Galactic Observer

John J. McCarthy Observatory

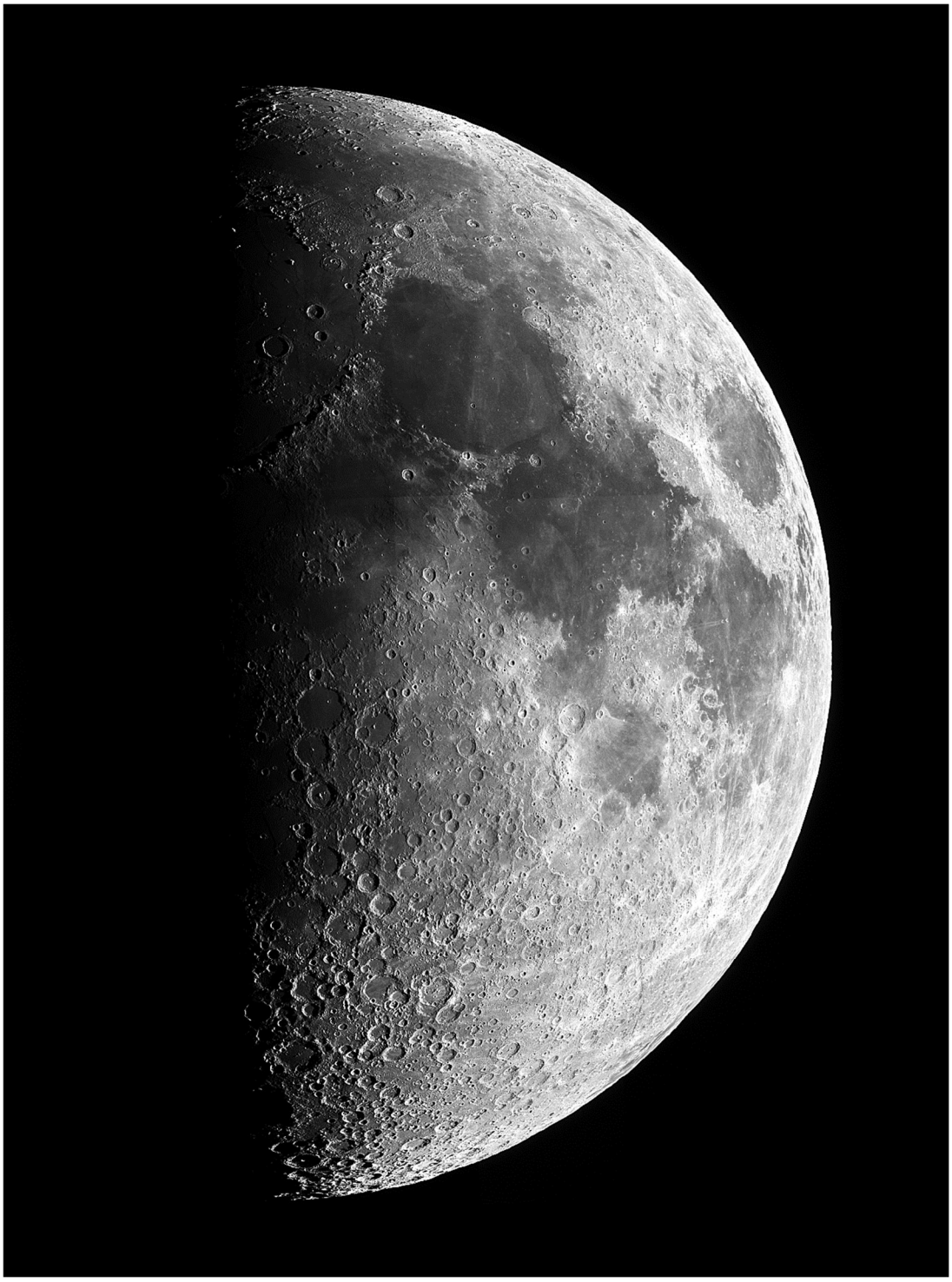
Volume 16, No. 10 October 2023

Partial Solar Eclipse
at the McCarthy Observatory
Maximum Obscuration: 1:22 p.m. EDT

The McCarthy Observatory will be open to the public at noon on October 14th for the start of the partial solar eclipse

Photo from 2017 eclipse simulating the maximum obscuration for the October 14th event
Credit: Bill Cloutier

October Astronomy Calendar and Space Exploration Almanac



International Observe the Moon Night 2023 - October 21st

7 Day Old Moon Mosaic: Bill Cloutier

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Celebrate the Moon

International Observe the Moon Night (InOMN) in 2023 is being celebrated on October 21st. The event was first inspired by public outreach activities sponsored by the Lunar Reconnaissance Orbiter (LRO) and Lunar CRater Observation and Sensing Satellite (LCROSS) educational teams at the Goddard Space Flight Center in Greenbelt, Maryland and at the Ames Research Center in Moffett Field, California, in August 2009. In 2010, the Lunar and Planetary Institute and Marshall Space Flight Center joined Goddard and Ames in a world-wide event to raise public awareness of lunar science and exploration.

The Moon will rise at 2:24 p.m. (EDT) on the 21st and set before midnight at 11:17 p.m. At approximately 230,300 miles (370,600 km) from the Earth, 48% of the near-side lunar surface will be illuminated as the Sun sets and twilight deepens. Unfortunately, the Moon will be quite low in the sky, never climbing above 21°, even at its greatest altitude just before 7 p.m. However, with clear skies and a good horizon to the south-southwest, the Moon's most spectacular mountain range (the Apennines) will dominate the terminator (the day/night dividing line).

The Imbrium Basin is the largest basin on the Moon's nearside and also the second youngest basin based on samples returned by Apollo 15. It was formed about 3.85 billion years ago by a large impactor and has a diameter of 720 miles (1,160 km). Characteristic of most large impact basins, Imbrium exhibits multiple topographic rings. These bullseye-appearing features, thought to have formed as material flowed inward during crater collapse, dragging along the Moon's outer rock shell, are generally hidden from our view by a subsequent and prolonged period of volcanism (the rings of the youngest basin, Mare Orientale, being the rare exception).

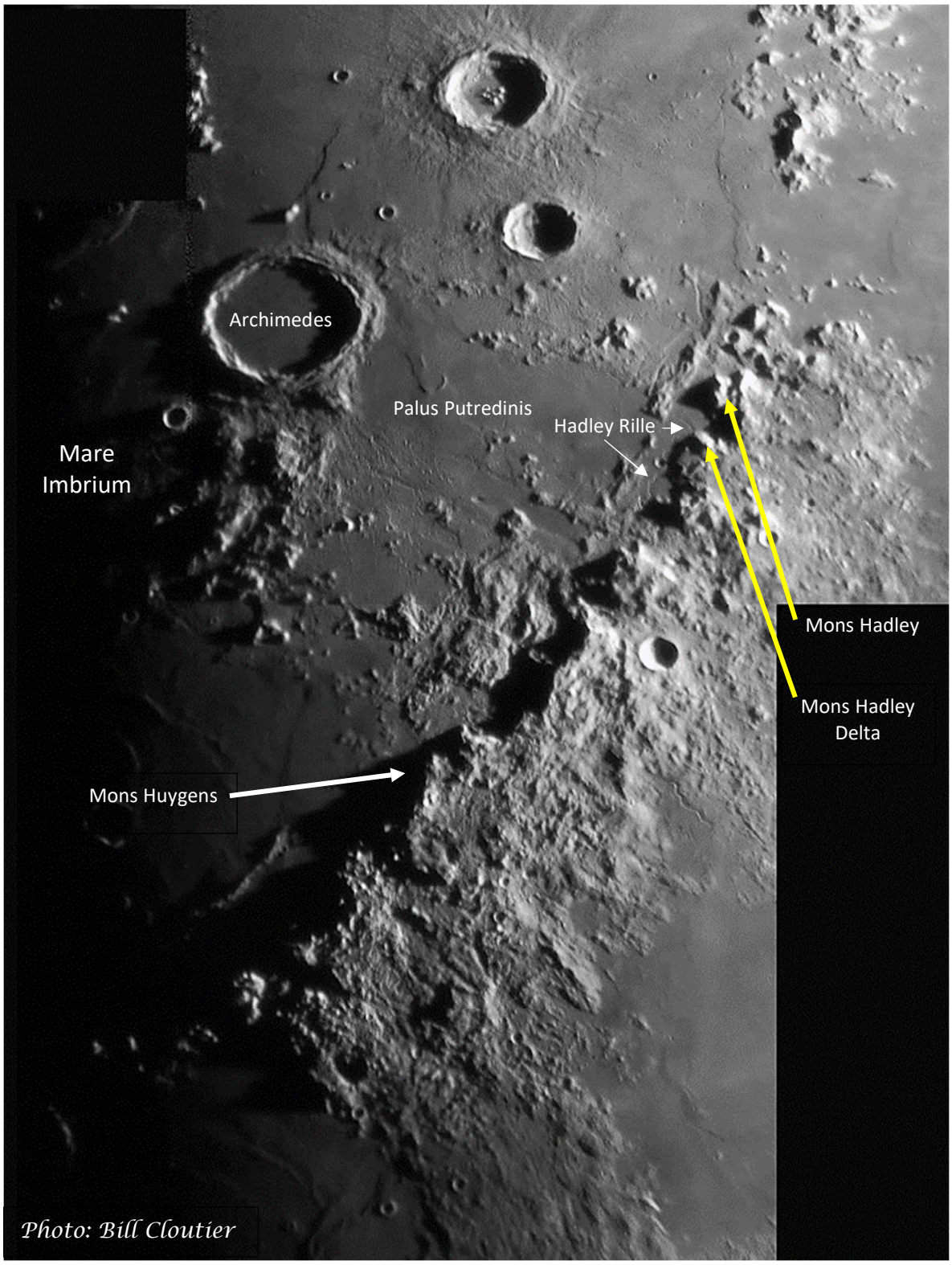
The Apennine mountains are a segment of the outermost of three rocky rings associated with the Imbrium basin. The range was named after its Italian counterpart by Johannes Hevelius, a seventeenth century astronomer who created and published some of the earliest detailed maps of the Moon's surface ("Selenographia," in 1647).

The mountain range extends about 370 miles (600 km), from a gap in the basin rim in the north that leads into the adjacent Mare Serenitatis, to its western terminus at the 37-mile diameter (59 km) crater Eratosthenes. The highest peak in the Apennines is Mons Huygens, which rises about 18,000 feet (5.5 km) above the surrounding plain, although Mons Hadley and Mons Delta Hadley are better known as they bound the landing site of Apollo 15.

There are few very large craters within the mare (lava plains) bounded by the Apennines, as well as other ranges, with two of the largest (Aristillus and Autolycus) visible on the 21st. Observers may be able to catch a glimpse of the sunlit rim of the largest crater in Mare Imbrium (Archimedes) just before moonset.

Archimedes denotes the western edge of Palus Putredinis (the Marsh of Decay) which stretches east to the foothills of the Apennines and Rima Hadley, a sinuous rille running alongside the Apollo 15 landing site. The rille (German for groove) snakes across the plain for about 84 miles or 135 km. Its average width is about 3,900 feet (1.2 km) with a depth of 1,200 feet or 370 meters, although the northern section is shallower. Through this long V-shaped channel, billions of years ago, once flowed low-viscosity magma from a nearby vent. The rille will be easier to discern as the shadows cast by the Apennines give way to a higher Sun.

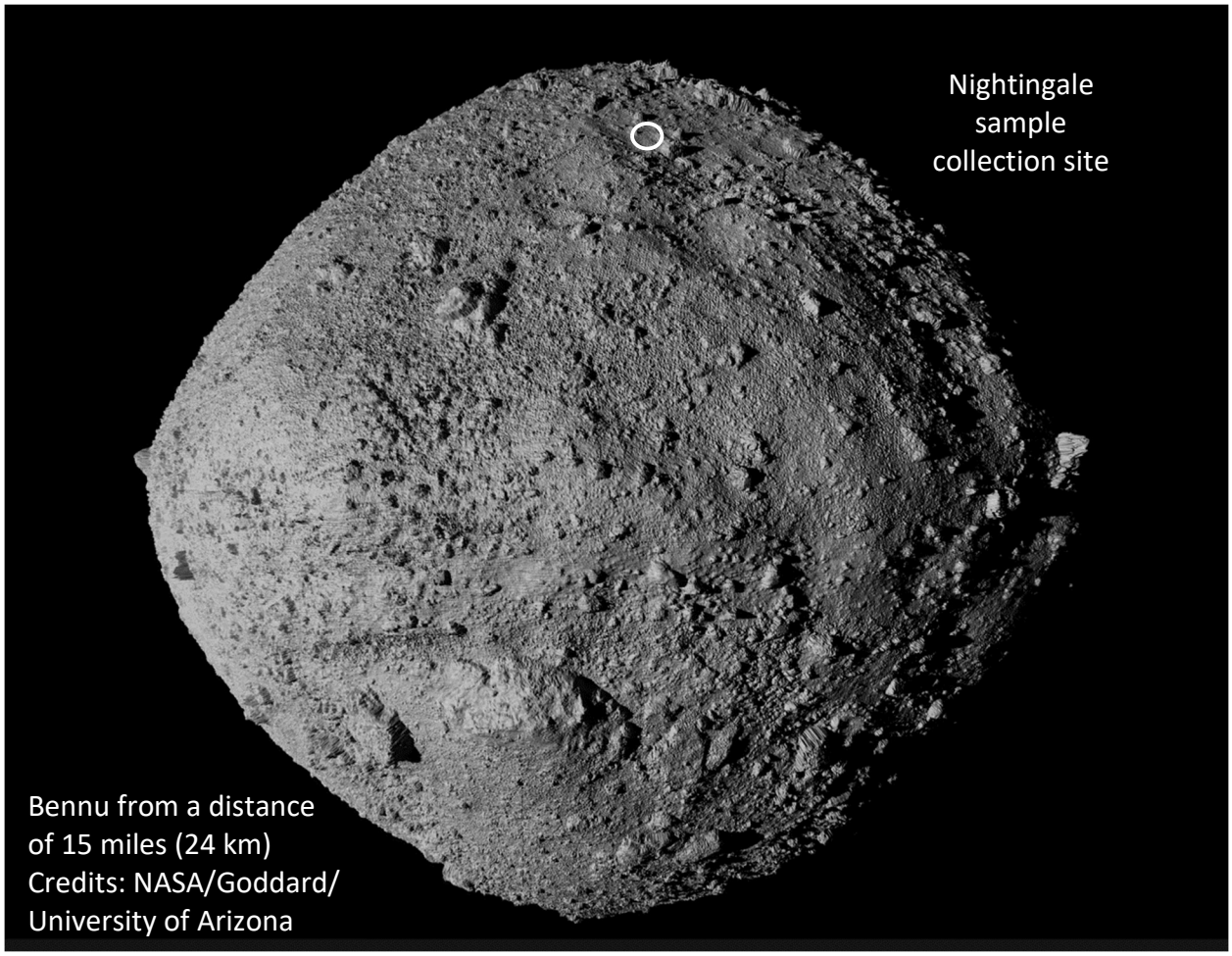
InOMN Highlight:
The Lunar Apennines



Special Delivery

After seven years and billions of miles, NASA's Origins, Spectral Interpretation, Resource Identification, Security, Regolith Explorer (OSIRIS-REx) spacecraft returned home on September 24th to deliver a sample of the asteroid Bennu. The material had been collected in October 2020 when, at a distance of more than 200 million miles (321 million km) from Earth, OSIRIS-REx briefly touched down on the asteroid. The sampling site, called "Nightingale," was located inside a crater near Bennu's north pole. Three years later, the spacecraft dropped off the reentry capsule as it flew by Earth, with the package descending by parachute to the Utah Test and Training Range in Utah's West Desert, before the spacecraft headed back out on a new mission.

The sample return capsule, blackened from reentry and containing material from the potentially hazardous asteroid Bennu, is seen on the desert floor shortly after landing in the photos (above). Recovery crews transported the capsule to a temporary clean room at the desert site where the backshell and heat shield were removed. The capsule was then packaged and loaded onto an Air Force C-17 military transport plane for the trip to the Johnson Space Center in Houston. After an initial analysis, the asteroid sample will be shared with over 60 laboratories around the world and hundreds of researchers.



Bennu from a distance of 15 miles (24 km) Credits: NASA/Goddard/ University of Arizona

Credits: NASA/Goddard/ University of Arizona

Nightingale was one of four sample sites considered. Its location near the north pole meant that the temperatures in the region were lower than elsewhere on the asteroid and the surface materials better preserved. The interior of the 66-foot diameter crater (20 meters) was judged to be relatively fresh, increasing the likelihood that the fine-grained material on its floor would be pristine and more representative of the asteroid's history than the Sun-weathered overburden.

Sampling did yield one surprise when the spacecraft's arm started to sink into the asteroid's loosely packed surface, which scientists now believe could be full of voids.

Annular Eclipse

As a prelude to the Great American Eclipse in April 2024, residents in the western United States will be treated to an Annular Solar Eclipse on October 14th. From the coast of Oregon to the Texas gulf, within a roughly 125-mile-wide path, the eclipse will climax in a "ring of fire."

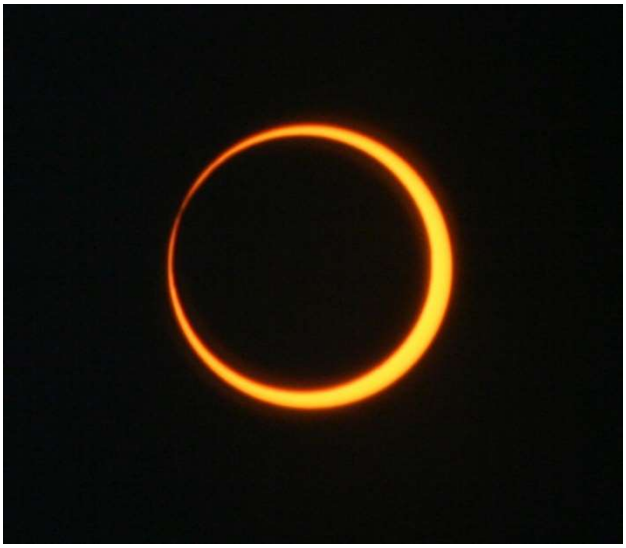
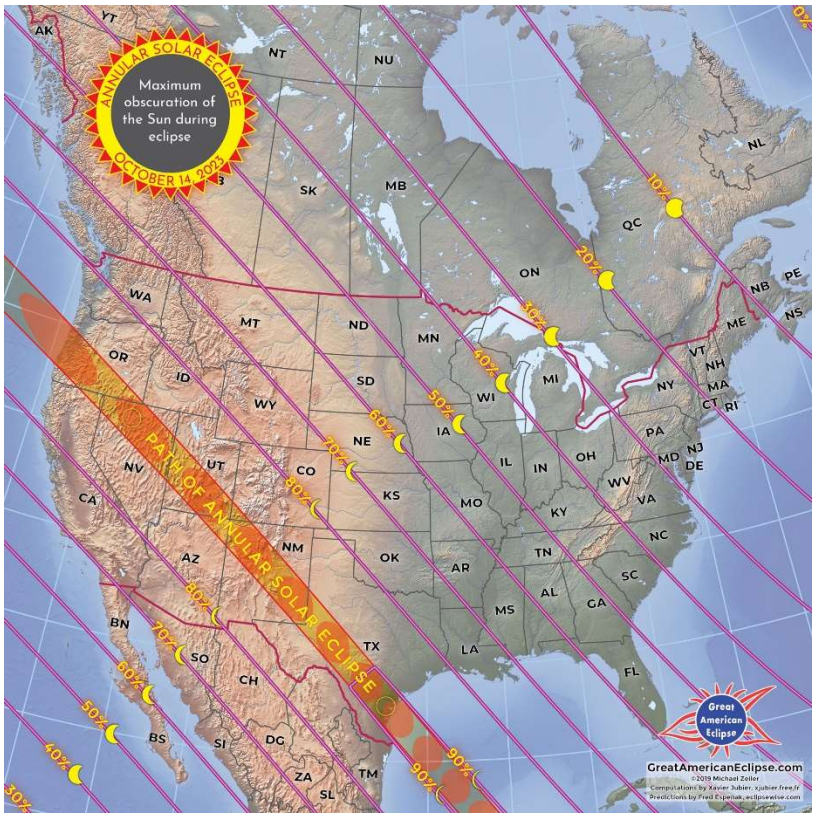


Image Credit: NASA/Bill Dunford

An annular eclipse occurs when the Moon moves between the Earth and Sun. Unlike a total eclipse, due to the Moon being too far away from the Earth or the Sun being too close, the Sun and Moon do not appear the same size in the sky. As a result, the Moon does not completely cover the Sun, with an annular or ring-shaped portion of the Sun visible (obscuring about 90% of the Sun on the 14th).

Residents in New England will experience a partial eclipse. At the McCarthy Observatory in New Milford, the eclipse will begin at 12:11 p.m. with maximum obscuration occurring at 1:22 p.m. At that time about 21% of the Sun will be covered (or obscured) by the Moon (as shown in the photo on the right).

Eclipse watchers will need to wear the appropriate eye protection to watch the progression (to avoid eye injury) or observe the eclipse by projection (for example, with a pinhole camera).



The path of the October 14, 2023 annular eclipse. The purple curves indicate how much of the Sun will be covered by the Moon outside the path of annularity. Courtesy Michael Zeiler, GreatAmericanEclipse.com

Twenty Years Ago

Photo: Bill Cloutier

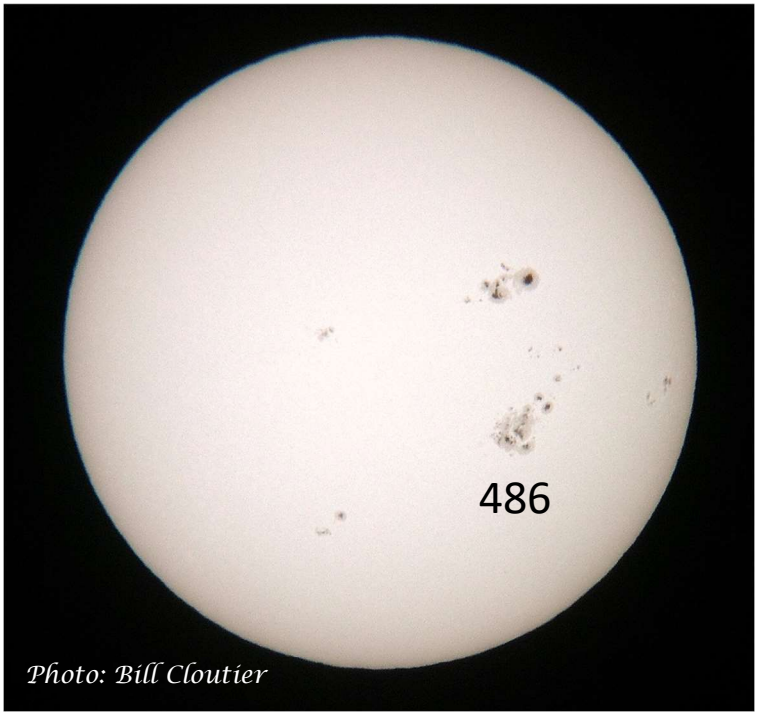
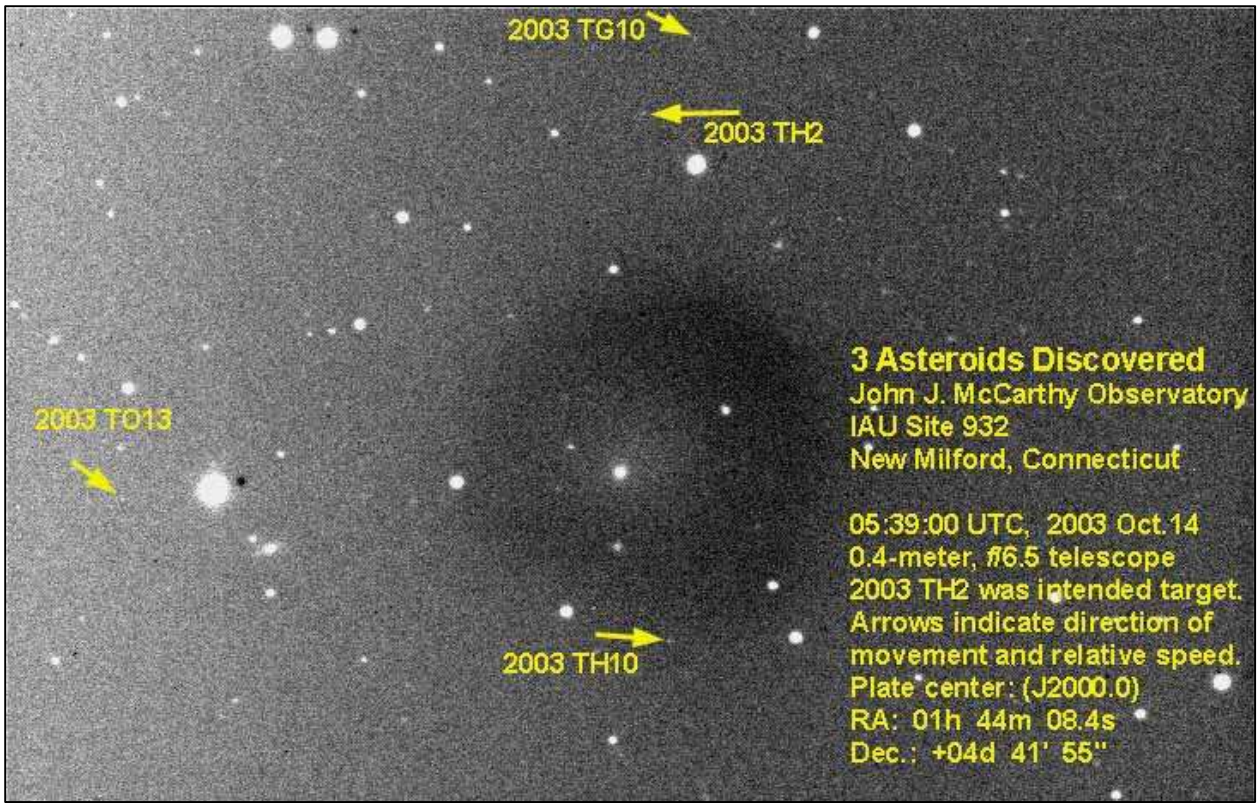


Photo: Bill Cloutier

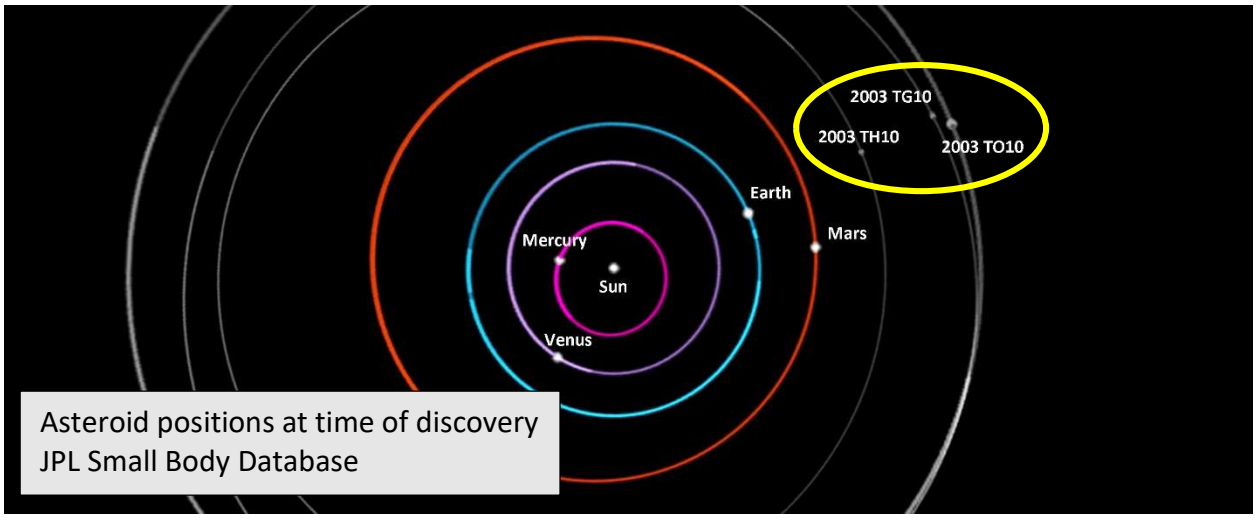
The Halloween Solar superstorms that occurred in late October and early November of 2003 were unusually energetic, especially since they occurred several years after solar maximum, when solar activity was on the decline. The storms (producing 17 major flares) affected over half of the Earth-orbiting spacecraft, destroyed the Martian Radiation Environment Experiment aboard NASA's Mars Odyssey spacecraft, and required space station astronauts to take shelter.

An eruption of superheated gas (plasma) associated with sunspot complex 486 on October 29th produced spectacular aurora in the autumn sky around New Milford on the 30th. It was one of the largest flares recorded in recent history.

McCarthy Observatory History



In the early morning hours of October 14, 2003, after making urgently needed observations of a newly discovered potentially hazardous asteroid (2003 TH2), the Director of the McCarthy Observatory, Monty Robson, discovered three other asteroids in the same field of view. The asteroids were given the provisional designations of 2003 TG10, TH10 and TO13 by the International Astronomical Union's Minor Planet Center and determined to be main asteroid belt objects (located between the planets Mars and Jupiter). At the time of discovery, they had an apparent brightness of about 18th magnitude; or more than 60,000 times fainter than the dimmest object that can be seen by the unaided eye under ideal conditions. With additional observations came the right to name the space rocks – 115449 Robson (TG10), 253587 Cloutier (TH10) and 271216 Boblambert (TO13) after three members of the Observatory's founding team.

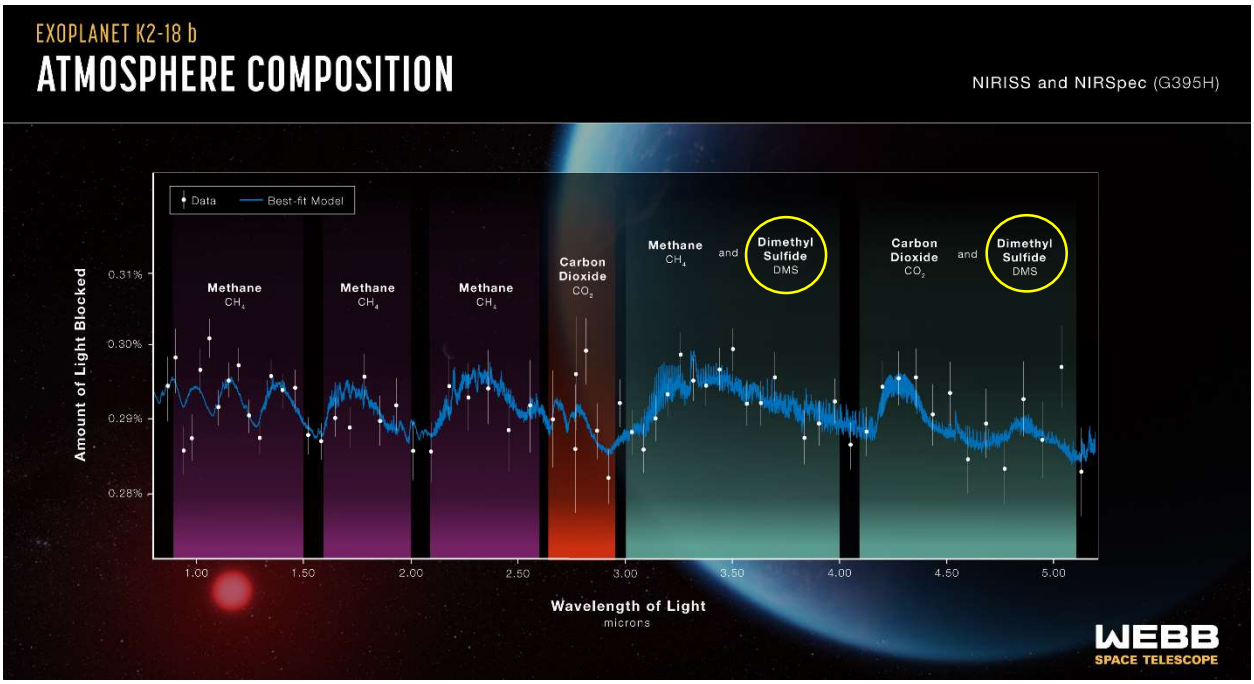


Asteroid positions at time of discovery
JPL Small Body Database

Life Indicator Found?

Artist's concept of K2-18b, an exoplanet 8.6 times more massive than Earth and 120 light years away
Credits: Illustration: NASA, CSA, ESA, J. Olmsted (STScI), Science: N. Madhusudhan (Cambridge University)

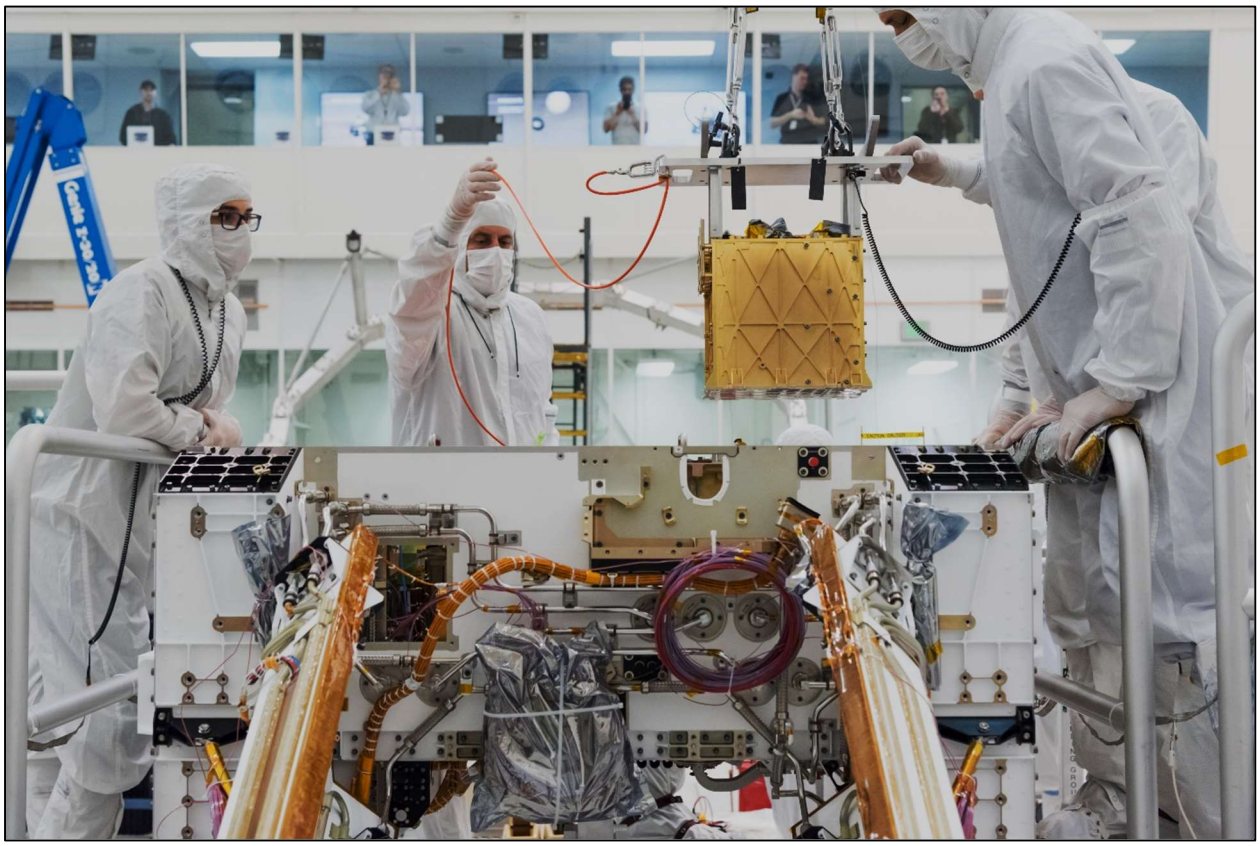
NASA's James Webb Space Telescope has not only found carbon-bearing molecules, including methane and carbon dioxide in the atmosphere of the exoplanet K2-18b, it has detected potential traces of dimethyl sulfide. The chemical is released, on Earth, only by phytoplankton or photosynthetic algae. If validated, the discovery would suggest a biologic source in what may be a liquid ocean on this world with a hydrogen-rich atmosphere. K2-18b orbits a cool dwarf star within its habitable zone and can be found in the constellation Leo.



Webb's spectra of the exoplanet K2-18 b with dimethyl sulfide circled
Credits: Illustration: NASA, CSA, ESA, R. Crawford (STScI), J. Olmsted (STScI), Science: N. Madhusudhan (Cambridge University)

MOXIE Technology Demonstration Concludes

Demonstration of NASA's Mars Oxygen In-situ Resource Utilization Experiment (MOXIE) has concluded. The microwave-oven-size device accompanied the Perseverance rover to the surface of Mars in February 2021. Designed by the Massachusetts Institute of Technology, the unit was designed to extract oxygen from the carbon dioxide that comprises ~95% of the Martian atmosphere.



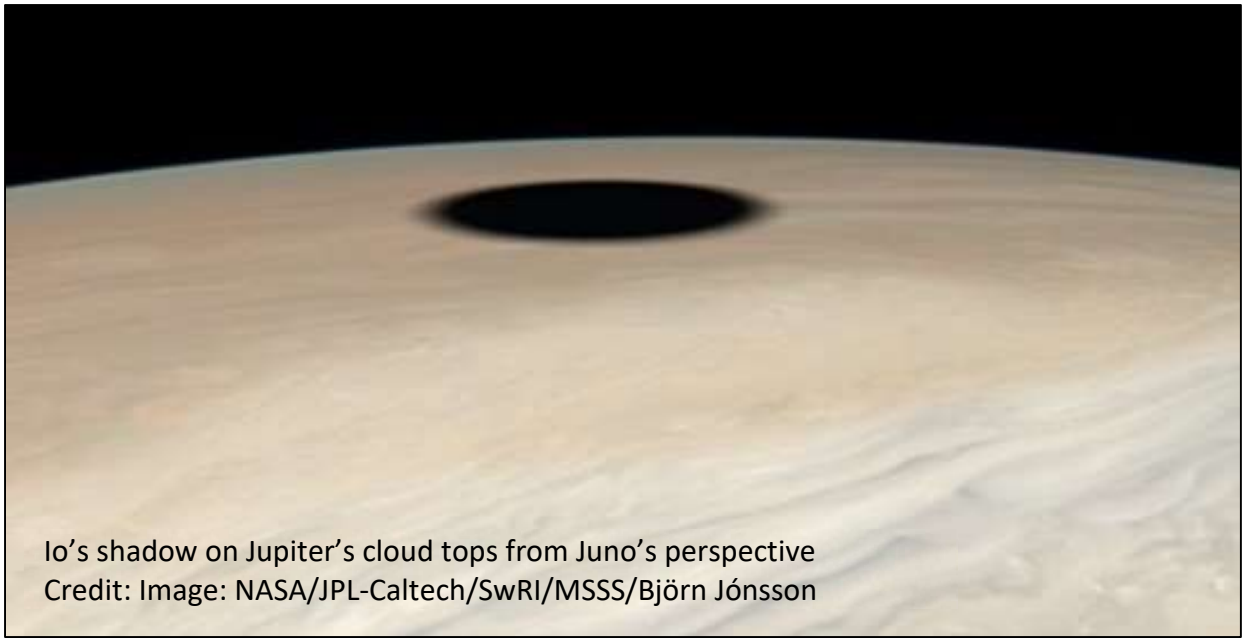
MOXIE, contained within the gold-colored package, being installed into the chassis of the Mars Perseverance rover at NASA's Jet Propulsion Laboratory, in Pasadena, California
Credit: NASA/JPL-Caltech

The instrument package unit used a small compressor to pull the Martian atmosphere inside the rover and pressurizes it to about half an atmosphere. The pressurized carbon dioxide gas was then fed to the Solid OXide Electrolyzer (SOXE), where it was electrochemically split (at a temperature of 1,472°F or 800°C), at the cathode to produce pure oxygen. MOXIE extracted oxygen from the Martian atmosphere 16 times over the course of an entire Mars year (equivalent to 687 Earth days), under a variety of conditions (during night and day throughout all Martian seasons). While its location inside the rover body led to volume, thermal, and power constraints, and precluded the continuous operation of the unit over long periods of time, MOXIE did prove that the technology was feasible and scalable, while meeting expectations for efficiency and purity.

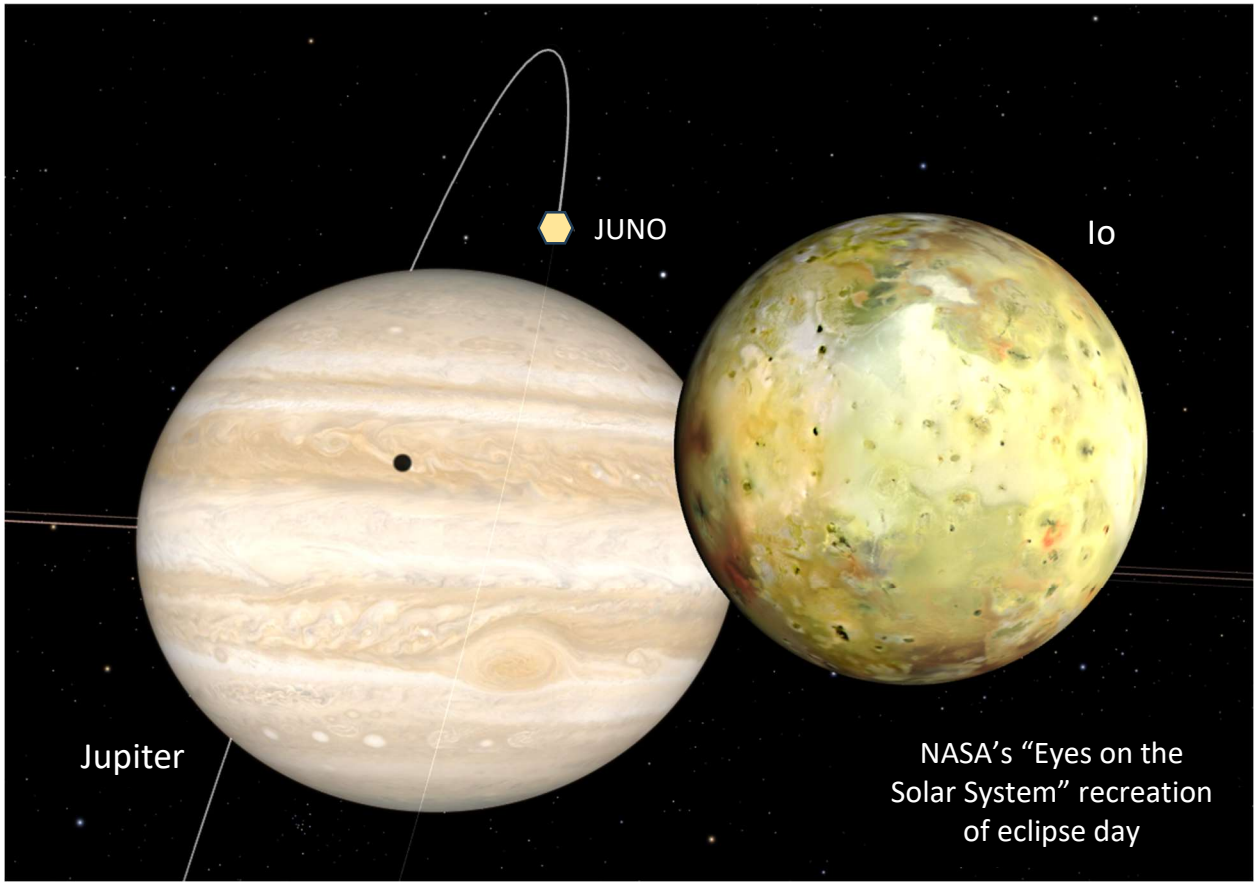
A full-scale plant on Mars would support sustainable human exploration by producing oxygen for both fuel and breathing. In-situ production of oxygen would also avoid the effort and expense of having to launch hundreds of tons of material from Earth's surface to Mars.

Jovian Solar Eclipse

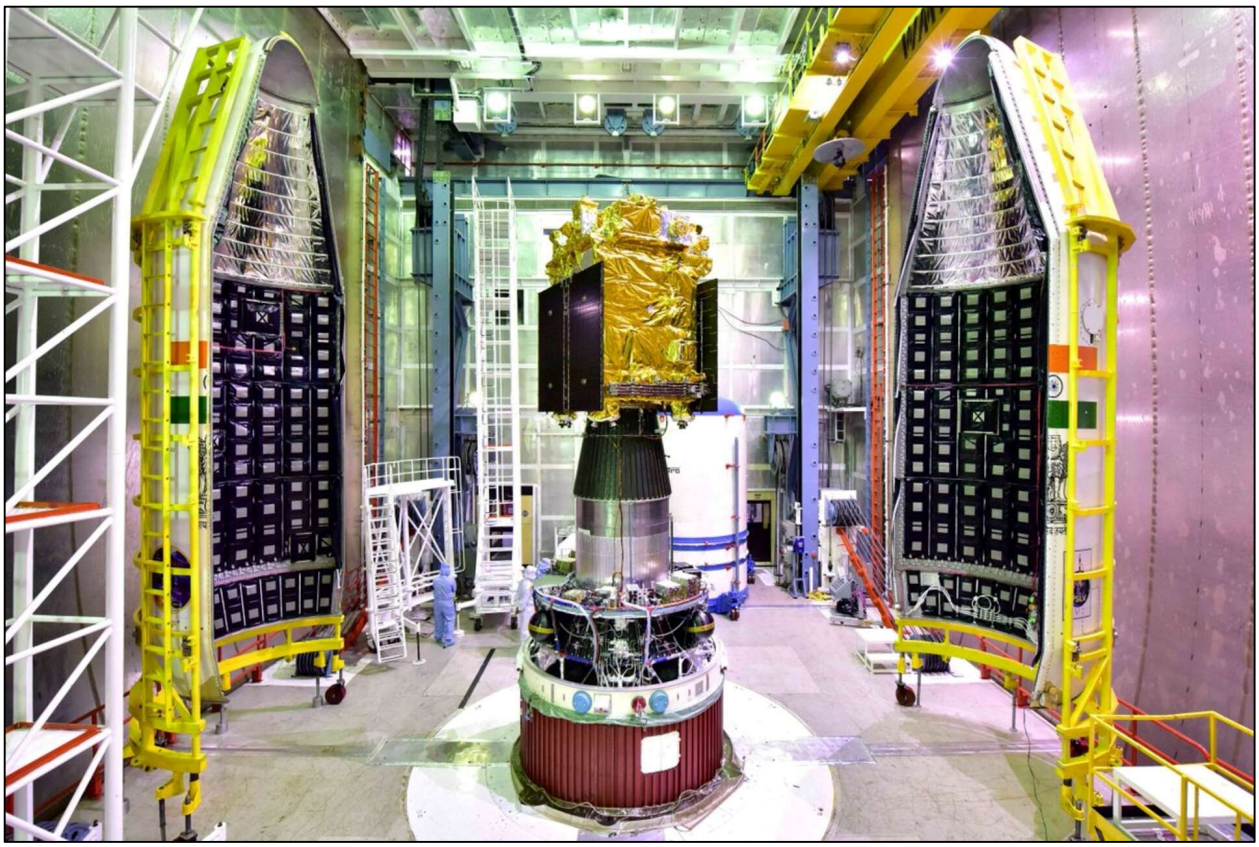
Solar eclipse are not exclusive to Earth. Moons of the outer planets routinely pass between the Sun and their host planet. NASA's Juno spacecraft, which arrived at Jupiter in July 2016, is moving closer to Io, the volcanic moon, in its polar orbit around the gas giant. It's unique vantage point yields breathtaking views of these shadow transits.



Io's shadow on Jupiter's cloud tops from Juno's perspective
Credit: Image: NASA/JPL-Caltech/SwRI/MSSS/Björn Jónsson



Aditya-L1



Aditya-L1 atop PSLV C57's fourth stage, shortly before being enclosed in the payload fairing. (Credit: ISRO)

The Indian Space Research Organization (ISRO) followed up their successful landing of its Vikram probe on the Moon with the launch of its first mission dedicated to studying the Sun. Aditya-L1 was designed to observe from the Earth-Sun L1 Lagrange point, about 900,000 miles from Earth (1.5 million km), where it will have an unobstructed and uninterrupted view of the Sun. The spacecraft was launched from the Satish Dhawan Space Centre on September 2nd, just ten days after ISRO celebrated its lunar triumph.

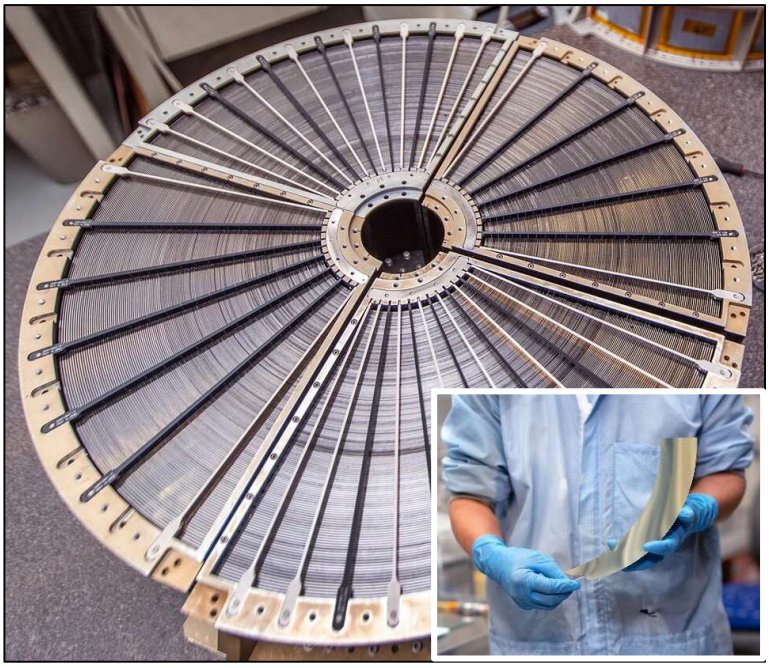
Aditya-L1 carries a suite of seven instruments, including a Visible Emission Line Coronagraph to study the Sun's corona and coronal mass ejection events, a Solar Ultraviolet Imaging Telescope designed to make observations of the full disc of the Sun at near-ultraviolet wavelengths, a pair of x-ray imaging instruments, a magnetometer, and several other instruments to investigate the solar wind. The spacecraft has a nominal five-year design life.

The science objectives for the mission are focused on space weather, include a better understanding of the phenomena of coronal heating (why the Sun's outer atmosphere can reach 2 million degrees (F) while the solar surface is significantly cooler at around 10,000 degrees) and how the corona interacts with the solar wind (a steady stream of charged particles the flows throughout the solar system). Other missions objectives are targeting the root cause of solar flares and coronal mass ejections and the unevenness in the distribution of particles (by direction) in the solar wind.

Japan Launches an X-ray Telescope and Lunar Lander

The Japan Aerospace Exploration Agency (JAXA) successfully launched its X-ray Imaging and Spectroscopy Mission (XRISM) from the Tanegashima Space Center on September 7th (JST), confirming shortly thereafter that the spacecraft was power-positive and that all systems were operating normally. Commissioning of the telescope and onboard equipment is expected to last about three months

X-ray Mirror Assembly and a Single Foil
Credit: NASA/Taylor Mickal

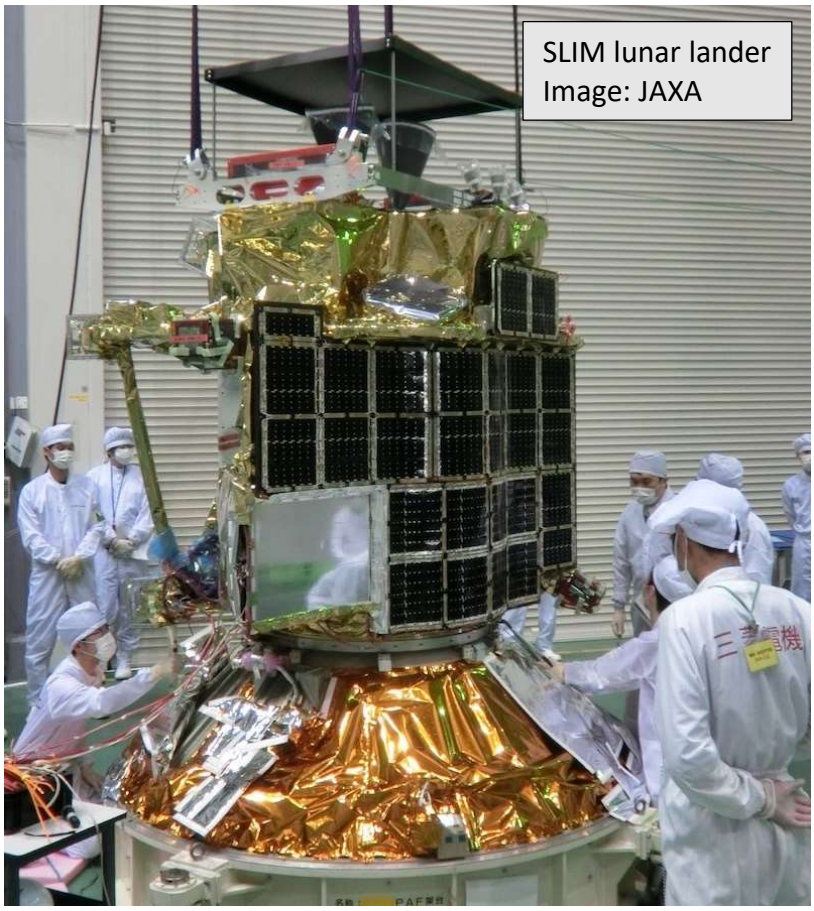


The X-ray telescope, unlike a classical optical telescope which X-rays would pass through, uses polished aluminum mirror segments to deflect incoming X-rays to the spacecraft's two instruments - an X-ray calorimeter spectrometer and an X-ray imager. The primary and secondary mirrors each contain a total of 1,624 segments or foils.

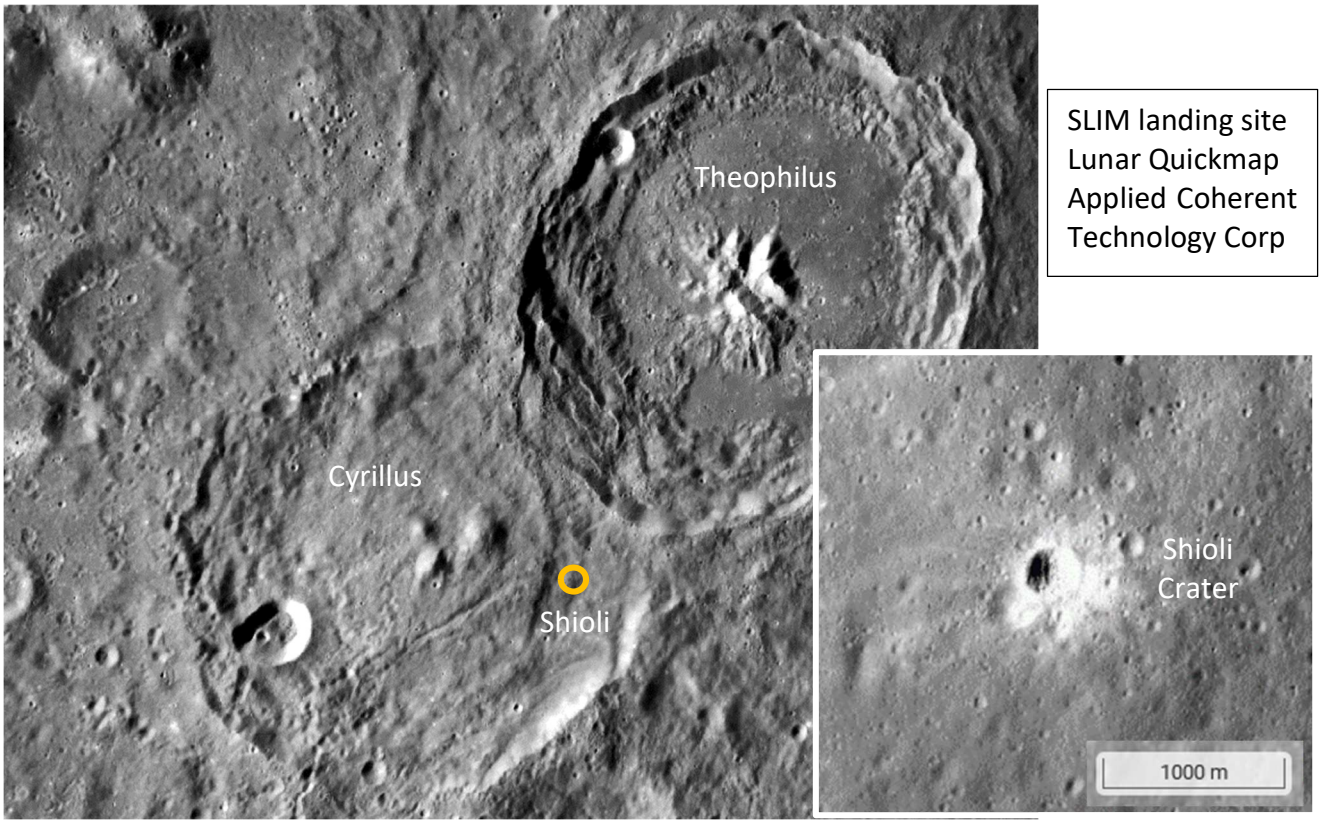
XRISM will orbit the Earth at an altitude of 340 miles (550 km). The helium supply, that cools the X-ray spectrometer, is expected to last about 3 years.

Sharing the ride into orbit onboard the H-2A rocket with XRISM was JAXA's Smart Lander for Investigating Moon (SLIM or "Moon Sniper"). The small-scale exploration lander is intended to demonstrate high-precision landing technology. The lander separated from the launch vehicle about 48 minutes after liftoff and was placed on a fuel-saving trajectory. It will take about 4 months to reach the Moon.

Once in orbit, the spacecraft will spend a month determining its location with respect to the targeted landing site before starting a powered descent. SLIM is expected to set down near the ejecta blanket of the 900 foot diameter (.27 km) Shioli crater located inside the much larger crater Cyrillus.

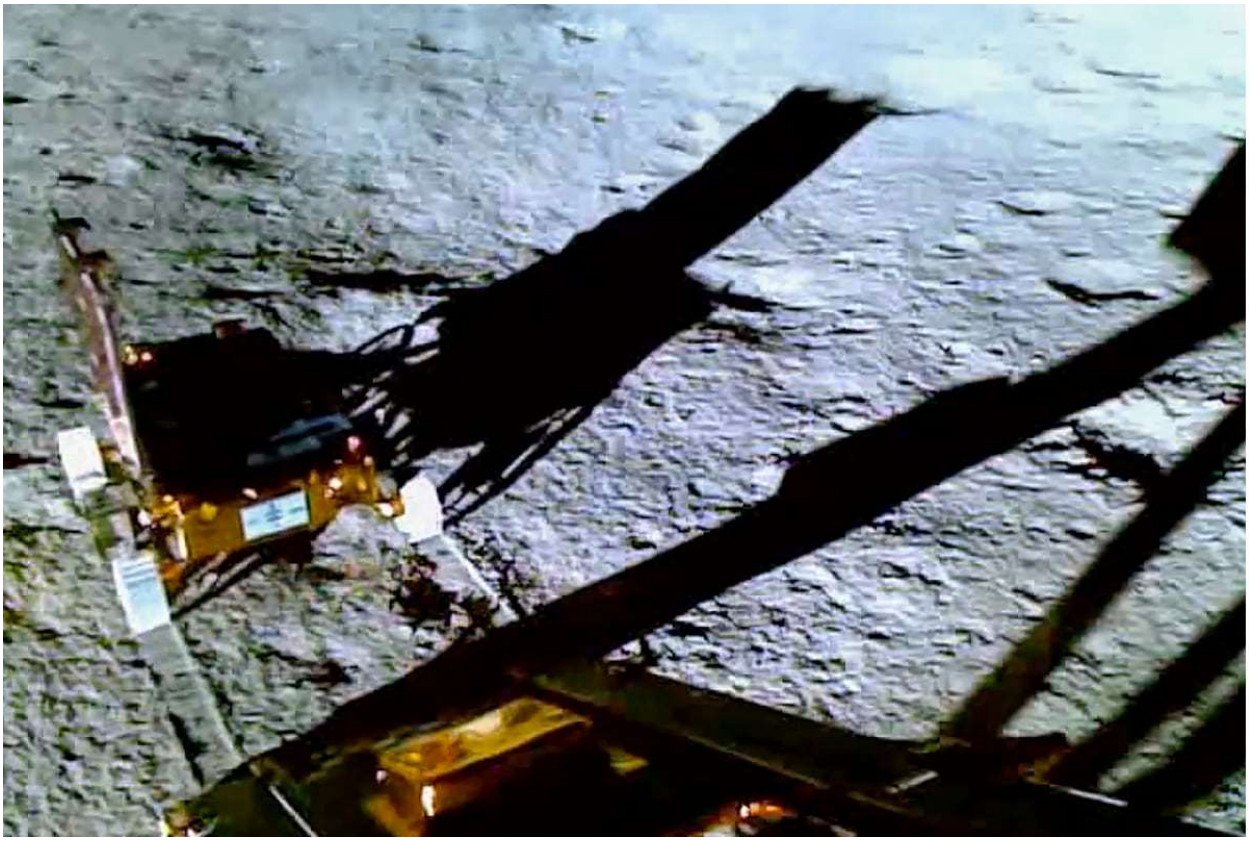


SLIM lunar lander
Image: JAXA



SLIM landing site
Lunar Quickmap
Applied Coherent
Technology Corp

Chandrayaan-3 Completes Mission



Pragyaan rover at the base of the ramp
Image: ISRO

The Indian Space Research Organization's (ISRO) Chandrayaan-3 Vikram lander released a six-wheeled 60 pound (27kg) rover called "Pragyan" (meaning "wisdom" in Sanskrit) shortly after a successful landing near the lunar south pole on August 23rd. The mission, meant to only last two weeks, or one lunar day, made history as the first to land near the pole.

In its short excursion around the landing site, Pragyan employed its Alpha Particle X-Ray Spectrometer and the Laser Induced Breakdown Spectroscope to identify the minerals present on the surface. The rover did detect Sulphur, a relatively rare element on the Moon, as well as traces of Aluminum, Calcium, Iron, Chromium, Titanium, Manganese, Silicon, and Oxygen, but was still searching for the elusive signs of hydrogen as the lunar day ended.

Instruments on the lander assessed the Moon's surface thermal properties, measured lunar seismic activity and analyzed the local gas and plasma environment. The lander did record a seismic event on its third day on the surface, possibly of natural origin (scientists had identified two lobate scarps or thrust faults in the vicinity of the landing site that could have generated shallow moonquakes)

While not designed to survive the lunar night, ISRO put the rover and lander to sleep on September 2nd with fully charged batteries and the rover's solar panel oriented to receive the light of the next sunrise on September 22nd. Unfortunately, the equipment appeared to succumb to the extreme nighttime temperatures (-184°F or -120°C). As of the end of September, no signals had been received from the site.

Saturn

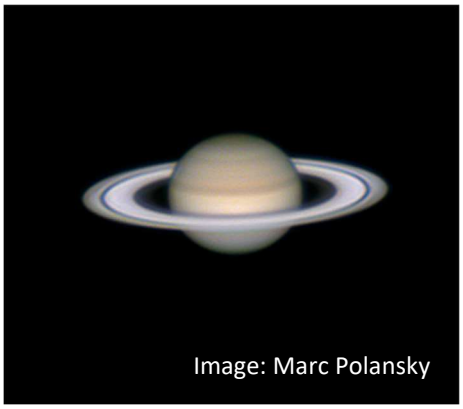


Image: Marc Polansky

Saturn reached Opposition on August 27th when the ringed-world was closest to Earth. Since that time, the distance between the Earth and Saturn has been gradually increasing with Earth's higher orbital velocity. Saturn is still well placed in the evening sky in the constellation Aquarius. The planet's north pole is currently tilted towards the Earth with its rings inclined at an angle of almost 8° to our line of sight. We see the ring tilt change (from our perspective) over Saturn's 29.5-year orbit. The last ring crossing (when the rings disappeared) was in 2009. Since then, the rings opened to a maximum of 27° before starting to close. The rings will disappear in 2025 before the process begins again, starting to open back up again, this time with the southern hemisphere tilted toward Earth.

Jupiter


Image: Marc Polansky

Jupiter reaches Opposition this year on November 3rd. By the end of September, the gas giant shines brightly in the eastern sky after sunset (almost 25 times brighter than Saturn). The largest planet in the solar system can be found in the constellation Pisces and to the east of Saturn.

	Rise and Meridian Transit Times (EDT)			
	October 1		October 31	
Planet	Rise	Transit*	Rise	Transit*
Saturn	5:30 p.m.	10:59 p.m.	3:30 p.m.	8:57 p.m.
Jupiter	8:52 p.m.	3:35 a.m.	6:43 p.m.	1:23 a.m.

* The celestial meridian is an imaginary the line that connects the north and south points of the horizon with the observer's zenith (point directly overhead). A planet is highest in the sky when it crosses or transits the meridian.

Jovian Moon Transits

Jupiter's four Galilean moons are large enough to be seen with a small telescope. The orbits of the inner three moons are synchronized (orbital resonance) with Europa's orbital period twice Io's period, and Ganymede's orbital period twice that of Europa (e.g., in the time it takes Ganymede to go around Jupiter once, Europa makes two orbits and Io makes four orbits). On nights of good visibility, the shadow(s) of Jupiter's moon(s) can also be seen on the cloud tops as they cross (transit) the planet's disk. Only events that start in the evening are included. A more complete listing can be found in Sky & Telescope's monthly magazine.

Jovian Moon Transits

Date	Moon	Transit Begins	Transit Ends
2nd	Europa	9:35 p.m.	11:54 p.m.
5th	Io	9:50 p.m.	11:59 p.m.
12th	Ganymede	9:56 p.m.	11:41 p.m.
14th	Io	6:12 p.m.	8:23 p.m.
21st	Io	8:07 p.m.	10:17 p.m.
27th	Europa	6:39 p.m.	8:59 p.m.
28th	Io	10:02 p.m.	12:12 a.m. (29th)

Great Red Spot Transits

The Great Red Spot is a large, long-lived cyclone in the upper Jovian atmosphere. The Earth-size storm will cross the center line of the planetary disk on the following evenings during the hours between 6 p.m. to midnight local time.

Date	Transit Time	Date	Transit Time
Sept 30th	10:15 p.m.	17th	9:14 p.m.
2nd	11:53 p.m.	19th	10:52 p.m.
3rd	7:44 p.m.	20th	6:43 p.m.
5th	9:22 p.m.	22nd	8:21 p.m.
7th	11:00 p.m.	24th	9:59 p.m.
8th	6:51 p.m.	26th	11:37 p.m.
10th	8:29 p.m.	27th	7:28 p.m.
12th	10:07 p.m.	29th	9:06 p.m.
15th	7:36 p.m.		

Space Race History

On October 11, 1968, a Saturn 1-B rocket carried Apollo 7, the first manned Apollo command and service module, into low-Earth orbit. The test flight would last almost 11 days and complete 163 orbits of the Earth. Walter Schirra (5th American in space when he flew the Mercury-Atlas 8 mission on October 3, 1962), commanded the crew along with command module pilot Donn Eisele and lunar module pilot Walter Cunningham.

The Block II command module was a redesigned and much improved version of the Block I model that was involved in the Apollo 1 accident. The two-piece, inward opening and bolted hatch on the Block I model was replaced with a one-piece, outward opening, quick release hatch on the Block II module. The 100% oxygen atmosphere used in the Block I module was also replaced with a less flammable 60% oxygen and 40% nitrogen mixture at launch. The air in the Block II module was purged and converted to 100% oxygen as the flight progressed.

Apollo 7 did not carry a lunar lander; however, a simulated docking with the third stage was planned (the lunar lander would be carried within the third stage in future flights). Schirra canceled the docking maneuvers when one of the adapter panels on the third stage did not fully deploy (the panels were jettisoned with explosive charges on future flights to avoid such a reoccurrence since access to the lunar module was vital to a lunar mission).

There were relatively few problems with the spacecraft and most were resolved before Apollo 8 made its historic trip to the Moon in the following December. The service module's main engine, which was required to enter into and leave lunar orbit performed flawlessly, restarting eight times during the mission. The overall performance of the Apollo 7 command and service module was a significant factor in NASA's decision to send Apollo 8 to the Moon after only one low-Earth test flight.

<u>October Nights</u>

As the nights grow longer and cooler our view of the night sky begins to change. Summer evenings showcase our own galaxy, the Milky Way. The center of our spiral galaxy is in the direction of the constellation Sagittarius, which appears in the southern sky throughout the summer. In the autumn, as Sagittarius disappears into the west, the stars forming the Great Square of Pegasus rise in the east. Following Pegasus is the Andromeda Galaxy, one of the most distant objects that can be seen with the unaided eye at approximately 2.5 million light years (14.7 million trillion miles). With the rising of Andromeda, we begin to look outward to the outer arms of our own galaxy and to other galaxies far, far away.

Sunrise and Sunset (from New Milford, CT)

Sun	Sunrise	Sunset
October 1st (EDT)	06:50	18:35
October 15th	07:05	18:12
October 31st	07:24	17:49

Astronomical and Historical Events

1st History: launch of Chang'e 2 – China's Moon Orbiter (2010)
1st History: NASA created by the National Aeronautics and Space Act (1958)
2nd History: First flyby of Mercury by the BepiColombo spacecraft (2021
2nd History: opening of the Hayden Planetarium (1935)
3rd Close approach of Apollo asteroid 349507 (2008 QY), Near-Earth Object (NEO) and Potentially Hazardous Asteroid (PHA)
3rd History: launch of the fifth Mercury flight, piloted by astronaut Walter Schirra (1962)
3rd History: fall of the Zagami Martian meteorite in Katsina Province, Nigeria; the meteorite is classified as a Shergottite and is the largest single individual Mars meteorite ever found at 40 pounds (1962)
3rd History: first successful test launch of the German A-4 rocket (V-2) (1942)
3rd History: fall of the Chassigny Martian meteorite in Haute-Marne province, France; the meteorite is distinctly different from other Martian meteorites (shergottites and nakhilites) and is classified as its own subgroup – "chassignites" (1815)
4th History: Japanese lunar probe "Selenological and Engineering Explorer" (SELENE) enters lunar orbit; also known as Kaguya, the spacecraft was designed to study the geologic evolution of the Moon (2007)
4th History: SpaceShipOne rockets to an altitude of almost 70 miles to win the $10 million Ansari X Prize (2004)
4th History: launch of Luna 3; Soviet spacecraft was first to photograph the far side of the Moon (1959)
4th History: launch of Sputnik 1, world's first artificial satellite (1957)
5th Launch window opens for NASA's Psyche asteroid mission. A SpaceX Falcon Heavy will launch the Psyche spacecraft from the Kennedy Space Center, Florida, to the metallic asteroid Psyche, where it will enter orbit in 2029
5th History: Edwin Hubble's discovery of Cepheid Variable Star V1, a special class of variables that can be used measure large cosmic distances (1923)
5th History: launch of the space shuttle Challenger (STS-41-G), crew included astronaut Kathryn Sullivan, first American women to walk in space (1984)
5th History: Robert Goddard born, founding father of modern rocketry (1882)
6th Last Quarter Moon
6th Close approach of Apollo asteroid (2022 TD), Near-Earth Object (NEO)
6th History: Asteroid 2008 TC3 discovered by astronomers on Mt. Lemmon less than 24 hours before exploding over the Sudan. The McCarthy Observatory submitted one of the last accepted observations. Meteorites from the fall were eventually recovered. (2008)
6th History: launch of the space shuttle Discovery and the solar polar orbiter spacecraft Ulysses (1990)
8th Close approach of Apollo asteroid (2018 ER1), Near-Earth Object (NEO)

Astronomical and Historical Events

9th Moon at apogee (furthest distance from Earth in its orbit)
9th Draconids Meteor Shower peak (produced by debris from Comet Giacobini-Zinner)
9th History: LCROSS impacts crater Cabeus near the Moon's south pole in search of water (2009)
9th History: Peekskill meteorite fall; 27-pound meteorite hits a 1980 Chevy Malibu sitting in its driveway in Peekskill, NY (1992)
9th History: discovery of Supernova 1604 (Kepler's Nova) (1604)
10th History: inauguration of the Very Large Array, one of the world's premier astronomical radio observatories; located west of Socorro, New Mexico (1980)
10th History: enactment of the Outer Space Treaty: 1) prohibited placement of nuclear and other weapons of mass destruction in orbit, on the Moon or other celestial body and 2) limited the use of the Moon and other celestial bodies to peaceful purposes (1967)
10th History: discovery of Neptune's moon *Triton* by William Lassell (1846)
11th Close approach of Apollo asteroid (2022 UX1), Near-Earth Object (NEO)
11th Close approach of Apollo asteroid (2015 KW120), Near-Earth Object (NEO)
11th History: NASA's historic 100th space shuttle flight as Discovery carries the Z1 Truss (first piece of the ISS structural backbone) into space (2000)
11th History: Magellan spacecraft burns up in the Venusian atmosphere after completing its mission to map the planet with its imaging radar (1994)
11th History: launch of first manned Apollo mission (Apollo 7) with astronauts Schirra, Eisele and Cunningham (1968)
11th History: launch of WAC Corporal, first man-made object (16-foot rocket) to escape Earth's atmosphere (1945)
12th History: launch of Voskhod 1; Soviet spacecraft was first to carry multiple (3) cosmonauts (a pilot, scientist and physician) into space. Due to the cramped conditions the crew flew without spacesuits, ejection seats, or an escape tower (1964)
12th History: first Symposium on Space Flight held at the Hayden Planetarium in New York City; participants included Wernher von Braun, Willy Ley, and Fred L. Whipple; topics included an orbiting astronomical observatory, survival in space, circumlunar flight, a manned orbiting space station, and the question of sovereignty in outer space (1951)
13th Close approach of Apollo asteroid (2021 NT14), Near-Earth Object (NEO) and Potentially Hazardous Asteroid (PHA)
13th History: launch of Shenzhou 6, China's second manned spacecraft (2005)
13th History: launch of Explorer 7; spacecraft measured solar X-rays, energetic particles, and cosmic rays (1959)
13th History: formation of the British Interplanetary Society by Phillip Cleator in Liverpool (1933)
14th New Moon
14th Annular Eclipse (Partial from Western Connecticut)
14th **Second Saturday Stars at the McCarthy Observatory** (starting at 7:00 p.m.)
14th History: three main belt asteroids discovered by the McCarthy Observatory while searching for NEOs. 2003 TG10 (its provisional name) was subsequently named after Monty Robson (115449 Robson), the founder and director of the observatory (2003)
14th History: launch of Shenzhou 5, first Chinese manned spacecraft (2003)

Astronomical and Historical Events (continued)

14th History: Air Force Captain Chuck Yeager breaks the sound barrier in the Bell X-1 rocket plane (called "Glamorous Glennis" as a tribute to his wife). The plane reached a speed of 700 miles per hour after being launched from the bomb bay of a Boeing B-29 (1947)
15th Close approach of Apollo asteroid (2011 GA), Near-Earth Object (NEO) and Potentially Hazardous Asteroid (PHA)
15th Close approach of Apollo asteroid (2007 SQ6), Near-Earth Object (NEO) and Potentially Hazardous Asteroid (PHA)
15th History: Interstellar Object 1I/2017 U1 (*'Oumuamua*) closest approach to Earth (0.162 AU) (2017)
15th History: launch of the Cassini spacecraft to the planet Saturn (1997)
16th Close approach of Apollo asteroid (2019 UZ3), Near-Earth Object (NEO)
16th Close approach of Apollo asteroid (1998 HH49), Near-Earth Object (NEO) and Potentially Hazardous Asteroid (PHA)
16th History: launch of the Lucy spacecraft on 12-year mission and a flyby of seven Trojan asteroids that orbit the Sun in front of and behind Jupiter (2021)
16th History: launch of GOES 1, first weather satellite placed in geosynchronous orbit (1975)
18th Close approach of Apollo asteroid (2022 UO10), Near-Earth Object (NEO)
18th History: launch of the space shuttle Atlantis (STS-34) and Galileo spacecraft to Jupiter (1989)
18th History: discovery of *Chiron* by Charles Kowal; *Chiron* has the characteristics of both a comet and an asteroid. These types of objects are called Centaurs after a mythological being that are half human/half horse (1977)
18th History: Soviet spacecraft Venera 4 enters the atmosphere of Venus; first probe to analyze the environment (in-situ) of another planet (1967)
18th History: discovery of Asteroid *8 Flora* by John Hind (1847)
19th Close approach of Apollo asteroid (2020 UR), Near-Earth Object (NEO)
19th History: launch of the BepiColombo spacecraft (Mercury orbiters) from the Kourou launch facility in French Guiana. BepiColombo is on a seven-year journey to Mercury carrying orbiters from the European Space Agency and the Japan Aerospace Exploration Agency (2018)
19th History: launch of the IBEX (Interstellar Boundary Explorer) (2008)
19th History: flyby of the planet Venus by the Mariner 5 spacecraft (1967)
19th History: Subrahmanyan Chandrasekhar born; awarded Nobel Prize in Physics (1983) for studies of the structure and evolution of stars; NASA named its premier X-ray observatory the Chandra X-ray telescope in his honor (1910)
20th History: launch of the Soviet spacecraft Zond 8; moon flyby mission (1970)
20th History: discovery of asteroid *577 Rhea* by Max Wolf (1905)
21st First Quarter Moon
21st International Observe The Moon Night
21st Orionids Meteor Shower peak (produced by debris from Comet Halley)
21st History: NASA's Mars Atmosphere and Volatile Evolution (MAVEN) spacecraft successfully entered orbit around Mars - first spacecraft dedicated to studying the Martian atmosphere and its connection to the Red Planet's climate (2014)
21st History: dedication of the Yerkes Observatory in Williams Bay, Wisconsin; home of the world's largest refractor with its 40-inch objective lens ground and polished by Alvan Clark and Sons (1897)

Astronomical and Historical Events (continued)

22nd History: launch of Chandrayaan-1, India's first mission to the Moon (2008)
22nd History: Soviet spacecraft Venera 9 touches down on Venus and transmits first pictures (black and white) of its surface (1975)
22nd History: launch of the Soviet Moon orbiter Luna 12 to take high-resolution photos of the Moon's surface from lunar orbit (1966)
23rd Close approach of Apollo asteroid (2020 FM6), Near-Earth Object (NEO) and Potentially Hazardous Asteroid (PHA)
23rd History: India's Mars Orbiter Mission (MOM) entered orbit around Mars (2014)
23rd History: first time female commanders led orbital missions at the same time: Pamela Melroy commanded space shuttle Discovery (STS-120) to the ISS while Peggy Whitson led the Expedition 16 team aboard the ISS in the installation of a new orbital node (2007)
24th Close approach of Apollo asteroid (2019 HH4), Near-Earth Object (NEO) and Potentially Hazardous Asteroid (PHA)
24th History: launch of Chang'e-1, Chinese lunar orbiter, from the Xichang Satellite Launch Center in the southwestern province of Sichuan (2007)
24th History: Mars Odyssey enters orbit around Mars (2001); science goals included mapping the elemental composition of the surface
24th History: launch of Deep Space 1; first of a series of technology demonstration probes developed by NASA's New Millennium Program; propulsion was provided by a xenon ion engine that operated for a total of 16,265 hours (1998)
24th History: discovery of Saturn's moon Prometheus by Stewart Collins in photos taken by the Voyager 1 probe (1980)
24th History: Over 100 people killed in a launch pad explosion when Air Marshal Mitrofan Nedelin, commander of the USSR's Strategic Rocket Forces, orders workers back to the pad to repair a defective R-16 missile without first unloading the unstable fuel (1960)
24th History: discovery of Uranus' moons *Umbriel* and *Ariel* by William Lassell (1851)
25th Moon at perigee (closest distance to Earth in its orbit)
25th History: launch of the twin Solar Terrestrial Relations Observatories (STEREO A and B); 3-D studies of the Sun and coronal mass ejections (2006)
25th History: Soviet spacecraft Venera 10 touches down on Venus 2,200 km from its twin Venera 9; lands on a flat boulder that was determined to be similar in composition to basalt on Earth (1975)
25th History: discovery of Saturn's moon *Iapetus* by Giovanni Cassini (1671)
26th Close approach of Apollo asteroid (2021 SZ4), Near-Earth Object (NEO) and Potentially Hazardous Asteroid (PHA)
26th Close approach of Aten asteroid 302169 (2001 TD45), Near-Earth Object (NEO) and Potentially Hazardous Asteroid (PHA)
27th History: first test flight of the Saturn I rocket (1961)
28th Full Moon (Hunter Moon)
28th History: Karl Reinmuth's discovery of Apollo asteroid *69230 Hermes* (1937)
28th History: first (and last) test flight of the Ares I-X rocket; a two-minute powered suborbital flight (2009)
28th History: launch of Prospero spacecraft, Great Britain's first space launch (1971)
29th History: launch of the space shuttle Discovery (STS-95) with astronaut and then U.S. Senator, John Glenn (1998)
29th History: flyby of asteroid *Gaspra* by the Galileo spacecraft on mission to Jupiter (1991)

Astronomical and Historical Events (continued)

30th Close approach of Apollo asteroid 525229 (2004 UU1), Near-Earth Object (NEO) and Potentially Hazardous Asteroid (PHA)
30th History: discovery of the Los Angeles (Mars) Meteorite (1999)
30th History: launch of Venera 13, Soviet Venus lander; lander survived for 127 minutes on the surface where the temperature was recorded at 855 °F (1981)
30th History: Mercury Theatre broadcasts Orson Welles' adaptation of H.G. Wells "War of the Worlds" (1938)
31st History: Walter Baade's discovery of the first Centaur Object, 944 Hidalgo (1920)
31st History: birthday of Apollo 11 Command Module pilot Michael Collins (1930)
31st History: first rocket engine tests by three young rocketeers that would be the beginning of what would become the Jet Propulsion Laboratory (1936)

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

International Space Station and Artificial Satellites

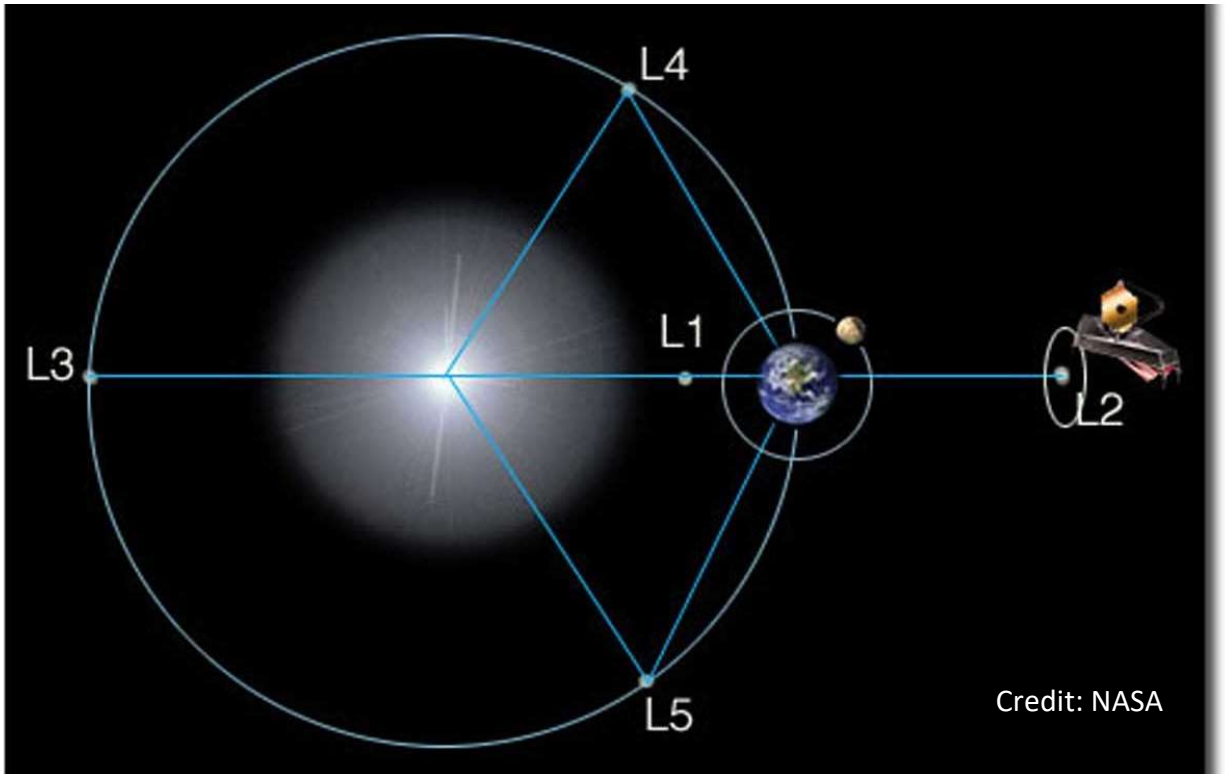
Visit www.heavens-above.com for the times of visibility and detailed star charts for viewing the International Space Station and other man-made objects in low-Earth orbit.

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.

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 James Webb telescope) is located almost a million miles (1.5 million km) beyond the Earth (as viewed from the Sun).



James Webb Space Telescope

- https://www.jwst.nasa.gov/

NASA's Global Climate Change Resource

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

Mars – Mission Websites

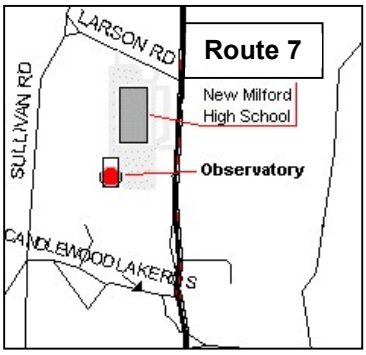
- Mars 2020 (Perseverance rover): https://mars.nasa.gov/mars2020/
- Mars Helicopter (Ingenuity): https://mars.nasa.gov/technology/helicopter/
- Mars Science Laboratory (Curiosity rover): https://mars.nasa.gov/msl/home/

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