

The Stargazer

November 2005

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	(change 'at' to @ to send email)	http://members.tripod.com/everett_astronomy

EAS BUSINESS...

NEXT EAS MEETING - SATURDAY NOVEMBER 19TH AT 3:00 PM AT THE EVERETT PUBLIC LIBRARY, IN THE AUDITORIUM (DOWNSTAIRS)

November 19th - EAS Meeting – Saturday 3:00 PM - Curtis Snow – of the Mars Society on “Changes in perspective / “discoveries” from our recent exploration of Mars’

December 10th – 7:00 PM - Holiday Dinner – with dinner speaker Keith Allred with CCD imaging presentation

January meeting - Oliver Fraser of UW Astronomy – Studying the changing period of a Pulsating White Dwarf Star”

Map to library - <http://www.epls.org/about/mlmap.htm>

**2702 Hoyt Avenue
Everett, WA 98201**

Directions to library - <http://www.epls.org/about/mldirect.htm>

CLUB STAR PARTY INFO

Upcoming star party schedule - Winding down for the winter.

People should send mail to the mail list to coordinate spur-of-the-moment Mars observing get-togethers, on nights when the sky clears.

We try to hold informal close-in star parties each month during the spring, summer, and fall months on a weekend near the New moon at a member's property or a local park. (call Mike Locke at (425) 259-5995 for info or check the EAS website.) Members contact Mike Locke for scope borrowing.

\$\$ - FINANCIAL HEALTH - \$\$

The club maintains a \$500+ balance. We try to keep approximately a \$500 balance to allow for contingencies. .

CLUB SCOPES

SCOPE	LOAN STATUS	WAITING
10-INCH DOBSONIAN	ON LOAN	NO WAIT LIST
EAS members: contact Mike Locke at (425) 259-5995 or 'mlocke at lionmts.com' to borrow a scope.		

ASTRO CALENDAR FOR 2005

November 2005

Nov 01 - New Moon
Nov 03 - Taurids meteor shower peak
Nov 03 - Mercury at its Greatest Eastern Elongation (23 Degrees)
Nov 03 - Venus at its Greatest Eastern Elongation (47 Degrees)
Nov 07 - Mars at opposition
Nov 19 - EAS MEETING - Saturday 3:00 PM at Everett Public Library

December 2005

Dec 02 - 10th anniversary (1995), SOHO Launch
Dec 12 - Moon occults Mars
Dec 12 - Mercury at its Greatest Western Elongation (21 Degrees)
Dec 13 - Geminids meteor shower peak
Dec 21 - Winter Solstice, 18:35 UT
Dec 22 - Ursids meteor shower peak
Dec 10th – EAS Dinner - Saturday 7:00 PM

January 2006

Jan 03 - Quadrantids Meteor Shower Peak
Jan 04 - Earth At Perihelion (0.983 AU From Sun)
Jan 07 - Asteroid 4 Vesta Closest Approach To Earth (1.552 AU)
Jan 15 - Stardust, Comet dust sample capsule Return To Earth
Jan 25 - Saturn Occults PPM 125631 (8.0 Magnitude Star)
Jan 27 - Saturn at Opposition
Jan 28 - 20th Anniversary (1986), Space Shuttle Challenger Accident
Jan 28 - EAS MEETING - Saturday 3:00 PM at Everett Public Library
Jan 29 - Chinese New Year
Jan 31 - 45th Anniv. 1961, Mercury-Redstone 2 launch with Ham the Chimpanzee

February 2006

March 2006

Mar 13 - 20th Anniversary (1986), Giotto, Comet Halley Flyby
Mar 14 - Penumbral Lunar Eclipse
Mar 20 - Vernal Equinox, 18:26 UT
Mar 20 - Earth Day

Mar 25 - 10th Anniversary (1996), Comet Hyakutake Near-Earth Flyby (0.1 AU)

Mar 29 - Solar Eclipse (Visible From North Africa & Central Asia)

April 2006

Apr 16 - Easter Sunday
Apr 22 - Lyrids meteor shower peak

May 2006

May 04 - Jupiter at Opposition
May 05 - Astronomy Day
May 05 - Eta Aquarids meteor shower peak
May 14 - Griffith Observatory reopens

June 2006

Jun 21 - Summer Solstice, 12:26 UT

UW Astronomy Colloquium Schedule

The Astronomy Department weekly colloquium meets Thursdays at 4:00 pm in PAB A102 (the classroom part of the Physics/Astronomy Building complex).

OVER THE AIRWAVES

"Our group of radio script writers now consists of EAS and SAS members Jim Ehrmin, Greg Donohue, and Ted Vosk, who are now regularly writing and helping to produce our astronomy radio show, "It's Over Your Head" on radio station **KSER, FM 90.7**. The six-minute segment is broadcast **every Wednesday morning at approximately 7:20 A.M.** and gives a weekly look at what's up in the sky over Snohomish County, with other information. If you are a listener to the program, show your support by giving the program director of KSER a call!" Web page with lots of archives and other info is available at <http://www.itsoveryourhead.org/>

KPLU 88.5 FM National Public Radio has daily broadcasts of "Star Date" by the McDonald Observatory of the University of Texas at Austin, Monday through Friday at about 6:05 pm. The short 2 minute radio show deals with current topics of interest in astronomy. The University of Washington TV broadcasts programs from NASA at 12:00 AM Monday through Friday, 12:30 AM Saturday, and 1:30 AM Sunday on the Channel 27 cable station.

EAS LIBRARY – BOOK & VIDEO LIST

The EAS has a library of books, videotapes, and software for members to borrow. We always value any items you would like to donate to this library. You can contact a club officer or **Librarian Mike Locke**, phone (425) 259-5995, email mlocke@lioninc.com, to borrow or donate any materials. See http://members.tripod.com/everett_astronomy/eas_library.htm here:

MEMBERSHIP BENEFITS & INFORMATION

Membership in the **Everett Astronomical Society (EAS)** will give you access to all the material in the lending library. The library, which is maintained by Mike Locke, consists of several VCR tapes, many books, magazines, and software titles. Membership includes invitations to all of the club meetings and star parties, plus the monthly newsletter, *The Stargazer*. In addition you will be able to subscribe to *Sky and Telescope* for \$7 off the normal subscription rate, contact the treasurer for more information. Link to registration form: http://members.tripod.com/everett_astronomy/application.htm

(When renewing your subscription to *Sky & Telescope* you should send your S&T renewal form along with a check made out to **Everett Astronomical Society to the EAS address**. The EAS treasurer will renew your *Sky and Telescope* subscription for you. *Astronomy* magazine offers a similar opportunity to club members.)

EAS is a member of the **Astronomical League** and you will receive the Astronomical League's newsletter, *The Reflector*. Being a member also allows you the use of the club's telescopes, an award winning 10 inch Dobsonian mount

reflector. Contact Mike Locke (425) 259-5995 to borrow a telescope. EAS dues are \$25.

Send your annual dues to the **Everett Astronomical Society**, P.O. Box 12746, Everett, WA 98206. Funds obtained from membership dues allows the Society to publish the newsletter, pay Astronomical League dues and maintain our library.

OBSERVER'S INFORMATION...

LUNAR FACTS

Nov 09	First Quarter Moon
Nov 16	Full Moon
Nov 23	Last Quarter Moon
Dec 01	New Moon
Dec 08	First Quarter Moon
Dec 15	Full Moon
Dec 23	Last Quarter Moon
Dec 31	New Moon

Digital Lunar Orbiter Photographic Atlas of the Moon

The Lunar and Planetary Institute has created a digital version of the Lunar Orbiter Photographic Atlas of the Moon, and Consolidated Lunar Atlas available online at:

<http://www.lpi.usra.edu/research/cla/menu.html>

http://www.lpi.usra.edu/research/lunar_orbiter

UP IN THE SKY -- THE PLANETS

Object	Rises	Transits	Sets	Con	Mag
Sun	7:42 am	11:55	18:07	Lib	-27
Mercury	Daylight	Daylight	Daylight	Oph	-1.5
Venus	Daylight	Daylight	18:33	Sag	-4.3
Mars	Daylight	22:47	6:22 am	Ari	-2.0
Jupiter	5:30 am	Daylight	Daylight	Vir	-1.7
Saturn	21:22	5:12 am	Daylight	Can	+0.2
Uranus	Daylight	18:49	0:03 am	Aqr	+5.8
Neptune	Daylight	Daylight	21:54	Cap	+7.9
Pluto	Daylight	Daylight	Daylight	Ser	+14.0

(times local time for Everett PST)

Transit times for Jupiter's Great Red Spot in 2005

http://skyandtelescope.com/observing/objects/planets/article_107_2.asp

NOAA SUN CALCULATOR

Need to know exactly what time the sun will set on Sept. 26, 2065? Or when it rose in 565 BC? How about the length of daylight a week from Tuesday in Albuquerque, N.M.? Just go to NOAA's solar calculator, now available on the Web. <http://www.srrb.noaa.gov/highlights/sunrise/gen.html>

INTERNATIONAL SPACE STATION – VISIBLE SEATTLE PASSES

ISS Visibility –

<http://spaceflight.nasa.gov/realdata/sightings/SSapplications/Post/SightingData/Seattle.html> or also see link <http://www.heavens-above.com/PassSummary.asp?lat=47.979&lng=-122.201&alt=0&loc=Everett&TZ=PST&satid=25544>

MEMBER NEWS

Seattle Astro Society Trying To Get a Dark Sky Site

"We feel that we need to raise \$25,000 in order to buy something appropriate on the other side of the mountains. We are making good progress within SAS. The deal basically is \$250 for dark sky membership, and some relatively nominal sum for annual dark sky dues. One would have to be a SAS member to do this,

but that is a rather nominal charge. We were wondering if anyone in your club would be interested in taking part. I personally think that the dark sky site is a necessary thing for SAS to do; otherwise, the club really has little tangible to offer its members. With a dark sky site, even city-bound members would have a place within a few hours where they could view from a dark site; even us suburban folks would benefit, I think. Thanks for your consideration."
 -- Mark de Regt, SAS.

CONSTELLATIONS OF THE MONTH: GEMINI & TAURUS

GEMINI: The Twins, as this winter constellation is also known, borders on the constellations of Auriga, Cancer, Canis Minor, Lynx, Monoceros, Orion, and Taurus, and ranks 26th in overall brightness among the constellations, containing 47 stars brighter than magnitude 5.5. Its central point is located at RA=7h,1m and Dec.= +22.5 degrees. It is completely visible from latitudes North of -55 degrees, and completely invisible from latitudes South of -80 degrees; this constellation ranks 30th in overall size. Gemini's most famous bright stars are Castor (Alpha) and Pollux (Beta), better known as "The Twins". Gemini has two associated meteor showers: the Epsilon Geminids (19 Oct.), and the Geminids (14 Dec.), and one Messier object: the open cluster M35 (NGC 2168). Two of the planet "discoveries" took place within this constellation. In 1781 William Herschel found the planet Uranus near Eta Geminorum; in the first half of this century (1930), Clyde Tombaugh (working at Flagstaff's Lowell Observatory), discovered Pluto near Delta Geminorum. Castor, appearing as one star to the naked eye, is officially designated as a triple star, but is in reality six stars, each of the three having a companion. Studies indicate that star systems containing more than six stars will more rapidly become unstable and separate. Gemini's midnight culmination date is January 5th, so try to enjoy the beauty of this constellation, and its beautiful and interesting neighbors, on the next clear night.

TAURUS: The Bull, as this late fall and winter constellation is also known, borders on the constellations of Aries, Auriga, Cetus, Eridanus, Gemini, Orion, and Perseus, and ranks 12th in overall brightness among the constellations, containing 98 stars brighter than magnitude 5.5. Associated asterisms involving Taurus include The Heavenly G, The Hyades, The Pleiades, The V, The Winter Octagon, and the Winter Oval. Its central point is located at RA=4h,39m and Dec.= +15.5 degrees. It is completely visible from latitudes North of -59 degrees, and portions of it are visible worldwide; this constellation ranks 17th in overall size, and takes up 797.25 square degrees (or 1.933% of the sky). Some of Taurus's most famous bright stars are Aldebaran, Merope, Alcyone, Electra, Pleione, Sterope, and Nath and El Nath. Taurus has three associated meteor showers: the Daytime Beta Taurids (29 June); the S. Taurids (3 November) and the N. Taurids (13 November); this wonderful constellation also contains two Messier objects: M1 (the Crab Nebula) and M-45 (the Pleiades). Aldebaran is one of the four Royal Stars of the ancient Persians. The star Beta Tauri was once shared by both the constellations of Auriga and Taurus; before the 20th century, star catalogs frequently listed this star as gamma Aurigae. Ever since the Belgian astronomer Delporte's standards for constellation boundaries were adopted, this star has been officially part of Taurus. M-45 (the Pleiades or "Seven Sisters") is the brightest open cluster in the sky. It is also one of the few members of Messier's list which does not possess a corresponding NGC number (probably because it is too bright); indeed, some cataloguers down through history had listed the Pleiades as a separate and distinct constellation. About one degree north of Zeta Tauri lies M-1 (the Crab Nebula, which received its name

from Lord Rosse in the mid-19th century when he noticed that its broad filaments resembled a crab's pincers. The Crab Nebula is a gaseous remnant of a supernova which first became visible in 1054, and is the brightest supernova remnant in the sky. It is within this beautiful constellation that the Italian astronomer Piazzi discovered the first asteroid, Ceres, on New Year's Day, 1801. Taurus has a midnight culmination date of November 30th (and a solar conjunction date of June 2): try to enjoy the beauty of this wonderful constellation, and its interesting neighbors, on the next clear fall or winter night.

YOUNG ASTRONOMER'S CORNER

Q. What is a light year?

A. A light year is a measure of distance. Distances between the stars are so great that astronomers came up with a unit of measurement to measure trillions of miles at a time: the light year. One light year is equal to the distance that light can travel in one year. Scientists believe that nothing can travel faster than light, which speeds along at 186,000 miles every second!! No wonder when you turn on a light switch at home the light appears instantaneously! Another way of saying this, is that if you lived 186,000 miles (in a straight line, no one lives 186,000 miles from anything on planet Earth(!)), but let's just say this to illustrate the point) from the nearest light house beacon on a beach, once the light turns toward you it would reach your eyes in one second!! So how fast does light travel in one year? There are 60 seconds in a minute, 60 minutes in an hour, 24 hours in a day, and 365 days in a year. Multiply all these together, then multiply that number times the speed of light per second, and you get 5,900,000,000,000 miles per year. So astronomers, instead of writing all those zeros every time they talk about these issues, call this one light year.....again, the distance that light travels in one year. The distances within our solar system and from star to star (interstellar distances) are huge. It takes 8.5 minutes for light to travel from our Sun to the Earth; 5.5 hours from the Sun to Pluto; and 4.2 years from the Sun to our nearest star neighbor: Alpha Centauri.

Q. What is the closest star to Earth?

A. You might think this is easy given the answer above... but the closest star to Earth is actually our own Sun!! Many people often forget that the Sun is also a star, and an average one at that, but even at average, it is immensely powerful and critical for all life to exist as we know it. A better way to ask this question is: what is the closest star to the Sun? (Now you can take the hint from above!!). It is Alpha Centauri, also the brightest star in the southern constellation of Centaurus. It is 40 trillion kilometers (25,000,000,000,000 miles), or 4.2 light-years (see above), away from us. Alpha Centauri lies too far south in the sky for people in Everett (and much of the Northern Hemisphere above the equator) to see it. Alpha Centauri is also a triple star: the two larger stars orbit each other very closely; the third, dimmer star (Proxima Centauri) is actually somewhat closer than the pair to Earth, and itself orbits the brighter pair. As the closest star system to Earth, Alpha Centauri is not however the brightest: two other stars, Sirius and Canopus, are brighter, even though each are farther away.

ASTRONOMY AND TELESCOPE LINGO

Astronomy Lingo: SOLAR PARALLAX: The angle subtended by the equatorial radius of the Earth at the Sun's center, at a distance of one astronomical unit. It is equal to 8.794 148 arc seconds, as defined by the International Astronomical Union.

Telescope Lingo: SOLAR CELL: A semiconductor device, identical in principal to a photovoltaic detector, by which incident solar radiation is converted directly into electrical energy. It has a p-n junction with a large surface area, and solar radiation falling on or near the junction produces an external voltage. Different semiconductors, dopants, and manufacturing techniques have been used to increase the conversion efficiency and the resultant electrical power; conversion efficiencies can exceed 30%. Solar cells form the main power supply in satellites, space stations, and short-range planetary probes. Solar cells are arranged on flat solar panels outside the spacecraft to receive the maximum amount of radiation from the Sun. For spacecraft traveling beyond the orbit of Mars, the solar radiation flux is insufficient for adequate electrical energy generation: for example, the solar constant at the orbit of Jupiter is only approximately 4% of the value here at Earth's orbit. Power at these greater distances must be obtained from other supply sources, such as nuclear or thermoelectric generators.

PLANETARY FOCUS

"Planetary Focus" is a column that will be published occasionally in the EAS "Stargazer". If you have a favorite planet that you would like similar information and/or statistics on, please contact newsletter co-editor Bill O'Neil.

This month's planetary focus is on: **Neptune**.

Rotation around the Sun: every 164.79 years

Orbit: from 29.76 (closest or 'perihelion') to 30.36 (furthest or 'aphelion') Astronomical Units (AU)*; this is an orbit that varies between approximately 2.77 billion and 2.82 billion miles from the sun. (*Note: One AU equals approximately 93 million miles).

Inclination of Orbit to Ecliptic: 1.8 degrees.

Mean Orbital Velocity: 5.43 km/sec.

Diameter at Equator: 50,538 kilometers (or 31,586 miles).

Mass: 17.2 (approximately 17.2 times more massive than earth); (5.9742 x 10²⁴ (10 to the 24th power)) kilograms = 1 Earth Mass).

Density: approximately 1.80 times that of water (global density).

Surface Gravity (Earth = 1): 1.19

Period of Rotation on its own axis: approximately 18 hours, 25 minutes.

Axis tilt: 29.56 degrees.

Satellites (moons): 8, as well as planetary rings.

Special Notes About Neptune: Neptune is the fourth largest planet in the solar system (one of the gas giants) in terms of equatorial diameter, but is more massive than Uranus, the third largest planet in diameter. Neptune is the most distant of the giant planets, and was discovered in 1846 by J.G. Galle at the Berlin Observatory, based on French (Urbain Leverrier) predictions resulting from disturbances in the orbit of Uranus (there were similar estimates made by Englishman John C. Adams). Neptune returns to opposition two days later every year, and appears as an indistinct magnitude 7.7 bluish-green object in binoculars; in fact, no markings can be seen on its bluish-green disk from earth-bound telescopes. Neptune's color arises primarily from methane within its atmosphere, which is principally helium and hydrogen and a blend of methane, water, and ammonia. In 1989, Voyager 2 sent back remarkable images of Neptune during its fly-by. The Great Dark Spot was noted in its atmosphere. Like Jupiter's Great Red Spot, it occupies a equivalent proportion of the surface area of Neptune (as the GRS does of Jupiter's surface area), and is a high-pressure system

around which near-supersonic winds flow in an anti-clockwise circuit. The Great Dark Spot measures approximately 12,000 by 8,000 kilometers. At about 50-70 kilometers above the main cloud plane, there are whitish cirrus-like clouds composed of methane ice crystals. Neptune also has belts and zones similar to Jupiter's, only much fainter. The core of Neptune is believed to be rocky, composed primarily of silicon and iron. The atmosphere of Neptune revolves more slowly than its core, and this is opposite to the atmospheres of the other gas giants; the implication is that circulation of Neptune's atmosphere may take place in a retrograde (backward or opposite) manner. Neptune also gives off more energy than it receives from the Sun, suggesting that it has its own internal source of heat; the planet also has a magnetic field, which is somewhat weaker than that of the other gas giant planets. Four dark planetary rings were discovered during the Voyager 2 fly-by in 1989.

Neptune has 8 known moons; six of them were discovered during the 1989 Voyager 2 fly-by, and the remaining two (Triton and Nereid) were discovered from Earth. Triton is the largest moon of Neptune, and was discovered the same year (1846) as the planet itself; it is about $\frac{3}{4}$ the size of our own Earth's Moon. Interestingly, Triton has an orbit in the opposite direction to that of Neptune (retrograde), and is slowly coiling its way down towards Neptune. Triton is a very cold moon, and has a thin atmosphere of mostly nitrogen, with some methane and carbon monoxide. Its South Pole cap is pinkish in color (probably nitrogen snow and ice). Triton's face has been shown to have both craters and long cracks, but no mountains; its surface resembles that of a cantaloupe. It has also been noted to have geysers of nitrogen, some reaching 8 km in height! Nereid was discovered from Earth in 1949, and has a very eccentric orbit (going from 2 to 10 million kilometers from the planet at various times during its orbit).

ASTRONOMY FUN FACTS

★★ In November of 1980, the Voyager I spacecraft passed by Saturn's moon Titan at a distance of only 2,500 miles from the surface: this was the closest approach to any celestial body encountered by either of the two Voyager spacecraft. At that particular time, the spacecraft was traveling at a speed of about 43,000 miles per hour and was more than 946 million miles from Earth. This solar system target accuracy is comparable to shooting an arrow at an apple 6 miles away and having the arrow pass by the apple at a carefully calculated distance of 1 inch!!!

★★ The remaining moons of Saturn are much smaller than massive Titan, but the densities of all of Saturn's moons are all very low. The best determined density is that of Titan, and it is only 1.32 times that of water. Because of these low densities, these moons of Saturn are mostly ice. Indeed, with diameters of its moons in the range of over 3,000 miles (Titan) to the smaller moons like Mimas and Hyperion (in the range of 50-325 mile diameters), these are probably the largest "snowballs" that we Earthlings will ever see!

★★ Voyager 1 and 2 together took more than 70,000 television pictures of Jupiter, Saturn, and their moons and surrounding environments. If all of these groundbreaking photographs were developed in a standard 8x10 format and mounted side by side to form a rectangular montage, the total area formed by the montage would be about 97.5 square miles, approximately equal to twice the area of Boston, Massachusetts!

★★ The longest winter (when the Sun is far south of the celestial equator) in the solar system is 21 Earth years long and is found on the south polar regions of the planet Uranus. The deep winter temperatures in this area of Uranus are estimated to be -362

degrees F. (-219 degrees C.). Any future astronauts exploring the liquid hydrogen "surface" of Uranus (if indeed that ever were to occur) would need much, much more than thermal undergarments to keep them warm!!

MIRROR IMAGES

Because we live in the Northern Hemisphere, we often tend to focus (in both observing and reading) on celestial objects in this hemisphere. The point of this column is to inform club members about similar objects in the Southern Hemisphere (to the ones we are already familiar with in the Northern Hemisphere). The general class of object (there are three objects/study items this month) is first defined below, and then a representative object from each hemisphere is described. Note: "MIRROR" IMAGES" is strictly the name of this column, and is not intended to imply that there is optical mirror symmetry between the two representative objects.

1). **CLASS OF OBJECT: RED GIANT STARS:** After a main-sequence star uses up the hydrogen in its core (and it begins to leave the main sequence of its evolution), it begins to contract. Dense core helium then heats up, making remaining hydrogen outside the core boundary burn faster, increasing the star's brightness. The great energy released by the burning hydrogen 'shell' (and continued gravitational contraction of the star), makes the star expand into a giant: the outer layers of the star expand rapidly. These giants have surface temperatures between 2,000 and 4,000 degrees Kelvin, and diameters anywhere from 10 to as much as 1,000 times that of our Sun. This expansion causes the star to cool with a lowered gas density and a dropping surface temperature. The star then turns red, and becomes known as a "red giant". Gravitational contraction continues, and the temperature inside the star rises immensely. Such stars may contract (to a hotter and denser giant), and then re-inflate back to the cooler red giant phase more than once during its lifetime; further core fusion reactions also add heavier elements such as oxygen, sodium, and magnesium. The helium core does not expand much during helium burning; without expanding, the star can't lose the heat generated (from the helium burning), and the star undergoes a runaway helium combustion known as the "helium flash". Since red giants are often so distended, they frequently lose much mass into space in the form of stellar winds, because the effects of gravity are weaker on such distended atmospheric surface layers. Many red giant stars are often variable stars simply because these surface layers slowly expand and contract; such pulsations can take up to a year to complete (e.g., Mira-type (long-period) variables). Lower mass red giants will eventually become planetary nebulae (and subsequently white dwarfs); this is the suspected evolution of our own Sun. Higher mass red giants may eventually explode as Type II supernovae.

REPRESENTATIVE NORTHERN HEMISPHERE OBJECT: Betelgeuse: Betelgeuse (alpha Orionis) is the second brightest star in the constellation of Orion, the tenth brightest in all the sky, and is a very luminous red supergiant. Betelgeuse is a semi-regular variable (period = approximately 5.8 years), that is also a strong source of infrared radiation. Its variable magnitude range is 0.3 to 0.9; its magnitude however has reached as high as 0.15 and has been as low as 1.3. IRAS (Infrared Astronomical Satellite) data has found long-wave infrared radiation emitted from three concentric shells, the largest of which has been ejected within the last 100,000 years and has a radius of 1.5 parsecs. Interferometry indicates that Betelgeuse has an irregular surface brightness. Betelgeuse lies at a distance of approximately 650 light years from our solar system, and has a diameter about 500

times that of the Sun. Betelgeuse has an absolute magnitude of -5.7, and is listed as spectral type M2-I-ab.

REPRESENTATIVE SOUTHERN HEMISPHERE OBJECT: Mira: Mira (omicron Ceti) is a red giant in the constellation of Cetus (the Whale); it is also the prototype for all the long-period pulsating variables. Hevelius gave the name "Mira" to this star; translated, Mira means "the Wonderful". Mira has an average period of 331 days. The radius of Mira varies by over 20% during its cycle; at maximum size and brightness its radius is over 330 times that of our Sun. The surface temperature at maximum brightness has been estimated as high as 2,600 degrees Kelvin; at minimum brightness, its temperature is approximately 1,900 degrees Kelvin. Visible light emitted during Mira's cycle spans about 6.0 magnitudes from peak to trough. The average apparent magnitude at maximum is between 3.0 and 4.0; however, as recently as 1969, its maximum apparent magnitude was measured to be 2.1. At minimum, Mira's apparent magnitude hovers between 8.0 and 10.0. Mira is also a visual binary (it has a faint peculiar and variable companion); an optical double; and an infrared source (arising from grains of dust in the expanding gas envelope of the red giant star). Mira lies at a distance of 40 parsecs from our solar system, has an absolute magnitude of -1.0, and is of spectral types M6e to M9e III during its cycle.

2). **STUDY ITEM: OBSERVATORY** A structure or complex built primarily for astronomical observation. Today's modern and major observatories often have far more than only visual capabilities. They are often outfitted with optical, radio and/or infrared equipment, and in the largest observatories, there is often associated instrumentation so that spectrographic, photometric, and similar measurements can be accomplished. Most major observatories are situated at sites that have minimal impact from light and air pollution, as well as minimized atmospheric disturbances. Many world-class observatories are situated in mountainous areas or on volcanic islands where the atmosphere is thin and water vapor absorption effects are minimized. Radio observatories are less hampered by the restrictions listed above, but still need to be located in areas where they can be isolated from radio and electrical interference.

REPRESENTATIVE NORTHERN HEMISPHERE ITEM: McDonald Observatory An observatory affiliated with the University of Texas on Mount Locke near Fort Davis, Texas, located at 2081 meters. This observatory has 2.7-meter (1969) and 2.1-meter (1939) reflecting telescopes; the 2.1-meter (the Otto Struve telescope) has recently been modernized for infrared astronomy. The Hobby-Eberly Telescope (HET) was commissioned in 1997 on the mountain, and is used mainly for spectrographic surveys. The HET has an 11-meter spherical segmented f/1.3 mirror on an azimuthal mounting, permanently tipped at an angle of 35 degrees to the zenith. A mobile secondary reflects images onto the primary, and as a result, 70% of the sky visible from Mount Locke can be surveyed.

REPRESENTATIVE SOUTHERN HEMISPHERE ITEM: Mount Stromlo and Siding Springs Observatories Two optical observatories owned and operated by the Australian National University in Canberra. They are located on Mount Stromlo near Canberra (at 770 meters) and on Siding Spring Mountain (1150 meters) in the Warrumbungle Mountain Range in New South Wales (NSW). The primary instrument on Mount Stromlo is a 1.9-meter reflector (1953), and on Siding Spring there is a 2.3-meter altazimuth reflector (1984), along with some smaller reflecting telescopes. Importantly, Siding Spring is also the home of the separate Anglo-Australian Observatory (AAO), which contains the 3.9-meter Anglo-Australian Telescope and the 1.2-meter UK Schmidt Telescope.

ASTRONOMICAL NOTES -- ON & OFF THE NET...

ICE BENEATH MARS IS ASKING, "CAN YOU HEAR ME NOW?"

<http://mars.jpl.nasa.gov/odyssey/spotlight/20051024.html>

In August 2003, as the twin Mars Exploration Rovers were barreling toward Mars in their flying saucers, scientists and engineers sent a radio signal disguised as the rovers' "voice" to the Odyssey orbiter at Mars. The call to Odyssey was what Dr. John Callas, Mars Exploration Rover Science Manager, defines as a "can-you-hear-me-now?" test. Scientists and engineers wanted to ensure the UHF (ultra-high frequency) radio system on Odyssey, a primary communications relay between the rovers and Earth, would work. Odyssey responded with a resounding yes, and something else from Mars responded too?. When the first, clear "I-can-hear-you" reply beamed back from Odyssey, modest high-fives and conservative cheers were exchanged amongst the small team of PhDs huddled around a computer near a 46-meter (150-foot) antenna at Stanford University known locally as the "Dish." SRI International manages the radio telescope, the only deep space antenna near the Jet Propulsion Laboratory that can send UHF radio waves from Earth to Mars. As each new line of relay test data streamed down to the computer screen at the Dish, Stanford University's Dr. Ivan Linscott began to mutter, "Huh? what's that? - that's strange." A peculiar stripe on the data-return-screen was arcing underneath the straight line that represented the primary communications from Odyssey. The mysterious curve then intersected the primary line, and stopped sending data at the same time the main signal disappeared. The team initially dismissed the strange line as signal noise that engineers term "radio frequency interference" (RFI). But the curved line of data has now earned the title, "Lucky Stripe," and the so-called static has become the subject of the "Mars Bi-Static UHF Radar Experiment."

After a week of studying the stripe, the team discovered that the extra data was actually a reflection from the surface of Mars. "Anyone who's used rabbit ears to pick up a television signal has probably seen a ghosting effect - a signal echo," explains Callas. The ghosted image arrives off-center and is more transparent because the source signal hit some neighboring wall or structure and then bounced back to the TV receiver a little later and more scattered. The Lucky Stripe is a reflection of the Martian surface, and the stripe is curved because the Odyssey spacecraft was traveling in an arcing orbit over the planet as the echo from the surface of Mars reverberated back to Earth. "Just like a distorted reflection in a fun house mirror tells you something about the mirror's shape, radar reads an echo of the surface of Mars that tells us about the shape of the surface it's reflecting," explains Callas. The team later confirmed multiple reflections, which suggests they are seeing "echoes" of material beneath the surface of Mars.

Fast-forward to October, 2005. The bi-static radar experiment team, led by Callas, is now using the Odyssey UHF radio system and SRI's antenna to hunt for subsurface water ice - a key component to understanding the history or future of life on Mars. Timing is best now as Earth and Mars merge toward a close approach on October 29, 2005 and UHF radio signals become stronger and take less time to travel between the planets. Scientists are hoping to find unexpected treats in the form of "noisy" radar tricks from now until just past Halloween. This bonus science is possible because the communications team didn't disregard the "noise" from the original test and later NASA support for the discovery. "This simple, inexpensive technique utilizes resources that are already in place," explains Callas. The

experiment uses antenna-scheduling resources and communication protocols already in place to support the rover mission. Rover Mission Planner Byron Jones reflects the mindset of various Mars experts who have helped the experiment succeed. "There's a real sense of community during our Mars Relay meetings as various missions work to share memory space on Odyssey so the bi-static experiment can operate," says Jones. When Mars is whispering, "Can you hear me now?" through cryptic radio echoes, all of the mission teams can't help but eagerly listen. http://mars.jpl.nasa.gov/express/mission/sc_science_marsis01.html

HUBBLE REVEALS POSSIBLE NEW MOONS AROUND PLUTO

Using Hubble Space Telescope to view the ninth planet in our solar system, astronomers discovered Pluto may have not one, but three moons. If confirmed, the discovery of the two new moons could offer insights into the nature and evolution of the Pluto system; Kuiper Belt Objects with satellite systems; and the early Kuiper Belt. The Kuiper Belt is a vast region of icy, rocky bodies beyond Neptune's orbit. "If, as our new Hubble images indicate, Pluto has not one, but two or three moons, it will become the first body in the Kuiper Belt known to have more than one satellite," said Hal Weaver, co-leader of the team that made the discovery.

Pluto was discovered in 1930. Charon, Pluto's only confirmed moon, was discovered by ground-based observers in 1978. The planet resides about 3 billion miles from the sun in the heart of the Kuiper Belt. "Our result suggests other bodies in the Kuiper Belt may have more than one moon. It also means planetary scientists will have to take these new moons into account when modeling the formation of the Pluto system," said Alan Stern, co-leader of the research team.

The candidate moons, provisionally designated S/2005 P1 and S/2005 P2, were observed approximately 27,000 miles away from Pluto. The objects are roughly two to three times as far from Pluto as Charon. The team plans to make follow-up Hubble observations in February to confirm the newly discovered objects are truly Pluto's moons. Only after confirmation will the International Astronomical Union consider names for S/2005 P1 and S/2005 P2. The Hubble Advanced Camera for Surveys observed the two new candidate moons on May 15, 2005. The candidates are roughly 5,000 times fainter than Pluto. Three days later, Hubble looked at Pluto again. The two objects were still there and appeared to be moving in orbit around Pluto. The team looked long and hard for other potential moons around Pluto. "These Hubble images represent the most sensitive search yet for objects around Pluto," said team member Andrew Steffl of the Southwest Research Institute. "It is unlikely that there are any other moons larger than about 10 miles across in the Pluto system," he said. http://www.nasa.gov/vision/universe/solarsystem/hubble_pluto.html

CLOSEST LOOK YET AT MILKY WAY'S MYSTERIOUS CORE

Astronomers have gotten their deepest glimpse into the heart of our Milky Way Galaxy, peering closer to the supermassive black hole at the Galaxy's core than ever before. Using the continent-wide Very Long Baseline Array (VLBA), they found that a radio-wave-emitting object at the Galaxy's center would nearly fit between the Earth and the Sun. This is half the size measured in any previous observation.

"We're getting tantalizingly close to being able to see an unmistakable signature that would provide the first concrete proof of a supermassive black hole at a galaxy's center," said Zhi-Qiang

Shen. A black hole is a concentration of mass so dense that not even light can escape its powerful gravitational pull.

The astronomers used the VLBA to measure the size of an object called Sagittarius A* (pronounced "A-star") that marks the exact center of our Galaxy. Last year, a different team announced that their measurements showed the object would fit inside the complete circle of Earth's orbit around the Sun. Shen and his team, by observing at a higher radio frequency, measured Sagittarius A* as half that size. A mass equal to four million Suns is known to lie within Sagittarius A*, and the new measurement makes the case for a black hole even more compelling than it was previously. Scientists simply don't know of any long-lasting object other than a black hole that could contain this much mass in such a small area. However, they would like to see even stronger proof of a black hole. "The extremely strong gravitational pull of a black hole has several effects that would produce a distinctive 'shadow' that we think we could see if we can image details about half as small as those in our latest images," said Fred K.Y. Lo, Director of the National Radio Astronomy Observatory and another member of the research team. "Seeing that shadow would be the final proof that a supermassive black hole is at the center of our Galaxy," Lo added. Many galaxies are believed to have supermassive black holes at their centers, and many of these are much more massive than the Milky Way's black hole. The Milky Way's central black hole is much less active than that of many other galaxies, presumably because it has less nearby material to "eat." Astronomers believe that the radio waves they see coming from Sagittarius A* are either generated by particle jets that have been detected in many more-active galaxies or from accretion flows that are spiraling into the central black hole. By observing the object at higher radio frequencies, scientists have detected a region of radiation ever closer to the black hole. The results announced last year were based on observations at 43 GigaHertz (GHz), and the latest observations were made at 86 GHz. "We believe that if we can double the frequency again, we will see the black-hole shadow produced by effects of Einstein's General Relativity theory," Lo said.

In a few years, when the Atacama Large Millimeter Array (ALMA) comes on line, it may be used in conjunction with other millimeter-wave telescopes to make the higher-frequency observations that will reveal the telltale black-hole shadow. At a distance of 26,000 light-years, the Milky Way's central black hole is the closest such supermassive object. That makes it the most likely one to finally reveal the concrete evidence for a black hole that astronomers have sought for years.

NEUTRON STAR DISCOVERED WHERE BLACK HOLE WAS EXPECTED

A very massive star collapsed to form a neutron star and not a black hole as expected, according to new results from NASA's Chandra X-ray Observatory. This discovery shows that nature has a harder time making black holes than previously thought. Scientists found this neutron star -- a dense whirling ball of neutrons about 12 miles in diameter -- in an extremely young star cluster. Astronomers were able to use well-determined properties of other stars in the cluster to deduce that the progenitor of this neutron star was at least 40 times the mass of the Sun. "Our discovery shows that some of the most massive stars do not collapse to form black holes as predicted, but instead form neutron stars," said Michael Muno lead author of a paper to be published about the discovery.

When very massive stars make neutron stars and not black holes, they will have a greater influence on the composition of future generations of stars. When the star collapses to form the neutron

star, more than 95% of its mass, much of which is metal-rich material from its core, is returned to the space around it. "This means that enormous amounts of heavy elements are put back into circulation and can form other stars and planets," said J. Simon Clark.

Astronomers do not completely understand how massive a star must be to form a black hole rather than a neutron star. The most reliable method for estimating the mass of the progenitor star is to show that the neutron star or black hole is a member of a cluster of stars, all of which are close to the same age. Because more massive stars evolve faster than less massive ones, the mass of a star can be estimated from if its evolutionary stage is known. Neutron stars and black holes are the end stages in the evolution of a star, so their progenitors must have been among the most massive stars in the cluster.

Muno and colleagues discovered a pulsing neutron star in a cluster of stars known as Westerlund 1. This cluster contains a hundred thousand or more stars in a region only 30 light years across, which suggests that all the stars were born in a single episode of star formation. Based on optical properties such as brightness and color some of the normal stars in the cluster are known to have masses of about 40 suns. Since the progenitor of the neutron star has already exploded as a supernova, its mass must have been more than 40 solar masses.

Introductory astronomy courses sometimes teach that stars with more than 25 solar masses become black holes -- a concept that until recently had no observational evidence to test it. However, some theories allow such massive stars to avoid becoming black holes. For example, theoretical calculations by Alexander Heger of the University of Chicago and colleagues indicate that extremely massive stars blow off mass so effectively during their lives that they leave neutron stars when they go supernovae. Assuming that the neutron star in Westerlund 1 is one of these, it raises the question of where the black holes observed in the Milky Way and other galaxies come from. Other factors, such as the chemical composition of the star, how rapidly it is rotating, or the strength of its magnetic field might dictate whether a massive star leaves behind a neutron star or a black hole. The theory for stars of normal chemical composition leaves a small window of initial masses -- between about 25 and somewhat less than 40 solar masses -- for the formation of black holes from the evolution of single massive stars. The identification of additional neutron stars or the discovery of black holes in young star clusters should further constrain the masses and properties of neutron star and black hole progenitors.

STAR ON THE RUN - SPEEDING STAR HINTS AT MASSIVE BLACK HOLE

Observations with Kueyen, one of the 8.2m telescopes composing the ESO Very Large Telescope (VLT), have led to the discovery of a short-lived massive star that is moving at a very high speed through the outer halo of the Milky Way galaxy and into intergalactic space. This finding could provide evidence for a previously unknown massive black hole in the heart of the Milky Way's closest neighbor, the Large Magellanic Cloud.

The star, named HE 0437-5439, was discovered by the Hamburg/ESO sky survey, a project aimed at detecting quasars but which discovered many faint blue stars as well. Scientists found what is likely to be a hot massive main-sequence star, far out in the halo. This came as a great surprise. Massive stars have lifetimes of only some tens or hundreds of million years, short lived for astronomical standards, but the halo does not usually host stars as young as this. In fact, it contains the oldest

stars in the Milky Way that are more than ten billion years old. Massive stars are usually found in or near star forming regions in the Galactic disc such as the famous Orion nebula: HE 0437-5439 is indeed similar to the trapezium stars that make the Orion nebula shine. Data were obtained with the ESO VLT and its high resolution UVES spectrograph. This allowed the chemical composition to be measured which turned out to be similar to that of the Sun, confirming that HE0437-5439 is a young star. Its mass is eight times larger than that of the Sun and the star is only 30 million years old. It is almost 200,000 light years away from us in the direction of the Doradus Constellation ("the Swordfish").

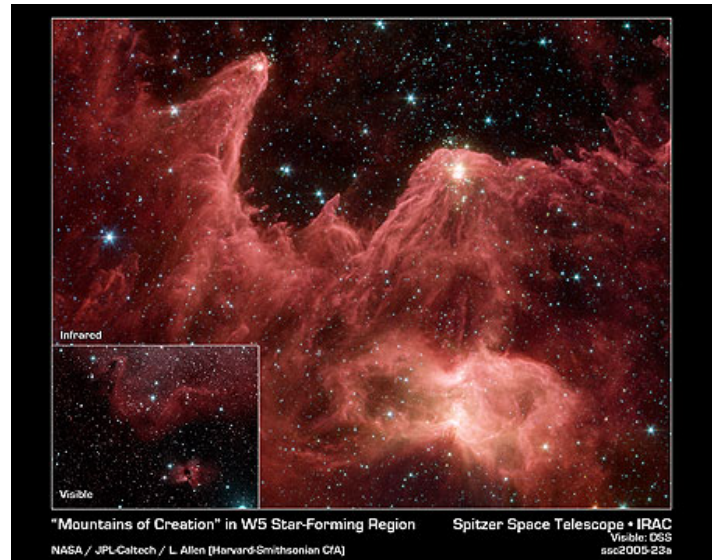
Even more exciting was the fact that the data indicated the star to be receding at a velocity of 723 km/s, or 2.6 million kilometers per hour. HE0437-5439 moves so fast that the gravitational attraction of the Milky Way is too small to keep it bound to the Galaxy. Hence the hyper-velocity star will escape into intergalactic space. As the star is moving so fast, it must have been born far away from its present position and accelerated to where we observe it today. What accelerated the star to such a high speed? Calculations carried out already in the late 1980s showed that a so-called massive black hole (SMBH), i.e. a black hole a million times as massive as the Sun, or larger, could provide the enormous acceleration. If a binary star approaches the SMBH, one star falls towards the SMBH while its companion is ejected. The Galactic Centre of the Milky Way hosts such a black hole of about 2.5 million solar masses, and this might have accelerated HE0437-5439. But the necessary travel time was found to be more than three times the age of the star. Hence the star is too young to have traveled all the way from the Galactic centre to its present location. Either the star is older than it appears or it was born and accelerated elsewhere.

A different clue to the origin of HE0457-5439 comes from its position in the sky. HE0437-5439 is 16 degrees away from the Large Magellanic Cloud (LMC), one of the nearest neighboring galaxies to the Milky Way. This galaxy lies at a distance of 156,000 light years. HE0457-5439 is even more distant than the LMC and is much closer to the LMC than to the galaxy. The astronomers showed that the star could have reached its present position within its lifetime if it were ejected from the centre of the LMC. This, in turn, would provide evidence for the existence of a SMBH in the LMC. Another explanation would require the star to be the result of the merging of two stars, belonging to so-called blue stragglers class of stars, which are older than standard evolution models predict them to be. Indeed, its age could then be as much as the lifetime of a 4 solar mass star which is more than 6 times the lifetime of an 8 solar mass star.

The astronomers propose two additional observations to distinguish between the two options. The abundance of certain elements in stars belonging to the LMC is only half that of the Sun. A more precise measurement with UVES would indicate whether the star has a metal abundance appropriate to LMC stars or not. The second is to measure how much the star moves in the transverse direction on the sky, using astrometric measurements.

SPITZER CAPTURES COSMIC MOUNTAINS OF CREATION

A new image from the Spitzer Space Telescope reveals billowing mountains of dust ablaze with the fires of stellar youth. Captured by Spitzer's infrared eyes, the majestic image resembles the iconic "Pillars of Creation" picture taken of the Eagle Nebula in visible light by the Hubble Space Telescope in 1995. Both views feature star-forming clouds of cool gas and dust that have been sculpted into pillars by radiation and winds from hot, massive stars.



The Spitzer image, which can be found at <http://www.spitzer.caltech.edu/Media>, shows the eastern edge of a region known as W5, in the Cassiopeia constellation 7,000 light-years away. This region is dominated by a single massive star, whose location outside the pictured area is "pointed out" by the finger-like pillars. The pillars themselves are colossal, together resembling a mountain range. They are more than 10 times the size of those in the Eagle Nebula.

The largest of the pillars observed by Spitzer entombs hundreds of never-before-seen embryonic stars, and the second largest contains dozens. "We believe that the star clusters lighting up the tips of the pillars are essentially the offspring of the region's single, massive star," said Dr. Lori Allen, lead investigator of the new observations. "It appears that radiation and winds from the massive star triggered new stars to form." Spitzer was able to see the stars forming inside the pillars thanks to its infrared vision. Visible-light images of this same region show dark towers outlined by halos of light. The stars inside are cloaked by walls of dust. But infrared light coming from these stars can escape through the dust, providing astronomers with a new view. "With Spitzer, we can not only see the stars in the pillars, but we can estimate their age and study how they formed," said Dr. Joseph Hora, a co-investigator.

The W5 region and the Eagle Nebula are referred to as high-mass star-forming regions. They start out as thick and turbulent clouds of gas and dust that later give birth to families of stars, some of which are more than 10 times more massive than the sun. Radiation and winds from the massive stars subsequently blast the cloudy material outward, so that only the densest pillar-shaped clumps of material remain. The process is akin to the formation of desert mesas, which are made up of dense rock that resisted water and wind erosion. According to theories of triggered star formation, the pillars eventually become dense enough to spur the birth of a second generation of stars. Those stars, in turn, might also trigger successive generations. Astronomers do not know if the sun, which formed about five billion years ago, was originally a member of this type of extended stellar family. Allen and her colleagues believe they have found evidence for triggered star formation in the new Spitzer image. Though it is possible the clusters of stars in the pillars are siblings of the single massive star, the astronomers say the stars are more likely its children.

COSMIC CLOUDSHINE: ITS BEAUTY IS MORE THAN SKIN DEEP

Hubble's iconic images include many shots of cosmic clouds of gas and dust called nebulae. For example, the famous "Pillars of Creation" mark the birthplace of new stars within the Eagle Nebula. Yet despite their beauty, visible-light images show only the nebulae surfaces. Baby stars may hide beneath, invisible even to Hubble's powerful gaze. Astronomers have pioneered a new way to peer below the surface using near-infrared light that is invisible to the human eye. The resulting images are both beautiful and scientifically valuable because they can be used to map the structure of interstellar matter.

"We can now see the structure of gigantic star-forming regions over vast distances with a resolution 50 times better than before," said Alyssa Goodman. "This technique will revolutionize the way we map stellar birthplaces." While Hubble's NICMOS instrument and Spitzer Space Telescope also use infrared light to study nebular interiors, ground-based images at near-infrared wavelengths provide an unparalleled combination of wide-field coverage and high resolution. "Images like these will give astronomers new insight into what those giant complexes of gas and dust really look like," added Jonathan Foster, the paper's author.

The researchers took long-exposure photographs of a star-forming region in the constellation Perseus and were surprised to see something they had never seen before. Just as earthly clouds shine orange at night as they reflect light from streetlights below, they discovered that clouds in outer space show a similar effect. In space, otherwise "dark" clouds of dust and gas are illuminated by faint starlight washing over them. Goodman and Foster dubbed the new celestial phenomenon "cloudshine." Their long-exposure, near-infrared images uncovered the faintly shining billows of material. Recent advances in infrared detectors, combined with longer than usual imaging times, led to the discovery. "Other astronomers have seen hints of cloudshine in their images, but our new photographs are the most spectacular evidence of cloudshine to date," said Goodman.

Reflection nebulae such as the wisps surrounding the Pleiades star cluster have been observed for decades. Importantly, the Pleiades and other famous "nebulae" are illuminated from within, by the stars associated with them, as a cloud is when fireworks explode inside of it. Cloudshine is the result of the illumination of otherwise "dark" clouds from "without," by the faint, and nearly uniform, ambient light produced by the sum of all the stars outside the cloud. Simple modeling in Foster & Goodman's paper demonstrates that there is enough of this faint ambient light to illuminate the clouds at the levels observed.

The cloudshine images were obtained as part of the COMPLETE survey (Coordinated Molecular Probe Line Extinction Thermal Emission) of star-forming regions. COMPLETE involves making wide-field, high-resolution studies of three nearby star-forming regions. COMPLETE will allow for detailed analysis and understanding of the physics of star formation on scales ranging from one-hundredth of a light-year up to 30 light-years.

A companion paper by astronomer Paolo Padoan and colleagues describes theoretical modeling of the cloudshine effect in turbulent clouds of gas. They showed that the near-infrared "color" of a nebula correlates to the nebula's density, and can therefore be used to map its structure. "By using cloudshine, astronomers can study star-forming regions at a very small scale," said Padoan. "We will be able to learn much more about the physics of star formation." Foster and Goodman anticipate gathering many additional images of cloudshine as the COMPLETE survey continues. "We can cover wide areas of the

sky at high resolution relatively quickly," said Foster. "We expect that this will become the best technique for mapping the density of 'dark' clouds with very high resolution." Foster and Goodman's paper reporting the cloudshine observations is available online at <http://arxiv.org/abs/astro-ph/0510624>. A paper on the theory of cloudshine is available online at <http://arxiv.org/abs/astro-ph/0510600>.

COSMIC PORTRAIT OF A PERTURBED FAMILY

An ESO photo shows in amazing details a group of galaxies known as Robert's Quartet. The image is from data collected with the FORS2 multi-mode instrument on the Very Large Telescope. Robert's Quartet is a family of four very different galaxies, located at a distance of about 160 million light-years, close to the centre of the southern constellation of the Phoenix. Its members are NGC 87, NGC 88, NGC 89 and NGC 92, discovered by John Herschel in the 1830s. NGC 87 is an irregular galaxy similar to the satellites of our Milky Way, the Magellanic Clouds. NGC 88 is a spiral galaxy with an external diffuse envelope, most probably composed of gas. NGC 89 is another spiral galaxy with two large spiral arms. The largest member of the system, NGC 92, is a spiral Sa galaxy with an unusual appearance. One of its arms, about 100,000 light-years long, has been distorted by interactions and contains a large quantity of dust.

The quartet is one of the finest examples of compact groups of galaxies. Because such groups contain four to eight galaxies in a very small region, they are excellent laboratories for the study of galaxy interactions and their effects, in particular on the formation of stars.

Using another set of VLT data also obtained with FORS2, astronomers were able to study the properties of regions of active star formation ("HII regions" [3]) in the sister members of Robert's Quartet. They found more than 200 of such regions in NGC 92, with a size between 500 and 1,500 light-years. For NGC 87, they detected 56 HII regions, while the two other galaxies appear to have far fewer of them. For NGC 88, however, they found two plume-like features, while NGC 89 presents a ring of enhanced stellar activity. The system is thus clearly showing increased star formation activity, most probably as the result of the interaction between its members. The sisters clearly belong to a perturbed family. The quartet has a total visual magnitude of almost 13, (i.e. it is about 600 times fainter than the faintest object that can be seen with the unaided eye). The brightest member of the group has a magnitude of about 14. On the sky, the four galaxies are all within a circle of radius of 1.6 arcmin, corresponding to about 75,000 light-years.

MARS KICKS UP DUST AS IT MAKES CLOSEST APPROACH

The Hubble Space Telescope snapped a picture of Mars on October 28, within a day of its closest approach to Earth on the night of October 29, showing a large regional dust storm that appeared as a brighter, redder, cloudy region in the middle of the planet's disk. This storm, which measures 930 miles (1500 km) has been churning in the planet's equatorial regions for several weeks now, and it is likely responsible for the reddish, dusty haze and other dust clouds seen across this hemisphere of the planet. Hubble's took this image when the red planet was 43 million miles (69 million km) from Earth. Mars won't be this close again to Earth until 2018. Mars is now in its warmest months, closest to the Sun in its orbit, resulting in a smaller than normal south polar ice cap which has largely sublimated with the approaching summer. <http://hubblesite.org/news/2005/34>

SCIENTISTS SEE LIGHT THAT MAY BE FROM FIRST OBJECTS IN UNIVERSE

Scientists using the Spitzer Space Telescope say they have detected light that may be from the earliest objects in the universe. If confirmed, the observation provides a glimpse of an era more than 13 billion years ago when, after the fading embers of the theorized Big Bang gave way to millions of years of pervasive darkness, the universe came alive. This light could be from the very first stars or perhaps from hot gas falling into the first black holes. The science team describes the observation as seeing the glow of a distant city at night from an airplane. The light is too distant and feeble to resolve individual objects. "We think we are seeing the collective light from millions of the first objects to form in the universe," said Dr. Alexander Kashlinsky, lead author of an article on the discovery. "The objects disappeared eons ago, yet their light is still traveling across the universe." Scientists theorize that space, time and matter originated 13.7 billion years ago in a Big Bang. Another 200 million years would pass before the era of first starlight. A 10-hour observation by Spitzer's infrared array camera in the constellation Draco captured a diffuse glow of infrared light, lower in energy than optical light and invisible to us. The team says that this glow is likely from Population III stars, a hypothesized class of stars thought to have formed before all others. (Population I and II stars, named by order of their discovery, comprise the familiar types of stars we see at night.)

Theorists say the first stars were likely over a hundred times more massive than Earth's sun and extremely hot, bright, and short-lived, each one burning for only a few million years. The ultraviolet light that Population III stars emitted would be redshifted, or stretched to lower energies, by the universe's expansion. That light should now be detectable in the infrared. "This deep observation was filled with familiar-looking stars and galaxies," said Dr. John Mather, senior project scientist and a co-author on the article. "We removed everything we knew -- all the stars and galaxies both near and far. We were left with a picture of part of the sky with no stars or galaxies, but it still had this infrared glow with giant blobs that we think could be the glow from the very first stars."

This new Spitzer discovery agrees with observations from the Cosmic Background Explorer (COBE) satellite from the 1990s that suggested there may be an infrared background that could not be attributed to known stars. It also supports observations from the Wilkinson Microwave Anisotropy Probe from 2003, which estimated that stars first ignited 200 million to 400 million years after the Big Bang. "This difficult measurement pushes the instrument to performance limits that were not anticipated in its design," said team member Dr. S. Harvey Moseley, instrument scientist for Spitzer. "We have worked very hard to rule out other sources for the signal we observed."

The low noise and high resolution of Spitzer's infrared array camera enabled the team to remove the fog of foreground galaxies, made of later stellar populations, until the cumulative light from the first light dominated the signal on large angular scales. The team, which also includes Dr. Richard Arendt, Science Systems and Applications scientist, noted that future missions, such as NASA's James Webb Space Telescope, will find the first individual clumps of these stars or the individual exploding stars that might have made the first black holes. The instrument's principal investigator is Dr. Giovanni Fazio. Images <http://www.spitzer.caltech.edu/Media/releases/ssc2005-22/visuals.shtml>

CASSINI FINDS PROMETHEUS A SCULPTOR OF SATURN'S RINGS

New findings from members of the Cassini imaging team show that certain prominent features in Saturn's narrow and contorted F ring can be understood in terms of a simple gravitational interaction with the small moon Prometheus. The F ring is notorious for exhibiting unusual structures, like "knots," "kinks," and "clumps" that continue to puzzle astronomers. Cassini images have shown that the gravitational effect of Prometheus appears to produce regular patterns in the ring, including a series of channels or gores in the tenuous ring material interior to the F ring core, and "streamers" of particles that temporarily link the ring to the moon. Prometheus is only about 100 kilometers (60 miles) wide and orbits just interior to the F ring. The Cassini imaging scientists' findings show that Prometheus causes the structure as the moon approaches and recedes from the F ring every 14.7 hours, during its orbit of Saturn.

As an example of a satellite that enters a ring on a regular basis, the phenomenon posed unique challenges to the understanding of ring-satellite interactions. Using Cassini data, the team developed a model that shows the mechanism by which Prometheus, as it recedes from its closest approach to the F ring, gravitationally extracts material from the ring. The affected particles do not escape the F ring region; rather, the changes to their orbits produced by Prometheus cause them to oscillate back and forth across the ring. One orbital period after the encounter, the effect is visible as a dark channel or "gore" in the interior of the F ring, and drape-like structures between the channels - in excellent agreement with Cassini images. In this way, Prometheus leaves its mark on the F ring long after the satellite has moved on.

Dr. Carl Murray lead author of the paper and member of the Cassini Imaging Science Subsystem team said, "As the closer and more massive of the F ring's two shepherding satellites, Prometheus was always the likely culprit for causing changes to this narrow ring. Our model provides a plausible mechanism for the origin of intricate structures detected in the F ring and suggests that streamers, channels and a variety of other phenomena can all be understood in terms of the simple gravitational effect of a satellite on ring particles."

Over time Prometheus is expected to dive deeper into the F ring - with more extreme perturbations - culminating in December 2009 when the two orbits approach their minimum separation.

Dr. Joseph Burns, an imaging team member and also one of the paper's co-authors said, "We're eager to learn what the satellite will do to this narrow, already contorted ring, and in turn whether the ring particles will strike Prometheus, changing its surface." Murray added, "We see the model we have developed very much as a first step in understanding the processes at work. Ultimately this type of research will help us to understand how planets form and evolve." A new image of the F ring is available at <http://ciclops.org>, <http://saturn.jpl.nasa.gov>, and <http://www.nasa.gov/cassini>

SOFTWARE ZOOMS TO NEARLY ANYWHERE ON MOON IN 3-D

Internet users can now take virtual 3-D trips to nearly anyplace on the moon, thanks to a NASA program first designed to show aerial views of the Earth. The newly expanded 'World Wind' computer program can 'transport' Web users to almost anyplace on the moon, when they zoom in from a global view to closer pictures of our natural satellite taken by the Clementine spacecraft in the 1990s. Computer programmers at Ames Research Center in California's Silicon Valley originally designed the World Wind program to deliver satellite images and data of

Earth to the Internet. Users can see detailed 3-D pictures of the Earth's land surface, including its elevation and climate.

"We have just digested the best of the Clementine images, so we can now deliver the moon at 66 feet (20 meters) of resolution," said Patrick Hogan, manager of the World Wind Project Office. "This is a first. No one has ever explored our moon in the 3-D interactive environment that World Wind creates," noted Hogan.

Launched in early 1994, Clementine took 1.8 million pictures of the lunar surface during a two-month orbit of the moon. The Ballistic Missile Defense Organization and NASA jointly sponsored the Deep Space Program Science Experiment that included the Clementine spacecraft. Its principal objective was to 'space-qualify' lightweight imaging sensors and component technologies for the next generation of Department of Defense spacecraft.

"Imagine riding a magic carpet through the world and being able to zoom down to any point, or appear magically at any location. That's what World Wind is like," said Mark Leon, chief of the Education Division. "Not only has Hogan's team produced new technology with World Wind, but they have done so as open source computer code, so it is free for all who would download it," Leon added. "World Wind allows users to explore their (computer) environment at will," Hogan said. "This leads to much greater engagement with, and by, the users and personalizes it for their own discovery." In contrast, movies are not as engaging, or immersive, in that the user does not control them, Hogan observed.

The personal computer (PC)-compatible World Wind program is available free of charge via Internet 'download.' Computer users from more than 100 nations have acquired the free World Wind program, though most users are from the United States. To download World Wind, visit: <http://worldwind.arc.nasa.gov/>

World Wind is delivering terabytes of global satellite data that are a result of years of daily observations of precipitation, temperature, barometric pressure and much more. Recently, hurricane Katrina data have been added to World Wind's collection of images. There are an estimated 10,000 daily users of World Wind. In addition to improving World Wind by adding images of the moon, NASA programmers recently have increased the resolution of images of Earth from 3,281-foot (one-kilometer) resolution to 1,640-foot (500-meter) resolution in an upgrade called 'Blue Marble, Next Generation Earth.' Also, some World Wind data sets include images of the entire Earth at 49-foot (15-meter) resolution. The United States data in World Wind is at 3.3-foot (one-meter) resolution with some urban areas at one-foot (0.33-meter) resolution.

FIRST GIANT MAGELLAN TELESCOPE MIRROR CASTING IS 'PERFECT'

The University of Arizona Steward Observatory Mirror Lab's casting of the first mirror for the Giant Magellan Telescope (GMT) "appears to be essentially perfect," Peter Strittmatter said after astronomers got their first look at the glass last Friday. "We're very happy to see this one come out looking so gorgeous," Roger Angel said. "We'll see more once the mold is removed, but so far, looking through the front surface, it looks great."

The mirror is the first of seven 8.4-meter (27-foot) mirrors that the Mirror Lab is making for the Giant Magellan Telescope. The GMT

is the world's first extremely large ground-based telescope to start construction.

The colossal telescope will feature six giant off-axis mirrors around a seventh on-axis mirror. This arrangement will give it a 22-meter (72-foot) aperture, or 4.5 times the collecting area of any current optical telescope. It will have the resolving power of a 24.5-meter (80-foot) diameter telescope, or 10 times the resolution of the Hubble Space Telescope. The GMT is slated for completion in 2016 at a site in northern Chile.

Randy Lutz and the Mirror Lab casting team knew they had a superb first GMT mirror blank when they removed the casting furnace lid Oct. 21. But they aren't standing around to admire their handiwork. They're racing to remove furnace walls and ready the mirror blank for moving off the furnace hearth.

"We're very eager to get on to the critical part of why we made this mirror -- to the polishing and the testing, which are really the new ground-breaking steps in making this mirror because its shape is so different," Angel said. "We're moving fast because we want to get on with casting the next mirror, a 3.7-meter mirror that will be needed to measure the shape of the GMT primary mirrors." Mirror Lab workers are about to disassemble their facility's 7.5-story test tower (that's 27 meters, or 88 feet) and construct a higher tower that will hold the 3.7-meter (12-foot) mirror for measuring the off-axis GMT mirrors. The test mirror is crucial for making measurements needed for shaping all the primary mirrors so they gather and focus light as a single gargantuan primary mirror. Meanwhile, Steward Observatory Mirror Lab scientists Buddy Martin and Jim Burge are already polishing a one-fifth scale prototype of the GMT primary. Polishing the full size off-axis mirror will be a huge step forward in the GMT project, Angel said.

For the casting last July, Mirror Lab workers used 40,000 pounds of Ohara E-6 borosilicate glass. The furnace hit peak temperature, 2,150 degrees Fahrenheit (1,178 Celsius) on July 23. As the furnace rotated at 5 revolutions per minute, glass melted around the 1,681 hexagonal cores in the mold. This created a 'honeycomb' mirror blank with a faceplate of the desired curvature. The honeycomb mirror weighs only a fifth as much as would a solid mirror of the same size.

The first GMT primary is the third 8.4-meter mirror cast at the Steward Observatory Mirror Lab. The GMT builds on the very successful 6.5-meter (21-foot) Magellan telescopes which many of the same GMT partners operate in Chile. The two other 8.4-meter mirrors cast at the Mirror Lab are at the Large Binocular Telescope (LBT) on Mount Graham, AZ, Italian and German partners in the LBT released 'first light' images obtained with the first of the LBT's primary mirrors yesterday (Oct. 26). The LBT, the forerunner of the GMT, will be the world's most powerful single telescope when its two primary mirrors, mounted side-by-side, become operational in 2006.

FROM THE EDITOR'S TERMINAL

The Stargazer is your newsletter and therefore it should be a cooperative project. Ads, announcements, suggestions, and literary works should be received by the editor before the 1st of the month of publication, for example, material for May's newsletter should be received May 1st. If you wish to contribute an article or suggestions to *The Stargazer* please contact Mark Folkerts by email or by telephone (425) 486-9733 or co-editor Bill O'Neil, at (774) 253-0747.

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<p>The next EAS Meeting is 3:00 P.M. SATURDAY, November 19th at the Everett Public Library Auditorium.</p>
