

The Stargazer

May 2007

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

See EAS website at:

http://members.tripod.com/everett_astronomy

EAS BUSINESS...

**NEXT EAS MEETING – SATURDAY MAY 12TH AT
 3:00 PM AT THE EVERETT PUBLIC LIBRARY, IN THE
 AUDITORIUM (DOWNSTAIRS)**

★★★ MAY 12th MEETING PROGRAM: ★★★

This Saturday May 12th at 3:00 PM at Everett Public Library auditorium our speaker will be **Dr. Don Brownlee from UW Astronomy, Principle Investigator of the Stardust mission.** *He will be giving an update on the Stardust mission to Comet Wild 2 ('vilt 2'), and results obtained from studying the particles captured and returned to Earth from the mission.* Dr. Brownlee's presentations are always fun and interesting -- Don't miss it !

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>

★ STAR PARTY INFO ★

Upcoming EAS star party schedule: (also see the regional star parties listed in the 'Astro Calendar for 2007')

Friday May 11th, and Saturday May 19 - weather permitting.

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

Listed below are proposed dates for **planned EAS star parties** at my [Ron Tam's] place, depending upon the weather, of course.

May 19 - Saturday
Jun 16 - Saturday
Jul 07 - Saturday
Aug 11 - Saturday
Sep 08 - Saturday
Sep 19 - Saturday
Oct 13 - Saturday
Nov 10 - Saturday

Other dates may be available, but these coincide with times around the new moon, and any conflicts we may have.

Fire In The Sky 2007 rocket launch in Mansfield, WA during the Memorial Day weekend is in a couple of months. The Tacoma Astronomical Society will be there with their telescopes having their star party. The EAS group is welcome to come out and join the crowd. You can see a pic of the flyer for the launch at:

<http://www.rocketsnw.com/uploads/FITS2007Flyer3JPEG800X600.jpg>

PacSci Astronomy Weekend in North Cascades - July 13-15

This July, Pacific Science Center is excited to offer a weekend of astronomy and natural discovery for its members. Educators from Pacific Science Center and the North Cascades Institute are teaming up to offer a variety of hands-on, family-friendly educational programs. During the day, there will be astronomy classes, guided nature hikes and canoe trips on nearby Diablo Lake. And then at night, discover the night sky like you've never seen it before. We hope you'll join us for a great weekend. July 13-15, North Cascades Environmental Learning Center North Cascades National Park. More information including pricing, detailed program, and reservation forms available shortly, so please check back at Pacific Science Center's website. http://www.pacsci.org/travel/astronomy_weekend.html

People should also join and send mail to the mail list everett_astronomy@topica.com to coordinate spur-of-the-moment observing get-togethers, on nights when the sky clears. We try to hold informal close-in star parties each month during the spring, summer, and fall months on a weekend near the New moon at a member's property or a local park. (call Jim Bielaga at (425) 337-4384 for info or check the EAS website.) Members contact Jim Bielaga for scope borrowing.

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

The club maintains a \$950+ balance. We try to keep approximately a \$500 balance to allow for contingencies. .

CLUB SCOPES

SCOPE	LOAN STATUS
10-INCH WARD DOBSONIAN	ON LOAN
10-INCH SONOTUBE DOBSONIAN	AVAILABLE
8-INCH DOBSONIAN	AVAILABLE

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

EAS MEMBER NEWS

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

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

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

- Clear Skies, Jim Bielaga”



Aurora Astro

Aurora Astro Products
 11419 19th Avenue SE #A102
 Everett, WA 98208
 425-337-4384
www.auroraastro.com
 Open Monday - Friday 9:00 am to 6:00 pm
 Saturday 10:00 am to 5:00 pm
 Over 37 product dealerships, and growing

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

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

- Club established date
- Who started the club
- When club joined the Astronomical League.

ASTRO CALENDAR FOR 2007**May 2007**

May 11 - Friday, EAS Star party at Ron Tam's
May 12 - EAS May Meeting 3:00 PM – Everett Public Library
 May 13-20 - Texas Star Party - <http://www.texasstarparty.org/>
 May 17 - Comet 2P Encke Closest Approach to Earth (0.507 AU)
May 19 - Saturday, EAS Star party at Ron Tam's
 May 25-28 - Riverside Telescope Makers Conf. - <http://www.rtmcc-inc.org/>
May 26-28 - Fire In The Sky (WAC launch & star party)
<http://www.washingtonaerospace.org/launches.php>
 May 28 – Memorial Day Holiday

June 2007

Jun 01 - Asteroid 4 Vesta Closest Approach To Earth (1.14 AU)
 Jun 06 - Jupiter at opposition
 Jun 9-16 Grand Canyon Star Party -
<http://www.tucsonastronomy.org/gcsp.html>
 Jun 14-17 Rocky Mountain Star Stare - <http://www.rmss.org/>
Jun 16 - EAS March Meeting 3:00 PM – Everett Public Library
Jun 16 - Saturday, EAS Star party at Ron Tam's
 Jun 18 - Dwarf Planet 134340 Pluto Closest Approach To Earth (30.2AU)
 Jun 20 - Summer Solstice, 20:24 UT
 Jun 22-24 - Klickitat County Star Party - <http://www.klickitatstarparty.net/>
 June 30 - Blue Moon (2nd Full Moon of month)

July 2007

Jul 04 - 4th of July Holiday
 Jul 07 - Earth At Aphelion (1.017 AU from Sun)
Jul 07 - Saturday, EAS Star party at Ron Tam's
 Jul 9-16 - Shingletown Star Party - <http://www.shingletownstarparty.net/>
 Jul 11-14 Golden State Star Party at Mt Lassen NP
<http://www.goldenstatestarparty.org/>
 Jul 13-15 - PacSci Astronomy Weekend in North Cascades
http://www.pacsci.org/travel/astronomy_weekend.html
 Jul 12-14 - Table Mountain Star Party - <http://www.tmspa.com/>
 Jul 13-15 - Klickitat County Star Party - <http://www.klickitatstarparty.net/>
 Jul 14 - OAS Hurricane Ridge Star Party -
http://www.olympicastronomicalsociety.com/hurricane_ridge_star_parties.htm
 Jul 29 - South Delta-Aquarids Meteor Shower Peak

August 2007

Aug 01 - Alpha Capricornids Meteor Shower Peak
Aug 3-4 - ALCON 2007 Portland Oregon - <http://www.alconexpo.com/>
 Aug 06 - Southern Iota Aquarids Meteor Shower Peak
 Aug 8-12 - Mt Bachelor Star Party - <http://www.mbsp.org/>
Aug 11 - Saturday, EAS Star party at Ron Tam's
 Aug 11 - Silver Falls (OR) Star Party -
http://www.oregonstateparks.org/park_211.php
 August 11 - ICAS Artist Point Lookout Star Party -
<http://groups.msn.com/WashingtonICAS/memberonlyevents.msnw>
 Aug 11-19 Mt. Kobau Star Party - <http://www.mksp.ca/>
 Aug 12 - Perseids Meteor Shower Peak
 Aug 11 - OAS Hurricane Ridge Star Party -
http://www.olympicastronomicalsociety.com/hurricane_ridge_star_parties.htm
 Aug 16-19 - Oregon Star Party - <http://www.oregonstarparty.org/>
 Aug 24-26 - RASCal's Star Party - <http://victoria.rasc.ca/events/StarParty/>
 Aug 25 - Northern Iota Aquarids Meteor Shower Peak
 Aug 28 - Total Lunar Eclipse - entire eclipse visible

September 2007

Sep 03 - Labor Day Holiday
 Sep 6-9 - OAS Camp Delaney Fall Star Party -
<http://www.olympicastronomicalsociety.com/Documents/CAMP%20DELANY%20V2.pdf>
Sep 08 - Saturday, EAS Star party at Ron Tam's
 Sep 6-9 Alberta Star Party - <http://calgary.rasc.ca/asp2007.htm>
Sep 15 - ASTRONOMY DAY (For Fall too this year!) Star Party
 Sep 14-16 - Klickitat County Star Party - <http://www.klickitatstarparty.net/>

Idaho Star Party, September 9-11, 2005 Boise Astronomical Society

<http://www.boiseastro.org/>

Sep 19 - Saturday, EAS Star party at Ron Tam's

Sep 20-23 - Orion Nebula Star Party -

<http://www.seattleastro.org/orionneb.html>

Sep 23 - Autumnal Equinox (09:51 UT)

Merritt Star Quest - <http://www.merrittastronomical.com/>

October 2007

Oct 09 - Draconids Meteor Shower Peak

Oct 13 - Saturday, EAS Star party at Ron Tam's

Oct 14 - Dwarf Planet 136199 Eris Closest Approach To Earth (95.8AU)

Oct 12-14 - Klickitat County Star Party - <http://www.klickitatstarparty.net/>

Oct 21 - Orionids Meteor Shower Peak

Oct 31 - Halloween

November 2007

Nov 03 - Taurids Meteor Shower Peak

Nov 04 - End Daylight Saving time - Set Clock Back 1 Hour (US)

Nov 10 - Saturday, EAS Star party at Ron Tam's

Nov 12 - Dwarf Planet Ceres Closest Approach To Earth (1.832 AU)

Nov 17 - Leonids Meteor Shower Peak

Nov 22 - Thanksgiving Holiday

December 2007

Dec 07 - 35th Anniv (1972), Apollo 17 Launch (Last Mission to Moon)

Dec 13 - Geminids Meteor Shower Peak

Dec 22 - Winter Solstice, 22:06 UT

Dec 22 - Ursids Meteor Shower Peak

Dec 24 - Mars at opposition

Dec 25 - Christmas Holiday

UW Astronomy Speakers 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, (or at 11:30 in C520).** www.astro.washington.edu/dept/colloquium.html

May 12 - Kristen Larson, WWU, 'Dust Maps: Characterizing Extinction and Reddening of Gas at High Galactic Latitude'

May 19 - Josh Grindlay, 'Chandra-HST Studies of Compact Objects and Binaries in Globular Clusters'

May 26 - Paul Boynton, U.W. Astronomy 'Discovery of the CMBR: Looking Back 40 Years'

Jun 02 - Jim Bell, Cornell, 'Sprit and Opportunity on Mars'

Jun 09 - Anjum Mukadam, U.W. Astronomy, tba

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

"Our group of radio script writers now consists of EAS and SAS members Jim Ehrmin, Greg Donohue, and Ted Vosk, who are now regularly writing and helping to produce our **astronomy radio show, "It's Over Your Head"** on radio station **KSER, FM 90.7**. The 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 MEMBERSHIP BENEFITS & INFORMATION

EAS Benefits -

Membership in the **Everett Astronomical Society (EAS)** includes invitations to all of the club meetings and star parties, plus the monthly

newsletter, **The Stargazer**. Currently, a 10% discount is also being offered to EAS members for purchases at Aurora Astro Products in Everett

Magazine Discounts -

In addition you will be able to subscribe to **Sky and Telescope** for \$7 off the normal subscription rate, contact the treasurer (Carol Gore) for more information.

http://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 Carol Gore will renew your *Sky and Telescope* subscription for you. **Astronomy** magazine offers a similar opportunity to club members.)

Membership in the Astronomical League -

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

EAS Club Telescope Borrowing -

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

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

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

EAS Library -

Membership will give you access to all the material in the lending library. The library, which is maintained by Mike Locke, consists of VCR tapes, DVDs, many books, magazines, and software titles. The EAS has a library of books, videotapes, and software for members to borrow. We always value any items you would like to donate to this library. You can contact a club officer or **Librarian Mike Locke**, phone (425) 259-5995, email mlocke at lioninc.com, to borrow or donate any materials. See list here: http://members.tripod.com/everett_astronomy/eas_library.htm

Joining or Renewing with the EAS -

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

Send your annual dues renewals to the Everett Astronomical Society

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

OBSERVER'S INFORMATION...

LUNAR FACTS

May 10	Last Quarter Moon
May 16	New Moon
May 23	First Quarter Moon
Jun 01	Full Moon
Jun 08	Last Quarter Moon
Jun 15	New Moon
Jun 22	First Quarter Moon
Jun 30	Full Moon
Jul 07	Last Quarter Moon
Jul 14	New Moon
Jul 22	First Quarter Moon
Aug 02	Full 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	04:37am	12:05	19:34	Ari	-27.5
Mercury	Daylight	Daylight	20:36	Psc	-1.3
Venus	Daylight	Daylight	23:23	Gem	-4.2
Mars	02:52 am	Daylight	Daylight	Psc	+0.9
Jupiter	21:40	02:01 am	Daylight	Oph	-2.5
Saturn	Daylight	20:09	1:39 am	Leo	+0.3
Uranus	02:31am	Daylight	Daylight	Aqr	+5.9
Neptune	01:33 am	Daylight	Daylight	Cap	+7.9
Pluto	21:56	02:47 am	Daylight	Sag	+13.9

(times local time for Everett PDT)

Observing Jupiter's Moons – Java tool

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

Transit times for Jupiter's Great Red Spot in 2007

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

NOAA SUN CALCULATOR

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

CONSTELLATION OF THE MONTH (SCUTUM)

SCUTUM: “The Shield” as this constellation is also known, borders on the constellations of Aquila, Sagittarius, and Serpens. It ranks 33rd in overall brightness among the constellations, containing 9 stars brighter than magnitude 5.5. Its central point is located at RA=18h37m and Dec.= -10 degrees. It is completely visible from latitudes South of +74 degrees, and completely invisible from latitudes North of +86 degrees. This constellation ranks 84th in overall size, taking up 109.11 square degrees, or 0.265% of the sky. Scutum has no known meteor showers, but two associated Messier objects (M-11 and M-26); it has no associated asterisms. Its midnight culmination date is July 1st, and its solar conjunction date is December 31st. M-11 is one of the finest open clusters (see “Mirror Images” in last month's Star Gazer) in the sky. The common name of this cluster comes from the well-known Bedford Catalogue (1844) by William Henry Smyth. He is quoted as saying: “This object, which somewhat resembles a flight of wild ducks in shape, is a gathering of minute stars, with a prominent 8th magnitude in the middle, and two following...”. This cluster has been known as “The Wild Duck” ever since. M-11 is also known as NGC 6705, and it lies directly in the very rich area of the Milky Way known as the Scutum star cloud. It is estimated that M-11 contains more than 600 stars brighter than 15th magnitude, contained in an area of 12 minutes of arc across. At the cluster's distance of 6,000 light-years, this corresponds to a linear diameter of 21 light-years. M-26 (NGC 6694) is another galactic cluster in the Scutum star cloud, about

3.5 degrees southwest of M-11. M-26 contains about 90 stars brighter than 15th magnitude in an area of about 11 arc minutes diameter; M-26 is 16 light-years in linear diameter.

PLANETARY FOCUS

The focus of this month “Planetary Focus” column is **JUPITER** (now up almost all night in the Southeast near the constellation of Scorpius):

Rotation around the Sun: every 11.86 years

Orbit: from 4.95 (closest or ‘perihelion’) to 5.46 (furthest or ‘aphelion’)

Astronomical Units (AU)*: this is an orbit that varies between approximately 460 and 508 million miles from the sun. (*Note: One AU equals approximately 93 million miles).

Inclination of Orbit to Ecliptic: 1.3 degrees.

Mean Orbital Velocity: 13.06 km/sec.

Diameter at Equator: 142,985 kilometers (or 88,865 miles).

Mass: 317.83 (approximately 318 times more massive than earth); (5.9742 x (10 e24 (10 to the 24th power)) kilograms = 1 Earth Mass).

Density: 1.3 times that of water (global density).

Surface Gravity (Earth = 1): 2.54

Period of Rotation on its own axis: approximately 9 hours, 55 minutes.

Axis tilt: 3.12 degrees.

Satellites (moons): 16, as well as planetary rings.

Special Notes About Jupiter: Jupiter is the largest planet in the solar system. Its rotation period is shorter than that of any other planet (less than 10 hours); this leads to a polar diameter (133,718 kilometers), much shorter than the equatorial diameter. Jupiter's mass is more than twice that of all the other planets combined. A density of only 1.3 times that of water however, suggests that it is mostly composed of the lighter elements of hydrogen and helium. At opposition (approximately every 13 months), Jupiter shines at an apparent magnitude of -2.5, and has an apparent diameter of 47 arc seconds. Among the 16 moons of Jupiter are the four famous Galilean satellites (Io, Europa, Ganymede (the largest moon in the entire solar system), and Callisto), all discovered in 1610 by Galileo (and independently by Simon Marius). These Galilean moons (see below) are bright enough to be seen with binoculars. Although not as famous or readily visible as Saturn's, Jupiter also has a ring system; they were discovered as the Voyager 1 probe moved inside of the orbit of one of the other 12 moons of Jupiter (Amalthea) in 1979. Jupiter has a series of wind-driven bands of light clouds (zones) and dark clouds (belts) that cross the disc of the planet parallel to the equator. Within these belts and zones, irregular streaks and spots are seen, including the Great Red Spot, which has been observed from earth since the 17th century; most of these spots and streaks are far more transitory or temporary, however. Several probes have flown by and investigated Jupiter's atmosphere and structure. These include Pioneer 10 and 11, the Voyager probes, and the Ulysses, and Galileo probes. Cloud zones and belts predominate below about +/- 45 degrees latitude. The lighter colored zones appear to be comprised of ammonia crystals, and are higher clouds lifted by convection of warmer gases; the darker belts are comprised of lower clouds of descending gas flows, and appear to be comprised of hydrogen, sulfur compounds, ammonium hydrosulphide, and possibly organic compounds formed in photochemical reactions. Jupiter is about 90% hydrogen and 10% helium with lower percentages of

methane, water, ammonia, other trace compounds, and "rock" (core). This is similar to the composition of the primordial Solar System Nebula from which the entire solar system was formed. The rapid rotation of Jupiter produces the colorful cloud systems.

Our knowledge of the innermost aspects of Jupiter (and the other gas planets) is very indirect. Jupiter's core is most likely silicate rock and iron, and above this is the vast bulk of the planet in the form of liquid metallic hydrogen. Outside of this is a layer of molecular hydrogen and helium, followed by the outermost hydrogen and helium atmosphere, with traces of other compounds as mentioned above. Liquid metallic hydrogen consists of ionized protons and electrons (like the interior of the Sun but at a far lower temperature). At the temperature and pressure of Jupiter's interior, hydrogen is a liquid, not a gas; it is also an electrical conductor and the source of Jupiter's immense magnetic field; this magnetic field is about 19,000 times stronger than the earth's. Jupiter radiates about twice as much heat as it receives from the sun, indicating an internal reservoir of heat energy left over from its creation. This energy may play a part in Jupiter's dynamic zonal and belted cloud (weather) systems (by contributing to convection and very high winds, for example). This energy flow, the planet's rapid rotation, and a greenhouse effect, help to minimize temperature variations in various regions of the planet. Jupiter also emits radio waves (by several mechanisms), but is not massive enough to undergo nuclear fusion reactions like the sun; Jupiter would have to be about 80 times more massive than it is for this to happen. Briefly, Jupiter's Galilean Moons are very interesting in their own right. Europa (the smallest) is smaller than the earth's moon; it is a smooth moon with an icy crust, which is crisscrossed by streaks and cracks. Callisto is the faintest and outermost of these famous moons, and is heavily rayed and cratered. Callisto is believed to have a thick crust of ice and rock, beneath which is thought to be water; this moon also has several systems of concentric ring mountain formations. Ganymede, the largest moon in the entire solar system, is also the brightest of these four Galilean moons. The main surface features on Ganymede are darker cratered areas, and lighter, geologically younger areas with long parallel grooves (sulci); these two features intermingle, and give Ganymede a very elaborate surface appearance; there are areas of exposed ice and long parallel mountain ridges. Finally, Io (the innermost) has intense volcanic action, and volcanoes have been seen to eject material over very extensive areas on this moon; Io is the most volcanically active body known in the solar system. Io orbits within Jupiter's magnetosphere, and its volcanic activity is thought to result from the heating gained by interaction with Jovian tidal forces. Erupted material (such as sulfur and hydrogen) escapes into the Jovian magnetosphere and is ionized; it forms a ring or torus centered on Io. This ionized matter may affect several phenomena on Jupiter, including aurorae and radio bursts.

One very famous surface feature of Jupiter should be mentioned: The Great Red Spot. This oval spot is located about 22 degrees south of Jupiter's equator. It is an immense high pressure storm (anticyclone), much colder and higher than surrounding clouds. It has been noted that the Great Red Spot (GRS) rotates in a counterclockwise manner with a rotation period of about six days. The north winds on the spot are blowing to the west; the south winds to the east; these outer perimeter winds can reach velocities of over 250 mph. The GRS has been observed for over 300 years (first observed by Robert Hooke in 1664), with variations in size, brightness, and color. At its greatest observed dimensions, the GRS can be as large as 40,000 by 14,000 kilometers. Color varies from pale pinkish beige to bright red; these color changes have been attributed to chemical changes,

such as the conversion of phosphene into red phosphorous. Try to enjoy this beautiful planet when visible anytime, but most especially, as for any superior (outside) planet, at opposition.

YOUNG ASTRONOMER'S CORNER

The following column publishes yearly in the EAS newsletter. It was also handed out at this year's Astronomy Day in April. It is always a timely column, especially this time of year when people are starting to get out again for outdoor pursuits... hopefully this will include stargazing for you and your family this year!

Star Parties: Hints for More Enjoyable Stargazing!!!

Star "Parties" are simply gatherings of people who are interested in looking at the stars and learning about the night sky, either with telescopes, binoculars, or just the naked eye (or any combination thereof!). If you can go to an official Star Party this summer with family or friends, such as the upcoming Table Mountain Star Party or Oregon Star Party, you should. Less 'formal' Star Parties given year-round and locally by amateur astronomers (such as those in the Everett Astronomical Society) are also lots of fun. It is a wonderful experience to look at the beautiful night stars and sky, and to meet lots of great people and perhaps make new friends. Your experience can be even more enjoyable if you follow a few certain 'rules' and hints that are tried and true in amateur astronomy circles, to help make your experience the most enjoyable and rewarding it can be. Some of these suggestions may even be "official" star party rules or regulations that must be followed in courtesy to other observers (these rules will be noted as such). (If you would like more information about Astronomy, Star Parties, and the Everett Astronomical Society in general, log on to: http://members.tripod.com/everett_astronomy/). So if you follow these specific practices and helpful hints, you're sure to have a great time at the next Star Party you attend:

★★ Dress warmly, or be prepared to dress warmly. Just because the evening starts out warm, it doesn't necessarily mean that it will end up that way. So take warm clothes with you just in case.

★★ The warmest clothes include polypropylene worn directly against the skin; other warm clothes include those made of wool. Layered cotton materials can also be warm, but you tend to need more layering, and if they get wet, cotton clothes do not transport moisture away from the body (like polypropylene and wool), and are more likely to chill you.

★★ Make sure you have a good hat that covers the ears, and also good gloves as well. Polypropylene glove liners make excellent astronomy gloves because they are not bulky, making it easier to use flashlights, eyepieces, and charts, for example.

★★ Never underestimate the power of a good hooded piece of clothing. Wearing a hood cuts down, and can sometimes almost eliminate, cool or cold wind from going down your neck and down your back or front. Wearing a hood serves two purposes: it cuts down on the aforementioned wind, and also helps to keep body heat in, as the head radiates more heat away from the body than any other area. A good hat that covers the ears is also essential in keeping body heat in.

★★ Always wear warm socks. Again, socks that conserve heat and take moisture away from the skin (such as polypropylene or wool) are excellent. It doesn't hurt to have an extra pair or two on hand either just in case it's extra nippy for you.

★★ A good windbreaker (such as Gortex or nylon), which also has an integral hood, is an excellent way to conserve body heat and minimize chill, and can be used over other layered clothing as necessary.

★★ Always eat well and drink plenty of fluids to avoid dehydration. Good nutrition (and yes, including carrots or other sources of Vitamin A which improves night vision) and hydration helps to maintain alertness, body warmth (especially by using drinks like hot chocolate), and helps to battle fatigue. Being hungry and thirsty, like in many other areas of life including school work, does not make for an enjoyable experience. Most areas allow camp stoves, but open fires are usually prohibited.

Importantly, alcohol and nicotine can interfere with the conservation of body heat. Also, tobacco use may also be annoying to your fellow astronomers, as the majority of people are non-smokers. So always be courteous to your fellow astronomers, and good to your own body, by NOT smoking.

★★ Always follow established Star Party etiquette. Use red flashlights ONLY, and point them downwards so as not to shine them in someone's eyes. Using any color other than red will cause your night adapted vision (the ability to see some contrast in the dark, and to see beautiful telescope objects more clearly) will be interrupted, and will not return to where it was at least for a good 20 minutes to a half-hour. (Night vision is never perfect, so it is also important to know your immediate surroundings and move slowly and ask questions if you are unsure of them; this helps to protect you from injury and from damaging other people's equipment). The use of red lights is a basic star party rule, and is a courtesy to other astronomers as well. No white lights (including car headlights!) are ever allowed in proximity to an official and large Star Party after darkness has arrived. Note: you may also want to have extra batteries for your red light, just in case.

★★ Everybody has different tastes in music. If you would like to listen to music while you observe, it is best and most often a Star Party rule (as well as a courtesy to your neighbors) to wear headsets. Star Parties may also have rules about pets, so be sure to check those rules out as well. If they are allowed, they should not be roaming freely.

★★ Always ask an amateur astronomer if it is OK to look through his or her scope. They make be taking pictures, or they may want to take a rest for a while without being disturbed. It is common courtesy to always respect another's wishes. Many, if not most, astronomers are very friendly and love to have people look through their telescopes, but always be sure to ask.

★★ Star Parties are frequently held in remote areas. It is never a good idea to go to unknown or remote areas alone. Also remember that such areas are also remote from medical attention. If you have bee-sting allergies, or other potential serious conditions, always be prepared, and be prepared for the fact that you may be an hour or more from medical attention. Always let someone at home know where you are and where you will be, including expected time of arrival back home.

★★ It is not necessary to have a telescope to enjoy a star party. A lawn chair and a blanket, perhaps with a pair of binoculars and a good, basic book of the sky, can give you countless hours of enjoyment and learning about astronomy without spending much money. *IT IS NOT NECESSARY TO SPEND LOTS OF MONEY TO ENJOY THE NIGHT SKY.* Going to a Star Party sponsored by your local astronomy club, or perhaps even joining your local astronomy club, is a GREAT way to learn about astronomy. Star parties also give you the opportunity to meet new people, ask lots of questions (and perhaps share your knowledge of astronomy too), as well as to look through many telescopes and possibly binoculars as well.

★★ Finally, respect for your fellow astronomers by following the simple rules as listed above, and respect for the environment

(never leave trash around, and stay away from fragile areas of grass and wilderness) will also make your Star Party experience more enjoyable. See you at an upcoming Star Party!!

ASTRONOMY AND TELESCOPE LINGO

ASTRONOMY "LINGO": TESSERA: A type of surface feature found on the planet Venus. It is a rugged and elevated track which extends for thousands of kilometers.

TELESCOPE / EQUIPMENT "LINGO": EVN: The abbreviation for European VLBI Network. It is an interferometric array of radio telescopes in Europe, as well as beyond Europe, which routinely participates in VLBI observations at wavelengths between 1.3 and 90 centimeters.

ASTRONOMY "FUN FACTS"

★★ If the Earth's orbit around the Sun had the same eccentricity as that of Pluto, Earth would approach to within only 12 million miles of Mars at its furthest point from the Sun and to within only about 2 million miles from Venus at its nearest point; this latter distance is only about 8 times the average distance of the Moon from the Earth.

★★ The intense pressure at Jupiter's core is 30 million times that of the pressure of the Earth's atmosphere. If Earth were ever subjected to those extreme pressures, planet Earth would be compressed to only a little more than half its present diameter, and to a density 3-4 times that of iron.

★★ Omega Centauri is undoubtedly the largest globular cluster in the entire Milky Way Galaxy. Omega Centauri's orbit takes it out from the Galactic center to 21,000 light years at its furthest point, and to within 6,200 light-years at its closest point to the Galactic center, during its orbit. Assuming that the entire Milky Way Galaxy is about 13 billion years old, Omega Centauri has orbited around the Galaxy 130 times since the Galaxy's birth, 50 times since the Sun's birth, 6 times since hard-bodies animals such as corals and starfish debuted on Earth, and once since flowering plants arrived. In only one Omega Centauri year, the Earth orbits the Sun 100 million times!!

★★ The Big Bang singularity at Plank time was the ultimate black hole; infinite temperature and density existed; (Plank time is that time after the big bang where the uncertainty principle of quantum mechanics prevents speculation on times shorter than it). What we are and where we live today emerged from this initial black hole. Some scientists conjecture that our universe began as a black hole in another universe, which began as a black hole in another universe, etc..., etc.....!!

★★ The Moon takes two thousandths of a second longer each year to circle the earth: this is about as long as it takes for a balloon to pop. In the far future, there will be increasingly less moonlight time as a result of this, and its light will be dimmer as well, as the earth's only natural satellite gradually pulls farther away.

★★ The interstellar dust in our Galaxy alone is equivalent to the mass of over 450 trillion planet Earths!! More interstellar dust grains can fit into about 12 cubic inches than there are stars in the entire Milky Way Galaxy (i.e., far more than 100 billion dust grains!).

"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: X-RAY BINARY: The most prevalent type of luminous galactic X-ray source. These systems involve a close binary system in which gas either flows (via the inner Lagrangian point) or discharges (from a strong stellar wind) from a normal (nondegenerate) star on to a more compact companion associate star. For the most luminous X-ray binaries, this companion is probably a neutron star or black hole; for less luminous sources, the associate star is probably a white dwarf. Gravitational energy activates these X-ray binary sources, with both luminosity and temperature proportional to the mass to radius ratio of the accreting (e.g. black hole, neutron star, or white dwarf) star. There are two main types of X-ray binaries: high-mass and low-mass. In high-mass binaries, the nondegenerate star (a star NOT composed primarily of degenerate matter such as electrons and neutrons stripped from atoms during gravitational collapse) is an early spectral type (O, B, or A) giant or supergiant; in low-mass binaries, the nondegenerate star is a middle or late main-sequence star with a mass approximately equal to that of our own Sun. Several X-ray binaries contain a pulsating X-ray source (which may be a magnetized, rotating neutron star), and the most luminous among them (such as Scorpius X-1 and Cygnus X-3) are also very strong variable radio sources which also sometimes emit radio flares.

REPRESENTATIVE NORTHERN HEMISPHERE ITEM: HERCULES X-1: A low-mass X-ray binary star in the constellation of Hercules (the low-mass optical companion (HZ Her) is of variable spectral type from A/F to B due to X-ray heating). Hercules X-1 exhibits regular (every 1.24 seconds) X-ray pulsations, binary companion star eclipses every 1.75 days, and longer-period modulations (35-day cycles) of X-ray intensity. Hercules X-1 was the first X-ray binary to be optically identified. The mass and rapid pulsations of the X-ray component suggest that it is a rotating neutron star; it is thus often referred to as an X-ray pulsar.

REPRESENTATIVE SOUTHERN HEMISPHERE ITEM: CENTAURUS X-3: The first X-ray binary to be discovered; it is located in the constellation Centaurus. It is a high-mass X-ray binary (the optical companion is a 13th magnitude spectral type O-6.5 supergiant), with regular X-ray eclipses observed every 2.09 days, with rapid pulsations of the X-ray source (a 4.8 second period), related to the rotation of a magnetized neutron star. Centaurus X-3 is thus also known as an X-ray pulsar.

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

DID WILLIAM HERSCHEL DISCOVER RINGS OF URANUS IN 1800s ?

In a recent paper, Dr. Stuart Eves challenges the orthodox view that the rings around the planet Uranus were first detected during an occultation experiment in 1977. Remarkably, a paper presented to the Royal Society in December 1797 by the then King's Astronomer, Sir William Herschel, (who had discovered Uranus in 1781), includes a description of a possible ring around

the planet. Dr. Eves believes this is the first observation of the rings that were not seen again for almost two hundred years.

Even Herschel was unable to confirm his possible sightings, and they were not repeated by several generations of astronomers who came after him. (Prior to 1977, when astronomers thought that Uranus lacked rings, Herschel's claims were dismissed as "clearly erroneous". And even after 1977, when the existence of the rings was finally established, it was suggested that the rings were far too dim to have been detected by Herschel's telescopes, and so his claim to priority was ignored). However, a recent re-evaluation of Herschel's 1797 paper by Dr. Stuart Eves suggests that Herschel's claim to have seen one of the rings may well have been correct. "*Herschel got a lot of things right!*", notes Dr. Eves, "*He has a ring of roughly the correct size relative to the planet, and he also has the orientation of this ring in the right direction. In addition, he accurately describes the way the appearance of the ring changes as Uranus moves around the Sun, and he even gets its color right. Uranus's Epsilon ring is somewhat red in color, a fact only recently confirmed by the Keck telescope, and Herschel mentions this in his paper.*"

But if Herschel could see the Epsilon ring in the late 1700s, why did no-one else follow up his observations in subsequent years as the telescopes astronomers used improved? "*There are several mechanisms that could account for this*", suggests Dr. Eves. "*The current Cassini satellite mission to Saturn is telling us that its rings are becoming darker and also expanding, (becoming more diffuse), over time. If these same mechanisms are also operating at Uranus, then the appearance of its rings could have changed quite markedly over 200 years, making them much harder to detect.*" Herschel's observations could thus be proof that planetary ring systems in our solar system are far more dynamic than has previously been supposed.

MASSIVE STAR BURPS, THEN EXPLODES

Tens of millions of years ago, in a galaxy far, far away, a massive star suffered a nasty double whammy. Signs of the first shock reached Earth on Oct. 20, 2004, when the star was observed letting loose an outburst so enormous and bright that Japanese amateur astronomer Koichi Itagaki initially mistook it for a supernova. The star survived for nearly two years, however, until on Oct. 11, 2006, professional and amateur astronomers witnessed it blowing itself to smithereens as Supernova (SN) 2006jc. "*We have never observed a stellar outburst and then later seen the star explode,*" said astronomer Ryan Foley. His group studied the 2006 event with ground-based telescopes, including the 10-meter (32.8-foot) W. M. Keck telescopes in Hawaii. Narrow helium spectral lines showed that the supernova's blast wave ran into a slow-moving shell of material, presumably the progenitor's outer layers that were ejected just two years earlier. If the spectral lines had been caused by the supernova's fast-moving blast wave, the lines would have been much broader.

Another group, led by Stefan Immler, monitored SN 2006jc with the Swift satellite and the Chandra X-ray Observatory. By observing how the supernova brightened in X-rays, a result of the blast wave slamming into the outburst ejecta, they could measure the amount of gas blown off in the 2004 outburst: about 0.01 solar mass, the equivalent of about 10 Jupiters.

"*The beautiful aspect of our SN 2006jc observations is that although they were obtained in different parts of the electromagnetic spectrum, in the optical and in X-rays, they lead to the same conclusions,*" said Immler. "*This event was a complete surprise,*" added Alex Filippenko, leader of the UC Berkeley/Keck supernova group and a member of the Swift

satellite team. *"It opens up a fascinating new window on how some kinds of stars die."* All the observations suggest that the supernova's blast wave took only a few weeks to reach the shell of material ejected two years earlier, which did not have time to drift very far from the star. As the wave smashed into the ejecta, it heated the gas to millions of degrees, hot enough to emit copious X-rays. The Swift satellite saw the supernova continue to brighten in X-rays for 100 days, something that has never been seen before in a supernova. All supernovae previously observed in X-rays have started off bright and then quickly faded to invisibility.

"You don't need a lot of mass in the ejecta to produce a lot of X-rays," noted Immler. Swift's ability to monitor the supernova's X-ray rise and decline over six months was crucial to the mass determination by Immler's team. But he added that Chandra's sharp resolution enabled his group to resolve the supernova from a bright X-ray source that appears in the field of view of Swift's X-ray telescope. *"We could not have made this measurement without Chandra,"* said Immler. *"The synergy between Swift's fast response and its ability to observe a supernova every day for a long period, and Chandra's high spatial resolution, is leading to a lot of interesting results."*

Foley and his colleagues propose that the star recently transitioned from a Luminous Blue Variable (LBV) star to a Wolf-Rayet star. An LBV is a massive star in a brief but unstable phase of stellar evolution. Similar to the 2004 eruption, LBVs are prone to blow off large amounts of mass in outbursts so extreme that they are frequently mistaken for supernovae, events dubbed "supernova impostors." Wolf-Rayet stars are hot, highly evolved stars that have shed their outer envelopes. Most astronomers did not expect that a massive star would explode so soon after a major outburst, or that a Wolf-Rayet star would produce such a luminous eruption, so SN 2006jc represents a puzzle for theorists. *"It challenges some aspects of our current model of stellar evolution,"* said Foley. *"We really don't know what caused this star to have such a large eruption so soon before it went supernova."* *"SN 2006jc provides us with an important clue that LBV-style eruptions may be related to the deaths of massive stars, perhaps more closely than we used to think,"* added coauthor and astronomer Nathan Smith. *"The fact that we have no well-established theory for what actually causes these outbursts is the elephant in the living room that nobody is talking about."* SN 2006jc occurred in galaxy UGC 4904, located 77 million light years from Earth in the constellation Lynx. The supernova explosion, a peculiar variant of a Type Ib, was first sighted by Itagaki, American amateur astronomer Tim Puckett and Italian amateur astronomer Roberto Gorelli. http://www.berkeley.edu/news/media/releases/2007/04/04_supernova.shtml

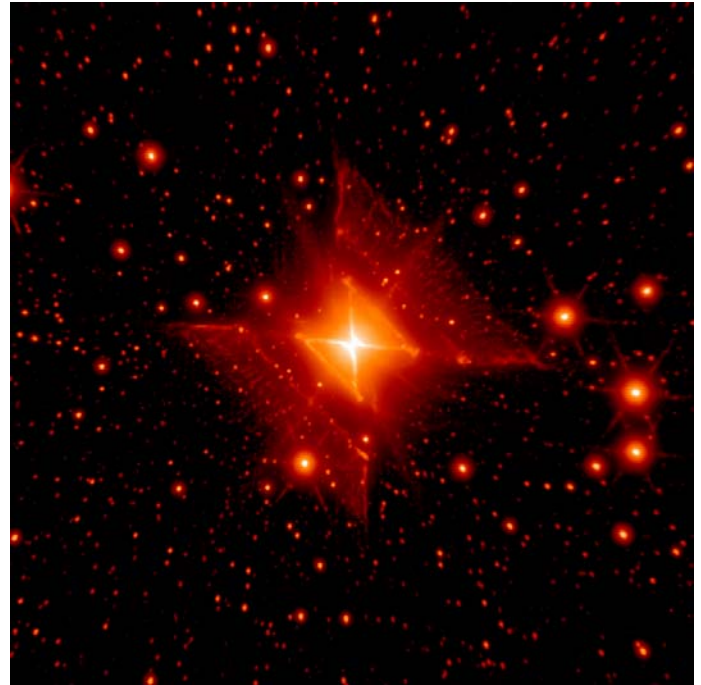
DETAILED IMAGE OF "RED SQUARE" USING ADAPTIVE OPTICS

Astronomers today announced the arrival of a new member in the pantheon of exotically beautiful celestial objects. Christened the "Red Square" by Peter Tuthill, leader of the team, the image was compiled with data from the 200-inch Hale Telescope at Palomar Observatory and the Keck-2 Telescope atop Mauna Kea, Hawaii. *"Discoveries as beautiful -- and interesting -- as this one don't come around very often in astronomy,"* said Tuthill, *"and it took some of the world's most advanced telescopes, together with a good dose of luck, to find this jewel hidden among the myriad stars in the galaxy."* *"The key to finding it was in the revolutionary new imaging technology of adaptive optics, which acts like a myopia cure for a telescope,"* agreed Lloyd. *"Startlingly clear images capable of revealing objects like this are now possible without the blurring."* The pair were studying a hot star called MWC 922 in the constellation Serpens (the serpent

mythologically associated with the origin of medicine). The image shown here combines data taken in near-infrared light (1.6 microns) and shows a region 30.8 arcseconds on a side around MWC 922. As the outer periphery of the nebula is very faint compared to the core, the image has been processed and sharpened to display the full panoply of detail and structure. *"The thing that really takes your breath away is the astonishing degree of symmetry within the intricate linear forms,"* said Tuthill. *"If you fold things across the principle diagonal axis, you get an almost perfect reflection symmetry. This makes the Red Square nebula the most symmetrical object of comparable complexity ever imaged."*

The overall architecture of twin opposed conical cavities (commonly known in astronomy as a "bipolar nebula") is seen to be adorned with a remarkable sequence of sharply defined linear rungs or bars. This series of rungs and conical surfaces lie nested, one within the next, down to the heart of the system, where the hyperbolic bicone surfaces are crossed by a dark lane running across the principle axis. One particularly fascinating feature visible in the images is a series of faint radial spokes, like teeth of a comb, pointing away from the center. *"Structures such as this are rarely seen in nebulae, and the high degree of regularity in this case may point to the intriguing possibility that these bands are shadows cast by periodic ripples or waves on the surface of an inner disk close to the star at the heart of the system,"* said Lloyd. But the most compelling and important implication for astronomy comes from the three-dimensional structure implied by the Red Square images.

"If you can really get a mental grasp of the three-dimensional



geometry implied by the Red Square images," said Tuthill, *"then it is fascinating to take a second look at one of the most famous astronomical images of them all: SN1987A."* An HST image of the supernova shows the beautiful and unexpected ring system revealed around SN1987A -- the only naked-eye supernova since the discovery of the telescope. *"We are not saying that the star MWC 922 at the heart of the Red Square is about to explode as a supernova,"* said Lloyd, *"but we're not ruling it out either, and if it did it would certainly put on quite a show as it kindles the outer*

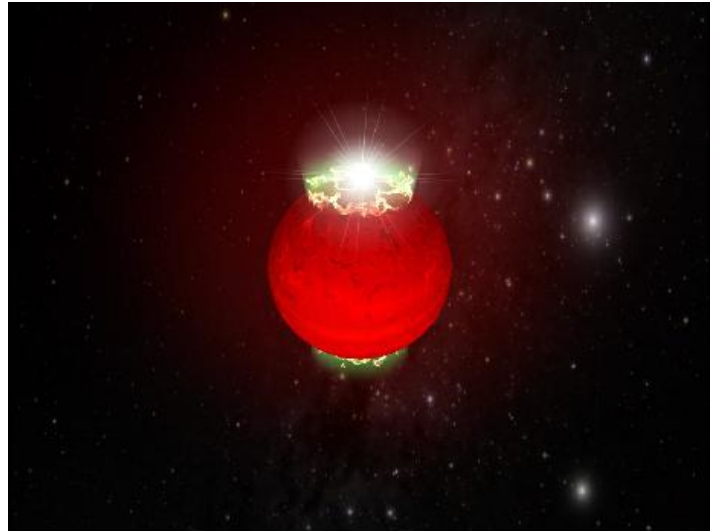
reaches of its nebula." Whatever the fate of the central star, the remarkable series of bars seen in the Red Square make it the best astrophysical laboratory yet discovered for studying the physics of generating the mysterious sharp polar-ring systems like that around SN1987A. According to Tuthill, "This is just the beginning -- a system as complex and fascinating as this is bound to keep us guessing for years to come." <http://www.physics.usyd.edu.au/~gekko/redsquare.html>

BROWN DWARFS: A NEW CLASS OF STELLAR LIGHTHOUSE

Brown dwarfs, thought just a few years ago to be incapable of emitting any significant amounts of radio waves, have been discovered putting out extremely bright "lighthouse beams" of radio waves, much like pulsars. A team of astronomers made the discovery using the Very Large Array (VLA) radio telescope. "These beams rotate with the brown dwarf, and we see them when the beam passes over the Earth. This is the same way we see pulses from pulsars," said Gregg Hallinan. "We now think brown dwarfs may be a missing link between pulsars and planets in our own Solar System, which also emit, but more weakly," he added. Brown dwarfs are enigmatic objects that are too small to be stars but too large to be planets. They are sometimes called "failed stars" because they have too little mass to trigger hydrogen fusion reactions at their cores, the source of the energy output in larger stars. With roughly 15 to 80 times the mass of Jupiter, the largest planet in our Solar System, brown dwarfs were long thought to exist. However, it was not until 1995 that astronomers were able to actually find one. A few dozen now are known.

In 2001, a group of summer students at the National Radio Astronomy Observatory used the VLA to observe a brown dwarf, even though they had been told by seasoned astronomers that brown dwarfs are not observable at radio wavelengths. Their discovery of a strong flare of radio emission from the object surprised astronomers and the students' scientific paper on the discovery was published in the prestigious scientific journal *Nature*. Hallinan and his team observed a set of brown dwarfs with the VLA last year, and found that three of the objects emit extremely strong, repeating pulses of radio waves. They concluded that the pulses come from beams emitted from the magnetic poles of the brown dwarfs. This is similar to the beamed emission from pulsars, which are superdense neutron stars, and much more massive than brown dwarfs.

The characteristics of the beamed radio emission from the brown dwarfs suggest to the scientists that it is produced by a mechanism also seen at work in planets, including Jupiter and Earth. This process involves electrons interacting with the planet's magnetic field to produce radio waves that then are amplified, or strengthened, by natural masers that amplify radio waves the same way a laser amplifies light waves. "The brown dwarfs we observed are between planets and pulsars in the strength of their radio emissions," said Aaron Golden. "While we don't think the mechanism that's producing the radio waves in brown dwarfs is exactly the same as that producing pulsar radio emissions, we think there may be enough similarities that further study of brown dwarfs may help unlock some of the mysteries about how pulsars work," he said. While pulsars were discovered 40 years ago, scientists still do not understand the details of how their strong radio emissions are produced. The brown dwarfs rotate at a much more leisurely pace than pulsars. While pulsars rotate -- and produce observed pulses -- typically several times a second to hundreds of times a second, the brown dwarfs observed with the VLA are showing pulses roughly once every two to three hours.



Graphics and Movie, <http://www.nrao.edu/pr/2007/browndwarfbeams/graphics.shtml>

CELESTIAL FENDER-BENDER LEFT ASTEROID TO COOL WITHOUT INSULATION

A fender-bender between two celestial bodies that left a 200 mile-wide metallic chunk to cool in space was the likely source of a group of meteorites known as the 'IVA iron meteorites', suggests new research by scientists Jijin Yang, Joseph Goldstein, and Edward Scott who collaborated on the research.. Their findings help explain conflicting meteorite data that has long puzzled scientists, and sheds new light on how and when asteroids form.

The standard model of asteroid formation says asteroidal bodies are just leftover debris from the collisions and subsequent melting that happens when planets form. Scientists find that these leftover chunks typically have a dense iron core containing nickel, surrounded by an insulating layer of silicate. Evidence has suggested that the iron-nickel core cools relatively evenly, thanks to the insulating silicate mantle. But when researchers have calculated cooling rates for the 60-odd meteorites that are known as the IVA iron meteorites (believed to have come from a single parent asteroid), they've gotten wildly different numbers, says Goldstein. "We find that these cooling rates of the IVA irons vary by a factor of more than 50 and directly with the nickel content of the iron meteorite," he says. "This means there's something goofy happening." Given the insulating silicate mantle, the cooling rates of the IVA irons ought to have been very similar, he says. So Goldstein and his colleagues re-calculated cooling rates for 10 IVA irons and combined the data with computer model simulations. They also examined the microstructure of several of the irons using a transmission electron microscope.

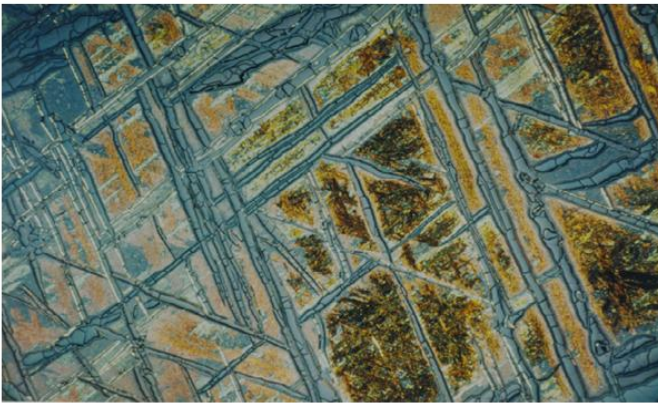
The IVA meteorites must have cooled as one, big chunk, roughly 200 miles-wide and without an insulating mantle, the scientists conclude, not in the form of a smaller insulated body as had previously been thought. If correct, the parent asteroid would have been comparable in size to the largest M class asteroid, 6 Psyche, says the research team. "You can see the same phenomenon occurring when cooling steel," explains Goldstein. "If you take a new piece of steel out of a huge blast furnace and set it down, we know that the outside cools a lot faster than the inside because there's no insulation. The same would be true of the IVA irons in a metallic asteroid."

Roughly 60 meteorites retrieved from around the world have the chemical makeup of the IVA irons, suggesting that they were all

part of one metallic asteroid that broke up about 450 million years ago and then fell to earth in pieces.

Scientists have proposed several theories over the decades to rationalize the varying cooling rates seen in IVA meteorites. One is that either the data or the computer simulations are faulty. There's the "Rubble-Pile" model, which posits that various pieces of the asteroid broke off at some point and then were thrown back together by influences such as gravity and centrifugal force. Another model, the so-called "Raisin Bread" effect, explains the various cooling rates by picturing various metal chunks spread throughout the silicate mantel of the asteroid. None however, could explain why the cooling rates vary directly with the nickel content of the meteorites. Now the researchers think the IVA irons' parent asteroid must have formed after two protoplanets sideswiped each other, thus breaking off many different pieces with varying amounts of silicate. The authors believe that the metal containing the IVA irons was one of these pieces that contained little or no silicate insulation. *"Our study was created to understand how the asteroid was formed almost one million years after the formation of the solar system,"* says Yang. *"Our theory explains the different cooling rates as part of a comprehensive description of the formation of the asteroid containing the IVA irons."* Scientists analyze certain patterns in meteorites, such as those in this Carlton Meteorite, to obtain the cooling rates of asteroids. (J. Goldstein, and H. Yakowitz,) http://www.newswise.com/images/uploads/2007/04/17/fullsize/Carlton_Meteorite_1.jpg

Carlton Meteorite



MAPPING OUT HOT STAR PLANETARY DANGER ZONE

Astronomers have laid down the cosmic equivalent of yellow "caution" tape around super hot stars, marking the zones where cooler stars are in danger of having their developing planets blasted away. In a new study from the Spitzer Space Telescope, scientists report the first maps of so-called planetary "danger zones." These are areas where winds and radiation from super hot stars can strip other young, cooler stars like our sun of their planet-forming materials. The results show that cooler stars are safe as long as they lie beyond about 1.6 light-years, or nearly 10 trillion miles, of any hot stars. But cooler stars inside the zone are likely to see their potential planets boiled off into space.

"Stars move around all the time, so if one wanders into the danger zone and stays for too long, it will probably never be able to form

planets," said Zoltan Balog, lead author of the new report. The findings are helping astronomers pinpoint the types of environments where planets beyond our solar system, including some that might be hospitable to life, are most likely to form. Planets are born out of a flat disk of gas and dust, called a protoplanetary disk, that swirls around a young star. They are believed to clump together out of the disk over millions of years, growing in size like dust bunnies as they sweep through the dust. Previous studies revealed that these protoplanetary disks can be destroyed by the most massive, hottest type of star in the universe, called an O-star, over a period of about a million years. Ultraviolet radiation from an O-star heats and evaporates the dust and gas in the disk, then winds from the star blow the material away. Last year, Balog and his team used Spitzer to capture a stunning picture of this "photoevaporation" process at work www.spitzer.caltech.edu/Media/happenings/20061003/.



The team's new study is the first systematic survey for disks in and around the danger zone, or "blast radius" of an O-star. They used Spitzer's heat-seeking infrared eyes to look for disks around 1,000 stars in the Rosette Nebula, a turbulent star-forming region 5,200 light-years away in the constellation Monoceros. The stars range between one-tenth and five times the mass of the sun and are between 2 and 3 million years old. They are all near at least one of the region's massive O-stars.

The observations revealed that, beyond 10 trillion miles of an O-star, about 45 percent of the stars had disks - about the same amount as there were in safer neighborhoods free of O-stars. Within this distance, only 27 percent of the stars had disks, with fewer and fewer disks spotted around stars closest to the O-star. In other words, an O-star's danger zone is a sphere whose damaging effects are worst at the core. For reference, our sun's closest star, a small star called Proxima Centauri, is nearly 30 trillion miles away. In addition, the new study indicates that a protoplanetary disk will boil off faster in the zone's perilous core. For example, a disk two times closer to an O-star than another disk will evaporate twice as fast. *"The edges of the danger zone are sharply defined,"* said Balog. *"It is relatively safe for protoplanetary disks outside it, whereas a disk that gets dragged along by its star to be really close to an O-star could disappear in as fast as a hundred thousand years."* Despite this doomsday scenario, there is a chance some planets could survive a close encounter with an O-star. According to one alternative theory of planet formation, some gas giants like Jupiter might form in less than one million years. If such a planet already existed around a

young star whose disk is blown away, the gas giant would stay put while any burgeoning rocky planets like Earth would be forever swept away.

Some astronomers think our sun was born in a similarly violent neighborhood studded with O-stars before migrating to its present, more spacious home. If so, it was lucky enough to escape a harrowing ride into any danger zones, or our planets, and life as we know it, wouldn't be here today. <http://www.spitzer.caltech.edu/Media> <http://www.nasa.gov/spitzer>

HST REVEALS AFTERMATH OF 'STAR WARS' EXPLOSION

A team of astronomers have used the Advanced Camera for Surveys on the Hubble to obtain the first direct optical images of the aftermath of a recent titanic explosion that took place in a star system 5,000 light years from Earth. During the night of February 12th 2006, Japanese amateur astronomers reported that a star in the constellation of Ophiuchus (known as RS Oph for short) had suddenly brightened and become visible even with the unaided eye in the night sky. Although this was the latest in a series of such outbursts of this star that have been spotted over the last hundred years or so, it was the first one since 1985 and gave scientists an opportunity to study it with new, more powerful, telescopes on the ground and in space. RS Oph consists of a white dwarf, a super-dense dead star about the size of the Earth which was once the core of a star like the Sun and whose outer layers have been lost into space, in close orbit with a much larger, so-called red giant star. The two stars are so close together that the strong gravitational field of the white dwarf continuously pulls hydrogen-rich gas from the outer layers of the red giant. After around 20 years, so much gas builds up that a runaway thermonuclear explosion occurs on the white dwarf's surface. In less than a day, its energy output increases to over 100,000 times that of the Sun, and a quantity of gas equivalent to the mass of the Earth is ejected into space at speeds of several thousand kilometers per second (several million miles per hour). Explosions such as this on short timescales of decades can only be explained if the white dwarf is near the maximum mass it could have without having collapsed to become an even denser object - a neutron star -- during a supernova explosion. Michael Bode described how these unique observations shed new light on the circumstances of such events.

What is also very unusual in RS Oph is that the red giant is losing enormous amounts of gas in a wind that envelops the whole system. As a result, the explosion on the white dwarf occurs effectively "inside" its companion's atmosphere and the ejected gas then slams into it at very high speed. Professor Bode explains: *"Immediately after the explosion, an observing campaign was set in train that involved most of the major space observatories, and many on the ground. We expected to see emission from the blast waves set up as the ejecta from the white dwarf impacted the red giant wind and we were not disappointed! For example, X-ray observations revealed temperatures in the shocked gas of over 100,000,000 degrees Celsius (around ten times that in the core of the Sun)."*

On the ground, radio observations from telescopes spread around the globe also allowed the team to probe the initial stages of the outburst. Professor Bode comments, *"Our first observations, made only two weeks after the explosion was reported, showed an expanding blast wave already comparable in size to Saturn's orbit around the Sun. Over the next few months we were surprised to find our radio observations apparently showing it turning from a ring into a cigar-like shape with two more extended blobs ("jets") gradually emerging, one on either side."*

In order to determine more precisely what was happening, optical observations with the orbiting Hubble Telescope were made in July 2006. Dr. Dan Harman took on the task of analyzing the resulting data. *"The problem here was that, seen from a distance of 5,000 light years, we were looking for what would appear to be very tiny and very faint features buried within the glare from the bright central star -- a bit like trying to read the license plate of an approaching car with its headlights on at night. However, after carefully removing the confusing effects of the star we were astounded by the results"*.



Professor Bode continues, *"Archival images taken before the latest outburst show no extended structure, but our latest HST images clearly show what appears to be two overlapping rings of total extent around 0.4 seconds of arc in size. At a distance of 5,000 light years, that equates to 8 times the diameter of Pluto's orbit around our Sun and an inferred speed of expansion from the time of the explosion of around 3,200 kilometers per second (over 7 million miles per hour). The overall size and orientation are consistent with continued expansion of the largest structures (so-called "jets") seen in the later radio images, but the picture is, perhaps unsurprisingly, not the simple one that had been assumed prior to the 2006 outburst."*

What Mike Bode and the team think we may be seeing is emission from the boundary of a rapidly expanding region shaped something like a peanut, but inclined towards us at an angle of around 40 degrees. The central stars orbit around each other in the plane of the "waist" region and the rings we see are a natural consequence of us looking through this inclined structure. They are now working with astronomers in Mexico who have high resolution optical spectra taken from the ground at around the time of the HST observations, and with these they expect to be able to tie down the geometry more precisely. *"Further scheduled HST observations should also help in this regard"*, says Bode. As Professor Sumner Starrfield adds, *"The HST images clearly resolve the effects of high velocity material that has been explosively ejected from the white dwarf and then impacting the environment of the companion star: Star Wars in Action."*

The big question is what causes this shaping in the first place? It is thought unlikely that it originates in the explosion itself. More probable is that the environment into which the material is ejected is denser in some directions (most likely the plane of the binary star orbit) than others. This will have important wider implications for our understanding of the explosion and how jet-like structures are formed in many other astronomical objects. <http://www.astro.livjm.ac.uk/press/>

MERCURY CORE MAYBE MOLTEN, SOLVING 30 YEAR MYSTERY

Researchers working with high-precision planetary radars, including the Goldstone Solar System Radar antenna (part of the Deep Space Network in Southern California's Mojave Desert) have discovered strong evidence that the planet Mercury has a molten core. The finding explains a more than three-decade old planetary mystery that began with the flight of Mariner 10 spacecraft. Launched in Nov. 1973, Mariner 10 made three close approaches to Mercury in 1974 and 75. Among its discoveries was that Mercury had its own weak magnetic field - about one percent as strong as that found on Earth. *"Scientists had not expected to find a magnetic field at Mercury,"* said Professor Jean-Luc Margot, leader of the research team. *"Planetary magnetic fields are associated with molten cores, and the prevailing theory was the planet was too small to have a molten core."*

Scientists theorized that Mercury consisted of a silicate mantle surrounding a solid iron core. This iron was considered solid - or so the theory went - because small planets like Mercury cool off rapidly after their formation. If Mercury followed this pattern, then its core should have frozen long ago. Many believed the Mercury mystery would only be resolved if and when a spacecraft landed on its aggressively toasty surface. Then, in 2002, scientists began pointing some of the most powerful antennas on our planet at Mercury in an attempt to find the answer.

"On 18 separate occasions over the past five years, we used the Goldstone 70-meter [230-foot] antenna to fire a strong radar signal at Mercury," said Planetary Radar Group Supervisor Martin Slade, a co-author of the paper. *"Each time, the radar echoes from the planet were received about 10 minutes later at Goldstone and another antenna in West Virginia."* Measuring the echo of particular surface patterns from the surface of Mercury and how long they took to reproduce at both Goldstone and the Robert Byrd Green Bank Telescope in West Virginia allowed scientists to calculate Mercury's spin rate to an accuracy of one-thousandth of a percent. The effect was also verified with three more independent radar observations of Mercury transmitted from the Arecibo Observatory in Puerto Rico.

With these data the science team was able to detect tiny twists in Mercury's spin as it orbited the sun. These small variations were double what would be expected for a completely solid body. This finding ruled out a solid core, so the only logical explanation remaining was that the core - or at the very least the outer core - is molten and not forced to rotate along with its shell.

Maintaining a molten core over billions of years requires that it also contain a lighter element, such as sulfur, to lower the melting temperature of the core material. The presence of sulfur supports the idea that radial mixing, or the combining of elements both close to the sun and farther away, was involved in Mercury's formation process. *"The chemical composition of Mercury's core can provide important clues about the processes involved in planet formation,"* said Margot. *"It is fundamental to our understanding of how habitable worlds -- planets like our own -- form and evolve."*

NEXT SOLAR STORM CYCLE WILL START 1 YEAR LATE - EXPERTS SPLIT OVER INTENSITY

The next 11-year cycle of solar storms will most likely start next March (2008) and peak in late 2011 or mid-2012 -- up to a year later than expected -- according to a forecast issued by the NOAA Space Environment Center in coordination with an international panel of solar experts, at the annual Space Weather Workshop in Boulder, CO.

Expected to start last fall, the delayed onset of Solar Cycle 24 stymied the panel and left them evenly split on whether a weak or strong period of solar storms lies ahead, but neither group predicts a record-breaker.

During an active solar period, violent eruptions occur more often on the sun. Solar flares and vast explosions, known as coronal mass ejections, shoot energetic photons and highly charged matter toward Earth, jolting the planet's ionosphere and geomagnetic field, potentially affecting power grids, critical military and airline communications, satellites, Global Positioning System (GPS) signals, and even threatening astronauts with harmful radiation. These same storms illuminate night skies with brilliant sheets of red and green known as auroras, or the northern or southern lights.

Solar cycle intensity is measured in maximum number of sunspots -- dark blotches on the sun that mark areas of heightened magnetic activity. The more sunspots there are, the more likely it is that major solar storms will occur. In the cycle forecast, half of the scientific panel predicts a moderately strong cycle of 140 sunspots, plus or minus 20, expected to peak in October 2011. The other half predicts a moderately weak cycle of 90 sunspots, plus or minus 10, peaking in August 2012. An average solar cycle ranges from 75 to 155 sunspots. The late decline of Cycle 23 has helped shift the panel away from its earlier leaning toward a strong Cycle 24. Now the group is evenly split between strong and weak. The first year after solar minimum, marking the end of Cycle 23, will provide the information scientists need to arrive at a consensus. NOAA and the panel decided to issue their best estimate now and update the forecast as the cycle progresses, since Space Environment Center customers have been requesting a forecast for more than a year. *"By giving a long-term outlook, we're advancing a new field -- space climate -- that's still in its infancy,"* said retired Air Force Brig. Gen. David L. Johnson, director of the National Weather Service. *"Issuing a cycle prediction of the onset this far in advance lies on the very edge of what we know about the sun."*

Scientists have issued cycle predictions only twice before. In 1989, a panel met to predict Cycle 22, which peaked that same year. Scientists met again in September of 1996 to predict Cycle 23 -- six months after the cycle had begun. Both groups did better at predicting timing than intensity, according to NOAA Space Environment Center scientist Douglas Biesecker, who chairs the current panel. He describes the group's confidence level as "high" for its estimate of a March 2008 onset and "moderate" overall for the two estimates of peak sunspot number and when those peaks would occur.

One disagreement among the current panel members centers on the importance of magnetic fields around the sun's poles as the previous cycle decays. End-cycle polar fields are the bedrock of the approach predicting a weak Cycle 24. The strong-cycle forecasters place more importance on other precursors extending over a several-cycle history. Another clue will be whether Cycle 24 sunspots appear by mid 2008. If not, the strong-cycle group might change its forecast. *"The panelists in each camp have clear views on why they believe in their prediction, why they might be wrong, and what it would take to change their minds,"* said Biesecker. *"We're on the verge of understanding and agreeing on which precursors are most important in predicting future solar activity."* The NOAA Space Environment Center is the nation's first alert of solar activity and its effects on Earth. Just as NOAA's hurricane experts predict the upcoming season of Atlantic storms and forecast individual hurricanes, the agency's space weather experts issue outlooks for the next 11-year solar cycle and warn of storms occurring on the sun that could impact Earth.

<http://www.sec.noaa.gov/SolarCycle/> <http://www.spaceweather.noaa.gov/http://www.noaanews.noaa.gov/stories2007/images/solar-cycle.jpg>

HOW OLD ARE STARS? GYROCHRONOLOGY - POWERFUL NEW METHOD TO DETERMINE STELLAR AGES

Gyrochronology, a new method for accurately determining the ages of field stars based on their rotational rates, was announced by astronomer Sydney Barnes. <http://arxiv.org/abs/0704.3068> "Gyrochronology transforms a rotating star into a clock which is set using the Sun and keeps time well," said Barnes. The age of a star is its most fundamental attribute apart from its mass. A star's age tells astronomers how astrophysical phenomena change over time. "For example, the ages of the host stars of planetary systems are needed to understand how these systems change over time," said Barnes. By showing that the rotation period of a star is a steadily changing and tight function of its age and color, gyrochronology allows the age to be determined by measuring the two other properties -- the rotation period and the color. "If you know the relationship between three quantities, measuring two of them allows you to calculate the third," said Barnes. "The relationship between age, color, and rotation period has particular and useful mathematical properties that simplify the analysis and allow the uncertainties to be calculated easily." A star's color is a proxy for its mass or surface temperature. The uncertainties in gyrochronology ages are typically 15 percent; with preexisting stellar aging methods the uncertainties range from 50 to 100 percent.

Gyrochronology can be calibrated using the known age of the Sun (4.6 billion years). Another distinguishing characteristic of the technique is that it works well for the vast majority of stars including field stars, or those not found in star clusters. For the first time, this new technique makes possible the derivation of accurate ages for solar- and late-type main sequence stars using only their rotation periods and colors. In his new paper, Barnes calculates ages for sun-like and other low mass stars that burn their hydrogen fuel at a relatively steady rate on what is known as the main sequence. Barnes derives ages for sample stars where rotation and color are known, but the stellar ages using other methods are not known.

The technique builds on an insight of Skumanich in 1972 who noticed that another measure of stellar rotation changes steadily with the ages of star clusters. However, the related imprecision greatly compromises the accuracy of ages derived using this insight alone. Measurements made at Lowell Observatory in the late 1980s showed that rotation also depends on the color/mass of a star. Gyrochronology combines and develops these two insights into a precise way of deriving stellar ages, and shows that it works even for single field stars. The paper shows that the rotation period of a star (whether in a cluster or in the field) can be written as a simple product of two separable functions of its age and color. This mathematical behavior provides the key simplification that makes gyrochronology unique.

Other methods works well for star clusters, but do not work well for individual (field) stars because they require the distance to be measured. And that is difficult. Also they do not work well for stars on the main sequence, where the majority of a star's life is spent. "However, gyrochronology is independent of distance and works well on main sequence stars," said Barnes.

Gyrochronology does not work well for the youngest stars, those that have not begun burning fuel at the steady rate indicative of the majority of stars (main-sequence) stars, or for those that have left the main sequence. However, future work might be able to extend the method for these stars as well.

For the vast majority of stars, gyrochronology ages are shown to be more consistent than other stellar aging techniques and will have applications across the field of astronomy. For example, the Kepler Mission, being readied for launch, is likely to yield not only discovery of new planets through observations of the transits of these new planets moving in orbits across the disks of their host stars, but also the rotation periods of those host stars. Kepler is likely to yield rotation periods for orders of magnitude more stars than planetary transits. "No matter what, stellar rotation periods will be determined routinely as time domain astronomy comes into its own," said Barnes. "A very significant portion of time domain work on stars will yield the stellar rotation period (it is a by-product of all searches for planetary transits), and since this measurement can be used to derive a precise stellar age, it would permit us to address many problems involving chronometry that are not presently solvable." "The age of a star is its most fundamental attribute apart from its mass, and usually provides the chronometer that permits the study of the time evolution of astronomical phenomena," said Barnes. "Gyrochronology refines the use of stars as clocks, revealing their own ages, and the ages of associated astronomical bodies." <http://arxiv.org/abs/0704.3068> http://www.lowell.edu/press_room/gyrobkgcmd.pdf <http://www.lowell.edu/People/bios/barnes.html>

FIRST HABITABLE EARTH-LIKE PLANET FOUND

Astronomers have discovered the most Earth-like planet outside our Solar System to date, an exoplanet with a radius only 50% larger than the Earth and capable of having liquid water. Using the ESO 3.6-m telescope, a team of Swiss, French and Portuguese scientists discovered a super-Earth about 5 times the mass of the Earth that orbits a red dwarf, already known to harbor a Neptune-mass planet. The astronomers have also strong evidence for the presence of a third planet with a mass about 8 Earth masses.

This exoplanet -- as astronomers call planets around a star other than the Sun -- is the smallest ever found up to now [1] and it completes a full orbit in 13 days. It is 14 times closer to its star than the Earth is from the Sun. However, given that its host star, the red dwarf Gliese 581 [2], is smaller and colder than the Sun -- and thus less luminous -- the planet nevertheless lies in the habitable zone, the region around a star where water could be liquid!

"We have estimated that the mean temperature of this super-Earth lies between 0 and 40 degrees Celsius, and water would thus be liquid," explains Sthane Udry, lead-author of the paper reporting the result. "Moreover, its radius should be only 1.5 times the Earth's radius, and models predict that the planet should be either rocky -- like our Earth -- or covered with oceans," he adds.

"Liquid water is critical to life as we know it," avows Xavier Delfosse, a member of the team. "Because of its temperature and relative proximity, this planet will most probably be a very important target of the future space missions dedicated to the search for extraterrestrial life. On the treasure map of the Universe, one would be tempted to mark this planet with an X."

The host star, Gliese 581, is among the 100 closest stars to us, located only 20.5 light-years away in the constellation Libra ("the Scales"). It has a mass of only one third the mass of the Sun. Such red dwarfs are intrinsically at least 50 times fainter than the Sun and are the most common stars in our Galaxy: among the 100 closest stars to the Sun, 80 belong to this class.

"Red dwarfs are ideal targets for the search for low-mass planets where water could be liquid. Because such dwarfs emit less light, the habitable zone is much closer to them than it is around the

Sun," emphasizes Xavier Bonfils, a co-worker. Planets lying in this zone are then more easily detected with the radial-velocity method, the most successful in detecting exoplanets.

Two years ago, the same team of astronomers already found a planet around Gliese 581. With a mass of 15 Earth-masses, i.e. similar to that of Neptune, it orbits its host star in 5.4 days. At the time, the astronomers had already seen hints of another planet. They therefore obtained a new set of measurements and found the new super-Earth, but also clear indications for another one, an 8 Earth-mass planet completing an orbit in 84 days. The planetary system surrounding Gliese 581 contains thus no fewer than 3 planets of 15 Earth masses or less, and as such is a quite remarkable system.

The discovery was made thanks to HARPS (High Accuracy Radial Velocity for Planetary Searcher), perhaps the most precise spectrograph in the world. Located on the ESO 3.6-m telescope at La Silla, Chile, HARPS is able to measure velocities with a precision better than one meter per second (or 3.6 km/h)! HARPS is one of the most successful instruments for detecting exoplanets and holds already several recent records, including the discovery of another 'Trio of Neptunes'.

The detected velocity variations are between 2 and 3 meters per second, corresponding to about 9 km/h! That's the speed of a person walking briskly. Such tiny signals could not have been distinguished from 'simple noise' by most of today's available spectrographs.

"HARPS is a unique planet hunting machine," says Michel Mayor, and HARPS Principal Investigator. "Given the incredible precision of HARPS, we have focused our effort on low-mass planets. And we can say without doubt that HARPS has been very successful: out of the 13 known planets with a mass below 20 Earth masses, 11 were discovered with HARPS!" HARPS is also very efficient in finding planetary systems, where tiny signals have to be uncovered. The two systems known to have three low mass planets -- HD 69830 and Gl 581 -- were discovered by HARPS. "And we are confident that, given the results obtained so far, finding a planet with the mass of the Earth around a red dwarf is within reach," affirms Mayor. http://obswww.unige.ch/~udry/udry_preprint.pdf

This fundamental observational method is based on the detection of variations in the velocity of the central star, due to the changing direction of the gravitational pull from an (unseen) exoplanet as it orbits the star. The evaluation of the measured velocity variations allows deducing the planet's orbit, in particular the period and the distance from the star, as well as a minimum mass.

Using the radial velocity method, astronomers can only obtain a minimum mass (as it is multiplied by the sine of the inclination of the orbital plane to the line of sight, which is unknown). From a statistical point of view, this is however often close to the real mass of the system. Two other systems have a mass close to this. The icy planet around OGLE-2005-BLG-390L, discovered by microlensing with a network of telescopes including one at La Silla, has a (real) mass of 5.5 Earth masses. It, however, orbits much farther from its small host star than the present one and is hence much colder. The other is one of the planets surrounding the star Gliese 876. It has a minimum mass of 5.89 Earth masses (and a probable real mass of 7.53 Earth masses) and completes an orbit in less than 2 days, making it too hot for liquid water to be present.

Gl 581, or Gliese 581, is the 581th entry in the Gliese Catalogue, which lists all known stars within 25 parsecs (81.5 light years) of

the Sun. It was originally compiled by Gliese and published in 1969, and later updated by Gliese and Jahreiss in 1991.

SCIENTISTS START SIFTING SUPERFINE STARDUST

Scientists are preparing to analyze miniscule impact craters collected by the Stardust mission as it flew through interstellar dust streams. These craters contain the residues of the dust particles that are the seeds of our own Solar System. A consortium of researchers have been studying the cometary samples which were delivered a few weeks after the samples were returned to Earth. The interstellar dust particles are about ten nanometers across (one hundred thousandth of a millimeter) and they are even smaller than many of the particles that Stardust collected when it flew through the coma of Comet Wild 2.

Dr. John Bridges described how techniques developed to analyze material from the comet's tail will be used to study the interstellar particles. A focused beam of electrically charged particles will be used to extract the residue of the dust from the craters. Once the material is no longer shielded by the crater walls, it can be examined using a transmission electron microscope. "The interstellar dust particles collected by Stardust are so tiny that they pose huge analytical challenges," said Dr. Bridges. "Having spent the time perfecting our techniques and analyzing Comet Wild 2, we are very excited by the prospect of these samples. Our analysis of samples from the comet's tail revealed that its composition was more complex than we'd thought and indicated an unexpected mixing of refractory and volatile material in the early Solar System. The interstellar particles will take us one step farther back and allow us to look at the composition of the dust cloud from which the Solar System formed."

The Stardust mission spent 4 months collecting interstellar dust during its 2.88 million mile journey to Comet Wild-2 and back to Earth. The return capsule, containing the dust and samples from the comet's tail, landed in the desert in Utah in January 2006. Since then, samples have been distributed to selected researchers around the world. The Stardust mission's Principal Investigator is Dr. Donald Brownlee of the University of Washington in Seattle, WA. <http://stardust.jpl.nasa.gov/home/index.html> http://www.ras.org.uk/index.php?option=com_content&task=view&id=1179

KEY "STARDUST" DISCOVERY MAY HAVE BEEN ROCKET MOTOR CONTAMINATION

One of the biggest scientific surprises from last year's "Stardust" space mission may have resulted from contamination from the spacecraft's rocket boosters, scientists in Spain are cautioning, in a report scheduled for publication in the May 16 issue of ACS' Energy & Fuels journal. Stardust was the first U.S. mission to capture samples of a comet (Comet Wild 2) and return that material, believed to hold clues to the origin of the solar system, to Earth for scientific analysis. In the report, Jesus Martinez-Frias and colleagues point out that scientists were surprised to find that Stardust had collected tiny grains of the mineral osbornite, which chemically is titanium nitride. Osbornite forms only at ultra-hot temperatures of about 3,140 Fahrenheit. Scientists thus concluded that the osbornite could have formed near the sun, and ejected to the outer reaches of the solar system -- an indication that the infant solar system was a much more violent and tumultuous place than previously believed.

Martinez-Frias and colleagues stress the plausibility and significance of such hypothesis, but suggest another possible explanation for osbornite presence, which they say has not yet

been considered. They point out that Stardust's rocket thrusters used a propellant of ultra-pure hydrazine, which chemists long have used for the so-called nitration reactions used to make titanium nitride on Earth. The propellant likewise could have reacted in space with titanium from the comet or spacecraft to form titanium nitride, the researchers state. They recommend that laboratory simulation analyses and further studies are needed before reaching a final conclusion on osbornite origin. "Stardust's Hydrazine (N₂H₄) Fuel: A Potential Contaminant for the Formation of Titanium Nitride (Osbornite)" <http://pubs.acs.org/cgi-bin/sample.cgi/enfuem/asap/pdf/ef070014r.pdf> <http://pubs.acs.org/cgi-bin/sample.cgi/enfuem/asap/html/ef070014r.html>

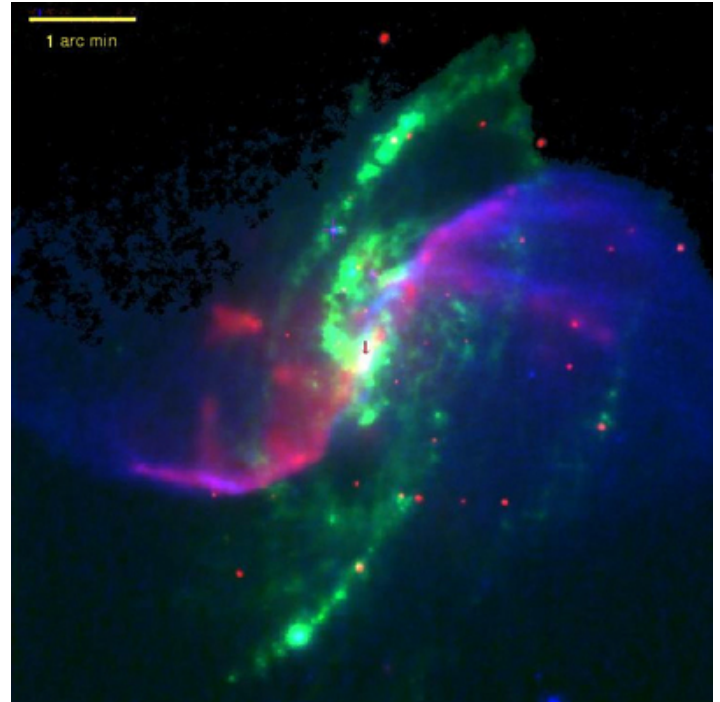
MYSTERY SPIRAL ARMS EXPLAINED?

Using a trio of space observatories, astronomers may have cracked a 45-year old mystery surrounding two ghostly spiral arms in the galaxy M106 (NGC 4258). The results took advantage of the unique capabilities of the XMM-Newton X-ray observatory, Chandra X-ray Observatory, and Spitzer Space Telescope. M106 (also known as NGC 4258) is a spiral galaxy 23.5 million light-years away, in the constellation Canes Venatici. In visible-light images, two prominent arms emanate from the bright nucleus and spiral outward. These arms are dominated by young, bright stars, which light up the gas within the arms. "But in radio and X-ray images, two additional spiral arms dominate the picture, appearing as ghostly apparitions between the main arms," says team member Andrew Wilson. These so-called "anomalous arms" consist mostly of gas. "The nature of these anomalous arms is a long-standing puzzle in astronomy," says Yuxuan Yang, lead author of the team. "They have been a mystery since they were first discovered in the early 1960s."

By analyzing data from XMM-Newton, Spitzer, and Chandra, the team have confirmed earlier suspicions that the ghostly arms represent regions of gas that are being violently heated by shock waves. It has been previously suggested that the anomalous arms are jets of particles being ejected by a supermassive black hole in M106's nucleus. But radio observations at the Very Large Array later identified another pair of jets originating in the core. "It is highly unlikely that an active galactic nucleus could have more than one pair of jets," says Yang.

In 2001, another team of astronomers noted that the two jets are tipped 30 degrees with respect to the disk. But if one could vertically project the jets onto the disk, they would line up almost perfectly with the anomalous arms. Figuring that this alignment was not strictly a matter of chance, the team proposed that the jets heat the gas in their line of travel, forming an expanding cocoon. Because the jets lie close to M106's disk, the cocoon heats gas in the disk and generates shock waves, heating the gas to millions of degrees and causing it to radiate brightly in X-rays and other wavelengths. To test this idea, Yang and his colleagues looked at archival spectral observations from XMM-Newton. With XMM-Newton's superb sensitivity, the team could measure the gas temperature in the anomalous arms and also see how X-rays from the gas are absorbed en route by intervening material. "One of the predictions of this scenario is that the anomalous arms will gradually be pushed out of the

galactic disk plane by jet-heated gas," says Yang. The XMM-Newton spectra show that X-rays are absorbed more strongly in the direction of the northwest arm than in the southeast arm. The results strongly suggest that the southeast arm is partly on the near side of M106's disk, and the northwest arm is partly on the far side. The scientists noted that these observations show clear consistency with their scenario. Confirmation of this interpretation has recently come from archival observations from the Spitzer Space Telescope, whose infrared view shows clear signs that X-ray emission from the northwest arm is being absorbed by warm gas and dust in the galaxy's disk. Moreover, Chandra's superior imaging resolution gives clear indications of gas shocked by interactions with the two jets.



Besides addressing the mystery of the anomalous arms, these observations allowed the team to estimate the energy in the jets and gauge their relationship to M106's central black hole. <http://xxx.lanl.gov/abs/astro-ph/0701569> http://www.esa.int/esaCP/SEMLVET4LZE_index_1.html

FROM THE EDITOR'S TERMINAL

The Stargazer is your newsletter and therefore it should be a cooperative project. Ads, announcements, suggestions, and literary works should be received by the editor at least two weeks prior to the next upcoming scheduled EAS meeting. If you wish to contribute an article or suggestions to *The Stargazer* please contact Mark Folkerts by email or by telephone (425) 486-9733 or co-editor Bill O'Neil, at (774) 253-0747.

The Star Gazer
P.O. Box 12746
Everett, WA 98206

In May's StarGazer:

- **** **ASTRO CALENDAR – STAR PARTY SCHEDULE – WESTERN US 2007 STAR PARTIES**
- **** **OBSERVER'S INFORMATION**
- **** **DID WILLIAM HERSCHEL DISCOVER RINGS OF URANUS IN 1800s ?**
- **** **DETAILED IMAGE OF "RED SQUARE" USING ADAPTIVE OPTICS**
- **** **BROWN DWARFS: A NEW CLASS OF STELLAR LIGHTHOUSE**
- **** **MASSIVE STAR BURPS, THEN EXPLODES**
- **** **CELESTIAL FENDER-BENDER LEFT ASTEROID TO COOL WITHOUT INSULATION**
- **** **MAPPING OUT HOT STAR PLANETARY DANGER ZONE**
- **** **HST REVEALS AFTERMATH OF 'STAR WARS' EXPLOSION**
- **** **MERCURY CORE MAYBE MOLTEN, SOLVING 30 YEAR MYSTERY**
- **** **NEXT SOLAR STORM CYCLE WILL START LATE - EXPERTS SPLIT OVER INTENSITY**
- **** **HOW OLD ARE STARS? GYROCHRONOLOGY - POWERFUL NEW METHOD TO DETERMINE STELLAR AGES**
- **** **FIRST HABITABLE EARTH-LIKE PLANET FOUND**
- **** **SCIENTISTS SIFT SUPERFINE STARDUST**
- **** **KEY STARDUST DISCOVERY MAY HAVE BEEN ROCKET MOTOR CONTAMINATION**
- **** **MYSTERY SPIRAL ARMS EXPLAINED?**

<p>The next EAS Meeting is 3:00 P.M. Saturday May 12th at the Everett Public Library Auditorium.</p>
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