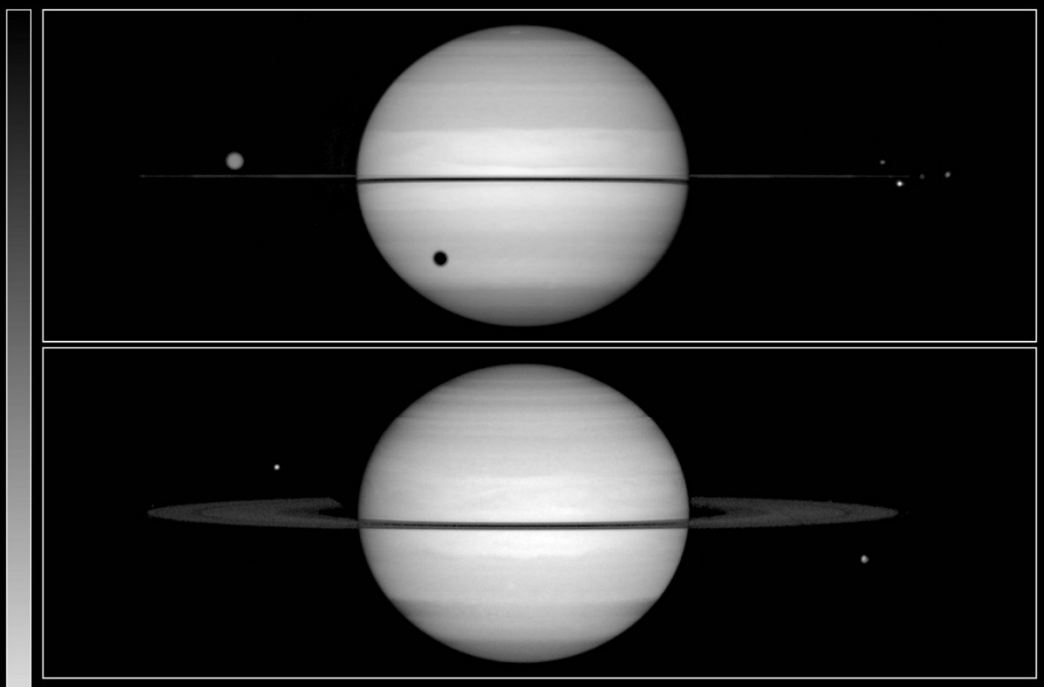
Galactic Observer

John J. McCarthy Observatory

Volume 18, No. 3 March 2025



Saturn Ring-Plane Crossing

Hubble Space Telescope · Wide Field Planetary Camera 2

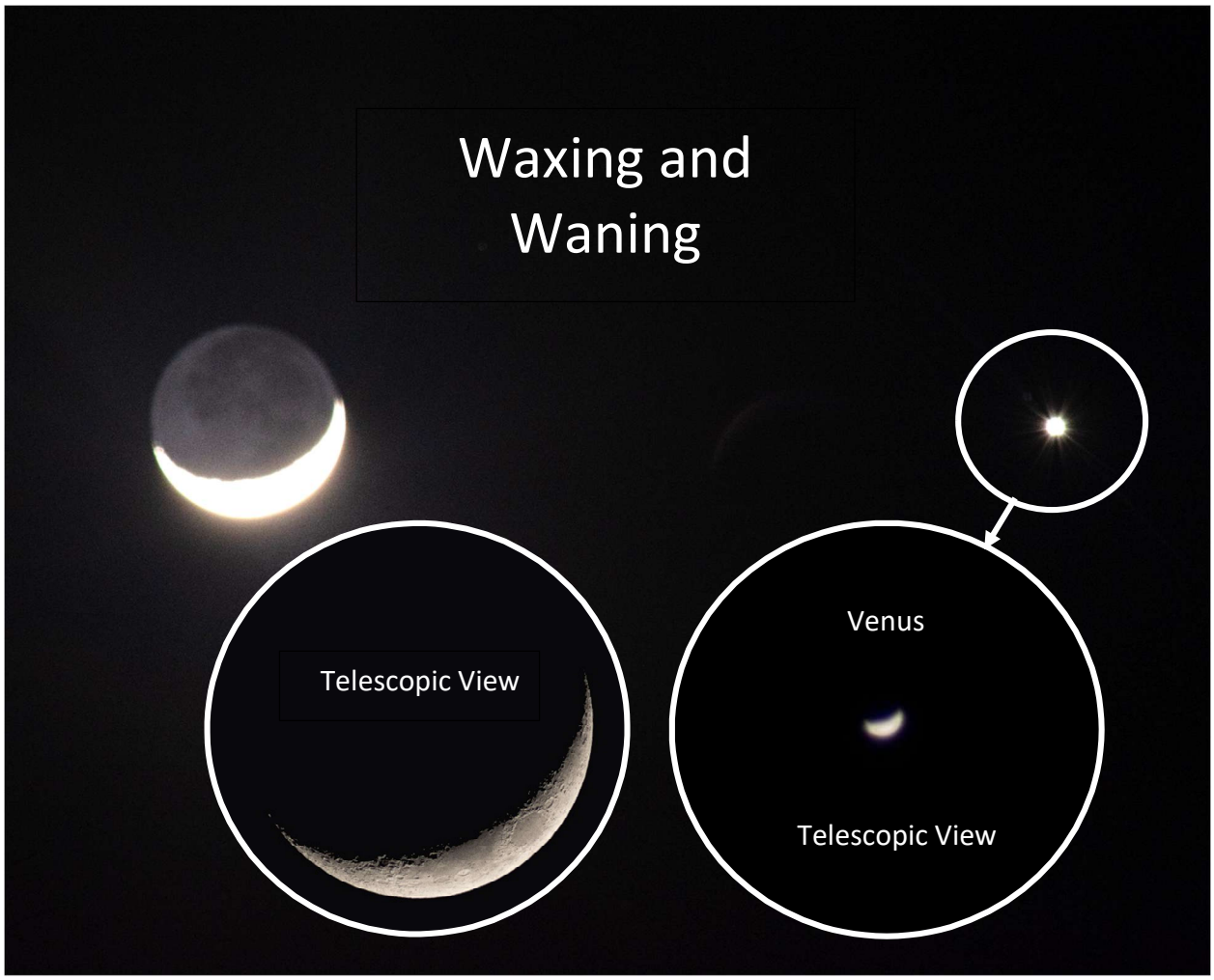
PRC96-16 · ST ScI OPO · April 24, 1996 · E. Karkoschka (LPL) and NASA

Saturn's axis is tilted by 26.7° with respect to its orbit around the Sun, as are its rings. On average, every 15 years or so Earth crosses Saturn's ring-plane. At that time, the rings appear edge-on to us. The "disappearance" of the rings provides an opportunity for astronomers to hunt for faint moons that would otherwise be lost in the glare of the rings. Unfortunately, at the time of the March 2025 ring crossing, Saturn will only be 10° west of the Sun and therefore not observable.

The Hubble Space Telescope's images of Saturn were taken on August 6th (top) and November 17th (bottom) in 1995 with the Wide Field Planetary Camera-2, shortly after ring-plane crossing in May. In the top image, Titan, Saturn's largest moon, casts a shadow on the planet. The four moons to the right of the ring (from left to right) are Mimas, Tethys, Janus, and Enceladus. In the bottom image, the moon Dione is on the lower right while Tethys is upper left.

Credit: Erich Karkoschka (University of Arizona Lunar & Planetary Lab) and NASA

March Astronomy Calendar and Space Exploration Almanac



On the evening of February 1st, a waxing crescent Moon slid alongside the planet Venus as the pair began to set in the western sky. The Moon was 15% sunlit which, when overexposed, revealed the remaining lunar disk illuminated only by the reflected light from the Earth.

Venus, the second brightest object in the night sky (only the Moon is brighter), was at magnitude -4.76 that evening. Through a telescope, the planet also displayed a crescent shape.

Venus was brightest on February 14th. Its profile will continue to grow as it moves closer to the Earth. The sunlit crescent will continue to thin until it passes between the Earth and Sun on March 22nd (Inferior Conjunction) before disappearing from our view. It will then move into the morning sky with the sunlit portion growing (waxing phase) as it moves away from Earth.

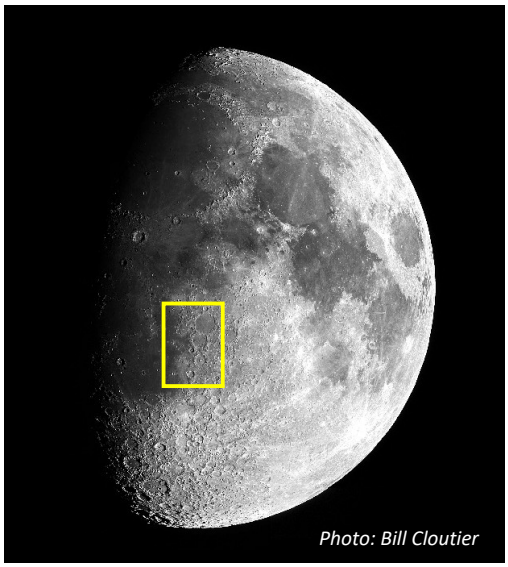
Images: Bill Cloutier

In This Issue

"Out the Window on Your Left"

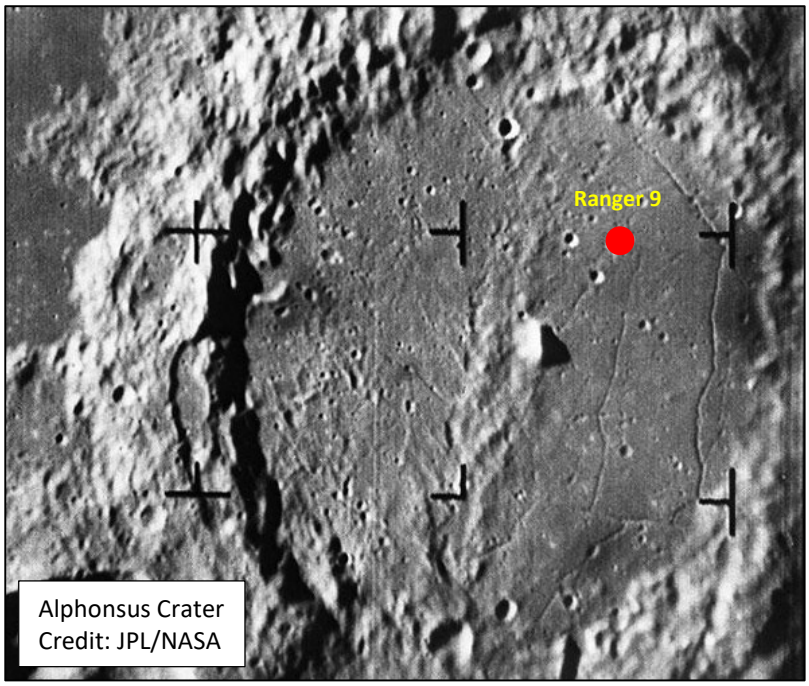
It's been more than 52 years since Apollo astronaut Gene Cernan left the last boot print on the Moon's surface. As a nation founded on exploration and the conquest of new frontiers, today's commitment to return to the Moon has been as fleeting as the funding. But what if the average citizen had the means 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).

In the early 1960s, NASA embarked on an ambitious program to develop the technologies needed to reach the Moon, including launch, spacecraft stabilization, cis-lunar navigation and precision targeting. The program would involve three different spacecraft, each with a specific mission profile. The first, using the Ranger spacecraft, was designed to relay pictures and other data as the spacecraft approached the Moon and on its way down to the surface before crash landing. Nine Ranger missions were launched with only the last three being successful. Ranger 9, launched in March 1965, was the last. Its target was Alphonsus, a 75-mile-diameter (90-km) crater located to the east of Mare Nubium in the south-central region of the near side.



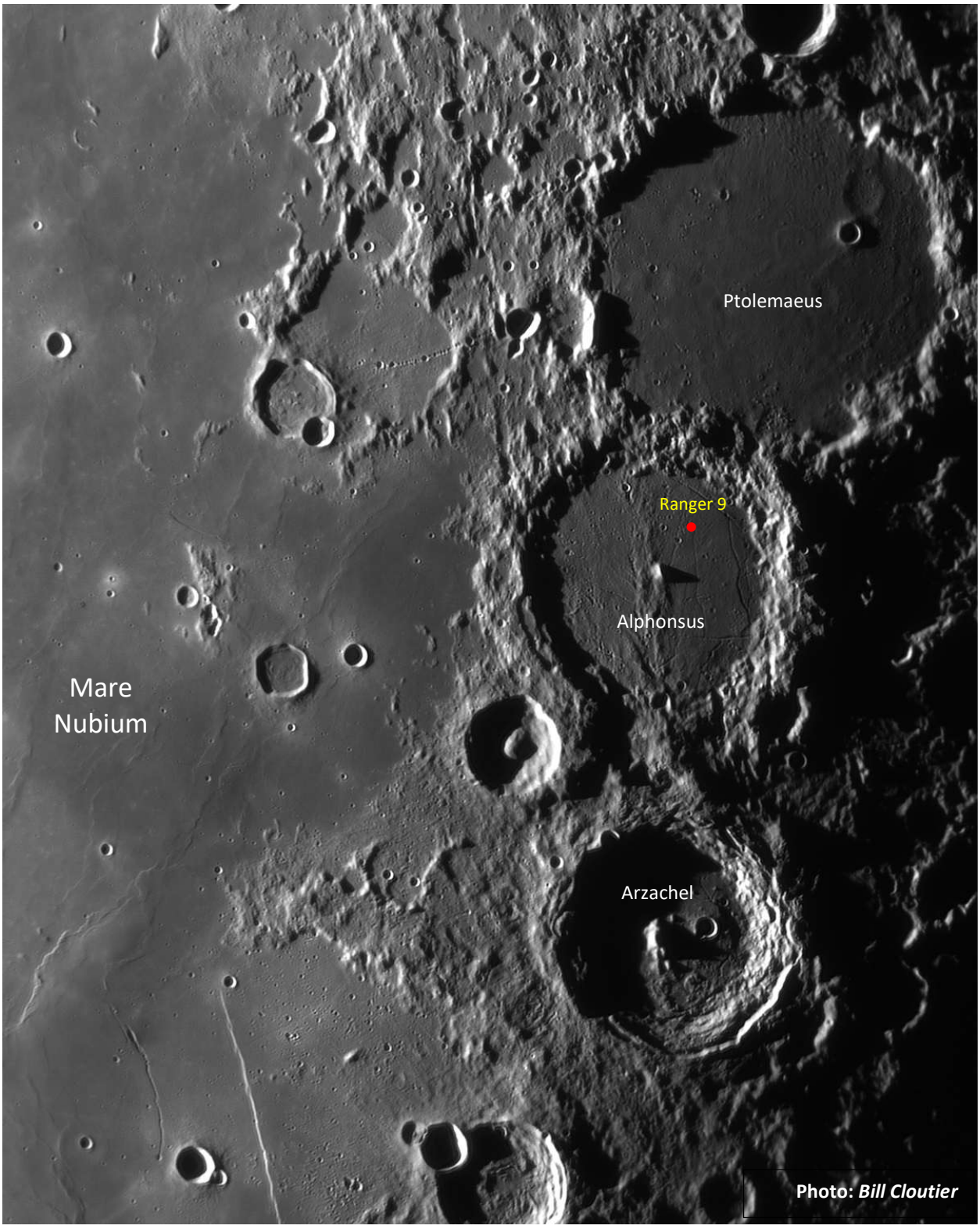
Ranger 9's cameras were powered up 18½ minutes prior to impact at an altitude of 1,476 miles (2,376 km). A stream of images was returned to the controllers at NASA's Jet Propulsion Laboratory with 5,814 images received prior to impacting the surface at a speed of almost 6,000 mph (2.671 km/s). The spacecraft's cameras imaged over 600,000 square miles of the lunar surface (1.6 million square km) on its descent with the last image sent from a height of only 2,000 feet (610 meters). It displayed details as small as 10 inches (25 cm).

The Ranger 9 image of Alphonsus crater (right) was taken about 3 minutes prior to impact. The impact site is marked with a red circle. The crater was of particular interest to scientists with its numerous rilles (channels) and dark halos around the cratered floor, which were believed to be cinder cones and evidence of volcanic activity.



The skills acquired from the Ranger program would further the Lunar Orbiter and Surveyor missions that followed.

Ptolemaeus, Alphonsus and Arzachel Craters
and Crash Landing Site of Ranger 9



35 Years Ago

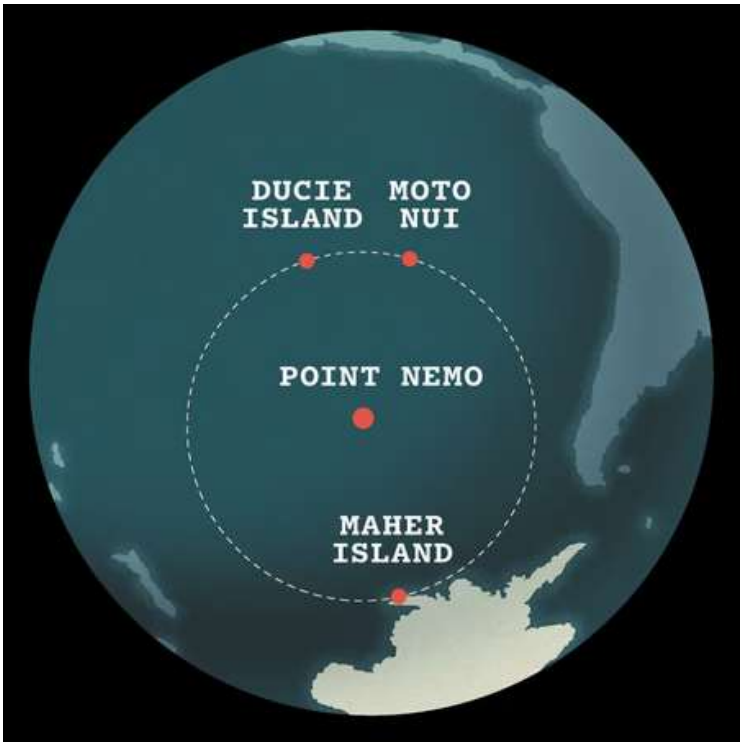
Thirty-five years ago, Voyager 1 would take its last photograph as it turned off its camera to conserve power and head out of our solar system. One of the last images transmitted to Earth was dubbed "the Pale Blue Dot." A fraction of a bright pixel, imbedded in scattered sunlight, captured Earth as seen from a distance of more than 4 billion miles away.

Voyager 1 was launched from the Kennedy Space Center on August 20, 1977, 16 days after its twin Voyager 2. Flying by Jupiter in 1979, and Saturn in 1980, the spacecraft is now more than 15 billion miles (25 billion km) from Earth, traveling at 38,000 mph (17 kps) with respect to the Sun. Voyager 1 crossed into interstellar space in August 2012, a region outside the influence of the Sun's magnetic field.

Four of its eleven instruments are still powered on, but with the energy from its radioisotope thermoelectric generators diminishing, NASA engineers expect that its remaining science instruments will be shutdown soon, although engineering data could still be received for another ten years, as long as the spacecraft has enough power to transmit the data.

Water World

About 71% of the Earth's surface is covered with water, although most images from space tend to focus on the land masses. The image released by ispace's *Resilience* lander as it slowly spirals away from Earth and towards the Moon brings our ocean world into the spotlight. Taken from a distance of 6,000 miles (10,000 km), Resilience's camera captured the whimsical "Point Nemo." Located in the middle of the Pacific ocean and 1,670 miles (2,688 km) from the nearest spit of land, this spot is the most remote place on the planet.



Named for a character from Jules Verne's "Twenty Thousand Leagues Under the Sea," Point Nemo is closer to the astronauts on the space station than other humans on Earth. With Ducie Island to the north; Motu Nui to the northeast and Maher Island, part of Antarctica, to the south, set your ship's course to 45º52.6S, 123º23.6W to visit this fanciful spot in the ocean.

Total Lunar Eclipse

The November 19, 2021 Partial Lunar Eclipse was one of the deepest and longest lasting with more than 95% of the lunar disk within the Earth's shadow. Photo: Bill Cloutier

It has been almost three years since a Total Lunar Eclipse was visible from our location. The cosmic drought ends on March 14th when the Full Moon will enter the Earth's shadow or umbra around 1:09 a.m. EDT with totality beginning at 2:26 a.m. Mid-eclipse will occur at 2:59 a.m. when the Moon is deepest into the shadow. Totality will end around 3:32 a.m. as the Moon exits the umbra with the partial phase (penumbra transit) continuing until 4:48 a.m.

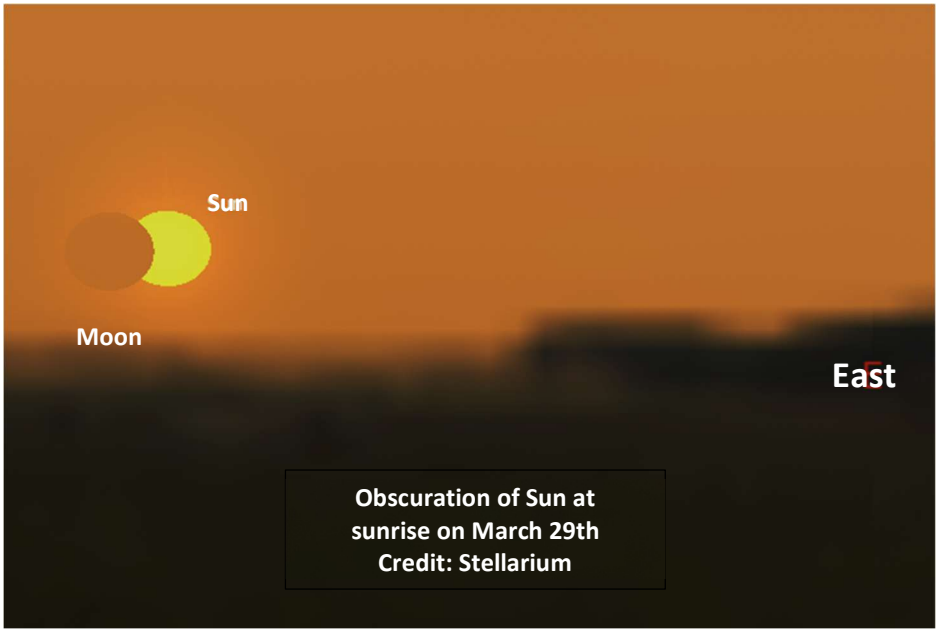
The Moon will pass above the center of Earth's umbra so, for the March eclipse, the northern portion of the Moon should be brighter, being closest to the edge of the shadow.

Partial Solar Eclipse

Two weeks after the Total Lunar Eclipse, the Moon will partially obscure the Sun as it rises on morning of March 29th. Approximately 24% of the Sun will be covered at sunrise with the Moon slowly moving away and to the east as Sun gets higher in the sky.

Partial Solar Eclipse at Sunrise
June 10, 2021
Photo: *Bill Cloutier*

Sunrise in New Milford on the 29th is at 6:41 a.m. The Moon will clear the solar disk shortly after 7 a.m., so a clear horizon to the east will be required to catch this brief event (as well as a cloudless sky).



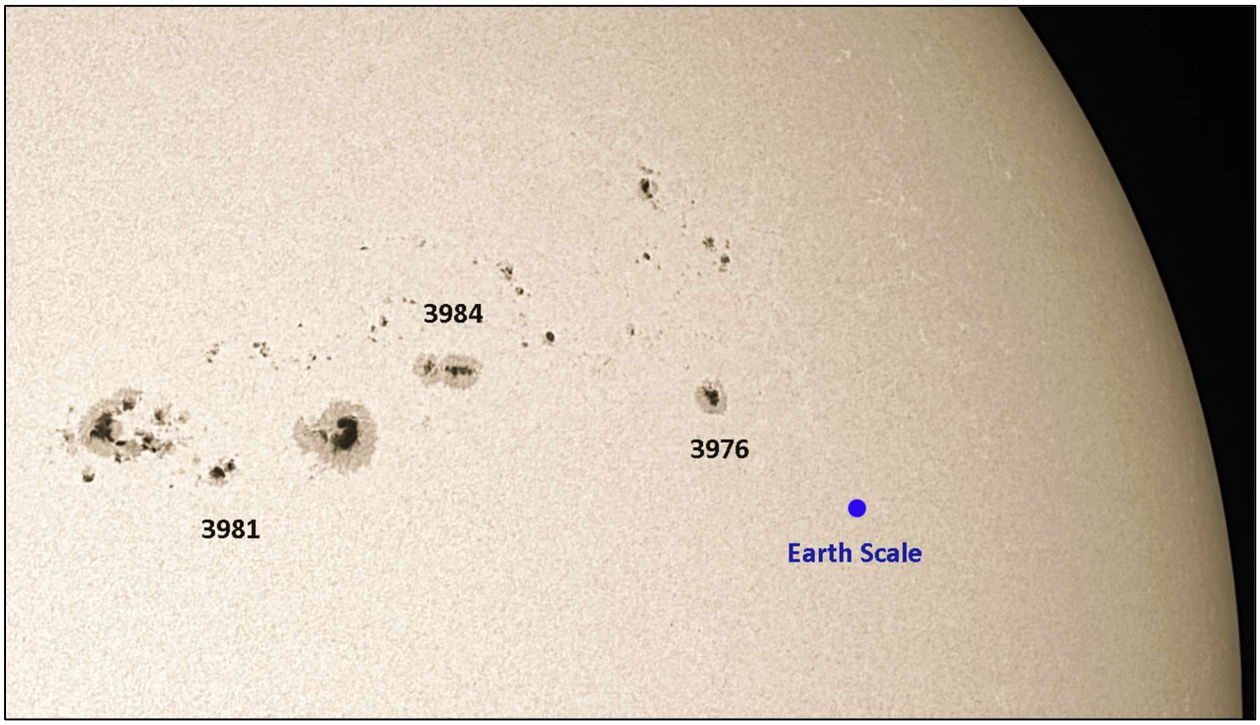
Obscuration of Sun at sunrise on March 29th
Credit: Stellarium

With any occurrence involving observation of the Sun, filters and proper eye protection are required to avoid permanent damage.

Solar Activity

A massive sunspot complex (3976-3981) rotated into view during the first week of February. Comprised of more than 3 dozen dark cores and spanning more than 300,000 miles (500,000 km) across the Sun's photosphere, the most active sunspot (3981) unleashed more than 20 M-class solar flares with several approaching X-class. Few were accompanied by coronal mass ejections and those that did were not Earth-directed.

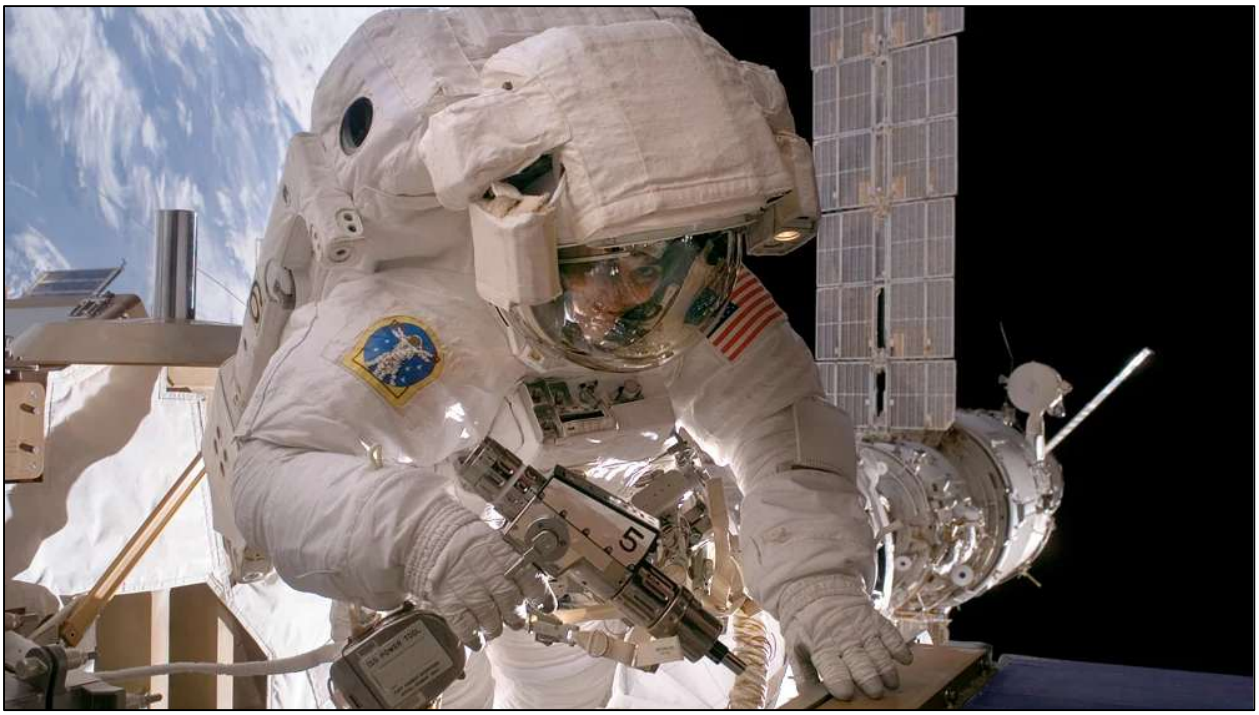
The solar images were captured on February 5th. By the end of the week, the sunspot complex had decayed so that it no longer posed a threat for X-class solar flares.



Solar images were captured with the McCarthy Observatory's 4.25 inch antique refractor, with multiple images used to create the mosaic of the full Sun

Credit: Bill Cloutier

New Spacewalk Record



NASA Astronaut Suni Williams performing maintenance activities outside the ISS
Credit: NASA

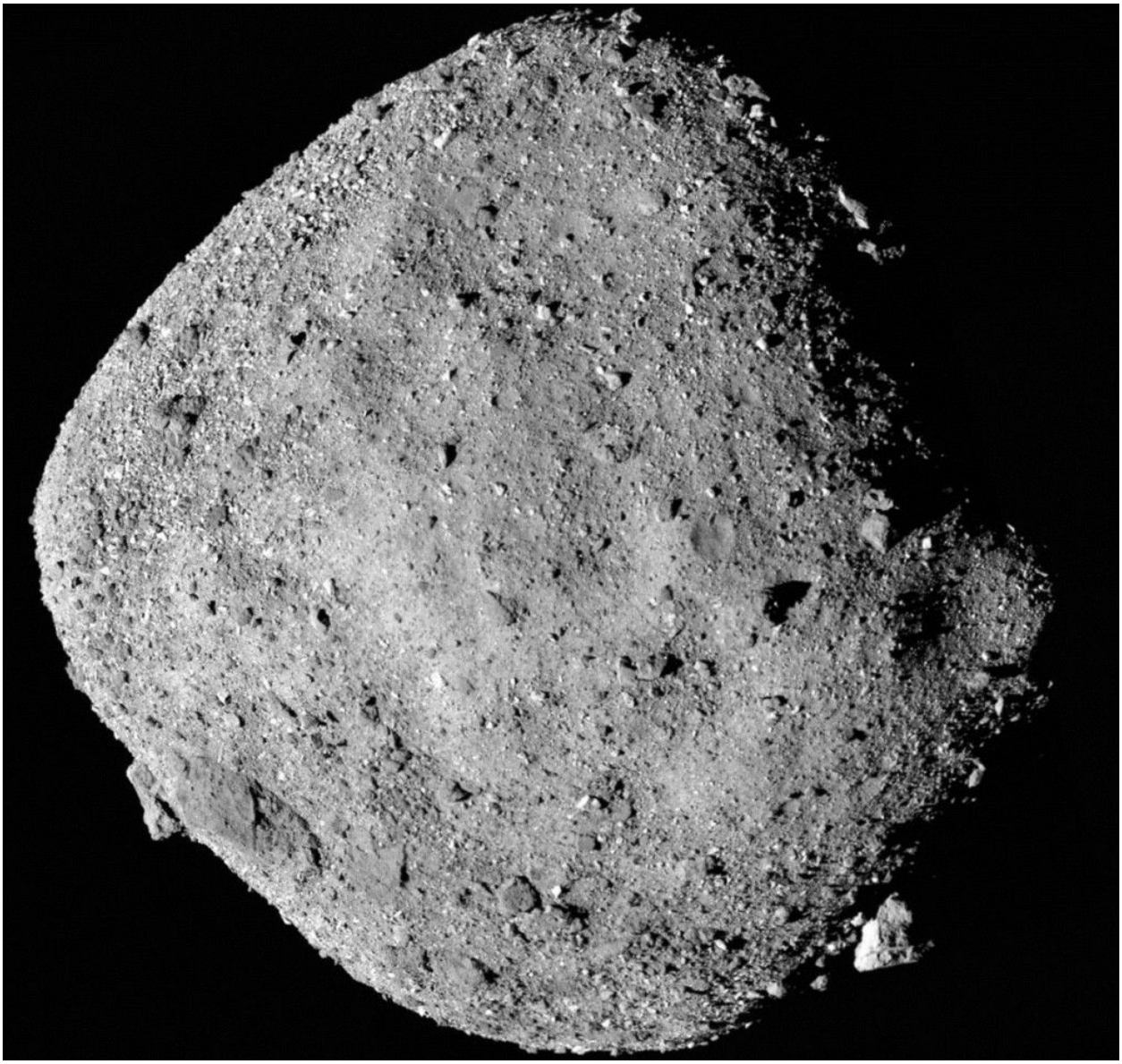
NASA astronaut Suni Williams never expected to be on the International Space Station (ISS) in 2025, not to mention becoming part of the Expedition 72 crew, or assuming command of the ISS for the second time. However, due to anomalies that were discovered in the Boeing Starliner's propulsion system on the trip to the ISS, NASA decided to err on the side of caution and bring back the Starliner capsule without the crew.

In August 2024, NASA announced that Williams and Butch Wilmore (the two Starliner astronauts) would remain on the ISS and join the Expedition 71/72 crew. They would then fly home aboard the Dragon spacecraft *Freedom* (which is currently parked at the ISS) along with the two crew members that arrived in September aboard Freedom (the SpaceX Crew-9 mission).

Since the decision was made to keep the Starliner astronauts on station, Suni and Butch have been busy supporting ISS operations, station research and conducting maintenance activities. This included a 6 hour spacewalk on January 16th and a 5½ hour spacewalk on January 30th by Williams, bringing her total to nine spacewalks since joining NASA in 1998. By the end of January, Williams had accumulated a total time of 62 hours and 6 minutes in the vacuum of space, the most by a woman and forth overall by any astronaut/cosmonaut.

The return of the Starliner astronauts (and Crew 9) has been delayed by SpaceX, with the processing of a new Dragon spacecraft for Crew 10 taking longer than expected (crew rotation is the normal protocol for ISS operations). Recently, NASA and SpaceX decided to swap out the new Dragon with a previously flown spacecraft (pending recertification). This could allow the astronauts to come home as early as mid-March assuming a timely launch and expedient handover of station operations to Crew 10 members.

Results of Bennu Sample Analysis



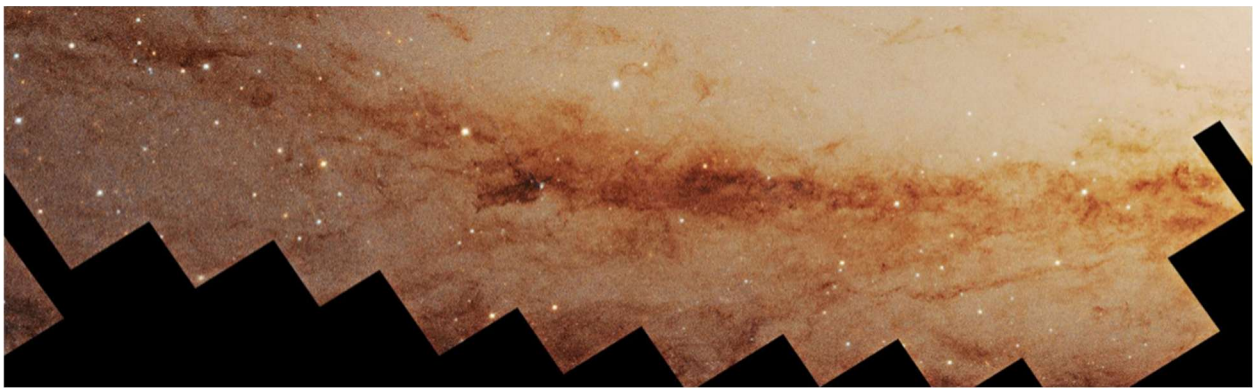
OSIRIS-REx spacecraft's view of asteroid Bennu
Credit NASA/Goddard/ University of Arizona

The results of the first in-depth analysis of the sample extracted from the asteroid Bennu have been released. The sample was collected from the carbon-rich asteroid by NASA's OSIRIS-REx spacecraft in October 2020 and returned to Earth in September 2023.

While the mission was not designed to detect life, the portion of the 120 grams of regolith examined contain the building blocks necessary for life, as well as evidence of an ancient wet environment in which life could have developed (determined from the trace minerals present in the sample that form when water containing dissolved salts evaporates). The most compelling evidence was the detection of amino acids, which life on Earth uses to make proteins, and a high abundance of ammonia, which can react with formaldehyde (also detected), to form complex molecules. However, unlike on Earth where life produces almost entirely "left-handed" shaped amino acids, the Bennu sample contains an equal mixture of both left and right handed varieties.

Andromeda Galaxy Mosaic

Andromeda Galaxy Mosaic (above) and M32 satellite dwarf galaxy (middle) and a close up of a dust lane (below)
Credit: NASA, ESA, Benjamin F. Williams (UWashington), Zhuo Chen (UWashington), L. Clifton Johnson (Northwestern); Image Processing: Joseph DePasquale (STScI)



NASA's Hubble Space Telescope team has released a stunning mosaic of the Andromeda Galaxy, the largest, closest spiral galaxy to our own Milky Way Galaxy. The galaxy, 2.5 million light years from Earth, covers an area six times the apparent diameter of the full Moon in our sky and is visible to the unaided eye from dark sites. Our view of Andromeda from Earth is almost edge-on, with just enough tilt so that that the galaxy's spiral structure can be seen, as well as the dust lanes and bright central core. A gargantuan black hole resides at its center with an estimated mass 140 million times greater than that of our Sun.

The final image, comprising at least 2.5 billion pixels, is the result of two observing programs, over 1,000 Hubble orbits, and 7,398 exposures over a ten year span. Over 200 million stars can be resolved within the image out of an estimated total population of 1 trillion stars.

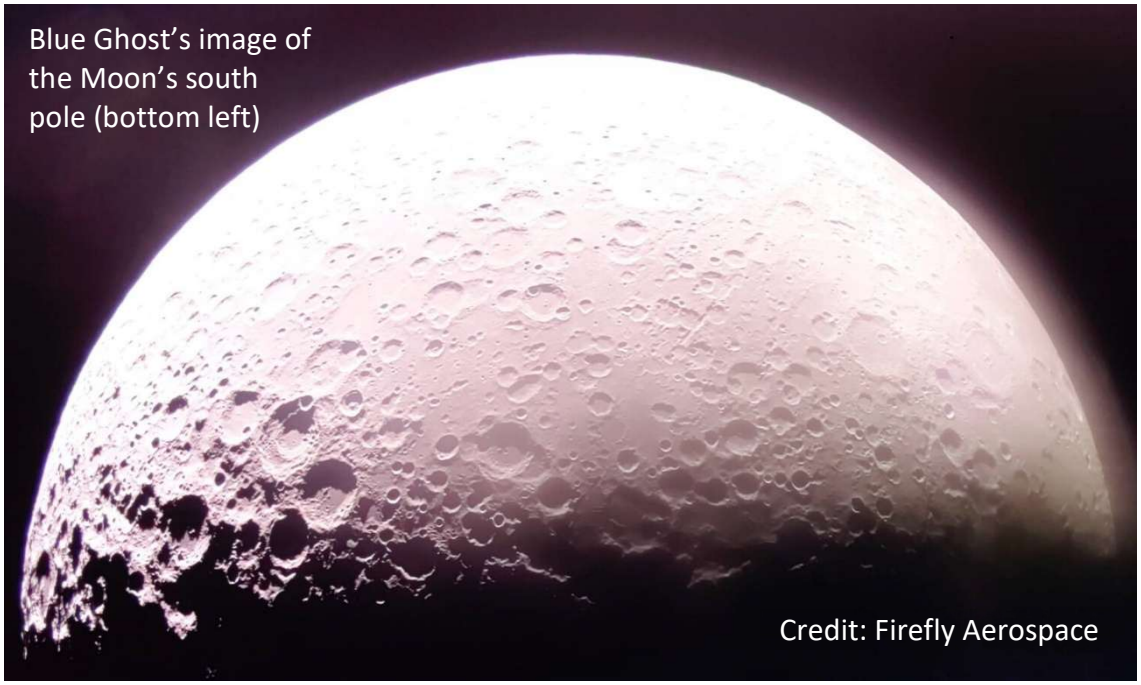
Cis-Lunar Traffic Report

In the next few weeks, there could be two new lunar landers operating on the Moon's surface with another lander, as well as an orbiter, in transit.

Firefly's *Blue Ghost* lunar lander and ispace's *Resilience* lunar lander shared a ride into orbit on January 15th atop a SpaceX Falcon 9 rocket. Blue Ghost spent the first 25 days of the mission in Earth orbit before heading to the Moon. The company confirmed that the craft successfully entered lunar orbit on February 13th. Landing is scheduled for March 2nd in Mare Crisium, near a volcanic feature called Mons Latreille, shortly after local sunrise. Payload operations are expected to continue throughout the lunar day (about 14 Earth-days). As night falls, the lander will capture imagery of the sunset and, while operating for several hours into the night, provide data on the transition to a nocturnal lunar environment.

The Resilience lunar lander is taking a low-energy trajectory to the Moon and not expected to enter lunar orbit until early May. On February 14th the lander flew by the Moon, passing about 5,200 miles (8,400 km) above its surface in a long, looping orbit that will take it almost 700 thousand miles (1.1 million km) from Earth before returning to rendezvous with the Moon. While a landing date has not been announced, the targeted landing area will be within the Mare Frigoris region. Its payload includes the "TENACIOUS" micro rover.

Intuitive Machines' (IM) *Athena Lander* and NASA's *Lunar Trailblazer* also shared a ride into orbit on a Falcon 9. IM's lunar lander is expected to set down on the rim of Shackleton Crater, near the Moon's south pole, around March 6th. Its payloads include a drill and mass spectrometer. The Lunar Trailblazer will also take a low-energy trajectory, which could take between four and seven months using the gravity of the Sun, Earth and Moon to minimize fuel consumption, before the 440 pound (200 km) spacecraft enters orbit 60 miles (100 kilometers) above the Moon's surface. Its orbit will allow the spacecraft's instruments to scan the permanently shadowed regions of the craters at the Moon's south pole where ice is suspected to exist.



Asteroid Watch

Asteroid 2024 YR4 was discovered by the Asteroid Terrestrial-impact Last Alert System (ATLAS) on December 27, 2024, just days after it made a close pass of the Earth. The asteroid has an Earth-crossing orbit (Apollo class) and is estimated to be between 130 and 300 feet in size (40 to 90 meters).

When first discovered, the odds of asteroid 2024 YR4 hitting the Earth on December 22, 2032 were only 1%, not unusual for a newly detected object with limited observations from which to determine its orbit. However, with addition observations, the odds began to increase rather than decrease, while still remaining very low. On January 29th, after the odds passed the one percent threshold, the International Asteroid Warning Network sent out a "Potential Impact Warning." By mid-February, NASA's Center for Near Earth Object Studies (CNEOS) has increased the probability to over 3% based on 370 observations over a 55 day period before dropping the risk back to near zero a week later as more data became available.

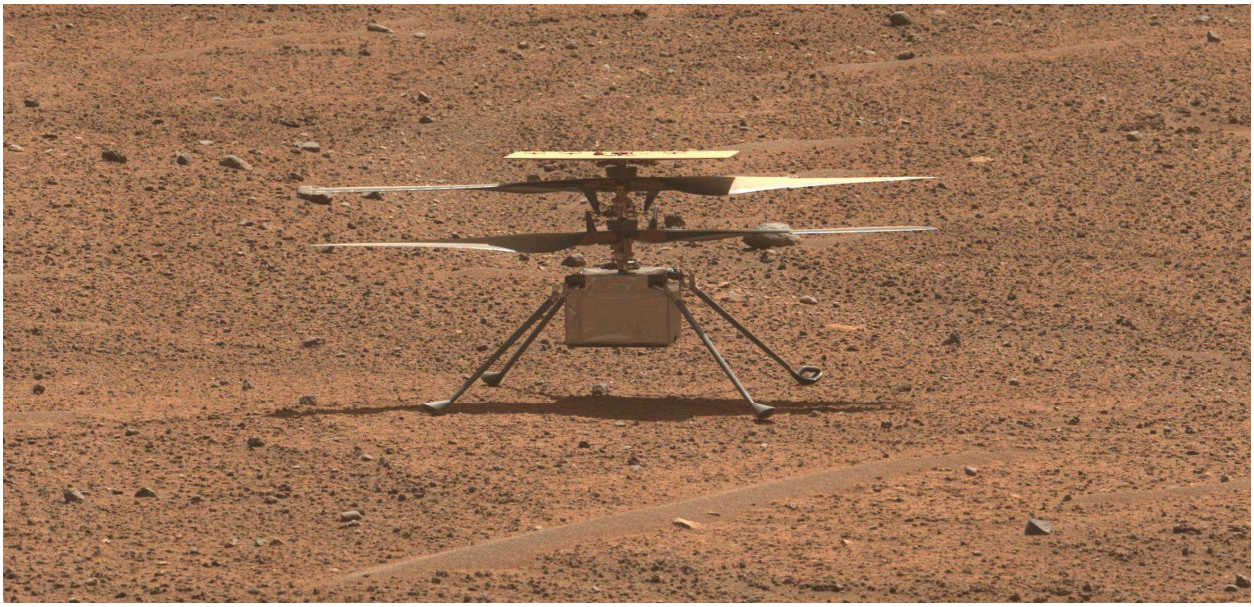
No Hazard (White Zone)	**0**	The likelihood of a collision is zero, or is so low as to be effectively zero. Also applies to small objects such as meteors and bodies that burn up in the atmosphere as well as infrequent meteorite falls that rarely cause damage.
Normal (Green Zone)	**1**	A routine discovery in which a pass near the Earth is predicted that poses no unusual level of danger. Current calculations show the chance of collision is extremely unlikely with no cause for public attention or public concern. New telescopic observations very likely will lead to re-assignment to Level 0.
Meriting Attention by Astronomers (Yellow Zone)	**2**	A discovery, which may become routine with expanded searches, of an object making a somewhat close but not highly unusual pass near the Earth. While meriting attention by astronomers, there is no cause for public attention or public concern as an actual collision is very unlikely. New telescopic observations very likely will lead to re-assignment to Level 0.
	3	A close encounter, meriting attention by astronomers. Current calculations give a 1% or greater chance of collision capable of localized destruction. Most likely, new telescopic observations will lead to re-assignment to Level 0. Attention by public and by public officials is merited if the encounter is less than a decade away.
	4	A close encounter, meriting attention by astronomers. Current calculations give a 1% or greater chance of collision capable of regional devastation. Most likely, new telescopic observations will lead to re-assignment to Level 0. Attention by public and by public officials is merited if the encounter is less than a decade away.
Threatening (Orange Zone)	**5**	A close encounter posing a serious, but still uncertain threat of regional devastation. Critical attention by astronomers is needed to determine conclusively whether or not a collision will occur. If the encounter is less than a decade away, governmental contingency planning may be warranted.
	6	A close encounter by a large object posing a serious but still uncertain threat of a global catastrophe. Critical attention by astronomers is needed to determine conclusively whether or not a collision will occur. If the encounter is less than three decades away, governmental contingency planning may be warranted.
	7	A very close encounter by a large object, which if occurring this century, poses an unprecedented but still uncertain threat of a global catastrophe. For such a threat in this century, international contingency planning is warranted, especially to determine urgently and conclusively whether or not a collision will occur.
Certain Collisions (Red Zone)	**8**	A collision is certain, capable of causing localized destruction for an impact over land or possibly a tsunami if close offshore. Such events occur on average between once per 50 years and once per several 1000 years.
	9	A collision is certain, capable of causing unprecedented regional devastation for a land impact or the threat of a major tsunami for an ocean impact. Such events occur on average between once per 10,000 years and once per 100,000 years.
	10	A collision is certain, capable of causing global climatic catastrophe that may threaten the future of civilization as we know it, whether impacting land or ocean. Such events occur on average once per 100,000 years, or less often.

The Torino Scale, adopted by the IAU in 1999, is used to categorize potential Earth impact events. Asteroid 2024 YR4 was ranked as high as a level 3 before dropping back to 0. Credit NASA

While an impact or airburst could yield considerable blast damage, the relatively small size of this asteroid would keep the destruction localized. Should the impact probability ever rise above 10%, the UN-endorsed Space Mission Planning Advisory Group recommends terrestrial preparedness planning, which could also include consideration of options for deflecting the asteroid.

Astronomers will continue to monitor 2024 YR4 until it becomes too faint to observe from Earth (until its next encounter in 2028). A proposal from an international team of astronomers from institutions including ESA's Planetary Defense Office to use the James Webb Space Telescope has been approved with time allotted in early March and again in May. The space telescope will be able to refine the asteroid's size and composition by analyzing the heat emitted by the object.

Windy Planet



Ingenuity helicopter captured by the Perseverance rover
Credit: NASA/JPL-Caltech/ASU/MSSS

While NASA's Mars helicopter Ingenuity has been permanently grounded after a landing mishap, researchers have found a way to extrapolate wind speeds from two hours of flight time amassed over nearly three years and 72 flights.

Ingenuity was included with the Mars 2020 mission as a technology demonstration (to establish whether a rotorcraft could fly in Mars' rarefied atmosphere, which is more than 100 times thinner than Earth's at sea level). Built from off-the-shelf components and designed for a 30-day test period, Ingenuity did not carry any scientific instruments capable of measuring wind speeds. It did, however, record and transmit its orientation or attitude, including yaw, pitch, and roll for navigation purposes.

A helicopter generates forward motion, in part, by tilting into the direction of thrust. The stronger the headwind, the greater the tilt needed. Researchers were able model this relationship to estimate both wind direction and speed encountered by Ingenuity during flight.

Ingenuity flew at altitudes up to 79 feet (24 meters). By comparison, the Perseverance rover's weather station has wind sensors, but only at a fixed altitude of 5 feet (1.5 meters) and with degraded performance (they were damaged several years ago by a dust-ladened wind gust).

Researchers were able to estimate the winds encountered by the rotorcraft across a range of altitudes. They found Mars to be a much windier place than expected with the strength and direction of the wind varying depending upon Ingenuity's altitude. Projected wind speeds for Ingenuity ranged from 9 to 54 miles per hour (4.1 to 24.3 meters per second). The variability in wind direction was attributed to the likely influence of local geological features within the crater.

Ingenuity's wind profile data can be used in modeling Mars' near-surface atmosphere, planning for the landing of future missions, and designing other flying aircraft to explore the Red Planet's challenging topography.

Mineral Moon

A single color shot of the Full Moon with the hue and saturation adjusted to accent the differences in mineral abundance. The blue color (most noticeable in Mare Tranquillitatis) is indicative of the high titanium oxide content, while the orange-red is from iron oxide. The light bronze in the lunar highland is due to the abundance of plagioclase feldspar. Photo: Bill Cloutier

If you take a high resolution photo of the Moon and examine it carefully, you will notice subtle differences in shading and intensity across the lunar surface, from the darker volcanic mare deposits to the lighter colored ancient cratered highlands. By adjusting the color settings (not adding color) in a photo processing program, the reflectance difference from the diverse mineral abundances becomes more apparent.

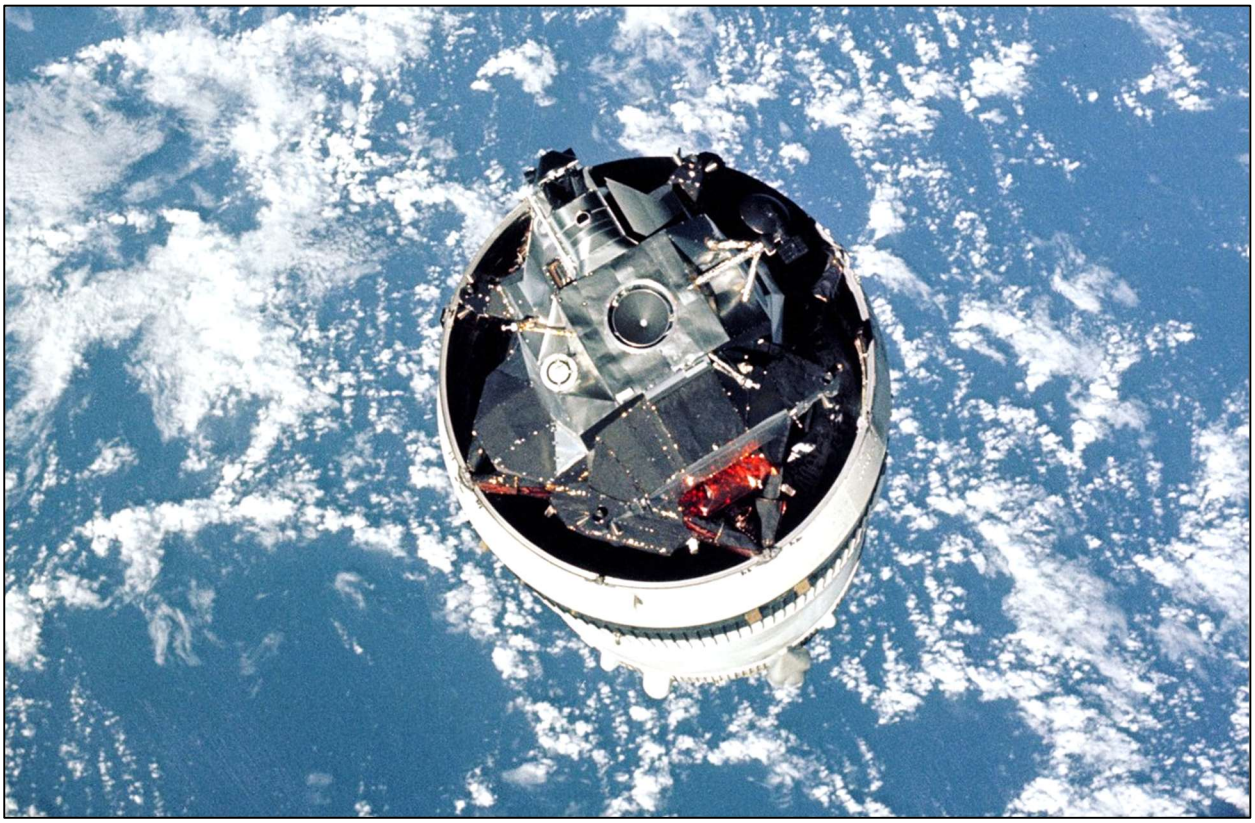
Flight of the Spider

The Apollo 9 mission was the first manned test flight of all the hardware needed for a lunar landing, including the lunar module. The Saturn V launched from the Kennedy Space Center on March 3, 1969 carried the record setting payload into low-Earth orbit. The mission was commanded by James McDivitt, with David Scott as the Command Service Module (CSM) Pilot and Russell Schweickart as the Lunar Module (LM) Pilot.

The Apollo 9 CSM taken from the window of the LM

Image: NASA

The crew would complete 152 orbits of the Earth, challenging the human physiology in ten days of weightlessness. During the first day on orbit, the CSM separated from the Saturn V's third stage. Turning around to face the rocket booster, the CSM docked with the LM nested inside. Using the CSM's thrusters, the joined pair moved a safe distance away. The third stage engine was then restarted to simulate a maneuver required for a deep space mission. It was eventually placed in a heliocentric orbit.



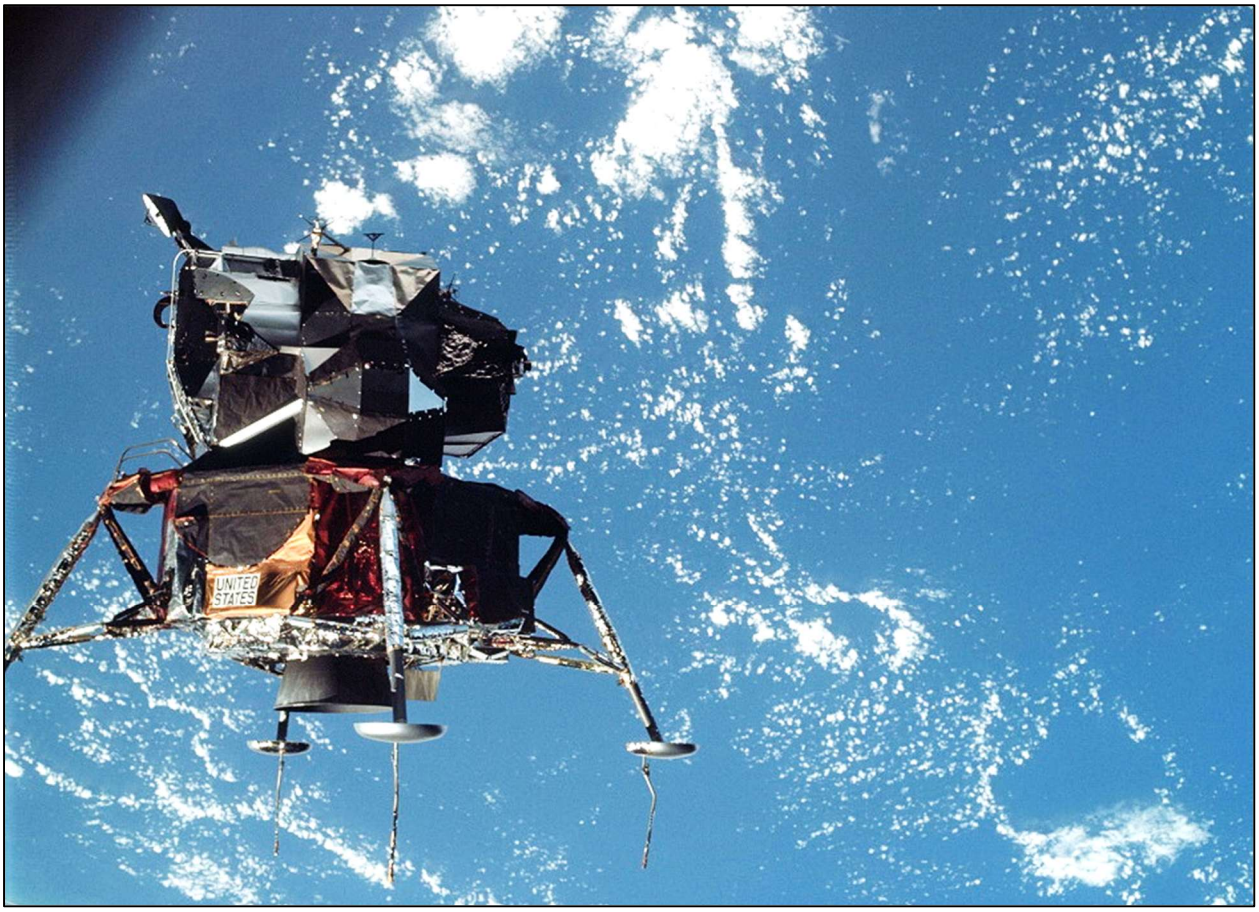
The Apollo 9 LM, nicknamed 'Spider,' shown in its launch position atop the Saturn V S-IVB third stage, its legs folded underneath. The image was taken from the CSM, nicknamed 'Gumdrop,' as it turned to face the LM. The conical drogue docking unit is visible at the top of the LM.

Image: NASA

The crew of Apollo 9 used the CSM's propulsion system to change orbit and test the structural integrity of the joined CSM and LM under load. On Flight Day 3, McDivitt and Schweickart entered the LM through a tunnel connecting the two vehicles to test fire the LM's descent engine before returning to the CSM. Schweickart's spacewalk scheduled for Flight Day 4 was cut short because of nausea. He did spend a short time outside the LM to check out the life support system backpack which the moonwalkers would use.

McDivitt and Schweickart would enter the LM again on Flight Day 5. This time the two vehicles separated, with the LM moving 113 miles away and 12 miles above the CSM. The descent stage of the LM was then jettisoned and the ascent stage engine fired for the first time. The ascent engine was used to lower the LM's altitude and rendezvous with the CSM. With docking and the transfer of McDivitt and Schweickart back into the CSM, the LM was jettisoned, its mission complete.

The crew of Apollo 9 accomplished all of the primary mission objectives, including rendezvous and docking of the two spacecraft, LM operations as a separate and independent spacecraft, transfer of the crew between the two spacecraft, a simulated rescue operation assuming a lunar landing abort, multiple restarts of the CSM's propulsion system (seven burns), and a full checkout of the CSM and LM systems. On Flight Day 10, the Command Module separated from the Service



A view of the free flying LM with its landing legs extended captured by David Scott who remained in the CSM while McDivitt and Schweickart checked out the LM. The Apollo 9 mission was the only time the LM flew in Earth orbit and would be photographed against a vibrant and colorful background rather than the stark lunar landscape.

Image: NASA

Module and reentered the Earth's atmosphere, splashing down in the Atlantic Ocean within three miles of the recovery ship, the USS Guadalcanal.

The near-Earth success of Apollo 9 would be repeated in lunar orbit by Apollo 10 in May of 1969, the precursor to the first Moon landing by the crew of Apollo 11 in July. Apollo 9 would also play a role in determining which astronaut would take that first step on Moon. McDivitt was originally selected to command Apollo 8, with the same mission objectives (full check out of the CSM and LM). However, the LM was behind schedule and wouldn't be ready, so NASA decided to send the Apollo 8 CM to the Moon without the LM.

McDivitt declined the command of Apollo 8's new mission (believing it was a publicity stunt), electing to trade places with the Apollo 9 crew, commanded by Frank Borman, in anticipation that the LM would be available for that flight. McDivitt's decision resulted in the swap of the backup crews for the two missions with Pete Conrad moving to command Apollo 12 rather than 11. Had McDivitt agreed to remain with Apollo 8, it's likely that Conrad would have taken the first step.

"The Times regrets the error"

Dr. Goddard with his liquid oxygen-gasoline rocket "Nell" in its launching frame on his aunt's farm in Auburn, MA

NASA photo

On March 16, 1926, in Auburn, Massachusetts, Robert Goddard launched the first liquid-fueled rocket on a flight that would last only 2½ seconds. A graduate of Worcester Polytechnic Institute, despite discharging a powder rocket from the basement of the physics building, the significance of Goddard's feat is compared by space flight historians to the first aircraft flight at Kitty Hawk. Among his achievements, Goddard was first to prove that rockets would work in a vacuum and to mathematically explore the practicality of using rocket propulsion to reach high altitudes and even the Moon (1912).

His revolutionary ideas on spaceflight were treated harshly by the press (a New York Times 1920 editorial suggested that "he only seems to lack the knowledge ladled out daily in high schools."). As such, Goddard retreated from the public eye, eventually moving his research on rockets to the New Mexico desert (he had been banished in 1929 from the farm fields of Auburn by the local fire marshal).

Between 1926 and 1941, Goddard and his team launched 34 rockets, achieving altitudes as high as 1.6 miles (2.6 km). He developed methods to control a rocket in flight using gyroscopes and steerable thrust. His patented inventions on multi-stage rockets and a liquid-fuel rocket in 1914 (Goddard is credited with 214 inventions) and his work as a theorist and engineer are considered significant to the advancement of spaceflight and Goddard is counted one of the founding fathers of modern rocketry. Before his death in 1945, he worked for the U.S. government on rocket research. NASA's Goddard Space Flight Center was named in his honor in 1959.

The location of the first liquid-fueled rocket flight is commemorated by granite markers erected on what is now the Pakachoag Golf Course, not far from where the Massachusetts Turnpike passes by the Auburn Mall heading east.

Forty-nine years after their mocking editorial, on July 17, 1969, the day after the launch of Apollo 11, the New York Times issued a correction stating that "Further investigation and experimentation have confirmed …it is now definitely established that a rocket can function in a vacuum as well as in an atmosphere," adding "The Times regrets the error."

Zodiacal Light

The solar system is a dusty place – the source of the dust was thought to be from passing comets and collisions of asteroids. However, an accidental discovery by the Juno spacecraft on its journey to Jupiter suggests that Mars may be the source of the interplanetary dust in the orbital plane, although a clear mechanism for the dust escaping the Red Planet hasn't been identified.

Shortly before sunrise and just after sunset, sunlight can be seen reflecting off this disk of debris. Called the zodiacal light, it is best observed when the ecliptic (the apparent path of the Sun and planets) is nearly perpendicular to the horizon (on spring evenings and autumn mornings). The best time to glimpse the zodiacal light is when the Moon is absent from the evening sky (for example, during the last week of March and around the New Moon on the 29th).

Sunrise and Sunset (New Milford, CT)

March, the month named for the planet Mars, denotes the end of the long winter nights. The Sun crosses the celestial equator at 5:01 a.m. (EDT) on the 20th marking the Vernal Equinox and the beginning of the spring season in the northern hemisphere.

Sun	Sunrise	Sunset
March 1st (EST)	06:27	17:44
March 15th (EDT)	07:04	19:00
March 31st (EDT)	06:37	19:18

Astronomical and Historical Events

1st Moon at perigee (closest distance from Earth)
1st NASA's Europa Clipper executes a gravity assist maneuver at Mars on its journey to Jupiter's moon Europa. The NASA spacecraft will fly within 600 miles (950 km) of Mars before returning to Earth for another gravity assist from its home planet.
1st History: Launch of the space shuttle Columbia (STS-109) on an eleven-day mission to service the Hubble Space Telescope (4th servicing mission) (2002)
1st History: U.S. astronaut Scott Kelly and Russian cosmonaut Mikhail Kornienko return to Earth after a one-year stay on the International Space Station (2016)
1st History: Soviet spacecraft Venera 13 lands on Venus and records first color panoramic views of the surface (1982)
1st History: discovery of Saturn's moon *Helene* by Pierre Laques and Jean Lecacheux from the Pic du Midi Observatory in the French Pyrenees; named after Helen of Troy (1980)
1st History: Soviet spacecraft Venera 3 lands (crashes) on Venus, becoming first spacecraft to impact the surface of another planet (1966)
2nd Close approach of Apollo class asteroid and Near-Earth Object (NEO) 2025 CV1
2nd History: launch of an unmanned SpaceX Crew Dragon spacecraft. First American spacecraft to autonomously dock with the International Space Station (2019)
2nd History: launch of the Rosetta spacecraft (2004); rendezvoused with *Comet 67 P/Churyumov-Gerasimenko* in May 2014, sending a lander to its surface in November 2014
2nd History: launch of Pioneer 10, a Jupiter flyby mission (1972)

Astronomical and Historical Events (continued)

3rd History: Chinese National Space Agency announces the Chang'e lunar exploration program (2003)
3rd History: launch of Apollo 9 with astronauts James McDivitt, David Scott and Russell Schweickart in the first manned flight test of the lunar module (1969)
3rd History: launch of the Pioneer 4 spacecraft towards the Moon; first U.S. spacecraft to escape the Earth's gravity (1959)
4th History: discovery of Jupiter's rings by the Voyager 1 spacecraft (1979)
5th Close approach of Apollo class NEO and Potentially Hazardous Asteroid (PHA) 535844 (2015 BY310)
5th History: discovery of Jupiter moon *Thebe* by Steve Synnott (1979)
5th History: Soviet spacecraft Venera 14 lands on Venus and uses a screw drill to obtain a surface sample that was determined to be similar to oceanic basalts on Earth (1982)
5th History: flyby of Jupiter by the Voyager 1 spacecraft (1979)
6th First Quarter Moon
6th History: Valentina Tereshkova's birthday (1937), Soviet cosmonaut became the first woman to fly to space in 1963
6th History: Dawn spacecraft enters orbit around the dwarf planet *Ceres* (2015)
6th History: launch of the Kepler telescope from Cape Canaveral Air Force Station aboard a Delta II rocket (2009); designed to survey nearby stars for Earth-size and smaller planets; to date Kepler discovered 2,778 confirmed planets with another 1,984 yet to be confirmed
6th History: flyby of Comet Halley by Vega 1, a Soviet spacecraft (1986)
7th History: John Herschel born, first astronomer to survey the southern hemisphere (1792)
8th **Second Saturday Stars - Open House at McCarthy Observatory**
8th History: maiden voyage of Europe's first unmanned cargo ship to the International Space Station; the Jules Verne was launched from Kourou, French Guiana aboard an Ariane 5 rocket; in addition to delivering supplies to the ISS, the cargo ship contained a manuscript by the 19th century French author and science fiction pioneer with computations of distances from Earth to several astronomical destinations, as well as to the center of the planet (2008)
8th History: flyby of *Comet Halley* by Susei, a Japanese spacecraft (1986)
8th History: discovery of rings around Uranus by NASA's airborne observatory (1977)
9th Daylight Saving - Set Clock Ahead 1 Hour (United States)
9th History: launch of Ivan Ivanovich on Sputnik 9, a mannequin used to test the Russian Vostok spacecraft in preparation for its crewed missions (1961)
9th History: Space Shuttle Discovery (STS-133) makes its final landing (2011)
9th History: flyby of *Comet Halley* by Vega 2, a Soviet spacecraft (1986)
9th History: launch of the Soviet spacecraft Sputnik 9, with dog Chernushka (1961)
9th History: Yuri Gagarin born; first person to orbit the Earth in 1961 (1934)
10th Close approach of Aten class asteroid and NEO 2021 EU3
10th History: Mars Reconnaissance Orbiter arrives at Mars (2006)
10th History: flyby of *Comet Halley* by Sakigake, a Japanese spacecraft (1986)
10th History: Uranus' rings discovered by astronomers James Elliot, Edward Dunham, and Jessica Mink using the Kuiper Airborne Observatory while observing a stellar occultation (1977)

Astronomical and Historical Events (continued)

11th History: launch of Pioneer 5 into solar orbit between the Earth and Venus; confirmed the existence of interplanetary magnetic fields (1965)
11th History: Urbain Leverrier born, mathematician and astronomer, predicted existence of Neptune (1811)
12th ESA's Hera spacecraft executes a gravity assist maneuver at Mars which will send it along to the Didymos asteroid system with arrival expected in late 2026. The spacecraft is expected to pass within less than 200 miles (300 km) of the Martian moon Deimos.
13th Close approach of Aten class asteroid and NEO 2025 CT1
13th History: flyby of *Comet Halley* by Giotto, a European Space Agency spacecraft (1986)
13th History: discovery of Saturn's moon *Calypso* by Dan Pascu, P.K. Seidelmann, William Baum and D. Currie (1980)
13th History: Percival Lowell born, established observatory in Flagstaff, AZ to observe Schiaparelli's Martian "canali" and look for other signs of life (1855)
13th History: William Herschel discovers the planet Uranus; originally named Georgium Sidus by Herschel in honor of his patron, King George III of England (1781)
13th History: Galileo Galilei publishes "Sidereus Nuncius" (Starry Messenger), the first scientific treatise based on observations made through a telescope; it described Galileo's early observations of the Moon, the stars, and the moons of Jupiter (1610)
14th Full Moon (Full Worm Moon)
14th Total Lunar Eclipse (mid-eclipse 2:59 a.m. EDT)
14th Pi Day
14th History: launch of ESA's ExoMars Trace Gas Orbiter and Schiaparelli lander aboard a Russian Proton rocket from the Baikonur Cosmodrome in Kazakhstan (2016)
14th History: Stardust passes within 112 miles (181 km) of the nucleus of *Comet Tempel 1* (2011)
14th History: John J. McCarthy Observatory issued Observatory Code Number 932 by the Minor Planet Center of the International Astronomical Union (2001)
14th History: first European launch of a liquid-fueled rocket by Johannes Winkler (1931)
14th History: Albert Einstein born, developed theories of mass to energy conversion and the curvature of space and time in large gravitational fields (1879)
14th History: Giovanni Schiaparelli born, director of the Milan Observatory and first to describe faint features on Mars as "canali" (1835)
15th Close approach of Apollo class asteroid and NEO 2020 FO
15th History: dedication of the Kitt Peak National Observatory (1960)
15th History: Alan Bean born; astronaut, moonwalker and artist (1932)
16th History: third and final flyby of Mercury by the Mariner 10 spacecraft (the last of the Mariner probes); Mariner 10 was also the first spacecraft to use solar radiation pressure on its solar panels and the antenna for attitude control during flight (1975)
16th History: launch of Gemini 8 with astronauts Neil Armstrong and David Scott; first docking with another space vehicle, an unmanned Agena stage (1966)
16th History: launch of the first Titan II Intercontinental Ballistic Missile, also used as the launch vehicle for the manned Gemini spacecraft in the early 1960's (1962)
16th History: Robert Goddard launches first liquid-fuel rocket in Auburn, MA (1926)
16th History: Caroline Herschel born (1750)
17th Moon at apogee (furthest distance from Earth)
17th History: discovery of Asteroid 16 *Psyche* by Annibale de Gasparis (1852)

Astronomical and Historical Events (continued)

17th History: launch of the Gravity Recovery And Climate Experiment (GRACE) spacecraft (2002)
17th History: launch of Vanguard 1, 4th artificial satellite and oldest still orbiting Earth (1958)
17th History: discovery of Saturn's moon *Phoebe* by William Pickering (1899)
18th History: MESSENGER enters orbit around Mercury (2011)
18th History: New Horizons spacecraft (on its way to Pluto) crosses the orbit of Uranus (2011)
18th History: explosion during launch of a Vostok rocket carrying a military spy satellite kills 48 members of the Soviet Missile Troop; likely cause of explosion was an oxygen peroxide leak caused by the poor quality of the rocket's fuel filters (1980)
18th History: Alexei Leonov performs first spacewalk from Soviet Voskhod spacecraft (1965)
19th History: Tenham meteorite fall; fragments of a large meteor rain down on a remote area of western Queensland, Australia (1879)
19th History: Moon flyby by the Hiten spacecraft; Japan's first lunar flyby, orbiter and surface impactor (1990)
20th Vernal Equinox (beginning of the Spring season in the northern hemisphere) at 5:01 a.m. EDT (9:01 UT)
21st Close approach of Apollo class asteroid and NEO 2021 FH1
21st History: launch of Ranger 9, Moon impact mission; transmitted the highest resolution imagery obtained to that date before impacting the floor of Alphonsus crater on the 24th (1965)
21st History: discovery of Saturn's moons *Tethys* and *Dione* by Giovanni Cassini (1684)
22nd Last Quarter Moon
22nd History: launch of space shuttle Atlantis (STS-76), third mission to Russian space station Mir and transfer of the first American woman, Shannon Lucid, to the station (1996)
23rd Ring crossing – Saturn's rings will be oriented edge-on toward Earth, effectively disappearing from view.
23rd History: launch of Gemini 3 with astronauts Virgil Grissom and John Young, first manned Gemini flight (1965)
23rd History: Wernher von Braun born, German rocket scientist and leader of the U.S. moon program (1912)
24th History: discovery of Comet Shoemaker-Levy 9 (1993)
25th History: launch of the IMAGE spacecraft, first mission dedicated to mapping the Earth's magnetosphere (2000)
25th History: close approach of Comet *Hyakutake* (0.10 AU) to Earth (1996)
25th History: launch of Soviet spacecraft Sputnik 10 with dog Zvezdochka (1961)
25th History: Christiaan Huygens discovers *Titan*, Saturn's largest moon (1655)
26th Close approach of Apollo class NEO and PHA 2014 TN17
26th History: American astronomer J.W. Draper takes first photograph of the Moon (1840)
27th History: U.S. astronaut Scott Kelly and Russian cosmonaut Mikhail Kornienko arrive at the International Space Station for a year-long mission (2015)
27th History: launch of the Soviet atmospheric probe and lander Venera 8 to Venus (1972)
27th History: launch of Mariner 7, Mars flyby mission (1969)
27th History: President Eisenhower approves the military lunar program to be managed by the Advanced Research Projects Agency (1958)
28th History: flyby of Comet Halley by the ICE spacecraft (1986)

Astronomical and Historical Events (continued)

28th History: Heinrich Olbers discovers the asteroid 2 *Pallas* (1802)
29th New Moon
29th Partial Solar Eclipse (at sunrise)
29th History: First flyby of Mercury by the Mariner 10 spacecraft (1974)
29th History: Heinrich Olbers discovers the asteroid 4 *Vesta* (1807)
30th Moon at perigee (closest distance from Earth)
30th Close approach of Aten class asteroid and NEO 2020 VA4
31st History: discovery of Dwarf Planet *Makemake* by Mike Brown, et al's (2005)
31st History: launch of Soviet spacecraft Luna 10, first man-made object to go into orbit around another planetary body; detected evidence of mass concentrations on the Moon called "mascons" (1966)

Commonly Used Terms

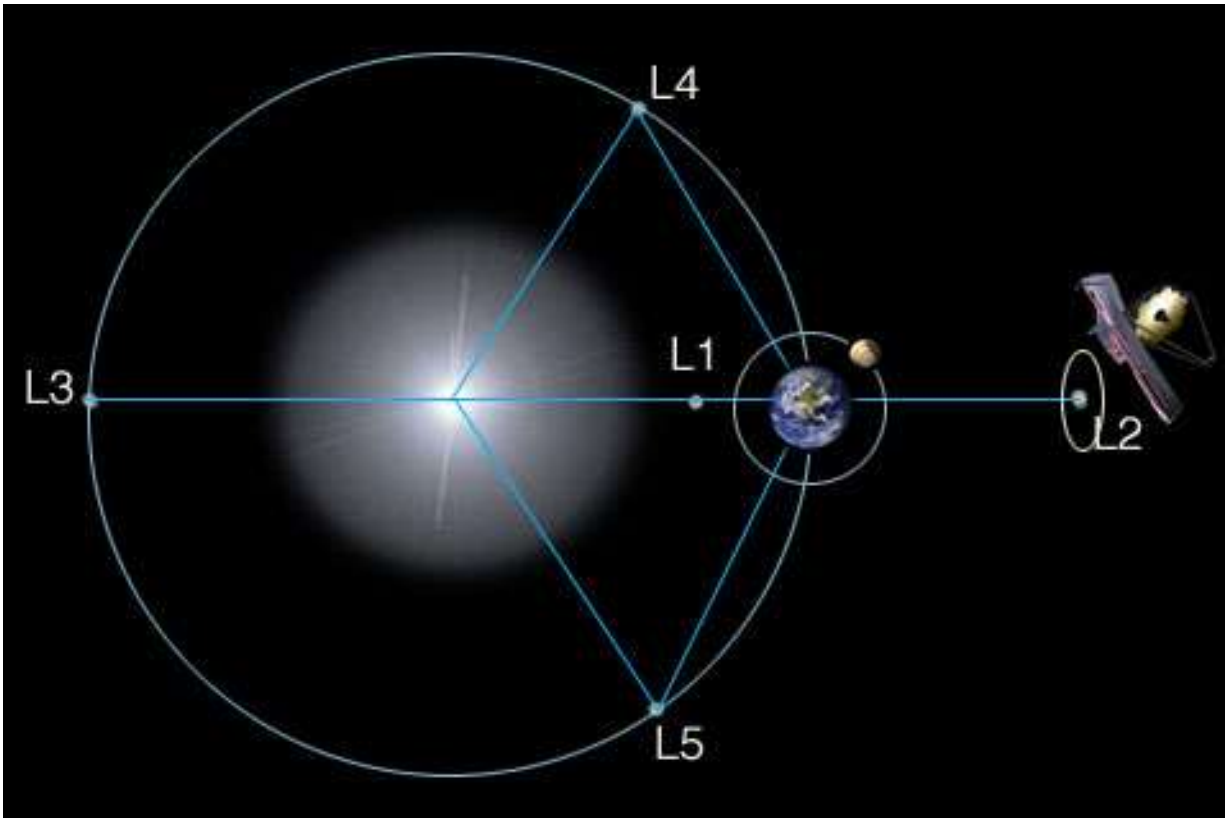
- Apollo: a group of near-Earth asteroids whose orbits also cross Earth's orbit; Apollo asteroids spend most of their time outside Earth orbit.
- Aten: a group of near-Earth asteroids whose orbits also cross Earth's orbit, but unlike Apollos, Atens spend most of their time inside Earth orbit.
- Atira: 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
- 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

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 (location of the Euclide and James Webb telescope) is situated 1.5 million kilometers beyond the Earth (as viewed from the Sun).



James Webb Space Telescope

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

Euclid Space Telescope

https://www.esa.int/Science_Exploration/Space_Science/Euclid

Gaia Star Surveyor
https://www.esa.int/Science_Exploration/Space_Science/Gaia

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

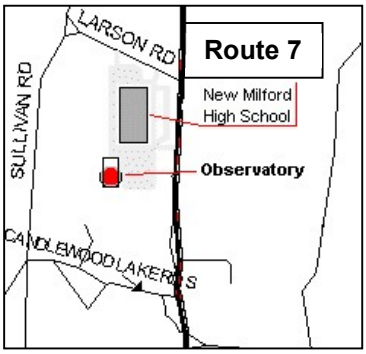
Mars Atmosphere and Volatile EvolutioN (MAVEN): https://science.nasa.gov/mission/maven/

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