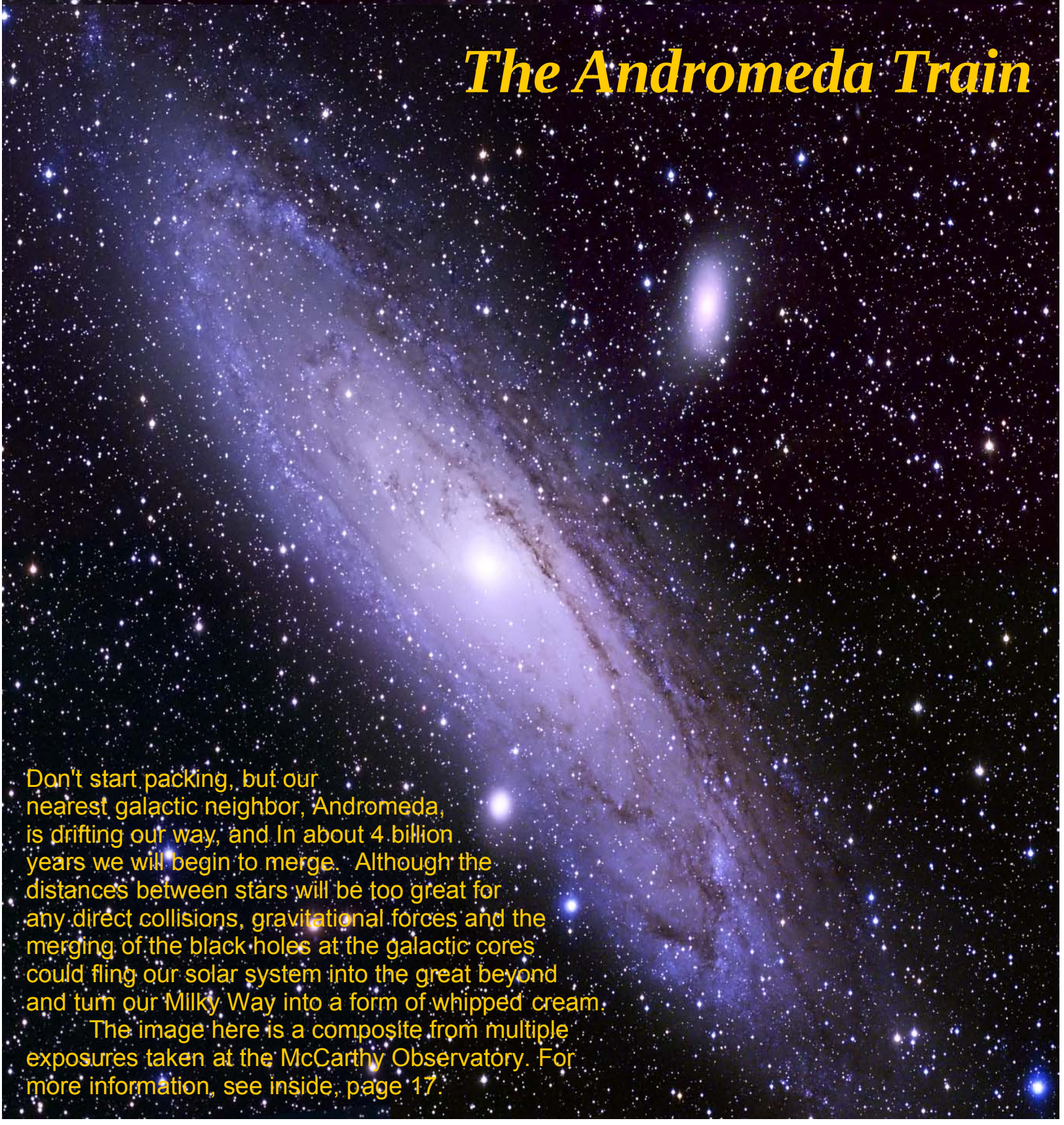
Galactic Observer

John J. McCarthy Observatory

Volume 8, No. 1 January 2015



The Andromeda Train

Don't start packing, but our nearest galactic neighbor, Andromeda, is drifting our way, and In about 4 billion years we will begin to merge. Although the distances between stars will be too great for any direct collisions, gravitational forces and the merging of the black holes at the galactic cores could fling our solar system into the great beyond and turn our Milky Way into a form of whipped cream.

The image here is a composite from multiple exposures taken at the McCarthy Observatory. For more information, see inside, page 17.

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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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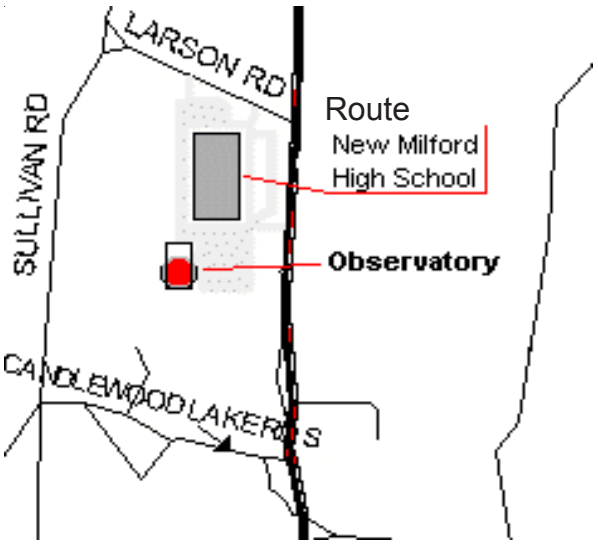

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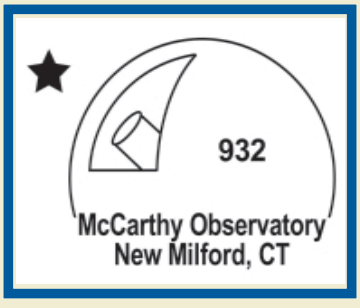
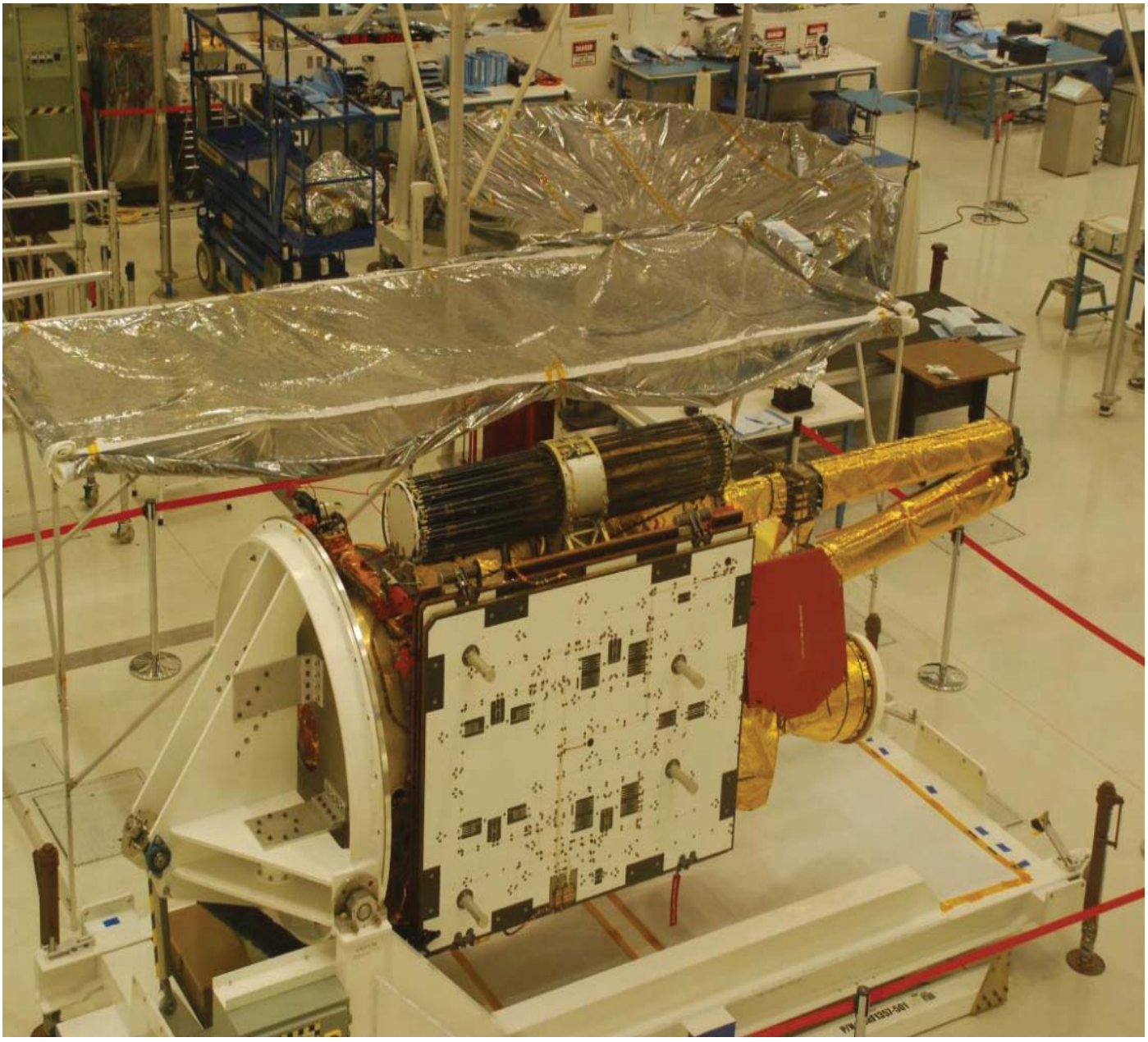


January Astronomy Calendar and Space Exploration Almanac



The Soil Moisture Active Passive (SMAP) spacecraft in the Spacecraft Assembly Facility's clean room at The Jet Propulsion Laboratory. The spacecraft's deployable mesh reflector antenna system (on top) and power-producing solar panels (sides) have been folded in preparation for launch.

SMAP has been transferred to the Vandenberg Air Force Base in California where it will be launched aboard a United Launch Alliance Delta 2 rocket in late January.

Photo: Bill Cloutier

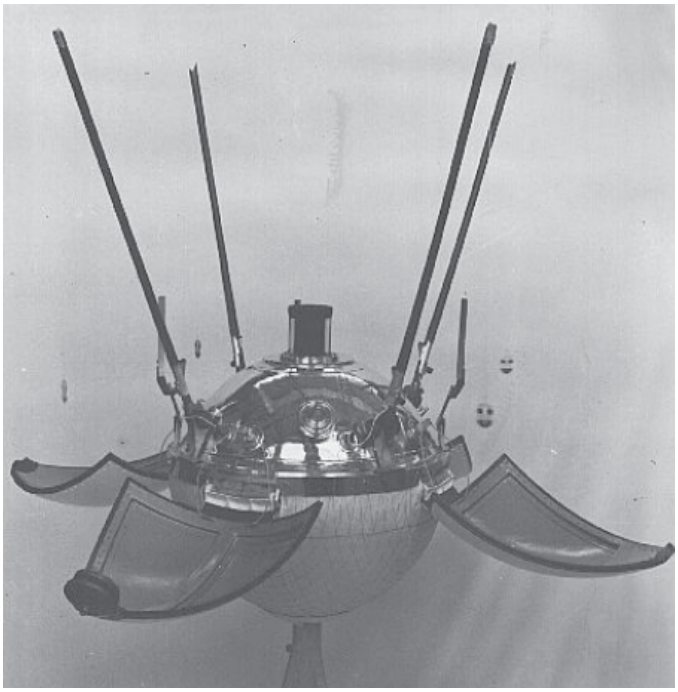
"Out the Window on Your Left"

IT'S BEEN OVER 40 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).

Lunar oceans (and seas) are vast plains of lava created during periods of volcanism

The view this month is of the western reach of Oceanus Procellarum (the Ocean of Storms) and the landing site of the Soviet Luna 9 spacecraft. Luna 9 was launched from the Baikonur Cosmodrome by a Molniya rocket on January 31, 1966. Three days later, the spacecraft became the first to execute a soft landing on the Moon and confirm that the Moon's surface could support the spacecraft (and not sink into a dusty quagmire).

The 23-inch (58 cm) spheroid-shaped spacecraft, weighing 218 pounds (99 kg), landed west of the Reiner and Marius craters. After landing, four petals, forming the outer shell of the spacecraft, opened to stabilize the spacecraft. Spring-controlled antennas were then deployed, establishing contact with the Earth, and a television camera began recording its surroundings. Over three



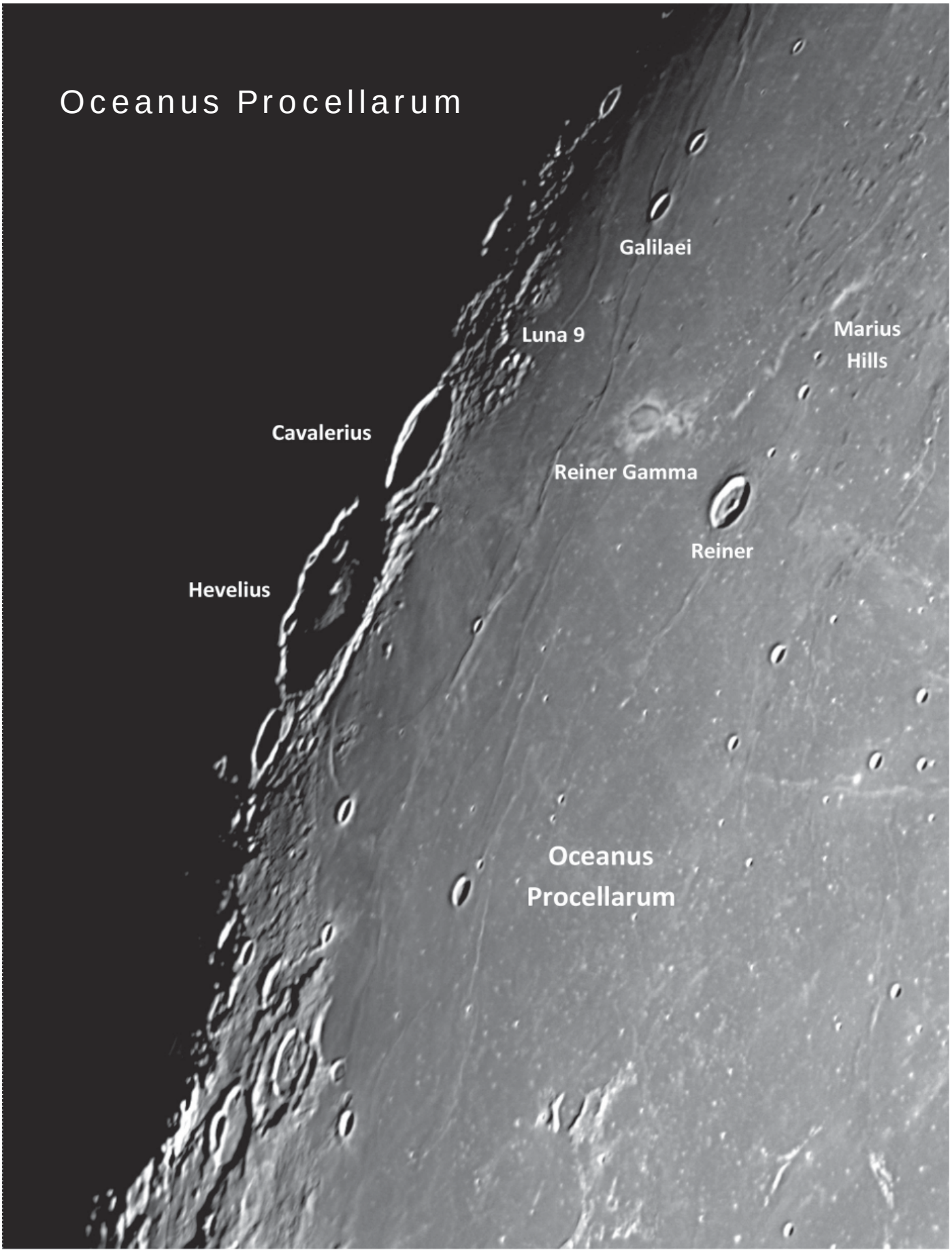
Luna 9 spacecraft on display
Credit: NSSDC Photo Gallery

days, Luna 9 transmitted information in seven radio sessions totaling over 8 hours before its batteries were exhausted. Twenty-seven individual images were received, including images of nearby rocks and the far horizon.

The area around crater Marius is cover with volcanic domes, one of the largest complexes on the nearside of the Moon. The formation of these low-lying mounds (the Marius Hills) dates back more than 3 billion years.

The ghostly feature west of crater Reiner is the Reiner Gamma swirl, a magnetic anomaly. These localized magnetic fields deflect the solar wind and alter how the surface weathers and darkens.

An image of Reiner Gamma.taken by the Lunar Reconnaissance Orbiter. Unlike a crater , this shallow surface feature has been described as "swirls of cream in a mug of hot chocolate." Source: NASA


Oceanus Procellarum
Galilaei
Luna 9
Marius Hills
Cavalerius
Reiner Gamma
Reiner
Hevelius
Oceanus Procellarum

Jodrell Bank Centre for Astrophysics and Luna 9

The Lovell radio telescope is the flagship of the Jodrell Bank Observatory located approximately 20 miles south of Manchester, England. In the 1950s and 1960s, the radio telescopes at the Observatory provided logistical and operational support to the US space program and gathered intelligence on Soviet launches and space missions.

As it had for previously missions, Jodrell Bank tracked Luna 9 on its way to the Moon, listening in and recording telemetry from the spacecraft. When transmissions abruptly stopped during the landing, it was assumed that the spacecraft had crashed. However, after a short time, the transmissions resumed. The radio signals were dutifully recorded until someone at the Observatory recognized the characteristics of the signals as being similar to those used in transatlantic transmissions. With a fax machine borrowed from the local office of the London Daily Express, the Observatory was able to convert the transmissions into images and release the first photo from the surface of the Moon, much to the embarrassment of the Soviets.

Lovell Radio Telescope
Credit: Anthony Holloway, Jodrell Bank

While the image produced by Jodrell Bank was distorted (due to an incorrect assumption as to the aspect ratio), it was telling in what it didn't show. The rocky and uneven surface depicted in the photo was devoid of a smothering blanket of dust hypothesized by some scientists. The transmission of the picture, in itself, confirmed that the surface of the Moon could

Intercepted image of the Luna 9 landing site
Credit: Jodrell Bank Centre for Astrophysics, University of Manchester

support the weight of the spacecraft. Once the Soviets released their corrected version of the photo, other theories on the origin and nature of the Moon were put to rest.

Test Flight of Orion

From all indications, the four-and-one-half-hour test flight of the unmanned Orion capsule on December 5th was nearly flawless. Launched atop a Delta IV Heavy rocket from the Cape Canaveral Air Force Station, the capsule traveled 3,600 miles (5,800 kilometers) from Earth before executing a return. Orion reentered the atmosphere at 20,000 mph (32,000 kph), exposing its heat shield to temperatures approaching 4,000°F. Eleven individual parachutes were deployed, bringing the capsule gently back to Earth, where is splashed down in the Pacific Ocean, approximately 600 miles (966 kilometers) west of San Diego.

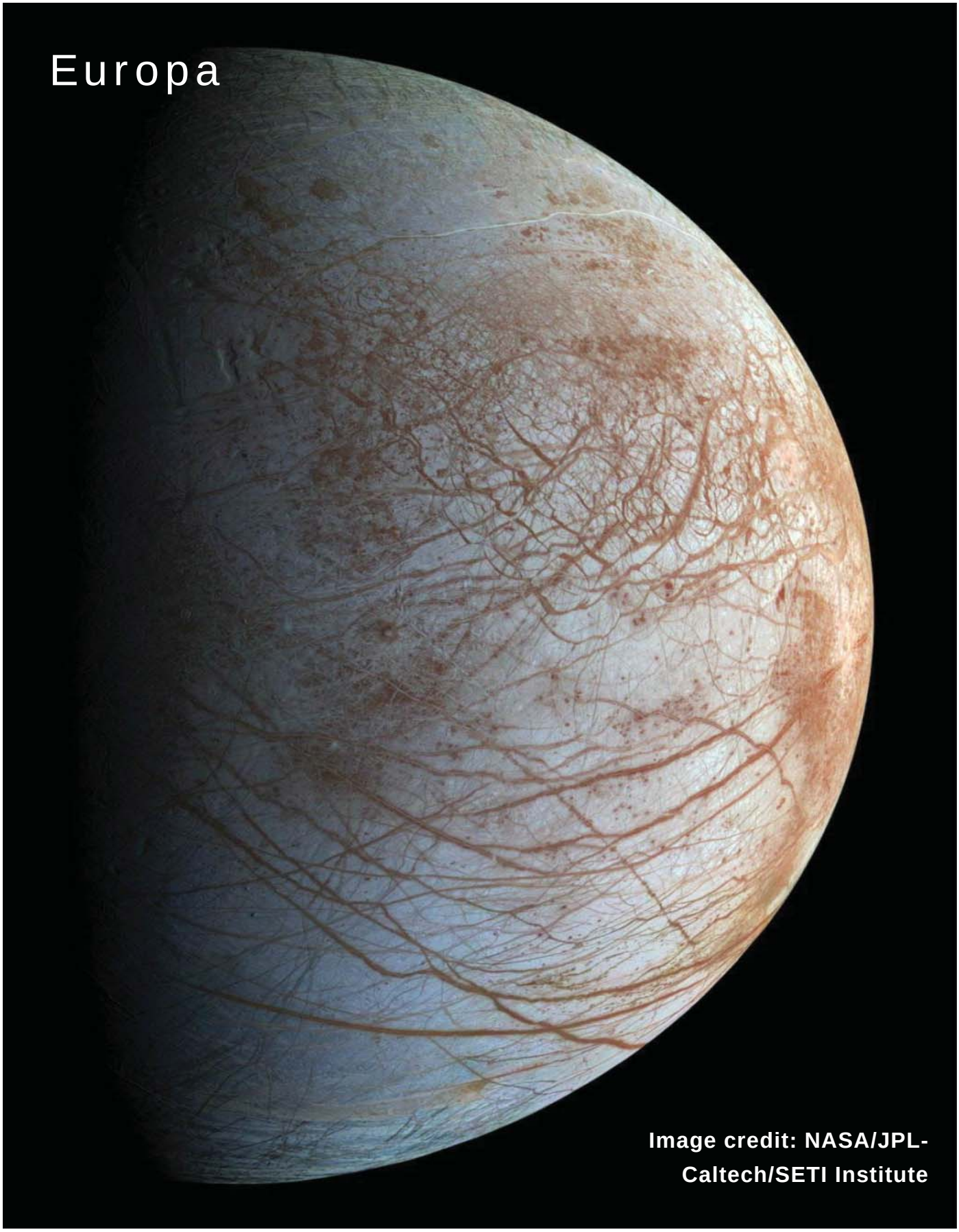
Orion was retrieved by the USS Anchorage and brought to port three days later. The capsule is being trucked to the Kennedy Space Center for analysis of the data collected by the 1,200 on-board sensors. The test flight was designed to evaluate Orion's heat shield performance, the crew environment and avionics, measure the radiation levels as it passed through the Van Allen belts, and practice recovery procedures.

Astronauts are not scheduled to fly on the capsule until 2021, after another unmanned test flight in 2018. NASA has been developing a new space launch system (SLS) rocket for deep space missions and to carry the Orion capsule. Agency officials are expecting the rocket to be ready for its first test launch sometime in 2018.

Orion Launch and Landing

Delta 4 Heavy rocket launch
Credit: United Launch Alliance

Orion capsule returns under the three main parachutes
Credit: U.S. Navy/Charles White


Europa
Image credit: NASA/JPL-
Caltech/SETI Institute

Europa: A Fatal Attraction

NASA has released its highest resolution image of Jupiter's moon, Europa, after reprocessing images taken by the Galileo spacecraft in the late 1990s. The colors in the image were adjusted to replicate the view of the moon as it would appear to the human eye from orbit. The colors are also associated with differences in the composition of the moon's icy shell, from the blues and whites signifying water ice to reds and browns for non-ice constituents.

Europa is subject to large tidal forces, due to its proximity to Jupiter. It is believed that the tidal flexing creates enough energy to keep the ocean below Europa's icy surface liquid. The potential of a large subsurface ocean makes Europa a prime candidate in the search for extraterrestrial life.

Europa orbits inside Jupiter's radiation belts, which are 10 times stronger than Earth's Van Allen belts. The high-energy particles that rain down on Europa's surface create a sterile environment. While the conditions are deadly on the surface, the radiation levels are significantly less below the surface (first meter of ice).

Jupiter's radiation belts rotate with the planet and faster than Europa. As such, the charged particles from the belt predominately strike the trailing hemisphere of the moon, which is always the same since the moon is tidally locked with Jupiter. Conversely, the leading hemisphere of Europa is bombarded by micrometeorites, creating a layer of regolith which provides additional shielding from radiation.

The radiation levels on the trailing hemisphere are estimated at 540 REM/day (500 REM being fatal to humans). Combined with a surface temperature of -274°F (-170°C), future colonists would need to burrow well below the surface to survive.

There are two future missions to Europa being considered. The European Space Agency's Jupiter Icy Moon Explorer (JUICE) would launch in 2022. The spacecraft would arrive at Jupiter in 2030 and spend at least three years observing the planet and three of its largest moons, Ganymede, Callisto and Europa.

JUICE would provide continuous observations of Jupiter's atmosphere and its magnetosphere. It would fly by Calisto and Europa (twice) before entering orbit around Ganymede for a detailed study of Jupiter's largest moon. The Europa flybys are intended to identify future landing sites.

The Europa Clipper is a concept mission being studied by NASA. The spacecraft would perform multiple close flybys of the moon in an elongated orbit that would minimize the time spent inside the radiation belts of Jupiter. The Clipper mission would perform 45 flybys over a 3½ year mission at altitudes varying from 1,700 miles to 16 miles (2,700 km to 25 km). Ground-penetrating radar would likely be included in the scientific payload to determine the thickness of the crust and spectrometers to analyze the composition of the surface and the moon's rarified atmosphere. If funded, the mission would launch around 2025.

Should NASA elect to launch the Europa Clipper on its new SLS rocket (as compared to an Atlas V), it could reduce the cruise duration by more than 4 years, eliminate the need for a Venus/Earth/Earth gravitational assist and allow for a larger payload.

A Martian Marathon

On January 25, 2004, the Mars Exploration Rover Opportunity entered the Martian atmosphere after a six month journey and bounced along the Martian surface in an inflatable cocoon before coming to rest in Eagle crater. While only 72 feet (22 meters) in diameter, small nodules of hematite (dubbed blueberries) in the rock layers that formed the crater wall provided the first clear evidence that liquid water played a role in geologic processes that transformed the Red Planet over the past 4 billion years. Eagle would be the first of several impact craters that Opportunity would explore as it traveled across the plains of Meridiani Planum.

Opportunity would spend the second half of 2004 traveling to and exploring nearby Endurance crater. In April 2005, the mission would be threatened when the rover became stuck in a sand dune. It would take six weeks of planning and many, centimeter-sized maneuvers to extract the rover. After escaping "Purgatory Dune," Opportunity narrowly avoided another dune when newly installed software stopped the rover before it lost traction. Circumventing the dune, Opportunity continued on its trek to Victoria crater, stopping by the smaller Erebus crater along the way. On its way, it would pass by its own discarded heat shield and the first of several meteorites.

The rover reached Victoria crater in September of 2006, after traveling 4.3 miles (7 km) from its landing site. It would spend the first nine months circumnavigating the crater's rim, during which it was photographed by the Mars Reconnaissance Orbiter. In mid-2007, a series of dust storms blotted out the Sun. The loss of power threatened to discharge the rover's battery and permanently disable the rover. By late August, however, the storms began to subside and Opportunity was receiving enough sunlight to recharge its battery and return to normal operation. The rover would spend another year exploring rock outcroppings within the crater.

Rover Tracks on Endeavour Crater's rim
Image Credit: NASA/JPL-Caltech/Cornell Univ./Arizona State Univ.

Leaving Victoria, Opportunity would begin a three year journey to Endeavour crater, reaching the rim of the 14 mile (22km) diameter impact crater in August 2011. Shortly after arriving, the rover would discover gypsum deposits on the surface, a clear indication that water once flowed through the surrounding rock. In May 2013, the rover was directed to drive to a high ridge on the rim, designated Solander Point. The sun-facing slope of the ridge allowed Opportunity to continue to work through the Martian winter. On its trek, the rover discovered rocks dating back to the earliest geologic (Noachian) period, approximately 4 billion years ago.

During Opportunity's almost eleven years on Mars, the rover has found water-borne materials and minerals deposited by water (including hematite, clay and gypsum) – conclusive signs that liquid water once flowed across or percolated through the Martian surface.

The 4.9 foot (1.5 m) high rover has survived dust storms, sand traps and equipment breakdowns. A malfunctioning heater switch has increased the electrical load. An inoperative shoulder azimuth joint limits the robotic arm movement. Non-functioning science instruments, sporadic issues with flash memory, and other glitches with software have affected Opportunity's operations as well. The rover drives backwards in an effort to prolong the life of a failing front wheel. Opportunity's ailments include a failed potentiometer in the arm, causing the rover to believe the arm has come unstowed (an event that would preclude driving). Despite the many challenges, Opportunity is still capable of executing its mission.

Opportunity's odometer is closing in on 26 miles (42 km) despite the deteriorating performance of its flash memory. The rover is currently traveling along the western rim of Endeavour Crater towards Marathon Valley. The valley is of interest to mission scientists, due to detection of clay minerals by orbiting spacecraft.

Return of the Falcon

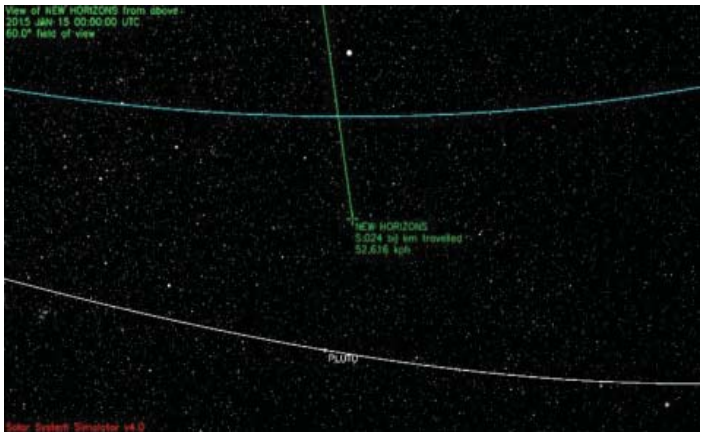
The Japan Aerospace Exploration Agency (JAXA) successfully launched its second asteroid sample return mission, Hayabusa 2, on December 3rd from the Tanegashima Space Center. The spacecraft is currently en route to asteroid 1999 JU3. In addition to a suite of scientific instruments, Hayabusa 2 carries a lander and a small rover. It is hoped that the spacecraft will be able to return samples (including subsurface rock) of the asteroid to Earth.

Artist's concept of the Hayabusa 2 spacecraft on approach Credit: Akihiro Ikeshita/ JAXA

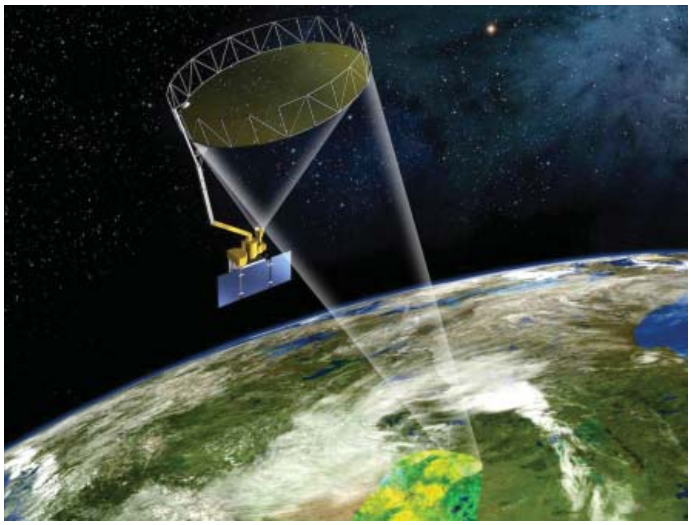
SMAP

NASA is scheduled to launch its Soil Moisture Active Passive (SMAP) satellite from the Vandenberg Air Force Base in California on January 29th.

Built at the Jet Propulsion Laboratory, the spacecraft is designed to create a global map of soil moisture every 2 to 3 days. The spacecraft is equipped with a 19.7-foot (6-meter) deployable mesh reflector antenna. Rotating at 14.6 rpm, the Earth is mapped in 620 miles (1,000 km) wide swaths. Soil moisture analysis can be used to monitor crop production, droughts, floods and in weather forecasting.



New Horizon's Position on January 15th JPL's Solar System Simulator *http://space.jpl.nasa.gov/*



Artist's concept of the SMAP spacecraft in orbit
Credit: NASA/JPL-Caltech

Wake-up Call

After nearly nine years and three billion miles, the New Horizons spacecraft came out of hibernation on December 6th for the last time before its encounter with Pluto on July 14 2015. In January, the spacecraft will begin long range observations of the dwarf planet.

By mid-May, New Horizon's cameras will be able to resolve Pluto and its moons better than the Hubble Space Telescope and the views will keep getting better as the spacecraft closes the remaining distance.

Maiden Flight

Russia launched an Angara 5 rocket on its maiden flight on December 23rd from the Plesetsk Cosmodrome. The heavy lift rocket will replace Russia's Proton launcher for its largest payloads and reduce its reliance on foreign suppliers and the Baikonur Cosmodrome in Kazakhstan.

Curiosity Update

NASA's Mars Science Laboratory Curiosity continues to explore the foothills of Mt. Sharp, a 3 mile high (5 km) layered mound located near the center of the Gale crater. The photograph (below) shows a deposit that on Earth would be found on a lake bed where an entering river lays down layers of sediment. The layers were likely deposited over tens of millions of years, suggesting a prolonged period when liquid water was abundant on the Martian surface.

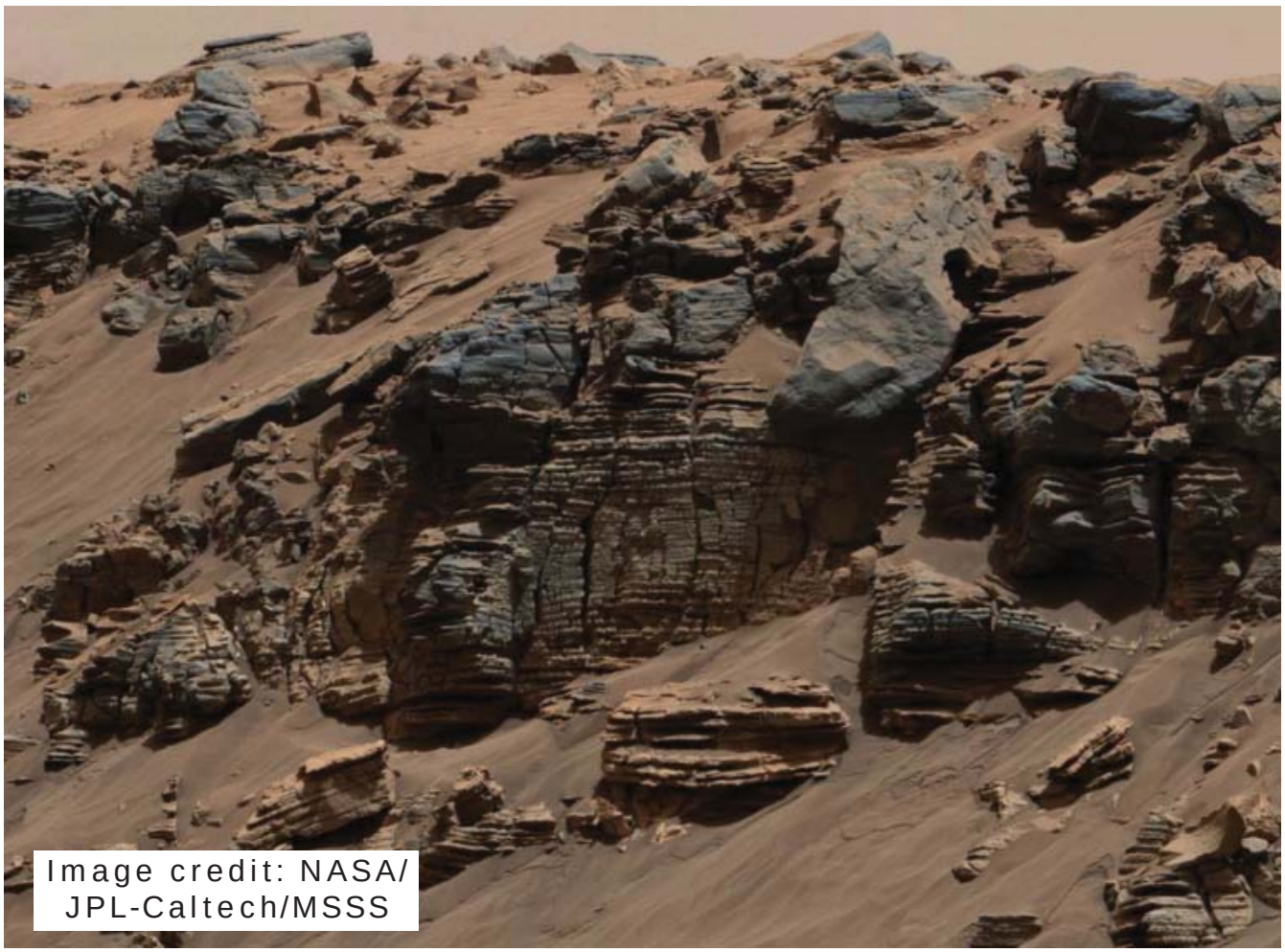


Image credit: NASA/ JPL-Caltech/MSSS

January History

The month of January has been a difficult one for both the American and Soviet space programs. Untimely deaths set back both the American and Soviet moon programs. The two space shuttles that have been lost were also launched in January.

Sergei Korolyov, the "Chief Designer" of the Soviet space program, died on January 14, 1966 from a botched medical procedure. Korolyov co-founded the Moscow rocketry organization in the 1930s before being thrown into prison during the peak of Stalin's purges. He spent a year in the Kolyma gold mine, the most dreaded part of the Gulag in Siberia before he was recalled to Moscow to aid the Red Army in developing new weapons. Korolyov went on to lead the Soviet space effort. Unfortunately, the Soviet Moon program died with Korolyov in 1966. While the race continued for some time after his death, his N-1 moon rocket never made a successful flight.

In January of 1967, after a successful Gemini program, NASA was moving forward with testing the new Apollo spacecraft. On the afternoon of the 27th, Gus Grissom, Ed White and Roger Chaffee were sealed inside the Apollo 1 command module sitting on top of an unfueled Saturn rocket in a simulated

countdown. The command module had been plagued with problems and was in a state of constant redesign. At 6:31 pm, a spark from a damaged wire ignited the pure oxygen atmosphere in the spacecraft. Within seconds the temperature reached 2,500°. The astronauts never had a chance to undo the bolts of the hatch before they were asphyxiated. Following their deaths, the spacecraft was completely redesigned. Lessons learned from this accident served to make the spacecraft much safer and contributed to the success of the six moon landings.

Twenty-two years ago, on January 28, 1986, the United States lost its first space shuttle, the Challenger. Due to the low temperature on the launch pad, a rubber-like O-Ring used to seal the joints of the solid rocket boosters failed to seat and stop the hot gasses from escaping. The gas produced a blowtorch-like flame that penetrated the external tank filled with liquid oxygen and hydrogen. The tank exploded 73 seconds after liftoff, destroying the shuttle and killing all seven crew members. Among the crew was Christa McAuliffe, a New Hampshire teacher.

Christa graduated from Framingham State College (Framingham, Massachusetts) in 1970. Following her death, the college established *The Christa McAuliffe Center* on the campus as a means to continue the educational mission which was Christa's life's work.

On February 1, 2003, a second space shuttle, the Columbia, was lost. The Columbia was the oldest shuttle in the fleet, having been first flown in 1981 by astronauts John Young and Robert Crippen. On its 28th flight, Columbia broke apart during reentry at an altitude of some 200,000 feet and a speed of 12,500 miles per hour. The shuttle and its crew of seven had just completed a 16 day science mission. The most likely cause of the accident was damage to a seal on the left wing from a piece of insulating foam that broke loose from the external fuel tank at launch, striking the wing. The resulting gap in the wing allowed the superheated atmosphere to penetrate the wing during reentry and destroy the spacecraft.

The crew of STS-107. L to R: Brown, Husband, Clark, Chawla, Anderson, McCool, Ramon

The Columbia accident ultimately led to the decision to stop flying the space shuttle once the International Space Station was complete and to develop a safer manned vehicle.

January Nights

January nights can be clear and cold with frigid blasts of polar wind. They also present an opportunity to see stars at every stage in their life cycle, from birth (Orion Nebula) to fiery demise (Crab supernova remnant).

If you are out observing the open star clusters Pleiades or Hyades in the constellation Taurus, don't overlook the red giant Aldebaran. This star is receding from us more rapidly than any other 1st magnitude star in the sky. It was the brightest star in the sky some 320,000 years ago when it was 21½ light years from Earth. Moving away, Aldebaran is currently 65 light years in distance and the thirteenth brightest star in the sky.

Sunrise and Sunset

Sun	Sunrise	Sunset
January 1st (EST)	07:20	16:34
January 15th	07:18	16:48
January 31st	07:06	17:08

Astronomical and Historical Events

1st Kuiper Belt Object 230965 (2004 XA192) at Opposition (34.694 AU)
1st History: GRAIL-B spacecraft enters lunar orbit (2012)
1st History: Giuseppe Piazzi discovers the first asteroid, now dwarf planet, *Ceres* (1801)
2nd History: flyby of Comet Wild 2 by the Stardust spacecraft (2004)
2nd History: launch of the Soviet spacecraft Luna 1; first probe to fly by the Moon (1959)
3rd Quadrantids meteor shower peaks; radiates from the constellation Boötes (name from an obsolete constellation called Quadrans Muralis)
3rd History: exploration rover Spirit lands on Mars in Gusev Crater; operational for six years before getting bogged down in loose soil at a winter haven called Troy (2004)
3rd History: Stephen Synnott discovers Uranus' moons *Juliet* and *Portia* (1986)
4th Full Moon
4th Earth at Perihelion; closest approach to the Sun (0.983 AU)
4th History: Isaac Newton born; inventor of the reflecting telescope, described universal gravitation, compiled the laws of motion, and invented calculus (1643)
5th History: launch of the Soviet atmospheric probe, Venera 5, to Venus (1969)
5th History: discovery of dwarf planet *Eris* (the Pluto killer) by Mike Brown, et al. (2005)
5th History: discovery of Jupiter's moon *Elara* by Charles Perrine (1905)
6th History: launch of the Lunar Prospector spacecraft; detected signs of water ice in permanently shadowed craters, mapped surface composition and Moon's gravity field and detected outgassing events in the vicinity of craters Aristarchus and Kepler (1998)
6th History: La Criolla (Argentina) meteorite fall (1985)
6th History: launch of Surveyor 7, the last of the unmanned Surveyor spacecrafts; soft-landed near Tycho crater; first probe to detect a faint glow on lunar horizon - thought to be sunlight reflected from electrostatically levitated moon dust (1968)
7th History: discovery and first recorded observations of Jupiter's four largest moons Io, Europa, Ganymede and Callisto by Galileo Galilei (1610)
8th History: launch of Japanese spacecraft Sakigake with mission to rendezvous with Comet Halley; measured the solar wind and magnetic field (1985)
8th History: launch of Luna 21 and the Lunokhod 2 moon rover (1973)
8th History: Stephen Hawking born (exactly 300 years after the death of Galileo); discovered that black holes could emit radiation - subsequently known as Hawking radiation (1942)
9th Moon at Apogee (furthest distance from Earth)
10th Second Saturday Stars – Open House at the McCarthy Observatory
10th History: launch of the Soviet atmospheric probe, Venera 6, to Venus (1969)
10th History: U.S. Army first bounces radio waves off the Moon (1946)
11th Flyby of Saturn's largest moon *Titan* by the Cassini spacecraft
11th Mars Winter Solstice in Northern Hemisphere
11th History: the Lunar Prospector spacecraft enters lunar orbit for a nineteen month chemical mapping mission (1998)
11th History: William Herschell discovers Uranus' moons *Titania* and *Oberon* (1787)
12th New Horizons spacecraft starts distant Pluto operations
12th History: launch of the Deep Impact spacecraft for a flyby of Comet Tempel 1; a small "impactor" was later released from the main spacecraft for a July 4th collision with the comet's nucleus (2005)
12th History: Sergei Pavlovich Korolyov born, Chief Designer of the Soviet space program (1907)
13th Last Quarter Moon
13th History: Stephen Synnott discovers Uranus' moons *Desdemona*, *Rosalind* and *Belinda* (1986)
13th History: discovery of the Martian meteorite EETA 79001 in Antarctica; second largest Martian meteorite recovered after Zagami (1980)

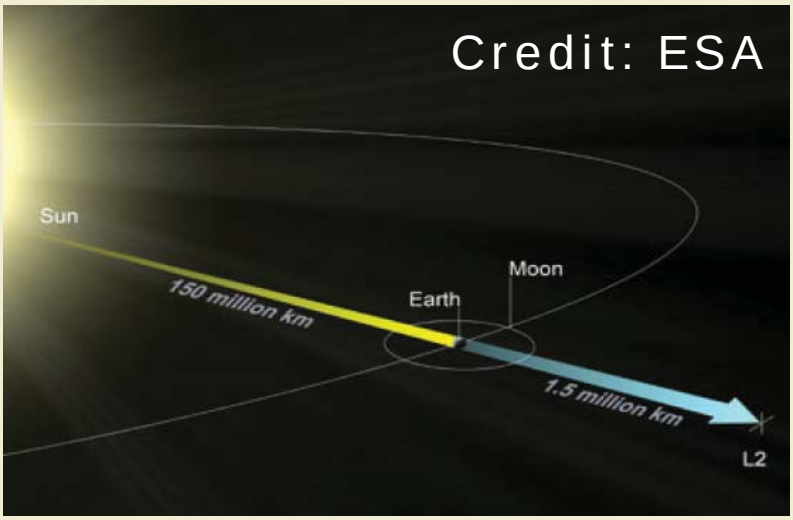
Astronomical and Historical Events (continued)

14th Mercury at its Greatest Eastern Elongation (19°)
14th History: first of three flybys of the planet Mercury by the Messenger spacecraft (2008)
14th History: landing of the Huygens probe on Saturn's largest moon Titan (2005)
15th History: Stardust spacecraft returns samples of Comet P/Wild 2 (2006)
15th History: launch of the spacecraft Helios 2, solar orbiter (1976)
15th History: Lunokhod 2, the second of two Soviet unmanned lunar rovers, lands in Le Monnier crater; covered a total distance of 23 miles in almost five months of exploring the floor of the crater and its southern rim (1973)
16th History: final launch of space shuttle Columbia (STS-107); lost on re-entry (2003)
17th Kuiper Belt Object 20000 Varuna at Opposition (42.767 AU)
19th History: launch of the New Horizons spacecraft to Pluto; due to arrive in July 2015 (2006)
19th History: discovery of the Martian meteorite SAU 090, a basaltic shergottite, in Oman (2002)
19th History: discovery of Saturn's moon *Janus* by the Voyager 1 spacecraft (1980)
19th History: launch of Gemini 2, an unmanned suborbital flight designed to test the spacecraft's heat shield (1965)
19th History: Johann Bode born, popularized an empirical law on planetary distances originally developed by J.D. Titius, known as "Bode's Law" or "Titius-Bode Law" (1747)
20th New Moon
20th Plutino 208996 (2003 AZ84) at Opposition (43.931 AU)
20th History: Rich Terrile discovers Uranus' moons *Cordelia* and *Ophelia* (1986)
20th Buzz Aldrin's 85th Birthday (1930)
21st Moon at perigee (closest distance from Earth)
21st History: launch of the rocket Little Joe-1B and a rhesus monkey named "Miss Sam" in a successful test of the Mercury capsule's escape system (1960)
21st History: John Couch Adams born, astronomer and mathematician who was the first person to predict the position of a planet beyond Uranus (1792)
22nd History: launch of Apollo 5, the first Lunar Module flight (1968)
23rd Scheduled launch of the Deep Space Climate Observatory (DSCOVR aboard a Space X Falcon 9 rocket from the Cape Canaveral Air Force Station, Florida; designed to monitor space weather and Earth's climate
23rd History: Brad Smith discovers Uranus' moon *Bianca* (1986)
24th History: launch of space shuttle Discovery (STS-51-C); 100th human spaceflight to achieve orbit (1985)
24th History: discovery of the Martian meteorite Dhofar 019 in Oman (2000)
24th History: launch of Japan's Hiten spacecraft; first use of a low-energy transfer to modify an orbit and the first demonstration of a transfer to the Moon requiring no change in velocity for capture (1990)
24th History: flyby of Uranus by the Voyager 2 spacecraft (1986)
25th History: exploration rover Opportunity lands on Mars at Meridiani Planum; still operational and currently exploring Endeavour Crater (2004)
25th History: launch of the Infrared Astronomical Satellite (IRAS); first space telescope to survey of the entire sky at infrared wavelengths (1983)
25th History: launch of the U.S. Moon orbiter Clementine (1994)
25th History: Joseph Lagrange born (1736); mathematician who discovered five special points in the vicinity of two orbiting masses where a third, smaller mass can orbit at a fixed distance from the larger masses. The L1 Lagrange Point of the Earth-Sun system is the current home of the Solar and Heliospheric Observatory Satellite (SOHO).
26th First Quarter Moon
26th History: discovery of dwarf planet *Haumea*'s moon *Hi'laka* by Mike Brown, et al. (2005)
26th History: discovery of Saturn's moon *Epimetheus* by the Voyager 1 spacecraft (1980)

Astronomical and Historical Events (continued)

26th History: launch of the International Ultraviolet Explorer (IUE); space telescope and spectrographs; designed to take ultraviolet spectra (1978)
27th History: fire in the Apollo 1 spacecraft kills astronauts Gus Grissom, Edward White and Roger Chaffee (1967)
27th History: Philibert Melotte discovers Jupiter's moon Pasiphae (1908)
28th History: final launch of the space shuttle Challenger (STS-51L); lost on lift-off (1986)
28th History: Johannes Hevelius born; leading observational astronomer of the 17th century, published detailed maps of the Moon and determined the rotational period of the Sun (1611)
29th Scheduled launch of the Soil Moisture Active Passive (SMAP) spacecraft/ GRIFEX/ ExoCube/ FIREBIRD C & D Delta 2 Launch
29th History: Soviet spacecraft Phobos 2 enter orbit around Mars; successfully returned 38 images before contact was lost; its lander was not deployed (1989)
31st History: launch of Apollo 14; third manned moon landing with astronauts Alan Shepard, Stuart Roosa and Edgar Mitchell (1971)
31st History: launch of Soviet Moon lander Luna 9; first spacecraft to land and to transmit photographs from the Moon's surface (1966)
31st History: launch of Mercury-Redstone 2 rocket with Ham the chimpanzee (1961)
31st History: launch of the first U.S. satellite, Explorer 1; detected inner radiation belt encircling the Earth (1958)

The Apollo 14 landing site (star), located about 30 miles north of the 57 mile diameter Fra Mauro crater



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).

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°)

• One astronomical unit (AU) is the distance from the Sun to the Earth or approximately 93 million miles

International Space Station/Space Shuttle/Iridium Satellites

Visit *www.heavens-above.com* for the times of visibility and detailed star charts for viewing the International Space Station, the Space Shuttle (when in orbit) 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.*

Image Credits

Front page design and graphic calendar: Allan Ostergren
Second Saturday Stars poster: Sean Ross, Ross Designs

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

Cover image: This 4 image mosaic of Andromeda, the largest and only naked eye visible galaxy in the sky was taken over 6 nights in late fall 2014 (October-November). It was shot through the Takahashi FSQ-106ED with the SBIG ST-10XME camera with each of the 4 sections comprised of roughly 45 minutes of Luminance, 20 minutes of the colors Red, Green, and Blue, using 2 minute 30 second exposures binned 1x1 for each filter. Processing done in MaximDL, PixInsight, and Photoshop.

Marc Polansky and the JJMO imaging team.

Editors' Note: For more information and an eye-popping multimedia preview of the galactic merger of Andromeda and the Milky Way, go to *http://www.nasa.gov/mission_pages/hubble/science/milky-way-collide.html*

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

January 10th

7:00 - 9:00 pm

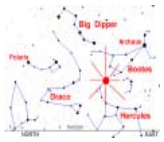
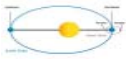
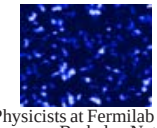
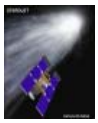
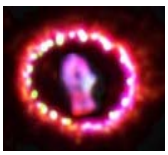
TELESCOPE TIME MACHINE

- Refreshments
- Family Entertainment
- Activity Center
- Stars & Planets
- Rain or shine

art & design · sean ross · rossgrafix13@yahoo.com

January 2015

Celestial Calendar

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
	Phases of the Moon  Jan 4 Jan 13  Jan 20 Jan 26			**1**  Giuseppe Piazzi discovers Ceres, 1st asteroid, now dwarf planet (1801)  GRAIL-B spacecraft enters lunar orbit (2012)	**2** Soviet spacecraft Luna 1 circles Moon (1959)   Flyby of comet Wild 2 by Stardust spacecraft (2004)	**3**  Rover Spirit on Mars (2004)  Quadrantids meteor shower peak
4  Isaac Newton born (1643)  Earth at Perihelion; closest to the Sun (0.983 AU)	**5**  Discovery of Jupiter's moon Elara by Charles Dillon Perrine (1905)	**6**  La Criolla (Argentina) meteorite fall (1985)  Launch of Lunar Prospector: detected signs of water ice in shadowed craters, mapped surface composition and Moon's gravity field (1998)	**7**  Launch of Surveyor 7, the last of the Surveyor Lunar landers; soft-landed near Tycho crater (1968)  Discovery and first recorded observations of Jupiter's four largest moons by Galileo Galilei (1610)	Moon at apogee (furthest from the Earth) **8** launch of Luna 21 and the Lunokhod 2 moon rover (1973)   Launch of Japanese spacecraft Sakigake to Comet Halley (1985)  Stephen Hawking born (1942)	**9**   Physicists at Fermilab and Lawrence Berkeley National Laboratory (Berkeley Lab) unveil maps of the invisible scaffolding of the universe - dark matter - opening new ways for understanding dark energy with ground-based telescopes (2012)	**10**  U.S. Army bounces radio waves off the Moon (1946) Surveyor 7 lands on Moon (1968)   2nd Saturday Stars Open House McCarthy Observatory
11  William Herschell discovers Uranus moons Titania and Oberon (1787)	**12** Launch of Deep Impact spacecraft for flyby of comet Tempel 1 (2005)   Sergei Pavlovich Korolyov born, designer of Soviet space program (1907)	**13** Discovery of Uranus moons Desdemona, Rosalind and Belinda by Stephen Synnott (1986)   Discovery of Martian meteorite EETA 79001 in Antarctica (1980)	**14**  Landing of the Huygens probe on Saturn's largest moon Titan (2005) Messenger spacecraft flyby of Mercury (2008) 	**15**  Stardust spacecraft returns with samples of comet P Wild 2 (2006) Launch of Helios 2, solar orbiter (1976) 	**16**  Final launch of space shuttle Columbia (2003)	**17**  Harvey H.Nininger born, American meteoriticist and founder of the American Meteorite Museum near Meteor Crater, Arizona (1887)
18  Astronomers discover a pulsar in remnants of Supernova 1987A, but observation not later confirmed (1989)	**19** discovery of the Martian meteorite SAU 090 in Oman (2002)   Launch of New Horizons spacecraft to Pluto (2006) Johann Bode born, developed law on planetary distances (1747) 	**20**  Rich Terrile discovers Uranus' moons Cordelia and Ophelia (1986)	Moon at perigee (closest distance to Earth) **21**  Launch of the rocket Little Joe-1B and a rhesus monkey "Miss Sam" (1960) John Couch Adams born, predicted planet beyond Uranus (1792)	**22** Apollo 5 launch to Moon (1968)	**23** Discovery of Uranus' moon Bianca by Brad Smith (1986)	**24** Discovery of the Martian meteorite Dhofar 019 in Oman (2000) Rover Opportunity arrives on Mars (2004) Flyby of Uranus by Voyager 2 (1986)
25 Launch of the Infrared Astronomical Satellite (IRAS): first space telescope to survey of the entire sky at infrared wavelengths (1983) Joseph Louis Lagrange born (1736) Launch of U.S. Moon orbiter Clementine (1994) 	**26** Launch of the International Ultraviolet Explorer (IUE); space telescope and spectrographs; designed to take ultraviolet spectra (1978) Discovery of Saturn's moon Epimetheus by the Voyager I spacecraft (1980)	**27** Philibert Melotte discovers Jupiter's moon Pasiphae (1908) Fire in Apollo 1 spacecraft (1967)	**28** Johannes Hevelius born (1611) Space shuttle Challenger lost on lift-off (1986)	**29** Phobos 2, Soviet spaecraft enters Mars orbit in study of solar environment. Mission, with cooperation of U.S and 3 others (1989)	**30** John Herschel uses camera obscura and hyposulphite to fix "snapshot" images from 48" (120cm) telescope (1839)	**31** Apollo 14, 3rd Moon mission (1971) Explorer 1, first U.S. satellite (1958) Launch of Mercury-Redstone 2 rocket with Ham, the astrochimp (1961)

Ham