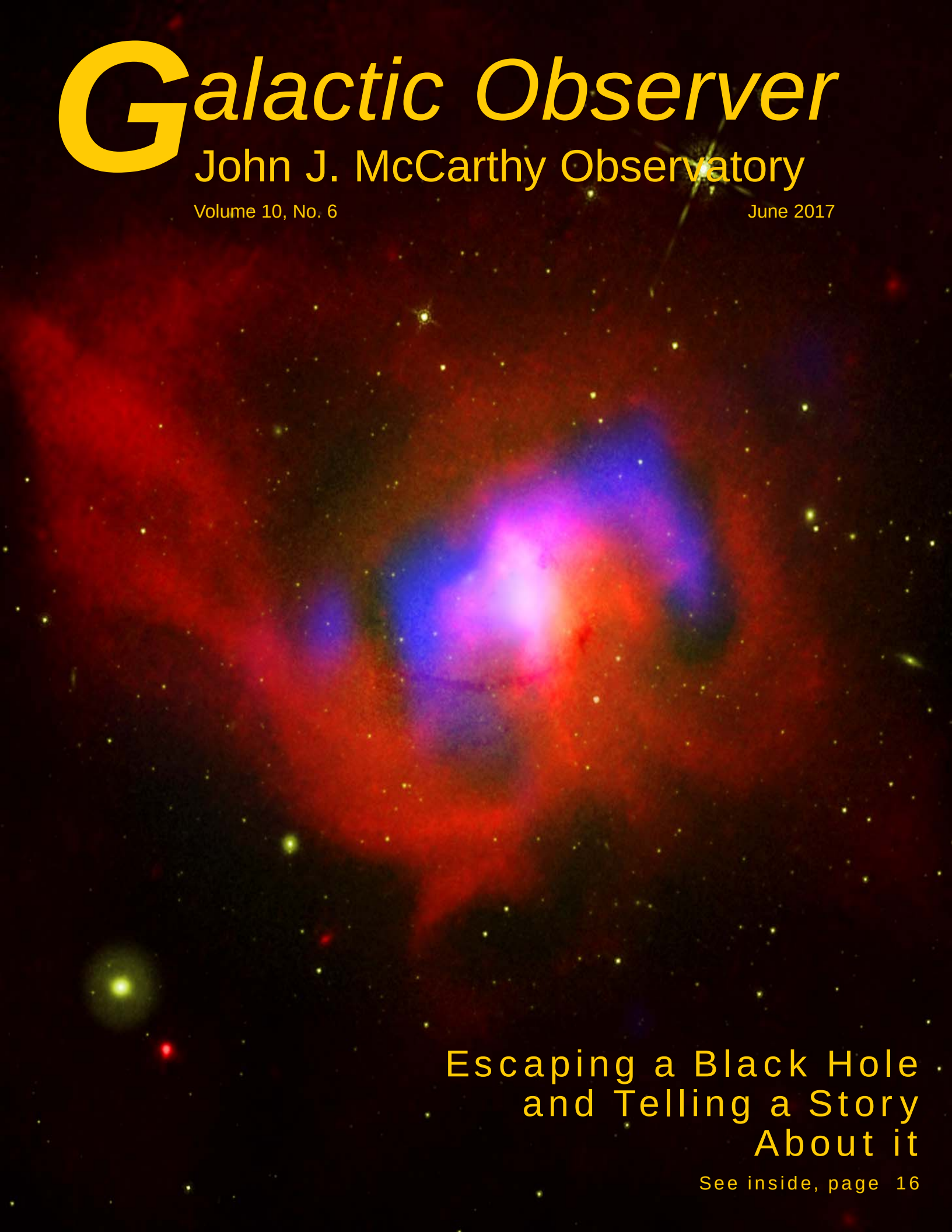
Galactic Observer

John J. McCarthy Observatory

Volume 10, No. 6 June 2017



Escaping a Black Hole and Telling a Story About it

See inside, page 16

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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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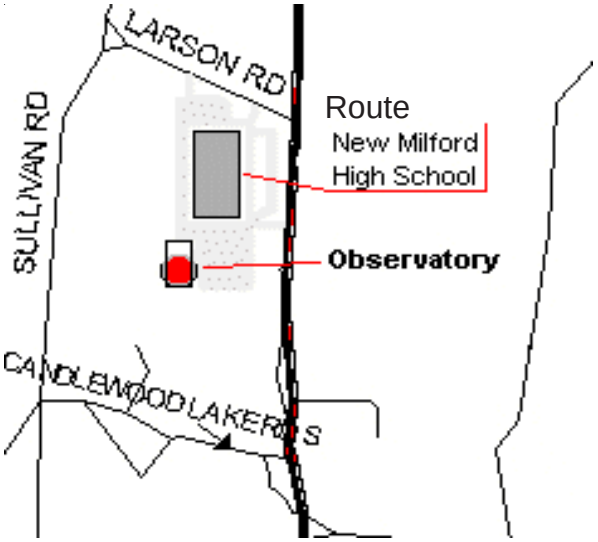
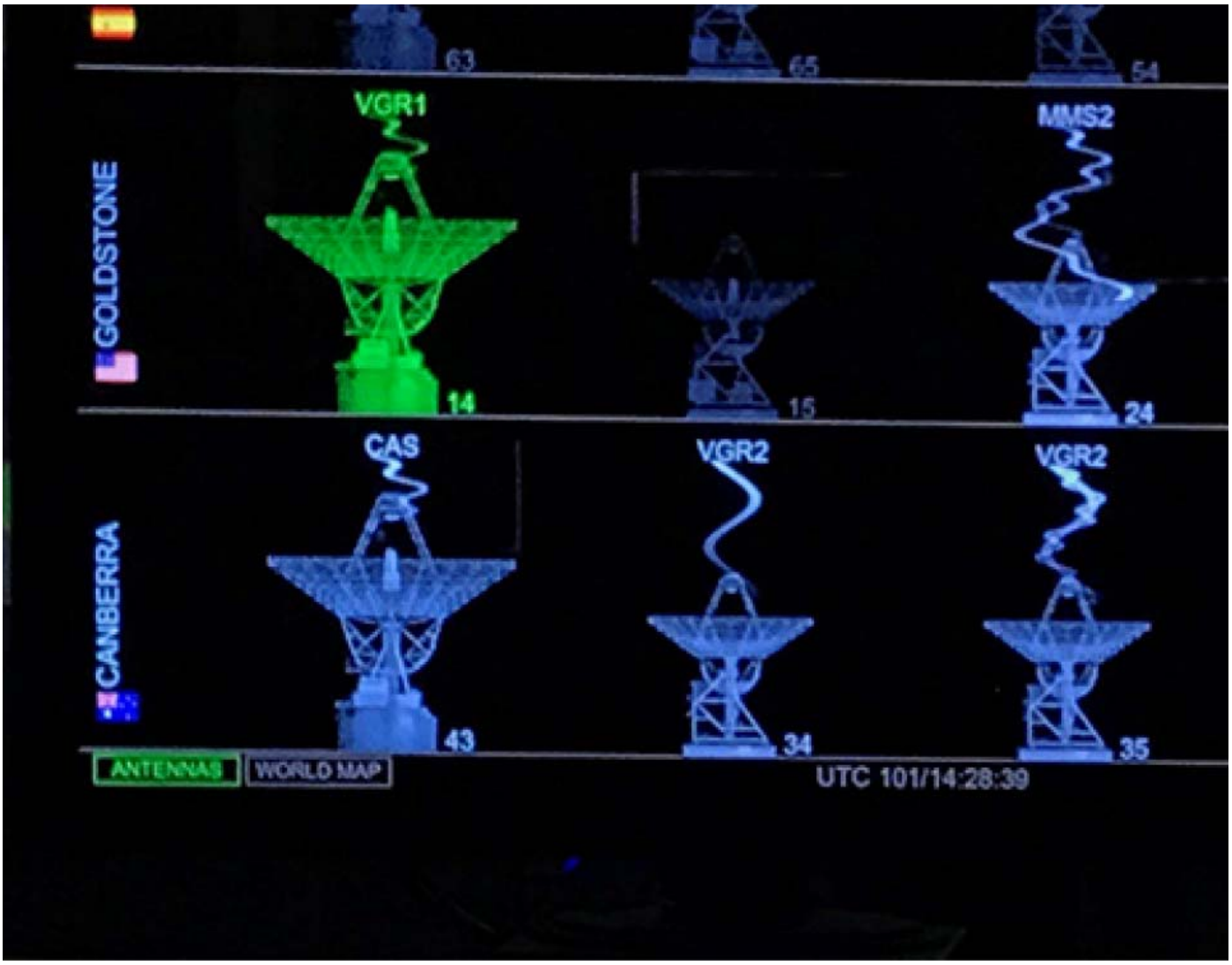


In This Issue

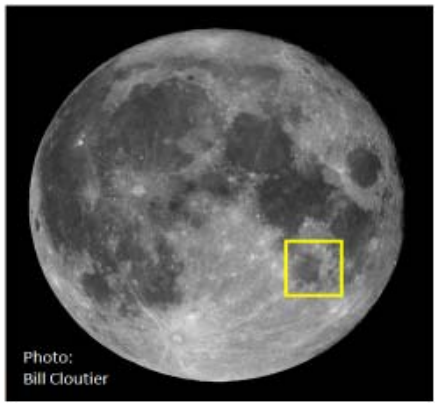


The command sequence that initiated the Grand Finale is transmitted to the Cassini spacecraft ("CAS") from JPL using the Deep Space Network's Canberra 70 meter antenna on April 11, 2017. Photo Credit: NASA/JPL-Caltech

"Out the Window on Your Left"

IT'S BEEN ALMOST 45 YEARS SINCE WE LEFT the last footprint on the dusty lunar surface. Sadly, as a nation founded on exploration and the conquest of new frontiers, we appear to have lost our will to lead as a space-faring nation. But, what if the average citizen had the means to visit our only natural satellite; what would they see out the window of their spacecraft as they entered orbit around the Moon? This column may provide some thoughts to ponder when planning your visit (if only in your imagination).

The Sun is rising on Mare Nectaris (Sea of Nectar) in this month's image. The relatively small (205 mile or 330 km diameter) and ancient lava plain fills the impact basin that lies beneath. The basin was created by an impact of an asteroid or comet



Lunar seas of actually expansive low-lying plains formed by ancient lava flows

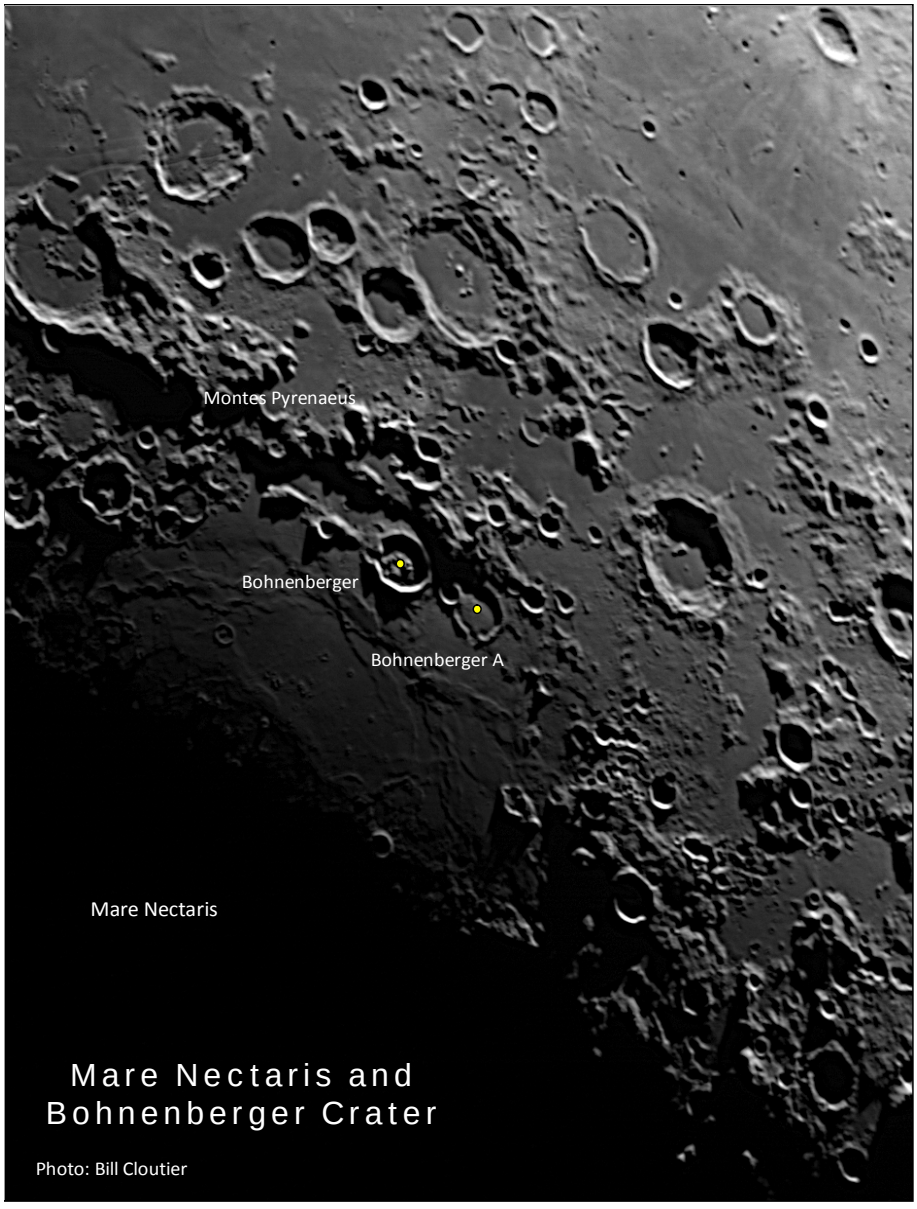
approximately 3.9 billion years ago. The dark patch of lava filling the basin is located to the south of Mare Tranquillitatis (Sea of Tranquility).

The impact that created the Nectaris basin uplifted the surrounding crust, creating chains of mountains including the Montes Pyrenaeus (Pyrenees Mountain) bordering the eastern shore. Situated between the flanks of the mountains and the shore of Nectaris lies Bohnenberger crater.

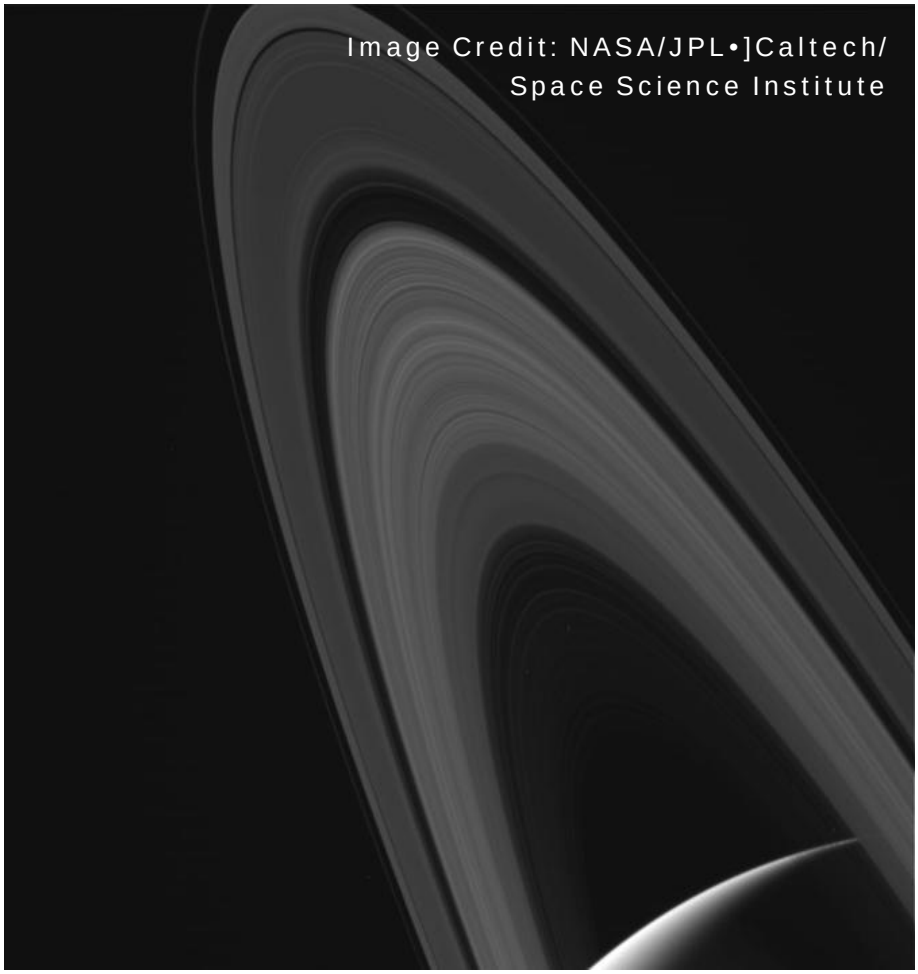
The lunar crater is about 20 miles (32 km) in diameter and 1.5 miles (2.4 km) in depth with a notch in its northern rim. Bohnenberger is classified as a Class IV fractured floor crater with a raised center, a wide central fracture and ridged, radial fractures, presumably caused by ponding of magma beneath the crater floor.

To the south is the Bohnen-berger A ring plain. At about the same size as Bohnenberger crater, its low ring wall is broken by a large impact crater on the northern portion of the rim and a smaller one on the south-western portion.


Bohnenberger Crater from the Lunar Reconnaissance Orbiter Credit: NASA/Goddard/Arizona State University



First Encounter



The Cassini spacecraft came up empty in its first pass through the gap between the planet Saturn and its rings. In the first of 22 weekly Grand Finale orbits on April 26, 2017, the spacecraft came within 1,900 miles (3,000 km) of Saturn's cloud tops and about 200 miles (300 km) of the edge of the innermost ring as it negotiated the gap. Mission managers were concerned that, at the spacecraft's high rate of speed (77,000 mph or 124,000 kph relative to the planet), even small particles within the gap could cause catastrophic damage. As a precaution, the spacecraft was orientated so that its large dish-shaped antenna faced forward, with most of the critical instruments within the shadow of the 13 foot (4 meter) shield. Surprisingly, the gap was relatively empty with Cassini encountering only a few particles, none larger than 1 micron across (analogous to smoke particles). While puzzling, the main antenna should not be needed as a shield during a majority of the future passes (except those that pass close to the edge of the inner ring) which will simplify how observations of Saturn's atmosphere and rings are conducted.

Opportunity Retrospective

Seconds before hitting the Martian surface on January 25, 2004, the lander carrying the second Mars Exploration Rover (Opportunity) inflated its four, six-lobed air bags. After twenty six bounces and tumbles, the lander came to rest inside a shallow impact crater (72 feet or 22 meters in diameter and only 10 feet or 3 meters deep) that would be named "Eagle." Once the Vectran fabric air bags were deflated, the 408 pound (185 kg) Opportunity rover was able to drive off the landing platform and begin its work as a field geologist.

Unlike Spirit (Opportunity's twin) that had landed inside Gusev Crater, Opportunity discovered rocks altered by ancient water at its landing site. The walls of Eagle crater appeared to be sedimentary, with layers having been deposited in shallow water. Small iron-rich concretions (dubbed blueberries) were found embedded within the rock layers and scattered about as erosion from wind and sand freed the spherules from the softer rock.

Eagle Crater would be only the beginning of a campaign by Opportunity to explore Meridiani Planum (an ancient plain located just south of the Martian equator). Almost 13½ years later, the intrepid rover is still operational, having traveled almost 28 miles (45 km) in a very hostile and sometimes treacherous landscape. Opportunity is currently beginning its exploration of Perseverance Valley on the rim of Endeavour Crater. Scientists believe that the valley may have been carved - possibly by water.

NASA's Mars Reconnaissance Orbiter recently imaged Opportunity's landing site. The photo, taken by the spacecraft's High Resolution Imaging Science Experiment camera, shows the bright landing platform left behind in Eagle Crater and the spacecraft's discarded parachute and backshell (which held the parachute before deployment).

High-Tech Postage Stamp

For the first time since 1918, a total eclipse of the Sun will be visible along a narrow path across the entire continental United States – from Oregon to South Carolina. On August 21st, the Moon will completely block the light from the Sun along a 70 mile-wide path. Total darkness will occur for approximately 2½ minutes as the Moon's shadow comes ashore in Oregon (mid-morning) and then races southeast through the heart of the country to the coast of South Carolina 90 minutes later. Observers within the path of the eclipse will be able to see the Sun's corona (outer atmosphere) during totality.

Information on viewing the August 21st eclipse, and other resources, can be found NASA's web-page: *https://eclipse2017.nasa.gov/*.

To commemorate the event, the Postal Service is issuing a first-of-its-kind stamp. The stamp will depict a fully eclipsed Sun, with the silhouette of the Moon covering the solar disk and the solar corona visible. The Postal Service is using thermochromic ink, which is heat sensitive, in printing the stamps. By using your body heat (e.g., from a finger) and touching the image, a second, photographic image of the Moon will be revealed and then disappear once the ink cools. The back of the stamp will show the eclipse path and viewing times for selected locations across the United States.

The commemorative stamp is being issued as a Forever stamp (always equal in value to the current First-Class Mail 1-ounce price). The First-Day-of-Issue ceremony will be on June 20th at the Art Museum of the University of Wyoming in Laramie, coinciding with the date of the Summer Solstice.

The Postal Service's Total Solar Eclipse stamp before and after heat is applied to reveal the surface details of the Moon. Image: USPS

Saturn at Opposition

The Earth will come between Saturn and the Sun on June 15th, an arrangement known as "Opposition." On that day, Saturn will rise in the evening sky opposite the setting Sun and reach its highest point in the sky at midnight. At closest approach, Saturn will be approximately 840.6 million miles (1.35 billion km) from Earth, slightly further away than in 2016. The difference in appearance (diameter) won't be noticeable. Saturn can be found in the non-zodiacal constellation of Ophiuchus, the serpent holder, where it will remain until the planet crosses back into the constellation Sagittarius in November.

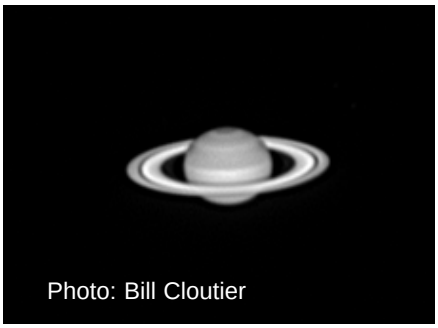


Photo: Bill Cloutier

Saturn will be relatively bright this year, with an apparent magnitude of +0.0 (as compared to Jupiter at magnitude -1.7). Saturn's axial tilt is almost 27° (as compared to Earth's 23.5° or Jupiter's 3°). The axial tilt produces seasons which last more than 7 years, since it takes Saturn almost 29½ years to complete an orbit around the Sun. It was summer in the southern hemisphere when the Cassini spacecraft arrived in 2004 with the planet's north pole in perpetual darkness. Saturn's Vernal equinox occurred in August 2009 with both hemispheres experiencing equal amounts of sunlight (at equinox, the rings appear almost edge on). Since that time, our view of the rings has improved. With the northern summer solstice in May, the rings are wide open with the planet's north pole sunlit and tipped towards Earth. This year the ring tilt is one of the best at 26.6°.

First Science Results from Juno

NASA's Juno spacecraft arrived at Jupiter on July 4, 2016. In a polar orbit that minimizes the time the spacecraft is exposed to the planet's intense magnetic field and radiation belts, Juno makes a high-speed pass (2 hours from pole to pole) once every 53 days, passing within several thousand miles of the gas giant's cloud tops. Early science results are being revealed in several recently published papers on the spacecraft's initial encounters and reveal a very complex and turbulent world. Among the revelations:

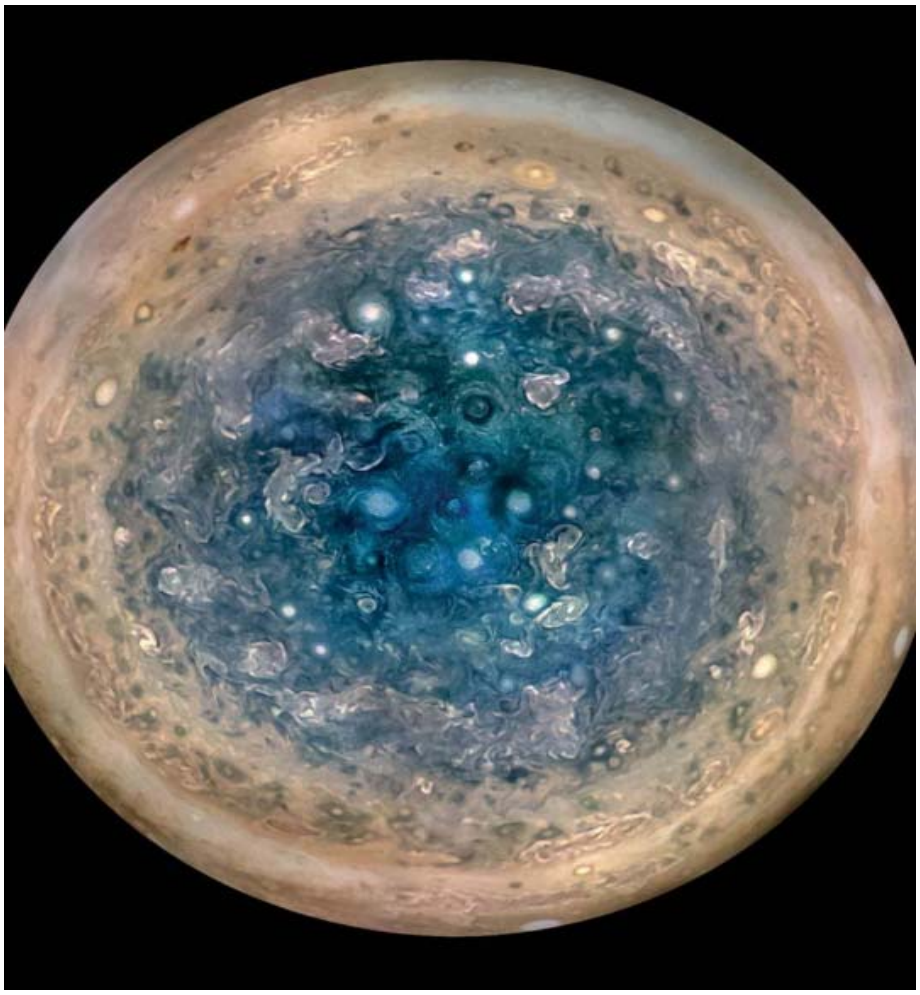
• although the planet's poles are different in appearance, both poles are covered with clusters of Earth-sized cyclones (up to 1,700 miles or 2,800 km in diameter) and even larger, less organized storms. Additional observations may reveal whether these storms are a permanent feature or systematic of a not-yet-understood dynamic system of circulation at the poles,

• the composition and structure of Jupiter's iconic belts and zones vary with latitude, extending deeper into the atmosphere near the equator and morphing into lower altitude structures at the higher latitudes,

• a band, high in ammonia and near the equator, extends deep into the Jovian atmosphere,

• Jupiter's magnetic field is even stronger than predicted or modeled – 10 times stronger than the strongest field found on Earth. The field is also uneven, stronger in some places and weaker in others, and

• the planet's core may not have a distinct boundary, but be partially dissolved.


Jupiter's south pole from an altitude of 32,000 miles (52,000 km)
Image credit: NASA/JPL-Caltech/SwRI/MSSS/Betsy Asher Hall/
Gervasio Robles

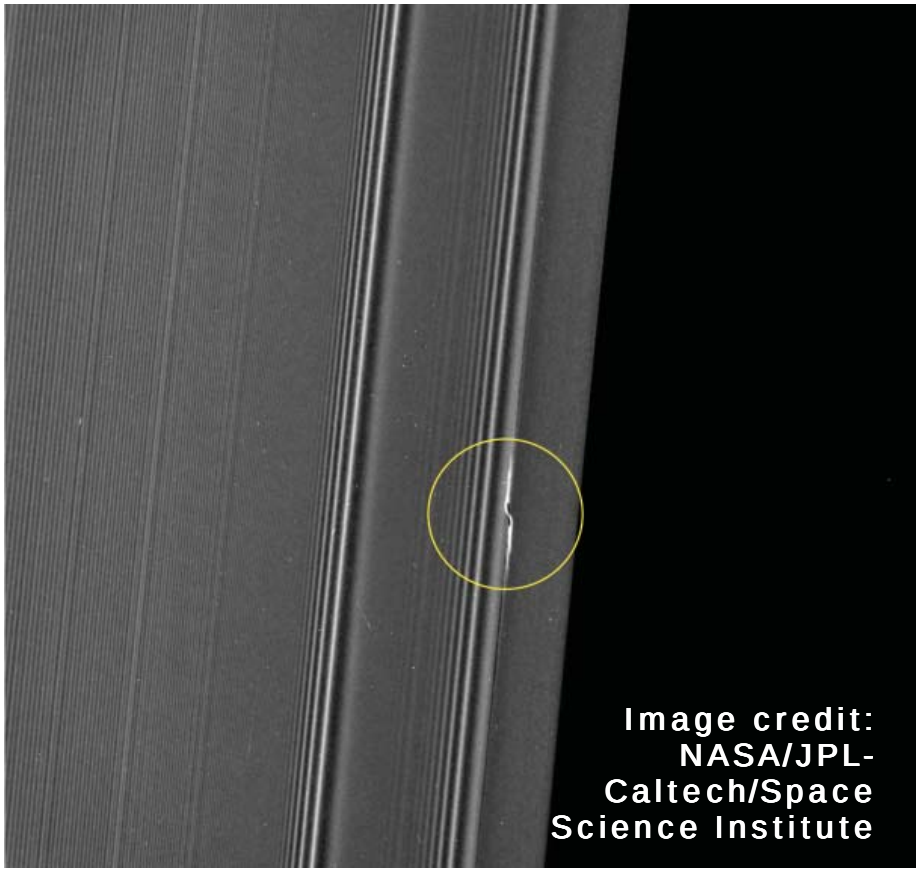
The spacecraft's next flyby is scheduled for July 11th. Juno's orbit will carry it directly over the Great Red Spot and give scientists their first look deep into the planet-sized cyclone.

Ring Propellers

Prior to the Grand Finale, the Cassini spacecraft was in ring-grazing orbit (from November 2016 to April 2017). During this time period, scientists had their best opportunity to examine the rings up close, in particular, the outermost parts of the main rings. One of the objects of interest are the "propellers" – propeller shaped disturbances in the plane of the ring material.

Propellers are localized gaps created by tiny moonlets embedded in the ring material. Much smaller than shepherd moons (like Prometheus and Pandora) that clear and maintain discernable gaps within the rings, there may be millions of moonlets, some not much larger than the material that comprises the rings. They include several dozen larger propellers - eleven of which have been imaged several times between 2005 and 2009. Created by larger moonlets (ranging up to one-half mile in diameter), their travel through the ring material clears out the space immediately around them and kicks up the surrounding ring material as high as 1,600 feet (0.5 km) above and below the ring plane (the rings average only 30 feet or 10 meters thick).

The visible light image of the Earhart Propeller (following page) was acquired by Cassini's narrow-angle camera from a distance of 69,183 miles (111,340 km). The image has not been processed to remove instrument noise or other artifacts so the small blemishes and streaks are from cosmic rays and charged particle radiation from Saturn striking the camera's detector.

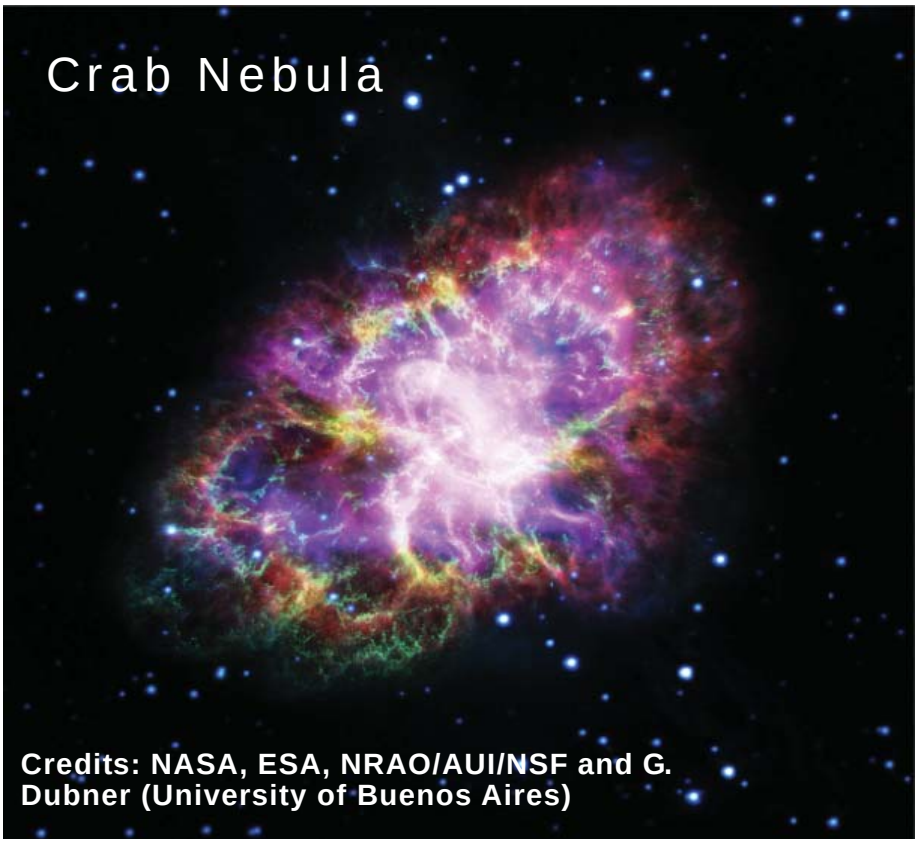


The "Earhart" Propeller in the A-Ring. The dark region to the right is the Encke Gap, kept open by the moon Pan. To the left of the propeller are wave features created by the wakes of moons Pandora, Prometheus and Pan.

The Composite Crab

Approximately 7,500 years ago, a massive star in the constellation Taurus exploded as its core suffered a rapid collapse. The light from the explosion reached Earth in the year 1054, appearing as a new "guest" star in the sky that was so bright that it was visible during the day for several weeks. The remnants of the stellar explosion are still visible today, having been discovered by John Bevis in 1731 and given the designation Messier 1 or M1 by comet hunter Charles Messier when he catalogued the object in 1758. Its common name, the "Crab Nebula," is attributed to sketches of the supernova remnant made by Lord Rosse around 1844.

The recently released image of the Crab Nebula is a composite, assembled from the data collected by five different telescopes, each targeting a different part (or wavelength) of the electromagnetic spectrum. The data from the Very Large Array (radio telescope) is shown in red, the Spitzer Space Telescope (infrared) in yellow, the Hubble Space Telescope (visible light) in green, the XMM-Newton Observatory (ultraviolet) in blue, and the Chandra X-ray Observatory (x-ray) in purple. The results provide an unprecedented view of this complex object and new detail about the pulsar (compact, rotating neutron star at the nebulas center), the highly energetic stream of particles streaming from the pulsar (rotating once every 33 milliseconds) and the interaction of that "wind" with the stellar material expelled in the original explosion (the nebula currently spans about 10 light years or almost 60 trillion miles). The expansion rate of the nebula has been measured at 930 miles/second (1,500 km/s).



Summer Solstice

On the morning of June 21st the Sun will rise over a prehistoric structure on the Salisbury Plain in southern England as it has for the last 4,000 years. For those individuals standing within the 100 foot diameter circle of 30 sandstone or sarsenstones (weighing up to 50 tons each), the Sun will appear over a large naturally shaped stone (Heel Stone) located outside and to the northeast of the circle. The alignment signals the start of the longest day, midsummer, or the summer solstice.

The photo at left below shows the current state of the stone circle. Many of the original stones are missing or damaged. Over time, they were taken to build houses and roads, chipped away by visitors and taken as souvenirs. What remains represents the last in a progressive sequence of monuments erected at the site between 3,000 and 1,600 B.C. The Heel Stone is adjacent to the access road to the site. The ancient people who constructed this monument left no written record of their accomplishments or the intended use of the stone circle. Its purpose has been widely debated and many groups have attempted to claim ownership. However, archeologists have clearly shown that the construction of Stonehenge predates the appearance of most modern cultures in Britain.

In the 1960s, Gerald Hawkins, an astronomer at the Smithsonian Astrophysical Observatory, found that each significant stone aligns with at least one other to point to an extreme position of the sun or moon ("Stonehenge Decoded," Doubleday & Company). That Stonehenge is an astronomical observatory or celestial calendar is intriguing, as the precision and architectural refinement by which it was constructed certainly suggests a significant purpose for this megalithic monument.


Heel Stone
Photo: Bill Cloutier


Stonehenge
Photo: Bill Cloutier

Commemorative Coin

On December 16, 2016, President Obama signed into law the "Apollo 11 50th Anniversary Commemorative Coin Act." The law authorized the U.S. Mint to strike up to 1.3 million gold, silver and clad coins, ranging in tender value from half a dollar to $5 each) to commemorate the anniversary of the moon landing. The domed coins will bear an image of Buzz Aldrin's helmet and the visor's reflection of Neil Armstrong, the lunar lander and the American flag on the surface of the Moon. Surcharges on the sale of the coins will

cover the cost of the minting, with the proceeds benefiting:

• the Astronaut Memorial Foundation, to honor the nation's fallen space explorers,

• the Astronaut Scholarship Foundation, to support college students excelling in science and technology degrees, and

• the Smithsonian's National Air and Space Museum, for its new "Destination Moon" gallery slated to open in Washington, D.C. in 2020.

On May 1st, the Mint announced a public design competition for the reverse side of the coin. The design must be "emblematic of the [U.S.] space program leading up to the first manned moon landing," Artists have until June 29th to submit their portfolios.

June History

Women in Space

On June 16, 1963, Valentina Tereshkova became the first woman in space. Shortly after Yuri Gagarin's flight, the Soviets began a search for suitable female candidates for spaceflight. With few female pilots, the majority of the candidates were women parachutists (Valentina had joined an amateur parachuting club at the age of 18). Control of the Vostok spacecraft was completely automatic, so piloting experience was not required. However, since the Vostok was not designed to return its occupant safely to Earth, the cosmonaut was required to eject from the spacecraft after re-entry and parachute to the landing site.

The selection of Valentina Tereshkova for the flight was made by Premier Khrushchev. In addition to experience and fitness, qualifications included being an ideal Soviet citizen and model Communist Party member. On June 16th, Valentina rode Vostok 6 into orbit with the call sign "Chaika" (Seagull). The mission was not without incident and included space-sickness, leg cramps and other discomforts from being strapped into the capsule for three days. More importantly, the capsule ended up in the wrong orientation and, had it not been corrected, would not have allowed her to return to Earth.

Valentina's three days in space was more flight time than all the American astronauts combined (at that time). After fulfilling her duties to her country, Tereshkova retired to a small house on the outskirts of Star City. The house is

topped with a seagull weathervane, the call sign of her flight.

Twenty years later on June 18th, Sally Ride became the first American woman in space. Launched aboard the space shuttle Challenger, Sally served as the mission specialist on the five person crew.

An Extraordinary Feat

If you have ever seen a Gemini space capsule (there is one on display at the Air and Space Museum in Washington, D.C.) it is difficult to comprehend how two people could have spent any length of time inside its cramped interior (Frank

Borman and Jim Lovell spent 14 days orbiting the Earth in Gemini 7). The reentry module, where the two astronauts sat, is approximately 11 feet long with a maximum diameter of 7½ feet and filled with instrumentation, life support systems and controls.

On June 3, 1965, Gemini 4 lifted off on a four day mission. The highlight of the mission was to be a spacewalk by Ed White. NASA was very concerned with "putting guys in vacuums with nothing between them but that little old lady from Worcester, Massachusetts [the seamstress at the David Clark Company], and her glue pot and that suit." However, the Soviets had challenged the United States with a spacewalk by Cosmonaut Alexei Leonov in March during a Voskhod II mission, and the United States did not want to appear to be falling behind its adversary.

After struggling with a faulty hatch, Ed White finally exited the spacecraft as it passed over the Pacific Ocean. Using a gun powered by compressed oxygen, he was able to maneuver outside the capsule, just avoiding the flaming thrusters of the Gemini capsule. After a 23 minute spacewalk, Jim McDivitt struggled to get the six foot tall Ed White back inside the capsule and close the balky door.

Unfortunately, after making history as the first American to walk in space, Ed White died during a launch pad test of the Apollo 1 spacecraft when the pure oxygen atmosphere exploded, killing all three astronauts inside.

Jupiter and its Moons

Jupiter reached Opposition and its closest approach to Earth in early April. During the month of June, Jupiter is still well placed in evening sky after sunset. Jupiter will be at its highest about 40 minutes after sunset on June 1st (9 pm) and almost two hours earlier by month's end. As the Earth moves ahead of Jupiter on its inside orbit, Jupiter will diminish slightly in brightness and apparent size. As one of the brightest star-like objects in the night sky, Jupiter can be found in the constellation Virgo.

Photo: Bill Cloutier

One of the more interesting and easier events to observe through a telescope is the projection of a shadow from one of Jupiter's moons on the Jovian disk as the moon passes in front of (or transits) the planet. On nights of good visibility the following events should be visible through a moderately-sized telescope. In June, we have two double transits (occurrences when the shadows of two moons are visible on the planet's cloud tops) starting on the 3rd and 19th that are visible in the late evening hours.

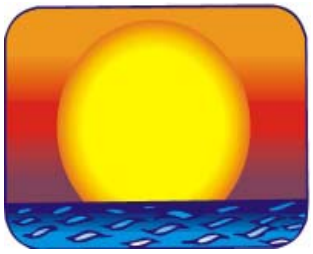
The Red Spot is a large cyclone in the upper Jovian atmosphere. The rapid rotation of this gas giant (10 hours) may be responsible for the longevity of this storm, which has been observed for over 300 years. The Red Spot will cross the center line of the planetary disk on the following evenings during the hours between 8 pm to midnight local time:

Jovian Moon Transits

Date	Moon	Transit Begins	Transit Ends
3rd	Io	10:11 pm	12:21 am (4th)
3rd	Ganymede	10:21 pm	12:37 am (4th)
11th	Io	6:34 pm	8:44 pm
11th	Europa	7:27 pm	9:51 pm
19th	Io	8:28 pm	10:38 pm
19th	Europa	10:04 pm	12:28 am (20th)
26th	Io	10:23 pm	12:33 am (27th)

Red Spot Transit

Date	Transit Time	Date	Transit Time
1st	11:16 pm	16th	8:43 pm
4th	8:46 pm	18th	10:21 pm
6th	10:25 pm	21st	12:00 am
9th	12:04 am	23rd	9:30 pm
11th	9:34 pm	25th	11:09 pm
13th	11:12 pm	28th	8:39 pm



Sunrise and Sunset (from New Milford, CT)

Sun	Sunrise	Sunset
June 1st (EDT)	05:22	20:22
June 15th (EST)	05:19	20:30
Juner 30th	05:23	20:32

Summer Nights

For the more adventurous and sleep deprived individuals, the summer sky sparkles as twilight deepens and the summer Milky Way rises. The Milky Way is heralded by the three stars of the summer triangle Vega, Deneb and Altair. Appearing like a gossamer stream of stars, it flows across the night sky, emptying into the constellation Sagittarius. In our light-polluted skies, it may be easier to see on nights when the Moon is absent (in the weeks preceding and following the New Moon on the 23rd).

High in the June sky is the constellation Hercules. Shaped like a keystone or trapezoid, Hercules is home to one of the finest globular star clusters in the northern hemisphere. The Great Hercules Cluster (M13) is a collection of several hundred thousand suns located near the galactic core of the Milky Way Galaxy at a distance of approximately 25,000 light years. Hercules rises in the evening after the constellation Boötes with its bright star Arcturus and before the constellation Lyra with its bright star Vega. The cluster can be found on the side of the keystone asterism facing Boötes.

Astronomical and Historical Events

- 1st Scheduled launch of a SpaceX Dragon cargo-carrying spacecraft from the Kennedy Space Center, Florida, to the International Space Station
- 1st First Quarter Moon
- 1st Apollo Asteroid 418094 (2007 WV4) near-Earth flyby (0.020 AU)
- 1st Apollo Asteroid 2101 *Adonis* closest approach to Earth (1.665 AU)
- 1st History: final landing of Space Shuttle Endeavour (STS-134) (2011)
- 1st History: launch of the ROSAT (Röntgen) X-ray observatory; cooperative program between Germany, the United States, and United Kingdom; among its many discoveries was the detection of X-ray emissions from Comet Hyakutake (1990)
- 2nd Asteroid 13188 *Okinawa* closest approach to Earth (1.060 AU)
- 2nd Kuiper Belt Object 278361 (2007 JJ43) at Opposition (40.059 AU)
- 2nd History: launch of the Mars Express spacecraft and ill-fated Beagle 2 lander (2003)
- 2nd History: launch of the Space Shuttle Discovery (STS-91); ninth and final Mir docking (1998)
- 2nd History: launch of Soviet Venus orbiter Venera 15; side-looking radar provided high resolution mapping of surface in tandem with Venera 16 (1983)
- 2nd History: Surveyor 1 lands on the Moon (1966)
- 2nd History: Gemini 5, Gemini 11, Apollo 12 and Skylab 2 astronaut Pete Conrad born (1930)
- 2nd History: discovery of Comet Donati by Italian astronomer Giovanni Battista Donati; brightest comet of the 19th century and first comet to be photographed (1858)
- 3rd Venus at its greatest western elongation (46°), apparent separation from the Sun in the morning sky
- 3rd History: launch of Gemini 4; Ed White becomes first American to walk in space (1965)
- 3rd History: launch of Gemini 9 with astronauts Thomas Stafford and Eugene Cernan (1966)
- 3rd History: dedication of the 200-inch Hale Telescope at Palomar Mountain (1948)
- 4th Distant flyby of Saturn's moons *Pan* and *Epimetheus* by the Cassini spacecraft
- 4th Apollo Asteroid 1685 *Toro* closest approach to Earth (1.355 AU)
- 4th History: discovery of Classical Kuiper Belt Object 50000 *Quaoar* by Mike Brown and Chad Trujillo from images acquired at the Samuel Oschin Telescope at Palomar Observatory (2002)

Astronomical and Historical Events (continued)

4th History: maiden flight of SpaceX's Falcon 9 rocket; launched from Cape Canaveral, Florida (2010)
6th Apollo Asteroid 2012 HN13 near-Earth flyby (0.073 AU)
6th History: launch of Soviet Venus orbiter Venera 16; side-looking radar provided high resolution mapping of surface in tandem with Venera 15 (1983)
7th Kuiper Belt Object 2010 KZ39 at Opposition (45.079 AU)
8th Moon at apogee (furthest distance from Earth)
8th Apollo Asteroid 2011 PU1 near-Earth flyby (0.061 AU)
8th Apollo Asteroid 2063 *Bacchus* closest approach to Earth (1.417 AU)
8th History: New Horizons spacecraft, on its way to Pluto, crosses the orbit of Saturn (2008)
8th History: launch of Soviet Venus orbiter/lander Venera 9; transmitted the first black and white images of the surface of Venus (1975)
8th History: Giovanni Cassini born, observer of Mars, Jupiter and Saturn (1625)
9th Full Moon (Strawberry Moon)
9th History: dedication of the Kathleen Fischer Sundial at the McCarthy Observatory (2012)
10th **Second Saturday Stars/Open House at the McCarthy Observatory 8:00 to 10:00 pm**
10th Distant flyby of Saturn's moons Pan and Janus by the Cassini spacecraft
10th Kuiper Belt Object 174567 *Varda* at Opposition (45.891 AU)
10th History: launch of Mars Exploration Rover A (Spirit) in 2003
10th History: launch of Explorer 49, Moon orbiter and radio astronomy explorer (1973)
11th History: flyby of Venus by Soviet spacecraft Vega 1 on its way to Comet Halley; dropped off lander and a balloon to study middle cloud layers (1985)
12th Amor Asteroid 1980 *Tezcatlipoca* closest approach to Earth (0.727 AU)
12th History: launch of Venera 4, Soviet Venus lander; first to enter atmosphere of another planet (1967)
13th Apollo Asteroid 2017 FR2 near-Earth flyby (0.078 AU)
13th History: return of the sample capsule from the Hayabusa (MUSES-C) spacecraft (2010)
14th Scheduled launch of a Progress, cargo-carrying spacecraft from the Baikonur Cosmodrome, Kazakhstan, to the International Space Station
14th History: launch of Mariner 5; Venus flyby mission (1967)
14th History: launch of Venera 10; Soviet Venus orbiter/lander (1975)
15th Saturn at Opposition, rising with the setting Sun and visible all night
15th History: flyby of Venus by Soviet spacecraft Vega 2 on its way to Comet Halley; dropped off lander and a balloon to study middle cloud layers (1985)
16th Apollo Asteroid 2010 VB1 near-Earth flyby (0.026 AU)
16th Amor Asteroid 9950 ESA closest approach to Earth (1.413 AU)
16th Plutino 28978 *Ixion* at Opposition (38.699 AU)
16th History: Liu Yang becomes the first Chinese woman in space aboard a Shenzhou-9 spacecraft, joining two other crew members on a thirteen day mission to the orbiting Tiangong 1 laboratory module (2012)
16th History: Valentina Tereshkova; first woman in space aboard Soviet Vostok 6 (1963)
17th Last Quarter Moon
17th Distant flyby of Saturn's moons *Prometheus*, *Atlas* and *Daphnis* by the Cassini spacecraft
18th Apollo Asteroid 471984 (2013 UE3) near-Earth flyby (0.049 AU)
18th History: launch of the Lunar Reconnaissance Orbiter (LRO) and Lunar CRater Observation and Sensing Satellite (LCROSS) to the Moon (2009)
18th History: Sally Ride becomes the first American woman in space aboard the Space Shuttle Challenger (1983)
19th Centaur Object 5145 *Pholus* at Opposition (26.390 AU)
19th History: flyby of Earth by the ill-fated Nozomi spacecraft on it way to Mars (2003)

Astronomical and Historical Events (continued)

20th Apollo Asteroid 2015 YC1 near-Earth flyby (0.084 AU)
20th Aten Asteroid 2013 ND15 (Venus Trojan) closest approach to Earth (1.200 AU)
20th History: successful landing of the Viking 1 spacecraft on Mars' Chryse Planitia (Plains of Gold) (1976)
20th History: discovery of Nova 1670 in Vulpeculae (1670)
21st Summer Solstice, 04:24 UT (12:24 am EDT)
21st Kuiper Belt Object 50000 Quaoar at Opposition (41.915 AU)
22nd Apollo Asteroid 2010 VZ11 near-Earth flyby (0.082 AU)
22nd Aten Asteroid 2014 OL339 closest approach to Earth (0.282 AU)
22nd Apollo Asteroid 24761 *Ahau* closest approach to Earth (1.455 AU)
22nd History: launch of Soviet space station Salyut 5 (1976)
22nd History: founding of the Royal Greenwich Observatory (1675)
22nd History: discovery of Pluto's largest moon *Charon* by Jim Christy (1978)
23rd New Moon
23rd Moon at perigee (closest distance from Earth)
23rd Distant flyby of Saturn's moons *Epimetheus*, *Daphnis* and *Pandora* by the Cassini spacecraft
23rd Apollo Asteroid 2102 Tantalus closest approach to Earth (0.332 AU)
24th Aten Asteroid 441987 (2010 NY65) near-Earth flyby (0.020 AU)
24th Apollo Asteroid 4257 *Ubasti* closest approach to Earth (1.759 AU)
24th History: launch of the Salyut 3 Soviet space station (1974)
24th History: Fred Hoyle born; British astronomer and proponent of nucleosynthesis (1915)
24th History: Sir William Huggins makes first photographic spectrum of a comet (1881)
25th Distant flyby of Saturn's largest moon *Titan* by the Cassini spacecraft
25th History: Rupert Wildt born, German-American astronomer and first to hypothesize that the CO_2 in the Venusian atmosphere was responsible for the trapped heat (1905)
25th History: Hermann Oberth born, father of modern rocketry and space travel (1894)
26th Apollo Asteroid 2005 LW3 near-Earth flyby (0.084 AU)
26th Apollo Asteroid 10563 *Izhdubar* closest approach to Earth (0.690 AU)
26th Aten Asteroid 398188 *Agni* closest approach to Earth (0.894 AU)
26th History: Charles Messier born, famed comet hunter (1730)
27th History: discovery of the Mars meteorite SAU 060, a small 42.28 g partially crusted grey-greenish stone found near Sayh al Uhaymir in Oman (2001)
27th History: flyby of the asteroid *Mathilde* by the NEAR spacecraft (1997)
27th History: Space Shuttle Atlantis (STS-71) first docking with the Russian space station Mir (1995)
27th History: launch of SEASAT, the first Earth-orbiting satellite designed for remote sensing of the Earth's oceans (1978)
27th History: Alexis Bouvard born, French astronomer, director of Paris Observatory, postulated existence of eighth planet from discrepancies in his astronomical tables for Saturn and Uranus. Neptune was subsequently discovered by John Couch Adams and Urbain Le Verrier after his death where he had predicted (1767)
28th Centaur Object 10370 *Hylonome* at Opposition (22.688 AU)
28th History: discovery of Pluto's moon *Kerberos* by Mark Showalter, et al., using the Hubble Space Telescope (2011)
28th History: Nakhla meteorite fall in Egypt (Mars meteorite), a piece of which was claimed to have vaporized a dog; first direct evidence of aqueous processes on Mars (1911)
29th History: George Ellery Hale born, founding father of the Mt. Wilson Observatory (1868)
30th First Quarter Moon
30th Distant flyby of Saturn's moons *Pan*, *Daphnis*, *Prometheus* and *Janus* by the Cassini spacecraft

Astronomical and Historical Events (continued)

30th Atira Asteroid 2007 EB26 closest approach to Earth (0.893 AU)
30th History: discovery of Haumea's moon Namaka, the smaller, inner moon of the dwarf planet, by Mike Brown, Chad Trujillo, David Rabinowitz, et al. (2005)
30th History: crew of Soyuz 11 dies upon return from the Salyut space station when capsule depressurizes (1971)
30th History: Tunguska Explosion Event (1908)

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/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.

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

Image Credits

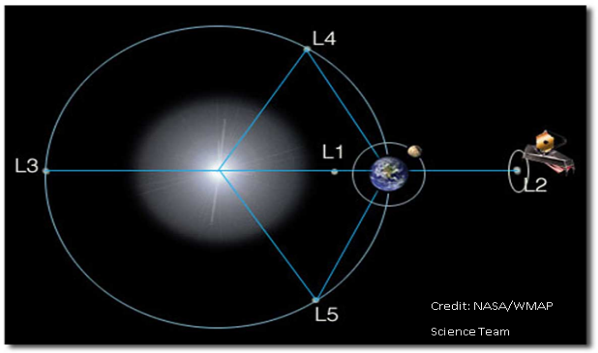
Front page design and graphic calendar: Allan Ostergren

Second Saturday Stars poster: Marc Polansky

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

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).



On the Cover

Black Holes have achieved a reputation as the ultimate roach hotels at the center of galaxies, where gravity is off the charts and nothing that enters ever escapes. That's a law of thermodynamics—Yet astrophysicists are finding increasing evidence of energetic particles and gases escaping the singularity and being hurled back into the surrounding void.

The image on the cover is of the center of the elliptical galaxy NGC 4696, about 145 million light years from Earth in the constellation Centaurus. The swirling dust and gas emanating from the black hole is a composite of data gathered from various observatories:

Red: X-Ray data from Chandra that reveals the hot gas in the cluster,

Blue: Radio data from the NSF's Karl G. Jansky Very Large Array that shows high-energy particles produced by the black hole-powered jets.

Green: Visible light data from the Hubble Space Telescope shows galaxies in the cluster, as well as galaxies and stars outside the cluster.

The outgassing occurred in bursts at intervals of five to ten million years, that have been likened to arhythmic heart beats, pulsing the gases and particles through the galaxy.

Do these observations indicate a flaw in the laws of thermodynamics? Steven Hawking has proposed that a black hole (singularity) could become superheated and eventually shrink or even disappear–but you would have to ask him to do the details. Perhaps a better explanation would be that not all matter gets through the event horizon, or outer layer of the singularity—some can be heated and ejected back into space. Even a roach motel has to occasionally put up a no vacancy sign.

For more information, go to *https://www.nasa.gov/mission_pages/chandra/the-arrhythmic-beating-of-a-black-hole-heart.htm*l.

Astronomy:

Past, Present & Future

A ***Free of Charge*** Summer Program for Young Scientists Grades 5 – 8

July 31 – August 5, 2017

7:00PM – 8:30PM

Eagle Nebula image by Marc Polansky

Course Outline

- ★ **Day 1**: The Origin of Astronomy
- ★ **Day 2**: Astronomy in the Renaissance
- ★ **Day 3**: Einstein and Newton
- ★ **Day 4**: Hubble, Galaxies, and the Astounding Expanding Universe
- ★ **Day 5**: The Big Bang Theory
- ★ **Day 6**: Observation Night – Parents welcome! Students will observe objects they've studied during the week and show off what they've learned.

Each day includes a fun, hands-on activity involving the day's topic.

John J. McCarthy Observatory

Furthering Science Literacy in Western Connecticut

Want to join us this summer? An Applicant . . .

- ★ Must **LOVE** science
- ★ Must be curious about the natural world
- ★ Must be a rising 5th – 8th grader
- ★ Is preferred to be able to attend all 6 nights of the program
- ★ Must apply by contacting **jjmosummerclass@gmail.com** to receive an online form

Application deadline is June 20, 2017 – space is limited!

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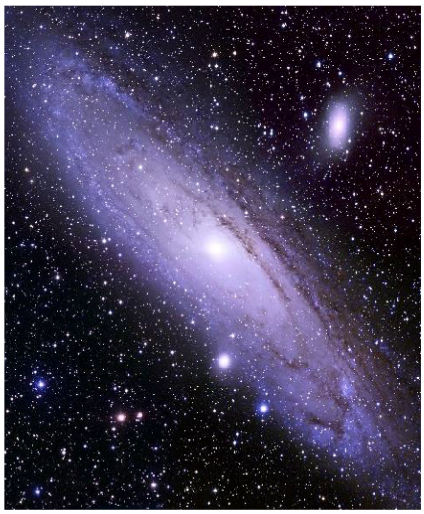


Class takes place at the JJ McCarthy Observatory, on the New Milford High School campus: 388 Danbury Road, New Milford, CT 06776

932

McCarthy Observatory
New Milford, CT

Second Saturday Stars

FREE EVENT

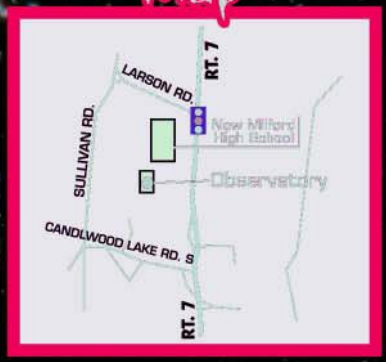
Every Month at the
John J. McCarthy Observatory
Behind the New Milford High School
860.946.0312
www.mccarthyobservatory.org

June 10th
8:00 - 10:00 pm

When Galaxies Collide

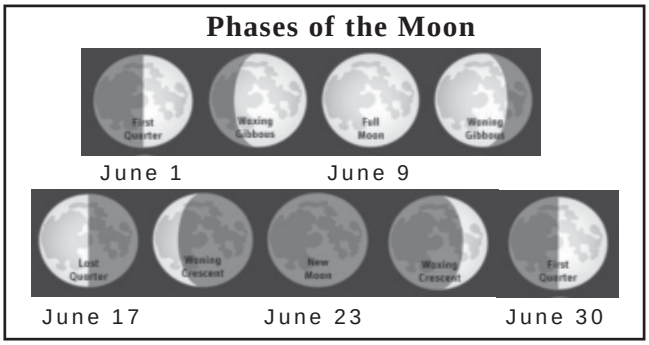
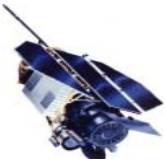
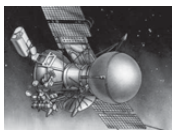
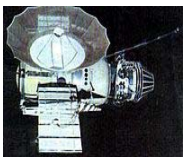
Refreshments
Family Entertainment
Handicapped Accessible
ASL Interpretation Available with Prior Notice
Rain or Shine

Map



June 2017

Celestial Calendar

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
				1 Moon at apogee (furthest from the Earth)   Launch of ROSAT (Röntgen) X-ray observatory (1990)	2 Full strawberry Moon  Launch of Soviet Venus Orbiter, Venera 15 to map surface of Venus, in tandem with Venera 16 (1983)   Launch of Mars Express spacecraft and ill-fated Beagle 2 lander. (2003)	3 Moon at Perigee (closest to earth)  200-inch Hale Telescope dedication (1948)   Gemini 9 launch, Thomas Stafford, Eugene Cernan. (1966) Launch of Gemini 4; Ed White 1st American to walk in space (1965) 
4  Maiden flight of Space X Falcon 9 rocket (2010)	5  Mercury-Redstone 3, or Freedom 7, first US human spaceflight, on May 5, 1961, piloted by astronaut Alan Shepard	6  Venera 16 - last of Soviet Venus orbiter/ lander missions to map Venusian landscape (1983)	7  "Three flames ate the sun, and big stars were seen." - etching on Chinese oracle bones indicating ancient solar eclipse, with three coronal streamers and stars visible in the darkened sky. (1302 BC)	8  Giovanni Cassini born, observer of Mars, Jupiter and Saturn (1625)  Launch of Venera 9, - 1st black/white images of surface of Venus (1975)	9 Dedicationof the Kathleen Fischer Sundial at the McCarthy Observatory (2012)  Johann Gottfried Galle, German astronomer, born - first to view planet Neptune, using calculations of Urbain Le Verrier 1846. (1812) 	10  Launch of Explorer 49 - moon orbiter and radio astronomy explorer (1973) Launch of Mars Exploration Rover A Spirit (2003)   2nd Saturday Stars Open House McCarthy Observatory
11  Flyby of Venus by Soviet spacecraft Vega 1 on its way to Comet Halley - dropped off lander and a balloon to study middle cloud layers (1985)	12  Launch of Venera 4, Soviet Venus lander, first to enter orbit of another planet (1967)	13  Return of sample capsule from the Hayabusa (MUSES-C) spacecraft, taken from near-Earth asteroid Itokawa (2010)	14  Launch of Mariner 5, Venus flyby mission (1967) Launch of Venera 10, Soviet Venus orbiter/ lander (1975)	15  flyby of Venus by Soviet spacecraft Vega 2 on its way to Comet Halley; dropped off lander and a balloon to study middle cloud layers (1985)	16  Liu Yang becomes the first Chinese woman in space (2012) Valentina Tereshkova, 1st woman in space (1963) 	17  Discovery of the Dhofar 378 Mars meteorite (2000)
18  Sally Ride, 1st U.S. woman in space (1983) Launch of Lunar Reconnais-sance Orbiter and LCROSS satellite to Moon (2009) 	19  Flyby of Earth by the ill-fated Nozomi spacecraft on its way to Mars (2003)	20  Discovery of Nova 1670 in Vulpeculae by Pere Dom Voiture Anthelme, a Carthusian monk in Dijon, France (1670)	21 Summer Solstice 05:04 UT (1:04 AM EDT)   Yáng Liwei, a Chi-nese major general, military pilot and a CNSA astronaut; was first man sent into space by the Chinese space program and his mission, Shenzhou 5, made China the third country to independently send people into space (1965)	22  Royal Greenwich Observatory founded (1675) Discovery of Pluto's largest moon Charon by Jim Christy (1978)   Launch of Soviet space station Salyut 5 (1976)	23 Moon at Apogee (farthest from earth)   Martin John Rees born, British cosmologist and astrophysicist, has contributed to knowlege of the cosmic background radiation, galaxy clustering and formation, and on the final disproof of Steady State theory. (1942)	24 Fred Hoyle born, British astronomer and proponent of nucleosynthesis (1915) Sir William Huggins makes 1st photographic spectrum of a comet (1881)
25 Rupert Wildt born, German astronomer (1905) Hermann Oberth born, father of modern rocketry and space travel (1894)	26 Charles Messier born, famed comet hunter (1730) German astronomer Walter Baade discovers near-earth asteroid 1566 Icarus inside orbit of Mercury, which became the subject of asteroid-busting "project Icarus." (1949) 	27 Alexis Bouvard born,postulated existence of 8th planet, later identified as Neptune (1767) launch of SEASAT 1, first Earth-orbiting satellite designed for remote sensing of oceans (1978) Flyby of the asteroid Mathilde by the NEAR spacecraft (1997) 	28 Nakhla meteor fall in Egypt - A piece of Mars object fabled to have hit dog (1911)	29 George Ellery Hale born, founding father of Mt. Wilson Observatory (1868) Shuttle Atlantis docks with Russian space station Mir to form the largest man-made satellite ever to orbit the Earth - the second time ships from two countries had linked up in space (1995). 	30 Death of 3 cosmonauts in Soyuz 11 when capsule depressurizes in reentry (1971) Tunguska explosion event (1908) Leap second added to world clocks	