January 2011

Inside this Issue:

1 • January Meeting • 2010 Calendar
2 • S*T*A*R Membership • Upcoming Star Parties
3 • 10 Years Since Jupiter
4 • Opportunity Studying a Football-Field Size Crater
5 • Asteroid Delivered Assortment Of Meteorites
6 • Potential Ice Volcano On Saturn Moon
7 • Next Mars Rover to Zap Rocks With Laser
8 • SOHO Spots 2000th Comet
10 • TRACE Spacecraft's New Slewing Procedure
11 • Celestial Events
12 • In the Eyepiece

January Meeting

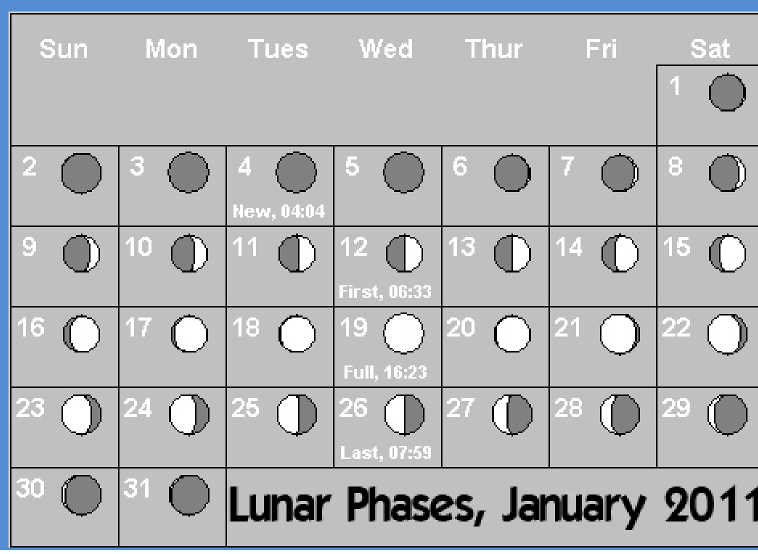
The next meeting of S*T*A*R will be on Thursday, January 6th, 2011. This not-to-be-missed event is our annual Winter Social, consisting of food, camaraderie, conversation and an important discussion of the club's 25" telescope. All are encouraged to attend.

A message from the editor:

My sincere apologies to all club members for the lack of a newsletter last month. Unexpected business travel, a family emergency, and a personal health issue prevented publication in a reasonable time.

Calendar

- January 6, 2011 – Winter Social



February Issue

Please submit articles and contributions for the next *Spectrogram* by January 27. Please email to fowler@verizon.net.

Are you a S*T*A*R Member?

S*T*A*R is the proud owner of a monstrous 25” Dobsonian Obsession reflector – which members can gain access to!

Meetings are the first Thursday of each month, except July and August, at 8:00 PM at the Monmouth Museum on the Brookdale Community College campus. Meetings generally consist of lectures and discussions by members or guest speakers on a variety of interesting astronomical topics. S*T*A*R is a member of United Astronomy Clubs of New Jersey (UACNJ), the Astronomical League (AL), and the International Dark Sky Association (IDA).

Memberships: ( )Individual....$25 ( ) Family...$35

Name____

Address______________________________________

City______________________State___Zip________

Phone____

Email____

Make checks payable to: S*T*A*R Astronomy Society, Inc. and mail to P.O. Box 863, Red Bank, NJ 07701

Upcoming Star Parties!

Campbell Elementary School Star Party
Thursday, January 6th
Cloud-out date: Friday January 7th

Note that this event is the same date as our January Meeting. The event runs from 7 to 9PM, expect folks to arrive about 6:45. Located on the athletic field, immediately west of the school. Address: 8 Talmadge Avenue, Metchuen NJ
POC: Dave N

Sayreville School Star Party
Friday, March 25th
Rain date: Friday, April 1st

We expect 200 (100 students with a parent or two, 4 stations with a 30 minute period), so we’ll need scopes. We also may ask for a volunteer to make an astronomy-related presentation.

More info to follow, check the message boards.
POC : KenL

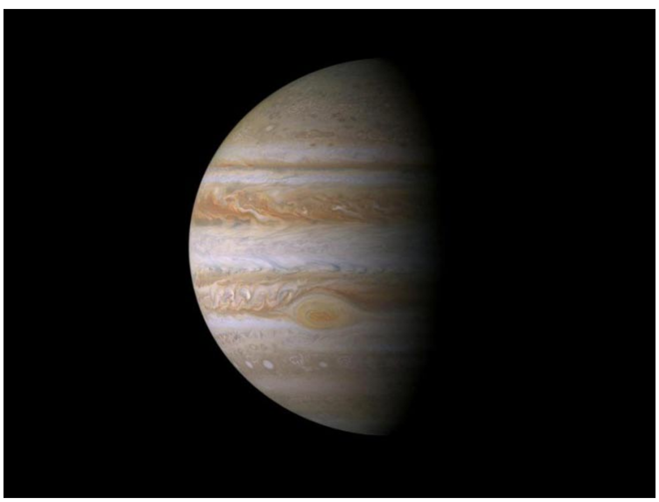
Cassini Celebrates 10 Years Since Jupiter Encounter

Ten years ago, on Dec. 30, 2000, NASA's Cassini spacecraft made its closest approach to Jupiter on its way to orbiting Saturn. The main purpose was to use the gravity of the largest planet in our solar system to slingshot Cassini towards Saturn, its ultimate destination. But the encounter with Jupiter, Saturn's gas-giant big brother, also gave the Cassini project a perfect lab for testing its instruments and evaluating its operations plans for its tour of the ringed planet, which began in 2004.

"The Jupiter flyby allowed the Cassini spacecraft to stretch its wings, rehearsing for its prime time show, orbiting Saturn," said Linda Spilker, Cassini project scientist based at NASA's Jet Propulsion Laboratory in Pasadena, Calif. "Ten years later, findings from the Jupiter flyby still continue to shape our understanding of similar processes in the Saturn system."

Cassini spent about six months - from October 2000 to March 2001 - exploring the Jupiter system. The closest approach brought Cassini to within about 9.7 million kilometers (6 million miles) of Jupiter's cloud tops at 2:05 a.m. Pacific Time, or 10:05 a.m. UTC, on Dec. 30, 2000.

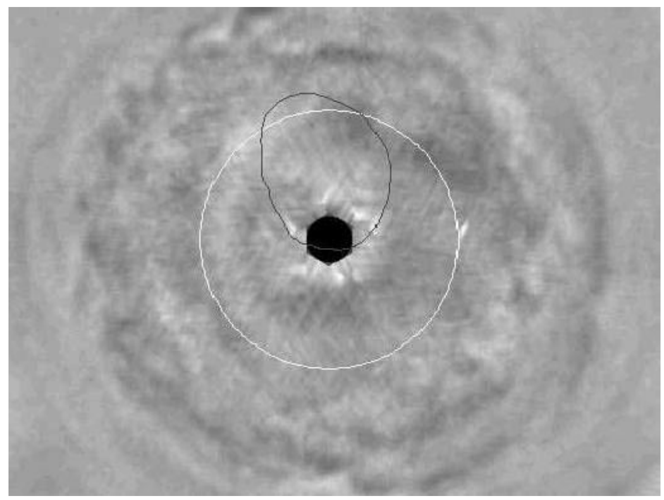
Cassini captured some 26,000 images of Jupiter and its moons over six months of continual viewing, creating the most detailed global portrait of Jupiter yet.



This true color mosaic of Jupiter was constructed from images taken by the narrow angle camera onboard NASA's Cassini spacecraft on December 29, 2000, during its closest approach to the giant planet at a distance of approximately 10 million kilometers (6.2 million miles). Image credit: NASA/JPL/Space Science Institute

While Cassini's images of Jupiter did not have higher resolution than the best from NASA's Voyager mission during its two 1979 flybys, Cassini's cameras had a wider color spectrum than those aboard Voyager, capturing wavelengths of radiation that could probe different heights in Jupiter's atmosphere. The images enabled scientists to watch convective lightning storms evolve over time and helped them understand the heights and composition of these storms and the many clouds, hazes and other types of storms that blanket Jupiter.

The Cassini images also revealed a never-before-seen large, dark oval around 60 degrees north latitude that rivaled Jupiter's Great Red Spot in size. Like the Great Red Spot, the large oval was a giant storm on Jupiter. But, unlike the Great Red Spot, which has been stable for hundreds of years, the large oval showed itself to be quite transient, growing, moving sideways, developing a bright inner core, rotating and thinning over six months. The oval was at high altitude and high latitude, so scientists think the oval may have been associated with Jupiter's powerful auroras.



Unexpected dynamics in Jupiter's upper atmosphere, or stratosphere, including the birth and motion of a dark vortex wider than Earth, appear in a movie clip spanning 11 weeks of ultraviolet imaging by NASA's Cassini spacecraft. The development of the vortex resembles development of ozone holes in Earth's stratosphere in that both processes appear to occur only within confined masses of high-altitude polar air. That similarity may help scientists understand both processes better. Image credit: NASA/JPL/Southwest Research Institute

The imaging team was also able to amass 70-day movies of storms forming, merging and moving near Jupiter's north pole. They showed how larger storms gained energy from swallowing smaller storms, the way big fish eat small fish. The movies also showed how the ordered flow of the eastward and westward jet streams in low latitudes gives way to a more disordered flow at high latitudes.

Meanwhile, Cassini's composite infrared spectrometer was able to do the first thorough mapping of Jupiter's temperature and atmospheric composition. The temperature maps enabled winds to be determined above the cloud tops, so scientists no longer had to rely on tracking features to measure winds. The spectrometer data showed the unexpected presence of an intense equatorial eastward jet (roughly 140 meters per second, or 310 mph) high in the stratosphere, about 100 kilometers (60 miles) above the visible clouds. Data from this instrument also led to the highest-resolution map so far of acetylene on Jupiter and the first detection of organic methyl radical and diacetylene in the auroral hot spots near Jupiter's north and south poles. These molecules are important to understanding the chemical interactions between sunlight and molecules in Jupiter's stratosphere.

As Cassini approached Jupiter, its radio and plasma wave instrument also recorded naturally occurring chirps created by electrons coming from a cosmic sonic boom. The boom occurs when supersonic solar wind - charged particles that fly off the sun - is slowed and deflected around the magnetic bubble surrounding Jupiter.

Because Cassini arrived at Jupiter while NASA's Galileo spacecraft was still orbiting the planet, scientists were also able to take advantage of near-simultaneous measurements from two different spacecraft. This coincidence enabled scientists to make giant strides in understanding the interaction of the solar wind with Jupiter. Cassini and Galileo provided the first two-point measurement of the boundary of Jupiter's magnetic bubble and showed that it was in the act of contracting as a region of higher solar wind pressure blew on it.

"The Jupiter flyby benefited us in two ways, one being the unique science data we collected and the other the knowledge we gained about how to effectively operate this complex machine," said Bob Mitchell, Cassini program manager based at JPL. "Today, 10 years later, our operations are still heavily influenced by that experience and it is serving us very well."

In celebrating the anniversary of Cassini's visit 10 years ago, scientists are also excited about the upcoming and proposed missions to the Jupiter system, including NASA's Juno spacecraft, to be launched next August, and the Europa Jupiter System Mission, which has been given a priority by NASA.

The Cassini-Huygens mission is a cooperative project of NASA, the European Space Agency and the Italian Space Agency. JPL, a division of the California Institute of Technology in Pasadena, Calif., manages the mission for NASA's Science Mission Directorate, Washington, D.C. The Cassini orbiter and its two onboard cameras were designed, developed and assembled at JPL. The imaging team is based at the Space Science Institute in Boulder, Colo. The composite infrared spectrometer team is based at NASA's Goddard Space Flight Center, Greenbelt, Md., where the instrument was built. The radio and plasma wave science team is based at the University of Iowa, Iowa City, where the instrument was built.

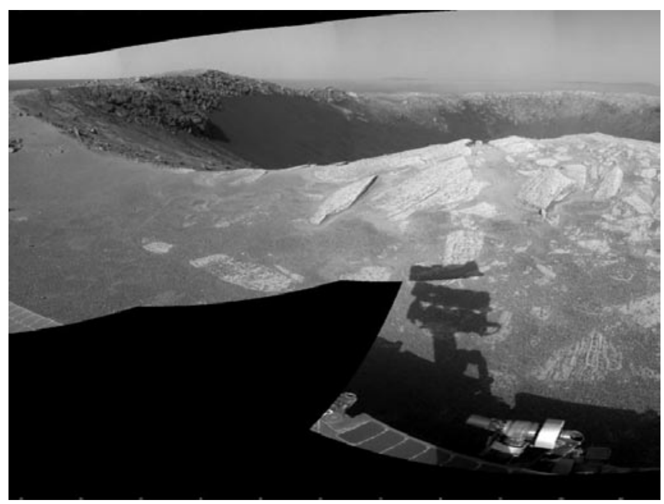
Media contacts:
Jia-Rui Cook/Priscilla Vega, Jet Propulsion Laboratory, Pasadena, Calif.
jccook@jpl.nasa.gov / Priscilla.r.vega@jpl.nasa.gov

Opportunity Studying a Football-Field Size Crater

On Dec. 16, 2010, NASA's Mars Exploration Rover Opportunity reached a crater about the size of a football field—some 90 meters (295 feet) in diameter. The rover team plans to use cameras and spectrometers during the next several weeks to examine rocks exposed at the crater, informally named "Santa Maria."

A mosaic of image frames taken by Opportunity's navigation camera on Dec. 16 shows the crater's sharp rim and rocks ejected from the impact that had excavated the crater.

Opportunity completed its three-month prime mission on Mars in April 2004 and has been working in bonus extended missions since then. After the investigations at Santa Maria, the rover team plans to resume a long-term trek by Opportunity to the rim of Endeavour Crater, which is about 22 kilometers (14 miles) in diameter.



A football-field-size crater, informally named "Santa Maria," dominates the scene in this 360-degree view from NASA's Mars Exploration Rover Opportunity. Image credit: NASA/JPL-Caltech

NASA's Jet Propulsion Laboratory, a division of the California Institute of Technology in Pasadena, manages the Mars Exploration Rover Project for the NASA Science Mission Directorate, Washington. For more information about the mission, see http://marsrovers.jpl.nasa.gov.

Guy Webster, Jet Propulsion Laboratory, Pasadena, Calif.
guy.webster@jpl.nasa.gov

NASA Discovers Asteroid Delivered Assortment Of Meteorites

WASHINGTON -- An international team of scientists studying remnants of an asteroid that crashed into the Nubian Desert in October 2008 discovered it contained at least 10 different types of meteorites.
Some of them contained chemicals that form the building blocks of life on Earth, and those chemicals were spread through all parts of the asteroid by collisions.

Chemists at Stanford University found that different meteorite types share the same distinct fingerprint of polycyclic aromatic hydrocarbons (PAHs). These complex organic molecules are distributed throughout the galaxy and form on Earth from incomplete combustion.

A research team from NASA's Goddard Space Flight Center in Greenbelt, Md., found amino acids in strongly heated fragments of the asteroid, where all such molecules should have been destroyed. Both PAHs and amino acids are considered building blocks of life.

Before landing on Earth, the 13-foot asteroid was detected by a telescope from the NASA-sponsored Catalina Sky Survey based at the University of Arizona in Tucson. Hours prior to its demise, astronomers and scientists around the world tracked and scanned the asteroid. It was the first time a celestial object was observed prior to entering Earth's atmosphere.

NASA's Jet Propulsion Laboratory in Pasadena, Calif., created a search grid and impact target area. The data helped Peter Jenniskens, an astronomer at NASA's Ames Research Center in Moffett Field, Calif.,
and the SETI Institute of Mountain View, Calif., guide a recovery team from the University of Khartoum in Sudan to search the desert landscape. During four expeditions, approximately 150 students recovered nearly 600 meteorite fragments weighing a total of more than 23 pounds.

"Right from the start, the students were surprised to find so much diversity in meteorite texture and hue," said Muawia Shaddad, an astronomer at the University of Khartoum, who led the search effort.
"We estimate the asteroid initially weighed about 59 tons, of which about 86 pounds survived the explosion high in the atmosphere."

Subsequently, scientists determined most of the fragments are a rare type of meteorite called ureilites. Less than 10 of the nearly 1,000 known meteorites are ureilites. The recovery team made history when they found the first-ever freshly fallen mixed-composition, or polymict ureilite. The majority of the remaining fragments are similar to the more common types of meteorites called chondrites.

Other Ames researchers showed the ureilite fragments contained widely varying amounts of the minerals called olivine and pyroxene. Carnegie Institute of Washington researchers found these minerals have the full range of oxygen atom signatures detected in previous ureilites. Scientists believe this is evidence all ureilites originated from the same source, called the ureilite parent body. Astronomers theorize the parent body experienced a giant collision approximately 4.5 billion years ago and caused iron-rich minerals to smelt into metallic iron. However, the olivine and pyroxene didn't melt, which allowed the oxygen atoms in them to stay in the same arrangement as when they first formed.

Researchers at NASA's Johnson Space Center in Houston were able to deduce that much of the ureilite parent body was reduced to fragments measuring 30 to 300 feet during this giant collision. After the catastrophic collision, scientists believe the material that ended up making 2008 TC3 had a long history of violent collisions and impacts. These later collisions ground the fragments down into the smaller sand grain-sized pieces that gathered loosely together with many voids.

Researchers believe the amino acids were delivered to 2008 TC3 during the later impacts, or formed directly from trapped gases as the asteroid cooled following the giant collision. Other non-ureilite types of meteorites also became part of the asteroid. To date, ten different meteorite types have been identified, accounting for 20-30 percent of the asteroid's recovered remains.

"Asteroids have just become a lot more interesting," Jenniskens said. "We were surprised to find that not all of the meteorites we recovered were the same, even though we are certain they came from the same asteroid."

Astronomers have known asteroids orbiting the sun frequently are broken and reassembled during collisions, but until now they thought little mixing occurred because asteroids, or impactors that broke them apart, are usually very small. The research is featured in 20 papers published this week in an issue of the Meteoritical Society's journal Meteoritics and Planetary Science. For information about NASA and agency programs, visit: http://www.nasa.gov

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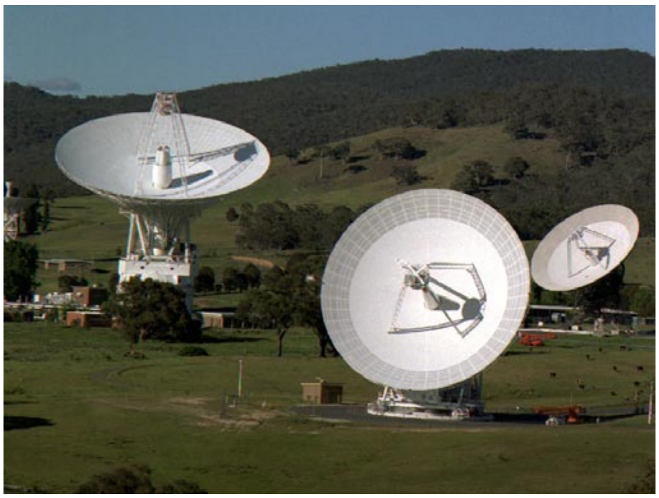
Contract Marks New Generation for Deep Space Network

PASADENA, Calif. – NASA has taken the next step toward a new generation of Deep Space Network antennas. A $40.7 million contract with General Dynamics SATCOM Technologies, San Jose, Calif., covers implementation of two additional 34-meter (112-foot) antennas at Canberra, Australia. This is part of Phase I of a plan to eventually retire the network's aging 70-meter-wide (230-foot-wide) antennas.

The Deep Space Network (DSN) consists of three communications complexes: in Goldstone, Calif.; Madrid, Spain; and Canberra, Australia. The 70-meter antennas are more than 40 years old and are showing signs of surface deterioration from constant use. Additional 34-meter antennas are being installed in Canberra in the first phase; subsequent phases will install additional 34-meter antennas in Goldstone and Madrid.



The Canberra Deep Space Communications Complex, located outside Canberra, Australia, is one of three complexes, which comprise NASA's Deep Space Network. In this image, the 70-meter (230-foot) antenna and the 34-meter (112-foot) antennas are working side-by-side. Image credit: NASA/JPL-Caltech

The 34-meter beam waveguide antennas are essential to keep communications flowing smoothly as NASA's fleet of spacecraft continues to expand. In addition, the waveguide design of the antennas provides easier access for maintenance and future upgrades, because sensitive electronics are housed in a below-the-ground pedestal equipment room, instead of in the center of the dish.

"As a result of several studies, it was determined that arrays of 34-meter beam waveguide antennas were the best solution to long-term continuation of DSN 70-meter capabilities," said Miguel Marina, who manages the 70-meter replacement task force at NASA's Jet Propulsion Laboratory in Pasadena, Calif. "The new antennas are critical communication resources for all current and future NASA missions."

NASA expects to complete the building of the first two 34-meter antennas in Canberra by 2016. They will be named Deep Space Stations 35 and 36. Deep Space Station 35 is due to be online in 2014, and Deep Space Station 36 is expected to follow in 2016.

In 1958, NASA established the Deep Space Network as a separately managed and operated communications facility to accommodate all deep space missions. This avoided the need for each flight project to acquire its own specialized space communications network. During the Apollo period (1967-1972), these stations supported America's missions to the moon, including the historic first manned landing. The Goldstone antenna, in particular, captured Neil Armstrong's words and sent them on to American television sets while the images came through another antenna.

The Deep Space Network is now sending commands to numerous robotic spacecraft, such as NASA's Mars Exploration Rovers, the Spitzer Space Telescope, the Saturn explorer Cassini and the two Voyager spacecraft, which are near the edge of the solar system.

JPL, a division of the California Institute of Technology in Pasadena, manages the Deep Space Network for NASA Headquarters, Washington. More information about the Deep Space Network is online at: http://deepspace.jpl.nasa.gov/dsn . More information about NASA's Space Communications and Navigation program is at: https://www.spacecomm.nasa.gov .

Priscilla Vega, Jet Propulsion Laboratory, Pasadena, Calif.
priscilla.r.vega@jpl.nasa.gov/jccook@jpl.nasa.gov

Cassini Spots Potential Ice Volcano On Saturn Moon

WASHINGTON -- NASA's Cassini spacecraft has found possible ice volcanoes on Saturn's moon Titan that are similar in shape to those on Earth that spew molten rock.

Topography and surface composition data have enabled scientists to make the best case yet in the outer solar system for an Earth-like volcano landform that erupts in ice. The results were presented today at the American Geophysical Union meeting in San Francisco.

"When we look at our new 3-D map of Sotra Facula on Titan, we are struck by its resemblance to volcanoes like Mt. Etna in Italy, Laki in Iceland and even some small volcanic cones and flows near my hometown of Flagstaff," said Randolph Kirk, who led the 3-D mapping work, and is a Cassini radar team member and geophysicist at the U.S. Geological Survey (USGS) Astrogeology Science Center in Flagstaff, Ariz.

Scientists have been debating for years whether ice volcanoes, also called cryovolcanoes, exist on ice-rich moons, and if they do, what their characteristics are. The working definition assumes some kind of subterranean geological activity warms the cold environment enough to melt part of the satellite's interior and sends slushy ice or other materials through an opening in the surface. Volcanoes on Jupiter's moon Io and Earth spew silicate lava.

Some cryovolcanoes bear little resemblance to terrestrial volcanoes, such as the tiger stripes at Saturn's moon Enceladus, where long fissures spray jets of water and icy particles that leave little trace on the surface. At other sites, eruption of denser materials might build up volcanic peaks or finger-like flows. But when such flows were spotted on Titan in the past, theories explained them as non-volcanic processes, such as rivers depositing sediment. At Sotra, however, cryovolcanism is the best explanation for two peaks more than 3000 feet high with deep volcanic craters and finger-like flows.

"This is the very best evidence, by far, for volcanic topography anywhere documented on an icy satellite," said Jeffrey Kargel, a planetary scientist at the University of Arizona, Tucson. "It's possible the mountains are tectonic in origin, but the interpretation of cryovolcano is a much simpler, more consistent explanation."

Kirk and colleagues analyzed new Cassini radar images. His USGS group created the topographic map and 3-D flyover images of Sotra Facula. Data from Cassini's visual and infrared mapping spectrometer revealed the lobed flows had a composition different from the surrounding surface. Scientists have no evidence of current activity at Sotra, but they plan to monitor the area.

"Cryovolcanoes help explain the geological forces sculpting some of these exotic places in our solar system," said Linda Spilker, Cassini project scientist at NASA's Jet Propulsion Laboratory in Pasadena, Calif. "At Titan, for instance, they explain how methane can be continually replenished in the atmosphere when the sun is constantly breaking that molecule down."

Cassini launched Oct. 15, 1997, and began orbiting Saturn in 2004. Saturn has more than 60 known moons, with Titan being the largest. The Cassini-Huygens mission is a cooperative project of NASA, the European Space Agency and the Italian Space Agency (ASI). JPL manages the mission for NASA's Science Mission Directorate at the agency's Headquarters in Washington.

The Cassini orbiter was designed, developed and assembled at JPL. The radar instrument was built by JPL and ASI, working with team members from the U.S. and several European countries. The visual and infrared mapping spectrometer was built by JPL, with a major contribution by ASI. The visual and infrared mapping spectrometer science team is based at the University of Arizona, Tucson.

For more information about the Cassini mission, visit: http://www.nasa.gov/cassini

NASA's Next Mars Rover to Zap Rocks With Laser

A rock-zapping laser instrument on NASA's next Mars rover has roots in a demonstration that Roger Wiens saw 13 years ago in a colleague's room at Los Alamos National Laboratory in New Mexico.

The Chemistry and Camera (ChemCam) instrument on the rover Curiosity can hit rocks with a laser powerful enough to excite a pinhead-size spot into a glowing, ionized gas. ChemCam then observes the flash through a telescope and analyzes the spectrum of light to identify the chemical elements in the target.

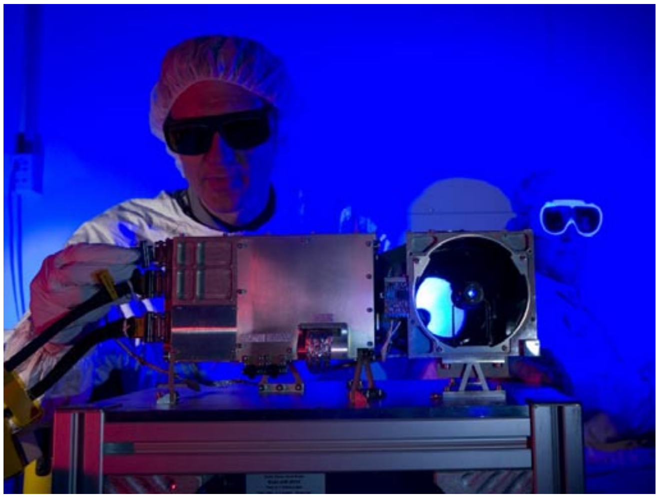
That information about rocks or patches of soil up to about 7 meters (23 feet) away will help the rover team survey the rover's surroundings and choose which targets to drill into, or scoop up, for additional analysis by other instruments on Curiosity. With the 10 science instruments on the rover, the team will assess whether any environments in the landing area have been favorable for microbial life and for preserving evidence about whether life existed. In late 2011, NASA will launch Curiosity and the other parts of the flight system, delivering the rover to the surface of Mars in August 2012.

Wiens, a geochemist with the U.S. Department of Energy's Los Alamos National Laboratory, serves as ChemCam's principal investigator. An American and French team that he leads proposed the instrument during NASA's 2004 open competition for participation in the Mars Science Laboratory project, whose rover has since been named Curiosity.

In 1997, while working on an idea for using lasers to investigate the moon, Wiens visited a chemistry laboratory building where a colleague, Dave Cremers, had been experimenting with a different laser technique. Cremers set up a cigar-size laser powered by a little 9-volt radio battery and pointed at a rock across the room.

"The room was well used. Every flat surface was covered with instruments, lenses or optical mounts," Wiens recalls. "The filing cabinets looked like they had a bad case of acne. I found out later that they were used for laser target practice."
Cremers pressed a button. An invisible beam from the laser set off a flash on a rock across the room. The flash was ionized gas, or plasma, generated by the energy from the laser exciting atoms in the rock. A spectrometer pointed at the glowing plasma recorded the intensity of light at different wavelengths for determining the rock's atomic ingredients.

Researchers have used lasers for inducing plasmas for decades. What impressed Wiens in this demonstration was the capability to do it with such a low-voltage power source and compact hardware. Using this technology for a robot on another planet seemed feasible. From that point, more than a decade of international development and testing resulted in ChemCam being installed on Curiosity in September 2010.



Researchers prepare for a test of the Chemistry and Camera (ChemCam) instrument that will fly on NASA's Mars Science Laboratory mission. The instrument uses a pulsed laser beam to vaporize a pinhead-size target, producing a flash of light from the ionized material -- plasma -- that can be analyzed to identify chemical elements in the target. Image Credit: NASA/JPL-Caltech/LANL

The international collaboration came about in 2001 when Wiens introduced a former Los Alamos post-doctoral researcher, Sylvestre Maurice, to the project. The core technology of ChemCam, laser-induced breakdown spectroscopy, had been used for years in France as well as in America, but it was still unknown to space scientists there. "The technique is both flashy and very compelling scientifically, and the reviewers in France really liked that combination," Maurice said. A French team was formed, and work on a new laser began.

"The trick is very short bursts of the laser," Wiens said. "You really dump a lot of energy onto a small spot -- megawatts per square millimeter -- but just for a few nanoseconds."

The pinhead-size spot hit by ChemCam's laser gets as much power focused on it as a million light bulbs, for five one-billionths of a second. Light from the resulting flash comes back to ChemCam through the instrument's telescope, mounted beside the laser high on the rover's camera mast. The telescope directs the light down an optical fiber to three spectrometers inside the rover. The spectrometers record intensity at 6,144 different wavelengths of ultraviolet, visible and infrared light. Different chemical elements in the target emit light at different wavelengths.

If the rock has a coating of dust or a weathered rind, multiple shots from the laser can remove those layers to provide a clear shot to the rock's interior composition. "We can see what the progression of composition looks like as we get a little bit deeper with each shot," Wiens said.

Earlier Mars rover missions have lacked a way to identify some of the lighter elements, such as carbon, oxygen, hydrogen, lithium and boron, which can be clues to past environmental conditions in which the rock was formed or altered. After NASA's Mars Exploration Rover Spirit examined an outcrop called "Comanche" in 2005, it took years of analyzing indirect evidence before the team could confidently infer the presence of carbon in the rock. A single observation with ChemCam could detect carbon directly.

ChemCam will be able to interrogate multiple targets the same day, gaining information for the rover team's careful selection of where to drill or scoop samples for laboratory investigations that will take multiple days per target. It can also check the composition of targets inaccessible to the rover's other instruments, such as rock faces beyond the reach of Curiosity's arm.

The instrument's telescope doubles as the optics for the camera part of ChemCam, which records images on a one-megapixel detector. The telescopic camera will show context of the spots hit with the laser and can also be used independently of the laser.

The French half of the ChemCam team, headed by Maurice and funded by France's national space agency, provided the instrument's laser and telescope. Maurice is a spectroscopy expert with the Centre d'Étude Spatiale des Rayonnements, in Toulouse, France. Los Alamos National Laboratory supplied the spectrometers and data processor inside the rover. The optical design of the spectrometers came from Ocean Optics, Dunedin, Fla.

The ChemCam team includes experts in mineralogy, geology, astrobiology and other fields, with some members also on other Curiosity instrument teams.

testing continues at NASA's Jet Propulsion Laboratory, Pasadena, Calif. JPL is assembling the rover and other components of the Mars Science Laboratory flight system for launch from Florida between Nov. 25 and Dec. 18, 2011.

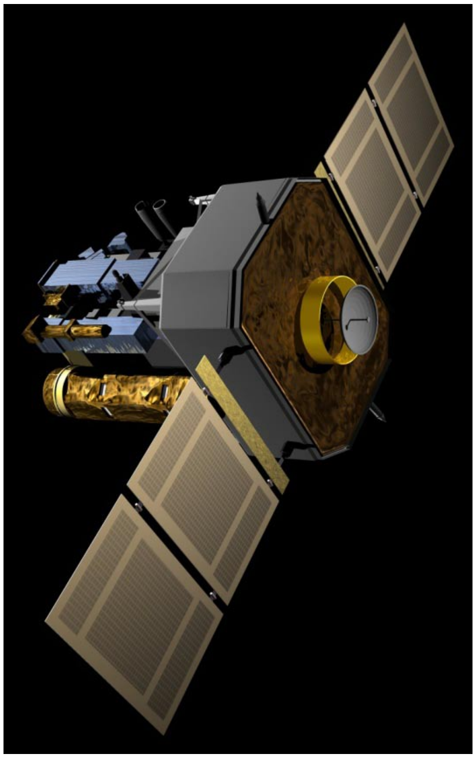
Guy Webster , Jet Propulsion Laboratory, Pasadena, Calif.

SOHO Spots 2000th Comet

As people on Earth celebrate the holidays and prepare to ring in the New Year, an ESA/NASA spacecraft has quietly reached its own milestone: on December 26, the Solar and Heliospheric Observatory (SOHO) discovered its 2000th comet.

Drawing on help from citizen scientists around the world, SOHO has become the single greatest comet finder of all time. This is all the more impressive since SOHO was not specifically designed to find comets, but to monitor the sun.

"Since it launched on December 2, 1995 to observe the sun, SOHO has more than doubled the number of comets for which orbits have been determined over the last three hundred years," says Joe Gurman, the U.S. project scientist for SOHO at NASA's Goddard Space Flight Center in Greenbelt, Md.

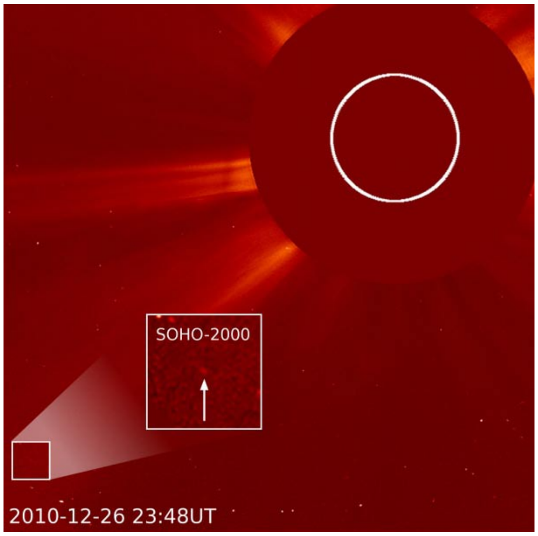


In 15 years since it launched in December 1995, the SOHO spacecraft, has doubled the number of comets sighted in the three hundred years previously. Credit: NASA/ESA/Alex Lutkus

Of course, it is not SOHO itself that discovers the comets -- that is the province of the dozens of amateur astronomer volunteers who daily pore over the fuzzy lights dancing across the pictures produced by SOHO's LASCO (or Large Angle and Spectrometric Coronagraph) cameras. Over 70 people representing 18 different countries have helped spot comets over the last 15 years by searching through the publicly available SOHO images online.

"There are a lot of people who do it," says Karl Battams who has been in charge of running the SOHO comet-sighting website since 2003 for the Naval Research Lab in Washington, where he also does computer processing for LASCO. "They do it for free, they're extremely thorough, and if it wasn't for these people, most of this stuff would never see the light of day."

Battams receives reports from people who think that one of the spots in SOHO's LASCO images looks to be the correct size and brightness and headed for the sun – characteristics typical of the comets SOHO finds. He confirms the finding, gives each comet an unofficial number, and then sends the information off to the Minor Planet Center in Cambridge, Mass, which categorizes small astronomical bodies and their orbits.

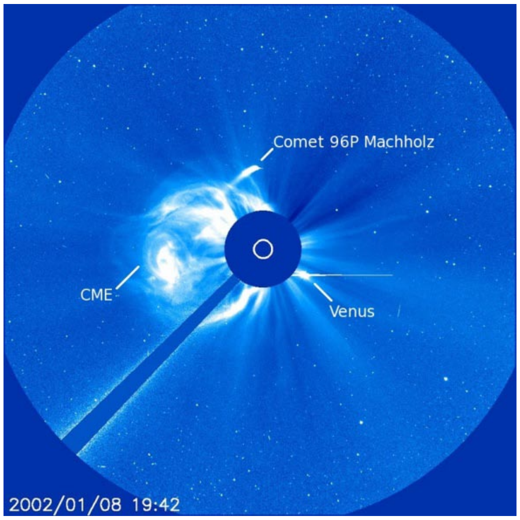


SOHO's 2000th comet, spotted by a Polish amateur astronomer on December 26, 2010. Credit: SOHO/Karl Battams

It took SOHO ten years to spot its first thousand comets, but only five more to find the next thousand. That's due partly to increased participation from comet hunters and work done to optimize the images for comet-sighting, but also due to an unexplained systematic increase in the number of comets around the sun. Indeed, December alone has seen an unprecedented 37 new comets spotted so far, a number high enough to qualify as a "comet storm."

LASCO was not designed primarily to spot comets. The LASCO camera blocks out the brightest part of the sun in order to better watch emissions in the sun's much fainter outer atmosphere, or corona. LASCO's comet finding skills are a natural side effect -- with the sun blocked, it's also much easier to see dimmer objects such as comets.

"But there is definitely a lot of science that comes with these comets," says Battams. "First, now we know there are far more comets in the inner solar system than we were previously aware of, and that can tell us a lot about where such things come from and how they're formed originally and break up. We can tell that a lot of these comets all have a common origin." Indeed, says Battams, a full 85% of the comets discovered with LASCO are thought to come from a single group known as the Kreutz family, believed to be the remnants of a single large comet that broke up several hundred years ago.



One comet discovered by SOHO is Comet 96P Machholz. It orbits the sun approximately every 6 years and SOHO has seen it three times. Credit: NASA/ESA/SOHO

The Kreutz family comets are "sungrazers" – bodies whose orbits approach so near the Sun that most are vaporized within hours of discovery – but many of the other LASCO comets boomerang around the sun and return periodically. One frequent visitor is comet 96P Machholz. Orbiting the sun approximately every six years, this comet has now been seen by SOHO three times.

SOHO is a cooperative project between the European Space Agency (ESA) and NASA. The spacecraft was built in Europe for ESA and equipped with instruments by teams of scientists in Europe and the USA.

For more information about the SOHO mission, visit: http://sohowww.nascom.nasa.gov/ .
Follow SOHO's comet findings more closely at: http://sungrazer.nrl.navy.mil/ or via Twitter at: http://twitter.com/SungrazerComets

Karen C. Fox - NASA's Goddard Space Flight Center

TRACE Spacecraft's New Slewing Procedure

The fastest path between Point A and Point B is a straight line. Not so fast, says a team of scientists and engineers who recently disproved this commonly accepted notion using a NASA satellite that had not moved more than 15 degrees during its 12-year mission studying the Sun.

In what may seem counterintuitive even to engineers, a team from the Naval Postgraduate School (NPS) in Monterey, Calif., Draper Laboratory in Houston, Texas, and the NASA Goddard Space Flight Center in Greenbelt, Md., proved that the spacecraft actually rotated faster to reach a particular target in the sky when it carried out a set of mathematically calculated movements. These maneuvers looked more like the steps dancers would perform doing the tango, the foxtrot, or another ballroom dance.

"That spacecraft was dancing on the sky," said Osvaldo Cuevas, the mission director of NASA's Transition Region and Coronal Explorer (TRACE), the spacecraft that carried the experiment before NASA decommissioned it in September. Had TRACE sported a pair of legs, its steps would have traced roughly the pattern of a five-point star. Until the spacecraft's debut on NASA's version of "Dancing with the Stars," TRACE stared steadily at the Sun producing millions of images of the corona, the Sun's outer atmosphere that extends millions of kilometers into space and is nearly 200 times hotter than the Sun's visible surface.

Benefits to Current and Future Missions

The team's first-ever time-optimal slew experiment was more than just an interesting performance or a theoretical question posed in a technical journal. The team's findings are particularly relevant to engineers designing future Earth-observing, astrophysics, and reconnaissance satellites that must image one object and then quickly reorient itself to observe another in a completely different location. Just as important, the experiment showed that existing spacecraft can "do things that they aren't designed to do," said Nazreth Bedrossian, a Draper scientist who played a pivotal role in the experiment.

"The payoff is in the pointing agility and being able to collect more science," explained Neil Dennehy, a Goddard engineer with the NASA Engineering and Safety Center (NESC). "NASA will benefit and so will industry." Currently, NASA engineers direct spacecraft to follow a straight line when slewing to different locations in the sky. While it may be the shortest path, it is not the fastest, as the experiment showed.

Although the findings might surprise some, they did not astonish scientists from NPS and Draper. Actually the discovery that a straight line is not the fastest path between two points was made in the early 1700s by Swiss mathematician Johann Bernoulli. He discovered that a sliding bead traveling from one point to another would move faster if it followed a curved line and allowed gravity to assist in the acceleration.

The challenge then was not whether it was faster moving along a non-linear path, but rather what that path might look like. "Over the years, we forgot that the straight line isn't the best solution because we didn't know how to calculate the fastest path. We didn't have the tools," said Mark Karpenko, an NPS research scientist and lead engineer in the experiment.

Artist's rendition of the TRACE spacecraft in orbit. Credit: NASA

Similar Movements Demonstrated on Space Station

It was a conundrum that NPS Professor Michael Ross eventually solved when he and his colleagues developed an optimal-control software package, called "DIDO," named for the ancient queen of Carthage who solved a challenging optimal-control problem even before the invention of calculus. In fact, Ross, Bedrossian, and his colleague, Sagar Bhatt, used DIDO four years earlier to maneuver the International Space Station 180 degrees without expending a drop of fuel.

"We became known as the people who can take this kind of an idea and make it fly," Ross said. "What needs to be emphasized is that the software used for solving the Space Station and TRACE maneuvers is exactly the same. Although the Space Station experiment demonstrated a minimum-fuel maneuver and TRACE a minimum-time maneuver — maneuvers that are quite different — the mathematics are similar."

All they needed was a chance to demonstrate DIDO's prowess by carrying out time-optimal maneuvers on a real satellite.

The stars had aligned in their favor. In the spring, NESC's Dennehy and Senior Engineer Kenneth Lebsock learned that the Space Science Mission Operations Office (SSMO) at Goddard planned to decommission TRACE in September. Before doing so, SSMO management offered experimenters an opportunity to use the spacecraft as an orbital testbed to investigate new ideas. "I talked with the people who worked on TRACE's design, and I asked them what they would like to do if they could it all over again," Lebsock recalled. "The guys thought it would be neat if we could uplink maneuvering commands to see if TRACE could carry out an optimal slew" — a job the spacecraft was never designed to do, let alone quickly.

Two-Month Turnaround

NESC knew whom to call. Usually it takes at least a year to develop a solution, Ross said. The team, however, had only two months to complete the job. "I called up Naz (Bedrossian) and I said, 'I know you made it happen with the space station. Do you think you can make it happen this time?'" The answer was obvious, Bedrossian said. "When do you get an opportunity to test your ideas on an actual satellite? For engineers, a flight test is like the Olympics. It's what you train for."

While Bernouilli calculated the optimum path using gravity to its best advantage, the team had to solve a pattern that exploited the spacecraft's mass and its four reaction wheels — a type of flywheel device that rotates spacecraft by very small amounts to keep it pointed at a star. "We have been working on time-optimal maneuvers for other types of spacecraft, but never a reaction wheel system," Karpenko said.

Had the team opted to take TRACE in a straight line from one point to another, for example, it would have had to push one of the wheels to full saturation, with the other three not working as hard, Lebsock explained. That means the spacecraft could not go any faster than the speed of the one wheel. The quest then was to determine mathematically the most efficient pattern where all four wheels worked equally hard.

By Aug. 10, the team was ready to begin the first of its 20 tests. Goddard engineers uploaded the team's series of pointing commands, starting conservatively with a 10-degree slew and then back to the starting position. By the fourth week, TRACE had slewed over 90 degrees off the Sun line. It maintained that position for about six minutes before slewing back. "That maneuver was interesting because it really demonstrated what we wanted to show," Karpenko said. "We can actually reorient the spacecraft more quickly than by using the conventional techniques."

"This was about taking a risk to find something and learn something new," Cuevas added. "Not only were the movements faster than standard maneuvers, they also consumed less than half the electrical power of a standard movement. This could translate into significant savings for NASA, to say nothing of the improved data collection."

Lori Keesey - NASA's Goddard Space Flight Center

January 2011 Celestial Events

supplied by J. Randolph Walton (Randy)

Day	Date	Time (EDT)	Event
Mon	3	20:00	**Quadrantid meteors (ZHR=120)**
Tue	4	03:50	Partial Solar Eclipse, not visible in NJ
		0403	**New Moon**
		07:29	Moon Rise
Sat	8	00:03	Saturn Rises
		03:43	Venus Rises
		05:37	Mercury Rises
		16:52	Sunset
		21:22	Moon set
		22:35	Jupiter Sets
Mon	10	16:07	**Two shadows transit on Jupiter**
Wed	12	06:31	**First Quarter Moon**
		17:00	**Lunar Straight Wall visible**
Sat	15	03:40	Venus Rises
		05:40	Mercury Rises
		07:20	Sunrise
		12:56	Moon rise
		16:59	Sunset
		17:17	Mars Sets
		22:15	Jupiter Sets
		23:35	Saturn Rises
Mon	17	16:51	**Double satellite transit on Jupiter**
		19:43	**Two shadows transit on Jupiter**
Wed	19	16:21	**Full Moon**
		17:09	Moon rise
Sat	22	04:00	Venus Rises
		06:05	Mercury Rises
		17:07	Sunset
		20:53	Moon rise
		21:53	Jupiter Sets
		23:10	Saturn Rises
Mon	24	19:05	**Double satellite transit on Jupiter**
Wed	26	00:30	Moon rise
		07:57	**Last Quarter Moon**
Sat	29	04:07	Venus Rises
		06:20	Mercury Rises
		07:11	Sunrise
		13:09	Moon set
		17:15	Sunset
		17:17	Mars Sets
		21:33	Jupiter Sets
		22:40	Saturn Rises

In the Eyepiece

Here is a list of objects for this month. This is reproduced from www.skyhound.com with the kind permission of its creator and author of SkyTools Greg Crinklaw.

Object(s)	Class	Con	RA	Dec	Mag
NGC 1501	**Planetary Nebula**	**Camelopardus**	**04h06m59.4s**	**+60°55'14"**	**13.3**
Cleopatra's Eye	**Planetary Nebula**	**Eridanus**	**04h14m15.8s**	**-12°44'21"**	**9.6**
The California Nebula	**Diffuse Nebula**	**Perseus**	**04h03m12.0s**	**+36°22'00"**	**5.0**
NGC 1664	**Open Cluster**	**Auriga**	**04h51m04.4s**	**+43°42'04"**	**7.2**
MSH 04-12	**Quasar**	**Eridanus**	**04h07m48.4s**	**-12°11'36"**	**14.8**
NGC 1360	**Planetary Nebula**	**Fornax**	**03h33m14.6s**	**-25°52'18"**	**9.6**
Crystal Ball	**Planetary Nebula**	**Taurus**	**04h09m17.0s**	**+30°46'33"**	**10.0**
Palomar 2	**Globular Cluster**	**Auriga**	**04h46m06.0s**	**+31°22'54"**	**13.0**
K 2-1	**Planetary Nebula**	**Auriga**	**05h07m07.1s**	**+30°49'18"**	**13.8**
NGC 1624	**Open Cluster**	**Perseus**	**04h40m25.4s**	**+50°26'49"**	**11.8**