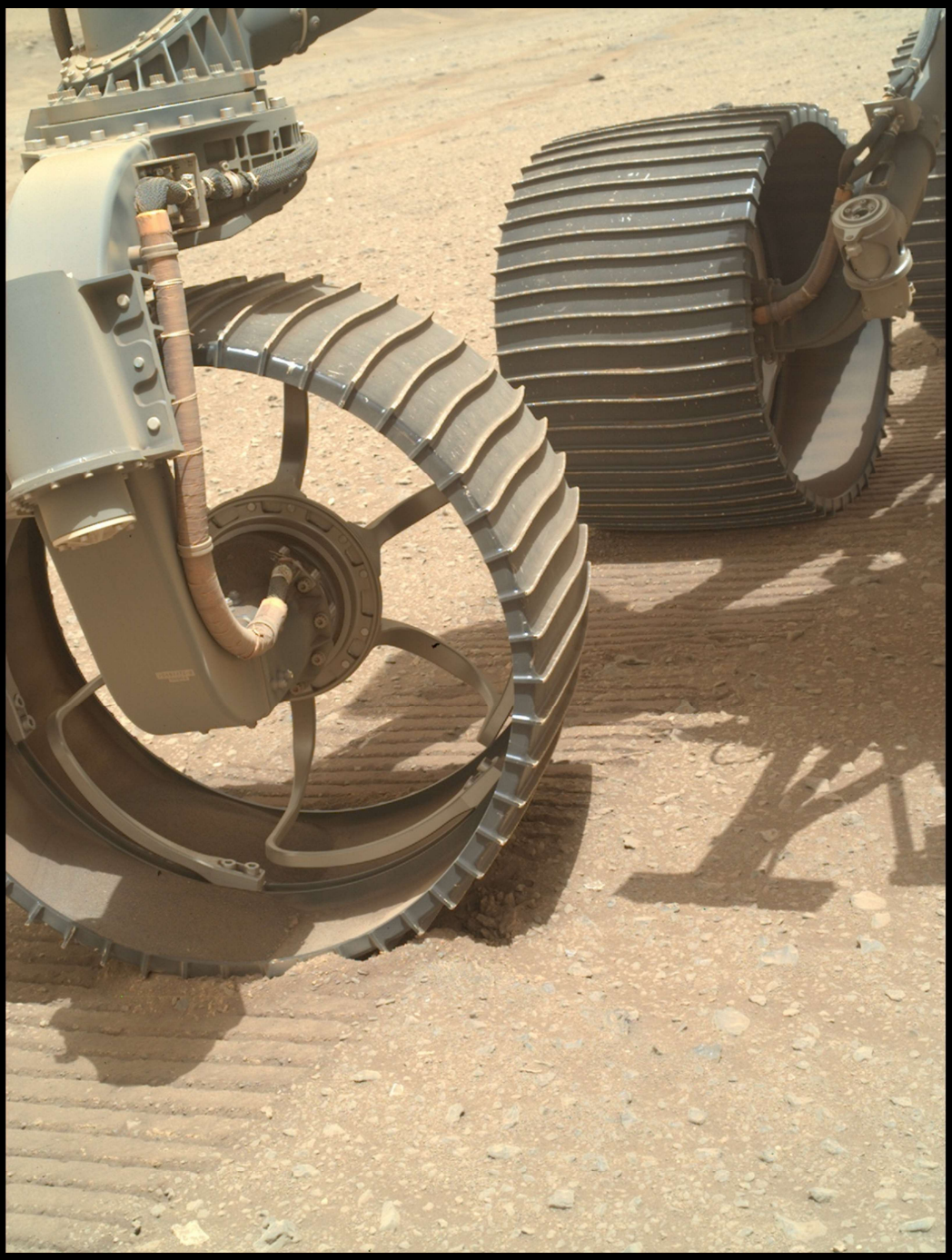
Galactic Observer

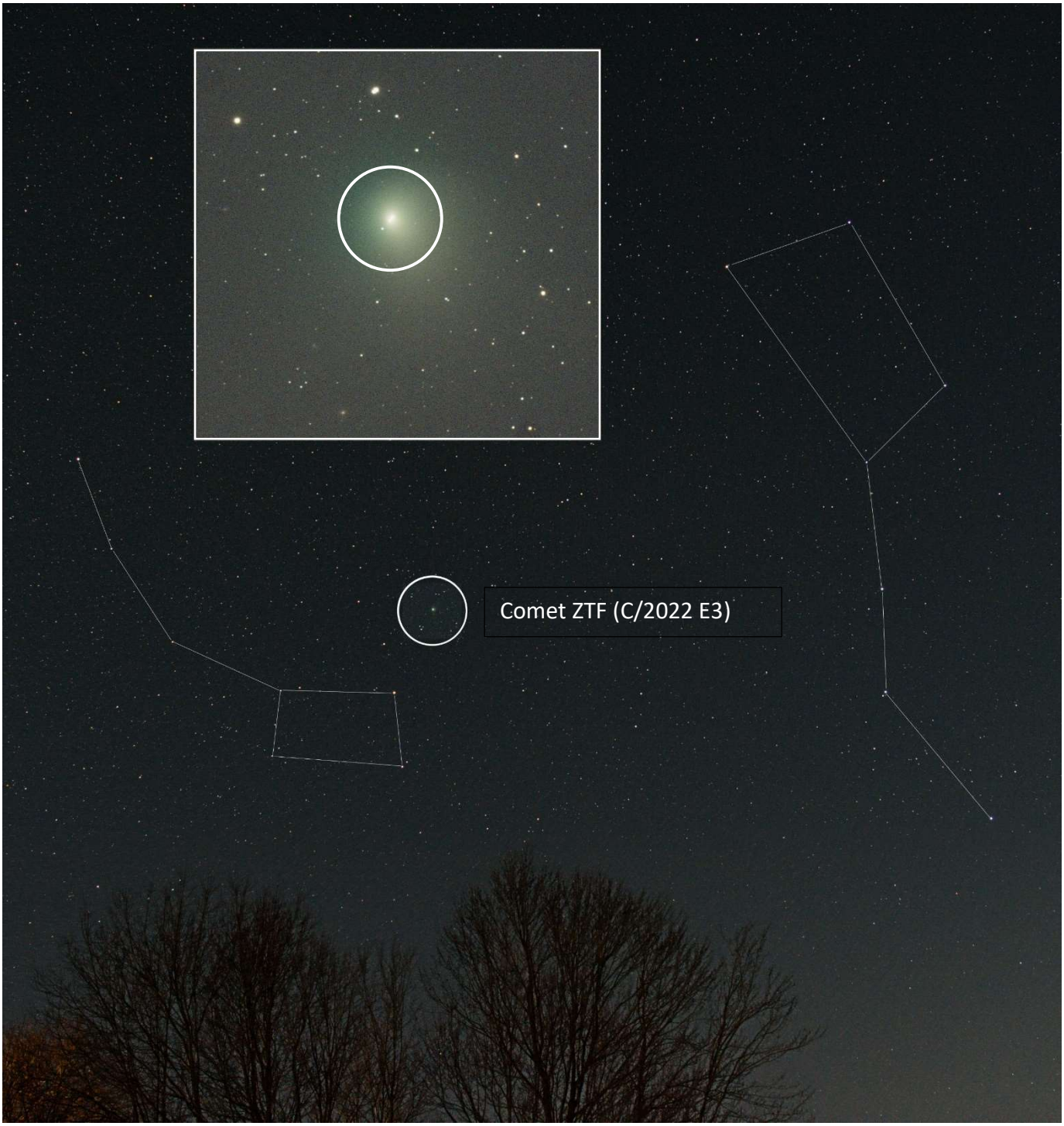
John J. McCarthy Observatory

Volume 16, No. 2 February 2023



The wheels of NASA's Perseverance rover as they await the command to start the climb up the Jezero crater delta Image Credit: NASA/JPL-Caltech

February Astronomy Calendar and Space Exploration Almanac



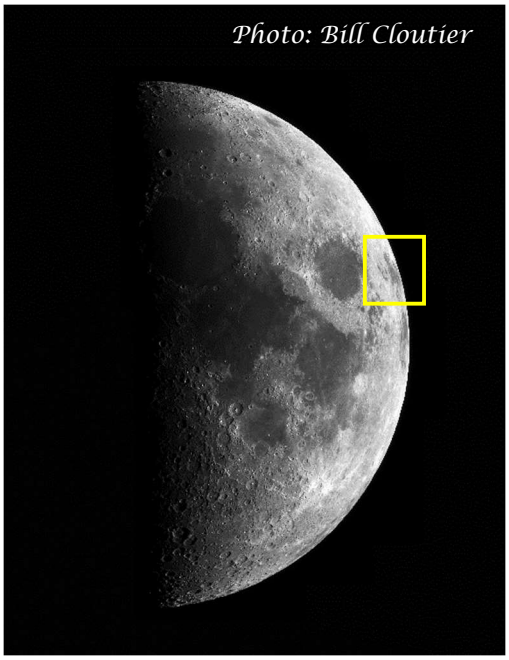
Comet ZTF (C/2022 E3) traveling between the two “Dipper” asterisms on the night of January 27th. The insert, captured with a 110mm refractor and Nikon D5300 on January 31st, highlights the extraordinary emerald green nucleus. Credits: Wide field - Bill Cloutier, Insert - John Gebauer

In This Issue

"Out the Window on Your Left"

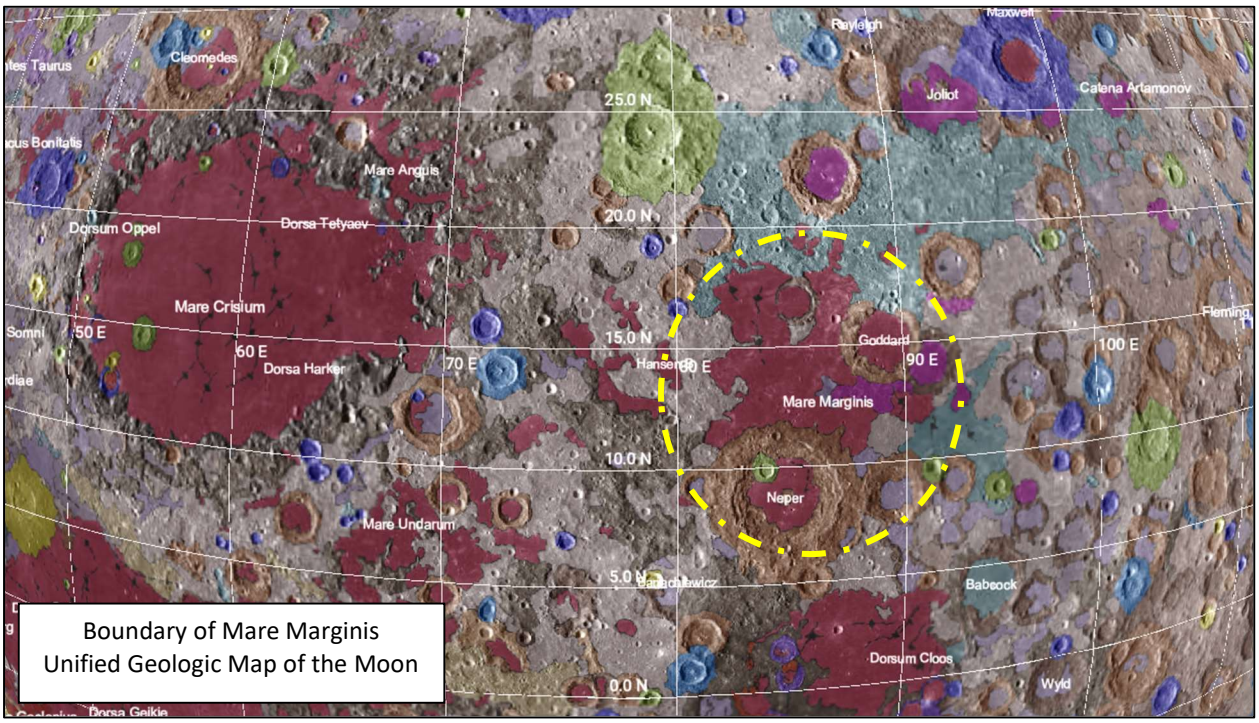
It's been more than 50 years since Apollo astronaut Gene Cernan left the last boot print on the Moon's surface. As a nation founded on exploration and the conquest of new frontiers, today's commitment to return to the Moon has been as fleeting as the funding. But what if the average citizen had the means 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).

Mare Marginis ("Sea of the Edge") is an irregular basaltic area located on the Moon's eastern limb, as viewed from Earth. Its center is listed at 86.5° longitude, with portions extending as far east as 93.4°. The lava patch is best seen during times of favorable longitudinal libration (a week or so after the Moon's closest approach to the Earth when it is possible to view lunar features up to an additional 7° over the eastern limb).



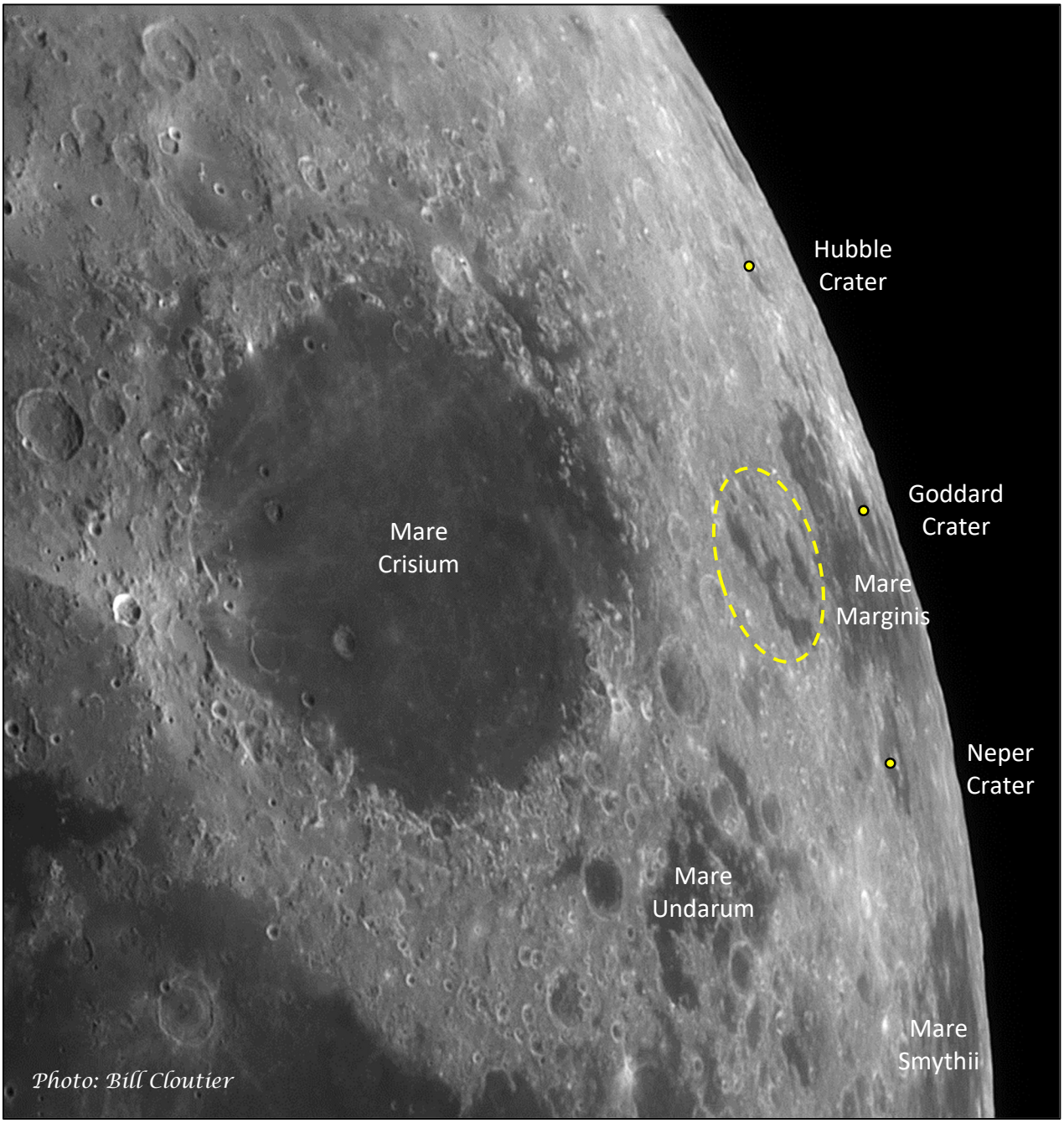
Location of Mare Marginis

The mare, bounded by the crater Goddard to the northeast and Neper to the south, doesn't appear to be associated with an impact basin and its basalts (estimated to be between 3.38 to 3.88 billion years old) are relatively thin. Mare Marginis might just be a low-lying region where near-surface lavas erupted and filled in the hollows over an area of about 25,000 square miles (64,900 square km). The mare contains several magnetic anomalies or lunar swirls, like Reiner Gamma, of unknown origin.



Boundary of Mare Marginis
Unified Geologic Map of the Moon

Mare Marginis



The lunar seas along the eastern limb of the Moon during a period of favorable libration (features were visible as far east as 96° in longitude). The photograph was taken on the night of December 29th using a 19th century antique refractor with a clear aperture of 4.2 inches.

Charles Wood, a lunar scientist, gave the lava lakes to the west of the mare (circled in yellow) the informal name of Lacus Risus Felis - the Cat's Smile.

Radiation Hazards of Jupiter's Magnetosphere

Io Encounter
Credit: NASA/SwRI/MSSS/j. Roger

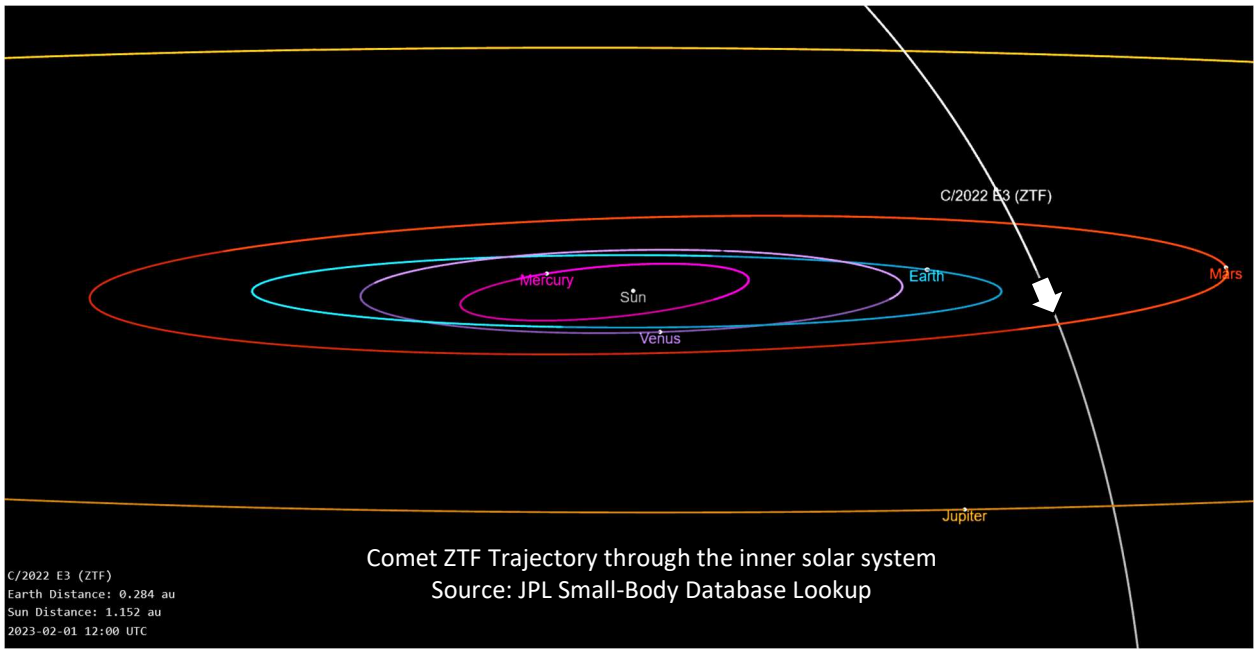
NASA's Juno orbiter captured the solar system's most geologically active moon during its 47th flyby of Jupiter. Io, the innermost Galilean moon, was imaged by the spacecraft's JunoCam on December 14th from a distance of about 40,000 miles (64,000 kms).

The flyby of Io was the first of nine that Juno will make over the next eighteen months, coming as close to the volcano-shrouded moon as 930 miles (1,500 km) during two future, high-speed passes.

Io is located deep in Jupiter's magnetosphere, a radiation-intense region. Despite being shielded, Juno's electronics and sensitive control systems are still exposed to life-shortening levels of radiation during each pass through the region. While the solar-powered spacecraft appeared to have survived its flyby, a likely radiation event delayed the mission team on Earth from directly accessing its memory and downloading the science data collected.

NASA/JPL controllers were eventually able to reboot the spacecraft's computer and reestablish the downlink of data. No data is believed to have been lost in the recovery process and Juno was on target for its next flyby of Jupiter on January 22nd. The flyby should also provide an opportunity for engineers to evaluate the overall health of the spacecraft.

The Green Comet Apparition



Comet ZTF Trajectory through the inner solar system
Source: JPL Small-Body Database Lookup

The month of February will be best for catching a glimpse of Comet ZTF (2022 E3) as it travels through the solar system's orbital plane between Earth and Mars on the 1st. The comet, which hasn't been this close to the Sun in 50,000 years, has been slowly brightening and should reach the threshold of naked-eye visibility early in the month. Early observations show a relatively compact nucleus with a bright, emerald green color (from the presence of dicarbon molecules).

On February 1st, ZTF will be in the northern sky, in the constellation Camelopardalis, about 60° in altitude at 9 pm (due north of Polaris). Unfortunately, any detail will likely be washed out by a very bright Moon (the Full Snow Moon is on the 5th).

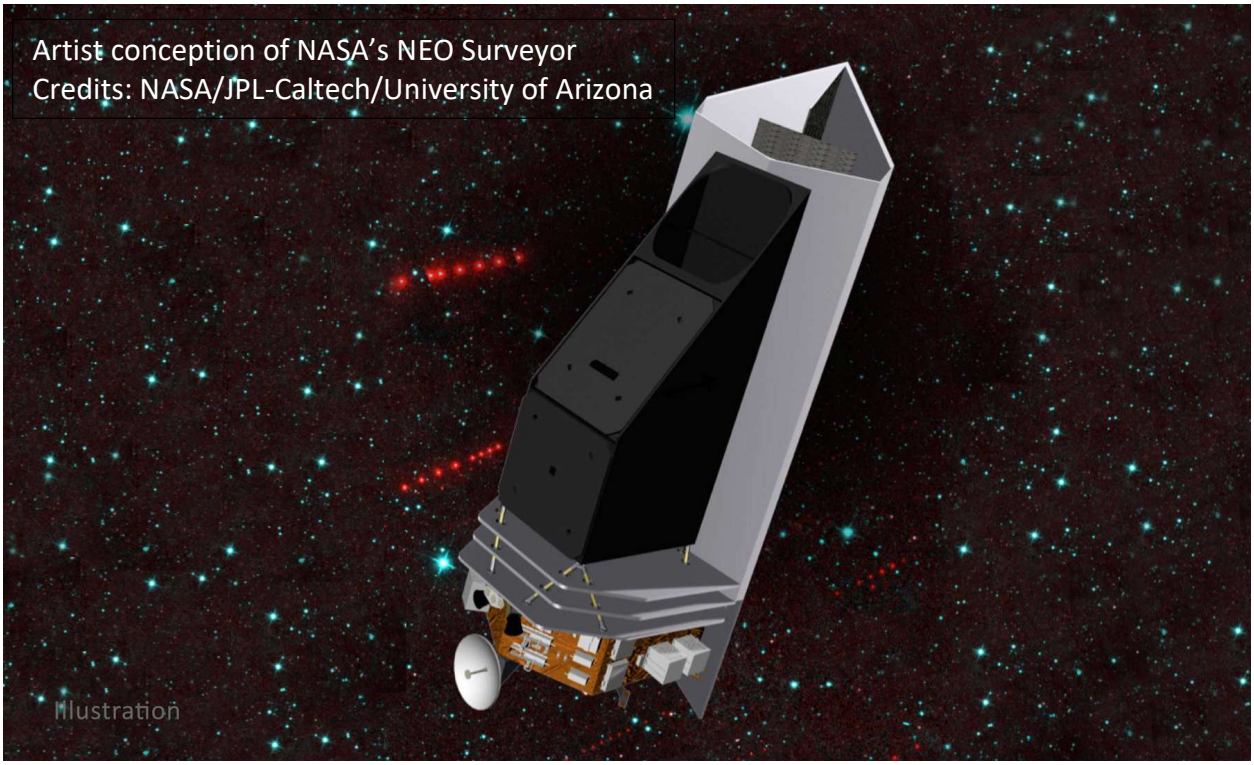
From night to night the comet moves towards zenith and then into the constellation Auriga in the western sky. By the 7th, at more than 70° in altitude at 9 pm, ZTF can be found between the bright star Capella and the planet Mars. A waning gibbous moon with be low in the east.

On February 11th, **the night of the McCarthy Observatory's open house**, ZTF will be close to Mars in the constellation Taurus. The comet will still be high in the sky at 9 pm and, should the weather cooperate, the sky will be moon-free until much later in the evening.

ZTF stays in Taurus for the remainder of the month. The Moon returns to the sky around the 22nd with the comet getting lower in the southwest. Best viewing will be earlier in the evening, e.g., as astronomical twilight ends around 7 pm.

Comet ZTF was discovered on March 2, 2022 at the Zwicky Transient Facility (ZTF) on Mount Palomar in Southern California. Based upon its current trajectory, ZTF will head back out to the outer solar system and may not return again. Relatively dim and diffuse comets can be difficult to see. For the best experience, plan your comet hunting activities during times when the Moon is not present, the sky is dark and transparent, and from a site free from artificial lights.

Go for NASA's Next-Generation Asteroid Hunter



Construction has begun on a space telescope designed to search for potentially hazardous asteroids. The project recently passed a rigorous technical and programmatic review that allows it to proceed to the next phase of development - final design and fabrication.

NASA's Near-Earth Object (NEO) Surveyor, which is scheduled to launch no later than June 2028, is an infrared telescope. With a 20 inch (50 cm) mirror, the telescope with be located at the Earth-Sun L-1 Lagrange point, almost a million miles (1.5 million km) from the Earth in the direction of the Sun. From this vantage point, the telescope can survey the region along Earth's orbit for potential hazards, as well as the difficult to observe area on Earth's Sun-facing side.

As an infrared telescope, NEO Surveyor will be able detect very dark objects - asteroids and comets that don't reflect much light, but do emit an infrared signature from solar heating.

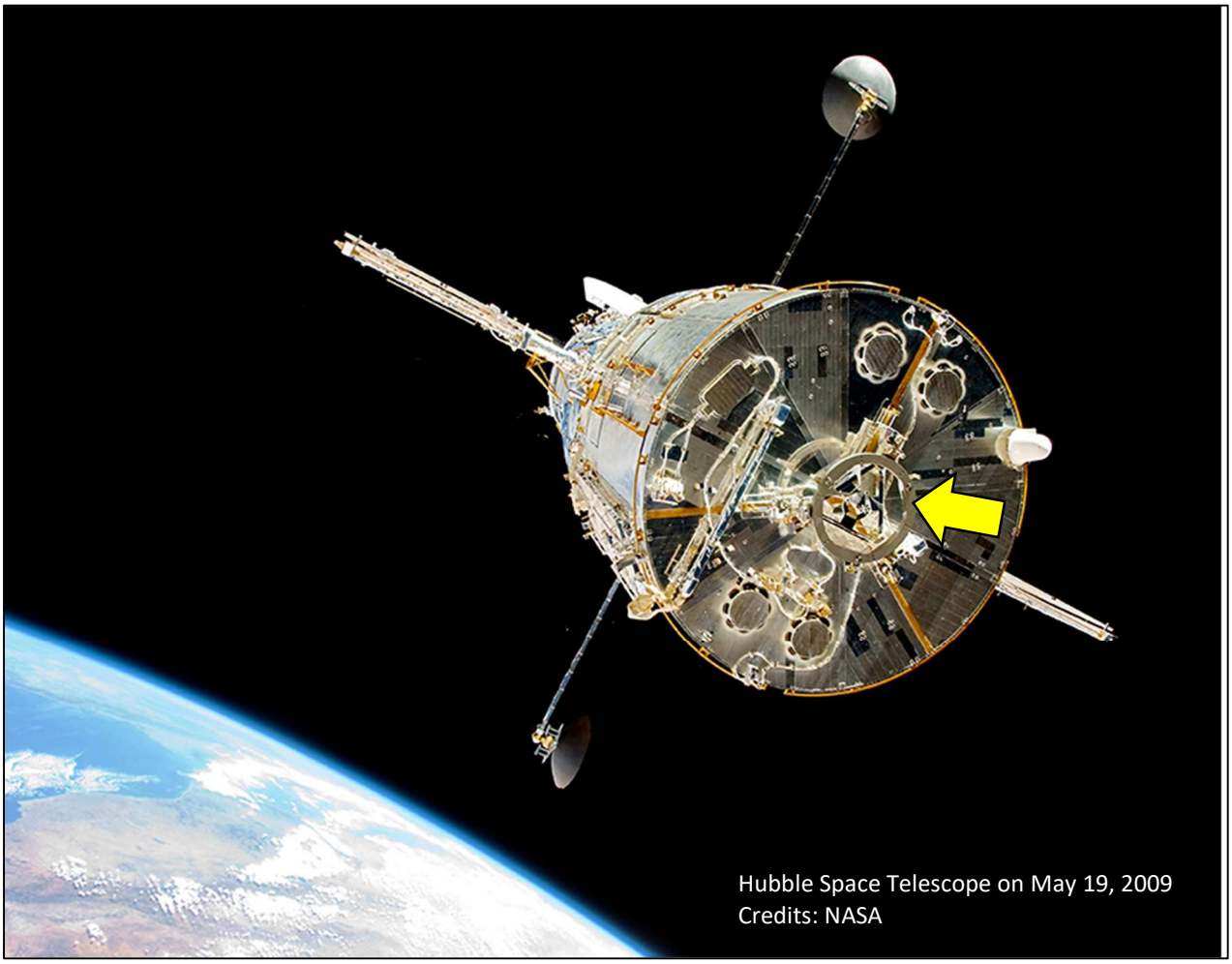
The NASA Authorization Act of 2005 directed NASA to "plan, develop, and implement a Near-Earth Object Survey program to detect, track, catalogue, and characterize the physical characteristics of near-Earth objects equal to or greater than 140 meters in diameter in order to assess the threat of such near-Earth objects to the Earth. It shall be the goal of the Survey program to achieve 90 percent completion of its near Earth object catalogue (based on statistically predicted populations of near-Earth objects) within 15 years after the date of enactment of this Act."

Complying with legislative directives is nearly impossible without adequate financing, which has not been forthcoming. Several members of Congress have made it known to the NASA Administration that they would like to see the launch of NEO Surveyor accelerated at least two years (2026). While the fiscal year 2023 spending bills would partially restore funding for the program, the money is not sufficient for a two-year acceleration in schedule.

Saving the Hubble

NASA issued a Request for Information (RFI) in late December as the agency continues to explore the possibility of raising the orbit of the Hubble Space Telescope. Without a reboost, the telescope is expected to reenter the Earth's atmosphere in the mid-2030s. The situation is more urgent than it appears. Hubble's current altitude is approximately 335 miles (540 km). According to NASA, a rendezvous with the space observatory becomes more difficult once its altitude drops below 310 miles (500 km), which it is predicted to reach in 2025.

At this time, NASA has not scheduled or funded a Hubble servicing mission. SpaceX had presented the idea of a reboost with its Dragon spacecraft, at no cost to the government. The RFI was issued to solicit additional ideas and gauge interest by other potential partners.

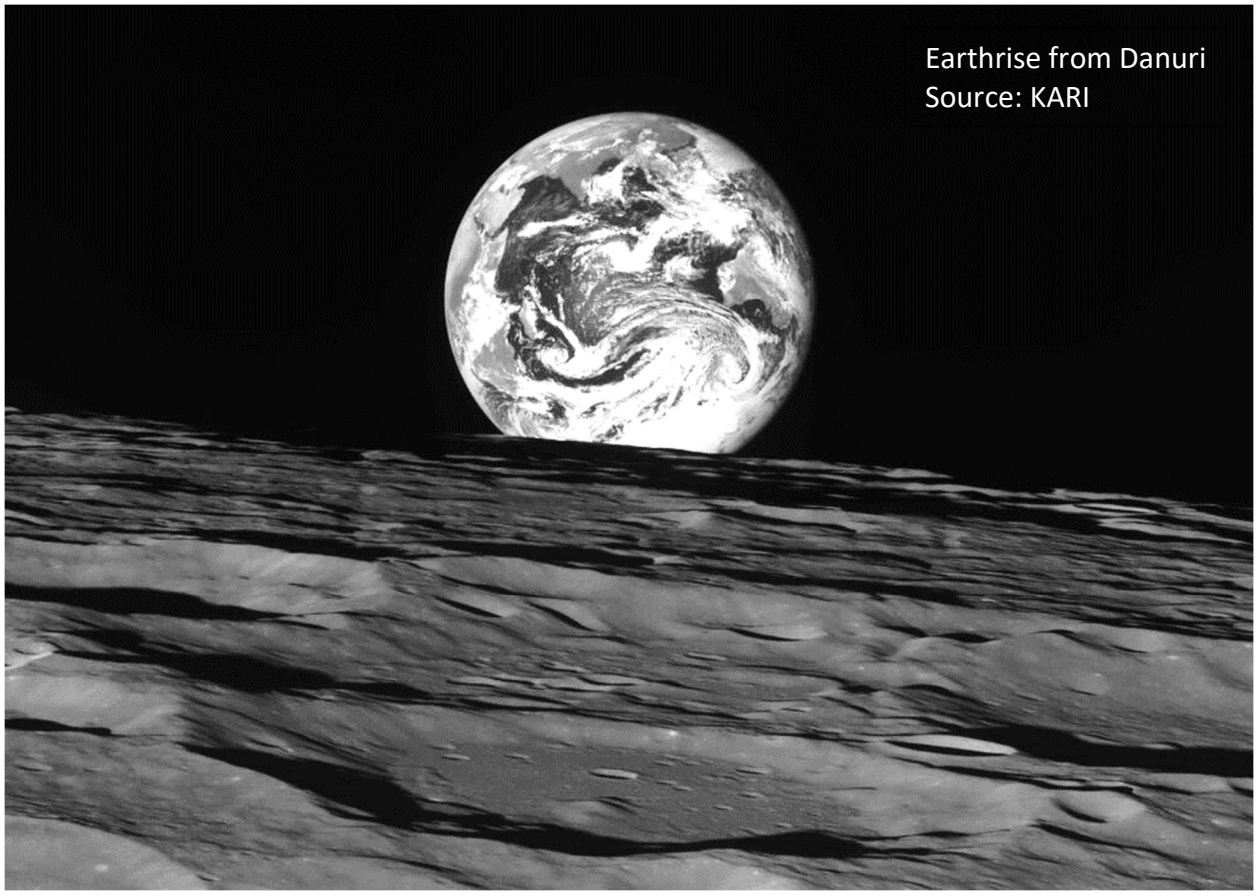


Hubble Space Telescope on May 19, 2009
Credits: NASA

Hubble was last visited in 2009 by the space shuttle Atlantis. The fifth and final servicing mission included the installation of a Soft Capture and Rendezvous System (circular feature seen on the aft end of the telescope's bulkhead in the photo). The mechanism is designed to facilitate the future capture of the telescope by a robotic or crewed spacecraft for deorbiting and disposal.

Should NASA and its partner(s) demonstrate a cost-effective and practical means of reboosting the telescope, the technology could also be used to service other, older satellites, extending operating lives or providing an option for safe disposal.

Korean Lunar Probe in Orbit



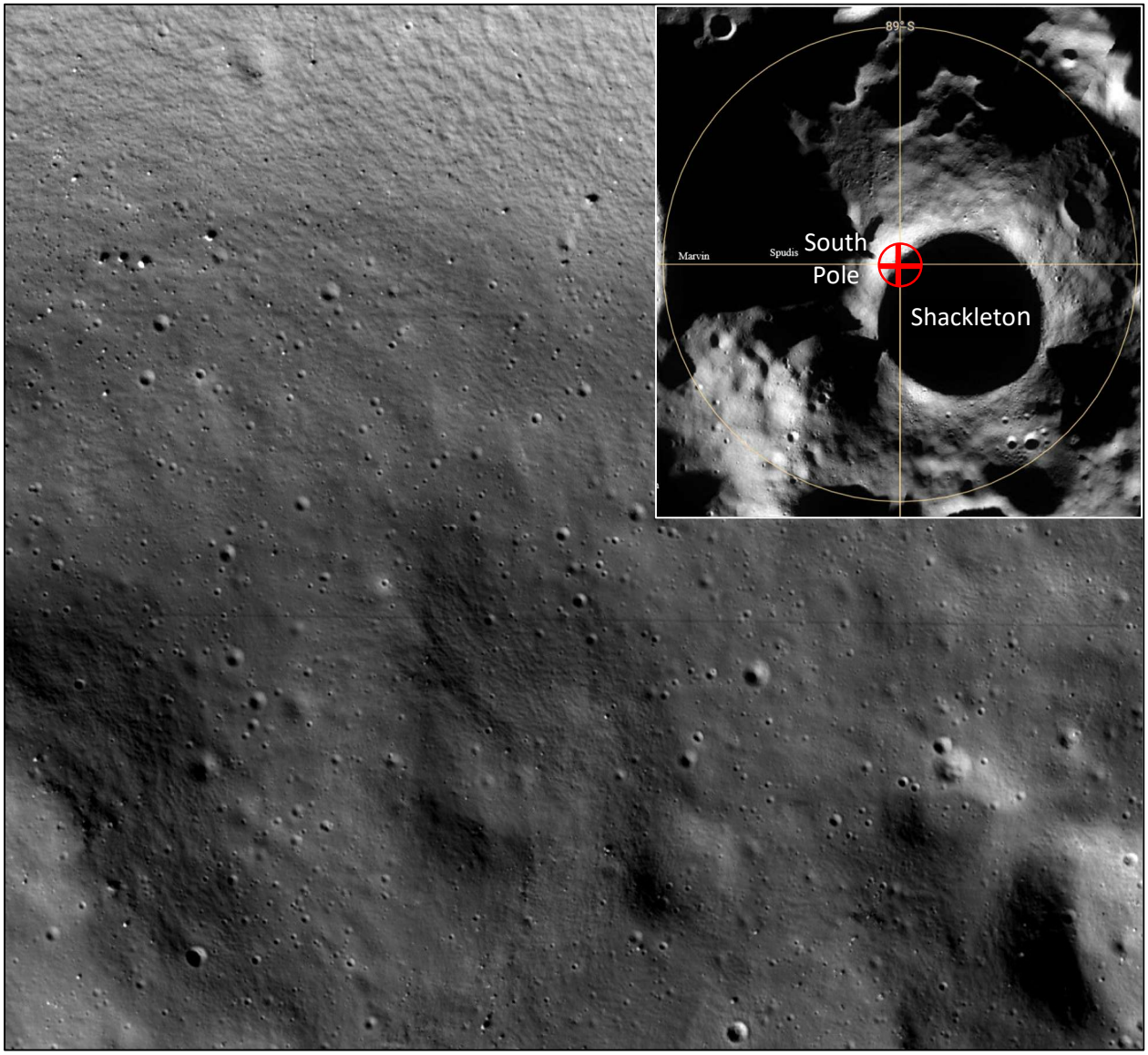
The Korean Aerospace Research Institute (KARI) has released its first images from its Danuri spacecraft after it entered orbit around the Moon. The photo (above), taken during the last week of December, shows the Earth appearing just above the lunar surface. At the time, the spacecraft was at an altitude of approximately 75 miles (120 km).

The Danuri orbiter, South Korea's first interplanetary spacecraft, was launched aboard a SpaceX rocket in August 2022. It was placed into a fuel-saving, economical ballistic transition trajectory, arriving at the Moon in a leisurely four months. It is currently circling the Moon every two hours.

Danuri is expected to begin scientific operations in February, once the commissioning phase (system checkout and instrument calibration) is complete. The orbiter's mission includes mapping and analyzing the lunar terrain, measuring magnetic field strength and the radiation background. Its high resolution camera will be used to photograph potential landing sites for a future mineral exploration mission, tentatively scheduled for 2032.

The six instrument suite aboard the orbiter includes a NASA-funded instrument (called "ShadowCam"). The ultrasensitive camera is designed to image the Moon's permanently shadowed regions, collecting data on the distribution and accessibility of water ice and other volatiles within craters near the Moon's south pole. These areas are only "illuminated" by light reflected from nearby, sunlit hills. ShadowCam sensitivity is such that it can use this very weak, secondary light to see details within the craters.

ShadowCam Reveal

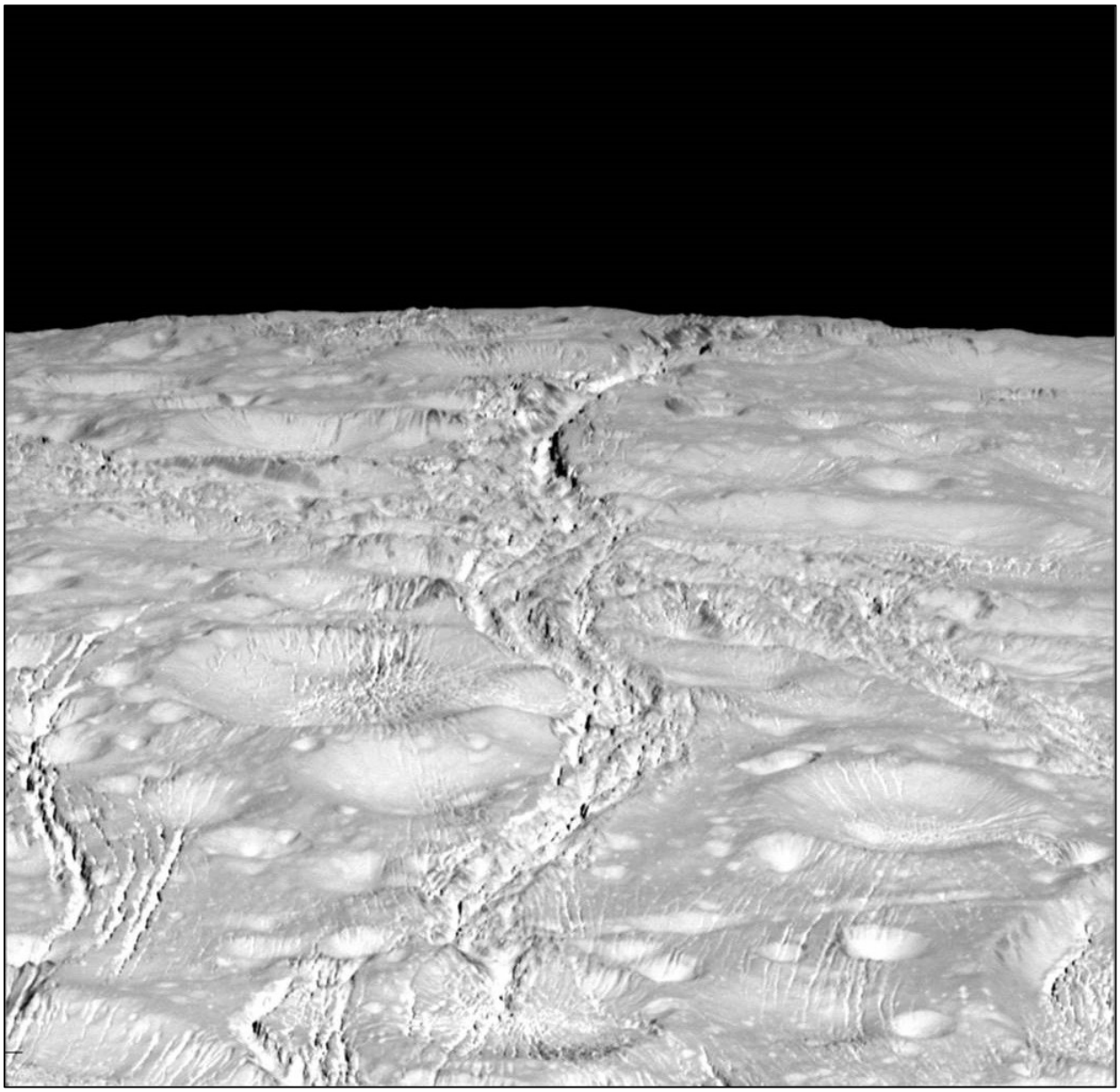


The interior of Shackleton crater (larger image), with the crater's location with respect to the Moon's south pole (insert) Credits: NASA/KARI/ASU and NASA/GSFC/ASU

The Korean Aerospace Research Institute (KARI) released it first image from its NASA-funded ShadowCam (carried aboard the Danuri spacecraft). The image reveals the permanently shadowed wall and floor of Shackleton crater. The upper portion of the image shows the base of the steep crater wall while the remainder of the image reveals the hummocky crater floor. Over the course of the mission, KARI plans to image all of the Moon's permanently shadowed craters in the search for frost and ice as well as any changes over time.

ShadowCam's design is based upon the Lunar Reconnaissance Orbiter's Narrow Angle Camera, with boosted sensitivity (ShadowCam is 200x more sensitive) for extreme low-light conditions. The data collected by the instrument will be used to support NASA's future Volatiles Investigating Polar Exploration Rover, also known as VIPER.

Snow Making Moon

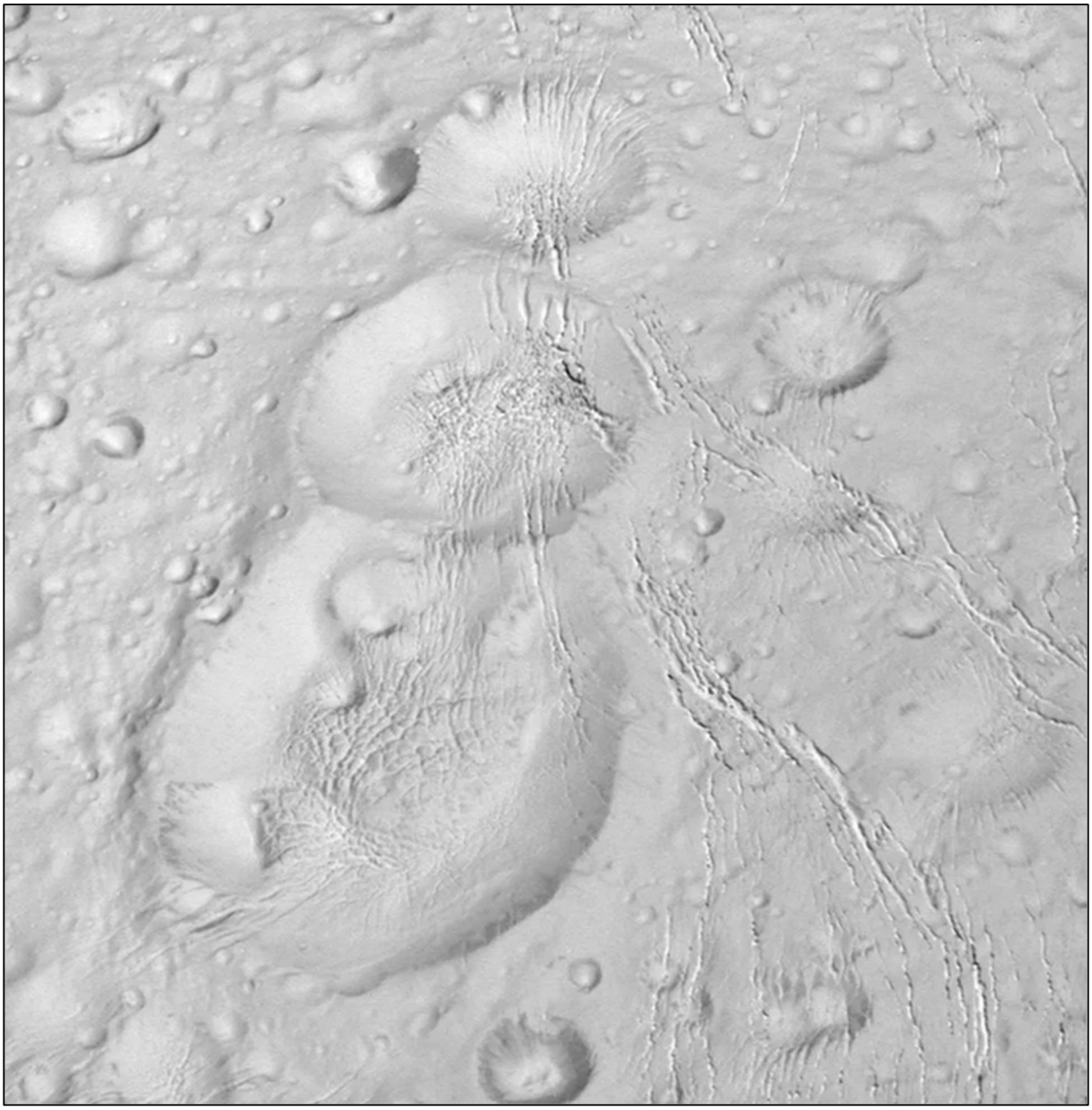


The north pole of Saturn's moon Enceladus captured by NASA's Cassini spacecraft in 2015
Credit: NASA/JPL-Caltech/Space Science Institute

Enceladus, a world with a subsurface global ocean and active icy geysers at its south pole, is covered with a blanket of snow that, in some locations, could be as thick as 2,300 feet (700 meters). The thickness was derived by planetary scientists using techniques developed in their work in Iceland on similar terrain.

Although a small portion of the icy spray from the active geysers (that reaches more than 100 miles or 175 kms into space) escapes from the diminutive moon, the majority falls back to its surface as snow. Understanding the physical properties of this snow cover will be necessary should the moon be targeted for a landing at some point in the future.

The sheer volume of snow suggests that the plumes were much more active in the past than they are today. Snow particles escaping the moon contribute to form Saturn's tenuous E-ring. The icy particles also migrate to neighboring moons, like Mimas and Tethys, refreshing their surfaces and increasing their reflectivity.



Closeup of a crater chain on Enceladus' north polar region captured by Cassini's cameras. The "snowman" was made by snow draining into fissures located under the snow pack. Credit: NASA/JPL-Caltech/Space Science Institute

The data collected by the Cassini spacecraft during several flybys of the moon, and through the plumes, indicate that Enceladus has all the basic ingredients to support life in its salty ocean. While NASA has targeted Jupiter's moon Europa for it next astrobiology mission, the active plumes on Enceladus may provide scientists easier access to an interior ocean.

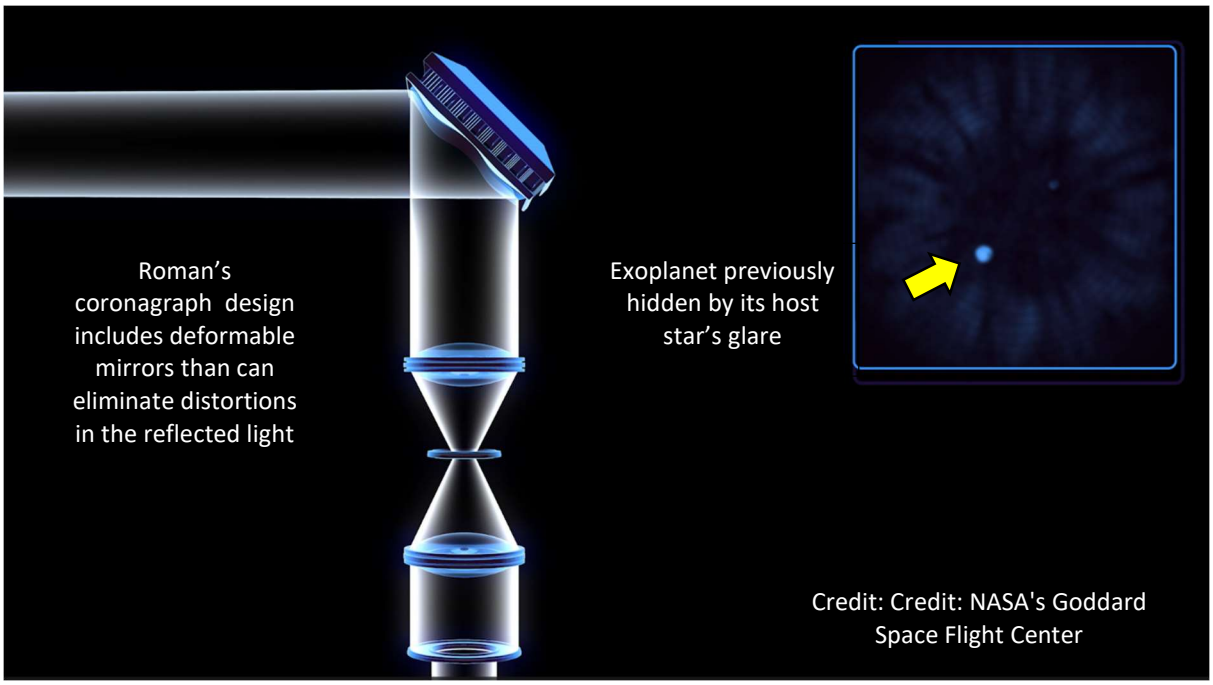
Proposed Exoplanet Telescope

A topic that gathered considerable interest and discussion at this year's American Astronomical Society was the announcement by Mark Clampin, NASA's astrophysics division director, that the agency has conceptualized an initial plan for a new space telescope. The telescope would be similar in size to the James Webb, the 6.5-meter space telescope that began operations last year, but instead of infrared wavelengths, would be designed for visible light observations.

The telescope, currently with a working name of the "Habitable Worlds Observatory" or "HWO," would look for signs of life on Earth-like planets in other star systems. HWO, like the James Webb, would be positioned at the Lagrange Point 2, a gravitationally stable location about a million miles (1.5 million km) beyond the Earth. Unlike the James Webb, HWO would be designed for servicing and upgrades by robotic spacecraft which, like the Hubble Space Telescope, could extend its operating life and take advantage of technological advances to improve its capabilities over time.

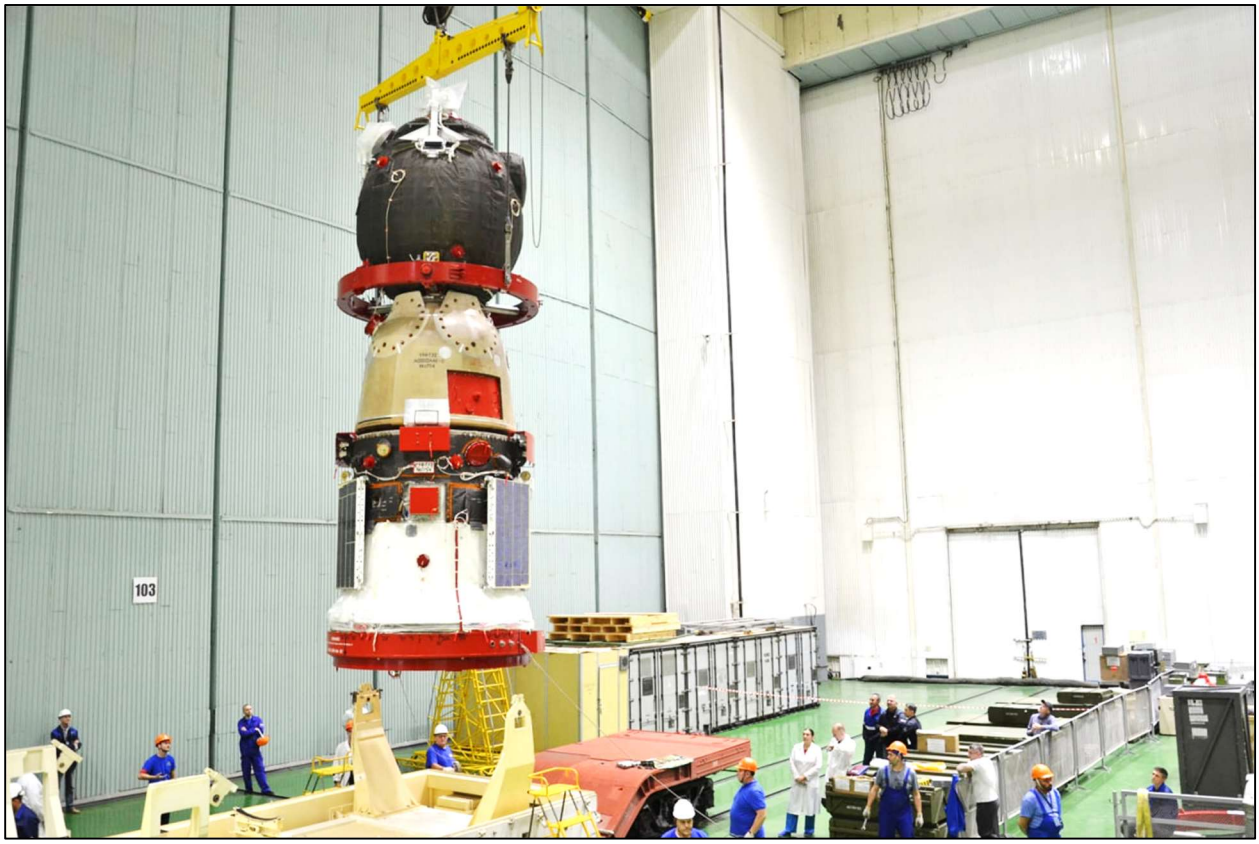
Until there is a working budget for HWO, little progress will be made in the detailed design of the instrument. NASA plans to launch its next space telescope, the Nancy Grace Roman Observatory, in 2027. Similar in size to the Hubble, the Roman will have a wide-field infrared camera with a field of view that is 100 times greater than Hubble, along with a high-tech coronagraph for imaging nearby exoplanets.

While there is support for NASA to resurrect its "Great Observatory" program (of which the Chandra and Hubble are still in operation), astrophysics was one of the areas where lawmakers reduced NASA's allocations in the latest budget.



Roman's coronagraph doesn't use a traditional opaque disk to block a star's light. Instead, it uses a combination of disks with complex patterns and light-blocking stops to reveal planets than are a billion times dimmer than their star. However, HWO's coronagraph will need to be 10 times more efficient if it is going to be able to characterize rocky exoplanets for evidence of life.

Russia to Launch Rescue Vehicle



A Soyuz spacecraft undergoing launch preparations last year at the Baikonur Cosmodrome in Kazakhstan Credit: Energia

While officials have declined to call it a rescue vehicle, the Russian space agency, Roscosmos, announced that it is accelerating the launch of the next Soyuz spacecraft (MS-23) to the International Space Station (ISS). The Soyuz will be flown without a crew and will replace the damaged MS-22 spacecraft currently docked at the ISS.

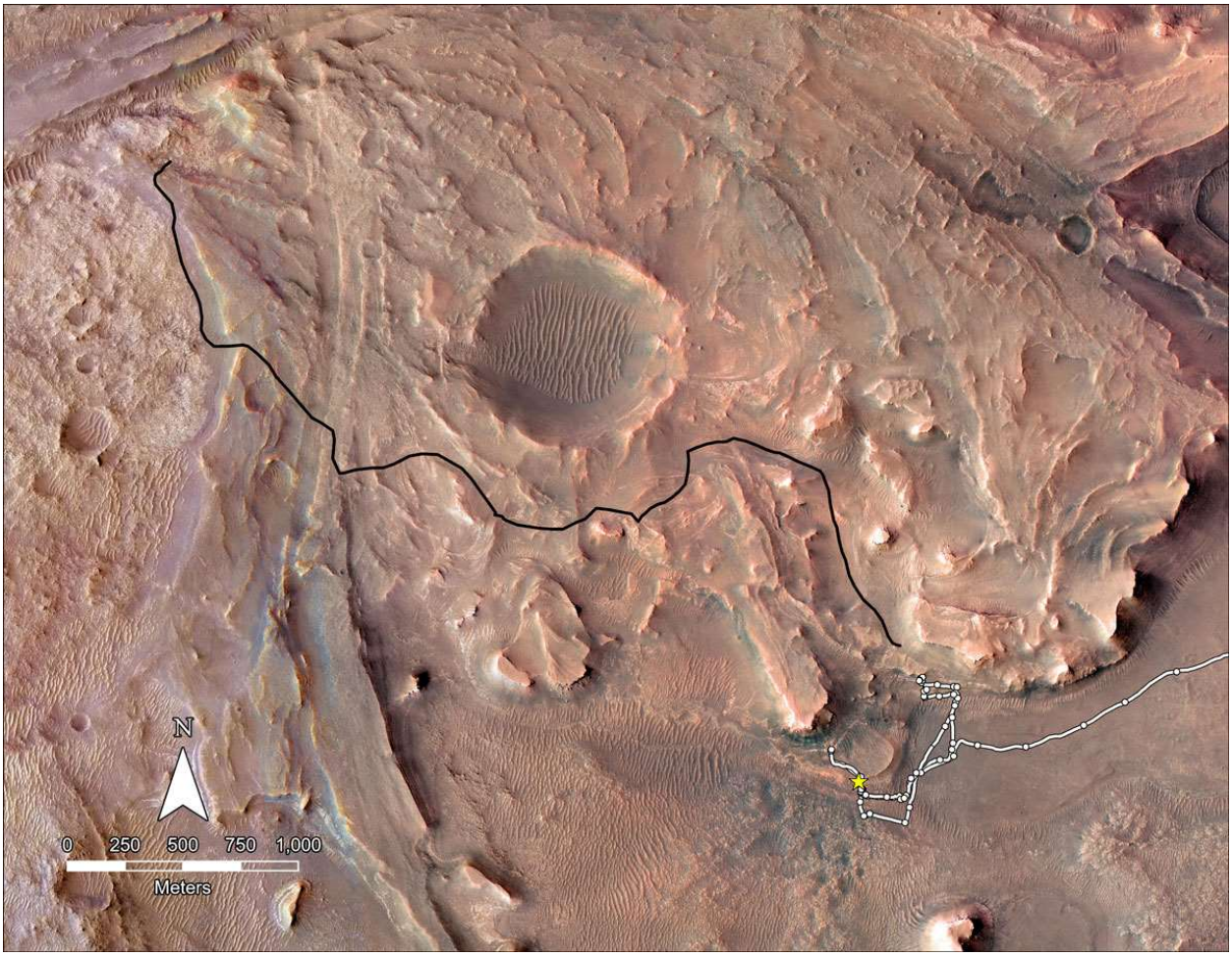
The damaged Soyuz was intended to return NASA astronaut Frank Rubio and Russian cosmonauts Sergey Prokopyev and Dmitri Petelin to Earth in March. Their stay will now be extended several months while the replacement crew awaits the preparation of another spacecraft.

Soyus-22 developed a sudden leak in its coolant system on December 14th while parked at the ISS. Without the ability to reject heat, engineers are concerned that higher temperatures within the capsule could adversely affect equipment and the crew in the confined compartment, although they are confident that it still could be flown safely. While NASA had asked SpaceX to assess their ability to evacuate the entire ISS contingent of seven with their 4-seat Dragon spacecraft, the decision was ultimately made to replace the Russian vehicle. In the interim, the damaged vehicle will remain at the ISS for emergency use.

Roscosmos believes, based upon an engineering analysis, that a radiator pipe on the Soyuz MS-22 spacecraft was most likely damaged by a micrometeorite. The object, traveling at a high velocity, created a hole smaller than 1 millimeter, which led to the draining of coolant.

Delta Top Campaign

After almost two Earth-years on Mars, NASA's Perseverance rover is wrapping up its Delta Front campaign and preparing for its next adventure. Perseverance has been exploring the floor of the 3.9-billion-year-old crater, as well as the front of an ancient river delta, since it landed on February 18, 2021. Along the way it has collected 18 samples (15 rock cores and 3 regolith or soil) of a total of 38 that are planned to be collected over the life of the mission. During the month of January, the rover placed 10 of those samples (which are duplicates of those stored onboard the rover) at a location called "Three Forks." The cache was established as a contingency, should the rover not be operational when the Mars Sample Return lander arrives, sometime in the next decade.



Planned route that NASA's Perseverance Mars rover will take across the top of Jezero Crater's delta in 2023. The rover's arrival at the front of the delta is indicated by a white line, with dots representing waypoints. The route up onto the delta and towards the crater rim is shown in black. Credit: NASA/JPL-Caltech

In February, Perseverance will embark on the "Delta Top" campaign, expected to take up to eight months. As the rover climbs the delta, scientists will be looking for material, including boulders, carried downstream from other parts of Mars by the river that formed the delta billions of years ago. Perseverance will be accompanied by Ingenuity, the intrepid rotorcraft. Ingenuity will provide a second pair of eyes as rover drivers on Earth look for the safest route to the top and crater rim.

Ingenuity
Credit: NASA/JPL-Caltech

Ingenuity completed its 40th flight on January 19th. Originally included as a technology demonstration, and given the month of April 2021 to conduct up to five test flights, the helicopter has proven its usefulness as a scout and surveyor of ground features unreachable by the rover.

This past fall, engineers at NASA's Jet Propulsion Laboratory upgraded Ingenuity's navigation software for the Delta Top campaign. As a technology demonstration, the rotorcraft had been designed and built for short flights on level ground. Its new capabilities allow Ingenuity to navigate rougher terrain by using digital elevation maps and to avoid hazards when preparing to land.

To date, Ingenuity has flown a total distance of about 26,300 feet (8,000 meters), with a cumulative flight time of 66 minutes (its flights are limited in duration by the inability to cool the rotor motor due to Mars' very thin atmosphere). It is currently positioned at the base of the delta where Perseverance will begin its ascent.

Remembering Columbia

Columbia crew photo from an undeveloped film canister recovered from the debris. From left (bottom row): Kalpana Chawla, Rick Husband, Laurel Clark and Ilan Ramon. From left (top row): David Brown, William McCool and Michael Anderson. (Image credit: NASA/JSC)

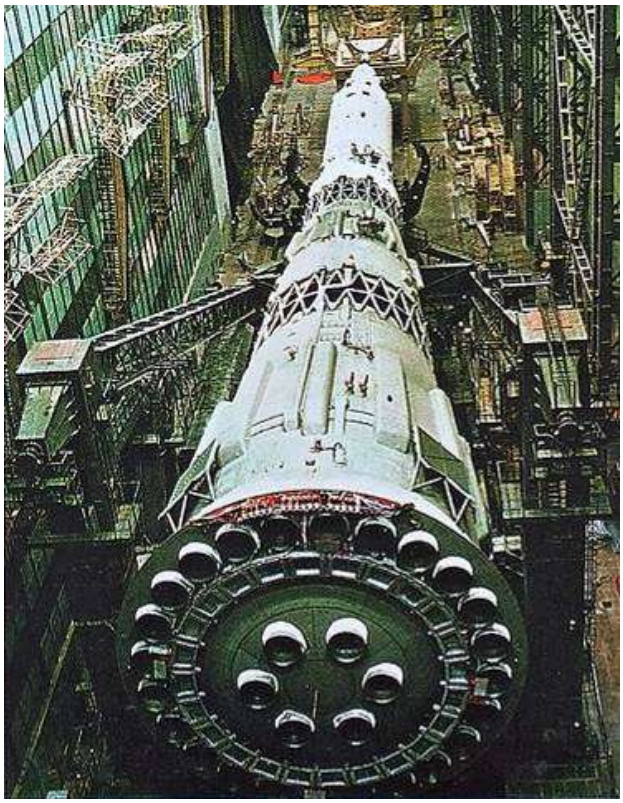
Twenty-five years ago on February 1st, the nation's first space shuttle to fly in space broke apart as it returned to Earth, killing all seven crew members aboard. The accident investigation board determined that a large piece of foam fell from the Columbia's external tank during launch, striking the orbiter's left wing. The resulting hole in the carbon-carbon composite insulation allowed hot gases to enter the wing during reentry, resulting in the loss of control and eventual destruction of the vehicle on its 28th flight. In the largest ground search in history, volunteers combed an area of east Texas the size of Rhode Island and Delaware for the remains of the shuttle and her crew. Eventually, almost 40 percent of the dry weight of the spacecraft was recovered (84,000 pieces), as well as all of the crew members.

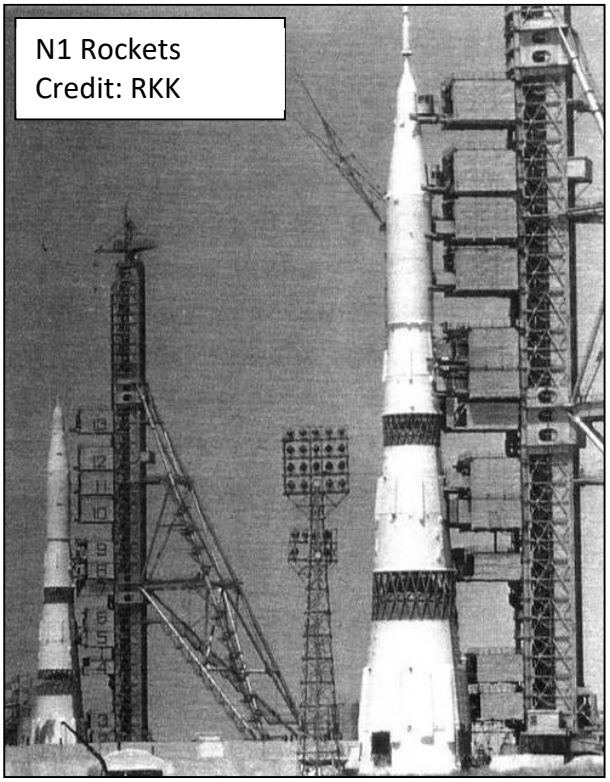
It would be 907 days before another space shuttle flew and, despite all the work to make the vehicle safer, Discovery's external tank shed several large pieces of foam. The largest piece missed the orbiter and the smaller ones caused only minimal damage, based on on-orbit inspections. STS-114, commanded by Eileen Collins, would return safely to Earth at the end of the 14-day mission.

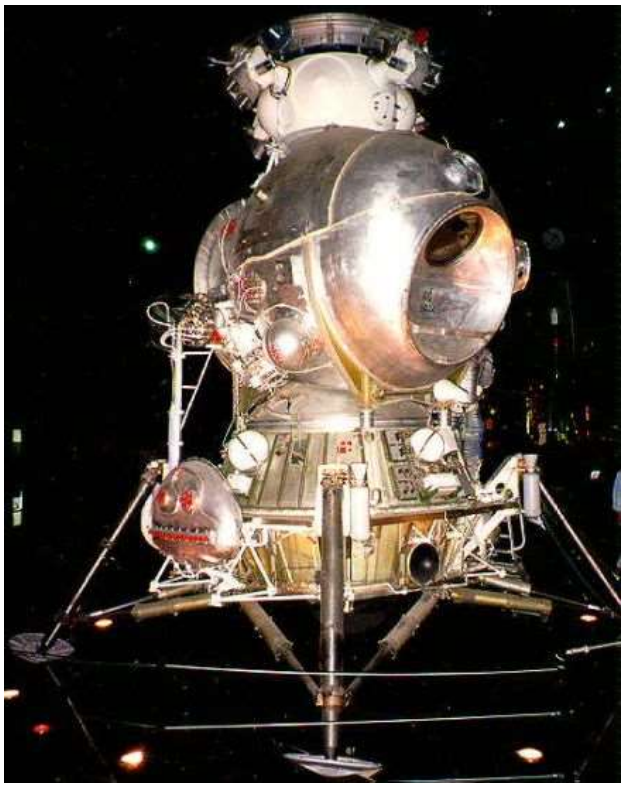
Soviet Moon Program

February 1969 marked the beginning of the end of the Soviet Moon program. While publicly denying its intentions to send cosmonauts to the Moon during the 1960s, the Soviets were secretly constructing rockets of mammoth proportions (rivaling the Saturn V). On February 21, 1969, the N1 moon rocket exploded during its first test flight. The rocket fell back to Earth after a safety system mistakenly shut down all 30 engines when a fire was detected in the first stage less than 70 seconds after liftoff. Three more failures would follow before the Soviet government would abandon their manned-Moon program.

The historic photos on the right shows 1) the N1 under construction with the 30-engine first stage, 2) the Soviet lunar lander and 3) two N1 rockets on pads at the Baikonur Cosmodrome (also known as Tyuratam) in Kazakhstan. The five stage rockets stood approximately 340 feet high.



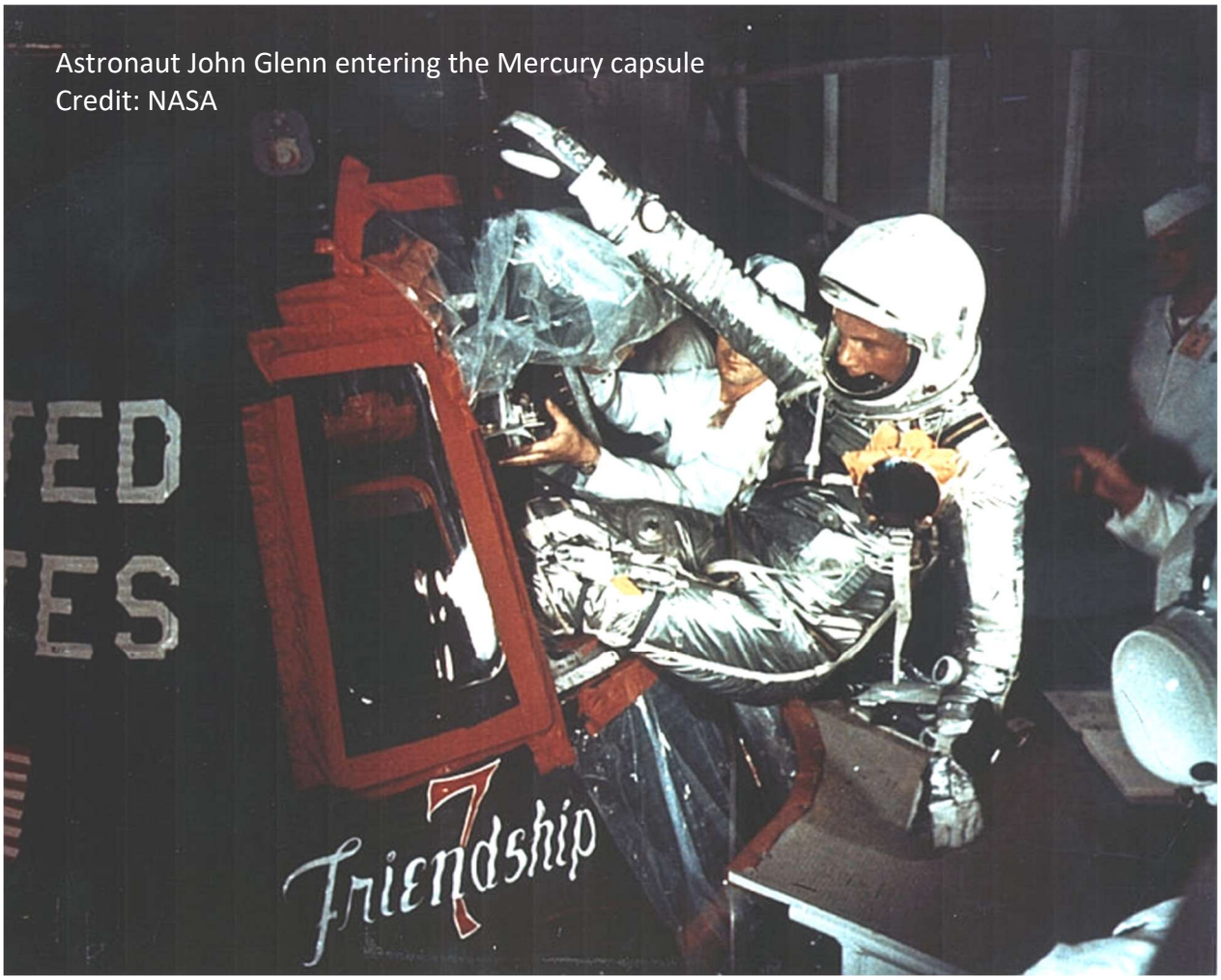




John Glenn and the Flight of Freedom 7

On the morning of February 20, 1962, John Glenn became the first American to orbit the Earth aboard a Mercury space capsule that Glenn named Friendship 7. Originally scheduled for the previous December, the launch was delayed by several technical and mechanical issues, including a fuel leak, and by weather.

Glenn served with the Marine Corps prior to being selected by NASA for its manned spaceflight program. As a fighter pilot, he flew 59 combat missions in the South Pacific during World War II. Following service in the Korean War (baseball Hall of Fame legend Ted Williams was one of his wingmen), he set a speed record for a transcontinental flight on July 16, 1957 when he flew a Vought F8U Crusader from California non-stop to New York in 3 hours 23 minutes in a test of a new Pratt & Whitney engine (it did require 3 mid-air refuelings).



Astronaut John Glenn entering the Mercury capsule
Credit: NASA

Glenn's trip around the Earth lasted 4 hours and 55 minutes and 23 seconds, completing 3 orbits before splashing down in the Atlantic Ocean southeast of Bermuda. While a public relations success, the flight was not without problems, the most serious of which was an indication that the capsule's heat shield had come loose and its landing bag deployed. Not knowing whether it was a faulty indicator, mission control asked Glenn to leave the retro-pack on during reentry. (The retro-pack consisted of three small rockets that were used to slow the spacecraft down. It was attached to the spacecraft by three straps that extended over the heat shield.) Fortunately, the indicator was

faulty and the flaming debris that Glenn saw streaming by his window during reentry was from the retro-pack and not the heat shield.

John Glenn would not return to space for another 36 years. In 1998, at the age of 77, Glenn joined the crew of the space shuttle Discovery for a nine-day mission. He was the oldest person to fly in space. John Glenn died Thursday, Dec. 8, 2016 at the age of 95. He was the last of the original Mercury 7 astronauts selected by NASA in 1958 for the agency's fledgling manned spaceflight program.

Sunrise and Sunset (from New Milford, CT)

Sun	Sunrise	Sunset
February 1st (EST)	07:05	17:09
February 15th	06:49	17:26
February 28th	06:30	17:42

Astronomical and Historical Events

1st History: loss of the space shuttle Columbia upon reentry (2003)
2nd History: Soviet space station Salyut 4 reenters the Earth's atmosphere (1977)
3rd History: Apollo 14, with astronauts Alan Shepard, Stuart Roosa and Edgar Mitchell, lands in the Moon's Fra Mauro region; 3rd manned Moon landing (1971)
3rd History: Soviet spacecraft Luna 9 becomes first spacecraft to soft land on the Moon (1966)
4th Moon at apogee (furthest distance from Earth)
4th History: launch of Lunar Orbiter 3; photographed potential Apollo landing sites (1967)
4th History: Clyde Tombaugh born (1906); discovered the dwarf planet Pluto in 1930
5th Full Moon
5th History: flyby of Venus by the Mariner 10 spacecraft on its way to Mercury; first U.S. spacecraft to photograph Venus, first to use gravity of one planet to propel itself to another, and the first spacecraft to visit Mercury (1974)
6th History: Soviet space station Salyut 7 reenters Earth's atmosphere (1991)
6th History: Apollo 14 astronaut Alan Shepard attempts to golf on the Moon (1971)
7th History: launch of the Stardust spacecraft for a rendezvous with Comet Wild 2 (1999)
7th History: Bruce McCandless makes first untethered spacewalk using a jet-powered backpack (1984)
7th History: Astronomical Society of the Pacific founded (1889)
7th History: William Huggins born, pioneered work in astronomical spectroscopy and first to differentiate nebular and galactic spectra (1824)
8th History: Allende Meteorite fall (meteorites from the fall were the first extraterrestrial rocks analyzed in the NASA Lunar Receiving Laboratory which had just been completed in September of 1967 to support the Apollo program) (1969)
8th History: discovery of the SAU 094 Mars meteorite in Sayh al Uhaymir, Oman; one of the largest Mars meteorites recovered and the only one with a documented strewn field (2001)
8th History: discovery of GRV 99027 Martian Meteorite on the ice sheet near the Grove Mountain region of Antarctica; the 9.97-gram meteorite was later characterized as a shergottite (2000)

Astronomical and Historical Events

8th History: flyby of Jupiter by the Ulysses spacecraft on its way to study the polar regions of the Sun (1992)
8th History: return of Skylab III crew (astronauts Gerald Carr, William Pogue and Edward Gibson) to Earth after a 3 month stay on the space station (1974)
8th History: Jules Verne born, author and futurist (1828)
9th Scheduled launch of a Russian Progress cargo-carrying spacecraft from the Baikonur Cosmodrome, Kazakhstan to the International Space Station
9th History: United Arab Emirates Hope (Al-Amal) spacecraft enters orbit around Mars (2021)
9th History: launch of the ESA's Solar Orbiter on an Atlas 5 rocket from the Cape Canaveral Air Force Station, Florida
10th History: China's Tianwen-1 enters orbit around Mars (2021)
10th History: flyby of Venus by the Galileo spacecraft (for a gravity assist) on its way to Jupiter; the encounter provided the first views of mid-level clouds on Venus and confirmed the presence of lightning (1990)
10th History: flyby of Mars by the Soviet Mars 4 spacecraft; failed to enter orbit but did detect night-side ionosphere (1974)
10th History: MIT, using Millstone Hill radar in Westford, MA, bounces radar off Venus (1958)
10th History: discovery of Asteroid 624 *Hecktor*, largest Jupiter Trojan, by August Kopff (1907)
11th McCarthy Observatory – Second Saturday Stars
11th History: launch of NASA's Solar Dynamics Observatory from Cape Canaveral, Florida; the first mission in the space agency's "Living with a Star" program; five-year mission to study the Sun's energy and its influence on space weather (2010)
11th History: launch of the space shuttle Discovery (STS-82), second Hubble Space Telescope servicing mission; **shuttle tire** on display at the Observatory is from this mission (1997)
11th History: launch of first Japanese satellite: Oshumi (1970)
12th History: landing of the Near-Earth Asteroid Rendezvous (NEAR) – Shoemaker spacecraft on the asteroid *Eros* (2001)
12th History: Soviet spacecraft Mars 5 enters orbit around Mars, providing information on surface temperatures, CO_2 concentrations, and detecting a thin ozone layer and water vapor concentrations near the Tharsis region (1974)
12th History: Sikhote Alin meteorite fall in Russia, one of the largest modern falls at 28 tons (1947)
13th First Quarter Moon
14th History: flyby of Comet *Tempel 1* by the Stardust spacecraft (2011)
14th History: NEAR-Shoemaker enters orbit around *Eros*, one of the largest of the near-Earth asteroids (2000)
14th History: Voyager 1 points its camera back towards the Sun and takes a family portrait, capturing six planets (Venus, Earth, Jupiter, Saturn, Uranus and Neptune) from a distance of approximately 4 billion miles; Mercury was too close to the Sun to be seen and Mars was lost in the scattered sunlight (1990)

Astronomical and Historical Events (continued)

14th History: launch of the Solar Maximum Mission (1980) to study the Sun during the peak of the solar cycle; a malfunction less than a year later cut the mission short. However, the satellite was recovered and repaired by the Space Shuttle Challenger in April 1984; operated successfully until burning up in the Earth's atmosphere in December 1989
14th History: launch of Luna 20, Soviet Moon sample return (1972)
14th History: launch of Syncom 1, the first geosynchronous satellite (1963)
15th History: meteor explodes over the Russian city of Chelyabinsk causing hundreds of minor injuries (2013)
15th History: discovery of Centaur Object *Chariklo* by Jim Scotti (1997)
15th History: flyby of the Moon by the Hiten spacecraft; Earth orbiting satellite designed by the Japanese Space Agency to test technologies for lunar and planetary missions (1992)
15th History: Pioneer 10 becomes the first spacecraft to traverse the Main Asteroid Belt (1973)
15th History: Galileo Galilei born (1564)
16th History: Gerard Kuiper discovers Uranus' moon *Miranda* (1948)
17th History: discovery of the Plutino *90482 Orcus* with its large moon, Vanth, by American astronomers Michael Brown of Caltech, Chad Trujillo of the Gemini Observatory, and David Rabinowitz of Yale University (2004)
17th History: Ann Harch discovers *Dactyl*, the first natural satellite of an asteroid (*Ida*) discovered from Galileo Images (1994)
17th History: launch of Ranger 8; lunar impact mission (1965)
17th History: launch of NEAR spacecraft, asteroid orbiter/lander; first of NASA's Discovery missions and the first mission to go into orbit around an asteroid (1996)
17th History: launch of Vanguard 2; designed to measure cloud-cover distribution over Earth (1959)
18th History: landing of the Mars 2020 Perseverance rover in Jezero crater (2021)
18th History: Mike Brown and Jean-Luc Margot's discovery of *Romulus*, the larger of two moon that orbit Asteroid 87 *Sylvia* (2001)
18th History: American astronomer Clyde Tombaugh discovers Pluto (1930)
19th Moon at perigee (closest distance from Earth)
19th Scheduled launch of an uncrewed Russian Soyuz spacecraft (MS-23) from the Baikonur Cosmodrome, Kazakhstan to the International Space Station as a replacement for the damaged Soyuz MS-22 spacecraft docked to the space station
19th History: Nicolas Copernicus born (1473)
20th New Moon
20th History: Clementine spacecraft enters lunar orbit and starts photographic survey; joint project between the Strategic Defense Initiative Organization and NASA, first of a new class of small spacecraft to enable long-duration, deep space missions at low cost using lightweight satellite technology (1994)
20th History: launch of the core module of the Soviet space station Mir (1986)
20th History: launch of Mercury-Atlas 6 and Friendship 7 with astronaut John Glenn; first American in orbit (1962)
21st History: launch of Israel's SpaceIL, privately-funded, lunar lander aboard a SpaceX Falcon 9 rocket from the Cape Canaveral Air Force Station, Florida
21st History: Soviet moon rocket (N-1) explodes during first test flight (1969)
22nd History: launch of Viking, Sweden's first satellite (1986)

Astronomical and Historical Events (continued)

22nd History: launch of Soviet spacecraft Kosmos 110, with dogs Veterok and Ugolyok (1966)
22nd History: Max Wolf discovers asteroid 588 *Achilles* – the first Trojan asteroid (1906)
23rd History: Supernova 1987A detected in the Large Magellanic Cloud (1987)
24th History: launch of the Space Shuttle Discovery (STS-133) on its final mission. The shuttle delivered space parts and critical components to the ISS (2011)
24th History: launch of Mariner 6; Mars flyby mission returned images showing the south polar cap as being composed predominantly of carbon dioxide; refined estimates of the mass, radius and shape of Mars (1969)
24th History: Jocelyn Bell announces discovery of rapidly rotating radio sources, later determined to emanate from neutron stars or pulsars (1968)
24th History: launch of Bumper WAC, first two-stage liquid-propellant rocket and the first human-made object to achieve hypersonic speeds (1949)
25th History: flyby of Mars by the Rosetta spacecraft (2007)
25th History: Soviet spacecraft Luna 20 returns lunar soil sample (30 grams) to Earth (1972)
26th Scheduled launch of a SpaceX Crew Dragon from the Kennedy Space Center, Florida, to the International Space Station
26th History: launch of the first Saturn 1B rocket booster (1966)
26th History: original crew of Gemini 9, Elliot See and Charles Bassett killed in plane crash at the McDonnell Aircraft building in St. Louis (1966)
27th Last Quarter Moon
27th History: discovery of Jupiter's moon Herse was by Brett J. Gladman, John J. Kavelaars, Jean-Marc Petit, and Lynne Allen (2003)
28th History: flyby of Jupiter by the New Horizons spacecraft bound for Pluto (2007)
28th History: launch of Discoverer 1; first of a series of satellites which were part of the Corona reconnaissance satellite program and first satellite launched into polar orbit (1959)

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
- 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

Commonly Used Terms

- 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 (½°), 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 Starlink Satellites

Visit www.heavens-above.com for the times of visibility and detailed star charts for viewing the International Space Station and the bright flares from Iridium satellites.

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

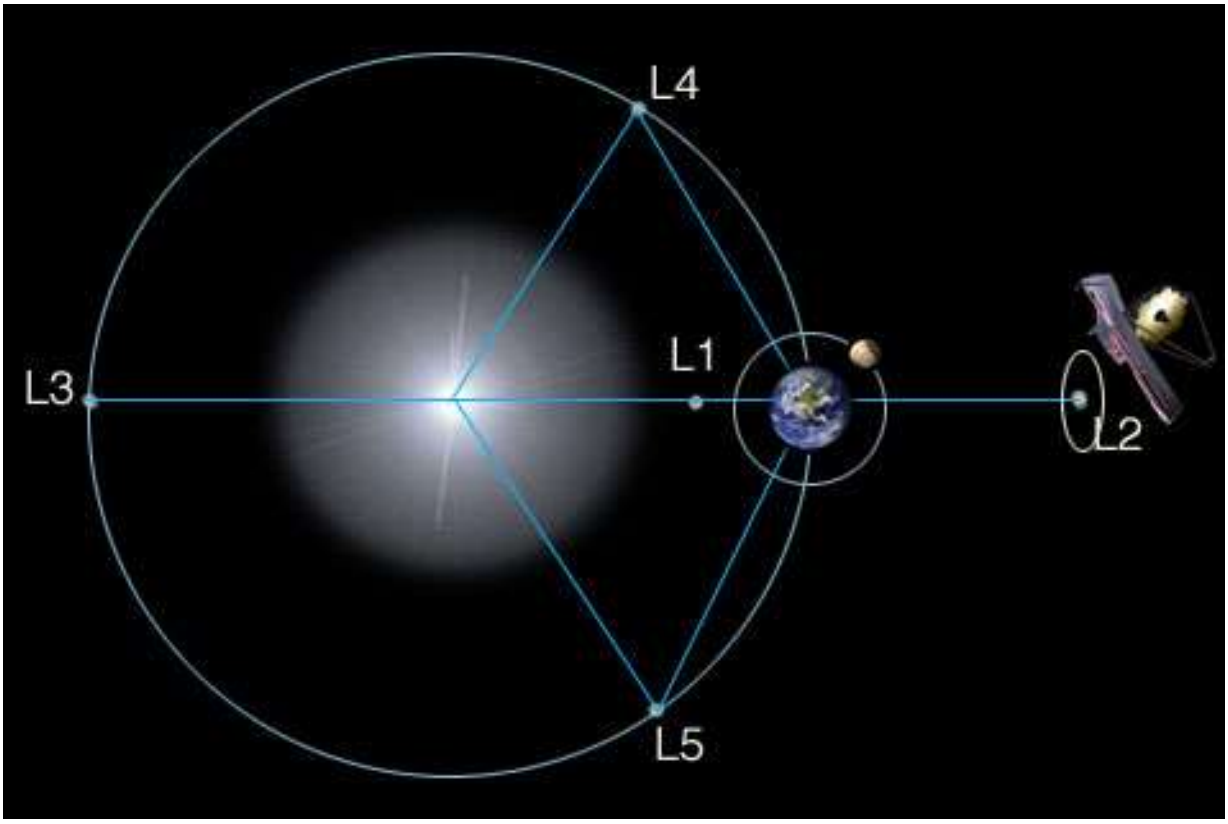
Mars 2020 (Perseverance rover): https://mars.nasa.gov/mars2020/

Mars Helicopter (Ingenuity): https://mars.nasa.gov/technology/helicopter/

Mars Science Laboratory (Curiosity rover): https://mars.nasa.gov/msl/home/

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

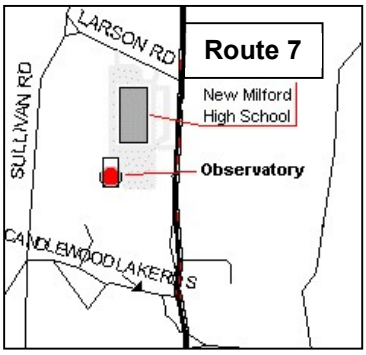
https://webb.nasa.gov/index.html

Contact Information

The John J. McCarthy Observatory
P.O. Box 1144
New Milford, CT 06776

New Milford High School
388 Danbury Road
New Milford, CT 06776

Phone/Message: (860) 946-0312
www.mccarthyobservatory.org



	www.mccarthyobservatory.org
	@McCarthy Observatory
	@McCarthy Observatory
	mccarthy.observatory@gmail.com
	@JJMObservatory
	@mccarthy.observatory