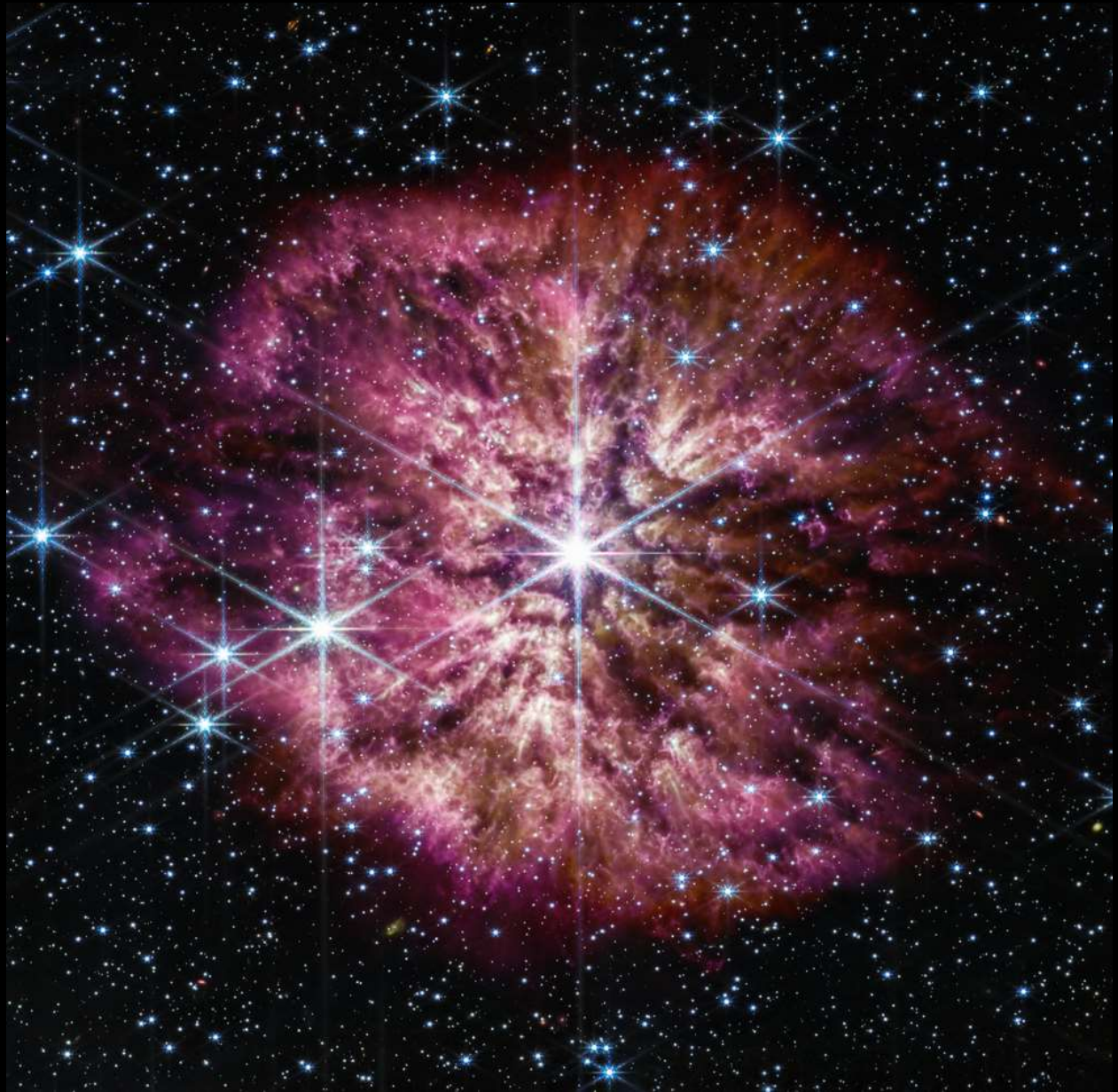


Galactic Observer

John J. McCarthy Observatory

Volume 16, No. 5

May 2023



Wolf-Rayet 124

Wolf-Rayet is a rare, short-lived stage in the final evolution of a massive star and a prelude to a supernova. The star was imaged by the James Webb Space Telescope's Near-Infrared Camera and Mid-Infrared Instrument.

May Astronomy Calendar and Space Exploration Almanac



SpaceX's Starship spacecraft and Super Heavy rocket – collectively referred to as "Starship" – represents a fully reusable transportation system designed to carry both crew and cargo to Earth orbit, the Moon, Mars and beyond. In its first test flight on April 20th the spacecraft failed to separate from the booster and was destroyed by ground control. More photos on page 6. Credit: SpaceX

In This Issue

	<u>Page</u>
☉ “Out the Window on Your Left”	3
☉ Lacus Somniorum	4
☉ Lost on Landing	5
☉ Starship	6
☉ 50 Flights	7
☉ Webb Images Uranus	8
☉ A Solar Wind-Derived Water Reservoir	9
☉ Otherworldly	10
☉ Enceladus – Riding the Ocean Currents	11
☉ Crab Nebula – A Portrait in X-Rays	12
☉ A Globular Cluster Revealed	13
☉ First Delta Sample	14
☉ Saturn’s Rings Heating Planet’s Atmosphere	15
☉ ESA’s Jupiter Icy Moons Explorer (JUICE) – the Journey Begins	16
☉ Apollo 10	17
☉ Space Shuttle Endeavour	18
☉ Public Astronomy	20
☉ Final Servicing Mission	21
☉ May Showers	23
☉ Sunrise and Sunset	23
☉ May Nights	23
☉ Astronomical and Historical Events	23
☉ Commonly Used Terms	26
☉ References on Distances	27
☉ International Space Station and Artificial	27
☉ Solar Activity	27
☉ NASA’s Global Climate Change Resource	27
☉ Mars – Mission Websites	27
☉ Lagrange Points	28
☉ James Webb Space Telescope	28
☉ Contact Information	29



“Out the Window on Your Left”

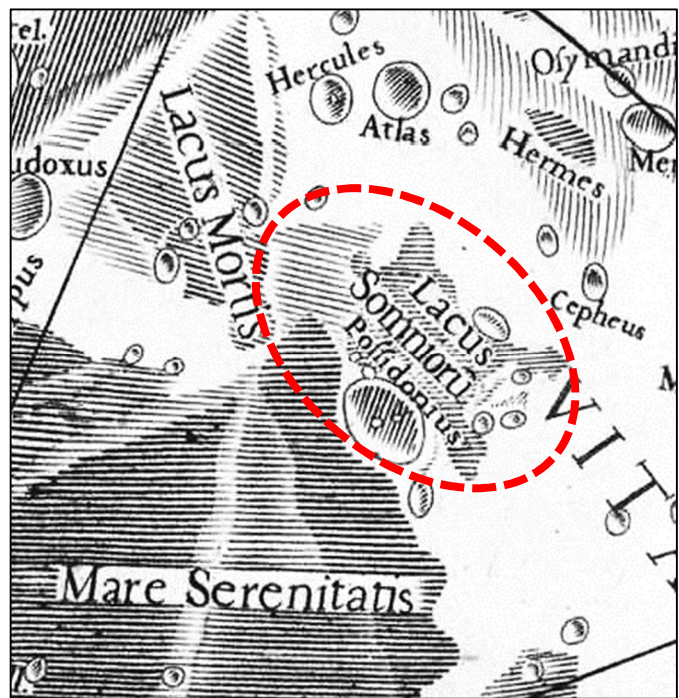
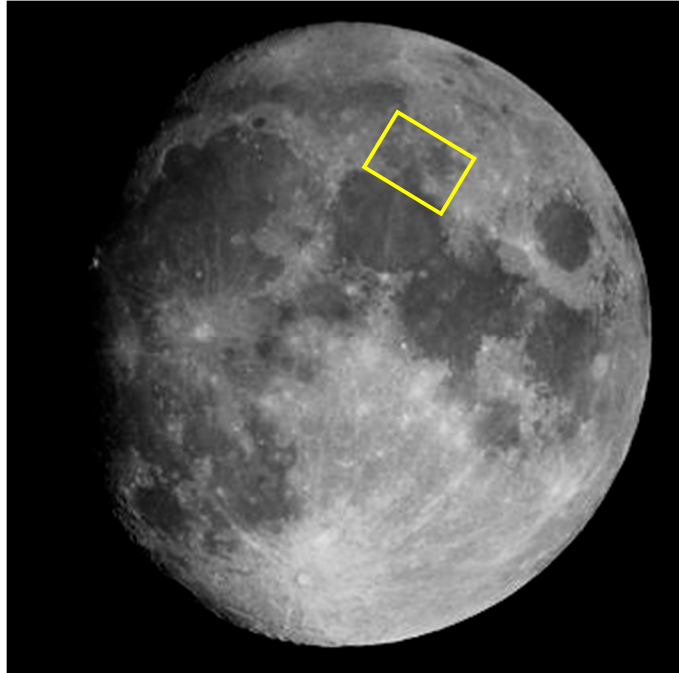
It’s been more than 50 years since Gene Cernan left the last boot print on the lunar soil. As a nation founded on exploration and the conquest of new frontiers, today’s commitment to return to the Moon has been as fleeting as the funding. But what if the average citizen had the means to visit our only natural satellite; what would they see out the window of their spacecraft as they entered orbit around the Moon? This column may provide some thoughts to ponder when planning your visit (if only in your imagination).

This month we visit a small expanse of lava with a whimsical name - Lacus Somniorum ("Lake of Dreams"). The basaltic plain is located in the northeastern sector of the Moon's near side. The feature is connected to and divided into two regions by a prong of Mare Serenitatis. The large crater Posidonius marks the entrance.

Lacus Somniorum has an estimated surface area of 18,000 square miles (47,300 sq km) and a depth of 1.55 miles (2.49 km). The small mare is traversed by a number of rilles or channels, which are likely associated with the formation of the adjacent impact basin.

The Daniell rille slashes diagonally across Lacus Somniorum for 87 miles (140 km) to the northeast of the bright 3.6-mile (6-km) Daniell D crater. On the southern boundary is the G. Bond rille, cutting through mixed terrain for 104 miles (167 km).

Posidonius is a 59 mile (95 km) fractured-floor crater, a class of craters with a shallow, mare-flooded floor, concentric and radial rilles, dark halo craters, and a location near a mare. The floor is not only fractured (likely from the intrusion of lava from beneath) but tilted, creating a cliff that drops to the smooth floor. The moat created by the cliff on the eastern side is in deep shadow in the image on the following page.



Map of the Moon by the Italian Jesuit astronomer Giovanni Battista Riccioli (1598-1671), published in 1651 in *Almagestum Novum*

Lacus Somniorum



View of the northeast quadrant, centered on Posidonius crater, around six days after a New Moon with the eastern shore of Mare Serenitatis illuminated. Photo: Bill Cloutier

Lost on Landing



Artist's impression of ispace's Hakuto-R lander on the Moon. Image credit: ispace

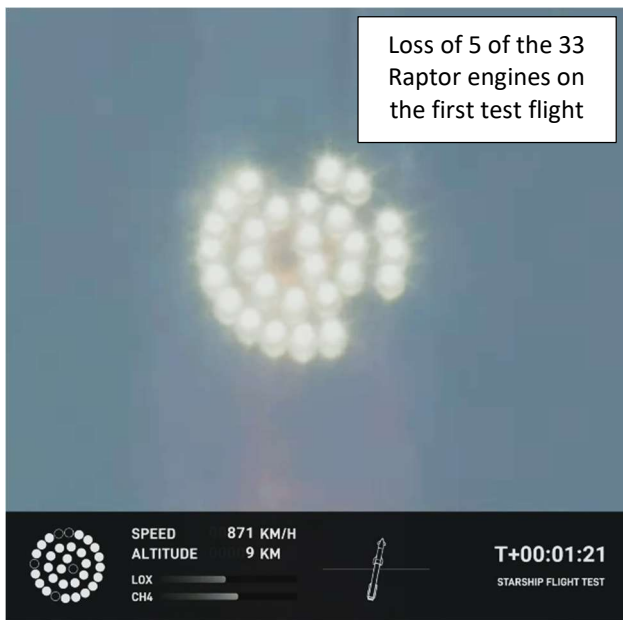
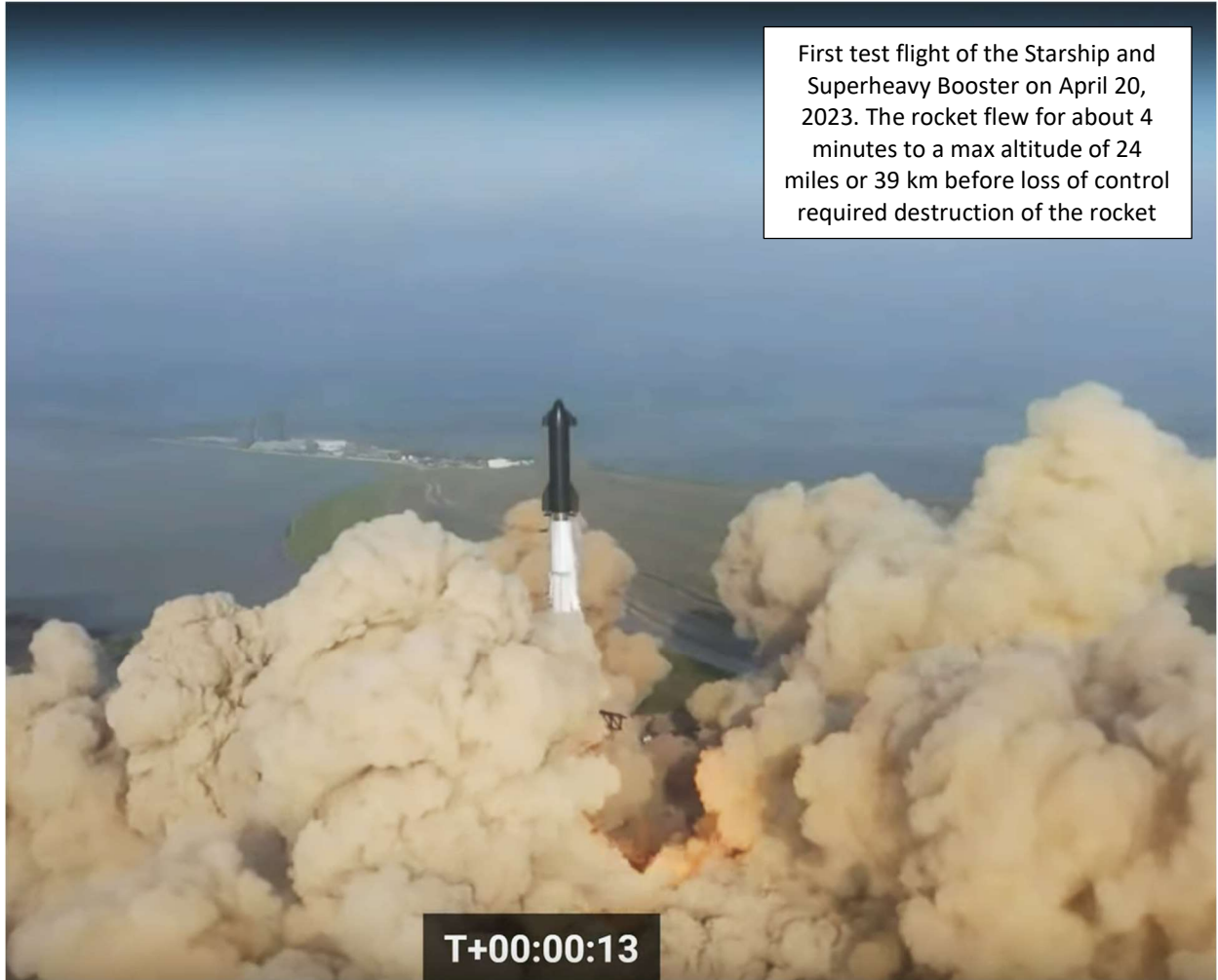
The private Japanese Hakuto-R Mission 1 Lunar Lander entered lunar orbit on March 21st after being launched on a SpaceX Falcon 9 rocket on December 11, 2022 and taking an elongated, highly energy-efficient route to the Moon.

The lander attempted a landing on April 25th. If it had been successful, the Tokyo-based ispace company would have been the first private venture to land a spacecraft on the Moon. Unfortunately, telemetry data from the Hakuto-R lander was lost during the final descent. The live webcast showed the spacecraft at an altitude of 295 feet (90 meters) and descending at 20.5 mph (33 kph) when communications ceased. While the engineering team is still reviewing the data, it appears that the spacecraft crash landed. The spacecraft was attempting to land in Atlas crater in the Mare Frigoris region on the Moon's near side.

Mission 1 was primarily a technology demonstration. The spacecraft did carry both commercial and government payloads, including two lunar rovers (the United Arab Emirates' Rashid and the Japanese Lunar Excursion Vehicle).

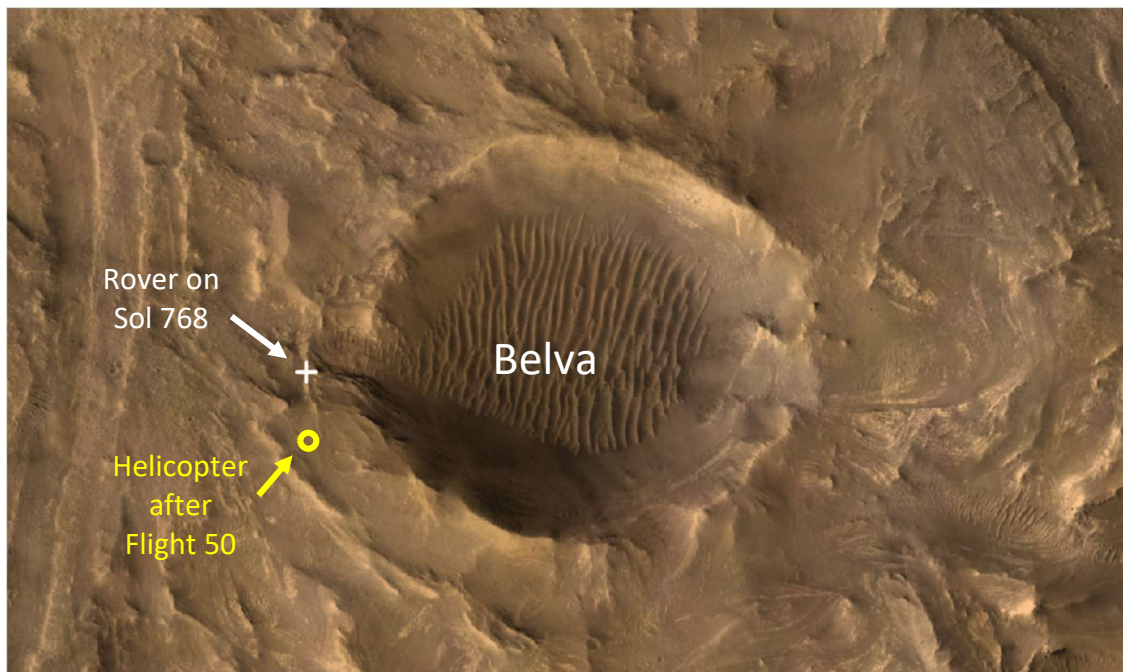
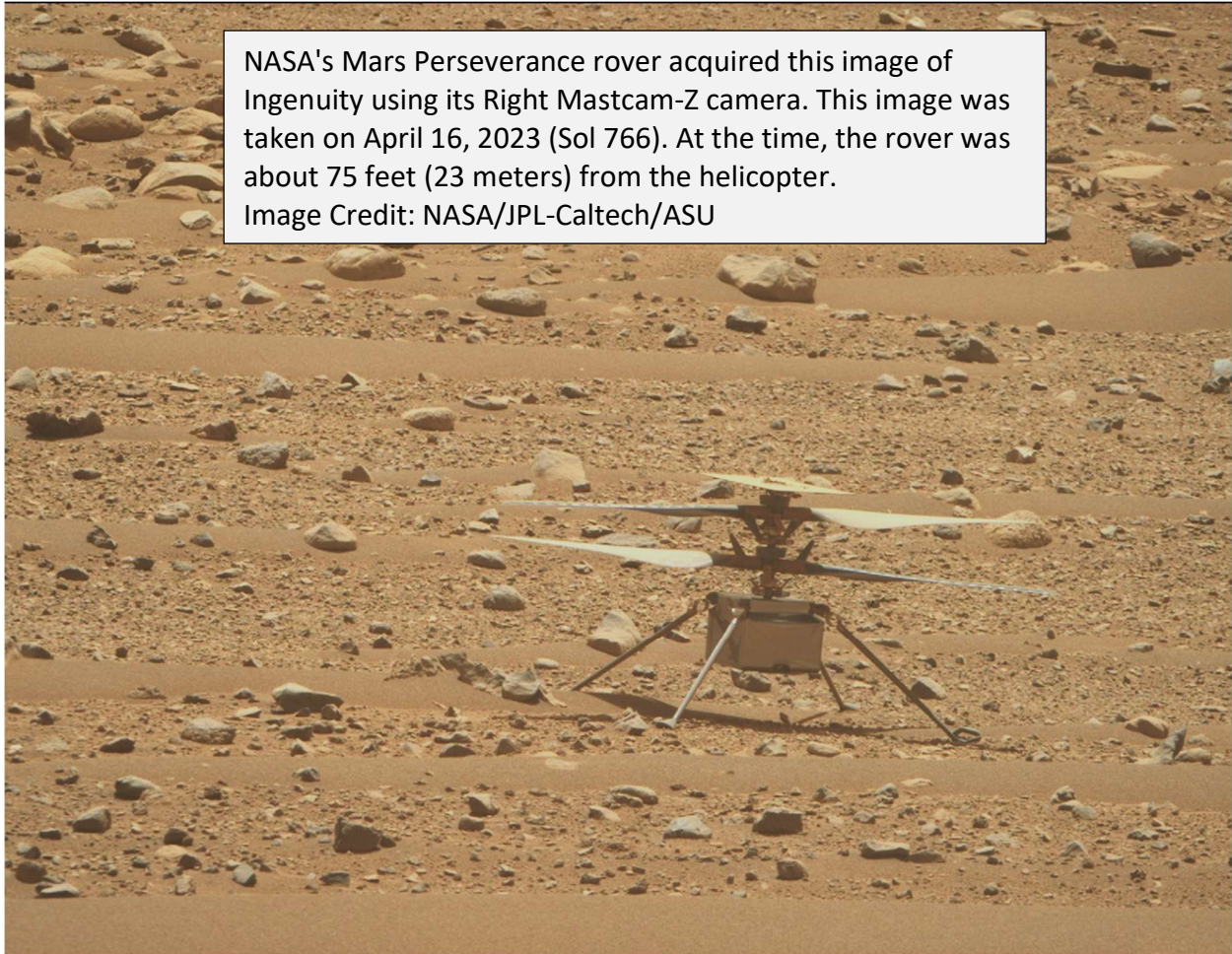
The company is planning on launching Missions 2 and 3 in 2024 and 2025, respectively, as ispace attempts to establish a payload transportation service. Mission 2 is expected to deploy a rover for surface exploration while Mission 3 will release two communications satellites into lunar orbit, as well as deliver payloads to the lunar surface.

Starship

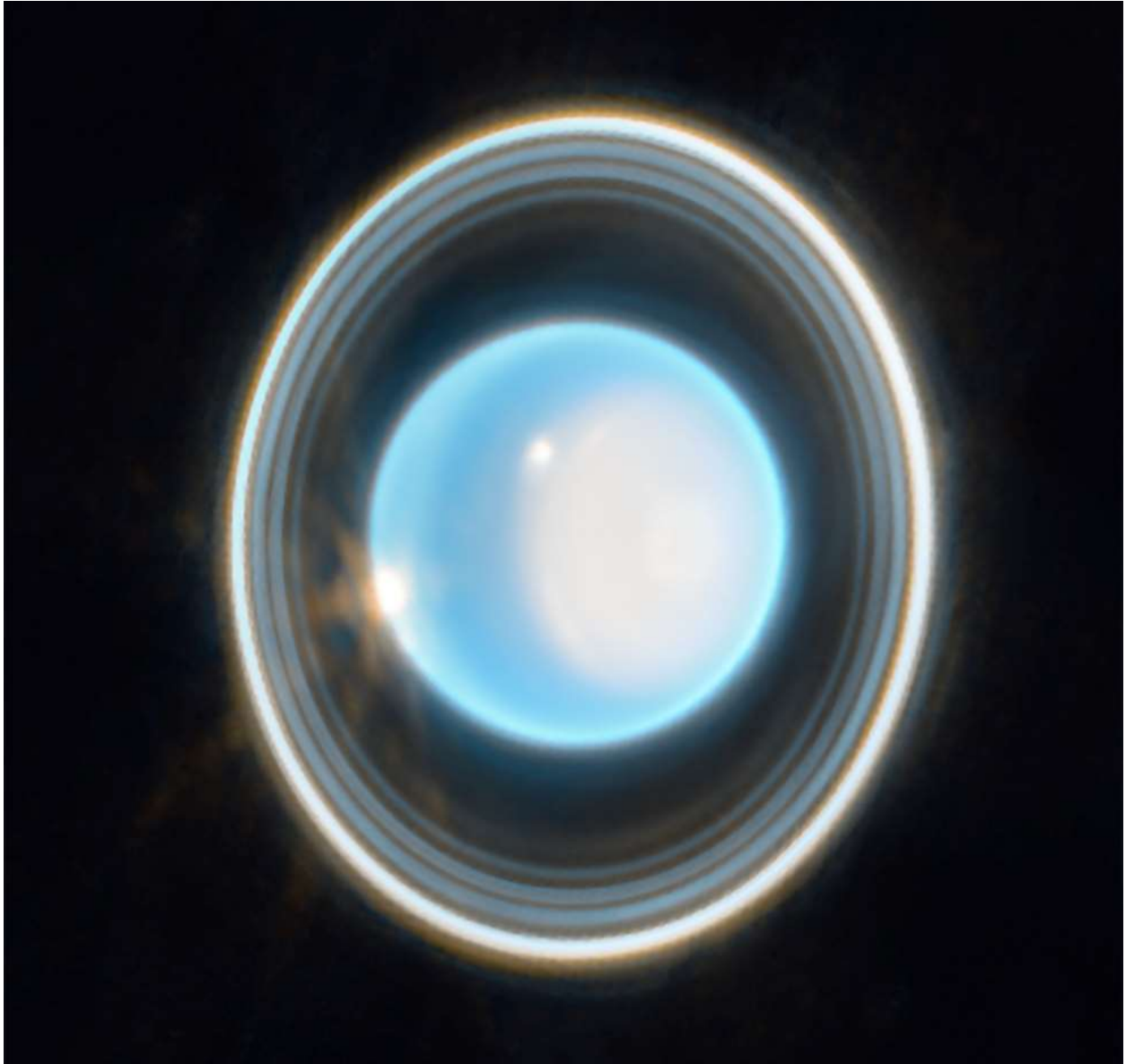


Video captures from SpaceX broadcast

50 Flights



Webb Images Uranus

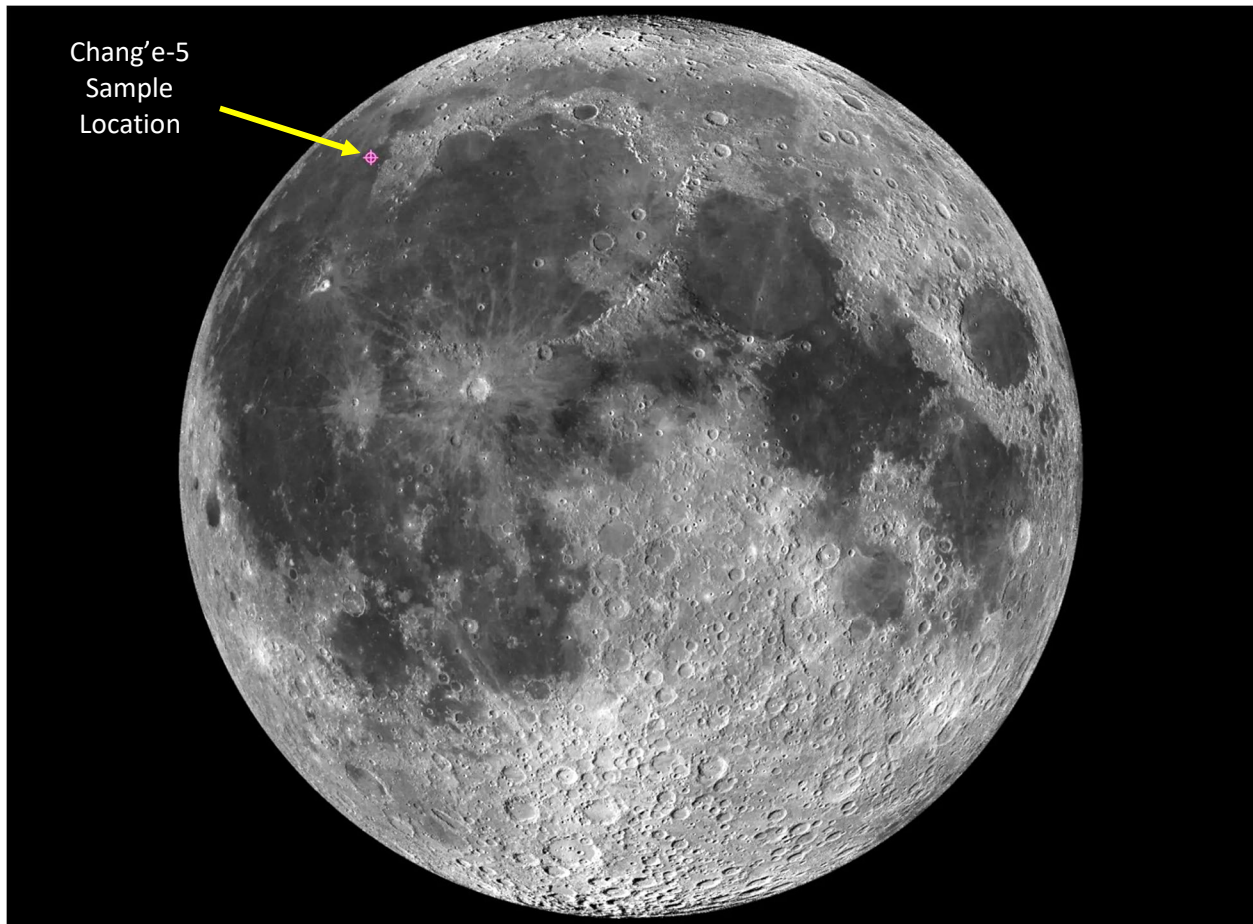


Zoomed-in image of Uranus, captured by Webb's Near-Infrared Camera (NIRCam)
Credits: NASA, ESA, CSA, STScI. Image processing: J. DePasquale (STScI)

NASA's James Webb Space Telescope's near-infrared image of the ice giant Uranus reveals atmospheric features not seen in visible light and accentuates the planet's faint, dusty rings (Uranus has 13 known rings with 11 visible in the original image).

The short 12-minute exposure, using just two filters, also captured several of Uranus' 27 known moons in the wider-view image. The lighter area on the right side of the planetary disk is the northern polar cap, with a subtle brightening near its center. Uranus rotates on its side, with the poles experiencing many years of constant sunlight followed by an equal number of years in complete darkness over its 84-year orbit. A bright cloud can be seen on the edge of the polar cap, as well as on the planet's left limb.

A Solar Wind-Derived Water Reservoir



China's Chang'e-5 lunar lander's sample collection location in northern Oceanus Procellarum near the Mons Rümker volcanic formation. Image created with: Lunar QuickMap, a collaboration between NASA, ASU & Applied Coherent Technology Corp.

Lunar soil returned by the Chang'e-5 mission in December 2020 contained tiny glass spherules, also known as impact glasses or microtektites. Glass beads form when the impact of meteorites (at tens to hundreds of thousands of miles per hour) heat the regolith's silicate minerals to molten temperatures.

Researchers found the impact glass displayed a hydration profile consistent with the inward diffusion of solar wind-derived water. The Moon's soil contains oxygen, which would be also present in the glass. The oxygen reacts with the ionized hydrogen atoms (protons) from solar wind to form water that is drawn inside the silicate matrix. Over time, the spheres are buried as additional impacts churn or "garden" the lunar surface, creating a water reservoir.

The water trapped inside the Chang'e-5 glass spherules shows that impact glass has the potential to store substantial quantities of moisture, even on the most desolate world. The abundance of the glass spherules scattered across the Moon's surface have the potential of storing up to 330 billion tons (300 billion metric tons) of water. The findings also suggest that impact glass may act as water reservoirs on other worlds with surfaces exposed to the solar wind.

Otherworldly



Nighttime view of the surface of asteroid (162173) Ryugu captured by Hayabusa-2's Mobile Asteroid Surface Scout (MASCOT) camera

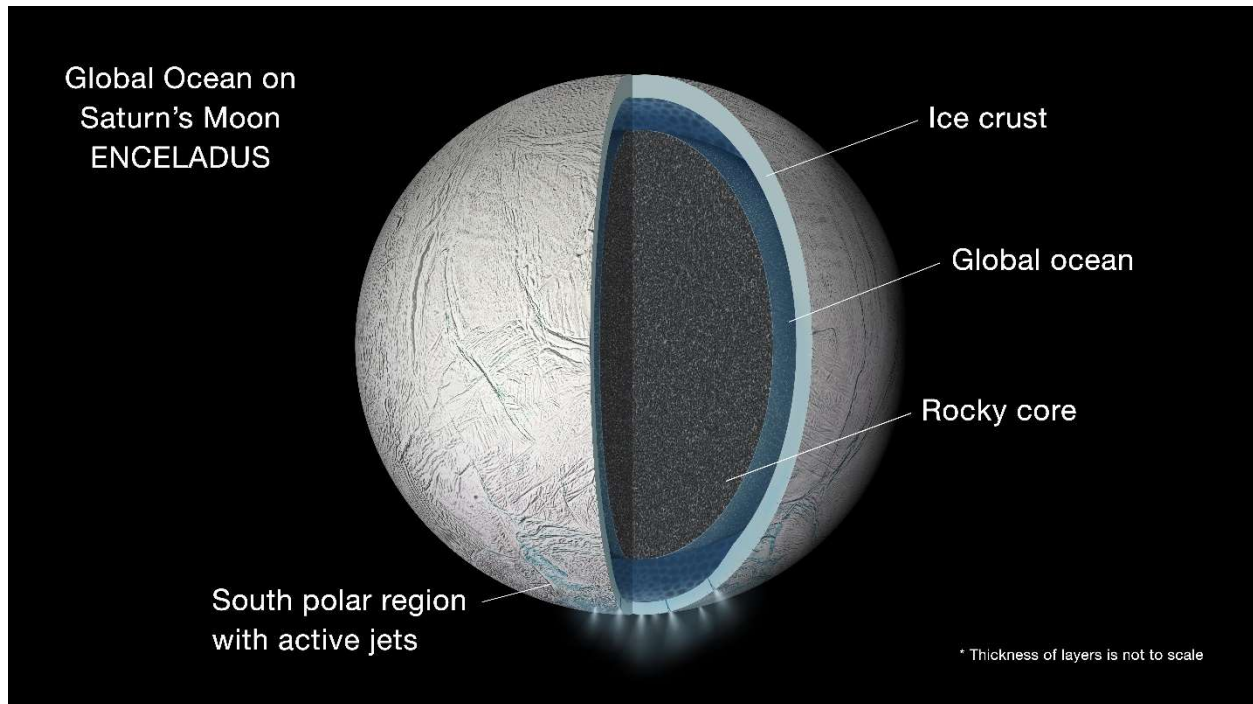
Credit: MASCOT/DLR/JAXA

The Japanese spacecraft Hayabusa2 completed its six-year mission to the asteroid Ryugu, delivering samples to Earth on December 6, 2020. The spacecraft spent 17 months in orbit around the primitive carbonaceous asteroid, deploying two rovers and a small lander. Hayabusa2 conducted two brief landings on the asteroid in 2019, during which it collected samples of the surface (and subsurface) material. The second sample was retrieved from an artificial crater, created by an impactor fired by the spacecraft.

The MASCOT rover was released from a height of about 170 feet (51 meters) and slowly fell to the asteroid's surface. It collected data for over one day/night 7.6-hour rotation period before the batteries ran out. The rover's science package included an IR Radiometer, magnetometer, camera, and a spectrometer. Analysis of the dusty, boulder-covered surface, as well as from the samples returned, indicate that the parent body from which Ryugu formed had sufficient liquid water present to alter its mineral composition. Researchers also found organic matter in the samples much older than the asteroid (and our solar system), with the protosolar cloud a likely source.

Enceladus – Riding the Ocean Currents

Enceladus is the sixth-largest moon of Saturn. At only 310 miles (500 km) in diameter, the diminutive moon is about a tenth of the size of Saturn's largest moon, Titan. Relatively unremarkable except for its smooth, bright white, snowy surface, Enceladus was thrust into the limelight by the Cassini mission as among the most likely place to host extraterrestrial life.

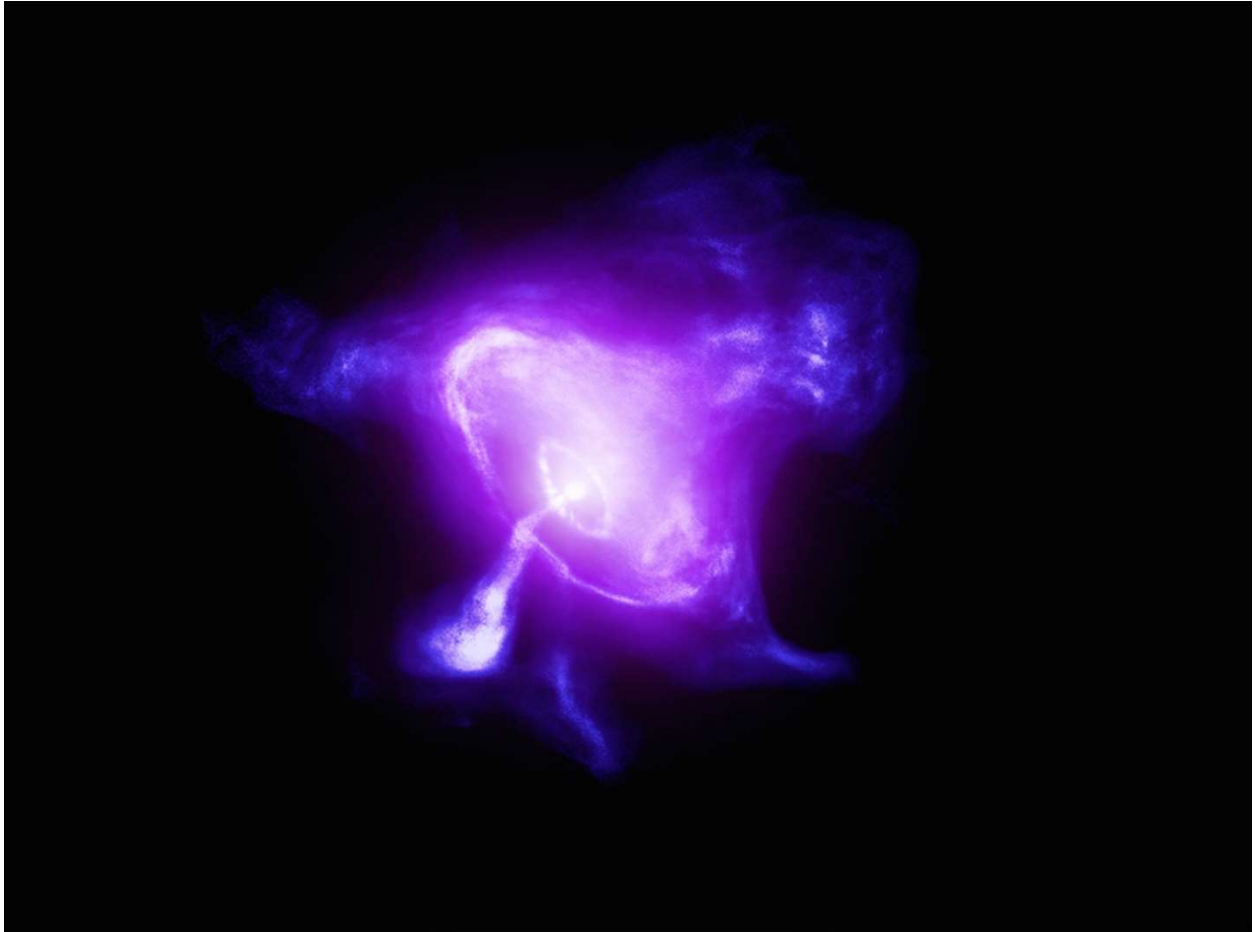


It was data from Cassini's magnetometer, indications of something, maybe an atmosphere, disturbing Saturn's magnetic field near Enceladus, that prompted a targeted flyby of the moon. What the spacecraft found was even more astonishing – a dynamic world with a global ocean beneath an icy crust. Along its south polar region active geysers spewed icy material for hundreds of miles into space. Material that failed to escape the moon's weak surface gravity (which is not much more than one-hundredth that of the Earth), fell back and coated the moon with a fresh layer of icy snow. Material that did escape fed Saturn's vast and nebulous E-ring.

Cassini's instruments characterized the contents of the geysers as a concoction of water, simple organic chemicals and microscopic silica particles (as well as detecting molecular hydrogen and carbon dioxide gas). The chemistry and size of the silica grains are consistent with formation in a high-temperature environment.

Enceladus' small rocky core is kept warm by tidal heating due to its elliptical orbit around Saturn (where fluctuations in gravitational forces stretch and then compress the core, creating heat). The core, in turn, keeps the global ocean from freezing. How the silica grains were transported off-world from the ocean floor has puzzled researchers. However, according to a new analytical model, internal heating from the moon's core can not only release energy through vents in the sea floor, but can create strong enough ocean currents to carry the silica particles from the ocean floor to the overlying icy shell where polar fissures in the crust provide a direct conduit to space. If accurate, samples from the ocean are being delivered to the surface, eliminating the need to penetrate 11 to 14 miles (18 to 22 km) of ice to search for life.

Crab Nebula – A Portrait in X-Rays



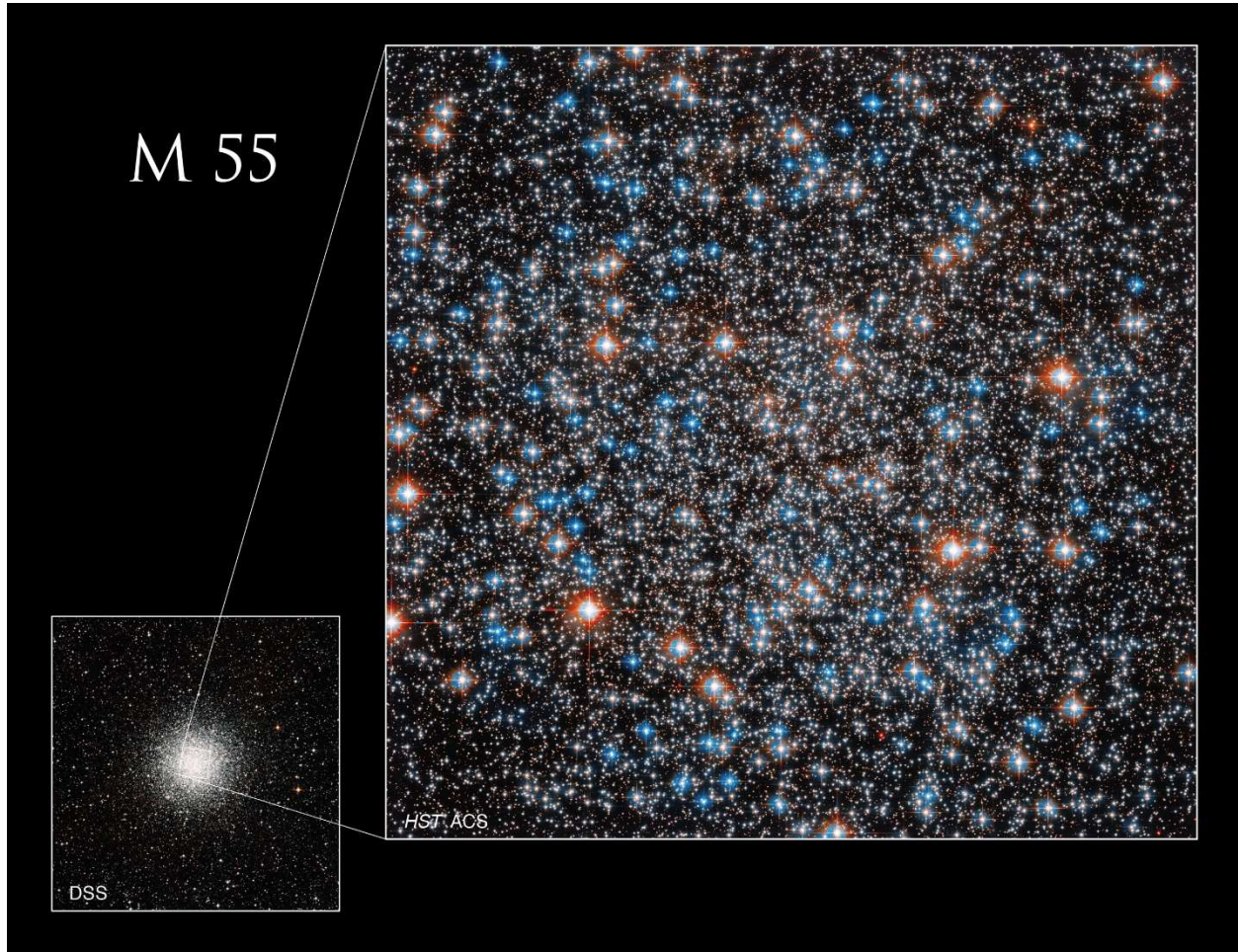
This image of the Crab Nebula combines data from NASA's Imaging X-ray Polarimetry Explorer (IXPE) in magenta and NASA's Chandra X-ray Observatory in dark purple. Credits: X-ray (IXPE: NASA), (Chandra: NASA/CXC/SAO) Image processing: NASA/CXC/SAO/K. Arcand & L. Frattare

The Crab Nebula, also known as Messier 1, is a supernova remnant located in the constellation Taurus, about 6,500 light years from Earth. At the center of the nebula, which spans about 12 light years, is a rapidly spinning neutron star or pulsar (the ultra-dense core of an imploded star). The city-sized, magnetized neutron star, which contains more mass than our Sun, spins at 30 times a second, sending out a beam of high-energy radiation, much like a lighthouse.

The supernova explosion, from which the pulsar and nebula were born, was witnessed on planet Earth in the year 1054 and described by Chinese astronomers. It was visible during daylight hours for 23 days before fading from view. The pulsar emits radiation across the electromagnetic spectrum from longer wavelength radio to high energy gamma and X-rays.

This recent composite image reveals unexpected patches and asymmetrical areas of turbulence within the nebula's donut-shaped magnetic field. The mapping was achieved by measuring the polarization of X-rays from within the nebula (the direction in which light waves oscillate as they are modified by an object's magnetic field).

A Globular Cluster Revealed



Credits: NASA, ESA, A. Sarajedini (Florida Atlantic University), and M. Libralato (STScI, ESA, JWST); Image Processing: Gladys Kober

Globular clusters are dense collections of stars drawn into a spherical shape by the stars' intense gravitational attraction. This particular globular cluster, known as Messier 55 or M55, was originally spotted by French astronomer Charles Messier in 1752 from what is now South Africa. It is about 20,000 light-years from Earth with a diameter of about 100 light-years. M55 is believed to contain an estimated 100,000 stars, with no clear core structure.

While ground-based telescopes can resolve individual stars, the Hubble Space Telescope's unobstructed view of M55 allows astronomers a much more detailed look at the inner regions of the cluster. The Hubble image (above), while capturing only a small portion of the cluster, is filled with white stars, along with blue-white and reddish-orange stars sprinkled throughout.

The star cluster can be found in the southern regions of the constellation Sagittarius. In larger aperture telescopes, M55 will appear much like the Digital Sky Survey image shown at the lower left, with a number of the brighter stars resolved. While sitting low in the sky, the best time to look for M55 is in August when the Milky Way is on the meridian (due south) shortly after sunset.

First Delta Sample



The cutting pile from the most recent coring. The image was captured by the rover's Front Right Hazard Avoidance Camera on Sol 750 (March 31, 2023)

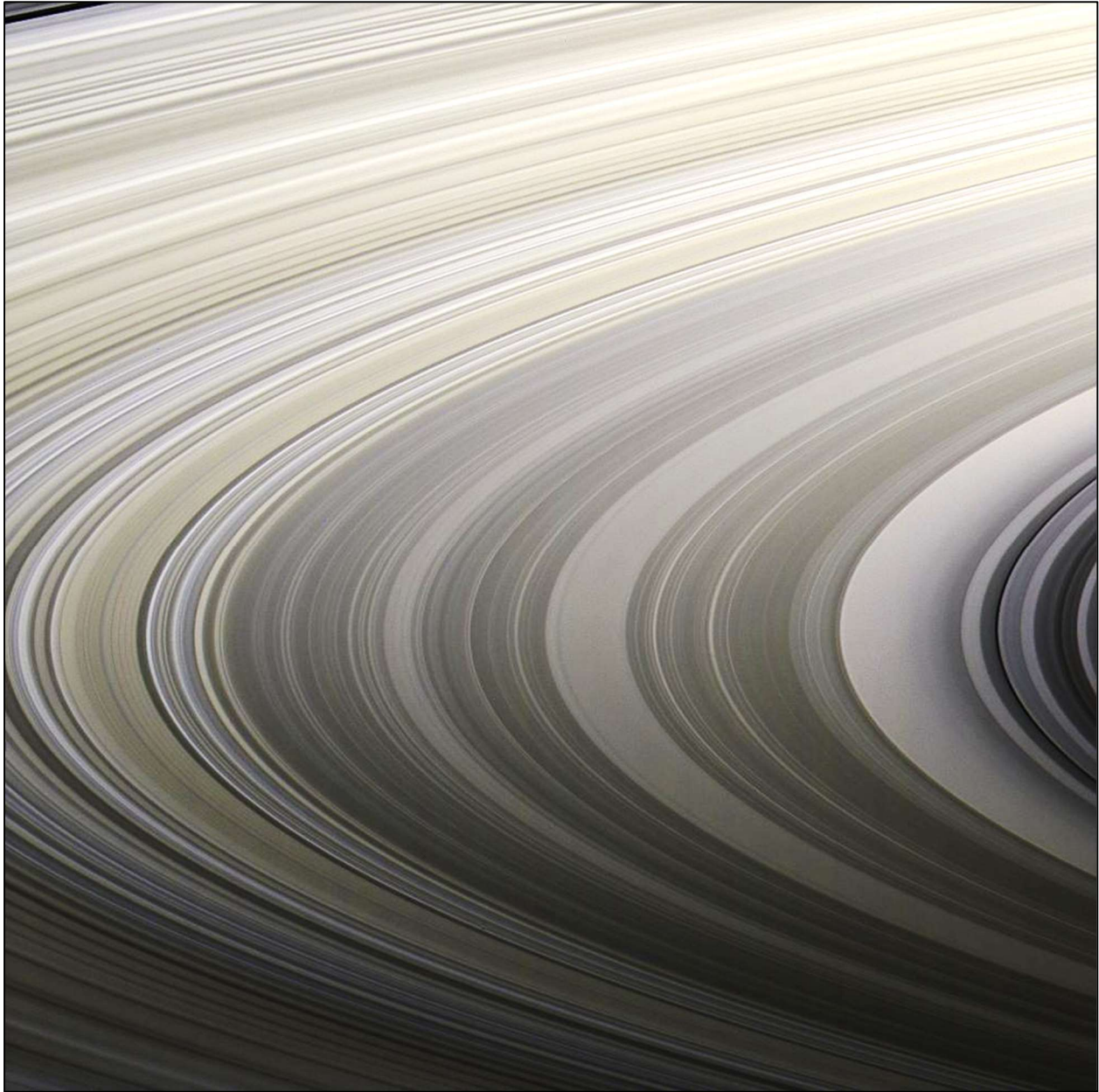
Credits: NASA/JPL-Caltech

The science objectives of NASA's Perseverance Mars rover include the search for signs of ancient microbial life and the collection of rock and soil samples that might have preserved those biosignatures for retrieval by a future mission. Since February, the rover has been making its way up the front of the ancient river delta in Jezero Crater, which rises about 130 feet (40 meters) above the crater floor. Along its journey, Perseverance has sampled igneous rock on the crater floor, fine-grained sedimentary rocks deposited at the base of the delta and now coarse-grained sedimentary rocks deposited in what was, billions of years ago, a river.

On March 30th, Perseverance successfully cored a rocky outcrop the science team called "Berea," its nineteenth sample. Scientists believe that Berea formed from rock deposits that were carried downstream by an ancient river from an area well beyond Jezero Crater. The rock is rich in carbonate, which on Earth can be good at preserving fossilized lifeforms. Carbonates form from chemical interactions in liquid water, so they can also provide scientists a long-term record of changes in the planet's climate.

The rover is currently driving along the riverbed towards the rim of Jezero Crater.

Saturn's Rings Heating Planet's Atmosphere



Researchers have found that Saturn's rings are heating up the gas giant's atmosphere. The discovery was based on elevated and consistent levels of ultraviolet radiation, from measurements taken using the Hubble Space Telescope's Imaging Spectrograph (as well as data from the retired Cassini probe, the Voyager 1 and 2 spacecraft, and the retired International Ultraviolet Explorer mission), which led scientists to search for the source of the warming of the planet's upper atmosphere.

A portion of the inner-central part of the planet's B Ring
Image Credit: NASA/JPL-Caltech/Space Science Institute

One plausible explanation is "ring rain." As the Cassini spacecraft flew through the gap between the planet and its rings during its final orbits, it detected icy particles falling into the planet's atmosphere as the rings slowly disintegrate. Collisions of the particles with atmospheric gasses could provide the best explanation for the excess energy observed.

ESA's Jupiter Icy Moons Explorer (JUICE) – the Journey Begins



April 14th launch from Europe's Spaceport in Kourou, French Guiana

Arrival at Jupiter in July 2031 - an eight-year cruise with four gravity-assist flybys of Earth and Venus

Apollo 10

Apollo 10 was the second mission to orbit the Moon (Apollo 8 being the first) and the first lunar mission to include the Lunar Module (LM). The Saturn V rocket, carrying the Command Module (CM) named Charlie Brown and LM, named Snoopy, was launched on May 18, 1969.



The Apollo 10 Saturn V and the mobile launch platform atop the crawler-transporter

Credit: NASA

Astronauts Thomas Stafford and Eugene Cernan flew the LM to within 47,000 feet (14,326 meters) of the lunar surface. The LM made two passes over the designated Apollo 11 landing site before jettisoning of the LM's descent stage (in preparation for the rendezvous with the CM). At that time, the ascent stage began to wildly gyrate and for three harrowing minutes, the spacecraft went into a near-fatal roll before Stafford could gain manual control. The cause was eventually traced to a switch being in the wrong position.

Space Shuttle Endeavour

The space shuttle Endeavour first arrived at the Kennedy Space Center on May 7, 1991 as a replacement for the lost Challenger. The orbiter was built out of spare parts from the construction of the Atlantis orbiter. Endeavour was first launched (STS-49) a year later on May 7, 1992.

The orbiter's name was selected through a national competition among students and was named after the ship commanded by British explorer James Cook in his exploration of the South Pacific in 1768-71. Cook, among other accomplishments, observed the transit of the Sun by Venus from Tahiti in June 1769.

Endeavour flew its 25th and final mission (STS-134) in May 2011 (the next to last shuttle flight). Commander Mark Kelly was the last astronaut to disembark from the shuttle at the conclusion of the mission. In September 2012, the shuttle was flown to Los Angeles on top of a Boeing 747 for permanent display at the California Science Center. Endeavour is currently in temporary storage at the museum and will be displayed in a launch configuration (vertical) once construction of a new exhibition center is complete.

In May 2015, the Science Center announced that they had acquired the only flight-qualified external tank in existence. The tank had been built in 2000 for the Columbia shuttle but never flew (it was replaced by a lighter version before it was assigned to a flight). The External Tank (ET-94) is 28 feet (8.5 meters) in diameter, 154 feet (47 meters) long and weighs approximately 65,000 pounds (29,500 kg).

The external tank left NASA's Michoud Assembly Facility in Louisiana for California on April 12, 2016. Traveling by barge, the tank passed through the Panama Canal and arrived in Marina del Rey in late May. The tank was moved through the streets of Los Angeles to the Science Center following the route previously taken by Endeavour.

The Science Center has also acquired a pair of flight-worthy solid rocket boosters for the display. The 149-foot-tall (45 meter) solid rocket boosters were donated by Orbital ATK and NASA. The refurbished tank will be lifted into a vertical configuration to form the structural support for the Endeavour orbiter and the twin solid rockets for display in Samuel Oschin Air and Space Center, a 200,000 square foot exhibition center being added to the Science Center's main building.

On June 1st, 2022, the California Science Center broke ground on the new addition which, when finished, will contain 150 educational exhibits spanning three multi-level galleries. Construction is expected to take three years. The space shuttle will be moved into the building, after nearly half of the construction is finished.

A temporary structure will protect the eighteen-story-high space shuttle during the remaining construction period with bracing for the roof until it can support itself. The outside of the building will be illuminated with lighting, including kinetic star patterns.



Artist rendering of the Endeavor exhibit courtesy of the California Science Center

Public Astronomy



Photo: Bill Cloutier

Eighty-eight years ago, on May 14, 1935, the Griffith Observatory opened to the public and its ownership transferred to the City of Los Angeles. Located on the southern slope of Mount Hollywood in Griffith Park, the public facility is operated by the city's Department of Recreation and Parks, and has welcomed over 76 million visitors since opening.

A public observatory was the brainchild of Griffith J. Griffith, a Welsh immigrant who made his fortune in Mexican silver mines and California real estate. In 1896, he purchased and donated 3,015 acres to the city for a public park after visiting grand open spaces in Europe. In 1912, after a visit to the Mount Wilson observatory, Griffith offered the city \$100,000 for a public observatory to be built on Mount Hollywood in Griffith Park. Griffith was quoted as saying "Man's sense of values ought to be revised. If all mankind could look through that telescope, it would change the world!"

Unfortunately, Griffith would not live to see his vision realized. Mired in political debate, work on the observatory didn't begin until 1933. However, guided by leading astronomers and scientists of the day, including astronomer George Ellery Hale, physicists Edward Kurth and Rudolph Langer, Adler Planetarium Director Philip Fox and Russell Porter, leader of the amateur telescope making movement, an observatory was constructed and dedicated two years later. The facility also included a planetarium. The planetarium was only the third of its kind in the United States; the technology was not even invented until four years after Griffith's death.

The Griffith Observatory is visible from many parts of Los Angeles, being located at an elevation of 1,134 feet above sea level. It is one of the most popular attractions in Southern California.

Final Servicing Mission

On May 11, 2009, the space shuttle Atlantis lifted off from Pad 29A at the Kennedy Space Center for its first visit to the Hubble Space Telescope and the telescope's last servicing mission. Atlantis ferried two new instruments to the telescope - the Cosmic Origins Spectrograph and the Wide Field Camera 3. The Atlantis crew repaired the Space Telescope Imaging Spectrograph (STIS) and the Advanced Camera for Surveys (ACS), replaced a Fine Guidance Sensor, six gyroscopes, and batteries. A new science computer was installed along with new insulation on three electronic bays. A soft-capture mechanism was added to the telescope's base to facilitate its de-orbiting at its end of operational life.

The Atlantis crew included three astronauts that had visited Hubble on previous repair missions - Scott Altman (STS-109), John Grunsfeld, (STS-103 and STS-109) and Mike Massimino (STS-109).

Construction began on NASA's fourth space shuttle in 1980 and, with lessons-learned from the construction and testing of the Enterprise, Columbia and Challenger, was completed with half the effort spent on the Columbia. Atlantis is named for a two-masted sailing ship that operated for the Woods Hole Oceanographic Institute in Massachusetts from 1930 to 1966. The shuttle was delivered to the Kennedy Space Center on April 9, 1985. Six months later, she carried a classified payload into orbit for the Department of Defense (STS-51J). Among Atlantis' many accomplishments were: flying the first mission to the Russian space station (Mir), providing on-orbit launch capabilities for the Magellan (Venus) and Galileo (Jupiter) planetary probes as well

as the Compton Gamma Ray Observatory, delivering the U.S. laboratory module Destiny, Joint Airlock Quest and multiple sections of the International Space Station's Integrated Truss structure.

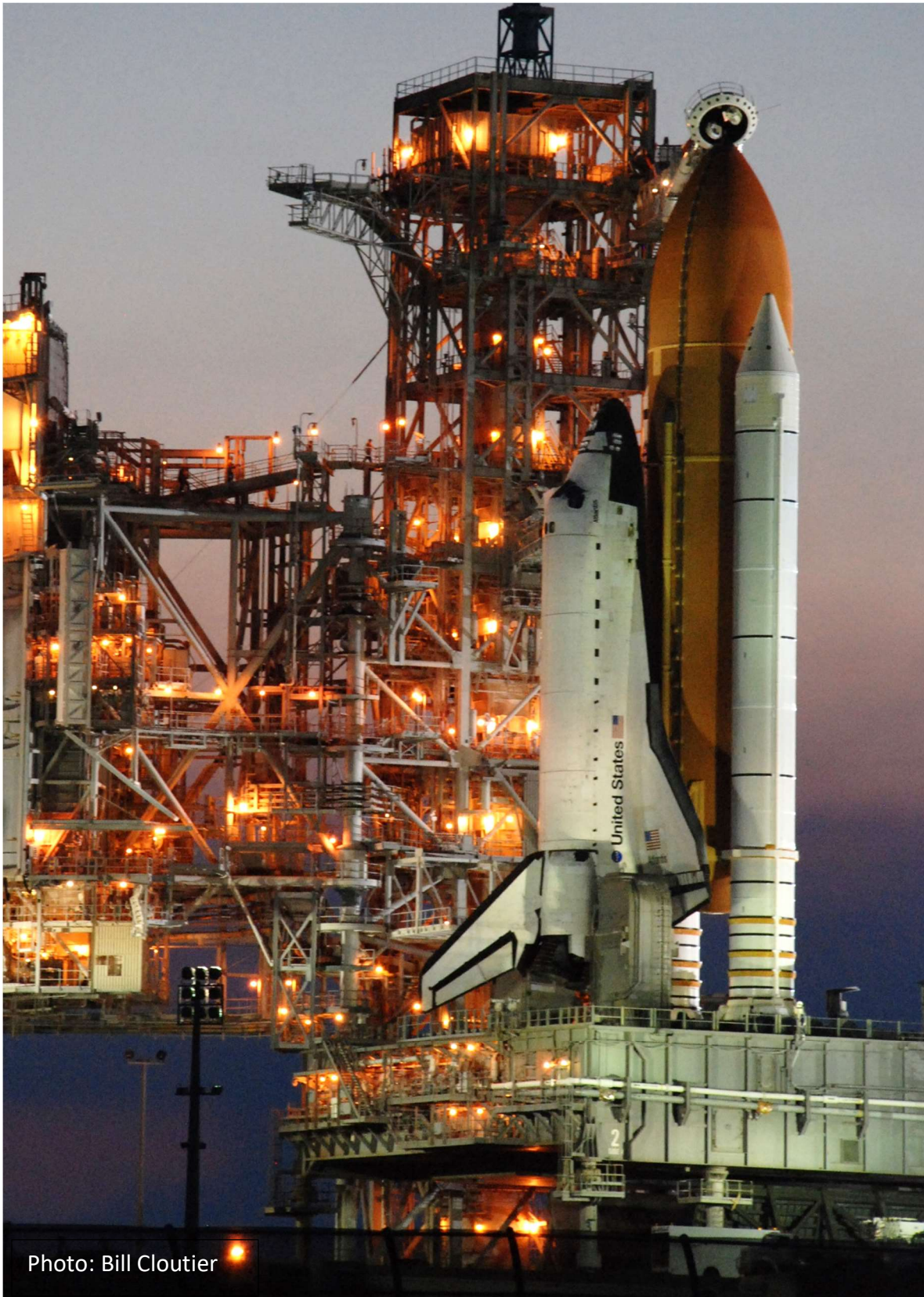


Photo: Bill Cloutier

May Showers

The *Eta Aquarids* meteor shower peaks in the early mornings of the 5th and 6th. The dust producing the shooting stars is from *Comet Halley*. As with all meteor showers, the Aquarids are named for the constellation (Aquarius) from which they appear to radiate. Typically, you can expect to see up to 20 meteors per hour. A Full Moon will interfere with viewing the shower this year.

Sunrise and Sunset (from New Milford, CT)

	<u>Sunrise</u>	<u>Sunset</u>
May 1 st (EDT)	05:50	19:51
May 15 th	05:34	20:06
May 31 st	05:22	20:20

May Nights

For those who do their stargazing early in the evening, a myriad of spectacular objects appear out of the twilight, winking into view as the Earth turns away from the Sun. Leo dominates the southwestern sky with its reverse question mark arrangement of stars, punctuated by the star Regulus, forming the front of the lion, and a triangular arrangement of stars forming the back or tail of the creature. To the west of Leo is an open star cluster called the Beehive (M44) in the constellation Cancer. On a dark night it can be seen with the naked eye. East of Leo, towards the constellation Boötes is the globular cluster M3. Boötes is easily identified by its bright star Arcturus. Follow the arc in the handle of the Big Dipper to find Arcturus, at the base of the kite-shaped constellation. M3 is located further away than the center of our galaxy, the Milky Way, and is one of the many outstanding globular clusters that will grace the late spring and summer skies.

Astronomical and Historical Events

- 1st Close approach of Apollo NEO 2018 VS6
- 1st Close approach of Apollo NEO 2023 HV
- 1st History: Goddard Space Flight Center established (1959)
- 1st History: discovery of Saturn's moon *Daphnis* by the Cassini spacecraft (2005)
- 1st History: discovery of the Mars meteorite *Dar al Gani 476* (1998)
- 1st History: discovery of Neptune's moon *Nereid* by Gerard Kuiper (1949)
- 2nd History: discovery of the first binary star (Xi Ursae Majoris) by William Herschel (1780)
- 4th Star Wars Day
- 4th History: launch of the AQUA satellite to study precipitation, evaporation, and the cycling of Earth's water (2002)
- 4th History: launch of the Magellan/Venus radar mapping spacecraft and attached Inertial Upper Stage from the space shuttle Atlantis (STS-30) (1989)
- 4th History: launch of Lunar Orbiter 4 for photographic evaluation of Apollo and Surveyor landing sites (1967)
- 5th Full Moon (Full Flower Moon)
- 5th Close approach of Apollo NEO 2006 HX57
- 5th *Eta Aquarids* meteor shower peak (best viewing: early morning on the 5th and 6th)

Astronomical and Historical Events (continued)

- 5th History: launch of NASA's InSight spacecraft (Mars lander) from the Vandenberg Air Force Base, California (2018)
- 5th History: launch of Freedom 7 and astronaut Alan Shepard aboard a Mercury-Redstone rocket, first American in space (1961)
- 6th History: groundbreaking for the John J. McCarthy Observatory, a world-class observatory in New Milford, CT., with a mission to promote science literacy (2000)
- 9th Close approach of Apollo NEO 2023 HG1
- 9th History: launch of MUSES-C (Hayabusa), Japanese sample return mission to asteroid *Itokawa* (2003)
- 9th History: first Earth-based laser aimed at the Moon: crater Albategnius (1962)
- 9th History: launch of first production model of the Project Mercury capsule from Wallops Island, Virginia to test the escape system (1960)
- 10th History: OSIRIS-REx departs asteroid Bennu for Earth (2021)
- 10th History: President Truman signs Public Law 507, creating the National Science Foundation (1950)
- 10th History: Estherville Meteorite Shower: a 455-pound meteorite fell to earth in Emmet County, just north of Estherville, Iowa, where it buried itself 15 feet in the ground - largest meteorite known to have fallen in North America (1879)
- 11th Moon at perigee (closest distance from Earth)
- 11th History: launch of the space shuttle Atlantis (STS-125), final Hubble Space Telescope servicing mission (2009)
- 12th Last Quarter Moon
- 12th History: first planetarium (Adler Planetarium in Chicago) opens in United States (1930)
- 13th **Second Saturday Stars - Open House at McCarthy Observatory**
- 13th History: launch of first Project Bumper rocket from White Sands, NM; the two stage rocket was a combination of a German V-2 and American WAC Corporal rocket (1948)
- 14th History: Griffith Observatory, one of the first institutions in the U.S. dedicated to public science, opens in Los Angeles (1935)
- 14th History: launch of the Herschel infrared telescope and the Planck microwave observatory (2009)
- 14th History: launch of Skylab, the United States' first space station (1973)
- 14th History: the American Interplanetary Society (later renamed the American Rocket Society) launches its first liquid fueled (liquid oxygen and gasoline) rocket from Staten Island, N.Y. (1933)
- 14th History: German Society for Space Travel (Verein für Raumschiffahrt or VfR) launches the Repulsor-1, a liquid fueled (liquid oxygen and gasoline) rocket (1931)
- 14th History: Orgueil meteorite shower: large carbonaceous chondrite that disintegrated and fell in fragments near the French town of Orgueil; presence of organics renewed the debate on spontaneous generation as the origin of life; fragments analyzed by the French chemist Louise Pasteur for indigenous microorganisms (1864)
- 15th History: discovery of Pluto's moons *Nix* and *Hydra* by Hal Weaver, et al's (2005)
- 15th History: sixth docking of a space shuttle (Atlantis) with Russian space station Mir (1997)
- 15th History: launch of Faith 7 and astronaut Gordon Cooper aboard a Mercury-Atlas rocket, final Mercury mission (1963)
- 15th History: Soviet Union launches Sputnik IV containing a self-sustaining biological cabin and dummy astronaut (1960)

Astronomical and Historical Events (continued)

- 16th History: launch of the space shuttle Endeavor to the International Space Station on its final mission (2011)
- 16th History: Soviet spacecraft Venera 5 returns 53 minutes of data while descending by parachute through the atmosphere of Venus and before impacting the surface (1969)
- 17th Moon occults Jupiter starting at 7:40 AM EDT (Caution: Sun will be close by)
- 17th History: Soviet spacecraft Venera 6 returns 51 minutes of data while descending by parachute through the atmosphere of Venus and before impacting the surface (1969)
- 17th History: discovery of Jupiter's cloud belts by Italian Jesuit, astronomer, and physicist Niccolo Zucchi (1630)
- 18th History: launch of Apollo 10 with astronauts John Young, Tom Stafford and Gene Cernan; the lunar module Snoopy was flown within 50,000 feet of the lunar surface while the command module Charlie Brown orbited the Moon (1969)
- 19th New Moon
- 19th History: launch of the Mars 2 orbiter/lander (which subsequently crashed) (1971)
- 19th History: launch of the first Army Hermes A-1 rocket from White Sands, NM (1950)
- 19th History: oldest recorded meteorite fall, a 472-gram, ordinary chondrite, falls in Nogata, Japan (861 AD)
- 20th History: launch of the Japanese Venus Climate Orbiter Akatsuki or Planet-C spacecraft and the Ikaros solar sail (2010)
- 20th History: launch of the Pioneer Venus 1 spacecraft (1978)
- 22nd Close approach of Apollo NEO 2021 JK7
- 22nd Close approach of Apollo NEO 2023 GY2
- 22nd History: launch of the GRACE Follow-On spacecraft from the Vandenberg Air Force Base, California. The tandem satellites tracking Earth's water movement and changes in sea level.
- 22nd History: launch (and recovery) of monkeys Patricia and Mike on an Aerobee rocket, reaching a record altitude of 30 miles (1952)
- 23rd Close approach of Apollo NEO 2019 UJ3
- 24th Close approach of Apollo NEO 2023 CL3
- 24th History: discovery of Neptune's moon Larissa by Stephen Synnott, Harold Reitsema, and David Tholen (1981)
- 24th History: launch of Aurora 7 and astronaut Scott Carpenter aboard a Mercury-Atlas rocket; second American to orbit Earth (1962)
- 24th History: launch of Midas 2; first Experimental Infrared Surveillance Satellite (1960)
- 24th History: Russian civil engineer Ivan Yarkovsky born. Proposed idea that heat radiated from rotating bodies, such as asteroids, would generate a small force which over time could change the orbit (1844)
- 25th Moon at apogee (furthest distance from Earth)
- 25th Towel Day - Annual Tribute to Douglas Adam
- 25th History: Phoenix spacecraft lands in the Martian arctic (2008)
- 25th History: launch of first Skylab crew; astronauts Pete Conrad, Paul Weitz and Joseph Kerwin (1973)
- 25th History: President John F. Kennedy's Moon goal speech to Congress (1961)
- 25th History: science fiction writer and futurist Arthur C. Clark proposes communication satellites in geosynchronous orbit (1945)

Astronomical and Historical Events (continued)

- 25th History: first recorded perihelion passage of comet Halley by Chinese astronomers (240 BC)
- 26th First Quarter Moon
- 26th Main belt asteroid 253587 Cloutier, discovered by the McCarthy Observatory, closest approach to Earth (1.497 AU)
- 26th History: launch of the first "Navaho Missile," a pilotless aircraft consisting of a missile and a booster; program goal was to determine the feasibility of an intercontinental missile (1948)
- 28th History: launch of Mars 3 (USSR) lander and rover; lander became the first spacecraft to attain soft landing on Mars, although transmissions ceased after 15 seconds (1971)
- 28th History: launch of an Army Jupiter missile carrying two primates (Able and Baker) to an altitude of 300 miles; monkeys survived the flight (1959)
- 28th History: Frank Drake born - radio astronomer devised the "Drake Equation" as an attempt to estimate the number of worlds in our galaxy that might harbor intelligent life (1930)
- 29th Close approach of Aten NEO *2021 KO2*
- 29th Mercury at Greatest Western Elongation (separation from the Sun in the morning sky)
- 29th History: Solar Eclipse observations (specifically, positions of stars in the vicinity of the Sun) used to confirm Einstein's General Theory of Relativity (1919)
- 29th History: launch of Luna 22 (USSR), lunar orbiter mission that included imaging as well as studying the Moon's magnetic field, the composition of lunar surface rocks, and the gravitational field (1974)
- 29th History: measurements during solar eclipse agree with predictions based on Einstein's General Relativity theory (1919)
- 30th History: launch of SpaceX's Crew Dragon with astronauts Doug Hurley and Bob Behnken to the International Space Station from the Kennedy Space Center. Designated Demo 2, it was the first launch of the spacecraft with astronauts aboard. (2020)
- 30th History: launch of Mariner 9, Mars orbiter and first artificial satellite of Mars; mapped Martian surface and imaged moons *Phobos* and *Deimos* (1971)
- 30th History: launch of Surveyor 1, Moon lander; transmitted over 11,000 images from Oceanus Procellarum (1966)
- 31st Close approach of Apollo NEO *2012 KP24*
- 31st History: European Space Agency's birthday (1975)

Commonly Used Terms

- Apollo: a group of near-Earth asteroids whose orbits also cross Earth's orbit; Apollo asteroids spend most of their time outside Earth orbit.
- Aten: a group of near-Earth asteroids whose orbits also cross Earth's orbit, but unlike Apollos, Atens spend most of their time inside Earth orbit.
- Atira: a group of near-Earth asteroids whose orbits are entirely within Earth's orbit
- Centaur: icy planetesimals with characteristics of both asteroids and comets

Commonly Used Terms (continued)

- Kuiper Belt: region of the solar system beyond the orbit of Neptune (30 AUs to 50 AUs) with a vast population of small bodies orbiting the Sun
- Opposition: celestial bodies on opposite sides of the sky, typically as viewed from Earth
- Plutino: an asteroid-sized body that orbits the Sun in a 2:3 resonance with Neptune
- Trojan: asteroids orbiting in the 4th and 5th Lagrange points (leading and trailing) of major planets in the Solar System

References on Distances

- the apparent width of the Moon (and Sun) is approximately one-half a degree ($\frac{1}{2}^\circ$), less than the width of your little finger at arm's length which covers approximately one degree (1°); three fingers span approximately five degrees (5°)
- 1 astronomical unit (AU) is the distance from the Sun to the Earth or approximately 93 million miles

International Space Station and Artificial Satellites

- www.heavens-above.com for the times of visibility and detailed star charts for viewing the International Space Station and other manmade objects.

Solar Activity

- For the latest on what's happening on the Sun and the current forecast for flares and aurora, check out www.spaceweather.com

NASA's Global Climate Change Resource

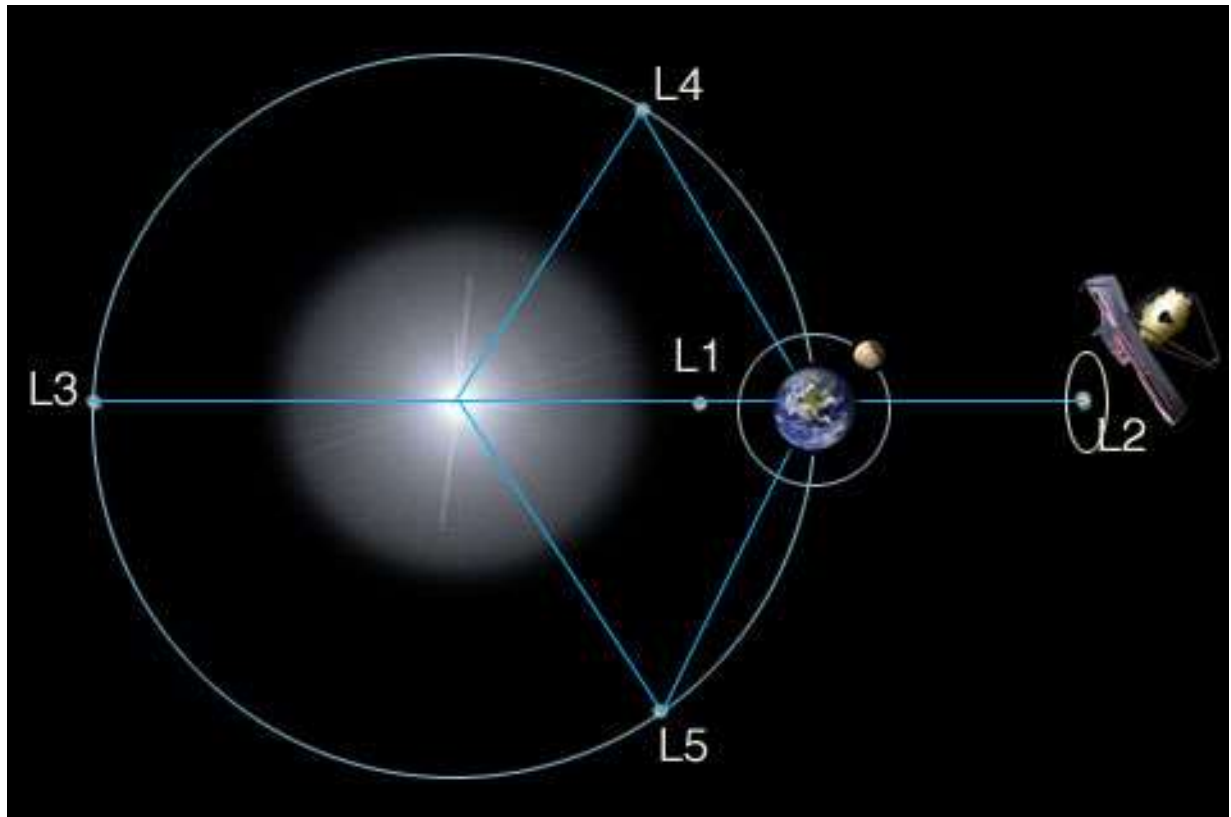
- Vital Signs of the Planet: <https://climate.nasa.gov/>

Mars – Mission Websites

- Mars 2020 (Perseverance rover): <https://mars.nasa.gov/mars2020/>
- Mars Helicopter (Ingenuity): <https://mars.nasa.gov/technology/helicopter/>
- Jezero Crater map: <https://mars.nasa.gov/mars2020/mission/where-is-the-rover/>
- Mars Science Laboratory (Curiosity rover): <https://mars.nasa.gov/msl/home/>
- Mars InSight (lander): <https://mars.nasa.gov/insight/>

Lagrange Points

Five locations discovered by mathematician Joseph Lagrange where the gravitational forces of the Sun and Earth (or other large body) and the orbital motion of the spacecraft are balanced, allowing the spacecraft to hover or orbit around the point with minimal expenditure of energy. The L2 point (and location of the Webb telescope) is located 1 million miles (1.5 million km) beyond the Earth (as viewed from the Sun).



James Webb Space Telescope

- <https://webb.nasa.gov/index.html>

Contact Information

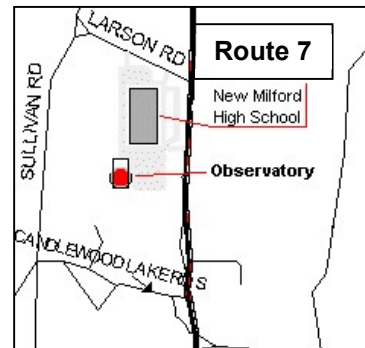
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