NGC 1068

Fleischmann Planetarium
University of Nevada - Reno

The Planetarium
College of Southern Nevada - Las Vegas
**The Cowboy Astronomer**

**Mystery of the Missing Seasons**

**Secret of the Cardboard Rocket**

**Seasonal Stargazing**
with all shows

**The Student Observatory**
Free observing sessions after 7:30 pm
planetarium shows, weather permitting.

---

**Extreme Planets in SciDome™**

**Ultimate Universe in SciDome™**

**The Living Sea in Skydome 8/70™**

**Seasonal Stargazing**
with some shows

**Telescope Viewing**
Free observing sessions on the first Friday of each month at Rancho San Rafael starting 30 minutes after sunset. Weather permitting.

---

3200 East Cheyenne Avenue
North Las Vegas, NV 89030

Show Info. 702-651-4SKY
Office 651-4505 or 651-4138
Word from the Editor

NASA Receives ‘Keys’ to ISS

(NASA) On March 5, NASA officially accepted the “keys” to the International Space Station from its prime contractor, Boeing, at the conclusion of an Acceptance Review Board (ARB) that verified the delivery, assembly, integration and activation of all hardware and software required by contract.

“The successful completion of this International Space Station contract is a testament to the hard work, dedication and perseverance of an amazing international team of government agencies and their commercial contractors,” said ISS Program Manager Michael Suffredini.

“I want to congratulate the entire Boeing team, including its many suppliers and subcontractors, for their service to NASA and the world,” Suffredini added. “As we near completion of this orbiting laboratory, we are only beginning to understand its true value as the dividends in our investment pay off with advances in medicine, technology and international relations.”

The ARB was an administrative formality that culminated in submission of government form DD 250, in which Boeing confirmed, and NASA accepted, that all major contract requirements have been met. In effect, the DD 250 transfers station ownership to NASA. The ARB examined in exhaustive detail the past and current performance since the first element was launched in 1998.

The review comes on the heels of the STS-130 mission of Endeavour, which delivered the Tranquility module and cupola, the final living areas of the U.S. On-orbit Segment (USOS). The USOS incorporates all contributions to the station by NASA, the Canadian Space Agency, the European Space Agency and the Japan Aerospace Exploration Agency, and interfaces with the Russian On-Orbit Segment, which includes the components provided by the fifth partner, the Russian Federal Space Agency.

The football field-sized outpost is now 90% complete by mass, and 98% complete by internal volume. Supporting a multicultural crew of six, the station has a mass of almost 400 tons and more than 12,000 cubic feet of living space.

Upon completion of assembly later this year, the station’s crew and its U.S., European, Japanese and Russian laboratory facilities will expand the pace of space-based research to unprecedented levels. Nearly 150 experiments are currently under way on the station, and more than 400 experiments have been conducted since research began nine years ago. These experiments already are leading to advances in the fight against food poisoning, new methods for delivering medicine to cancer cells and the development of more capable engines and materials for use on Earth and in space.

© 2010, Board of Regents, Nevada System of Higher Education. onOrbit is published monthly by the Planetariums of the Nevada System of Higher Education. It may be copied in whole or part as long as credit is given. While every effort is made to insure the accuracy of the information presented, the Planetariums are not responsible for any errors or the consequences of those errors. All the news that fits is print.

Editor: Dr. Dale Etheridge, CSN Planetarium Director • Graphic Design: Denise MacRae
Circulation Manager: Pam Maher
Winds of Change: How Black Holes May Shape Galaxies

(NASA/CXC) New observations from NASA’s Chandra X-ray Observatory provide evidence for powerful winds blowing away from the vicinity of a supermassive black hole in a nearby galaxy. This discovery indicates that "average" supermassive black holes may play an important role in the evolution of the galaxies in which they reside.

For years, astronomers have known that a supermassive black hole grows in parallel with its host galaxy. And, it has long been suspected that material blown away from a black hole, as opposed to the fraction of material that falls into it, alters the evolution of its host galaxy.

A key question is whether such "black hole blowback" typically delivers enough power to have a significant impact. Powerful relativistic jets shot away from the biggest supermassive black holes in large, central galaxies in clusters like Perseus are seen to shape their host galaxies, but these are rare. What about less powerful, less focused galaxy-scale winds that should be much more common?

"We’re more interested here in seeing what an "average"-sized supermassive black hole can do to its galaxy, not the few, really big ones in the biggest galaxies," said Dan Evans of the Massachusetts Institute of Technology who presented these results at the High Energy Astrophysics Division of the American Astronomical Society meeting in Kona, Hawaii.

Evans and his colleagues used Chandra for five days to observe NGC 1068, one of the nearest and brightest galaxies containing a rapidly growing supermassive black hole. This black hole is only about twice as massive as the one in the center of our Galaxy, which is considered to be rather ordinary size.

The X-ray images and spectra obtained using Chandra's High Energy Transmission Grating Spectrometer (HETGS) showed that a strong wind is being driven away from the center of NGC 1068 at a rate of about a million miles per hour. This wind is likely generated as surrounding gas is accelerated and heated as it swirls toward the black hole. A portion of the gas is pulled into the black hole, but some of it is blown away. High energy X-rays produced by the gas near the black hole heat the outflowing gas, causing it to glow at lower X-ray energies.

This Chandra study by Evans and his colleagues is much deeper than previous X-ray observations. It allowed them to make
a high-definition map of the cone-shaped volume lit up by the black hole and its winds. By combining measurement of the velocity of the clouds with estimates of the density of the gas, Evans and his colleagues showed that each year several times the mass of the Sun is being deposited out to large distances, about 3,000 light years from the black hole. The wind may carry enough energy to heat the surrounding gas and suppress extra star formation.

"We have shown that even these middle-of-the-road black holes can pack a punch," said Evans. "I think the upshot is that these black holes are anything but ordinary."

Further Chandra HETGS studies of other nearby galaxies will examine the impact of other AGN outflows, leading to improvements in our understanding of the evolution of both galaxies and black holes.

"In the future, our own Galaxy's black hole may undergo similar activity, helping to shut down the growth of new stars in the central region of the Milky Way," said Evans.

These new results provide a key comparison to previous work performed at Georgia State University and the Catholic University of America with the Hubble Space Telescope's STIS instrument.


Take a Field Trip to a Planetarium

Shows available for all grade levels are offered Monday thru Friday at both the Fleischmann Planetarium and the CSN Planetarium. For information, call 702-651-4505 in Las Vegas or 775-784-4812 in Reno.

NASA's newest Mars orbiter, completing its fourth year at the Red Planet in March, had passed a data-volume milestone unimaginable a generation ago and still difficult to fathom: 100 terabits.

That 100 trillion bits of information is more data than in 35 hours of uncompressed high-definition video. It's also more than three times the amount of data from all other deep-space missions combined, not just the ones to Mars, but every mission that has flown past the orbit of Earth's moon.

"What is most impressive about all these data is not the sheer quantity, but the quality of what they tell us about our neighbor planet," said Mars Reconnaissance Orbiter Project Scientist Rich Zurek, of NASA's Jet Propulsion Laboratory.

This view of an inverted crater in the Arabia Terra region of Mars is among the images taken by NASA's Mars Reconnaissance Orbiter in early 2010 as the spacecraft approached the 100-terabit milestone in total data returned. The inverted crater seen here spans about 800 feet in diameter. Sand in the dark dunes around the crater was probably derived from basalt, a black volcanic rock that is common on Mars. [NASA/JPL-Caltech/University of Arizona]
The spacecraft entered orbit around Mars on March 10, 2006, following an August 12, 2005, launch from Florida. It completed its primary science phase in 2008 and continues investigations of Mars’ surface, subsurface and atmosphere.

The orbiter sports a dish antenna 10 feet in diameter and uses it to pour data Earthward at up to 6 megabits per second. Its science instruments are three cameras, a spectrometer for identifying minerals, a ground-penetrating radar and an atmosphere sounder.

The capability to return enormous volumes of data enables these instruments to view Mars at unprecedented spatial resolutions. Half the planet has been covered at 20 feet per pixel, and nearly 1 percent of the planet has been observed at about 1 foot per pixel, sharp enough to discern objects the size of a desk. The radar, provided by Italy, has looked beneath the surface in 6,500 observing strips, sampling about half the planet.

Among the mission’s major findings is that the action of water on and near the surface of Mars occurred for hundreds of millions of years. This activity was at least regional and possibly global in extent, though possibly intermittent. The spacecraft has also observed that signatures of a variety of watery environments, some acidic, some alkaline, increase the possibility that there are places on Mars that could reveal evidence of past life, if it ever existed.

JPL, a division of the California Institute of Technology, Pasadena, manages the Mars Reconnaissance Orbiter for NASA’s Science Mission Directorate, Washington. Lockheed Martin Space Systems, Denver, is the spacecraft development and integration contractor for the project and built the spacecraft.

The Shallow Radar instrument was provided by the Italian Space Agency, and its operations are led by the InfoCom Department, University of Rome “La Sapienza.” Thales Alenia Space Italia, in Rome, is the Italian Space Agency’s prime contractor for the radar instrument. Astro Aerospace of Carpinteria, Calif., a business unit of Los Angeles-based Northrop Grumman Corp., developed the instrument’s antenna as a subcontractor to Thales Alenia Space Italia.

Radar Map of Buried Martian Ice Adds to Climate Record

(NASA/JPL) Extensive radar mapping of the middle-latitude region of northern Mars shows that thick masses of buried ice are quite common beneath protective coverings of rubble.

The ability of NASA’s Mars Reconnaissance Orbiter to continue charting the locations of these hidden glaciers and ice-filled valleys, first confirmed by radar two years ago, adds clues about how these deposits may have been left as remnants when regional ice sheets retreated.

The subsurface ice deposits extend for hundreds of kilometers, or miles, in the rugged region called Deuteronilus Mensae, about halfway from the equator to the Martian north pole. Jeffrey Plaut of NASA’s Jet Propulsion Laboratory, Pasadena, Calif., and colleagues prepared a map of the region’s confirmed ice for presentation at the 41st Lunar and Planetary Science Conference near Houston.

The Shallow Radar instrument on the orbiter has obtained more than 250 observations of the study area, which is about the size of...
"We have mapped the whole area with a high density of coverage," Plaut said "These are not isolated features. In this area, the radar is detecting thick subsurface ice in many locations." The common locations are around the bases of mesas and scarps, and confined within valleys or craters.

Plaut said, "The hypothesis is the whole area was covered with an ice sheet during a different climate period, and when the climate dried out, these deposits remained only where they had been covered by a layer of debris protecting the ice from the atmosphere."

The researchers plan to continue the mapping. These buried masses of ice are a significant fraction of the known non-polar ice on Mars. The ice could contain a record of environmental conditions at the time of its deposition and flow, making the ice masses an intriguing possible target for a future mission with digging capability.

The Shallow Radar instrument was provided by the Italian Space Agency, and its operations are led by the InfoCom Department, University of Rome "La Sapienza." Thales Alenia Space Italia, in Rome, is the Italian Space Agency's prime contractor for the radar instrument. Astro Aerospace of Carpinteria, Calif., a business unit of Los Angeles-based Northrop Grumman Corp., developed the instrument's antenna as a subcontractor to Thales Alenia Space Italia.

The Mars Reconnaissance Orbiter mission is managed by JPL for NASA’s Science Mission Directorate in Washington. Lockheed Martin Space Systems in Denver was the prime contractor for the orbiter and supports its operations. The California Institute of Technology in Pasadena manages JPL for NASA.

**Cassini Finds Plethora of Plumes, Hotspots at Enceladus**

(NASA/JPL) Newly released images from last November’s swoop over Saturn’s icy moon Enceladus by NASA’s *Cassini* spacecraft reveal a forest of new jets spraying from prominent fractures crossing the south polar region and yield the most detailed temperature map to date of one fracture.

The new images from the imaging science subsystem and the composite infrared spectrometer teams also include the best 3-D image ever obtained of a “tiger stripe,” a fissure that sprays icy particles, water vapor and organic compounds. There are also views of regions not well-mapped previously on Enceladus, including a southern area with crudely circular tectonic patterns.

“Enceladus continues to astound,” said Bob Dramatic plumes, both large and small, spray water ice out from many locations along the famed "tiger stripes" near the south pole of Saturn's moon Enceladus. The tiger stripes are fissures that spray icy particles, water vapor and organic compounds.
Pappalardo, Cassini project scientist at NASA’s Jet Propulsion Laboratory in Pasadena, Calif. “With each Cassini flyby, we learn more about its extreme activity and what makes this strange moon tick.”

For Cassini's visible-light cameras, the November 21, 2009 flyby provided the last look at Enceladus’ south polar surface before that region of the moon goes into 15 years of darkness, and includes the most detailed look yet at the jets.

Scientists planned to use this flyby to look for new or smaller jets not visible in previous images. In one mosaic, scientists count more than 30 individual geysers, including more than 20 that had not been seen before. At least one jet spouting prominently in previous images now appears less powerful.

“This last flyby confirms what we suspected,” said Carolyn Porco, imaging team lead based at the Space Science Institute in Boulder, Colo. “The vigor of individual jets can vary with time, and many jets, large and small, erupt all along the tiger stripes.”

A new map that combines heat data with visible-light images shows a 25-mile segment of the longest tiger stripe, known as Baghdad Sulcus. The map illustrates the correlation, at the highest resolution yet seen, between the geologically youthful surface fractures and the anomalously warm temperatures that have been recorded in the south polar region. The broad swaths of heat previously detected by the infrared spectrometer appear to be confined to a narrow, intense region no more than half a mile wide along the fracture.

In these measurements, peak temperatures along Baghdad Sulcus exceed -135°F, and may be higher than -100°F. These warm temperatures probably result from heating of the fracture flanks by the warm, upwelling water vapor that propels the ice-particle jets seen by Cassini’s cameras. Cassini scientists will be testing this idea by investigating how well the hot spots correspond with the jet sources.

“The fractures are chilly by Earth standards, but they’re a cozy oasis compared to the numbing -370°F of their surroundings,” said John Spencer, a composite infrared spectrometer team member based at Southwest Research Institute in Boulder, Colo. “The huge amount of heat pouring out of the tiger stripe fractures may be enough to melt the ice underground. Results like this make Enceladus one of the most exciting places we’ve found in the solar system.”

Some of Cassini’s scientists infer that the warmer the temperatures are at the surface,
The greater the likelihood that jets erupt from liquid. “And if true, this makes Enceladus’ organic-rich, liquid sub-surface environment the most accessible extraterrestrial watery zone known in the solar system,” Porco said.

The November 21 flyby was the eighth targeted encounter with Enceladus. It took the spacecraft to within about 1,000 miles of the moon’s surface, at around 82° south latitude.

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, 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 operations center 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.

Spitzer Detects the 'Heartbeat' of Star Formation in the Milky Way Galaxy

by Adam Hadhazy

(NASA/SSC) Astronomers have used NASA’s Spitzer Space Telescope rather like a doctor’s stethoscope to listen in on the "heartbeat" of star formation in our galaxy, a finding that will help trace the "life" of the Milky Way and other galaxies.

A key vital sign in people is our heart rate, or the number of beats the heart muscle makes in a given time. Galaxies, too, have a sort of heartbeat, which is their pace of forming new stars. This rate indicates a galaxy’s activity level and gives clues about its "lifetime," or how long the celestial body might keep making new stars and planets before growing old and quiet.

Now astronomers have felt the pulse of star formation in the Milky Way more directly than ever before by using observations from Spitzer to count up baby stars in our galaxy. This information was then plugged into a computer simulation of galactic star formation, a novel technique which revealed that our home galaxy beats to a rhythm of creating about one star like our sun every year.

"Measuring the rate of star formation inside the Milky Way with this method is important not just for understanding our galaxy, but also has implications for measuring star formation rates for all galaxies," says Thomas Robitaille of the Harvard-Smithsonian Center for Astrophysics and lead author of a new study describing the results.

Previous measurements have suggested a slightly faster Milky Way star formation rate, as high as five times the mass of the Sun annually, but have relied on indirect methods. One technique required measuring the radio
waves emanating from hydrogen gas clouds energized by the biggest, brightest and hottest stars. Scientists have made estimates of how many smaller, more common stars like our sun form per every one of these rare, yet easily detected behemoths. Such an extrapolation, however, is somewhat imprecise.

Because we cannot see individual stars and young stellar objects (YSOs) in distant galaxies, and therefore have to indirectly take their pulse, it's important to gauge these other methods' accuracy. Accordingly, the new YSO-counting technique, which will only get sharper in the future, will help calibrate ways of measuring star formation rates in other galaxies.

Stars form from the gravitational collapse of gas that is scattered throughout space. As budding stars rotate and their cores heat up, leftover material gets spun into a surrounding dusty disk that can clump together in places to make planets. These YSOs, though extremely faint in the visible light we see, shine brightly in the infrared light that Spitzer sees.

To take the Milky Way’s star formation vital sign, Robitaille first counted up thousands of these YSOs spotted by Spitzer’s Infrared Array Camera for a survey called the Galactic Legacy Infrared Mid-Plane Survey Extraordinaire (GLIMPSE). This survey looked at a slice of sky about two degrees high by 130 degrees long, large enough to fit over 330 times the full moon. Other infrared surveys had previously captured fuzzy light from tens of thousands of stars, but GLIMPSE saw 100 million stars clearly and as many as 20,000 YSOs.

"We are seeing forming stars all the way through the galaxy for the first time," says paper co-author Barbara Whitney, a Senior Research Scientist at the Space Science Institute in Boulder, Colorado.

Whitney and Robitaille designed a realistic computer model of overall galactic star birth. By tweaking the model’s star formation rate to correspond with the number of YSOs that Spitzer saw, the research duo came up with a directly measured, annual star formation rate of two-thirds to one and a half times the mass of the Sun.

This current star formation rate may seem low when considering that the galaxy contains 100 billion stars. To make all the stars we see now, the rate must have been far greater in the past, the researchers agree, and that the present figure is indeed reasonable for a mature galaxy like the Milky Way. As our galaxy has calmed since a wild youth over its 11 billion year history, the Milky Way’s star formation rate has slowed to a more sedate, middle-aged pace.

The galaxy has settled into near equilibrum
Friends of The CSN Planetarium
Be a Star in Our Sky

onOrbit is made possible, in part, by donations from the Friends of The Planetarium. Anyone can become a Friend by sending an annual donation of $25.00 or more (checks made payable to: CSN Foundation, Inc.) to:

The Planetarium - S1A
College of Southern Nevada
3200 E. Cheyenne Avenue
North Las Vegas, NV  89030

Benefits:
•Receive onOrbit each month.
•Discount admission to all shows.
•10% discount in the Astronomy Store.
•Screen credit in prologue presentations prior to each public performance:
  Star ($25) - three months credit.
  Nova ($50) - six months credit, discount admission for Friend & family.
  Supernova ($100) - year credit, free admission for Friend & discount admission for family.
  Star Cluster ($200) - year large credit, free admission for Friend & family.
  Galaxy ($500) - year large credit, free admission for Friend & all guests.

Merging Galaxies Create a Binary Quasar

(NASA/CXC) Astronomers have found the first clear evidence of a binary quasar within a pair of actively merging galaxies. Quasars are the extremely bright centers of galaxies surrounding super-massive black holes, and binary quasars are pairs of quasars bound together by gravity. Binary quasars, like other quasars, are thought to be the product of galaxy mergers. Until now, however, binary quasars have not been seen in galaxies that are unambiguously in the act of merging. But images of a new binary quasar from the Carnegie Institution’s Magellan telescope in Chile show two distinct galaxies with "tails" produced by tidal forces from their mutual gravitational attraction.

"This is really the first case in which you see two separate galaxies, both with quasars, that are clearly interacting," says Carnegie astronomer John Mulchaey who made observations crucial to understanding the galaxy merger.

Most, if not all, large galaxies, such as our in generating stars from some of the gas that older stars expel back into the cosmic environment. In this cyclical way, Whitney says that star formation rates are like "the heartbeat of a galaxy": if a galaxy is making stars very quickly, it may deplete the amount of gas available, stalling the genesis of new stars, not unlike someone having to take a rest after exercising and getting their heart rate up. Similarly, galaxies with low star formation rates may be winding down their youthful eons of star-producing activity.

The new Spitzer results were published in the February 10, 2010 issue of The Astrophysical Journal Letters. The observations as part of GLIMPSE were made before Spitzer began its "warm" mission in May 2009 upon exhausting its liquid coolant.
galaxy the Milky Way, host super-massive black holes at their centers. Because galaxies regularly interact and merge, astronomers have assumed that binary super-massive black holes have been common in the Universe, especially during its early history. Black holes can only be detected as quasars when they are actively accreting matter, a process that releases vast amounts of energy. A leading theory is that galaxy mergers trigger accretion, creating quasars in both galaxies. Because most such mergers would have happened in the distant past, binary quasars and their associated galaxies are very far away and therefore difficult for most telescopes to resolve.

The binary quasar, labeled SDSS J1254+0846, was initially detected by the Sloan Digital Sky Survey, a large scale astronomical survey of galaxies and over 120,000 quasars. Further observations by Paul Green of the Harvard-Smithsonian Center for Astrophysics and colleagues* using NASA's Chandra's X-ray Observatory and telescopes at Kitt Peak National Observatory in Arizona and Palomar Observatory in California indicated that the object was likely a binary quasar in the midst of a galaxy merger. Carnegie's Mulchaey then used the 6.5 meter Baade-Magellan telescope at the Las Campanas observatory in Chile to obtain deeper images and more detailed spectroscopy of the merging galaxies.

"Just because you see two galaxies that are close to each other in the sky doesn't mean they are merging," says Mulchaey. "But from the Magellan images we can actually see tidal tails, one from each galaxy, which suggests that the galaxies are in fact interacting and are in the process of merging."

Thomas Cox, now a fellow at the Carnegie Observatories, corroborated this conclusion using computer simulations of the merging galaxies. When Cox's model galaxies merged, they showed features remarkably similar to what Mulchaey observed in the Magellan images. "The model verifies the merger origin for this binary quasar system," he says. "It also hints that this kind of galaxy interaction is a key component of the growth of black holes and production of quasars throughout our universe."

* The authors of the paper published in the Astrophysical Journal are Paul J. Green of the Harvard-Smithsonian Center for Astrophysics, Adam D. Myers of the University of Illinois at Urbana-Champaign, Wayne A. Barkhouse of the University of North Dakota, John S. Mulchaey of the Observatories of the Carnegie Institution for Science, Vardha N. Bennert of the Department of Physics, University of California, Santa Barbara, Thomas J. Cox of the Observatories of the Carnegie Institution for Science, Thomas L. Aldcroft of the Harvard-Smithsonian Center for Astrophysics, and Joan M. Wrobel of National Radio Astronomy Observatory, Socorro, NM.
Give a Star

A popular service of The CSN Planetarium lets you dedicate a star to a loved one. For a donation of $35, we will provide an attractive certificate that proclaims your dedication of the star of your choice to any other person. The certificate will have a chart of the constellation containing the star and complete information about the star. A donation of $100 will give you an exclusive dedication. Call 651-4138 or 651-4505 for further information.
Sky Calendar

All times are Pacific Daylight Time. Rise and set times are for the astronomical horizon at Las Vegas or Reno as noted.

The Planets

Mercury. Mercury is low in the east shortly before sunrise for the last half of the month. Greatest western elongation (25°) occurs on May 25.

Venus. Venus is appears low in the western sky after sunset. It is setting about an two hours after the sun. Look for the waxing crescent moon above Venus on the evening of May 16.

Mars. Mars, moving from Cancer into Leo, is high in the southeast at sunset. Look for the nearly first quarter moon below Mars on the evening of May 19.

Jupiter. Jupiter, from Aquarius into Pisces, is rising in the east about four hours before the sun. The waning crescent moon is above Jupiter and Uranus on the morning of May 9.

Saturn. Saturn, in Virgo, is high in the south in the early evening. The waxing gibbous moon will be below Saturn on the evening of May 22.

Uranus. Uranus, in Pisces, is low in the eastern sky just before sunrise. It is rising just after Jupiter.

Neptune. Neptune, near the Capricornus-Aquarius border is rising in the east in the early morning about four hours before Sun. The waning crescent moon will rise shortly before Neptune on the morning of May 7.

Dwarf Planets. (At mid-month - 15th)

<table>
<thead>
<tr>
<th>Planet</th>
<th>Constellation</th>
<th>Transit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pluto</td>
<td>Sagittarius</td>
<td>3:30 am (36°)</td>
</tr>
<tr>
<td>Ceres</td>
<td>Sagittarius</td>
<td>3:25 am (30°)</td>
</tr>
<tr>
<td>Eris</td>
<td>Cetus</td>
<td>10:48 pm (50°)</td>
</tr>
<tr>
<td>MakeMake</td>
<td>Coma Berenices</td>
<td>9:37 pm (82°)</td>
</tr>
<tr>
<td>Haumea</td>
<td>Boötes</td>
<td>10:47 am (73°)</td>
</tr>
</tbody>
</table>

All Dwarf Planets require a telescope. Ceres is visible through most amateur telescopes. Pluto usually requires a telescope of at least 12" diameter. Dwarf planets beyond the orbit of Neptune can also be referred to as Plutoids. Eris ("EE-ris"), MakeMake (mah-keh-mah-keh) and Haumea, like most Plutoids, require a professional sized telescope. Transit times and altitudes (from Las Vegas) are when the object is at its highest in the southern sky. Each will appear slightly lower in the sky from Reno.  

The Moon

Each day the moon rises about one hour later than the day before. The New Moon (not visible) is in the direction of the sun and rises and sets with the sun. The first quarter moon rises at about noon and sets near midnight. The full moon is opposite the sun in the sky and rises at sunset and sets at sunrise. The last quarter moon rises near midnight and sets near noon. Perigee is when the moon is closest to the earth and apogee is when it is farthest. The distance varies by ±6% from the average.

<p>| | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Full Moon</td>
<td>Apr. 28</td>
<td>5:18 am pdt</td>
</tr>
<tr>
<td>Last quarter</td>
<td>May 5</td>
<td>9:15 pm</td>
</tr>
<tr>
<td>New Moon</td>
<td>May 13</td>
<td>6:04 pm</td>
</tr>
<tr>
<td>First quarter</td>
<td>May 20</td>
<td>4:43 pm</td>
</tr>
<tr>
<td>Full Moon</td>
<td>May 27</td>
<td>4:07 pm</td>
</tr>
<tr>
<td>Perigee</td>
<td>Apr. 24</td>
<td>2:00 pm pdt</td>
</tr>
<tr>
<td>Apogee</td>
<td>May 6</td>
<td>2:54 pm</td>
</tr>
<tr>
<td>Perigee</td>
<td>May 20</td>
<td>1:40 am</td>
</tr>
</tbody>
</table>
The Sun
Las Vegas

<table>
<thead>
<tr>
<th>Date</th>
<th>Sunrise</th>
<th>Sunset</th>
<th>Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>May 1</td>
<td>5:48 am pdt</td>
<td>7:28 pm pdt</td>
<td>Sat.</td>
</tr>
<tr>
<td>May 4</td>
<td>5:45</td>
<td>7:31</td>
<td>Tue.</td>
</tr>
<tr>
<td>May 7</td>
<td>5:42</td>
<td>7:33</td>
<td>Fri.</td>
</tr>
<tr>
<td>May 10</td>
<td>5:39</td>
<td>7:36</td>
<td>Mon.</td>
</tr>
<tr>
<td>May 13</td>
<td>5:36</td>
<td>7:38</td>
<td>Thu.</td>
</tr>
<tr>
<td>May 16</td>
<td>5:34</td>
<td>7:41</td>
<td>Sun.</td>
</tr>
<tr>
<td>May 19</td>
<td>5:31</td>
<td>7:43</td>
<td>Wed.</td>
</tr>
<tr>
<td>May 22</td>
<td>5:30</td>
<td>7:46</td>
<td>Sat.</td>
</tr>
<tr>
<td>May 25</td>
<td>5:28</td>
<td>7:48</td>
<td>Tue.</td>
</tr>
<tr>
<td>May 28</td>
<td>5:26</td>
<td>7:50</td>
<td>Fri.</td>
</tr>
<tr>
<td>May 31</td>
<td>5:25</td>
<td>7:52</td>
<td>Mon.</td>
</tr>
</tbody>
</table>

The Sun
Reno

<table>
<thead>
<tr>
<th>Date</th>
<th>Sunrise</th>
<th>Sunset</th>
<th>Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>May 1</td>
<td>6:00 am pdt</td>
<td>7:53 pm pdt</td>
<td>Sat.</td>
</tr>
<tr>
<td>May 4</td>
<td>5:57</td>
<td>7:56</td>
<td>Tue.</td>
</tr>
<tr>
<td>May 7</td>
<td>5:53</td>
<td>7:59</td>
<td>Fri.</td>
</tr>
<tr>
<td>May 10</td>
<td>5:50</td>
<td>8:02</td>
<td>Mon.</td>
</tr>
<tr>
<td>May 13</td>
<td>5:47</td>
<td>8:05</td>
<td>Thu.</td>
</tr>
<tr>
<td>May 16</td>
<td>5:44</td>
<td>8:07</td>
<td>Sun.</td>
</tr>
<tr>
<td>May 19</td>
<td>5:42</td>
<td>8:10</td>
<td>Wed.</td>
</tr>
<tr>
<td>May 22</td>
<td>5:39</td>
<td>8:13</td>
<td>Sat.</td>
</tr>
<tr>
<td>May 25</td>
<td>5:37</td>
<td>8:15</td>
<td>Tue.</td>
</tr>
<tr>
<td>May 28</td>
<td>5:36</td>
<td>8:18</td>
<td>Fri.</td>
</tr>
<tr>
<td>May 31</td>
<td>5:34</td>
<td>8:20</td>
<td>Mon.</td>
</tr>
</tbody>
</table>

Meteor Shower

On the night of May 4/5, the Eta Aquarid meteor shower will reach its peak. At its peak, this shower typically produces about 10-15 meteors per hour. This is not a particularly rich shower. The last quarter moon will interfere with observing this shower as it rises around midnight. Adding sporadic meteors that are not part of the shower, the typical observer can expect over 20 meteors per hour during this shower.

Shower meteors are caused by particle entering the earth's atmosphere on paths parallel to each other. While these meteors can be seen anywhere in the sky, there paths trace back to a common direction making them appear to radiate outward from this "vanishing point."

Sporadic meteors are the random meteors that occur all of the time. They can be seen anywhere in the sky traveling any direction. On the average, about 10 sporadic meteors can be seen each hour on any night of the year.

The particles from this shower are associated with Comet Halley. They follow the same path as the comet and are thought to be material ejected from the comet. As seen in the sky, the meteors seem to radiate outward from a point near the star Eta Aquarii, giving the name to the shower.

In the Fall, the Orionid shower is caused by the same stream as the earth crosses it again in five months.

The best conditions for observing meteors are found by traveling away from the city where the sky is dark. More meteors are seen after midnight when you are on the leading side of the earth as it travels around the sun.

When possible, observe meteors at times when the moon is below the horizon. The moon provides additional light in the sky that can impede meteor viewing.

This year, the best viewing period will be shortly after midnight while the moon is still low until the beginning of astronomical twilight a little after 4 am.

Astronomical twilight is when the sun is 18° below the horizon. There is no significant dawn visible. Nautical twilight is when the sun is 12° below the horizon and dawn is visible in the east, but the brighter stars are still easily seen. In early May, this occurs a little before 5 am. Civil twilight occurs when the sun is 6° below the horizon (about 5:15 am) and no stars are easily visible. Civil twilight is bright enough to preclude artificial lighting.

While meteors can be seen anywhere in the sky during the shower, the meteors are more easily viewed near the overhead point. With this shower, the greatest numbers are likely to be viewed in the early morning hours before dawn when the radiant point for the shower is high in the sky.
### Now Playing

<table>
<thead>
<tr>
<th>In Las Vegas</th>
<th>In Reno</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>The Cowboy Astronomer</strong></td>
<td><strong>Extreme Planets</strong></td>
</tr>
<tr>
<td><strong>Mystery of the Missing Seasons</strong></td>
<td><strong>Ultimate Universe</strong></td>
</tr>
<tr>
<td><strong>Secret of the Cardboard Rocket</strong></td>
<td><strong>The Living Sea</strong></td>
</tr>
<tr>
<td><strong>Seasonal Stargazing</strong></td>
<td><strong>Seasonal Stargazing</strong></td>
</tr>
</tbody>
</table>

*The CSN Planetarium and The Fleischmann Planetarium* are units of the Nevada System of Higher Education.  
**CSN President:** Dr. Michael Richards  
**UNR President:** Dr. Milton Glick  
**NSHE Chancellor:** Daniel Klaich  
**NSHE Board of Regents:** James Dean Levitt - Chair, Dr. Jason Geddes - Vice Chair, Mark Alden, Dr. Andrea Anderson, Robert Blakely, William Cobb, Cedric Crear, Dorothy Gallagher, Ronald Knecht, Kevin Page, Dr. Ray Rawson, Dr. Jack Lund Schofield, Michael Wixom.

---

**Contact us at:**

- **The Planetarium** - S1A  
  College of Southern Nevada  
  3200 E. Cheyenne Avenue  
  North Las Vegas, NV 89030-4228  
  [http://www.csn.edu/planetarium/](http://www.csn.edu/planetarium/)

- **Fleischmann Planetarium**  
  University of Nevada  
  1664 N. Virginia Street  
  Reno, NV 89557-0010  
  [http://planetarium.unr.edu/](http://planetarium.unr.edu/)