Lewes Astronomical Society

Newsletter - May 2024

Astronomy News, Spaceflight News, and Observational Highlights

Lewes Astronomical Society

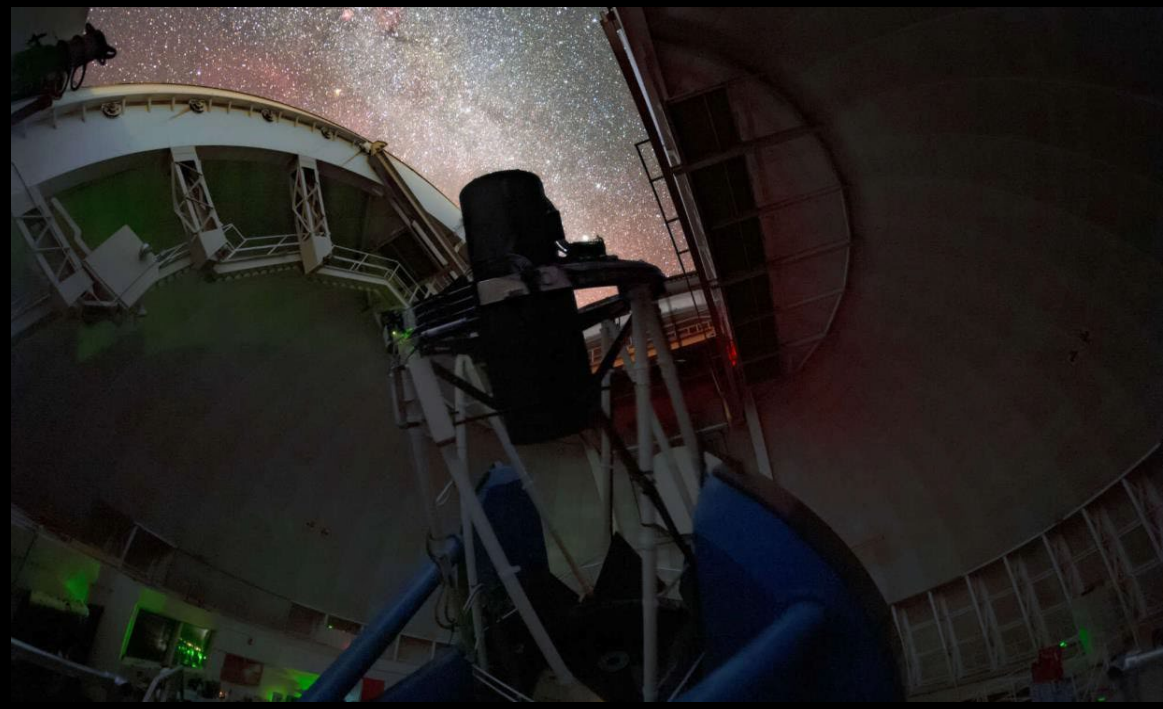
May 2024

Astronomy News

Lewes Astronomical Society

Dark Energy & the expansion of the Universe (1)

- A hundred years ago, astronomers realised that the Universe was expanding. If it was expanding, it must have expanded from something a lot smaller and, by reversing the process (and time), the idea of it starting from an infinitesimally-dense point of energy at the Big Bang, many billions of years ago, came about
- The natural assumption was that the rate of expansion would start to slow down in the future as gravity took hold
- Gravity could put everything into reverse leading to the “Big Crunch” in billions of years’ time. Alternatively, the rate could slow but not actually stop, leading to the “Big Freeze” as stars eventually died and the Universe became a cold, dark place



DESI making observations in the night sky
Credit: KPNO/NOIRLab/NSF/AURA/T. Slovinský

Lewes Astronomical Society

Dark Energy & the expansion of the Universe (2)

- However, in the 1990s, this cosy assumption was overturned due to evidence that the rate of expansion was in fact increasing over time. Something must be counteracting gravity. This mysterious force was termed Dark Energy
- Dark Energy, which is still not understood, is likely to have been present around the time of the Big Bang, but its effects were not noticeable in the first 6 billion years after the Big Bang. Since then, the rate of expansion has really taken off, to the extent that some models have suggested that the Universe will eventually tear itself apart in the “Big Rip”
- So, understanding what dark energy is, how it works and how it will affect the Universe are vitally important questions. The Lambda CDM model is our best hypothesis of the evolution of the Universe. CDM stands for Cold Dark Matter and Lambda signifies dark energy and the unchanging cosmological constant

Lewes Astronomical Society

Dark Energy & the expansion of the Universe (3)

- Two main methods have been explored for measuring the rate of expansion – the so-called “Hubble Constant”: using the redshifts of type 1a supernovae, and using the Cosmic Microwave Background (CMB). These methods do not agree, the redshift method gives an estimate of 73.2 kilometres per second per megaparsec, whilst observations of the CMB give an estimate of 67.8 kilometres per second per megaparsec. This difference of about 10% is known as the Hubble Tension
- DESI, the Dark Energy Spectroscopic Instrument, on the Mayall Telescope at the Kitt Peak National Observatory in Arizona has offered a third approach. Using 5,000 robotically-controlled fibre optics, DESI has gathered spectroscopic data on galaxies and quasars to measure the baryon acoustic oscillations (BAO) that galaxies are aligned to, drawing a map of the Universe. This has allowed an estimate to be made as to how fast the Universe is expanding (as the BAO can be used to constrain the dark matter and dark energy densities)

Lewes Astronomical Society

Dark Energy & the expansion of the Universe (4)

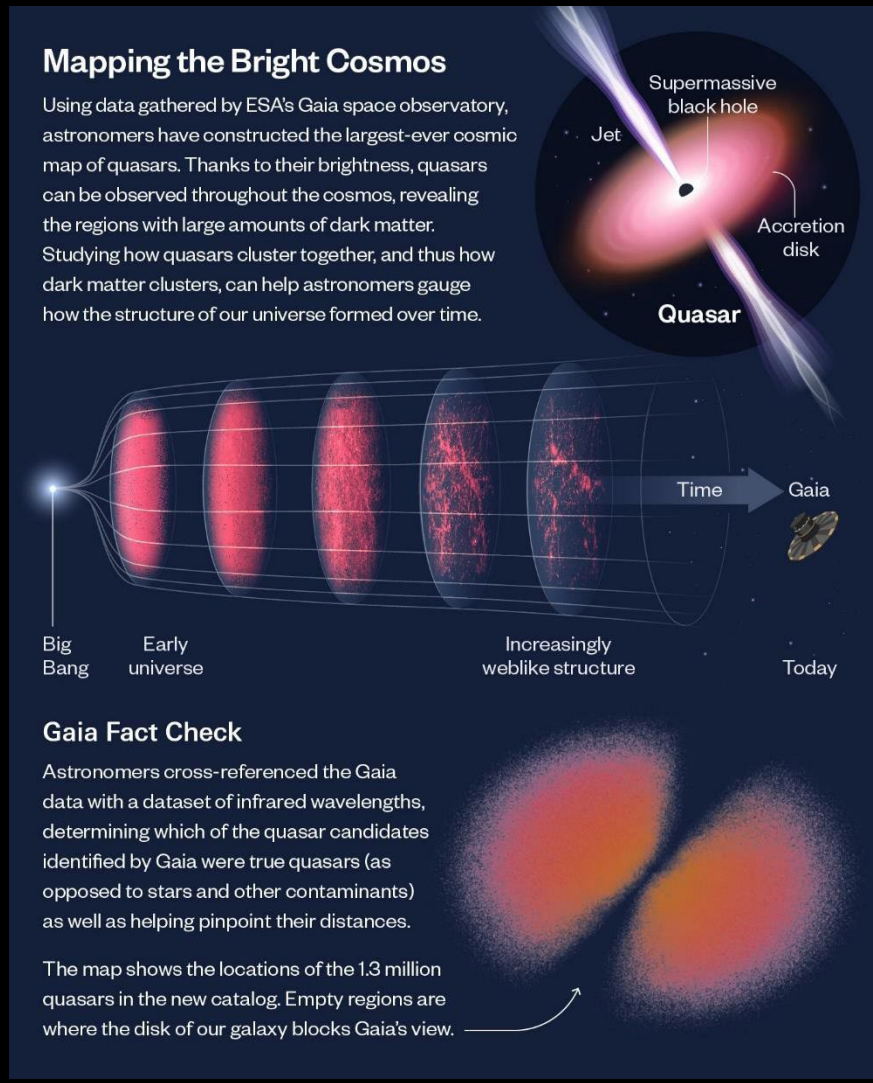
- The first year's data (from a five-year project), has just been released, and the results are remarkable. Using data gathered from 5.7 million galaxies and quasars that go back up to 11 billion years to a much younger Universe, it appears that, contrary to our previous understanding, the rate of expansion seems to be actually slower now than it was a few billion years ago. Could dark energy and its effects be evolving with time? If so then dark energy would be a variable energy field called quintessence
- It will be some time before the results can be confirmed, with more data from DESI required and also from Euclid, before the textbooks need to be rewritten
- See the video at: https://youtu.be/tl0z26rzcFY for an animation of how baryon acoustic oscillations act as a cosmic ruler for measuring the expansion of the universe

Video credit: Claire Lamman/DESI collaboration and Jenny Nuss/Berkeley Lab

Lewes Astronomical Society

Mapping the Universe's active SMBHs

- A new map has been created showing the location of about 1.3 million quasars, the most active and brightest supermassive black holes
- Unlike other maps, it provides a 3D view of a huge proportion of the visible universe; literally, the largest volume of the universe ever mapped
- The data comes from the Gaia space observatory. Although its main function is to map the position of stars in the Milky Way, as part of the imaging it captures objects outside our own galaxy. The researchers used data released from Gaias third data release which included 6.6 million quasar candidates

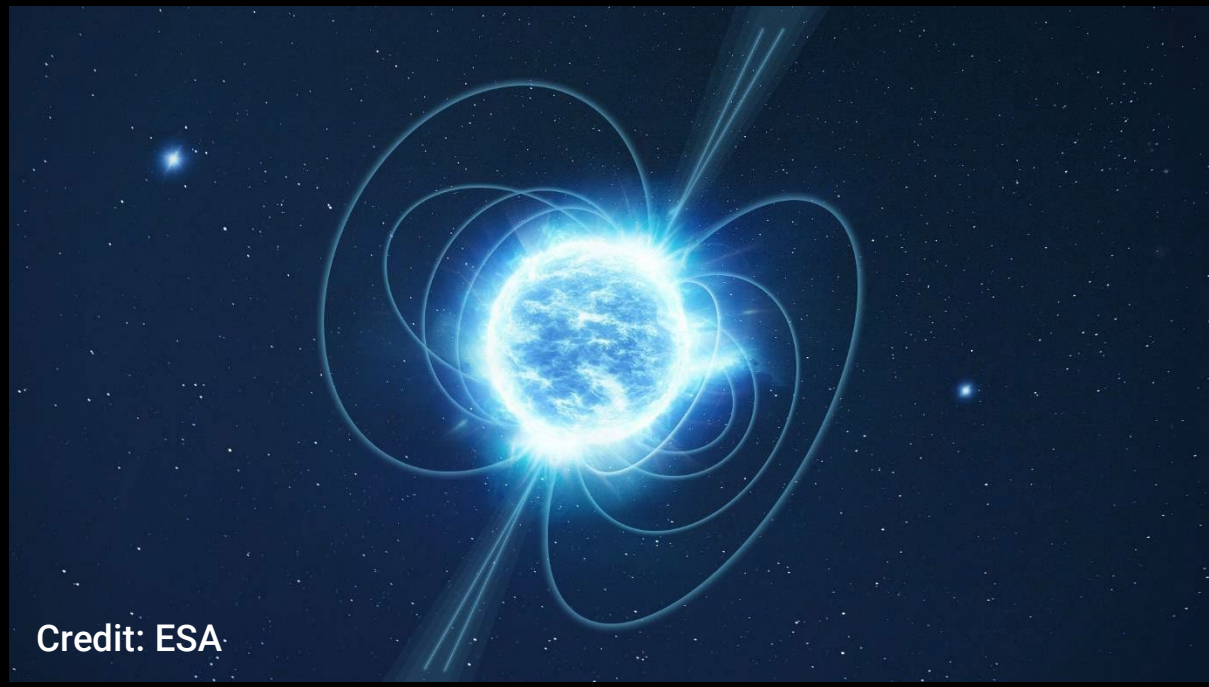


An infographic explaining the creation of a new map of around 1.3 million quasars from across the visible universe
Credit: ESA/Gaia/DPAC; Lucy Reading-Ikkanda/Simons Foundation; K. Storey-Fisher et al. 2024

Lewes Astronomical Society

Are neutron stars the key to dark matter? (1)

- It is well known that dark matter (assuming it actually exists) doesn't interact with any normal matter, or light, and its presence is only shown through its effects on gravity, such as galaxy cluster gravitational lensing
- So, scientists have spent a long time trying to invent new techniques that would help in the study of dark matter



- A new line of thought is turning towards neutron stars. Being the densest normal matter objects in the Universe, it is possible that they could act as dark matter detectors

Are neutron stars the key to dark matter? (2)

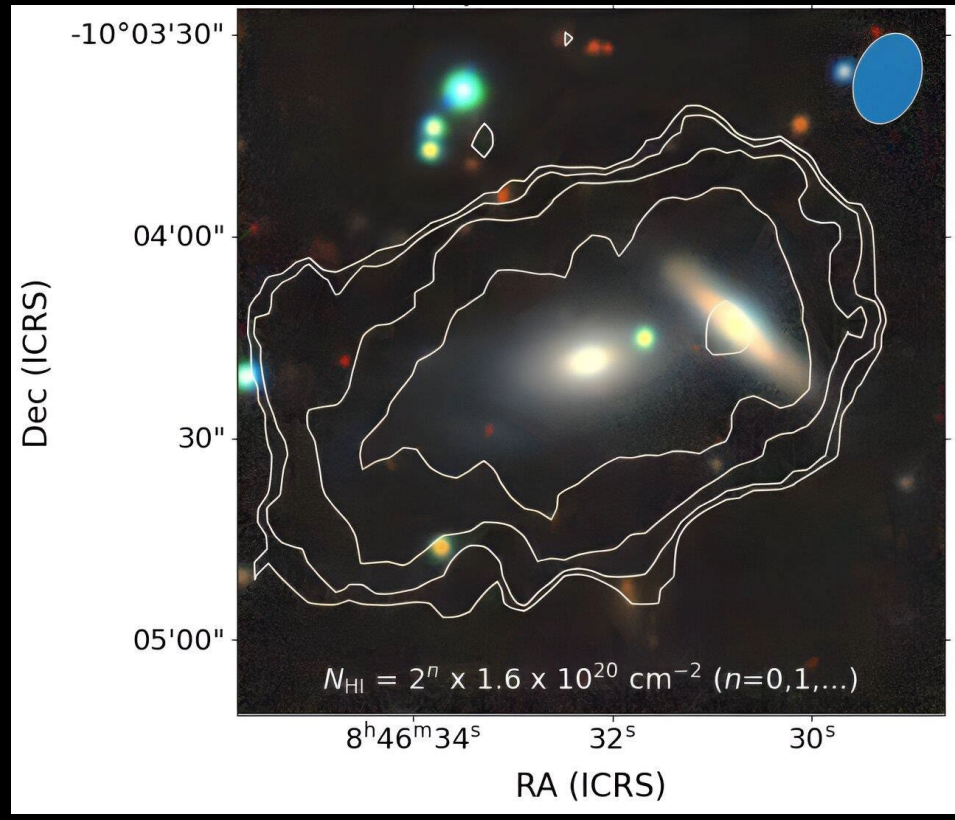
- Dark matter particles should be trapped by neutron stars and their energy dissipated. This should lead to an accumulation of dark matter within the neutron stars, with the resulting energy heating up the cold stars to a level at which future detectors may be able to observe them
- It had previously been thought that the process of energy deposition would take a very long time, longer than the current age of the Universe. Now, researchers have calculated that the energy transfer should be extremely quick; within a matter of a few days
- So instead of looking for dark matter directly, detecting warm or hot neutron stars may be the way forward

Lewes Astronomical Society

MeerKAT's golden haul

Watch the video at:
https://vimeo.com/926177232

- The new Square Kilometre Array radio telescope is expected to able to revolutionise exploration of deep space. Based on two different continents, the low-frequency aerials are still in the process of being installed in the Murchison Desert of Western Australia and are not yet operational. However, Phase One of the mid-frequency array, in the Karoo of South Africa is now up and running
- Known as MeerKAT, the radio dishes have just astonished astronomers by revealing 49 galaxies in a matter of 3 hours. The astronomers were hoping to study star-forming gas in a single galaxy when they stumbled on a gold haul of 49 galaxies. The gold references the Californian Gold Rush of 1849

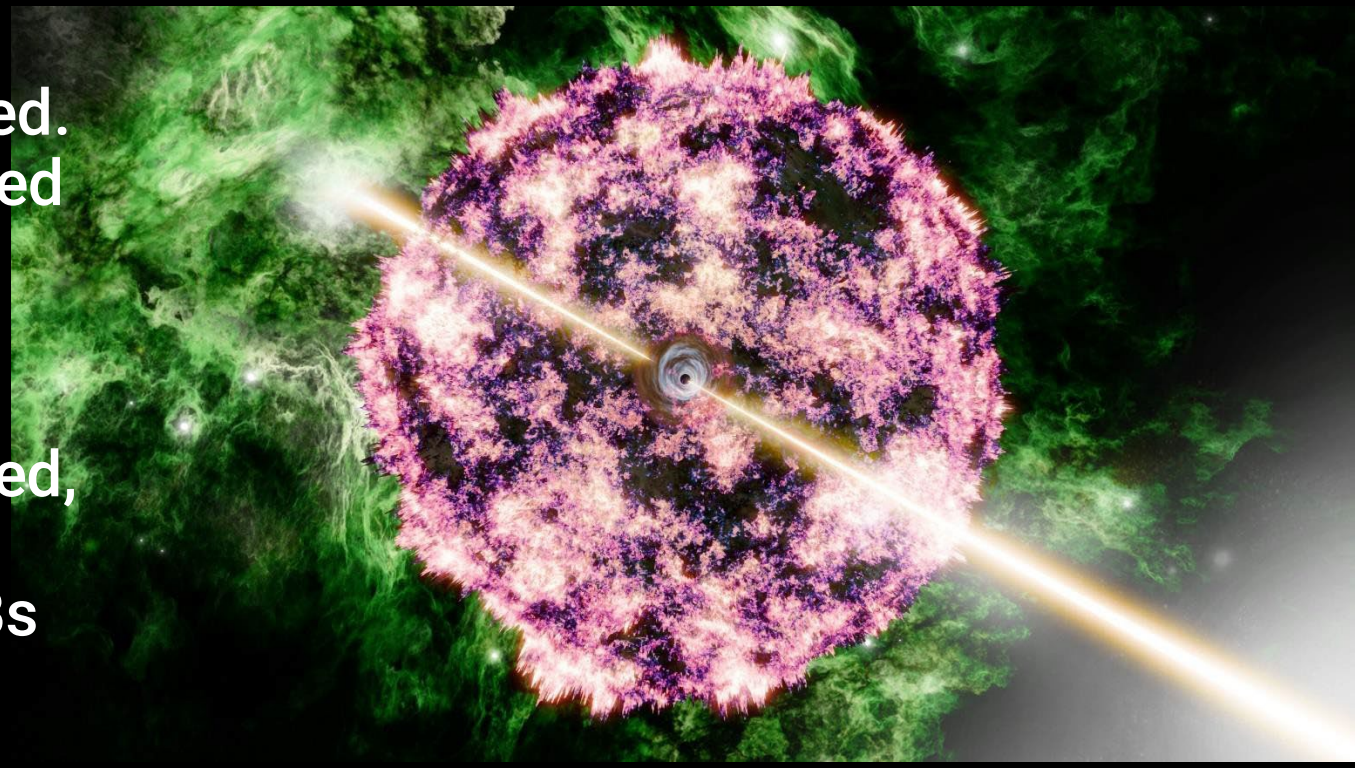


Example of individual detections of the gas detected by MeerKAT
Credit: International Center for Radio Astronomy Research (ICRAR)

Lewes Astronomical Society

But no gold from the biggest GRB! (1)

- Two years ago, the brightest ever Gamma Ray Burst (GRB) was detected. GRB221009A has now been confirmed as coming from the collapse of a massive star and subsequent supernova
- Although one mystery has been solved, it has produced another; supernova explosions and their associated GRBs are thought to be one of the main sources of heavy elements, such as gold, platinum and uranium. Neutron star mergers do produce heavy elements but are too rare to account for the amounts found in the Universe



Artist's visualization of GRB 221009A showing the narrow relativistic jets—emerging from a central black hole—that gave rise to the GRB and the expanding remains of the original star ejected via the supernova explosion. Using JWST, researchers detected the supernova for the first time, confirming GRB 221009A was the result of the collapse of a massive star

Credit: Aaron M. Geller / Northwestern / CIERA / IT Research Computing and Data Services

But no gold from the biggest GRB! (2)

- The discovery of the supernova gave researchers the opportunity to test the theory. However, they have drawn a blank. The researchers, led by Peter Blanchard of Northwestern University, and Ashley Villar of Harvard University, had to wait for six months as the GRB was so bright, it obscured everything
- Using JWSTs Near Infrared Spectrograph, the researchers found the signature of calcium and oxygen, both of which are typical of supernovas. Surprisingly, the supernova itself was no brighter than other supernovae observed, despite the huge GRB accompanying it
- However, no heavy elements have been found. The search for the source goes on

Lewes Astronomical Society

Hubble and the ULYSSES legacy (1)

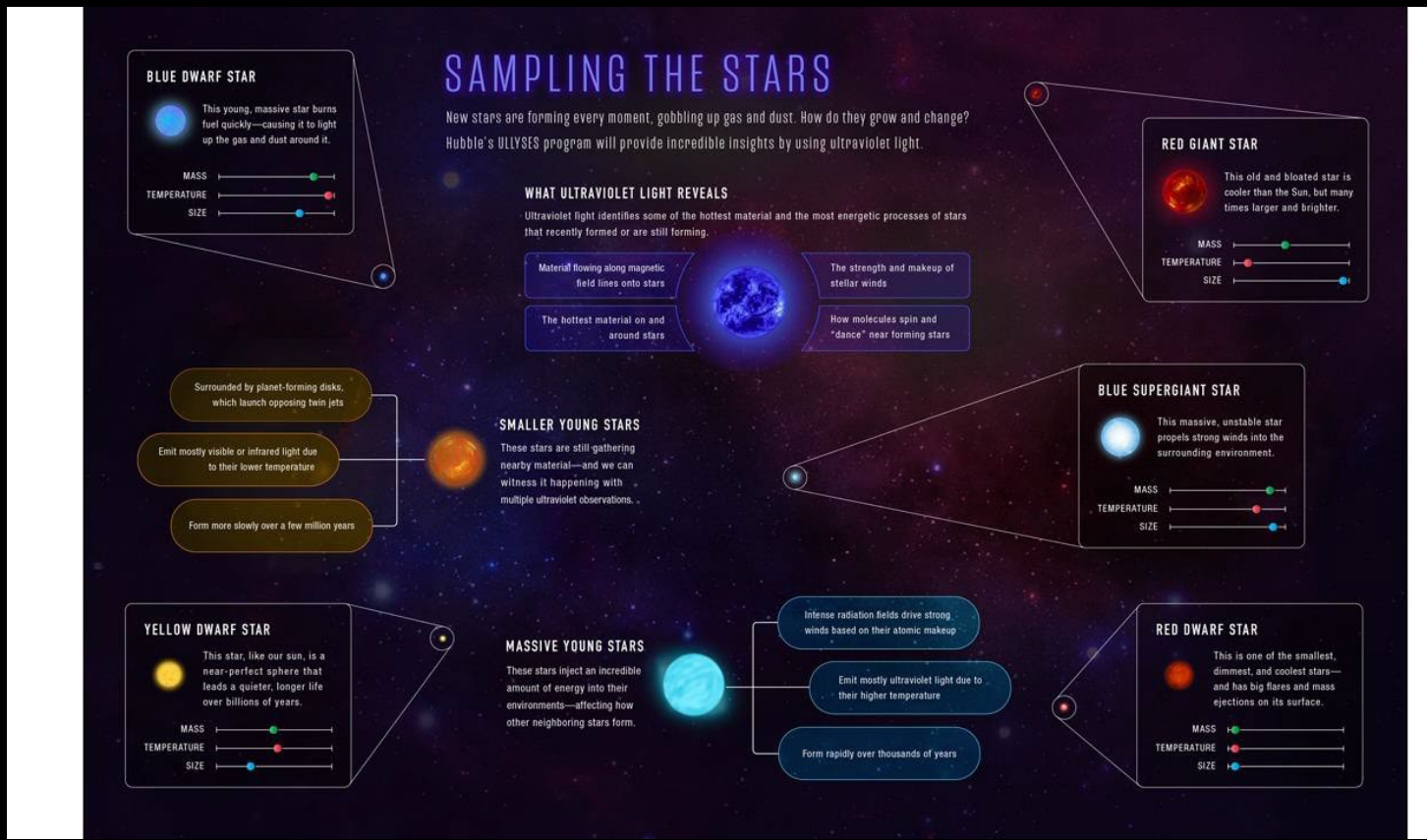
- Over the last 3 years Hubble has been tasked with recording some of the hottest and brightest stars in the nearby sky. These are over a million times brighter than the Sun and emit powerful radiation in the UV part of the spectrum; a region Hubble can observe in
- ULLYSES (Ultraviolet Legacy Library of Young Stars as Essential Standards) is one of the most ambitious surveys ever carried out. It has provided a wealth of information on nearly 500 stars

30 Doradus in the Tarantula Nebula in the Large Magellanic Cloud (LMC)
Credit: NASA, ESA, STScI, Francesco Paresce (INAF-IASF Bologna), Robert O'Connell (UVA), SOC-WFC3, ESO

Lewes Astronomical Society

Hubble and the ULYSSES legacy (2)

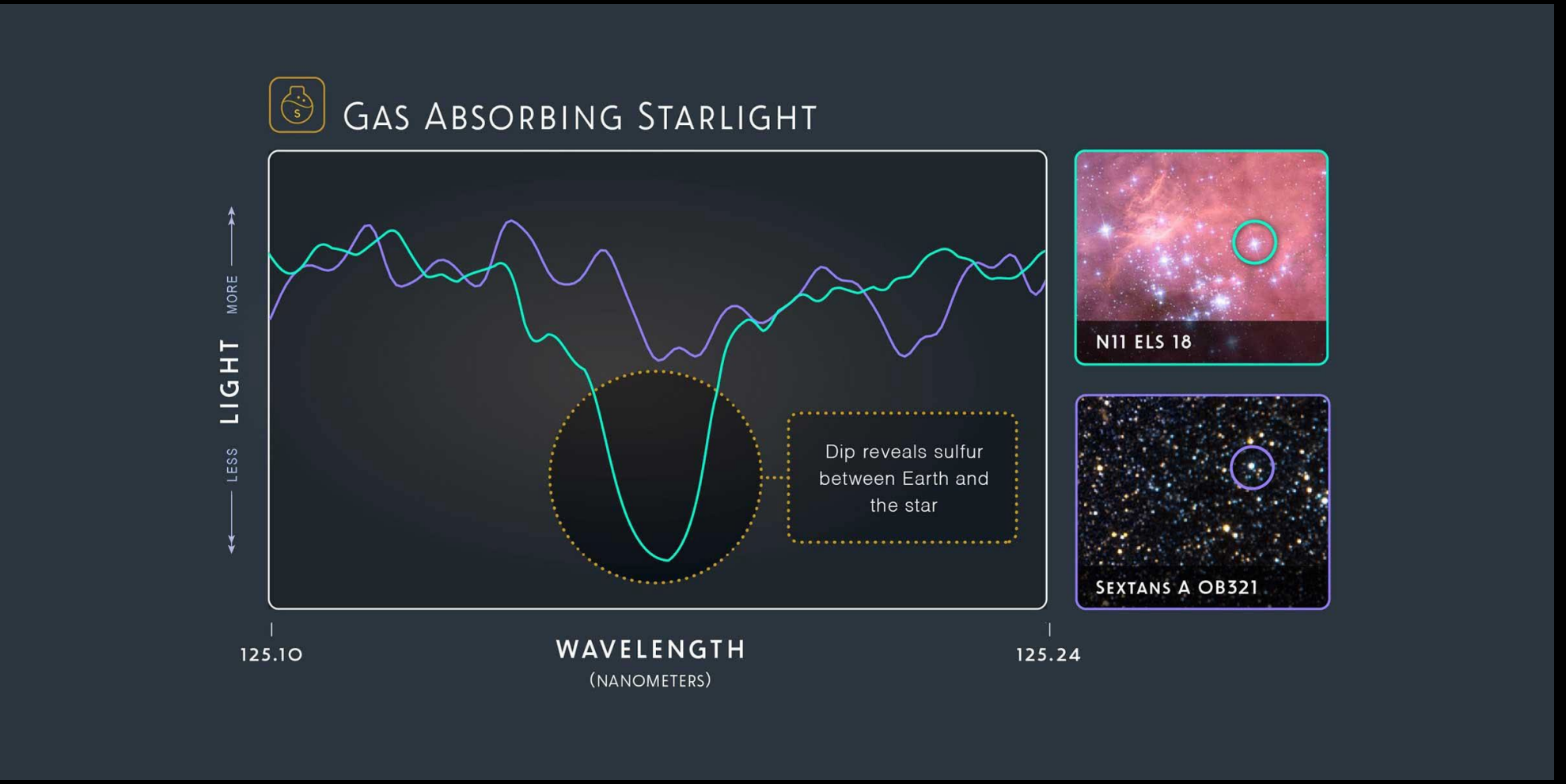
- Working with ground-based telescopes and dipping into the legacy of an existing study of 275 stars, the dataset covers detailed spectra of hot and massive stars, as well as some of the cooler, dim & smaller stars (which also unleash powerful blasts of UV and X-ray radiation)
- The spectra not only show the composition of the stars but can also be used to trace the powerful solar winds, their direction, and speed
- Stars with low metallicity are older



Credit: Hubble/ STScI/ULYSSES

Lewes Astronomical Society

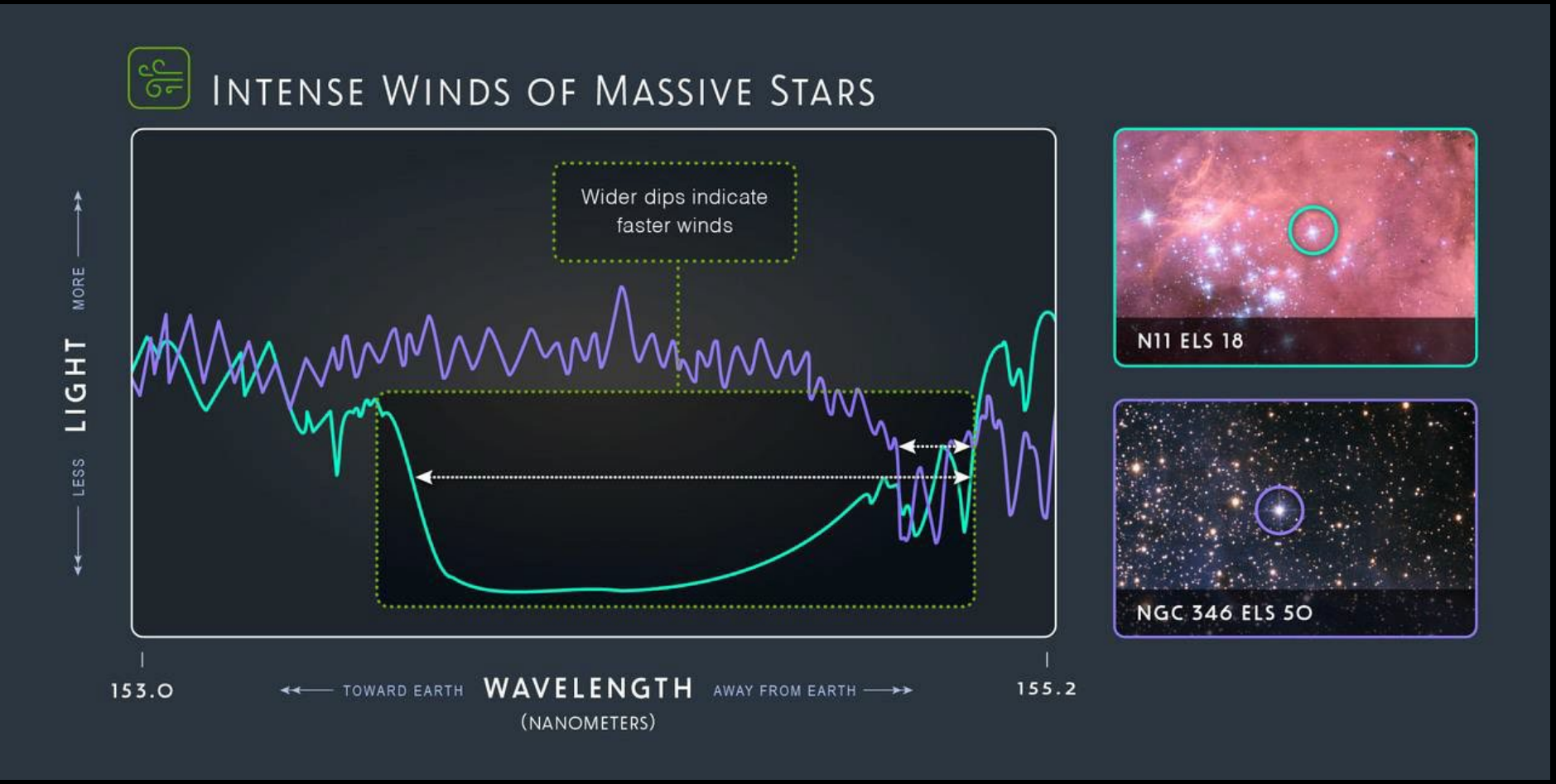
Hubble and the ULYSSES legacy (3)



The ULYSSES spectra collected by Hubble can reveal the presence of chemical elements in the stars
Credit: Hubble/ STScI/ULYSSES

Lewes Astronomical Society

Hubble and the ULYSSES legacy (4)

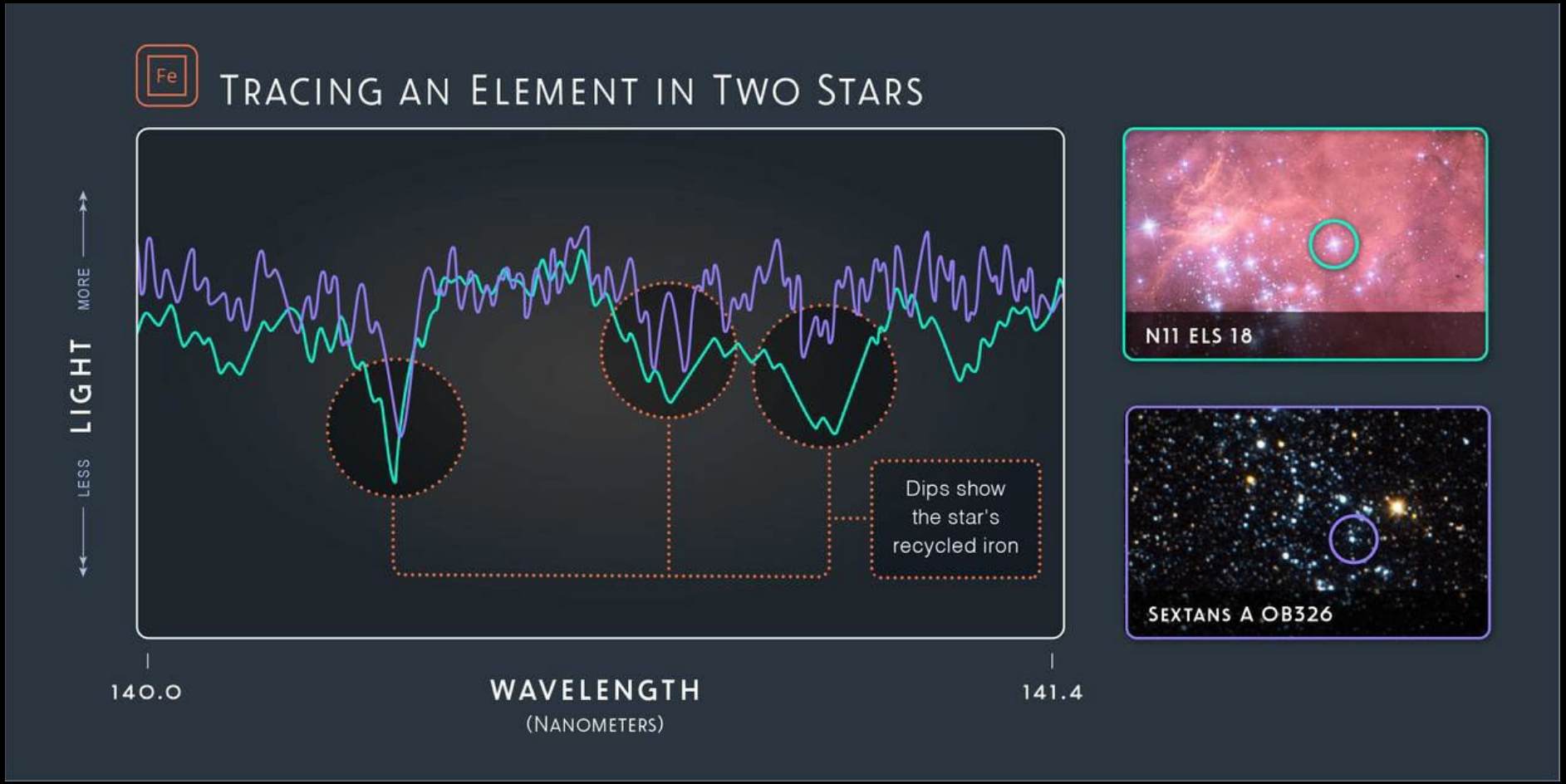


Massive blue stars have powerful winds that shape their surroundings. The Hubble spectra can tell which way the winds travel and how fast they travel. The star represented by the teal line has slower winds than the star shown by the purple line

Credit: Hubble/ STScI/ULYSSES

Lewes Astronomical Society

Hubble and the ULYSSES legacy (5)



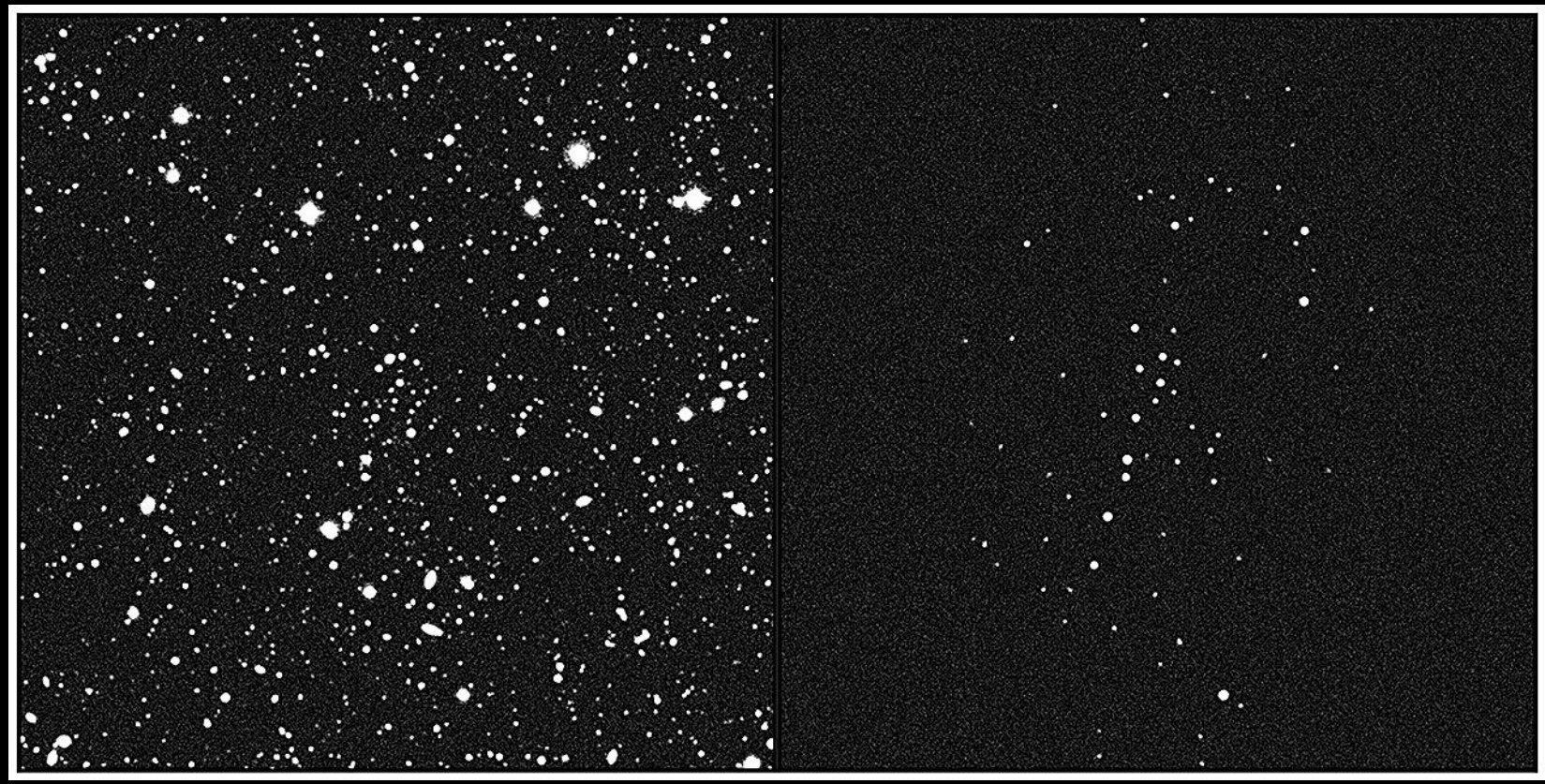
These spectra show the iron content for two stars. In this image, the star represented by the purple line has less iron, indicating that it's older than the other star. Iron content affects a star's lifetime and the strength of its winds

Credit: Hubble/ STScI/ULYSSES

Lewes Astronomical Society

Faintest satellite dwarf system found (1)

- 30,000 light years from the Sun, a small and ancient satellite star system is orbiting the Milky Way
- The stellar system is tiny; just 10 light years in diameter. Only 60 stars have been detected, with a mass amounting to only 16 times that of the Sun. It is about 15 times lighter than the smallest dwarf galaxy



Hidden in this deep sky image (left) is Uma3/U1, a minuscule group of stars (right) bound together by their own gravity (and possibly even dark matter!) in orbit around the Milky Way
Credit: CFHT/S. Gwyn (right) / S. Smith (left). The Astrophysical Journal (2024). DOI: 10.3847/1538-4357/ad0d9f

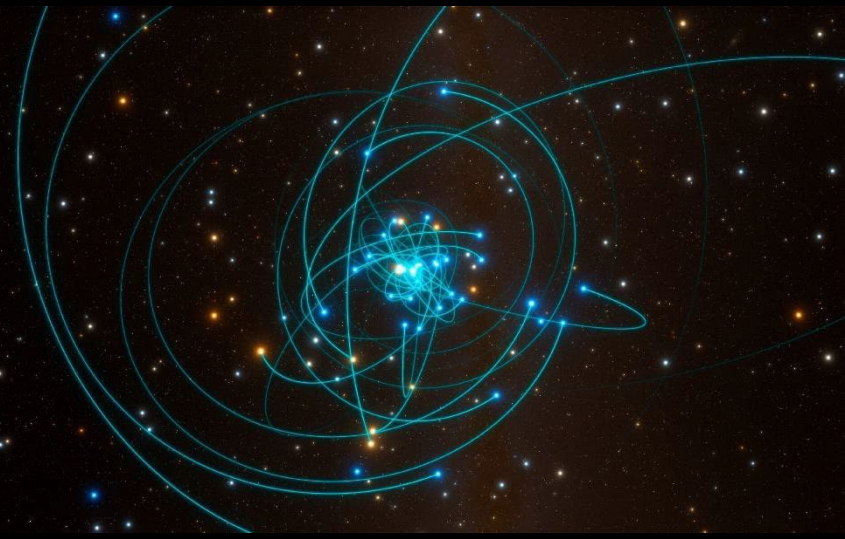
Faintest satellite dwarf system found (2)

- UMa3/U1 is located in the Ursa Major and has not been noticed before because of its extreme low luminosity
- Data from Ultraviolet Near Infrared Optical Northern Survey (UNIONS) at CFHT and Pan-STARRS, was the first indication of the existence of the star system. This was followed up by astronomers working at the W. M. Keck Observatory and Canada-France-Hawai‘i Telescope (CFHT)—as well as the University of Hawai‘i Institute for Astronomy Pan-STARRS (Panoramic Survey Telescope and Rapid Response System)
- Analysis suggests that the 10-billion year-old system is being held together by enough dark matter to overcome the Milky Way’s tidal forces, which would normally tear such a system apart

Lewes Astronomical Society

Life near the centre of the galaxy

- Being close to Sgr A*, the supermassive black hole at the centre of the Milky Way, is not a fun place to be – and certainly not if you are a star
- The nearest star to the Sun is 4 light years distant. At the centre of the Milky Way there are over one million stars within 4 light years of the black hole
- As you get closer to Sgr A*, the stars are moving faster and faster and within 0.01 parsec of the black hole, the speed is of the order of thousands of kilometres per second



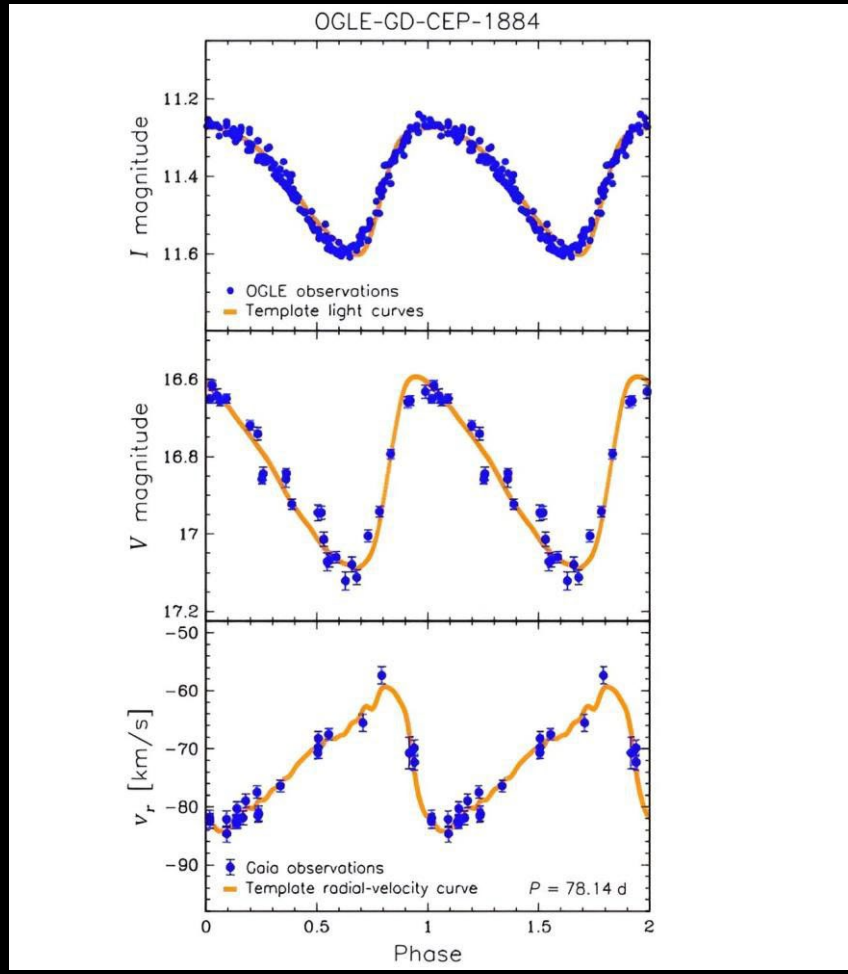
This illustration shows the orbits of stars very close to Sagittarius A*, a supermassive black hole at the heart of the Milky Way
Credit: ESO / L. Calçada / Spaceengine.org

- That leads to lots of collisions; not enough to cause total annihilation, but many stars will lose their outer layers, and much of their mass. Further out, the speed is slower and collisions lead to mergers, causing the acquisition of more hydrogen. Growth means youthfulness but they burn through the hydrogen quicker and die!

Lewes Astronomical Society

Long period Cephids

- Cephid stars are variables; they change in brightness due to regular star pulsations. 120 years ago, work done by Henrietta Levitt established that there is a close relationship between the length of the periodicity of a Cephid star and its intrinsic brightness. This has led them to be used as standard candles for measuring distances in the Milky Way and beyond
- Classical Cephids (also known as Population I Cephids) have very regular periods of the order of days, or weeks. Now, astronomers working at the University of Warsaw, led by Igor Soszyński, have discovered a new variable, OGLE-GD-CEP-1884, 14,500 light years distant, with a long period of 78.14 days; this beats the previous record (S Vulpeculae) by nearly 10 days

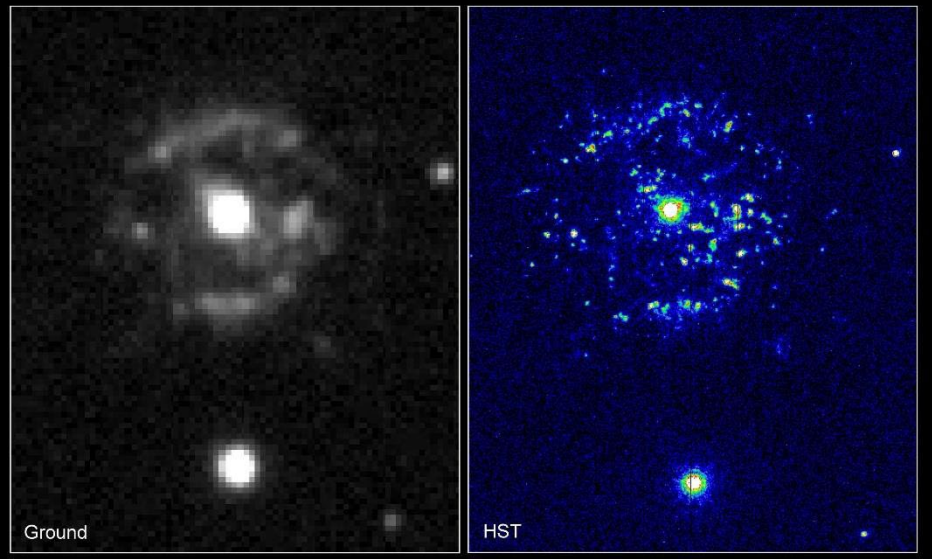


Phase-folded I-band (upper panel) and V-band (middle panel) OGLE light curves of OGLE-GD-CEP-1884 and radial-velocity curve of this star from the Gaia Focused Product Release (Gaia Collaboration et al. 2023, lower panel)
Credit: Soszyński et al., 2024

Lewes Astronomical Society

Recurrent Nova

- Novae are known to light up the skies. However, since the invention of the telescope, only one has occurred close enough to the Milky Way to be easily observed; most are in distant galaxies
- However, there is another category of nova which has the chance to shine; the recurring nova
- In this case, a star system only 3,000 light years away, T Coronae Borealis, should provide us with a naked eye view, sometime over the next six months. The nova will be as bright as Polaris for about a week
- The recurring nova (only one of five in the Milky Way that is visible to the naked eye), is caused by a white dwarf star drawing off material from its companion, in this case a bloated red giant. Once every 80 years, the amount of material accreted on the white dwarf is enough to ignite it

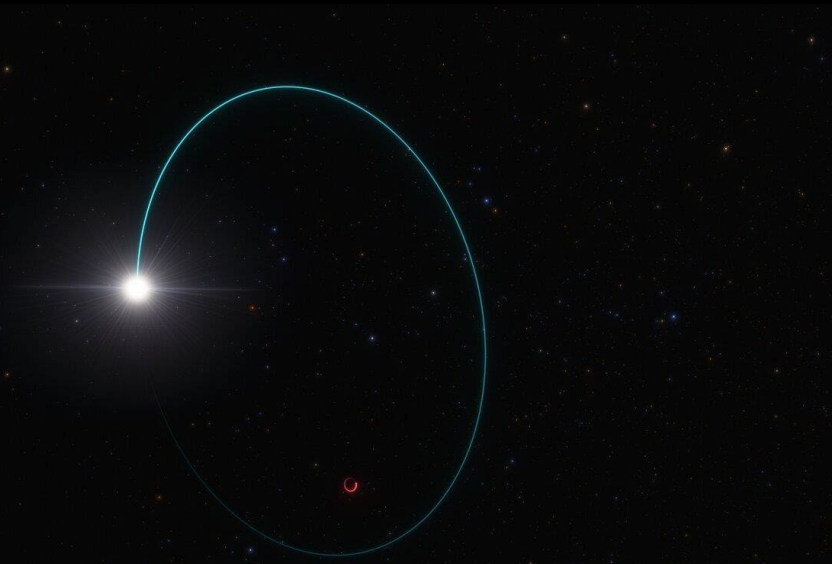


The prolific number of eruptions by the recurrent nova T Pyxidis, has attracted the attention of many telescopes Credit: Mike Shara, Bob Williams, and David Zurek (Space Telescope Science Institute); Roberto Gilmozzi (European Southern Observatory); Dina Prialnik (Tel Aviv University); and NASA/ESA

Lewes Astronomical Society

Stellar-mass black hole on Earth’s doorstep

- Well, not literally. A comfortable 2,000 light years away (and not less than a mile and 2,000 feet as some of the media would have us believe!), a 33 solar mass black hole is throwing its weight around
- Now confirmed as the largest stellar-mass black hole in the Milky Way, it was given away by a companion star which wobbled in its orbit around “nothing”. Data from Gaia first pointed astronomers to it, and ESA’s ELT (using the Ultraviolet and Visual Echelle Spectrograph (UVES) instrument) was able to confirm its actual size



This artist's impression shows the orbits of both the companion star and the black hole, dubbed Gaia BH3, around their common centre of mass
Credit: ESO/L. Calçada

- Located in the constellation of Aquilla, Gaia BH3, as it is now known, is half as big again as the next largest stellar-mass black hole, Cygnus X-1. The dormant black hole is the result of a massive star that collapsed at the end of its life. The companion star appears to be metal-poor suggesting the collapsed star was as well

Lewes Astronomical Society

A new star is born

- 450 light years from Earth lies the FS Tau system, a multi-star system where new stars are being born. Hubble has captured the moment of birth as a powerful jet erupts from a cloud of gas and dust
- Part of the Taurus-Auriga region, the 2.8m year old nebula is home to young stars and protostars. The new star, FS Tau B, is still not a fully-fledged star, as it is still growing and, when large enough (and with enough pressure and heat), it will be able to undergo nuclear fusion. Currently, it is heated by gravitational energy

A Hubble image of the FS Tau system with a bright four-pointed light at its centre representing the infant star FS Tau B
Credit: NASA, ESA, K. Stapelfeldt (NASA JPL), G. Kober (NASA/Catholic University of America)

Lewes Astronomical Society

Impact caused Pluto's heart-shaped feature (1)

- Nearly a decade ago, the New Horizons space probe dashed past Pluto on its journey to the outer Solar System
- Although the flyby was brief, images taken revealed Pluto in a new light. One feature that stood out is the heart-shaped region which is almost pure white. It is unusual in its size, elevation and composition; what exactly is it and how did it form?
- Scientists, led by researchers at the University of Bern, believe they have now cracked the puzzle. Computer modelling suggests that it was caused by the slow collision, at an acute angle, with a large planetary body, approximately 700km in diameter, sometime in the early history of the Solar System

Credit: NASA/Johns Hopkins University Applied Physics Laboratory/Southwest Research Institute/Alex Parker

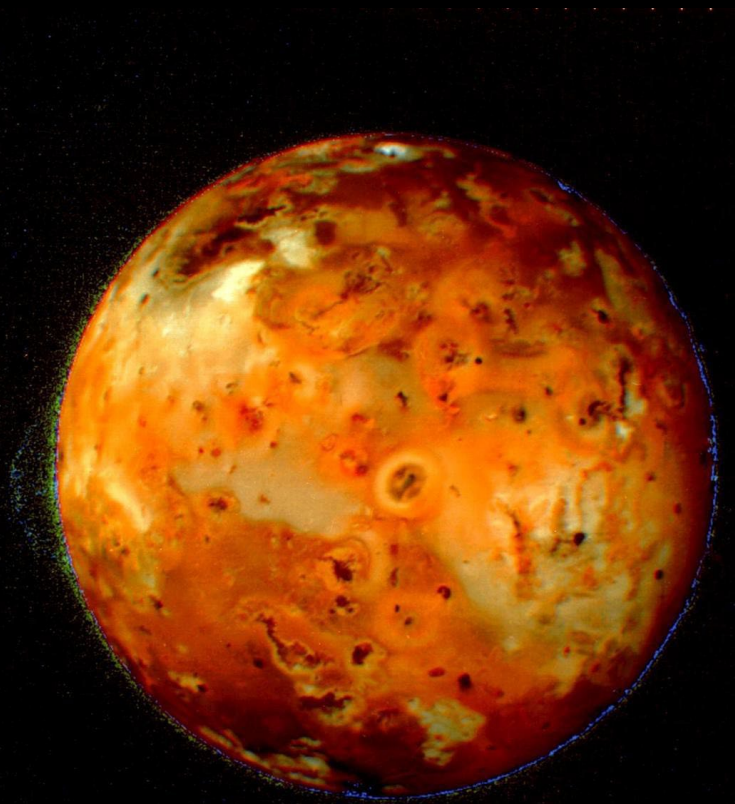
Impact caused Pluto’s heart-shaped feature (2)

- This both gouged out part of the then surface of Pluto and deposited part of the impact body leaving the region up to 4km lower in elevation
- The shape of the feature points to a glancing blow. The speed was probably relatively slow and this helped reduce the usual heating process that happens in collisions. The rocky core remained hard and did not melt and the core of the impactor remained close to the surface and did not sink, creating a local mass excess. This also explains why the feature has remained near the Equator rather than migrating, with time, towards the poles
- The striking white colour is caused by frozen nitrogen ice which slowly spreads and fills the depression. As it is in constant movement, it smooths out the surface

Lewes Astronomical Society

The 4.5 million year old volcanic eruption (1)

- Io is the most volcanically-active body in the Solar System. Subject to gravitational forces from Jupiter, and also from the neighbouring moons of Europa and Ganymede, Io is constantly being stretched, and the resulting friction creates an immense amount of internal heat and pressure
- The result is an unending series of eruptions across the moon; the constant flow of lava means that studying history of Io is fraught with problems and determining how long the volcanic action has been going on is near impossible



Credit: NASA/JPL-Caltech

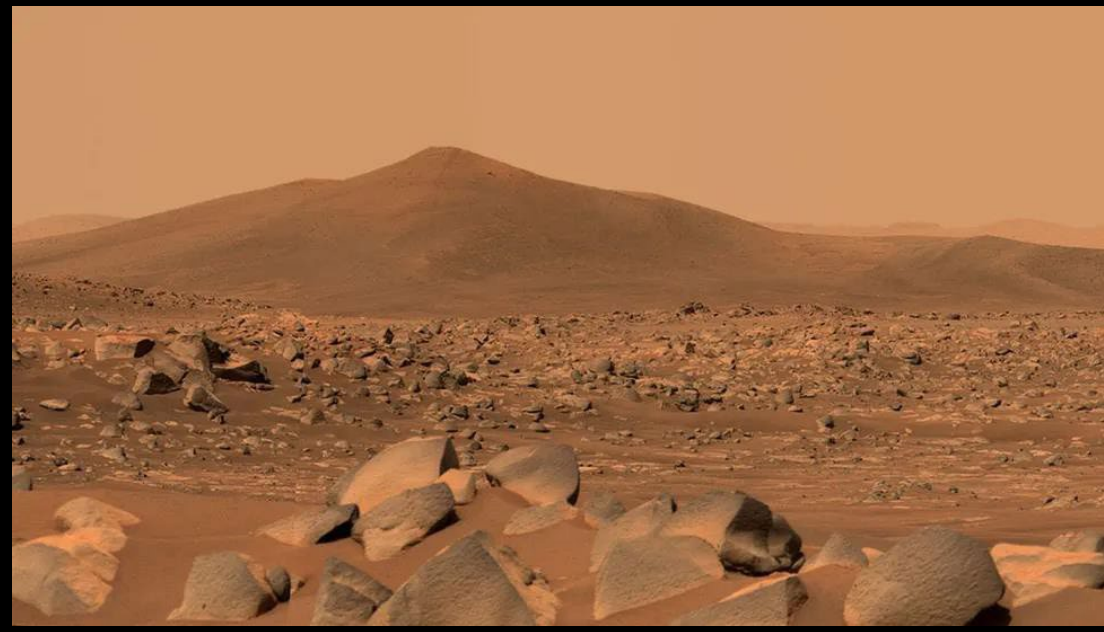
The 4.5 million year old volcanic eruption (2)

- With the surface of the moon in constant flux, researchers turned to looking at what the atmosphere could tell us about Io's history. ALMA (the Atacama Large Milimeter Array) in Chile, has been used to analyse the gases in the atmosphere, and in particular, stable isotopes of sulphur and chlorine
- Up to 95% of the sulphur released through eruptions is lost to space. Results suggest that the rate of volcanism has been steady and dates back to when the Solar System and Io were formed, 4.5 billion years ago

Lewes Astronomical Society

When red isn’t the only colour

- When you think of Mars, you think of red. Everything appears to be a shade of rusty-red, except for 4,000 odd, white-coloured pebbles
- Since 2021, Perseverance has come across these pebble-sized, pale-coloured rocks, scattered over the crater floor
- It is obvious that these pebbles have been carried here from somewhere else but, so far, Perseverance has not found the source
- The pebbles, apart from appearing to be whitish, are a mixed bunch. Some appear to be agglomerations of different layers, others have pronounced pits but all are quite smooth
- All seem to be dehydrated and leached of most minerals. They remain a mystery

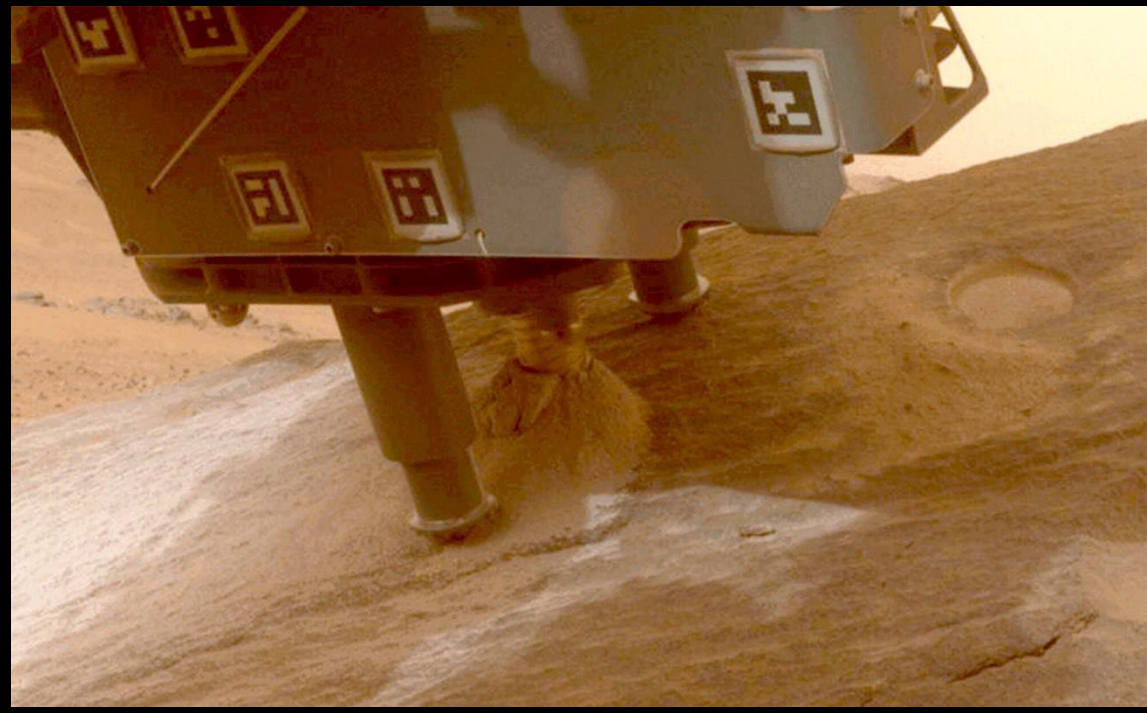


NASA's Perseverance Mars rover used its dual-camera Mastcam-Z imager to capture this image of "Santa Cruz," a hill within Jezero Crater, on April 29, 2021
Credit: NASA/JPL-Caltech/ASU/MSSS)

Lewes Astronomical Society

A cheaper way to retrieve Martian samples

- NASA is to conduct a review to see if a cheaper and quicker way can be found to return the samples (up to 30) collected by Perseverance on Mars, back to Earth
- The original plan, which has been developed over the last decade, has grown a lot more expensive: $8 to $11 billion at the latest estimate, and has slipped back by almost a decade to 2040
- NASA Administrator Bill Nelson has put a ceiling on the costs of no more than $7 billion, with quite a few years cut-off the return date. Private industry has been asked to help out

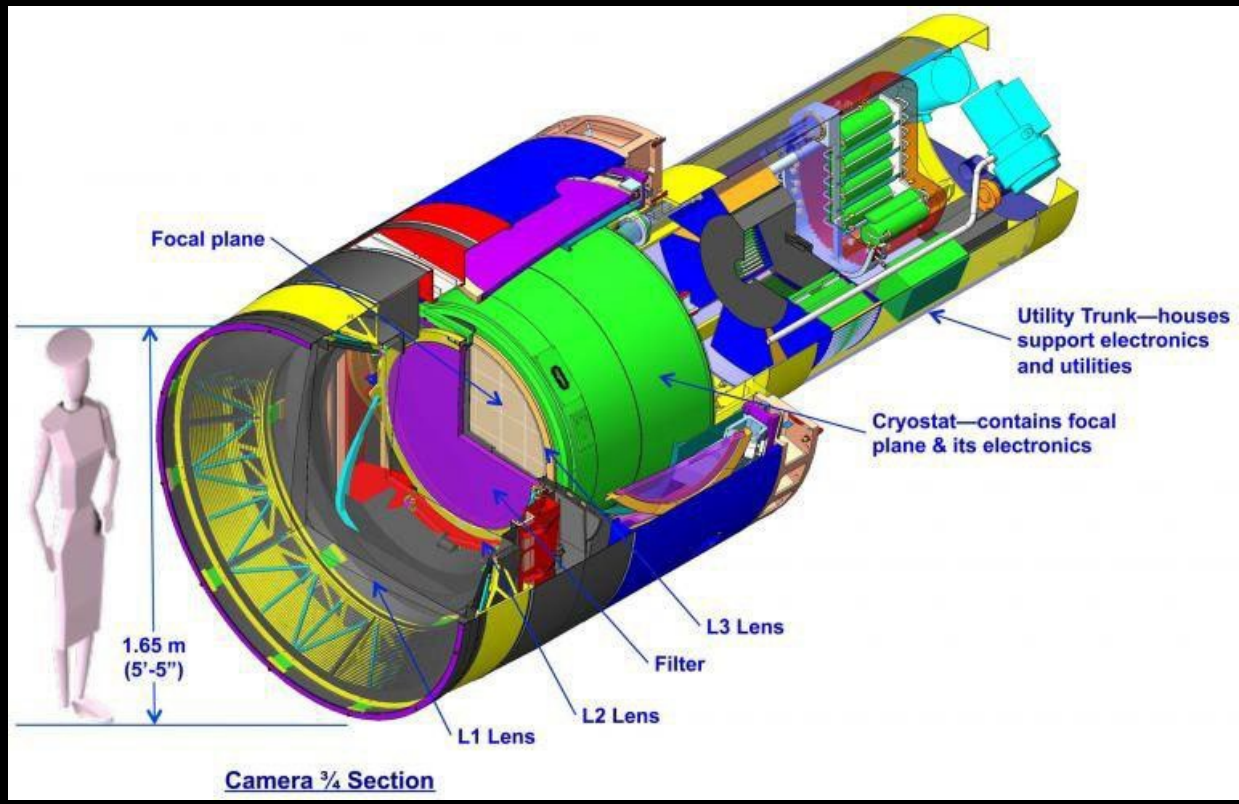


Perseverance collecting a sample from a rock called "Bunsen Peak" using a coring bit on the end of its robotic arm on March 11, 2024
Credit: NASA/JPL-Caltech/ASU via AP

Lewes Astronomical Society

The world's largest camera (1)

- Mobile phone cameras have come a long way in only a few years. They are ubiquitous and have made the lower-priced end of the automatic camera market redundant
- But how about trying to put the latest camera in your pocket. It is about the size of a car (1.65 x 3m), weighs 2,800kg and has a lens 1.5m in diameter. With a camera like this we're not talking about megapixels; it has 3.2 gigapixels (using 189 16-megapixel silicon detectors)



A schematic of the LSST Camera. Note the size comparison; the camera will be the size of a small SUV
Credit: Vera Rubin Observatory/DOE

Lewes Astronomical Society

The world's largest camera (2)

- It will be fitted on the Simonyi Survey Telescope in the new Vera C. Rubin Observatory, currently being built in Chile and designed to see first light in August 2025. The LSST (Legacy Survey of Space and Time) Camera, is a Charge-Coupled Device (CCD), and has been under development since 2004
- So what can it see? Imagine losing your golf ball, not on the 15th hole but a full 25km away. Yes, this camera will spot it in a 3.5° field of view (nine full Moons widths). The range it can see in covers a spectrum from near ultraviolet to near infrared (0.3-1 μm) wavelengths
- The 10-year Legacy Survey of Space and Time (LSST) will map the large-scale structures of the Universe with the camera taking an image of a different part of the Southern Hemisphere every 30 seconds. Over the 10-year period, the camera will image the whole sky a thousand times and image over 20 billion galaxies. This is the equivalent of 5,000 terabytes of raw images and data annually
- Watch a video about the camera at: https://youtu.be/LWrNoE6G18k

Lewes Astronomical Society

Peter Ware Higgs (1929 – 2024) (1)

- The British theoretical physicist, Peter Higgs, has died on April 8th at the age of 94
- Born in Newcastle upon Tyne on May 29th 1929 to a Scottish mother and English father, Higgs, a very humble and unassuming person, remained quiet, shy and retiring for much of his working life. He shot to international stardom when scientists, working at the Large Hadron Collider at CERN in 2012, announced that the mysterious Higgs Boson had finally been discovered

Peter Higgs photographed at the offices of UOP Publishing in Bristol in 2012
Credit: Dirk Dahmer

Lewes Astronomical Society

Peter Ware Higgs (1929 – 2024) (2)

- As the Standard Model of Particle Physics was developed during the 1960s and 1970s, one feature stood out – what gives some particles (and therefore everything in the Universe) their mass
- The Universe has four fundamental forces of nature: gravity, electromagnetism, the strong nuclear force, and the weak nuclear force, and to transmit those forces there are bosons (gravity excepted – currently). The best known is the photon, which is the force carrier of the electromagnetic force. The photon has no mass
- In the early 1960s, physicists were studying the weak nuclear force (which is why the Sun shines and how protons can be transformed into neutrons) and the carriers of the force: the W and Z bosons. Like the photon, they were expected to be massless, but the opposite is true and they are heavier than nearly all the other fundamental particles. (The weak nuclear force is strong over a very short distance - smaller than an atom - but extremely weak over longer distances)

Lewes Astronomical Society

Peter Ware Higgs (1929 – 2024) (3)

- If the W and Z bosons were massless, it would break one of the most fundamental and sacrosanct rules: symmetry, which means that the laws of nature are the same from whichever angle you look at them
- In 1964, three young researchers: Peter Higgs (University of Edinburgh), François Englert and Robert Brout (both at the Université libre de Bruxelles), proposed a solution. There is “something” which could trick nature into breaking the rules of symmetry
- This “something” filled the Universe at the moment it was created. Called the “Higgs Field”, it would exist in a symmetrical but unstable state. Within the first second or so, the Higgs Field would find a stable state to exist in but, in doing so, would break its own symmetry. This then, in turn, produces the "the Brout-Englert-Higgs mechanism”, which then allows the W and Z bosons to have mass and solve the conundrum. How the Higgs Field interacts with other particles would then give them varying masses

Peter Ware Higgs (1929 – 2024) (4)

- Finally, the Higgs Field needed a messenger, a carrier of this force, and so the Higgs Boson was born
- Trying to discover the Higgs Boson was the primary reason why the Large Hadron Collider, the largest particle collider in the world, was built
- It took nearly 50 years and major upgrades in various particle colliders and in the power that could be used before ,finally, on July 4th 2012, scientists at CERN announced they had observed the Higgs Boson
- Peter Higgs and François Englert shared the Nobel Prize in 2013 (sadly, Robert Brout had died in 2011)

Lewes Astronomical Society

Astronomy News in Brief (1)

- PAGB star discovered – astronomers have found a PAGB (Post-Asymptotic Giant Branch) star in a small globular cluster some 32,600 light years from Earth. PAGB stars are very luminous supergiant stars in a late phase of stellar evolution and this one certainly outshines all the other stars in the cluster. Such stars are rare in globular clusters (which last for billions of years) as they have a life of around only 500,000 years. The globular cluster, ESO 37-1 (or E3) is small and very faint, with a size of around only 2,900 solar masses. The PAGB appears to be in a binary system with a post-main sequence star about 0.5 – 0.8 solar masses, whereas the PAGB star is 4.61 times larger than the Sun, but has a solar mass of only 0.55 and appears to be enriched with carbon and oxygen
- Most powerful solar flare since 2017 – as the Sun moves towards “solar max” later this year, it is sending out more and more powerful coronal mass ejections. The latest, erupting on 23rd March, was recorded as the most intense since 2017 and categorised as an X-class, hitting the Earth on 24th March at 14:37 GMT, causing a G4 geomagnetic storm (G5 is the highest level and can cause radio blackouts)

Lewes Astronomical Society

Astronomy News in Brief (2)

- Just when did the Moon form? – researchers have proposed a new timeline for when the Moon was formed. It is thought that the Moon was formed from material ejected into space when Theia collided with the young Earth, likely caused by Jupiter's unstable orbit, within 100 million years after the birth of the Solar System (the best guess is between 37 and 62 million years). Any later would have upset the orbits of the inner planets, and Jupiter's Trojan asteroids would not be in the positions they are seen today. The Moon would have taken about 10 million years to form a solid crust. However, current geological evidence suggests that the earliest Moon rocks crystallised 208 million years after the formation of the Solar System. A third estimate, coming from the half-life of hafnium and its decay into Tungsten, points to 50 million years. Now, a new theory proposes that the Moon was formed 10 million years after an early impact (50 million years) but, due to tidal interaction with the Earth, the Moon went through a period of reheating which lasted a further 150 million years – in the same way as the inner moons of Jupiter are squeezed and stretched, causing heating

Lewes Astronomical Society

Astronomy News in Brief (3)

- Another close encounter – another asteroid, 2024 GJ2, had a very close shave with the Earth on 11th April, passing within 18,700km (11,600 miles). Only discovered 2 days earlier, the asteroid is about the size of a car, somewhere between 2.5m and 5m in diameter. If it had been on a direct trajectory, it would have burnt up in the atmosphere. Calculations suggest it won't make another close flyby until 2093 (albeit at a further distance)
- Is purple the new green? – of all the visible colours seen on Earth, green is the one most associated with life because of photosynthesis and the use of the green pigment chlorophyll A. But life on another world is unlikely to be using the same mechanism. Bacteria, which may be the first alien life to be found, can live in environments with low light levels and little or no oxygen and, on Earth, some of these bacteria use other power sources, such as infrared light. These bacteria have a purple pigment (although many have other coloured pigments too – red, yellow, orange and brown). Should we be looking for a purple exoplanet?
  See the video at: https://youtu.be/tA6lm-wcpO0

Lewes Astronomical Society

Astronomy News in Brief (4)

- Other Sun-like stars emit solar winds too – researchers from the University of Vienna and other institutes have found the first direct evidence of stellar winds coming from three sun-like stars. X-rays were detected coming from the astrospheres (the equivalent of the Sun's heliosphere). These X-rays were created by hot, energetic plasma interacting with the interstellar medium; heavy-charged ions from oxygen and carbon atoms captured electrons from the medium and, in the process, emitted X-rays. From this the researchers were able to estimate the total mass of stellar wind emitted by the stars (70 Ophiuchi, Epsilon Eridani, and 61 Cygni). In each case, the loss is greater than seen from the Sun (from 10 to 65 times). Care had to be taken to ensure the X-ray count did not include ones coming directly from the stars themselves

Lewes Astronomical Society

May 2024

Spaceflight News

Lewes Astronomical Society

NASA’s Europa Clipper unveiled (1)

- In October 2024, a SpaceX Falcon Heavy rocket will lift-off with an extremely expensive package ($5 bn) on board. NASA’s latest space probe, the Europa Clipper, will be on its 7-year journey to Jupiter and one of its Galilean Moons, Europa
- The Europa Clipper mission will determine if conditions for life exist on the moon. To ensure it doesn’t contaminate Europa, the probe currently sits in a clean room at the Jet Propulsion Lab in Pasadena, California

NASA's Europa Clipper Spacecraft is headed for one of Jupiter's moons to see if it has the right conditions to sustain life
Credit: NASA

NASA’s Europa Clipper unveiled (2)

- The Europa Clipper carries all the right instruments needed to find out if the moon is the right place, cameras: ice-penetrating radar, spectrometers, and a magnetometer. But, in order to use the instruments, the probe will have to endure an extremely powerful radiation field around Europa, one that could easily fry the systems. In addition, being so far away means that a signal takes 45 minutes to cross the ether to Earth
- Keeping Europa powered is also a headache. When launched, the solar panels will be able to generate 23,000 watts but, by the time it reaches Jupiter, only 700 watts will be available
- When the mission comes to an end, in 2034, the plan is for Europa Clipper to crash into one of the other (inert) moons, Ganymede

Lewes Astronomical Society

Static test of SpaceX 4th Starship prototype

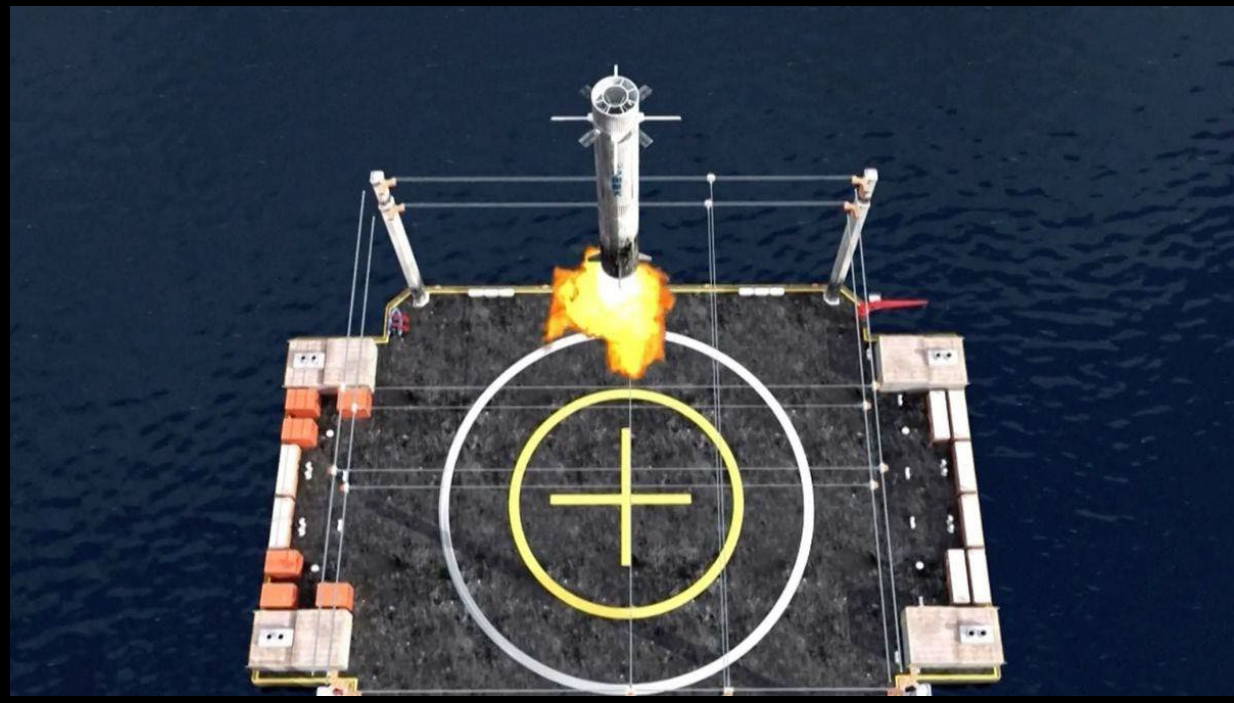
- Following the launch of the third prototype Starship on 14th March, SpaceX were eager to push forward with the next launch and brought the next prototype to the Starbase centre in South Texas to conduct static test firing of the engines
- The 50m upper stage Starship fired all six of its Raptor engines in a full-duration static fire on 25th March. This was followed by a single Raptor engine test on 27th March to simulate a de-orbit burn
- You can watch a short video of the text at: https://youtu.be/cvagnihR0WE

Credit: SpaceX

Lewes Astronomical Society

China’s reusable rockets

- Reusing rockets seems to be catching on. The first stage of China’s new Long March 10 rocket will be able to return to the ground
- Similar in principle to the SpaceX Falcon 9 approach, with engines being used to control the descent and fins to guide the booster, China’s solution then differs in using a wire and hook capture-method
- A hook will be deployed at the top of the first stage, which will then engage with wires on the sea-based landing platform



Still from an animation showing how China's main state-owned space contractor, CASC, plans to catch its reusable rockets after launch
Credit: CCTV

Lewes Astronomical Society

Launch of Russian heavy-lift rocket

- Russia test launched a new heavy-lift rocket from its Far East Vostochny space complex on 11th April. This followed two earlier aborted attempts
- The launch, the first from Vostochny after 3 previous launches from the Plesetsk launchpad in northwestern Russia, is intended to test out the launch vehicle which is likely to be used in the prospective lunar research programme
- The Angara A-5 will be able to place communications and intelligence satellites into geostationary orbit. The Angara family of rockets will replace the Soviet-designed Proton

A still taken from the video released by the Roscosmos space corporation on 11th April 2024, as an Angara-A5 rocket lifts off from Vostochny space launch facility outside the city of Tsiolkovsky, about 200 kilometres (125 miles) from the city of Blagoveshchensk in the far eastern Amur region, Russia. The lift-off comes after two aborted attempts earlier in the week
Credit: Roscosmos Space Corporation

Lewes Astronomical Society

First selected black American astronaut to go into space

- The next Blue Origin flight of the New Shepherd rocket (NS-25), which will launch 6 space “tourists” into sub-orbit, will include the very first black person selected to train as an astronaut
- Former U.S. Air Force Capt. Ed Dwight, was selected to go forward for training at the Aerospace Research Pilot School (ARPS) in 1961, by President John F Kennedy. This programme was a pathway for getting into the NASA Astronaut Corps

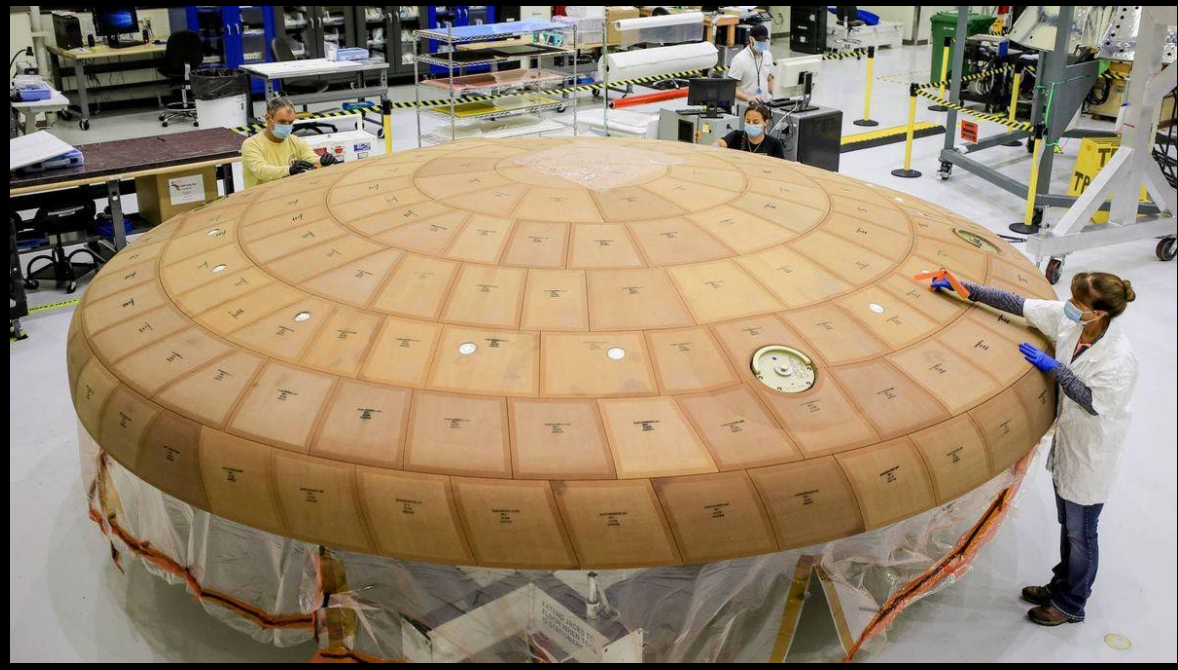
Captain Edward J. Dwight, Jr., the first African American selected as a potential astronaut, looks over a model of Titan rockets in November 1963
Credit: Bettmann Archive / Getty Images

- Capt. Dwight successfully completed the programme in 1963 but was not picked for the Astronaut Corps. It was another 20 years before a black astronaut, Guion Bluford, made it into space on the space shuttle Challenger

Lewes Astronomical Society

Orion heat shield ongoing investigations (1)

- The delays to the Artemis I mission and the fuelling problems of the new SLS rocket in 2022 masked other areas that need to be resolved before the first crewed flight can take place
- The unmanned Orion capsule parachuted to safety after re-entry on 11th December 2022, after a historic and largely successful 25-day mission and, whilst the interior of the capsule was undamaged, it soon became clear that there were performance issues with the heat shield



Orion's heat shield features an ablative material called Avcoat
Credit: Lockheed Martin

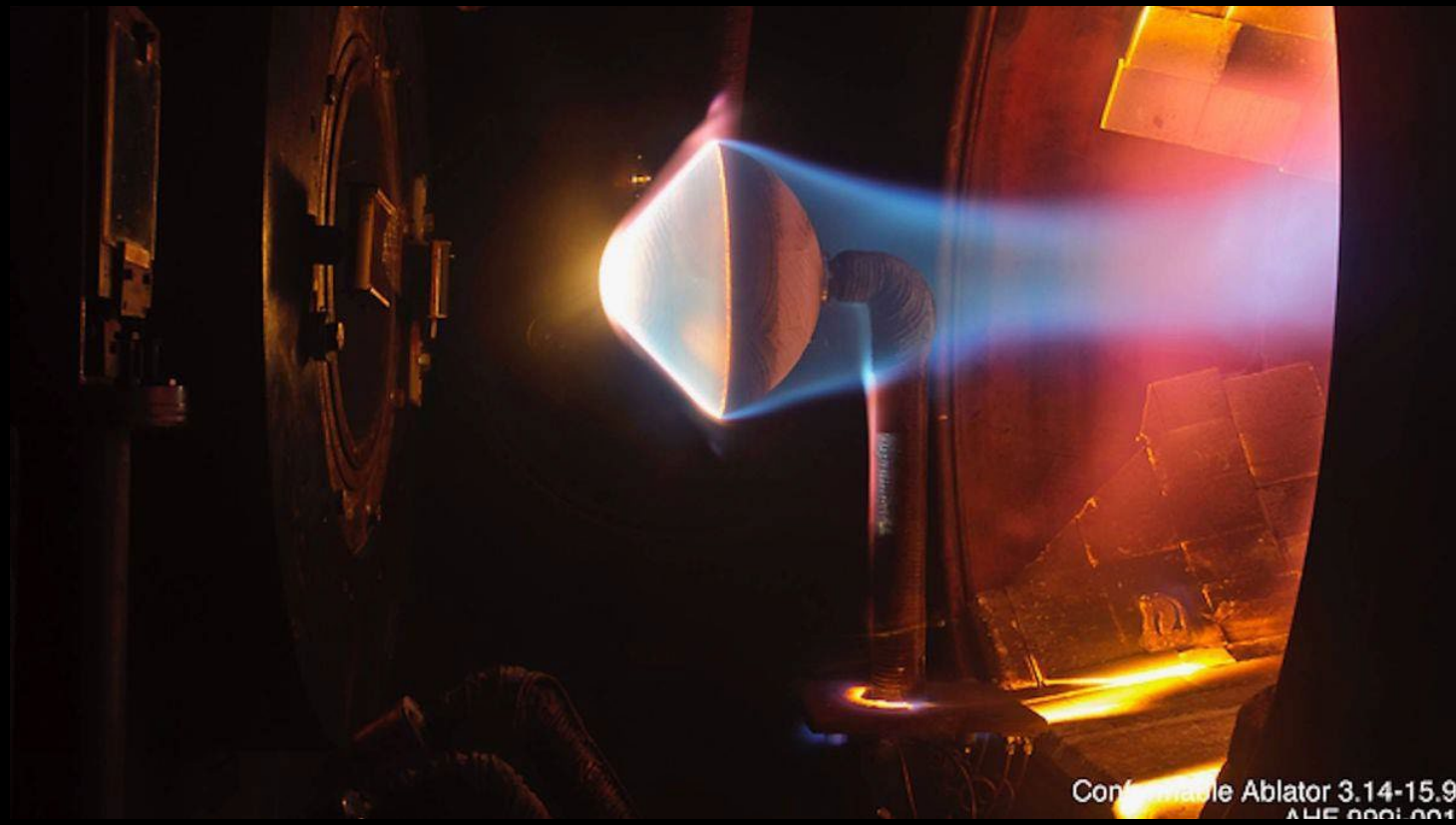
Orion heat shield ongoing investigations (2)

- The ablative layer, applied to the bottom of the capsule, is designed to burn away in a controlled fashion, taking the immense heat generated during the 40,000kph re-entry safely away. However, following a detailed examination of Orion, it was soon obvious that more material had been burnt off than modelled and some areas were more badly affected than others, including the cracking of some tiles
- The ablative layer is made of Avcoat, the same material as used on the Apollo missions of the late 1960s/early 1970s. What has been updated is the construction process
- For Apollo, a honeycomb structure was affixed to the bottom of the command module, and then each of the 300,000 cells was individually filled with the ablative material before being heat-cured and machined to the right dimensions and shape
- 50 years on and the production process is completely different. Less than 200 Avcoat blocks are manufactured, pre-machined and then affixed to the carbon-fibre base. This saves both time and money

Lewes Astronomical Society

Orion heat shield ongoing investigations (3)

- Tests, including thermal simulation using high-powered lasers, have been carried out through 2023, and the root cause of the problems should be released soon. Whether the manufacturer, Lockheed Martin, will have to revise the process, or if the issue is unique to this particular heat shield, has yet to be determined



The Arc Jet Complex at NASA's Ames Research Center in Silicon Valley has been used to study unexpected heat shield issues found after the Orion capsule's Artemis 1 flight in late 2022
Credit: NASA Ames Research Center

Lewes Astronomical Society

New solar sail to be tested

- A new generation of solar sails is to be tested: the Advanced Composite Solar Sail System, or ACS3, will be launched by a Rocket Lab Electron rocket on 24th April. Once the spacecraft reaches an altitude of 1,000 kilometres, the new solar sail will be deployed. If successful, then the engineers hope to be able to move the spacecraft using only the power of photons
- By using carbon-fibre reinforced polymer (CFRP) booms instead of metal, a very lightweight frame can be erected in under 30 minutes from a rolled-up version which fits into the palm of a hand
- The 7m booms will hold taut 4 triangular-shaped sheets, covering 80 square metres

An illustration of NASA's upcoming ACS3 solar sail in orbit above Earth's surface
Credit: ASA/Aero Animation/Ben Schweighart

Lewes Astronomical Society

Dragonfly gets green light for Titan

- A fond farewell to Ingenuity has been given by the team responsible for 72 flights. The craft is now grounded but is working as a stationary testbed whilst still in communication range with Perseverance. The first space helicopter will long be remembered as it blazed a new trail for future rotorcraft to follow
- Now, Dragonfly, the rotorcraft destined to go to the largest moon of Saturn, Titan, has passed the next hurdle and has been given approval to proceed with final design work and fabrication. The plan is to launch in July 2028 and arrive at Titan in 2034
- Due to cost overruns, the project is now about two years late and the budget has doubled to $3.35 billion. NASA is hoping to keep a tight grip on both the budget and schedule

Artist's concept of Dragonfly soaring over the dunes of Saturn's moon Titan
Credit: NASA/Johns Hopkins APL/Steve Gribben

Lewes Astronomical Society

Spaceflight News and Updates (1)

- Why did Voyager 1 stop communicating? – engineers found that a small part, less than 3% of the memory in one of the two computers, had become corrupted. It was causing the spacecraft to send a random series of 0s and 1s that is total gibberish. Unfortunately, it is in the spacecraft's flight data subsystem (FDS), which is responsible for science and engineering data. It is only a single computer chip and could have become worn out. The team found a workaround, which put the affected code in another part of the memory (slicing it up to prevent it corrupting anything else), and Voyager 1 is sending back usable information on its health and operating status. Getting science data back is the next step
- EUCLID de-icing successful – ice, which had formed on the telescope’s mirrors, and which had led to a decrease in the starlight that could be captured, was successfully evaporated. One of the 6 mirrors, which was suspected of being the most affected, was heated from a rather chilly -147 degrees to a balmy -113 degrees over a period and 1.6 hours before being allowed to cool back to its original temperature. Now it is collecting 15% more light

Lewes Astronomical Society

Spaceflight News and Updates (2)

- Chandra X-Ray Spacecraft may go silent – the NASA budgets for the next five years make particularly gloomy reading if you are a supporter or user of the Chandra X-ray observatory. The budget for keeping Chandra operational will go down from £41.1m in 2025, to $26.6m in years 2026, 2027, and 2028, and then down again to a tiny $5.2m. In spite of being one of the very few X-ray observatories (and has been since 1999), it faces being shut down by the end of the decade, with the replacement, Lynx, not seen as requiring high priority funding. This would be potentially calamitous for many researchers and for astronomers in general. Other projects are also subject to major budgeting issues and it is likely that only one of the two massive ground-based telescopes: the Thirty Metre Telescope and the Giant Magellan Telescope, will proceed to be built and operated, despite of both being actively worked on with substantial funding already in place

Lewes Astronomical Society

Spaceflight News and Updates (3)

- Odysseus lunar lander forever silent – Intuitive Machine's Odysseus lunar lander, which completed the first private venture launch and landing on the Moon, is now officially dead. On landing on 22nd February, one of the lander's legs broke, probably due to a heavier-than-anticipated touch-down, tipping Odysseus onto its side. Even though this prevented it from being aligned with the Earth and reduced its ability to charge up its batteries, Odysseus managed to carry out most of its mission for nearly seven days, until it ran out of power and nighttime came. Although not designed to survive the intense coldness of a lunar night, there was some hope that Odysseus might wake up and recharge its batteries, but alas, no
- SLIM awakens for the third time – Japan's SLIM lunar lander has survived the third deep freeze (or lunar night) and has awoken on 23rd April. Despite being upside down, the probe has taken another photo of the lunar surface and it has now completed all of its primary objectives. Whether it can survive another bout in the freezer is debatable as it is experiencing degradation of some instruments and unused battery cells

Lewes Astronomical Society

Spaceflight News and Updates (4)

- Lunar plants – the next humans to go to the Moon will take with them a mini greenhouse. In an experiment called LEAF (“Lunar Effects on Agricultural Flora”), which is one of the first 3 scientific experiments just announced, we will look at how space and the lunar environment affects plant growth and photosynthesis. After all, if Matt Damon is going to grow his potatoes on Mars, he needs to select the right variety!
- New generation lunar rover – NASA has announced the three private organisations who are now on the front row of the grid to develop the next lunar rover. Intuitive Machines, Lunar Outpost and Venturi Astrolab will now work on developing their concepts of the Lunar Terrain Vehicle (LTV) before the end of the decade, and launch on one of the Artemis flights

Lewes Astronomical Society

Spaceflight News and Updates (5)

- Nutrients for long-duration space flights – current pre-packaged meals, prepared on Earth, will have little nutritional value on a long flight to another planet, such as Mars, as they degrade over time. In an effort to overcome this, the Ames Research Center's Space Biosciences Division established the BioNutrients project. By using genetic engineering, microbially-based food can be created, and these will produce the necessary nutrients and medicines with minimal inputs. Using dried microbes and food-grade media in small bioreactors that can be stored for several years and then rehydrated, a number of important nutrients have been made, including carotenoids as antioxidants, yogurt and kefir for a healthy gut biome, and follistatin to help reduce muscle loss. However, muscle atrophy is caused by changes in the way calcium is absorbed and even intensive exercise cannot overcome this. Testing has taken place on the ISS where strains of baker’s yeasts have been shown to have an ambient shelf life of almost 4 years, and possibly 5 years in the near future; nearly as long as the tin of baked beans in the cupboard!

Lewes Astronomical Society

Spaceflight News and Updates (6)

- Indian space plane has wings – following in the footsteps of the US and China, India now has a space plane. The 6.5m long prototype, called “Pushpak”, was released from a helicopter at an altitude of 4,500m and made an autonomous landing on a runway 4km away. The 22nd March test was the second RLV Landing Experiment (RLV-LEX-02): the first one was carried out last year but the recent flight was more complicated. It also showed that the design is fully reusable. In due course, a two-stage orbital version is planned by the end of the decade
- Space junk hits house, no one hurt – not all space junk burns up on entry into the Earth’s atmosphere. One household in Naples, Florida, had a lucky escape (they were away on holiday) when a discarded metal support used to mount old batteries on a cargo pallet for disposal, crashed through the roof of the house and made a bit of a mess of the flooring. The source: the ISS which discarded the part back in 2021. What about insurance and any damages? The Outer Space Treaty of 1967 lays responsibility with the country that authorised the launch. Countries are also liable for spacecraft and rockets launched by the private sector

Lewes Astronomical Society

Spaceflight News and Updates (7)

- First crewed Boeing Starliner delayed – the launch of the new Boeing Starliner capsule has been put back to 6th May
- Final ULA Delta IV Heavy rocket launched – On 9th April the last Delta IV rocket was launched putting a classified payload for the US National Reconnaissance Office (NRO) into orbit. It was not only the last Delta IV (there have been 16) but after 64 years, the last ever Delta rocket launch: coming to a total of 389
- Another month, another record – SpaceX rockets continue to stretch performance records. This time a Falcon 9 first stage has been recovered 20 times following launch. It landed on a drone ship called “A Shortfall of Gravitas” on 12th April, whilst the upper stage continued and put 23 Starlink satellites into Low Earth Orbit. There have been 302 successful Falcon 9/Falcon Heavy booster landings now. There have been 43 Falcon 9 launches in 2024, 29 of them putting a total of 654 Starlink satellites into Low Earth Orbit. 45 Falcon 9 launches were planned by the end of April 2024

Lewes Astronomical Society

Spaceflight News and Updates (8)

- SpaceX overusing Vandenberg Launch Site – the Santa Barbara County military base is being used by SpaceX well in excess of the 6 annual launches agreed between base officials and the Californian State Coastal Commission. SpaceX have now said they would like to be allowed to launch up to 36 rockets per year. The Coastal Commission may not be able to stop them as the base, being part of the Department of Defense (DoD), is governed by federal law, and not state law, and the DoD could claim that all SpaceX launches either have a strategic function or benefit the military. So far, only a quarter of SpaceX launches have been classified, the rest have been used to put more Starlink satellites in orbit. Locals are also concerned with the potentially massive increase in launches as they can force closures and evacuations

Lewes Astronomical Society

Spaceflight News and Updates (9)

- The Martian rover we forget about – with most of the news these days focussed on Perseverance, it is easy to forget that an earlier rover, Curiosity, is still active, now almost 12 years after it landed in the Gale Crater on 6th August 2012. It is currently traversing the upper Gediz Vallis ridge and investigating the broken bedrock. It continues to send back a steady stream of images and data

Lewes Astronomical Society

May 2024

Observational Highlights

Lewes Astronomical Society

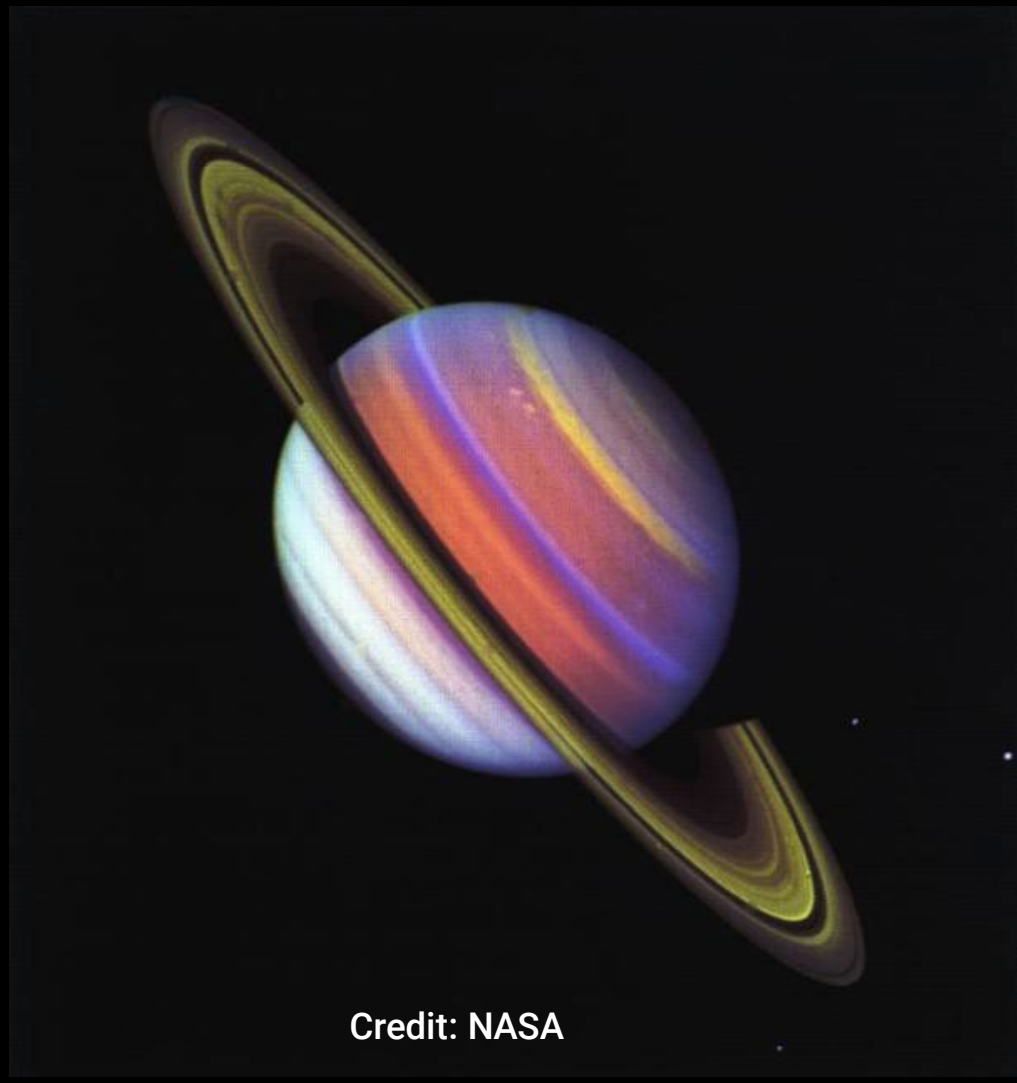
May 2024 dates

- 5th May – Eta Aquarid meteor shower maximum (pre-dawn)
- 9th May – Mercury at greatest elongation west (26°) from the Sun
- 13th May – Uranus in conjunction with the Sun
- 18th May – Jupiter in conjunction with the Sun
- 19th May – Minor planet (2) Pallas (+9.0) at opposition (15:00 UTC)

Lewes Astronomical Society

No planets – until the end of the month!

- With the planets either in conjunction, too close to the Sun, or too low at the beginning of the month, we will have to wait until the end of the month for Saturn to make a welcome reappearance low down in the pre-dawn sky
- By the end of the month, Saturn (+1.2) will be 15° high above the south-eastern horizon at 4am BST. The waning Moon will be to the south-west
- The rings will have closed up and will now appear to be almost edge on



Credit: NASA

Lewes Astronomical Society

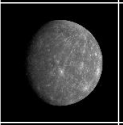
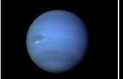
Comet 2023 A3 (Tsuchinshan-ATLAS)

- This comet could present as a brilliant naked-eye object in October 2024, after passing through perihelion on 27th September, but before that it will be a target for comet hunters with telescopes (250mm and above)
- Currently tracking westwards through Virgo towards Coma Berenices, it is still a long way from the Sun, between Jupiter and Mars, so is only a 11th magnitude object
- By late evening it will be about 33° high at the beginning of the month and will climb a further 5° before midnight. By the end of the month, it will still be around 30° in the south-west. Although brightening, it will drop nearer to the horizon and be lost by mid-July

Comet 2023 A3 (Tsuchinshan-ATLAS) taken on April17th 2024 in Kendal, Cumbria, using a Canon 700D DSLR camera, 300mm lens, and iOptronSky Tracker motorised mount
Credit: Stuart Atkinson/BBC Sky at Night Magazine

Lewes Astronomical Society

Planets (information for 1st May)

	Planet	Rises	Sets	Highest	Direction	Altitude	Magnitude	Visible
	MERCURY	05:03	17:54	11:28			+0.06	NO
	VENUS	05:24	19:24	12:23			-3.91	NO
	MARS	04:27	16:24	10:25			+1.09	NO
	JUPITER	06:11	21:27	13:49			-2.00	NO
	SATURN	04:02	15:00	09:31			+1.19	NO
	URANUS	06:03	21:18	13:41			+5.84	NO
	NEPTUNE	04:24	16:14	10:19			+7.93	NO

* = Highest point at Dawn (03:57 - last visible sighting)

** = Highest point at Dusk (21:57 - first visible sighting)

▫ = Highest point when last visible

◊ = Highest point when first visible (18:01)

▫▫ = Highest point when last visible

◊◊ = Highest point when first visible (18:59)

Lewes Astronomical Society

100 Deep Sky Objects - 1 (Information for 1st May)

Object	Name	Constellation	Type	↗	↘	Highest	Direction	Alt	Mag
Cr302	The Antares Cluster	Scorpius	Open Cluster	01:53	02:48	03:43	South	12°	+1.0
Mel20	The Alpha Persei Cluster	Perseus	Open Cluster	21:18	21:18	21:22 ◊◊	North-West	23°	+1.2
Cr39	Collinder 39	Perseus	Open Cluster	21:18	04:35	21:18 ◊◊	North-West	24°	+1.2
Mel111	The Coma Star Cluster	Coma Berenices	Open Cluster	21:27	04:26	22:44	South	65°	+1.8
Cr256	Collinder 256	Coma Berenices	Open Cluster	21:27	04:26	22:44	South	65°	+1.8
C33	The Eastern Veil Nebula	Cygnus	Nebula	21:54	03:57	03:57 *	East	48°	+2.7
Mel186	Melotte 186	Ophiuchus	Open Cluster	22:04	04:05	04:05 ◊	South	42°	+3.0
Cr359	Collinder 359	Ophiuchus	Open Cluster	22:05	04:05	04:05 ◊	South	41°	+3.0
M44	Beehive Cluster	Cancer	Open Cluster	21:49	02:48	21:49 ◊◊	South-West	44°	+3.1
M31	Andromeda Galaxy	Andromeda	Galaxy	03:13	03:58	03:58 ◊	North-East	22°	+3.4
Cr439	The Elephant Trunk	Cepheus	Cluster with Nebulosity	21:57	03:57	03:57 *	North-East	54°	+3.5
Cr399	Brocchi's Cluster	Vulpecula	Open Cluster	21:55	03:57	03:57 *	South-East	52°	+3.6
Cr62	Collinder 62	Auriga	Open Cluster	21:57	23:18	21:57 **	North-West	28°	+4.2
Cr464	Collinder 464	Camelopardalis	Open Cluster	21:53	03:57	03:57 *	North-West	72°	+4.2
Cr349	Open Cluster	Ophiuchus	Open Cluster	21:37	03:57	03:57 *	South	44°	+4.2

* = Highest point at Dawn (03:57 - last visible sighting)
** = Highest point at Dusk (21:57 - first visible sighting)
◊ = Bright object last visible sighting after dawn
◊◊ = Bright object first visible sighting before dusk

Lewes Astronomical Society

100 Deep Sky Objects - 2 (Information for 1st May)

Object	Name	Constellation	Type	↗	↘	Highest	Direction	Alt	Mag
C14	The Perseus Double Cluster	Perseus	Open Cluster	21:57	03:57	03:57 *	North-West	25°	+4.3
M39	Open Cluster	Cygnus	Open Cluster	23:26	03:57	03:57 *	South-East	52°	+4.6
NGC6633	Open Cluster	Ophiuchus	Open Cluster	22:13	03:57	03:57 *	South	44°	+4.6
M24	Delle Caustiche	Sagittarius	Asterism	00:11	03:57	03:57 *	South	20°	+4.6
Cr386	Graff's Cluster	Serpens Cauda	Open Cluster	22:30	03:57	03:57 *	South	42°	+4.6
M35	Open Cluster	Gemini	Open Cluster	21:57	00:49	21:57 **	West	23°	+5.1
NGC6871	Open Cluster	Cygnus	Open Cluster	21:57	03:57	03:57 *	East	59°	+5.2
NGC869	h Per Cluster	Perseus	Open Cluster	21:57	03:57	03:57 *	North-East	25°	+5.3
NGC2281	Open Cluster	Auriga	Open Cluster	21:57	00:24	21:57 **	West	40°	+5.4
NGC7686	Open Cluster	Andromeda	Open Cluster	01:39	03:57	03:57 *	North-East	36°	+5.6
M37	The Auriga Salt-and-Pepper	Auriga	Open Cluster	21:57	01:46	21:57 **	West	26°	+5.6
Cr89	Collinder 89	Gemini	Open Cluster	21:57	00:52	21:57 **	West	24°	+5.7
M5	Globular Cluster	Serpens Caput	Globular Cluster	21:57	03:57	01:41	South	41°	+5.7
NGC6882	Open Cluster	Vulpecula	Open Cluster	21:57	03:57	03:57 *	South-East	51°	+5.7
M13	Great Globular Cluster	Hercules	Globular Cluster	21:57	03:57	03:04	South	75°	+5.8

* = Highest point at Dawn (03:57 - last visible sighting) ** = Highest point at Dusk (21:57 - first visible sighting)

◊ = Bright object last visible sighting after dawn ◊◊ = Bright object first visible sighting before dusk

Lewes Astronomical Society

100 Deep Sky Objects - 3 (Information for 1st May)

Object	Name	Constellation	Type	↗	↘	Highest	Direction	Alt	Mag
M11	Wild Duck Cluster	Scutum	Open Cluster	23:40	03:57	03:57 *	South-East	30°	+5.8
Cr29	Collinder 29	Perseus	Open Cluster	21:57	03:57	21:57 **	North-West	23°	+5.9
M36	The Pinwheel Cluster	Auriga	Open Cluster	21:57	01:50	21:57 **	North-West	25°	+6.0
IC405	The Flaming Star Nebula	Auriga	Nebula	21:57	01:33	21:57 **	North-West	22°	+6.0
NGC7000	The North American Nebula	Cygnus	HII Region	21:57	03:57	03:57 *	East	55°	+6.0
M17	The Omega Cluster	Sagittarius	Open Cluster	00:02	03:57	03:57 *	South	22°	+6.0
M16	The Eagle Nebula	Serpens Cauda	Open Cluster	23:47	03:57	03:57 *	South	24°	+6.0
NGC6605	Open Cluster	Serpens Cauda	Open Cluster	23:51	03:57	03:57 *	South	23°	+6.0
NGC7160	Open Cluster	Cepheus	Open Cluster	21:57	03:57	03:57 *	North-East	54°	+6.1
M12	Globular Cluster	Ophiuchus	Globular Cluster	23:47	03:57	03:09	South	37°	+6.1
Cr350	Collinder 350	Ophiuchus	Open Cluster	22:00	03:57	03:57 *	South	40°	+6.1
NGC884	chi Per Cluster	Perseus	Open Cluster	21:57	03:57	03:57 *	North-East	24°	+6.1
NGC1545	Open Cluster	Perseus	Open Cluster	21:57	03:57	21:57 **	North-West	27°	+6.2
M3	Globular Cluster	Canes Venatici	Globular Cluster	21:57	03:57	00:05	South	67°	+6.3
M15	Globular Cluster	Pegasus	Globular Cluster	00:46	03:57	03:57 *	East	28°	+6.3

* = Highest point at Dawn (03:57 - last visible sighting) ** = Highest point at Dusk (21:57 - first visible sighting)
◊ = Bright object last visible sighting after dawn ◊◊ = Bright object first visible sighting before dusk

Lewes Astronomical Society

100 Deep Sky Objects - 4 (Information for 1st May)

Object	Name	Constellation	Type	↗	↘	Highest	Direction	Alt	Mag
NGC6940	Open Cluster	Vulpecula	Open Cluster	22:05	03:57	03:57 *	East	49°	+6.3
M38	The Starfish Cluster	Auriga	Open Cluster	21:57	02:09	21:57 **	North-West	25°	+6.4
NGC457	The Dragonfly Cluster	Cassiopeia	Open Cluster	21:57	03:57	03:57 *	North-East	30°	+6.4
NGC7243	Open Cluster	Lacerta	Open Cluster	00:26	03:57	03:57 *	East	47°	+6.4
NGC1528	Open Cluster	Perseus	Open Cluster	21:57	03:57	21:57 **	North-West	27°	+6.4
Cr26	The Heart Nebula	Cassiopeia	Cluster with Nebulosity	21:57	03:57	03:57 *	North	28°	+6.5
Cr34	The Soul Nebula	Cassiopeia	Cluster with Nebulosity	21:57	03:57	21:57 **	North-West	27°	+6.5
NGC129	Open Cluster	Cassiopeia	Open Cluster	21:57	03:57	03:57 *	North-East	36°	+6.5
NGC654	Open Cluster	Cassiopeia	Open Cluster	21:57	03:57	03:57 *	North-East	31°	+6.5
M92	Globular Cluster	Hercules	Globular Cluster	21:57	03:57	03:57 *	South-East	81°	+6.5
NGC6604	Open Cluster	Serpens Cauda	Open Cluster	23:38	03:57	03:57 *	South	26°	+6.5
M29	The Cooling Tower	Cygnus	Open Cluster	21:57	03:57	03:57 *	East	58°	+6.6
M10	Globular Cluster	Ophiuchus	Globular Cluster	00:11	03:57	03:19	South	35°	+6.6
NGC1444	Open Cluster	Perseus	Open Cluster	21:57	03:57	21:57 **	North-West	26°	+6.6
NGC6709	Open Cluster	Aquila	Open Cluster	22:18	03:57	03:57 *	South-East	46°	+6.7

* = Highest point at Dawn (03:57 - last visible sighting) ** = Highest point at Dusk (21:57 - first visible sighting)

◊ = Bright object last visible sighting after dawn ◊◊ = Bright object first visible sighting before dusk

Lewes Astronomical Society

100 Deep Sky Objects - 5 (Information for 1st May)

Object	Name	Constellation	Type	↗	↘	Highest	Direction	Alt	Mag
NGC1027	Open Cluster	Cassiopeia	Open Cluster	21:57	03:57	03:57 *	North-West	28°	+6.7
NGC7789	The Caroline's Rose	Cassiopeia	Open Cluster	21:57	03:57	03:57 *	North-East	37°	+6.7
NGC7023	The Iris Nebula	Cepheus	Nebula	21:57	03:57	03:57 *	North-East	64°	+6.8
NGC6811	The Hole in a Cluster	Cygnus	Open Cluster	22:17	03:57	03:57 *	East	69°	+6.8
NGC1502	Open Cluster	Camelopardalis	Open Cluster	21:57	03:57	21:57 **	North-West	35°	+6.9
M67	Open Cluster	Cancer	Open Cluster	21:57	02:14	21:57 **	South-West	38°	+6.9
M52	The Cassiopeia Salt-and-Pepper	Cassiopeia	Open Cluster	21:57	03:57	21:57 **	North-East	44°	+6.9
M81	Bode’s Galaxy	Ursa Major	Galaxy	21:57	03:57	21:57 **	North-East	71°	+6.9
NGC1857	Open Cluster	Auriga	Open Cluster	21:57	22:35	21:57 **	North-West	27°	+7.0
NGC225	The Sailboat Cluster	Cassiopeia	Open Cluster	21:57	03:57	03:57 *	North-East	36°	+7.0
NGC7635	The Bubble Nebula	Cassiopeia	HII Region	21:57	03:57	03:57 *	North-East	44°	+7.0
NGC6960	The Western Veil Nebula	Cygnus	Supernova Remnant	21:57	03:57	03:57 *	East	49°	+7.0
NGC7063	Open Cluster	Cygnus	Open Cluster	21:57	03:57	03:57 *	East	47°	+7.0
NGC1582	Open Cluster	Perseus	Open Cluster	21:57	22:15	21:57 **	North-West	24°	+7.0
NGC663	Open Cluster	Cassiopeia	Open Cluster	21:57	03:57	03:57 *	North-East	30°	+7.1

* = Highest point at Dawn (03:57- last visible sighting)
** = Highest point at Dusk (21:57 - first visible sighting)
◊ = Bright object last visible sighting after dawn
◊◊ = Bright object first visible sighting before dusk

Lewes Astronomical Society

100 Deep Sky Objects - 6 (Information for 1st May)

Object	Name	Constellation	Type	↗	↘	Highest	Direction	Alt	Mag
NGC6823	Open Cluster	Vulpecula	Open Cluster	21:57	03:57	03:57 *	South-East	52°	+7.1
NGC7380	The Wizard Nebula	Cepheus	Open Cluster	21:57	03:57	03:57 *	North-East	46°	+7.2
NGC7082	Open Cluster	Cygnus	Open Cluster	00:04	03:57	03:57 *	East	52°	+7.2
Cr418	Open Cluster	Cygnus	Open Cluster	21:57	03:57	03:57 *	East	58°	+7.3
NGC6819	Open Cluster	Cygnus	Open Cluster	23:02	03:57	03:57 *	East	65°	+7.3
M103	Open Cluster	Cassiopeia	Open Cluster	21:57	03:57	03:57 *	North-East	31°	+7.4
M27	Apple Core Nebula	Vulpecula	Planetary Nebula	22:13	03:57	03:57 *	South-East	50°	+7.4
NGC6888	The Crescent Nebula	Cygnus	HII Region	21:57	03:57	03:57 *	East	59°	+7.5
M14	Globular Cluster	Ophiuchus	Globular Cluster	22:12	03:57	03:57 *	South	35°	+7.6
C9	The Cave Nebula	Cepheus	HII Region	21:57	03:57	03:57 *	North-East	47°	+7.7
M53	Globular Cluster	Coma Berenices	Globular Cluster	21:57	03:57	23:32	South	57°	+7.7
M107	Globular Cluster	Ophiuchus	Globular Cluster	01:08	03:57	02:55	South	26°	+7.8
NGC2726	Galaxy	Ursa Major	Galaxy	21:57	03:57	21:57 **	North-West	66°	+7.8
M101	The Pinwheel Galaxy	Ursa Major	Galaxy	21:57	03:57	00:26	North	86°	+7.9
M26	Open Cluster	Scutum	Open Cluster	23:50	03:57	03:57 *	South	27°	+8.0

* = Highest point at Dawn (03:57 - last visible sighting) ** = Highest point at Dusk (21:57 - first visible sighting)
◊ = Bright object last visible sighting after dawn ◊◊ = Bright object first visible sighting before dusk

Lewes Astronomical Society

100 Deep Sky Objects - 7 (Information for 1st May)

Object	Name	Constellation	Type	↗	↘	Highest	Direction	Alt	Mag
M110	Galaxy	Andromeda	Galaxy	03:52	03:57	03:57 *	North-East	22°	+8.1
NGC6885	20 Vulpeculae Cluster	Vulpecula	Duplicate	21:57	03:57	03:57 *	South-East	51°	+8.1
M94	'Spiral' Galaxy	Canes Venatici	Galaxy	21:57	03:57	21:57 **	South-East	74°	+8.2
M51	Whirlpool Galaxy	Canes Venatici	Galaxy	21:57	03:57	21:57 **	East	71°	+8.4
M56	Globular Cluster	Lyra	Globular Cluster	21:57	03:57	03:57 *	South-East	61°	+8.4
M71	Globular Cluster	Sagitta	Globular Cluster	22:32	03:57	03:57 *	South-East	47°	+8.4
M82	The Cigar Galaxy	Ursa Major	Galaxy	21:57	03:57	21:57 **	North-East	68°	+8.4
M49	Galaxy	Virgo	Galaxy	21:57	03:08	22:49	South	47°	+8.4
M64	The Black Eye Galaxy	Coma Berenices	Galaxy	21:57	03:57	23:15	South	60°	+8.5
M63	The Sunflower Galaxy	Canes Venatici	Galaxy	21:57	03:57	21:57 **	East	71°	+8.6

Twilight	Civil	Naut	Astro		Rises	Sets
Ends	20:59	21:48	22:47	Sun	05:31	20:21
Starts	04:54	04:05	03:07	Moon	03:10	11:18

* = Highest point at Dawn (03:57 - last visible sighting) ** = Highest point at Dusk (21:57 - first visible sighting)

◊ = Bright object last visible sighting after dawn ◊◊ = Bright object first visible sighting before dusk

Lewes Astronomical Society

Brown Lunation Numbers

numbered from first New Moon in 1923

Phases of the Moon

Phase	Date	Time	Lunation
LAST QUARTER	1st May	11:28	1253
NEW MOON	8th May	03:23	1254
FIRST QUARTER	15th May	11:49	1254
FULL MOON	21st May	13:54	1254
LAST QUARTER	30th May	17:13	1254

Credit: NASA

Data credit: Time and Place