Abell 1689

Fleischmann Planetarium
University of Nevada - Reno

The Planetarium
College of Southern Nevada - Las Vegas
Now Playing

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

Stars of the Pharaohs
Ice Worlds
Zula Patrol: Under the Weather

Show Times:
Pharaohs: 7:30 pm Friday & Saturday
Ice Worlds: 6:00 pm Friday & Saturday
Zula Patrol: 3:30 pm Saturday
General admission price: $6.00
Students, children & seniors: $4.00
Gift Shop: Fri.: 5 - 9 pm, Sat.: 3 - 9 pm

Seasonal Stargazing with all shows

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

Wild Ocean in Skydome 8/70™
Saturn: Jewel of the Heavens in SciDome™

Show Times:
Hourly from opening. Call for times and titles for additional programs.
General Admission: $6.00
Children and Seniors: $4.00
Open Mon., Tue. Noon - 5 pm, Fri.: Noon - 9 pm
Sat.: 10 am - 9 pm, Sun.: 10 am - 5 pm
Closed Wednesday & Thursday
775-784-4811 Show Info.

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.
775-784-4812 Office
Characterizing Super-Earth Atmosphere

(NASA/JPL) A team of astronomers, including two NASA Sagan Fellows, has made the first characterizations of a super-Earth's atmosphere, by using a ground-based telescope. A super-Earth is a planet up to three times the size of Earth and weighing up to 10 times as much. The findings, reported in the Dec. 2 issue of the journal *Nature*, are a significant milestone toward eventually being able to probe the atmospheres of Earth-like planets for signs of life.

The team determined the planet, GJ 1214b, is either blanketed with a thin layer of water steam or surrounded by a thick layer of high clouds. If the former, the planet itself would have an icy composition. If the latter, the planet would be rocky or similar to the composition of Neptune, though much smaller.

"This is the first super-Earth known to have an atmosphere," said Jacob Bean, a NASA Sagan Fellow and astronomer at the Harvard-Smithsonian Center for Astrophysics in Cambridge, Mass. "But even with these new measurements, we can’t say yet what that atmosphere is made of. This world is being very shy and veiling its true nature from us."

GJ 1214b, first discovered in December 2009, is 2.7 times the size of Earth and 6.5 times as massive. Previous observations of the planet's size and mass demonstrated it has a low density for its size, leading astronomers to conclude the planet is some kind of solid body with an atmosphere.

The planet orbits close to its dim star, at a distance of 0.014 astronomical units. An astronomical unit is the distance between Earth and the sun, approximately 93 million miles. GJ 1214b circles too close to its star to be habitable by any life forms.

Bean and his team observed infrared light as the planet crossed in front of its star. During such transits, the star's light filters through the atmosphere. Gases absorb the starlight at particular wavelengths, leaving behind chemical fingerprints detectable from Earth. This same type of technique has been used to study the atmospheres of distant "hot Jupiters," or Jupiter-like planets orbiting close to their stars, and found gases like hydrogen, methane and sodium vapor.

In the case of the super-Earth, no chemical fingerprints were detected; however, this doesn’t mean there are no chemicals present. Instead, this information ruled out some possibilities for GJ 1214b’s atmosphere, and narrowed the scope to either an atmosphere of water steam or high clouds. Astronomers believe it's more likely the atmosphere is too thin around the planet to let enough light filter through and reveal chemical fingerprints.

"A steamy atmosphere would have to be very dense, about one-fifth water vapor by volume, compared to our Earth, with an atmosphere that’s four-fifths nitrogen and one-fifth oxygen with only a touch of water vapor," Bean said. "During the next year, we should have some solid answers about what this planet is truly like."
Detailed Dark Matter Map Yields Clues to Galaxy Cluster Growth

(Available via NASA/STScI) Astronomers using NASA’s Hubble Space Telescope took advantage of a giant cosmic magnifying glass to create one of the sharpest and most detailed maps of dark matter in the universe. Dark matter is an invisible and unknown substance that makes up the bulk of the universe’s mass.

The new dark matter observations may yield new insights into the role of dark energy in the universe’s early formative years. The result suggests that galaxy clusters may have formed earlier than expected, before the push of dark energy inhibited their growth. A mysterious property of space, dark energy fights against the gravitational pull of dark matter. Dark energy pushes galaxies apart from one another by stretching the space between them, thereby suppressing the formation of giant structures called galaxy clusters. One way astronomers can probe this primeval tug-of-war is through mapping the distribution of dark matter in clusters.

A team led by Dan Coe at NASA’s Jet Propulsion Laboratory in Pasadena, Calif., used Hubble’s Advanced Camera for Surveys to chart the invisible matter in the massive galaxy cluster Abell 1689, located 2.2 billion light-years away. The cluster’s gravity, the majority of which comes from dark matter, acts like a cosmic magnifying glass, bending and amplifying the light from distant galaxies behind it. This effect, called gravitational lensing, produces multiple, warped, and greatly magnified images of those galaxies, like the view in a funhouse mirror.

By studying the distorted images, astronomers estimated the amount of dark matter within the cluster. If the cluster’s gravity only came from the visible galaxies, the lensing distortions would be much weaker. Based on their higher-resolution mass map, Coe and his collaborators confirm previous results showing that the core of Abell 1689 is much denser in dark matter than expected for a cluster of its size, based on computer simulations of structure growth. Abell 1689 joins a handful of other well-studied clusters found to have similarly dense cores. The finding is surprising, because the push of dark energy early in the universe’s history would have stunted the growth of all galaxy clusters.
"Galaxy clusters, therefore, would have had to have started forming billions of years earlier in order to build up to the numbers we see today," Coe explains. "At earlier times, the universe was smaller and more densely packed with dark matter. Abell 1689 appears to have been well fed at birth by the dense matter surrounding it in the early universe. The cluster has carried this bulk with it through its adult life to appear as we observe it today."

Abell 1689 is among the most powerful gravitational lensing clusters ever observed. Coe's observations, combined with previous studies, yielded 135 multiple images of 42 background galaxies.

"The lensed images are like a big puzzle," Coe says. "Here we have figured out, for the first time, a way to arrange the mass of Abell 1689 such that it lenses all of these background galaxies to their observed positions." Coe used this information to produce a higher-resolution map of the cluster's dark matter distribution than was possible before.

Coe teamed with mathematician Edward Fuselier, who, at the time, was at the United States Military Academy at West Point, to devise a new technique to calculate the new map. "Thanks, in large part, to Eddie's contributions, we have finally `cracked the code' of gravitational lensing. Other methods are based on making a series of guesses as to what the mass map is, and then astronomers find the one that best fits the data. Using our method, we can obtain, directly from the data, a mass map that gives a perfect fit."

Coe explained that astronomers are planning to study more clusters to confirm the possible influence of dark energy. A major Hubble program that will analyze dark matter in gigantic galaxy clusters is the Cluster Lensing and Supernova survey with Hubble (CLASH). In this survey, the telescope will study 25 clusters for a total of one month over the next three years. The CLASH clusters were selected because of their strong X-ray emission, indicating they contain large quantities of hot gas. This abundance means the clusters are extremely massive. By observing these clusters, astronomers will map the dark matter distributions and look for more conclusive evidence of early cluster formation, and possibly early dark energy.

**Hubble Captures New Life in an Ancient Galaxy**

(NASA/STScI) Elliptical galaxies were once thought to be aging star cities whose star-making heyday was billions of years ago. But new observations with NASA's Hubble Space Telescope are helping to show that elliptical galaxies still have some youthful vigor left, thanks to encounters with smaller galaxies.

Images of the core of NGC 4150, taken in near-ultraviolet light with the sharp-eyed Wide Field Camera 3 (WFC3), reveal streamers of
dust and gas and clumps of young, blue stars that are significantly less than a billion years old. Evidence shows that the star birth was sparked by a merger with a dwarf galaxy.

The new study helps bolster the emerging view that most elliptical galaxies have young stars, bringing new life to old galaxies. "Elliptical galaxies were thought to have made all of their stars billions of years ago," says astronomer Mark Crockett of the University of Oxford, leader of the Hubble observations. "They had consumed all their gas to make new stars. Now we are finding evidence of star birth in many elliptical galaxies, fueled mostly by cannibalizing smaller galaxies.

"These observations support the theory that galaxies built themselves up over billions of years by collisions with dwarf galaxies," Crockett continues. "NGC 4150 is a dramatic example in our galactic backyard of a common occurrence in the early universe."

The Hubble images reveal turbulent activity deep inside the galaxy's core. Clusters of young, blue stars trace a ring around the center that is rotating with the galaxy. The stellar breeding ground is about 1,300 light-years across. Long strands of dust are silhouetted against the yellowish core, which is composed of populations of older stars.

From a Hubble analysis of the stars' colors, Crockett and his team calculated that the star-formation boom started about a billion years ago, a comparatively recent event in cosmological history. The galaxy's star-making factory has slowed down since then.

"We are seeing this galaxy after the major starburst has occurred," explains team member Joseph Silk of the University of Oxford. "The most massive stars are already gone. The youngest stars are between 50 million and 300 to 400 million years old. By comparison, most of the stars in the galaxy are around 10 billion years old."

The encounter that triggered the star birth would have been similar to our Milky Way swallowing the nearby Large Magellanic Cloud.

"We believe that a merger with a small, gas-rich galaxy around one billion years ago supplied NGC 4150 with the fuel necessary to form new stars," says team member Sugata Kaviraj of the Imperial College London and the University of Oxford. "The abundance of 'metals,' elements heavier than hydrogen and helium, in the young stars is very low, suggesting the galaxy that merged with NGC 4150 was also metal-poor. This points towards a small, dwarf galaxy, around one-twentieth the mass of NGC 4150."

Minor mergers such as this one are more ubiquitous than interactions between hefty galaxies, the astronomers say. For every major encounter, there are probably up to 10 times more frequent clashes between a large and a small galaxy. Major collisions are easier to see because they create incredible fireworks: distorted galaxies, long streamers of gas, and dozens of young star clusters. Smaller interactions are harder to detect because they leave relatively little trace.
Over the past five years, however, ground- and space-based telescopes have offered hints of fresh star formation in elliptical galaxies. Ground-based observatories captured the blue glow of stars in elliptical galaxies, and satellites such as the Galaxy Evolution Explorer (GALEX), which looks in far- and near-ultraviolet light, confirmed that the blue glow came from fledgling stars much less than a billion years old. Ultraviolet light traces the glow of hot, young stars.

Crockett and his team selected NGC 4150 for their Hubble study because a ground-based spectroscopic analysis gave tantalizing hints that the galaxy's core was not a quiet place. The ground-based survey, called the Spectrographic Areal Unit for Research on Optical Nebulae (SAURON), revealed the presence of young stars and dynamic activity that was out of sync with the galaxy.

"In visible light, elliptical galaxies such as NGC 4150 look like normal elliptical galaxies," Silk says. "But the picture changes when we look in ultraviolet light. At least a third of all elliptical galaxies glow with the blue light of young stars."

Adds Crockett: "Ellipticals are the perfect laboratory for studying minor mergers in ultraviolet light because they are dominated by old red stars, allowing astronomers to see the faint blue glow of young stars."

The astronomers hope to study other elliptical galaxies in the SAURON survey to look for the signposts of new star birth. The team's results have been accepted for publication in The Astrophysical Journal.

Astronomers Probe 'Sandbar' Between Islands of Galaxies

(NASA/SSC) Astronomers have caught sight of an unusual galaxy that has illuminated new details about a celestial "sandbar" connecting two massive islands of galaxies. The research was conducted in part with NASA’s Spitzer Space Telescope.

These "sandbars," or filaments, are known to span vast distances between galaxy clusters and form a lattice-like structure known as the cosmic web. Though immense, these filaments are difficult to see and study in detail. Two years ago, Spitzer’s infrared eyes revealed that one such intergalactic filament containing star-forming galaxies ran between the galaxy clusters called Abell 1763 and Abell 1770.

Now these observations have been bolstered by the discovery, inside this same filament, of a galaxy that has a rare boomerang shape and unusual light emissions. Hot gas is sweeping the wandering galaxy into this shape as it passes through the filament, presenting a new way to gauge the filament’s particle density. Researchers hope that other such galaxies with oddly curved profiles could serve as signposts for the faint threads, which in turn signify regions ripe for forming stars.

"These filaments are integral to the evolution of galaxy clusters, among the biggest gravitationally bound objects in the universe, as well as the creation of new generations of stars," said Louise Edwards, a postdoctoral researcher at the California Institute of Technology in Pasadena, and lead author of a study detailing the findings in the December 1 issue of the Astrophysical Journal Letters. Her collaborators are Dario Fadda, also at Caltech, and Dave Frayer from the National Science Foundation’s National Radio Astronomy Observatory, based in Charlottesville, Virginia.

Astronomers spotted the bent galaxy about 11 million light-years away from the center of
the galaxy cluster Abell 1763 during follow-up observations with the WIYN Observatory near Tucson, Ariz., and radio-wave observations by the Very Large Array near Socorro, N.M. The WIYN Observatory is named after the consortium that owns and operates it, which includes the University of Wisconsin, Indiana University, Yale University, and the National Optical Astronomy Observatories.

The galaxy has an unusual ratio of radio to infrared light, as measured by the Very Large Array and Spitzer, making it stand out like a beacon. This is due in part to the galaxy having twin jets of material spewing in opposite directions from a supermassive black hole at its center. These jets have puffed out into giant lobes of material that emit a tremendous amount of radio waves.

Edwards and her colleagues noticed that these lobes appear to be bent back and away from the galaxy’s trajectory through the filament. This bow shape, the astronomers reasoned, is due to particles in the filament pushing on the gas and dust in the lobes.

By measuring the angle of the arced lobes, Edwards' team calculated the pressure exerted by the filaments' particles and then determined the density of the medium. The method is somewhat like looking at streamers on a kite soaring overhead to judge the wind strength and the thickness of the air.

According to the data, the density inside this filament is indeed about 100 times the average density of the universe. This value agrees with that obtained in a previous X-ray study of filaments and also nicely matches predictions of supercomputer simulations.

Galaxies tend to bunch together as great islands in the void of space, called galaxy clusters. These galaxy groupings themselves often keep company with other clusters in "superclusters" that loom as gargantuan, gravitationally associated walls of galaxies. These structures evolved from denser patches of material as the universe rapidly expanded after the Big Bang, some 13.7 billion years ago.

The clumps and threads of this primordial matter eventually cooled, and some of it has condensed into the galaxies we see today. The leftover gas is strewn in filaments between galaxy clusters. Much of it is still quite hot, about 1.8 million degrees Fahrenheit, and blazes in high-energy X-rays that permeate galaxy clusters. Filaments are therefore best detected in X-ray light, and one direct density reading of the strands has previously been obtained in this band of frequencies.

But the X-ray-emitting gas in filaments is much more diffuse and weak than in clusters, just as submerged sandbars are extremely hard to spot at sea compared to islands poking above the water. Therefore, obtaining quality observations of filaments is time-consuming with current space observatories.

The technique by Edwards and her colleagues, which uses radio frequencies that can reach a host of ground-based telescopes, points to an easier way to probe the interiors of galaxy-cluster filaments. Instead of laboring to find subtle X-rays clues, astronomers could trust these arced "lighthouse" galaxies to indicate...
just where cosmic filaments lie.

Knowing how much material these filaments contain and how they interact with galaxy clusters will be very important for understanding the overall evolution of the universe, Edwards said.

The Spitzer observations were made before it ran out of its liquid coolant in May 2009 and began its warm mission.

**A Powerful Shrouded Starburst**

(NASA/SSC) These images show how a brilliant burst of star formation (red glow, right image) is revealed in infrared observations from NASA's Spitzer Space Telescope. The collision of two spiral galaxies, has triggered this luminous starburst, the brightest ever seen taking place far away from the centers, or nuclei, of merging galaxies.

The merging galaxies, known collectively as II Zw 096, can be clearly seen in the image from NASA’s Hubble Space Telescope (left). This image combines light spanning the far-ultraviolet through the near-infrared. The real action in this galactic train wreck is barely hinted at in the red speckles near the middle of it all.

The booming blast of star formation only jumps out when Spitzer’s mid-infrared view, represented in red, is folded into the mix (right). This tiny region may be as small as 700 light-years across, just a tiny portion of the full 50,000 light-year extent of II Zw 096, yet it blasts out 80 percent of the infrared light from this galactic tumult. The surrounding shroud of dust renders the stars here nearly invisible in other wavelengths of light.

Researchers were surprised to see such a brilliant infrared glow in an area so far offset from the center of the spiral galaxy. Starbursts are often found crammed into the very centers of merging galaxies, but this is the brightest starburst ever seen outside a galaxy’s nucleus. Based on Spitzer data, researchers estimate the starburst is cranking out stars at the breakneck
pace of around 100 solar masses, or masses of our Sun, per year.

The *Hubble* image (left) represents ultraviolet light at a wavelength of 0.15 microns as blue, visible light at 0.44 microns as cyan, and near infrared light at 0.9 microns as red.

In the combined image (right) *Hubble’s* far-ultraviolet and visible light at wavelengths of 0.15 and 0.44 microns is shown as blue, and the near infrared light at 0.9 microns is cyan. *Spitzer’s* infrared light at 4.5 microns is represented by orange, and the mid-infrared light at 8.0 and 24 microns is red.

Observations of II Zw 096 were taken as part of the Great Observatories All-Sky LIRG Survey (GOALS).

---

**Cassini Finds Warm Cracks on Enceladus**

(NASA/JPL) New images and data from NASA’s *Cassini* spacecraft give scientists a unique Saturn-lit view of active fissures through the south polar region of Saturn’s moon Enceladus. They reveal a more complicated web of warm fractures than previously thought.

Scientists working jointly with *Cassini’s* composite infrared spectrometer and its high-resolution imaging camera have constructed the highest-resolution heat intensity maps yet of the hottest part of a region of long fissures spraying water vapor and icy particles from Enceladus. These fissures have been nicknamed "tiger stripes." Additional high-resolution spectrometer maps of one end of the tiger stripes Alexandria Sulcus and Cairo Sulcus reveal never-before-seen warm fractures that branch off like split ends from the main tiger stripe trenches. They also show an intriguing warm spot isolated from other active surface fissures.

"The ends of the tiger stripes may be the places where the activity is just getting started, or is winding down, so the complex patterns of heat we see there may give us clues to the life cycle of tiger stripes," said John Spencer, a *Cassini* team scientist based at Southwest Research Institute in Boulder, Colo.

The images and maps come from the August 13, 2010, Enceladus flyby, *Cassini’s* last remote sensing flyby of the moon until 2015. The geometry of the many flybys between now and 2015 will not allow *Cassini* to do thermal scans like these, because the spacecraft will be too close to scan the surface and will not view the south pole. This Enceladus flyby, the 11th of *Cassini’s* tour, also gave *Cassini* its last look at any part of the active south polar region in sunlight.

The highest-resolution spectrometer scan examined the hottest part of the entire tiger stripe system, part of the fracture called Damascus Sulcus. Scientists used the scan to measure fracture temperatures up to -120°F. This temperature appears slightly higher than previously measured temperatures at Damascus, which were around -150°F.

Spencer said he isn’t sure if this tiger stripe is just more active than it was the last time *Cassini’s* spectrometer scanned it, in 2008, or if the hottest part of the tiger stripe is so narrow that previous scans averaged its temperature out over a larger area. In any case, the new scan had such good resolution, showing details as small as 2,600 feet, that scientists could see for the first time warm material flanking the central trench of Damascus, cooling off
quickly away from the trench. The Damascus thermal scan also shows large variations in heat output within a few miles along the length of the fracture. This unprecedented resolution will help scientists understand how the tiger stripes deliver heat to the surface of Enceladus.

*Cassini* acquired the thermal map of Damascus simultaneously with a visible-light image where the tiger stripe is lit by sunlight reflecting off Saturn. The visible-light and thermal data were merged to help scientists understand the relationships between physical heat processes and surface geology.

"Our high-resolution images show that this section of Damascus Sulcus is among the most structurally complex and tectonically dynamic of the tiger stripes," said imaging science team associate Paul Helfenstein of Cornell University, Ithaca, N.Y. Some details in the appearance of the landforms, such as a peculiar pattern of curving striations along the flanks of Damascus, had not previously been noticed in ordinary sunlit images.

The *Cassini-Huygens* mission is a cooperative project of NASA, the European Space Agency and the Italian Space Agency. The Jet Propulsion Laboratory, a division of the California Institute of Technology in Pasadena, manages the mission for NASA's Science Mission Directorate, Washington. 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.

---

### 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.

---

### Venus Holds Warning For Earth

(ESA) A mysterious high-altitude layer of sulphur dioxide discovered by ESA's *Venus Express* has been explained. As well as telling us more about Venus, it could be sending a warning to those on Earth seeking to inject our atmosphere with sulphur droplets in an attempt to mitigate climate change.

Venus is blanketed in sulphuric acid clouds that block our view of the surface. The clouds
form at altitudes of 50–70 km when sulphur dioxide from volcanoes combines with water vapour to make sulphuric acid droplets. Any remaining sulphur dioxide should be destroyed rapidly by the intense solar radiation above 70 km.

So the detection of a sulphur dioxide layer at 90–110 km by ESA’s Venus Express orbiter in 2008 posed a complete mystery. Where did that sulphur dioxide come from?

Now, computer simulations by Xi Zhang, California Institute of Technology, USA, and colleagues from America, France and Taiwan show that some sulphuric acid droplets may evaporate at high altitude, freeing gaseous sulphuric acid that is then broken apart by sunlight, releasing sulphur dioxide gas.

“We had not expected the high-altitude sulphur layer, but now we can explain our measurements,” says Håkan Svedhem, ESA’s Venus Express Project Scientist.

“However, the new findings also mean that the atmospheric sulphur cycle is more complicated than we thought.”

As well as adding to our knowledge of Venus, this new understanding may be warning us that proposed ways of mitigating climate change on Earth may not be as effective as originally thought.

Nobel prize winner Paul Crutzen has recently advocated injecting artificially large quantities of sulphur dioxide into Earth’s atmosphere at around 20 km to counteract the global warming resulting from increased greenhouse gases.

The proposal stems from observations of powerful volcanic eruptions, in particular the 1991 eruption of Mount Pinatubo in the Philippines that shot sulphur dioxide up into Earth’s atmosphere. Reaching 20 km in altitude, the gas formed small droplets of concentrated sulphuric acid, like those found in Venus’ clouds, which then spread around Earth. The droplets created a haze layer that reflected some of the Sun’s rays back into space, cooling the whole planet by about 0.5°C.

However, the new work on the evaporation of sulphuric acid on Venus suggests that such attempts at cooling our planet may not be as successful as first thought, because we do not know how quickly the initially protective haze will be converted back into gaseous sulphuric acid: this is transparent and so allows all the Sun’s rays through.

“We must study in great detail the potential consequences of such an artificial sulphur layer in the atmosphere of Earth,” says Jean-Loup Bertaux, Université de Versailles-Saint-Quentin, France, Principal Investigator of the SPICAV sensor on Venus Express. “Venus has an enormous layer of such droplets, so anything that we learn about those clouds is likely to be relevant to any geo-engineering of our own planet.”

In effect, nature is doing the experiment for us and Venus Express allows us to learn the lessons before experimenting with our own world.
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.

Month in History

February

1: The Space Shuttle Columbia broke up during re-entry due to wing damage in 2003. The vehicle and its crew were lost.

2: Christopher Clavius, responsible for the calendar reform implemented by Pope Gregory XIII, died on this date in 1612. The Gregorian calendar is still in use today.

3: Luna 9, launched by the Soviet Union, made the first soft landing on the moon and returned pictures from another world for the first time on this date in 1966.

4: Clyde Tombaugh, the discoverer of Pluto, was born on this date in 1916. See Feb. 18.

5: The US spacecraft, Mariner 10, returned the first close images of our sister planet as it passed Venus on this date in 1974 headed towards Mercury.

5: Apollo 12, the 2nd mission to the moon’s surface landed near Fra Mauro close to the lunar equator on this date in 1971. Alan Sheppard and Ed Mitchell visited the surface and Stuart Roosa remained in orbit aboard the command module.

7: American astronauts Bruce McCandless and Robert Steward accomplished the first untethered space walks with Manned Maneuvering Units (MMU) during the STS-41B shuttle mission in 1984.

11: Japan became the fourth nation to launch an artificial satellite in 1970 with the launch of the 50 pound Ohsumi satellite. They used a newly developed solid fuel, multi-staged rocket similar to the US Scout rocket. The satellite’s battery failed the next day.

14: The US launched Syncom 1, the first geosynchronous satellite, in 1963.

15: Galileo Galilei was born in 1564 in Pisa, Italy. In December, 1609, he was the first person to use a telescope to look at the heavens and report what he saw.

18: Clyde Tombaugh, an observing assistant at the Lowell Observatory, announced the discovery of the planet Pluto in 1930 from photos taken over the previous two months.

19: Nicolaus Copernicus was born in 1473. He was the first modern proponent for a model of the solar system with the sun at the center.

19: The Soviet Union launched the Mir space station into orbit in 1986. This space station was deorbited and burned up in the atmosphere in March 2001.

20: John Glenn became the first American astronaut to orbit the earth in 1962 aboard the Friendship 7 Mercury craft. His mission lasted for three orbits which ended in less than five hours.

24: The discovery of the first pulsar was announced by Jocelyn Bell in 1968 at Cambridge in the United Kingdom.

28: The US launched the first spacecraft into a polar orbit on this date in 1959. 

*
Sky Calendar

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

**The Planets**

**Mercury.** Mercury is visible in the morning sky at the beginning of the month. Greatest western elongation (23°) occurred on January 9. Superior conjunction on the far side of the sun occurs on February 25. The waning crescent moon rises just before mercury on the morning of February 1.

**Venus.** Venus is appears in the southeastern sky rising about 3 hours before the sun. Look for the waning crescent moon above and to the right of Venus on the morning of February 28.

**Mars.** Mars, passing from Aquarius into Capricornus late in the month, is too close in direction to the sun to be observed. Conjunction on the far side of the sun occurs on February 4. It will next be visible in late spring in the morning sky.

**Jupiter.** Jupiter, in Pisces, is low in the west after sunset. Look for the waxing crescent moon to the right of Jupiter on the evening of February 6.

**Saturn.** Saturn, in Virgo, is rising in the east in the mid-evening. The waning gibbous moon will be to the right of Saturn when they rise near 9 pm on the evening of February 20.

**Uranus.** Uranus, also in Pisces, is near in direction to Jupiter. It can be found about 6° below Jupiter in the western sky where they set about three hours after the sun.

**Neptune.** Neptune, near the Aquarius-Capricornus border, is too close in direction to the sun to be observed. Conjunction on the far side of the sun occurs on February 17.

**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>8:28 am (35°)</td>
</tr>
<tr>
<td>Ceres</td>
<td>Capricornus</td>
<td>11:25 am (32°)</td>
</tr>
<tr>
<td>Eris</td>
<td>Cetus</td>
<td>3:37 pm (50°)</td>
</tr>
<tr>
<td>MakeMake</td>
<td>Coma Berenices</td>
<td>2:41 am (82°)</td>
</tr>
<tr>
<td>Haumea</td>
<td>Boötes</td>
<td>3:51 am (72°)</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.

<table>
<thead>
<tr>
<th>Phase</th>
<th>Date</th>
<th>Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Last quarter</td>
<td>Jan. 26</td>
<td>4:57 am pst</td>
</tr>
<tr>
<td>New Moon</td>
<td>Feb. 2</td>
<td>6:31 pm</td>
</tr>
<tr>
<td>First quarter</td>
<td>Feb. 10</td>
<td>11:18 pm</td>
</tr>
<tr>
<td>Full Moon</td>
<td>Feb. 18</td>
<td>12:36 am</td>
</tr>
<tr>
<td>Last quarter</td>
<td>Feb. 24</td>
<td>3:26 pm</td>
</tr>
<tr>
<td>Perigee</td>
<td>Jan. 21</td>
<td>4:11 pm pst</td>
</tr>
<tr>
<td>Apogee</td>
<td>Feb. 06</td>
<td>3:14 pm</td>
</tr>
<tr>
<td>Perigee</td>
<td>Feb. 18</td>
<td>11:28 pm</td>
</tr>
</tbody>
</table>
The Mid-Winter Sky

High in the south at about 8:00 pm during February is the bright constellation of Orion. Orion has more bright stars in it than most other constellations. Orion is the hourglass figure in the middle of the diagram.

The left shoulder of Orion is marked by the bright red star Betelgeuse. The right foot of Orion is the bright blue star Rigel. These are the two brightest stars of Orion.

The three stars at the waist of the hourglass form the “belt” of Orion. They are called Mintaka, Alnilam and Alnitak. Extending the line formed by the belt stars upward, takes you to the bright red star Aldebaran, the brightest star in Taurus, the Bull. Continuing the line takes you through the “V”-shaped pattern of the Hyades star cluster and eventually to the small “dipper-shaped” pattern of the Pleiades star cluster. The Pleiades are seven sisters kidnapped by Zeus in the form of Taurus.

Extending that same line downward takes you to Sirius, the brightest star in Canis Major, the Big Dog. Sirius is also the brightest appearing star in the sky.

Below the Belt of Orion, in the lower part of the hourglass, are three faint stars in a row. The middle star does not look quite sharp to the eye. This fuzziness is caused by the fact that the middle star is not actually a star, but a nebula. It is the famous Great Nebula of Orion, also known as M42. This cloud of glowing gas can be easily seen with a pair of binoculars. It is a star forming region that is 400 light years across and nearly 1500 light years away. Telescopes have shown evidence of hundreds of new stars being born there.

Above and to the left of Orion is the constellation of Gemini, the Twins. The two brightest stars, along the left side of the diagram, are Castor and Pollux. These stars are very similar in appearance which led to them being called “The Twins”.

---

<table>
<thead>
<tr>
<th>Date</th>
<th>Sunrise</th>
<th>Sunset</th>
<th>Day</th>
<th>Date</th>
<th>Sunrise</th>
<th>Sunset</th>
<th>Day</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feb. 1</td>
<td>6:42 am pst</td>
<td>5:07 pm pst</td>
<td>Tue.</td>
<td>Feb. 1</td>
<td>7:07 am pst</td>
<td>5:19 pm pst</td>
<td>Tue.</td>
</tr>
<tr>
<td>Feb. 4</td>
<td>6:39</td>
<td>5:10</td>
<td>Fri.</td>
<td>Feb. 4</td>
<td>7:04</td>
<td>5:23</td>
<td>Fri.</td>
</tr>
<tr>
<td>Feb. 7</td>
<td>6:37</td>
<td>5:13</td>
<td>Mon.</td>
<td>Feb. 7</td>
<td>7:01</td>
<td>5:26</td>
<td>Mon.</td>
</tr>
<tr>
<td>Feb. 28</td>
<td>6:12</td>
<td>5:34</td>
<td>Mon.</td>
<td>Feb. 28</td>
<td>6:34</td>
<td>5:50</td>
<td>Mon.</td>
</tr>
</tbody>
</table>
Now Playing

In Las Vegas

Stars of the Pharaohs
Ice Worlds
Zula Patrol: Under the Weather
Seasonal Stargazing
all in Digistar 4™

In Reno

Wild Ocean
in Skydome 8/70™
Saturn: Jewel of the Heavens
in SciDome™
Seasonal Stargazing

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, Dr. Mark Doubrava, Ronald Knecht, Kevin Melcher, Kevin Page, 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/

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