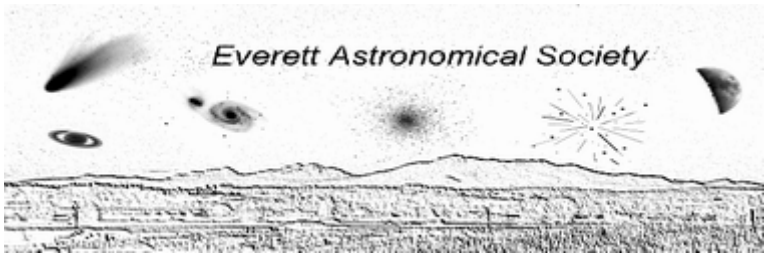
Volume MMV. No. 4



The Stargazer

April 2005

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

EAS BUSINESS…

NEXT EAS MEETING - SATURDAY MARCH 30TH AT 4:00 PM AT THE EVERETT PUBLIC LIBRARY, IN THE AUDITORIUM (DOWNSTAIRS)

★ April meeting topic – **Dramatic visualizations from 'Atlas of the Sky'"**

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

2702 Hoyt Avenue
Everett, WA 98201

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

Scheduled Meeting Dates: (NOTE THAT THEY CHANGE)
Apr 30 - EAS Meeting - Saturday 4:00 PM at Everett Public Library
May 21 - EAS Meeting - Saturday 4:00 PM at Everett Public Library
Jun 18 - EAS Meeting - Saturday 4:00 PM at Everett Public Library
Or-
Jun 26 – EAS Meeting – SUNDAY 3:00 PM at Everett Public Library
Jul 30 – EAS Meeting – SUNDAY 3:00 PM at Everett Public Library

CLUB STAR PARTY INFO

Upcoming star party schedule:

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

$$ - FINANCIAL HEALTH - $$

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

CLUB SCOPES

SCOPE	LOAN STATUS	WAITING
10-INCH DOBSONIAN	ON LOAN	NO WAIT LIST

EAS members: contact Mike Locke at (425) 259-5995 or 'mlocke at lionmts.com' to borrow a scope.

ASTRO CALENDAR FOR 2005

April 2005

Apr 26 - Mercury at Greatest Western Elongation (27 degrees from Sun)
Apr 30 - EAS MEETING - Saturday 4:00 PM at Everett Public Library

May 2005

May 05 - Eta Aquarids Meteor Shower Peak
May 6-8 - Olympic Astronomy club – Dry Falls Spring Star Party
May 07 - Potential Saturday EAS star party night, location TBD
May 08 - New Moon
May 19 - Moon Occults Jupiter
May 21 - EAS MEETING* - Saturday 4:00 PM at Everett Public Library
May 27-29 - Riverside Telescope Makers Conference Astronomy Expo
May 27-29 - Memorial Day Weekend
May 31 - Moon Occults Mars

June 2005

Jun 04 - Potential Saturday EAS star party night, location TBD
Jun 06 - New Moon
Jun 09 - Two moon shadows visible on Jupiter for USA – 10:30 pm
Jun 13 - Pluto at opposition
Jun 16 - Moon occults Jupiter
Jun 17 - Two moon shadows visible on Jupiter for USA – 12:57 am
Jun 21 - Summer Solstice, 06:46 UT – first day of N hemisphere summer
Jun 26 - Mercury passes 1.4 degrees from Saturn
Jun 27 - Mercury passes 0.1 degrees from Venus
Jun 26 - EAS MEETING - SUNDAY 3:00 PM at Everett Public Library

July 2005

Jul 02 - Potential Saturday EAS star party night, location TBD
Jul 03 - Venus 0.4 deg. North of M44 Beehive cluster
Jul 04 - Deep Impact, Comet Tempel 1 impact/flyby
Jul 04 - Earth at aphelion (1.017 AU From Sun)
Jul 6-10 - Mt Bachelor Star Party
Jul 6-10 - Shingleton Star Party – Redding California
Jul 09 - Mercury Greatest Eastern Elongation (26 Degrees)
Jul 09 - Potential Saturday EAS star party night, location TBD
Jul 12 - Asteroid 3259 Brownlee closest approach to Earth (2.19 AU)
Jul 13 - Moon occults Jupiter
Jul 18 - Moon occults Antares from southern US, near for north.
Jul 21 - Largest full moon for 2005
Jul 23 - 10th Anniversary (1995), Alan Hale's & Tom Bopp's Discovery of Comet Hale-Bopp
Jul 27-29 - South Delta-Aquarids meteor shower peak
Jul 31 - EAS MEETING - SUNDAY 3:00 PM at Everett Public Library
Jul 30-Aug 07 Mt. Kobau Star Party – Osoyoos BC

August 2005

Aug 01 - Alpha Capricornids Meteor Shower Peak
Aug 4-6 - Table Mountain Star Party
Aug 04 - Furthest lunar apogee of 2005
Aug 05 - Neil Armstrong's 75th birthday (1930)
Aug 06 - Southern Iota Aquarids meteor shower peak
Aug 08 - Moon 1.0 right of Venus
Aug 08 - Neptune at opposition – visible all night
Aug 11 - Perseid meteor watch - Rooster Rock St Park - Columbia Gorge
Aug 12 - Perseids meteor shower peak
Aug 24 - Mercury at Greatest Western Elongation (18 degrees from Sun)
Aug 25 - Northern Iota Aquarids meteor shower peak
Aug 27 - EAS MEETING - Saturday 4:00 PM at Everett Public Library
Aug 31 - Uranus at opposition – visible all night

September 2005

Sep 01 - Uranus at opposition
Sep 01 - Venus passes 1.2 degrees from Jupiter
Sep 03 - New Moon
Sep 03 - Potential Saturday EAS star party night, location TBD
Sep 1-4 - Oregon Star Party
Sep 2-5 – Olympic Astronomy – Dry Falls Star Party
Sep 05 - Labor Day holiday
Sep 07 - Moon occults Venus
Sep 22 - Autumnal Equinox (22:23 UT) – 1st day of autumn N hemisphere
Sep 24 - EAS MEETING - Saturday 4:00 PM at Everett Public Library

October 2005

Oct 01 - Potential Saturday EAS star party night, location TBD
Oct 03 - New Moon
Oct 03 - Annular Solar Eclipse, Visible From Africa
Oct 04 - Moon occults Mercury
Oct 05 - Mercury passes 1.3 degrees From Jupiter
Oct 09 - Draconids meteor shower Peak
Oct 16 - Venus occults PPM 265560 (7.7 Magnitude Star)
Oct 17 - Partial Lunar eclipse
Oct 21 - Orionid meteor shower peak
Oct 29 - EAS MEETING - Saturday 4:00 PM at Everett Public Library
Oct 30 - Daylight Saving - set clock back 1 Hour

November 2005

Nov 01 - New Moon
Nov 05 - Potential Saturday EAS star party night, location TBD
Nov 03 - Taurids meteor shower peak
Nov 03 - Mercury at its Greatest Eastern Elongation (23 Degrees)
Nov 03 - Venus at its Greatest Eastern Elongation (47 Degrees)
Nov 07 - Mars at opposition
Nov 19 - EAS MEETING - Saturday 4:00 PM at Everett Public Library

December 2005

Dec 02 - 10th anniversary (1995), SOHO Launch
Dec 12 - Moon occults Mars
Dec 12 - Mercury at its Greatest Western Elongation (21 Degrees)
Dec 13 - Geminids meteor shower peak
Dec 21 - Winter Solstice, 18:35 UT
Dec 22 - Ursids meteor shower peak
Dec 10th or 17th – EAS Dinner - Saturday 7:00 PM

UW Astronomy Colloquium Schedule

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

Over The Airwaves

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

KPLU 88.5 FM National Public Radio has daily broadcasts of "Star Date" by the McDonald Observatory of the University of Texas at Austin, Monday through Friday at new times, not yet on their website. The short 2 minute radio show deals with current topics of interest in astronomy. The University of Washington TV broadcasts programs from NASA at 12:00 AM Monday through Friday, 12:30 AM Saturday, and 1:30 AM Sunday on the Channel 27 cable station.

EAS Library – Book & Video List

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

MEMBERSHIP BENEFITS & INFORMATION

Membership in the **Everett Astronomical Society** (EAS) will give you access to all the material in the lending library. The library, which is maintained by Scott Gibson, consists of several VCR tapes, many books, magazines, and software titles. Membership includes invitations to all of the club meetings and star parties, plus the monthly newsletter, ***The Stargazer.*** In addition you will be able subscribe to ***Sky and Telescope*** for $7 off the normal subscription rate, contact the treasurer for more information. **When renewing your subscription to *Sky & Telescope* you should send your S&T renewal form along with a check made out to Everett Astronomical Society to the EAS address.** The EAS treasurer will renew your *Sky and Telescope* subscription for you. **Astronomy** magazine offers a similar opportunity to club members.
EAS is a member of the **Astronomical League** and you will receive the Astronomical League's newsletter, ***The Reflector***. Being a member also allows you the use of the club's telescopes, an award winning 10 inch Dobsonian mount reflector, built as a club project or the 60mm refractor. Contact Bob Lyons (425) 337-1510 to borrow a telescope. EAS dues are $25. Send your annual dues to the **Everett Astronomical Society**, P.O. Box 12746, Everett, WA 98206. Funds obtained from membership dues allows the Society to publish the newsletter, pay Astronomical League dues and maintain our library.

OBSERVER'S INFORMATION…

Lunar Facts

Apr 24	Full Moon
May 01	Last Quarter Moon
May 08	New Moon
May 16	First Quarter Moon
May 23	Full Moon
May 30	Last Quarter Moon
Jun 06	New Moon
Jun 15	First Quarter Moon

Digital Lunar Orbiter Photographic Atlas of the Moon

The Lunar and Planetary Institute has created a digital version of the Lunar Orbiter Photographic Atlas of the Moon, and Consolidated Lunar Atlas available online at:
http://www.lpi.usra.edu/research/cla/menu.html
http://www.lpi.usra.edu/research/lunar_orbiter

Up In The Sky -- The Planets

Jupiter is at opposition on April 3, at its best for the year.

Object	Rises	Transits	Sets	Con	Mag
Sun	5:53 am	13:06	20:20	Ari	-27

Mercury	**5:14 am**	Daylight	19:45	**Psc**	**+0.3**
Venus	Daylight	Daylight	**21:01**	**Ari**	**-3.9**
Mars	**3:39 am**	Daylight	Daylight	**Aqr**	**+0.6**
Jupiter	**Daylight**	**23:14**	**5:08 am**	**Vir**	**-2.4**
Saturn	Daylight	18:07	**1:58 am**	**Gem**	**+0.2**
Uranus	**3:56 am**	Daylight	Daylight	**Aqr**	**+5.9**
Neptune	**3:03 am**	Daylight	Daylight	**Cap**	**+7.9**
Pluto	**23:13**	**4:11 am**	Daylight	**Ser**	**+13.9**

(times local time for Everett PST)

Transit times for Jupiter's Great Red Spot in 2005
http://skyandtelescope.com/observing/objects/planets/article_107_2.asp

NOAA Sun Calculator

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

International Space Station – Visible Seattle Passes

ISS Visibility –
http://spaceflight.nasa.gov/realdata/sightings/SSapplications/Post/SightingData/Seattle.html or also see link

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

'Photon' – Astronomy Ezine

Issue 6 of 'Photon' PDF astronomy ezine is now available for download from: http://www.photonezine.com Here's what's in this issue: Book Review: Deep Sky Wonders [George Reynolds] RoboScoping! [Tom Nicolaides] The Ancient Astronomers of Newgrange [Anthony Murphy] The Sikhote-Alin Meteorite [Mark Bostick] Solstices Are Milestones of Civilization [Von Del Chamberlain] Aerial Explorations of Terrestrial Meteorite Craters - Sudbury Crater [Charles O'Dale] RTGUI Freeware for Telescope Control [Rod Mollise] Canon EOS "Digital Rebel" [Phil Harrington] Some Images Through the "Digital Rebel" [Phil Harrington] Thoughts About Astronomical Image Processing for Digital Cameras [Tom Licha] Great Astronomers [Tim Carr] Showcase [Astrophotos] Plus a peppering of short stories and anecdotes.

Member News

Space Day 2005 is coming up on Thursday, May 5th at Museum of Flight. This is an event held at various museums and centers around the world, and is designed to introduce people to the wonders of astronomy, science, history and spaceflight. Last year's event here at The Museum of Flight had a great turnout and a lot of positive response! We will be having presentations and showcasing our education programs for the public, and we're expecting a big turnout again this year. A big part of the event is the exhibitor area, where local astronomy/science/education groups are on display to interact with the public.

Does the EAS want to have a booth???

Museum of Flight would love to have EAS participate as an exhibitor at this event! Exhibitors will be set up from 6 PM - 9 PM, and we'll be charging a small $25 fee for having a table in the Great Gallery around the Blackbird. For this fee we will provide you with one standard 6 foot table, a tablecloth, 2 chairs and a small table top sign. We're still working on details for the day, but the events, activities and schedule will be very similar to past years. Let me know if you want more details about the event.
Rich Lienesch - Outreach Manager - The Museum of Flight - 206-768-7143

President's Corner

This is an essay I wrote a few years ago, about springtime nights; I was thinking about it again as the frogs were singing recently, so republish it here.

Frogs and Galaxies

Growing up with a love of astronomy, I have spent uncounted hours at night outside in rural and suburban areas, observing the sky with binoculars, telescopes, and simply laying back and taking it in with just my eyes. This also allows my other senses to experience a rich connection to the outdoor world. Being outside, with the sky's clockwork wheeling overhead, and with the sounds and smells of the outdoors available to my senses completely eliminates the need of a calendar to tell me what season is at hand.

The changing of winter into spring is announced by a swelling chorus of the tree frogs, the soft scent of the earliest flowers and shrubs, and by the great cat Leo in the south and the Great Bear high in the northeast soon after dark. Tonight the waxing crescent moon rides very high in the west, above the fringe of bare trees, instead of gliding through them as in other months. In recent years, the most dynamic of sights in my telescope -- Jupiter -- has appeared in the evening at this time.

As the sky fully darkens, somewhat later now each night, pointing the telescope to the southeast finds an area poor in stars, but rich with clouds of galaxies. The Virgo and Coma Bernices clusters of galaxies show a confusing number of somewhat faint patches of light to my 8-inch telescope -- I still often come across a galaxy unexpectedly in my eyepiece without knowing its name until I can scrutinize its placement relative to nearby stars and check my atlas. If the sky is dark enough, many are recognizable by their individual appearance or by their grouping with nearby neighbors. Some are soft round shapes, others oval with hints of structure, others needle-like, seen edge-on. Some, like M86 and M87, are massive and bright; others barely perceptible at all.

Spring has grown to be my favorite season -- filled as it is with rebirth, renewal, and possibilities -- the return of warmth and color, and the reassurance that the cycles of life continue unabated, just as all the treasures in the sky unerringly return to be savored again. The frogs singing to each other is a wonderful part of the spring night -- sometimes I close my eyes momentarily at the telescope just because I become aware that I have been so absorbed in examining a faint spot of light that the melodic sound has gone unnoticed. Frogs and galaxies have formed links in my mind.

The warmth, fragrance and repeated songs all combine to set a calm and tranquil mood. They hint at primeval connections to nature -- they satisfy us by touching deep within the amphibian part of our brain. The galaxies at their immense untouchable distance also reinforce a calming message about the unimportance of day-to-day problems, by showing the scale of our surroundings. On rainy nights when the galaxies are only visible in books, the frogs still provide a pleasant ambiance.

Because of the geometry of the solar system, and my location on the earth, the spring galaxies have a short evening apparition. They progress from being visible only in the middle of the night to being overtaken by the glow of the lengthening day in what seems a short span of weeks, as the sunset and ever more persistently lingering evening twilight rapidly eat up the sky to the west of them. The frogs' song, in concert, also rapidly reaches a crescendo and then, much sooner than I would like, fades away into the globular clusters of summer. Sometimes it is replaced by

the crickets and their rhythmic thermometric chirps -- but to me, they are only the understudies.

A portion of the evolution of frogs is coincident in time with the 50-million-year flight of photons from the Virgo galaxies -- for four times longer than the light has taken on its journey, the frogs have been here. The light travel time from the closest major galaxy of all (the Andromeda galaxy M31, visible in Autumn) has allowed 2.2 million years of frog evolution to occur -- and perhaps all of man's. Only the Magellanic clouds (minor galaxies, interacting directly with our Milky Way) are close enough to have sent their light since man walked fully upright and approached that which we call 'modem'.

The places that provide the best views of the faint smudges of ancient light tend to be the best places to hear the frog symphony -- in pastoral rural fields or remote mountain venues, far from the spill of light and noise of urban life. I recall a camping trip to a lake near Mt. Adams where I saw the brief orange prominence of nova Cygni 1976 in binoculars as I lay looking up through the rich plane of our own Milky Way galaxy from my sleeping bag, and how all along the mountain roads nearby at that time, there were uncountable numbers of frogs or toads involved in a massive nighttime cross-country migration, believed to be guided, in part, by the stars.

Galaxies intrigue me because they are the most tangible objects that help us to realize the concept of infinity -- they challenge our comprehension with such vast numbers, distances, and energies. The hierarchy of *town, country, planet, solar system, star cluster, galaxy, cluster, super-cluster, universe* -- is only able to be personally confirmed out to the Virgo cluster, directly visible in a telescope. A single field of stars in our own local region of the Milky Way can be breathtaking in number -- a major galaxy can have a few hundred billion, and the galaxy clusters show hundreds of these almost imperceptible individual Milky Ways. It almost demands a momentary pause of awe, as each magnitude is allowed to register.

Near my home in the outer fringe of suburbs, where I most often observe, there is a pond and streams that seem to provide habitat for frogs. The nearby lots are large and wooded, but there are also driveways and cats and lawns all around the pond that hinder the frogs. The sound of engines climbing the grade of the highway a mile away, or the barking of a nearby dog, like coughs from the audience at a musical performance, sometimes obscure the frog song, and occasionally interrupts it altogether for a bit. The neighboring porch or living room lights are sometimes suddenly switched on, pouring their light in my direction, constricting my pupils, removing the fainter galaxies from my view. The frogs and I shift around a bit, wait for the disturbances to stop, and then try to begin our work again.

As I stand outside by myself in the dark, I sometimes feel a sadness that the people in the brightly-lit houses with the stereo and television running mostly unattended are totally unaware of the wondrous stuff just beyond the range of their fouled senses -- that they have no comprehension of or appreciation for what they are missing, or for the impact they have on those outside. I steadfastly resolve to invest time in setting up my telescope while they are out in the yard, to try to pique their curiosity and draw them out into the natural world.

There has been a disconcerting change over the last 10 to 15 years or so (about the light travel time to the nearest few stars); at that time thick woods surrounded my property with darkness, few cars traveled the road at night, and the city glow was unobtrusively low in the southwest. Over this short time, houses were placed behind my yard, the trees cleared away, a well-lighted shopping center appeared up the hill, and now the sound of engines and sirens has grown increasingly rancorous and constant, at all hours. The astrophoto exposures I attempt are quickly fogged by the aggregate of insecurity lights. I am now considering a CCD camera, which is said to have some ability to cut through the unnatural orange glow, and digitally capture the galaxies beyond -- but it is an imperfect solution. I read articles describing the discovery that insidious pollution by many of our common chemicals and medicines is proving devastating to frogs all over the world. Each year fewer frog voices are heard in my yard, and fewer galaxies can be found above. The frogs that used to overwhelm me as I stepped outdoors now have to be listened for, and the galaxies are harder to see. We are being engulfed.

The fading of frog melody and brightening night skies are both losses totally unnoticed, or considered inconsequential by most of my peers, but they are losses I deeply feel; partly because of the insensitive steamroller inevitability and permanence of 'progress' they represent. The frogs and I will have difficulty in adapting to the changes.

At least the galaxies will still be out there, unchanged, even if I can no longer as easily confirm it -- and with any galaxy I do see, I will always remember the sound of frogs**.**

-Mark Folkerts

CONSTELLATIONS OF THE MONTH: ARA AND LUPUS

. **ARA:** Ara, “the Altar”, is a Southern Hemisphere constellation, and borders on the constellations of Apus, Corona Australis, Norma, Pavo, Scorpius, Telescopium, and Triangulum Australe. There are no established asterisms within its borders, nor is the constellation known for any meteor showers; it also contains no Messier objects. Ara ranks 34th in overall brightness among the constellations, but only 63rd in size: it takes up approximately 237.06 square degrees (0.575%) of the sky. Ara is completely visible from latitudes South of +22 degrees, and completely invisible from latitudes North of +45 degrees. It has 19 stars brighter than magnitude 5.5, and its central point is at RA=17h18m, Dec.= -56.5 degrees. The midnight culmination date of Ara is June 10th, and the solar conjunction date is December 9th.

Some of the nearest stars to our Sun are contained within the borders of this small constellation. These include LFT 1351 (the 30th closest to our Sun; apparent magnitude of 9.4; absolute magnitude of 11.0; light-year distance: 15.09); 41 Ara A-B (103rd closest system: 41 Ara-A: apparent magnitude of 5.5; absolute magnitude of 6.1; light-year distance: 24.89; 41 Ara-B: apparent magnitude of 8.7; absolute magnitude of 9.3; light-year distance: 24.89); and LFT 1297 (167th closest: apparent magnitude of 14.4; absolute magnitude of 14.5; light-year distance of 31.05).

In addition to being known for many multiple and double (such as Gamma Arae) star systems, as well as many variable stars (such as the eclipsing binary R Arae and the long-period variable X Arae), Ara contains two special deep sky objects of note within its confines. Lying at a distance of “only” about 8,400 light years, and with a visual magnitude of 7.5, NGC-6397 is most likely the nearest globular cluster to our solar system. The other object of note, the beautiful diffuse nebula NGC 6188, is located near the central line of the Milky Way Galaxy. NGC-6188 is located about 7 degrees south and west of Zeta Scorpii. The brightest portion of the nebula, discovered by John Herschel in 1836, has an irregular triangular shape. The illumination for the entire nebula is supplied by the massive stars of the galactic star cluster NGC-6193, a grouping itself about 15 light years in diameter (the

brightest star in this grouping is the visual double h4876, an O-type giant star with a probable actual luminosity of about 3,000 suns.) The dark areas of this nebula are bordered by brighter rims which appear to reflect the glare of the involved stars, making an entire scene reminiscent of the Horsehead Nebula in Orion. Some experts have proposed that these bright-rim nebulae mark the leading edge of advancing shock waves as the dark cloud expands and sweeps up interstellar gas and dust. First observed by Lacaille in 1755, NGC-6397 is located on the left edge of the Milky Way, about 10.5 degrees south of Theta Scorpii; again, studies indicate that it may be the closest of all globulars to our Solar System. This globular is easily resolved in smaller scopes because of its relatively scattered structure. Burnham states that this lesser known cluster actually resembles the much better-known M4 in Scorpius in structure, brightness, and apparent size. The integrated spectral type of this cluster is F5 and the radial velocity is about 6.5 miles per second in recession. An odd feature of NGC-6397 is the likely absence of short-period pulsating variables which are often found in globulars. For example, Omega Centauri contains over 160, and M3 has almost 200. The brightest members of NGC-6397 are red giants of about 500 times the luminosity of the Sun; the total luminosity of the cluster is about 8,000 times the light of the Sun, and is therefore much fainter than many other globular clusters. The true diameter of the cluster is somewhere around 50 light years.

LUPUS: Lupus (the Wolf) borders on the constellations of Centaurus, Circinus, Libra, Norma, and Scorpius. There are no established asterisms within its borders. Lupus ranks 5th in overall brightness among the constellations, but 46th in size: it takes up approximately 333.68 square degrees (0.809%) of the sky. Lupus contains no known meteor showers, and no Messier objects. Lupus is completely visible from latitudes South of +35 degrees, and completely invisible from latitudes North of +60 degrees. It has 50 stars brighter than magnitude 5.5, and its central point is at RA=15h09m, Dec.= -42.5 degrees. The solar conjunction date of Lupus is November 8th, and its midnight culmination date is May 9th. One of the most spectacular and brightest supernovae explosions occurring in our Galaxy was observed near Beta Lupi in the year 1006. The only supernova to be recorded in Europe and the Arab empire before the Renaissance, historical descriptions estimated its brightness as "three times as bright as Venus" and "a quarter the brightness of the Moon". These and other descriptions place the visual magnitude at approximately –8 to –10. Lupus is well known for containing some fine globular and open clusters, as well as planetary nebulae. The unusually shaped planetary nebula IC-4406 glows at photographic magnitude 10.6, and has a long dimension of only 28"; this gives a relatively high average surface brightness. IC-4406's central star is embedded in a thick cloud of nebulosity, dimly glowing at photographic magnitude 14.7, making it extremely difficult for backyard observers. Larger scopes show this nebula to be a bright, bluish-gray rectilinear patch of light. NGC-5882, another planetary nebula in Lupus, appears as a slightly out-of-focus bluish green "star", with a photographic magnitude of 10.5; it is located right between two relatively bright stars of 7th and 8th magnitude. Another planetary nebula in Lupus (NGC-6026) lies near its eastern border, about halfway between Chi and Theta Lupi: this is NGC-6026, a 45" diameter planetary. This object for a long time was thought to be a galaxy, until University of Texas astronomer Gerard de Vaucouleurs identified it as a member of the Milky Way. NGC-6026 is a rather large planetary with a very low surface brightness due to a magnitude of 12.5; a moderate sized scope shows this object as uniformly illuminated faint haze, with a condensed stellar-like nucleus. NGC-5824 is a fine globular cluster in Northwestern Lupus. It shines at magnitude 9.0, and measures 6.2' across. This cluster is condensed strongly towards its center and is thus difficult to resolve with smaller scopes. Brighter and larger than NGC-5824 is NGC-5986; this globular measures 9.6' across, and shines at magnitude 7.1, making it easily visible as a large, fuzzy disk of light. A moderate backyard scope at high power shows many individual points of light ringing the cluster's edges. Another beautiful globular in Lupus is NGC-5927, lying about 3 degrees northeast of Zeta Lupi. It glows at magnitude 8.3, and measures about 12'; it appears in smaller scopes as a nebulous haze dotted with tiny stellar points with a bright white central core surrounded by a field full of sparkling stars. Many astronomers have raved about this lesser known globular cluster. Lupus also contains two bright open clusters : NGC-5749 and NGC-5822. NGC-5749 is a 9th magnitude group of 30 stars compressed into an area measuring only 8' across. NGC-5822 is a much larger and brighter open cluster, requiring a larger field of view. It contains 150 stars in an area covering 40', and has a total photographic magnitude of 6.5; its brightest stars glow at 10th magnitude, making the object visible in small telescopes as a large scattered field of bright and faint stars loosely comprising an open, or galactic, cluster. If you are able to get a good southern horizon this spring and early summer, try to enjoy some of the wonders of the constellation Lupus.

YOUNG ASTRONOMER'S CORNER

The Young Astronomer's Corner periodically asks some questions that young people may be seeking an answer to. Here are some such questions about astronomy and space exploration:

Q: Why should we build a space station?

A: The simple answer is that if humans are going to explore outer space, we need to know a lot more information about it. Space has no air to breathe and a micro-gravity atmosphere. The space shuttle and space station missions allow astronauts and cosmonauts to conduct many useful experiments in the weightlessness of space; but because shuttle missions are only about 2 weeks in duration, the longer orbiting time for the space station would allow longer time for some important experiments to be conducted. These include the long-term effects of weightlessness on humans, certain medical and laboratory experiments (including crystal, food and plant growth) and the effects of living in close, cramped quarters over long periods of time. By studying issues such as these in space, we can prepare perhaps for a future colony on the Moon and perhaps on another planet, as well as gain a fuller appreciation and knowledge of our life here on Earth.

Q: How long do stars live?

A: When a star is born from a large cloud of gas and dust, its size determines how long it will live. In general, the smaller the star, the longer it will live. Smaller stars with very low mass make helium from hydrogen (also known as fusion) very slowly. These stars tend to be cooler and thus redder in appearance, and burn for trillions(!) of years before they use all of their hydrogen found in the core. Medium sized stars, like our Sun, burn faster however. Because they are larger, there is more pressure from gravity in their cores, which causes nuclear fusion reactions to happen more quickly: they use up their hydrogen fuel more quickly. Stars such as the size of our Sun live for a few billion years. The most massive stars are generally the hottest and most unstable; they 'die' from processes such as a collapse from their own weight to form supernovae, neutron stars, and/or pulsars for example; these largest stars die within 'only' a few million years.

In general, when it comes to stars, the bigger you are, the shorter your life.

Q: Could we land a spacecraft on the planet Jupiter?

A: No, because Jupiter has no true "surface" to land on. Additionally, any spacecraft able to make it that far would sink through thicker and thicker "clouds", until the clouds were so thick that the pressure created would crush the spacecraft. The deeper you go inside Jupiter, the greater the crushing pressures.

Q: Which planet has the largest moon?

A: Jupiter. The name of the moon is Ganymede, and it also happens to be the largest moon in the entire solar system. It is 3,166 miles in diameter, and is thus larger than the planets Mercury (2,930 miles diameter) and Pluto (1,380 miles diameter). By comparison, Earth's Moon is 2,086 miles in diameter.

ASTRONOMY AND TELESCOPE LINGO

ASTRONOMY LINGO: ***COBE:*** An orbiting satellite launched by NASA in 1989 to study cosmic microwave background radiation. The acronym stands for Cosmic Background Explorer. The satellite was constructed with three detectors: DIRBE (the diffuse IR background experiment); FIRAS (the far-IR absolute spectrophotometer); and the DMR (the differential microwave radiometer). Measurements have shown that the background microwave radiation is not completely uniform, resulting from the real motion of the Milky Way Galaxy relative to the fixed background. Weak temperature fluctuations have also been detected, and are generally regarded as signatures of quantum fluctuations in the early universe (see "CAT" below).

TELESCOPE LINGO: ***CAT:*** Also known as the Cosmic Anisotropy Telescope. CAT is a 3-element interferometer operating at frequencies between 13 and 17 GHz (on baselines of 1 to 5 meters.) CAT measures early, primordial temperature variations in the cosmic microwave background radiation, and is located at the Mullard Radio Astronomy Observatory in Cambridge, England.

PLANETARY FOCUS

"Planetary Focus" is a periodic column that is published occasionally in the EAS "Stargazer". If you have a favorite planet that you would like similar information and/or statistics on, please contact newsletter co-editor Bill O'Neil. This column will return for the warm-weather months, beginning in May, in time for observing season.

ASTRONOMY FUN FACTS

★ T-Tauri stars, named after the first to be discovered in the constellation Taurus, are newly born or created stars, and are always associated with giant gaseous nebulae from which they arise. The luminosities of these stars vary erratically, most probably because they are still growing and accumulating material before they reach the more stable main-sequence state. The prototype star T-Tauri is expected to evolve to main-sequence status about 10 million years from now, at about the same time when a long succession of earthquakes along the California San Andreas fault will have moved Los Angeles essentially to the latitude of San Francisco!!

★ The interstellar dust in our Galaxy alone is equivalent to the mass of over 450 trillion planet Earths!!

★ More interstellar dust grains can fit into about 12 cubic inches than there are stars in the entire Milky Way Galaxy (i.e., far more than 100 billion dust grains!).

★ The central regions of the Milky Way Galaxy are obscured from visual astronomers by almost 30,000 light-years' worth of interposing gas and dust. If one were to optically view the center of the Galaxy, it would be similar to viewing the Sun through clouds so dense that any sunlight which *is* able to penetrate would only give off 1,000th as much light as the full Moon. Looking at this another way, the light reduction would be similar to the attenuation effect that several thousand feet of ocean water would have on the Sun's light!

★ Sirius B (a companion of the brightest star in all the sky after the Sun: Sirius) is the first white dwarf to be discovered, and lies at a distance from Earth of about 9 light-years. Even though smaller than Earth, all its matter weighs almost as much as the Sun……as a matter of fact, just a handful of its matter would weigh about 500 tons!

★ Although it has been known for almost 2,000 years, the largest globular cluster, Omega Centauri (NGC 5139), was thought to be a single star until Edmund Halley realized it was a cluster in 1677. This globular cluster, at 620 light-years diameter, is one of the most massive in our Galaxy, with a mass perhaps equal to 500,000 Suns. The actual number of component stars exceeds 1 million, and their collective light outshines our Sun by 1,000, 000 times. With an age of 13 billion years, it may also be the oldest of the globular clusters. The orbit of this cluster has a maximum distance of 21,000 light-years from the galactic center to its closest orbital point of 6,200 light years from the galactic center. With an assumed age of 13 billion years, Omega Centauri has orbited around the Milky Way Galaxy 50 times since the birth of the Sun, 6 times since corals and starfish appeared on Earth, and once since flowering plants appeared. In just one single Omega Centauri year, Earth will have orbited the Sun 100 million times!!

★ Any globular cluster that contains 1 million stars would have more stars packed within its volume than anywhere else in the Galaxy except the galactic core. If each star in the cluster could be represented by a 1-inch diameter golf ball, the entire cluster could be contained in a spherical volume with a diameter of 10,000 miles, and the average separation between golf balls could still be 100 miles. Even in the most densely packed globular cluster cores, the golf balls would still have 33 miles separation between them. This is comparable to your next-door neighbor living 40,000 miles away (if the Earth were big enough!!).

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: PULSARS: A celestial body which emits short duration (periods range from about 1.56 milliseconds to 4 seconds) radiation pulses at very regular intervals (from a fraction of a second to about 10 seconds). Pulsars with very short duration periods (less than 0.01 seconds) are among the class noted as millisecond pulsars. Most pulsars are single, but binary

pulsars are also known. They are thought to be rotating neutron stars, extremely dense stars which are generated from high mass stellar explosions such as supernovae; however, some pulsars may also be generated by other processes, such as the accretion of gas onto a white dwarf. Pulsars were originally discovered at radio wavelengths; a few others have been discovered at optical, gamma-ray, and X-ray wavelengths. These gamma-ray and X-ray pulsars will not be discussed in detail here. The first radio pulsar, PSR 1919+21, was detected by Antony Hewish and Jocelyn Bell during a study of atmospheric scintillation. More than 500 radio pulsars are now known; the Milky Way galaxy is thought to have about 100,000 of them. The received pulses occur when a beam of radio waves, emitted by a rotating neutron star, sweeps past Earth; this beam of radiation arises from electrons moving within the neutron star's strong magnetic field (the direction of which differs from that of the pulsar's rotational axis). The actual emission site of the beam (e.g., the magnetic poles; near the star, or further out) is still in some dispute. The period of all radio pulsars is gradually lengthening as the parent neutron star loses rotational energy. The central star of the Crab Nebula, the youngest known pulsar, is slowing at a rate of one part in a million per day. A steady slow down rate can also be interrupted or changed by rearrangements of the crust or core of the parent neutron star. The Crab and Vela pulsars' slow down rate are thought to be interrupted in this way; these two pulsars are optical radio pulsars.

REPRESENTATIVE NORTHERN HEMISPHERE OBJECT: *CRAB NEBULA (M-1; NGC 1952)* The star whose explosion produced the Crab nebula is an optical pulsar (Crab pulsar NP-0532; discovered in 1967). Its pulsations are also observed at radio, infrared, X-ray, and gamma-ray wavelengths; these pulsations have a period of only 0.0331 seconds. The energy loss by the highly energetic electrons mentioned above equals the total energy lost by the Crab nebula; ultraviolet aspects of this radiation ionizes the gas in the filaments, causing the atoms to fluoresce. It is associated with a supernova remnant; in fact, the Crab nebula is the prototype member of the class of filled supernova remnants, known as plerions.

REPRESENTATIVE SOUTHERN HEMISPHERE OBJECT: *VELA PULSAR:* The second optical pulsar discovered (1977). With a brightness of only 26 magnitudes, it is much fainter than the Crab pulsar, although it is 4 times nearer (about 500 parsecs). It is known to emit pulses of radio emission in a period of every 0.089 seconds, and gamma ray pulses twice every revolution (at gamma-ray wavelengths, it is the brightest object in the sky). The Vela pulsar is a young pulsar (about 10,000 years old). The associated supernova remnant (Vela-X) has been observed at X-ray, XUV, optical, and radio wavelengths.

CLASS OF OBJECT: B-STARS: Massive hot blue ultraviolet stars of spectral type B that have surface temperatures of about 10,000 to 28,000 kelvin for main-sequence stars and up to 30,000 kelvin for supergiants. Absorption lines of neutral helium (He-I) dominate the spectrum. Balmer lines of hydrogen intensify from B-0 to B-9, with lines of ionized magnesium and silicon also present. Some B-stars – the B-E stars - have emission lines emanating from a circumstellar shell of gas. B-0, B-1, and B-2 stars are found in OB associations (groups of highly luminous and massive main-sequence stars of spectral types O and B) found in the gas and dust-rich areas of the spiral arms of galaxies.

REPRESENTATIVE NORTHERN HEMISPHERE OBJECT: *BELLATRIX:* A remote very luminous blue-white giant that is the third brightest star in the constellation of Orion (as we face Orion and he "looks" at Earth, his sword (the Great Orion Nebula) hangs down on his right (our left); Bellatrix is thus the bright star we see in his opposite (to the sword), or left, shoulder (Betelgeuse is thus his *right* shoulder). Bellatrix has a visual magnitude of 1.6; spectral type B-2-III; and a distance of 110 parsecs.

REPRESENTATIVE SOUTHERN HEMISPHERE OBJECT: *ALPHA CRUCIS:* The brightest in the constellation Crux, this bright white star is actually a visual binary with a separation of 4"; both components are spectroscopic binaries. The visual magnitude of component A is 1.3; component B is 1.7; together their visual magnitude is 0.76. The spectral type of component A is B-1 (IV) and component B is B-1 (V); the distance to the system is 160 parsecs.

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

FIRST DIRECT DETECTION OF LIGHT OF EXTRASOLAR PLANETS

Two teams of astronomers announced that they have directly detected light from two known planets orbiting distant stars. This discovery opens a new frontier in the study of extrasolar planets. Researchers now can directly measure and compare such planetary characteristics as color, reflectivity, and temperature. A team led by David Charbonneau announced their detection of the planet TrES-1. A team led by Drake Deming published observations of the planet HD 209458b. "It's an awesome experience to realize we are seeing the glow of distant worlds," said Charbonneau. "When I first saw the data, I was ecstatic." Each of the two target planets periodically crosses in front of and behind its star. When in front, the planet partially eclipses the star and blocks a small portion of the star's light. Similarly, the system dims slightly when the planet disappears behind its star since the star blocks the planet's light. By observing this "secondary eclipse," astronomers can tease out the faint signal of the planet from the overwhelming light of the nearby star.

Planets Can't Hide The Heat. Charbonneau and his colleagues used the Infrared Array Camera (IRAC), an instrument aboard NASA's Spitzer Space Telescope, to observe TrES-1 in the infrared region of the spectrum. Deming and associates used Spitzer's Multiband Imaging Photometer for Spitzer (MIPS) to observe HD 209458b. "*Planets like TrES-1 are tiny and faint compared to their stars, but the one thing they can't hide is their heat*," said Charbonneau. "*We are like detectives. Previous clues told us the planet must be there, so we put on our 'infrared goggles' and suddenly, it popped into view*." Infrared offers an advantage because the star outshines the planet by a factor of 10,000 in visible light, while in the infrared the star is only about 400 times brighter, making it easier to pick out a planet's feeble light. Astronomers compare the challenge to trying to spot a firefly buzzing next to a searchlight. Planet TrES-1

IRAC team members Lori Allen and Tom Megeath planned the TrES-1 observations, which required precise timing to catch the system just before and after the secondary eclipse, as well as precise pointing. Their experience and familiarity with the performance of the IRAC camera were crucial in obtaining the best data possible. Allen and Megeath also provided insights into IRAC instrument features encountered during data analysis. "*Teasing out the signal from TrES-1 was both challenging and exciting*," said Allen. "*We were actually seeing light from another world hundreds of light-years away from us, circling around another sunlike star*." Although two groups previously claimed to have directly photographed an extrasolar planet, neither one is confirmed and neither orbits a sun-like star.

Using Spitzer data combined with previous measurements, Charbonneau and his colleagues confirmed that TrES-1, which orbits its star at a distance of 4 million miles, has a temperature

of about 1,450 degrees Fahrenheit (1060 Kelvin). They also calculated that the planet has a reflectivity of only 31%, meaning it absorbs the majority of the star's light that falls on it.

CfA researcher Guillermo Torres modeled the dynamics of the TrES-1 system to constrain the planet's orbit. He determined that the orbit has been made very nearly circular by the tidal effect of the nearby star, as expected.

Future Exoplanet Research Charbonneau is quick to point out that the achievement of directly detecting an extrasolar planet's light is only the beginning. "*We've caught our first 'firefly.' Now we want to study a swarm of them*." Astronomers expect the TrES network, which spotted TrES-1, to locate additional "hot Jupiters." That ground-based network is designed to spot planets orbiting bright stars, which can be more easily studied with Spitzer and other instruments. By comparing many "hot Jupiter" planets, researchers hope to determine what gases their atmospheres contain and how their composition was affected by when and how they formed. "*We never imagined we would find planets as strange and varied as we have. Who knows what new worlds are waiting for us?"* said Charbonneau.

High resolution images and animations http://www.cfa.harvard.edu/pre-ss/pr0509image.html

WAYWARD PLANET KNOCKS EXTRASOLAR PLANETS FOR A LOOP

The peculiar orbits of three planets looping around a faraway star can be explained only if an unseen fourth planet blundered through and knocked them out of their circular orbits, according to a new study by researchers at Berkeley, and Northwestern. The conclusion is based on computer extrapolations from 13 years of observations of planet motions around the star Upsilon Andromedae. It suggests that the non-circular and often highly elliptical orbits of many of the extrasolar planets discovered to date may be the result of planets scattering off one another. In such a scenario, the perturbing planet could be shot out of the system entirely or could be kicked into a far-off orbit, leaving the inner planets with eccentric orbits. "*This is probably one of the two or three extrasolar systems that have the best observations and tightest constraints, and it tells a unique story*," said Eric Ford, a postdoctoral fellow at Berkeley. "*Our explanation is that the outer planet's original orbit was circular, but it got this sudden kick that permanently changed its orbit to being highly eccentric. To provide that kick, we've hypothesized that there was an additional planet that we don't see now. We believe we now understand how this system works*." If such a planet had caromed through our solar system early in its history, the researchers noted, the inner planets might not now have such nicely circular orbits, and, based on current assumptions about the origins of life, Earth's climate might have fluctuated too much for life to have arisen. "*While the planets in our solar system remain stable for billions of years, that wasn't the case for the planets orbiting Upsilon Andromedae*," Ford said. "*While those planets might have formed similarly to Jupiter and Saturn, their current orbits were sculpted by a late phase of chaotic and violent interactions*."

According to Ford's colleague, Frederic Rasio, "*Our results show that a simple mechanism, often called 'planet-planet scattering' - a sort of slingshot effect due to the sudden gravitational pull between two planets when they come very near each other - must be responsible for the highly eccentric orbits observed in the Upsilon Andromedae system. We believe planet-planet scattering occurred frequently in extrasolar planetary systems, not just this one, resulting from strong instabilities. So, while planetary systems around other stars may be common, the kinds of systems that could support life, which, like our solar system, presumably must remain stable over very long time scales, may not be so common*."

The planetary system around Upsilon Andromedae is one of the most studied of the 160-some systems with planets discovered so far outside our own solar system. The inner planet, a "hot Jupiter" so close to the star that its orbit is only a few days, was discovered in 1996 by UC Berkeley's Geoff Marcy and his planet-hunting team. The two outer planets, with elongated orbits that perturb each other strongly, were discovered in 1999. These three, huge, Jupiter-like planets around Upsilon Andromedae comprised the first extrasolar multi-planet system discovered by Doppler spectroscopy.

Because of the unusual nature of the planetary orbits around Upsilon Andromedae, Marcy and his team have studied it intensely, making nearly 500 observations - 10 times more than for most other extrasolar planets that have been found. These observations, the wobbles in the star's motion induced by the orbiting planets, allow a very precise charting of the planets' motions around the star. "*The observations are so precise that we can watch and predict what will happen for tens of thousands of years in the future*," Ford said. Today, while the innermost planet huddles close to the star, the two outer planets orbit in egg-shaped orbits. Computer simulations of past and future orbital changes showed, however, that the outer planets are engaged in a repetitive dance that, once every 7,000 years, brings the orbit of the middle planet to a circle. "*That property of returning to a very circular orbit is quite remarkable and generally doesn't happen,"* Ford said*. "The natural explanation is that they were once both in circular orbits, and one got a big kick that caused it to become eccentric. Then, the subsequent evolution caused the other planet to grow its eccentricity, but because of the conservation of energy and angular momentum, it returns periodically to a very nearly circular orbit*."

Previously, astronomers had proposed two possible scenarios for the formation of Upsilon Andromedae's planet system, but the observational data was not yet sufficient to distinguish the two models. Another astronomer, Renu Malhotra, had previously suggested that planet-planet scattering might have excited the eccentricities in Upsilon Andromedae. But an alternative explanation claimed that interactions among the planets and a gas disk surrounding the star could also have produced such eccentric orbits. By combining additional observational data with new computer models, Ford and his colleagues were able to show that interactions with a gas disk would not have produced the observed orbits, but that interactions with another planet would naturally produce them.

"T*he key distinguishing feature between those theories was that interactions with an outer disk would cause the orbits to change very slowly, and a strong interaction with a passing planet would cause the orbits to change very quickly compared to the 7,000-year time scale for the orbits to evolve*," Ford said. "*Because the two hypotheses make different predictions for the evolution of the system, we can constrain the history of the system based on the current planetary orbits*." Ford said that as the planets formed inside a disk of gas and dust, the drag on the planets would have kept their orbits circular. Once the dust and gas dissipated, however, only an interaction with a passing planet could have created the particular orbits of the two outer planets observed today. Perhaps, he noted, the perturbing planet was knocked into the inner planets by interactions with other planets far from the central star.

However it started, the resulting chaotic interactions would have created a very eccentric orbit for the third planet, which then also gradually perturbed the second planet's orbit. Because the outer planet dominates the system, over time it perturbed the middle planet's orbit enough to deform it slowly into an eccentric orbit as well, which is what is seen today, although every 7,000 years or so, the middle planet returns gradually to a circular orbit. "*This is what makes the system so peculiar*," said Rasio. "*Ordinarily, the gravitational coupling between two elliptic orbits would never make one go back to a nearly perfect circle. A circle is very special*." "*Originally the main objective of our research was to simulate the Upsilon Andromedae planetary system, essentially in order to determine whether the outer two planets lie in the same plane like the planets in the solar system do*," said Lystad, who started working with Rasio when she was a sophomore and did many of the computer integrations as part of her senior thesis. "*We were surprised to find that, for many of our simulations, it was difficult to tell whether the planets were in the same plane due to the fact that the middle planet's orbit periodically became so very nearly circular. Once we noticed this strange behavior was present in all of our simulations, we recognized it as an earmark of a system that had undergone planet-planet scattering. We realized there was something much more interesting going on than anyone had found before*."

Understanding what happened during the formation and evolution of Upsilon Andromedae and other extrasolar planetary systems has major implications for our own solar system. "*Once you realize that most of the known extrasolar planets have highly eccentric orbits (like the planets in Upsilon Andromedae), you begin to wonder if there might be something special about our solar system*," Ford said. "*Could violent planet-planet scattering be so common that few planetary systems remain calm and habitable? Fortunately, astronomers - led by Geoff Marcy, a professor of astronomy at UC Berkeley - are diligently making the observations that will eventually answer this exciting question*." http://www.berkeley.edu/news/m-edia/releases/2005/04/13_plane-t.shtml

DON'T BREATHE THE MOONDUST

When humans return to the Moon and travel to Mars, they'll have to be careful of what they inhale.

This is a true story. In 1972, Apollo astronaut Harrison Schmidt sniffed the air in his Lunar Module, the Challenger. *"[It] smells like gunpowder in here*," he said. His commander Gene Cernan agreed. *"Oh, it does, doesn't it?"* The two astronauts had just returned from a long moonwalk around the Taurus-Littrow valley, near the Sea of Serenity. Dusty footprints marked their entry into the spaceship. That dust became airborne--and smelly. Later, Schmidt felt congested and complained of "lunar dust hay fever." His symptoms went away the next day; no harm done. He soon returned to Earth and the anecdote faded into history.

But Russell Kerschmann never forgot. He's a pathologist at the NASA Ames Research Center studying the effects of mineral dust on human health. NASA is now planning to send people back to the Moon and on to Mars. Both are dusty worlds, extremely dusty. Inhaling that dust, says Kerschmann, could be bad for astronauts. "*The real problem is the lungs*," he explains. "*In some ways, lunar dust resembles the silica dust on Earth that causes silicosis, a serious disease*." Silicosis, which used to be called "stone-grinder's disease," first came to widespread public attention during the Great Depression when hundreds of miners drilling the Hawk's Nest Tunnel through Gauley Mountain in West Virginia died within half a decade of breathing fine quartz dust kicked into the air by dry drilling--even though they had been exposed for only a few months. "*It was one of the biggest occupational-health disasters in U.S. history*," Kerschmann says.

This won't necessarily happen to astronauts, he assures, but it's a problem we need to be aware of--and to guard against. Quartz, the main cause of silicosis, is not chemically poisonous: "*You could eat it and not get sick*," he continues. "*But when quartz is freshly ground into dust particles smaller than 10 microns (for comparison, a human hair is 50+ microns wide) and breathed into the lungs, they can embed themselves deeply into the tiny alveolar sacs and ducts where oxygen and carbon dioxide gases are exchanged*." There, the lungs cannot clear out the dust by mucous or coughing. Moreover, the immune system's white blood cells commit suicide when they try to engulf the sharp-edged particles to carry them away in the bloodstream. In the acute form of silicosis, the lungs can fill with proteins from the blood, "*and it's as if the victim slowly suffocates*" from a pneumonia-like condition. Lunar dust, being a compound of silicon as is quartz, is (to our current knowledge) also not poisonous. But like the quartz dust in the Hawk's Nest Tunnel, it is extremely fine and abrasive, almost like powdered glass. Astronauts on several Apollo missions found that it clung to everything and was almost impossible to remove; once tracked inside the Lunar Module, some of it easily became airborne, irritating lungs and eyes.

Martian dust could be even worse. It's not only a mechanical irritant but also perhaps a chemical poison. Mars is red because its surface is largely composed of iron oxide (rust) and oxides of other minerals. Some scientists suspect that the dusty soil on Mars may be such a strong oxidizer that it burns any organic compound such as plastics, rubber or human skin as viciously as undiluted lye or laundry bleach. "*If you get Martian soil on your skin, it will leave burn marks,"* believes University of Colorado engineering professor Stein Sture, who studies granular materials like Moon- and Mars-dirt for NASA. Because no soil samples have ever been returned from Mars, "*we don't know for sure how strong it is, but it could be pretty vicious*." Moreover, according to data from the Pathfinder mission, Martian dust may also contain trace amounts of toxic metals, including arsenic and hexavalent chromium--a carcinogenic toxic waste featured in the docudrama movie Erin Brockovich (Universal Studios, 2000). That was a surprising finding of a 2002 National Research Council report called Safe on Mars: Precursor Measurements Necessary to Support Human Operations on the Martian Surface.

The dust challenge would be especially acute during windstorms that occasionally envelop Mars from poles to equator. Dust whips through the air, scouring every exposed surface and sifting into every crevice. There's no place to hide. To find ways of mitigating these hazards, NASA is soon to begin funding Project Dust, a four-year study headed by Masami Nakagawa, associate professor in the mining engineering department of the Colorado School of Mines. Project Dust will study such technologies as thin-film coatings that repel dust from tools and other surfaces, and electrostatic techniques for shaking or otherwise removing dust from spacesuits. These technologies, so crucial on the Moon and Mars, might help on Earth, too, by protecting people from sharp-edged or toxic dust on our own planet. Examples include alkaline dust blown from dry lakes in North American deserts, wood dust from sawmills and logging operations, and, of course, abrasive quartz dust in mines. The road to the stars is surprisingly dusty. But, says Kerschmann, "*I strongly believe it's a problem that can be controlled*." http://science.nasa.gov/headli-nes/y2005/22apr_dontinhale.htm

CASSINI CAPTURES SWISS-CHEESE LOOK OF SATURN MOON

An image of Saturn's small moon, Epimetheus (epp-ee-MEE-thee-uss), was captured by the Cassini spacecraft in the closest view ever taken of the pockmarked body. Epimetheus is irregularly shaped and dotted with soft-edged craters. The many large, softened craters on Epimetheus indicate a surface that is several billion years old. The moon shares an orbit with another of Saturn's small moons, Janus. The two dance in a planetary tango as they move in almost identical orbits, exchanging orbits every four years, instead of colliding. Both play a role in creating intricate waves in Saturn's rings; both have densities significantly lower than that of solid ice, suggesting they may be "rubble piles" held together by gravity. At 116 kilometers (72 miles) across, Epimetheus is slightly smaller than Janus at 181 kilometers (113 miles) across. Spectra of Epimetheus from the Cassini visual infrared mapping spectrometer indicate that the moon is mostly water ice. The new Epimetheus image is available at http://saturn.jpl.nasa.gov http://www.nasa.gov/cassini and http://ciclops.org

CASSINI FINDS AN ATMOSPHERE ON SATURN'S MOON ENCELADUS

The Cassini spacecraft's two close flybys of Saturn's icy moon Enceladus have revealed that the moon has a significant atmosphere. Scientists, using Cassini's magnetometer instrument for their studies, say the source may be volcanism, geysers, or gases escaping from the surface or the interior.

When Cassini had its first encounter with Enceladus on Feb. 17 at an altitude of 1,167 kilometers (725 miles), the magnetometer instrument saw a striking signature in the magnetic field. On March 9, Cassini approached to within 500 kilometers (310 miles) of Enceladus' surface and obtained additional evidence.

The observations showed a bending of the magnetic field, with the magnetospheric plasma being slowed and deflected by the moon. In addition, magnetic field oscillations were observed. These are caused when electrically charged (or ionized) molecules interact with the magnetic field by spiraling around the field line. This interaction creates characteristic oscillations in the magnetic field at frequencies that can be used to identify the molecule. The observations from the Enceladus flybys are believed to be due to ionized water vapor.

"*These new results from Cassini may be the first evidence of gases originating either from the surface or possibly from the interior of Enceladus*," said Dr. Michele Dougherty, principal investigator for the Cassini magnetometer. In 1981, Voyager spacecraft flew by Enceladus at a distance of 90,000 kilometers (56,000 miles) without detecting an atmosphere. It's possible detection was beyond Voyager's capabilities, or something may have changed since that flyby. This is the first time since Cassini arrived in orbit around Saturn last summer that an atmosphere has been detected around a moon of Saturn, other than its largest moon, Titan. Enceladus is a relatively small moon. The amount of gravity it exerts is not enough to hold an atmosphere very long. Therefore, at Enceladus, a strong continuous source is required to maintain the atmosphere.

The need for such a strong source leads scientists to consider eruptions, such as volcanoes and geysers. If such eruptions are present, Enceladus would join two other such active moons, Io at Jupiter and Triton at Neptune. "*Enceladus could be Saturn's more benign counterpart to Jupiter's dramatic Io*," said Dr. Fritz Neubauer, co- investigator for the Cassini magnetometer, and a professor at the University of Cologne in Germany.

Since the Voyager flyby, scientists have suspected that this moon is geologically active and is the source of Saturn's icy E ring. Enceladus is the most reflective object in the solar system, reflecting about 90 percent of the sunlight that hits it. If Enceladus does have ice volcanoes, the high reflectivity of the moon's surface might result from continuous deposition of icy particles originating from the volcanoes.

Enceladus' diameter is about 500 kilometers (310 miles), which would fit in the state of Arizona. Yet despite its small size, Enceladus exhibits one of the most interesting surfaces of all the icy satellites. For images and information on the Cassini mission visit http://saturn.jpl.nasa.gov and http://www.nasa.gov/cassini

CASSINI FINDS PARTICLES NEAR SATURN'S MOON ENCELADUS

The Cassini spacecraft has discovered intriguing dust particles around Saturn's moon Enceladus. The particles might indicate the existence of a dust cloud around Enceladus, or they may have originated from Saturn's outermost ring, the E-ring. "*We are making measurements in the plane of the E-ring,"* said Dr. Thanasis Economou, the lead researcher on the high rate detector, part of a larger instrument on Cassini called the cosmic dust analyzer. "*It will take a few more flybys to distinguish if the dust flux is originating from the E-ring as opposed to a source at Enceladus*."

Enceladus is rapidly becoming a very interesting target for Cassini. So much so that scientists and engineers are planning to revise the altitude of the next flyby to get a closer look. Additional Cassini encounters with Enceladus are scheduled for July 14, 2005, and March 12, 2008. The July 14 flyby was to be at an altitude of 1,000 kilometers (620 miles), but the mission team now plans to lower that altitude to about 175 kilometers (109 miles). This will be Cassini's lowest-altitude flyby of any object during its nominal four-year tour.

Earlier this year Cassini completed two flybys of Enceladus. On February 17, Cassini encountered Enceladus at an altitude of 1,167 kilometers (725 miles). On that date, the cosmic dust analyzer with its high rate detector recorded thousands of particle hits during a period of 38 minutes. Cassini executed another flyby of Enceladus on March 9 at an altitude of 500 kilometers (310 miles). "*Again we observed a stream of dust particles*," said Economou. The largest particles detected measure no more than the diameter of a human hair -- too small to pose any danger to Cassini.

Scientists have speculated that Enceladus is the source of Saturn's E ring, the planet's widest, stretching 302,557 kilometers (188,000 miles). It's possible, the scientists say, that tidal interactions between Enceladus and Mimas, two other moons of Saturn, have heated Enceladus' interior causing water volcanism.

"*These measurements are extremely important in order to understand the role of Enceladus as the source of the water ice particles in the E ring*," said Dr. Ralf Srama, of the Max Planck Institute for Nuclear Physics, Heidelberg, Germany. Srama is principal investigator of the cosmic dust analyzer science team. This study requires precise measurements of dust densities near the Enceladus region, "*but without the high rate detector this would not be possible*," said Srama.

Another of Cassini's instruments, the magnetometer, recently discovered water ions which could be part of a very thin atmosphere around Enceladus. Enceladus is a relatively small moon. The amount of gravity it exerts is not enough to hold an atmosphere very long. Therefore a strong, continuous source is required to maintain the atmosphere.

Enceladus measures 500 kilometers (310 miles) in diameter and reflects nearly 100 percent of the light that hits its ice- covered

surface. It orbits Saturn at a distance of approximately 237,378 kilometers (147,500 miles), about two-thirds the distance from Earth to the moon.

The cosmic dust analyzer provides direct observations of small ice or dust particles in the Saturn system in order to investigate their physical, chemical and dynamical properties. It is made up of two detectors. The University of Chicago built the high rate detector, which made these observations. With further analysis, the cosmic dust analyzer might be able to determine whether the particles are made of ice or dust. For images and information on the Cassini mission visit http://saturn.jpl.nasa.gov and http://www.nasa.gov/cassini

CASE OF SEDNA'S MISSING MOON SOLVED

When the distant planetoid Sedna was discovered on the outer edges of our solar system, it posed a puzzle to scientists. Sedna appeared to be spinning very slowly compared to most solar system objects, completing one rotation every 20 days. Astronomers hypothesized that this world possessed an unseen moon whose gravity was slowing Sedna's spin. Yet Hubble Space Telescope images showed no sign of a moon large enough to affect Sedna.

New measurements by Scott Gaudi, Krzysztof (Kris) Stanek, and colleagues have cleared up this mystery by showing that a moon wasn't needed after all. Sedna is rotating much more rapidly than originally believed, spinning once on its axis every 10 hours. This shorter rotation period is typical of planetoids in our solar system, requiring no external influences to explain. "*We've solved the case of Sedna's missing moon. The moon didn't vanish because it was never there to begin with*," said Gaudi.

Sedna is an odd world whose extreme orbit takes it more than 45 billion miles from the Sun, or more than 500 astronomical units (where one astronomical unit is the average Earth-Sun distance of 93 million miles). Sedna never approaches the Sun any closer than 80 astronomical units, and takes 10,000 years to complete one orbit. In comparison, Pluto's 248-year-long oval orbit takes it between 30 and 50 astronomical units from the Sun.

"*Up until now, Sedna appeared strange in every way it had been studied. Every property of Sedna that we'd been able to measure was atypical*," said Gaudi. "*We've shown that Sedna's rotation period, at least, is entirely normal.*" Sedna appears unusual in other ways besides its orbit. First and foremost, it is one of the largest known "minor planets," with an estimated size of 1,000 miles compared to Pluto's 1,400 miles. Sedna also displays an unusually red color that is still unexplained.

Initial measurements indicated that Sedna's rotation period was also extreme - extremely long compared to other solar system residents. By measuring small brightness fluctuations, scientists estimated that Sedna rotated once every 20-40 days. Such slow rotation likely would require the presence of a nearby large moon whose gravity could apply the brakes and slow Sedna's spin. As a result of this interpretation, artist's concepts released when Sedna's discovery was announced showed a companion moon. One month later, images taken by NASA's Hubble Space Telescope demonstrated that no large moon existed.

In true detective fashion, Gaudi and his colleagues re-investigated the matter by observing Sedna using the new MegaCam instrument on the 6.5-meter-diameter MMT Telescope at Mount Hopkins, AZ. They measured Sedna's brightness looking for telltale, periodic brightening and dimming that would show how fast Sedna rotates.

As noted by Matthew Holman, one of the members of the team, "*The variation in Sedna's brightness is quite small and could have been easily overlooked*." Their data fits a computer model in which Sedna rotates once every 10 hours or so. The team's measurements definitively rule out a rotation period shorter than 5 hours or longer than 10 days. While these data solve one mystery of Sedna, other mysteries remain. Chief among them is the question of how Sedna arrived in its highly elliptical, eons-long orbit. "*Theorists are working hard to try to figure out where Sedna came from*," said Gaudi. Astronomers will continue to study this strange world for some time to come. "*This is a completely unique object in our solar system, so anything we can learn about it will be helpful in understanding its origin*," said Stanek. This research has been posted online at http://arxiv.org/abs/astro-ph/-0503673 High-res artwork at: http://www.cfa.harvard.edu/pre-ss/pr0510image.html

SEDNA REVEALS PRISTINE SURFACE IN GEMINI NEAR-INFRARED SPECTRA

Sedna was discovered on November 14, 2003 using the 48-inch Samuel Oschin Telescope at Palomar Observatory. The object lies more than 8 billion miles from the Earth, making it the most distant object ever observed in the solar system. Its official IAU provisional designation was minor planet 2003 VB12, but as of September 28, 2004 it officially became known as Sedna after the Inuit goddess of arctic sea life. Recent spectroscopic studies of infrared light reflected from the surface of Sedna reveal that it is probably unlike Pluto and Charon since Sedna's surface does not display evidence for a large amount of either water or methane ice. Due to Sedna's extreme distance from the Sun, the frigid surface has probably been untouched for millions of years by anything except cosmic rays and solar ultraviolet radiation.

Gemini Observatory astronomer Chad Trujillo led an effort by the same CalTech research team responsible for Sedna's original discovery to obtain spectra of this distant planetoid using the Near Infrared Imager (NIRI) on Gemini North. Their aim was to better understand the surface of this distant world and how it has evolved since its formation. "*It is likely that Sedna has experienced an extremely isolated life in the outskirts of our solar system*," said Trujillo. "*Out there beyond what we used to think was the edge of the solar system, interactions or collisions between bodies are probably very rare. Our observations confirm what you would expect from a surface that has been so far out in our solar system for such a long time and exposed to space weathering*." The Sedna data lack the strong spectral lines that would indicate the existence of substances like methane and water ice, but deeper studies are needed to confirm how low the levels of these ices might be on this planetoid. Sedna might be more like the minor planet Pholus (that lies just inside the orbit of Saturn), which is similar in its redness in visible light. This same "space weathering" may also affect Pluto and Charon, but there may be other processes that replenish their water- and methane-rich surfaces, such as atmospheric effects, geological processes and collisions.

The data could reveal something of Sedna's evolutionary history in the outer solar system. Astronomers think that objects like Sedna start out with icy surfaces. Over time cosmic rays and solar ultraviolet radiation "bake and burn" the surfaces into black hydrocarbon-rich substances similar to asphalt, which do not reveal themselves well in infrared spectra. Such a history might explain why Sedna doesn't exhibit traces of methane and water ice, whereas Pluto and Charon do. "*Like a sandblaster operating for several billion years, most of the objects out as far as Pluto are constantly being resurfaced by impacts and collisions which*

expose and supply fresh surface materials before the black stuff can get baked on," said Michael Brown of the team that originally discovered Sedna. "*Pluto and its moon Charon provide an excellent example of this process, with Pluto displaying a strong methane ice signature in its spectrum and Charon dominated by water ice*." The team does not rule out the possibility that longer-duration (deeper) observations might reveal evidence of methane or water ice on Sedna. However, the Gemini data indicate that if they do exist their extent is limited.

Gemini Observations of Sedna

The Gemini observations of Sedna were possible due to the observatory's powerful ability to collect infrared radiation reflected from the planetoid (which lies over 12 light-hours from Earth). The research team used NIRI (Near Infrared Imager) on Gemini North to obtain the spectra over a period of about two hours on the night of December 27, 2003. The infrared light captured by Gemini is really "recycled" starlight from the Sun, which at Sedna's distance would appear more like a very bright nighttime star. Just as some of the sunlight striking this object is reflected back as optical light (which allowed its discovery), some of the infrared light is also reflected back. Materials on the surface imprint a characteristic fingerprint on the re-emitted light, which can reveal details about the composition of the planetoid's surface.
http://www.gemini.edu/index.ph-p?option=content&task=view&id=-126

STUDY FINDS EARTH'S AURORAS ARE NOT MIRROR IMAGES

Scientists looking at the Earth's northern and southern auroras were surprised to find they are not mirror images of each other, as was once thought. The main cause behind the differences appears to be the interaction between the Sun's outer atmosphere and the Earth's magnetic field. Analysis of the images from NASA's Polar spacecraft and the Imager for Magnetopause-to-Aurora Global Exploration (IMAGE) spacecraft showed how the auroras move and change, based on the "tilt" of the Earth's magnetic field toward the Sun and conditions in the solar wind. By knowing how auroras react to the solar wind, scientists can better determine the impacts of space weather in the future. The new discovery shows that auroras may be more complicated than previously thought. The aurora form near-circular bands around both the northern and southern poles of the Earth, known as the auroral ovals. These phenomena also are known as the aurora borealis, or northern lights, and the aurora australis, or southern lights. It was expected that the auroral ovals would be mirror images of each other.

"*This is the first analysis to use simultaneous observations of the whole aurora in* both the Northern and Southern Hemispheres to track their locations," said lead author Timothy J. Stubbs. The Sun's outer atmosphere is an extremely thin electrified gas, or "plasma," better known as the "solar wind," since it blows constantly out from the Sun at around 250 miles per second. The Earth's magnetic field provides an obstacle in the solar wind flow and becomes compressed into an extended teardrop-shaped bubble known as the "magnetosphere." The magnetosphere protects the Earth by shielding it from the solar wind. However, under certain conditions charged particles from the solar wind are able to penetrate this magnetic shield and become energized. Collisions between these charged particles and the Earth's upper atmosphere emit light which we observe as an "aurora."

Stubbs and his colleagues used data from the two spacecraft to study the auroras. By luck the orbits of Polar and IMAGE were aligned so the entire auroral ovals in both hemispheres could be observed simultaneously in detail. Stubbs and his colleagues noted four important items in their study of auroras observed in October 2002. As predicted, they observed the auroral ovals shift in opposite directions to each other depending on the orientation of the Interplanetary Magnetic Field (IMF). The IMF is the Sun's magnetic field that travels out into space with the solar wind. They noted the auroral ovals also shift in opposite directions to each other depending on how far the Earth's northern magnetic pole is leaning toward the Sun (known as the "dipole tilt angle"). Following a change in the orientation of the IMF, they observed the southern auroral oval shift toward the Sun while the northern auroral oval remained in about the same location. The scientists believe the southern aurora moved because the solar wind was able to penetrate into the magnetosphere in the southern hemisphere, but not in the northern hemisphere. What was most surprising was that both the northern and southern auroral ovals were leaning toward the dawn (morning) side of the Earth for this event. The scientists suspect the leaning may be related to "imperfections" of the Earth's magnetic field. The Earth has a similar type of magnetic field to that which occurs around a simple bar magnet, which causes iron filings to arrange themselves in loops around it. "*Because Earth's magnetic field is not a perfect dipole, we think this fact plays some role in causing the auroras to not be mirror images of each other*," Stubbs said. For more information and images related to this story on the Internet, visit: http://www.nasa.gov/vision/ear-th/lookingatearth/dueling_auro-ras.html

EXPLOSIONS IN SPACE MAY HAVE INITIATED ANCIENT EXTINCTION ON EARTH

Scientists say that a mass extinction on Earth hundreds of millions of years ago could have been triggered by a star explosion called a gamma-ray burst. The scientists do not have direct evidence that such a burst activated the ancient extinction. The strength of their work is their atmospheric modeling -- essentially a "what if" scenario. The scientists calculated that gamma-ray radiation from a relatively nearby star explosion, hitting the Earth for only ten seconds, could deplete up to half of the atmosphere's protective ozone layer. Recovery could take at least five years. With the ozone layer damaged, ultraviolet radiation from the Sun could kill much of the life on land and near the surface of oceans and lakes, and disrupt the food chain.

Gamma-ray bursts in our Milky Way galaxy are indeed rare, but the scientists estimate that at least one nearby likely hit the Earth in the past billion years. Life on Earth is thought to have appeared at least 3.5 billion years ago. This research, supported by a NASA astrobiology grant, represents a thorough analysis of the "mass extinction" hypothesis first announced by members of this science team in September 2003. "*A gamma-ray burst originating within 6,000 light years from Earth would have a devastating effect on life*," said Dr. Adrian Melott. "*We don't know exactly when one came, but we're rather sure it did come -- and left its mark. What's most surprising is that just a 10-second burst can cause years of devastating ozone damage*," Melott added. Gamma-ray bursts are the most powerful explosions known. Most originate in distant galaxies, and a large percentage likely arise from explosions of stars over 15 times more massive than our Sun. A burst creates two oppositely-directed beams of gamma rays that race off into space. Thomas says that a gamma-ray burst may have caused the Ordovician extinction 450 million years ago, killing 60 percent of all marine invertebrates. Life was largely confined to the sea, although there is evidence of primitive land plants during this period

In the new work, the team used detailed computer models to calculate the effects of a nearby gamma-ray burst on the atmosphere and the consequences for life. Thomas, with Dr. Charles Jackman, calculated the effect of a nearby gamma-ray burst on the Earth's atmosphere. Gamma- rays, a high-energy form of light, can break molecular nitrogen (N2) into nitrogen atoms, which react with molecular oxygen (O2) to form nitric oxide (NO). NO will destroy ozone (O3) and produce nitrogen dioxide (NO2). NO2 will then react with atomic oxygen to reform NO. More NO means more ozone destruction. Computer models show that up to half the ozone layer is destroyed within weeks. Five years on, at least 10 percent is still destroyed. Next researchers calculated the effect of ultraviolet radiation on life. Deep-sea creatures living several feet below water would be protected. Surface-dwelling plankton and other life near the surface, however, would not survive. Plankton is the foundation of the marine food chain.

Dr. Bruce Lieberman, a paleontologist, originated the idea that a gamma-ray burst specifically could have caused the great Ordovician extinction, 200 million years before the dinosaurs. An ice age is thought to have caused this extinction. However, gamma-ray burst could have caused a fast die-out early on and also could have triggered the significant drop in surface temperature on Earth. "*One unknown variable is the rate of local gamma-ray bursts*," Thomas said. "*The bursts we detect today originated far away billions of years ago, before the Earth formed. Among the billions of stars in our Galaxy, there's a good chance that a massive one relatively nearby exploded and sent gamma rays our way*," he added. The Swift mission, launched in November 2004, will help determine recent burst rates. For images, movies, and more information via the Internet: http://www.nasa.gov/vision/uni-verse/starsgalaxies/gammaray_e-xtinction

ORGANIC MATERIALS SPOTTED HIGH ABOVE TITAN'S SURFACE

During its closest flyby of Saturn's moon Titan on April 16, the Cassini spacecraft came within 1,027 kilometers (638 miles) of the moon's surface and found that the outer layer of the thick, hazy atmosphere is brimming with complex hydrocarbons.

Scientists believe that Titan's atmosphere may be a laboratory for studying the organic chemistry that preceded life and provided the building blocks for life on Earth. The role of the upper atmosphere in this organic "factory" of hydrocarbons is very intriguing to scientists, especially given the large number of different hydrocarbons detected by Cassini during the flyby.

Cassini's ion and neutral mass spectrometer detects charged and neutral particles in the atmosphere. It provides scientists with valuable information from which to infer the structure, dynamics and history of Titan's atmosphere. Complex mixtures of hydrocarbons and carbon-nitrogen compounds were seen throughout the range of masses measured by the Cassini ion and neutral mass spectrometer instrument.

"*We are beginning to appreciate the role of the upper atmosphere in the complex carbon cycle that occurs on Titan*," said Dr. Hunter Waite, principal investigator of the Cassini ion and neutral mass spectrometer. "*Ultimately, this information from the Saturn system will help us determine the origins of organic matter within the entire solar system*."

Hydrocarbons containing as many as seven carbon atoms were observed, as well as nitrogen-containing hydrocarbons (nitriles). Titan's atmosphere is composed primarily of nitrogen, followed by methane, the simplest hydrocarbon. The nitrogen and methane are expected to form complex hydrocarbons in a process induced by sunlight or energetic particles from Saturn's magnetosphere. However, it is surprising to find the plethora of complex hydrocarbon molecules in the upper reaches of the atmosphere. Titan is very cold, and complex hydrocarbons would be expected to condense and rain down to the surface.

"*Biology on Earth is the primary source of organic production we are familiar with, but the key question is: what is the ultimate source of the organics in the solar system?"* added Waite.

Interstellar clouds produce abundant quantities of organics, which are best viewed as the dust and grains incorporated in comets. This material may have been the source of early organic compounds on Earth from which life formed. Atmospheres of planets and their satellites in the outer solar system, while containing methane and molecular nitrogen, are largely devoid of oxygen. In this non-oxidizing environment under the action of ultraviolet light from the Sun or energetic particle radiation (from Saturn's magnetosphere in this case), these atmospheres can also produce large quantities of organics, and Titan is the prime example in our solar system. This same process is a possible pathway for formation of complex hydrocarbons on early Earth.

This was Cassini's sixth flyby of Titan, but its exploration has just begun. Thirty-nine more flybys of this strange, remote world are planned during Cassini's nominal mission. The next Titan flyby is August 22. The latest images from the Titan flyby are available at: http://saturn.jpl.nasa.gov and http://www.nasa.gov/cassini

FROM THE EDITOR'S TERMINAL

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

The Star Gazer
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In April's Stargazer:

The next EAS Meeting is 4:00 P.M. Saturday, April 30th at the Everett Public Library Auditorium.