Galactic Observer

John J. McCarthy Observatory

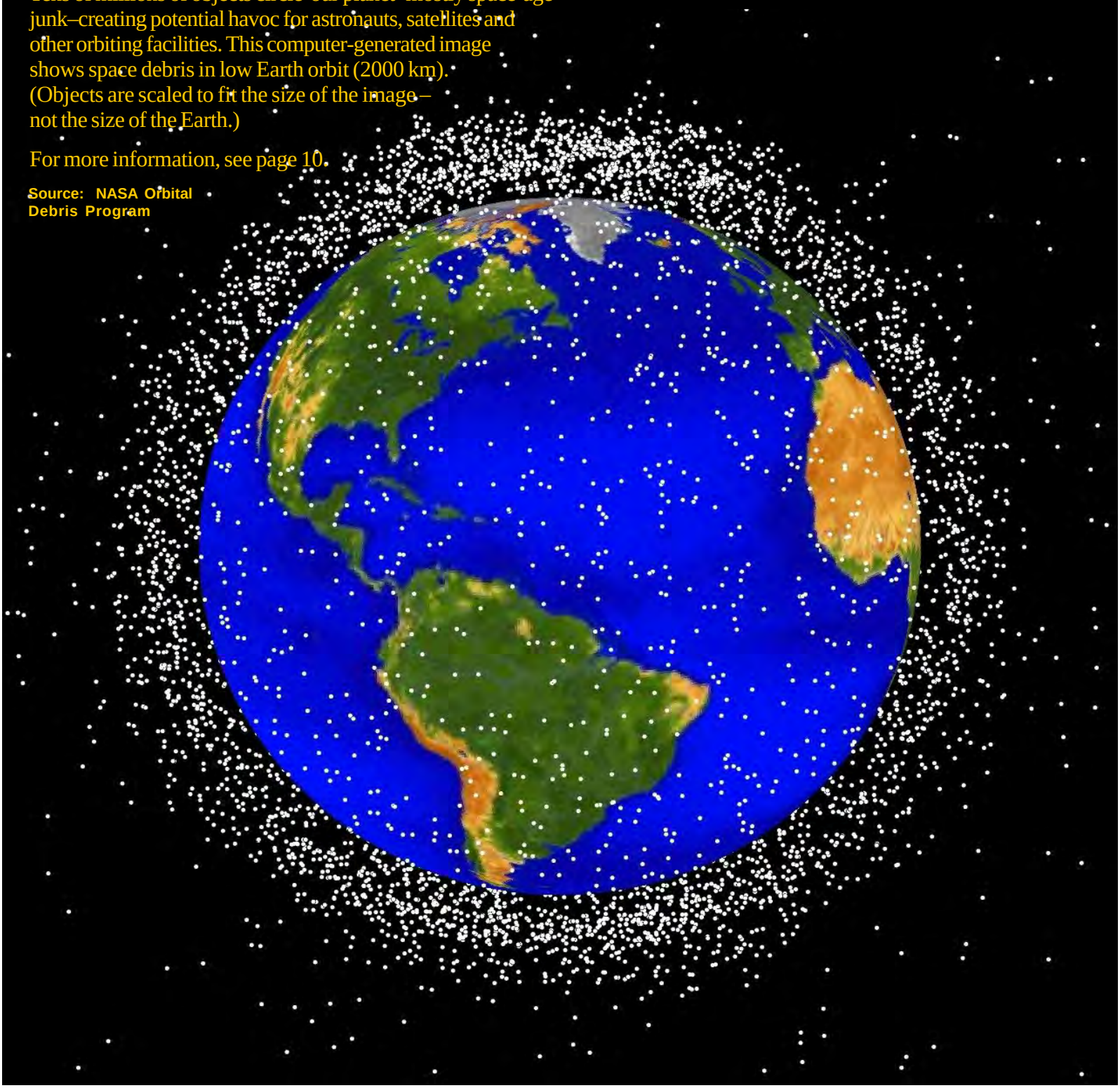
Volume 4, No. 11 November 2011

Shooting Gallery

Tens of millions of objects circle our planet–mostly space-age junk–creating potential havoc for astronauts, satellites and other orbiting facilities. This computer-generated image shows space debris in low Earth orbit (2000 km). (Objects are scaled to fit the size of the image – not the size of the Earth.)

For more information, see page 10.

Source: NASA Orbital Debris Program



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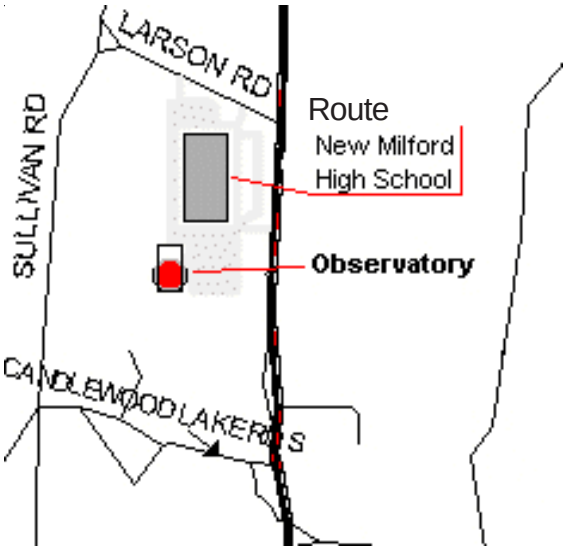

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The Year of the Solar System

NASA announced on Oct. 7, 2010 that the upcoming year would be "The Year of the Solar System." The "Year," however, is a Martian year and, as such, 23 months in length. Some of the highlights of the "Year" of exploration are:

Date	Mission		Status
4 Nov 2010	Deep Impact encounters Comet Hartley 2		Successful rendezvous, see http://www.nasa.gov/mission_pages/epoxi/index.html
19 Nov 2010	Launch of O/OREOS, a shoebox-sized satellite designed to test the durability of life in space		Ground stations receiving data
19 Nov 2010	Launch of an experimental solar sail (NanoSail-D) aboard the Fast Affordable Scientific and Technology Satellite (FASTSAT)		Delayed separation from FASTSAT on 17 Jan 2011, deployment confirmed, sail is operational
7 Dec 2010	Japan's Akatsuki (Venus Climate Orbiter) spacecraft		Spacecraft fails to enter orbit around Venus - now in orbit around the Sun
14 Feb 2011	Stardust NExT encounters Comet Tempel 1		Successful rendezvous; see http://stardustnext.jpl.nasa.gov/
17 Mar 2011	MESSENGER enters orbit around Mercury		First spacecraft to achieve orbit around Mercury; see http://messenger.jhuapl.edu/
18 Mar 2011	New Horizons spacecraft crosses the orbit of Uranus		4+ more years to Pluto; see http://pluto.jhuapl.edu/
16 Jul 2011	Dawn spacecraft arrives at the asteroid Vesta		Orbit achieved; see http://dawn.jpl.nasa.gov/
5 Aug 2011	Launch of the Juno spacecraft to Jupiter		Successful launch/deployment; see http://missionjuno.swri.edu/
10 Sept 2011	Launch of twin GRAIL spacecraft to map Moon's gravitational field		Successful launch/deployment; see http://solarsystem.nasa.gov/grail/
8 Nov 2011	Launch of the Phobos-Grunt sample-return mission		
25 Nov 2011	Launch of Mars Science Laboratory (MSL)		
Aug 2012	MSL lands on Mars		

Other notable events:

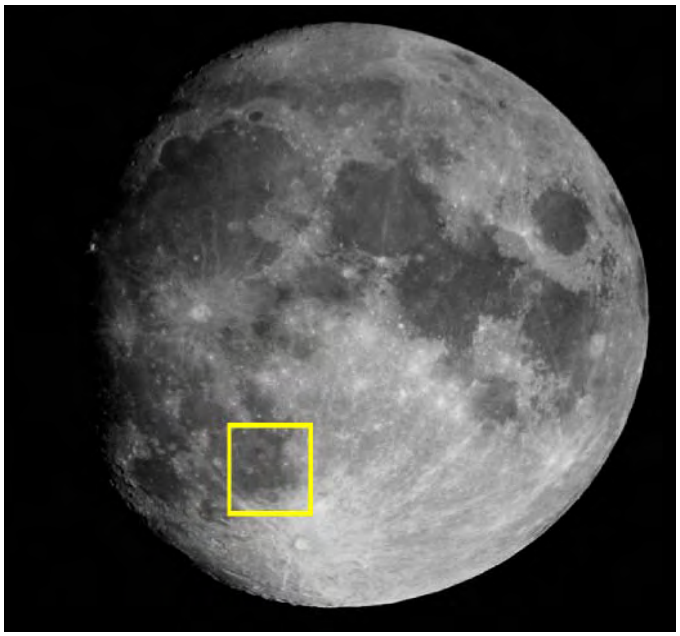
- August 9, 2011 Opportunity reached the rim of Endeavour crater
- March 3, 2012 Mars at Opposition
- May 20, 2012 Annular Solar Eclipse (visible in southwest U.S.)
- June 6, 2012 Venus Transit

"Out the Window on Your Left"

IT'S BEEN 39 YEARS SINCE we left the last foot print 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 view this month is of Rupes Recta, commonly known as the Straight Wall or the Railway (by British observers). It is one of the best examples of a lunar fault, running approximately 70 miles from northwest to southeast across the bed of an ancient unnamed crater. The east side of the fault is up to 1,600 feet higher than the west. While not sheer, the wall does rise at an imposing angle.

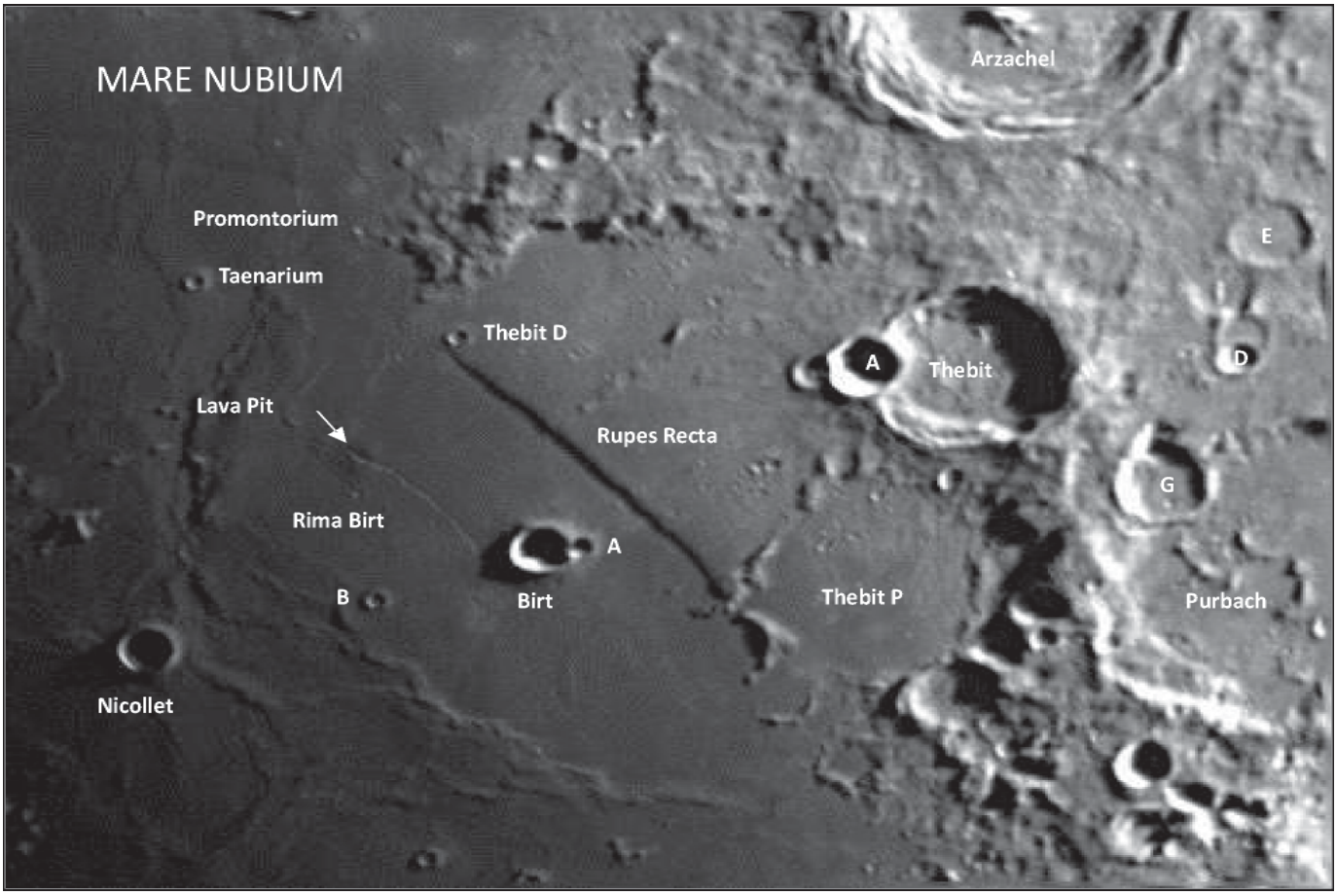
The remnants of the ancient crater can be seen on the eastern shore of Mare Nubium (Sea of Clouds). The eastern rim is well defined, with only wrinkle ridges in the Nubium lava flows providing any indication of its western boundary. Collapse or subsidence of the crater's western



rim most likely allowed the Nubium lava flows to breach and flood the crater.

The fault line is best viewed near first or third quarter, when the rising Sun casts a shadow along the fault to the west or the setting Sun illuminates the face of the wall. The fault line terminates in the south with an arc

Rupus Recta at Sunrise



of mountainous formations, the shape of which was compared to the handle of a sword by the 17th-century Dutch astronomer Christiaan Huygens (with the Straight Wall being the blade).

A faint line is visible in the photo on the next page running parallel to the Straight Wall and just west of the crater Birt. Designated as Rima Birt, the 30 mile long fissure appears to be a sinuous rille or channel created by flowing lava. Dome formations at the northern end of the rille support a volcanic origin as well as the localized discoloration (darkening) of the lava around the dome vents/pit. The darkening can be produced by eruptions of ash and debris, lava fountains, as well from the metallic content of the lava.

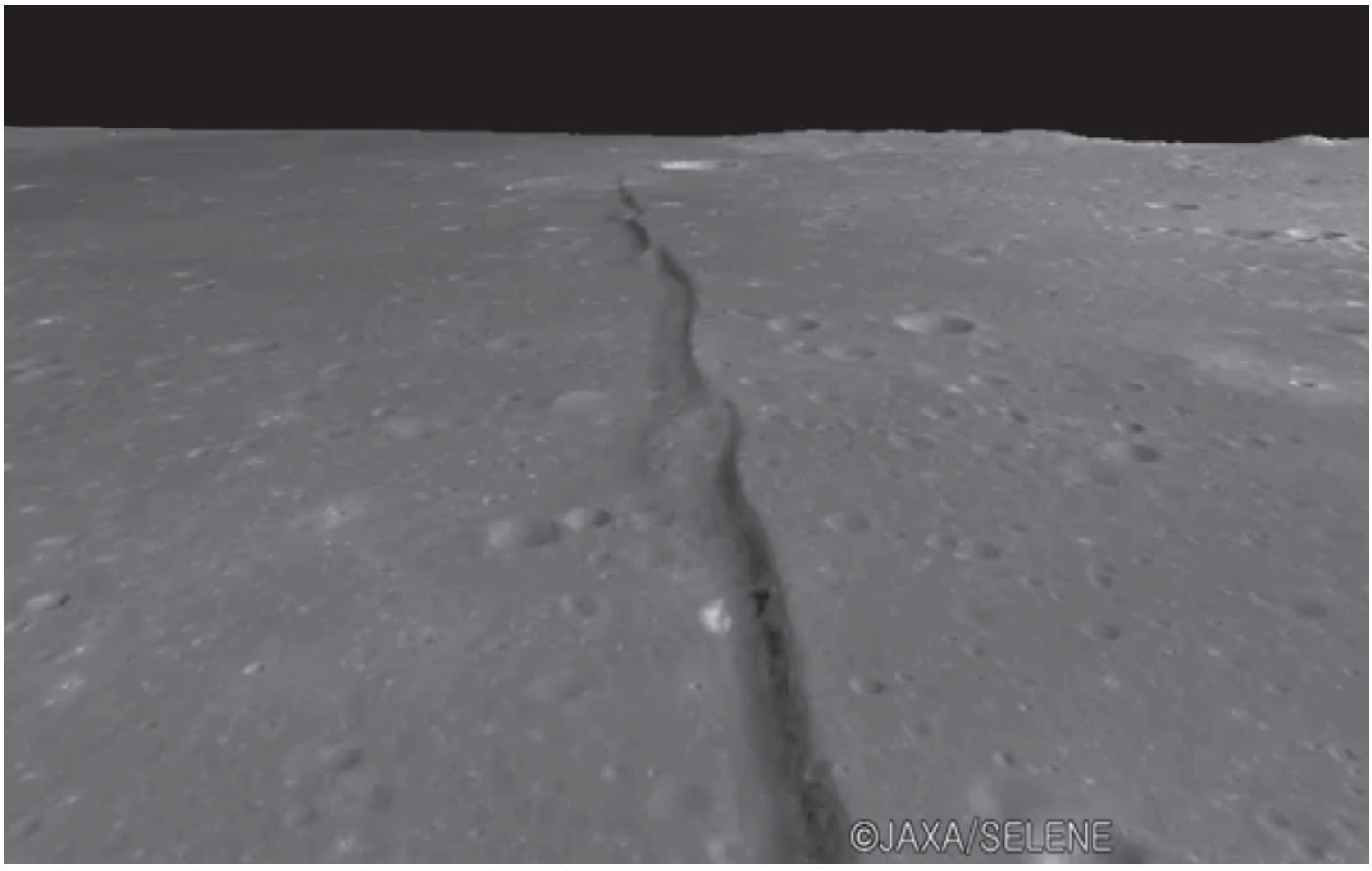
The image belowis a frame from a video assembled from stereo images taken by the high resolution Terrain Camera on the Japanese lunar orbiter Kayuga. The flyover video of the Straight Wall and the surrounding area can be found at the website: *http://wms.selene.jaxa.jp/selene_viewer/jpn/observation_mission/tc/058/Rupes_Recta_ 20Mbps.swf.*

Mars Science Laboratory

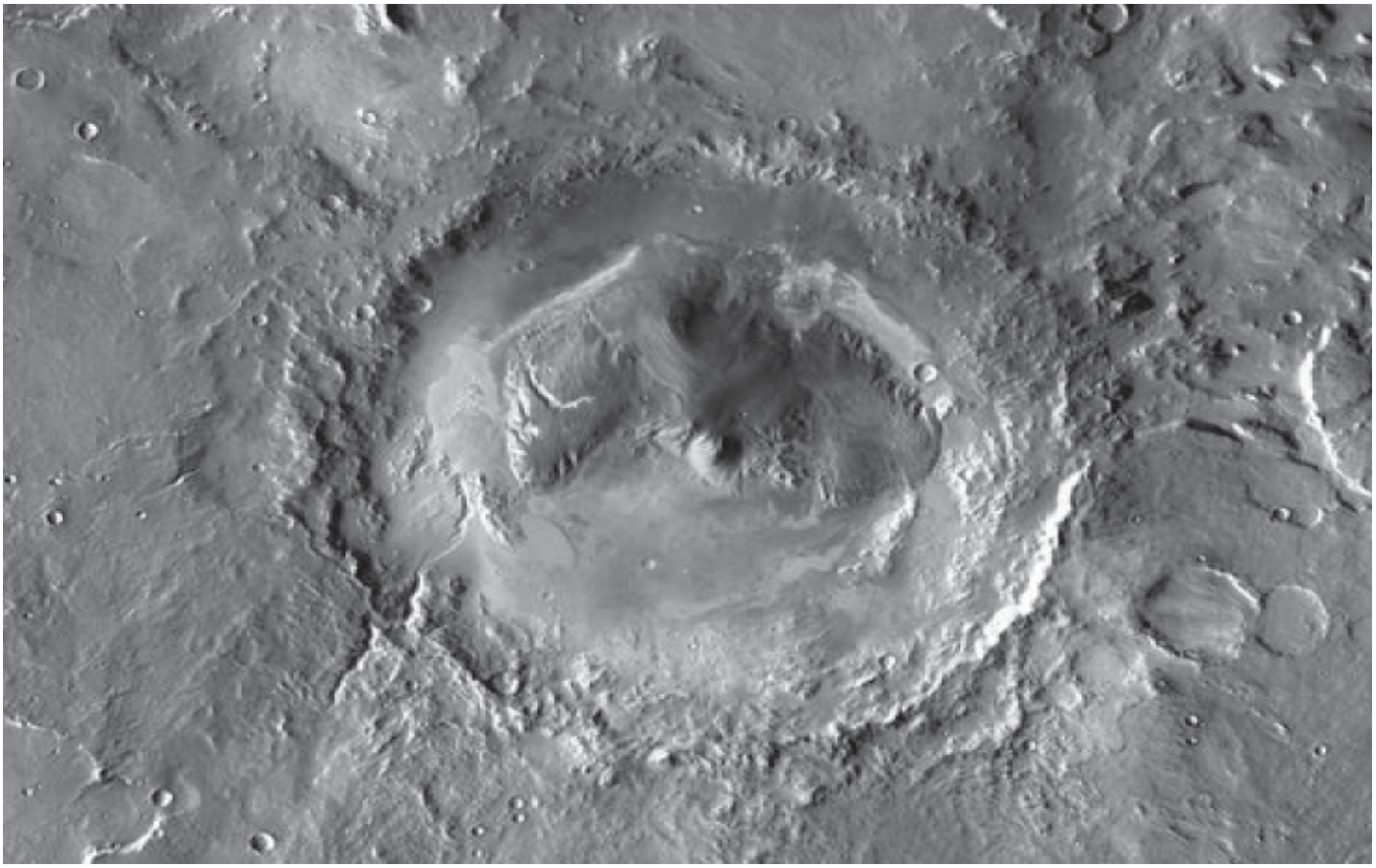
If all goes according to plan, the fiery breath of an Atlas 5 rocket will carry the Mars Science Laboratory into the morning sky over Florida on November 25th. Eight months later, the aeroshell containing the rover will blaze across the ruddy Martian sky towards its destination: Gale Crater.

The Mars Science Laboratory rover (named Curiosity) will be set down near the foot of a three mile high mountain rising from inside the crater. About the size of a small car (10 feet long, 9 feet wide, 7 feet tall, and weighing 2,000 pounds), Curiosity will employ a suite of instruments as it endeavors to determine whether Mars was ever capable of supporting microbial life. The roving laboratory will explore the area around the mountain as well as the layers of sedimentary rock exposed on the mountain as it looks for clues to Mars' watery past.

The Gale Crater site was chosen based upon information gathered by the Mars Reconnaissance Orbiter (MRO) that indicated the presence of clay and other minerals in and around the crater that are formed in the presence of water. The data from the MRO, as well as the surface rovers Opportunity and Spirit, strongly suggest that water once flowed across the surface of Mars. A wet Mars increases the likelihood that life (at least microbial) may have established a foothold during that time period when the climate was more hospitable. Curiosity will spend a Martian year (23 months) exploring the landing site.



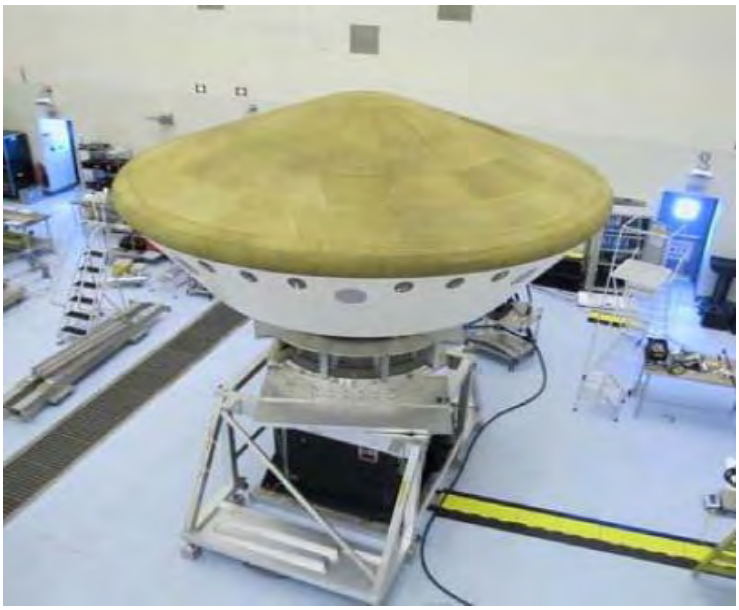
Rupes Recta as viewed from Kayuga's Terrain camera



Gale Crater photographed from the Mars Odyssey orbiter

Test driving the Mars Science Laboratory rover (Credit: NASA)

the first stage of the Atlas 5 rocket that will launch the rover to Mars is lifted into position at Launch Complex 41 on the Cape Canaveral Air Force Station (Credit: NASA/Cory Huston)



The aeroshell with the Mars Science Laboratory inside (Credit: NASA)

Phobos-Grunt

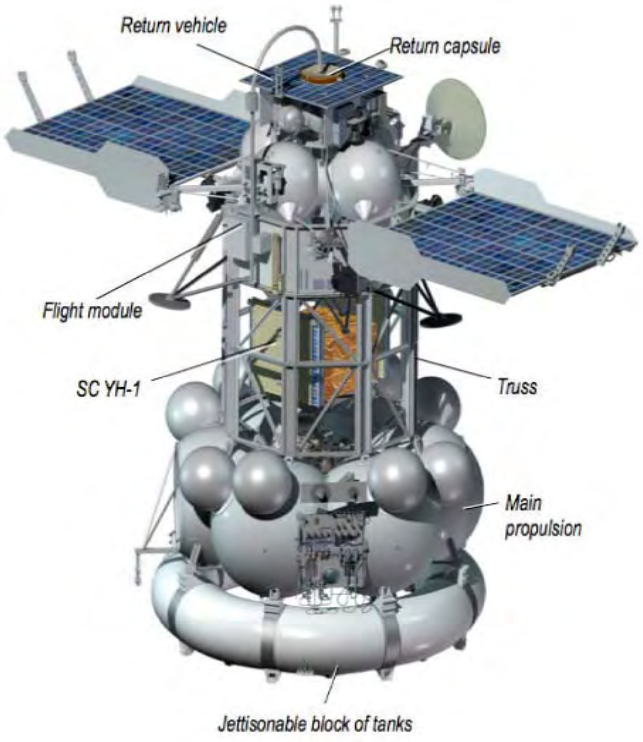
Russia will attempt to revive its solar system exploration program on November 8th after a 15 year hiatus (following the failure of the Mars 96 mission).

A Zenit rocket, scheduled to be launched from the Baikonur Cosmodrome in Kazakhstan, will send the Phobos-Grunt spacecraft on its way to the Martian moon Phobos, the larger of Mars' two diminutive moons.

After an interplanetary cruise lasting almost a year, the spacecraft will enter orbit around Mars before dropping down to the surface of Phobos. In addition to being able to collect and analyze Phobos' soil, the spacecraft is equipped with a sample return capsule. Not since 1976 has Russia (then the U.S.S.R.) successfully executed a sample return from a planetary body (when Luna 24 returned 170.1 grams of soil from the Moon's Sea of Crises).

The most controversial aspect of the mission is the inclusion of the Living Interplanetary Flight Experiment. The Planetary Society's experiment will include samples of Earth life (bacteria) that will travel to Phobos and back to Earth along with the sample return capsule. The experiment is intended to test one aspect of the "transpermia" hypothesis: the possibility that life is robust enough to be able to travel from planet to planet, for example, inside a meteorite.

Also along for ride is a small Chinese sub-satellite named Yinghuo 1. The 250 pound satellite will be placed into orbit around Mars where it will spend two years



Phobos-Grunt Spacecraft (Credit: NPO Lavochkin)

studying the planet's surface, atmosphere, ionosphere and magnetic field. Yinghuo 1 will be China's first planetary mission.

The potato-shaped Phobos is only 27 kilometers (16 miles) across at its widest point. At a distance of only 6,000 kilometers (3,600 miles) above the surface of Mars, Phobos rises in the west and sets in the east, usually twice a day. Its orbit is so low that Mars' tidal forces will eventually shatter the moon (within the next 50 to 100 million years). The resulting ring of debris will be the only telling indication of the former Martian companion.

JJMO Solar System Model – Two Years Later

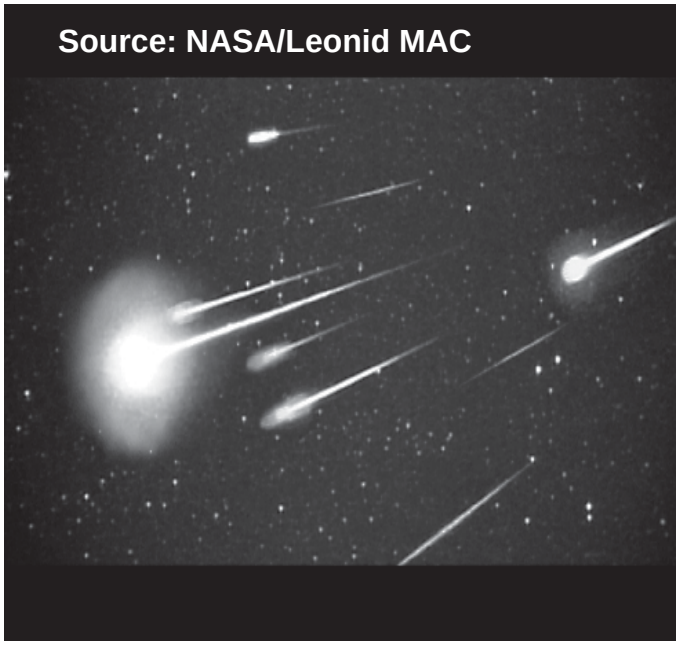
In celebration of the International Year of Astronomy in 2009, the McCarthy Observatory constructed a scale model of the solar system. The model stretches across the town of New Milford. The size of the planets and their distance from the center of the solar system is based upon a six-foot diameter Sun that is installed adjacent to the Observatory at the New Milford High School.

The solar system was dedicated on a rainy afternoon in November 2009. In the two years since the dedication the model has been subject to vandalism and wanton destruction. Uranus was the initial victim, just weeks after its installation. It remains the only planet that was subsequently recovered. Theft of Neptune and the New Horizons model followed, with Saturn being the latest casualty. With Saturn, the crown jewel of the solar system gone, the Observatory reluctantly removed the cast-bronze Jupiter from its station. The missing planets will be replaced by surrogates.

Leonid Meteor Shower

Almost everyone has seen a "shooting star," but not everyone knows what they are, where they come from and how best to view them. For those of you that remember that chilly November night in 2001 when the stars fell like rain, a meteor shower or meteor storm is truly unforgettable. As with that night, all you need are a comfortable chair and a warm blanket to enjoy the show.

Meteor showers occur when the Earth passes through a cloud of debris left behind by a comet. As a comet nears the Sun, the volatile gases warm and erupt along with trapped particles of rock and dust. Pushed away from the comet by the solar wind, this material forms the comet's tail. Each time a comet crosses the Earth's orbit it leaves behind a small cloud of debris. When the Earth passes through these clouds, the debris quickly heats up in the atmosphere, creating streaks of light across the night sky. The point in the sky where the meteors appear to originate from is called the radiant. Meteor showers are identified by the constellation in which the radiant appears. As such, if you trace the path of the meteors in the early morning of November 17th, you will notice that most seem to originate from a point in the constellation Leo, hence the name Leonids.



Leonid meteor shower: 2009

Why does the same meteor shower excite one year and disappoint the next? While comets are responsible for seeding Earth's orbit with the makings of a meteor shower, most comets are not frequent visitors to the inner solar system. Comet Tempel-Tuttle (the source of the Leonid meteors) crosses Earth's orbit once every 33 years. The resulting cloud is about 10 Earth diameters across and continues to drift along the comet's path. Most years the Earth misses these clouds altogether. In those years the meteor shower is sparse. Other years, as in 2001, the Earth can interact with several debris clouds from Comet Tempel-Tuttle. If the debris cloud is dense (containing a lot of rock and dust) the show can be spectacular. However, as debris clouds age they stretch out and become less dense. The resulting encounter produces fewer and fewer meteors.

What can we expect this year? With a late rising Moon near the radiant, expect to see an average of 10-15 meteors per hour during the peak period from a dark site.

Danger ;Space Debris

More than a ton of meteoroids bombards the Earth and moon every day. Most disintegrate in the Earth's atmosphere. The moon is not so fortunate; the lunar surface is continually modified by the bombardment, as shown by the samples brought back from there by the Apollo astronauts. NASA is supporting projects that monitor the frequency of lunar impacts, anticipating that the information will be useful in designing more robust lunar structures and contingency plans for astronauts venturing out on the lunar surface.

NASA launched the Chandra X-ray Observatory in July 1999, placing it in an elliptical orbit that extends almost one-third the distance to the moon. In November 2003, the telescope's operators placed the telescope in a safe configuration during its passage through four meteor shower streams. Despite an extremely low probability (one in a million) that the telescope would be hit by a meteoroid, that's what apparently happened early on the morning of November 15th. Fortunately, there was no apparent damage to the more sensitive parts of the telescope.

In 2006, the right-hand payload bay door radiator of the space shuttle Atlantis was hit by space debris. The object blasted its way through the metal skin and aluminum honeycomb material inside before exiting the other side. The resulting hole missed the Freon coolant lines inside the panel and did not endanger the crew. (The radiators are only deployed once the shuttle is in space and are stored in the cargo bay during reentry.) However, the impact illustrates the danger presented by space debris to spacecraft and their human occupants.

The Hubble Space Telescope's Wide Field Planetary Camera 2 was returned to Earth as part of the telescope's servicing mission in 2009 (STS-125). Attached to the cam-

View of an orbital debris hole made in the panel of the Solar Max experiment.
Source: NASA Orbital Debris Program

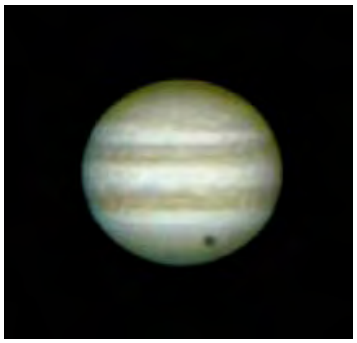
era was a large radiator (2.2 m by 0.8 m). The radiator had been in space since the camera was installed in 1993, and its large flat surface provided an excellent measure for determining impact rates for orbital debris at the telescope's altitude (between 560 and 620 km). Initial analysis of the radiator, completed last September, found a total of 685 micrometeoroid and orbital debris impact features (larger than about 0.3 mm).

It is estimated that tens of millions of man-made objects orbit the Earth, the vast majority smaller than 1 centimeter in size. The objects come from derelict spacecraft, exploding rocket boosters, discarded motors, deterioration of man-made structures including thermal blankets and solar panels, as well as from accidental and deliberate collisions. The objects orbit the Earth in many different directions, altitudes, and velocities, traveling up to 30,000 miles an hour or 20 times faster than a rifle bullet. At these speeds, it doesn't take a very large object to inflict considerable damage to another object, including the International Space Station. The space shuttle windows were hit by small pieces of debris 32 times during an average mission. Micrometeorites are involved in approximately one-third of the collisions. The grains of sand are generally less dense than man-made debris and therefore, relatively harmless. The remaining two-thirds do have some penetrating power and are primarily bits of aluminum, followed by paint, steel, and copper.

NASA currently tracks more than 16,100 objects, most larger than 10 centimeters (4 inches). This is double the number of objects tracked ten years ago. While the United States and Russia are the largest contributors to the swarm of man-made objects, newer space faring nations, in particular China, have added to the problem (particularly after its intentional destruction of its Fengyun 1C spacecraft). While debris in low-Earth orbit will eventually fall back to Earth, objects higher than 800 kilometers (480 miles) can continue to circle the Earth for decades and even centuries.

Until a solution can be found to cleaning up the debris (that is both technically feasible and economical), NASA has developed guidelines it hopes other nations will adopt to minimize the creation of even more debris. In the meantime, surveillance of the existing debris (only practical for the larger objects) will allow spacecraft that can maneuver to avoid future collisions, and more importantly, the loss of life. For additional information, NASA publishes the "Orbital Debris Quarterly News," complete with a "satellite box score." The newsletter (past and present) is available at http://www.orbitaldebris.jsc.nasa.gov/newsletter/newsletter.html.

Jupiter and its Moons



Jupiter reached Opposition on October 29th, so the gas giant is well placed for viewing in the November evening sky. As one of the brightest star-like objects in the night sky, Jupiter can be found in the constellation Aries.

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. The photo on the right shows the shadow of Ganymede on the Jovian disk. On nights of good visibility the following events should be visible through a moderately-sized telescope (between approximately 8 pm and midnight).

Date	Moon	Transit Begins	Transit Ends
5th	Io	7:43 pm	9:54 pm
11th	Europa	5:56 pm	8:23 pm
12th	Io	8:39 pm	10:49 pm
14th	Ganymede	8:50 pm	10:45 pm
18th	Europa	8:32 pm	10:59 pm
19th	Io	10:34 pm	12:44 am (20th)
28th	Io	6:58 pm	9:08 pm

Transit of Jupiter's Red Spot

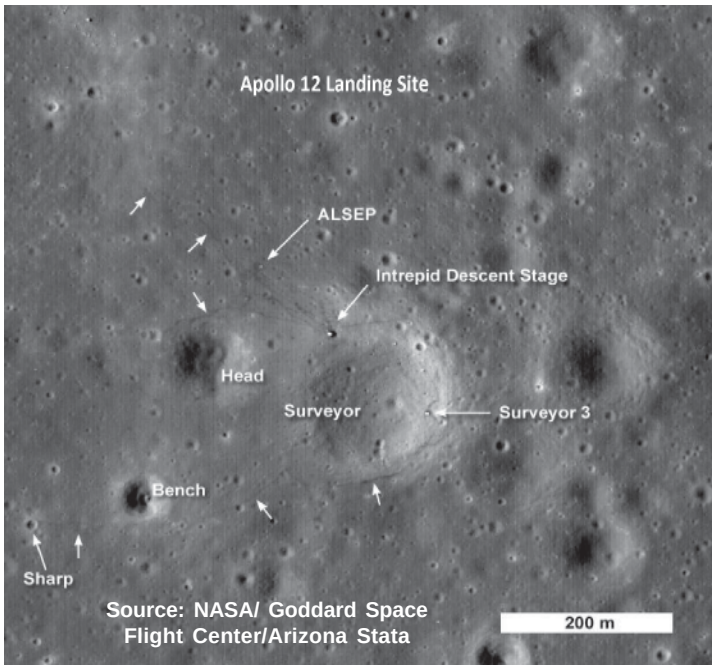
The Red Spot is a large cyclone in the upper Jovian atmosphere. The rapid rotation of this gas giant (10 hours) may be responsible for the longevity of this storm, which has been observed for over 300 years. The Red Spot will cross the center line of the planetary disk on the following evenings during the hours of approximately 8 pm to midnight local time (EDT through 11/5; EST thereafter):

Date	Transit Time	Date	Transit Time
2nd	11:07 pm	17th	7:29 pm
5th	8:36 pm	19th	9:07 pm
7th	9:14 pm	21st	10:45 pm
9th	10:52 pm	24th	8:14 pm
12th	8:21 pm	26th	9:53 pm
14th	9:59 pm	29th	7:22 pm

November History: Apollo 12

The second manned mission to the lunar surface was launched on November 14, 1969. The mission was almost lost before it started. The Saturn V rocket booster was hit by lighting as it rose from the launch pad. Fortunately, a young flight controller in mission control (John Aaron) remembered seeing the same dizzying display of warning lights and alarms in a practice run and was able to provide the crew directions on re-establishing power and control to the spacecraft.

After leaving Earth orbit, the command module extracts the lunar excursion module from the third stage. The trajectory (or path) of the third stage is then modified so as not to interfere with the lunar landing (either by placing it into orbit around the Sun or deliberately crashing it into the Moon). In what would become of interest 33 years later, the engine on the third stage burned 300 seconds too long, sending the rocket booster into a semi-stable orbit around the Earth. Two years later, it finally entered into an orbit around the Sun (by passing through a region of space controlled by the Earth and Sun).



The Ocean of Storms was the designated landing site for Apollo 12, southeast of the large crater Lansberg. Mission Commander Pete Conrad made a pinpoint landing 600 feet from the Surveyor 3 spacecraft which had landed two years earlier. The diminutive Conrad joked as he stepped out onto the lunar surface for the first time, "Whoopee! Man, that may have been one small one for Neil, but that's a long one for me."

In 2002, amateur astronomer Bill Yeung discovered a new object orbiting the Earth. Designated J002E3, the object was later determined to be artificial (from the analysis of reflected sunlight). After considerable study, it was concluded that J002E3 was most likely the third stage of Apollo 12. The object made six elongated orbits of the Earth before disappearing, presumably returning to its previous orbit around the Sun.

J002E3 was imaged from the McCarthy Observatory during three of its close approaches to Earth. Although the images are just snapshots, the tumbling motion of the booster is clearly seen as the sunlight alternatively reflects off the white painted sides of the rocket and then the darkened ends.

November Nights

The late Harvard University astronomer Harlow Shapley was born in November 1885. One of his many accomplishments was accurately measuring the distance to globular star clusters and their position around the Milky Way Galaxy. While warm summer nights are usually reserved for hunting globulars, the autumnal sky contains several impressive clusters including M15 in Pegasus and M2 in Aquarius. M30 in Capricorn is also visible in the southwest sky in the evening.

On the eastern side of the Great Square of Pegasus is the constellation Andromeda. Within this constellation and visible to the unaided eye on a dark night is the Andromeda Galaxy (M31), a massive pinwheel of 500 billion suns. Larger than the Milky Way, the Andromeda Galaxy is rushing towards us at 75 miles per second. Fortunately, it is approximately 2½ million light years (15 quintillion miles) distant, so it will be some time before the two galaxies merge. Visible through a telescope are Andromeda's two

companion galaxies, M32 and M110. While M32 can be mistaken for a bright star due to its close proximity to the core of the Andromeda Galaxy, M110 is a bit easier, being further away and larger than M32.

Located not far from M31 is the Triangulum or Pinwheel Galaxy (M33). Smaller and less massive than the Milky Way, this galaxy can be a challenge to see on less than ideal nights due to its low surface brightness. However, through a large telescope on a dark, steady night the view looking face-on at this giant pinwheel can be spectacular. The large spiral arms of M33 are filled with star-forming regions that almost appear to be gliding through space.

Sunrise and Sunset

Sun	Sunrise	Sunset
November 1st (EDT)	07:25	17:49
November 15th (EST)	06:42	16:34
November 30th	06:59	16:25

Astronomical and Historical Events

1st History: launch of the Wind spacecraft, designed to monitor the solar wind (1994)
2nd First Quarter Moon
2nd History: flyby of Asteroid 5535 Annefrank by the Stardust spacecraft (2002)
2nd History: first light at the 100-inch telescope on Mount Wilson (1917)
3rd Taurids Meteor Shower peak
3rd History: launch of Mariner 10 to Venus and Mercury; first mission to use the gravitational pull of one planet (Venus) to reach another (Mercury) (1973)
3rd History: launch of Sputnik 2 and a dog named Laika (1957)
4th Comet 73P-C/Schwassmann-Wachmann C closest approach to Earth (1.595 AU)
4th History: Deep Impact's closest approach to the nucleus of Comet 103P/ Hartley 2 (2010)
4th History: launch of the Soviet Venus lander Venera 14 (1981)
6th End of Daylight Savings Time - set clock back one hour at 2 a.m.
6th Flyby of Saturn's moon Enceladus by the Cassini spacecraft
6th Distant flyby of Saturn's moons Methone, Pandora and Calypso by the Cassini spacecraft
7th History: launch of Mars Global Surveyor (1996)
7th History: launch of Surveyor 6 moon lander (landed two days later). On November 17th, the lander's small vernier engines were fired for 2½ seconds, lifting the lander off the lunar surface 10 to 12 feet and almost 8 feet sideways. This lunar "hop" was the first powered takeoff from the lunar surface. It also provided NASA a view of the original landing site and a baseline for acquiring stereoscopic images of its surroundings. (1967)
7th History: launch of Lunar Orbiter 2, Apollo landing site survey mission (1966)
8th Scheduled launch of Phobos-Grunt from the Baikonur Cosmodrome in Kazakhstan to the Martian moon Phobos. The spacecraft will collect soil samples for return to Earth and launch a small Chinese satellite named Yinghuo 1 into orbit around Mars.
8th Moon at apogee (furthest distance from Earth)
8th History: meteorite hits a house in Wethersfield, Connecticut (1982)
8th History: launch of Pioneer 9 into solar orbit (1968)
8th History: launch of Little Joe rocket, qualifying flight for the Mercury spacecraft (1960)
8th History: Edmund Halley born, English astronomer who calculated the orbit and predicted the return of the comet now called Comet Halley (1656)
9th History: launch of the Venus Express spacecraft; ESA Venus orbiter (2005)
9th History: launch of the first Saturn V rocket, Apollo 4 (1967)
10th Full Moon (Full Beaver Moon)
10th History: launch of Luna 17, Soviet Moon rover mission (1970)
10th History: launch of USSR spacecraft Zond 6; Moon orbit and return (1968)
10th History: Waseda Meteorite Fall; hits house in Japan (1823)
11th History: launch of Gemini 12 with astronauts James Lovell and Edwin Aldrin (1966)
11th History: Tycho Brahe discovers a new star in the constellation Cassiopeia shining as bright as Jupiter; later determined to be a supernova - SN1572 (1572)

Astronomical and Historical Events (continued)

12th Second Saturday Stars - Open House at the McCarthy Observatory (7:00 pm)
12th History: launch of STS-2, second flight of the Space Shuttle Columbia (1981)
12th History: flyby of Saturn by the Voyager 1 spacecraft (1980)
12th History: Seth Nicholson born, American astronomer who discovered four of Jupiter's moons, a Trojan asteroid, and computed orbits of several comets and of Pluto (1891)
13th Asteroid 30 Urania at Opposition (9.6 Magnitude)
13th Scheduled launch of the next expedition crew to the International Space Station from the Baikonur Cosmodrome in Kazakhstan aboard a Soyuz rocket
13th History: launch of HEAO-2, the second of NASA's three High Energy Astrophysical Observatories; renamed Einstein after launch, it was the first fully imaging X-ray space telescope (1978)
14th Mercury at its Greatest Eastern Elongation; apparent separation from the Sun (23°)
14th History: dedication of the New Milford Solar System Scale Model (2009)
14th History: Mariner 9 arrives at Mars; first spacecraft to orbit another planet (1971)
14th History: launch of Apollo 12, with astronauts Pete Conrad, Richard Gordon and Alan Bean to the moon's Ocean of Storms and near the robotic explorer Surveyor 3 (1969)
15th Kuiper Belt Object 90377 Sedna at Opposition (86.067 AU)
15th History: ESA's spacecraft SMART-1 enters lunar orbit; first ESA Small Mission for Advanced Research in Technology; travelled to the Moon using solar-electric propulsion and carrying a battery of miniaturized instruments (2004)
15th History: the only orbital launch of the Russian space shuttle Buran; the unmanned shuttle orbited the Earth twice before landing (1988)
16th History: launch of the third (and last) Skylab crew with astronauts Gerald Carr, William Pogue and Edward Gibson (1973)
16th History: launch of Venera 3, Soviet Venus lander (1965)
17th Leonids Meteor Shower peak
17th History: Soviet lunar lander Luna 17 deploys first rover - Lunokhod 1 (built by the Kharkov state bicycle plant); operated for 11 months, photographing and mapping the lunar surface and analyzing the regolith (1970)
18th Last Quarter Moon
18th History: Leonids Meteor Storm (2001)
18th History: launch of the COBE spacecraft; observed diffuse cosmic background radiation (1989)
20th History: launch of the Swift spacecraft; first-of-its-kind multi-wavelength observatory dedicated to the study of gamma-ray bursts (2004)
22nd Scheduled return to Earth of Soyuz 27 from the International Space Station
23rd Moon at perigee (closest approach to Earth)
23rd Distant flyby of Saturn's moon Helene by the Cassini spacecraft
23rd History: launch of the European Space Agency's first satellite, Meteosat 1 (1977)
23rd History: launch of Tiros II weather satellite (1960)
24th Distant flyby of Saturn's moons Enceladus, Epimetheus and Titan by the Cassini spacecraft
25th New Moon
25th Scheduled launch of the Mars Science Laboratory (MSL) aboard an Atlas 5 rocket from the Cape Canaveral Air Force Station
26th History: discovery of Mars meteorites SAU 005 and SAU 008 (1999)
26th History: launch of France's first satellite, Asterix 1 (1965)
26th History: launch of Explorer 18; studied charged particles and magnetic fields in and around the Earth–Moon (1963)
27th Distant flyby of Saturn's moon Titan by the Cassini spacecraft
27th History: Soviet spacecraft Mars 2 arrives at Mars; lander crashes, becoming first human artifact to impact the surface of Mars (1971)
28th History: launch of Algeria's first satellite, Alsat 1 (2002)

Astronomical and Historical Events (continued)

28th History: launch of Mariner 4; first spacecraft to obtain and transmit close range images of Mars (1964)
29th History: discovery of Y000593 Mars meteorite in Antarctica (2000)
29th History: launch of Australia's first satellite, Wresat 1 (1967)
29th History: launch of Mercury 5 with Enos the chimpanzee (1961)
30th Asteroid 15 Eunomia at Opposition (7.9 Magnitude)
30th History: Sylacauga Meteorite Fall; hits women (1954)

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 and graphic calendars: Allan Ostergren

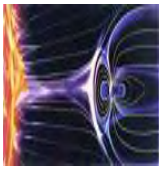
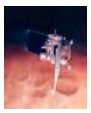
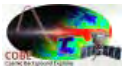
Page 3: Jupiter and Io imaged through a Celestron C-11 telescope with an Imaging Source DMK 21AU04.AS CCD camera by Bill Cloutier on September 05, 2010 at 11:15 pm

Multiple images stacked with AviStack to produce final image

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

November 2011

Celestial Calendar

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
		1  Launch of Wind spacecraft to study solar wind (1994)	**2** Flyby of asteroid 5535 Anne Frank by Stardust spacecrafr - (2002)   First light of Mt. Wilson 100-inch telescope - (1917)	**3** Taurids meteor showers peak   Launch of Mariner 10 to Venus and Mercury (1973) Launch of Sputnik 2, with dog Laika (1957) 	**4**  Deep Impact closest approach to the nucleus of Comet 103/P Hartley 2 (2010)	**5**  Fred Lawrence Whipple born, American astronomer; first to theorize of comets as "dirty snowballs" (1906)
6  End of Daylight Savings Time	**7**  Launch of Mars Global Surveyor (1996) Launch of Surveyor 6 Moon Lander, dry-run for later manned mission (1967) 	Moon at apogee (furthest from the Earth) **8**   Launch of Little Joe rocket (1960) Meteorite hits house in Wethersfield CT (1982)   Edmund Halley born (1656)	**9**  Launch of Venus Express spacecraft; ESA Venus orbiter (2005)  Launch of 1st Saturn V rocket - Apollo 4 (1967)	**10**  Launch of Soviet spacecraft Zond 6 to Moon (1968) Launch of Luna 17, Soviet Moon Rover mission (1970)   Waseda meteor hits house in Japan (1823)	**11**  Tycho Brahe discovers supernova SN1572 (bright as Jupiter) (1572) Launch of Gemini 12, with astronauts Lovell and Aldrin (1966) 	**12**  Seth Nicholson born, American astronomer (1891) Space Shuttle Columbia safe re-launch, with commander Joe Engle and pilot Richard Truly (1981)   2nd Saturday Stars Open House McCarthy Observatory
13  Launch of HEAO-2 (Einstein), 1st fully-imaging x-ray telescope in space - 1978 Dawn spacecraft enters Asteroid Belt on way to Vesta and Ceres (2009) 	**14**  Launch of Apollo 12 - Conrad, Gordon, Bean, 1969 Mariner 9 arrives at Mars, 1st spacecraft to orbit another planet, 1971   Model solar system inauguration McCarthy Observatory (2009)	Astronomer William Herschel born 1738 **15**   ESA Smart-1 enters lunar orbit, using solar-electric propulsion 2004 Only orbital launch of Russian Buran space shuttle in unmanned mission (1988) 	**16**  Launch of Venera 3, Soviet Venus lander (1965)  Launch of 3rd and last Skylab crew - Carr, Pogue, Gibson (1973)	**17**  Soviet lunar lander, Luna 17 with 1st rover, Lunakhod 1 (1970) Leonids meteor shower peak 	**18**  Leonids Meteor Storm (2001) Alan Shepard born, 1st American in space and 5th to walk on Moon - 1923   Launch of the COBE spacecraft; observed diffuse cosmic background radiation (1989)	**19** Apollo 12 astronauts Charles Conrad and Alan Bean made man's second landing on the moon (1969)
20 Launch of the Swift spacecraft, multi-wavelength observatory to study gamma wave bursts (2004)	**21** India's space program begins with the launch of a Nike-Apache sounding rocket from coconut groves in Thumba, a small fishing village in Kerala state (1963)	**22** Scheduled return to Earth of Soyuz 27 from the International Space Station	**23** Moon at perigee (closest distance to Earth) Launch of European Space Agency's 1st satellite, Meteosat (1977)	**24** Space-walking astronauts from shuttle Columbia catch a 1 1/2 -ton satellite, and the cockpit crew used the shuttle's robot arm to return it to the cargo bay (1997)	**25** Scheduled launch of the Mars Science Laboratory (MSL) aboard an Atlas 5 rocket from the Cape Canaveral Air Force Station	**26** Launch of France's first satellite, Asterix 1 (1965) Launch of Explorer 18; studied charged particles and magnetic fields in and around the Earth - Moon (1963) Discovery of Mars meteorites AU 005 and SAU 008 (1999)
27 Soviet spacecraft Mars 2, first human artifact to impact Martian surface (1971)	**28** Launch of Algeria's 1st satellite, Alsat 1 2002 Launch of Mariner 4, first spacecraft to send close range images of Mars (1964)	**29** Launch of Australia's 1st satellite, Wresat 1 1967 Launch of Mercury 5, with Enos the chimp 1961 Discovery of Y000593 Mars meteorite in Antarctica (2000)	**30** Sylicauga meteorite fall strikes Alabama woman (1954)	**Phases of the Moon** Nov 2 Nov 10 Nov 18 Nov 25	