NWASNEWS

Volume28 Issue 3

November 2022

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

November for Meteorites...

The autumn meteorite showers are well on the way with the Taurids well on their way at the start of the month, and Leonids taking over for the middle of the month (18th morning peak).

Meteorites have even been felt striking the surface of Mars by instruments on board the curiosity rover, itself reaching an important region of the planet where salts are abundant, perhaps an area of a dried up 'sea'. We h

Ave to be careful when using Earthly terms on other planets. Salts ar not sodium chloride, and seas can be small lakes with high mineral content, but the mix is there.

NASA are even setting up a high level committee to investigate data past and present looking at the evidence for UFOs. Ifeel a silly season coming on.

Hopefully Artemis 1 will launch this month, with a pencilled in nighttime launch on the 14th.

Coming to Wiltshire society matters our experiment to get WIFI connection working in the meeting hall was eventually successful (using window rather than next to projector for position) which means we can take speakers over Zoom AND keep them as hall meeting nights. ThIs can make a big difference to the club expenditure, and range of speakers we can get to speak to us.

Peter has asked to stand down as speaker secretary after his long period of service at the end of June 23 including some rather difficult times through the pandemic. I have approached Nick Howes, who has been absent due to commitments for a while, but has begun to surface from those duties and will be available. His contacts within the realms of astronomy are legion and with the option of remote speakers at meetings now possible we should get a good mix of speakers and topics.

Observing sessions: At the last session on Friday we encountered a problem with access to the field due to refurbishment to the toilet block. I have been to the Lacock Estates Office and asked to use the picnic area behind the Café and toilets, it has access from the car park and from the road so should give us space to use telescopes without the squeeze! The person who grants use was away until tomorrow, but because we have helped them in the past it should be OK, but watch this space.

Not many members turned up for the partial eclipse viewing event on the 25th, 0 being the number… oh well.

Clear Skies

Andy

Getting Lucky. Imaging a Moon rising against Silbury Hill I was taking handheld pictures through my Nikon P1000 bridge camera with its huge built in zoom, 24mm to 3000mm equivalent.
The aircraft was too far to determine on the Flight24 app, but it was probably at least 100 miles awa Y, over London, high enough to be above local traffic and around 28,000 feet for the contrails to be forming. Lower flights did not have contrails.
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 2020/2021.

HALL VENUE the Pavilion, Rusty Lane, Seend

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

Meet 7.30 for 8.00pm start

SEASON 2022/23

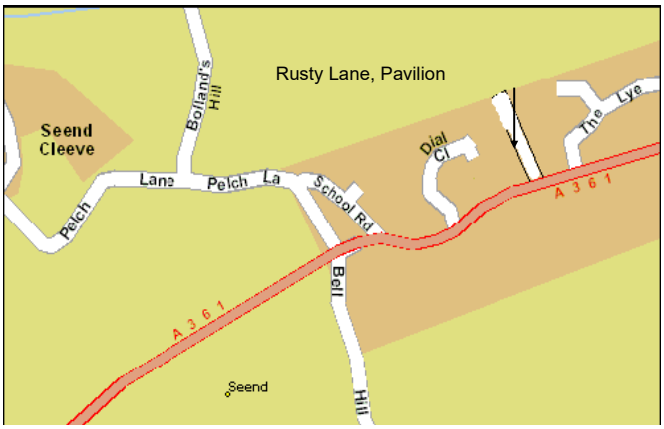
1 Nov Chris Hooker The planet Mercury
6 Dec Martin Griffiths How the Moon was formed
2023
3 Jan Mike Alexander Heaven's on Earth (zoom meeting)
7 Feb Prof. David Southwood JUICE
7 Mar Mary McIntyre Shadows in Space & the stories they tell
4 Apr Chris Starr Heavy Metal World
2 May Dr Paul A Daniels The Mega-constellation threat
6 Jun Andrew Lound Venus, Paradise Lost

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

Andy Burns Chair, anglesburns@hotmail.com
Andy Burns Outreach and newsletter editor.
Bob Johnston, Sam Franklin (Treasurer)
Rebecca Rowan (Hall coordinator)
??? (Teas and Projector)
Peter Chappell (Speaker secretary) Retiring
Nick Howes (Technical Guru)
Observing Sessions coordinators: Chris Brooks, Jon Gale,
Web coordinator: Sam Franklin
Contact via the web site details.



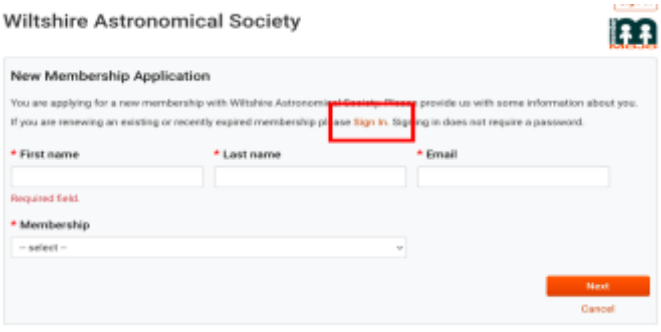
Chris Hooker.

Mercury is the innermost planet of our Solar System, and the smallest of the true planets, with a diameter of about 4880 km. The name Mercury (Latin *Mercurius*) is the Roman equivalent of the Greek god Hermes, the winged messenger of the gods. For a time the planet was actually known as Hermes, and even today

the adjective *Hermean* is sometimes used in connection with Mercury. It is one of the five planets readily visible to the naked eye, and has been known since ancient times.

The apparent diameter of Mercury is typically between 5 and 8 arc seconds, making it a tricky subject for amateur study. A modest telescope will show the phase of the disc. Picking out surface markings requires an aperture of 20 cm or more, and the most that can be seen is variations in surface brightness, with light spots or patches corresponding to deposits of ejected material around the larger impact craters. Figure 5 shows some examples of what can be seen and imaged. For those who wish to try observing the planet, there is an Observing Guide which BAA members can download from the web-page of the Mercury & Venus Section.

Observing Sessions see back page



Swindon's own astronomy group

Physical meetings continuing!

Following the relaxation of the Covid rules we are continuing physical meetings.

Friday, 18 November 19.30 onwards

Programme: Richard Fleet - The Winchcombe Meteorite

Richard Fleet - 18 November, 2022

Talk: The Winchcombe Meteorite

Richard is a member of Newbury Astronomical Society and has had a lifelong interest in astronomy. For the past 10 years he has been running a number of video cameras as part of the UK Meteor Observation Network.

He was fortunate to capture a good video of the Winchcombe fireball hence the personal interest in this particular event. He will talk a bit about the meteor observation networks and the equipment used by amateurs and then about why the Winchcombe meteorite fall was such an important event. For that he will try to put it in context with other exciting developments in the study of solar system rubbish.

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 meeting. To join these events please visit our website on the link below.

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

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

Meetings at Liddington Village Hall, Church Road, Liddington, SN4 0HB – 7.30pm onwards

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

Friday, 18 November 19.30 onwards

Programme: Richard Fleet - The Winchcombe Meteorite

Friday, 9 December 19.30 onwards

Programme: Christmas Social

Meeting Dates For 2023

Friday, 20 January 19.30 onwards

Programme: Peter Williamson FRAS: From Herschel to Hawkwind - Music and the Cosmos

Friday, 17 February 19.30 onwards Programme: Simon Holbeche: Frankenscope Reborn

Friday, 17 March 19.30

Programme: AGM

Friday, 21 April 19.30 onwards

Programme: Prof Matt Griffin: Far Infrared Astronomy from Space

Friday, 19 May 19.30 onwards

Programme: Prof Nick Evans - Dark Energy - a cosmological overview of empty space and links to particle physics

Friday, 16 June 19.30 onwards

Programme: Bob Mizen MBE - Stars over the Nile - Ancient Egyptian Astronomy and star lore

Friday, 15 September 19.30 onwards -

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

Friday, 20 October 19.30 onwards Programme: Prof Martin Hendry MBE - The Science of Star Wars

Friday, 17 November 19.30 onwards Programme: Dr Lillian Hobbs: Eisa Esinga - The Planetarium in the Bedroom

Friday, 8 December 19.30 onwards Programme: Christmas Social

Website:

http://www.swindonstargazers.com

Chairman: Robin Wilkey

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BECKINGTON ASTRONOMICAL SOCIETY

Society Details & Speakers programme can be found on our Website www.beckingtonas.org

General enquiries about the Society can be emailed to chairman@beckingtonas.org.

Our Committee for 2016/2017 is

Chairman: Steve Hill (email chairman@beckingtonas.org)
Treasurer: John Ball
Secretary: Sandy Whitton
Ordinary Member: Mike Witt

People can find out more about us at www.beckingtonas.org

Meetings take place in Beckington Baptist Church Hall in Beckington Village near Frome.

See the location page for details of how to find us on our website……

Post Code for Sat Nav is BA11 6TB.

Our start time is 7.30pm No hall meetings.

STAR QUEST ASTRONOMY CLUB

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

BATH ASTRONOMERS

FEDERATION OF ASTRONOMICAL SOCIETIES

The Next GoSpaceWatch Online Lecture: Orion European Service Module – Europe's Contribution to Artemis by Siân Cleaver, Airbus Space, Bremen, Germany. Thursday 24th November at 20:00 GMT. Open to all. Everyone Welcome. Tickets just £3.00 pp available from https://orionesm.eventbrite.co.uk

The Talk: NASA's Artemis programme will return astronauts to the Moon for the first time in 50 years and mark the start of a new era of human space exploration. Unlike the Apollo missions, the focus of the Artemis missions will be to create a more sustainable human presence on and around the Moon, and develop and demonstrate technologies that will prepare for future crewed missions to Mars.

The first Artemis mission is set to launch in November 2022 and will see an uncrewed 'Orion' spacecraft orbit around the Moon. Orion is powered by the European Service Module which, together with propulsion capabilities, provides the Orion spacecraft with everything needed to successfully sustain a human crew on lunar missions.

Siân will give an overview of the Artemis programme and Europe's contribution to it – the European Service Module (ESM). She will talk about the achievements so far, the work currently ongoing at Airbus Defence and Space, Bremen (the Prime contractor for Orion ESM) and where the Artemis programme is headed in the next 5 years.

The Speaker: Siân Cleaver is the Industrial Manager for the Orion European Service Module (ESM) programme at Airbus Defence and Space in Bremen, Germany. Previously located at the Airbus Stevenage site, Siân transferred to Bremen three years ago driven by her dream to work on human spaceflight missions. She is now responsible for ensuring the timely delivery of all equipment across all ESMs currently under development (ESMs 3 to 6) and also heavily involved with the proposals to secure contracts for future ESMs.

Open to all. Everyone Welcome. Tickets just £3.00 pp available from https://orionesm.eventbrite.co.uk

For further information go to-
GoSpaceWatch website - www.gospacewatch.earth

SPACE NEWS TO NOVEMBER 22

Exploring Phobos Close-up

Recently, the European Space Agency's Mars Express orbiter flew past Phobos as part of its regular mission. The idea was to get "up close and personal" with this moon and bombard it with low-frequency radio waves from the onboard MARSIS instrument. There was only one hitch—a typical flyby of Phobos by the spacecraft would put it too close to get useful MARSIS data. That's because the instrument always did its best work from a distance. The original software allowed it to study the Martian surface (and beneath it) from about 250 kilometers away

An artist's illustration of the Mars Express Orbiter above Mars. Its MARSIS instrument has been updated so it can study the moon Phobos. Image Credit: Spacecraft: ESA/ ATG Medialab; Mars: ESA/DLR/FU Berlin, CC BY-SA 3.0 IGO

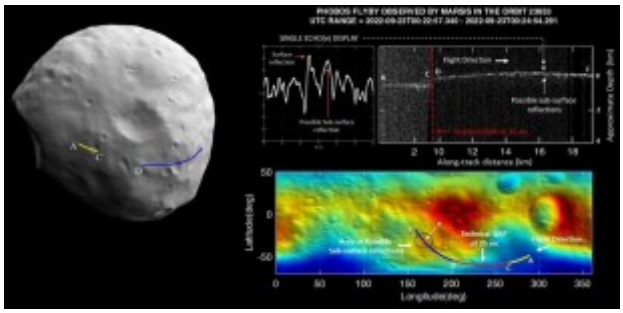
The radio waves MARSIS sends mostly reflect from the surface of an object and provide valuable information about conditions and structures there. But, some signals actually penetrate the crust and reflect back from deeper layers. The reflections helped scientists map the substructures on Mars and figure out if there are different layers of ice, rock, water, or soil. The instrument also played a role in finding signs of liquid water on the Red Planet.

So, how can MARSIS help figure out the big questions about Phobos and its origin? At the moment, scientists have two hypotheses about its past. "Whether Mars's two small moons are captured asteroids or made of material ripped from Mars during a collision is an open question, said ESA Mars Express scientist Colin Wilson. "Their appearance suggests they were asteroids, but the way they orbit Mars arguably suggests otherwise."

MARSIS Delivers an Early Look

The best way to find out its origin is to look inside Phobos. Typical optical images can only tell scientists so much. But, instruments that can probe inside Phobos can reveal a lot. That's where MARSIS comes in. Thanks to a major software upgrade, MARSIS made observations during the recent close approach. It can now "see" beneath the surface of this little moon as it flies by to look for structural clues.

"During this flyby, we used MARSIS to study Phobos from as close as 83 km," said Andrea Cicchetti from the MARSIS team at the Italian National Institute for Astrophysics. "Getting closer allows us to study its structure in more detail and identify important features we would never have been able to see from further away. In the future, we are confident we could use MARSIS from closer than 40 km. The orbit of Mars Express has been fine-tuned to get us as close to Phobos as possible during a handful of flybys between 2023 and 2025, which will give us great opportunities to try."



MARSIS data from Phobos flyby. The top-right image shows the 'radargram' acquired by MARSIS during the flyby of Phobos on 23 September 2022. A radargram reveals the 'echoes' created when the radio signal emitted by MARSIS bounces off something and returns to the instrument. The brighter the signal, the more powerful the echo. The continuous bright line shows the echo from the moon's surface. The lower reflections are either 'clutter' caused by features on the moon's surface, or, more interestingly, signs of possible structural features below the surface (e). Section A—C was recorded using an older configuration of the MARSIS software. The new configuration was prepared during the 'technical gap' and successfully used for the very first time from D—F. The left and bottom-right images show the path of the observation across the surface of Phobos. Credit: INAF – Istituto Nazionale di Astrofisica

The Data Indicate Something Beneath the Phobos Landscape

MARSIS output a radargram based on data captured on September 23, 2022. Essentially, the radargram depicts "echoes" created when the signal from MARSIS's 40-meter-long antenna bounced back off of something beneath the surface. That could indicate a layered structure, which might indicate that Phobos is a captured asteroid. It could also mean that there's a variety of objects inside Phobos that could make it a floating rubble pile. Of course, more flybys will capture more data, which should give more details about what's lurking beneath the crust of Phobos.

The close-up studies will help scientists program the upcoming Martian Moons eXploration (MMX) mission that will land on Phobos no earlier than 2024. It will gather samples and return them to Earth in 2029. Data from those samples should help settle Phobos's origin question once and for all.

Too Many Supernovae Can Slow Star Formation in a Galaxy

Interstellar winds are powerful agents of change. For one thing, they can interrupt or shut down the process of star birth completely. That's what a team of astronomers using the Karl Jansky Very Large Array in New Mexico found when they studied the galaxy M33. They also learned that speedy cosmic rays play a huge role in pushing those winds across interstellar space.

The idea that winds from supernova explosions and jets from galactic cores could "quench" star formation isn't new. Essentially they rob protostars of the gas and dust they need to form

The Crab Nebula (aka. Messier Object 1) is an example of a supernova explosion that emitted cosmic rays. Credit: NASA

Now here's an interesting twist. When those supernovae occur, they eject large numbers of cosmic rays. The more supernovae that "pop off", the more cosmic rays are emitted. Then they exert more influence on the interstellar winds that ultimately end up destroying star birth nurseries.

"We have seen galactic winds driven by cosmic rays in our own Milky Way and the Andromeda galaxy, which have much weaker rates of star formation, but not before in a galaxy such as M33," said Fatemah Tabatabaei, of the Institute for Research in Fundamental Sciences in Iran. Tabatabaei and a team of scientists used the VLA, the Effelsberg radio telescope in Germany, and a selection of millimeter-wave, visible-light, and infrared telescopes to observe this neighboring galaxy.

Cosmic Rays, Star Formation, and Galaxies

Star formation and galaxy-building are intimately connected. Generally speaking, galaxies start out as small collections of stars, which form in hydrogen-rich clouds. Galaxies grow by merging together. The smallest ones mingle to create bigger ones. The bigger ones also collide and merge. Often enough, those mergers spur new episodes of star birth. Our own Milky Way grew this way, and so did M33.

Stars continue to form in clouds of hydrogen gas laced with dust scattered throughout galaxies. Bursts of star formation eat up the available gas and dust and that affects the galactic shape (or morphology). In addition, as stars age, they contribute the elements they make in their cores back to the interstellar medium (ISM). Those materials end up in the next generations of stars and planets. And, as the team led by Tabatabaei has found, the most massive stars generate cosmic rays when they die. These fast-moving particles push winds through interstellar space and interact with magnetic fields.

Large amounts of cosmic rays build up a pressure front that slams into stellar creches filled with gas and dust. The wind action blasts apart the clouds and carries away the needed stellar building blocks. Essentially, the cosmic rays drive winds that quench star formation. That can be pretty damaging to a growing galaxy, which should be rich with star birth regions. This is why it's important to study the ISM and trace the creation and emission of cosmic rays during star death.

What VLA Observed at M33

VLA observations allowed Tabatabaei's team to study the ISM in M33 in regions as small as 30 parsecs (just under a hundred light-years) across. They could look at star-forming regions as well as areas where no star birth was taking place. Both areas are important to understand what processes and events can affect star formation.

The Very Large Array in New Mexico. It was used along with other radio astronomy and optical observatories to study M33 and the effects of cosmic ray-driven winds that disrupt star formation.Credit: NRAO/AUI/NSF; J. Hellerman

"The VLA observations indicated that cosmic rays in M33 are escaping the regions where they are born, making them able to drive more extensive winds," said William Cotton, of the National Radio Astronomy Observatory. Based on these observations, the astronomers suspect that many supernova explosions and supernova remnants in M33's highly active star formation regions made such cosmic ray-driven winds more likely.

"This means that cosmic rays probably are a more general cause of galactic winds, particularly at earlier times in the universe's history, when star formation was happening at a much higher rate," Tabatabaei said. She added, "This mechanism thus becomes a more important factor in understanding the evolution of galaxies over time."

The team hopes that similar studies in large samples of galaxies beyond M33 will give more information about the cosmic ray-driven winds that can disrupt star formation. In particular, such facilities as the Square Kilometer Array (SKA) and ngVLA (next generation VLA) should be well-suited to survey other galaxies in both the modern universe as well as galaxies earlier in time.

InSight Felt the Ground Shake From a Meteorite Impact on Mars

Boulder-sized blocks of water ice lie around an crater blasted out by a meteoroid on December 24, 2021. NASA's InSight lander measured the earthquake the impact caused. Credit: NASA/JPL-Caltech/University of Arizona.

The Mars InSight lander might be nearing the end of its life on the Red Planet, but its scientific data are still shaking up the planetary science community. That's because it detected another Marsquake on December 24, 2021. It was a major shaker and generated surface waves that rippled across the crust of the planet. The data from that quake allowed science team members to get a better idea of the Martian crust's structure.

Now, this wasn't just any old magnitude-4 Marsquake. It was evidence of a major meteoroid impact on the planet. So, scientists began looking for a crater. Before-and-after images from NASA's Mars Reconnaissance Orbiter (MRO, which reached orbit in 2006) revealed a new one in Amazonis Planitia. That's a region that lies between the Tharsis and Elysium regions on the planet.

With images and seismic data that pinpoint the crater's location, scientists think it's of the largest craters ever witnessed forming any place in the solar system. Of course, many larger ones exist on Mars, but they're older than any of the missions sent to the Red Planet. Luckily, InSight was there to measure the seismic aftermath of the event. Scientists used some of its data to create a sound "recording" of the impact.

"It's unprecedented to find a fresh impact of this size," said Ingrid Daubar of Brown University, who leads InSight's Impact Science Working Group. "It's an exciting moment in geologic history, and we got to witness it."

This video includes a seismogram and sonification of signals received by NASA's InSight Lander as it detected a meteoroid impact on Mars. Courtesy NASA/JPL-Caltech/Imperial College London.

Meet the Meteorite Impactor

The crater is about 150 meters across and 21 meters deep. When the meteoroid hit, it blasted material out from the crust and sent it as far away as 37 kilometers. So, what was this impactor? Based on the available data, the meteoroid was somewhere around 5 to 12 meters in size. On Earth, an object that size would never have reached the surface. Instead, it would have broken up and vaporized in our atmosphere. But, on Mars, where the atmosphere is quite thin, it just blasted right through to the surface.

The crater was first spotted on Feb. 11, 2022, by scientists working at Malin Space Science Systems (MSSS), which built and operates two cameras aboard MRO. The blast zone was visible in data from the MRO. The spacecraft team then correlated with the InSight data taken at the time of the impact. That allowed them to figure out the epicenter of the impact and start the search for the crash site.

"The image of the impact was unlike any I had seen before, with the massive crater, the exposed ice, and the dramatic blast zone preserved in the Martian dust," said Liliya Posiolova, who leads the Orbital Science and Operations Group at MSSS. "I couldn't help but imagine what it must have been like to witness the impact, the atmospheric blast, and debris ejected miles downrange."

Why Bother With Crater-causing Events?

Cratering is one of several processes that change the surfaces of worlds in the solar system. Planetary scientists can use the number of craters on a surface to determine how old it is. On Mars, for example, it's important to know how often craters get dug out of the surface. That knowledge helps determine the planet's geologic timeline. The older a region on Mars is, the more craters it has.

gAside from aging, craters also provide an important look inside the crust of the planet. Every time an object gouges out a crater, it reveals materials beneath the surface. On Mars, that turns out to be ice, and the December 24 impactor dug out huge blocks of ice. Mars has a lot of permafrost beneath the surface, so in a sense, the impactor acted as a geological "pick". The region where this meteoroid created the crater is fairly close to the Martian equator, so finding ice there is important. Future Mars explorers may be able to use that ice to melt for water, propellants, and other needs.

Here's a simulated flyover of the crater site created by the December 24, 2021 impact event. Courtesy NASA/JPL-Caltech/University of Arizona.

InSight's Role

The December 24, 2021 event wasn't InSight's first rodeo with impact-related events. Since landing in November 2018, the spacecraft has detected 1,318 marsquakes, including several caused by smaller meteoroid impacts. The mission was sent to study the planet's crust, mantle, and core using seismic waves created by impacts and other events. It has performed well but is starting to lose the power to perform science-gathering tasks. The power drain is largely due to dust on the solar panels, which the teams have tried to shoo off using sand and wind to dislodge the dust grains. As the power wanes, scientists continue to squeeze every bit of observational time they can out of the mission. The spacecraft now is expected to shut down within the next six weeks, bringing the mission's science to an end.

Another Version of the Pillars of Creation from Webb

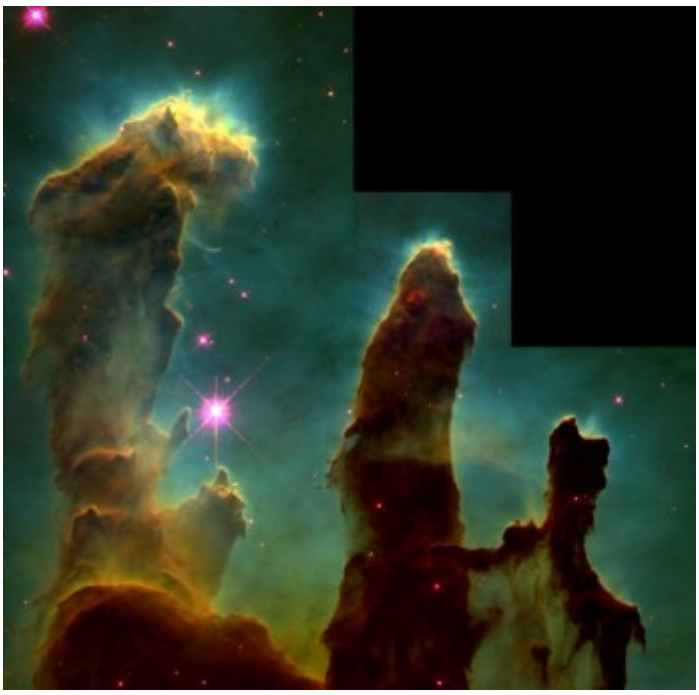
The hits just keep on streaming back to Earth from James Webb Space Telescope (JWST). This time, arriving to help celebrate Hallowe'en, data from the MIRI mid-infrared instrument onboard JWST shows another view of the Pillars of Creation. Thousands of stars are embedded in those pillars, but many are "invisible" to MIRI.

In the latest image, the Pillars have a steely gray look about them. They almost look like cosmic gravestones instead of stellar birthplaces. Why is this? Mid-infrared light is an important part of the spectrum for astronomers interested in studying clouds of dust. It reveals gas and dust in extreme detail. The densest areas of dust in the pillars show up as the darkest shades of grey. The red V-shaped region toward the top is where the dust clouds are thinner and cooler.

At these wavelengths, MIRI is only able to "see" the young stars still embedded in their gas and dust cocoons. They glow a mysterious red—almost like the eyes of jack-o-lanterns—at the tips of formations in the pillars. The blue-looking stars are older ones that have burst free and eaten their birth clouds away.

The Pillars of Creation in Retrospect

This star-birth region has a long history of observations. It's certainly visible to astronomers using backyard-type telescopes. However, it takes Hubble Space Telescope and now JWST to dig into the rich detail of this massive cloud. HST first looked at it in 1995, using the Wide Field and Planetary Camera 2. It returned 32 images, which were combined into a mosaic. The pillars are part of the Eagle Nebula. It's a diffuse emission nebula that covers a region of space about 70 x 55 light-years across. It lies about 6,500 light-years away from us. The pillars are a part of the nebula, and some of its tiniest stellar birthplaces are larger than our solar system.



Eagle Nebula Pillars of Creation as seen by Hubble Space Telescope in 2005. (Credit NASA, ESA, STScI, J. Hester and P. Scowen (ASU)

When the first HST image appeared, astronomers could see the places where stars were born and are eating away at their gas clouds but couldn't see INTO the clouds. Those hungry stellar babies in their cocoons were dubbed "evaporating gaseous globules", or EGGs. They're in other stellar nurseries, giving astronomers a good idea of how star birth progresses in thick clouds of gas and dust.

The Pillars of Creation have since been imaged again in 2015 by HST, as well as by the Chandra X-ray Observatory (which found no x-ray sources associated with the newborn stars). Spitzer Space Telescope also studied this region of space. It found evidence of hot gases that suggested a supernova exploded in the area. If it did, there's little evidence of the shock wave hurting the stellar newborns or evaporating the rest of the cloud away.

JWST's Looks at the Pillars

The latest steely gray view of the Pillars of Creation set against the glowing red and gray backdrop isn't JWST's first rodeo with this region of space. Earlier in October, the science teams released a NIRCam (Near Infrared Camera) image of it. That view revealed many of the protostars forming inside those cosmic stalagtites in space. Thanks to NIRCam, we can peer right through the gas and dust, lifting the veil on star birth.

A compare and contrast of a 2014 HST view of the Pillars of Creation and the October 19, 2022, JWST image. Both views show us what is happening locally. Although Hubble highlights many more thick layers of dust and Webb shows more of the stars, neither shows us the deeper universe. Dust blocks the view in Hubble's image, but the interstellar medium plays a major role in Webb's. It acts like thick smoke or fog, preventing us from peering into the deeper universe, where countless galaxies exist. Courtesy of NASA, ESA, CSA, STScI, Hubble Heritage Project (STScI, AURA) Image processing: Joseph DePasquale (STScI), Anton M. Koekemoer (STScI), Alyssa Pagan (STScI)

The protostars as seen by NIRCam are the ones with multiple diffraction spikes. They're still accreting mass, and when they get enough, they'll collapse under their own gravity and slowly heat up. When they're hot and massive enough, fusion will ignite in their cores. That's when they become stars. The young stars in these pillars are probably only a few hundred thousand years old and won't be finished forming for millions of years.

The stellar birth process often creates jets that shoot out from the newborn stars. Those jets eat away at the remaining birth cloud materials. They sculpt the clouds, which is why the pillars look wavy and deformed.

Understanding Star Formation from JWST Images

Both of these JWST images of the Pillars of Creation give astronomers a more detailed look at star formation. While scientists have a pretty good overall view of how stars form, the intricate details are what they need. All that data about star birth will help create better models of such an important process.

Compare and contrast the NIRCam view (left) with the MIRI view (right) from JWST to understand how each instrument sees the Pillars of creation. NASA, ESA, CSA, STScI; J. DePasquale (STScI), A. Pagan (STScI), A. Koekemoer (STScI)

By looking at populations of newborns like the ones in the Pillars, and mapping the huge clouds of gas and dust in this region, they'll add to the store of knowledge about star birth. Images such as these also give a good look at what our own region of space must have looked like about five billion years ago. That's when our own Sun and its stellar siblings began to form from a similar type of gas and dust cloud..

NASA Announces the Team who'll be Studying UFO Data. It's a Pretty Impressive List

In June, NASA announced that it had commissioned an independent study team to investigate unidentified aerial phenomena (UAPs) from a scientific perspective. Last week, NASA announced the members of the independent team that will study observed events in the sky that cannot be identified as aircraft or natural phenomena. These sixteen individuals, a collection of scientists and researchers from premier institutions across the U.S., will analyze all possible data sources that could help NASA and other agencies learn more about this phenomenon.

Until recently, the study of UAP was a matter of national security and air safety pursued exclusively by government and military agencies. However, since the Office of Director of National Intelligence (ODNI) released its report last year (aka. the UFO Report), it has become the subject of scientific research. However, scientists require access to extensive sets of data to verify and explain observed events. Therefore, the focus of the study is to inform NASA about possible data sources that could discern the nature of UAP.

The team began their work on Monday, October 24th, and will spend the next nine months laying the groundwork for future studies of UAPs by NASA and other organizations. This will consist of the team reviewing how data gathered by government, commercial, military, and other entities (which has since been declassified) can be analyzed to learn more about UAPs. This team will then prepare a series of recommendations for UAP data analysis to NASA and a full report of its findings for the public (to be released by mid-2023).

Screencapture of video of New Jersey UFO, which turned out to be the Goodyear Blimp. Credit: @DRoyFlor

Thomas Zurbuchen, associate administrator of the Science Mission Directorate at NASA Headquarters, said in a recent NASA press statement:

"Exploring the unknown in space and the atmosphere is at the heart of who we are at NASA. Understanding the data we have surrounding unidentified aerial phenomena is critical to helping us draw scientific conclusions about what is happening in our skies. Data is the language of scientists and makes the unexplainable, explainable."

Daniel Evans, the assistant deputy associate administrator for research at NASA's Science Mission Directorate (SMD), is responsible for orchestrating the study. The team is led by David Spergel, the President of the Simons Foundation and the founding director of the Flatiron Institute's Center for Computational Astrophysics). The UAP independent study team is comprised of leading scientists, data and artificial intelligence analysts, and aerospace safety experts.

Other group members include **Anamaria Berea**, an associate professor at George Mason University, research affiliate with the SETI Institute, and a research investigator with the Blue Marble Space Institute of Science (BMSIS). There's **David Grinspoon**, a senior scientist at the Planetary Science Institute (PSI), adjunct professor, the former inaugural Baruch S. Blumberg/NASA Chair in Astrobiology,and member of NASA's upcoming DAVINCI mission. And then there's **Scott Kelly**, a former NASA astronaut who commanded Expeditions 26, 45, and 46, and spent a year aboard the ISS as part of the NASA Twins Study.

Other people of interest include **Mike Gold**, the executive VP of Civil Space and External Affairs at Redwire Space, and a former NASA associate administrator who helped draft the Artemis Accords and the international agreements for the Lunar Gateway; and **Shelley Wright**, an associate professor of physics at the UCSD's Center for Astrophysics and Space Studies (CASS), SETI researcher and instrumentalist, and principal investigator for the UCSD Optical Infrared Laboratory (OIR).

Every member is charged with a specific area of focus, with the ultimate purpose of informing NASA how to apply the full focus of science and data to the study of UAPs. Each member was appointed in accordance with the Federal Advisory Committee Act (FACA), which governs the operation of independent federal advisory committees and ensures public involvement in the process. Said Evans:

"NASA has brought together some of the world's leading scientists, data and artificial intelligence practitioners, aerospace safety experts, all with a specific charge, which is to tell us how to apply the full focus of science and data to UAP. The findings will be released to the public in conjunction with NASA's principles of transparency, openness, and scientific integrity."

This study and the resulting recommendations are part of NASA's astrobiology program, which is dedicated to the search for extraterrestrial life. This consists of looking for chemical signatures that are associated with life and biological processes ("biosignatures") and indications of technological activity ("technosignatures"). Through the study of UAP, NASA will be searching for evidence of active or defunct technology through which we can infer the existence of extant or extinct civilizations.

These efforts include searches here at home through the study of UAP, throughout the Solar System via robotic missions, and the Universe at large through the study of extrasolar planets. Potential technosignatures include space probes, radio communications, directed energy signatures, megastructures, and other indications of advanced intelligence. These efforts are paralleled by the work of non-profit organizations like the Galileo Project, led by Prof. Abraham

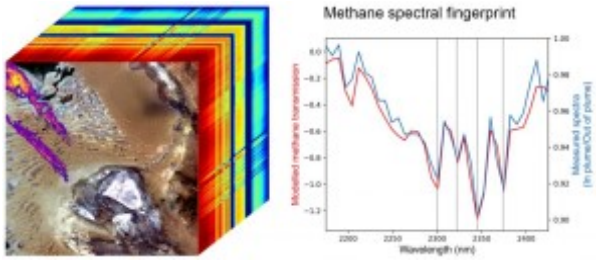
Loeb of Harvard University, and the Harvard & Smithsonian Center for Astrophysics (CfA).

NASA is Mapping Giant Clouds of Methane Released by "Super-Emitters" Across the World

Everybody's heard of methane. It's a major part of the atmosphere in places like Uranus and Neptune. On Earth, it's also part of our atmosphere, where it works to warm things up. Some of it gets there from natural causes. But, a lot of it comes from industrial super-emitters and other human-caused processes. That's not good because too much methane works, along with other greenhouse gases (like carbon dioxide, or CO_2) to "over warm" our atmosphere.

In the right amounts, methane's role in warming the atmosphere is perfectly normal. For humans, methane has other uses. It's a big component of natural gas, used for everything from cooking to heating our homes and businesses. But, the releases of methane from big industrial processes, outgassing from landfills, and oil and gas exploration are not normal. They all contribute to climate change.

How to track methane emissions? It turns out this gas can be detected from space and has been for some time. Currently, a satellite called EMIT (for Earth Surface Mineral Dust Source Investigation) is using spectroscopic studies to find big clouds of methane. There are at least 50 "super-emitters" of methane in EMIT's data, and their existence is cause for concern. Unfortunately, scientists expect to find more as time goes by.



The cube (left) shows methane plumes (purple, orange, yellow) over super-emitters in Turkmenistan. The rainbow colors are the spectral fingerprints from corresponding spots in the front image. The blue line in the graph (right) shows the methane fingerprint EMIT detected; the red line is the expected fingerprint based on an atmospheric simulation. Credit: NASA/JPL-Caltech

Super-emitters deliver methane to the atmosphere at very high rates. How high? "Some of the plumes EMIT detected are among the largest ever seen – unlike anything that has ever been observed from space," said Andrew Thorpe, a researcher at JPL leading the EMIT methane effort. "What we've found in just a short time already exceeds our expectations."

Infamous Super-emitters

EMIT has been busy. For example, it detected a plume about 3.3 kilometers long southeast of Carlsbad, New Mexico. It's smack dab over the Permian Basin, one of the largest oilfields in the world. EMIT also found 12 plumes from oil and gas infrastructure in Turkmenistan, some stretching over 32 kilometers. In Iran, near Tehran, there's a plume at least 4.8 kilometers long. It's blowing out from a waste-processing plant. These are all known super-emitters.

The flow rates of gas into the atmosphere from these sites are dismaying. In the Permian basin, the flow rate is 18,300 kilograms per hour. The Turkmenistan plumes are sending 50,400 kilograms per hour in total into the atmosphere. That's roughly similar to a gas leak in the 2015 Aliso Canyon event in California. It sent 50,000 kilograms per hour into the air at various times and was among the largest methane releases in U.S. history.

Curtailing Methane Gas Emissions

The fight to reduce greenhouse gases is an important one in the effort to slow global warming. Scientists do use ground-based methods to find methane emissions. However, space-based detectors deliver clearer looks at where it and other gases are polluting the atmosphere.

"Reining in methane emissions is key to limiting global warming. This exciting new development will not only help researchers better pinpoint where methane leaks are coming from, but also provide insight on how they can be addressed – quickly," said NASA Administrator Bill Nelson. "The International Space Station and NASA's more than two dozen satellites and instruments in space have long been invaluable in determining changes to the Earth's climate. EMIT is proving to be a critical tool in our toolbox to measure this potent greenhouse gas – and stop it at the source."

While CO_2 is the prime greenhouse gas in the news most of the time, methane is critically important to regulate, too. It makes up a smaller fraction of human-caused greenhouse-gas emissions than CO_2. However, methane is roughly 80 times more effective at trapping heat in the atmosphere for 20 years after it is released. It also stays in the atmosphere over shorter time periods, compared to CO_2. Its short lifetime in our air does have an upside. If we can curtail methane emissions, the atmosphere will see improvement more quickly. That leads to a slower warming cycle in the short term.

Finding More Methane Super-emitters

EMIT will likely find many more super-emitters. "As it continues to survey the planet, EMIT will observe places in which no one thought to look for greenhouse-gas emitters before, and it will find plumes that no one expects," said Robert Green, EMIT's principal investigator at JPL. The mission is the first of a new class of spaceborne imaging spectrometers to study Earth. Another is the Carbon Plume Mapper (CPM), designed to detect methane and CO_2. JPL is working with a nonprofit, Carbon Mapper, along with other partners, to launch two satellites equipped with CPM in late 2023.

Identifying methane point sources is a huge step in the process of reducing greenhouse gases. EMIT supplies knowledge of the locations of big emitters, and that gives operators of the super-emitter facilities the chance to take quick action. The ultimate goal is to reduce or even eliminate the release of methane into our already warming atmosphere.

The EMIT observations aren't the first ones to detect methane emissions on Earth. GHGSat, which is a private company that monitors such emissions from space spotted leaks from the Nordstream pipeline between Denmark and Sweden. The pipeline was sabotaged and emitted methane at 79,000 kg per hour.

Lucy Took This Picture of Earth as it was Making its Gravity Assist Maneuver

We may take it for granted, but every day we receive picture postcards from the robotic travelers we have sent out to explore our Solar System. Usually, we get to see faraway planets, moons, asteroids, or comets. But sometimes we get to see ourselves.

The Lucy spacecraft took a couple of amazing images of our home planet as the spacecraft was approaching Earth for the first of three slingshot gravity assists on its way out to explore the Trojan asteroids along Jupiter's orbit.

The first image, above was taken on October 15, 2022 from a distance of 620,000 km (380,000 miles) by Lucy's Terminal Tracking Camera (T2CAM) system, a pair of identical cameras that are responsible for tracking the asteroids during Lucy's high speed flybys when it reaches Jupiter's orbit. The flyby had Lucy coming closer to Earth than many Earth orbiting satellites, including the International Space Station. It was close enough that observers in Western Australia were able to track Lucy from the ground on October 16th.

The second photo, below, shows both Earth and the Moon and was taken on October 13, 2022 as Lucy approached Earth, from 1.4 million km (890,000 miles). You'll need to look closely to see the Moon, as the Moon is less reflective than the brighter and bigger Earth. Both images were taken as part of an instrument calibration sequence.

On October 13, 2022, NASA's Lucy spacecraft captured this image of the Earth and the Moon from a distance of 890,000 miles (1.4 million km). Credit: NASA/Goddard/SwRI

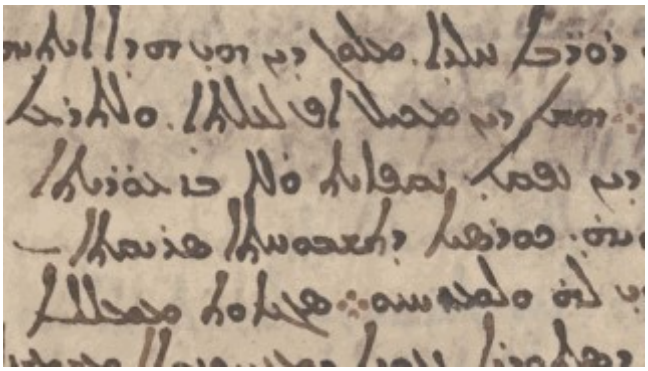
Lucy launched on October 19 of last year, and so is currently one year into its twelve-year voyage. This gravity assist will place Lucy on a two year orbit, at which time it will return to Earth for a second gravity assist. That second assist will give Lucy the energy it needs to cross the main asteroid belt and observe the asteroid DonaldJohanson, and travel into the leading Trojan asteroid swarm. There Lucy will fly past six Trojan asteroids: Eurybates and its satellite Queta, Polymele and its yet unnamed satellite, Leucus, and Orus. After that tour, Lucy will return to Earth for a third gravity assist in 2030 to increase the spacecraft's inclination for the final rendezvous with the binary asteroid pair Patroclus/ Menoetius. This is a record-breaking tour for a single spacecraft, visiting nine asteroids.

The mission is named after the Lucy hominin fossils, and the view of Earth in the first image includes a view of Hadar, Ethiopia, where the 3.2 million-year-old human ancestor fossil was found. The name Lucy was chosen because study of the trojans could reveal the "fossils" of planet formation, the materials that clumped together in the early history of the Solar System to form planets and other bodies.

Scientists Find an Ancient Stellar Catalog Written by Hipparcus Hidden in a Medieval Tome

If you think writing paper is expensive these days, be glad you didn't live in the middle ages. Back then, paper was as rare as hen's teeth, so good luck finding some to write one. But if you happened to be a monk, chances are there were plenty of old books made of parchment. Many of them have useless stuff like old star catalogs, so why not just recycle the parchment for your new copy of religious literature?

This is basically how the *Codex Climaci Rescriptus* came about. Parchment is made from animal skin and processed into a thin, paper-like material. It's laborious to make, but it can last for millennia under the right conditions. It can also be easily erased. Just scrape the old ink off with a sharp knife, and you are good to go. This kind of recycling was occasionally used throughout the early middle ages until paper production became common in the 1500s. As a result, we have a few books like the *Codex Climaci Rescriptus* with medieval texts overwritten on much older works. We have known about this kind of thing for more than a century. In many cases, you can even see hints of the older underlying text, but good luck reading it. That has changed thanks to multispectral imaging.



How multispectral imaging reveals text. Credit: Museum of the Bible CC BY-SA 4.0

With multispectral imaging, you illuminate the text with different colors of light and make high-resolution images of the parchment. Different inks and even the same inks of different ages reflect light in different ways. By combining images at different wavelengths, you can tease out the background text while minimizing the foreground text, thus making the old text readable. In a recent study, a team did this with the *Codex Climaci Rescriptus*, and found the original writing contained fragments of the Hipparchus star catalog, which is thought to be the earliest detailed map of the northern night sky.

Hipparchus was a Greek astronomer who compiled his catalog around 135 BCE. Unfortunately, his catalog was lost to the ages. We know of it because four centuries later Ptolemy mentions it in the text of his own star catalog, *Almagest*, which we do have copies of. The *Codex Climaci Rescriptus* contains the only direct fragments of the Hipparchus catalog we have. The team first found the fragments in 2017, but this new study has revealed some interesting details, particularly regarding the connection between the Hipparchus and Ptolemy catalogs.

One of the long-standing mysteries was whether Ptolemy copied the Hipparchus catalog wholesale and expanded it, or whether Ptolemy simply referenced Hipparchus while making his own measurements. The team was able to find four constellations within the Hipparchus fragments and discovered their star locations are slightly different from those in the Ptolemy catalog. Surprisingly, they also found that the Hipparchus constellations were more precise, with positions measured to the nearest degree. The accuracy of Hipparchus wasn't equaled until the Persian astronomer Ulugh Beg compiled his *Zij-i Sultani* star catalog in the 1400s.

A Monster Black Hole has Been Found Right in our Backyard (Astronomically Speaking)

Black holes are among the most awesome and mysterious objects in the known Universe. These gravitational behe-

moths form when massive stars undergo gravitational collapse at the end of their lifespans and shed their outer layers in a massive explosion (a supernova). Meanwhile, the stellar remnant becomes so dense that the curvature of spacetime becomes infinite in its vicinity and its gravity so intense that nothing (not even light) can escape its surface. This makes them impossible to observe using conventional optical telescopes that study objects in visible light.

As a result, astronomers typically search for black holes in non-visible wavelengths or by observing their effect on objects in their vicinity. After consulting the Gaia Data Release 3 (DR3), a team of astronomers led by the University of Alabama Huntsville (UAH) recently observed a black hole in our cosmic backyard. As they describe in their study, this monster black hole is roughly twelve times the mass of our Sun and located about 1,550 light-years from Earth. Because of its mass and relative proximity, this black hole presents opportunities for astrophysicists.

The study was led by Dr. Sukanya Chakrabarti, the Pei-Ling Chan Endowed Chair in the Department of Physics at UAH. She was joined by astronomers from the Observatories of the Carnegie Institution for Science, the Rochester Institute of Technology, the SETI Institute Carl Sagan Center, UC Santa Cruz, UC Berkeley, the University of Notre Dame, Wisconsin-Milwaukee, Hawaii, and Yale. The paper that describes their findings recently appeared online and is being reviewed by the *Astrophysical Journal*.

The Magellan Telescopes at the Las Campanas Observatory in Chile. Credit: Carnegie Institute of Science

Black holes are of particular interest to astronomers because they offer opportunities to study the laws of physics under the most extreme conditions. In some cases, like the supermassive black holes (SMBH) that reside at the center of most massive galaxies, they also play a vital role in galaxy formation and evolution. However, there are still unresolved questions regarding the role noninteracting black holes play in galactic evolution. These binary systems consist of a black hole and a star, where the black hole does not draw material from the stellar companion. Said Dr. Chakrabari in a UAH press release:

"It is not yet clear how these noninteracting black holes affect galactic dynamics in the Milky Way. If they are numerous, they may well affect the formation of our galaxy and its internal dynamics. We searched for objects that were reported to have large companion masses but whose brightness could be attributed to a single visible star. Thus, you have a good reason to think that the companion is dark."

To find the black hole, Dr. Chakrabarti and her team analyzed data from the Gaia DR3, which included information on nearly 200,000 binary stars observed by the European Space Agency's (ESA) *Gaia Observatory*. The team followed up on sources of interest by consulting spectrographic measurements from other telescopes, like the Lick Observatory's Automated Planet Finder, the Magellan Telescopes, and the W.M. Keck Observatory in Hawaii. These measurements showed a main sequence star subject to a powerful gravitational force. As Dr. Chakrabari explained:

"The pull of the black hole on the visible sun-like star can be determined from these spectroscopic measurements, which give us a line-of-sight velocity due to a Doppler shift. By analyzing the line-of-sight velocities of the visible star – and this visible star is akin to our own Sun – we can infer how massive the black hole companion is, as well as the period of rotation, and how eccentric the orbit is. These spectroscopic measurements independently confirmed the Gaia solution that also indicated that this binary system is composed of a visible star that is orbiting a very massive object."

Members of GCOI posing in front of the Keck Observatory at the summit of Maunakea, Hawaii. Credit: W.M. Keck Observatory

Interacting black holes are typically easier to observe in visible light because they are in tighter orbits and pull material from their stellar companions. This material form a torus-shaped accretion disk around the black hole that is accelerated to relativistic velocities (close to the speed of light), becoming highly energetic and emitting X-ray radiation. Because noninteracting black holes have wider orbits and do not form these disks, their presence has to be inferred from analyzing the motions of the visible star. Said Dr. Chakrabarti:

"The majority of black holes in binary systems are in X-ray binaries – in other words, they are bright in X-rays due to some interaction with the black hole, often due to the black hole devouring the other star. As the stuff from the other star falls down this deep gravitational potential well, we can see X-rays. In this case, we're looking at a monster black hole, but it's on a long-period orbit of 185 days, or about half a year. It's pretty far from the visible star and not making any advances toward it."

The techniques employed by Dr. Chakrabarti and her colleagues could lead to the discovery of many more noninteracting systems. According to current estimates, there could be a million visible stars in our galaxy that have massive black hole companions. While this represents a tiny fraction of its stellar population (~100 billion stars), the *Gaia Observatory*'s precise measurements have narrowed that search. To date, *Gaia* has obtained data on the positions and proper motions of over 1 billion astronomical objects – including stars, galaxies,

Further studies of this population will allow astronomers to learn more about this population of binary systems and the formation pathway of black holes. As Dr. Chakrabarti summarized:

"There are currently several different routes that have been proposed by theorists, but noninteracting black holes around luminous stars are a very new type of population. So, it will likely take us some time to understand their demographics, and how they form, and how these channels are different –

or if they're similar – to the more well-known population of interacting, merging black holes."

Curiosity Arrives in a Salty Region of Mars. Was it Left Over From a Dying Sea?

The Curiosity rover has now reached its primary target on Mount Sharp on Mars, the mountain in the middle of Gale Crater the rover has been climbing since 2014. This target is not the summit, but a region over 600 meters (2,000 feet) up the mountain that planetary geologists have long anticipated reaching.

Known as the "sulfate-bearing unit," the region is a boundary between the rocks that saw a lot of water in their history and those that didn't; a possible shoreline, if you will. That boundary is already providing insights into Mars' transition from a wet planet to dry, filling in a key gap in the understanding of the planet's history.

"It's official: @MarsCuriosity has reached the sulfate-bearing unit," said planetary scientist Abigail Fraeman on Twitter. Fraeman is the Deputy Project Scientist for the Curiosity mission. "What secrets do these salty rocks contain about the transformation of Mars from watery and habitable to dry and desolate…?"

The rover had to travel through a treacherous, narrow sand-lined pass to reach the sought-after region that – from orbital data – appear to be enriched with salty minerals. Those minerals should be able to provide tantalizing clues as to how the Red Planet's climate changed from being more Earth-like to the frozen desert it is today.

Curiosity landed in 2012 and spent about two years studying the region around the base of Mount Sharp. Then the rover began climbing, and along the way finding progressively younger rocks that serve as a record on how Mars has evolved from a wet, habitable planet to a cold desert environment.

The hypotheses is that billions of years ago, the water in Gale Crater – in streams, ponds or even a lake — left behind the minerals as the water dried up.

Curiosity used its Mast Camera, or Mastcam, to capture this image of its 36th successful drill hole on Mount Sharp, at a rock called "Canaima." The rovers Mars Hand Lens Imager took the inset image. The pulverized rock sample was acquired on Oct. 3, 2022, the mission's 3,612th Martian day, or sol. Credit: NASA/JPL-Caltech/MSSS

Now at the sulfate-bearing unit, the rover team has already used the jackhammering rotary drill at the end of its 2-meter (7-foot) arm to pulverize rock samples for analysis. But they had to choose the rock carefully. Worn brakes on the arm recently led the team to conclude that some harder rocks may require too much hammering to drill safely.

They selected a rock nicknamed "Canaima" for the mission's 36th drill sample.

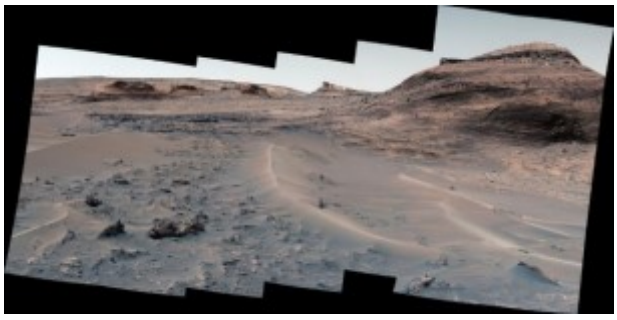
"As we do before every drill, we brushed away the dust and then poked the top surface of Canaima with the drill. The lack of scratch marks or indentations was an indication that it may prove difficult to drill," said Curiosity's new project manager, Kathya Zamora-Garcia from the Jet Propulsion Laboratory, in a press release. "We paused to consider whether that posed any risk to our arm. With the new drilling algorithm, created to minimize the use of percussion, we felt comfortable collecting a sample of Canaima. As it turned out, no percussion was needed."

This rock may be one that could be too hard and dense for the rover to drill. From Sol 3565 and the rover's Mastcam. Credit: NASA/JPL-Caltech/MSSS/Kevin M. Gill

The mission's scientists said they look forward to analyzing portions of the sample with the Chemical and Mineralogy instrument (CheMin) and the Sample Analysis at Mars instrument (SAM).

This region, while providing stunning vistas, also provides challenges for the rover. Sharp rocks can damage Curiosity's wheels (which already filled with holes), and sand can be just as hazardous, potentially causing the rover to get stuck if the wheels lose traction. Rover drivers need to carefully navigate these areas. Additionally, the hills in the area have blocked Curiosity's view of the sky, requiring the rover to be carefully oriented based on where it could point its antennas toward Earth and how long it could communicate with orbiters passing overhead.

The the sulfate minerals were spotted by NASA's Mars Reconnaissance Orbiter years before Curiosity landed in 2012, so scientists have been waiting a long time to see this terrain up close. Soon after arriving, the rover discovered a diverse array of rock types and signs of past water, among them popcorn-textured nodules and salty minerals such as magnesium sulfate (Epsom salt is one kind), calcium sulfate (including gypsum), and sodium chloride (ordinary table salt).



NASA's Curiosity Mars rover used its Mast Camera, or Mastcam, to capture this panorama of a hill nicknamed Bolívar and adjacent sand ridges on Aug. 23, the 3,572nd Martian day, or sol, of the mission.
Credit: NASA/JPL-Caltech/MSSS

Recently, the Curiosity team celebrated 10 years of their rover on Mars. During the past decade, the rover has acquired over 494,550 images, returned more than 3,100 gigabytes of data to Earth, drilled 36 samples, and scooped up 6 samples. The findings from the mission has yielded over 880 science papers.

Uncontrolled Rocket Reentries are a Bigger Problem Than you Think

Over 60% of the launches in 2020 resulted in one or more rocket parts making an uncontrolled reentry into the atmosphere. While thankfully no one was hurt by that debris, with the expected rise in rocket launches over the coming decade the chances of a casualty are increasing. A new study paints the picture of how current methods of assessing risk are inadequate and new steps need to be taken.

Rocketry is a complex business. A typical lunch will usually require multiple stages to get the payload into orbit. Most of the time everything goes well, with the individual stages designed to either burn up in the atmosphere or end up on an escape trajectory away from the Earth. But in 2020 alone, 60% of the launches to low Earth orbit ended up with at least one significantly sized rocket part simply abandoned in an uncontrolled orbit. These pieces of space junk are no longer under any human control, and they will eventually fall back onto the Earth.

When they do, they will first enter through our atmosphere. While the heat of that reentry is good at vaporizing most materials, scientists estimate that for any one piece of rocket about 20 to 40% of its mass will make it to the Earth's surface.

This poses a significant risk to lives and property. While to date there have not been any serious consequences of uncontrolled rocket debris, we cannot assume this to be true going into the future. Many companies are planning on launching fleets of communication satellites and the number of rocket launches is expected to dramatically increase over the coming decade.

Some space agencies, like NASA, require that any launches have no more than a 1 in 10,000 risk of harming people or property from uncontrolled debris re-entering the atmosphere after launch. But in a new study, several astronomers have pointed out that this is inadequate. Many companies are given waivers to avoid having to satisfy this rule if it is too expensive to uphold it. And this ratio may be fine for a limited number of lunches every year, but it ignores the cumulative effect of thousands of launches happening year over year.

The researchers analyzes the current orbits of 600 known pieces of space junk and estimated where they will re-enter the Earth. They found that most pieces of uncontrolled space junk are associated with geostationary orbits, which means that the risk of reentry is concentrated near the equator.

This means that people living near the equator are at a much higher risk than those living at higher latitudes. But the countries that typically make these launches are situated away from the equator, so they are in effect shifting the risk of debris from their own populations onto countries that didn't even participate in the launch process.

Overall the researchers found a roughly 10 to 20% risk of a casualty over the coming decade from uncontrolled debris. That casualty could take the form of a single person getting hit, or it could be something more catastrophic like a large building or an airplane being struck.

The researchers call for more honest and consistent risk assessments and more uniform application of the rules by the community to properly address the next generation of spaceflight.

Astronomers Have Found More Than 30,000 Near-Earth Asteroids… so far

Asteroid hunters have become increasingly good at their job. The discipline, which took a back seat in the early days of astronomy, has really come into its own as of late. Once the general public, probably spurred on by popular 1990s movies like Deep Impact and Armageddon, realized the potentially existential threat they posed, support for finding all asteroids that could be planet killers skyrocketed. At this point, astronomers think that most planet-killing asteroids have been found and have worked their way down to much smaller but still devastating impactors. And now they've reached a new milestone with over 30,000 Near Earth Asteroids (NEAs) officially discovered.

That milestone results from years of steady work identifying and tracking those objects. Better equipment has helped with that task – over 15,000 have been discovered in the last ten years alone. Given that the first NEA was discovered in the 1800s, that is a pretty impressive pickup in pace.

A new crop of improved instruments helps with that. The Catalina Sky Survey (CSS) is the most prolific, having been responsible for approximately 47% of all NEOs discovered. It continues to find a few new asteroids every week, but even so, it has dramatically improved its capabilities in recent years. In 2005, it found 310 new asteroids, whereas, in 2019, it found 1067.

UT video discussing the need to find NEOs

With those sensing capabilities, the CSS has been even more effective at finding smaller asteroids. Scientists are pretty sure they've found all the large space rocks that fit the definition of an NEA – i.e., that its orbit takes it at least within 1.3 AU of the Sun. "Large," in this case, is quantified as a few kilometers in diameter – enough to cause an extinction-level event if it were to hit Earth.

More recently, CSS and its fellow asteroid hunters have been concentrating on smaller rocks on the order of a few hundred meters in diameter. Being much smaller, these are also much harder to detect as they aren't as bright in the night sky as their larger cousins. While these could still cause significant damage if they were to impact Earth, none appear to be on an immediate collision course – at least for the next 100 years.

However, there are over 1,400 that have a "non-zero" chance of hitting Earth in the future. A team of planetary defenders (and asteroid hunters) employed by ESA stress that there isn't any immediate danger, and we will have plenty of time to summon up a mission like the recently successful DART to push any threatening asteroid out of the way well before it causes any issues.

Finding asteroids is a popular theme on UT's YouTube Channel.

But if you're still interested in learning which floating balls of rock and ice are most dangerous, ESA maintains an Asteroid Risk List that keeps track of their orbits and the chances they will impact Earth. Hopefully, that won't be useful for anything other than to keep track of potential sites for asteroid mining.

However, even with all its improving technology and continually growing list of potential targets, there is still a chance that the planetary defenders at ESA and elsewhere missed one. Or there might be a long-period metallic comet with no tail that could literally come out of the black directly on a collision course. The only way we can

eliminate that possibility is by continually monitoring the sky and, when necessary, by taking action. This 30,000 NEA milestone is another successful step on that journey.

Learn More:
ESA – 30 000 near-Earth asteroids discovered and rising
ESA – NEO Risk List
UT – The Most Threatening Asteroid Just got Downgraded to "Harmless". No Impact in 2052
UT – Astronomers Just Practiced What Would Happen if a Potentially Dangerous Asteroid was Detected

SpaceIL's Beresheet 2 Lander Will try Growing Various Plants on the Moon

Where better to grow plants that on the Moon? Well, lots of places, to be honest, including almost everywhere on planet Earth. But that's not going to stop people from trying to do so – especially as plants grown in space are going to be critical to any long-term space exploration program, and the Moon seems as good a place as any to do that. So the idea of a team of scientists from Australia, Israel, South Africa, and the US to grow some plants on the Moon by 2025 might not be as far-fetched as it seems.

The project, known as the Australian Lunar Experiment Promoting Horticulture (ALEPH), is sponsored by Lunaria One, an Australian start-up that plans to grow plants continually on the Moon. As with any significant undertaking, it must begin with a single step, and ALEPH is that first step.

That first step will require a launch to the Moon, though, and Lunaria One plans to hitch a ride aboard the Beresheet 2 lunar lander, a private mission to the Moon run by Israeli company SpaceIL. Planned for a 2024 launch, the landers would most likely use a SpaceX rocket in order to make their way to the lunar surface.

UT Q&A video discussing plants on the moon.

Once there, the plan is to monitor a set of specially designed, hermetically sealed pods that will contain the plants. Most likely, these observations will happen for about three days, and the real crux of the mission is to get people interested in watching its progress. Lunaria One states that engaging interested parties, especially school children, in watching the mission's progress is one of its primary goals.

What they'll be watching is, hopefully, life flourishing in harsh conditions. The plants selected for this mission are known for their hearty reputation. One, known as *Triogon loliiformis*, is famous for its ability to survive with little to no water. It enters a dormant state, which will be useful when being shipped to the Moon, but upon the reintroduction of water, it quickly reverts to its usual self.

That resilience, or "resurrection," in the words of the biologists working on the project, is an excellent trait for plants in space. Whether or not it will be enough for them to thrive there remains to be seen. But we won't have to wait too long – the mission is currently planned to set down on the Moon in 2025.

A new Launch Date for Artemis 1: November 14th … at Night

If the next launch attempt of the Artemis I mission goes as planned, it should be a spectacular sight.

NASA is now targeting Monday, November 14 at just after midnight Eastern Time for the liftoff of the Space Launch System (SLS) rocket carrying the Orion spacecraft. A 69-minute launch window opens at 12:07 a.m. EST.

This will be the fourth attempt to launch the long awaited first mission for the Artemis program. Artemis-1 is an uncrewed flight test, the first full integrated test of the super heavy-lift SLS launch vehicle and the Orion capsule. The mission will fly around the Moon and back to Earth, going further into space than all the Apollo missions, and last several weeks.

NASA first attempted to launch the Moon rocket on August 29, but a bad reading from a faulty temperature sensor scrubbed the launch. A second try came on September 3, but this was scrubbed due to a persistent hydrogen leak. After repairs, a fueling test appeared to confirm the leak was fixed. But then, the next launch attempt scheduled for September 27 had to be waved off when Hurricane Ian's uncertain path forced NASA to roll the giant rocket back to safety inside the Vehicle Assembly Building.

The stack of the Space Launch System rocket in the Vehicle Assembly Building at Kennedy Space Center earlier this year. Credit and copyright: Alan Walters, for Universe Today.

NASA said they took the opportunity while in the VAB to conduct inspections and analyses, and determined minimal work would be required to prepare the rocket and spacecraft to roll out to Launch Pad 39B at Kennedy Space Center. Teams are performing standard maintenance to repair minor damage to the foam and cork on the thermal protection system and recharge or replace batteries on the rocket, several secondary payloads, and the flight termination system. The agency plans to roll the rocket back to the launch pad as early as Friday, Nov. 4.

If the mission launches on November 14, the orbital mechanics of that specific timing would allow for a 25.5-day mission for the Orion spacecraft before it splashes down in the Pacific Ocean on December 9.

NASA said they have also requested back-up night-time launch opportunities for Wednesday, Nov. 16, at 1:04 a.m. and Saturday, Nov. 19, at 1:45 a.m., which are both two-hour launch windows.

The flight will test out not only the rocket and spacecraft but also the supporting ground systems and teams. If all goes well, NASA will announce the crew and schedule for a crewed Artemis 2 flight around the Moon, likely in 2024 and the crewed Artemis 3 Moon landing mission would follow, perhaps in 2025

The Moon Might be One Large Chunk that was Blasted Off the Earth Billions of Years Ago

Where did the Moon come from?

The widely-accepted view is that the Moon is a result of an ancient collision between the young Earth and a Mars-sized planet named Theia about 4.5 billion years ago. The impact melted Earth and Theia and sent molten material into orbit around Earth, where it formed a rotating torus of molten rock. That rock eventually coalesced into the Moon. It's called the Giant Impact Hypothesis, and isotopic evidence from Apollo moon rocks illustrates the link between Earth and its Moon.

Case closed?

Not so fast. There've always been problems with this hypothesis. Can a new study answer them?

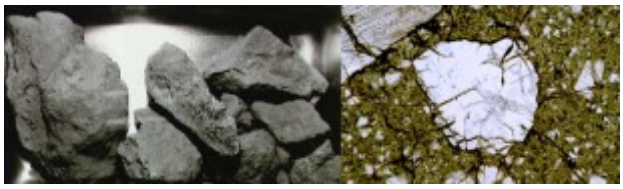
In our quest to understand Nature, the Moon is a primary target for many of us. We look up at it when we're children and wonder what it is. We wonder where it came from and why it's there. A well-meaning relative might tell us that a God put it there. But if that's where your curiosity ends, you're probably not a Universe Today reader.

Throughout history and even prehistory, people in different cultures have wondered about the Moon. Maoris thought it was the husband of all women since it controls their menstrual cycles. Siberians believed that a monster named Alklha explained the Moon. It eats a bit of it each night which makes it disappear. But the Moon disagrees with Alklha, and the monster vomits it up bit by bit, making it reappear. (If there's an eclipse, throw rocks at the Moon to scare Alklha away.) Some indigenous people on the African continent thought the Moon goddess was a companion to the Sun god, and when they met and made love, there was an eclipse. Something to aspire to in our personal lives.

Humans have been trying to understand the Moon for a long time. New high-resolution simulations of the impact

But that was all before science got going. Science improved things a little, like when the British astronomer William Herschel said the Moon was inhabited, and he watched through his telescope as the Martians constructed things. He was wrong, but at least he was using a telescope. And after World War 2, some thought that Nazi astronauts had already landed on the Moon and were living in a top-secret base. Only slightly more plausible.

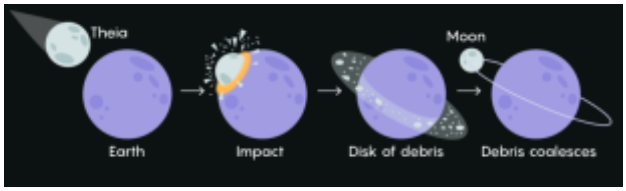
Lunar science took a giant step forward during NASA's Apollo missions. Between 1969 and 1972, six Apollo missions brought back 382 kilograms (842 pounds) of lunar material. Scientists found no evidence of gods or supernatural beings. Nor of lovemaking so passionate that it caused an eclipse.



The image on the left shows some of the rocks returned to Earth by Apollo. On the right is a microscopic image of a zircon crystal used to date events billions of years ago. Image Credit: (L) NASA. (R) Apollo 17 / Nicholas E. Timms.

But they did find solid scientific evidence, and chief among the evidence was isotopes of oxygen. Scientists found that oxygen isotopes contained inside Moon rocks were uncannily similar to oxygen isotopes in Earth rocks. Could it be a coincidence?

Since then, generations of scientists have developed the Giant Impact Hypothesis. But they've also pointed out the holes in that hypothesis. One of the holes is in the initial finding that Earth and the Moon share isotope signatures. That means they had to come from the same source. But for that to happen, the impactor would've had to have the same isotope signature. That's not likely because lighter elements were dispersed by the stellar wind in the early, still-forming Solar System. That's why the inner planets are heavier rocky planets, while the outer planets are gas planets. The stellar wind couldn't move the heavy elements so easily. So if Theia came from a region more distant from the Sun than Earth, it would have a different composition, and that should be reflected in the Moon.



This is a simple illustration of the Giant Impact Hypothesis. Earth was going about its business 4.5 billion years ago when a protoplanet named Theia arrived from elsewhere in the Solar System, perhaps kicked out of its orbit by another calamity or by migrating gas giants. Theia impacts Earth and creates a torus of debris that coalesces into the Moon. Image Credit: By Citronade – Own work, CC BY-SA 4.0, https://commons.wikimedia.org/w/index.php?curid=72720188

There's lots of evidence to support the current Giant Impact Hypothesis (GIH) and many unanswered questions. The Moon, the first target in our quest to understand the celestial, is still a hot topic of study.

That's where this new study comes in. It still posits an impact as the source of Earth's Moon, but thanks to improvements in supercomputer simulations, it arrives at a different type of impact.

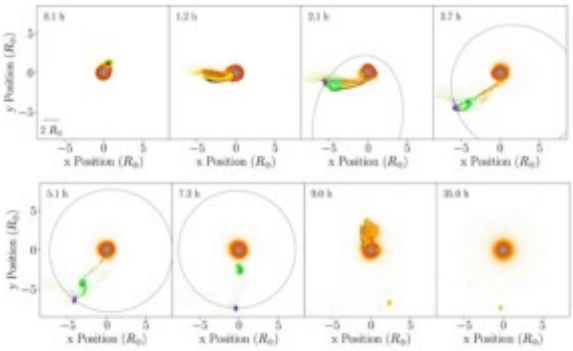
The study is "Immediate Origin of the Moon as a Post-impact Satellite," published in The Astrophysical Journal Letters. The lead author is Jacob Kegerreis from the Institute for Computational Cosmology in the Physics Department at Durham University. Kegerreis is also associated with NASA's Ames Research Facility.

The researchers used advances in computational power to run simulations of impacts with Earth at higher resolutions than ever before. These simulations show that the impact between Earth and Theia was much different than the Giant Impact Hypothesis. Instead of an impact casting a vast amount of molten material into space that condensed into the Moon over a longer timeframe, the simulation shows that the impact created the Moon by sending a single satellite immediately into orbit.

If true, this is a massive shift in understanding, like finding out that Alkiha isn't real.

The researchers ran hundreds of simulations of impacts and varied impact angles, speeds, planet spins, masses and more. They found that previous lower-resolution simulations could miss essential aspects of massive collisions. A press release announcing the work said, "… qualitatively new behaviours emerge in a way that wasn't possible in previous studies."

The simulations showed that the material was sent into space when the impact occurred, just like in the GIH. But the material never formed a torus of rotating molten rock. Instead, the proto-satellite that would become the Moon separated from the remnant of the impactor. The remnant from the impactor also forms two bodies: an inner remnant and an outer remnant. The inner remnant transfers its angular momentum to the outer remnant and the ejected Earth and Theia material forming the proto-Moon. Then the inner remnant falls back to Earth, leaving the Moon.



These figures are screenshots from an impact simulation run at high resolution. It shows the impact at the upper left, then the material launched into space and separated into an outer remnant (green), an inner remnant (yellow), and the proto-Moon (purple.) The inner remnant falls back to Earth after imparting its angular momentum to the outer remnant. Image Credit: J. A. Kegerreis et al 2022 ApJL 937 L40.

The researchers released an animation of their impact simulations that illustrates the impact and the Moon's formation.

A new NASA and Durham University simulation puts forth a different theory of the Moon's origin – the Moon may have formed in a matter of hours when material from the Earth and a Mars sized-body was launched directly into orbit after the impact. Credit: NASA/ Durham University/ Jacob Kegerreis

Kegerreis and his research colleagues found that their immediate satellite scenario can answer some questions that the GIH can't.

The main roadblock to acceptance of the GIH is the isotopic similarity between Earth and the Moon. A cataclysmic impact with another planet from a distant part of the Solar System can't produce the kind of isotopic similarity between the Earth and the Moon.

But the new scenario can explain it. Instead of melting and mixing the material from Theia and Earth, larger amounts of Earth material are contained in the Moon's outer layers. And if the material ejected from Earth wasn't entirely molten, then the early Moon wasn't completely molten either. That could explain the Moon's thin crust, another obstacle the GIH has to clear.

There's also the issue of the Moon's orbit. It's tilted relative to Earth's equator by about 5 degrees, and the instant satellite explanation can account for that. "In contrast," the authors explain, "we find that an impact onto a spinning target with angular momentum misaligned to that of Theia's orbit can readily produce significantly inclined debris, including a satellite, as illustrated in Figure 5."

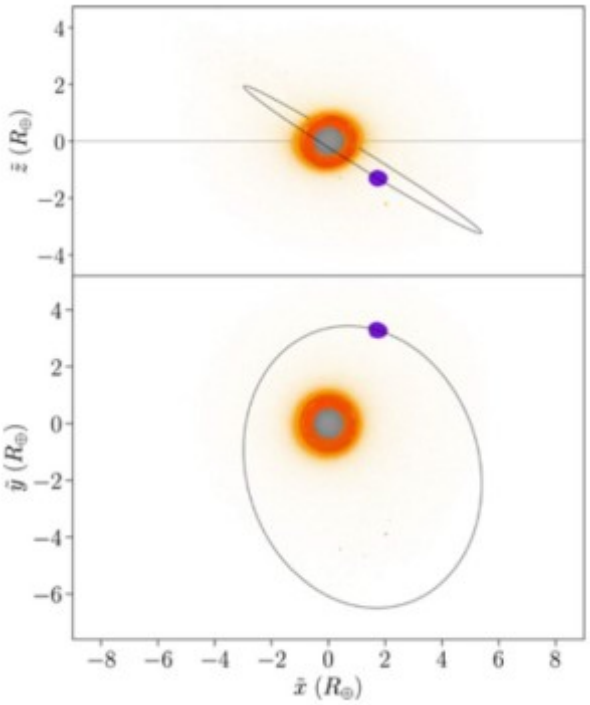


Figure 5 from the study shows how an impact onto a spinning proto-Earth misaligned to Theia's orbital angular momentum can produce a satellite with an inclined or tilted orbit. Image Credit: J. A. Kegerreis et al 2022 ApJL 937 L40.

The team's simulations showed that instant satellite creation depends on several factors like impact angles and speed and spin of Theia and Earth. But interestingly, the temperature and internal structure of both bodies don't change results much.

One of the problems with the GIH is that there's no self-consistent model that starts with a giant impact and creates debris that results in a single Moon. But these higher resolution simulations have produced a single Moon. Will this be the final word?

"In conclusion," the authors write, "high-resolution simulations reveal how giant impacts can immediately place a satellite into a wide orbit with a Moon-like mass and iron content. The resulting outer layers rich in proto-Earth ma-

terial and the new options opened up for the initial lunar orbit, and internal structure could help to explain the isotopic composition of the Moon and other unsolved or debated lunar mysteries."

While compelling in its ability to answer some long-standing questions, the instant satellite scenario doesn't answer all of our questions. But supercomputers will keep getting more powerful, and scientists will keep improving their models.

"The likelihood and potential of this and other Moon-formation scenarios will be constrained by: more reliable models for the long-term evolution of satellite orbits, magma oceans, post-impact planets, and disks," the authors write.

Satellite View of Stromboli's New Eruption in Italy. You Can See a River of Lava Flowing to the Ocean

Mount Stromboli is one of the busiest volcanoes on the planet. It's been erupting off and on for thousands of years, and almost continuously since the early 1930s. So, it's no surprise that ESA's orbiting Copernicus Sentinel-2 mission caught its latest eruption in the act. It used infrared-sensitive instruments to chart the flow and follow its course to the sea.

Stromboli upped its action early Sunday, October 9th, sending huge pyroclastic flows down the mountain. Right after that, a "bench" of hardened lava from earlier flows collapsed. That revealed a fast-moving lava river that the ESA satellite saw from space. The image from Sentinel-2 highlights that superhot lava stream as it plunges down the mountain and into the sea.

The current lava flow is traveling in a feature called the Sciara del Fuoco (the Stream of Fire). It is the site where the ground collapsed about 5,000 years ago. The resulting scar provides a pathway for lava to flow down the mountain. It remains an active and very dangerous region. If it collapsed again, the resulting tsunami could have far-reaching effects on other islands in the region.

A Volcano's Famous History

Stromboli created its own island, which is part of the Aeolian island chain in the Mediterranean. It rises up from a thousand meters below the surface of the Tyrrhenian Sea and towers up about 924 meters above sea level. Stromboli is long-lived. It has been continuously active for at least 2,000 years, and ancient mariners used it as a lighthouse. That's because it erupted often. People could see the glow from those outbursts for miles across the open water. They called it the "Lighthouse of the Mediterranean."

Stromboli is one of several volcanoes located along the Calabrian volcanic arc. Mount Etna on Sicily is part of that chain. These volcanic mountains formed as the African tectonic plate ducks under (subducts) the Eurasian plate. Volcanic arcs are fairly common around the world. There's one in the Pacific Northwest in North America that built up Mount Hood, Mount Rainier, and Mount Saint Helens, for example. It's where the Juan de Fuca, Explorer, and Gorda plates meet. The Pacific Ring of Fire also has these volcanic arcs and active volcanoes thanks to a subduction zone.

The subduction action gives Stromboli fuel for its eruptions. It first began building up about 200,000 years ago, building up an ancient volcano called Strombolicchio. That eventually eroded away, and about 160,000 years ago, the current Stromboli began erupting and forming its island. The mountain today is a "stratovolcano", built up by the nearly constant eruptions.

Stromboli as a Prototype

When Stromboli erupts, it follows a pattern that geologists call "Strombolian". That means an eruption that begins with "slugs" of gas rising up through the magma chamber in the mountain, through conduits to the surface. When the gases get to the surface, they explode and throw fountains of lava into the air. Over time, those bursts build up a lava cone. Sometimes there will be pyroclastic flows, which are fast-moving clouds of gas and lava debris that barrel down the mountain. Other mountains around the world also send similar "Strombolian" flows out, patterned after the famous namesake.

On February 27, 2007, the Stromboli volcano began a strong eruption that lasted for several days. It was imaged here by NASA's infrared-capable ASTER instrument onboard the Terra satellite. Courtesy NASA.

Volcanic activity is one of several processes that change Earth's surface. ESA's satellite is not the only one tracking its activity. NASA's Advanced Spaceborne Thermal Emission and Reflection Radiometer on the TERRA satellite also captured views of it in 2007. Ongoing space-based studies augment ground-based monitoring of this and other volcanoes to track how they change over time.

For Stromboli and the few hundred inhabitants of this island, continuing activity risks life and property. The island is often rocked by earthquakes. These indicate the movement of magma below the surface. The eruptions themselves can destroy homes and villages. For those reasons, most inhabitants left the island, migrating to other islands.

Stromboli in Literature and on Our Plates

Interestingly, Stromboli is a prototype for more than just its type of eruption. It shows up in popular culture as well. The widely read Tolkien trilogy "Lord of the Rings" features "Mount Doom" where the hobbits bring the Ring of Power. Author J.R.R. Tolkien reportedly used Stromboli as an inspiration for that famous fictional volcano. In addition, Jules Verne has his adventurers exit from their trip to the Earth's core via Stromboli in his book "Journey to the Center of the Earth." The 1950 film "Stromboli" features a story about people who live on the island. That inspired a dish called a Stromboli, which is a kind of Italian meat and cheese sandwich. No word on whether it's melty hot, just like its namesake.

Success! DART Impact Shortened Asteroid's Orbit Time by 32 Minutes

NASA says its DART spacecraft caused a larger-than-expected change in the path of its target asteroid when they

collided two weeks ago — marking a significant milestone in the effort to protect our planet from killer space rocks.

Ten months after it was launched, the Double Asteroid Redirection Test's refrigerator-sized robotic probe crashed into a 560-foot-wide asteroid called Dimorphos on Sept. 26, as it circled a bigger asteroid known as Didymos. The paired asteroids were 7 million miles from Earth at the time, and posed no threat to Earth before or after the smashup.

Before the crash, DART's science team said they expected the collision to reduce the time it took for Dimorphos to go around Didymos by about 10 minutes. NASA would have regarded any change in excess of 73 seconds as a success.

After the crash, detailed observations from ground-based observatories showed that the orbit was actually 32 minutes shorter — going from 11 hours and 55 minutes to 11 hours and 23 minutes. That's three times as much of a change as scientists were expecting. Scientists also said Dimorphos appears to be slightly closer to Didymos.

"This is a watershed moment for planetary defense, and a watershed moment for humanity," NASA Administrator Bill Nelson said today. "All of us have a responsibility to protect our home planet. After all, it's the only one we have."

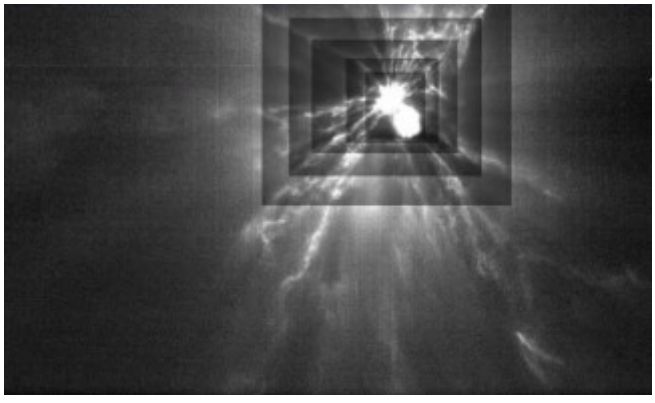
The results suggest that an impactor spacecraft could change the path of a threatening near-Earth object enough to avoid a collision. However, scientists cautioned that further analysis will be needed.

"This result is one important step toward understanding the full effect of DART's impact with its target asteroid," Lori Glaze, director of NASA's Planetary Science Division, said in a news release. "As new data come in each day, astronomers will be able to better assess whether, and how, a mission like DART could be used in the future to help protect Earth from a collision with an asteroid if we ever discover one headed our way."

In the months ahead, astronomers will study imagery from an Italian-built piggyback probe called LICIACube to get a better sense of Dimorphos' size and shape. Additional readings are also coming in from ground-based radio telescopes. And about four years from now, a European Space Agency mission known as Hera will send a follow-up probe to make close-range surveys of Dimorphos and Didymos.

Scientists said the effect of the DART impact might have been greater than expected because Dimorphos is basically a "rubble pile" in outer space, primarily consisting of loosely bound gravel and ice.

"You're getting an enhanced deflection due to the amount of ejecta — that rocky material that's being thrown off when the DART collision happened," said Nancy Chabot, the DART coordination lead from the Johns Hopkins University Applied Physics Laboratory in Maryland.



A mosaic of enhanced imagery shows the material that was ejected from the asteroid Dimorphos as a result of the DART collision. The nested "windows" in the picture reflect how the exposure was adjusted to compensate for the brightness of the material. (NASA via YouTube)

An asteroid made of sterner stuff — for example, the iron-rich space rock that's due to be studied up close by NASA's Psyche mission in 2026 — might not have been deflected as much by an impactor of equivalent mass.

A successful asteroid deflection operation is likely to require more advance planning and coordination than the operations portrayed in movies like "Armageddon."

Chabot noted that DART produced a 4% change in Dimorphos' orbital parameters. "It just gave it a small nudge," she said. "If you wanted to do this in the future … it could potentially work, but you'd want to do it years in advance. Warning time is really key here in order to enable this sort of asteroid deflection to potentially be used in the future, and it is part of a much larger planetary defense strategy."

Dimorphos' size puts it in a class of asteroids that are considered a high priority for detection and study, Chabot said — perhaps not big enough to cause a dinosaur-level mass extinction, but big enough to cause a regional catastrophe in the event of a collision. "It's the first time we've been to an object of that size," she said.

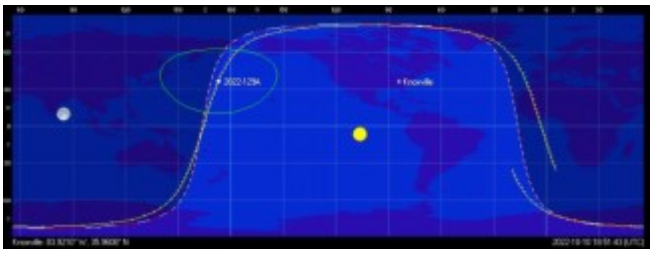
Glaze said that an infrared space telescope called Near-Earth Object Surveyor, due for launch in 2026, should help NASA identify and characterize potentially hazardous objects in Dimorphos' size category — that is, more than 460 feet (140 meters) wide. Researchers supported by the B612 Foundation and the University of Washington are also developing software tools to accelerate the pace of asteroid detection.

China Launches First Solar Observatory ASO-S

China launches ASO-S, its first mission to explore the Sun.

One thing's certain in modern astronomy: you can't have too many missions exploring our host star. This is especially true in 2022, as Solar Cycle #25 gets underway in earnest, and heads towards its peak in 2025. China entered the quest to explore our Sun this past weekend, with the launch of its new Advanced Space-based Solar Observatory (ASO-S).

The launch occurred on Saturday, October 8th (Sunday, October 9th local time) at 7:43 PM EDT/23:43 Universal Time (UT) from Jiuquan Satellite Launch Center in China, aboard a Long March-2C rocket for the China Aerospace and technology Corporation (CASC). Though China has fielded brief solar experiments on crewed Shenzhou missions in the past, ASO-S is the nation's first dedicated solar observing mission.



The orbital trace of ASO-S. Credit: Dave Dickinson/Orbitron

ASO-S is now listed in the satellite catalog as NORAD ID 2022-129A/54029. The mission is now healthy and in a 713 by 732 kilometer sun-synchronous orbit around the Earth. The Advanced Space-based Solar Observatory (ASO-S) is nicknamed Kuafu-1, after a giant in Chinese lore who attempted to chase the Sun (depicted on the mission patch).

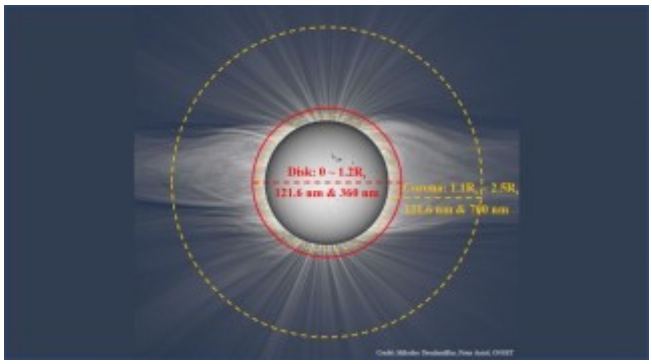
The mission is part of the proposed Kuafu Project, a triad of space weather satellites.

ASO-S patch. (Credit: CAS/CNSA).

The 900 million yuan ($126 million USD) mission was a long time coming, tracing its roots all the way back to the 1976 ASTRON-1 concept. The idea got more traction in 2011, and was formalized in 2017 under the Chinese Academy of Sciences' Strategic Priority Research Program of Space Science, which is analogous to NASA's Decadal Survey.

An artist's conception of ASO-S in orbit. Credit: CAS/CNSA.

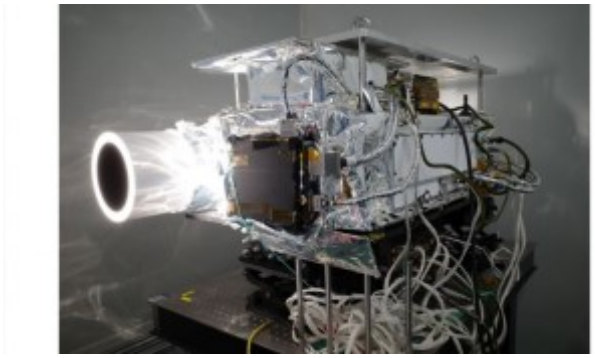
A key goal for ASO-S will be to chronicle and understand the relationship between the Sun's magnetic field, and the often energetic emissions it produces. On a four year nominal mission, scientists hope that spanning the peak of Solar Cycle #25 should provide lots of opportunities to see an abundance of solar flares. ASO-S is also unique in that it will see the poorly understood 'middle corona' region along the entirety of the UV ultraviolet spectrum.



The coronagraph foot-print versus the 'middle corona' region. CASA/ASO-S/ONSET

Observations provided by ASO-S will also complement ESA's Solar Orbiter and NASA's Parker Solar Orbiter. These contrasting perspectives could provide stereoscopic views of flares from heliocentric versus geocentric perspectives. This, in turn, could help to solve the puzzle of 'directivity' or how intense solar flares tend to flow in a particular path.

To accomplish this, ASO-S carries a trio of instruments: a Sun-blocking coronagraph which will study the corona in the ultraviolet to visible range, a magnetograph to cover the Sun's magnetic field, and an X-ray imager for studying high energy bursts in powerful solar flares. These instruments will combine to provide simultaneous observations during solar events.



ASO-S in the clean room on Earth. (CAS/CNSA).

A Unique Solar Mission

To this end, ASO-S observe the "two most violet phenomena on the Sun—solar flares and CMEs—to observe their formation, evolution, interaction and relationships," chief mission scientist Dr. Weigun Gan of Purple Mountain Observatory in Nanjing, China told *Universe Today*. "With such characteristics, ASO-S is specially good for studying the relationships between the solar magnetic field, solar flares and Coronal Mass Ejections (CMEs)."

Next up, ASO-S will undergo a 3-6 months of commissioning phase on-orbit. Watch for the mission to begin providing images of the Sun daily to the public once commissioning and checkout is complete.

"After the commission phase is finished, all the data and software will be opened to the community," says Gan.

The ASO-S team with the spacecraft, shortly after encapsulation. CAS/CNSA/ASO-S.

Solar Cycle 25 is shaping up to become the most studied solar cycle in history: in addition to ground-based observatories, missions in space looking sunward include: NASA's Solar Dynamics Observatory, Japan's Hinode, ESA's Proba-2, the joint ESA/NASA SOHO mission, the Parker Solar Probe, STEREO-A and ESA's Solar Orbiter.

ASO-S/Kuafu-1 will be one to watch, as we unlock the secrets of our host star.

India's Mars Orbiter Mission is Finally out of Fuel After 8 Years of Science Operations

Scientists and engineers seem to have difficulty coming up with estimated mission timelines for their space exploration projects. Most don't even reach the first day after succumbing to one form or another of technical failure, sometimes resulting in a dramatic fireball. Others have missions that extend orders of magnitude longer than they were originally designed for. Such is the case for India's first mission to the Red Planet, which finally seems to have run out of fuel eight years into its original six-month mission.

The mission, known colloquially as the Mars Orbiter Mission, or MOM, was initially launched in 2013 and entered an orbit around Mars in 2014. While in orbit, it spent the better part of eight years collecting data to send back to its operating scientists at the Indian Space Research Organization (ISRO).

Though technically planned as a technology demonstrator, MOM, also known as Mangalyaan (or "Mars craft" in Sanskrit), carried five scientific instruments, which, while they were relatively small and inexpensive, weighing in at just over 15 kg for the whole payload, they also provided critical insight into areas that scientists didn't understand about Mars at the time.

UT video discussing why its so hard to send a spacecraft to Mars.

One of those critical areas was methane – there was a long-standing debate about the sources of methane in Mars' atmosphere, and MOM helped to provide some insight into that. It acted as an excellent complement to other, more advanced, and therefore more expensive, western orbiter efforts such as Maven, which was launched around the same time.

But all good things must come to an end, and that was no exception for MOM. The spacecraft was designed to withstand many of the challenges associated with orbiting around the Red Planet, including using a limited supply of fuel to dodge out of the way of eclipses so that its batteries wouldn't be too diminished before being recharged by its on-board solar panels.

However, the fuel it used for maneuvering eventually ran out, and it was unable to dodge out of the way of an eclipse that lasted more than seven hours. Its batteries were designed to withstand an eclipse that lasted less than two hours. So when the craft finally emerged from the eclipse, its batteries were below the critical threshold that would allow it to restart. ISRO eventually declared the craft as officially decommissioned on October 3rd.

Brief description of the MOM mission.
Credit – thecuriousengineer YouTube channel

It leaves a generally positive legacy, though. India was one of the first countries to successfully introduce a craft to the Mars system on its first try. America and the Soviet Union suffered plenty of setbacks before the current round of successful rovers (and helicopters) traversing the planet.

That being said, the next step for ISRO in its Mars exploration program remains unclear. While the organization solicited ideas for a follow-up mission to Mars in 2016, no discernible progress has come through on that front in the last six years.

Despite that stagnation, ISRO should be proud of the work they already put in on MOM and of the scientific data that it collected. The more countries that can interact with Mars in one way or another, the better.

E Mails Viewings Logs and Images from Members.

Hello Andy/Sam,

I have arranged with Mr Putin to take out Lloyds Bank as soon as possible. I have discovered today that despite their online banking providing details of how to order a cheque book it is not possible to do it online, being a naive gullible idiot I did ask why is it on the Website then unfortunately she had no idea. She has sent me a link to a form to try and accomplish the change of Treasurer. I will try it later after my blood pressure returns to an acceptable level after another wasted half an hour on the phone. The bad news is that I have tried to fill in this form three times before and it has bounced me every time. The even worse news is that if I am able to successfully fill it in I have to send it off in the post. What is online banking all about?????????
Currently on an intensive care life support machine
Bob

Viewing Log for 5th of October

Had a free evening and decided to go out and try some viewing. I arrived at my usual viewing spot near Uffcott and had my Meade LX90 set up and ready by 20:09, I would be using a Pentax 14 mm eye piece. With a temperature of 9 °C and some wind, the conditions were not bad BUT I had some slight rain to deal with! I could make out Jupiter very clearly in the south but there was cloud coming in from the north which had some rain with it. I decided to wait a while and see what happened, after I while the rain stopped and I could carry on with my viewing session. I had a waxing gibbous Moon for company, so some deep sky objects might be washed out?

I had brought along the September edition of Astronomy Now, inside was a section about viewing some planetary nebula. First object was NGC 7009, the Saturn nebula AKA Caldwell (C) 55, this was a bright blob to look at, could not make out any extensions that would give it a ring system like Saturn has. On to NGC 40, the Bow Tie nebula or C 2, this was hard to see a real faint fuzzy blob, a dim satellite went thru the field of view while I was looking at this object. Next on the list was NGC 7662, the Blue Snowball nebula or C 22, just looked like a grey blob but this time a bright satellite went thru while I was viewing this object! Messier (M) 76, the Little Dumbbell nebula was the next object to view, this was very hard to see and easy to miss if I was not using GO-TO equipment? Final object in this list was NGC 246, the Skull nebula or C 56, no luck with this object was it was hiding behind a hedge! At this time I had a power failure, what! Turns out the power lead connector to the mount became loose, had to use a tie and secure the connector to the hand controller plug so it would not move, think the connector is getting a bit worn and might need replacing in the future? While I was doing my set ups again a car went past me, so no harm was done to my night vision. On to October's magazine and this time the object was the constellation of Cassiopeia. First object was M 52, a nice open cluster (OC) which was small and dense to look at. Next was NGC 147 or C 17 a dwarf spheroidal galaxy but I could not see it, coming in a mag 10.5 is about the limit for this telescope and me, Moon light would not help either. NGC 7789, Caroline's Rose is a fine OC to look at, large dense but dim. I do not often look at stars as they are a point of light and not much more but I would try Eta Cass, a nice red and yellow double star system. Another car went pass me while I was looking at NGC 457, the Owl cluster or C 13, a large spread out cluster with two bright stars which makes out the eyes of the Owl? That was it for the magazine. Had a look at the star Almaak, a nice tight double star in Andromeda. Time to go back to the planets and first was Saturn, could make out Titan and no other moons of this mini system, looked quite bright to view, the earlier rain probably cleared the sky of any dust? On to Jupiter, could see all of the moons in the finder scope as small points of light. Looking with the 14 mm, Jupiter was bright! Calisto and Io were to the east of the planet with Ganymede and Europa to the west, the Red Spot was on view but I do not see it while viewing unfortunately. Found Uranus in the finder scope, so had to do some adjustments before I could view the seventh planet from the Sun, some hint of blue/green? Mars had been up for 22 minutes but was hiding in the hedge. Another car had just gone past me, while looking away from the lights I thought I saw M 45 in the eastern sky? Sending the telescope to M 45 confirmed what I had saw, yes winter is well on its way! As usual this OC I must view with the finder scope as it is too big for the eye piece and another car goes past me! Think I will look at the Moon before calling it time, it was 9.06 days old or 66.28 % lit, as usual the terminator was a good place to look at seeing all the shadows from the craters coming in to day light.

It was now 22:11, while packing up I noticed no dew on any of the equipment which is rare. I would still dry everything used this evening at home overnight before putting them away for storage. After I had packed up I noticed Mars had now cleared the hedge, maybe next time it will get my attention?

Clear skies.

Peter Chappell

PS while slewing to M 45, I thought the motors in the telescope while having some trouble, did not sound correct? After I had finished I noticed the battery level was on red and would need a recharge, yet I had only recharged the battery a few days before after the WAS viewing session at Lacock? This would affect the next viewing session which would need a new plan of action, more to come in next viewing log!

Viewing Log for 15th of October

Having another free evening, I asked if anyone from the Swindon Stargazers What Apps group would be interested in joining me for a viewing session at Uffcott, a couple of people said they could not make it but Damian OHara said he would be available and would meet me later on.

After the problems I had with the power pack when it went flat, I thought I would check its charge before going out and this was after a recharge, turns out it was flat! I would need an alternate power supply, as it was I had a cigar plug extension which I could put into the back of my car and then plug in the normal power cable I use to the mount. This would meant I could not go completely around the telescope in case I knocked the power cable and might have pulled it out of the mount, so I decided to put my table between the car and the mount that way I could not touch the cable. Of course viewing anything out to the west might be a bit difficult with a table in the way? I have my Meade LX90 set up and ready by 19:46, as usual I would be using my Pentax WX 14 mm eye piece, we had some wind to deal with and a temperature of 12 °C. Damian arrived while I was doing my set ups, he is a very good astro photographer but rarely has looked in an eye piece. So I asked him what he would like to look at, not sure what to see I gave him a few suggestions and we went from there. We started with Messier (M) 29 in Cygnus, a nice open cluster (OC) to look at, the main stars look like a rectangle with the two central stars pushed in a bit? Off to Saturn which was a bit hazy, could make out Titan as usual but no other moons, the first of three cars went past us while we were viewing this planet. I suggested to Damian the best way to keep ones night vision when cars went past you, turn away from the direction the cars is coming from and keep eyes close, as the car is parallel with you turn your body the other way, that way the light beams are always behind your head. Managed to find Neptune this time but apart being round nothing else showed up. Next was Jupiter shining brightly in the southern sky, we had

Calisto, Io and Ganymede out to the west and lonely Europa out to the east of the planet, again the Great Red Spot was on view but we could not see it? Final planet was Uranus, no detail could be made out. With the planets finished we went on to galaxies and started with M 81, a spiral galaxy which was hazy to look at or a fuzzy blob (FB)! Nearby is M 82, known as the Cigar galaxy as it is long and thin, this is an irregular galaxy, also a FB. On to a planetary nebula (PN) and M 57, the Ring Nebula, this was poor to look at, I think the conditions in the sky were not the best, maybe high thin cloud which we could not make out, the Moon was out of the way. Back to another OC and M 52 in Cass, this was tight and dense to look at. In to Hercules and globular cluster (GC) viewing, starting with the best in M 13, this was brilliant to look at, managed to see a couple of stars on the edge of this GC. Told Damian about an often over looked GC also in Hercules namely M 92, this was good to look at, not as big as M 13 but still good. NGC 6229 another GC also in Hercules is a small FB to look at but had a bright core. Second car now went past us as we turned to M 31, this galaxy is large and has a bright centre. On to another PN and Caldwell 15, the blinking planetary, to me it was a FB and nothing else? Back to Cass and M 103, a small OC with some bright stars that made up a triangle within this cluster. Back to Lyra and M 56, a GC which was faint to look at. M 45, the Pleiades is best looked at with the finder scope and not the eyepiece, this is probably the best OC in the sky. Damian showed me a great picture he took of this cluster a while ago. As we had not looked at any double stars this evening I thought we would finish off with Albireo, probably best colourful double in the sky?

By now it was 21:36 and we still had wind for company as I packed up the telescope for the evening, lucky for us, the hedge acted like a wind break, the temperature had only dropped to 11 °C and there was some dew on the kit used.

Clear skies.

Peter Chappell

Viewing Log for 20th of October

After finishing golf in the afternoon and having a free evening and the skies were clear, I just had to go out and do a viewing session. I gave members of the Swindon Stargazers Adhoc group a late warning that I would be going out and Hilary Wilkey said she would join me soon after I had planned to arrive?

I had my Meade LX90 set up and ready by 19:44, this time I would be using my Pentax 20 mm eye piece instead of the 14 mm one which I normally use. Still having no battery for power I had to use the back of my car with an extension but this time instead of using a table I took along a small seat to cover the cable, that way I would be able to see objects out to the west much better than having to deal with a table. With a temperature of 14 °C and no wind, it should be a pleasant evening for viewing? While I was doing the set ups Hilary joined me and set up her own telescope (this being a Skywatcher 102 mm refractor telescope on a Skywatcher AZ5 mount which I thought was a very solid piece of kit which I might get sometime in the future as I find my Porta Mount I tripod a bit bouncy at times!) First object for the evening was Saturn, this time very clear to look at, I could make out Titan to the west of Saturn and thought I could see another moon (looking at Stellarium later on it might have been Rhea?), as usual I could not make out Neptune at all, right pain in the neck! I might have to come out with one of my other mounts and see if I can locate it that way? On to Jupiter and this was bright! Calisto was by itself out to the east while Io, Europa and Ganymede were to the west with no Red Spot on view? First of only two cars went past us while viewing Jupiter, Uranus could be made out by no details to look at? Would be a while before Mars comes up, so it was time to look at some deep sky objects starting with Messier (M) 15 which is in the head of Pegasus, this globular cluster had a bright core and I could make out some stars around the edge of this object. On to M 33, the Pinwheel galaxy in Triangulum, this spiral galaxy (SG) was a large fuzzy blob (FB) and could be easy to miss. It has a mag of 5.7 but covers a large area so is quite dim. Could not miss M 31, the Andromeda galaxy, this SG has a large bright core? A first for me, I think seeing M 32 in the same field of view as M 31? Normally I see them one at a time but using a lower mag eye piece they came together, M 32 has a bright core but is much smaller than its neighbour. Meanwhile M 110 is a faint fuzzy blob (FFB) which I could easy miss if not using GOTO equipment? In to Cass and M 103, this open cluster (OC) is small but some brighter stars of the cluster make up a triangle within it. Next stop was M 52 also in Cass but I could not see it, strange? Turns out the eye piece had dewed up and needed to be dried with a tissue, this OC is small, dense and dim to look at. With the time of 21:20 Hilary decided it was time to pack up and go home, about the same time another car went past us. I got a feeling it would not be long before I called it a day as the sky was starting to fill up with cloud, would be a case of where clear I could view? On to M 45, the Pleiades cluster as usual this OC is best viewed with a finder scope and not the eye piece. I could make out Capella in Auriga just clearing the hedge, I tried for M 36, this had just cleared the hedge but was very dim to look at. Time to go higher and in to Ursa Major and M 81, this FB had a bright core for a while before fading out? The dew had come back again, time for another wipe down. On to M 82, a real FFB this time, quite hard to see yet normally this is one of the better SG's for me to see? Final object for the evening was NGC 457 or Caldwell 13, the Owl cluster, the two eye stars could be seen easily yet the rest of the OC I could just make out.

I had to finally give up at 21:39 as the dew was a real problem but the sky was now totally clouded out! Temperature had dropped to 11 °C by now.

Clear skies.

Peter Chappell

Viewing Log for 28th of October (WAS viewing evening)

With cloud cover during the day, it was not sure whether Chris Brookes would do the viewing session at Lacock, late afternoon he said it was on J. Packing up my car around 19:00, the skies were clear in Swindon, so it should be okay, well maybe?

I arrived at the car park behind the Red Lion and met some large containers (which turned out to be temporary lavatories')! Wondered if anyone had turned up or not, so I went for a walk around some buildings and managed to get into the playing fields, I saw a group of people where we normally set up and a telescope could be seen, so I knew the session was on. Chris said there is a small gap between the two containers which you might be able to get a telescope thru? The gap was not big but decided to give it a go, first with the telescope, if that could get thru it would be a case of doing several trips to get the rest of the equipment in to the playing field. I had my Meade LX90 set up and ready by 19:57 with the usual 14 mm Pentax eye piece for company. I have now managed to sort out my power problem by using one of my golf trolley batteries with the required connectors at the end of the power lead. I did this job during the day and gave it a quick test to make sure everything would be okay if I went out that night. I had brought a battery from Amazon but it came holed and damaged, so I returned the battery to them, with a full refund. One of the group came over for a chat and I asked them if they would like to have a look at some objects in the sky? First stop was Saturn, could see Titan quite clear to the east and probably Rhea to the west of the planet? As usual Neptune was a no go, so on to Jupiter which was bright! The moons were spilt two either side with Io and Europa to the east and Ganymede and Calisto to the west. No detail with Uranus but I could find it within the finder scope and had to manually move the scope to centre this planet. Messier (M) 27, the Dumbbell

nebula was large and grey, shaped like an apple core. M 56 was right on the edge of a thin cloud bank, this globular cluster (GC) was a fuzzy blob to look at. Nearby is M 57, the Ring nebula, this was good to look at. By now I was having real trouble with the clouds, finding clear skies was hard work! On to Hercules and M 13, the best GC in the northern hemisphere, this was good to start with but faded soon afterwards, the cloud bank was moving, fast! Nearby was M 92, another GC which has a bright core but much smaller than M 13. While I was viewing, Andy turned up with a pair of binoculars, it seems to be just the three of us from the club which do these sessions and no one else recently?

Had a chat with Chris about what to do with no stars to be seen to the south (the way the close was coming from) we decided to call it a night at 21:03 and went to white light to pack up. Now I had to battle with the containers again to get all of my equipment back to the car. Thanks to Andy for bringing some of my equipment back to the car for me.

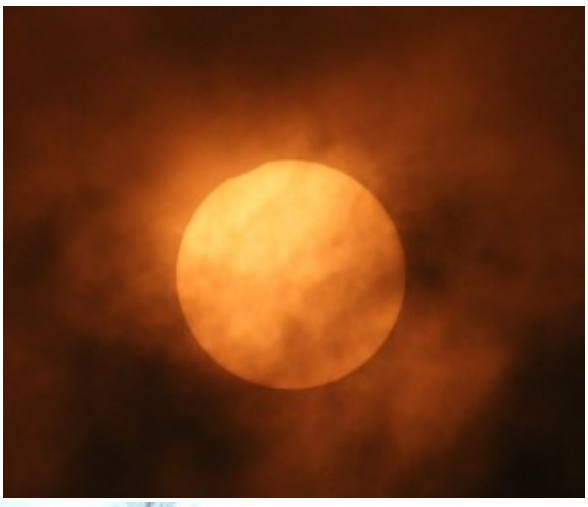
One thing I found quite strange is no other person apart from the person at the beginning wanted to have a look thru my scope during the evening apart from Chris, they just seems to stand around and have a chat?

If the containers are still up at next WAS session, I might just bring grab and go kit, a lot easier to move around.

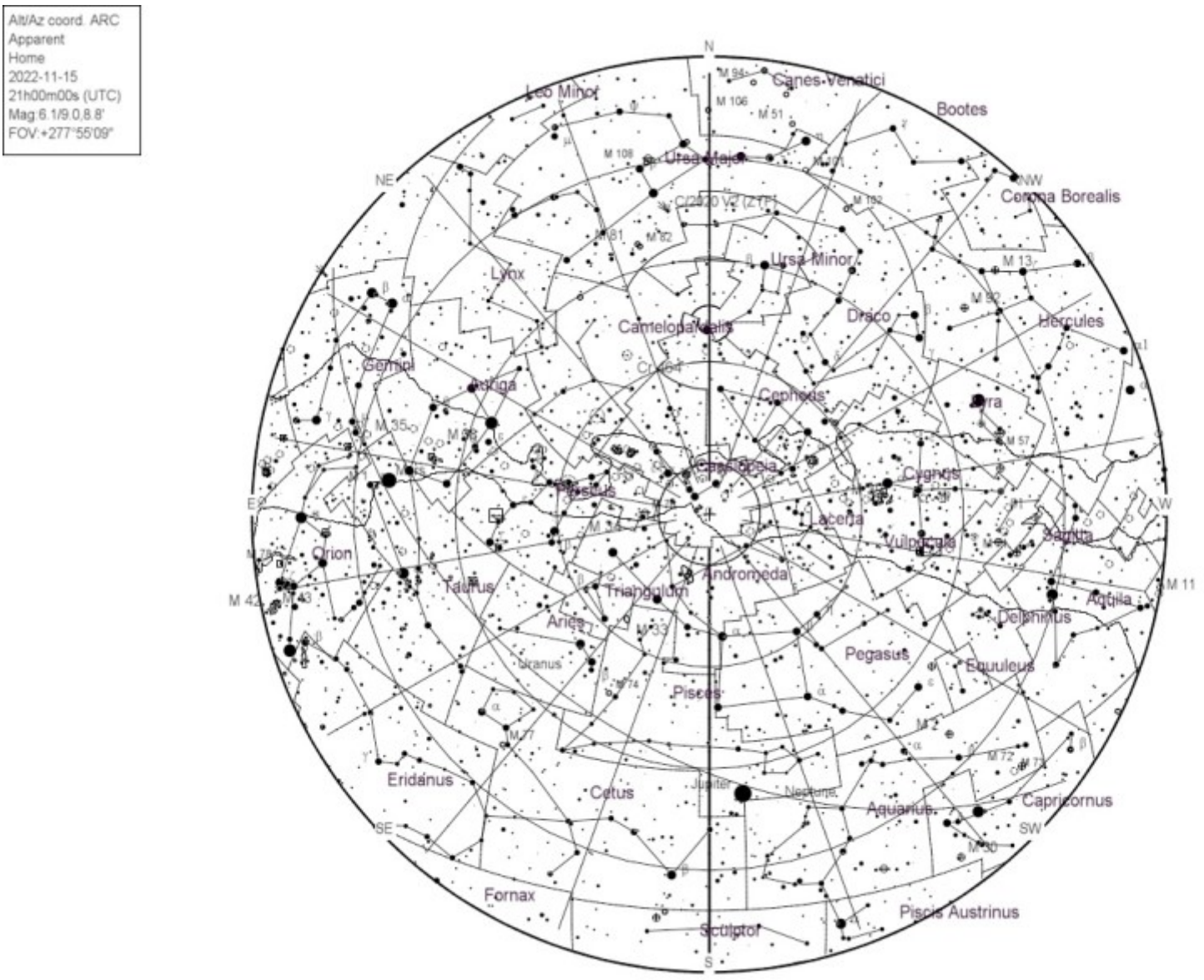
Clear skies.

Peter Chappell

Peter was busy at Avebury barn museum during the partial eclipse on the 25th while I was at Silbury. Here are his images…



WHATS UP, NOVEMBER 2022



November 4, 5 - **Taurids Meteor Shower.** The Taurids is a long-running minor meteor shower producing only about 5-10 meteors per hour. It is unusual in that it consists of two separate streams. The first is produced by dust grains left behind by Asteroid 2004 TG10. The second stream is produced by debris left behind by Comet 2P Encke. The shower runs annually from September 7 to December 10. It peaks this year on the the night of November 4. This year the nearly full moon will block out all but the brightest meteors. But if you are patient, you may still be able to catch a few good ones. Best viewing will be just after midnight from a dark location far away from city lights. Meteors will radiate from the constellation Taurus, but can appear anywhere in the sky.

November 8 - **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 11:03 UTC. This full moon was known by early Native American tribes as the Beaver Moon because this was the time of year to set the beaver traps before the swamps and rivers froze. It has also been known as the Frosty Moon and the Dark Moon.

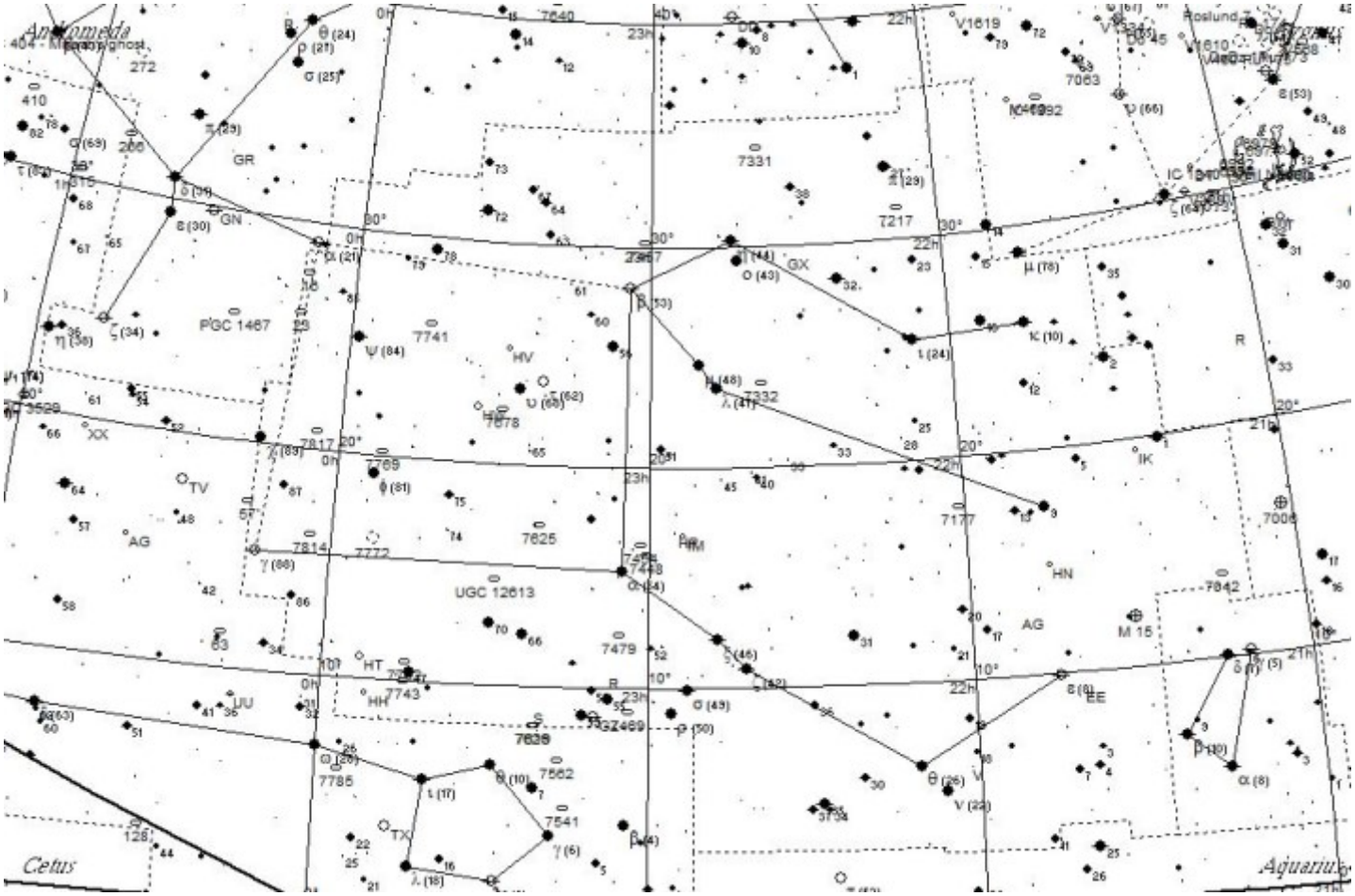
November 8 - **Total Lunar Eclipse.** A total lunar eclipse occurs when the Moon passes completely through the Earth's dark shadow, or umbra. During this type of eclipse, the Moon will gradually get darker and then take on a rusty or blood red color. The eclipse will be visible throughout eastern Russia, Japan, Australia, the Pacific Ocean, and parts of western and central North America. (**NASA Map and Eclipse Information**)

November 9 - **Uranus at Opposition.** The blue-green planet will be at its closest approach to Earth and its face will be fully illuminated by the Sun. It will be brighter than any other time of the year and will be visible all night long. This is the best time to view Uranus. Due to its distance, it will only appear as a tiny blue-green dot in all but the most powerful telescopes.

November 17, 18 - **Leonids Meteor Shower.** The Leonids is an average shower, producing an average of up to 15 meteors per hour at its peak. This shower is unique in that it has a cyclonic peak about every 33 years where hundreds of meteors per hour can be seen. That last of these occurred in 2001. The Leonids is produced by dust grains left behind by comet Tempel-Tuttle, which was discovered in 1865. The shower runs annually from November 6-30. It peaks this year on the night of the 17th and morning of the 18th. The second quarter moon will block many of the fainter meteors this year. But the Leonids can be unpredictable so there is still potential for a good show. Best viewing will be from a dark location after midnight. Meteors will radiate from the constellation Leo, but can appear anywhere in the sky.

November 23 - **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 22:58 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.

CONSTELLATIONS OF THE MONTH: PEGASUS



.Pegasus

Positioned north of the ecliptic plane, the constellation of Pegasus was one of the original 48 constellations listed by Ptolemy, and endures as one of the 88 modern constellations.adopted by the IAU. It covers 1121 square degrees of sky and ranks 11th in size. Pegasus contains between 9 and 17 main stars in its asterism (depending on how you depict it) and has 88 Bayer Flamsteed designated stars within its confines. Pegasus is bordered by the constellations of Andromeda, Lacerta, Cygnus, Vulpecula, Delphinus, Equuleus, Aquarius and Pisces. It is visible to observers located at latitudes between +90° and ?60° and is best seen at culmination during the month of October.

There is one annual meteor shower associated with the constellation of Pegasus which peaks on or about November 12 of each year – the Pegasids. The radiant – or point of origin – for the meteor shower is near the asterism of the "Great Square". Activity begins around October 10 and lasts to late November. The average fall rate at maximum during the peak is 10 per hour. This particular meteor used to be spectacular, but Jupiter has perturbed the meteor stream over the years and lessened the activity.

In mythology, Pegasus represents the Winged Horse, and child of Medusa who was slain by the hero Perseus. According to Greek mythology, Pegasus was delivered to Mount Helicon by Bellerophon, where the magnificent horse kicked the source of poetic inspiration – the Spring of Hippocrene – into flowing. When Bellerophon defeated Chimaera, he became so proud he ordered Pegasus to fly him to Mount Olympus. This action angered Zeus, who ordered an insect to sting Pegasus, resulting in Bellerophon's fatal fall to Earth. Zeus then went on to recognize Pegasus in the stars as the "Thundering Horse of Jove" – carrier of his lightning bolts.

Let's begin our binocular tour of Pegasus with its brightest star – Alpha – the "a" symbol on our map. Alpha Pegasi's proper name is Markab and it marks the southwestern corner of the asterism of the Great Square. Located 140 light years from Earth, Markab is a hot class B (B9) dwarf star which shines about 205 times brighter than our own Sun and is about three times larger. This fast rotator completes a full turn on its axis in just about 36 hours! Right now, Markab sits on the edge of the main sequence, about to die and become a much cooler orange giant star. It's about as "normal" as a star can be!

Now, turn your binoculars towards Beta – the "B" symbol. Named Scheat, you'll find this particular star located in the northwestern corner of the Great Square and about 200 light years from our solar system. Scheat is unusual among bright stars in having a relatively cool surface temperature of 3700 degrees Kelvin, compared to stars such as our Sun. Scheat is a red giant star some 95 times larger than Sol and has a total stellar luminosity of 1500 times solar. It is also an irregular variable star, its brightness changing from magnitude 2.31 to 2.74.

You'll need a telescope to reveal the mysteries surrounding Eta Pegasi – the "n" symbol on our map. Named Matar and located about 215 light years away, this spectral class G2II-III star has a close binary star companion of class F0V. There are also 2 class G stars further away that may or may not be physically related to the main pair. According to Jim Kaler, "Matar is double star and may well be quadruple, consisting of a very unequal pair of pairs, an unbalanced double-double. The brighter of the bright pair is on its way to becoming a much larger giant, and will eventually expand to a radius of a quarter the distance that now separates the two stars, streams of matter running

from the brighter to the dimmer creating quite a sight from the smaller pair. Eventually the bright star of the brighter pair will fade to become a white dwarf, this double perhaps looking something like Sirius does today."

Next up? Epsilon Pegasi – the backwards "3" symbol on our map. Located 670 light years away, Enif is a cool star for more than one reason! To begin with, Enif is orange class K (K2) supergiant star whose stellar temperature only averages about 4460 degrees Kelvin. Even in binoculars you'll notice the reddish hue. It's big, too… About 150 times the size of our Sun and if located in our solar system would fill out the space about halfway to the orbit of Venus. This supergiant star's fate awaits it as a supernova, but there is always a possibility it could become a heavy, rare neon-oxygen white dwarf whose size would be no larger than the Earth. What makes Enif so cool is that it is very unpredictable. According to records, in 1972 Enif had a flare event which caused it to brighten 5 times more than its normal stellar magnitude!

Keep your binoculars handy, because following the trajectory from Theta to Epsilon just another third of the way will bring you to awesome globular cluster – Messier 15 (RA 21:29:58.3 Dec +12:10:01). Located almost equidistantly from both the galactic center and from us, this superior globular cluster was first discovered by Jean-Dominique Maraldi on September 7, 1746 and later listed by Charles Messier on his famous Messier Catalog list of "objects which are not comets". It ranks third in variable star population and M15 is perhaps the oldest and most dense of all globulars located in the Milky Way Galaxy. Its compact central core may be the result of mutual gravitational interaction, or it could contain a dense, supermassive object – a black hole. One thing we do know that M15 contains is a planetary nebula known as Pease 1 – only four known planetary nebulae in Milky Way globular clusters! Another curiosity is M15 also contains 9 pulsars, the remnants of ancient supernova explosions leftover from its youthful beginnings. While you can easily see M15 with binoculars, even a small telescope can begin resolution on this great deep sky object!

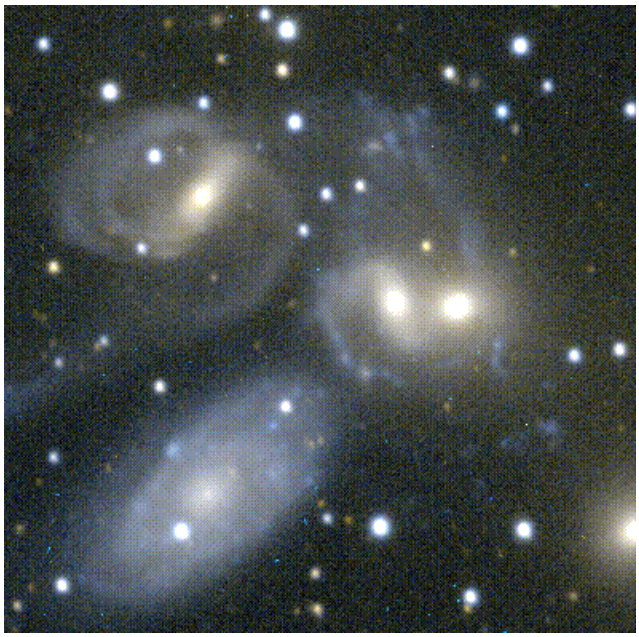
For telescopes, have a look at spiral galaxy NGC 7217 (RA 22:07.9 Dec +31:22). This magnitude 10 jewel displays a bright nucleus and hazy frontier over its generous 3.7 arc minute size. Taken photographically this particular galaxy exhibits very tight spiral galaxy structure and is sometimes considered an "unbarred" spiral galaxy with a dark ring of obscuring material around the nucleus.

Try your hand at spiral galaxy NGC 7814 (RA 0:03.3 Dec +16:09), too. At magnitude 10 and a huge 6.3 arc minutes in diameter, this particular galaxy is easily seen in small telescopes and larger binoculars. Often referred to as Caldwell 43, it's located about 40 million light years from Earth and gives a great edge-on presentation! It is sometimes referred to as the a miniature version of Messier 104, or "the Little Sombrero".

Now, it's time for NGC 7331 (RA 22:37.1 Dec +34:25). Easily spotted in big binoculars and small telescopes under dark skies, it was first discovered by Sir William Herschel. This beautiful, 10th magnitude, tilted spiral galaxy is very much how our own Milky Way would appear if we could travel 50 million light-years away and look back. Very similar in structure to both our own Milky Way and the Great Andromeda Galaxy, this particular galaxy gains more and more interest as scope size increases – yet it can be spotted with larger binoculars. At around 8″ in aperture, a bright core appears and the beginnings of wispy arms. In the 10″ to 12″ range, spiral patterns begin to emerge and with good seeing conditions, you can see "patchiness" in structure as nebulous areas are revealed, and the western half is deeply outlined with a dark dustlane. But hang on… Because the best is yet to come!

Return to NGC 7331 with a big telescope. What we are about to look at is truly a challenge and requires dark skies, optimal position and excellent conditions. Now breathe the scope about one half a degree south-southwest and behold one of the most famous galaxy clusters in the night. In 1877, French astronomer Edouard Stephan was using the first telescope designed with a coated mirror when he discovered something a bit more with NGC 7331. He found a group of nearby galaxies! This faint gathering of five is now known as "Stephan's Quintet" and its members are no further apart than the diameter of our own Milky Way galaxy.

Visually in a large scope, these members are all rather faint, but their proximity is what makes them such a curiosity. The Quintet is made up of five galaxies numbered NGC 7317, 7318, 7318A, 7318B, 7319 and the largest is 7320. Even with a 12.5″ telescope, this author has never seen them as much more than tiny, barely-there objects that look like ghosts of rice grains on a dinner plate. So why bother? Because I've seen them with large aperture… What our backyard equipment can never reveal is what else exists within this area – more than 100 star clusters and several dwarf galaxies. Some 100 million years ago, the galaxies collided and left long streamers of their materials which created star forming regions of their own, and this tidal pull keeps them



connected. The stars within the galaxies themselves are nearly a billion years old, but between them lie much younger ones. Although we cannot see them, you can make out the soft sheen of the galactic nuclei of our interacting group. Enjoy their faint mystery!

There are many more faint galaxies and deep sky objects in Pegasus to be enjoyed, so grab a good star map and fly with the “Winged Horse”!

Sources:
Chandra Observatory
SEDS
Wikipedia

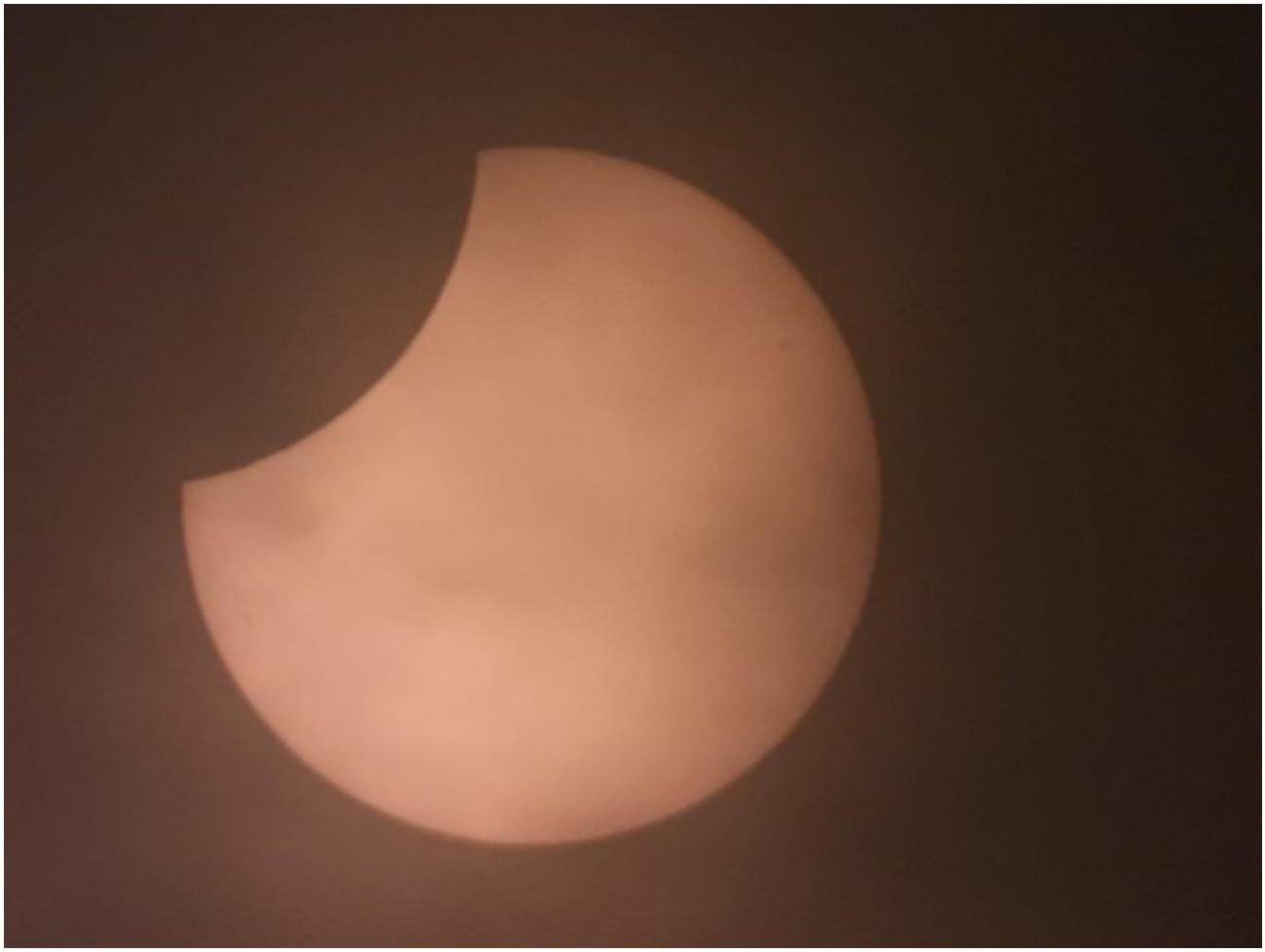
ISS PASSES For NOVEMBER/DECEMBER 2022

from Heavens Above website maintained by Chris Peat.

Date	Brightn	Start	Highest point	End						
	(mag)	Time	Alt.	Az.	Time	Alt.	Az.	Time	Alt.	Az.
01 Nov	-3.9	04:58:01	83°	NW	04:58:07	86°	N	05:01:30	10°	E
02 Nov	-1.4	04:11:58	24°	E	04:11:58	24°	E	04:13:27	10°	E
02 Nov	-3.6	05:44:54	23°	W	05:46:49	61°	SSW	05:50:09	10°	ESE
03 Nov	-3.8	04:58:51	75°	S	04:58:51	75°	S	05:02:09	10°	ESE
04 Nov	-1.2	04:12:48	21°	E	04:12:48	21°	E	04:14:04	10°	E
04 Nov	-2.8	05:45:44	22°	WSW	05:47:17	35°	SSW	05:50:22	10°	SE
05 Nov	-3.1	04:59:42	43°	S	04:59:42	43°	S	05:02:29	10°	SE
06 Nov	-0.9	04:13:42	16°	ESE	04:13:42	16°	ESE	04:14:28	10°	ESE
06 Nov	-2.0	05:46:38	17°	WSW	05:47:28	18°	SW	05:49:52	10°	S
07 Nov	-1.8	05:00:41	20°	S	05:00:41	20°	S	05:02:18	10°	SSE
19 Nov	-1.9	18:28:07	10°	SSW	18:29:51	21°	S	18:29:51	21°	S
20 Nov	-1.9	17:40:11	10°	S	17:42:30	18°	SE	17:43:21	16°	ESE
20 Nov	-0.9	19:15:28	10°	WSW	19:16:15	16°	WSW	19:16:15	16°	WSW
21 Nov	-1.4	16:52:44	10°	SSE	16:54:06	12°	SE	16:55:28	10°	ESE
21 Nov	-2.9	18:27:00	10°	SW	18:29:40	41°	S	18:29:40	41°	S
22 Nov	-2.7	17:38:36	10°	SW	17:41:39	33°	SSE	17:43:00	23°	ESE
22 Nov	-1.0	19:14:50	10°	W	19:15:53	19°	WSW	19:15:53	19°	WSW
23 Nov	-2.1	16:50:21	10°	SSW	16:53:06	24°	SSE	16:55:52	10°	E
23 Nov	-3.5	18:26:10	10°	WSW	18:29:09	65°	SW	18:29:09	65°	SW
24 Nov	-3.5	17:37:31	10°	WSW	17:40:49	58°	SSE	17:42:22	27°	E
24 Nov	-1.0	19:14:09	10°	W	19:15:15	19°	W	19:15:15	19°	W
25 Nov	-3.0	16:48:56	10°	SW	16:52:08	43°	SSE	16:55:20	10°	E
25 Nov	-3.6	18:25:23	10°	W	18:28:24	71°	W	18:28:24	71°	W
26 Nov	-3.8	17:36:36	10°	WSW	17:39:57	84°	S	17:41:32	29°	E
26 Nov	-1.0	19:13:21	10°	W	19:14:25	19°	W	19:14:25	19°	W
27 Nov	-3.6	16:47:50	10°	WSW	16:51:09	71°	SSE	16:54:30	10°	E
27 Nov	-3.6	18:24:32	10°	W	18:27:32	69°	WNW	18:27:32	69°	WNW
28 Nov	-3.8	17:35:40	10°	W	17:39:02	85°	N	17:40:38	29°	E
28 Nov	-1.0	19:12:25	10°	W	19:13:30	19°	W	19:13:30	19°	W
29 Nov	-3.8	16:46:48	10°	W	16:50:09	88°	N	16:53:31	10°	E
29 Nov	-3.6	18:23:32	10°	W	18:26:37	69°	WSW	18:26:37	69°	WSW
30 Nov	-3.8	17:34:38	10°	W	17:38:00	88°	S	17:39:45	26°	E
30 Nov	-1.0	19:11:26	10°	W	19:12:37	19°	W	19:12:37	19°	W
01 Dec	-3.8	16:45:41	10°	W	16:49:03	86°	N	16:52:24	10°	E
01 Dec	-3.1	18:22:26	10°	W	18:25:40	48°	SSW	18:25:48	48°	SSW
02 Dec	-3.4	17:33:27	10°	W	17:36:46	64°	SSW	17:39:03	18°	ESE
02 Dec	-0.9	19:10:36	10°	W	19:11:56	16°	WSW	19:11:56	16°	WSW
03 Dec	-3.6	16:44:27	10°	W	16:47:48	79°	SSW	16:51:08	10°	ESE
03 Dec	-1.9	18:21:21	10°	W	18:24:14	27°	SSW	18:25:19	22°	S
04 Dec	-2.4	17:32:11	10°	W	17:35:20	38°	SSW	17:38:27	10°	SE
05 Dec	-2.9	16:43:05	10°	W	16:46:21	52°	SSW	16:49:37	10°	SE
05 Dec	-0.8	18:20:39	10°	WSW	18:22:31	14°	SW	18:24:21	10°	S
06 Dec	-1.1	17:31:03	10°	W	17:33:38	21°	SW	17:36:12	10°	SSE
07 Dec	-1.6	16:41:44	10°	W	16:44:41	29°	SSW	16:47:38	10°	SSE
08 Dec	-0.1	17:31:12	10°	SW	17:31:39	10°	SW	17:32:08	10°	SW
09 Dec	-0.6	16:40:39	10°	WSW	16:42:44	16°	SW	16:44:48	10°	S

END IMAGES, AND OBSERVING

The Partial Solar Eclipse of 25th October was very much in the lap of the clouds. And again the trusty Nikon P1000 was its built in zoom and a Thousandoaks solar filter was the saviour with its quick availa-bility. Too much cloud for a Hal-pha rig, and too tricky under foot for full tripod/ telescope set up, I was happy to get anything. Andy Burns.



Observing Sessions

Proposed Observation Sessions for 2022-2023

Planned observing evenings will be on a Friday night in the Lacock playing fields behind the Red Lion pub at 19:00 or an Hour after sunset depending on the time of year.
With the New Moon being around the beginning of the month and the full moon generally around the middle, the following dates for observing are proposed:

a ad-hoc session for other reasons and at other locations, such as astro-photography, solar observing etc, with other like-minded members then they can do so through the Society Members Facebook Page or through the WAS contact page on the website.

Opportunity	Day	Date	Month	Set-up	Observe
First	Friday	18th	November	18:30	19:00
Second	Friday	25th	November	18:30	19:00
First	Friday	16th	December	18:30	19:00
Second	Friday	23rd	December	18:30	19:00
First	Friday	13th	January	18:30	19:00
Second	Friday	20th	January	18:30	19:00
First	Friday	10th	February	18:30	19:00
Second	Friday	17th	February	19:00	19:30
Third	Friday	24th	February	19:00	19:30
First	Friday	17th	March	19:00	19:30
Second	Friday	24th	March	19:30	20:00
First	Friday	14th	April	20:00	20:30
Second	Friday	21st	April	20:30	21:00
First	Friday	12th	May	20:30	21:00
Second	Friday	19th	May	20:30	21:00

OUTREACH: Stanton St Quinton school TBC
Chirton School TBC These will be daytime visits

NOTE: Due to building work likely to extend into early 2023 I have been in touch with the National Trust Lacock Estates Office for permission to use the Picnic area just behind the Café and Toilets. News hopefully later this week.