Lewes Astronomical Society

Newsletter – December 2022

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Astronomy & Space News

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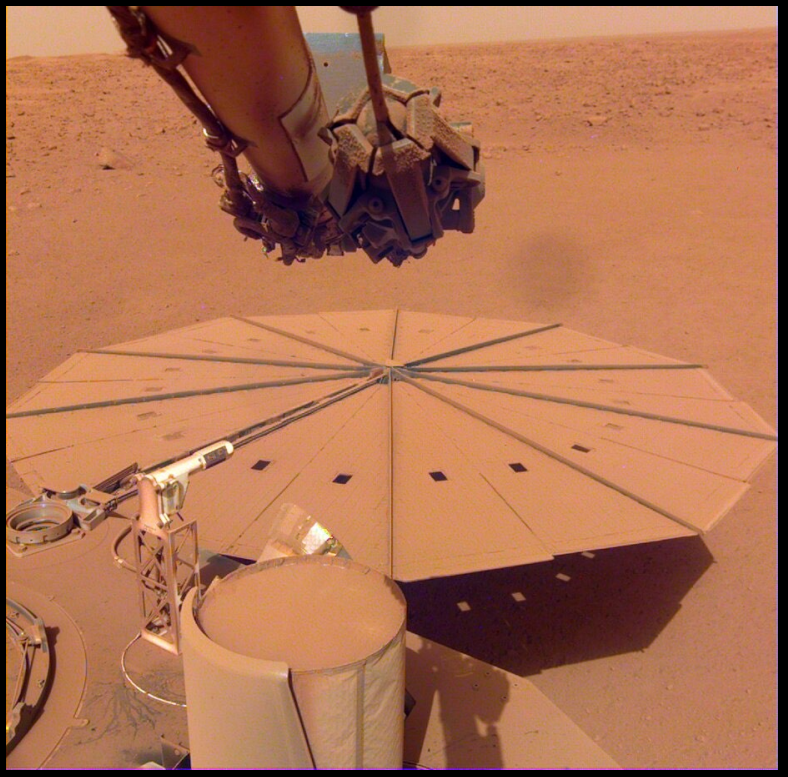
Mars – Landers and Probes

- NASA's InSight Lander is in the final few weeks of its extended mission. It has been on Mars since 2018
- Increasing levels of dust are covering the solar panels and the power supply is dwindling
- It was put into hibernation for 2 weeks during October to save power during a dust storm
- Working on keeping seismometer operational
- Dust ended Opportunity Rover's life in 2018
- Meanwhile the Indian Space Research Organisation has lost contact with its Mars Orbiter; it is believed to have crashed. It was launched in 2013 and went into orbit in 2014



InSight Lander selfie, covered in dust!

Credit:
NASA/JPL-Caltech

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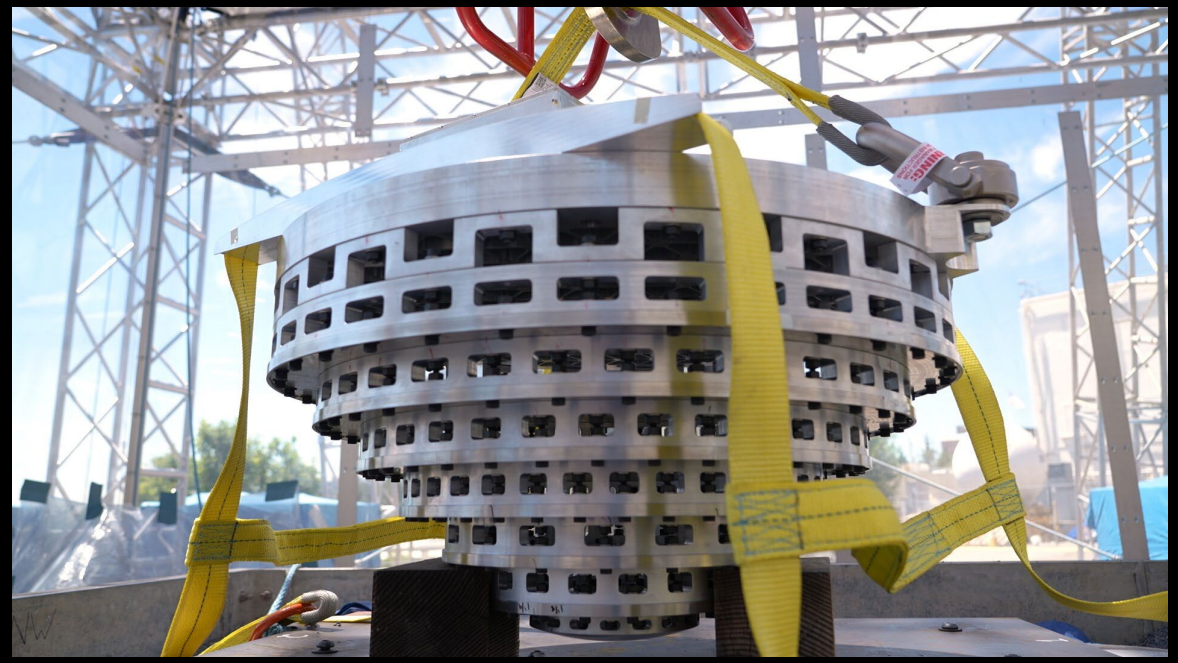
How to land on Mars

- NASA has used
  - Parachutes
  - Gas-filled balloons
  - Sky Cranes

  to land safely on Mars
- But it is costly, complicated and hazardous!
- NASA is exploring the idea of crash-landing – using a design similar in concept to a car crumple zone
- The lander has an accordion-type base which collapses on impact



The prototype SHIELD (Simplified High Impact Energy Landing Device)

Credit:
NASA/JPL-Caltech

- See it survive being dropped from a 30m high tower
- https://www.youtube.com/watch?v=_m6SEKNgxno&feature=emb_rel_end

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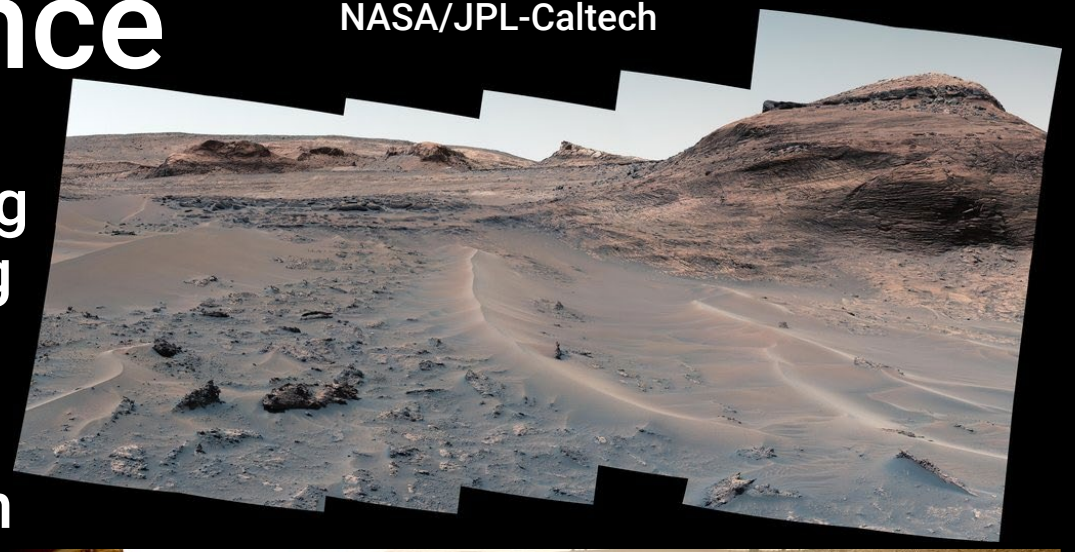
Curiosity and Perseverance

- Curiosity has now reached a sulphate-bearing region on Mount Sharp, the remains of a long dried-up river bed (the hill is nicknamed ‘Bolivar’)
- Samples will be analysed using the ChemMin and SAM instruments
- Perseverance is on sandstone in the Yori Pass near the base of Jezero Crater’s river delta. NASA hopes to find biosignatures here
- Meanwhile evidence of a huge ancient ocean in the Northern Hemisphere has emerged. Images show a shoreline with up to 900m deep sedimentary layers over 1000 sq km

Curiosity (top) and Perseverance (bottom)

Credit:
NASA/JPL-Caltech



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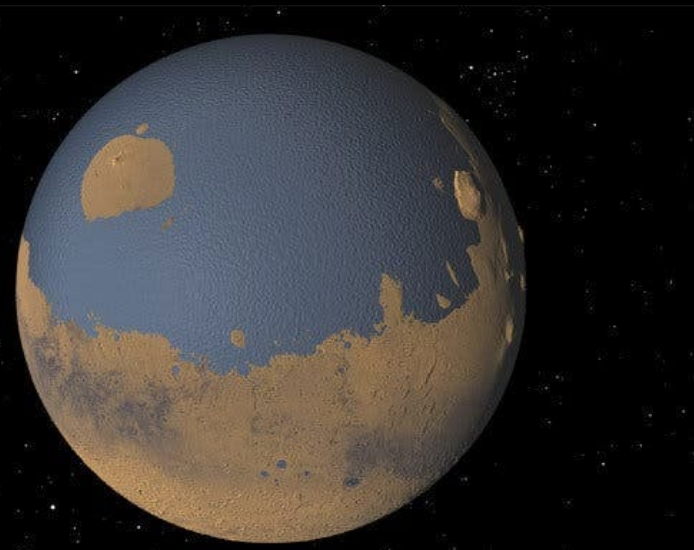
Mars – Water and Microbes?

- Water for the oceans may have come from carbon-rich chondrite meteorites from outer solar system
- Conclusion comes from analysing fragments flung to Earth following asteroid impacts on Mars
- Modelling suggests that microbes buried deep into the soil to protect themselves from harsh solar radiation may have thrived in warm, wet conditions with a high hydrogen & carbon dioxide atmosphere
- Hydrogen, a very good greenhouse gas would have been easily lost to space due to Mars's weak gravity
- Microbes may yet exist. The bacterium, *Deinococcus radiodurans* can survive massive doses of radiation and "hibernate" for up to 280 million years if buried 10 metres below surface



Artists impression of Mars 4 billion years ago

Credit: NASA/Greg Shirah

For more on ancient oceans see:

https://youtu.be/s3xlyen_tnQ

& on a possible massive tsunami-causing impact:

https://youtu.be/YvHknUEX91c

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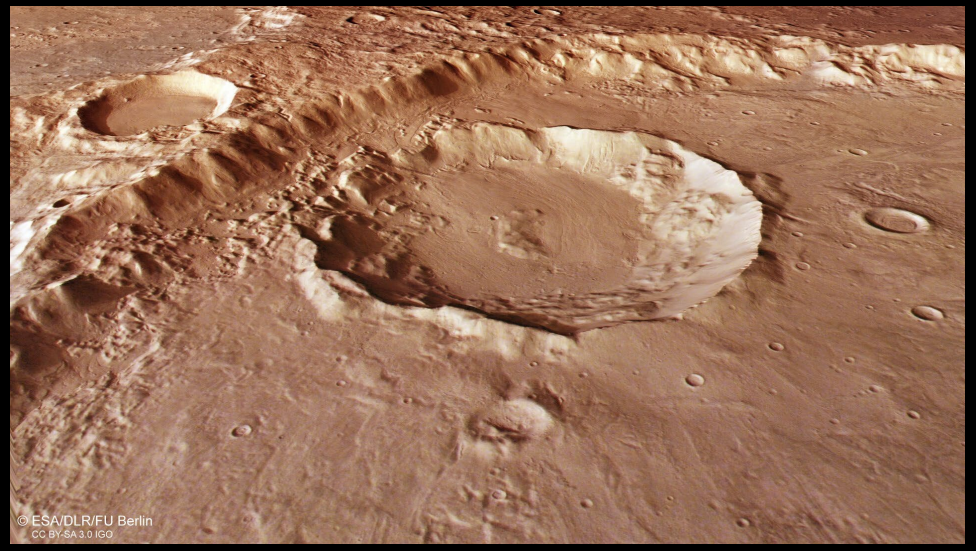
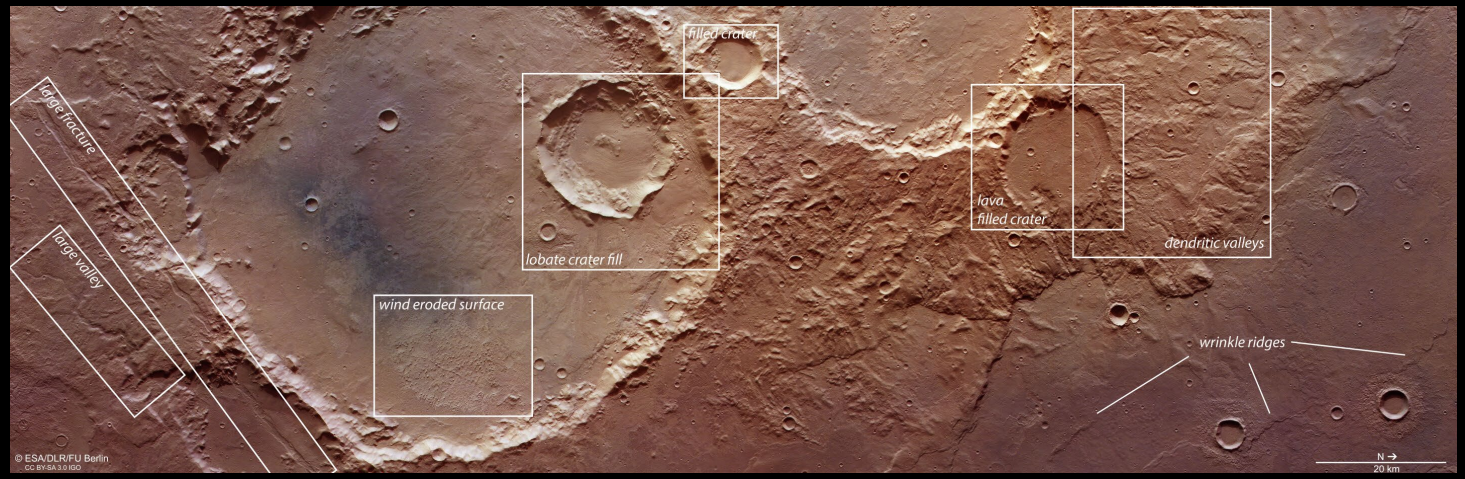
Martian Craters

- Images taken by the Mars Express High Resolution Stereo Camera of the Terra Sirenum region show the effects of wind erosion, glacial action and melt waters on the sides of craters. There are also tectonic stress fractures



Terra Sirenum craters

Credit:
ESA/DLR/FU Berlin/CC BY-SA 3.0 IGO



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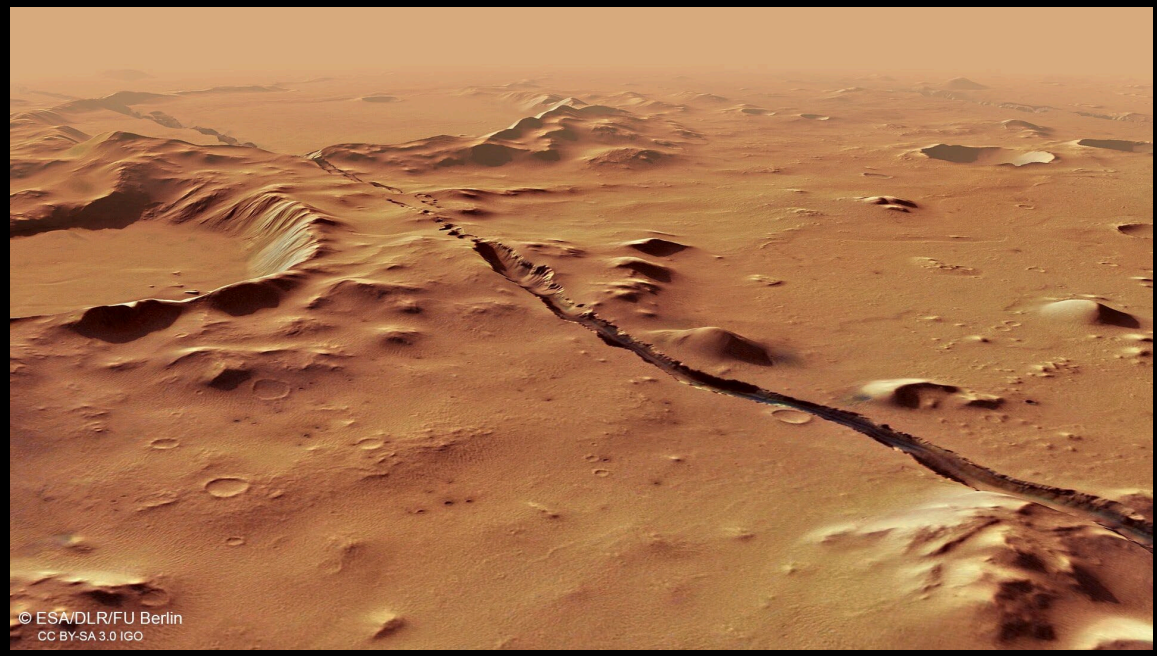
Marsquakes 1

- The seismometer on NASA's InSight Lander has recorded more than 1,300 Marsquakes since 2018
- The epicentre for the vast majority is the Cerberus Fossae region
- Images show a number of graben, rifts caused by volcanic activity
- Some of the ongoing quakes are probably caused by molten magma
- Darker deposits lie in all directions, not just the prevailing wind suggesting volcanic activity in past 50,000 years



Graben or rifts caused by continuing volcanic activity

Credit:
ESA/DLR/FU Berlin/CC BY-SA 3.0 IGO and core (Dr Sheng Wang & Professor Hrvoje Thalčič (Australian National University)

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Marsquakes 2

- Some of the quakes are due to meteorite impacts. Two recent events which caused craters 130m and 150m across, were 3,500 km and 7,000 km from the lander
- They are the largest and most recent impacts in the Solar System
- Huge blocks of water ice were thrown out by the impacts suggesting there is more frozen water on Mars than originally thought
- The quakes helps us determine the size of the core and shape of the crusts (flatter in the north, thicker and mountainous in the south)

Christmas Eve 2021 meteorite impact showing blocks of water ice scattered around crater

Credit:
NASA/JPL-Caltech

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Martian Clouds

- Clouds seen over Mars seem to bear a remarkable similarity to those on Earth
- This is surprising given how thin the Martian atmosphere is, the totally different chemical composition and solar-driven convection patterns.

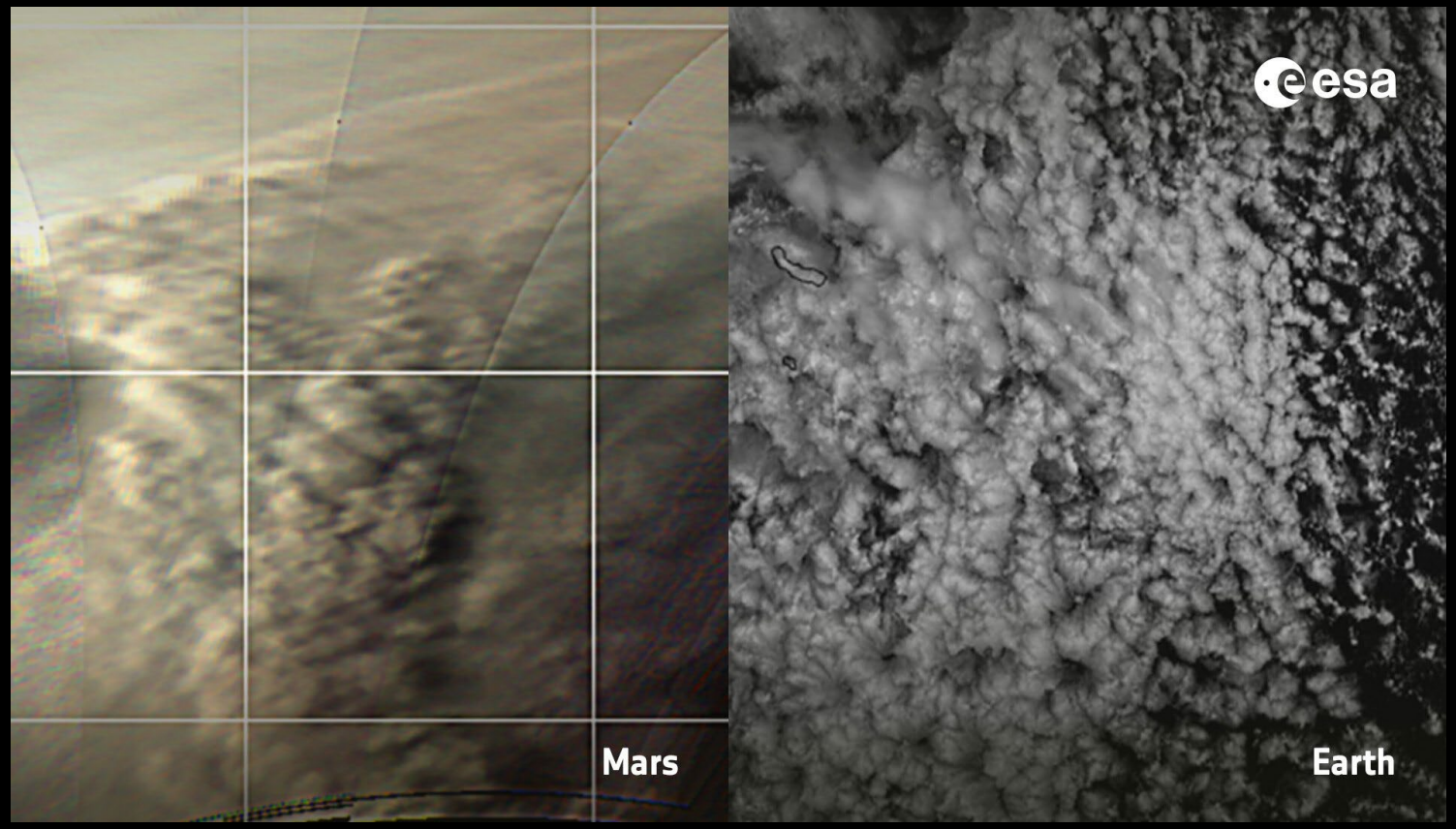

Image over North Pole taken by Mars Express Visual Monitoring Camera

Credit:
ESA/GCP/UPV/EHU Bilboa
[Earth image over Azores in 2020 by Meteosat 8; credit: EUMETSET]

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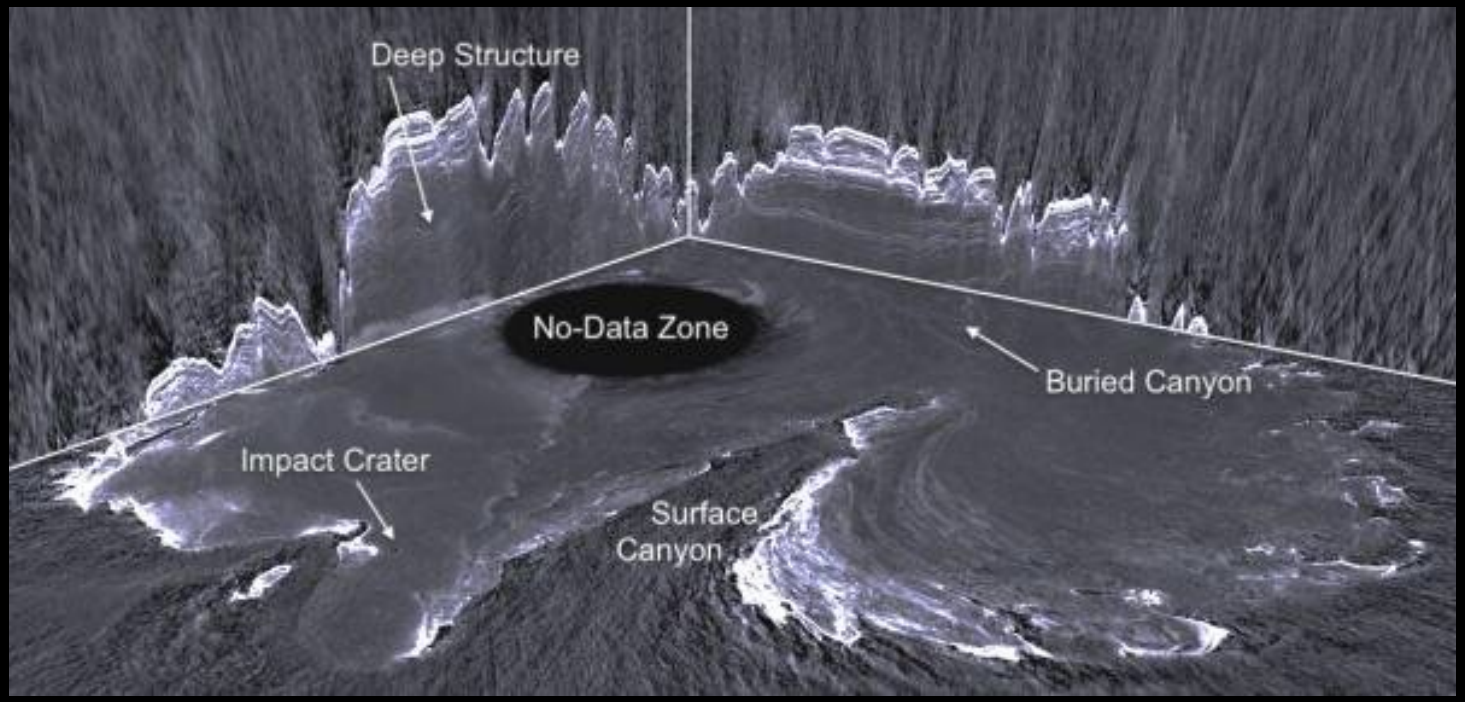
Martian Polar Region Study

- The Shallow Radar (SHARAD) instrument on the Mars Reconnaissance Orbiter (MRO) has now provided a detailed image of the structure of the North Pole (Planum Boreum)
- SHARAD is able to penetrate to depths of 4 km and will help with the study of the origins of polar deposits and their implications for climate history



3D Radargram image of structure of North Pole with horizontal slice at bottom and 2 opposing vertical slices above. The Mars Reconnaissance Orbiter does not pass over the central area

Credit: PSI/ASI/JPL/NASA

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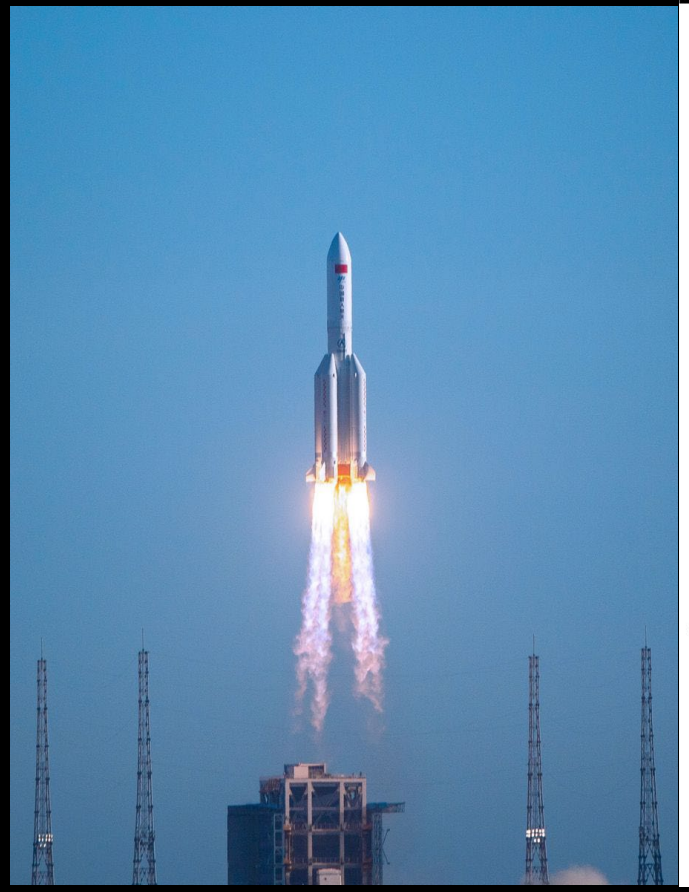
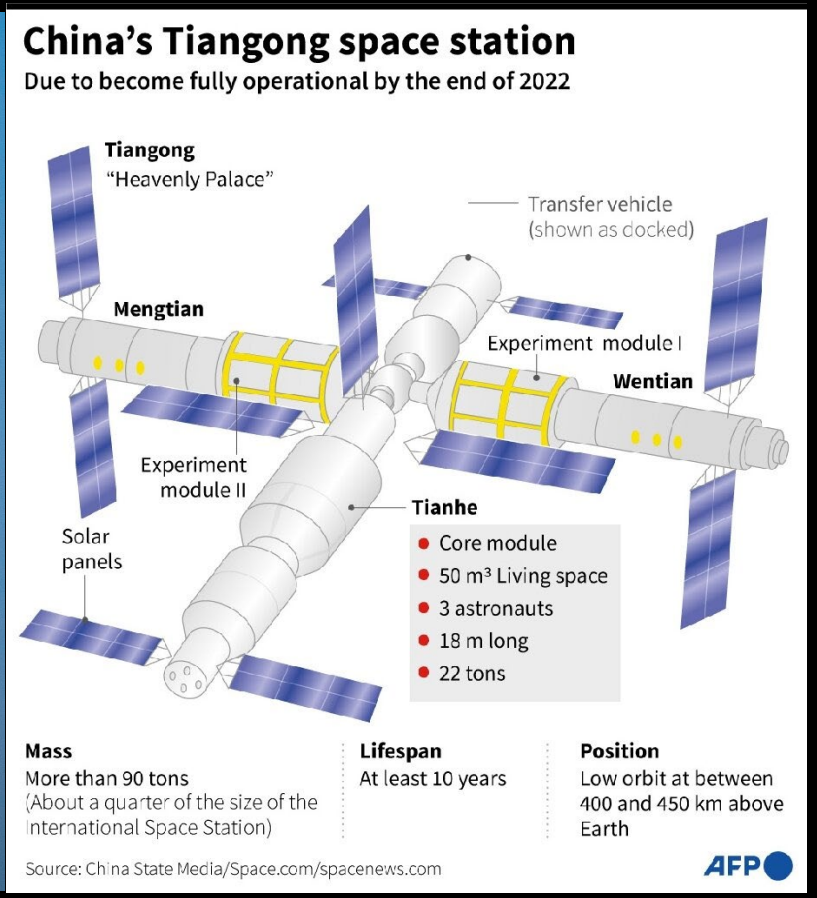
Tiangong – China's New Space Station

- China launched the final module ("Mengtian") for the new Tiangong Space Station on November 1st
- Mengtian is 18m long and weighs almost 23 tonnes
- The 3-man crew of the Shenzhou-14 mission already on Tiangong have been joined by the new 3-man crew of Shenzhou-15 to help complete construction by end of year





Long March 5B Rocket Launch carrying final module for Tiangong Space Station
Credit: Xinhau

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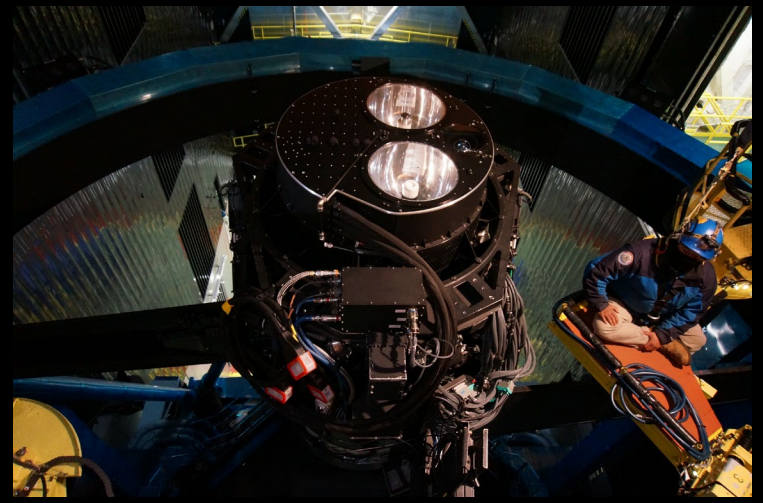
3 New Telescope Instruments

- Keck Planet Finder (on 10m Keck 1 telescope in Hawaii): an Earth-sized exoplanet hunter with world's most advanced high-resolution spectrometer
- Prime Focus Spectrograph (on 8.2m Subaru Telescope in Hawaii): for simultaneous exposure of large numbers of stars/galaxies
- Enhanced Resolution Imager and Spectrograph (ERIS) (on 8.4m VLT in Chile): an upgraded replacement for NACO

Credit: W M Keck Observatory



Credit: Kavli IPMU

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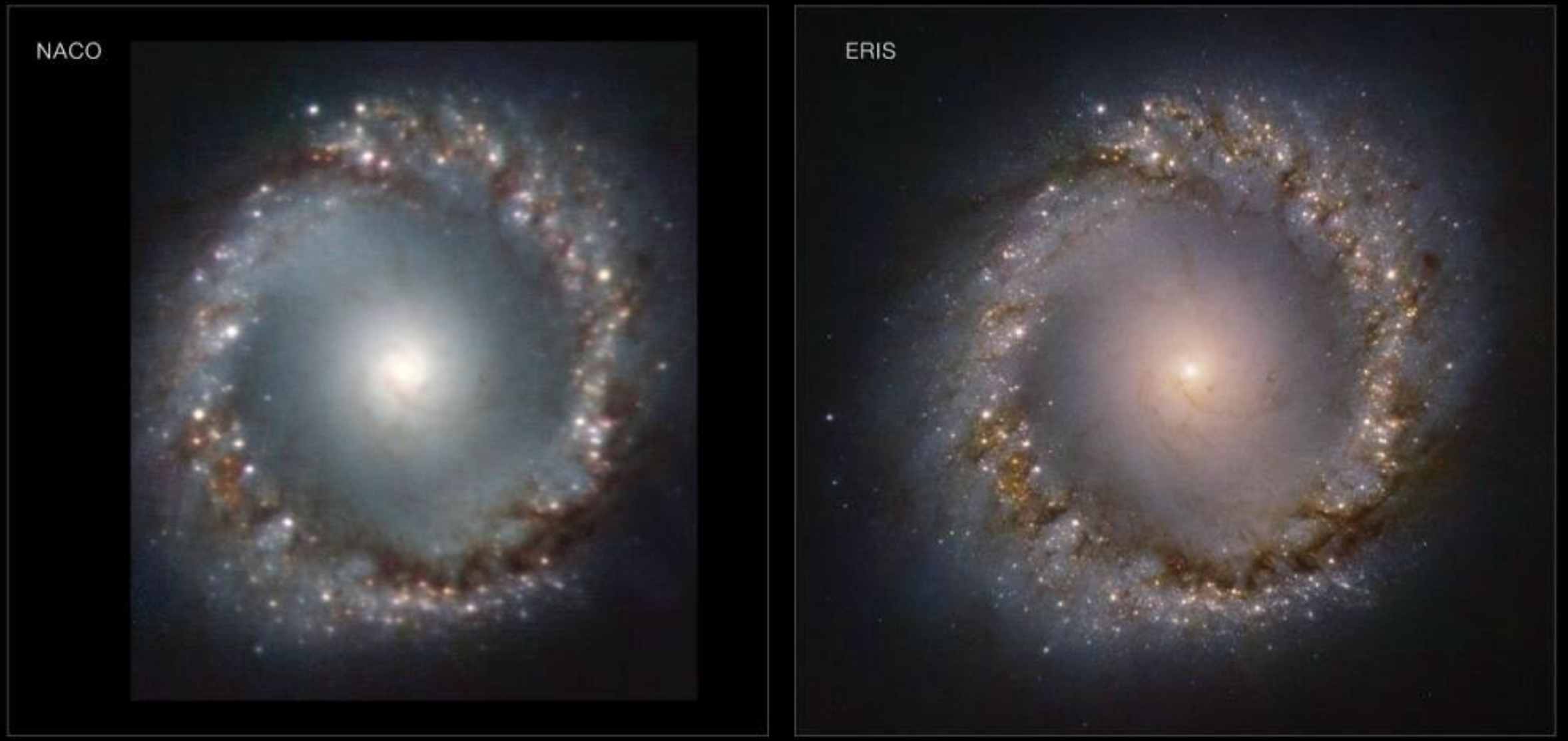

The first VLT image using ERIS of NGC 1097 (right) compared with image from the previous NACO instrument (left) Credit: ESO/ERIS team

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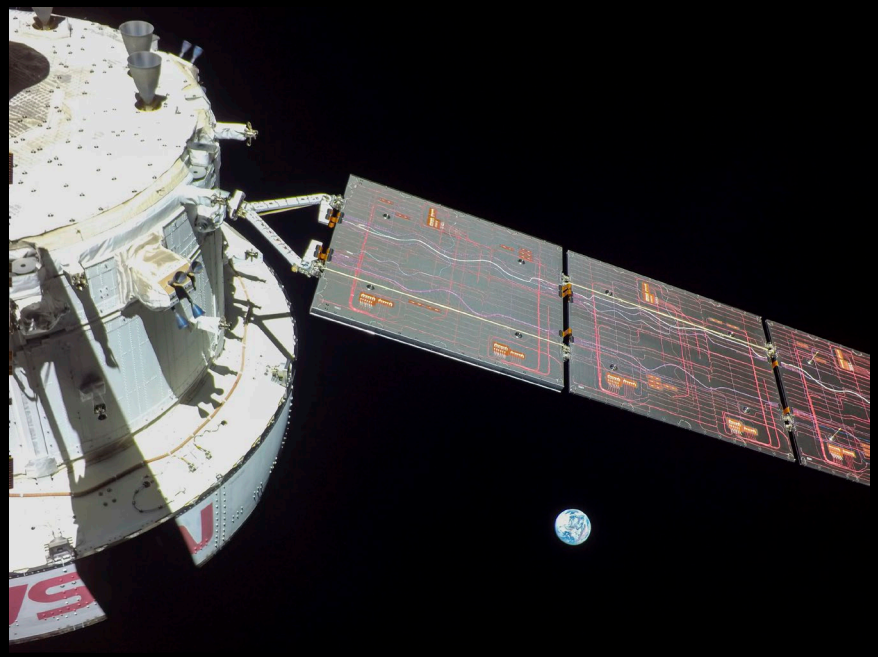
Artemis 1

- Artemis 1 was finally launched on Wednesday 16th November at 06:04
- After a number of embarrassing cancellations, the launch and subsequent mission has been almost flawless
- The Orion spacecraft completed a lunar fly-by on Day 5 getting to within 81 km of the surface before entering a distant retrograde orbit (between 50,000 and 70,000 km). It fired the engine to leave orbit on Thurs 1st Dec



Credit: NASA via AP

- The mission is due to last until Sunday 11th December. Watch the launch at: https://www.youtube.com/watch?v=CMLD0Lp0JBg

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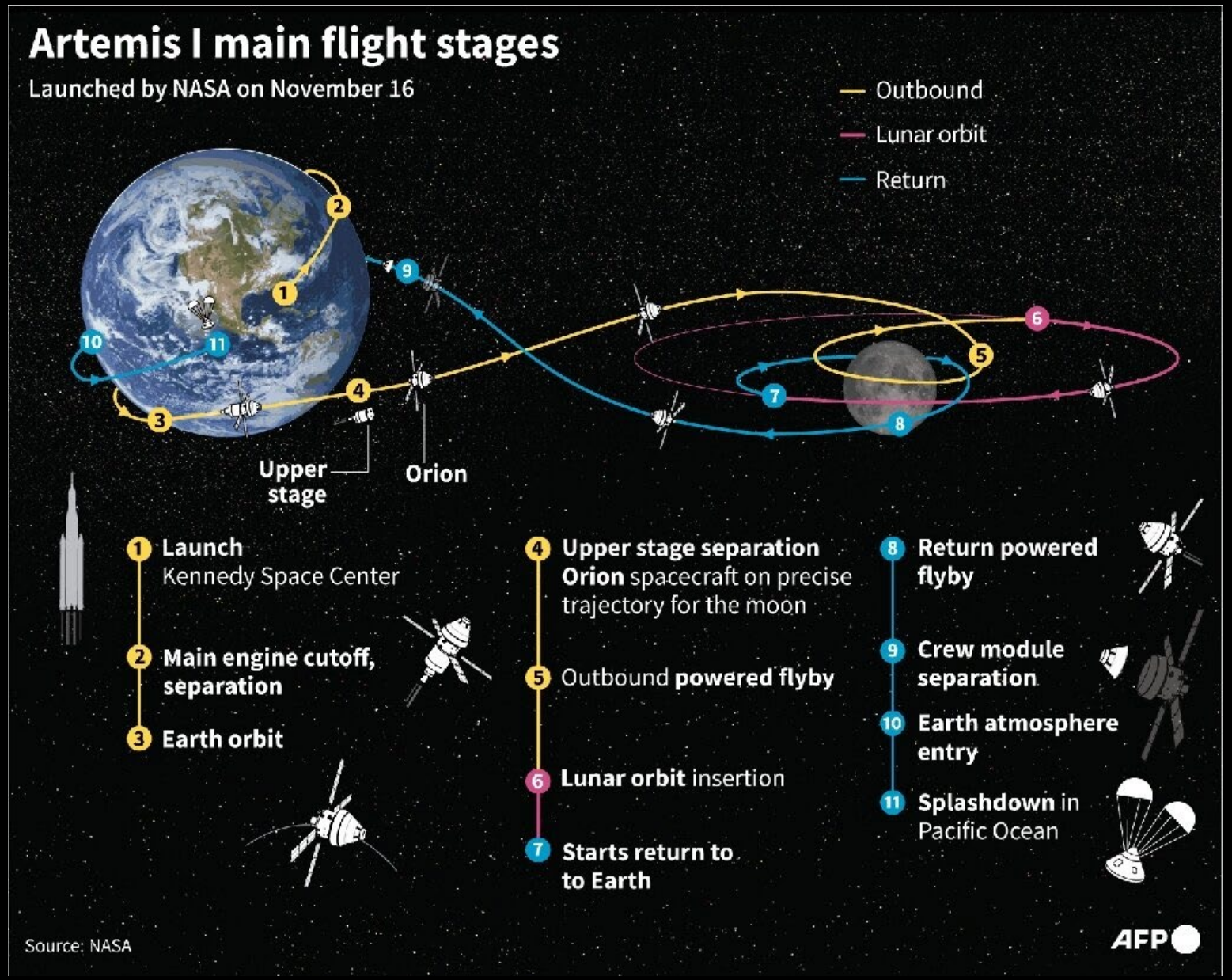

Credit: NASA

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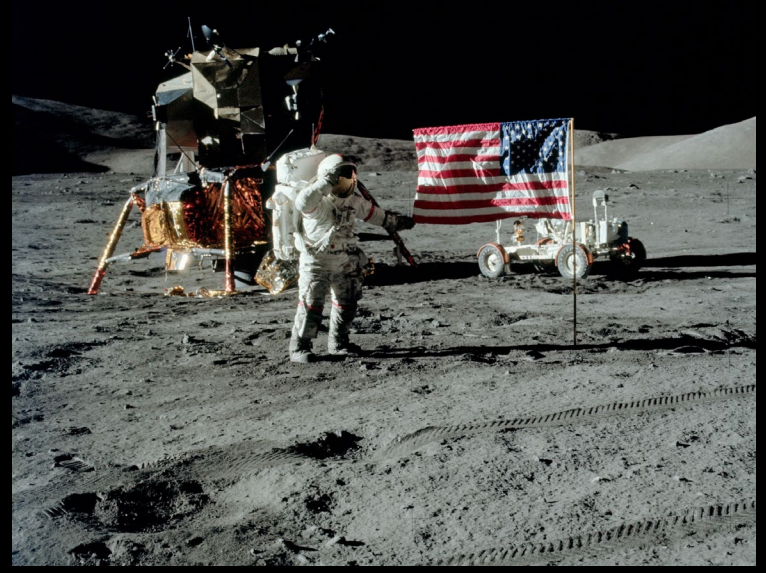
Apollo 17 50th Anniversay

- Apollo 17, the last manned mission to the Moon, was launched 50 years ago on Thursday 7th December 1972 at 05:33
- Crew:
  - Eugene “Gene” Cernan – Commander
  - Harrison “Jack” Schmidt – Lunar Pilot
  - Ronald E. Evans – Command Module Pilot
- Jack Schmidt was the only scientist (and geologist) to walk on the Moon

Standing: Jack Schmidt, Ron Evans.
Seated: Gene Cernan (and below)
Credit (both photos): NASA



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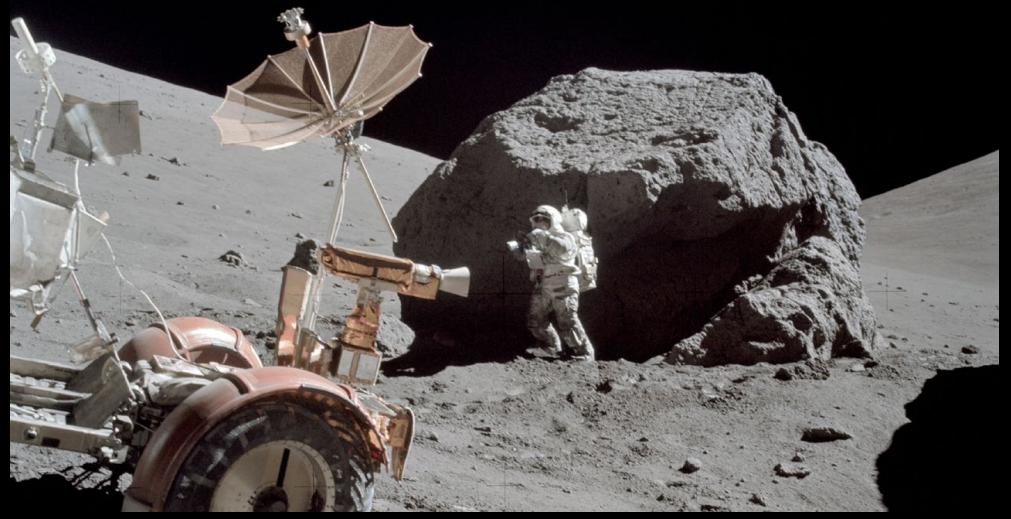
- The mission was based in the Taurus-Littrow Valley
- They carried out 3 moonwalks (with the lunar rover) and brought back 75 kg of moonrock (including volcanic orange soil)
- They set a number of records:
  - Longest mission (12 days 14 hours)
  - Longest time in lunar orbit (6 days 4 hours = 75 orbits)
  - Longest extravehicular activity (22 hours 4 mins)
  - Furthest distance travelled = 7.6 km



Jack Schmidt by a boulder during moonwalk 3 at the Taurus-Littrow landing site
Credit: NASA

- Watch the story “How America won the Space Race – Apollo 17” at: https://www.youtube.com/watch?v=BfQbs__kc5M

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JWST and Hubble latest photos 1

- Hubble image of galactic triplet ARP-248, in constellation of Virgo some 200 million light years distant

Credit: ESA/Hubble & NASA, Dark Energy Survey/Department of Energy/Fermilab Cosmic Physics Center/Dark Energy Camera/Cerro Tololo Inter-American Observatory/NOIRLab/National Science Foundation/AURA Astronomy; J. Dalcanton

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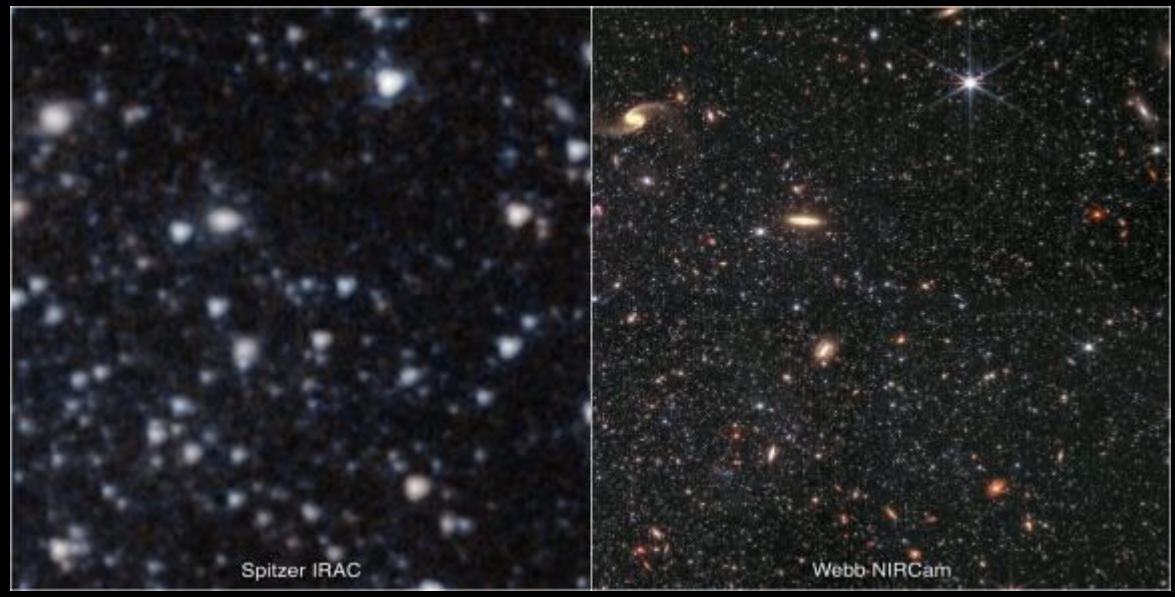
JWST and Hubble latest photos 2

- The Wolf-Lundmark-Melotte (WLM) dwarf galaxy lies only 3 million LY from The Milky Way
- It is unusual in that it appears to have never interacted with another galaxy
- It is very low in metals (elements other than hydrogen and helium)
- Metals formed in supernovae have been subsequently ejected.



JWST image on right. Credit: NASA/ESA/CSA/STScI/Kirsten McQuinn (Rutgers University)/Alyssa Pagan (STScI)

- This is due to it being very sparse with little gravity

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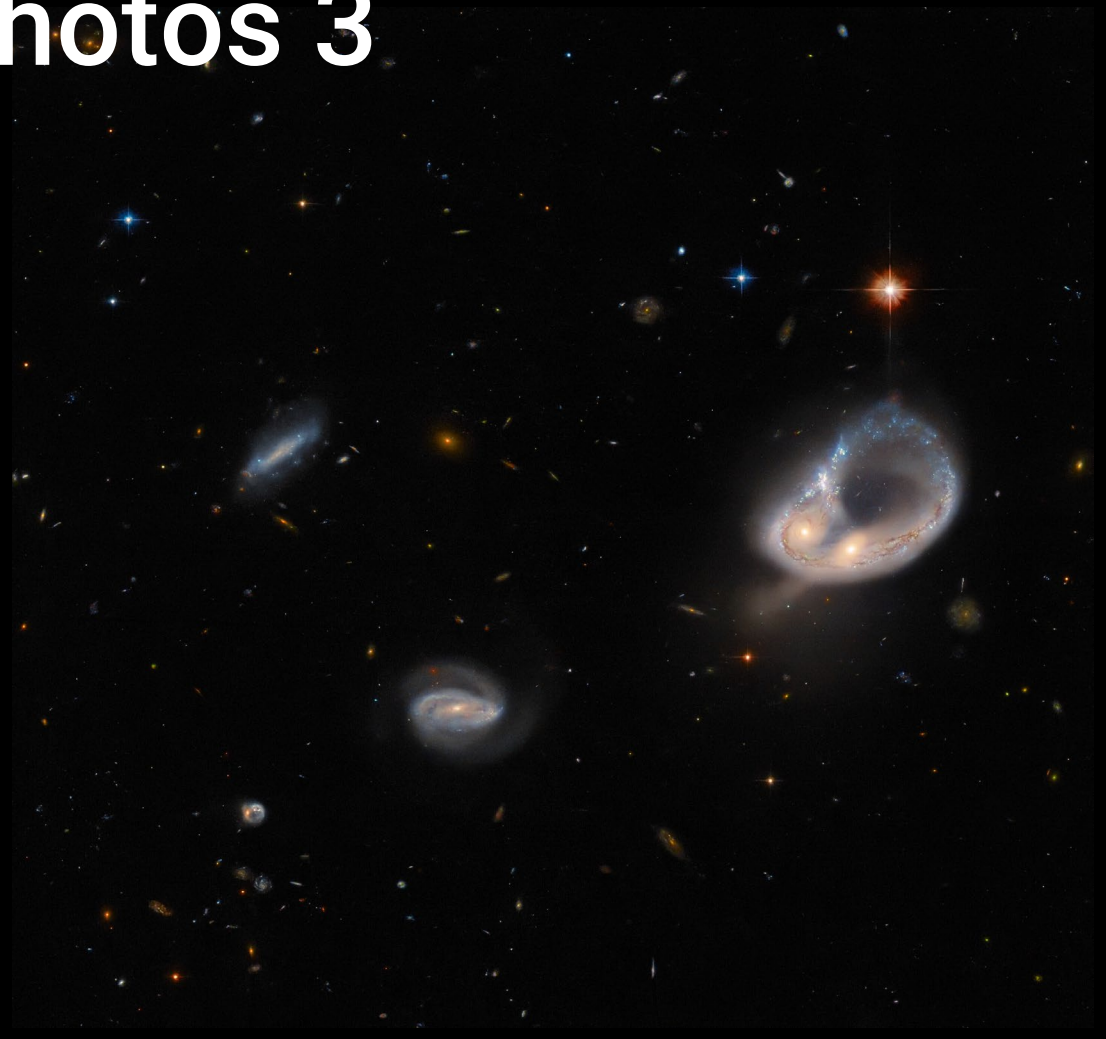
JWST and Hubble latest photos 3

- Hubble image of Arp Madore 417-391, a pair of galaxies in the process of merging
- They are situated in the constellation of Eridanus, some 670 million light years away



Credit: ESA/Hubble & NASA, Dark Energy Survey/DOE/FNAL/DECam/CTIO/NOIRLab/NSF/AURA, J. Dalcanton

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JWST and Hubble latest photos 4

- JWST images the birth of a new star
- L1527, in Taurus, is only 100,000 years old and hasn’t started nuclear fusion yet
- It is about 20-40% the mass of our Sun and is accreting material as it grows
- Light is leaking from above and below the protoplanetary disk (at the neck of the hourglass)
- Dust between the star and JWST appears coloured (blue is thinnest, orange is thickest)
- Pink streaks are molecular hydrogen

Credit: NASA, ESA, CSA, and STScI. Image processing: J. DePasquale, A. Pagan, and A. Koekemoer (STScI)

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JWST and Hubble latest photos 5

- Hubble image of CB 130-3, a huge cloud of gas and dust in the constellation, Serpens
- The gas and dust is most dense in the centre and somewhere a new protostar is being born hidden in the dust

Credit: ESA/Hubble, NASA, STScI, C. Britt, T. Huard, A. Pagan

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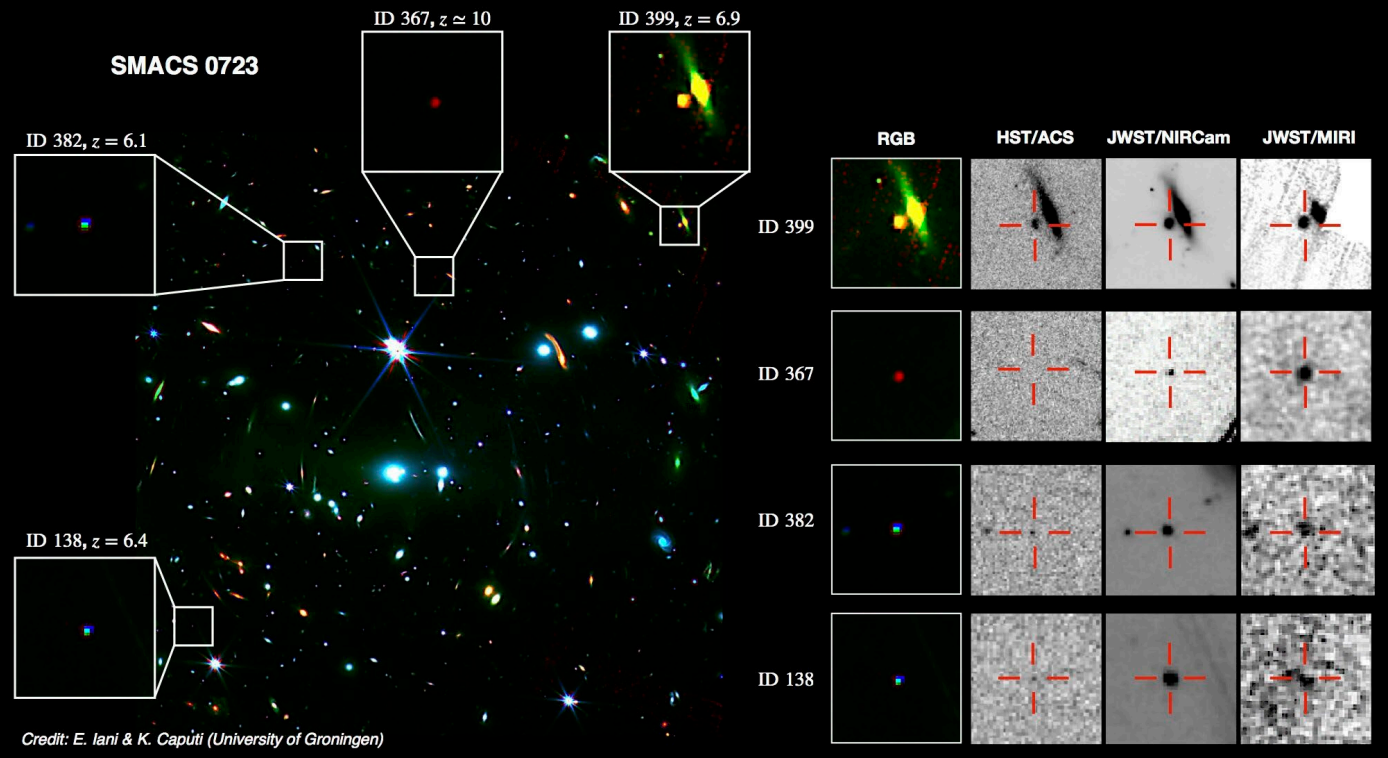
JWST and Hubble latest photos 6

- MIRI instrument on JWST is working better than expected
- This image shows galaxies less than 1 billion years after Big Bang (BB)
- Z = redshift value, how far the wavelength of light has been stretched over time



Credit: JWST/E. Iani & K. Caputi (University of Groningen)

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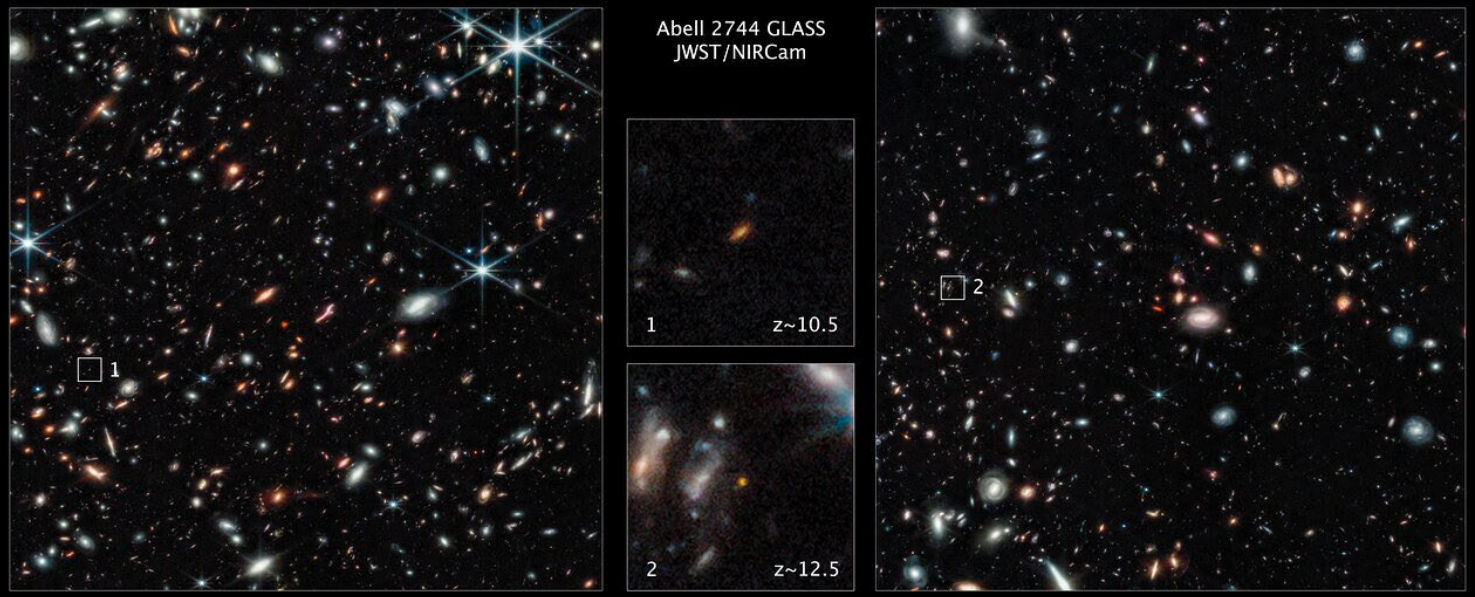
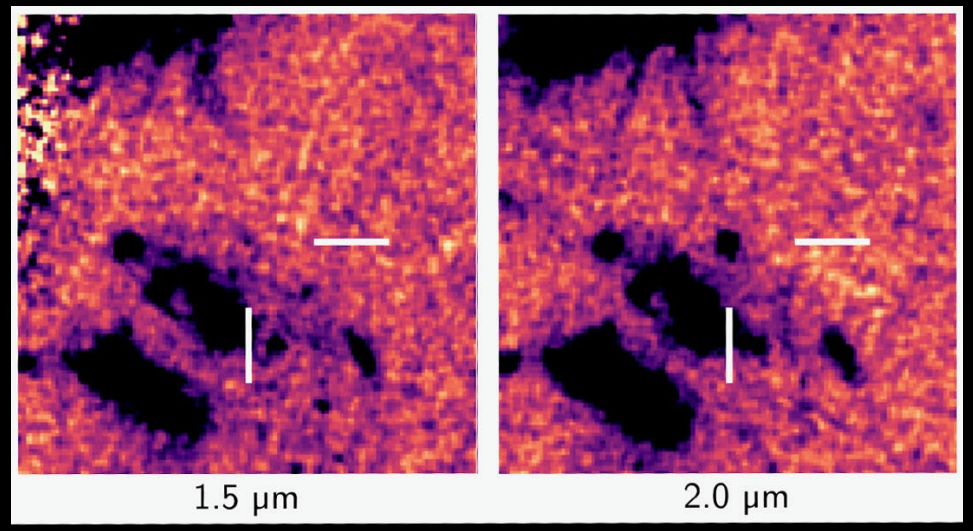
JWST and Hubble latest photos 7





Credit: NASA, ESA, CSU, T. Treu (UCLA)

- Deep field image of Abell 2744 galaxy cluster picks up two very distant galaxies which have been gravitationally lensed (GLASS-z10 and GLASS-z12)
- Right-hand image of GLASS-z12 using IR filters applied at 1.5 and 2.0μm where darker colours indicate more light
- 2 teams used different techniques to estimate age at 350m years post Big Bang

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JWST and Hubble latest photos 8

- Hubble image of open cluster NGC 2660 in constellation of Vela (southern sky)
- Red star on left side with large diffraction spike is not part of the cluster, being is much closer

Credit: NASA, ESA, and T. von Hippel (Embry-Riddle Aeronautical University); Gladys Kober (NASA/Catholic University of America)

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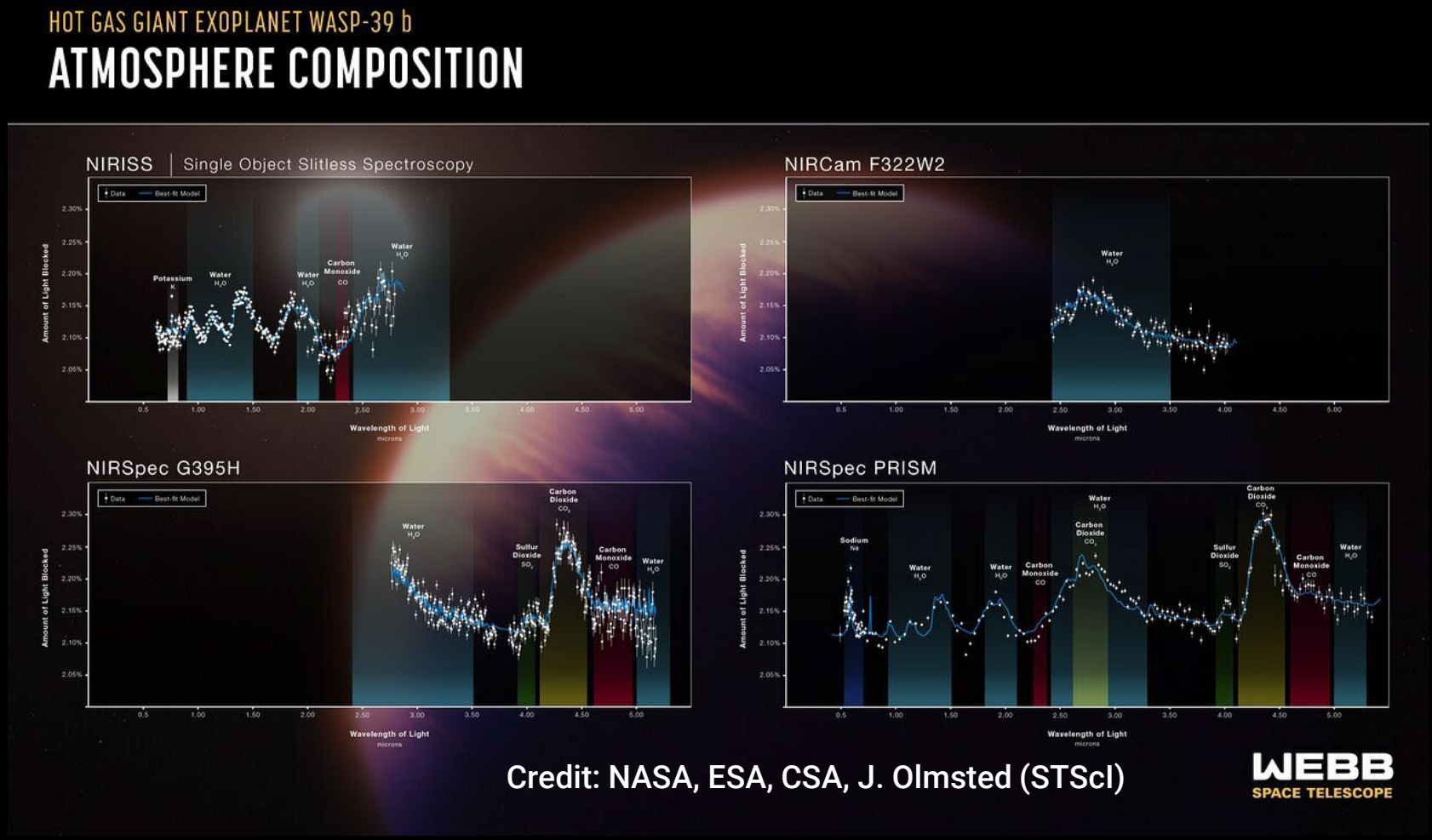
JWST and Hubble latest photos 9

- Analysis by JWST instruments of WASP-39b, a “hot Saturn” exoplanet shows atmosphere is made up of water, potassium, sodium, and sulphur dioxide – very unusual!



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Observational Highlights

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December 2022 dates

- 1st December – Mars closest to Earth (81.451 million km @ 02:00)
- 5th December – Occultation of Uranus (18:00)
- 8th December – Occultation (04:59) & Opposition of Mars (05:36)
- 14th December – Geminid meteor shower maximum
- 21st December – Winter Solstice (@ 21:48)
- 22nd December – Ursid meteor shower
- 23rd December – New Moon (Lunation 1237) – “Super” New Moon

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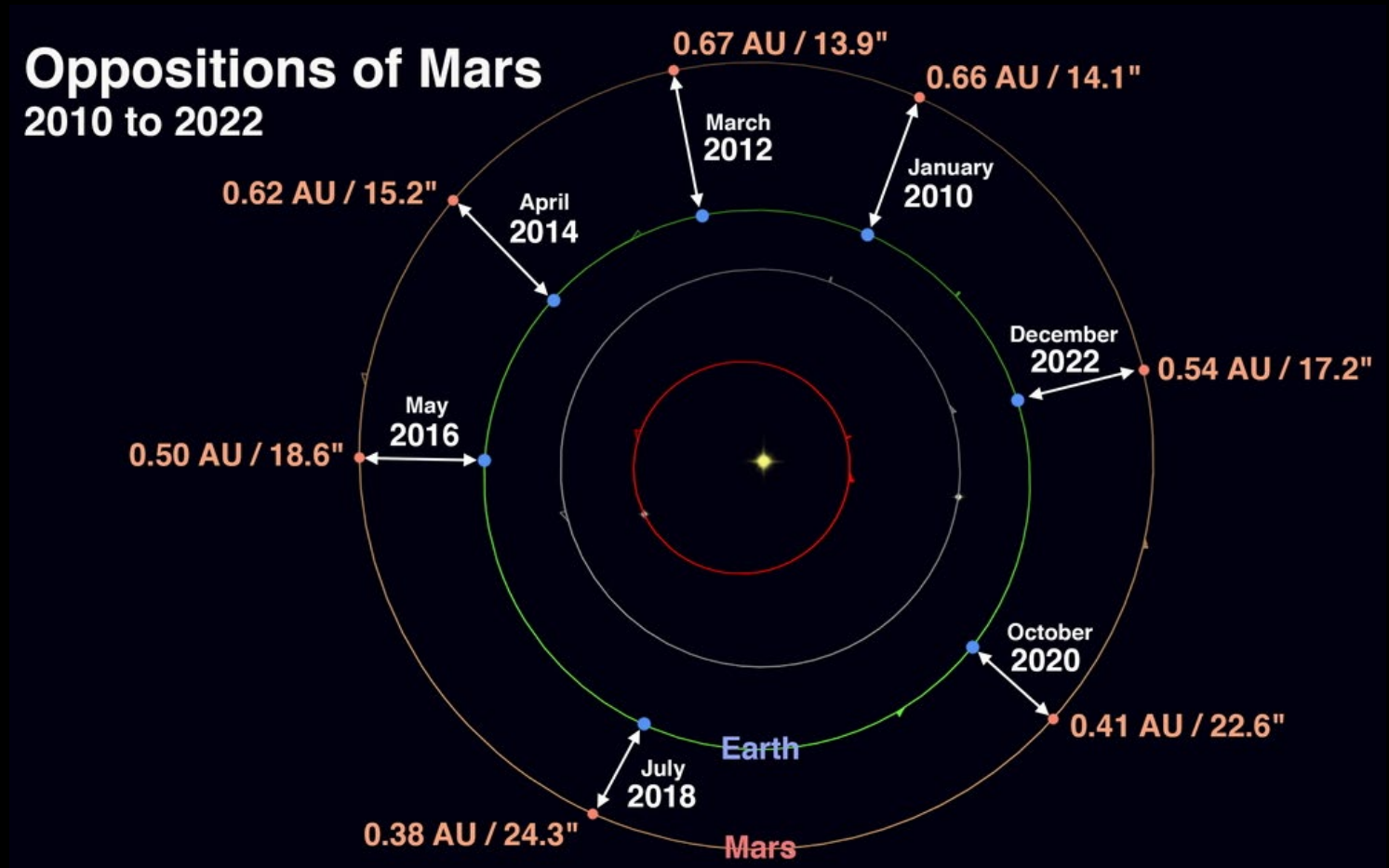
Mars at Opposition

- Planetary opposition is when two planets align with The Sun
- Mars and Earth are in opposition every 26 months
- Perihelic opposition is where the Earth and Mars are at their closest (2018 and 2020). The 2003 opposition was the closest for 60,000 years!



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Mars

- A day on Mars (sol) is 39.6 minutes longer than on Earth
- It is a little over half the diameter of the Earth (6,790km) but only one-ninth the mass
- A year lasts 687 days or 668 sols
- The orbit is much more eccentric than Earth's ranging from 206.7 million km at perihelion to 249.2 million km at aphelion
- Mars axial tilt is 25.19º (Earth is 23.26º)

Hubble image of Mars at opposition in 2016
Credit: NASA, ESA, the Hubble Heritage Team (STScI/AURA), J. Bell (ASU), and M. Wolff (Space Science Institute)

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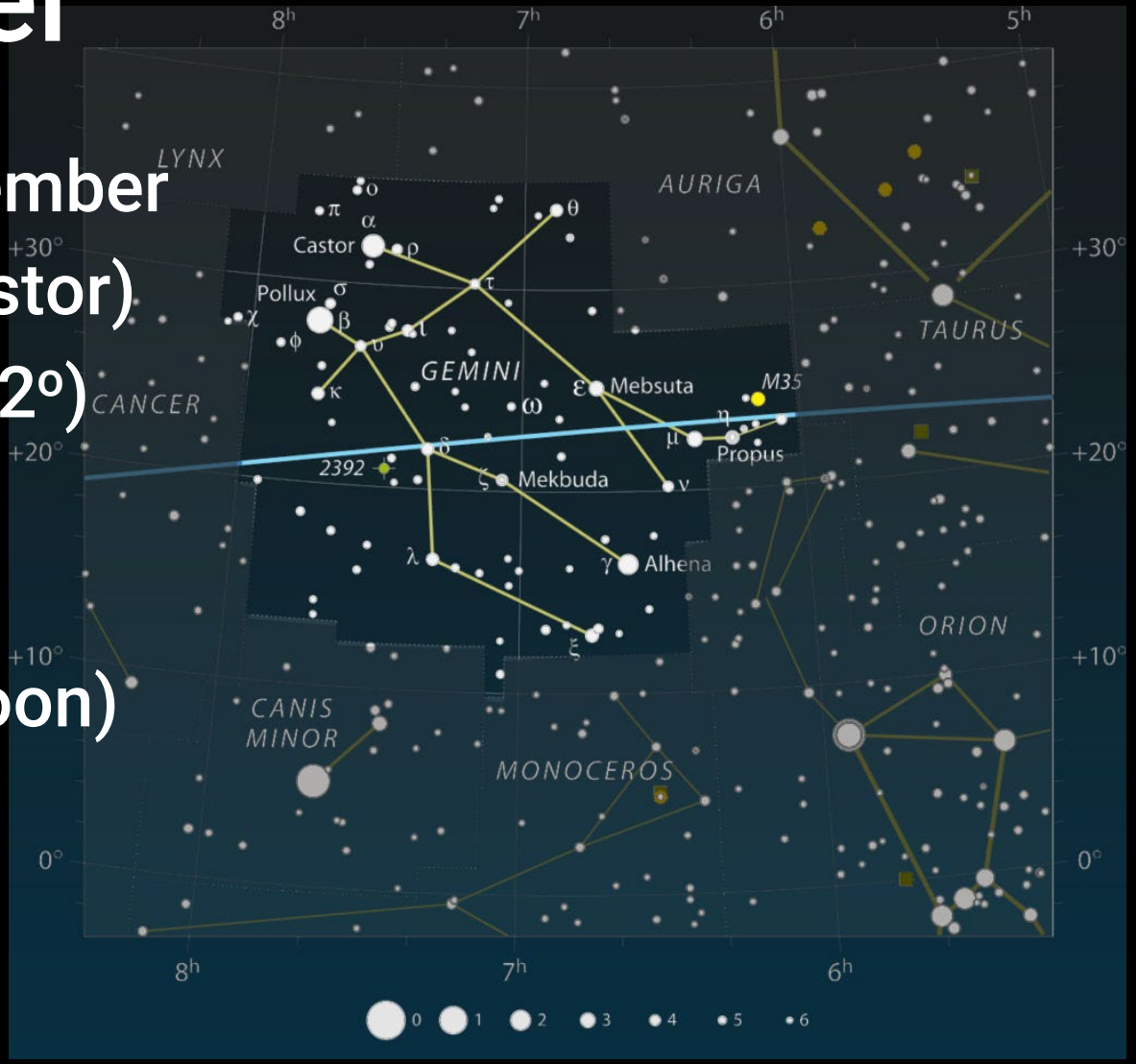
Geminid Meteor Shower

- Pre-dawn of 14th/evening 14th December
- In Gemini (radiant position near Castor)
- Look south at 2am when highest (72º)
- Rate: 100+ per hour
- Speed: slow
- Brightness: medium (3rd quarter Moon)
- Parent: Asteroid 3200 Phaethon



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Planets (@ 01-12-2022)

Planet	Rises	Sets	Highest	Direction	Altitude	Magnitude	Visible?
Mercury	08:57	16:25	12:38			-0.6	NO
Venus	08:33	16:26	12:27			-3.9	NO
Mars	16:05	08:53	00:30	South	64º	-1.8	YES
Jupiter	13:20	01:09	19:15	South	37º	-2.6	YES
Saturn	12:07	21:28	16:47	South	23º	+0.8	YES
Uranus	14:43	05:38	22:11	South	55º	+5.7	YES
Neptune	13:08	00:35	18:51	South	35º	+7.9	YES

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Deep Sky Objects 1 (@ 01-12-2022)

Object	Name	Type	Rises	Sets	Highest	Direction	Alt	Mag
M45	The Pleiades (Taurus)	Open Cluster	14:46	07:22	23:04	South	63°	+1.3
M44	The Beehive Cluster (Cancer)	Open Cluster	20:12	11:49	04:00	South	58°	+3.1
M31	Andromeda Galaxy (Andromeda)	Galaxy	***	***	20:00	South	80°	+3.4
M42	The Orion Nebula (Orion)	Open Cluster	21:25	04:26	00:56	South	33°	+4.0
NGC1981	Sword Cluster (Orion)	Open Cluster	19:14	06:38	00:56	South	34°	+4.2
NGC2232	Open Cluster (Monoceros)	Open Cluster	20:09	07:28	01:48	South	34°	+4.2
IC4665	Open Cluster (Ophiuchus)	Open Cluster	06:33	19:37	17:24**	South-West	32°	+4.2
M47	Open Cluster (Puppis)	Open Cluster	22:07	07:47	02:57	South	24°	+4.4
NGC6633	Open Cluster (Ophiuchus)	Open Cluster	07:10	20:22	17:24**	South-West	26°	+4.6
IC4756	Graff's Cluster (Serpens Cauda)	Open Cluster	07:27	20:28	17:24**	South-West	27°	+4.6
NGC2244	"Rosette Nebula" (Monoceros)	Open Cluster	19:24	08:20	01:52	South	44°	+4.8
NGC869	H Persei (Double) (Perseus)	Open Cluster	***	***	21:36	North	83°	+5.3
M33	Triangulum Galaxy (Triangulum)	Galaxy	11:38	06:04	20:51	South	69°	+5.7
M13	Great Globular Cluster (Hercules)	Globular Cluster	01:29	22:32	17:24**	West	32°	+5.8
NGC884	Chi Persei (Double) (Perseus)	Open Cluster	***	***	21:40	North	83°	+6.1
M3	Globular Cluster (Canes Venatici)	Globular Cluster	00:10	17:53	06:11*	East	50°	+6.3

* = Highest point at Dawn (last visible sighting) ** = Highest point at Dusk (first visible sighting) *** = circumpolar

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Deep Sky Objects 2 (@ 01-12-2022)

Object	Name	Type	Rises	Sets	Highest	Direction	Alt	Mag
M15	Globular Cluster (Pegasus)	Globular Cluster	09:43	23:53	17:24**	South	50º	+6.3
M92	Globular Cluster (Hercules)	Globular Cluster	***	***	17:24**	West	42º	+6.5
M2	Globular Cluster (Aquarius)	Globular Cluster	10:52	22:51	17:24**	South	37º	+6.6
M81	Bode's Galaxy (Ursa Major)	Galaxy	***	***	06:11*	North-East	85º	+6.9
M103	Open Cluster (Cassiopeia)	Open Cluster	***	***	20:51	North	80º	+7.4
M101	Pinwheel Galaxy (Ursa Major)	Galaxy	***	***	06:11*	North-East	61º	+7.9
M104	Sombrero Galaxy (Virgo)	Galaxy	02:54	13:05	06:11*	South-East	23º	+8.0
M110	'Satellite' Galaxy - 1 (Andromeda)	Galaxy	***	***	19:58	South	80º	+8.1
M94	'Spiral' Galaxy (Canes Venatici)	Galaxy	***	***	06:11*	East	67º	+8.2
NGC7009	The Saturn Nebula (Aquarius)	Planet'ry Nebula	17:24	21:29	17:24**	South	26º	+8.3
M1	The Crab Nebula (Taurus)	S'nova Remnant	19:28	06:11	00:55	South	61º	+8.4
M51	Whirlpool Galaxy (Canes Venatici)	Galaxy	***	***	06:11*	East	64º	+8.4
M57	The Ring Nebula (Lyra)	Planet'ry Nebula	17:24	23:51	17:24**	West	50º	+8.8
M32	'Satellite' Galaxy - 2 (Andromeda)	Galaxy	***	***	20:00	South	80º	+9.0
IC342	'Spiral' Galaxy (Camelopardalis)	Galaxy	***	***	23:00	North	73º	+9.2
M74	The Phantom Galaxy (Pisces)	Galaxy	17:24	01:51	20:54	South	54º	+9.5

* = Highest point at Dawn (last visible sighting) ** = Highest point at Dusk (first visible sighting) *** = circumpolar

Lewes Astronomical Society

Phases of the Moon

Brown Lunation Number: 1236 (numbered from first New Moon in 1923)

New Moon	23rd November	22:57
First Quarter	30th November	14:36
Full Moon	8th December	04:08
Last Quarter	16th December	08:56

Lewes Astronomical Society

Friday 20th January 2023
A short talk followed by an evening of observing with telescopes
Arlington village hall, members only

Wednesday 1st February 2023
"Satellite megaconstellations and their impact on astronomy today"
Dr Robert Massey, Lewes town hall, guests welcome

Wednesday 1st March 2023
"The rise and fall of an observatory at Herstmonceux"
Keith Brackenborough, Lewes town hall, guests welcome

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