Galactic Observer

John J. McCarthy Observatory

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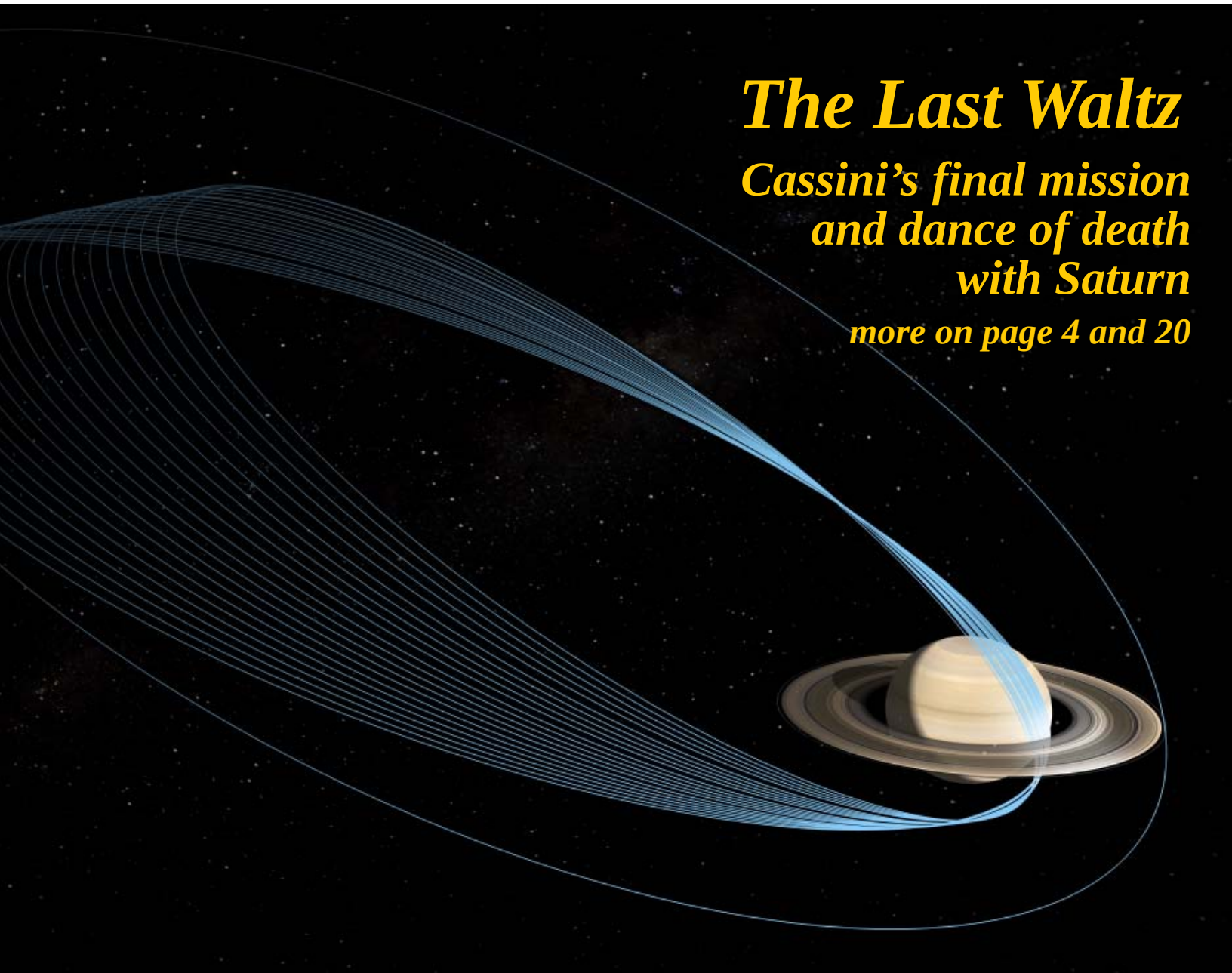

The Last Waltz

Cassini's final mission and dance of death with Saturn

more on page 4 and 20

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It is through their efforts that the McCarthy Observatory has established itself as a significant educational and recreational resource within the western Connecticut community.

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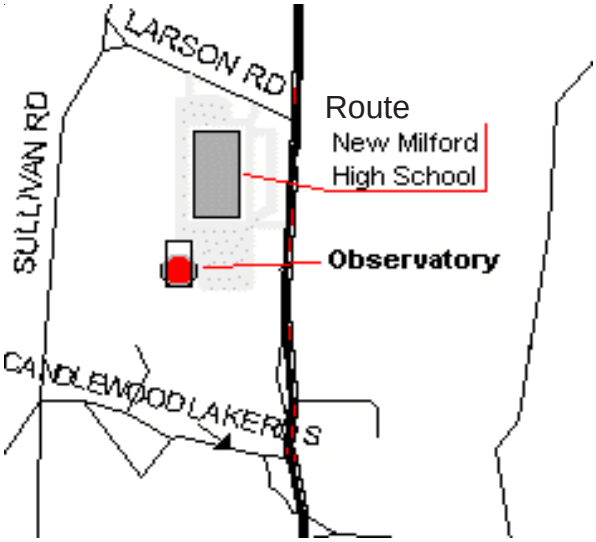

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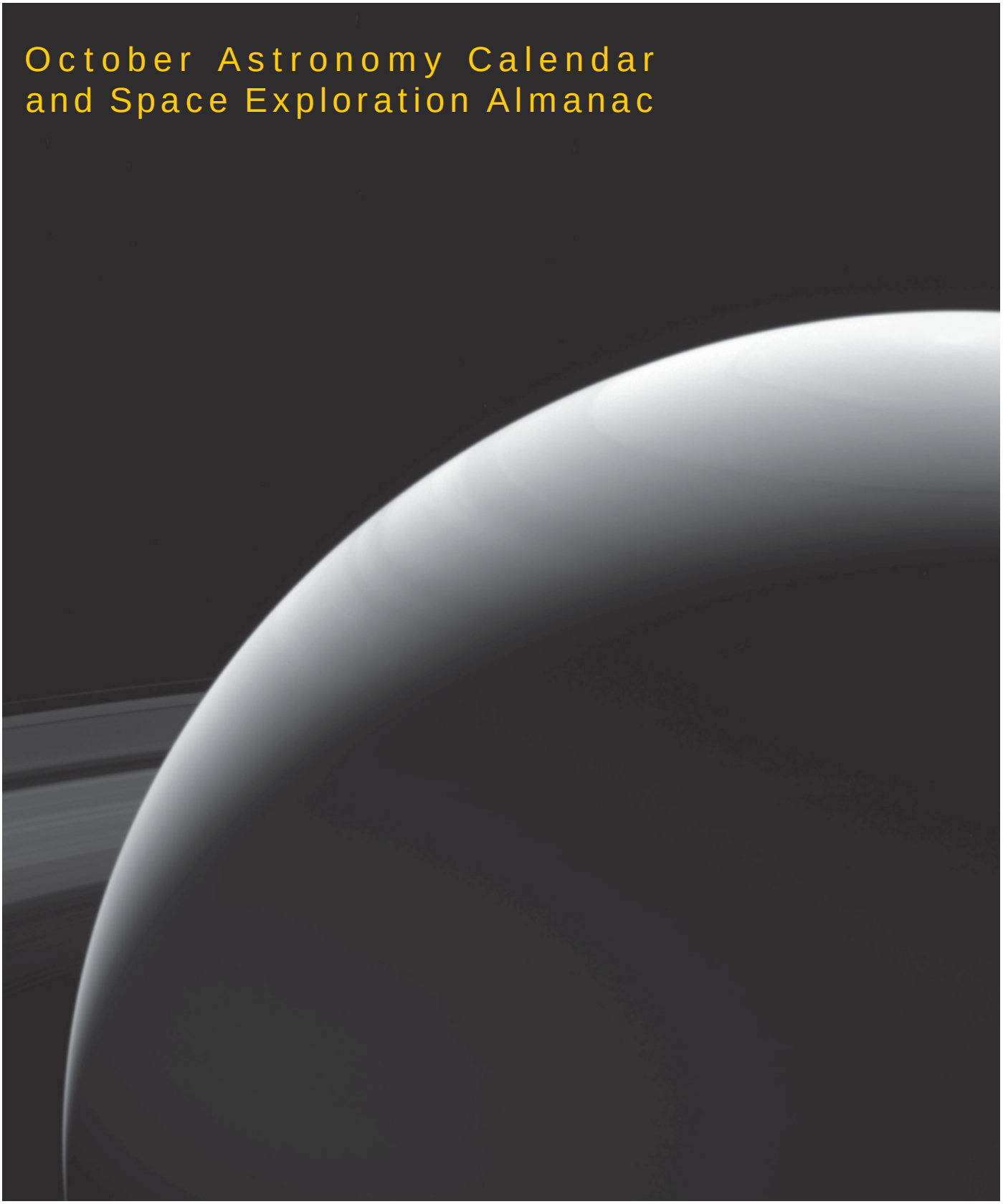


One of the last images transmitted by the Cassini spacecraft, just two days prior to mission end. The raw image, in visible red light, was taken at a distance of 684,000 miles (1.1 million kilometers) and looks down on the rings from above Saturn's north pole.

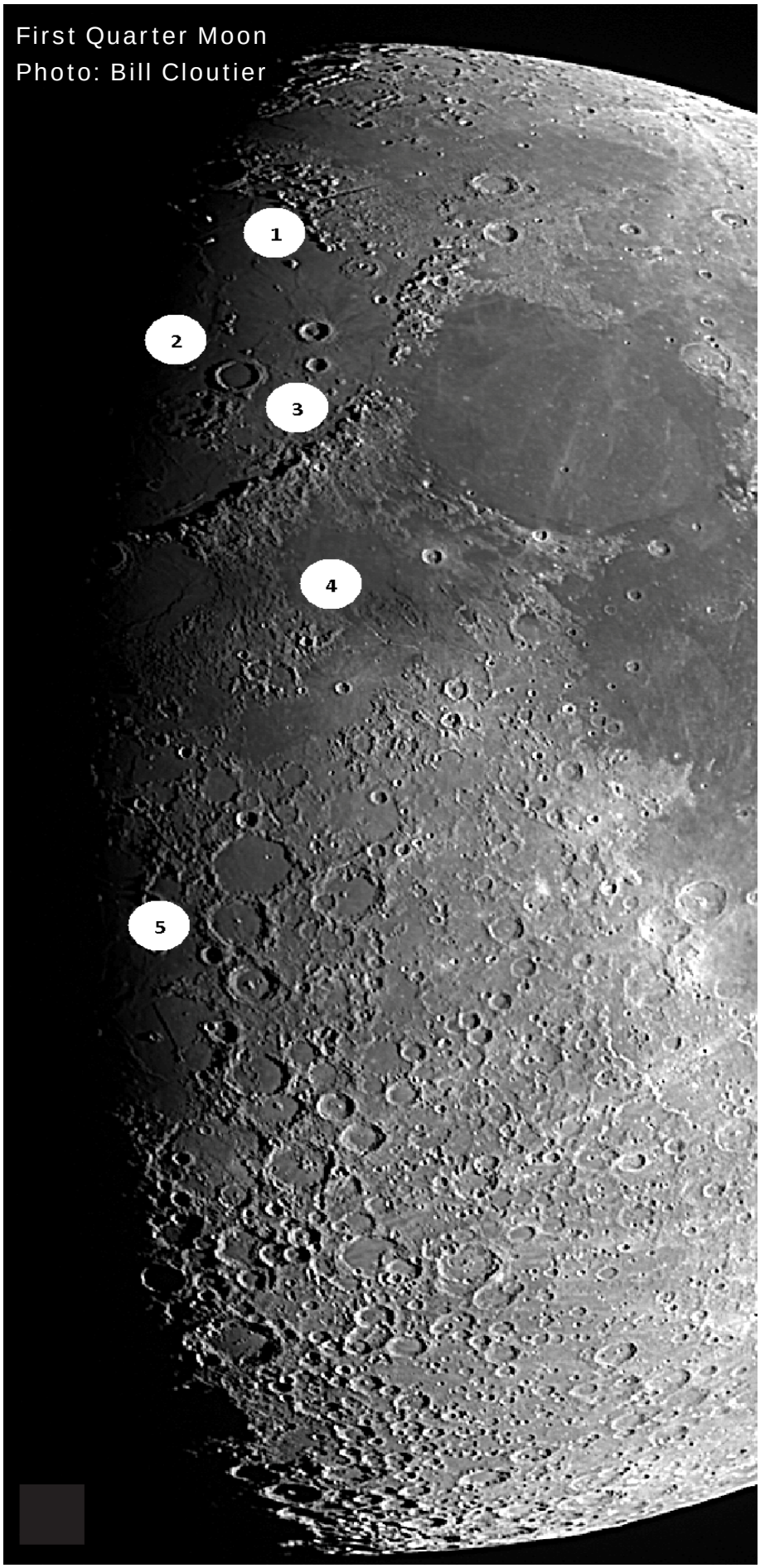
Image Credit: NASA/JPL-Caltech/Space Science Institute

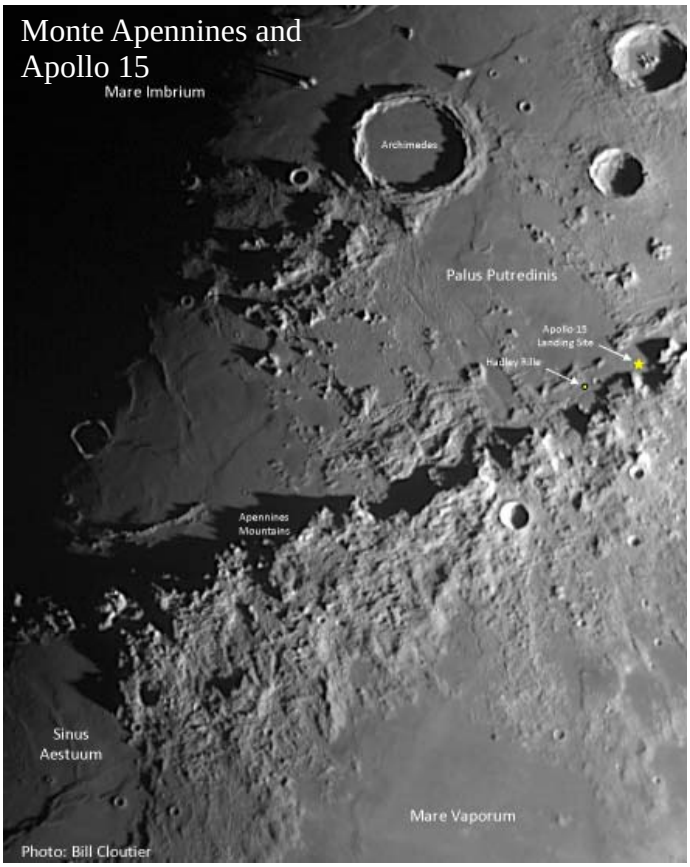
International Observe the Moon Night

OCTOBER 28th is the International Observe the Moon Night (InOMN). The event was first inspired by public outreach events held in August 2009 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, respectively. 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. Information on InOMN events is available on their website *http://observethemoonnight.org/*.

The Moon will rise at 2:32 pm (EDT) on the 28th and set after midnight. Approximately 57% of the near-side surface will be illuminated as the Sun sets and twilight deepens. With clear skies, the following lunar features will be visible along the terminator (day/night boundary):

1. Vallis Alpes (Alpine Valley): a graben traversing the lunar Alps;
2. Archimedes crater: a 50 mile (81 km) diameter impact crater flooded with mare basalt;
3. Montes Apenninus (Apennine Mountains): segment of Imbrium impact basin rim and landing site of Apollo 15;
4. Hyginus crater and intersecting linear rille: likely formed by the collapse of a lava tube roof;
5. Alphonsus crater: a 68 mile (110 km) diameter crater with dark halo deposits from volcanic eruptions.





Farewell to the Ring World

Epilogue by Bill Cloutier

In the early morning hours of October 15, 1997, a Titan IVB/Centaur rocket blasted off from Cape Canaveral Air Force Station's Space Launch Complex 40. Aboard the rocket was the Cassini orbiter and the Huygens probe. With mulitple gravitational assists from Venus (twice), Earth and Jupiter, the spacecraft entered orbit around Saturn seven years later in 2004. The mission was a joint project of NASA, the European Space Agency and the Italian Space Agency, with more than 5,000 people worldwide contributing to the endeavor over the life of the mission.

Nearly 20 years later, in the early morning of September 15th, the Cassini spacecraft, nearly out of fuel, concluded its mission as it entered the Saturn atmosphere at a relative velocity of 77,000 miles per hour (123,000 kph) – transmitting data in real-time until its thrusters could no longer keep the spacecraft's antenna pointed to Earth. Shortly thereafter, the spacecraft was vaporized, joining the atmosphere of the world that it had been studying for more than 13 years.

The end of the mission was marked with tears and accolades. Cassini was described by those who knew her best as the perfect machine for the mission and she exceeded all expectations right to the end, transmitting data on the gas giant's atmosphere and its magnetic field 30 seconds longer than expected. The Deep Space Network's (DSN) antenna in Canberra, Australia, received the spacecraft's last data bits.

I was fortunate to be able to witness the end of this iconic mission from the Caltech campus in Pasadena with my daughter Kyle, an engineer and science planner on the project, along with hundreds of mission personnel, project scientists, project alumni, dignitaries and honored guests, as telemetry streamed in from the control room at the nearby Jet Propulsion Laboratory and was displayed on movie-house-sized screens set up on campus in the pre-dawn hours. The crowd was reflective, most of the chairs were empty, as people stood and watched, in some cases, the conclusion of a mission on which they had spent their entire career.

The end came quickly as the density of the atmosphere rapidly increased and the pressure wave that formed in front of the spacecraft created Sun-like temperatures. The reaction control system thrusters fought to maintain antenna lock on Earth, peaking at 100 percent power, but the effort was short-lived as the spacecraft started to break apart.

The crowd fell silent as the radio singles from Cassini flat-lined. The last data packet received was believed to be from the spacecraft's

magnetometer - valuable information that may explain the unusually close alignment of the planet's spin axis and magnetic field.

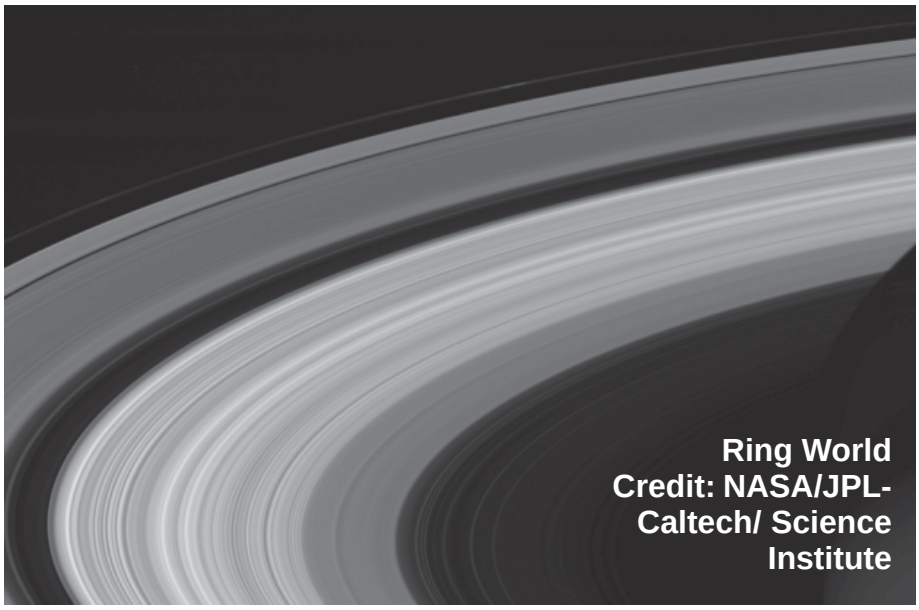
The final images captured by the spacecraft's cameras included, appropriately, the ice-covered watery moon Enceladus setting behind the planet's rings, Saturn's largest moon Titan (relied upon over the years to modify the spacecraft's orbit), a final color mosaic of the planet and its vast ring system, the small moon Daphnis and the gravity waves created along its wake in the Keeler ring gap, a propeller-like feature in the rings created as small, embedded moonlets attempt to open new gaps and a close-up of the impact site within the planet's turbulent cloud banks.

The melancholy mood of the crowd was slowly replaced by a sense of satisfaction – pride in designing a spacecraft and executing a mission far beyond the expectations of the original planners. At Titan, scientists found a prebiotic chemistry and an organic haze. A liquid ocean with active geysers was detected, possibly heated by hydrothermal activity under the icy surface, on the tiny moon Enceladus. Both discoveries present compelling arguments for future exploration of the Saturnian system.

The scientists and engineers watching the downlink of the spacecraft's telemetry were well aware that the mission had ended well before the final data packet reached Earth. A graphic of the solar system displayed the progress of the final bits of data as it made its way across the void - requiring 83 minutes to cross the distance between the two planets, despite traveling at the speed of light.

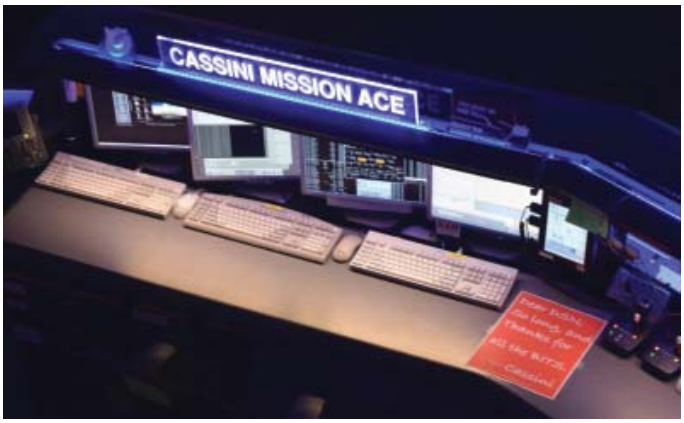
Our resident eye upon the crown jewel of solar system, with its seemingly infinite ringlets and diverse moons, has now gone dark. Life may teem below the icy surface of Saturn's moons or in the tidal pools of Titan, but those discoveries will have to wait until we choose to return.

Artist Rendering of Atmospheric Entry NASA/JPL-Caltech



Ring World Credit: NASA/JPL-Caltech/ Science Institute

Entry Site of the Cassini Orbiter Image credit: NASA/JPL-Caltech/ University of Arizona



24 hours after mission end, the console of the Cassini Mission Controller still displayed the final telemetry from the spacecraft in the Jet Propulsion Laboratory's Control Room along with a note left for the Deep Space Network (DSN)

The Great American Solar Eclipse

Photo Montage: Bill Cloutier

On August 21st, residents of North America were treated to a total solar eclipse as the Moon passed directly between the Sun and the Earth. Within a narrow path, from Oregon to South Carolina, the Moon completely covered the Sun for up to 2½ minutes (a phase called "Totality"). Outside that path, the Moon only obscured a portion of the Sun (Partial Eclipse) – how much depended upon your distance from the centerline of Totality.

The images of the eclipse were captured from Rexburg, Idaho, at an elevation of approximately 5,000 feet and less than 4 miles from the eclipse centerline. At that location, the Moon's shadow (umbra) was 65.8 miles wide and moving 1,873 mph from west to east. Totality lasted 2 minutes and 17.5 seconds in clear skies. The corona (the Sun's ghostly atmosphere) radiated from the seemingly empty space formally occupied by the Sun.

Photo :Bill Cloutier

Pin holes in a piece of card stock were used to project images of the partially eclipsed Sun onto a solar cover blanket - spelling out the date of the Great American Total Eclipse

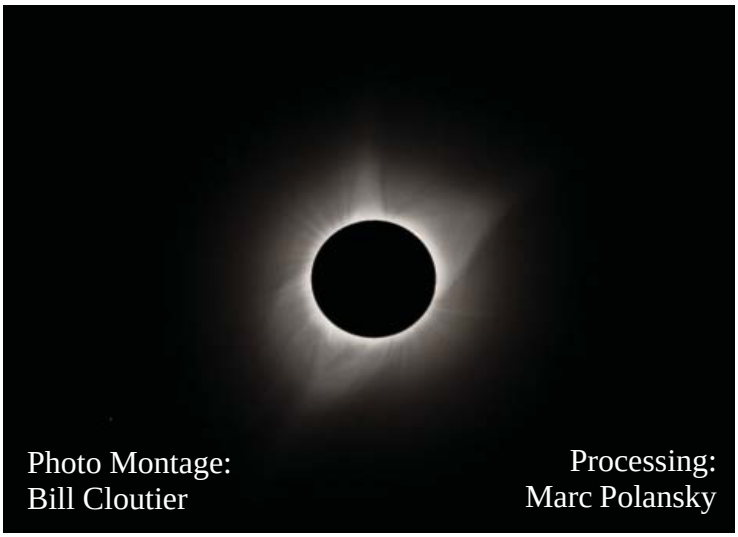


Photo Montage:
Bill Cloutier

Processing:
Marc Polansky

The total eclipse viewing corridor stretched across 14 states, according to NASA. The first sighting in the U.S. on Aug. 21 was in Lincoln Beach, Oregon, at 9:05 a.m. PDT (12:05 p.m. EST) and the last eas expected in Charleston, South Carolina, at 4:05 p.m.

According to *eclipse2017.org*, Connecticut would experience an occultation of 68 percent. The partial phases started in our area at 1:25 p.m., according to both Yale University and Wesleyan University. A maximum effacement of the sun's disk came at 2:45 p.m. and ended around at 4 p.m. A pesky cloud cover hampered viewing for much of the event, but parted just in time to unveil its partial glory.

Bob Lambert, lead volunteer for McCarthy Observatory, described the resources brought to the event and the encouraging public turnout:

- Eighteen volunteers, working as hard and as fast they could to anticipate needs and help every way possible!

- Somewhere around 2,000 visitors: impossible to count or estimate
- Twelve telescopes/binoculars with excellent filters (including projection and time lapse systems.) Every one of them worked perfectly.
- Four projection images to observe: bowling ball scope to foamboard, spotting scope to paper in sonotube (picture in the News Times), video monitor with lightshade around it, and time-lapse image on main screen in warmroom. This helped greatly with the glasses limitation.
- Three wavelength ranges to see: visible spectrum, H-alpha, and CaK

Living in Space

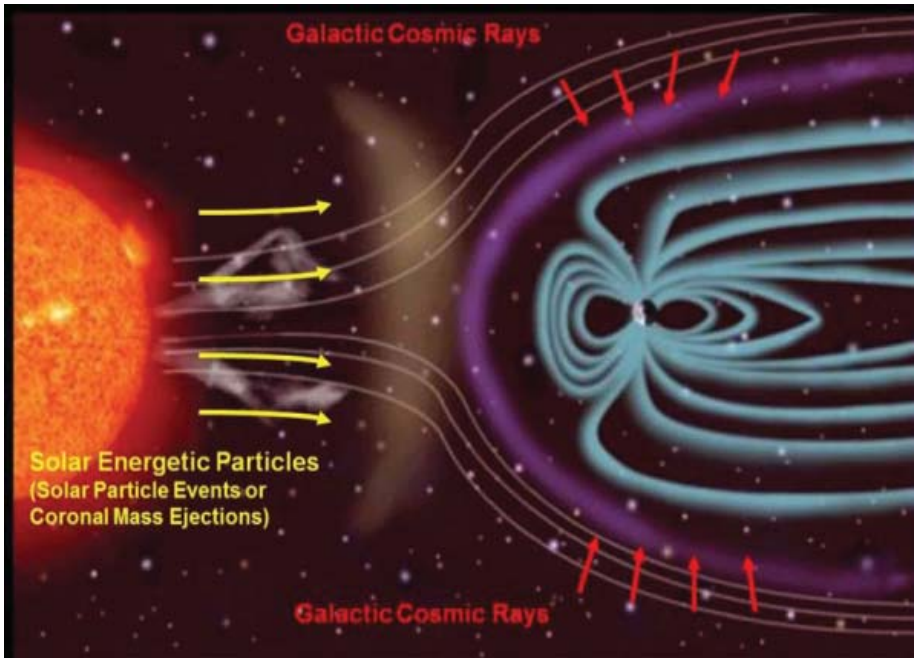
NASA's Mars Science Laboratory (Curiosity) has been operating in Gale Crater on Mars and climbing the slopes of Mount Sharp for the past five years. The evidence suggests that early Mars had an atmosphere with higher concentrations of oxygen and a surface where water flowed in streams and pooled in small lakes – an environment that could have supportted microbial life.

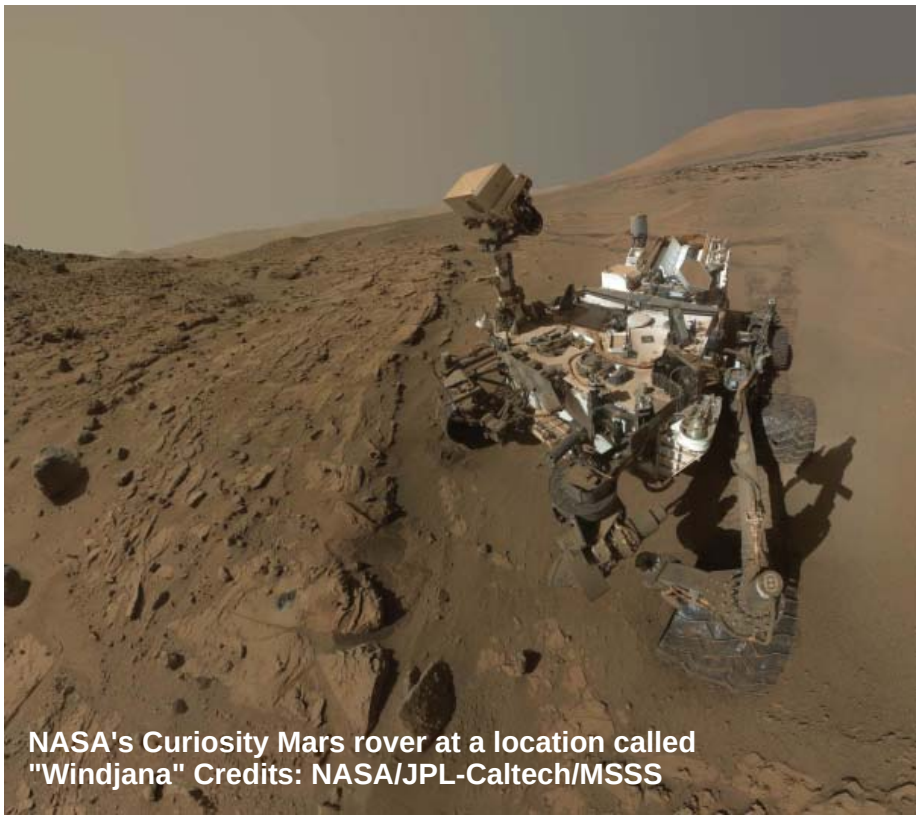
The rover is also equipped with a Radiation Assessment Detector (RAD), an instrument designed to measure the radiation levels during the cruise phase to Mars as well as on the surface. Radiation is one of the major health challenges to humans traveling in deep space and living/working outside the Earth's protective atmosphere and magnetic field, e.g., on the Moon and/or Mars. Long-term health effects from radiation include cancer, cognitive impairment, and damage to genetic material. There are two primary sources of radiation to the space traveler: streams of fast moving protons and electrons from the Sun and atoms of heavier elements (stripped of their electrons) moving at nearly light speed from sources outside the solar system (Galactic Cosmic Radiation or Cosmic Rays).

The data collected by RAD indicates that the surface dose is primarily from cosmic rays, although there were no major solar storms impacting the planet during the reported measurement period. The radiation levels at the Curiosity site were found to be comparable to those measured on the International Space Station (ISS), which are 10 times the levels that humans are exposed to on the Earth's surface from natural, background radiation. (Radiation levels were noticeably less when Curiosity was working next to a cliff which provided a natural shield from cosmic rays).

The exposure to radiation for deep space travelers is approximately three times higher than on the ISS (which orbits inside the Earth's protective magnetic field). For a 3 year mission to Mars (during solar minimum or the least active phase of the Sun) scientists project a cumulative exposure of 1,000-1,300 mSv. This would correspond to a 5% increase in the risk of developing fatal cancer (NASA's current limit for astronauts is 3%).

The data gathered by Curiosity, as well as sensors on the ISS, are being used to advance technologies (passive and active) to mitigate the space traveler's





NASA's Curiosity Mars rover at a location called "Windjana" Credits: NASA/JPL-Caltech/MSSS

exposure to radiation, including innovative spacecraft shielding, deployable magnetic fields, and advanced propulsion technologies to shortening the cruise time.

Eye on the Spot

The Juno spacecraft celebrated its first year in orbit around Jupiter by flying directly over the gas giant's Great Red Spot, the anticyclonic feature that spans 10,159 miles (16,350 km) and that has been monitored by Earthbound observers for several hundred years. In recent times, the storm appears to be shrinking and becoming more circular in appearance.

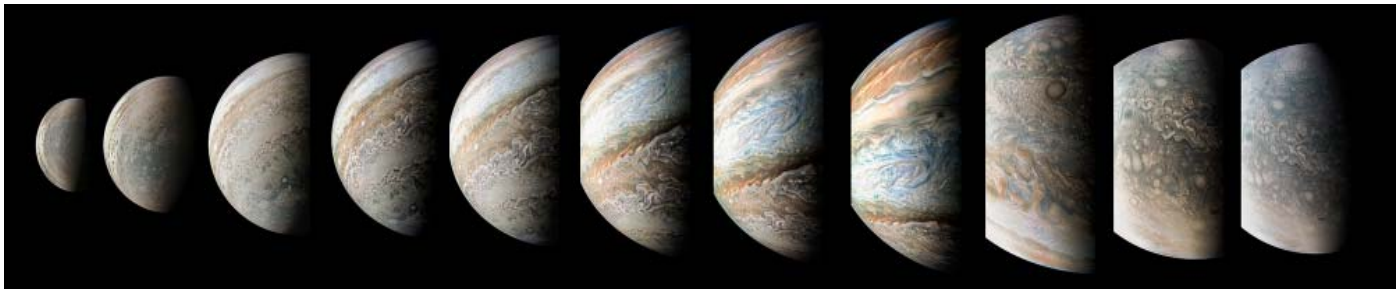
The spacecraft passed about 5,600 miles (9,000 km) above the atmospheric storm. The Great Red Spot rises above the surrounding atmosphere and is significantly cooler. While Jupiter is primarily composed of hydrogen and helium, trace gases such as ammonia, hydrogen sulfide, water vapor and other gases are responsible for its multi-colored appearance. During its December 2000 flyby (and gravity assist), the Cassini spacecraft observed Jupiter with its Visible and Infrared Mapping Spectrometer. With the data, Cassini scientists were able to duplicate the spot's ruddy color in the laboratory by exposing ammonia and acetylene (compounds known to exist in Jupiter's atmosphere) with ultraviolet light (as a proxy for sunlight). Kevin Baines, one of the Cassini team scientists, believes that the storm may play a role in intensifying the color by confining the exposed elements to within the vortex.

Approximate True Color of the Great Red Spot
Credit: NASA/JPL-Caltech/SwRI/MSSS/Björn Jónsson © cc nc sa

Stellar Nurseries

One of the closest stellar nurseries in the Milky Way galaxy is the Orion Nebula, at a distance of 1,350 light years. Astronomers, using the European Southern Observatory's (ESO) Very Large Telescope in Chile, found three distinct groups of newly formed stars, with slightly different ages (born within a 3 million year span), in the nebula. The findings suggest that star formation within these clouds of gas and dust occurs in bursts and not as a more instantaneous process.

The Orion Nebula (at top of next page) can be found in the Orion constellation and is visible to the unaided eye in dark winter skies as a hazy "star" in the middle of Orion's sword.



A sequence of 11 color-enhanced images taken by JunoCam in its 95-minute north-south pass by Jupiter (perijove) on September 1, 2017. In this sequence the south pole is on the left (image 11) and north pole on the right (image 1). Image Credits: NASA/JPL-Caltech/SwRI/MSSS/Kevin M. Gill .

The Orion Nebula captured by the ESO's VLT Survey Telescope's OmegaCAM. Credit: ESO/G. Beccari

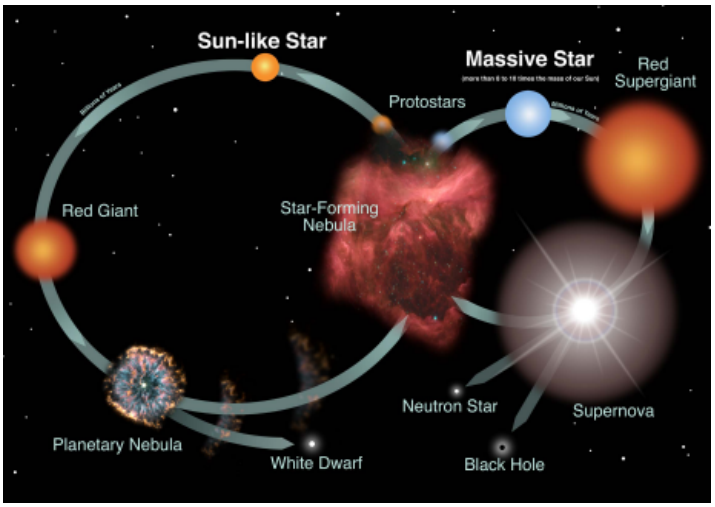
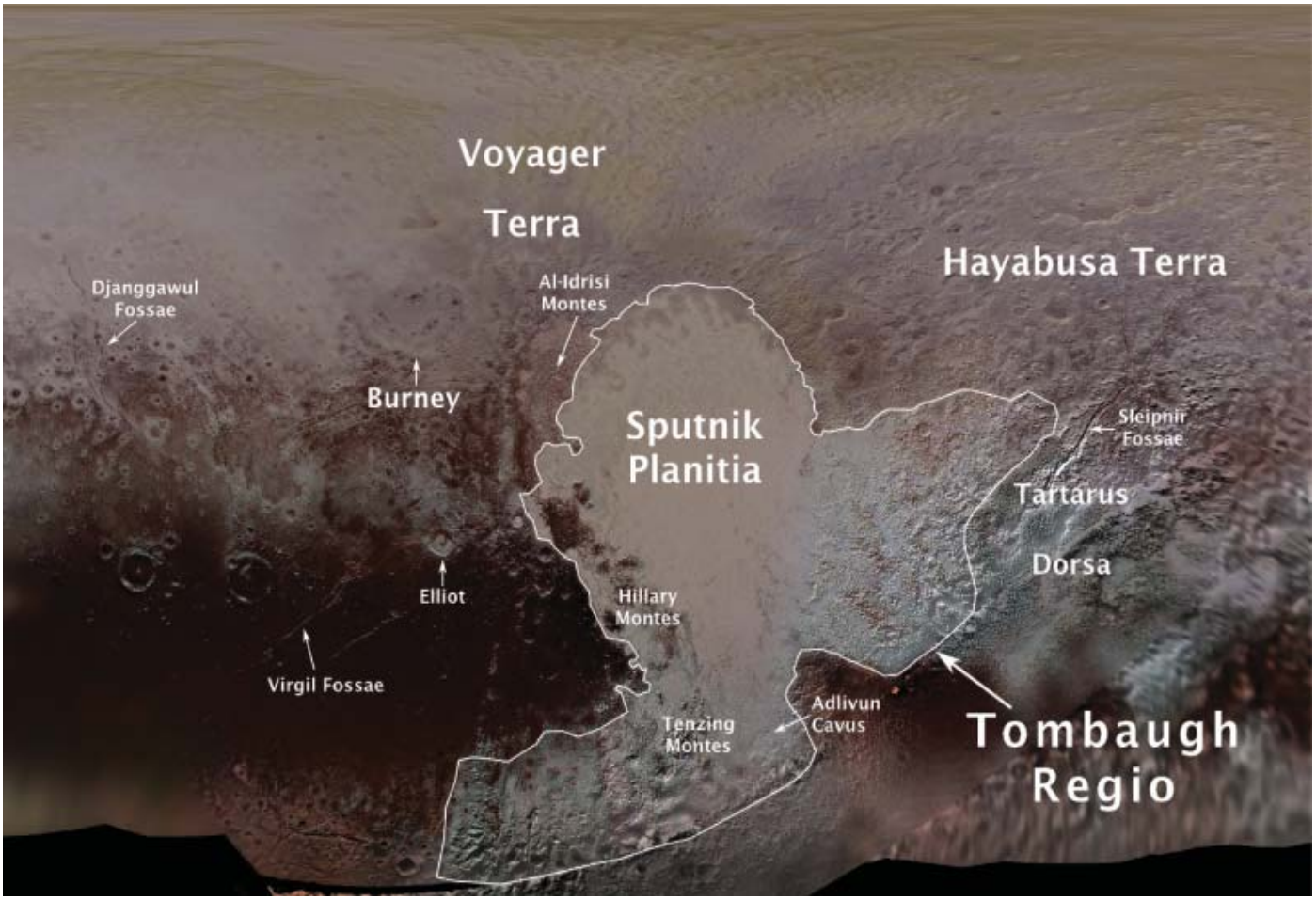


Diagram showing the lifecycles of Sun-like and massive stars.Credit: NASA and the Night Sky Network.

IAU Approves Pluto Nomenclature

The International Astronomical Union's (IAU) Working Group for Planetary System Nomenclature has officially recognized fourteen surface features on the surface of Pluto. Some of the names have been used informally since the 2015 flyby, others were suggested by the public through an on-line campaign. The names recognize historic space missions, historical figures, and underworld mythology.



Pluto Nomenclature
Credit: NASA/JHUAPL/SwRI/Ross Beyer

The names approved by the IAU include:

Tombaugh Regio: honors Clyde Tombaugh (1906–1997), the 24 year old astronomer who discovered Pluto in 1930 while working at the Lowell Observatory

Burney Crater: honors Venetia Burney (1918–2009), who, as an 11-year-old schoolgirl, suggested the name "Pluto"

Sputnik Planitia: an icy plain named after Sputnik 1, the first space satellite, launched by the Soviet Union in 1957

Tenzing and Hillary Montes: mountain ranges that honor Tenzing Norgay (1914–1986) and Sir Edmund Hillary (1919–2008), the first to reach the summit of Mount Everest and return safely

Al-Idrisi Montes: mountain range honors Ash-Sharif al-Idrisi (1100–1165/66), a noted Arab mapmaker

Djanggawul Fossae: network of shallow depressions named for three ancestral beings in Australian mythology who travelled between the island of the dead and Australia

Sleipnir Fossa: shallow depression named for the eight-legged horse of Norse mythology that carried the god Odin into the underworld

Virgil Fossae: honors Virgil, Roman poet and Dante's fictional guide through hell and purgatory in the Divine Comedy

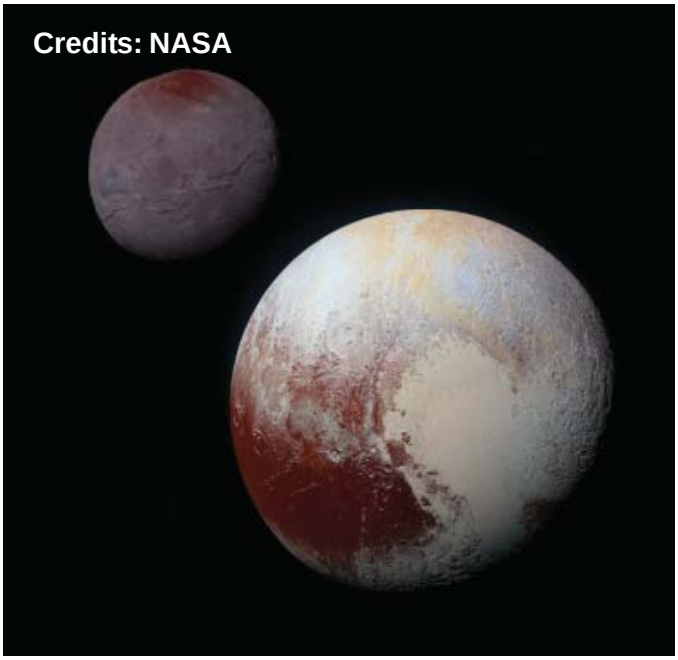
Adlivun Cavus: deep depression named for Adlivun, the underworld in Inuit mythology

Hayabusa Terra: large land mass recognizing the Japanese spacecraft and mission (2003–2010) that returned the first asteroid sample

Voyager Terra: honors the NASA spacecrafts, launched in 1977. Voyager 2 is the only spacecraft to visit all four giant planets. The spacecrafts are now or will soon be entering interstellar space.

Tartarus Dorsa: ridge named for Tartarus, the deepest, darkest pit of the underworld in Greek mythology

Elliot Crater: recognizes James Elliot (1943–2011), an MIT researcher who pioneered the use of stellar occultations that led to discoveries such as the rings of Uranus and the first detection of Pluto's thin atmosphere



Pluto and its largest moon Charon.- The Tombaugh Regio is the lighter, heart-shaped feature in the eastern hemisphere of the dwarf planet.

The X-37B Returns to Orbit

On September 7th, SpaceX successfully launched a Falcon 9 rocket from Launch Complex 39A at NASA's Kennedy Space Center (KSC). Inside the payload fairing was the Air Force's X-37B Orbital Test Vehicle (OTV). It was the first launch of the spaceplane by SpaceX, with United Launch Alliance's Atlas V rocket providing the previous rides to orbit.

X-37B OTV on the runway during a test. Credit: USAF

Balanced on a Tail of Fire

The Falcon 9 first stage booster returns to Earth approximately 8 minutes after launch. Credit: SpaceX

The Air Force operates two spaceplanes, alternating the vehicles on long-term missions to low-Earth orbit. This was the fifth flight of the X-37B, which was developed by Boeing. Originally designed for missions up to 270 days in length, the spaceplane remained in orbit for almost two years (718 days) in its 4th flight.

The X-37B is 39 feet, 3 inches (8.9 meters) long with a wingspan of 14 feet, 11 inches (4.5 meters). At launch, it weighs 11,000 pounds (5,000 kgs). The spaceplane has a small cargo bay and a deployable gallium arsenide solar array with lithium-ion batteries for on orbit power. It is designed to return to a runway, most recently landing on the airstrip formerly used by the space shuttle at KSC.

Following the separation of the first and second stages approximately 2.5 minutes after launch, the Falcon 9's first stage returned to the Earth, successfully landing on a SpaceX landing pad at the Cape Canaveral Air Force Station, Florida. SpaceX has now successfully landed sixteen boosters, seven on land and nine on the company's autonomous spaceport drone ship (a robotic barge) stationed off the coast of the launch site(s).

Space Race History

On October 11, 1968, a Saturn 1-B rocket carried 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, 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.

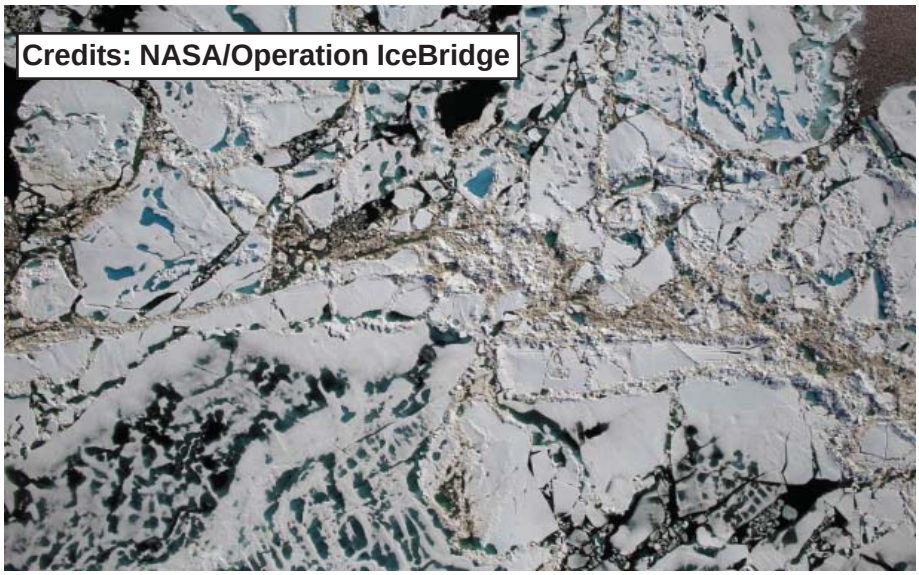
Operation IceBridge

NASA's Operation IceBridge is an annual airborne survey of the polar and Greenland ice sheets. Arctic sea ice retreats during the northern hemisphere's summer months, reaching its lowest area of coverage in September. That minimum area of coverage has been steadily declining, with sea ice today covering 40% less area than it did in the 1970s and 1980s.

The photo (below) shows a field of broken sea ice in the Chukchi Sea (an area just north of the Bering Strait and bounded by the East Siberian and Beaufort seas). The darker areas are open water and the lighter blue patches, melt water ponds. The melt water ponds, formed from surface melt, accelerate the melting process as their darker color absorbs more sunlight.

Arctic ice reached its lowest point on September 13th and was the eighth lowest since satellite records began in 1978.

If the warming trends continue, ice could disappear from the summer Arctic Ocean before the middle of the century. Sea ice plays an important role in the polar ecosystem, regulating regional and global temperatures, affecting ocean salinity and circulation patterns, providing a habitat for animals, as well as protecting coastlines from erosion (by mitigating wave action). The disappearance of sea ice won't raise the sea level by itself (since it already floats on top of the water), but its disappearance may trigger other changes in the climate that will.



Arctic ice reached its lowest point on September 13th and was the eighth lowest since satellite records began in 1978.

At the southern pole, the sea ice is reaching its maximum extent. Scientists have observed a short-term reversal in coverage from record highs in 2012 through 2014 to lows in 2015, 2016 and 2017. Worldwide, total sea ice has been decreasing since the 1970s.

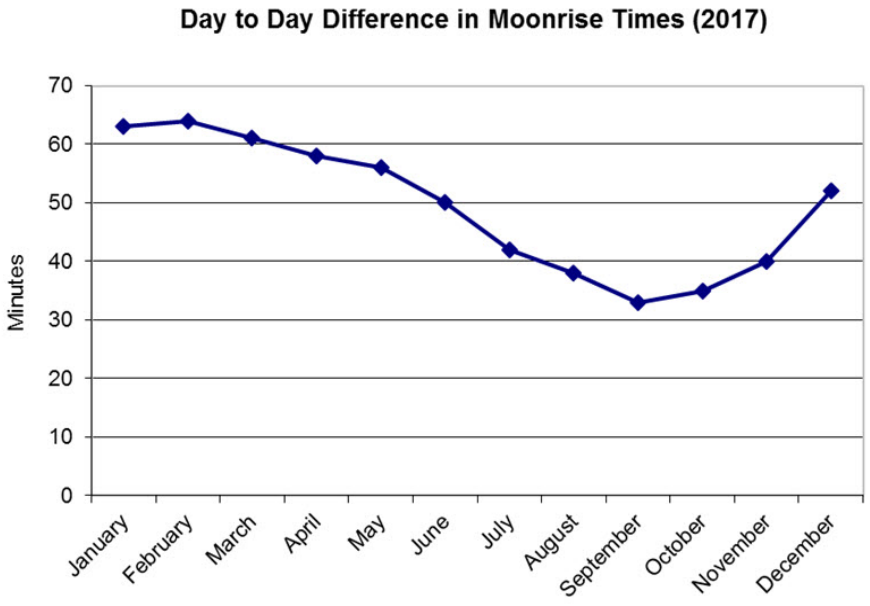
Harvest Moon

The Full Moon that occurs closest to the Autumnal Equinox is known as the Harvest Moon. This year the Full Moon occurs on October 5th. The Harvest Moon traditionally appears around the time when farmers in the northern hemisphere are working long days to bring in their crops. The full moon provides a bit more light, longer into the evening. However, what is really special at this time of the year is the appearance of the Moon in the days just before and after it reaches its full phase.

Throughout the year the Moon rises, on average, 50 minutes later each day. The difference can be more than an hour in the spring and closer to 30 minutes in the fall. On the following graph, the average difference in the time of moonrise on the three days preceding and following the

full moon are plotted. In September, the difference is as little as 33 minutes (from one night to the next). The effect is that an almost fully illuminated moon is in the evening sky earlier each evening, benefiting farmers still out in the field (and children playing after school).

For example, the Moon rises at 6:49 pm on October 5th, the night of the full Moon. On each of the next three nights the Moon rises 35 to 40 minutes later. As such, on October 8th, (three days after full) a bright moon is back in the sky just two hours after sunset (8:41 pm).



October Nights

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

Sun	Sunrise	Sunset
October 1 (EDT)	06:51	18:35
October 15	07:06	18:12
October 31	07:25	17:49

Astronomical and Historical Events

- 1st Aten Asteroid 2004 QA22 near-Earth flyby (0.065 AU)
- 1st Apollo Asteroid 2015 XE near-Earth flyby (0.083 AU)
- 1st Apollo Asteroid 2329 Orthos closest approach to Earth (0.158 AU)
- 1st Kuiper Belt Object 2015 RR245 at Opposition (62.481 AU)
- 1st History: NASA created by the National Aeronautics and Space Act (1958)
- 2nd History: opening of the Hayden Planetarium (1935)
- 3rd Binary Asteroid 90 Antiope closest approach to Earth (1.836 AU)
- 3rd History: first successful test launch of the German A-4 rocket (V-2) (1942)
- 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: 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 Aten Asteroid 2004 TD10 near-Earth flyby (0.085 AU)

Astronomical and Historical Events (continued)

4th Apollo Asteroid 4197 Morpheus closest approach to Earth (0.474 AU)
4th Apollo Asteroid 2004 RE84 near-Earth flyby (0.039 AU)
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 Full Moon (Harvest Moon)
5th Apollo Asteroid 2017 QO17 near-Earth flyby (0.077 AU)
5th Atira Asteroid 2012 VE46 closest approach to Earth (0.791 AU)
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 Apollo Asteroid 2011 TB4 near-Earth flyby (0.065 AU)
6th Apollo Asteroid 2017 GS6 near-Earth flyby (0.078 AU)
6th Aten Asteroid 5381 Sekmet closest approach to Earth (0.649 AU)
6th History: Asteroid 2008 TC3 discovered by astronomers on Mt. Lemmon less than 24 hours before exploding over the Sudan. The McCarthy Observatory submitted the last accepted observation. Fragments of the asteroid were eventually recovered. (2008)
6th History: launch of the space shuttle Discovery and the solar polar orbiter spacecraft Ulysses (1990)
7th **Second Saturday Stars** at the McCarthy Observatory (7:00 PM)
7th Kuiper Belt Object 2008 ST291 at Opposition (59.575 AU)
8th History: discovery of Supernova 1604 (Kepler's Nova) (1604)
9th Moon at perigee (closest distance to Earth)
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)
10th Asteroid 16897 (1998 DH10) Occults HIP 20804 (5.9 Magnitude Star)
10th Apollo Asteroid 2014 DQ near-Earth flyby (0.082 AU)
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 Apollo Asteroid 2007 DM41 near-Earth flyby (0.090 AU)
11th Kuiper Belt Object 303775 (2005 QU182) at Opposition (51.333 AU)
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 Last Quarter Moon

Astronomical and Historical Events (continued)

12th Scheduled launch of a Russian cargo-carrying Progress spacecraft from the Baikonur Cosmodrome in Kazakhstan to the International Space Station
12th Apollo Asteroid 2012 TC4 near-Earth flyby (0.0003 AU)
12th Apollo Asteroid 11500 Tomaiyowit closest approach to Earth (0.421 AU)
12th Apollo Asteroid 4183 Cuno closest approach to Earth (1.473 AU)
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 Aten Asteroid 2005 TE49 near-Earth flyby (0.022 AU)
13th Apollo Asteroid 2014 UR116 near-Earth flyby (0.072 AU)
13th Kuiper Belt Object 19308 (1996 TO66) at Opposition (46.380 AU)
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 Apollo Asteroid 2016 UO41 near-Earth flyby (0.055 AU)
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)
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 Comet 9P/Tempel at Opposition (2.591 AU)
15th Apollo Asteroid 2013 UM9 near-Earth flyby (0.044 AU)
15th Apollo Asteroid 2012 EN5 near-Earth flyby (0.091 AU)
15th History: launch of the Cassini spacecraft to the planet Saturn (1997)
16th Atira Asteroid 2013 JX28 closest approach to Earth (0.733 AU)
16th History: launch of GOES 1, first weather satellite placed in geosynchronous orbit (1975)
17th Amor Asteroid 2011 PT near-Earth flyby (0.058 AU)
17th Dwarf Planet 136199 Eris at Opposition (95.195 AU)
18th Aten Asteroid 2006 TU7 near-Earth flyby (0.048 AU)
18th Kuiper Belt Object 202421 (2005 UQ513) at Opposition (47.230 AU)
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 New Moon
19th Uranus at Opposition, rising with the setting Sun and highest in the sky at midnight
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)

Astronomical and Historical Events (continued)

20th Aten Asteroid 2014 UR near-Earth flyby (0.064 AU)
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 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)
22nd Apollo Asteroid 171576 (1999 VP11) near-Earth flyby (0.015 AU)
22nd Apollo Asteroid 2010 VT11 near-Earth flyby (0.092 AU)
22nd Kuiper Belt Object 308379 (2005 RS43) at Opposition (42.562 AU)
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 Apollo Asteroid 2008 GH110 near-Earth flyby (0.087 AU)
23rd Aten Asteroid 3362 Khufu closest approach to Earth (1.281 AU)
23rd Centaur Object 2015 KJ153 at Opposition (4.876 AU)
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 Moon at apogee (furthest distance from Earth in its orbit)
24th Aten Asteroid 2016 GK135 near-Earth flyby (0.077 AU)
24th Aten Asteroid 2008 TC4 near-Earth flyby (0.086 AU)
24th Apollo Asteroid 2201 Oljato closest approach to Earth (2.063 AU)
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: 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 Aten Asteroid 2013 UR5 near-Earth flyby (0.085 AU)
25th Apollo Asteroid 2017 FT102 near-Earth flyby (0.100 AU)
25th Kuiper Belt Object 55636 (2002 TX300) at Opposition (41.567 AU)
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 Apollo Asteroid 2017 QV34 near-Earth flyby (0.083 AU)
26th Amor Asteroid 1943 Anteros closest approach to Earth (2.038 AU)

Astronomical and Historical Events (continued)

27th First Quarter Moon
27th History: first test flight of the Saturn I rocket (1961)
28th International Observe the Moon Night
28th Apollo Asteroid 29075 (1950 DA) closest approach to Earth (1.578 AU)
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 Apollo Asteroid 161989 Cacus closest approach to Earth (1.274 AU)
29th Apollo Asteroid 2212 Hephaistos closest approach to Earth (2.650 AU)
29th Centaur Object 49036 Pelion at Opposition (19.848 AU)
29th Centaur Object 20461 Dioretsa at Opposition (28.552 AU)
29th Kuiper Belt Object 15760 (1992 QB1) at Opposition (40.320 AU)
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)
30th Aten Asteroid 3753 Cruithne closest approach to Earth (0.526 AU)
30th Kuiper Belt Object 42301 (2001 UR163) at Opposition (51.765 AU)
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 Apollo Asteroid 2003 UV11 near-Earth flyby (0.038 AU)
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)

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.*

International Space Station and Iridium Satellites

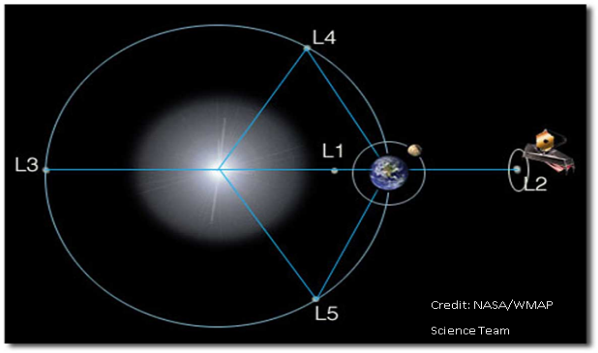
Visit www.heavens-above.com for the times of visibility and detailed star charts for viewing the International Space Station and the bright flares from Iridium satellites.

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 un like 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

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 future location of the James Webb telescope) is located 1.5 million kilometers beyond the Earth (as viewed from the Sun).



Front Page

On September 15, the Cassini orbiter ended its 20-year mission to study Saturn with a fiery plunge toward the ringed planet. Out of fuel, the spacecraft was deliberately sacrificed to avoid any chance of contamination from an earth-based object.

The panoramic view at top was created from 165 images taken by the Cassini wide-angle camera during a three hour pass in September 2006. At bottm is an artist's impression of Cassini's final orbit before plunging and burning up in the planet's atmosphere.

For more video and animation on Cassini's final mission, go to *https://saturn.jpl.nasa.gov/resources/?topic=178.*

Image Credits

Front page design and graphic calendar: Allan Ostergren

Second Saturday Stars poster: Marc Polansky

All other non-credited photos were taken by the author: Bill Cloutier

Second Saturday Stars

FREE EVENT

Every Month at the

John J. McCarthy Observatory

Behind the New Milford High School

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www.mccarthyobservatory.org

October 14th

7:00 - 9:00 pm

Kid's Night

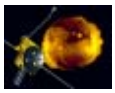
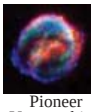
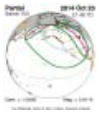
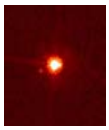
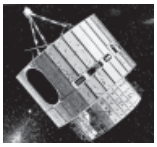
LIGHTS ON

STARS GONE

Refreshments
Family Entertainment
Handicapped Accessible
ASL Interpretation Available with Prior Notice
Rain or Shine

October 2017

Celestial Calendar

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
1  NASA created by the National Aeronautics and Space Act (1958)	**2**  Hayden Planetarium founded (1935)	**3** Launch of Mercury-Atlas 8 with Walter Schirra (1962)   Chassigny meteorite, determined origin of Mars (1815) Zagami Martian meteorite in Katsina Province, Nigeria (1962) 	**4**  Luna 3; Soviet spacecraft, first to photograph the far side of the Moon (1959) SpaceShipOne, 70 miles up, to win Ansari X Prize (2004)   World Space Week, Oct. 4-10 "The Era of Deep Space Discovery" Launch of first manned Apollo mission (1968)	**5**  Robert Goddard born, founding father of modern rocketry (1882)	**6**  Launch of space shuttle Discovery and solar polar orbiter spacecraft Ulysses (1990) Asteroid 2008 TC3, tracked by McCarthy Observatory, explodes over Sudan (2008) 	**7**  Launch of Explorer 6, with "paddlewheel satellite," a photocell scanner transmitting a crude picture of the earth's surface and cloud cover (1959))
8  Discovery of Supernova 1604 - Kepler's Nova (1604) Pioneer Venus orbiter concludes mission and begins fiery plunge into Venusian atosphere (1992)   Total Lunar Eclipse, with totality beginning shortly before sunrise on the east coast	**9** Moon at Perigee (closest to earth)   LCROSS impacts Moon's south pole (2009) Draconids meteor shower peak   Peekskill meteorite hits Chevy Malibu (1992)	**10** Enactment of outerspace treaty (1967)   Inauguration of the Very Large array in New Mexico (1980)	**11**  WAC Corporal, first rocket to escape Earth's atmosphere (1945) 100th space shuttle flight carries Z1 Truss, backbone of the ISS (2000) 	**12**  First symposium on space travel, held at Hayden Planetarium (1951)  Launch of Voskhod 1, Soviet spacecraft, first to carry multiple cosmonauts (1964)	**13**  Launch of Explorer 7 spacecraft (1959) Launch of Shenzou 6, China's 2nd manned spacecraft (2005)   British Interplanetary Society founded (1933)	**14**  Launch of Shenzou 5, China's 1st manned spacecraft (2003) Chuck Yeager breaks sound barrier (1947)   Three main belt asteroids discovered by McCarthy Observatory (2003) 2nd Saturday Stars Open House McCarthy Observatory 
15 Dwarf Planet Eris (formally 2003 UB313 and/or Xena) at Opposition (95.542 AU)   Launch of Cassini spacecraft to planet Saturn (1997)	**16**  Launch of GOES 1, first weather satellite in geosynchronous orbit (1975)	**17**  Mae Carol Jemison born, American physician and NASA astronaut; became first black woman in space aboard the Shuttle Endeavour on September 12, 1992; has appeared on television several times, including an episode of *Star Trek: The Next Generation*. (1956)	**18**  Soviet spacecraft Venera 4 probes atmosphere of Venus; (1967) Discovery of Asteroid 8 Flora by John Hind (1847)   Discovery of asteroid/ comet Chiron in Taurus by Charles Kowal (1977) Launch of space shuttle Atlantis and Galileo spacecraft to Jupiter (1989) 	**19** launch of IBEX (Interstellar Boundary Explorer) to explore the edge of solar system (2008) Subrahamanyan Chandrasekar wins Nobel physics prize for study of star evolution (1983) 	**20** Discovery of asteroid 577 Rhea by Max Wolf (1905) Launch of Soviet spacecraft Zond 8, Moon flyby mission (1970)	**21** Opening of the Yerkes Observatory, Williams Bay, Wisonsin, with world's largest refractor lens (40") (1897) Orionids meteor shower peak
Soviet spacecraft Venera 9 lands on Venus, takes first b/w pictures of Venus' surface(1975) **22** Launch of the Soviet orbiter Luna 12 to take high-resolution photos of the Moon's surface from lunar orbit (1966) Launch of India's first Moon mission Chandrayaan-1 (2008) 	**23** Partial Solar Eclipse, visible from eastern United States Pamela Melroy and Peggy Whitson first women to lead two missions at same time (shuttle and space station) (2007)	Moon at Apogee (farthest from earth) **24** Launch of Deep Space 1 (1998) Launch of Chang'e-1, Chinese lunar orbiter (2007) Discovery of Uranus' moons Umbriel and Ariel by William Lassell (1851)	**25** Discovery of Saturn's moon Iapetus by Giovanni Cassini (1671) Launch of twin Solar Terrestrial Relations Observatories (STEREO A&B) for 3-D studies of Sun (2006) Soviet spacecraft Venera 10 touches down on Venus (1975)	**26** Soviet Union releases first images of the far side of the Moon, taken by Luna III spacecraft, showing a more mountainous terrain than seen from Earth and only two dark, low-lying regions. (1959)	**27** first test flight of the Saturn I rocket (1961) Cañon City, Colorado meteor hits garage - 1973	First test flight of the Ares I-X rocket; a two minute powered suborbital flight (2009) **28** Launch of Prospero, Britain's first space mission (1971) International Observe the Moon Night
29 Launch of space shuttle Discovery (STS-95) with astronaut and former senator John Glenn (1998) Flyby of asteroid Gaspra by the Galileo spacecraft on mission to Jupiter (1991)	**30** Mercury Theatre War of Worlds broadcast with Orson Welles produces panic(1938) Discovery of the Los Angeles (Mars) Meteorite (1999) Launch of Venera 13, Soviet Venus lander; survived for 127 minutes on the surface where the temperature was recorded at 855 °F (1981)	**31** Apollo 11 Command module pilot Michael Collins born (1930) First rocket engine tests that spawned the Jet Propulsion Laboratory (1936) 			

Phases of the Moon

Oct 5 Oct 12 Oct 19 Oct 27