Lewes Astronomical Society

Newsletter - August 2024

Astronomy News, Spaceflight News, and Observational Highlights

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Astronomy News

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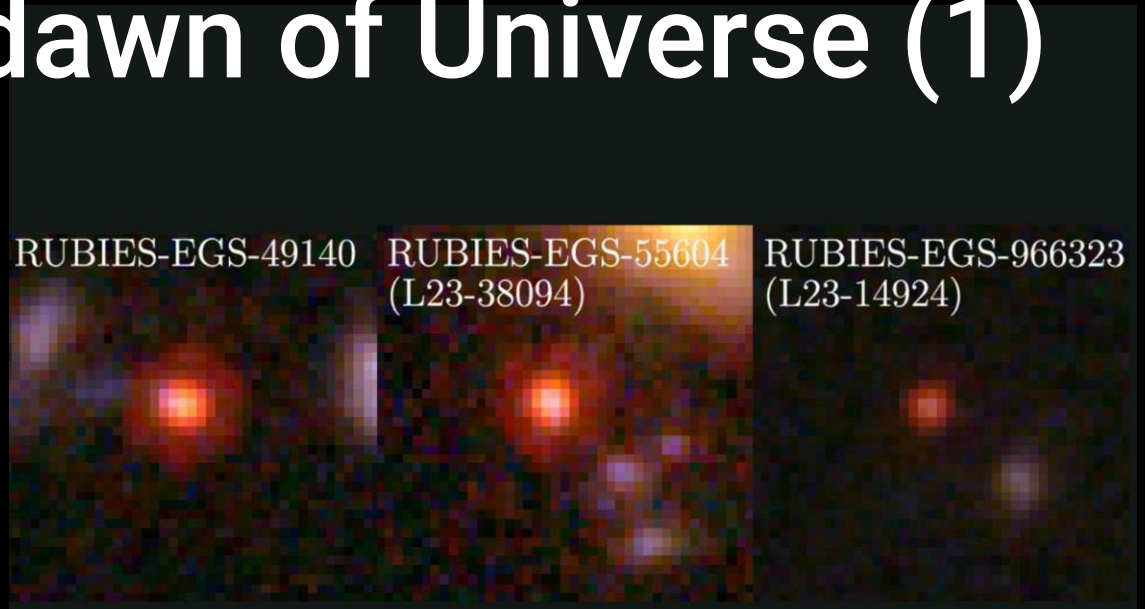
Baffling bright objects at dawn of Universe (1)

- Not a month goes by without some discovery by JWST challenging the very foundations of our understanding of the Universe. When the initial dataset from JWST was released in July 2022, researchers spotted three very luminous and very red objects
- Now, an international team, led by Bingjie Wang and Joel Leja at Penn State University, believe they have found out what they are, and it upends conventional thinking about the early universe and how galaxies and supermassive black holes have evolved



Researchers investigated three mysterious objects in the early universe. Shown here are their colour images, composited from three NIRCam filter bands onboard the JWST. They are remarkably compact at red wavelengths (earning them the term "little red dots"), with some evidence for spatial structure at blue wavelengths
Credit: Bingjie Wang/Penn State; JWST/NIRSpec.

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Baffling bright objects at dawn of Universe (2)

- These three objects have been dated to between 600 and 800 million years after the Big Bang. Analysis of the intensity of the different wavelengths of light shows signatures of “old” stars, many hundreds of millions of years old, and far older than should be expected in galaxies this young
- At the same time, there were signatures of supermassive black holes in these young galaxies; the data suggesting that they are between 100 and 1,000 times more massive than our own Sagittarius A* black hole at the centre of the Milky Way
- The challenge in analysing the data is working out how much light has come from each: stars or black holes. This could mean that these galaxies are older and more massive than our own Milky Way and formed far earlier than predicted. Or, they could be normal-mass galaxies with super-huge black holes

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Baffling bright objects at dawn of Universe (3)

- But what seems more puzzling is that these young galaxies are, in terms of size, actually quite tiny at only a few hundred light years across. The estimate is that the galaxies hold roughly the same number of stars as our Milky Way, between 10 billion and 1 trillion, in a volume 1,000 times smaller than our own galaxy
- If the Milky Way were to be compressed to this size, then our nearest star would be only just outside our solar system, and the centre of the galaxy, only 26 light years away
- More observations will be required if this puzzle is going to be solved

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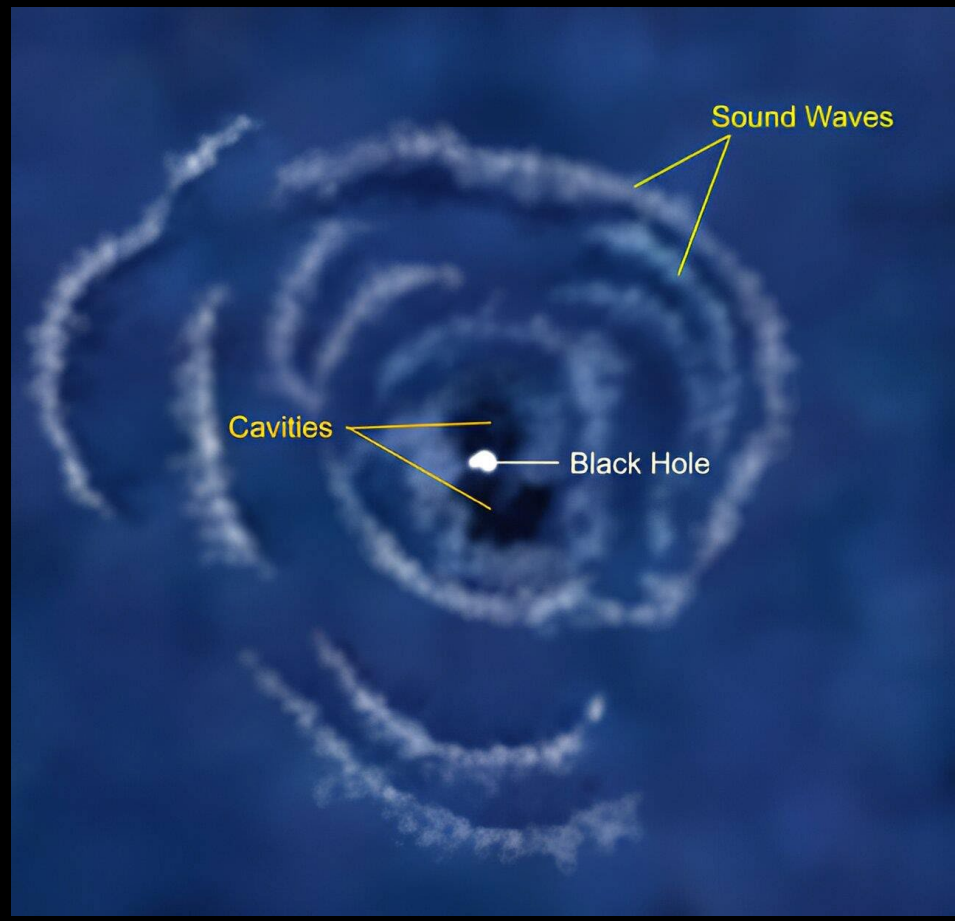
Galaxies can regulate their own growth (1)

- Gravity may be a very weak force on a local scale but, acting across millions of light years, it has shaped the whole Universe
- Left to its own accord, gravity would condense the huge clouds of molecular gas to form enormous stars and supermassive black holes, causing galaxies to live – and die – very quickly
- Even after nearly 14 billion years, we don't live in a universe dominated by huge "zombie" galaxies, full of dead or dying stars. Today's universe is full of vibrant living galaxies



The sound waves (ripples) in the hot gas that fills the Perseus cluster are shown in this artist's impression. They are thought to have been generated by cavities blown out by jets from a supermassive black hole (bright white spot) at the centre of the galaxy
Credit: NASA/NASA/CXC/M.Weiss

Galaxies can regulate their own growth (2)

- What prevents galaxies from endlessly growing out of control? Researchers at the University of Kent believe that a galaxy is able to self-regulate its growth through a feedback system that affects how the supermassive black hole behaves
- Using an analogy we can all understand, they believe that galaxies control their growth through “breathing”: that the supermassive black hole is the “heart”, and that the two bipolar jets they emit are the airways leading to the “lungs”
- Pulses from the black hole effectively force shock waves to travel up and down the jets (in a similar way to air being pumped into the lungs by the movement of the diaphragm, like a pair of bellows). The resulting supersonic sound waves produce high-pressure ripples which can slow gas accretion and growth, and maintain an ambient environment
- We can see evidence of ripples in huge hot gas bubbles in the Perseus galaxy cluster; these are believed to be an example of sound waves in action

Galaxies can regulate their own growth (3)

- Computer modelling puts constraints on the type of pulsation and size of the black hole. As Professor Michael Smith at The University of Kent said, “Breathing too fast or too slow will not provide the life-giving tremors needed to maintain the galaxy medium and, at the same time, keep the heart supplied with fuel."

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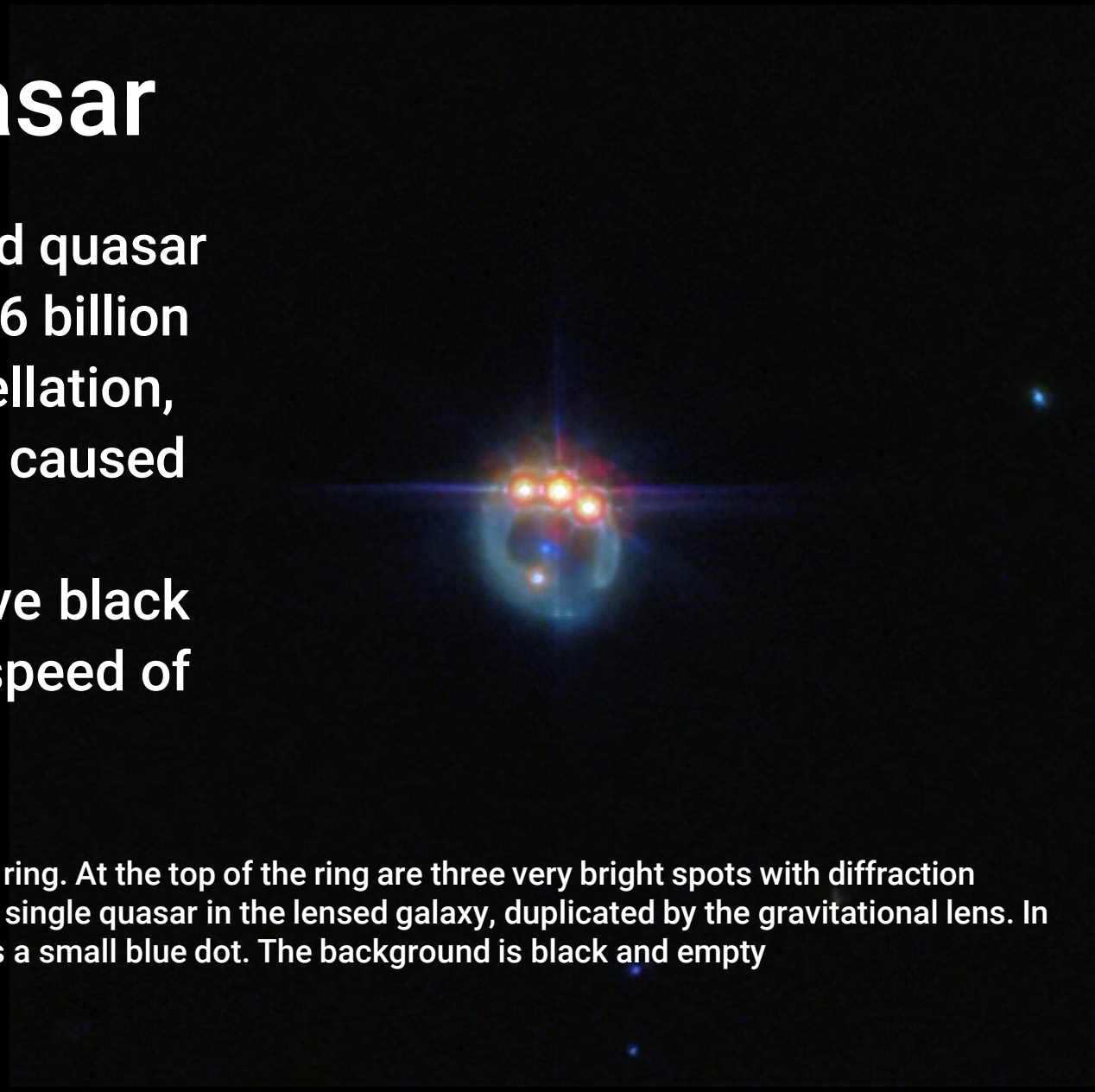
Bejewelled ring of a quasar

- JWST has imaged the gravitational lensed quasar known as RX J1131-1231. The quasar is 6 billion light years from Earth in the Crater constellation, and is visible due to gravitational lensing caused by a foreground elliptical galaxy
- The quasar is powered by a supermassive black hole which is spinning at about half the speed of light



A small image of a galaxy distorted by gravitational lensing into a dim ring. At the top of the ring are three very bright spots with diffraction spikes coming off them, right next to each other: these are copies of a single quasar in the lensed galaxy, duplicated by the gravitational lens. In the centre of the ring, the elliptical galaxy doing the lensing appears as a small blue dot. The background is black and empty
Credit: ESA/Webb, NASA & CSA, A. Nierenberg/CC BY 4.0 INT

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Measuring the distance to a supernova (1)

- A type 1a category supernova happens when a white dwarf, through accretion of material from a binary partner star, reaches a certain critical mass (approximately the Chandrasekhar Limit, about 1.44 solar masses)
- Type 1a supernovae produce an almost consistent peak luminosity due to the fixed critical mass. As there is a direct correlation between distance and apparent luminosity, these supernovae act as "standard candles" in measuring how far away the explosion occurred and, therefore, the distance between us and the host galaxy

This annotated Hubble image of NGC 3810 denotes the location of the Type Ia supernovae SN 2022zut. It was the 18,142nd supernova found in 2022
Credit: ESA/Hubble & NASA, D. Sand, R. J. Foley

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Measuring the distance to a supernova (2)

- However, it is not quite so simple to calculate the distance this way; the apparent luminosity can be affected by how much interstellar dust lies between the galaxy and the observer
- The Hubble Space Telescope observed SN2022zut in 2022. Astronomers have got around the dust problem by taking images in ultraviolet and in infrared light. The ultraviolet light was almost completely blocked out by the dust, whereas the infrared light passed through the dust unaffected. By noting how much light was received in each wavelength, astronomers were able to determine how much dust lies between NGC 3810 and Hubble
- Results show that NGC 3810 lies approximately 50 million light years from Earth
- By the way, this supernova was the 18,142 found in 2022. In a galaxy the size of our own, the Milky Way, a supernova should occur every hundred years (we have been waiting over 400 years for one) – just an indication of the scale of the Universe!

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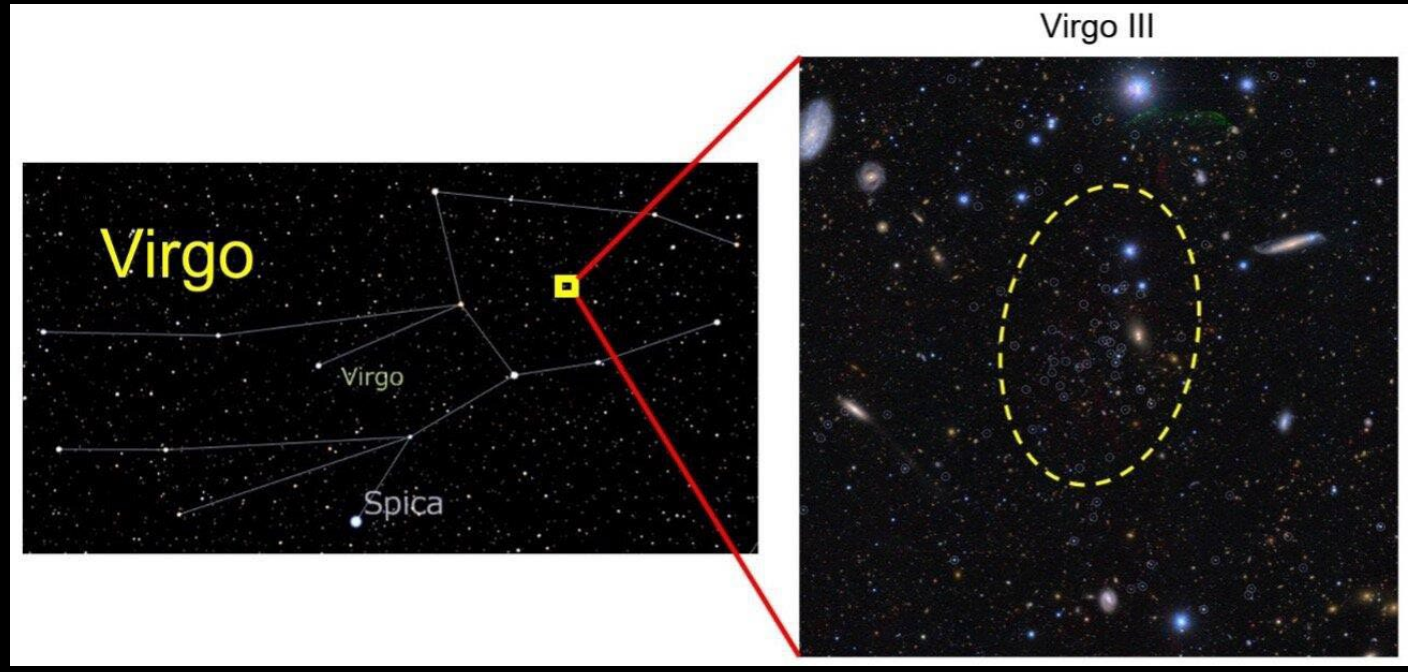
How many satellite galaxies do we have? (1)

- The standard dark matter model gives a prediction as to how much normal matter should be in a galaxy and, by default, the number of satellite galaxies that are gravitationally bound to the main galaxy
- For a galaxy such as the Milky Way there should be about 220 satellite galaxies but, until now, only seven had been found, leading to the "missing satellites problem"



The position of a newly found dwarf galaxy (Virgo III) in the constellation Virgo (left) and its member stars (right; those circled in white). The member stars are concentrated inside the dashed line in the right panel
Credit: NAOJ/Tohoku University

How many satellite galaxies do we have? (2)

- Now, a team working on data from the Hyper Suprime-Cam (HSC) Subaru Strategic Program (SSP), using the Subaru Telescope in Hawaii, have discovered two more, called Virgo III and Sextans II
- It had been thought for a while that detecting satellite galaxies would be difficult, but the Subaru Telescope is the ideal instrument to help locate them. In fact it had already found three of the previous dwarf galaxies
- Still a long way to go. But, the footprint of the HSC-SSP only covers a small part of the entire Milky Way and, if the distribution of the current nine known satellite galaxies is reflected across the whole region, then there may be up to 500 satellite galaxies. Could this mean we have a "too many satellites” problem, rather than a "missing satellites” problem?

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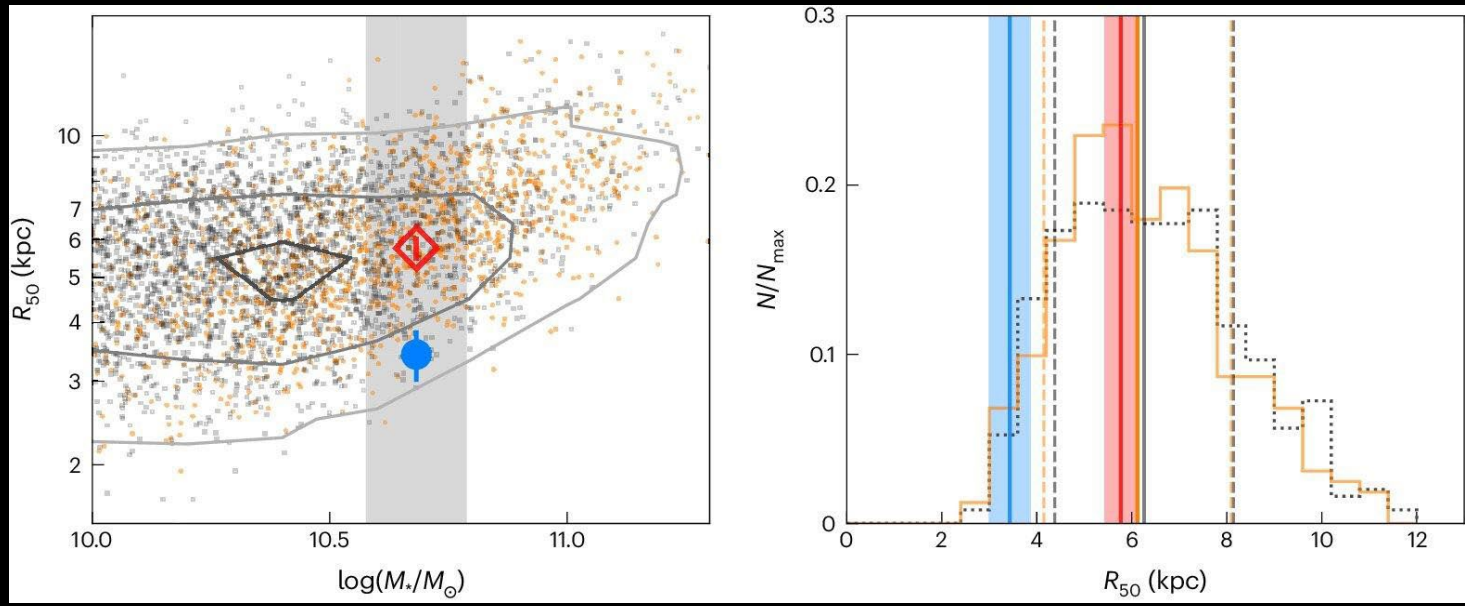
A less-dense, fewer starred Milky Way (1)

- Over the past few years, there have been many investigations into the size of the Milky Way. Until ten years ago, most research was pointing to a larger Milky Way than originally thought, with up to 50% more stars. Recent work though has been revising the size and density downwards



The half-light radius of the Milky Way in comparison with that of local disk galaxies
Credit: Nature Astronomy (2024). DOI: 10.1038/s41550-024-02315-7

- How do astronomers estimate how big the Milky Way is? Sitting along an arm of the galaxy, midway from the centre, makes it quite difficult to accurately discern the structure of the Milky Way. Previous estimates used the star count in small discrete parts of the galaxy, together with the structural appearance of similar spiral galaxies

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A less-dense, fewer starred Milky Way (2)

- A new model of the Milky Way, created by a team from New Mexico State University, the University of Utah, the University of St Andrews, and Yunnan University, suggests that there are far fewer stars in our galaxy than previously thought
- The study was based on a census of red giants, using data from the Apache Point Observatory Galactic Evolution Experiment (APOGEE). This data allowed the researchers to see red giants normally obscured by interstellar dust. The resulting count (about 250,000) and their positions, allowed the team to build a better distribution map, especially near the galactic bulge
- The findings showed that the density of red giants levelled off midway between the bulge and the edge of the galaxy. Previous models indicated that the numbers increased exponentially. It also indicated that the bulge is not as dense as previously thought. In addition, the galaxy half-light radius (from within which half of the total light of a galaxy is emitted) is about twice as large as in earlier models

A less-dense, fewer starred Milky Way (3)

- This means that stars are more spread out, and that there are fewer of them than previously thought. So, the Milky Way has less mass (from normal matter) which means, from calculations of the rotational curve, it must have more dark matter to compensate

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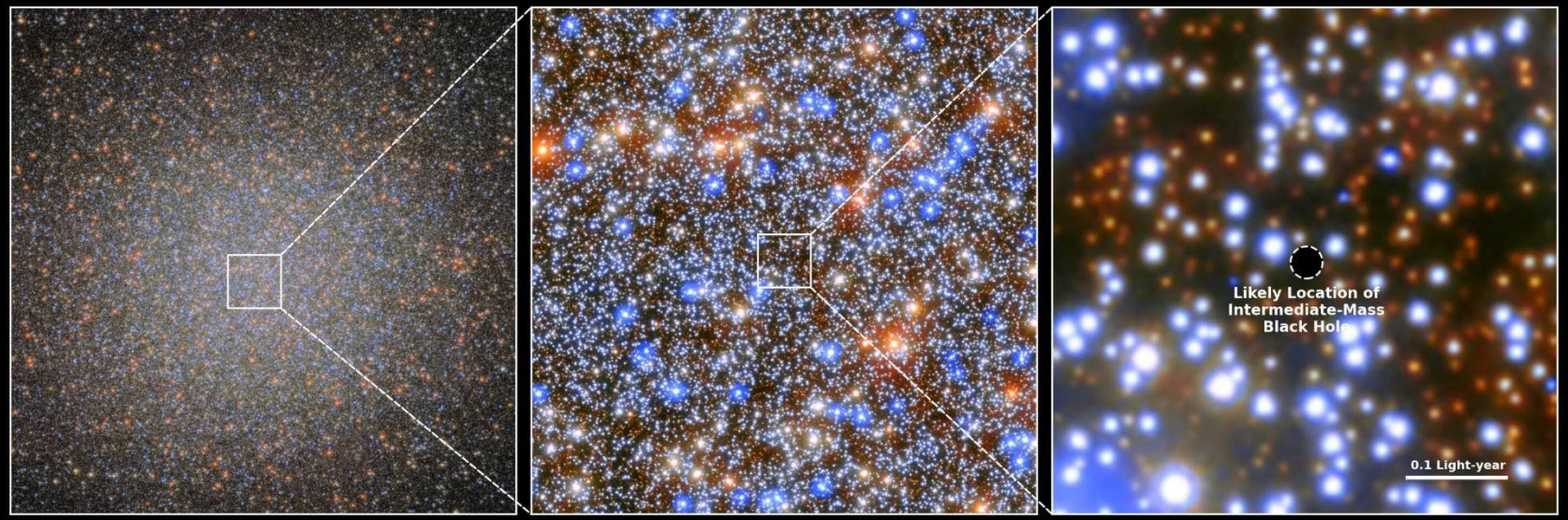
The missing black hole link (1)

- Black holes come in all sorts of sizes – or should do. Astronomers know of many supermassive black holes; one is thought to be at the centre of most galaxies. These have masses millions or billions of times that of the Sun



From left to right: The globular star cluster Omega Centauri as a whole, a zoomed-in version of the central area, and the region in the very centre with the location of the mid-size black hole that was identified in the present study marked
Credit: ESA/Hubble & NASA, M. Häberle (MPIA)

- At the other end are the stellar black holes, with masses between one and a few dozen solar masses (the mergers of these are responsible for the gravitational waves detected by LIGO and VIRGO over the past 10 years). But, up to now, intermediate-sized black holes have remained stubbornly elusive

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The missing black hole link (2)

- A new study of the star cluster Omega Centauri, 18,000 light-years from Earth, led by Maximilian Häberle of the Max Planck Institute for Astronomy, may have discovered the missing link; a black hole with a solar mass of 8,200
- Omega Centauri, with about 10 million stars, looks no different to many other globular clusters. But Häberle believes that it is the core region of a small galaxy that was devoured by the Milky Way billions of years ago; this has been suspected for a little while. Now stripped of its outer stars, the core remains frozen in time, its evolution stopped. With no more mergers, the black hole has not been able to grow further
- To test this idea, Häberle had to find stars with abnormally high velocities in the neighbourhood of the suspected black hole. To do this he had to study over 500 images provide by Hubble. In the end he found seven such stars

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The missing black hole link (3)

- By plotting the speed and direction of each of the seven stars, Häberle was able to determine that there must be a central mass with at least 8,200 solar masses, in an area no more than three light months in diameter – the equivalent of three arc seconds on the images. Where it should be, there was nothing visible, indicating the presence of a candidate black hole
- Watch the video of the discovery at: https://youtu.be/ilymo1qI2qo

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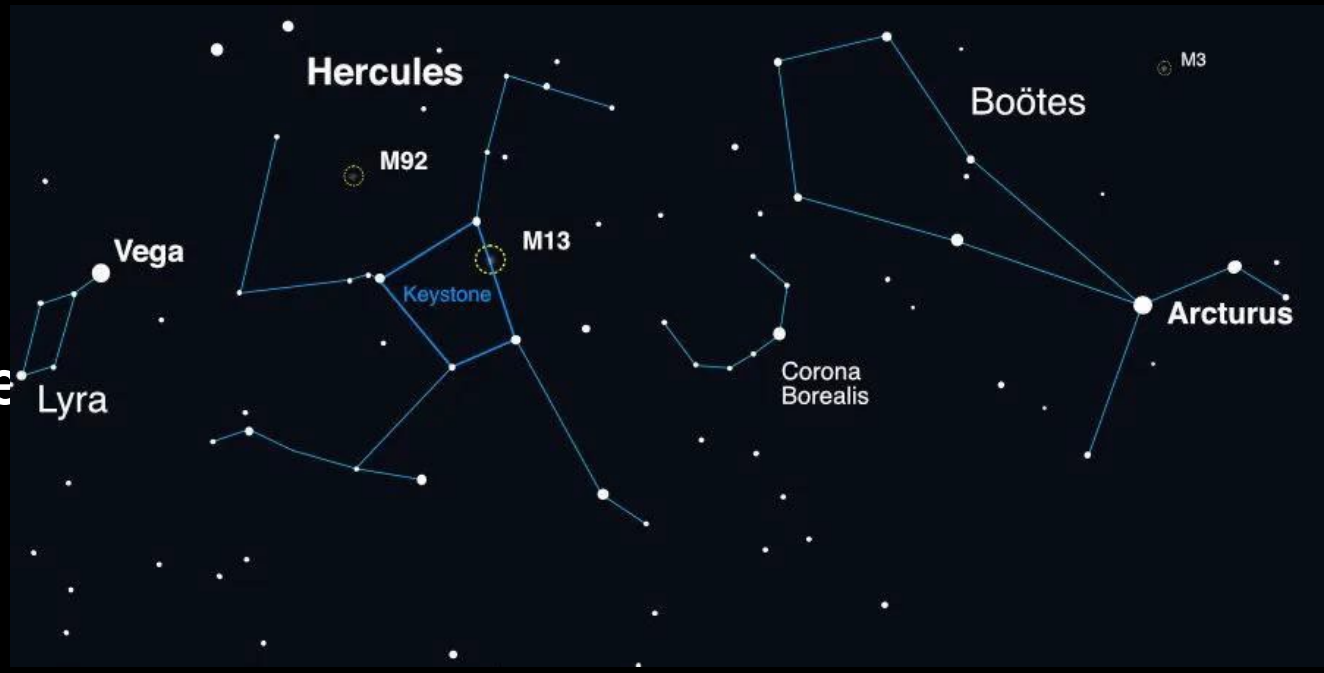
A close-by nova explosion coming soon (1)

- A star lighting up the night sky in an explosion is something we would all like to witness
- Most stellar explosions are supernovae, where the sudden collaps e of a giant star at the end of its life creates a cataclysmic explosion.
- They are a fairly regular occurrence across the Universe but, given the great distances to other galaxies, unlikely to be seen by anyone but a professional astronomer with a powerful telescope



A conceptual image of how to find Hercules and the “Northern Crown” in the night sky, created using planetarium software. Look up after sunset during summer months to find Hercules, then scan between Vega and Arcturus, where the distinct pattern of Corona Borealis may be identified
Credit: NASA

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A close-by nova explosion coming soon (2)

- To see one with the naked eye or a low-powered telescope would require the supernova to be in the Milky Way. One should happen every hundred years or so on average. The last one occurred just before Galileo had his first telescope, so one is overdue (cue, Betelguese!)
- But another less massive explosion does occur more frequently, and more locally – a Nova explosion
- Nova explosions may be less powerful, but they have one major advantage over supernovae – they are not the final end game; they recur in a relatively predictable way
- T Coronae Borealis, known as “TCrB”, or the “Blaze Star”, is a binary system some 3,000 light years from Earth. The binary consists of a red giant and white dwarf. The white dwarf is drawing hydrogen off the red giant

A close-by nova explosion coming soon (3)

- The hydrogen accretes on the surface of the white dwarf, leading to a build-up of pressure and heat. Eventually, the situation becomes unstable and a thermonuclear explosion is triggered, powerful enough to blast off the accreted material
- Records of this nova date back over 800 years. The first sighting was noted by the monks of Ursberg Abbey in Germany, in 1217; the abbot wrote, “a faint star that for a time shone with great light”. The last observation was in 1946 and, given the periodicity of around 79 years, astronomers believe it could happen again as early as September 2024. Just over a year ago a pre-eruption dip in TCrB’s brightness was detected, could this be the prelude to the nova?
- But, like many astronomical events, some predictions have a habit of not happening or of being a bit of a let-down – there are no guarantees!

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Astronomy News in Brief (1)

- **Early Supermassive Black Hole defies astronomers** – SMBHs exist at the heart of almost all galaxies. Many are billions of times the mass of the Sun and the assumption is that they have grown to such sizes both through feeding frenzies of surrounding material (known as “ultra-effective feeding mode”) and through mergers. But the SMBH in J1120+0641, a galaxy that was 770 million years old when observed by JWST, shows no efficient feeding mechanism. How did it grow so large, so quickly?
- **Ancient star clusters discovered** – an international team of astronomers have used JWST to discover gravitationally-bound star clusters in an infant galaxy, dating to 460 million years after the Big Bang. The five-star clusters are part of the Cosmic Gems arc (SPT0615-JD1); a strongly-lensed galaxy. The arc was first found by Hubble during the RELICS (Reionization Lensing Cluster Survey) program of the lensing galaxy cluster SPT-CL J0615−5746. ESA has produced a short video panning across the Cosmic Gems arc; to view go to: https://youtu.be/WOIVc3bT93M
- **Pillar of Creation visualisations** – NASA, using data from Hubble (visible light) and JWST (infrared light), have produced two new short videos which take you on a trip around the Pillars of Creation in the Eagle Nebula, and how the interplay of stars and dust both create and are influenced by the Pillars. Watch them at: https://youtu.be/6aqnBoCuVVU and https://youtu.be/1itvyekUbWU

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Astronomy News in Brief (2)

- Brown dwarfs – “not planets, only failed stars”. Not the sort of tag line a brown dwarf should be given, being up to 75 times the size of Jupiter. But then, not much is known about them. With not enough mass to create the temperatures and pressures required to initiate nuclear fusion, brown dwarfs glow too dimly to be easily seen (the surface temperatures range from around 0°C to 2,000°C), and glowing only in the visible and near infrared spectrum means that they aren’t easily spotted. Surveys such as Pan- STARRS and Sloan Digital Sky Survey have discovered brown dwarfs up to a limit of about 150 light years from Earth. The new Vera C. Rubin Observatory on Cerro Pachón in Chile, which should come online next year, will use the LSST camera to take images across whole sky every few days. It is equipped with six filters in the optical and near infrared wavelengths, allowing it to detect faint brown dwarfs up to three times further away. It should then discover enough brown dwarfs that whole populations can be studied, and determine the distribution patterns of various subgroups

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Astronomy News in Brief (3)

- Mars meteorites – an international team of researchers, led by Ingrid Dauber of Brown University, USA, has been studying data provided by the NASA Insight lander. This reveals that meteorite hits have been underestimated by between two and tenfold. Separately, scientists from Imperial College and ETH-Zurich, led by Natalia Wójcicka and Geraldine Zenhaeusern, respectively have estimated that between 280 and 360 meteorites strike the planet each year, forming impact craters at least 8m in diameter. To get to these figures, the teams looked at 6 seismic events that happened near to the Insight Lander that could be categorically attributed to meteorite strikes; based on a specific acoustic atmospheric signal generated when meteorites enter the Martian atmosphere. These 6 events caused a particular type of marsquake at a much higher frequency than the tectonic type. Using these unique signatures allowed the researchers to get the new estimate

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Astronomy News in Brief (4)

- A cold and icy Martian past – over the past twenty years, investigations by a series of rovers and landers, together with observations from orbital satellites, have pointed to Mars having had a warm and wet past billions of years ago, before most of the atmosphere was lost. However, a new study of the soils on Mars suggests that there are many similarities with those found in Newfoundland; a cold, subarctic climate. The soils in the Gale Crater, where Curiosity has been working for the past 13 years, were laid down between 3 and 4 billion years ago in a period of relatively abundant water. Curiosity, in testing soil samples, has found that between 15% and 73% can be classified as “X-ray amorphous material”; rich in iron and silicon, but missing aluminium. Similar types of material are found back on Earth in the Tablelands of Gros Morne National Park in Newfoundland, in Northern California's Klamath Mountains, and in western Nevada. However, only in Newfoundland are the materials chemically similar to those in the Gale Crater, whereas those formed in the warmer climates of California and Nevada are quite different

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Astronomy News in Brief (5)

- **Two more close encounters of the asteroid kind** – within the space of a week, two large asteroids passed quite close to Earth. The first asteroid, 2024 MK, is thought to be between 120 and 260m in size, was only discovered a week before passing Earth at a distance of 290,000km. The second, asteroid (415029) 2011 UL21, is much larger, at 2,310m in diameter, and has been known about since its discovery in October 2011. At its closest point, on 27th June, it was about seventeen times further away than the Moon is, at 6,634,850km. If you are interested in following the latest news about these close encounters, go to: https://www.esa.int/Space_Safety/Planetary_Defence
- **Many near-Earth objects likely to be dark comets** – up to 60% of the near-Earth objects could be dark comets which either contain, or have had, ice. This is another possible route that water was delivered to the young Earth. Dark comets seem to be a cross between normal comets and asteroids, and probably originate in the inner band of the main asteroid belt, rather than the Kuiper Belt or Oort Cloud

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Astronomy News in Brief (6)

- Time on the Moon just flies by – a key prediction, stemming from Einstein's Law of General Relativity, is that time is affected by the presence (or absence) of a large gravitational body. This is called Time Dilation, and one of its more dramatic examples is that the atomic clocks on GPS satellites run faster than they would do on Earth by about 45 microseconds a day. The same effect would be seen on the surface of the Moon, as compared with the Earth. Now a team of physicists at the Jet Propulsion Laboratory, at the California Institute of Technology, have calculated exactly what that would be: time on the Moon runs 0.0000575 seconds faster a day than it would do back on Earth. Should an astronaut spend 47.6 years on the Moon, they would be 1 second older than if they had stayed on Earth. This has practical implications, for example, in communications, and when landing and docking spacecraft, which demand a high degree of precision. Incidentally, scientists have found that climate change, in particular the melting of the Antarctic Ice Shelf which is causing rising sea levels, is making the Earth bulge more at the Equator, and is slowing down the rate of spin. At the current rate this will add 2.62 milliseconds on to the day-length by the end of the 21st century. This will have a serious effect on navigation and precise timekeeping – never mind the enormous inundation of much of the low-lying land

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Spaceflight News

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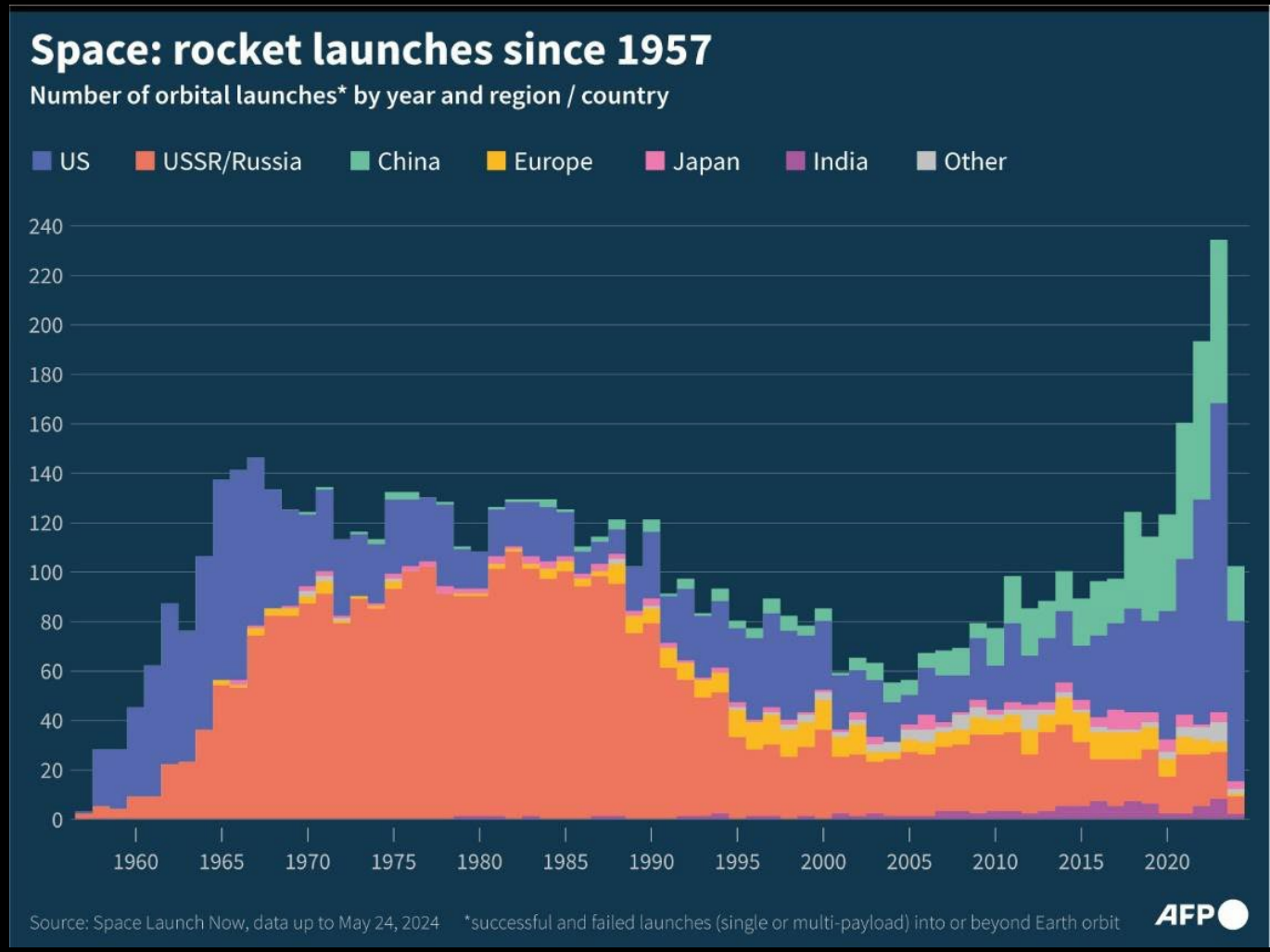
Ariane 6 (1): the expanding space market

- Over the past few years, there has been a surge in new rockets that are able to put everything from small cube satellites to rovers and landers on distant planets. Competition is fierce and any failure can set back a programme by months, or even years. With Europe's new entrant having completed its first test mission, just what can it do



Credit: Julia Han Janicki, Hervé Bouilly/AFP

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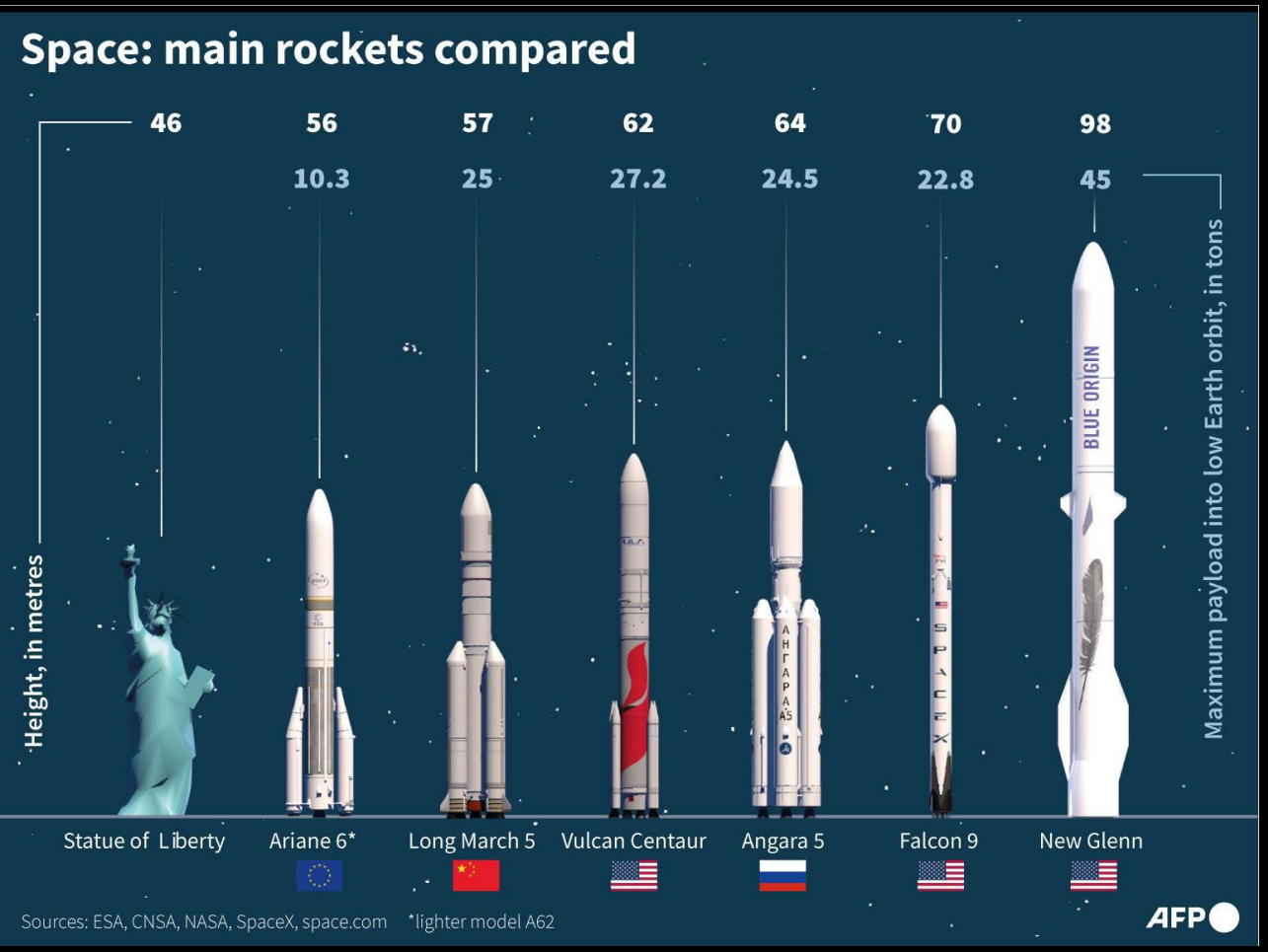
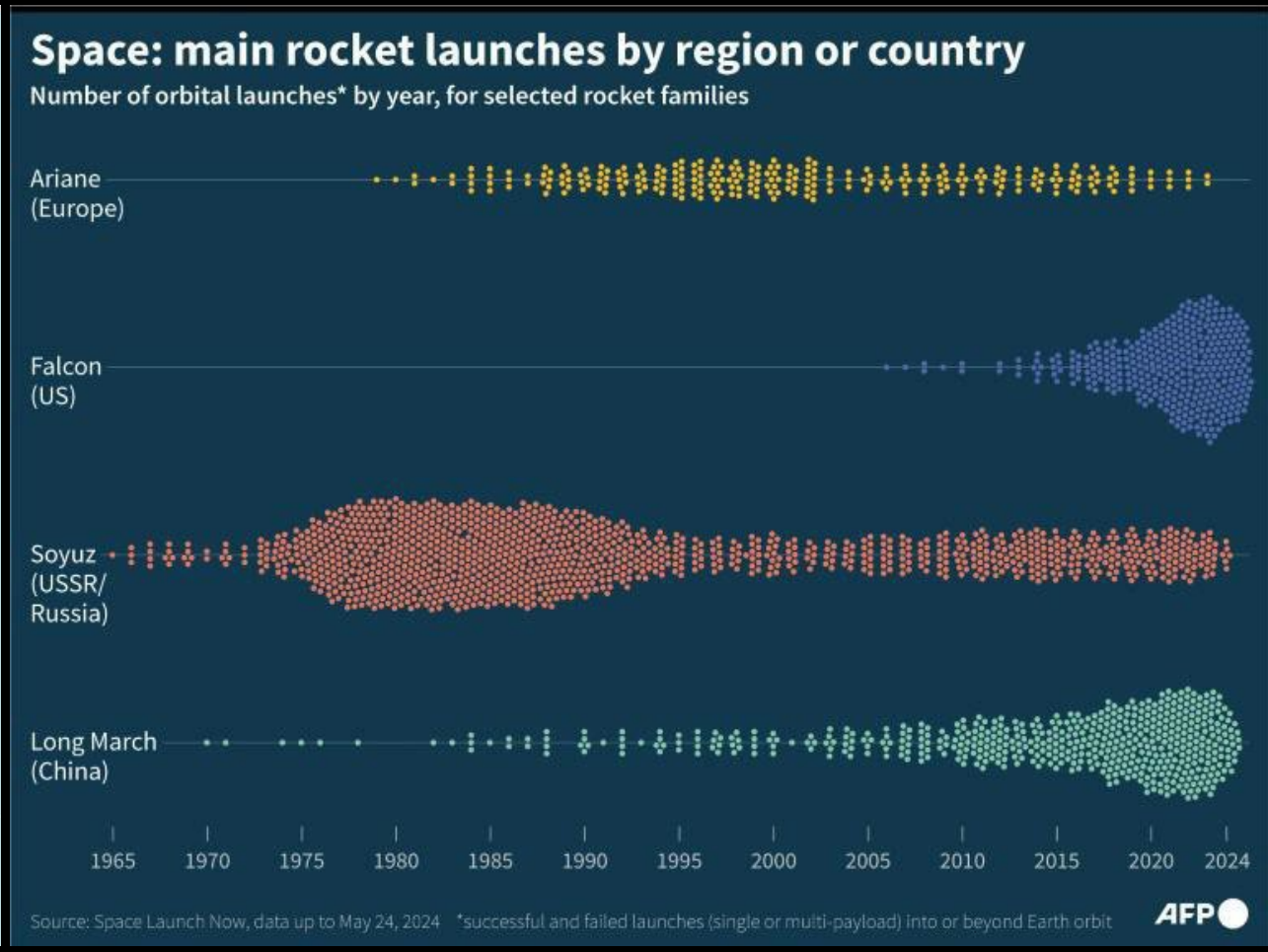
Ariane 6 (2): the main players



Credit: Stéphane Koguc, Gal Roma, Emmanuelle Michel/AFP



Credit: Julia Han Janicki, Hervé Bouilly/AFP

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Ariane 6 (3): Europe’s new rocket

- By 2014, the successful Ariane 5 rocket was approaching 20 years old and had been through a number of variations. The last, the Ariane 5ME, was designed to meet the challenge of lower-priced competitors. But, after nearly 8 years in development and with rising costs, it was cancelled in favour of a new model: the Ariane 6
- Although the carrying capacity is not much greater than the Ariane 5, advances in manufacturing means the launch cost will come down from 150m€ to about 75m€
- The two-stage liquid hydrogen/oxygen-powered Ariane 6 uses an upgraded Vulcain engine from the Ariane 5 for the first stage, but a completely new engine, Vinci, for the second stage
- The P120 solid fuel boosters is already used by Europe’s other rocket: the Vega C
- There are two variants: the A-62 (using 2 boosters) and the A-64 (Using 4 boosters), which determine how heavy a payload can be put into orbit
- Development overruns meant the first launch slipped from 2020 to 2024

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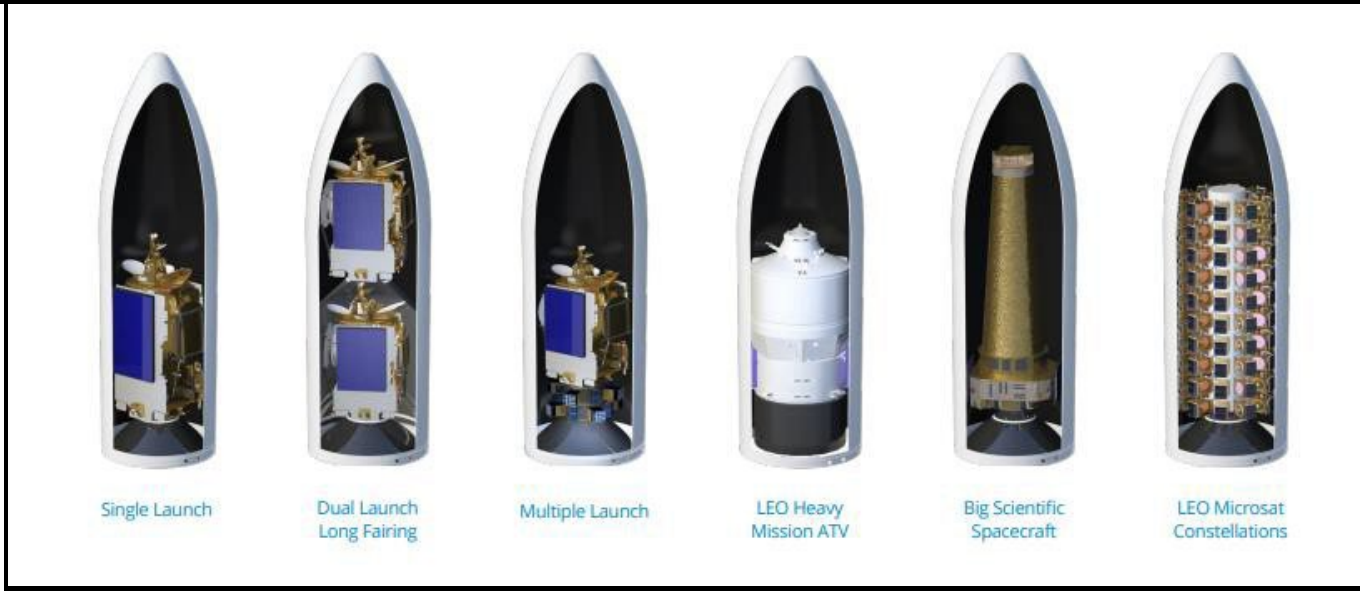
Ariane 6 (4): evolution of the Ariane



Left: Evolution of the Ariane family
Right: Satellite configuration in fairing of Ariane 6
Illustrations taken from Ariane 6 Brochure and Ariane 6 User's Manual

- The first flight of Ariane 5 took place on 4th June 1996; the last on 5th July 2023
- Over 27 years, there were 117 launches of Ariane 5 in its six versions (G: 16, G+: 3, GS:6, ES: 8, ECA: 72 and ECA+: 12); 112 were successful

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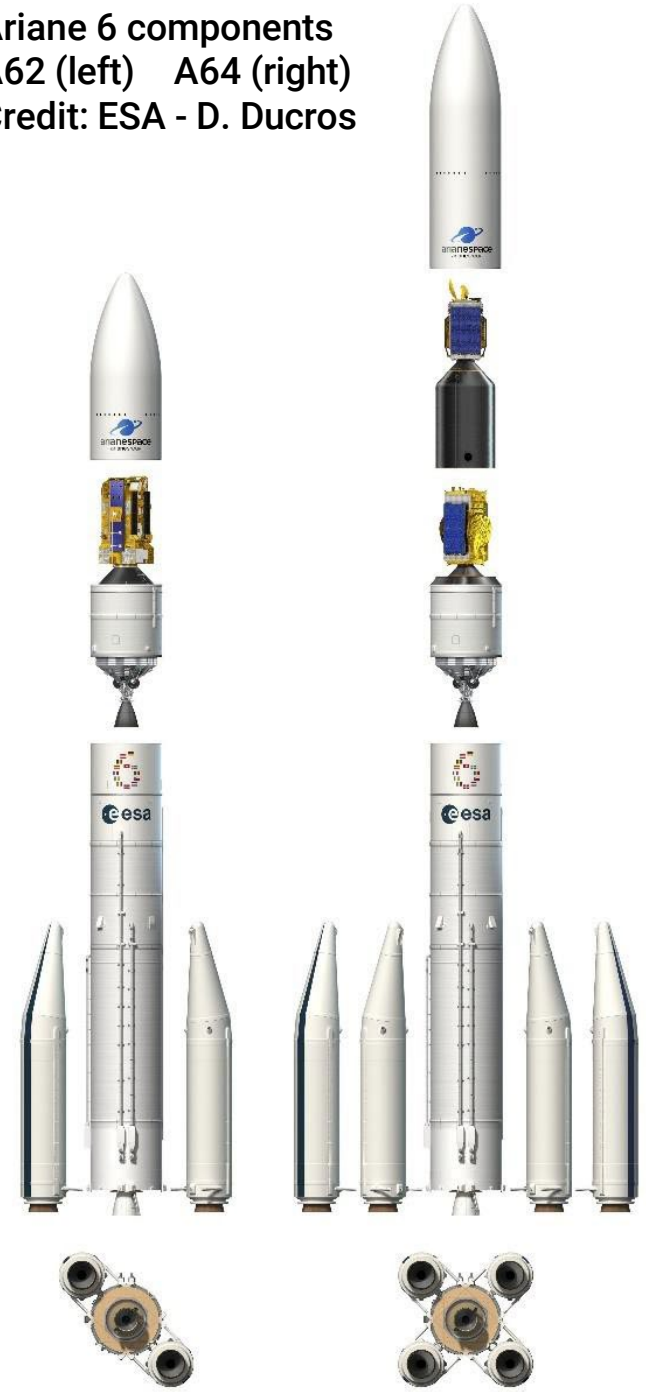
Ariane 6 (5): Ariane 5 comparison

	Ariane 6 - A62	Ariane 6 - A64	Ariane 5
Height	from 56m	up to 62m	50.5m
Fairing Height	14.0m	20.0m	20.0m
Diameter	5.4m	5.4m	5.4m
Booster Height	11.7m	11.7m	30.0m
Booster Diameter	3m	3m	3.06m
Take-off Weight	530 tonnes	860 tonnes	780 tonnes
Stages	2	2	2
Take-off Thrust	8,000kN	15,000kN	13,400kN
First Stage Engine: Vulcain 2.1	1,350kN	1,350kN	-
First Stage Engine: Vulcain 2.0	-	-	1,390kN
Second Stage Engine: Vinci	180kN	180kN	-
Second Stage Engine: HM7B	-	-	67kN
Boosters: P120C (P241 - Ariane 5)	2 x 3,500kN	4 x 3,500kN	2 x 7,080kN
PAYLOAD			
Low Earth Orbit (LEO)	10.35 tonnes	21.65 tonnes	20.00 tonnes
Medium Earth Orbit (MEO)	10.00 tonnes	20.00 tonnes	-
High Earth Orbit (HEO)	3.30 tonnes	8.00 tonnes	-
Sun-synchronous Orbit (SSO)	7.20 tonnes	15.50 tonnes	-
Geostationary Transfer Oribit (GTO)	4.50 tonnes	11.50 tonnes	10.86 tonnes
Lunar Transfer Orbit (LTO)	3.50 tonnes	8.60 tonnes	-
Earth Escape Mission	2.60 tonnes	6.90 tonnes	-

Ariane 6 components
A62 (left) A64 (right)
Credit: ESA - D. Ducros



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Ariane 6 (6): maiden flight (1)

- Flight VA262 lifted off from ELA-4 (Ariane Launch Complex 4) at the Guiana Space Centre (Europe's Spaceport), to the northwest of Kourou in French Guiana, at 19:01 UTC on 9th July 2024. The Ariane 6, in A-62 mode, used rocket serial number L6001
- This test flight carried a mass simulator and a number of payload satellites (cubesats)
- The launch was completely successful and achieved orbit. The second stage engine was briefly relit to release the cubesats at 580km
- On attempting a third burn to deorbit the upper stage, the auxiliary propulsion system failed and the engine could not be relit; two re-entry capsules were lost

Ariane 6 first test flight, July 9th 2024, Kourou, French Guiana
Credit: ESA - S. Corvaja

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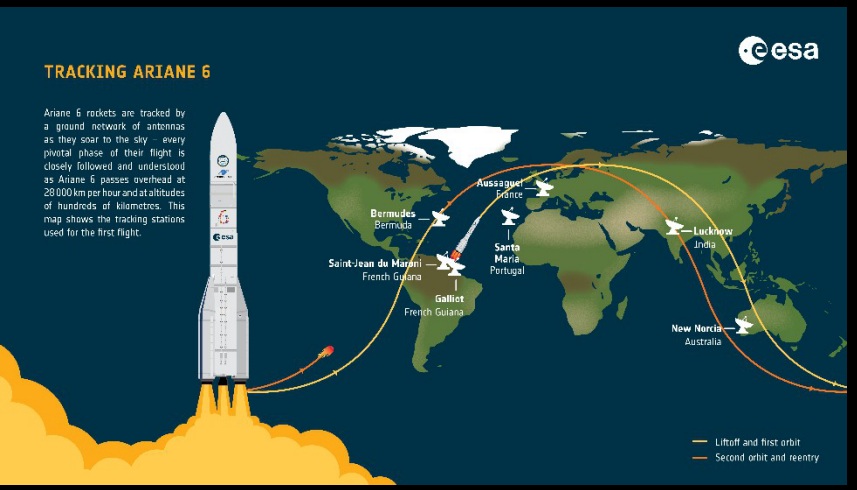
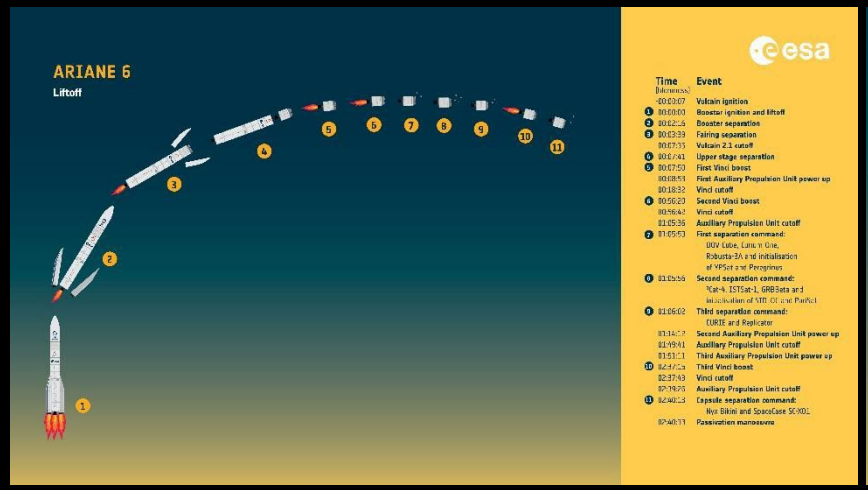
Ariane 6 (7): maiden flight (2)





Tracking Ariane 6 flight

Mission timeline

Satellites on first flight

Credit: ESA - D. Ducros (all three infographics)

- Although only about 95% successful, a second launch is still on track for later this year. This will deploy a French military satellite
- Three more A-62 launches are planned for early 2025 (carrying 6 Galileo navigation satellites) before the first A-64 mission, putting Intelsat 41 and 44 in orbit; 42 and 43 will be launched on a Falcon 9 rocket

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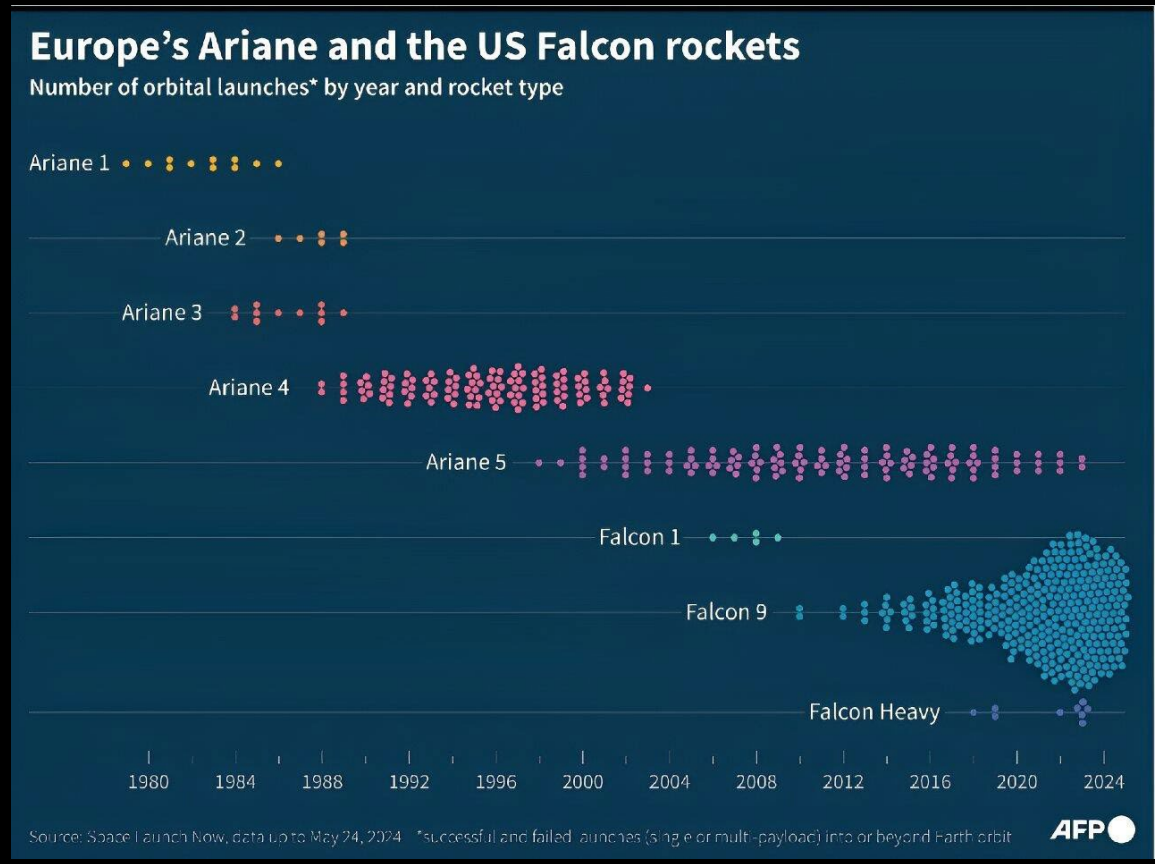
Ariane 6 (8): versus SpaceX Falcon 9

- The slow development of Ariane 6 has allowed SpaceX to gain a huge amount of market share with its Falcon 9 rocket
- Falcon 9's first stage is fully reusable (and can be turned around in a matter of weeks after landing on a drone ship), and a Falcon 9 rocket launches once every 2-3 days on average (Ariane 6 will only manage a once the month launch at best)
- Falcon 9 can carry 22,800kg to LEO (when fully expended) and 17,500kg when first stage is recovered; 8,300kg/3,500kg respectively to GTO



Credit: Julia Han Janicki, Hervé Bouilly/AFP

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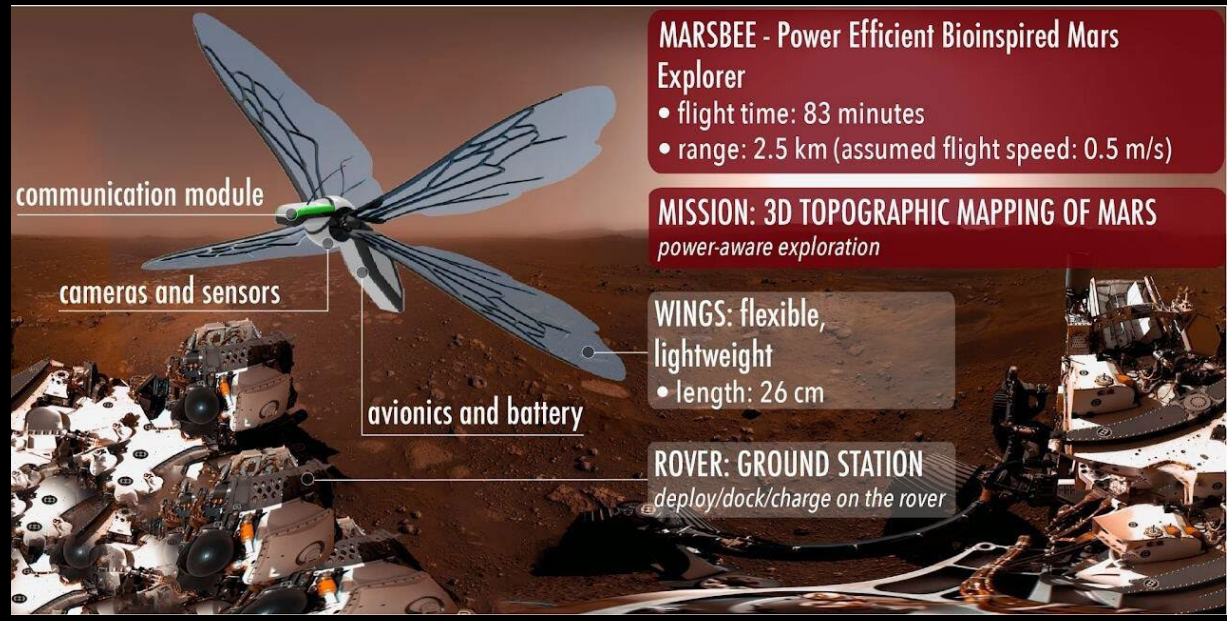
From Ingenuity to Bees over Mars (1)

- The Ingenuity quadcopter has been one of the most successful innovations ever taken to another planet. The unproven design out-performed its design parameters; flying further, higher and longer than ever dreamed possible
- Now that its operational life is over, what follows it? Further quadcopters, or something else?



Artist's depiction of the Marsbee concept
Credit: Chang-Kwon Kang, University of Alabama at Huntsville, et al

- Although it has been very successful, a quadcopter does have limitations; a relatively large size and limited flight time. Researchers from the University of Alabama have been following up on a concept that originated from the University of Tokyo – a dragonfly-like micro aerial vehicle (MAV)

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From Ingenuity to Bees over Mars (2)

- A fixed but flexible wing design would be smaller and, using less energy, be airborne for longer, so more could be carried by a lander: a Marsbee
- But, whilst the design could work in the Earth's relatively-thick atmosphere, there would be major issues getting the wings to push against the thin Martian atmosphere. If solved, will a small Marsbee be able to survive the vagaries of the Martian winds? It would also need to rely on a GPS system, something which doesn't yet exist around Mars
- For the time being, the project has been put on hold but, as technology develops, a time will come when there may be a swarm of robotic bees above the Martian surface
- See the video at: https://youtu.be/HjhPqE3hUzs

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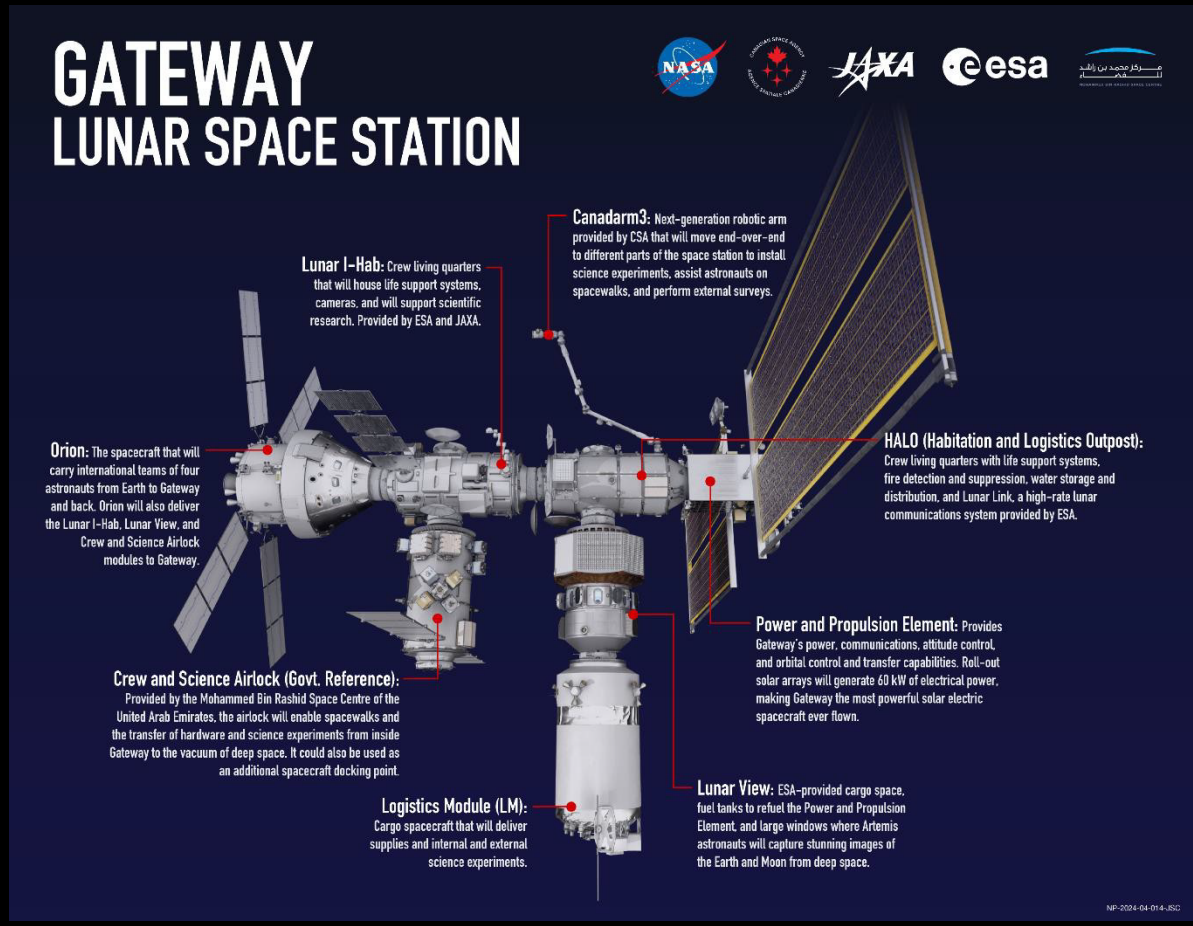
NASA’s Gateway Luna Space Station (1)

- NASA has released a detailed 3D animation of the future Gateway space station, construction of which is due to start in 2028 with the Artemis IV mission
- The Gateway space station consists of the following modules:

1. Power and Propulsion Element that will make Gateway the most powerful solar electric spacecraft ever flown. The module will use the Sun’s energy to power the space station’s subsystems and ionize xenon gas to produce the thrust that will maintain Gateway’s unique polar orbit



Credit: NASA

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NASA’s Gateway Luna Space Station (2)

2. HALO (Habitation and Logistics Outpost): Gateway’s command and control nexus providing communications between Earth and the lunar surface, with the Lunar Link system provided by ESA (European Space Agency). HALO will house life support systems, including exercise equipment and science payload banks
3. Lunar I-Hab, provided by ESA with hardware contributions from JAXA (Japan Aerospace Exploration Agency), will host environmental control and life support systems, sleeping quarters, and a galley, among other features
4. Lunar View, provided by ESA, will have refuelling capabilities for the Power and Propulsion Element, cargo storage, and large windows
5. Crew and Science Airlock, provided by the Mohammad Bin Rashid Space Centre of the United Arab Emirates, for crew and hardware transfer from Gateway’s interior to the vacuum of space

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NASA’s Gateway Luna Space Station (3)

6. Canadarm3 advanced external robotic system provided by CSA (Canadian Space Agency)
- Deep Space Logistics spacecraft that will transport cargo to Gateway to support Artemis missions
- Various payloads are illustrated in the animation, including: ERSA (European Radiation Sensors Array), provided by ESA, attached to the Power and Propulsion Element, and the NASA-led HERMES (Heliophysics Environmental and Radiation Measurement Experiment Suite), attached to HALO
- A third payload, IDA (Internal Dosimeter Array), provided by ESA and JAXA, will be inside of HALO
- See the animation at: https://youtu.be/xpsX3qOgBj0 (credit: NASA/Bradley Reynolds, Alberto Bertolin)

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Space Tug to deorbit ISS when time comes (1)

- NASA has awarded SpaceX a $843 million contract to design and build a space vehicle which will be used to deorbit the ISS and have it safely crash into the Pacific Ocean, once the platform's operational life comes to an end in 2030 (or later)
- The space station is too expensive and high risk to take apart in space; it was never designed to be. There are no current reusable spacecrafts as big as the Shuttle that could do that

This image, provided by SpaceX, shows an artistic rendering of the powerful capsule that will be used, once developed, to bring the ISS down through the atmosphere in January 2031. On 17th July 2024, NASA and SpaceX outlined the plan to burn the International Space Station up on reentry and plunge what's left into the ocean, ideally at the beginning of 2031 when it hits the 32-year mark
Credit: SpaceX via AP

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Space Tug to deorbit ISS when time comes (2)

- Boosting the ISS into a higher orbit is also a very risky strategy, although visiting spacecraft do currently give it small boosts now to maintain it at about 420km above the Earth’s surface
- Steering it towards a fiery end would still mean large chunks not burning up, leaving a debris field up to 2,000 km long. A controlled de-orbit is required
- SpaceX will use a souped-up Dragon capsule with up to 46 thrusters to give it a huge amount of control
- The enlarged capsule would require a very powerful rocket to launch it. It would be sent up about 18 months before ISS’s planned demise. For the first year, the ISS would still be manned but 6 months before D-day, and whilst the station was gradually lowered, they would return to Earth
- Once the ISS reaches about 220km, the Dragon capsule will initiate the final four-day countdown

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Spaceflight News and Updates (1)

- Satellite breakup causes ISS astronauts to take shelter – in a precautionary measure, the nine crew of the ISS were moved to their three docked spacecraft after a non-operational Russian satellite (Resurs-P1) appeared to be breaking up. From Earth, over 100 trackable pieces of debris were recorded. Currently, the North American Aerospace Defense Command (NORAD) is tracking more than 45,300 space objects overall. There are 7,560 operational satellites orbiting the Earth, and many more non-operational satellites which are not controllable
- French-Chinese joint satellite launched – in a rare example of cooperation between China and a western country, the Space Variable Objects Monitor (SVOM) satellite has been launched, using a Chinese Long March 2-C on 22nd June. The satellite carries 4 instruments (2 Chinese, 2 French) and will investigate gamma-ray bursts, which often date back to the early universe. The rays carry traces of the environment they move through, such as gas clouds and galaxies, and the data they provide helps in the understanding of the evolution of the universe

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Spaceflight News and Updates (2)

- GOES-U becomes GOES-19 – the latest GOES satellite (Geostationary Operational Environmental Satellite) operated by NOAA (US National Oceanic and Atmospheric Administration) has been successfully placed in geostationary orbit, 22,236 miles above the Equator. As with all preceding GOES satellites, the letter suffix used prior and during launch is replaced by a number once in geostationary orbit. Launched on 25th June by a SpaceX Falcon Heavy rocket from Cape Canaveral, the satellite was put into a highly-elliptical geostationary transfer orbit (GTO), before GOES-U performed a number of burns and manoeuvres to get into the geostationary orbit. Prior to coming online in September, it will need to move to second-stage deployment of its solar array, release the magnetometer boom, carry out instrument checks, and move to a position 89.5° west in order to observe storms approaching the American continent, and to monitor solar activity that could affect communications and navigations. You can see the launch at: https://youtu.be/KvhJd23TNAI and separation of GOES-U from the Falcon Heavy rocket at: https://youtu.be/CNO9QTw9dvo

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Spaceflight News and Updates (3)

- China opens sample container from Chang'e 6 – the sample container, from the Chang'e 6 mission to the far side of the Moon, has been opened at the China Academy of Space Technology (CAST), in Beijing, on 26th June. 1.9353kg of lunar material was recovered. It will now be transferred to specially developed facilities for storage, analysis and distribution for research. In 2 years-time, international groups will be able to apply for access to the material
- Ariane 6 delays cost it a European customer – the years of delays over the development and launch of the new European Space Agencies' Ariane 6 rocket has led Europe's weather satellite operator (EUMETSAT) to cancel the MTG-S1 weather satellite launch and opt for a ride on a Falcon 9. The European Organization for the Exploitation of Meteorological Satellites (EUMETSAT) signed a contract with Arianespace, operator of the Ariane range of rockets, four years ago and was due to be third in line to use Ariane 6

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Spaceflight News and Updates (4)

- Rare Falcon 9 failure – a routine launch of 20 Starlink satellites on 11th July ended in failure when a liquid oxygen tank in the second stage developed a leak, resulting in the second stage engine not completing the burn. This means that the satellites have been placed in a lower orbit than planned, where they will be affected by atmospheric drag and will re-enter to meet an earlier-than-anticipated fiery end. The FAA had to investigate the mission, meaning that all SpaceX Falcon 9 and Heavy Falcon launches were suspended. SpaceX quickly identified the problem and fixed the issue. With the FAA investigation completed, flights were able to resume and a Falcon 9 took off in the early hours of 27th July placing 23 Starlink satellites into their correct orbit
- Dream Chaser spaceplane launch delayed to 2025 – the new Dream Chaser spaceplane from Sierra Space, which was due to be launched this summer on United Launch Alliance's Vulcan Centaur rocket, has been pushed back until next year by ULA. The new Vulcan Centaur rocket was first flown earlier this year in the launch of the Peregrine Lunar Lander, which failed to make it to the Moon due to an unrelated anomaly. Now, ULA have to complete two launches for the US military first

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Spaceflight News and Updates (5)

- Household, hit by space debris, make claim – in the May Newsletter, we reported on the house that was hit by a small part of waste jettisoned from the ISS. An object, weighing less than 700 grams, hit the roof of a house in Naples, Florida, causing some damage. Although the owner's son was in the house at the time he was not hurt. Now the family are making a claim against NASA for $80,000. Their lawyer announced, "My clients are seeking adequate compensation to account for the stress and impact that this event had on their lives". The object was the remains of a cargo pallet of used batteries which failed to fully burn up on reentry
- SpaceX space junk rains onto farm in Canada – it is supposed to burn up in the atmosphere, or land harmlessly in the oceans, but more space debris has crashed onto famers fields in Saskatchewan, Canada. The remains were part of the cargo module attached to the SpaceX Crew Dragon capsule, used on the Axiom Space private astronaut mission in February. Jettisoned prior to the capsule's return, the cargo module re-entered the Earth's atmosphere several weeks later. This episode, which happened in April, isn't the first time that parts from a SpaceX Crew Dragon cargo module have hit the Earth; the first crewed Dragon mission resulted in pieces being strewn across fields in Australia, and parts from a different Crew Dragon mission landed in North Carolina

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Spaceflight News and Updates (6)

- Spacesuit leak – a coolant leak from the spacesuits worn by astronaut Tracy Dyson, just as a spacewalk was about to start on 24th June, has caused NASA to suspend all spacewalks until the issue has been fully investigated. Meanwhile, the astronauts on the Polaris Dawn mission, SpaceX's first privately-funded crewed mission, which is due to launch later this year, have just completed acceptance testing of their new extravehicular activity (EVA) spacesuits. This will allow them to become the first private citizens to perform spacewalks

Polaris Dawn EVA spacesuit acceptance testing (left)
Anna Menon and Sarah Gillis (above) Credit: Polaris Program / John Kraus

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Observational Highlights

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Perseid meteor shower

- This year's Perseid meteor shower should be one of the best, as the Moon is out of the way
- The shower, which is a result of the Earth moving through the debris trail of comet 109P/Swift Tuttle, should be visible between 17th July to 24th August
- The peak is over the night of 12th August/morning of 13th August

Credit: Orbital Today/Almanac.com

- In dark skies, up to 100 meteors an hour may be seen, although with light pollution the numbers visible will be lower. The meteors are classified as 'fast'. The Moon sets at 22:50 BST

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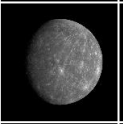
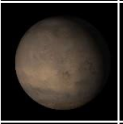
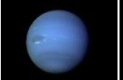
Planets (information for 1st August)

	Planet	Rises	Sets	Highest	Direction	Altitude	Magnitude	Visible
	MERCURY	07:51	21:15	14:33			+0.95	NO
	VENUS	06:48	21:26	14:07			-3.85	NO
	MARS	00:44	16:37	08:41	East	32° ▫	+0.89	YES
	JUPITER	01:07	17:12	09:09	East	33° ▫▫	-2.12	YES
	SATURN	22:08	09:10	03:39	South	32°	+0.85	YES
	URANUS	00:11	15:40	07:56	East	31° *	+5.76	YES
	NEPTUNE	22:22	10:15	04:19	South	37° *	+7.84	YES

* = Highest point at Dawn (03:41 - last visible sighting)
** = Highest point at Dusk (22:27 - first visible sighting)
▫ = Highest point when last visible (04:29)
◊ = Highest point when first visible
▫▫ = Highest point when last visible (05:00)
◊◊ = Highest point when first visible

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

Object	Name	Constellation	Type	↗	↘	Highest	Direction	Alt	Mag
Cr50	The Hyades	Taurus	Open Cluster	01:19	04:27	04:27 ◊	East	28°	+1.0
Mel20	The Alpha Persei Cluster	Perseus	Open Cluster	21:45	04:24	04:24 ◊	East	58°	+1.2
Cr39	Collinder 39	Perseus	Open Cluster	21:45	04:24	04:24 ◊	East	58°	+1.2
M45	The Pleiades	Taurus	Cluster with Nebulosity	23:48	04:22	04:22 ◊	East	39°	+1.3
Mel111	The Coma Star Cluster	Coma Berenices	Open Cluster	21:55	01:15	21:55 ◊◊	West	27°	+1.8
Cr256	Collinder 256	Coma Berenices	Open Cluster	21:55	01:14	21:55 ◊◊	West	26°	+1.8
M102	The Spindle Galaxy	Draco	Galaxy	22:27	03:41	22:27 **	North-West	62°	+10.0
M76	The Little Dumbell Nebula	Perseus	Planetary Nebula	22:27	03:41	03:41 *	East	68°	+10.1
M108	Galaxy	Ursa Major	Galaxy	22:27	03:41	22:27 **	North-West	33°	+10.1
C33	The Eastern Veil Nebula	Cygnus	Nebula	22:27	03:41	01:16	South	70°	+2.7
Mel186	Melotte 186	Ophiuchus	Open Cluster	22:17	04:36	22:17 ◊◊	South	42°	+3.0
Cr359	Collinder 359	Ophiuchus	Open Cluster	22:27	04:35	22:27 **	South	42°	+3.0
M31	Andromeda Galaxy	Andromeda	Galaxy	22:26	03:42	03:42 ◊	South-East	73°	+3.4
Cr439	The Elephant Trunk	Cepheus	Cluster with Nebulosity	22:27	03:41	01:58	North	83°	+3.5
Cr399	Brocchi's Cluster	Vulpecula	Open Cluster	22:27	03:41	23:41	South	59°	+3.6

* = Highest point at Dawn (03:41 - last visible sighting)
** = Highest point at Dusk (22:27 - 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 August)

Object	Name	Constellation	Type	↗	↘	Highest	Direction	Alt	Mag
Cr62	Collinder 62	Auriga	Open Cluster	02:05	03:41	03:41 *	North-East	30°	+4.2
Cr464	Collinder 464	Camelopardalis	Open Cluster	22:27	03:41	03:41 *	North-East	53°	+4.2
Cr349	Open Cluster	Ophiuchus	Open Cluster	22:27	04:34	22:27 **	South	44°	+4.2
C14	The Perseus Double Cluster	Perseus	Open Cluster	22:27	03:41	03:41 *	North-East	63°	+4.3
M39	Open Cluster	Cygnus	Open Cluster	22:27	03:41	03:41 *	West	72°	+4.6
NGC6633	Open Cluster	Ophiuchus	Open Cluster	22:27	03:13	22:43	South	45°	+4.6
M24	Delle Caustiche	Sagittarius	Asterism	22:27	23:39	22:33	South	20°	+4.6
M25	Open Cluster	Sagittarius	Open Cluster	22:27	23:38	22:48	South	20°	+4.6
Cr386	Graff's Cluster	Serpens Cauda	Open Cluster	22:27	03:19	22:55	South	44°	+4.6
NGC1499	The California Nebula	Perseus	Bright Nebula	22:27	03:41	03:41 *	East	39°	+5.0
NGC6871	Open Cluster	Cygnus	Open Cluster	22:27	03:41	00:26	South	74°	+5.2
M34	The Spiral Cluster	Perseus	Open Cluster	22:27	03:41	03:41 *	North-East	55°	+5.2
NGC869	h Per Cluster	Perseus	Open Cluster	22:27	03:41	03:41 *	North-East	63°	+5.3
NGC7686	Open Cluster	Andromeda	Open Cluster	22:27	03:41	03:41 *	South-East	87°	+5.6
NGC752	Open Cluster	Andromeda	Open Cluster	22:27	03:41	03:41 *	East	59°	+5.7

* = Highest point at Dawn (03:41 - last visible sighting) ** = Highest point at Dusk (22:27 - 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 - 3 (Information for 1st August)

Object	Name	Constellation	Type	↗	↘	Highest	Direction	Alt	Mag
M5	Globular Cluster	Serpens Caput	Globular Cluster	22:27	01:49	22:27 **	South-West	29°	+5.7
NGC6882	Open Cluster	Vulpecula	Open Cluster	22:27	03:41	00:32	South	65°	+5.7
M13	Great Globular Cluster	Hercules	Globular Cluster	22:27	03:41	22:27 **	South-West	68°	+5.8
M11	Wild Duck Cluster	Scutum	Open Cluster	22:27	02:03	23:07	South	32°	+5.8
M33	Triangulum Galaxy	Triangulum	Galaxy	22:27	03:41	03:41 *	South-East	58°	+5.8
Cr29	Collinder 29	Perseus	Open Cluster	22:27	03:41	03:41 *	North-East	61°	+5.9
M36	The Pinwheel Cluster	Auriga	Open Cluster	00:01	03:41	03:41 *	North-East	23°	+6.0
IC405	The Flaming Star Nebula	Auriga	Nebula	22:38	03:41	03:41 *	North-East	26°	+6.0
NGC7000	The North American Nebula	Cygnus	HII Region	22:27	03:41	22:27 **	East	61°	+6.0
M17	The Omega Cluster	Sagittarius	Open Cluster	22:27	23:30	22:37	South	23°	+6.0
M16	The Eagle Nebula	Serpens Cauda	Open Cluster	22:27	00:12	22:35	South	25°	+6.0
NGC6605	Open Cluster	Serpens Cauda	Open Cluster	23:33	02:08	00:50	South	24°	+6.0
NGC7160	Open Cluster	Cepheus	Open Cluster	22:27	03:41	02:13	North	78°	+6.1
M12	Globular Cluster	Ophiuchus	Globular Cluster	22:27	02:58	22:27 **	South-West	34°	+6.1
Cr350	Collinder 350	Ophiuchus	Open Cluster	22:27	04:15	22:27 **	South	40°	+6.1

* = Highest point at Dawn (03:41 - last visible sighting) ** = Highest point at Dusk (22:27 - 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 - 4 (Information for 1st August)

Object	Name	Constellation	Type	↗	↘	Highest	Direction	Alt	Mag
NGC884	chi Per Cluster	Perseus	Open Cluster	22:27	03:41	03:41 *	North-East	63°	+6.1
NGC1545	Open Cluster	Perseus	Open Cluster	22:27	03:41	03:41 *	North-East	44°	+6.2
M3	Globular Cluster	Canes Venatici	Globular Cluster	22:27	02:51	22:27 **	West	35°	+6.3
M15	Globular Cluster	Pegasus	Globular Cluster	22:27	03:41	01:50	South	51°	+6.3
NGC6940	Open Cluster	Vulpecula	Open Cluster	22:27	03:41	00:54	South	67°	+6.3
M38	The Starfish Cluster	Auriga	Open Cluster	22:27	03:41	03:41 *	North-East	25°	+6.4
NGC457	The Dragonfly Cluster	Cassiopeia	Open Cluster	22:27	03:41	03:41 *	North-East	71°	+6.4
NGC7243	Open Cluster	Lacerta	Open Cluster	22:27	03:41	03:41 *	West	79°	+6.4
NGC1528	Open Cluster	Perseus	Open Cluster	22:27	03:41	03:41 *	North-East	45°	+6.4
Cr26	The Heart Nebula	Cassiopeia	Cluster with Nebulosity	22:27	03:41	03:41 *	North-East	62°	+6.5
Cr34	The Soul Nebula	Cassiopeia	Cluster with Nebulosity	22:27	03:41	03:41 *	North-East	59°	+6.5
NGC129	Open Cluster	Cassiopeia	Open Cluster	22:27	03:41	03:41 *	North-East	76°	+6.5
NGC654	Open Cluster	Cassiopeia	Open Cluster	22:27	03:41	03:41 *	North-East	67°	+6.5
M92	Globular Cluster	Hercules	Globular Cluster	22:27	03:41	22:27 **	South-West	78°	+6.5
NGC6604	Open Cluster	Serpens Cauda	Open Cluster	22:27	03:41	22:27 **	South	26°	+6.5

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

Object	Name	Constellation	Type	↗	↘	Highest	Direction	Alt	Mag
M2	Globular Cluster	Aquarius	Globular Cluster	22:27	03:41	01:53	South	38°	+6.6
M29	The Cooling Tower	Cygnus	Open Cluster	22:27	03:41	00:44	South	77°	+6.6
M10	Globular Cluster	Ophiuchus	Globular Cluster	22:27	02:57	22:27 **	South	32°	+6.6
NGC1444	Open Cluster	Perseus	Open Cluster	23:45	03:41	03:41 *	North-East	50°	+6.6
NGC6709	Open Cluster	Aquila	Open Cluster	22:27	03:41	23:07	South	49°	+6.7
NGC1027	Open Cluster	Cassiopeia	Open Cluster	22:27	03:41	03:41 *	North-East	60°	+6.7
NGC7789	The Caroline's Rose	Cassiopeia	Open Cluster	22:27	03:41	03:41 *	North-East	82°	+6.7
NGC1342	Open Cluster	Perseus	Open Cluster	22:27	03:41	03:41 *	East	44°	+6.7
NGC7023	The Iris Nebula	Cepheus	Nebula	22:27	03:41	01:29	North	72°	+6.8
NGC6811	The Hole in a Cluster	Cygnus	Open Cluster	22:27	03:41	22:27 **	East	75°	+6.8
NGC1502	Open Cluster	Camelopardalis	Open Cluster	02:43	03:41	03:41 *	North-East	51°	+6.9
M52	The Cassiopeia Salt-and-Pepper	Cassiopeia	Open Cluster	22:27	03:41	03:41 *	North	79°	+6.9
M18	Open Cluster	Sagittarius	Open Cluster	22:27	22:50	22:36	South	22°	+6.9
M81	Bode’s Galaxy	Ursa Major	Galaxy	22:27	03:41	22:27 **	North-West	37°	+6.9
NGC1857	Open Cluster	Auriga	Open Cluster	02:43	03:41	03:41 *	North-East	29°	+7.0

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

Object	Name	Constellation	Type	↗	↘	Highest	Direction	Alt	Mag
NGC225	The Sailboat Cluster	Cassiopeia	Open Cluster	22:27	03:41	03:41 *	North-East	74°	+7.0
NGC7635	The Bubble Nebula	Cassiopeia	HII Region	22:27	03:41	03:41 *	North	79°	+7.0
NGC6960	The Western Veil Nebula	Cygnus	Supernova Remnant	22:27	03:41	01:06	South	69°	+7.0
NGC7063	Open Cluster	Cygnus	Open Cluster	22:27	03:41	01:44	South	75°	+7.0
NGC1582	Open Cluster	Perseus	Open Cluster	01:27	03:41	03:41 *	North-East	39°	+7.0
NGC663	Open Cluster	Cassiopeia	Open Cluster	22:27	03:41	03:41 *	North-East	67°	+7.1
NGC6823	Open Cluster	Vulpecula	Open Cluster	22:27	03:41	00:03	South	62°	+7.1
NGC7380	The Wizard Nebula	Cepheus	Open Cluster	22:27	03:41	03:02	North	82°	+7.2
NGC7082	Open Cluster	Cygnus	Open Cluster	22:27	03:41	03:41 *	West	71°	+7.2
Cr418	Open Cluster	Cygnus	Open Cluster	22:27	03:41	00:36	South	76°	+7.3
NGC6819	Open Cluster	Cygnus	Open Cluster	22:27	03:41	22:27 **	South-East	71°	+7.3
Cr41	Collinder 41	Perseus	Open Cluster	22:34	03:41	03:41 *	East	39°	+7.3
Cr21	Collinder 21	Triangulum	Open Cluster	22:27	03:41	03:41 *	South-East	53°	+7.3
M103	Open Cluster	Cassiopeia	Open Cluster	22:27	03:41	03:41 *	North-East	69°	+7.4
M27	Apple Core Nebula	Vulpecula	Planetary Nebula	22:27	03:41	00:19	South	61°	+7.4

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

Object	Name	Constellation	Type	↗	↘	Highest	Direction	Alt	Mag
NGC6888	The Crescent Nebula	Cygnus	HII Region	22:27	03:41	00:32	South	77°	+7.5
M14	Globular Cluster	Ophiuchus	Globular Cluster	22:27	03:41	22:27 **	South	35°	+7.6
C9	The Cave Nebula	Cepheus	HII Region	22:27	03:41	03:16	North	78°	+7.7
M53	Globular Cluster	Coma Berenices	Globular Cluster	22:27	01:09	22:27 **	West	23°	+7.7
M107	Globular Cluster	Ophiuchus	Globular Cluster	22:27	01:47	22:27 **	South-West	22°	+7.8
NGC2726	Galaxy	Ursa Major	Galaxy	22:27	03:41	22:27 **	North-West	26°	+7.8
M101	The Pinwheel Galaxy	Ursa Major	Galaxy	22:27	03:41	22:27 **	North-West	53°	+7.9
NGC246	The Skull Nebula	Cetus	Planetary Nebula	00:02	03:41	03:41 *	South-East	24°	+8.0
M26	Open Cluster	Scutum	Open Cluster	22:27	01:27	23:01	South	29°	+8.0
M110	Galaxy	Andromeda	Galaxy	22:27	03:41	03:41 *	South-East	73°	+8.1

Twilight	Civil	Naut	Astro		Rises	Sets
Ends	21:25	22:17	23:27	Sun	05:24	20:45
Starts	04:44	03:51	02:39	Moon	01:24	19:38

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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	4th August	12:13	1257
FIRST QUARTER	12th August	16:18	1257
FULL MOON	19th August	19:25	1257
LAST QUARTER	26th August	10:25	1257

Credit: Vito Technology, Inc.

Credit: NASA
Data credit: Time and Place

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August Star Guide

The night of 12th-13th August marks the peak of the Perseid meteor shower. Meteors are debris left behind by comets. They typically range in size from a grain of sand to the size of a peanut and travel at speeds up to 45 miles per second. They burn up rapidly when they enter our atmosphere. The best sightings are on moonless nights. Perseid meteors can generally be seen from 17th July until 24th August, appearing to radiate from Perseus. You don't need any equipment to enjoy them; just look up after midnight and you might see one streak across the sky every minute or so.

Saturn rises in the East after sunset, appearing as a pale yellow star. Viewing this giant planet through a telescope is an unforgettable experience. Most people are amazed when they see its rings for the first time. The waning Moon is near Saturn on 20th August.

Watch out for a star known as T Coronae Borealis that is expected to explode soon in Corona Borealis, the northern crown. The nova is predicted to occur between now and October, shining brightly for about a week before fading. This happens every 80 years.

The chart shows the stars as they appear at 11pm at the start of August or just after sunset at the end of the month, and the phase and position of the Moon on 12th, 16th, and 21st August.