Lewes Astronomical Society

Newsletter - August 2023

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Astronomy News

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Have we got the Universe all wrong? (1)

- The best estimate we currently have for the age of the Universe is 13.797 billion years old
- But with JWST peering further and further back we are discovering stars and galaxies that are almost as old as the Universe itself
- Is it time for a new theory?
- Almost 100 years ago, Fritz Zwicky came up with the idea of “lazy light”. Light lost its “puff” because of how wide the Universe was. With lower energy came longer (redder) wavelengths

Credit: Unsplash/Andy Holmes

- The theory got forgotten, overtaken by the expanding Universe doing the same kind of thing by stretching light and making it redder
- But the two theories are not mutually exclusive and some scientists think they can co-exist, and thus redshift is a hybrid concept

Have we got the Universe all wrong? (2)

- At around the same time, Paul Dirac developed the idea of “coupling constants”
- Coupling constants are fundamental physical constants that govern the interactions between particles. And, according to Dirac, these coupling constants could vary over time
- By allowing them to evolve, the timeframe for the formation of early galaxies observed by JWST at high redshifts can be extended from a few hundred million years to several billion years
- This provides a more feasible explanation for the advanced level of development and mass observed in these ancient galaxies
- If the Cosmological Constant was revised in line with these Coupling Constants it would account for the formation of these early galaxies taking not hundreds, but billions of years
- And, when worked through, this gives a new estimate of the age of Universe as 26.7 billion years

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Is the Universe speeding up as it ages?

- One of the key ideas coming out of Einstein's Theory of General Relativity is that we should observe the distant (and therefore very old) Universe running at a much slower speed than it does today. This is because space and time are intertwined
- As the Universe expands, it should get faster
- Astronomers had already observed this in action by looking at the Universe as it was about 7 billion years ago (half its current age) by using supernovae. But applying this to the earliest times proves fruitless

Artists interpretation of the accretion disk in ULAS J1120+0641 a very distant quasar powered by a supermassive black hole
Credit: ESO/M. Kornmesser

- But now researchers have used 190 quasers in the early universe to be "standard candles" (in the same way supernovae are) to measure time. And it appears at that era, time was running five times slower than it does today
- Watch a video on time dilation at: https://youtu.be/3prF2V_a2gY

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The early Cosmic Web

- Galaxies are not scattered randomly across the universe. They gather together not only into clusters, but into vast interconnected filamentary structures with gigantic barren voids in between
- JWST has identified 10 galaxies arranged in a long thin line at about 850 million years after the Big Bang. The end of the line is anchored by a large galaxy with a quaser (an active supermassive black hole at the core)
- It is believed that these galaxies will eventually turn into a massive cluster

This deep galaxy field from JWST's NIRCam (Near-Infrared Camera) shows an arrangement of 10 distant galaxies, 850 billion years after the Big Bang, marked by eight white circles in a diagonal, thread-like line. (Two of the circles contain more than one galaxy.) This 3 million light-year-long filament is anchored by a very distant and luminous quasar – a galaxy with an active, supermassive black hole at its core. The quasar, called J0305-3150, appears in the middle of the cluster of three circles on the right side of the image. Its brightness outshines its host galaxy.

Credit: NASAs Goddard Space Flight Center

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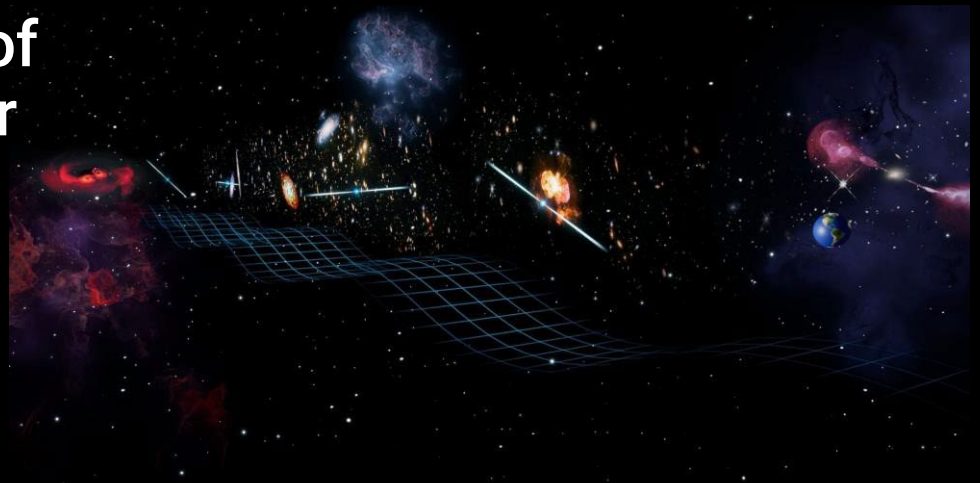
Gravitational Waves from a SMBH heard (1)

- In July we reported on changes in the behaviour of pulsars that may point to the merger of two Super Massive Black Holes (SMBH)
- Scientists at the North American Nanohertz Observatory for Gravitational Waves (NANOGrav) are now reporting that, following more than 15 years of data collection in a galaxy-sized experiment, scientists have "heard" the perpetual chorus of gravitational waves rippling through our universe - and it's louder than expected
- They are a million times more powerful than the one-off bursts of gravitational waves from black hole and neutron star mergers that have been detected by experiments such as LIGO and Virgo



An artist’s rendering of gravitational waves from a pair of close-orbiting black holes (visible on the left in the distance). The waves are passing by several pulsars and the Earth (on the right)

Credit: Keyi “Onyx” Li/U.S. National Science Foundation

Gravitational Waves from a SMBH heard (2)

- For now, NANOGrav can only measure the overall gravitational wave background noise rather than the radiation from the individual "singers". Analysis of the data is looking at whether the deafening volume comes from experimental limitations or from heavier and more abundant supermassive black holes
- Unlike the high-pitched gravitational waves produced by stellar-sized black holes, the new waves are at ultra-low frequency. A single rise and fall of one of the waves could take years, or even decades, to pass by. Since gravitational waves travel at the speed of light, a single wavelength could be tens of light-years long
- No Earth-based experiment could detect these sorts of waves, hence the use of pulsars. These act like a stellar-lighthouse as their pulses arrive on Earth like a perfectly timed metronome. As a gravitational wave passes between us and a pulsar, it throws off the radio wave timing as space is stretched and compressed
- Radio telescopes around the United States have been following 67 pulsars for the last 15 years

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Gravitational Waves from a SMBH heard (3)

- The NANOGrav scientists first noticed hints of a signal; an extra "hum" common to the timing behaviour of all pulsars in the array which, in time, became concrete evidence for the existence of the gravitational wave background. These are probably caused by the death spiral of two supermassive black holes
- Since supermassive black hole pairs form due to galaxy mergers, the abundance of their gravitational waves will help cosmologists estimate how frequently galaxies have collided throughout the universe's history
- By studying the intensity of the gravitational wave background, an estimate suggests that hundreds of thousands or maybe even a million or more supermassive black hole binaries inhabit the universe
- But other theories need to be ruled out, notably String Theory. This predicts one-dimensional defects called cosmic strings. These may have formed in the early universe and may have dissipated energy in the form of gravitational waves. Pulsars may not be the perfect metronome for detecting these waves

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Gravitational Waves from a SMBH heard (4)

- For more on pulsars, SMBH and gravitational waves go to:

1. Clamour of gravitational waves from the universe's merging supermassive black holes heard for first time at: https://youtu.be/HhacTSqjE9s
(credit: National Science Foundation)
2. Astronomers find possible 'fingerprints' of gravitational waves at: https://youtu.be/1La7lLINLCw
3. Pulsar with Earth at: https://youtu.be/Jfkr4VFe_0E
4. Pulsar Close up at: https://youtu.be/fNtIr6rml0k
5. Pulsar wide at: https://youtu.be/k8rmfOUkFoM
(numbers 2 – 5 inclusive credit: OzGrav)
6. Vela Pulsar imaged by Chandra at: https://youtu.be/zsDOqLWuWQ4
(credit: Alex Joss)

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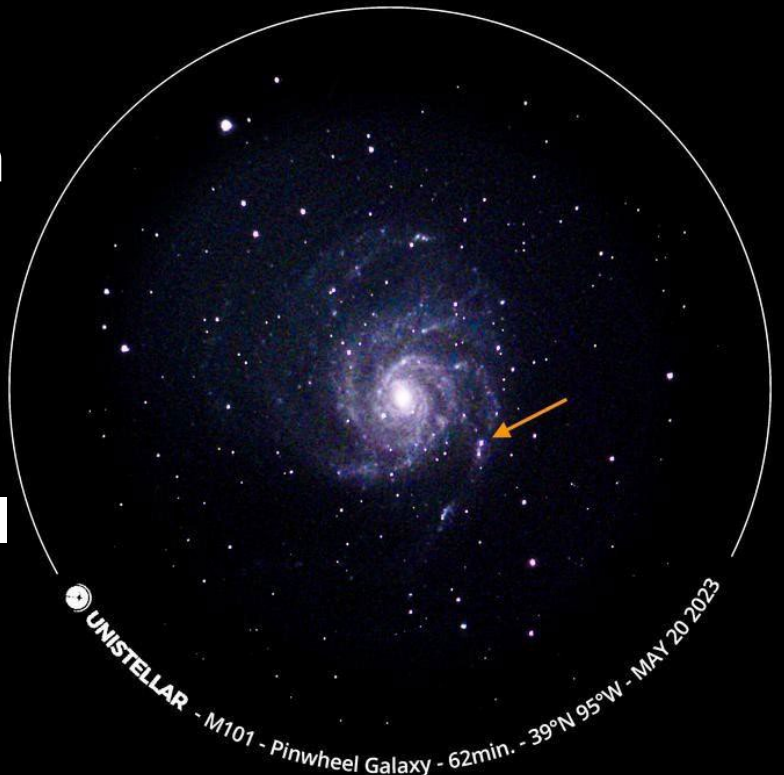
Citizen scientists help observe supernova

- The closest supernova explosion in the past 10 years (SN2023ixf) in the Pinwheel Galaxy 21 million light years from Earth, was first observed on May 19th. Within an hour of its discovery, citizen scientists from the SETI and Unistellar's Cosmic Cataclysms program were gathering data
- 123 amateur astronomers have made 252 observations that followed the changing light patterns over time. SETI scientists built a light curve from the data, thus helping to understand how Type II supernovae behave
- Participants in the Cosmic Cataclysms program receive real-time alerts when transient features like this occur, and these initiate observing campaigns to allow large amounts of data to be gathered



An image of the pinwheel galaxy showing the location of the closest supernova to Earth for 10 years

Credit: Michael Cunningham

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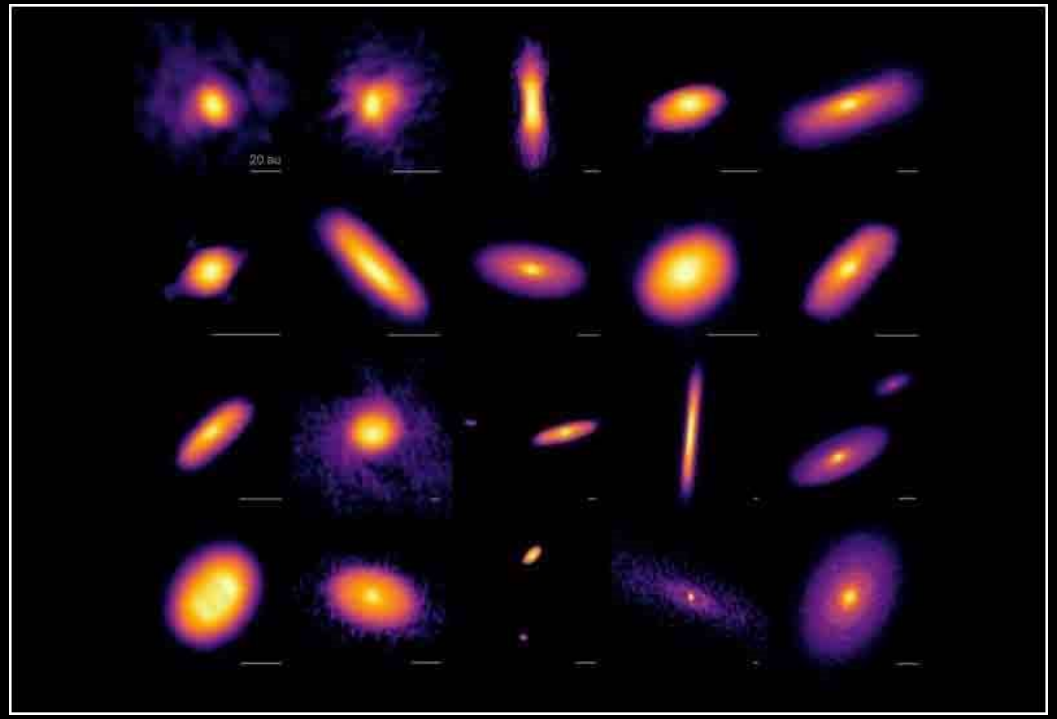
ALMA digs deep into planet formation (1)

- ALMA has been used to observe 19 protostars and their encircling disks within 650 million light years from the Earth for the earliest signs of planet formation
- Evidence suggests that ‘proto-planetary’ disks may only last for a few million years around a newborn star, indicating the potential rapid formation of planets within the system
- Substructures, such as gaps and rings, within the proto-planetary disks indicate that planets are already forming, suggesting that planetary formation progresses rapidly within the first million years



Images of disks around 19 protostars, including the four binary systems observed with ALMA. Disks are presented in the order of their evolutionary sequence; the oldest two (top left) show signs of faint ring-gap structure
Credit: ALMA (ESO/NAOJ/NRAO), N. Ohashi et al.

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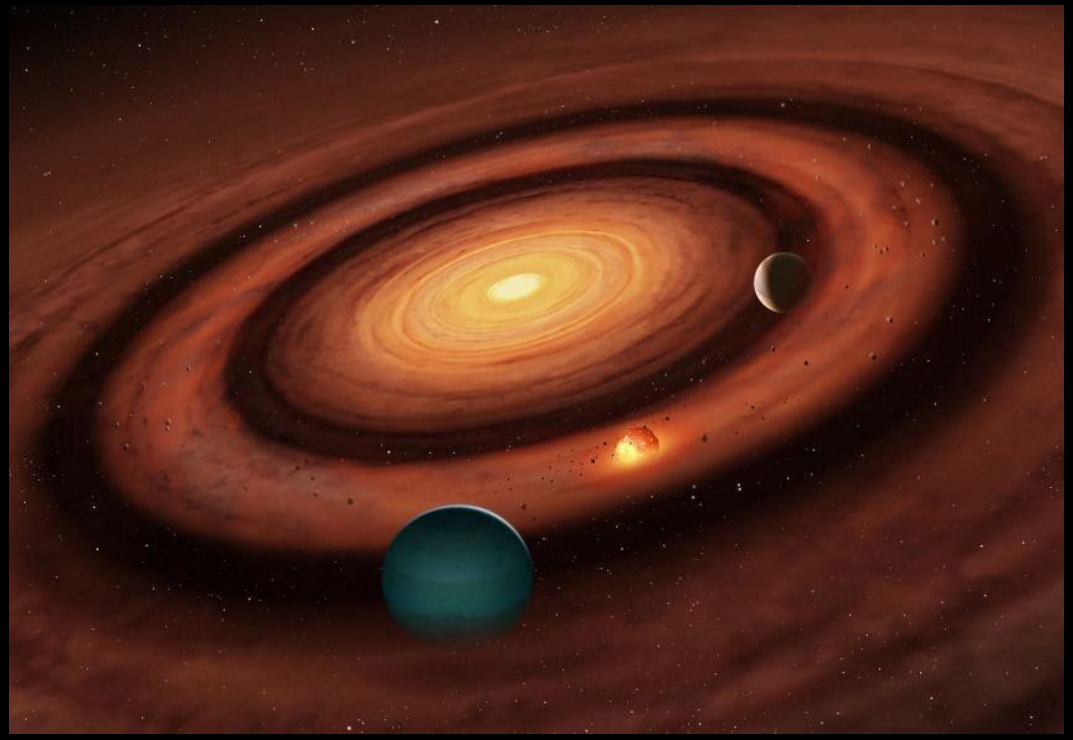
ALMA digs deep into planet formation (2)

- ALMA has given researchers clues as to how planets are formed and evolve
- A newly proposed method of planet formation in protoplanetary disks; the “birth environment” of planets which exist as areas of dust and gas encircling a central star, suggests that a smaller planet may be created by two large planets within the disk
- Restricted inward flows of dust, and the consequent reduction of dust collected between the two large planets, would restrict the size of a potential middle planet
- This may indicate how both Mars and Uranus were formed



Artistic rendering of how small planets can form ‘sandwiched’ in between two larger ones
Credit: University of Warwick/Mark A. Garlick

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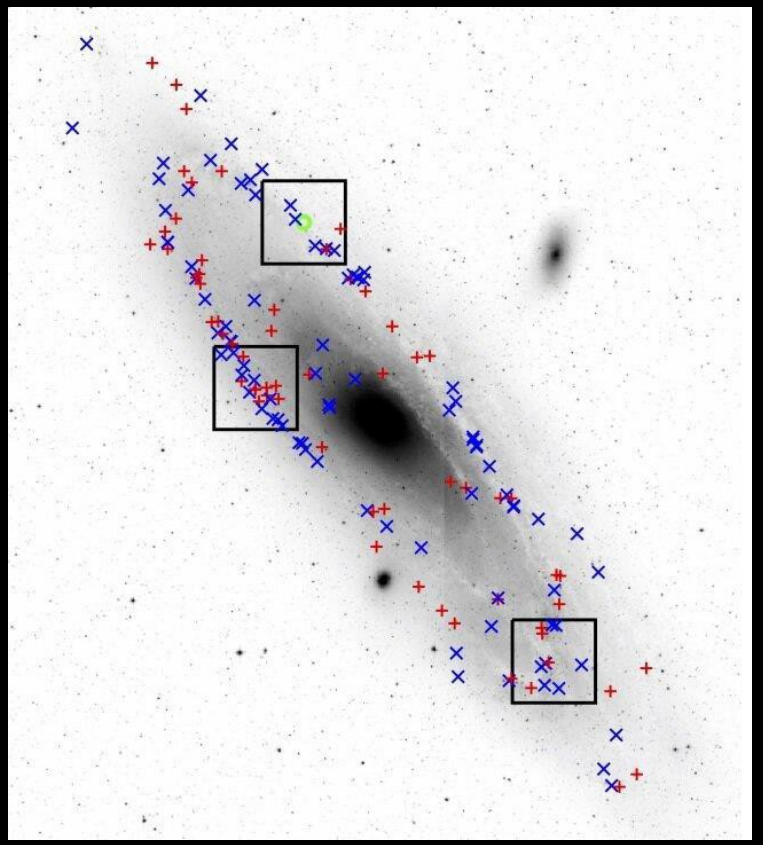
19 Wolf-Rayet stars found in Andromeda

- Wolf-Rayet (WR) are massive stars at an advanced stage of stellar evolution and are losing mass at a very high rate. They are extremely hot and very luminous stars with strong, broad helium emission lines. They can be either carbon-rich (WC-type) or nitrogen-rich (WN-type)
- To date only a few hundred have been found, the vast majority of which are in the Milky Way
- Most of the new 19 are WN-type
- Astronomers estimate there may be about 60 more Wolf-Rayet stars left to be found in the Andromeda galaxy



The blue ×s represent WN stars while the red +s represent WC stars, the green circle is the reddened WR discovered in 2016. The three fields observed in this latest survey are denoted by black boxes

Credit: Kathryn F. Neugent (Harvard-Smithsonian Center for Astrophysics (CfA), USA) et al, 2023

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A new neutrino view of the Milky Way

- The IceCube Lab is a one-of-a-kind detector which encompasses a cubic kilometre of deep Antarctic ice and is instrumented with over 5,000 light sensors. It searches for signs of high-energy neutrinos originating from our galaxy and beyond, out to the farthest reaches of the universe
- Looking for neutrinos from the Milky Way is difficult as the universe outshines the nearby sources in our own galaxy. But using a dataset of 60,000 neutrinos over a 10-year period and some ground-breaking new techniques, including machine learning, allowed researchers to build a picture of the Milky Way, in neutrinos

IceCube Lab Credit: Yuya Makino, IceCube/NSF

Two images of the Milky Way galaxy. The top is captured with visible light and the bottom is the first-ever captured with neutrinos
Credit: IceCube Collaboration/U.S. NSF (Lily Le & Shawn Johnson)/ESO (S. Brunier)

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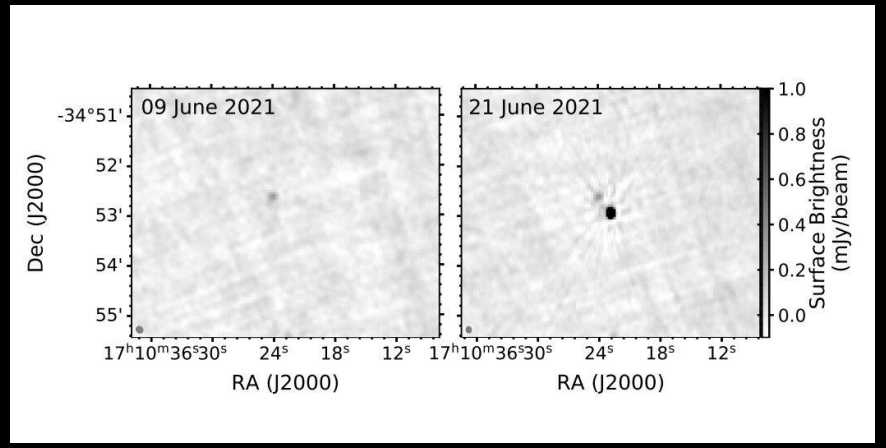
Old Magnetar found in Milky Way

- Pulsars are highly magnetized rotating neutron stars emitting a beam of electromagnetic radiation. They can be found at all frequencies, from radio to x-ray and gamma ray
- Using the South African MeerKAT radio observatory, an international team have discovered an extremely intermittent radio pulsar: PSR J1710−3452
- Unlike other pulsars being studied, PSR J1710−3452 had a fairly long spin period of 10.4 seconds. Together with other unusual features, this points to it being a radio loud magnetar (a neutron star with an extremely strong magnetic field)
- The highly intermittent nature and its positioning suggests this magnetar is part of an old population



MeerKAT images of the position of PSR J1710−3452 on June 9, 2021 (left) and June 21, 2021 (right)
Credit: Mayuresh Surnis (Indian Institute of Science Education and Research Bhopal, India) et al., 2023

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Low-mass stars and high radiation levels

- A star's surface magnetism is linked to its rate of spin, which also causes local magnetic disturbances such as sunspots
- Low-mass (cool) stars have been thought to have weaker magnetic fields, making them ideal host candidates for habitable exoplanets
- But analysis of 136 stars in the Beehive Cluster (M44) has shown this to be untrue. A new mechanism called 'core-envelope decoupling' (where the surface and core spin at different rates) may be responsible
- And such stars could generate much higher levels of radiation for billions of years, making their exoplanets inhospitable

Credit: Drew Evans / NASA

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A two-faced white dwarf called Janus

- A white dwarf is the burnt-out core of a dead star. Extremely dense, it is thought that heavier elements, such as carbon and oxygen sink to the middle, and lighter elements, such as hydrogen and helium, float to the top. As the white dwarf cools some mixing occurs
- But ZTF J1901+1458, a highly magnetised white dwarf spinning on its axis once every 15 minutes, is different; one side is hydrogen, and one side is helium, and hence the nickname: “Janus”

Credit: K. Miller, Caltech/IPAC

- No one understands why, but strong magnetic fields are suspected to be behind the phenomena. Either they could be preventing the mixing or they could be changing the pressure and density of the atmospheric gases
- See a short video on Janus presented by Ilaria Caiazzo of Caltech, who discovered it, at: https://youtu.be/y27GF03kaZ0

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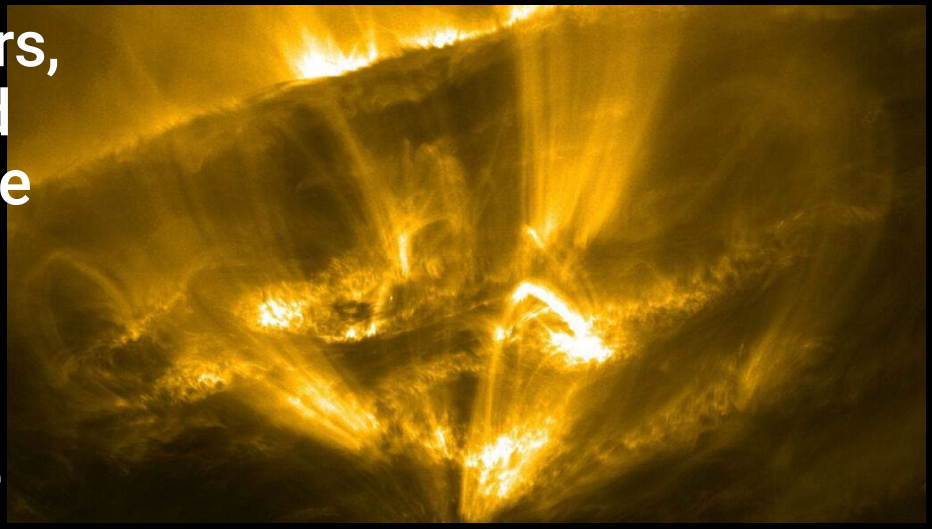
‘Shooting stars’ on the Sun

- Using the ESA’s Solar Orbiter, European astronomers, led by the University of Northumbria, have observed meteor-like fireballs crashing onto the Sun’s surface
- Known as “coronal rain”, it occurs when a large amount of ejected material encounters a localised cool-spot, allowing the plasma to condense into clumps that can be as much as 250km wide. These plummet back to the Sun as gravity pulls them in at speeds in excess of 100km/sec. As the Sun’s corona is fairly thin it is likely that most of the “shooting stars” make it to the surface
- There is a brief, strong brightening as the fireballs impact, with an upward surge of material and shockwaves that reheat the gas above



Loops and filaments around the Sun’s corona. Image taken on March 26th

Credit: ESA/Solar Orbiter EUI/HRI and Patrick Antolin

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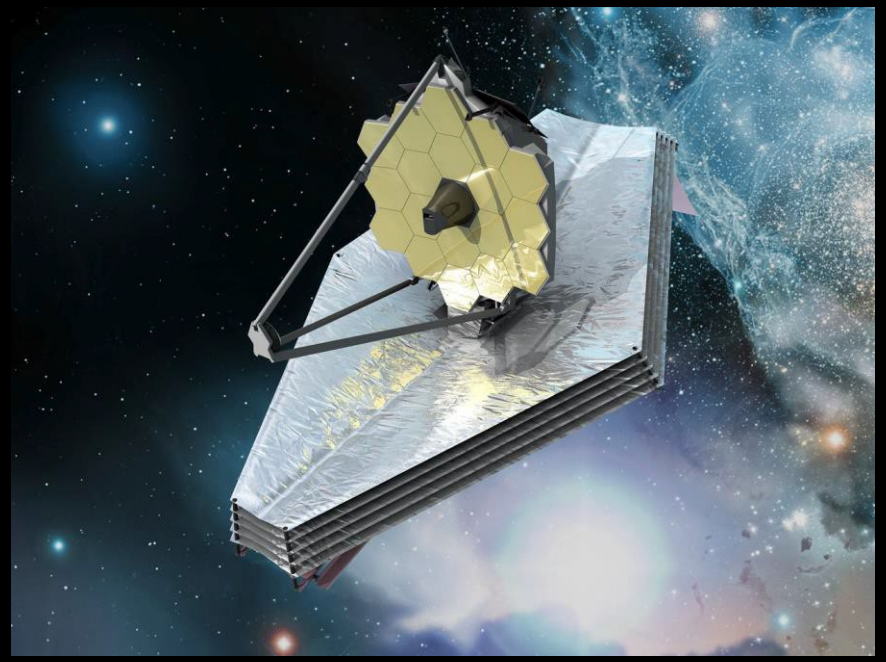
JWST celebrates its first anniversary (1)

- It is hard to believe that JWST took its first images only a year ago. During that time, we have been amazed by the stunning pictures and the data which have provided a generational leap forward in our understanding of the Universe
- Apart from time allocated to the major international agencies (NASA, CSA and ESA for instance), the Space Telescope Science Institute (STScI) allocates time to the worldwide astronomical community to make use of JWST



Credit: ESA (C. Carreau)

- The Cycle 1 General Observers (GO) program provided the first extensive opportunity to make observations, with approximately 6,000 hours awarded to observing programs using the full suite of JWST instrumentation. Now STScI have announced the Cycle 2 program for the next year

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JWST celebrates its first anniversary (2)

- The focus of Cycle 2 will be in the following six areas:

1. Exoplanets – JWST will be used to directly image exoplanets and obtain spectra of their atmospheres, such as giant rocky planets around red dwarfs
2. Galaxies – the focus will be on the Cosmic Dawn and the Epoch of Reionisation and pushing back the barriers even further, with redshifts over 15
3. Intergalactic and ‘At Large’ – focus on characterizing the space between galaxies and the large-scale structure of the Universe, such as protoclusters
4. Solar System – General Observation time will also be dedicated to studying planets, satellites, and nearby objects, such as Jupiter’s upper atmosphere
5. Stars and the ISM – multiple observation campaigns that address questions surrounding stellar physics, stellar types, and the interstellar medium (ISM)
6. SMBHs & AGNs – studying supermassive black holes (SMBHs) and the resulting Active Galactic Nuclei (AGNs), or quasars

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Astronomy News in Brief (1)

- To the beginning of time – NASA have released a 3-D visualisation from JWST that takes you back to Maisie's Galaxy, one of the most distant galaxies ever discovered and seen a mere 390 million years after the Big Bang. To watch go to: https://cdn.jwplayer.com/previews/FQozj9gq
- Gravitational Waves – Chinese researchers have found key evidence for nanohertz gravitational waves based on observations of pulsar timings carried out at the Five-hundred-meter Aperture Spherical radio Telescope (FAST). This backs up evidence from the North American Radio Arrays. Additional confirmation has also come from separate groups of European, Japanese and Indian astronomers, collaborating within the European Pulsar Timing Array (EPTA) and the Indian Pulsar Timing Array (InPTA) using five of the largest European radio telescopes, including the Lovell Telescope at Jodrell Bank. See the video at: https://youtu.be/EPDQCGaKwbk

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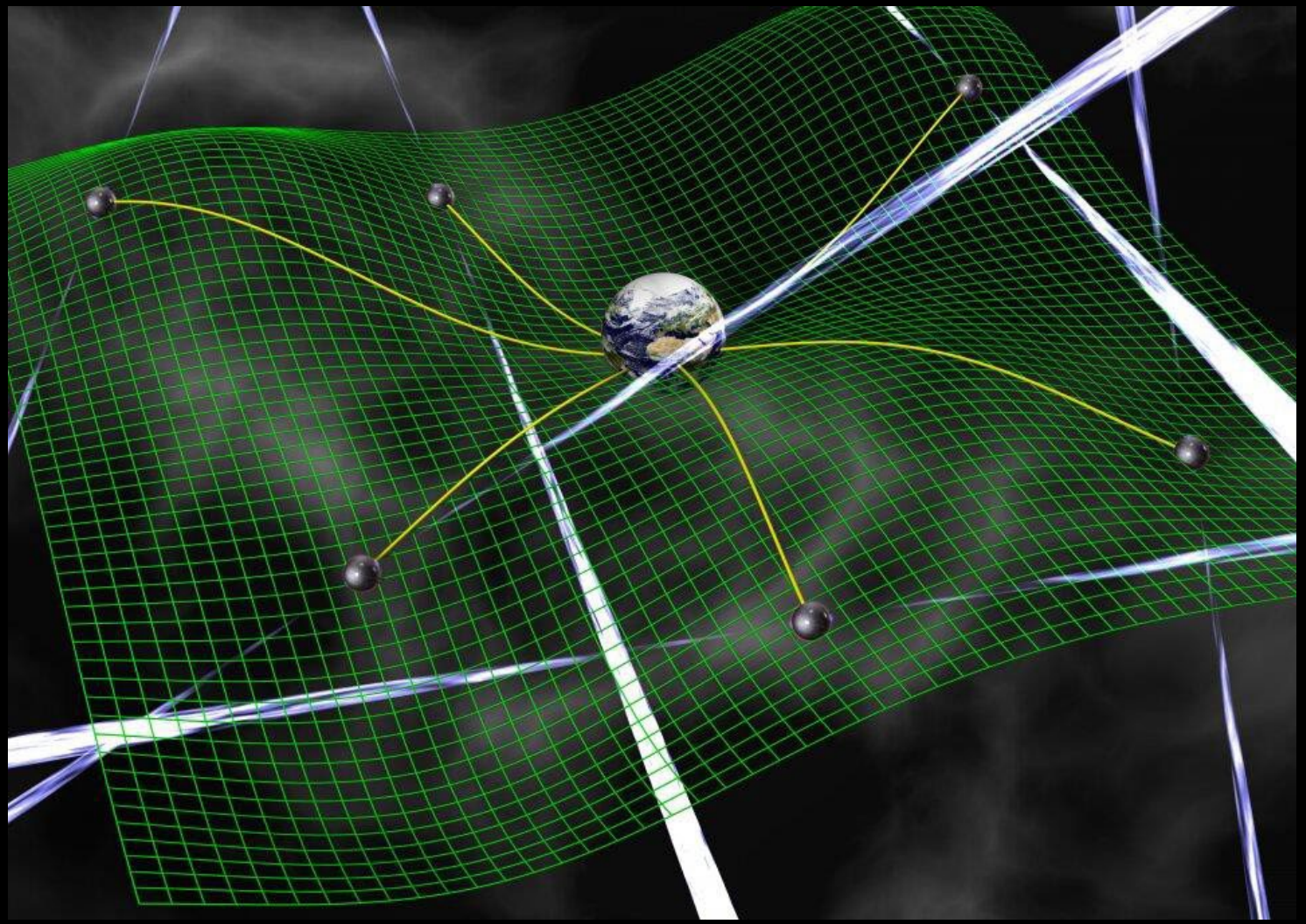
Astronomy News in Brief (2)

Gravitational waves are ripples in space-time, represented by the green grid, produced by accelerating bodies such as interacting supermassive black holes. These waves affect the time it takes for radio signals from pulsars to arrive at Earth



Credit: David Champion, NASA, JPL

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Astronomy News in Brief (3)

- Axions – for more on the possibility of Axions as a candidate for Dark Matter watch Fraser Cain's interview with Dr Keir Rogers at the University of Toronto: https://youtu.be/SruXU-Owz_M
- No Dark Matter Galaxy – a giant galaxy, NGC 1277, has been found to have no, or very little dark matter. The galaxy, regarded as a relic left over from the earliest giant galaxy, doesn't interact with any others. It is several times the size of the Milky Way. Theories suggest that dark matter should make up between 10 and 70% of the total mass. Whether it has always been like this or if the dark matter has been lost or striped away is presently unknown
- Cold Star – astronomers have found a brown dwarf, T8 Dwarf WISE J062309.94−045624.6, which has a surface temperature of 425 degrees centigrade. Located 37 light years from Earth, its rapid rotation generates a magnetic field and produces radio waves. For comparison, the Sun's surface temperature is about 5,600 degrees centigrade

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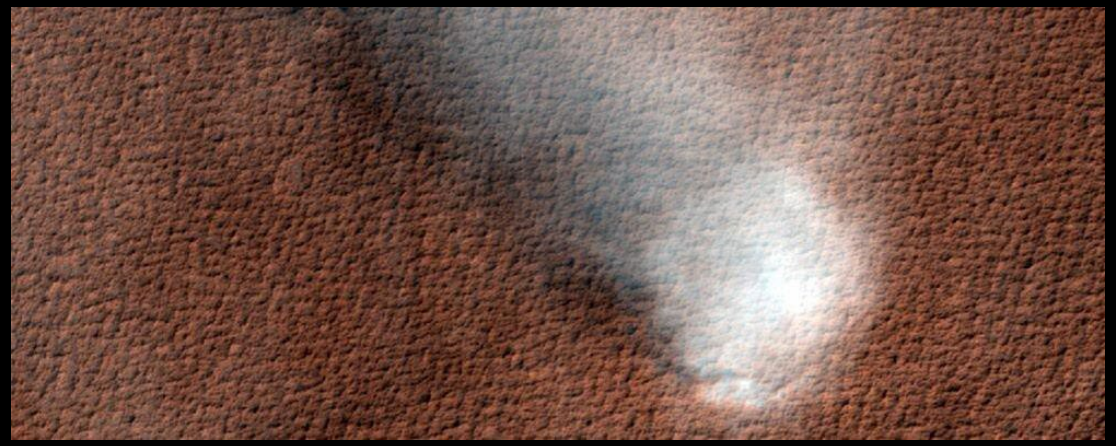
Astronomy News in Brief (4)

- Mirror Exoplanet – astronomers have discovered that the Neptune-sized exoplanet, LTT9779b, which was first detected in 2020 over 260 light years from Earth, is so close to its parent star, and so blisteringly hot, that metal clouds rain drops of titanium. This allows the planet to reflect over 80% of the light making, it as comparably bright as Venus
- Martian Dust Devils - NASA's High Resolution Imaging Experiment (HiRISE) camera onboard the Mars Reconnaissance Orbiter has captured stunning photographs of a dust devil rising over the surface of Mars. These dust devils can reach a height of 20km and are formed in the same way as on Earth, with a spinning column of warm air rising from a hot surface



Martian Dust Devil
Credit: NASA/JPL-Caltech/UArizona

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Astronomy News in Brief (5)

- Doughnut-shaped rock on Mars – Perseverance has found a doughnut-shaped rock in the Jezero Crater. The shape is likely to have been caused by water and wind erosion
- British researcher and JWST – Prof Tom Stallard of Northumbria University will be the only British scientist granted telescope time on JWST in 2023. He will be studying Jupiter's upper atmosphere

Doughnut Rock
Credit: NASA/JPL-Caltech/ASU/MSSS/LANL/CNES/IRAP

- Sunspots – the Sun went into overdrive as it approaches the peak of the current cycle (25) during June as there were 163 sunspots, the highest number in one month for over two decades. Indications now suggest that the peak will occur during the next year, rather than in 2025. Watch a video on how scientists are unlocking the secrets of sunspots at: https://cdn.jwplayer.com/previews/30mPg5wk

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Astronomy News in Brief (6)

- Solar Flares – meanwhile, a giant sunspot exploded on July 2nd, creating a solar flare seven times the width of the Earth. Classified as a X1.07 magnitude flare, it was only at its most powerful between the 10th and 14th, yet caused deep shortwave radio blackout over western parts of the U.S. and the Pacific Ocean that lasted around 30 minutes. Another Coronal Mass Ejection sent another colossal flare Earthwards at the end of the first week of July
- Solar Storm in 2025 – NASA has downplayed any suggestion that solar storms over the next few years could jeopardise the internet by causing a global outage. There has been a wave of misinformation spread by a non-existent NASA alert about an imminent "internet apocalypse”. However, modelling of the effects of complex solar storms is ongoing in an effort to provide sufficient advance warning for satellite operators, power grid managers and telecommunication companies to take their systems offline temporarily, or to move satellites to safer orbits to reduce damage, if possible

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Astronomy News in Brief (7)

- Earth's birth – scientists, studying magma from the upper and lower mantles beneath the Earth's surface, believe that the Earth was formed from hot and dry material, and that water arrived quite late on in the process. The lower mantle (from 680km below the surface to the Core at about 2,900km), which formed first, is lacking in so-called volatiles, which are easily evaporated materials like water and iodine. However, the upper mantle (from 15km to 680km below the surface) has a higher proportion of volatiles: three times those found in the lower mantle
- Volcanoes on the Moon – scientists have discovered a large formation of granite over 50km wide beneath an ancient volcano, called Compton-Belkovich, on the far side of the Moon. NASA's Lunar Reconnaissance Orbiter discovered hot spots in this area, which are thought to be caused by radioactive decay of elements contained in granite within the batholith: underground rock formations created when magma cools without eruption, or when it is cooled by water

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Astronomy News in Brief (8)

- Extremely Large Telescope (ELT) – work on the construction of the ESO's Extremely Large Telescope (ELT) at the Cerro Armazones in Chile's Atacama Desert has passed the 50% mark. The ESO will feature the world's largest primary mirror at 39m. It is made up of 798 hexagonal segments. The project is still on course to start observations in 2028
- To see how the telescope is being constructed go to: https://youtu.be/NfWBnDBB0f0

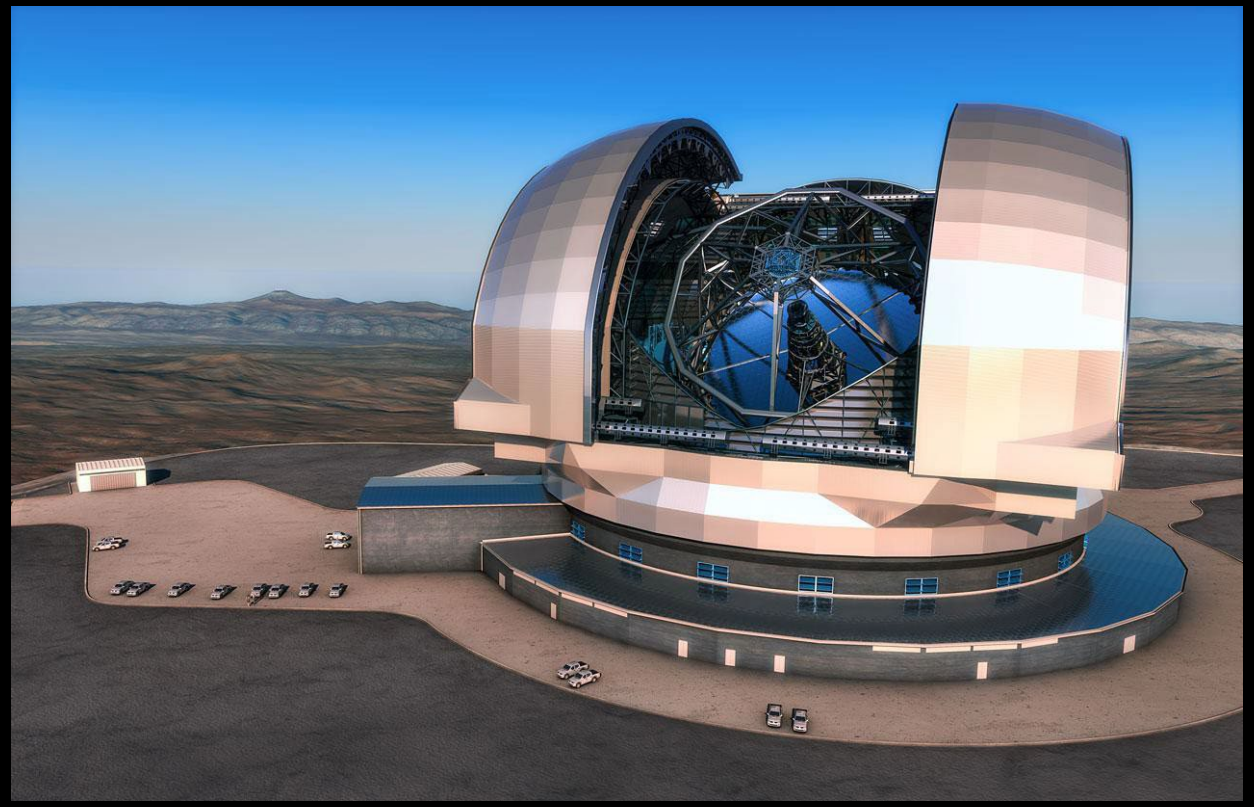

Image of completed Extremely Large Telescope
Credit: ESO/L. Calçada

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Spaceflight News

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SpaceX static test fires new Starship

- SpaceX's latest Starship prototype test vehicle (Ship 25) was put through a static test firing of all six of its Raptor engines on June 26th. The test lasted about 5 seconds
- Ship 25 is being prepared for the second test flight of a fully stacked Starship vehicle which, Elon Musk announced, may happen as soon as mid-August. Over 1,000 changes have been made since the ill-fated launch of the first fully-stacked Starship on April 20th
- See the video of the static test at: https://cdn.jwplayer.com/previews/MGuRRkxW

Credit: SpaceX

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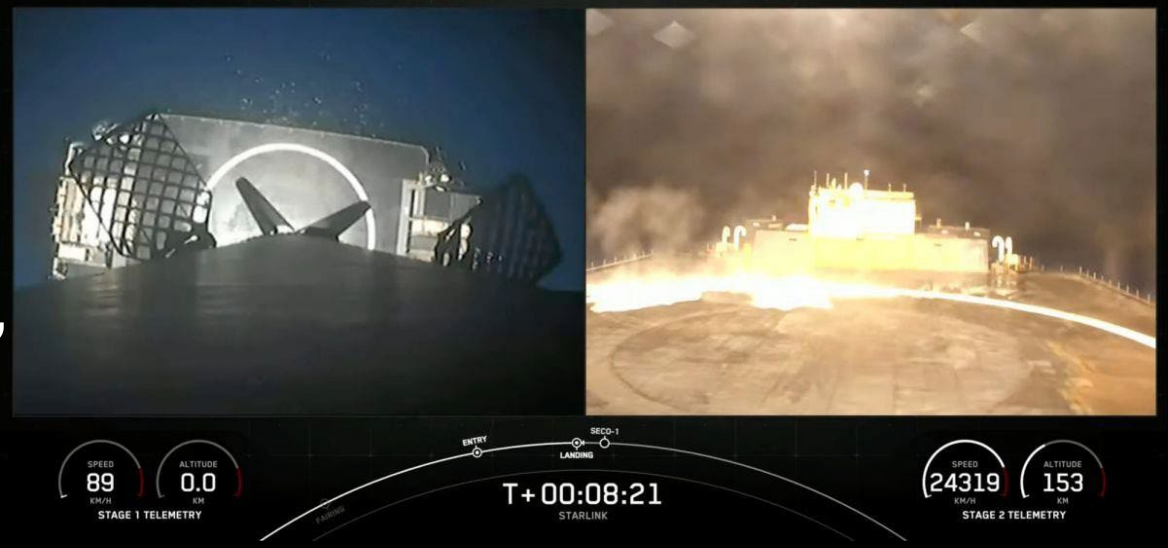
SpaceX Falcon Rocket reused for 16th time

- A SpaceX Falcon 9 rocket was launched from Cape Canaveral on July 10th and deployed 22 Starlink satellites. Nothing unusual in this but the first stage (booster) has been reused a record number of times, 16 in all, with several other Falcon 9 rockets also coming close to reaching the same record
- Eight and a half minutes after blasting off the rocket touched down safely on the deck of a SpaceX droneship in the Atlantic Ocean
- Watch the launch at: https://cdn.jwplayer.com/previews/4xj7m3Jl



Credit: SpaceX

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India launches Moon Lander and Rover (1)

- The Chandrayaan 3 mission, which carries a moon lander (Vikram (valour)) and rover (Pragyan (wisdom)), successfully launched from the Satish Dhawan Space Centre on the coastal island of Sriharikota in the southern state of Andhra Pradesh on July 14th, utilising the Launch Vehicle Mark-3 (LVM3-M4) rocket. This mission does not carry an orbiter. The rover has a mission life of 14 days

Credit: Indian Space Research Organisation (ISRO)

- Being far less powerful than a Saturn 5, the spacecraft will take much longer to reach the Moon. The probe needed to orbit the Earth five times to gain enough speed before being put on a lunar trajectory, due to arrive near the south pole on August 23rd. The lander on the previous mission, Chandrayaan 2 (July 2019), crashed, but the orbiter is still operating and will be used with the new mission

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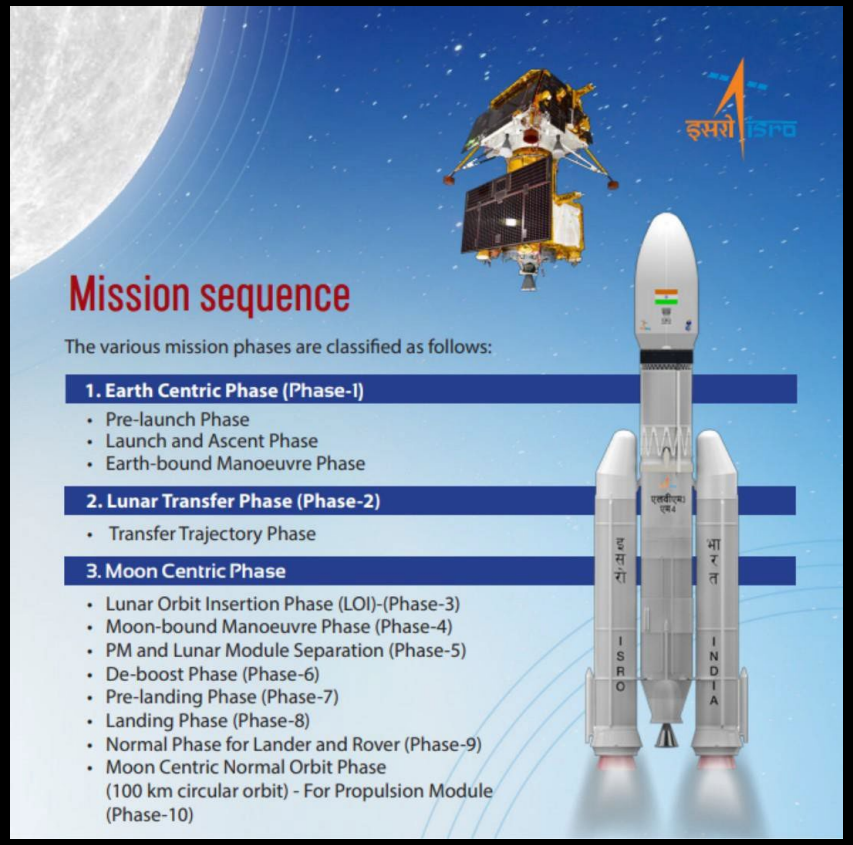
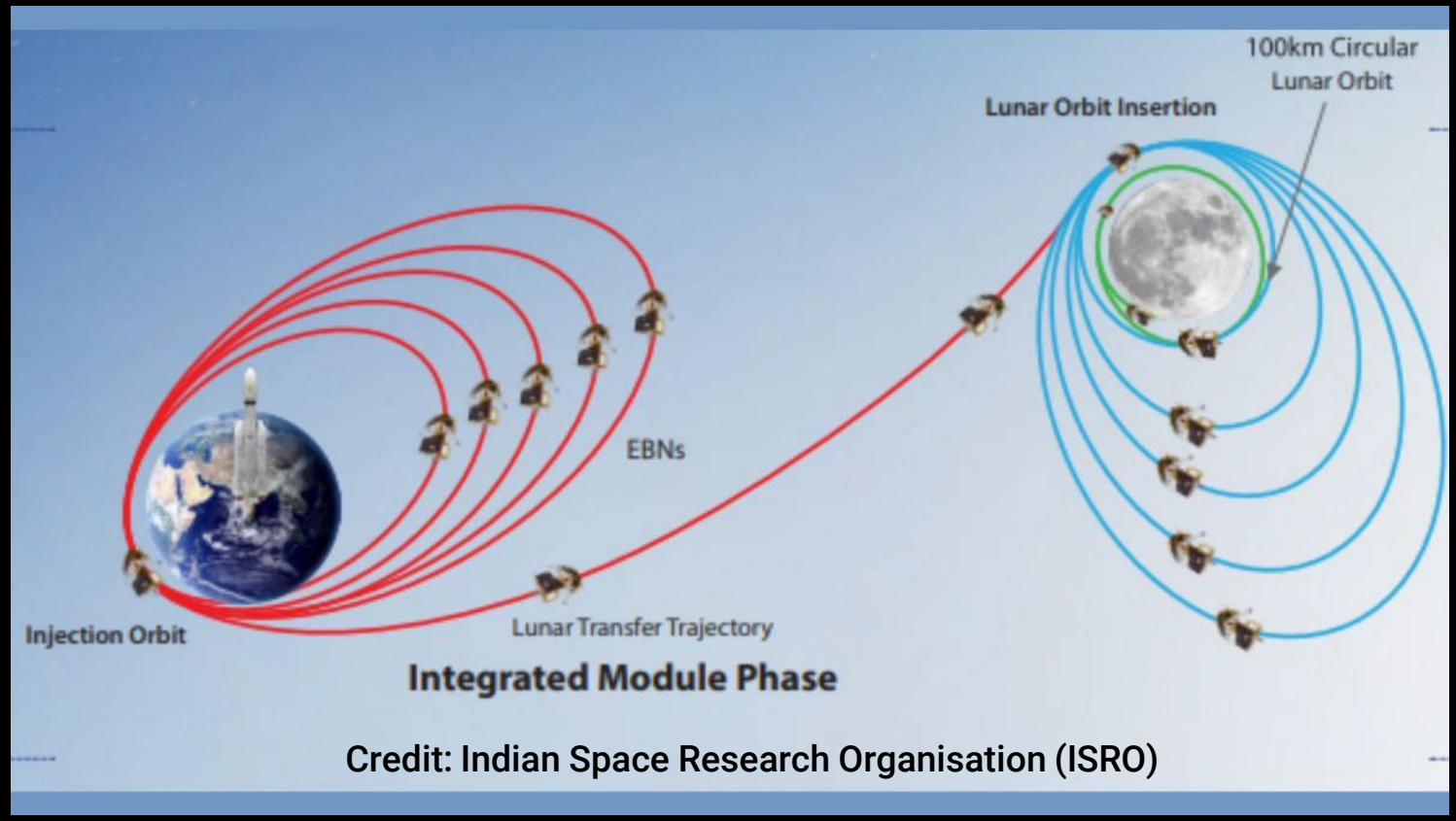
India launches Moon Lander and Rover (2)





- If successful, India will join the USA, China and Russia as the only countries to have soft-landed a craft on the Moon. And all for a price tag of $74.6 million
- Watch the launch at: https://cdn.jwplayer.com/previews/wVLiRDA5

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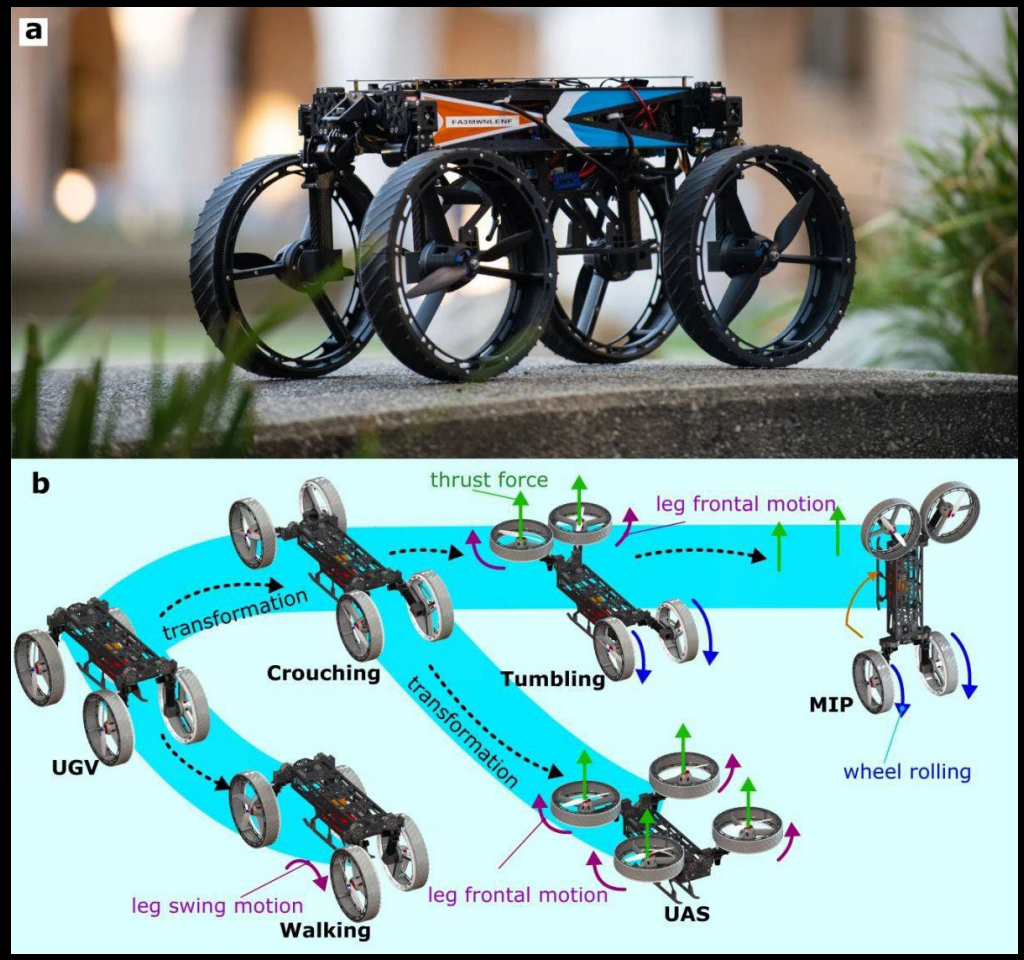
NASA’s next Rover

- Caltech and the Jet Propulsion Lab (JPL) have designed a new type of rover for planetary exploration
- The four-wheeled Multi-Modal Mobility Morphobot (M4) is designed to autonomously assess its surrounding terrain to determine how to best traverse upcoming obstacles
- Dealing with rough terrain is no problem: the M4’s four wheels can pivot through 90° and work as propellers, turning it into a quadcopter drone. The M4 can stand on its rear wheels and, using them as legs, pivot-walk around to a clearer way ahead
- Watch how the M4 works at: https://cdn.jwplayer.com/previews/GgvcAOZ7



Credit: Nature Communications (Nat Commun)

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The ISS version of turning wine into water

- So how do you save water for reuse up in space?
- The ISS Environmental Control and Life Support System (ECLSS) has recently demonstrated that it is capable of achieving the recovery of nearly 98% of water used on board by the crew
- Drinkable water is produced from waste via the Water Recovery System, which contains the Water Processor Assembly (WPA). Water is collected via advanced dehumidifiers from moisture released by the breath and sweat of the crew into the air
- The Urine Processor Assembly (UPA) utilises vacuum distillation to recover water from urine, and a Brine Processor Assembly (BPA) extracts water from waste urine brine to achieve the 98% water recovery goal

ESA astronaut Matthias Maurer changes out the bladder in the space station's Brine Processor Assembly
Credit: NASA

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Turning a Shuttle vertical

- Since they were decommissioned in 2012, the remaining Space Shuttles have been displayed in museums in the horizontal position, as they would appear when taxiing after landing
- Now, Endeavour, currently on display at the California Science Center, is about to be turned through 90 degrees and mated with an external tank and boosters; to be shown as it would be whilst awaiting take-off on the launch pad. The total cost of the project is approximately $400 million, and will take six months to complete. It will be the centre piece of the new Samuel Oschin Air and Space Center

Media gathering for a news conference in 2016
Credit: AP Photo/Richard Vogel, File

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Meet NASA’s new quiet supersonic plane

- It is nearly 80 years since the first jet broke the sound barrier and, in achieving this, the jet gave the world its first sonic boom. Since then every supersonic plane has created a sonic boom – until now
- NASA’s new X-59 supersonic plane is part of NASA’s Quesst mission, which aims to demonstrate that the aircraft can fly faster than the speed of sound and only produce a gentle thump; or the equivalent of a nearby car door slamming, for close-by observers
- Watch an X-59 plane being built at: https://cdn.jwplayer.com/previews/46kGMlos

The new plane is rolled out of its hanger at Lockheed Martin’s Skunk Works facility in Palmdale, California on June 19th prior to undergoing ground tests to ensure it is safe. It will first fly during 2024 over select US cities to gather data on how people respond to the sound generated during supersonic flight
Credit: Lockheed Martin

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Spaceflight News and Updates (1)

- Ingenuity Mars Helicopter – NASA's Jet Propulsion Lab has re-established contact with the helicopter after a break of 63 days. At the end of the helicopter's 52nd flight it landed behind a hill and was out of direct line of sight of Perseverance. Ingenuity seems to be in good shape
- Hera – ESA's planetary defence satellite, Hera, is due to go to the asteroid, Dimorphos, part of a binary system with Didymos, to study the effects of the DART impact in 2022. Hera is due to launch in October 2024 and rendezvous with the asteroid system in December 2026. ESA have released a video showing a leakage test of the propulsion system prior to the full assembly of the spacecraft. To watch go to: https://youtu.be/zdQvKNG7qck
- Parker Solar Probe – on its 16th close approach to the Sun on June 27th, the Parker Solar Probe came to within 5.3 million miles of the solar surface whilst moving at 364,610 miles per hour. The probe emerged unscathed

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Spaceflight News and Updates (2)

- Janus Probes – two probes, which were designed to go to two binary near-Earth asteroid systems, will now go into long term storage after their piggy-back ride on the Psyche mission was delayed from August 2022 to October 2023. The delay means that the intended targets are now out-of-reach. Meanwhile, the Psyche probe, which will use solar electric propulsion on its 6 year journey to the asteroid Psyche, is now being made ready at Cape Canaveral. Watch the Psyche mission video: https://youtu.be/y__vwRQ3PVg
- Virgin Galactic – the first commercial flight of the Virgin Galactic rocket-powered plane (VSS Unity) took place on June 29th, carrying two Italian Air Force pilots and an Italian engineer of the National Research Council of Italy and accompanied by a British Virgin Galactic astronaut instructor. The plane soared to 85.1km above Earth at Mach 2.88 before gliding back down in a 75 minute flight (14 minutes sub-orbital). The rocket plane is carried underneath a carrier aeroplane (VMS Eve – a specially made Scaled Composites White Knight Two quadjet cargo aircraft). The next flight is scheduled for early August

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Spaceflight News and Updates (3)

- Ariane 5 – the 117th and last flight of the Ariane 5 rocket took place on July 5th from Europe's Spaceport in Kourou in French Guiana. As has happened so many times in the past, the launch was faultless, and within 30 minutes two satellites (Heinrich-Hertz – a German communications satellite and Syracuse 4B – a French military communications satellite) were successfully placed in orbit. Apart from the maiden flight in 1996, when it exploded minutes after launch, the only other failure was in 2002. Watch the launch at: https://cdn.jwplayer.com/previews/kgmr4oHN
- Ariane 6 – ESA's new Ariane 6 rocket was moved to the launch pad at Europe's Spaceport in French Guiana, ahead of the Vulcain 2.1 engine testing. The earliest Ariane 6 will launch is the second quarter of 2024
- Next Generation Ariane – development of the next generation of Ariane rocket took a major step forward with the first hot-fire test of its reusable 100 tonne Prometheus engine. For the test the engine was mated to the Themis first stage demonstrator; the test fire lasted 12 seconds

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Spaceflight News and Updates (4)

- Delta – United Launch Alliance has closed its Delta rocket assembly line in Alabama, USA after the 389th and last Delta rocket rolled out of the factory for the journey to its launch base in Florida
- SpaceX 200th Falcon stage 1 landing – with the launch of 72 small satellites into polar orbit on June 12th, the successful recovery of the Falcon booster (stage 1) was the 200th since the first one in 2015. In the first six months of the year, SpaceX has completed 44 launches. At least 4 Falcon 9 launches were due in July, each with a Starlink payload
- Methane-fuelled rocket – China has launched the first methane-fuelled rocket, Zhuque-2, from the Jiuquan Satellite Launch Center in the Gobi Desert on July 12th. The next generation Ariane rocket will also be powered by a mixture of oxygen and methane

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Spaceflight News and Updates (5)

- Blue Origin (1) – one of the BE-4 rocket engines which will power the New Glenn rocket United Launch Alliance's (ULA) Vulcan Centaur, exploded 10 seconds into a test at the West Texas facility on June 30th. The engine was destroyed and the test stand infrastructure heavily damaged. Watch a BE-4 engine test at: https://cdn.jwplayer.com/previews/cGe7t7xJ
- Blue Origin (2) – back on March 29th, the Centaur upper stage exploded during the 15th test of a tank due to a hydrogen leak at the top of the dome. Apparently, this Centaur had been welded using lasers rather than with arc welding used in earlier versions. Future tanks will include an extra stainless-steel ring to strengthen that area. Recertification of the Centaur is now going to be done before the first flight, now scheduled for late 2023
- Japanese rocket engine explosion – a test of the Epsilon S rocket, a new upgrade on the Epsilon rocket, on July 14th ended in failure after problems with the main H3 engine caused the flight controllers to send self-destruct instructions 50 seconds into the test

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Spaceflight News and Updates (6)

- Orion Spacecraft – three Orion Spacecraft, built by Lockheed Martin for Artemis missions 2, 3 and 4, are seen together at the Kennedy Space Center, Cape Canaveral. The spacecraft, which will sit atop the SLS, will take astronauts from the launch pad to deep space and a rendezvous with one of the lunar landing modules such, as Blue Origin

Credit: NASA/Marie Reed

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Spaceflight News and Updates (7)

- 4 volunteers to spend a year on “Mars” – on June 25th, four volunteers entered a simulated Martian habitat in order that scientists can learn about the effects on human physiology and psychology on living long-term on another planet
- European astronauts to go to Moon – both the Artemis 4 and Artemis 5 missions, due to fly in 2028 and 2029 respectively, will include one European Space Agency astronaut. Another European astronaut is guaranteed a place in another, as-yet-undecided, future mission
- Spacesuits – NASA has commissioned Axiom Space and Collins Aerospace to develop four new spacesuits for the Moon and low-Earth orbit Artemis missions. Watch a short video from Axiom on their spacesuits at: https://cdn.jwplayer.com/previews/fgQX7IsU

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Spaceflight News and Updates (8)

- Space Junk – British company ODIN, have successfully tested their new sensor, which will be able to detect debris as small as 1 cm or less. The sensor was incorporated into D-Orbit ION satellite which was launched on June 12th. Meanwhile, what is thought to be an upper-stage engine from an Indian rocket has been washed up on a beach at Green Head, Australia

Credit: CHANNEL 9 via AP

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JWST and Hubble latest photos (1)

- In this image from JWST, Saturn's iconic rings seem to glow eerily in this incredible infrared picture. The image also unveils unexpected features in Saturn's atmosphere
- Saturn’s usual striped pattern can’t be seen as sunlight is absorbed by methane at the infrared wavelength used (3.23 microns)
- As the rings lack methane they glow and outshine the planet

Credit: NASA, ESA, CSA, STScI, Matt Tiscareno (SETI Institute), Matt Hedman (University of Idaho), Maryame El Moutamid (Cornell University), Mark Showalter (SETI Institute), Leigh Fletcher (University of Leicester), Heidi Hammel (AURA), J. DePasquale (STScI)

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JWST and Hubble latest photos (2)

- The irregular galaxy ESO 174-1, is 11 million light years from Earth, in the local group of galaxies
- It appears to be a lonely, hazy diffuse galaxy, consisting of a bright cloud of stars and a faint, meandering tendril of dark gas and dust
- This image is part of a collection of Hubble observations which aim to better understand our nearby galactic neighbours; those within 10 megaparsecs/32 million light years

Credit: ESA/Hubble & NASA, R. Tully

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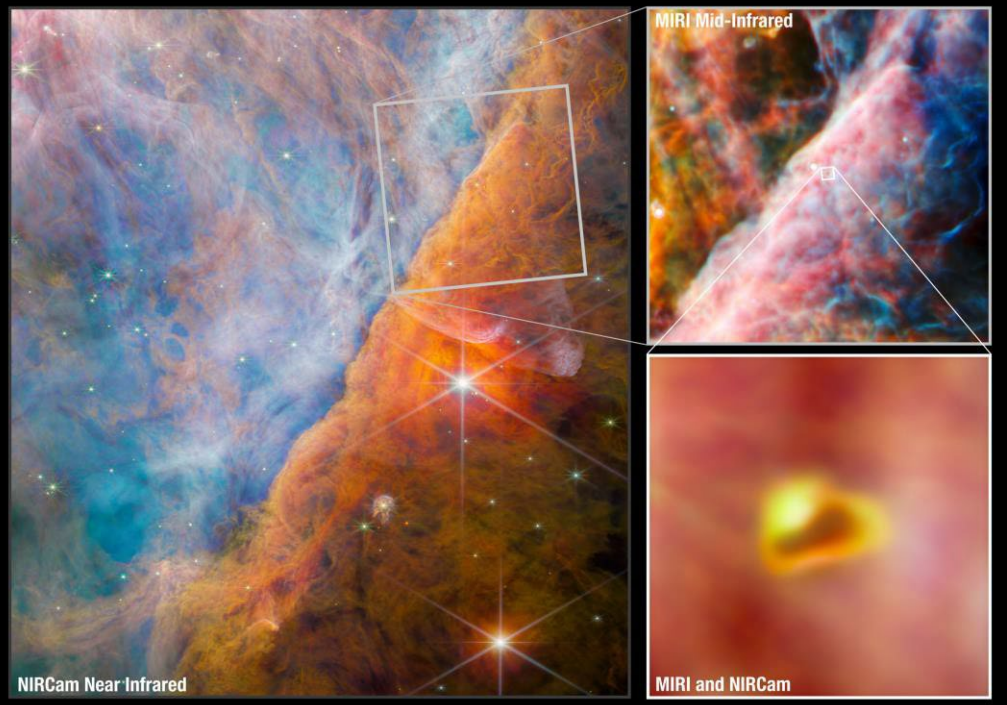
JWST and Hubble latest photos (3)

- Astronomers have discovered a new carbon compound in space for the first time known as methyl cation (CH_3^+). The molecule is important because it aids the formation of more complex carbon-based molecules
- Methyl cation was detected in a young star system, with a protoplanetary disk known as d203-506, which is located about 1,350 light-years away in the Orion Nebula
- These JWST images show a part of the Orion Nebula known as the Orion Bar
- Watch NIRCam's view of the Orion Bar region at: https://youtu.be/VmGvbd5B6Pg



Credit: ESA/Webb, NASA, CSA, M. Zamani (ESA/Webb), and the PDRs4All ERS Team

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JWST and Hubble latest photos (4)

- JWST has been studying NGC 6946, a local group galaxy approximately 22 million light years from Earth
- Due to the near dozen supernovae observed in the previous 100 years, it is known as the “Fireworks Galaxy”
- JWST focussed its attention on Supernova 2004et and Supernova 2017eaw, using MIRI. It has found large amounts of dust within the ejecta of each of these objects. This supports the theory that supernovae played a key role in supplying dust to the early universe and, therefore, later to planets

Credit: Monthly Notices of the Royal Astronomical Society (2023). DOI: 10.1093/mnras/stad1681

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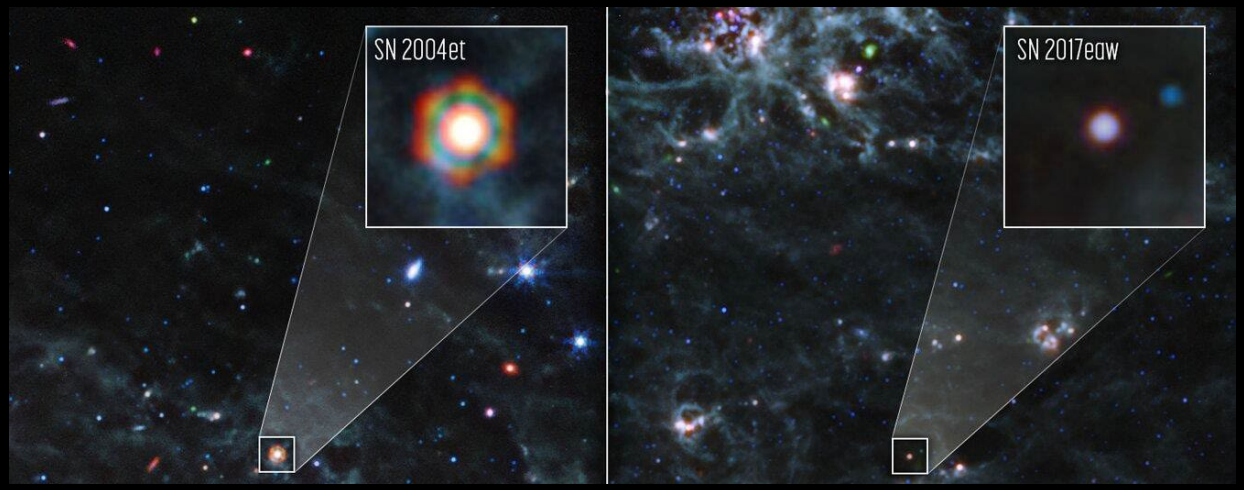
JWST and Hubble latest photos (5)

- JWST has located the most distant active supermassive black hole to date, as part of the Cosmic Evolution Early Release Science (CEERS) Survey
- The galaxy, CEERS 1019, existed about 570 million years after the Big Bang. This is one of eleven identified when the Universe was between 450 and 675 million years old
- At about 9 million solar masses (still twice the size of Sagittarius A* at the heart of the Milky Way), the black hole is less massive than any other yet identified in the early universe



Credit: NASA, ESA, CSA, Steve Finkelstein, Micaela Bagley and Rebecca Larson (University of Texas at Austin, USA)

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JWST and Hubble latest photos (6)

- Like many other galaxies, UGC 11860 looks quiet and peaceful in this image from Hubble
- But, 9 years ago, in July 2014, an enormous type II-P supernova explosion, designated ASASSN-14dq was detected there
- The dwarf galaxy, characteristically asymmetric and completely bulge-less late-type spiral with an unclear spiral structure, lies about 184 million light years from Earth in the constellation of Pegasus

Credit: ESA/Hubble & NASA, A. Filippenko, J. D. Lyman

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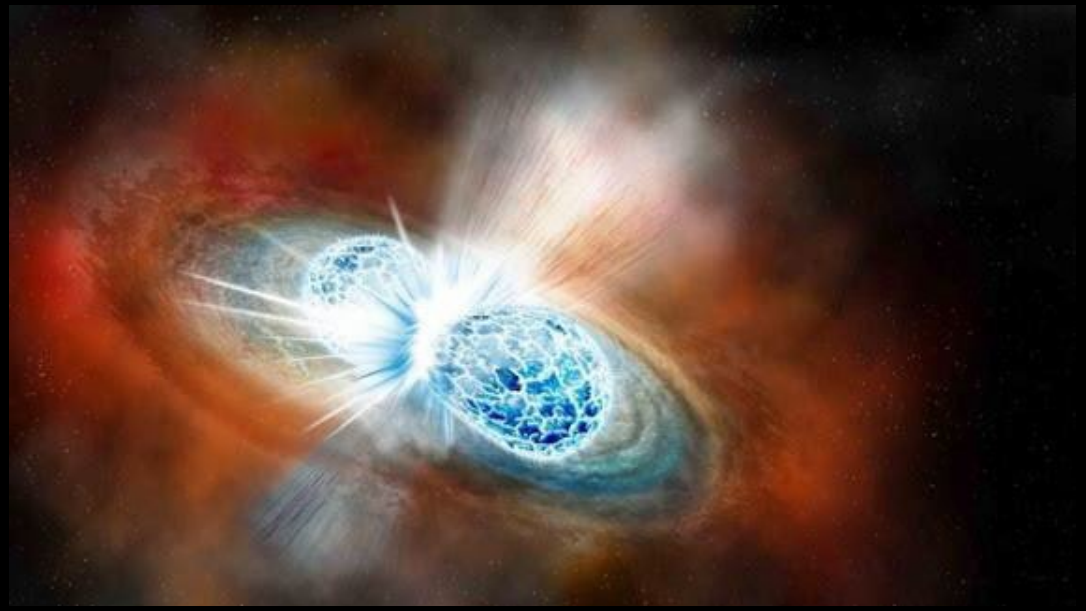
JWST and Hubble latest photos (7)

- The second most powerful Gamma Ray Burst (GRB230307a) ever recorded was observed earlier this year, on March 7th, using the Fermi Space Telescope
- It lasted 34 seconds and other telescopes, including JWST, were able to record the event. From these observations, the probable source, a kilonova caused by 2 colliding neutron stars, was identified in a galaxy 8.3 million light years distant



Artist's impression: Robin Dienel/The Carnegie Institution for Science

- To see the resulting kilonova from colliding neutron stars: https://cdn.jwplayer.com/previews/4kMsXlGB

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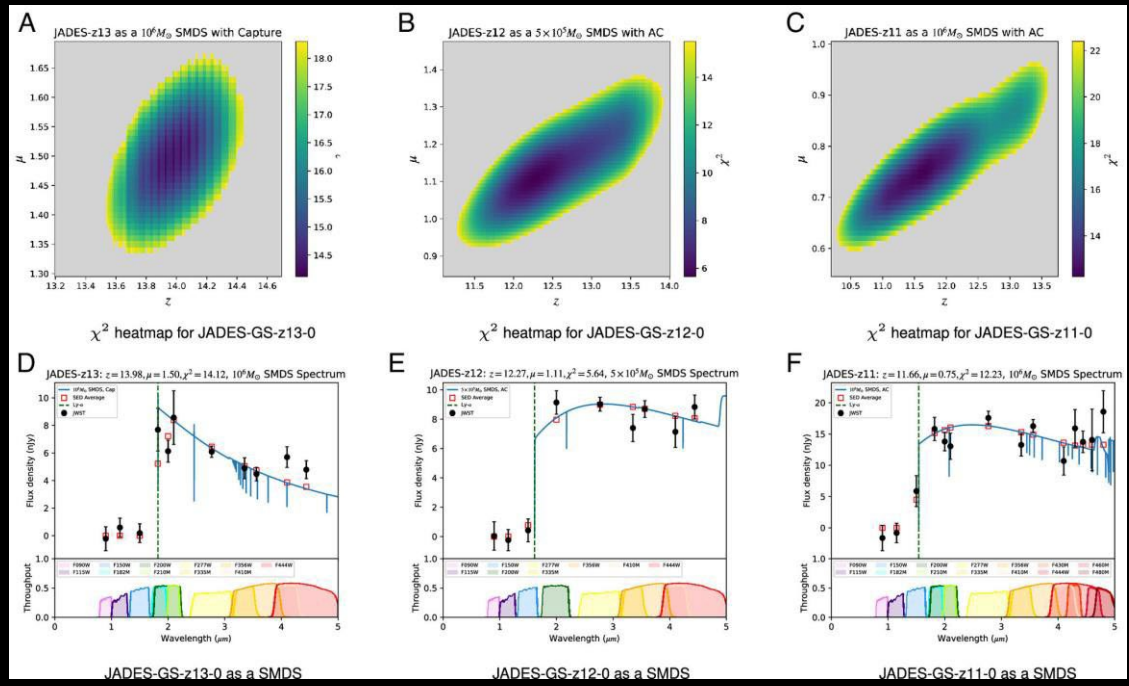
JWST and Hubble latest photos (8)

- In 2007, three astrophysicists, Katherine Freese, Douglas Spolyar and Paolo Gondolo proposed the idea of a dark star. Rather than nuclear fusion, these theorized dark stars are powered by dark matter. Since then, researchers have built models of what these stars would look like and what characteristics they would have
- Now the latter two astrophysicists have found evidence in data from JWST that fit the dark star bill. The three candidate galaxies are JADES-GS-z11, z12, and z13.0



Heat map for the three dark star candidate galaxies

Credit: Proceedings of the National Academy of Sciences (2023).
DOI: 10.1073/pnas.2305762120

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JWST and Hubble latest photos (9)

- NASA have released a new image from JWST to celebrate its first anniversary
- The Rho Ophiuchi cloud complex is the closest star-forming region to Earth, positioned at 390 light years distant in the constellation of Ophiuchus
- The image shows a region containing approximately 50 young stars, all of them similar in mass to the Sun, or smaller. The darkest areas are the densest, where thick dust cocoons still-forming protostars. Huge jets of molecular hydrogen, represented in red, dominate the image

Credit: NASA, ESA, CSA, STScI, Klaus Pontoppidan (STScI)

- Watch a video zooming in on Rho Ophiuchi at: https://youtu.be/MOGzdqaQzBo

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JWST and Hubble latest photos (10)

- The new Netflix series, “Unknown, Cosmic Time Machine” was released on July 24th. It looks at how the $9 billion JWST project was planned and executed
- Watch the official trailer at: https://youtu.be/X1G0cYnZBHo

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Observational Highlights

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August 2023 dates

- 1st August – Full Moon – Super Moon (18:32) – the first of two full moons in a calendar month
- 8th August – Perseid meteor shower peaks
- 10th August – Mercury at its greatest eastern elongation (27°) from the Sun (02:00)
- 10th August – Asteroid (10) Hygiea at opposition (magnitude +9.7) in Capricornus
- 13th August – Venus in inferior conjunction (11:00)
- 18th August – Comet C/2023 E1 (ATLAS) – closest approach to Earth (0.38 AU). It lies south-east of Cygnus; magnitude +10 – +11
- 27th August – Saturn is at opposition (08:00) in Aquarius, magnitude +0.4
- 31st August – Full Moon – Super Blue Moon (01:36)

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The Perseid Meteor Shower

- The Perseid meteor shower is one of the major showers of the year
- It occurs over the 5 weeks between the 17th July and the 24th August, but peaks over the evenings of the 12th to 13th August
- It is caused by debris from Comet 109P/Swift-Tuttle burning up in the atmosphere
- It is a very bright and active event with up to 100 meteors an hour at the peak with an average speed of 36 miles per second
- Any larger pieces entering the atmosphere can explode as fireballs

Credit: Sky & Telescope

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Saturn at opposition

- Saturn is at opposition on August 27th
- Still low above the southern horizon, it will only reach 28° shortly after 1am, and will steadily become easier to see in future years as it climbs into the northern skies from 2026. Having said this, the rings will get harder to see because they are moving side-on; becoming fully side-on in March 2025
- However, due to the Earth-Saturn alignment, they are actually opening up slightly during the second half of 2023 (from 7.2° in June to 10.4° in November) and will be at 9° at opposition
- So, this year is a pretty good compromise

Credit: STScI/NASA/ESA/A. Simon/A. Pagan

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Summer Milky Way

- Summer is the best season to see the Milky Way. The night side of the Earth from the UK faces the core of our galaxy
- Although it is not dark for very long (astronomical darkness returns in August), if you have a clear unrestricted southerly view, and are in a dark sky area, it can be quite spectacular
- With binoculars, or a small telescope, some of the well-known nebulae, such as M17 (the Swan), and M8 (the Lagoon), should be visible, as mentioned last month

The Milky Way over Durdle Door
Credit: Anton Vamplew

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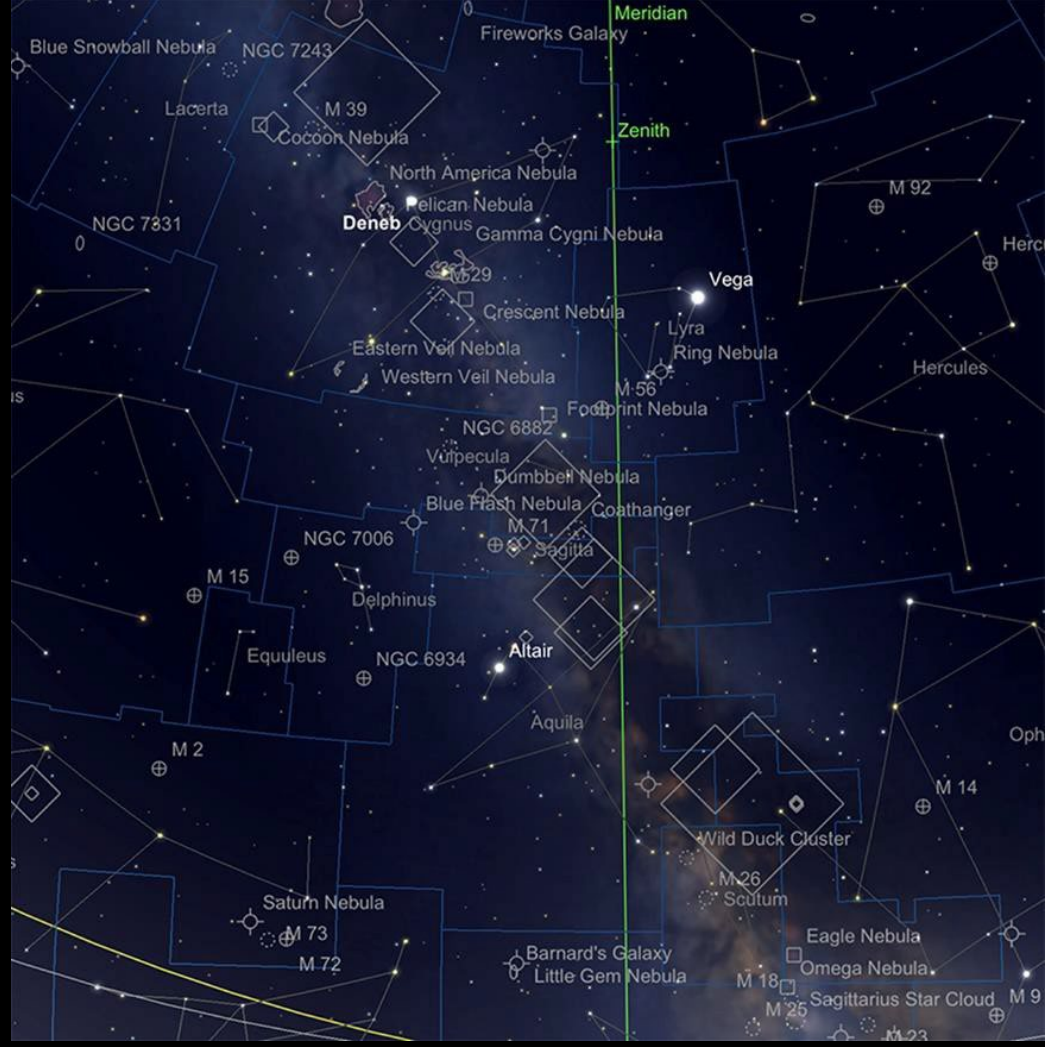
The Summer Triangle (1)

- Three of the brightest stars almost overhead mark out the corners of the Summer Triangle: Deneb (+1.25, the “tail” star of Cygnus), Vega (+0.03, Lyra), and Altair (+0.77, Aquila)
- Although popularised by Patrick Moore in the 1950s, it has been well known for millennia (the Chinese legend of ‘The Cowherd and the Weaver Girl’ dates back 2,600 years)
- Albireo (beta Cygni) is the head star of Cygnus and in the middle of the Triangle. It is actually a double star; the primary (yellowish) has a magnitude of +3.1, and the secondary (blue-green), +5.1



Credit: Image created with SkySafari 5 for Mac OS X, ©2010-2016 Simulation Curriculum Corp; skysafariastronomy.com

- The Summer Triangle is an asterism, a noticeable pattern of stars (like a constellation)

The Summer Triangle (2)

- The Summer Triangle lies in a rich field of the Milky Way with plenty of nebulae. All three principle stars have close-by nebulae:

1. Altair
   - B142 and B143 which together make ‘Barnard’s E’
   - LDN 673, known as ‘Lynds’ Dark Nebula’
2. Deneb
   - The North American Nebula with B352 and B353
   - Gulf of Mexico (LDN 935)
3. Vega
   - M57 – The Ring Nebula

Lynds’ Dark Nebula
Credit: Adam Block/Mount Lemmon SkyCenter/University of Arizona

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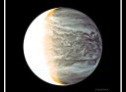
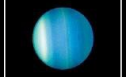
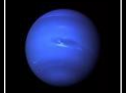
Planets (for evening of 1st/morning of 2nd August)

	Planet	Rises	Sets	Highest	Direction	Altitude	Magnitude	Visible
	MERCURY	07:49	21:37	14:43			+0.03	NO
	VENUS	07:28	20:49	14:09			-4.23	NO
	MARS	08:37	22:00	15:19			+1.77	NO
	JUPITER	23:48	14:26	07:07	South-East	45° ▫	-2.42	YES
	SATURN	21:46	08:02	02:54	South	28° ▫▫	+0.59	YES
	URANUS	00:03	15:21	07:42	East	32° *	+5.78	YES
	NEPTUNE	22:21	10:06	04:14	South	36° *	+7.84	YES

* = Highest point at Dawn (03:29 - last visible sighting)

** = Highest point at Dusk (22:29 - first visible sighting)

◊ = Highest point when first visible

◊◊ = Highest point when first visible

▫ = Highest point when last visible (04:59)

▫▫ = Highest point when last visible (04:33)

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Deep Sky Objects 1 (for evening of 1st/morning 2nd August)

Object	Name	Type	Rises	Sets	Highest	Direction	Alt	Mag
Cr50	The Hyades (Taurus)	Open Cluster	01:53	16:46	09:20 *	East	27°	+1.0
M45	The Pleiades (Taurus)	Open Cluster	23:51	16:27	08:09 *	East	38°	+1.3
M31	Andromeda Galaxy (Andromeda)	Galaxy	***	***	05:05 *	South-East	72°	+3.4
IC4665	Open Cluster (Ophiuchus)	Open Cluster	15:34	04:37	22:06 **	South	44°	+4.2
C14	Double Cluster (Perseus)	Open Cluster	***	***	06:42 *	North-East	27°	+4.3
NGC6633	Open Cluster (Ophiuchus)	Open Cluster	16:10	05:22	22:46	South	45°	+4.6
IC4756	Graff's Cluster (Serpens Cauda)	Open Cluster	16:27	05:29	22:58	South	44°	+4.6
M5	Globular Cluster (Serpens Caput)	Globular Cluster	13:24	01:52	19:38 **	South-West	29°	+5.7
M33	Triangulum Galaxy (Triangulum)	Galaxy	20:43	15:09	05:56 *	South-East	57°	+5.8
M13	Great Globular Cluster (Hercules)	Globular Cluster	10:29	07:33	21:01 **	South-West	68°	+5.8
M12	Globular Cluster (Ophiuchus)	Globular Cluster	15:13	03:01	21:07 **	South-West	34°	+6.1
M3	Globular Cluster (Canes Venatici)	Globular Cluster	09:10	02:54	18:02 **	West	35°	+6.3
M15	Globular Cluster (Pegasus)	Globular Cluster	18:47	08:58	01:52 *	South-West	45°	+6.3
M92	Globular Cluster (Hercules)	Globular Cluster	***	***	21:36 **	South-West	78°	+6.5
M2	Globular Cluster (Aquarius)	Globular Cluster	19:56	07:56	01:56	South	38°	+6.6

* = Highest point at Dawn (03:39 - last visible sighting) ** = Highest point at Dusk (22:29 - first visible sighting)
◊ = For bright objects highest point pre-Dusk - first visible sighting) *** = circumpolar

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Deep Sky Objects 2 (for evening of 1st/morning 2nd August)

Object	Name	Type	Rises	Sets	Highest	Direction	Alt	Mag
M10	Globular Cluster (Ophiuchus)	Globular Cluster	15:33	03:00	21:16 **	South	32°	+6.6
M81	Bode's Galaxy (Ursa Major)	Galaxy	***	***	14:16 **	North-West	33°	+6.9
M101	Pinwheel Galaxy (Ursa Major)	Galaxy	***	***	18:23 **	North-West	53°	+7.9
M94	'Spiral' Galaxy (Canes Venatici)	Galaxy	***	***	17:11 **	West	36°	+8.2
M51	Whirlpool Galaxy (Canes Venatici)	Galaxy	***	***	17:50 **	North-West	45°	+8.4
M57	The Ring Nebula (Lyra)	Planetary Nebula	***	***	23:13	South	72°	+8.8
NGC2403	'Spiral' Galaxy (Camelopardalis)	Galaxy	***	***	11:58 *	North	34°	+8.9

Twilight ends (1st), Twilight starts (2nd)	Twilight	Civil	Naut	Astro
Sunset (1st), Sunrise (2nd)	Ends	21:26	22:19	23:30
Moon rises (1st), Moon sets (2nd)	Starts	04:44	03:51	02:40

	Rises	Sets
Sun	05:24	20:46
Moon	20:41	04:10

* = Highest point at Dawn (03:39 - last visible sighting) ** = Highest point at Dusk (22:29 - first visible sighting)
◊ = For bright objects highest point pre-Dusk - first visible sighting) *** = circumpolar

Lewes Astronomical Society

Brown Lunation Numbers

numbered from first New Moon in 1923

Phases of the Moon

Phase	Date	Time	Lunation
FULL MOON	1st August 31st August	19:31 02:35	1244 1245
LAST QUARTER	8th August	11:28	1244
NEW MOON	16th August	10:38	1245
FIRST QUARTER	24th August	10:57	1245

Credit: Sean Smith/NASA