Lewes Astronomical Society

Newsletter - July 2024

Astronomy News, Spaceflight News, and Observational Highlights

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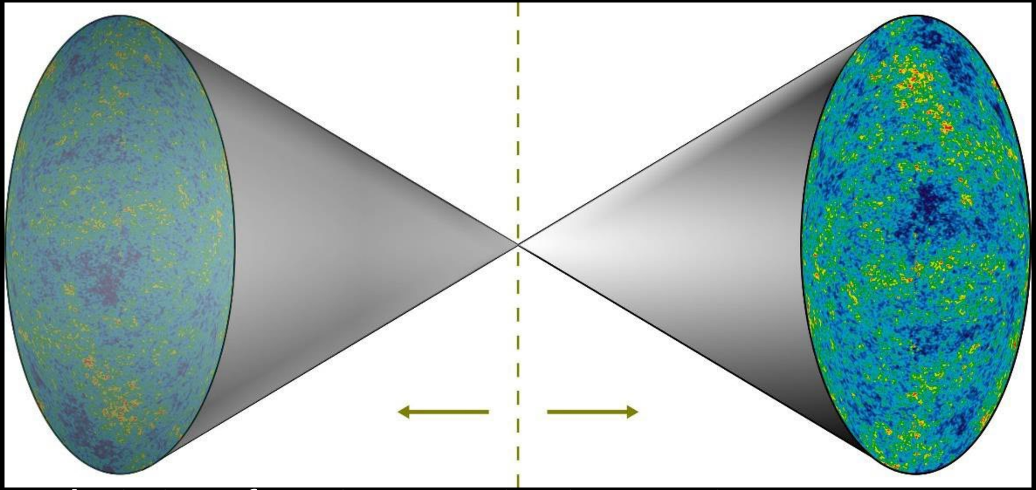
July 2024

Astronomy News

Anti-universe avoids need for Dark Energy



A depiction of a universe-anti-universe pair
Credit: Wikipedia, C.C.

- The ongoing accelerated expansion of the Universe is believed to be driven by dark energy. However, dark energy remains a mystery
- The best explanation for the expansion comes from the Standard Model of Cosmology (Λ-CDM), as the cosmological constant in Einstein's field equations, but this is incomplete
- Into the breach have sprung many other explanations: quintessence, modified gravity, and multi-dimensions beyond the recognised four (3 positional and time)
- Another new theory proposes a partner anti-universe, whose time flow is directly opposite to our own Universe. As two states are required by relative entropy, the accelerated expansion would happen in both universes. This would eliminate the need for dark energy by using constants from general relativity and quantum theory

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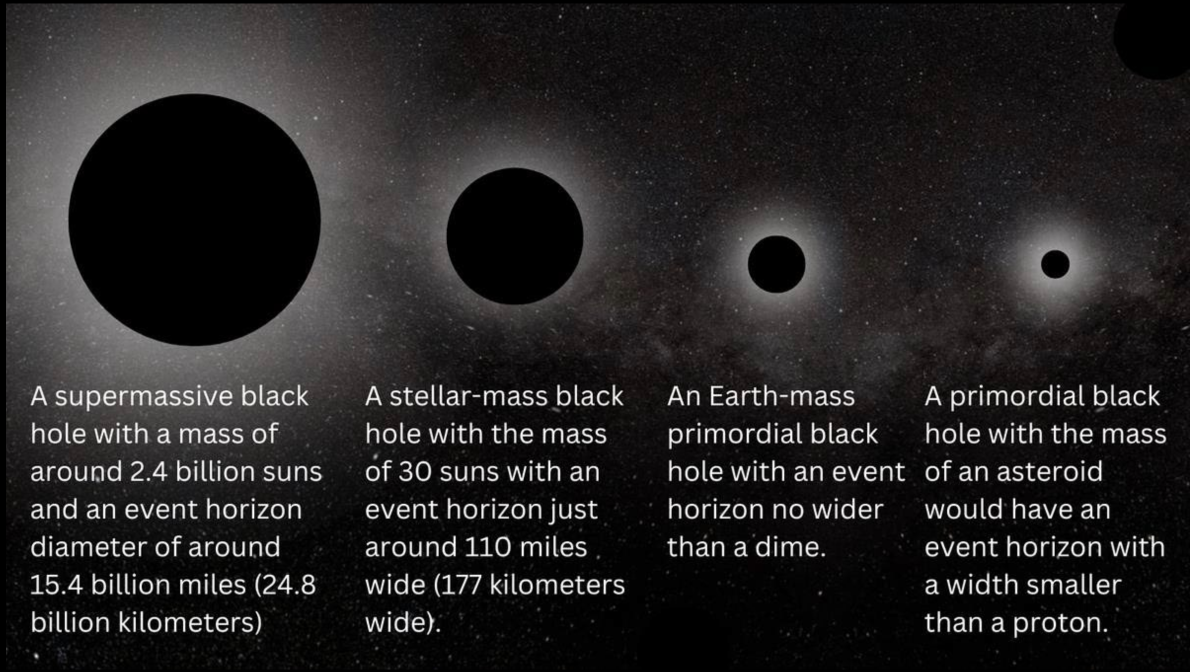
Primordial Black Holes formed in Big Bang (1)

- Looking at the cosmos today, astronomers know there are supermassive black holes sitting at the centre of nearly every galaxy. There are also stellar-mass black holes, formed when a huge star dies in a supernova. Somewhere between the two lies intermediate black holes
- These have yet to be discovered, theoreticians believe that small black holes were formed within a tiny fraction of a second after the Big Bang



A diagram showing the vast difference in scale between supermassive black holes and hypothetical primordial black holes
Credit: Robert Lea (created with Canva)

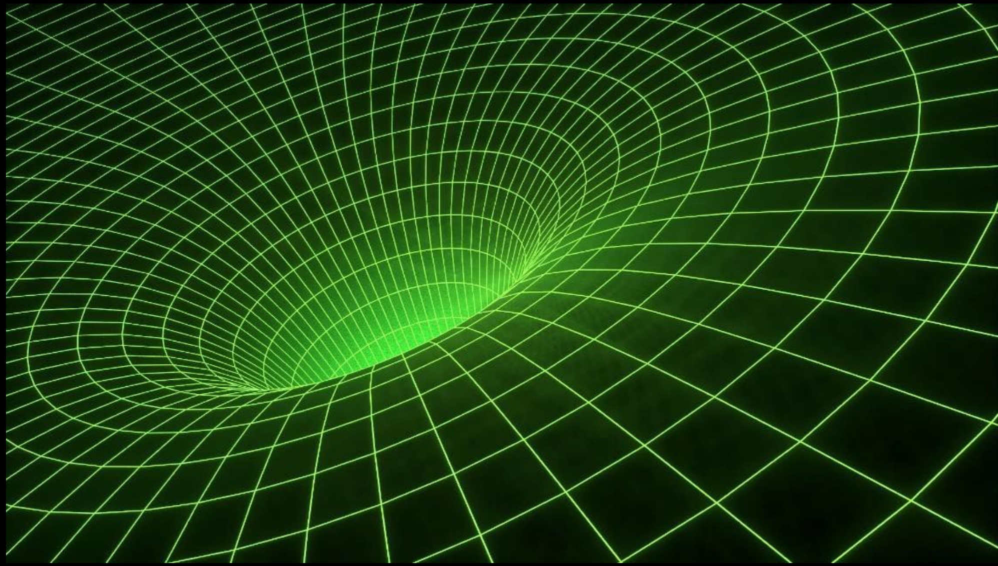
- These primordial black holes could weigh anything between the mass of an asteroid and a small planet, with an event horizon sized between an atom and a coin

Primordial Black Holes formed in Big Bang (2)

- They would have not survived long; evaporating due to Hawking Radiation
- Now a team led by Professor David Kaiser, of Massachusetts Institute of Technology (MIT), believe that even smaller primordial black holes formed as well, with a mass of a rhino and size smaller than a proton. These supercharged black holes were formed before atoms existed and were filled with quarks and gluons, fundamental particles and forces that make up protons and neutrons
- These rhino-mass sized black holes may have affected the balance of fusing nuclei in the infant universe. Such disturbances should have affected matter in a way that may be observable
- Although primordial black holes should have disappeared very early on, some theories suggest that they could account for dark matter, and therefore could still be around

The ongoing Dark Matter controversy: Part 1 (1)

- In 1932, the Dutch astronomer, Jan Oort, had suggested that some sort of missing mass was needed to help galaxies to clump together
- The following year, the Swiss-American astronomer, Fritz Zwicky, proposed that there was unseen matter that was helping to give extra mass to galaxies as a way of explaining why the Coma galaxy cluster had excessive rotational velocity



Gravitational Field Lines around a massive object
Credit: CC0 Public Domain

- Zwicky called this mass, “Dunkle Materie” – Dark Matter
- The controversial Zwicky’s views were mainly dismissed by astronomers. However, in the late 1970s, Vera Rubin and Kent Ford, rediscovered the same phenomena when studying the rotational curves of galaxies and, in particular, the Andromeda Galaxy

The ongoing Dark Matter controversy: Part 1 (2)

- Rubin and Kent found that the stars at the edge of the galaxy are moving at the same speed as the ones near the centre, in violation to Newton's Laws of Motion. This was the first concrete evidence of dark matter
- Since then, the presence of dark matter in nearby galaxy clusters has been used by astronomers as a gravitational lens to study distant galaxies
- Dark matter interacts with gravity but with none of the other fundamental forces in the Universe
- But after several more decades, countless experiments and billions of dollars, we are no nearer understanding what dark matter is, or how it actually works
- Without this proof there are many astronomers and astrophysicists who question whether it actually exists

The ongoing Dark Matter controversy: Part 1 (3)

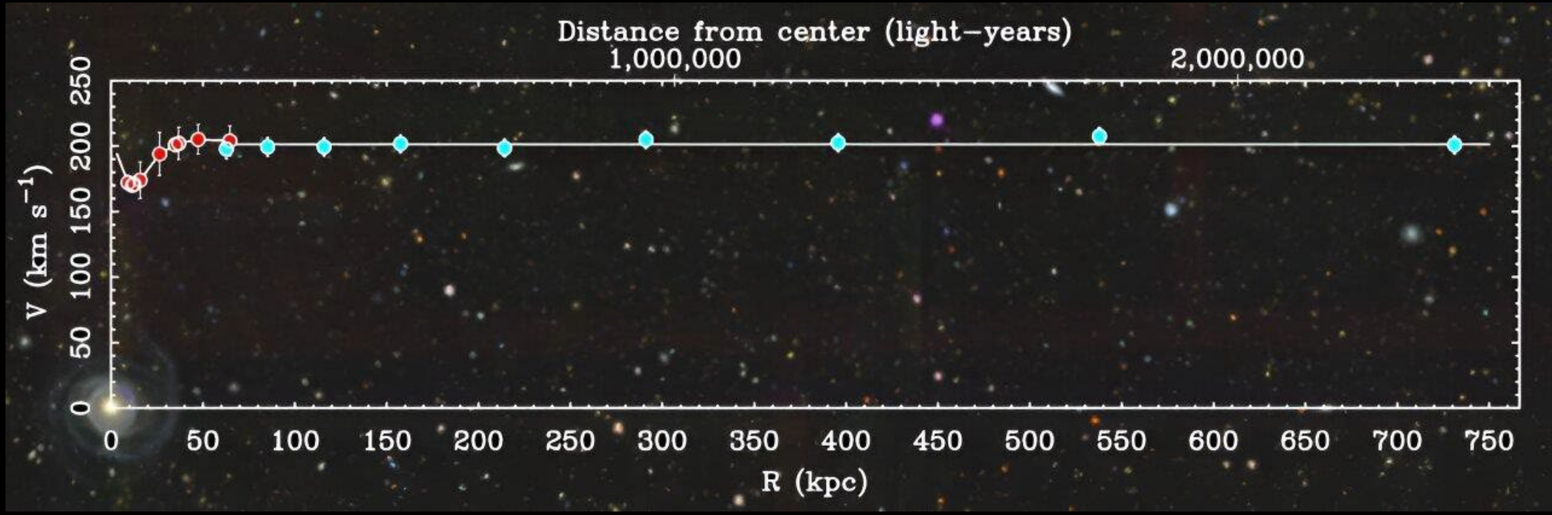
- Now, Dr Richard Lieu at The University of Alabama in Huntsville (UAH) in the USA, writing in the Monthly Notices of the Royal Astronomical Society, has proposed that gravity can exist without mass, eliminating the need for dark matter
- Dr Lieu contends that “excess” gravity needed to bind galaxies and clusters together may be the result of topological defects in structures in the early universe. These occurred during phase transitions where the overall state of matter changed across the entire cosmos. This produced concentric sets of shells
- Lieu’s shells consist of a thin inner layer of positive mass and a thin outer layer of negative mass, which balances out to be mass-less
- Anything massive on the shell , such as a star, will experience a large gravitational force pulling towards the centre of the shell

The ongoing Dark Matter controversy: Part 1 (4)

- As the gravitational force warps space-time, all objects, with or without mass, can interact with each other. Hence, massless photons feel the effects of gravitationally-massive bodies such as stars, galaxies, and galaxy clusters
- The concentric shells would bend the light as it passes through the layers, in the same way that it is bent moving through a glass prism. The amount of deflection (and also stellar orbital velocities) is a measure of the strength of the gravitational field

The ongoing Dark Matter controversy: Part 2

- In another potential nail in the coffin of dark matter, Tobias Mistele, of Case Western Reserve University, USA, has found that the rotation curves of galaxies remain flat for millions of light years away from the galactic centres, with no end in sight



The primary technique Mistele used in his research, gravitational lensing, is a phenomenon predicted by Einstein's theory of general relativity. As part of the research, Mistele plotted out what's called Tully–Fisher relation on a chart to highlight the empirical relationship between the visible mass of a galaxy and its rotation speed
Credit: Tobias Mistele (Case Western Reserve University)

- Current theories suggest that rotation curves of galaxies should decline as you travel away from the centre of the galaxy. The dark matter halos, which regulate the rotations of galaxies, should come to an eventual end, so the curves should not remain flat indefinitely. Either dark halos are much larger, or a new model is required

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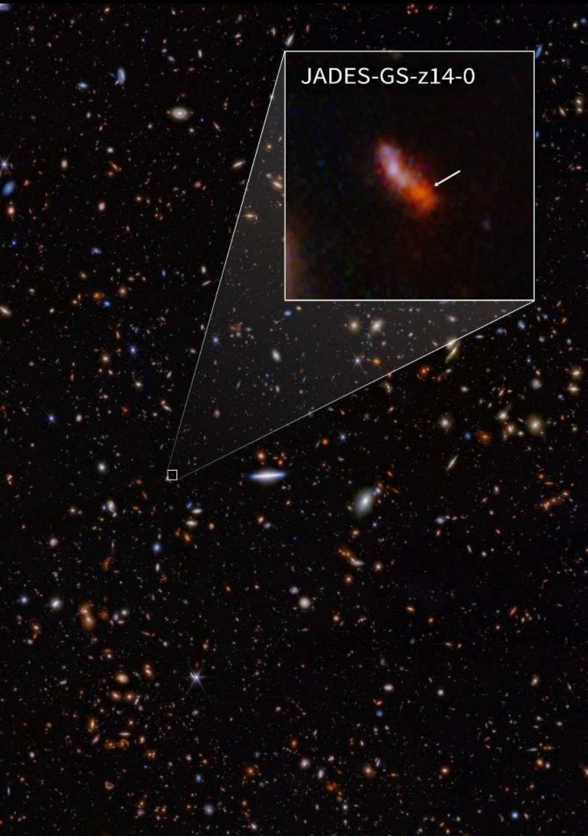
The most distant galaxy detected

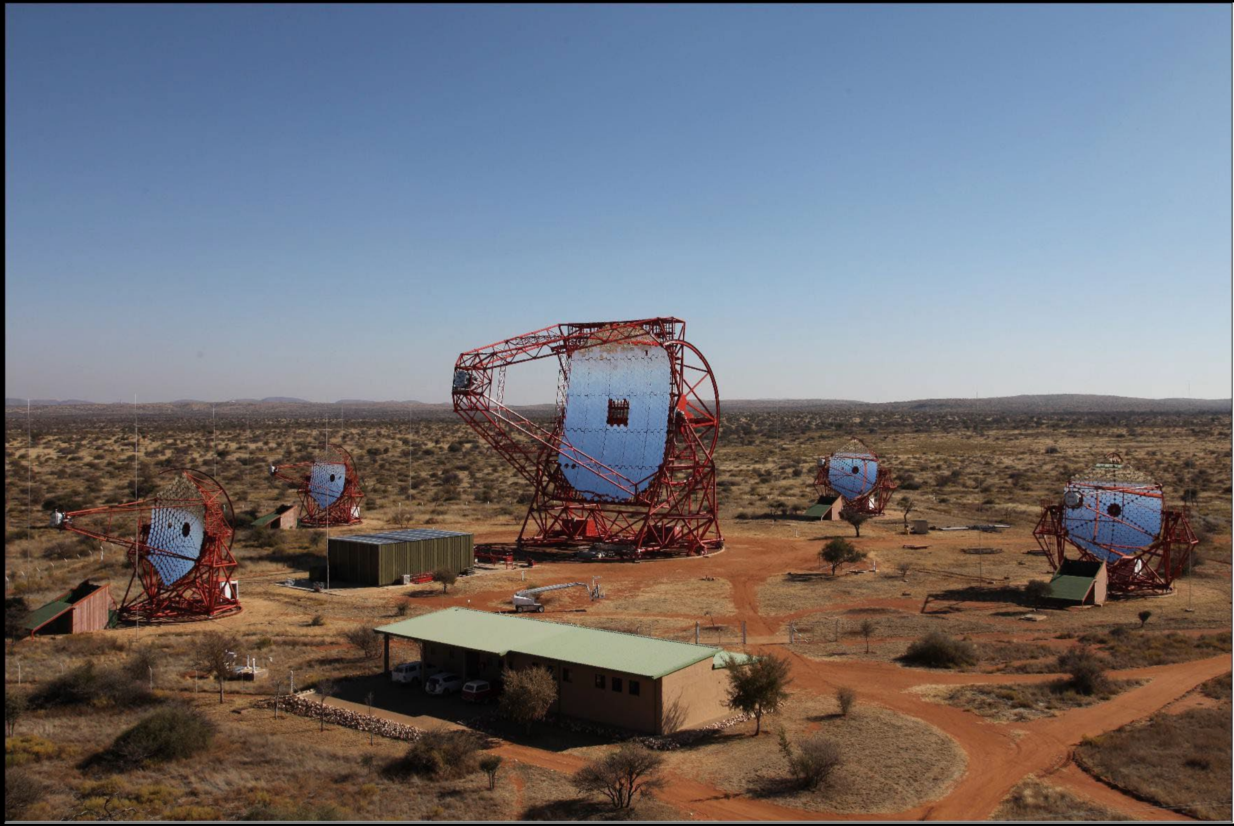
- JWST continues to push the limits of the most distant and oldest galaxies known. Although first observed over a year ago, researchers from JWST Advanced Deep Extragalactic Survey (JADES) team have only just released their findings revealing that JADES-GS-z14-0 and JADES-GS-z14-1 date back to between 290 and 300 million after the Big Bang
- JADES-GS-z14-0, the furthest of the two and new distance holder, is remarkable for how large and bright it is, (due to the sheer number of young stars) and the rapid formation of such a vigorous galaxy has taken astronomers by surprise



This infrared image from NASA's James Webb Space Telescope was taken by the NIRCam (Near-Infrared Camera) for the JWST Advanced Deep Extragalactic Survey, or JADES, program. The NIRCam data was used to determine which galaxies to study further with spectroscopic observations. One such galaxy, JADES-GS-z14-0 (shown in the pullout), was determined to be at a redshift of 14.32 (+0.08/-0.20), making it the current record-holder for the most distant known galaxy. This corresponds to a time less than 300 million years after the Big Bang
Credit: NASA, ESA, CSA, STScI, Brant Robertson (UC Santa Cruz), Ben Johnson (CfA), Sandro Tacchella (Cambridge), Phill Cargile (CfA)

Detecting Hawking Radiation (1)

- In 1974, Stephen Hawking famously predicted that black holes not only absorb matter but also, over time, emit matter in the form of high energy radiation ("Hawking Radiation"). Over a long enough period, this would cause the black hole to slowly evaporate
- To date, no Hawking radiation has been detected. However, researchers now suggest that if there is Hawking radiation, we may be able to detect it with ground-based high energy atmospheric Cherenkov telescopes



The HESS. II five-telescope gamma-ray detector in Namibia
Credit: The H.E.S.S. Collaboration/Clementina Medina

Detecting Hawking Radiation (2)

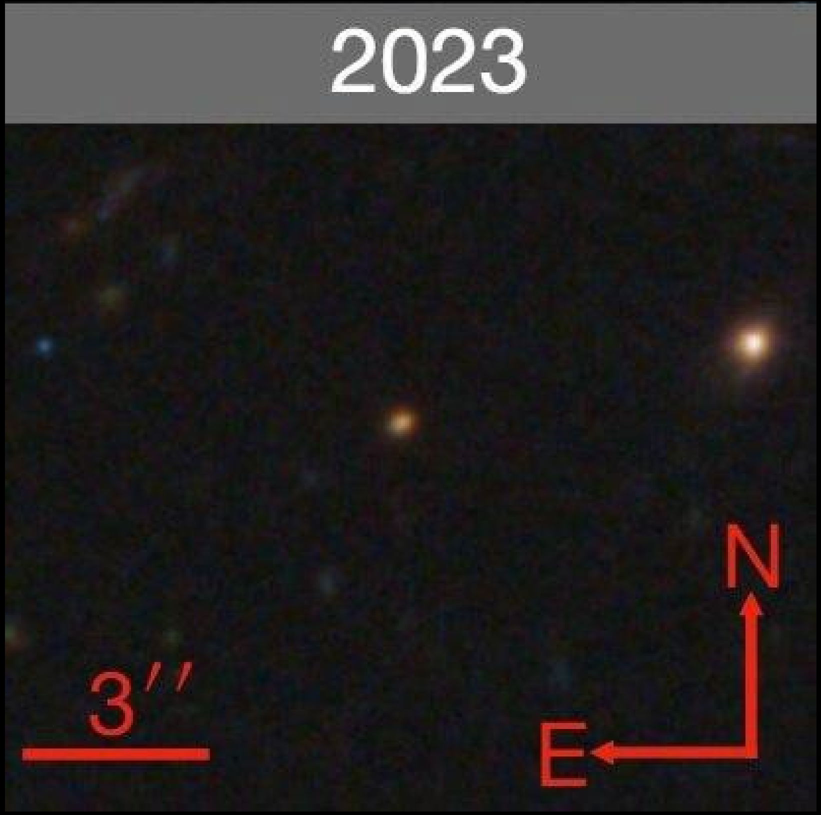
- One of the spin-offs of Einstein’s Theory of General Relativity is the existence of black holes and of the gravitational waves generated when they merge
- The complex solutions to Einstein’s Theory also suggest that, when black holes merge, they also produce small splinters or morsels: tiny black holes about the size of an asteroid. Such a small black hole should evaporate in a relatively short period of time; with a mass of 20 kilotons the evaporation lifetime is about 16 years. In evaporating they will give off gamma ray bursts of extremely energetic photons
- These gamma ray bursts will have a distinctive fingerprint; the photons will have an energy in the order of above TeV range (a trillion electron volts, about 0.2 microjoules). For comparison, the CERN Large Hadron Collider collides protons head-on with a total energy of 13.6 TeV

Detecting Hawking Radiation (3)

- When gamma rays enter the Earth’s atmosphere, they travel faster than the speed of light in air (light is slowed down by air so is not travelling as fast as in a vacuum). This produces Cherenkov radiation with an effect of a blue leading edge
- Four existing telescopes should be able to detect these cascades of Cherenkov radiation: the High Energy Stereoscopic System (HESS) in Namibia, the Major Atmospheric Gamma Imaging Cherenkov Telescopes (MAGIC) and the First G-APD Cherenkov Telescope (FACT), both on La Palma in the Canary Islands, and the Very Energetic Radiation Imaging Telescope Array System (VERITAS) in Arizona. Now researchers will start working with the groups at these telescopes to analyse data to search for Hawking radiation

Most distant Type 1a Supernova detected

- Supernovae (SN) are one of the most spectacular, if fleeting, sights in the Universe. Their enormous output of energy means that they can very briefly outshine the whole of their host galaxy
- Type 1a supernovae have a predictable intrinsic brightness. When a white dwarf in a binary star system draws off too much material from its companion and reaches a critical mass, it becomes hot enough to fuse carbon. The runaway process releases 1 x 10^{44} joules of energy. As brightness and distance are related, astronomers can work out how far away the supernova occurred. SN 2023adsy is 15 billion light years away and happened 8.7 billion years ago



Full colour image of SN 2023adsy. It has a redshift of z=2.903 ±0.007 and was a transient object in JADES-GS+53.13485−27.82088
Credit: Justin R. Pierel (STScI) et al., 2024

New EUCLID images released (1)

- The second set of five images from the recently launched Euclid Space Telescope have just been released

1. Abell 2390 (left) is a massive cluster of over 50,000 galaxies, approximately 2.7 billion light years from Earth in the constellation of Pegasus. It contains over 10 trillion times as much mass as the Sun, much of it, dark matter

2. Messier 78 (right) is a stellar nursery 1,300 light years from Earth in the Orion constellation with newly formed stars emerging from the orange and purple dust shrouds at the bottom of the image. The bright nebula, NGC 2071 is at the top of the image

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New EUCLID images released (2)

3. NGC 6744 is 30 million light years from Earth in the constellation, Pavo. The image shows the feather-like lanes of dust in unprecedented detail

4. An image of the Dorado Cluster of galaxies, 62 million light years from Earth in the constellation of Dorado, revealed a never-seen-before dwarf galaxy

5. The image of galaxy cluster Abell 2764 in the constellation, Phoenix, top right about 1 billion light years away, also captured a rogue yellow star (V*BP-Phoenicis/HD 1973) in the Milky Way

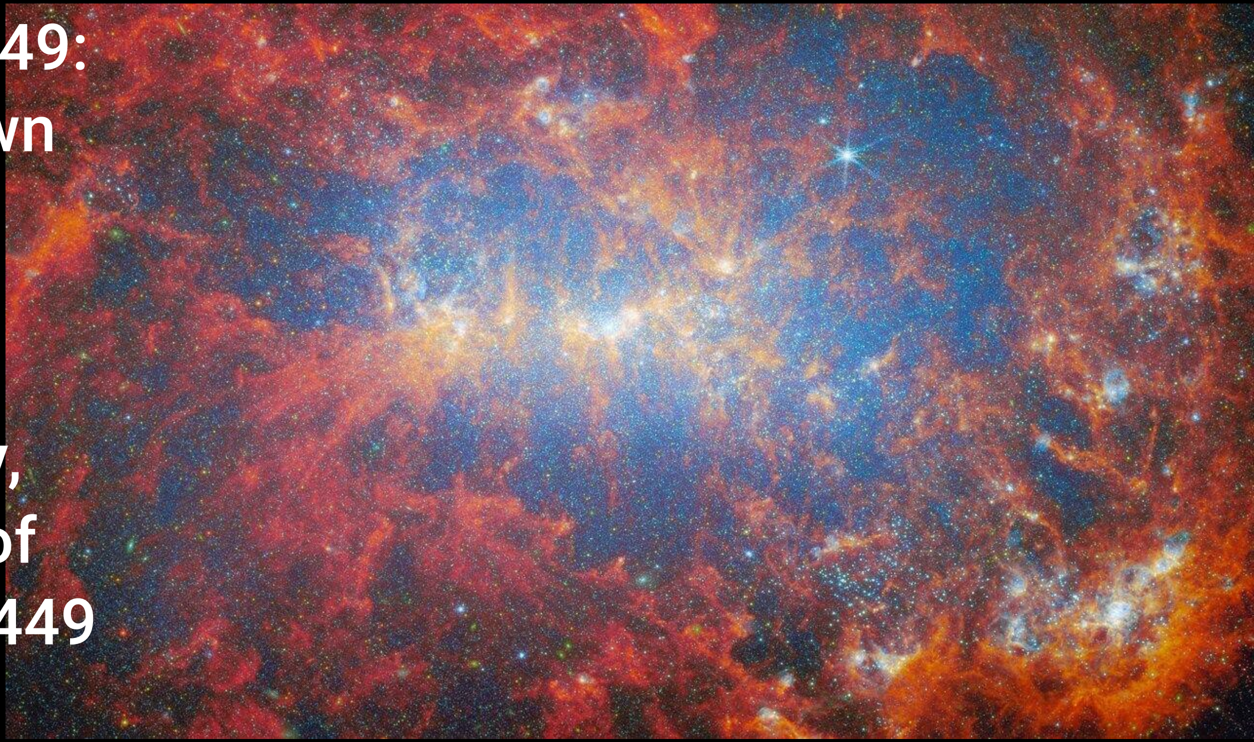
Credit (all five images): ESA/Euclid/Euclid Consortium/NASA, image processing by J.-C. Cuillandre (CEA Paris-Saclay), G. Anselmi

Hubble still able to take dramatic images

- In spite of its slowly deteriorating hardware (see article in 'Astronomy News in Brief'), Hubble is still able to take superb images of distant galaxies
- In early June, NASA released the latest, taken during May, of NGC 3059, a barred galaxy 57 million light years away, in the constellation, Carina
- Using its Wide Field Camera 3 and a narrow-band filter (F657N), which allows light very close to the 656.46 nanometer H-alpha line's wavelength through, the image shows pinkish areas which are star forming regions. The five wideband filters revealed blueish patches where older stars reside

Credit: ESA/Hubble & NASA, D. Thilker

'Starburst' galaxy



Credit: ESA/Webb, NASA & CSA, A. Adamo (Stockholm University) and the FEAST JWST team

- JWST has captured this image of NGC 4449: a "starburst" galaxy. NGC 4449, also known as Caldwell 21, is an irregular Magellanic type galaxy in the constellation, Canes Venatici. It is located in the M94 Group of galaxies about 13 million light years away, and close to the Local Group of galaxies of which the Milky Way is a member. NGC 4449 is similar to our own satellite galaxy: the Large Magellanic Cloud (LGC)
- The starburst is much wider than normal indicating the galaxy has interacted with a neighbour in the recent past. Two dwarf galaxies are in the process of being absorbed

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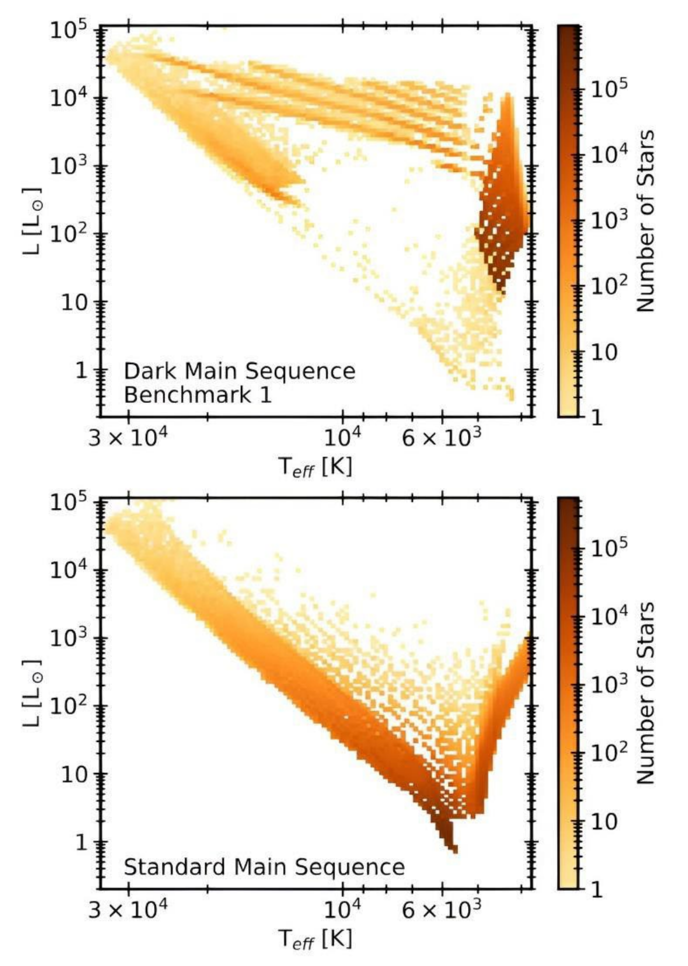
Immortal stars at the centre of the Milky Way (1)

- The centre of the Milky Way is a weird place. Dominated by Sagittarius A*, a 4 million solar mass Supermassive Black Hole (SMBH), the region around it is hostile to star formation
- So, stars within 3 light years of the centre must have come from further afield. These stars whizz around the SBMH at breakneck speeds, several thousand kilometres per second, unlike the stately Sun, at a mere 240 km/s
- These close inner stars, known as “S-cluster”, are also totally different from other stars in the Milky Way; they appear to be very young (far younger than if they had migrated from somewhere else), and they are extremely heavy



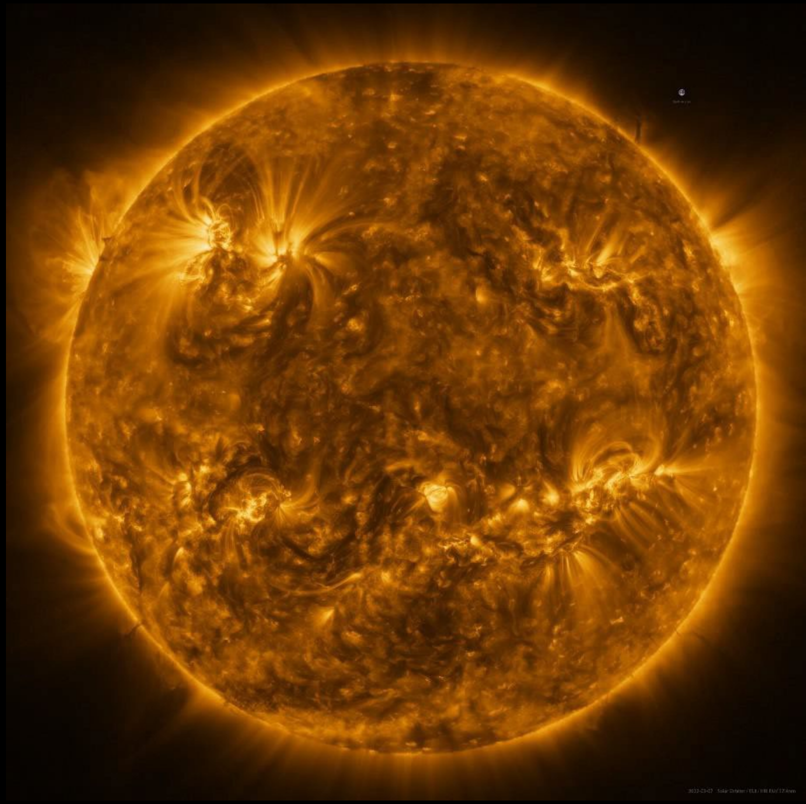
The new population of dark main sequence of stars (top) on the Hertzsprung-Russell diagram compared to the standard main sequence (bottom)
Credit: arXiv (2024). DOI: 10.48550/arxiv.2405.12267

Immortal stars at the centre of the Milky Way (2)

- Researchers at Stockholm and Stanford universities have come up with a possible reason – they don't rely on the normal hydrogen nuclear fusion process but on dark matter annihilation
- Not only is there a lot of ordinary matter concentrated at the centre of the galaxy but there is also a huge amount of dark matter, and this dark matter should be expected to be incorporated into these S-cluster stars. If so, then dark matter particles and antiparticles would collide and produce normal electrons and photons. The process would create an outward pressure, balancing the inward pull of gravity. It is even possible that the normal hydrogen fusion would grind to a complete halt. The S-cluster stars may live forever (if not swallowed by Sagittarius A*!)
- Such stars would appear as a new stellar population on the standard Hertzsprung–Russell (HR) diagram above the main sequence. Until the next generation of telescopes can peer into this region, this remains a theory

Planetary influences on the Sun's cycle (1)

- With the dramatic aurora events of the last few months highlighting that we are now at the peak of one of the Sun's regular cycles, attention has turned again as to what causes the cycle in the first place
- Actually, the approximately 11-year cycle we see, especially in the sunspot activity, isn't the only periodic cycle that has been detected, but it is the best known. In the early nineteenth century, the German amateur astronomer, Heinrich Schwabe, determined that the Sun rotated on its axis once every 27 days. He also established that activity on the Sun increases and decreases over an approximate 11-year cycle



The Sun is currently approaching a maximum activity in the 11-year "Schwabe cycle" again, here a Solar Orbiter image from October 2023
Credit: ESA & NASA/Solar Orbiter/EUI team; Data processing: E. Kraaikamp (ROB)

Planetary influences on the Sun’s cycle (2)

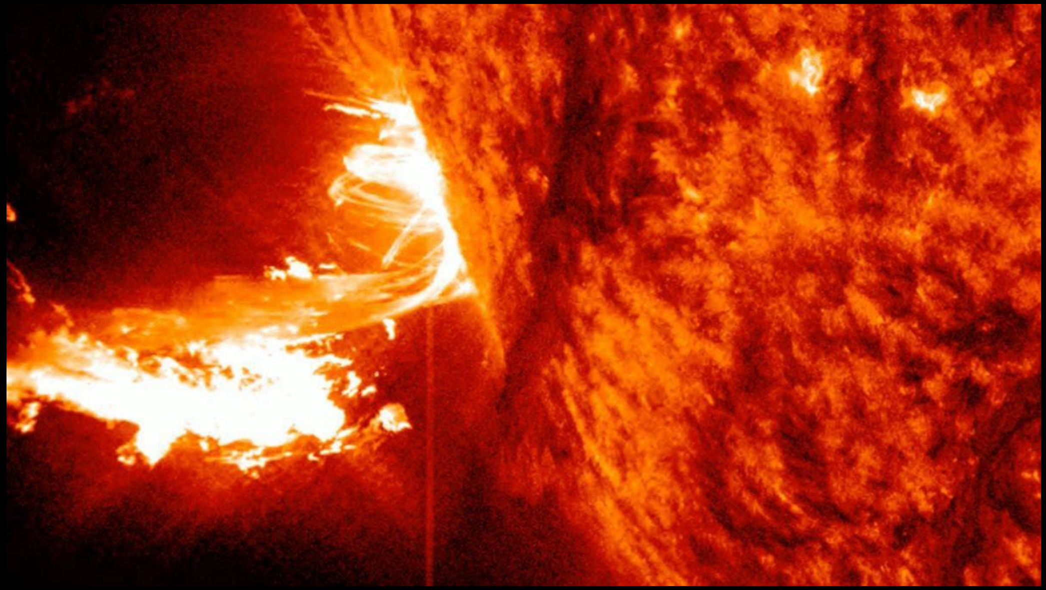
- The Sun’s activity cycle, also known as the “solar cycle”, is now known as the Schwabe cycle
- But why 11 years? Researchers at Helmholtz-Zentrum Dresden-Rossendorf (HZDR) and the University of Latvia, led by Dr Frank Stefani, have now proposed that the influence of the three largest bodies to the Sun: Venus, the Earth, and Jupiter, influence the vortex-shaped currents on the Sun, known as Rossby waves. The gravity of the planets affects the Sun in much the same way that the Moon affects the Earth, causing tides. On the Sun, this causes Rossby waves to accelerate and push the solar dynamo, which generates the cycle and changes in the magnetic field
- Every 11.07 years, the three planets are aligned in a way that has an effect similar to the spring tides seen on Earth. This alignment coincides with the Schwabe cycle. The underlying cycle may already be present, but the planetary alignment gives an extra kick to keep it very stable

Planetary influences on the Sun’s cycle (3)

- The researchers suggest that the planetary alignment also affects other cycles, such as the Rieger cycles (every 118, 193 and 299 days), and the Suess-de Vries cycle (which has a period of 193 years). Superimposing the three shorter Rieger cycles produces the prominent 11.07-year Schwabe cycle. The Suess-de Vries peak of 193 years relies on phase stability in the Schwabe cycle
- Incidentally, Erich Rieger, a German astrophysicist, discovered the 154-day period for hard solar flares in 1984. The Suess-de Vries cycle, built on variations in the production rates of the cosmic isotopes 14C and 10Be, has a periodicity of about 210 years, and is named after Hans Suess (Austrian/American) and Hessel de Vries (Dutch)

More massive solar flares expected (1)

- Solar flares happen when powerful magnetic fields in and around the Sun reconnect. They are usually associated with active regions such as sunspots
- Flares are graded by their strength, from B (the smallest), through C and M to X (the largest); Each group is ten times more powerful than the lower one; an M is 10 times more powerful than a C and 100 times more powerful than a B. Within each group there is a finer scale, from 1 to 9, although X can go much higher

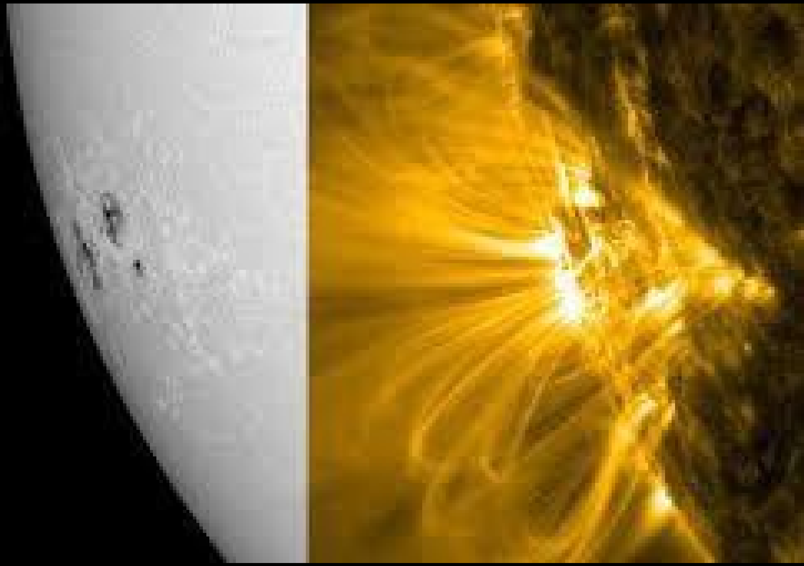


Solar Flare X2.9 (May 27th 2024)
Credit: NASA / SDO and the AIA, EVE, and HMI science teams / helioviewer.org)

- During the 2003 solar max period, one flare was measured at X17 before overloading the sensors (later calculations estimated it to be a massive X45)

More massive solar flares expected (2)

- It appears that sunspot group AR13664 was responsible for the massive solar flares and the associated auroras seen during May. In fact, the early eruptions produced a G5 geomagnetic storm on Earth
- Many of the flares were X-rated (12 in total), with the last and the largest measured at X8.79 (the largest since 2017)
- When a sunspot group disappears behind the Sun it is renamed on re-emergence

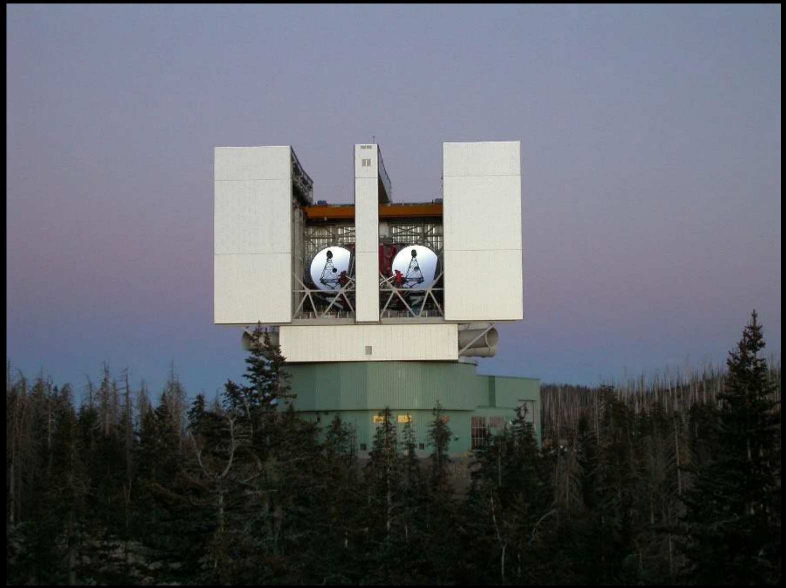


AR 13664 / 13697 rotating back into view, observed by NASA's Solar Dynamics Observatory on May 29th
Credit: NASA Solar Dynamics Observatory

- The Solar Orbiter was able to track AR13664 as it transited the far side of the Sun. Whilst it was hidden from view behind the Sun, the Solar Orbiter noted a number of much smaller flares. On re-emergence it has been renamed AR13697

A new view of Io’s volcanoes (1)

- Over the past 20 years, spacecraft visiting the Solar System’s planets and moons have become so sophisticated that close-up images of far-off worlds are now relatively commonplace. Taken from within a thousand or less kilometres of the surface, these images reveal details which once could only be imagined
- Many hundreds of images of some of the Galilean Moons of Jupiter have been taken by NASA’s Juno probe over the past few years. In early April 2024, Juno, on its 60th flyby of Jupiter, came within 1,500 km above the surface of Io
- You thought the use of Earth-bound telescopes is a thing of the past? Think again!



The Large Binocular Telescope
Credit: NASA

A new view of Io’s volcanoes (2)

- The University of Arizona-managed Large Binocular Telescope on Mount Graham in southeast Arizona, is the only one of its kind, with two 8.4m mirrors mounted side by side (a combined collecting area equal to a single 11.8m mirror). A powerful adaptive optics system compensates for blurring caused by atmospheric turbulence, making it one of the most powerful Earth-based observatories in the world
- Recently, it has been equipped with a new Italian-designed, high-contrast optical imaging instrument, dubbed SHARK-VIS. This has allowed the telescope to image surface features on Io less than 50 miles across
- SHARK-VIS has led researchers to identify a major resurfacing event around Pele, one of Io's most prominent volcanoes, located just south of the equator, where a nearby volcano, Pillan Patera, is depositing dark lava and white sulphur dioxide residues over Pele’s red-coloured plume deposits

A new view of Io’s volcanoes (3)

- Repeat observations over time can help establish the location of eruptions, something a snapshot taken on a high-speed flyby can’t be used for
- Essentially, work by SHARK-VIS and the LBT will compliment data collected by spacecraft such as Juno, especially where the probes are using infrared rather than visible wavelengths

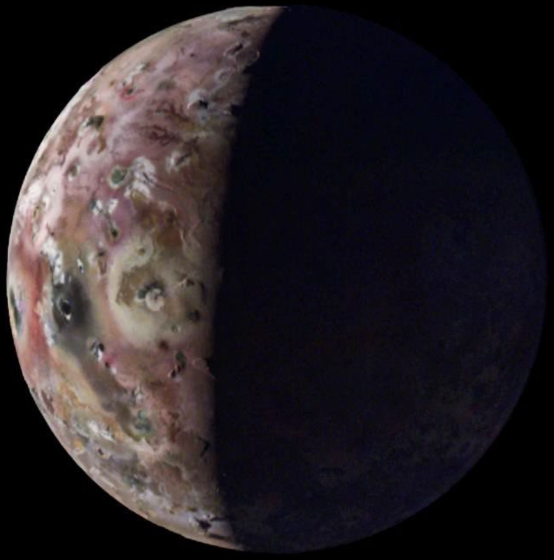


Image (left) taken by Juno on 9th April 2024 showing volcanoes on Io and the south polar region. Taken at approximately 16,500km above the surface of the moon
Credit: NASA/JPL-Caltech/SwRI/MSSS Image processing by Gerald Eichstädt/Thomas Thomopoulos © CC BY

Io (right), imaged by SHARK-VIS on 10th January 2024. This is the highest resolution image of Io ever obtained by an Earth-based telescope. The image combines three spectral bands — infrared, red and yellow — to highlight the reddish ring around the volcano Pele (below and to the right of the moon's centre) and the white ring around Pillan Patera, to the right of Pele
Credit: INAF/Large Binocular Telescope Observatory/Georgia State University; IRV-band observations by SHARK-VIS/F. Pedichini

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Astronomy News in Brief (1)

- Wandering Black Hole jets – Supermassive Black Holes that are engaged on a feeding frenzy are messy eaters. Much of the material that should be destined to disappear with a black hole ends up being blasted out in jets of relativistic supercharged and superheated cleared particles, effectively clearing anything out of its path. There is usually no gas or dust left surrounding these jets. Changes in the magnetic fields surrounding black holes means that these jets can wobble, clearing a wider region around themselves. These holes can point to where the jets are directed, if not aimed towards Earth. That is the theory, but researchers, using the VLBA (the Very Long Baseline Array) and the Chandra X-ray Space Observatory, to study 16 such black holes, found that in at least 6 candidates the jets did not align with the missing gas. In a number of cases the gas holes and jets were out of alignment by as much as 90 degrees. Even more remarkable is that this seems to have happened on a relatively short timescale of between 1 and 10 million years. Such disruptive jets could be actually putting a much lower limit on the ability of the host galaxy to form new stars

Astronomy News in Brief (2)

- “Plunging region” around black holes – Einstein’s theory of gravity predicted not only the existence of black holes, but also that material spinning around the black hole does not continue to spin right up to the moment it disappears where it stops and falls straight in. This area, which separates the accretion disk from the black hole, is known as the “plunging region”. Now, researchers led by a team at Oxford University, and using X-ray data from NASA's space-based Nuclear Spectroscopic Telescope Array (NuSTAR) and Neutron star Interior Composition Explorer (NICER) telescopes, have provided the first observational proof that Einstein is correct. The study looked at small black holes close to Earth. Hopefully, this will give extra impetus in the development and building of the projected Africa Millimetre Telescope, which could be used to make direct images of black holes
- Disappearing massive stars – the end stage of most large stars is well known; they will either produce a planetary nebula with a white dwarf at the centre, or in a supernova explosion with a neutron star or black hole as the remains. But others seem to just disappear. Researchers studying the binary system, VFTS 243, a main sequence star 25 times the mass of the Sun and with a 10-solar mass black hole companion in the Large Magellanic Cloud, believe it suddenly imploded into a black hole. Models suggest that some stars may be so large that the force of gravity prevents the supernova explosion occurring

Astronomy News in Brief (3)

- Milky Way cannibalism – the Milky Way has grown over time by consuming smaller galaxies and merging with larger ones. Most of this activity happened within a few billion years of the Milky Way's formation. After a merger, stars processions around the centre are disturbed and it takes time for the resonances to settle down, so as the galaxy ages, it gets less wrinkles. Now, astronomers, using data from Gaia, have shown that a much later act of cannibalism happened about 2.7 billion years ago in an event now called the Virgo Radial Merger, when a dwarf galaxy was swallowed
- Nearby star system has asteroid collisions – Beta Pictoris is a young star system located about 63 light years away. First studied in detail by Spitzer in 2004-2005, JWST has now followed up. It appears that giant asteroid collisions were occurring about twenty years ago, smashing many to small grains of dust but imparting a lot of energy. The dust that was initially heated up by the young stars radiation, has now cooled as it disperse further out. Still only about 20 million years old, the major giant planets will have formed, but terrestrial-type planets are still in the process of being built

Astronomy News in Brief (4)

- **Carbon dioxide ice in outer Solar System** – a recent investigation of the chemical composition of Trans Neptunian Objects (TNOs) by JWST has found that the vast majority have carbon dioxide ice present. Of the 59 TNOs and Centaurs looked at, 56 showed varying degrees of carbon dioxide ice and 28 had carbon monoxide ice. This suggests that carbon dioxide was (and still is) abundant in the cold outer regions of the protoplanetary disk
- **Slow solar wind** – scientists, using the Solar Orbiter, have confirmed that “slow” solar winds, travelling at less than 500km/s, are caused when regions with closed corona (where the magnetic fields are connected at both ends) break and briefly allow solar material to escape, before reconnecting and forming a closed loop again. Fast solar winds come from open corona, where only one end is anchored to the Sun and the other end stretches out into space
- **Volcanoes on Venus** – analysis of radar data of Venus, first conducted over 30 years ago, suggests that at least two major lava flows are in progress and that active volcanoes are still erupting. The study, using data, acquired by the Magellan spacecraft between 1990 and 1992, indicates that there may be as many as 42 volcanic eruptions a year, with about half lasting at least 1,000 (Earth) days

Astronomy News in Brief (5)

- Martian Ice – new investigations suggest that the bright white radar reflections from Mars's ice caps are not due to underground lakes of liquid water but variations in the thin layers of water ice causing interference in the radio waves. Water frost has also been found for the first time on the tallest mountains in the Solar System. The finding of frost on the Tharsis volcanoes was unexpected as they lie close to the equator. With the thin atmosphere, they should be as warm as other areas in the low latitudes
- Solar flares could be a major hazard on Mars – the recent heightened activity with the Sun doesn't just give us pretty aurora to look out for; a planet such as Mars would also be hit by huge clouds of solar plasma. These could be potentially very hazardous for any astronaut or even colonist on the surface as the Martian atmosphere and very weak magnetic force would offer little protection. At such times, the best place would be to retreat to an underground cavern

Astronomy News in Brief (6)

- Jupiter's Giant Red Spot – might not be as old as previously imagined. Giovanni Cassini first spotted a dark oval shape at the same latitude as the Giant Red Spot (GRS) in 1665. It was observed by astronomers until 1713 but then seemed to disappear until rediscovered in 1831 Samuel Schwabe (who incidentally also revealed the sun-spot cycle of about 10 years). Analysis by research staff at the University of the Basque Country (UPV/EHU), the Universitat Politècnica de Catalunya—BarcelonaTech (UPC) and the Barcelona Supercomputing Center (CNS-BSC), suggest that the oval seen by Cassini and others is not the same as the current Giant Red Spot (GRS). Today, the GRS is a lot smaller than in earlier times (14,000km against 39,000km in 1879) and there is much speculation that the gigantic superstorm may soon blow itself out

Astronomy News in Brief (7)

- Cold interstellar cloud caused Earth to freeze – in a new paper, by Merav Opher of Boston University, is the suggestion that about 2 million years ago, the Sun and the accompanying Solar System moved through a dense cloud of cold interstellar gas. This cloud was so dense and squeezed the heliosphere so much that most planets, including the Earth, were temporarily outside it and did not experience the solar winds. As well as cooling the Earth, it also allowed radioactive elements in the interstellar medium to bombard the planet. This is supported by geological evidence showing increased levels of ^{60}Fe (iron 60), and ^{244}Pu (plutonium 244) isotopes in the oceans, in Antarctic ice cores, and on the Moon
- Ozone layer at danger from satellite megaconstellations – holes in the protective ozone layer (where ozone has been depleted by reaction with chemicals such as CFCs) is not a thing of the past. Now, the fear comes from satellites – not whilst they are in orbit, but when they burn up in the atmosphere at the end of their lives. In the process, tiny particles of aluminium oxide are left suspended in the atmosphere; between 2016 and 2022 there was an eight-fold increase in the amount. The aluminium oxide enhances destructive chemical reactions between chlorine and ozone and, because the aluminium oxide particles aren't destroyed in the reaction, they can continue to affect the stratosphere as they drift downwards, a process that may last decades

Lewes Astronomical Society

July 2024

Spaceflight News

Fourth launch of SpaceX Starship success (1)

- Each test launch of the massive SpaceX Starship is an exciting event and, with each launch, SpaceX makes huge strides forward
- From Raptor engines cutting out, stages failing to separate and unexpected explosions of the first launch fourteen months earlier, SpaceX has problem-solved and got further (and higher) with each subsequent launch. The fourth test launch finally achieved almost all of its goals

Credit: SpaceX

- In preparation for the launch, SpaceX had to carry out various wet and hot test fire dress rehearsals; loading the rocket with fuel and simulating a countdown without firing the vehicle’s engines, as well as test firing all 33 Raptor engines on the Super Heavy Booster. All went to plan

Fourth launch of SpaceX Starship success (2)

- For this launch, the Starship consisted of Booster 11 and Ship 29. Work on testing Ships 30 and 31 is also on-going
- The launch on 6th June at 12:50 GMT went almost perfectly with only one of the engines failing to ignite
- After separation (hot-staging) at 2 mins 52 secs, the 72m high Super Heavy Booster made a controlled return to Earth and landed in the Gulf of Mexico as planned, 7 mins 30 secs after launch, using 12 of the 13 engines used for the landing burn. It looked more or less intact. The 50m Starship did manage to make it to its planned targeted landing (within 6km) in the Indian Ocean but did look a little worse for wear, with many heat shield tiles being lost and one off the flaps nearly being burnt off by friction. Touchdown on the ocean surface was 65 mins 56 secs after launch

Fourth launch of SpaceX Starship success (3)

- With the next launch there may be an attempt to land the Booster back at the launch site, rather than losing it in the ocean
- SpaceX long term plans suggest they want to build a Starship megarocket every day at its new Starfactory; under construction at the company’s Starbase in south Texas
- Relive the launch and landing at: https://youtu.be/r8IfY_gK8ro
- Watch the landing of the Super Heavy Booster and the launch (in slow motion) at: https://videos.space.com/m/t1hpE97J/watch-spacex-starship-booster-splashdown-and-launch-in-amazing-new-views?list=9wzCTV4g

Crewed Boeing Starliner finally launched (1)

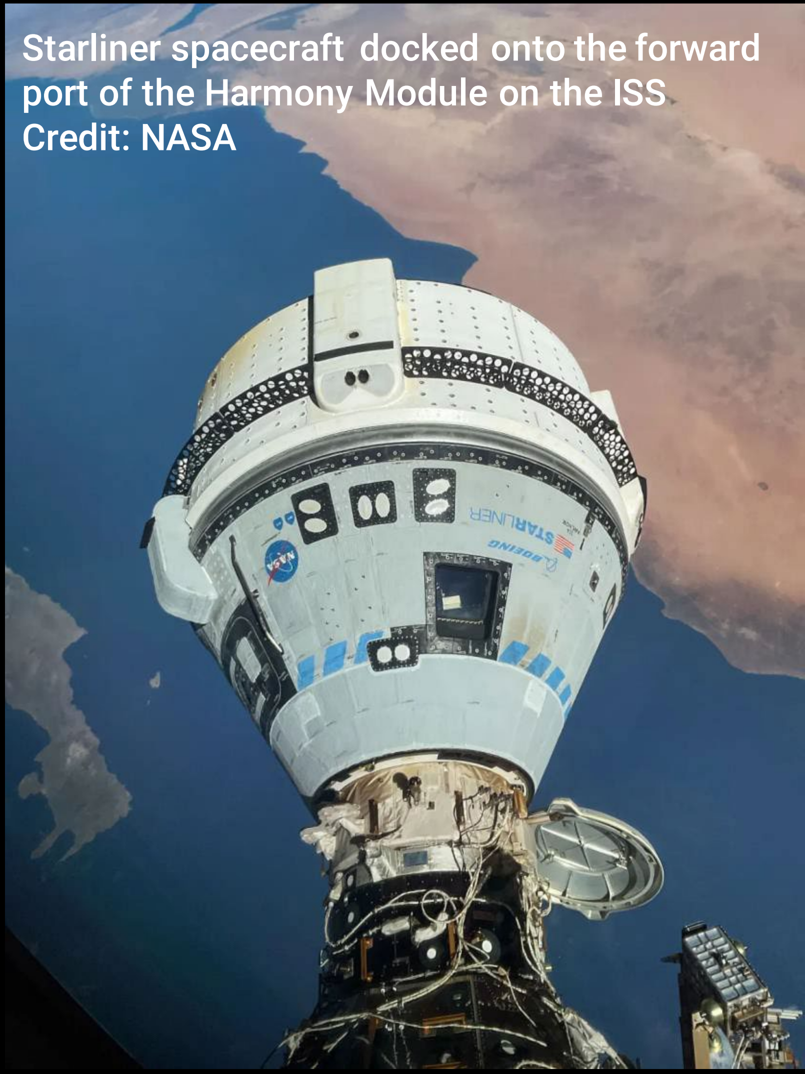
- After delays of several years, and a number of recent postponements, the Boeing Starliner was finally launched on 5th June using a ULA Atlas V rocket from Space Launch Complex-41 at Cape Canaveral Space Force Station. The Boeing's Starliner Crew Flight Test was the first to take humans into space, and to the ISS. It is piloted by NASA astronauts, Barry “Butch” Wilmore and Sunita “Suni” Williams

Credit: NASA

- Amongst the ongoing problems are helium leaks; one was discovered prior to launch but was not ruled to be serious, with four more found in the service module helium manifold since the craft arrived in space. However, the helium loss isn’t critical, and there will be plenty left for the return trip to Earth

Crewed Boeing Starliner finally launched (2)

- Other issues surround the reaction control system (RCS) thrusters, five of the 28 weren’t working properly, causing the first docking window to be missed. The crew manged to get four functioning again and only one is now out of commission. The thrusters help with fine manoeuvring and will be next used on undocking from the ISS. Sorting out these issues means the Starliner has been delayed in returning to Earth; the earliest it will depart from the ISS is now 2nd July, 3 weeks later than originally planned
- The Starliner capsule received a thorough test, being powered down and then up. It has also been assessed for use as a “safe haven” in case of an emergency



Starliner spacecraft docked onto the forward port of the Harmony Module on the ISS
Credit: NASA

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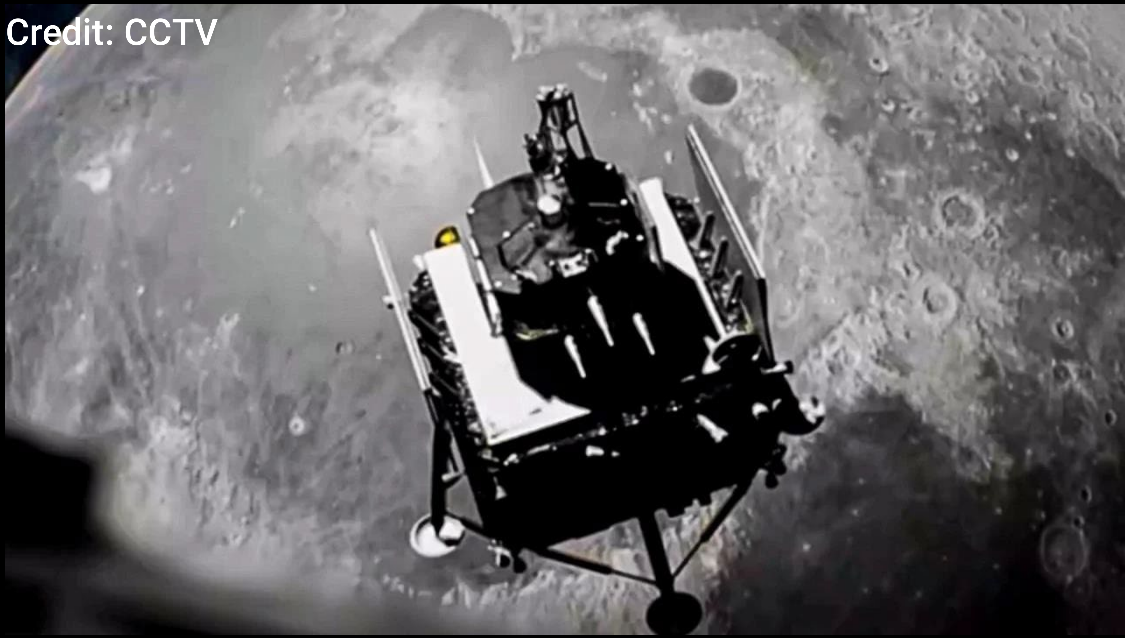
China’s Chang’e 6 probe on far side of Moon (1)

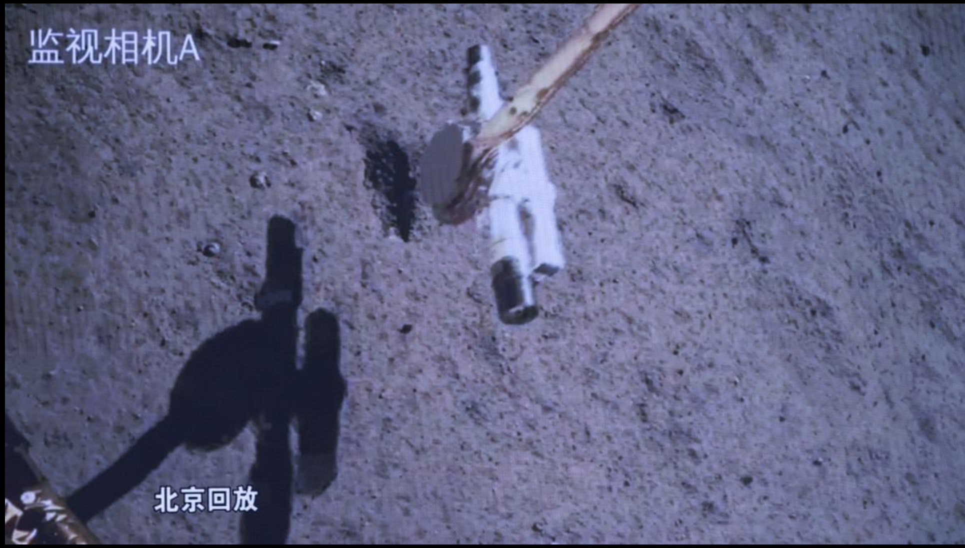
- Launched on 3rd May and placed into lunar orbit five days later, the Chang’e 6 spacecraft landed on the far side of the Moon on 2nd June (Chinese time). The probe landed in the South Pole-Aitken (SPA) Basin. It was spotted on the surface by NASA’s Lunar Reconnaissance Orbiter (LRO) on 7th June on the rim of a 50m crater



- The massive South Pole-Aitken Basin is an impact crater dating back over 4 billion years. It is about 2,500km in diameter and 13km deep. It is likely to be the oldest such crater on the Moon
- See a video taken of the landing on the Moon at: https://youtu.be/ilhzeWfvaeg and beamed back to Earth by the QueQiao-2 Relay Satellite

China’s Chang’e 6 probe on far side of Moon (2)

- The probe collected samples of rocks and minerals using core drilling and surface scooping. The sample will probably be a mixture of 2.5 million year old volcanic rock and meteorite impact material



- The probe’s ascent stage was successfully ignited on 3rd June before being reunited with the orbiter 2 days later
- The re-entry module successfully landed back on Earth on 25th June with the sample intact

Sample collecting and the re-entry module following successful recovery
Credit: CCTV

New reusable engine tested

- Stoke Space Technologies, a company based in Seattle, Washington, USA, is planning to make its debut with its fully reusable Nova rocket sometime next year. The start-up company, founded in 2020, intends to be able to launch, land, and relaunch the Nova rocket in under 24 hours
- As part of the preparations, Stoke Space have carried out a successful hot-fire test of its new full-flow, staged-combustion (FFSC) rocket engine, where the engine was throttled up to about 50% of full power
- Stoke Space is one of four companies granted use of the launch pads at Cape Canaveral Space Force Station

A drone camera captures the hotfire test of Stoke Space's full-flow staged combustion engine at the company's testing facility in early June
Credit: Stoke Space

Bill Anders, Apollo 8 astronaut, dies aged 90 (1)

- Bill Anders, one of the first astronauts to go to the Moon, has died aged 90. He was killed when the vintage T-34 Mentor plane he was piloting failed to come out of loop and hit the sea off the coast of Washington State
- William Alison “Bill” Anders was a US Air Force pilot when he was selected as part of the third NASA astronaut intake in 1963
- Missing out on a flight aboard one of the Gemini missions, Anders’ only trip into space was on the iconic Apollo 8 spacecraft in December 1968

Astronaut Bill Anders holds models of the Gemini spacecraft and its docking target vehicle in his 1964 NASA official portrait
Credit: NASA

Bill Anders, Apollo 8 astronaut, dies aged 90 (2)

- In the Space Race of the 1960s, America feared that the Soviet Union would get to the Moon first. Although the new Apollo rocket had only had one flight with astronauts onboard (Apollo 7) and had been severely delayed following the launchpad fire on Apollo 1 in January 1967 which killed Gus Grissom, Ed White, and Roger Chaffey, and though the lunar module wasn't ready, the decision was taken to send an Apollo spacecraft to the Moon, orbit it and return; the rest is history
- Anders was selected as the lunar module pilot, alongside Frank Borman (commander) and James Lovell (command module pilot), but, as there was no lunar module, he had a 'relatively' easy ride
- Launched on 21st December 1968, the Apollo 8 command module (and service module) went into lunar orbit on Christmas Eve. The three astronauts took it in turns to read the creation section in Genesis from the Bible, broadcasting it live to millions back on Earth

Bill Anders, Apollo 8 astronaut, dies aged 90 (3)

- With Borman and Lovell, Anders became the first human to see the far side of the Moon. However, his legacy will always be the famous “Earthrise” photo taken as the spacecraft came back from the far side of the Moon and the Earth became visible again
- Once back, Anders realised there was little chance of actually walking on the Moon and, after acting backup to the Apollo 11 crew, he left the astronaut corps in 1969. He had spells in a senior role in various national organisations, aerospace industry, and was briefly, U.S. Ambassador to Norway

Earthrise
Credit: NASA

Spaceflight News and Updates (1)

- Voyager 1 back doing science – the most distant spacecraft from Earth, at over 24 billion kms, is once more sending back scientific data from its four instruments now that the communications issue and computer problems have been resolved. Initially, only two of the instruments were providing data but, after some nifty work by the support team, all four are now back working
- Contact lost with Akatsuki – the Japanese spacecraft, Akatsuki, which has been in orbit around Venus since 2015, may have been lost. Launched in 2010, the mission appeared to be over when the main engine failed, preventing it from entering orbit and leaving it circling the Sun. However, in 2015, the engineers overcame the issues and successfully placed it above Venus. Designed to study the climate of Venus, it made some unexpected observations, such as the fast atmospheric flow near the equator and differential rotational speeds at varying altitudes
- Hubble trouble – Hubble has temporarily gone off-line again and into hibernation after one of its three remaining gyroscopes failed. Attempts to fix it have not been successful so engineers will try to run Hubble on one of its two last gyroscopes, keeping the other in reserve. It was launched with six gyroscopes but they failed one by one and had to be replaced by six new ones when the last service was carried out in 2009

Spaceflight News and Updates (2)

- XRISM jammed door – the joint JAXA and NASA XRISM X-ray Observatory is due to take over the mantle of the aged Chandra. However, although all the instruments, including the soft X-ray spectrometer known as Resolve, are functioning as normal, all is not as it should be. A door which covers Resolve has not opened in spite of all attempts to free it; this is preventing low energy x-rays reaching the detector. A decision has been taken to leave it alone and let the rest of the probe get on with its work, which is providing rafts of new data, before reviewing the issue in about 18-month's time
- ISS problems – a planned spacewalk by astronauts Tracy Dyson and Matt Dominick, was called off after they had started to suit up on 13th June. Reports suggested that spacesuit discomfort was the problem, though for which astronaut it was not revealed. Meanwhile, a recorded simulation of crew and staff back on Earth dealing with a medical emergency was accidentally broadcast on the ISS livestream channel, and caused news media to report on a dire situation evolving. After 8 minutes the simulation was cut-off and everyone listening was reassured that all was well!

Spaceflight News and Updates (3)

- **EarthCARE satellite launched** – the European-Japanese climate research satellite, EarthCARE, was launched using a SpaceX Falcon 9 rocket from the Vandenberg Space Centre in California on May 28th. EarthCARE (short for Earth Cloud Aerosol and Radiation Explorer) has four instruments on board: Atmospheric Lidar - ATLID (vertical profiles of aerosols and thin clouds); Cloud Profiling Radar – CPR (vertical profiles Doppler measurements of clouds and vertical velocities of cloud particles); Multi-Spectral Imager – MSI (across-track information on clouds and aerosols with channels in the visible, near infrared, shortwave and thermal infrared); and Broad-Band Radiometer – BBR (measures top-of-the-atmosphere radiances and fluxes) . It is a collaboration between ESA and JAXA
- **Virgin Galactic space plane retires** – following six earlier flights, the Virgin Galactic VSS Unity space plane made its last trip on 8th June. Carrying Tuva Atasever, a Turkish Space Agency astronaut, and three space tourists, Unity was dropped from its carrier plane at an altitude of 13,582m before igniting its engines and soaring to 87.5km. The space plane is being retired to make way for the new Delta spacecraft, due in 2026

Spaceflight News and Updates (4)

- Starlink satellites seen by airplane pilots – with the numbers of satellites being placed in orbit increasing on an almost daily basis, concerns have been expressed by both professional and amateur astronomers and astrophotographers for a number of years that these satellites are interfering with observations. Whilst corporations like SpaceX have made some efforts to address those concerns by attempting to camouflage the latest generation of satellites to prevent sunlight bouncing off them and down towards Earth, there are increasing instances of flashing occurring. It appears that astronomers are not alone and that commercial airline pilots have also seen these flashes. On one occasion, pilots on two separate flights over the Pacific Ocean spotted these and managed to take photos on their mobiles; these were reported as Unidentified Aerial Phenomenon (UAP). These flashes were reported as having a brightness of between -4 and -5 (roughly the same as Venus). Investigations revealed that these were caused by Starlink satellites (Group 4-26) launched earlier the same day

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July 2024

Observational Highlights

Lewes Astronomical Society

Outer planets start to reappear

- All five outer planets will be visible by the end of the month
- Saturn will be the first one to be seen, appearing earlier in the night and at a higher altitude than the others. By the end of the month, it will be rising before midnight, reaching 32° before dawn over the southern horizon. The rings are almost completely closed (only 2°) so are not really visible
- Jupiter is an early morning object but at the start of the month will lie quite low down. By the middle of the month, it will have reached a creditable 22° above the eastern horizon and 33° before dawn breaks at month-end
- Mars makes a really welcome return but, being still 6 months away from opposition, it is quite small; 5.8” at the end of July as opposed to the 14.5” it will be in mid-January 2025. It will be joined in Taurus by Uranus mid-month, about 24° above the eastern horizon
- Neptune is in Pisces, reaching 36° above the southern horizon at dawn

Credit: NASA

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Comet 13P/Olbers possible naked eye object

- The 69.3-year long period comet 13P/Olbers will make its closest approach to Earth on 20th July, at a distance of 1.9AU (284.2 million kms), having reached perihelion on 30th June (1.18AU = 176.5 million kms)
- On 2nd July, at its brightest, it is predicted to be magnitude +6.1, but could be even brighter

Credit: Dan Bartlett/Sky&Telescope

Credit: Vito Technology Inc/S tar Walk

- During the month, it will track eastwards through the boundary of Leo Minot and Ursa Major, steadily climbing from about 17° above the horizon
- The comet was discovered by Heinrich Olbers on 6th March 1815. He also found the asteroids, Pallas and Vesta

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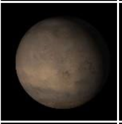
Planets (Information for 1st July)

	Planet	Rises	Sets	Highest	Direction	Altitude	Magnitude	Visible
	MERCURY	06:10	22:24	14:17			-0.59	NO
	VENUS	05:19	21:44	13:32			-3.91	NO
	MARS	01:50	16:38	09:14	East	16° ▫	+0.99	YES
	JUPITER	02:49	18:42	10:45	East	12° ▫▫	-2.03	YES
	SATURN	00:11	11:17	05:44	South-East	27° ▫	+1.05	YES
	URANUS	02:10	17:36	09:53			+5.82	NO
	NEPTUNE	00:25	12:19	06:22			+7.87	NO

* = Highest point at Dawn (02:38 - last visible sighting)

** = Highest point at Dusk (23:26 - first visible sighting)

▫ = Highest point when last visible (03:42)

◊ = Highest point when first visible

▫▫ = Highest point when last visible (04:21)

◊◊ = Highest point when first visible

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

Object	Name	Constellation	Type	↗	↘	Highest	Direction	Alt	Mag
Cr302	The Antares Cluster	Scorpius	Open Cluster	22:23	23:39	22:44 ◊◊	South	12°	+1.0
Cr39	Collinder 39	Perseus	Open Cluster	22:27	03:38	03:38 ◊	North-East	35°	+1.2
Mel20	The Alpha Persei Cluster	Perseus	Open Cluster	22:27	03:38	03:38 ◊	North-East	34°	+1.2
M45	The Pleiades	Taurus	Cluster with Nebulosity	01:50	03:35	03:35 ◊	East	13°	+1.3
Cr256	Collinder 256	Coma Berenices	Open Cluster	22:40	03:16	22:40 ◊◊	West	39°	+1.8
Mel111	The Coma Star Cluster	Coma Berenices	Open Cluster	22:40	03:17	22:40 ◊◊	West	39°	+1.8
C33	The Eastern Veil Nebula	Cygnus	Nebula	23:26	02:38	02:38 *	South-East	69°	+2.7
Cr359	Collinder 359	Ophiuchus	Open Cluster	23:11	02:54	00:23	South	42°	+3.0
Mel186	Melotte 186	Ophiuchus	Open Cluster	23:11	02:54	00:23	South	42°	+3.0
M31	Andromeda Galaxy	Andromeda	Galaxy	23:26	02:40	02:40 ◊	East	44°	+3.4
Cr439	The Elephant Trunk	Cepheus	Cluster with Nebulosity	23:26	02:38	02:38 *	North-East	76°	+3.5
Cr399	Brocchi's Cluster	Vulpecula	Open Cluster	23:26	02:38	01:47	South	59°	+3.6
Cr349	Open Cluster	Ophiuchus	Open Cluster	23:26	02:38	00:08	South	44°	+4.2
Cr464	Collinder 464	Camelopardalis	Open Cluster	23:26	02:38	02:38 *	North-East	37°	+4.2
C14	The Perseus Double Cluster	Perseus	Open Cluster	23:26	02:38	02:38 *	North-East	40°	+4.3

* = Highest point at Dawn (02:38 - last visible sighting)   ** = Highest point at Dusk (23:26 - first visible sighting)

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

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

Object	Name	Constellation	Type	↗	↘	Highest	Direction	Alt	Mag
M24	Delle Caustiche	Sagittarius	Asterism	23:33	01:45	00:39	South	20°	+4.6
NGC6633	Open Cluster	Ophiuchus	Open Cluster	23:26	02:38	00:49	South	45°	+4.6
M25	Open Cluster	Sagittarius	Open Cluster	00:04	01:44	00:54	South	20°	+4.6
Cr386	Graff's Cluster	Serpens Cauda	Open Cluster	23:26	02:38	01:01	South	44°	+4.6
M39	Open Cluster	Cygnus	Open Cluster	23:26	02:38	02:38 *	East	77°	+4.6
NGC6871	Open Cluster	Cygnus	Open Cluster	23:26	02:38	02:28	South	74°	+5.2
M34	The Spiral Cluster	Perseus	Open Cluster	01:33	02:38	02:38 *	North-East	29°	+5.2
NGC869	h Per Cluster	Perseus	Open Cluster	23:26	02:38	02:38 *	North-East	40°	+5.3
NGC7686	Open Cluster	Andromeda	Open Cluster	23:26	02:38	02:38 *	East	59°	+5.6
NGC6882	Open Cluster	Vulpecula	Open Cluster	23:26	02:38	02:34	South	65°	+5.7
NGC752	Open Cluster	Andromeda	Open Cluster	23:26	02:38	02:38 *	North-East	31°	+5.7
M5	Globular Cluster	Serpens Caput	Globular Cluster	23:26	02:38	23:26 **	South-West	36°	+5.7
M11	Wild Duck Cluster	Scutum	Open Cluster	23:26	02:38	01:13	South	32°	+5.8
M33	Triangulum Galaxy	Triangulum	Galaxy	22:42	02:38	02:38 *	East	29°	+5.8
M13	Great Globular Cluster	Hercules	Globular Cluster	23:26	02:38	23:26 **	South	74°	+5.8

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

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

Object	Name	Constellation	Type	↗	↘	Highest	Direction	Alt	Mag
Cr29	Collinder 29	Perseus	Open Cluster	23:26	02:38	02:38 *	North-East	37°	+5.9
NGC6605	Open Cluster	Serpens Cauda	Open Cluster	23:26	01:56	00:38	South	24°	+6.0
M16	The Eagle Nebula	Serpens Cauda	Open Cluster	23:26	02:17	00:41	South	25°	+6.0
M17	The Omega Cluster	Sagittarius	Open Cluster	23:50	01:36	00:43	South	23°	+6.0
NGC7000	The North American Nebula	Cygnus	HII Region	23:26	02:38	02:38 *	South-East	80°	+6.0
Cr350	Collinder 350	Ophiuchus	Open Cluster	23:26	02:38	00:10	South	40°	+6.1
NGC7160	Open Cluster	Cepheus	Open Cluster	23:26	02:38	02:38 *	North-East	72°	+6.1
NGC884	chi Per Cluster	Perseus	Open Cluster	23:26	02:38	02:38 *	North-East	39°	+6.1
M12	Globular Cluster	Ophiuchus	Globular Cluster	23:26	02:38	23:26 **	South	37°	+6.1
NGC1545	Open Cluster	Perseus	Open Cluster	23:26	02:38	02:38 *	North-East	22°	+6.2
M15	Globular Cluster	Pegasus	Globular Cluster	23:26	02:38	02:38 *	South-East	48°	+6.3
NGC6940	Open Cluster	Vulpecula	Open Cluster	23:26	02:38	02:38 *	South	67°	+6.3
M3	Globular Cluster	Canes Venatici	Globular Cluster	23:26	02:38	23:26 **	West	45°	+6.3
NGC457	The Dragonfly Cluster	Cassiopeia	Open Cluster	23:26	02:38	02:38 *	North-East	47°	+6.4
NGC7243	Open Cluster	Lacerta	Open Cluster	23:26	02:38	02:38 *	East	71°	+6.4

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

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

Object	Name	Constellation	Type	↗	↘	Highest	Direction	Alt	Mag
NGC1528	Open Cluster	Perseus	Open Cluster	23:26	02:38	02:38 *	North-East	24°	+6.4
NGC6604	Open Cluster	Serpens Cauda	Open Cluster	23:26	02:38	00:40	South	26°	+6.5
Cr26	The Heart Nebula	Cassiopeia	Cluster with Nebulosity	23:26	02:38	02:38 *	North-East	41°	+6.5
Cr34	The Soul Nebula	Cassiopeia	Cluster with Nebulosity	23:26	02:38	02:38 *	North-East	38°	+6.5
NGC129	Open Cluster	Cassiopeia	Open Cluster	23:26	02:38	02:38 *	North-East	54°	+6.5
NGC654	Open Cluster	Cassiopeia	Open Cluster	23:26	02:38	02:38 *	North-East	46°	+6.5
M92	Globular Cluster	Hercules	Globular Cluster	23:26	02:38	23:26 **	South	82°	+6.5
M2	Globular Cluster	Aquarius	Globular Cluster	23:26	02:38	02:38 *	South-East	35°	+6.6
M29	The Cooling Tower	Cygnus	Open Cluster	23:26	02:38	02:38 *	South	77°	+6.6
NGC1444	Open Cluster	Perseus	Open Cluster	23:26	02:38	02:38 *	North-East	27°	+6.6
M10	Globular Cluster	Ophiuchus	Globular Cluster	23:26	02:38	23:26 **	South	35°	+6.6
NGC6709	Open Cluster	Aquila	Open Cluster	23:26	02:38	01:13	South	49°	+6.7
NGC1027	Open Cluster	Cassiopeia	Open Cluster	23:26	02:38	02:38 *	North-East	40°	+6.7
NGC7789	The Caroline's Rose	Cassiopeia	Open Cluster	23:26	02:38	02:38 *	North-East	57°	+6.7
NGC7023	The Iris Nebula	Cepheus	Nebula	23:26	02:38	02:38 *	North-East	70°	+6.8

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

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

Object	Name	Constellation	Type	↗	↘	Highest	Direction	Alt	Mag
NGC6811	The Hole in a Cluster	Cygnus	Open Cluster	23:26	02:38	02:38 *	South-West	82°	+6.8
M18	Open Cluster	Sagittarius	Open Cluster	00:28	00:56	00:42	South	22°	+6.9
M52	The Cassiopeia Salt-and-Pepper	Cassiopeia	Open Cluster	23:26	02:38	02:38 *	North-East	62°	+6.9
NGC1502	Open Cluster	Camelopardalis	Open Cluster	23:26	02:38	02:38 *	North-East	33°	+6.9
M81	Bode's Galaxy	Ursa Major	Galaxy	23:26	02:38	23:26 **	North-West	41°	+6.9
NGC225	The Sailboat Cluster	Cassiopeia	Open Cluster	23:26	02:38	02:38 *	North-East	53°	+7.0
NGC7635	The Bubble Nebula	Cassiopeia	HII Region	23:26	02:38	02:38 *	North-East	62°	+7.0
NGC6960	The Western Veil Nebula	Cygnus	Supernova Remnant	23:26	02:38	02:38 *	South	69°	+7.0
NGC7063	Open Cluster	Cygnus	Open Cluster	23:26	02:38	02:38 *	South-East	71°	+7.0
NGC6823	Open Cluster	Vulpecula	Open Cluster	23:26	02:38	02:05	South	61°	+7.1
NGC663	Open Cluster	Cassiopeia	Open Cluster	23:26	02:38	02:38 *	North-East	46°	+7.1
NGC7380	The Wizard Nebula	Cepheus	Open Cluster	23:26	02:38	02:38 *	North-East	67°	+7.2
NGC7082	Open Cluster	Cygnus	Open Cluster	23:26	02:38	02:38 *	East	77°	+7.2
Cr418	Open Cluster	Cygnus	Open Cluster	23:26	02:38	02:38 *	South	76°	+7.3
NGC6819	Open Cluster	Cygnus	Open Cluster	23:26	02:38	02:38 *	South-West	77°	+7.3

* = Highest point at Dawn (02:38 - last visible sighting)   ** = Highest point at Dusk (23:26 - first visible sighting)

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

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

Object	Name	Constellation	Type	↗	↘	Highest	Direction	Alt	Mag
Cr21	Collinder 21	Triangulum	Open Cluster	23:30	02:38	02:38 *	East	24°	+7.3
M27	Apple Core Nebula	Vulpecula	Planetary Nebula	23:26	02:38	02:21	South	61°	+7.4
M103	Open Cluster	Cassiopeia	Open Cluster	23:26	02:38	02:38 *	North-East	47°	+7.4
NGC6888	The Crescent Nebula	Cygnus	HII Region	23:26	02:38	02:38 *	South	77°	+7.5
M14	Globular Cluster	Ophiuchus	Globular Cluster	23:26	02:38	23:56	South	35°	+7.6
C9	The Cave Nebula	Cepheus	HII Region	23:26	02:38	02:38 *	North-East	44°	+7.7
M53	Globular Cluster	Coma Berenices	Globular Cluster	23:26	02:38	02:38 *	West	33°	+7.7
M107	Globular Cluster	Ophiuchus	Globular Cluster	23:26	02:38	23:26 **	South	25°	+7.8
NGC2726	Galaxy	Ursa Major	Galaxy	23:26	02:38	23:26 **	North-West	30°	+7.8
M101	The Pinwheel Galaxy	Ursa Major	Galaxy	23:26	02:38	23:26 **	North-West	62°	+7.9
M26	Open Cluster	Scutum	Open Cluster	23:26	02:38	01:07	South	29°	+8.0
NGC6885	20 Vulpeculae Cluster	Vulpecula	Duplicate	23:26	02:38	02:34	South	65°	+8.1
M110	Galaxy	Andromeda	Galaxy	23:52	02:38	02:38 *	North-East	45°	+8.1
M94	'Spiral' Galaxy	Canes Venatici	Galaxy	23:26	02:16	23:26 **	West	45°	+8.2
NGC7009	The Saturn Nebula	Aquarius	Planetary Nebula	23:26	02:38	02:38 *	South	26°	+8.3

* = Highest point at Dawn (02:38 - last visible sighting) ** = Highest point at Dusk (23:26 - 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 July)

Object	Name	Constellation	Type	↗	↘	Highest	Direction	Alt	Mag
M56	Globular Cluster	Lyra	Globular Cluster	23:26	02:38	01:38	South	69°	+8.4
M71	Globular Cluster	Sagitta	Globular Cluster	23:26	02:38	02:15	South	57°	+8.4
NGC1245	Open Cluster	Perseus	Open Cluster	01:47	02:38	02:38 *	North-East	21°	+8.4
M51	Whirlpool Galaxy	Canes Venatici	Galaxy	23:26	02:38	02:38 *	West	54°	+8.4
M82	The Cigar Galaxy	Ursa Major	Galaxy	23:26	02:38	23:26 **	North-West	43°	+8.4
M64	The Black Eye Galaxy	Coma Berenices	Galaxy	23:26	02:38	23:26 **	West	33°	+8.5
M63	The Sunflower Galaxy	Canes Venatici	Galaxy	23:26	02:38	23:26 **	West	50°	+8.6
NGC6543	The Cat's Eye Nebula	Draco	Planetary Nebula	23:26	02:38	00:15	West	73°	+8.8
M57	The Ring Nebula	Lyra	Planetary Nebula	23:26	02:38	01:15	South	72°	+8.8
M60	Galaxy	Virgo	Galaxy	23:26	02:05	23:26 **	West	24°	+8.8

Twilight	Civil	Naut	Astro		Rises	Sets
Ends	22:02	23:11	-	Sun	04:48	21:17
Starts	04:02	02:54	-	Moon	01:15	16:51

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Lewes Astronomical Society

Phases of the Moon

Brown Lunation Numbers

numbered from first New Moon in 1923

Phase	Date	Time	Lunation
NEW MOON	5th July	23:57	1256
FIRST QUARTER	13th July	23:48	1256
FULL MOON	21st July	11:17	1256
LAST QUARTER	28th July	03:51	1256

Credit: Vito Technology, Inc.

Credit: NASA
Data credit: Time and Place