Massive Clusters

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The Stars of the Pharaohs

Show Times:

**Pharaohs:** 6 pm Fri., 7:30 pm Fri. & Sat.

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**Sky Watch** follows every show.

General admission price: $5.00

Students, children & seniors: $3.00

Gift Shop: Fri.: 5 - 9 pm, Sat.: 3 - 9 pm

Sky Watch

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

Oceans in Space

Show Times:

**Oceans in Space:** 2, 4, 6 pm (& 12 weekends)

**Adrenaline Rush:** 1, 3, 5, 7 pm

General Admission: $5.00

Children and Seniors: $4.00

Open Mon.-Fri.: 8:00 am - 8:00 pm

Sat.-Sun.: 11:00 am - 8:00 pm

775-784-4811 Show Info.

Adrenaline Rush

Telescope Viewing
Free observing sessions on the first Friday of each month at Rancho San Rafael from 7:30 pm - 8:30 pm.

Weather permitting.

775-784-4812 Office
Word from the Editor

SuitSat

(NASA) One of the strangest satellites in the history of the space age was scheduled to go into orbit on Feb. 3rd. That's when astronauts onboard the International Space Station (ISS) planned to hurl an empty space-suit overboard.

The spacesuit is the satellite, SuitSat for short.

"SuitSat is a Russian brainstorm," explains Frank Bauer of NASA's Goddard Space Flight Center. "Some of our Russian partners in the ISS program, mainly a group led by Sergey Samburov, had an idea: Maybe we can turn old spacesuits into useful satellites." SuitSat is a first test of that idea.

"We've equipped a Russian Orlon spacesuit with three batteries, a radio transmitter, and internal sensors to measure temperature and battery power," says Bauer. "As SuitSat circles Earth, it will transmit its condition to the ground."

Unlike a normal spacewalk, with a human inside the suit, SuitSat's temperature controls will be turned off to conserve power. The suit, arms and legs akimbo, possibly spinning, will be exposed to the fierce rays of the sun with no way to regulate its internal temperature.

"Will the suit overheat? How long will the batteries last? Can we get a clear transmission if the suit tumbles?" wonders Bauer. These are some of the questions SuitSat will answer, laying the groundwork for SuitSats of the future.

SuitSat can be heard by anyone on the ground. "All you need is an antenna (the bigger the better) and a radio receiver that you can tune to 145.990 MHz FM," says Bauer. "A police band scanner or a hand-talkie ham radio would work just fine." He encourages students, scouts, teachers and ham radio operators to tune in.

For years, Bauer and colleagues at Goddard have been connecting kids on Earth with astronauts on the ISS through the ARISS program (Amateur Radio on International Space Station). "There's a ham rig on the ISS, and the astronauts love talking to students when they pass over schools," Bauer explains. ARISS is co-sponsoring SuitSat along with the Radio Amateur Satellite Corporation (AMSAT), the American Radio Relay League (ARRL), the Russian Space Agency and NASA.

SuitSat transmits for 30 seconds, pauses for 30 seconds, and then repeats. "This is SuitSat-1, RS0RS," the transmission begins, followed by a prerecorded greeting in five languages. The greeting contains "special words" in English, French, Japanese, Russian, German and Spanish for students to record and decipher. (Awards will be given to students who do this.)

Next comes telemetry: temperature, battery power, mission elapsed time. "The telemetry is stated in plain language, in English," says Bauer. Everyone will be privy to SuitSat's condition. Bauer adds, "SuitSat 'talks' using a voice synthesizer. It's pretty amazing."

The transmission ends with a Slow Scan TV picture. Of what? "We're not telling," laughs Bauer. "It's a mystery picture." (More awards will be given to students who figure out what it is.)
High-Energy Fireworks Linked to Massive Star Cluster

(NASA/STScI) Call it the Bermuda Triangle of our Milky Way Galaxy: a tiny patch of sky that has been known for years to be the source of the mysterious blasts of X-rays and gamma rays. Now, a team of astronomers, led by Don Figer of the Space Telescope Science Institute (STScI) in Baltimore, Md., has solved the mystery by identifying one of the most massive star clusters in the galaxy. The little-known cluster, which has not been catalogued, is about 20 times more massive than typical star clusters in our galaxy, and appears to be the source of the powerful outbursts.

Supporting evidence for the hefty weight of this cluster is the presence of 14 red supergiants, hefty stars that have reached the end of their lives. They bloat up to about 100 times their normal size before exploding as supernovae. In fact, Figer’s team believes that the blasts of X-rays and gamma rays were released in supernova explosions. Sightings of red supergiants are rare. Astronomers have spotted only about 200 such stars in the Milky Way. The lack of sightings is because the red supergiant phase is very short in astronomical terms, lasting about half a million to a million years.

"Only the most massive clusters can have lots of red supergiants, because they are the only clusters capable of making behemoth stars," Figer explained. "They are good signposts that allow astronomers to predict the mass of the cluster. This observation is also a rare chance to study huge stars just before they explode. Normally, we don’t get to see stars before they pop off."

Figer presented his results on Jan. 9 at the 207th meeting of the American Astronomical Society in Washington, D.C. The 14 red supergiants in this cluster represent almost three times as many as in any other star cluster in our galaxy. The runner-up, NGC 7419, has five. Stars that become red supergiants weigh between 8 to 25 times our Sun’s mass and are 6 to 15 million years old.

The team identified the star cluster as a potential behemoth from the newly found clusters compiled in the Two Micron All Sky Survey catalogue. Astronomer John MacKenty, also of STScI, performed follow-up observations of the cluster in Sept. and Oct. 2005 with a unique ground-based infrared spectrograph at Kitt Peak National Observatory in Arizona. Called the Infrared Multi-object Spectrograph, "the instrument has about 500,000 movable microscopic mirrors in its focal plane which allow astronomers to take infrared spectra of up to 100 stars at once," said MacKenty, the instrument’s lead investigator. Spectra display...
stars' energy output as a series of individual wavelengths of light for study. The resulting patterns are akin to sets of fingerprints for stars, revealing characteristics such as composition, temperature, mass, and age. Astronomers plan to use similar technology on the Near Infrared Spectrograph aboard the James Webb Space Telescope, scheduled for launch in 2013.

Figer relied on data from a variety of telescopes, including the Spitzer Space Telescope, to confirm that the infrared colors of the suspected red supergiants are consistent with those of known red supergiants. The red supergiants discovered by Figer's team are very bright, indicating that the cluster is a youngster of about 8 to 10 million years old. The cluster has to be young enough for astronomers to see these short-lived stars before they explode, yet old enough to have stars that have evolved to the red supergiant stage. The cluster's mass equals 20,000 times the mass of our Sun. An estimated 20,000 stars reside in the cluster.

The cluster is the first of 130 massive star cluster candidates that Figer and his team will study over the next five years using a variety of telescopes, including the Spitzer and Hubble Space telescopes. "We can only see a small part of our galaxy in visible light because a dusty veil covers most of our galaxy," Figer said. "I know there are other massive clusters in the Milky Way that we can't see because of the dust. My goal is to find them using infrared light, which penetrates the dusty veil."

The monster cluster's location, nearly two-thirds of the way to our galaxy's center and 18,900 light-years from Earth, is in an area known for energetic activity. Several observatories, the High Energy Stereoscopic System, the International Gamma-Ray Astrophysics Laboratory and the Advanced Satellite for Cosmology and Astrophysics, detected very high-energy X-rays and gamma rays from that region. Astronomers knew that something powerful was occurring there, but they couldn't identify the source.

**Hubble Images Polaris' Companion**

(NASA/STScI) We tend to think of the North Star, Polaris, as a steady, solitary point of light that guided sailors in ages past. But there is more to the North Star than meets the eye. The North Star is actually a triple star system. And while one companion can be seen easily through small telescopes, the other hugs Polaris so tightly that it has never been seen, until now.

By stretching the capabilities of NASA's Hubble Space Telescope to the limit, astronomers have photographed the close companion of Polaris for the first time. They presented their findings in a press conference at the 207th meeting of the American Astronomical Society in Washington, D.C.

"The star we observed is so close to Polaris that we needed every available bit of Hubble's resolution to see it," said Smithsonian astronomer Nancy Evans (Harvard-Smithsonian Center for Astrophysics). The companion proved to be less than two-tenths of an arcsecond from Polaris, an incredibly tiny angle equivalent to

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**Polaris B**

**Polaris Ab**

**Polaris A**
provided us," added Bond. "With the best instruments like Hubble, we can push farther into space and study more of them up close."

The researchers plan to continue observing the Polaris system for several years. In that time, the movement of the small companion in its 30-year orbit around the primary should be detectable.

"Our ultimate goal is to get an accurate mass for Polaris," said Evans. "To do that, the next milestone is to measure the motion of the companion in its orbit."

the apparent diameter of a quarter located 19 miles away. At the system's distance of 430 light-years, that translates into a separation of about 2 billion miles.

"The brightness difference between the two stars made it even more difficult to resolve them," stated Howard Bond of the Space Telescope Science Institute (STScI). Polaris is a supergiant more than two thousand times brighter than the Sun, while its companion is a main-sequence star. "With Hubble, we've pulled the North Star's companion out of the shadows and into the spotlight."

By watching the motion of the companion star, Evans and her colleagues expect to learn not only the stars' orbits but also their masses. Measuring the mass of a star is one of the most difficult tasks facing stellar astronomers.

Astronomers want to determine the mass of Polaris accurately, because it is the nearest Cepheid variable star. Cepheids' brightness variations are used to measure the distances of galaxies and the expansion rate of the universe, so it is essential to understand their physics and evolution. Knowing their mass is the most important ingredient in this understanding.

"Studying binary stars is the best available way to measure the masses of stars," said science team member Gail Schaefer of STScI.

"We only have the binary stars that nature

**Dusty Planetary Disks Around Nearby Stars**

(NASA/STScI) These two bright debris disks of ice and dust appear to be the equivalent of our own solar system's Kuiper Belt, a ring of icy rocks outside the orbit of Neptune and the source of short-period comets. The disks encircle the types of stars around which there could be habitable zones and planets for life to develop. The disks seem to have a central area cleared of debris, perhaps by planets.

The new disks, each about 60 light-years from Earth, bring to nine the number of dusty debris disks observable at visible wavelengths. The new ones are different, however, in that they are old enough, more than 300 million years, to have settled into stable configurations akin to those in our own solar system, which is 4.6 billion years old.

The wide disk on the left, which is inclined obliquely to the line-of-sight, surrounds HD 53143, a K star slightly smaller than the Sun but about 1 billion years old. The narrow disk on the right, which is tipped nearly edge-on encircles the star HD 139664, an F star slightly larger than the Sun but only 300 million years old. The sharp outer edges of the narrow belt may be telltale evidence for
The existence of an unseen companion object that gravitationally keeps debris gravitationally corralled, in the same way that shepherding moons trim the edges of debris rings around Saturn and Uranus.

A survey by NASA's Hubble Space Telescope shows that such disks fall into two categories: those with a broad belt, wider than about 50 astronomical units; and narrow ones with a width of between 20 and 30 AU and a sharp outer boundary, seemingly like our own Kuiper Belt. An astronomical unit, or AU, is the average distance between the Earth and Sun, about 93 million miles. Our Kuiper Belt, for example, is thought to be narrow, extending from the orbit of Neptune at 30 AU to about 50 AU.

The false-color images were taken with Hubble's Advanced Camera for Surveys in September 2004. The black central circle is an image artifact produced by the camera's coronagraph which blocks the glare from the central star to allow the much fainter disks to be seen. A smaller black circle at the edge of each photo is a "coronagraphic finger" also used to block light from a bright object in the field.

SN 1006: The Hot Remains of a 1000 Year-Old Supernova

(NASA/CXC) In 1006 AD, what was thought to be a "new star" suddenly appeared in the sky and over the course of a few days became brighter than the planet Venus. The supernova of 1006, or SN 1006, may have been the brightest supernova on record.

We now know that SN 1006 heralded not the appearance of a new star, but the cataclysmic death of an old one located about 7,000 light years from Earth. It was likely a white dwarf star that had been pulling matter off an orbiting companion star. When the white dwarf mass exceeded the stability limit (known as the Chandrasekhar limit), it exploded.

The supernova ejected material at millions of miles per hour, generating a forward shock wave that raced ahead of the ejecta. Particles accelerated to extremely high energies by this shock wave produce the bright blue filaments seen in the upper left and lower right of the image.
image. Why the bright filaments occur only in the observed locations and do not encircle the remnant is not understood. One possibility is that they are due to the orientation of the interstellar magnetic field which may be roughly perpendicular to the filaments.

High pressure behind the forward shock wave pushes back on the supernova ejecta, causing a reverse shock that heats the ejecta to millions of degrees. The fluffy red features seen throughout the interior of the remnant are from gas heated by the reverse shock. The X-ray spectrum of this gas indicates that it is enriched in oxygen and other elements synthesized by nuclear reactions during the stellar explosion.

**Partial Ingredients for DNA and Protein Found Around Star**

(NASA/SSC) NASA’s *Spitzer Space Telescope* has discovered some of life’s most basic ingredients in the dust swirling around a young star. The ingredients, gaseous precursors to DNA and proteins, were detected in the star’s terrestrial planet zone, a region where rocky planets such as Earth are thought to be born.

The findings represent the first time that these gases, called acetylene and hydrogen cyanide, have been found in a terrestrial planet zone outside of our own.

"This infant system might look a lot like ours did billions of years ago, before life arose on Earth," said Fred Lahuis of Leiden Observatory in the Netherlands and the Dutch space research institute called SRON. Lahuis is lead author of a paper to be published in the Jan. 10 issue of the Astrophysical Journal Letters.

Lahuis and his colleagues spotted the organic, or carbon-containing, gases around a star called IRS 46. The star is in the Ophiuchus (pronounced OFF-ee-YOO-kuss), or "snake carrier," constellation about 375 light-years from Earth. This constellation harbors a huge cloud of gas and dust in the process of a major stellar baby boom. Like most of the young stars here and elsewhere, IRS 46 is circled by a flat disk of spinning gas and dust that might ultimately clump together to form planets.

When the astronomers probed this star’s disk with *Spitzer’s* powerful infrared spectrometer instrument, they were surprised...
to find the molecular "barcodes" of large amounts of acetylene and hydrogen cyanide gases, as well as carbon dioxide gas. The team observed 100 similar young stars, but only one, IRS 46, showed unambiguous signs of the organic mix.

"The star's disk was oriented in just the right way to allow us to peer into it," said Lahuis.

The Spitzer data also revealed that the organic gases are hot. So hot, in fact, that they are most likely located near the star, about the same distance away as Earth is from our sun.

"The gases are very warm, close to or somewhat above the boiling point of water on Earth," said Dr. Adwin Boogert of the California Institute of Technology, Pasadena. "These high temperatures helped to pinpoint the location of the gases in the disk."

Organic gases such as those found around IRS 46 are found in our own solar system, in the atmospheres of the giant planets and Saturn's moon Titan, and on the icy surfaces of comets. They have also been seen around massive stars by the European Space Agency's Infrared Space Observatory, though these stars are thought to be less likely than sun-like stars to form life-bearing planets.

Here on Earth, the molecules are believed to have arrived billions of years ago, possibly via comets or comet dust that rained down from the sky. Acetylene and hydrogen cyanide link up together in the presence of water to form some of the chemical units of life's most essential compounds, DNA and protein. These chemical units are several of the 20 amino acids that make up protein and one of the four chemical bases that make up DNA.

"If you add hydrogen cyanide, acetylene and water together in a test tube and give them an appropriate surface on which to be concentrated and react, you'll get a slew of organic compounds including amino acids and a DNA purine base called adenine," said Dr. Geoffrey Blake of Caltech, a co-author of the paper. "And now, we can detect these same molecules in the planet zone of a star.
hundreds of light-years away."

Follow-up observations with the W.M. Keck Telescope atop Mauna Kea in Hawaii confirmed the Spitzer findings and suggested the presence of a wind emerging from the inner region of IRS 46's disk. This wind will blow away debris in the disk, clearing the way for the possible formation of Earth-like planets.

The Jet Propulsion Laboratory manages the Spitzer Space Telescope mission for NASA's Science Mission Directorate, Washington. Science operations are conducted at the Spitzer Science Center at Caltech. JPL is a division of Caltech. Spitzer's infrared spectrograph was built by Cornell University, Ithaca, N.Y. Its development was led by Dr. Jim Houck of Cornell.

Possible Comet Dust Around Dead Star

(NASA/SSC) NASA's Spitzer Space Telescope has spotted what may be comet dust sprinkled around the white dwarf star G29-38, which died approximately 500 million years ago.

The findings suggest the dead star, which most likely consumed its inner planets, is still orbited by a ring of surviving comets and possibly outer planets. This is the first observational evidence that comets can outlive their suns.

"Astronomers have known for decades that stars are born, have an extended middle age, and then wither away or explode. Spitzer is helping us understand how planetary systems evolve in tandem with their parent stars," said David Leisawitz, NASA's Spitzer program scientist.

Astronomers believe white dwarfs are shrunken skeletons of stars that were once similar to Earth's sun. As the stars aged over billions of years, they grew brighter and eventually swelled in size to become red giants. Millions of years later, the red giants shed their outer atmospheres, leaving behind white dwarfs.

If any planets did orbit in these systems, the red giants would have engulfed at least the inner ones. Only distant outer planets and an orbiting icy outpost of comets would have survived.

"The dust seen by Spitzer around G29-38 was probably generated relatively recently when one such outlying comet may have been knocked into the inner region of the system and ripped into dust shreds by the tidal forces of the star," said astronomer William Reach of the Spitzer Science Center at the California Institute of Technology in Pasadena, Calif.

Prior to the Spitzer findings, astronomers studying G29-38 noticed an unusual and unknown source of infrared light. Spitzer, with its powerful infrared spectrometer, was able to break this light apart, revealing its makeup. These data told astronomers the light was coming from the same types of dusty minerals found in comets in our solar system.

"We detected a large quantity of very small, dirty silicate grains," said astronomer Marc Kuchner of NASA's Goddard Space Flight Center, Greenbelt, Md. "The size of these grains tells us they are probably from comets.
onOrbit 2006

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In our own solar system, comets reside in the cold outer fringes in regions known as the Kuiper Belt and Oort Cloud. Only when something disturbs their orbits, such as another comet or an outer planet, do they begin periodic journeys into the sunwarmer neighborhood. However, these trips to the tropics often end in destruction. Comets slowly disintegrate as they pass close to the sun, or they crash into it. They also occasionally crash into planets, as comet Shoemaker-Levy 9 did when it plunged into Jupiter.

This artist's concept illustrates a comet being torn to shreds around a dead star, or white dwarf, called G29-38. NASA's Spitzer Space Telescope observed a cloud of dust around this white dwarf that may have been generated from this type of comet disruption. The findings suggest that a host of other comet survivors may still orbit this long-dead solar system.

Though the dust seen by Spitzer around the white dwarf is most likely the remains of such a torn-up comet, there may be other explanations. One possibility is that a second wave of planets formed long after the death of the star, leaving a dusty construction zone. Another is that the comets formed the second wave of planets. A third possibility is that a second wave of planets formed after the death of the star, leaving a dusty construction zone. A fourth possibility is that a second wave of planets formed after the death of the star, leaving a dusty construction zone.

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Smallest Extrasolar Planet

(NASA/STScI) Using an armada of telescopes, an international team of astronomers has found the smallest planet ever detected around a normal star outside our solar system.

The extrasolar planet is five times as massive as Earth and orbits a red dwarf, a relatively cool star, every 10 years. The distance between the planet, designated OGLE-2005-BLG-390Lb, and its host is about three times greater than that between the Earth and the Sun. The planet’s large orbit and its dim parent star make its likely surface temperature a frigid -364°F (-220°C). This temperature is similar to that of Pluto, but the newly found planet is about one-tenth closer to its star than Pluto is to the Sun.

Its detection, however, opens a new window in the search for Earth-like worlds. "This finding means that Earth-mass planets are not that uncommon," said Kailash Sahu of the Space Telescope Science Institute, and a founding member of the Probing Lensing Anomalies Network (PLANET) team that helped detect the new planet. "If we found one, there must be more."

The finding also supports theories for how our solar system formed. "The favored theory proposes that planets were created from material accreting around a star," explained Bohdan Paczynski of Princeton University, a member of the Optical Gravitational Lensing Experiment (OGLE), a group that also helped to discover the planet. Paczynski and Shude Mao proposed the idea of using gravitational microlensing to discover planets in 1991. "Around red dwarfs, the theory predicts Earth- and Neptune-sized planets to be more common than Jupiter-sized planets. The planets would be located between 0.1 and 10 times the Earth-Sun distance from their stars."

Astronomers discovered the planet indirectly with a technique called gravitational microlensing. The technique takes advantage of the random motions of stars, which are generally too small to be noticed. If one star, however, passes precisely in front of another star, the gravity of the foreground ("lens") star bends the light from the background ("source") star. The foreground star, therefore, acts like a giant lens, amplifying the light from the background star, a phenomenon called gravitational microlensing. A planetary companion around the foreground star can produce additional brightening of the background star. This additional brightening can thus reveal the planet, which is otherwise too faint to be seen by telescopes.

The higher the mass of the "lensing" star, the longer is the duration of the microlensing event. So, while a microlensing event due to a star lasts many days, the extra brightening due to a planet lasts a few hours to a couple of days. In the case of the newly found planet, the extra brightening lasted only about 12 hours.

Using the microlensing technique, astronomers determined the planet's mass. This method, however, does not reveal any clues about an object's composition. Astronomers think the planet is composed of ice and rock. Its estimated mass suggests that it is a giant version of terrestrial planets like Earth and Mars. The planet orbits the most common star in our Milky Way Galaxy, a red dwarf five times less massive than the Sun. The pair is located about 20,000 light-years away in the constellation Sagittarius.
Month in History

March

1: Venera 3 became the first spacecraft to impact on another planet. Launched by the USSR in 1965, it impacted on Venus this day in 1966.

4: Voyager 1 discovered the faint, gas ring of Jupiter in 1979.

5: Gerardus Mercator, the map maker, was born in 1512.

6: Joseph Fraunhofer was born in 1787. He developed the first diffraction grating and established a naming convention for the prominent features in the solar spectrum.

6: The Soviet spacecraft Vega 1 was the first craft to encounter a comet when it sent back close-up pictures of Comet Halley in 1986.

7: John Herschel, son of Sir William Herschel and the author of the General Catalogue of Nebulae, was born in 1792.

9: Voyager 1 returned the first images of active volcanoes on another celestial body as it flew by Io in 1979.

10: Several observatories reported rings about Uranus as the planet (and rings) occulted the 9th magnitude star SAO 15867 in 1977.

13: Percival Lowell, ardent observer of Mars and founder of the Lowell Observatory where Pluto was discovered, was born in 1855.

13: The European spacecraft Giotto returned the first images of a comet nucleus as it flew by Comet Halley in 1986.

14: Albert Einstein, formulator of the Theory of Relativity, was born in 1879.

16: Mariner 10 makes its third and final flyby of the planet Mercury in 1975

16: The first liquid fueled rocket launched by Robert Goddard from “Aunt Effie’s Farm” in 1926. The rocket traveled a distance of about 184 feet in a flight that lasted 2½ seconds.

17: Vanguard 1 was launched by the US in 1958. It is the oldest satellite still in orbit of the earth.

18: Voskhod 2 carried Alexey Leonov and Pavel Belyayev into space in 1965 in the first flight carrying more than one person into space. Leonov spent 20 minutes outside the craft conducting the first tethered space walk.

22: With the launch of Gemini 3, Virgil “Gus” Grissom became the first person to fly in space twice in 1965.

23: Werner von Braun, creator of the Apollo moon program, was born in 1912.

29: Mariner 10 returned the first close views of Mercury on a flyby in 1974.

31: Sir William Herschel discovered the planet Uranus in 1781.

Give a Star

A popular service of The CCSN 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. Accompanying the certificate will be The Sky Challenger, which contains a series of adjustable charts of the sky as seen from North America to help you find your star. A donation of $100 will give you an exclusive dedication. Call 651-4138 or 651-4505 for further information.
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 too close in direction to the sun to be seen this month. Inferior conjunction between the earth and sun occurs on March 11.

**Venus.** Venus is visible in the morning sky rising about three hours before the sun. It will be a Greatest Western Elongation (47°) on March 24. Look for the waning crescent moon to the right of Venus on the morning of March 25.

**Mars.** Mars is moving eastward in Taurus this month. It is visible in the southwest in the early evening. Look for the nearly first quarter moon to the right of Mars on the evening of March 5.

**Jupiter.** Jupiter, in Libra, is rising near midnight. On the night of March 18/19, Jupiter will rise to the left of the waning gibbous moon.

**Saturn.** Saturn, in Cancer, is high in the east in the evening. Look for the waxing gibbous moon near Saturn on the evening of March 10.

**Uranus.** Uranus, in Aquarius, is rising just before the sun by the end of the month. Uranus passes conjunction on the far side of the sun on March 1.

**Neptune.** Neptune, in Capricornus, rises about an hour before Uranus. It can be viewed in the early morning hours shortly before sunrise.

### 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.

- New Moon: Feb. 27, 4:31 pm PST
- First quarter: Mar. 6, 12:16 pm
- Full Moon: Mar. 14, 3:35 pm
- Last quarter: Mar. 22, 2:11 pm
- New Moon: Mar. 29, 2:15 am
- Perigee: Feb. 27, 12:28 pm
- Apogee: Mar. 12, 5:45 pm
- Perigee: Mar. 27, 11:14 pm

### Total Solar Eclipse

The New Moon will pass directly in front of the sun on March 29, 2006 causing a total eclipse of the sun. This event will not be visible from the United States. Observers east of the east coast of Brazil across the Atlantic through the Sahara Desert into the Middle East and central Siberia will see the event. Most of Africa, Europe and central Asia will see a partial eclipse of the sun.
The Sun
Las Vegas

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<td>5:46</td>
<td>Mon.</td>
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<td>Mar. 16</td>
<td>5:50</td>
<td>5:49</td>
<td>Thu.</td>
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<tr>
<td>Mar. 22</td>
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<td>Mar. 28</td>
<td>5:33</td>
<td>5:59</td>
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<tr>
<td>Mar. 31</td>
<td>5:28</td>
<td>6:02</td>
<td>Fri.</td>
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</table>

The Sun
Reno

<table>
<thead>
<tr>
<th>Date</th>
<th>Sunrise</th>
<th>Sunset</th>
<th>Day</th>
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<td>6:32 am pst</td>
<td>5:52 pm pst</td>
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<td>5:45</td>
<td>6:22</td>
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Vernal Equinox

Spring begins this year at 10:26 am on March 20. On that date, the sun crosses the celestial equator, heading back into our Northern Hemisphere to bring us our beloved Las Vegas summer heat.

Only on this date or on the autumnal equinox does the sun rise directly in the east and set directly in the west. At noon on these two dates, the sun is 36° south of the zenith (39½° in Reno), the angle of our latitude. We would get exactly 12 hours of daylight today, if refraction by the atmosphere didn’t add 8 minutes.

Messier Marathon

In the late 1700’s, the French astronomer Charles Messier (mess-ee-ay) spent long nights looking for comets. He often came across faint, diffuse objects that could be comets. After watching these objects for a while it was obvious they were nebulae (glowing clouds of gas) because they did not move with respect to the stars.

In order to save time in his comet searches, Messier began a list of these objects. Today, Messier is remembered for his catalog and not for the many comets he discovered. The Messier Catalog contains all of the bright nebulae and galaxies visible from the northern hemisphere.

While Messier’s List originally had 45 objects, other astronomers have added similar objects to the list making the current list of 110 objects. Because of the distribution of the Messier Objects, mid-March is the best time to see most of them in one night.

In theory, by starting right after sunset in the west and slowly working your way eastward across the sky over the night ending at the eastern horizon just before sunrise it is possible to see all 110 objects in one night.

In practice, several objects are difficult. The faint, diffuse galaxy M74 in Pisces sets soon after the sun in March while the faint globular cluster M30 rises just before the sun. Experienced observers can often detect over 100 Messier objects near the March new moon. The best night for conducting a Messier marathon is the night of the new moon nearest the Vernal Equinox. This year, most will observe on the weekend nights of March 25-26.
The CCSN Planetarium and The Fleischmann Planetarium are units of the Nevada System of Higher Education.

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