

The Stargazer

May 2009

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EAS BUSINESS...

NEXT EAS MEETING – SAT. MAY 30TH 7PM AT AURORA ASTRO PRODUCTS STORE AT SILVER LAKE.

★★ Saturday May 30th 7:00 pm Meeting ★★

The program will be 2009 EAS president Mark Folkerts with a presentation on the Allen Telescope Array (ATA) and Hat Creek Radio Observatory, in the Hat Creek Valley of northern California between Mt. Shasta and Mt. Lassen. The state of the art radio telescopes there are being used for astrophysical observing and SETI search (simultaneously).

Attending members will be eligible for drawing for our monthly door prize item.

**Map/Directions to Aurora Astro Products store location -
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 ★

★ Scheduled EAS Star Parties at Ron Tam's: ★

Saturday June 20

Saturday July 18

Saturday August 22

Saturday September 19

Saturday October 17

Saturday November 14

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.

Please also join the EAS mail list, and then send mail to the mail list at 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.

Other Western US Star Parties This Season

JUNE -

Jun 13 2009 - OMSI-RCA Summer Solstice Star Party, Rooster Rock State Park & Stub Stewart State Park, OR http://www.rca-oms.org/sp/sp_schedule.htm

Jun 13-20 2009 Grand Canyon Star Party (GCSP), On South Rim - <http://www.tucsonastronomy.org/gcsp.html>

Jun 17-21 2009 - The Rocky Mountain Star Stare (RMSS) 2009, Pike Nat Forest, Colorado Springs, CO <http://www.rmss.org/>

Jun 17-20 - Bryce Canyon Astronomy Festival, Bryce Canyon Nat. Pk, UT <http://www.nps.gov/bcrca/planyourvisit/astronomyprograms.htm>

Jun 18-21 2009 - Goldendale 2009 NWRAL "First Light", Skyview Acres - Goldendale WA <http://klickitatstarparty.net/>

Jun 19-21 2009 - RCA Maupin Dark Sky Star Party, Maupin, OR - <http://www.rca-oms.org/sp/maupin.htm>

Jun 19-20, Jul 24-25, Aug 21-22 2009 - Stars Over Yellowstone Star Parties, Madison Campground Amphitheater, <http://smasweb.org/>

Jun 20-24 2009 - Golden State Star Party 2009, Frosty Acres Ranch, Adin, CA <http://goldenstatestarparty.blogspot.com/>

Jun 19-20 2009 Craters of the Moon Star Party 2009, Craters of the Moon Nat. Monument, ID <http://ifastro.org/web/index.php>
<http://www.boiseastro.org/>

JULY -

Jul 15-19, 2009 - Mt Bachelor Star Party (MBSP) 2009, Mt. Bachelor (Bend) OR <http://www.mbsp.org/>

Jul 15-19, 2009 - RASCals Vancouver Island Star Party 2009, Victoria Fish & Game Assoc - Holker Place, Malahat, (Near Victoria) BC, CA
<http://victoria.rasc.ca/events/StarParty/>

Jul 18 2009 - OMSI-RCA Summer Night Sky Star Party, Rooster Rock State Park & Stub Stewart State Park, OR http://www.rca-omsi.org/sp/sp_schedule.htm

Jul 20-25 2009 - Table Mt. Star Party (TMSP) 2009, Ellensburg WA
<http://www.tmspa.com/>

Jul 24-25 2009 - Lava Hot Springs Star Party 2009, Lava Hot Springs ID - <http://ifastro.org/web/index.php>

Jul 24-26 2009 - RCA Trout Lake Star Party Weekend, Trout Lake, WA - <http://www.rca-omsi.org/sp/pix/troutlake.pdf>

Jul 25 2009 - OAS Hurricane Ridge Star Party, Hurricane Ridge, WA
http://www.olympicastronomicalsociety.com/Documents/2009_OAS_calendar.pdf

AUGUST -

Aug 11 2009 - OMSI-RCA Perseid Meteor Shower Star Party, Rooster Rock State Park & Stub Stewart State Park, OR http://www.rca-omsi.org/sp/sp_schedule.htm

Aug 15-23 2009 - Mt. Kobau Star Party 2009 (MKSP), Mt. Kobau, near Osoyoos BC <http://www.mksp.ca/>

Aug 19-23 2009 - Oregon Star Party 2009 (OSP), Ochocco NF
<http://www.oregonstarparty.org/>

Aug 20-22 2009 - SAS Brooks Memorial Park Star Party 2009, SR 97 near Goldendale <http://www.seattleastro.org/events.shtml>

Aug 20-22 2009 - 19th Annual 'Weekend Under the Stars' 2009, Foxpark WY - <http://home.bresnan.net/~curranm/wuts.html>

Aug 21-23 2009 - Idaho Star Party 2009, Bruneau Dunes State Park - <http://ifastro.org/web/index.php> (Boise AS) <http://www.boiseastro.org/>

SEPTEMBER -

Sep 12 2009 - OMSI-RCA Autumnal Equinox Star Party, Rooster Rock State Park & Stub Stewart State Park, OR http://www.rca-omsi.org/sp/sp_schedule.htm

Sep 17-18 2009 - OAS Camp Delany Fall Star Party, Sun Lakes SP - <http://www.olympicastronomicalsociety.com/Documents/FALLCAMPDELANYSign-UpForm.pdf>

Sep 17-19 2009 - CalStar2009, Lake San Antonio Park CA
<http://www.sjaa.net/calstar/> - <http://www.sjaa.net/>

Sep 18-19 2009 - Craters of the Moon Star Party 2009, Craters of the Moon Nat. Monument, ID <http://ifastro.org/web/index.php>
<http://www.boiseastro.org/>

Sep 19-20-28 2009 - Alberta Star Party 2009, Starland Recreation Area Campground near Drumheller, Alberta, CA
<http://www.astronomycalgary.com/events/info/155>
<http://calgary.rasc.ca/asp2009.htm>

OCTOBER -

Oct 14-17 2009 - The Enchanted Skies Star Party 2009, Socorro NM - <http://enchantedskies.org/>

NOVEMBER -

Nov 12-15 2009 - Nightfall 2009, Palm Canyon Resort, Borrego Springs, CA <http://www.rtmcastronomyexpo.org/nightfall.htm>

Nov 14 2009 - Night Under the Stars 2009, Alamo Lake, AZ - <http://azstateparks.com/Parks/ALLA/events.html>

OTHER

(tbd Aug) - **Deception Pass Star Party 2009**, Bowman Bay, Deception Pass, WA - http://squakmountain.org/deception_pass_star_party.htm
<http://squakmountain.org/events.html#upcoming>

(tbd Sep) - **Orion Nebula 2009 Star Party**, Table Mt. (Ellensburg) WA
<http://www.seattleastro.org/orionnebsp.shtml>

(tbd Sep) - **White Sands Star Party**, Alamogordo/White Sands, NM
<http://www.zianet.com/wssp/>

(tbd Oct) - **All Arizona Star Party** (near Arizona City, AZ) - <http://www.eastvalleyastronomy.org/aasp.htm>

(tbd) - **Blue Mountain Star Party**, Ukiah, OR
<http://www.stargazing.net/tcac/EventsCalendar.htm>
<http://www.stargazing.net/tcac/gmBluMtn.htm>

(tbd) - **Montana Starwatch**, Great Falls, MT <http://smaasweb.org/>

Other Star parties:

<http://www.cloudynights.com/ubbthreads/showflat.php/Cat/0/Number/2858373/Main/2858366>

EAS MEMBER NEWS

Outreach chairperson: (currently **vacant**) - Coordinate requests from public for EAS member volunteers to conduct star parties or presentations at visits to schools, senior centers, scout meetings, etc. 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. A star party night can be a rewarding event for all involved. **Please email Mark Folkerts with your interest (or suggestions).**

Sidewalk astronomy committee: (currently **vacant**). - Plan and conduct urban/suburban sidewalk astronomy events to allow passers-by to experience astronomy. Needs 2-3 people for each event, and to schedule events. 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.

Other volunteers? Find a way to help and contribute. Come up with a new idea to promote the EAS and astronomy in your community. Come to Astronomy Day or a star party and share your interest in the sky...

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

"Mention your EAS club membership at Jim Bielaga's astronomy store 'Aurora Astro Products' and receive a 10% discount on all purchases. This is an exclusive discount to current 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. <<**



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

Hours:

Monday, Thursday, Friday – 9:00 am to 6:00 pm
Tuesday/Wednesday – Noon to 6:00 pm
Saturday – 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.

ASTRO CALENDAR FOR 2009

May 2009

May 23 – EAS Star Party at Ron Tam's place
May 30 – EAS Meeting – Aurora Astro Products – 7:00 pm

June 2009

Jun 05 - Venus at its Greatest Western Elongation (46 Degrees)
Jun 13 – EAS Meeting – Aurora Astro Products – 5:30 PM ???

Jun 20 – EAS Star Party at Ron Tam's place

Jun 21 - Summer Solstice, 05:45 UTC
Jun 23 - Pluto At Opposition

July 2009

Jul 04 - Earth At Aphelion (1.017 AU From Sun)
Jul 07 - Penumbral Lunar Eclipse
Jul 18 – EAS Star Party at Ron Tam's place
Jul 20 - 40th Anniversary (1969), 1st Man On The Moon (Apollo 11)
Jul 22 - Total Solar Eclipse (China/Pacific)
Jul 29 - South Delta-Aquarids Meteor Shower Peak

August 2009

Aug 01 - Alpha Capricornids Meteor Shower Peak
Aug 06 - Penumbral Lunar Eclipse
Aug 06 - Southern Iota Aquarids Meteor Shower Peak
Aug 12 - Perseids Meteor Shower Peak
Aug 17 - Neptune At Opposition
Aug 22 – EAS Star Party at Ron Tam's place
Aug 24 - Mercury At Its Greatest Eastern Elongation (27 Degrees)
Aug 25 - Northern Iota Aquarids Meteor Shower Peak

September 2009

Sep 04 - Saturn's Rings Edge-on From Earth
Sep 17 - Uranus At Opposition
Sep 19 – EAS Star Party at Ron Tam's place
Sep 22 - Autumnal Equinox (21:18 UT)
Sep 26-27 - Pacific Astronomy & Telescope Show - Pasadena Conv. Ctr.

October 2009

Oct 09 - Draconids Meteor Shower Peak
Oct 17 – EAS Star Party at Ron Tam's place
Oct 21 - Orionids Meteor Shower Peak

November 2009

Nov 14 – EAS Star Party at Ron Tam's place

December 2009

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, and entitles members to the monthly newsletter, *The Stargazer*. Also, a 10% discount is also being offered to EAS members for purchases at Aurora Astro Products in Everett. Only members may vote in EAS elections, or be eligible for EAS drawings.

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 an 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, located at Aurora Astro Products store. 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, or contact Jim Bielaga at Aurora Astro. 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

May 31	First Quarter Moon
Jun 07	Full Moon
Jun 15	Last Quarter Moon
Mar 22	New Moon
Jun 29	First Quarter Moon
Jul 07	Full Moon
Jul 15	Last Quarter Moon
Jul 22	New Moon
Jul 28	First Quarter Moon
Aug 06	Full Moon
Aug 13	Last Quarter Moon
Aug 20	New Moon

UP IN THE SKY -- THE PLANETS (AND PLUTO)

Object	Rises	Sets	Con	Diam.	Mag
Sun	05:18 am	20:14	Tau	30'	-27.5
Mercury	04:54 am	19:16	Tau	08"	+2.4
Venus	03:33 am	16:42	Psc	42"	-4.3
Mars	03:39 am	17:15	Psc	04"	+1.1
Jupiter	01:34 am	11:39 am	Cap	37"	-2.4
Saturn	13:09	02:28 am	Leo	19"	+0.9
Uranus	02:35 am	14:20	Psc	03"	+5.9
Neptune	01:32 am	11:40 am	Cap	02"	+7.9
Pluto	22:06	07:33 am	Sag	--	+13.9

(times listed are in local time for Everett PDT)

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

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 - CORONA BOREALIS

CORONA BOREALIS: (The Northern Crown). With a midnight culmination date of May 19th, Corona Borealis is perfectly placed for spring viewing. It contains no asterisms, but the stars of the constellation do trace out an "upside-down letter 'C'" (the closed portion of the 'C' faces south), situated between the Northern constellations of Bootes and Hercules. The only other bordering constellation is that of Serpens, located to its south. Corona Borealis ranks 11th in overall brightness among the constellations, but 73rd in size; it takes up almost 179 square degrees of the entire sky (0.433%). It contains no known meteor showers, and no Messier objects. Corona Borealis is completely visible from latitudes North of -50 degrees, and completely invisible from latitudes South of -64 degrees. It has 22 stars greater than magnitude 5.5, and its central point is at RA=15h48m, Dec.= +33 degrees. The solar conjunction date of Corona Borealis is November 18th. Even though Corona Borealis has no Messier objects or known meteor showers, besides being a visually beautiful constellation, it does contain two very interesting objects in their own right. Near epsilon Corona Borealis, a nova suddenly flared up in May, 1866. It reached 2nd magnitude and remained easily visible for over a week. It is now known as the "Blaze Star" (also known as T Corona Borealis), and is the most famous example of a recurring nova. (It last brightened, to 3rd magnitude, in 1946). There is also another interesting variable star within

Corona Borealis (CrB), known as R CrB. It is normally a 6th magnitude star, but it dims (at irregular intervals) to as low as 15th magnitude. It is suspected that clouds of carbon (e.g., soot and graphite) are emitted from the star and therefore dim its light; when these materials are reabsorbed, the star brightens. There are two well-known legends associated with the constellation of Corona Borealis. The Native (North) American Indians considered it to be a semicircle of chiefs, at council to discuss the future of their peoples. In ancient Greek mythology, Ariadne (daughter of King Minos) was asked by Bacchus (the god of vegetation and wine) to marry him. But Ariadne did not believe that Bacchus was a god. To prove that he was, Bacchus asked Venus (goddess of love) to design a crown of jewels as his wedding present to Ariadne. When Ariadne saw the crown, she believed that Bacchus was a god, and consented to marry him. Bacchus was so overwhelmed with joy, that he threw the crown into the heavens, where it has resided and shone ever since. Corona Borealis is a visually beautiful Northern constellation, and is well placed to be easily enjoyed by any spring sky-watcher.

YOUNG ASTRONOMER'S CORNER

The Young Astronomer's Corner will return in June, 2009 with information on enjoying Star Parties for the summer season. See you then!

PLANETARY FOCUS - NEPTUNE

This month, our guest planet is **Neptune**, and these are the facts:

Rotation around the Sun: every 164.79 years

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

Inclination of Orbit to Ecliptic: 1.8 degrees.

Mean Orbital Velocity: 5.43 km/sec.

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

Mass: 17.2 (approximately 17.2 times more massive than earth); (5.9742 x (10 e24 (10 to the 24th power)) kilograms = 1 Earth Mass).

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

Surface Gravity (Earth = 1): 1.19

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

Axis tilt: 29.56 degrees.

Satellites (moons): 13, as well as planetary rings.

Special Notes About Neptune: **Neptune** is the fourth largest planet in the solar system (one of the gas giants) in terms of equatorial diameter, but is more massive than Uranus, the third largest planet in diameter. Neptune is the most distant of the giant planets, and was discovered in 1846 by J.G. Galle at the Berlin Observatory, based on French (Urbain Leverrier) predictions resulting from disturbances in the orbit of Uranus (there were similar estimates made by Englishman John C. Adams). Neptune returns to opposition two days later every year.

It appears as an indistinct magnitude 7.7 bluish-green object in binoculars; in fact, no markings can be seen on its bluish-green disk from earth-bound telescopes. Neptune's color arises primarily from methane within its atmosphere, which is principally helium and hydrogen and a blend of methane, water, and ammonia.

In 1989, Voyager 2 sent back remarkable images of Neptune during its fly-by. The Great Dark Spot was noted in its atmosphere. Like Jupiter's Great Red Spot, it occupies a equivalent proportion of the surface area of Neptune (as the GRS does of Jupiter's surface area), and is a high-pressure system around which near-supersonic winds flow in an anti-clockwise circuit. The Great Dark Spot measures approximately 12,000 by 8,000 kilometers. At about 50-70 kilometers above the main cloud plane, there are whitish cirrus-like clouds composed of methane ice crystals. Neptune also has belts and zones similar to Jupiter's, only much fainter.

The core of Neptune is believed to be rocky, composed primarily of silicon and iron. The atmosphere of Neptune revolves more slowly than its core, and this is opposite to the atmospheres of the other gas giants; the implication is that circulation of Neptune's atmosphere may take place in a retrograde (backward or opposite) manner.

Neptune also gives off more energy than it receives from the Sun, suggesting that it has its own internal source of heat; the planet also has a magnetic field, which is somewhat weaker than that of the other gas giant planets. Four dark planetary rings were discovered during the Voyager 2 fly-by in 1989.

Neptune has 13 known moons; six of them were discovered during the 1989 Voyager 2 fly-by; two (Triton and Nereid) were discovered from Earth. Triton is the largest moon of Neptune, and was discovered the same year (1846) as the planet itself; it is about ¾ the size of our own Earth's Moon. Interestingly, Triton has an orbit in the opposite direction to that of Neptune (retrograde), and is slowly coiling its way down towards Neptune. Triton is a very cold moon, and has a thin atmosphere of mostly nitrogen, with some methane and carbon monoxide. Its South Pole cap is pinkish in color (probably nitrogen snow and ice). Triton's face has been shown to have both craters and long cracks, but no mountains; its surface resembles that of a cantaloupe. It has also been noted to have geysers of nitrogen, some reaching 8 km in height! Nereid was discovered from Earth in 1949, and has a very eccentric orbit (going from 2 to 10 million kilometers from the planet at various times during its orbit).

ASTRONOMY AND TELESCOPE "LINGO" AND ASTRONOMY "FUN FACTS"

These two columns will return in June. See you then.

"MIRROR IMAGES"

"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 will first be defined, and then a representative object from each hemisphere will be described. **Note: "MIRROR" IMAGES is strictly the name of the new column, and is not intended to imply that there is optical mirror symmetry between the two objects.**

CLASS OF OBJECT: OPTICAL DOUBLE STARS: A pair of stars that *appear* close together in the sky (as opposed to actually *being* close together in the sky: this would be a physical double star system). Optical double stars appear close together because they lie in roughly the same direction – the same line of sight – as seen from Earth. However, unlike physical doubles, they share no gravitational attraction, as they are too far apart to be members of the same stellar system.

REPRESENTATIVE NORTHERN HEMISPHERE OBJECT: Albireo (Beta Cygni): This very famous, and very beautiful, double star is a favorite of all astronomers, and a favorite new object of all budding night-sky enthusiasts. It is the second brightest "star" (i.e., it is actually two stars) in Cygnus. The primary star is an orange giant with an apparent visual magnitude of 3.1 and is of spectral type K5-II; the secondary, 35 arc seconds away, is deep blue, has an apparent visual magnitude of 5.1, and is of spectral type B8-V. Albireo is 120 parsecs distant from Earth, and its individual components are separated by about 400 billion miles.

REPRESENTATIVE SOUTHERN HEMISPHERE OBJECT: AL GIEDI (ALPHA CAPRICORN): The brighter of the two stars in this system has an apparent visual magnitude of 3.6, and is a light yellow spectral type G3 supergiant. The dimmer of the pair has an apparent visual magnitude of 4.2, is also light yellow in color, and is classified as a G9 giant. Interestingly, each member of this optical double star system has dimmer, closer companions as well. The G3 supergiant in the line-of-sight Alpha Capricorni star system lies 110 light-years away from Earth, but the G9 giant lies much further away.....1,600 light-years away to be exact!!

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

HUBBLE TOUCHED BY HUMANS FOR THE LAST TIME



HST Floats free, released after its last repair mission

TITAN MAY HAVE SUBSURFACE OCEAN OF HYDROCARBONS

Saturn's largest moon, Titan, may have a subterranean ocean of hydrocarbons and some topsy-turvy topography in which the summits of its mountains lie lower than its average surface elevation, according to new research.

Titan is also more squashed in its overall shape - like a rubber ball pressed down by a foot - than researchers had expected, said Howard Zebker, a geophysicist and electrical engineer involved in the work. The new findings may help explain the presence of large lakes of hydrocarbons at both of Titan's poles, which have been puzzling researchers since being discovered in 2007.

"Since the poles are squished in with respect to the equator, if there is a hydrocarbon 'water table' that is more or less spherical in shape, then the poles would be closer down to that water table and depressions at the poles would fill up with liquid," Zebker

said. The shape of the water table would be controlled by the gravitational field of Titan, which is still not fully understood.

Hydrocarbons are the only materials on Titan's surface that would remain liquid at minus 180 degrees Celsius, the average temperature of the moon's surface. Any water would be frozen, making it plausible that instead of groundwater, Titan would have the equivalent in hydrocarbons.

Zebker, the lead author, and a group of colleagues have been making radar measurements of Titan's surface over the last four years using an instrument aboard the Cassini spacecraft, which is orbiting Saturn. Whenever Cassini passes close enough, they sweep beams of cloud-penetrating radar through Titan's thick atmosphere and across the surface. Using the radar data, they can calculate the surface elevations along the tracks of the sweep. Combining more than 40 tracks across the surface, the researchers were able to calculate the three-dimensional shape of Titan.

Zebker said that there were theoretical reasons to expect that Titan was not a perfect sphere, but instead probably slightly oblate, or flattened, due to the centrifugal force from its rotation while orbiting Saturn. But the degree to which Titan is flattened exceeds what would be expected, based upon how close it is to Saturn and its roughly 16-day orbit.

It also turns out that Titan is not flattened uniformly. By way of analogy, if you were to put your foot on a rubber ball and press down, the ball would bulge out equally on all sides in the directions perpendicular to the downward force from your foot.

But the bulge of Titan is asymmetrical. The longest axis is oriented so that it points toward Saturn, a result of tidal forces from the planet. The shortest axis runs through the poles. And the other axis, oriented in the direction in which Titan orbits Saturn, is intermediate in length.

"While some asymmetry is expected from Saturn's gravitational pull, there is obviously something going on that causes Titan to have a different shape than expected," Zebker said.

There are several possible explanations for Titan's deformity. It might be that when the shape of the moon was determined, it was in an orbit closer to Saturn. *"Another is that there are active geophysical processes occurring inside Titan that further distort the shape,"* Zebker said. *"There are probably many other explanations as well, but we don't have enough information from this one experiment to be able to distinguish those."*

Active geophysical processes might help account for another of Titan's oddities.

Zebker said that if you look at images of the surface of Titan, you see surface features that look every bit like mountains on Earth but don't have the high elevations compared to the plains stretching out around them.

"One of the really surprising finds that we have from this, is that the largest apparent continent is lower than the average elevation on Titan, as opposed to higher than the average elevation, as we have on the Earth," Zebker said.

"My favorite explanation is that the material that forms the mountains is simply more dense than the material surrounding them," he said. That would result in the mountains pushing down the surrounding crust, effectively putting the mountains in a basin of their own creation.

On Earth, the situation is the reverse: The crust that lies under the oceans is denser than the material that makes up the continental crust, where mountain ranges are built up.

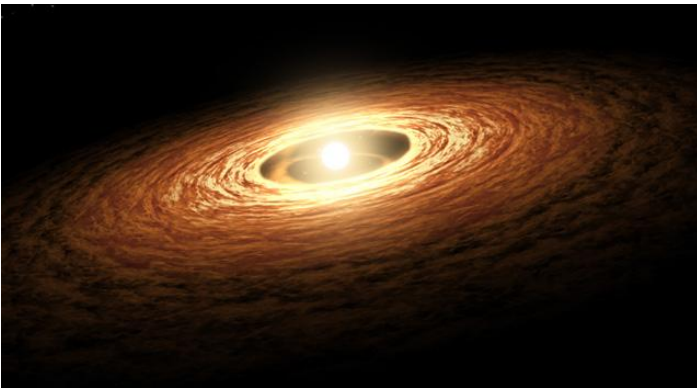
"The things that we would expect to exist on the surface of Titan would either be solid hydrocarbon materials, essentially frozen ethane and methane, and that is fairly light, and then frozen water ice, which is denser," Zebker said. *"If the mountains are composed of water ice and the plain features in between are composed of these solid hydrocarbons, that could lead to this kind of a situation."*

Zebker said that research currently being conducted by other scientists to decipher the gravity field of Titan should help resolve some of the questions raised by his team's latest work. But he's holding off making any predictions. *"All of it surprises me because you never know what you are going to see,"* he said. <http://news.stanford.edu/pr/2009/pr-titan-040809.html>
<http://www.sciencemag.org/cgi/content/abstract/1168905>

SPITZER CATCHES STAR COOKING UP COMET CRYSTALS

Scientists have long wondered how tiny silicate crystals, which need sizzling high temperatures to form, have found their way into frozen comets, born in the deep freeze of the solar system's outer edges. The crystals would have begun as non-crystallized silicate particles, part of the mix of gas and dust from which the solar system developed.

A team of astronomers believes they have found a new explanation for both where and how these crystals may have been created, by using Spitzer Space Telescope to observe the growing pains of a young, sun-like star. Their study results provide new insight into the formation of planets and comets.



The researchers from Germany, Hungary and the Netherlands found that silicate appears to have been transformed into crystalline form by an outburst from a star. They detected the infrared signature of silicate crystals on the disk of dust and gas surrounding the star EX Lupi during one of its frequent flare-ups, or outbursts, seen by Spitzer in April 2008. These crystals were not present in Spitzer's previous observations of the star's disk during one of its quiet periods.

"We believe that we have observed, for the first time, ongoing crystal formation," said one of the paper's authors, Attila Juhasz. *"We think that the crystals were formed by thermal annealing of small particles on the surface layer of the star's inner disk by heat from the outburst. This is a completely new scenario about how this material could be created."*

Annealing is a process in which a material is heated to a certain temperature at which some of its bonds break and then re-form,

changing the material's physical properties. It is one way that silicate dust can be transformed into crystalline form.

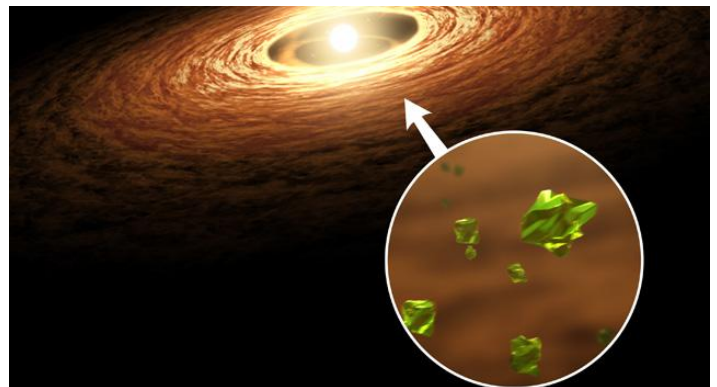
Scientists previously had considered two different possible scenarios in which annealing could create the silicate crystals found in comets and young stars' disks. In one scenario, long exposure to heat from an infant star might anneal some of the silicate dust inside the disk's center. In the other, shock waves induced by a large body within the disk might heat dust grains suddenly to the right temperature to crystallize them, after which the crystals would cool nearly as quickly.

What Juhasz and his colleagues found at EX Lupi didn't fit either of the earlier theories. *"We concluded that this is a third way in which silicate crystals may be formed with annealing, one not considered before,"* said the paper's lead author, Peter Abraham.

EX Lupi is a young star, possibly similar to our sun four or five billion years ago. Every few years, it experiences outbursts, or eruptions, that astronomers think are the result of the star gathering up mass that has accumulated in its surrounding disk. These flare-ups vary in intensity, with really big eruptions occurring every 50 years or so.

The researchers observed EX Lupi with Spitzer's infrared spectrograph in April 2008. Although the star was beginning to fade from the peak of a major outburst detected in January, it was still 30 times brighter than when it was quiet. When they compared this new view of the erupting star with Spitzer measurements made in 2005 before the eruption began, they found significant changes.

In 2005, the silicate on the surface of the star's disk appeared to be in the form of amorphous grains of dust. In 2008, the spectrum showed the presence of crystalline silicate on top of amorphous dust. The crystals appear to be forsterite, a material often found in comets and in protoplanetary disks. The crystals also appear hot, evidence that they were created in a high-temperature process, but not by shock heating. If that were the case, they would already be cool.



"At outburst, EX Lupi became about 100 times more luminous," said Juhasz. *"Crystals formed in the surface layer of the disk but just at the distance from the star where the temperature was high enough to anneal the silicate--about 1,000 Kelvin (1,340 degrees Fahrenheit)-- but still lower than 1,500 Kelvin (2,240 degrees Fahrenheit). Above that, the dust grains will evaporate."* The radius of this crystal formation zone, the researchers note, is comparable to that of the terrestrial-planet region in the solar system.

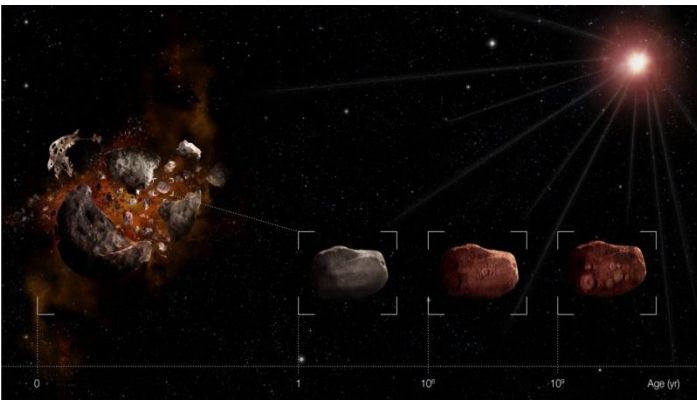
"These observations show, for the first time, the actual production of crystalline silicates like those found in comets and meteorites in our own solar system," said Spitzer Project Scientist Michael Werner. *"So what we see in comets today may have been*

produced by repeated bursts of energy when the sun was young."
<http://www.jpl.nasa.gov/news/news.cfm?release=2009-083>

SOLAR WIND 'TANS' YOUNG ASTEROIDS

A new recently published study reveals that asteroid surfaces age and redden much faster than previously thought - in less than a million years, the blink of an eye for an asteroid. This study has finally confirmed that the solar wind is the most likely cause of very rapid space weathering in asteroids. This fundamental result will help astronomers relate the appearance of an asteroid to its actual history and identify any after effects of a catastrophic impact with another asteroid.

"Asteroids seem to get 'sun tan' very quickly," says lead author Pierre Vernazza. "But not, as for people, from an overdose of the Sun's ultraviolet radiation, but from the effects of its powerful wind." It has long been known that asteroid surfaces alter in appearance with time - the observed asteroids are much redder than the interior of meteorites found on Earth - but the actual processes of this "space weathering" and the timescales involved were controversial. Thanks to observations of different families of asteroids using ESO's New Technology Telescope at La Silla and the Very Large Telescope at Paranal, as well as telescopes in Spain and Hawaii, Vernazza's team have now solved the puzzle.



Artist's impression of how the solar wind makes young asteroids look old. After undergoing a catastrophic collision, the color of an asteroid gets modified rapidly by the solar wind so that it resembles the average color of extremely old asteroids. After the first million years, the surface "tans" much more slowly. At that stage, the color depends more on composition than on age.

When two asteroids collide, they create a family of fragments with "fresh" surfaces. The astronomers found that these newly exposed surfaces are quickly altered and change color in less than a million years - a very short time compared to the age of the Solar System. "The charged, fast moving particles in the solar wind damage the asteroid's surface at an amazing rate", says Vernazza. Unlike human skin, which is damaged and aged by repeated overexposure to sunlight, it is, perhaps rather surprisingly, the first moments of exposure (on the timescale considered) - the first million years - that causes most of the aging in asteroids.

By studying different families of asteroids, the team has also shown that an asteroid's surface composition is an important factor in how red its surface can become. After the first million years, the surface "tans" much more slowly. At that stage, the color depends more on composition than on age. Moreover, the observations reveal that collisions cannot be the main mechanism behind the high proportion of "fresh" surfaces seen among near-Earth asteroids. Instead, these "fresh-looking" surfaces may be

the results of planetary encounters, where the tug of a planet has "shaken" the asteroid, exposing unaltered material. Thanks to these results, astronomers will now be able to understand better how the surface of an asteroid - which often is the only thing we can observe - reflects its history. This result was presented in a paper published in the journal *Nature*, "Solar wind as the origin of rapid reddening of asteroid surfaces", by P. Vernazza et al.

Meteorites are small fragments of asteroids that fall on Earth. While a meteorite enters the Earth's atmosphere its surface can melt and be partially charred by the intense heat. Nevertheless, the meteorite interior remains unaffected, and can be studied in a laboratory, providing a wealth of information on the nature and composition of asteroids.

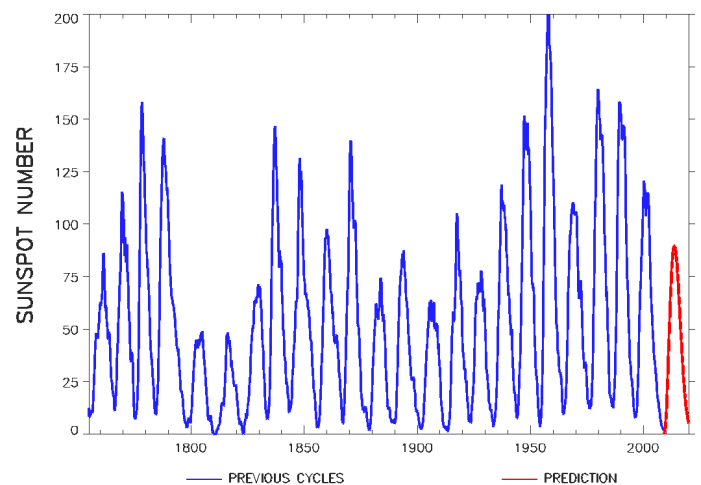
An asteroid family is a group of asteroids that are on similar orbits around the Sun. The members of a given family are believed to be the fragments of a larger asteroid that was destroyed during a collision.

The surface of an asteroid is affected by the highly energetic particles forming the solar wind. These particles partially destroy the molecules and crystals on the surface, re-arranging them in other combinations. Over time, these changes give formation of a thin crust or irradiated material with distinct colors and properties.
<http://www.eso.org/public/outreach/press-rel/pr-2009/pr-16-09.html>

NOAA: MILD CYCLE 24 SOLAR STORM SEASON PREDICTED

Although its peak is still four years away, a new active period of Earth-threatening solar storms will be the weakest since 1928, predicts an international panel of experts led by NOAA's Space Weather Prediction Center and funded by NASA. Despite the prediction, Earth is still vulnerable to a severe solar storm. Solar storms are eruptions of energy and matter that escape from the sun and may head toward Earth, where even a weak storm can damage satellites and power grids, disrupting communications, the electric power supply and GPS. A single strong blast of "solar wind" can threaten national security, transportation, financial services and other essential functions.

SOLAR CYCLE 24 SUNSPOT NUMBER PREDICTION



Solar Cycle 24 prediction. Credit: NOAA

<http://www.noaanews.noaa.gov/stories2009/images/solargraph.gif>

The panel predicts the upcoming Solar Cycle 24 will peak in May 2013 with 90 sunspots per day on average. If the prediction proves true, Solar Cycle 24 will be the weakest cycle since

number 16, which peaked at 78 daily sunspots in 1928, and ninth weakest since the 1750s, when numbered cycles began.

The most common measure of a solar cycle's intensity is the number of sunspots -- Earth-sized blotches on the sun marking areas of heightened magnetic activity. The more sunspots there are, the more likely it is that solar storms will occur, but a major storm can occur at any time.

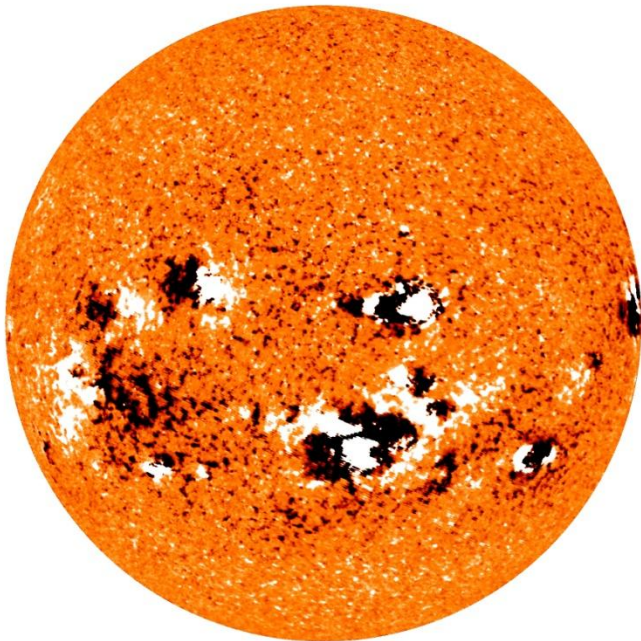
"As with hurricanes, whether a cycle is active or weak refers to the number of storms, but everyone needs to remember it only takes one powerful storm to cause huge problems," said NOAA scientist Doug Biesecker, who chairs the panel. *"The strongest solar storm on record occurred in 1859 during another below-average cycle."*

The 1859 storm shorted out telegraph wires, causing fires in North America and Europe, sent readings of Earth's magnetic field soaring, and produced northern lights so bright that people read newspapers by their light.

A recent report by the National Academy of Sciences found that if a storm that severe occurred today, it could cause \$1-2 trillion in damages the first year and require four to 10 years for recovery, compared to \$80-125 billion that resulted from Hurricane Katrina.

The panel also predicted that the lowest sunspot number between cycles -- or solar minimum -- occurred in December 2008, marking the end of Cycle 23 and the start of Cycle 24. If the December prediction holds up, at 12 years and seven months Solar Cycle 23 will be the longest since 1823 and the third longest since 1755. Solar cycles span 11 years on average, from minimum to minimum.

An unusually long, deep lull in sunspots led the panel to revise its 2007 prediction that the next cycle of solar storms would start in March 2008 and peak in late 2011 or mid-2012. The persistence of a quiet sun also led the panel to a consensus that the next cycle will be "moderately weak."



Solar storm. Credit: NOAA

<http://www.noaanews.noaa.gov/stories2009/images/solarstorm.jpg>

NOAA's Space Weather Prediction Center (SWPC) is the nation's first alert of solar activity and its effects on Earth. The Center's

space weather experts issue outlooks for the next 11-year solar cycle and warn of storms occurring on the Sun that could impact Earth. SWPC is also the world warning agency for the International Space Environment Service, a consortium of 12 member nations.

As the world economy becomes more reliant on satellite-based communications and interlinked power grids, interest in solar activity has grown dramatically. In 2008 alone, SWPC acquired 1,700 new subscription customers for warnings, alerts, reports, and other products. Among the new customers are emergency managers, airlines, state transportation departments, oil companies, and nuclear power stations. SWPC's customers reside in 150 countries.

"Our customer growth reflects today's reality that all sectors of society are highly dependent on advanced, space-based technologies," said SWPC director Tom Bogdan. *"Today every hiccup from the sun aimed at Earth has potential consequences."*

POSSIBLE BLOW FOR DINOSAUR-KILLING ASTEROID THEORY

Some geologists propose that an impact didn't lead to mass extinction 65 million years ago, after all. The enduringly popular theory that the Chicxulub crater holds the clue to the demise of the dinosaurs, along with some 65 percent of all species 65 million years ago, is challenged in a paper to be published in the *Journal of the Geological Society* on April 27, 2009.

The crater, discovered in 1978 in northern Yucatan and measuring about 180 kilometers (112 miles) in diameter, records a massive extra-terrestrial impact.

When spherules from the impact were found just below the Cretaceous-Tertiary (K-T) boundary, it was quickly identified as the "smoking gun" responsible for the mass extinction event that took place 65 million years ago. It was this event which saw the demise of dinosaurs, along with countless other plant and animal species.

However, a small number of scientists have since disagreed with this interpretation. The newest research, led by Gerta Keller of Princeton University in New Jersey, and Thierry Adatte of the University of Lausanne, Switzerland, uses evidence from Mexico to suggest that the Chicxulub impact predates the K-T boundary by as much as 300,000 years.



Sediments show that the Chicxulub meteorite predates a mass extinction 65 million years ago. Credit: Gerta Keller, Princeton University

"Keller and colleagues continue to amass detailed stratigraphic information supporting new thinking about the Chicxulub impact,

and the mass extinction at the end of the Cretaceous," says H. Richard Lane, program director in the National Science Foundation (NSF)'s Division of Earth Sciences. *"The two may not be linked after all."*

From El Penon and other localities in Mexico, says Keller, *"we know that between four and nine meters of sediments were deposited at about two to three centimeters per thousand years after the impact. The mass extinction level can be seen in the sediments above this interval."*

Advocates of the Chicxulub impact theory suggest that the impact crater and the mass extinction event only appear far apart in the sedimentary record because of earthquake or tsunami disturbance that resulted from the impact of the asteroid. *"The problem with the tsunami interpretation,"* says Keller, *"is that this sandstone complex was not deposited over hours or days by a tsunami. Deposition occurred over a very long time period."* The study found that the sediments separating the two events were characteristic of normal sedimentation, with burrows formed by creatures colonizing the ocean floor, erosion and transportation of sediments, and no evidence of structural disturbance.



This artist's rendering shows the Chicxulub crater at the time of the meteorite's impact. Credit: NASA

The scientists also found evidence that the Chicxulub impact didn't have the dramatic impact on species diversity that has been suggested. At one site at El Penon, the researchers found 52 species present in sediments below the impact spherule layer, and counted all 52 still present in layers above the spherules. *"We found that not a single species went extinct as a result of the Chicxulub impact,"* says Keller.

This conclusion should not come as too great a surprise, she says. None of the other great mass extinctions are associated with an impact, and no other large craters are known to have caused a significant extinction event.

Keller suggests that the massive volcanic eruptions at the Deccan Traps in India may be responsible for the extinction, releasing huge amounts of dust and gases that could have blocked out sunlight and brought about a significant greenhouse effect. http://www.nsf.gov/news/news_summ.jsp?cntn_id=114648&org=NSF&frcm=news

SPITZER TELESCOPE WARMS UP TO NEW CAREER

The primary mission of Spitzer Space Telescope is about to end after more than five and a half years of probing the cosmos with its keen infrared eye. Within about a week of May 12, the telescope is expected to run out of the liquid helium needed to chill some of its instruments to operating temperatures.

The end of the coolant will begin a new era for Spitzer. The telescope will start its "warm" mission with two channels of one instrument still working at full capacity. Some of the science explored by a warm Spitzer will be the same, and some will be entirely new.

"We like to think of Spitzer as being reborn," said Robert Wilson, Spitzer project manager at JPL. *"Spitzer led an amazing life, performing above and beyond its call of duty. Its primary mission might be over, but it will tackle new scientific pursuits, and more breakthroughs are sure to come."*

Spitzer is the last of the 'Great Observatories', a suite of telescopes designed to see the visible and invisible colors of the universe. The suite also includes Hubble and Chandra space telescopes, and the late Compton gamma-ray telescope. Spitzer has explored, with unprecedented sensitivity, the infrared side of the cosmos, where dark, dusty and distant objects hide.

For a telescope to detect infrared light -- essentially heat -- from cool cosmic objects, it must have very little heat of its own. During the past five years, liquid helium has run through Spitzer's "veins," keeping its three instruments chilled to -456 degrees Fahrenheit (-271 Celsius), or less than 3 degrees above absolute zero, the coldest temperature theoretically attainable. The cryogen was projected to last as little as two and a half years, but Spitzer's efficient design and careful operations enabled it to last more than five and a half years.

Spitzer's new "warm" temperature is still quite chilly at -404 degrees Fahrenheit (-242 Celsius), much colder than a winter day in Antarctica when temperatures sometimes reach -75 degrees Fahrenheit (-59 Celsius). This temperature rise means two of Spitzer's instruments -- its longer wavelength multiband imaging photometer and its infrared spectrograph -- will no longer be cold enough to detect cool objects in space.

However, the telescope's two shortest-wavelength detectors in its infrared array camera will continue to function perfectly. They will still pick up the glow from a range of objects: asteroids in our solar system, dusty stars, planet-forming disks, gas-giant planets and distant galaxies. In addition, Spitzer still will be able to see through the dust that permeates our galaxy and blocks visible-light views.

"We will do exciting and important science with these two infrared channels," said Spitzer Project Scientist Michael Werner. Werner has been working on Spitzer for more than 30 years. *"Our new science program takes advantage of what these channels do best. We're focusing on aspects of the cosmos that we still have much to learn about."* Since its launch from Cape Canaveral, in Aug. 2003, Spitzer has made countless breakthroughs in astronomy. Observations of comets both near and far have established that the stuff of comets and planets is similar throughout the galaxy. Breathtaking photos of dusty stellar nests have led to new insights into how stars are born. And Spitzer's eye on the very distant universe, billions of light-years away, has revealed hundreds of massive black holes lurking in the dark.

Perhaps the most revolutionary and surprising Spitzer finds involve planets around other stars, called exoplanets. Exoplanets are, in almost all cases, too close to their parent stars to be seen

from our Earthly point of view. Nevertheless, planet hunters continue to uncover them by looking for changes in the parent stars. Before Spitzer, everything we knew about exoplanets came from indirect observations such as these.

In 2005, Spitzer detected the first actual photons from an exoplanet. In a clever technique, now referred to as the secondary-eclipse method, Spitzer was able to collect the light of a hot, gaseous exoplanet and learn about its temperature. Further detailed spectroscopic studies later revealed more about the atmospheres, or "weather," on similar planets. More recently, Spitzer witnessed changes in the weather on a wildly eccentric gas exoplanet -- a storm of colossal proportions brewing up in a matter of hours before quickly settling down.

"Nobody had any idea Spitzer would be able to directly study exoplanets when we designed it," Werner said. "When astronomers planned the first observations, we had no idea if they would work. To our amazement and delight, they did."

These are a few of Spitzer's achievements during the past five and a half years. Data from the telescope are cited in more than 1,500 scientific papers. And scientists and engineers expect the rewards to keep on coming during Spitzer's golden years.

Some of Spitzer's new pursuits include refining estimates of Hubble's constant, or the rate at which our universe is stretching apart; searching for galaxies at the edge of the universe; assessing how often potentially hazardous asteroids might impact Earth by measuring the sizes of asteroids; and characterizing the atmospheres of gas-giant planets expected to be discovered soon by Kepler mission. As was true during the cold Spitzer mission, these and the other programs are selected through a competition in which scientists from around the world are invited to participate.

ASTEROIDS MAY HAVE ACCELERATED LIFE ON EARTH

A study indicates that an intense asteroid bombardment nearly 4 billion years ago may not have sterilized the early Earth as completely as previously thought. The asteroids, some the size of Kansas, possibly even provided a boost for early life.

The study focused on a particularly cataclysmic occurrence known as the Late Heavy Bombardment, or LHB. This event occurred approximately 3.9 billion years ago and lasted 20 to 200 million years. In a letter published in the May 21 issue of Nature magazine titled "Microbial Habitability of the Hadean Earth during the Late Heavy Bombardment," Oleg Abramov and Stephen J. Mojzsis, astrobiologists, report on the results of a computer modeling project designed to study the heating of Earth by the bombardment.

Results from their project show that while the Late Heavy Bombardment might have generated enough heat to sterilize Earth's surface, microbial life in subsurface and underwater environments almost certainly would have survived.

"Exactly when life originated on Earth is a hotly debated topic," said Michael H. New, the astrobiology discipline scientist and manager of the Exobiology and Evolutionary Biology Program. *"These findings are significant because they indicate that if life had begun before the LHB or some time prior to 4 billion years ago, it could have survived in limited refuges and then expanded to fill our world."* *"Our new results point to the possibility life could have emerged about the same time that evidence for our planet's oceans first appears,"* said Mojzsis, principal investigator of the project.

A growing scientific consensus is that during our solar system's formation, planetary bodies were pummeled by debris throughout the Late Heavy Bombardment. A visual record of the event is preserved in the form of the scarred face of our moon. On Earth, all traces of the bombardment appear to have been erased by rock recycling forces like weathering, volcanoes or other conditions that cause the crust to move or change.

Surface habitats for microbial life on early Earth would have been destroyed repeatedly by the bombardment. However, at the same time, impacts could have created subsurface habitats for life, such as extensive networks of cracks or even hydrothermal vents. Any existing microbial life on Earth could have found refuge in these habitats. If life had not yet emerged on Earth by the time of the bombardment, these new subsurface environments could have been the place where terrestrial life emerged.

"Even under the most extreme conditions we imposed on our model, the bombardment could not have sterilized Earth completely," said Abramov, lead author of the paper. *"Our results are in line with the scientific consensus that hyperthermophilic, or 'heat-loving,' microbes could have been the earliest life forms on Earth, or survivors from an even more ancient biosphere. The results also support the potential for the persistence of microbial biospheres on other planetary bodies whose surfaces were reworked by the bombardment, including Mars."* <http://astrobiology.nasa.gov>

NASA DETAILS LUNAR EXPLORATION ROBOTIC MISSION PLANS

NASA's return to the moon will get a boost in June with the launch of two satellites that will return a wealth of data about Earth's nearest neighbor. The agency outlined the upcoming missions of the Lunar Reconnaissance Orbiter, or LRO, and the Lunar Crater Observation and Sensing Satellite, or LCROSS, the spacecraft that will launch together June 17 aboard an Atlas V rocket from Cape Canaveral.

Using a suite of seven instruments, LRO will help identify safe landing sites for future human explorers, locate potential resources, characterize the radiation environment and test new technology. LCROSS will seek a definitive answer about the presence of water ice at the lunar poles. LCROSS will use the spent second stage Atlas Centaur rocket in an unprecedented way that will culminate with two spectacular impacts on the moon's surface.



Lunar Reconnaissance Orbiter, or LRO, being prepared for fairing installation. Credit: NASA/Jack Pfaller

"These two missions will provide exciting new information about the moon, our nearest neighbor," said Doug Cooke, associate administrator of Exploration Systems Mission Directorate. "Imaging will show dramatic landscapes and areas of interest down to one-meter resolution. The data also will provide information about potential new uses of the moon. These teams have done a tremendous job designing and building these two spacecraft."

LRO's instruments will help scientists compile high resolution, three-dimensional maps of the lunar surface and also survey it in the far ultraviolet spectrum. The satellite's instruments will help explain how the lunar radiation environment may affect humans and measure radiation absorption with a plastic that is like human tissue.

LRO's instruments also will allow scientists to explore the moon's deepest craters, look beneath its surface for clues to the location of water ice, and identify and explore both permanently lit and permanently shadowed regions. High resolution imagery from its camera will help identify landing sites and characterize the moon's topography and composition. A miniaturized radar will image the poles and test the system's communications capabilities.

"LRO is an amazingly sophisticated spacecraft," said Craig Tooley, LRO project manager. "Its suite of instruments will work in concert to send us data in areas where we've been hungry for information for years." While most Centaurs complete their work after boosting payloads out of Earth's orbit, the LCROSS Centaur will journey with the spacecraft for four months and be guided to an impact in a permanently shadowed crater at one of the moon's poles. The resulting debris plume is expected to rise more than six miles. It presents a dynamic observation target for LCROSS as well as a network of ground-based telescopes, LRO, and possibly the Hubble Space Telescope. Observers will search for evidence of water ice by examining the plume in direct sunlight. LCROSS also will increase knowledge of the mineralogical makeup of some of the remote polar craters that sunlight never reaches. The satellite represents a new generation of fast development, cost capped missions that use flight proven hardware and off the shelf software to achieve focused mission goals.

"We look forward to engaging a wide cross section of the public in LCROSS' spectacular arrival at the moon and search for water ice," said LCROSS Project Manager Dan Andrews. "It's possible we'll learn the answer to what is increasingly one of planetary science's most intriguing questions."

LRO and LCROSS are the first missions launched by the Exploration Systems Mission Directorate. Their data will be used to advance goals of future human exploration of the solar system. LRO will spend at least one year in low polar orbit around the moon, collecting detailed information for exploration purposes before being transferred to Science Mission Directorate to continue collecting additional scientific data. <http://www.nasa.gov/lro> <http://www.nasa.gov/lcross>

OPPORTUNITY ROVER SEES VARIABLE ENVIRONMENTAL HISTORY AT VICTORIA CRATER

One of the two Mars rovers has recorded a compelling saga of environmental changes that occurred over billions of years at a Martian crater. The Mars rover Opportunity, surveyed the rim and interior of Victoria Crater on the Red Planet from September 2006 through August 2008. Key findings from that work reinforce

and expand what researchers learned from Opportunity's exploration of two smaller craters after landing on Mars in 2004.

The rover revealed the effects of wind and water. The data show water repeatedly came and left billions of years ago. Wind persisted much longer, heaping sand into dunes between ancient water episodes. These activities still shape the landscape today. At Victoria, steep cliffs and gentler alcoves alternate around the edge of a bowl about a half a mile in diameter. The scalloped edge and other features indicate the crater once was smaller than it is today, but wind erosion has widened it gradually.

"What drew us to Victoria Crater is the thick cross-section of rock layers exposed there," said Steve Squyres, principal investigator for the science payloads on Opportunity and its twin rover Spirit. "The impact that excavated the crater millions of years ago provided a golden opportunity, and the durability of the rover enabled us to take advantage of it."

Imaging the crater's rim and interior, Opportunity inspected layers in the cliffs around the crater, including layered stacks more than 30 feet thick. Distinctive patterns indicate the rocks formed from shifting dunes that later hardened into sandstone, according to Squyres and 33 co-authors of the findings.

Instruments on the rover's arm studied the composition and detailed texture of rocks just outside the crater and exposed layers in one alcove called Duck Bay. Rocks found beside the crater include pieces of a meteorite, which may have been part of the impacting space rock that made the crater.

Other rocks on the rim of the crater apparently were excavated from deep within it when the object hit. These rocks bear a type of iron-rich small spheres, or spherules, that the rover team nicknamed "blueberries" when Opportunity first saw them in 2004. The spherules formed from interaction with water penetrating the rocks. The spherules in rocks deeper in the crater are larger than those in overlying layers, suggesting the action of groundwater was more intense at greater depth.



Inside Duck Bay, the rover found that, in some ways, the lower layers differ from overlying ones. The lower layers showed less sulfur and iron, more aluminum and silicon. This composition matches patterns Opportunity found earlier at the smaller Endurance Crater, about 4 miles away from Victoria, indicating the processes that varied the environmental conditions recorded in the rocks were regional, not just local.

Opportunity's first observations showed interaction of volcanic rock with acidic water to produce sulfate salts. Dry sand rich in these salts blew into dunes. Under the influence of water, the

dunes hardened to sandstone. Further alteration by water produced the iron-rich spherules, mineral changes, and angular pores left when crystals dissolved away. A rock from space blasted a hole about 2,000 feet wide and 400 feet deep. Wind erosion chewed at the edges of the hole and partially refilled it, increasing the diameter by about 25 percent and reducing the depth by about 40 percent.

Since leaving Victoria Crater about eight months ago, Opportunity has been on its way to study a crater named Endeavour that is about 20 times bigger than Victoria. The rover has driven about one-fifth of what could be a 10-mile trek to this new destination. The twin rovers Spirit and Opportunity continue to produce scientific results while operating far beyond their design life. The mission, designed to last 90 days, celebrated its fifth anniversary in January. Both rovers show signs of aging but are still capable of exploration and scientific discovery. <http://www.nasa.gov/rovers>

ASTROMETRY PLANET-HUNTING METHOD SUCCEEDS AT LAST

A long-proposed tool for hunting planets has netted its first catch - a Jupiter-like planet orbiting one of the smallest stars known. The technique, called astrometry, was first attempted 50 years ago to search for planets outside our solar system, called exoplanets. It involves measuring the precise motions of a star on the sky as an unseen planet tugs the star back and forth. But the method requires very precise measurements over long periods of time, and until now, has failed to turn up any exoplanets.

A team of two astronomers, has, for the past 12 years, been mounting an astrometry instrument to a telescope at the Palomar Observatory near San Diego. After careful, intermittent observations of 30 stars, the team has identified a new exoplanet around one of them -- the first ever to be discovered around a star using astrometry.

"This method is optimal for finding solar-system configurations like ours that might harbor other Earths," said astronomer Steven Pravdo of JPL, lead author of a study about the results. *"We found a Jupiter-like planet at around the same relative place as our Jupiter, only around a much smaller star. It's possible this star also has inner rocky planets. And since more than seven out of 10 stars are small like this one, this could mean planets are more common than we thought."*

The finding confirms that astrometry could be a powerful planet-hunting technique for both ground- and space-based telescopes. For example, a similar technique would be used by SIM Lite, a NASA concept for a space-based mission that is currently being explored.

The newfound exoplanet, called VB 10b, is about 20 light-years away in the constellation Aquila. It is a gas giant, with a mass six times that of Jupiter's, and an orbit far enough away from its star to be labeled a "cold Jupiter" similar to our own. In reality, the planet's own internal heat would give it an Earth-like temperature.

The planet's star, called VB 10, is tiny. It is what's known as an M-dwarf and is only one-twelfth the mass of our sun, just barely big enough to fuse atoms at its core and shine with starlight. For years, VB 10 was the smallest star known -- now it has a new title: the smallest star known to host a planet. In fact, though the

star is more massive than the newfound planet, the two bodies would have a similar girth.

Because the star is so small, its planetary system would be a miniature, scaled-down version of our own. For example, VB 10b, though considered a cold Jupiter, is located about as far from its star as Mercury is from the sun. Any rocky Earth-size planets that might happen to be in the neighborhood would lie even closer in.

"Some other exoplanets around larger M-dwarf stars are also similar to our Jupiter, making the stars fertile ground for future Earth searches," said Stuart Shaklan, Pravdo's co-author and the SIM Lite instrument scientist at JPL. *"Astrometry is best suited to find cold Jupiters around all kinds of stars, and thus to find more planetary systems arranged like our home."*

Two to six times a year, for the past 12 years, Pravdo and Shaklan have bolted their Stellar Planet Survey instrument onto Palomar's five-meter Hale telescope to search for planets. The instrument, which has a 16-megapixel charge-coupled device, or CCD, can detect very minute changes in the positions of stars. The VB 10b planet, for instance, causes its star to wobble a small fraction of a degree. Detecting this wobble is equivalent to measuring the width of a human hair from about three kilometers away.

Other ground-based planet-hunting techniques in wide use include radial velocity and the transit method. Like astrometry, radial velocity detects the wobble of a star, but it measures Doppler shifts in the star's light caused by motion toward and away from us. The transit method looks for dips in a star's brightness as orbiting planets pass by and block the light. The space-based Kepler mission, which began searching for planets on May 12, will use the transit method to look for Earth-like worlds around stars similar to the sun.

"This is an exciting discovery because it shows that planets can be found around extremely light-weight stars," said Wesley Traub, the chief scientist for NASA's Exoplanet Exploration Program at JPL. *"This is a hint that nature likes to form planets, even around stars very different from the sun."* <http://planetquest.jpl.nasa.gov>
<http://www.astro.caltech.edu/palomar/>

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 May's StarGazer:

- **** ASTRO CALENDAR - UPCOMING ASTRONOMY EVENTS
- **** OBSERVER'S INFORMATION - SUN, MOON, AND PLANET VISIBILITY
- **** UP IN THE SKY -- THE PLANETS (AND PLUTO)
- **** WESTERN US STAR PARTIES THIS SEASON
- **** CONSTELLATION OF THE MONTH – CORONA BOREALIS
- **** MIRROR IMAGES
- **** PLANETARY FOCUS - NEPTUNE
- **** TITAN MAY HAVE SUBSURFACE OCEAN OF HYDROCARBONS
- **** SPITZER CATCHES STAR COOKING UP COMET CRYSTALS
- **** SOLAR WIND 'TANS' YOUNG ASTEROIDS
- **** NOAA: MILD CYCLE 24 SOLAR STORM SEASON PREDICTED
- **** POSSIBLE BLOW FOR DINOSAUR-KILLING ASTEROID THEORY
- **** SPITZER TELESCOPE WARMS UP TO NEW CAREER
- **** ASTEROIDS MAY HAVE ACCELERATED LIFE ON EARTH
- **** NASA DETAILS LUNAR EXPLORATION ROBOTIC MISSION PLANS
- **** OPPORTUNITY ROVER SEES VARIABLE ENVIRONMENTAL HISTORY AT VICTORIA CRATER
- **** ASTROMETRY PLANET-HUNTING METHOD SUCCEEDS AT LAST

The next EAS Meeting is 7:00 P.M. Saturday May 30th at the 'Aurora Astro Products' store location at Silver Lake.