

# Lewes Astronomical Society

Newsletter - May 2023

[www.lewesas.org.uk](http://www.lewesas.org.uk)

**Lewes Astronomical Society**

**Astronomy & Space News**

# Lewes Astronomical Society

## The Early Universe: more questions than answers (1)

- The current **Standard Model of Cosmology** is based on the assumption that it all started with the Big Bang from pure energy about 13.8 billion years ago
- It is based on three components:
  - Dark Energy (68%)  
( $\Lambda$  – Cosmological Constant)
  - (Cold) Dark Matter (27%)
  - Normal Matter (5%)
- It also presumes that **Einstein's Theory of General Relativity** is the accepted theory for gravity on the scale of the Universe
- It is sometimes called the **LAMBDA CDM**

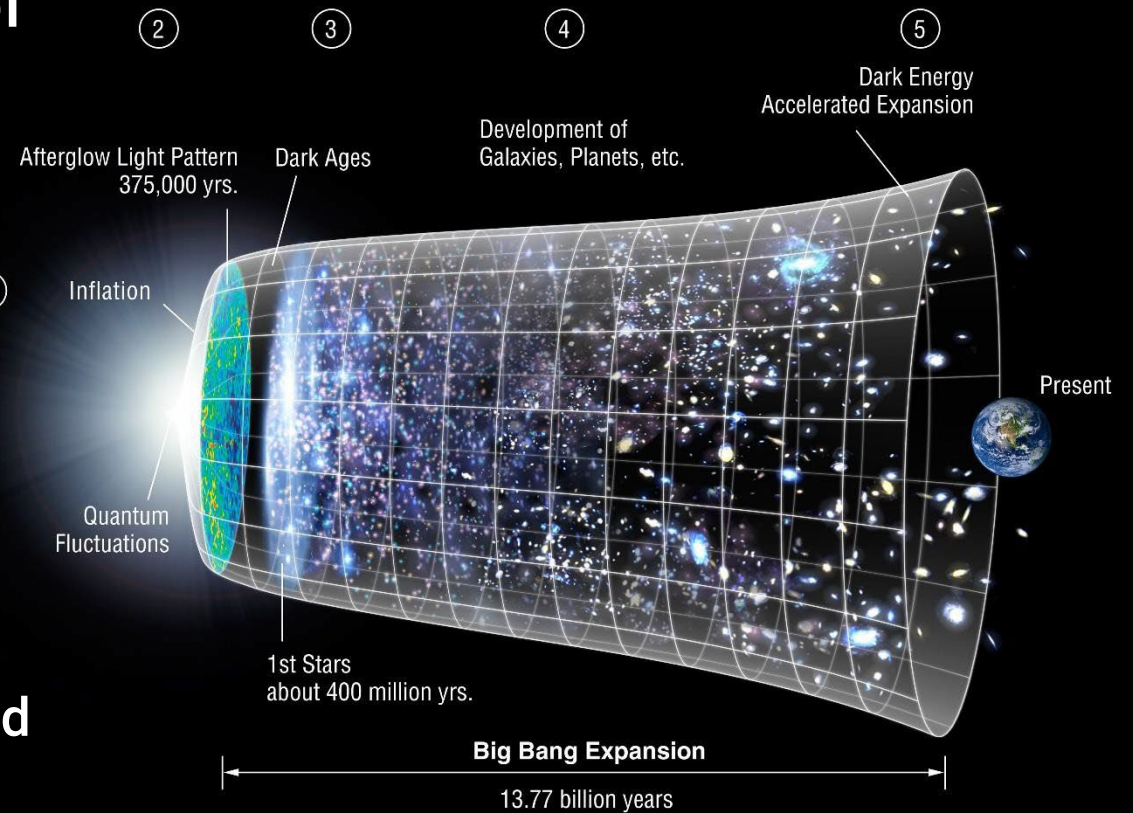


Credit: Terry Gilliam

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## The Early Universe: more questions than answers (2)

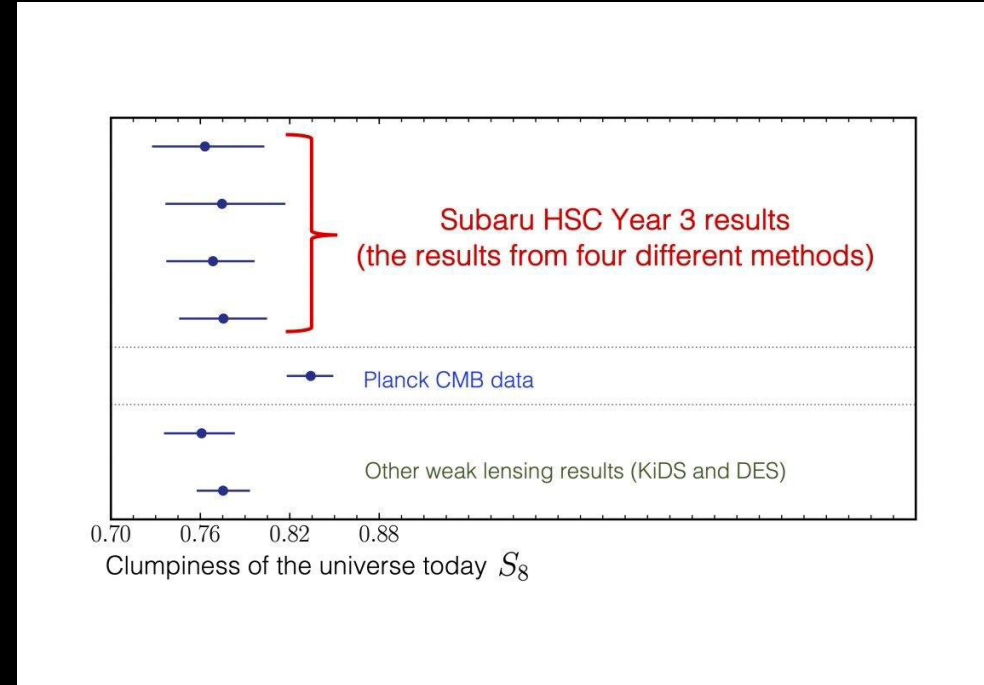
- The Model gives a good approximation of the following properties of the Cosmos
  1. The existence and structure of the Cosmic Microwave Background (CMB)
  2. The distribution of galaxies and clusters and the Universe on a large scale
  3. The observed composition of the Universe – the proportions of hydrogen, helium and lithium
  4. The accelerating expansion of the Universe as seen by the light of distant galaxies and measured using supernovae
- But the Model is not perfect and recent discoveries are highlighting issues



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## The Early Universe: more questions than answers (3)

- In three areas pressure is now being put on the Model:
  1. Galaxies formed earlier and are larger, more developed and complex than predicted – as observed by JWST and ALMA as they push back the boundaries of distance
  2. Measurement of the “clumpiness” of Dark Matter – (known as  $S_8$ ). Derived from the **CMB** it is 0.83 but a gravitational lens survey of 25 million galaxies, using the **Hyper Suprime Camera**, gives a value of 0.78
  3. The Hubble Constant ( $H_0$ ) is being reassessed. Based on **CMB** and measured by the Planck satellite, it is  $67.4 \pm 0.5$  km/sec/Mpc. But, having looked at supernovae, and now Cepheid Variables, and measured by the Gaia satellite, it is  $73.0 \pm 0.9$  km/sec/Mpc



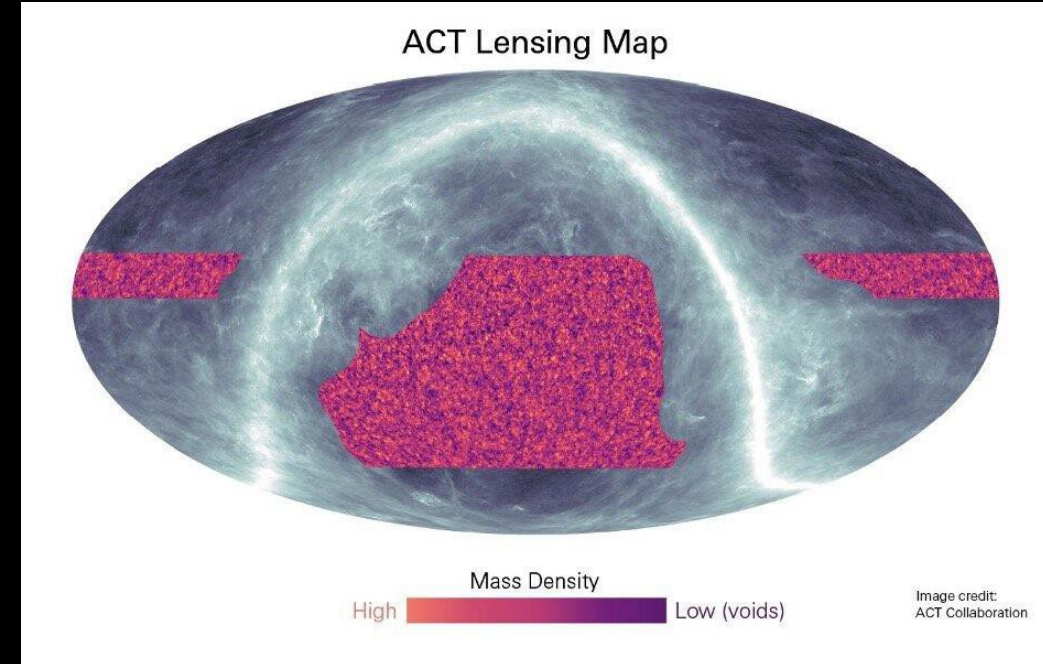
$S_8$  measurement based on gravitational lensing data on 25 million galaxies from the Hyper-Suprime Camera (HSC) on the Subaru Telescope in Hawaii

Credit: Kavli IPMU

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## The Early Universe: more questions than answers (4)

- As more questions are raised, new supporting evidence is coming in from the **Atacama Cosmology Telescope (ACT) Collaboration**
- They have produced the most detailed map of the distribution of Dark Matter across the whole Universe
- Studying how large structures and Dark Matter warp the CMB over the course of its almost 14-billion year journey to us, it seems to confirm the current **Standard Model of Cosmology**
- The vast clumps of Dark Matter seen in the image from ACT are exactly the right size as predicted by **Einstein's Theory**



A new map of dark matter compiled by the Atacama Cosmology Telescope. The orange regions show where there is more mass; purple where there is less or none. The grey-white regions show where contaminating light from dust in our Milky Way galaxy, measured by the Planck satellite, obscures a deeper view. Typical features in the map are hundreds of millions of light-years across. Credit: ACT Collaboration

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## The Early Universe: more questions than answers (5)

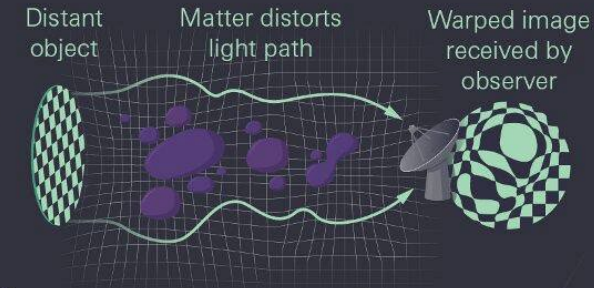
- The results from ACT do contradict some of the other studies. However, it can be argued that the two methods will never agree as the light from the CMB is quite different than the light from stars in galaxies
- Meanwhile, proponents of modified gravity theory are suggesting new ways to test their model. It seems that seismic waves travelling through the Earth would do so at different rates and ways under modified gravity; could seismic data be used?
- For more on the issues around Dark Matter visit: <https://youtu.be/qm0dYbs5Dkc>

Credit: Lucy Reading-Ikkanda, Simons Foundation

### A Lens on the Universe

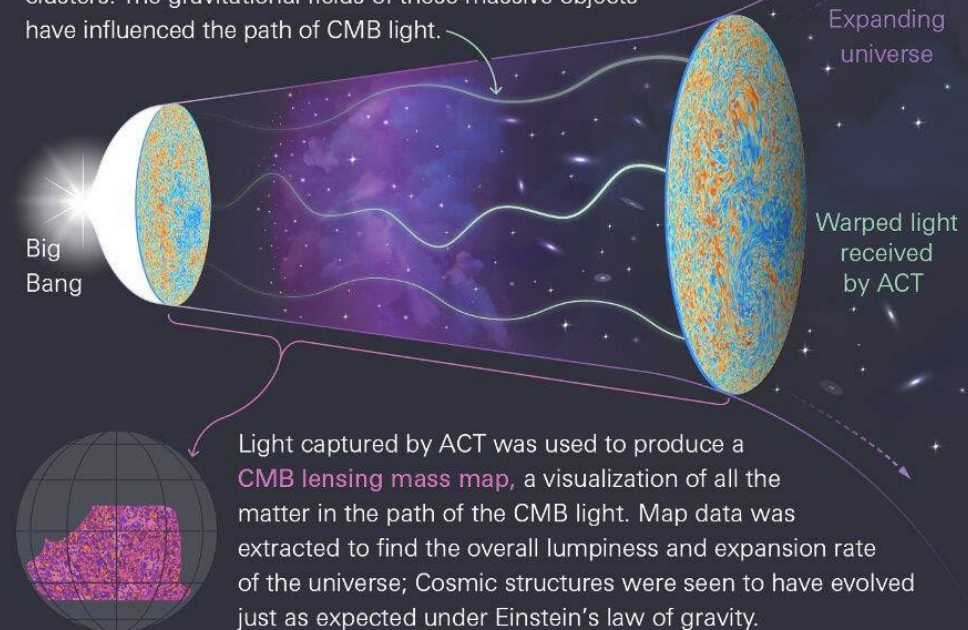
Measuring the amount of matter in the universe — including the invisible dark variety thought to account for ~85% of matter — is fundamental to understanding the evolution of the universe. Using a phenomenon called ‘gravitational lensing’ scientific collaborators have produced the most precise matter map to date. The results were obtained using the Atacama Cosmology Telescope (ACT) in Chile.

**Gravitational lensing** occurs when light travels near a massive object — such as a galaxy, galaxy cluster, or clump of dark matter. The gravitational field generated by these huge objects bends the light’s path.



### Mapping Matter with Light

Cosmic microwave background (CMB) radiation — ancient light emitted when the universe was in its infancy — has travelled billions of years, witnessing the formation of stars, galaxies, and galaxy clusters. The gravitational fields of these massive objects have influenced the path of CMB light.

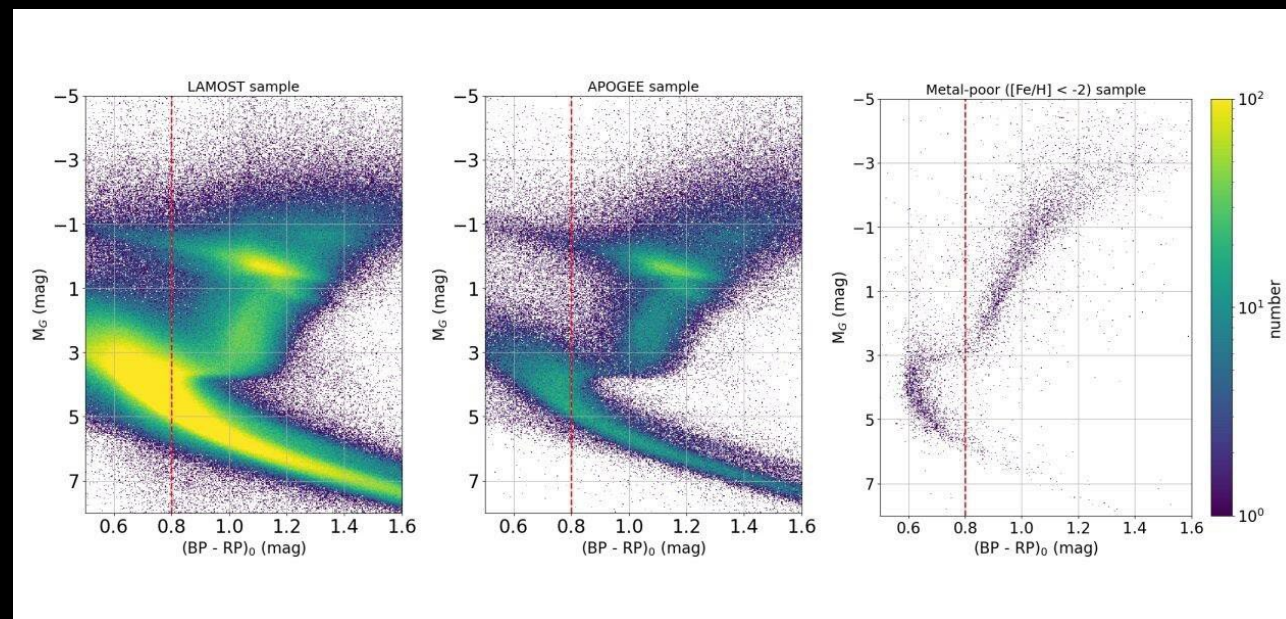


Light captured by ACT was used to produce a **CMB lensing mass map**, a visualization of all the matter in the path of the CMB light. Map data was extracted to find the overall lumpiness and expansion rate of the universe; Cosmic structures were seen to have evolved just as expected under Einstein’s law of gravity.

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## Many more early stars found in Milky Way

- Our current thinking suggests that stars formed in the early universe would have contained almost nothing but hydrogen and helium
- Elements larger and heavier than either hydrogen or helium are known as “metals”. So, first generation stars are “**metal-poor**”
- Metal-poor stars have iron abundances  $[Fe/H]$  below  $-2$ . The most metal-poor star (SMSS J0313–6708) has an index of  $-7.3$
- Data from Gaia, together with LAMOST and APOGEE surveys, suggest that of the 210 million stars investigated, up to 180,000 are possibly metal-poor



Colour-magnitude diagram. The horizontal axis is the Gaia intrinsic colour and the vertical axis is the Gaia absolute magnitude

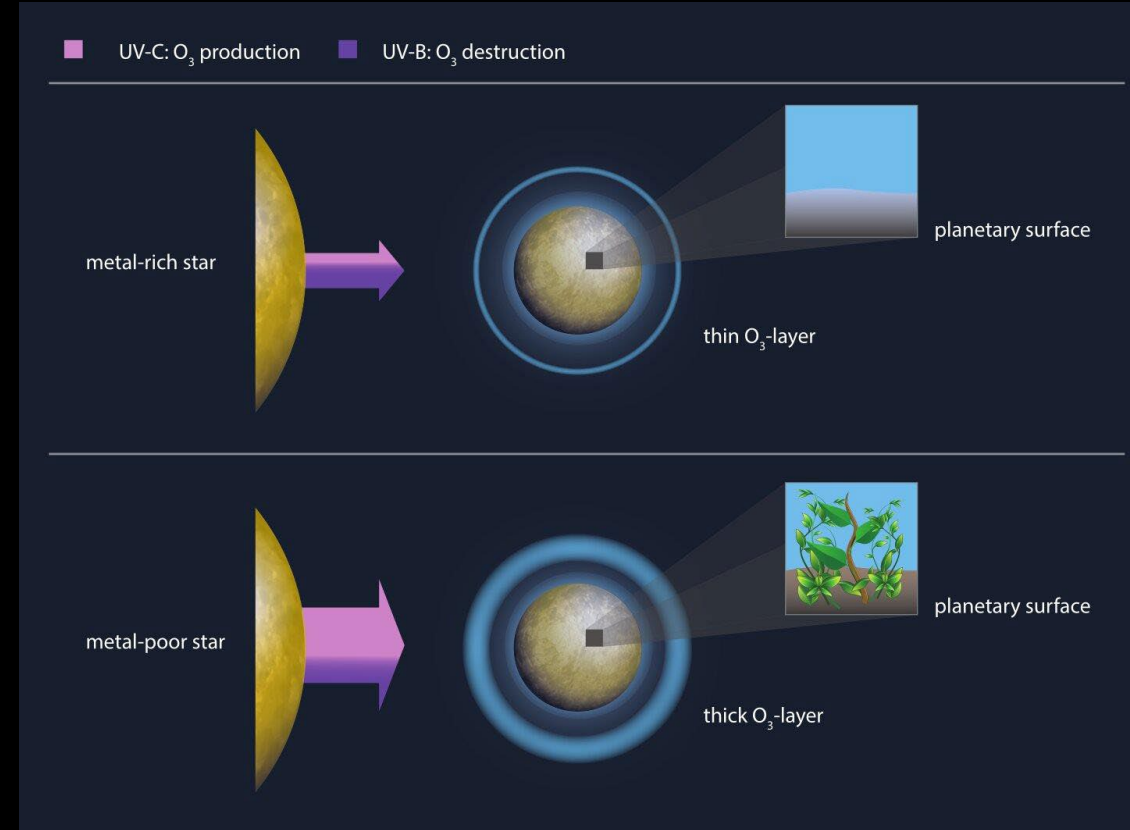
Credit: Yupeng Yao (University of Chicago, USA) et al, 2023



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## Metal-Poor Stars – more life friendly?

- About half the stars that have known exoplanets are sun-like. They have surface temperatures between 5,000 and 6,000° Celsius
- Such stars are often very variable in brightness producing large amounts of ultraviolet radiation. There are two sorts: **UV-B** (long-wave) and **UV-C** (short-wave). The former destroys life-protecting ozone (O<sub>3</sub>), the latter helps produce it
- Metal-poor stars, whilst producing more overall radiation, have a much higher **UV-C/UV-B** ratio than metal-rich stars, such as the Sun

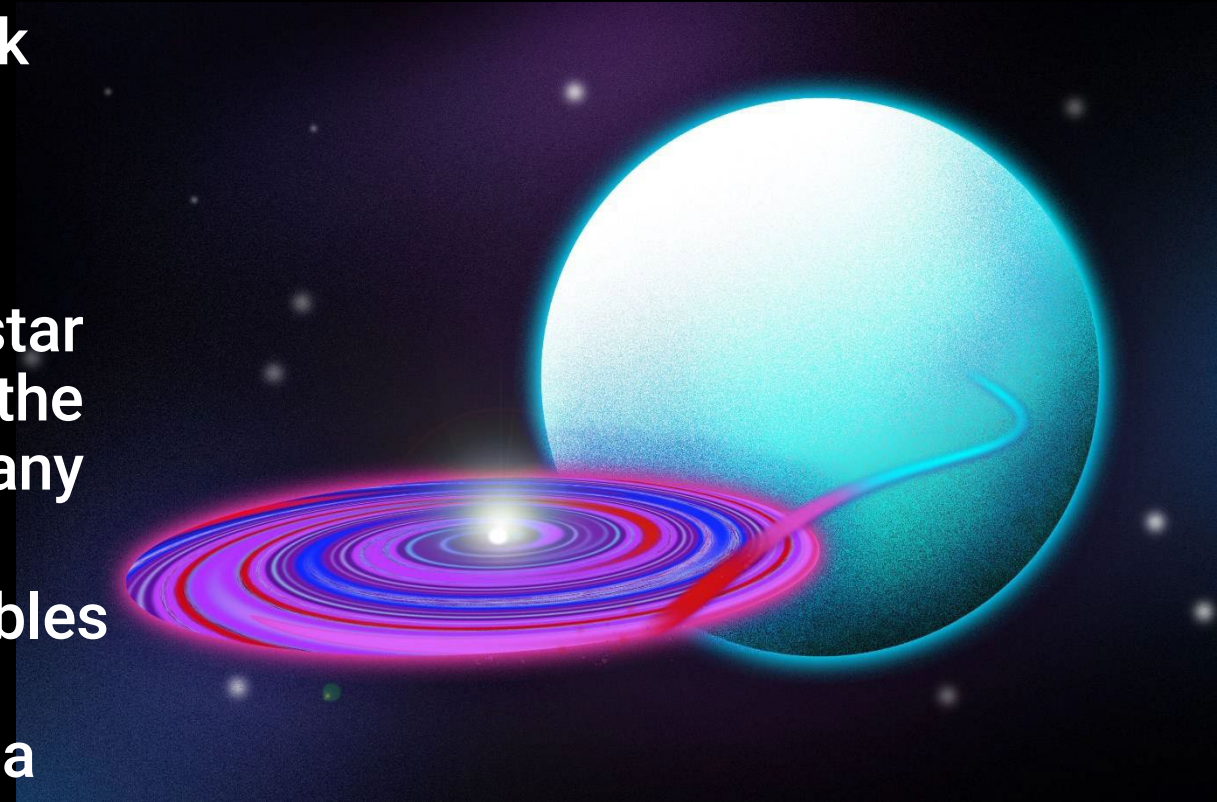


Credit: MPS/hormesdesign.de

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## Disk Winds from a Neutron Star

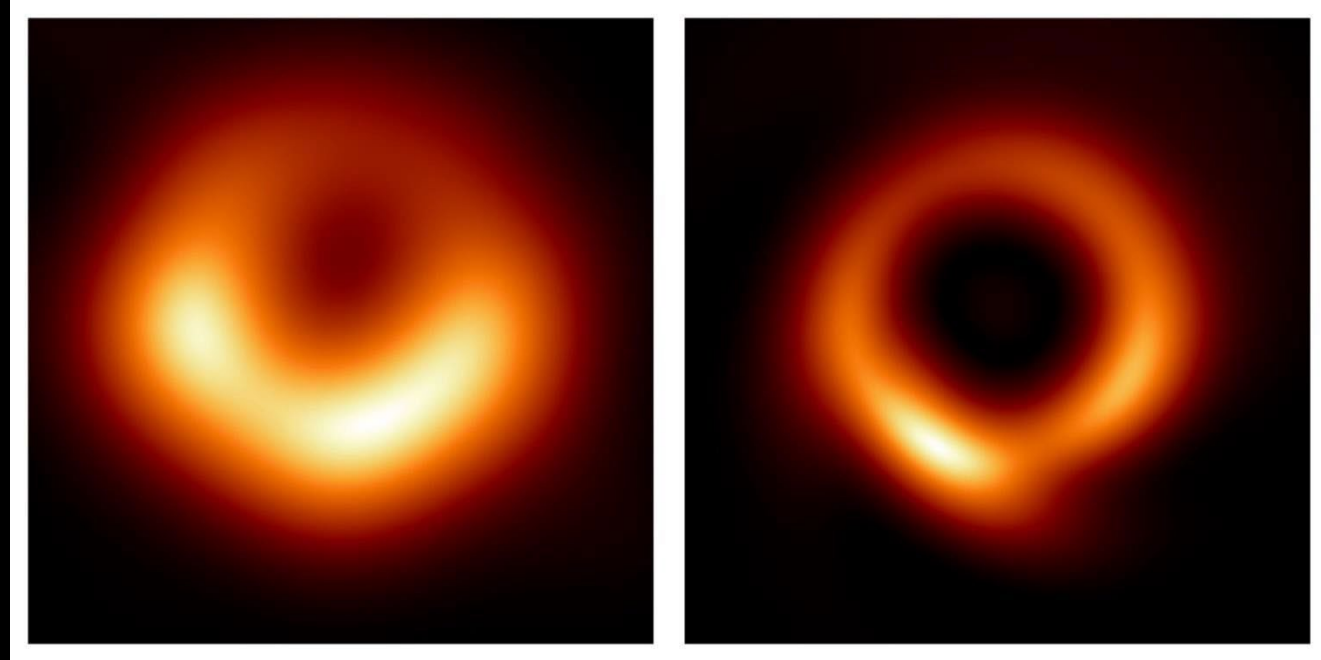
- When a neutron star (or stellar-sized black hole) is in a binary system, the intense gravity can draw off material from the companion star
- This material swirls around the neutron star in an accretion disk. The speed at which the material moves causes it to heat up to many millions of degrees through friction
- **Hercules X-1** is a neutron star which wobbles over a 35-day period. This causes the accretion disk to move up and down (like a vinyl record on a turntable) and this produces wind which can blow off streams of plasma and x-ray photons across many light years



Credit: D Klochkov, European Space Agency

## The Supermassive Black Hole inside M87

- A few years ago, the world was astounded by the first pictures of the black hole at the heart of the M87 galaxy, 57 million light years away in the Virgo constellation
- The image was developed using the 7 radio telescopes of the **Event Horizon Telescope Collaboration**, spread around the planet, and this allowed the overall “telescope” to have a baseline the size of the Earth
- Unfortunately, the distribution of the radio telescopes left gaps in the coverage. Now, using a machine learning technique, **PRIMO**, researchers have refined and enhanced the data to produce a new image (right). Watch what would happen if we fell into a black hole: <https://youtu.be/4rTv9wvvat8> (15 minutes)



Credit: Lia Medeiros, Institute for Advanced Study

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## Astronauts for first trip to Moon named

- The four astronauts, who will go around the Moon onboard Artemis II in November 2024, have been named
  1. **Reid Wiseman** – mission commander and US Navy aviator. He has spent six months on the ISS (Expedition 40/41) in 2014. Carried out 2 spacewalks
  2. **Christina Koch** – is the most experienced female astronaut and was on the ISS (Expedition 59/60/61) in 2019-20. She holds the longest spaceflight by a woman (328 days) record and has carried out 6 spacewalks (3 all-women)
  3. **Victor Glover** – US Navy aviator. He was on the second crewed SpaceX Dragon spacecraft and on the ISS (Expedition 64 with 4 spacewalks) in 2020-21
  4. **Jeremy Hansen** – Canadian Air Force (first space flight)



Credit: NASA

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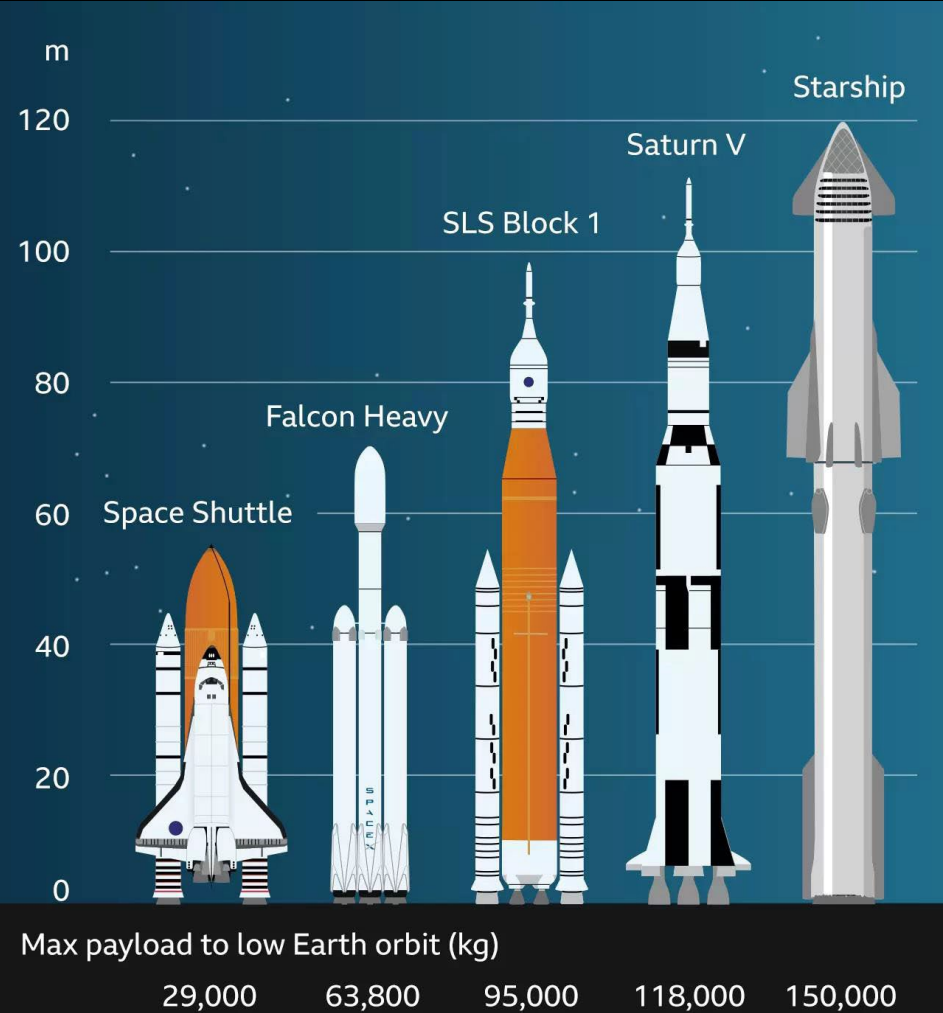
## Starship Super Heavy Rocket Launch (1)

- The **Starship Super Heavy Rocket** from SpaceX is the largest (at 119m high) and most powerful launcher (75.9 MN/17,100,00 lbs if thrust) ever built
- It is made up of a first stage Super Heavy booster and second stage Starship. The second stage is a fully containable spacecraft. It is designed to be fully reusable
- It is expected to be able to lift up to 150 tonnes into low-Earth orbit (in reusable mode) or 250 tonnes if expended. It could take up to 100 astronauts to Mars. The payload bay alone is 17m tall by 8m in diameter, a volume of 1,000m<sup>3</sup>



Credit: SpaceX

# Starship Super Heavy Rocket Launch (2)



BBC

### SpaceX's Starship

The biggest rocket ever built, designed to carry both crew and cargo to Earth orbit, the Moon and Mars

 Height: 120 m Diameter: 9 m Payload capacity: 100 - 150 tonnes	<b>RAPTOR Engines</b> 	<b>SUPER HEAVY First stage/booster</b> 	<b>STARSHIP Second stage</b> 
	Reusable	Fully reusable	Fully reusable
	Methane-oxygen staged-combustion engines (33 in total)	Will re-enter Earth's atmosphere to land back at launch site	Spacecraft is also capable of point-to-point transport on Earth

Source: SpaceX  
(3 images are not to scale)

AFP

Credit (left): BBC

Credit: (above): AFP

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## Starship Super Heavy Rocket Launch (3)

- After a cancellation on Monday 17<sup>th</sup> April due to a frozen valve, the test launch took place at 13:33 BST on Thursday 20<sup>th</sup> April
- The rocket cleared the tower and climbed to an attitude of 39 km, with speeds in excess of 2,000 km/hour, in just over 3 minutes
- At this point, the rocket was due to flip over for stage separation but instead, carried on slowly tumbling and no separation occurred
- It appears that at least 8 engines flamed-out causing a loss of power and instability. On-board computers detonated the rocket on the 4-minute mark
- Although SpaceX had stated that they regarded just clearing the tower as a success, it was obviously clearly disappointing. SpaceX and the FAA will study the huge amount of data collected before deciding on when the next launch is



Credit: Patrick T. Fallon/AFP/Getty Images

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## Starship Super Heavy Rocket Launch (4)



At least 8 out of 33 engines flameout

Credit: AP Photo/Eric Gay



Tumbling out-of-control 3 minutes 50 seconds

Credit: Patrick T. Fallon/AFP/Getty Images



Rocket detonation at 4 minutes

Credit: Patrick T. Fallon/AFP/Getty Images

- Watch the launch at: [https://youtu.be/ZnA-6rkt\\_HU](https://youtu.be/ZnA-6rkt_HU) (6 minute presentation)
- There are longer programmes at: <https://youtu.be/rVLp8nKc0Cg> (32 minutes) and <https://youtu.be/-1wcilQ58hl> (53 minutes)



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## Starship Super Heavy Rocket Launch (5)



Credit: social media post



Credit: social media post



Credit: social media post

- **Aftermath of launch – a scene of desolation**
- **Debris blasted over 400 metres from launch site as dust covered town 5km away**
- **Concrete pad left shattered with huge crater formed, months to repair**
- **No water-cooling system or flame trench installed**
- **Massive water-cooled steel plate wasn't completed in time**

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## JUICE (1)

- The **JU**piter **IC**y Moons **E**xplorer (JUICE) Mission is the third major one to the Jovian system. Although primarily an ESA mission, both NASA and JAXA have made important contributions
- It follows in the footsteps of Galileo and Juno but its primary mission is to survey 3 of the 4 Galilean moons: Europa, Ganymede and Callisto
- The journey will take 8 years, with a couple of swing-bys of Venus and Earth to pick up additional speed
- It will be joined by NASA's Europa Clipper spacecraft (launching next year)



Credit: European Space Agency

Watch an animation of the launch and moon flybys at:  
<https://cdn.jwplayer.com/previews/kU8Wmajz>

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## JUICE (2)

- The Ariane 5 rocket was launched at 13:14 BST on Friday 14<sup>th</sup> April from Kourou in French Guiana
- There was a 1 second window where the planetary alignments helped with the trajectory and allows the spacecraft to save as much fuel as possible for later manoeuvres when it reaches Jupiter
- The 2.42 metric tonnes spacecraft carries 3.65 metric tonnes of fuel in its tanks
- Watch the mission timeline at:  
<https://cdn.jwplayer.com/previews/rVNJu9QB>



Credit: ESA

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## Journey to Jupiter

Everything you need to know about ESA's much-anticipated JUICE mission

Words Catherine Regan  
Infographic James Round

### What is JUICE?

JUICE, or the Jupiter Icy moons Explorer, is a European Space Agency (ESA) mission that will travel to Jupiter and its moon system with various instruments to help us understand gas giant systems. It will be launching on 13 April 2023. Although it is an ESA-led mission, there have been engineering contributions from NASA and JAXA.

To help us understand our own Solar System and gas giants across the Universe, JUICE will be studying Jupiter's environment, in addition to some of its icy moons. The mission's theme is 'the emergence of habitable worlds around gas giants', as it is thought that moons such as Europa are likely to contain signs of life.

JUICE will be the first spacecraft ever to orbit a moon in the outer Solar System, when it changes orbit from Jupiter to Ganymede at the end of the nominal mission.

In 2024, the Europa Clipper will blast off, arriving at the moon in 2030 to carry out further research.

### JUICE: IN NUMBERS

**10** The number of scientific instruments carried by JUICE from spectral imaging tools to radar. Find out more about these tools on the opposite page.

**8 years** The total duration of JUICE's mission. In that time it will have been to Venus and back to Earth (twice), before reaching Jupiter and its moons.

**85m<sup>2</sup>** The impressive size of JUICE's solar panels, JUICE has to operate where sunlight is 25 times weaker than on Earth, so it needs to be able to collect lots of light.

**-230°C** The temperature that JUICE will have to operate in while in the orbit of Jupiter. However, during its Venus flyby, the temperature will be +250°C!

**> 2,000** The number of people who worked on the JUICE mission. This ESA-led, global collaboration included 18 institutions, 23 countries and 83 companies.

JUICE is the latest in a long line of ambitious missions involving Jupiter, starting with the first flyby by Pioneer 10 in 1973. In 1995, Galileo became the first spacecraft to orbit Jupiter, with the broad aim of studying the planet and its moons. And Juno followed two decades later to further investigate the gas giant.

01

### A visit to Venus

In August 2025, JUICE will perform a flyby of Venus, where it will receive another gravity assist.

04

03

### Lunar-Earth Flyby

In August 2024, JUICE will perform a flyby of the Earth-Moon system, known as a Lunar-Earth gravity assist (LEGA) – the first ever to be carried out.

### All systems ready!

After launch, it will take JUICE around 2.5 weeks to complete the deployment of its antennas, probes and magnetometer boom.

02

### What will JUICE's journey look like?

During its eight-year journey, JUICE will take in some of our Solar System's most spectacular sights, as it uses the gravity of other planets and moons to help it reach its final destination.

Start here

### Lift-off!

JUICE will be launching from French Guiana, which is Europe's spaceport, within the launch window in April 2023.

05

### Next stop... Earth?

JUICE will then travel back to Earth, where it will perform not one, but two flybys in September 2025 and January 2029. These gravity assists allow the craft to save a significant amount of propellant on its journey.

06

### Welcome to Jupiter

In January 2031, JUICE will begin its science phase, before reaching Jupiter in July.

07

### A Jovian joyride

JUICE will perform 35 flybys as it explores Jupiter's moons, then will settle into orbit around Ganymede in 2034.

!

JUICE will be focusing its attention on three of Jupiter's moons – Europa, Callisto and Ganymede – but it's estimated that the gas giant has more than 90 moons, the most of any planet in our Solar System!

### Europa



It's believed that this moon could potentially support life, so JUICE will be looking for evidence of organic molecules and other biosignatures within the ice, and also within water vapour that Europa may vent into space.

Number of flybys  
**2**  
Closest approach  
**400km**

### Callisto



With the oldest and most heavily cratered surface in the Solar System, JUICE will be investigating Callisto to better understand the features and environment of the early Jovian system. It will also study its structure, composition and chemistry.

Number of flybys  
**21**  
Closest approach  
**200km**

### Ganymede



Ganymede is the only moon in the Solar System to generate its own magnetic field. JUICE will analyse this, along with the moon's atmosphere, complex core, its ice content, and the potential of a subsurface ocean.

Number of flybys  
**12**  
Closest approach  
**400km**

### What tools does JUICE have on-board?



#### JANUS

This optical camera system will be JUICE's eyes, studying the features of the moon, as well as the clouds of Jupiter itself.



#### Moons and Jupiter Imaging Spectrometer (MAJIS)

This will be used to study the atmospheric features of Jupiter, as well as the ice and other minerals found on the Jovian moons.



#### Ganymede Laser Altimeter (CALA)

This tool will help to provide evidence for subsurface oceans within the Jovian moons. It will also map the topography of the moons.



#### JUICE Magnetometer (J-MAG)

This will allow JUICE to study the magnetic fields of Jupiter and Ganymede, and how they interact with each other.



#### Radio and Plasma Wave Investigation (RPWI)

This will characterise radio emissions of Jupiter's magnetic field and the plasma environment on Jupiter and its moons.



#### UV imaging spectrograph (UVS)

This will study the composition and dynamics of the moon's exospheres, as well as Jupiter's atmosphere and beautiful aurorae.



#### Sub-millimeter Wave Instrument (SWI)

This will measure the atmosphere of Jupiter and the exospheres of its moons, to determine their structure and composition.



#### Radar for Icy Moons Exploration (RIME)

This ice-penetrating radar can see nine kilometres below the surface, in order to discover the subsurface features of the moons.



#### Particle Environment Package (PEP)

This includes a number of sensors to characterise the plasma environment of the Jupiter system.



#### Gravity and Geophysics of Jupiter and Galilean Moons (JGM)

This will study the gravitational field of Ganymede, and the atmospheres and ionospheres of Jupiter and its moons.

\*A plasma is a partly or wholly ionised gas whose particles exhibit collective responses to magnetic and electric fields.

Credit: James Round/  
BBC Science Focus

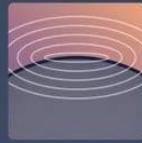
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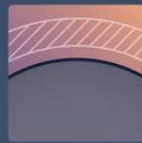
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## Technology Demonstration Mission (TDM) Design objectives

- \* A/m ratio  $> 50\text{m}^2/\text{kg}$
- \* Achieve 6-8 AU/year exit velocity
- \* Survive perihelion of 0.2 AU
- \* Low cost and manufacturable
- \* Capabilities-based and no development
- \* Rideshare compatible

## TDM Design features

- \* A/m ratio  $22.3\text{m}^2/\text{kg}$
- \* 6 x  $20\text{m}^2$  vanes
- \* Carbon fibre truss (120g)

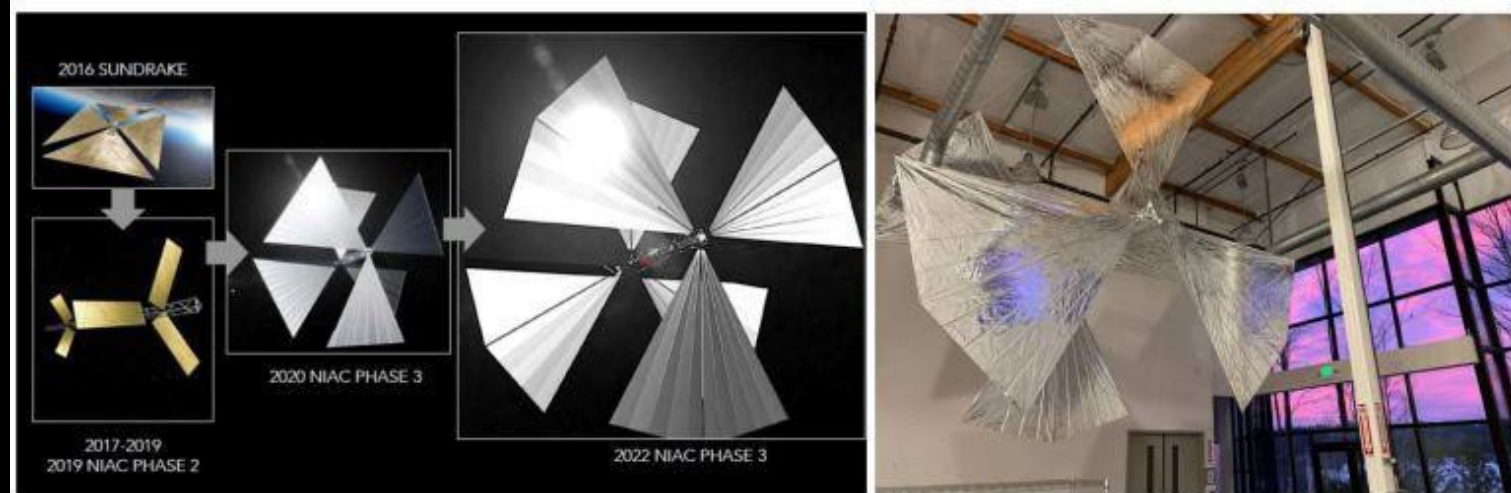
## Avionics and GNC leverages

- \* 500g for X-band SRD, 3 wheels, 2 star trackers, battery
- \* 100g for shape memory motors

## Total Mass

- \* 5.37kg (86% mass in vanes)

# Sundancer Concept



Credit: James Round/  
BBC Science Focus

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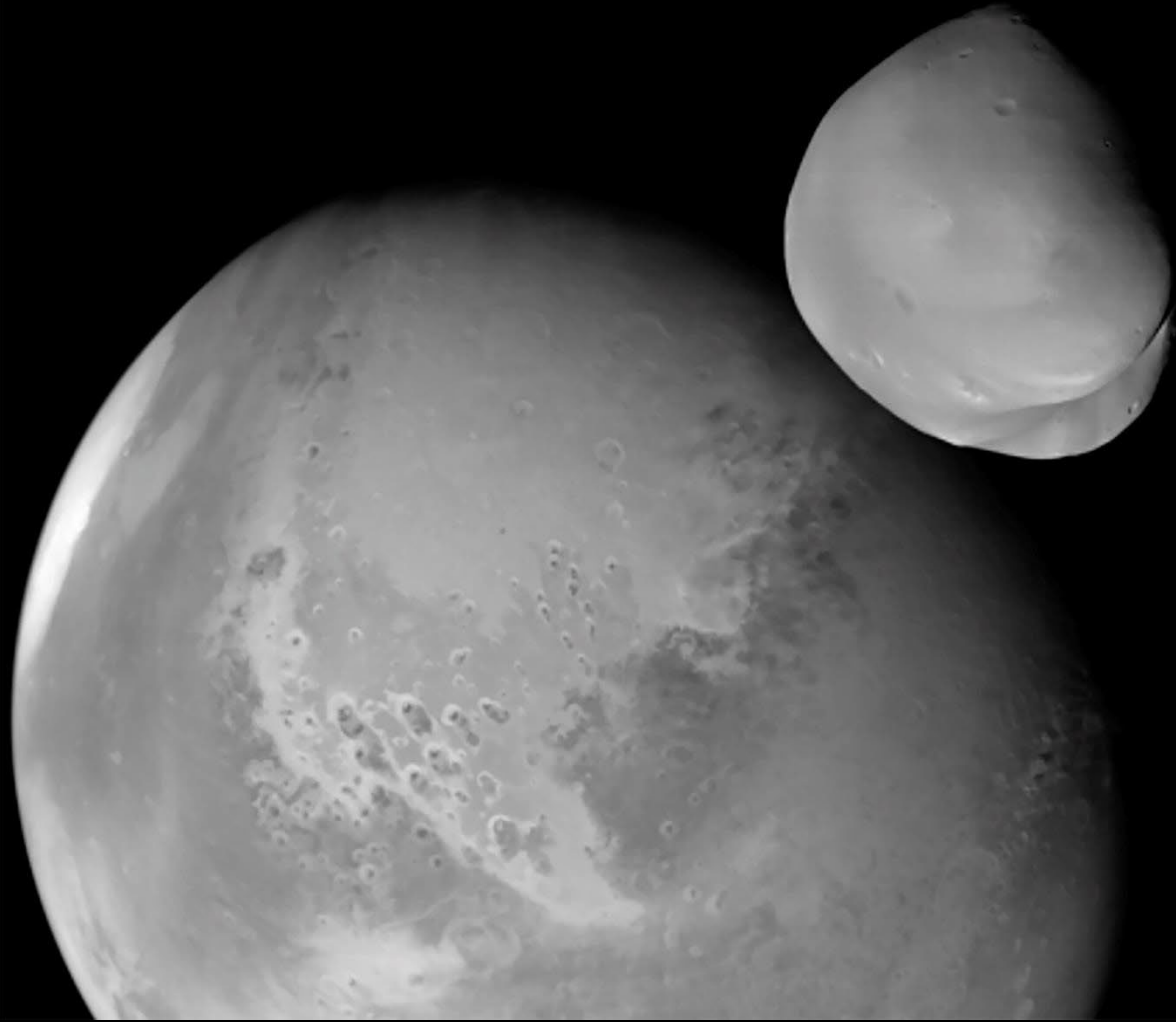
## Brief One-liners

- **Supernova explosions damage planets atmospheres up to 160 light years away**
- **Quaoar, minor planet and TNO has two rings**
- **2 super-Earth exoplanets found on edge of habitable zone of M dwarf TOI-2095**
- **New type of star masquerading as a black hole**
- **World's 1<sup>st</sup> mid-infrared solar observation telescope nearing trials in China**
- **3D-printed rocket, Terran 1, is no more; replaced by bigger Terran R, due 2026**
- **Next generation space telescopes to have flexible mirrors**
- **Ingenuity helicopter completes 50<sup>th</sup> flight on Mars**
- **ESA's Solar Orbiter makes nearest approach to Sun (29% distance)**
- **New Horizon mission may be changed from KBOs to Heliospheric Science**
- **Moon possible place to mine and store rocket fuel**
- **Martian moon Deimos photographed by UAE space probe "Amal"**

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## Deimos

2023-03-10 02:16:06 UTC  
f635 range: 104 km



Credit: UAE Space Agency via AP



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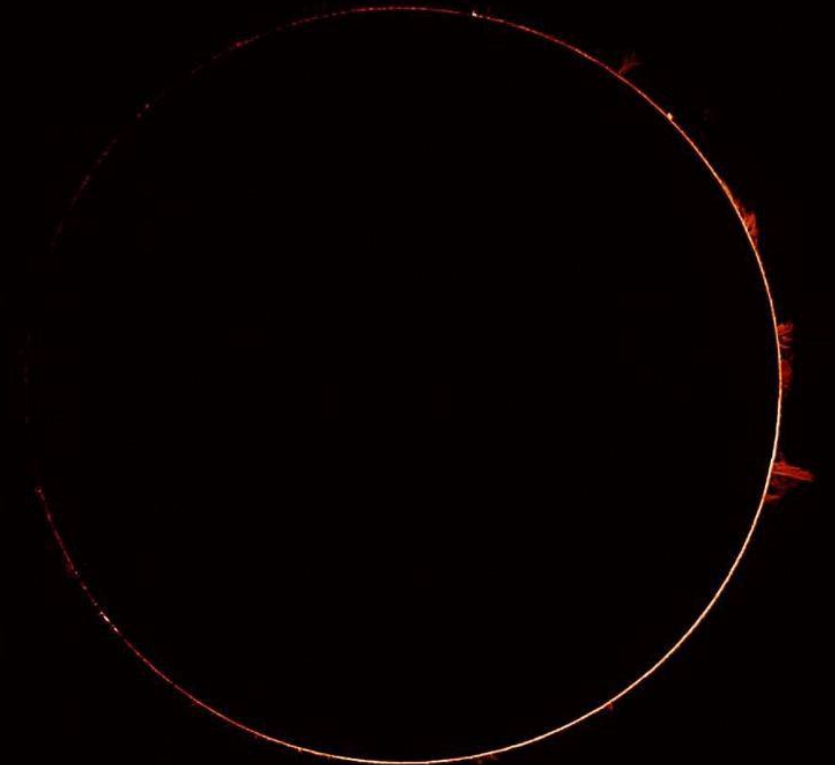
## Hybrid Solar Eclipse: 20<sup>th</sup> April, Australia & South Pacific

Total Solar Eclipse  
Exmouth Australia  
20/4/2023



©Mohamad Sol  
www.eclipse262728.com

Credit: Mohamad Sol



PoitevinLunt35DMK41\_23-04-20 05-49-26

Credit: Patrick Poitevin

- Watch the youTube video at: <https://youtu.be/S2U3a1xXv8k> (2 hours 32 mins)

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## Finally: Aftermath of a launch

- Another successful rocket launch. Boosters and lower stages fall to Earth (hopefully to be reused). Upper stages burn up in the atmosphere. Payload safely placed in orbit
- But sometimes the rocket carries a small amount of excess fuel – and that needs to be jettisoned, usually at high altitude
- On April 15<sup>th</sup> SpaceX conducted a night-time polar launch from the Vandenberg Space Force Base in California. Three hours later in Alaska residents were treated to the spectacle of a blue spiral in the light of the Aurora as the excess fuel froze and reflected sunlight in the upper atmosphere



Credit: Todd Salat via AP

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## JWST and Hubble latest photos (1)

- This is **Globular Cluster NGC 2419** (Caldwell 25) which is situated 300,000 light years from Earth in the Lynx constellation
- Further away than the Magellanic Clouds but is still considered to be part of the Milky Way
- It takes 3 billion years to orbit the Milky Way
- Unusually, it has two different populations of Red Giants, one is richer in helium and nitrogen and these stars orbit nearer the centre
- Could two separate globular clusters have merged in the distant past?
- The **Globular Cluster M92**, 26,740 light years away in the Hercules constellation is similar

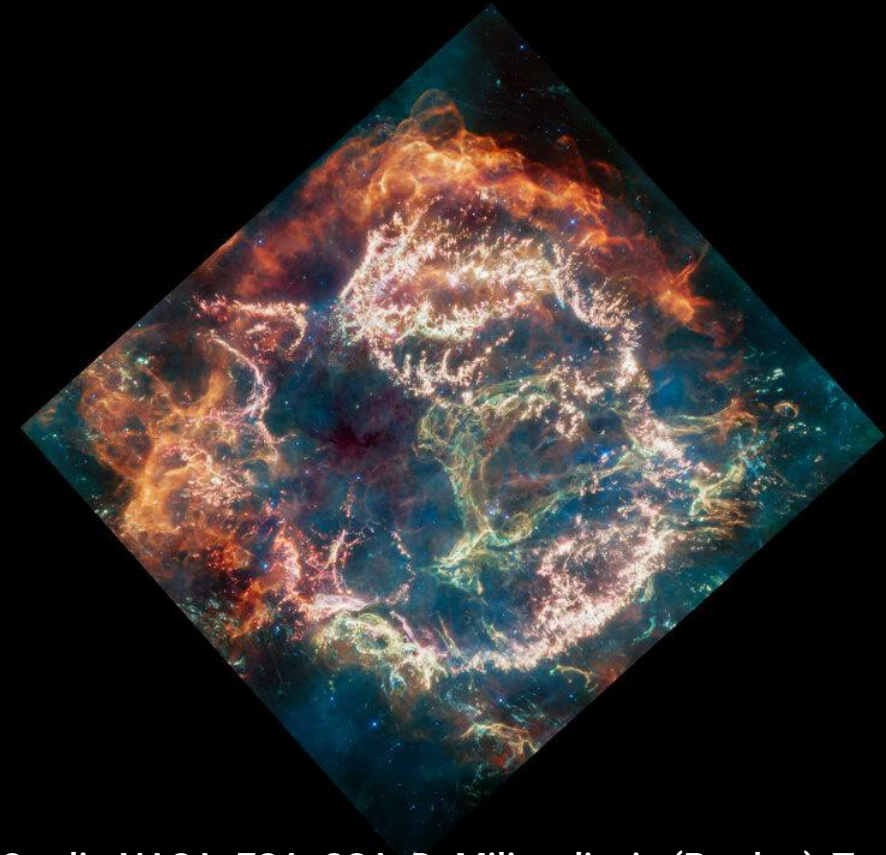


Credit: ESA/Hubble/NASA/S. Larsen et al

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## JWST and Hubble latest photos (2)

- JWST recently took this image of the supernova remnant (SNR) Cassiopeia A
- It lies about 11,000 light years from Earth and can be seen (with the aid of a 12" telescope and suitable filters) to the right of the last stroke of the 'W' of Cassiopeia. It is about 10 light years across
- Said to be the last known Milky Way supernova seen with the naked eyes but accounts vary (John Flamsteed possibly catalogued it as the star **3 Cassiopeiae** on 16<sup>th</sup> August 1680)
- It is the brightest radio source above 1GHz in the sky



Credit: NASA, ESA, CSA, D. Milisavljevic (Purdue), T. Temim (Princeton), I. De Looze (Ghent University).  
Image Processing: J. DePasquale (STScI)

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## JWST and Hubble latest photos (3)

- The **Hubble Ultra Deep Field** image of 2004 is one of the most iconic deep sky pictures ever taken, even surpassing the amazing 1995 first Deep Field image
- In October 2022, JWST imaged the same area using its NIRCam (1.8 – 4.8 microns wavelength). Taken over a period of 20 hours (Hubble took over 11 days to produce the original) the recently released image reveals previously unseen red galaxies



Hubble UDF (exposure time: 11.3 days)

Webb (exposure time: 0.83 days)

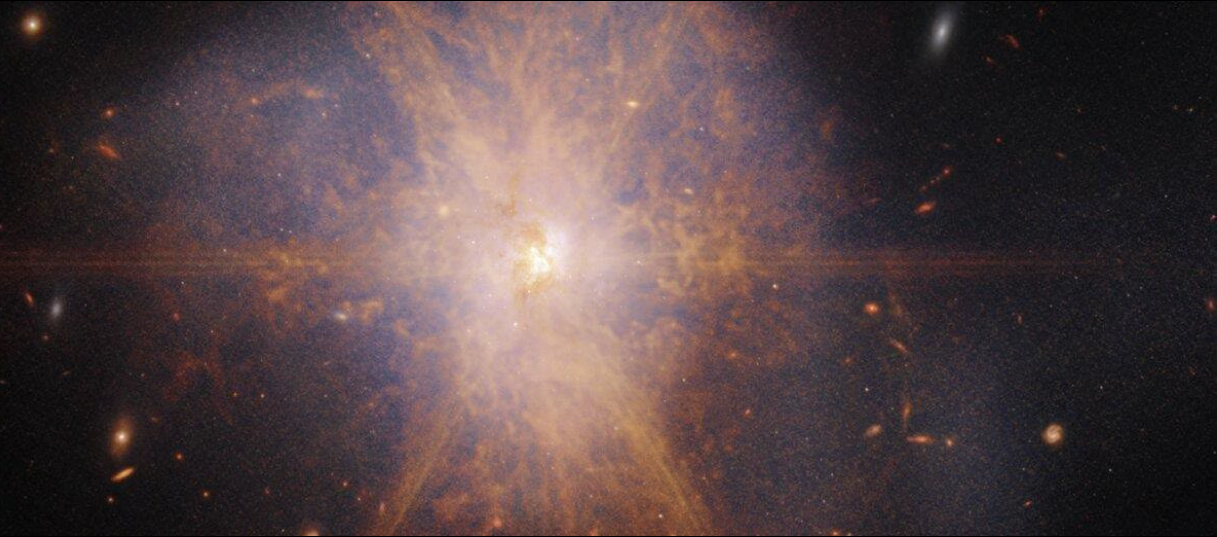
Credit: NASA/ESA/CSA/STScI, C. Williams (University of Arizona)  
Image processing: J. DePasquale (STScI)

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## JWST and Hubble latest photos (4)

- In the constellation, Serpens, 2 galaxies are in the process of merging. Known as **ARP 220**, the new combined galaxy is 250 million light years away
- It glows in infrared light (so is an ideal candidate for JWST) and is the closest ULIRG (Ultra-Luminous Infrared Galaxy) to Earth
- This is the result of a massive increase in star formation triggered by the merger, which started 700 million years ago
- About 200 huge star clusters are packed into an area only 5% the width of the Milky Way (5,000 light years). The amount of gas and dust in this small area is the same as that found in the entire Milky Way

Credit: NASA, ESA, CSA, STScI, Alyssa Pagan (STScI)



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# **Observational Highlights**

## May 2023 dates

- **6<sup>th</sup> May – peak of Eta Aquariid meteor shower. Best seen after midnight and before dawn although Full Moon will affect visibility. Meteors will be quite low near eastern horizon (best seen from Southern Hemisphere). Under ideal conditions up to 50 meteors per hour could be observed. Medium speed – 40 miles per second. The shower is associated with comet Halley (as is the Orionid Meteor Shower in October)**
- **29<sup>th</sup> May – Mercury reaches greatest western elongation**
- **Venus remains a magnificent sight during May. It will become visible at 20:45 at the beginning of the month, 29° above the western horizon, shining at magnitude 4.13. By mid-May it will become visible at 21:08, 28° above the western horizon at 4.19. On the 31<sup>st</sup> May it will become visible at 21:29, 24° above the western horizon, brightening to -4.28**



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Dominic Ford – original author & copyright holder

## Planets (for evening of 1<sup>st</sup>/morning of 2<sup>nd</sup> May)

	<u>Planet</u>	<u>Rises</u>	<u>Sets</u>	<u>Highest</u>	<u>Direction</u>	<u>Altitude</u>	<u>Magnitude</u>	<u>Visible</u>
	MERCURY	05:28	20:18				-0.65	NO
	VENUS	07:20	00:20	15:50	West	29° ◇	-4.13	YES
	MARS	09:27	01:59	17:43	South-West	48° ◇◇	+1.19	YES
	JUPITER	05:09	18:48				-2.04	NO
	SATURN	03:41	13:59				+1.02	NO
	URANUS	05:51	20:54				+5.87	NO
	NEPTUNE	04:17	16:00				+7.94	NO

◇ = Highest point when first visible (20:45)

◇◇ = Highest point when first visible (21:21)

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## Deep Sky Objects (1) for evening of 1<sup>st</sup>/morning of 2<sup>nd</sup> May

Object	Name	Type	Rises	Sets	Highest	Direction	Alt	Mag
M44	The Beehive Cluster (Cancer)	Open Cluster	12:06	03:42	21:57 **	South-West	44°	+3.1
M31	Andromeda Galaxy (Andromeda)	Galaxy	***	***	03:56 *	North-East	22°	+3.4
C14	Double Cluster (Perseus)	Open Cluster	***	***	03:56 *	North-East	25°	+3.7
IC4665	Open Cluster (Ophiuchus)	Open Cluster	22:31	11:34	03:56 *	South	44°	+4.2
NGC6633	Open Cluster (Ophiuchus)	Open Cluster	23:07	12:19	03:56 *	South	44°	+4.6
IC4756	Graff's Cluster (Serpens Cauda)	Open Cluster	23:24	12:25	03:56 *	South	42°	+4.6
M5	Globular Cluster (Serpens Caput)	Globular Cluster	20:21	08:49	01:40	South	41°	+5.7
M13	Great Globular Cluster (Hercules)	Globular Cluster	17:26	14:29	03:03	South	75°	+5.8
M12	Globular Cluster (Ophiuchus)	Globular Cluster	22:09	09:57	03:08	South	37°	+6.1
M3	Globular Cluster (Canes Venatici)	Globular Cluster	16:07	09:50	00:04	South	67°	+6.3
M15	Globular Cluster (Pegasus)	Globular Cluster	01:40	15:51	03:56 *	East	28°	+6.3
M92	Globular Cluster (Hercules)	Globular Cluster	***	***	03:56 *	South-West	81°	+6.5
M10	Globular Cluster (Ophiuchus)	Globular Cluster	22:30	09:57	03:18	South	35°	+6.6
M81	Bode's Galaxy (Ursa Major)	Galaxy	***	***	21:55	North	69°	+6.9
M101	Pinwheel Galaxy (Ursa Major)	Galaxy	***	***	00:25	North	86°	+7.9

\* = Highest point at Dawn (03:56 - last visible sighting)    \*\* = Highest point at Dusk (21:57 - first visible sighting)

\*\*\* = circumpolar

## Deep Sky Objects (2) for evening of 1<sup>st</sup>/morning of 2<sup>nd</sup> May

Object	Name	Type	Rises	Sets	Highest	Direction	Alt	Mag	
M94	'Spiral' Galaxy (Canes Venatici)	Galaxy	***	***	21:57 **	South-East	74°	+8.2	
M51	Globular Cluster (Hercules)	Globular Cluster	***	***	21:57 **	East	71°	+8.4	
M104	Sombrero Galaxy (Virgo)	Galaxy	18:48	04:58	22:58	South	27°	+8.6	
M57	The Ring Nebula (Lyra)	Planetary Nebula	***	***	03:56 *	South-East	67°	+8.8	
NGC2403	'Spiral' Galaxy (Camelopardalis)	Galaxy	***	***	21:57 **	North	57°	+8.9	
Twilight ends (1 <sup>st</sup> ), Twilight starts (2 <sup>nd</sup> )			Twilight	Civil	Naut	Astro		Rises	Sets
Sunset (1 <sup>st</sup> ), Sunrise (2 <sup>nd</sup> )			Ends	21:00	21:48	22:48		Sun 05:31	20:22
Moon rises (1 <sup>st</sup> ), Moon sets (2 <sup>nd</sup> )			Starts	04:53	04:05	03:06		Moon 16:37	04:48

\* = Highest point at Dawn (03:56 - last visible sighting)    \*\* = Highest point at Dusk (21:57 - first visible sighting)

\*\*\* = circumpolar

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## Brown Lunation Numbers numbered from first New Moon in 1923

# Phases of the Moon



<u>Phase</u>	<u>Date</u>	<u>Time</u>	<u>Lunation</u>
FULL MOON	5 <sup>th</sup> May	18:34	1241
LAST QUARTER	12 <sup>th</sup> May	15:28	1241
NEW MOON	19 <sup>th</sup> May	16:53	1242
FIRST QUARTER	27 <sup>th</sup> May	16:22	1242



Credit: Sean Smith/NASA

# Lewes Astronomical Society

**Wednesday 7<sup>th</sup> June 2023**

*"A beginner's guide to cosmology and the insights gained  
from studying the cosmic microwave background"*

Kate Land, Lewes town hall, guests welcome

**The 2023-24 season starts on Wednesday 6<sup>th</sup> September 2023**

**More details at our AGM which precedes our talk next month**

**These slides are available as a newsletter at**

**[www.lewesas.org.uk/newsletters/LAS-May-23.pdf](http://www.lewesas.org.uk/newsletters/LAS-May-23.pdf)**