NWASNEWS

Volume30 Issue 5

January 2024

Newsletter for the Wiltshire, Swindon, Bath Astronomical Societies

HAPPY NEW YEAR

2024 seems to be blowing in as 2023 blew out, making astronomy very difficult, I am sure I am one of many trying to set up a 'new' but of kit under the clouds.
But the year ahead has many exciting things to see, from eclipses to perhaps a naked eye comet!
One of our members, John Baker, caught a very bright fire through cloud on the 39th December, his video can be seen on YouTube and a still on the back of this newsletter.
Paul Money is a frequent visitor to us here in Wiltshire though his geographical location means Zoom has become the best way to get his talks to the members,
He has adapted, merged and updated some of his previous talks with the advent of 'new' telescope images and probe views of the solar system, stars and nebulae in our galaxy and indeed views of galaxies out to the start of our universe,
These views are changing much of our theories and processes within our universe. A truly New View of the Universe.
I am sure this will be a captivating and entertaining talk.
Details for the Zoom link below.
Wiltshire Astronomical Society Zoom Meeting

Tuesday 2nd January 2024

Speaker Paul Money: The New Images of the Universe

Andy Burns is inviting you to a scheduled Zoom meeting.

Topic: WAS Zoom Meeting

Time: Jan 2, 2024 07:45 PM London

Join Zoom Meeting

https://us02web.zoom.us/j/83700372815?pwd=eDVvTzRQeCtHSVBWdEExUFNaV2hmUT09

Meeting ID: 837 0037 2815

Passcode: 485892

Clear skies.

Andy Burns.

December Christmas Moon. Well 22nd December...
Nikon P1000 bridge camera, I set the exposure to automatic +1.7 EV, prevents blowing out detail and gives a fast exposure of around 1/2000th second and f8.
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/

Meetings 2023

HALL VENUE the Pavilion, Rusty Lane, Seend

Some Speakers have requested Zoom Meetings will be stay at home sessions.

Meet 7.45 for 8.00pm start

SEASON 2023/24

2024

January 2nd Zoom Meeting Paul Money
February 6th Hall Meeting:
March 5th Venue will depend on turnout in February
Andy Burns: The Spring Skies. Galaxy season!
April 2nd
May 7th
June 4th

Zoom meeting details for log on will be sent out and published the Sunday before the meeting.
AWAITING A SPEAKER SECRETARY FOR 23/24 SEASON

Paul L Money FRAS, FBIS, is an astronomer based in Horncastle, Lincolnshire, England. He is well known for his extensive talks and is the reviews editor of the BBC Sky at Night magazine. He broadcasts occasionally on BBC Radio Lincolnshire and Lincoln City Radio. He was awarded the 'Eric Zucker' award for 2002/2003 for contributions to Astronomy by the Federation of Astronomical Societies. In October 2012 he was also awarded the Sir Arthur Clarke Lifetime Achievement Award for 2012 by the British Rocketry Oral History Project for his active promotion of astronomy and space to the public. From 2004 until 2013 he was one of the three Astronomers on the Omega Holidays Northern Lights Flights and was also a Solar Eclipse Astronomer for their 2006 Turkey Solar Eclipse Trip and their 2009 China Solar Eclipse trip. In 2008 he was the Solar Eclipse expert and part of the expedition team for Poseidon Arctic Voyages on board the Russian Nuclear powered Ice Breaker 'Yamal' for the 2 August 2008 Solar Eclipse, viewed from the Arctic ice near the Franz Joseph Lands Islands. He has published a night sky guide called Nightscenes since 2000 and more recently has become a novelist with a Ghost Mysteries series and several Sci Fi works in the pipeline.

'New' Images of the Universe

The original 6 talks have been retired but a new up-to-date talk is now available for bookings.

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/ 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

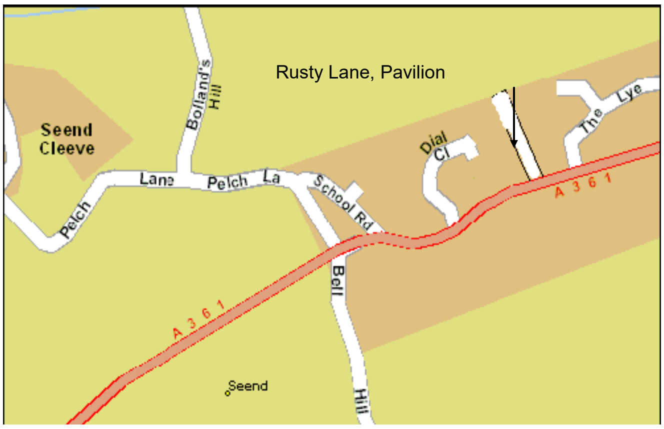
Speaker secretary

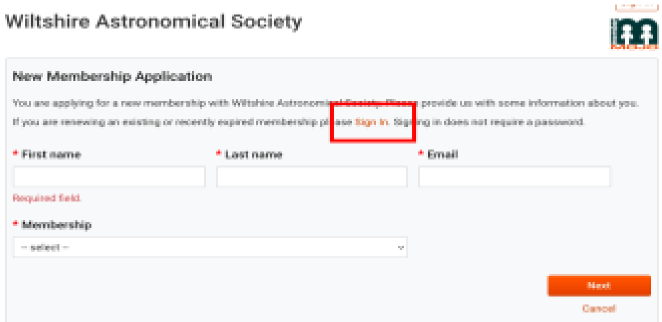
Zoom session coordinator

Observing Sessions coordinators: Chris Brooks, Jon Gale,

Web coordinator: Sam Franklin

Contact via the web site details.





Observing Sessions see back page

As per the original format there are 10 primary images with additional images to help tell each story

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, 19th January 2024:

Ocean Worlds of the Solar System by Bernard Henin

Bernard studied applied science in biotechnology, and after working in the pharmaceutical industry, he decided to go on a quest to find other life aspirations and in doing so he resolved to share his passion for space science with the general public.

Bernard was born in Belgium and speaks both fluent English and French.
His talk is on the Ocean Worlds of the Solar System: In the last 25 years, planetary science experienced a revolution, as vast oceans of liquid water have been discovered within the heart of the icy moons of our Solar System. These subsurface oceans lie hidden under thick layers of ice. We call them ocean worlds.

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.

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

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

Following Meeting Dates

Friday 16 February 2024 @ 19:30

John Gale: The Lunar 100

Friday, 15 March 2024 @ 19:30

Club AGM

Friday, 19 April 2024 @ 19:30

Michael Perriman: Gaia and Advances in our Understanding of the Galaxy

Friday, 17 May 2024 @ 19:30

Kate Earl: Magnetars – The Beauty behind the Beast

Friday, 21 June 2024 @ 19:30

Mary McIntyre FRAS: Shadows in Space and the Stories they tell.

Website:
http://www.swindonstargazers.com

Chairman: Damian OHara
Email: swindonstargazers@duck.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 community of stargazers and enthusiastic astronomers who share experiences and know-how. They offer an extensive outreach programme of public and young people’s observing and activities. As a partner with Bath Preservation Trust, they are the resident astronomers at the Herschel Museum of Astronomy, Bath. They also partner with Bath Abbey to showcase the skies above the city both day and night. Bath Astronomers operate a 5m mobile planetarium which they take to schools and community events to present the night sky even when the clouds mask the starry sky.
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.

Next Meetings:
Wednesday, 31st January 2024
Talk by Dr Carolin Villforth on Active Galactic Nuclei. Carolin studies accreting supermassive black holes at the centres of galaxies and is interested in understanding the processes that fuel supermassive black holes, the physical properties of AGN as well as the impact AGN have on their host galaxies. Her work is observational, and she works with both imaging and spectroscopic data. This meeting will be held at the Herschel Museum of Astronomy, 19 New King Street, Bath.
More information and news are available via:
https://bathastronomers.org.uk
https://www.youtube.com/@bathastronomers
On Social Media (Facebook, Twitter, Instagram, Threads, Mastodon, Bluesky)
as **@BathAstronomers**
https://stem.bathastronomers.org.uk/ for shared outreach materials
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. Members’ observing is conducted from the Monkton Combe Community Observatory using the Victorian 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 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 Martin, Meyrick, Prim and Simon will be happy to help you.

SPACE NEWS

How a Small Town in Japan Fiercely Defends its Dark Skies

Light pollution ruins dark skies. It's a scourge that ground-based observatories have to deal with in one form or another. Scientists used a small observatory in Japan to measure what changed when a nearby town improved its lighting practices. They also noted the challenges it still faces.

Bisei Town lies in a semi-rural area in the southwestern part of Okayama Prefecture in Japan. It's a designated dark sky place and the locals are adamant about keeping their view of the stars. However, they still have to contend with light pollution from other cities in the region. The town itself has several astronomical observation posts, including the Bisei Astronomical Observatory. That facility sports a 101-cm telescope, along with smaller instruments, and is open to the public for sky viewing year-round.

The town enacted light pollution ordinances in 1989, making it the first local government in Japan to pass such a law. Several years ago, the town and observatory, along with other partners, worked with Panasonic to create a dark sky-friendly region. As part of the effort, the town replaced all its public lighting with LEDs that have a color temperature of 3000K or less. As a result, Bisei was certified by DarkSky International (formerly the International Dark-Sky Association) as "DarkSky Approved." However, there are still some very bright, higher-temperature LEDs still in use, particularly in neighboring towns, where the populations are a half-million or more. Their light continues to create problems.

What does Light do to Dark Skies?

In general, light pollution is a growing global problem. It dims the sky, obstructs the view, and makes life more difficult for astronomers. The most obvious effect of light pollution anywhere is its ability to wipe out the view of dim and distant objects. For visible-light observers, that means they can't detect faraway galaxies or measure variations in variable stars (for example). Astronomers who want to take spectra of specific objects often find their work "polluted" by such things as light from mercury-vapor lamps and other sources.

Urban sprawl and accompanying light pollution is an issue for both astronomers and fireflies. This view shows the light dome from the city of Duluth, Minn. 20 miles north of town. It erases the dark skies. Credit: Bob King

Light pollution affects more than the night sky, however. Study after study shows that it affects human health and safety. Ironically, one of the reasons given for increased lighting in many places is "safety". However, aiming lights willy-nilly to provide a safe place often results in light trespass. It also creates an unintended effect: bright lights aimed directly at people's eyes often blind them to dangers hidden in shadows, or to cars and pedestrians on brightly lit streets. In addition, light pollution has definite effects on other forms of life, from migrating birds to ocean populations.

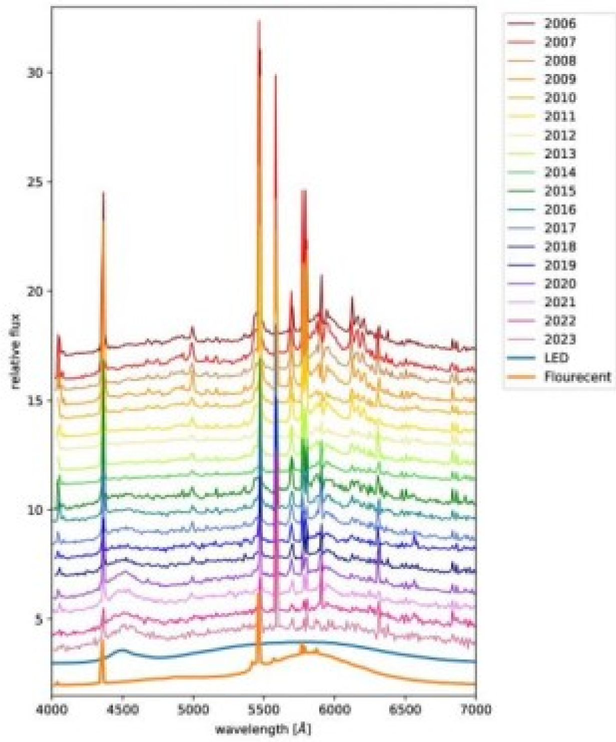
A short video showing how lighting can actually provide the opposite of safety. Courtesy: DarkSky.org.

In recent decades, organizations such as DarkSky International, the American Astronomical Society, and the International Astronomical Union have been joined by architects, safety officials, and others to work on solutions to light pollution. For some places, that works very well and dark skies are returning while maintaining required lighting for safety. In other places, there's still a lot of work to be done. The recent rise in the use of LEDs for lighting poses some of the same problems that incandescent lighting does. Astronomers and others continue to work on recommendations for the wise use of such lighting to mitigate the problems of light pollution.

Are there Dark Skies Over Bisei?

Japanese astronomers Ryosuke Itoh and Syota Maeno decided to monitor how the light pollution ordinances in Bisei Town have affected viewing at the Bisei Observatory. The town has replaced all of the fluorescent lights with LED lamps, which they hoped would reduce sky brightness in the nearby region. However, light pollution from these and lights farther away is still scattered by the atmosphere, which can result in a perceptible sky glow.

Sky brightness is one way of determining the effects of light pollution. It can be measured in several ways. One is to photograph the entire sky with an all-sky lens-equipped camera. That gives you a wide-angle view. Another way is to use a CCD camera attached to a telescope to get a good view of the entire sky. Finally, you can use a specially equipped sky meter that gives a photometric value to sky brightness. Itoh and Maeno used this third method to measure the skies over the Bisei Observatory. They also used sky spectra dating between 2006 to 2023 to see if the changes in lighting affected the data.



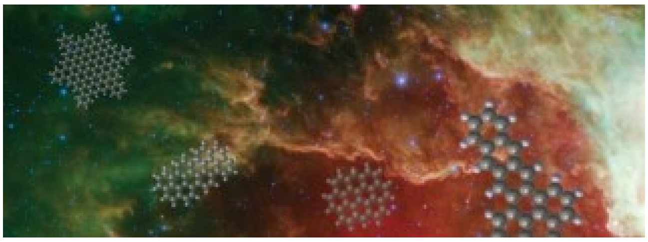
Sky spectra from BAO from 2006 to 2023. Different colors represent different years. Spectra of LEDs and fluorescent lamps taken with the same instruments are shown for comparison (bottom). Courtesy Itoh, et al.

What they found with their all-sky measurements and data analysis is something of a mixed bag. Bisei Town itself now has an observed sky brightness on the Bortle Scale of class 4. That corresponds roughly to a rural/suburban transition zone. In part, the shift to lower color-temperature LEDs in place of bright incandescent lamps did reduce some light pollution in town. However, Itoh and Maeno observed a very definite spectral line around 4500 A that they call a "blue hump". It comes from the bright white, higher-temperature LEDs still in use in nearby towns, but they couldn't directly identify all the sources specifically.

Future Work
In a paper they are submitting for publication, the two scientists conclude that while Bisei Town's skies are not outstandingly dark, there is some improvement since the lighting changes were made. However, the night sky is still affected by light pollution from nearby areas, and more work needs to be done in those regions to mitigate the problem.
Most importantly, they note how important it is to separate the distinct origins of light pollution in any given area. While Bisei Town may well have improved its local environment, it still has to deal with scatted light from large metropolitan areas. Identifying those specific light pollution sources will be a big step towards helping those municipalities find ways to reduce the light pollution problems of their smaller rural neighbours.

How Many Planets Could Be in the Kuiper Belt?
A recent study published in *The Astrophysical Journal Letters* investigates the potential existence of Mars-sized free-floating planets (FFPs)—also known as rogue planets, starless planets, and wandering planets—that could have been captured by our Sun's gravity long ago and orbit in the outer solar system approximately 1,400 astronomical units (AU) from the Sun. For context, the farthest known planetary body in the solar system is Pluto, which orbits approximately 39 AU from the Sun, and is also part of the Kuiper Belt, which scientists estimate extends as far out as 1,000 AU from the Sun.
This study comes as scientists currently estimate that billions, if not trillions, of FFPs could exist within our Milky Way Galaxy, with a recently submitted study using data from NASA's James Webb Space Telescope (JWST) to identify 540 potential Jupiter-sized rogue planet candidates, with some hypothesized to be pairs of rouge planets, also called binary rogue planets. This was followed up by another recently submitted study that investigated the origin and evolution of those binary rogue planets, as well. Scientists currently hypothesize that rogue planets are formed from two scenarios: As part of their own solar system but are then somehow ejected into the cosmos, or they form in isolation. But what is the significance of studying free-floating planets, overall?
"There are three interesting areas of astrophysics that we can learn about from free-floating planets," Amir Siraj, who is a PhD student in the Department of Astrophysical Sciences at Princeton University and sole author of the study, tells *Universe Today*. "The first is planetary system formation — free-floating planets are ostensibly byproducts of the planetary system formation process, so studying them can help illuminate how planetary systems like our own came to be. The second is habitability — free-floating planets may greatly outnumber bound planets, so if any fraction of them have regions with energy budgets that can support liquid water, free-floating planets could collectively represent an important swath of habitable real estate in the universe. The third is dynamical interactions with stars and planetary systems — since free-floating planets are not bound to any particular star, they roam the galaxy and can have dynamical interactions with many different stars and planetary systems."
It was this third area that Siraj tells *Universe Today* he used as influence for this study, as he asked the probability of FFPs potentially being captured by our own solar system throughout its approximate 4.5-billion-year history.
For the study, Siraj used computer models to simulate the potential for FFPs being captured in the outer solar system while incorporating a myriad of factors, including semimajor axis, eccentricity, and observation times of FFPs. After conducting approximately 100,000,000 simulations, the results indicate the potential for the existence of a Mars-sized, or even a Mercury-sized planetary body somewhere in the outer solar system approximately 1,400 AU from the Sun, with Siraj noting in the study the distance could range between 600 to 3,500 AU. But what is the significance of a terrestrial planet so far out in the outer solar system as opposed to a gas giant planet?
"Since this planet would be a former exoplanet, studying it in detail would reveal a wealth of information about how planets form around other stars," Siraj tells *Universe Today*. "The fact that it's a terrestrial planet means that its surface is probably rocky — which is very exciting because it means that by studying its surface, we could learn about the habitability of terrestrial exoplanets in general."
Siraj recommends in his study that future work could include gaining greater understanding of how rogue planets are captured in the first place, along with investigating observational tests to identify where to look in the sky for rogue planets, as well. He also notes how microlensing has become the preferred method in identifying rogue planets based on past studies.
What new discoveries will scientists make about rogue planets in the coming years and decades? Only time will tell, and this is why we science!

Organic Molecules Come from the Universe's Cold Places
Life, as we all know, is based on chemistry. Prebiotic chemical building blocks existed on our planet for a long time before life arose. Astrobiology and cosmochemistry focus on the formation of those building blocks. They also look at the role each played in creating all the life forms we know today.
For a long time, cosmo-chemists have known that organic molecules called polycyclic aromatic hydrocarbons (PAHs) are quite plentiful in the Universe. Scientists consider them plausible prebiotic building blocks that likely played an important role in the formation of life on Earth. What's not as well understood is their origin story. For a long time, scientists suspected that they formed in regions where temperatures get to around 1000 K. That would supply energy to promote chemical activity to create PAHs, such as in star-forming molecular clouds or circumstellar disks. It's also possible they form as part of the processing of carbon-rich dust grains by nearby energy sources (such as stars).
However, based on recent studies of an asteroid and meteorite, it turns out that some PAHs formed in cold regions of space, too. In those regions, the temperature does not get much higher than 100 K. That finding opens up new pathways for understanding life's chemical journey on other planets and celestial bodies.
Understanding These Organic Molecules
According to Professor Kliti Grice, a researcher at the Western Australia Organic and Isotope Geochemistry Centre at Curtin University, understanding these materials is a big step. "PAHs are organic compounds made up of carbon and hydrogen that are common on Earth but are also found in celestial bodies like asteroids and meteorites," said Grice. They're spread throughout the interstellar medium and detected in galaxies across the Universe. Generally, they're used as a tracer of cold molecular gas, which is where stars—and planets—begin their formation journey.



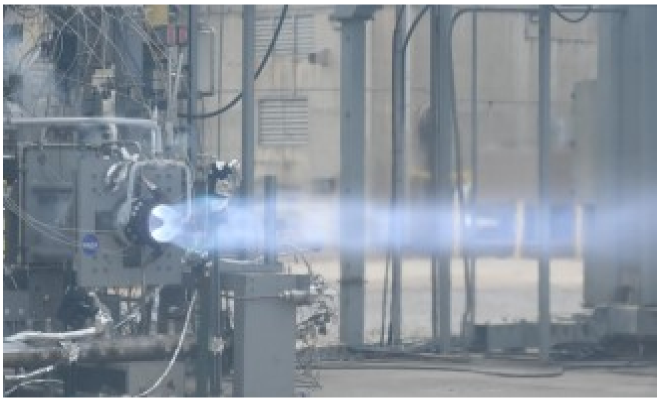
An image of an interstellar nebula with some polycyclic aromatic hydrocarbon (PAH) molecular structures superimposed. These organic molecules exist throughout the Universe. Courtesy: NASA.
As such, scientists want to trace their path from space to Earth and compare space-based PAHs to Earth-based ones. That's because PAHs are a very likely precursor to the kinds of materials that eventually lead to the formation of life. That makes their presence on other celestial bodies intriguing as scientists work to understand the formation and evolution of life.
Beyond Earth, PAHs account for about 30 percent of all car-

bon found in regions around stars, in molecular clouds, and on planets (and other bodies). On Earth, many PAHs exist in coal deposits and oil reservoirs. Plants burning (as in forest fires) also produce these compounds. They work their way into the soil and eventually end up in plants (among other things).

Organic Molecules and Rocky Bodies

Grice is part of an international research team that focused on pieces of asteroid Ryugu and the famous Murchison meteorite to figure out where their PAHs formed. The team started with an unusual chemistry project: burning plants. That's because plants contain PAHs that form here on Earth. "We performed controlled burn experiments on Australian plants," said Grice, "which were isotopically compared to PAHs from fragments of the Ryugu asteroid that were returned to Earth by a Japanese spacecraft in 2020, and the Murchison meteorite that landed in Australia in 1969. The bonds between light and heavy carbon isotopes in the PAHs were analyzed to reveal the temperature at which they were formed."

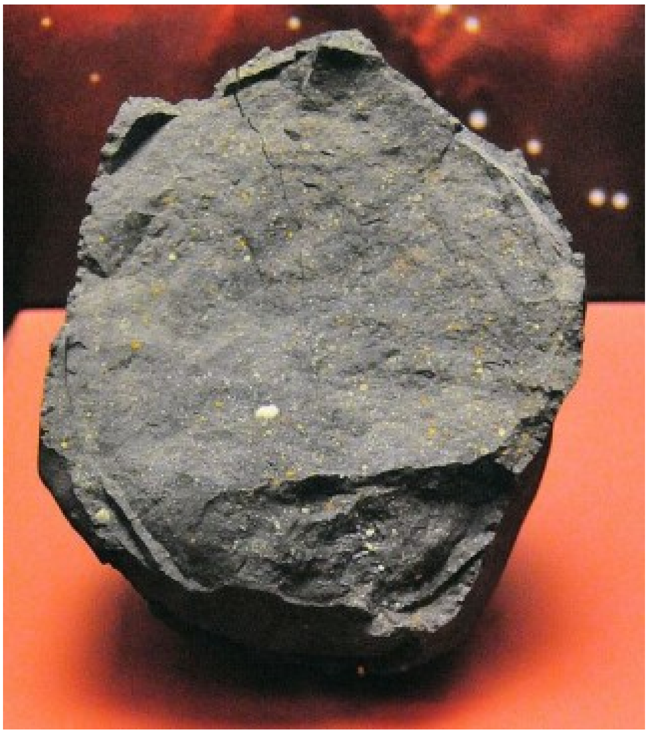
NASA Tests Out 3D-printed Rotating Detonation Rocket Engine!



Engineers at NASA's Marshall Space Flight Center in Huntsville, Alabama, conduct a successful, 251-second hot fire test of a full-scale Rotating Detonation Rocket Engine combustor in fall 2023, achieving more than 5,800 pounds of thrust. Credit: NASA

Looking to the future, NASA is investigating several technologies that will allow it to accomplish some bold objectives. This includes returning to the Moon, creating the infrastructure that will let us stay there, sending the first crewed mission to Mars, exploring the outer Solar System, and more. This is particularly true of propulsion technologies beyond conventional chemical rockets and engines. One promising technology is the Rotating Detonation Engine (RDE), which relies on one or more detonations that continuously travel around an annular channel.

In a recent hot fire test at NASA's Marshall Space Flight Center in Huntsville, Alabama, the agency achieved a new benchmark in developing RDE technology. On September 27th, engineers successfully tested a 3D-printed rotating detonation rocket engine (RDRE) for 251 seconds, producing more than 2,630 kg (5,800 lbs) of thrust. This sustained burn meets several mission requirements, such as deep-space burns and landing operations. NASA recently shared the footage of the RDRE hot fire test (see below) as it burned continuously on a test stand at NASA Marshall for over four minutes.



The Murchison Meteorite, which fell to Earth in 1969. It contains organic molecules. Courtesy Basilicofresco, CC BY-SA 3.0

Using high-tech methods to study Ryugu and Murchison, the team found two sources of PAHs with slightly different characteristics. "The smaller ones likely formed in cold outer space, while bigger ones probably formed in warmer environments, like near a star or inside a celestial body," according to Grice.

Ryugu is particularly interesting since it formed early in the Solar System's history. A critical analysis of its chemistry found several PAHs. The team also detected organosulfides (compounds with sulfur). These all likely formed in very cold interstellar clouds. That means they predate the formation of the Solar System, making bits of Ryugu older than the Sun and planets.

PAHs on the Pathway of Life

Why are scientists interested in PAHs? Their role as precursor compounds for life is intriguing. The fact that they can exist out in space opens up avenues of research into life beyond Earth. In addition, their presence gives new insight into the bodies that contain them.

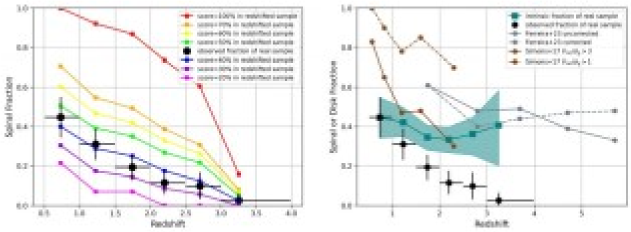
Research team member Dr. Alex Holman said that studying the isotopic composition of PAHs found in celestial bodies offers a glimpse of their formation conditions. "This research gives us valuable insights into how organic compounds form beyond Earth and where they come from in space," Dr Holman said. Ultimately, in the search for life elsewhere in the Universe, understanding the chemical pathways it takes through different formation environments will be important information.

The Early Universe Was Surprisingly Filled With Spiral Galaxies

If we could travel far beyond our galaxy, and look back upon the Milky Way, it would be a glorious sight. Luminous spirals stretching from a central core, with dust and nebulae scattered along the spiral edges. When you think about a galaxy, you probably imagine a spiral galaxy like the Milky Way, but spirals make up only about 60% of the galaxies we see. That's because spiral galaxies only form when smaller galaxies collide and merge over time. Or so we thought, as a new study suggests that isn't the case.

The standard model of galaxies is that they evolve over

time. Galaxies formed from vast clouds of primordial hydrogen and helium, and so likely had a fairly amorphous structure at the beginning. Given the density of the early Universe, galactic collisions and mergers were common, which gave galaxies their rotations and caused them to form disks and spirals. All of this takes time, so we would expect spiral galaxies to be fairly common in the local Universe, but rare in the early Universe.
This new work used data from the Cosmic Evolution Early Release Science Survey (CEERS), which was gathered by the James Webb Space Telescope. The team identified 873 galaxies greater than 10 billion solar masses, with redshifts between z = 0.5 and z = 4. Galaxies at this redshift are between 5 billion and 12 billion years old, so they span the range of early galaxies to modern ones.



The fraction of spiral galaxies as a function of redshift. Credit: Kuhn, et al
Of these galaxies, 216 were classified as spirals. The authors were careful to note that some may be merging galaxies that were misclassified, but even then 108 of the galaxies were unanimously classified as spirals by evaluators. When the team arranged them by redshift, they found that while the fraction of spirals decreased as you went further into the past, the fraction of spirals at redshifts above z = 3 was much higher than expected. When the team calibrated observations, they found about a fifth of galaxies at z = 3 are spiral galaxies. These very early galaxies would have had to become spirals less than two billion years after the Big Bang, meaning that there would have been little time for mergers and collisions to be the cause.
In other words, many galaxies evolved into disk-shaped spirals quite early in the Universe. So while collisions and mergers do play a role in the formation of spiral galaxies, there are likely other factors that come into play. At the moment it isn't clear what those factors are. With future data from JWST, the team hopes to determine just how these early galaxies evolve, and why spiral galaxies have been around for so long.
Reference: Kuhn, Vicki, et al. "JWST Reveals a Surprisingly High Fraction of Galaxies Being Spiral-like at 0.5 ? z ? 4." *arXiv preprint* arXiv:2312.12389 (2023).

Mars is Surprisingly Volcanically Active
Like many that grew up watching the skies, I have been captivated by the planets. Mars is no exception, with its striking red colour, polar caps and mysterious dark features. Many of the surface features have been driven by ancient volcanic activity but whether any geological activity moulds the terrain today is still subject to scientific debate. A recent study however has revealed that Mars is surprisingly active..even today!
Mars is the fourth planet from the Sun and has captivated our imagination for centuries. It's often called the red planet due to the amount of iron oxide in the fine powdery, dusty surface material. The atmosphere is thin and tenuous and is believed to be unable to support life. Numerous probes have visited Mars to shape our current understanding but this new view is quite removed from the view during the days of Schiaparelli in the 19th Century. The poor quality telescopes of the day led to equally poor quality observations that erroneously recorded a surface criss-crossed with canals from an unknown alien civilization.
Until recently, it has also been thought that Mars was volcanically inactive but a recent study by a team led by Joana Voigt from the Arizona's Lunar and Planetary Laboratory have shone new light on the story. The team combined data from ground penetrating radar and spacecraft images to develop a new model of Martian volcanism.
The use of the ground penetrating radar allowed the team to penetrate as deep as 140 meters below the surface and construct a 3D model of the lava flow in Elysium Planitia and use it to identify over 40 volcanic events with the most recent depositing at least 1,600 cubic kilometers of molten lava into the plain. Although the team are keen to stress that they have not observed any volcanic activity but believe that Mars may be far more active now than previously thought.
The study explored a vast, featureless plain on the Martian surface (which is known to be one of the youngest volcanic regions) and found far more volcanic activity than expected. They found significant quantities of lava that had been erupted from cracks and fissures spanning timescales as recent as one million years – geologically that's just a few days ago.
Adding to the conclusion of a more active Mars than before is the number of quakes detected by NASA's InSight lander in recent years. Evidence also points to a number of significant floods in Elysium Planitia and that has implications for the possibility of Mars ever being capable of supporting life. Not just floods but evidence of 'geyser' like hydrothermal vents all of which help to support a model of Mars that is far from dormant.

JWST Sets a New Record, Sees Newly Forming Stars in the Triangulum Galaxy
Our Milky Way bristles with giant molecular clouds birthing stars. Based on what we see here, astronomers assume that the process of star creation also goes on similarly in other galaxies. It makes sense since their stars have to form somehow. Now, thanks to JWST, astronomers have spotted baby stellar objects in a galaxy 2.7 million light-years away. That's millions of light-years more distant than any previous observations of newly forming stars have reached.
The targets of JWST's observations are "young stellar objects" (YSOs) in the Triangulum Galaxy (M33). Astronomers used the telescope's mid-infrared imager (MIRI) to study one section of one of M33's spiral arms in the hunt for YSOs. They found 793 of these baby stars, hidden inside massive clouds of gas and dust. That's an important discovery, signaling that the processes of star birth we know so well in our galaxy occur as we expect them to in others.
About Young Stellar Objects
To put this discovery into some kind of context, let's take a look at young stellar objects in a bit more detail. Generally speaking, these are simply stars in the earliest phases of their evolution. Starbirth begins when materials in a giant molecular cloud start to "clump together" gravitationally. The densest part of the clump gets denser, temperatures rise, and eventually, it starts to glow. Young stellar objects can be protostars still sweeping up mass from their giant molecular clouds. They aren't quite stars yet—that is, they haven't ignited fusion in their cores. That won't happen for maybe half a billion years (more or less, depending on mass).

This image from Hubble Space Telescope, reveals a newly forming star within the Chamaeleon cloud in the Milky Way. This young star is throwing off narrow streams of gas from its poles — creating this ethereal object known as HH 909A. These structures are very common within star-forming regions like the Orion Nebula, or the Chameleon I molecular cloud.
Once the infall of gas onto an infant stellar core finishes the object becomes a pre-main-sequence stellar object. It's still not

officially a star. That happens when fusion ignites inside the star. Then it becomes a main-sequence star. Generally, it has cleared much of its birth cloud away and that makes it easier to observe.

Detecting Newly Forming Stars

Stars in in the earliest stages of formation are hard to observe even in our galaxy. For one thing, their birth clouds hide these infant stars. That makes it very hard to detect them in visible light. But, once they're warm enough to glow, they emit infrared radiation. Given the right instruments, astronomers can easily detect that light. Infrared light is a primary tool astronomers use to search for areas where stars are just starting to form.

As they "grow up", young stellar objects often emit jets of material. Those jets stand out in radio emissions, which can also be detected fairly easily. These baby stars also blow off material in outflows of material called bipolar flows. Astronomers detect these by looking for evidence of hot molecular hydrogen, or warm carbon monoxide molecules—again, in infrared wavelengths. Generally, these bipolar flows emanate from the very youngest objects less than 10,000 years old.

NASA's James Webb Space Telescope's high-resolution, near-infrared look at Herbig-Haro 211 reveals exquisite detail of the outflow of a newly forming young star, an infantile analog of our Sun. Image Credit: ESA/Webb, NASA, CSA, Tom Ray (Dublin)

Many young stars have circumstellar disks around them. These are part of the cloud that formed the star and continue to feed material into it. Eventually, this disk becomes the site of planetary formation, which is why astronomers often refer to them as "protoplanetary disks" or "proplyds". These disks get observed in visible and infrared light by a variety of ground-based and space-based observatories.

All of these manifestations of star birth exist in our galaxy, particularly in the spiral arms, and astronomers have cataloged many of them. One of the best-known examples is the Orion Nebula. It hosts a number of these stellar infants, complete with protoplanetary disks, jets, and bipolar outflows. One particular object, called YSO 244-440, is part of the Orion Nebula Cluster, a grouping of very young stars. This stellar infant is still hidden in the circumstellar disk that gave it birth. Earlier in 2023, astronomers using the Very Large Telescope in Chile announced they'd observed a jet emanating from this object.

Young stellar objects with circumstellar disk, as seen in the Orion Nebula by Hubble Space Telescope. These newly forming stars may one day also have planetary systems around them.

In addition, astronomers used the Spitzer Space Telescope to observe these objects in the Large Magellanic Cloud, a satellite galaxy to the Milky Way. They've spotted at least a thousand YSO candidates in the Spitzer data, allowing them to trace the process of star birth outside our Milky Way.

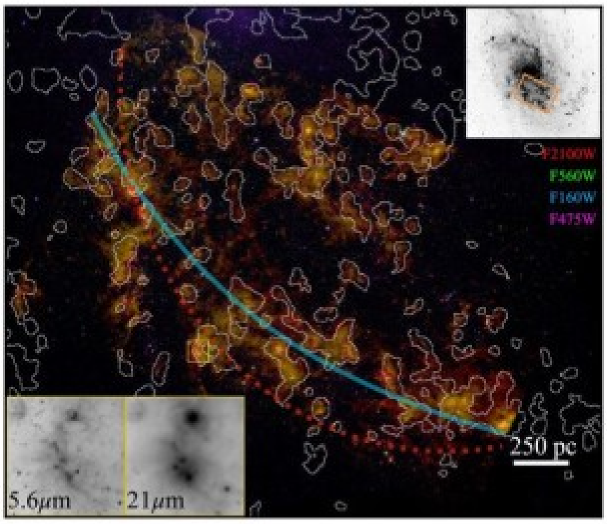
Finding Newly Forming Stars in Other Galaxies

Astronomers want to understand the process of star formation in other galaxies because each one has a unique chemical environment and evolutionary history. Star formation helps fill in the story of galaxy evolution. That's why it's so important to look for YSOs in other galaxies.

Until now, looking for infant stars beyond our immediate galactic neighborhood has been nearly impossible. Spotting them requires very high-resolution imaging and infrared detection capabilities to discern these baby stars from their birth clouds. As happens in the Milky Way, the cloud surrounding the young stars absorb their visible light emissions. Also, if you have a number of them in one cloud, distinguishing one from another can be impossible at great distances. Telescopes such as Spitzer, Herschel, and ground-based observatories don't have the high-resolution capability to detect all YSOs beyond the Large Magellanic Cloud.

This is where JWST comes in handy. It has high-resolution capability and is infrared-sensitive, which allows astronomers to study star-forming regions at greater distances. That's why a team of observers used the telescope to look at the Triangulum Galaxy. It's very similar to the Large Magellanic Cloud in terms of how many stars it makes, its metallicity, and its size. However, unlike the LMC, M33 has puffy spiral arms that are home to star birth regions in giant molecular clouds. So, it made a perfect target.

The team used the MIRI instrument to look at a 5.5-kiloparsec-sized section of M33's southern spiral arms. They used previously made HST observations to identify likely sites of YSOs in the arm. Then they focused JWST on those sites. The result is a whopping catalog of nearly 800 individual candidate YSOs that they then analyzed.



A four-color image showing the MIRI data from JWST and *HST* data from the PHATTER survey. It shows the region of M33 where nearly 800 YSOs lie. Courtesy Peltonen, et al.

Analyzing the YSOs in the Triangulum Galaxy

After sorting the observations and classifying what they found, the astronomers came to some interesting conclusions about star formation in M33. They found that the most massive giant molecular clouds there host a great many young stellar object candidates. The numbers are about similar to what's seen in similar clouds in the Milky Way. The spiral arm they studied seems to have a very efficient star-formation mechanism, which isn't necessarily correlated with the mass of the giant molecular clouds there. They're still trying to figure out why the spiral arm is such a star-formation engine.

It's possible that even with JWST, we aren't seeing into the earliest phases of star formation in that section of the Triangulum galaxy spiral arm. It's also likely that M33's spiral arms (which are described as "flocculent") are different in several ways from the spiral arms of the Milky Way (for example). Flocculence could be caused by multiple episodes of star formation that affect the structure of the gas and dust clouds inside. Our own galaxy's spiral arms are quite well-defined and certainly less flocculent than M33's. That could point to an evolutionary change that takes place as a galaxy continues its star-forming activities. The astronomers also suggest that the region between spiral arms that they studied in M33 isn't as efficient when it comes to star production.

Since this is a "first look" at star formation in a distant galaxy, astronomers will be using those observations to model what they think is happening in M33. Eventually, they should be able to use what they learn to make some very accurate estimates of just how much star formation is happening in the region they studied. Finally, they should be able to extrapolate that star formation rate to other arms in M33. That should give them much-needed insight into that galaxy's evolutionary state and history.

We Owe Our Lives to the Moon

Life appeared on Earth through a series of lucky coincidences, and that luck started with our Moon. None of the other planets of the inner solar system have significant moons. Space is lonely around Mercury and Venus. Mars does have two small moons, Phobos and Deimos (Fear and Despair, befitting companions for the God of War), but those are simply captured asteroids, lassoed in the not-too-distant past and doomed to eventually come close enough to their unloving parent to be torn to shreds by gravitational forces.

In fact, no other planet in the solar system – or any exoplanet known orbiting other stars – has a moon quite like the Moon. With the exception of Pluto and its companion Charon, no other planet has a satellite with the relative mass of Luna. The giant worlds like Jupiter and Saturn have some moons large enough to be planets in their own right, but they are insignificant next to the massive bulk of their parents. The Moon is roughly 1% the mass of the Earth, a percentage unheard of in the galaxy.

And, as is the nature of nature, we found ourselves with our satellite through the chance encounter of a violent collision. Billions of years ago, when our solar system was but a churning mass of gas and dust swirling around a fitful young star, the planets began to coalesce. But before they could become planets, they were mere planetesimals, agglomerations of rock and ice, dozens of them swarming in the chaos of those early days.

In the orbit of what would one day become the Earth, we were not alone. At some point, due to some accident of trajectory and conceit of momentum, a planetesimal the size of Mars struck us. The details of the collision and its aftermath are muddied; with no time machine we can only rely on computer simulations of the impact. But this much is clear: the cosmic accident vaporized part – and possibly the whole – of the Earth and its impactor, creating a ring of superheated plasma that looked more like a rage-filled donut than a proto-world.

But with time the fury ceased; the plasma cooled. The ring coalesced back into the shape of a sphere, but now with an orbiting companion. The traces of the impactor are almost lost to us, the evidence of its existence only slim. The Earth contains more heavy metals in its core than it should for a planet its size – a contribution from the interloper. And the Moon itself, when sampled to measure the composition of its fundamental elements, reveals itself to be made of the exact same mixture as the Earth. A common origin then, not an object formed elsewhere and captured by our gravity.

And we're lucky to have that faithful companion. Day to day, the Moon doesn't largely affect the Earth. It raises and lowers the tides in its month-long orbit, sharing the duty with the gravitational pull of the Sun itself. Some creatures, like dung beetles, use the polarized light of the Moon to guide their way back home after a night of collecting. But otherwise our satellite does nothing more than give us something beautiful to look it – there's nothing quite like the cool blue light cast over freshly fallen snow in quiet winter nights.

But over the long haul, when we zoom our perspective out over billions of years, the Earth wouldn't be the same without our sole friend. Our planet spins about its axis, but that spin is tilted with respect to the movement of the Earth in orbit around the Sun by 23 and a half degrees. This tilt gives us our seasons, with half our year spent with the northern pole facing the Sun, and the other half trading places with the southern pole.

Our planet could have had any orientation it wished. The other planets have lesser and greater tilts, with Uranus tipped completely over on its side and Venus rotating backwards. And there's nothing to keep that tilt fixed over cosmic time. Our planet was born spinning, but the internal arrangements of its core, mantle, and crust, along with the ever-present gravitational machinations of Jupiter, can cause the Earth to wobble, shifting its tilt ever so slightly.

With every shift in the tilt, the seasons would radically change. Instead of regular, predictable changes year after year, we would experience ages with endless summers, or ages with violent but short winters, or anything in between. The rhythm of the seasons provides a pulse for life, which has the freedom to grow and evolve without trying to overcome great climactic shifts caused by a changing axis.

Luna acts as a great gravitational counterweight, stabilizing the motion of the Earth. By providing a source of gravity external to our planet, the Earth's interior is free to shift and reconfigure as it pleases – the Moon steadies our hand and keeps us upright.

Top 12 Events: Astronomy 2024

Astronomy is always a paradox of knowns and unknowns. Eclipses and occultations are surefire bets in a clockwork Universe, while clear skies and whether the next touted 'great comet' or meteor outburst will perform are less certain. Here's our quick rundown of the 'best of the best' skywatching events for 2024:

-The April 8th total solar eclipse across North America
-The Eta Aquariid meteor shower on May 6th, with a ZHR=50
-Mercury passes 7' from Jupiter on June 4th
-The September 18th partial lunar eclipse for the Americas, Europe and Africa
-The October 2nd annular solar eclipse for the southern tip of South America
-The 2024 apparition of Comet 12P (which reaches perihelion on April 21st)
-The Moon occults Saturn 10 times in 2024
-The Moon occults Spica eight times and Antares fourteen times in 2024
-Solar activity ramps up ahead of the peak of Solar Cycle 25
-The Moon heads towards a Major Lunar Standstill in January 2025
-Comet C/2023 A3 Tsuchinshan-ATLAS may be bright towards the end of 2024
-A Leonid meteor outburst in November 2024?

Catching the total solar eclipse in 2017. Credit: Dave Dickinson

The Sun, Seasons and Solar Cycle in 2024

Expect the Sun to be busy in 2024 in terms of space weather and sunspots, as we head towards the peak of the solar cycle 25 in 2025. 2023 had an average sunspot number of around 120 and no spotless days, the first year since 2015 where this was the case. In fact, solar activity in 2023-2024 is climaxing well ahead of expectations, leading to a stronger than expected solar maximum in 2024. This means more sunspots, more wild space weather, and more aurorae for folks watching from mid- to high- northern latitudes.

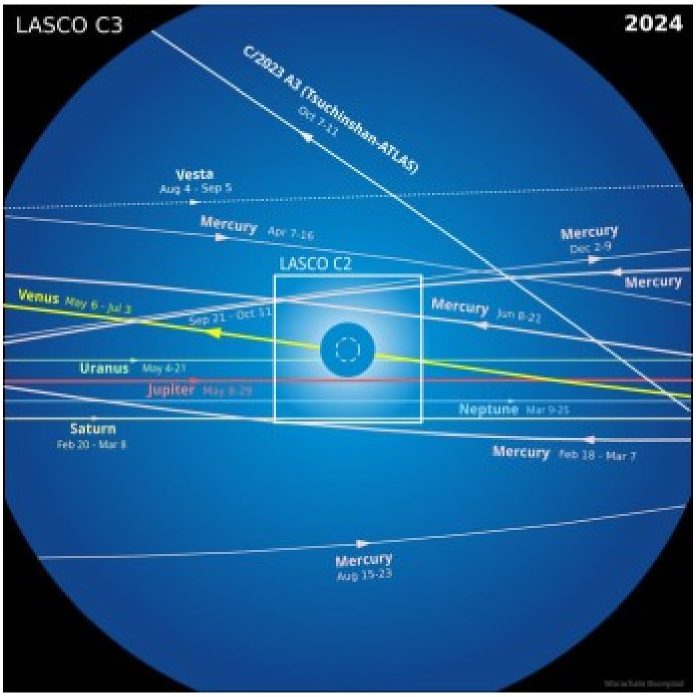
The astronomical seasons for the northern hemisphere in 2024 kick off on:

Spring (northward) equinox: March 20th
Summer (northward) solstice: June 20th
Fall (southward) equinox: September 22nd
Winter (southward) solstice: December 21st

Of course, things are reversed south of the equator. Aurorae tend to pick up around the equinox due to a phenomenon known as the Russell-McPherron Effect and so does GEOSat flare season, as satellites way out in geosynchronous/geostationary orbit brighten into naked eye visibility, then wink out when they hit the Earth's shadow.

The solstice tends to see spans where the International Space Station enters reaches full illumination, favoring the northern hemisphere in June and the southern hemisphere in December.

In 2024, the Earth reaches perihelion on January 2nd, and aphelion July 5th.



Transits through the field of view for the Solar Heliospheric Observatory (SOHO's) LASCO C3 and C2 imagers for 2024. Credit: Worachate Bloonplod.

The Moon in 2024

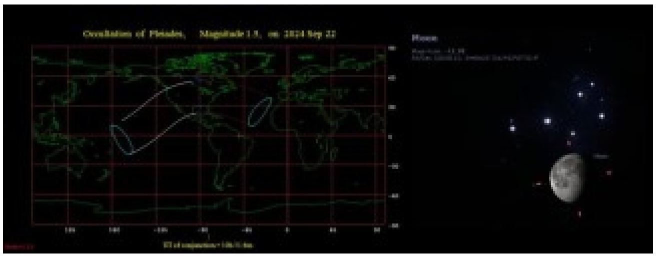
The path of the Moon continues its trek towards the Major Lunar Standstill in early 2025, riding extra high versus the ecliptic and the horizon in the winter season, and low in the summer.

The Moon also reaches its closest perigee for 2024 on March 10th at 356,893 kilometers distant, and is at its farthest apogee on October 2nd at 406,516 kilometers distant.

We also have a 'Black Moon' on December 30th, with the second New Moon in a month with two. February 24th is the 'Minimoon' or smallest apparent Moon for the year, and October 17th is the Supermoon or largest Full Moon of 2024.

The high declination also means the Moon begins to approach the Pleiades (Messier 45) in 2024. The Moon started to occult stars in the outer 'Seven Sisters' once every lunation on September 5th, 2023 and will continue to do so until July 7th, 2029. These occultations become more central in 2024 and 2025, and the best ones to watch for in 2024 are:

-September 22nd for North America (75% illuminated, waning gibbous Moon)
-October 19th for southern Asia (92% illuminated, waning, gibbous Moon)
-November 16th for North America (99% illuminated, Full Moon)
-December 13th for southern Asia (96 illuminated, waxing gibbous Moon)



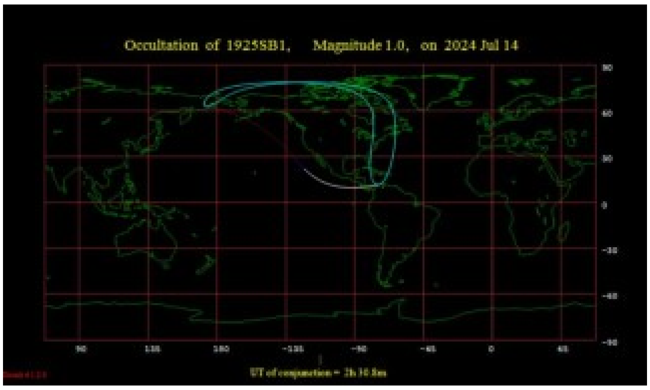
The September 22nd occultation of the Pleiades by the Moon. Credit: Occult 4.2/Stellarium

The Moon also occults (passes in front of) several bright stars and planets in its passage through the sky. The Moon occults Antares 14 times in 2024, and Spica 8 times:

Antares Events

(note: '+/- denotes waxing/waning phase for the Moon, along with the percent illuminated).

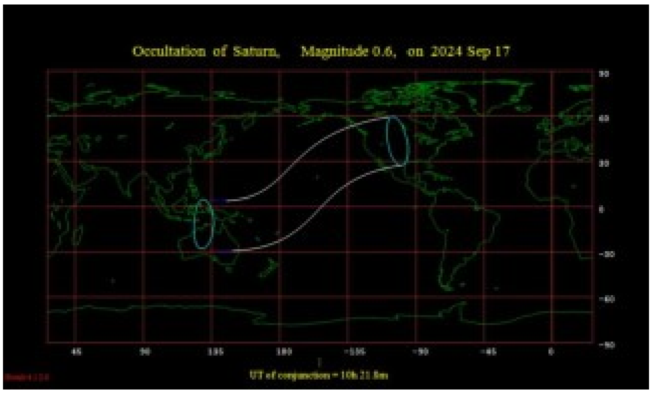
-January 8th for western North America (-11% Moon)
-February 5th for southeast Asia (-24% Moon)
-March 3rd for Central America (-51% Moon)
-March 30th for the central Pacific (-77% Moon)
-April 26th for the Middle East and east Africa (-93% Moon)
-May 24th for northern South America (-99% Moon)
-June 20th for the central Pacific (+70% Moon)
-July 17th for South Africa (+84% Moon)
-August 14th for the South Pacific (+70% Moon)
-September 10th for western Australia (+45% Moon)
-October 7th for the South Atlantic (+21% Moon)
-November 4th for the southeast Pacific (+10% Moon)
-December 1st for South Africa (+1% Moon)
-December 28th for the central Pacific (-6% Moon)



The Moon occults Spica on July 14th. Credit: Occult 4.1.2.

Spica Events:

-June 16th for Russia (+73% Moon)
-July 14th for North America (+58% Moon)
-August 10th for southeast Asia (+32% Moon)
-September 6th for East Africa (+12% Moon)
-October 3rd for Hawaii (in the daytime, +1% Moon)
-November 27th for North America (-12% Moon)
-December 24th for southeast Asia (-26% Moon)



The Moon occults Saturn on September 17th. Credit: Occult 4.1.2.

Planetary occultations: next, there are 15 lunar versus planetary occultations in 2024, involving 4 planets:

-Mercury (March 11th) by the +3% Moon, for the South Pacific
-Venus (April 7th) (daytime) by the -2% Moon, for eastern North America
-Venus (September 5th) by the +6% Moon for Antarctica
-Mars (May 5th) by the -8% Moon for Madagascar
-Mars (December 18th) by the ~87% Moon for the Arctic

Saturn Occultation Events:

-April 6th by the -7% Moon for Antarctica
-May 3rd by the -26% Moon for the southern Indian Ocean
-May 31st by the -39% Moon for southern South America
-June 27th by the -64% Moon for northern New Zealand
-July 24th by the -86% Moon for southeast Asia
-August 21st by the -95% Moon for northern South America and northwest Africa
-September 17th by the +99% Moon for western North America
-October 14th by the +89% Moon for India and eastern Africa
-November 11th by the +77% Moon for Central America
-December 8th by the +51% Moon for the western Pacific

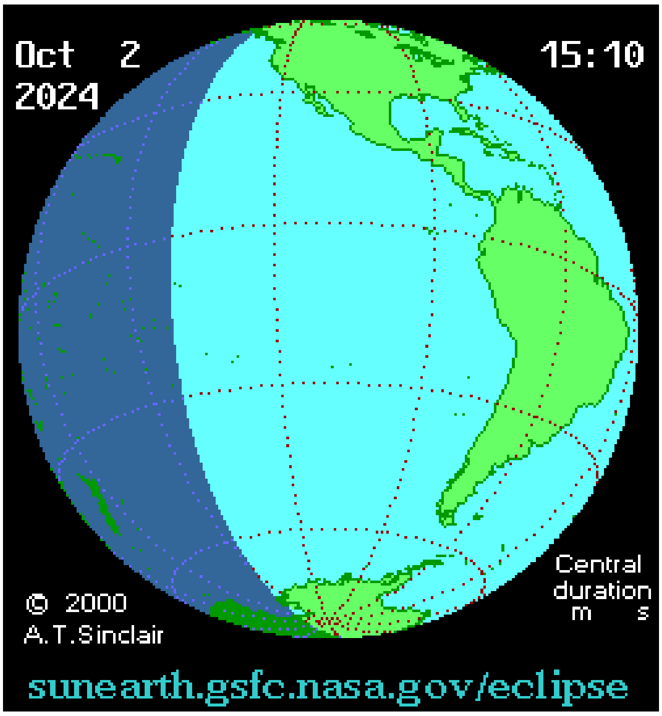
The path of the April 8th total solar eclipse across North America. Credit: Michael Zeiler

Eclipses in 2024

Of course, the Great North American Eclipse on April 8th, 2024 dominates the year. But 2024 also features other eclipses as well spanning two eclipse seasons, including:

-March 25th: an 87% penumbral lunar eclipse, favoring the Americas.
-April 8th: A total solar eclipse, (maximum totality: 4 minutes and 28 seconds) spanning North America. This eclipse 'could' feature a rare treat, with (naked eye?) comet 12P/Pons-Brooks nearby, just 25 degrees east of the Sun.
-September 18th: A 9% partial lunar eclipse favoring the Americas, Europe and Africa.
-October 2nd: An annular eclipse with a maximum annularity of 7 minutes, 25 seconds favoring the southern tip of South America.

4 eclipses (2 lunar and 2 solar) is the minimum number that a calendar year can contain.



The path of the October 2nd, 2024 annular solar eclipse. NASA/GSFC/A.T. Sinclair

The Inner Planets in 2024

The two inner planets Mercury and Venus never stray far from the Sun. In early 2024 Venus lingers in the dawn, but does not reach greatest elongation in 2024. Instead, Venus reaches inferior conjunction on the solar farside opposite to the Earth on June 4th, transitioning from the dawn to the dusk sky.

Mercury reaches greatest elongation 7 times in 2024, an extra one versus its normal six:

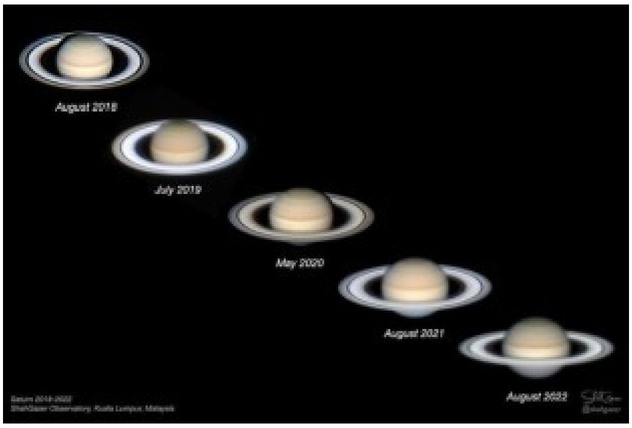
-24 degrees west at dawn (January 12th)
-19 degrees east at dusk (March 24th)
-26 degrees west at dawn (May 9th)
-27 degrees east at dusk (July 22nd)
-18 degrees west at dawn (September 5th)
-23 degrees east at dusk (November 16th)
-22 degrees west at dawn (December 25th)
-Venus also occults the +6.4 magnitude star HIP 86060 for India on January 18th, and the +4.7 magnitude star HIP 92111 on (February 1st) for Brazil.

Mercury and Venus also both transit the open star cluster Messier 44 in 2024:

-Mercury meets M44 on July 6th (with asteroid 4 Vesta nearby!), 24 degrees from the Sun.
Venus meets M44 on July 18th, 11 degrees from the Sun.

The Outer Planets in 2024

Saturn's ring angle in 2024 is 2 to 5 degrees wide, as they head towards edge on in March 23rd, 2024. Meanwhile, Jupiter's outermost moon Callisto continues to 'miss' Jupiter, though that'll change as the orbital plane of the Galilean moons head towards edge-on once again in 2026.

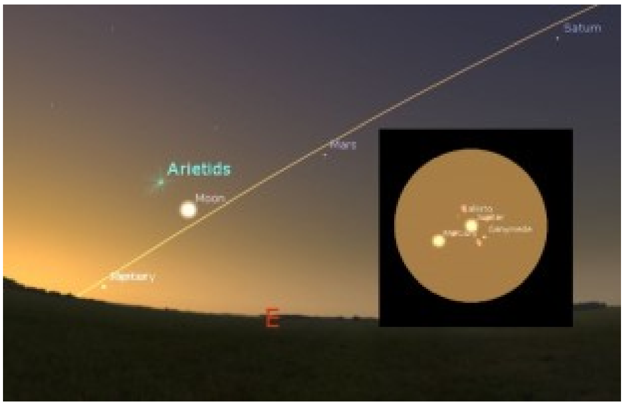


Saturn rings: from wide open, to approaching edge-on in 2024. Credit: Shahrin Ahmad.

Oppositions and the best season to observe the outer planets in 2024 include:

-Pluto (June 23rd)
-Saturn (September 8th)
-Neptune (September 21st)
-Uranus (November 17th)
-Jupiter (December 7th)

The top planet versus planet conjunction for 2024 is Mercury versus Jupiter on June 4th 7' apart and 12 degrees west of the Sun at dawn.



Mercury meets Jupiter at dawn on June 4th. Credit: Stellarium.

The top bright star versus asteroid occultation for 2024 occurs on June 29th, when asteroid 2819 Ensor occults the +3.2 magnitude star Phi Sagittarii for north Asia.

The top star versus planet conjunction for 2024 is Mercury versus Regulus on September 9th 30' apart, 17 degrees west of the Sun at dawn.

Astronomy 2024: Meteor Showers

There are 112 meteor showers known and recognized by the International Astronomical Union (IAU), about a dozen of which are major annual favorites. Of course, showers are always best when the pesky light-polluting Moon is near New and out of the way. In 2024, the best showers versus the Moon are:

-Eta Aquariids (May 6th) -1% Moon, ZHR~50
-Daytime Arietids (June 7th) +4% Moon ZHR~30
-Delta Aquariids (July 30th) -18% Moon ZHR~30
-Taurids (October 10th) +45% Moon ZHR~10
-Andromedids (December 10th) +5% Moon ZHR~20

Is a Leonid outburst due for November 14th 2024? The Earth may encounter the 1633 trail for source comet 55P/Tempel-Tuttle… the same stream that caused the 2001 outburst.

Comet 12P versus the bright star Vega. Credit: Dan Bartlett.

Comets to Watch For in 2024

We're certainly due for the next great comet of the century. Though there's nothing amazing to see in the sky in terms of comets (yet), that could all swiftly change with the discovery of a bright new comet inbound. As of writing this in late December 2023, these are the following comets expected to break binocular visibility:

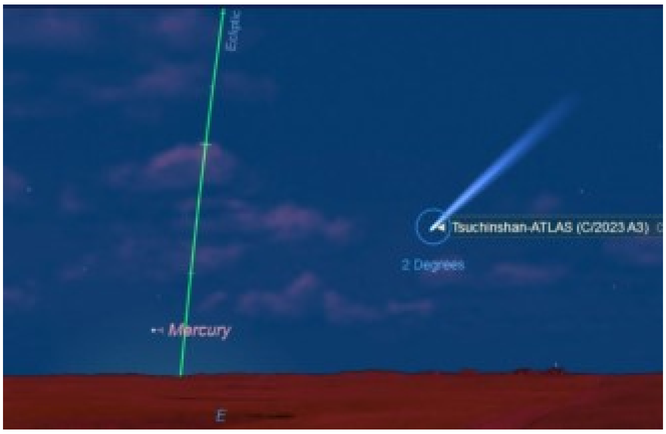
-12P/Pons-Brooks reaches magnitude +3.9 at perihelion on April 21st in the constellation Taurus, 21 degrees east on the Sun.

-13P/Olbers reaches magnitude +7.5 at perihelion on July 1st in the constellation Lynx, 21 degrees east of the Sun.

-144P/Kushida reaches perihelion on January 26th at magnitude +7.9 in the constellation Taurus, 126 degrees east of the Sun.

-C/2021 S3 PanSTARRS reaches perihelion on February 15th at magnitude +7.4 in the constellation Pegasus, 23 degrees east of the Sun.

-Comet C/2023 A3 Tsuchinshan-ATLAS reaches perihelion on September 28th at magnitude +2.5 in the constellation Hercules, 83 degrees east of the Sun.



Comet Tsuchinshan-ATLAS at dawn in late September. Credit: Starry Night.

Weirdness and More:

Looking farther out afield, a few double stars on our 'orbits with spans with short enough to live through' reach maximum separation in 2023-2025:

-70 Ophiuchus reaches a maximum separation of 6.7";

-Delta Equulei reaches a maximum separation of 0.3"; and

-The 'Pup' of the Dog Star Sirius B reaches its maximum apparent separation of 11.5 arc seconds on its 50-year orbit. True story: I 'finally' got to cross the Pup off my visual observing life list in 2023, courtesy of Richard Drumm and his access to the 26-inch refractor at the Charlottesville Virginia McCormick Observatory.

Also, 2050.00 celestial coordinates come into vogue in 2025 versus 2000.00, as we'll officially be closer to 2050 than 2000… it's strange to think, we've been using 2000.00 (and occasionally, 1950.00) for most of our lives.

Astronomy 2024…and a Teaser for 2025

…and as always, there's more to come. 2025 sees the peak of Solar Cycle 25, the Moon at Major Lunar Standstill, Saturn's rings edge on, Mars at opposition, two total lunar and two partial solar eclipses and more.

Don't miss all of these events and more in Astronomy 2024!

Miniaturized Jumping Robots Could Study An Asteroid's Gravity

Missions focusing on small bodies in the solar system have been coming thick and fast lately. OSIRIS-Rex, Psyche, and Rosetta are all examples of projects that planned or did rendezvous with a small body in the solar system. But one of their biggest challenges is understanding the gravity of these bodies – which was especially evident when Philae, Rosetta's lander, had a hard time staying on the surface of its intended comet. A new idea from researchers at the University of Colorado Boulder and NASA's Jet Propulsion Laboratory could help solve that problem – by bouncing small probes around.

The concept, called Gravity Poppers, resulted from a NIAC grant back in 2020. The idea is simple enough – release a bunch of probes onto the surface of a small body and have them periodically jump off it. When they do so, keep track of them. If you know the force they jumped off with and can track them as they return to the surface, you can estimate the gravity of the area they're floating over more accurately than alternative techniques.

Scientists use three main alternative techniques to calculate the gravity of small bodies – radar tomography, seismic imaging, and gravimetry. Each has disadvantages that the Gravity Poppers can overcome.

Here's Dr. Benjamin Hockman, one of the researchers, describing the concept at the NIAC symposium.

Credit – Ben Hockman YouTube Channel

Radar tomography uses reflections of radio signals to estimate what the gravity is like in a particular area. However, it's difficult to penetrate the deeper sections of a small body. Some materials don't reflect electromagnetic waves at all, making it impossible to characterize areas with these materials.

Seismic imaging is commonly used on Earth. By tracking the movement of seismic waves across the surface of a body, scientists can estimate the gravity of regions surrounding them. However, some small bodies, especially asteroids, are just piles of rubble with no internal coherent structure. Seismic waves don't do very well in such environments. Ryugu, the asteroid Hayabusa-2 visited, absorbed the seismic energy of an impact event such that the spacecraft couldn't even discern any changes in its surface features.

Gravimetry is the most straightforward of the three techniques and requires the least equipment onboard the spacecraft. How does the small body pull on the spacecraft orbiting it? As it passes over different regions, does the gravity increase or decrease? However, measuring gravity from far away isn't easy, as orbits tend to be relatively far away. So, the accuracy of this technique is relatively low.

Fraser discusses techniques to stop a potentially dangerous asteroid from hitting Earth. Many of the techniques would involve understanding its gravity.

Enter Gravity Poppers. An orbiter could release a few dozen of these – a paper detailing the idea suggests 20. As they land on the surface of the asteroid, comet, or small moon, they occasionally use an internal force to jump off the surface, but not enough to break the hold of gravity. Depending on the intended area to be studied, they could do this at an angle or straight up.

As they fly off the surface, the orbiting mothership tracks them and calculates their trajectory, which can then be used to calculate the gravity of the region they are flying over. They then land, reset themselves, and do it repeatedly with the orbiter tracking them. The team studied two types of structures for the poppers: spherical and cubic. They settled on the cube, which also had embedded LEDs that create a

light source the orbiter could track.
It's not as simple as tracking the light source, though – plenty of system dynamics go into calculating the trajectory angle, the force with which the popper jumped, and the landing location. The paper also details simulations of how such a mission would operate in practice, using modeling software developed at NASA.
Unfortunately, that means that there are no prototypes in the works for this as of yet. It did not receive NIAC Phase II funding as of yet either. But the idea is unique and simple enough that with a little bit of development effort, engineers might be able to master this novel way of prospecting some of the most economically and interesting asteroids.

Ouch. Canadarm2 Took a Direct Hit From a Micrometeorite
Living in space comes with risks. For astronauts on the International Space Station (ISS), those risks occasionally make themselves intrusively apparent.
Earlier this month, European Space Agency astronaut Andreas Mogensen snapped a photo of the Canadarm2, in which damage from a micrometeorite impact is clearly visible.
"The hole was made in 2021, where a 1 mm object, traveling at over 25,000 km/h relative to the Space Station hit the robotic arm. Fortunately, no critical components were damaged," said Mogensen on social media.
The impact punched through the arm's thermal blanket and impacted the boom. The robotic arm, which has been in service on the ISS for over twenty years, continues to function normally.
But the ISS isn't always so lucky. In October, the Nauka science module suffered damage from a similar micrometeorite impact, causing 72 litres of coolant to leak from the module's radiator out into space. After determining that the leaking coolant might contaminate astronauts' spacesuits, a spacewalk planned for October 12th was postponed.
Mogensen, alongside NASA astronaut Loral O'Hara, was scheduled to recover science samples from the station exterior, where tests are ongoing to measure the ability of resilient microbial life to survive in space. In addition, the pair were expected to carry out a variety of exterior maintenance activities, including camera replacements and jumper cable installations.
That spacewalk will now occur in January or February 2024.


Canadarm with a micrometeorite impact: ESA/NASA-A.Mogensen.

In its decades-long history, the ISS has so far avoided any serious damage to its pressurized modules. The station has the ability to maneuver itself out of harm's way in the case of a close approach with a known piece of space debris. These evasive actions have occurred regularly throughout the ISS's operations, occurring at a cadence of once or twice per year (and thrice in more recent years).
The challenge is knowing when debris might be on a collision course.
Ground-based orbital debris tracking programs currently monitor about 33,000 pieces of known space debris. But smaller pieces of debris and micrometeorites cannot be tracked from Earth, so the station relies on shielding to protect itself. A multi-layered structure known as Whipple shielding disperses the force of impact over a wider area, preventing depressurization.
There are also technology demonstration tests in the works for on-orbit debris trackers, which will be able to detect much smaller pieces of debris (as small as 3 cm).
In the meantime, astronauts like Mogensen stay ready for the worst-case scenario. A carefully planned regimen of emergency procedures is one way that space agencies try to minimize the risks.
"Most of the modules have shielding against smaller impacts, but it is not strong enough to withstand impacts against larger ones," says Mogensen. "This is why we repeatedly practice emergency scenarios, including depressurization."
Mogensen will stay in orbit until February 2024, when he will return to Earth with four of his crewmates on a SpaceX Dragon capsule. This is Mogensen's second mission in space.

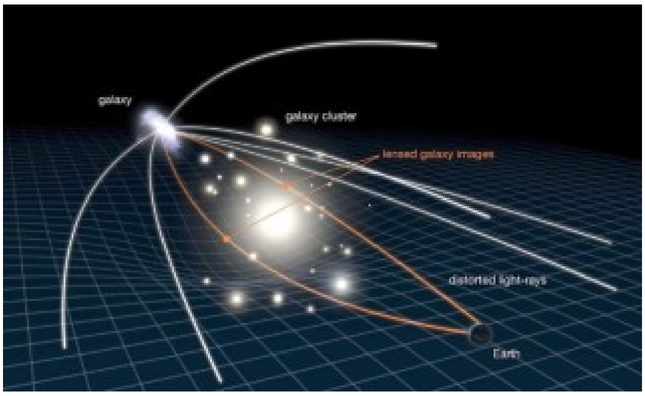
Webb Sees a Supernova Go Off in a Gravitationally Lensed Galaxy – for the Second Time
Nature, in its infinite inventiveness, provides natural astronomical lenses that allow us to see objects beyond the normal reach of our telescopes. They're called gravitational lenses, and a few years ago, the Hubble Space Telescope took advantage of one of them to spot a supernova explosion in a distant galaxy.

Now, the JWST has taken advantage of the same lens and found another supernova in the same galaxy.

A gravitational lens is a massive object like a galaxy or galaxy cluster. The object's mass creates a curvature in space-time. When light from an object behind the lens travels past the cluster, it's magnified. Most gravitational lenses were discovered accidentally, but recently, dedicated searches have found more of them, and they've become an important tool in astronomy.

In 2019, astronomers found a supernova in images the Hubble Space Telescope captured in 2016 of a galaxy named MRG-M0138. Those images were gravitationally lensed by a galaxy cluster called MACS J0138.0-2155. Now, the JWST has observed the same galaxy through the same lens and found another supernova that exploded only seven years after the previous one. This is remarkable and is the first time astronomers have found two supernovae in the same galaxy.

Gravitational lenses do more than just magnify background objects. They also create multiple images of the objects. But the images don't arrive at the same time, and their temporal separation is another astronomical tool.



This illustration shows how astronomers use gravitational lensing to study very distant and very faint objects. Note that the scale has been greatly exaggerated in this diagram. In reality, the distant galaxy is much further away and much smaller. Image Credit: NASA, ESA & L. Calcada

In a NASA blog post, Justin Pierel of NASA's Space Telescope Science Institute (STScI) and Andrew Newman from the Observatories of the Carnegie Institution for Science explained the findings.

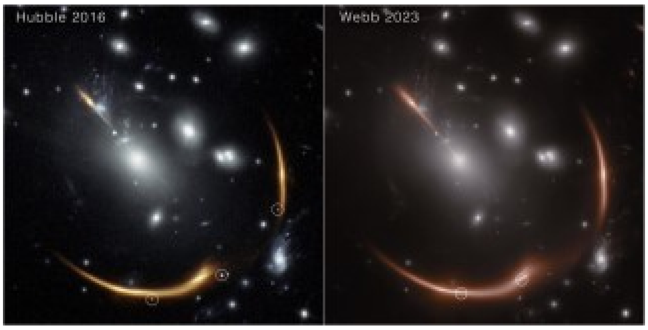
"When a supernova explodes behind a gravitational lens, its light reaches Earth by several different paths," the pair explain. "We can compare these paths to several trains that leave a station at the same time, all travelling at the same speed and bound for the same location. Each train takes a different route, and because of the differences in trip length and terrain, the trains do not arrive at their destination at the same time."

So, images of a single supernova can arrive at our telescopes at different times, sometimes separated by several years. This arrangement, though it can seem confounding, is actually another useful tool. Studying the images can help scientists measure the Hubble constant, which is the history of the expansion rate of the Universe. "The catch is that these multiply-imaged supernovae are extremely rare: fewer than a dozen have been detected until now," the pair of scientists explain.

"Within this small club, the 2016 supernova in MRG-M0138, named Requiem, stood out for several reasons," Pierel and Newman explain. The first is that the supernova is 10 billion light years away. The second is that it's also a Type 1a supernova. Type 1a supernovae serve as standard candles, objects with known luminosities that can be used to gauge distances in the cosmic distance ladder. The third reason is that one of the images will be so delayed that it won't arrive until the middle of the 2030s.

"Unfortunately, since Requiem was not discovered until 2019, long after it had faded from view, it was not possible to gather sufficient data to measure the Hubble constant then," the scientists explain.

But now Webb has observed a second supernova called Encore.



The left panel shows Hubble's image of supernova Requiem from 2016. The right panel shows the JWST's image of the Encore supernova from 2023. Three images of the supernova are visible in the Hubble image, and two images of Encore are visible in the JWST image. This is the first known system to produce more than one multiply-imaged supernova, a boon for astronomers. Hubble Image Credit: NASA, ESA, STScI, Steve A. Rodney (University of South Carolina) and Gabriel Brammer (Cosmic Dawn Center/Niels Bohr Institute/University of Copenhagen); JWST image credit: NASA, ESA, CSA, STScI, Justin Pierel (STScI) and Andrew Newman (Carnegie Institution for Science).

"Encore was discovered serendipitously, and we are now actively following the ongoing supernova with a time-critical director's discretionary program," the scientists write. "Using these Webb images, we will measure and confirm the Hubble constant based on this multiply imaged supernova. Encore is confirmed to be a standard candle or type Ia supernova, making Encore and Requiem by far the most distant pair of standard-candle supernova 'siblings' ever discovered."

Measuring the Hubble constant is an ongoing challenge in cosmology. The expansion of the Universe is the prime piece of evidence supporting the Big Bang. So getting the constant right is an important part of understanding the Universe. The Hubble constant measures how galaxies are moving away from us at speeds proportional to their distance. It's expressed in km/s of a galaxy 1 megaparsec away, and over the decades, different researchers have come up with different numbers. The most recent measurement of Hubble's constant is 68.3 (km/s)/Mpc.

Shortly after the Big Bang, the Universe was expanding due to inflation. About three billion years ago, the mysterious force we've named Dark Energy took over. Dark Energy's force isn't diluted as the Universe expands, and it's still driving the expansion. In fact, that expansion is accelerating, and we don't know why. But somehow, an accurate measurement of the Hubble Constant is part of the explanation. And measuring the same supernova several years apart will yield an accurate measurement.

The quest for the most accurate measurement is the quest for a better understanding of the Universe. Finding two standard candle supernovae in the same galaxy is a unique opportunity to measure the Hubble constant more accurately than ever before. "Considering the rarity of finding multiple SNe Ia in the same host galaxy, compounded with the extreme rarity of lensed SNe, this discovery is truly surprising," the scientists wrote in their observing proposal.

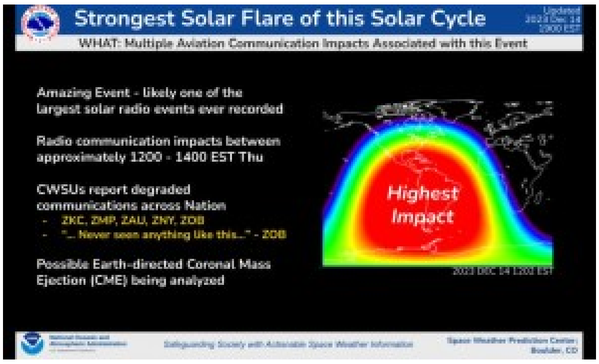
Supernovae in distant galaxies don't give us any prior indication that they're going to explode. We know which type of stars will explode and end themselves as supernovae, but can't measure when. But this case is unique. We know when the next one will appear, or rather when the next image of the same one will appear.

"Supernovae are normally unpredictable, but in this case, we know when and where to look to see the final appearances of Requiem and Encore. Infrared observations around 2035 will catch their last hurrah and deliver a new and precise measurement of the Hubble constant," the pair of scientists write.

We Just had the Strongest Solar Flare in the Current Solar Cycle

On December 14th, at 12:02 PM Eastern (09:02 AM Pacific), the Sun unleashed a massive solar flare. According to the Space Weather Prediction Center, part of the National Oceanic Atmospheric Administration (NOAA), this was the strongest flare of Solar Cycle 25, which began in 2019 and will continue until 2030. What's more, scientists at the SWPC estimate that this may be one of the most powerful solar flares recorded since 1755 when extensive recording of solar sunspot activity began.

Solar flares occur in the Sun's active regions, and activity varies over an 11-year solar cycle. This phenomenon is believed to result from stored magnetic energy in the Sun's atmosphere accelerating charged particles in the surrounding plasma. These flares release radiation across the electromagnetic spectrum and are often accompanied by Coronal Mass Ejections (CME) and other solar phenomena. According to the SWPC, this recent flare may have triggered an Earth-bound CME, which they are currently analyzing.



The SWPC reported the largest solar flare of Solar Cycle 25. Credit: SWPC-NOAA

The SWPC also localized the flare to Region 3514, located over the far northwest area of the Sun. The flare caused interference with radio communications on Thursday, December 14th, between 12:00 PM to 02:00 PM EST (09:00 AM to 11:00 AM PST). According to the National Weather Service (NWS), Center Weather Service Units (CWSU) from the Eastern Seaboard to the Midwest reported interference with aircraft communications. The SWPC recommends that people continue to monitor their web page for the latest information and updates on the CME.

It's Time for Saturn's "Spokes" to Return

Astronomers have been observing Saturn with the Hubble Space Telescope and several other spacecraft for decades and have noticed something unusual. During seasonal changes, transient spoke-like features appear in the rings. These dark, ghostly blobs orbit around the planet 2-3 times, and then disappear.

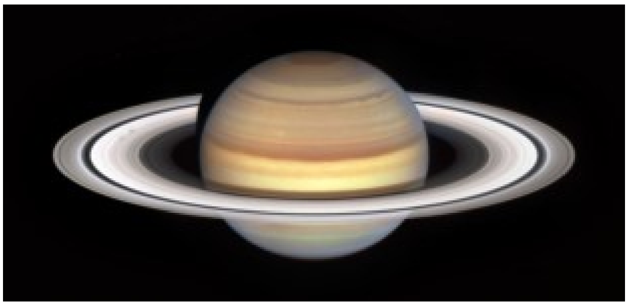
As Saturn is approaching its equinox, this is prime spoke activity time. Once again, Hubble has been called to gaze at Saturn, tracking the behavior of the spokes and hopefully giving astronomers more clues as to why they occur.

Earlier this year in February, Hubble took an image showing the spokes only on one side of the rings. The latest image, above, taken on October 22, 2023, shows spokes structures appearing on both sides of the planet simultaneously as they spin around the giant world.

While these features might look small compared with Saturn, their length and width can stretch longer than Earth's diameter.

The spokes were first seen by the Voyager missions in the 1980s, and more recently, the Cassini spacecraft captured the phenomena up close. After the Cassini mission ended in 2017, observations of the Saturn system have largely been carried out from afar using Hubble and other Earth-based telescopes.

This latest photo by Hubble was taken when the ringed planet was approximately 850 million miles from Earth. The observations are part of Hubble's Outer Planets Atmospheres Legacy (OPAL) program that began nearly a decade ago to annually monitor weather changes on all four gas-giant outer planets.



The Hubble Space Telescope captured this image of Saturn in February, 2023. Image Credit: STScI

Long-term monitoring show that both the number and contrast of the spokes vary with Saturn's seasons. Saturn is tilted on its axis like Earth and has seasons lasting approximately seven years.

"We are heading towards Saturn equinox, when we'd expect maximum spoke activity, with higher frequency and darker spokes appearing over the next few years," said the OPAL program lead scientist, Amy Simon of NASA's Goddard Space Flight Center in Greenbelt, Maryland, in a Hubble observing update from NASA.

Like Earth, Saturn has a four-season year based on its tilt. However, it takes about thirty Earth years to complete one year on Saturn due its more distant orbit. The spokes tend to occur around the equinox, when the rings are edge-on to the Sun, and fade away as the summer or winter solstices draw near.

Saturn will reach its fall equinox on May 6, 2025.

Planetary scientists think the spokes are made of charged ice and/or dust particles bulging up and away from the rest of the rings, but no theory perfectly predicts the spokes.

"The leading theory is that spokes are tied to Saturn's powerful magnetic field, with some sort of solar interaction with the magnetic field that gives you the spokes," said Simon.

One way to figure out the mystery is to keep observing. Hubble, along with the James Webb Space Telescope and several ground-based observatories will continue keeping an eye on the enigmatic spokes.

Astronomers Find the Birthplaces of Stars in the Whirlpool Galaxy

Understanding how star-forming works at a galactic scale is challenging in our Milky Way. While we have a general understanding of the layout of our galaxy, we can't see all of the details head-on like we would want to if we were exploring a single galaxy for details of star formation.

Luckily, we have a pretty good view of the entirety of one of the most famous galaxies in all of astronomy – M51, the Whirlpool Galaxy. Now, a team of researchers from the Max Planck Institute for Astronomy has completed a survey of molecules throughout the galaxy and developed a map of potential star-forming regions.

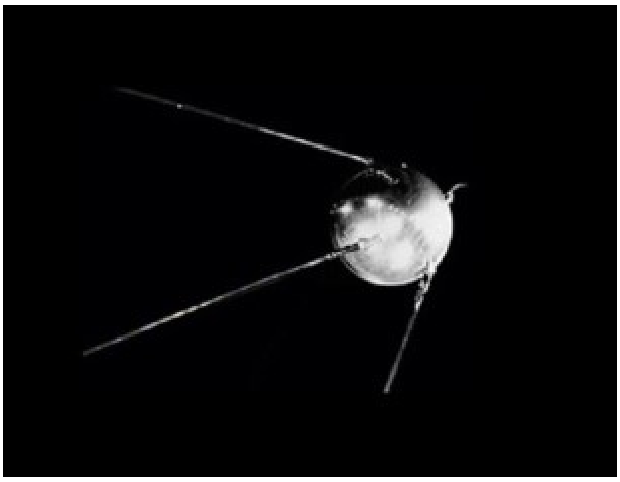
Tracking star formation from far away is best done by monitoring cold clouds of gas and dust formed as part of the creation process. These clouds can span entire galaxies and are tracked by astronomers using two types of molecules – hydrogen cyanide (HCN) and diazenylium (N_2H+).

Typically, these molecules interact with hydrogen floating in interstellar space and are spun up with some rotational speed. If that rotation is slowed down, say by interacting

with other molecules, they emit a specific radio frequency signal at a three-millimeter wavelength.
Fraser explains how galaxies form arms.
So far, there haven't been any telescopes sensitive enough to track HCN and diazenylium outside our galaxy carefully. However, the researchers found a tool that could do so – the Northern Extended Millimetre Array (NOEMA). Located in the French Alps, NOEMA uses a technique called interferometry to detect radio signals much fainter than a single -dished telescope would be able to.
That sensitivity allowed the researchers to look at the HCN and diazenylium signals of the Whirlpool Galaxy in all regions for the first time. What they found was surprising. Even from a distance of 28 million light years, the researchers can see obvious patterns of gaseous clouds in the spiral arms, signified by signals for both identifying molecules.
However, things get trickier closer to the center of the galaxy. HCN jumps up in brightness compared to the brightness of diazenylium. The researchers think this might be caused by the supermassive black hole at the center of the galaxy pulling the HCN at much higher speeds than out in the spiral arms, which causes friction with other molecules, and again, the type of radio radiation that astronomers would rely on to track the gas clouds.
Some of the world's best observatories have observed M51 – here's a compilation of what that looks like.
Credit – VideosFromSpace YouTube Channel
Diazenylium doesn't appear to be affected by this phenomenon, so it remains a stable source of information for tracking gas clouds even close to the galaxy's center. However, it has a very simple disadvantage – it's up to five times fainter than the signal for HCN. That is where NOEMA comes in.
The researchers used 214 observational hours on the interferometer to watch the Whirlpool galaxy and supplemented it with another 70 hours on a smaller, single-dish radio telescope in Spain. Interferometry data is complicated, though, so it took the researchers over a year to collect, categorize, and analyze it to the point where it is now ready to publish in Astronomy & Astrophysics.
That's just a start, though – plenty of other galaxies with star-forming regions could be explored using this technique. However, the Whirlpool Galaxy seems unique in its signal strength for these two molecules in particular. The researchers think collecting data on other galaxies would require even more sensitive telescopes. Luckily, there are plenty of powerful radio telescopes on the horizon, including the next-generation Very Large Array, so hopefully, shortly, researchers will have even more robust tools to peer into the star-forming regions of nearby galaxies.

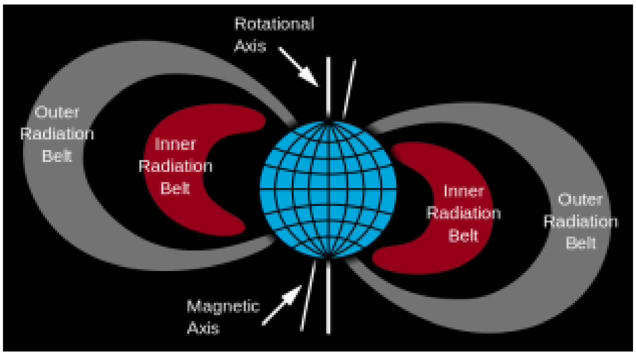
Millions of Satellites Could Have a Profound Effect on the Earth's Ionosphere

Hardly a day goes by where a story hits the headlines about our abuse of the Earth's precious environment be that the atmosphere or the oceans, forests or desert. When it comes to the atmosphere we all tend to immediately turn our attention to pollution, to gasses being released and disturbing the delicate balance. Yet a paper recently published points to a new demon, megaconstellations of satellites damaging the ionosphere – the ionised part of the upper atmosphere.
It was back in 1957 that the Sputnik, the first artificial satellite was put into orbit. Now, just over 50 years on and there are almost 5,500 satellites in orbit. A new approach to satellite technology has emerged, satellite constellations that consist of a group of satellites that work together to provide various services like GPS for example. The system provides greater coverage, redundancy and even distributed workload across the satellites.



The Sputnik spacecraft stunned the world when it was launched into orbit on Oct. 4th, 1954. Credit: NASA

Over the next few decades, it's likely that anything between 500,00 and 1 million additional satellites will be put into orbit into giant megaconstellations, primarily to build world wide internet connectivity. Unfortunately the nature of the satellites in megaconstellations is that they are disposable, their orbits will slowly decay and the satellites destroyed in the atmosphere creating a layer of conductive particles. They are of course replaced to keep the system running but its the remains of the destroyed satellites which is the problem and the focus of the paper by S. Solter-Hunt.
The paper shows that the overall mass of the particles in the upper levels of the atmosphere as a result of satellite re-entry from megaconstellations is many times that mass of the Van Allen Belts. The belts are torus shaped regions of charged particles which are thought to originate from the solar wind. The wind travels to Earth at several hundred kilometres per second and on arrival are captured by the magnetosphere (the region around Earth dominated by the magnetic field) and held in place.



The Van Allen radiation belts surrounding Earth. Image: NASA

The estimated mass of the Van Allen Belts is 0.00018 kilograms yet the mass of one Starlink satellite is 1250 kilograms! When these satellites are destroyed during re-entry (and it is estimated that eventually one satellite will be re-entering per hour!) all of the mass will become conductive particulates in the magnetosphere. Multiply this up to several hundred thousand satellites and you can see how the industry is dumping vast quantities and creating an artificial layer of conductive dust.
The maths is quite horrific. Every second, the space industry will be adding approximately 2,000 times more conductive material into the ionosphere than exists in the entire mass of the Van Allen Belts. The shear scale of the deposition into the ionosphere likely to perturb the magnetosphere and create a global band of plasma with as yet, untold impacts.
Source : Potential Perturbation of the Ionosphere by Megaconstellations and Corresponding Artificial Re-entry

Plasma Dust

Hubble Sees a Random Collection of Galaxies, Perfectly Lined Up

This new image from the Hubble Space Telescope looks like a series of smaller spiral galaxies are falling out of a larger and brighter galaxy. That's just one of the many reasons this collection of galaxies belongs to the Arp-Madore catalogue of peculiar galaxies.

The two big and bright galaxies comprise an interacting galaxy system known as Arp-Madore 2105-332, which is located about 200 million light-years away. The smaller galaxies that form the 'falling line' of galaxies are not actually associated with Arp-Madore 2105-332, but are farther away. Hubble just happened to capture this beautiful coincidence, where the collection of background galaxies are fortuitously positioned to look like they are pouring out of the bigger galaxy on the left.

We can see all the galaxies in this image with great detail and clarity, thanks to the wonderful and enduring quality of Hubble's instruments.

The two large and bright galaxies of Arp-Madore 2105-332 are emission-line galaxies. As ESA explains, that means that when observed with spectrometers, the spectra of both galaxies exhibit characteristic bright peaks, known as emission lines.

By hunting for specific signs of emission from various elements within a galaxy's spectrum of light — or, conversely, the signs of absorption from other elements, called absorption lines — astronomers can start to figure out what might be happening in a galaxy, such as the galaxy's type and composition, the density and temperature of any emitting gas, the star formation rate, or how massive the galaxy's central black hole might be.

If a galaxy's spectrum shows many emission lines and few absorption lines, this suggests it might be bursting with star formation and energetic stellar newborns. Conversely, if the spectrum shows a lot of absorption lines and few emission lines, this suggested that its star-forming material has been depleted and that its stars are mainly old. These two emission-line galaxies are highly energetic, and are hotbeds of star formation.

The large galaxy on the left is known individually as 2MASX J21080752-3314337. The galaxy on the right is called 2MASX J21080362-3313196. While those two names don't roll off the tongue very easily, astronomers use these two galaxies to provide valuable information. They are coordinates in the right ascension and declination system used widely by astronomers to locate astronomical objects.

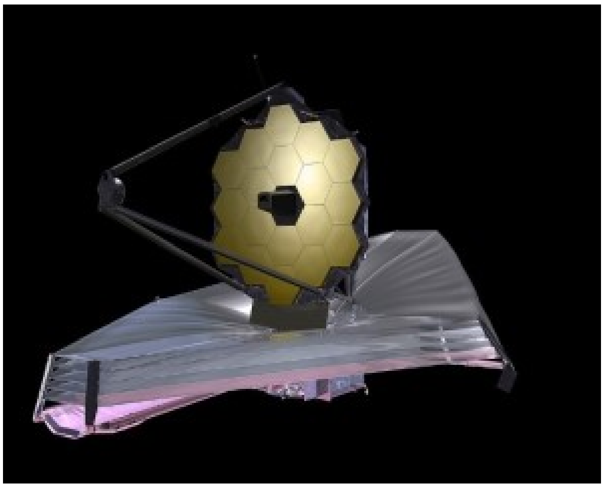
Strange alignment of galaxies. ESA/Hubble & NASA, J. Dalcanton; Acknowledgement: L. Shatz

What's the Source of Binary Rogue Planets?

The James Webb Space Telescope (JWST) is already making great strides in helping us to unravel the mysteries of the Universe. Earlier this year, hundreds of rogue planets were discovered in the Orion Nebula. The real surprise to this discovery was that 9% of the planets were paired up in wide binary pairs. To understand how this binary planets formed, astronomers simulated various scenarios for their formation.

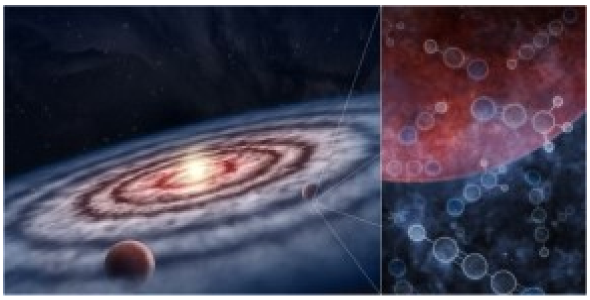
As their name suggests, rogue planets are wanderers. They do not orbit around a star, and they are not gravitationally bound to one, they simply wander around the cosmos. The first rogue planets were discovered in 2000 by the UK team Lucas and Roche using the UK InfraRed Telescope (UKIRT). They were discovered in the Orion Nebula but more recently, JWST has been exploring the region too.

Back in December 2021, JWST was launched atop an Ariane 5 rocket from French Guiana. It then coasted off to its destination, a point in solar orbit near one of the Earth-Sun Lagrange point 1.5 million kilometres away. Since then it has been exploring the universe and in particular, taking a look at the rogue planets in the Orion Nebula.



Artist impression of the James Webb Space Telescope

The team led by Simon F. Portegies Zwart, from Netherlands, announced the discovery of 42 Jupiter-Mass Binary Objects (JuMBOs) in the direction of the Trapezium cluster in the heart of the nebula. Among the objects, their masses range from 0.6 times the mass of Jupiter to 14 times and their separations vary between 25 and 380 astronomical units (one astronomical unit is the average distance between the Earth and the Sun). They also observed 540 single objects of similar ranging masses. These latter individual objects have been detected previously about twenty years ago but the JuMBO's are new. Stars form out of the collapse of giant molecular clouds through gravitational instability and during their formation, disks form around their equator. The disks ultimately collapse to form planets with lower mass. There are current theories to suggest Jupiter mass objects may for independently but the consensus is that they are ejected from planetary systems. The team explore just how the JuMBO systems form.

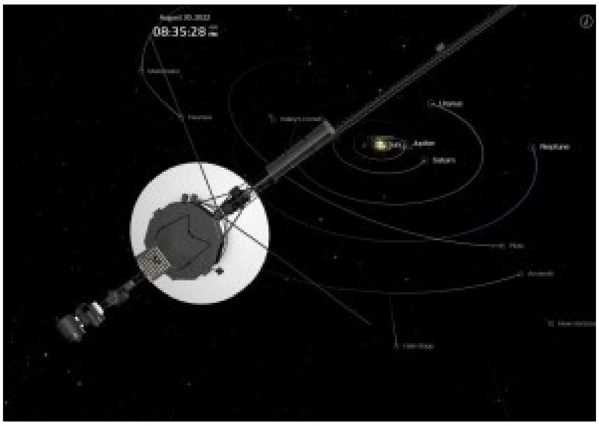


Artist's depiction of a protoplanetary disk with young planets forming around a star. The right-side panel zooms in to show various nitrile molecules that are accreting onto a

planet.
To understand this the team ran simulations of star clusters similar to that found in the Orion Nebula. The model the team considered included those where planets form around stars and the simulation showed how many free floating planets could be formed but not enough pairs to match observations. When the team ran simulations with planet-moon systems orbiting a star, they found a much better result to match observations. It seems then that the JuMBOs are planet-moon systems that have been ejected from what might be considered a conventional solar system.

Voyager 1 Has Another Problem With its Computer System

For more than 46 years, the *Voyager 1* probe has been traveling through space. On August 25th, 2012, it became the first spacecraft to cross the heliopause and enter interstellar space. Since then, mission controllers have maintained contact with the probe as part of an extended mission, which will last until the probe's radioisotopic thermoelectric generators (RTGs) finally run out. Unfortunately, the *Voyager 1* probe has been showing its age and signs of wear and tear, which is unavoidable when you're the farthest spacecraft from Earth.
This includes issues with some of the probe's subsystems, which have been a bit buggy lately. For instance, engineers at NASA recently announced that they were working to resolve an error with the probe's flight data system (FDS). This system consists of three onboard computers responsible for communicating with another of Voyager 1's subsystems, known as the telemetry modulation unit (TMU). As a result, while the spacecraft can receive and execute commands sent from Earth, it cannot send any science or engineering data back.
The main purpose of the FDS is to collect data from the probe's science instruments and engineering data from the spacecraft itself. This data is then combined into a single package and sent to the TMU, which transmits in binary code back to Earth. Recently, mission controllers noticed that the TMU was transmitting a repeating pattern of ones and zeroes, which raised some eyebrows. After reviewing and ruling out all other potential causes, the *Voyager* team determined that the FDS was the source of the problem.



Artist's impression of the Voyager mission looking back at the Solar System. Credit: NASA

Over the weekend, the mission team attempted to restart the FDS in the hopes that this would restore it to a working state. They did not succeed, and now the team anticipates that it could take several more weeks to develop a new plan to address the problem. This was not unexpected since both *Voyager* and its twin (*Voyager 2*) are the longest-serving spacecraft in history. When they launched in 1977, both probes represented cutting-edge astronautics, navigation, and communication technology.
However, both are now over forty years out of date, so finding solutions to problems often requires engineers and technical experts to consult the original documents. These decades-old documents were created by engineers who didn't anticipate of problems the probes are countering today. As a result, it takes the mission team time to determine how a new command will affect the spacecraft's operations and how to avoid unintended consequences. What's more, commands from mission controllers take 22.5 hours to reach Voyager 1, which means that two-way communications take 45 hours.
This means that Voyager 1's controllers have to wait almost two full days before they will learn if the solution they implemented worked. In the meantime, all NASA can do is troubleshoot the problem and wait for a solution that works to take effect. As for the *Voyager 1* probe, it continues to explore the outermost regions of the Solar System and the is farthest artificial objects from Earth – 24 billion km (15 billion mi) and counting!

JWST Delivers A Fantastic New Image Of Supernova Remnant Cassiopeia A

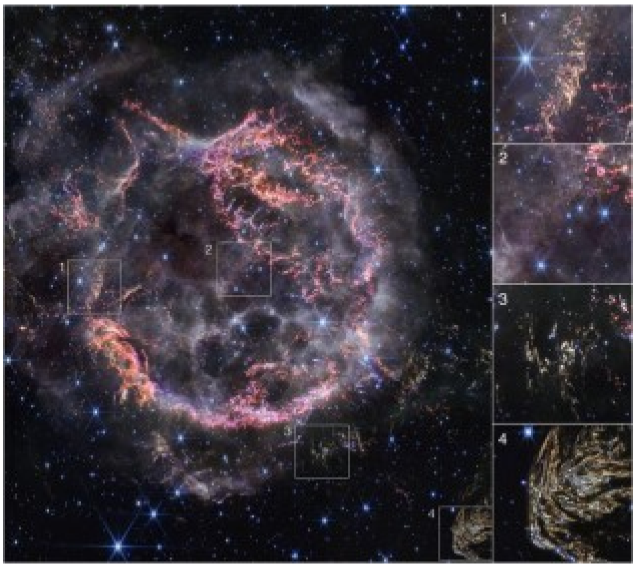
Astronomy is all about light. Sensing the tiniest amounts of it, filtering it, splitting it into its component wavelengths, and making sense of it, especially from objects a great distance away. The James Webb Space Telescope is especially adept at this, as this new image of supernova remnant (SNR) Cassiopeia A exemplifies so well.
Before a massive star explodes as a supernova, it convulses and sends its outer layers into space, signalling the explosive energy about to follow. When the star does explode, it sends a shockwave out into its own ejected outer layer, lighting it up as different chemical elements shine with different energies and colours. Intermingled with this is any pre-existing matter near the supernova. The result is a massive expanding shell with filaments and knots of ionized gas, populated by even smaller bubbles.
"With NIRCam's resolution, we can now see how the dying star absolutely shattered when it exploded, leaving filaments akin to tiny shards of glass behind."
Danny Milisavljevic, Purdue University
Cassiopeia A exploded about 10,000 years ago, and the light may have reached Earth around 1667. But there's much uncertainty, and it's possible that English astronomer John Flamsteed observed it in 1680. It's also a possibility that it was first observed in 1630. That's for historians to determine.
But whenever the exact date is, the light has reached us and continues to reach us, making Cassiopeia A an object of astronomical fascination. It's one of the most-studied SNRs, and astronomers have observed it in multiple wavelengths with different telescopes.
The SNR is about 10 light-years across and is expanding between 4,000 and 6,000 km/second. Some outlying knots are moving much more quickly, with velocities from 5,500?14,500 km/s. The expanding shell is also extremely hot, at about 30 million degrees Kelvin (30 million C/54 million F.)

The JWST's NIRCam high-resolution image of Cass. A reveals intricate detail that remains hidden from other telescopes. Image Credit: NASA, ESA, CSA, STScI, Danny Milisavljevic (Purdue University), Ilse De Looze (UGent), Tea Temim (Princeton University)

But none of our prior images are nearly as breathtaking as these JWST images. These images are far more than just pretty pictures. The cursive swirls and knotted clumps of gas reveal some of nature's detailed interactions between light and matter.

The JWST sees in infrared, so its images need to be translated for our eyes. The wavelengths the telescope can see are translated into different visible colours. Clumps of bright orange and light pink are most noticeable in these images, and they signify the presence of sulphur, oxygen, argon, and neon. These elements came from the star itself, and gas and dust from the region around the star are intermingled with it.

The image below highlights some parts of the Cassiopeia A SNR.



1 shows tiny knots of gas comprised of sulphur, oxygen, argon, and neon from the star itself. 2 shows what's known as the Green Monster, a loop of green light in Cas A's inner cavity, which is visible in the MIRI image of the SNR. Circular holes are outlined in white and purple and represent ionized gas. This is likely where debris from the explosions punched holes in the surrounding gas and ionized it. 3 shows a light echo, where light from the ancient explosion has warmed up dust which shines as it cools down. 4 shows an especially large and intricate light echo known as Baby Cas A. Baby Cas A is actually about 170 light-years beyond Cas A. Image Credit: NASA, ESA, CSA, STScI, Danny Milisavljevic (Purdue University), Ilse De Looze (UGent), Tea Temim (Princeton University)

The JWST's MIRI image shows different details. The outskirts of the main shell aren't orange and pink. Instead, it looks more like smoke lit up by campfire flames.

Seeing the NIRCam image (L) and the MIRI image (R) tells us about the SNR and the JWST. First of all, the NIRCam image is sharper because of its higher resolution. The NIRCam image also appears less colourful, but that's because of the wavelengths of light being emitted that are more visible in Mid-Infrared. In the MIRI image, the outer ring is lit up more brightly than in the NIRCam image, while the MIRI image also shows the 'Green Monster,' the green inner ring that is invisible in the NIRCam image. Image Credit: NASA, ESA, CSA, STScI, Danny Milisavljevic (Purdue University), Ilse De Looze (UGent), Tea Temim (Princeton University)

The Hubble Space Telescope, the Spitzer Space Telescope, and the Chandra X-Ray Observatory have all studied Cas A. In fact, Spitzer's first light image back in 1999 was of Cas A.

The Hubble has imaged Cas A too. This image is from 2006 and is a composite of 18 separate images. While interesting and stunning at the time, the JWST's image surpasses it in both visual and scientific detail.

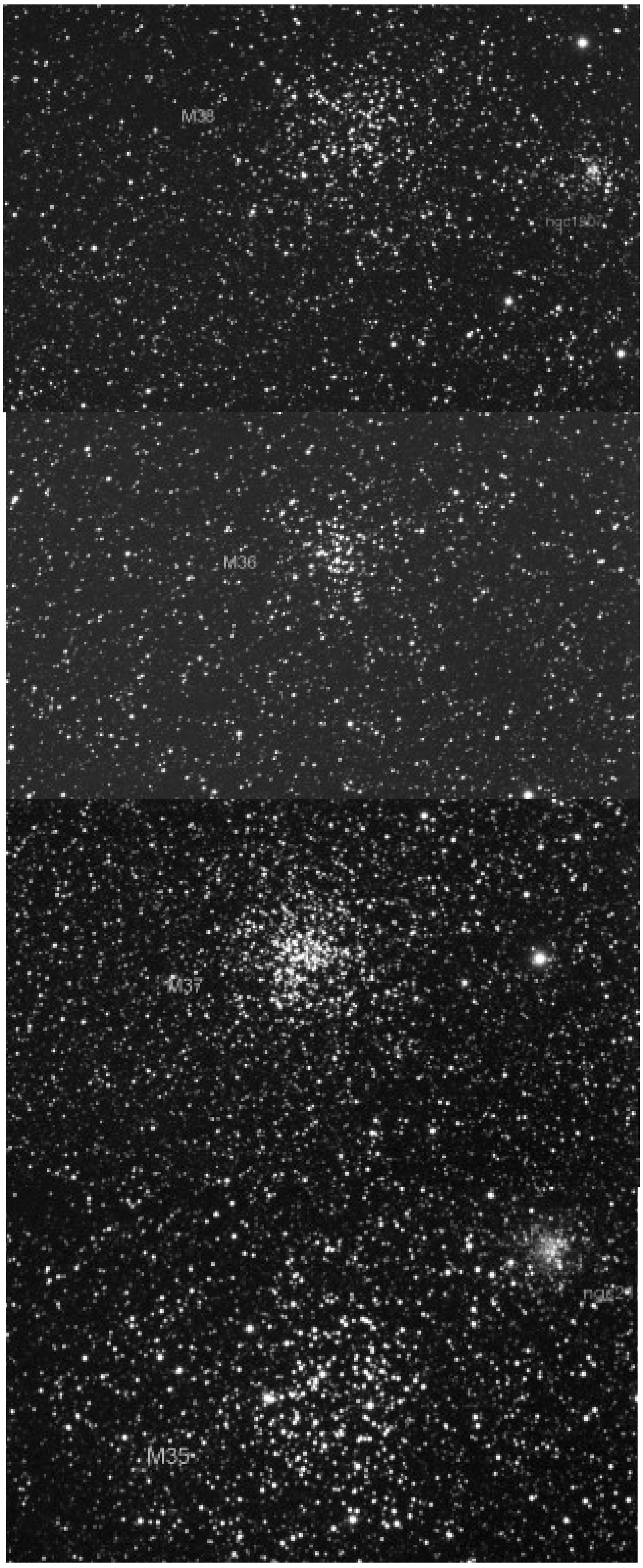
This NASA/ESA Hubble Space Telescope image provides a detailed look at the tattered remains of Cassiopeia A (Cas A). It is the youngest known remnant from a supernova explosion in the Milky Way. Image Credit: NASA, ESA, and the Hubble Heritage (STScI/AURA)-ESA/Hubble Collaboration. Acknowledgement: Robert A. Fesen (Dartmouth College, USA) and James Long (ESA/Hubble)

The JWST's incredible images are giving us a more detailed look at Cas A than ever. Danny Milisavljevic leads the Time Domain Astronomy research team at Purdue University and has studied SNRs extensively, including Cas A. He emphasizes how important the JWST is in his work. "With NIRCam's resolution, we can now see how the dying star absolutely shattered when it exploded, leaving filaments akin to tiny shards of glass behind," said Milisavljevic. "It's really unbelievable after all these years studying Cas A to now resolve those details, which are providing us with transformational insight into how this star exploded."

E MAILS and MEMBERS VIEWING LOGS.

Observing Log 29th December 23

Observing session at Lacock this evening was very patchy and even the odd shower prevented telescope set up, but we did have binoculars to fall back on with Jupiter and its moons lined up to its east, then views of the the Pleiades, the Hyades, and the Auriga clusters of M38, M36 and M37, even M35 in Gemini, The image stabilising binoculars 20x50 Canon were particularly useful, but others were available for comparison.



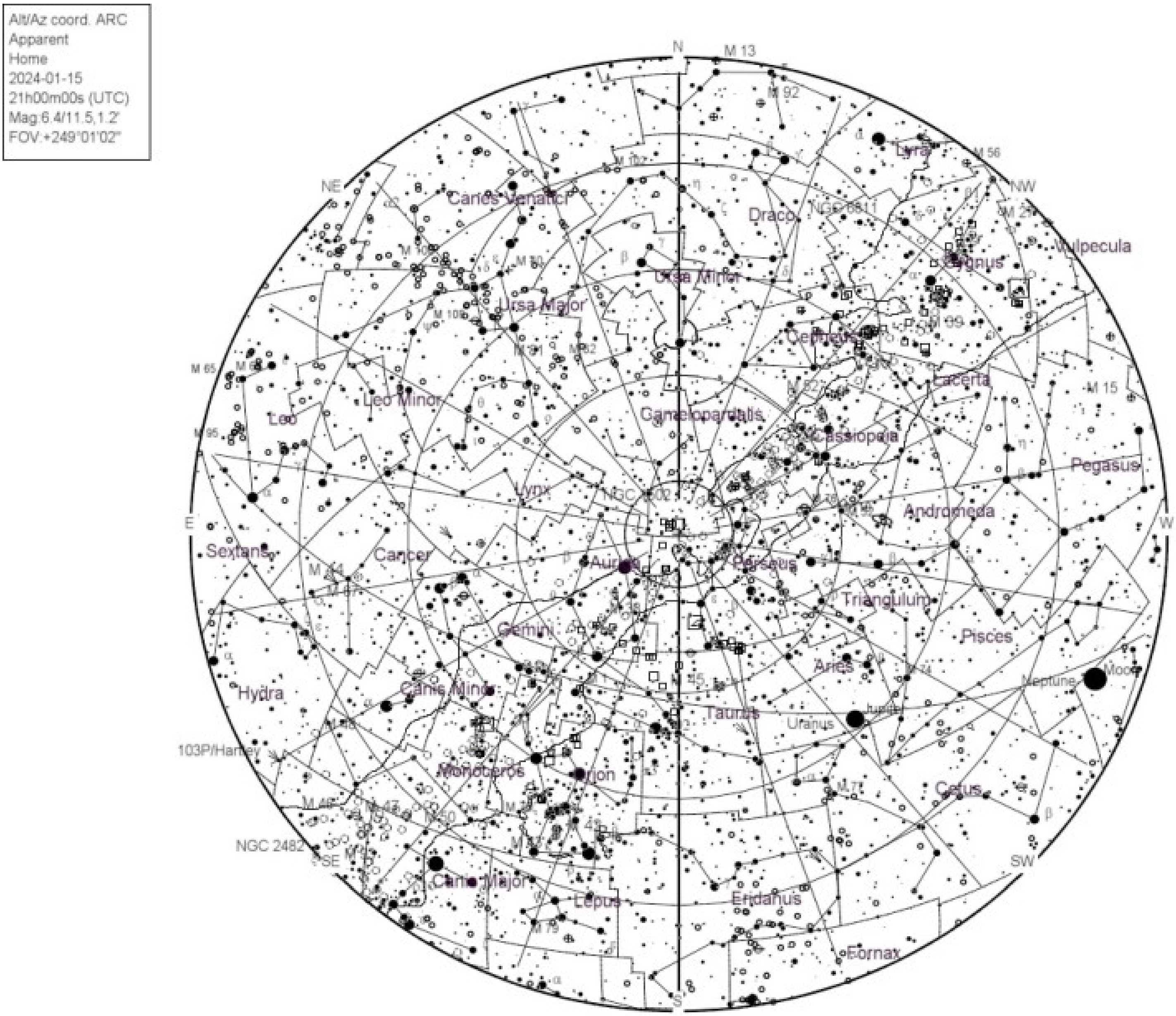
The Moon was rising through trees and cloud eventually high enough to use the handheld P1000 bridge camera at full zoom to get the Sea of Crisis.

Andy Burns

Our next viewing evening will be Moonless, so lets hope it is also cloudless!

Friday 5th January or reserve 12th January. Though Chris and I may not be available that evening…

WHATS UP, JANUARY 25



bJanuary 3, 4 - **Quadrantids Meteor Shower.** The Quadrantids is an above average shower, with up to 40 meteors per hour at its peak. It is thought to be produced by dust grains left behind by an extinct comet known as 2003 EH1, which was discovered in 2003. The shower runs annually from January 1-5. It peaks this year on the night of the 3rd and morning of the 4th. The waning gibbous moon will block out some of the fainter meteors, but if you are patient this could still be a good show. Best viewing will be from a dark location after midnight. Meteors will radiate from the constellation Bootes, but can appear anywhere in the sky.

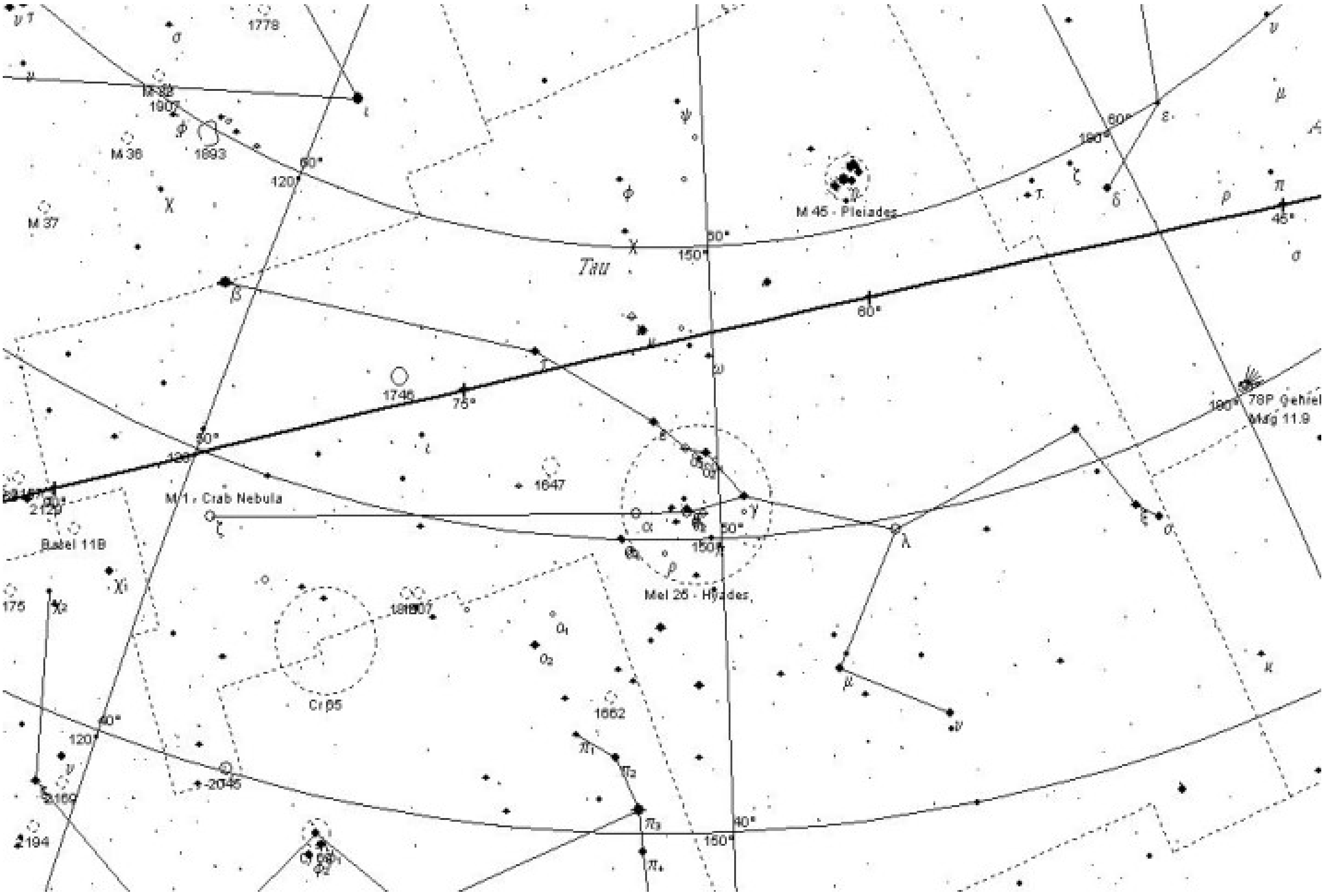
January 11 - **New Moon.** The Moon will located on the same side of the Earth as the Sun and will not be visible in the night sky. This phase occurs at 11:59 UTC. This is the best time of the month to observe faint objects such as galaxies and star clusters because there is no moonlight to interfere.

January 12 - **Mercury at Greatest Western Elongation.** The planet Mercury reaches greatest western elongation of 23.5 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.

January 25 - **Full Moon.** 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 17:55 UTC. This full moon was known by early Native American tribes as the Wolf Moon because this was the time of year when hungry wolf packs howled outside their camps. This moon has also been know as the Old Moon and the Moon After Yule.

February 9 - **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 23:00 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.

CONSTELLATION OF THE MONTH: TAURUS



The ancient zodiacal constellation of Taurus was one of Ptolemy's original 48 constellations and remains today as part of the official 88 modern constellations recognized by the IAU. It is perhaps one of the oldest constellations of all and may have even been recognized prehistorically. Taurus spreads over 797 square degrees of sky and contains 7 main stars in its asterism with 130 Bayer Flamsteed designated stars located within its confines. It is bordered by the constellations of Auriga, Perseus, Aries, Cetus, Eridanus, Orion and Gemini. Taurus is visible to all observers located at latitudes between +90Â° and ?65Â° and is best seen at culmination during the month of January.

There is one major annual meteor shower associated with the constellation of Taurus, the annual Taurids, which peak on or about November 5 of each year and have a duration period of about 45 days. The maximum fall rate for this meteor shower is about 10 meteors per hour average, with many bright fireballs often occuring when the parent comet – Encke – has passed near perihelion. Look for the radiant, or point of origin, to be near the Pleiades.

Taurus is considered by some to be one of the oldest recognized constellations known, and may have even been depicted with the Pleiades in cave paints dating back to 13,000 BC. According to Greek myth, Taurus was the god Zeus, transformed into a bull in order to woo princess Europa, and perhaps could represent one of the Cretean Bull of Herculean fame. The ancient Egyptians also worshiped a bull-god for which this constellation might represent, just as the Arabs also considered it to be bovine by nature. The Hyades cluster was meant to represent the sisters of Hyas, a great hunter, placed in the sky to honor their mourning for the loss of their brother – just as the Pleiades represent the seven sisters of Greek mythology – as well as many other things in many other cultural beliefs. The Persians called this group of stars "Taura", just as the Arabs referred to it as "Al Thaur". No matter what way you want to look at it, this handsome collection of stars contains many fine deep sky objects to pique your interest!

Let's begin our binocular and telescope tour of Taurus with its brightest star- Alpha – the "a" symbol on our map. Known to the Arabs as Al Dabaran, or "the Follower," Alpha Tauri got its name because it appears to follow the Pleiades across the sky. In Latin it was called Stella Dominatrix, yet the Olde English knew it as Oculus Tauri, or very literally the "eye of Taurus." No matter which source of ancient astronomical lore we explore, there are references to Aldebaran.

As the 13th brightest star in the sky, it almost appears from Earth to be a member of the V-shaped Hyades star cluster, but this association is merely coincidental, since it is about twice as close to us as the cluster is. In reality, Aldebaran is on the small end as far as K5 stars go, and like many other orange giants, it could possibly be a variable. Aldebaran is also known to have five close companions, but they are faint and very difficult to observe with backyard equipment. At a distance of approximately 68 light-years, Alpha is “only” about 40 times larger than our own Sun and approximately 125 times brighter. To try to grasp such a size, think of it as being about the same size as Earth’s orbit! Because of its position along the ecliptic, Aldebaran is one of the very few stars of first magnitude that can be occulted by the Moon.

Now, head off to Beta Tauri – the “B” symbol on our chart. Located 131 light years from our solar system, El Nath, or Gamma Aurigae, is a main sequence star about to evolve into a peculiar giant star – one high in manganese content, but low in calcium and magnesium. While you won’t find anything else spectacular about El Nath, there is a good reason to remember its position – it, too, get frequently occulted by the Moon. Such occultations occur when the moon’s ascending node is near the vernal equinox. Most occultations are visible only in parts of the Southern Hemisphere, because the star lies at the northern edge of the lunar occultation zone and occasionally it may be occulted as far north as southern California.

Now, turn your binoculars or small telescopes towards Omicron – the “o”. Omicron is sometimes called Atirsagne, meaning the “Verdant One”, but there’s nothing green about this 212 light year distant yellow G-type giant star, only that it has a great optical companion! Be sure to take a look at Kappa Tau, too… the “k”. Kappa is also a visual double star – but a whole lot more. Located 153 light years from Earth, this Hyades cluster member is dominated by white A-type subgiant star K1 and white A-type main sequence dwarf star, K2. They are 5.8 arcminutes, or at least a quarter light year apart. Between the two bright stars is a binary star made up of two 9th magnitude stars, Kappa Tauri C and Kappa Tauri D, which are 5.3 arcseconds from each other and 183 arcseconds from K1 Tau. Two more 12th magnitude companions fill out the star system, Kappa Tauri E, which is 136 arcseconds from K1 Tau, and Kappa Tauri F, 340 arcseconds away from K2 Tau. Still more? Then have a look at 37 Tauri, an orange giant star with a faint optical companion star… or 10 Tauri! 10 Tauri is only 45 light years away, and while it just slightly larger and brighter than our Sun, its almost the same age. It is believed to be a spectroscopic binary star, but you’ll easily see it’s optical companion. What’s more, thanks to noticing a huge amount of infrared radiation being produced by 10, we know it also has a dusty debris disk surrounding it!

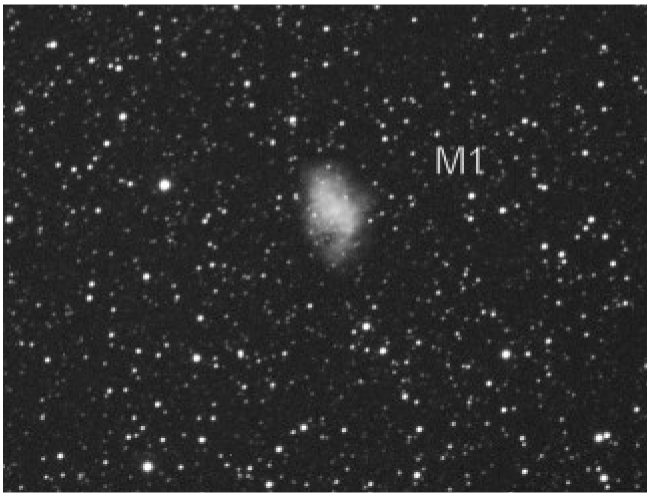
Now, let’s have a go at variable stars – starting with Lambda, the upside down “Y” on our map. Al Thaur is in reality a binary star system as well as being an eclipsing variable star. The primary is a blue-white B-type main sequence dwarf star located about 370 light years away. However, located at a distance of 0.1 AU away from it is a white A-type subgiant star, too… and a third player even further away. Watch over a period of 3.95 days as first one, then the other passes in front of the primary star, dimming it by almost a full stellar magnitude! Don’t forget to check out HU Tauri, too. It is also an eclipsing binary star that drops by a magnitude every 2.6 days!

Ready to take a look at Messier 45? Visible to the unaided eye, small binoculars and every telescope, the Pleiades bright components will resolve easily to any instru-

ment and is simply stunning. The recognition of the

Pleiades dates back to antiquity and they’re known by many names in many cultures. The Greeks and Romans referred to them as the “Starry Seven,” the “Net of Stars,” “The Seven Virgins,” “The Daughters of Pleione” and even “The Children of Atlas.” The Egyptians referred to them as “The Stars of Athyr,” the Germans as “Siebengestiren” (the Seven Stars), the Russians as “Baba” after Baba Yaga, the witch who flew through the skies on her fiery broom. The Japanese call them “Subaru,” Norsemen saw them as packs of dogs and the Tongans as “Matarii” (the Little Eyes). American Indians viewed the Pleiades as seven maidens placed high upon a tower to protect them from the claws of giant bears, and even Tolkien immortalized the stargroup in The Hobbit as “Remmirath.” The Pleiades have even been mentioned in the Bible! So, you see, no matter where we look in our “starry” history, this cluster of seven bright stars has been part of it. The date of the Pleiades culmination (its highest point in the sky) has been celebrated through its rich history by being marked with various festivals and ancient rites â€” but there is one particular rite that really fits this occasion! What could be spookier on this date than to imagine a bunch of Druids celebrating the Pleiades’ midnight “high” with Black Sabbath? This night of “unholy revelry” is still observed in the modern world as “All Hallows Eve” or more commonly as “Halloween.” Although the actual date of the Pleiades’ midnight culmination is now on November 21 instead of October 31. Thanks to its nebulous regions M45 looks wonderfully like a “ghost” haunting the starry skies. Binoculars give an incredible view of the entire region, revealing far more stars than are visible with the naked eye. Small telescopes at lowest power will enjoy M45’s rich, icy-blue stars and fog-like nebulae. Larger telescopes and higher power reveal many pairs of double stars buried within its silver folds. No matter what you chose, the Pleiades definitely rocks!

Our next most famous Messier catalog object in Taurus is M1 – the “Crab Nebula”. Although M1 was discovered by John Bevis in 1731, it became the first object on Charles Messier’s astronomical list. He rediscovered M1 while searching for the expected return of Halley’s Comet in late August 1758 and these “comet confusions” prompted Messier to start cataloging. It wasn’t until Lord Rosse gathered enough light from



M1 in the mid-1840's that the faint filamentary structure was noted (although he may not have given the Crab Nebula its name). To have a look for yourself, locate Zeta Tauri and look about a finger-width northwest. You won't see the "Crab legs" in small scopes – but there's much more to learn about this famous "supernova remnant".

Factually, we know the "Crab Nebula" to be the remains of an exploded star recorded by the Chinese in 1054. We know it to be a rapid expanding cloud of gas moving outward at a rate of 1,000 km per second, just as we understand there is a pulsar in the center. We also know it as first recorded by John Bevis in 1758, and then later cataloged as the beginning Messier object – penned by Charles himself some 27 years later to avoid confusion while searching for comets. We see it revealed beautifully in timed exposure photographs, its glory captured forever through the eye of the camera â€" but have you ever really taken the time to truly study the M1? Then you just may surprise yourselfâ€¦ In a small telescope, the "Crab Nebula" might seem to be a disappointment – but do not just glance at it and move on. There is a very strange quality to the light which reaches your eye, even though at first it may just appear as a vague, misty patch. To small aperture and well-adjusted eyes, the M1 will appear to have "living" qualities – a sense of movement in something that should be motionless. This aroused my curiosity to study and by using a 12.5″ scope, the reasons become very clear to me as the full dimensions of the M1 "came to light".

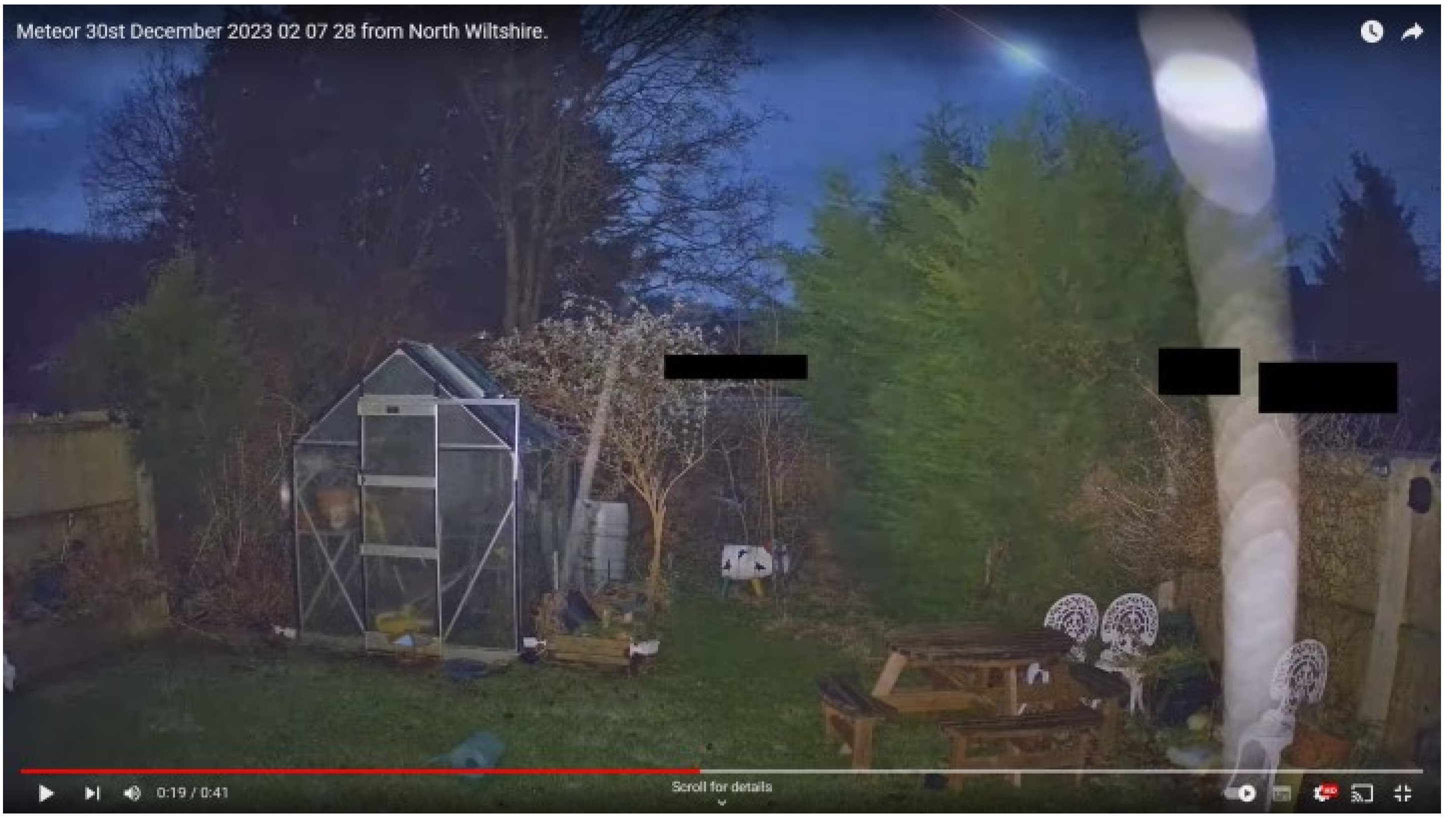
ISS PASSES For December 2023

from Heavens Above website maintained by Chris Peat.

Date	Brightn	Start	Highest	End						
	(mag)	Time	Alt.	Az.	Time	Alt.	Az.	Time	Alt.	Az.
01 Jan	**-1.2**	**05:08:56**	**22°**	**ESE**	**05:08:56**	**22°**	**ESE**	**05:10:14**	**10°**	**ESE**
01 Jan	-2.2	06:41:51	18°	WSW	06:43:19	25°	SSW	06:46:07	10°	SSE
02 Jan	-2.6	05:55:29	33°	S	05:55:29	33°	S	05:58:09	10°	SE
03 Jan	-1.0	05:09:05	16°	SE	05:09:05	16°	SE	05:09:55	10°	SE
03 Jan	-1.5	06:41:59	12°	WSW	06:42:49	13°	SW	06:44:20	10°	SSW
04 Jan	-1.5	05:55:34	16°	SSW	05:55:34	16°	SSW	05:56:53	10°	S
16 Jan	-1.2	19:13:11	10°	SSW	19:14:03	16°	SSW	19:14:03	16°	SSW
17 Jan	-2.1	18:23:58	10°	SSW	18:26:33	22°	SSE	18:26:33	22°	SSE
18 Jan	-1.6	17:35:02	10°	S	17:36:59	15°	SE	17:38:54	10°	ESE
18 Jan	-2.1	19:09:49	10°	SW	19:11:44	30°	SW	19:11:44	30°	SW
19 Jan	-3.0	18:20:08	10°	SW	18:23:16	38°	SSE	18:23:57	34°	ESE
19 Jan	-0.4	19:56:25	10°	W	19:56:45	12°	W	19:56:45	12°	W
20 Jan	-2.4	17:30:30	10°	SSW	17:33:24	27°	SSE	17:36:03	11°	E
20 Jan	-2.7	19:06:25	10°	WSW	19:08:51	45°	WSW	19:08:51	45°	WSW
21 Jan	-3.6	18:16:23	10°	WSW	18:19:41	64°	SSE	18:20:50	36°	E
21 Jan	-0.6	19:52:58	10°	W	19:53:38	15°	W	19:53:38	15°	W
22 Jan	-3.1	17:26:21	10°	SW	17:29:34	47°	SSE	17:32:43	11°	E
22 Jan	-3.2	19:02:46	10°	W	19:05:30	57°	W	19:05:30	57°	W
23 Jan	-3.8	18:12:30	10°	W	18:15:51	87°	SSE	18:17:18	32°	E
23 Jan	-0.8	19:49:09	10°	W	19:50:05	17°	W	19:50:05	17°	W
24 Jan	-3.6	17:22:11	10°	WSW	17:25:31	73°	SSE	17:28:51	10°	E
24 Jan	-3.6	18:58:47	10°	W	19:01:48	69°	WNW	19:01:48	69°	WNW
25 Jan	-3.8	18:08:20	10°	W	18:11:42	85°	N	18:13:27	26°	E
25 Jan	-1.1	19:44:58	10°	W	19:46:13	21°	W	19:46:13	21°	W
26 Jan	-3.7	17:17:49	10°	W	17:21:10	88°	NNW	17:24:32	10°	E
26 Jan	-3.8	18:54:27	10°	W	18:57:47	75°	SSW	18:57:49	75°	S
27 Jan	-3.8	18:03:50	10°	W	18:07:11	88°	S	18:09:23	20°	E
27 Jan	-1.4	19:40:31	10°	W	19:42:09	23°	WSW	19:42:09	23°	WSW
28 Jan	-3.1	18:49:45	10°	W	18:53:01	50°	SSW	18:53:42	41°	SSE
29 Jan	-3.5	17:58:57	10°	W	18:02:17	66°	SSW	18:05:17	12°	ESE
29 Jan	-1.4	19:35:55	10°	W	19:38:03	20°	SW	19:38:03	20°	SW
30 Jan	-2.0	18:44:48	10°	W	18:47:46	29°	SSW	18:49:40	17°	SSE
31 Jan	-2.6	17:53:45	10°	W	17:56:56	42°	SSW	18:00:06	10°	SE
31 Jan	-0.7	19:32:04	10°	WSW	19:32:50	11°	SW	19:33:36	10°	SSW
01 Feb	-1.0	18:39:51	10°	W	18:42:03	17°	SW	18:44:14	10°	S
02 Feb	-1.4	17:48:20	10°	W	17:51:07	24°	SSW	17:53:53	10°	SSE
04 Feb	-0.6	17:43:07	10°	WSW	17:44:50	13°	SW	17:46:34	10°	S

END IMAGES, AND OBSERVING

Hi. I am a WASNET member, and I managed to capture the Meteor that was in the news (30/12/23) on my CCTV.
I have uploaded it to YouTube https://youtu.be/WJUCeOcZe-w?si=dhkf0Q4eg55-i0TR
The source file is about 50MB. Regards
John Baker



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	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