NWASNEWS

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NOVEMBER 2020

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

Great, Second Lockdown...

Keeping the politics out of it, we are being put into a complicated lockdown, knowing people on the borders of Wales and those over there who have been in tight lockdown for a while it is a nightmare. But being able to use Zoom has been a bit of a lifesaver for the societies and also in schools they are starting asking us to work with them presenting astronomy on Zoom. I do my first session tomorrow to three schools simultaneously.

I know Zoom isn't the long term answer, and we are missing several members who don't want to partake in Zoom sessions, but for those I hope the Newsletter goes some way to keep you all in touch.

I have investigated putting recordings of our Zoom sessions on line but they are huge files (about 100mb each session) and the society web page has nothing near the capacity needed to work these files online, and nor is the extra cost justified (over £70 per month). This is nearly the cost of using the StarLink constellation G5 services. So much philanthropy Elon Musk. Its all about the money not what his acolytes were saying.

Hopefully we will get some more dark but clear skies so we can use the lockdown to do some viewings. The suggested observation targets by the observing team are in the newsletter pages 20-24.

The big announcement of last month, evidence of life in the atmosphere of Venus may turn out to be rogue data from the telescope array. Highlighting the dangers of rushing into announcements to beat the leak of sensitive news ahead of peer reviews.

So this month three major and several minor new announcements are featured in the News section of the newsletter.

The discover of water on the sunlit Moon. Low to the southern pole, but there. Not in liquid form but it could be enough to be relevant for future lunar exploration.

The metallic nature of the asteroid Psyche points to it being a failed core of a planet. The value of the metal has been put at $10,000 QUADRILLION. But this 120miles wide asteroid will be difficult to pull close enough to Earth to mine.

Another finding this month has been the relevance of the Siberian volcanic outflow that released so much carbon dioxide to be released that the life on Earth was decimated to 2% of the species surviving. Compare this with the 35% surviving the 'Dinosaur' killer.

Hope you all stay well and have clear skies

Andy

The Moon rising last night from behind Waden Hill alongside Silbury Hill.

Nikon P1000 zoom lens, hand held. Auto exposure adjusted 1.3 stops darker to speed the exposure time and improve the darkness on the Moon so you can see the lunar features on the 16day phase. The terminator is moving from the eastern horizon of the Moon now crossing the sea of Crisis.

Andy

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.
During COVID19 ZOOM meetingd

HALL VENUE the Pavilion, Rusty Lane, Seend

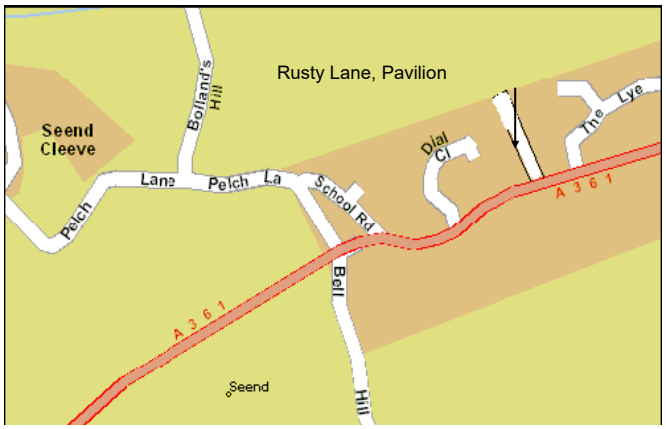
Meet 7.30 for 8.00pm start

SEASON 2020/21
3 Nov Andrew Lound/A Jupiter Odyssey
1 Dec Dr Lilian Hobbs/Eisa Eisinga: The Planetarium in the Bedroom.
2021
5 Jan Open Forum/Beginner meeting.
2 Feb Prof David Southwood/Moon and Mars the next Giant Leap.
2 Mar Pete Williamson/The moon & Moons of the Solar System.
6 Apr Prof Mike Edmunds/The Clockwork universe.
4 May TBC
1 Jun Robert Harvey/Understanding the Universe.

Thank you Peter and those that have helped get a list together in the circumstances.

Membership Meeting nights £1.00 for members £3 for visitors

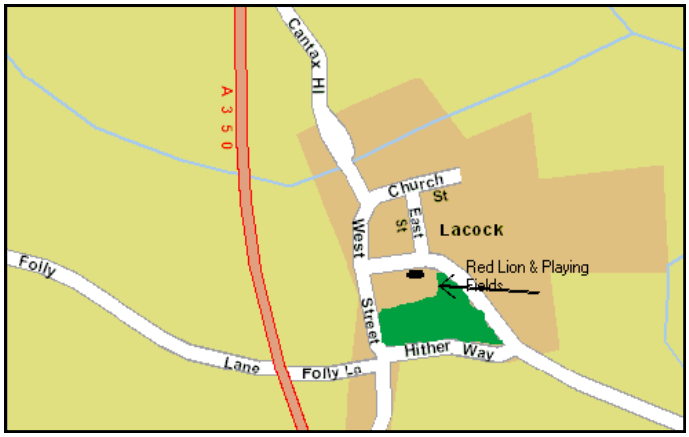
Wiltshire AS Contacts
Andy Burns Chair, anglesburns@hotmail.com
Andy Burns Outreach and newsletter editor.
Bob Johnston (Treasurer) Debbie Croker (vice Treasurer)
Philip Proven (Hall coordinator) Dave Buckle (Teas)
Peter Chappell (Speaker secretary)
Nick Howes (Technical Guru)
Observing Sessions coordinators: Chris Brooks, Jon Gale,
Web coordinator: Sam Franklin
Contact via the web site details.



Observing Sessions see back page

Andrew Lound has been presenting public lectures and staging exhibitions for nearly 50years and has participated in ove 5000 events. He regularly tours the UK with Odyssey Dramatic Presentation and lectures and is back by popular demand.

.He has supported astronomy and space science public awareness in the UK since the late 1970s having organised and funded many public activities in support of Birmingham Museum of Science and Industry, Soho House Museum and the Avery Historical Museum. He was co=organiser of the National Astronomy and Spaceflight Shows.
He has worked around the world and in 2005 became the first western science speaker to tour Libya.
He is a man of many interests, who specialises in space science and astronomy from both a current and historical perspective. His research into the 18th century Lunar Society revealed many new and exciting discoveries about their activities including the discovery that Matthew Boulton, a man ahead of his time, had built an astronomical observatory in the grounds of Soho House, Birmingham.
Another interest for Andrew has been the Titanic, and is regarded as one of the world's leading authorities on the subject.
He has a masters degree in Astronomy with particular emphasis on Planetary Science. He worked with CalTech JPL on promoting the Cassini mission to Saturn, and project manager of the Antoniadi Project, a British concept of a space probe to the Hellas Region on Mars.
Having studied performing art and acting at a number of theatres and stage schools, he combines the skills acquired into the trade marked Odyssey Dramatic Presentations and Lectures that combine scientific knowledge, journalistic research with drama to present a unique performance.
He has 4 books published, Lunatick Astronomy, Life in the Balance, RMS Titanic: Made in the Midlands, and The Power of Balance.



Swindon's own astronomy group

Hall Venue Meetings cancelled

Due to the current crisis our meetings, like many other physical meetings have been suspended and replaced with Zoom meetings.

Ad-hoc viewing sessions postponed

All ad-hoc meetings are currently cancelled until further notice.

Regular stargazing evenings are being organised near Swindon. To join these events please visit our website for further information.

Lately we have been stargazing at Blakehill Farm Nature Reserve near Cricklade, a very good spot with no distractions from car headlights.

We often meet regularly at a lay-by just outside the village of Uffcott, near Wroughton. Directions are also shown on the website link below.

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

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

For insurance reasons you need to be a club member to take part. If you think you might be interested email the organiser Robin Wilkey (see below). With this you will then be emailed regarding the event, whether it is going ahead or whether it will be cancelled because of cloud etc.
We are a small keen group and I would ask you to note that you DO NOT have to own a telescope to take part, just turn up and have a great evening looking through other people's scopes. We are out there to share an interest and the hobby. There's nothing better than practical astronomy in the great cold British winter! And hot drinks are often available, you can also bring your own.

Enjoy astronomy at it's best!

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:

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

Meeting Dates for 2020

Friday 20 November Zoom meeting

Programme: Ian Smith: Narrowband Imaging

Friday 11 December Zoom meeting

Programme: Prof. Martin Hendry FRSE: Einstein Goes to Hollywood

Meeting Dates for 2021

Friday 15 January Zoom meeting
Programme: David Bryant: Meteorites and their planet of origin

Friday 19 February Zoom meeting
Programme: Prof Rene Breton: Cosmic Fireworks

Friday 19 March Zoom meeting
Programme: AGM + speaker: Viv Williams 'Setting up and using telescope mounts'

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

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

STAR QUEST ASTRONOMY CLUB

Meet at Sutton Veey near Warminster.

BATH ASTRONOMERS

Bath Astronomers are holding webinar sessions linking in with Stargazers web sight.

The third of our series of Zoom lectures is coming up at 7.30 pm on Friday 6th November. You may have already received an email about it. I am making a special effort to reach out to more people with this one, as it crosses the boundary between Art and Physics, so it would be great if you could make your colleagues in the Wiltshire Astro Soc and others aware that this is an especially good lecture.

Venue: 7.30 pm Friday 6th November 2020 online as a BRLSI Zoom lecture
Title: How the sun Paints the Sky
Speaker: Dr Robert (Bob) Fosbury
Tickets: https://www.eventbrite.co.uk/e/live-how-the-sun-paints-the-sky-tickets-124064982703, proceeds to the BRLSI.

Description:
Unless they are astronauts, humans must view the Universe through the window of the Earth's atmosphere. Although a clear sky is relatively transparent to visible light, bright astronomical objects — most noticeably the Sun — can paint the entire sky with luminosity, colour and shadow to be captured by both landscape painters and photographers. How does this happen and what physical processes are responsible for these beautiful colours, gradations and patterns? The talk explains some of this and is illustrated with spectacular images of the sky from space and from above the European observatories in the Chilean Atacama desert.
Background of speaker:
Dr Bob Fosbury worked for the European Space Agency (ESA) as part of ESA's collaboration with NASA on the Hubble Space Telescope (HST) project at ST-ECF. Based at the European Southern Observatory (ESO) near Munich in Germany, Fosbury joined this initiative in 1985, more than 5 years before launch. During the latter part of this period, Bob served on NASA's Ad Hoc Science Working Group and ESA's Study Science Team as they developed the instrument concepts for the James Webb Space Telescope, the next generation space observatory.
He is currently an emeritus astronomer at the European Southern Observatory and an honorary professor at the Institute of Ophthalmology at UCL.

Bob Fosbury lives in Bath and is a very good speaker. He is particularly interested in light and colour and his approach crosses a number of fields. This lecture wil interest people ranging from scientists to artists, his first slide is of Turner's Fighting Temeraire and introduces a discussion of the colour palette that Turner used for the sunset.

For everyone who participates, I can promise that your enjoyment of future sunsets will be enhanced!

I should point out that we continue to charge for these lectures (£5, £2 for members and students) because our partners at the BRLSI where we normally hold our lectures are in severe financial difficulty since their room hire income has disappeared. They have a building to maintain and although supported by many volunteers they also have some staff whose livelihoods are under threat. So the ticket proceeds all go to the BRLSI. To participate in the lecture and the Q & A session afterwards, you need to go to the above link to Eventbrite to buy tickets. If you prefer, you can also watch the lecture on the BRLSI's Youtube channel at no cost when it is added a month later - just go to the BRLSI Events page in December.

If you know anyone who might be interested, please pass this email on. Note the discounted rate for school kids and students.

Best regards,

Tony

SPACE NEWS FOR NOVEMBER

Hurricane Zeta seen from space

(Image credit: NASA)
Monday, November 2, 2020: Hurricane Zeta churns in the Gulf of Mexico in this view captured from the International Space Station on Wednesday (Oct. 28), as the Category 2 storm approached Louisiana. In the upper foreground of the image is Russia's Progress 76 cargo resupply spacecraft, which is docked to the Russian Pirs module. At the bottom of the frame is Russia's Soyuz MS-17 spacecraft, which brought three crew members to the space station on Oct. 14. — Hanneke Weitering

It's the great pumpkin, Hubble!

(Image credit: NASA, ESA, and W. Keel (University of Alabama))
Oct. 30, 2020: Just in time for Halloween, the Hubble Space Telescope spotted a "pumpkin patch" made up of two galaxies just starting to collide, spanning 109,000 light-years across. The galaxies, NGC 2292 and NGC 2293, are pumpkin-orange in colour because of the aging stars in the galaxies, which appear red.

Get ready for the 'Great Conjunction' of Jupiter and Saturn

By Joe Rao 21 hours ago

In their closest encounter since 1623, Jupiter and Saturn appear as a single star in the evening sky next month.

During the "Great Conjunction" on Dec. 21, 2020, Jupiter and Saturn will be about one-tenth of a degree apart, their closest approach since 1623.
(Image: © SkySafari app)
All through the summer and into the fall, the two gas giants of the solar system, Jupiter and Saturn, have been calling attention to themselves in the southern evening sky.
Jupiter of course, always appears brilliant and is usually one of the brightest nighttime objects, but in recent months it has stood out even more than usual because of the presence of bright Saturn trailing just off to its left (east).

Appearing about one-twelfth as bright, Saturn has, in a way, served as Jupiter's "lieutenant" in this year of 2020.

An infrequent meeting

Whenever Jupiter and Saturn are in conjunction — that is, when they have the same right ascension or celestial longitude — it is referred to as a "Great Conjunction," primarily

because unlike conjunctions with the other bright planets, these two don't get together very often. The average frequency of occurrence is merely the product of their sidereal periods divided by the absolute value of their difference.
A sidereal period is defined as the time required for a celestial body within the solar system to complete one revolution with respect to the fixed stars. Saturn's period of 29.65 years multiplied by Jupiter's period of 11.86 years amounts to 351.65. Dividing this value by the difference in their sidereal periods gives us 19.76 years.
So, about every 20 years, Jupiter and Saturn will have a rendezvous. The next one is coming very soon; scheduled for Dec. 21.

Exceptionally close!

The "Great Conjunction" on Dec. 21, 2020 will be a once-in-a-lifetime opportunity to see Jupiter and Saturn together through a telescope. (Image credit: SkySafari app)
Most of the time, when Jupiter overtakes Saturn, they usually are separated by more than a degree. But come Dec. 21, they will be separated by just about one-tenth of a degree or 6.1 arc minutes. To gauge how close that is, on the next clear night, check out Mizar, the middle star in the handle of the Big Dipper. A fainter star, Alcor, is positioned only 11.8 arc minutes away and the ability to perceive the separation of these two stars, was once considered a test of good vision.
And yet Jupiter and Saturn will approach to within about half that distance!
That's just 0.102 degrees
This means, under high magnification in your telescope you'll be able to see both planets — Saturn with its famous ring system and Jupiter with its cloud bands and Galilean satellites — simultaneously in the same field of view!

How great is that?
It will be interesting to watch how the gap between these two planets will gradually close during November and December. On Nov. 1st, they are 5.1 degrees apart; by Nov. 15, 3.8 degrees. By Dec. 1, they'll be separated by 2.2 degrees and by Dec. 15 it will be down to just 0.7 degrees, then 0.1 degrees closer each night thereafter until their long-awaited meeting on Dec. 21.
This sky map shows Jupiter and Saturn on Nov. 1,

A coalescence?

As to whether the two planets might appear as a single star, I personally can recall on June 5, 1978 when Mars and Saturn were separated by a similar distance, and yet I could clearly separate both planets with my naked eye. However, those who are near-sighted might see Jupiter and Saturn appear as one merely by removing their eyeglasses.
The last time these two planets appeared so close was on July 16, 1623, when they were only 5 arc minutes apart. We will get another 6-arc minute separation on March 15, 2080. Maybe a few of our younger readers will be around to catch that one.
Joe Rao serves as an instructor and guest lecturer at New York's Hayden Planetarium. He writes about astronomy for Natural History magazine, the Farmers' Almanac and other publications. Follow us on Twitter @Spacedotcom and on Facebook.

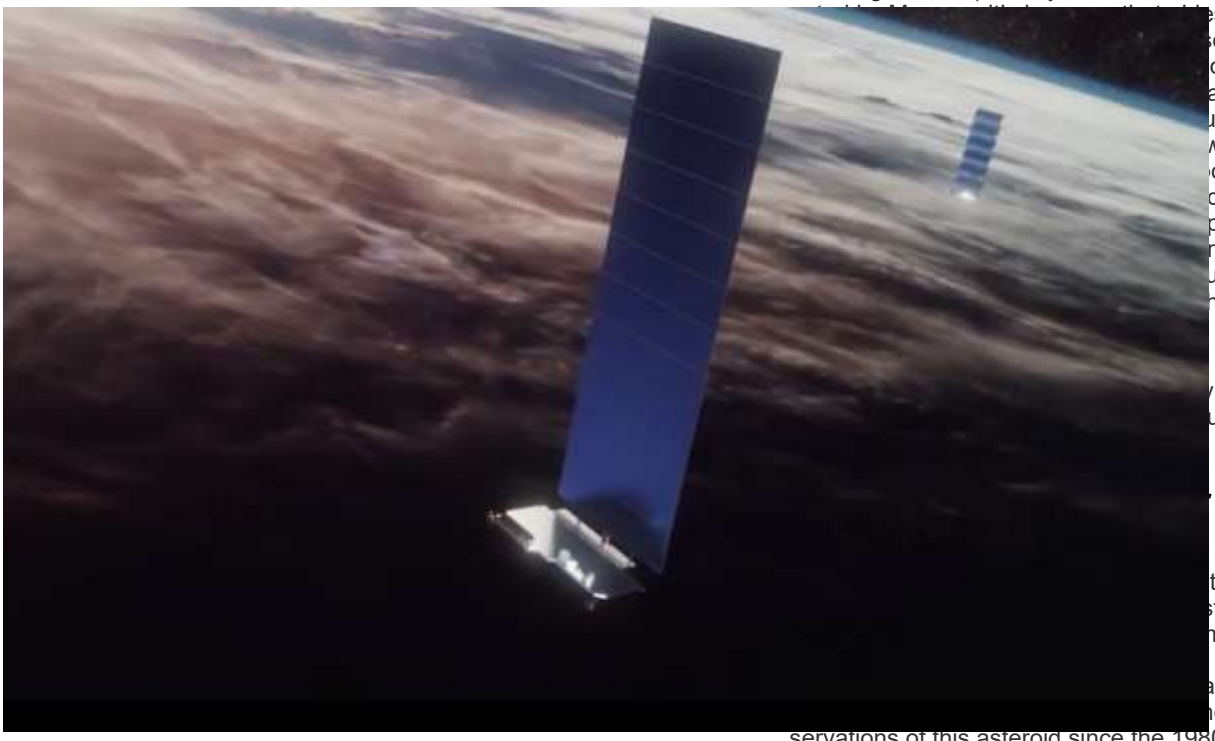
Elon Musk's SpaceX charging $99 a month for spotty Starlink internet

By Noah Manskar

October 28, 2020 | 8:28am | Updated

Getty Images
Elon Musk's SpaceX is reportedly charging $99 a month for a test version of its Starlink satellite internet service that it expects to be somewhat spotty.
In addition, customers who sign up for the "Better Than Nothing Beta" test will also have to shell out $499 for the equipment needed to hook up their homes to the network of space satellites that will connect them to the web, according to reports.
They can expect data speeds ranging from 50 to 150 megabits per second "as we enhance the Starlink system," SpaceX told prospective customers in an email reviewed by CNBC and Reuters — but even that isn't guaranteed.
"There will also be brief periods of no connectivity at all," SpaceX admitted in the email, according to Reuters.
"As you can tell from the title, we are trying to lower your initial expectations," the message reportedly said.
Starlink's reported speeds are far slower than those offered by traditional internet service providers such as Verizon FiOs and Spectrum, which charge $59.99 and $44.99, respectively, for up to 400 megabits per second in New York City.
However, Starlink could prove faster and cheaper than rival satellite provider Viasat, which charges a starting rate of $100 per month for up to 30 megabits per second, according to its website.
SpaceX said in August that "nearly 700,000 individuals" expressed interest in the Starlink service. The privately held company — best known for its rocket launches — expects to offer the test service in the US and Canada this year before "rapidly expanding to near-global coverage of the populated world by 2021," according to the description for Starlink's new iPhone app.
Starlink aims to provide high-speed connections to people in rural areas with limited options for internet access. The service reportedly got positive reviews from an official with Washington state's first-responder military team, which has used Starlink to provide internet to people in areas ravaged by wildfires.
Investors are also excited about the service — demand for SpaceX's privately held shares recently jumped 25 percent thanks to enthusiasm about Starlink, as The Post reported last month.
SpaceX did not immediately respond to a request for comment early Wednesday.

About 3% of Starlinks Have Failed So Far



SpaceX has drawn plenty of praise and criticism with the creation of *Starlink*, a constellation that will one-day provide broadband internet access to the entire world. To date, the company has launched over 800 satellites and (as of this summer) is producing them at a rate of about 120 a month. There are even plans to have a constellation of 42,000 satellites in orbit before the decade is out.

However, there have been some problems along the way as well. Aside from the usual concerns about light pollution and Radio Frequency Interference (RFI), there is also the rate of failure these satellites have experienced. Specifically, about 3% of its satellites have proven to be unresponsive and are no longer maneuvering in orbit – which could prove hazardous to other satellites and spacecraft in orbit.

How did the Earth get its water? The answer might be found on Mercury

I don't know if you've noticed by now, but the Earth is a little bit wet. How Earth got all its water is one of the major mysteries in the formation of the solar system, and a team of Japanese researchers have just uncovered a major clue. But not on Earth – the clue is on Mercury.

Here's the traditional story of the early solar system as best we know it. The sun forms with a disk of dusted gas surrounding it. Within a certain distance from the sun, known as the snow line, the sun's radiation is too hot and too intense to support the formation of ices or lighter elements. Hence, the rocky planets form. Beyond the ice line, which sits somewhere around the present-day orbit of the asteroid belt, ices and light elements can glue themselves together to become the giant bulky planets of the outer system.

In between is a sort of no man's land of rocks, ices, debris, and basically a whole bunch of other junk.

Once the giant planets form, they rearrange themselves, and their gravitational influence sends chunks of random junk plowing into the inner solar system, delivering all sorts of goodies like water. Those goodies land on the surfaces of the rocky worlds, where they sit for billions of years.

But a team of Japanese researchers are challenging this view by looking at the cratering record on Mercury. To explain the abundance of lighter elements within Mercury's crust, there has to be at least three times as many impacts as we observe in the cratering record. (And if you're wondering why we're so fasci-

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View of the

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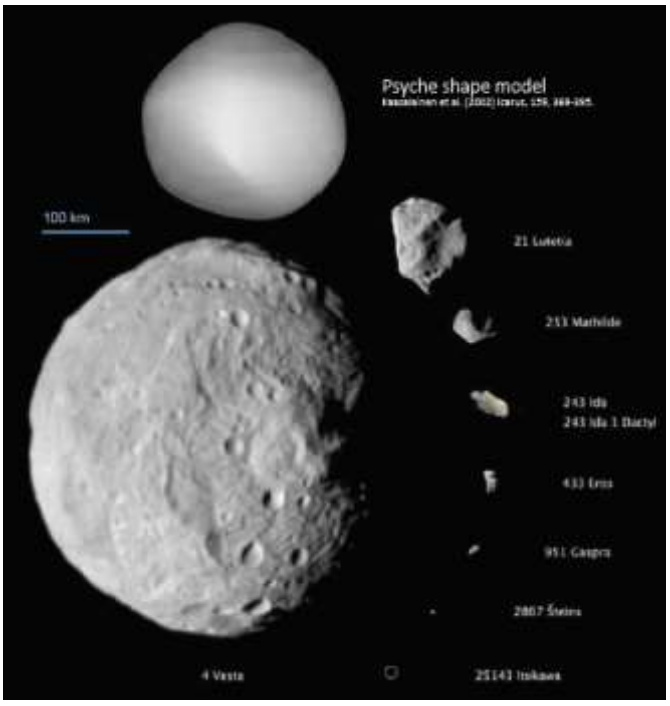
servations of this asteroid since the 1980s. Hubble has provided new insights into Psyche's surface and composition, as well as possible activity taking place on Psyche's surface.

"We were able to identify for the first time on any asteroid what we think are iron oxide ultraviolet absorption bands," said planetary scientist Dr. Tracy Becker from the Southwest Research Institute, lead author of a new paper describing the observations. "This is an indication that oxidation is happening on the asteroid, which could be a result of the solar wind hitting the surface."

Scientists have long speculated that this metallic asteroid might be the leftover surviving core of a protoplanet, where perhaps a violent collision with a planetesimal stripped off Psyche's outer, rocky layers, leaving behind only the dense, metallic interior. This theory has been supported by estimates of Psyche's bulk density, spectra, and radar surface properties, all of which show it to be an object unlike any others in the asteroid belt. Additionally, this composition of 16 Psyche is strikingly similar to that of Earth's metal core.



The asteroid Psyche is one of the larger asteroids. Credit: Lindy T. Elkins-Tanton

"We've seen meteorites that are mostly metal, but Psyche could be unique in that it might be an asteroid that is totally made of iron and nickel," Becker said in a press release. "Earth has a metal core, a mantle and crust. It's possible that as a Psyche protoplanet was forming, it was struck by another object in our solar system and lost its mantle and crust."

Becker and her team used Hubble to make high-resolution UV observations of Psyche taken in 2017 with the observatory's Space Telescope Imaging Spectrograph (STIS). They observed the asteroid at two specific points in its rotation to view both sides of Psyche completely at ultraviolet (UV) wavelengths.

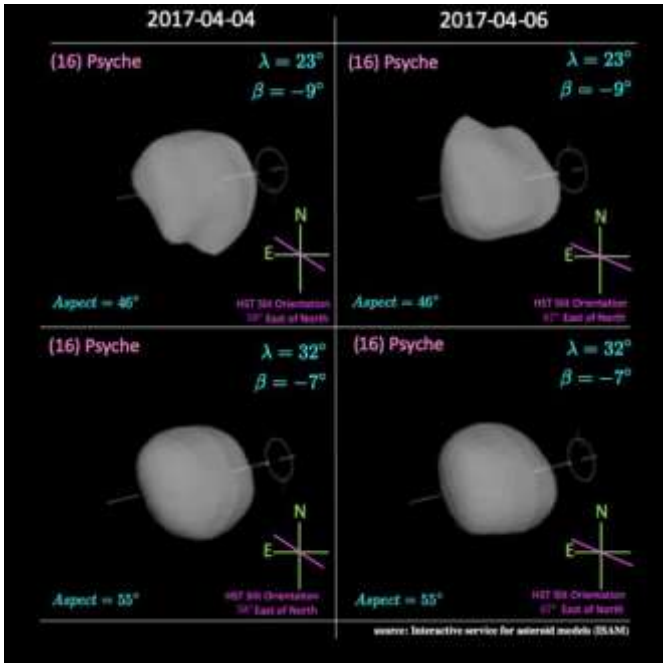


Figure 1. *Orientation of Psyche at the time of the two HST observations. Image courtesy Becker et al.*

They observed some small spectral differences between the sides, perhaps suggesting an unusual feature in the northern hemisphere, but overall, the spectra they observed showed iron to be the primary surface feature.

"We did not find significant spectral variations with rotation, though the equatorial region of the asteroid may have a higher overall reflectance than the northern hemisphere," the team wrote in their paper. Psyche also appeared increasingly reflective at deeper UV wavelengths.

"This is something that we need to study further," Becker said. "This could be indicative of it being exposed in space for so long. This type of UV brightening is often attributed to space weathering."

The team also compared the spectrum of Psyche with meteorite samples from specific database, but did not find any strong matches.

The observations were made in preparation for the Psyche mission, which will travel to the asteroid as part of an effort to understand the origin of planetary cores. The mission is set to launch in 2022 and arrive at Psyche in 2026. Since asteroid Psyche is so far from Earth — approximately 280,0000,000 km, we don't have a clear understanding or clear images of this object. Metal asteroids are relatively rare in the solar system, and scientists believe Psyche could offer a unique opportunity to see inside a planet.

"What makes Psyche and the other asteroids so interesting is that they're considered to be the building blocks of the solar system," Becker said. "To understand what really makes up a planet and to potentially see the inside of a planet is fascinating. Once we get to Psyche, we're really going to understand if that's the case, even if it doesn't turn out as we expect. Any time there's a surprise, it's always exciting."

The study was published in The Planetary Science Journal and was presented at the virtual meeting of the American Astronomical Society's Division for Planetary Sciences last week

NASA Announces the Discovery of Water in the Sunlit Parts of the Moon

For decades, astronomers have speculated that there may be water on the Moon. In recent years, this speculation was confirmed one orbiting satellite after another detected water ice around the Moon's southern polar region. Within this part of the lunar surface, known as the South-Pole Aitken Basin, water ice is able to persist because of the many permanently-shadowed craters that are located there.

But until now, scientists were operating under the assumption that lunar water was only to be found in permanently shadowed craters. But thanks to NASA's Stratospheric Observatory for Infrared Astronomy (SOFIA), water has been observed on the sunlit side of the Moon for the first time. This discovery indicates that water may be distributed all across the lunar surface, and not limited to the dark corners.

The study that describes their findings recently appeared in the journal *Nature Astronomy.* The study was led by Casey Honniball, a NASA postdoctoral fellow at the University of Hawaii's Institute of Geophysics and Planetology, and included members from the Space Science Institute (SSI), the Georgia Institute of Technology, the Johns Hopkins University Applied Physics Laboratory (JHUAPL), and NASA's Goddard Space Flight Center.

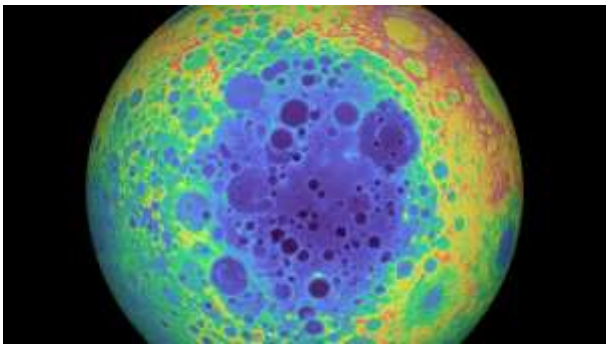
SOFIA is essentially a modified Boeing 747SP aircraft equipped with a 2.7-meter (106-inch) infrared telescope. With a service ceiling of 11,600 to 13,700 meters (38,000 to 45,000 feet), SOFIA is able to fly above 99% of Earth's infrared-blocking atmosphere and search for otherwise faint objects using its Faint Object infraRed CAmera for the SOFIA Telescope (FORCAST).

When Dr. Honnibal and her colleagues observed the Moon with SOFIA, what they noticed was the presence of water molecules (H_2O) in the second-largest crater visible from Earth. This is known as Clavius Crater, which is located in the Moon's southern hemisphere and measures 231 km (143.5 mi) in diameter and 3.5 km (2 mi) in depth.

As Paul Hertz, director of the Astrophysics Division in NASA's Science Mission Directorate (SMD), said in a recent NASA statement:

"We had indications that H_2O – the familiar water we know – might be present on the sunlit side of the Moon. Now we know it is there. This discovery challenges our understanding of the lunar surface and raises intriguing questions about resources relevant for deep space exploration."

While previous observations had detected traces of hydrogen in this crater but were unable to determine if it was because of water or hydroxyl (OH). This chemical forms when molecular oxygen in lunar regolith bonds with hydrogen atoms, which are the result of charged particles (protons) emanating from the Sun (solar wind) picking up electrons as they travel through space.



Elevation data of the Moon showing the South Pole-Aitken Basin. Credit: NASA/GSFC/University of Arizona

Using the FORCAST telescope, Honnibal and her team were able to make that determination since the hydrogen they detected was had a specific wavelength that is unique to water molecules (6.1 microns). As Honnibal explained: *"Prior to the SOFIA observations, we knew there was some kind of hydration. But we didn't know how much, if any, was actually water molecules – like we drink every day – or something more like drain cleaner… Without a thick atmosphere, water on the sunlit lunar surface should just be lost to space. Yet somehow we're seeing it. Something is generating the water, and something must be trapping it there."*

The data obtained by SOFIA revealed water concentrations of 100 to 412 parts per million (ppm) in a single cubic meter of soil spread across the lunar surface. This is the equivalent of about a 350 ml (12 oz) bottle and is about 100 times less water than the Sahara desert possesses. Despite this scant amount of water, the discovery is very significant since it raises new questions about the origins of lunar water and how it is able to persist.

In addition, this find has implications for lunar exploration, particularly where long-duration missions and lunar habitats are concerned. As part of Project Artemis, NASA is looking to establish a program of "sustainable lunar exploration" that will include a base around the southern polar region. The presence of water ice will not only ensure a supply of drinking water but could also be used to manufacture propellants.

"Water is a valuable resource, for both scientific purposes and for use by our explorers," said Jacob Bleacher, chief exploration scientist for NASA's Human Exploration and Operations Mission Directorate. "If we can use the resources at the Moon, then we can carry less water and more equipment to help enable new scientific discoveries."

A close-up of SOFIA's telescope and primary mirror. Credit: NASA/Tom Tschida

This find is also significant because of the way it represents the culmination of decades of research. When the Apollo astronauts first landed on the Moon, the Moon was believed to be completely dry. Interestingly, it was the rocks these missions returned that provided the first indications of lunar water, though these were dismissed as the result of contamination at the time.

Another interesting takeaway from this latest find is the fact that it's not the kind of research the SOFIA mission usually performs. Ordinarily, SOFIA's high-altitude observations are guided by a camera that tracks stars, which allows the controllers to keep the telescope locked steadily on its target. These include objects that are faint (like red dwarfs and black holes) or distant objects, like star clusters and galaxies.

The Moon, which is neither faint nor distant, would typically fill the guide camera's entire field of view. After conducting a test observation in August of 2018, NASA scientists were convinced it was worth a try. Said Naseem Rangwala, SOFIA's project scientist at NASA's Ames Research Center: *"It was, in fact, the first time SOFIA has looked at the Moon, and we weren't even completely sure if we would get reliable data, but questions about the Moon's water compelled us to try. It's incredible that this discovery came out of what was essentially a test, and now that we know we can do this, we're planning more flights to do more observations."*

SOFIA in flight, with its telescope exposed. Image: NASA/Jim Ross

Naturally, there are a number of unanswered questions that scientists still need to contend with. For starters, there's the question of whether or not water deposits on the sunlit portions of the Moon are accessible. There's also the ongoing mystery about the origins of lunar water (whether it was produced indigenously or deposited), how it's able to accumulate and persist in sunlit regions, and how its transported across the Moon.

In the near future, NASA hopes to conduct follow-up observations with SOFIA to gather more data and (hopefully) answer these questions. In particular, they will be looking for additional sources of water in sunlit locations and during different lunar phases. This data will also inform future missions like NASA's Volatiles Investigating Polar Exploration Rover (VIPER), and help create the first water source maps for human exploration.

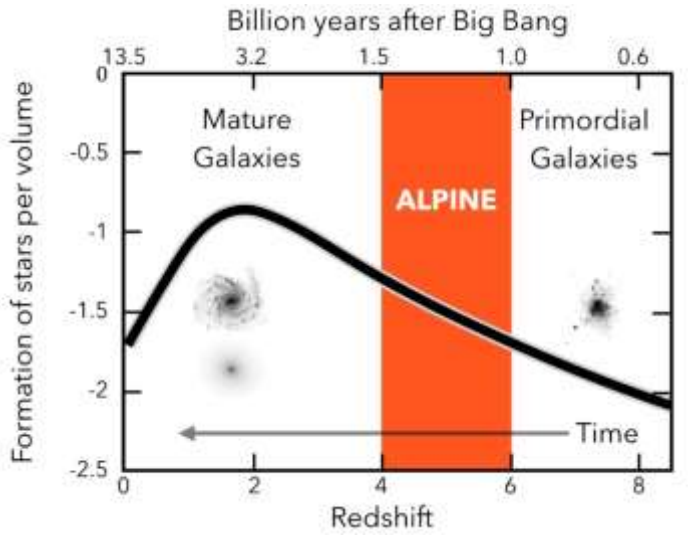
Galaxies Grew Quickly and Early On in the Universe

The behaviour of galaxies in the early Universe attracts a lot of attention from researchers. In fact, everything about the early Universe is under intense scientific scrutiny for obvious reasons. But unlike the Universe's first stars, which have all died long ago, the galaxies we see around us—including our own—have been here since the early days.

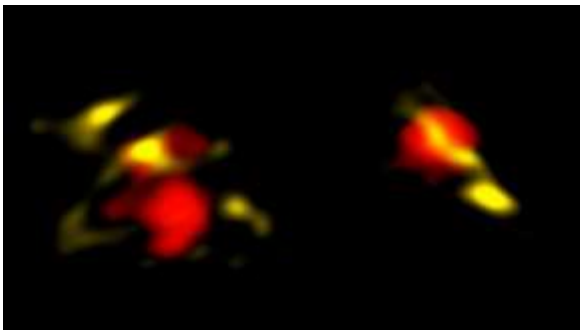
Current scientific thinking says that in the early days of the Universe, the galaxies grew slowly, taking billions of years to become what they are now. But new observations show that might not be the case.

The new observations are from a survey called ALPINE (the ALMA Large Program to Investigate C+ at Early Times). ALPINE is a program that studies gas and dust properties of young galaxies during the early growth phase at redshifts z = 4-6.

The survey found that many galaxies experienced a growth spurt between 1 and 1.5 billion years after the Big Bang. During that growth spurt, galaxies acquired a significant amount of their stellar mass and dust. They also developed into the spiral galaxies that we see today and acquired heavy element content.
In the ALPINE survey, an international team of astronomers looked at 118 of these early galaxies that underwent growth spurts.
Andreas Faisst is one of the researchers involved in ALPINE. Faisst is a researcher at the Infrared Processing and Analysis Center (IPAC) at the California Institute of Technology (Caltech) and is also the lead principal investigator for ALPINE in the USA. In a press release, he said, "To our surprise, many of them were much more mature than we had expected."



The ALPINE project surveys galaxies that are between 1 and 1.5 billion years after the Big Bang. At that age galaxies are in a transition phase between primordial and mature. The transition phase is critical in understanding how galaxies formed and evolved. Image Credit: ALPINE
The dust content heavy element in a galaxy is what differentiates young galaxies from mature galaxies. Only mature galaxies have higher amounts of dust and metals, because they're a by-product of dying stars. Young galaxies haven't been around long enough for generations of stars to die and create the dust and metals.
When researchers looked at the 118 young galaxies they were surprised to see so much dust and so much metallicity. Their presence indicated that there had already been more stellar activity than thought. "We didn't expect to see so much dust and heavy elements in these distant galaxies," said Faisst.
Daniel Schaerer of the University of Geneva is another scientist involved with ALPINE. "From previous studies, we understood that such young galaxies are dust-poor," said Schaerer.
"However, we find around 20 percent of the galaxies that assembled during this early epoch are already very dusty and a significant fraction of the ultraviolet light from newborn stars is already hidden by this dust," he added.



These are two of the galaxies in the early universe that ALMA observed in radio waves. The galaxies are considered more "mature" than "primordial" because they contain large amounts of dust (yellow). ALMA also revealed the gas (red), which is used to measure the obscured star-formation and motions in the galaxies.
Credit: B. Saxton NRAO/AUI/NSF, ALMA (ESO/NAOJ/NRAO), ALPINE team.

Another question about the early galaxies is when they established rotation, and how soon that affected their structure. Spiral galaxies like our own Milky Way rotate, and that creates the spiral structure. Many of the galaxies in the study showed signs of rotationally-supported disks and diverse structures.
This goes against expectations.
According to accepted thinking, the early galaxies should be more chaotic and messy. Frequent galactic collisions and mergers should have prevented so much structure from emerging at such a young Universal age. "We see many galaxies that are colliding, but we also see a number of them rotating in an orderly fashion with no signs of collisions," said John Silverman of the Kavli Institute for the Physics and Mathematics of the Universe in Japan.
Artist's animation of a galaxy in the early universe that is very dusty and shows the first signs of a rotationally supported disk. In this image, the red color represents gas, and blue/brown represents dust as seen in radio waves with ALMA. Many other galaxies are visible in the background, based on optical data from VLT and Subaru.
Credit: B. Saxton NRAO/AUI/NSF, ESO, NASA/STScI; NAOJ/Subaru
Astronomers have observed distant galaxies from this time period before, like MAMBO-9 and the Wolfe Disk. MAMBO-9 is very dusty, and the Wolfe Disk has a rotating disk, so they were clues that galaxies could mature faster than thought. But they may have been outliers, and it took a larger survey like ALPINE to give researchers a clearer picture.

Artist impression of the Wolfe Disk, a massive rotating disk galaxy in the early, dusty universe. The galaxy was initially discovered when ALMA examined the light from a more distant quasar (top left). Credit: NRAO/AUI/NSF, S. Dagnello
But even though ALPINE has identified a handful of these early-bloomers, astronomers still don't know how they grew up so fast and why some of them have rotating disks at such a young age.
ALMA (Atacama Large Millimeter/submillimetre Array) played a huge role in this work. It's an extremely powerful radio telescope, and that's what's needed to see these distant galaxies. While many of these galaxies are basically invisible in optical and infrared light, they can shine quite brightly in millimetre and submillimetre radiation. Whereas optical and infrared can't pierce the dusty regions where stars form, or the motion of gas in these galaxies, ALMA can. In fact, optical and infrared telescopes sometimes miss entire galaxies.
"With ALMA we discovered a few distant galaxies for the first time. We call these Hubble-dark as they could not be detected even with the Hubble telescope," said Lin Yan of Caltech.

Three of the dishes that make up the Atacama Large Millimeter/submillimter Array (ALMA). Image Credit: H. Calderón – ALMA (ESO/NRAO/NAOJ)

The team intends to keep using ALMA's strength to try and understand why these young galaxies are so mature. While ALPINE was a survey that used 70 hours of observing time, they'd like to use ALMA to observe individual galaxies for longer periods of time. "We want to see exactly where the dust is and how the gas moves around. We also want to compare the dusty galaxies to others at the same distance and figure out if there might be something special about their environments," added Paolo Cassata of the University of Padua in Italy, formerly at the Universidad de Valparaíso in Chile.

ALMA can't do this work alone, of course. ALPINE is the largest survey of this type, where multiple telescopes at different wavelengths were used to study galaxies in the early Universe. A whole fleet of optical 'scopes were used, including the Hubble, Keck, and VLT.

And Spitzer's infrared capabilities were used, too. It's impossible to understand the history of distant galaxies without observations across multiple wavelengths.

"Such a large and complex survey is only possible thanks to the collaboration between multiple institutes across the globe," said Matthieu Béthermin of the Laboratoire d'Astrophysique de Marseille in France.

Something other than just gravity is contributing to the shape of dark matter halos

It now seems clear that dark matter interacts more than just gravitationally. Earlier studies have hinted at this, and a new study supports the idea even further. What's interesting about this latest work is that it studies dark matter interactions through entropy.

Entropy is a subtle and powerful concept in physics. It was first introduced as a property in thermodynamics, but it plays a role in everything from black holes to the flow of time. It's also rather difficult to define without relying on mathematics.

This is what entropy really is. Credit: Brian Koberlein

Entropy is often described as a measure of the disorder of a system. Ice, for example, with its water molecules arranged into symmetrical crystals has lower entropy than water, with its chaotic dance of water molecules. Since warmer things tend to be more disordered, entropy is also related to the temperature of an object. Hence, the second law of thermodynamics states that the entropy of a system can't decrease, which also means that heat flows from warm objects to cold ones.

For this latest work, entropy is better described in terms of how likely an object is to be in a particular state. Imagine lighting a scented candle in the corner of a room. While it is statistically for the scent of the candle to hover around the candle, the motion of the air in the room will most likely spread the scent throughout the room. An evenly spread scent is the most likely outcome because it is the state with the maximum entropy. It's a state also known as thermodynamic equilibrium.

There are more ways to scramble an egg than unscramble one. Credit: Brian Koberlein

In this new study, the team used computer models to calculate the state of maximum entropy for dark matter in dwarf galaxies. The distribution of dark matter determines how strongly light will gravitationally lens. When the team looked at theoretical lensing by galactic dark matter in maximum entropy, they found it agreed with observed lensing around dwarf galaxies. Thus, dark matter seems to be in a state of maximum entropy.

This means dark matter must interact in some way. The scent in a room reaches maximum entropy because the aroma molecules interact strongly with molecules of air. All those interactions work to increase the entropy of the room. Dark matter doesn't interact strongly with regular matter, so this study suggests it strongly interacts with itself.

Without knowing exactly what dark matter is, we don't know how it can interact. But this study and others further confirm the reality of dark matter.

Reference: Brinckmann, Thejs, et al. "The structure and assembly history of cluster-sized haloes in self-interacting dark matter." *Monthly Notices of the Royal Astronomical Society* 474.1 (2018): 746-759.

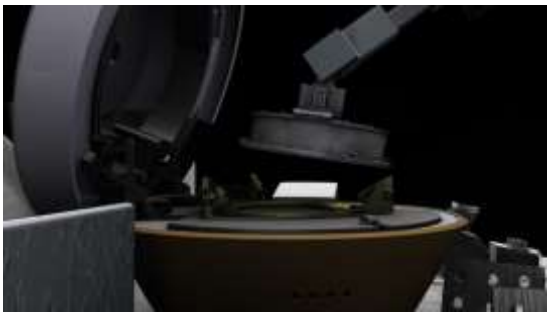
New Simulation Shows Exactly What's Happening as Neutron Stars Merge

Neutron stars are the remnants of massive stars that explode as supernovae at the end of their fusion lives. They're superdense cores where all of the protons and electrons are crushed into neutrons by the overpowering gravity of the dead star. They're the smallest and densest stellar objects, except for black holes, and possibly other arcane, hypothetical objects like quark stars.

When two neutron stars merge, we can detect the resulting gravitational waves. But some aspects of these mergers are poorly-understood. One question surrounds short-lived gamma-ray bursts from these mergers. Previous studies have shown that these bursts may come from the decay of heavy elements produced in a neutron star merger.

OSIRIS-REx Collected So Much Material, the Sample Capsule Overflowed. Time to Bring it All Home.

Is there such as thing as too much asteroid?
Scientists and engineers for NASA's OSIRIS-REx decided to perform an "early stow" of the sample from Asteroid Bennu collected by the spacecraft on October 20, because the collection container is full-to-overflowing, possibly jamming the collector head from sealing shut.
Images sent back from OSIRIS-REx on Oct. 22 showed asteroid regolith slowly escaping from the spacecraft's collector head, called the Touch-And-Go Sample Acquisition Mechanism (TAGSAM).

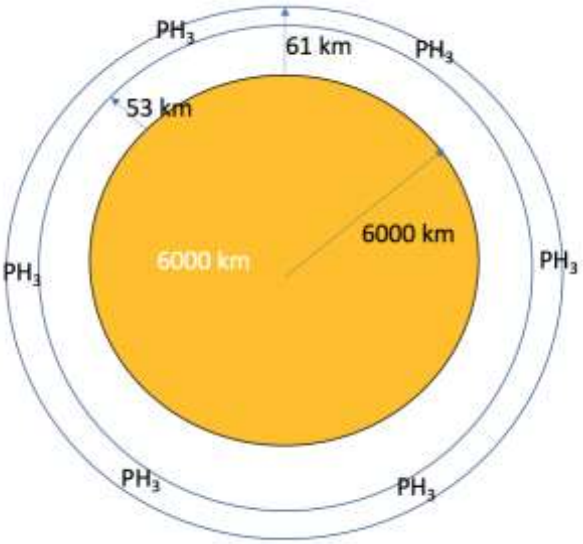


This illustration shows NASA's OSIRIS-REx spacecraft stowing the sample it collected from asteroid Bennu on Oct. 20, 2020. The spacecraft will use its Touch-And-Go Sample Acquisition Mechanism (TAGSAM) arm to place the TAGSAM collector head into the Sample Return Capsule (SRC). ***Credits: NASA/University of Arizona, Tucson***

"The abundance of material we collected from Bennu made it possible to expedite our decision to stow," said Dante Lauretta, OSIRIS-REx principal investigator at the University of Arizona, Tucson. "The team is now working around the clock to accelerate the stowage timeline, so that we can protect as much of this material as possible for return to Earth."
The science team wants to collect at least 60 grams of regolith; the sample container can hold as much as 2 kg. NASA said a mylar flap on the TAGSAM allows material to easily enter the collector head, and should seal shut once the particles pass through. However, larger rocks that didn't fully pass through the flap into the TAGSAM appear to have wedged this flap open, allowing bits of the sample to leak out.
The sample stowage was originally scheduled for November 2, 2020, but NASA has given the mission the go-ahead to begin stowing it today, October 27.
"We are working to keep up with our own success here, and my job is to safely return as large a sample of Bennu as possible," said Lauretta. "The loss of mass is of concern to me, so I'm strongly encouraging the team to stow this precious sample as quickly as possible."
For the sample collection sequence on October 20, OSIRIS-REx autonomously conducted the operations, with software on board to navigate the spacecraft safely to the surface, enable the collection and then conduct a "back away" burn to bring the spacecraft away from the asteroid's surface. Since Bennu is so far away from Earth, there was an 18.5-minute delay for the signal to get from the spacecraft to the Earth.
The entire event, from deorbit burn to sample collection, took about four and a half hours.
But now for the stowing sequence, stowing the sample is done in stages and requires the team's oversight and input. The team will send the preliminary commands to the spacecraft to start the stow sequence, then wait for the spacecraft to send telemetry and images back to Earth so the team can confirm the success of the process. The process may take several days.
It might not be possible to determine exactly how much sample was collected until the sample return container comes back to Earth in September of 2023. A spin maneuver called the Sample Mass Measurement, where the spacecraft would spin with the sample arm extended, has been canceled in order to preserve remaining material in the sample head. This spin would have allowed the team to determine the change in the spacecraft's "angular moment of inertia," and how it changes with the sample aboard. This would allow them to deduce the weight of the added sample.
"I'm proud of the OSIRIS-REx team's amazing work and success to this point," said NASA's Associate Administrator for Science Thomas Zurbuchen. "This mission is well positioned to return a historic and substantial sample of an asteroid to Earth, and they've been doing all the right things, on an expedited timetable, to protect that precious cargo."

Astronomers Challenge Recent Findings About Venus. "No Statistically Significant Detection of Phosphine"

In September, a team of scientists reported finding phosphine in the upper atmosphere of Venus. Phosphine can be a biomarker and is here on Earth. But it's also present on Jupiter, where it's produced abiotically. The discovery led to conjecture about what kind of life might survive in Venus' atmosphere, continually producing the easily-degraded phosphine.
The authors of that study were circumspect about their own results, saying that they hope someone can determine a source for the phosphine, other than life.
Now a new study says that the original phosphine detection is not statistically significant.
The new study is a re-production and re-evaluation of the original ALMA (Atacama Large Millimeter/sub-millimeter Array) data that the initial detection of phosphine was based on. It comes from a team of five researchers from the Netherlands.
The title of the study is "Re-analysis of the 267-GHz ALMA observations of Venus: No statistically significant detection of phosphine." The lead author is Ignas Snellen, Professor of Astronomy at Leiden University in the Netherlands. The paper has not been peer-reviewed yet and is available on the pre-press site arxiv.org.
After the initial discovery of phosphine at Venus, reported here at Universe Today, other scientists took notice. Other studies followed up on that work. One attempted to calculate how much life would be needed to produce the detected phosphine. Another suggested that life isn't necessary, and volcanoes could produce it.



The phosphine was detected in the upper layers of Venus' atmosphere in the original study. Image Credit: Greaves et al., 2020

But now it looks like the phosphine might not even be there at all.

The detection of the phosphine depended on a single 267 GHz spectroscopic line in the ALMA observations. It revealed a 20 parts per billion concentration of phosphine in Venus' upper atmosphere according to the original paper (Greaves et al. 2020). But the authors of this new study point out some problems in the initial detection.

First of all they point out that there are no evident ways for phosphine to be produced on Venus. Then they write that "The aim of this work is to assess the statistical reliability of the line detection by independent re-analysis of the ALMA data." The team used the same data and followed the same methods and used the same scripts as the original study. In fact, the authors of the original study, Greaves et al., even contacted this team to provide them with an updated ALMA data-processing script.

The new study says that the method used to fit the original ALMA spectral data in the prior study "…leads to spurious results." They go on to say that their independent analysis shows a phosphine detection feature that's "…below the common threshold for statistical significance." Then, "…we consider a feature at such level as statistically unreliable that cannot be linked to a false positive probability."

Astronomical data like the type used in these studies is subject to a signal-to-noise ratio. It compares the level of the desirable, information-rich signal to the background noise. In order to be significant, the signal has to rise far enough above the noise. A low SNR means the data signal has not risen far enough above the noise to be significant. The ALMA data failed to do that, according to this study. The authors found SNRs of only two and one, depending on the analysis of the data and how it was fitted.

The planet Venus, as imaged by the Magellan mission. It looks like the phosphine detection was unreliable and that the phosphine signal in the ALMA data did not rise far enough above the noise to be statistically significant, according to a new study. Credit: NASA/JPL

They don't hold any punches in their conclusion, saying "We find that the 267-GHz ALMA observations presented by GRB20 <Greaves et al. 2020> provide no statistical evidence for phosphine in the atmosphere of Venus."

This is exactly how science is supposed to work. For scientific results to be valid, their findings have to be recreated and validated by others. The authors of this study make sure to mention that the authors of Greaves et al. were just as interested as they were in having their results tested and that Greaves and the other researchers behind the phosphine discovery made their data and methods available to them. "We thank the authors of GRB20 for publicly sharing their calibration and imaging scripts."

Stay tuned. This may not be the last word on phosphine on Venus.

Scientists Think They Know What Caused the Deadliest Mass Extinction in the History of the Earth

Humanity can have a love/hate relationship with itself, but there's no denying that we're the pinnacle of evolution on Earth as things stand now. But it took an awfully long time for evolution to produce beings such as we. Several times, life had to drag itself back from near annihilation.

The largest extinction setback was the Permian-Triassic extinction, also called the "Great Dying," some 252 million years ago. Up to 96% of all marine species and 70% of terrestrial vertebrate species went extinct.

What happened?

There's some uncertainty surrounding the cause or causes of the extinction. Many of the usual suspects have been accused: impact events, climate change brought on by methane-producing bacteria, massive volcanic eruptions, as well as some lesser-known potential causes like a fungal spike. There's some evidence for each hypothesis, but it's still controversial. The uncertainty around the Great Dying also extends to the timeline and sequence of events, including how long Earth took to recover.

Now, the authors of a new study say they have finally, conclusively figured it out. The paper is titled "Permian–Triassic mass extinction pulses driven by major marine carbon cycle perturbations." The lead author is Dr. Hana Jurikova from the School of Earth and Environmental Sciences at St. Andrews University. The study is published in the journal Nature Geoscience.

The team of scientists behind this research includes researchers from Germany, Italy, and Canada. They're part of an EU-funded project called BASE-LiNE Earth. BASE-LiNE Earth is led by Prof. Dr. Anton Eisenhauer from GEOMAR Helmholtz Centre for Ocean Research Kiel in cooperation with the Helmholtz Centre Potsdam GFZ German Research Centre for Geosciences. BASE-LiNE stands for Brachiopods As SEnsitive tracers of

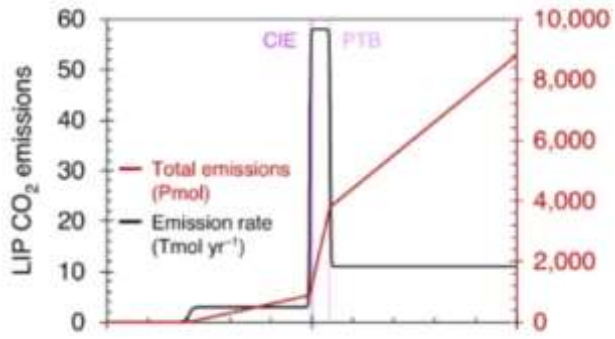
gLobal mariNe Environment. The effort focuses on brachiopod fossils, which, according to a press release, haven't received much attention and are sometimes overlooked. Brachiopods are a group of creatures that have hard shells on their upper and lower surfaces. They're different from bivalve molluscs like clams, which have shells on the sides. Brachiopods are still around today, but are far less numerous than they were in the Paleozoic.

The researchers studied brachiopod shells from Italy and China. The Siberian Traps, the source of the CO2, is shown in red on the map. Image Credit: Jurikova et al., 2020.

Many brachiopod species went extinct during the Great Dying. But some survived, and the team of researchers found brachiopod shells that span the critical time period during the Permian-Triassic extinction event.

The shells are a record over time of the ocean's pH level. The pH level reflects the amount of absorbed carbon dioxide (CO2) in the ocean when the animal made the shell. When combined with carbon isotope constraints, the team was able to construct a timeline of not only the amount of atmospheric CO2 but also their sources at the time of the extinction.

The researchers determined that a large pulse of CO2 triggered the Permian-Triassic extinction. The pulse originated in Siberia, where a huge volcanic eruption created a massive flood basalt province. All of that activity released an enormous amount of CO2 into the atmosphere; 100,000 billion tonnes (= 1×10^{14} tonnes).



This figure from the study shows the Large Igneous Province CO2 emissions, both total and rate/year. For a more detailed explanation, see the research paper. Image Credit: Jurikova et al. (2020).

That is an almost incomprehensible amount of carbon injected into the atmosphere in a short (geologically speaking) period of time. A press release announcing the paper says that's "more than 40 times the amount of all carbon available in modern fossil fuel reserves including carbon already burned since the industrial revolution."

All of that CO2 threw Earth's biogeochemical makeup out of balance and spelled doom for most of the species on Earth. The team used innovative modeling to determine exactly what that sudden injection of CO2 meant for our planet.

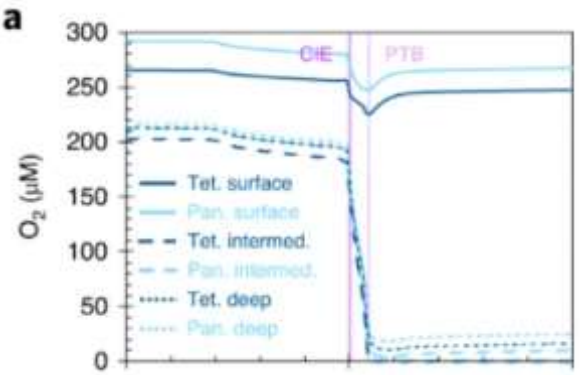
This image illustrates the onset of the Permian-Triassic mass extinction based on findings of the new research. (Jurikova et al (2020)). The Siberian Traps released an enormous amount of CO2 into the atmosphere, acidifying the oceans and extinguishing marine life in the surface ocean. Illustrated by Dawid Adam Iurino (PaleoFactory, Sapienza University of Rome) for Jurikova et al. (2020).

There's already a lot of evidence showing that Siberian volcanic activity led to the extinction. But the evidence has never been this unified. "The exact causes and consequences, however, remain controversial, and a coherent unifying scenario for the environmental evolution over this important interval in Earth's history is still lacking," the researchers write.

"Our findings enable us to assemble a consistent biogeochemical reconstruction of the mechanisms that resulted in the largest Phanerozoic mass extinction," the authors write in their paper. The CO2 led to extreme warming of the Earth's atmosphere and lethal acidification of the oceans. For marine animals that build their own shells, like the brachiopods at the heart of this research, it was devastating. As the ocean became more acidic, the carbonate that they need to build shells becomes unavailable, locked into the ocean's new chemistry. Some brachiopods survived, creating the evidential record that enabled this study.

The extreme climate warming was the second severe blow for life on Earth. The greenhouse effect created pronounced changes in weathering on the land, and on nutrient input and cycling in the ocean. The result was vast deoxygenation of the Earth's oceans. It likely also poisoned the oceans with sulfides, killing other groups of organisms.

The oceans, birthplace of life on Earth, became a place of death.



This figure from the study shows how the amount of dissolved oxygen in the oceans plunged rapidly in intermediate depths and in the deep ocean. The plunge wasn't so pronounced at the surface, where interaction with the atmosphere introduced oxygen into the ocean. The deoxygenation spelled doom for many species. Image Credit: Jurikova et al. 2020.

While volcanic activity has been proposed as a cause of the Great Dying before, this study is a more complete timeline of events. Then, as now, life on Earth relies on global cycles of nutrients, carbon, nitrogen, and other things. In only a few thou-

sand years, those cycles were upended by the CO2 from the Siberian eruptions. Climate warming, ocean acidification, ocean deoxygenation, and sulfide poisoning came one after another, creating the most severe extinction in the Earth's history.

"These findings lead us to view the PTB <Permian-Triassic Boundary> mass extinction as a cascading marine collapse, triggered by a multimillennial-scale voluminous injection of carbon to the atmosphere by the emplacement of Siberian Traps sill intrusions," the authors write. "Its magnitude profoundly altered the biogeochemical processes and set off a chain of events that selectively eliminated different groups of marine organisms."

In a press release, lead researcher Dr. Jurikova said: "Our research provides the first precise reconstruction of the carbon source and with it the trigger of the crisis, as well as uncovers the subsequent chain of processes that resulted in Earth's largest mass extinction."

The extent of the Siberian Traps, in German. Image Credit: By derivative work: Jo (talk)Sibirien_topo2.png: Ulamm 21:06, 18 April 2008 (UTC) – Sibirien_topo2.png, CC BY-SA 3.0, https://commons.wikimedia.org/w/index.php?curid=4229776

"It took several hundreds of thousands to millions of years for the ecosystem to recover from the catastrophe, which profoundly altered the course of evolution of life on Earth."

It's natural to wonder if these findings can tell us anything about our current predicament, where our own carbon emissions are warming the climate and acidifying the oceans.

In their paper's conclusion the authors write: "Given the vastly differing timescales and carbon budgets involved, LIP <Large Igneous Province> carbon cycle dynamics is a poor analogy for present-day fossil fuel emissions; notwithstanding that, the modern geological carbon reservoirs are insufficient for anthropogenic release beyond centennial time scales."

Alarmingly, we may still be emitting more carbon than during the Siberian volcanic activity that triggered the Permian-Triassic extinction. "It is, however, noteworthy that even the peak emissions rate during the largest known mass extinction is still more than 14 times less than the current anthropogenic rate."

Image Credit: Western Washington University.

During the Great Dying, it took thousands of years for the effects of all of that carbon to unfold. But we're already seeing the effects of our carbon emissions, and we're barely out of the Industrial Revolution. "The environmental deterioration during the PTB took several thousands of years to unfold, whereas the current, unprecedented emissions rate has already started to take a toll on the marine ecosystems," the authors point out.

The paper ends with what could be an ominous understatement: "A coupled increase in atmospheric CO2 and decrease in surface ocean pH, global warming, changes in productivity and oxygen depletion have been reported worldwide, which suggests that the scenario outlined here for the PTB may also be relevant to understanding future environmental and climatic trends."

E Mails Viewings Logs and Images from Members.

Hi Andy,
I hope you are well.
Here are my submissions for the WAS November 2020 newsletter. With the poor weather there few chances except for moonlit evenings.
26/10/2020

81% Lit Waxing Gibbous Moon
Canon SX50HS 1200mm, ISO 80, F8, 1/160 sec

80 raw images converted to tiff in DPP, cropped and centred in Pipp, stacked in Registax 6 and post processed in Affinity Photo.

27/10/2020
88% Lit Waxing Gibbous Moon

Canon SX50HS 1200mm, ISO 80, F8, 1/160 sec
80 raw images converted to tiff in DPP, cropped and centred in Pipp, stacked in Registax 6 and post processed in Affinity Photo.

I have also been re-working some of my Argentina 2019 total solar eclipse images using techniques found in Astronomy Now, Sky and Telescope, Sky at Night and Dave Eagle's book Affinity Photo for Astrophotography. This involved a seven process starting with converting the images to tiff in Canon DPP and then post processing in Affinity Photo. Dave Eagle's book revealed features in Affinity Photo that I have not seen described elsewhere. The attached image of corona streamers and prominences is the combination of twelve exposures from 1 sec to 1/1000 sec at F8, ISO 100 taken with my Canon Sx50HS at 1200mm.
Clear Skies,
John

Andy,

It doesn't look like I can join you tomorrow as I am still in hospital. Hopefully the the next one.

Mike.

Viewing Log for 9th of October

With it being a full week since full Moon and the sky was clear and I had a free evening, it was time to do some viewing!

I arrived at my usual viewing spot near Uffcott just south of Swindon and had my Meade LX90 eight inch (203 mm in new money) GOTO telescope set up and ready by 20:51 with no wind and a temperature of 7 °C conditions should be good? For over a year the GPS function on this telescope was not working correctly and I had been setting up manually but recently I uploaded a fixing patch which hopefully would work? Switching on the power for the first time, the telescope actually slewed to the required star, same with the second star, once aligned would be interested to see how it functioned?

First target for the evening was Jupiter and for a change it was actually in the field of view of the eye piece (normally I can see it in the finder scope and have to adjust it slightly?), Io was just to the west of Jupiter with Calisto and Europa sitting on top of each other (line of site only) with Ganymede further to the east? Onto Saturn and this ringed wonder was also in the eye piece! Could only make out the large moon of Titan and no others? Onto Mars shining very brightly (mag -2.6 and the brightest evening object after the Moon?) in the eastern skies, this planet was just out of the eye piece. Using a No. 8 filter (yellow), I could make out some markings in the southern hemisphere on the red planet? By now I had the first of many cars going past me this evening, over the course of the whole session there would be 11 cars going past! Uranus was about half the way to the edge of the finder scope view, could not make out any detail on the seventh planet, as for Neptune could not find it at all?

For a change I thought I would let the hand controller choose objects to view, the programme is called 'Tonight's Best' and first three objects were Mars, Jupiter and Saturn, as I had already looked at them I carried on with the next object which was the 'Double Cluster' or Caldwell (C) 14, these open clusters (O C) looked better in the finder scope, will have to bring out one of my refracting telescopes to view this object and get better results? Next object was the star Vega in Lyra, this is a brilliant white star which is the fifth brightest in the whole night sky? Messier (M) 45, the Pleiades was better to view with the finder scope, another object for a refractor? Onto Albireo at the head of the Swan, this is probably the best double star in the whole sky? Best globular cluster (G C) in the northern sky is M 13, tonight this had 3 B's for viewing: bright, big and brilliant, could even make out the odd star in the G C? Onto Pegasus and the head of the horse and the star Enif, this is a K class star? M 38 was my next target, this was just above the hedge in the north eastern sky, this O C was large, loose and dim to view, did not help being so low? Back to the second star of the summer triangle and Altair, this is also a white star and 12th brightest in the night sky? Onto M 34, this O C was loose but bright to look at. Back to the north east and M 36, this O C was compact and dim to view, again low in the sky? M 15 was spot on (centre of eye piece, some previous objects I had to move the scope slightly to centre the object), this G C is small but had a bright centre? M 27, largest planetary nebula (P N) in the sky was a large grey blob to look at. Spot on also was M 2, this is very similar to M 15 to look at? Final star of the summer triangle and Deneb, this is also a brilliant white star. For some reason the hand controller went to M 92, a very good G C in Hercules which often gets over looked for M 13, I had visited M 13 10 objects ago, thought M 92 would have followed M 13 as they are so close together in the sky? M 82 in Ursa Major I could just see this galaxy thru a tree, dim to look at! The Wild Duck cluster or M 11 was large and could make out quite a few stars in this O C? Over the next three objects I had four cars go past me, so my viewing sessions stopped and started for a while, lucky this was the last of any cars for the evening! Onto second P N of the evening and M 57, the Ring Nebula, small grey circle sums up this object. M 31, the great Andromeda galaxy was a large grey lump, no other way I could really call it! M 52 was not in the eye piece but in the finder scope so I had to do some manual adjustment to get this O C in the eye piece! M 51 was in the hedge so I could not view that object! Now onto M 32 which is right next door to M 31 but had to go via two other objects before I came to it! Small fuzzy blob to my eyes? C 63, the Helix nebula was even duller to view than M 32, this P N is fairly small to look at? Back to the planets and Uranus, this time the planet was higher and I could make out more blue in the planet. Even managed to find Neptune this time, just a point of light!

That was the end of the tour for 'Tonight's Best', I could not make out why the hand controller took the telescope all over the sky instead of following the sky was west to east? At least the telescope had a good work out for the evening. The waning gibbous Moon was just starting to rise and with the time being 23:03 I packed up the equipment for the evening, temperature when I finished was 6 °C.

Clear skies.

Peter Chappell

Thankyou all. My own view sessions have been curtailed by the weather too. Odds of lunar work and Mars, Jupiter and Saturn not well placed for me and needs everything to be steady early evenings now.

I have been ready an excellent book on the Moon photography by James Harrop, The Moon, a beginners guide to Lunar Features and Photography.

It got me out to set up my planetary scope (9.25" Celestron) and a webcam to have a go at better colour than before. But a lot of experimentation needed.

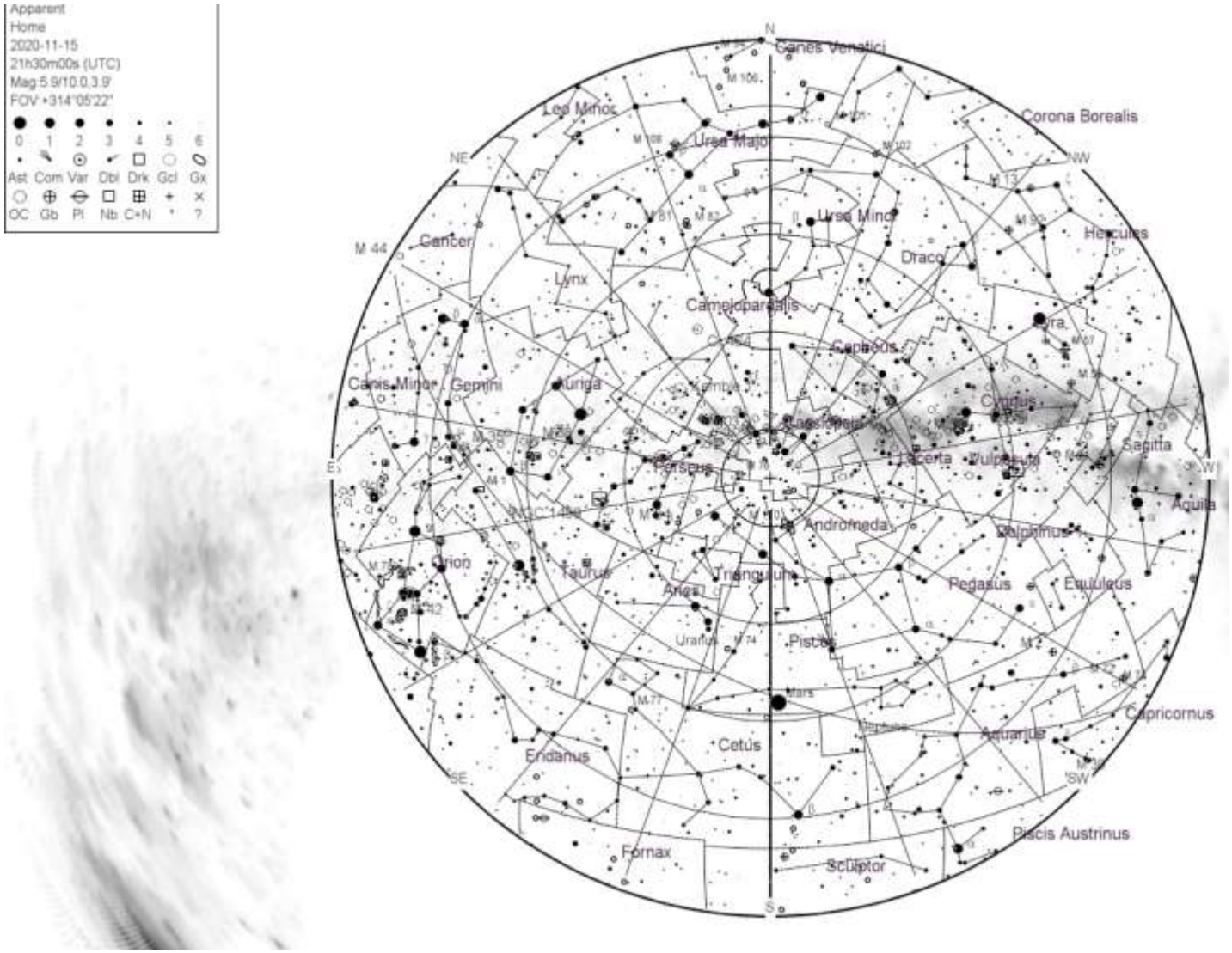
But last night I thought I would go to Silbury 17:30 for Moon rise around 18:00 with Mars over the hill, then the Moon rise over Waden. Done it so many times and still got a basic wrong… The widefield view with Mars and the hills of Silbury and Waden for the Moon. Totally ruined by poor focus. Just touched the focus when setting up after tripod mounting and then everything blurred. Stupid mistake BUT I think useful to mention here as a lesson to all while I where me sackcloth and ashes.

A saving grace, I took shots on my iPhone of the wide-view, then a series of Moon rising shots at 1000 -2000mm on zoom with my bridge camera Nikon P1000. So rescued… a bit.

I like this iPhone shot with Mars, the hills and a shine of the Moon just in the horizon clouds. Then the grass looks look a dark rocket launch.

Series of the Moon rising. I prefer the Moon to be a couple of days after full, then the sky horizon is dark enough to show silhouette and lunar features.

WHATS UP, NOVEMBER 2020



November 10 - **Mercury at Greatest Western Elongation.** The planet Mercury reaches greatest western elongation of 19.1 degrees from the Sun. This is the best time to view Mercury since it will be at its highest point above the horizon in the morning sky. Look for the planet low in the eastern sky just before sunrise.

November 11, 12 - **Northern Taurids Meteor Shower.** The Northern Taurids is a long-running minor meteor shower producing only about 5-10 meteors per hour. This shower is, however, famous for producing a higher than normal percentage of bright fireballs. The Northern Taurids is produced by dust grains left behind by Asteroid 2004 TG10. The shower runs annually from October 20 to December 10. It peaks this year on the the night of the 11th and morning of the 12th. The thin crescent moon will not be much of a problem this year leaving dark skies for what could be a really good show. 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 15 - **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 05:08 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.

November 16, 17 - **Leonids Meteor Shower.** The Leonids is an average shower, producing 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 16th and morning of the 17th. The crescent moon will set early in the evening leaving dark skies for what should be an excellent show. Best viewing will be from a dark location after midnight. Meteors will radiate from the constellation Leo, but can appear anywhere in the sky.

November 30 - **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 09:32 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 30 - **Penumbral Lunar Eclipse.** A penumbral lunar eclipse occurs when the Moon passes through the Earth's partial shadow, or penumbra. During this type of eclipse the Moon will darken slightly but not completely. The eclipse will be visible throughout most of North America, the Pacific Ocean, and northeastern Asia including Japan. Not here…

Clear skies, Andy

Observing Notes - November 2020

Talking Bull with Taurus!

This month we 'Talk Bull' as we focus on Taurus

We are now well and truly into autumn, the clocks have gone back an hour, it gets dark early and before the temperature really drops for winter, we have the opportunity to observe the constellation, that in my opinion, heralds the new observing season.

One of the oldest asterisms, the 'V' of the constellation of Taurus the Bull is easily recognisable in the sky sitting on the Ecliptic, between Aries to the west and Gemini to the east; to the north lies Perseus and Auriga, to the south-east Orion. By late November, the constellation is opposite the Sun and is visible the entire night.

The constellation is an important agricultural symbol and can be dated back to the mythologies of Ancient Sumer, Akkad, Assyria, Babylon, Egypt, Greece, and Rome and even into prehistory (there is a belief by some, that this constellation is represented in the 17,000 year old cave paintings of Lascaux in France).

In Greek mythology Taurus was identified with Zeus and sometimes Io, who both assumed the form of a bull to enable to carry out various underhanded exploits.

Taurus has two great open cluster within it, called Hyades and Pleiades, which I will talk about later, but according to the myth, the Hyades are the daughters of Atlas and Aethra - who are forever crying for their brother Hyas, who was killed by a wild animal - and is represented in the night sky by the constellation of Aquarius. The Hyades are the half-sisters to the Pleiades, the daughters of Atlas and Pleione, who were purposely kept away and safe from Orion the Hunter and his unwanted advances.

The Constellation

The brightest member of this constellation is the first magnitude orange star Aldebaran (α Tauri), Arabic for "the follower" and normally representing the Bulls raging red eye. It forms part of the profile of a Bull's face with a V-shaped cluster of stars known as the Hyades.

This very open cluster is 150 light years away

▲ Looking East to Taurus

▲ Detail of Taurus and location of the Pleiades

and our nearest moving group of stars after those in Ursa Major. However, Aldebaran is not part of the cluster and is only in line of sight. The cluster spans about 5° of the sky, so that they are best viewed with binoculars or even with the just one's own eyes.

The Hyades includes a number of naked eye double stars including Chakumuy (θ1 and θ2 Tauri) which have a separation of 5.6 arc-minutes so should be viewable with just keen eyes.

Another doubles star worth looking for in the Hyades is δ1 and δ2 Tauri which is a true double star located just 2° north-west of the θ1 and θ2 Tauri. δ1 is easy to pick out at magnitude 3.8, but its companion is a magnitude fainter and may require an averted vision approach to see even though there is 18′ of separation between them. If all else fails binoculars will separate them easily.

There are two other doubles stars worth seeking out but that are not in the Hyades 'V' as it were. these are σ1 and σ2 Tauri located 1° south-east of Aldebaran though not a true double as the two stars are 9 light-years apart. And the other is κ1 and κ2 Tauri located 3° north of the "V" of Taurus. To be fair both these doubles are a bit of a challenge to the naked eye but can be seen easily in binoculars

There is a theory that there is a cosmological link between the Hyades cluster and the Beehive star cluster in the constellation Cancer the Crab. Even though the clusters are separated from one another by hundreds of light-years, they are remarkably similar in age and travel in a similar direction in space. Therefore, astronomers believe these clusters might have originated from the same gaseous nebula some 700 to 800 million years ago.

Moving away from the Hyades to the west of Aldebaran, are the two horns of the bull formed by the white magnitude 1.6 giant star El Nath (β Tauri) which is an Arabic phrase meaning "the butting", and also by Tianguan (ζ Tauri) an eclipsing binary star that completes an orbit every 133 days.

β Tauri actually shares its 'constellational' border with that of the neighbouring Auriga and as a result, it also bears the designation Gamma (γ) Aurigae.

ε Tauri or Ain is located on the open end of the Hyades cluster and located about 1.8° west of this is T Tauri, which is a variable star which undergoes erratic changes in luminosity, varying between magnitude 9 to 13 over a period of weeks or months. This is a newly formed stellar object

that is just emerging from its envelope of gas and dust and is not yet on the main sequence star. There is a surrounding reflection nebula called NGC 1555 which is illuminated by T Tauri, and therefore varies in luminosity.

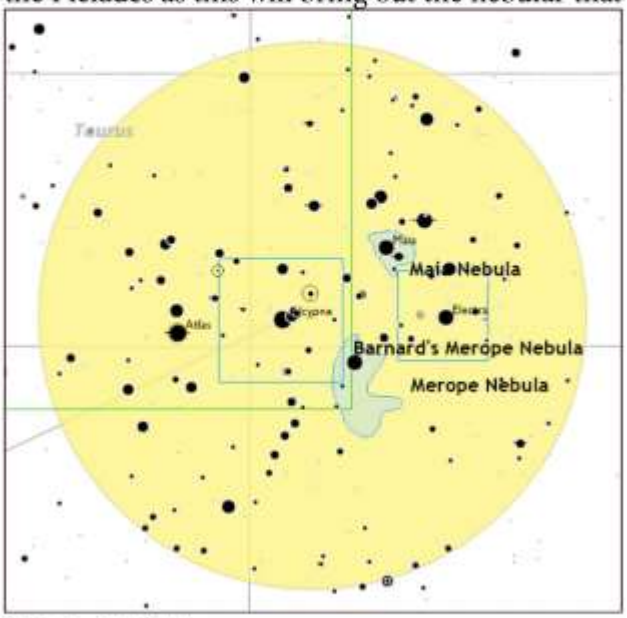
λ Tauri is a 3.4 magnitude eclipsing binary star to the west of the pointy end of the Hyades as it were and who's plane of orbit lies almost along the line of sight to the Earth so that every 4 days (ish), the system temporarily decreases in brightness by 1.1 magnitudes as the brighter star is partially eclipsed by its dimmer companion.

Deep Sky Objects

The Pleiades

As mentioned, Taurus hosts two of the nearest open clusters to Earth. The second cluster is called the Pleiades or Messier 45 (M45) and is easily visible to the naked eye to the north-east of the Hyades. The seven most prominent stars in this cluster are at least visual magnitude six, and so the cluster is also named the "Seven Sisters". However, many, many more stars are visible with a modest telescope on low power or small binoculars and in fact this is how the cluster is viewed best.

This cluster just so happens to be moving through a nebula and if you are interested in doing a bit of astrophotography and have a driven mount, it is worth taking a long exposure photo of the Pleiades as this will bring out the nebular that surrounds this cluster.

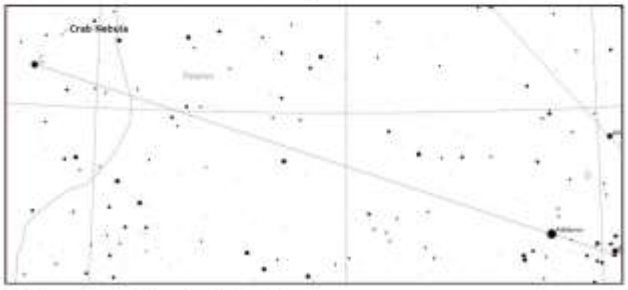


▲ Detail of the Pleiades

The remaining deep skies objects are all quite difficult to located and observe even in larger telescopes and so are both in this month's challenge.

The Crab Nebula

A degree to the north-west of ζ Tauri is the Messier object M1, the Crab Nebula, a supernova remnant. This expanding nebula was created by a supernova explosion, which was seen from Earth on July 4, 1054. It was bright enough to be observed during the day reaching Magnitude -4 (similar to that of Venus).



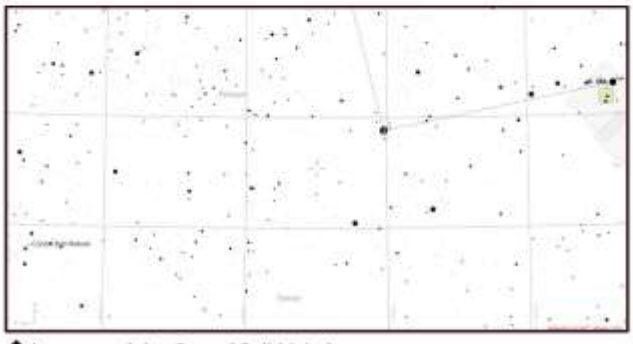
▲ Location of the Crab Nebula

The magnitude of the nebula now however is 8.4 and requires a small telescope to observe, (although it can be spotted in 15 x 70 binoculars from a dark site) but even then, it is a very small and faint a to be fair, a little disappointing.

The Crystal Ball Nebula

The Crystal Ball Nebula or NGC 1514 lies on the border of Taurus and Perseus to the north-west of the Pleiades. The closest bright star in the area is ξ Persei, a blue supergiant with a visual magnitude of 2.86. ψ Tauri appears closer to the nebula, but with a magnitude of 5.22, it is not easily visible from light-polluted areas.

This planetary nebula discovered by William



▲ Location of the Crystal Ball Nebula

Herschel in 1790 and is quite dim and quite difficult to find even with larger telescopes so good luck with this one.

Meteor Showers

I often use a reclining deck chair and wear a nice thick coat when watching meteor is this time of year. It keeps your feet of the ground and its nice just to see the short flashes of luminance as a meteor catches your eye. During November, the Taurid meteor shower appears to radiate from the general direction of this constellation.

Although quite week showers both the Northern Taurids and the Southern Taurids are active between November 1st and 10th. However, the moon will be very bright and its Guy Fawkes, so both are likely to spoil the view somewhat.

The Leonids are usually one of the more prominent meteor showers and is associated with Comet Tempel-Tuttle. The point of origin, where the meteors seem to originate from is at the head or 'sickle' of the constellation Leo the Lion. The maximum number is likely to be seen around the 17th/18th and the good news is that the moon will be thin crescent setting at 17:00 so we are hopeful.

Moon and planets

All five bright and the two not so bright planets are in the November. The big three of the moment – Mars, Jupiter and Saturn are visible just after dusk while Mercury and Venus can be found in the early morning sky.

The bright planets are easily visible without optical aids like telescopes or binoculars (although Mercury can be difficult from the UK at times.

The two not so bright planets are Uranus, which is at the very limits of the best eyesight and not regarded as a naked eye object. And Neptune which is only visible with a telescope or binoculars. Even then, both these objects are small even when using a good telescope and in the case of Neptune I often have to refer to on-line sky maps to convince myself I have seen it. With bigger telescopes, and higher magnifications, some of the moons can be seen.

Mars and Jupiter will be the first two 'stars' out in the evening sky. Jupiter will be low down in the south and west and Mars will be rising in the eastern half of skies

As the sky darkens, the planet Saturn will make an appearance about 5 degrees (two fingers width at arm's length) to the east of Jupiter

All three of these planets will be magnificent in a telescope although Jupiter and Saturn will be affected by the murk in the Earth's atmosphere and Mars is shrinking days by day as its distance from earth increases.

▲ Looking south to Mars, Saturn and Jupiter

Uranus Well positioned evening planet in Aries and lay approximately central between Mars and the Pleiades in the middle of the month.

Neptune is also a well-placed evening planet laying close to the star Phi (φ) Aquarii.

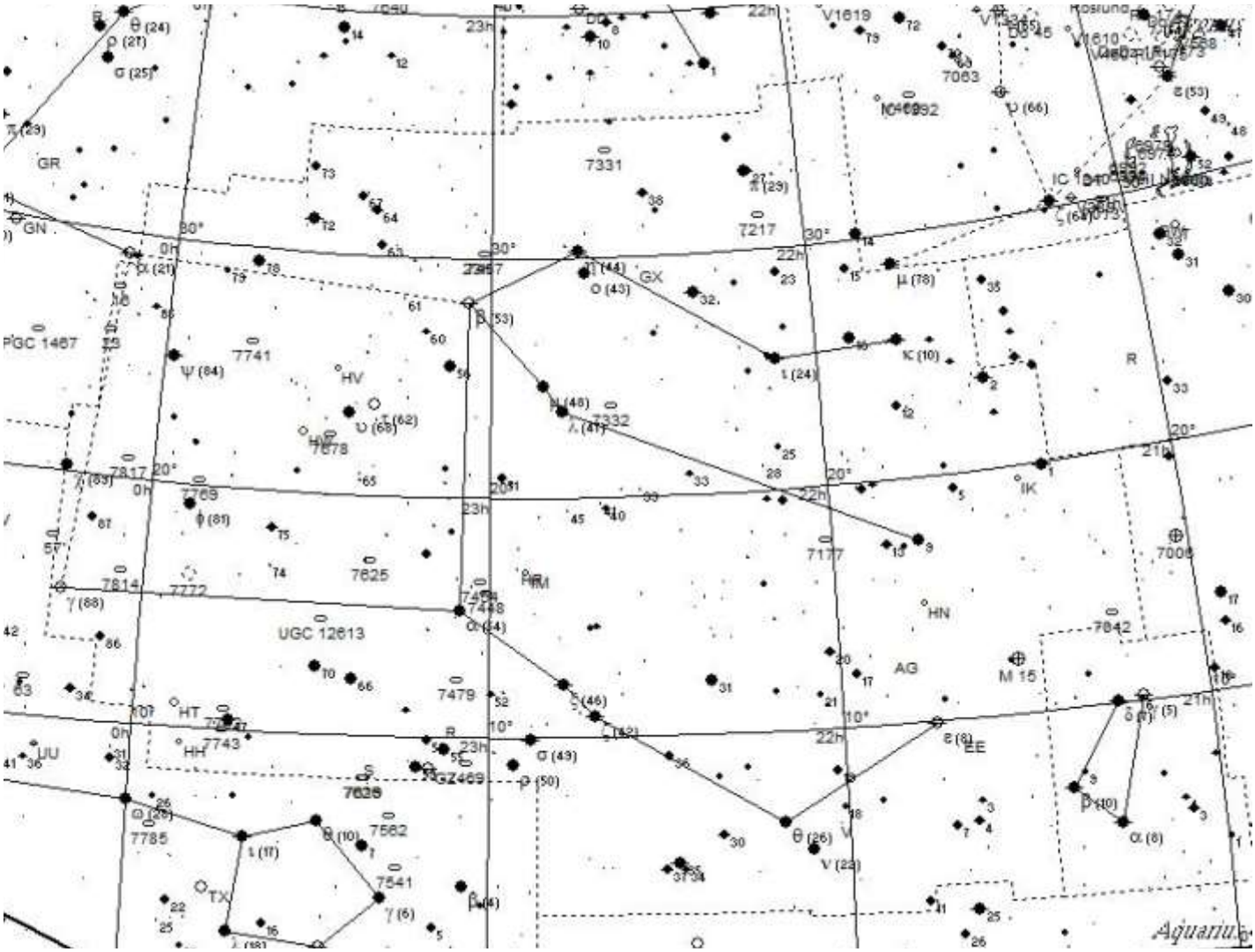
Both Mercury and Venus are morning planets. Mercury reaches its farthest from the sun (western elongation) on 10th November when it rises 2 hours before it and Venus, despite getting closer and closer to the Sun, remain a prominent object rising a couple of hours before Mercury.

The Moon is biggest and brightest at the beginning and end of the month so if you are looking for those deep sky faint fuzzies, then lets hope the skies are clear a week either side of the 15th. The Lunar 'X' & 'V' starts at 14:30 and should be visible after sunset on 22nd November or even possible during the day with a telescope.

Chris Brooks
WAS Observing Team

▲ Looking east early morning to Mercury and Venus

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

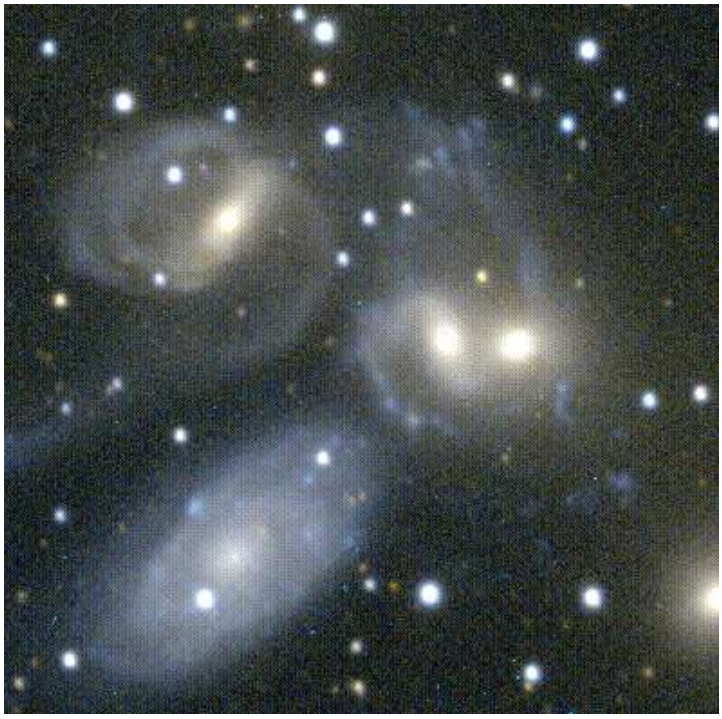
the way will bring you to awesome globular cluster – Messier 15 (RA 21:29:58.3 Dec +12:10:01). Located almost equidistantly from both the galactic center and from us, this superior globular cluster was first discovered by Jean-Dominique Maraldi on September 7, 1746 and later listed by Charles Messier 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:
ChandraObservatory
SEDS
Wikipedia

Stephen’s Quintet and NGC 7331 taken through a 42 telescope and 60 seconds exposure ISO1600, from my home observatory this September.

Andy

ISS PASSES For Nov/Dec 2020 From Heavens Above website maintained by Chris Peat

Date	Brightness	Start	Highest point	End						
	(mag)	Time	Alt.	Az.	Time	Alt.	Az.	Time	Alt.	Az.
02 Nov	-3.9	04:59:11	84°	NW	04:59:15	85°	N	05:02:37	10°	E
03 Nov	-1.4	04:13:22	24°	E	04:13:22	24°	E	04:14:49	10°	E
03 Nov	-3.7	05:46:18	23°	W	05:48:15	75°	SSW	05:51:37	10°	ESE
04 Nov	-3.9	05:00:29	87°	SSE	05:00:29	87°	SSE	05:03:50	10°	E
05 Nov	-1.3	04:14:41	22°	E	04:14:41	22°	E	04:16:02	10°	E
05 Nov	-3.2	05:47:37	23°	W	05:49:21	46°	SSW	05:52:35	10°	SE
06 Nov	-3.5	05:01:51	58°	S	05:01:51	58°	S	05:04:55	10°	ESE
06 Nov	-1.8	06:35:35	10°	W	06:37:56	18°	SW	06:40:16	10°	S
07 Nov	-1.1	04:16:07	19°	ESE	04:16:07	19°	ESE	04:17:10	10°	ESE
07 Nov	-2.3	05:49:04	20°	WSW	05:50:17	25°	SSW	05:53:06	10°	SSE
08 Nov	-2.4	05:03:24	30°	S	05:03:24	30°	S	05:05:41	10°	SE
09 Nov	-0.7	04:17:46	12°	SE	04:17:46	12°	SE	04:18:07	10°	SE
09 Nov	-1.5	05:50:44	12°	SW	05:51:02	12°	SW	05:52:31	10°	SSW
10 Nov	-1.2	05:05:12	13°	S	05:05:12	13°	S	05:05:47	10°	S
20 Nov	-1.2	18:38:27	10°	SSW	18:39:09	14°	S	18:39:09	14°	S
21 Nov	-1.6	17:51:26	10°	S	17:53:21	15°	SE	17:53:25	15°	SE
21 Nov	-0.4	19:26:18	10°	SW	19:26:22	10°	SW	19:26:22	10°	SW
22 Nov	-2.1	18:38:36	10°	SW	18:40:33	28°	SSW	18:40:33	28°	SSW
23 Nov	-2.5	17:51:02	10°	SSW	17:53:59	28°	SSE	17:54:40	26°	SE
23 Nov	-0.5	19:27:08	10°	WSW	19:27:37	13°	WSW	19:27:37	13°	WSW
24 Nov	-1.9	17:03:40	10°	SSW	17:06:15	20°	SE	17:08:44	10°	E
24 Nov	-2.6	18:39:16	10°	WSW	18:41:40	42°	SW	18:41:40	42°	SW
25 Nov	-3.4	17:51:29	10°	SW	17:54:46	52°	SSE	17:55:42	37°	ESE
25 Nov	-0.5	19:28:05	10°	W	19:28:38	14°	W	19:28:38	14°	W
26 Nov	-2.8	17:03:46	10°	SW	17:06:55	38°	SSE	17:09:41	13°	E
26 Nov	-2.7	18:40:10	10°	W	18:42:37	45°	W	18:42:37	45°	W
27 Nov	-3.8	17:52:15	10°	WSW	17:55:38	80°	SSE	17:56:35	44°	E
27 Nov	-0.4	19:29:03	10°	W	19:29:31	13°	W	19:29:31	13°	W
28 Nov	-3.6	17:04:23	10°	WSW	17:07:43	66°	SSE	17:10:32	14°	E
28 Nov	-2.5	18:41:08	10°	W	18:43:28	42°	W	18:43:28	42°	W
29 Nov	-3.8	17:53:10	10°	W	17:56:33	85°	N	17:57:26	47°	E
29 Nov	-0.4	19:29:58	10°	W	19:30:22	13°	W	19:30:22	13°	W
30 Nov	-3.8	17:05:14	10°	W	17:08:36	90°	S	17:11:24	14°	E
30 Nov	-2.4	18:42:02	10°	W	18:44:20	40°	W	18:44:20	40°	W
01 Dec	-3.8	17:54:06	10°	W	17:57:29	90°	S	17:58:21	47°	E
01 Dec	-0.3	19:30:56	10°	W	19:31:17	12°	W	19:31:17	12°	W
02 Dec	-3.8	17:06:08	10°	W	17:09:31	85°	N	17:12:24	14°	E
02 Dec	-2.3	18:42:56	10°	W	18:45:20	38°	WSW	18:45:20	38°	WSW
03 Dec	-3.5	17:54:58	10°	W	17:58:20	66°	SSW	17:59:28	37°	SE
03 Dec	-0.3	19:32:08	10°	W	19:32:24	11°	W	19:32:24	11°	W
04 Dec	-3.7	17:07:01	10°	W	17:10:23	80°	SSW	17:13:41	11°	ESE
04 Dec	-1.9	18:43:57	10°	W	18:46:38	28°	SW	18:46:38	28°	SW
05 Dec	-2.5	17:55:53	10°	W	17:59:03	39°	SSW	18:00:59	20°	SSE
06 Dec	-3.0	17:07:52	10°	W	17:11:10	52°	SSW	17:14:27	10°	SE
06 Dec	-1.0	18:45:28	10°	WSW	18:47:24	14°	SW	18:48:30	13°	SSW
07 Dec	-1.2	17:57:02	10°	W	17:59:39	21°	SW	18:02:13	10°	SSE
08 Dec	-1.7	17:08:50	10°	W	17:11:49	29°	SSW	17:14:46	10°	SSE
10 Dec	-0.6	17:10:16	10°	WSW	17:12:16	15°	SW	17:14:15	10°	S

END IMAGES, OBSERVING AND OUTREACH

Mars and the crescent Venus from October 14th.
And the Moon as a crescent on the same morning. Very much pictures from my upstairs window (my only view due West.
First was taken with a DSLR Nikon D7200 with a zoom lens (Sigma 18-200mm).
Second using my Nikon P1000 bridge camera. Andy

November Observing Suggestion

Wiltshire Astronomical Society Observing Suggestions for November 2020 @ 21:00
We have updated the observation targets this month for those with binoculars or smaller wide field telescopes to have something to search for.

The WAS Observing Team will provide recommended observing sessions for you to do while maintaining social distancing away from the home or as part of your social bubble at the homes of close friends or relatives. Please always follow the latest government guidelines if observing away from the home.

These observing recommendations will continue until we can start our group observing again (hopefully) in the new year.

Most target objects can be found around due South and South-West at about 21:00.

Where To Look This Month:
This month we concentrate on the constellation of Taurus.
Just select 'What's Up' link below to get the PDF file.
What's Up Link:
WAS_November_2020.pdf
Also Wiltshire Astronomical Society will produce the monthly newsletter containing further information, which can be downloaded here: https://wasnet.org.uk/

OUTREACH
I am beginning Zoom education sessions at schools with a triple school Zoom session in Trowbridge on 4th Nov.