



# The Stargazer

August 2005

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	(change 'at' to @ to send email) <a href="http://members.tripod.com/everett_astronomy">http://members.tripod.com/everett_astronomy</a>	

## EAS BUSINESS...

**NEXT EAS MEETING - SATURDAY AUGUST 27<sup>TH</sup> AT 3:00 PM AT THE EVERETT PUBLIC LIBRARY, IN THE AUDITORIUM (DOWNSTAIRS)**

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>

**Scheduled Meeting Dates: (NOTE THAT THEY CHANGE)**

**Aug 27 - EAS Meeting – SATURDAY 3:00 PM at Everett Public Library – Program will be 'Destination Mars', an in-depth look at the science and logistics of a first manned mission to the Red Planet. (Mars is looming brighter in the evening sky as it approaches opposition at Halloween)**

## CLUB STAR PARTY INFO

### Upcoming star party schedule:

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.

### Camp Delaney Star Party – Labor Day Weekend ---

"My name is Cliff Mygatt and I am the President of the Olympic Astronomical Society in Bremerton. I would like to invite your EAS members to our annual camp Delaney star party at Sun Lakes state park. The star party will be over Labor Day weekend. We have had several of your members attend over the years. If any members are interested, they can contact me at [cliffandchris@wavecable.com](mailto:cliffandchris@wavecable.com) Cost is \$50.00 due to additional day of food and lodging. Anyone interested in attending can get a registration form from me, which needs to be in by 24 Aug. . Thanks, LCDR Cliff Mygatt"

### Oregon Star Party – Labor Day Weekend -

I would like to ask that you include a note in your next newsletter, and/or announce at your next meeting that our registration for the 2005 Oregon Star Party is online and available. It is a short 3 months until OSP and we have a great lineup of speakers, events, and of course, the dark central Oregon skies. We invite your members to tour our website at <http://www.oregonstarparty.org> to obtain more information, register, and plan for a great Labor Day star party. Thanks much, and I hope we see you soon!

- Bill Jensen, OSP Committee

**Klickitat County Star Party(s)** <http://klickitatstarparty.net/>

Sept 30th - Oct 2nd, 2005

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

The club maintains a \$500+ balance. We try to keep approximately a \$500 balance to allow for contingencies. Emailing a digital copy of the newsletter has been suggested to reduce printing and postage costs, and speed up delivery, please email Mark if electronic copy would be OK for you.

## 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

### August 2005

Aug 01 - Alpha Capricornids Meteor Shower Peak  
**Aug 4-6 - Table Mountain Star Party**  
 Aug 04 - Furthest lunar apogee of 2005  
 Aug 05 - Neil Armstrong's 75th birthday (1930)  
 Aug 06 - Southern Iota Aquarids meteor shower peak  
 Aug 08 - Neptune at opposition – visible all night  
 Aug 12 - Perseids meteor shower peak  
 Aug 24 - Mercury at Greatest Western Elongation (18 degrees from Sun)  
 Aug 25 - Northern Iota Aquarids meteor shower peak  
**Aug 27 - EAS MEETING - Saturday 3:00 PM at Everett Public Library**  
 Aug 31 - Uranus at opposition – visible all night

### September 2005

Sep 01 - Uranus at opposition  
 Sep 01 - Venus passes 1.2 degrees from Jupiter

Sep 03 - New Moon  
 Sep 03 - Potential Saturday EAS star party night, location TBD  
**Sep 1-4 - Oregon Star Party**  
**Sep 2-5 - Olympic Astronomy - Dry Falls Star Party**  
 Sep 05 - Labor Day holiday  
 Sep 07 - Moon occults Venus  
 Sep 22 - Autumnal Equinox (22:23 UT) - 1<sup>st</sup> day of autumn N hemisphere  
**Sep 24 - EAS MEETING - Saturday 3:00 PM at Everett Public Library**

### October 2005

Oct 01 - Potential Saturday EAS star party night, location TBD  
 Oct 03 - New Moon  
 Oct 03 - Annular Solar Eclipse, Visible From Africa  
 Oct 04 - Moon occults Mercury  
 Oct 05 - Mercury passes 1.3 degrees From Jupiter  
 Oct 09 - Draconids meteor shower Peak  
 Oct 16 - Venus occults PPM 265560 (7.7 Magnitude Star)  
 Oct 17 - Partial Lunar eclipse  
 Oct 21 - Orionid meteor shower peak  
**Oct 29 - EAS MEETING - Saturday 3:00 PM at Everett Public Library**  
 Oct 30 - Daylight Saving - set clock back 1 Hour

### November 2005

Nov 01 - New Moon  
 Nov 05 - Potential Saturday EAS star party night, location TBD  
 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 4:00 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 10<sup>th</sup> or 17<sup>th</sup> - EAS Dinner - Saturday 7:00 PM**

### 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 at lioninc.com, to borrow or donate any

materials. See list here:  
[http://members.tripod.com/everett\\_astronomy/eas\\_library.htm](http://members.tripod.com/everett_astronomy/eas_library.htm)

### 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](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

Aug 13	First Quarter Moon
Aug 19	Full Moon
Aug 26	Last Quarter Moon
Sep 03	New Moon
Sep 11	First Quarter Moon
Sep 18	Full Moon
Sep 25	Last Quarter Moon
Oct 03	New Moon
Oct 10	First Quarter Moon
Oct 17	Full Moon
Oct 25	Last Quarter Moon
Nov 02	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](http://www.lpi.usra.edu/research/lunar_orbiter)

### UP IN THE SKY -- THE PLANETS

Object	Rises	Transits	Sets	Con	Mag
<b>Sun</b>	<b>6:21 am</b>	<b>13:10</b>	<b>19:58</b>	<b>Leo</b>	<b>-27</b>
<b>Mercury</b>	<b>4:44 AM</b>	Daylight	Daylight	Can	-0.6
<b>Venus</b>	Daylight	Daylight	<b>21:13</b>	<b>Vir</b>	<b>-4.0</b>
<b>Mars</b>	<b>22:32</b>	<b>5:40 AM</b>	Daylight	<b>Ari</b>	<b>-0.9</b>
<b>Jupiter</b>	Daylight	Daylight	<b>21:27</b>	<b>Vir</b>	<b>-1.7</b>
<b>Saturn</b>	<b>3:43 am</b>	Daylight	Daylight	<b>Can</b>	<b>+0.3</b>
<b>Uranus</b>	<b>20:03</b>	<b>1:30 am</b>	Daylight	<b>Aqr</b>	<b>+5.7</b>
<b>Neptune</b>	Daylight	<b>23:55 am</b>	4:48 am	<b>Cap</b>	<b>+7.8</b>
<b>Pluto</b>	Daylight	<b>20:10 am</b>	1:07 am	<b>Ser</b>	<b>+13.7</b>

(times local time for Everett PDT)

### Transit times for Jupiter's Great Red Spot in 2005

[http://skyandtelescope.com/observing/objects/planets/article\\_107\\_2.asp](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.srb.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: PEGASUS

**PEGASUS:** (The Winged Horse). With a midnight culmination date of September 1<sup>st</sup>, Pegasus is well-placed for late summer and Fall viewing. Pegasus borders on the constellations of Andromeda, Aquarius, Cygnus, Delphinus, Equuleus, Lacerta, Pisces, and Vulpecula, and contains the well-known asterism of The Great Square (composed of the famous stars of Markab, Scheat, Algenib, and Alpheratz), and the lesser known asterisms of The Baseball Diamond and another dipper known as The Large Dipper (as opposed to the Big Dipper of Ursa Major). Pegasus ranks 75<sup>th</sup> in overall brightness among the constellations, but 7<sup>th</sup> in size: it takes up approximately 1120.8 square degrees of the sky (2.717%). Pegasus contains two known meteor showers: the Xi Pegasids (July 9) and the Pegasids (November 12). Pegasus contains one Messier object: M-15. M-15 is the most easily found deep-sky object in Pegasus for amateur astronomers, and is a bright (7<sup>th</sup> magnitude) globular cluster. M-15 is the only known globular cluster containing a planetary nebula (almost 15<sup>th</sup> magnitude; one second of arc in diameter). M-15 is located 40,000 light-years away from Earth, and itself has a diameter of 12 minutes of arc. M-15 contains many variable stars, and is one of the richest globulars with respect to variable stars, most of which are RR Lyrae stars. M-15 is a very unusual globular cluster for several reasons: in addition to the planetary nebula and the high concentration of variable stars as mentioned above, M-15 also is an intense X-ray source, leading astronomers to speculate that it contains a central black hole, which is postulated to be the cause of one of the most concentrated and bright cores of any of the globular clusters in the night sky. Pegasus is completely

visible from latitudes North of -54 degrees, and completely invisible from latitudes South of -88 degrees. It has 57 stars brighter than magnitude 5.5, and its central point is at RA=22h39m, Dec.= +19 degrees. The solar conjunction date of Pegasus is March 2<sup>nd</sup>.

Pegasus contains many other interesting objects as well as M-15. A few of them are listed as follows: AG Pegasi (one of the brightest symbiotic stars, containing both a Wolf-Rayet star and an M-giant star); NGC-7331 (10<sup>th</sup> magnitude Sb-type spiral galaxy); NGC-7217 (a magnitude 10.2, Sb-type nearly face-on spiral with relatively high surface brightness); NGC-7332 (11<sup>th</sup> magnitude elliptical (E7) galaxy with a visible lens-shape); NGC-7448 (11.7 magnitude Sc spiral exhibiting a bright nucleus encircled by a irregular dim haze); NGC-7479 (11<sup>th</sup> magnitude, beautiful barred spiral); and NGC-7619 and NGC-7626 (two of the brighter members, and both ellipticals, of the Pegasus-I galaxy cluster). Perhaps the next famous deep-sky object of Pegasus after M-15 is actually a combination of five galaxies – Stephan's Quintet. The brightest member (magnitude 12.7 spiral) of the Quintet is NGC-7320; the others are all 13<sup>th</sup> magnitude galaxies: NGC-7317 (elliptical), NGC-7318-A (peculiar elliptical), NGC-7318-B (peculiar barred spiral), and NGC-7319 (peculiar barred spiral). This assemblage of galaxies all lie along the same line of sight; however, while the brightest of the five (NGC-7320) lies 13 megaparsecs away, the remaining four all lie at a distance of 90 megaparsecs!!

There are some other interesting facts about Pegasus which should not be overlooked for the amateur astronomer. The first object in the New General Catalog (NGC-1), lies within Pegasus. NGC-1 is a faint, 13<sup>th</sup> magnitude galaxy which shows minimal detail in most amateur scopes. A good test of vision and darkness for a dark-sky observing site is to count the stars within the Great Square; 30-50 stars have been reported, and the closer towards 40 or 50 stars, obviously the better the observing. Finally, the constellation of Pegasus contains a good example of what is known as a "shared star": Alpha Andromedae had been known as Delta Pegasi on some ancient maps, but was assigned to Andromeda permanently by the IAU in 1928; i.e., it was "shared" by more than one constellation before 1928. Be sure to make the wonders of Pegasus an integral part of your Fall observing.

### YOUNG ASTRONOMER'S CORNER

The Young Astronomer's Corner addresses items of interest to young astronomers. Sometimes, particular questions are asked so frequently among young astronomers, that they bear repeating.

**"ARE ALL THE STARS THE SAME?"** is just such a question. This is a repeat, but modified, column first published in the *Stargazer* in 1998. There is often confusion regarding the fact that all stars indeed are not the same: there are many different properties of stars, such as temperature, that distinguish one from the other. As a result of this confusion, this column is worth repeating for all "Young Astronomers" readers.

If you've studied any Astronomy in school, perhaps you've seen the letters **OBAFGKM**, all in a row and listed exactly like that. What does this mean??? Perhaps you recall that in several previous *Young Astronomer's Corners* we've talked about the fact the even though most stars look like white dots from earth, there ARE some that are unusual looking, even from earth. Vega and Sirius are very bright and bluish-white, while Arcturus and Betelgeuse are yellowish-orange, even to the naked eye. These are OBVIOUSLY different, even without the aid of binoculars or telescopes. What's causing this distinct difference? By looking

closely at the light from these stars, such as through an instrument utilizing a slit and a prism (a spectroscope; you've probably seen the resulting "rainbow of light" when light passes through a crystal, or even through millions of raindrops, forming (you guessed it!).....a rainbow!!), we can see that the pattern formed is a continuous spectrum of colors (the different wavelengths of light, or 'colors'), on which are superimposed darker (absorption) and brighter (emission) lines.

Believe it or not, this is a tremendous amount of information (i.e., star color) that relates closely to the surface temperature of the star, and, as a result, enables astronomers to figure out many basic properties of the star itself. The traditional way to remember the letters above are "Oh Be A Fine Girl (or Guy) Kiss Me"; these letters are still used today. The colors of the stars closely relate to the surface temperatures and chemical makeup of the stars, which frequently relate to the mass and life cycle stage of the star. Red Giants, Blue Supergiants, Red Dwarfs, White Dwarfs, and various and sundry Yellow Stars all have their place in a spectroscopic chart of the stars, and the color / temperature of the star can be charted against the absolute magnitude (brightness) of the star to learn much about its stage of evolution, or where it is in its life cycle. That is, its age and relative size and temperature, and what chemicals it is composed of (different chemicals in the stars "give off" different colors upon analysis of their starlight), can be compared to other stars in the sky. On such a chart, the "O" in our saying above generally corresponds to the hotter and younger stars, while the "M" generally corresponds to older, cooler stars. Our own sun, if viewed from very far away outside our own solar system, would be an unspectacular yellow dwarf "G" star. But all things are relative, because from earth, the sun is by far the most spectacular natural object around, and we cannot live without it! So then, with respect to temperature and color, size and mass, magnitude or brightness, chemical composition or makeup, and life-stage and age, one star can be **VERY** different from another....that is, they are **NOT** all the same!

#### ASTRONOMY AND TELESCOPE LINGO

This column will return in September with all new content.

#### PLANETARY FOCUS

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

#### ASTRONOMY FUN FACTS

★★ The Earth, in the year A.D. 51, 974, may receive a return reply message from the Great M-13 globular in the constellation Hercules. This would be in response to the first extraterrestrial radio transmission from the Earth, sent from Earth toward this area of the sky in 1974 from the 1,000 foot Arecibo radio telescope during the dedication of the dish's new surface. The time it takes for the message to reach M-13 and return to Earth.....at the speed of light.....is 50,000 years. By the time the message reaches the cluster, it will have also spread out to be about as wide as it.....about 150 light-years (about 9.5 million times the Earth-Sun distance). If there are any advanced civilizations living in the M-13 vicinity at the time, they should hear the signal!!

★★ One of the greatest mountains in the solar system lies in the eastern Ishtar Terra highlands on Venus; it is known as Maxwell Montes. It is almost 35,000 feet above the "plain" level of Venus

(an imaginary sphere with the planet's average radius of 3,758 miles), and is almost 1.2 miles (~2 kilometers) higher than Mt. Everest on Earth. The Maxwell mountain region is very rough terrain, the roughest on Venus according to Pioneer -Venus measurements. This spacecraft also discovered a dark feature on the eastern slopes of Maxwell Montes, with a diameter of about 60 miles and a depth of about 3,000 feet; this is believed to be a volcanic crater almost 3 times larger than the largest caldera on Earth. About nine cities the size of New York could fit at the bottom of this massive cone crater.

★★ The motion of the Sun across Mercury's sky, when the planet is closest to the Sun in its orbit, is strange to say the least. From a site on Caloris Basin (Mercury's largest geographical feature), viewers (who would need protection from broiling temperatures) would see the Sun (also 3x larger than it appears in Earth's sky) first rise in the east. Then it would move very slowly across the sky, slow down and come to a complete halt when almost due south, and then again move westward, finally setting in the west. An interesting detail however of Mercury's Sun cycle is that the entire process of sunrise, sunstop, and sunset would take about 88 Earth days!

★★ A baseball hit on the surface of the asteroid Eros would reach escape velocity immediately. It would go into orbit around the sun, and would never come down!!

★★ The Big Bang singularity at Plank time was the ultimate black hole; infinite temperature and density existed; (Plank time is that time after the big bang where the uncertainty principle of quantum mechanics prevents speculation on times shorter than it). What we are and where we live today emerged from this initial black hole. Some scientists conjecture that our universe began as a black hole in another universe, which began as a black hole in another universe, etc..., etc....!!

★★ The strong nuclear force governs the reactions between nuclear particles. If this force had been more forceful by a few percent during the first moments of the universe, then helium-2, which presently does not exist, would have been created in large quantity. The stars would have been made of helium instead of primarily hydrogen, and would have been very unstable as a result. They would have burned and/or exploded quickly, and the life of our universe would have been very quick indeed.

#### 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). CLASS OF OBJECT: CLUSTER OF GALAXIES (or GALAXY CLUSTER):** This is a grouping of galaxies, which may contain as much as a few thousand member galaxies. The majority of galaxies appear to occur in clusters or in smaller groups such as

doublets or triplets. The Local Group (of which the Milky Way is a member), is a smaller, irregular galaxy cluster; irregular clusters may be large or small, but tend to contain more variable types of galaxies as members (e.g., barred spirals, ellipticals, regular spirals). The larger, denser clusters tend to have more uniform membership amongst their hundreds or thousands of members (for example, most members of the group may be elliptical galaxies, rather than a more variable mix). Adjacent galaxy clusters are grouped into larger superclusters. Rich galaxy clusters are those with higher concentrations of galaxies in their centers; the Abell Catalogue lists many of this latter type, and the Coma and Perseus clusters are examples. The mass required to keep the galaxies in rich clusters gravitationally bound is about 10 times greater than the mass actually observed. The large amount of hot gas that galaxy clusters have been shown to contain is not sufficient to explain this “missing mass”. In irregularly shaped clusters, the gas is associated with individual galaxies, but in regular galaxy clusters, this gas has been shown to form more of a large common pool between the galaxies; this “regular cluster” gas then is more enriched as a result of cluster member interactions, and tends to be more metallic as a result.

Hot, intracluster gas loses energy via X-ray radiation; gas in the cluster core is most dense. Cooling gas flows inward towards the center of the cluster to maintain the pressure required to support the mass of the outer hot atmosphere; this forms a cooling flow. Cooling flows have been detected from X-ray spectra in 70-90% of all larger galaxy clusters; these cooling flows can deposit up to several hundred solar masses per year towards the center of the cluster. A significant portion of this flow will be deposited to the centrally located cD galaxy, which are the most massive galaxies yet detected. Recent studies show that galaxy clusters are a relatively recent phenomenon, evolving from the merging of smaller clusters to form the rich clusters observed today. More distant galaxy clusters show a greater proportion of blue galaxies; this color is due to star formation (initiated either by ram pressure stripping of galaxies in merging subclusters, or by interactions between galaxies on the periphery of the cluster).

**REPRESENTATIVE NORTHERN HEMISPHERE OBJECT:**

**Virgo Cluster:** A giant irregular galaxy cluster lying near the North Galactic Pole in the constellation of Virgo. With a distance of approximately 15 megaparsecs, it is the nearest large cluster to earth. About 2,500 galaxies have been observed in this cluster, and about 75% are spirals; the remaining members are mostly ellipticals. One of this cluster's brightest members (the giant elliptical M-87), is a radio source and an X-ray source, and the X-ray halo around this galaxy is contributing about 10 solar masses per year to the slight cooling flow. Another large member of the group (M-86), is, (in addition to being an X-ray source as well), exhibiting this X-ray source as a ‘plume’ directed away from the center of the galaxy; this is as a result of the gas being stripped away from the galaxy by ram pressure as it descends into the cluster proper. The Virgo cluster is the center of the Local Supercluster, which itself exerts a considerable gravitational influence on the Local Group of galaxies, of which the Milky Way is a member.

**REPRESENTATIVE SOUTHERN HEMISPHERE OBJECT:**

**Fornax Cluster:** This cluster in the constellation of the same name contains 18 bright galaxies and at least 10 fainter ones; these are all compressed into an area of about a 6-degree diameter circle, and most members lie between 20 and 25 megaparsecs away from Earth. NGC-1380 is at the center of the cluster, and is a lenticular shaped galaxy. There are several other member galaxies within the one degree field of this central cluster galaxy: it is possible to see nine galaxies total with NGC-1380

centered. There are still other galaxies just outside this immediate area. About one degree southwest of this main cluster is NGC-1365, also known as the "Great Barred Spiral of Fornax". NGC-1365 shines at magnitude 9.5, and measures 9.8' x 5.5'; it is one of the brightest galaxies in the area, and the spiral arms and bar structure are visible in backyard telescopes.

**3). 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...

### WATCH THE TWO BRIGHTEST PLANETS KISS IN TWILIGHT

Anyone who looks low in the west early on a clear evening for the next couple of weeks will witness an unusual sight. Venus and Jupiter, the two brightest planets, will draw closer and closer together from day to day, will then have an eye-catching conjunction (close pairing) on the evenings of August 31 to September 2, 2005, and then will begin to move apart.

The direction to look is low in the west-southwest, and the best time is about 40 to 60 minutes after your local sunset. The brightest of the two "stars" shining there will be Venus. Jupiter closes in on it from the upper left during August and passes closest to it on September 1st, when the two will appear

separated by hardly the width of your finger held at arm's length (about 1.2 degrees).

Also in the vicinity is the much dimmer star Spica. If Spica isn't bright enough to show through the twilight, binoculars should reveal it easily. In addition, the waxing crescent Moon joins the party on September 6th and 7th.

Sky and Telescope provides a series of daily sky scenes that illustrate what to look for in the fading twilight on any date from August 21st through September 7th. They can also be played in sequence as a QuickTime movie to show the dance of the planets, Spica, and the Moon throughout this period.

Although these objects appear the same distance away as you watch them in the deepening dusk, this is very much an illusion. Venus is roughly 106 million miles from Earth (its distance changes during the period illustrated), while Jupiter is 575 million miles away, more than five times farther. The Moon is about 220,000 miles distant; Spica lies 1.5 quadrillion miles in the background.

Such big distances are better expressed by how long it takes light to cross them. Venus is about 10 light-minutes from Earth. Jupiter is 52 light-minutes from us, the Moon is only 1.2 light-seconds away, and Spica is some 260 light-years away. The light reaching your eyes from these sights has been in flight for very different amounts of time -- something to think about when gazing at this unearthly view. [http://skyandtelescope.com/aboutsky/pressreleases/article\\_1569\\_1.asp](http://skyandtelescope.com/aboutsky/pressreleases/article_1569_1.asp). Permission is granted for one-time, nonexclusive use in print and broadcast media, as long as appropriate credits are included. Web publication must include a link to <http://SkyandTelescope.com>. [http://skyandtelescope.com/observing/ata glance/article\\_110\\_1.asp](http://skyandtelescope.com/observing/ata glance/article_110_1.asp)

### '10TH PLANET' HAS A PLUTO-LIKE SURFACE

Gemini Observatory has obtained a preliminary spectrum of 2003 UB313, the so-called "10th planet". These observations were obtained on January 25, 2005 by Chad Trujillo, who is also on the discovery team for 2003 UB313, the existence of which was formally announced by the Minor Planet Center on July 29, 2005. The discovery team (Mike Brown, Chad Trujillo and David Rabinowitz) are still uncertain of the exact size of the body, but report that it must be Pluto-sized or larger. The body is the most distant solar system body known to orbit the sun at 97 AU from the sun, over 3 times farther away than planet Pluto. The "planet" was originally discovered in late December 2004 with data collected from the Samuel Oschin 1.2 meter telescope at Palomar Mountain. To better characterize the surface of the object the team obtained spectra with NIRI (the near-infrared spectrograph) on the much larger 8 meter Gemini North telescope on Mauna Kea. The NIRI spectra shows strong signatures of methane ice, remarkably similar to the spectrum of Pluto, which is also dominated by methane ice in near-infrared observations. Figure 2 shows the spectra of Pluto and 2003 UB313, with arrows marking the "dips" that correspond to methane features. The same features are readily apparent in both the Pluto and the 2003 UB313 spectra. 2003 UB313 spectrum and Pluto spectra show "dips" characteristic of methane ice that are present in both 2003 UB313 and Pluto. Trujillo states, "*We still do not know much about this object, however, it is clear that it is very similar to Pluto in both size and composition, at least upon first glance.*" The presence of methane ice is unusual in that it indicates a primitive surface that has not likely been heated significantly since the solar system formed 4.5

billion years ago. "If 2003 UB313 ever got close to the sun, all the methane ice would have boiled off immediately," Trujillo continued. "To date, no one has seen methane on any other Kuiper Belt Object, only on Pluto and Neptune's moon Triton." The distant Kuiper Belt is a collection of bodies orbiting the sun beyond Neptune, and is likely the parent population to the comets. The team have also obtained spectra of the smaller mini-planet 2003 EL61, which was reported on July 28, 2005 by two independent teams: one from the Sierra Nevada Observatory in Spain and the Brown, Trujillo and Rabinowitz team. This object is smaller than Pluto, but shows strong water-ice features, similar to what is seen on the surface of Pluto's moon Charon.

### SATURN'S RINGS HAVE OWN ATMOSPHERE

Data from the Cassini spacecraft indicate that Saturn's majestic ring system has its own atmosphere - separate from that of the planet itself. During its close fly-bys of the ring system, instruments on Cassini have been able to determine that the environment around the rings is like an atmosphere, composed principally of molecular oxygen. This atmosphere is very similar to that of Jupiter's moons Europa and Ganymede. The finding was made by two instruments on Cassini, the Ion and Neutral Mass Spectrometer (INMS) and the Cassini Plasma Spectrometer (CAPS) instrument, the latter having a European involvement with co-investigators from US, Finland, Hungary, France, Norway and UK.

Saturn's rings consist largely of water ice mixed with smaller amounts of dust and rocky matter. They are extraordinarily thin: though they are 250 000 kilometers or more in diameter they are no more than 1.5 kilometers thick. Despite their impressive appearance, there is very little material in the rings - if the rings were compressed into a single body it would be no more than 100 kilometers across. The origin of the rings is unknown. Scientists once thought that the rings were formed at the same time as the planets, coalescing out of swirling clouds of interstellar gas 4000 million years ago. However, the rings now appear to be young, perhaps only hundreds of millions of years old. Another theory suggests that a comet flew too close to Saturn and was broken up by tidal forces. Possibly one of Saturn's moons was struck by an asteroid smashing it to pieces that now form the rings.

Though Saturn may have had rings since it formed, the ring system is not stable and must be regenerated by ongoing processes, probably the break-up of larger satellites. Water molecules are first driven off the ring particles by solar ultraviolet light. They are then split into hydrogen and atomic oxygen, by photo-dissociation. The hydrogen gas is lost to space, the atomic oxygen and any remaining water are frozen back into the ring material due to the low temperatures, and this leaves behind a concentration of oxygen molecules on the ring surfaces and, maybe through ion-neutral chemistry, molecular oxygen is formed, but this is not yet well understood. Dr Andrew Coates, co-investigator for CAPS, said: "As water comes off the rings, it is split by sunlight; the resulting hydrogen and atomic oxygen are then lost, leaving molecular oxygen." "INMS and CAPS see molecular oxygen ions, and CAPS sees an 'electron view' of the rings. These represent the ionized products of that oxygen and some additional electrons driven off the rings by sunlight." Dr Coates said the ring atmosphere was probably kept in check by gravitational forces and a balance between loss of material from the ring system and a re-supply of material from the ring particles.

### CASSINI FLIES BY SATURN'S TORTURED MOON MIMAS

On its recent close flyby of Mimas, the Cassini spacecraft found the Saturnian moon looking battered and bruised, with a surface

that may be the most heavily cratered in the Saturn system. The Aug. 2 flyby of Saturn's 'Death Star' moon returned eye-catching images of its most distinctive feature, the spectacular 140-kilometer diameter (87-mile) landslide-filled Hershel crater. Numerous rounded and worn-out craters, craters within other craters and long grooves reminiscent of those seen on asteroids are also seen in the new images. The new Mimas images are available at <http://saturn.jpl.nasa.gov> <http://www.nasa.gov/cassini> and <http://ciclops.org>. Also available is an approach movie showing Mimas, and a zoom and pan across the surface of one of the highest resolution images. The closest images show Mimas, measuring 397 kilometers (247 miles) across, in the finest detail yet seen. One dramatic view acquired near Cassini's closest approach shows the moon against the backdrop of Saturn's rings. A false color composite image reveals a region in blue and red of presumably different composition or texture just west of, and perhaps related to, the Hershel crater. Scientists hope that analysis of the images will tell them how many crater-causing impactors have coursed through the Saturn system, and where those objects might have come from. There is also the suspicion, yet to be investigated, that the grooves, first discovered by NASA's Voyager spacecraft but now seen up close, are related to the giant impact that caused the biggest crater of all, Herschel, on the opposite side of the moon.

### FIRST TRIPLE ASTEROID SYSTEM FOUND

One of the thousands of asteroids orbiting the sun has been found to have a mini planetary system of its own. Astronomer Franck Marchis and his colleagues at the Observatoire de Paris have discovered the first triple asteroid system - two small asteroids orbiting a larger one known since 1866 as 87 Sylvia.

Because 87 Sylvia was named after Rhea Sylvia, the mythical mother of the founders of Rome, Marchis proposed naming the twin moons after those founders: Romulus and Remus. The International Astronomical Union (IAU) approved the names, to be announced in its Aug. 11 circular.

The asteroid 87 Sylvia is one of the largest known from the asteroid main belt, which is located between the orbits of Mars and Jupiter. Shaped like a lumpy potato, Sylvia is about 280 kilometers (175 miles) in diameter and is located in the Cybele outer part of the belt, about 3.5 astronomical units (AU) from the sun. An AU is 93 million miles, the average distance between the sun and Earth. [http://astron.berkeley.edu/~fmarchis/document/Sylvia/Movies/ES\\_O\\_movie\\_SMALL.mov](http://astron.berkeley.edu/~fmarchis/document/Sylvia/Movies/ES_O_movie_SMALL.mov)  
[http://astron.berkeley.edu/~fmarchis/document/Sylvia/Movies/sylvia\\_animAug2004.mpg](http://astron.berkeley.edu/~fmarchis/document/Sylvia/Movies/sylvia_animAug2004.mpg)  
[http://astron.berkeley.edu/~fmarchis/document/Sylvia/Movies/sylvia\\_animNov2005.mpg](http://astron.berkeley.edu/~fmarchis/document/Sylvia/Movies/sylvia_animNov2005.mpg)

Four years ago, Sylvia was discovered to have a moon, making it one of some 60 known binary asteroids in various asteroid populations of the solar system. Seventeen of these binary systems are in the main asteroid belt and have been imaged directly either by adaptive optics systems on large, ground-based telescopes or by the Hubble Space Telescope.

Now, a second moon has been seen around Sylvia, making it a triple asteroid system. Sylvia's newly discovered moons orbit in nearly circular orbits in the same plane and direction (prograde) as the moon orbits the Earth. The closest moonlet, orbiting about 710 km (450 miles) from Sylvia, is Remus, a body only 7 km (4.4 miles) across and circling Sylvia every 33 hours. The second, Romulus, orbits at about 1360 km (860 miles), measures about

18 km (11.3 miles) across, and orbits in 87.6 hours. The asteroid Sylvia spins at a rapid rate, once every 5 hours and 11 minutes.

*"People have been looking for multiple asteroid systems for a long time, because binary asteroid systems in the main belt seem to be common and formation scenarios, such as a collision between two asteroids followed by disruption and re-accretion, suggest that fragments should be orbiting bigger asteroids,"* Marchis said. *"I couldn't believe we found one."*

From two months' of observations of the moonlets' orbits, Marchis and his Paris colleagues were able to precisely calculate the mass and density of Sylvia, which shows it to be a "rubble-pile" asteroid, Marchis said. These asteroids are loose aggregations of rock presumably created when one asteroid smacked into another, disrupting one or both of them. A new asteroid formed later by accretion of large fragments from the disruption. The moonlets probably are debris left over from the collision that were gravitationally captured by the newly formed asteroid and which eventually settled into orbits around it. *"That's why most main-belt asteroids with companions have a rubble-pile structure,"* he said. *"Because of the scenarios of their formation, we expect to see more multiple asteroid systems like this."* The density, 1.2 grams per cubic centimeter, is 20 percent higher than the density of water, which suggests it is composed of water, ice and rubble from a primordial asteroid, probably a hydrated carbonaceous chondrite, based on previous spectroscopic studies of the asteroid. *"It could be up to 60 percent empty space,"* said astronomer Daniel Hestroffer, one of three co-authors.

The discovery was made with one of the ESO's 8-meter telescopes (Yepun) of the Very Large Telescope at Cerro Paranal, using the telescope's infrared camera and the high angular resolution provided by the adaptive optics system (NACO). Via the observatory's promising "service observing mode," Marchis and his colleagues were able to obtain sky images of many asteroids over a six-month period without actually having to travel to Chile. DVD data of the observations were sent regularly via mail to Berkeley. Marchis had the discovery sitting on his shelf for months, since November 2004, because he waited for the completion of the project before starting to process the data and before sending them to colleague Pascal Descamps. Just as Marchis was set to go on vacation in March 2005, Descamps sent him a brief note entitled "87 Sylvia est triple?" pointing out that he could see two moonlets around several images of Sylvia. The entire team then focused quickly on analysis of the data, wrote a paper, submitted an abstract to the August meeting in Rio de Janeiro, and submitted a naming proposal to the IAU.

Marchis and his colleagues hope to use the adaptive optics of the Keck and the Gemini telescopes to obtain better images of the triple-asteroid system in order to pin down the precise orbits, verify Sylvia's formation scenario and chart the system's evolution. Already they see precession of the moon's orbits resulting from the irregular shape of Sylvia.

#### **DISCOVERY SUGGESTS 'PROTOSUN' WAS SHINING DURING FORMATION OF FIRST MATTER IN SOLAR SYSTEM**

From chemical fingerprints preserved in primitive meteorites, scientists have determined that the collapsing gas cloud that eventually became our sun was glowing brightly during the formation of the first material in solar system more than 4.5 billion years ago. Their discovery provides the first conclusive evidence that this "protosun" played a major role in chemically shaping the solar system by emitting enough ultraviolet energy to catalyze the

formation of organic compounds, water and other compounds necessary for the evolution of life on Earth. Scientists have long argued whether the chemical compounds created in the early solar system were produced with the help of the energy of the early sun or were formed by other means. *"The basic question was, Was the sun on or was it off?"* says Mark H. Thiemens who headed the research team that conducted the study. *"There is nothing in the geological record before 4.55 billion years ago that could answer this."*

Vinai Rai came up with a solution, developing an extremely sensitive measurement that could answer the question. He searched for chemical fingerprints of the high-energy wind that emanated from the protosun and became trapped in the isotopes, or forms, of sulfide found in four primitive groups of meteorites, the oldest remnants of the early solar system. Astronomers believe this wind blew matter from the core of the rotating solar nebula into its pancake-like accretion disk, the region in which meteorites, asteroids and planets later formed. Applying a technique Thiemens developed five years ago to reveal details about the Earth's early atmosphere from variations in the oxygen and sulfur isotopes embedded in ancient rocks, the chemists were able to infer from sulfides in the meteorites the intensity of the solar wind and, hence, the intensity of the protosun. They conclude in their paper that the slight excess of one isotope of sulfur in the meteorites indicated the presence of "photochemical reactions in the early solar nebula," meaning that the protosun was shining strongly enough to drive chemical reactions. *"This measurement tells us for the first time that the sun was on, that there was enough ultraviolet light to do photochemistry,"* says Thiemens. *"Knowing that this was the case is a huge help in understanding the processes that formed compounds in the early solar system."*

Astronomers believe the solar nebula began to form about 5 billion years ago when a cloud of interstellar gas and dust was disturbed, possibly by the shock wave of a large exploding star, and collapsed under its own gravity. As the nebula's spinning pancake-like disk grew thinner and thinner, whirlpools of clumps began to form and grow larger, eventually forming the planets, moons and asteroids. The protosun, meanwhile, continued to contract under its own gravity and grew hotter, developing into a young star. That star, our sun, emanated a hot wind of electrically charged atoms that blew most of the gas and dust that remained from the nebula out of the solar system. Planets, moons and many asteroids have been heated and had their material reprocessed since the formation of the solar nebula. As a result, they have had little to offer scientists seeking clues about the development of the solar nebula into the solar system. However, some primitive meteorites contain material that has remained unchanged since the protosun spewed this material from the center of the solar nebula more than 4.5 billion years ago.

Thiemens says the technique his team used to determine that the protosun was glowing brightly also can be applied to estimate when and where various compounds originated in the hot wind spewed out by the protosun. *"That will be the next goal,"* he says. *"We can look mineral by mineral and perhaps say here's what happened step by step."*

#### **ASTEROID'S NEAR-MISS MAY BE HOME RUN FOR SCIENTISTS**

A research team has discovered that for the first time in history, scientists will be able to observe how the Earth's gravity will disrupt a massive asteroid's spin. Scientists predict a near-miss when Asteroid 99942 Apophis passes Earth in 2029. An asteroid flies this close to the planet only once every 1,300 years. The chance to study it will help scientists deal with the object should it

threaten collision with Earth. Only about three Earth diameters will separate Apophis and Earth when the 400-meter asteroid hurtles by Earth's gravity, which will twist the object into a complex wobbling rotation. Such an occurrence has never been witnessed but could yield important clues to the interior of the sphere, according to a paper entitled, "Abrupt alteration of the spin state of asteroid 99942 Apophis (2004 MN4) during its 2029 Earth flyby," in the journal *Icarus*. The team of scientists is led by Daniel Scheeres, and includes Peter Washabaugh.

Apophis is one of more than 600 known potentially hazardous asteroids and one of several that scientists hope to study more closely. In Apophis' case, additional measurements are necessary because the 2029 flyby could be followed by frequent close approaches thereafter, or even a collision. Scheeres said not only is it the closest asteroid flyby ever predicted in advance, but it could provide a birds-eye view of the asteroid's "belly." *"In some sense it's like a space science mission 'for free' in that something scientifically interesting will happen, it will be observable from Earth, and it can be predicted far in advance,"* Scheeres said. If NASA places measuring equipment on the asteroid's surface, scientists could for the first time study an asteroid's interior, similar to how geologists study earthquakes to gain understanding of the Earth's core, Scheeres said. Because the torque caused by the Earth's gravitational pull will cause surface and interior disruption to Apophis, scientists have a unique opportunity to observe its otherwise inaccessible mechanical properties, Scheeres said. Throwing the asteroid off balance could also affect its orbit and how close it comes to Earth in future years. *"Monitoring of this event telescopically and with devices placed on the asteroid's surface could reveal the nature of its interior, and provide us insight into how to deal with it should it ever threaten collision,"* Scheeres said.

The asteroid will be visible in the night sky of Europe, Africa and Western Asia. The asteroid was discovered late last year and initially scientists gave it a 1-in-300 chance of hitting the Earth on April 13, 2029. Subsequent analysis of new and archived pre-discovery images showed that Apophis won't collide with Earth that day, but that later in 2035, 2036, and 2037 there remains a 1-in-6,250 chance that the asteroid could hit Earth, Scheeres said. Conversely, that's a 99.98 percent chance that the asteroid will miss Earth. The asteroid is relatively small, about the length of three football fields. If it hit it wouldn't create wide-scale damage to the Earth, but would cause major damage at the impact site, Scheeres said.

### SWIFT SATELLITE FINDS NEWBORN BLACK HOLES

Scientists using NASA's Swift satellite say they have found newborn black holes, just seconds old, in a confused state of existence. The holes are consuming material falling into them while somehow propelling other material away at great speeds.

These black holes are born in massive star explosions. An initial blast obliterates the star, yet the chaotic black hole activity appears to re-energize the explosion several times in just a few minutes. This is a dramatically different view of star death, one that entails multiple explosive outbursts and not just a single bang, as previously thought. *"Stars are exploding two, three and sometimes four times in the first minutes following the initial explosion,"* said Prof. David Burrows. *"First comes a blast of gamma rays followed by intense pulses of X-rays. The energies involved are much greater than anyone expected,"* he added.

Scientists have seen this phenomenon in nearly half of the longer gamma-ray bursts detected by Swift. These gamma-ray bursts are the most powerful explosions known. They are forerunners of

a massive star explosion called a hypernova, which is bigger than a supernova. Using Swift, scientists are finally able to see gamma-ray bursts within minutes after the trigger, instead of hours or days, and are privy to newborn black hole activity. Until this latest Swift discovery, scientists assumed a simple scenario of a single explosion followed by a graceful afterglow of the dying embers. The new scenario of a blast followed by a series of powerful "hiccups" is particularly evident in a gamma-ray burst from May 2, 2005, named GRB 050502B. This burst lasted 17 seconds during the early morning hours in the constellation Leo. About 500 seconds later, Swift detected a spike in X-ray light about 100 times brighter than anything seen before. Previously there had been hints of an "X-ray bump" between the burst and afterglow in previous gamma-ray bursts, coming a minute or so after the burst. Swift has seen more than one dozen clear cases of multiple explosions. There are several theories to describe this newly discovered phenomenon and most point to the presence of a newborn black hole.

*"The newly formed black hole immediately gets to work,"* said Prof. Peter Meszaros, head of the Swift theory team. *"We aren't clear on the details yet, but it appears to be messy. Matter is falling into the black hole, which releases a great amount of energy. Other matter gets blasted away from the black hole and flies out into the interstellar medium. This is by no means a smooth operation,"* he added.

Another theory is the jet of material shooting away from the dead star starts to fall back onto itself, creating shockwaves in the jet core that ram together blobs of gas and produce X-ray light. *"None of this was realized before simply because we couldn't get to the scene of the explosion fast enough,"* said Dr. Neil, Swift principal investigator. *"Swift has the unique ability to detect bursts and turn its X-ray and ultraviolet-optical telescopes to the explosion's embers within minutes. As such, Swift is detecting new burst details that might rewrite theory,"* Gehrels said.

### DEEP IMPACT SCIENCE

The Deep Impact science team gathered in Hilo, Hawaii the last week of July for a working retreat to examine the results from Deep Impact's encounter on July 4th. Collaborating astronomers from around the world joined them both in person and via videoconference. The impact of comet Tempel 1 was scheduled to be observable from the ground while the comet was above the horizon in Hawaii, the location of some of the darkest and driest skies in the world. Many of the astronomers who used telescopes at Mauna Kea attended the workshop to learn about the impact from the Deep Impact science team's perspective, which would enable them to better interpret their own data. It was truly a collaborative effort, as the science team is interested in ground-based and space-based results to give us perspective on the Deep Impact spacecraft data. While about 50 people were present at the workshop, colleagues were attending by videoconference from as far as Germany and Maryland. We spanned 12 time zones, and didn't know whether to say "Good morning" or "Good Night". We settled on "Aloha" and appreciated our distant colleagues wearing their Hawaiian shirts to feel closer to the pulse of the meeting.

Our tasks involved reviewing some of the most interesting data that we collected, reporting on the calibration, checking it and crosschecking, and discussing possible interpretations. We also defined additional questions we need to have answered in order to arrive at robust interpretations of the nature of the comet before impact, the phenomenon of the impact itself, and the effects of the impact afterwards.

From the images posted on the web pages, it is known that the Deep Impact spacecraft returned spectacular data from the collision. Bright dust glowed and illuminated space shortly after impact. The comet zipped by and the spacecraft looked back to see what effects had been made. So much dust was kicked up by the impact, that the science team is still analyzing the images to measure the size of the crater. This analysis continues.

The spectrometer showed spectral signatures of water, hydrocarbons, CO and CO<sub>2</sub>. We continue the analysis of the spectra to determine how hot the water was (between 1000 and 2000 K) and how long it remained hot. The interpretation is a challenge, because the spacecraft and the comet were in motion. That is both an advantage and a challenge. We continue to put together the story of what we saw, when, and how fast the spacecraft was moving.

Initial reports from ground-based and space-based observers are varied. Some telescopes saw dramatic changes as a result of the impact, while others did not. One has to recall that the results depend not only on how large a telescope is being used, and its sensitivity, but also at what region of the spectrum the data are acquired. The physics of the impact is not active in all spectral regions. There is a lot of information to be gleaned from both positive and negative results from ground-based and space-based data. Combining those results with that of the Deep Impact spacecraft, that was right there when it happened, but carried only two types of instruments (visible imagers and an IR spectrometer) will provide an interesting scientific story when we get it all sorted out.

#### **SUPERNOVA 1987A: FAST FORWARD TO THE PAST**

Recent Chandra X-ray telescope observations have revealed new details about the fiery ring surrounding the stellar explosion that produced Supernova 1987A. The data give insight into the behavior of the doomed star in the years before it exploded, and indicate that the predicted spectacular brightening of the circumstellar ring has begun. The supernova occurred in the Large Magellanic Cloud, a galaxy only 160,000 light years from Earth. The outburst was visible to the naked eye, and is the brightest known supernova in almost 400 years. The site of the explosion was traced to the location of a blue supergiant star called Sanduleak -69 202 (SK -69 for short) that had a mass estimated at approximately 20 Suns.

Subsequent optical, ultraviolet and X-ray observations have enabled astronomers to piece together the following scenario for SK -69: about ten million years ago the star formed out of a dark, dense, cloud of dust and gas; roughly a million years ago, the star lost most of its outer layers in a slowly moving stellar wind that formed a vast cloud of gas around it; before the star exploded, a high-speed wind blowing off its hot surface carved out a cavity in the cool gas cloud. The intense flash of ultraviolet light from the supernova illuminated the edge of this cavity to produce the bright ring seen by the Hubble Space Telescope. In the meantime the supernova explosion sent a shock wave rumbling through the cavity.

In 1999, Chandra imaged this shock wave, and astronomers have waited expectantly for the shock wave to hit the edge of the cavity, where it would encounter the much denser gas deposited by the red supergiant wind, and produce a dramatic increase in X-radiation. The latest data from Chandra and the Hubble Telescope indicate that this much-anticipated event has begun. Optical hot-spots now encircle the ring like a necklace of incandescent diamonds. The Chandra image reveals multimillion-degree gas at the location of the optical hot-spots.

X-ray spectra obtained with Chandra provide evidence that the optical hot-spots and the X-ray producing gas are due to a collision of the outward-moving supernova shock wave with dense fingers of cool gas protruding inward from the circumstellar ring. These fingers were produced long ago by the interaction of the high-speed wind with the dense circumstellar cloud. The dense fingers and the visible circumstellar ring represent only the inner edge of a much greater, unknown amount of matter ejected long ago by SK -69. As the shock wave moves into the dense cloud, ultraviolet and X-radiation from the shock wave will heat much more of the circumstellar gas. Then, as remarked by Richard McCray, one of the scientists involved in the Chandra research, "Supernova 1987A will be illuminating its own past." <http://chandra.harvard.edu/photo/2005/sn87a/>

#### **GEMINI TELESCOPE UNCOVERS 'LOST CITY' OF STARS**

Like archaeologists unearthing a 'lost city,' astronomers using the 8-meter Gemini South telescope have revealed that the galaxy NGC 300 has a large, faint extended disk made of ancient stars, enlarging the known diameter of the galaxy by a factor of two or more.

The finding also implies that our own Milky Way Galaxy could be much larger than current textbooks say. Scientists will also need to explain the mystery of how galaxies like NGC 300 can form with stars so far from their centers. The team used the Gemini Multi-Object Spectrograph on the Gemini South telescope in Chile, and were able to clearly resolve extremely faint stars in the disk up to 47,000 light-years from the galaxy's center -- double the previously known radius of the disk. To detect these stars, images were obtained that went more than ten times 'deeper' than any previous images of this galaxy. *"A few billion years ago the outskirts of NGC 300 were brightly lit suburbs that would have shown up as clearly as its inner metropolis,"* said the paper's lead author, Joss Bland-Hawthorn. *"But the suburbs have dimmed with time, and are now inhabited only by faint, old stars -- stars that need large telescopes such as Gemini South to detect them."*

The finding has profound implications for our own galaxy since most current estimates put the size of our Milky Way at about 100,000 light-years or about the size now estimated for NGC 300. *"However, the galaxy is much more massive and brighter than NGC 300 so on this basis, our galaxy is also probably much larger than we previously thought -- perhaps as much as 200,000 light-years across,"* said Bland-Hawthorn.

Adding to these compelling findings is the fact that the team found no evidence for truncating, or an abrupt 'cutting-off' of the star population as seen in many galaxies further from the central regions. Team member Bruce Draine explains: *"It's hard to understand how such an extensive stellar disk that falls off so smoothly in density could have formed -- this is really a huge surprise to us. Because it takes an incredibly long time to evenly disperse stars from a galaxy's central disk to these extreme distances, it seems more likely that we are seeing the results of star formation that took place long ago, perhaps as much as ten billion years ago."*

*"We now realize that there are distinctly different types of galaxy disks,"* said team member Ken Freeman. *"Probably most galaxies are truncated -- the density of stars in the disk drops off sharply. But NGC 300 just seems to go on forever. The density of stars in the disk falls off very smoothly and gradually."* The observers traced NGC 300's disk out to the point where the surface density of stars was equivalent to a one-thousandth of a

sun per square light-year. "This is the most extended and diffuse population of stars ever seen," said Bland-Hawthorn.

NGC 300 is a spiral member of the Sculptor group of galaxies, the closest extragalactic cluster to us, and is about 6.1 million light-years away. Most of its stars lie in a fairly flat disk making it appear to be a very normal spiral galaxy like our Milky Way. NGC 300 is the first galaxy outside of our Local Group to be studied to this depth. There have only been two others studied to such faint levels, the Andromeda galaxy and its neighbor M33, both in our Local Group.

The researchers have been granted more time on Gemini South to determine exactly what kind of stars they are seeing in the outskirts of NGC 300, and to make similar studies of other galaxies. "We still have a lot to learn about how galaxies like ours formed," said Bland-Hawthorn. "Our next Gemini observations, that we have planned for later this year, should provide even more important clues and hopefully even more surprises!" How did the stars get into the distant reaches of galaxies like NGC 300? Were they formed in place or are they the result of captures or external interactions? It is difficult to explain how hydrogen gas could have come into the outer regions of NGC 300 -- either by accreting onto the galaxy as gas per se, or dumped in by mergers with other small galaxies -- and still left the disk density so smooth. Mixing processes could have scattered stars out from the inner parts of the disk. "It's hard to see how that could produce such an extensive stellar disk that falls off so smoothly in density," says Ken Freeman. The reason why these outer regions are so faint compared to the bright disk is due to the relative scarcity of hydrogen in the out-lying regions from which to build new generations of stars (as happens frequently in the inner disk).

In May 2005 another research team using the Keck Observatory on Mauna Kea announced that the Andromeda galaxy was also twice as large as previously thought. Much like NGC 300, the disk just keeps on going. However, this is not the case for the other Local Group galaxy, M33, which shows clear evidence of truncation in its outer regions. <http://www.gemini.edu/index.php?option=content&task=view&id=144&Itemid>

### METEOR IMPACTS: LIFE'S JUMP STARTER?

Meteor impacts are generally regarded as monstrous killers and one of the causes of mass extinctions throughout the history of life. But there is a chance the heavy bombardment of Earth by meteors during the planet's youth actually spurred early life on our planet, say Canadian geologists. A study of the Haughton Impact Crater on Devon Island, in the Canadian Arctic, has revealed some very life-friendly features at ground zero. These include hydrothermal systems, blasted rocks that are easier for microbes to inhabit, plus the cozy, protected basin created by the crater itself. If true, impact craters could represent some of the best sites to look for signs of past or present life on Mars and other planets. The idea that meteor impacts could benefit or even create conditions suitable for the beginning of early life struck Canadian Space Agency geologist Gordon Osinski while he and colleagues were conducting a geological survey of the 24-kilometer (15-mile) diameter Haughton Crater. Along the rim of the crater they noticed what looked like fossilized hydrothermal pipes, a few meters in diameter. "That set the bells ringing about possible biological implications," said Osinski. "Hydrothermal

systems are thought by many people to be the favorable places for life to evolve."

Detailed mineralogical analyses have since revealed that when the Haughton meteor smacked into the icy ground 23 million years ago it created not only a crater, but fractured the ground in such a way as to create a system of steamy hydrothermal springs reaching temperatures of 250 degrees C. The heat appears to have gradually dropped over a period of tens of thousands of years, the researchers report. Besides providing heat and cracking the ground, the impact also created pore spaces in otherwise dense granitic rocks, giving microbes more access to the minerals and the surfaces inside the rocks - basically more real estate and more supplies. The shocked rocks are also more translucent, which would be beneficial to organisms that possessing with any photosynthetic capabilities.

A crater shape itself also might serve as a protective environment, says Osinski. As such, impact craters are also good places to store evidence of past life. On Earth many craters fill with water and become lakes. Lakes accumulate sediments, the layers of which are a geological archive of the time after the crater formed. The Haughton Impact crater, for instance, contains the only Miocene-age sediments in the entire Canadian Arctic.

"One of the most interesting aspects of the Haughton Impact Crater is that it's in a polar desert," said Osinski. The dry, frigid weather makes for a barren landscape that's easy to study, he said. The same features make it one of the more Mars-like places on Earth.

"Most people put impacts with mass extinctions," said Osinski. "What we're trying to say is that following the impact, the impact sites are actually more favorable to life than the surrounding terrain." It's interesting to note, says Osinski, that on Earth the heaviest meteor bombardment of the planet happened at about the same time as life is believed to have started: around 3.8 billion years ago. Impact craters of that age were long ago erased on Earth by erosion, volcanic resurfacing and plate tectonics.

But other planets and moons - including Mars - still bear the cosmic scars of that early debris-clogged period in the solar system. It may be possible, therefore, that the best places to look for at least fossil evidence of life on Mars is inside those very same craters, he said. "What we're doing is trying to narrow down the search area," said Osinski.

### 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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### **In August's Stargazer:**

- \*\*\*\* **OBSERVER'S INFORMATION**
- \*\*\*\* **ASTRO CALENDAR**
- \*\*\*\* **CONSTELLATIONS OF THE MONTH:**
- \*\*\*\* **ASTRONOMY FUN FACTS**
- \*\*\*\* **YOUNG ASTRONOMER'S CORNER**
- \*\*\*\* **ASTRONOMY AND TELESCOPE LINGO**
- \*\*\*\* **WATCH THE TWO BRIGHTEST PLANETS KISS IN TWILIGHT**
- \*\*\*\* **'10TH PLANET' HAS A PLUTO-LIKE SURFACE**
- \*\*\*\* **SATURN'S RINGS HAVE OWN ATMOSPHERE**
- \*\*\*\* **CASSINI FLIES BY SATURN'S TORTURED MOON MIMAS**
- \*\*\*\* **FIRST TRIPLE ASTEROID SYSTEM FOUND**
- \*\*\*\* **SUGGESTION 'PROTOSUN' SHINING DURING FORMATION OF FIRST MATTER IN SOLAR SYSTEM**
- \*\*\*\* **ASTEROID'S NEAR-MISS MAY BE HOME RUN FOR SCIENTISTS**
- \*\*\*\* **SWIFT SATELLITE FINDS NEWBORN BLACK HOLES**
- \*\*\*\* **DEEP IMPACT SCIENCE**
- \*\*\*\* **SUPERNOVA 1987A: FAST FORWARD TO THE PAST**
- \*\*\*\* **GEMINI TELESCOPE UNCOVERS 'LOST CITY' OF STARS**
- \*\*\*\* **Meteor Impacts: Life's Jump Starter?**

**The next EAS Meeting is 3:00 P.M. SATURDAY, August 27<sup>th</sup>  
at the Everett Public Library Auditorium.**