NWASNEWS

Volume30 Issue 7

March 2024

Newsletter for the Wiltshire, Swindon, Bath Astronomical Societies

Getting Ready For Messier Marathon II

Well I have had four or five responses after my sharp email to members after our last hall meeting. Only 6 attended. A round table event!

Hopefully I will get some pdf files to Sam to put on our web page which have a batch of finder charts for the Messier marathon, in the order for best finding the objects in March moonless nights.

Tonight's meeting will be a Zoom meeting with Tony Vale taking is through observing variable stars (or What He Gets Up To In His Back Garden After Dark)

Time: Mar 5, 2024 07:45 PM London

Join Zoom Meeting

https://us02web.zoom.us/j/82679919726?pwd=UlhCanlLMy9Fd2QxeVVHcC8vanpzUT09

Meeting ID: 826 7991 9726

Passcode: 250286

These Zoom talks are open to all, wether you are members or not. Enjoy.

April will also be a Zoom meeting, but May and June should be hall meetings.

Please check our observing meetings at Lacock, that are also open for all.

Clear skies.

Andy Burns.

Messier 42 and Messier 43
Not a huge opportunity to use my observatory in February, and the Orion nebulae will be disappearing from our skies in April.
60seconds exposure, using 5” refractor and Nikon D810a camera. Field flattening used. Stars a little bloated, but there was thin cloud at the time.
Let us hope for clear skies this month!
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

March 5th Zoom: Tony Vale: Observing Variable Stars (or What I Get Up To In My Back Garden After Dark)
April 2nd Zoom: Andy Burns: The Spring Skies. Galaxy season!
May 7th Hall Meeting, Rob Lucas Building a Garden observatory
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

Tony Vale

Observing Variable Stars

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

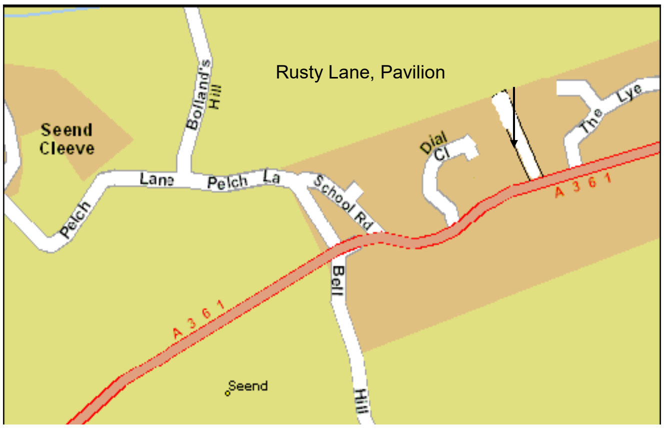
Speaker secretary

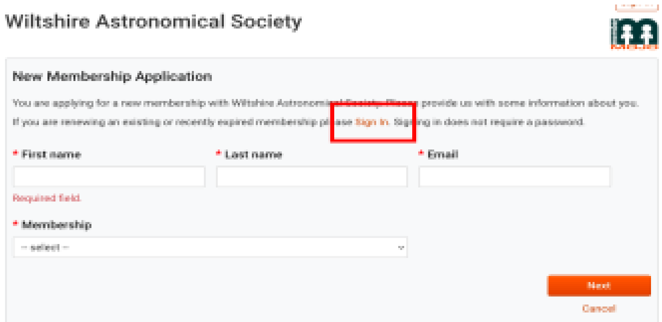
Zoom session coordinator

Observing Sessions coordinators: Chris Brooks, Jon Gale,

Web coordinator: Sam Franklin

Contact via the web site details.





Wiltshire Astronomical Society

New Membership Application

You are applying for a new membership with Wiltshire Astronomical Society. Please provide us with some information about you.
If you are renewing an existing or recently expired membership please Sign In. Signing in does not require a password.

* First name
* Last name
* Email

Required field.

* Membership

-- select --

Next

Cancel

Observing Sessions see back page

Swindon'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, 15th March 2024:

Swindon Stargazers AGM

Our Annual General Meeting will take place this evening and we will be covering all aspects of the clubs activities. It is hoped that as many members as possible will be able to attend.

There will be a Mystery Presentation following the AGM

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, 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, 27th March 2024
JWST's First Year of Science. Dr Emma Curtis Lake will be joining us via Zoom to update her talk to us from early 2022 of the plethora of discoveries made by JWST since it's science programme commenced in mid-2022. 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 Julia, Martin, Meyrick, Prim and Simon will be happy to help you.

SPACE NEWS

Euclid Begins its 6-Year Survey of the Dark Universe

On July 1, 2023, the Euclid Spacecraft launched with a clear mission: to map the dark and distant Universe. To achieve that goal, over the next 6 years, Euclid will make 40,000 observations of the sky beyond the Milky Way. From this data astronomers will be able to map the positions of billions of galaxies, allowing astronomers to observe the effects of dark matter.

There have been several galactic sky surveys before, but Euclid's mission will take them to the next level. Euclid is equipped with a widefield imaging system. With each 70-minute exposure of the dark sky, it will capture the image and spectra of more than 50,000 galaxies. When it is complete, the Euclid survey will be the most detailed survey of galactic positions and distances. The mission will also make several deep sky observations, where it focuses on the most distant and dim galaxies.

Euclid's field of view compared to the Moon. Credit: ESA/ESA/Euclid/Euclid Consortium/NASA, S. Brunier

One of the mysteries Euclid could answer is the nature of dark energy. The standard model of cosmology describes dark energy as a property of space and time. A cosmological constant that drives cosmic expansion. But some theories of dark energy argue that it's an energy field within space and time, and that cosmic expansion isn't constant. Euclid will study whether cosmic expansion varies, allowing astronomers to constrain or rule out certain models. The mission will also look at how dark matter distorts galaxies, allowing us to learn more about the properties of dark matter and how it interacts with regular matter.

The Euclid mission officially began its survey on Valentine's Day and will complete about 15% of its survey this year. An initial deep sky data set will be released in Spring 2025, and data from the first year of the general survey will be released in Summer 2026.

You can read more about the Euclid Mission on ESA's website.

OSIRIS-REx's Final Haul: 121.6 Grams from Asteroid Bennu

After several months of meticulous, careful work, NASA has the final total for their haul of asteroidal material from the OSIRIS-REx mission to Bennu. The highly successful mission successfully collected 121.6 grams, or almost 4.3 ounces, of rock and dust. It won't be long before scientists get their hands on these samples and start analyzing them. These samples have been a long time coming. The OSIRIS-REx (Origins, Spectral Interpretation, Resource Identification, and Security-Regolith Explorer) was approved by NASA back in 2011 and launched in September 2016. It reached its target, the carbonaceous Apollo group asteroid 101955 Bennu, in December 2018. After spending months studying the asteroid and reconnoitring for a suitable sampling location, it selected one in December 2019. After two sampling rehearsals, the spacecraft gathered its sample on October 20th, 2020.

In September 2023, the sample finally returned to Earth. There was some serendipity in the way the final total was reached. Some of it hitched a ride outside of the main sample container. There was some drama, too, as stubborn bolts on the TAGSAM head resisted removal and delayed access to the sample contained inside. Personnel from NASA's Astromaterials Research and Exploration Science (ARES) had to design, build, and test new tools that they used to finally open the TAGSAM head and access the sample.

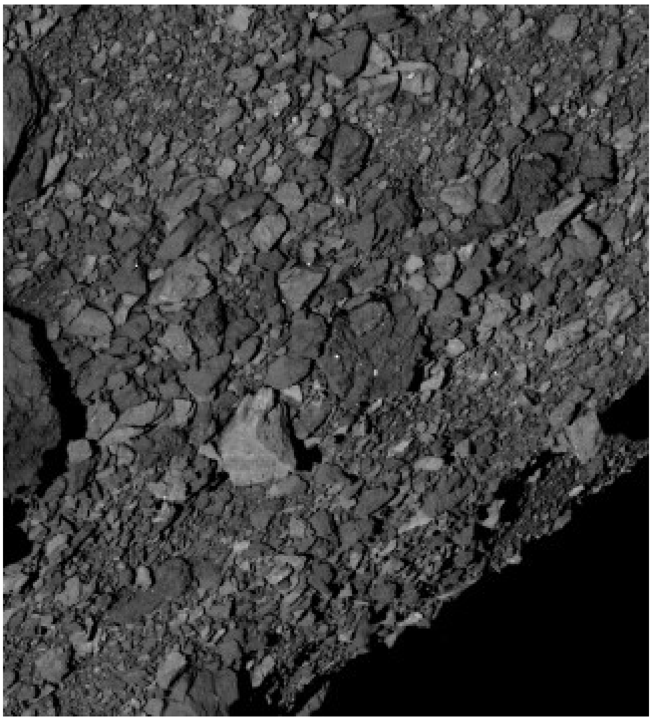
For OSIRIS-REx to be successful, it had to collect at least 60 grams of material. With a final total that is double that, it should open up more research opportunities and allow more of the material to be held untouched for future research. NASA says they will preserve 70% of the sample for the future, including for future generations.

OSIRIS-REx astromaterials processors, from left, Rachel Funk, Julia Plummer, and Jannatul Ferdous, prepare to lift the top plate of the Touch-and-Go Sample Acquisition Mechanism (TAGSAM) head and pour the final portion of asteroid rocks and dust into sample trays below. Credit: NASA/Robert Markowitz

The next step is for the material to be put into containers and sent to researchers. More than 200 researchers around the world will receive samples. Many of the samples will find their way to scientists at NASA and institutions in the US, while others will go to researchers at institutions associated with the Canadian Space Agency, JAXA, and other partner nations. Canada will receive 4% of the sample, the first time that Canada's scientific community will have direct access to a returned asteroid sample.

Asteroid Bennu was chosen because it's close to Earth and has been observed extensively. It's a carbonaceous asteroid, which make up about 75% of asteroids. But it's also a sub-type of carbonaceous asteroids called a B-type. These are much more uncommon than other carbonaceous asteroids, and scientists think they're very primitive and contain volatiles that date back to the early Solar System. Researchers around the world have been eagerly waiting for these samples.

Bennu is a natural time capsule that holds clues to how the Solar System formed, including Earth. It's also a rubble pile asteroid, and OSIRIS-REx showed that Bennu has over 200 boulders on its surface that are larger than 10 meters. Some of these boulders have veins of carbonate minerals that predate the formation of the asteroid.



Bennu's boulder-strewn surface. Bennu is a rubble pile asteroid that was likely part of a much larger parent body at one time in the distant past. Image Credit: NASA/University of Arizona.

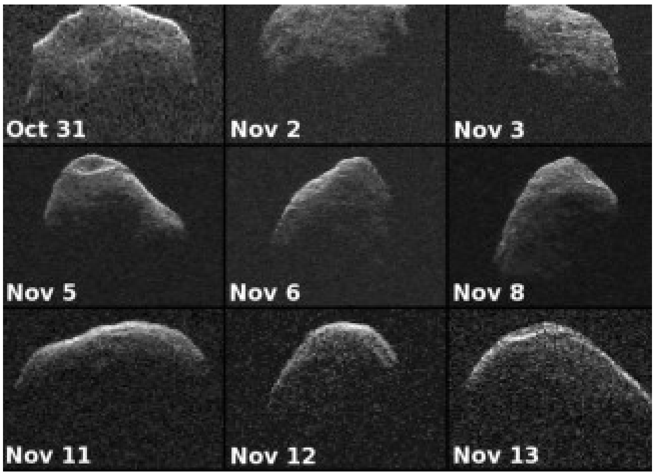
The "O" in OSIRIS-REx stands for Origins, and that's one of the things scientists hope to learn more about from Bennu. Will the sample contain any organic compounds that could've played a role in the appearance of life? If so, that supports the panspermia theory.

Laboratory testing will also show how accurate the spacecraft's instruments were by comparing the samples to what the instruments told us from orbit around the asteroid. This is invaluable feedback for future missions.

But the main scientific value in the Bennu sample concerns what the samples will tell us about the asteroid's origins. Scientists think that Bennu broke off from a much larger parent body before migrating to the inner Solar System. It could hold clues to that journey and how it changed over time. Astronomers suspect that Bennu is actually older than the Solar System itself. It could hold important clues to the gas and dust in the solar nebula that eventually formed the Sun and all the planets.

We already have some early results from the Bennu sample. Initial observations showed that the asteroid contains carbon and water. Carbon wasn't unexpected since the asteroid is a carbonaceous one. Neither was water surprising since scientists have long thought that asteroids were one of the main ways that Earth got its water.

While the OSIRIS-REx sampling mission is over, the spacecraft is still going. It's in its extended mission now, called OSIRIS-APEX (Origins, Spectral Interpretation, Resource Identification and Security – Apophis Explorer.) Its target is the asteroid Apophis, which will have a close encounter with Earth in 2029. The mission will study how the close encounter affects the asteroid, including its orbit and trajectory, and any surface changes that Earth's gravity might trigger, like landslides.



These are images of the asteroid Apophis captured in 2012. Apophis was considered at risk of impacting Earth, but now astronomers are confident it will pass by. (NASA / JPL-Caltech)

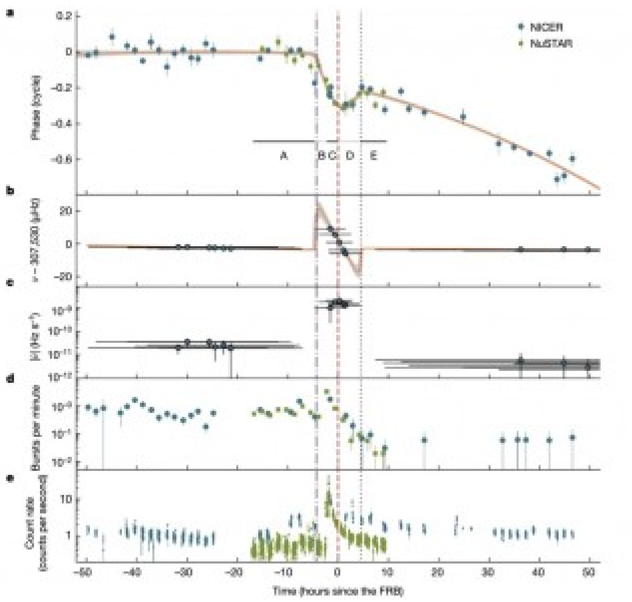
The OSIRIS-REx mission is an impressive display of human ingenuity and cooperation. Once scientists get their hands on the samples, we can expect a stream of fascinating results. Who knows which of our ideas about the Solar System will be confirmed and which ones will be discarded? No matter what we learn, it's guaranteed to be interesting.

Another Clue Into the True Nature of Fast Radio Bursts

Fast radio bursts (FRBs) are strange events. They can last only milliseconds, but during that time can outshine a galaxy. Some FRBs are repeaters, meaning that they can occur more than once from the same location, while others seem to occur just once. We still aren't entirely sure what causes them, or even if the two types have the same cause. But thanks to a collaboration of observations from ground-based radio telescopes and space-based X-ray observatories, we are starting to figure FRBs out.

Most FRBs happen well beyond our galaxy, so while we can pin down their locations, it's difficult to observe any details about their cause. Then in 2020 we observed a fast radio burst in our galaxy. Subsequent observations found that it originated in the region of a highly magnetized neutron star known as a magnetar. This led to the idea that magnetars were the source of FRBs, possibly through magnetic flares similar to solar flares. But magnetars and Sun-like stars are very different. It still wasn't clear how a magnetar could release such a tremendous amount of energy so quickly, even with their intense magnetic fields. Now a new study suggests the magnetar's rotation plays a key role.

The study focuses on the 2020 FRB magnetar. Known as SGR 1935+2154, it is both a magnetar and a pulsar. This means it emits a regular radio pop as it rotates. Pulsars are incredibly regular and are used as a kind of cosmic clock for everything from studying gravitational waves to hypothetical navigation through the galaxy. But over time a pulsar's rotation slows down as rotational energy radiates away thanks to its magnetic field. By observing this rate of decay, astronomers can better understand the structure of neutron stars and magnetars.



How two magnetar glitches correlate with a fast radio burst. Credit: Hu, Chin-Ping, et al

But sometimes the rate of rotation will shift suddenly. It's known as a glitch if the rotation suddenly speeds up, and an anti-glitch if it suddenly slows down. These glitches are thought to occur when there's some kind of sudden structural change in the neutron star, such as a starquake.

In 2022, NASA's Nuclear Spectroscopic Telescope Array (NUSTAR) spacecraft and the Neutron Star Interior Composition Explorer (NICER) on the international space station both observed another fast radio burst from SGR 1935+2154. Together they had X-ray data on the magnetar before, during, and after the burst. The team then looked at radio observations during the same time and found a dip in the pulsar rotation rate during the burst. This implies a connection between rotation and burst.

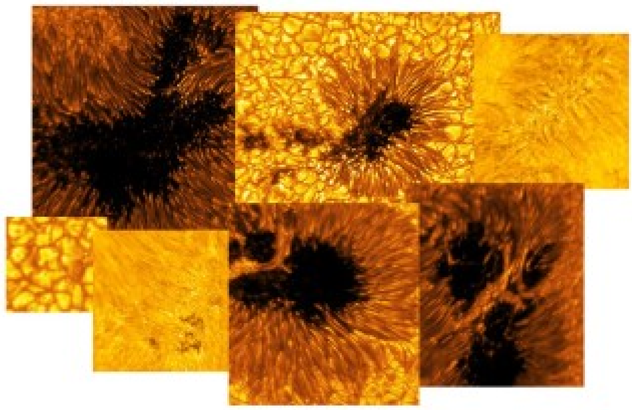
Overall what the team observed was a fluttering of X-ray emissions from SGR 1935+2154 a bit before the burst, then a glitch in the rotation, the burst itself, and a return to the regular rotation rate. This is only one observation, but it looks like the magnetar had the magnetic energy ready to release before the burst, and the shift in rotation created the conditions necessary to generate the FRB.

Look at How Much the Sun Has Changed in Just Two Years

The solar cycle has been reasonably well understood since 1843 when Samuel Schwabe spent 17 years observing the variation of sunspots. Since then, we have regularly observed the ebb and flow of the sunspots cycle every 11 years. More recently ESA's Solar Orbiter has taken regular images of the Sun to track the progress as we head towards the peak of the current solar cycle. Two recently released images from February 2021 and October 2023 show how things are really picking up as we head toward solar maximum.

The Sun is a great big ball of plasma, electrically charged gas, which has the amazing property that it can move a magnetic field that may be embedded within. As the Sun rotates, the magnetic field gets dragged around with it but, because the Sun rotates faster at the equator than at the poles, the field lines get wound up tighter and tighter.

Under this immense stressing, the field lines occasionally break, snap or burst through the surface of the Sun and when they do, we see a sunspot. These dark patches on the visible surface of the Sun are regions where denser concentrations of solar material prohibit heat flow to the visible surface giving rise to slightly cooler, and therefore darker patches on the Sun.



A collage of new solar images captured by the Inouye Solar Telescope, which is a small amount of solar data obtained during the Inouye's first year of operations throughout its commissioning phase. Images include sunspots and quiet regions of the Sun, known as convection cells. (Credit: NSF/AURA/NSO)

The slow rotation of the Sun and the slow but continuous winding up of the field lines means that sun spots become more and more numerous as the field gets more distorted. Observed over a period of years the spots seem to slowly migrate from the polar regions to the equatorial regions as the solar cycle progresses.

To try and help understand this complex cycle and unlock other mysteries of the Sun, the European Space Agency launched its Solar Orbiter on 10 February 2020. Its mission to explore the Sun's polar regions, understand what drives the 11 year solar cycle and what drives the heating of the corona, the outer layers of the Sun's atmosphere.

Solar Orbiter

Images from Solar Orbiter have been released that show closeups of the Sun's visible surface, the photosphere as it nears peak of solar activity. At the beginning of the cycle, at solar minimum in 2019, there was relatively little activity and only a few sunspots. Since then, things have been slowly increasing. The image from February 2021 showed a reasonably quiet Sun but an image taken in October last year shows that things are, dare I say, hotting up! The maximum of this cycle is expected to occur in 2025 which supports theories that the period of maximum activity could arrive a year earlier.

Understanding the cycle is not just of whimsical scientific interest, it is vital to ensure we minimise damage to ground based and orbiting systems but crucially understand impact on life on Earth.

Source : Sun's surprising activity surge in Solar Orbiter snapshot

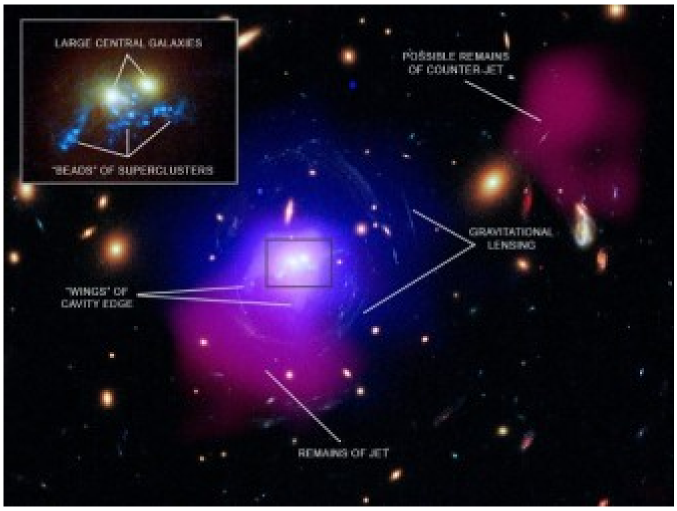
China's Chang'e-8 Mission Will Try to Make Bricks on the Moon

The China National Space Administration (CNSA) has put

out a call for international and industry partners to contribute science payloads to its Chang'e-8 lunar lander, set for launch to the Moon in 2028. The mission, which will involve a lander, a rover, and a utility robot, will be China's first attempt at in-situ resource utilization on the Moon, using lunar regolith to produce brick-like building materials.
Just like NASA's Artemis plans, the CNSA's plans for the Moon are targeted at the Lunar south pole, which is expected to be rich in useable resources, especially water. The presence of these resources will be vital for long-term human activity on the lunar surface.
Possible landing sites for Chang'e-8 include Leibnitz Beta, Amundsen crater, Cabeus crater, and the ridge connecting the Shackleton and de Gerlache craters, according to a presentation by Chang'e-8 chief deputy designer in October 2023.
Chang'e-8 will be the last CNSA robotic mission to be launched before construction begins on the International Lunar Research Station, China's crewed moonbase being planned in collaboration with Russia's Roscosmos. That makes Chang'e-8's attempt to create building materials out of regolith a vital proof-of-concept for their lunar aspirations.
In order to make moon-bricks, the lander will carry an instrument that uses solar energy to melt lunar soil and turn it into useable parts at a speed of 40 cubic cm per hour.
Alongside the regolith processing equipment, the lander will be equipped with an array of science instruments, including cameras, a seismometer to detect moonquakes, and an x-ray telescope. Part of the mission will focus on moon-based Earth observation, with several instruments designed to monitor Earth's atmosphere and magnetosphere.
The rover, meanwhile, will carry ground penetrating radar, cameras, a mineral analyzer, and tools for collecting and storing samples (leaving open the possibility of future missions to retrieve the samples).
The utility robot is a key piece of the mission, but CNSA isn't developing it in-house. Instead, the space agency is seeking proposals from partners interested in developing it as a piggyback payload to ride alongside the rest of Chang'e-8.
According to the call for proposals, the 100kg, battery-powered robot will need to be able to "capture, carry and place items, shovel, and transfer lunar soil." It will also need to be able to travel at 400m per hour.
There is room for an additional 100kg of piggyback payloads besides the robot, for which full proposals are expected to be submitted later this year.
While planning for Chang'e 8 is ongoing, the CNSA has two additional robotic moon missions in the works for the near future. The first, Chang'e-6, will launch this spring, and aims to return a regolith sample from the lunar far side (a never before accomplished feat). The next mission is planned for 2026, when Chang'e-7 will carry out a geological examination of the permanently shadowed craters scattered around the Moon's south pole.

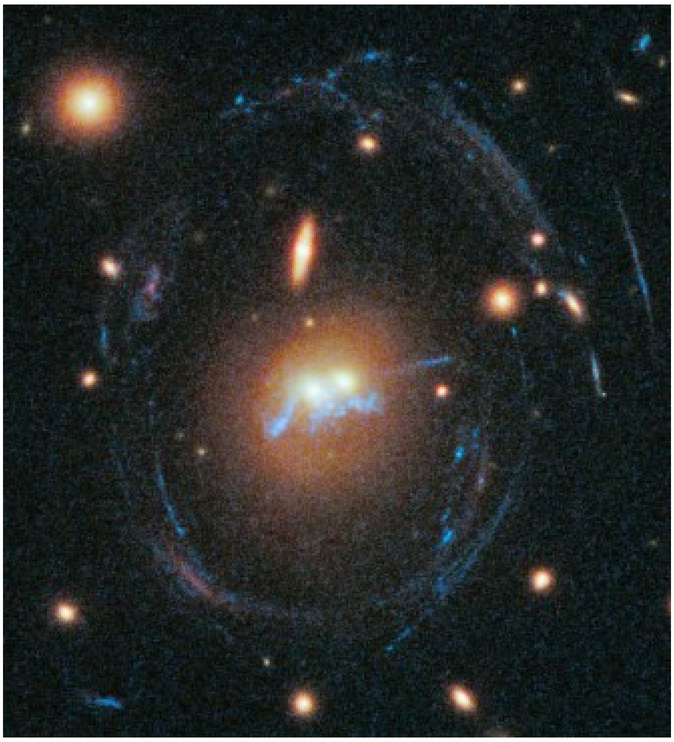
Powerful Jets From a Black Hole are Spawning Star Clusters

Supermassive black holes are messy feeders, and when they're gorging on too much material, they can hurl high-energy jets into the surrounding Universe. Astronomers have found one of the most powerful eruptions ever seen, emanating from a black hole 3.8 billion light-years away. The powerful jets are blowing out cavities in intergalactic space and triggering the formation of a huge chain of star clusters.
The black hole is part of a massive galaxy cluster, named SDSS J1531, which contains hundreds of individual galaxies, and all these galaxies have huge reservoirs of hot gas and dark matter. Using several telescopes for multiwavelength observations — including the Chandra X-ray Observatory, the Low Frequency Array (LOFAR) radio telescope, the Atacama Large Millimeter and submillimeter Array (ALMA), the Gemini North telescope's Gemini Multi-Object Spectrograph (GMOS), and the Very Large Array (VLA) — astronomers were able to discern that two of the central galaxies were engaged in a major merger. The merger activated the supermassive black hole in the center of one of the large galaxies, which produced an extremely powerful jet. As the jet moved through space, it pushed the surrounding hot gas away from the black hole, creating a gigantic cavity.
The merger and the resulting jets from the black hole created a remarkable and stunning chain of 19 young stellar superclusters wound the two galaxies like a string of beads.
In their paper, the astronomers said the dynamic environment of SDSS J1531 offers an excellent laboratory to study the interplay between mergers, and their multiwavelength studies allowed them to uncover the origin and evolution of the "beads on a string" star formation complex.
"We've reconstructed a likely sequence of events in this cluster that occurred over a vast range of distances and times," said co-author Grant Tremblay, from the Harvard & Smithsonian Center for Astrophysics CfA). "It began with the black hole a tiny fraction of a light-year across forming a cavity almost 500,000 light-years wide. This single event set in motion the formation of the young star clusters nearly 200 million years later, each a few thousand light-years across."



A labeled view of the multiwavelength Image of SDSS J1531. Credit: X-ray: NASA/CXC/SAO/O. Omoruyi et al.; Optical: NASA/ESA/STScI/G. Tremblay et al.; Radio: ASTRON/LOFAR; Image Processing: NASA/CXC/SAO/N. Wolk.

Chandra's X-ray vision allowed the scientists to see wing-shaped emissions in bright X-rays, which traced dense gas near the center of SDSS J1531. The said these wings make up the edge of the cavity, and then LOFAR revealed radio waves from the remains of the jet's energetic particles filling in the giant cavity. Together, these data provide compelling evidence of an ancient, massive explosion.
Osase Omoruyi, also from CfA who led the study, compared finding this cavity to unearthing a buried fossil.
"We are already looking at this system as it existed four billion years ago, not long after the Earth formed," she said. "This ancient cavity, a fossil of the black hole's effect on the host galaxy and its surroundings, tells us about a key event that happened nearly 200 million years earlier in the cluster's history."



This Hubble Space Telescope image from 2014 shows two galaxies (yellow, center) from the cluster SDSS J1531 found to be merging into one and a "chain" of young stellar super-clusters are seen winding around the galaxies' nuclei. The galaxies are surrounded by an egg-shaped blue ring caused by the immense gravity of the cluster bending light from other galaxies beyond it. Credit: NASA/ESA/Grant Tremblay

You can learn more about a Hubble Space Telescope view of this supercluster back in 2014.

The astronomers said that some of the hot gas pushed away from the black hole eventually cooled to form cold and warm gas. The team thinks tidal effects from the two merging galaxies compressed the gas along curved paths, leading to the star clusters forming in the bead-like pattern.

Omoruyi and her colleagues could only see radio waves and a cavity from one jet, but black holes usually fire two jets in opposite directions. This led them to surmise that the radio and X-ray signals from the jet in the other direction might have faded to the point that they are undetectable.

"We think our evidence for this huge eruption is strong, but more observations with Chandra and LOFAR would clinch the case," said Omoruyi. "We hope to learn more about the origin of the cavity we've already detected, and find the one expected on the other side of the black hole."

A New, More Accurate Measurement for the Clumpiness of the Universe

Cosmologists are wrestling with an interesting question: how much clumpiness does the Universe have? There are competing but not compatible measurements of cosmic clumpiness and that introduces a "tension" between the differing measurements. It involves the amount and distribution of matter in the Universe. However, dark energy and neutrinos are also in the mix. Now, results from a recent large X-ray survey of galaxy clusters may help "ease the tension".

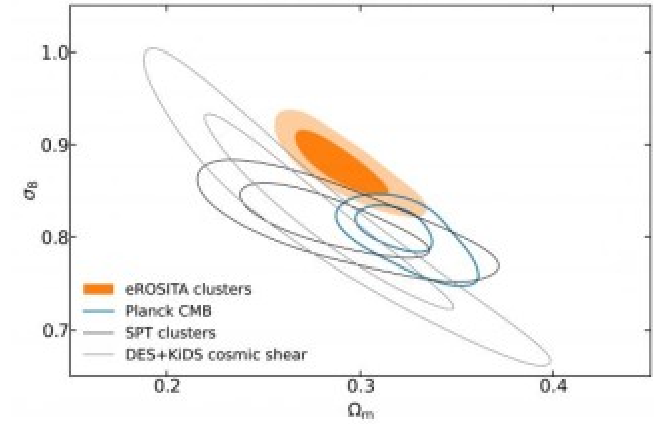
The eROSITA X-ray instrument orbiting beyond Earth performed an extensive sky survey of galaxy clusters to measure matter distribution (clumpiness) in the Universe. Scientists at the Max Planck Institute for Extraterrestrial Physics recently shared their analysis of its cosmologically important data.

"eROSITA has now brought cluster evolution measurement as a tool for precision cosmology to the next level," said Dr. Esra Bulbul (MPE), the lead scientist for eROSITA's clusters and cosmology team. "The cosmological parameters that we measure from galaxy clusters are consistent with state-of-the-art cosmic microwave background, showing that the same cosmological model holds from soon after the Big Bang to today."

eROSITA, the Standard Cosmological Model, and Clumpiness

To get a better feel for what this means, let's look at what the team is trying to confirm. The idea is to figure out just what the Universe has been like through time. That means understanding matter, its distribution (or clumpiness), and what role dark matter and dark energy have played. It all began just after the Big Bang when the Universe was in a hot, dense state. The only things existing were photons and particles. The Universe expanded and began to condense into regions of higher density. Think of these as density variations, or areas of more or less clumpiness in the primordial soup. As things cooled and expanded, the denser clumps in the soup became galaxies and eventually galaxy clusters. The clumpiness was smoother (or "isotropic") than expected. That raises questions about the role of dark matter and dark energy, among other things.

eROSITA's observations of galaxy clusters and distribution of matter showed several interesting results. First, both dark matter and visible matter (baryonic matter), make up about 29 percent of the total energy density of the Universe. Presumably, the rest consists of dark energy, which we don't know much about, yet. Energy density is the amount of energy stored in a region of space as a function of volume. In cosmology, it also includes any mass in that volume of space.

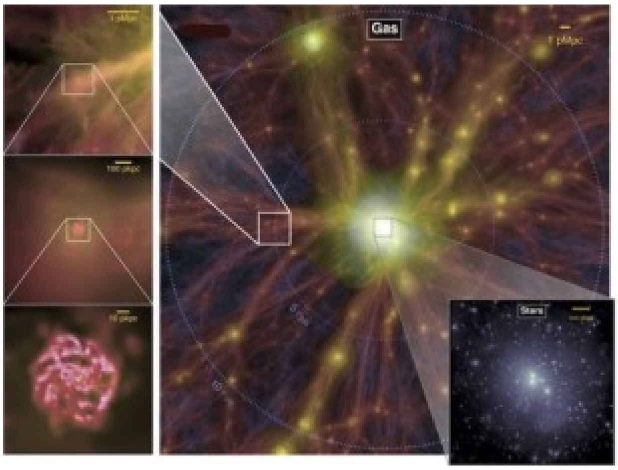


This plot shows the constraints put on the total matter density in the Universe and the S_8 "tension". Constraints from eROSITA galaxy clusters are in orange, from the Cosmic Microwave Background (Planck) in blue, from weak lensing (DES+KiDS) in grey, and from cluster number counts (SPT) in black. Credit: MPE, V. Ghirardini for the eROSITA consortium

The measurement of energy density agrees with measurements of the cosmic microwave background radiation—also known as the CMB. Think of that as a map of the density variations in the early Universe. It's made up of microwave radiation that permeates the Universe. That radiation is not completely smooth or uniform. That's the variability in density that eventually became the seeds of the first galaxies.

Measuring Clumpiness

eROSITA's goal is to measure the assembly of galaxy clusters over cosmic time. By tracing their evolution via the X-rays emitted by hot gas, the instrument traced both the total amount of matter in the Universe and its clumpiness. Those measurements solve the "tension" or discrepancy between past clumpiness measurements that used different techniques. Those included the CMB and observations of weak gravitational lensing.

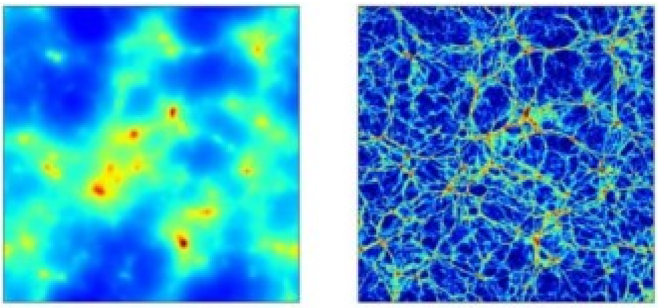


A computer simulation of what gas and stars in a galaxy cluster look like, and how they look embedded in the cosmic web. The assembly of galaxy clusters has implications for the clumpiness of the Universe throughout time. Credit: Yannick Bahé.

The eROSITA data shows the distribution of matter is actually in good agreement with previous measurements of the CMB. That's good news because cosmologists were afraid they'd have to invoke "new physics" to explain the tension between measurements. "eROSITA tells us that the Universe behaved as expected throughout cosmic history," says Dr. Vittorio Ghirardini, the postdoctoral researcher at MPE who led cosmology study. "There's no tension with the CMB. Maybe the cosmologists can relax a bit now."

But Wait, There are Neutrinos to Worry About!

Interestingly, the eROSITA measurements of galaxy clusters and other large structures also provide information about neutrinos. They're the most abundant particles with mass that we know of in the Universe. They come from the Sun and supernovae (for example), but also originated in the Big Bang. eROSITA's survey offers new information about the mass of neutrinos and their prevalence. "We have obtained tight constraints on the mass of the lightest known particles from the abundance of the largest objects in the Universe," said Ghirardini.



Computer simulations show how neutrinos can form cosmic clumpiness. Credit: Yoshikawa, Kohji, et al

Neutrinos may be small and tough to "see", but they have mass that contributes to the total density of matter in the Universe. Cosmologists describe them as "hot", which means they travel at nearly the speed of light. Therefore, they tend to smooth out the distribution of matter—which can be probed by analyzing the evolution of galaxy clusters in the Universe. And, there's a good chance that eROSITA may help solve the mystery of neutrino mass. "We are even on the brink of a breakthrough to measure the total mass of neutrinos when combined with ground-based neutrino experiments," added Ghirardini.

How eROSITA Did It

There's a lot more to explore in the eROSITA data, but it's also fascinating to look at the extent of the survey data. It comprises one of the most extensive catalogs of clusters of galaxies done so far. The so-called "Western Galactic half" of the all-sky survey contains 12,247 optically identified X-ray galaxy clusters. "Of these, 8,361 represent new discoveries – almost 70%," said Matthias Kluge, a postdoctoral researcher at MPE who is responsible for the optical identification of the detected clusters. "This shows the huge discovery potential of eROSITA." All that data can be charted in three dimensions, and when scientists do that, galaxy clusters show up as intersections of the cosmic web. In addition, there's a supercluster catalog, which also shows connected clusters and the filaments of matter between them. "We find more than 1,300 supercluster systems, which makes this the largest-ever X-ray supercluster sample," said Ang Liu, a postdoctoral researcher at MPE.

This new look at clumpiness in the Universe comes from the first release of data from eROSITA. The instrument completed additional surveys in early 2022. Once those data are analyzed, astronomers expect to be probing even deeper into the distribution of matter in the Universe and testing their models against reality. "When the full data are analyzed," said Esra Bulbul, "eROSITA will again put our cosmological models to the most stringent test ever conducted through a cluster survey."

Finally! Webb Finds a Neutron Star from Supernova 1987A

I can remember seeing images of SN1987A as it developed back in 1987. It was the explosion of a star, a supernova in the Large Magellanic Cloud. Over the decades that followed, it was closely monitored in particular the expanding debris cloud. Predictions suggested there may be a neutron star or even a black hole at the core but the resolution of the telescopes was insufficient to pick anything up. Now we have the James Webb Space Telescope and using its more powerful technology, signs of a neutron star have been detected.

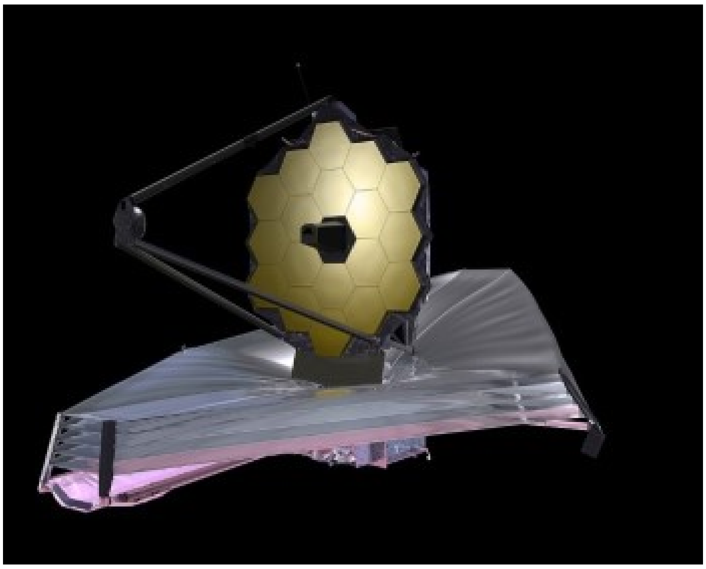
Supernova are among the most spectacular and intense explosions in the Universe that signal the end of a massive star's life. They emit vast amounts of energy and radiation and at the moment of explosion, their light can exceed that of all the stars in the host galaxy put together. There are the type II supernova and it is this type of phenomenon that brought 1987A to our skies.

1987A occurred in the Large Magellanic Cloud which is approximately 160,000 light years away and was first observed in February 1987. It continued to brighten until its luminosity peaked three months later in May. It even became visible to the naked eye, the first since Kepler's Supernova of 1604. Before the visible light signals were detected, three observatories detected short bursts of neutrinos. The bursts were attributed to the supernova and they gave insight into the events leading up to the collapse. Since the event, astronomers have been searching for its existence.

Part of the SMASH dataset showing an unprecedented wide-angle view of the Large Magellanic Cloud. Image Credit: CTIO/NOIRLab/NSF/AURA/SMASH/D. Nidever (Montana State University) Acknowledgment: Image processing: Travis Rector (University of Alaska Anchorage), Mahdi Zamani & Davide de Martin

Observations of similar objects, like the supernova remnant in Taurus, the Crab Nebula , revealed a neutron star at the core of the debris field. In the years that followed astronomers hunted for evidence but no direct evidence had been

found.
The James Webb Space Telescope was focussed onto the 1987A remnant in July 2022, making it one of the earliest objects observed by Webb. The team used the Medium Resolution Spectrograph (MRS) mode of the Mid-Infrared instrument (MIRI). It was a tool that had been partly developed by the team that were hunting for the 1987A neutron star. MIRI was a wonderful tool that could simultaneously image an object whilst it was obtaining its spectrum! This allowed observers the ability to detect spectroscopic variations across the object while analysing the Doppler shift at various points to assess velocity at each position.

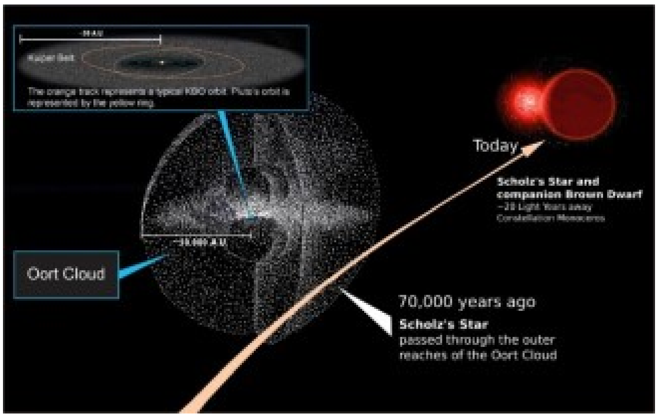


Artist impression of the James Webb Space Telescope

The team found a strong signal due to ionised argon that seemed to originate from a region around the site of the original 1987A event. Using Webb's Near-Infrared Spectrograph (NIRSpec) they observed shorter wavelengths and detected even more ionised elements including five times ionised argon (this mean the argon atoms have lost five of their eighteen electrons). For these to be created, they required highly energetic photons and these had to come from somewhere.
The conclusion is that their must be some source of high-energy radiation in the centre of the 1987A remnant. Of all the options discussed in their paper, lead author Claes Fransson of Stockholm University hints that only a few of the scenarios are likely but they all involve a young energetic neutron star. More observations are now required to follow up on this and probe the heart of the 1987A supernova remnant to see if the neutron star can finally be visually identified.
Source : Webb Finds Evidence for Neutron Star at Heart of Young Supernova Remnant

A Star Passed Through the Oort Cloud Less Than 500,000 Years Ago. It Wasn't the Only One.

As stars in the Milky Way move through space, some of them have an unexpected effect on the Solar System. Over time, one comes closer to the Sun during its orbit in the galaxy. Some of them actually get within a light-year of our star and pass through the Oort Cloud. Such close flybys can affect the orbits of the outer planets and send cometary nuclei on a long inward rush to the Sun.
Astronomer Igor Yu Potemine at the Université Paul Sabatier in France, and his colleagues decided to look for likely "close-passing" stars and so-called "Nemesis" stars. Their tool was the SIMBAD database, which contains updated stellar parallaxes and proper motions from ESA's Gaia satellite. They found a number of possible candidates. These stars drifted through the outer Oort Cloud and then went back out to interstellar space. Their actions set off gravitational perturbations responsible for cometary visits to the inner Solar System over the past billions of years. It's important to note that gravitational influences from the giant planets, as well as something called the "Galactic tide" can also perturb objects in the Oort Cloud. For purposes of his study, Potemine restricted his search to nearby stars as candidates for Oort Cloud disturbances.
Stars and the Oort Cloud Region
When we look at which stars could cause a comet swarm from the Oort Cloud region, a couple of types of stellar candidates come to mind. The first is what some researchers call a "Nemesis" star. That's the name for a still-theoretical companion star to the Sun. It's thought to be a dwarf star that occasionally (like every 25-30 million years) passes too close to the Sun. That action sends a swarm of comets to the inner solar system. Astronomers continue to look for candidates for this solar Nemesis, although the search hasn't identified "the one" as yet. They also look for other stars that periodically get too close to the Solar System and even pass through the inner regions of the Oort Cloud.



A comparison of the Solar System and its Oort Cloud. 70,000 years ago, Scholz's Star and companion passed along the outer boundaries of our Solar System (Credit: NASA, Michael Osadciw/University of Rochester)

The Oort Cloud/outer solar system region is a still-largely unknown place. It's not one monolithic cloud but several regions with populations of icy cometary bodies. The outer edge of the region could extend out 3.2 light-years away from the Sun. Inside the Oort Cloud is the Kuiper Belt, which also contains cometary bodies and a population of small worlds such as Pluto, Eris, Makemake, and others. There's also a sort of intermediate population of cometary objects thought to exist between the Oort cloud and the Kuiper Belt, sometimes referred to as the Hills Cloud. This region may be populated with many more cometary nuclei than the actual Oort Cloud. So, there's plenty of material "out there" for passing stars to perturb, and it's likely many have in the billions of years that the Solar System has existed.
Typically, you can expect a star to pass through (or near) the Oort Cloud every hundred thousand years. Very close flybys (like within 52,000 AU, happen more rarely—about every nine million years. So, it's a fairly regular occurrence in the long history of the Solar System. The star's motion sets off gravitational disturbances that eventually jostle cometary nuclei out of their orbits in the cloud. These "long period" comets (named because of their extraordinarily lengthy orbits) eventually pass by the Sun and then head back out to the depths of the outer Solar System. The ones with the lengthiest orbits have only been recorded once or twice in human history. That's because some orbits can be thousands of years long.
Lists of Likely Flyby Candidates
Patomine came up with several lists of likely "transgressor stars" from the SIMBAD search. Some are the so-called "Nemesis" objects and others are stars that have come closest to the Sun (within a light-year). Further research needs to be done to establish precise orbits and proper motions for all of the candidates. But, it's interesting to look at a few of them in more detail.

Scholz's star, a red dwarf, once came as close as 1 light-year to our Solar System. At that time, neanderthals were still around. Image: Credit: José A. Peñas/SINC

One of the Nemesis candidates is Scholz's star. It's a red dwarf, and likely grazed the edge of the Oort Cloud some 70,000 years ago, along with a companion brown dwarf. Currently, it's about 22 light-years from the Sun and probably stirred up a swarm of comets that won't get to the inner solar system for more than a million years. It's also likely that its passage affected the orbits of Kuiper Belt objects. Others have also been studied, including the G-type star HD 7977. It's currently about 247 light-years from Earth and made its close flyby some 2.8 million years ago.

Of course, there aren't just past encounters to calculate. Other stars will come near in the future. One of the best-known examples of a close future passage is the star Gliese 710. It will fly past the Sun in about 1.29 million years at a distance of around 10,520 AU. It has a very good chance of passing through the Oort Cloud, which means it could very well perturb the Oort Cloud. That would send showers of comets toward the Sun for millions of years. Some researchers estimate it could result in about 10 naked-eye comets per year. Far from being a search for comets of the past, the hunt for stars passing close to the Sun could also predict an interesting future for observers on Earth thousands or millions of years from now.

For More Information

Stellar flybies within 1 ly from the Sun and stars passing through the Hills cloud

Gliese 710 Will Pass the Sun Even Closer

Solar Physics: Why study it? What can it teach us about finding life beyond Earth?

Universe Today has investigated the importance of studying impact craters, planetary surfaces, exoplanets, and astrobiology, and what these disciplines can teach both researchers and the public about finding life beyond Earth. Here, we will discuss the fascinating field of solar physics (also called heliophysics), including why scientists study it, the benefits and challenges of studying it, what it can teach us about finding life beyond Earth, and how upcoming students can pursue studying solar physics. So, why is it so important to study solar physics?

Prof Maria Kazachenko, who is a solar astrophysicist and assistant professor in the Astrophysical & Planetary Science Department at the University of Colorado, Boulder, tells *Universe Today*, "Solar physics studies how our Sun works, and our Sun is a star. We should understand how our home star works for various reasons. First, stars are the building blocks of our Universe. Even we are made of stardust. Second, our Sun provides energy for life and affects our life here on Earth (space weather, digital safety, astronauts' safety). So, to be safe we need to understand our star. Finally, the Sun is the only star where we could obtain high-quality maps of magnetic fields, which define stellar activity. To summarize, studying the Sun is fundamental for our space safety and for understanding the Universe."

The field of solar physics dates to 1300 BC Babylonia, where astronomers documented numerous solar eclipses, and Greek records show that Egyptians became very proficient at predicting solar eclipses. Additionally, ancient Chinese astronomers documented a total of 37 solar eclipses between 720 BC and 480 BC, along with keeping records for observing visible sunspots around 800 BC, as well. Sunspots were first observed by several international astronomers using telescopes in 1610, including Galileo Galilei, whose drawings have been kept to this day.

Presently, solar physics studies are conducted by both ground - and space-based telescopes and observatories, including the National Science Foundation's (NSF) Daniel K. Inouye Solar Telescope located in Hawai'i and NASA's Parker Solar Probe, with the latter coming within 7.26 million kilometers (4.51 million miles) of the Sun's surface in September 2023. But with all this history and scientific instruments, what are some of the benefits and challenges of studying solar physics?

Prof. Kazachenko tells *Universe Today* that some of the scientific benefits of studying solar physics include "abundant observations and many science problems to work on; benefits from cross-disciplinary research (stellar physics, exoplanets communities)" with some of the scientific challenges stemming from the need to use remote sensing, sometimes resulting in data misinterpretation. Regarding the professional aspects, Prof. Kazachenko tells *Universe Today* that some of the benefits include "small and friendly community, large variety of research problems relying on amazing new observations and complex simulations, ability to work on different types of problems (instrumentation, space weather operation, research)" with some of the professional challenges including finding permanent employment, which she notes is "like everywhere in science".

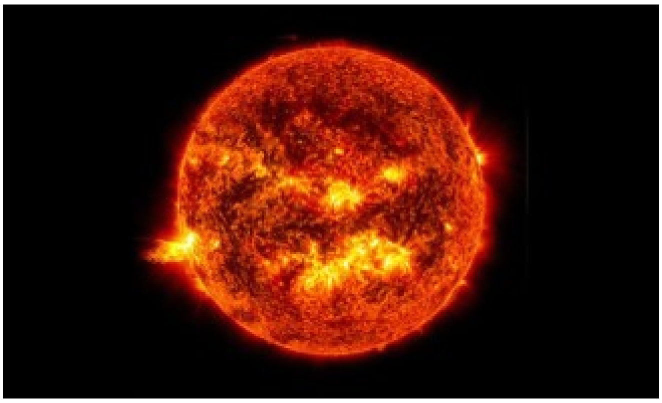


Image of the Sun obtained by NASA's Solar Dynamics Observatory (SDO) on June 20, 2013, with a solar flare discharging on the left side. (Credit: NASA/SDO)

As noted, the study of solar physics involves investigating space weather, which is when the solar wind interacts with the Earth, specifically with our magnetic field, resulting in the beautiful auroras observed in the high northern and southern latitudes. On occasion, the solar wind is strong enough to wreak havoc on satellites and even knock out power grids across the Earth's surface. This was demonstrated with the Carrington Event on September 1-2, 1859, when fires at telegraph stations were reported across the globe, along with several strong aurora observations, as well. While this event occurred with the Earth's magnetic field largely deflecting the incoming solar wind, life on this planet could be doomed without our magnetic field protecting us. Therefore, what can solar physics teach us about finding life beyond Earth?

Prof. Kazachenko tells *Universe Today*, "The Sun can tell us about stellar activity, including flares and coronal mass ejections that might be crucial for the creation of life on the planets. How frequent are these flares? How strong could they be? Why are some flares eruptive (leaving the star) and others confined (keeping erupted plasma on the star)? Why do we observe mostly confined flares on other stars? The Sun could also tell us about the science behind the long-term stellar evolution (stellar cycles, stellar dynamo)."

Image of a coronal mass ejection being discharged from the Sun. (Credit: NASA/Goddard Space Flight Center/ Solar Dynamics Observatory)

Like most scientific disciplines, solar physics encompasses researchers from a myriad of backgrounds, including the aforementioned exoplanet communities, but also includes standard physics, astrophysics, computer science, plasma physics, and fluid dynamics, just to name a few. It is through constant collaborative and innovative efforts from these backgrounds that researchers can study not only our own Sun, but suns in other solar systems throughout the cosmos. Therefore, what advice can Prof. Kazachenko offer upcoming students who wish to pursue studying solar physics?

"Be brave, ambitious, and work hard," Prof. Kazachenko tells *Universe Today*. "Talk to students and scientists who work in the field and do not be afraid to contact scientists you would like to work with. Work on your math and communication skills."

As noted, solar eclipses are an important facet of studying solar physics, as they have been both observed and documented for thousands of years by a myriad of civilizations across the globe. The Holy Grail of eclipses are total solar eclipses, which is when the Moon completely blocks out the Sun, offering solar physicists a rare opportunity to observe and study coronal mass ejections, which Prof. Kazachenko mentions could be vital to the creation of life.

The upcoming total solar eclipse that will cross the United States in a couple of months will provide scientists with even greater opportunities to study the Sun's many attributes, even more than the 2017 total solar eclipse. For this upcoming eclipse, Prof. Kazachenko plans to lead an expedition "Eclipses en la Frontera" to Eagle Pass, TX, with the National Solar Observatory's Education & Public Outreach Team.

Prof. Kazachenko tells *Universe Today*, "We had such a wonderful time during the annular solar eclipse (in October 2023), so now we are coming back for totality!"

Prof. Kazachenko (left of center) and CU Boulder graduate student, Marcel Corchado-Albelo (center), participating in an educational workshop on solar research at Sacred Heart Catholic Elementary School before the annular solar eclipse in October 2023 in Uvalde, TX. (Credit: Prof. Kazachenko)

Image of the total solar eclipse August 21, 2017, above Madras, Oregon, and the same event will be occurring in April 2024, although in different parts of the United States. (Credit: NASA/Aubrey Gemignani)

Prof. Kazachenko continues, "The solar eclipse on April 8, 2024, is around the corner. It is a life-changing experience. Not because I am a solar physicist, but because it makes you feel like you are part of the Universe. The best place to see it in the US will be in Texas (e.g. San Antonio, Austin, or Dallas), as it might be cloudy in the rest of the eclipse path."

How will solar physics help us better understand our place in the cosmos in the coming years and decades? Only time will tell, and this is why we do science!

Intuitive Machines' Odysseus Lander Sends Faint Signal From the Moon

Intuitive Machines' Odysseus lander made space history today — becoming the first commercial spacecraft to survive a descent to the moon, and the first U.S.-built spacecraft to do so since the Apollo 17 mission in 1972. But it wasn't a trouble-free landing.

Ground controllers had a hard time establishing contact with the robotic lander just after the scheduled touchdown time of 6:23 p.m. ET (2323 UTC). Several minutes passed, and then Intuitive Machines mission director Tim Crain reported that there was a faint signal coming from Odysseus' high-gain antenna.

"We're not dead yet," he said.

A few minutes later, the IM-1 mission team decided that the signal was evidence enough that Odysseus was still operating.

"What we can confirm without a doubt is our equipment is on

the surface of the moon, and we are transmitting," Crain said. "So, congratulations, IM team, we'll see how much more we can get from that."
As mission team members applauded, Intuitive Machines CEO Steve Altemus radioed in with his congratulations. "I know this was a nail-biter, but we are on the surface and we are transmitting," he said. "Welcome to the moon."
"Houston, Odysseus has found his new home," Crain replied.
What Odysseus was designed to do
Odysseus, which is named after a seafaring hero in Greek mythology, was launched from NASA's Kennedy Space Center on Feb. 15. The mission's objective was to deliver payloads from NASA and commercial customers to a spot near Malapert A crater in the lunar south polar region. That area of the moon is of high interest because its cratered terrain is thought to hold resources of water ice that could be eventually be used to supply crewed outposts.
NASA is paying Houston-based Intuitive Machines $118 million for the delivery under the terms of its Commercial Lunar Payload Services initiative.
The space agency's payloads include a camera system that was designed to document the plumes of dust kicked up by the landing, an experimental radio navigation beacon, a radio-based fuel gauge, a laser range finder, a set of laser reflectors and a sensor that will study the moon's electron plasma environment. Data from the experiments could help NASA plan for the Artemis program's crewed lunar landings, which could start happening as soon as 2026.
The commercial payloads range from a box of 125 marble-sized moon sculptures and a digital data storage device to a mini-observatory that could capture pictures of the lunar surface and the Milky Way above. There's also a camera system that was designed to be dropped off during the descent to take "selfie" pictures of the touchdown.

Backup systems come into play
Odysseus reached lunar orbit on Feb. 21, and went through a series of maneuvers today to descend from an altitude of 92 kilometers (57 miles).
NASA's laser range finder, known as the Navigation Doppler Lidar or NDL, ended up playing a crucial backup role in guiding the descent. Just a couple of hours before landing, Intuitive Machines reported that controllers couldn't get Odysseus' own laser range finders to work — so they reprogrammed the lander to use NASA's NDL system instead.
In the wake of the landing, Intuitive Machines' mission control team went through a series of procedures aimed at resetting equipment and boosting the signal from Odysseus.
"After troubleshooting communications, flight controllers have confirmed Odysseus is upright and starting to send data," Intuitive Machines reported in a posting to X / Twitter. "Right now, we are working to downlink the first images from the lunar surface."
There's a chance that Odysseus went off track during the final stages of the descent and ended up landing askew. That's what happened a month ago when Japan's SLIM spacecraft tumbled into an awkward position on its lunar landing site. SLIM's off-kilter solar arrays were able to soak up enough power for an abbreviated round of science observations.
Even under the best of circumstances, the solar-powered Odysseus lander is expected to be in operation on the lunar surface for only seven days. The mission is slated to end when the sun drops below the lunar horizon and the circuit-chilling lunar night begins.
Past and future lunar robots
NASA's deputy associate administrator for exploration, Joel Kearns, noted in advance of the landing that the odds for a completely successful commercial moon landing were slim.
"This is not an easy thing we've asked these companies to do, but if they're successful, the up side for American exploration is just so great we have to try it," Kearns said.
Last month, Pittsburgh-based Astrobotic missed out on sending its Peregrine lander to the lunar surface, due to a propellant leak that was detected after launch. The past year has also seen moon landing failures by Russia and a Japanese private venture, as well as successes by the Japan Aerospace Exploration Agency's SLIM team and India's space agency.
Still more commercial moon landing attempts are on NASA's calendar: Intuitive Machines is already working on another lander that will drill for ice in the moon's south polar region. Meanwhile, Astrobotic is getting set to send NASA's VIPER rover to a spot near the south pole, and Firefly Aerospace is due to deliver 10 NASA payloads to Mare Crisium aboard its Blue Ghost lander.

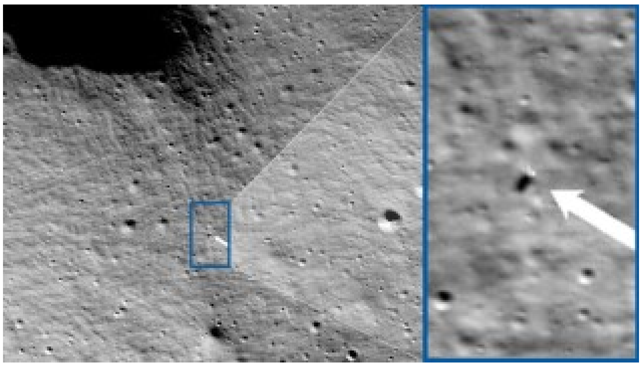
NASA Administrator Bill Nelson accentuated the positive in a pre-recorded video message that was released on the assumption that Odysseus survived its descent to the surface. "Today, for the first time in more than half a century, the U.S. has returned to the moon," Nelson said. "Today, for the first time in the history of humanity, a commercial company, an American company, launched and led the voyage up there. Today is a day that shows the power and promise of NASA's commercial partnerships. … This feat is a giant leap forward for all of humanity. Stay tuned."
Stay tuned, indeed.

Odysseus Moon Lander Sends More Pictures — and We Know Where It Is

Four days after Intuitive Machines' Odysseus lander made an off-kilter touchdown on the moon, the mission team is releasing snapshots that were taken during its descent.

The ultra-wide-angle images confirm that the lander is continuing to communicate with flight controllers, even though it's lying in an awkward angle that limits how much data its antennas can transmit.
Meanwhile, images from NASA's Lunar Reconnaissance Orbiter have identified Odysseus' landing spot, within a mile (1.5 kilometers) of its intended target near a crater called Malapert A in the moon's south polar region. The bad news is that the solar-powered lander may have to go dark sooner than anticipated.

This low-resolution, ultra-wide-angle image from the Odysseus lander shows the lunar terrain with a scrunched view of the lander itself off to the right side of the frame. (Credit: Intuitive Machines)
The lander is the first-ever commercial spacecraft to survive a descent to the moon, and the first U.S-built spacecraft to do so since NASA's Apollo 17 mission in 1972. NASA is paying Intuitive Machines $118 million to deliver six science payloads to the surface, and there are another six private-sector payloads on board.
Odysseus' descent wasn't easy: Just hours before the landing, the Nova Control team had to reprogram the lander to work around a disabled laser range-finding system. The spacecraft instead made use of one of the NASA payloads, an experimental laser range-finding system. Fortunately, the work-around worked.
The lander also hit the dirt faster than originally planned, with a lateral motion that's thought to have tripped up one of Odysseus' landing legs. As a result, the spacecraft is lying on its side. Mission managers say that doesn't seem likely to affect data collection, but it is affecting data transmission. Lunar Reconnaissance Orbiter's images from this past weekend indicate that Odysseus hit a bull's-eye, just like the hero from Greek mythology after whom it was named.



An overhead image from NASA's Lunar Reconnaissance Orbiter shows the location of the Odysseus lander, highlighted by the blue-bordered inset. (Credit: NASA / Goddard / Arizona State University)

"After traveling more than 600,000 miles, Odysseus landed within 1.5 km of its intended Malapert A landing site, using a contingent laser range-finding system patched hours before landing," Intuitive Machines said in today's update.

But Intuitive Machines also suggested that Odysseus won't be able to remain in operation for the week to 10 days that mission managers had hoped for. "Flight controllers intend to collect data until the lander's solar panels are no longer exposed to light," according to the update. "Based on Earth and moon positioning, we believe flight controllers will continue to communicate with Odysseus until Tuesday morning."

Maybe Odysseus and its controllers will have to hope for an unexpected revival similar to what the team behind another off-kilter moon lander, Japan's SLIM spacecraft, experienced this weekend.

Update for Feb. 27: On Tuesday morning, Intuitive Machines said Odysseus had a little more life left in it. "Flight controllers are working on final determination of battery life on the lander, which may continue up to an additional 10-20 hours," the mission team reported. NASA and Intuitive Machines have scheduled a news briefing on Feb. 28 to recap the mission and presumably administer last rites.

Intuitive Machines also released more pictures of Odysseus and the lunar terrain below, captured during the Feb. 22 descent when the lander was closing in from a height of 30 meters (100 feet):

Surprise! Japan's SLIM Moon Lander Wakes Up After a Freezing Night

Japan's space agency didn't expect its wrong-side-up SLIM moon lander to revive itself after powering down for a circuit-chilling lunar night on Feb. 1. But that's exactly what happened.

"Last night, a command was sent to SLIM and a response received, confirming that the spacecraft has made it through the lunar night and maintained communication capabilities!" the SLIM mission team reported today in a posting to X / Twitter.

This wasn't SLIM's first resurrection: The boxy spacecraft touched down and tumbled onto its side on Jan. 19-20, settling in a position where its solar arrays couldn't charge up its batteries. To conserve power, mission managers put the probe into hibernation and waited for the sun's rays to hit the panels at a more favorable angle.

The team was able to revive the lander and get a few days' worth of science data before putting it back into hibernation. Mission managers thought that might have been the end. During the 14-day lunar night, surface temperatures were expected to fall to about 200 degrees below zero Fahrenheit (-130 degrees Celsius) — a deep-freeze that was colder than what SLIM was designed to endure.

The lunar night ended days ago. After giving SLIM's solar panels a chance to charge up the batteries again, the team at the Japan Aerospace Exploration Agency decided to check in — and got the good news. The circuitry is warm again. Actually, it's hot: SLIM's team members said that when the lander resumed contact, some of its equipment was hotter than 212 degrees Fahrenheit (100 degrees Celsius). That's too hot for their liking.

"Communication with SLIM was terminated after a short time, as it was still lunar midday and the temperature of the communication equipment was very high," the mission team reported. "Preparations are being made to resume operations when instrument temperatures have sufficiently cooled."

Based on that information, it sounds as if SLIM (whose acronym stands for "Smart Lander for Investigating Moon") would be able to get in only a few days of work before the team has to put it to sleep again for the next lunar night. But that's better than nothing. During SLIM's previous opportunity to do some science, it made multispectral observations of its surroundings near Shioli Crater — including an assortment of rocks that were nicknamed after canine breeds.

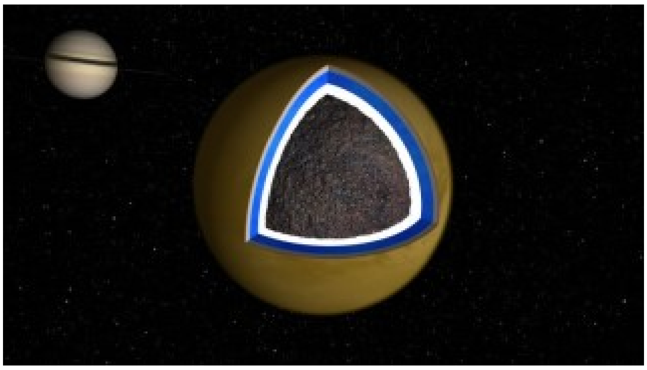
SLIM's remarkable revival may also boost the hopes of the team behind Intuitive Machines' Odysseus lander, which touched down near the moon's south pole last week and is expected to be in operation until lunar sunset about a week from now. Like SLIM, Odysseus made an off-kilter landing. Like SLIM, Odysseus was equipped with electronics that weren't designed to survive the lunar night. And like SLIM, Odysseus will nevertheless get a wakeup call after the coming night has ended — just in case its circuits are more resilient than its designers thought.

Update: The SLIM team has posted a fresh photo from the lander. "During the SLIM overnight operation, we took images with a navigation camera!" the team said in a Japanese-language posting to X / Twitter:

Titan Probably Doesn't Have the Amino Acids Needed for Life to Emerge

Does Saturn's largest moon, Titan, possess the necessary ingredients for life to exist? This is what a recent study published in *Astrobiology* hopes to address as a team of international researchers led by Western University investigated if Titan, with its lakes of liquid methane and ethane, could possess the necessary organic materials, such as amino acids, that could be used to produce life on the small moon. This study holds the potential to help researchers and the public better understand the geochemical and biological processes necessary for life to emerge throughout the cosmos.

Along with its liquid lakes of methane and ethane, Titan is also strongly hypothesized to possess a subsurface liquid water ocean like Saturn's icy moon, Enceladus, and Jupiter's icy moon, Europa. For the study, the researchers used data from impact cratering from comets to estimate the number of organic molecules that could relocate from Titan's surface to its subsurface liquid water ocean. The team hypothesized that when comets strike Titan's surface, their icy materials would melt from the heat of the impact and mix with the surface organics, resulting in a unique mixture. However, the heavier liquid water would then sink to the subsurface, slowly filling the subsurface ocean over time.



Artist's cutaway illustration displaying Titan's subsurface ocean (blue). (Credit: NASA/JPL)

After accounting for a presumed annual number of cometary impacts on Titan's surface throughout its billions of years of existence, the researchers then calculated how much water would make its way from the surface to the subsurface ocean. In the end, the team concluded that the amount of glycine, which is the most basic amino acid that forms the proteins to create life, was measured at no greater than 7,500 kilograms/year (16,530 pounds/year). This amount approximately equals the size of a smaller African forest elephant, hence indicating number of organic materials that exist on Titan is quite miniscule.

"One elephant per year of glycine into an ocean 12 times the volume of Earth's oceans is not sufficient to sustain life," said Dr. Catherine Neish, who is an associate professor in the Department of Earth Sciences at Western University and lead author of the study. "In the past, people often assumed that water equals life, but they neglected the fact that life needs other elements, in particular carbon."

While Dr. Neish's study presents somewhat dire implications for finding life on Titan, this study comes on the heels of a recent investigation into how organic hazes on ancient Earth could have contained the necessary building blocks of life, including nucleobases and amino acids, which could hold implications for finding life on Titan due to the moon's hazy atmosphere. For this study, the researchers used laboratory experiments to determine that "warm little ponds" on ancient Earth could host nucleobases. Both studies offer profound insights into the processes responsible for both creating and sustaining life beyond Earth, and further research is undoubtedly required to better understand these processes.

One such research opportunity that could help solidify these studies could be NASA's upcoming Dragonfly mission, which is a quadcopter designed to search Titan's surface for signs of potential habitability with Dr. Neish assigned as a mission co-investigator. Dragonfly currently has a scheduled launch date of July 2028, arriving at Saturn's largest moon sometime in 2034. While Dragonfly will not be the first aircraft on another world, as that honor goes to NASA's Ingenuity Mars Helicopter, it will be the first aircraft to land and operate in the outer solar system. Dragonfly will launch more than 20 years after the European Space Agency's Huygens probe landed on Titan in January 2005, beaming back images of rounded rocks that could have formed from liquid processes.

What new discoveries will scientists make about Titan and its potential for life in the coming years and decades? Only time will tell, and this is why we science!

Ingenuity Won't Fly Again Because It's Missing a Rotor Blade

Ingenuity has been the first aerial vehicle on another world. NASA announced the end of the Martian helicopter's life at the end of its 72nd flight. During the flight there had been a problem on landing and, following the incident a few photos revealed chips in one of the rotor blades but nothing too serious. New images have been revealed that show the craft is missing one of its rotor blades entirely!

Mars Ingenuity was developed by NASA as a small lightweight drone that made history by becoming the first powered flight on Mars. It was part of the mission that took the Perseverance rover to Mars in February 2021. Undertaking powered flights in the thin Martian atmosphere it demonstrated that powered flight was possible as it surveyed the surrounding area for items of interest for further exploration.

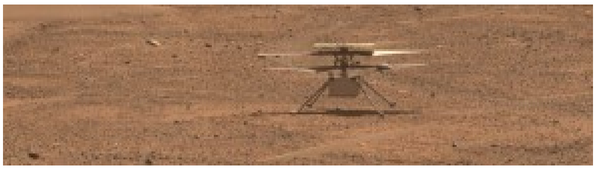


Image of the Mars Ingenuity helicopter (Source : NASA)

The construction was the brainchild of the NASA Jet Propulsion Laboratory who oversaw the construction on behalf of the agency. NASA's Ames Research Centre and Langley Research Center played a significant role in flight performance analysis and technical support

On board the vehicle was some cutting edge technology that was tailored for the conditions on Mars. First of course, are the rotors, the thin atmosphere on Mars mean larger than usual blades were needed to generate the lift required. It was built with lightweight materials like carbon fibre to make it as efficient as possible, new and efficient solar cells that would drive the autonomous navigation systems. It was equipped with sensors and cameras to enable data collection of the Martian terrain to send back to Perseverance rover and controllers on Earth.

Ingenuity had been flying in a terrain with few rocks – which it uses in some part for navigation – and so had been experiencing difficulties. On 6 Jan it made an emergency landing because it couldn't accurately identify its location. It happened again on the next flight but this time it seems to have come down at an angle and struck the ground with one of its rotors. Images suggested it had suffered some chips on one of the rotor blades however, recent images reveal the damage is more severe.

On 11 Feb, NASA used the black and white navigation camera to record a video showing the shadow of the rotors turning. It was an ingenious idea by the engineers to try and understand the extent of the damage to the 1.2m blades. To their surprise the footage revealed that one fo the blades, the upper blade seems to be absent! It looks like the blade detected near the mast.

Planet-Forming Disk has More Water Than Earth's Oceans

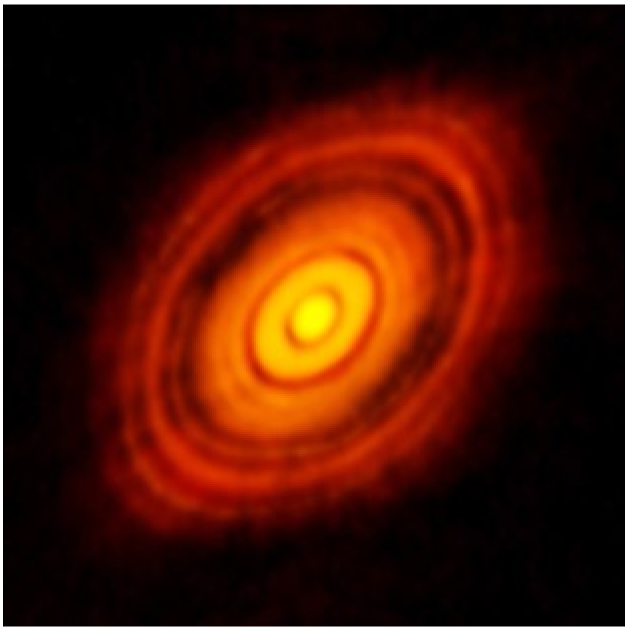
Astronomers have detected a large amount of water vapour in the protoplanetary disk around a young star. There's at least three times as much water among the dust as there is in all of Earth's oceans combined. And it's not spread throughout the disk; it's concentrated in the inner disk region.

No water means no life, so finding this much water in the part of a protoplanetary disk where rocky planets form is an intriguing discovery. And this isn't just any disk. It's a cold, stable disk, the type most likely to form planets.

The findings are presented in a new paper published in Nature Astronomy. It's titled "Resolved ALMA observations of water in the inner astronomical units of the HL Tau disk." The lead author is Stefano Facchini, an astronomer at the Dipartimento di Fisica, Università degli Studi di Milano, Milano, Italy.

"I had never imagined that we could capture an image of oceans of water vapour in the same region where a planet is likely forming," said Facchini.

The star, HL Tau (HL Tauri), is a young star about 450 light-years away. It's likely less than 100,000 years old, making it a prime observing target in the quest to understand planet formation. When it comes to seeing inside the gas and dust surrounding young stars like this, ALMA is our best tool. One of ALMA's first high-resolution images is of HL Tau and its disk. The image shows rings in the disk that indicate where young planets are probably forming.



This is the sharpest image ever taken by ALMA — sharper than is routinely achieved in visible light with the NASA/ ESA Hubble Space Telescope. It shows the protoplanetary disc surrounding the young star HL Tauri. These new ALMA observations reveal substructures within the disc that have never been seen before and even show the possible positions of planets forming in the dark patches within the system. Image Credit: ALMA

HL Tau has always intrigued scientists, and now that they've detected such a large amount of water vapour in its planet-forming disk, the young star is an even more compelling target for observations.

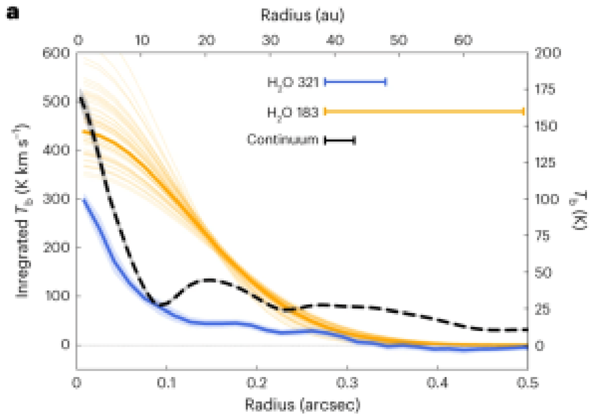
"These observations pave the way to the characterization of the water content of the inner regions of protoplanetary disks," the researchers write in their paper. "The tremendous angular resolution and sensitivity of the ALMA telescope, even in spectral ranges of low atmospheric transmission, are providing spatially and spectrally resolved images of the vapour of the main water isotopologue in a planet-forming disk."

Not only did ALMA detect the water, but it also determined where it is in the disk and how much of it there is. "Our analysis implies a stringent lower limit of 3.7 Earth oceans of water vapour available within the inner 17 astronomical units of the system," the researchers write in their paper.

When planets take shape in a protoplanetary disk like the one around HL Tauri, they clear out lanes in the dust. Nothing else is likely to create the tell-tale gaps that signal the presence of young, still-forming planets. We have the powerful ALMA to thank for this understanding.

"It is truly remarkable that we can not only detect but also capture detailed images and spatially resolve water vapour at a distance of 450 light-years from us," said study co-author Leonardo Testi, an astronomer at the University of Bologna, Italy. The spatial resolution Testi is referring to is thanks to ALMA. The radio interferometer allowed astronomers to see how the water vapour is distributed throughout the disk. "Taking part in such an important discovery in the iconic HL Tauri disc was beyond what I had ever expected for my first research experience in astronomy," added Mathieu Vander Donckt from the University of Lie?ge, Belgium, a master's student when he participated in the research.

ALMA is a radio interferometer, meaning it observes wavelengths from 0.3 mm to 3.6 mm, which correspond to the range from 84 GHz to 950 GHz. In this study, the researchers observed different "flavours" of water molecules at different temperatures. "We observed HL Tau in two different ALMA bands (band 5, originally developed with the goal of studying water in the local Universe, and band 7) to target three transitions of water," the researchers explain.



This figure from the research illustrates some of the findings. The blue line is water detected by ALMA at 321 GHz, a high-excitation state for water vapour. The yellow line is water detected at 183 MHz, an important diagnostic line used in remote sensing of water vapour. Both lines indicate more water vapour in the inner regions of the disk. Image Credit: Facchini et al. 2024.

The observations didn't just find water in the inner region where rocky planets form. It found water in one of the gaps that indicate a planet is sweeping up disk material and adding it to its mass. "Our recent images reveal a substantial quantity of water vapour at a range of distances from the star that includes a gap where a planet could potentially be forming at the present time," said Facchini. The natural conclusion is that the water is becoming part of the planet.

These results are all thanks to ALMA's power. It's the only facility we have that can detect water in a disk like this. "To date, ALMA is the only facility able to spatially resolve water in a cool planet-forming disc," said study co-author Wouter Vlemmings, a professor at the Chalmers University of Technology in Sweden.

ALMA's different observational frequencies capture water as it transitions, and part of this research looks at water as it's liberated from dust particles. The relationship between water and dust in a planet-forming disk is important. Where it's cold enough for water to freeze onto dust particles, the particles stick together more readily, aiding the planet formation process.

"It is truly exciting to directly witness, in a picture, water molecules being released from icy dust particles," said Elizabeth Humphreys, an astronomer at ESO who also participated in the study.

Some of what astronomers see in the disk around HL Tauri is like a window into the past. Our planet formed in a similar way, and the same processes and mechanisms must be similar from disk to disk.

"Our results show how the presence of water may influence the development of a planetary system, just like it did some 4.5 billion years ago in our own Solar System," Facchini said.

ALMA really flexed its muscles in this work, and the facility has played a primary role in our study of protoplanetary disks around young stars. But upcoming telescopes will surpass ALMA and give us even deeper, more detailed looks inside the dusty, obscured disks. The Extremely Large Telescope is due to see first light in 2028. Its powerful METIS (Mid-infrared ELT Imager and Spectrograph) will give us unprecedented insight into the process of planet formation.

A Nova in the Making: Will T Coronae Borealis Pop in 2024?

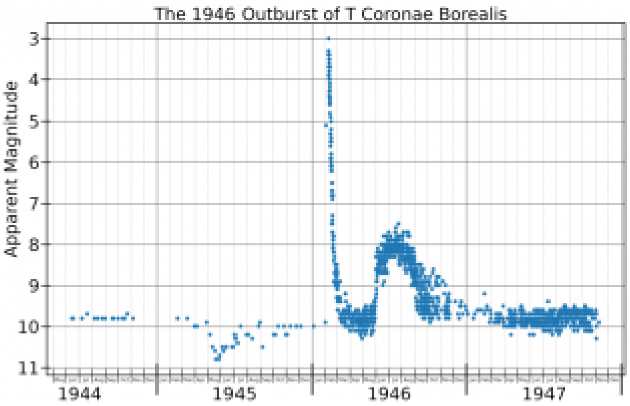
If predictions are correct, a key outburst star could put on a show in early 2024.

If astronomers are correct, a familiar northern constellation could briefly take on a different appearance in 2024, as a nova once again blazes into prominence. The star in question is T Coronae Borealis, also referred to as the 'Blaze Star' or T CrB. Located in the corner of the constellation Corona Borealis or the Northern Crown, T CrB is generally at a quiescent +10th magnitude, barely discernible with binoculars… but once every 80 years, the star has flared briefly into naked eye visibility at around +2nd magnitude.

Finding T CrB in the sky. Credit: Stellarium

The Curious Case of T Coronae Borealis

The enigma that is T Coronae Borealis was first noted by Irish astronomer John Birmingham on the night of May 12, 1866. Observers later scoured the region for decades to come, until hitting pay-dirt with a second flare-up from the star once again in 1946. None other than astronomer Leslie Peltier of *Starlight Nights* fame witnessed the 1946 outburst. A recent study by Bradley Shaefer Louisiana State University in 2023 suggests that a bright 'guest star' seen in 1217 and again in 1787 in the same region mentioned in medieval manuscripts may in fact have been apparitions of T CrB.



The light curve from the 1946 outburst. Wikimedia Commons CCA 4.0, compiled from AAVSO data.

We now know that T Coronae Borealis is what's known as a recurrent nova. This occurs when a white dwarf companion star orbiting a red giant siphons off material, which accretes and compresses around the white dwarf star. This accumulates on the white dwarf, until it reaches a limit where runaway fusion occurs, and it shines briefly as a nova. Recurrent novae are rare, and less than 10 are known of in our galaxy.

RECURRENT NOVAE THAT PEAK BRIGHTER THAN +10 MAGNITUDE

NAME	CONSTELLATION	HISTORIC MAX TO MIN	LAST PEAK	AVERAGE	CHART	NOTES
T Coronae Borealis	Corona Borealis	+2.0 to +10.8	1946	~80 years	6 (page xx)	2020s
RS Ophiuchi	Ophiuchus	+5 to +13	2006	~22 years	12 (page xx)	2020s
T Pyxidis	Pyxis	+6.4 to +15.5	2011	~24 years	16 (page xx)	2030s
V394 Coronae Australis	Corona Australis	+7.2 to +19.7	1987	38 years	18 (page xx)	2020s
U Scorpii	Scorpius	+7.5 to +17.6	2010	~21 years	12 (page xx)	2030s
V3890 Sagittarii	Sagittarius	+7 to +18	2019	28 years	18 (page xx)	2040s
IM Normae	Norma	+8.5 to +18	2002	80 years	17 (page xx)	2080s
CI Aquilae	Aquila	+8.6 to +16	2000	~42 years	12 (page xx)	2040s
V745 Scorpii	Scorpius	+9.4 to less than +20	2014	39 years	18 (page xx)	2050s
V2487 Ophiuchi	Ophiuchus	+9.5 to +18	1998	98 years	12 (page xx)	2090s

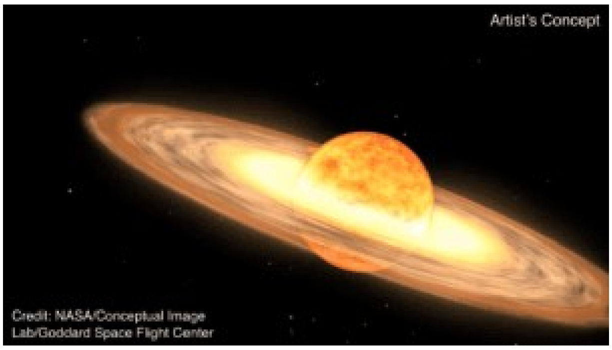
* Due in the next decade as of this writing (2019–2020).

A list of known recurrent novae. From *The Backyard Astronomer's Deep-Sky Field Guide* by David Dickinson

An Outburst for 2024?

This seems to suggest a periodicity of 80 years for the Blaze Star, suggesting another appearance running up to 2026. A suspicious dimming recorded in 2023, however, is now giving astronomers pause. The star behaved the same way in 1945, about a year prior to outburst. Astronomers are now hoping that we'll see T CrB brighten this year.

Located about 3,000 light-years distant, the white dwarf in the T CrB system orbits the red giant once every 228 days at just 0.54 Astronomical Units distant, inclined 67 degrees along our line of sight. Flare ups tend to happen quickly—over a span of mere hours—and last a maximum of just a day or so. Keep in mind, a change of eight magnitudes is equal to over *1,500 times* in terms of brightness.



A recurrent nova in the making. Credit: NASA

The American Association of Variable Star Observers (AAVSO) has a long running campaign to follow T CrB, and NASA's Neil Gehrels Swift Observatory and Hubble are also on alert to follow the Blaze Star, as an outburst would provide an unprecedented opportunity to monitor such an astrophysical event in gamma-rays and across the spectrum. Hubble may also manage to catch the light echo from the event.

Finding T Coronae Borealis in the Sky

The very worst time for T CrB to pop would be in late November, when the pesky Sun sits at the same Right Ascension in the sky. Right now, Corona Borealis is well-placed for observation rising in the northeast late in the evening. T CrB is located very near +4th magnitude Epsilon Coronae Borealis and at its peak, could rival the brightest star in the constellation: +2nd magnitude Alphecca (Alpha Coronae Borealis).

If skies are clear, keep an eye on the Northern Crown in the coming months. Who knows, *you* might be the first observer to spy if something is amiss in the sky.

New Study Addresses how Lunar Missions will Kick up Moondust.

Before the end of this decade, NASA plans to return astronauts to the Moon for the first time since the Apollo Era. But this time, through the Artemis Program, it won't be a "footprints and flags" affair. With other space agencies and commercial partners, the long-term aim is to create the infrastructure that will allow for a "sustained program of lunar exploration and development." If all goes according to plan, multiple space agencies will have established bases around the South Pole-Aitken Basin, which will pave the way for lunar industries and tourism.

For humans to live, work, and conduct various activities on the Moon, strategies are needed to deal with all the hazards – not the least of which is lunar regolith (or "moondust"). As the Apollo astronauts learned, moondust is jagged, sticks to everything, and can cause significant wear on astronaut suits, equipment, vehicles, and health. In a new study by a team of Texas A&M engineers, the regolith motion was found to be significantly altered due to inter-particle collisions. Given the many spacecraft and landers that will be delivering crews and cargo to the Moon in the near future, this is one hazard that merits close attention!

The study was conducted by Shah Akib Sarwar and Zohaib Hasnain, a Ph.D. Student and an Assistant Professor (respectively) with the J. Mike Walker '66 Department of Mechanical Engineering at Texas A&M University. For their study, Sarwar and Hasnain investigated particle-particle collisions for lunar regolith using the "soft sphere" method, a contact force model (accounting for particle deformation) is integrated with relevant fluid forces to study how regolith grains will travel according to Newton's equations of motion.

Apollo 15 astronaut salutes next to the American flag in 1971. The Moon's regolith or soil appears in various shades of gray. Credit: NASA

This sets it apart from the "hard sphere" method, which does not model any particle deformation and can only represent binary contacts. While lunar regolith ranges from tiny particles to large rocks, the main component of "Moondust" is fine, silicate minerals with an average size of 70 microns. These were created over billions of years as the Moon's airless surface was struck by meteors and asteroids that pounded much of the lunar soil into a fine powder. The absence of an atmosphere also meant that erosion by wind and water (common here on Earth) was absent. Lastly, constant exposure to solar wind has left lunar regolith electrostatically charged, which means it adheres to anything it touches.

When the Apollo astronauts ventured to the Moon, they reported having problems with regolith that would stick to their suits and get tracked back into their lunar modules. Once inside their vehicles, it would adhere to everything and became a health hazard, causing eye irritation and respiratory difficulties. But with the Artemis missions on the horizon and the planned infrastructure it will entail, there's the issue of how spacecraft (during take-off- and landing) will cause regolith to get kicked up in large quantities and accelerated to high speeds.

As Sarwar related to Universe Today via email, this is one of the key ways lunar regolith will be a major challenge for regular human activities on the Moon:

"During a retro-propulsive soft landing on the Moon, supersonic/hypersonic rocket exhaust plumes can eject a large quantity (10^8 – 10^{15} particles/m3 seen in Apollo missions) of loose regolith from the upper soil layer. Due to plume-generated forces – drag, lift, etc. – the ejecta can travel at very high speeds (up to 2 km/s). The spray can harm the spacecraft and nearby equipment. It can also block the view of the landing area, disrupt sensors, clog mechanical elements, and degrade optical surfaces or solar panels through contamination."

Data acquired from the Apollo missions served as a touchstone for Sarwar and Hasnain, which included how ejecta from the exhaust plume from the *Apollo 12* Lunar Module (LM) damaged the *Surveyor 3* spacecraft, located 160 meters (525 ft) away. This uncrewed vehicle had been sent to explore the Mare Cognitum region in 1967 and characterize lunar soil in advance of crewed missions. Surveyor 3 was also used as a landing target site for *Apollo 12* and was visited by astronauts Pete Conrad and Alan Bean in November 1969.

A look at the Apollo 12 landing site. Astronaut Alan Bean is shown working near the Modular Equipment Stowage Assembly (MESA) on the Apollo 12 Lunar Module (LM) during the mission's first extravehicular activity (EVA) on Nov. 19, 1969. Credit: NASA.

The damage was mostly mitigated by the fact that *Surveyor 3 was sitting in a crater* below the landing site of the Apollo 12 LM. However, a significant portion of the ejecta, scattered by particle collisions, hit the deactivated spacecraft directly. Another example is the *Apollo 15* mission that landed in the Hadley–Apennine region in 1971. During the LM's descent, astronauts David R. Scott and James B. Irwin could not see the landing site because their exhaust plume had created a thick cloud of regolith above it. This forced the crew to select a new landing site on the rim of Béla, an elongated crater to the east of the region.

The LM could not achieve a balanced footing at this site and tilted backward 11 degrees before stabilizing itself. Research conducted since these missions took place led to the conclusion that collisions between regolith particles is an important mechanism for scattering. As Sarwar indicated, these examples illustrate how disturbed regolith can become a hazard, especially where other spacecraft and facilities are positioned nearby:

"The above two examples from the Apollo-era were not severe enough to jeopardize mission success. But future Artemis (and CLPS) missions will take place on the lunar

south pole, where the soil is assumed to be significantly more porous/weak than the equatorial and mid-latitude Apollo landing regions. Also, Artemis landers are expected to deliver much larger payloads than Apollo, and therefore require more thrust to slow down. As a result, deep cratering can happen (not seen in Apollo) due to rocket exhaust plumes and blow the regolith at much higher angles than those seen previously (~1-3 degrees above ground)."

In accordance with the long-term goals of the Artemis Program, NASA plans to build infrastructure around the southern polar region to allow for a "sustained program of lunar exploration and development." This includes the Artemis Base Camp, consisting of a foundation surface habitat, a habitable mobility platform, a lunar terrain vehicle (LTV), and the Lunar Gateway in orbit. "As such, protecting humans, structures, or nearby spacecraft from the hazards of lunar regolith particles is of paramount concern," said Sarwar.

Illustration of NASA astronauts on the lunar South Pole. Mission ideas we see today have at least some heritage from the early days of the Space Age. Credit: NASA

Similar research has shown how clouds of regolith caused by landing and take-off could also pose a hazard to the safe operation of the Lunar Gateway and lunar orbiters. These threats have driven considerable research into how lunar dust can be mitigated during future missions. As noted, Sarwar and Hasnain used the soft sphere method to evaluate the risks posed by particle-particle collisions:

"In this method, adjacent particles are allowed to overlap each other by a tiny amount, which is taken as an indirect measure of the deformation expected in a real particle-particle collision. This overlap value, along with relevant material properties of lunar regolith, are then used in a spring-dashpot-friction slider representation to calculate forces in each collision event. The inelasticity involved in a collision is varied from completely inelastic to highly elastic. "Our results reveal that highly elastic collisions between relatively large regolith grains (~100 microns) cause a significant portion of them to eject at large angles (some can fly out at ~90 degrees). The rest of the grains are, however, contained in a small-angle region (<3 degrees) along the ground – which is in line with the visible regolith sheet observed during the Apollo missions."

In terms of safeguards, Sarwar and Hasnain suggest that berms or fences around a landing zone are a way to mitigate ejecta sprays. However, as their research suggests, a certain percentage of regolith particles may scatter at large angles due to collisions, making berms or fencing insufficient. "A better solution for future Artemis missions would be to build a landing pad," said Sarwar. "In this regard, a multi-organization team with personnel from both academia (including Dr. Hasnain) and industry is working on developing the in-Flight Alumina Spray Technique, or FAST landing pads."

The FAST method envisions lunar landers equipped with alumina particles that are ejected during landing maneuvers. They are then liquefied by engine plumes to create molten aluminum on the lunar surface, which cools and solidifies to create a stable landing surface. NASA has also investigated how landing pads could be built using sintering technology, where regolith is blasted with microwaves to create molten ceramics that harden on contact with space. Another idea is to build landing pads with blast walls to contain ejected regolith, which the Texas-based construction company ICON included in their Lunar Lantern habitat concept.

Illustration of the in-Flight Alumina Spray Technique (FAST). Credit: Masten Space Systems

Alas, experimental investigations concerning lunar regolith are very difficult because lunar conditions are vastly different than those on Earth. This includes the lower gravity (roughly 16.5% of Earth's), the vacuum environment, and the extreme temperature variations. Hence why researchers are forced to rely heavily on numerical modeling, which typically focuses on plume forces and largely ignores the role of particle collisions. But as Sarwar noted, their research offers valuable insight and illustrates why it is important to consider this often-overlooked phenomenon when planning future lunar missions:

"[However,] our research on particle collisions has shown that this is a very important phenomenon to consider for accurate regolith trajectory prediction and, therefore, must be included. There are still a lot of challenges remaining in this area, such as a lack of knowledge on regolith particle restitution coefficient (which determines energy loss in a collision), effects of regolith size distribution, implications of turbulent plumes etc. We hope to elucidate some of these uncertainties in the future and contribute towards a more comprehensive lunar PSI model for safer Artemis lunar landings."

Further Reading: Acta Astronautica

Planetary Atmospheres: Why study them? What can they teach us about finding life beyond Earth?

Universe Today has surveyed the importance of studying impact craters, planetary surfaces, exoplanets, astrobiology, solar physics, and comets, and what these fantastic scientific fields can teach researchers and space fans regarding the search for life beyond Earth. Here, we will discuss how planetary atmospheres play a key role in better understanding our solar system and beyond, including why researchers study planetary atmospheres, the benefits and challenges, what planetary atmospheres can teach us about finding life beyond Earth, and how upcoming students can pursue studying planetary atmospheres. So, why is it so important to study planetary atmospheres?

Dr. Brian Toon, who is a Professor and Research Scientist in the Department of Atmospheric and Oceanic Sciences at the University of Colorado, Boulder, tells *Universe Today*, "There are many reasons to study planetary atmospheres. For example, we think the sun was much dimmer in the early history of the solar system, yet Earth and Mars each were as warm or warmer than now. How is this possible? Venus and Mars have carbon dioxide dominated atmospheres with more CO_2 in the vertical column than Earth. Yet one is colder than Earth and the other warmer. Even though Venus is closer to the sun its clouds reflect so much light that it effectively has less sunlight than Earth, yet its surface is warm enough to melt lead. How is this possible? We need to understand other atmospheres to understand the past and future of Earth."

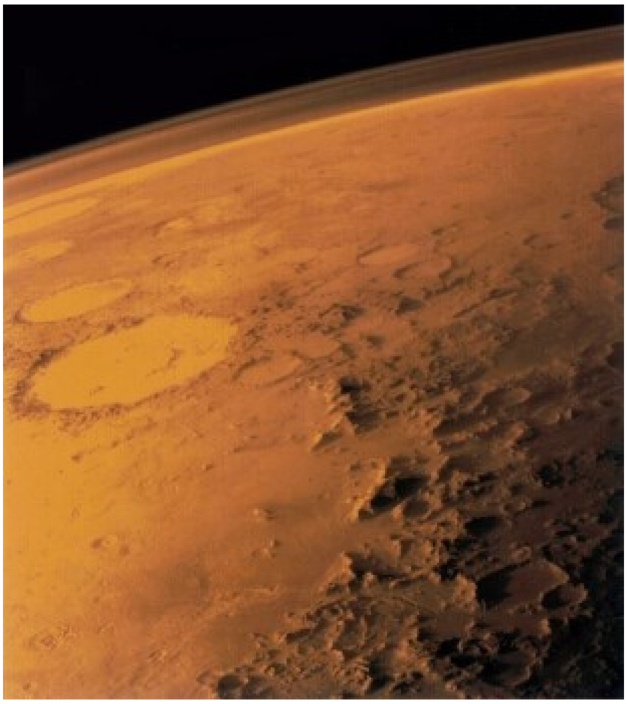
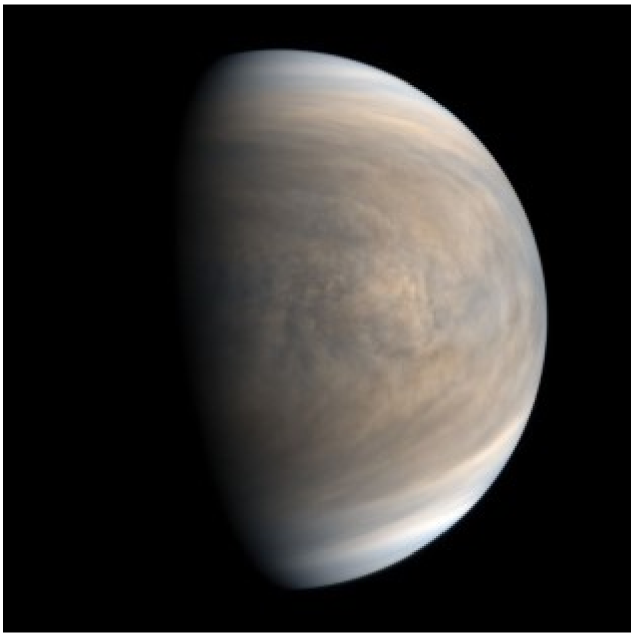


Image of Mars with its thin atmosphere comprised primarily of carbon dioxide obtained by NASA's Viking 1 orbiter in 1976. (Credit: NASA)



Ultraviolet and filtered image of Venus with its thick and cloudy atmosphere obtained by the Japanese Aerospace Exploration Agency's (JAXA) *Akatsuki* spacecraft on May 23, 2018. (Credit: JAXA/ISAS/DARTS/Kevin M. Gill)

Aside from Earth, Venus, and Mars, the other planetary bodies in our solar system that possess atmospheres include Jupiter, Saturn, Uranus, Neptune, dwarf planet Pluto, and Saturn's largest moon, Titan, which is the only solar system moon with a dense atmosphere. The formation and evolution of these atmospheres are what scientists are attempting to better understand via computer models that are often combined with data obtained by ground- or space-based telescopes. Through this, scientists have learned, and continue to learn, a great deal about the atmospheres of these intriguing and mysterious worlds that inhabit our solar system. But even with all the instruments and technological advancements, what are some of the benefits and challenges of studying planetary atmospheres?

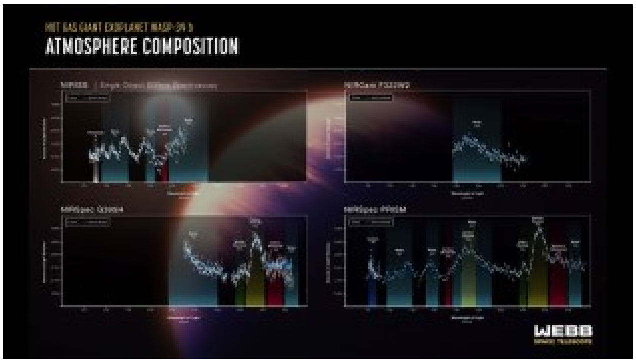
Image of Saturn's largest moon, Titan, and its dense atmosphere comprised of nitrogen and methane obtained by NASA's Cassini spacecraft on July 3, 2004. (Credit: NASA/JPL/Space Science Institute)

"The same climate models used for Earth are now used for other planets, such as Mars," Dr. Toon tells Universe Today. "When the models fail on Earth it is tempting to force them to match Earth data rather than fixing the physics and chemistry in the models. Having the examples from other planets force us to look for errors in Earth models or in our understanding of how Earth climate models work."

Planetary atmospheres within our own solar system range from sulfuric acid and carbon dioxide (Venus) to carbon dioxide (Mars) to hydrogen and helium (Jupiter, Saturn, Uranus, and Neptune) to nitrogen and methane (Titan and Pluto). Despite the sulfuric acid within Venus' atmosphere, past studies have postulated the possibility of Venus' higher altitudes potentially having the ingredients to support life as we know it. Therefore, these unique worlds could offer a glimpse of what scientists could find beyond our solar system, known as exoplanets. But what can studying planetary atmospheres within our own solar system teach us about exoplanet atmospheres?

Dr. Toon tells *Universe Today*, "We expect a wide range of exoplanetary atmospheres, some are so hot that they likely are raining metals. Even in the solar system there are planets raining condensed natural gas. So, the solar system planets are analogs for exoplanets, but there are definitely exoplanets very different from solar system planets."

Since the distance to exoplanets ranges from a few light-years to hundreds of light-years, it takes extremely powerful instruments to study their atmospheres. One example is NASA's James Webb Space Telescope (JWST), which has examined the atmospheres of several exoplanets, including WASP-39 b, which is located just under 700 light-years from Earth. With its powerful infrared instruments, JWST successfully identified water, carbon dioxide, and potassium on this Jupiter-sized world. As demonstrated on Earth, water is essential for life as we know it. Therefore, finding water on an exoplanet could indicate its likelihood for life, as well.



Atmospheric data of WASP-39 b obtained from NASA's James Webb Space Telescope, which identified water, carbon dioxide, and potassium. (Credit: NASA, ESA, CSA, Joseph Olmsted (STScI))

However, out of the almost 5,600 confirmed exoplanets as of this writing, only 69 are deemed potentially habitable. This is primarily due to their orbit residing within their star's habitable zone (HZ), meaning they orbit at the correct distance from their star for liquid water to potentially exist on its surface, assuming the exoplanet is terrestrial (rocky) like Earth. But finding water within an exoplanet's atmosphere could also pose the prospect for finding life, as well. Therefore, what can studying planetary atmospheres teach us about finding life beyond Earth?

"The Earth's atmosphere is out of chemical balance due to emissions of various gases by life," Dr. Toon tells *Universe Today*. "For example, the oxygen in Earth's atmosphere is not compatible with the methane in the atmosphere. The methane is largely a waste product of life. So, trying to detect life elsewhere is most likely going to start with looking at the chemistry of exoplanet atmospheres for signs of chemical imbalance."

The scientific discipline responsible for studying planetary atmospheres is known as atmospheric science and encompasses several subdisciplines, including computer science, astronomy, physics, and meteorology, just to name a few. It is through constant collaboration and innovation of these subdisciplines that allows scientists to study planetary atmospheres both within and beyond our solar system. As noted, the planetary atmospheres within our solar system provide a wide range of diversity and scientists have observed the same diversity on exoplanets, as well. So, what is the most exciting planetary atmosphere(s) that Dr. Toon has studied during his career?

"I have studied every atmosphere in the solar system, and some exoplanets," Dr. Toon tells *Universe Today*. "The most interesting is Mars, because there is a lot of data for Mars, and Mars once had a climate more like Earth's than the barren desert it is now. Titan, a moon of Saturn is also interesting because it has methane rain, and lakes and seas of hydrocarbons. It also is shrouded in a haze composed of complex organic material." Additionally, what advice can Dr. Toon offer upcoming students who wish to pursue studying planetary atmospheres?

"I suggest students first learn about the Earth's atmosphere," Dr. Toon tells *Universe Today*. "It is surprising how many astronomers looking at planetary atmospheres don't know about parallels with Earth."

How will planetary atmospheres help us better understand our place in the universe in the coming years and decades? Only time will tell, and this is why we science!

E MAILS and MEMBERS VIEWING LOGS.

Viewing Log for 11th of February

Normally on a Monday evening I am doing my job doing home delivery's for Asda but as they required me to work on the Saturday, I had to night free and as it was a clear sky I decided I would go out and do some viewing at Nebo farm. After getting permission to view from the farm I sent out a notice to see if anyone was interested in viewing that evening. Hilary and Damian said they were free and would meet me there.

When I left home, the skies were clear but by the time I got to Nebo there was some cloud in the sky. Anyway, I had my Meade LX90 set up and ready by 19:35, as usual I would be using my 14 mm XW Pentax eye piece, there was some wind with us and a temperature of 4 °C. Guide stars were Procyon and Rigel.

First target for the evening was the waxing crescent Moon (normally the last object I look at) 1.89 days old or 5.3% lit but it was now getting close to the western horizon and would set very soon. The terminator look very good to view, could make out the beginnings of Mare Crisium (Sea of Crises) and Mare Fecunditatis (Sea of Fruitfulness) coming out of their 14 plus day of darkness. After the Moon it was time to look at Jupiter, still shining very brightly in the south west sky, I could make out the moon Io to the east of the planet with Ganymede (very close to Jupiter's edge) followed by Europa and Calisto further out to the east. Then on to Uranus, it took me a couple of star hops before I found the planet, as usual it was in the finderscope but I had to manually slew the telescope to find this Ice Giant planet. With the planets finished for the evening, I asked Damian (who was busy using his SeeStar S50 kit) what he would like to look at. I suggested looking at Messier (M) 79, an odd ball globular cluster (GC) in Lepus, there are not many GC's in the winter sky, and these are more common in the summer skies. To me it was a small fuzzy blob (FB) to look at, this object I rarely look at as it is quite low from UK skies. Any objects we wished to look at had to be clear of any clouds, to the north this was impossible, totally clouded out but we did have some clear patches to the south, so this is the only real area we could look at. Next object was M1 in Taurus, the only Supernova Remnant on his list, this star explored in the year 1054 and has been getting larger in the sky since. The skies were not brilliant to look at, this object was only a faint fuzzy blob (FFB) to view and was hard to see, even with GOTO kit! Going east we landed on M46, a large dim open cluster (OC), I told Damian there was a small planetary nebula (NGC2438) within this cluster. So he set his SeeStar to take some pictures of this cluster and within a few minutes we witness the cluster. I have yet to see this with my own eyes even though I have looked at this OC many times, maybe one day I will? Not far away is M47, another OC which was large and had some bright stars in the cluster. A third of the way in a line from Sirius to Procyon you come across another OC in M50, this is a small and compact object to look at. Going below Sirius you come across M41, yet another OC, this is large and loose to view. Back to Orion and M78, an Emission and Reflection nebula, only thing I could make out were the two main stars within this object. Final object for the evening was M42, as usual this was good to look at but unfortunately it was bouncing around in the eye piece, the winds had now picked up a bit and with it feeling colder we called it a night, time was 20:49. The temperature had not dropped while we were at Nebo but the winds had picked up making it feel colder. One of the downsides to Nebo is it is very open and no shelter (from any winds) like we have at Uffcott! At least there was no dew on the equipment used, I will still dry the equipment used over night to be on the safe side. Hilary had brought along her 80 mm refractor and was star hopping to various targets, some which she found and other not, at least Hilary was having a go at finding different objects, well done for having a go.

Cloud report for the evening: totally cloudy to the north of us with some clear patches to the south as said earlier in the report, yet when I got home, the skies were totally clear! Strange?

Clear skies.

Peter Chappell

Hi Andy,
Only one log for the mag this month, been very poor viewing session for month! Have a few pictures for the mag as well.
Info for pictures:

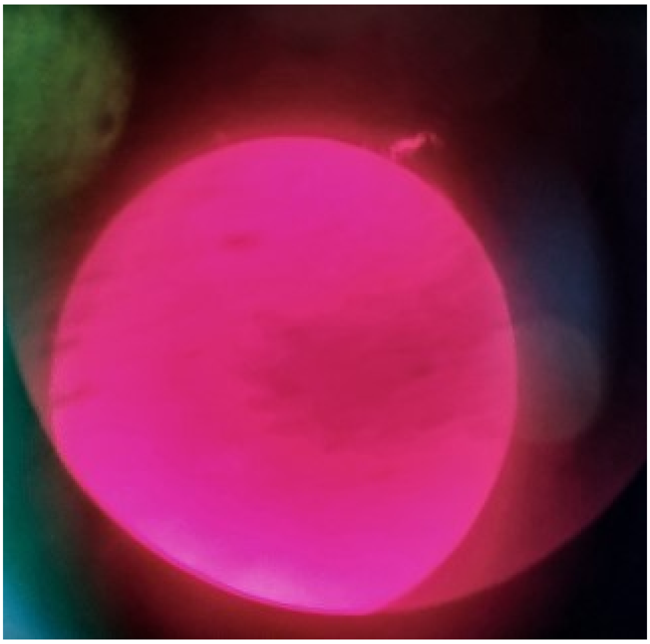
Full moon: 99.8% waning full moon taken on the 24th of Feb.

Sun: taken thru clouds, many sunspots' on the surface with the large one AR3590 (which is the biggest I have ever seen) centre and AR 3594, 3592 and 3591 to the left and AR 3586 to the right of picture.

M41: nice open cluster below the star Sirius.

All above taken with Seestar S50.

Solar flare: while I was viewing the sun on the 12th with my Solarscope I saw a very large flare on the edge of the sun, best I could get was a picture with my camera phone



near the eye piece, not the best.

Peter

Donations at Outreach Meetings.

Em Windsor (she/her)

Fundraising Administrator

Starlight Children's Foundation

Phone: 02045667664

STARLIGHT

Third Floor, 227 Shepherd's Bush Road, London, W6 7AU

Twitter Facebook Instagram

Charity Reg No: 296058 (England and Wales) SC047600 (Scotland)

From: David Buckle <david.buckle@outlook.com>
Sent: Monday, February 19, 2024 2:53 PM
To: fundraising@starlight.org.uk
Cc: Andrew Burns <anglesburns@hotmail.com>
Subject: Collection boxes, posters, etc.

Hi,

As a member of Wiltshire Astronomical Society, we sometimes do Public Outreach observing sessions and talks for local community groups, e.g. schools, scout groups, etc. We do not charge these activities, so I thought it might be an idea to raise funds for a worthwhile charity instead. Having come across your website, I thought Starlight UK would be an appropriate choice.

Do you have any information posters detailing your charitable work and Starlight branded collection boxes that we could use for donations, when we hold these outreach events?

Regards,

Dave Buckle - WAS member.

https://wasnet.org.uk/about

ASTRONOMY WEEK 2025

Dear Society

I am delighted to announce that National Astronomy Week will be returning in 2025.

It's very much at the planning stage at the moment but the steering committee (I sit on it to represent the FAS) is aware that many societies make plans a long way in advance. We wanted you to have the dates as soon as they were set to help you with your plans. The week that has been chosen is Saturday 1 February to Sunday 9 February 2025, which we know is longer than a week but it gives everyone two weekends.

Why has this week been chosen? In early 2025 there will be a spectacular array of bright planets in the evening sky: Mars at opposition in Gemini, Jupiter a couple of months after opposition in Taurus, Venus at greatest eastern elongation and Saturn also visible in the early evening. During the 8 days, the Moon waxes from a crescent to full, moving past each of the planets as it does so.

More details will follow but for the time being, please put the dates in your calendar.

Kind regards
Clare

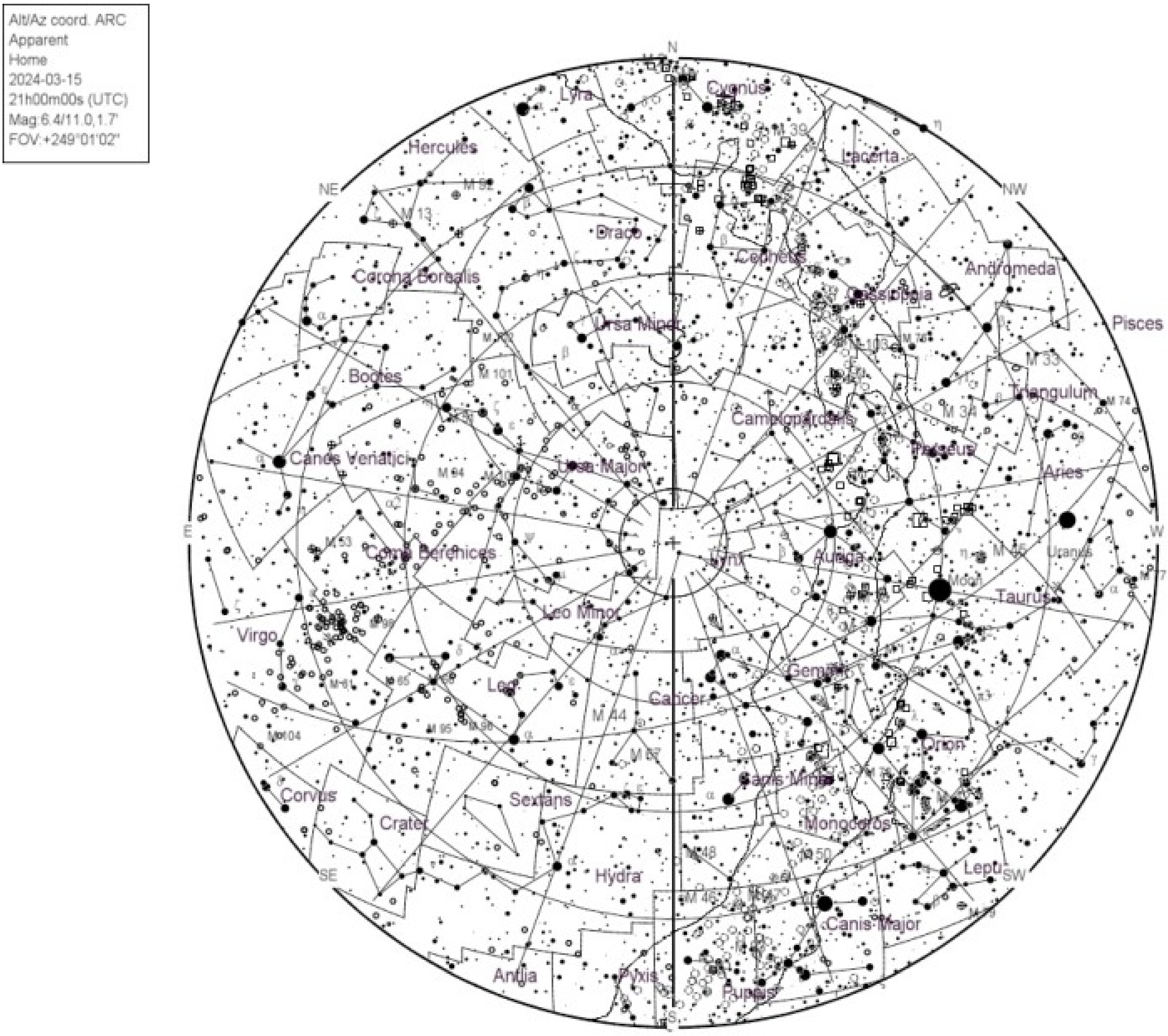
Clare Lauwerys

Vice President
Federation of Astronomical Societies

Phone: 07710 494445
Email: vicepresident@fedastro.org.uk

Web: https://fedastro.org.uk/fas/

WHATS UP, MARCH 24



March 10 - **Comet Pan-STARRS Closest Approach to the Sun.** Newly discovered comet Pan-STARRS will make its closest approach to the Sun on March 10. The comet will start to be visible in the morning sky in early February in the Southern Hemisphere. It will gradually increase in brightness until its encounter with the Sun on March 10. By this time it will be visible in the evening sky in the Northern Hemisphere. It can be seen just to the left of the setting sun. It will continue to be visible in the evening sky for the rest of March and into early April.

March 11 - **New Moon.** The Moon will be directly between the Earth and the Sun and will not be visible from Earth. This phase occurs at 19:51 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.

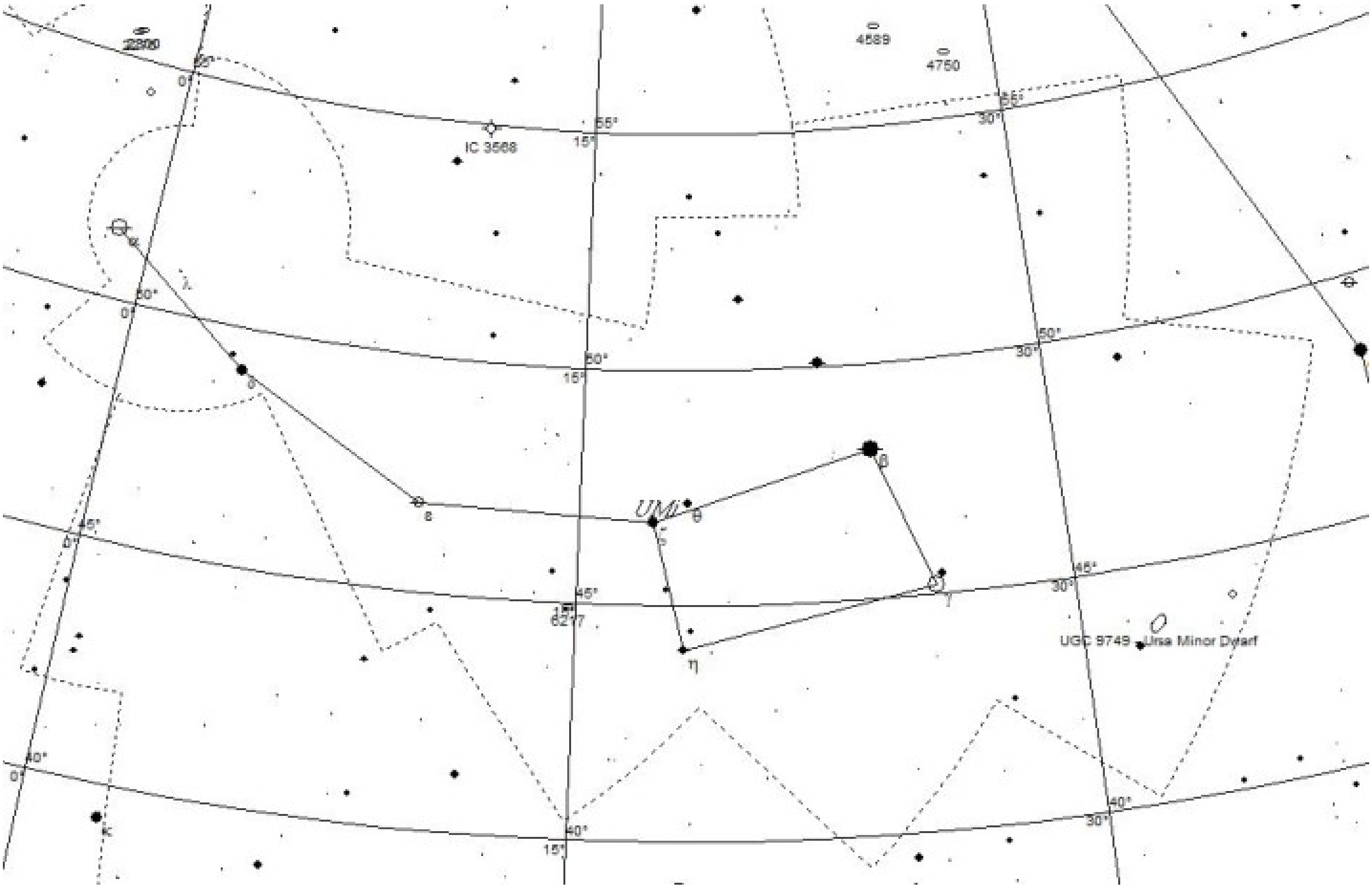
March 17 - **Conjunction of the Moon and Jupiter.** The Moon will pass about one and a half degrees of the giant planet Jupiter in the evening sky. The first quarter moon will be at magnitude -11.4 and Jupiter will be at magnitude -2.2. Look for both objects in the west after sunset. The pair will be visible in the evening sky for about 5 hours after sunset.

March 20 - **March Equinox.** The March equinox occurs at 11:02 UTC. The Sun will shine directly on the equator and there will be nearly equal amounts of day and night throughout the world. This is also the first day of spring (vernal equinox) in the Northern Hemisphere and the first day of fall (autumnal equinox) in the Southern Hemisphere.

March 27 - **Full Moon.** The Moon will be directly opposite the Earth from the Sun and will be fully illuminated as seen from Earth. This phase occurs at 09:27 UTC. This full moon was known by early Native American tribes as the Full Worm Moon because this was the time of year when the ground would begin to soften and the earthworms would reappear. This moon has also been known as the Full Crow Moon, the Full Crust Moon, and the Full Sap Moon.

April 10 - **New Moon.** The Moon will be directly between the Earth and the Sun and will not be visible from Earth. This phase occurs at 09:35 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.
Yhis will be the American Eclipse of 2024.

CONSTELLATION OF THE MONTH: URSA MINOR



Ursa Minor

The northern circumpolar constellation of Ursa Minor was one of the 48 original constellations listed by Ptolemy, and remains one of the 88 modern constellations recognized by the IAU. Ursa Minor is currently the location of the north celestial pole, yet in several centuries, due the precession of the equinoxes, it will change. Ursa Minor covers 256 square degrees of sky and ranks 56th in size. It contains 7 main stars in its asterism and has 23 Bayer Flamsteed designated stars within its confines. Ursa Minor is bordered by the constellations of Draco, Camelopardalis and Cepheus. It is visible to all observers located at latitudes between +90° and ?10° and is best seen at culmination during the month of June.

There is one annual meter shower associated with Ursa Minor called the Ursids. Beginning on or about December 17th of each year, we encounter the meteoroid stream and activity can last through the end of December. The meteor shower itself is believed to be associated with Comet Tuttle and was probably discovered by William F. Denning during the 20th century. The peak date of activity occurs on December 22 during about a 12 hour window and you can expect to see about 10 meteors per hour on the average from a dark sky location.

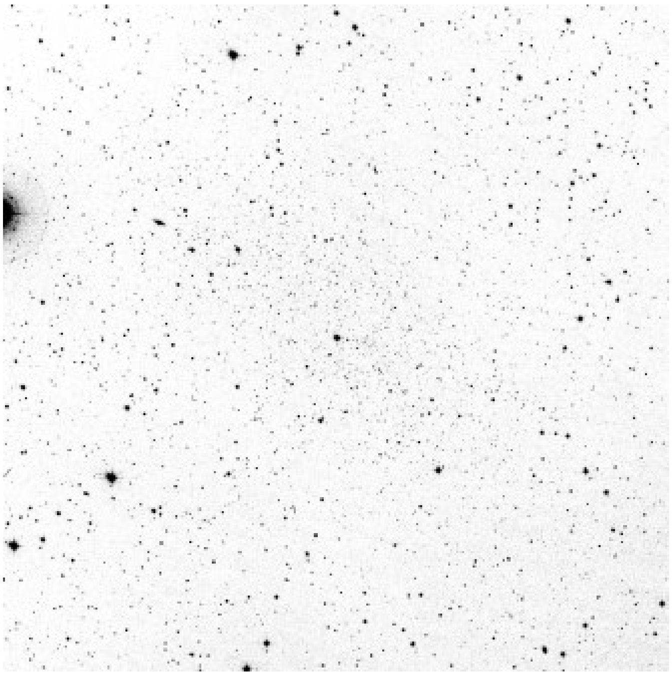
In mythology, Ursa Minor is meant to represent a baby bear with a very long tail. Perhaps this springs from the "tale" of Kallisto and her son, who were placed in the sky as a bear and son. The tail is believed to be elongated from have been swung around the north star! In some forms of mythology, the seven stars of the Little Dipper were considered to be the Hesperides, daughters of Atlas… and it forms the "dragon's wing" in yet other stories. While the "Little Dipper" asterism is a bit more difficult to recognize because its stars are more faint, once you do understand the pattern, you'll always remember it. How? The star at the end of the little dipper handle is Polaris, the North Star. Polaris is easily identified by drawing a mental line through the two stars which form the end of the "bowl" of the Big Dipper and extending that line five times the distance.

Now, let's take a look at Ursa Minor! While there are only a very few deep space objects here (and they require a large telescope) that doesn't mean the constellation isn't interesting. One handy thing to note is the stars themselves. The four stars in the "bowl" of the little dipper are unusual because they are of second, third, fourth and fifth stellar magnitude. While that might not seem like a big deal, it's a great way to judge your sky conditions. What is the dimmest of the stars that you can see? Beta (B) is 2, Gamma (Y) is 3, Zeta (the squiggle) is 4 and the unmarked corner is Eta (n) and it is stellar magnitude 5.

Ready for the brightest star? Then say hello to Alpha (a) – Polaris. Alpha Ursae Minoris is also known as the "North Star" and even as the Lodestar. While it might be 430 light-years from Earth, it is currently the closest star to the north celestial pole and a main sequence supergiant star. But don't just glance at it and walk away… Get out your telescope! In 1780, Sir William Herschel noticed something a little strange when he was looking at Polaris, and so will you… it has a companion star. That's right. Polaris is a binary star. Not only that… But when astronomers were examining Polaris B's spectrum, they noticed something else… You got it! Polaris B also has a spectroscopic companion, making this a tertiary star system. Are you ready for more? Then get this… Polaris A is also a Cepheid variable star! While its changes are very small (about 0.15 of a magnitude every 3.97 days), Polaris has brightened by 15% since we first began studying it and its variability period has lengthened by about 8 seconds each year since. That makes Polaris more than just a another star… It's a super star!

Now aim your binoculars at Beta Ursae Minoris. Its name is Kochab and it is about 127 light years from our solar system. This orange giant star shines about 130 times more brightly than our own Sun. Somewhere around 3000 years ago, Kochab was once the pole star – but as Earth's precessional motion changed, so did its position. Even then it still wasn't quite as close as Polaris!

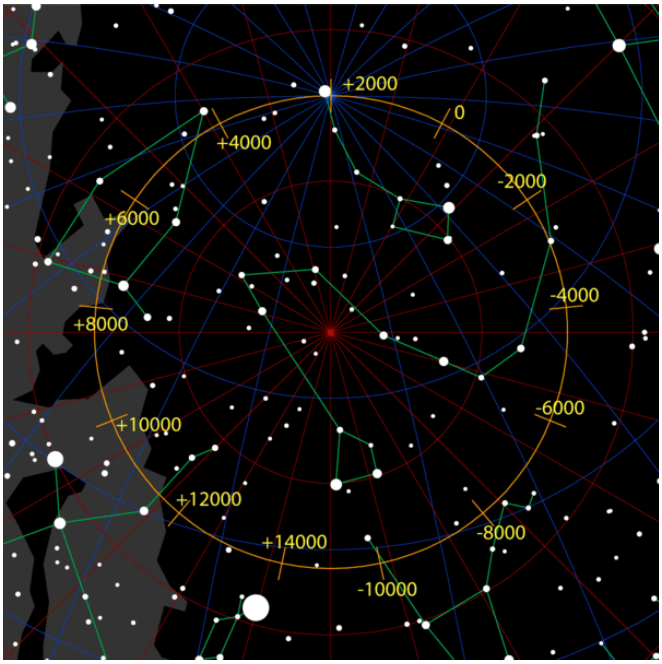
How about Gamma Ursae Minoris? That's the "Y" symbol on our chart. Known as Pherkad, this spectral class A3 star is



about 480 light years away and it is pretty special, too. Why? Because it's a Delta Scuti type variable star and its brightness varies by 0.05 magnitudes with a period of 3.43 hours. While you're not going to notice any change by just watching, image the power behind a star that shines 1100 times more luminous than the Sun, and possesses a radius 15 times larger!

Are you ready for Epsilon? Then get out the telescope, because 347 light year distant Epsilon is an eclipsing spectroscopic binary star. (Say that five times fast!) It is classified as a yellow G-type giant star with a mean apparent stellar magnitude of 4.21. In addition to light changes due to eclipses, the system is also classified as an RS Canum Venaticorum type variable star and its brightness varies from magnitude 4.19 to 4.23 with a period of 39.48 days, which is also the orbital period of the binary. The binary it orbited by a third component, Epsilon Ursae Minoris B, which is an 11th magnitude star, 77 arc seconds distant.

Now for Delta – the "8". Delta Ursae Minoris is about 183 light years away and goes by the strange name, Pherkard. While it isn't as grand as its mates, at least it is a white A-type main sequence dwarf star!



Last, but not least, is RR Ursae Minoris. You've got it… The double letter designation denotes a variable star. While changes are very small (4.73 at minimum and magnitude 4.53 at maximum) it's the period that counts here. The changes take period of 748.9 days to happen! This means that RR has been highly studied to make sure it doesn't have a spectroscopic companion – and so far none have been found.

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.
05 Mar	-2.2	**04:23:46**	30°	**SE**	04:23:46	30°	**SE**	04:25:43	10°	**ESE**
05 Mar	-1.8	05:56:43	11°	WSW	05:58:39	15°	SW	06:00:43	10°	S
06 Mar	-2.3	05:10:52	22°	SSW	05:10:52	22°	SSW	05:13:28	10°	SSE
07 Mar	-1.3	04:25:08	15°	SSE	04:25:08	15°	SSE	04:25:53	10°	SSE
14 Mar	-1.7	20:17:52	10°	SW	20:19:03	18°	SSW	20:19:03	18°	SSW
15 Mar	-2.5	19:30:01	10°	SSW	19:32:42	23°	SE	19:33:18	22°	SE
15 Mar	-0.9	21:05:46	10°	WSW	21:06:14	13°	WSW	21:06:14	13°	WSW
16 Mar	-3.3	20:17:30	10°	WSW	20:20:17	49°	SSW	20:20:17	49°	SSW
17 Mar	-3.3	19:29:18	10°	SW	19:32:28	42°	SSE	19:34:10	23°	E
17 Mar	-1.5	21:05:45	10°	W	21:07:06	22°	W	21:07:06	22°	W
18 Mar	-4.0	20:17:20	10°	WSW	20:20:41	84°	S	20:20:50	79°	ESE
19 Mar	-3.8	19:28:56	10°	WSW	19:32:15	70°	SSE	19:34:29	19°	E
19 Mar	-1.8	21:05:39	10°	W	21:07:24	28°	W	21:07:24	28°	W
20 Mar	-3.9	20:17:10	10°	W	20:20:32	85°	N	20:20:57	66°	ENE
21 Mar	-3.8	19:28:39	10°	W	19:32:01	89°	N	19:34:26	18°	E
21 Mar	-2.0	21:05:25	10°	W	21:07:20	31°	W	21:07:20	31°	W
22 Mar	-3.9	20:16:53	10°	W	20:20:15	88°	SSW	20:20:45	62°	ESE
23 Mar	-3.8	19:28:19	10°	W	19:31:41	86°	N	19:34:09	17°	E
23 Mar	-2.1	21:05:05	10°	W	21:07:02	30°	W	21:07:02	30°	W
24 Mar	-3.7	20:16:28	10°	W	20:19:48	64°	SSW	20:20:24	51°	SSE
25 Mar	-3.8	19:27:52	10°	W	19:31:12	78°	SSW	19:33:45	16°	ESE
25 Mar	-1.8	21:04:46	10°	W	21:06:38	23°	WSW	21:06:38	23°	WSW
26 Mar	-2.8	20:16:00	10°	W	20:19:08	37°	SSW	20:19:59	31°	S
27 Mar	-3.2	19:27:17	10°	W	19:30:33	51°	SSW	19:33:20	13°	SE
27 Mar	-1.2	21:04:55	10°	WSW	21:06:14	13°	SW	21:06:14	13°	SW
28 Mar	-1.7	20:15:41	10°	W	20:18:13	20°	SW	20:19:36	16°	S
29 Mar	-2.2	19:26:43	10°	W	19:29:39	28°	SSW	19:32:34	10°	SSE
31 Mar	-1.1	20:26:30	10°	WSW	20:28:29	15°	SW	20:30:27	10°	S

There are no more ISS passes until late April.

END IMAGES, AND OBSERVING

Took this last night from the Pewsham estate. The OTA is just a standard 6" Newtonian with a non-cooled hypercam using a deep sky filter. It's comprised of about 75 x 1 minute frames. Not bad considering the light pollution, first time I've used the filter.
Best wishes
Rob Lucas.
Editor: Rob will be giving us a talk in our May 7th Meeting which will be a hall meeting. He will be going through the trials of setting up a small observatory in his back garden from where he took this picture.

OUTREACH

See emails for a proposal by Dave Buckle to take donations at outreach observing sessions for Starlight Children's Foundation

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
Second	Friday	08th	March	19:30	20:00	Cres	Rising	6:45	rising.
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