Environmental and Radiation Measurement Experiment Suite (HERMES) provided by NASA

Internal Dosimeter Array (IDA) provided by the ESA and JAXA

"Currently, we live in a golden age of Solar System physics," said Marco Pinto, an ESA research fellow working on radiation detectors. "Radiation detectors aboard planetary missions such as BepiColombo, on its way to Mercury, and Juice, cruising to Jupiter, add a much-needed coverage to study the acceleration and propagation of solar energetic particles,"



*Earth's protective shield. Credits: ESA/ATG medialab*

NASA and the ESA are also developing next-generation space suits to provide improved protection against deep-space radiation, including NASA's Exploration Extravehicular Mobility Unit (xEMU). The ESA also sent two mannequins developed by the German Aerospace Center (DLR) to space as part of the Artemis I mission, which conducted a circumlunar test flight between November 16th to December 11th, 2022. These mannequins, nicknamed Helga and Zohar, were studded with radiation sensors provided by NASA and the DLR, while one (Zohar) wore a protective radiation vest.

The data obtained during this test flight will help inform future spacesuits developed for ESA crews. Said Colin Wilson, ExoMars TGO project scientist:

*"Space radiation can create a real danger to our exploration throughout the Solar System. Measurements of high-level radiation events by robotic missions is critical to prepare for long-duration crewed missions. Thanks to data from missions like ExoMars TGO we can prepare for how best to protect our human explorers."*

## Yes! A JWST Image of the Ring Nebula

Brace yourselves for great JWST views of the iconic Ring Nebula (M57). An international team of astronomers just released a fantastic near-infrared image of the nebula, showing incredible details.

The Ring is a planetary nebula in the constellation Lyra and is what's left over at the death of sun-like star. The star in the center blew all its material away to space, which is what we see as the ring. The star itself is now becoming a white dwarf.

Astronomers have long been fascinated by this form of star death because it shows what will happen to the Sun in about 5 billion years. Albert Zijlstra, Professor in Astrophysics at the University of Manchester, said of the JWST view, "We are amazed by the details in the images, better than we have ever seen before. We always knew planetary nebulae were pretty. What we see now is spectacular."

Planetary nebulae exist throughout the galaxy. Each one is different, and they have many shapes. Some have glowing rings, others show bubble-like structures, while others look like butterflies and wispy phantoms. In the case of the Ring Nebula, it's really more like a jelly donut or bagel in shape, which gives some tantalizing clues to its past. Astronomers can trace the chemical elements in planetary nebulae by studying the light they emit in great detail. Those elements tell the tale of the star's evolution through time.


M57 (the Ring Nebula) is accessible to amateur astronomers with good cameras. This ‘deep version’ taken by by amateur astronomers Terry Hancock of Michigan and Fred Herrmann of Alabama, who both used Astro-Tech 12 inch Ritchey-Chrétien astrographs.

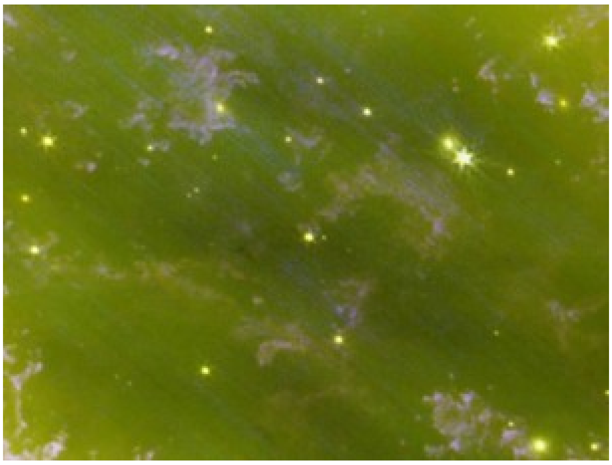
**An Infrared View of the Ring Nebula**

In this case, JWST looked at the ring in near-infrared light using its NIRCam instrument. It’s sensitive to light that ranges from 0.6 to 5 microns (600-5000 nanometers). The human eye can see a little into the infrared, to perhaps around 0.7 microns (700 nm), so JWST extends our vision to realms where we can’t see.

According to Mike Barlow, lead scientist of the JWST Ring Nebula Project, the high-resolution views really tell much more of the Ring’s story as the star moved through its life cycle. “The high-resolution images not only showcase the intricate details of the nebula’s expanding shell but also reveal the inner region around the central white dwarf in exquisite clarity,” he said. “We are witnessing the final chapters of a star’s life, a preview of the Sun’s distant future so to speak, and JWST’s observations have opened a new window into understanding these awe-inspiring cosmic events. We can use the Ring Nebula as our laboratory to study how planetary nebulae form and evolve.”

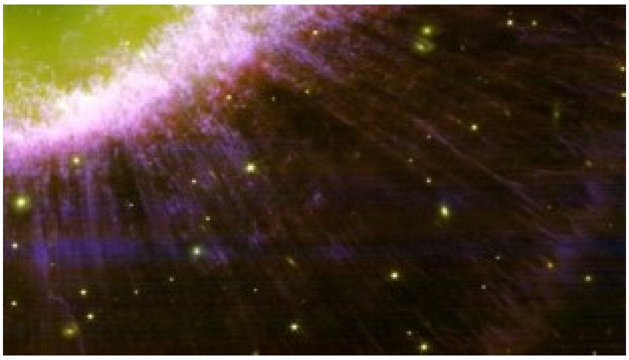
**Colors and Details**

In the JWST view, colors coding shows temperatures of the ejected material at different distances from the star. Those clouds of gas and dust glow thanks to ultraviolet light streaming away from the stellar remnant. The star itself is about 100,000 degrees, which heats up the nearby clouds quite well. The rest of the material lies further out and is much cooler. Astronomers estimate that the star began ejecting its outer layers at least 4,000 years ago. Based on earlier observations, including those by Hubble Space Telescope, the outer parts of the nebula appear to be expanding at a rate of about 20 kilometers per second and is just slightly over a light-year across.



A close-up of the central region of the Ring Nebula. The brightest star is the very hot progenitor of the nebula. Courtesy JWST Ring Nebula Project.

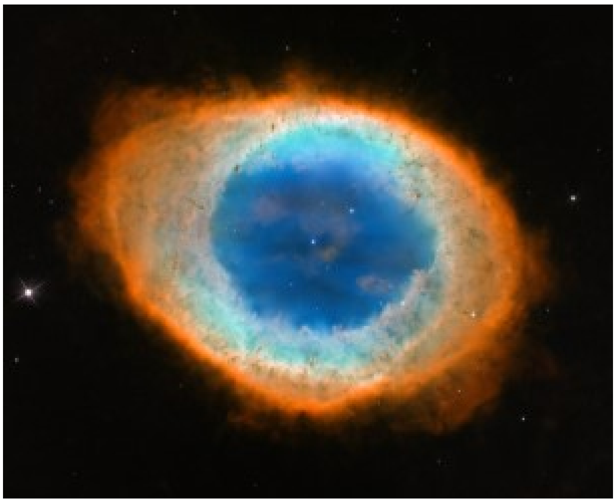
Astronomers can see more details in the nebula using the JWST’s infrared-sensitive capabilities. For example, NIRCam can peer through any surrounding dust clouds to zero in on structures in the nebula. It can also detect any material that glows in infrared light. In JWST’s view, we can now see thin streamers of material at the edges of the nebula in more detail. In addition, it identifies faint structures in the ring itself. Astronomers will study those closely to figure out what caused them.



A close-up of the outer halo of the Ring Nebula, with linear features stretching out from the main body. Courtesy JWST Ring Nebula Project.

**Origin and Evolution of the Ring Nebula**

The colors of the Ring are well-known from many astrophotographs, as well as views from both ground-based and orbiting telescopes. Perhaps the most famous recent view came from the Hubble Space Telescope in 2013. It shows a great deal of colorful detail, including some strange-looking “cometary knots”. Those were created as material was cast away from the star. In HST’s view, blue colors indicate hot helium emission lines, green indicates ionized oxygen, and red is ionized nitrogen.



Hubble image of the Ring Nebula (aka. Messier 57). Credit: NASA/ESA/ Hubble Heritage (STScI/AURA) – ESA /Hubble Collaboration

Those colors and structures tell an interesting tale about the evolution of the Ring Nebula’s star, according to astronomer Nick Cox, a project co-leader. “These images hold more than just aesthetic appeal; they provide a wealth of scientific insights into the processes of stellar evolution. By studying the Ring Nebula with JWST, we hope to gain a deeper understanding of the life cycles of stars and the elements they release into the cosmos,” he said.

The Ring Nebula has been a case study in planetary nebulae for more than a century. Here’s what astronomers know about its origins. The progenitor star was several times more massive than the Sun. It spent much of its life doing what stars do: converting hydrogen to helium in the core. About 4,000 years ago, it ran out of hydrogen and began converting helium in its core. That caused the star to heat up and it ballooned out to become a red giant. As it did, it shed its outer layers to space. Ultraviolet light from the now-collapsing star heats up the gases, causing them to glow. The result, after several thousand years is the Ring Nebula we now see through our telescopes.

**More Images to Come**

The JWST NIRCam images aren't the only ones of the Ring JWST has taken. More taken with MIRI (another infrared instrument) will be released soon. The team of astronomers working on this project hail from UK, France, Canada, USA, Sweden, Spain, Brazil, Ireland and Belgium.

## Light Pollution from Skyglow Changes Bird Behavior

In the astronomy community, we typically this of light pollution as an overall negative. Much research points out its negative effect on our sleep and even our observational equipment. It also significantly impacts wildlife; however, according to a new paper from some Belgian, Swiss, and German researchers, not all of that impact is negative.
The paper, released in the journal Science of the Total Environment, discusses light pollution's impact on birds that are typically most active near twilight. Known as crepuscular species, these include a bird called the European Nightjar. This tiny bird, which looks a bit like an American Sparrow, is commonly found on several continents, including Europe, Asia, and Africa.
That relatively large range makes it ideal for the experiment Dr. Ruben Evens and his colleagues spread over several institutions had in mind for their experiment. They were interested in seeing how the nightjars were affected by "skyglow," indirect illumination of the night sky caused by artificial lighting. While it might seem akin to light pollution, the authors stress that it is indirect rather than being in the direct line of sight of the light source.
To measure how the nightjars were affected, they used one of the most common tools of ornithology – an activity tracker. These can easily be fitted to birds and are small enough that it doesn't affect their flight patterns, but they tell the researchers where they are going and, most importantly, in this case, when they do so.
They fitted activity trackers to birds in three separate locations: Belgium, sub-tropical Africa, and Mongolia. In Belgium, there is a relatively high occurrence of skyglow, whereas, in Africa and Mongolia, there was hardly any, with "pristine skies," as the paper describes them. They found that, on moonless nights (i.e., when there is very little natural light), nightjars are four times more active in Belgium than in Africa and twice as active as in Mongolia.
Even those relatively easy-to-understand data points would have been interesting for ornithologists and environmentalists alike. But, the researchers took it a step further by looking at the effect weather conditions had on the nightjars.
Here's a TED talk on light pollution – and how to fix it.
Credit – TED YouTube Channel
Clouds dramatically decrease natural brightness, making crepuscular species like the nightjar less active under typical conditions. However, clouds can also increase skyglow by allowing light to bounce off their undersides, thereby increasing the brightness on overcast nights in built-up areas.
In those built-up areas, the researchers found that nightjars dramatically increased their activity on overcast nights, while in the areas less affected by skyglow, their activity level decreased. Simply put, skyglow allowed the birds to operate more effectively under low natural light conditions than they might have otherwise.
Why precisely this might be the case then becomes the question – and the researchers believe it's a relatively straightforward answer. Increased sky glow allows the nightjars to see better, making it less risky for them to move about. In the technical jargon of scientists, the effect is to "relieve.. [the] visual constraints on being active", as the paper's title suggests.
No matter the benefits to a relatively small number of species, most researchers will still think of light pollution, or the skyglow it creates, as an overall harmful effect of the Anthropocene period. However, it's sometimes refreshing to see how what is typically thought of as a negative can sometimes have a positive impact on wildlife. At least for nightjars and other birds of its ilk, the world has gotten just a little brighter lately.

## Senseless Vandalism Damages Canadian Observatory

The Royal Astronomical Society of Canada's observatory in Hamilton, Ontario was vandalized earlier this month, with at least $100,000 in damage to equipment and facilities.
Security video shows two people using a truck to repeatedly ram into two buildings – the observatory and a meeting center — knocking down exterior walls on both buildings and damaging telescopes and other equipment inside. Nothing was stolen, but damaged for no apparent reason.
"It appears to be a failed robbery turned utter vandalism," said the group's president Andy Blanchard. "It looked like they wanted to destroy everything."
Blanchard told Universe Today that another member of the group discovered the damage on July 4, 2023 when he went out to the center to do some maintenance. He first saw that a heavy-duty entrance gate had been ripped out of the ground, but that was only the start.
"It was shocking and upsetting and it took us about 3-4 hours to manage to get into the clubhouse building to access to security video," Blanchard said "On that video we saw they backed their truck into the observatory wall three times to knock it down, and they spent 5 minutes in the building, doing further damage to our equipment, such as throwing eyepieces to the floor. Then they used their truck to knock down the walls on our meeting and warming center, but the wall collapsed in a way that they couldn't enter the building."

*Damage to the Hamilton Observatory's meeting center after vandalism on July 3, 2023. Image courtesy Victor Abraham/ Hamilton Centre.*

The police say the two perpetrators are known and are being sought in connection with this and several other break-ins and acts of vandalism in the area in southern Ontario.

The Hamilton Centre of the RASC is one of 28 non-profit centers across Canada, powered by over 140 astronomy enthusiast members. The Hamilton group was originally founded 1901, and is one of the longest standing amateur astronomy organizations in Canada.

When the wall on the observatory was knocked down, it crushed a CGE Pro mount from Celestron, hurling the mounted telescope, worth at least $11,000 USD, across the room. In total, the astronomical equipment damaged is valued at more than $40,000 USD.

Blanchard said that's a substantial amount for a group of volunteers that are doing a public service by sharing the wonders of the night sky with their community.

*The Hamilton Observatory and meeting center before the damage. Image courtesy Victor Abraham/ Hamilton Centre.*

"It was basically several decades worth of collection and work," Blanchard said. "The biggest problem is that when the wall came down, the lime dust from the concrete walls settled on all the astronomical surfaces, and lime is very caustic to the expensive coatings on the eyepieces and optics. All have to be sent away for repair."

The group has started a GoFundMe page, and club member Jeff Parsons said their story seems to have struck a cord, "evidenced by the growing outpouring of support and generosity from not just the local community but the broad astronomy community."

Blanchard said they've been overjoyed with the support they've received, with both cash donations, as well as of offers for help with reconstruction of their buildings.

"It's a wonderful feeling to get such support from around the world," Blanchard said. "Many times, you don't realize you are part of a community until that community comes together for support. We are very proud of our community and all the people who are stepping up and saying they want to help."

But the group has also received offers of substantial donations, such as an observatory and other astronomical equipment. Additionally, a recognized member of the Canadian astronomy community offered to donate a 36″ telescope, valued at about $85,000.

"This is such a rare, extraordinary opportunity, and we are overwhelmed," Blanchard said. "To look through this telescope, you need to climb a 12-foot ladder. Plus, with the size of this telescope, you can see colors in space, where typically when you look through a regular telescope, everything is in shades of grey. I'm sure we will have line-ups around the block to look through this telescope."

They are using the GoFundMe to purchase a sea-can shipping container to hold all the equipment that survived the break in while their buildings are repaired or rebuilt. The group is still awaiting word on how much their insurance will cover.

The Hamilton group regularly holds public viewing events and they didn't let the vandalism stop them from holding their usual weekly observing events.

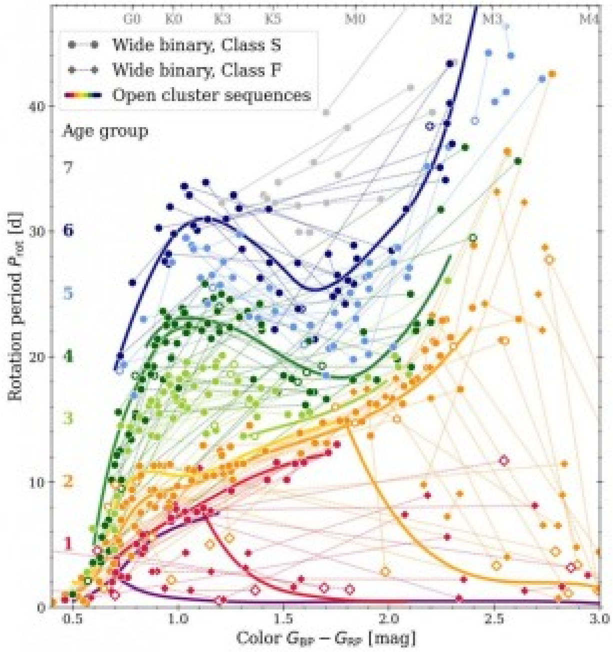
"We decided we weren't going to let this tragedy stop us and we've had more people than ever come out to look through our members' telescopes," Blanchard said. "The community has come together in ways we never would have dreamed possible."

## Astronomers Have a New Trick to Work out the Age of Stars

Twinkle, twinkle little star, I wonder just how old you are. It isn't an easy question to answer. Stars are notoriously difficult to age. We know the age of the Sun because we happen to live on one of its orbiting rocks, and we know very well how old the rock is. Without that information, things become a bit more fuzzy. But that could change thanks to a new study.

We do know a few broad rules about determining the age of a star. For example, generally the higher the metallicity of a star the younger it is. And main sequence stars like the Sun tend to get hotter as they age, so if two stars have the same mass and composition, the hotter of the two is likely the older. But by themselves, these general rules aren't enough to get a precise age determination. For that, we typically look at clusters of stars.

Star clusters such as open clusters and globular clusters generally form within a single molecular cloud, and they do so around the same time. When you look at the stars in a cluster you know they are all around the same age. Astronomers can use this fact to get a good age for star clusters. Individually there will be variations in things like metallicity and temperature, but statistically, the average age determination is a good measure of the cluster's age. But one thing that has been noticed is that among star clusters, older clusters have stars that rotate more slowly than stars in young clusters. This suggests that a star's rotation rate slows down as it ages. This would be a great way to determine stellar age because many stars have starspots, which we can use to measure rotation pretty easily. There are just two problems. The first is that within a cluster stars can be gravitationally bound, and this interaction might be driving the slowdown. If so, then individual stars wouldn't experience the same rotational decay. The second is that the metallicity of a star affects its density and temperature, so metallicity could have a significant effect on the slowdown rate.



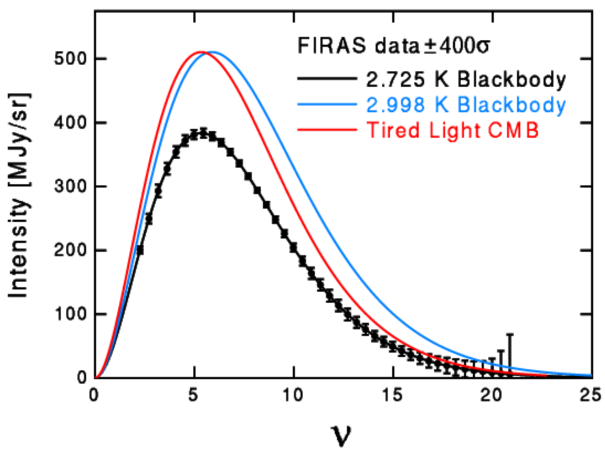

Star cluster age (lines) vs binary star age (circles/ diamonds). Credit: Gruner, et al

Still, the technique would be so useful that a team wanted to explore it further. They looked at 300 wide binary stars. These are binary stars with orbital distances large enough

that their rotations are independent of each other. And since binary systems form all at once, the team could be confident that binary pairs were the same age.
The team then applied the cluster method of using temperature and rotation rate to determine the age of each star in a pair. They found that the ages of binary pairs matched using this method. And with 300 samples to work with, they are confident the method works. The team also found the approach worked regardless of the metallicity of the stars. So while metallicity might have a small effect on stellar age, the rotation approach works all the same.
From this work, astronomers can feel confident in using rotation as an age measure regardless of whether a star is single, binary, or part of a cluster. This is great news. Telescope satellites such as Gaia and the upcoming PLATO mission have the search for exoplanets as part of their mission. The same method used to find the dip in stellar brightness as an exoplanet transits can also be used to measure the rotational rate of a star through starspots. In time could know the age of billions of stars as well as their motion and whether they have planets.
**Reference:** Gruner, D., S. A. Barnes, and K. A. Janes. "Wide binaries demonstrate the consistency of rotational evolution between open cluster and field stars." *Astronomy & Astrophysics* 675 (2023): A180.

The Universe Could Be Twice As Old if Light is Tired and Physical Constants Change

When the James Webb Space Telescope started collecting data, it gave us an unprecedented view of the distant cosmos. Faint, redshifted galaxies seen by Hubble as mere smudges of light were revealed as objects of structure and form. And astronomers were faced with a bit of a problem. Those earliest galaxies seemed too developed and too large to have formed within the accepted timeline of the universe. This triggered a flurry of articles claiming boldly that JWST had disproven the big bang. Now a new article in the *Monthly Notices of the Royal Astronomical Society* argues that the problem isn't that galaxies are too developed, but rather that the universe is twice as old as we've thought. A whopping 26.7 billion years old to be exact. It's a bold claim, but does the data really support it?
The model proposed in the paper begins with something known as tired light. In the tired light model, light spontaneously loses energy over time. So as photons travel billions of light years through the cosmos, they become redshifted. Thus, the light of distant galaxies is redshifted not because of cosmic expansion, but because of the inherent reddening of light over time. The idea of tired light has been around since Edwin Hubble first observed cosmic expansion as a way to maintain the idea of a steady-state universe. It lost popularity as the evidence for cosmic expansion became clear, and regained some popularity as the Webb observations started rolling in.
We've long known that tired light doesn't work on its own, so this paper adds a new twist dealing with universal physical constants. Quantities such as the speed of light, the charge of an electron, or the gravitational constant seem to be built into the structure of the universe. They have the values they do because of the way the universe formed, and it's generally assumed they don't change over time. We have geological and astronomical observations that show physical constants haven't changed for at least several few billion years.



Cosmic Microwave Background observations don't match tired light. Credit: Ned Wright

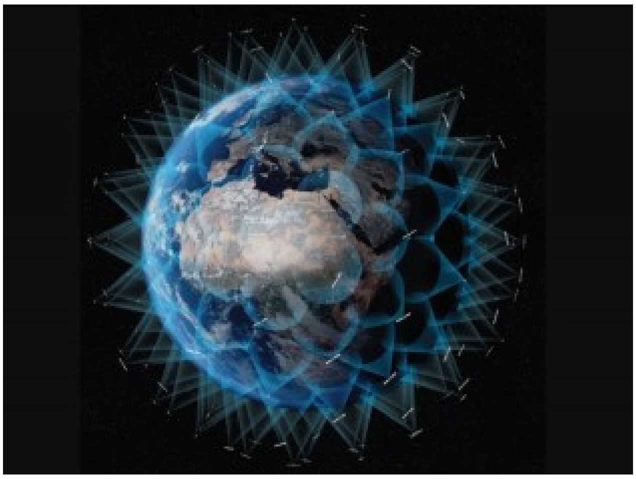
But this new paper argues that if you combine tired light and changing physical constants, you can get a universe that appears younger than it actually is. Basically, tired light gives you the cosmological redshift you observe, and gradually shifting physical constants means those mature distant galaxies aren't just 100 million years old, they are billions of years old. By tweaking tired light and variable physical constants *just so* to match the data, you get a universe that is 26.7 billion years old.
Does the model work? Yes, but there are two problems with it. The first is that *tweak theories are weak theories*. While this model can be made to fit observational data, there's no physical motivation for doing it. There are lots of models that can be tweaked to fit data, which is not the same as having a robust physical model. The author of the work argues that there could be some underlying mechanism that causes tired light and the physical constants to shift in just the right way, but there is still a lot of fudging in the model.
The second problem is that JWST's observations don't rule out the standard 13.7 billion-year-old universe. The galaxies are more complex than some computer simulations have predicted, but that's not surprising given the limits of large structure models. There are plenty of ways early galaxies could have evolved quickly that don't require rewriting cosmology.
But even without a strong physical motivation to create this model, the work is still useful. It's the kind of paper that thinks outside the box, which is a great way to make sure we aren't locked into old models just because they've worked so far. It isn't likely that this new model overturns standard cosmology, but as long as ideas are testable and disprovable, as this model is, there is no harm in adding it to the pile of ideas.

## China Has Begun Launching its Own Satellite Internet Network

Since 2019, Elon Musk and SpaceX have led the charge to create high broadband satellite internet services. As of May 2023, the Starlink constellation consisted of over 4,000 satellites operating in Low Earth Orbit (LEO) and roughly 1.5 million subscribers worldwide. Several competitors began launching constellations years before Starlink began, and several companies have emerged since. This includes HughesNet, OneWeb, and Amazon's Kuiper Systems. But Starlink's latest challenger could be its most fearsome yet: a company in China backed by the Beijing government!

On Sunday, July 9th, a prototype internet satellite was launched aboard a Long March 2C carrier rocket from China's Jiuquan Satellite Launch Center in Inner Mongolia. The satellite has since entered a predetermined orbit, where it will conduct several tests to validate the broadband satellite technology. The long-term aim of the project is to create a constellation of 13,000 satellites code-named "Guo Wang," – which loosely translates to "state network" in Mandarin – reflecting Beijing's vision for a state-run share of the satellite internet market.

This project was created by China's State-Owned Assets Supervision and Administration Commission (SASAC), which oversees China's largest state-owned enterprises and is led by Chinese company SatNet. According to filings issued to the International Telecommunication Union (ITU), the company intends to create two constellations (GW-A59 and GW-2) with a coverage of 37.5 to 42.5 GHz (space-to-Earth) and 47.2 to 51.4 GHz (Earth-to-space). According to multiple sources, this constellation is part of a wider effort by China to stake its claim to the growing satellite internet market.



*Artist's impression of global satellite broadband internet coverage. Credit: ESA-Science Office*

According to a report by Grand View Research, Inc., the satellite internet market was valued at $8.23 billion in 2022 and is expected to reach $22.57 billion by 2030 – a compound annual growth rate (CAGR) of 13.6%. The number of satellite internet users worldwide went from 43 million in 2020 (roughly 1% of global internet users) and is expected to grow to 110 million by the end of the decade (roughly 1.4% of global users). Despite their success, Starlink's market share is only about 3.5%, and future growth is expected to be driven by developing countries in Africa, Asia, Latin America, and elsewhere.

The Chinese government opened the satellite internet market to private investment in 2014, and roughly two dozen projects have been started since then. This includes GalaxySpace, China's first satellite internet developer, thanks to financing by venture firms and the partly government-led China International Capital Corporation (CICC), valued at $1.5 billion last year. A similar trend is happening worldwide, where governments are providing significant funding for satellite internet companies to provide broadband services for underserved markets.

China has committed to several ambitious programs in recent years. This includes the creation of an International Lunar Research Station (ILRS) in the South Pole-Aitken Basin that will rival the Artemis Program. There's also China's secret space plane, a competitor to the U.S. Space Force's X-37B, which returned to Earth a few months ago after spending 276 days in orbit. There's also the way they have established landing platforms at sea, began developing the super-heavy Long March-9 rocket, and proposed sending crewed missions to Mars, starting in 2033 (same as NASA).

And as recent developments suggest, China also wants to make its presence felt in the commercial space sector. Beyond satellite internet services, they are also working on reusable rockets and have dropped hints about reusable rockets similar to the Starship and Super Heavy. In keeping with China's modus operandi, the process appears to be state-driven, with private industry fulfilling mandates and objectives set by the government.

## Light Pollution is Out of Control

Concern over global light pollution is growing. Astronomers are noticing its growing effect on astronomical observations, just as predicted in prior decades. Our artificial light, much of which is not strictly necessary, is interfering with our science.

But there's more than just scientific progress at stake. Can humanity afford to block out the opportunities for wonder, awe, and contemplation that the night sky provides?

We've all seen satellite images of Earth at night, with glittering interconnected cities lit up like strings of holiday lights. These images show us how our global civilization has grown, how we've made progress, and how advanced we've become. But in reality, what we're seeing is also light pollution. And we're beginning to pay a price for that pollution.

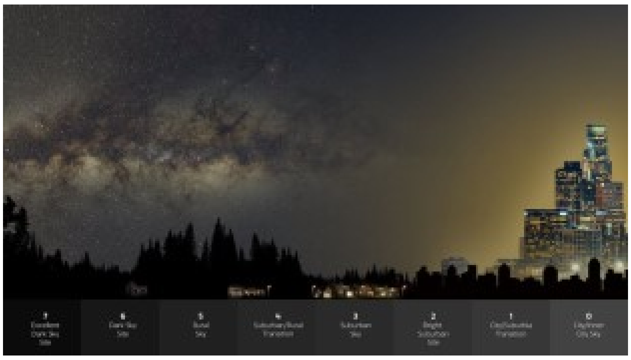
In January 2023, the Globe at Night organization released a paper based on 10 years of data on the night sky. The data wasn't from satellites—an important point that we'll get to later—it was from citizen scientists spread around the world.

Globe at Night published a research article showing that the night sky is getting 10% brighter each year. Each year, more of the sky's dimmest stars are being drowned out by sky glow from streetlights, traffic lights, and other sources. For more and more people around the globe, the sky shows fewer and fewer stars, never mind the grand arch of the Milky Way.

Globe at Night gathered over 50,000 individual naked-eye observations of the night sky, where they asked citizen scientists to find the dimmest stars. The decrease in dim stars visible in these observations over the ten-year effort indicated a steadily brightening sky.

Map of 2022 GLOBE at Night participation. For more information, click on the image. Image Credit: GLOBE at Night / NOAO

If the Globe at Night paper was a rallying cry, other researchers are responding. A pair of researchers have released their own brief paper that acts as a kind of addendum to the Globe at Night paper. They are Fabio Falchi from the Applied Physics Department at the Universidade de Santiago de Compostela in Spain, and Salvador Bara, an independent researcher in Spain. Falchi is also affiliated with the Light Pollution Science and Technology Institute in Italy.



A startling analysis from Globe at Night — a citizen science program run by NSF’s NOIRLab — concludes that stars are disappearing from human sight at an astonishing rate. Not only that, but the Milky Way is invisible in our cities, obscuring humanity’s connection to nature and the cosmos. Image Credit: NOIRLab/NSF/AURA, P. Marenfeld

Satellite data paints a less worrying picture, but satellites have a different perspective. They can only measure the light that reaches them and only in wavelengths their instruments are tuned to. But the light that reaches them is not necessarily the light that drowns out the sky from the perspective of people on the Earth’s surface. That’s why the Globe at Night effort eschewed satellite data in favour of citizen scientists spread around the globe.

Forecasts based on satellite data predicted that light pollution will increase by 2% each year, but the Globe at Night effort showed that the actual number is 10%. That’s a huge discrepancy, and it means that light pollution will double in fewer than 8 years. That number should seize everyone’s attention, but why the discrepancy? Why can’t high-tech satellites get it right?

“Part of this discrepancy could be explained by the impossibility of these satellites to detect the blue light, emitted in great quantity by the LED light that started to be used outdoors about 10 years ago,” the pair of researchers write. “These satellites are also not able to see well the light emitted mainly horizontally, such as that from the increasing number of ultra-bright LED billboards and lighted buildings’ façades.”

Falchi and Bara urge the building of next-generation satellites that can overcome this weakness. Multi-band sensitivity is necessary, as are “… multi-angle monitoring capabilities,” according to the pair.

They’re not the only ones. In 2020 a group of researchers tackled the issue in a paper titled “Remote sensing of night lights: A review and an outlook for the future.” One of the authors was Christopher Kyba, who also co-authored the paper from Globe at Night.

Standing beside the Milky Way. Drowing out the night sky blocks us off from nature, and that’s not good for humans. Credit: P. Horálek/ESO

In that paper, the authors agree with Falchi and Bara that we need satellites that can sense the rapidly spreading LED lights. They also point out that we need a better understanding of angular patterns of light emission. They don’t stop there. “Perhaps most importantly,” they write, “we make the case that higher spatial resolution and multispectral sensors covering the range from blue to NIR are needed to more effectively identify lighting technologies, map urban functions, and monitor energy use.”

That’s great. Detailed, robust data is part of any genuine effort. But we already know that light pollution is increasing. “People, media and politicians are used to associating artificial light thaumaturgical properties on road safety and personal security that it seems not to merit,” the pair of researchers point out. “So, year after year, more and more light is installed to light up the night.”

What can we do about it?

Something in the human psyche wants to eliminate darkness. We want comfort, safety, convenience, and an overall sense of well-being and prosperity. There’s nothing wrong with creating safety if well-lit areas can combat crime, but is more and more light the answer? Is there a point of diminishing returns? Not only for us but for the natural world?

“Life on Earth evolved with sunlight during the day and starlight and the Moon, when present, during the night,” Falchi and Bara write. “If we introduce in ecosystems artificial light to levels that surpass, even by thousands of times and more, the level experienced in natural conditions, animal behaviour will change consequently.” Increased night-time lighting could disrupt predator-prey relationships, change mating behaviour, and even help drive some populations or species to extinction.

It’s not just star-gazing and the natural world that’s paying a price for light pollution. Science is taking a hit, too, as observatories near urban centres have faced the light pollution problem head-on. Take the case of the 100-inch Hooker Telescope at the Mt. Wilson Observatory near Los Angeles.

From its completion in 1917 up to 1949, it was the largest aperture telescope in the world. But as light pollution increased, it became more and more difficult to perform useful astronomical observations. The light was extinguishing faint stellar images, and it kept getting worse. Finally, in 1985, in direct response to the growing artificial light problem, the Hooker Telescope was mothballed.

The Hooker Telescope enclosure at the Mt. Wilson Observatory. The telescope was mothballed in 1985 due to light pollution. Image Credit: By Craig Baker – Own work, CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=73093247

This was no small matter. The telescope was in good working order and had played an important role in establishing extra-galactic distances, figuring out the nature of spiral galaxies, and establishing the expansion of the Universe, among other scientific endeavours. Other instruments at the Mt. Wilson Observatory are still operating, but the Hooker Telescope’s potential was eliminated by excessive sky-glow.

Nobody thoughtful would say they want species driven towards extinction and powerful telescopes shuttered while they're still effective. Nobody thoughtful wants sky-gazing curtailed, either. But one of the main problems in this issue is our prosperity. As lighting becomes cheaper—and LEDs are cheaper—we're putting up more and more lights and illuminating roads and streets that never needed it before. What can be done?

We're not likely to go on a mass campaign of streetlight removal, for example, but people have tried other things. "Attempts to control light pollution have been carried out in the last decades in several places, at local up to national level," Falchi and Bara write. These attempts haven't been successful, even when lights are pointed so that they only shine below the plane of the horizon. "This approach is not sufficient, as any new light, even if shielded, will add pollution to the night environment after being reflected off the surfaces intended to be lit," they explain. Instead, we need to put caps on lighting just like we do on other forms of pollution. The authors point to the Clean Air Act in the USA as an example, which limits the use of air contaminants like cancer-causing solvents and toxic fuel additives.

It's axiomatic that human activities will affect nature. But that doesn't mean we can put the blinders on and just accept it. Light pollution might not seem like a big deal in a world enduring the growing catastrophe of the global climate crisis. Can't we just go on the internet and see the sky in far more detail, and even from different parts of the globe? Sure, but computer monitors are not the same as sitting out under the sky, gazing and letting your mind take it all in. Those activities form memories we reflect on, and that stir something inside of us. Even the wildest, hallucinogenic technological imaginings of a techno-zealot like Zuckerberg can never replace that.

This is an astronomy news website. But astronomy divorced from humanity's natural spirit is an impoverished venture. Without simple star-gazing, and the way it can engage our imaginations, and our sense of wonder and awe, most of us might not even care about the science of astronomy.

Embrace the darkness.

## Meet Annie Jump Cannon, the "Harvard Computer" that Brought Order Out of Chaos

In the early 20th century our understanding of stars was a complete and total disaster. It took the genius of Annie Jump Cannon, who was hired as a human computer, to create some order out of the chaos.

The development of photographic plates and their application to astronomy revolutionized the field. No longer were astronomers tied to their telescopes, forced to make hand-drawn sketches or charts. The end of the 19th century marked the beginning of the era of massive surveys, where astronomers could capture thousands and even hundreds of thousands of stars.

With this abundance of data astronomers were eager to understand the different kinds of stars in the universe and how they behaved. And at first it was a madhouse. There were small red stars, there were giant red stars, there were big blue stars, and there were medium yellow stars. Astronomers wondered if these different colors meant something and if there was a deeper connection to be found.

Around the same time many astronomers began to come up with classification systems. However, they did not have a lot of data to work with. All they really had was the star's position in the sky, its observed brightness, maybe its distance if they were lucky, and its spectrum, which was a breakdown of the components of all the light emitted by that star. And so the earliest classification schemes were focused mainly on the spectra, assigning categories to stars based on how strong certain spectral features appeared.

As a part of this effort Edward Pickering at the Harvard Observatory began an extensive and exhaustive data collection process. He harvested observations of hundreds of thousands of stars and planned to publish them in a massive catalog. The existence of that catalog de-

manded a sane classification scheme, which meant that all of the stellar spectra had to be examined by hand and categorized. To help with that effort Pickering hired a team of women to serve as "human computers" who would do that exhausting manual labor.

One of those human computers was a woman named Annie Jump Cannon, who had been encouraged to go into the field of astronomy by her mother. But at the time women could not join the ranks of traditional professional astronomers, and so working as a human computer for Pickering was the best she could do.

But in that task she excelled. Over the course of her long career she manually categorized over 350,000 stars. And that intimate access to the data gave her insights that nobody else could match. She started with an existing classification scheme, which ran from the letters A to O based on the strength of the appearance of various spectral lines. Soon, however, she realized that this classification scheme had its weaknesses: some categories overlapped, others were unnecessary, and some were out of order.

And so Cannon proposed a brand new classification scheme, which remains the basis of the classification scheme used in modern astronomy today.

What's amazing about this is that not only did Cannon get it right, she got it right before we understood what this classification scheme meant. Once she hit upon the correct ordering of stellar categories, other astronomers were able to piece together the story of stellar evolution and the relationship between star size, brightness, and color. We now understand much more about stars than we used to, and we have Annie Jump Cannon's genius insights to thank for it.

# E MAILS and MEMBERS VIEWING LOGS.

**<u>For those of a certain age:</u>**

Just watched a re-run of Gerry Anderson's popular 1960's space adventure on freeview channel 82.

Tuesdays 5:25 pm - Fireball XL5 (powered by a nutomic reactor), starring Colonel Steve Zodiac as commander and pilot. Also starred: Doctor Venus, Zoonie and Robert the Robot.

This was the forerunner of Stingray and Thunderbirds and was my favorite TV programme (well I was only 6 at the time) and probably kindled my interest in space and astronomy.

https://en.wikipedia.org/wiki/Fireball_XL5

Dave.

DONATION

Donation given to us by John Hall a couple of months ago.

I have put together the following as a suggestion but feel free to amend as required as my English can be poor.

*The Wiltshire Astronomical Society would very much like to thank John Hall of Swindon for his very generous donation of astronomical equipment to the observing team.*

*Back in June John wrote to WAS stating;*

*" I am currently in the process of moving. Alas the new property lacks a garden and because of that and other reasons, I am looking to donate my astrophotography equipment to someone who can make better use of it and enjoy.*

*I was therefore wondering if the society or any of your members would be interested in the equipment…"*

*WAS were delighted to receive the equipment from John, with the extensive donation including two tripods, a number of refracting telescopes as well as some astrophotography accessories.*

*The observing team are currently assessing the equipment and carrying a few of minor repairs. The longer-term hope is that the equipment can be lent to members and also used for demonstrations as part of some practical talks at Seend and in the field.*

*John was invited to attend the society's talks and observing sessions during the new season.*

*Chris Brooks*

*WAS Observing Coordinator.*

Dear FAS Member Society

You may be aware of the growing threat to amateur astronomy posed by the surge in the number of satellites placed in low Earth orbit (LEO). Most of the satellites *should* be fainter than naked eye brightness but they still pose a problem to telescopic observations, astrophotography, spectroscopy and radio astronomy.

According to the Union of Concerned Scientists' satellite database, up to the end of 2022 there were 6,718 functioning satellites in Earth orbit of which 5,938 were in LEO and over 80% of those were launched in just the past 3 years. There are proposals for an estimated 250,000 satellites to be launched into LEO over the next decade. This represents about a 40-fold increase over the current number. Jonathan McDowell maintains a list of planned constellations on *Jonathan's Space Pages* where, up to 22-Aug-2023, he shows a maximum total of 543,811 LEO satellites from 18 different planned constellations. He doesn't give a timescale but, if all are launched as planned, this would eventually represent a more than 90-fold increase over the current number!

The FAS is organising a survey to investigate the effect that these satellites have had on amateur astronomy observations. The survey will run until midnight on 22nd September 2023 after which the results will be collated and analysed and presented at *IAU Symposium 385 Astronomy and Satellite Constellations: Pathways Forward* (2nd–6th October 2023, La Palma, Canary Islands, Spain). The recommendations from that symposium will be used to advise the international bodies that make policy on the operation of satellites and the sustainable use of space (particularly LEO).

**This survey is open to all.** Whether or not the growth in the number of satellites has affected you, the FAS urges your members to take part in the survey. Can I ask that you please pass this on to them and ask them to take part – the survey should only take about 5 minutes to complete.

This is an opportunity for your members' contributions to make a positive difference to the future of astronomy!

The link to the survey form is at:

https://form.jotform.com/232251987986069

If any of your members have any images that demonstrate the problem of satellite intrusion that you'd be willing to share (credited) then please ask them to send them to me at fas@qsoft.ltd.uk.

Best wishes

PETER CHAPPELL OBSERVING LOGS

**<u>Viewing Log for 15th of August</u>**

This would be my first viewing session of the new season, I finished off last season on the 21st of May, a gap of nearly three months.

I arrived at my usual viewing place near Uffcott and had my Meade LX90 GOTO telescope with a Pentax 14 mm XW eye piece attached set up and ready by 21:27, with a temperature of 17 °C and no wind, the conditions would be good? While setting up a tractor and a car went past me, at the time I did not think much about this but the tractor problem would be a problem all the time. When I set up my equipment, it was still not dark enough for deep sky viewing but could use the two guide stars of Arcturus and Altair to set up the telescope. I have to align the scope with Polaris and level the telescope before I did the guide stars, this is its 'Home' position. While waiting for the sky to get dark enough a tractor and van went up the road only for another tractor to go down the road before I actually started viewing!

Saturn was still in the hedge, so I would have to return to this planet later on, the same tractor now went up the road. All I could do was close my eyes and look the other way to try and avoid the powerful lights on the tractors, front and rear of the vehicle! First actual object was M29, nearly overhead, this open cluster (OC) was good to look at, one of my more favourite OC's. Another tractor went up, so this again stopped me for a minute or more. On to M39, a very loose OC, even the hand set agreed with me when I read the write up about this cluster, probably better to view this object with the finder scope. Now a car went past me while I tried to find M27, this planetary nebula was a large grey blob to look at, looking similar to an apple core? I came out this evening to try and see objects in Sagittarius which are always low on the horizon from the UK, it does not help having a hedge which is about 10 feet high that evening! Using my sky atlas, I tried for M17 first, the Swan or Omega nebula, this like

M27 was a large grey blob to look at, as for the Swan could not make it out, at all. Yep, another tractor with trailer went pass me while I went to M24, the Star Cloud, this OC has lots of dim stars that fills the eye piece. M20, the Trifid nebula was the next object to look at (not far above the hedge line now), this was a fuzzy blob (FB) to look at, while viewing this object a bright shooting star flew nearby until burnt in the atmosphere. By now Saturn had cleared the hedge line, so I slewed the telescope around to the planet, not sure if I could make out the moon Titan or not? Another tractor went past me with a trailer with all lights blazing! Having another look at the sky atlas I might be able to find M8, the Lagoon nebula and yes I found this object. Just a FB to look at with a small OC nearby which might be linked to the nebula? Another tractor went past me as I tried to find M22, a large globular cluster which was large and had a bright core which if higher in the sky might give M13 a good run for its money? My final object for the evening was M75 right on the border between Sagittarius and Capricornus, this is a very compact and dim GC which the handset said was the most distance GC from Earth? This time a bike with a tractor following it was my time to pack up and I was not viewing for more than 5 minutes before something went past me, they were in a field collecting wheat and storing it in a nearby shed, just choose the wrong day to view unfortunately!

Time was now 22:35 and the temperature had only dropped to 15°C, I had only needed a coat but not done up to keep me warm. Hopefully the next time I come out I will not have all this traffic going past me?

Clear skies.

Peter Chappell

**Viewing Log for 19th of August**

The weather was good all day, in the morning I was at the allotment plot collecting veg for home and had a game of golf in the afternoon/early evening to finish off the busy day with a viewing session which hopefully would be better than my last effort four days ago which was affected by tractors (mostly) and cars going past me.

I arrived at Uffcott and had my Meade set up and ready by 22:23, same equipment as last time with a temperature of 16 °C and again no wind. For a change I thought I would try the objects in the August's edition of Astronomy Now magazine deep sky section covering the Scutum and Serpens area of the sky. The first object was M5, a compact globular cluster (GC) with a bright core, next was NGC 5921, a barred spiral galaxy which needed adverted vision to find this faint fuzzy blob (FFB)! On to M16 the Eagle nebula, unfortunately I could not make out any nebula at all but could see the small open cluster (OC) that goes with M16. On to NGC 6118, could not find this object at all, coming in at mag 12 is probably beyond the limits of my scope? While viewing this object the first car went past me. The same could be said for NGC6535, this was a bit brighter at mag 10.6 but still nothing? The second car now went past me, hopefully not same as the 15th? On to M11, the Wild Duck cluster, initially I thought this was a loose GC but turns out to be a tight OC instead? Next was NGC6712, a FFB GC which was hard to locate. Had no luck with M26 as it was hiding in clouds. When I arrived here I noticed the whole of the southern part of the sky was covered in clouds but the rest was clear. So with August's finished I thought I would have ago at the July edition. First object was M57, the Ring Nebula, this was good as always. Next object was the bright star Vega which I could not find at all, the clouds had rolled in very fast. Only area of sky that was clear was in the Cassiopeia direction, so I had a look at NGC 457, the Owl cluster, I could just about make out the stars that makes its wings.

By now, the sky was totally clouded out, time to pack up as I was getting tired after all of the days effort I had put in. Time was 23:07 and temperature had dropped to 14 °C which needed a coat to be done up this time.

While on the way home I could make out Jupiter very low in the eastern sky, the cloud had not got to this object yet but the planet could wait for another session.

Clear skies.

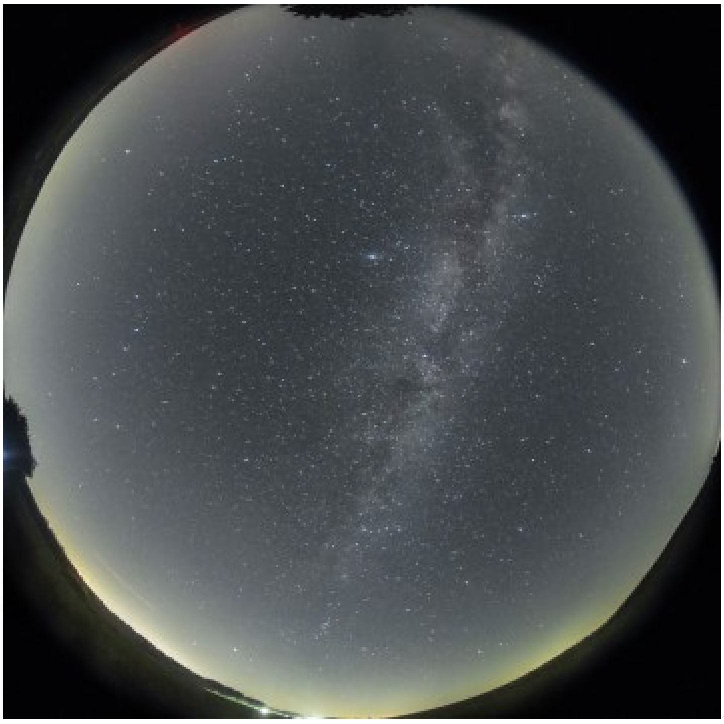
Peter Chappell

ANDY BURNS VIEWING/IMAGING WIDE FIELD

From our impromptu Perseid viewing session from the car park above Alton Barnes. Announced on Facebook pages, open and members, we did interrupt some affections in a van but Dave Starling, Peter Chappell and I set up (with a few excuses for others with work).

I was trying to get all sky views with 8mm fisheye lens, and 20mm wide angle Milky Way shots plus a time lapse camera for startrails going. I saw 9 good Perseids and caught one cracker on camera.

But after 90 minutes the dew was causing big problems on all equipment, but some good Milky Way shots.



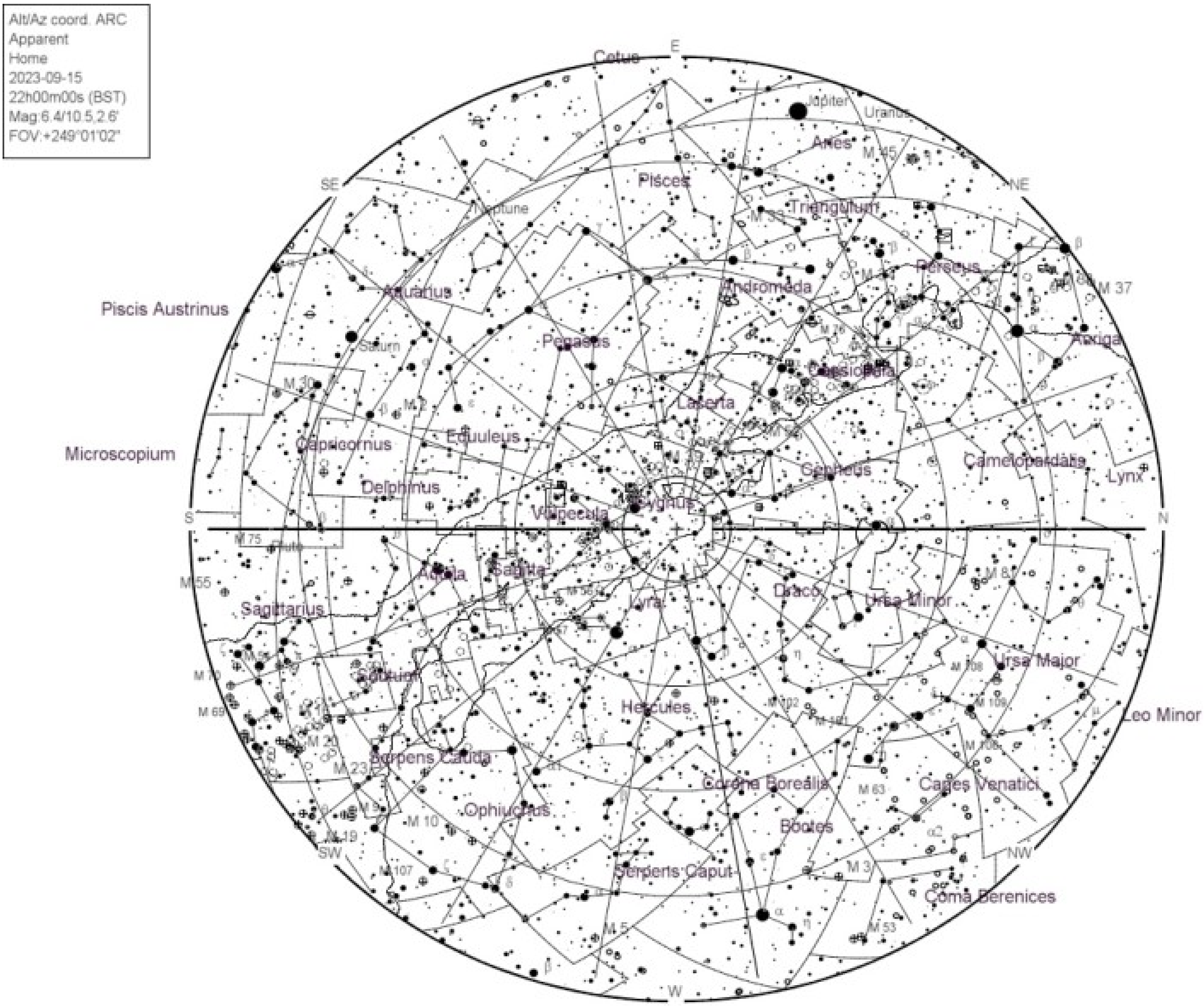
Here are some other shots from our dismal summer, mainly grabbed Moon shots using my P1000 bridge camera with high zoom, usually through my upstairs windows to get above trees.

'Super' or perigee blue Moon from 31st August.

Some noctilucent clouds from July...

From June

# WHATS UP, SEPT 23




**September 15** - **New Moon.** The Moon will located on the same side of the Earth as the Sun and will not be visible in the night sky. This phase occurs at 01:41 UTC. This is the best time of the month to observe faint objects such as galaxies and star clusters because there is no moonlight to interfere.

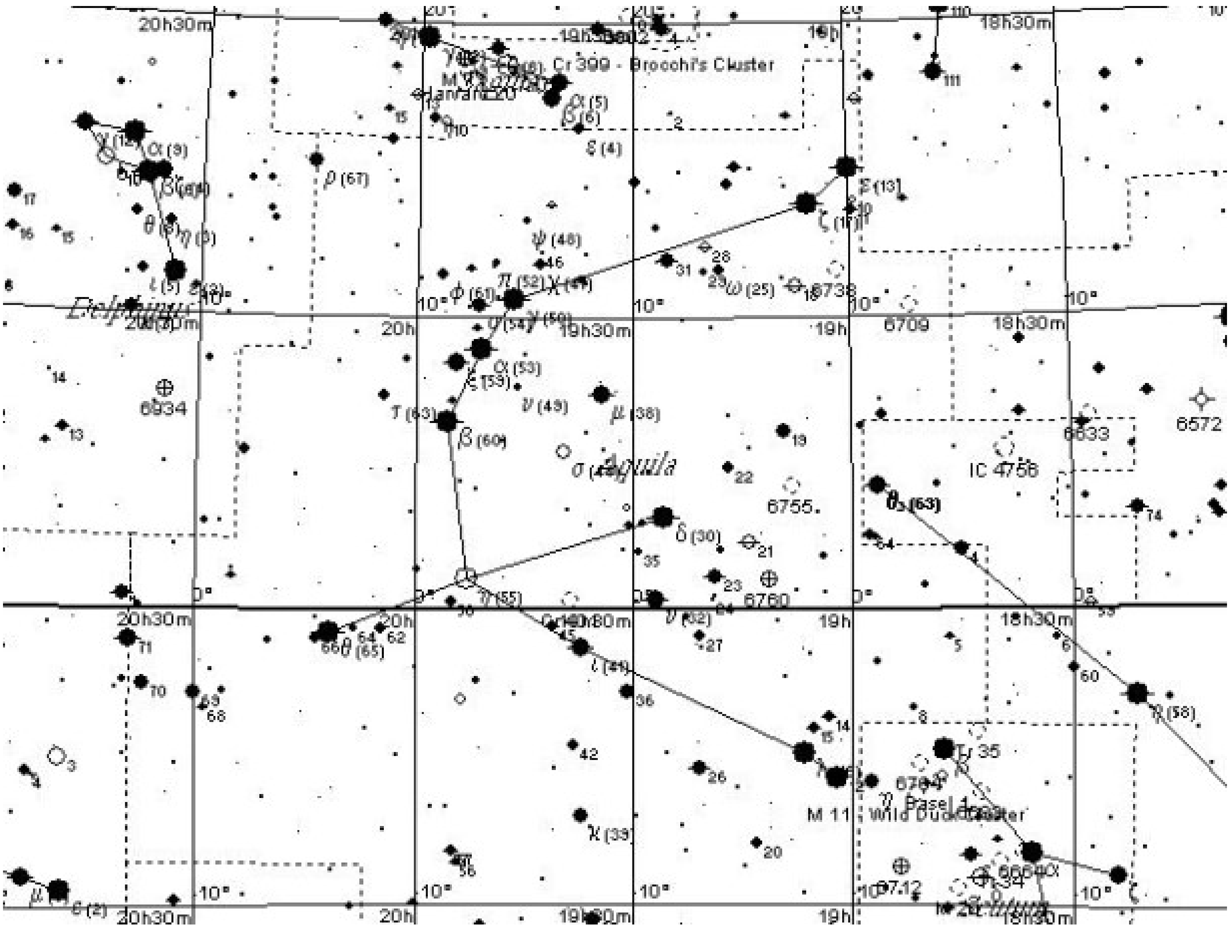
**September 19** - **Neptune at Opposition.** The blue giant planet will be at its closest approach to Earth and its face will be fully illuminated by the Sun. It will be brighter than any other time of the year and will be visible all night long. This is the best time to view and photograph Neptune. Due to its extreme distance from Earth, it will only appear as a tiny blue dot in all but the most powerful telescopes.

**September 22** - **Mercury at Greatest Western Elongation.** The planet Mercury reaches greatest western elongation of 17.9 degrees from the Sun. This is the best time to view Mercury since it will be at its highest point above the horizon in the morning sky. Look for the planet low in the eastern sky just before sunrise.

**September 23** - **September Equinox.** The September equinox occurs at 06:43 UTC. The Sun will shine directly on the equator and there will be nearly equal amounts of day and night throughout the world. This is also the first day of fall (autumnal equinox) in the Northern Hemisphere and the first day of spring (vernal equinox) in the Southern Hemisphere.

**September 29** - **Full Moon, Supermoon.** The Moon will be located on the opposite side of the Earth as the Sun and its face will be will be fully illuminated. This phase occurs at 09:59 UTC. This full moon was known by early Native American tribes as the Corn Moon because the corn is harvested around this time of year. This moon is also known as the Harvest Moon. The Harvest Moon is the full moon that occurs closest to the September equinox each year. This is also the last of four supermoons for 2023. The Moon will be near its closest approach to the Earth and may look slightly larger and brighter than usual.

# CONSTELLATIONS OF THE MONTH: AQUILLA




In the 2nd century CE, Greek-Egyptian astronomer Claudius Ptolemaeus (aka. Ptolemy) released one of the most influential books in the history of astronomy. Known as the *Almagest*, this book included the 48 then-known constellation into a system of cosmology that would remain influential for over a thousand years. Among the 48 constellations listed in this book was Aquila, a constellation in the northern sky that extends across the celestial equator.

Also known as the "Eagle", this constellation is one of the 88 constellations that is recognized today by the International Astronomical Union (IAU). It belongs to the Hercules family of constellations, which include Ara, Centaurus, Corona Australis, Corvus, Crater, Crux, Cygnus, Hercules, Hydra, Lupus, Lyra, Ophiuchus, Sagitta, Scutum, Serpens Caput, Serpens Cauda, Sextans, Triangulum Australe, and Vulpecula.

Name and Meaning:

Aquila takes it name from the Latin word for "Eagle". According to classic Greek mythology, Aquila was the eagle that carried the thunderbolts of Zeus. He was also sent to retrieve the Trojan shepherd boy – Ganymede, whom Zeus desired – to become a wine-pourer for the gods. Aquila's proximity to Aquarius, which represents Ganymede, is one of the reasons why the constellation is so-named.

In another story, the eagle is found guarding the arrow of Eros (represented by the constellation Sagitta), which hit Zeus and made him love-struck. In yet another, Aquila represents Aphrodite disguised as an eagle, pretending to pursue Zeus in the form of a swan. This she did so that Zeus' love interest, the goddess Nemesis, would give him shelter.

Zeus later placed the images of the eagle and the swan (the constellation Cygnus) among the stars to commemorate the event. Aquila may also represent one of the twelve labors of Hercules.

History of Observation:

Though it one of the 48 constellations included by Ptolemy in the *Almagest*, the first recorded mention of Aquila that still survives come from Eudoxus of Cnidus – a Greek astronomer and student of Plato's during the 4th century BCE – and Aratus, the didactic poet who wrote of the constellations in the 3rd century BCE.

It is also believed that the Greek version of the Aquila constellation is based on the Babylonian constellation of MUL.A.MUSHEN), which occupied the same spot in the northern sky. The constellation was also known as *Vultur volans* (the flying vulture) to the Romans, which is not to be confused with *Vultur cadens* – their name for Lyra.

Ptolemny was also responsible for cataloging 19 stars in the Aquila constellation and the now obsolete constellation of Antinous. These stars are sometimes erroneously attributed to Tycho Brahe, who later catalogued the same stars, but identified 12 as belonging in Aquila and 7 in Antinous. Ultimately, it was 17th century Polish astronomer Johannes Hevelius who determined the 23 stars in Aquila and 19 in Antinous.

Notable Features:

Aquila's alpha star – Altair, which is translated from the Arabic *al-nasr al-tair* ("flying eagle") – is located 17 light-years from Earth. This star rotates very rapidly (286 km/s), which is what gives Altair it's shape – i.e. flattened at the poles. Beta Aquilae (aka. Alshain) is a yellow-hued star of magnitude 3.7 is located 45 light-years from Earth. Its name comes from the Arabic phrase “shahin-i tarazu”, meaning “the balance”.

Gamma Aquilae is an pranged-hued giant star of magnitude 2.7 which is located 460 light years away. It’s name, like Alshain, comes form the Arabic term for “the balance”. Whereas Altair is one of the three stars that form the Summer Triangle – an asterism that can be seen directly overhead at mid-northern latitudes in the summer – Alshain and Tarazed form the wings of the eagle.

According to SEDS, two major novae have been observed in Aquila. The first one was in 389 AD and was recorded to be as bright as Venus. The other shone brighter than Altair, the brightest star in the Aquila constellation. Two major novae have been observed in Aquila – the first one being in 389 BCE that was recorded as being as bright as Venus – and the other in 1918 (Nova Aquilae 1918), which briefly shone brighter than Altair.

*The Glowing Eye of Planetary Nebula NGC 6751. Credit: NASA/ Hubble Heritage Team/STScI/ AURA*

The constellation is also home to several Deep Sky Objects. Foremost amongst these is NGC 6751, a planetary nebula that is also known as the Glowing Eye. The nebula is estimated to be around 0.8 light-years in diameter and is estimated to be roughly 6,500 light-years away from Earth. It was formed when a star collapsed and threw off its outer layer of gas several thousand years ago.

The nebula was the subject of the winning picture in the 2009 Gemini School Astronomy Contest, in which Australian high school students competed to select an astronomical target to be imaged by the Gemini Observatory.

Finding Aquila:

The constellation of Aquila is easily recognized as a small cruciform configuration east of the Milky Way. For those using binoculars, those looking for Aquila should first look at Altair. It’s the twelfth brightest star in the sky. A groundbreaking study with the Palomar Testbed Interferometer revealed that Altair is not spherical, but is rather flattened at the poles due to its high rate of rotation.

Synthetic aperture techniques with multiple optical telescopes have imaged this phenomenon. Located on 17 light years away from Earth, this Delta Scuti type variable spins completely on its axis in a matter of about 6 hours and 30 minutes. Now compare it to Gamma – Tarazed – which is about 460 light years from here. It is a giant star with a diameter of approximately half an AU.

*Altair, the brightest star in the constellation Aquila and the twelfth brightest star in the nighttime sky. Credit: starrynightphotos.com*

Now, here’s something you can study – Eta Aquilae. Eta is one of the brightest of the Cepheid variables, ranging from magnitude 4.1 to magnitude 5.3 every 7.2 days. It is a super giant star about 3400 times more luminous than the Sun, located 1200 light years from our solar system.

For both binoculars and small telescopes, try double star 57 Aquilae (located about 15 degrees south or less than a handspan from Eta). This is a very cool matched pair of stars of equal 6th magnitude brightness separated by about 36 arc seconds. Check out R Aquilae, too. It’s a Mira-type variable. It takes about 300 days to go through its changes but at its peak it’s about 200 times brighter than our Sun. R is visible with the unaided eye at maximum brightness and its magnitude ranges from 5.5 to 12 every 284 days exactly.

Now, get out the telescopes and let’s go for some binary stars. First, Beta Aquilae – Alschain. Located almost 45 light years away and shining at magnitude 3.7, you’ll find its disparate 12th-magnitude companion 12.8 arc seconds away. Now try Zeta Aquilae, a much more difficult double star located about 83 light years away. The primary star is a 3rd magnitude white dwarf and its companion is a disparate 12th -magnitude found 6.5 arc seconds from the primary.

And then there’s Pi Aquilae, a double star easily resolved with a 6-inch telescope into its two components of magnitudes 6 and 7, separated by 1.4 arc seconds. More? Try 15 Aquilae. Star 15 is a yellow 5th-magnitude giant with a 7th-magnitude companion positioned 40 arc seconds away. It can easily be observed with small telescopes.

*The NGC 6709 open cluster, part of the Aquila constellation (taken from Stellarium). Credit: Wikipedia Commons/Roberto Mura*

If you’re looking for some great deep sky objects, why not try some Barnard Dark nebula? E.E. Barnard classed these great objects, and with just a little practice, you can learn to see “nothing”, too! Head about a degree and a half west of Gamma for B143 and B144. Here you will find a large patch of nothing that will stand away from the starry fields. It covers about a full degree of sky, so use a wide field eyepiece and low magnification.

If you’re looking for something a bit brighter, let’s try some open clusters for the telescope. Find Zeta and go about five degrees southwest for NGC 6709. It’s a nice compressed star field of about 30 stars covering an average diameter of about 15 arc minutes. Located about 5 degrees west of Delta you’ll find NGC 6755, another small open cluster. At low magnification, it’s not very well resolved, but up the magnification and you’ll find about a dozen faint stars as your reward.

For large telescopes, look for NGC 6760. This globular cluster is roughly magnitude 10 and about 5 arc minutes in size. Or try 12th magnitude planetary nebula NGC 6751 – the “Glowing Eye”. Other notable planetary nebula include NGC 6804, NGC 6778, NGC 6741, NGC 6772 and NGC 6804 discovered by Sir William Herschel. It’s a nice bright one which exhibits some evidence of an interaction with the interstellar medium, along with a characteristic central torus and outer halo

# ISS PASSES For September/Mid Oct 2023

from Heavens Above website maintained by Chris Peat.

| Date | Brightn | Start | Highest | End | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | (mag) | Time | Alt. | Az. | Time | Alt. | Az. | Time | Alt. | Az. |
| 05 Sep | -0.9 | 03:01:53 | 14° | E | 03:01:53 | 14° | E | 03:02:29 | 10° | E |
| 05 Sep | -3.9 | 04:34:47 | 39° | W | 04:35:53 | 83° | SSW | 04:39:14 | 10° | ESE |
| 06 Sep | -2.7 | 03:48:22 | 40° | E | 03:48:22 | 40° | E | 03:50:38 | 10° | E |
| 06 Sep | -3.3 | 05:21:17 | 14° | W | 05:23:53 | 42° | SSW | 05:27:04 | 10° | SE |
| 07 Sep | -3.7 | 04:34:59 | 53° | SW | 04:35:20 | 56° | SSW | 04:38:36 | 10° | ESE |
| 08 Sep | -1.6 | 03:48:54 | 20° | ESE | 03:48:54 | 20° | ESE | 03:50:03 | 10° | ESE |
| 08 Sep | -2.5 | 05:21:50 | 18° | WSW | 05:23:06 | 23° | SW | 05:25:48 | 10° | SSE |
| 09 Sep | -2.1 | 04:35:58 | 22° | SSE | 04:35:58 | 22° | SSE | 04:37:35 | 10° | SE |
| 13 Sep | -1.4 | 21:15:20 | 10° | SSW | 21:15:50 | 13° | S | 21:15:50 | 13° | S |
| 14 Sep | -1.9 | 20:27:22 | 10° | S | 20:29:20 | 15° | SE | 20:29:45 | 15° | SE |
| 14 Sep | -1.1 | 22:02:16 | 10° | WSW | 22:02:39 | 13° | SW | 22:02:39 | 13° | SW |
| 15 Sep | -3.1 | 21:13:37 | 10° | SW | 21:16:17 | 37° | S | 21:16:17 | 37° | S |
| 16 Sep | -2.7 | 20:25:06 | 10° | SSW | 20:28:00 | 28° | SSE | 20:29:40 | 18° | ESE |
| 16 Sep | -1.8 | 22:01:07 | 10° | WSW | 22:02:34 | 24° | WSW | 22:02:34 | 24° | WSW |
| 17 Sep | -3.9 | 21:12:17 | 10° | WSW | 21:15:36 | 66° | SSE | 21:15:48 | 64° | SE |
| 18 Sep | -3.5 | 20:23:29 | 10° | SW | 20:26:44 | 50° | SSE | 20:28:54 | 19° | E |
| 18 Sep | -1.9 | 22:00:01 | 10° | W | 22:01:46 | 28° | W | 22:01:46 | 28° | W |
| 19 Sep | -3.9 | 21:11:05 | 10° | W | 21:14:25 | 89° | SSW | 21:14:45 | 71° | E |
| 20 Sep | -3.8 | 20:22:08 | 10° | WSW | 20:25:28 | 78° | SSE | 20:27:40 | 20° | E |
| 20 Sep | -1.8 | 21:58:51 | 10° | W | 22:00:32 | 27° | W | 22:00:32 | 27° | W |
| 21 Sep | -3.9 | 21:09:51 | 10° | W | 21:13:12 | 85° | N | 21:13:23 | 78° | ENE |
| 22 Sep | -3.8 | 20:20:50 | 10° | W | 20:24:11 | 86° | N | 20:26:11 | 22° | E |
| 22 Sep | -1.6 | 21:57:34 | 10° | W | 21:59:03 | 24° | W | 21:59:03 | 24° | W |
| 23 Sep | -3.8 | 19:31:47 | 10° | W | 19:35:08 | 87° | S | 19:38:29 | 10° | E |
| 23 Sep | -3.9 | 21:08:31 | 10° | W | 21:11:49 | 82° | SSW | 21:11:49 | 82° | SSW |
| 24 Sep | -3.8 | 20:19:27 | 10° | W | 20:22:48 | 88° | N | 20:24:34 | 26° | E |
| 24 Sep | -1.3 | 21:56:12 | 10° | W | 21:57:25 | 20° | W | 21:57:25 | 20° | W |
| 25 Sep | -3.7 | 19:30:22 | 10° | W | 19:33:42 | 85° | N | 19:37:03 | 10° | E |
| 25 Sep | -3.4 | 21:07:05 | 10° | W | 21:10:10 | 55° | SW | 21:10:10 | 55° | SW |
| 26 Sep | -3.7 | 20:17:59 | 10° | W | 20:21:18 | 72° | SSW | 20:22:54 | 28° | ESE |
| 26 Sep | -0.9 | 21:54:57 | 10° | W | 21:55:45 | 15° | WSW | 21:55:45 | 15° | WSW |
| 27 Sep | -3.8 | 19:28:50 | 10° | W | 19:32:11 | 86° | S | 19:35:31 | 10° | ESE |
| 27 Sep | -2.5 | 21:05:39 | 10° | W | 21:08:30 | 32° | SW | 21:08:30 | 32° | SW |
| 28 Sep | -3.0 | 20:16:24 | 10° | W | 20:19:36 | 45° | SSW | 20:21:17 | 24° | SE |
| 29 Sep | -3.4 | 19:27:12 | 10° | W | 19:30:30 | 60° | SSW | 19:33:47 | 10° | ESE |
| 29 Sep | -1.6 | 21:04:25 | 10° | W | 21:06:44 | 18° | SW | 21:06:56 | 17° | SSW |
| 30 Sep | -2.0 | 20:14:54 | 10° | W | 20:17:42 | 25° | SSW | 20:19:47 | 14° | SSE |
| 01 Oct | -2.4 | 19:25:32 | 10° | W | 19:28:36 | 35° | SSW | 19:31:42 | 10° | SE |
| 02 Oct | -1.0 | 20:13:55 | 10° | WSW | 20:15:33 | 13° | SW | 20:17:11 | 10° | SSW |
| 03 Oct | -1.3 | 19:24:02 | 10° | W | 19:26:30 | 19° | SW | 19:28:57 | 10° | SSE |

## END IMAGES, AND OBSERVING

The Milky Way for August 14th viewing session on Alton Barnes common. Some light from Urchfont area and Devizes but we managed to see several Perseid meteors. The stones are Sarsen sandstone, ad this is the route the big stones took from Westwoods to Stonehenge.

It was not the best summer for observing.
I did manage to get into my Observatory last night 4th September for the first time since May!
Andy Burns

## Wiltshire Astronomical Society Public Observing Dates for the 2023-2024 Season.

**The observing site is normally in the Picnic Area beside the Red Lion Pub car park, in Lacock but can change, so sign up for email confirmation at https://wasnet.org.uk/observing/**

The WAS Observing team have provided at least two opportunities for observing evenings each month. If the first is cancelled due to weather then we have normally have a second chance the following week. A reminder email is sent out on the Tuesday before the day and a 'Go, No-Go' email sent by 16:00 on the observing day which based on various weather Apps and looking out of the window at work.

| Opportunity | Day | Date | Month | set-up | Observe | Moon Phase and Rise/Set Times | | | Suggested Observing Targets |
|---|---|---|---|---|---|---|---|---|---|
| **First** | Friday | 08th | September | 20:00 | 20:30 | Cres | Rising | 0:10 | Jupiter, Saturn and Uranus are very late risers only just getting above the horizon as it gets dark but things improve as the month progresses. The summer triagle is high above a full of faint fuzzies. |
| **Second** | Friday | 15th | September | 20:00 | 20:30 | New | Setting | 19:15 | |
| **First** | Friday | 06th | October | 19:00 | 19:30 | Qtr | Rising | 23:00 | Orionid Meteor Shower on the 21st and the Usual planets throughout the month along with the Pleiades open cluster rising around 9pm. |
| **Second** | Friday | 13th | October | 19:00 | 19:00 | New | Rising | 7:15 | |
| **October Special** | Saturday | 28th | October | 19:30 | 20:00 | Full | Rising | 7:15 | A Partial Eclipse of the Moon starting around 20:30 if anybody would like to observe - let me know! |
| **First** | Friday | 10th | November | 18:30 | 19:00 | Cres | Rising | 5:00 | Saturn heads for the horizon but Jupiter burns brightly ,and the normally quiet Leonid meteor shower makes an appearance with the occassional bright display. |
| **Second** | Friday | 17th | November | 18:30 | 19:00 | Cres | Setting | 18:30 | |
| **First** | Friday | 08th | December | 18:30 | 19:00 | Cres | Rising | 13:15 | Orion makes an appearance above the horizon much earlier and we catch the end of the Geminid Meter shower on the 16th, bring your binoculars and comfy chair! |
| **Second** | Friday | 15th | December | 18:30 | 19:00 | Cres | Setting | 17:45 | |
| **Third** | Friday | 29th | December | 18:30 | 19:00 | Gibb | Rising | 18:45 | New Equipment Practical session with nearly full moon |
| **First** | Friday | 5th | January | 18:30 | 19:00 | Cres | Rising | 3:00 | Saturn has now gone but the remaining outer planets are still on deplay. Worth observing and photographing the Andromeda Galaxaxy as it is high in the sky now. |
| **Second** | Friday | 12th | January | 18:30 | 19:00 | Cres | Setting | 16:45 | |
| **First** | Friday | 2nd | February | 18:30 | 19:00 | Cres | Rising | 1:45 | Jupiter is still observable but is starting to head to the horizon at the start of the month and becomes less favourable. |
| **Second** | Friday | 9th | February | 19:00 | 19:30 | New | Rising | !7:30 | |
| **First** | Friday | 01st | March | 19:00 | 19:30 | Qtr | Rising | 1:00 | The outer planets are becoming less favourable and Orion is at his heighest at the very beginning of the night. Galaxy season is beginning with as Leo Coma Berenices and Ursa Major rising. |
| **Second** | Friday | 08th | March | 19:30 | 20:00 | Cres | Rising | 6:45 | |
| **First** | Friday | 05th | April | 20:00 | 20:30 | Cres | Rising | 6:00 | With Virgo rising the Galaxy observbing season is well underway. We are also graced by the Great Star Clust M13 in Hercules with Venus and Mars only obserable in the morning skies |
| **Second** | Friday | 12th | April | 20:30 | 21:00 | Cres | Setting | 1:00 | |
| **First** | Friday | 03rd | May | 20:30 | 21:00 | Cres | Rising | 4:30 | The nights are short and the rise of Vega, Deneb and Altair, mark the rise of the summer triangle and the final few weeks of the Wiltshire Astronomical Societies observing season. |
| **Second** | Friday | 10th | May | 20:30 | 21:00 | Cres | Setting | 23:45 | |

Always feel free to contact the observing team for advice on what to see in the night sky.
Also if members want to see a particular event the observing team can look into setting up ad-hoc sessions where possible.

Wiltshire Astronomical Society Observing Team