

The Stargazer

September 2008

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The Stargazer
P.O. Box 12746
Everett, WA 98206

See EAS website at:

EAS BUSINESS...

NEXT EAS MEETING – SATURDAY SEPT 13TH
7:00 PM AT AURORA ASTRO PRODUCTS STORE AT
SILVER LAKE.

★★ Saturday September 13th 7:00 pm MEETING ★★

The speaker will be **Jonathan Fay**, of **Microsoft Research**, talking about and demonstrating the **WorldWide Telescope**.

The WorldWide Telescope (WWT) is a Web 2.0 visualization software environment that enables your computer to function as a virtual telescope—bringing together terra-bytes of imagery from the best ground and space-based telescopes in the world for a seamless exploration of the universe. It allows seamless panning and zooming around the night sky, planets, and image environments. View the sky from multiple wavelengths: See the x-ray view of the sky and zoom into bright radiation clouds, and then cross-fade into the visible light view and discover the cloud remnants of a supernova explosion from a thousand years ago. Switch to the Hydrogen Alpha view to see the distribution and illumination of massive primordial hydrogen cloud structures lit up by the high energy radiation coming from nearby stars in the Milky Way. These are just two of many different ways to reveal the hidden structures in the universe with the WorldWide Telescope. Seamlessly pan and zoom from aerial views of the Moon and selected planets, as well as see their precise positions in the sky from any location on Earth and any time in the past or future with the Microsoft Visual Experience Engine.

Microsoft Research is dedicating WorldWide Telescope to the memory of Jim Gray, and is releasing WWT as a free resource to the astronomy and education communities with the hope that it will inspire and empower people to explore and understand the universe like never before.

(It may be helpful for some folks to bring a folding chair to the meeting.)

Map/Directions to Aurora Astro Products store location -
http://www.skyvalleyscopes.com/aurora_astro_products_silver_lak.htm

Silver Lake Plaza, 11419 19th AVE. SE, Everett, WA 98208

If you are traveling northbound on I-5:

Take exit #186/128th St. and go east - to the right on 128th St. continue until you come to Murphy's Corner/Intersection with Highway 527/19th Ave SE/Old Bothell-Everett Highway (all one in the same) and turn left/north. Follow until you see Silver Lake Plaza (red brick construction) on your right with the lake is on your left.

If you are traveling southbound on I-5:

Take exit 187/Everett Mall Way and at the top of the exit's hill turn right following signs for Highway 527. At the light turn right following the signs for Highway 527. Then stay on Highway 527/19th Ave SE/Old Bothell-Everett Highway until you have Silver Lake on your right and the Silver Lake Plaza on your left. You may also continue down I-5 until exit 186 and turn left onto 128th then follow previous directions. If you have a problem you can always call (425) 337-4384

★ STAR PARTY INFO ★

Next EAS Star Party: Sep 20 - Ron Tam's home.

EAS member Ron Tam has offered a flexible opportunity to EAS members to come to his home north of Snohomish for observing on clear weekend evenings and for EAS starparties. Anyone wishing to do so needs to contact him in advance and confirm available dates, and let him know if plans change. "Our place is open for star parties any Saturday except weekends of the Full Moon. People can call to get weather conditions or to confirm that there is a star party. Our phone number is (360) 568-5152. They can e-mail me too (tam1951@verizon.net) but I don't check my email daily. They can email me for directions if they never have been out here." Listed below are proposed dates for **planned EAS star parties** at my [Ron Tam's] place, depending upon the weather, of course. Call Ron about spur-of-the-moment observing.

Upcoming tentative EAS star party schedule: (also see the regional star parties listed in the 'Astro Calendar for 2008') Sep 20, Oct 4, Nov 1.

Please also join the EAS mail list, and send mail to the mail list everett_astronomy@topica.com to coordinate spur-of-the-moment 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 Jim Bielaga at (425) 337-4384 for info or check the EAS website.) Members contact Jim Bielaga for scope borrowing.

DARK MOON PERIODS THIS YEAR

New Moon	1 st Qtr	3 rd Qtr	EAS Star Party at Ron's
Jan 8 th	Jan 15 th	Jan 29 th	--

Feb 6 th	Feb 13 th	Feb 28 th	--
Mar 7 th	Mar 14 th	Mar 29 th	Sat Mar 08, Sat Mar 29
Apr 5 th	Apr 12 th	Apr 28 th	Saturday April 05
May 5 th	May 11 th	May 27 th	Saturday May 03
Jun 3 rd	Jun 10 th	Jun 26 th	Saturday Jun 07
Jul 2 nd	Jul 9 th	Jul 25 th	Saturday Jul 05
Aug 1 st , 30 th	Aug 8 th	Aug 23 rd	Saturday Aug 23
Sep 29 th	Sep 7 th	Sep 21 st	Saturday Sep 20
Oct 28 th	Oct 7 th	Oct 21 st	Saturday Oct 04
Nov 27 th	Nov 5 th	Nov 19 th	Saturday Nov 01
Dec 27 th	Dec 5 th	Dec 19 th	--

Attention EAS Members – 10% Discount for all Everett Astronomical Society Members at Aurora Astro Products

"Show your club membership card at Jim Bielaga's new astronomy store 'Aurora Astro Products' and receive a 10% discount on all purchases. This is an exclusive discount to E.A.S. members only.

I am proud to be able to offer this discount to Everett club members, and thanks for the support you have shown me on opening my new store. Also I have made great friends and learned a lot being a club member since 1991.

- Clear Skies, Jim Bielaga"

>> **Members – please look at your EAS membership card to see when your membership dues are payable. If you are more than three months past due, the club will officially assume that you no longer wish to be a member, and remove you from the membership rolls. <<**

Other Western US Star Parties This Season...

Sep 25-28 - OAS Camp Delany Star Party - Sun Lakes SP -
<http://www.olympicastronomicalsociety.com/Documents/FALLCAMPDELANYSign-UpForm.pdf>

Sep 26-27 - Orion Nebula 2008 Star Party – Table Mt. (Ellensburg) WA
<http://www.seattleastro.org/orionnebsp.shtml>

Sep 26-28 - Blue Mountain Star Party, Ukiah, OR
<http://www.stargazing.net/tcac/> mw.bryant@hotmail.com

Sep 24-27 - The Enchanted Skies Star Party 2008 - Socorro NM -
<http://www.socorro-nm.com/starparty/>

Sep 25-28 - Alberta Star Party 2008 – Eccles Ranch Obs., Caroline, Alberta, CA http://calgary.rasc.ca/RASCcalendar.htm#_September

Sep 25-27 - CalStar08 - Lake San Antonio Park CA
<http://www.sjaa.net/calstar/> - <http://www.sjaa.net/>

Sep 26-28 - White Sands Star Party - Alamogordo/White Sands, and Cloudcroft NM <http://www.zianet.com/wssp/>

Oct 30-Nov 02 - Nightfall 2008 - Palm Canyon Resort, Borrego Springs, CA <http://www.rtmcastronomyexpo.org/nightfall.htm>

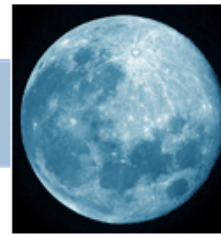
EAS MEMBER NEWS

Sidewalk Astronomy

We are looking for volunteers who could do a series of Sidewalk Astronomy sessions this spring and summer, at a local park or public venue. For safety, moral support, and effectiveness, this should be done in teams of at least two people with telescopes. Special events like eclipse or comets especially draw the interest of the public.

School and Community Group Astronomy Outreach

We often have requests for members of the EAS to come and help with an 'astronomy night' event from local schools, scout groups, senior homes, or similar groups. Usually this would be in the form of a star party at their gathering, or perhaps a short slide show or night sky talk. Providing education and support to the community about interest astronomy is one of the main missions of the EAS. Please let club president know if you are interested and available to be on list of volunteers to handle these requests, so that we can say YES when people ask. Recent January cubscout group visited by Jim Bielaga, Mark Folkerts, Mike Schilling, and Ron Tam for a star party night was a great example of how this can be a rewarding event for all involved. **Please email Mark Folkerts with your interest (or suggestions).**



Aurora Astro

Aurora Astro Products

"Your Northern Light in the Astronomy Business"
Over 37 product dealerships, and growing

11419 19th Avenue SE #A102
Everett, WA 98208
www.auroraastro.com
425-337-4384
425-337-4758 fax

New hours:

Mon, Thu, Fri – 9:00 am to 6:00 pm
Tues/Weds – Noon to 8:00 pm
Sat – 10:00 am to 5:00 pm

Also, those who have subscriptions to Sky and Telescope can now pay their own subscription as long as they are EAS members in good standing. Members will now be able to renew directly via mail or phone and still obtain the club discount. The subscribers may mail in the renewal notices with their payment, or renew via phone at (800) 253-0245. Payment at the time of renewal is required. Once a year, Sky and Telescope will check with the EAS club treasurer to see that the subscribers are still members in good standing to qualify for the discount. New members will continue to subscribe through the club treasurer.

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

The club maintains a \$750+ balance. We try to keep approximately a \$500 balance to allow for contingencies.

CLUB SCOPES

SCOPE

10-INCH WARD DOBSONIAN
10-INCH SONOTUBE DOBSONIAN
8-INCH DOBSONIAN

LOAN STATUS

AVAILABLE
AVAILABLE
AVAILABLE

EAS members: contact VP James Bielaga at (425) 337-4384 or jamesbielaga@aol.com to borrow a scope.

Does Anyone know about the history of the EAS ???

The Northwest Region of the Astronomical League (NWRAL) is putting together a new website and needs the following information from each club of the NWRAL. The EAS is looking for any information from members about the early history. Please contact Mark Folkerts if you have any info that could be of help. NWRAL would like a brief history of the club

- Club established date (approx 1986 ?)
- Who started the club (Terry Bacon, et. al.)
- When club joined the Astronomical League.

ASTRO CALENDAR FOR 2008

September 2008

- Sep 08 - delta-Aurigids meteor shower peak
- Sep 11 - Mercury At Its Greatest Eastern Elongation (27 Degrees)
- Sep 13 - Uranus At Opposition
- Sep 19 - Piscids meteor shower peak
- Sep 20 – EAS Meeting 7:00 pm Aurora Astro Products store**
- Sep 20 – EAS monthly suburban star party – Ron Tam’s place**
- Sep 22 - Autumnal Equinox (22:16 UT)
- Sep 26-28 – Orion Nebula Star Party – Table Mt. WA**

October 2008

- Oct 04 – EAS monthly suburban star party – Ron Tam’s place**
- Oct 08 - Draconids meteor shower peak
- Oct 17 - epsilon-Geminids meteor shower peak
- Oct 21 - Orionids Meteor Shower Peak
- Oct 25 – EAS Meeting 7:00 pm Aurora Astro Products store**
- Oct 27 - Asteroid 4 Vesta Closest Approach To Earth (1.539 AU)

November 2008

- Nov 01 – EAS monthly suburban star party – Ron Tam’s place**
- Nov 03 - Taurids meteor Shower Peak
- Nov 17 - Leonids meteor Shower Peak
- Nov 22 – EAS Meeting 7:00 pm Aurora Astro Products store**

December 2008

- Dec 01 - Conjunction of Moon, Venus, and Jupiter (3 Degree Triangle)
- Dec 01 - Moon Occults Venus
- Dec 13 - Geminids meteor shower peak
- Dec 21 - Winter Solstice, 12:04 UT
- Dec 22 - Ursids meteor shower peak
- Dec 29 - Moon Occults Jupiter

UW Astronomy Speakers Colloquium Schedule

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

<http://www.astro.washington.edu/pages/colloquium.html>

ON THE AIRWAVES - KSER 90.7 - 'IT'S OVER YOUR HEAD'

"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 five-minute segment is broadcast **every Wednesday morning at approximately 8:20 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.celestialnorth.org/radio/index.php> and podcasts at <http://www.celestialnorth.org/radio/index.php>

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 MEMBERSHIP BENEFITS & INFORMATION

EAS Benefits -

Membership in the **Everett Astronomical Society (EAS)** includes invitations to all of the club meetings and star parties, plus the monthly newsletter, **The Stargazer**. Currently, a 10% discount is also being offered to EAS members for purchases at Aurora Astro Products in Everett

Magazine Discounts -

In addition you will be able to subscribe to **Sky and Telescope** for \$7 off the normal subscription rate, contact the treasurer (Carol Gore) for more information. <http://everettastro.org/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 Carol Gore will renew your **Sky and Telescope** subscription for you. **Astronomy** magazine offers a similar opportunity to club members.)

Membership in the Astronomical League -

EAS is a member of the **Astronomical League** and you will receive the Astronomical League's quarterly newsletter magazine, **The Reflector**.

EAS Club Telescope Borrowing -

Being a member also allows you the use of the club's telescopes, including an award winning 10 inch Dobsonian mount reflector, a second 10" dob, or and 8" Dobsonian. Contact Jim Bielaga (425) 337-4384 to borrow a telescope.

10% Discount on Purchases at 'Aurora Astro Products' in Everett -

EAS members are currently offered a 10% discount for all purchases of any telescopes, accessories, or other items at Aurora Astro Products, when they show their EAS membership card.

EAS Library -

Membership will give you access to all the material in the lending library. The library, which is maintained by Mike Locke, consists of VCR tapes, DVDs, many books, magazines, and software titles. 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 lockemi at comcast.net, to borrow or donate any materials. See list here: http://everettastro.org/eas_library.htm

Joining or Renewing with the EAS -

EAS dues are \$25 / year per family. Funds obtained from membership dues allows the EAS to publish the Stargazer newsletter, pay Astronomical League dues, pay insurance, host a web site, and maintain our library. If it has been a year since you paid your dues, please re-subscribe to keep the club financially solvent, and to continue to receive membership benefits. <http://everettastro.org/application.htm>

**Send your annual dues renewals to the Everett Astronomical Society
P.O. Box 12746, Everett, WA 98206.**

OBSERVER'S INFORMATION...

LUNAR FACTS

Sep 07	First Quarter Moon
Sep 15	Full Moon
Sep 22	Last Quarter Moon
Sep 29	New Moon
Oct 07	First Quarter Moon
Oct 14	Full Moon
Oct 21	Last Quarter Moon
Oct 28	New Moon
Nov 06	First Quarter Moon
Nov 13	Full Moon
Nov 19	Last Quarter Moon
Nov 27	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/cia/menu.html>

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

UP IN THE SKY -- THE PLANETS

Object	Rises	Sets	Con	Diam.	Mag
Sun	06:43 am	19:26	Leo	30'	-27.5
Mercury	09:17 am	20:01	Vir	07"	+0.2
Venus	09:03 am	20:19	Leo	11"	-3.9
Mars	09:02 am	20:16	Vir	04"	+1.7
Jupiter	16:22	00:50	Sag	42"	-2.4
Saturn	06:02 am	19:19	Leo	16"	+0.9
Uranus	19:23	06:53am	Aqr	04"	+5.7
Neptune	18:20	04:18 am	Cap	02"	+7.8
Pluto	14:50	00:20 am	Sag	--	+13.9

(times are in local time for Everett PDT)

Observing Jupiter's Moons – Java tool

<http://skytonight.com/observing/objects/javascript/jupiter>

Transit times for Jupiter's Great Red Spot in 2008

<http://skytonight.com/observing/objects/planets/3304091.html>

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 – Heavens Above:

<http://www.heavens-above.com/PassSummary.asp?lat=47.979&lng=-122.201&alt=0&loc=Everett&TZ=PST&satid=25544>

CONSTELLATIONS OF THE MONTH – PEGASUS

PEGASUS: (The Winged Horse). With a midnight culmination date of September 1st, 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 75th in overall brightness among the constellations, but 7th 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 (7th magnitude) globular cluster. M-15 is the only known globular cluster containing a planetary nebula (almost 15th 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 2nd. 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 (10th magnitude Sb-type spiral galaxy); NGC-7217 (a magnitude 10.2, Sb-type nearly face-on spiral with relatively high surface brightness); NGC-7332 (11th 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 (11th 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 13th 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, 13th 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

Planet Earth: The Upper "Non-Weather" Atmosphere

We have in the past talked about the Earth's atmosphere (see below), concentrating mostly on the lower atmosphere, where weather "happens". This month we will talk about the earth's "non-weather", or upper atmosphere, right to the interface and boundaries with what we know as "outer space".

The Earth's atmosphere is composed of many chemicals and other inclusions. The primary elements and molecules are nitrogen, oxygen, argon, neon, helium, hydrogen, xenon, water vapor, carbon-dioxide, methane, nitrous oxide, ozone, particles (such as dust, soot, etc...), and chlorofluorocarbons - byproducts of the use of air conditioners, various sprays, and other industrial processes the world over. Water vapor is highest in tropical areas, where it can be as much as 4% of all atmospheric gases, and is important because it releases large amounts of latent heat, an important source for the transfer of atmospheric energy such as through thunderstorms and hurricanes. Water vapor is also an important greenhouse gas, because it absorbs and re-emits

strongly some of the heat (infrared radiation) that leaves the Earth (like a greenhouse works), thus potentially contributing to global warming. Carbon dioxide, another “greenhouse gas” is also an important component of the Earth’s atmosphere. Ozone is a component of photochemical (formed by a chemical reaction with sunlight) smog. Saltwater droplets which evaporate and leave microscopic salt particles, dust, soil, and smoke from fires and volcanoes are called aerosols and are suspended in the atmosphere. Most man-made impurities such as nitrous dioxide, carbon monoxide, and hydrocarbons are all emitted by automobiles, and the burning of oil and coal releases destructive sulfur dioxide into the atmosphere.

From the surface up to about 11 kilometers is where we find the weather and most of the phenomena described above. Above this level however, Earth’s remaining atmospheric layers are still very varied in nature. The first layer above the weather layer is the stratosphere, in which heating occurs up to a maximum of zero degrees Celsius (from –80 C. at the weather layer boundary near the equator (and –50 C. at midlatitudes)), at about 50 kilometers. This heating is caused by the absorption of high energy ultraviolet rays by ozone molecules, and makes this layer also vertically stable (unlike the marked convection seen in the “weather” layers). Decreases in the ozone layer within the stratosphere (as caused by ozone destruction with use of man-made chemicals such as chlorofluorocarbons) can cause increased levels of harmful UV radiation to reach the Earth’s surface. Above the stratosphere is the mesosphere, within which the temperature falls with height to reach approximately –90 C. at about 85 kilometers. Above the mesosphere is the thermosphere, where temperature rises with height as solar far-ultraviolet energy is absorbed by oxygen and nitrogen, giving rise to the ionospheric layers which begin at about 60 kilometers. The ionospheric layers are used to bounce radio waves and communications from Earth, and are where we see meteors and aurorae. The atmospheric density at these layers are only very slight fractions of what the density and pressure is at sea level. Above the thermosphere and ionosphere is the exosphere (at approximately 500 kilometers above Earth’s surface). Atoms and molecules are so rare at this level, that they also rarely collide with each other, thus making it easy for them to escape into space. This level (the exosphere) contains the Van Allen radiation belts, and extends to the magnetosphere, where it meets with interplanetary space.!!

ASTRONOMY & 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 - SATURN

“Planetary Focus” publishes periodically 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. The planetary focus of this month’s column is “Saturn”:

Rotation around the Sun: every 29.46 years

Orbit: from 9.01 (closest or ‘perihelion’) to 10.04 (furthest or ‘aphelion’) **Astronomical Units (AU)*:** this is an orbit that varies between approximately 838 and 934 million miles from the sun. (*Note: One AU equals approximately 93 million miles).

Inclination of Orbit to Ecliptic: 2.5 degrees.

Mean Orbital Velocity: 9.65 km/sec.

Diameter at Equator: 120,537 kilometers (or 75,335 miles).

Mass: 95.16 (approximately 95 times more massive than earth); (5.9742 x (10 e24

(10 to the 24th power)) kilograms = 1 Earth Mass).

Density: 0.7 times that of water (global density); Saturn is the only planet with an overall density less than 1 (water = 1).

Surface Gravity (Earth = 1): 1.08

Period of Rotation on its own axis: approximately 10 hours, 39 minutes.

Axis tilt: 26.73 degrees.

Satellites (moons): 33, as well as the most famous of all planetary rings.

Special Notes About Saturn: Saturn is the second largest planet in the solar system. It has a polar diameter of 107,500 kilometers, and, as such, has the highest oblateness of any planet: 0.108. (Oblateness is the “elliptical” nature or “flattening” of a celestial body; i.e., the degree to which that body differs from a true sphere). The appearance of Saturn in a telescope is dominated by its ring system that lies in the plane of Saturn’s equator; the axis of Saturn is tilted by approximately 27 degrees with respect to the plane of its orbit. This phenomenon leads to opposite ring faces being tilted toward the sun and Earth by up to 27 degrees. Approximately every 15 years, the rings of Saturn (which are at most only about 2 kilometers thick!) become “edge-on” to Earth observers and virtually disappear. The ring system, which is about 270,000 kilometers across, adds to the average apparent magnitude (approximately 0.7) of Saturn at opposition. We will talk more about the ring system below. Saturn’s disk appears similar to that of Jupiter, as it too is crossed by yellowish dark (belts) and light (zones) cloud bands which run parallel to the equator. These bands are not as striking as those of Jupiter, although they too contain anticyclonic (counterclockwise-rotating) “spots” or “weather systems”, (although they are less common and generally less dramatic (e.g., compared to Jupiter’s Great Red Spot). Like Jupiter however, these spots are probably caused by different rotation speeds of the planet between the equator and the poles. Saturn has been studied by the Pioneer 11 and Voyager probes, as well as Cassini.

The early probes helped to determine that Saturn, like Jupiter, most likely has an internal heat source that helps drive its convection-weather systems; Saturn also, like Jupiter, emits more radiation than it absorbs from the Sun. These convective weather systems give rise to the cloud banks that are observed and most likely composed of ammonia crystals; the weather systems are also, like Jupiter, somewhat dependent on the zones they are located in (i.e., equator winds are comparatively stronger).

Further studies show that the bulk of Saturn's mass and atmosphere is more than likely hydrogen, with methane and ethane present in the upper atmosphere. Internal composition models for Saturn indicate an iron-rich rock core, surrounded by ammonia, methane and water, which is further surrounded by liquid metallic hydrogen and then liquid molecular hydrogen, and finally the atmosphere as described above. Saturn has a magnetic field that is approximately 20 times weaker than that of Jupiter. Pioneer also found radiation belts (composed of electrons and protons). These energetic particles interact in the magnetic field and contribute to the emission of radio waves from Saturn; they also interact with the ring system, contributing to the brightness and "spoking" pattern seen especially in one of the rings (ring B); lightning discharges have also been noted in this region of the ring system.

The most famous part of Saturn to most folks is indeed its ring system. They were first seen (but not clearly) by Galileo in 1610, (he called them ears) and recognized as a true ring system later by Huygens in 1656. The rings are now known to be composed of literally thousands of smaller "ringlets" containing innumerable individual particles: all of these particles (maximum size is probably just a few meters in size; most are much smaller) are actually each an individual satellite of Saturn!! There are several distinct ring separations (divisions or gaps), creating distinctly appearing larger rings. These larger rings have been named (for example, the D-ring is closest to the planet itself, and may even interact with the upper atmosphere of Saturn). Other rings (heading outward from the planet) are the, C-ring (the "Crepe" ring, with a large number of distinct ringlets within its grooved confines), and the B-ring (see above), and then the A, F, G, and E-rings. There are significant gaps between several of these larger, more distinct rings. The most noticeable and well known of these gaps is also the largest (4,200 kilometers), and has been named the Cassini Division; with appropriate optical aid, it, and the larger rings, are easily visible from Earth by amateur astronomers. It is theorized that the Cassini Division, which separates the B and A rings, was probably formed from the disturbances from the orbit of one of Saturn's moons (Mimas), as well as the effect of the energetic particles in ring-B (see above).

Briefly, some of Saturn's moons are interesting in their own right. In addition to Mimas as mentioned above, at least two other moons bear mention: Titan and Tethys. Titan is the second largest moon in the entire solar system at 5,150 kilometers (Earth's moon = 3,476 kilometers), and it appears reddish-orange in color. Its atmosphere is mostly nitrogen, with traces of other molecules such as methane and hydrogen cyanide; it has enough of an atmosphere with the right gases to be warmed by a small greenhouse effect. Atomic and molecular hydrogen formed by photochemical reactions on this moon of Saturn probably lead to the formation of the doughnut-shaped ring around this moon as these types of hydrogen easily escape from its atmosphere. The interior is probably rock and water-ice, and the surface may have some very large methane "oceans". Titan was visited by the Huygens "sub"-probe of the Cassini mission detailed above. Tethys is interesting not only as the largest of the inner moons of Saturn, but also because of an unusual and enormous canyon network that extends from its north to almost its south pole; this is known as the Ithaca Chasma, and it averages 100 kilometers wide and 4-5 kilometers deep. There is also a huge crater called Odysseus, which is 400 kilometers in diameter, a diameter that is fully 40% that of this moon's entire diameter! Substantial craters noted elsewhere on this moon of Saturn, indicates that Tethys has suffered considerable bombardment by large debris in its history..

ASTRONOMY "FUN FACTS"

★★ If an advanced galactic civilization responds at the speed of light to Earth's first extraterrestrial message (transmitted in 1974), we'll receive the reply message in about the year 51,974 A.D.!

★★ If several Earth-sized planets lined up and waited their turns, the biggest black holes known could devour them up at over three per second per black hole, or about 111 million Earth-sized planets per year!

★★ Deep within the Sun's core, nuclear reactions are converting hydrogen into helium, releasing energy in the process. Each second, the Sun loses 4.5 million tons of its mass by converting it into energy; alternatively, every 42 years, the Sun loses the equivalent mass of the planet Earth.

★★ If there were enough hydrogen contained within it to fuel it, the Sun would use it all up (i.e., it would consume itself) and disappear in about 14 trillion years. However the Sun does not have enough hydrogen: it is estimated that the Sun will run out of hydrogen in about 3.5 billion years – and then start burning helium for fuel to maintain itself (an eventual losing battle however: as successive fuels run out, the Sun will one day become a red giant, then a white dwarf, and eventually die)

"MIRROR IMAGES"

"Mirror Images" publishes approximately every other month; it last published in August, and will return next month (October). see you then! .

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

SOLVING PUZZLE OF METEORITE-ASTEROID LINK -- 'KNOWING OUR ENEMY'

For the last few years, astronomers have faced a puzzle: The vast majority of asteroids that come near the Earth are of a type that matches only a tiny fraction of the meteorites that most frequently hit our planet. Since meteorites are mostly pieces of asteroids, this discrepancy was hard to explain, but a team has now found what they believe is the answer to the puzzle. The smaller rocks that most often fall to Earth, it seems, come straight in from the main asteroid belt out between Mars and Jupiter, rather than from the near-Earth asteroid (NEA) population.

The puzzle gradually emerged from a long-term study of the properties of asteroids carried out by professor of planetary science Richard Binzel and his students, along with postdoctoral researcher P. Vernazza, , and A.T. Tokunaga. By studying the spectral signatures of near-Earth asteroids, they were able to compare them with spectra obtained on Earth from the thousands of meteorites that have been recovered from falls. But the more they looked, the more they found that most NEAs - about two-thirds of them - match a specific type of meteorites called LL chondrites, which only represent about 8 percent of meteorites. How could that be?

"Why do we see a difference between the objects hitting the ground and the big objects whizzing by?" Binzel asks. "It's been a headscratcher." As the effect became gradually more and more noticeable as more asteroids were analyzed, "we finally had a big enough data set that the statistics demanded an answer. It could no longer be just a coincidence."

Way out in the main belt, the population is much more varied, and approximates the mix of types that is found among meteorites. But why would the things that most frequently hit us match this distant population better than it matches the stuff that's right in

our neighborhood? That's where the idea emerged of a fast track all the way from the main belt to a "splat!" on Earth's surface. This fast track, it turns out, is caused by an obscure effect that was discovered long ago, but only recently recognized as a significant factor in moving asteroids around, called the Yarkovsky effect.

The Yarkovsky effect causes asteroids to change their orbits as a result of the way they absorb the sun's heat on one side and radiate it back later as they rotate around. This causes a slight imbalance that slowly, over time, alters the object's path. But the key thing is this: The effect acts much more strongly on the smallest objects, and only weakly on the larger ones. *"We think the Yarkovsky effect is so efficient for meter-size objects that it can operate on all regions of the asteroid belt,"* not just its inner edge, Binzel says.

Thus, for chunks of rock from boulder-size on down - the kinds of things that end up as typical meteorites - the Yarkovsky effect plays a major role, moving them with ease from throughout the asteroid belt on to paths that can head toward Earth. For larger asteroids a kilometer or so across, the kind that we worry about as potential threats to the Earth, the effect is so weak it can only move them small amounts.

Binzel's study concludes that the largest near-Earth asteroids mostly come from the asteroid belt's innermost edge, where they are part of a specific "family" thought to all be remnants of a larger asteroid that was broken apart by collisions. With an initial nudge from the Yarkovsky effect, kilometer-sized asteroids from the Flora region can find themselves "over the edge" of the asteroid belt and sent on a path to Earth's vicinity through the perturbing effects of the planets called resonances.

The new study is also good news for protecting the planet. One of the biggest problems in figuring out how to deal with an approaching asteroid, if and when one is discovered on a potential collision course, is that they are so varied. The best way of dealing with one kind might not work on another.

But now that this analysis has shown that the majority of near-Earth asteroids are of this specific type - stony objects, rich in the mineral olivine and poor in iron - it's possible to concentrate most planning on dealing with that kind of object, Binzel says. *"Odds are, an object we might have to deal with would be like an LL chondrite, and thanks to our samples in the laboratory, we can measure its properties in detail,"* he says. *"It's the first step toward 'know thy enemy'."*

CASSINI PINPOINTS SOURCE OF JETS ON ENCELADUS

In a feat of interplanetary sharpshooting, the Cassini spacecraft has pinpointed precisely where the icy jets erupt from the surface of Saturn's geologically active moon Enceladus.

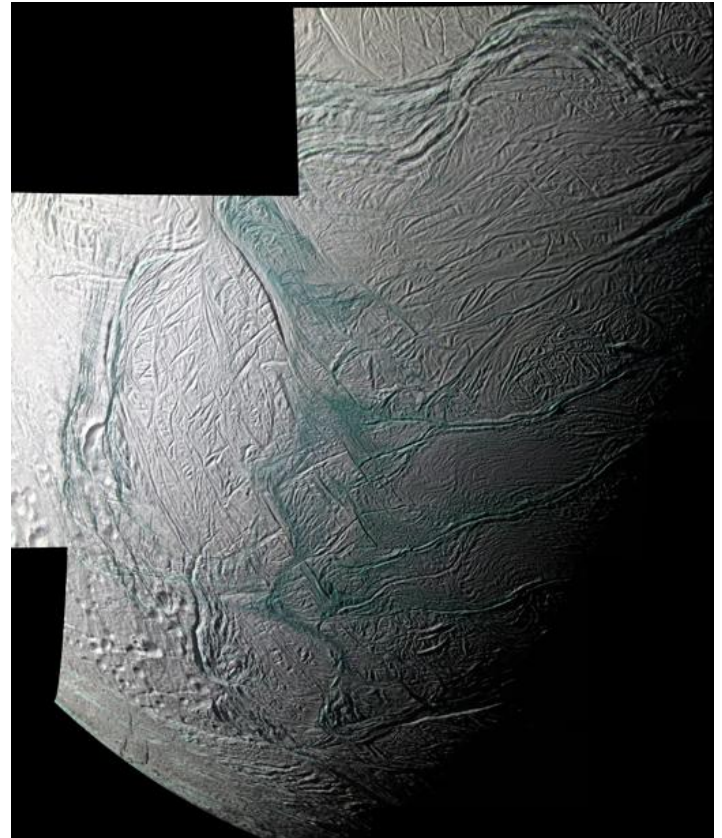
New carefully targeted pictures reveal exquisite details in the prominent south polar "tiger stripe" fractures from which the jets emanate. The images show the fractures are about 300 meters (980 feet) deep, with V-shaped inner walls. The outer flanks of some of the fractures show extensive deposits of fine material. Finely fractured terrain littered with blocks of ice tens of meters in size and larger (the size of small houses) surround the fractures. *"This is the mother lode for us,"* said Carolyn Porco, Cassini imaging team leader. *"A place that may ultimately reveal just exactly what kind of environment -- habitable or not -- we have within this tortured little moon."*

One highly anticipated result of this flyby was finding the location within the fractures from which the jets blast icy particles, water vapor and trace organics into space. Scientists are now studying the nature and intensity of this process on Enceladus, and its

effects on surrounding terrain. This information, coupled with observations by Cassini's other instruments, may answer the question of whether reservoirs of liquid water exist beneath the surface.

The high-resolution images were acquired during an Aug. 11, 2008, flyby of Enceladus, as Cassini sped past the icy moon at 64,000 kilometers per hour (40,000 miles per hour). A special technique, dubbed "skeet shooting" by the imaging team, was developed to cancel out the high speed of the moon relative to Cassini and obtain the ultra-sharp views.

"Knowing exactly where to point, at just the right time, was critical to this event," said Paul Helfenstein, Cassini imaging team associate, who developed and used the skeet-shoot technique to design the image sequence. *"The challenge is equivalent to trying to capture a sharp, unsmearred picture of a distant roadside billboard with a telephoto lens out the window of a speeding car."*



Helfenstein said that from Cassini's point of view, *"Enceladus was streaking across the sky so quickly that the spacecraft had no hope of tracking any feature on its surface. Our best option was to point the spacecraft far ahead of Enceladus, spin the spacecraft and camera as fast as possible in the direction of Enceladus' predicted path, and let Enceladus overtake us at a time when we could match its motion across the sky, snapping images along the way."* For scientists, having the combination of high-resolution snapshots and broader images showing the whole region is critical for understanding what may be powering the activity on Enceladus. *"There appears to have been extensive fallout of icy particles to the ground, along some of the fractures, even in areas that lie between two jet source locations, though any immediate effects of presently active jets are subtle,"* said Porco. Imaging scientists suggest that once warm vapor rises from underground to the cold surface through narrow channels, the icy particles may condense and seal off an active vent. New jets may then appear elsewhere along the same fracture. *"For the first time, we are*

beginning to understand how freshly erupted surface deposits differ from older deposits," said Helfenstein, an icy moons expert. "Over geologic time, the eruptions have clearly moved up and down the lengths of the tiger stripes." The new images, with jet source locations labeled, are available at: <http://www.nasa.gov/cassini> , <http://saturn.jpl.nasa.gov> and <http://ciclops.org> <http://www.jpl.nasa.gov/news/news.cfm?release=2008-160>

UNUSUAL NEW DENIZEN OF THE SOLAR SYSTEM ANNOUNCED BY UW ASTRONOMERS

A "minor planet" with the prosaic name 2006 SQ372 is just over two billion miles from Earth, a bit closer than the planet Neptune. But this lump of ice and rock is beginning the return leg of a 22,500-year journey that will take it to a distance of 150 billion miles, nearly 1,600 times the distance from the Earth to the Sun, according to a team of researchers from the Sloan Digital Sky Survey (SDSS-II).

The discovery of this remarkable object was reported at an international symposium titled "The Sloan Digital Sky Survey: Asteroids to Cosmology." A paper describing the discovery technique and the properties of 2006 SQ372 is being prepared for submission to The Astrophysical Journal.

The orbital paths of the major planets are nearly circular, but the orbit of 2006 SQ372 is an ellipse that is four times longer than it is wide, said University of Washington astronomer Andrew Becker, who led the discovery team. The only known object with a comparable orbit is Sedna -- a distant, Pluto-like dwarf planet discovered in 2003 -- but 2006 SQ372's orbit takes it more than one-and-a-half times further from the Sun, and its orbital period is nearly twice as long. The new object is much smaller than Sedna, Becker said, probably 30-60 miles across instead of nearly 1,000. "It's basically a comet, but it never gets close enough to the Sun to develop a long, bright tail of evaporated gas and dust."

Becker's team found 2006 SQ372 by applying a specialized computer searching algorithm to data taken for a completely different purpose: finding supernova explosions billions of light years away to measure the expansion of the universe. The SDSS-II supernova survey scanned the same long stripe of sky, an area 1,000 times larger than the full moon, every clear night in the fall of 2005, 2006, and 2007. "If you can find things that explode, you can also find things that move, but you need different tools to look for them," said team member Lynne Jones, also of the University of Washington. The only objects close enough to change position noticeably from one night to the next are in our own solar system, Jones explained.

SQ372 was first discovered in a series of images taken between September 27 and October 21, 2006. Team member Andrew Puckett, then searched the supernova survey's Fall 2005 observations to find earlier detections, thus securing the discovery. Subsequent SDSS detections of SQ372 have been found in data from the 2006 and 2007 observing seasons.

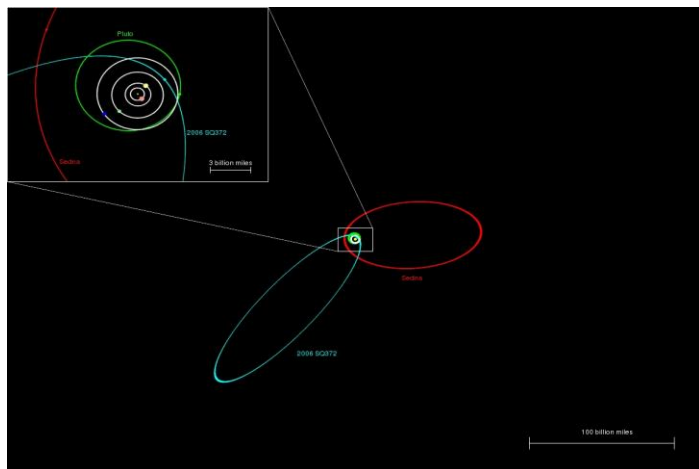
University of Washington graduate student Nathan Kaib, another member of the discovery team, has been running computer simulations to try to understand out how 2006 SQ372 might have acquired its unusual orbit. "It could have formed, like Pluto, in the belt of icy debris beyond Neptune, then been kicked to large distance by a gravitational encounter with Neptune or Uranus," said Kaib. "However, we think it is more probable that SQ372 comes from the inner edge of the Oort Cloud."

In 1950, Kaib explained, the Dutch astronomer Jan Oort hypothesized that most comets come from a distant reservoir of icy, asteroid-like bodies, which were ejected from the inner solar

system by gravitational kicks from the giant planets as the planets themselves were forming four and a half billion years ago. Most objects in the Oort cloud orbit the Sun at distances of several trillion miles, but the gravity of passing stars can alter their orbits, flinging some into interstellar space and deflecting others to the inner solar system where they "light up" as comets.

Even at its most distant turning point, 2006 SQ372 will be ten times closer to the Sun than the supposed main body of the Oort Cloud, said Kaib. "The existence of an 'inner' Oort cloud has been theoretically predicted for many years, but SQ372 and perhaps Sedna are the first objects we have found that seem to originate there. It's exciting that we are beginning to verify these predictions."

Becker noted that 2006 SQ372 was bright enough to find with the SDSS only because it is near its closest approach to the Sun, and that the SDSS-II supernova survey observed less than one percent of the sky. "There are bound to be many more objects like this waiting to be discovered by the next generation of surveys, which will search to fainter levels and cover more area," said Becker. "In a decade, we should know a lot more about this population than we do now." "One of our goals," said Kaib, "is to understand the origin of comets, which are among the most spectacular celestial events. But the deeper goal is to look back into the early history of our solar system and piece together what was happening when the planets formed." <http://www.sdss.org> http://www.astronomy.ohio-state.edu/~dhw/SDSS08/sq372_orbit.jpg



The orbit of the newly discovered solar system object SQ372 (blue), in comparison to the orbits of Neptune, Pluto, and Sedna (white, green, red). The location of the Sun is marked by the yellow dot at the center. The inset panel shows an expanded view, including the orbits of Uranus, Saturn, and Jupiter inside the orbit of Neptune. Even on this expanded scale, the size of Earth's orbit would be barely distinguishable from the central dot. (Credit: N. Kaib)

AMATEUR ASTRONOMERS SEE PERSEID METEORS HIT MOON

There's more than one way to watch a meteor shower. One, the old-fashioned way: Find a dark place with starry skies and count the meteors streaking overhead. Two, the new way: Find a dark place with starry skies and then completely ignore the meteors. Instead, watch the Moon. That's where the explosions are.

On August 9th, a pair of amateur astronomers on opposite sides of the United States did it the new way. With the Perseid meteor shower just underway, they fixed their cameras on the Moon and watched meteoroids slam into the lunar surface. Silent explosions equivalent to ~100 lbs of TNT produced flashes of light visible a quarter of a million miles away on Earth. It was a good night for

"lunar Perseids." *"I love watching meteor showers this way,"* says George Varros, who recorded this impact from his home in Mt. Airy, Maryland:

The flash, which lit up a nighttime patch of Mare Nubium (the Sea of Clouds), was a bit dimmer than 7th magnitude--*"an easy target for my 8-inch telescope and low-light digital video camera."* Hours later, another Perseid struck, on the western shore of Oceanus Procellarum (the Ocean of Storms). This time it was Robert Spellman of Azusa, California, who caught the flash. *"It's exciting to witness these explosions in real time,"* he says. *"I used a 10-inch telescope and an off-the-shelf Supercircuits video camera."*

Rob Suggs of NASA's Meteoroid Environment Office has reviewed the data. *"They look real to me,"* he says. *"The flashes appear in multiple video frames and the light curves are similar to other lunar meteors we've recorded in the past."* Suggs would know. Along with colleague Bill Cooke, he leads a team that has recorded more than 100 lunar explosions since 2005. *"We monitor lunar meteors in support of NASA's return to the Moon,"* Suggs says. *"The Moon has no atmosphere to protect the surface, so meteoroids crash right into the ground. Our program aims to measure how often that happens and answer the question, what are the risks to astronauts?"*

NASA's official lunar meteor observatories are located in Alabama and Georgia. Both were off-line on August 9th, so the NASA team didn't see how many Perseids were hitting the Moon that night. *"This shows how amateur astronomers can contribute to our research,"* points out Suggs. *"We can't observe the Moon 24-7 from our corner of the USA. Clouds, sunlight, the phase of the Moon—all these factors limit our opportunities. A global network of amateur astronomers monitoring the Moon could, however, approach full coverage."*

By day, George Varros is a software engineer at NASA headquarters. After work, he takes off his NASA badge, goes home and fires up his self-described "barely adequate" telescope. *"Until a few years ago, I really didn't like the Moon because it interfered with my observations of comets and meteors. Then, in 1999 during the Leonid meteor storm, (fellow amateur astronomer) David Dunham photographed six lunar impact events from my backyard in Maryland,"* Varros recalls. *"I was hooked."* Dunham's observations inspired not only Varros, but also NASA. *"Our own observing program can be traced back to those early amateur observations of lunar Leonids,"* says Suggs.

A major advance in lunar meteor detection came in 2006 in the form of LunarScan, a computer program written by amateur astronomer Pete Gural that searches digital video of the Moon for split-second flashes. Using LunarScan, Varros has bagged at least a dozen lunar meteors. Three of them were observed simultaneously by the NASA team in Alabama, confirming the fidelity of Varros' techniques. (LunarScan may be freely downloaded from Varros' web site <http://gvarros.com>; NASA uses the program, too!)

Like Varros, Robert Spellman's interest in lunar meteors began with the Leonids of 1999. *"I read about the success of amateurs recording impact flashes,"* he recalls. *"I've been in love with the Moon since my first observation when I was five years old, and I wanted to conduct an observing program with scientific value. Lunar meteors were a natural."* Spellman's day job is at the Natural History Museum of Los Angeles and the La Brea tar pits where he works as an educator. He also conducts public astronomy programs three nights a week at the Griffith Observatory. The rest of his evenings he devotes to the Moon. Spellman uses no special software to catch his impacts. *"I look for the flashes in real time,"* he says. *"Although it may sound*

tedious to stare at a blank screen for hours on end, the prospect of seeing an explosion keeps me alert. In future, I do plan to use LunarScan to increase my success rate."

Suggs hopes other amateurs will take up this hobby, not only to improve NASA's lunar impact statistics, but also to support the agency's LCROSS mission: In 2009, the Lunar CRater Observation and Sensing Satellite (LCROSS) will intentionally dive into the Moon, producing a flash akin to a natural lunar meteor. Unlike natural meteoroids, which hit the Moon in random locations, LCROSS will carefully target a polar crater containing suspected deposits of frozen water. If all goes as planned, the impact will launch debris high above the lunar surface where astronomers can search the ejecta for signs of H₂O. The impact flash (if not hidden by crater walls) and the debris plume may be visible to backyard telescopes on Earth: details <http://science.nasa.gov/headlines/y2008/11aug_lcross.htm>.

Ready for meteor watching--the new way? NASA offers a FAQ http://science.nasa.gov/headlines/y2008/images/lunarperseids/166651main_FAQ2-2.pdf and telescope tips http://science.nasa.gov/headlines/y2008/images/lunarperseids/166643main_MinimumSystemRequirements4-1.pdf to help you get started. Good hunting!

CLOSEST LOOK EVER AT THE EDGE OF A BLACK HOLE

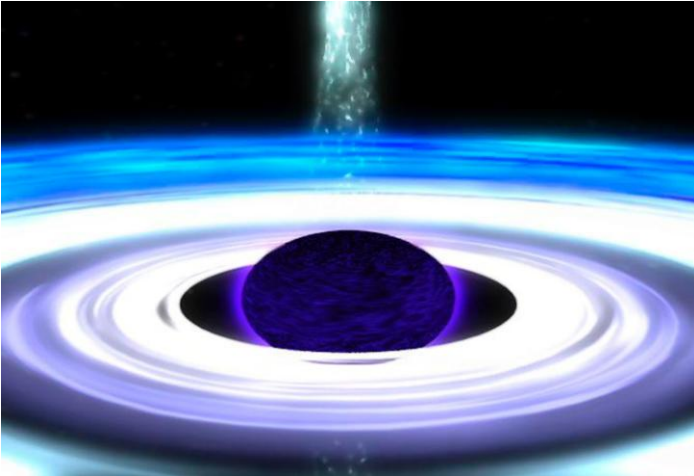
Astronomers have taken the closest look ever at the giant black hole in the center of the Milky Way. By combining telescopes in Hawaii, Arizona, and California, they detected structure at a tiny angular scale of 37 micro-arcseconds -- the equivalent of a baseball seen on the surface of the moon, 240,000 miles distant. *"This technique gives us an unmatched view of the region near the Milky Way's central black hole,"* said Sheperd Doleman author of the study. *"No one has seen such a fine-grained view of the galactic center before,"* agreed co-author Jonathan Weintraub. *"We've observed nearly to the scale of the black hole event horizon -- the region inside of which nothing, including light, can ever escape."*

Using a technique called Very Long Baseline Interferometry (VLBI), a team of astronomers led by Doleman employed an array of telescopes to study radio waves coming from the object known as Sagittarius A* (A-star). In VLBI, signals from multiple telescopes are combined to create the equivalent of a single giant telescope, as large as the separation between the facilities. As a result, VLBI yields exquisitely sharp resolution.

The Sgr A* radio emission, at a wavelength of 1.3 mm, escapes the galactic center more easily than emissions at longer wavelengths, which tend to suffer from interstellar scattering. Such scattering acts like fog around a streetlamp, both dimming the light and blurring details. VLBI is ordinarily limited to wavelengths of 3.5 mm and longer; however, using innovative instrumentation and analysis techniques, the team was able to tease out this remarkable result from 1.3-mm VLBI data.

The team clearly discerned structure with a 37 micro-arcsecond angular scale, which corresponds to a size of about 30 million miles (or about one-third the earth-sun distance) at the galactic center. With three telescopes, the astronomers could only vaguely determine the shape of the emitting region. Future investigations will help answer the question of what, precisely, they are seeing: a glowing corona around the black hole, an orbiting "hot spot," or a jet of material. Nevertheless, their result represents the first time that observations have gotten down to the scale of the black hole itself, which has a "Schwarzschild radius" of 10 million miles. *"This pioneering paper demonstrates that such observations are feasible,"* commented theorist Avi Loeb, who is not a member of the discovery team. *"It also opens*

up a new window for probing the structure of space and time near a black hole and testing Einstein's theory of gravity."



In 2006, Loeb and his colleague, Avery Broderick, examined how ultra-high-resolution imaging of the galactic center could be used to look for the shadow or silhouette of the supermassive black hole lurking there, as well as any "hot spots" within material flowing into the black hole. Astronomers now are poised to test those theoretical predictions. *"This result, which is remarkable in and of itself, also confirms that the 1.3-mm VLBI technique has enormous potential, both for probing the galactic center and for studying other phenomena at similar small scales,"* said Weintraub.

The team plans to expand their work by developing novel instrumentation to make more sensitive 1.3-mm observations possible. They also hope to develop additional observing stations, which would provide additional baselines (pairings of two telescope facilities at different locations) to enhance the detail in the picture. Future plans also include observations at shorter, 0.85-mm wavelengths; however, such work will be even more challenging for many reasons, including stretching the capabilities of the instrumentation, and the requirement for a coincidence of excellent weather conditions at all sites. *"The technical capabilities that have been developed for the Submillimeter Array on Mauna Kea are a crucial contribution to this program,"* said Jim Moran http://cfa-www.harvard.edu/press/2008/pr200816_images.html

MISSING LINK TO THE OORT CLOUD

Astronomers have spotted a surprising asteroid, whose unusual orbit may help explain where comets come from. The asteroid, currently named 2008 KV42, is orbiting the Sun backwards and almost perpendicular to the orbits of the planets -- a 104 degree tilt. This odd orbit suggests that 2008 KV42 may have been pulled into our solar system from the Oort Cloud. Comets can originate in the Oort Cloud and this discovery may finally show how they transition from the Oort Cloud to become objects like Halley's Comet. The orbits of asteroids in the region beyond Neptune's orbit provide important clues as to how the outer Solar System took form and evolved. Discoveries of new classes of objects have led to fresh insights into the early history of our solar system, challenging accepted theories. The discovery of 2008 KV42, the first-ever object in this region to be detected with a backwards (retrograde) orbit, promises to do just that. *"Although we've been specifically looking for highly-tilted trans-Neptunians for some time now, we didn't expect to find a retrograde one,"* said Dr. JJ Kavelaars. *"A number of theories on the formation of the outer solar system have suggested that such things might be*

out there, but observational searches for them are very difficult." Part of the difficulty is that these objects are extremely rare. Despite having surveyed most of the northern sky for bright objects of this type, astronomers have found only one other that might belong to the same class as 2008 KV42. Discovered six years ago by the Deep Ecliptic Survey, 2002 XU93 has an orbit on a 77 degree tilt. One of the great frustrations for researchers looking into the solar region beyond Neptune has been trying to pin down the source regions for various comet types. Finding objects that provide a link between the source region and the observed comet population is an enormous help in choosing between the source regions, greatly clarifying our understanding of the formation of the outer solar system.

This discovery was made using the Canada-France-Hawaii Telescope in Hawaii, with follow-up observations provided by the MMT telescope in Arizona, the Cerro Tololo Inter-American Observatory (CTIO) 4-metre telescope in Chile, and the Gemini South telescope, also in Chile, of Canada's Gemini Observatory.

"Having quick access to the MMT and Gemini South telescopes, via the generous support of the observers at MMT, was a huge help here. Given the highly unusual orbit, the object would have been lost without the critical tracking contribution of these large telescopes," said Dr. Brett Gladman, an astronomy professor at the University of British Columbia. The discovery team is currently planning follow-up observations of 2008 KV42 to pin down its orbit with greater precision. The exciting work of unraveling the archaeological information trapped in the orbit of this highly exceptional member of the trans-Neptunian population can then begin. Recent observations taken with the Canada-France-Hawaii Telescope have further refined our knowledge of the orbit, securing this as a possible link between the inner Oort cloud and the Halley-type comets. With a semi-major axis of 46 +/- 5 AU, 2008 KV42 was discovered while at a distance of 32 AU and has a perihelion (closest approach to the Sun) at roughly the distance of Uranus. http://www.cfeps.net/CFEPS/KV42_Science.html

"NAKED-EYE" GAMMA-RAY BURST WAS AIMED SQUARELY AT EARTH

Data from satellites and observatories around the globe show a jet from a powerful stellar explosion witnessed March 19 was aimed almost directly at Earth. Swift satellite detected the explosion - formally named GRB 080319B - at 2:13 a.m. EDT that morning and pinpointed its position in the constellation Bootes. The event, called a gamma-ray burst, became bright enough for human eyes to see. Observations of the event are giving astronomers the most detailed portrait of a burst ever recorded. *"Swift was designed to find unusual bursts,"* said Swift principal investigator Neil Gehrels. *"We really hit the jackpot with this one."*

Judith Racusin and a team of 92 coauthors report on observations across the spectrum that began 30 minutes before the explosion and followed its afterglow for months. The team concludes the burst's extraordinary brightness arose from a jet that shot material directly toward Earth at 99.99995 percent the speed of light. At the same moment Swift saw the burst, the Russian KONUS instrument on Wind satellite also sensed the gamma rays and provided a wide view of their spectral structure. A robotic wide-field optical camera called "Pi of the Sky" in Chile simultaneously captured the burst's first visible light. The system is operated by institutions from Poland.

Within the next 15 seconds, the burst brightened enough to be visible in a dark sky to human eyes. It briefly crested at a magnitude of 5.3 on the astronomical brightness scale. Incredibly, the dying star was 7.5 billion light-years away. Telescopes around the world already were studying the afterglow of another

burst when GRB 080319B exploded just 10 degrees away. TORTORA, a robotic wide-field optical camera operated in Chile with Russian-Italian collaboration, also caught the early light. TORTORA's rapid imaging provided the most detailed look yet at visible light associated with a burst's initial gamma-ray blast. Immediately after the blast, Swift's UltraViolet and Optical Telescope and X-Ray Telescope indicated they were effectively blinded. Racusin initially thought something was wrong. Within minutes, however, as reports from other observers arrived, it was clear this was a special event.

Gamma-ray bursts are the universe's most luminous explosions. Most occur when massive stars run out of nuclear fuel. As a star's core collapses, it creates a black hole or neutron star that, through processes not fully understood, drive powerful gas jets outward. These jets punch through the collapsing star. As the jets shoot into space, they strike gas previously shed by the star and heat it. That generates bright afterglows. The team believes the jet directed toward Earth contained an ultra-fast component just 0.4 of a degree across. This core resided within a slightly less energetic jet about 20 times wider. *"It's this wide jet that Swift usually sees from other bursts,"* Racusin explained. *"Maybe every gamma-ray burst contains a narrow jet, too, but astronomers miss them because we don't see them head-on."* Such an alignment occurs by chance only about once a decade, so a GRB 080319B is a rare catch. http://www.nasa.gov/mission_pages/swift/bursts/naked_eye_telecon.html

1843 STELLAR ERUPTION NEW TYPE OF STAR EXPLOSION

Eta Carinae, the galaxy's biggest, brightest and perhaps most studied star after the sun, has been keeping a secret: Its giant outbursts appear to be driven by an entirely new type of stellar explosion that is fainter than a typical supernova and does not destroy the star. Astronomer Nathan Smith proposes that Eta Carinae's historic 1843 outburst was, in fact, an explosion that produced a fast blast wave similar to, but less energetic than, a real supernova. This well-documented event in our own Milky Way Galaxy is probably related to a class of faint stellar explosions in other galaxies recognized in recent years by telescopes searching for extragalactic supernovae. *"There is a class of stellar explosions going off in other galaxies for which we still don't know the cause, but Eta Carinae is the prototype,"* said Smith, a postdoctoral fellow.

Eta Carinae (Eta Car) is a massive, hot, variable star visible only from the Southern Hemisphere, and is located about 7,500 light years from Earth in a young region of star birth called the Carina Nebula. It was observed to brighten immensely in 1843, and astronomers now see the resulting cloud of gas and dust, known as the Homunculus nebula, wafting away from the star. A faint shell of debris from an earlier explosion is also visible, probably dating from around 1,000 years ago.

Presumably blown off by the star's fierce wind, the shells of gas and dust are moving slowly -- at speeds of 650 kilometers per second (1.5 million miles per hour) or less -- compared to the blast shell of a supernova. Smith's recent observations reveal something new: Extremely fast filaments of gas moving five times faster than the debris in the Homunculus nebula were propelled away from Eta Carinae in the same event. The amount of mass in the relatively slow-moving Homunculus was already at the edge of plausibility in terms of what an extreme stellar wind could do physically, Smith said. The much faster and more energetic material he discovered poses even harsher difficulties for current theories. Instead, the speeds and energies involved are reminiscent of material accelerated by the fast blast wave of a supernova explosion. The fast speeds in this blast wave could roughly double earlier estimates of the energy released in the

1843 eruption of Eta Carinae, an event that Smith argues was not just a gentle surface eruption driven by the stellar wind, but an actual explosion deep in the star that sent debris hurtling into interstellar space. In fact, the fast-moving blast wave is now colliding with the slow-moving cloud from the 1,000-year-old eruption and generating X-rays that have been observed by the orbiting Chandra Observatory. *"These observations force us to modify our interpretation of what happened in the 1843 eruption,"* he said. *"Rather than a steady wind blowing off the outer layers, it seems to have been an explosion that started deep inside the star and blasted off its outer layers. It takes a new mechanism to cause explosions like this."* If Smith's interpretation is correct, supermassive stars like Eta Carinae may blow off large amounts of mass in periodic explosions as they approach the end of their lives before a final, cataclysmic supernova blows the star to smithereens and leaves behind a black hole.

Much fainter than a supernova, the explosion that generated the fast-moving blast wave around Eta Carinae would have been similar to faint stellar explosions, sometimes called "supernova imposters," now being discovered in other galaxies by Earth-based robotic telescopes and other supernova searches. Such searches have been looking primarily for Type Ia supernovae that could help astronomers understand the accelerating expansion of the universe, but they also find other gems along the way, Smith said. *"Looking at other galaxies, astronomers have seen stars like Eta Carinae that get brighter, but not quite as bright as a real supernova,"* he said. *"We don't know what they are. It's an enduring mystery as to what can brighten a star that much without destroying it completely."* Eta Carinae is a rare supermassive star in our galaxy, probably once having had a mass 150 times that of the sun. Such large stars burn brightly for only a few million years, all the while shedding mass as the intense light pushes the outer layers of the star away in a stellar wind. After 2 to 3 million years of this, Eta Carinae now weighs about 90 to 100 solar masses, having shed about 10 solar masses in its most recent 1843 eruption alone. *"These explosions may be the primary way by which massive stars can shed their outer hydrogen layers before they die,"* Smith said. *"If Eta Carinae is able to shed 10 solar masses every thousand years or so, that's an efficient mechanism for peeling off a large fraction of the star."*

Astronomers now believe that Eta Carinae and other luminous blue variable stars are nearing the end of their lives, having burned hydrogen in their cores into helium. If they explode at the stage where they still have an envelope of hydrogen shrouding the helium core, the resulting supernova will look vastly different from one that results from a star that sloughs off all its hydrogen before exploding.



Image credit: Gemini Observatory artwork by Lynette Cook

Smith suggests that it is still unclear if supernova impostors are scaled-down versions of supernovae, failed supernovae, precursor events or entirely different kinds of explosions. "This could be an important clue for understanding the last violent phases in the lives of massive stars," he said, noting that astronomers still cannot accurately predict the fate of stars that are 30 or more times the mass of the sun.

The observations included visible spectra from the Blanco telescope, and near-infrared spectra taken with the Gemini South telescope. Both telescopes are in Chile's Andes mountains near an elevation of 9,000 feet. <http://www.gemini.edu/node/11120>]

VERY HIGH ENERGY GAMMA RAYS FROM FAR AWAY

With a 17-m diameter mirror, the MAGIC telescope (Major Atmospheric Gamma-ray Imaging Cherenkov) telescope on the Canary island of La Palma is the world's largest stand-alone gamma-ray telescope. MAGIC has discovered the most distant very-high energy gamma-ray emission, and Using the MAGIC, scientists have succeeded in detecting very-high energy gamma rays from a source more than double as distant as any previously known gamma-ray source. The scientists discovered very high energy gamma rays from "3C 279", the active nucleus of a distant galaxy. 3C 279 is more than five billion light years away -- roughly half the radius of the Universe.

3C279 is a prominent member of the class of active galactic nuclei (AGNs) containing super-massive black holes, typically a billion times more massive than our own Sun, powered by accreting matter from surrounding stars or gas. AGNs emit radiation across the entire electromagnetic spectrum from radio wavelengths to very high energy gamma-rays. Whereas most of the emission can travel through the Universe without being absorbed, the flux of very high energy gamma rays is attenuated by pair-production in interactions with low energy photons of the extragalactic background light. This extragalactic background light comprises the history of all light produced by stars and galaxies in the Universe and is, therefore, of great interest as a record of cosmological structure formation. The detection of very high energy gamma-ray emission from a source at such a distance as 3C279 limits current theories about the density of the extragalactic background light. It shows that the Universe appears more transparent to gamma rays at far cosmological distances than believed, precluding any significant contributions from light other than from sources observed by current optical and infrared telescopes.

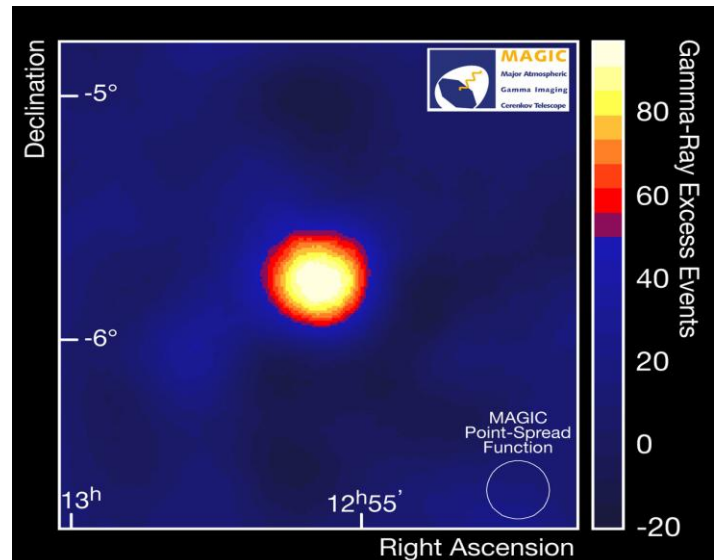
The MAGIC result confirms once more the rich potential of gamma-ray observations to open new avenues in astronomy. Gamma rays constitute the highest-energy electromagnetic radiation observable, and are generated by the most violent cosmic objects such as supernovae, active galactic nuclei, and gamma ray bursts. They allow us to zoom into a realm of extreme physical conditions, far beyond what can be studied in terrestrial laboratories. Gamma rays are of great importance as messengers in modern astroparticle physics and astronomy: they provide precious information about the processes that generated them, without deflections by magnetic fields that affect all charged cosmic rays. Since such particles travel for distances comparable with the radius of the Universe, they also give important information on fundamental physics and cosmology, in particular about the evolution of the Universe.

The MAGIC telescope is located at the Roque de los Muchachos Observatory, on the Canary island of La Palma. It detects gamma rays through short light flashes that are produced when gamma rays cross the atmosphere (Cherenkov light). A second

MAGIC telescope (MAGIC-II) is under construction close to the first, and will be inaugurated in September 2008.



http://www.mpg.de/bilderBerichteDokumente/multimedial/bilderWissenschaft/2008/06/Magic0802/Web_Zoom.jpeg Shortly after sunset, the MAGIC telescope is getting ready for the next observation night. Image: R. Wagner, Max Planck Institute



http://www.mpg.de/bilderBerichteDokumente/multimedial/bilderWissenschaft/2008/06/Magic0801_englisch/Web_Zoom.jpeg Sky Map of 3C279 in Very-High Energy photons as seen by the MAGIC telescope. The active galactic nucleus, from which these photons originated, is a quasar which is more than five billion light years from the Earth. The detection of very-high energy gamma emission by a source at such a distance challenges current theories about the intergalactic medium, which appears more transparent than previously believed.

CASSINI IMAGES RING ARCS AMONG SATURN'S MOONS

Cassini images reveal the existence of a faint arc of material orbiting with Saturn's small moon Anthe. The spacecraft has detected a faint, partial ring orbiting with one small moon of Saturn, and has confirmed the presence of another partial ring orbiting with a second moon. This is further evidence that most of the planet's small, inner moons orbit within partial or complete rings. Recent images show material, called ring arcs, extending ahead of and behind the small moons Anthe and Methone in their orbits. The new findings indicate that the gravitational influence of

nearby moons on ring particles might be the deciding factor in whether an arc or complete ring is formed.

Both Anthe and Methone orbit Saturn in locations called resonances, where the gravity of the nearby larger moon Mimas disturbs their orbits. Gravitational resonances are also responsible for many of the structures in Saturn's magnificent rings. Mimas provides a regular gravitational tug on each moon, which causes the moons to skip forward and backward within an arc-shaped region along their orbital paths, according to Nick Cooper, a Cassini imaging team associate. *"When we realized that the Anthe and Methone ring arcs were very similar in appearance to the region in which the moons swing back and forth in their orbits due to their resonance with Mimas, we knew we had a possible cause-and-effect relationship,"* Cooper said.

Scientists believe the faint ring arcs from Anthe and Methone likely consist of material knocked off these small moons by micrometeoroid impacts. This material does not spread all the way around Saturn to form a complete ring, because of the gravitational resonance with Mimas. That interaction confines the material to a narrow region along the orbits of the moons.

This is the first detection of an arc of material near Anthe. The Methone arc was previously detected by Cassini's Magnetospheric Imaging Instrument, and the new images confirm its presence. Previous Cassini images show faint rings connected with other small moons either embedded within or near the outskirts of Saturn's main ring system, such as Pan, Janus, Epimetheus and Pallene. Cassini had also previously observed an arc in the G ring, one of Saturn's faint, major rings.



"This is probably the same mechanism responsible for producing the arc in the G ring," said Matthew Hedman, a Cassini imaging team associate at Cornell University in Ithaca, N.Y. Hedman and his Cassini imaging team colleagues previously determined that the G-ring arc is maintained by a gravitational resonance with Mimas, much like the new, small moon arcs. *"Indeed, the Anthe arc may be similar to the debris we see in the G-ring arc, where the largest particles are clearly visible. One might even speculate*

that if Anthe were shattered, its debris might form a structure much like the G ring," Hedman said.

Additional analysis by scientists indicates that, while the gravitational influence of Mimas keeps the Anthe, Methone and G-ring arcs in place, the material that orbits with the moons Pallene, Janus and Epimetheus is not subject to such powerful resonant forces and is free to spread out around the planet, forming complete rings without arcs. The intricate relationships between these ring arcs and the moons are just one of many such mechanisms that exist in the Saturn system. Cassini Imaging Team member said, *"There are many examples in the Saturn system of moons creating structures in the rings and disturbing the orbits of other moons. Understanding these interactions and learning about their origins can help us to make sense of what we are seeing in the Cassini images."*

PERSEIDS METEOR SHOWER CREATES SEPTEMBER SURPRISE

An unexpected flurry of bright fireballs appeared over the eastern United States early on Sept. 9th, but sharp-eyed Marshall Space Flight Center astronomers were on the case. Lasting almost four hours, the shower contained about 25 meteors that were as bright as Jupiter and Venus in the morning sky. Early analysis suggests that NASA's photos are the first-ever observed outburst of the September Perseids, which result from an unknown comet.

William Cooke, of the NASA Meteoroid Environments Office, reported that a single station all-sky video observation system captured images showing a significant outburst of bright meteors on September 9 between 1:20 am and 5:30 am Central Time. In total, some 25 meteors of apparent magnitude greater than -2 were detected from a single radiant during this four hour interval. This is an apparent rate of such events exceeding the Perseid peak, suggestive of ZHRs ~100. The timing and radiant are consistent with an outburst from the previously seen "September Perseid meteor shower.

A meteor is a bright streak of light that appears briefly in the sky, occurring when a particle or chunk of metallic or stony matter called a meteoroid enters the earth's atmosphere from outer space. Air friction heats the meteoroid so that it glows and creates a shining trail of gases and melted meteoroid particles. The gases include vaporized meteoroid material and atmospheric gases that heat up when the meteoroid passes through the atmosphere. Most meteors are visible for about a second. Observers often call meteors shooting stars or falling stars because they look like stars falling from the sky. The brightest meteors -- those brighter than the planet Jupiter -- are called fireballs.

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 at least two weeks prior to the next upcoming scheduled EAS meeting.

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.

The Star Gazer
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In September's StarGazer:

- **** **ASTRO CALENDAR - UPCOMING ASTRONOMY EVENTS FOR 2008**
- **** **OBSERVER'S INFORMATION - SUN, MOON, AND PLANET VISIBILITY**
- **** **CONSTELLATIONS OF THE MONTH**
- **** **YOUNG ASTRONOMER'S CORNER**
- **** **ASTRONOMY "FUN FACTS"**
- **** **ASTRONOMY & TELESCOPE LINGO**
- **** **Perseids Meteor Shower Creates September Surprise**
- **** **CASSINI IMAGES RING ARCS AMONG SATURN'S MOONS**
- **** **VERY HIGH ENERGY GAMMA RAYS FROM FAR AWAY**
- **** **"NAKED-EYE" GAMMA-RAY BURST WAS AIMED SQUARELY AT EARTH**
- **** **MISSING LINK TO THE OORT CLOUD**
- **** **1843 STELLAR ERUPTION NEW TYPE OF STAR EXPLOSION**
- **** **CLOSEST LOOK EVER AT THE EDGE OF A BLACK HOLE**
- **** **AMATEUR ASTRONOMERS SEE PERSEID METEORS HIT MOON**
- **** **UNUSUAL NEW DENIZEN OF THE SOLAR SYSTEM DISCOVERED BY UW ASTRONOMERS**
- **** **CASSINI PINPOINTS SOURCE OF TIGER-STRIPE JETS ON ENCELADUS**
- **** **SOLVING PUZZLE OF METEORITE-ASTEROID LINK -- 'KNOWING OUR ENEMY'**

The next EAS Meeting is 7:00 P.M. Saturday September 13th at the 'Aurora Astro Products' store location at Silver Lake.