
March 2011

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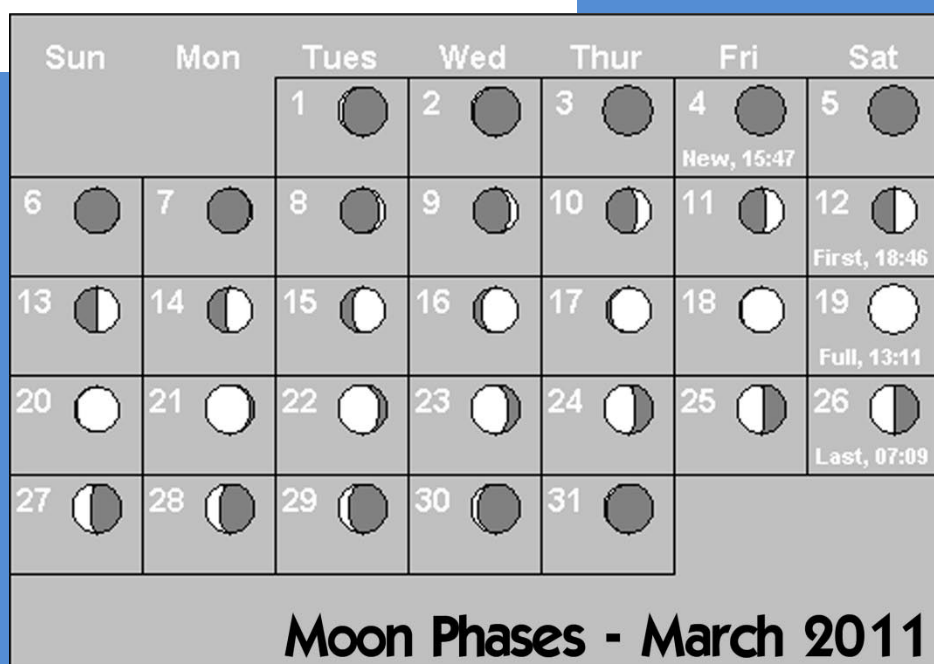
# March Meeting

The next meeting of S*T*A*R will be on Thursday, March 3rd 2011. Professor of Astronomy Marcos Puga from Brookdale College will present a description of our solar planets . Kepler's laws are introduced and used to explain properties, characteristics and even names of the planets around the sun. Their number is definitely settled. It is not eight, not nine (Pluto?), not even eleven (Eris? Ceres?) Come to find out!

# Calendar

- March 3, 2011 Properties and Characteristics of the Solar Planets as Related to their Roman god Namesakes with Marcos Puga




## April Issue

**Please submit articles and contributions for the next *Spectrogram* by March 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!

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

This event is scheduled to start around 7:30 and go until 9:30. 100 students plus one parent each...200 total.
Eisenhower School in Parlin, NJ
POC : KenL

Messier Marathon Observing:

We will Reserve Dordrook Park for Messier Marathon Observing on the first weekend in March and the first weekend in April.

Please note by "clicking" on the Observing link on the top of our web site there is a Messier Marathon list and Telrad charts for the objects.

Thanks
Rich G.

***I imaged Saturn on 2-22-11 near midnight but there was considerable fog and high clouds and the moon was about 20 degrees above the horizon. Within 20 minutes the fog was so heavy even the moon vanished. This was taken using a C 11 at F/10 using a DBK21 planetary color camera. I wasn't able to use a barlow since it also magnified the water vapor and caused a blur. This was my first time this year and the rings are now opening and the cassini division stood out very easy and pretty sharp. I can also see on the inner edges the Grape ring and a white glow can be seen under the ring. However, I don't think this is the white northern streak and it could have been on the opposite side. : Ernie Rossi***

# February Meeting Minutes

The February 3, 2011 meeting of S*T*A*R Astronomy club began at 8:13 p.m. The meeting was attended by about 23 people. President Nancy McGuire chaired the meeting and began by presenting the agenda and asking if there were first-time attendees. There were none. She then asked if anyone would be able to present an event of the month talk at future meetings. There was some discussion of possible forms such a talk could take. Topics of talks for the remainder of the meetings for this season were presented, with only May’s talk yet to be decided.

Nancy then introduced the speaker for the evening. Ed Collett is a long-time club member and former club president. Ed presented “Telescope Optics Equations,” which provided a number of results useful for evaluating the optical performance of telescopes, together with explanations of the methods by which lenses create images. Results included the significance of the focal point of a lens, formulas for the magnification, apparent field, brightness, and exit pupil. He applied the results to Galileo’s telescope and some modern telescopes, showing that some telescopes are not optimized for exit pupil. He also noted that some common binocular designs yield the correct exit pupil of 5 mm.

Following the break, Rich Gaynor presented information on upcoming star parties. Ahmed Jrad noted that late March will be an appropriate time for a Messier Marathon, and that he will make a reservation at Doorbrook for the event. There was some discussion of the possibility of finding a new place for the club to meet, because Monmouth Museum has doubled the fee it charges. The possibility of selling the 25-inch telescope is still being considered. Ahmed Jrad offered to present a constellation of the month talk at the next meeting. Michael Kozic had the winning ticket in the 50/50 drawing, earning $13. The meeting was adjourned shortly after 10 pm.

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# Leonardo: Frequently Visited ISS Soon to Be Home

The new Permanent Multipurpose Module (PMM) Leonardo should know its way around the International Space Station by now. This flight marks its eighth and final visit to the orbiting laboratory, its new home.

Leonardo was one of three Multipurpose Logistics Modules built by the Italian Space Agency under contract. It was delivered to Kennedy Space Center in 1998.

Its first spaceflight was on Discovery’s STS-102 mission launched March 8, 2001. Leonardo brought six systems racks to the station: two robotic workstation racks for the station's robotic arm and its four cameras, two DC-to-DC converter units which convert electrical power from the station's solar arrays to a form usable by station systems and experiments, the U.S. lab Avionic 3 and a Crew Health Care System rack.

***Canadarm2 or the Space Station Remote Manipulator System arm grasps the Italian-built Multipurpose Logistics Module Leonardo to place it back in Discovery's cargo bay. Credit: NASA***

Just over five months later, it was on its way to the station again on Discovery, this time on STS-105 launched Aug. 10, 2001. Its cargo included two science racks for the U.S. laboratory Destiny, six resupply stowage racks and four resupply stowage platforms. Total cargo weight was about 6,775 pounds.

***Space shuttle Discovery approaches the International Space Station for docking. Multipurpose Logistics Module Leonardo can be seen in the shuttle's cargo bay. Credit: NASA***

On June 5, 2002, it launched on STS-111, this time in Endeavour’s payload bay. Leonardo brought a total of 8,062 pounds of supplies and equipment to the station, including a new science rack to house microgravity experiments and a glovebox for experiments that require isolation. In addition to carrying home the results of several science experiments, Leonardo returned to Earth more than 4,000 pounds of equipment and supplies no longer needed aboard the station.

After a shuttle stand-down after the loss of Columbia, Leonardo found itself back in Discovery's cargo bay for STS-121, launched July 4, 2006. It carried food, clothing and consumables on five resupply stowage racks and three resupply stowage platforms. Also aboard was a minus 80 lab freezer, a European Modular Cultivation System for biology experiments, the Oxygen Generation System and a new cycle ergometer.

STS-126, an almost 16-day flight by Endeavour launched Nov. 14, 2008, marked Leonardo's next visit to the station. It carried a record 14,000 pounds of equipment and supplies for the ISS. Major cargo included two crew quarters racks, the Advanced Resistive Exercise Device, two water reclamation racks, a waste and hygiene compartment and a galley.

On Aug. 28, 2009, Leonardo launched once again to the station on Discovery, this time on STS-128. It carried two research racks, four station system racks, seven resupply stowage platforms two resupply stowage racks, one zero stowage rack and an integrated stowage platform.

Leonardo's final flight as an MPLM was aboard Discovery on STS-131, launched April 5, 2010. Its cargo included the third minus 80-degree freezer, a window orbital research facility, a crew quarters rack, a resistive exercise rack and resupply stowage racks and platforms.

Two additional MPLMs were built by the Italian Space Agency. The second, Raffaello, flew three missions to the station and is scheduled to fly again on STS-135. The third, Donatello, never flew in space.

On STS-133, again on Discovery, Leonardo will be attached to the station as the PMM. Modifications before this flight included enhanced shielding and modifications to allow station crew members access to its internal equipment.

Its final cargo for the station includes an experiment rack, six resupply stowage platforms and five resupply stowage racks, as well as two integrated stowage platforms. The experiment rack, Express Rack 8, is designed to support and store a variety of experiments.

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# Herschel Measures Dark Matter for Star-Forming Galaxies

PASADENA, Calif. -- The Herschel Space Observatory has revealed how much dark matter it takes to form a new galaxy bursting with stars. Herschel is a European Space Agency cornerstone mission supported with important NASA contributions.

The findings are a key step in understanding how dark matter, an invisible substance permeating our universe, contributed to the birth of massive galaxies in the early universe.

***A region of the sky called the "Lockman Hole," located in the constellation of Ursa Major, is one of the areas surveyed in infrared light by the Herschel Space Observatory. All of the little dots in this picture are distant galaxies. The pattern of their collective light is what's known as the cosmic infrared background. By studying this pattern, astronomers were able to measure how much dark matter it takes to create a galaxy bursting with young stars. Regions like this one are almost completely devoid of objects in our Milky Way galaxy, making them ideal for astronomers studying galaxies in the distant universe. Image credit: ESA/Herschel/SPIRE/HerMES***

"If you start with too little dark matter, then a developing galaxy would peter out," said astronomer Asantha Cooray of the University of California, Irvine. He is the principal investigator of new research appearing in the journal Nature, online on Feb. 16 and in the Feb. 24 print edition. "If you have too much, then gas doesn't cool efficiently to form one large galaxy, and you end up with lots of smaller galaxies. But if you have the just the right amount of dark matter, then a galaxy bursting with stars will pop out."

The right amount of dark matter turns out to be a mass equivalent to 300 billion of our suns.

Herschel launched into space in May 2009. The mission's large, 3.5-meter (11.5-foot) telescope detects longer-wavelength infrared light from a host of objects, ranging from asteroids and planets in our own solar system to faraway galaxies.

"This remarkable discovery shows that early galaxies go through periods of star formation much more vigorous than in our present-day Milky Way," said William Danchi, Herschel program scientist at NASA Headquarters in Washington. "It showcases the importance of infrared astronomy, enabling us to peer behind veils of interstellar dust to see stars in their infancy."

Cooray and colleagues used the telescope to measure infrared light from massive, star-forming galaxies located 10 to 11 billion light-years away. Astronomers think these and other galaxies formed inside clumps of dark matter, similar to chicks incubating in eggs.

Giant clumps of dark matter act like gravitational wells that collect the gas and dust needed for making galaxies. When a mixture of gas and dust falls into a well, it condenses and cools, allowing new stars to form. Eventually enough stars form, and a galaxy is born.

Herschel was able to uncover more about how this galaxy-making process works by mapping the infrared light from collections of very distant, massive star-forming galaxies. This pattern of light, called the cosmic infrared background, is like a web that spreads across the sky. Because Herschel can survey large areas quickly with high resolution, it was able to create the first detailed maps of the cosmic infrared background.

"It turns out that it's much more effective to look at these patterns rather than the individual galaxies," said Jamie Bock of NASA's Jet Propulsion Laboratory in Pasadena, Calif. Bock is the U.S. principal investigator for Herschel's Spectral and Photometric Imaging Receiver instrument used to make the maps. "This is like looking at a picture in a magazine from a reading distance. You don't notice the individual dots, but you see the big picture. Herschel gives us the big picture of these distant galaxies, showing the influence of dark matter."

The maps showed the galaxies are more clustered into groups than previously believed. The amount of galaxy clustering depends on the amount of dark matter. After a series of complicated numerical simulations, the astronomers were able to determine exactly how much dark matter is needed to form a single star-forming galaxy.

"This measurement is important, because we are homing in on the very basic ingredients in galaxy formation," said Alexandre Amblard of UC Irvine, first author of the Nature paper. "In this case, the ingredient, dark matter, happens to be an exotic substance that we still have much to learn about."

NASA's Herschel Project Office is based at JPL, which contributed mission-enabling technology for two of Herschel's three science instruments. The NASA Herschel Science Center, part of the Infrared Processing and Analysis Center at the California Institute of Technology in Pasadena, supports the U.S. astronomical community. JPL is managed by Caltech.

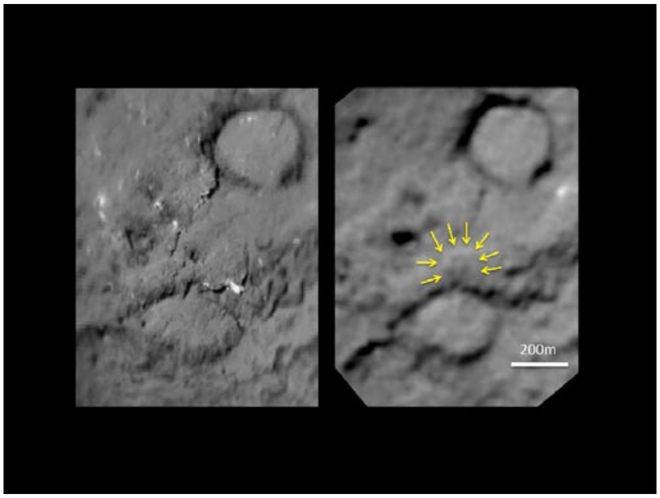
More information is online at
http://www.herschel.caltech.edu
http://www.nasa.gov/herschel
and http://www.esa.int/SPECIALS/Herschel/index.html

Whitney Clavin, Jet Propulsion Laboratory, Pasadena, Calif.

Trent Perrotto, Headquarters, Washington

## NASA Releases Images of Man-Made Crater on Comet

PASADENA, Calif. -- NASA's Stardust spacecraft returned new images of a comet showing a scar resulting from the 2005 Deep Impact mission. The images also showed the comet has a fragile and weak nucleus.




***This pair of images shows the before-and-after comparison of the part of comet Tempel 1 that was hit by the impactor from NASA's Deep Impact spacecraft. The left-hand image is a composite made from images obtained by Deep Impact in July 2005. The right-hand image shows arrows identifying the rim of the crater caused by the impactor. The crater is estimated to be 150 meters (500 feet) in diameter. This image also shows a brighter mound in the center of the crater likely created when material from the impact fell back into the crater. Image credit: NASA/JPL-Caltech/University of Maryland/Cornell***

The spacecraft made its closest approach to comet Tempel 1 on Monday, Feb. 14, at 8:40 p.m. PST (11:40 p.m. EST) at a distance of approximately 178 kilometers (111 miles). Stardust took 72 high-resolution images of the comet. It also accumulated 468 kilobytes of data about the dust in its coma, the cloud that is a comet's atmosphere. The craft is on its second mission of exploration called Stardust-NExT, having completed its prime mission collecting cometary particles and returning them to Earth in 2006.

The Stardust-NExT mission met its goals, which included observing surface features that changed in areas previously seen during the 2005 Deep Impact mission; imaging new terrain; and viewing the crater generated when the 2005 mission propelled an impactor at the comet.

"This mission is 100 percent successful," said Joe Veverka, Stardust-NExT principal investigator of Cornell University, Ithaca, N.Y. "We saw a lot of new things that we didn't expect, and we'll be working hard to figure out what Tempel 1 is trying to tell us."

Several of the images provide tantalizing clues to the result of the Deep Impact mission's collision with Tempel 1. "We see a crater with a small mound in the center, and it appears that some of the ejecta went up and came right back down," said Pete Schultz of Brown University, Providence, R.I. "This tells us this cometary nucleus is fragile and weak based on how subdued the crater is we see today."

Engineering telemetry downlinked after closest approach indicates the spacecraft flew through waves of disintegrating cometary particles, including a dozen impacts that penetrated more than one layer of its protective shielding.

"The data indicate Stardust went through something similar to a B-17 bomber flying through flak in World War II," said Don Brownlee, Stardust-NExT co-investigator from the University of Washington in Seattle. "Instead of having a little stream of uniform particles coming out, they apparently came out in chunks and crumbled."

While the Valentine's Day night encounter of Tempel 1 is complete, the spacecraft will continue to look at its latest cometary obsession from afar.

"This spacecraft has logged over 3.5 billion miles since launch, and while its last close encounter is complete, its mission of discovery is not," said Tim Larson, Stardust-NExT project manager at JPL. "We'll continue imaging the comet as long as the science team can gain useful information, and then Stardust will get its well-deserved rest."

Stardust-NExT is a low-cost mission that is expanding the investigation of comet Tempel 1 initiated by the Deep Impact spacecraft. The mission is managed by JPL for NASA's Science Mission Directorate in Washington. Lockheed Martin Space Systems in Denver built the spacecraft and manages day-to-day mission operations.

The latest Stardust-Next/Tempel 1 images are online at: http://www.nasa.gov/mission_pages/stardust/multimedia/gallery-index.html.

More information about Stardust-NExT is at: http://stardustnext.jpl.nasa.gov.

DC Agle, Jet Propulsion Laboratory, Pasadena, Calif.

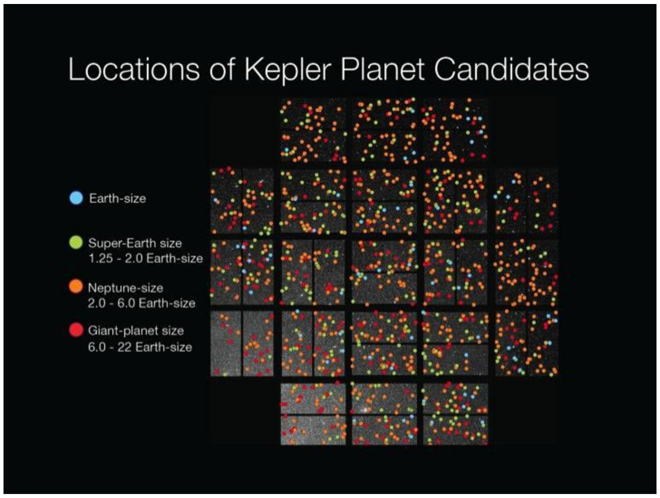
Dwayne Brown, NASA Headquarters, Washington

Blaine Friedlander, Cornell University, Ithaca, N.Y.

# NASA Finds Earth-size Planet Candidates in the Habitable Zone

Is our Milky Way galaxy home to other planets the size of Earth? Are Earth-sized planets common or rare? NASA scientists seeking answers to those questions recently revealed their discovery.

"We went from zero to 68 Earth-sized planet candidates and zero to 54 candidates in the habitable zone - a region where liquid water could exist on a planet's surface. Some candidates could even have moons with liquid water," said William Borucki of NASA's Ames Research Center, Moffett Field, Calif., and the Kepler Mission's science principal investigator. "Five of the planetary candidates are both near Earth-size and orbit in the habitable zone of their parent stars."

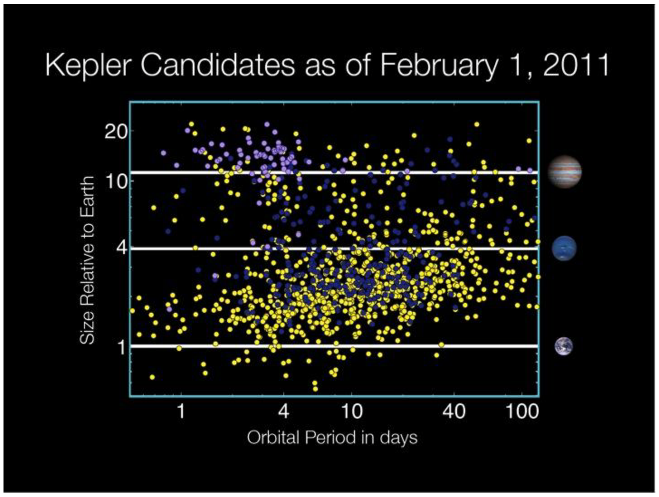



***Kepler's planet candidates by size. Image credit: NASA/Wendy Stenzel***

Planet candidates require follow-up observations to verify they are actual planets.

"We have found over twelve hundred candidate planets - that's more than all the people have found so far in history," said Borucki. "Now, these are candidates, but most of them, I'm convinced, will be confirmed as planets in the coming months and years."

The findings increase the number of planet candidates identified by Kepler to-date to 1,235. Of these, 68 are approximately Earth-size; 288 are super-Earth-size; 662 are Neptune-size; 165 are the size of Jupiter and 19 are larger than Jupiter. Of the 54 new planet candidates found in the habitable zone, five are near Earth-sized. The remaining 49 habitable zone candidates range from super-Earth size -- up to twice the size of Earth -- to larger than Jupiter. The findings are based on the results of observations conducted May 12 to Sept. 17, 2009 of more than 156,000 stars in Kepler's field of view, which covers approximately 1/400 of the sky.




***Kepler's planet candidates as of Feb. 1, 2011. Image credit: NASA/Wendy Stenzel***

"The fact that we've found so many planet candidates in such a tiny fraction of the sky suggests there are countless planets orbiting stars like our sun in our galaxy," said Borucki. "Kepler can find only a small fraction of the planets around the stars it looks at because the orbits aren't aligned properly. If you account for those two factors, our results indicate there must be millions of planets orbiting the stars that surround our sun."

"We're about half-way through Kepler's scheduled mission," said Roger Hunter, the Kepler project manager. "Today's announcement is very exciting and portends many discoveries to come. It's looking like the galaxy may be littered with many planets."

Among the stars with planetary candidates, 170 show evidence of multiple planetary candidates, including one, Kepler-11, that scientists have been able to confirm that has no fewer than six planets.

"Another exciting discovery has been the tremendous variations in the structure of the confirmed planets – some have the density of Styrofoam and others are denser than iron. The Earth's density is in between."

"The historic milestones Kepler makes with each new discovery will determine the course of every exoplanet mission to follow," said Douglas Hudgins, Kepler program scientist at NASA Headquarters in Washington.

Kepler, a space telescope, looks for planet signatures by measuring tiny decreases in the brightness of stars caused by planets crossing in front of them - this is known as a transit.

Since transits of planets in the habitable zone of sun-like stars occur about once a year and require three transits for verification, it is expected to take three years to locate and verify Earth-size planets orbiting sun-like stars.

The Kepler science team uses ground-based telescope and the Spitzer Space Telescope to perform follow-up observations on planetary candidates and other objects of interest found with the spacecraft. The star field that Kepler observes in the constellations Cygnus and Lyra can only be seen from ground-based observatories in spring through early fall. The data from these other observations helps determine which of the candidates can be validated as planets.

"The first four months of data have given us an enormous amount of interesting information for the science community to explore and to find the planets among the candidates that we have found," said Borucki. "Keep in mind, in the future, we'll have even more data for small planets in and near the habitable zone for everyone to look at."

Kepler will continue conducting science operations until at least November 2012, searching for planets as small as Earth, including those that orbit stars in a warm habitable zone where liquid water could exist on the surface of the planet. Since transits of planets in the habitable zone of solar-like stars occur about once a year and require three transits for verification, it is expected to take three years to locate and verify Earth-size planets orbiting sun-like stars.

Borucki predicted that the search using the Kepler spacecraft's continuous and long-duration capability will significantly enhance scientists' ability to determine the distributions of planet size and orbital period in the future.

"In the coming years, Kepler's capabilities will allow us to find Earth-size planets in the habitable zone of other stars," Borucki said. "Future missions will be developed to study the composition of planetary atmospheres to determine if they are compatible with the presence of life. The design for these missions depends of Kepler finding whether Earth-size planets in the habitable zone are common or rare."

The Kepler Mission team has discovered a total of 15 exoplanets, including the smallest known exoplanet, Kepler-10b.

"Kepler is providing data 100 times better than anyone has ever done before," said Borucki. "It's exploring a new part of phase space, a new part of the universe that could not be explored without this kind of precision, so it's producing absolutely beautiful data. We're seeing the variability of stars like no one has ever seen before. We're finding planets smaller than anyone has ever seen before, because the data quality is extremely good."

"In one generation we have gone from extraterrestrial planets being a mainstay of science fiction, to the present, where Kepler has helped turn science fiction into today's reality," said NASA Administrator Charles Bolden. "These discoveries underscore the importance of NASA's science missions, which consistently increase understanding of our place in the cosmos."

Kepler is NASA's tenth Discovery mission. Ames is responsible for the ground system development, mission operations and science data analysis. NASA's Jet Propulsion Laboratory, Pasadena, Calif., managed the Kepler mission development. Ball Aerospace and Technologies Corp., Boulder, Colo., was responsible for developing the Kepler flight system, and along with the Laboratory for Atmospheric and Space Physics at the University of Colorado, is supporting mission operations. Ground observations necessary to confirm the discoveries were conducted at the Keck I in Hawaii; Hobby-Ebberly and Harlan J. Smith 2.7m in Texas; Hale and Shane in California; WIYN, MMT and Tillinghast in Arizona, and the Nordic Optical in the Canary Islands, Spain.

Michael Mewhinney / Rachel Hoover
Ames Research Center, Moffett Field, Calif.

Trent J. Perrotto
Headquarters, Washington

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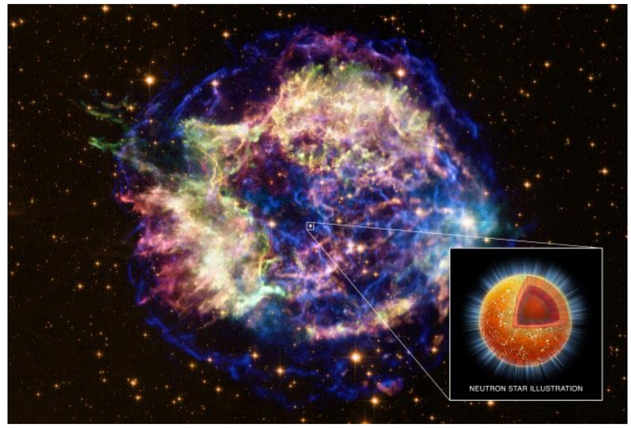
# NASA'S Chandra Finds Superfluid in Neutron Star's Core

NASA's Chandra X-ray Observatory has discovered the first direct evidence for a superfluid, a bizarre, friction-free state of matter, at the core of a neutron star. Superfluids created in laboratories on Earth exhibit remarkable properties, such as the ability to climb upward and escape airtight containers. The finding has important implications for understanding nuclear interactions in matter at the highest known densities.

Neutron stars contain the densest known matter that is directly observable. One teaspoon of neutron star material weighs six billion tons. The pressure in the star's core is so high that most of the charged particles, electrons and protons, merge resulting in a star composed mostly of uncharged particles called neutrons.

Two independent research teams studied the supernova remnant Cassiopeia A, or Cas A for short, the remains of a massive star 11,000 light years away that would have appeared to explode about 330 years ago as observed from Earth. Chandra data found a rapid decline in the temperature of the ultra-dense neutron star that remained after the supernova, showing that it had cooled by about four percent over a 10-year period.

"This drop in temperature, although it sounds small, was really dramatic and surprising to see," said Dany Page of the National Autonomous University in Mexico, leader of a team with a paper published in the February 25, 2011 issue of the journal Physical Review Letters. "This means that something unusual is happening within this neutron star."




***This composite image shows a beautiful X-ray and optical view of Cassiopeia A (Cas A), a supernova remnant located in our Galaxy about 11,000 light years away. These are the remains of a massive star that exploded about 330 years ago, as measured in Earth's time frame. X-rays from Chandra are shown in red, green and blue along with optical data from Hubble in gold. At the center of the image is a neutron star, an ultra-dense star created by the supernova. Ten years of observations with Chandra have revealed a 4% decline in the temperature of this neutron star, an unexpectedly rapid cooling. Two new papers by independent research teams show that this cooling is likely caused by a neutron superfluid forming in its central regions, the first direct evidence for this bizarre state of matter in the core of a neutron star. The inset shows an artist's impression of the neutron star at the center of Cas A. The different colored layers in the cutout region show the crust (orange), the core (red), where densities are much higher, and the part of the core where the neutrons are thought to be in a superfluid state (inner red ball). The blue rays emanating from the center of the star represent the copious numbers of neutrinos -- nearly massless, weakly interacting particles -- that are created as the core temperature falls below a critical level and a neutron superfluid is formed, a process that began about 100 years ago as observed from Earth. These neutrinos escape from the star, taking energy with them and causing the star to cool much more rapidly. Credits: X-ray: NASA/CXC/xx; Optical: NASA/STScI; Illustration: NASA/CXC/M.Weiss***

Superfluids containing charged particles are also superconductors, meaning they act as perfect electrical conductors and never lose energy. The new results strongly suggest that the remaining protons in the star's core are in a superfluid state and, because they carry a charge, also form a superconductor.

"The rapid cooling in Cas A's neutron star, seen with Chandra, is the first direct evidence that the cores of these neutron stars are, in fact, made of superfluid and superconducting material," said Peter Shternin of the Ioffe Institute in St Petersburg, Russia, leader of a team with a paper accepted in the journal Monthly Notices of the Royal Astronomical Society.

Both teams show that this rapid cooling is explained by the formation of a neutron superfluid in the core of the neutron star within about the last 100 years as seen from Earth. The rapid cooling is expected to continue for a few decades and then it should slow down.

"It turns out that Cas A may be a gift from the Universe because we would have to catch a very young neutron star at just the right point in time," said Page's co-author Madappa Prakash, from Ohio University. "Sometimes a little good fortune can go a long way in science."

The onset of superfluidity in materials on Earth occurs at extremely low temperatures near absolute zero, but in neutron stars, it can occur at temperatures near a billion degrees Celsius. Until now there was a very large uncertainty in estimates of this critical temperature. This new research constrains the critical temperature to between one half a billion to just under a billion degrees.

Cas A will allow researchers to test models of how the strong nuclear force, which binds subatomic particles, behaves in ultradense matter. These results are also important for understanding a range of behavior in neutron stars, including "glitches," neutron star precession and pulsation, magnetar outbursts and the evolution of neutron star magnetic fields.

Small sudden changes in the spin rate of rotating neutron stars, called glitches, have previously given evidence for superfluid neutrons in the crust of a neutron star, where densities are much lower than seen in the core of the star. This latest news from Cas A unveils new information about the ultra-dense inner region of the neutron star.

"Previously we had no idea how extended superconductivity of protons was in a neutron star," said Shternin's co-author Dmitry Yakovlev, also from the Ioffe Institute.

The cooling in the Cas A neutron star was first discovered by co-author Craig Heinke, from the University of Alberta, Canada, and Wynn Ho from the University of Southampton, UK, in 2010. It was the first time that astronomers have measured the rate of cooling of a young neutron star.

Page's co-authors were Prakash, James Lattimer (State University of New York at Stony Brook), and Andrew Steiner (Michigan State University.) Shternin's co-authors were Yakovlev, Heinke, Ho, and Daniel Patnaude (Harvard-Smithsonian Center for Astrophysics.)

More information, including images and other multimedia, can be found at: http://chandra.nasa.gov

Janet Anderson, NASA Marshall Space Flight Center, Ala.
Megan Watzke, Chandra X-ray Center, Cambridge, Mass.

# Waiter, There's Metal in My Moon Water!

Bring a filter if you plan on drinking water from the moon. Water ice recently discovered in dust at the bottom of a crater near the moon's south pole is accompanied by metallic elements like mercury, magnesium, calcium, and even a bit of silver. Now you can add sodium to the mix, according to Dr. Rosemary Killen of NASA's Goddard Space Flight Center in Greenbelt, Md.

Recent discoveries of significant deposits of water on the moon were surprising because our moon has had a tough life. Intense asteroid bombardments in its youth, coupled with its weak gravity and the Sun's powerful radiation, have left the moon with almost no atmosphere. This rendered the lunar surface barren and dry, compared to Earth.

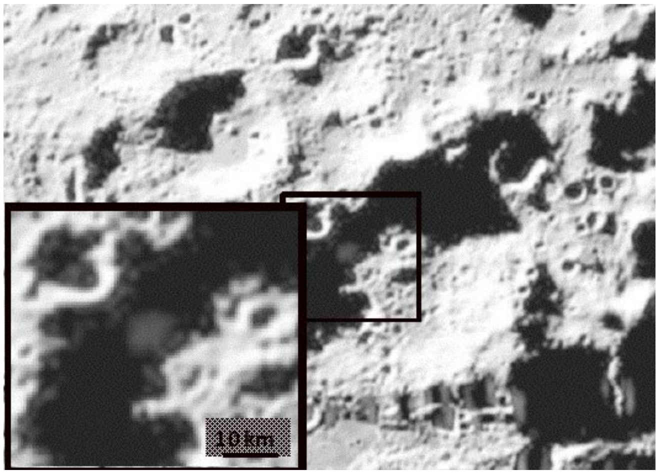
However, due to the moon's orientation to the Sun, scientists theorized that deep craters at the lunar poles would be in permanent shadow and thus extremely cold, and able to trap volatile material like water as ice if such material were somehow transported there, perhaps by comet impacts or chemical reactions with hydrogen, a major component of the solar wind.

The October 9, 2009 impact of NASA's Lunar CRater Observation and Sensing Satellite (LCROSS) spacecraft into the permanently shadowed region of the Cabeus crater confirmed that a surprisingly large amount of water ice exists in this region, along with small amounts of many other elements, including metallic ones.

LCROSS was launched June 18, 2009 as a companion mission to NASA's Lunar Reconnaissance Orbiter, or LRO, from NASA's Kennedy Space Center in Florida. After separating from LRO, the LCROSS spacecraft held onto the spent Centaur upper stage rocket of the launch vehicle, executed a lunar swingby, and entered into a series of long looping orbits around Earth.

After traveling approximately 113 days and nearly 5.6 million miles (9 million km), the Centaur and LCROSS separated on final approach to the moon. Moving faster than most rifle bullets, the Centaur impacted the lunar surface with LCROSS and LRO watching using their onboard instruments. Approximately four minutes of data were collected by LCROSS before the spacecraft itself impacted the lunar surface.

Killen and her team observed the LCROSS impacts with the National Solar Observatory's McMath-Pierce solar telescope at the Kitt Peak National Observatory, Tucson, Ariz. They were the only team able to see the results of the impacts from the ground.



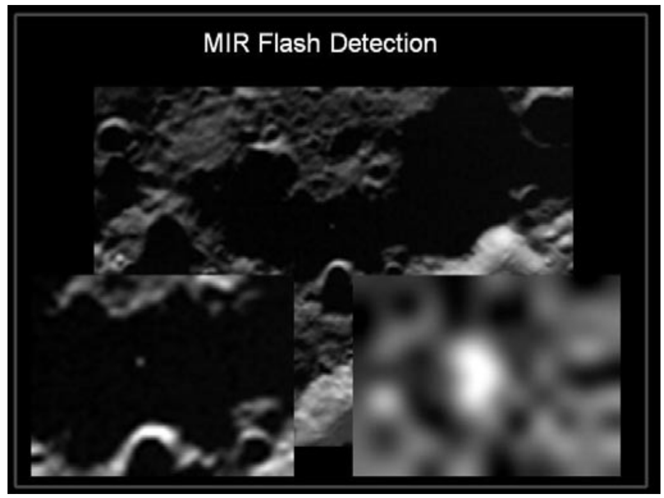

***The LCROSS visible camera image showing the ejecta plume at about 20 seconds after the Centaur impact. Credit: NASA***

The impacts vaporized volatile material from the bottom of Cabeus crater, including water and sodium. After the vapor plume rose about 800 meters (around 2,600 feet) – high enough to clear the shadow from the crater rim -- sunlight stimulated the sodium atoms, causing them to emit their signature yellow-orange glow. A high-resolution Echelle spectrometer attached to the telescope detected this unique glow. The instrument separates light into its component colors to identify materials by the characteristic colors they emit when energized by radiation or other events in space.

The spectrometer views the sky through a narrow slit to separate the colors, so the team had to make assumptions about the shape and temperature of the plume to estimate the total amount of sodium liberated by the impacts. Using a computer model of the impact and other data on the impacts from instruments on LCROSS and LRO to guide their assumptions, the team calculated that about one to two kilograms (about 2.2 to 4.4 pounds) of sodium were released. "This is one to two percent of the amount of water released by the impacts," said Killen. "Our oceans have a comparable sodium to water ratio – about one percent." (The amount of sodium derived from the observations depends on the assumed temperature of the vapor.)

This much sodium raises the question: where did it all come from? Sodium atoms from comet impacts could bounce across the lunar surface until they landed in the permanently shadowed regions, where they would get "cold trapped" -- frozen in place. The solar wind carries small amounts of sodium, which could become embedded in the lunar surface, and it might also liberate sodium from lunar rocks, which are about 0.4 percent sodium. Sodium is also liberated from lunar rocks by meteoroid impacts. (The LCROSS impacts didn't have enough energy to vaporize rock, so it's unlikely the sodium vapor plume simply came from rocks at the impact site, according to Killen.)

"Two percent sodium to water is consistent with the amount of sodium in comets, so perhaps the bulk of the sodium and water came from comet impacts," said Killen. She makes it clear that this is just speculation at this point, and that it's possible they came from a different source or even a variety of sources, including cold-trapped lunar volatiles and solar-wind-induced chemistry. Better evidence for a cometary origin would come from an analysis of the hydrogen isotopes in lunar water, according to Killen.




***A flash of infrared light from sodium vapor released at the Centaur impact site, detected with the LCROSS mid infrared camera. Credit: NASA***

Isotopes are versions of an element with different weights, or masses. For example, a deuterium atom is a heavier version of a common hydrogen atom because it has an extra particle – a neutron – in its nucleus at the center. Deuterium can be substituted for the regular form of hydrogen in a water molecule, but it is much less common than hydrogen, and its concentration varies in objects across the solar system. If the deuterium to hydrogen ratio in lunar water is similar to the ratio in comets, it would suggest the water came from comet impacts. Since comets as "dirty snowballs" carry many other materials, it would imply that much of the sodium and other volatiles came from comets as well.

The team plans to shed light on the origin of lunar water and other volatiles using data from the upcoming Lunar Atmosphere and Dust Environment Explorer (LADEE) mission, scheduled to be launched in May, 2013. The mission will orbit the moon and observe its tenuous atmosphere (technically called an exosphere, because it is so thin, atoms rarely collide with each other above the surface).

The research was funded by NASA's Dynamic Response of the Environment At the Moon (DREAM) project. "This discovery highlights a particular value of the DREAM program – we can rapidly support missions like the LCROSS impact with additional observations and analysis," said Dr. William Farrell of NASA Goddard, lead of the DREAM institute.

The McMath-Pierce telescope is operated by the National Solar Observatory, which is funded by the National Science Foundation and managed by the Association of Universities for Research in Astronomy. Killen's paper on this research was published in Geophysical Research Letters in December 2010.

Bill Steigerwald, NASA's Goddard Space Flight Center, Greenbelt, Md.

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# New View of Family Life in the North American Nebula

PASADENA, Calif. -- Stars at all stages of development, from dusty little tots to young adults, are on display in a new image from NASA's Spitzer Space Telescope.

This cosmic community is called the North American nebula. In visible light, the region resembles the North American continent, with the most striking resemblance being the Gulf of Mexico. But in Spitzer's infrared view, the continent disappears. Instead, a swirling landscape of dust and young stars comes into view.

"One of the things that makes me so excited about this image is how different it is from the visible image, and how much more we can see in the infrared than in the visible," said Luisa Rebull of NASA's Spitzer Science Center at the California Institute of Technology, Pasadena, Calif. Rebull is lead author of a paper about the observations, accepted for publication in the Astrophysical Journal Supplement Series. "The Spitzer image reveals a wealth of detail about the dust and the young stars here."

The new image is online at [http://www.nasa.gov/mission_pages/spitzer/multimedia/pia13844.html](http://www.nasa.gov/mission_pages/spitzer/multimedia/pia13844.html) .

Rebull and her team have identified more than 2,000 new, candidate young stars in the region. There were only about 200 known before. Because young stars grow up surrounded by blankets of dust, they are hidden in visible-light images. Spitzer's infrared detectors pick up the glow of the dusty, buried stars.

A star is born inside a collapsing ball of gas and dust. As the material collapses inward, it flattens out into a disk that spins around together with the forming star like a spinning top. Jets of gas shoot perpendicularly away from the disk, above and below it. As the star ages, planets are thought to form out of the disk -- material clumps together, ultimately growing into mature planets. Eventually, most of the dust dissipates, aside from a tenuous ring similar to the one in our solar system, referred to as Zodiacal dust.

The new Spitzer image reveals all the stages of a star's young life, from the early years when it is swaddled in dust to early adulthood, when it has become a young parent to a family of developing planets. Sprightly "toddler" stars with jets can also be identified in Spitzer's view.

"This is a really busy area to image, with stars everywhere, from the North American complex itself, as well as in front of and behind the region," said Rebull. "We refer to the stars that are not associated with the region as contamination. With Spitzer, we can easily sort this contamination out and clearly distinguish between the young stars in the complex and the older ones that are unrelated."

***This new view of the North American nebula combines both visible and infrared light observations, taken by the Digitized Sky Survey and NASA's Spitzer Space Telescope, respectively, into a single vivid picture. The nebula is named after its resemblance to the North American content in visible light, which in this image is represented in blue hues. Infrared light, displayed here in red and green, can penetrate deep into the dust, revealing multitudes of hidden stars and dusty clouds. Only the very densest dust clouds remain opaque, like the dark bands seen in the "Gulf of Mexico" area. Clusters of young stars (about one million years old) can be found throughout the image. Slightly older but still very young stars (about three to five million years) are also liberally scattered across the complex, with concentrations near the "head" region of the Pelican nebula, which is located to the right of the North American nebula (upper right, bluish portion of this picture). In this combined view, the visible part of the spectrum from the Digitized Sky Survey is represented in blues and blue-green hues. The Spitzer component contains data from the infrared array camera. Light with a wavelength of 3.6 microns has been color-coded green; 4.5-micron light is orange; 5.8-micron and 8.0-micron light are red. Image credit: NASA/JPL-Caltech***

The North American nebula still has a mystery surrounding it, involving its power source. Nobody has been able to identify the group of massive stars that is thought to be dominating the nebula. The Spitzer image, like images from other telescopes, hints that the missing stars are lurking behind the Gulf of Mexico portion of the nebula. This is evident from the illumination pattern of the nebula, especially when viewed with the detector on Spitzer that picks up 24-micron infrared light. That light appears to be coming from behind the Gulf of Mexico's dark tangle of clouds, in the same way that sunlight creeps out from behind a rain cloud.

The nebula's distance from Earth is also a mystery. Current estimates put it at about 1,800 light-years from Earth. Spitzer will refine this number by finding more stellar members of the North American complex.

***This image layout reveals how the appearance of the North American nebula can change dramatically using different combinations of visible and infrared observations from the Digitized Sky Survey and NASA's Spitzer Space Telescope, respectively. In this progression, the visible-light view (upper left) shows a striking similarity to the North American continent. The image highlights the eastern seaboard and Gulf of Mexico regions. The view at upper right includes both visible and infrared observations. The hot gas comprising the North American continent and the Pelican now takes on a vivid blue hue, while red colors display the infrared light. Inky black dust features start to glow in the infrared view. In the bottom two images, only infrared light from Spitzer is shown -- data from the infrared array camera is on the left, and data from both the infrared array camera and the multiband imaging photometer, which sees longer wavelengths, is on the right. In addition, Spitzer's infrared detectors pick up the glow of dusty cocoons enveloping baby stars. Color is used to display different parts of the spectrum in each of these images. In the visible-light view (upper right) from the Digitized Sky Survey, colors are shown in their natural blue and red hues. The combined visible/infrared image (upper left) shows visible light as blue, and infrared light as green and red. The infrared array camera (lower left) represents light with a wavelength of 3.6 microns as blue, 4.5 microns as green, 5.8 microns as orange, and 8.0 microns as red. In the final image, incorporating the multiband imaging photometer data, light with a wavelength of 3.6 microns has been color coded blue; 4.5-micron light is blue-green; 5.8-micron and 8.0-micron light are green; and 24-micron light is red. Image credit: NASA/JPL-Caltech***

The Spitzer observations were made before it ran out of the liquid coolant needed to chill its longer-wavelength instruments. Currently, Spitzer's two shortest-wavelength channels (3.6 and 4.5 microns) are still working. The composite image shows light from both the infrared array camera and multiband imaging processor. Infrared light with a wavelength of 3.6 microns is color-coded blue; 8.0-micron light is green; and 24-micron light is red.

***This swirling landscape of stars is known as the North American nebula. In visible light, the region resembles North America, but in this new infrared view from NASA's Spitzer Space Telescope, the continent disappears. Where did the continent go? The reason you don't see it in Spitzer's view has to do, in part, with the fact that infrared light can penetrate dust whereas visible light cannot. Dusty, dark clouds in the visible image become transparent in Spitzer's view. Clusters of young stars (about one million years old) can be found throughout the image. Slightly older but still very young stars (about three to five million years) are also liberally scattered across the complex, with concentrations near the "head" region of the Pelican nebula, which is located to the right of the North American nebula (upper right portion of this image). Some areas of this nebula are still very thick with dust and appear dark even in Spitzer's view. For example, the dark "river" in the lower left-center of the image -- in the Gulf of Mexico region -- are likely to be the youngest stars in the complex (less than a million years old). This image contains data taken by Spitzer's infrared array camera at wavelengths of 3.6 (blue), 4.5 (green), 5.8 and 8.0 (red) microns. Image credit: NASA/JPL-Caltech***

For more information about Spitzer, visit http://spitzer.caltech.edu/ and http://www.nasa.gov/spitzer.

Whitney Clavin, Jet Propulsion Laboratory, Pasadena, Calif.

# March 2011 Celestial Events

***supplied by J. Randolph Walton (Randy)***

| Day | Date | Time (EDT) | Event |
|---|---|---|---|
| Fri | 4 | 15:46 | **New Moon** |
| | | 18:03 | Moon set |
| Sat | 5 | 04:35 | Venus Rises |
| | | 06:20 | Mars Rises |
| | | 06:28 | Sunrise |
| | | 17:56 | Sunset |
| | | 18:33 | Mercury Sets |
| | | 19:01 | Moon set |
| | | 19:50 | Jupiter Sets |
| | | 20:20 | Saturn Rises |
| Sat | 12 | 04:35 | Venus Rises |
| | | 06:05 | Mars Rises |
| | | 06:17 | Sunrise |
| | | 10:20 | Moon rise |
| | | 18:03 | Sunset |
| | | 18:45 | **First Quarter Moon** |
| | | 19:10 | Mercury Sets |
| | | 19:35 | Jupiter Sets |
| | | 19:50 | Saturn Rises |
| | | 22:00 | **Lunar Straight Wall visible** |
| Sun | 13 | 02:00 | **Daylight Saving Time begins** |
| Sat | 19 | 05:35 | Venus Rises |
| | | 06:50 | Mars Rises |
| | | 07:06 | Sunrise |
| | | 14:10 | **Full Moon** |
| | | 19:11 | Sunset |
| | | 19:31 | Moon rise |
| | | 20:12 | Jupiter Sets |
| | | 20:20 | Saturn Rises |
| | | 20:40 | Mercury Sets |
| Sun | 20 | 19:21 | **Spring Equinox** |
| Mon | 21 | After 20:45 | **Zodiacal Light** visible in W after evening twilight for next two weeks |
| Sat | 26 | 05:30 | Venus Rises |
| | | 06:37 | Mars Rises |
| | | 06:54 | Sunrise |
| | | 08:07 | **Last Quarter Moon** |
| | | 11:56 | Moon set |
| | | 19:18 | Sunset |
| | | 19:45 | Saturn Rises |
| | | 19:55 | Jupiter Sets |
| | | 20:50 | Mercury Sets |

## 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 |
|---|---|---|---|---|---|
| M 81 & M 82 | Galaxies | Ursa Major | 09h55m34.1s | +69°03'59" | 7.8 |
| NGC 3511 | Galaxy | Crater | 11h03m23.7s | -23°05'11" | 11.5 |
| The Spindle | Galaxy | Sextans | 10h05m14.1s | -07°43'07" | 10.1 |
| Ghost of Jupiter/Eye | Planetary Nebula | Hydra | 10h24m46.1s | -18°38'32" | 8.6 |
| NGC 2903 | Galaxy | Leo | 09h32m09.7s | +21°30'03" | 9.6 |
| M95 | Galaxy | Leo | 10h44m00.0s | +11°41'57" | 10.5 |
| M96 | Galaxy | Leo | 10h46m48.1s | +11°48'54" | 10.1 |
| The Leo I Dwarf | Galaxy | Leo | 10h08m30.6s | +12°18'07" | 11.2 |
| Markarian 421 | Galaxy | Ursa Major | 11h04m27.4s | +38°12'34" | 14.8 |
| Arp 270 | Galaxy Pair | Leo Minor | 10h49m52.4s | +32°58'35" | 12.4 |
| NGC 2818 | Planetary Nebula in Open Cluster | Pyxis | 09h16m01.5s | -36°36'37" | 13.0 |
| The Twin Quasar | Quasar | Ursa Major | 10h01m20.8s | +55°53'54" | 17.0 |
| Hickson 44 | Galaxy Group | Leo | 10h18m00.4s | +21°48'44" | 10.0 |
| Abell 33 | Planetary Nebula | Hydra | 09h39m09.2s | -02°48'35" | 13.4 |