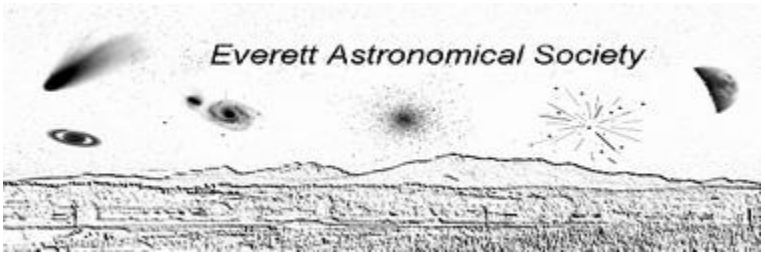
Volume MMVIV. No. 10



The Stargazer

September/October 2009

President: Mark Folkerts	(425) 486-9733	folkerts at seanet.com	***The Stargazer***
Vice President: James Bielaga	(425) 337-4384	jamesbielaga at aol.com	**P.O. Box 12746**
Librarian: Mike Locke	(425) 259-5995	lockemi at comcast.net	**Everett, WA 98206**
Treasurer: Carol Gore	(360) 856-5135	janeway7C at aol.com	
Newsletter co-editor: Bill O'Neil	(774) 253-0747	wonastrn at netway.com	
Web assistance: Cody Gibson		cgibson41 at austin.rr.com (change 'at' to @ to send email)	*See EAS website at:* http://everettastro.org

EAS BUSINESS…

NEXT EAS MEETING – SATURDAY OCTOBER 24TH - 6:00 PM AT AURORA ASTRO STORE AT SILVER LAKE .

★ ★ ★★★★ Saturday October 24th 6:00 PM ★★★ ★ ★

The meeting program will be - Sharing the Universe: Tips for Stellar Presentations (And Star Parties). Many amateur astronomers love sharing the universe with the public. Whether you're just getting started or are an old pro, there are many ways to make your time with the public more enjoyable. Includes: 'Getting Started with Outreach', How to Say "I Don't Know", 'Connecting with Kids', 'Handling Difficult Questions (and Difficult People)', and 'How to get "WOW!" (When not showing Saturn)'

Attending members will be eligible for a monthly door prize.
(We have several new nice books to choose from).

The meeting will be at the Aurora Astro Products store in Silver Lake area (directions below) located at Silver Lake Plaza *11419 19th Avenue SE #A102, Everett, WA 98208*.

Map / Directions to store location – click the address link above:

If you are traveling northbound on I-5: Take exit #186/128th St. and go east - to the right on 128th St. continue until you come to Murphy's Corner/Intersection with Highway 527/19th Ave SE/Old Bothell-Everett Highway (all one in the same) and turn left/north. Follow until you see Silver Lake Plaza (red brick construction) on your right with the lake is on your left.

If you are traveling southbound on I-5: Take exit 187/Everett Mall Way and at the top of the exit's hill turn right following signs for Highway 527. At the light turn right following the signs for Highway 527. Then stay on Highway 527/19th Ave SE/Old Bothell-Everett Highway until you have Silver Lake on your right and the Silver Lake Plaza on your left. You may also continue down I-5 until exit 186 and turn left onto 128th then follow previous directions. If you have a problem you can always call 425-337-4384

★ STAR PARTY INFO ★

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

Saturday October 17
Saturday November 14

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

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

Other Western US Star Parties This Season

OCTOBER -

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

NOVEMBER -

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

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

Other Star parties:
http://www.cloudynights.com/ubbthreads/showflat.php/Cat/0/Number/2858373/Main/2858366

EAS MEMBER NEWS

Other Member News…

Outreach chairperson: (currently **vacant**) - Coordinate requests from public for EAS member volunteers to conduct star parties or presentations at visits to schools, senior centers, scout meetings, etc. We often have requests for members of the EAS to come and help with an 'astronomy night' event from local schools, scout groups, senior homes, or similar groups. Usually this would be in the form of a star

party at their gathering, or perhaps a short slide show or night sky talk. Providing education and support to the community about interest astronomy is one of the main missions of the EAS. A star party night can be a rewarding event for all involved. **Please email Mark Folkerts with your interest (or suggestions).**

Sidewalk astronomy committee: (currently **vacant**). – Plan and conduct urban/suburban sidewalk astronomy events to allow passers-by to experience astronomy. Needs 2-3 people for each event, and to schedule events. We are looking for volunteers who could do a series of Sidewalk Astronomy sessions this spring and summer, at a local park or public venue. For safety, moral support, and effectiveness, this should be done in teams of at least two people with telescopes. Special events like eclipse or comets especially draw the interest of the public.

Newsletter Co-editor: (soon to be vacant) Contribute columns or articles for the StarGazer on a regular basis.

Other volunteers? Find a way to help and contribute. Come up with a new idea to promote the EAS and astronomy in your community.

EAS Membership Benefits & Information

EAS Benefits -
Membership in the Everett Astronomical Society (EAS) includes invitations to all of the club meetings and star parties, and entitles members to the monthly newsletter, *The Stargazer.* Also, a 10% discount is also being offered to EAS members for purchases at Aurora Astro Products in Everett. Only members may vote in EAS elections, or be eligible for EAS drawings.

Magazine Discounts –
In addition you will be able subscribe to ***Sky and Telescope*** for $7 off the normal subscription rate, contact the treasurer (Carol Gore) for more information. http://everettastro.org/application.htm (**When renewing your subscription to *Sky & Telescope* you should send your S&T renewal form along with a check made out to Everett Astronomical Society to the EAS address.** The EAS treasurer Carol Gore will renew your *Sky and Telescope* subscription for you. **Astronomy** magazine offers a similar opportunity to club members.)

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

EAS Club Telescope Borrowing -
Being a member also allows you the use of the club's telescopes, including an award winning 10 inch Dobsonian mount reflector, a second 10" dob, or 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, consists of VCR tapes, DVDs, many books, magazines, and software titles. The EAS has a library of books, videotapes, and software for members to borrow, **located at Aurora Astro Products store**. We always value any items you would like to donate to this library. You can contact a club officer or **Librarian Mike Locke**, phone (425) 259-5995, email lockemi at comcast.net, to borrow or donate any materials, or **contact Jim Bielaga at Aurora Astro**. See library items list here: http://everettastro.org/eas_library.htm

Joining or Renewing with the EAS -

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

Send your annual dues renewals to the Everett Astronomical Society P.O. Box 12746, Everett, WA 98206.

Those who have **subscriptions to Sky and Telescope** can now pay their own subscription as long as they are EAS members in good standing. Members will now be able to renew directly via mail or phone and still obtain the club discount. The subscribers may mail in the renewal notices with their payment, or renew via phone at (800) 253-0245. Payment at the time of renewal is required. Once a year, Sky and Telescope will check with the EAS club treasurer to see that the subscribers are still members in good standing to qualify for the discount. New members will continue to subscribe through the club treasurer.

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

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

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

- Clear Skies, Jim Bielaga"

>> Members – please look at your EAS membership card to see when your membership dues are payable. If you are more than three months past due, the club will officially assume that you no longer wish to be a member, and remove you from the membership rolls. <<

Aurora Astro Products
"*Your Northern Light in the Astronomy Business*"
Over 37 product dealerships, and growing

11419 19th Avenue SE #A102
Everett, WA 98208
www.auroraastro.com
425-337-4384
425-337-4758 fax

Hours:
Monday, Thursday, Friday – 9:00 am to 6:00 pm
Tuesday/Wednesday – Noon to 6:00 pm
Saturday – 10:00 am to 5:00 pm

$$ - Financial Health - $$

The club maintains a $750+ balance. We try to keep approximately a $500 balance to allow for contingencies.

Club Scopes

Scope	Loan Status
13-inch thin-mirror Dob	Finishing Rehabilitation

10-INCH WARD DOBSONIAN	AVAILABLE
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.

ASTRO CALENDAR FOR 2009

October 2009

Oct 09 - Draconids Meteor Shower Peak
Oct 17 – EAS Star Party at Ron Tam's place
Oct 21 - Orionids Meteor Shower Peak
Oct 24 – EAS Meeting at Aurora Astro – 6:00 PM

November 2009

Nov 14 – EAS Star Party at Ron Tam's place
Nov 21 – EAS Meeting at Aurora Astro – 6:00 PM

December 2009

Dec 12 or 19 – EAS Holiday Meeting at Alfy's on Broadway – 6:00 PM

UW Astronomy Speakers Colloquium Schedule

Astronomy Department weekly colloquium meets Thursdays at 4:00 pm in PAB A102 - the classroom part of the Physics/Astronomy Building complex. http://www.astro.washington.edu/pages/colloquium.html

'IT'S OVER YOUR HEAD' – ASTRONOMY PODCASTS

Web page with lots of archives and other info is available at http://www.celestialnorth.org/radio/index.php and podcasts at http://www.celestialnorth.org/radio/index.php

KPLU 88.5 FM National Public Radio has daily broadcasts of "Star Date" by the McDonald Observatory of the University of Texas at Austin, Monday through Friday at about 6:05 pm. The short 2 minute radio show deals with current topics of interest in astronomy. The University of Washington TV broadcasts programs from NASA at 12:00 AM Monday through Friday, 12:30 AM Saturday, and 1:30 AM Sunday on the Channel 27 cable station.

OBSERVER'S INFORMATION…

LUNAR FACTS

Oct 18	New Moon
Oct 26	First Quarter Moon
Nov 02	Full Moon
Nov 09	Last Quarter Moon
Nov 16	New Moon
Nov 24	First Quarter Moon
Dec 02	Full Moon
Dec 09	Last Quarter Moon
Dec 16	New Moon
Dec 24	First Quarter Moon
Dec 31	Full Moon
Jan 07	Last Quarter Moon

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

Object	*Rises*	*Sets*	*Con*	*Diam.*	*Mag*
Sun	***07:39 am***	***18:08***	***Vir***	***30'***	***-27.5***
Mercury	**06:46 am**	**17:56**	**Vir**	**05"**	**-1.1**
Venus	**05:49 am**	**17:35**	**Vir**	**13"**	**-3.9**
Mars	**23:44**	**15:08**	**Can**	**07"**	**+0.6**
Jupiter	**15:36**	**01:13 am**	**Cap**	**43"**	**-2.5**
Saturn	**04:52 am**	**17:16**	**Vir**	**16"**	**+1.1**
Uranus	**16:51**	**04:31 am**	**Aqr**	**04"**	**+5.8**
Neptune	**15:48**	**01:51 am**	**Cap**	**02"**	**+7.9**
Pluto	**12:29**	**21:47**	**Sag**	**--**	**+14.0**

(*times listed are in local time for Everett PDT*)

Mercury and Saturn are visible low in the west after sunset. **Jupiter, Uranus, and Neptune** are well placed for observation throughout the night. **Pluto** is visible in the evening sky with a large scope. **Mars, and Venus** are visible in the morning sky.

Digital Lunar Orbiter Photographic Atlas of the Moon

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

Observing Jupiter's Moons – Java tool
http://skytonight.com/observing/objects/javascript/jupiter

Transit times for Jupiter's Great Red Spot in 2008
http://skytonight.com/observing/objects/planets/3304091.html

NOAA SUN CALCULATOR

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

INTERNATIONAL SPACE STATION – VISIBLE SEATTLE PASSES

ISS Visibility – Heavens Above:

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

CONSTELLATIONS OF THE MONTH – TRIANGULUM, ARIES, PEGASUS, AND INDUS

TRIANGULUM (The Triangle): With a midnight culmination date of October 23rd, Triangulum is well-placed for Fall viewing. Triangulum borders on the constellations of Andromeda, Aries, Perseus, and Pisces; there are no established asterisms within its borders. Triangulum ranks 27th in overall brightness among the constellations, but 78th in size: it takes up approximately 131.85 square degrees (0.320%) of the sky. Triangulum contains no known meteor showers, but one Messier object: M-33 (also known as the Northern Pinwheel Galaxy). Triangulum is completely visible from latitudes North of –53 degrees, and completely invisible from latitudes South of –65 degrees. It has 12 stars brighter than magnitude 5.5, and its central point is at RA=2h08m, Dec.= +31 degrees. The solar conjunction date of Triangulum is April 24th.

M-33 is a large, face-on spiral galaxy in Triangulum, and is, at a distance of 1.1 megaparsecs, the closest directly face-on spiral galaxy to Earth observers, but is notorious for being difficult to find in backyard telescopes. Its total magnitude is 5.7, but on viewing nights with sub-optimal seeing, backyard scopes will barely even show its nucleus, let alone any spiral structure. The reason for this is that M-33 is a very large, diffuse galaxy, with dimensions of 62 x 39 arc minutes. When this is combined with its direct face-on orientation, the spiral arms of

the galaxy offer a surface brightness of only 14.0 magnitudes per square arc-minute. Larger apertures, good seeing and dark skies, and low f/ratios show knotty patches of darker nebulosity, faintly glowing spiral arms containing scattered brighter patches, a small stellar-like nucleus, and NGC-206, a bright starcloud lying 10 arc-minutes northeast of M-33's core. In very, very dark skies with good seeing, M-33 is visible naked eye: when this occurs, it overtakes the Andromeda Galaxy as the furthest object visible without optical aid.

Triangulum contains other galaxies as well: NGC-672 (an 11.6 magnitude barred spiral); NGC-925 (a large but faint Sb-type spiral); and NGC 750-751, a small double galaxy containing two elliptical galaxies: one 13th magnitude and one 13.8 magnitude, separated by only 24 arc seconds. See if you can discover some of the beauties of Triangulum on a clear, moonless night this Fall in the darkness away from city lights.

ARIES: ("The Ram"): This zodiacal constellation borders on the constellations of Cetus, Perseus, Pisces, Taurus, and Triangulum. It ranks 53rd in overall brightness among the constellations, and contains 28 stars brighter than magnitude 5.5. Its central point is located at RA=2h35m and Dec.= +20.5 degrees. It is completely visible from latitudes North of -59 degrees, and completely invisible from latitudes South of -80 degrees. This constellation ranks 39th in overall size, taking up 441.39 square degrees, or 1.07% of the sky.

Aries has two known meteor showers, (the Daytime Arietids on 7 June, and the delta Arietids on 11 December), but no associated Messier objects; its midnight culmination date is October 30th. It also contains one star asterism known as the "Northern Fly". Also, at about the year 27 BC, the vernal equinox (or "the First Point of Aries") moved from the constellation Aries into that of Pisces. The vernal (spring) equinox marks the position of the Sun on the ecliptic, where it crosses the celestial equator as it heads north to its highest point in the northern sky in June, at the summer solstice.

Gamma Arietis (Mesarthim) was one of the first double stars telescopically detected, and was discovered accidentally by Robert Hooke in 1664, who had been following a comet with his telescope. Each star shines at magnitude 4.8, and the two stars are resolvable in most telescopes, being separated by 7.8". Gamma Arietis is generally considered one of the most beautiful of equal magnitude doubles, each shining with a sparkling blue-white color. This double star system lies about 50 parsecs away from Earth, and together shine with a luminosity of about 50 suns.

Aries also contains many other interesting objects: NGC-772 (magnitude 10.3 spiral galaxy); NGC-770 (blue magnitude 14.1 elliptical galaxy); NGC-821 (bright elliptical 10.8 magnitude galaxy); NGC-803 (magnitude 12.4 Sb-type spiral); NGC-697 (highly inclined barred spiral of photographic magnitude 12.7); NGC-691 (blue magnitude 12.4 spiral galaxy); NGC-976 (12.4 magnitude spiral galaxy); NGC-1156 (interesting irregular galaxy lying within a rich starfield and showing mottling in small scopes); and NGC-972 (an 11th magnitude highly inclined spiral galaxy).

Briefly, the legend of Aries is as follows: Aries, with a coat of golden fleece, was the pet ram of Zeus, the supreme Greek mythological God. One day Zeus looked down on his people on Earth, and noticed that two innocent little children were in danger of being killed. He sent Aries down to save them and, just in the nick of time, the children jumped on the ram's back, and were safely taken away from imminent death. To honor his pet ram, Zeus placed him in the celestial sphere where the ram can freely roam near the winged, flying horse named Pegasus.

PEGASUS: (The Winged Horse): With a midnight culmination date of September 1st, Pegasus is well-placed for late summer and Fall viewing. Pegasus borders on the constellations of Andromeda, Aquarius, Cygnus, Delphinus, Equuleus, Lacerta, Pisces, and Vulpecula, and contains the well-known asterism of The Great Square (composed of the famous stars of Markab, Scheat, Algenib, and Alpheratz), and the lesser known asterisms of The Baseball Diamond and another dipper known as The Large Dipper (as opposed to the Big Dipper of Ursa Major).

Pegasus ranks 75th in overall brightness among the constellations, but 7th in size: it takes up approximately 1120.8 square degrees of the sky (2.717%). Pegasus contains two known meteor showers: the Xi Pegasids (July 9) and the Pegasids (November 12).

Pegasus contains one Messier object: M-15. M-15 is the most easily found deep-sky object in Pegasus for amateur astronomers, and is a bright (7th magnitude) globular cluster. M-15 is the only known globular cluster containing a planetary nebula (almost 15th magnitude; one second of arc in diameter). M-15 is located 40,000 light-years away from Earth, and itself has a diameter of 12 minutes of arc. M-15 contains many variable stars, and is one of the richest globulars with respect to variable stars, most of which are RR Lyrae stars. M-15 is a very unusual globular cluster for several reasons: in addition to the planetary nebula and the high concentration of variable stars as mentioned above, M-15 also is an intense X-ray source, leading astronomers to speculate that it contains a central black hole, which is postulated to be the cause of one of the most concentrated and bright cores of any of the globular clusters in the night sky.

Pegasus is fully visible from latitudes North of –54 degrees, and completely invisible from latitudes South of –88 degrees. It has 57 stars brighter than magnitude 5.5, and its central point is at RA=22h39m, Dec.= +19 degrees. The solar conjunction date of Pegasus is March 2nd.

Pegasus contains many other interesting objects as well as M-15. A few of them are listed as follows: AG Pegasi (one of the brightest symbiotic stars, containing both a Wolf-Rayet star and an M-giant star); NGC-7331 (10th magnitude Sb-type spiral galaxy); NGC-7217 (a magnitude 10.2, Sb-type nearly face-on spiral with relatively high surface brightness); NGC-7332 (11th magnitude elliptical (E7) galaxy with a visible lens-shape); NGC-7448 (11.7 magnitude Sc spiral exhibiting a bright nucleus encircled by a irregular dim haze); NGC-7479 (11th magnitude, beautiful barred spiral); and NGC-7619 and NGC-7626 (two of the brighter members, and both ellipticals, of the Pegasus-I galaxy cluster).

Perhaps the next famous deep-sky object of Pegasus after M-15 is actually a combination of five galaxies – Stephan's Quintet. The brightest member (magnitude 12.7 spiral) of the Quintet is NGC-7320; the others are all 13th magnitude galaxies: NGC-7317 (elliptical), NGC-7318-A (peculiar elliptical), NGC-7318-B (peculiar barred spiral), and NGC-7319 (peculiar barred spiral). This assemblage of galaxies all lie along the same line of sight; however, while the brightest of the five (NGC-7320) lies 13 megaparsecs away, the remaining four all lie at a distance of 90 megaparsecs!!

There are some other interesting facts about Pegasus which should not be overlooked for the amateur astronomer. The first object in the New General Catalog (NGC-1), lies within Pegasus. NGC-1 is a faint, 13th magnitude galaxy which shows minimal detail in most amateur scopes. A good test of vision and darkness for a dark-sky observing site is to count the stars within the Great Square; 30-50 stars have been reported, and the closer towards 40 or 50 stars, obviously the better the observing. Finally, the constellation of Pegasus contains a good

example of what is known as a "shared star": Alpha Andromedae had been known as Delta Pegasi on some ancient maps, but was assigned to Andromeda permanently by the IAU in 1928; i.e., it was "shared" by more than one constellation before 1928. Be sure to make the wonders of Pegasus an integral part of your Fall observing.

INDUS: (The American Indian): With a midnight culmination date of August 12th, Indus (abbreviated Ind) is best viewed from August to October, and is thus well placed for winter viewing in the Southern Hemisphere. It contains no asterisms, associated Messier objects or meteor showers. Bordering constellations include Grus, Microscopium, Octans, Pavo, Telescopium, and Tucana. Indus ranks 80th in overall brightness among the constellations (overall brightness is calculated by dividing the number of visible stars in a constellation by the size of the constellation in square degrees, and then multiplying that number by 100). Indus ranks 49th in size, taking up 294.01 square degrees (0.713% of the sky; note: this square degree factor would be the denominator in the above equation: the smaller the denominator the larger the result – in this case, overall brightness). The number of visible stars (stars brighter than magnitude 5.5) in this moderately sized constellation is 13. Indus is completely visible from latitudes South of +15 degrees, and completely invisible from latitudes North of +45 degrees. Its central point is at RA=21h55m, Dec.= -60 degrees. The solar conjunction date of Indus is February 19th.

Some interesting facts about Indus:

Indus is one of 11 constellations invented by Pieter Dirksz Keyser and Frederick de Houtman, during the years 1595-97.

One of the nearest of the solar-type stars – magnitude +4.68 Epsilon Indi – lies within this constellation and is 11.2 light years away. This star has been investigated by radio astronomers (searching for signs of other planets) and by SETI. Except for Alpha Indi, the stars are faint. Theta Indi is an interesting double star with magnitude 4.5 and 6.9 components, separated by seven arc seconds.

There is a relatively good selection of galaxies in Indus however, (located in the northern areas of the constellation), and these are best viewed in a eight-inch scope or larger. One interesting galaxy is IC-5152, an irregular 11.6 magnitude galaxy. However, with an eight-magnitude star in its field of view that outshines the galaxy itself, IC-5152 is a difficult galaxy to view.

YOUNG ASTRONOMER'S CORNER

The Young Astronomer's Corner will return this month to a question and answer format. Here are the answers to some familiar questions heard in young astronomer circles! (Note: If you, or a friend, ever have any questions that you would like answered in this column, please e-mail one of the EAS newsletter editors and we will do our best to find and provide the answer for you!!).

Q: What does the planet Earth have to do with the science of Astronomy?

A: Astronomy is the study of space and absolutely everything found within it: other galaxies, black holes, the Sun and stars other than the Sun, comets, asteroids, various moons (including our own), the planets (including Earth), and many, many more objects. Our Sun lies within one section of the vast Milky Way galaxy, which itself is one of countless other galaxies in the Universe. By studying Earth as well as the other known planets, astronomers and geologists (those scientists dedicated to the study of Earth's physical structure, as well as to what it is composed of) can learn more about Earth. For example, by comparing volcanoes and impact craters on one planet or moon with those of Earth, they can learn more about similar structures found on Earth. Also, by studying the atmospheres of other planets such as Venus and Jupiter, the can learn more about how Earth's atmosphere works (and potential problems with our atmosphere, such as the ozone hole and greenhouse effect). Also, to learn more about the Earth, scientists and astronomers also study our own Sun; changes in the Sun's surface temperature and increased activity on the Sun's surface could cause weather or radio and satellite communication changes on Earth, respectively. So, it is important to know that the planet Earth is an important and integral member of the Sun's "solar" system, not just because it supports our lives, but also because we can learn more about our lives and how the Earth affects us and maintains its overall balance. We do this at least in part by studying all the other astronomical objects that we see in the solar system, (as well as gathering information from outside the solar system which may also be helpful in understanding the workings of our home planet Earth).

Q. Why does the Sun move across the sky?

A. The Sun only "appears" to move across the sky. As the Sun rises in the East and sets in the West, what is really moving is the Earth, not the Sun. It is the rotation of the Earth on its axis (which takes 24 hours, or a day) that causes the Sun to "appear" to move across the sky. This is similar to riding in a car; when we do so, we appear to be sitting still while everything else outside the car is moving quickly by. But we all know that the trees and cows for example are NOT moving at 60 miles per hour!! As we are inhabitants of planet Earth (like inhabitants in the car), the only way we can sense our own motion is to see things outside the Earth, like the Sun and the stars, move by us. That is, as the Earth turns on its axis, the Sun and stars "appear" to move in and out of view!!

Q. How do we get all the beautiful pictures of the planets from the spacecraft that visit them?

A. In exactly the same way we listen to music on the radio or see TV images… by using radio waves. These radio waves (which like visible light, X-rays, and infrared waves for example, are only one part of the entire "electromagnetic" spectrum) are used to send and receive messages from spacecraft computers. These radio commands are used to point cameras or to direct other robotic systems (such as laboratory studies) related to the spacecraft. In the example of cameras, the radio waves can tell the computers where to point them and how long to shoot. This information (which the computer remembers as a series of numbers), is sent back to Earth as a radio signal; computers on Earth convert that signal back to an image. That's how we get all those pretty pictures from space!!

ASTRONOMY FUN FACTS

★★ Saturn is composed mostly of hydrogen and helium (like Jupiter), but is the only planet to have a density lower than water (water = 1; Saturn = 0.7). If a large "piece" of Saturn could be brought to earth for a party, this "piece" of Saturn would float in the punch bowl if it were placed therein!

★★ Fifty of the earth's largest hurricanes could be placed side by side inside the Great Red Spot on Jupiter (see above), itself a massive anticyclonic "storm".

★★ The Martian moon Deimos is so small, and its gravity so slight, that a human being could launch themselves into space by simply running at the relatively modest speed of seven miles per hour -– the escape velocity of Deimos!

★★ Neptune is about 1 billion miles further away from the Sun than Uranus. This average distance between Uranus and Neptune is almost 11 times the Sun-Earth distance, and almost 290,000 times the distance

between New York and London. If a Boeing 747 could be made space-worthy, it would take approximately 1,900 years to fly from Uranus to Neptune, flying at an average speed of 600 miles per hour!

★★ Before Voyager 2 traveled to the outer planets, the record for deep-space communication was set by Pioneer 5, which communicated (non-image data only) data back to earth from a distance of 22 million miles. Voyager 2, when it visited Uranus in 1986 at a distance of approximately 2 billion miles, improved the communication distance record (with image data as well), by a factor of about 100!

★★ The Sun radiates more energy in one second than mankind has consumed throughout all of its history. One second of the Sun's energy is 13 million times the mean annual electricity usage in the entire United States!

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.***

M STARS: Cool, red stars of spectral type M, with surface temperatures in the range of 2400-3480 degrees Kelvin. There is a greater proportion of oxygen to carbon in their surface layers compared to carbon stars; this excess oxygen is available for the formation of molecular oxides. The spectra of M stars are characterized by more expansive absorption bands of titanium and vanadium oxides; lines of neutral metals are also present. Some M stars show emission lines as well; these are categorized as ME stars. MS stars are M-type stars showing bands of zirconium oxide, rather than the strong presence of titanium and vanadium oxides.

NORTHERN HEMISPHERE EXAMPLE: **BETELGEUSE.**

SOUTHERN HEMISPHERE EXAMPLE(S): **ANTARES.**

RV TAURI STARS: A small group of very luminous pulsating variables; these are primarily G and K stars with some F stars included as well. RV Tauri stars are yellow supergiants with extended atmospheres of gas that emit infrared radiation; these atmospheres may have possibly been driven off (or 'extended') by the pulsations themselves. RV Tauri stars have characteristic light curves with alternating shallow and deep minima, and periods ranging from 20 to 145 days. These stars are classified as semiregular variables, because the luminosity fluctuations can be significantly perturbed in shape and period (for example), being most pronounced for longer-period stars. RV Tauri stars can be discerned from other similar semiregular yellow stars by variations in their color indices: RV Tauri stars' color indices mimic the light curves of these other similar yellow stars, but go through a maximum only a short time before the luminosity minimum. A smaller group of RV Tauri stars also have double periodicity: DF Cygni is an example. DF Cygni has two separate oscillations in luminosity: one is a rapid 50-day oscillation, and this is superimposed on a much slower 780-day oscillation with a significantly greater amplitude.

NORTHERN HEMISPHERE EXAMPLE: ***RV TAURI.***

SOUTHERN HEMISPHERE EXAMPLE(S): ***R SCUTI; R SAGITTAE.***

ASTRONOMY AND TELESCOPE "LINGO"

ASTRONOMY "LINGO": INTERSTELLAR BUBBLE: A large cavity in the distribution of gas within and near to the plane of the Milky Way Galaxy. The "bubble" is distributed and blown by the winds of several supernovae from the most massive of stars affiliated with stellar clusters or associations, and is generally filled with coronal gas. The borders of the bubble are outlined by swept-up filaments and clouds of denser gases.

ASTRONOMY "LINGO": "SMALL SOLAR SYSTEM OBJECTS": Solar system entities which are not defined as either planets, dwarf planets (such as Ceres, Pluto, and 2003-UB-313), or satellites, were placed in this category in 2006 by the International Astronomical Union (IAU). These objects include most asteroids, comets, Trans-Neptunian Objects, and other smaller solar system matter.

TELESCOPE "LINGO": DETECTOR ARRAY: An electronic device, such as a CCD imager, composed of thousands or even millions of individual detectors (formed on centimeter-sized wafers of silicon (or similar material)), which act together to generate a composite output, such as an astronomical image..

TELESCOPE "LINGO": "COMPTON GAMMA RAY OBSERVATORY": Launched April 7, 1991, to Earth orbit, the "GRO" was designed to make the first survey of gamma ray sources across the entire sky, including quasars, black holes, supernovae, neutron stars and pulsars. At the completion of its very successful mission, the "GRO" had its orbit disintegrated, and was sent crashing into the Pacific Ocean on June 4, 2000.

PLANETARY FOCUS – JUPITER AND NEPTUNE

"Planetary Focus" is a periodic column that publishes occasionally in the EAS "Stargazer", within which we list the astronomical facts about each planet. For the month of October 2009, and in honor of the 2009 International Year of Astronomy's Cornerstone Project "Galilean Nights" program (10/22/09-10/24/09), our first guest planet is **JUPITER**, and these are the facts:

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): 62, 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) known at the time in 1979 (there are presently at least 62 known moons of Jupiter). 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.

NEPTUNE: Our other guest planet is Neptune, and these are the facts:

Rotation around the Sun: every 164.79 years

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

Inclination of Orbit to Ecliptic: 1.8 degrees.

Mean Orbital Velocity: 5.43 km/sec.

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

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

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

Surface Gravity (Earth = 1): 1.19

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

Axis tilt: 29.56 degrees.

Satellites (moons): 8, as well as planetary rings.

Special Notes About Neptune: **Neptune** is the fourth largest planet in the solar system (one of the gas giants) in terms of equatorial diameter, but is more massive than Uranus, the third largest planet in diameter. Neptune is the most distant of the giant planets, and was discovered in 1846 by J.G. Galle at the Berlin Observatory, based on French (Urbain Leverrier) predictions resulting from disturbances in the orbit of Uranus

(there were similar estimates made by Englishman John C. Adams). Neptune returns to opposition two days later every year, and appears as an indistinct magnitude 7.7 bluish-green object in binoculars; in fact, no markings can be seen on its bluish-green disk from earth-bound telescopes. Neptune's color arises primarily from methane within its atmosphere, which is principally helium and hydrogen and a blend of methane, water, and ammonia. In 1989, Voyager 2 sent back remarkable images of Neptune during its fly-by. The Great Dark Spot was noted in its atmosphere. Like Jupiter's Great Red Spot, it occupies a equivalent proportion of the surface area of Neptune (as the GRS does of Jupiter's surface area), and is a high-pressure system around which near-supersonic winds flow in an anti-clockwise circuit. The Great Dark Spot measures approximately 12,000 by 8,000 kilometers. At about 50-70 kilometers above the main cloud plane, there are whitish cirrus-like clouds composed of methane ice crystals. Neptune also has belts and zones similar to Jupiter's, only much fainter. The core of Neptune is believed to be rocky, composed primarily of silicon and iron. The atmosphere of Neptune revolves more slowly than its core, and this is opposite to the atmospheres of the other gas giants; the implication is that circulation of Neptune's atmosphere may take place in a retrograde (backward or opposite) manner. Neptune also gives off more energy than it receives from the Sun, suggesting that it has its own internal source of heat; the planet also has a magnetic field, which is somewhat weaker than that of the other gas giant planets. Four dark planetary rings were discovered during the Voyager 2 fly-by in 1989.

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

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

NO REAL 2012 DOOMSDAY, JUST PROFITS FOR PURVEYORS OF DOOM

The widespread Internet belief that Dec. 21, 2012, will be doomsday for planet Earth because some astronomical event will destroy or decimate our planet is a complete hoax, according to NASA scientist David Morrison. His concise summary of the claims and the scientific response is being published by the Astronomical Society of the Pacific as a public service at: http://www.astrosociety.org/2012

For several months, NASA and many astronomers have received increasingly worried letters and e-mails from members of the public about the possibility, widely touted on the Internet, that the world will end in 2012. Many mechanisms for doomsday are being proposed, including a collision with a **fictional** planet called Nibiru, deadly activity on the surface of the Sun that lashes out at Earth, alignments with the center of our galaxy, etc. David Morrison has coined the term "cosmophobia" -- fear of the cosmos -- for these concerns, and has seen a huge increase in the phenomenon this year.

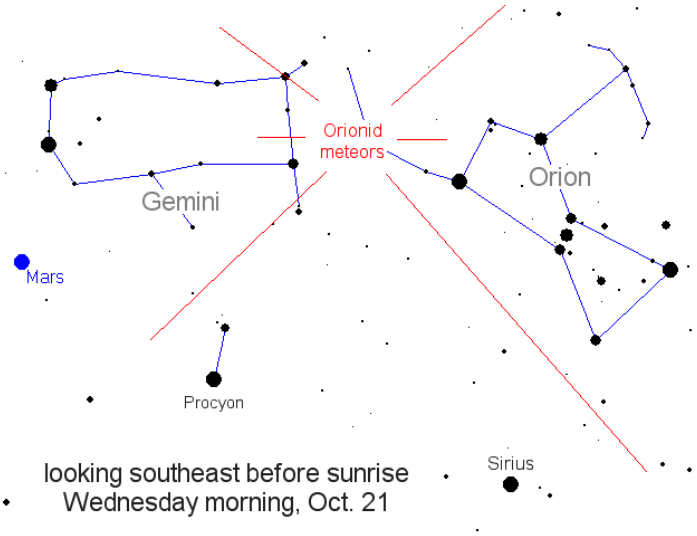
Dr. Morrison, a world-renowned expert on the solar system (and asteroid impacts), also serves as the public scientist for NASA's "Ask an Astrobiologist" service, where he answers questions for the public. He has received so many questions about 2012 and the end of the world, that he felt he had to investigate and set the record straight. One of his most interesting findings is that the distributors of the science-fiction motion picture "2012", to be released this November, are purposely feeding the flames of the Internet panic (as a viral marketing campaign) by creating fake science websites and encouraging people to search for "2012" on the Web. Most of the sites such searches encounter are full of nonsense and misunderstanding, often by people who have written books on coming disaster that they are trying to sell.

Morrison's article is in the form of questions and answers, and is followed by a resource guide that allows readers to find even more scientific information about why no 2012 disaster is in the cards. There are many reasons to worry about the future of planet Earth, of course, but absolutely no reason to single out the winter solstice of 2012 as a special time to be concerned. For an annotated guide of resources for responding to claims of astronomical pseudo-science, from astrology to crop circles, and ancient astronauts to Moon-landing denial, see:
http://www.astrosociety.org/education/resources/pseudobib.html
http://www.astrosociety.org/2012/index.html
http://www.astrosociety.org/2012/ab2009-32.pdf

Founded in 1889, the Astronomical Society of the Pacific is an international scientific and educational organization, with a goal of providing reliable, authoritative information to help the public understand and appreciate astronomy. Their website at http://www.astrosociety.org has a host of information and resource guides for those who want learn more about the exploration of the universe.

THE 2009 ORIONID METEOR SHOWER

The Orionid meteor shower peaks this week and it could be a very good show. "*Earth is passing through a stream of debris from Halley's Comet, the source of the Orionids*," says Bill Cooke of NASA's Meteoroid Environment Office. "*Flakes of comet dust hitting the atmosphere should give us dozens of meteors per hour*." The best time to look is before sunrise on Wednesday, Oct. 21st. That's when Earth encounters the densest part of Halley's debris stream. Observing is easy: Wake up a few hours before dawn, brew some hot chocolate, go outside and look up. No telescope is required to see Orionids shooting across the sky.



Orionids appear every year around this time when Earth orbits through

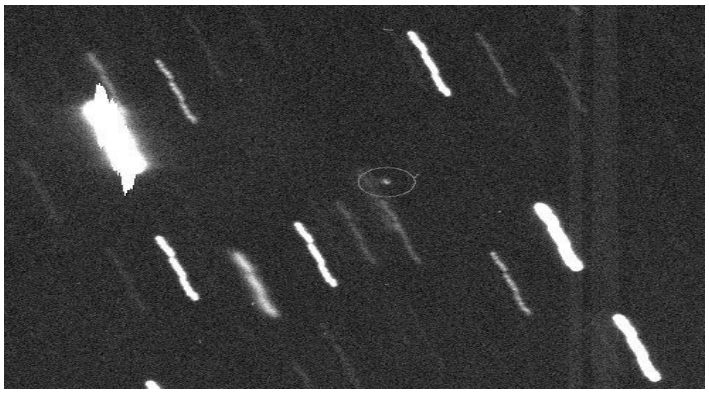
an area of space littered with debris from the ancient comet. Normally, the shower produces 10 to 20 meteors per hour, a modest display. The past few years, however, have been much better than usual. "*Since 2006, the Orionids have been one of the best showers of the year, with counts of 60 or more meteors per hour*," says Cooke. According to Japanese meteor scientists Mikiya Sato and Jun-ichi Watanabe, 2006 marked Earth's first encounter with some very old debris. "*We have found that the [elevated activity of 2006] was caused by dust trails ejected from 1P/Halley in 1266 BC, 1198 BC, and 911 BC*". Sato and Watanabe used a computer to model the structure and evolution of Halley's many debris streams stretching back in time as far as 3400 years. The debris that hit Earth in 2006 was among the oldest they studied and was rich in large fireball-producing meteoroids.

Repeat encounters produced good displays in 2007 and 2008 and "*the meteoroids are expected to approach Earth [again] in 2009*," say Sato and Watanabe. They note that these old broad streams tend to produce equally broad showers, lasting several nights around the peak. So, if clouds interfere on the 21st, try again on the 22nd or 23rd. The phase of the Moon favors a good show. The Moon is almost new and completely absent from the pre-dawn sky at the time of the shower's peak. Bright moonlight will not be a problem.

Last but not least, the display will be framed by some of the prettiest stars and planets in the night sky. In addition to Orionids, you'll see brilliant Venus, red Mars, the Dog star Sirius, and bright winter constellations such as Orion, Gemini and Taurus. Even if the shower is a dud, the rest of the sky is dynamite. Set your alarm and enjoy the show. http://science.nasa.gov/headlines/y2009/19oct_orionids.htm

NASA REFINES ASTEROID APOPHIS' PATH, RELATIVE TO EARTH

Using updated information, scientists have recalculated the path of a large asteroid. The refined path indicates a ***significantly reduced likelihood of a hazardous encounter*** with Earth in 2036. The Apophis asteroid is approximately the size of two-and-a-half football fields. The new data were documented by near-Earth object scientists Steve Chesley and Paul Chodas at the Jet Propulsion Laboratory. "*Apophis has been one of those celestial bodies that has captured the public's interest since it was discovered in 2004*," said Chesley. "*Updated computational techniques and newly available data indicate the probability of an Earth encounter on April 13, 2036, for Apophis has dropped from one-in-45,000 to about four-in-a million*."



A majority of the data that enabled the updated orbit of Apophis came from observations Dave Tholen and collaborators made. Tholen pored over hundreds of previously unreleased images of the night sky made with the University of Hawaii's 88-inch telescope, located near the summit of Mauna Kea. Tholen made improved measurements of the asteroid's position in the images, enabling him to provide Chesley and Chodas with new data sets more precise than previous measures for Apophis. Measurements from the Steward Observatory's 90-inch Bok telescope on Kitt Peak in Arizona and the Arecibo Observatory on the island of Puerto Rico also were used in Chesley's calculations. The information provided a more accurate glimpse of Apophis' orbit well into the latter part of this century. Among the findings is another close encounter by the asteroid with Earth in 2068 with chance of impact currently at approximately three-in-a-million. As with earlier orbital estimates where Earth impacts in 2029 and 2036 could not initially be ruled out due to the need for additional data, it is expected that the 2068 encounter will diminish in probability as more information about Apophis is acquired.

Initially, Apophis was thought to have a 2.7 percent chance of impacting Earth in 2029. Additional observations of the asteroid ruled out any possibility of an impact in 2029. However, the asteroid is expected to make a record-setting -- but harmless -- close approach to Earth on Friday, April 13, 2029, when it comes no closer than 18,300 miles above Earth's surface. "*The refined orbital determination further reinforces that Apophis is an asteroid we can look to as an opportunity for exciting science and not something that should be feared*," said Don Yeomans, manager of the Near-Earth Object Program Office at JPL. "*The public can follow along as we continue to study Apophis and other near-Earth objects by visiting us on our AsteroidWatch Web site and by following us on the @AsteroidWatch Twitter feed*."

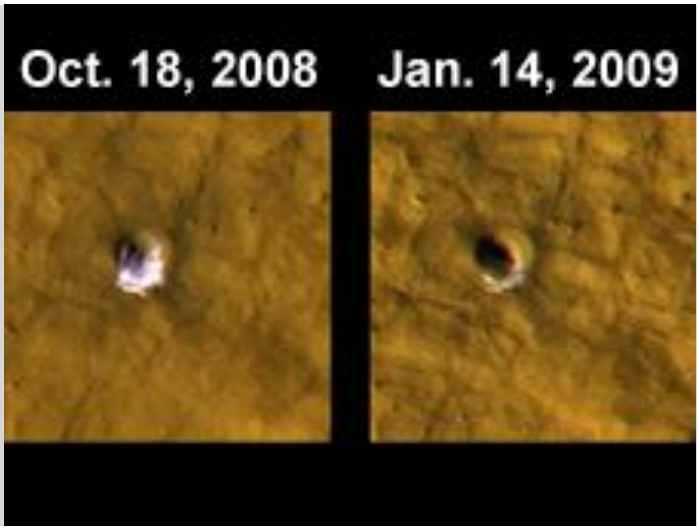
The science of predicting asteroid orbits is based on a physical model of the solar system which includes the gravitational influence of the sun, moon, other planets and the three largest asteroids. NASA detects and tracks asteroids and comets passing close to Earth using both ground and space-based telescopes. The Near Earth-Object Observations Program, commonly called "Spaceguard," discovers these objects, characterizes a subset of them and plots their orbits to determine if any could be potentially hazardous to our planet. For more info about asteroids and near-Earth objects: http://www.jpl.nasa.gov/asteroidwatch

MRO SEES ICE ON MARS EXPOSED BY METEOR IMPACTS

The Mars Reconnaissance Orbiter has revealed frozen water hiding just below the surface of mid-latitude Mars. The spacecraft's observations were obtained from orbit after meteorites excavated fresh craters on the Red Planet. Scientists controlling instruments on the orbiter found bright ice exposed at five Martian sites with new craters that range in depth from approximately 1.5 feet to 8 feet. The craters did not exist in earlier images of the same sites. Some of the craters show a thin layer of bright ice atop darker underlying material. The bright patches darkened in the weeks following initial observations, as the freshly exposed ice vaporized into the thin Martian atmosphere. One of the new craters had a bright patch of material large enough for one of the orbiter's instruments to confirm it is water ice.

The finds indicate water ice occurs beneath Mars' surface halfway between Mars' north pole and the equator, a lower latitude than expected in the Martian climate. "*This ice is a relic of a more humid climate from perhaps just several thousand years ago*," said Shane Byrne. Byrne is a member of the team operating the orbiter's High Resolution Imaging Science Experiment, or HiRISE camera, which captured the unprecedented images. "*We now know we can use new impact sites as probes to look for ice in the shallow subsurface*," said Megan Kennedy, a co-author of the paper and member of the team operating the orbiter's Context Camera. During a typical week, the Context Camera returns more than 200 images of Mars that cover a total area greater than California. The camera team examines each image, sometimes finding dark spots that fresh, small craters make in terrain covered with dust. Checking earlier photos of the same areas can confirm a feature is new. The team has found more than 100 fresh

impact sites, mostly closer to the equator than the ones that revealed ice. An image from the camera on Aug. 10, 2008, showed apparent cratering that occurred after an image of the same ground was taken 67 days earlier. The opportunity to study such a fresh impact site prompted a look by the orbiter's higher resolution camera on Sept. 12, 2009, confirming a cluster of small craters. "*Something unusual jumped out*," Byrne said. "*We observed bright material at the bottoms of the craters with a very distinct color. It looked a lot like ice*."



Images of a fresh, 6-meter-wide (20-foot-wide) crater on Mars on Oct. 18, 2008, (left) and on Jan. 14, 2009. Each image is 35 meters (115 feet) across. Image Credit: NASA/JPL-Caltech/University of Arizona

The bright material at that site did not cover enough area for a spectrometer instrument on the orbiter to determine its composition. However, a Sept. 18, 2008, image of a different mid-latitude site showed a crater that had not existed eight months earlier. This crater had a larger area of bright material. "*We were excited about it, so we did a quick-turnaround observation*," said co-author Kim Seelos., "*Everyone thought it was water ice, but it was important to get the spectrum for confirmation*."

The Mars orbiter is designed to facilitate coordination and quick response by the science teams, making it possible to detect and understand rapidly changing features. The ice exposed by fresh impacts suggests that NASA's Viking 2 lander, digging into mid-latitude Mars in 1976, might have struck ice if it had dug four inches deeper. The Viking 2 mission, which consisted of an orbiter and a lander, launched in September 1975 and became one of the first two space probes to land successfully on the Martian surface. The Viking 1 and 2 landers characterized the structure and composition of the atmosphere and surface. They also conducted on-the-spot biological tests for life on another planet.

"*We knew there was ice below the surface at high latitudes of Mars, but we find that it extends far closer to the equator than you would think, based on Mars' climate today*," said Shane Byrne, a member of the High Resolution Imaging Science Experiment, or HiRISE, which runs the high-resolution camera on Mars Reconnaissance Orbiter. "*The other surprising discovery is that ice exposed at the bottom of these meteorite impact craters is so pure*," Byrne said. "*The thinking before was that ice accumulates below the surface between soil grains, so there would be a 50-50 mix of dirt and ice. We were able to figure out, given how long it took that ice to fade from view, that the mixture is about one percent dirt and 99 percent ice*." Scientists used several instruments on the Mars Reconnaissance Orbiter, or MRO, in quick succession in detecting and confirming highly pure, bright ice exposed in new craters, ranging from 1.5 feet to 8 feet deep, at five different Martian sites. In August 2008, the orbiter's Context camera team examined their images for any dark spots or other changes that weren't visible in earlier images of the same area. Meteorites usually leave dark marks when they crash into dust-covered Mars terrain. The HiRISE team followed up in September 2008 by taking high-resolution images of the dark spots. "*We saw something very unusual when we followed up on the first of these impact craters*," Byrne said, "*and that was this bright blue material poking up from the bottom of the crater. It looked a lot like water ice. And sure enough, when we started monitoring this material, it faded away like you'd expect water ice to fade, because water ice is unstable on Mars' surface and turns directly into water vapor in the atmosphere*." A few days later that September, the orbiter's "CRISM" team used their Compact Reconnaissance Imaging Spectrometer for Mars and got the spectral signature of water ice exposed in one of the impact craters, further clinching the discovery. "*All of this had to happen very quickly because 200 days after we first saw the ice, it was gone, it was the color of dirt*," Byrne said. "*If we had taken HiRISE images just a few months later, we wouldn't have noticed anything unusual. This discovery would have just passed us by*." How far water ice extends toward the equator depends largely on how much water has been available in the Martian atmosphere in the recent past, Byrne said: "*The ice is a relic of a more humid climate not very long ago, perhaps just several thousand years ago*."

The Phoenix Mars Lander mission last year also found clean ice at its landing site on the northern plains of Mars, Byrne noted. But to find highly pure ice far closer to the equator because of random meteor impacts was unexpected, he said. There are several theories about how a layer of such pure ice could have formed beneath Mars surface. Byrne said he thinks that one of the most promising ideas is that this ice on Mars formed in the same way that pure ice lenses form beneath the surface of the Earth. "*That's where you have very thin films of liquid water around ice grains and soil grains and they migrate around to form clear ice lenses on top of the ice table, even at temperatures well below zero. This process is called 'frost heave' on Earth, and it's considered a nuisance in most places because it cracks up roads and tilts walls and destroys foundations of houses. "But on Mars it would be of great interest if we could discover a process that involved liquid water in today's climate, and not just in some of the warmest areas of the planet but in some of the coldest areas of the planet in the high latitude regions*," Byrne said. http://hirise.lpl.arizona.edu http://www.nasa.gov/mro

SPITZER SPOTS CLUMP OF SWIRLING PLANETARY MATERIAL

Astronomers have witnessed odd behavior around a young star. Something, perhaps another star or a planet, appears to be pushing a clump of planet-forming material around. The observations, made with Spitzer Space Telescope, offer a rare look into the early stages of planet formation. Planets form out of swirling disks of gas and dust. Spitzer observed infrared light coming from one such disk around a young star, called LRLL 31, over a period of five months. To the astronomers' surprise, the light varied in unexpected ways, and in as little time as one week. Planets take millions of years to form, so it's rare to see anything change on time scales we humans can perceive. One possible explanation is that a close companion to the star -- either a star or a developing planet -- could be shoving planet-forming material together, causing its thickness to vary as it spins around the star. "*We don't know if planets have formed, or will form, but we are gaining a better understanding of the properties and dynamics of the fine dust that could either become, or indirectly shape, a planet*," said James

Muzerolle. "*This is a unique, real-time glimpse into the lengthy process of building planets*."

One theory of planet formation suggests that planets start out as dusty grains swirling around a star in a disk. They slowly bulk up in size, collecting more and more mass like sticky snow. As the planets get bigger and bigger, they carve out gaps in the dust, until a so-called transitional disk takes shape with a large doughnut-like hole at its center. Over time, this disk fades and a new type of disk emerges, made up of debris from collisions between planets, asteroids and comets. Ultimately, a more settled, mature solar system like our own forms.

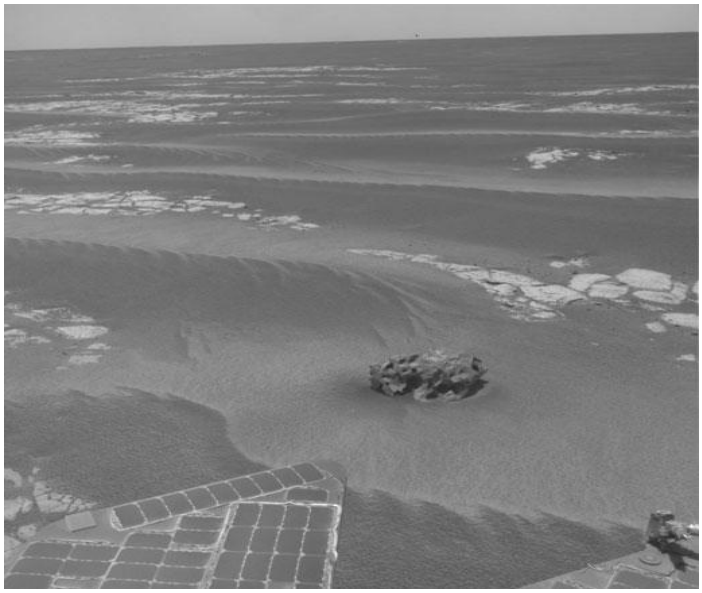
Before Spitzer was launched in 2003, only a few transitional disks with gaps or holes were known. With Spitzer's improved infrared vision, dozens have now been found. The space telescope sensed the warm glow of the disks and indirectly mapped out their structures. Muzerolle and his team set out to study a family of young stars, many with known transitional disks. The stars are about two to three million

years old and about 1,000 light-years away, in the IC 348 star-forming region of the constellation Perseus. A few of the stars showed surprising hints of variations. The astronomers followed up on one, LRLL 31, studying the star over five months with all three of Spitzer's instruments. The observations showed that light from the inner region of the star's disk changes every few weeks, and, in one instance, in only one week. "*Transition disks are rare enough, so to see one with this type of variability is really exciting*," said co-author Kevin Flaherty. Both the intensity and the wavelength of infrared light varied over time. For instance, when the amount of light seen at shorter wavelengths went up, the brightness at longer wavelengths went down, and vice versa.

Muzerolle and his team say that a companion to the star, circling in a gap in the system's disk, could explain the data. "*A companion in the gap of an almost edge-on disk would periodically change the height of the inner disk rim as it circles around the star: a higher rim would emit more light at shorter wavelengths because it is larger and hot, but at the same time, the high rim would shadow the cool material of the outer disk, causing a decrease in the longer-wavelength light. A low rim would do the opposite. This is exactly what we observe in our data*," said Elise Furlan, a co-author. The companion would have to be close in order to move the material around so fast -- about one-tenth the distance between Earth and the sun. The astronomers plan to follow up with ground-based telescopes to see if a companion is tugging on the star hard enough to be perceived. Spitzer will also observe the system again in its "warm" mission to see if the changes are periodic, as would be expected with an orbiting companion. Spitzer ran out of coolant in May of this year, and is now operating at a slightly warmer temperature with two infrared channels still functioning. "*For astronomers, watching anything in real-time is exciting*," said Muzerolle. "*It's like we're biologists getting to watch cells grow in a Petri dish, only our specimen is light-years away*."

Opportunity Finds Yet Another Meteorite

The Mars Exploration Rover Opportunity has found a rock that apparently is another meteorite, less than three weeks after driving away from a larger meteorite that the rover examined for six weeks. Opportunity used its navigation camera during the mission's 2,022nd Martian day, or sol, (Oct. 1, 2009) to take this image of the apparent meteorite dubbed "Shelter Island." The pitted rock is about 47 centimeters (18.5 inches) long. Opportunity had driven 28.5 meters (94 feet) that sol to approach the rock after it had been detected in images taken after a drive two sols earlier.



A meteorite recently discovered by Opportunity
http://www.nasa.gov/mission_pages/mer/multimedia/mer20091002.html

Opportunity has driven about 700 meters (about 2,300 feet) since it finished studying the meteorite called "Block Island" on Sept. 11, 2009.

Cassini Sees New Ring Quirks, Shadows During Saturn Equinox

Scientists are marveling over the extent of ruffles and dust clouds revealed in the rings of Saturn during the planet's equinox last month. Scientists once thought the rings were almost completely flat, but new images reveal the heights of some newly discovered bumps in the rings are as high as the Rocky Mountains. "*It's like putting on 3-D glasses and seeing the third dimension for the first time*," said Bob Pappalardo, Cassini project scientist. "*This is among the most important events Cassini has shown us*." On Aug. 11, sunlight hit Saturn's rings exactly edge-on, performing a celestial magic trick that made them all but disappear. The spectacle occurs twice during each orbit Saturn makes around the sun, which takes approximately 10,759 Earth days, or about 29.7 Earth years. Earth experiences a similar equinox phenomenon twice a year; the autumnal equinox will occur Sept. 22, when the sun will shine directly over Earth's equator.

For about a week, scientists used the Cassini orbiter to look at puffy parts of Saturn's rings caught in white glare from the low-angle lighting. Scientists have known about vertical clumps sticking out of the rings in

a handful of places, but they could not directly measure the height and breadth of the undulations and ridges until Saturn's equinox revealed their shadows. "*The biggest surprise was to see so many places of vertical relief above and below the otherwise paper-thin rings*," said Linda Spilker, deputy project scientist at JPL. "*To understand what we are seeing will take more time, but the images and data will help develop a more complete understanding of how old the rings might be and how they are evolving*." The chunks of ice that make up the main rings spread out 85,000 miles from the center of Saturn, but they had been thought to be only around 30 feet thick in the main rings, known as A, B, C, and D. In the new images, particles seemed to pile up in vertical formations in each of the rings. Rippling corrugations -- previously seen by Cassini to extend approximately 500 miles in the innermost D ring -- appear to undulate out to a total of 11,000 miles through the neighboring C ring to the B ring. The heights of some of the newly discovered bumps are comparable to the elevations of the Rocky Mountains. One ridge of icy ring particles, whipped up by the gravitational pull of Saturn's moon Daphnis as it travels through the plane of the rings, looms as high as 2.5 miles. It is the tallest vertical wall seen within the rings. "*We thought the plane of the rings was no taller than two stories of a modern-day building and instead we've come across walls more than two miles high*," said Carolyn Porco, Cassini imaging team leader. "*Isn't that the most outrageous thing you could imagine? It truly is like something out of science fiction*."

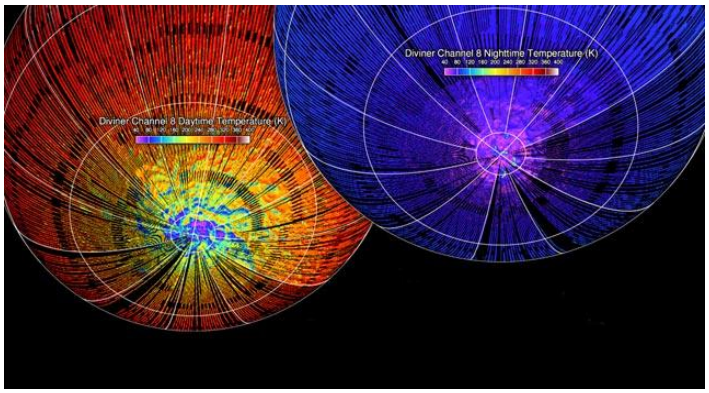
Scientists also were intrigued by bright streaks in two different rings that appear to be clouds of dust kicked up in collisions between small space debris and ring particles. Understanding the rate and locations of impacts will help build better models of contamination and erosion in the rings and refine estimates of their age. The collision clouds were easier to see under the low-lighting conditions of equinox than under normal lighting conditions.

At the same time Cassini was snapping visible-light photographs of Saturn's rings, the Composite Infrared Spectrometer instrument was taking the rings' temperatures. During equinox, the rings cooled to the lowest temperature ever recorded. The A ring dropped down to a frosty 382 degrees below zero Fahrenheit. Studying ring temperatures at equinox will help scientists better understand the sizes and other characteristics of the ring particles. http://www.nasa.gov/cassini

A Whole New Way of Seeing the Moon

The Lunar Reconnaissance Orbiter, an unmanned mission to comprehensively map the entire moon, has returned its first data. One of the instruments aboard, the Diviner Lunar Radiometer Experiment, is making the first global survey of the temperature of the lunar surface. Diviner has obtained enough data already to characterize many aspects of the moon's current thermal environment. So far, the instrument has revealed richly detailed thermal behavior throughout the north and south polar regions that extends to the limit of Diviner's spatial resolution of just a few hundred yards. "*Most notable are the measurements of extremely cold temperatures within the permanently shadowed regions of large polar impact craters in the south polar region*," said David Paige, professor of planetary science and principal investigator of the Diviner Lunar Radiometer Experiment. "*Diviner has recorded minimum daytime brightness temperatures in portions of these craters of less than -238 degrees Celsius (-397 degrees Fahrenheit). These super-cold brightness temperatures are, to our knowledge, among the lowest that have been measured anywhere in the solar system, including the surface of Pluto*." "*After decades of speculation, Diviner has given us the first confirmation that these strange, permanently dark and extremely cold places actually exist on our moon*," said science team member Ashwin Vasavada. "*Their presence greatly increases the likelihood that water or other compounds are frozen there. Diviner has lived up to its name*."

The Diviner "commissioning phase" observations provide a snapshot in time of current polar temperatures that will evolve with the lunar seasons. "*It is safe to conclude that the temperatures in these super-cold regions are definitely low enough to cold-trap water ice, as well as other more volatile compounds for extended periods*," Paige said. "*The existence of such cold traps has been predicted theoretically for almost 50 years. Diviner is now providing detailed information regarding their spatial distribution and temperatures*." "*Getting a look at the first global thermal maps of the lunar surface is a whole new way of seeing the moon*," Paige said.



Daytime and nighttime temperature observations of the lunar south pole recorded by the Diviner Radiometer Experiment, one of seven instruments on NASA's Lunar Reconnaissance Orbiter. Image credit: NASA/JPL/UCLA

Since the instrument was first activated on July 5, 2009, it has acquired more than 8 billion calibrated radiometric measurements and has mapped almost 50 percent of the surface area of the moon. Diviner's web site http://diviner.ucla.edu LRO: http://lunar.gsfc.nasa.gov/ http://www.jpl.nasa.gov/news/features.cfm?feature=2316

Instruments Reveal Water Molecules on Lunar Surface

Scientists have discovered water molecules in the polar regions of the moon. Instruments aboard three separate spacecraft revealed water molecules in amounts that are greater than predicted, but still relatively small. Hydroxyl, a molecule consisting of one oxygen atom and one hydrogen atom, also was found in the lunar soil. The Moon Mineralogy Mapper, or M3, instrument reported the observations. M3 was carried into space on Oct. 22, 2008, aboard the Indian Space Research Organization's Chandrayaan-1 spacecraft. Data from the Visual and Infrared Mapping Spectrometer, or VIMS, on Cassini spacecraft and the High-Resolution Infrared Imaging Spectrometer on the EPOXI spacecraft contributed to confirmation of the finding. The spacecraft imaging spectrometers made it possible to map lunar water more effectively than ever before. The confirmation of elevated water molecules and hydroxyl at these concentrations in the moon's polar regions raises new questions about its origin and effect on the mineralogy of the moon. Answers to these questions will be studied and debated for years to come. "*Water ice on the moon has been something of a holy grail for lunar scientists for a very long time*," said Jim Green.

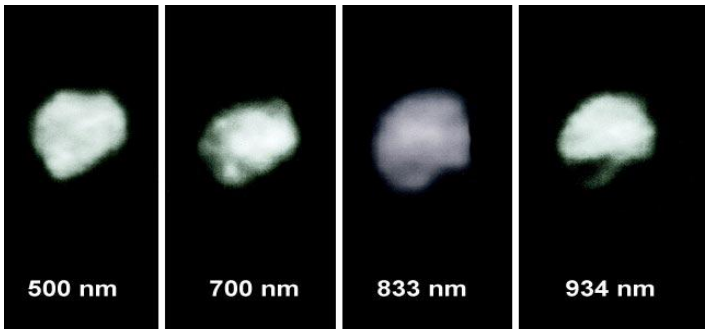
From its perch in lunar orbit, M3's state-of-the-art spectrometer measured light reflecting off the moon's surface at infrared wavelengths, splitting the spectral colors of the lunar surface into small enough bits to reveal a new level of detail in surface composition. When the M3 science team analyzed data from the instrument, they found the wavelengths of light being absorbed were consistent with

the absorption patterns for water molecules and hydroxyl. "*For silicate bodies, such features are typically attributed to water and hydroxyl-bearing materials*," said Carle Pieters, M3's principal investigator. "*When we say 'water on the moon,' we are not talking about lakes, oceans or even puddles. Water on the moon means molecules of water and hydroxyl that interact with molecules of rock and dust specifically in the top millimeters of the moon's surface*. " The M3 team found water molecules and hydroxyl at diverse areas of the sunlit region of the moon's surface, but the water signature appeared stronger at the moon's higher latitudes. Water molecules and hydroxyl previously were suspected in data from a Cassini flyby of the moon in 1999, but the findings were not published until now. "*The data from Cassini's VIMS instrument and M3 closely agree*," said Roger Clark, a member of both the VIMS and M3 teams. "*We see both water and hydroxyl. While the abundances are not precisely known, as much as 1,000 water molecule parts-per-million could be in the lunar soil. To put that into perspective, if you harvested one ton of the top layer of the moon's surface, you could get as much as 32 ounces of water*." For additional confirmation, scientists turned to the EPOXI mission while it was flying past the moon in June 2009 on its way to a November 2010 encounter with comet Hartley 2. The spacecraft not only confirmed the VIMS and M3 findings, but also expanded on them. "*With our extended spectral range and views over the north pole, we were able to explore the distribution of both water and hydroxyl as a function of temperature, latitude, composition, and time of day*," said Jessica Sunshine. Sunshine is EPOXI's deputy principal investigator and a scientist on the M3 team. "*Our analysis unequivocally confirms the presence of these molecules on the moon's surface and reveals that the entire surface appears to be hydrated during at least some portion of the lunar day*."

Images from the instruments: http://www.nasa.gov/topics/moonmars
Chandrayaan-1 mission: http://isro.gov.in/Chandrayaan/htmls/home.htm
EPOXI mission: http://www.nasa.gov/epoxi
Cassini mission: http://www.nasa.gov/cassini

ASTEROID JUNO GRABS THE SPOTLIGHT

Toward the end of September, the sun will turn a spotlight on the asteroid Juno, giving that bulky lump of rock a rare featured cameo in the night sky. Those who get out to a dark, unpolluted sky will be able to spot the asteroid's silvery glint near the planet Uranus with a pair of binoculars. "*It can usually be seen by a good amateur telescope, but the guy on the street doesn't usually get a chance to observe it*," said Don Yeomans, manager of the Near Earth Object Program Office at JPL. "*This is going to be as bright as it gets until 2018*."



The asteroid Juno was photographed in 2003 with a special optics system on the Hooker telescope at the Mount Wilson Observatory. The researchers who took the picture used varying wavelengths of light as measured in nanometers, starting with cyan and going into the infrared.
Image credit: Harvard-Smithsonian Center for Astrophysics
http://www.jpl.nasa.gov/news/features.cfm?feature=2314

Juno, one of the first asteroids discovered, is thought to be the parent of many of the meteorites that rain on Earth. The asteroid is composed mostly of hardy silicate rock, which is tough enough that fragments broken off by collisions can often survive a trip through Earth's atmosphere. Though pockmarked by bang-ups with other asteroids, Juno is large; in fact, it is the tenth largest asteroid. It measures about 234 kilometers (145 miles) in diameter, or about one-fifteenth the diameter of the moon.

The asteroid, which orbits the sun on a track between Mars and Jupiter, will be at its brightest on Sept. 21, when it is zooming around the sun at about 22 kilometers per second (49,000 miles per hour). At that time, its apparent magnitude will be 7.6, which is about two-and- a-half times brighter than normal. The extra brightness will come from its position in a direct line with the sun and its proximity to Earth. (The asteroid will still be about 180 million kilometers [112 million miles] away, so there is no danger it will fall towards Earth.)

Skywatchers with telescopes can probably see Juno from now until the end of the year, but it is most visible to binoculars in late September. On or before Sept. 21, look for Juno near midnight a few degrees east of the brighter glow of Uranus and in the constellation Pisces. It will look like a gray dot in the sky, and each night at the end of September, it will appear slightly more southwest of its location the night before. By Sept. 25, it will be closer to the constellation Aquarius and best seen before midnight. For more information: http://neo.jpl.nasa.gov/ .

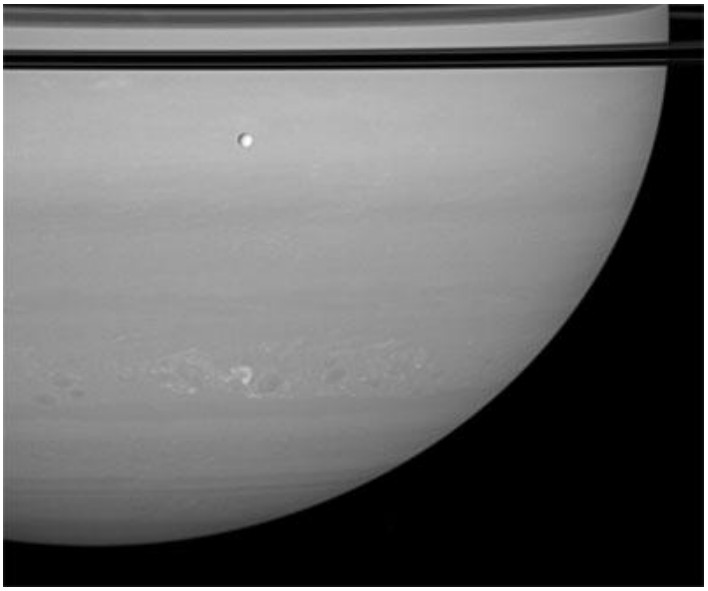
LIGHTNING STORM ON SATURN BREAKS SOLAR SYSTEM RECORD

A powerful lightning storm in Saturn's atmosphere that began in mid-January 2009 has become the Solar System's longest continuously observed thunderstorm. It broke the record duration of 7.5 months set by another thunderstorm observed on Saturn by Cassini spacecraft between November 2007 and July 2008. The observations of the thunderstorm are by Dr. Georg Fischer. The current thunderstorm on Saturn is the ninth that has been measured since Cassini swung into orbit around Saturn in July 2004. Lightning discharges in Saturn's atmosphere emit very powerful radio waves, which are measured by the antennas and receivers of the Cassini Radio and Plasma Wave Science (RPWS) instrument. The RPWS instrument receives and measures the radio signals coming from Saturn, including the radio waves given off by the interaction of the solar wind with Saturn and Titan. The radio waves are about 10,000 times stronger than their terrestrial counterparts and originate from huge thunderstorms in Saturn's atmosphere with diameters around 3000 km. Dr. Fischer said, "*These lightning storms are not only astonishing for their power and longevity, the radio waves that they emit are also useful for studying Saturn's ionosphere, the charged layer that surrounds the planet a few thousand kilometers above the cloud tops. The radio waves have to cross the ionosphere to get to Cassini and thereby act as a natural tool to probe the structure of the layer and the levels of ionization in different regions*."

The observations of Saturn lightning are performed using the Cassini RPWS instrument. Results have confirmed previous studies of the Voyager spacecraft indicating that levels of ionization are approximately 100 times higher on the day-side than the night side of Saturn's ionosphere. Lightning storms on Saturn usually occur in a region that nicknamed "Storm Alley" by scientists, which lies 35 degrees south of Saturn's equator. Dr. Fischer commented, "*The reason why we see lightning in this peculiar location is not completely clear. It could be that this latitude is one of the few places in Saturn's atmosphere that allow large-scale vertical convection of water clouds, which is necessary for thunderstorms to develop. However, it may be a seasonal effect. Voyager observed lightning storms near the equator, so*

now that Saturn has passed its equinox on 11 August, we may see the storms move back to equatorial latitudes."

Saturn's role as the source of lightning was given added confirmation during Cassini's last close flyby of Titan on August 25. During the half hour that Cassini's view of Saturn was obscured by Titan, no lightning was observed. "*Although we know from Cassini images where Saturn lightning comes from, this unique event was another nice proof for their origin*." said Dr. Fischer.



A train of storms rumbles through Saturn's southern hemisphere.
Credit: NASA/JPL/Space Science Institute

The Saturnian equinox occurred in August 2009 when the sun shone directly on the equator. Cassini will observe seasonal changes brought by the Sun as it begins to illuminate the northern hemisphere and the rings' northern face. Saturn, the rings and moons were illuminated by the Sun from the south during the mission's first four years http://www.spaceflightnow.com/news/n0909/14saturn/

CRATERS ON VESTA AND CERES COULD TELL JUPITER'S AGE

Crater patterns on Vesta and Ceres could help pinpoint when Jupiter began to form during the evolution of the early Solar System. A study modeling the cratering history of the largest two objects in the asteroid belt, which are believed to be among the oldest in the Solar System, indicates that the type and distribution of craters would show marked changes at different stages of Jupiter's development. Results will be presented by Dr. Diego Turrini at the European Planetary Science Congress in Potsdam, Germany, on Monday 14 September.

The study, carried out by scientists at the Italian National Institute for Astrophysics in Rome, explored the hypothesis that one or both objects formed during Jupiter's formation by modeling their cratering histories during the birth of the giant planet. Their simulation described Jupiter's formation in three stages: an initial accretion of its core followed by a stage of rapid gas accretion. This is, in turn, followed by a phase where the gas accretion slows down while the giant planet reaches its final mass. During the last two phases Jupiter's gravitational pull starts to affect more and more distant objects. For each of these phases, the team simulated how Jupiter affected the orbits of asteroids and comets from the inner and outer Solar System, and the likelihood of them being moved onto a collision path with Vesta or Ceres. "*We found that the stage of Jupiter's development made a big difference on the speed of impacts and the origin of potential impactors. When Jupiter's core approaches its critical mass, it causes a sharp increase in low-velocity impacts from small, rocky bodies orbiting nearby to Vesta and Ceres which lead to intense and uniform crater distribution patterns. These low-speed collisions may have helped Vesta and Ceres gather mass. Once Jupiter's core has formed and the planet starts to rapidly accrete gas, it deflects more distant objects onto a collision course with Ceres and Vesta and the impacts become more energetic. Although rocky objects from the inner Solar System are the dominant impactors at this stage, the higher energies of collisions with icy bodies from the outer Solar System make the biggest mark*," said Dr. Turrini.

The third stage of Jupiter's formation is complicated by a period known as the Late Heavy Bombardment, which occurred around 3.8 to 4.1 billion years ago. During this time a significant number of objects, rich in organic compounds, from the outer Solar System were injected on planet-crossing orbits with the giant planets and may have reached the Asteroid Belt. In addition, Jupiter is thought to have migrated in its orbit around this time, which would have caused an addition flux of impactors on Vesta and Ceres.

The team will have an opportunity to confirm their results when NASA's Dawn space mission reaches Vesta in 2011 and then flies on for a further rendezvous with Ceres in 2015. Dawn will gather information on the structure and the surface morphology of the two asteroids and send back high-resolution images of crater patterns.

"*If we can see evidence of an underlying intense, uniform crater pattern, it will support the theory that one or both of these minor planets formed during the final phases of Jupiter accretion, provided that they aren't obliterated by the later heavy bombardment. Dawn will also measure concentrations of organic material, which may give us further information about the collisional history with organic-rich objects from the outer Solar System*," said Dr. Turrini. http://www.spaceflightnow.com/news/n0909/14jupiterage/

JUPITER CAPTURED COMET FOR 12 YEARS IN LAST CENTURY

Comet 147P/Kushida-Muramatsu was captured as a temporary moon of Jupiter in the mid-20th century and remained trapped in an irregular orbit for about twelve years. There are only a handful of known comets where this phenomenon of temporary satellite capture has occurred and the capture duration in the case of Kushida-Muramatsu, which orbited Jupiter between 1949 and 1961, is the third longest.

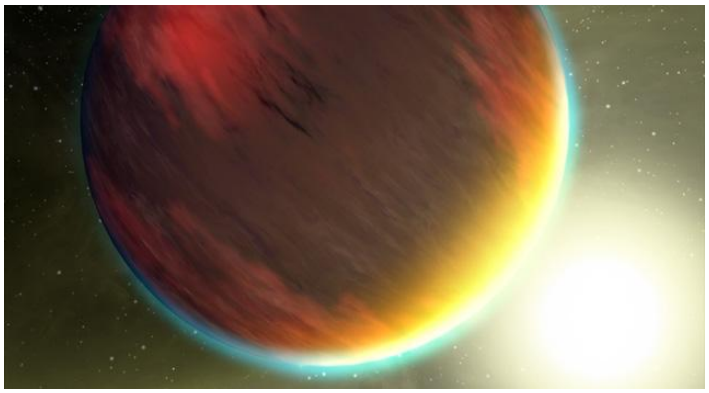
A team led by Dr. Katsuhito Ohtsuka modeled the trajectories of 18 "quasi-Hilda comets", objects with the potential to go through a temporary satellite capture by Jupiter that results in them either leaving or joining the "Hilda" group of objects in the asteroid belt. Most of the cases of temporary capture were flybys, where the comets did not complete a full orbit. However, Dr. Ohtsuka's team used recent observations tracking Kushida-Muramatsu over nine years to calculate hundreds of possible orbital paths for the comet over the previous century. In all scenarios, Kushida-Muramatsu completed two full revolutions of Jupiter, making it only the fifth captured orbiter to be identified.

Dr. Asher said, "*Our results demonstrate some of the routes taken by cometary bodies through interplanetary space that can allow them either to enter or to escape situations where they are in orbit around the planet Jupiter*." Asteroids and comets can sometimes be distorted or fragmented by tidal effects induced by the gravitational field of a capturing planet, or may even impact with the planet. The most famous victim of both these effects was comet D/1993 F2 (Shoemaker-Levy 9), which was torn apart on passing close to Jupiter and whose fragments then collided with that planet in 1994. Previous computational studies have shown that Shoemaker-Levy 9 may well have been a quasi-Hilda

comet before its capture by Jupiter. "*Fortunately for us Jupiter, as the most massive planet with the greatest gravity, sucks objects towards it more readily than other planets and we expect to observe large impacts there more often than on Earth. Comet Kushida-Muramatsu has escaped from the giant planet and will avoid the fate of Shoemaker-Levy 9 for the foreseeable future*", said Dr. Asher. The object that impacted with Jupiter this July, causing the new dark spot discovered by Australian amateur astronomer Anthony Wesley, may also have been a member of this class, even if it did not suffer tidal disruption like Shoemaker-Levy. "*Our work has become very topical again with the discovery this July of an expanding debris plume, created by the dust from the colliding object, which is the evident signature of an impact. The results of our study suggest that impacts on Jupiter and temporary satellite capture events may happen more frequently than we previously expected*," said Dr. Asher. The team has also confirmed a future moon of Jupiter. Comet 111P/Helin-Roman-Crockett, which has already orbited Jupiter three times between 1967 and 1985, is due to complete six laps of the giant planet between 2068 and 2086. http://www.spaceflightnow.com/news/n0909/14comet/

ASTRONOMERS FIND ORGANIC MOLECULES AROUND 2ND GAS PLANET

Peering far beyond our solar system, researchers have detected the basic chemistry for life in a second hot gas planet, advancing astronomers toward the goal of being able to characterize planets where life could exist. The planet is not habitable but it has the same chemistry that, if found around a rocky planet in the future, could indicate the presence of life. "*It's the second planet outside our solar system in which water, methane and carbon dioxide have been found, which are potentially important for biological processes in habitable planets*," said researcher Mark Swain. "*Detecting organic compounds in two exoplanets now raises the possibility that it will become commonplace to find planets with molecules that may be tied to life*."



The basic chemistry for life has been detected in a second hot gas planet, HD 209458b, depicted in this artist's concept. Image credit: NASA/JPL-Caltech

Two of NASA's Great Observatories – the Hubble Space Telescope and Spitzer Space Telescope, yielded spectral observations that revealed molecules of carbon dioxide, methane and water vapor in the planet's atmosphere. HD 209458b, bigger than Jupiter, occupies a tight, 3.5-day orbit around a sun-like star about 150 light years away in the constellation Pegasus. Planets like this one, which circle stars beyond our sun, are called exoplanets. Swain and his co-investigators used data from the Hubble and Spitzer Space Telescopes, to study HD 209458b. The detections were made through spectroscopy, which splits light into its components to reveal the distinctive spectral signatures of different chemicals. Data from Hubble's near- infrared camera and multi-object spectrometer revealed the presence of the molecules, and data from Spitzer's photometer and infrared spectrometer measured their amounts.

"*This demonstrates that we can detect the molecules that matter for life processes*," said Swain. Astronomers can now begin comparing the two planetary atmospheres for differences and similarities. For example, the relative amounts of water and carbon dioxide in the two planets is similar, but HD 209458b shows a greater abundance of methane than HD 189733b. "*The high methane abundance is telling us something*," said Swain. "*It could mean there was something special about the formation of this planet*."

The new finding follows the detection of these same carbon dioxide water vapor, methane, and organic molecules in the atmosphere of another hot, giant planet, called HD 189733b, by astronomers using Hubble and Spitzer data. Astronomers can now begin comparing the chemistry and dynamics of these two planets, and search for similar measurements of other candidate exoplanets, advancing toward the goal of being able to characterize planets where life could exist. Neither of the two planets studied is habitable, but they display the same molecules that, if found around a rocky planet in the future, could potentially indicate the presence of life. The new findings pave the way for future work that will help astronomers shortlist any promising rocky Earth-like planets where the signatures of organic chemicals might indicate the presence of life. Rocky worlds are expected to be found by the Kepler mission, which launched earlier this year, but astronomers believe we are a decade or so away from being able to detect any chemical signs of life on such a body. If and when such Earth-like planets are found in the future, "*the detection of organic compounds will not necessarily mean there's life on a planet, because there are other ways to generate such molecules*," Swain said. "*If we detect organic chemicals on a rocky, Earth-like planet, we will want to understand enough about the planet to rule out non-life processes that could have led to those chemicals being there*." "*These objects are too far away to send probes to, so the only way we're ever going to learn anything about them is to point telescopes at them. Spectroscopy provides a powerful tool to determine their chemistry and dynamics*."

You can follow the history of planet hunting from science fiction to science fact with the PlanetQuest Historic Timeline at http://planetquest.jpl.nasa.gov/timeline/timeline.html. This interactive web feature, developed by JPL, conveys the story of exoplanet exploration through a rich tapestry of words and images spanning thousands of years, beginning with the musings of ancient philosophers and continuing through the current era of space-based observations by Spitzer and Kepler missions. The timeline highlights milestones in culture, technology and science, and includes a planet counter that tracks the pace of exoplanet discoveries over time. More information about exoplanets http://planetquest.jpl.nasa.gov . accompanying images is at: http://www.jpl.nasa.gov/news/features.cfm?feature=2340

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 September/October StarGazer:

The next EAS Meeting is 6:00 pm, Saturday October 24th at the Aurora Astro products store near Silver Lake in SE Everett