NWASNEWS

Volume30 Issue 7

March 2024

Newsletter for the Wiltshire, Swindon, Bath Astronomical Societies

Spring Galaxy Season is here

Don't forget our May meeting will be a hall meeting.

Tonight is an open Zoom meeting.

April 2nd Zoom Meeting

Andy Burns is inviting you to a scheduled Zoom meeting.

Topic: The Spring Skies

Topic: Wiltshire Astronomy Society' Zoom Meeting

Time: Apr 2, 2024 07:45 PM London

Join Zoom Meeting

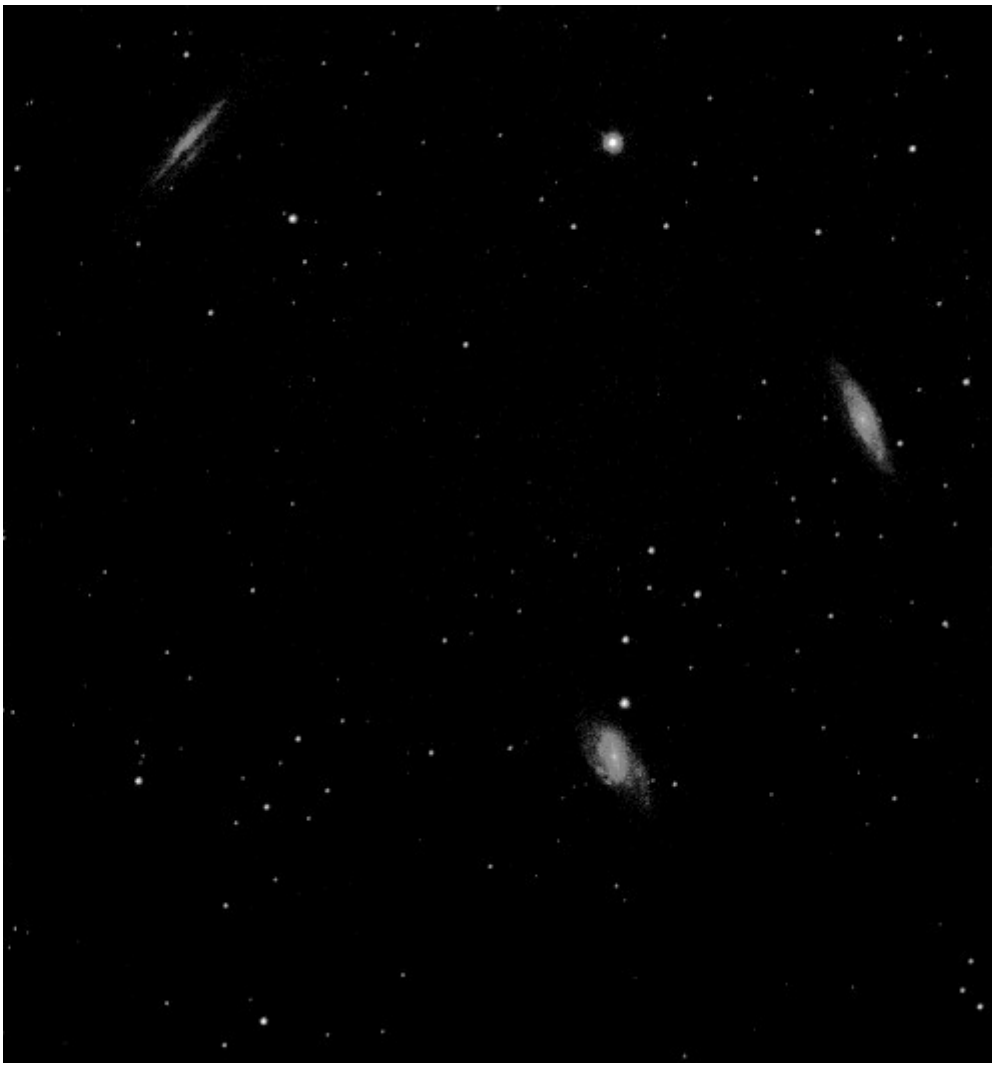
https://us02web.zoom.us/j/85047477218?pwd=RktwNDY4WEFBRlBPTk53SmJDc2Mwdz09

Meeting ID: 850 4747 7218

Passcode: 138040

Clear skies.

Andy Burns.



\the Leo triplet of galaxies.
2 Messier objects and one ngc object found by William Herschel.
N|ikon D810a on 6" Istar refractor at the Griffon Observatory Spain.
60 seconds, ISO 1200, Single exposure.
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

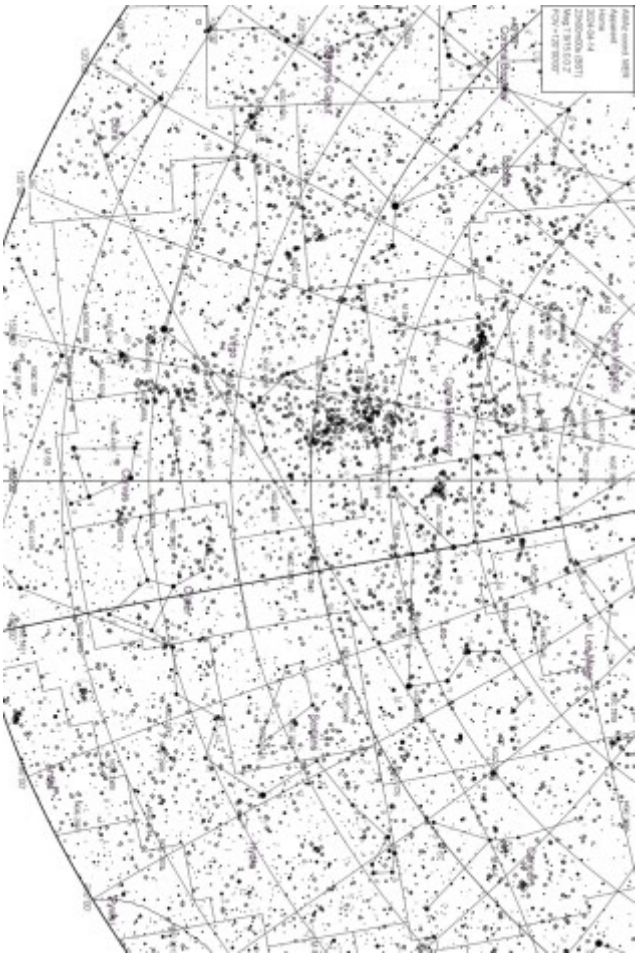
2024

April 2nd Zoom: Andy Burns: The Spring Skies. Galaxy season!
May 7th Hall Meeting, Rob Lucas Building a Garden observatory
June 4th:

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

Speaker tonight: Andy Burns

The Spring Skies

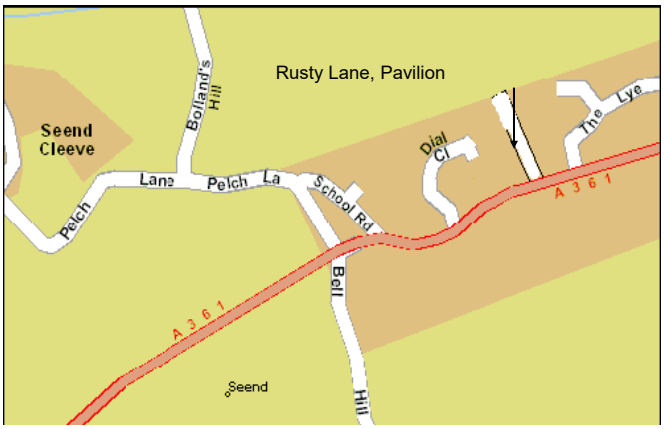


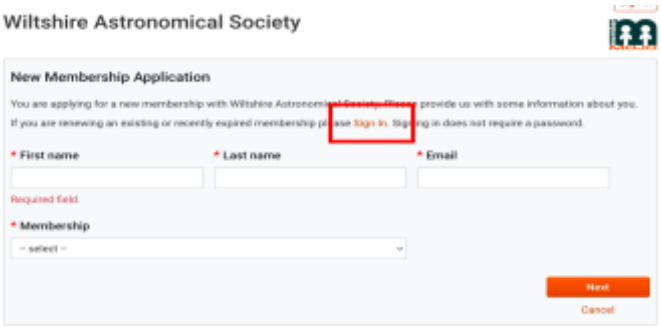
Membership Meeting nights £1.00 for members £3 for visitors

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

Wiltshire AS Contacts

Chairperson:
Outreach coordinator:
Newsletter/Publicity
Treasurer and Membership: Sam Franklin
Hall coordinator:
Live Meeting Supplies
Speaker secretary
Zoom session coordinator
Observing Sessions coordinators: Chris Brooks, Jon Gale,
Web coordinator: Sam Franklin
Contact via the web site details.





Observing Sessions see back page

Spring is the season we look out of our Milky Way galaxy confining dust and material and get clearer views of the galaxies that lay outside our own. Thois brings the comparatively near string on clusters of the Virgo Coma Berenices super cluster and beyond.

Swindon's Own Astronomy Group

Physical meetings

The club meets in person once per month.

Online Meetings

Once per month to discuss equipment and techniques.

Friday, 15th March 2024:

Swindon Stargazers AGM

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

There will be a Mystery Presentation following the AGM

Ad-hoc viewing sessions

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

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

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

Meetings at Liddington Village Hall

Church Road, Liddington, SN4 0HB

7.30pm onwards

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

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

Following Meeting Dates

Friday, 19 April 2024 @ 19:30

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

Friday, 17 May 2024 @ 19:30

Kate Earl: Magnetars – The Beauty behind the Beast

Friday, 21 June 2024 @ 19:30

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

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.co

Chairman: Damian OHara
Email: swindonstargazers@duck.com

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

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

Next Gatherings:
Wednesday, **24th April 2024** - Talk by **Prof. Leigh Fletcher**, Professor of Planetary Science, University of Leicestershire.
Wednesday, **29th May 2024** – Talk by **Dr. Penny Wozniakiewicz**, University of Kent.
Wednesday, **26th June 2024** – Talk by **Pete Richardson**, Construction of a 20" telescope with science grade optics… in your garage.

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.

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

A visit to GRANTECAN

Mike Alexander

Apologies for the abbreviations, they come with the territory.

Two major events occurred in my life last March: firstly, I lost my beloved Hearing Dog, Lyla. I'm sure some of you will remember her, she was a wonderful dog and she is greatly missed.

The other event, which may be of interest was a visit to the Observatorio de Roque de Los Muchachos (ORM), here on La Palma, where I was able to tour the Gran Telescopio de Canarias, GTC or GRANTECAN. My Spanish partner, Nasay, comes from the Garafia area in the north of the island and she has a relative who works as a technician at GRANTECAN, and so was able to arrange a visit whilst the telescope was being prepared for the night's observations.

One thing common to all observational astronomers, amateur or professional, is they all wish they had a bigger one – telescope, that is! Well, currently, at 10.4 metres aperture, GRANTECAN is the biggest single aperture telescope on the planet.

La Palma has become a World-renowned site for astronomy over the last few decades. There are several reasons for this: firstly, the Rocque de los Muchachos – the Rock of the Brothers, which is the

Figure 1 GranTelescopio Canarias (GRANTECAN)

highest point on the island, generally sits above the cloud layer; Secondly, the constant trade winds that revolve around the Azores high ensure that the atmosphere over the Taburiente volcanic Caldera rim, where ORM is situated, is very smooth, which allows for outstanding 'seeing' conditions; finally, the entire island is a 'dark sky reserve', this means that light pollution, the bane of astronomers, is reduced to an absolute minimum. There are no heavy industrial plants on the island, all streetlamps, by law have to point downwards, airways are routed away from the island. The result is that La Palma, officially, has the darkest skies on the planet.

WHY LA PALMA?

It all began with the Isaac Newton Telescope (INT). This was constructed in the 1960s, with a 98in Pyrex mirror, scrounged from the US and sited at RGO Herstmonceux in Sussex. Yes, whilst everyone else was building their large telescopes on mountain tops, Britain built theirs in a swamp! The reason for this was that the Government insisted that it was built in UK and as the RGO had recently moved from Greenwich to Herstmonceux, the cheapest location they could find at that time, that's where it would be built! The result, predictably, was the third largest telescope in the World, at the time of its

Figure 2 Isaac Newton Group (ING) at Observatorio de Roque de los Muchachos (ORM)

construction, was pretty much useless, on most nights surrounded by cloud and mist, and on clear nights inhibited by the light pollution from nearby Eastbourne.

Faced with the embarrassing prospect of a gigantic 'white elephant' of their own making, the "powers that be" agreed to the INT being relocated, this time to a location chosen by astronomers. At that time Britain was in the process of joining what was then the European Economic Community (EEC), which later morphed into the EU. One of the extant projects was the setting up of a common European Astronomical Observatory to rival Mauna Kea in Hawai'i. Several sites were surveyed in the Alps and the Pyrenees, then somebody suggested Mount Teide on Tenerife. A survey team was despatched – not that easy in those days, Tenerife was not the holiday mecca it is today and very remote. The 'seeing' conditions there were found to be 'Excellent', far better than the other sites surveyed and *as good as Mauna Kea.* (my italics). The locals told the team in the pub one night that the 'seeing' was even better on top of the neighbouring island of La Palma. The survey team were sceptical about this claim, but as they had come so far, they decided to take a boat to La Palma and investigate it. The results proved the locals were quite right, the 'seeing' conditions on La Palma were assessed as 'Outstanding'. The final recommendation was that INT should be relocated there.

The Government were not pleased. In the early 1970s, the original choice of Tenerife, a remote island, few had heard of

then, now the scientists wanted to go to an even more remote island, and in both cases it meant dealing with the Spanish Government, then still under the Franco dictatorship. The Foreign Office were not keen, but the desire to show 'European' credentials to the EEC outweighed the FO's objections. INT would be moved to La Palma. The Spanish would provide the access road and other infrastructure, UK and later other European states would provide the telescopes.

Moving the INT proved to be a far more expensive exercise than had been anticipated. In retrospect, it would have been cheaper to have built a completely new telescope. However, the opportunity was taken to upgrade the telescope. A new 100in mirror of Zerodur, a ceramic material with a coefficient of thermal expansion of near zero, was made among other changes. If you visit Herstmonceux today, now a museum, you can still see the original INT dome and 98in Pyrex mirror.It had been decided that the original outfit of what was to become ORM, should consist of three telescopes – a 1 metre, which became the Anglo-Dutch Jacobus Kapteyn Telescope (JKT), a 100in (the INT) and a new telescope of around 5 metres, which subsequently became the William Hershel Telescope (WHT). Over the years they have been joined by many other instruments, notably the Nordic Optical Telescope (NOT); the

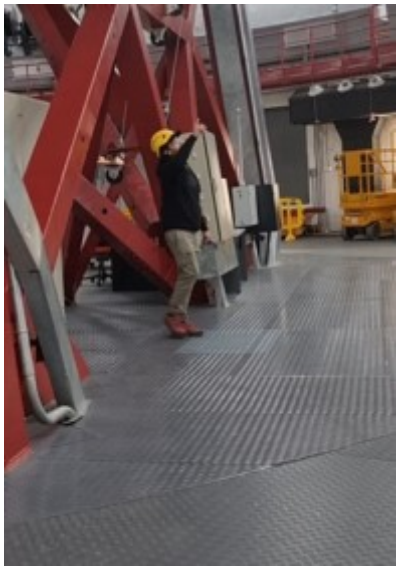


Figure 3 The azimuth axis in the floor of GRANTECAN

Dutch Open Solar Telescope (DOT); the Swedish Solar Telescope (SST); the Liverpool Robotic Telescope (LT) and the Belgian Mercator Telescope and many others. These are known as the Isaac Newton Group of instruments (ING).

In 1987 a consortium of nations including the Spanish, UK and Mexican Governments decided to embark on the construction of a 10-metre optical telescope based on the design of the twin WM Keck telescopes on Mauna kea. The UK Government pulled out on cost grounds (obviously) and their place was taken by the University of Florida. This would become the Gran Telescopio de Canarias GRANTECAN or GTC. It was constructed between 2002 and 2008, First Light was on 13 July 2007. The telescope was formally opened by King Juan Carlos I of Spain on 24 July 2009, more than 500 VIPs attended. A heliport with four landing spots was constructed, adjacent to the telescope, so that the VIPs would be spared the tortuous journey up the winding access road. The heliport has not been used since!

Figure 4 The primary mirror of GRANTECAN showing the mirror segments

Roberto, the technician met us at the entrance to the office block attached to the telescope. He had driven up from Garafia in one of the electric cars attached to the GRANTECAN project, they have chargers at the telescope site. We entered the complex and walked past several offices and workshops, and then past the control room of the Telescope. In a space between the office block and the telescope we were given a safety brief (in Spanish, so not much use to me). We were then shown a film projected on a wall explaining, again in Spanish, what the telescope was about and how it was used. For my benefit, they put the subtitles up in English. We were then issued with hard hats and entered the dome itself.

Figure 5

GRANTECAN ready for a night's observations

As you would expect, the telescope and its mount are massive pieces of engineering and the dome is a cathedral of science. The baseplate on which the telescope sits moves incredibly silently and smoothly. The only indication that it is moving is the sounding of a siren and the movement of the baseplate in relation to the dome floor which can clearly be seen. The 10.4 metre primary mirror is made up 36 zerodur hexagonal segments, each of these has a name related to the Canary Islands, rather than just a number. The maintenance and re-silvering of these segments is done in house. Similar work for all the other telescope at ORM is done at the William Herschel telescope. The opening of the dome is announced by squealing noise similar to squeaky brakes on a car! I would have liked to stay for the night's observations, but after dusk the ORM site is strictly staff only. There is no doubt that GRANTECAN is a very impressive feat of engineering and it will only be exceeded in size at the end

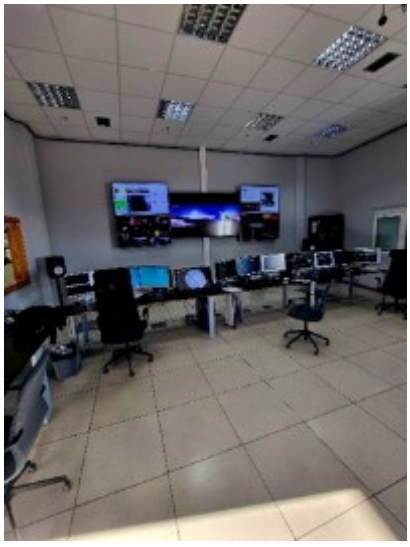


Figure 6 The Control Room at GRANTECAN

of the decade when the European Extremely Large Telescope (E-ELT) is commissioned in the Atacama Desert in Chile at 39 metres aperture. Two other Extremely Large

Telescopes are being planned: the Giant Magellen Telescope (GMT), also in Chile, and the Thirty Meter Telescope (TMT), which if it is ever built, will be sited in the Northern Hemisphere. It is planned to build it on Mauna Kea on the Big Island of Hawai'i. The problem is that Mauna Kea is sacred to the native Hawaiian population, who believe only their gods should live there.

Unfortunately, the summit of Mauna Kea just happens to be the best site for astronomical observation in the Northern Hemisphere, especially for infra-red work. Therefore, there are many Telescopes on the mountain, including the twin W.M.Keck 10 metre telescopes and the United Kingdom Infra-Red Telescope (UKIRT). All the telescopes are presently sub-leased from the University of Hawaii for a nominal one dollar a year each. Each new Telescope that has been built there has been promised to be 'the last', as has TMT. There are now 17 of them!

The natives, surprise, surprise, don't believe it and are revolting! The dome of the TMT will be the size of a nineteen-story building, and it will dominate the mountain top, so TMT has proved to be the 'straw that broke the camel's back', and after over a decade of legal objections and blocking the only access road by the 'protectors' of the mountain, not a stone has been laid. (This is subject to yet another legal argument. The permit to build was time limited and the 'Protectors' say that construction cannot start until a new permit is issued, a process that can take years.) The committee running the project have identified an alternative site, 'should it not prove possible to build in Hawai'i. That alternative is ORM, here on La Palma, which, incidentally, when measurements were made, proved to be every bit as good an observing site as Mauna Kea.

There are no objections from the native people of the Canary Islands – the Spanish slaughtered them all in the 16th.Century, and all the necessary legal permissions have been obtained. Construction on La Palma could start more or less immediately. TMT is an international project including the US, China, India, and Canada, and many of these countries are getting irritated by the constant delays in Hawai'i and are threatening to pull funding.

STOP PRESS!

Last Month, a bombshell was dropped by the US National Science Board (NSB). This is the US Congressional committee that controls the budget of the US National Science Foundation (NSF). The NSF allocates funding to various US science projects. Last year the NSF decided that the US Extremely Large Telescope Program (US-ELTP) was the highest priority and wanted to provide $3 billon of funds to support both the GMT and TMT. Both projects are collaborations of various universities and other nations, but neither is fully funded. NSF funding was supposed to allow both projects to continue and ensure that US astronomers were allocated time on both telescopes. The NSB have told the NSF that funding for the US-ELTP is to be capped at $1.6 billion, citing that other projects also need funding, and $3 billion proposed to fund both Telescopes in the US-ELTP represented 80% of the NSF budget. This means the NSF can only support one of the ELT projects. The NSF has been given until the next meeting of the NSB in May 2024 to come up with a plan to choose which project to support.

Figure 7 Artist's impression of the Giant Magellan Telescope (GMT)

This decision has been welcomed by some astronomers in the US, as both projects were coasting along and falling ever further behind the E-ELT project, which is so advanced in construction, that the dome was rotated under power for the first time last month. Other US astronomers are furious as they will now have access to only one ELT instead of the two, they were expecting. Competition for telescope time will therefore become more intense.

This does not look good for TMT. Construction of GMT is underway, the mountain on which it is to be built has had the top flattened by explosives and all 7 of the 8 metre diameter mirrors that will make up the primary mirror have been cast and three have completed the polishing process Whilst TMT has not succeeded in laying a brick at Mauna Kea in two decades. The project is still bogged down in legal arguments and protests by Native Hawaiians opposed to building TMT on their sacred mountain. The only thing going for it is that it will be in the Northern Hemisphere, which means it can cover parts of the sky which E-ELT and GMT cannot see from Chile and it is a more international project, with Canada, China., Japan and India also involved.

Figure 8 Artist's impression of the European Extremely Large Telescope (E-ELT)

I'm biased of course, but I think it's only hope for survival is to finally ditch the idea of building on Mauna Kea and go to the alternative site – which is ORM on La Palma! All the necessary permissions have been granted by the municipality of Garafia, where ORM is located, so construction could begin almost immediately. The project includes an educational package to support STEM subjects in local schools and universities. That would be transformational to the prospects of local kids, who presently have only low-paid agricultural and tourism jobs available. We shall see.

Figure 9 Artist's impression of the Thirty Meter Telescope (TMT)

Thank you Mike.

SPACE NEWS

Against all Odds. Japan's SLIM Lander Survived a Second Lunar Night Upside Down

You might remember the SLIM lunar lander that managed to land upside-down! The probe from the Japanese Space Agency has survived its second night on the Moon and returns a new photograph. Despite the solar panels pointing away from the Sun during the day it was still able to capture the image and transmit to Earth. All that while surviving the harsh -130C lunar night.

The Japanese Space Agency (JAXA) sent SLIM (the Smart Lander for Investigating the Moon) back in January but the lightweight spacecraft landed completely wrong. Despite the wonky landing, SLIM touching down in one piece made Japan the fifth nation to land on the surface without crashing. The biggest problem for the mission was the solar panels pointing the wrong way. To the surprise of JAXA though they were able to announce the probe awoke for a second night.

The lander's purpose was to research and test the pinpoint landing technology for future lunar missions. The hope is that it will pave the way for future missions to land where we want them to rather than where it is safest and easy to land. This will have benefits for landing on the Moon and on other astronomical bodies.

The black and white image sent back revealed the rocky surface and a lunar crater. It was released on the SLIM official social media platform with the accompanying text 'Since the Sun was still high in the sky and the equipment was still hot, we recorded images of the usual scenery with the navigational camera, among other activities for a short period of time.'

The post came shortly after an American unscrewed lander known as Odysseus had failed to wake. The craft became the first American spacecraft to land on the lunar surface since the Apollo 17 mission in 1972. It also became the first privately funded probe to land safely on the Moon's surface. In a similar landing to SLIM, Odysseus (which came in at just over 4 metres tall) also managed to topple over onto its side following an approach that was too fast. The manufacturers of the Odysseus spacecraft, Intuitive Machines based in Houston, had hoped that it might awake just like SLIM but sadly this does not seem to have occurred.

A SpaceX Falcon 9 rocket rises from its Florida launch pad to send Intuitive Machines' Odysseus moon lander spaceward. (NASA via YouTube)

Aside from testing the precision landing technology, SLIM also aims to study part of the Moon's mantle which it is thought was accessible at the landing site. After its landing, it switched off to save power but the incoming sunlight managed to switch it back on again to enable a couple of days to scientific observations. Given that the probe was not designed to survive the lunar nights, it was a fabulous surprise and bonus for the team.

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

Universe Today has explored the importance of studying impact craters, planetary surfaces, exoplanets, astrobiology, solar physics, comets, planetary atmospheres, planetary geophysics, and cosmochemistry, and how this myriad of intricately linked scientific disciplines can assist us in better understanding our place in the cosmos and searching for life beyond Earth. Here, we will discuss the incredible research field of meteorites and how they help researchers better understand the history of both our solar system and the cosmos, including the benefits and challenges, finding life beyond Earth, and potential routes for upcoming students who wish to pursue studying meteorites. So, why is it so important to study meteorites?

Dr. Alex Ruzicka, who is a Professor in the Department of Geology at Portland State University, tells *Universe Today*, "They provide our best information about how the solar system formed and evolved. This includes planet formation. We also obtain information on astrophysics (stellar processes) through studies of pre-solar grains."

There is often confusion regarding the differences between an asteroid, meteor, and meteorite, so it's important to explain their respective differences to help better understand why scientists study meteorites and how they study them. An asteroid is a physical, orbiting planetary body that is primarily comprised of rock, but can sometimes be comprised of additional water ice, with most asteroids orbiting in the Main Asteroid Belt between Mars and Jupiter and the remaining orbiting as Trojan Asteroids in the orbit of Jupiter or in the Kuiper Belt with Pluto. A meteor is the visual phenomena that an asteroid produces as it burns up in a planet's atmosphere, often seen as varying colors from the minerals within the asteroid when heated up. The pieces of the asteroid that survive the fiery entry and hit the ground are called meteorites, which scientists' study to try and learn about the larger asteroid body it came from, and where that asteroid could have come from, as well. But what are some of the benefits and challenges of studying meteorites?

Dr. Ruzicka tells *Universe Today*, "Benefits: scientific knowledge, information on potential resources (e.g., metals, water) for humans to utilize, information on how to link meteorites and asteroids, which can provide information on space collision hazards for Earth. Challenges: compared to Earth rocks, we lack field evidence for their source bodies and parent bodies (how they relate to other rocks), we have to factor in the element of time that is longer for space rocks than for Earth rocks, and sometimes we are dealing with formation environments completely unlikely what we have on Earth. So, the challenges are big and many."

According to NASA, more than 50,000 meteorites have been retrieved from all over the world, ranging from the deserts of Africa to the snowy plains of Antarctica. In terms of their origins, it is estimated that 99.8 percent of these meteorites have come from asteroids, with 0.1 percent coming from the Moon and 0.1 percent coming from Mars. The reason why we've found meteorites from the Moon and Mars is due to pieces of these planetary bodies being catapulted off their surfaces (or sub-surfaces) after experiencing large impacts of their own, and these pieces then travel through the Solar System for thousands, if not millions, of years before being caught in Earth's gravity and the rest is history. Therefore, with meteorites originating from multiple locations throughout the Solar System, what can meteorites teach us about finding life beyond Earth?

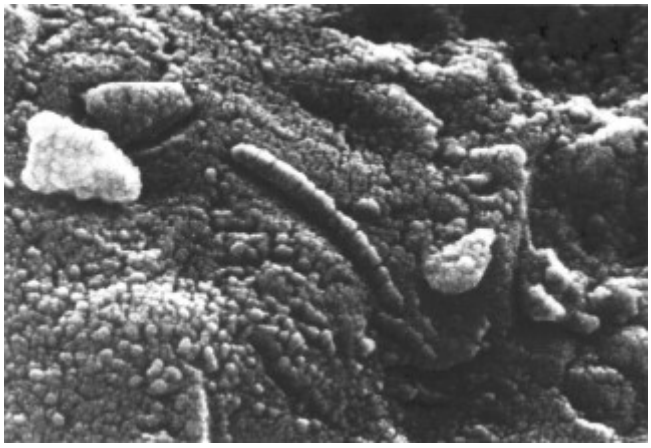
Morgan Nunn Martinez, who was a PhD student at UC San Diego, and Dr. Alex Meshik seen photographing and measuring a meteorite specimen in Antarctica's Miller Range during the 2013-2014 Antarctic Search for Meteorites (ANSMET) program field season. (Credit: NASA/JSC/ANSMET)

"That the ingredients for making life formed in space and were delivered to Earth," Dr. Ruzicka tells *Universe Today*. "We know organic molecules formed in gas clouds, were incorporated in our solar system, and processed in asteroidal and cometary bodies under higher temperatures in the presence of water. These were then delivered to Earth which wouldn't have been very hospitable in early times due to sterilizing impacts. We also know that there must have been a lot of planetary rock swapping early when impact rates were high. Life itself may have been transplanted to Earth from Mars."

As it turns out, one of the most fascinating meteorites ever recovered did come from Mars, which was identified as ALH84001, as it was found in Allan Hills of Antarctica on December 27, 1984, during the 1984-85 field season where researchers from all over the world gather in Antarctica to search for meteorites using snowmobiles. Despite being collected in 1984, it wasn't until 1996 that a team of scientists discovered what initially appeared to be evidence of microscopic bacteria fossils within the 1.93-kilogram (4.25-pound) meteorite.

ALH84001, which is one of the most famous meteorites ever recovered, helped catapult the field of astrobiology to new heights when scientists uncovered what initially appeared to be microscopic bacteria fossils within this meteorite, though those findings remain inconclusive to this day. (Credit: NASA)

This immediately made headlines across the globe, resulting in countless non-scientific claims that these microfossils were clear evidence of life on Mars. However, both the researchers of the initial study and the scientific community were quick to point out the unlikelihood that these features resulted from life based on other observations made about ALH84001. For example, while ALH84001 is estimated to be 4.5 billion years old, which is when Mars is hypothesized to have possessed liquid water on its surface, radiometric dating techniques revealed that ALH84001 was catapulted off Mars approximately 17 million years ago and landed on Earth approximately 13,000 years ago.



Microscopic image of ALH84001, which initially made headlines for potentially possessing microscopic bacteria fossils, though these finding remain inconclusive to this day. (Credit: NASA)

To this day, there has been no clear evidence that ALH84001 ever contained traces of life. Despite this, ALH84001 has nonetheless helped launch the field of astrobiology into new heights, with present-day scientists claiming this one meteorite was the reason they pursued their career path to find life beyond Earth. But what have been the most exciting aspects about meteorites that Dr. Ruzicka has studied throughout his career?

Dr. Ruzicka tells *Universe Today*, "A lot is interesting, what's most exciting? That's hard to say. I get satisfaction from taking clues left by the rocks to figure out or constrain the processes that formed them. I am engaged in a meteoritic version of CSI, we can call it MSI (for meteoritic scene investigation)."

Like many scientific fields, this "meteoritic version of CSI" requires individuals from a myriad of backgrounds and disciplines, including geology, physics, geochemistry, cosmochemistry, mineralogy, and artificial intelligence, just to name a few, with the aforementioned radiometric dating frequently used to estimate the ages of meteorites by measuring the radioactive isotopes within the sample. It is through this constant collaboration and innovation that scientists continue to unlock the secrets of meteorites with the goal of understanding their origins and compositions, along with how our Solar System, and life on Earth (and possibly elsewhere), came to be. Therefore, what advice can Dr. Ruzicka offer upcoming students who wish to pursue studying meteorites?

Dr. Ruzicka tells *Universe Today*, "Work hard and pursue your dreams. Find a rigorous program of study because it will come in handy."

While meteorites are space rocks that crash land on Earth after traveling through the heavens for millions, and possibly billions, of years, these incredible geologic specimens are slowly helping scientists' piece together the origins of the Solar System and beyond, and even how life might have come to be on our small, blue world, and possibly elsewhere. With a myriad of tools and instruments at their disposal, scientists from all over the world will continue to study meteorites in hopes of answering the universe's toughest questions.

Dr. Ruzicka concludes by telling *Universe Today*, "Rocks from space are the best kinds of rocks to study. Way more cool than most rocks on Earth because they are in some ways more puzzling."

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

The Milky Way's Smallest, Faintest Satellite Galaxy Found

The Milky Way has many satellite galaxies, most notably the Large and Small Magellanic Clouds. They're both visible to the naked eye from the southern hemisphere. Now astronomers have discovered another satellite that's the smallest and dimmest one ever detected. It may also be one of the most dark matter-dominated galaxies ever found.

The galaxy is called Ursa Major III / UNIONS 1 (UMa3/U1), and it contains very few stars. In fact, its luminosity is so low that it's gone undetected until new, even though it's in our neighbourhood.

The discovery is in a new paper titled "Ursa Major III/UNIONS 1: the darkest galaxy ever discovered?" The paper has been published in The Astrophysical Journal, and the lead author is Simon Smith. Smith is an astronomy graduate student at the University of Victoria, BC, Canada.

"UMa3/U1 is located in the Ursa Major (Great Bear) constellation, home of the Big Dipper. It is in our cosmic backyard, relatively speaking, at about 30,000 light-years from the Sun," said Smith. "UMa3/U1 had escaped detection until now due to its extremely low luminosity."

There are only about 60 stars in UMa3/U1, which barely qualifies it as a galaxy. There are star clusters with more members than that. In fact, the tiny galaxy is more in line with an open cluster in terms of number of stars.

"There are so few stars in UMa3/U1 that one might reasonably question whether it's just a chance grouping of similar stars."
Marla Geha, professor of astronomy and physics at Yale University

The tiny galaxy contains stars that are more than 10 billion years old and is only 10 light-years across, small for a galaxy. Its mass is also low for a galaxy. It contains just 16 times the mass of the Sun and is 15 times less massive than the faintest suspected dwarf galaxy. Those are small numbers more similar to a globular cluster, but it still might be a galaxy because of the presence of dark matter.

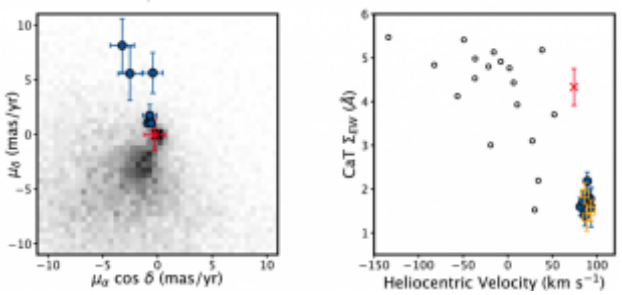
While stellar associations like globular clusters are more massive than this dwarf galaxy, they're not galaxies. Astronomers think that globulars are dominated by baryonic (normal) matter processes. Ultra-faint galaxies (UFG) like this one have masses many orders of magnitude greater than their stars can account for. "Therefore, in the framework of ?CDM (Lambda Cold Dark Matter) cosmology, dwarf galaxies are thought to lie at the center of their own dark matter halos," the research states. Astrophysicists think the dark matter haloes account for all that mass, something that globulars and other star clusters lack.

The tiny galaxy was first spotted as part of the Ultraviolet Near Infrared Optical Northern Survey (UNIONS) at Canada France Hawaii Telescope (CFHT) and the Panoramic Survey Telescope and Rapid Response System (Pan-STARRS,) both in Hawaii. Once detected, the researchers studied it in more detail with Keck Observatory's Deep Imaging Multi-Object Spectrograph (DEIMOS). Those observations confirmed that the stars are gravitationally bound, meaning they had to be either in a cluster or a tiny galaxy.

The CFHT is at Hawaii's Mauna Kea Observatory, Hawaii, and Pan-STARRS is at the Haleakala Observatory in Hawaii. Both are key parts of UNIONS, the Ultraviolet Near Infrared Optical Northern Survey. Image Credit: UNIONS

The galaxy's small number of stars would make anyone question whether it can be rightly called a galaxy. Even the researchers had their doubts.

"There are so few stars in UMa3/U1 that one might reasonably question whether it's just a chance grouping of similar stars. Keck was critical in showing this is not the case," says co-author Marla Geha, professor of astronomy and physics at Yale University. "Our DEIMOS measurements clearly show all the stars are moving through space at very similar velocities and appear to share similar chemistries."



This figure from the research shows the motion (L) and velocity (R) of the dwarf galaxy's member stars. In the left panel, the great region marks the motion of stars in the Milky Way and shows how the member stars (blue) are clustered together differently. In the panel on the right, the member stars are clustered together by velocity, and the empty circles are other non-member stars. Image Credit: Smith et al. 2024

Astronomers have struggled to understand dwarf galaxies and their dark matter. For one thing, the diagnostics astronomers use, like the stellar mass-metallicity relation, leads to arguments that they're more like star clusters than galaxies. Also, their observed properties place them at the mid-point between clusters and dwarf galaxies.

Uncertainty abounds when it comes to UMa3/U1. Somehow, this association of stars has remained intact for a long time. With such low stellar mass, the grouping should've been torn apart by now, its members diluted into the larger Milky Way population. The fact that it's still together is an intriguing indication that dark matter is involved.

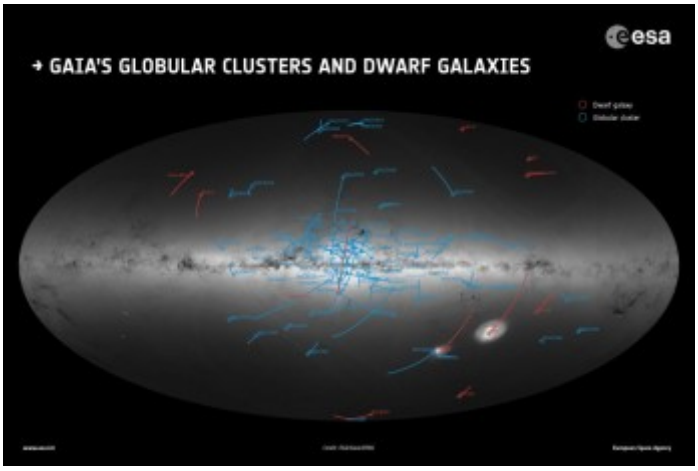
"The object is so puny that its long-term survival is very surprising."
Will Cerny, co-author, Yale University

"Excitingly, a tentative spread in velocities among the stars in the system may support the conclusion that UMa3/U1 is a dark matter-dominated galaxy – a tantalizing possibility we hope to scrutinize with more Keck observations," said Yale University graduate student Will Cerny, the second author of the study.

"The object is so puny that its long-term survival is very surprising. One might have expected the harsh tidal forces from the Milky Way's disk to have ripped the system apart by now, leaving no observable remnant," says Cerny. "The fact that the system appears intact leads to two equally interesting possibilities. Either UMa3/U1 is a tiny galaxy stabilized by large amounts of dark matter, or it's a star cluster we've observed at a very special time before its imminent demise."

If astrophysicists can confirm that the galaxy has dark matter, that would be a big deal. It would be more evidence in support of the Lambda Cold Dark Matter (CDM) model, the leading theory for dark matter and the Big Bang. CDM predicts that as the Milky Way formed, its gravity attracted large numbers of dwarf galaxies, much more than found so far. If this is one of them, and if the others are as difficult to detect as UMa3/U1, it supports the CDM.

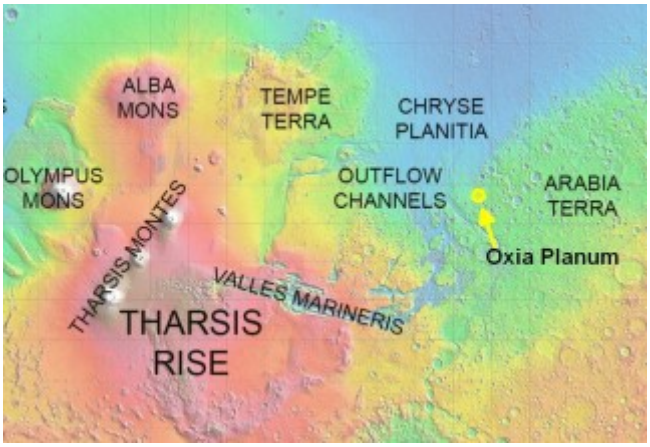
But for the researchers behind the discovery, there's more to it than just dark matter. They've found something unusual that's difficult to detect. Are there more of them out there?



The ESA's Gaia mission has found many dwarf galaxies and globular clusters in the Milky Way's halo. This image from the mission's second data release shows 75 globular clusters (blue) and 12 nearby dwarf galaxies (red). However, deeper observations are needed to understand the nature of the dwarf galaxies. Image Credit: ESA/Gaia/DPAC; Map and orbits: CC BY-SA 3.0 IGO LICENCE CC BY-SA 3.0 IGO or ESA Standard Licence
"Whether future observations confirm or reject that this system contains a large amount of dark matter, we're very excited by the possibility that this object could be the tip of the iceberg – that it could be the first example of a new class of extremely faint stellar systems that have eluded detection until now," says Cerny.
As for its origins, there are really only two options. It either formed in situ or was accreted by the Milky Way. Astronomers use metallicity and orbit to determine a dwarf galaxy's origins, but in this case, neither measurement showed clearly that it formed in situ. Only further observations will constrain its origins, but as it stands, the authors are leaning toward accretion. "We favour a scenario where UMa3/U1 was accreted onto the Milky Way halo," they write in their conclusion. That scenario also supports the Lambda CDM model.
Its fate is similarly unclear. So far, it hasn't been torn apart, which signals the presence of dark matter. But if it doesn't have dark matter, it may be on the verge of being destroyed. We'll have to wait and see.
For now, the object has an uncertain past and an uncertain future. But whatever it ends up being classified as, it's something new, and that means it's a challenge.
"This discovery may challenge our understanding of galaxy formation and perhaps even the definition of a 'galaxy,'" says Smith .

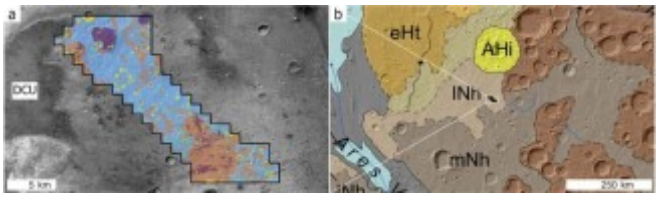
The ESA's Mars Rover Gets a New Map

Rosalind Franklin, the ESA's Mars rover, is scheduled to launch no sooner than 2028. Its destination is Oxia Planum, a wide clay-bearing plain to the east of Chryse Planitia. Oxia Planum contains terrains that date back to Mars' Noachian Period, when there may have been abundant surface water, a key factor in the rover's mission.
Rosalind Franklin's primary mission mirrors that of NASA's Perseverance rover: to search for fossil evidence of life. To do that, both rovers are equipped with a suite of powerful instruments. They both have sampling drills, but Franklin's drill wins the tale of the tape. It can penetrate to a depth of two meters, compared to Perseverance's which can only drill a few inches deep.
In order for the Franklin to be successful, it needs to land in a place where its drilling capability can be put to good use. That's why the ESA chose Oxia Planum. Not only is it flat, which makes for a safer landing, but it contains hydrated minerals. In fact, it's one of the largest exposed sections of clay-bearing minerals on Mars, and that's where the fossilized evidence of life it seeks may be found.

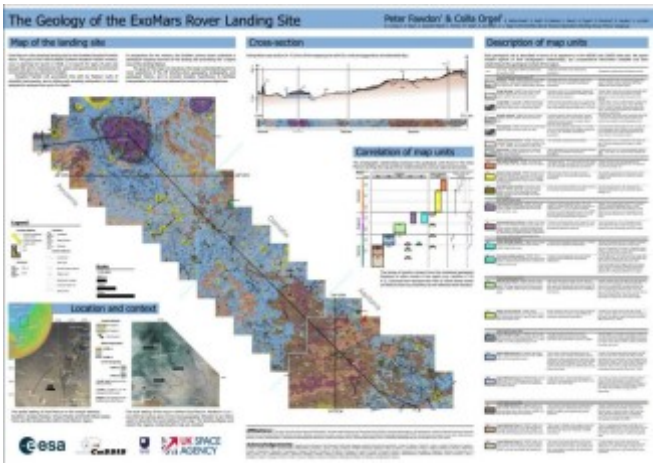


A team of European scientists has created the most detailed geological map of Oxia Planum ever. It took four years to complete and leans heavily on data from orbiters. The detailed map shows 15 units with characteristic geological features that can help decide how the rover explores the area. The map will also help the rover interpret its surroundings and collect evidence of primitive life.
"This map is exciting because it is a guide that shows us where to find the answers."
Peter Fawdon, co-lead author, Open University
Oxia Planum preserves a record of the forces that shaped the region and that shaped Mars. It's a transitional region between Chryse Planitia, which contains lower elevation plains from the Amazonian/Hesperian, and Arabia Terra, the heavily cratered Noachian-aged region.

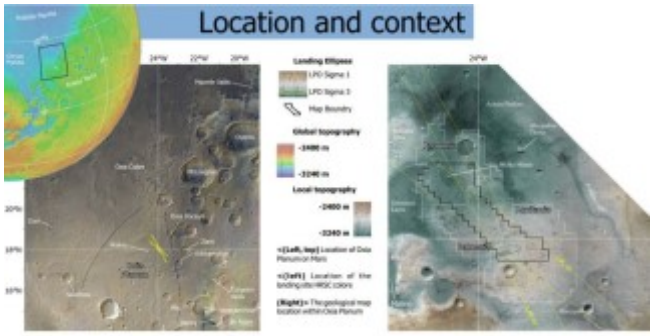
The sediments at Oxia Planum are nearly four billion years old. This will be the oldest site ever visited by a rover.
The new map has its roots in the COVID lockdowns. During that time, the Rosalind Franklin science team trained 80 volunteers to help them map Oxia Planum. The ExoMars Trace Gas Orbiter and NASA's Mars Reconnaissance Orbiter supplied the data.
The result is a map that shows Oxia Planum's geology in high detail. It shows types of bedrock and features like ridges and craters. It also shows crater ejecta and windborne dust. The map will not only help the rover navigate through difficult terrain; it'll inform the choices of where to drill for samples.



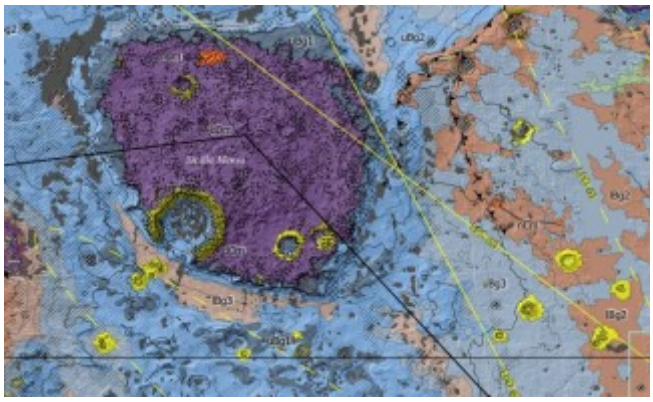
This isn't the first geological map of the Martian surface. But as this comparison shows, the new map (left) is much more detailed than previous ones (right.) The map on the right is a global geological map that labels the entire landing region as INh, or late Noachian highlands. Image Credit: L: Fawdon et al. 2024. R: Tanaka et al. 2014.
"The map represents our current understanding of bedrock units and their relationships prior to Rosalind Franklin's exploration of this location," the map creators write in the paper presenting the map.
"The objectives of this map are (i) to identify where the most astrobiologically relevant rocks are likely to be found, (ii) to show where hypotheses about their geological context (within Oxia Planum and in the wider geological history of Mars) can be tested, (iii) to inform both the long-term (hundreds of metres to ~1 km) and the short-term (tens of metres) activity planning for rover exploration, and (iv) to allow the samples analyzed by the rover to be interpreted within their regional geological context," the authors explain.
You can download the map and explore it here.



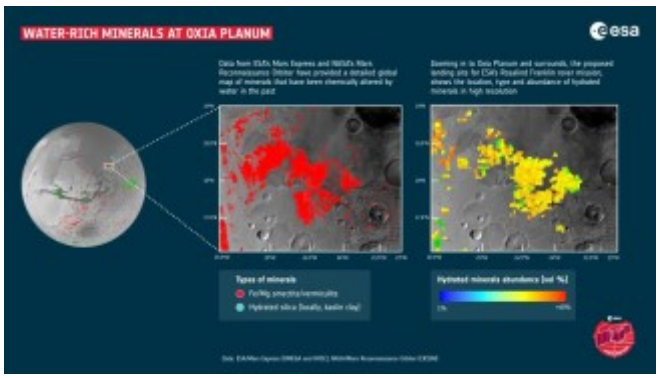
This is the new geological map of Oxia Planum, along with explanatory text. Image Credit: Fawdon et al. 2024.
"The wider region was extensively modified during the late Noachian and Hesperian periods, as shown by evidence of fluvial and paleo-lake activity, possible shoreline formation, volcanism, and aqueous alteration," the authors write. The Hesperian is when Mars lost its water and transitioned from a warm, wet environment to a dry, cold environment. Understanding how that happened is a primary goal in Mars science.



The map contains a location and context section that orients viewers. The image on the left shows Rosalind Franklin's landing site, and the image on the right shows the geological context. Image Credit: Fawdon et al. 2024.
The map shows mound materials, different types of bedrock, features like Mensas and crater materials of different ages.



This zoom-in of the map shows Sicilla Mensa, a flat-topped feature with cliff-like edges. oDm stands for overlying dark material. The image also shows craters and the extent of their ejecta, shown in yellow. It's labelled rCm for recent crater material. Image Credit: Fawdon et al. 2024.
This is the highest-resolution map of the region ever made. With a scale of 1:25,000, each centimetre on the map equals 250 meters on Mars. Since Rosalind Franklin will travel an average of 25 to 50 meters each day, a day's journey is one or two millimetres on the map.
The making of the map has already provided some benefits to the Rosalind Franklin mission. "The mapping exercise has provided the wider <ExoMars> rover team with a sound knowledge of the landing site and has also helped us to develop new geological hypotheses for the region," the authors write.



Oxia planum is rich in clays, also called hydrated minerals. Because clays are formed in water-rich environments, it makes these sites excellent locations to study for clues as to whether life once began on Mars. Image Credit: ESA/Mars Express (OMEGA and HRSC) and NASA/Mars Reconnaissance Orbiter (CRISM). LICENCE: ESA Standard Licence
The map is more than just a driving guide. It's essentially a summary of our hypotheses about Mars. When the rover begins its mission, its initial exploration and drilling will test some of these existing hypotheses for Martian geology and history. Those results will inform the rover team, leading to better decisions about where to drill and explore. That will "… improve the chances of the mission meeting its search for life goals," the authors explain.
"This map is exciting because it is a guide that shows us where to find the answers. It serves as a visual hypothesis of what we currently know about the different rocks in the landing site. The instruments on Rosalind Franklin will allow us to test our knowledge on the spot when the time comes," explained Peter Fawdon, one of the lead authors from the Open University.

Lunar Night Permanently Ends the Odysseus Mission

On February 15th, Intuitive Machines (IM) launched its first Nova-C class spacecraft from Kennedy Space Center in Florida atop a SpaceX Falcon 9 rocket. On February 22nd, the spacecraft – codenamed *Odysseus* (or "Odie") – became the first American-built vehicle to soft-land on the lunar surface since the *Apollo 17* mission in 1972. While the landing was a bit bumpy (*Odysseus* fell on its side), the IM-1 mission successfully demonstrated technologies and systems that will assist NASA in establishing a "sustained program of lunar exploration and development."

After seven days of operation on the lunar surface, Intuitive Machines announced on February 29th that the mission had ended with the onset of lunar night. While the lander was not intended to remain operational during the lunar night, flight controllers at Houston set *Odysseus* into a configuration that would "call home" if it made it through the two weeks of darkness. As of March 23rd, the company announced that their flight controllers' predictions were correct and that Odie would not be making any more calls home.
The company started listening for a wake-up signal from *Odysseus* on March 20th, when they projected that there was enough sunlight in the lander's vicinity. At the time, it was thought that this could potentially charge *Odysseus*' power system, allowing it to activate its radio and reestablish contact with Houston. However, three days later, at 10:30 AM Central Standard Time (08:30 AM PST; 11:30 AM EST), flight control-

lers determined that the lander was not charging up after it completed its mission.

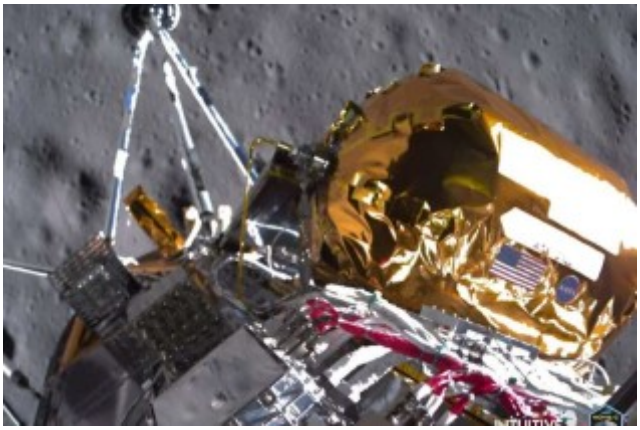


Image from the IM-1 Odysseus lander after it soft landed on the lunar surface. Credit: Intuitive Machines

This consisted of the Nova-C spacecraft making its inaugural soft landing on the Moon, the first time an American spacecraft has done so in over 50 years. The IM-1 mission was also the first time a spacecraft used methalox – the combination of liquid methane and liquid oxygen (LOX) – to navigate between the Earth and the Moon. While the IM-1 was not expected (or intended) to survive the lunar night, the data acquired by this mission could prove useful as the company continues to improve the lunar landing systems to deliver payloads to the Moon.

One of the company's main objectives is to develop heat and power sources that can "keep systems from freezing during the lunar night." This technology will greatly extend the life of lunar surface missions and facilitate the buildup of infrastructure on the Moon's surface. A second Nova-C lander with the IM-2 mission will launch aboard a Falcon 9 no earlier than December 2024. This mission will land a drill and the Polar Resources Ice Mining Experiment-1 (PRIME-1) mass spectrometer near the south pole of the Moon.

This NASA payload will demonstrate the feasibility of In-Situ Resource Utilization (ISRU) and measure the volatile content of subsurface samples. ISRU and the presence of water are vital to the creation of a lunar base and the ability to send crews to the lunar surface well into the foreseeable future. A third mission (IM-3) is scheduled for early 2025, which will carry four NASA payloads to the Reiner Gamma region of the Moon, a rover, a data relay satellite, and secondary payloads to be determined. All three launches were contracted as part of NASA's Commercial Lunar Payload Services (CLPS) program.

In addition, the IM-1 mission controllers and company managed to have a final farewell with the Odysseus mission before nightfall and the depletion of its battery power. On February 22nd, the lander transmitted a final image (shown below), which mission controllers in Houston received by February 29th. The image, Intuitive Machines said in a statement, "showcases the lunar vista with the crescent Earth in the backdrop, a subtle reminder of humanity's presence in the universe. Goodnight, Odie. We hope to hear from you again."

The last image sent by the IM-1 Odysseus mission on Feb. 22nd, 2024. Credit: Intuitive Machines

DART Changed the Shape of Asteroid Dimorphos, not Just its Orbit

On September 26th, 2022, NASA's *Double Asteroid Redirection Test* (DART) collided with the asteroid Dimorphos, a moonlet that orbits the larger asteroid Didymos. The purpose of this test was to evaluate a potential strategy for planetary defense. The demonstration showed that a kinetic impactor could alter the orbit of an asteroid that could potentially impact Earth someday – aka. Potentially Hazardous Asteroid (PHA). According to a new NASA-led study, the DART mission's impact not only altered the orbit of the asteroid but also its shape!

The study was led by Shantanu P. Naidu, a navigation engineer with NASA's Jet Propulsion Laboratory (JPL) at Caltech. He was joined by researchers from the Lowell Observatory, Northern Arizona University (NAU), the University of Colorado Boulder (UCB), the Astronomical Institute of the Academy of Sciences of the Czech Republic, and Johns Hopkins University (JHU). Their paper, "Orbital and Physical Characterization of Asteroid Dimorphos Following the DART Impact," appeared on March 19th in the *Planetary Science Journal*.

The Didymos double asteroid system consists of an 851-meter-wide (2792 ft) primary orbited by the comparatively small Dimorphos. The latter was selected as the target for DART because any changes in its orbit caused by the impact would be comparatively easy to measure using ground-based telescopes. Before DART impacted with the moonlet, it was an oblate spheroid measuring 170 meters (560 feet) in diameter with virtually no craters. Before impact, the moonlet orbited Didymos with a period of 11 hours and 55 minutes.

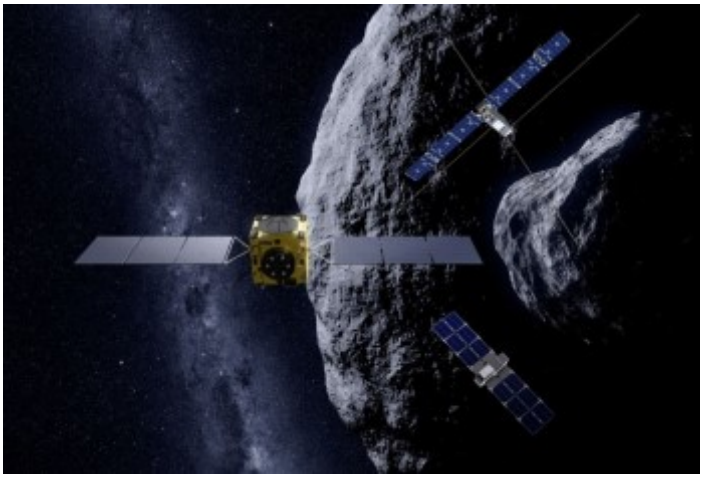
Artist's impression of the DART mission impacting the moonlet Dimorphos. Credit: ESA

Before the encounter, NASA indicated that a 73-second change in Dimorphos' orbital period was the minimum requirement for success. Early data showed DART surpassed this minimum benchmark by more than 25 times. As Naidu said in a NASA press release, the impact also altered the moonlet's shape:

"When DART made impact, things got very interesting. Dimorphos' orbit is no longer circular: Its orbital period is now 33 minutes and 15 seconds shorter. And the entire shape of the asteroid has changed, from a relatively symmetrical object to a 'triaxial ellipsoid' – something more like an oblong watermelon."

Naidu and his team combined three data sources with their computer models to determine what happened to the asteroid after impact. The first was the images DART took of Dimorphos right before impact, which were sent back to Earth via NASA's Deep Space Network (DSN). These images allowed the team to gauge the dimensions of Didymos and Dimorphos and measure the distance between them. The second source was the Goldstone Solar System Radar (GSSR), part of the DNS network located in California responsible for investigating Solar System objects.

The GSSR was one of several ground-based instruments that precisely measured the position and velocity of Dimorphos relative to Didymos after impact – which indicated how the mission greatly exceeded expectations. The third source was provided by ground-based telescopes worldwide that measured changes in the amount of life reflected (aka. light curves) of both asteroids. Much like how astronomers monitor stars for periodic dips (which could indicate a transiting planet), dips in Didymos' luminosity are attributable to Dimorphos passing in front of it.



Artist's impression of the ESA's Hera mission rendezvousing with Dimorphos. Credit: NASA

By comparing these light curves from before and after impact, the team learned how DART altered Dimorphos' motion. Based on these data sources and their models, the team calculated how its orbital period evolved and found that it was now slightly eccentric. Said Steve Chesley, a senior research scientist at JPL and a co-author on the study:

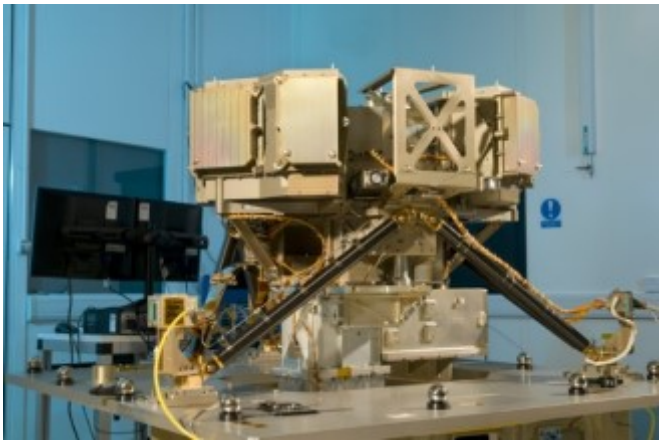
"We used the timing of this precise series of light-curve dips to deduce the shape of the orbit, and because our models were so sensitive, we could also figure out the shape of the asteroid. Before impact, the times of the events occurred regularly, showing a circular orbit. After impact, there were very slight timing differences, showing something was askew. We never expected to get this kind of accuracy."

According to their results, DART's impact reduced the average distance between the two asteroids to roughly 1,152 meters (3,780 feet) – closer by about 37 meters (120 feet). It also shortened Dimorphos' orbital period to 11 hours, 22 minutes, and 3 seconds – a change of 33 minutes and 15 seconds. These results are consistent with other independent studies based on the same data. They will be further tested by the ESA's *Hera* mission, scheduled to launch in October 2024, when it makes a flyby of the double-asteroid and conducts a detailed survey.

Webb Finds Deep Space Alcohol and Chemicals in Newly Forming Planetary

Since its launch in 2021, the James Webb Space Telescope (JWST) has made some amazing discoveries. Recent observations have found a number of key ingredients required for life in young proto-stars where planetary formation is imminent. Chemicals like methane, acetic acid and ethanol have been detected in interstellar ice. Previous telescopic observations have only hinted at their presence as a warm gas. Not only have they been detected but a team of scientists have synthesised some of them in a lab.

These molecules found in the solid stage phase in young protostars are an indicator that the processes leading to formation of life may be more common than first thought. The complex organic molecules (COMs) were first predicted decades ago before space telescopes observations inconclusively identified them. A team of astronomers using the Mid-InfraRed Instrument (MIRI) on the JWST as part of the James Webb Observations of Young ProtoStars programme have identified the COMs individually.



MIRI, (Mid InfraRed Instrument), flight instrument for the James Webb Space Telescope, JWST, during ambient temperature alignment testing in RAL Space's clean rooms at STFC's Rutherford Appleton Laboratory, 8th November 2010.

One of the target objects observed as part of this study was IRAS 2A, a low mass protostar. The science team are particularly interested because the system has similar characteristics as our own star, the Sun. It gives us a great test bed to explore the processes of the Solar System and Earth's development.

The presence in the solid phase and earlier detections in the gas phase suggests the process behind their existence is sublimation of ice. The process of sublimation is the transition straight from solid to gas without going through the liquid phase. The detection of COMs in ice suggests this is the origin of the COMs in gas.

The scientific community are now looking at the liklihood of transportation of the COMs to early planets as they form around the young stars. It is believed that their transportation as an ice are far more efficient to the protoplanetary disks than as a gas. It is quite likely that the icy COMs can be

transported and inherited by comets and asteroids as the planets form. These new icy objects that develop can then, through their impacts, carry the complex molecules to planets, seeding them with the ingredients for life.

A closeup of the inner region of the Orion Nebula as seen by JWST. There's a protoplanetary disk there that is recycling an Earth's ocean-full of water each month. Credit: NASA, ESA, CSA, PDRs4All ERS Team; Salomé Fuenmayor image

The team not only detected complex molecules, they also detected formic acid (the stuff that makes some insect bites sting), sulphur dioxide and formaldehyde. The sulphur dioxide was particularly useful since it allowed the team to calculate the deposits of oxidised sulphur as a function of emissions of the same. This is particularly of interest since it was pivotal in the development of metabolic reactions and processes in the young Earth.

A team from the University of Hawaii's Department of Chemistry led by Professor Ralf I. Kaiser managed to synthesise a complex molecule known as Glyceric Acid. Understanding its formation process helps us to understand how life evolved on Earth. The experiments used interstellar model ices and estimates of Galactic Cosmic Ray levels to form Glyceric Acid with a photo ionisation laser. This may have been similar to the role of lightning in the evolution of our own atmosphere.

New View Reveals Magnetic Fields Around Our Galaxy's Giant Black Hole

Fresh imagery from the Event Horizon Telescope traces the lines of powerful magnetic fields spiraling out from the edge of the supermassive black hole at the center of our Milky Way galaxy, and suggests that strong magnetism may be common to all supermassive black holes.

The newly released image showing the surroundings of the black hole known as Sagittarius A* — which is about 27,000 light-years from Earth — is the subject of two studies published today in The Astrophysical Journal Letters. This picture follows up on an initial picture issued in 2022. Both pictures rely on radio-wave observations from the Event Horizon Telescope's network of observatories around the world.

Sagittarius A* wasn't the first black hole whose shadow was imaged by the EHT. Back in 2019, astronomers showed off a similar picture of the supermassive black hole at the center of the galaxy M87, which is more than a thousand times bigger and farther away than the Milky Way's black hole.

In 2021, the EHT team charted the magnetic field lines around M87's black hole by taking a close look at the black hole in polarized light, which reflects the patterns of particles whirling around magnetic field lines. Researchers used the same technique to determine the magnetic signature of Sagittarius A*, or Sgr A* for short.

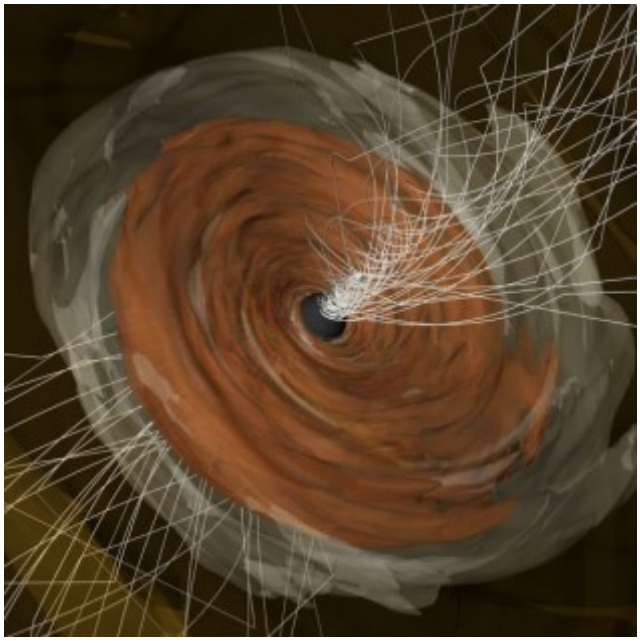
Getting the image wasn't easy, largely due to the fact that Sgr A* was harder to pin down than M87. The EHT team had to combine multiple views to produce a composite image.

"Making a polarized image is like opening the book after you have only seen the cover," EHT project scientist Geoffrey Bower, an astronomer at Academia Sinica in Taiwan, explained in today's news release. "Because Sgr A* moves around while we try to take its picture, it was difficult to construct even the *unpolarized* image. … We were relieved that polarized imaging was even possible. Some models were far too scrambled and turbulent to construct a polarized image, but nature was not so cruel."

The resulting picture met the research team's expectations, and then some.

"What we're seeing now is that there are strong, twisted and organized magnetic fields near the black hole at the center of the Milky Way galaxy," said project co-leader Sara Issaoun, an astronomer at the Harvard-Smithsonian Center for Astrophysics. "Along with Sgr A* having a strikingly similar polarization structure to that seen in the much larger and more powerful M87* black hole, we've learned that strong and ordered magnetic fields are critical to how black holes interact with the gas and matter around them."

The structure of the magnetic fields around Sgr A* suggests that the black hole is launching a jet of material into the surrounding environment. Previous research has shown that to be the case for M87's black hole.



A computer simulation of the disk of plasma around M87's supermassive black hole shows how magnetic fields help launch jets of matter at near the speed of light. Scientists say the Milky Way's black hole appears to be doing something similar. (Credit: George Wong/ EHT)

"The fact that the magnetic field structure of M87* is so similar to that of Sgr A* is significant because it suggests that the physical processes that govern how a black hole feeds and launches a jet might be universal among supermassive black holes, despite differences in mass, size and surrounding environment," said EHT deputy project scientist Mariafelicia De Laurentis, a professor at the University of Naples Federico II in Italy.

In the seven years since the EHT began gathering observations, the collaboration has been adding to its array of radio telescopes, which is resulting in the production of higher-quality imagery. The EHT team plans to observe Sgr A* again next month — and in the years ahead, the researchers aim to produce high-fidelity movies of Sgr A* that may reveal a hidden jet. They'll also look for evidence of similar polarization features around other supermassive black holes.

Gaia Finds Ancient Streams of Stars That Formed the Milky Way

Using ESA's Gaia spacecraft, astronomers have tracked down two streams of stars that likely formed the foundation of the Milky Way. Named "Shakti and Shiva," the two streams contain about 10 million stars, all of which are 12 to 13 billion years old and likely came together even before the spiral

arms and disk were formed. These star streams are all moving in roughly similar orbits and have similar compositions. Astronomers think they were probably separate galaxies that merged into the Milky Way shortly after the Big Bang.,

"What's truly amazing is that we can detect these ancient structures at all," said lead author Khyati Malhan of the Max Planck Institute for Astronomy (MPIA) in Heidelberg, Germany, in an ESA press release. "The Milky Way has changed so significantly since these stars were born that we wouldn't expect to recognize them so clearly as a group – but the unprecedented data we're getting from Gaia made it possible."

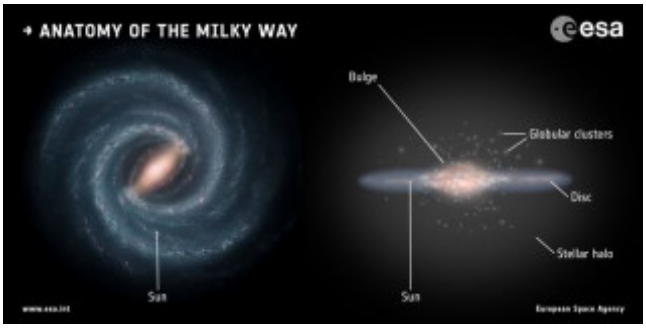
Astrometry Data

Gaia uses astrometry — the precise measurements of the positions and movements of stars and other celestial bodies – and is building the largest, most precise three-dimensional map of our Galaxy by surveying nearly two billion objects.

With Gaia's data, the researchers were able to determine the orbits of individual stars in the Milky Way, as well as determine their content and composition. These ancient stars are all moving in very similar orbits and the structure of the two different star streams stood out because their stars contained a certain chemical composition.

"Shakti and Shiva populations possess an unconventional combination of orbital and abundance properties that have not been observed previously," the researchers wrote in their paper, published in the Astrophysical journal.

By compiling very detailed chemical abundance patterns for each, the astronomers determined these stars were the oldest stars in the galaxy, all born before the disc of the Milky Way had formed.



The components of the Milky Way Galaxy. This artist's impression shows our roughly 13 billon-year-old 'barred spiral galaxy' that is home to a few hundred billion stars. Credit: Left: NASA/JPL-Caltech; right: ESA; layout: ESA/ATG medialab.

"The stars there are so ancient that they lack many of the heavier metal elements created later in the Universe's lifetime," said co-author Hans-Walter Rix, also of MPIA and the lead 'galactic archaeologist' in this research, which began in 2022. "These heavy metals are those forged within stars and scattered through space when they die. The stars in our galaxy's heart are metal-poor, so we dubbed this region the Milky Way's 'poor old heart'. Until now, we had only recognized these very early fragments that came together to form the Milky Way's ancient heart. With Shakti and Shiva, we now see the first pieces that seem comparably old but located further out. These signify the first steps of our galaxy's growth towards its present size."

While the two streams are similar, they aren't exactly the same. Shakti stars orbit a little further from the Milky Way's center and in more circular orbits than Shiva stars. The streams are named two divine beings from Hindu philosophy who worked together to create the Universe.

Because of Gaia's ability to provide data to create incredibly detailed celestial maps, the researchers were able to build a dynamical map of that includes the two star streams plus other known components that have played a role in our galaxy's formation.

"Revealing more about our galaxy's infancy is one of Gaia's goals, and it's certainly achieving it," said Timo Prusti, Project Scientist for Gaia at ESA. "We need to pinpoint the subtle yet crucial differences between stars in the Milky Way to understand how our galaxy formed and evolved. This requires incredibly precise data – and now, thanks to Gaia, we have that data. As we discover surprise parts of our galaxy like the Shiva and Shakti streams, we're filling the gaps and painting a fuller picture of not only our current home, but our earliest cosmic history."

Dwarf Galaxies Could be the Key to Explaining Dark Matter

If you have a view of the southern celestial sky, on a clear night you might see two clear smudges of light set off a bit from the great arch of the Milky Way. They are the Large and Small Magellanic Clouds, and they are the most visible of the dwarf galaxies. Dwarf galaxies are small galaxies that typically cluster around larger ones. The Milky Way, for example, has nearly two dozen dwarf galaxies. Because of their small size, they can be more significantly affected by dark matter. Their formation may even have been triggered by the distribution of dark matter. So they can be an excellent way to study this mysterious unseen material.

In a recent study, a team looked at dwarf galaxies to see exactly what they would reveal about dark matter. Specifically, they were interested in how dark matter might interact with itself. One idea about dark matter particles is that when they collide with each other they could emit gamma-ray light. This would mean that the central regions of galaxies should show evidence of gamma radiation without a clear astrophysical source. There have been some studies looking for gamma rays within our own galaxy, but the results have been inconclusive.

This new study focused on dwarf galaxies because they are smaller and therefore less likely to obscure gamma-ray light from colliding dark matter. There are also plenty of dwarf galaxies within our local group. Using 14 years of archival data from the Fermi-Large Area Telescope (LAT), the team looked at 50 dwarf galaxies. Overall they didn't find strong evidence of gamma-ray emissions from any of the galaxies, but in 7 of them they found a small statistical excess at around 2? – 3?. To be definitive we'd like to see it at a level of 5?, so this result is far from conclusive. But if we take the energy levels of the excess at face value, it would put the mass of dark matter particles around 30 – 50 GeV or 150 ? 230 GeV, depending on the way dark matter might decay. By comparison, protons have a mass of about 1 GeV.

So once again a study of dark matter fails to discover the elusive particles. But as with earlier studies, this research narrows down what dark matter might be. Specifically, the study rules out certain mass ranges for dark matter more than ever before. It's yet another small step toward solving the mystery of dark matter.

Reference: McDaniel, Alex, et al. "Legacy analysis of dark matter annihilation from the Milky Way dwarf spheroidal galaxies with 14 years of Fermi-LAT data." *Physical Review D* 109.6 (2024): 063024.

A Brief History of Total Solar Eclipse Science

Eclipses have always offered astronomers a chance to carry out rare observations. The element helium (named after 'Helios' the Greek god of the Sun) was discovered in the solar chromosphere during the August 18th, 1868 total solar eclipse. Astronomers swept the sky near the eclipsed Sun in July 29th, 1878, looking for the hypothetical planet Vulcan. World War I thwarted astronomer's plans to test Einstein's Theory of General Relativity during the August 21st, 1914 eclipse. This had to wait until Arthur Eddington led an expedition to Principe in 1919. Eddington vindicated Einstein with measurements of the deflection of stars observed near the Sun during totality.

Stranger experiments continued right up into the 20th century. One of the more bizarre eclipse experiments was hunting for the elusive 'Allais Effect,' looking for the deflection of a pendulum during totality. Alas, Maurice Allais' findings alluding to this fringe idea have never been replicated. Maybe LIGO Livingston just outside the path of totality on 2024 could take up the challenge?

Four Eclipse Science Projects

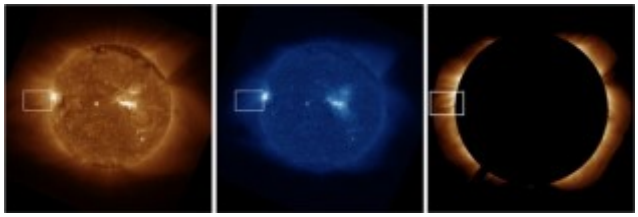
In 2023, NASA selected four major experiments to chase totality:

1. The Solar Patrol sunspot campaign: This effort is led by Thangasamy Velusamy out of NASA's Jet Propulsion Laboratory. This initiative seeks to monitor subtle changes in the magnetic fields of active sunspot regions as the Moon passes over them. The team will use the 34-meter Goldstone Apple Valley Radio Telescope based in California (outside of the path of totality) to carry out this experiment. We're headed towards the peak of Solar Cycle 25 over the coming year, so the odds are pretty good that the Sun will be dappled with multiple sunspots, come eclipse day.
2. SuperDARN to probe the ionosphere: Led by Bharat Kunduri out of Virginia Polytechnic Institute and State University, this experiment seeks to measure how the upper ionosphere reacts to the eclipse. Crucially, totality passes over three SuperDARN (Super Dual Auroral Radar Network) sites during the eclipse, offering an unprecedented opportunity.
3. Pro/AM 'Listening Party' to observe QSOs: Ham radio operators are familiar with the enhanced nighttime reflectivity of the upper ionosphere. This effect allows for reception of distant stations that are otherwise silent in the daytime. This sort of contact is known as a 'QSO' in ham radio-speak, and it also occurs during an eclipse, as totality briefly mimics the approach of night. Nathaniel Frissell of the University of Scranton is leading an effort to make QSO contacts on April 8th. A good strategy is to pick an AM station a few hundred miles distant and listen before, during and after totality passes. Even today, most cars still come equipped with AM/FM radios. This is also an experiment that can be done from outside of the path of totality.

A modified, eclipse-chasing WB-57 aircraft is towed out for a mission. NASA

Chasing the Shadow

4. NASA's WB-57 missions to take flight once again. The most ambitious endeavor is once again underway, as NASA's two converted WB-57 Canberra aircraft will once again chase the shadow of the Moon. NASA owns the last three Canberra aircraft still in service. Two of these aircraft will fly out of Ellington Field outside of Houston, Texas on eclipse day. The jet aircraft will intercept the Moon's shadow, which will be moving at over 2,500 miles per hour. This allows for an extra two minutes of totality. Both aircraft will carry a suite of cameras and spectrometers, allowing astronomers to analyze the inner corona very near the Sun. Studying the region could go a long ways towards solving the 'coronal heating problem,' a mystery evolving why the corona is exponentially hotter than the photosphere of the Sun.



Images of the Sun from GOES-16, versus the Sun during eclipse (far right) showing loops in the lower corona. NASA

Observations from the 2017 eclipse hinted that oscillations in the lower corona may feed 'nano-flares' that pump energy into the outer corona. This time, two new observatories will be on hand to back up NASA's eclipse measurements. These are the European Space Agency's Solar Observatory (SolO) and NASA's Parker Solar Observatory.

The flight will also continue the campaign to scan the sky near the eclipsed Sun to hunt for elusive Vulcanoid asteroids interior to the orbit of Mercury. General Relativity did away with the need to evoke an inter-Mercurial world to explain the anomalous precession of Mercury's orbit. The jury is still out, however, on whether smaller asteroids could still exist near the Sun. MESSENGER scoured the region near the Sun en route to Mercury. NASA will once again look for Vulcanoids as a secondary objective during the 2024 eclipse.

NASA has also chased eclipses aloft using Gulfstream III aircraft:

More Total Solar Eclipse Science

Other citizen-science projects are also planned for April 8th. One intriguing project is the Citizen Continental-America Telescope Eclipse network, known as Citizen CATE. This project sees volunteers setup along the total solar eclipse path, with the objective of augmenting corona observations.

An animation of the corona in polarized light, as seen during the 2017 total solar eclipse. NASA/Gopalswamy et al.

I have a deep respect for all those who are devoting precious time during totality to eclipse science. Perhaps, you'll simply be happy will clear skies to enjoy the view. If you haven't got your eclipse glasses yet to safely obverse the Sun, Astronomy For Equity still has 'em available. Hey, they're for a good cause…

Good luck and clear skies to all who are headed into the shadow of the Moon on eclipse day, whether its for the cause of science, or just to enjoy the view.

The Mars Science Helicopter Could be an Airborne Geologist on Mars

After over 70 successful flights, a broken rotor ended the remarkable and groundbreaking Ingenuity helicopter mission on Mars. Now, NASA is considering how a larger, more capable helicopter could be an airborne geologist on the Red Planet. For the past several years scientists and engineers have been working on the concept, proposing a six-rotor hexacopter that would be about the size of the Perseverance rover.

Called the Mars Science Helicopter (MSH), it would not only serve as an aerial scout for a future rover, but more importantly, it could also carry up to 5 kg (11 lbs) of science instruments aloft in the thin Martian atmosphere and land in terrain that a rover can't reach.

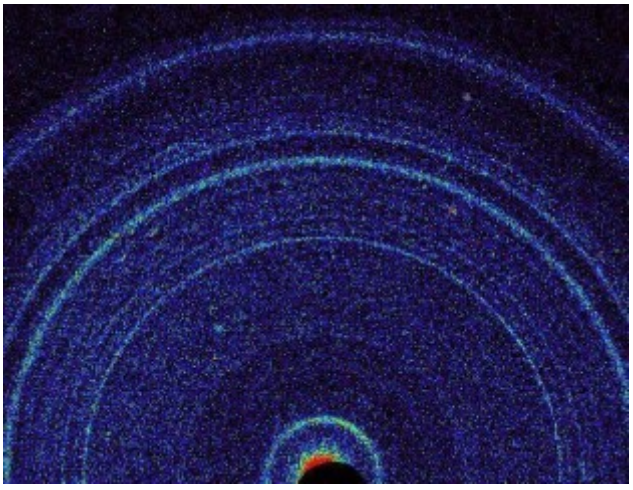
A new paper presented at the March 2024 Lunar and Planetary Science Conference outlines the geology work that such a helicopter could accomplish.

The paper, "Unraveling the Origin and Petrology of the Martian Crust with a Helicopter," notes there are several outstanding questions about the makeup and history of Mars' surface, especially with recent discoveries of unexpected dichotomies in the composition of basaltic rocks. In observations from the Mars rovers and orbital spacecraft, some regions appear to have been influenced by water while some have not.

"Up to last decade, we thought that magmatic rocks were only basaltic on Mars," said Valerie Payré from the University of Iowa, the paper's lead author. "But with recent rover and orbital measurements, we observed that there is a wide diversity of magmatic rocks similar to what we see on Earth."

Payré explained via email that there are rocks on Mars with elevated silica concentrations called felsic rocks – feldspar and silicate — that are rich in elements and were not expected to be found on the Martian surface.

"We measured these with the Curiosity rover and have some hints of where there might be others using orbital measurements," Payré said. "However, close-up images (millimetric scale) and composition analyses are lacking from the orbital dataset to know if these felsic rocks are widespread on Mars or just at a few locations. This is yet highly important to understand what the crust of Mars is made of and if it is similar to Earth's crust, which has implications regarding the formation of the planet and even past climate."

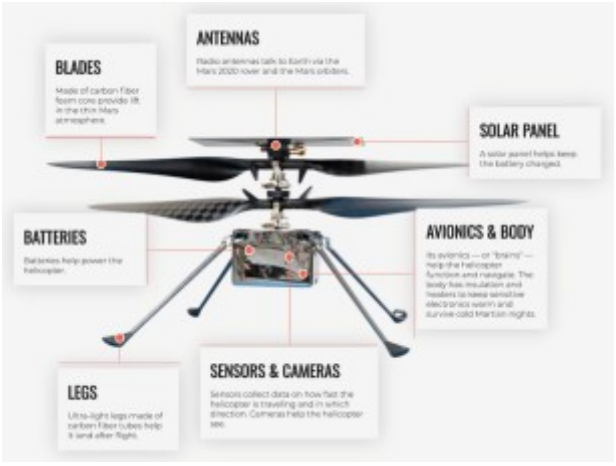


First X-ray view of Martian soil – feldspar, pyroxenes, olivine revealed (Curiosity rover at "Rocknest", October 17, 2012). Credit: NASA/JPL-Caltech/Ames

Payré and her team feel that a helicopter would be perfect to explore places where a rover could never traverse, such as terrains that are too high in altitude, since landing there would require too much fuel.

The instruments they propose include a miniaturized visible and near-infrared (VNIR) spectrometer for small scale mineralogical mapping and a small Laser Induced Breakdown Spectrometer (LIBS) with a micro-imager, an instrument similar to the ChemCam laser instrument on both the Curiosity and Perseverance rovers. In their paper, the team writes that a helicopter with these instruments could travel kilometers to detect promising felsic terrains, and measure their composition at a micron scale.

"We could fly over these possible felsic terrains and look at their minerals using a visible/near infrared spectrometer, land on locations of interest, take close-up images, and measure the compositions of these rocks with the LIBS," Payré said. "We could finally know what Mars' crust is, and better constrain how it formed."

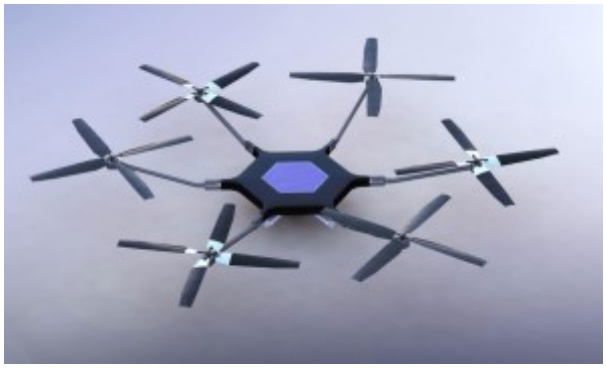


A graphic show the parts of the Ingenuity helicopter. Credit: NASA

There could also be an onboard a magnetometer, which measures magnetic field anomalies, to better understand how Mars' magnetic field operated, which is still uncertain. Mars does not presently have a global magnetic field, but had one early in its lifetime.

"Such payload would finally enable us to better understand the past climate on Mars by measuring the composition and minerals of sedimentary rocks of various age," Payré told Universe Today.

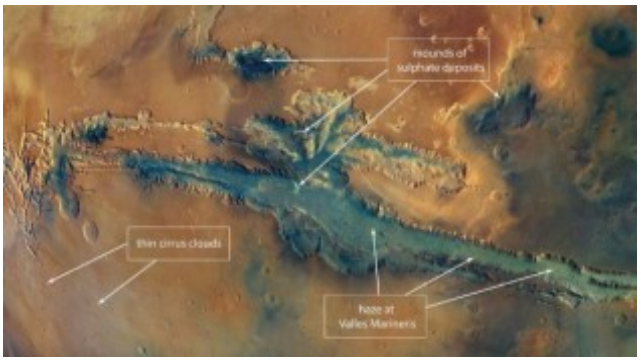
A conceptual design paper published in 2020 proposed a Mars hexacopter with a mass of about 31 kg (70 lbs) and a total diameter of just over four meters (13 feet). Each set of rotors would have blades about 0.64 meters (2 ft) long. The helicopter would be powered by a rechargeable solar cell. This would not only power the rotors, but the desired scientific instruments.



A model of NASA's Mars Science Helicopter concept. Credit: NASA.

This helicopter could move as fast as 30 meters a second (60 mph) but also could hover over a spot for as long as five minutes. Engineers from Ames Research Center, the Jet Propulsion Lab and the University of Maryland wrote that MSH could fly with a range of up to 10 km (6.2 miles) per flight. With this speed and range, MSH could potentially cover as much ground in a few days as rovers like Perseverance and Curiosity have traversed in years.

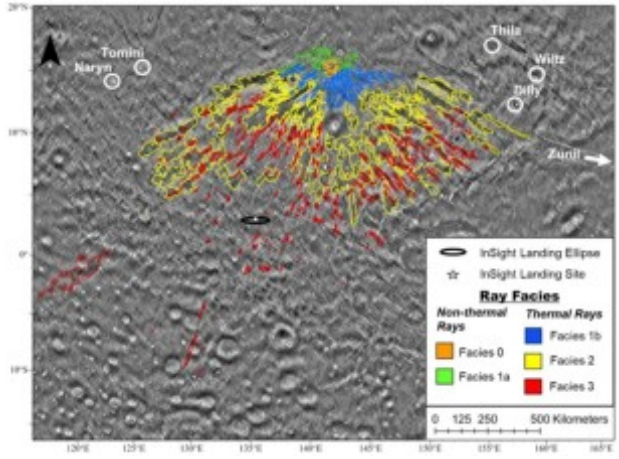
"The fact that a helicopter can fly would facilitate the mission to visit to places that would be inaccessible for a rover, and we could access locations that we never imagined before," Payré said.
Payré and team proposed several landing sites including Gale Crater Gale crater where evolved felsic rocks were found by the Curiosity Rover; the massive canyon of Valles Marineris, where orbital observations have revealed a deep crust with feldspar-bearing rocks; and Hellas basin, 2,300 km impact crater known to have layers of feldspar.



Annotated view of Valles Marineris from the High-Resolution Stereoscopic Camera (HRSC) on the Mars Express spacecraft. Credit: ESA/DLR/FU Berlin (G. Michael)

One Impact on Mars Produced More than Two Billion Secondary Craters

There are plenty of craters on Mars, especially when compared to Earth. That is primarily thanks to the lack of weathering forces and strong plate tectonics that disrupt the formations of such impacts on our home planet. However, not all impact craters on Mars are directly caused by asteroid impacts. Many of them are caused by the ejecta from an asteroid impact falling back to the planet. One recent study showed how impactful this can be – it concludes that a single large impact crater on Mars created over two billion other smaller craters up to almost 2000 km away.
The study, released at the 55th annual Lunar and Planetary Science Conference in Texas, focuses on a crater called Corinto. It's located in Elysium Planitia, only about 17 degrees north of the Red Planet's equator. It's a relatively young crater by Martian standards, with the scientists' best estimate of its age being around 2.34 million years ago. It's pretty massive for being that young, though, as the average time between impacts of its size is around 3 million years. As such, the scientists think it might be the most recent crater of its size on Mars.
That's not why it's interesting, though. It has an extensive "ray system". That means that a significant amount of ejecta was cast out from the impact site and landed elsewhere on the planet, creating "rays" from the central impact point that can be seen on a map of the planet's surface even today.
A video from JHU APL shows the details of how we understand how impact craters are made.
Credit – JHU APl YouTube Channel
Corinto crater is about 14 km in diameter and 1 km deep. Its interior bowl is pock-marked with other, smaller craters that happened its impact. Indications suggest it was full of water ice when it was hit, as there appeared to be some degassing of the superheated ice after the impact. Calculations point to a relatively steep impact angle of about 30-45 degrees from straight on – and the impactor appeared to be coming from the north.
As a result, much of the ejecta impact field lies to the south, especially the southwest, of the crater. While some secondary ejecta craters are sitting to the north of the main one, it appears clear that the impactor's angle was significant enough to push most ejecta to the south.
Tracking the path of this ejecta a few million years later isn't easy. Scientists used data collected by HiRISE and the Context Camera (CTX) on the Mars Reconnaissance Orbiter (MRO) and analyzed characteristics of smaller craters surrounding the main Corinto crater. In particular, they looked for craters that looked like they would be caused by ejecta rather than by an interplanetary impactor.



Graphical Depiction of the Facies of Maritan craters around Corinto.
Credit – Golombek et al.
They grouped the different types of ejecta craters they found into five different "facies," primarily focused on how far away they were from the main crater. Each facies has its distinct characteristics. For example, Facies 0, the one closest to the main crater, are semi-circular, don't appear to have any ejecta, or have very distinct rims. On the other hand, Facies 3 craters are long and narrow rather than semi-circular (hinting that something rolled through to create them) and have shown up as very bright in the MRO images.
Two main findings from the paper will probably turn the most heads. The scientists found that there are close to 2 billion secondary impact craters larger than 10 meters caused by the ejecta from Corinto. And those secondary craters appear up to 1850 km away. That would make it, by far, the most impactful (pun intended) of the recent Martian craters in terms of the sheer number and distance of its ejecta.
The paper didn't go into what that might mean for our larger understanding of these processes on the red planet, nor what future work might be completed – the version reviewed for this article was only two pages. But, as with most things in science, a new record for something – in this case, distance and amount of secondary impact craters, attracts additional research, so we'll have to see what if any, future discoveries can be made regarding this interesting Martian crater.
Learn More:
Golombek et al. – CORINTO: A YOUNG, EXTENSIVELY RAYED CRATER THAT PRODUCED A BILLION SECONDARIES ON MARS
UT – Here's Something Rare: a Martian Crater That isn't a Circle. What Happened?
UT – This Crater on Mars is Just a Couple of Years Old
UT – It's Been Constantly Raining Meteors on Mars for 600 Million Years. Earth too.

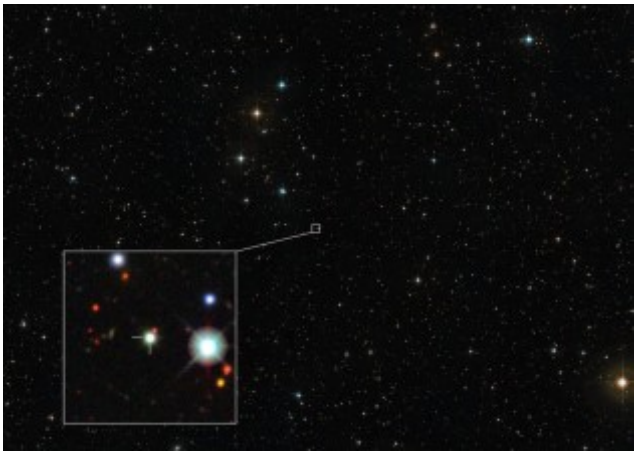
Little Red Dots in Webb Photos Turned Out to Be Quasars

In its first year of operation, the *James Webb Space Telescope* (JWST) made some profound discoveries. These included providing the sharpest views of iconic cosmic structures (like the Pillars of Creation), transmission spectra from exoplanet atmospheres, and breathtaking views of Jupiter, its largest moons, Saturn's rings, its largest moon Titan, and Enceladus' plumes. But *Webb* also made an unexpected find during its first year of observation that

may prove to be a breakthrough: a series of little red dots in a tiny region of the night sky.

These little red dots were observed as part of Webb's Emission-line galaxies and Intergalactic Gas in the Epoch of Reionization (EIGER) and the First Reionization Epoch Spectroscopically Complete Observations (FRESCO) surveys. According to a new analysis by an international team of astrophysicists, these dots are galactic nuclei containing the precursors of Supermassive Black Holes (SMBHs) that existed during the early Universe. The existence of these black holes shortly after the Big Bang could change our understanding of how the first SMBHs in our Universe formed.

The research was led by Jorryt Matthee, an Assistant Professor in astrophysics at the Institute of Science and Technology Austria (ISTA) and ETH Zürich. He was joined by researchers from the MIT Kavli Institute for Astrophysics and Space Research, the Cosmic Dawn Center (DAWN), the National Astronomical Observatory of Japan (NAOJ), the Niels Bohr Institute, the Max Planck Institute for Astronomy (MPIA), the Centro de Astrobiología (CAB), and multiple universities and observatories. Their findings were published in a study recently published in *The Astrophysical Journal*.



This image shows the region of the sky in which the record-breaking quasar J0529-4351 was observed by the ESO's Very Large Telescope (VLT) in Chile. Credit: ESO

Scientists have known for some time that Supermassive Black Holes reside at the center of most massive galaxies. And whereas some are relatively dormant, like the SMBH located in the center of the Milky Way (Sagittarius A*), others are extremely active and are growing at the rate of several Solar masses a year. These fast-growing black holes power particularly luminous Active Galactic Nuclei (AGNs) – or quasars – which become so bright they temporarily outshine all the stars in their disk, the brightest of which are known as quasars.

Quasars are among the brightest objects known to astronomers and can be seen at the very edge of our expanding Universe. In recent years, though, astronomers have spotted several quasars and SMBHs in the early Universe that are larger than cosmological models predict. As Matthee explained in a recent ISTA press release:

"One issue with quasars is that some of them seem to be overly massive, too massive given the age of the Universe at which the quasars are observed. We call them the 'problematic quasars.' If we consider that quasars originate from the explosions of massive stars–and that we know their maximum growth rate from the general laws of physics, some of them look like they have grown faster than is possible. It's like looking at a five-year-old child that is two meters tall. Something doesn't add up."

Mathee and his team identified the population of little red dots while studying images taken during the EIGER and FRESCO surveys, a large and medium first-year JWST campaign in which Mathee was involved. The EIGER campaign was specifically designed to search for rare blue supermassive quasars and their environments, and not for quasars in the early Universe. However, *Webb*'s Near Infrared Camera (NIRCam) can acquire emissions spectra from all objects in the known Universe. These objects had been previously observed by *Hubble* and mistaken for regular galaxies.

JWST's near-infrared view of the star-forming region NGC 604 in the Triangulum galaxy. Credit: NASA, ESA, CSA, STScI

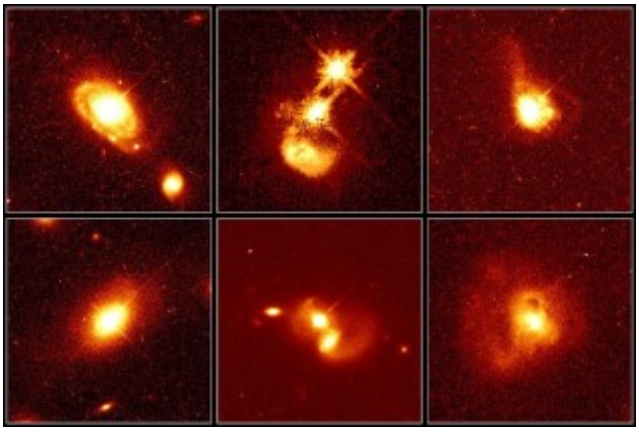
But thanks to the NIRCam's resolution, the ISTA-led team identified them as SMBHs almost by accident. According to Mathee, this accidental discovery could have profound implications for astronomy and cosmology:

"Without having been developed for this specific purpose, the JWST helped us determine that faint little red dots–found very far away in the Universe's distant past–are small versions of extremely massive black holes. These special objects could change the way we think about the genesis of black holes. The present findings could bring us one step closer to answering one of the greatest dilemmas in astronomy: According to the current models, some supermassive black holes in the early Universe have simply grown 'too fast'. Then how did they form?"

The team was able to make the distinction between galaxies and small quasars thanks to NIRCam's detection of deep-red emission lines (aka. H? spectral lines) that are produced when hydrogen atoms are heated. They also found that the lines they observed had a wide-line profile, which they used to trace the motion of the hot hydrogen gas. "The wider the base of the H? lines, the higher the gas velocity," said Mathee. "Thus, these spectra tell us that we are looking at a very small gas cloud that moves extremely rapidly and orbits something very massive like an SMBH."

Just as important were the redshift values they obtained for these SMBGs (z= 4.2-5.5), which indicate these objects existed more than 12 billion years ago – roughly 1 billion years after the Big Bang. Furthermore, they observed that these SMBHs were not overly massive like those visible in nearby galaxies today. As Mathee indicated:

"While the 'problematic quasars' are blue, extremely bright, and reach billions of times the mass of the Sun, the little red dots are more like 'baby quasars.' Their masses lie between ten and a hundred million solar masses. Also, they appear red because they are dusty. The dust obscures the black holes and reddens the colors."



Long exposures made with the Hubble Space Telescope show brilliant quasars flaring in the hearts of six distant galaxies. Credit: NASA/ESA

Eventually, the outflow of hydrogen gas will puncture the clouds of dust and gas that surround and obscure massive black holes ("dust cocoon"), and these smaller SMBHs will evolve into much larger ones. Thus, Mathee and his team hypothesized that the little red dots are small, red versions of giant blue SMBHs in the phase that predates the "problematic quasars." Through follow-up observations, astronomers can conduct detailed studies of these baby SMBHs, which could lead to a better understanding of how problematic quasars come to exist.

"Black holes and SMBHs are possibly the most interesting things in the Universe. It's hard to explain why they are there, but they are there," Mathee concluded. "We hope that this work will help us lift one of the biggest veils of mystery about the Universe."

Webb Continues to Confirm That Universe is Behaving Strangely

Over a century ago, astronomers Edwin Hubble and Georges Lemaitre independently discovered that the Universe was expanding. Since then, scientists have attempted to measure the rate of expansion (known as the Hubble-Lemaitre Constant) to determine the origin, age, and ultimate fate of the Universe. This has proved very daunting, as ground-based telescopes yielded huge uncertainties, leading to age estimates of anywhere between 10 and 20 billion years! This disparity between these measurements, produced by different techniques, gave rise to what is known as the Hubble Tension.

It was hoped that the aptly named *Hubble Space Telescope* (launched in 1990) would resolve this tension by providing the deepest views of the Universe to date. After 34 years of continuous service, *Hubble* has managed to shrink the level of uncertainty but not eliminate it. This led some in the scientific community to suggest (as an Occam's Razor solution) that *Hubble*'s measurements were incorrect. But according to the latest data from the *James Webb Space Telescope* (JWST), Hubble's successor, it appears that the venerable space telescope's measurements were right all along.

The research was conducted by the Supernova H0 for the Equation of State of Dark Energy (SH0ES) project, an international effort to eliminate uncertainties in the Hubble-Lemaitre Constant. The team is led by Dr. Adam Guy Riess and consists of astrophysics from the Space Telescope Science Institute (STScI), John Hopkin's University (JHU), the NSF National Optical-Infrared Astronomy Research Laboratory (NOIRLab), Duke University, the École Polytechnique Fédérale de Lausanne (EPFL), and Raytheon Technologies. Their findings were published in the February 6th, 2024, issue of *The Astrophysical Journal Letters*.

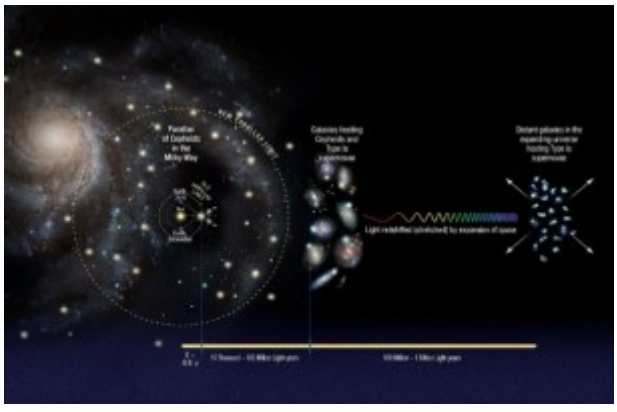
The Hubble Tension arises from the fact that different distance measurements (aka. the "Cosmic Distance Ladder") result in different values. For the calibration of short distances or the first "rung" on the ladder, astronomers rely on parallax measurements of nearby stars. For the next "rung," they rely on Cepheid variables and Type Ia supernovae to measure the distances to objects tens of millions of light-years away. Distance measurements for these stars by *Hubble* yielded a value of 252,000 km/h per megaparsec (Mpc).

The final rung consists of using redshift measurements of the Cosmic Microwave Background (CMB) to calibrate distances of billions of light-years. The mapping of this background by the ESA's *Planck* satellite yielded an estimate of about 244,000 km/h per Mpc (or about 269 km/s per light year). The simplest explanation for the discrepancy was that *Hubble*'s measurements were inaccurate, perhaps because of uncertainties in the Cosmic Distance Ladder. Since it was launched in December 2021, the JWST has made its own measurements of Cepheid variables with its advanced infrared optics.

This has allowed astronomers to cross-check the optical-light measurements made by *Hubble*. This includes Riess, the Bloomberg Distinguished and Thomas J. Barber Professor of Physics and Astronomy at John Hopkins University. In 2011, Riess was awarded the Nobel Prize in Physics and the Albert Einstein Medal for his co-discovery of the accelerating rate of cosmic expansion – which led to the theory of "Dark Energy." The team's first look at *Webb's* observations in 2023 confirmed that *Hubble*'s measurements of the expanding Universe were accurate.

Their latest analysis was based on Webb's observations of over 1,000 Cepheids used as "anchors" in the distance ladder, eight Type Ia supernovae, and NGC 5468 – the farthest galaxy where Cepheids have been well measured, roughly 130 million light-years distant. As Riess stated in an ESA press release, these findings have erased any lingering doubt about measurement errors:

"With measurement errors negated, what remains is the real and exciting possibility that we have misunderstood the Universe. We've now spanned the whole range of what Hubble observed, and we can rule out a measurement error as the cause of the Hubble Tension with very high confidence."



The Cosmic Distance Ladder visualized, showing the methods employed to measure the Hubble Constant. Credit: NASA, ESA, A. Feild (STScI), and A. Riess (STScI/JHU)

In particular, these findings have eliminated any lingering doubts that measurement inaccuracies might grow with distance. These inaccuracies would result from "stellar crowding," where light from the Cepheids blended with that of adjacent stars. For many astronomers, the prospect of looking deeper into the Universe meant that these errors would become visible. Accounting for this effect is made all the more difficult thanks to intervening

dust in the interstellar and intergalactic medium (ISM, IGM) that naturally obscures visible light.
Thanks to Webb's sharp imaging capabilities at infrared wavelengths, astronomers can now see through the obscuring dust and get a clearer look at distant Cepheids. Combined with Hubble's observations, the SH0E team determined that *Hubble*'s observations were correct. As a result, said Riess, scientists are left with only one explanation for the Hubble Tension, which is that there is an unseen force responsible for how the cosmos is expanding: *"Combining Webb and Hubble gives us the best of both worlds. We find that the Hubble measurements remain reliable as we climb farther along the cosmic distance ladder. We need to find out if we are missing something on how to connect the beginning of the Universe and the present day."*
Next-generation telescopes will investigate this mysterious unseen force in the coming years by measuring its influence on cosmic expansion. This includes NASA's upcoming *Nancy Grace Roman Space Telescope* and the ESA's *Euclid* mission (which launched on July 1st, 2023). Paired with additional data obtained by *Webb*, these observations will allow astronomers to test "early Dark Energy" and other theories that attempt to explain the observations of *Hubble* and *Webb*. In the meantime, the so-called "crisis in cosmology" will persist, but perhaps not for long.

Mars Was Hiding Another Giant Volcano

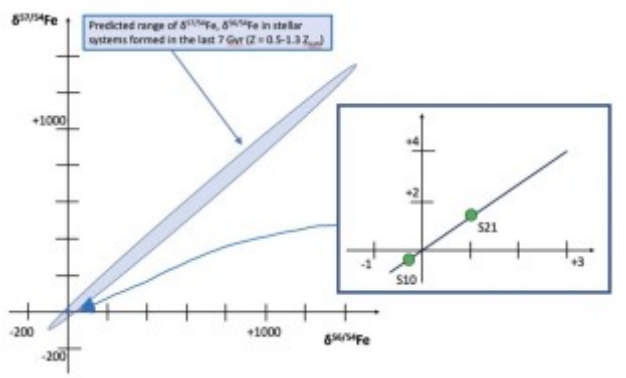
Olympus Mons is well known for being the largest volcano in the Solar System. It's joined on Mars by three other shield volcanoes; Ascraeus, Pavonis and Arsia but a recent discovery has revealed a fifth. Provisionally called Noctis volcano, this previously unknown Martian feature reaches 9,022 metres high and 450 kilometres across. Its presence has eluded planetary scientists because it has been heavily eroded and is on the boundary of the fractured maze-like terrain of Noctis Labyrinthus.
Mars seems to like shield volcanoes. They are a type of volcano that have a broad gently sloping profile and are generally composed of basaltic lava flows. The flows spread out over large distances during eruptions before eventually solidifying and creating long gently sloping faces. They tend to be the result of divergent plate boundaries where tectonic plates gently drift apart. It's not just Mars that hosts them, here on Earth Mauna Loa and Mauna Kea in Hawaii are great examples of shield volcanoes.

Olympus Mons, captured by the ESA's Mars Express mission from orbit. Credit: ESA/DLR/FUBerlin/AndreaLuck
Noctis volcano was found on the edges of Noctis Labyrinthus, a region whose name means Labyrinth of the Night. It's a fascinating surface feature with a complex valley, canyon and ridge system within Valles Marineris. It's a distinctive feature on the Martian surface with disorderly, intersecting valleys and plateaus. Thought to be the result of erosion and tectonic activity the region has masked the new volcano, until now.

Noctis Labyrinthus on Mars as seen by Viking 1 orbiter. Courtesy NASA.
A team of scientists, led by SETI Institute planetary scientist Dr Pascal Lee said "We were examining the geology of an area where we had found the remains of a glacier last year when we realised we were inside a huge and deeply eroded volcano." There were a number of signs that revealed the volcanic activity in the region and led to the volcano's discovery. Located on the eastern edge of Noctis Labyrinthus there were a number of meseas – or flat topped mountains – arranged in an arc that seemed to reach a peak before descending away from an apparent summit area. A gentle slope softly slips away over distances of over 200km and close study seems to reveal the remains of a caldera. The study revealed what looked like a collapsed crater that once contained a lava lake and there was significant evidence of lava flows in the area including pyroclastic deposits.
The study of Mars over the years since the invention of the telescope and more recently the advent of space flight has revealed a complex geological history. The features across the planet seem to reveal significant modification too perhaps from thermal erosion, glacial erosion and fracturing of the crust.
The team conclude that the volcano is a shield volcano that has been built up of layers of accumulations of pyroclastic material, lava and ice. The ice it seems, just like volcanic lava, has built up over repeated years of snow and ice build up on the flanks of the volcano. With the fractures, likely driven by plate uplifts in the general Tharsis region, lava was able to seep through different regions of the volcano. Where the ice has been buried and subsequently melted, catastrophic collapses have occurred compounding the challenge of identifying it.

A 790,000 Year-Old Asteroid Impact Could Explain Seafloor Spherules

Our solar system does not exist in isolation. It formed within a stellar nursery along with hundreds of sibling stars, and even today has the occasional interaction with interstellar objects such as Oumuamua and Borisov. So it's reasonable to presume that some interstellar material has reached Earth. Recently Avi Loeb and his team earned quite a bit of attention with a study arguing that it had found some of this interstellar stuff on the ocean seabed. But a new study finds that the material has a much more local origin.
The original study is based on a 2014 meteor that entered the Earth's atmosphere off the coast of Papua New Guinea. Observations of its impact trajectory suggested it might have been extraterrestrial in origin. And since we had an idea of where it hit, why not look for its debris? This led Loeb's team to the seafloor near Papua New Guinea, where they found small, iron-rich spheres known as spherules. The study analyzed the composition of these spherules and found the isotope distribution was so unusual they must have an interstellar origin.



The iron isotopes of these spherules show a local origin. Credit: Desch, et al

While that sounds compelling, there are a few caveats. The first is that the trajectory of the 2014 meteor isn't that precisely known. We know the general impact region, but the data simply isn't good enough to prove that these spherules came from this particular meteor. The second is that "unusual" isotopes aren't uncommon within our solar system. As the new study shows, there is a distribution of iron isotope ratios for objects originating in the solar system, specifically the ratios of ^{57}Fe and ^{56}Fe. The ratio for the "alien" spherules is well within that range. So well that the odds of them being interstellar is less than 1 in 10,000. So these spherules have a local origin.

But they were likely formed from an impact event, so this new study went further. Is there a known impact from which these spherules originated? Turns out there is. The region in which they were found is part of what's known as the Australasian tektite strewn field. It is a vast field that spans southeast Asia to Antarctica and was caused by a large impact 790,000 years ago. The team looked at other isotope ratios and found they are consistent with other known Australasian tektites.

So these particular spherules have a local origin. But that doesn't mean interstellar meteorites don't exist. Given what we know, there are almost certainly interstellar objects on Earth just waiting to be found. We just have to keep looking for them.

Reference: Loeb, A., et al. "Recovery and Classification of Spherules from the Pacific Ocean Site of the CNEOS 2014 January 8 (IM1) Bolide." *Research Notes of the AAS* 8.1 (2024): 39.

Ariane 6 is Coming Together

The European Space Agency (ESA)'s next generation heavy lift rocket is just months away from its first flight, and its major components are now being assembled for launch at the Vehicle Assembly Building in Kourou, French Guiana.

The new rocket is Europe's upgrade to the retired Ariane 5, which flew for the last time in 2023. With a large payload fairing and lift capacity, Ariane 6 will be able to carry seriously heavy satellites (or multiple smaller ones). The heavy lift capability of the Ariane 6 is achieved using Hydrolox engines on both the first and second stages, assisted by up to four solid rocket boosters, enabling it to bring up to 11,000kg to geostationary transfer orbit.

The Ariane 6's upper stage features the capability to relight its engine multiple times, giving it plenty of flexibility in the types of missions it can carry out, and improving the precision of the orbits it can reach. That makes it useful for both interplanetary missions and for unique orbital requirements around Earth.

Part of the first Ariane 6 rocket inside the Vehicle Assembly Building, Kourou, French Guiana. Credit: ESA/CNES/Arianespace/Arianegroup.

What it won't be is reusable.

Ariane 6 is an expendable rocket, bringing critics to wonder if it can keep up with notable competitors pursuing reusability like SpaceX. But Ariane 6 has different capabilities and caters to different launch parameters than SpaceX, giving it a market share that the Falcon Heavy isn't tuned for. Perhaps more importantly, independent access to space is a priority for Europe, making Ariane 6 a strategic imperative as much as a technological or competitive advancement. Still, Ariane 6 may not remain ESA's workhorse rocket long-term – they are already investigating reusable alternatives that should come onto the scene in the 2030s.

The rocket stages themselves aren't the only place where ESA can make eco-and-budget-friendly innovations, and some changes are happening now. The support and logistics infrastructure for the Ariane 6, for example, includes shipping the rocket stages aboard the Canopée, a wind-assisted hybrid cargo ship that can cut emissions by more than 20% – up to 30% depending on its speed – compared to a conventionally powered ship.

the Canopée, arriving in French Guiana in February, carrying the first Ariane 6 rocket for launch later this summer. Credit: ESA/CNES/Arianespace/Arianegroup/Optique Vidéo du CSG – S. Martin.

The Canopée delivered the first Ariane 6 to Kourou last month, arriving at port after a 10-day, 7,000km journey from mainland Europe in February.

The rocket now being prepared for flight within the vehicle assembly building will go vertical on the pad in the coming months.

Ariane 6's first flight is set for no earlier than June 15. It will carry out a rideshare mission bringing multiple small spacecraft into orbit.

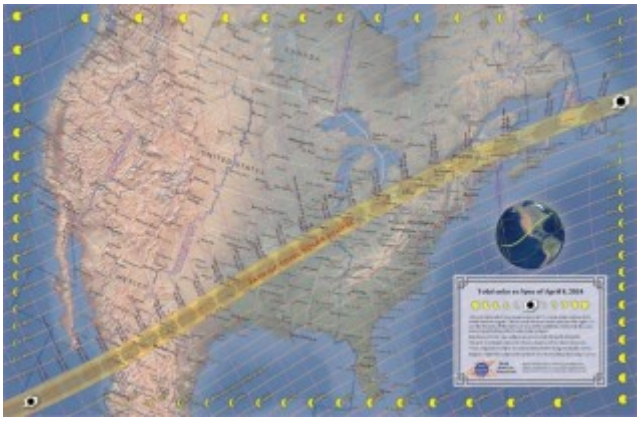
After that, the vehicle will have a steady launch cadence, with a series of flights scheduled for 2025 to carry upgraded satellites for Europe's Galileo constellation (an independent GPS system). There are also plans to launch several deep space missions in the next few years, including ESA's exoplanet hunting telescope PLATO, components of the Mars Sample Return infrastructure, and ESA's Comet Interceptor mission.

Into Totality: Our Complete Guide to the April 8th Total Solar Eclipse Across North America

What to watch for on April 8th as totality sweeps across the continent.

The time has come. Seven years ago on an August afternoon, the shadow on the Moon swept across the United States. Now we're in the one month stretch, leading up to the big ticket astronomical event for 2024: the April 8th total solar eclipse spanning North America.

This is the last total solar eclipse for the 'lower 48 states' until August 23rd, 2044. Totality does nick remote northwest corner of the state of Alaska on March 30th, 2033. The path of totality on April 8th spans Mexico, the contiguous United States from Texas to Maine, and the Canadian Maritimes.



The path of the April 8th, 2024 total solar eclipse. Credit: Michael Zeiler/Great American Eclipse

The eclipse will be partial from southeast Alaska, all the way down to the very northwest edge of South America. Hawaii will see a rising partial. On the other end, Iceland and the very western coast of Ireland will see the reverse underway at sunset.

A rising partial solar eclipse, over NASA's Vehicle Assembly Building. Credit: Dave Dickinson

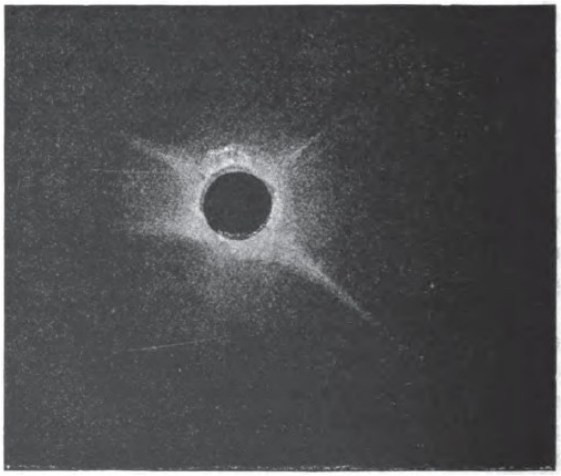
A Penumbral Prelude

The first eclipse season of 2024 actually begins on the night of Sunday/Monday March 24/25. A penumbral lunar eclipse that night puts the whole celestial game into play. This subtle eclipse is visible from the Americas. Don't expect to see much more than a slight ragged darkening on the southwest limb of the Moon around 7:12 Universal Time.

Though it's a slight affair, this penumbral eclipse means that the nodes where the Moon's path intersect the ecliptic are aligning for the total solar eclipse two weeks later. Though the 2017 event was an ascending node eclipse, the 2024 one is a descending node event, crisscrossing the path.

Tales of the Saros

This eclipse is member 30 of the 71 eclipses in solar saros series 139. This saros began way back on May 17th, 1501, and produced its first fully total solar eclipse (as opposed to a hybrid annular-total) on December 21st, 1843. It'll cease doing so with the brief total solar eclipse of March 26th, 2601, and finally end on July 3rd, 2763.



THE LONG CORONAL STREAMERS OF 22D JANUARY 1898
(*From a photograph in India by Mrs* MAUNDER)

A photograph of coronal streamers seen during the 1898 eclipse, another saros 139 member. Credit: Public Domain image.

One famous alumni for saros 139 occurred one exeligmos (three saroses or 54 years) ago on March 7th, 1970. This eclipse moved right up the U.S. East Coast in a path just slightly east of the upcoming eclipse. The three saros period is crucial, as each pass shifts the path 120 degrees in longitude westward, and three brings it nearly back around the globe full circle. The 1970 eclipse is one of two suspects referenced in Carly Simon's song *You're so Vain*… and the April 8th eclipse passes over the very tip of northern Nova Scotia. Will someone once again take their "Learjet to Nova Scotia, to see a total eclipse of the Sun?"

To be sure, we enjoy living in an epoch on a planet where total solar eclipses *can* occur… but this won't always be the case. The Moon is slowly receding from the Earth, meaning that in about 600 million years time, all solar eclipses will be partial or annular only. Already, in the current 5,000 year epoch, annulars are now *more* common than totals. We're also not the only place in the solar system where you could stand and see a moon versus the Sun in a close fit; the surfaces of the Jovian moons witness something similar about twice a decade.

Chasing the Shadow of the Moon

On Monday April 8th, the action begins when the penumbral (partial) shadow of the Moon first touches down over the South Pacific at 15:42 Universal Time (UT). Then, the inner umbral shadow touches down over the south-central Pacific at 16:42 UT, sweeping its way to the northeast. The shadow then first makes landfall over the Pacific coast of Mexico at 18:09 UT, and reaches its maximum duration of 4 minutes and 28 seconds over northern Mexico just shy of the Texas border.

This eclipse is on the long side of medium, with a maximum totality of just over three minutes shy of the maximum 7 minutes 32 seconds possible.

The 198 kilometer-wide shadow then continues to sweep 2,517 kilometers per hour to the northeast, intersecting the path of the 2017 eclipse over the states of Missouri, Illinois and Kentucky around 19:00 UT. Continuing its trek, the shadow then ranges over Lake Erie, northern New England and the Canadian Maritime provinces until departs the Earth over the North Atlantic at 19:55 UT. The final partial phases of the eclipse wrap up at 20:52 UT. Millions live along the path of totality or within an easy day drive from the path. Major cities, including Dallas-Fort

Worth, Indianapolis and Buffalo are all in the eclipse path. It's well worth it to make the trip to the path to witness a total solar eclipse; even a deep 99% partial (such as an annular eclipse) is still *pretty* bright, something you might not notice otherwise.

"We urge anyone who can to go inside the path of total solar eclipse on April 8," Michael Zeiler (Great American Eclipse) told *Universe Today*. "It will be an amazing experience when the sunlight suddenly disappears and the Sun's stunning corona shimmers in the darkened sky. A total solar eclipse is nature's most beautiful sight and you will never regret the effort to go see totality. If hotels are booked, stay with a friend or relative or go camping."

"If someone in a location of 95% partial solar eclipse and says they will see most of the interesting phenomena, sorry but they're wrong," says Zeiler. "You have to be inside the path of totality with clear skies to see the full glory of totality. It's the difference between watching the World Series final game in person or staying in a car in the stadium parking lot listening to the radio."

Eclipse Safety

Proper safety precautions must be adhered to during all partial phases of the eclipse. This means covering finderscopes, and either projecting the eclipsed Sun or using eclipse glasses meant for solar viewing. Approved glasses are stamped "Conforms to ISO 12312-2 standards for safe observation of the Sun" on the arms. Check those 2017 eclipse glasses in the daylight for cracks or pinholes before using them on eclipse day. NASA has a good page on eclipse safety, and tips on building a pinhole projector.

Eclipse safety practiced during totality in 2017. Credit: Myscha Theriault

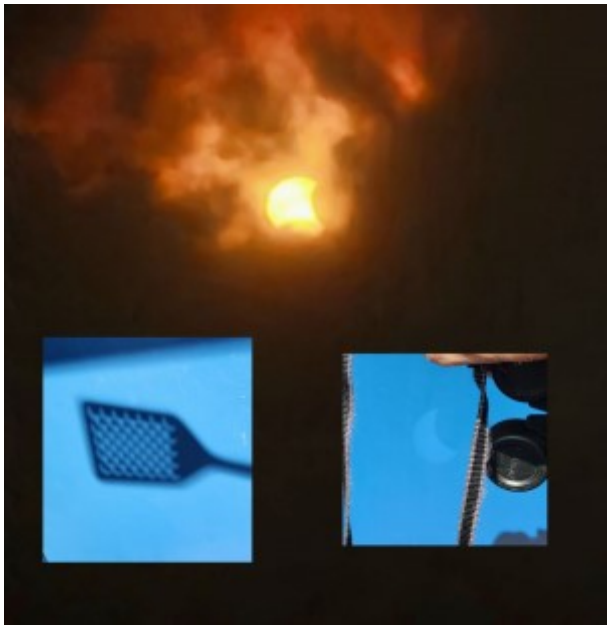
Wild Card Weather

We should know just what the weather might do about a week out from eclipse day. Likewise, we should start to have an idea of just how photogenic the partially eclipsed Sun will be in terms of sunspots, with a peek at what's starting to rotate into view around April 1st. We're nearing maximum for Solar Cycle 25, so we could be in for a fairly active Sun.

Best bets for clear skies are on Texas and Mexico, though April cloud cover can be fickle along the entire track. Keep in mind, you don't need a crystal clear sky to see the eclipse; just a good view of the Sun. We had memorable views of the partially eclipsed Sun in 2017 leading up to totality, filtered though an approaching cloud bank.

Mobility and road access is key on eclipse day. Range and options dwindle hours prior as to where to head to to observe. NOAA's GOES-East is a great site to see how the potential cloud cover situation is developing, come eclipse day. Don't despair if clouds thwart the view: nearly every eclipse chaser has at least one story of the one that got away, and plans made to head to the next.

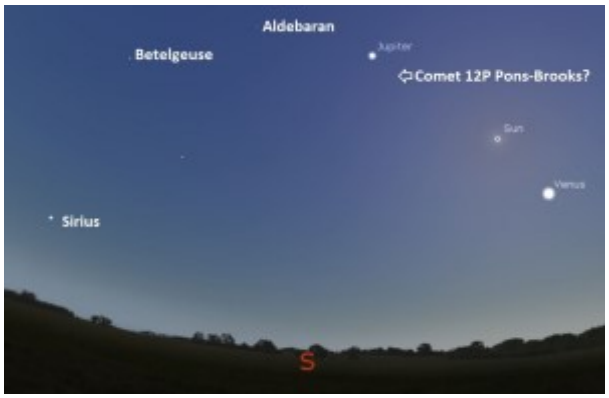
As the partial phases deepen, watch for crescent Suns dappling the ground. These are cast though natural pinhole projectors such as gaps in tree leaves and lattice-work. Spaghetti strainers or cheese graters are great tools for replicating this effect. Projecting the Sun back on a high contrast surface such as a piece of white paper can really enhance the view.



Projecting the annular eclipse in 2023. Credit: Dave Dickinson

What to Expect During Totality

If it's your first time experiencing totality, I'd advise you to simply enjoy the experience. The scant few minutes of totality goes by pretty quickly. Most people are surprised by the abrupt transition from broad daylight, to an eerie otherworldly twilight. You can drop the glasses as totality begins, and note the glow that circles the horizon. Jupiter and Venus will be visible near the eclipsed Sun. Also, watch for the +1st magnitude stars Aldebaran, Betelgeuse and -1st magnitude Sirius, all above the general horizon. Imagers may be treated views of Comet 12P Pons-Brooks, just two weeks from perihelion.



Sky at totality as seen from Buffalo, New York. Credit: Stellarium

Fun fact: comets have been discovered during eclipses, as occurred on November 1st, 1948.

Totality is the only time you'll see the corona, the ethereal outermost atmosphere of the Sun. The streamers of the corona can look different from one eclipse to the next. Seasoned eclipse chasers can actually tell *which* eclipse a given image is from, based on the appearance of the corona.

Totality stages, seen in 2017. Credit: Eliot Herman
Temperatures may drop, and nocturnal wildlife may be briefly fooled by the onset of a false dusk. In 2017, we suddenly faced an onslaught of mosquitoes as totality fell over the Smoky Mountains of North Carolina.
As totality deepens, ask yourself: what would *you* think, centuries or millennia ago, if you were going about your daily business and such an event occurred, without warning?
These days, it is possible to nab a quick photo during totality with a smartphone camera. Be sure to shoot in RAW/Pro mode, and have your settings at the ready. Totality comes and goes very quickly. Here's a great link to shooting an eclipse with your smartphone, and DSLR settings for totality. Check out this amazing smartphone eclipse video, courtesy of Tom Kerss:

The reappearance of the 'diamond ring' effect as sunlight streams down the valleys along the lunar limb signals that its time to put the eclipse glasses back on. Folks along the edge of the path may witness a string of similar flashing effects known as Baily's Beads. Key sites may also see the elusive 'double diamond ring' effect.

Chasing Eclipses Worldwide
Bitten by the 'eclipse bug?' The next total solar eclipse isn't until August 12th, 2026 across Greenland, Iceland, and northern Spain. Incidentally, Spain becomes totality central after 2024. Two more eclipses grace the Iberian peninsula: a total on August 2nd, 2027 and an annular on January 26th, 2028.

Eclipses worldwide for the coming decade. Credit: Michael Zeiler/Great American Eclipse
Lots of amateur and professional projects are also underway leading up to the eclipse. We also typically see amazing views of the eclipse from space. These include views from ESA's Proba-2 mission, NOAA's GOES satellites, and from the International Space Station.

One of NASA's eclipse chasing WB-57 aircraft. Credit: NASA
Also, expect NASA to livestream the event, come eclipse day.
And me? In an act of astronomical hubris, I'm once again tempting clouds and heading to northern Maine come eclipse day. This one has a special significance for us. It's the only time that totality graces my hometown of Mapleton, Maine for this century. My rationale is, if we're clouded out, we'll then have an argument to chase after the next one…

E MAILS and MEMBERS VIEWING LOGS.

FAS
ASTRONOMY WEEK 2025

Dear Society
I am delighted to announce that National Astronomy Week will be returning in 2025.
It's very much at the planning stage at the moment but the steering committee (I sit on it to represent the FAS) is aware that many societies make plans a long way in advance. We wanted you to have the dates as soon as they were set to help you with your plans. The week that has been chosen is Saturday 1 February to Sunday 9 February 2025, which we know is longer than a week but it gives everyone two weekends.
Why has this week been chosen? In early 2025 there will be a spectacular array of bright planets in the evening sky: Mars at opposition in Gemini, Jupiter a couple of months after opposition in Taurus, Venus at greatest eastern elongation and Saturn also visible in the early evening. During the 8 days, the Moon waxes from a crescent to full, moving past each of the planets as it does so.
More details will follow but for the time being, please put the dates in your calendar.
Kind regards
Clare

Dear All,

The insurance documents are now available on the members page in Membermojo.

As ever, go to https://membermojo.co.uk/fas/signin and put in the address you use to renew your membership.

When you have logged in, click on the button to view the Members Page

As societies are still renewing, we do not yet have a document that you can show anyone who needs to see proof you have PLI. If this is an issue, please get in touch and I will liaise with the broker.

Kind regards

Clare

Dear FAS Member

I'm very pleased to be able to let you know that today we have paid the premium on a new FAS PLI group policy.

Here are the instructions for membership renewal and PLI for those that need it:

1. If you haven't yet renewed your membership then log into Membermojo in the normal way and click the tick-box to opt into PLI + Volunteer cover.
2. If you've *already* renewed and wish to add PLI + Volunteer cover then log into Membermojo as though you were going to renew or update details, *etc*, and you will see the option for a Store Purchase. Click on this and follow the instructions to purchase the insurance.
3. If you renewed early and paid last year's amount for PLI then we'll contact you with details on how to pay the difference.

If you already have PLI with another insurer then please *don't* opt to join the FAS PLI group policy as well.

Please, if you're paying by BACS use 'PLI <your society name>' as the transaction reference so that we can more easily track the payments and match them to societies.

Once we have the final policy documents from the broker we'll upload them to the FAS Google Drive for you to download.

If you have any questions then please email Clare at vicepresident@fedastro.org.uk.

Best wishes

Paul

And From Sam:

Hi Both
Just to confirm I have renewed the Society's FAS membership and OPTED IN to the PLI insurance option £73 in total.

Cheers Sam.

Acting Chair's Note. This Public Liability Insurance is a remarkable price and took a lot of work for the FAS committee to source. It is imperative that we have this cover for any public (open) sessions to go ahead, even our Friday evening open sessions, also for any out reach that the society is involved with.

Andy

OBSERVING NOTES

Viewing Log for 5TH March (Messier marathon part 1)

Finished playing golf late afternoon with fairly clear skies, so instead of playing chess during the evening (my normal for Wednesday evenings), I decided I would go out and start my Messier (M) marathon, around a new moon in March, this is the best chance to see most of the objects during one night but I would be doing the marathon over several nights and several months, do not fancy staying up all night doing a viewing session, getting too old for this! It is normal to star hop to the objects on the list but I would be getting help from a GOTO kit, as most of the galaxies I would never see, eye sight not as good as it used to be?

So, after getting permission from the farmer at Nebo farm I headed off to my viewing place and had my Meade LX90 set up and ready by 19:57, with a temperature of 5 ° C and some wind, the conditions would not be the best? I would be using my Televue Delos 14 mm eye piece for a change. I also had the local church bells ringing in the distance at Board Hinton for company. I did ask other people from Swindon Stargazers and had some interesting during the day but no one turned up, so I had the church bells only for company. Guide stars were Sirius and Capella.

Before I started the marathon I had a look at Jupiter (now starting to sink into the western skies), I could make out the two main weather belts on the surface of Jupiter with Io and Ganymede to the west of the planet and Europa with Calisto out to the east, Calisto was a long way from Jupiter and probably at its most distance as viewed from Earth? Uranus was in the finderscope and it was the first star I manually slewed the telescope too. Could make out some colour but nothing else with Uranus.

Now on to the marathon and the first object was M77, a spiral galaxy (SG) in Cetus, this had a bright core and I would say it was a fuzzy blob (FB) to look at, probably did not help only being 16 ° above the horizon. Going higher in the sky we come across M74, another SG in Pisces but this was a faint fuzzy blob (FFB) to look at, this object I could easy miss and would never find it by star hoping!

On to M33, the Pinwheel galaxy in Triangulum, this was another FFB and hard to see. It is a large object but has low surface brightness which makes it hard to locate? M31, the Andromeda galaxy, I could not really miss, this is a very large SG and has a really bright core, easy to think this was a comet? Not far away is M32, an Elliptical galaxy (EG) and satellite of M31, this has a small bright core. As for M110, another EG, I could not find it! Maybe there was some murk in the sky? While viewing this object two satellites went thru the eye piece, on the same track, probably an Elon Musk piece of junk! That was the last of galaxies for the evening, now onto open clusters (OC), starting with M52 in Cassiopeia, this is a small, compact and dim cluster with no bright stars in the group. M103 is another small and loose OC with some bright stars in the group. Off to Perseus and M76, the Little Dumbbell nebula, this is the first of four planetary nebula (PN) on this list and only one I would visit tonight. It looked more like an out of focused star but had some shape to it. M34 is another OC, small loose and had some bright stars in this cluster. Next object did not require any visual aid, I could see M45, the Pleiades cluster clearly, it is also the largest object the whole list, I did view it with the finderscope and it looked great. On to an object I rarely see and M79 in Lepus, this globular cluster (GC) is a bit of an odd ball as there are no other GC's nearby, most are seen in the summer sky. This FB has a small bright core, did not help only being 9 ° above the horizon. On to Orion and M42, the great Orion nebula, this is a diffuse nebula (DN), could make out the Trapezium stars clearly and the major dust lanes also looked good. Right next door (and in the same field of view) is M43, another DN. Above the belt stars in Orion is M78, a reflection nebula, I could make out the two main stars in this group and thought I could see some dust, not sure? On to the first object on the list in Taurus is M1, the only Supernova Remnant, a large grey blob to look at. To finish the evening it would OC's only, first was M35 in Gemini, a very large OC with some bright stars. On to Auriga and M37, another very large OC which had more stars in the cluster but they were dimmer. M36, is a large and loose cluster with some bright stars. The last cluster in Auriga is M38, another very large OC but the stars were all dim. Below Sirius in Canis Major is M41, a large but very loose OC but did have some bright stars in the cluster. Into my final constellation for the evening and Puppis, first object was M93 an object I do not often look at, this is a small compact and dim cluster. M47 is a very loose OC but did have some bright stars. Final object was M46, a very large OC with mainly dim stars, this has a PN within the group (which is probably a line of sight object?), namely NGC2438 which I have still yet to see, maybe one day I will find it but being Mag 10.8 it could be beyond the power of my telescope?

Time was now 21:25 and only one car had gone pass me on the lane about 50 yards away during the whole session. By now the wind had picked up after it had gone quiet for a while, there was some dew on the equipment used and temperature had dropped to 4 °C.

Clear skies.

Peter Chappell

PS Hope to start part 2 sometime in April before probably stopping for the summer and finishing the rest in the autumn?

<u>Viewing Log for 30th March</u> (Messier marathon part 2)

As I had a free Saturday evening and the skies had some clear patches I thought I would carry on with my Messier (M) marathon. I did ask earlier if anyone would like to come out and join me but no one was available, either busy or away from the area. I spoke to Phil and got permission to do the viewing at his farm. I arrived at 19:39 and set up my Seestar S50 first hoping to see comet 12/P before it gets too low in the sky. It did not help having

cloud low down in the general direction of the comet. So, after I had set up the S50, I then set up my Meade LX90 with the Pentax XW 14 mm eye piece attached. The temperature was 7 ° C with some wind and scatted clouds for company. Guide stars were Capella and Procyon this evening. It was now 20:11 and the cloud which had been on the horizon had moved on and I managed to capture the comet with the S50. I thought I would have a go with my telescope, I knew it was fairly close to the star Hamal in Aries and by luck I slewed to it manually straight away. It looked like a large globular cluster with a bright core, I could also see it with the 9x50 finderscope and later on I used 7x50 binoculars. If I did not know where to look, I think I might not find it with the finder or bino's?

With the S50 now taking pictures I could get stuck in to doing some visual viewing, before I started the marathon I had a look at Jupiter, now below 20 ° above the horizon. I

could make out Calisto to the west with Europa and Io beside each other and Ganymede beyond them to the east of Jupiter. Next stop was Uranus which was in the finderscope, this was the first star point I went too. I could make out a hint of pale green from the planet? I noticed Uranus was fairly close to Jupiter and by moving the telescope I could get both of them in the finderscope field of view. A car had gone past me while I was doing the initial set up and now went in the other direction. Part 2 of the marathon and M50, a large and rather sparse open cluster (OC)

in Monoceros. On to Hydra and M48, another OC which was very sparse, I think I could easy miss this object? Next object should be hard to miss, namely M44, the Beehive cluster in Cancer. It is better to view this OC with the finderscope as it is too large for the eye piece! Also in Cancer and often over looked is M67, a large dim OC. Now into Leo starting with M95, a faint fuzzy blob, spiral galaxy (SG) which was easy to miss had to use adverted vision to find it! Not far away is M96, another SG which was a faint blob (FB) to look at, had a hint of a core. M105 was similar to M96 but an elliptical galaxy (EG), a FB with a hint of a core. While viewing M105 I noticed another FB in the eye piece, looking at Stellarium the following night I think it was NGC3384, an EG? Staying with Leo I went to M65 (part of the triplet system with M66 and NGC3628), this SG was a FFB to look at, viewing the sky I knew why it was a FFB, some high thin cloud had rolled in! It was the same for M66, a SG and FFB!

I gave it a few minutes but the cloud still came on, so I decided to call it a night at 21:27, temperature had now dropped to 6 °C but the wind had picked up a bit making it feel colder. There was little dew around but I would still dry all equipment used during this session overnight and then pack them away. After I had packed everything up I noticed Leo was now clear of cloud!

While I was doing the marathon I took a few photos with the S50 which hopefully will be in the magazine?

Clear skies.

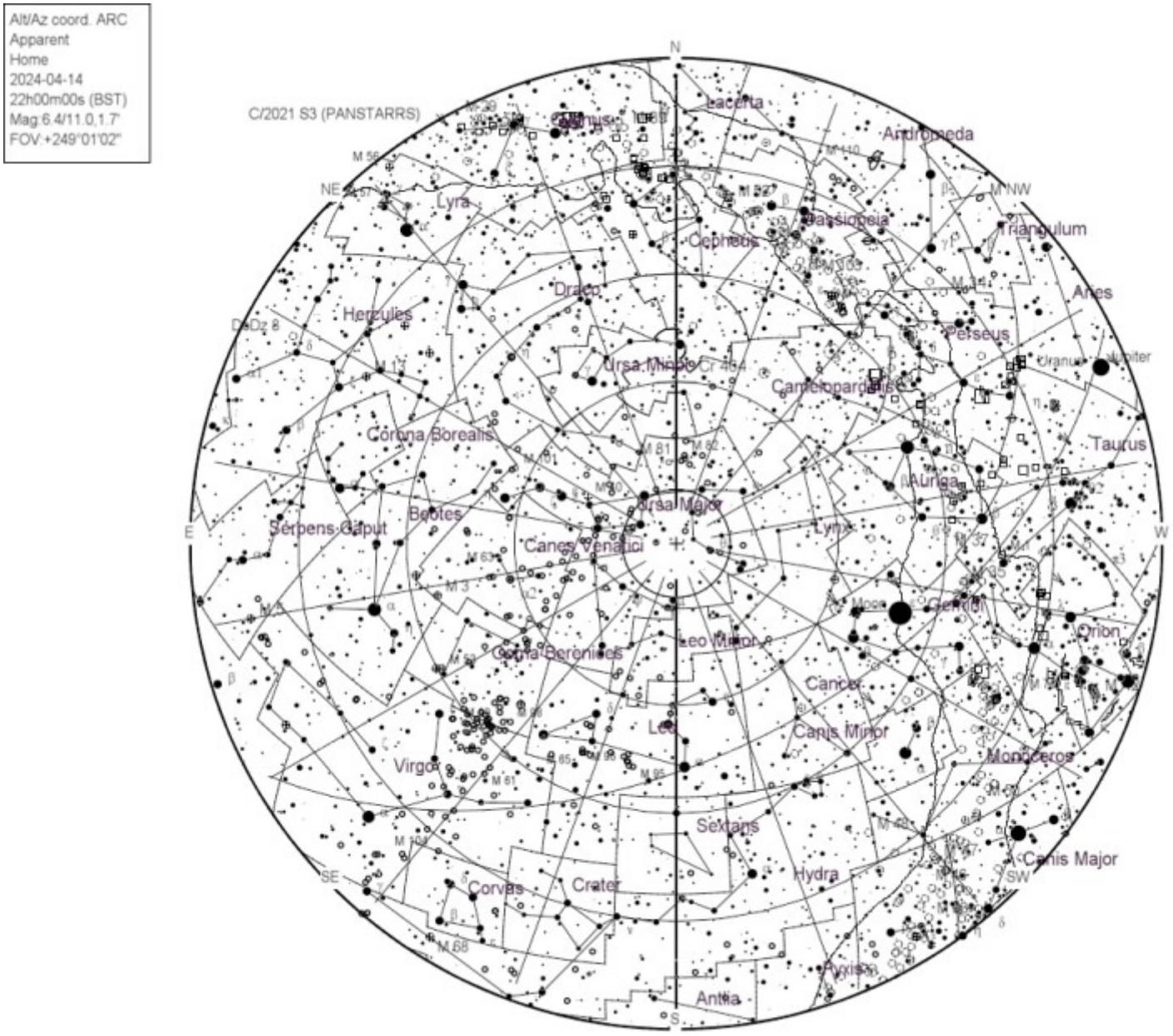
Peter Chappell

Hi Andy,

Very large sunspot AR 3615 for magazine.

Peter

WHATS UP, APRIL 24



April 8 - New Moon. The Moon will located on the same side of the Earth as the Sun and will not be visible in the night sky. This phase occurs at 18:22 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.

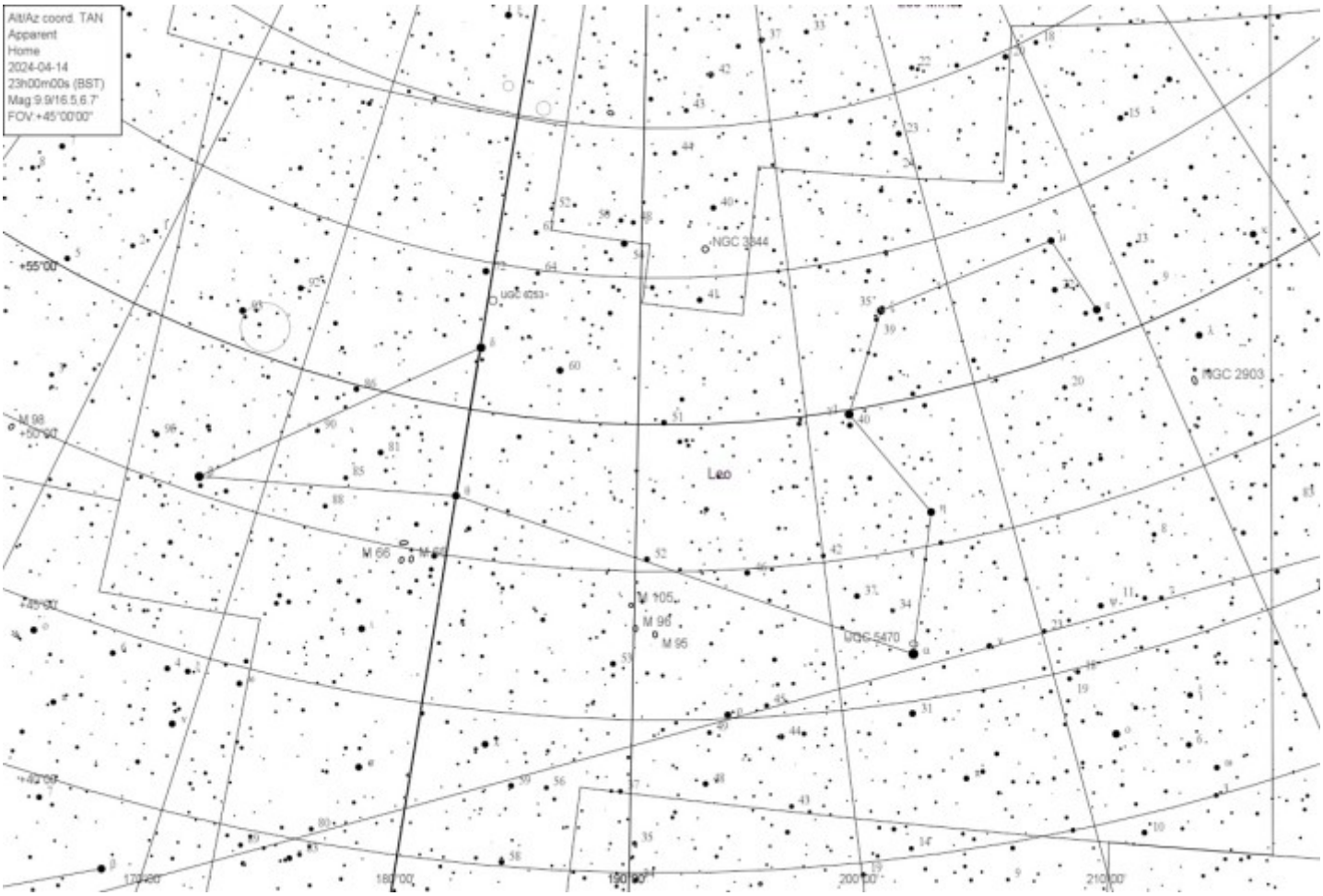
April 8 - Total Solar Eclipse. A total solar eclipse occurs when the moon completely blocks the Sun, revealing the Sun's beautiful outer atmosphere known as the corona. This is a rare, once-in-a-lifetime event for viewers in the United States. The last total solar eclipse visible in the continental United States occurred in 2017 and the next one will not take place until 2045. The path of totality will begin in the Pacific Ocean and move across parts of Mexico and the eastern United States and Nova Scotia. The total eclipse will be visible in parts of Texas, Arkansas, Missouri, Illinois, Indiana, Kentucky, Ohio, Pennsylvania, New York, Vermont, New Hampshire, and Maine. (NASA Map and Eclipse Information) (NASA Interactive Google Map)

April 22, 23 - Lyrids Meteor Shower. The Lyrids is an average shower, usually producing about 20 meteors per hour at its peak. It is produced by dust particles left behind by comet C/1861 G1 Thatcher, which was discovered in 1861. The shower runs annually from April 16-25. It peaks this year on the night of the night of the 22nd and morning of the 23rd. These meteors can sometimes produce bright dust trails that last for several seconds. Unfortunately the glare of the full moon will block out all but the brightest meteors this year. But if you are patient, you may still be able to catch a few good ones. Best viewing will be from a dark location after midnight.

Meteors the constellation Lyra, but can appear anywhere in the sky.

April 23 - Full Moon. The Moon will be located on the opposite side of the Earth as the Sun and its face will be will be fully illuminated. This phase occurs at 23:50 UTC. This full moon was known by early Native American tribes as the Pink Moon because it marked the appearance of the moss pink, or wild ground phlox, which is one of the first spring flowers. This moon has also been known as the Sprouting Grass Moon, the Growing Moon, and the Egg Moon. Many coastal tribes called it the Fish Moon because this was the time that the shad swam upstream to spawn.

CONSTELLATION OF THE MONTH: LEO



Leo

Positioned directly on the ecliptic plane, Leo is a constellation of the zodiac preceded by Cancer to the west and followed by Virgo to the east. It is an ancient constellation, originally charted by Ptolemy and recognized by the International Astronomical Union as one of the 88 modern constellations. Leo spans 947 square degrees of sky and is the twelfth largest of all. It contains 3 bright stars and around 15 stars in its asterism, with 92 Bayer/Flamsteed designated stars within its confines. It is bordered by the constellations of Ursa Major, Leo Minor, Lynx, Cancer, Hydra, Sextans, Crater, Virgo and Coma Berenices. Leo is visible to all observers located at latitudes between +90° and ?65° and is best seen at culmination during the month of April.

There are five annual meteor showers associated with constellation Leo. The first is the Delta Leonid meteor stream which begins becoming active between February 5 through March 19 every year. The activity peaks in late February with no exact date, and the maximum amount of activity averages around 5 meteor per hour. The next date is April 17 and the Sigma Leonid meteor shower. Look for this rare occurrence to happen near the Leo/Virgo border. It is a very weak shower and activity rates no higher than 1 to 2 meteors per hour. The next is the most dependable shower of all – the November Leonids. The peak date is November 17th, but activity occurs around 2 days on either side of the date. The radiant is near Regulus and this is the most spectacular of modern showers. The year 1966 saw 500,000 per hour a rate of up 140 per second! Just a few years ago, in 2005 the rates were equally impressive. Why? Comet Temple-Tuttle is the answer. Whenever it nears perihelion, it adds fresh material to the stream and gives us a spectacular show. On the average, you can expect around 20 per hour between 33 year shows, but they are the fastest known at 71 kps. The last is the Leo Minorids which peak on or about December 14. This meteor shower was discovered by amateurs in 1971 and hasn't really been confirmed yet, but do look for around 10 faint meteors per hour.

In Greek mythology, Leo was identified as the Nemean Lion, which may have been the source of the "tail" of the lion that killed Hercules during one of his twelve labours. While many constellations are difficult to visualize, Leo's backwards question-mark is relatively easily to picture as a majestic lion set in stars. One of the reasons for its placement in the zodiac is possibly due to the fact that lions left their place in the desert for the banks of the Nile when the Sun was positioned in these stars. It is also possible that the Nile's rise at this time and the lion's migration is also the reason for the Sphinx to appear as it does – a leonine figure. The Persians called it Ser or Shir; the Turks, Artan; the Syrians, Aryo; the Jewish, Arye; the Indians, "Sher"; and the Babylonians, Aru — all meaning a lion. Early Hindu astronomers recognized it by regal names, as did other cultures. All befitting of the "King of Beasts"!

Let's begin our tour by taking a look at the brightest star – Alpha Leonis – the "a" symbol on our map. Its name is Regulus and it is one hot customer when it comes to spin rate. Revolving completely on its axis in a little less than 16 hours, oblate Regulus would fly apart if it were moving any faster. Ranking as the twenty-first brightest star in the night sky, Alpha Leonis is a helium type star about 5 times larger and 160 times brighter than our own Sun. Speeding

away from us at 3.7 kilometres per second, Regulus isn't alone, either. The "Little King" is a multiple star system composed of a hot, bright, bluish-white star with a pair of small, faint companions easily seen in small telescopes. The companion is itself a double at around magnitude 13 and is a dwarf of an uncertain type. There is also a 13th magnitude fourth star in this grouping, but it is believed that it is not associated with Regulus since the "Little King" is moving toward it and will be about 14″ away in 785 years. Not bad for a star that's been reigning the skies for around for a few million years!

Let's fade east now, and take a look at Beta Leonis – the "B" symbol on our map. Its name is Denebola which means the "Lion's tail" in Arabic. Located about 36 light years from Earth, this white class A dwarf star is more luminous than the Sun, emitting 12 times the solar energy and a Delta-Scuti type variable star. While that in itself isn't particularly rare, what makes Denebola unusual is that it belongs to the Vega-class stars – ones that have a shroud of infra-red emitting dust around them. This could mean a possibility of planet forming capabilities! In binoculars, look for an optical double star companion to Beta.

It's not gravitationally, or physically related, but it's a pleasing pairing.

Now, return to Regulus and hop up for Eta Leonis, the "n" symbol on our map. Eta is very special because of its huge distance – about 2100 light years from our solar system – and that's only a guess. It is a supergiant star, and one that is losing its stellar mass at a huge rate. Compared to Sol, Eta loses 100,000 times more mass each year! Because of its position near the ecliptic plane, Eta is also frequently occulted by the Moon. Thanks to alert observers, that's how we learned that Eta is also a very close binary star, too – with a companion only about 40% dimmer than the primary. Some time over the next 17 million years, the pair of red supergiant stars will probably merge to become a pair of massive white dwarf stars… or they may just blow up. Only time will tell…

Hop north for Gamma Leonis – the "Y" symbol on our map. Its name is Algeiba and it is a very fine double visual star for binoculars and true binary star small telescopes. Just take a look at this magnificent orange red and yellow pair under magnification and you'll return again and again. The brighter primary star is a giant K type and orbiting out about four times the distance of Pluto is its giant G type companion. Further north you'll find another excellent visual double star for binoculars – Zeta Leonis. It's name is Aldhafera and this stellar spectral class F star is about 260 light years away.

Are you ready to try your hand at locating a pair of galaxies with binoculars? Then let's try the "Leo Trio" – M65, M66 and NGC 3623. Return towards Beta and look for the triangular area that marks the asterism of Leo's "hips". If the night is suitable for binocular galaxy hunting, you will clearly see fifth magnitude Iota Leonis south of Theta. Aim your binoculars between them. Depending on the field of view size of your binoculars, a trio of galaxies will be visible in about one third to one fourth of the area you see. Don't expect them to walk right out, but don't sell your binoculars short, either. The M65 and M66 pair have

higher surface brightness and sufficient size to be noticed as two opposing faint smudges. NGC 3623 is spot on the same magnitude, but is edge on in presentation instead of face-on. This makes it a lot harder to spot, but chances are very good your averted vision will pick it up while studying the M65/66 pair. The "Leo Trio" makes for a fine challenge!

Now let's begin working with larger binoculars and small telescopes as we head for M96 galaxy group (RA 10h 46m 45.7s Dec +11 49′ 12″). Messier 96 is the brightest spiral galaxy within the M96 Group which includes Messier 95 and Messier 105 as well as at least nine other galaxies. Located about 38 million light years away, this group of galaxies with the Hubble Space Telescope and 8 Delta Cephei variable stars were found to help determine each individual galaxy's distance. While you can't expect to see each member in small optics, larger telescopes can hope to find elliptical galaxies NGC 3489 (11:00.3 +13:54), NGC 3412 (10:50.9 +13:25), NGC 3384 (10:48.3 +12:38) and NGC 3377 (10:47.7 +13:59), as well as barred spiral galaxy NGC 3299 (10:36.4 +12:42),

For an awesome spiral galaxy in a small telescope, don't overlook NGC 2903 (RA 9:32.2 Dec +21:30). At a bright magnitude 9, you can often see this particular galaxy in binoculars from a dark sky site as well. Discovered by William Herschel in 1784, this beauty is often considered a missing Messier because it just so bright and conspicuous. As a matter of fact, the comet of 1760 passed it on a night Messier was watching and he didn't even see it! For larger telescopes, look for NGC 2905 – a bright knot which is actually a star forming region in the galaxy itself with its own Herschel designation.

Before we leave, you must stop by NGC 3521 (RA 11:05.8 Dec -00:02). This 35 million light year distant spiral galaxy is often overlooked for no apparent reason – but it shouldn't be. At a very respectable magnitude 9, you can often find this elongated gem with the bright nucleus in larger binoculars from a dark sky site and you can easily study spiral galaxy structure with a larger telescope. Look for an inclined view with patchiness in the structure that indicates great star forming regions at work. Its stellar counter rotation is being studied because it has a bar structure that we are seeing "end on"!

This doesn't even begin to scratch the surface of what you can find on Leo's hide. Be sure to get yourself a good star chart or sky atlas and go lion taming!

Sources: SEDS, Wikipedia

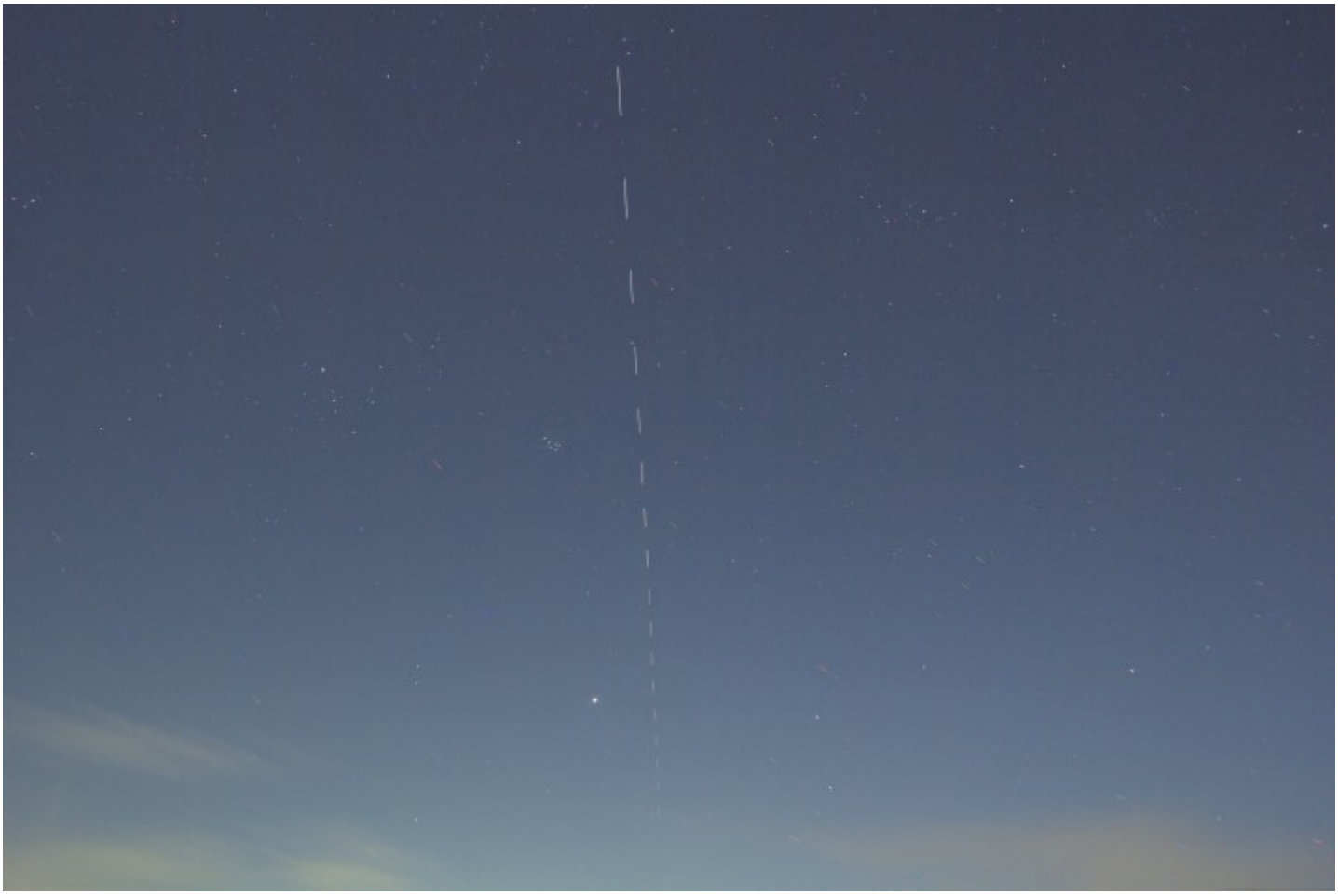
ISS PASSES For April 2024

from Heavens Above website maintained by Chris Peat.

Date	Brightn	Start	Highest	End						
	(mag)	Time	Alt.	Az.	Time	Alt.	Az.	Time	Alt.	Az.
21 Apr	-1.0	05:19:47	10°	SSE	05:20:52	11°	SE	05:21:56	10°	ESE
23 Apr	-1.9	05:16:35	10°	SSW	05:19:14	22°	SE	05:21:55	10°	E
24 Apr	-1.4	04:28:22	10°	S	04:30:26	15°	SE	04:32:29	10°	ESE
25 Apr	-1.1	03:41:17	10°	SE	03:41:37	10°	SE	03:41:58	10°	SE
26 Apr	-2.5	04:26:43	17°	SSW	04:28:40	29°	SSE	04:31:37	10°	E
27 Apr	-2.1	03:39:21	20°	SSE	03:39:42	20°	SE	03:42:16	10°	E
28 Apr	-1.2	02:51:55	12°	ESE	02:51:55	12°	ESE	02:52:36	10°	ESE
28 Apr	-3.4	04:24:45	19°	SW	04:26:54	51°	SSE	04:30:10	10°	E
29 Apr	-3.1	03:37:15	35°	S	03:37:47	37°	SSE	03:40:55	10°	E
30 Apr	-2.0	02:49:41	23°	ESE	02:49:41	23°	ESE	02:51:34	10°	E
30 Apr	-3.8	04:22:31	16°	WSW	04:25:05	78°	S	04:28:27	10°	E
01 May	-3.8	03:34:53	40°	SW	03:35:51	63°	SSE	03:39:10	10°	E
02 May	-3.0	02:47:13	41°	ESE	02:47:13	41°	ESE	02:49:51	10°	E
02 May	-3.8	04:20:02	11°	W	04:23:13	86°	N	04:26:34	10°	E
03 May	-1.5	01:59:29	17°	E	01:59:29	17°	E	02:00:27	10°	E
03 May	-3.9	03:32:18	29°	W	03:33:52	87°	S	03:37:13	10°	E
04 May	-3.9	02:44:32	74°	SSE	02:44:32	74°	SSE	02:47:51	10°	E
04 May	-3.8	04:17:51	10°	W	04:21:12	88°	NNE	04:24:33	10°	E
05 May	-2.2	01:56:42	27°	E	01:56:42	27°	E	01:58:26	10°	E
05 May	-3.8	03:29:30	19°	W	03:31:47	85°	N	03:35:08	10°	E
06 May	-1.0	01:08:51	11°	E	01:08:51	11°	E	01:08:57	10°	E
06 May	-3.9	02:41:39	54°	W	02:42:19	87°	N	02:45:41	10°	E
06 May	-3.8	04:15:40	10°	W	04:19:01	73°	SSW	04:22:21	10°	ESE
07 May	-3.0	01:53:46	45°	E	01:53:46	45°	E	01:56:11	10°	E
07 May	-3.9	03:26:34	13°	W	03:29:32	86°	SSW	03:32:53	10°	ESE
08 May	-1.4	01:05:52	16°	E	01:05:52	16°	E	01:06:40	10°	E
08 May	-3.8	02:38:41	34°	W	02:40:01	86°	N	02:43:22	10°	E
08 May	-3.5	04:13:22	10°	W	04:16:35	46°	SSW	04:19:48	10°	SE
09 May	-3.7	01:50:48	69°	ENE	01:50:48	69°	ENE	01:53:48	10°	E
09 May	-3.8	03:23:48	10°	W	03:27:06	62°	SSW	03:30:24	10°	ESE

END IMAGES, AND OBSERVING

Attached is an ISS flyby of M45 and Hyades star clusters.
Peter



OUTREACH

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

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

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

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

Opportunity	Day	Date	Month	set-up	Observe	Moon Phase and Rise/Set Times			Suggested Observing Targets
First	Friday	08th	December	18:30	19:00	Cres	Rising	13:15	Orion makes an appearance above the horizon much earlier and we catch the end of the Geminid Meter shower on the 16th, bring your binoculars and comfy chair!
Second	Friday	15th	December	18:30	19:00	Cres	Setting	17:45	
Third	Friday	29th	December	18:30	19:00	Gibb	Rising	18:45	New Equipment Practical session with nearly full moon
First	Friday	5th	January	18:30	19:00	Cres	Rising	3:00	Saturn has now gone but the remaining outer planets are still on deplay. Worth observing and photographing the Andromeda Galaxaxy as it is high in the sky now.
Second	Friday	12th	January	18:30	19:00	Cres	Setting	16:45	
First	Friday	2nd	February	18:30	19:00	Cres	Rising	1:45	Jupiter is still observable but is starting to head to the horizon at the start of the month and becomes less favourable.
Second	Friday	9th	February	19:00	19:30	New	Rising	17:30	
First	Friday	01st	March	19:00	19:30	Qtr	Rising	1:00	The outer planets are becoming less favourable and Orion is at his heighest at the very beginning of the night. Galaxy season is beginning with as Leo Coma Berenices and Ursa Major rising.
Second	Friday	08th	March	19:30	20:00	Cres	Rising	6:45	
First	Friday	05th	April	20:00	20:30	Cres	Rising	6:00	With Virgo rising the Galaxy observbing season is well underway. We are also graced by the Great Star Clust M13 in Hercules with Venus and Mars only obserable in the morning skies
Second	Friday	12th	April	20:30	21:00	Cres	Setting	1:00	
First	Friday	03rd	May	20:30	21:00	Cres	Rising	4:30	The nights are short and the rise of Vega, Deneb and Altair, mark the rise of the summer triangle and the final few weeks of the Wiltshire Astronomical Societies observing season.
Second	Friday	10th	May	20:30	21:00	Cres	Setting	23:45	

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

Wiltshire Astronomical Society Observing Team