NWASNEWS

Volume27 Issue 4

DECEMBER 2021

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

Happy Christmas and Good Health

Not quite at lock down yet, but lets hope we all stay safe and well especially during the Christmas period.

We did manage a viewing evening at Lacock in November and it was good to see three new interested people turn up, and you can read Peter Chappell's observing log in the newsletter. Hopefully we can do a Christmas week session that begins earlier in the evening, and it would be nice to keep the actual day as open as possible to allow for changes in the weather to be taken into consideration.

Normally in December we would try a meteor viewing session for the 150+ hourly rate of the Geminids on the 17th of the month BUT it is full Moon two days later and this will hugely affect the viewing of meteors on the night.

Our speaker for the evening is the ever encouraging Paul Money FRAS FIBS, who unfortunately had a major glitch on his computer on Monday morning and has had to change his talk from Voyager Trials and Tribulations but has promised to give us that talk next year. Meanwhile he is going to give us a talk on Why There Are No Green Stars. It is a fascinating topic that takes us into the nature of light, and even how our eyes can be mislead into seeing false colours.

We were not in a good position for the last lunar eclipse, despite what was being wrongly reported in some media, and on Saturday there was a very good solar eclipse to seen in Antarctica. I knew an old friend David Eicher caught some good images from the southerly continent. He'll be used to the cold supporting the Green Bay Packers as he does.

Meanwhile there is plenty to see in our own skies with 6 of the 8 planets visible in the evening skies and Mars in the morning skies. Also with Orion rising in the evening to be followed by Leo before midnight we will see nebulae, clusters and other galaxies. Not to ignore a potentially naked eye 2021 A1 Leonard moving from Bootes through Serpens.

Even the ISS will be seen on Christmas Day morning twice, at 5:15 for the super excited, and 6:48 for others.

Enjoy and hope to see many of you at our Zoom meetingd,

Andy Burns is inviting you to a scheduled Zoom meeting.

Topic: Wiltshire A S December Zoom Meeting

Time: Dec 7, 2021 07:45 PM London

Meeting ID: 886 3133 3751

Passcode: 527500

Clear skies Andy

Through this month those with a clear view to the South and South East are in for a treat with Jupiter Saturn and Venus putting on a show that is joined by the Moon until the 9th. Lets hope for clear skies. Whilst we due a couple of meteor showers the wonderful Geminids are spoiled by a full Moon. In the morning of 25th watch out for Santa on his rounds. 05:15 and 06:48… (ISS)

Wiltshire Society Page

Wiltshire Astronomical Society

Web site: www.wasnet.org.uk

Facebook members page: https://www.facebook.com/groups/wiltshire.astro.society/

Meetings 2020/2021.

HALL VENUE the Pavilion, Rusty Lane, Seend

Some Speakers have requested Zoom Mweetings and these will be at home sessions.

Meet 7.30 for 8.00pm start

SEASON 2020/21

2021

7th Dec Paul Money Why Are There No Green Stars (Zoom)

2022

4th Jan Martin Lunn The Star of Bethlehem (Zoom)

1st Feb Prof David Southwood TBN (Zoom)

1st Mar Martin Griffiths Dark Energy and Matter (Zoom)

5th Apr Pete Williamson Herschel to Hawkwind, Astronomy & Music & How each other influence each other

3rd May Andrew Lound The Moon at Christmas: The Epic Voyage of Apollo 8

7th Jun Prof Matt Griffin The hazards of Asteroid Impacts on the Earth – Should we worry?

Paul L Money FRAS, FBIS, is an astronomer based in **Horncastle, Lincolnshire, England**. He is well known for his extensive talks and is the reviews editor of the BBC Sky at Night magazine. He broadcasts occasionally on BBC Radio Lincolnshire and Lincoln City Radio.
He loves both visual and deep sky observing with all manner of equipment and is the long running organiser of the annual Horncastle Astronomy Weekend as well as the writer and publisher of the popular annual 'Nightscenes monthly night sky guide'.

' In astronomy, a **green star** is a white or blueish star that appears greenish in some viewing conditions (*see* § Psychology *below*). Under typical viewing conditions, there are no greenish stars, because the color of a star is more or less given by a black-body spectrum. However, there are a few stars that appear greenish to some observers, due to the viewing conditions, for example the optical 'illusion' that a red object can make nearby objects look greenish (and vice versa). Some multiple star systems, such as Antares, have a bright reddish star where this contrast makes other stars in the system seem greenish.'

Membership Meeting nights £1.00 for members £3 for visitors

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

Wiltshire AS Contacts

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Andy Burns Outreach and newsletter editor.

Bob Johnston (Treasurer)

Philip Proven (Hall coordinator)

??? (Teas and Projector)

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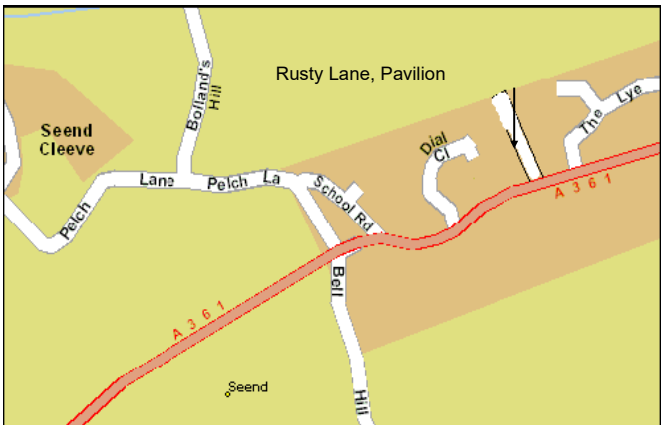
Nick Howes (Technical Guru)

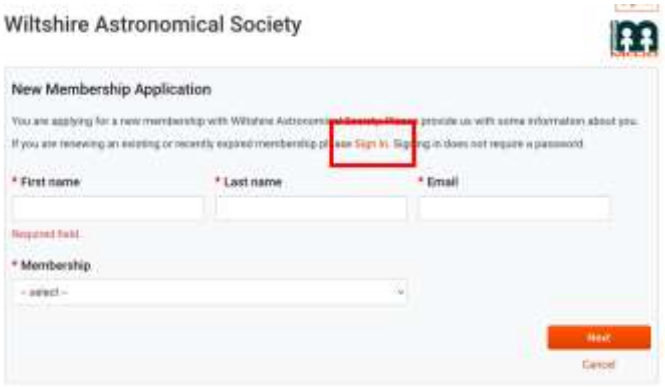
Observing Sessions coordinators: Chris Brooks, Jon Gale,

Web coordinator: Sam Franklin

Contact via the web site details.



Observing Sessions see back page



Swindon Stargazers

Swindon's own astronomy group

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

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 2021

Friday 10 December 19.30

Programme: Christmas Social

Meeting Dates for 2022

Friday, 21 January 19.30 onwards - Meeting in person

Programme: TBA

Website:
http://www.swindonstargazers.com

Chairman: Robin Wilkey

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BECKINGTON ASTRONOMICAL SOCIETY

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

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

Our Committee for 2016/2017 is

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

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

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

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

Post Code for Sat Nav is BA11 6TB.

Our start time is 7.30pm No hall meetings.

STAR QUEST ASTRONOMY CLUB

This young astronomy club meets at the

Sutton Veny Village Hall.

Second Thursday of the Month.

Meet at Sutton Veny near Warminster.

BATH ASTRONOMERS

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

Simon at Bath Astronomers has sent the following information. An afternoon of "Extreme Stellar Environments" is yours on the afternoon of Saturday 13th November comprising 4 online talks on this theme from respected astronomy professionals focussing on their specific interests from supernovae, neutron stars, zombie stars to black holes. Guiding us through this journey of cataclysm and atom wrenching adventure is Dr Robert Massey, Deputy Executive Director of the Royal Astronomical Society.
Organised jointly by Bath Astronomers, Bristol Astronomical Society, and Cardiff Astronomical Society, this free Zoom event runs from 1:30pm to 5:30pm and is open to all. It just requires you to register your place in advance to avoid the disappointment of your name not being down. Simply visit https://www.eventbrite.co.uk/e/extreme-stellar-environments-tickets-169977235487 to secure your spot.
The talks are as follows:
Supernovae by Dr Philip Wiseman, Southampton University
Supernovae are the explosive ends to stars' lives and are some of the most powerful and energetic events in the Universe. Despite having been observed by humans at least as long ago as the 11th Century, it is only in the last few decades that we have begun to discover the true diversity of stellar deaths that pervade the night sky. In this talk I will outline the different routes to forming a supernova and how those differences change their appearance. I'll describe the process of observing supernovae on a mass scale, and will highlight how this has led to some of the strangest and unexplained phenomena still puzzling astronomers today.
Stellar Black holes by Dr Vivien Raymond, Cardiff University
Black holes are some of the strangest, most puzzling objects in the Universe. They deform space and time to extremes, and for the longest time could only be observed indirectly via their effect on their environment. However, we are now capable of listening to the very space-time deformation they produce. In this talk I will present how we study those invisible objects with gravitational-wave observatories, and what we can learn from them.
How we study neutron stars by Dr Diego Alamarino, Southampton University
Neutron Stars are the most compact objects in the Universe where we can still see a surface. They are tiny 30km diameter spheres lost in the immense sky. So how is it that astronomers are able to study them? In this talk I will summarize some of the techniques used to study those Neutron Stars that interact with their nearby environments
The extreme physics of zombie stars by Professor Nils Andersson, Southampton University
A neutron star is born when a massive star runs out of nuclear fuel and dies in a supernova explosion. The object that emerges when the dust settles – effectively a zombie star – involves physics at the extremes of our understanding (and beyond). In this talk, I will explain how we are using astrophysical observations (both electromagnetic and through gravitational waves) to explore this physics and make progress on a range of challenging questions

SPACE NEWS TO NOVEMBER 2021

Space News

'Potentially hazardous' asteroid worth nearly $5 billion will pass by Earth this week, NASA says

By Ben Turner about 4 hours ago

The asteroid is expected to pass by Earth without harm.

An artist's impression of a distant asteroid approaching Earth. (Image credit: Erik Simonsen via Getty Images)

A gigantic, "potentially hazardous" space rock bigger than the Eiffel Tower will pass by Earth this week, according to NASA.

The egg-shaped asteroid, named 4660 Nereus, is 1,082 feet (330 meters) long and will break into Earth's orbit traveling at 14,700 mph (23,700 km/h) on Saturday, Dec. 11. Thankfully for all of our weekend plans, the asteroid is expected to skim past Earth at some distance without making impact, but it will still be closer to us than it has been in 20 years.

Nereus — named after the Greek sea god who was the son of Gaia, the personification of the Earth — will be roughly 2.4 million miles away (3.86 million km), around 10 times the distance between Earth and the moon. This may sound like an enormous gap, but by cosmic standards, it's actually a stone's throw away.

NASA flags any space object that comes within 120 million miles (193 million kilometers) of Earth as a "near-Earth object" and any fast-moving object within 4.65 million miles (7.5 million km) as "potentially hazardous." Once flagged, astronomers closely monitor the objects, looking for any deviation from their predicted trajectory that could put them on a collision course with Earth.

First discovered in 1982, Nereus' 1.82-year orbit of the sun brings it close to Earth nearly every 10 years. Because Nereus visits our region of the solar system so frequently NASA and the Japanese space agency JAXA once considered collecting a sample from it using JAXA's Hayabusa spacecraft, but the agencies eventually settled upon a different asteroid (25143 Itokawa) instead.

NASA projects that Nereus will make its next close approaches to Earth on March 2, 2031 and November 2050. An even closer, tantalizingly close visit is forecast to occur on Feb. 14, 2060, when Nereus may come within roughly 0.74 million miles (1.2 million km) of Earth. This will put the mineral-rich space rock at a tempting three moons distance from our planet.

That's because beyond being a target for a potential robotic craft sent by NASA, Nereus is also an enticing prize for prospective space mining. Asterank, a database that monitors more than 600,000 asteroids, estimates that the asteroid has nickel, iron and cobalt deposits worth a collective $4.71 billion.

If we ever do spot an asteroid headed straight for us, space agencies are working on a solution. On Nov. 23, NASA launched a spacecraft as part of its Double Asteroid Redirection Test mission in order to redirect an asteroid by ramming it off course, Live Science previously reported. China is also in the early planning stages of an asteroid-ramming mission; they propose that by slamming 23 of their Long March 5 rockets into the asteroid Bennu, they would be able to divert it from a potentially catastrophic impact with Earth, Live Science previously reported.

Originally published on Live Science.

China's Yutu 2 rover spots cube-shaped 'mystery hut' on far side of the moon

By Andrew Jones 1 day ago

It's likely a large boulder excavated by an ancient lunar impact.

An image from China's Yutu 2 showing a cube-shaped object on the horizon on the far side of the moon. (Image credit: CNSA/Our Space)

China's Yutu 2 rover has spotted a mystery object on the horizon while working its way across Von Kármán crater on the far side of the moon.

Yutu 2 spotted a cube-shaped object on the horizon to the north and roughly 260 feet (80 meters) away in November during the mission's 36th lunar day, according to a Yutu 2 diary published by Our Space, a Chinese language science outreach channel affiliated with the China National Space Administration (CNSA).

Our Space referred to the object as a "mystery hut" (神秘小屋/shenmi xiaowu), but this a placeholder name rather than an accurate description.

Team scientists have expressed a strong interest in the object and Yutu 2 is now expected to spend the next 2-3 lunar days (2-3 Earth months) traversing lunar regolith and avoiding craters to get a closer look, so updates can be expected.

A likely explanation for the shape would be a large boulder which has been excavated by an impact event.

Space station faced a new space debris threat

The International Space Station as seen by Russian cosmonaut Oleg Novitsky on Sept. 29, 2021. (Image credit: Oleg Novitsky/Roscosmos via Twitter)

The crew aboard the International Space Station faced space junk scares this week, too. On Friday (Dec. 3), the space lab's orbit was lowered to ensure it would safely pass through the debris of a decades-old Pegasus rocket. Rus-

sian space agency Roscosmos flagged the risk two days prior and it was their cargo ship that performed the maneuver which shifted the station's orbit. This comes just two weeks after Russia conducted an anti-satellite test that produced debris, prompting the station's crew to take shelter.

Full story: Space station dodges space debris from decades-old Pegasus rocket

Astronauts perform a 6.5-hour spacewalk to replace a faulty antenna

Two NASA astronauts left the safety of the International Space Station to perform a spacewalk on Thursday (Dec. 2). In total, Expedition 66 crewmates Tom Marshburn and Kayla Barron spent 6 hours 32 minutes on their extravehicular activity. They replaced an antenna that served as one way that the station's crew could communicate with Earth.

Alien planet spotted with year lasting 8 hours

Artist's illustration of the newfound exoplanet GJ 367b, which orbits its red dwarf host star once every 7.7 hours. GJ 367b is a rocky world that's much denser than Earth and similar in structure to Mercury. It probably has a large iron core. (Image credit: SPP 1992 (Patricia Klein))

A three-year old spacecraft has spotted an alien planet with a very short year. NASA's Transiting Exoplanet Survey Satellite (TESS) launched in April 2018 to discover planets that orbit stars other than the sun. A team of researchers sifted through TESS data and detected a rocky planet orbiting a red dwarf star about half as wide as our sun. This exoplanet zips once around the red dwarf every 7.7 hours.

Try spotting Comet Leonard next week

Stargazer Steven Bellavia captures this image of Comet Leonard and Leonid meteor on Nov. 13, 2021 from Mattituck, New York. (Image credit: Steven Bellavia)

Next week, Comet C/2021 A1 (Leonard) will be bright enough for skywatchers to view without any optical aid in a sky free of light pollution. Comet Leonard will appear on Dec. 6, about two hours before sunrise in the eastern sky. The lunar phase will be new moon, meaning moonlight will not wash out comet observations.

Full story: Comet Leonard will light up the sky this month — here's how to see it

Two huge black holes are discovered very close to each other (and to Earth)

This image shows close-up (left) and wide (right) views of the two bright galactic nuclei of NGC 7727 89 million light-years from Earth. Each nuclei is home to a supermassive black hole at its center. (Image credit: ESO/Voggel et al.; ESO/VST ATLAS team. Acknowledgement: Durham University/CASU/WFAU)

Scientists have spotted two black holes that are surprising in their proximity to one another, but also in their proximity to Earth. Two supermassive black holes are orbiting each other at the center of a galaxy located about 89 million light-years away in the constellation Aquarius. The two will gradually get closer together until they merge into an even larger black hole in about 250 million years.

Full story: This pair of merging black holes is the closest to Earth we've ever found

On Wednesday (Dec. 1), the National Space Council (NSC) met for the first time under Vice President Kamala Harris. That morning, the White House released the seven-page "United States Space Priorities Framework," which lays out a handful of space-related principles and goals for the nation over the next few years. During the event, Harris highlighted the topic of climate change, among many others.

Full story: 1st Space Council meeting under VP Harris highlights climate change, competitiveness and responsible space behavior

One-year anniversary of Arecibo Observatory's collapse

An image taken on Dec. 8, 2020, shows the wreckage of the radio telescope at Arecibo Observatory. (Image credit: Michelle Negron, National Science Foundation)

A new documentary about the Arecibo Observatory touches on the iconic facility's legacy and how scientists and the local community in Puerto Rico are processing the telescope's collapse. Wednesday (Dec. 1) marked the one-year anniversary of the collapse of the 1,000-foot-wide (305 meters) dish's suspended platform. The film premiered in special showings in Puerto Rico, where the observatory is located.

Full story: Arecibo Observatory: A year after telescope's collapse, an icon gets continuing cleanup and a new documentary

SpaceX faces Raptor engine 'crisis,' Elon Musk says

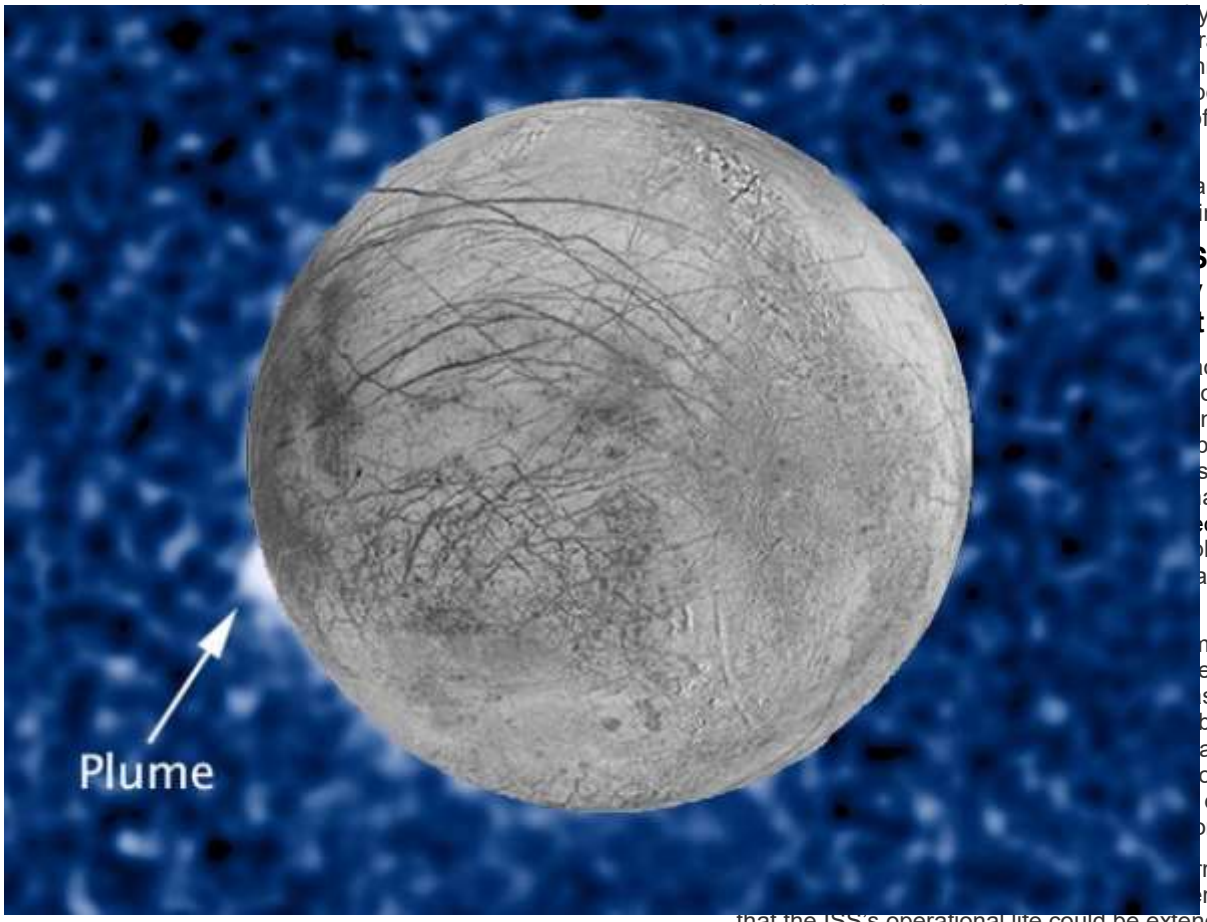
SpaceX's Starship Booster 4 , which sports a whopping 29 Raptor engines, is being prepped for an orbital test mission. (Image credit: Elon Musk via Twitter)

If There are Water Plumes on Europa, Here’s how Europa Clipper Will Study Them

NASA’s Europa Clipper is one of the most anticipated missions of the coming decade, in large part because its target, the large Jovian moon Europa, is considered one of the most likely places in our solar system that extraterrestrial life might exist. If Europa is harboring alien microbes, however, they’re likely to be buried deep beneath the moon’s thick icy crust in a vast subsurface ocean. Unlocking the secrets of this water world isn’t going to be easy, but the Clipper team has a plan to make the most of the opportunity they have: If you can’t get to the ocean, let the ocean come to you.

There is a good possibility that Europa regularly ejects plumes of water into space, squeezing the water through cracks in the icy surface and blasting it off-world. With Europa’s low gravity (the moon is slightly smaller than Earth’s Moon) and lack of atmosphere, water plumes could theoretically reach many hundreds of kilometers high, offering a chance to ‘taste’ Europa’s oceans without ever touching down.

This stunt has been done before elsewhere in the Solar System. In 2015, the Cassini spacecraft orbiting Saturn flew through plumes erupting from Enceladus, a small water world not entirely dissimilar to Europa in composition. Cassini recorded hints of organic compounds, salts, and minerals, all of which suggested the tantalizing possibility of habitable ecosystems on Enceladus. Cassini’s instrument suite included a ‘cosmic dust analyzer,’ allowing it to study any tiny particles it encountered as it flew through the plumes. Europa Clipper will carry a similar instrument.



A composite image showing suspected plumes of water vapor erupting from Europa. The image of the plume was made from data collected by NASA's Hubble's Space Telescope Imaging Spectrograph in 2014. The image of Europa itself is made from data from NASA's Galileo and Voyager missions. Credit: NASA/ESA/W. Sparks (STScI)/USGS Astrogeology Science Center.

The first challenge for the Clipper mission will be to determine whether these plumes exist on Europa at all. Unlike Enceladus, where we had clear indications of the plumes' existence, the evidence for plumes on Europa are far from conclusive. "We're still in the space where there's really intriguing evidence, but none of it is a slam dunk," said Matthew McKay Hedman, a researcher with Europa Clipper's spectrometer team. Europa's plumes, if they exist, may also be harder to find, being weaker and more sporadic.

The Clipper spacecraft will search for plumes using several of its instruments. Its cameras will watch for their silhouettes against the bright light reflected from Jupiter. Plumes may also be visible in ultraviolet, and if so, the team will be able to use spectroscopy to determine their chemical makeup. Clipper will also be equipped with a thermal imager to look for hotspots in the ice sheets, which would hint at recent or ongoing eruptions.

Whether Clipper finds plumes or not, its instruments will enable it to study Europa in more detail than ever before. To be clear, the mission isn't designed to look for life directly – instead, its job is to determine habitability – to find out whether life could exist there. The chemistry and conditions on Europa need to be just right for it to harbour life, and Europa Clipper is the first step in determining its viability for life.

The Clipper will be working in a difficult environment. Radiation levels around Jupiter can be hazardous to its instruments with extended exposure, meaning that it can't simply sit in orbit around Europa, which is Jupiter's sixth-closest moon. Instead, the Clipper will circle Jupiter in an elongated

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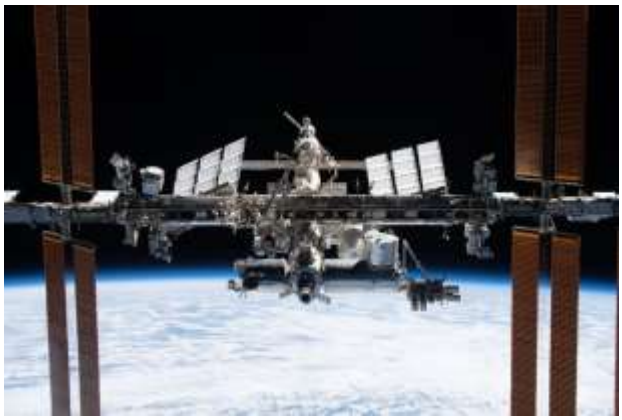
rrently scheduled
rs have indicated
that the ISS's operational life could be extended to 2030.

"The Station was designed with a life expectancy of 15 years with a safety factor of two, meaning it could last 30 years after the 1998 launch of its first segments," the report says, adding that "NASA is optimistic that the Station's life can be extended to 2030."



The International Space Station is pictured from the SpaceX Crew Dragon Endeavour during a flyaround of the orbiting lab that took place following its undocking from the Harmony module's space-facing port on Nov. 8, 2021. Credit: NASA/ESA

But structural wear and tear is becoming evident. NASA and Roscosmos are investigating the cause and long-term impacts of cracks and leaks that were recently discovered in the Station's Service Module Transfer Tunnel, which connects the Service Module to one of eight docking ports on the Station. Causes being explored include structural fatigue, internal damage, external damage, and material defects.

Notably, the report says an updated analysis of the structural longevity of other segments as well should be done because

the leaks were caused by cracks that models suggest should not exist. This would suggest the possibility of an earlier-than-projected obsolescence for at least one element of the Station.

The ISS costs about $3 billion a year, roughly a third of NASA's annual human space flight budget. Commercial companies say they can provide brand new facilities for a better price, making for a better investment for NASA.

NASA says the Artemis program, aimed at returning humans to the Moon and ultimately landing astronauts on Mars, is not feasible without continued human health research and technology demonstrations being conducted on the ISS and its eventual replacement.

Therefore, in looking ahead, NASA announced today they have signed agreements with three U.S. companies to develop designs of space stations and other commercial destinations in space. They agency said they want to "enable a robust, American-led commercial economy in low-Earth orbit."

The companies are Blue Origin for their Orbital Reef space station design, receiving $130 million, Nanoracks LLC, for $160 million, Northrop Grumman Systems Corporation for $125.6 million.

Starlab, from Nanoracks, Voyager Space, and Lockheed Martin, is a continuously crewed, free-flying, commercial space station dedicated to conducting advanced research, fostering commercial industrial activity, and ensuring continued U.S. presence and leadership in low-Earth Orbit. Credits: Nanoracks/Lockheed Martin/Voyager Space

"NASA seeks to maintain an uninterrupted U.S. presence in low-Earth orbit by transitioning from the International Space Station to other platforms," NASA said in a press release. "These awards will stimulate U.S. private sector development of commercial, independent space stations that will be available to both government and private-sector customers."

In early 2020, NASA announced a Plan for Commercial LEO Development, which they hope will foster economic development in LEO and to drive innovation. At that time, they announced the selection of Axiom Space of Houston to provide a commercial habitation module for the ISS.

It's great that NASA and the other international partners are planning ahead to keep an operational space station in orbit for the long term. But ultimately, whether in response to an emergency or at the end of its useful service life, NASA acknowledged in the report that there needs to be a plan decommission and deorbit the ISS. This will be technically complex, as well as costly, requiring international participation and a critical decision on timing.

An Upcoming Asteroid Mission Will be Able to Peer 100 Meters Under the Surface

Engineers only get one shot at making a spacecraft work as intended. Or at least they only get one shot in space. In the preparation leading up to that final, climactic moment, there are typically thousands of hours of tests run on numerous systems and subsystems. If all goes well, it bodes well for the mission's overall success, but if problems arise, it's much easier to address them on the ground than while a spacecraft is already orbiting. A model of a new spacecraft known as Juventas just completed a significant testing milestone – passing testing in a room known as an anechoic chamber.

That milestone is essential for Juventas as its primary mission focuses on a low-frequency radar the craft will use to peer 100 m beneath the surface of Dimorphos, the smaller partner in the Didymos binary asteroid system. Planned for launch with ESA's Hera satellite in 2024, it will arrive at the Didymos system in 2027, about five years after NASA's recently launched DART mission will purposefully collide with Dimorphos in an attempt to change its orbit.

Juventas' demo body being lifted by a drone.
Credit – ESA / TU Dresden

Just watching the fallout from that spectacular collision is only part of the mission, though. Pointing a ground-penetrating radar at Dimorphos will help scientists understand the effects of the impact on the asteroid's internal structure, which is only 160 km in diameter. But it will also help flesh out what the asteroid's interior is made of in the first place.

The low-frequency radar has to work well to accomplish that mission, and it hasn't proved easy to test. Operating at 60 MHz, it would need to be tested at a range far below the standard operating frequency of the Hybrid European Radio Frequency and Antenna Test Zone, or "Hertz" chamber. The Hertz chamber, coated with the usual assortment of foam spikes, could test the power output and interference from devices operating at the 400 MHz range.

ESA video describing the Hera mission, which Juventas will accompany, in detail.
Credit – ESA YouTube Channel

Such a high-frequency cut-off didn't work for the Juventas team. To get the data they needed, they needed to change

the capabilities of the Hertz chamber itself – and luckily, they came across an opportunity to do so. ESA provided some funding for a general upgrade to the Hertz chamber for general testing purposes but then tailored some aspects specific to the testing environment needed by Juventas.

Buying better foam panels wasn't the only upgrade to the chamber. The upgrade installed a combination of hardware (fiberglass towers) and software (noise cancellation) improvements that engineers hope will help deal with some of the signal reflection and echoing that plagued low-frequency testing in the chamber in the past.

ESA's minimalist graphic of the Juventas probe.
Credit – ESA

When all the upgrades were done, researchers put an actual model of the Juventas probe body into the refurbished chamber. They attached its solar panels and antennas in a specific attempt to understand how all the different wireless power, sensing, and communication systems would interact with one another. The mockup still passed with flying colors, right before a critical design review for the project next month.

The mission looks set to pass that design review and keep moving forward to development. The actual Juventas spacecraft body will return to the Hertz chamber in 2023 for final electromagnetic testing. If all goes well, the 6U sized CubeSat will hitch a ride with Hera and prove that all the testing that went into its design was worthwhile when it gives us our first up-close images of the interior of an asteroid.

InSight Peers Deep Below the Surface on Mars

The InSight lander has been on Mars, gathering data for a thousand days now, working to give us a better understanding of the planet's interior. It's at Elysium Planitia, the second largest volcanic region on Mars. A newly-published paper based on seismic data from the lander shows something unexpected underground: a layer of sediment sandwiched between layers of lava flows.

Much of InSight's media coverage has centred around the lander's Heat Flow and Physical Properties Package (HP^3), also called the Mole. Its job was to measure the heat coming from the planet's interior to the surface. After an epic struggle to get the instrument working, NASA and the DLR (German Aerospace Center) announced in January 2021 that the Mole's mission was over before it got started.

But the Mole isn't InSight's only instrument. Its other main science instrument is called the Seismic Experiment for Interior Structure (SEIS.) SEIS is working fine and has already delivered some solid science. This new paper rests on seismic data from SEIS.

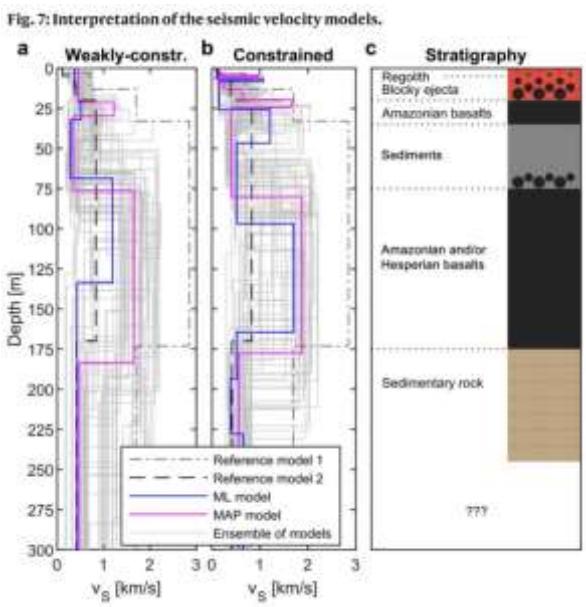
The InSight Lander's seismometer underneath its protective wind and thermal shield. Image Credit: NASA/JPL-Caltech

The new paper is titled "The shallow structure of Mars at the InSight landing site from inversion of ambient vibrations." It's published in the journal Nature Communications, and the authors are an international team of scientists.

The team used seismic data from InSight's SEIS lander to analyze the sub-surface structure at Elysium Planitia to a depth of 200 meters. Directly beneath the lander, they found a three-meter layer of sandy material that makes up the regolith. Beneath that, there's a 15-meter layer of material described as coarse, rocky ejecta. That material is debris from a meteorite impact, thrown up into the air before falling back to Mars.

Then it gets interesting.

Below the ejecta layer, InSight found a 150-meter region of layered basaltic material made of solidified lava. That layer is in line with expectations. But there's something unexpected between the basaltic rock. Between 30 to 75 meters, there's a "seismic low-velocity zone" that the team interpreted as a layer of less dense sedimentary material.

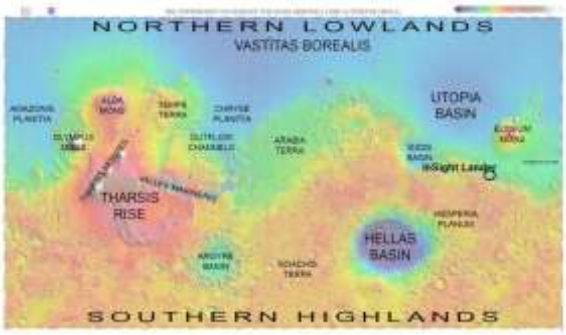


This figure from the paper shows the near-surface region under the InSight Lander. The left and center panels show what different models predicted. Reference models 1 and 2 are pre-landing models. ML and MAP stand for Maximum Likelihood and Maximum A Posteriori models, and the grey lines are an ensemble of all the models. On the right is the authors' interpretation of the seismic data. See the study for more detail. Image Credit: Hobiger et al 2021.

InSight has made progress probing Mars' deeper planetary structure, and it's studied the shallow subsurface to a depth of 10 to 20 meters. But it hasn't studied the first few tens or hundreds of meters before. This data is helping build a detailed model of the near-surface region that will help explain the formation of Elysium Planitia.

InSight's mission focuses on the Martian sub-surface, so it landed at Elysium Planitia, which is relatively flat and featureless. It's not easy landing a spacecraft on Mars, which made it a safer spot to land. Still, the lander is near the border of two regions: the ancient southern heavily cratered highlands and low-standing younger, smoother northern plains.

There is a sharp distinction between Mars' younger northern plains and its much older southern highlands. This distinction is known as the Martian Dichotomy, and it's one of the planet's enduring mysteries. The region between the two types of geography is also quite complex, and scientists hope that InSight can help build a stronger understanding of what's going on there. Three competing hypotheses explain the Martian Dichotomy: the single impact hypothesis, the multiple impact hypothesis, and the plate tectonics hypothesis.



The InSight Lander is at Elysium Planitia, in the border region between the younger Northern Lowlands and the older Southern Highlands. Image Credit: MOLA map: NASA / JPL / GSFC. Map by Emily Lakdawalla.

By studying the near-surface region, InSight should help scientists "…understand the stratigraphy and the role of volcanism as well as sedimentation in the transition zone…" between the older and younger areas.

The researchers wanted to date the shallow lava flows, and for that, they turned to crater counts. On a basic level, the more craters there are, the older the surface area is. An area with fewer craters must be younger. Scientists use this basic fact to date rocks. Also, when a crater is deeper, it allows scientists to date the deeper rock, and the reverse is true for shallower craters.

The team was able to date the pair of solidified lava flows that sandwich the sedimentary layer. They found that the shallower lava layer is about 1.7 billion years old when Mars was in its Amazonian Period. The deeper layer is about 3.6 billion years old, from Mars' Hesperian period when the planet was undergoing widespread volcanic activity. The authors think that the sedimentary layer is either between the basaltic layers or embedded within the deeper, older layer.

Artist's impression: The InSight lander is in Homestead Hollow, a small impact crater. The seismometer SEIS used in this study is the light-coloured hemisphere on the ground in front of the lander. The ground beneath it consists of a sandy regolith layer on top of alternate layers of sediments (yellow-orange colours) and basaltic rocks, i.e. former lava flows (brown colours). Image Credit: University of Cologne.

This study is the first time scientists have compared Mars' near-surface region to models mainly based on remote data. InSight data shows that there's additional layering and more porous rocks.

One of the paper's authors is Dr. Knapmeyer-Endrun from the Institute of Geology and Mineralogy at the University of Cologne. In a press release, she said, "While the results help to better understand the geological processes in Elysium Planitia, comparison with pre-landing models is also valuable for future landed missions since it can help to refine predictions." A better understanding of the load-bearing conditions and travelling conditions for rovers will help with planning. It may also help locate sub-surface water ice.

Seismic study on Mars is different than on Earth. Scientists can probe the structure here on Earth by sending seismic signals into the ground and reading how they bounce back to sensors. But on Mars, the SEIS instrument reads ambient vibrations. Those ambient vibrations come from interactions between the wind and the planet's surface. But the thin atmosphere, the lower solar irradiation, and the lack of oceans make the ambient vibrations much weaker than here on Earth.

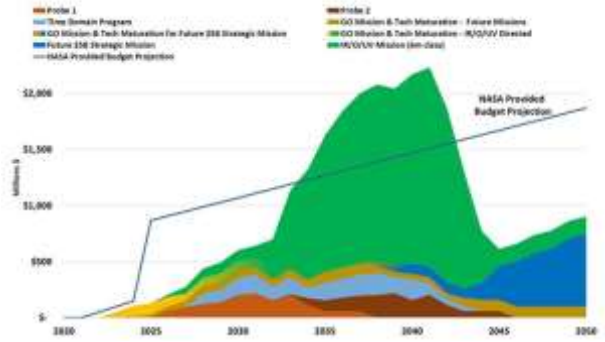
The InSight lander has been on Mars since November 26th, 2018. Its mission length was set at 709 sols but has reached 1070 sols. The lander is solar-powered, so it could conceivably last much longer. InSight stands for Interior Exploration using Seismic Investigations, Geodesy and Heat Transport. It's a joint mission between NASA and European space agencies, most notably Germany's DLR.

The Decadal Survey is out! What new Missions and Telescopes are in the Works?

It's that time again. Once every ten years, the American astronomy community joins forces through the auspices of the National Academies to produce one of the most important and influential reports in their discipline – the decadal survey. This report has been the impetus for some of the great observational instruments of our time, including Spitzer, the Large Millimeter Array, and Chandra. Upcoming heavy-hitting observatories, such as Nancy Grace Roman and Vera C. Rubin, also spawned from suggestions made in the Decadal Survey. In short, if you want to get a grandiose space telescope funded, your best bet is to have it supported by the National Academies in the form of the Decadal Survey. Now a new one is out – so what does it back for the upcoming decade and beyond?

The report itself is broken down into three "priority scientific areas:"

1. New Messengers and New Physics
2. Cosmic Ecosystem
3. Worlds and Suns in Context



One of the primary outcomes from the Decadal survey is suggesting where the money should go. This graph helps understand the breakdown of that spending.
Credit – National Academies

These are further broken down into 24 individual questions that the report hopes scientists can answer shortly, ranging from "What are the mass and spin distributions of neutron stars and black holes" to "How do the Sun and other stars create space weather?" All valid questions, but arguably the most critical part of the report, are the suggested methods to answer those questions – particularly what projects it suggests for funding.

The most eye-catching of those proposed missions was an infrared / optical / ultraviolet space-based telescope that would be the most sensitive ever launched. Very similar in scope to LUVOIR, one of the primary missions of this massive project would be to search for biosignatures on at least 25 extrasolar planets. As a bonus, it could help address two-thirds of the questions posed by the survey.

Up for some more crazy telescope ideas? UT has got you covered.

Don't expect any results anytime soon, though – the survey suggests that the earliest launch date for any such ambitious project would be 2039 – almost 20 years from now. It could cost as much as $11 billion, but if the cost overruns of the James Webb Space Telescope are any indication, that figure would likely end up much higher.

But the report also suggests not putting all of the scientific community's eggs in one basket. It supports an idea floated by NASA to launch a series of "probe" missions that will cap out at about $1.5 billion and launch every ten years. These "medium" capability missions would allow scientists to continually work with new data as they are simultaneously developing the next great mission that will be collecting data ten years from now.

And yet more ideas touted for the future of telescopic space exploration.

The report also suggests the "Great Observatories Mission and Technologies Maturation Program" to support that continual development path." While not directly tied to any one mission, this would represent a "[change] in the way projects are planned and developed." It suggests that several large-scale missions could be co-developed simultaneously with technological overlap to ease their development pathways.

Two of those pathways would point towards other "Great Observatory" missions – a Far-IR mission and an X-ray mission, each of which would cost between $3 and $5 billion. These would fill in the spectral gaps noticeable in the flagship LUVOIR equivalent and allow scientists updated access to almost all spectra of light data that they need to fully understand what they see.

Some spectacular telescopes, such as the concepts discussed in this UT video, make their home on the ground.

There is one noticeable gap in that spectral band, though – radio. America's National Science Foundation (NSF) runs most of its primarily ground-based radio observatories. The report suggests that NSF should develop an upgrade to the Very Large Array and Very Long Baseline Array, two of the current workhorses of radio astronomy. Known (not so creatively) as the Next-Generation Very Large Array, ideally, the new system would have ten times the observational capabilities of the existing radio telescopes. It could be online early in the next decade.

Other NSF projects supported by the report include investments in the Cosmic Microwave Background Stage 4 Observatory, the Giant Magellan Telescope, and Thirty Meter Telescope, all of which have the potential to offer "transformative" scientific results. The investments should allow them to continue doing so for the next decade.

Artist's concept of the Giant Magellan Telescope.
Credit – Giant Magellan Telescope / GMTO Organization

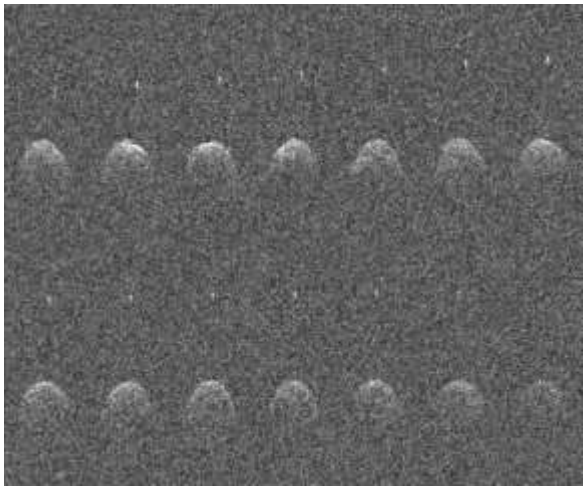
Overall, the program suggests billions of dollars in funding for a cornucopia of scientific projects and has received generally positive feedback from the community. Now, it's up to Congress and the various federal agencies to decide whether they want the suggest the Survey's advice, and if so, to what degree. There's still a long way to go before any project supported in the report sees the light of day, but this is a great step for the astrophysics and astronomy community.

NASA Launches DART, to Learn how to Defend the Earth From a Future Asteroid Impact

In the early hours of the morning on Wednesday, Nov. 24th, NASA's Double Asteroid Redirection Test (DART) launched from Space Launch Complex 4 East at Vandenberg Space Force Base (SFB) in California. This spacecraft is the world's first full-scale mission to demonstrate technologies that could someday be used to defend our planet from Near-Earth Asteroids (NEAs) that could potentially collide with Earth.

Put simply, the DART mission is a kinetic impactor that will evaluate a proposed method for deflecting asteroids. Over the next ten months, the DART mission will autonomously navigate towards the target asteroid – the binary NEA (65803) Didymos – and intentionally collide with it. If everything goes according to plan, this will alter the asteroid's motion so that ground-based telescopes can accurately measure any changes.

The launch took place at 01:31 AM EST (Tues. Nov. 23rd, 10:31 PM PST) when the DART mission took off from SLC-4E atop a SpaceX *Falcon 9* rocket. At 02:17 AM (11:17 PM PST), DART separated from the booster's second stage and began sending telemetry data back to missions controllers minutes later. About two hours later, the spacecraft unfurled the two 8.5-meter (28-foot) large solar arrays that will power its Solar-Electric Propulsion (SEP) thruster.



Fourteen sequential Arecibo radar images of the near-Earth asteroid (65803) Didymos and its moonlet. Credit: NASA/ Arecibo

The collaborative DART effort was built and is led by the Johns Hopkins University Applied Physics Laboratory (JHUAPL). The mission is managed under NASA's Planetary Defense Coordination Office and Planetary Science Division, with support provided by multiple NASA centers. The mission is compromised of multiple elements provided by NASA, the European Space Agency (ESA), and other partner agencies. As NASA Administrator Bill Nelson explained in a recent NASA press release:

"DART is turning science fiction into science fact and is a testament to NASA's proactivity and innovation for the benefit of all. In addition to all the ways NASA studies our universe and our home planet, we're also working to protect that home, and this test will help prove out one viable way to protect our planet from a hazardous asteroid should one ever be discovered that is headed toward Earth."

"At its core, DART is a mission of preparedness, and it is also a mission of unity," said Thomas Zurbuchen, the associate administrator for the Science Mission Directorate at NASA Headquarters. "This international collaboration involves DART, ASI's LICIACube, and ESA's Hera investigations and science teams, which will follow up on this groundbreaking space mission."

The mission consists of two spacecraft, the 610 kg (1,340 lb) impactor that relies on the NEXT ion thruster, a type of solar electric propulsion that uses solar arrays to power its NASA Evolutionary Xenon Thruster–Commercial (NEXT-C) engine. The target for this mission, named for the Greek word "twin," consists of a larger primary asteroid (65803) named Didymos, and an orbiting moonlet named Dimorphos.

Artist's impression of the DART mission rendezvousing with the NEA Didymos. Credit: NASA/JHUAPL

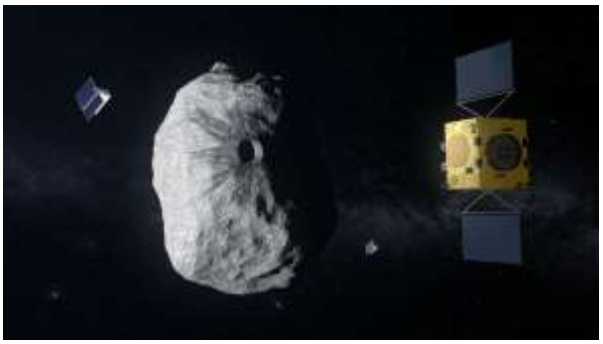
Whereas (65803) Didymos measures about 780 meters (2,560 ft) in diameter, Dimorphos is less than one-quarter the size (160 m; 530 ft). This moonlet will be the primary target for DART, which will rendezvous with the system between Sept. 26th and

Oct. 1st, 2022. At this time, the binary asteroid's orbit will bring it within 11 million km (6.8 million mi) from Earth, where DART will be waiting to collide with Dimorphos at a speed of about 6 km/s (4 mi/s).

Scientists estimate that this will shorten Dimorphos' orbit around Didymos by several minutes, which they will precisely measure using ground-based telescopes. The results will be used to validate and improve the computer models that are currently used to predict the outcomes of asteroid deflection. This change in speed will be far easier to measure than a change in Didymos' orbital velocity (hence why Dimorphos was selected).

The DART spacecraft will be accompanied by a second spacecraft called the Light Italian CubeSat for Imaging of Asteroids (LICIACube), provided by the Italian Space Agency (ASI). This small CubeSat will piggyback with DART, separate ten days before impact, then capture images of the impact's effect and the ejecta created. Roughly four years after DART impacts the moonlet, the ESA's *Hera* project will arrive at Didymos to conduct detailed surveys of both asteroids.

This test will provide vital data that will be used to develop improved preparations and strategies for asteroid defense. While Didymos does not currently pose a threat to Earth, it is classified as a "potentially hazardous asteroid." This designation applies to asteroids measuring 100 m (~330ft) or more in diameter and whose orbit brings them within 0.05 AU (7.5 million km) of Earth.



Artist's impression of the Hera mission examining Dimorphos after the DART impact. Credit: ESA/Science Office

In the past, impacts by these similarly-sized objects are believed to have caused extinction level events (ELEs), such as the Chicxulub Impact Event that triggered the extinction of the dinosaurs. As Lindley Johnson, planetary defense officer at NASA Headquarters, said:

"We have not yet found any significant asteroid impact threat to Earth, but we continue to search for that sizable population we know is still to be found. Our goal is to find any possible impact, years to decades in advance, so it can be deflected with a capability like DART that is possible with the technology we currently have. DART is one aspect of NASA's work to prepare Earth should we ever be faced with an asteroid hazard.

"In tandem with this test, we are preparing the Near-Earth Object Surveyor Mission, a space-based infrared telescope scheduled for launch later this decade and designed to expedite our ability to discover and characterize the potentially hazardous asteroids and comets that come within 30 million miles of Earth's orbit."

Next week, DART will activate the only instrument it carries – the Didymos Reconnaissance and Asteroid Camera for Optical navigation (DRACO) – and take the spacecraft's first images. In addition to its sophisticated navigation system, DART will rely on a series of Small-body Maneuvering Autonomous Real Time Navigation (SMART Nav) algorithms. These will enable DART to identify and distinguish between the two asteroids, then direct itself towards Dimorphos.

Image released by the European Space Agency that shows DART impacting the binary asteroid system (65803) Didymos. Credit: ESA/AFP

Joan Marie is a science communicator, STEM advocate, and an Aerospace Integration Engineer with the NASA Kennedy Space Center (KSC). She and her colleagues worked through the night in order to prepare the DART mission for launch at Vandenburg SFB. "It felt amazing," she said. "Being able to see (visually) the hard work our team put into this launch was an incredible feeling."

Also present was Andy Cheng, one of the DART investigation leads at JHUAPL and the individual who came up with the idea of DART. As he described it, seeing the mission he conceived take flight was a dream come true:

"It is an indescribable feeling to see something you've been involved with since the 'words on paper' stage become real and launched into space. This is just the end of the first act, and the DART investigation and engineering teams have much work to do over the next year preparing for the main event? DART's kinetic impact on Dimorphos. But tonight we celebrate!"

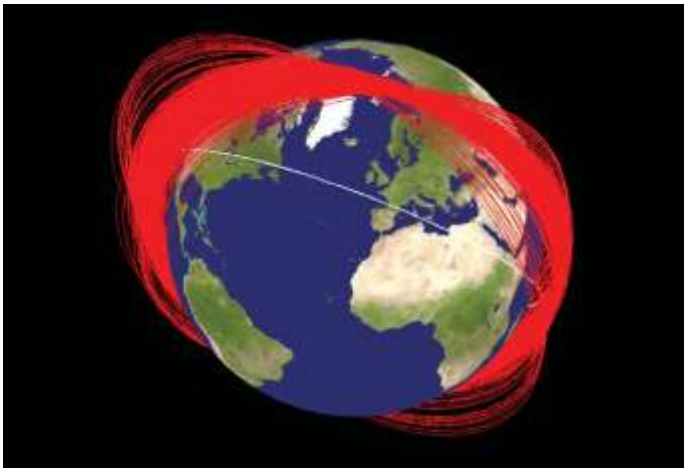
It's Time to Stop Doing Anti-Satellite Tests

Earlier this month, the Russian military conducted an anti-satellite (ASAT) missile test, launching a PL19 *Nudol* interceptor missile at a now-defunct Soviet-era intelligence satellite, KOSMOS 1408. The impact obliterated the spacecraft, creating a debris field consisting of approximately 1500 pieces of trackable debris, and potentially hundreds of thousands of pieces that are too small to monitor with ground-based radar. In the aftermath of the test, the debris field crossed the orbit of the International Space Station (ISS) repeatedly, causing the crew to take emergency precautions and shelter in their descent capsules, ready for a quick return to Earth in the event that the station was hit.

While the station and its crew escaped without harm this time around, the November 15 test demonstrated far too clearly that ASATs pose a real danger to human life. They can also wreak havoc on the rest of Earth's space infrastructure, like communications satellites and other orbital systems. Debris from an ASAT test remains in orbit long after the initial incident is over (the higher the orbit, the longer lasting the debris), and if humanity's space infrastructure is to be sustainable, the era of ASATs must come to an end, and soon.

Russia's November 15 test was a particularly egregious incident, sending debris into the path of Russia's own cosmonauts living aboard the ISS. But if we're honest, there's plenty of blame to throw around when it comes to ASAT tests. Few launch-capable countries have abstained from conducting their own. In 2007, China blew up one of its satellites, creating 40,000 new pieces of debris in a high enough orbit that much of it remains, and will remain, for decades to come. A year later, the United States shot down its own malfunctioning spy satellite, claiming the toxic hydrazine-filled machine posed a threat to human health if it crashed down to Earth in one piece. It was a weak excuse – space debris falls back to Earth all the time and rarely causes an incident – but at least the American test was at

a lower altitude than the Chinese test, meaning the debris deorbited more quickly. More recently, India conducted an ASAT test in 2019, also at a relatively low altitude. But even these low altitude tests are not without risk, as the impact can boost debris into higher, longer-lasting orbits. The bottom line is that there's no such thing as a responsible ASAT test, yet they keep happening.



The known orbit planes of Fengyun-1C debris one month after its disintegration by a Chinese interceptor in 2007. The white orbit represents the International Space Station. Credit: NASA Orbital Debris Program Office.

Perhaps we shouldn't be surprised. In the history of space exploration, there's no shortage of nations using spaceflight to show off their military prowess, a legacy of Cold War politics that just won't go away. But going forward, these irresponsible displays have no place in a sustainable space environment, and the consequences will only get worse as low Earth orbit becomes a busier place. Planned Mega-constellations promise to increase the number of active satellites by an order of magnitude in the coming decades. It's already begun, with Elon Musk's Starlink constellation rapidly expanding to nearly 1700 units this year.

This growing population of spacecraft has experts worried that future ASAT tests might be more catastrophic. A new paper by UBC researchers Sarah Thiele and Aaron Boley was released on *ArXiv* this week, modeling what an ASAT test like the 2019 Indian test might look like in a busier space environment. What if, they ask, there were 65,000 active satellites in orbit – as opposed to the current ~7000 – a number that may not be too unrealistic in the near future. In this high-density scenario, their result indicated a 30% chance of a collision for every test conducted (for fragments of 1cm or larger), and an impact of debris smaller than 3mm would be almost guaranteed. Long story short, the busier space gets, the less room there is to blow things up consequence-free.

This video contains audio from the moment Mission Control informed astronauts on the ISS about the risk of debris from the Kosmos-1408 ASAT test. The crew subsequently carried out emergency procedures and took shelter. Time stamps for key moments during the critical first three hours are available in the video's description. Credit: NASA, via Space SPAN.

Public opinion is certainly turning against ASAT test perpetrators, with rapid, widespread condemnation following the most recent tests by India and Russia. But something more substantial may be necessary to reign in the worst offenders. International norms, treaties promising good behaviour in space, and United Nations resolutions could all use an update, and the major spacefaring nations will need to take the lead if there is to be any hope of success.

There are already plenty of challenges to overcome in space in the next decade, like how to deal with radiation in long-term human spaceflight, or how to manage mega-constellations without impeding ground-based astronomy. Adding to the list of challenges by conducting unnecessary, irresponsible ASAT tests is absurdly short-sighted in today's space environment. It's about time they stop. Period.

Learn more: Sarah Thiele and Aaron Boley, "Investigating the risks of debris-generating ASAT tests in the presence of megaconstellations," *ArXiv*.

Featured image: A model of the orbital debris environment. Credit: ESA.

A Machine-Learning Algorithm Just Found 301 Additional Planets in Kepler Data

Looking to the future, astronomers are excited to see how machine learning – aka. deep learning and artificial intelligence (AI) – will enhance surveys. One field that is already benefitting in the search for extrasolar planets, where researchers rely on machine-learning algorithms to distinguish between faint signals and background noise. As this field continues to transition from discovery to characterization, the role of machine intelligence is likely to become even more critical.

Take the *Kepler Space Telescope*, which accounted for 2879 confirmed discoveries (out of the 4,575 exoplanets discovered made to date) during its nearly ten years of service. After examining the data collected by Kepler using a new deep-learning neural network called ExoMiner, a research team at NASA's Ames Research Center was able to detect 301 more planetary signals and add them to the growing census of exoplanets.

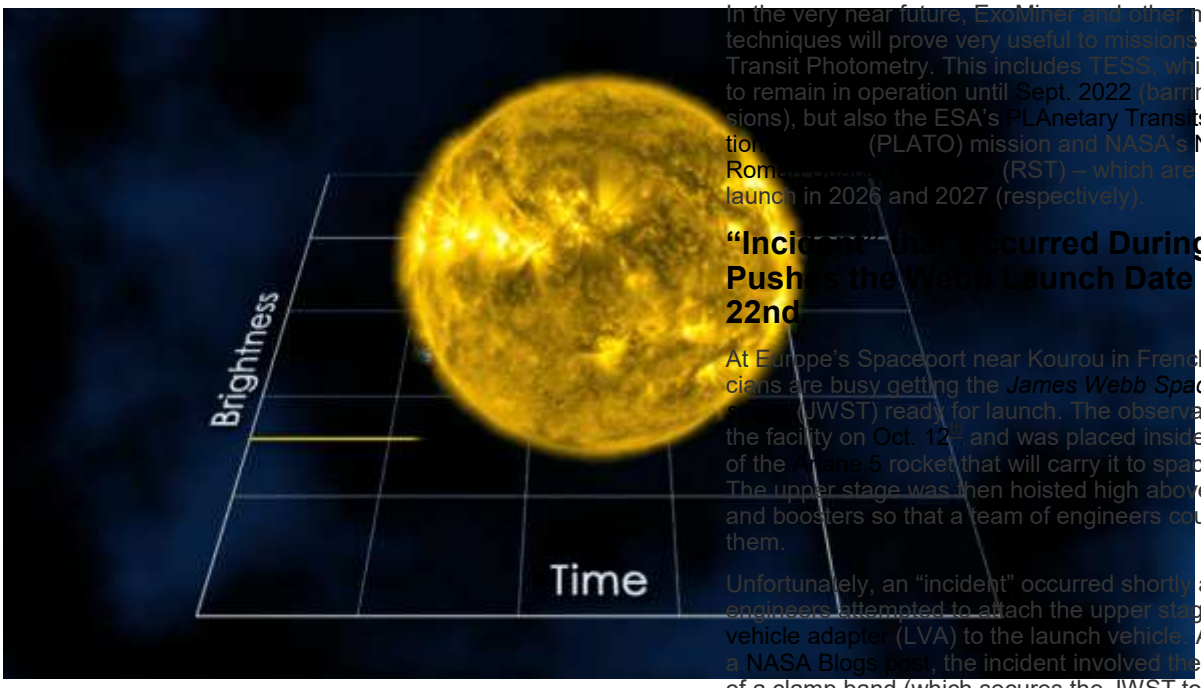
These newly-detected exoplanets and the ExoMiner algorithm were described in a paper that was recently accepted for publication in the *Astrophysical Journal*. The paper and project team were led by Hamed Valizadegan, a machine learning manager with the Universities Space Research Association (USRA) at NASA Ames', and included multiple researchers from the USRA, the SETI Institute, and universities from all around the world.

As they indicate in their paper, all 301 of the machine-validated planets were originally detected by the Kepler Science Operations Center pipeline. These planets were also promoted to the status of planet "candidate" by the Kepler Science Office (in other words, not confirmed). However, before the Kepler Kepler archive was examined using ExoMiner, no one was able to verify that these potential signals were exoplanets.

Like all machine-learning techniques, this new deep neural network learns to identify patterns based on the data it has been provided. In the case of ExoMiner, researchers at NASA Ames designed it using various tests and properties that human experts use to confirm the presence of exoplanets. Combined with NASA's Supercomputer (Pleiades), it uses this knowledge to distinguish between actual exoplanets and various types of "false positives."

Also indicated in the paper is how ExoMiner is more precise and consistent in ruling out false positives and identifying signatures of planets while also showing science teams how it arrived at its conclusion. As Valizadegan explained:

"When ExoMiner says something is a planet, you can be sure it's a planet. ExoMiner is highly accurate and in some ways more reliable than both existing machine classifiers and the human experts it's meant to emulate because of the biases that come with human labeling. Now that we've trained ExoMiner using Kepler data, with a little fine-tuning, we can transfer that learning to other missions, including TESS, which we're currently working on. There's room to grow."



When a planet crosses directly between us and its star, the light curve is altered slightly, which astronomers use to determine the presence of planets. Credit: NASA's Goddard Space Flight Center

ExoMiner was specifically designed to assist experts who search through the data gathered during the *Kepler* and *K2* campaigns. The reason for this has to do with the exoplanet-hunting method used by *Kepler* and its successor, the *Transiting Exoplanet Survey Satellite* (TESS). This consists of monitoring thousands of stars for signs of periodic dips in luminosity, which could be caused by exoplanets passing in front of them (aka. transiting) relative to the observer.

Known as the Transit Method (aka. Transit Photometry), this technique is the most effective means of exoplanet-detection to date, accounting for over 75% of all discoveries made to date. However, it is also subject to a substantial rate of false positives, which can be as high as 40% in single-planet systems (based on a 2012 study of Kepler mission data). What's more, it is only effective for about 10% of star systems since they must be edge-on relative to the observer for transits to be visible.

The primary way of getting around this is to monitor thousands of stars in a single field, which creates the data-mining burden (mentioned above). For all of these reasons, having an automated helper that can process the data reliably (by knowing exactly what to look for) is a huge game-changer. As Jon Jenkins, an exoplanet scientist at NASA's Ames Research Center, said in a recent NASA press release:

"Unlike other exoplanet-detecting machine learning programs, ExoMiner isn't a black box – there is no mystery as to why it decides something is a planet or not. We can easily explain which features in the data lead ExoMiner to reject or confirm a planet… These 301 discoveries help us better understand planets and solar systems beyond our own, and what makes ours so unique."

Unfortunately, none of the newly confirmed planets are believed to be "Earth-like," meaning they are not rocky in composition nor do they orbit within their parent stars' habitable zone (HZ). But they have some characteristics in common with the overall population of confirmed exoplanets in our galactic neighborhood, making these 301 planets a fitting addition to the exoplanet census.

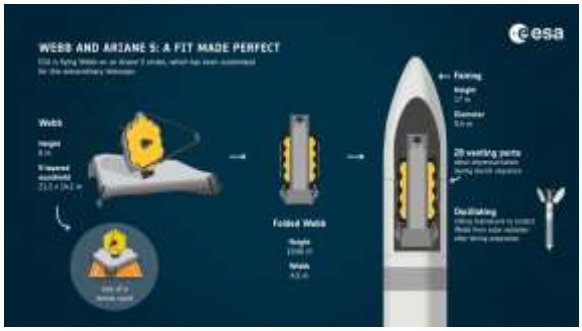
In the very near future, ExoMiner and other machine learning techniques will prove very useful to missions relying on Transit Photometry. This includes TESS, which is scheduled to remain in operation until Sept. 2022 (barring further extensions), but also the ESA's PLAnetary Transits and Oscillations (PLATO) mission and NASA's Nancy Grace Roman (RST) – which are scheduled to launch in 2026 and 2027 (respectively).

"Incident" that Occurred During Loading Pushes the Webb Launch Date to Dec. 22nd

At Europe's Spaceport near Kourou in French Guiana, technicians are busy getting the *James Webb Space Telescope* (JWST) ready for launch. The observatory arrived at the facility on Oct. 12th and was placed inside the upper stage of the Ariane 5 rocket that will carry it to space on Nov. 11th. The upper stage was then hoisted high above the core stage and boosters so that a team of engineers could integrate them.

Unfortunately, an "incident" occurred shortly after when the engineers attempted to attach the upper stage to the launch vehicle adapter (LVA) to the launch vehicle. According to a NASA Blogs post, the incident involved the sudden release of a clamp band (which secures the JWST to the LVA), which sent vibrations throughout the observatory. According to NASA, this incident could push the JWST's launch date (slated for Dec. 18th) to Dec. 22nd.

A NASA-led anomaly review board was immediately convened to investigate the unexpected development and recommend how to proceed. The board recommended that additional testing be instituted to "determine with certainty" that the incident did not damage any components. NASA also indicated that it and its mission partners would provide an update when the testing is completed, which is expected to be by the end of this week.



The second stage of the Ariane 5 is ideally suited to transporting the JWST to space. Credit: ESA

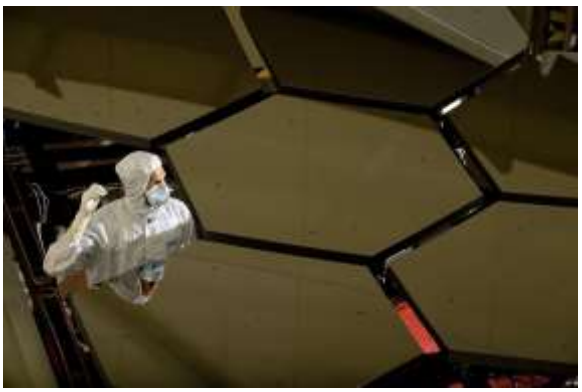
In the meantime, these additional tests mean that the JWST will not make its target launch date of Dec. 18th. But that is not surprising given the telescope's development history, which has been plagued by delays from the beginning. Development efforts began in 1996 with an initial plan to launch by 2007, but delays and cost overruns meant that the observatory was not finished construction until 2016.

Further delays occurred in 2018 when a section of the Sun Shield ripped during a practice deployment and again in March 2020 due to the pandemic. Once work resumed, a launch date of Oct. 31st was selected but was delayed yet again due to concerns over the Ariane 5 launch vehicle. These concerns were due to issues experienced during two previous launches, where the vehicle accelerated unexpectedly during rocket-fairing separation.

Despite these anomalies, the Ariane 5 rocket has a solid reputation for safely sending payloads to space. Since 1996, 111

launches have been made using this launch vehicle, and only five were unsuccessful (two failures and three "partial failures"). That's a 95.5% success rate, which is nothing less than excellent. But given the precious nature of the cargo, there can be no room for doubt when the JWST launches.

As of the writing of this article, the date for Webb's launch stands at Dec. 22nd at the earliest. Once additional tests are complete and the JWST and upper stage are given a clean bill of health, the Webb and Ariane 5 engineering teams will resume their efforts prepping the telescope for launch. This will culminate with the Webb and Ariane 5 teams uniting for the final integration of the upper stage to the core stage and boosters, then launch.



A primary mirror segment *of the James Webb Space Telescope, made of beryllium. Credit: NASA/MSFC/David Higginbotham/Emmett Given*

Once launched, Webb will be the largest, most complex, and most powerful telescope ever deployed to space. Using its 6.5-meter (21-foot) primary mirror, infrared instruments, spectrometers, and coronagraph, the JWST will attempt some of the most ambitious scientific operations in the history of astronomy. These include observing the first stars and galaxies in the Universe, studying galactic formation and evolution, completing the census of exoplanets, and answering fundamental questions about the origins of life.

With that in mind, it's easy to see why these delays have caused so much frustration for the mission team, NASA, ESA, and all of its commercial partners. The same is true of the astronomical community, amateur astronomers, and good old-fashioned space exploration enthusiasts. It is no exaggeration to say that countless people have been waiting for years to see what Webb will reveal about our Universe.

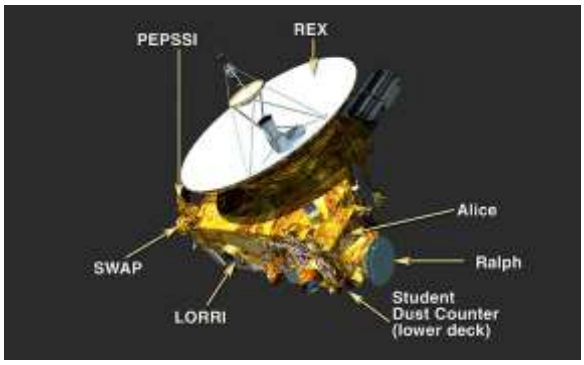
Once New Horizons was out Beyond Pluto, it Could Finally Measure the Brightness of the Milky Way

The New Horizons spacecraft has been speeding away from Earth since it launched in 2006. Scientists using the Alice UV imaging spectrograph on board New Horizons, have been patiently but sporadically gathering data during those 15 years, but also waiting to get far enough away from the Sun to make a specific measurement: the brightness of the Lyman-alpha background of the Milky Way. Until now, this had never been measured accurately.

"The farther we moved away from the Sun, the less we were blinded by the solar component of the Lyman-alpha background," said New Horizons team member Dr. Randy Gladstone, author of a new paper published in the Astronomical Journal. "This has been something that's been guessed at by astronomers for decades. Now we have a much more precise number."

Gladstone and his team used Alice to make the observations of the Lyman-alpha background (Ly?) several times during the mission: Three times during the cruise to Pluto, another observation just one month prior to the mission's flyby of Pluto, as well as one day after, and five times since then, out to just over 47 au from the Sun.

What Alice found is that the galactic component of the Lyman -alpha background is about 20 times less bright than the Lyman-alpha background is near Earth.



Instruments on New Horizons. The Alice UV imaging spectrograph has been used to study the composition of atmosphere and search for atmosphere around Charon, as well as measure the Lyman-alpha ultraviolet background in our galaxy.. Credit: NASA/Johns Hopkins University Applied Physics Laboratory/Southwest Research Institute.

The Lyman-alpha ultraviolet background was first detected in the 1960s, and until now, scientists have only been able to makes estimates of how pervasive it is – and these estimates have varied widely over the last 60 years.

The Lyman-alpha ultraviolet background glow permeates space and can be used to characterize the tenuous wind of hydrogen atoms which blows through our Solar System. Studying this wavelength of light – which is about four times shorter than what human eyes can see – allows astronomers to literally see in the dark. Observational cosmologists have been able to map out the distribution of matter in the universe, and an instrument similar to Alice on the Lunar Reconnaissance Orbiter called LAMP (Lyman Alpha Mapping Project) was used to image permanently dark craters near the north and south poles of the Moon.

*A map showing the permanently shadowed regions (blue) that cover about 3 percent of the moon's south pole. Credit: NASA Goddard/LRO miss*ion.

In space, the galactic Lyman-alpha background comes from hot regions around massive stars which ionize all the matter near them, which is primarily hydrogen. Hydrogen atoms between the stars scatter these photons into a roughly uniform glow throughout space. But in most of our solar system, the background is dominated by Lyman-alpha photons emitted by the sun.

"The Lyman-alpha background has been studied a lot near the Earth's orbit, and is bright enough that if we could see it, the night sky would never get darker than twilight," Gladstone explained in a press release. "It's so bright from solar Lyman-alpha that we weren't certain how much the Milky Way galaxy contributed to its overall brightness. It's like standing near a streetlamp on a foggy night. The fog scatters the lamp's light, making it hard to see anything else."

Out in the Kuiper Belt where New Horizons is traveling, the scattered sunlight component of the Lyman-alpha signal is far less bright and the fainter components from the nearby regions of the Milky Way become easier to distinguish. The team said in their paper that a more precise measurement will help astronomers better understand the nearby regions of the Milky Way galaxy.

"What a great resource New Horizons is," said New Horizons principal investigator Alan Stern, "not just for the exploration of the Kuiper Belt, but also to understand more about our galaxy and even the universe beyond our galaxy through this and other observations by our scientific instrument payload."

There's Enough Oxygen in the Lunar Regolith to Support Billions of People on the Moon

When it comes to the future of space exploration, a handful of practices are essential for mission planners. Foremost among them is the concept of In-Situ Resource Utilization (ISRU), providing food, water, construction materials, and other vital elements using local resources. And when it comes to missions destined for the Moon and Mars in the coming years, the ability to harvest ice, regolith, and other elements are crucial to mission success.

In preparation for the Artemis missions, NASA planners are focused on finding the optimal way to produce oxygen gas (O_2) from all of the elemental oxygen locked up in the Moon's surface dust (aka. lunar regolith). In fact, current estimates indicate that there is enough elemental oxygen contained in the top ten meters (33 feet) of lunar regolith to create enough O_2 for every person on Earth for the next 100,000 years – more than enough for a lunar settlement!

While the Moon does have a very tenuous atmosphere that contains elemental oxygen, it is so thin that scientists characterize the Moon as an "airless body." But within the lunar regolith, the fine powder and rocks that cover the surface, there are abundant amounts of oxygen in lunar rocks and regolith. Also known as "Moondust," this fine dust permeates the lunar surface and is the result of billions of years of impacts by meteors and comets.

According to John Grant, a lecturer in soil science at Southern Cross University, Australia, the Moon's regolith is approximately 45% oxygen by content. However, this oxygen is bound up in oxidized minerals – particularly silica, aluminum, iron, and magnesium. The isoptic composition of these minerals is almost identical to minerals on Earth, which led to theories that the Earth-Moon system formed together billions of years ago (aka. the Giant Impact Hypothesis).

However, for that oxygen to be usable by future astronauts and lunar inhabitants, it needs to be extracted from all that regolith, which requires a significant amount of energy to break the chemical bonds. On Earth, this process (known as electrolysis) is commonly used to manufacture metals, where melted-down oxides are subjected to electrical current to separate the minerals from the oxygen.

In this case, the oxygen gas is produced as a byproduct so that metals can be produced for the sake of construction and fabrication. But on the Moon, oxygen would be the main product while the metals would be set aside as a potentially useful byproduct – most likely for habitat construction. As Grant explained in a recent article in *The Conservation*, the process is straightforward but suffers from two major roadblocks when adapted for space:

"[I]t's very energy hungry. To be sustainable, it would need to be supported by solar energy or other energy sources available on the Moon. Extracting oxygen from regolith would also require substantial industrial equipment. We'd need to first convert solid metal oxide into liquid form, either by applying heat, or heat combined with solvents or electrolytes. We have the technology to do this on Earth, but moving this apparatus to the Moon – and generating enough energy to run it – will be a mighty challenge.

The ESA lunar base, showing its location within the Shackleton Crater. Credit: SOM/ESA

In short, the process needs to be much more energy-efficient to be considered sustainable, which could be accomplished through solar power. Around the South-Pole Aitken Basin, solar arrays could be positioned around the rim of the permanently-shadowed craters to provide an uninterrupted flow of energy. But getting the industrial equipment there would still present a monumental challenge.

But if and when we did establish the infrastructure, there's still the question of how much oxygen we could extract. As Grant indicates, if we consider just the regolith that is easily accessible on the surface and factor in data provided by NASA and the Lunar Planetary Institute (LPI), some estimates are possible:

"Each cubic metre of lunar regolith contains 1.4 tonnes of minerals on average, including about 630 kilograms of oxygen. NASA says humans need to breathe about 800 grams of oxygen a day to survive. So 630kg oxygen would keep a person alive for about two years (or just over).

"Now let's assume the average depth of regolith on the Moon is about ten metres, and that we can extract all of the oxygen from this. That means the top ten metres of the Moon's surface would provide enough oxygen to support all eight billion people on Earth for somewhere around 100,000 years."

Illustration of Artemis astronauts on the Moon. Credits: NASA

In many ways, estimating how an astronomical body will present opportunities for ISRU is like mineral prospecting. For example, NASA recently announced that the metallic asteroid Psyche II might contain as much as $10,000 quadrillion worth of precious metals and ores. In 2022, the *Psyche* orbiter will rendezvous with this asteroid, which could be the core remnant of a planetoid that lost its outer layers, to study it closely.

Naturally, some disagree with this assessment, citing that Pysche II's composition and density are not particularly well-constrained. For others, estimates of this nature ignore the sheer cost of extracting that wealth, which would require that extensive infrastructure be built beforehand. And even then, hauling that kind of mass from the Asteroid Belt to Earth presents numerous logistical issues.

The same goes for asteroid mining, a potentially-lucrative venture that could result in trillions being mined from Near-Earth Asteroids (NEAs) in the near future. However, this is also contingent on creating a robust space-mining infrastructure that is still very much in the conceptual stage. Luckily, when it comes to establishing ISRU-related infrastructure on the Moon, proposed methods and pathways have been in place since the 1960s.

In the coming years, multiple missions will be sent to the Moon to investigate these possibilities further, two of which Grant cites in his article. In early October, NASA signed a deal with the Australian Space Agency to develop a small lunar rover that could be sent to the Moon as early as 2026. The purpose of this rover will be to collect samples of lunar regolith and transfer them to a NASA-operation ISRU system on a commercial lunar lander.

Artist's illustration of the new spacesuit NASA is designing for Artemis astronauts. It's called the xEMU, or Exploration Extravehicular Mobility Unit. Credit: NASA

Also, the Belgium-based startup Space Applications Systems (SAS) announced this past summer that it was building three experimental reactors for on the Moon. They were one of four finalists contracted by the European Space Agency (ESA) to develop a compact technology demonstrator that can harvest oxygen to manufacture propellant for spacecraft, air for astronauts, and metallic raw materials for equipment.

The company hopes to send the technology to the Moon as part of a planned ESA ISRU Demonstration mission, which is currently scheduled to go to the Moon by 2025. These and other technologies are being pursued to ensure that humanity's long-awaited return to the Moon will be to say.

LightSail 2 has Been Flying for 30 Months now, Paving the way for Future Solar Sail Missions

Even after 30 months in space, The Planetary Society's LightSail 2 mission continues to successfully "sail on sunbeams" demonstrating solar sail technology in Earth orbit. The mission is providing hard data for future missions that hope to employ solar sails to explore the cosmos.

LightSail 2, a small cubesat, launched in June 2019 on a SpaceX Falcon Heavy, as a demonstration mission to test how well a solar sail could change the orbit of a spacecraft. A month after launch, when LightSail 2 unfurled its ultra-thin 32-square-meter Mylar sail, the mission was declared a success because the sail raised the orbit of the small, loaf-of-bread-sized spacecraft.

"We're going to a higher orbital altitude without rocket fuel, just with the push of sunlight," The Planetary Society's (TPS) CEO Bill Nye said at a press conference following the deployment. "This idea that you could fly a spacecraft and could get propulsion in space form nothing but photons, it's surprising, and for me, it's very romantic that you'd be sailing on sunbeams."

TPS, whose members funded the $7 million mission, said it shares mission data with NASA to assist three upcoming solar sail missions: NEA Scout, Solar Cruiser and ACS3. . NEA Scout is scheduled to hitch a ride to lunar space as early as February 2022 on NASA's Space Launch System rocket during the Artemis I test flight. The mission will use its solar sail to leave the vicinity of the Moon and visit an asteroid.

Solar sails use the power of photons from the Sun to propel spacecraft. While photons have no mass, they can still transfer a small amount of momentum. So, when photons hit the solar sail, the craft is pushed very slightly away from the Sun. Over time, if a spacecraft is out in space without any atmosphere to encumber it, it could potentially accelerate to incredibly high speeds.

A spacecraft with a solar sail wouldn't need to carry fuel and so could theoretically travel for longer periods of time, as it wouldn't need to refuel.

But LightSail 2 is in in orbit around the Earth. As the spacecraft swings its sails into the sunlight, it raises its orbit by as much as few hundred meters a day. But the small spacecraft doesn't have the means to tilt the sails precisely enough to prevent lowering its orbit on the other side of the planet. Eventually, LightSail 2 will dip far into the Earth's atmosphere to succumb to atmospheric drag. It will deorbit and burn up.

This image taken by The Planetary Society's LightSail 2 spacecraft on Aug. 7, 2021 shows tropical storm Mirinae off the coast of Japan during the Tokyo Olympics. North is approximately at top left. This image has been color-adjusted

and some distortion from the camera's 180-degree fisheye lens has been removed. Credit: The Planetary Society

A recent update from TPS says that LightSail 2's altitude above Earth is currently about 687 kilometers.

"Thanks to optimized sail pointing over time, altitude decay rates during recent months have been the best of the entire mission," wrote TPS's Jason Davis. "Thrust even occasionally overcame atmospheric drag, slightly raising the spacecraft's orbit. Additionally, below-average Sun activity has kept Earth's upper atmosphere thin for much of the mission, creating less drag on the sail."

But the Sun has recently become more active, emitting significant solar flares. The LightSail 2 team believes that this activity is likely now causing higher orbital decay rates than those seen earlier in the mission. However, mission engineers estimate the spacecraft could stay in orbit at least another year.

And in the meantime, while the spacecraft keeps sending back incredible pictures from orbit, engineers continue to glean insights that can be passed along to future missions.

A Black Hole has been Found Lurking Just Outside the Milky Way

Astronomers have found a smaller, stellar-mass black hole lurking in a nearby satellite galaxy of our own Milky Way. The black hole has been hiding in a star cluster named NGC 1850, which is one of the brightest star clusters in the Large Magellanic Cloud. The black hole is 160,000 light-years away from Earth, and is estimated to be about 11 times the mass of our Sun.

Using the European Southern Observatory's Very Large Telescope in Chile, astronomers found the black hole when they noticed a star with a peculiar motion among the star cluster, where other stars weren't behaving the same way. Further investigation revealed the gravitational influence came from a stellar mass black hole.

This is the first time astronomers have used this detection method to reveal the presence of a black hole outside of our galaxy. Astronomers say this method could be helpful in locating other hidden black holes in the Milky Way and nearby galaxies, and it can also help shed light on how these mysterious objects form and evolve.

Usually, black holes can be detected by the X-ray glow they emitted as they swallow matter, or from the gravitational waves generated as black holes collide with one another or with neutron stars.

But most smaller stellar-mass black holes don't give away their presence through X-rays or gravitational waves.

"The vast majority can only be unveiled dynamically," says Stefan Dreizler, one of the team members who contributed to the new paper, published in the Monthly Noticed of the Royal Astronomical Society. "When they form a system with a star, they will affect its motion in a subtle but detectable way, so we can find them with sophisticated instruments."

The team said they have been acting as detectives, trying to track down a criminal gang from their missteps.

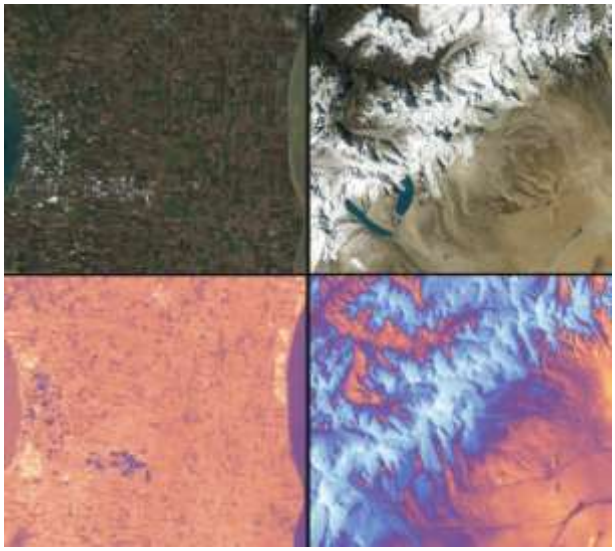
"We are looking at every single star in this cluster with a magnifying glass in one hand trying to find some evidence for the presence of black holes but without seeing them directly," said Sara Saracino from the Astrophysics Research Institute of Liverpool John Moores University in the UK, who led the research. "The result shown here represents just one of the wanted criminals, but when you have found one, you are well on your way to discovering many others, in different clusters."

NGC1850 as seen with the Very Large Telescope and the Hubble Space Telescope. ***Credit:*** *ESO, NASA/ESA/R. Gilmozzi/S. Casertano, J. Schmidt.*

NGC 1850 is an unusual double star cluster that lies in the bar of the Large Magellanic Cloud, a neighbor galaxy of our own Milky Way. NGC 1850 is the second brightest star cluster in the LMC, and contains thousands of stars.

A specialized instrument on the VLT, the Multi Unit Spectroscopic Explorer (MUSE) allowed the researchers to observe the very crowded star cluster and analyze the light of every single star in the vicinity.

"The net result is information about thousands of stars in one shot, at least 10 times more than with any other instrument," said co-author Sebastian Kamann, also from Liverpool's Astrophysics Research Institute.



Landsat 9's First Images are Here

The latest satellite in the Landsat family of Earth observation spacecraft has collected its "first light" images of our planet. Landsat 9 launched on September 27, 2021 and it continues the nearly 50-year tradition of making critical observations to help with energy and water management, forest monitoring, human and environmental health, urban planning, disaster recovery and agriculture.

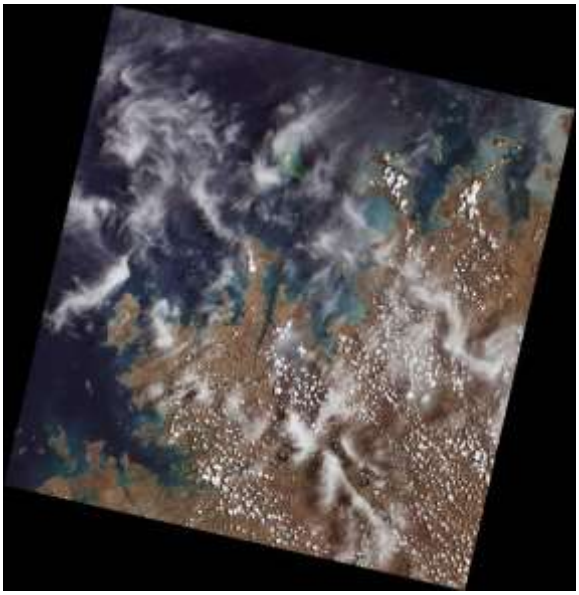
The first images were taken on October 31, and have now been posted online. Our lead image shows (left) rectangles of farm fields in southern Ontario, sandwiched between Lake Erie and Lake St. Clair, and (right) snow and glaciers in the Himalayan mountains, leading to the flat Tibetan Plateau. Both photos are shown in different wavelengths from two instruments. The Operational Land Imager 2 (OLI -2), detects visible, near-infrared and shortwave-infrared light in nine wavelengths, and the Thermal Infrared Sensor 2 (TIRS-2), detects thermal radiation in two wavelengths to measure Earth's surface temperatures and its changes.

"The incredible first pictures from the Landsat 9 satellite are a glimpse into the data that will help us make science-based decisions on key issues including water use, wildfire impacts, coral reef degradation, glacier and ice-shelf retreat and tropical deforestation," said?USGS Acting Director Dr. David Applegate.?"This?historic moment?is the culmination of?our?long?partnership with NASA on Landsat 9's development, launch and initial operations, which will better support environmental sustainability, climate change resiliency and economic growth – all while expanding an unparalleled record of Earth's changing landscapes."?

Sediments swirl in Lake Erie and Lake St. Clair in this Landsat 9 image of both Detroit, Michigan, and Windsor, Ontario, from Oct. 31, 2021. Credit: NASA/USGS

Landsat 9 reached its final orbital altitude of 438 miles (705 kilometers), in a near-polar, Sun-synchronous orbit.

Its predecessor, Landsat 8 – launched in 2013 — is still hard and work. By combining the power of both Landsat 8 and 9, the two satellites can now photograph the entire Earth every eight days.



The first image collected by Landsat 9, on Oct. 31, 2021, shows mangroves clustered in protected inlets and bays on the edge of the Indian Ocean. Fluffy cumulus clouds and high -altitude cirrus clouds hover nearby. The aqua colors of the shallow near-shore waters give way to the deep, dark blues of the ocean. Credit: NASA/USGS

The two Landsats are very similar in design, but Landsat 9 features several improvements. NASA said the new satellite transmits data with higher radiometric resolution back down to Earth, allowing it to detect more subtle differences, especially over darker areas like water or dense forests. For example, Landsat 9 can differentiate more than 16,000 shades of a given wavelength color; Landsat 7, the satellite being replaced, detects only 256 shades. This increased sensitivity will allow Landsat users to see much more subtle changes than ever before.

"First light is a big milestone for Landsat users – it's the first chance to really see the kind of quality that Landsat 9 provides. And they look fantastic," said Jeff Masek NASA's Landsat 9 project scientist at Goddard Space Flight Center. "When we have Landsat 9 operating in coordination with Landsat 8, it's going to be this wealth of data, allowing us to monitor changes to our home planet every eight days."

All of the new Landsat imagery – as well as data from over the years –is available online here.

E Mails Viewings Logs and Images from Members.

Viewing Log for 1ST of November

Starting to get free evenings with clear skies (tonight I was actually on holiday from Asda, so that was a bonus) and the moon not being around, this means time to go out and try some viewing!

I went to my usual spot near Uffcott and had my eight inch (203 mm in new money) Meade LX90 GOTO telescope fitted with a Pentax 14 mm WX eye piece set up and ready to use at 20:11. Temperature was 6 °C with no wind, so should be pretty good and with a wet road, conditions should be good for the sky?

First object to view was Saturn, this planet was getting low in the western sky now, could not make out any details on this planet but could see Titan (second largest moon in solar system) close by. Hopefully Jupiter would give me some details as it was higher in the sky and more eastwards, saw the four large moons of this planet, namely Europa to the east and Io, Ganymede and Calisto of to the west of the planet. Looking at a programme called Jupiter 2 which I have at home, the Great Red Spot was on view but I never saw it? Uranus had no colour to show and as for Neptune, never saw it even slewing around the area it should be. Saturn, Jupiter and Uranus were not in the eye piece either, had to do a minor slew to view these objects, yet all deep sky were in eye piece throughout the evening, strange!

Giving up with the solar system, it was time to head off for some Messier (M) objects instead. First object was M 36, a large loose open cluster (OC) in Auriga, M 37 which is close by was also large but denser with stars and dimmer to look at. Final Messier object in this constellation is M 38, another large OC which was dim to look at. Staying with OC's I went across to Cassiopeia and viewed M 52, a large dense subject, M 103 is a lot smaller but also dense to look at. Onto some New General Catalogue (NGC) objects, starting with NGC 457, the Owl Cluster or Caldwell (C) 13, this cluster was very large and loose to look at, the two main stars that make up the eyes were quite bright. Onto NGC 869 and 884 better known as the 'Double Cluster' or C 15, 869 is large with a dense centre, 884 is larger and more loose, of the two 884 looked the more impressive to me. I had already had one car go past me but this time a person was walking up the road towards me with a torch, oh no I thought. But they turned in a field about 30 yards from me and brought a horse out from the field and went back down the road, problem over. Onto my first planetary nebula (PN) for the evening and M 76, one of the more harder objects to see on this list, a fuzzy blob (FB) to me! Back to OC's and M 34, very loose, noticed six stars that made a three prop propeller within this OC? Onto spiral galaxies (SG) and M 33, the Pin Wheel galaxy, this was a FB to look at. M 31, the Andromeda galaxy is large with a bright core, nearby is M 32 a much smaller SG with a bright core. Had trouble making out M 110, a faint fuzzy blob (FFB) to look at, cloud in the general area probably did not help? First globular cluster (GC) was M 15 near the nose of Pegasus, this GC has a bright core. Staying in Pegasus and NGC 7662 or C 22, the Blue Snowball nebula. This PN looked like a large out of focus star? Nearby is NGC 7331 or C 30 an unbarred SG more like a FFB to me? Back to another PN and M 27, the Dumbbell nebula, a large grey blob but could make out the apple core within it. Into Sagitta and M 71 an often overlooked (to me) GC, this object was a FB and easy to miss. Staying with GC's and M 56, a grey blob was the best way for me to describe this object. Final PN was M 57, the Ring Nebula, this object never fails me, nice to view. Around the Taurus and M 1, a FFB and the only Super Nova Remnant on the list of 110 objects. Into Gemini and M 35 a very loose OC to look at. An OC which I can see with my own eyes is M 45, the Pleiades now climbing out of the eastern horizon, best seen with the finder scope but this had now dewed up well but still could make out the main seven stars.

Final object for the evening and probably the jewel of the winter sky and M 42 which was just clearing the hedge.

Time to pack up as it was now 22:05 and the equipment used was quite wet which would need drying overnight (most important), temperature had now dropped to 4 °C, still quite pleasant for viewing?

Clear skies.

Peter Chappell

Viewing Log for 4th of November

Three days later and out again doing another viewing session! Again I went to my usual spot near Uffcott but this time I decided to pull out my Skywatcher EQ3-2 Pro mount with William Optics 80 mm telescope and 10 mm Pentax WX eye piece. This meant objects would be much small than viewing them with my Meade scope, less magnification? Setting up this equipment takes a lot longer as you have to balance both the scope and mount (most important not to stain the gear teeth), so was not set up until 20:36. Temperature was 4 °C which is okay for viewing, noticed while doing the set ups I last used this scope during lockdown 3 on 11th of February at home? While doing the two star align, three cars went past me!

On to first object and Saturn, like last time it was not in the field of view of the telescope! Think too much atmosphere was affecting the conditions for this planet as it was very low in western sky? Jupiter was better to look at, two moons were on either side of this large planet. While viewing these planets another two cars went past me! Is it going to be one of those nights with lots of traffic on the road? As both of these planets were out of view I thought I would check with a star, choose Altair and it was in view of the eye piece, so I knew set up was correct? Going to next object the DEC cable got caught on the mount, so I had to switch of the equipment, reroute the cable to other side of the mount and redo set up. On to Uranus, again out of view but managed to find it. With solar system objects finished I thought I would try the 'Deep Sky Tour' programme in the hand controller and see what comes up. First object was M 1, a faint blob (FB) in Taurus, easy to miss! I could see more of this object the longer I looked. Noticed two of the polar scope screws loose, tighten these up and would check over the mount once I got home as it will have been years since I last gave this mount the once over, needs to be done more often! Slewed around to M 45, the Pleaides but the mount jammed on its travel's, now what is happening I thought? Went other way to Albireo for a check in alignments and this was okay. Thought I would stay out to the west for the time being and started with M27, this planetary nebula (PN) was a large grey blob to look at. Onto Sagitta a now often looked at constellation and M 71, a small faint fuzzy blob to look at. M 56 this time was a fuzzy blob and no better, nearby is M 57 the Ring Nebula which is usually a good view for me but using a small refractor it looked like an out of focus star? Onto M 29 in Cygnus, small and dim to look at. Then onto M 39 and the mount stopped and made strange noises! Looking around the equipment I noticed the battery was reading red, out of juice and finished for the evening?

With it being 22:22, it was time to pack everything up and go home! Think I spent more time setting up the equipment than actual viewing time on this evening, hopefully better the next time this kit comes out!

Clear skies.

Peter Chappell

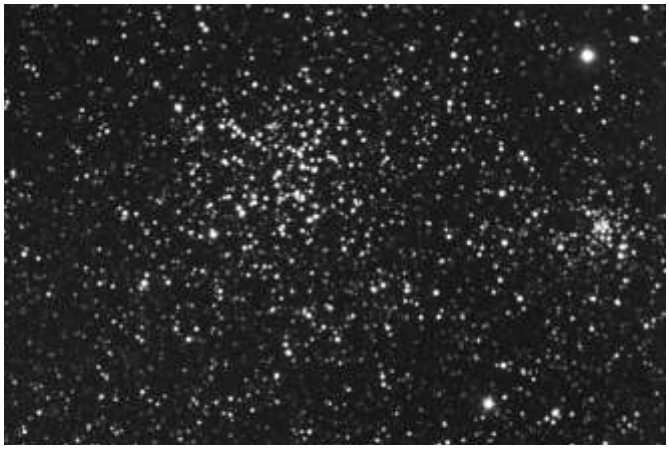
PS The following day I checked all of the fasteners on the mount, all screws were a bit loose but the Allen keys bolts were all tight, could be lack of maintenance by me? One thing I have noticed with EQ mounts, they drain battery power much more quickly than fork mounts, do not know why as both of them use two motors to run the equipment?

Viewing Log for 26th of November Club Viewing

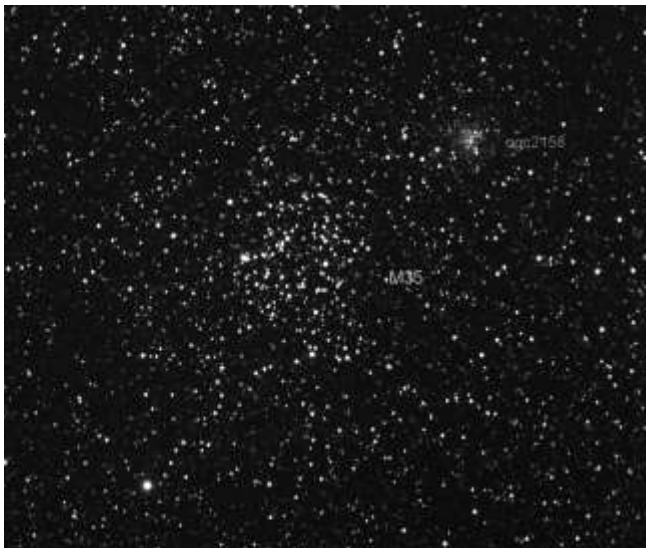
Chris books had arranged a viewing session at Lacock and said it was on, read this message around 17:00, looked out of the window and thought, probably not as it had just started to rain hard with a strong wind for company? Anyway after finishing our pub meal we returned home and noticed Jupiter in the sky with a few clouds around. Thought I would wait until 19:15 ish and see what was happening, had a look outside and the sky looked promising, so thought I would get some gear together and go down and see who would be there.

As it might rain suddenly I decided not to take any GOTO gear with me as if the heavens suddenly opened up it takes quite a few minutes to get everything back in the car, electronics and rain do not go together. So I took my Porta Mount II tripod and 80 mm William Optics refractor with me, would be using a Pentax 10 mm eye piece. If we had any rain I could just pick the equipment up in one go and get back to the car which was about 25 yards away.

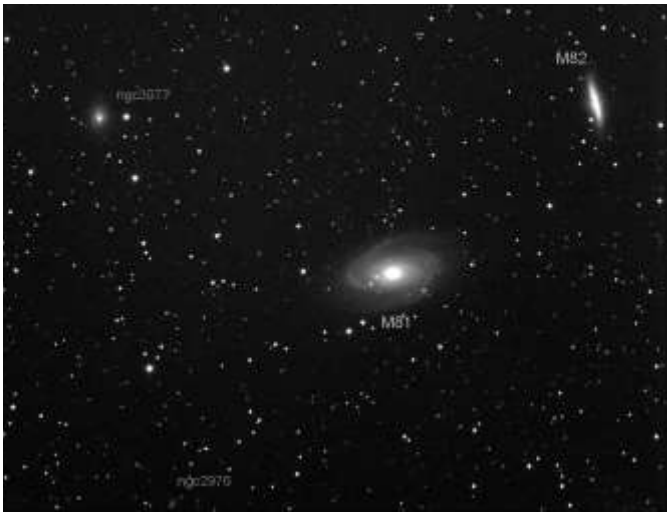
Setting up the equipment only took minutes and had everything ready by 20:07, with a temperature of 4 °C and a strong wind to keep us company I knew it could be on the cold side for viewing. The toilet block in the car park and hedge did give us some wind protection BUT the security light for the car park would give us some light pollution



which we could not remove, one of the problems at viewing a Lacock? There was a total of six hardy or fools at the viewing session, Chris, Andy Burns and myself plus three newbies. I got speaking to one of the newbies by the name of Terry, he said he had a 12 inch Dobsonian with him, so with a bit of encouragement from me he set his



equipment up. By now Saturn had gone into the cloud on the horizon but Jupiter was shining brightly so that would be my first target, could make out the two main weather belts plus the usual four moons circling the planet, namely Io to the east and Europa, Ganymede and Calisto out to the west of the planet as provided by Jupiter 2 programme. Not using GOTO equipment for the evening, everything would have to be found by star hopping or being in the general area and scanning the area and hopefully picking up the object visually. Not far from the square of Pegasus is the globular cluster Messier (M) 15, it is actually to the south west of the square at the end of its nose, the star Enif (which makes up the end of the nose) is the starting point. I had several tries at finding the cluster with no luck, so I ended up chatting to some of the people there, after a while I had another go and bingo I found it, small with a bright core. As magnification was not that much (around 50?), everything would be much smaller than using the Meade LX90 which I normally have at around 140. I had to skip around the sky as cloud started to block some areas of the sky, so I went to the double Albireo at the end of Cygnus, looked very nice. From here I can go to M 27, the Dumbbell nebula by star hopping via the triangle of four stars. First thing I had to sort out was getting the slewing knobs to go the correct way, things are a bit different using a refractor instead of a SCT! After getting the right directions off I went but I could not find the stars at all, the security light in the car park does not help as some of the light was coming into the dew shield, must have tried for around 10 minutes but gave up and tried another object. Could not miss M 45, the Pleiades in the sky, even using a 10 mm eye piece I could not fit the cluster in, so I went for a 20 mm one instead, could see the seven main stars in the field of view, looked very nice to view. By now a couple of the newbies had gone, getting cold and not wearing the correct clothes, jeans and trainers are not the best gear to wear on viewing sessions, I know this from personal experience! Had a chat to Andy about speakers for a few minutes and then subject went on to finding deep sky objects by star hoping which I said I was pretty rubbish! Can I find some for you? Why thank you for the offer, so the rest was found with Andy's help. First object was M 38 in Auriga, I had tried earlier in the evening with no luck, this open cluster (OC) was good to look at, nearby is M 36 which was a bit more denser with stars but smaller, same could be said about M 37, also in Auriga. Popped across the border and into Gemini to find M 34, again this is a smaller and denser OC than M 38? Going to the northern horizon and Ursa Major and M 81 and 82, both of these galaxies could be



seen in the same field of view, small but beautiful to look at. Final object for the evening with Andy was M 29 in Cygnus, very easy to overlook with smaller equipment, again I had a look for this OC earlier but had no luck even using the star Sadr as a reference point. Started to have a long chat with Chris as Terry and Andy had now packed up their equipment and left the area. Before we finished for the evening I had a look at M 42, the trapezium stars were too close together to

split with this equipment.

Time was now 22:07 and time to pack up what little gear I had out, I could very easy had my usual LX90 out as there was no chance of rain coming along while we were at Lacock, sky was mainly clear, yet by the time I had got home which was about 15 miles away the sky was totally clouded out!

Clear skies.

Peter Chappell

Viewing Log for 1st of December

Looking out of the window at 16:30 there was heavy rain with some wind even though the forecast was supposed to be clear later in the evening? Moving forward by a couple of hours and the skies started to clear, normally I played Chess of Wednesday evenings but as I had a match the following night I thought I would give it a miss. Before I went out I thought I would look at some emails and in one of them a team member for the match said he was ill and would not be available for the match. Now I had to try and reach the other captain before I went out, tried his home phone and got an answering machine instead, must have already gone to the club? As we would be playing the Swindon A team (I am in the B team), it was a case of going to the Merlin pub and speaking to him, wrong direction for astronomy unfortunately! After postponing the match I could do some astro.

I arrived at my usual viewing spot of Uffcott and had my Meade LX90 GOTO telescope set up and ready by 20:28, this time I would be using a 14 mm Televue Delos eye piece instead of the Pentax XW. Temperature was 4 ° C with little wind to keep me company. While doing the set-up, two cars went past me, would it be one of those evenings with a lot of traffic going by (turns out another three went past me during the evening, not including the tractor)? Saturn had already gone, so I went to Jupiter and this time the planet was in the eye piece, not dead centre but in view. There was one moon (Io) out to the east of the planet and Calisto, Europa and Ganymede to the west, light time was 42.9 minutes or 5.153 AU away! As usual I could not find either Uranus or Neptune which seemed a bit strange! So with the solar system out of the way, it was time to hit the deep sky object. Thought I would start in the west and some summer constellations, first up was Messier (M) 27, the Dumbbell nebula, this planetary nebula (PN) was a large grey blob to look at and I could make out the apple core with in it. With the rain we had earlier in the evening, the sky conditions might be pretty good for viewing? On to M 71, a globular cluster (GC) in Sagitta, a large object to look at and could just make out some detail of this object? Going north and on to M 56 another GC, this was smaller but had a bright core. The Ring Nebula, M 57 I could make out the circle of the PN quite easy, think was the first time I had really noticed this? Going west again and on to M 29 in Cygnus, this open cluster (OC), six main stars were fairly bright. Still in this constellation and M 39, a large OC which is better viewed with the finderscope and the main scope I was looking thru the cluster. By now the wind had picked up and getting a bit colder, I had some protection from the hedge but not much! Ursa Major was just above this hedge, so I headed off to M 81, this spiral galaxy (SG) had a bright core, and one of the better SG's to look at? Next door is M 82, this Irregular galaxy (IR) was long and thin to look at. On to my old nemesis and M 97, the Owl Cluster, this was a faint fuzzy blob (FFB) to view and easy to miss? For M 108 and 109, I had to move the eye piece to find both of these SG's, very easy to overlook! M 106 was in the hedge, so a non-starter, the final Messier object in this constellation is really a double star, namely M 40, not much else can be said about this item? By now the wind had died down again, while the wind was around some cloud had rolled in but by now had gone.

Final PN on his list is M 76, probably one of the harder objects to find with the eye? This was a fuzzy blob (FB) but had some brightness, maybe it helped being at an attitude of 87 ° (nearly overhead!). Now on to a batch of OC's starting with M 52, this object was compact and dim to look at, also in Cassiopeia is M 103 more wedge shape OC with not many stars in it. Across to Auriga and M 36, large and loose. M 37 is slightly larger than M 36 with more stars but dimmer to view. M 38 was large, loose and dim to look at. Nearby is M 34, a very loose OC with not many stars in this cluster? Slewing around to the west again and M 15 in Pegasus, this GC is small with a bright core, lower down was M 2, again small with a bright core being only 10 ° above the horizon it did well for viewing. Going east and M 33, the Pinwheel galaxy, this SG was large but hard to see, a FFB! M 31, the Andromeda galaxy was large and had a really bright core! When I went to M 32, I had a laugh as it was really small and a FB to look at. M 110 is also an Elliptical galaxy like M 32, another FB. Now a tractor went past me, must be working late! On to M 45, the Pleaides, again better to look at with the finderscope than the main scope. M 1, the Crab nebula in Taurus is the only Super Nova Remnant on his list, this is a large grey blob to look at. For the first time while viewing M 78 in Orion I could make out some grey around the two main stars in this reflection nebula? On to M 42, the Orion nebula and M 43 close by, I could make out the two arms of this nebula very well, just brilliant to look at! Final object for the deep sky was M 35 in Gemini, this OC was very large and loose to look at.

Before packing up, I thought I would try and find Uranus or Neptune again, all of the deep sky objects were in the field of view of the eye piece, again could not find either! Writing down the RA and Dec of these objects I thought I would compare them to internet positioning. Uranus to start with, hand controller said RA = 2:39.8 and Dec = 15° 7', internet said RA = 2:36.15 and Dec = 14° 50'31" both out! Neptune, hand controller said RA = 23:22.6 and Dec = 5°15', internet said RA = 23:25 and Dec = 4°59'9" again both out! Does make a differences in trying to find these dim objects?

Time was now 22:35 and my feet felt cold, so time to pack up and go home. The wind had died down completely and there was a frost on the roof of the car, temperature was now 2 ° C.

Clear skies.

Peter Chappell

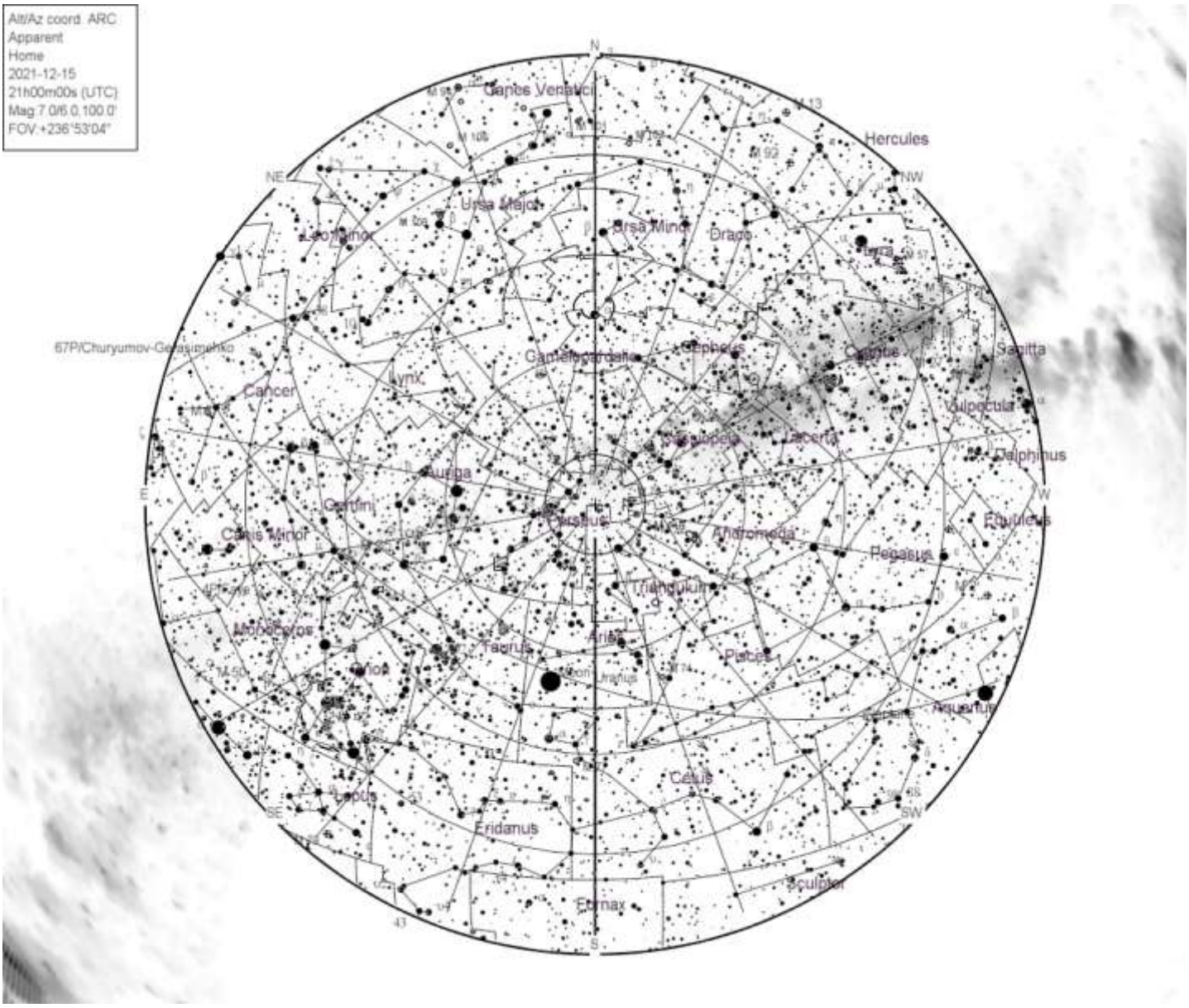
PS I think the sky conditions were probably one of the best I had witnessed in the UK, having the rain earlier helped clear the sky of dust, I did try the Pentax eye piece on M 42 to compare with the Delos, not much differences to see.

Editor note

Thank you very much Peter for these viewing notes.

I have added some to the viewing evening section for illustration.

WHATS UP, DECEMBER 2021



December 4 - **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 07:44 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.

December 4- **Total Solar Eclipse.** A total solar eclipse occurs when the moon completely blocks the Sun, revealing the Sun's beautiful outer atmosphere known as the corona. The path of totality will for this eclipse will be limited to Antarctica and the southern Atlantic Ocean. A partial eclipse will bee visible throughout much of South Africa. (**NASA Map and Eclipse Information**) (**Interactive NASA Google**)

December 13, 14 - **Geminids Meteor Shower.** The Geminids is the king of the meteor showers. It is considered by many to be the best shower in the heavens, producing up to 120 multicolored meteors per hour at its peak. It is produced by debris left behind by an asteroid known as 3200 Phaethon, which was discovered in 1982. The shower runs annually from December 7-17. It peaks this year on the night of the 13th and morning of the 14th. The waxing gibbous moon will block out most of the fainter meteors this year. But the Geminids are so numerous and bright that this could still be a good show. Best viewing will be from a dark location after midnight. Meteors will radiate from the constellation Gemini, but can appear anywhere in the sky.

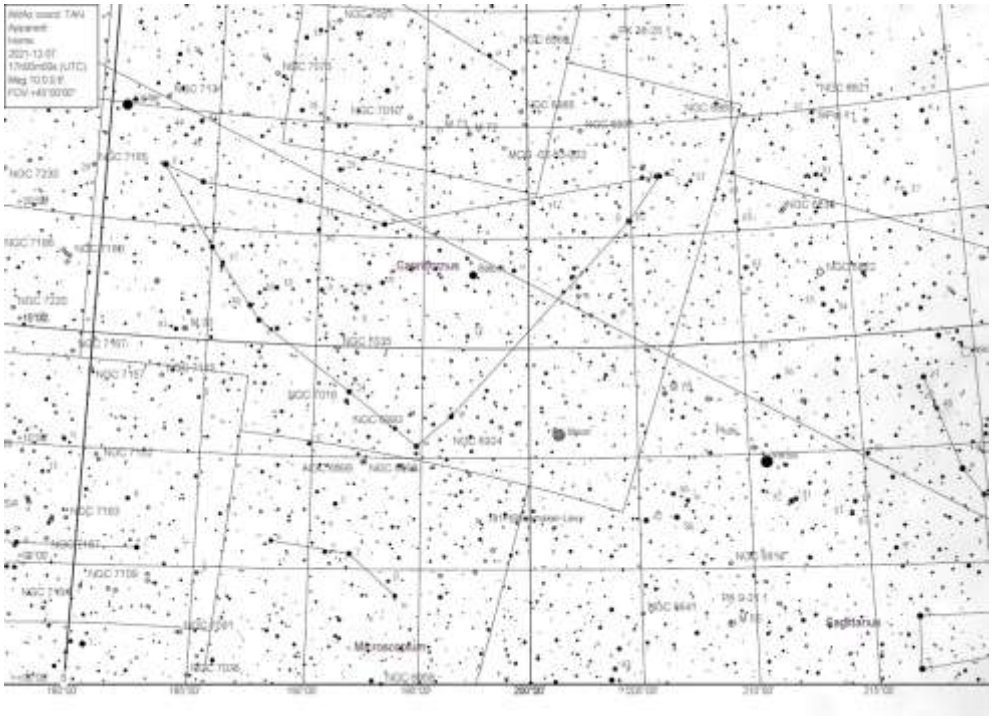
December 19 - **Full Moon.** The Moon will be located on the opposite side of the Earth as the Sun and its face will be will be fully illuminated. This phase occurs at 04:37 UTC. This full moon was known by early Native American tribes as the Cold Moon because this is the time of year when the cold winter air settles in and the nights become long and dark. This moon has also been known as the Long Nights Moon and the Moon Before Yule.

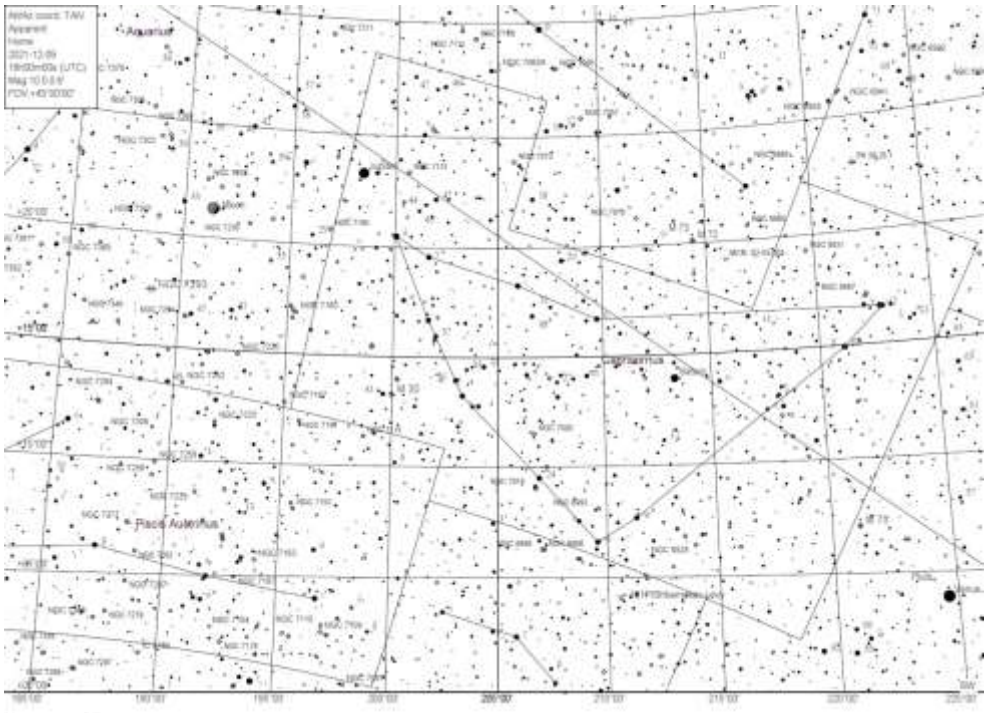
December 21 - **December Solstice.** The December solstice occurs at 15:50 UTC. The South Pole of the earth will be tilted toward the Sun, which will have reached its southernmost position in the sky and will be directly over the Tropic of Capricorn at 23.44 degrees south latitude. This is the first day of winter (winter solstice) in the Northern Hemisphere and the first day of summer (summer solstice) in the Southern Hemisphere.

December 21, 22 - **Ursids Meteor Shower.** The Ursids is a minor meteor shower producing about 5-10 meteors per hour. It is produced by dust grains left behind by comet Tuttle, which was first discovered in 1790. The shower runs annually from December 17-25. It peaks this year on the the night of the 21st and morning of the 22nd. The nearly full moon will be a problem this year, blocking all but the brightest meteors. But if you are patient enough, you may still be able to catch a few good ones. Best viewing will be just after midnight from a dark location far away from city lights. Meteors will radiate from the constellation Ursa Minor, but can appear anywhere in the sky.

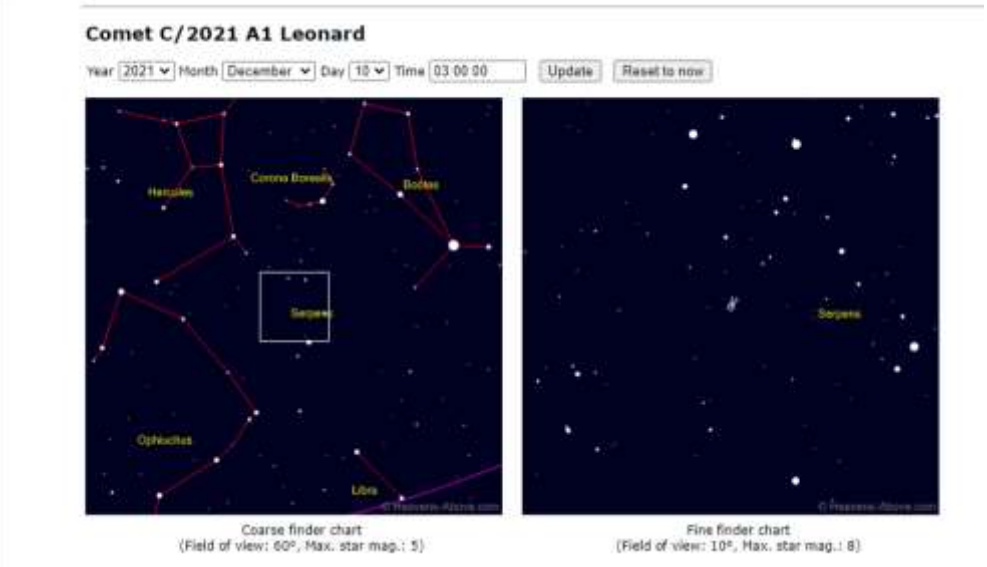
The Dance of the Planets and a bright Comet(?)/

Tonight (meeting night 7th) Venus is at its brightest in an orbit, at magnitude –4.7. If it wasn't for the Moon running below the planets this week you could try to photograph the sharp penumbra free shadow that it makes as a small single light source. I have photographed once whilst in Spain at the Griffon Observatory. Here it is usually below the tree and building line before it is dark enough to see this shadow.
All this month the planets of Neptune (binoculars), Jupiter, Saturn and Venus crowd the South Eastern sky, but the first few days from last night to the 9th our Moon underlines the ecliptic, showing the tilt in the lunar orbital path compared to the Solar ecliptic.



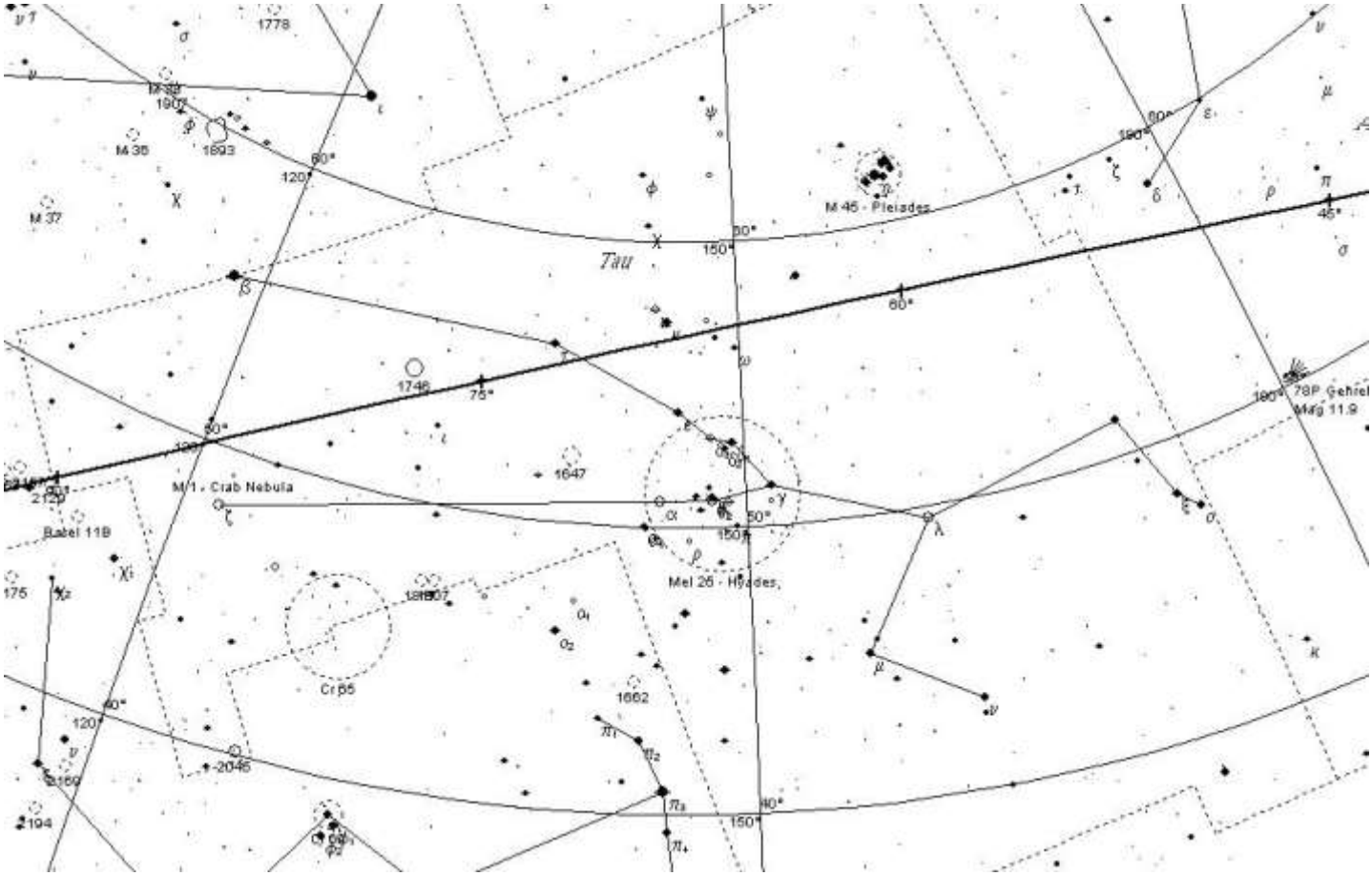


Comet C/2021 A1 Leonard is getting quite bright as it runs through Bootes. Binoculars and Photoimaging will show this best, I have selected the chart for the 10th as it drops into Serpens and tentatively the best viewing night this week. Heavens Above web site gives finder charts for most bright comets that can be changed for date and time.



Comet 67P Churyumov Gerasimenko (the Rosetta mission final target) is in Cancer above M44 Beehive cluster, but now it is down to magnitude 9.3..

CONSTELLATIONS OF THE MONTH: TAURUS



The ancient zodiacal constellation of Taurus was one of Ptolemy's original 48 constellations and remains today as part of the official 88 modern constellations recognized by the IAU. It is perhaps one of the oldest constellations of all and may have even been recognized prehistorically. Taurus spreads over 797 square degrees of sky and contains 7 main stars in its asterism with 130 Bayer Flamsteed designated stars located within its confines. It is bordered by the constellations of Auriga, Perseus, Aries, Cetus, Eridanus, Orion and Gemini. Taurus is visible to all observers located at latitudes between +90Â° and ? 65Â° and is best seen at culmination during the month of January.

There is one major annual meteor shower associated with the constellation of Taurus, the annual Taurids, which peak on or about November 5 of each year and have a duration period of about 45 days. The maximum fall rate for this meteor shower is about 10 meteors per hour average, with many bright fireballs often occuring when the parent comet – Encke – has passed near perihelion. Look for the radiant, or point of origin, to be near the Pleiades.

Taurus is considered by some to be one of the oldest recognized constellations known, and may have even been depicted with the Pleiades in cave paints dating back to 13,000 BC. According to Greek myth, Taurus was the god Zeus, transformed into a bull in order to woo princess Europa, and perhaps could represent one of the Cretean Bull of Herculean fame. The ancient Egyptians also worshiped a bull-god for which this constellation might represent, just as the Arabs also considered it to be bovine by nature. The Hyades cluster was meant to represent the sisters of Hyas, a great hunter, placed in the sky to honor their mourning for the loss of their brother – just as the Pleiades represent the seven sisters of Greek mythology – as well as many other things in many other cultural beliefs. The Persians called this group of stars "Taura", just as the Arabs referred to it as "Al Thaur". No matter what way you want to look at it, this handsome collection of stars contains many fine deep sky objects to pique your interest!

Let's begin our binocular and telescope tour of Taurus with its brightest star- Alpha – the "a" symbol on our map. Known to the Arabs as Al Dabaran, or "the Follower," Alpha Tauri got its name because it appears to follow the Pleiades across the sky. In Latin it was called Stella Dominatrix, yet the Olde English knew it as Oculus Tauri, or very literally the "eye of Taurus." No matter which source of ancient astronomical lore we explore, there are references to Aldebaran.

As the 13th brightest star in the sky, it almost appears from Earth to be a member of the V-shaped Hyades star cluster, but this association is merely coincidental, since it is about twice as close to us as the cluster is. In reality, Aldebaran is on the small end as far as K5 stars go, and like many other orange giants, it could possibly be a vari-

able. Aldebaran is also known to have five close companions, but they are faint and very difficult to observe with backyard equipment. At a distance of approximately 68 light-years, Alpha is “only” about 40 times larger than our own Sun and approximately 125 times brighter. To try to grasp such a size, think of it as being about the same size as Earth’s orbit! Because of its position along the ecliptic, Aldebaran is one of the very few stars of first magnitude that can be occulted by the Moon.

Now, head off to Beta Tauri – the “B” symbol on our chart. Located 131 light years from our solar system, El Nath, or Gamma Aurigae, is a main sequence star about to evolve into a peculiar giant star – one high in manganese content, but low in calcium and magnesium. While you won’t find anything else spectacular about El Nath, there is a good reason to remember its position – it, too, get frequently occulted by the Moon. Such occultations occur when the moon’s ascending node is near the vernal equinox. Most occultations are visible only in parts of the Southern Hemisphere, because the star lies at the northern edge of the lunar occultation zone and occasionally it may be occulted as far north as southern California.

Now, turn your binoculars or small telescopes towards Omicron – the “o”. Omicron is sometimes called Atirsagne, meaning the “Verdant One”, but there’s nothing green about this 212 light year distant yellow G-type giant star, only that it has a great optical companion! Be sure to take a look at Kappa Tau, too… the “k”. Kappa is also a visual double star – but a whole lot more. Located 153 light years from Earth, this Hyades cluster member is dominated by white A-type subgiant star K1 and white A-type main sequence dwarf star, K2. They are 5.8 arcminutes, or at least a quarter light year apart. Between the two bright stars is a binary star made up of two 9th magnitude stars, Kappa Tauri C and Kappa Tauri D, which are 5.3 arcseconds from each other and 183 arcseconds from K1 Tau. Two more 12th magnitude companions fill out the star system, Kappa Tauri E, which is 136 arcseconds from K1 Tau, and Kappa Tauri F, 340 arcseconds away from K2 Tau. Still more? Then have a look at 37 Tauri, an orange giant star with a faint optical companion star… or 10 Tauri! 10 Tauri is only 45 light years away, and while it just slightly larger and brighter than our Sun, its almost the same age. It is believed to be a spectroscopic binary star, but you’ll easily see it’s optical companion. What’s more, thanks to noticing a huge amount of infrared radiation being produced by 10, we know it also has a dusty debris disk surrounding it!

Now, let’s have a go at variable stars – starting with Lambda, the upside down “Y” on our map. Al Thaur is in reality a binary star system as well as being an eclipsing variable star. The primary is a blue-white B-type main sequence dwarf star located about 370 light years away. However, located at a distance of 0.1 AU away from it is a white A-type subgiant star, too… and a third player even further away. Watch over a period of 3.95 days as first one, then the other passes in front of the primary star, dimming it by almost a full stellar magnitude! Don’t forget to check out HU Tauri, too. It is also an eclipsing binary star that drops by a magnitude every 2.6 days!

Ready to take a look at Messier 45? Visible to the unaided eye, small binoculars and every telescope, the Pleiades bright components will resolve easily to any instrument and is simply stunning. The recognition of the Pleiades dates back to antiquity and they’re known by many names in many cultures. The Greeks and Romans referred to them as the “Starry Seven,” the “Net of Stars,” “The Seven Virgins,” “The Daughters of Pleione” and even “The Children of Atlas.” The Egyptians referred to them as “The Stars of Athyr,” the Germans as “Siebengestiren” (the Seven Stars), the Russians as “Baba” after Baba Yaga, the witch who flew through the skies on her fiery broom. The Japanese call them “Subaru,” Norsemen saw them as packs of dogs and the Tongans as “Matarii” (the Little Eyes). American Indians viewed the Pleiades as seven maidens placed high upon a tower to protect them from the claws of giant bears, and even Tolkien immortalized the stargroup in The Hobbit as “Remmirath.” The Pleiades have even been mentioned in the Bible! So, you see, no matter where we look in our “starry” history, this cluster of seven bright stars has been part of it.

The date of the Pleiades culmination (its highest point in the sky) has been celebrated through its rich history by being marked with various festivals and ancient rites â€” but there is one particular rite that really fits this occasion! What could be spookier on this date than to imagine a bunch of Druids celebrating the Pleiades’ midnight “high” with Black Sabbath? This night of “unholy revelry” is still observed in the modern world as “All Hallows Eve” or more commonly as “Halloween.” Although the actual date of the Pleiades’ midnight culmination is now on November 21 instead of October 31. Thanks to its nebulous regions M45 looks wonderfully like a “ghost” haunting the starry skies. Binoculars give an incredible view of the entire region, revealing far more stars than are visible with the naked eye. Small telescopes at lowest power will enjoy M45’s

rich, icy-blue stars and fog-like nebulae. Larger telescopes and higher power reveal many pairs of double stars buried within its silver folds. No matter what you chose, the Pleiades definitely rocks!

Our next most famous Messier catalog object in Taurus is M1 – the “Crab Nebula”. Although M1 was discovered by John Bevis in 1731, it became the first object on Charles Messier’s astronomical list. He rediscovered M1 while searching for the expected return of Halley’s Comet in late August 1758 and these “comet confusions” prompted Messier to start cataloging. It wasn’t until Lord Rosse gathered enough light from M1 in the mid-1840’s that the faint filamentary structure was noted (although he may not have given the Crab Nebula its name). To have a look for yourself, locate Zeta Tauri and look about a finger-width northwest. You won’t see the “Crab legs” in small scopes – but there’s much more to learn about this famous “supernova remnant”.

Factually, we know the “Crab Nebula” to be the remains of an exploded star recorded by the Chinese in 1054. We know it to be a rapid expanding cloud of gas moving outward at a rate of 1,000 km per second, just as we understand there is a pulsar in the center. We also know it as first recorded by John Bevis in 1758, and then later cataloged as the beginning Messier object – penned by Charles himself some 27 years later to avoid confusion while searching for comets. We see it revealed beautifully in timed exposure photographs, its glory captured forever through the eye of the camera â€” but have you ever really taken the time to truly study the M1? Then you just may surprise yourselfâ€¦ In a small telescope, the “Crab Nebula” might seem to be a disappointment – but do not just glance at it and move on. There is a very strange quality to the light which reaches your eye, even though at first it may just appear as a vague, misty patch. To small aperture and well-adjusted eyes, the M1 will appear to have “living” qualities – a sense of movement in something that should be motionless. This aroused my curiosity to study and by using a 12.5″ scope, the reasons become very clear to me as the full dimensions of the M1 “came to light”.

ISS PASSES For NOVEMBER and early DECEMBER 2021

from Heavens Above website maintained by Chris Peat.

Date	Brightness	Start	Highest point	End						
	(mag)	Time	Alt.	Az.	Time	Alt.	Az.	Time	Alt.	Az.
06 Dec	-2.7	16:59:37	10°	W	17:02:54	46°	SSW	17:06:11	10°	SE
06 Dec	-0.7	18:37:37	10°	WSW	18:39:06	12°	SW	18:40:35	10°	SSW
07 Dec	-0.9	17:49:32	10°	W	17:51:55	18°	SW	17:54:17	10°	S
08 Dec	-1.3	17:01:49	10°	W	17:04:41	25°	SSW	17:07:31	10°	SSE
10 Dec	-0.3	17:04:47	10°	WSW	17:06:14	12°	SW	17:07:41	10°	SSW
19 Dec	-0.7	06:44:27	10°	S	06:46:36	16°	SE	06:48:45	10°	E
20 Dec	-0.4	05:58:24	10°	SSE	05:59:19	11°	SE	06:00:13	10°	ESE
21 Dec	-1.9	06:45:00	10°	SW	06:48:01	31°	SSE	06:51:04	10°	E
22 Dec	-1.4	05:57:57	10°	SSW	06:00:38	23°	SE	06:03:21	10°	E
23 Dec	-1.1	05:13:03	16°	SE	05:13:16	16°	SE	05:15:26	10°	E
23 Dec	-3.1	06:46:16	10°	WSW	06:49:35	56°	SSE	06:52:54	10°	E
24 Dec	-2.7	06:00:53	29°	SSW	06:02:05	42°	SSE	06:05:19	10°	E
25 Dec	-1.6	05:15:34	26°	ESE	05:15:34	26°	ESE	05:17:40	10°	E
25 Dec	-3.7	06:48:33	15°	WSW	06:51:13	84°	SSE	06:54:36	10°	E
26 Dec	-3.6	06:03:06	56°	SW	06:03:39	71°	SSE	06:07:01	10°	E
27 Dec	-1.8	05:17:33	29°	E	05:17:33	29°	E	05:19:26	10°	E
27 Dec	-3.8	06:50:31	18°	W	06:52:52	85°	N	06:56:15	10°	E
28 Dec	-3.9	06:04:54	69°	W	06:05:16	88°	N	06:08:39	10°	E
29 Dec	-1.8	05:19:14	29°	E	05:19:14	29°	E	05:21:03	10°	E
29 Dec	-3.8	06:52:11	19°	W	06:54:30	86°	SSW	06:57:53	10°	E
30 Dec	-3.9	06:06:29	67°	WNW	06:06:53	87°	N	06:10:16	10°	E
31 Dec	-1.9	05:20:45	31°	E	05:20:45	31°	E	05:22:38	10°	E
31 Dec	-3.5	06:53:42	18°	W	06:56:02	60°	SSW	06:59:22	10°	ESE
01 Jan	-3.8	06:07:58	61°	WSW	06:08:26	75°	SSW	06:11:48	10°	ESE
02 Jan	-1.9	05:22:15	32°	ESE	05:22:15	32°	ESE	05:24:11	10°	E
02 Jan	-2.6	06:55:12	16°	W	06:57:25	34°	SSW	07:00:30	10°	SE
03 Jan	-0.1	04:36:32	10°	E	04:36:32	10°	E	04:36:33	10°	E
03 Jan	-3.3	06:09:29	43°	SW	06:09:52	46°	SSW	06:13:06	10°	SE
04 Jan	-1.9	05:23:47	28°	SE	05:23:47	28°	SE	05:25:36	10°	ESE
04 Jan	-1.7	06:56:45	12°	WSW	06:58:36	18°	SW	07:00:56	10°	S

END IMAGES, OBSERVING AND OUTREACH

The Moon from the 22nd of November, multiple imges stacked in sequator and wavelets processed in Registax which pulls out the details.
17.6 day lunation.
Andy

Observing Sessions and Covid19 - Update

Proposed Observation Sessions for 2021-2022

Any observing meetings will need to to be safe and follow social distancing recommendations.
A reminder email shall be sent out early on in the week to inform you of the planned event but it should also be noted that like the weather, Government guidelines may change at any time and therefore the usual email will be sent out by 16:00 on the day giving notice of whether observing is 'ON' or 'OFF' that evening, so look out for these. If a session is cancelled we may then possibly plan a new different date.

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

- **Wednesday 29/Thursday 30th 7pm start December 2021 We will decide when more weather details available**
- **Friday 28 January 2022**
- **Friday 25 February 2022**
- **Friday 25 March 2022 (Messier Marathon)**
- **Friday 29 April 2022**
- **Friday 27 May 2022**
- **Friday 03 June 2022 (limited sky darkness)**

The final decision on the planned dates will be advised shortly and published on the website :https://wasnet.org.uk/observing/ **but we shall also try to arrange special evenings for events such as meteor showers/ Lunar eclipses etc.**
Also if members wish to propose a ad-hoc session for other reasons and at other locations, such as astro-photography, solar observing etc, with other like-minded members then they can do so through the Society Members Facebook Page or through the WAS contact page on the website.

OUTREACH

Zoom sessions and Google Classroom sessions have kept outreach going to schools

I have been asked to return to Westbury Leigh, but Covid has hit...

If any schools or clubs are interested in having talks from WAS please contact Andy Burns.

Dark Skies Wales are starting their live observing sessions, but talks are delayed.