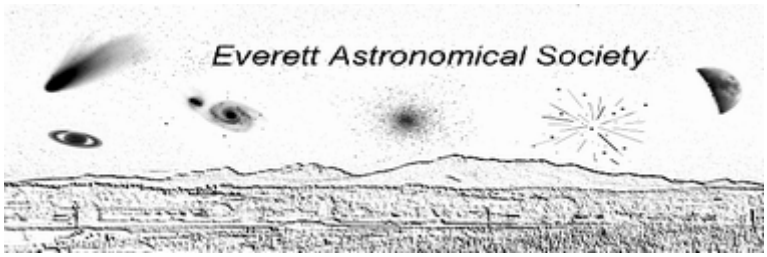
Volume MMIV. No. 6



The Stargazer

June 2004

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EAS BUSINESS…

RECAP OF MAY MEETING

Jonathan Fay showed a presentation of building his 'Bear Creek' observatory in Redmond on converting a garden shed into a domed observatory. He illustrated the pros and cons of various observatory types and building approaches. He showed the construction steps and discussed the kinds of issues he ran into and strategies he considered.

(I incorrectly referred to it as the *Littlebear* observatory in the May Stargazer, which is another domed observatory nearby in Redmond, causing some confusion, and resulting in changes to the descriptions of the Clear Sky Clocks for both observatories.... Here is the *correct* link for Jonathan's Bear Creek observatory - http://www.bearcreekobservatory.com/index.aspx)

NEXT EAS MEETING - SATURDAY JUNE 26TH 7:00 PM - PROVIDENCE PACIFIC CLINIC (916 PACIFIC AVENUE) IN THE MONTE CRISTO ROOMS ON THE MAIN FLOOR.

Eric Algol from the University of Washington will be presenting a talk about "*The Black Hole at the Center of the Galaxy*" this month on Saturday June 26th.

Map/directions to the EAS meeting are available at: http://members.tripod.com/everett_astronomy/directions_to_club_meetings.htm

Scheduled Meeting Dates:

Jun 26th – EAS Mtg – Eric Algol, UW, Black Hole at the Center of the Galaxy 7:00 PM
Jul 14-17th – Table Mt. Star Party
Jul 31st – EAS Mtg – (Bill Cook, Captain's on Optics) – 7:00 PM
Aug 11-14th – Oregon Star Party
Aug 28th – EAS Mtg – (Dr. Julie Lutz, UW Astronomy) 7:00 PM
Sep 17-18th – Sun Lakes Star Party
Sep 25th – EAS Meeting – 7:00 PM
Oct 30th – EAS Meeting – 7:00 PM
Nov 20th – EAS Meeting – 7:00 PM
Dec 11th – EAS Holiday Dinner

MEMBER NEWS

New EAS T-Shirts available ! See our updated T-shirts, available at this month's meeting. Chose from T, Long-sleeve T, or sweat shirt in a variety of sizes.

Telescope for Sale: The club has been contacted by a woman wishing to sell a 5" Celestron Cometron reflector and mount, along with an observing stool, and some astronomy books – asking $325 OBO. Contact Mark Folkerts if interested.

CLUB STAR PARTY INFO

Upcoming star party schedule:

We try to hold informal close-in star parties each month during the spring and summer months on a weekend near the New moon at a member's property or a local park. (call Bob Lyon at (425) 337-1510 for info or check the EAS website.)
Members contact Bob Lyons 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' STATUS

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

EAS members: contact Bob Lyons (425) 337-1510 or 'bdlyons at verizon.net' to borrow a scope.

ASTRO CALENDAR

June 2004
Jun 08 - Venus Transits The Sun
Jun 09 - Moon Occults Vesta
Jun 11 - Pluto At Opposition
Jun 12 - Mercury Passes 1.3 Degrees From Venus
Jun 21 - Summer Solstice (00:57 UT)

Jun 26 - Mercury Passes 2.1 Degrees From Saturn

July 2004
Jul 01 - Cassini, Saturn Orbit Insertion
Jul 05 - Earth At Aphelion (1.017 AU From Sun)
Jul 07 - Asteroid 3 Juno At Opposition (9.6 Magnitude)
Jul 11 - Mercury Passes 0.1 Degrees From Mars
Jul 26 - Mercury Greatest Eastern Elongation (27 Degrees)
Jul 29 - South Delta-Aquarids Meteor Shower Peak

August 2004
Aug 01 - Alpha Capricornids Meteor Shower Peak
Aug 06 - Southern Iota Aquarids Meteor Shower Peak
Aug 06 - Neptune At Opposition
Aug 12 - Perseids Meteor Shower Peak
Aug 25 - Northern Iota Aquarids Meteor Shower Peak
Aug 27 - Uranus At Opposition
Aug 31 - Venus Passes 1.9 Degrees From Saturn
Aug 31 - Start of Mars Solar Conjunction

September 2004
Sep 22 - Autumnal Equinox, 16:30 UT
Sep 27 - Mars Passes 0.2 Degrees From Jupiter
Sep 29 - Mercury Passes 0.6 Degrees From Jupiter
Sep 29 - Mercury Passes 0.8 Degrees From Mars

October 2004
Oct 09 - Draconids Meteor Shower Peak
Oct 13 - Moon Occults Mars
Oct 14 - Moon Occults Mercury
Oct 21 - Orionid Meteor Shower Peak
Oct 28 - Lunar Eclipse
Oct 31 - Daylight Saving - Set Clock Back 1 Hour

OVER THE AIRWAVES

"Our group of radio script writers now consists of EAS and SAS members Jim Ehrmin, Pat Lewis writer emeritus, 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 have a good idea for an astronomy broadcast or would like to try your hand at writing a script, call Pat Lewis at (206) 524-2006 or email to joagreen@aol.com 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 8:58 A.M. and 5:58 P.M. Saturday and Sunday). 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

Jun 03	Full Moon
Jun 09	Last Quarter Moon
Jun 17	New Moon
Jun 25	First Quarter Moon
Jul 02	1st Full Moon of the month !
Jul 09	Last Quarter Moon
Jul 17	New Moon
Jul 25	First Quarter Moon
Jul 31	2nd Full Moon of the month !

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	Constellation
Sun	**5:12 am**	**13:11**	**21:11**	**Gemini**
Mercury	Daylight	Daylight	**21:50**	**Gemini**
Venus	**4:03 am**	Daylight	Daylight	**Taurus**
Mars	Daylight	Daylight	**22:52**	**Cancer**
Jupiter	Daylight	Daylight	**0:33 am**	**Leo**
Saturn	Daylight	Daylight	**21:50**	**Gemini**
Uranus	**0:13 am**	Daylight	Daylight	**Aquarius**
Neptune	**23:15**	04:07 am	Daylight	**Capricornus**
Pluto	Daylight	**00:10 am**	**5:17 am**	**Serpens**

(times local time for Everett PDT)

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

CONSTELLATIONS OF THE MONTH

YOUNG ASTRONOMER'S CORNER

PLANETARY FOCUS

ASTRONOMY & TELESCOPE LINGO

ASTRONOMY FUN FACTS

MIRROR IMAGES

Due to a death in the family of our co-editor, these columns will not be available this month. Watch for them to return next month.

ASTRONOMICAL NOTES -- ON & OFF THE NET…

FIREBALL OVER SEATTLE THURSDAY JUNE 3RD - 2:40 AM

The object was seen from Vancouver Island, and from multiple points on the Olympic Peninsula in western Washington. There were reports from eyewitnesses and flashes on video cameras, across the region to Spokane, Couer d'Alene, and from northern Oregon as well. Most reports were from a 60 mile section from Tacoma to Whidbey Island, but it was seen from Vancouver Island, from 550 miles north, in British Columbia, to northern Oregon and east to Montana. It was estimated to be the size of a computer monitor or suitcase. A sonic boom, explosion, or series of booms was widely heard, which woke up many people sleeping at the time, and triggered earthquake seismic detectors and car alarms.

One witness in north Seattle reported that the event occurred in the northern sky, from his vantage point, and that he thinks it disappeared from his sight before it reached his location, that it did not pass to the south of his position. The same witness, who described himself as an amateur astronomer, stated that he counted the elapsed time between the final flash and the rumbling he heard was approximately 10 seconds. If so, the object may have reached to within approximately 2 miles of the Earth's surface, which is rather low, relative to most dramatic meteors. They usually either burn up, or fragment, at an altitude above tens of miles. (Others reported times of several (4-5) minutes, which is more consistent with the 60 km height of most meteors ceasing to radiate light.)

The explosion was picked up by about 80 University of Washington seismic stations, registering "magnitude 1.6 on the earthquake scale." UW seismologist Steve Malone "*was able to use the instrument readings to pinpoint the site of the explosion: About six miles northeast of the town of Snohomish and 26 miles above ground... 'And it looks like it entered the atmosphere at a fairly steep angle.*'" It was also reported that Bill Steele of the UW Pacific Northwest Seismograph Network said that "*The meteor appears to have exploded about 27 miles [43 km.] above and 6.4 miles northeast of the city of Snohomish.*" He was quoted as saying "*we saw only a point source (a single explosion) . . . rather than the sonic-boom kind of sound wave that comes as an object rapidly enters the atmosphere*," thus conclude that the meteor's entry was steep.

A person in Marysville who saw it reported: "*At 2:30 a.m. I was looking toward the western sky when I noticed a very bright object. It was about the size of a dime from my viewpoint. About 10 to 15 minutes later I saw what I believed to be a meteor shower. This started as very white and turned to orange light which lasted about 5 to 10 seconds. This was followed by a concussion and loud boom by about 10 mins*."

An observer on the Olympic peninsula reported "*There were two distinct pulses of light*". "*Then about four minutes later, a loud noise sounded like a sonic boom*". Many described it as being incredibly bright, like a lightning flash, a flash attachment, a nuclear explosion, "*the brightest thing I have ever seen*", and changing color as it moved across the sky.

I received email from 'Wayne' in Everett, who said: "*I was in my front yard this morning when what looked like a skyrocket came down and it appeared to come down right across the street in a wooded area off Federal Avenue (which passes next to Providence Hospital), followed by thunder-like sounds. I know nothing about meteors, and maybe it was further off, but it was not just a flash of light. There also was a policeman in our yard looking for a car thief at the time, who heard the booms and also had no idea what caused them. Just thought you might be interested*."

An amateur astronomer reported on a web forum "*I was in the process of trying to find M27 (Dumbbell Nebula), by star hopping from M57 (Ring Nebula). I had my eye to the eyepiece, and was getting anxious, because I knew I was getting close to M27. Out of nowhere, the whole backyard lit up, like the sun just all of a sudden popped up to high noon. I was frozen stiff for a moment, since many ideas came to my head of what it could be. Less than half a second after the flash occurred, my instincts kicked in, and I looked upward to see what caused the huge flash. I was lost, when all of a sudden I saw a bright orange streak heading NNE from my direction. I realized it was a meteor coming through our atmosphere, and the sheer size floored me. The next thought I had was that of the dinosaurs, even though I figured the meteor could not be that large. Although it did not appear too small either, so I high-tailed it inside, imagining the worst. After my adrenaline came down, I went back outside to look and listen for any after effects. About 90 seconds after the flash had occurred, I heard the sonic boom of what the meteor caused." … "This event will be unforgettable, and I am pleased to have been one to witness it. Also I was able to finally locate M27, and was excited, but the fireball event earlier exceeded the excitement I felt when I found M27*."

A Neah Bay security camera showed two flashes of light followed by a loud noise four minutes and 33 seconds later.

It was reported that UW astronomer Don Brownlee said his son saw the bright light and then the whole family heard the sonic boom from inside their houseboat. "*We heard this incredible noise that sounded like a truck landing on the dock*."

The Cascadia Meteorite Laboratory at Portland State University posted a request for observers to submit reports to them on a form on their web site, which is passed along here: "*A bright fireball lit up the skies of the Pacific Northwest early on the morning of June 3, 2004. Reports have come in from numerous localities in Washington and Oregon, and as far east as Couer d'Alene, Idaho. Sonic booms were heard from Portland, Oregon to Olympia, Washington. A "burning sulfur smell" was reported in Chehalis. Based on numerous eyewitness reports, the fireball appears to have been moving west to east towards the Centralia-Chehalis area of Washington. This fireball is likely to have produced many meteorites."*

"*If you saw this fireball, please call (503) 287-6733 or fill out the fireball report form and mail it to us at the address below*. " http://meteorites.pdx.edu/CML_Fireball_form.htm

Portland State University
Department of Geology, 17 Cramer Hall

1721 SW Broadway, P.O. Box 751
Portland, OR 97207-0751

Also a follow-up report was posted from Cascadia - "*Dick Pugh of the Cascadia Meteorite Laboratory has spent the last week interviewing approximately 50 eyewitnesses to the June 3 fireball. Based on those interviews, he has made a preliminary determination of the trajectory of the fireball. It first entered the atmosphere over Puget Sound moving southeast. It was seen from Canada to northern Oregon, from the Pacific Coast to Idaho. Sonic booms were heard from Canada to Portland, Oregon. The fireball came down at approximately a 45 degree angle, breaking up at least three times, producing a dozen or more fragments. The best estimate is that these fragments landed somewhere between Randle, WA and Yakima, WA, most likely in the Goat Rocks Wilderness area. Based on the rough and timbered terrain, recovery of meteorites will be most difficult.*

If you have any questions, please contact Dick Pugh at (503) 287-6733 or mail the address above."

STARDUST REVEALS SURPRISING ANATOMY OF COMET WILD

Findings from a historic encounter between NASA's Stardust spacecraft and a comet revealed much stranger findings than previously believed. The comet's rigid surface, dotted with towering pinnacles, plunging craters, steep cliffs, and dozens of jets spewing violently, has surprised scientists.

"*We thought Comet Wild ("vilt") 2 would be like a dirty, black, fluffy snowball*," said Stardust Principal Investigator Dr. Don Brownlee of the University of Washington, Seattle. "*Instead, it was mind-boggling to see the diverse landscape in the first pictures from Stardust, including spires, pits and craters, which must be supported by a cohesive surface*," Brownlee said.

Stardust gathered the images on Jan. 2, 2004, when it flew 236 kilometers (about 147 miles) from Wild 2. The flyby yielded the most detailed, high-resolution comet images ever. "*We know Wild 2 has features sculpted by many processes. It may turn out to be typical of other comets, but it is unlike any other type of solar system body*," Brownlee said. He is lead author of one of four Stardust papers appearing in this issue of Science. "*We're fortunate that nature gave us such a rich object to study*," he added.

Stardust images show pinnacles 100 meters tall (328 feet), and craters more than 150 meters deep (492 feet). Some craters have a round central pit surrounded by ragged, ejected material, while others have a flat floor and straight sides. The diameter of one large crater, called Left Foot, is one fifth of the surface of the comet. Left Foot is one kilometer (.62 miles) across, while the entire comet is only five kilometers (3.1 miles) across.

"*Another big surprise was the abundance and behavior of jets of particles shooting up from the comet's surface. We expected a couple of jets, but saw more than two dozen in the brief flyby*," said Dr. Benton Clark, Chief Scientist of Space Exploration Systems, Lockheed Martin Space Systems. The team predicted the jets would shoot up for a short distance, and then be dispersed into a halo around Wild 2. Instead, some super-speedy jets remained intact, like blasts of water from a powerful garden hose. This phenomenon created quite a wild ride for Stardust during the encounter. "*Stardust was absolutely pummeled. It flew through three huge jets that bombarded the spacecraft with about a million particles per second*," said Thomas Duxbury, Stardust project manager. Twelve particles, some larger than a bullet, penetrated the top layer of the spacecraft's protective shield.

The violent jets may form when the sun shines on icy areas near or just below the comet's surface. The solid ice becomes a gas without going through a liquid phase. Escaping into the vacuum of space, the jets blast out at hundreds of kilometers per hour. The Stardust team theorizes sublimation and object hits may have created the comet's distinct features. Some features may have formed billions of years ago, when life began on Earth, Brownlee said. Particles collected by Stardust during the Wild 2 encounter may help unscramble the secrets of how the solar system formed.

Stardust was launched in 1999. It is zooming back to Earth with thousands of captured particles tucked inside a capsule. The capsule will make a soft landing in the Utah desert in January 2006. The samples will be analyzed at the planetary material curatorial facility at NASA's Johnson Space Center.

Comets have been objects of fascination through the ages. Many scientists believe they delivered carbon and water, life's building blocks, to Earth. Yet their destructive potential is illustrated by the widely held theory, a comet or asteroid wiped out the dinosaurs. Stardust images: http://stardust.jpl.nasa.gov or http://photojournal.jpl.nasa.gov/

ASTEROIDS CHANGE COLOR AS THEY AGE

A team led by Robert Jedicke of the University of Hawaii's Institute for Astronomy provides convincing evidence that asteroids change color as they age. David Nesvorny used a variety of methods to estimate asteroid ages that range from 6 million up to 3 billion years. Accurate color measurements for over 100,000 asteroids were obtained by the Sloan Digital Sky Survey (SDSS), and catalogued by team members **Zeljko Ivezic from the University of Washington** and Mario Juric from Princeton.

Robert Whiteley points out that "*the age-color correlation we found explains a long-standing discrepancy between the colors of the most numerous meteorites known as ordinary chondrites (OC) and their presumed asteroid progenitors*." Meteorites are chips of asteroids and comets that have fallen to Earth's surface. According to Jedicke, "*If you were given a piece of rock from the Grand Canyon, you might expect that it would be red, like the colorful pictures in travel magazines. You'd be forgiven for questioning its origin if the rock had a bluish color. But if you were then told that the rocks turn from blue to Grand Canyon red because of the effects of weather, then everything might make sense. Your gift is simply a fresh piece of exposed rock, whereas the pictures you've seen show weathered cliff faces millions of years old*."

Nesvorny explains that this is similar to the situation experienced by asteroid astronomers. "*The meteorites are gifts of the solar system to scientists on Earth - pieces of asteroids delivered to their own backyard. The mystery is that the OC meteorites have a bluish color relative to the reddish color of the asteroids from which they were supposedly released*." Jedicke asks, "*How could they possibly be related?*"

About thirty years ago, a "space weathering" effect was proposed to explain the color change. Meteorites, whose surface is affected by their fall through Earth's atmosphere, are usually studied in laboratories by observing their freshly cut and exposed interiors. Billions of years of exposure of the same material on the surface of an asteroid to solar and cosmic radiation and the heating effect of impacts of tiny asteroids might alter the surface color of asteroids in exactly the manner required to match the color of asteroids.

Jedicke said that they found that "*asteroids get more red with time in exactly the right manner and at the right rate to explain the mystery of the color difference between them and OC*

meteorites." He added, "*Even though we have found a link between the two types of objects, we still don't know what causes space weathering*."

Once these researchers refine their analysis by obtaining more colors of the youngest-known asteroid surfaces, it will be possible to determine the age of any asteroid from its surface color. They are currently searching for a space weathering effect on other types of asteroids in the solar system.

PHOEBE FLYBY SHOWS MOON WITH A BATTERED PAST

First images from the Cassini flyby of Phoebe reveal it to be a scarred, cratered outpost with a very old surface and a mysterious past, and a great deal of variation in surface brightness across its surface.

"*What spectacular images*," said Dr. Carolyn Porco, Cassini Imaging Team leader. "*So sharp and clear and showing a great many geological features, large and small. It's obvious a lot of new insights into the origin of this strange body will come as a result of all this*." "*What we are seeing is very neat. Phoebe is a heavily cratered body. We might be seeing one of the chunks from the formation of the solar system, 4.5 billion years ago. It's too soon to say*," said Dr. Torrence Johnson, Cassini imaging team member. "*It's important to see the big picture from all of the other instruments to get the global view on this tiny moon*."

Dr. Gerhard Neukum, an imaging team member, said, "*It is very interesting and quite clear that a lot of craters smaller than a kilometer are visible. This means, besides the big-ones, lots of projectiles smaller than 100 meters (328 feet) have hit Phoebe*." Whether these projectiles came from outside or within the Saturn system is debatable.

There is a suspicion that Phoebe, the largest of Saturn's outer moons, might be parent to the other, much smaller retrograde outer moons that orbit Saturn. Dr. Joseph Burns, an imaging team member said, "*Looking at those big 50 kilometers (31 mile) craters, one has to wonder whether their impact ejecta might be the other tiny moons that orbit Saturn on paths much like Phoebe's.*"

All planned 11 instruments operated as expected and all data was acquired. Scientists plan to use the data to create global maps of the cratered moon, and to determine Phoebe's composition, mass and density. It will take scientists several days to pour over the data to make more concrete conclusions.

Cassini came within approximately 2,068 kilometers (about 1,285 miles) of the dark moon on Friday, June 11. The spacecraft was pointing its instruments at the moon during the flyby. Several hours later it turned to point its antenna to Earth. The signal was received through the Deep Space Network antennas in Madrid, Spain and Goldstone, in California's Mojave Desert. Cassini was traveling at a relative speed of 20,900 kilometers per hour (13,000 miles per hour) relative to Saturn. It's been 23 years since a spacecraft last visited Phoebe. The Voyager 2 flyby in 1981 was at a distance from 2.2 million kilometers, (about 1.4 million miles), 1,000 times farther away.

With the Phoebe flyby accomplished, Cassini is on course for Saturn. A trajectory correction maneuver is scheduled for June 16. Cassini will conduct a critical 96-minute burn before going into orbit around Saturn on June 30 (July 1 Universal Time). During Cassini's planned four-year tour it will conduct 76 orbits around the Saturn system and execute 52 close encounters with seven.

Cassini-Huygens mission, http://saturn.jpl.nasa.gov/index.cfm
Cassini imaging team home page, http://ciclops.lpl.arizona.edu/

Prometheus and Knots in the F Ring
http://saturn.jpl.nasa.gov/cgibin/gs2.cgi?path=../multimedia/images/rings/images/PIA05402.jpg&type=image

Atmospheric Detail and Enceladus
http://saturn.jpl.nasa.gov/cgibin/gs2.cgi?path=../multimedia/images/saturn/images/PIA05403.jpg&type=image

Closing in on Phoebe
http://saturn.jpl.nasa.gov/cgibin/gs2.cgi?path=../multimedia/images/small-moons/images/PIA06062.jpg&type=image

Titan's Murky Skies
http://saturn.jpl.nasa.gov/cgibin/gs2.cgi?path=../multimedia/images/large-moons/images/PIA05404.jpg&type=image

Countdown to Phoebe (Released June 11, 2004)
http://saturn.jpl.nasa.gov/cgibin/gs2.cgi?path=../multimedia/images/small-moons/images/PIA06063.jpg&type=image

HI-TEMP IO VAPORIZING ROCK GASES INTO ATMOSPHERE

The hottest spot in the solar system is neither Mercury, Venus, nor St. Louis in the summer. Io, one of the four satellites that the Italian astronomer Galileo discovered orbiting Jupiter almost 400 years ago, takes that prize. The Voyager spacecraft discovered volcanic activity on Io over 20 years ago and subsequent observations show that Io is the most volcanically active body in the solar system. The Galileo spacecraft, named in honor of the astronomer Galileo, found volcanic hot spots with temperatures as high as 2,910 Fahrenheit (1,610 Celsius).

Now computer models of volcanic eruptions on Io show that the lavas are so hot that they are vaporizing sodium, potassium, silicon and iron and probably other gases as well into its atmosphere. Using an updated version of 'MAGMA', a versatile computer program he developed 15 years ago, Bruce Fegley, Jr., PhD., professor of earth and planetary sciences, found that some of these elements are vaporized at least partly as single-atom gases. Others are vaporized in different molecular forms, for instance, silicon monoxide, silicon dioxide and iron monoxide.

"*Reaction of these gases with sulfur and chlorine species in volcanic gases could lead to the formation of such unusual gases as sodium chloride, potassium chloride, magnesium dichloride and iron dichloride*, " Fegley said.

In 2000, Fegley and Mikhail Zolotov, PhD predicted formation of sodium chloride and potassium chloride vapor in volcanic gases on Io. Three years later astronomers found sodium chloride gas on Io. However, these observations were not sensitive enough to detect the less abundant potassium chloride vapor.

Now Fegley has found that sodium and potassium in Ionian volcanic gases are being vaporized from the hot lavas. Fegley and research assistant Laura Schaefer used data from the Galileo mission and Earth-based observations from high-powered telescopes in their research. "*We're basically doing geology on Io using data from telescopes on Earth, which shows that observations like this can compete with expensive space missions*," said Fegley. "*It's amazing how hot and how volcanically active Io is. It is 30 times more active than Earth. It's the hottest body outside of the sun in the solar system*."

The innermost of the four major satellites of Jupiter - there are at least 16 - Io gets its high rate of volcanism from tidal interactions with Jupiter, which has the strongest magnetic field of all the planets. Over 100 active volcanoes have been identified on Io. Hotspots there have temperatures as high as 1,600 degrees Celsius. This is several hundred degrees hotter than terrestrial volcanoes like Kilauea in Hawaii, which has a temperature of about 1,000 Celsius (1,830 Fahrenheit).

Fegley and Schaefer found that silicon monoxide is the major silicon-bearing gas over the lavas. "*The interesting thing about this is that astronomers have observed silicon monoxide in other environments in interstellar space, most notably in the atmospheres of cool stars*," said Fegley. Astronomical observations of actively erupting volcanoes on Io may be able to detect the silicon monoxide gas in its atmosphere.

Fegley and Schaefer recommend an Io volcanic probe mission to directly measure the pressure, temperature and composition of gases of Pele, one of Io's most active volcanoes. Such an endeavor is "*feasible using present technology*," Fegley said. "*It would vastly expand our knowledge of the most volcanically active body in the solar system*." The volcanic probe mission would represent an advance in the effort to unveil some of Io's mysteries, such as how the satellite, about the size of our own Moon, can maintain its high magma temperatures without being nearly totally molten, and how does Io maintain a strong enough lithosphere to support mountains higher than Mount Everest?

HUBBLE REFINES DISTANCE TO PLEIADES STAR CLUSTER

Astronomers using NASA's Hubble Space Telescope have helped settle a mystery that has puzzled scientists concerning the exact distance to the famous nearby star cluster known as the Pleiades, or the Seven Sisters. The Pleiades cluster, named by the ancient Greeks, is easily seen as a small grouping of stars lying near the shoulder of Taurus, the Bull, in the winter sky. Although it might be expected that the distance to this well-studied cluster would be well established, there has been an ongoing controversy among astronomers about its distance for the past seven years.

The mystery began in 1997, when the European Space Agency's satellite Hipparcos measured the distance to the Pleiades and found it is 10 percent closer to Earth than traditional estimates, which were based on comparing the Pleiades to nearby stars. If the Hipparcos measurements were correct, then the stars in the Pleiades are peculiar because they are fainter than Sun-like stars would be at that distance. This finding, if substantiated, would challenge our basic understanding of the structure of stars.

But measurements made by the Hubble telescope's Fine Guidance Sensors show that the distance to the Pleiades is about 440 light-years from Earth, essentially the same as past distance estimates and differing from the Hipparcos results by more than 40 light-years. The new results agree with recent measurements made by astronomers at Cal Tech and JPL. Those astronomers used interferometer measurements from Mt. Wilson and Palomar observatories in California, reporting that the star cluster is between 434 and 446 light-years from Earth.

The discrepancy in the distance to the Pleiades is more than an arcane argument over details. Astronomers have only one direct means for gauging distances to stars, called the parallax method. With current telescopes, this method gives accurate results only for distances up to about 500 light-years. Distances beyond that limit must be determined by indirect methods, based on comparing the brightness of distant stars with those of nearer ones of the same type, and making the assumption that both objects have the same intrinsic, or true, brightness. Astronomers can thus build up a distance ladder, based on ever more-distant objects, ultimately leading to the use of supernovae as "standard candles" for the most distant reaches of the universe.

"*Reliance on the accuracy of the measurements of nearby objects is crucial to getting the distance ladder of the universe correct*," said David Soderblom of the Space Telescope Science Institute, and lead astronomer on the Hubble study. "*The new Hubble result shows that the measurements made by Hipparcos contain a small, but significant, source of error that requires further exploration. New space missions are now being planned to carry out even more precise distance measurements out to greater distances*."

Soderblom and his team used Hubble's Fine Guidance Sensors to measure slight changes in the apparent positions of three stars within the cluster when viewed from different sides of Earth's orbit. Due to the motion of the Earth around the Sun, the position of a star in the Pleiades, will appear to shift relative to stars farther away. This effect, called parallax, can be used to calculate the distance to the star with simple geometry; a similar method of triangulation is used by surveyors to measure distances on Earth. Soderblom's team took its measurements six months apart over a 2 1/2-year period. Making these kinds of measurements of a star's movement is very difficult. The Fine Guidance Sensors are so precise that if the human eye had the same ability to measure small angles, it would be able to see a quarter 16,000 miles away. Hipparcos was the first space observatory to make precise measurements of the positions and motions of celestial objects. Before Hipparcos, astronomers determined the distances to stars like the Pleiades by measuring parallax with ground-based telescopes. Those observations were less precise because Earth's atmosphere distorts light from stars, limiting the telescopes' resolution.

PLANET FORMATION - CAUGHT IN THE ACT

How old is too old? Pro football players tend to peak in their late 20s, and few continue their careers beyond the age of 35. For young stars, the peak age for planet formation is around 1 to 3 million years. By 10 million years old, their resources are exhausted and they retire to a life on the stellar "main sequence." Using telescopes on the ground and in space, a team of astronomers led by Lee Hartmann and Aurora Sicilia-Aguilar is studying Sun-like stars in their waning formative years, within clusters older than previously explored. They seek to refine our understanding of planet formation by studying dusty protoplanetary disks around such stars. Their results better define the time span during which planets might form. "*While the planets that may be forming cannot be detected directly*," said Sicilia-Aguilar, "*we can see changes in the circumstellar dusty accretion disks caused as the planets sweep up and accumulate mass*."

"*The data also has shown dramatic differences between stars of 3 and 10 million years of age: the younger stars frequently have dusty disks capable of forming planets, while such disks are essentially absent in the older population*," she continued.

The team used data from the Smithsonian Institution's Whipple Observatory telescopes, the WIYN telescope at Kitt Peak National Observatory, and from the Spitzer Space Telescope, to make these findings.

"*We are trying to understand the evolution of protoplanetary disks around stars not too different from the Sun*," said team leader Hartmann. "*Many stars about 1 million years old have disks, but by 10 million years, almost none have disks. We are trying to find stars at an in-between age and 'catch them in the act' of forming planets.*"

Circumstellar dust disks enshroud young stars, and astronomers understand this to be a common feature of stellar evolution and of possible planetary system formation. The initial protoplanetary disks contain the gas and dust that provide the raw materials for the formation of later planetary systems.

"*After stars form planets in their disks and clear out most of the material- either by accretion onto the star, accretion onto planets, or ejection-small amounts of dust can remain in so-called 'debris*

disks.' Most or all of this debris dust is thought to be continuously generated by the collision of small bodies, much like the zodiacal light in our solar system," said Hartmann.

The team is presenting the first identification of low mass stars in the young clusters Trumpler-37 and NGC-7160. (These clusters are loose associations of stars that have formed together in the comparatively recent past.) "*The cluster members confirm the age estimates of 1 to 5 million years for Tr37 and 10 million years for NGC-7160,*" said Sicilia-Aguilar.

"*We do find active accretion in some of the stars in Tr37. The average accretion rate is equivalent to swallowing up 10 Jupiter masses in a million years*," said Sicilia-Aguilar. "*This is consistent with models of viscous disk evolution.*" "*In comparison, we have detected no signs of active accretion so far in the older cluster NGC-7160, suggesting that disk accretion ends within 10 million years. This probably coincides with the major phase of giant planet formation*."

Trumpler-37 is of more immediate interest, said Hartmann, because we hope to find stars with Jupiter-size planets that are still accumulating material from the disks, so the disks are not completely cleared out yet. However, there may be a few objects in the 10 million-year-old cluster NGC-7160 that are also still forming their giant planets. Not all disks evolve at the same rate. "*Thus we expect eventually to find out more about the frequency of debris disks, and the rate at which the dust in such disks is removed, by studying the 10-million-year-old cluster NGC-7160 and comparing it to Trumpler-37*," said Hartmann. http://www.cfa.harvard.edu/press/pr0423image.html

Ancient Meteorite Crash Turned Earth Inside Out

New research paints a picture of what happened billions of years ago when a devastating meteorite crashed into the Earth and the collision caused part of the Earth's crust to flip inside out, and left a dusting of a rare metal scattered on the top of the crater, says new research. The study examines the devastating effects of meteorite impacts on the Earth's evolution. Researchers from the University of Toronto and the Geological Survey of Canada studied the remains of a 250-kilometre wide crater in Sudbury, Ontario, known as the Sudbury Igneous Complex, caused by a collision with a Mount Everest-sized meteorite 1.8 billion years ago. They discovered that the meteorite burrowed deep into the Earth's upper crust - which measures an average of 35 kilometers thick - and caused the upper crust to be buried under several kilometers of melted rock derived from the lower crust.

The dynamics of meteorite impacts remain a source of debate among researchers and, until now, there has been little hard evidence to prove a meteorite could pierce through the Earth's upper crust and alter its compositional makeup. "*It had not really been appreciated that large impacts would selectively move material from the bottom of the crust up to the top*," says lead researcher James Mungall, a geology professor. "*This has been suggested for the Moon at times in the past but ours is the first observational evidence that this process has operated on Earth*."

In the study, Mungall, graduate student Jacob Hanley and Geological Survey researcher Doreen Ames concluded Sudbury Igneous Complex is predominantly derived from shock-melted lower crust rather than the average of the whole crust as has been previously supposed. The researchers discovered a subtle but significant enrichment of iridium, an extremely rare metal found mainly in the Earth's mantle and in meteorites. Due to the low magnesium and nickel content found in the samples they concluded that the iridium came from the meteorite itself rather than the Earth's mantle.

The discovery of the iridium allowed the researchers to paint a picture of what happened billions of years ago, when a meteorite collided with the earth at a velocity exceeding 40 kilometers per second and caused a shock melting of 27,000 cubic kilometers of the crust. "*The impact punched a hole to the very base of the crust and the meteorite itself was probably vaporized*," says Mungall. This collision, he says, caused a plume of iridium-enriched vaporized rock to surge up and recondense on top of the impact site. Simultaneously, the cavity collapsed within minutes or hours to form a multi-ring basin 200 to 300 kilometers in diameter and one to six kilometers deep.

"*Picture a drop falling into a cup of milk, thus producing a bowl-shaped depression for a moment before the milk outside rushes back in to fill the hole*," says Mungall. "*Now imagine that the falling drop of milk is a rock 10 kilometers in diameter, and the resulting depression is 30 to 40 kilometers deep*."

The Sudbury Basin is the second oldest very large impact crater site in the world but is one of the most accessible and well preserved. The oldest one, South Africa's two-billion year-old Vredefort Crater, has eroded over time and only the basement remains. Another impact site, the Chicxulub Crater in Yucatan Peninsula, believed to be responsible for the extinction of the dinosaurs, lies buried under beds of limestone.

Raw Ingredients For Life Detected in Planetary Construction Zones

NASA has announced new findings from the Spitzer Space Telescope, including the discovery of significant amounts of icy organic materials sprinkled throughout several "planetary construction zones," or dusty planet-forming discs, which circle infant stars. These materials, icy dust particles coated with water, methanol and carbon dioxide, may help explain the origin of icy planetoids like comets. Scientists believe these comets may have endowed Earth with some of its water and many of its biogenic, life-enabling materials. Drs. Dan Watson and William Forrest identified the ices. They surveyed five very young stars in the constellation Taurus, 420 light-years from Earth. Previous studies identified similar organic materials in space, but this is the first time they were seen unambiguously in the dust making up planet-forming discs.

In another finding, Spitzer surveyed a group of young stars and found intriguing evidence that one of them may have the youngest planet detected. The observatory found a clearing in the disc around the star CoKu Tau 4. This might indicate an orbiting planet swept away the disc material, like a vacuum leaving a cleared trail on a dirty carpet. The new findings reveal the structure of the gap more clearly than ever before. Because CoKu Tau 4 is only about one million years old, the possible planet would be even younger. As a comparison, Earth is approximately 4.5-billion years old.

"*These early results show Spitzer will dramatically expand our understanding of how stars and planets form, which ultimately helps us understand our origins*," said Dr. Michael Werner, Spitzer project scientist. Spitzer also discovered two of the farthest and faintest planet-forming discs ever observed. These discs surround two of more than 300 newborn stars uncovered for the first time in a stunning new image of the dusty stellar nursery called RCW 49. It is approximately 13,700 light-years from Earth in the constellation Centaurus.

"*Preliminary data suggest all 300 or more stars harbor discs, but so far we've only looked closely at two. Both were found to have discs,*" said Dr. Ed Churchwell, principal investigator of the RCW 49 research, with Dr. Barbara Whitney.

Planet forming, "protoplanetary," discs are a natural phase in a star's life. A star is born inside a dense envelope of gas and dust. Within this envelope, and circling the star, is a flat, dusty disc, where planets are born.

"*By seeing what's behind the dust, Spitzer has shown us star and planet formation is a very active process in our galaxy*," Churchwell said. Spitzer's exquisitely sensitive infrared eyes can see planet forming discs in great detail. "*Previously, scientists could study only a small sample of discs, but Spitzer is already on its way toward analyzing thousands of discs*," Werner said. Spitzer's infrared spectrograph instrument, which breaks apart infrared light to see the signatures of various chemicals, was used to observe the organic ices and the clearing within CoKu Tau 4's disc. Spitzer's infrared array camera found the new stars in RCW 49.

MEASURING THE SUN'S SMALLEST VISIBLE MAGNETIC FIELDS

Solar physicists from Lockheed Martin and The Institute of Theoretical Astrophysics of the University of Oslo have analyzed the highest resolution images ever taken near the solar disk center and found surprising new small-scale magnetic field structures. Their results, which were reported yesterday at the American Astronomical Society's meeting in Denver, address long-standing issues on the formation and decay of sunspots and the forecasting of magnetic activity such as solar flares and coronal mass ejections. Such activity influences the upper atmosphere and magnetosphere of Earth and can damage satellites in orbit.

"*These new images and magnetic field measurements show that the Sun can still surprise us when we look at things 100 km (62 mile) in size*," said Dr. Tom Berger, principal investigator on the study, and solar physicist at the Lockheed Martin Solar and Astrophysics Lab (LMSAL) at the company's Advanced Technology Center. "*Using the Swedish one-meter Solar Telescope (SST) on the island of La Palma, we have discovered new ways in which the smallest 'elements' of the Sun's magnetic field arrange themselves in the turbulent flowfields of the Sun's surface.*"

The Sun undergoes an 11-year cycle in which its magnetic flux, as seen most prominently in the form of dark sunspots, peaks and wanes. Sunspots demarcate highly magnetic 'active regions' in the solar atmosphere that unleash flares and coronal mass ejections. When coronal mass ejections are directed toward Earth they can damage satellites in orbit, expose high flying airplanes to radiation, and even adversely effect power stations on the ground. Scientists still do not understand how active regions are formed, why they vary with a roughly 11-year period, or how and when flares and mass ejections occur.

In addition to the large and obvious sunspots, active regions contain a myriad of smaller magnetic structures surrounding the sunspots. These smaller structures are much more dynamic than sunspots, constantly emerging, moving, and rearranging due to their interactions with the convective flowfield. This constant motion in the small- scale 'plage' fields around sunspots builds up magnetic 'tension' in the larger scale magnetic fields, like a spring winding tighter and tighter. The magnetic 'spring' eventually snaps causing 'magnetic reconnection' and subsequent flares and/or mass ejections.

Scientists are uncertain of the origin of the small-scale magnetic structures on the Sun. Some of the structure clearly originates from sunspots as they decay away over their lifetime. But small-scale structure is found all over the Sun, often far from sunspots in regions of 'quiet Sun.' Sunspots are believed to be formed by a 'global-scale dynamo' system located about 30% of the way down to the Sun's center, at the bottom of the 'convection zone.'

However recent observational and theoretical evidence suggests that most of the small-scale magnetic flux in the quiet Sun may be generated by a 'local dynamo' mechanism seated in the upper convection zone and photosphere. Determining where and how magnetic fields are generated on the Sun, and by inference on other stars as well, is a key goal of astrophysics.

The images used in this study (that can be accessed at the URL below) reveal small-scale magnetic fields in the area of a decaying active region. By studying the structure and motion of these small-scale fields, scientists hope to be able to differentiate between magnetic structures generated from sunspot decay and those perhaps generated by a local dynamo process.

When these images were first seen, Dr. Berger and the team were surprised to find a variety of magnetic formations that had not previously been seen on the Sun. Earlier studies, based on images from smaller telescopes, had led scientists to believe that small-scale magnetic structure always took the form of small discrete 'flux tubes,' or individual blobs of magnetic field. However the new images show surprising 'ribbon' and 'flower' structures that indicate much more complex interactions of the small-scale magnetic field with the granule flowfield.

In addition to the images, the new data includes the highest resolution magnetogram, or direct measurement of the density of magnetic fields on the Sun, ever taken. By combining the images and the magnetogram, Dr. Berger and the team are measuring the magnetic content of these new structures for the first time. Further studies of magnetic flux in quiet Sun regions will be used to compare with the images shown here in an effort to understand the origin and fate of small-scale magnetic flux on the Sun.

Preliminary analyses of the data are in a paper submitted to the journal Astronomy & Astrophysics. Future studies will examine movies of these small-scale structures to determine their dynamical interactions with the solar granules. http://www.lmsal.com/Press/SPD2004/

DOUBLE STARS EMERGE AS NEW HEAVYWEIGHT CHAMPIONS

About 20,000 light-years from Earth, two massive stars grapple with each other like sumo wrestlers locked in combat. Both giants, each weighing in at around 80 times the mass of our Sun, are the heaviest stars ever. They orbit each other every 3.7 days, nearly touching as they spin on the celestial stage. And they lead tempestuous lives worthy of any Hollywood couple, blasting each other with hot, violent stellar winds.

"*We could not resist exploring this system because it's so remarkable. It's a place of true extremes*," said astronomer Alceste Bonanos. The binary star system Bonanos studied, known as WR 20a, was pegged as particularly interesting only weeks ago by a team of European researchers headed by Gregor Rauw. That team's spectroscopic observations showed that both stars were very massive. However, the only way to determine the masses precisely was to establish at what angle we were viewing the system, as well as the orbital period.

Bonanos and her advisor, Krzysztof Stanek, requested photometric observations from the Optical Gravitational Lensing Experiment (OGLE) team led by Andrzej Udalski. Bonanos and Stanek knew that if the system were nearly edge-on, one star would periodically pass in front of, or eclipse, the other. Fortuitously, those eclipses were detected by the OGLE group, thereby firmly establishing the characteristics of the system.

"*When we realized how important it would be to obtain an accurate light curve for WR 20a, we immediately decided to contact Andrzej Udalski, who leads the Polish project known as OGLE. They are a premier facility for optical surveys, and we were very happy when they agreed to collaborate on this project,*" said Stanek. Observations were collected in May 2004 with the 1.3-meter-diameter OGLE telescope at the Las Campanas Observatory in Chile. "*The results have exceeded our expectations; after just two nights, we realized that the star significantly changed its brightness, and after a few more we were certain that the system is eclipsing*," said Udalski. "*After obtaining data each night for more than two weeks, we were able to measure very accurately the period, inclination angle, and hence the masses of the two stars*," added Stanek.

A System of Extremes

WR 20a is part of the Westerlund 2 star cluster, which resides in a region of ionized hydrogen left over from the cluster's formation in the constellation Carina. WR 20a contains two hot, young Wolf-Rayet stars - a type of star that is extremely rare and short-lived. "*Wolf-Rayet stars are likely progenitors of the extremely powerful explosions known as gamma-ray bursts*," said Bonanos. "*These stars are already 2 or 3 million years old. In another few million years, whichever one is slightly more massive will undergo core collapse and blast off its outer layers. The companion star likely will survive despite its nearness, at least until it goes supernova sometime later*."

While other stars, such as the Pistol Star and eta Carinae, are suspected of containing enough material to make more than 100 Suns, their masses have not been determined accurately. The possibility exists that they are simply very close binaries. WR 20a is the most massive known binary system where both stars have precisely determined masses.

"*It is important to study and understand these massive stars because they probe the realm of the first stars that formed in the Universe. Learning more about this system will help improve star formation models, as well as increase our understanding of the connection of these stars to supernovae and gamma-ray bursts*," said Stanek. This research has been posted online at http://arxiv.org/abs/astro- ph/0405338 CfA scientists, organized into six research divisions, study the origin, evolution and ultimate fate of the universe. High-resolution artwork is available online at: http://cfa-www.harvard.edu/press/pr0418image.html

ULTRA-COOL DIMINUTIVE STAR WEIGHS IN

The power of the some of the world's biggest telescopes has been brought to bear to directly measure the mass, for the first time, of one of the smallest stars ever seen in the universe. Barely the size of the planet Jupiter, the dwarf star weighs in at just 8.5 percent of the mass of our Sun.

This is the first ever mass measurement of an L-type dwarf star belonging to a new stellar class of very low mass objects in space discovered just a few years ago. The observation is a major step toward our understanding of the types of objects that occupy the gap between Sun-like stars and planets.

The star, named 2MASSW J0746425+2000321, is a binary star that was observed for four years with the ESO Very Large Telescope (Chile), the Keck Telescopes (Hawaii), and the Hubble Space Telescope. The mass was measurable because the so-called L-Dwarf is in orbit around an even smaller object, a brown dwarf that is 6.6 percent of the Sun's mass, and too puny to shine by nuclear fusion. The L-Dwarf is precariously close to the theoretical minimal fusion limit, which is 8 percent of our Sun's mass.

FROM THE EDITOR'S TERMINAL

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

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In June's Stargazer:

The next EAS Meeting is 7:00 P.M. Saturday, June 26th at the Providence Pacific Clinic – 916 Pacific Avenue in Everett.