NWASNEWS

Volume30 Issue 10

June 2024

Newsletter for the Wiltshire, Swindon, Bath Astronomical Societies

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Garden Observatories

This months meeting is a hall meeting at Seend Lye Fields Pavilion.

Our September 3rd Meeting will also be our AGM. I would like to thank Chris and Sam for there efforts behind the scenes to keep the society going. The finances and balance sheet provisional look healthy ut the season ends 30th June, so will not be presented.

As ever we need volunteers to keep going and I am desperate to stand aside while I still can!

One of our now members, Rob Lucas has been building a small garden observatory to make the most of our climate clear nights, and he will be speaking at tonights hall meeting.

There are some side anecdotes to this. Steve Allen caught some wildlife intruders on his web cams near his home observatory, and I have had families of badgers and many hedgehogs visiting whilst I have been in my home observatory.

In Spain the slightly larger observatory is visited be slightly more exotic species, many geckos, the odd whip snake, scopions but also many birds including owls and nightingales.

My I wish you all a good summer break, and I have mentioned my unofficial Perseid observing evening at Alton Barnes Down viewing session.

Through the summer also watch out for more Aurora, and around 2 hours after sunset and before Sun rise watch out for the bright blue noctilucent clouds. The star Capella gives a good good for the NLC zome in the north west evening or north east morning apparitions.

Clear Skies

Andy Burns.

Ps After 30 years of writing and editing the newsletter does anyone else want a go?

We can't always guaranty the weather at our observing evenings, planned as they are nearly a year in advance.
But in May the second alternative night turned out to be miraculous!
I turned up (after my daughter's birthday party) and had news that their maybe an aurora. I was imaging the spring constellations wide field (Leo and Virgo) and was a little disappointed with an eerie red glow overhead and stretching into the southern skies… but hen WHAM. Not an aurora but the AURORA!
Whole sky image from about 10:30pm. 8mm fisheye, f4.5, 12 seconds at ISO 1000.
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

June 4th:Hall Meeting, Rob Lucas Building a Garden observatory

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

Speaker tonight:

Rob Lucas.

Building a Garden Observatory

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

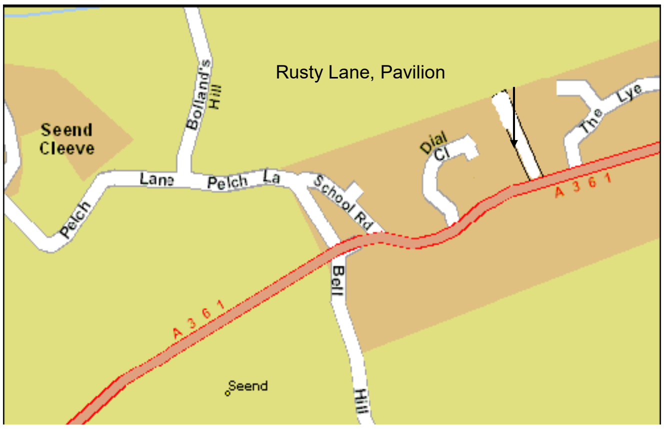
Speaker secretary

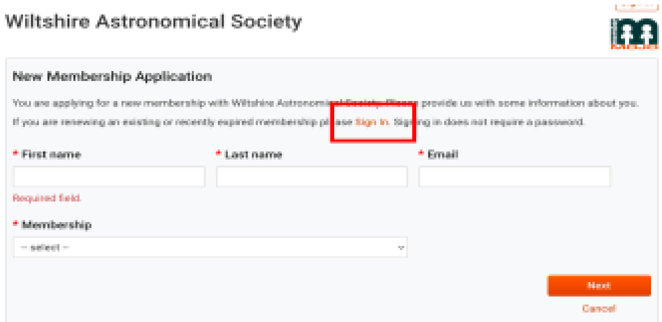
Zoom session coordinator

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, 21st June 2024:

Mary McIntyre FRAS: Shadows in Space & the stories they tell.

Mary moved to rural Oxfordshire in 2011 and, along with her husband Mark, they have a garden observatory. She is a dedicated astro-photographer and has been actively involved in astronomy outreach since 2015. She gives talks on Astronomy and Astrophotography to various groups, including camera clubs, astronomy societies, local schools, and Scouts, and also conducts astronomy sketching workshops. She enjoys sharing her knowledge and experiences.

Her talk, "Shadows in Space and the Stories They Tell," covers how shadows on Earth and the Moon provide valuable information. Additionally, she discusses how studying shadows captured by cameras on probes orbiting other planets and their moons can reveal significant insights.

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, 20 September 2024 @ 19:30

Owen Brazell: Choosing an Eyepiece – it is half the telescope

Friday, 18 October 2024 @ 19:30

Prof Martin Hendry MBE - The Science of Star Wars

Friday, 18 October 2024 @ 19:30

Prof David Southwood CBE: How and why the Icy Moons of Jupiter became a goal for space exploration?

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

BATH ASTRONOMERS

A friendly community of stargazers and enthusiastic astronomers who share experiences and know-how and offer an extensive outreach programme of public and young people's observing and activities. As a partner of Bath Preservation Trust and the Herschel Society, Bath Astronomers are the resident astronomers at the Herschel Museum of Astronomy. Bath Astronomers also operate a 5-metre mobile planetarium taking it to schools and community events to show off the night sky even when the clouds hide the starry sky.

Contact us using hello@bathastronomers.org.uk

Members:

Over 127 members enjoy free monthly talks, free access to the Herschel Museum, astronomy WhatsApp groups and free telescope loans. https://bathastronomers.org.uk/membership/ shows the benefits and annual subscription fees.

Next Gatherings:

Wednesday, **26th June 2024** – Talk by **Pete Richardson**, Construction of a 20" telescope with science grade optics… in your garage.

Wednesday, **25th September 2024** – Talk by **Prof. Catherine Heymans**, Astronomer Royal for Scotland

Wednesday, **30th October 2024** – Talk by **Prof. Chris Lintott**, Gresham Professor of Astronomy. To be held at BRLSI.

Wednesday, **27th November 2024** – Talk by **Dr Meganne Christian**, UK Reserve Astronaut. To be held at BRLSI.

Wednesday, **11th December 2024** – Talk by **Meyrick Williams** on planetary weather.

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

Venue for Gatherings:

Unless otherwise specified, meetings are held at the Herschel Museum of Astronomy, 19 New King Street, Bath, BA1 2BL.

The Team:

Chair: Simon Holbeche

Treasurer: Julia Matthews

Coordinators: Martin Farrell, Meyrick Williams, Prim Pike

Outreach Guru: Camilla Evans

Shared Stargazing:

Public stargazing is scheduled twice a month on Friday or Saturday evenings 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.

Public Solargazing is also scheduled when the weather permits with pop-up events at locations all over Bath to increase access. The society has a range of solar telescopes that are safe to share the Sun's surface with.

Outreach:

Bath Astronomers are very active providing stargazing, workshops and talks for the local community, schools, and young peoples' organisations. Planetarium shows, rocket launching, and night sky experiences. The offerings include the Discover Astronomy Loan Box, a flight case full of astronomy goodies for teachers and the classroom available for no charge.

Visit https://stem.bathastronomers.org.uk/ for more.

Video channel for BA adventures:

https://www.youtube.com/@bathastronomers

Web & Social Media links:

https://bathastronomers.org.uk

https://www.instagram.com/bathastronomers

https://bsky.app/profile/bathastronomers.org.uk

https://www.facebook.com/BathAstronomers

https://www.threads.net/@bathastronomers

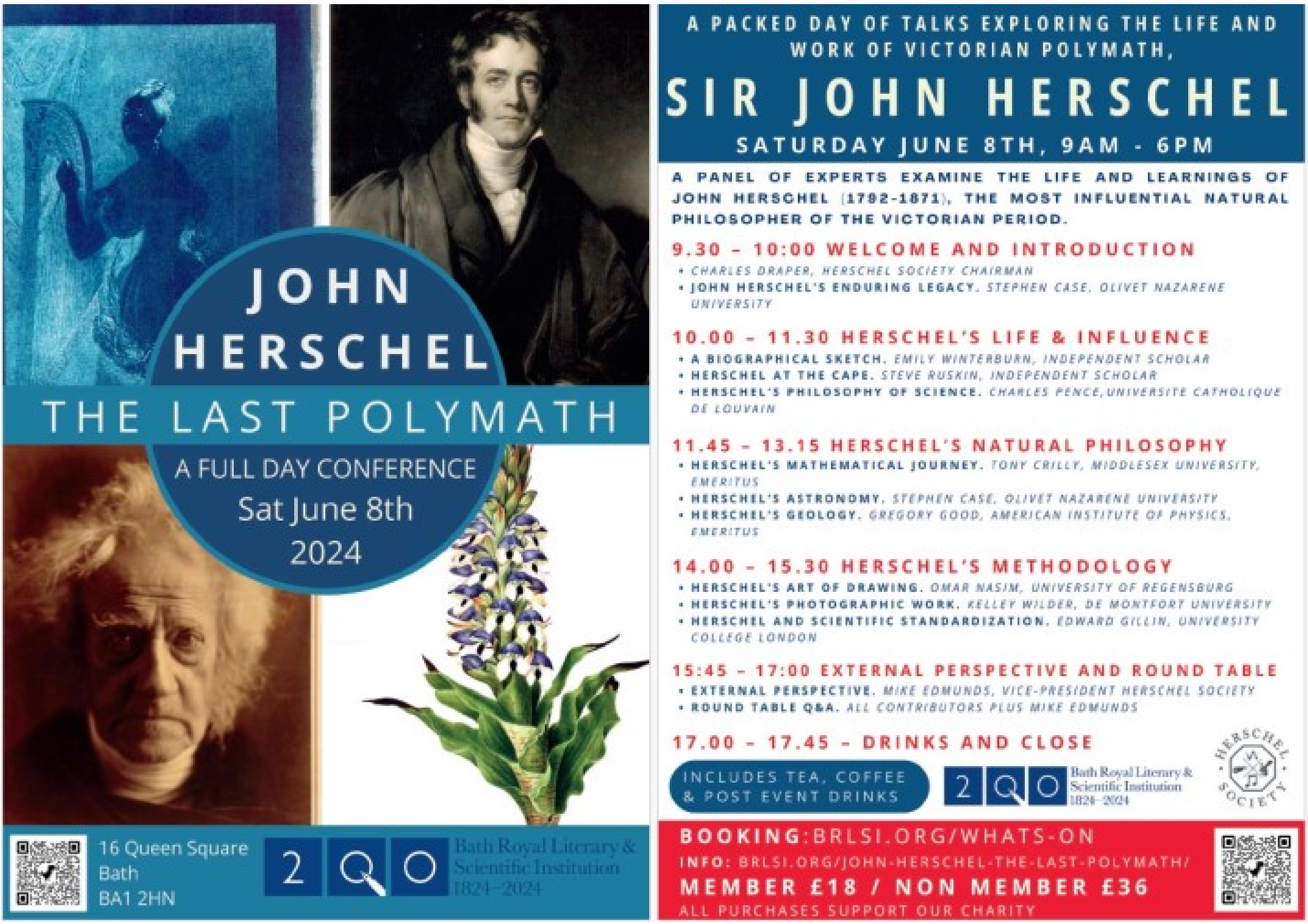
https://mastodonapp.uk/@bathastronomers

https://twitter.com/bathastronomers

John Hershel, the Last Polymath
Bath Royal Literary and Scientific Institution
8 June 2024

John Herschel's Enduring Legacy
Stephen Case, Olivet Nazarene University
STEPHEN CASE is a professor in the Department of Chemistry and the Geosciences at Olivet Nazarene University. He is the author of *Making Stars Physical: The Astronomy of Sir John Herschel* (2018) and of the forthcoming *Creatures of Reason: John Herschel and the Invention of Science* (2024).

A Biographical Sketch
Emily Winterburn, independent scholar
EMILY WINTERBURN has been researching the Herschel family since 1999 when she became curator of astronomy at the Royal Observatory, Greenwich, and first encountered their collection of Herschel artefacts. She completed her PhD on the Herschels in 2011 and is the author of *The Stargazer's Guide: How to Read Our Night Sky* (2009) and *The Quiet Revolution of Caroline Herschel: the Lost Heroine of Astronomy* (2017).
Through careful selection of schools, tutors and university William Herschel created the perfect scientific education for his son John. At Cambridge, Herschel banded with other students to revolutionize British mathematics. Later he dabbled in chemistry, geology, and physics, seeking mentors and teachers throughout Europe. Gradually he began to



form an increasingly coherent view of "science." Herschel decided science could be about more than personal advancement and reputation building. It could be about making the world a better place. Through his father and aunt, he began to build expert knowledge on astronomical observing and instrumentation. During his long marriage to Margaret Stewart Herschel, Herschel's interest in science as a force for public good grew. Upon their return to England from South Africa, he joined committees and took up public office, cultivating a public persona that helped create the image of science and scientist we still recognize today.

Herschel at the Cape
Steve Ruskin, independent scholar
STEVE RUSKIN's work focuses on the history of nineteenth-century science, specifically astronomy, exploration, and the field sciences. He is the author of *John Herschel's Cape Voyage: Private Science, Public Imagination, and the Ambitions of Empire* (2004) and *America's First Great Eclipse: How Scientists, Tourists, and the Rocky Mountain Eclipse of 1878 Changed Astronomy Forever* (2017).
In 1833, John Herschel traveled with his family to the farthest edge of the British Empire. Resisting efforts by the Admiralty and Royal Family to fund his voyage, Herschel insisted that it be a "private adventure" and paid for everything from his own considerable funds. At the Cape, Herschel undertook a four-year survey of the entire visible skies of the southern hemisphere. He was also the unwitting subject of the infamous episode known as the "Great Moon Hoax." Herschel engaged in other scientific activities in South Africa as well, such as botanical classification, and briefly hosted a young Charles Darwin when HMS Beagle landed at the Cape in 1836. The results of this South African endeavor became the massive Cape Results, published in 1847 after his return to England.

Herschel's Philosophy of Science
Charles Pence, Universite catholique de Louvain
CHARLES H. PENCE is Chargé de cours at the Université catholique de Louvain, in Louvain-la-Neuve, Belgium, where he directs the Center for Philosophy of Science and Societies (CEFISES). He also serves as a co-editor of the journal *Philosophy, Theory, and Practice in Biology* (*PTPBio*). His work centers on the philosophy and history of biology, with a focus on the introduction and contemporary use of chance and statistics in evolutionary theory.
Scholarship on Herschel has underlined the extent to which his Preliminary Discourse *should be read in context, as more than a work purely concerning the methodology of science, fitting into a broader 19th-century tradition of pamphlets and books seeking to improve the human condition and provide advice for life. That said, it is still a work with injunctions about both how one ought to proceed in scientific inquiry and present those results. By examining Herschel's influence on Charles Darwin, Michael Faraday, and Charles Lyell, this talk treats his connections to the development of the physical sciences over the second half of the 19th century. Herschel's influence is emblematic of a shift toward professionalized and standardized presentations of scientific theories, one important aspect of the ongoing construction of the professional scientific career.*

Herschel's Mathematical Journey
Tony Crilly, Middlesex University, emeritus
TONY CRILLY is Emeritus Reader in Mathematical Sciences at Middlesex University. His principal research interest is the history of mathematics. He has written and edited many works on fractals, chaos and computing and is the author of *Arthur Cayley: Mathematician Laureate of the Victorian Era* (2005).
Entering St John's College in October 1809 Herschel had already been introduced to "French analytics." With a background in astronomy gained from his father, Herschel saw that analytics could advance celestial mechanics—yet the

course at Cambridge was of little help to him. The business of the university was the training of clerics, and mathematics was seen as a static body of knowledge laid down by Newton. In reaction to this mathematical stasis, Charles Babbage had the idea of forming an undergraduate mathematical society: the Analytical Society. This brought Herschel and Babbage together as the Society's leading lights. Herschel's Tripos rival George Peacock was also a member and translated Lacroix's Calculus, *replacing the "limit based approach" favoured by Lacroix with the algebraic version of Lagrange. As a Moderator of the Mathematical Tripos Peacock brought these ideas to bear on the Cambridge curriculum, and by the beginning of the 1820s the Cambridge Analytic Revolution had taken place. Though Herschel had by this time abandoned Cambridge, in 1821 he was awarded the Royal Society's highest honour, the Copley Medal, for his work in the new analysis.*

Herschel's Astronomy
Stephen Case, Olivet Nazarene University
In 1820, when Herschel began observing in earnest, astronomy largely involved positional measurements in fixed observatories. By the time of Herschel's death in 1871, the practice of astronomy had expanded to include investigating physical properties of stars, galaxies, and nebulae. Herschel was central to this shift, laying the foundations of astrophysics and establishing the "sidereal revolution" that William and Caroline Herschel had begun. Unifying the observational practices of his father and organizational techniques of his aunt, Herschel brought rigor to the observation of objects beyond the traditional remit of positional astronomy. This talk explores his work on double stars, which transformed observations of amateurs into a coordinated research program and helped confirm the extension of Newtonian gravity to the sidereal universe, and his role in shaping the nomenclature of the solar system as two aspects of his enduring astronomical legacy.

Herschel's Planet Earth
Gregory Good, American Institute of Physics, emeritus
GREGORY A. GOOD is Director Emeritus of the Center for History of Physics, American Institute of Physics. He writes about the history of Earth sciences from the time of John Herschel to the twenty-first century. His current books are on astronomers' research on Earth and on space weather.
Just as William Herschel discovered a planet, Uranus, his son John Herschel discovered the Earth. The younger Herschel worked his way through chemical, optical, mineralogical, and magnetic experimental series, keeping up with the best Continental experimenters. At the same time, he mastered celestial mechanics, from Newton to Lagrange and Laplace. With this background, Herschel launched himself into the scientific study of Earth, from its crystals and chemical constituents to the edge of space high in the Alps or on Mt. Aetna. He became a Fellow of the Geological Society and studied fossils, crystals, and strata as eagerly as any geologist, as well as developing new instruments for measuring the intensity of solar radiation and studying the absorption of radiation by the atmosphere. Herschel coordinated and encouraged observational networks in meteorology, geodesy, and tidal studies, was an essential supporter of the Magnetic Crusade of the 1840s, and promoted science on a global scale.

Herschel's Art of Drawing
Omar Nasim, University of Regensburg
OMAR W. NASIM is Professor of the History of Science at the University of Regensburg in Germany. He is the author of the award-winning book *Observing by Hand: Sketching the Nebulae in the Nineteenth Century* (2013) and more recently *The Astronomer's Chair: A Visual and Cultural History* (2021).
Herschel was an avid draughtsman. His well-developed skills were used not only to document his European Grand Tour and illustrate landscapes and ruins, as was the norm in the period; Herschel also deliberately employed his abilities with graphite pencils for the purposes of scientific observation. Besides his exquisite botanical illustrations, Herschel made sketches of celestial objects like nebulae and star-clusters. The extent to which he dedicated himself to these astronomical drawings betrays their importance to his work as an astronomer. This talk will detail the occasion, context, and purposes of Herschel's drawing practices, especially as a way to understand his scientific observational techniques. It will also attempt to situate those practices into a broader context of Herschel's graphical methods as applied to science. This informs an analysis of what Herschel thought to be the promises and ideals held out by photography for the sciences.

Herschel's Photographic Work
Kelley Wilder, De Montfort University
KELLEY WILDER is Professor of Photographic History and Director of the Photographic History Research Centre at De Montfort University (Leicester, UK). She has published widely on material cultures of nineteenth and twentieth century photography and science, including *Photography and Science* (2009) and, with Gregg Mitman, *Documenting the World: Film, Photography and the Scientific Record* (2016).
Herschel's involvement with photography remains little known, in spite of his central place in its early years. Throughout his long career, Herschel maintained an active correspondence on his photography, or, as he sometimes called it, his actinochemistry. Collections show the remarkable extent to which Herschel's activity has been defined by photohistorical ambitions directed toward origin stories of photography. Nearly every photographic history mentions Herschel but confines his contribution to the invention of terminology, with a passing mention of this invention of the cyanotype process. Newly digitized materials have increased the visibility of Herschel's photographic experiments, allowing a reappraisal of his activity. Through Herschel's early interest in light sensitivity, which yielded numerous papers, this talk expands on Herschel as a central figure in early photography, through the early years of photochemistry and his role in collecting a substantial photographic archive, which has shaped the way we think about early photography.

Herschel and Scientific Standardization
Edward Gillin, University College London
EDWARD J. GILLIN is Lecturer in the History of Building Sciences and Technology at the Bartlett School of Sustainable Construction, UCL. His books include *Entente Imperial: British and French Power in the Age of Empire* (2022), *Sound Authorities: Scientific and Musical Knowledge in Nineteenth-century Britain* (2021), and *An Empire of Magnetism: Global Science and the British Magnetic Survey in the Age of Imperialism* (2023).
In 19th-century Britain, few individuals rivaled Herschel's scientific authority, and it was through questions of standardization and measurement that these credentials were most clearly demonstrated. Following the loss of the nation's standard set of weights and measures in the fire that destroyed the Palace of Westminster in 1834, Herschel secured appointment to the parliamentary commission charged with devising a new imperial system of measurement. Having previously worked to standardize astronomical practices, he took a central role in the formation of Britain's new Imperial Yard. When, in the 1860s, politically radical MPs proposed the adoption of the French metric system, Herschel responded by proposing an entirely new decimalized yard. As Master of the Mint from 1850-55, Herschel took responsibility for national questions of currency, of which metallurgic standards were crucial, and in his later years he became increasingly concerned with the standardization of musical notes and practice by the application of mathematical principles.

SPACE NEWS

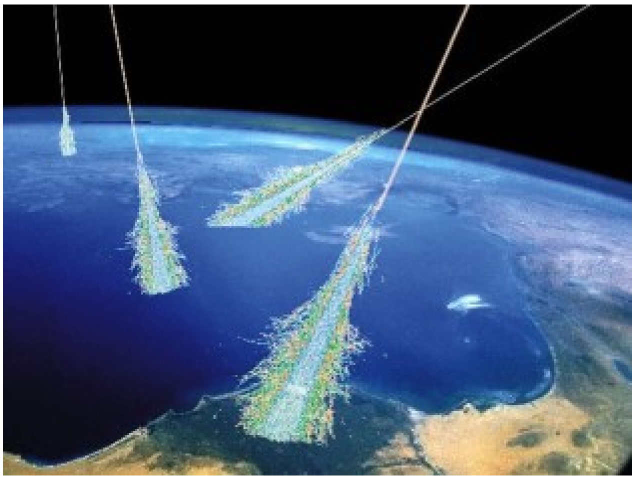
41,000 Years Ago Earth's Shield Went Down

Earth is naked without its protective barrier. The planet's magnetic shield surrounds Earth and shelters it from the natural onslaught of cosmic rays. But sometimes, the shield weakens and wavers, allowing cosmic rays to strike the atmosphere, creating a shower of particles that scientists think could wreak havoc on the biosphere.

This has happened many times in our planet's history, including 41,000 years ago in an event called the Laschamps excursion.

Cosmic rays are high-energy particles, usually protons or atomic nuclei, that travel through space at relativistic speeds. Normally, they're deflected into space and away from Earth by the planet's magnetic shield. But the shield is a natural phenomenon and its strength fluctuates, as does its orientation. When that happens, cosmic rays strike the Earth's atmosphere.

That creates a shower of secondary particles called cosmogenic radionuclides. These isotopes become embedded in sediments and ice cores and even in the structure of living things like trees. There are different types of these isotopes, including ones like Calcium 41 and Carbon 14.



Showers of high-energy particles occur when energetic cosmic rays strike the top of the Earth's atmosphere. Illustration Credit: Simon Swordy (U. Chicago), NASA.

Some of the isotopes are stable, and some are radioactive. The radioactive ones have half-lives ranging from only 20 minutes (Carbon 11) up to 15.7 million years (Xenon 129.)

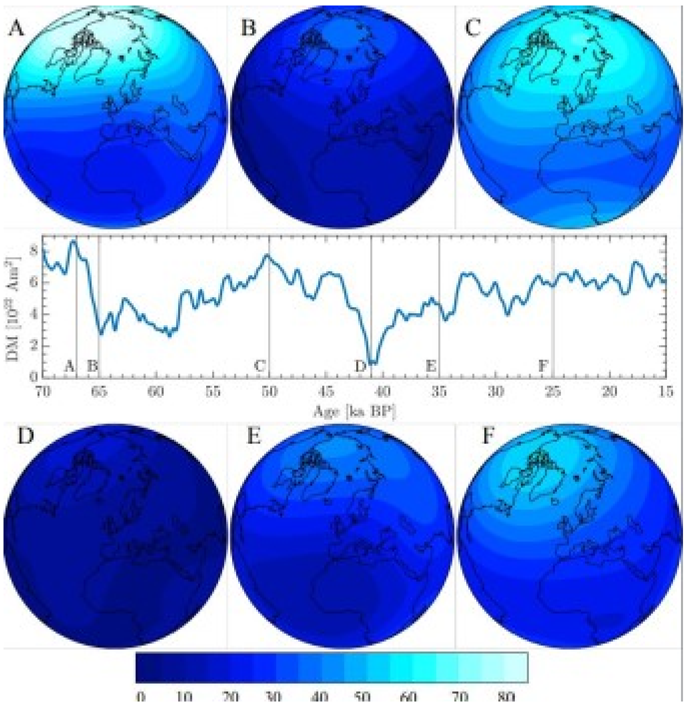
When Earth's shield weakens, more of these isotopes reach the planet's surface and collect in sediments and ice. By studying these cores and sediments, scientists can determine the magnetic shield's history. Their observations show that Earth experienced a geomagnetic excursion or reversal 41,000 years ago. It's called the Laschamps excursion after the Laschamps lava flows in France, where geomagnetic anomalies revealed its occurrence.

Every few hundred thousand years, the Earth's magnetic poles flip. North becomes South and vice versa. In between those major events are more minor events called excursions. During excursions, the poles shift around for a while without swapping places. The excursions weaken the Earth's shield and can last from a few thousand to tens of thousands of years. When that happens, more cosmic rays strike the atmosphere, creating more radionuclides that shower down onto Earth.

Scientists often focus on one particular radioactive isotope in paleomagnetic studies. Beryllium 10 has a relatively long half-life of 1.36 million years and tends to accumulate on the soil surface.

Sanja Panovska is a researcher at GFZ Potsdam, Germany, who studies geomagnetism. At the recent European Geosciences Union (EGU) General Assembly 2024, Panovska presented new research on the Laschamps excursion. She found that during the Laschamps excursion, production of Be 10 was twice as high as normal.

To understand the Laschamps excursion more thoroughly, Panovska combined cosmogenic radionuclide and paleomagnetic data to reconstruct the Earth's magnetic field at the time. She found that when the field decreased in strength, it also shrank. The transition from normal field to reversed field took about 250 years, and it stayed flipped for about 440 years. During the transition, the Earth's shield weekend to as little as 5% of its normal strength. When it was fully reversed, it was at about 25% of its regular strength. This weakening allowed more Be 10 and other cosmogenic radionuclides to reach Earth's surface.



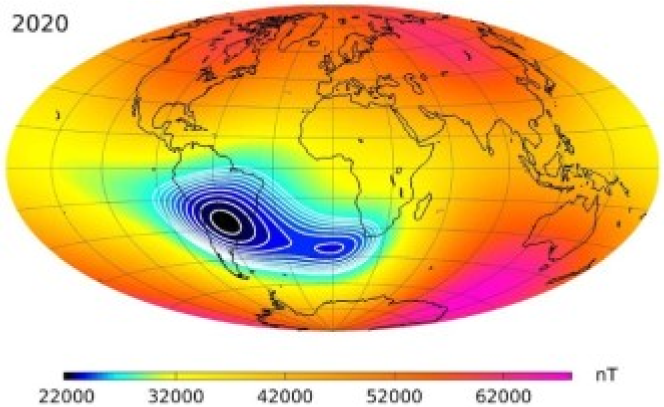
Each map shows the intensity of Earth's geomagnetic field at different snapshots in time, according to Panovska's reconstructions that are constrained by both paleomagnetic data and records of cosmogenic beryllium-10 radionuclides. DM stands for Dipole Moment, which is a measure of the field's polarity or separation of positive and negative. Age [ka BP] is the age measures in thousands of years before the present. Image Credit: Sanja Panovska.

These radionuclides do more than collect in sediments and ice. Some of them are radioactive. The weakening of the shield also weakened the ozone layer, letting more UV radiation reach Earth's surface. The high-altitude atmosphere also cooled, which changed the wind flows. This could've caused drastic changes on the Earth's surface.

For these reasons, the Laschamps event has been linked to the extinction of the Neanderthals, the extinction of Australian megafauna, and even to the appearance of cave art. Those links haven't withstood scientific scrutiny, but that doesn't mean that events like the Laschamps event aren't hazardous. If it occurred now, it would knock out our power grids. The Earth's equatorial region would light up with aurorae.

"Understanding these extreme events is important for their occurrence in the future, space climate predictions, and assessing the effects on the environment and on the Earth system," Panovska said.

Scientists are learning that the magnetic shield isn't static. There are anomalies. One of them is the South Atlantic Anomaly, a region where the magnetic field is weakest near Earth. When satellites pass over this region, they're exposed to higher levels of ionizing radiation. The anomaly is likely caused by a reservoir of dense rock inside Earth, illustrating how complex the magnetic shield is.



The 'South Atlantic Anomaly' refers to an area where Earth's protective magnetic shield is weak. Image Credit:
By Christopher C. Finlay, Clemens Kloss, Nils Olsen, Magnus D. Hammer, Lars Tøffner-Clausen, Alexander Grayver & Alexey Kuvshinov – "The CHAOS-7 geomagnetic field model and observed changes in the South Atlantic Anomaly", Earth, Planets and Space, Volume 72, Article number 156 (2020), https://earth-planets-space.springeropen.com/articles/10.1186/s40623-020-01252-9, CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=99760567

Scientists are uncertain about what effect the cosmic rays have on life when the magnetic shield is weak. It's tempting to correlate extinctions with events like the Laschamps excursion when they line up temporally. But the poles have shifted, weakened, and reversed many times and life is still here and still thriving.

If humanity lasts long enough, we'll go through one of these reversals. Then we'll know.

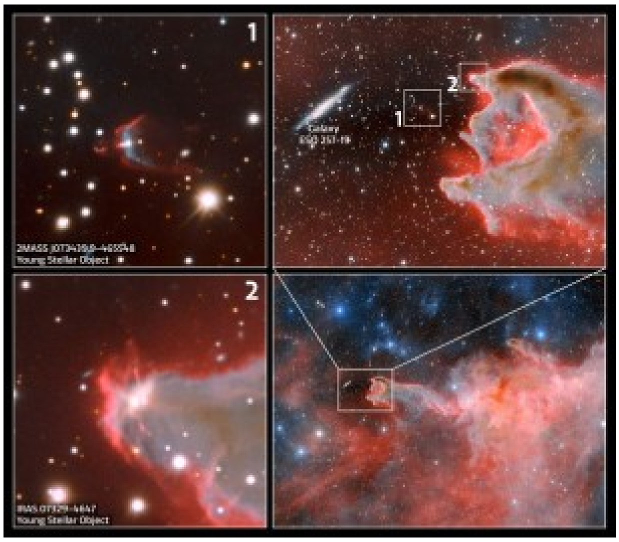
A Nebula that Extends its Hand into Space

The Gum Nebula is an emission nebula almost 1400 light-years away. It's home to an object known as "God's Hand" among the faithful. The rest of us call it CG 4.

Many objects in space take on fascinating, ethereal shapes straight out of someone's psychedelic fantasy. CG4 is definitely ethereal and extraordinary, but it's also a little more prosaic. It looks like a hand extending into space.

The Dark Energy Camera (DECam) on the NSF's Víctor M. Blanco 4-meter Telescope captured the image. DECam's primary job is to survey hundreds of millions of galaxies in its study of dark energy. But it's also a general-purpose instrument used for other scientific endeavours.

CG 4 is called a cometary globule because of its appearance. But it's actually a star-forming region. It has a head that's about 1.5 light-years in diameter and a tail that's about 8 light-years long. The head is dense and opaque and is lit up by a nearby star. The globule is surrounded by a diffuse red glow, emissions from ionized hydrogen.



This excerpt shows a close-up of CG 4. The hand looks like it's about to grasp an edge-on spiral galaxy named ESO 257-19 (PGC 21338). But the galaxy is more than a hundred million light-years beyond CG 4. Only a chance alignment makes it seem close. Near the head of the cometary globule are two young stellar objects (YSOs). They're stars in their early stage of evolution before they become main-sequence stars. Image Credits: Credit: CTIO/NOIRLab/DOE/NSF/AURA
Image Processing: T.A. Rector (University of Alaska Anchorage/NSF's NOIRLab), D. de Martin & M. Zamani (NSF's NOIRLab)

There are lots of cometary globules in the Milky Way. They're a sub-class of objects called Bok globules, after astronomer Bart Bok, who discovered them. Both types of globules are dark nebulae, molecular clouds so dense they block optical light. Astronomers aren't absolutely certain how cometary globules get their shape.

But they do know what's happening to them.

The red glow surrounding CG 4 is ionized hydrogen lit up by radiation from nearby hot, massive stars. That same radiation is eroding CG 4 away. Since the globule is denser than its surroundings, it's resisting diffusion. It still contains enough gas and dust to form several new stars about as massive as the Sun.

In this zoom-in, the hand looks more like the mouth of the

Shai-Hulud, reaching out into space to destroy the approaching Sardaukar. Image Credit: CTIO/NOIRLab/DOE/NSF/AURA. Image Processing: T.A. Rector (University of Alaska Anchorage/NSF's NOIRLab), D. de Martin & M. Zamani (NSF's NOIRLab)

Even though there are many of these globules in the Milky Way, the majority of them are in the Gum Nebula. Scientists know of 31 other globules in the nebula. This one's called CG 4 (Cometary Globule 4) because they're all numbered.

This image shows three of the 32 CGs in the Gum Nebula: CG 30, 31, and 8. Image Credit: By Legacy Surveys / D.Lang (Perimeter Institute) & Meli Thev – Own work, CC BY 4.0, https://commons.wikimedia.org/w/index.php?curid=143429111

The Gum Nebula is likely the remnant of a huge supernova explosion, and that could be the reason the globules have their unique shape. They may have originally been spherical nebula like the Ring Nebula. But a powerful supernova explosion about one million years ago stretched them into their long, comet-like forms.

The James Webb Space Telescope captured this image of the Southern Ring Nebula, or NGC 3132, with its NIRCAM instrument. Cometary globules could've started out as ring-shaped nebulae before being deformed by supernova explosions. Image Credit: By Image: NASA/ESA/CSA/Space Telescope Science Institute. Public Domain

Astronomers also suggest another reason for their shape. Nearby hot, massive stars exert radiation pressure on the globules, and their stellar wind also slams into them. In the Gum Nebula, their tails point away from the Vela Supernova Remnant and the pulsar that sits in its centre. Since the Vela Pulsar is a spinning neutron star, it's possible that its winds and radiation pressure are shaping CG 4.

We Need to Consider Conservation Efforts on Mars

Astrobiology is the field of science that studies the origins, evolution, distribution, and future of life in the Universe. In practice, this means sending robotic missions beyond Earth to analyze the atmospheres, surfaces, and chemistry of extraterrestrial worlds. At present, all of our astrobiology missions are focused on Mars, as it is considered the most Earth-like environment beyond our planet. While several missions will be destined for the outer Solar System to investigate "Ocean Worlds" for evidence of life (Europa, Ganymede, Titan, and Enceladus), our efforts to find life beyond Earth will remain predominantly on Mars.

If and when these efforts succeed, it will have drastic implications for future missions to Mars. Not only will great care need to be taken to protect Martian life from contamination by Earth organisms, but precautions must be taken to prevent the same from happening to Earth (aka. Planetary Protection). In a recent study, a team from the University of New South Wales (UNSW) in Sydney, Australia, recommends that legal or normative frameworks be adopted now to ensure that future missions do not threaten sites where evidence of life (past or present) might be found.

The study was led by Clare Fletcher, a Ph.D. student with the Australian Centre for Astrobiology (ACA) and Earth and Sustainability Science Research Centre at UNSW. She was joined by Professor Martin Van Kranendonk, a researcher with the ACA and the head of the School of Earth and Planetary Sciences at Curtin University, and Professor Carol Oliver of the School of Biological, Earth & Environmental Sciences at UNSW. Their research paper, "Exogeoconservation of Mars," appeared on April 21st in *Space Policy*.

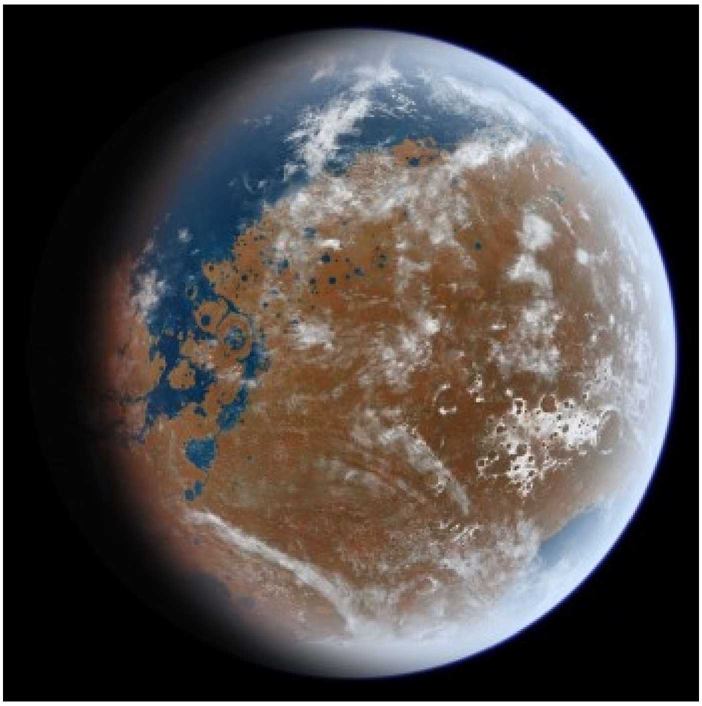
The search for life on Mars can be traced to the late 19th and early 20th centuries when Percival Lowell made extensive observations from his observatory in Flagstaff, Arizona. Inspired by Schiaparelli's illustrations of the Martian surface (which featured linear features he called "canali"), Lowell recorded what he also believed were canals and spent many years searching for other indications of infrastructure and an advanced civilization. During the ensuing decades, observatories worldwide observed Mars closely, looking for indications of life and similarities with Earth.

However, it was not until the Space Age that the first robotic probes flew past Mars, gathering data directly from its atmosphere and taking close-up images of the surface. These revealed a planet with a thin atmosphere composed predominantly of carbon dioxide and a frigid surface that did not appear hospitable to life. However, it was the *Viking 1* and *2* missions, which landed on Mars in 1976, that forever dispelled the myth of a Martian civilization. But as Fletcher told Universe Today via email, the possibility of extant life has not been completely abandoned:

"It's my personal belief that it is unlikely we will find evidence

of extant (current) life on Mars, as opposed to evidence of past life on Mars. If we were to find extant life on Mars that could be proven to be endemic to Mars and not contamination from Earth, some think it might be found underground in lava tubes, for example, and some think the ice caps or any possible source of liquid water might be suitable places."

Ironically, it was the same missions that discredited the notion of there being life on Mars that revealed evidence that water once flowed on its surface. Thanks to the many orbiter, lander, and rover missions sent to Mars since the turn of the century, scientists theorize that this period coincided with the Noachian Era (ca. 4.1 – 3.7 billion years ago). According to the most recent fossilized evidence, it was also during this period that life first appeared on Earth (in the form of single-celled bacteria).



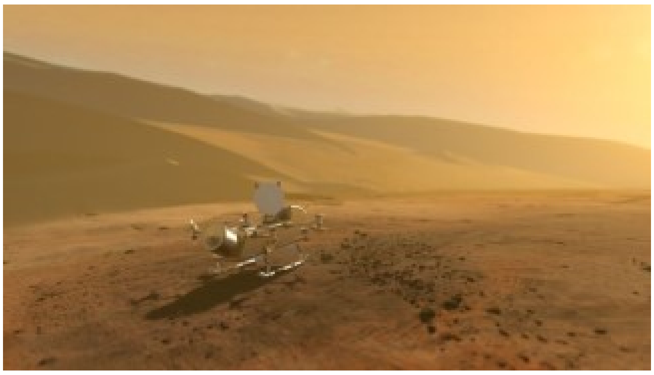
Artist's impression of Mars during the Noachian Era. Credit: Ittiz/ Wikipedia Commons

Our current astrobiology efforts on behalf of NASA and other space agencies are focused on Mars precisely for this reason: to determine if life emerged on Mars billions of years ago and whether or not it co-evolved with life on Earth. This includes the proposed Mars Sample Return (MSR) mission that will retrieve the drill samples obtained by the Perseverance rover in the Jezero Crater and return them to Earth for analysis. In addition, NASA and China plan to send crewed missions to Mars by 2040 and 2033 (respectively), including astrobiology studies.

These activities could threaten the very abodes where evidence of past life could be found or (worse) still exists. "Human activities might threaten sites like this in part due to possible microbial contamination," said Fletcher. "Evidence of life (past and extant) also has greater scientific value when in its palaeoenvironmental context, so any human activities that might damage the evidence of life and/or its surrounding environmental context pose a risk. This could be something innocuous, like debris falling in the wrong spot, or something more serious, like driving over possibly significant outcrops with a rover."

Conservation measures must be developed and implemented before additional missions are sent to Mars. Given humanity's impact on Earth's natural environment and our attempts to mitigate this through conservation efforts. In particular, there have been numerous cases where scientific studies were conducted without regard for the heritage value of the site and where damage was done because of a lack of proper measures. These lessons, says Fletcher, could inform future scientific efforts on Mars:

"It's important that we learn from what has been considered "damaging" on Earth and take this into consideration when exploring Mars. If a site is damaged beyond being able to be studied in the future, then we limit what can actually be learned from a site. When considering Mars missions cost billions of dollars and are to meet specific scientific goals, limiting the information being learned from a site is incredibly detrimental. My recommendations are that of my paper: interdisciplinary cooperation, drawing on experience and knowledge from Earth, creating norms and a code of practice (part of my PhD work), and working towards creating legislation for these issues."



Artist's rendition of NASA's Dragonfly on the surface of Titan. Credit: NASA/Johns Hopkins APL/Steve Gribben

The need for exogeoconservation is paramount at this juncture. In addition to Mars, multiple astrobiology missions will travel to the outer Solar System this decade to search for evidence of life on icy moons like Europa, Ganymede, Titan, and Enceladus. This includes the ESA's JUpiter ICy moons Explorer (JUICE) mission, currently en route to Ganymede, and NASA's Europa Clipper and Dragonfly missions that will launch for Europa and Titan in October 2024 and 2028 (respectively). Therefore, the ability to search for extant or past life without damaging its natural environment is an ethical and scientific necessity.

"I hope this paper is very much a starting point for anyone working in Mars science and exploration, as well as anyone thinking about space policy and exogeoconservation," said Fletcher. "My goal was to start drawing attention to these issues, and that way start a generation of researchers and practitioners focused on exogeoconservation of Mars."

Does the Milky Way Have Too Many Satellite Galaxies?

The Large and Small Magellanic Clouds are well known satellite galaxies of the Milky Way but there are more. It is surrounded by at least 61 within 1.4 million light years (for context the Andromeda Galaxy is 2.5 million light years away) but there are likely to be more. A team of astronomers have been hunting for more companions using the Subaru telescope and so far, have searched just 3% of the sky. To everyone's surprise they have found nine previously undiscovered satellite galaxies, far more than expected.

Data from Gaia (the satellite collecting accurate position information of astronomical objects) suggests that most of the satellite galaxies orbiting our own are newcomers! Even the Large and Small Magellanic Clouds are now known to be newcomers. Whether any of these will fall into orbit around the Milky Way is as yet unknown, largely because we do not have an accurate measure for the mass of our home Galaxy.

The recent search hopes to expand our understanding of this corner of the Universe with the first detailed search for companion dwarf galaxies. The paper from lead author Daisuke Homma and team from the National Astronomical Observatory of Japan reports on the findings of their survey using the Subaru Telescope.

Based on Mauna Kea in Hawaii The Subaru Telescope is an 8.2m diameter telescope located at the Mauna Kea Observatory in Hawaii. Until 2005 it was the largest single mirror telescope in the world with a gigantic 8.2 metre mirror. In all telescopes, larger mirrors collect more light bringing with it the ability to see fainter objects and finer levels of detail. A number of telescopes have now surpassed Subaru's massive light collecting power but multi-mirror telescopes are becoming more popular.

As the cornerstone of the study is a drive to understand dark matter distribution. The concept of the Universe being dominated by cold dark matter nicely describes the large scale model of the cosmos. It struggles however, to describe the structure in the local Universe predicting hundreds of satellite galaxies to the Milky Way. Until recently, we only knew of a handful of satellite galaxies contradicting the model in a quandary known as the missing satellites problem. The team from Japan hopes their work will help provide clues to understand this problem.

The paper reports that the previous data obtained before 2018 of an area of sky covering 676 degrees2 revealed three candidate satellite galaxies; Vir I, Cet III and Boo IV. Data released over the three years that followed covering 1,140 degrees2 revealed two additional candidates; Sext II and Vir III. Unexpectedly, the model suggests there should be 3.9 ± 0.9 satellite galaxies within 10 pc within the virial radius of the Milky Way (based on the density distribution of the Milky Way). Instead the team found more, nine to be precise! It seemed then that the missing satellite problem was no worse than expected, indeed there were too many galaxies!

The team acknowledged that their research was based on statistically small numbers and several assumptions had been made based on an isotropic distribution of satellites. To progress this further, there will need to be follow up studies of stars in the satellite galaxies and high resolution imaging.

Source : Final Results of Search for New Milky Way Satellites in the Hyper Suprime-Cam Subaru Strategic Program Survey: Discovery of Two More Candidates

Supermassive Black Holes Got Started From Massive Cosmic Seeds

Supermassive black holes are central to the dynamics and evolution of galaxies. They play a role in galactic formation, stellar production, and possibly even the clustering of dark matter. Almost every galaxy has a supermassive black hole, which can make up a small fraction of a galaxy's mass in nearby galaxies. While we know a great deal about these gravitational monsters, one question that has lingered is just how supermassive black holes gained mass so quickly.

Most of what we know about early black holes comes from quasars. These occur when supermassive black holes are in an extremely active phase, consuming prodigious amounts of matter and emitting intense light that can be seen across the Universe. Observations from the James Webb Space Telescope (JWST) and other observatories have observed quasars as far back as 13 billion years ago, meaning that they were already large and active just a few hundred million years after the big bang. But these brilliant beacons also pose an observational challenge. Early quasars are so bright they vastly outshine their host galaxy, making it difficult to observe the environments of early quasars. But a new study in *The Astrophysical Journal* has used a spectral trick to see these distant galactic hosts.

The team gathered JWST data on six distant quasars known to be about 13 billion light-years away. Since the quasars were observed at a range of wavelengths, the team then compared the light to model quasars and was able to categorize which wavelengths likely came from the compact source of the quasar, and which from the more diffuse galaxy surrounding it. By filtering out the quasar light, they obtained the first images of the distant galaxies that are home to these ancient quasars.

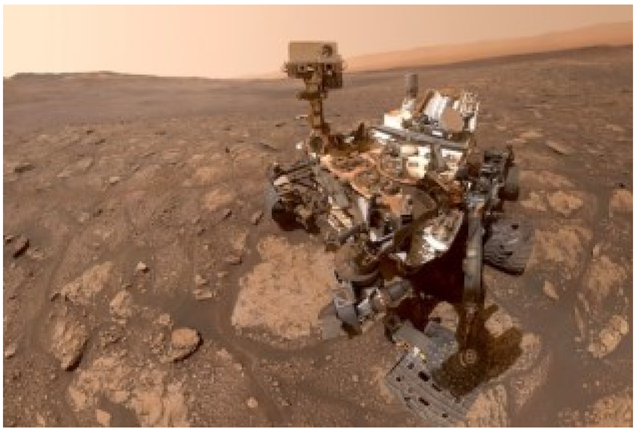
Since the brightness of each light source is related to its mass, the team could compare the mass of a quasar to the mass of its host galaxy. The result was surprising. In these early galaxies, the mass of the supermassive black hole is about 10% of that of the galaxy. This is much larger than the mass ratio seen in local galaxies, where supermassive black holes can comprise just a tenth of a percent of a galaxy's mass. This likely means that early supermassive black holes grew extremely quickly, and could have even been the seeds of their galaxies. The observations go against the idea that early galaxies formed first and that their black holes formed later.

Astronomers still don't know just how supermassive black holes formed so quickly in the early Universe, but it's now clear that they did. In answering one question about the evolution of supermassive black holes, the team has raised several other questions.

These Rocks Formed in an Ancient Lake on Mars

We already know that water has existed on the surface of Mars but for how long? Curiosity has been searching for evidence for the long term presence of water on Mars and now, a team of researchers think they have found it. The rover has been exploring the Gale Crater and found it contains high concentrations of Manganese. The mineral doesn't form easily on Mars so the team think it may have formed as deposits in an ancient lake. It is interesting too that life on Earth helps the formation of Manganese so its presence on Mars is a mystery.

The Mars Curiosity Rover was launched in November 2011. It arrived on 6 August 2012 in the Gale Crater region of Mars. It's purpose was to explore the geology of the area, climatic conditions and the potential for habitability for future explorers. We have seen stunning images from the surface of Mars thanks to Curiosity and our understanding of Mars both past and present has been improved as a result of its work.



New simulations are helping inform the Curiosity rover's ongoing sampling campaign. Credit:NASA/JPL-Caltech/MSSS

A paper published in the Journal of Geophysical Research : Planets has reported on findings using the ChemCam instrument on board Curiosity. The paper's lead author Patrick Gasda from the Los Alamos National Laboratory's Space Science and Application group announced the findings of high levels of manganese in rocks from the base of the crater. It is thought that the Gale Crater is an ancient lake so this poses interesting questions as to its origin.

On Earth, biological processes are fundamental to the formation of materials like manganese oxide with photosynthesis producing atmospheric oxygen. There are also microbes that act as a catalyst to the oxidisation of manganese. The problem is that there is no such sign other life on Mars so the process that led to the formation of oxygen in the ancient Martian atmosphere is unclear. If we cannot understand the formation of oxygen, then we struggle to understand how manganese oxide might form. Perhaps something relating to large bodies of surface water could be responsible.

The ChemCam instrument on Curiosity uses a laser to generate small amounts of plasma on the surface of Martian rocks. Light is then collected to enable the composition of the rock to be identified. The team studied sand, silts and muds, the former being more porous than the latter. The majority of the manganese found in the sands is thought to have been the result of ground water percolation. On Earth the manganese is oxidised by atmospheric oxygen in a process that is accelerated by microbes.

We still don't have all the answers but but the study has revealed yet again, to an environment that was once suitable for life. That environment seems similar to many places on Earth that also display rich manganese deposits.

Gravitational Lenses Could Pin Down Black Hole Mergers with Unprecedented Accuracy

Gravitational wave astronomy has been one of the hottest new types of astronomy ever since the LIGO consortium officially detected the first gravitational wave (GW) back in 2016. Astronomers were excited about the number of new questions that could be answered using this sensing technique that had never been considered before. But a lot of the nuance of the GWs that LIGO and other detectors have found in the 90 gravitational wave candidates they have found since 2016 is lost.

Researchers have a hard time determining which galaxy a gravitational wave comes from. But now, a new paper from researchers in the Netherlands has a strategy and developed some simulations that could help narrow down the search for the birthplace of GWs. To do so, they use another darling of astronomers everywhere—gravitational lensing.

Importantly, GWs are thought to be caused by merging black holes. These catastrophic events literally distort space-time to the point where their merger causes ripples in gravity itself. However, those signals are extraordinarily faint when they reach us—and they are often coming from billions of light-years away

Detectors like LIGO are explicitly designed to search for those signals, but it's still tough to get a strong signal-to-noise ratio. Therefore, they're also not particularly good at detailing where a particular GW signal comes from. They can generally say, "It came from that patch of sky over there," but since "that patch of sky" could contain billions of galaxies, that doesn't do much to narrow it down.

Fraser discusses the crazy physics that happen when black holes run into each other.
But astronomers lose a lot of context regarding what a GW can tell them about its originating galaxy if they don't know what galaxy it came from. That's where gravitational lensing comes in.

Gravitational lenses are a physical phenomenon whereby the signal (in most cases light) coming from a very faraway object is warped by the mass of an object that lies between the further object and us here on Earth. They're responsible for creating "Einstein Rings," some of the most spectacular astronomical images.

Light is not the only thing that can be affected by mass, though—gravitational waves can, too. Therefore, it is at least possible that gravitational waves themselves could be warped by the mass of an object between it and Earth. If astronomers are able to detect that warping, they can also tell which specific galaxy in an area of the sky the GW sign is coming from.

Once astronomers can track down the precise galaxy, creating a gravitational wave, the sky is (not) the limit. They can narrow down all sorts of characteristics not only of the wave-generating galaxy itself but also of the galaxy in front of it, creating the lens. But how exactly should astronomers go about doing this work?

Fraser celebrates the workhorses of the GW detector stable – LIGO and VIRGO – coming back online after upgrades.
That is the focus of the new paper from Ewoud Wempe, a PhD student at the University of Groningen, and their co-authors. The paper details several simulations that attempt to narrow down the origin of a lensed gravitational wave. In particular, they use a technique similar to the triangulation that cell phones use to determine where exactly they are in relation to GPS satellites.

Using this technique can prove fruitful in the future, as the authors believe there are as many as 215,000 potential GW lensed candidates that would be detectable in data sets from the next generation of GW detectors. While those are still coming online, the theoretical and modeling worlds remain hard at work trying to figure out what kind of data would be expected for different physical realities of this newest type of astronomical observation.

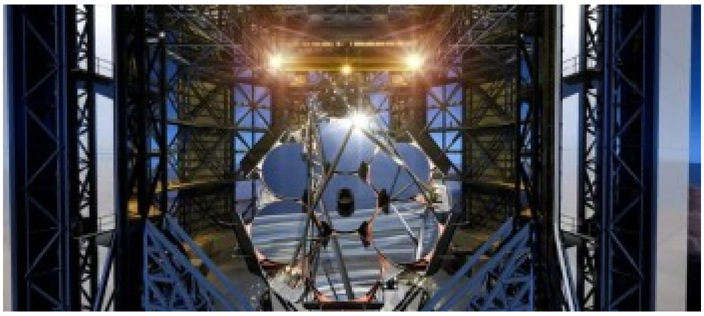
Learn More:
Wempe et al. – On the detection and precise localization of merging black holes events through strong gravitational lensing
UT – After Decades of Observations, Astronomers have Finally Sensed the Pervasive Background Hum of Merging Supermassive Black Holes
UT – A Neutron Star Merged with a Surprisingly Light Black Hole
UT – When Black Holes Merge, They'll Ring Like a Bell

Three of the Oldest Stars in the Universe Found Circling the Milky Way

Mention the Milky Way and most people will visualise a great big spiral galaxy billions of years old. It's thought to be a galaxy that took shape billions of years after the Big Bang. Studies by astronomers have revealed that there are the echo's of an earlier time around us. A team of astronomers from MIT have found three ancient stars orbiting the Milky Way's halo. The team think these stars formed when the Universe was around a billion years old and that they were once part of a smaller galaxy that was consumed by the Milky Way.

The Milky Way is our home galaxy within which our entire Solar System and an estimated 400 billion other stars. It measures 100,000 light years from sided to side and is home to almost everything else we can see in the sky with our naked eyes. On a clear dark night we can see the combined light from all the stars in the galaxy forming a wonderful band of hazy light arching across the sky from horizon to horizon. If you could view the Galaxy from the outside its broad shape would resemble two fried eggs stuck back to back.

The story of the discovery takes us back to 2022 during a new Observational Stellar Archaeology course at MIoT when students were learning how they can analyse ancient stars. They then applied them to stars that have not yet been analysed. They worked with data from the 6.5m Magellan-Clay telescope at Las Campanas Observatory and were searching for stars that had formed soon after the Big Bang. At this time in the evolution of the Universe, there was mostly hydrogen and helium with trace amounts of strontium and barium. The team therefore searched for stars with spectra indicating these elements



Precision manufacturing is at the heart of the Giant Magellan Telescope. The surface of each mirror must be polished to within a fraction of the wavelength of light. Image: Giant Magellan Telescope Organization

They honed in on just three stars that had been observed in 2013 and 2014 but they had not been previously analysed so were a great study for the students. On completion of their analysis (which took several hundred hours at a computer), the team identified that the stars had very low levels of strontium and barium as predicted if they were ancient stars. The stars they studied were estimated at having formed between 12 and 13 billion years ago. What wasn't clear was the origin of the stars. How did they come to be in the Milky Way given that it was relatively new and young.

The team decided to analyse the orbital characteristics of the stars to see how they moved. The stars were all in different locations through the Milky Way's halo and all thought to be about 30,000 light years from Earth. Comparing the motion with data from the Gaia astrometric satellite they discovered the stars were going in the opposite direction to the majority of other stars in the Milky Way. We call this retrograde motion and it suggests the stars came from somewhere else, not having formed with the Milky Way. The chemical signatures of the stars coupled with their motion give strong credibility to the liklihood these ancient stars are not native to the Milk Way.

Now they have developed there approach to identify ancient stars, the students are keen to expand their search to see if any others can be located. However with 400 billion stars in the Milky Way, a slightly more efficient method needs to be found.

New Answers for Mars' Methane Mystery

Planetary scientists perk up whenever methane is mentioned. Methane is produced by living things on Earth, so it's considered to be a potential biosignature elsewhere. In recent years, MSL Curiosity detected methane coming from the surface of Gale Crater on Mars. So far, nobody's successfully explained where it's coming from.

NASA scientists have some new ideas.

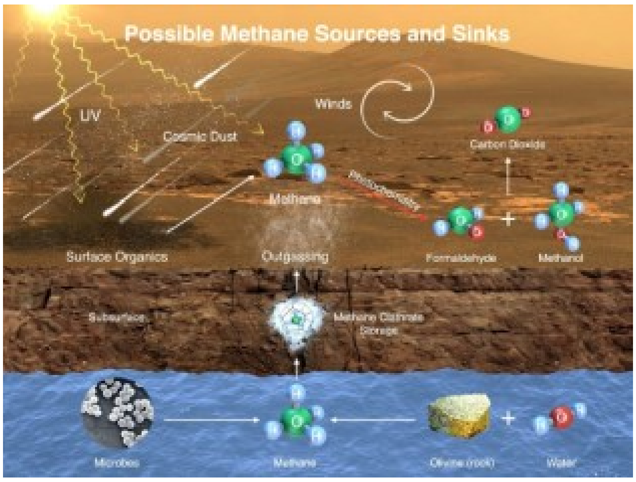
Ever since Curiosity landed on Mars in 2012, it's been sensing methane. But the methane displays some odd characteristics. It only comes out at night, it fluctuates with the seasons, and sometimes, the amount of methane jumps to 40 times more than the regular level.

The ESA's ExoMars Trace Gas Orbiter entered a science orbit around Mars in 2018, and scientists fully expected it to detect methane in the planet's atmosphere. But it didn't, and it has never been detected elsewhere on Mars' surface.

If life was producing the methane, it appears to be restricted to the subsurface under Gale Crater.

There's no convincing evidence that life exists on Mars. It may have in the past, and it's possible that some extant life clings to a tenuous existence in subsurface brines or something. But we lack evidence, so life is basically ruled out as the methane source. Especially since the evidence shows life would have to be under Gale Crater and nowhere else.

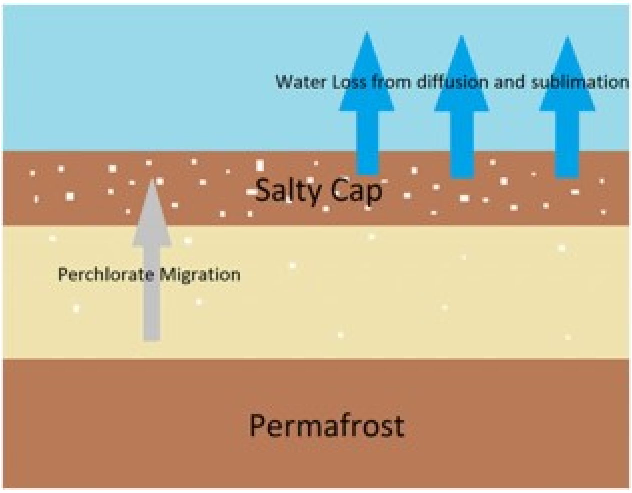
Scientists have been trying to determine the source of methane, but so far, they haven't come up with a specific answer. It has something to do with subsurface geological processes involving water, most likely.



This image illustrates possible ways methane might get into Mars' atmosphere and also be removed from it: microbes (left) under the surface that release the gas into the atmosphere, weathering of rock (right), and stored methane ice called a clathrate. Ultraviolet light can work on surface materials to produce methane as well as break it apart into other molecules (formaldehyde and methanol) to produce carbon dioxide. Credit: NASA/JPL-Caltech/SAM-GSFC/Univ. of Michigan

"It's a story with a lot of plot twists," said Ashwin Vasavada, Curiosity's project scientist at NASA's Jet Propulsion Laboratory in Southern California, which leads Curiosity's mission.

Alexander Pavlov is a planetary scientist at NASA's Goddard Space Flight Center who leads a group of NASA scientists studying the Martian Methane Mystery. In recent research, they suggested that the methane is stored underground. They didn't explain what produced it, but they showed that methane can be sealed underground by salt solidified in the Martian regolith.



This figure from research published in 2024 illustrates how a salt cap could form and trap methane under the Martian surface. There's strong evidence of subsurface water on Mars, and it can migrate to the surface and evaporate. Some of the salt in the ground is transported to the surface with the water. Once the water or ice is gone, the salt is left behind in the upper few centimetres of soil. The researchers hypothesized that the salt can become cemented into the same type of duricrust that the InSight lander struggled with. Image Credit: Pavlov et al. 2024.

They suggested that the methane could be released from its subsurface reservoir by the weight of the Curiosity rover itself. The rover's weight could break the salt seal and release methane in puffs. That's an interesting proposition, but it doesn't explain the seasonal and diurnal fluctuations. That makes sense since the Gale Crater is one of only two regions where a rover is working. The other is Jezero Crater, where the Perseverance Rover is working, but it doesn't have a methane detector. (Neither will the ESA's Rosalind Franklin rover, which is scheduled to land on Mars in 2029.)

The research group addressed those fluctuations by suggesting that seasonal and daily heating could also break the seal and release methane.

Their potential explanations stem from research Pavlov conducted in 2017. He grew bacteria called halophiles, which grow in salty conditions, in simulated Martian permafrost. The simulated soil was infused with salt, replicating conditions on much of Mars. The microbe growth was inconclusive, but the researchers noticed something else. As the salty ice sublimated, a layer of solidified salt remained, forming a crust.

"We didn't think much of it at the moment," Pavlov said.

But he remembered it when MSL Curiosity detected an unexplained burst of methane on Mars in 2019.

"That's when it clicked in my mind," Pavlov said. Then, he and a team of researchers began testing conditions that could form the hardened salt seals and then break them open.

Perchlorate is a chemical salt that's widespread on Mars. Pavlov and his fellow researchers recreated different simulated Martian permafrosts with varying amounts of perchlorate. Inside a Mars simulation chamber, they subjected the samples to different temperatures and atmospheric pressures to see if they would form seals.

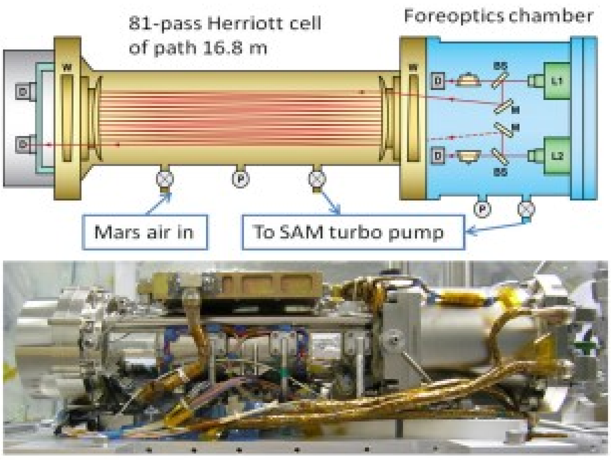
In their experiments, they used neon as a methane analog and injected it under the soil. Then, they measured the gas pressure below and above the soil. They found that the pressure was higher under the soil, meaning the gas was being trapped by the salty permafrost. Furthermore, they found that seals formed in samples containing as little as 5% or 10% perchlorate, and they formed within 3 to 13 days. Those are compelling results.

This image shows one of the Mars analog samples with a hardened crust of salt sealing the surface. The lighter colour is where the sample has been scratched. The lighter colour indicates drier soil, and once it was exposed to air outside the Mars Chamber, it quickly absorbed moisture and turned brown. Image Credit: Pavlov et al. 2018.

While 5-10% perchlorate doesn't sound like much, it's actually a higher concentration than in Gale Crater, where the methane has been detected. But perchlorate isn't the only salt in Martian regolith. It also contains sulphates, another type of salt mineral. Pavlov says he and his team will test sulphates next for their ability to form a seal.

The Martian Methane Mystery is commanding a lot of attention. It's a juicy mystery, and once it's solved, our understanding of methane as a biosignature or false positive will be much improved. NASA's 2022 Planetary Mission Senior Review recommended that the issue of methane production and destruction at Mars be investigated further.

The type of work that Pavlov and his colleagues are doing is important, but it's being held back. Pavlov says that they need more consistent methane measurements. The problem is that Curiosity's SAM (Sample Analysis at Mars) instrument, which senses the methane, is busy with other tasks. It only checks for methane a few times per year. It's mostly occupied with drilling samples and testing them, a critical and time-consuming part of the rover's mission.



The Tunable Laser Spectrometer is one of the tools within the Sample Analysis at Mars (SAM) laboratory on NASA's Curiosity Mars rover. By measuring the absorption of light at specific wavelengths, it measures concentrations of methane, carbon dioxide and water vapour in Mars' atmosphere. (Image Credit: NASA/JPL-Caltech)

"Methane experiments are resource intensive, so we have to be very strategic when we decide to do them," said Goddard's Charles Malespin, SAM's principal investigator.

Curiosity's mission wasn't designed to measure methane fluctuations. In 2017, NASA said its SAM instrument only sampled the atmosphere 10 times in 20 months. That's a very inconsistent sample that leaves lots of unanswered questions.

Scientists think another mission is needed to advance their understanding of Martian methane. Rather than one sensor taking irregular methane readings from one location, we need multiple testing stations on the surface that regularly monitor the atmosphere. Nothing like it is in the works.

"Some of the methane work will have to be left to future surface spacecraft that are more focused on answering these specific questions," Vasavada said.

Webb Sees Black Holes Merging Near the Beginning of Time

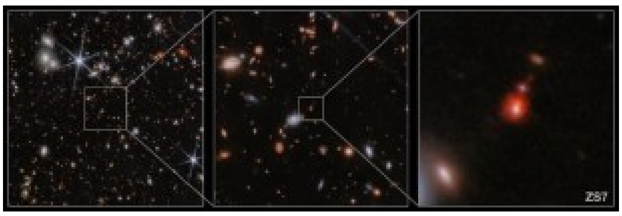
A long time ago, in two galaxies far, far away, two massive black holes merged. This happened when the Universe was only 740 million years old. A team of astronomers used JWST to study this event, the most distant (and earliest) detection of a black hole merger ever.

Such collisions are fairly commonplace in more modern epochs of cosmic history and astronomers know that they lead to ever-more massive black holes in the centers of galaxies. The resulting supermassive black holes can contain millions of billions of solar masses. They affect the evolution of their galaxies in many ways.

Using JWST and HST, astronomers have found behemoth black holes earlier and earlier in cosmic time, within the first billion years of the Universe's history. That raises the question: how did they get so massive so fast? Black holes accrete matter as they grow, and for the most supermassive ones, their colliding galaxies are part of that matter-harvesting history.

What JWST Shows Us about Early Black Holes Merging

The most recent JWST observations focused on a system called ZS7. It's a galaxy merger where two very early systems come together, complete with colliding black holes. This is not something astronomers can detect with ground-based telescopes. The merger itself lies quite far away. Plus, the expansion of the Universe stretches its light into the infrared part of the electromagnetic spectrum. That makes it inaccessible from Earth's surface. However, infrared is detectable with JWST's Near-infrared Spectrometer (NIRSpec). It can find signatures of mergers in the early Universe, according to astronomer Hannah Übler of the University of Cambridge in the United Kingdom.



Zeroing in on the ZS7 galaxy system and the colliding black holes. Courtesy: The field in which the ZS7 galaxy merger was observed by JWST. Courtesy ESA/Webb, NASA, CSA, J. Dunlop, D. Magee, P. G. Pérez-González, H. Übler, R. Maiolino, et. al

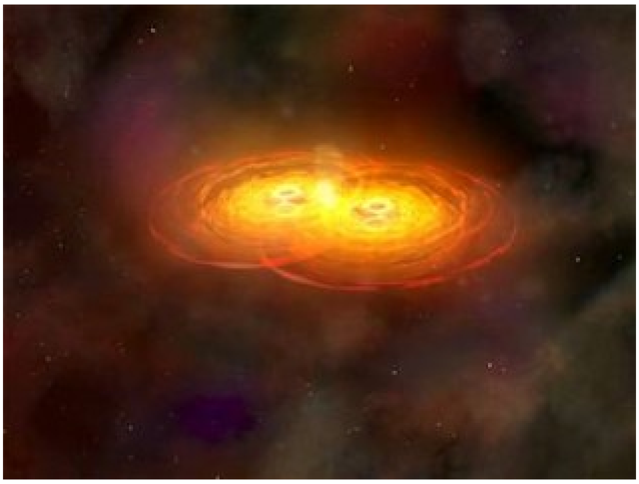
"We found evidence for very dense gas with fast motions in the vicinity of the black hole, as well as hot and highly ionized gas illuminated by the energetic radiation typically produced by black holes in their accretion episodes," said Übler, who is lead author on a paper about the discovery. "Thanks to the unprecedented sharpness of its imaging capabilities, Webb also allowed our team to spatially separate the two black holes."

Those black holes are pretty massive: one contains about 50 million solar masses. The other probably has about the same mass, but it's hard to tell because it's embedded in a dense gas region. The stellar masses of the galaxies puts them in about the same stellar-mass population as the nearby Large Magellanic Cloud, according to astronomer Pablo G. Pérez-González of the Centro de Astrobiología (CAB), CSIC/INTA, in Spain. "We can try to imagine how the evolution of merging galaxies could be affected if each galaxy had one supermassive black hole as large or larger than the one we have in the Milky Way".

Other Implications of Black Hole Mergers at Cosmic Dawn

The analysis of the JWST observations reinforces the idea that mergers are an important way for black holes to grow. That's particularly true in the early Universe, according to Ühler. "Together with other Webb findings of active, massive black holes in the distant Universe, our results also show that massive black holes have been shaping the evolution of galaxies from the very beginning."

Many active galactic nuclei (AGN) in the very early Universe are associated with somewhat massive black holes. These are likely part of a general merger process in early epochs. Astronomers want to know when these mergers began. That would help them pinpoint the growth of the central supermassive black holes. Mergers of that kind are a likely route for the growth of black holes so early in cosmic time.



An artist's impression of two merging black holes. Image: NASA/CXC/A. Hobart

That's why astronomers are so anxious to spot them with JWST and future telescopes. They hold the key to understanding the evolution of galaxies and black holes in the infancy of the Universe. Uhler and her team members point this out in their paper, saying: "Our results seem to support a scenario of an imminent massive black hole merger in the early universe, highlighting this as an additional important channel for the early growth of black holes. Together with other recent findings in the literature, this suggests that massive black hole merging in the distant universe is common."

Of course, these mergers don't just generate light we can detect with JWST. They also generate very faint gravitational waves. But, there's hope of detecting those waves with the upcoming Laser Interferometer Space Antenna (LISA). It will be in place in the 2030s and should be able to focus on the types of galaxy and black-hole mergers JWST is detecting today in infrared light.

The Venerable Hubble Space Telescope Keeps Delivering

The world was much different in 1990 when NASA astronauts removed the Hubble Space Telescope from Space Shuttle Discovery's cargo bay and placed it into orbit. The Cold War was ending, there were only 5.3 billion humans, and the World Wide Web had just come online.

Now, the old Soviet Union is gone, replaced by a smaller but no less militaristic Russia. The human population has ballooned to 8.1 billion. The internet is a fixture in daily life. We also have a new, more powerful space telescope, the JWST.

But the Hubble keeps delivering, as this latest image shows.

The lenticular galaxy NGC 4753 is about 60 million light-years away. Lenticular galaxies are midway between elliptical and spiral galaxies. They have large-scale disks but only poorly defined spiral arms. NGC 4753 sees very little star formation because like other lenticulars, it's used up most of its gas. The fact that they contain mostly older stars makes them similar to elliptical galaxies.

Among lenticulars, NGC 4753 is known for the dust lanes surrounding its nucleus. Astronomers think that spirals evolve into lenticulars in dense environments because they interact with other galaxies and with the intergalactic medium. However, NGC 4753 is in a low-density environment. Its environment and complex structure make it a target for astronomers to test their theories of galaxy formation and evolution.

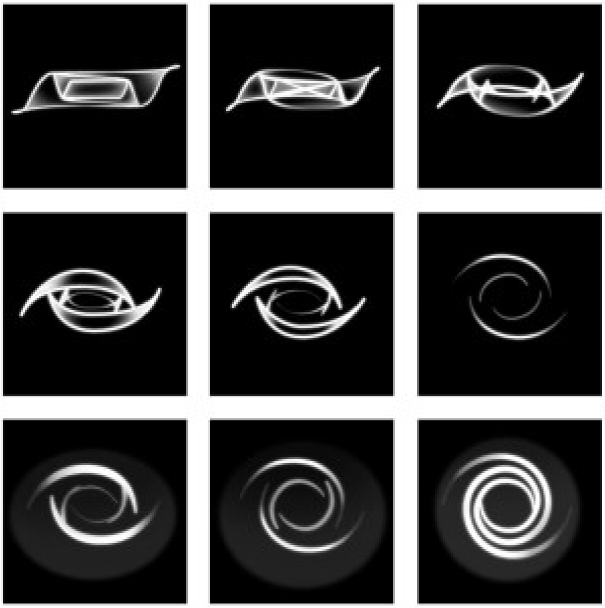
This Hubble image is the sharpest ever taken of NGC 4753, revealing its intriguing complexity and highlighting the space telescope's impressive resolving power.

Astronomers think that NGC 4753 is the result of a merger with a dwarf galaxy over one billion years ago. The dwarf galaxy was gas-rich, and NGC 4753's distinct dust rings probably accreted from the merger. NGC 4753's powerful gravity then shaped the gas into the complex shapes we see in this image. Image Credit: ESA/Hubble & NASA, L. Kelsey

NGC 4763's unique structure results from a merger with a dwarf galaxy about 1.3 billion years ago. The video below from NOIRlab explains what happened.

NGC 4753 also hosts two known Type 1a supernovae, which are important because they help astronomers study the expansion of the Universe. They serve as standard candles, an important rung in the cosmic distance ladder.

Galaxies like NGC 4753 may not be rare, but the viewing angle plays a key role in identifying them. Our edge-on view of the galaxy makes its lenticular form clear. We could be seeing others like it from different angles that obscure its nature.



This is a model of NGC 4753, as seen from various viewing orientations. From left to right and top to bottom, the angle of the line of sight to the galaxy's equatorial plane ranges from 10° to 90° in steps of 10°. Although galaxies similar to NGC 4753 may not be rare, only certain viewing orientations allow for easy identification of a highly twisted disk. This infographic is a recreation of Figure 7 from a 1992 research paper.

If we were looking at NGC 4753 from the "top" down, its detailed dust lanes wouldn't be obvious to us. But fortunately, we are.

And so is the Hubble.

Did Earth's Multicellular Life Depend on Plate Tectonics?

How did complex life emerge and evolve on the Earth and what does this mean for finding life beyond Earth? This is what a recent study published in *Nature* hopes to address as a pair of researchers investigated how plate tectonics, oceans, and continents are responsible for the emergence and evolution of complex life across our planet and how this could address the Fermi Paradox while attempting to improve the Drake Equation regarding why we haven't found life in the universe and the parameters for finding life, respectively. This study holds the potential to help researchers better understand the criterion for finding life beyond Earth, specifically pertaining to the geological processes exhibited on Earth.

Here, *Universe Today* discusses this study with Dr. Taras Gerya, who is a Professor of Earth Sciences at the Swiss Federal Institute of Technology (ETH-Zurich) and co-author of the study, regarding the motivation behind the study, significant results, follow-up studies, what this means for the Drake Equation, and the study's implications for finding life beyond Earth. So, what was the motivation behind this study?

Dr. Gerya tells *Universe Today*, "It was motivated by the Fermi Paradox ("Where is everybody?") pointing out that the Drake Equation typically predicts that there are from 1000 to 100,000,000 actively communicating civilizations in our galaxy, which is too optimistic of an estimate. We tried to figure out what may need to be corrected in this equation to make the prediction with the Drake Equation more realistic."

For the study, the research duo compared two types of planetary tectonic processes: single lid (also called stagnant lid) and plate tectonics. Single lid refers to a planetary body that does not exhibit plate tectonics and cannot be broken into separate plates that exhibit movement by sliding towards each other (convergent), sliding past each other (transform), or slide away from each other (divergent). This lack of plate tectonic activity is often attributed to a planetary body's lid being too strong and dense to be broken apart. In the end, the researchers estimated that 75 percent of planetary bodies that exhibit active convection within their interiors do not exhibit plate tectonics and possess single lid tectonics, with Earth being the only planet that exhibits plate tectonics. Therefore, they concluded that single lid tectonics "is likely to dominate the tectonic styles of active silicate bodies in our galaxy", according to the study.

Additionally, the researchers investigated how planetary continents and oceans contribute to the evolution of intelligent life and technological civilizations. They noted the significance of life first evolving in oceans due to them being shielded from harmful space weather with single-celled life thriving in the oceans for the first few billion years of Earth's history. However, the researchers also emphasize how dry land provides a myriad of benefits for the evolution of intelligent life, including adaptations to various terrains, such as eyes and new senses, which contributed to animals evolving for speed to hunt among other biological assets that enabled life to adapt to the various terrestrial environments across the planet.

In the end, the researchers concluded dry land helped contribute to the evolution of intelligent life across the planet, including abstract thinking, technology, and science. Therefore, what were the most significant results from this study, and what follow-up studies are currently in the works or being planned?

Dr. Gerya tells *Universe Today*, "That very special condition (>500 million years coexistence of continents, oceans, and plate tectonics) is needed on a planet with a primitive life in order to develop an intelligent technological communicative life. This condition is very rarely realized: only <0.003-0.2 % of planets with any life may satisfy this condition."

Dr. Gerya continues, "We plan to study water evolution in the planetary interior in order to understand how stability of surface ocean volume (implying stability of coexistence of oceans and continents) can be maintained for billions of years (like on Earth). We also plan to investigate the survival time of technological civilizations based on societal collapse models. We also started a project on the oxygenation state evolution of planetary interior and atmosphere in order to understand how oxygen-rich atmospheres (essential in particular for developing technological civilizations) can be formed on planets with oceans, continents and plate tectonics. Progress in these three directions is essential but will greatly depend on the availability of research funding."

As noted, this study was motivated and attempts to improve the Drake Equation, which proposes a multivariable equation that attempts to estimate the number of active, communicative civilizations (ACCs) that exist in the Milky Way Galaxy. It was proposed by in 1961 Dr. Frank Drake to postulate several notions that he encouraged the scientific community to consider when discussing both how and why we haven't heard from ACCs and reads as follows:

$$N = R_* \times f_p \times n_e \times f_l \times f_i \times f_c \times L$$

N = the number of technological civilizations in the Milky Way Galaxy who can potentially communicate with other worlds

R_* = the average star formation rate in the Milky Way Galaxy

f_p = the fraction of those stars with planets

n_e = the average number of planets potentially capable of supporting life per star with planets

f_l = the fraction of planets capable of supporting and developing life at some point in its history

f_i = the fraction of planets that develop life and evolves into intelligent life

f_c = the fraction of civilizations who develop technology capable of sending detectable signals into space

L = the length of time that technological civilizations send signals into space

According to the study, the Drake Equation estimates the number of ACCs range widely, between 200 to 50,000,000. As part of the study, the researchers proposed adding two additional variables to the Drake Equation based on their findings that plate tectonics, oceans, and continents have played a vital role in the development and evolution of complex life on Earth, which are as follows:

f_{oc} = the fraction of habitable exoplanets that possess notable continents and oceans

f_{pt} = the fraction of habitable exoplanets that possess notable continents and oceans that also exhibit plate tectonics that have been functioning for at least 500 million years

Using these two new variables, the study provided new estimates for f_i (chances of planets that develop life and evolve into intelligent life). So, what is the importance of adding two new variables to the Drake Equation?

Dr. Gerya tells *Universe Today*, "This allowed us to redefine and estimate more correctly the key term of the Drake equation f_i – probability of a planet with primitive life to develop an intelligent technological communicative life. Originally, f_i was (incorrectly) estimated to be very high (100%). Our estimate is many orders of magnitude lower (<0.003-0.2 %), which likely explains why we are not contacted by other civilizations."

Additionally, when inputting these two new variables into the entire Drake Equation, the study estimates a far smaller number of ACCs at < 0.006 to 100,000, which is in stark contrast to the original estimates of the Drake Equation of 200 to 50,000,000. Therefore, what implications could this study have on the search for life beyond Earth?

Dr. Gerya tells *Universe Today*, "It has three key consequences: (1) we should not hope much that we will be contacted (probability of this is very low, in part because the life time of technological civilizations can be shorter than previously expected), (2) we should use remote sensing to look for planets with oceans, continents and plate tectonics (COPT planets) in our galaxy based on their likely distinct (CO_2-poor) atmospheres and surface reflectivity signatures (due to the presence of oceans and continents), (3) we should take care about our own planet and civilization, both are extremely rare and must be preserved."

This study comes as the search for life beyond Earth continues to gain traction, with NASA having confirmed the existence of 5,630 exoplanets as of this writing, with almost 1,700 being classified as Super-Earths and 200 being classified as rocky exoplanets. Despite these incredible numbers, especially since exoplanets first started being discovered in the 1990s, humanity has yet to detect any type of signal from an extraterrestrial technological civilization, which this study referred to as ACCs.

Arguably the closest we have come to receiving a signal from outer space was the Wow! signal, which was a 72-second radio blast received by Ohio State University's Big Ear radio telescope on August 15, 1977. However, this signal has yet to be received since, along with a complete lack of signals at all. With this study, perhaps scientists can use these two new variables added to the Drake Equation to help narrow the scope of finding intelligent life beyond Earth.

Dr. Gerya concludes by telling *Universe Today*, "This research is part of an emerging new science – Biogeodynamics, which we try to support and develop. Biogeodynamics aims to understand and quantify relations between the long-term evolution of planetary interiors, surface, atmosphere, and life."

How will these two new variables added to the Drake Equation help scientists find life beyond Earth in the coming years and decades? Only time will tell, and this is why we science!

That Recent Solar Storm Was Detected Almost Three Kilometres Under the Ocean

Aurora at Cassidy Point, Northwest Territories, Canada
CREDIT: mericsso

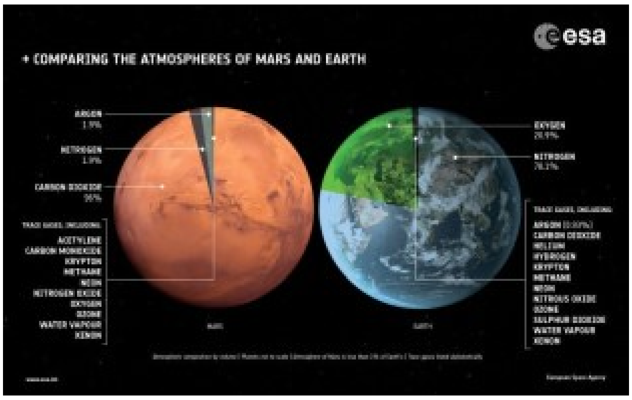
On May 10th, 2024, people across North America were treated to a rare celestial event: an aurora visible from the Eastern Seaboard to the Southern United States. This particular sighting of the Northern Lights (aka. Aurora Borealis) coincided with the most extreme geomagnetic storm since 2003 and the 27th strongest solar flare ever recorded. This led to the dazzling display that was visible to residents all across North America but was also detected by some of Ocean Networks Canada's (ONC) undersea sensors at depths of almost three kilometers.

Could Martian atmospheric samples teach us more about the Red Planet than surface samples?

NASA is actively working to return surface samples from Mars in the next few years, which they hope will help us better understand whether ancient life once existed on the Red Planet's surface billions of years ago. But what about atmospheric samples? Could these provide scientists with better information pertaining to the history of Mars? This is what a recent study presented at the *55th Lunar and Planetary Science Conference* hopes to address as a team of international researchers investigated the significance of returning atmospheric samples from Mars and how these could teach us about the formation and evolution of the Red Planet.

Here, *Universe Today* discusses this research with the study's lead author, Dr. Edward Young, who is a professor in the Department of Earth, Planetary, and Space Sciences at UCLA, and study co-author, Dr. Timothy Swindle, who is a Professor Emeritus in the Lunar & Planetary Laboratory at the University of Arizona, regarding the motivation behind the study, how atmospheric samples would be obtained, current or proposed missions, follow-up studies, and whether they think life ever existed on the Red Planet. Therefore, what was the motivation for the study?

Dr. Young tells *Universe Today*, "We learn a lot about the origin of a planet from its atmosphere as well as its rocks. In particular, isotope ratios of certain elements can constrain the processes leading to the formation of the planet."



Credit: European Space Agency

Dr. Swindle follows this with, "There are two basic types of motivation. One is that we're planning on bringing all these rock samples, and we're going to be interested in knowing how they've interacted with the atmosphere, but we can't figure that out without knowing the composition of the atmosphere in detail. So, we need an atmospheric sample to know what the rocks might have been exchanging elements and isotopes with. But we'd also like to have a sample of the Martian atmosphere to answer some basic questions about processes that have occurred, or are occurring, on Mars. For example, Martian meteorites contain trapped atmospheric noble gases, like krypton and xenon. But it appears that there are at least two different "atmospheric" components in those meteorites."

For the study, the researchers proposed several benefits of returning a Mars atmospheric sample to Earth, including atmospheric samples being among the NASA Perseverance (Percy) rover sample tubes, gaining insight into potential solar gar within the Martian interior, evolutionary trends in atmospheric compositions, nitrogen cycling, and sources of methane on Mars. For the Percy atmospheric sample, also known as Sample No.1 "Roubion", the study notes how this sample was obtained after Percy tried to collect a rock core sample but ended up collecting atmospheric gases instead. Additionally, the study proposes the lack of leakage the sample tube will experience while awaiting its return to Earth and the gases present within the sample are ideal for analysis once returned to Earth, as well. But aside from the Percy rover sample, how else could a Martian atmosphere sample be obtained?

"At least two other ideas for collecting a sample of Martian atmosphere have been suggested," Dr. Swindle tells *Universe Today*. "One is to fly a spacecraft through the Martian atmosphere, collect a sample as it goes through, then return it to Earth. The other is to have a sample return "cannister" (it doesn't have to be any bigger than a Perseverance tube) that has valves and a (Martian) air compressor. You could land it on the surface of Mars, open the valve to the atmosphere, turn on the compressor, and get a sample that has hundreds or thousands of times as much Martian atmosphere as a volume that is just sealed without compression, as Perseverance has done, and hopefully will do again."

Dr. Swindle and Dr. Young both mention the Sample Collection for Investigation of Mars (SCIM) mission, which was proposed in 2002 by a team of NASA and academic researchers with the goal of collecting atmospheric samples at an altitude of 40 kilometers (25 miles) above the Martian surface and return them to Earth for further analysis. While SCIM was selected as a semi-finalist for the 2007 Mars Scout Program, it was unfortunately not selected for further development, and both Dr. Young and Dr. Swindle tell *Universe Today* there are currently no atmospheric sample missions being planned aside from the Percy rover sample. Therefore, what follow-up studies from this research are currently underway or being planned?

Dr. Swindle and Dr. Young both mention how efforts are being made to collect small quantities of atmospheric gas due to the small size of the sample tubes, with Dr. Swindle telling *Universe Today*, "A big set of questions right now is how good a sealed Perseverance tube would be at containing an atmospheric sample. How good is the seal? Might the tube spring a leak on a hard landing? Would some molecules in the Martian atmosphere stick to the coatings of the tubes? There's been some activity on all of these questions, and so far, the answers have all been good – it looks like those Perseverance tubes may do well, even though they weren't really designed with atmospheric sampling in mind."

As noted, the purpose of obtaining and returning an atmospheric sample from Mars could help scientists better understand the formation and evolution of the Red Planet. While present-day Mars is a very cold and dry world with an atmosphere that is a fraction of the Earth's atmosphere, with liquid water being unable to exist on the surface, along with no active volcanism, as well. However, significant evidence obtained from landers, rovers, and orbiters over the last several decades point to a much different Mars billions of years ago after it first formed. This included an active interior that produced a magnetic field that shielded the surface from harmful solar and cosmic radiation, a much thicker atmosphere being replenished from active volcanism, and flowing liquid water, all of which potentially led to the existence of some forms of life on the surface.

However, given Mars' small size (half of Earth), this means its internal heat cooled off much faster (possibly over millions of years), resulting in volcanism becoming inactive and the dissipation of the magnetic field the interior activity was driving, the latter of which led to harmful solar and cosmic radiation stripping the atmosphere, with the surface liquid water evaporating to space along with it. Therefore, do Dr. Young and Dr. Swindle believe life ever existed on Mars, and will we ever find it?

Dr. Young tells *Universe Today*, "I really don't know. I think microbial life sometime in the past, or even now, is a reasonable hypothesis but we don't have enough information."

Dr. Swindle also echoes his uncertainty whether life ever existed on Mars, but elaborates by telling *Universe Today*, "If there hasn't, why did life start so early on Earth, but didn't start on Mars, which had a similar climate at the time. If there has been, how similar is it to life on Earth? Since Earth and Mars are always exchanging rocks because of impacts, is life on Earth related to life on Mars? If it has existed, it will be tough to find. But an atmospheric sample could help. For instance, there seems to be methane in the Martian atmosphere. Most, but not all, of the methane in Earth's atmosphere is biological, and analyzing the relative ratios of the isotopes of carbon or hydrogen is one of the best ways to figure that out."

When will we obtain an atmospheric sample of Mars and what will it teach us about the formation and evolution of the Red Planet in the coming years and decades? Only time will tell, and this is why we science!

Starlinks Can Produce Surprisingly Bright Flares to Pilots

How can sunlight reflecting off SpaceX's Starlink satellites interfere with ground-based operations? This is what a recently submitted study hopes to address as a pair of researchers investigate how Starlink satellites appear brighter—which the researchers also refer to as flaring—to observers on Earth when the Sun is at certain angles, along with discussing past incidents of how this brightness has influenced aerial operations on Earth, as well. This study holds the potential to help spacecraft manufacturers design and develop specific methods to prevent increased brightness levels, which would help alleviate confusion for observers on Earth regarding the source of the brightness and the objects in question.

Here, *Universe Today* discusses this research with Anthony Mallama of the IAU – Centre for the Protection of Dark and Quiet Skies from Satellite Constellation Interference regarding the motivation behind the study, significant results, potential follow-up studies, importance of studying Starlink satellite brightness, and implications for managing satellite constellations in the future. So, what was the motivation behind this study?

"I study the brightness of Starlink satellites under all circumstances," Mallama tells *Universe Today*. "That includes their operational phase at 550 km [342 mi] altitude, when they are rising from the initial orbit around 300 km [186 mi] to operation height, ordinary flares which occur frequently but have small amplitudes and these extreme flares."

For the study, the researchers conducted a geometrical analysis of the brightness of Starlink satellites based on the Sun's location and angle in the sky. This comes despite SpaceX taking steps to mitigate reflectivity off Starlink satellites, which only decreases reflectivity when the satellites are directly overhead. The study also discussed how reflectivity from Starlink satellites has affected aerial operations, specifically with commercial airline pilots. Therefore, what were the most significant results from this study?

Mallama tells *Universe Today*, "This study demonstrated that Starlinks can be exceedingly bright under certain conditions. In one instance they were reported as Unidentified Aerial Phenomenon (UAP) by pilots on two commercial aircraft."

Regarding potential follow-up studies, Mallama tells *Universe Today*, "I am characterizing the brightness of other satellite constellations including Amazon's Kuiper, AST SpaceMobile's BlueWalker/BlueBirds and Planet's Pelicans."

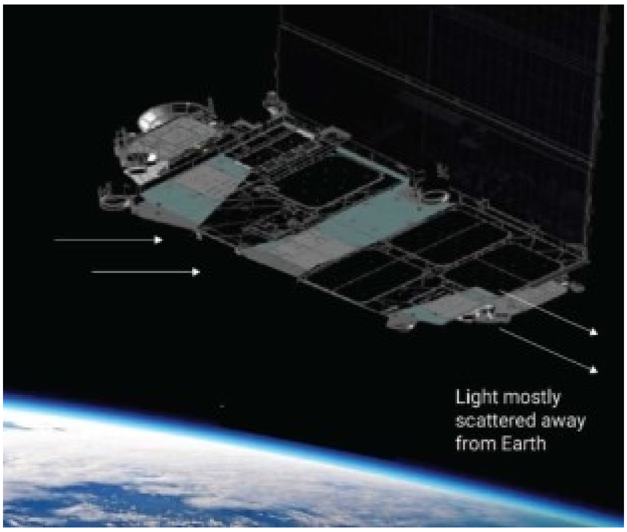
The study mentions how the UAP incidents occurred in 2022 and was recently discussed in Buettner et al (2024) with the pilots' reporting brightness magnitudes (also called stellar magnitude or apparent magnitude) of -4 to -5. For context, a stellar magnitude of -5 is equivalent to the planet Venus at its brightest, which is known for being observed before sunrise or after sunset periodically throughout the year. The apparent magnitude scale ranges from -30 to 30 with higher numbers corresponding to decreasing brightness.

Buettner et al (2024) was recently presented at the 4th IAA Conference on Space Situational Awareness (ICSSA). That paper discussed how the incident occurred on August 10, 2022, and was observed by five pilots aboard two separate commercial airline flights over the Pacific Ocean, which resulted in two photographs obtained by the pilot's cell phones. After analyzing a series of simulations and additional data, the researchers determined these UAPs were Starlink satellites launched earlier that day, which was designated as Starlink Group 4-26. Given this incident, what is the importance of studying Starlink brightness/flaring?

Mallama tells *Universe Today*, "The importance of studying Starlink brightness is that the satellites interfere with astronomical research if they are brighter than magnitude 7. Furthermore, casual sky watchers, such as amateur astronomers and naturalists, are distracted by those brighter than magnitude 6 because they are visible to the unaided eye."

This study comes as SpaceX's Starlink constellation continues to grow on a regular basis, with the number of current Starlink satellites in orbit have reached more than 5,600 with almost 6,000 having been launched by SpaceX as of this writing. As noted by both the study and Mallama, sunlight reflectivity off Starlink satellites causes issues with both aerial operations on Earth and astronomical observing, with Mallama also conducting research on satellite constellation brightness for Amazon, AST SpaceMobile, and Planet Labs. Therefore, with the number of satellites in orbit rapidly increasing due to constellations, what implications could this study have on managing satellite constellations in the future?

Mallama tells *Universe Today*, "One approach to reducing satellite brightness is to reflect sunlight into space rather than allowing it to scatter diffusively toward observers on the ground. That works very well most of the time. However, there are certain Sun-satellite-observer geometries where it fails and observers see a mirror-like reflection of the Sun." Mallam published a 2023 article with *Sky & Telescope* discussing how SpaceX's second-generation of Starlink satellites are fainter than their predecessors.



This diagram and artist illustration demonstrates how sunlight reflects off a Starlink version 1.5 satellite, and was discussed in a 2023 article authored by Anthony Mallama and published in Sky & Telescope. (Credit: SpaceX)

Mallama credits his co-author, Richard Cole, as playing a "crucial role" in this study, noting how Cole "predicted the extreme flares based on his numerical model of Starlink satellite brightness."

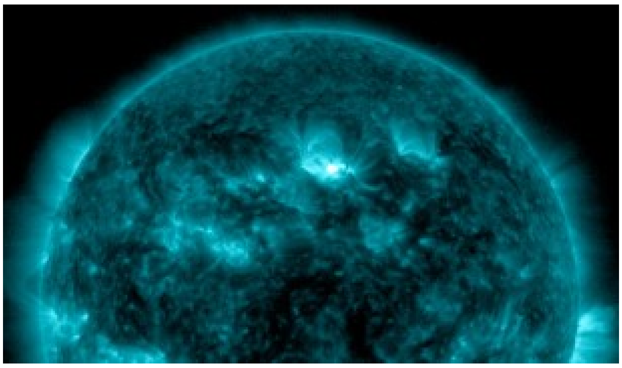
How will sunlight reflectivity off Starlink satellites influence ground operations in the coming years and decades, and what steps can be taken to mitigate this activity? Only time will tell, and this is why we science!

The Sun's Magnetic Field Might Only Be Skin Deep

It's coming back! Sunspot AR3664 gave us an amazing display of northern lights in mid-May and it's now rotating back into view. That means another great display if this sunspot continues to flare out. It's all part of solar maximum—the peak of an 11-year cycle of solar active and quiet times. This cycle is the result of something inside the Sun—the solar dynamo. A team of scientists suggests that this big generator lies not far beneath the solar surface. It creates a magnetic field and spurs flares and sunspots.

For a long time, solar physicists thought the magnetic dynamo was deep inside the Sun. That view may change thanks to work by researchers at MIT, the University of Edinburgh, the University of Colorado, Bates College, Northwestern University, and the University of California.

The dynamo may be related to instabilities in what's called the "near-surface shear layer" in the Sun's outermost regions. The activities in this layer result in the flares and sunspots we see more of as the Sun nears "solar maximum". Flares are high-energy outbursts while sunspots are surface features with local magnetic fields. Sunspots are relatively cool regions on the solar surface and occur in 11-year cycles.

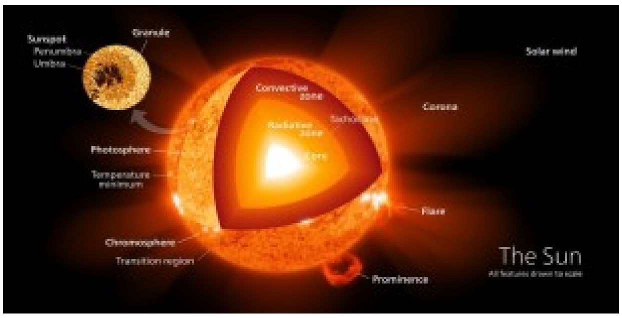


NASA's Solar Dynamics Observatory captured these images of the solar flares — as seen in the bright flashes in the upper right — on May 5 and May 6, 2024. The image shows a subset of extreme ultraviolet light that highlights the extremely hot material in flares and which is colorized in teal. The loops are magnetic field lines channeling plasma. Credit: NASA/SDO

"The features we see when looking at the Sun, like the corona that many people saw during the recent solar eclipse, sunspots, and solar flares, are all associated with the sun's magnetic field," said MIT researcher Keaton Burns. "We show that isolated perturbations near the sun's surface, far from the deeper layers, can grow over time to potentially produce the magnetic structures we see."

How is the Sun's Magnetic Field Connected to Activity?

To understand the magnitude of this finding, let's look at the structure of the Sun. We all know the Sun is a superheated ball of plasma. So, how does boiling plasma create a magnetic dynamo? "One of the basic ideas for how to start a dynamo is that you need a region where there's a lot of plasma moving past other plasma and that shearing motion converts kinetic energy into magnetic energy," Burns explained. "People had thought that the Sun's magnetic field is created by the motions at the very bottom of the convection zone."



The interior structure of our Sun. The dynamo generating a magnetic field could lie very close to the solar surface. Credit: Kelvin Ma, via Wikipedia

Of course, pinning down the exact location of the solar dynamo in the upper layers is difficult. Simulations can only go so far, and modeling the plasma flow throughout the entire Sun is a massive computing task. So, Burns and the team decided simulate a smaller piece of the Sun. They studied the stability of plasma flow near the solar surface. That required helioseismology data showing vibrations on the Sun's surface, which allowed them to determine the average flow of plasma in that region. "If you take a video of a drum and watch how it vibrates in slow motion, you can work out the drumhead's shape and stiffness from the vibrational modes," said Burns. "Similarly, we can use vibrations that we see on the solar surface to infer the average structure on the inside."

Think of the Sun as layered like an onion. Different plasma layers rush past each other as the Sun rotates, according to Burns. "Then we ask: Are there perturbations, or tiny changes in the flow of plasma, that we could superimpose on top of this average structure, that might grow to cause the sun's magnetic field?"

Computing an Answer

The team developed algorithms that they incorporated into a numerical framework called the Dedalus Project. They looked for self-reinforcing changes in the Sun's average surface flows. The algorithm discovered new patterns that could grow and result in realistic solar activity. Interestingly, those patterns also match the locations and timescales of sunspots. It turns out that certain changes in the flow of plasma at the very top of the Sun's surface layers generate magnetic structures. This isn't a new idea. Burns pointed out that the conditions there resembled the unstable plasma flows in accretion disks around black holes. Accretion disks are massive collections of gas and stellar dust that rotate in towards a black hole. They're driven by "magnetorotational instability," which generates turbulence in the flow and causes it to fall inward.

Burns and the team thought this phenomenon at a black hole might also be at work inside our Sun. They suggest that magnetorotational instability in the Sun's outermost layers could be the first step in generating its magnetic field. "I think this result may be controversial," he said. "Most of the community has been focused on finding dynamo action deep in the Sun. Now we're showing there's a different mechanism that seems to be a better match to observations."

Implications of the New Model

Not only will the team's work help solar physicists understand the creation of the magnetic dynamo, but may give them insight into other solar phenomena. In particular, a dynamo in the upper 10 percent of the Sun may explain things like the Maunder Minimum. This was a period between 1645 to 1715 when there were very few sunspots. In some years, observers saw no sunspots at all. In other years, they observed fewer than 20. Astronomers did chart the 11-year sunspot cycle through that time, so the Sun wasn't entirely inactive.

If the Sun's magnetic dynamo operates in its outermost layers, the science of solar activity forecasting could get a big boost. Right now, it's difficult to tell when a flare might break out. Flares and coronal mass ejections like those that contributed to the May 10-11 geomagnetic storm can damage satellites and telecommunications systems here on Earth. In addition, power grids and other technology are at risk. In the long run, however, gaining new understanding of the Sun's dynamo is a big deal.

"We know the dynamo acts like a giant clock with many complex interacting parts," says co-author Geoffrey Vasil, a researcher at the University of Edinburgh. "But we don't know many of the pieces or how they fit together. This new idea of how the solar dynamo starts is essential to understanding and predicting it."

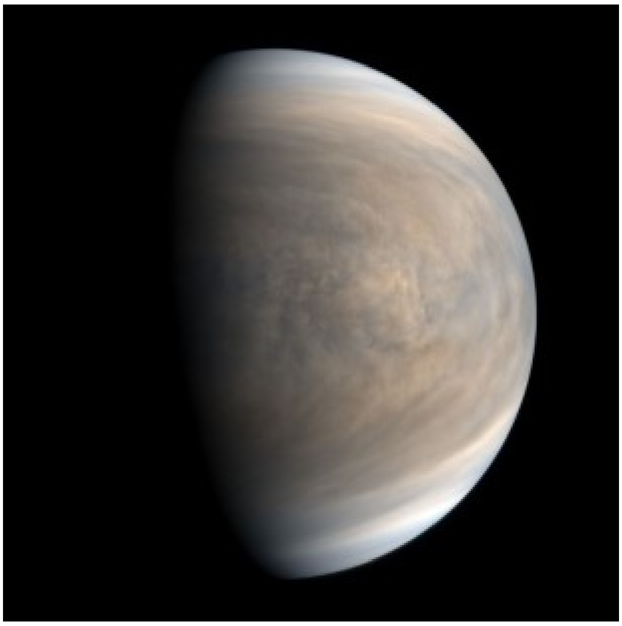
For More Information

The Origin of the Sun's Magnetic Field Could Lie Close to Its Surface
The Solar Dynamo Begins Near the Surface

Volcanoes Were Erupting on Venus in the 1990s

Start talking about Venus and immediately my mind goes to those images from the Venera space probes that visited Venus in the 1970's. They revealed a world that had been scarred by millennia of volcanic activity yet as far as we could tell those volcanoes were dormant. That is, until just now. Magellan has been mapping the surface of Venus and between 1990 and 1992 had mapped 98% of the surface. Researchers compared two scans of the same area and discovered that there were fresh outflows of molten rock filling a vent crater! There was active volcanism on Venus.

Venus is the second planet from the Sun and similar in size to Earth, the similarities end there though. It has a thick atmosphere that is toxic to life as we know it, there is sulphuric acid rain high in the atmosphere and a surface temperature of almost 500 degrees. When the Venera probes visited they measured an atmospheric pressure of around 90 times that at the Earth's surface. Combined with the other hostile properties of the atmosphere, a human visitor would not survive long.



Venus

The dense atmosphere of Venus is largely the result of volcanic activity. Over the millennia, there have been extensive volcanic eruptions that pumped carbon dioxide into the atmosphere. The lack of bodies of water on Venus meant the built up carbon dioxide in the atmosphere didn't get absorbed. In addition to this, the lack of a magnetic field meant the solar wind – the pressure from the Sun – drove away the lighter elements leaving behind the thick, carbon dioxide rich atmosphere we see today. But the volcanoes that drove the atmospheric changes are thought to have been extinct for a long time.

It's not just the Venera probes that have been exploring Venus. In 1980, the Magellan spacecraft was launched by NASA to map the surface of the hottest planet in the Solar System. On arrival, it was put into a polar orbit and used radar to penetrate the thick clouds. Back in 2023, a study of some of the Magellan images from the synthetic aperture radar showed changes to a vent near the summit of Maat Mons. It was the first direct evidence of an eruption on the surface of Venus and changes in the lava flows.

The surface of Venus captured by a Soviet Venera probe.
Credit: Russian Academy of Sciences / Ted Stryk

In the latest study that was published in Nature Astronomy, more data from the synthetic aperture radar was studied. The team focussed on Sif Mons and Niobe Planitia and the data that had been collected from both areas in 1990 and again in 1992. The data revealed stronger radar returns in the later set of data suggesting new rock formations from volcanic activity. The team did consider it may have been caused by some other phenomena such as sand dunes or atmospheric effects but altimeter data confirmed the presence of new solidified lava.

The team were able to use lava flows on Earth as a comparison to help understand the new flows on Venus. They estimated that the new flows are between 3 and 20 metres deep. They could go a step further though and estimated that the eruption at Sif Mons produced about 30 square kilometres of rock which would be enough to fill over 36,000 swimming pools. The eruption at Niobe Planitia produced even more with an estimated 45 square kilometres of rock..

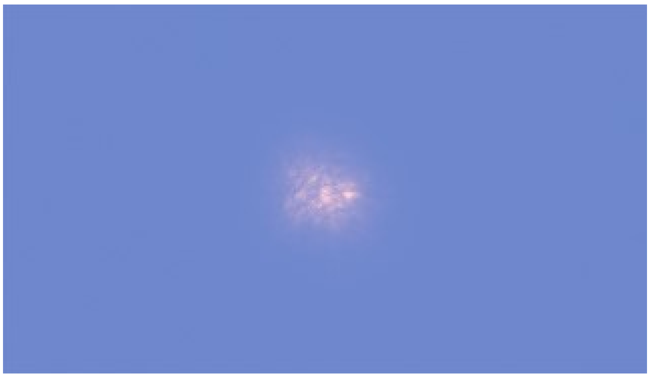
Studying volcanic activity on Venus helps to understand not just the geological processes but also helps to understand the structure of the interior too. This can help inform the likelihood of habitability for future explorers. None of which would have been possible without the recent volcanic activity to help us probe further the secrets of Venus.

A New Telescope Can Observe Even in Broad Daylight

Astronomy is a profession that, so far, has only been done at night, at least on Earth. Light from the Sun overwhelms any light from other stars, making it impractical for both professional and amateur astronomers to look at the stars during daytime. There are several disadvantages to this, not the least of which is that many potentially exciting parts of the sky aren't visible at all for large chunks of the year as they pass too close to the Sun. To solve this, a team from Macquarie University, led by graduate student Sarah Caddy, developed a multi-camera system for a local telescope that allows them to observe during daytime.

The University has a system known as the Huntsman Telescope, named after the famous Australian spider species. Its design was inspired by the Dragonfly Telescope Array, initially designed by researchers at the University of Toronto and Yale, among other institutions. Both telescopes feature an array of 10 telephoto lenses from Canon, the camera manufacturer, arranged in a honeycomb pattern.

Typically, the telescope is used for nighttime astronomy at the Siding Spring Observatory, about a seven-hour drive from Sydney. However, Ms. Caddy thought it could do better and potentially continue observations during the day.



An image of Betelgeuse during the day using the Huntsman Telescope.
Credit – Macquarie University

They originally tested their ideas, which focused on a number of broadband filters and a single-lens test version of the Huntsman telescope. This allowed them to optimize things like exposure times and timing and show a proof of concept that they then wrote up in a paper in the Publications of the Astronomical Society of Australia.

In particular, Ms. Caddy and her colleagues are excited about several use cases. One is tracking particular stars that might soon undergo an exciting event. Betelgeuse comes to mind, as astronomers expect it to undergo a supernova sometime "soon," though soon in astronomical terms could mean anywhere between tomorrow and 10 million years from now. If Betelgeuse happens to be on the other side of the Sun when it goes supernova, without daylight astronomy, there would be months of a gap where we would miss out on collecting data on the supernova that happened nearest to us in recorded history, and astronomers everywhere would be frustrated.

This is exactly why the Huntsman team used a daytime image of Betelgeuse as part of their proof of concept. While it might not look like a typical image of the star that is 650 light years away, the fact that it is visible at all during the daytime is striking.

Betelgeuse is one of the most interesting stars in the sky – a potential supernova that goes through occasional dimming periods, as Fraser explains.

Another use case is the tracking of satellites. As the orbital space around Earth becomes increasingly crowded, there's a higher likelihood that satellites will begin colliding, which could eventually result in something as severe as Kessler syndrome, which we've discussed before here at UT. Unfortunately, astronomers can only track satellites during the night, so if one of their orbits happens to shift for some reason during a day cycle, it would be impossible for them to suggest changes to the orbital paths of other satellites that are close by.

Unless you have daytime astronomy, which allows you to track satellites during the day, there's a significantly decreased risk of two running into each other unexpectedly. This data can be combined with radar readings to help avoid catastrophic collisions, no matter how crowded orbital space gets.

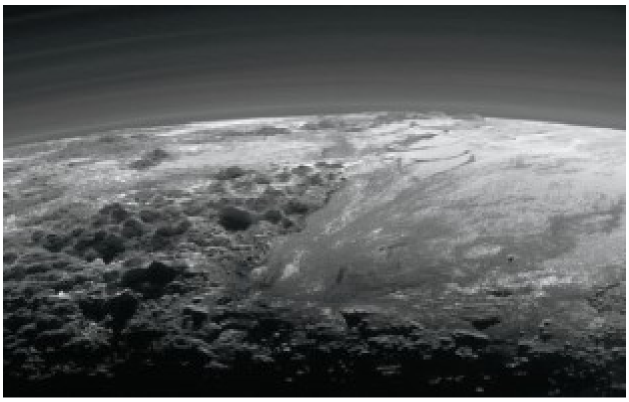
This proof of concept is a step toward making those observations a reality. As it is more fully tested, the southern sky will become much more accessible, and it could pave the way for other daytime astronomy projects in other parts of the world.

Pluto Has an Ocean of Liquid Water Surrounded by a 40-80 km Ice Shell

On July 14th, 2015, the *New Horizons* spacecraft conducted the first-ever flyby of Pluto, which once was (and to many, still is) the ninth planet of the Solar System. While the encounter was brief, the stunning images and volumes of data it obtained revealed a stunningly vibrant and dynamic world. In addition to Pluto's heart, floating ice hills, nitrogen icebergs, and nitrogen winds, the *New Horizons* data also hinted at the existence of an ocean beneath Pluto's icy crust. This effectively made Pluto (and its largest moon, Charon) members of the "Ocean Worlds" club.

Almost a decade after that historic encounter, scientists are still making discoveries from New Horizons data. In a new paper, planetary scientists Alex Nguyen and Dr. Patrick McGovern used mathematical models and images to learn more about the possible ocean between Pluto's icy surface and its silicate and metallic core. According to their analysis, they determined that Pluto's ocean is located beneath a surface shell measuring 40 to 80 km (25 to 50 mi), an insulating layer thick enough to ensure that an interior ocean remains liquid.

Nguyen is a graduate student in Earth, environmental, and planetary sciences in Arts & Sciences at Washington University in St. Louis (WUSTL), while Dr. McGovern is a Senior Staff Scientist with the Lunar and Planetary Institute (LPI) in Houston. Their paper, "The role of Pluto's ocean's salinity in supporting nitrogen ice loads within the Sputnik Planitia basin," recently appeared in the journal *Icarus*. The study is part of Nguyen's Ph.D. research at Washington University, where he is an Olin Chancellor's Fellow and a National Science Foundation Graduate Research Fellow.



This cutaway image of Pluto shows a section through the area of Sputnik Planitia, with dark blue representing a subsurface ocean and light blue for the frozen crust. Artwork by Pam Engebretson, courtesy of UC Santa Cruz.

For decades, planetary scientists assumed Pluto was far too cold to support an interior ocean. Pluto orbits well beyond the Solar System's "Frost Line," the boundary beyond which volatile elements (water, carbon dioxide, ammonia, etc.) become solid. With an average surface temperature of -229 °C (-380°F), even nitrogen and methane become as solid as rock. As Nguyen indicated in a recent interview with The Source (WUSTL's news site), "Pluto is a small body. It should have lost almost all of its heat shortly after it was formed, so basic calculations would suggest that it's frozen solid to its core."

But thanks to *New Horizons*, scientists were presented with multiple lines of evidence that suggest Pluto likely has an interior ocean. This includes cryovolcanoes, such as those observed on Ceres, Europa, Ganymede, Enceladus, Titan, Triton, and other "Ocean Worlds." While the existence of this ocean is still subject to debate, the theory is gaining acceptance to the point that it is considered a very real possibility. For their study, Nguyen and McGovern created mathematical models to explain the cracks and bulges in the ice covering Pluto's Sputnik Planitia Basin.

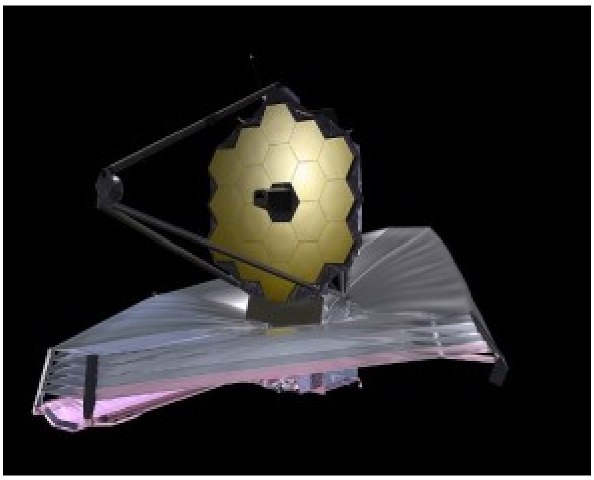
Their results indicate that an ocean could exist beneath an icy shell 40 to 80 km (25 to 50 mi) thick, which would be sufficient to ensure that Pluto could maintain a liquid water ocean in its interior despite surface conditions. They also calculated the likely density or salinity of the ocean based on the surface features and determined that Pluto's ocean could be up to 8% denser than Earth's oceans. This salinity level would make Pluto's ocean comparable to the Great Salt Lake, the Dead Sea, and other high-salinity bodies of water on Earth.

According to Nguyen, any variations in this density (greater or lower) would be evident from the cracks and fractures in the Sputnik Platina Basin. "We estimated a sort of Goldilocks zone where the density and shell thickness is just right," he said. If the ocean were less dense, the ice shell would collapse, leading to many more fractures in the surface. If it were denser, the ice sheet would be more buoyed, which would be evident from there being fewer fractures. Unfortunately, it could be many decades before another spacecraft reaches Pluto to help confirm these findings. In the meantime, the case for Pluto's interior ocean grows stronger!

Webb Finds the Farthest Galaxy Ever Seen (So Far)

There are some things that never cease to amaze me and the discovery of distant objects is one of them. The James Webb Space Telescope has just found the most distant galaxy ever observed! It has the catchy title JADES-GS-z14-0 and it has a redshift of 14.32. This means its light left when the Universe was only 290 million years old! That means the light left the source LOOOONG before even our Milky Way was here! How amazing is that!

The James Webb Space Telescope (JWST) with its 6.5m mirror was launched on 25 December 2021 and has quickly proven itself to be the most powerful space telescope ever built. It was designed to explore the Universe in visible and infrared radiation so that it could probe straight through dust to reveal hidden details behind. It is positioned at the second Lagrange point where the gravity of the Earth is balanced by the gravity of the Sun and it maintains a stable 1.5 million km from Earth.



Artist impression of the James Webb Space Telescope

Over the last couple of years, astronomers have been using JWST to study the Cosmic Dawn! This period of time existed just a few hundred million years after the big bang but studying galaxies so far back in time required the sensitivity of the JWST. They provide valuable information about the gas and stars within and help to understand their formation.

An international team were using JWST data that had been collected as part of the Advanced Deep Extragalactic Survey (JADES) using the Near-Infrared Spectrograph known as NIRSpec. They were able to acquire a spectrum of the galaxy revealing a redshift of 14.32. The redshift phenomenon occurs when the light from distant objects in space shift toward the red end of the spectrum. It was originally thought this was due to the movement but instead it is caused by the expansion of space. The greater the redshift, the faster the object is moving away and therefore the further away it is.

The redshift of JADES-GS-z14-0 makes it the most distant galaxy known and it corresponds to the light having been emitted at a time when the Universe was just under 300 million years old. The team estimate the galaxy to be just over 1,600 light years across, that's in comparison to the Milky Way which is thought to be 100,000 light years across. It is fairly typical of distant, early galaxies to be bright due to gas falling into a supermassive black hole but in the case of JADES-GS-z14-0 the light seems to be created by hot young stars.

The image that has been released shows a field of thousands of distant galaxies of all manner of shapes, colours and sizes. One solitary bright star is visible in the foreground with the trademark diffraction spikes caused by the JWST optics. A box just to the lower right of centre highlights the location with the zoomed in image of the galaxy superimposed. The galaxy looks very different from those we tend to see in today's Universe as it appears far less structured.

Chinese Probe Lands on Moon's Far Side to Collect Samples for Return

After touching down on the moon's far side, China's Chang'e-6 lander is collecting samples to bring back to Earth — and sending back imagery documenting its mission.

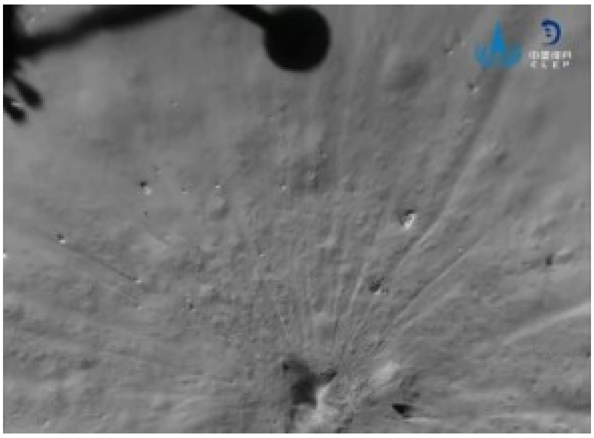
Chang'e-6, which was launched May 3, went through weeks' worth of in-space maneuvers that climaxed with its weekend landing in the moon's South Pole-Aitken Basin region. The mission plan calls for the probe to collect samples of lunar soil and rock over the course of about two days, and then pack them up for the return trip.

If the operation is successful, Chang'e-6 would bring back the first fresh lunar samples ever collected on the moon's far side — following up on the Chang'e-5 mission in 2020, which returned samples from the moon's Earth-facing side.

The China National Space Administration said the lander used its onboard camera during its powered descent to detect obstacles autonomously and select a safe landing site. Chang'e-6 captured video imagery during the final phase of the lander's descent and transmitted the views back to Earth. One video frame shows the shadow of the lander itself moments before touchdown.

Chang'e-6 is built to collect samples using a drill and a robotic arm. It's also expected to gather scientific data about its surroundings using a radon detector, a negative-ion detector and a mini-rover. During surface operations, data and telemetry are being relayed between Chang'e-6 and Earth via China's Queqiao-2 satellite.

Up to 2 kilograms (4.4 pounds) of lunar samples will be stowed inside the lander's "ascender" stage. The rocket-powered ascender will then lift off from the surface and transfer the samples to the Chang'e-6 orbiter, which is currently in lunar orbit. Following the model set by Chang'e-5, the orbiter will head back toward Earth and release the sample capsule for atmospheric re-entry and touchdown in Inner Mongolia.



An image captured by a camera aboard the Chang'e-6 lander shows the spacecraft's shadow on the lunar surface just moments before touchdown. (Credit: CLEP / CNSA)

The moon's south polar region is of particular interest because it's thought to harbor reserves of water ice that could support lunar settlement. Studying fresh samples from the South Pole-Aitken Basin could help scientists and mission planners learn more about the region's resources.

Chang'e-6 is the latest spacecraft in an international armada of moon landers — including Russia's Luna 25, iSpace's Hakuto-R and Astrobotic's Peregrine, which were unsuccessful, plus more fruitful missions such as India's Chandrayaan-3, Japan's SLIM and Intuitive Machines' Odysseus.

Coming attractions include NASA's VIPER rover, which is currently due to be delivered to the moon late this year; and China's Chang'e-7 mission, which features a hopping probe and is set for launch in 2026. Looking further ahead, China aims to send astronauts to the lunar surface by 2030 — not long after

WHATS UP, SUMMER 24

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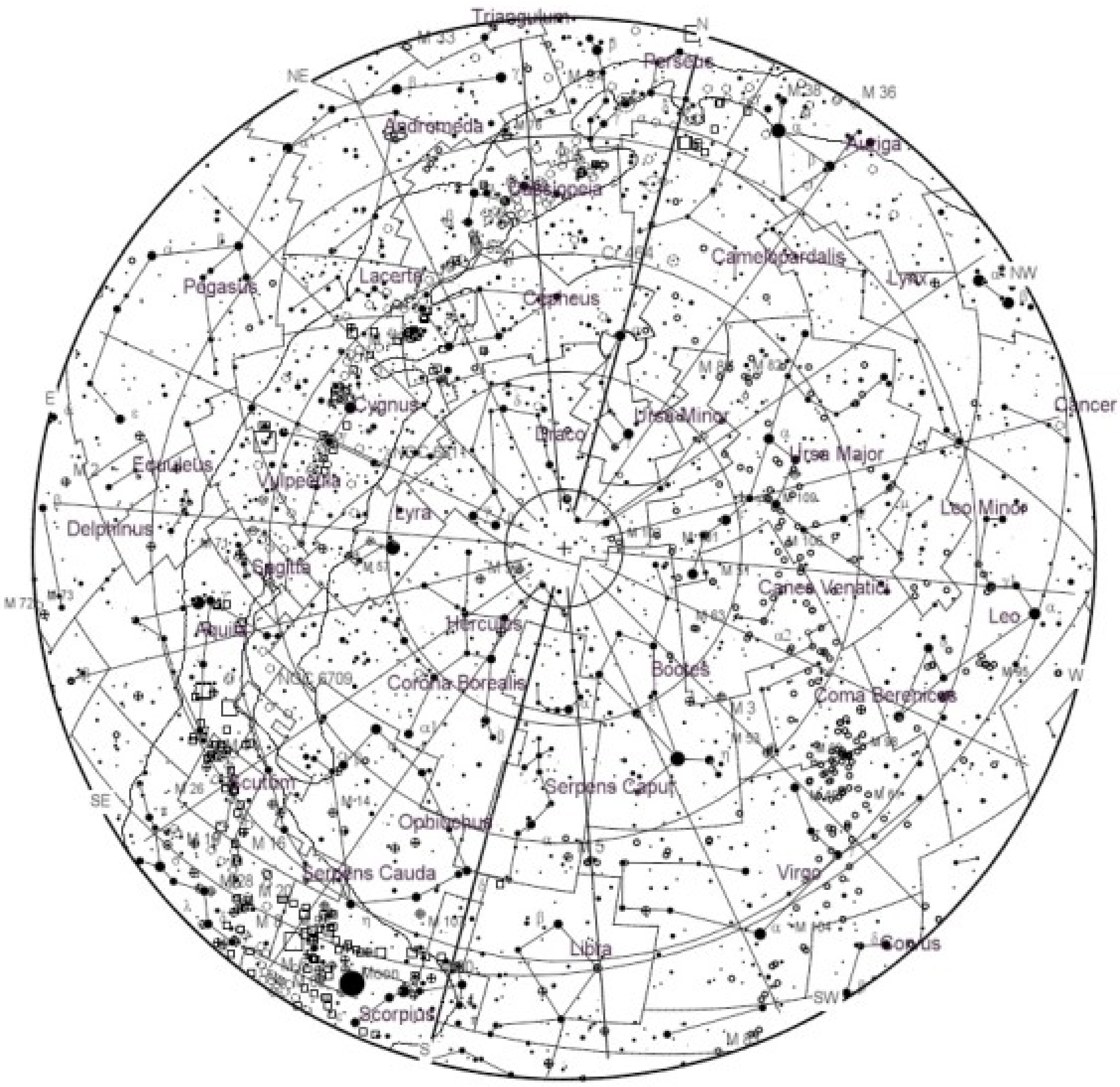


June 8 - **New Moon.** The Moon will be directly between the Earth and the Sun and will not be visible from Earth. This phase occurs at 15:56 UTC. This is the best time of the month to observe faint objects such as galaxies and star clusters because there is no moonlight to interfere.

June 12 - **Mercury at Greatest Eastern Elongation.** The planet Mercury will be at its furthest angle from the Sun, known as greatest elongation. It will be at its highest point in the night sky after sunset. This is the best time to try to view Mercury since it stays so close to the Sun and doesn't usually climb very high above the horizon.

June 21 - **June Solstice.** The June solstice occurs at 05:04 UTC. The North Pole of the earth will be tilted toward the Sun, which will have reached its northernmost position in the sky and will be directly over the Tropic of Cancer at 23.44 degrees north latitude. This is the first day of summer (summer solstice) in the Northern Hemisphere and the first day of winter (winter solstice) in the Southern Hemisphere.

June 23 - **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 11:32 UTC. This full moon was known by early Native American tribes as the Full Strawberry Moon because it signaled the time of year to gather ripening fruit. It also coincides with the peak of the strawberry harvesting season. This moon has also been known as the Full Rose Moon and the Full Honey Moon.

July 8 - **New Moon.** The Moon will be directly between the Earth and the Sun and will not be visible from Earth. This phase occurs at 07:14 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.

July 22 - **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 18:15 UTC. This full moon was known by early Native American tribes as the Full Buck Moon because the male buck deer would begin to grow their new antlers at this time of year. This moon has also been known as the Full Thunder Moon and the Full Hay Moon.

July 27, 28 - **Delta Aquarids Meteor Shower.** The Delta Aquarids is an average shower that can produce up to 20 meteors per hour at its peak. It is produced by debris left behind by comets Marsden and Kracht. The shower runs annually from July 12 to August 23. It peaks this year on the night of July 27 and morning of July 28. The second quarter moon will block out most of the faint meteors, but you should still be able to catch quite a few good ones if you are patient. Best viewing will be from a dark location after midnight. Meteors will radiate from the constellation Aquarius, but can appear anywhere in the sky.

August 6 - **New Moon.** The Moon will be directly between the Earth and the Sun and will not be visible from Earth. This phase occurs at 21:51 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.

August 11, 12 - **Perseids Meteor Shower.** The Perseids is one of the best meteor showers to observe, producing up to 60 meteors per hour at its peak. It is produced by comet Swift-Tuttle, which was discovered in 1862. The Perseids are famous for producing a large number of bright meteors. The shower runs annually from July 17 to August 24. It peaks this year on the night of August 11 and the morning of August 12. The first quarter moon will set shortly after midnight leaving dark skies for what should be an excellent show. Best viewing will be from a dark location after midnight. Meteors will radiate from the constellation Perseus, but can appear anywhere in the sky.

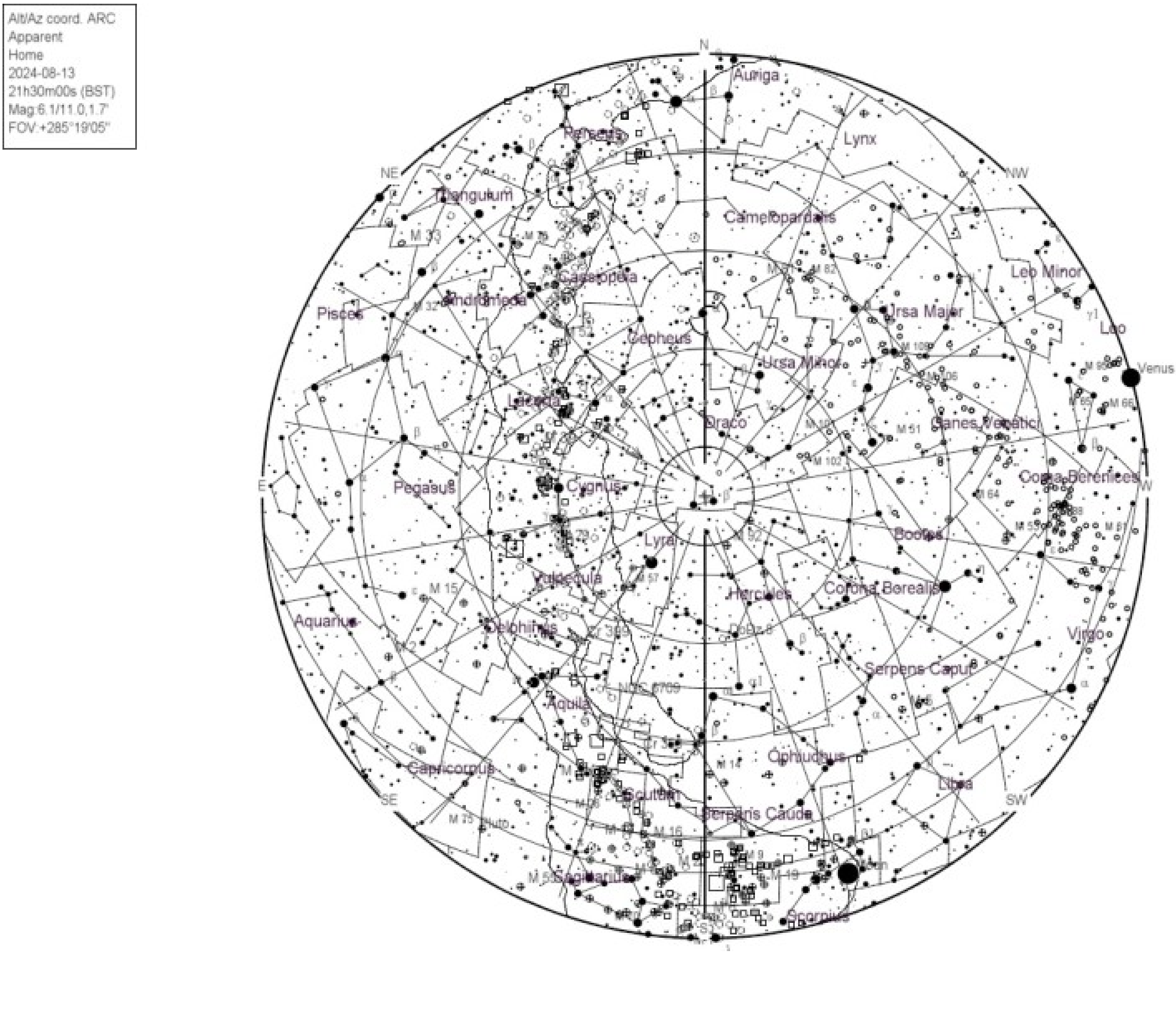
August 21 - **Full Moon.** The Moon will be directly opposite the Earth from the Sun and will be fully illuminated as seen from Earth. This phase occurs at 01:45 UTC. This full moon was known by early Native American tribes as the Full Sturgeon Moon because the large sturgeon fish of the Great Lakes and other major lakes were more easily caught at this time of year. This moon has also been known as the Green Corn Moon and the Grain Moon.

August 27 - **Neptune at Opposition.** The blue giant planet will be at its closest approach to Earth and its face will be fully illuminated by the Sun. This is the best time to view and photograph Neptune. Due to its extreme distance from Earth, it will only appear as a tiny blue dot in all but the most powerful telescopes.

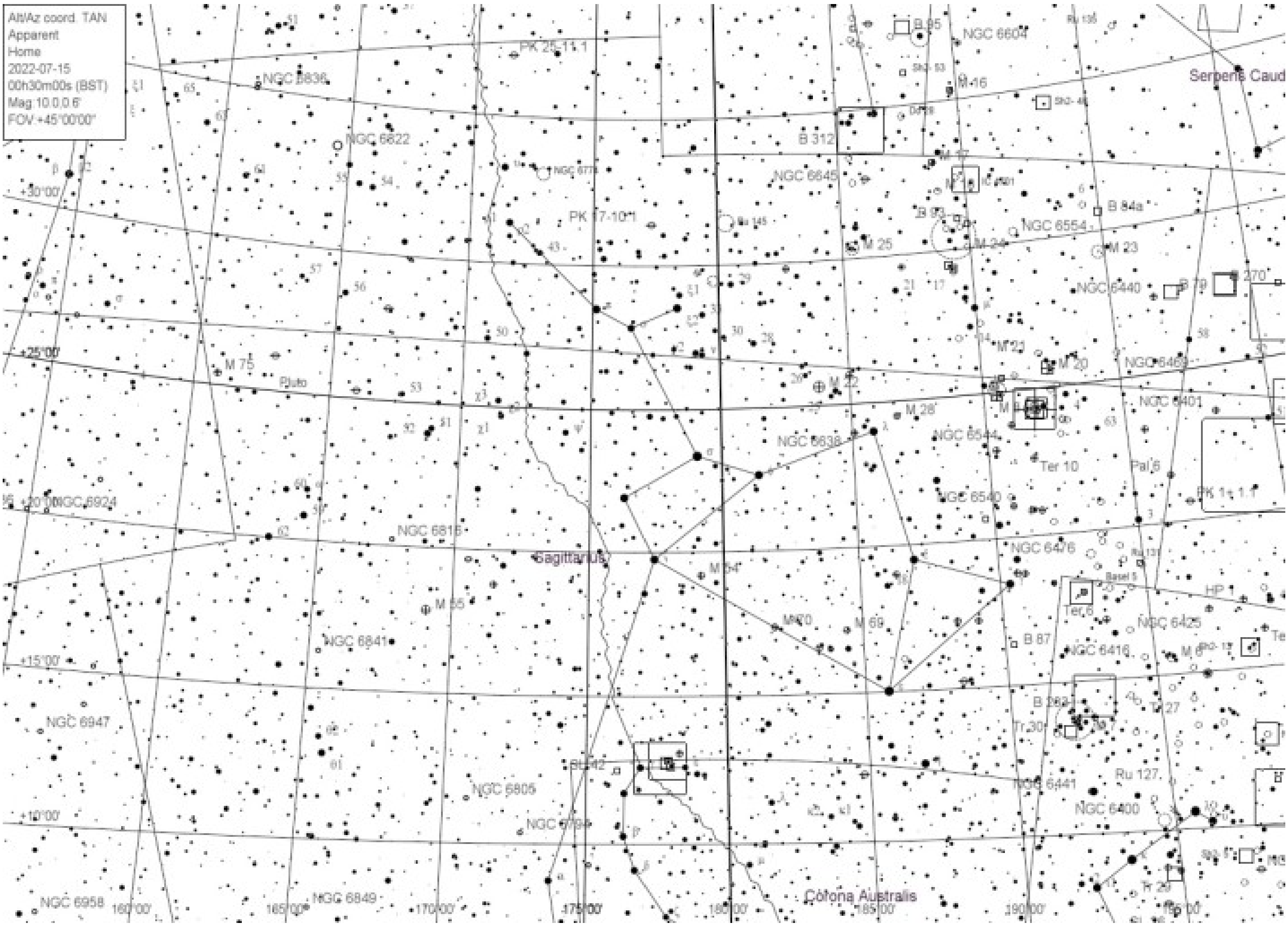
September 5 - **New Moon.** The Moon will be directly between the Earth and the Sun and will not be visible from Earth. This phase occurs at 11:36 UTC. This is the best time of the month to observe faint objects such as galaxies and star clusters because there is no moonlight to interfere.

September 8 - **Conjunction of the Moon and Venus.** The Moon will pass within about a half of a degree from the the planet Venus in the early evening sky. The thin crescent moon will be at magnitude -10.4 and Venus will be at magnitude -4.5. Look for both objects low in the western sky in the early evening. The pair will be visible in the evening sky for about 2 hours after sunset.

Maps for June solstice and August Perseids night.



CONSTELLATION OF THE MONTH: SAGITTARIUS



Sagittarius

The zodiacal constellation of Sagittarius resides on the ecliptic plane and was one of the original 48 constellations charted by Ptolemy to be later adopted as a modern constellation by the IAU. It spans 867 square degrees of sky and ranks 15th in constellation size. It has 7 primary stars in its main asterism and 68 Bayer Flamsteed designation stars within its confines. Sagittarius is bordered by the constellations of Aquila, Scutum, Serpens Cauda, Ophiuchus, Scorpius. Corona Australis, Telescopium, Indus, Microscopium and Capricornus. It is visible to all observers located at latitudes between +55° and ?90° and is best seen at culmination during the month of August.

The easily recogniged "tea pot" shape of Sagittarius was well known in mythology as being represented by the half-man, half-horse – the Centaur. According to some legends, he was the offspring of of Philyra and Saturn. Named Chiron, he turned himself into a horse to hide from his jealous wife and was eventually immortalized in the stars. He is often depicted as an archer as well, with his arrow pointed directly at the red heart of the Scorpion – Antares. Sagittarius may represent the son of Pan, who invented archery and was sent to entertain the Muses who threw a laurel wreath at his feet. No matter what identity you choose, one thing is for certain – there's no mistaking the presence of the nearby Sagittarius arm of the Milky Way!

(Since the constellation of Sagittarius is simply slopping over with deep sky objects, creating a small, workable chart here would be very confusing. For this reason, I have only chosen a few of my favorite objects to highlight and I hope you enjoy them, too!)

Let's begin our binocular tour of Sagittarius with its alpha star – the "a" symbol on our map. Located far south in the constellation, Alpha Sagittarii is far from being the brightest of its stars and goes by the traditional name of Rukbat – the "knee of the Archer". It's nothing special. Just a typical blue, class AB dwarf star located about 170 light years from Earth, but it often gets ignored because of its position. Have a look at Beta while you're there, too. It's the "B" symbol on our map. That's right! It's a visual double star and its name is Arkab – the "hamstring". Now, power up in a telescope. Arkab Prior is the westernmost and it truly is a binary star accompanied by a 7th magnitude dwarf star and seperated by about 28 arcseconds. It's located about 378 light years from Earth. Now, hop east for Arkab Posterior. It is a spectral type F2 giant star, but much closer at 137 light years in distance.

Now turn your attention towards Epsilon Sagittarii – the backwards "3" symbol on our chart. Kaus Australis is actually the brightest star in the bottom righthand corner of the teapot and the brightest of all the stars in Sagittarius and the 36th brightest in the night sky. Hanging out in space some 134 light years from our solar system, this A-class giant star is much hotter than most of its main sequence peers and spinning over 70 times faster on its axis than our Sun. This rapid movement has caused a shell to form around the star, dimming its brightness… But not nearly as dim as its 14th magnitude companion! That's right… Epsilon is a binary star. The disparate companion is well seperated at 32 arc seconds, but will require a larger telescope to pick away from its bright companion!

Ready for more? Then have a look at Gamma – the "Y" symbol on our map. Alnasl, the "arrowhead" is two star systems that share the same name. If you have sharp eyes, you can even split this visual double star without aid! However, take a look in the telescope… Gamma-1 Sagittarii is a Cepheid 1500 light year distant variable star in disguise. It drops by almost a full stellar magnitude in just a little under 8 days! Got a big telescope? Then take a closer look, because Gamma-1 also shows evidence of being a close binary star, as well has having two more distant 13th magnitude companions, W Sagittarii B, and C separated by 33 and 48 arcseconds respectively. How about Gamma-2? It's just a regular type-K giant star – but it's only 96 light years from Earth!

Located just slightly more than a fingerwidth above Gamma Sagittarii and 5500 light-years away, NGC 6520 (RA 18 03 24 Dec -27 53 00) is a galactic star cluster which formed millions of years ago. Its blue stars are far younger than our own Sun, and may very well have formed from what you don't see nearby – a dark, molecular cloud. Filled with dust, Barnard 86 literally blocks the starlight coming from our galaxy's own halo area in the direction of the core. To get a good idea of just how much light is blocked by B 86, take a look at the star SAO 180161 on the edge. Behind this obscuration lies the densest part of our Milky Way! This one is so dark that it's often referred to as the "Ink Spot." While both NGC 6520 and B 86 are about the same distance away, they don't reside in the hub of our galaxy, but in the Sagittarius Spiral Arm. Seen in binoculars as a small area of compression, and delightfully resolved in a telescope, you'll find this cluster is on the Herschel "400" list and many others as well.

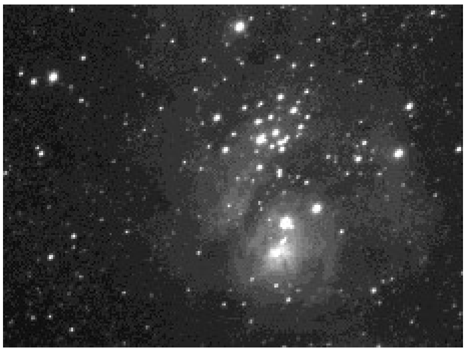
Are you ready for a whirlwind tour of the Messier Catalog objects with binoculars or a small telescope? Then let's start at the top with the "Nike Swoosh" of M17.

Easily viewed in binoculars of any size and outstanding in every telescope, the 5000 light-year distant Omega Nebula was discovered by Philippe Loys de ChÃ©seaux in 1745-46 and later (1764) cataloged by Messier as object 17 (RA 18 20 26 Dec -16 10 36). This beautiful emission nebula is the product of hot gases excited by the radiation of newly born stars. As part of a vast region of interstellar matter, many of its embedded stars don't show up in photographs, but reveal themselves beautifully to the eye at the telescope. As you look at its unique shape, you realize many of these areas are obscured by dark dust, and this same dust is often illuminated by the stars themselves. Often known as "The Swan," M17 will appear as a huge, glowing check mark or ghostly "2" in the sky – but power up if you use a larger telescope and look for a long, bright streak across its northern edge with extensions to both the east and north. While the illuminating stars are truly hidden, you will see many glittering points in the structure itself and at least 35 of them are true members of this region, which spans up to 40 light-years and could form up to 800 solar masses. It is awesome…

Keeping moving south and you will see a very small collection of stars known as M18, and a bit more south will bring up a huge cloud of stars called M24. This patch of Milky Way "stuff" will show a wonderful open cluster – NGC 6603 – to average telescopes and some great Barnard darks to larger ones. M24 is often referred to as the "Small Sagittarius Star Cloud". This vast region is easily seen unaided from a dark sky site and is a stellar profusion in binoculars. Telescopes will find an enclosed galactic cluster – NGC 6603 – on its northern border. For those of you who prefer a challenge, look for Barnard Dark Nebula, B92, just above the central portion.

Now we're going to shift to the southeast just a touch and pick up the M25 open cluster. M25 is a scattered galactic cluster that contains a cephid variable – U Sagittarii. This one is a quick change artist, going from magnitude 6.3 to 7.1 in less than seven days. Keep an eye on it over the next few weeks by comparing it to the other cluster members. Variable stars are fun! Head due west about a fist's width to capture the next open cluster – M23. From there, we are dropping south again and M21 will be your reward. Head back for your scope and remember your area, because the M20 "Triffid Nebula" is just a shade to the southwest. Small scopes will pick up on the little glowing ball, but anything from about 4″ up can see those dark dust lanes that make this nebula so special. The "Trifid" nebula appears initially as two widely spaced stars – one of which is a low power double – each caught in its own faint lobe of nebulosity. Keen eyed observers will find that the double star – HN 40 – is actually a superb triple star system of striking colors! The 7.6 magnitude primary appears blue. Southwest is a reddish 10.7 magnitude secondary while a third companion of magnitude 8.7 is northwest of the primary.

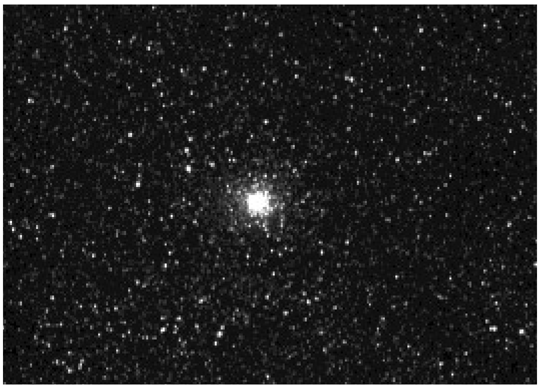
Described as "trifid" by William Herschel in 1784, this tri-lobed pattern of faint luminosity broken by a dark nebula – Barnard 85 – is associated with the southern triple. This region is more brightly illuminated due to the presence of the star cluster and is suffused with a brighter, redder reflection nebula of hydrogen gas. The northern part of the Trifid (surrounding the solitary star) is fainter and bluer. It shines by excitation and is composed primarily of doubly ionized oxygen gas. The entire area lies roughly 5000 light-years away. What makes M20 the "Trifid" nebula, are the series of dark, dissecting dust lanes meeting at the nebula's east and west edges, while the southernmost dust lane ends in the brightest portion of the nebula. With much larger scopes, M20 shows differences in concentration in each of the lobes along with other embedded stars. It requires a dark night, but the Trifid is worth the hunt. On excellent nights of seeing, larger scopes will show the Trifid much as it appears in black and white photographs!



You can go back to the binoculars again, because the M8 "Lagoon Nebula" is south again and very easy to see. Easily located about three fingerwidths above the tip of the teapot's spout (Al Nasl), M8 is one of Sagittarius' premier objects. This combination of emission/reflection and dark nebula only gets better as you add an open cluster. Spanning a half a degree of sky, this study is loaded with features. One of the most prominent is a curving dark channel dividing the area nearly in half. On its leading (western) side you will note two bright stars. The southernmost of this pair (9 Sagittarii) is thought to be the illuminating source of the nebula. On the trailing (eastern) side, is brightly scattered cluster NGC 6530 containing 18 erratically changing variables known as "flare stars." For large scopes, and those with filters, look for small patches of dark nebulae called "globules." These are thought to be "protostar" regions – areas where new stars undergo rapid formation. Return again to 9 Sagittarii and look carefully at a concentrated portion of the nebula west-southwest. This is known as the "Hourglass" and is a source of strong radio emission.

This particular star hop is very fun. If you have children who would like to see some of these riches, point out the primary stars and show them how it looks like a dot-to-dot "tea kettle." From the kettle's "spout" pours the "steam" of the Milky Way. If you start there, all you will need to do is follow the "steam" trail up the sky and you can see the majority of these with ease.

At the top of the "tea kettle" is Lambda. This is our marker for two easy binocular objects. The small M28 globular cluster is quite easily found just a breath to the north/northwest. The larger, brighter and quite wonderful globular cluster M22 is also very easily found to Lambda's northeast. Ranking third amidst the 151 known globular clusters in total light, M22 is probably the nearest of these incredible systems to our Earth, with an approximate distance of 9,600 light-years. It is also one of the nearest globulars to the galactic plane. Since it resides less than a degree from the ecliptic, it often shares the same eyepiece field with a planet. At magnitude 6, the class VII M22 will begin to show individual stars to even modest instruments and will burst into stunning resolution for larger aperture. About a degree west-northwest, mid-sized telescopes and larger binoculars will capture the smaller 8th magnitude NGC 6642 (RA 18 31 54 Dec -23 28 34). At class V, this particular globular will show more concentration toward the core region than M22. Enjoy them both!



Now we're roaming into "binocular possible" but better with the telescope objects. The southeastern corner of the "tea kettle" is Zeta, and we're going to hop across the bottom to the west. Starting at Zeta, slide southwest to capture globular cluster M54. Keep heading another three degrees southwest and you will see the fuzzy ball of M70. Just around two degrees more to the west is another globular that looks like M70's twin. The small globular M55 is out there in "No Man's Land" about a fist's width away east/south east of Zeta .

Ready for a big telescope challenge? Then try your hand at one the sky's most curious galaxies – NGC 6822. This study is a telescopic challenge even for skilled observers. Set your sights roughly 2 degrees northeast of easy double 54 Sagittarii, and have a look at this distant dwarf galaxy bound to our own Milky Way by invisible gravitational attraction…

Named after its discoverer (E. E. Barnard – 1884), "Barnard's Galaxy" is a not-so-nearby member of our local galaxy group. Discovered with a 6″ refractor, this 1.7 million light-year distant galaxy is not easily found, but can be seen with very dark sky conditions and at the lowest possible power. Due to large apparent size, and overall faintness (magnitude 9), low power is essential in larger telescopes to give a better sense of the galaxy's frontier. Observers using large scopes will see faint regions of glowing gas (HII regions) and unresolved concentrations of bright stars. To distinguish them, try a nebula filter to enhance the HII and downplay the star fields. Barnard's Galaxy appears like a very faint open cluster overlaid with a sheen of nebulosity, but the practiced eye using the above technique will clearly see that the "shine" behind the stars is extragalactic in nature.

Now look less than a degree north-northwest to turn up pale blue-green NGC 6818 – the "Little Gem" planetary. Easily found in any size scope, this bright and condensed nebula reveals its annular nature in larger scopes but hints at it in scopes as small as 6″. Use a super wide field long-focus eyepiece to frame them both!

Be sure to get a good star chart and enjoy the constellation of Sagittarius to its fullest potential – there's lots more out there!

Sources:
SEDS
Chandra Observatory
Wikipedia

All images: Andy Burns

ISS PASSES For Summer 2024

from Heavens Above website maintained by Chris Peat.

Date	Brightn	Start	Highest point	End						
	(mag)	Time	Alt.	Az.	Time	Alt.	Az.	Time	Alt.	Az.
25 Jun	-1.7	04:00:11	10°	S	04:02:25	17°	SE	04:04:39	10°	E
26 Jun	-1.3	03:11:39	10°	SSE	03:12:41	11°	SE	03:13:41	10°	ESE
27 Jun	-2.7	03:55:46	10°	SW	03:58:44	31°	SSE	04:01:43	10°	E
28 Jun	-2.2	03:07:17	16°	S	03:08:50	21°	SE	03:11:27	10°	E
29 Jun	-1.7	02:18:51	15°	SE	02:18:57	15°	SE	02:20:52	10°	ESE
29 Jun	-3.5	03:51:47	10°	SW	03:55:02	53°	SSE	03:58:18	10°	E
30 Jun	-3.1	03:03:06	20°	SSW	03:04:59	38°	SSE	03:08:06	10°	E
01 Jul	-2.7	02:14:29	26°	SSE	02:14:56	27°	SSE	02:17:47	10°	E
01 Jul	-3.8	03:47:57	10°	WSW	03:51:16	79°	SSE	03:54:36	10°	E
02 Jul	-1.8	01:25:48	17°	ESE	01:25:48	17°	ESE	01:27:17	10°	E
02 Jul	-3.8	02:58:33	16°	WSW	03:01:05	63°	SSE	03:04:23	10°	E
03 Jul	-3.5	02:09:44	31°	SSW	02:10:53	47°	SSE	02:14:06	10°	E
03 Jul	-3.8	03:44:05	10°	W	03:47:25	86°	N	03:50:45	10°	E
04 Jul	-3.0	01:20:51	33°	SE	01:20:51	33°	SE	01:23:44	10°	E
04 Jul	-3.9	02:53:47	10°	W	02:57:07	86°	SSE	03:00:27	10°	E
05 Jul	-2.0	00:31:47	18°	ESE	00:31:47	18°	ESE	00:33:14	10°	E
05 Jul	-3.9	02:04:31	19°	WSW	02:06:48	73°	SSE	02:10:07	10°	E
05 Jul	-3.8	03:40:05	10°	W	03:43:25	87°	N	03:46:46	10°	E
06 Jul	-3.8	01:15:12	32°	SW	01:16:28	56°	SSE	01:19:44	10°	E
06 Jul	-3.8	02:49:42	10°	W	02:53:03	85°	N	02:56:22	10°	E
07 Jul	-3.4	00:25:25	35°	S	00:26:08	41°	SSE	00:29:18	10°	E
07 Jul	-3.9	01:59:17	10°	W	02:02:37	88°	N	02:05:58	10°	E
07 Jul	-3.9	03:35:56	10°	W	03:39:15	76°	SSW	03:42:34	10°	ESE
07 Jul	-3.0	23:33:14	12°	SSW	23:35:49	29°	SSE	23:38:45	10°	E
08 Jul	-3.9	01:08:51	10°	WSW	01:12:10	81°	SSE	01:15:30	10°	E
08 Jul	-3.9	02:45:28	10°	W	02:48:49	88°	S	02:52:08	10°	E
08 Jul	-2.4	22:43:02	10°	SSW	22:45:31	20°	SE	22:48:01	10°	E
09 Jul	-3.9	00:18:25	10°	WSW	00:21:43	66°	SSE	00:25:01	10°	E
09 Jul	-3.8	01:55:00	10°	W	01:58:19	85°	N	02:01:39	10°	E
09 Jul	-3.6	03:31:37	10°	W	03:34:51	50°	SSW	03:38:05	10°	SE
09 Jul	-3.7	23:28:02	10°	SW	23:31:16	49°	SSE	23:34:29	10°	E
10 Jul	-3.8	01:04:27	10°	W	01:07:47	85°	N	01:11:07	10°	E
10 Jul	-3.9	02:41:04	10°	W	02:44:23	66°	SSW	02:47:41	10°	ESE
10 Jul	-3.2	22:37:44	10°	SW	22:40:48	35°	SSE	22:43:52	10°	E
11 Jul	-3.9	00:13:53	10°	W	00:17:13	88°	S	00:20:33	10°	E
11 Jul	-3.9	01:50:31	10°	W	01:53:51	82°	S	01:57:10	10°	ESE
11 Jul	-3.0	03:27:16	10°	W	03:30:12	29°	SSW	03:33:07	10°	SSE
11 Jul	-3.9	23:23:19	10°	WSW	23:26:38	75°	SSE	23:29:57	10°	E
12 Jul	-3.9	00:59:55	10°	W	01:03:15	88°	N	01:06:35	10°	E
12 Jul	-3.5	02:36:34	10°	W	02:39:43	41°	SSW	02:42:52	10°	SE
12 Jul	-1.7	04:15:05	10°	SW	04:15:38	10°	SW	04:16:12	10°	SW
12 Jul	-3.8	22:32:47	10°	WSW	22:36:02	58°	SSE	22:39:19	10°	E
13 Jul	-3.8	00:09:16	10°	W	00:12:37	85°	N	00:15:57	10°	E
13 Jul	-3.8	01:45:54	10°	W	01:49:10	57°	SSW	01:50:50	25°	SE
13 Jul	-1.5	03:23:08	10°	W	03:23:23	11°	WSW	03:23:23	11°	WSW
13 Jul	-3.8	23:18:35	10°	W	23:21:56	88°	N	23:25:15	10°	E
14 Jul	-4.0	00:55:13	10°	W	00:58:32	74°	SSW	01:00:12	27°	ESE
14 Jul	-1.7	02:32:04	10°	W	02:32:52	15°	W	02:32:52	15°	W
14 Jul	-3.9	22:27:54	10°	WSW	22:31:13	83°	S	22:34:33	10°	E
15 Jul	-3.9	00:04:30	10°	W	00:07:50	87°	SSW	00:10:23	16°	E
15 Jul	-2.5	01:41:11	10°	W	01:43:05	26°	WSW	01:43:05	26°	WSW
15 Jul	-3.8	23:13:45	10°	W	23:17:05	86°	N	23:20:25	10°	E
16 Jul	-3.6	00:50:22	10°	W	00:53:31	48°	SSW	00:53:31	48°	SSW
16 Jul	-3.7	22:22:58	10°	W	22:26:17	85°	N	22:29:37	10°	E
16 Jul	-3.9	23:59:34	10°	W	00:02:52	65°	SSW	00:04:05	34°	SE
17 Jul	-1.2	01:36:35	10°	W	01:36:48	11°	W	01:36:48	11°	W
17 Jul	-3.9	23:08:44	10°	W	23:12:04	80°	SSW	23:14:42	15°	ESE
18 Jul	-2.3	00:45:29	10°	W	00:47:25	24°	WSW	00:47:25	24°	WSW
18 Jul	-3.8	22:17:53	10°	W	22:21:13	89°	N	22:24:33	10°	E

ISS PASSES For Summer 2024

from Heavens Above website maintained by Chris Peat.

18 Jul	-3.3	23:54:31	10°	W	23:57:39	40°	SSW	23:58:04	38°	S
19 Jul	-3.7	23:03:34	10°	W	23:06:51	56°	SSW	23:08:44	22°	SE
20 Jul	-1.3	00:40:50	10°	WSW	00:41:26	12°	WSW	00:41:26	12°	WSW
20 Jul	-3.8	22:12:38	10°	W	22:15:57	73°	SSW	22:19:16	10°	ESE
20 Jul	-2.3	23:49:29	10°	W	23:52:06	23°	SW	23:52:06	23°	SW
21 Jul	-2.9	22:58:20	10°	W	23:01:22	33°	SSW	23:02:47	23°	SSE
22 Jul	-3.3	22:07:15	10°	W	22:10:28	47°	SSW	22:13:28	11°	SE
22 Jul	-1.4	23:44:56	10°	WSW	23:46:11	12°	SW	23:46:11	12°	SW
23 Jul	-1.9	22:53:12	10°	W	22:55:38	19°	SW	22:56:52	16°	S
24 Jul	-2.4	22:01:49	10°	W	22:04:44	28°	SSW	22:07:34	10°	SSE
26 Jul	-1.5	21:56:38	10°	WSW	21:58:43	16°	SW	22:00:47	10°	S
20 Aug	-1.0	05:17:50	10°	SSE	05:18:40	11°	SE	05:19:28	10°	ESE
22 Aug	-1.8	05:08:05	10°	SSW	05:10:31	20°	SE	05:12:59	10°	E
23 Aug	-1.4	04:17:29	11°	SSE	04:18:34	13°	SE	04:20:07	10°	ESE
24 Aug	-2.7	05:00:02	14°	SSW	05:02:21	33°	SSE	05:05:21	10°	E
25 Aug	-2.2	04:09:50	22°	SSE	04:10:15	23°	SE	04:12:53	10°	E
26 Aug	-1.1	03:19:35	12°	ESE	03:19:35	12°	ESE	03:20:07	10°	ESE
26 Aug	-3.5	04:52:14	21°	SW	04:54:08	54°	SSE	04:57:20	10°	E
27 Aug	-3.1	04:01:55	38°	SSE	04:01:55	38°	SSE	04:04:57	10°	E
27 Aug	-3.8	05:34:58	10°	W	05:38:13	89°	N	05:41:29	10°	E
28 Aug	-1.3	03:11:34	15°	E	03:11:34	15°	E	03:12:26	10°	E
28 Aug	-3.9	04:44:13	27°	WSW	04:45:51	78°	SSE	04:49:06	10°	E
29 Aug	-3.5	03:53:49	55°	SE	03:53:49	55°	SE	03:56:41	10°	E
29 Aug	-3.8	05:26:39	10°	W	05:29:54	85°	N	05:33:11	10°	E
30 Aug	-1.2	03:03:24	16°	E	03:03:24	16°	E	03:04:12	10°	E
30 Aug	-3.9	04:36:03	31°	W	04:37:26	87°	N	04:40:42	10°	E
31 Aug	-3.2	03:45:38	53°	E	03:45:38	53°	E	03:48:13	10°	E
31 Aug	-3.9	05:18:16	11°	W	05:21:26	87°	S	05:24:42	10°	E
01 Sep	-0.9	02:55:13	13°	E	02:55:13	13°	E	02:55:41	10°	E
01 Sep	-3.9	04:27:52	40°	W	04:28:55	85°	N	04:32:10	10°	E
02 Sep	-2.5	03:37:29	37°	E	03:37:29	37°	E	03:39:35	10°	E
02 Sep	-3.9	05:10:08	14°	W	05:12:47	66°	SSW	05:16:00	10°	ESE
03 Sep	-4.0	04:19:50	67°	W	04:20:12	82°	S	04:23:26	10°	ESE
04 Sep	-1.6	03:29:38	20°	E	03:29:38	20°	E	03:30:49	10°	E
04 Sep	-3.5	05:02:18	23°	W	05:03:53	43°	SSW	05:06:59	10°	SE
05 Sep	-2.9	04:12:16	38°	SE	04:12:16	38°	SE	04:14:29	10°	ESE
05 Sep	-2.1	05:45:05	10°	W	05:47:17	17°	SW	05:49:29	10°	S
06 Sep	-2.7	04:55:09	25°	SSW	04:55:09	25°	SSW	04:57:31	10°	SSE
10 Sep	-1.3	21:16:07	10°	SSW	21:16:14	11°	S	21:16:14	11°	S

END IMAGES, AND OBSERVING

Well an incredible last observing night of the season.
Lacock was blessed with the Aurora of a lifetime from the UK. It started with the skies looking a little milky and disappointing for deep sky stuff, but stars (and planets) were shining, and the crescent Moon low in the sky. But as the 10:35 ISS came over the Aurora kicked in.
Here the full frame cameras came into their own, 14mm on the Z9 camera should have been well wide for most UK auraro, but it took the 8mm lens on the D810a on tripod to show the full majesty. The stream of intense magnetic interference lasted 22 hours. Just fading out as the Saturday night light dipped low enough to show anything. But nothing there…
We may get another session but not as bright this week but watch for Noctilucent clouds too.   Andy

WILTSHIRE ASTRONOMICAL SOCIETY

No official summer observing sessions are planned but around the 12/13th August is the Perseid Meteor shower, unfortunately a near full Moon will be up.

However if clear on the 12th evening around 9pm I will be up at the Alton Barnes Down carpark near the gate. The provides reasonable all sky views with cut off for pollution from the local towns.

Andy