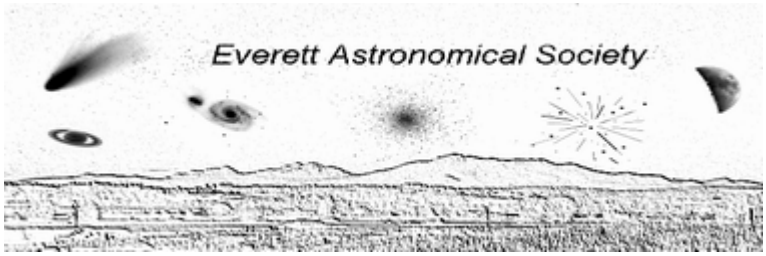
Volume MMV. No. 10



The Stargazer

October 2005

President: Mark Folkerts	(425) 486-9733	folkerts at seanet.com	***The Stargazer***
VP & Librarian: Mike Locke	(425) 259-5995	mlocke at lionmts.com	**P.O. Box 12746**
Treasurer: Carol Gore	(360) 856-5135	janeway7C at aol.com	**Everett, WA 98206**
Newsletter co-editor: Bill O'Neil	(774) 253-0747	wonastrn at seanet.com	
Web assistance: Cody Gibson	(425) 348-1608	sircody01 at comcast.net	*See EAS website at:*
		(change 'at' to @ to send email)	http://members.tripod.com/everett_astronomy

EAS BUSINESS…

NEXT EAS MEETING - SATURDAY OCTOBER 29TH AT 3:00 PM AT THE EVERETT PUBLIC LIBRARY, IN THE AUDITORIUM (DOWNSTAIRS)

October 29th - EAS Meeting – Saturday 3:00 PM - Dr. Paula Szkody from UW Astronomy will discuss recent findings about "Cataclysmic Variables: Insights from HST, FUSE, Chandra and SDSS" Don't miss it !

November 19th - EAS Meeting – Saturday 3:00 PM
Curtis Snow – Mars Society 'Changes in perspective / "discoveries" from our recent exploration of Mars'

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

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

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

2702 Hoyt Avenue
Everett, WA 98201

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

CLUB STAR PARTY INFO

Upcoming star party schedule - Winding down for the winter.

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

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

$$ - FINANCIAL HEALTH - $$

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

CLUB SCOPES

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

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

ASTRO CALENDAR FOR 2005

October 2005

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

November 2005

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

December 2005

Dec 02 - 10th anniversary (1995), SOHO Launch
Dec 12 - Moon occults Mars
Dec 12 - Mercury at its Greatest Western Elongation (21 Degrees)
Dec 13 - Geminids meteor shower peak
Dec 21 - Winter Solstice, 18:35 UT
Dec 22 - Ursids meteor shower peak
Dec 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 about 6:05 pm. The short 2 minute radio show deals with current topics of interest in astronomy. The University of Washington TV broadcasts programs from NASA at 12:00 AM Monday through Friday, 12:30 AM Saturday, and 1:30 AM Sunday on the Channel 27 cable station.

EAS Library – Book & Video List

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

MEMBERSHIP BENEFITS & INFORMATION

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

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

EAS is a member of the **Astronomical League** and you will receive the Astronomical League's newsletter, ***The Reflector***. Being a member also allows you the use of the club's telescopes, an award winning 10 inch Dobsonian mount reflector. Contact Mike Locke (425) 259-5995 to borrow a telescope. EAS dues are $25.

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

OBSERVER'S INFORMATION…

Lunar Facts

Oct 17	Full Moon
Oct 25	Last Quarter Moon
Nov 02	New Moon
Nov 09	First Quarter Moon
Nov 16	Full Moon
Nov 23	Last Quarter Moon
Dec 01	New Moon
Dec 08	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

Object	Rises	Transits	Sets	Con	Mag
Sun	**7:44 am**	**13:02**	**18:01**	**Vir**	**-27**
Mercury	Daylight	Daylight	**18:41**	Vir	-1.5
Venus	Daylight	Daylight	**19:57**	**Oph**	**-4.3**
Mars	**18:35**	**1:58 am**	Daylight	**Ari**	**-2.2**
Jupiter	Daylight	Daylight	Daylight	Vir	-1.7
Saturn	**0:15 am**	**7:41 am**	Daylight	**Can**	**+0.3**
Uranus	Daylight	**21:22**	**2:46 am**	**Aqr**	**+5.8**
Neptune	Daylight	**19:56 am**	**0:47 am**	**Cap**	**+7.8**
Pluto	Daylight	Daylight	**21:08**	**Ser**	**+13.8**

(times local time for Everett PDT)

Transit times for Jupiter's Great Red Spot in 2005

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

NOAA Sun Calculator

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

International Space Station – Visible Seattle Passes

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

Member News

Seattle Astro Society Trying To Get a Dark Sky Site

"We feel that we need to raise $25,000 in order to buy something appropriate on the other side of the mountains. We are making good progress within SAS. The deal basically is $250 for dark sky membership, and some relatively nominal sum for annual dark sky dues. One would have to be a SAS member to do this, but that is a rather nominal charge. We were wondering if anyone in your club would be interested in taking part. I personally think that the dark sky site is a necessary thing for SAS to do; otherwise, the club really has little tangible to offer its members. With a dark sky site, even city-bound members would have a place within a few hours where they could view from a dark site; even us suburban folks would benefit, I think. Thanks for your consideration."
-- Mark de Regt, SAS.

Constellations of the Month: Fornax and Reticulum

Fornax, Reticulum: As the October-November skies begin to more steadily cloud up, it would be interesting perhaps to broaden our "constellation horizons" by learning a little bit about two constellations (which both have late Fall midnight culmination

dates) that are not completely visible, or visible at all, from our latitude.

Fornax: "The Laboratory Furnace" as this constellation is also known, borders on the constellations of Cetus, Eridanus, Phoenix, and Sculptor. It ranks 87th (next to last, or the second dimmest) in overall brightness among the constellations, containing 12 stars brighter than magnitude 5.5. Its central point is located at RA=2h46m and Dec.= -32 degrees. It is completely visible from latitudes South of + 50 degrees, and completely invisible from latitudes North of +64 degrees. This constellation ranks 41st in overall size, taking up 397.50 square degrees, or 0.964% of the sky. Fornax has no known meteor showers and no Messier objects; it also has no associated asterisms. Its midnight culmination date is November 2nd, and its solar conjunction date is May 4th. Fornax is one of 14 constellations invented by Lacaille while at the Cape of Good Hope in 1751-2.

Most of the celestial objects found in Fornax are galaxies, and most of them are faint. However, if they can be viewed from one's latitude and with adequate amateur telescopic equipment, many of them are beautiful. One of the most beautiful is NGC-1097, a 9.3' x 6.6' barred spiral with a magnitude of 9.3. Being fairly bright and nearly face-on, NGC-1097 is one of the best barred spirals in the sky. With an eyepiece that gives a magnification of approximately 12x per aperture inch, a small telescope should show a bright and round nucleus which is encircled by an oval-shaped, somewhat fainter nebulosity. The "bar", which should be visible in 6-inch scopes with good seeing, is a relatively brighter strip of nebulosity running through this fainter oval halo. Larger scopes may show faint, semi-circular extensions on each of the bar's ends, and these extensions denote light from the galaxy's spiral arms. Slightly northwest of the northern spiral arm of NGC-1097 lies NGC-1097A, a 13th-magnitude elliptical galaxy. A very interesting globular cluster (magnitude = 13, with a 24" diameter) is known as NGC-1049, and is actually a huge globular cluster positioned about 170 kiloparsecs away in the Fornax dwarf galaxy, one of the Local Group galaxies. The Fornax dwarf galaxy itself was discovered in 1938, and is one of several, very small elliptical galaxies scattered throughout the Local Group. The Fornax dwarf galaxy is one of the smallest galaxies known (only 2 kiloparsecs across), and contains only about 50 times as much mass as a representative Milky Way globular cluster. Interestingly enough, NGC-1049 is easier to view by amateur scopes than is the Fornax dwarf galaxy itself. Fornax also contains a bona-fide galaxy cluster, called (cleverly enough!!) the Fornax Galaxy Cluster; this group contains eighteen bright and at least 10 faint galaxies, all of which are compacted into about a six-degree diameter circle. Most of the cluster members lie between 20 and 25 megaparsecs away. These cluster galaxies include NGC-1380 (lenticular galaxy of magnitude 11.1, which itself is surrounded by many other fainter cluster members in a single one-degree field); NGC-1365 (magnitude 9.5, large face-on barred spiral); NGC-1427 (12.2 magnitude elliptical); and NGC-1316 (bright peculiar barred spiral, and a very dusty galaxy with a bright nucleus that is also a strong radio source: it is designated radio source Fornax-A). Also within the confines of the constellation Fornax are NGC-1406 (magnitude 12.6 spiral), NGC-1255 (11.1 magnitude spiral), NGC-1371 (11.5 magnitude barred spiral), NGC-1385 (magnitude 11.2 spiral), and NGC-1398 (a fairly bright barred spiral). Fornax also contains one of the southern sky's best planetary nebulae, NGC-1360. NGC-1360 has a very high surface brightness, with an estimated magnitude of 8.0 and a central star of approximately 12th magnitude, and measures 6.5 arc-minutes across.

Reticulum (the Net (no, not that 'net'!!)) borders on the constellations of Dorado, Horologium, and Hydrus. It is 24th in overall brightness, and ranks 82nd in size, and has 11 stars with a magnitude greater than 5.5. Its central point is at RA=3h54m, and its Dec. = -60 degrees, and is completely visible from latitudes S of +23, and completely invisible from latitudes N of +37 degrees. It has no associated Messier objects, and no associated meteor showers. Its midnight culmination date is November 19th. The star Zeta Reticuli was the subject of one of the most famous and much publicized "UFO incidents", when, in 1961, Betty and Barney Hill from New Hampshire claimed they were abducted by aliens who showed Mrs. Hill a star map. The area described by the map, upon further study, described an area near the double star system of Zeta Reticuli. All three of these constellations are among the 14 constellations that Lacaille devised while at the Cape of Good Hope in 1751-2. Reticulum also contains many lesser known double, multiple, and variable stars, as well as galaxies such as NGC-1313 (an S-B nuclear barred galaxy) and NGC-1543 (an E-0/S-0 12th magnitude galaxy).

YOUNG ASTRONOMER'S CORNER

FUN FACT: IT TAKES THE SUN'S LIGHT (I.E., HEAT AND ENERGY) APPROXIMATELY EIGHT (8) MINUTES TO REACH THE EARTH.

The SUN: The Sun is not just a uniform "ball of fire". It is a very interesting and variable structure. The nearest star to earth is the center of gravity of our solar system, and keeps the other planets in their orbits. It is a star that is very much still evolving, and is classified as a middle-aged star. Its light spectrum also classifies it as a relatively cooler yellow star (compared to hotter, and younger, blue or white stars), and although it contains mostly hydrogen and helium, it also contains ionized calcium and other metal lines in its spectrum (the chemical and physical analysis of its light). The sun generates its heat and light (i.e., its energy), by nuclear fusion of hydrogen in its core, and it is losing its mass (its substance) in the form of heat, light, and electromagnetic radiation, at the rate of 4,000,000 tons per second. Outside of the core, the sun has two other important zones that help to transport energy to its surface: the inner radiative zone, and the outer convective zone. The surface of the sun that we see (the photosphere) is the boundary between its inner layers and the transparent outer layers (corona); almost all of the energy given off by the sun into space is given off by the granular-appearing (mottled-looking) photosphere. The sun also rotates, faster at its equator, just like the earth. Above the photosphere is the chromosphere (where the temperature begins to rise greatly), and this region extends into the corona (the very high temperature, gas-like streamers that are visible during an eclipse around the disc of the sun), which extends millions of miles out from the sun into the interplanetary medium, where the solar wind carries heat, light, and elementary particles (some of which cause the "Northern Lights" (see below) when they hit the earth's atmosphere) to the farthest reaches of the solar system. The sun has a magnetic field, and sunspots (intense, localized and cooler portions of the magnetic fields) within the photosphere. The age of the sun is 4.6 billion years, and after the same amount of time, it will become a "red giant", and then a "white dwarf" before it dies. The sun is not just a "ball of fire"; it is much more interesting than that!

The "Northern Lights" or aurora borealis (there are also "Southern Lights" or aurora australis) is a display of diffuse, changing colored light (usually varying hues of blue, green, or red, but it can also be whitish and yellowish in color) seen very high (about 60 miles up) in the Earth's atmosphere, **usually** in the regions of the poles. They can appear in spectacular formations, such as

streamers or curtains. These lights form around two irregular, changing ovals which are centered on the Earth's magnetic poles; these ovals get bigger (and dip more south, as they did recently) during periods of high solar activity. Aurora are caused by charged particles from the solar wind (the flow of energetic charged particles (like protons and electrons) from the solar corona) and solar flares (explosive releases of particle and radiation from the upper solar chromosphere and inner corona) which carries energy that becomes trapped in the Earth's magnetic sphere; beams of charged particles are then focused into the upper atmosphere. These beams are then sent spiraling along Earth's magnetic field lines toward the two poles. Here these charged particles interact with atoms and molecules in the Earth's atmosphere to produce the beautiful displays that we frequently see on Earth, especially and usually (but not always) at higher latitudes.

ASTRONOMY AND TELESCOPE LINGO

ASTRONOMY LINGO: IMMERSION: The entry of a celestial body into a state of invisibility during an eclipse or occultation.

TELESCOPE LINGO: SMTO: Abbreviation for: Submillimeter Telescope Observatory. This observatory is a joint facility of the University of Arizona's Steward Observatory and the Max-Planck Institute for Radioastronomy in Bonn, Germany. The SMTO is located on Arizona's Mount Graham at an altitude of 3186 feet; it houses the Heinrich-Hertz Submillimeter Telescope, a 10-meter dish with a surface accuracy of 12 micrometers.

PLANETARY FOCUS

Planetary Focus will return next month.

ASTRONOMY FUN FACTS

★★ The variable star Eta Carinae was bright for over 100 years before it flashed its record brilliance in 1843. The 1843 Eta Carinae star flash has been estimated at several million times more luminous than the Sun, making Eta Carinae the most brilliant and luminous star ever recorded. At this luminosity, it could have been observed with a powerful telescope (such as the 200-inch Mount Palomar reflector) from over 450 million light years away!!!

★★ Vesta, the 4th asteroid to be discovered (in 1807), is the brightest of all the asteroids. This is true probably for two reasons: it is relatively large (about 450 kilometers across), and it is highly reflective (it is probably composed of basaltic minerals). Sometimes, Vesta can be seen with the naked eye as a faint speck of light. The darkest or blackest asteroid known is 324 Bamberga, which is nearly as dark as the soot from your fireplace!!

★★ Van Biesbroeck's star, a cool M-class star about 20 light-years away, is a red dwarf. It is almost 600,000 times dimmer than the Sun. If it were in the same physical position as the Sun, it would shine only a bit brighter than a full Moon. At its actual location, this star is invisible to the naked eye: to see van Biesbroeck's star from Earth would be like seeing a 60-watt light bulb at a distance of 34,000 miles!!!!

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: LUMINOUS BLUE VARIABLES (LBVs): A class of very massive luminous blue stars well-known for sporadic mass ejections; sub-classes of these objects include P-Cygni Stars and Hubble-Sandage variables. These stars are generally found near the upper luminosity limit in the observed H-R diagram; most are thought to have evolved from stars with initial masses greater than 40 solar masses. The mass ejections detected in these objects are thought to be due to instabilities in their stellar envelopes induced by radiation pressure. LBV's show different types of variations with a wide range of time scales. The largest are correlated with sudden brightenings by more than 3 magnitudes lasting for several hundred to several thousand years. The smallest, which are less than 0.5 magnitude, last several months to several years.

REPRESENTATIVE NORTHERN HEMISPHERE OBJECT: P-Cygni: A massive LBV lying about 2,000 parsecs away in the constellation of Cygnus. It has undergone random outbursts in the past (in 1600 and 1653 it considerably brightened then faded); since 1700 its brightness has gradually increased. P-Cygni is also an ultraviolet source: it is however gradually cooling, and the U-V brightness is diminishing as the visual brightness is increasing.

REPRESENTATIVE SOUTHERN HEMISPHERE OBJECT: Eta Carinae: Among the most luminous and unstable stars in the entire Milky Way Galaxy, this LBV lies at a distance of 2,000 parsecs in the southern constellation of Carina. It undergoes large variations in magnitude at very irregular periods. From 1835-45 it was brighter than every star except Sirius, reaching a magnitude as bright as –0.8; since 1880, the magnitude range has been between 5.9 to 7.9. Eta Carinae is surrounded by a shell of cool dust that is thought to have contributed to its decreased light output after about 1843 since that dust was ejected; the dust obscures the light output of the star, (which may very well have remained constant), and the dust converts the light to infrared energy. The total luminosity of this star is about 5,000,000 (yes, 5 million!!) times that of the Sun, and its mass is about 120 times that of the Sun. A small nebula of ejected gas that surrounds it contains a very high proportion of nitrogen, indicating that substantial nucleosynthesis has taken place.

ASTRONOMICAL NOTES -- ON & OFF THE NET…

MARS LOOMS BIG AND BRIGHT AS IT SWINGS CLOSE TO EARTH

Look east late these evenings and you'll see a big, fiery yellow "star" shining much brighter than any other. This is the planet Mars, and it's passing unusually close to Earth during late October and early November 2005. Anyone can see it -- no matter how little you know about the stars or how badly light-polluted your sky may be. During mid- to late October, look for Mars glaring low in the east after 8 p.m. local daylight-saving time. In November, it's there in view as early as 6 p.m. standard time. Later in the evening, Mars climbs higher into better view and shifts over to the southeast. There's nothing else nearly as bright that you can confuse it with. Mars will be closest to Earth on the night of October 29-30, passing 43.1 million miles (69.4 million kilometers) from our planet around 11:25 p.m. on the 29th

Eastern Daylight Time. However, Mars will look just about as big and brilliant for a couple of weeks before and after that date. Mars is at opposition (opposite the Sun in our sky) on November 7th. This means it rises at sunset, is up all night, and sets at sunrise. This is the nearest that Mars has come since its record-breaking close approach in August 2003. At that time it passed by at a distance of only 34.7 million miles (55.8 million kilometers), the closest it had come in nearly 60,000 years. But for amateur telescope users, now is still a very special time. The planet will reach an apparent diameter of 20.2 arcseconds (the angular size of a penny seen at a distance of 620 feet), offering an usually detailed view of its surface. That compares with 25.1 arcseconds in August 2003 (the angular size of a penny at 500 feet), and only 15.9 arcseconds at Mars's next swing-by, in December 2007 (a penny at 800 feet). In fact, not until the summer of 2018 will Mars again come as close to Earth as it is right now (this statement remains true until mid-November). Moreover, this year skywatchers at the latitudes of North America and Europe have a big advantage they didn't have in 2003. That year Mars was far south in the sky and never got very high for telescope users at mid-northern latitudes. But this time Mars is farther north and rises higher during the night, affording a sharper, cleaner view in a telescope through Earth's blurry atmosphere.

Telescope Tips - Good as this fall's showing is, surface details on Mars are always a pretty tough target in a telescope. To begin with, Mars is only about half the size of Earth. Even at its closest, under high magnification it will appear as only a surprisingly small, bright ball with some subtle dark markings, possible white clouds around its edges, and perhaps a tiny remnant of the white South Polar Cap shrunken in the warmth of the Martian summer. The brightest yellow areas are deserts covered by fine, windblown dust. The darker markings are terrain displaying more areas of bare rock or darker sand and dust. Mars rotates every 24 1/2 hours, so you can see it turning in just an hour or two of watching. To see much detail on Mars, several things all have to be working in your favor. You'll need at least a moderately large telescope with high-quality optics. And you'll need to wait until Mars rises high in the sky, well above the thick, murky layers of Earth's atmosphere near the horizon. Moreover, the atmospheric "seeing" must be good. This is the astronomer's term for the constant fuzzing and shimmering of highly magnified telescopic images due to the tiny heat waves that are always rippling through the atmosphere. The seeing changes from night to night and sometimes from moment to moment. http://skyandtelescope.com/aboutsky/pressreleases/article_1613_1.asp
Mars: Which Side Is Visible? http://skyandtelescope.com/observing/objects/planets/article_997_1.asp

NEW MAP PROVIDES MORE EVIDENCE MARS ONCE LIKE EARTH

NASA scientists have discovered additional evidence that Mars once underwent plate tectonics, slow movement of the planet's crust, like the present-day Earth. A new map of Mars' magnetic field made by the Mars Global Surveyor spacecraft reveals a world whose history was shaped by great crustal plates being pulled apart or smashed together. Scientists first found evidence of plate tectonics on Mars in 1999. Those initial observations, also done with the Mars Global Surveyor's magnetometer, covered only one region in the Southern Hemisphere. The data was taken while the spacecraft performed an aerobraking maneuver, and so came from differing heights above the crust. This high resolution magnetic field map, the first of its kind, covers the entire surface of Mars. The new map is based on four years of data taken in a constant orbit. Each region on the surface has been sampled many times. "*The more measurements we obtain, the more accuracy, and spatial resolution, we achieve*," said Dr. Jack Connerney, co-investigator for the Mars Global Surveyor magnetic filed investigation.

"*This map lends support to and expands on the 1999 results*," said Dr. Norman Ness. "*Where the earlier data showed a "striping" of the magnetic field in one region, the new map finds striping elsewhere. More importantly, the new map shows evidence of features, transform faults, that are a "tell-tale" of plate tectonics on Earth*." Each stripe represents a magnetic field pointed in one direction_ -- positive or negative_ -- and the alternating stripes indicate a "flipping" of the direction of the magnetic field from one stripe to another. Scientists see similar stripes in the crustal magnetic field on Earth. Stripes form whenever two plates are being pushed apart by molten rock coming up from the mantle, such as along the Mid-Atlantic Ridge. As the plate spreads and cools, it becomes magnetized in the direction of the Earth's strong global field. Since Earth's global field changes direction a few times every million years, on average, a flow that cools in one period will be magnetized in a different direction than a later flow. As the new crust is pushed out and away from the ridge, stripes of alternating magnetic fields aligned with the ridge axis develop. Transform faults, identified by "shifts" in the magnetic pattern, occur only in association with spreading centers. To see this characteristic magnetic imprint on Mars indicates that it, too, had regions where new crust came up from the mantle and spread out across the surface. And when you have new crust coming up, you need old crust plunging back down_ -- the exact mechanism for plate tectonics. Connerney points out that plate tectonics provides a unifying framework to explain several Martian features. First, there is the magnetic pattern itself. Second, the Tharsis volcanoes lie along a straight line. These formations could have formed from the motion of a crustal plate over a fixed "hotspot" in the mantle below, just as the Hawaiian islands on Earth are thought to have formed. Third, the Valles Marineris, a large canyon six times as long as the Grand Canyon and eight times as deep, looks just like a rift formed on Earth by a plate being pulled apart. Even more, it is oriented just as one would expect from plate motions implied by the magnetic map. "*It's certainly not an exhaustive geologic analysis*," said Dr. Mario Acuña, principal investigator for the Mars Global Surveyor magnetic filed investigation at Goddard Space Flight Center. "*But plate tectonics does give us a consistent explanation of some of the most prominent features on Mars*." http://www.nasa.gov/centers/goddard/news/topstory/2005/mgs_plates.html

MARS' CLIMATE IN FLUX: MID-LATITUDE GLACIERS

New high-resolution images of mid-latitude Mars are revealing glacier-formed landscapes far from the Martian poles, says a leading Mars researcher. Conspicuous trains of debris in valleys, arcs of debris on steep slopes and other features far from the polar ice caps bear striking similarities to glacial landscapes of Earth, says Brown University's James Head III. When combined with the latest climate models and orbital calculation for Mars, the geological features make a compelling case for Mars having ongoing climate shifts that allow ice to leave the poles and accumulate at lower latitudes. "*The exciting thing is a real convergence of these things*," said Head. "*For decades people have been saying that deposits at mid and equatorial latitudes look like they are ice-created*," said Head. But without better images, elevation data and some way of explaining it, ice outside of Mars' polar regions was a hard sell. Now high-resolution images from the Mars Odyssey spacecraft's Thermal Emission Imaging System combined with images from the Mars Global Surveyor spacecraft's Mars Orbiter Camera and Mars Orbiter

Laser Altimeter can be compared directly with glacier features in mountain and polar regions of Earth. The likenesses are hard to ignore. For instance, consider what Head calls "lineated valley fill". These are lines of debris on valley floors that run downhill and parallel to the valley walls, as if they mark some sort of past flow. The same sorts of lines of debris are seen in aerial images of Earth glaciers. The difference is that on Mars the water ice sublimes away (goes directly from solid ice to gas, without any liquid phase between) and leaves the debris lines intact. On Earth the lines of debris are usually washed away as a glacier melts. The lines of debris on Mars continue down valleys and converges with other lines of debris -- again, just like what's seen on Earth where glaciers converge. "*There's so much topography and the debris is so thick (on Mars) that it's possible some of the ice might still be there*," said Head. The evidence for present day ice includes unusually degraded recent impact craters in these areas -- just what you'd expect to see if a lot of the material ejected from the impact was ice that quickly sublimed away.

Another peculiarly glacier-like feature seen in Martian mid-latitudes are concentric arcs of debris breaking away from steep mountain alcoves -- just as they do at the heads of glaciers on Earth. As for how ice could reach Mars lower latitudes, orbital calculations indicate that Mars may slowly wobble on its spin axis far more than Earth does (the Moon minimizes Earth's wobble). This means that as Mars' axis tilted to the extremes -- up to 60 degrees from the plane of Mars' orbit -- the Martian poles get a whole lot more sunshine in the summertime than they do now. That extra sun would likely sublime water from the polar ice caps, explains Head. "*When you do that you are mobilizing a lot of ice and redistributing it to the equator*," Head said. "*The climate models are saying it's possible*." It's pure chance that we happen to be exploring Mars when its axis is at a lesser, more Earth-like tilt. This has led to the false impression of Mars being a place that's geologically and climatically dead. In fact, says Head, Mars is turning out to be a place that is constantly changing.

MOON DISCOVERED ORBITING 10TH PLANET

New Class of Satellites Discovered - Scientists are over the moon at the Keck Observatory over a new discovery of a satellite orbiting the Solar System's 10th planet (2003 UB313). The newly discovered moon orbits the farthest object ever seen in the Solar System. The existence of the moon will help astronomers resolve the question of whether 2003 UB313, temporarily nicknamed "Xena," is more massive than Pluto and hence the 10th planet. "*We were surprised because this is a completely different type of satellite from anything we've seen before*," said Dr. Mike Brown, professor of Planetary Sciences. "*It is essentially a new class of satellites to large Kuiper Belt objects. It is tiny compared to the primary, and much fainter. We have never seen satellites like this before*." The newly discovered moon, which is 60 times fainter than its parent body, is affectionately called "Gabrielle" after the faithful traveling companion to Xena on the syndicated TV series. Future observations with the 10-meter Keck II telescope and the Hubble Space Telescope will determine the moon's orbital characteristics, which has an estimated period of about 14 days, and will therefore reveal the precise mass and density of Xena. "*What is interesting is that Xena, Pluto and Santa, three of the four largest objects in the Kuiper belt, all have moons*," said Dr. Marcos van Dam, adaptive optics scientist at the W. M. Keck Observatory and co-author on the paper describing the discovery. "*These moons suggest that these Kuiper belt objects may have formed differently than smaller objects in the same region*."

The moon circling Xena was first discovered with the Keck II telescope on September 10, 2005 (UT) using the Laser Guide Star Adaptive Optics system (LGS AO). Since 2003, this system has been providing very high spatial resolution imaging in the infrared comparable to that of visible light images from Hubble Space Telescope. With LGS AO, observers not only get higher resolution, but the light from distant objects is concentrated over a much smaller area on the instrument detector, making faint detections possible. The results are quickly advancing the understanding of binary Kuiper belt objects, a region in the Solar System beyond the orbit of Neptune.

The Keck LGS AO system has also been used to look at other recently discovered large bodies in the Kuiper belt. A small moon was found circling around 2003 EL61 (codenamed "Santa") but none was found orbiting 2005 FY9 ("Easterbunny"), the two largest known Kuiper belt objects after Xena and Pluto. "*When we test collision models to predict how Pluto and Charon formed, the models kept producing tiny satellites, much smaller than Charon*," added Brown "*But we had never seen satellites that small before in the Kuiper belt. But then we found a moon in the Santa system, and then we found another moon circling Xena, and they both look very similar to one another. This leads us to conclude that the largest objects in the Kuiper belt may have been subject to collisions*." Van Dam described the discovery: "*At first we saw this little faint thing that kept cropping up in all the images, and we knew it was not a background star or galaxy because it moved across the sky with the primary. We could also tell that it was not an image artifact because it did not rotate with the sky and was consistent in each of the 24 images. By morning we knew that we had made a major discovery*." The discovery of the moon's primary, Xena, was announced July 29th by planetary astronomers Mike Brown of Caltech, Chad Trujillo of Gemini Observatory and David Rabinowitz of Yale University. It is currently about 97 astronomical units from the Sun (an astronomical unit is the 93-million-mile distance between the Sun and Earth), and is larger than the size of Pluto. It takes 560 years to complete one trip around the Sun (versus 250 years for Pluto) and has a very steep angle in relation to the other planets, about 45 degrees off from the orbital plane of the other nine planets. Xena also has a very elliptical orbit, coming in as close as 3.5 billion miles (38 AU) and as far away as 9 billion miles. The names "Xena," "Gabrielle," "Santa" and "Easterbunny" are temporary nicknames until the International Astronomical Union (IAU) rules on their official names. The proposed names have been submitted to the IAU and will follow the mythological and spiritual traditions of Kuiper belt objects. Meanwhile, the IAU has stated it will not rule on a name until the IAU Working Group in charge of defining a planet determines a minimum size for a planet. Until then, the IAU considers all objects discovered in the outer solar system as "Trans-Neptunian" objects.

Adaptive Optics is a technique that corrects the effect of atmospheric blurring to produce images with a resolution comparable to what would be obtained from space. To measure atmospheric distortion, the adaptive optics system relies on a relatively bright guide star very close in the field of view to the scientific object of study. Since there was no naturally-occurring guide star sufficiently bright enough with which to study Xena, astronomers used the Keck Laser Guide Star system to create an artificial star instead.

METEORITES OFFER GLIMPSE OF THE EARLY EARTH

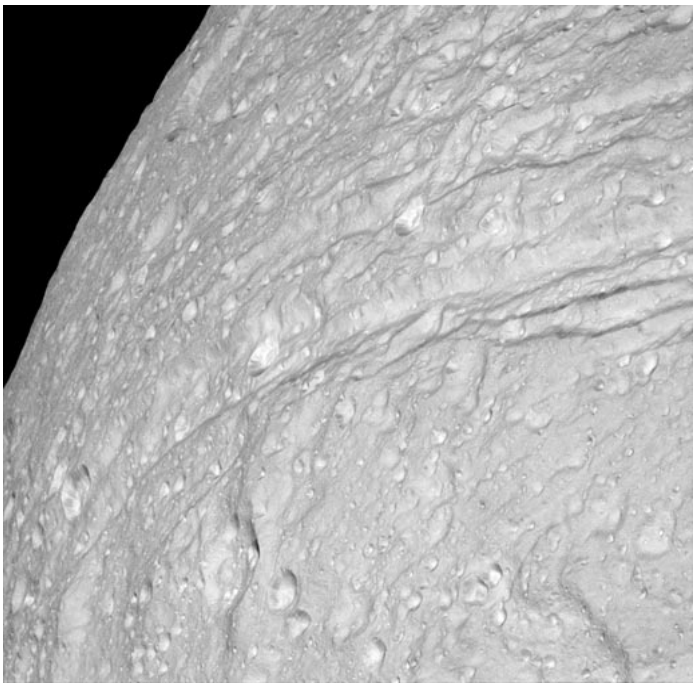
Important clues to the environment in which the early Earth formed may be emerging from scientists' recent study of a particular class of meteorites. By examining the chemistry of 29 chunks of rock that formed billions of years ago, probably in close proximity to our planet, two researchers, Michael E. Lipschutz and

Ming-Sheng Wang, have clarified our understanding of the conditions present in the vicinity of the ancient Earth's orbit. Because direct evidence for these conditions is lacking in terrestrial samples, the scientists believe that the composition of these so-called enstatite chondrite (EC) meteorites could offer a window into the planet's distant past. "*What happened to these rocks most likely happened to the Earth in its early stages - with one great exception*," said Lipschutz. "*Shortly after the early Earth formed, an object the size of Mars smashed into it, and the heat from the cataclysm irrevocably altered the geochemical makeup of our entire planet. These EC meteorites, however, are likely formed of matter similar to that which formed the early Earth, but they were not involved in this great collision and so were not chemically altered. They might be the last remaining pristine bits of the material that became the planet beneath our feet*." Lipschutz and Wang initially set out to increase our knowledge of EC meteorites, one of many different meteorite classes. Meteorites come from many different parts of the solar system, and a scientist can link one with its parent object by determining the different isotopes of oxygen in a meteorite's minerals. Chunks of the moon, the Earth and EC meteorites, for example, have very similar isotopic "signatures," quite different from those of Mars and other objects formed in the asteroid belt. The variations occurred because different materials condensed in different regions of the disk of gas and dust that formed the sun and planets. Bits of these materials orbit the sun, occasionally falling to earth as meteorites. But there is one place on our planet that meteorites accumulate and are preserved in a pristine fashion - the ice sheet of Antarctica. "*Over the millennia, many thousands of meteorites have struck the Antarctic ice sheet, which both preserves them and slowly concentrates them near mountains sticking through the ice, much as ocean waves wash pebbles to the shore*," said Lipschutz. "*These stones have come from many different parts of the solar system and have given us a better picture of the overall properties of their parent objects*."

By examining their mineralogy, scientists have determined that about 200 of these Antarctic stones are EC meteorites that formed from the same local batch of material as the Earth did more than 4.5 billion years ago. But there is additional information that the chemistry of these ECs can offer on the temperatures at which they formed. To obtain this information, however, required Lipschutz to analyze chemicals in the meteorites called volatiles - rare elements such as indium, thallium and cadmium. "*Volatiles in meteorites can give unique information on their temperature histories, but only 14 of them had ever been analyzed for these elements*," Lipschutz said. "*Naturally, we want to know the story behind the formation of objects in our own neighborhood, so we set out to increase that number*." In this study, the researchers gathered samples taken from another 15 EC meteorites that had, for the most part, landed in Antarctica tens of thousands of years ago. Using a unique method involving bombardment of the samples with neutrons, chemically separating the radioactive species and counting them, the researchers were able to determine the amounts of 15 volatiles that together offered clues to each rock's heating history. "*Volatiles can act like thermometers*," Lipschutz said. "*They can tell you whether the temperature was high or low when the rock formed. We tested two different kinds of ECs, and the oldest, most primitive examples of each kind had very similar volatile contents - which means their temperature at formation was similar. These rocks have essentially recorded the temperature at which the early Earth formed, and we now know that this was much lower than 500 degrees Celsius*." The two different kinds of EC meteorites, known as ELs and EHs, were found in the Purdue study to have condensed at low temperatures like the Earth. However, the two groups are controversial because scientists have not been able to agree on whether they originated from a single parent object or two different ones. Unfortunately, Lipschutz said, the data from the 29 ECs they analyzed were insufficient to settle the issue. "*There are still quite a few unanswered questions about the earliest periods of the Earth's history, and this study only provides one piece of the puzzle*," he said. "*But aspects of this study also show that ECs differ substantially from other meteorite types that came from much farther out in the disk, in the region of the asteroid belt*." For Lipschutz, who had an asteroid named for him on his 50th birthday in honor of his many studies of meteorites, their parent bodies and the early history of the solar system, deeper answers may lie farther away than Antarctica. "*If we understand how our solar system formed, we might be better able to understand the processes at work in other solar systems, which we are just beginning to discover*," he said. "*Probing the asteroid belt could give us clues to these processes*."

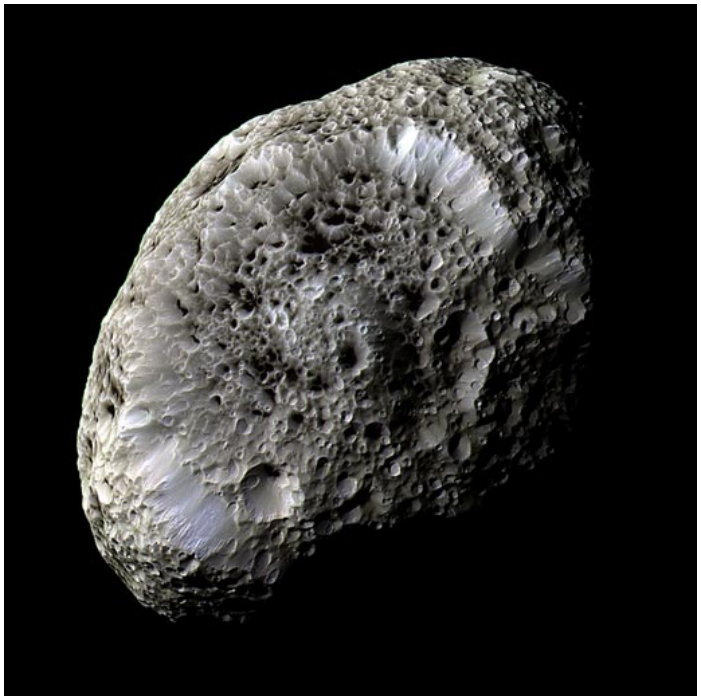
CASSINI'S DOUBLEHEADER FLYBYS SCORE HOME RUN

Cassini performed back-to-back flybys of Saturn moons Tethys and Hyperion last weekend, coming closer than ever before to each of them. Tethys has a scarred, ancient surface, while Hyperion is a strange, spongy-looking body with dark-floored craters that speckle its surface. Images of Tethys taken during Cassini's close approach to the moon on Sept. 24, 2005, reveal an icy land of steep cliffs and craters. Cassini photographed the moon's south pole, a region not seen by the Voyager spacecraft.



A giant rift called Ithaca Chasma cuts across the disk of Tethys. Much of the topography in this region, including that of Ithaca Chasma, has been thoroughly hammered by impacts. This appearance suggests that the event that created Ithaca Chasma happened very long ago. Near a prominent peaked crater named Telemachus are the remnants of a very old crater named Teiresias. The ancient impact site is badly overprinted and eroded by impact weathering and degradation. All that remains is a circular pattern of hummocks that mark where the old crater rim existed. Many of the fresh-appearing craters exhibit unusually bright crater floors, in contrast to the dark-floored craters seen on Saturn's oddly tumbling moon Hyperion.

Images of Hyperion taken on Sept. 26 show a surface dotted with craters and modified by some process, not yet understood, to create a strange, "spongy" appearance, unlike the surface of any other Saturn moon. A false-color image of Hyperion reveals crisp details and variations in color across the strange surface that might represent differences in the composition of materials. Hyperion has a notably reddish tint when viewed in natural color.



Scientists are extremely curious to learn what the dark material is that fills many craters on this moon. Features within the dark terrain, including a 200-meter-wide (650-feet) impact crater surrounded by rays and numerous bright-rimmed craters, indicate that the dark material may be only tens of meters thick with brighter material beneath. Scientists will also be examining Cassini's sharp views in hopes of determining whether there have been multiple episodes of landslides on Hyperion. Such "downslope" movement is evident in the filling of craters with debris and the near elimination of many craters along the steeper slopes. Answers to these questions may help solve the mystery of why this object has evolved different surface forms from other moons of Saturn. Cassini flew by Hyperion at a distance of only 500 kilometers (310 miles). Hyperion is 266 kilometers (165 miles) across, has an irregular shape, and spins in a chaotic rotation. Much of its interior is empty space, explaining why scientists call Hyperion a rubble-pile moon. This flyby was Cassini's only close encounter with Hyperion in the prime mission four-year tour. Over the next few months, scientists will study the data in more detail. Cassini flew by Tethys at a distance of approximately 1,500 kilometers (930 miles) above the surface. Tethys is 1,071 kilometers (665 miles) across and will be visited again by Cassini in the summer of 2007.

CRACKS OR CRYOVOLCANOES?
SURFACE GEOLOGY CREATES CLOUDS ON TITAN

Like the little engine that could, geologic activity on the surface of Saturn's moon Titan-maybe outgassing cracks and perhaps icy cryovolcanoes-is belching puffs of methane gas into the atmosphere of the moon, creating clouds. This is the conclusion of planetary astronomer Henry G. Roe, and Michael E. Brown, professor of planetary astronomy at Caltech. Roe, Brown, and their colleagues at Caltech and the Gemini Observatory in Hawaii based their analysis on new images of distinctive clouds that sporadically appear in the middle latitudes of the moon's southern hemisphere. The clouds provide the first explanation for a long-standing Titan mystery: From where does the atmosphere's copious methane gas keep coming? That methane is continuously destroyed by the sun's ultraviolet rays, in a process called photolysis. This photolysis forms the thick blanket of haze enveloping the moon, and should have removed all of Titan's atmospheric methane billions of years ago.

Clearly, something is replenishing the gas-and that something, say Roe and his colleagues, is geologic activity on the surface. "*This is the first strong evidence for currently active methane release from the surface*," Roe says. Adds Brown: "*For a long time we've wondered why there is methane in the atmosphere of Titan at all, and the answer is that it spews out of the surface. And what is tremendously exciting is that we can see it, from Earth; we see these big clouds coming from above these methane vents, or methane volcanoes. Everyone had thought that must have been the answer, but until now, no one had found the spewing gun*."

Roe, Brown, and their colleagues made the discovery using images obtained during the past two years by adaptive optics systems on the 10-meter telescope at the W. M. Keck Observatory on Mauna Kea in Hawaii and the neighboring 8-meter telescope at the Gemini North Observatory. Adaptive optics is a technique that removes the blurring of atmospheric turbulence, creating images as sharp as would be obtained from space-based telescopes. "*These results came about from a collaborative effort between two very large telescopes with adaptive optics capability, Gemini and Keck*," says astronomer Chadwick A. Trujillo. "*At both telescopes, the science data were collected from only about a half an hour of images taken over many nights. Only this unusual 'quick look' scheduling could have produced these unique results. At most telescopes, the whole night is given to a single observer, which could not have produced this science*."

The two telescopes observed Titan on 82 nights. On 15 nights, the images revealed distinctive bright clouds-two dozen in all-at midlatitudes in the southern hemisphere. The clouds usually popped up quickly, and generally had disappeared by the next day. "*We have several observations where on one night, we don't see a cloud, the next night we do, and the following night it is gone*," Roe says. Some of the clouds stretched as much as 2,000 km across the 5,150 km diameter moon. "*An equivalent cloud on Earth would cover from the east coast to the west coast of the United States*," Roe says. Although the precise altitude of the clouds is not known, they fall somewhere between 10 km and 35 km above the surface, within Titan's troposphere (most cloud activity on the earth is also within its troposphere).

Notably, all of the clouds were located within a relatively narrow band at around 40 degrees south latitude, and most were clustered tightly near 350 degrees west longitude. Both their sporadic appearance and their specific geographic location led the researchers to conclude that the clouds were not arising from the regular convective overturn of the atmosphere due to its heating by the sun (which produces the cloud cover across the moon's southern pole) but, rather, that some process on the surface was creating the clouds. "*If these clouds were due only to the global wind pattern, what we call general circulation, there's no reason the clouds should be linked to a single longitude. They'd be found in a band around the entire moon*," Roe says. Another possible explanation for the clouds' patchy formation is variation in the albedo, or brightness, of the surface. Darker surfaces absorb more sunlight than lighter ones. The air above

those warmer spots would be heated, then rise and form convective clouds, much like thunderstorms on a summer's day on Earth. Roe and his colleagues, however, found no differences in the brightness of the surface at 40 degrees south latitude. Clouds can also form over mountains when prevailing winds force air upward, but in that case the clouds should always appear in the identical locations. "*We see the clouds regularly appear in the same geographic region, but not always in the exact same location*," says Roe.

The other way to make a cloud on Titan is to raise the humidity by directly injecting methane into the atmosphere, and that, the scientists say, is the most likely explanation here. Exactly how the methane is being injected is still unknown. It may seep out of transient cracks on the surface, or bubble out during the eruption of icy cryovolcanoes. Although no such features have yet been observed on the moon, Roe and his colleagues believe they may be common. "*We think there are numerous sources all over the surface, of varying size, but most below the size that we could see with our instruments*," he says. One large feature near 350 degrees west longitude is probably creating the clump of clouds that forms in that region, while also humidifying the band at 40 degrees latitude, Roe says, "*so you end up creating areas where the humidity is elevated by injected methane, making it easier for another, smaller source to also generate clouds. They are like weather fronts that move through. So we are seeing weather, on another planet, with something other than water. With methane. That's cool. It's better than science fiction*."

STORMY WEATHER: TITAN'S ENIGMATIC CLOUD BAND IS CONVECTIVE

Scientists say that the peculiar clouds at middle latitudes in Titan's southern hemisphere may form in the *same way as distinct bands of clouds form at Earth's equator. "Titan's weather is very different from Earth's*," said Caitlin Griffith. "*If you walked past Titan's minus-40-degree-latitude line, you might be showered with liquid natural gas. If you decided to visit Titan's south pole, you might encounter a storm the size of a hurricane which also consists of methane, more commonly known as natural gas,"* Griffith said. "*Otherwise, don't expect clouds on Titan*."

Titan's weather forecast has remained the same for years, and that baffles scientists. They don't understand why clouds a thousand miles long stretch over the temperate latitude. "*Imagine how curious it would be if beyond Earth's poles, clouds existed only at the latitude that crosses New Zealand, Argentina and Chile*," Griffith said. "*Furthermore, Henry Roe and his colleagues find that most of these peculiar clouds bunch up at zero degrees and 90 degrees longitude, analogous to Earth longitudes southwest and southeast of the Cape of Good Hope*," she added.

The highly localized nature of the clouds suggests that they have something to do with Titan's surface, Griffith said. Scientists think ice volcanoes must be venting methane -- the gas that condenses as clouds -- into Titan's hazy, mostly nitrogen atmosphere. Otherwise, the moon's atmospheric methane would have vanished billions of years ago because methane is destroyed by ultraviolet sunlight.

Griffith, Paulo Penteado and Robert Kursinski studied the origin of the clouds by analyzing cloud height and thickness using images from Cassini's visual and infrared mapping spectrometer (VIMS). This instrument is among a suite of instruments on the Cassini spacecraft orbiting Saturn. It measures light at 256 different wavelengths. Griffith is a member of the VIMS team, headed by Robert Brown. Griffith and her colleagues analyzed images that gave them a 3-D view of the cloud and a six-frame movie that shows how it evolved over three hours.

"*The structure of the clouds turns out to be complicated*," Griffith said. "*We detected not one region, but many regions of cloud formation. Each long cloud consists of a number of vigorous storms where clouds rise to 40 kilometers altitude (25 miles) in a couple of hours and dissipate in the next half hour. The rate of cloud ascent and dissipation suggests that we are witnessing the formation of convective clouds, likely similar to thunderstorms, that disappear through rainfall*. "

"*Over the next several hours we see the clouds form long tails, indicating that strong westerly winds stretch out the clouds and carry the particles downwind a thousand kilometers (more than 600 miles). This detailed look into the structure of these clouds reveals that the clouds evolve from a number of small active cloud formation centers lined up like an uneven string of beads long 40 degrees south latitude. These localized storms cause a healthy rain, and very long clouds, once the wind has stretched them out.*"

Griffith argues that it's improbable that many ice volcanoes, all aligned at 40 degrees south latitude, are forming these clouds. In addition, the scientists estimate that the cloud activity at zero degrees longitude, if volcanic, does not appear to spew out enough methane to create the mid-latitude cloud band. Smaller clouds actually lie upwind of the main cloud at zero degrees longitude, they note. The team also conclude that the clouds aren't obviously caused by Saturn's tidal pull on Titan's atmosphere. They also don't find evidence that mountains and lakes might cause mountain clouds or marine clouds, Griffith said.

"*We believe that it's no coincidence that Titan's south polar cap of smog extends from the pole to 40 degrees south latitude -- exactly where the methane cloud band appears*," Griffith said. The researchers suggest that global circulation may cause the air to rise at this attitude on Titan, much as clouds form in a band around the Earth's equator and rain on the Caribbean islands. "*Such rising air would cut off air from the south polar region from mixing with the rest of the moon's atmosphere, causing smog to build up and form a cap over the pole*," Griffith added.

Theoretical modeling supports the team's conclusion, Griffith said. Pascal Ranou and his group in Paris studied Titan's circulation with an elaborate and complicated general circulation model. His model predicts that solar heating naturally creates rising air on Titan at 40 degrees south latitude. The next mystery is why Titan's southern mid-latitude clouds are bunched at zero degrees longitude. There's no evidence yet that volcanoes, mountain ranges or Saturn's tides are involved, Griffith said. "*What's causing the bunching is unclear, and likely involves unknown features on Titan's still largely unexplored surface*," Griffith said.

NEW ANALYSIS PUTS DARK MATTER BACK INTO ELLIPTICAL GALAXIES

According to the prevailing "cold dark matter" theory of the evolution of the universe, every galaxy is surrounded by a halo of dark matter that can only be detected indirectly by observing its gravitational effects. This theory faced a challenge in 2003, when a team of astronomers reported a surprising absence of dark matter in elliptical galaxies. But a new analysis published in the Sep 29 issue of the journal Nature provides an explanation for the earlier observations that fits comfortably with the standard theory and puts the dark matter back into elliptical galaxies.

"*These are very normal, nearby elliptical galaxies that they studied, and if those galaxies don't have dark matter it calls into question the whole theory of cold dark matter*," said Joel Primack,

a coauthor. "*A dearth of dark matter in elliptical galaxies is especially puzzling in the context of the standard theory of galaxy formation, which assumes that ellipticals originate from mergers of disk galaxies*," added Avishai Dekel. "*Massive dark matter halos are clearly detected in disk galaxies, so where did they disappear to during the mergers?"* said Dekel. Primack, one of the originators and developers of the cold dark matter theory, uses supercomputers to run simulations of galaxy formation and the evolution of structure in the universe. The new paper used simulations of galaxy mergers run last year by Thomas J. Cox, then a graduate student working with Primack at UCSC and now a postdoctoral researcher at Harvard University.

The simulations show that the observations reported in 2003 are a predictable consequence of the violent galactic mergers that give rise to elliptical galaxies, Primack said. The simulations were analyzed by Dekel, Felix Stoehr, and Gary Mamon. Graduate student Greg Novak also contributed to the analysis.

Elliptical galaxies are thought to form when two spiral galaxies collide and merge. Whereas spiral galaxies are dominated by flattened, rotating disks of stars and gas, elliptical galaxies are round, smooth collections of stars. Evidence for dark matter halos around spiral galaxies comes from studying the circular motions of stars in these galaxies. Because most of the visible mass in a galaxy is concentrated in the central region, stars at great distances from the center would be expected to move more slowly than stars closer in. Instead, careful observations of spiral galaxies show that the rotational speed of stars in the outskirts of the disk remains constant as far out as astronomers can measure it. The reason for this, according to cold dark matter theory, is the presence of an enormous halo of unseen dark matter surrounding the galaxy and exerting its gravitational influence on the stars. Additional support for dark matter halos has come from a variety of other observations. In elliptical galaxies, however, it has been difficult to study the motions of stars at great distances from the center. The 2003 study (A. J. Romanowsky et al., Science 301:1696-1698) focused on bright planetary nebulas in the outer parts of four nearby elliptical galaxies. Planetary nebulas are old stars that have blown off their outer layers and glow brightly in characteristic wavelengths of light. The researchers were able to determine the line-of-sight velocities of large numbers of planetary nebulas in these elliptical galaxies. They found a decrease in the velocities with increasing distance from the center of the galaxy, which is inconsistent with simple models of the gravitational effects of dark matter halos.

Part of the explanation put forth in the new Nature paper lies in the fact that the velocities were measured along the line of sight. "*You cannot measure the absolute speeds of the stars, but you can measure their relative speeds along the line of sight, because if a star is moving toward us its light is shifted to shorter wavelengths, and if it is moving away from us its light is shifted to longer wavelengths*," Primack explained. This limitation would not be a problem if the orbits of the observed stars were randomly oriented with respect to the line of sight, because any differences resulting from the orientations of the orbits would average out over a large number of observations. According to Cox's simulations, however, the stars farthest from the center of the galaxy at any given time are likely to be moving in elongated, eccentric orbits such that most of their motion is perpendicular to the line of sight. Therefore, they could be moving at high velocities without exhibiting much motion toward or away from the observers.

To understand why, it is necessary to look at what happens to the stars during galaxy mergers. As the merging galaxies interact, the stars themselves do not collide because they are separated by great distances, so the two galaxies essentially pass through one another. But the huge gravitational fields of the galaxies cause powerful tidal disturbances. Some of the stars are flung outward in extended tidal tails as the cores of the galaxies pass close by one another and spin apart. Sometimes the cores remain connected by a tidal bridge of stars and gas. Eventually, gravity pulls the cores back together, and the stars that were flung outward fall back in toward the center. "*In the merger process that produces these galaxies, a lot of the stars get flung out to fairly large distances, and they end up in highly elongated orbits that take them far away and then back in close to the center*," Primack said.

To an observer outside the galaxy, a star on such an elongated orbit would only appear to be far from the galactic center if the long axis of its orbit is more or less perpendicular to the observer's line of sight. If the long axis of the orbit is aligned with the line of sight, the star would always appear to be in the crowded center of the galaxy from the perspective of the observer. "*If we see a star at a large distance from the center of the galaxy, that star is going to be mostly moving either away from the center or back toward the center. Almost certainly, most of its motion is perpendicular to our line of sight*," Primack said. The simulated mergers involved typical spiral galaxies, each embedded in a halo of cold dark matter. The simulations followed the gravitational and hydrodynamic evolution of the merger systems, taking into account the complicated feedbacks from star formation, supernovae, and the heating and cooling of gases in the galaxies. Each simulation was then "observed" from three different directions and at two slightly different times after the merger. From more than 200 merger simulations run by Cox on a supercomputer at UCSC, the researchers analyzed 10 mergers that yielded elliptical galaxies with masses similar to those of the galaxies observed in 2003. The results were completely consistent with the reported observations, Primack said. "*Our conclusion is that what they saw is exactly what the cold dark matter model would predict*," he said. "*Their data are great, and this actually gives us more insight into how elliptical galaxies form*." "*We predict that other velocity tracers in the same elliptical galaxies will show higher velocities if they are less concentrated toward the galaxy center or if they move on more circular orbits*," Dekel said. "*This is likely to be the case for compact star clusters, which are also observable in the outskirts of elliptical galaxies*."

THIS SUPERNOVA JUST WON'T FADE AWAY

Scientists say that a star which exploded in 1979 still shines as brightly in X-rays today as it did when X-ray telescopes first observed it years ago. This is a surprise finding because such objects usually fade significantly after only a few months.

The scientists could document a unique history of the star, both before and after the explosion, by studying rings of light leftover from the blast, similar to the way climate history is derived from analyzing rings in a tree trunk. Dr. Stefan Immler, led this observation using the European Space Agency's XMM-Newton observatory. The star explosion (supernova), called SN 1979C, shows no sign of letting up, he said. "*This 25-year-old candle in the night has allowed us to study aspects of a star explosion never before seen in such detail*," Immler said. "*All the important information that usually fades away in a couple of months is still there*." Among the many unique finds, Immler said, is the history of the star's stellar wind dating back 16,000 years before the explosion. Such a history is not even known about our Sun. Also, the scientists could measure the density of the material around the star, another first. The lingering mystery, though, is how this

star could fade away in visible light yet remain so radiant in X-rays.

Stars explode when they run out of fuel to burn. Stars more than 10 times the mass of our Sun will explode in an event called a core-collapse supernova. Without fuel and thus energy to support its gravity, such stars first implode. The core reaches a critical density, and much of the infalling matter gets bounced back out violently into space by powerful shockwaves. Supernovae can outshine an entire galaxy and are often easily seen in neighboring galaxies with a backyard telescope. Supernovae are typically half as bright after about ten days and fade steadily after that, regardless of the wavelength. SN 1979C has in fact faded in optical light which is now just barely visible with a good amateur telescope. In X-rays, however, this supernova is still the brightest object in its host galaxy. "*We can use the X-ray light from SN 1979C as a 'time machine' to study the life of a dead star long before it exploded*," Immler said. Immler's team will attempt to identify the history of the star that created SN 1979C through a process similar to counting rings in a tree trunk. This star, about 18 times more massive than our Sun, produced fierce stellar winds. That material was flung into space for millions of years, creating concentric rings around the star and the X-rays have illuminated 16,000 years' worth of stellar activity. Immler speculates that the abundance of stellar wind has provided ample material to keep SN 1979C glowing so brightly. "*XMM-Newton is known among scientists as a superior X-ray observatory, but the study of SN 1979C demonstrates the importance of the satellite's simultaneously observing UV and optical telescope*," said Dr. Norbert Schartel, XMM-Newton Project Scientist.

FLASH HELPS SOLVE 35-YEAR-OLD COSMIC MYSTERY

Scientists have solved the 35-year-old mystery of the origin of powerful, split-second flashes of light known as short gamma-ray bursts. These flashes, brighter than a billion suns, yet lasting only a few milliseconds, have been simply too fast to catch -- until now. Through the unprecedented coordination of observations from several ground-based telescopes and NASA satellites, scientists determined the flashes arise from violent collisions in space. The clashes are either between a black hole and a neutron star or between two neutron stars. In either scenario, the impact creates a new black hole. In at least one burst, scientists saw tantalizing, first-time evidence of a black hole eating a neutron star. The neutron star was first stretched into a crescent, then swallowed by the black hole. These observations could enable direct detection of exotic gravitational waves that have never before been seen. "*Gamma-ray bursts in general are notoriously difficult to study, but the shortest ones have been next to impossible to pin down*," said Dr. Neil Gehrels, principal investigator for the Swift satellite. "*All that has changed. We now have the tools in place to study these events*," he said. Gamma-ray bursts, first detected in the 1960s, are the most powerful explosions known. They are random, fleeting and can occur from any region of the sky. Two years ago, scientists discovered longer bursts, lasting more than two seconds, arise from the explosion of very massive stars. About 30 percent of bursts are short and under two seconds.

The Swift satellite detected a short burst on May 9, and the High-Energy Transient Explorer (HETE) detected another on July 9. The May 9 event marked the first time scientists identified an afterglow for a short gamma-ray burst, something commonly seen after long bursts. "*We had a hunch that short gamma-ray bursts came from a neutron star crashing into a black hole or another neutron star, but these new detections leave no doubt*," said Dr. Derek Fox. Fox is lead author of one report detailing a multi-wavelength observation. Fox's team discovered the X-ray afterglow of the July 9 burst with the Chandra X-ray Observatory. A team led by Jens Hjorth, identified the optical afterglow using the Danish 1.5-meter telescope at the La Silla Observatory in Chile. Fox's team continued studying the afterglow with Hubble Space Telescope and ground-based telescopes, and the National Radio Astronomy Observatory.

"*The July 9 burst was like the dog that didn't bark*," said Dr. George Ricker, HETE principal investigator. "*Powerful telescopes detected no supernova as the gamma-ray burst faded, arguing against the explosion of a massive star. Also, the July 9 burst, and probably the May 9 burst, are located in the outskirts of their host galaxies, just where old merging binaries are expected*," he added. Mergers create gravitational waves, ripples in space-time predicted by Einstein but never directly detected. The July 9 burst was about 2 billion light-years away. A big merger closer to the Earth could be detected by the National Science Foundation's Laser Interferometer Gravitational-Wave Observatory (LIGO). If Swift detects a nearby short burst, scientists could go back and check the data with a precise time and location. "*This is good news for LIGO*," said Dr. Albert Lazzarini. "*The connection between short bursts and mergers firms up projected rates for LIGO, and they appear to be at the high end of previous estimates. Also, observations provide tantalizing hints of black hole-neutron star mergers, which have not been detected before*," he said.

FROM THE EDITOR'S TERMINAL

The Stargazer is <u>your</u> 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
P.O. Box 12746
Everett, WA 98206

In October's Stargazer:

The next EAS Meeting is 3:00 P.M. SATURDAY, October 29th at the Everett Public Library Auditorium.