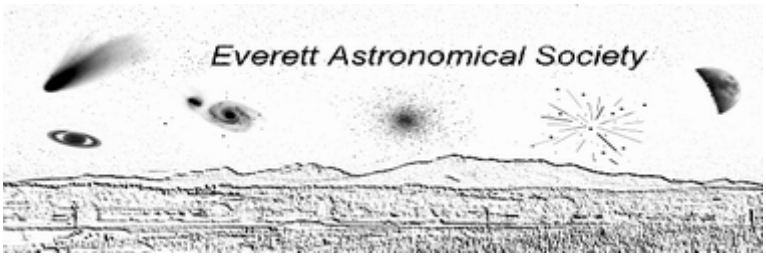
Volume MMIV. No. 7



The Stargazer

July 2004

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EAS BUSINESS…

RECAP OF MAY MEETING

Eric Agol from the University of Washington presented a talk about "*The Black Hole at the Center of the Galaxy*".

NEXT EAS MEETING - SATURDAY JULY 31ST 7:00 PM - PROVIDENCE PACIFIC CLINIC (916 PACIFIC AVENUE) IN THE MONTE CRISTO ROOMS ON THE MAIN FLOOR.

Jul 31st – EAS Mtg – Bill Cook from Captain's Nautical, will be on speaking on 'The History of the Telescope'

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

Scheduled Meeting Dates:

Jul 31st – EAS Mtg – (Bill Cook, Captain's on The History of the Telescope) – 7:00 PM
Aug 12-15th – Oregon Star Party http://www.oregonstarparty.org/
Aug 11-14th – 1st Annual Klickitat Star Party – Goldendale WA
www.klickitatstarparty.net
Aug 28th – EAS Mtg – (Dr. Julie Lutz, UW Astronomy) 7:00 PM
Sep 17-18th – OAS Sun Lakes Star Party
Sep 25th – EAS Meeting – 7:00 PM – (Greg Donahue, Celestial North, on the Mars Exploration Rover(s) mission)
Oct 30th – EAS Meeting – 7:00 PM
Nov 20th – EAS Meeting – 7:00 PM
Dec 11th – EAS Holiday Dinner

MEMBER NEWS

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

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

CLUB STAR PARTY INFO

Upcoming star party schedule:

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

FINANCIAL HEALTH

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

CLUB SCOPES' STATUS

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

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

ASTRO CALENDAR

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

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

October 2004
Oct 09 - Draconids Meteor Shower Peak
Oct 13 - Moon Occults Mars
Oct 14 - Moon Occults Mercury

Oct 21 - Orionid Meteor Shower Peak
Oct 28 - Lunar Eclipse
Oct 31 - Daylight Saving - Set Clock Back 1 Hour

OVER THE AIRWAVES

"Our group of radio script writers now consists of EAS and SAS members Jim Ehrmin, Pat Lewis writer emeritus, Greg Donohue, and Ted Vosk, who are now regularly writing and helping to produce our astronomy radio show, "It's Over Your Head" on radio station KSER, FM 90.7. The six-minute segment is broadcast every Wednesday morning at approximately 7:20 A.M. and gives a weekly look at what's up in the sky over Snohomish County, with other information. If you have a good idea for an astronomy broadcast or would like to try your hand at writing a script, call Pat Lewis at (206) 524-2006 or email to joagreen@aol.com If you are a listener to the program, show your support by giving the program director of KSER a call!" Web page with lots of archives and other info is available at http://www.itsoveryourhead.org/

KPLU 88.5 FM National Public Radio has daily broadcasts of "Star Date" by the McDonald Observatory of the University of Texas at Austin, Monday through Friday at 8:58 A.M. and 5:58 P.M. Saturday and Sunday). The short 2 minute radio show deals with current topics of interest in astronomy. The University of Washington TV broadcasts programs from NASA at 12:00 AM Monday through Friday, 12:30 AM Saturday, and 1:30 AM Sunday on the Channel 27 cable station.

EAS LIBRARY – BOOK & VIDEO LIST

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

MEMBERSHIP BENEFITS & INFORMATION

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

OBSERVER'S INFORMATION…

LUNAR FACTS

Jul 25	First Quarter Moon
Jul 31	2nd Full Moon of the month !
Aug 07	Last Quarter Moon
Aug 16	New Moon
Aug 23	First Quarter Moon
Aug 30	Full Moon
Sep 06	Last Quarter Moon
Sep 14	New Moon

Digital Lunar Orbiter Photographic Atlas of the Moon

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

UP IN THE SKY -- THE PLANETS

Object	Rises	Transits	Sets	Constellation
Sun	**5:43 am**	**13:15**	**20:47**	**Cancer**
Mercury	Daylight	Daylight	**21:38**	**Leo**
Venus	**2:37 am**	Daylight	Daylight	**Taurus**
Mars	Daylight	Daylight	**21:30**	**Leo**
Jupiter	Daylight	Daylight	**22:23**	**Leo**
Saturn	**4:15 am**	Daylight	Daylight	**Gemini**
Uranus	**21:50**	Daylight	Daylight	**Aquarius**
Neptune	**20:56**	**1:476am**	Daylight	**Capricornus**
Pluto	Daylight	**21:55**	**2:56 am**	**Serpens**

(times local time for Everett PDT)

NOAA SUN CALCULATOR

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

INTERNATIONAL SPACE STATION – VISIBLE SEATTLE PASSES

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

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

CONSTELLATIONS OF THE MONTH

Pavo: "The Peacock", as this Southern Hemisphere constellation is also known, borders on the constellations of Apus, Ara, Indus, Octans, and Telescopium. It ranks 39th in overall brightness among the constellations, containing 28 stars brighter than magnitude 5.5. Its central point is located at RA=19h33m and Dec.= -66 degrees. It is completely visible from latitudes South of + 15 degrees, and completely invisible from latitudes North of +33 degrees. This constellation ranks 44th in overall size, taking up 377.67 square degrees, or 0.916% of the sky. Pavo has no known meteor showers and no Messier objects; it also has no associated asterisms. Its midnight culmination date is July 15th, and its solar conjunction date is January 14th. Pavo is one of 11 constellations invented by Peter Dirksz Keyser and Frederick de Houtman, during the years 1595-7.

One of the best globular clusters in the sky is in Pavo, and it is NGC-6752. It is a magnitude 5.4 collection of yellowish stars, about 2 degrees east of Omega Pavonis. There is also a beautiful foreground double star visible at the cluster's edge: it contains magnitude 7.7 and 9.3 stars which are separated by about 3". The other objects of note within the Milky Way and contained within the confines of Pavo include two faint planetary nebulae, which also happen to be located very close to each other. NGC-6630 and IC-4723 are separated by less than one degree in a southeast-northwest orientation, both lying about 2 degrees south of 6th magnitude Nu Pavonis. Each of these constellations glows at about 15th magnitude and measure approximately 19" across their long axes; IC-4723 is more circular

in appearance than NGC-6630. Both planetaries are visible as faint, blurry stars with high magnification, and the surface brightness of each is too low to show any color. Pavo also contains some beautiful galaxies. One of the nicest in the Southern Hemisphere is the multiple-armed spiral galaxy, NGC-6744. This galaxy shines at blue magnitude 9.0, and measures 15.5' by 10.2' across, showing a large oval halo of greenish nebulosity with a brighter glow at the galaxy's central hub, in a 10-inch telescope. Other noteworthy galaxies in Pavo include: NGC-6684 (barred spiral); NGC-6776 (elliptical galaxy); NGC-6753 (spiral galaxy); NGC-6769 (barred sprial galaxy); NGC-6699 (barred spiral); NGC-6810 (spiral galaxy); NGC-6943 (barred spiral); IC-5052 (edge-on barred spiral); NGC-6876 (elliptical galaxy); and NGC-7020 (a blue magnitude 12.4 lenticular galaxy). If you are able to travel far enough South, you would do well to try to discover some of the deep sky wonders of Pavo "the Peacock".

YOUNG ASTRONOMER'S CORNER

Periodically, the Young Astronomer's Corner addresses questions of interest to young astronomers. That is the format this column will take this month.

Q: What's the big deal about Halley's Comet?

A: After noting the appearance of an extremely bright comet in the year 1682, English scientist Edmund Halley attempted to calculate and project the comet's path. While doing this, he realized that there were several similarly bright comets seen and documented during much of recorded history, and many of these had passed through the same region of the sky as the one in 1682. Halley determined that several of these different comet sightings, which seemed to take place every 75-76 years, were actually the same comet returning over and over again, and were not in fact different comets as had been thought. When this comet reappeared in 1758 as he had predicted, it proved he was right, and the comet was named in his honor. This comet had frequently, during these past sightings, been a spectacular sight in the night sky. When it last returned in 1986 however, the Earth was not in a good position in its orbit to observe the comet. Many people were disappointed to only wind up seeing a faint, fuzzy blob, especially with the tremendous buildup from the news media. However, when it returns in 2062, the comet and Earth will be in favorable positions relative to each other, and it promises to be a much more spectacular comet encounter! Many of you "young astronomers" out there will undoubtedly live to see a sensational and beautiful sight!!

Q: Why is Mars sometimes called the "red planet"?

A: The surface of Mars is yellow-orange in color, giving Mars a ruddy or somewhat reddish glow. The Martian "soil" contains a small amount of iron. However, there is also a small amount of oxygen in the Martian atmosphere, and just like on Earth, iron left exposed to the atmosphere will begin to rust (or in more technical terms, to oxidize). In other words, the surface of Mars is acting just like an old tire rim: it's rusting!! If you have ever seen something rusty on Earth, like at an old car parts yard, or at a landfill, the reddish color to the rusting material is unmistakable!

PLANETARY FOCUS

Planetary Focus is an occasional column within which we are listing the astronomical facts about each planet; for the month of September, our guest is **Venus**, and these are the facts:

Rotation around the Sun: approximately every 225 days (earth = 365 days).

Orbit: from 0.72 to 0.73 Astronomical Units; this is an orbit that varies between approximately 67 and 68 million miles from the sun.

Inclination of Orbit: 3.4 degrees.

Diameter at Equator: 12,104 kilometers (or 7,565 miles).

Mass: 0.82 that of earth (about 8-tenths that of earth).

Density: 5.2 times that of water

Period of Rotation on its own axis: 243 days, zero hours, and 14.4 minutes (earth = 24 hours).

Satellites (moons): none

Gravity: about nine-tenths (0.91) that of earth.

Special Notes: Venus is never very far from the sun in the sky. It reaches its greatest elongation of 45 to 47 degrees approximately 72 days before and after inferior conjunction. At its greatest brightness, Venus is close to magnitude –4.4, and is then brighter than everything in the sky except the sun and the moon. Venus has very hostile surface and atmospheric conditions; it has been determined that its atmosphere rotates almost 60 times faster than the solid planet itself. In a telescope, the disc of Venus appears a brilliant yellowish-white in color, and, like the moon, exhibits phases. The atmosphere of Venus consists primarily of carbon dioxide (98%), 1-3% nitrogen, and smaller percentages of helium, neon, krypton, and argon. The atmospheric pressure on the surface of Venus is about 90 times greater than that of earth, and the surface temperature is extremely high, much higher than that of earth's average surface temperature. In fact, the surface temperature of Venus is higher than that of any other planet. This is the result of the planet's "greenhouse effect" involving the layered clouds of Venus, and the large amount of carbon dioxide in its atmosphere. Venus has a nickle-iron core, which rotates slowly; as a result, Venus has little of its own magnetic field. The surface of Venus shows much evidence of past volcanic activity. Venus has had several man-made probes visit it: these include the Russian Venera probes, as well as the Mariner 2, 5, and 10 probes; the Pioneer Venus probes, and Magellan.

Try to get up in the early morning hours of this July to train your eyes, binoculars, and/or telescope on beautiful, spectacular Venus.

ASTRONOMY & TELESCOPE LINGO

ASTRONOMY LINGO: ***HOBA METEORITE:*** The world's largest single meteorite mass; it was found in 1920 in Namibia, Africa. Measuring 2.7 x 2.7 x 1 meters, it is an iron meteorite which weighs 60 tonnes. It remains in its original resting place and produced no crater, being only partly buried in the ground. As an iron meteorite, a significant percentage has rusted away.

TELESCOPE LINGO: ***HET (HOBBY-EBERLY TELESCOPE):*** A telescope at the McDonald Observatory in Texas, commissioned in 1997; it is used mainly for spectrographic surveys. The HET has an 11-meter segmented spherical mirror (f/1.3) on an azimuthal mount, which is sloped at a permanent angle of 35 degrees to the zenith. A movable secondary mirror reflects images onto it; in this fashion it can survey 70% of the sky visible at the Observatory.

ASTRONOMY FUN FACTS

★★ The Moon causes tidal motions not only in the Earth's oceans and other water bodies, but also in Earth's atmosphere and solid body itself. Lunar and solar tidal effects in the center of the ocean are between 2 and 3 feet, the height varying (and

sometimes much higher) depending on water depth, shoreline shape, and other factors. The effect of the Moon on the Earth's atmosphere results in a slightly increased air pressure. When the Moon is directly overhead, it causes a solid Earth tide that raises up any land mass, including North America, about 6 inches. This means that we all walk a little taller at least twice a month……during new Moon and during full Moon!!

★★ If the Moon were closer to Earth – let's say 50,000 miles away instead of its mean distance of 239,000 miles, its tidal forces would be tremendously more significant, flooding coastal regions of the world under hundreds of feet of water. New York City for example, in order to be safe, would have to move to the high ground of the Adirondacks, and Paris, France to the Ardennes Plateau in northeastern France!

★★ Many people would think that the full Moon is twice as bright as the half-Moon. But this is not the case: the full Moon is actually nine times as bright as a half-Moon. This is mainly because the surface of the visible half-Moon is very rough and mountainous, causing more shadows and less reflected sunlight. As the Moon waxes towards full, more smooth surfaces, such as maria, are hit with sunlight and reflect it much more efficiently, increasing brightness proportionately.

"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 listed. ***Note: "MIRROR" IMAGES" is strictly the name of the new column, and is not intended to imply that there is optical mirror symmetry between the two objects.***

Class of Object: ***X-RAY Pulsators:*** Regularly variable X-ray binaries that have periods of a few seconds up to a few minutes (in the case of slow X-ray pulsators). This pulsation is generally acknowledged to be associated with the rotation of a magnetized neutron star: thus, these objects may be regarded as X-ray pulsars. These X-ray pulsations are thought to arise from the conveyance of the accreting gas onto the magnetic poles of the neutron star. This gas flow affects the neutron star's spin and as a result, all X-ray pulsars (unlike other pulsars) are gradually speeding up.

Representative Northern Hemisphere Object: ***Cygnus X-3***

Representative Southern Hemisphere Object: ***Centaurus X-3***

ASTRONOMICAL NOTES -- ON & OFF THE NET…

SCIENTISTS FIND SATURN'S ROTATION PERIOD IS A PUZZLE

On approach to Saturn, data obtained by the Cassini spacecraft are already posing a puzzling question: How long is the day on Saturn?

Cassini took readings of the day-length indicator regarded as most reliable, the rhythm of natural radio signals from the planet. The results give 10 hours, 45 minutes, 45 seconds (plus or minus 36 seconds) as the length of time it takes Saturn to complete each rotation. Here's the puzzle: That is about 6 minutes, or one percent, longer than the radio rotational period measured by the Voyager 1 and Voyager 2 spacecraft, which flew by Saturn in 1980 and 1981.

Cassini scientists are not questioning Voyager's careful measurements. And they definitely do not think the whole planet of Saturn is actually rotating that much slower than it did two decades ago. Instead, they are looking for an explanation based on some variability in how the rotation deep inside Saturn drives the radio pulse.

The radio sounds of Saturn's rotation, which are also the first sounds from Saturn studied by Cassini, are like a heartbeat and can be heard by visiting http://www.jpl.nasa.gov/videos/cassini/0604/ and http://www-pw.physics.uiowa.edu/space-audio

"*The rotational modulation of radio emissions from distant astronomical objects has long been used to provide very accurate measurements of their rotation period*," said Dr. Don Gurnett, principal investigator for the Cassini Radio and Plasma Wave Science instrument. "*The technique is particularly useful for the giant gas planets, such as Jupiter and Saturn, which have no surfaces and are covered by clouds that make direct visual measurements impossible*."

The first hint of something strange about that type of measurement at Saturn was in 1997, when a researcher from Observatoire de Paris reported that Saturn's radio rotation period differed substantially from Voyager. Dr. Michael D. Desch, Cassini Radio Plasma Wave Science team member, has analyzed Saturn radio data collected by Cassini from April 29, 2003, to June 10, 2004. "*We all agree that the radio rotation period of Saturn is longer today than it was in during the Voyager flyby in 1980*," he said.

Gurnett said, "*Although Saturn's radio rotation period has clearly shifted substantially since the Voyager measurements, I don't think any of us could conceive of any process that would cause the rotation of the entire planet to actually slow down. So it appears that there is some kind of slippage between the deep interior of the planet and the magnetic field, which controls the charged particles responsible for the radio emission*." He suggests the solution may be tied to the fact that Saturn's rotational axis is nearly identical to its magnetic axis. Jupiter, with a more substantial difference between its magnetic axis and its rotational axis, shows no comparable irregularities in its radio rotation period.

"*This finding is very significant. It demonstrates that the idea of a rigidly rotating magnetic field is wrong*," said Dr. Alex Dessler, a senior research scientist at the University of Arizona, Tucson. In that way, the magnetic fields of gas giant planets may resemble that of the Sun. The Sun's magnetic field does not rotate uniformly. Instead, its rotation period varies with latitude. "*Saturn's magnetic field has more in common with the Sun than the Earth. The measurement can be interpreted as showing that the part of Saturn's magnetic field that controls the radio emissions has moved to a higher latitude during the last two decades*," said Dressler.

"*I think we will be able to unravel the puzzle, but it's going to take some time*," said Gurnett. "*With Cassini in orbit around Saturn for four years or more, we will be in an excellent position to monitor long-term variations in the radio period, as well as investigate the rotational period using other techniques*."

Cassini, carrying 12 scientific instruments, is just two days from its planetary rendezvous with Saturn. On June 30 it became the first spacecraft to orbit Saturn, when it began a four-year study of the

planet, its rings and its 31 known moons. The spacecraft recently flew past Saturn's cratered moon Phoebe, where it captured spectacular images as well as data on its mass and composition. For the latest images and more information about the Cassini-Huygens mission, visit http://www.nasa.gov/cassini

CASSINI EXPOSES PUZZLES ABOUT INGREDIENTS IN SATURN'S RINGS

Just two days after the Cassini spacecraft entered Saturn orbit, preliminary science results were already beginning to show a complex and fascinating planetary system. One early result intriguing scientists concerns Saturn's Cassini Division, the large gap between the A and B rings. While Saturn's rings are almost exclusively composed of water ice, new findings show the Cassini Division contains relatively more "dirt" than ice. Further, the particles between the rings seem remarkably similar to the dark material that scientists saw on Saturn's moon, Phoebe. These dark particles refuel the theory that the rings might be the remnants of a moon. The F ring was also found to contain more dirt.

Another instrument on Cassini has detected large quantities of oxygen at the edge of the rings. Scientists are still trying to understand these results, but they think the oxygen may be left over from a collision that occurred as recently as January of this year.

"*In just two days, our ideas about the rings have been expanded tremendously*," said Dr. Linda Spilker, deputy project scientist for the Cassini-Huygens mission. "*The Phoebe-like material is a big surprise. What puzzles us is that the A and B rings are so clean and the Cassini Division between them appears so dirty*."

The visual and infrared mapping spectrometer onboard Cassini revealed the dirt mixed with the ice in the Cassini Division and in other small gaps in the rings, as well as in the F ring.

"*The surprising fingerprint in the data is that the dirt appears similar to what we saw at Phoebe. In the next several months we will be looking for the origin of this material*," said Dr. Roger Clark, a member of the Cassini science team.

Cassini's ultraviolet imaging instrument detected the sudden and surprising increase in the amount of atomic oxygen at the edge of the rings. The finding leads scientists to hypothesize that something may have collided with the main rings, producing the excess oxygen.

Dr. Donald Shemansky, co-investigator for Cassini's ultraviolet imaging spectrograph instrument, said, "*What is surprising is the evidence of a strong, sudden event during the observation period causing substantial variation in the oxygen distribution and abundance*." Although atomic oxygen has not been previously observed, its presence is not a surprise because hydroxyl was discovered earlier from Hubble Space Telescope observations, and these chemicals are both products of water chemistry.

Cassini's examination of Saturn's atmosphere began while the spacecraft was still approaching the planet. Winds on Saturn near the equator decrease dramatically with altitude above the cloud tops. The winds fall off by as much 140 meters per second (approximately 300 miles per hour) over an altitude range of 300 kilometers (approximately 200 miles) in the upper stratosphere. This is the first time winds have been measured at altitudes so high in Saturn's atmosphere.

"*We are finally defining the wind field in three dimensions, and it is very complex*," said Dr. Michael Flasar, principal investigator for Cassini's composite infrared spectrometer. "*Temperature maps obtained now that Cassini is orbiting Saturn are expected to show more detail, helping us to unravel the riddles of Saturn's winds above the cloud tops*."

Early Friday, Cassini imaged Saturn's largest moon Titan, one of the prime targets for the mission. Titan is thought to harbor simple organic compounds that may be important in understanding the chemical building blocks that led to life on Earth. Although too cold to support life now, Titan serves as a frozen vault to see what early Earth might have been like. For the latest images and information about the Cassini-Huygens mission, visit http://saturn.jpl.nasa.gov and http://www.nasa.gov/cassini

GLIMPSE AT EARLY UNIVERSE REVEALS SURPRISINGLY MATURE GALAXIES

Observations challenge standing view of how and when galaxies formed A rare glimpse back in time into the universe's early evolution has revealed something startling: mature, fully formed galaxies where scientists expected to discover little more than infants.

"*Up until now, we assumed that galaxies were just beginning to form between 8 and 11 billion years ago, but what we found suggests that that is not the case*," said Karl Glazebrook, co-principal author of a paper in the July 8 issue of Nature. "*It seems that an unexpectedly large fraction of stars in big galaxies were already in place early in the universe's formation, and that challenges what we've believed. We thought massive galaxies came much later*."

Using the Frederick C. Gillett Gemini North Telescope in Mauna Kea, Hawaii, Glazebrook and a multinational team of researchers called the Gemini Deep Deep Survey (GDDS) employed a special technique called the "Nod and Shuffle" to peer into what had traditionally been a cosmological blind spot. Called "the Redshift Desert," this era -- 8 billion to 11 billion years ago, when the universe was only 3 billion to 6 billion years old -- has remained relatively unexplored until now, mainly because of the challenges inherent in collecting data from the faintest galactic light ever to be dissected into the rainbow of colors called a spectrum. In all, the team collected and analyzed spectra from 300 galaxies, making it the most complete sample ever taken from the Redshift Desert.

"*This was the most comprehensive survey ever done covering the bulk of the galaxies that represent conditions in the early universe*," Glazebrook said. "*We expected to find basically zero massive galaxies beyond about 9 billion years ago, because theoretical models predict that massive galaxies form last. Instead, we found highly developed galaxies that just shouldn't have been there, but are*."

These findings challenge the dominant theory of galactic evolution, which posits that at this early stage, galaxies should have formed from the bottom up, with small pieces crashing together to build small and then ever larger galaxies. Called the "hierarchical model," this scenario predicts that normal-to-large galaxies such as those studied by GDDS would not yet exist.

"*There are obviously some aspects of the early lives of galaxies that we don't yet completely understand*" Glazebrook said. "*We do find fewer massive galaxies in the past, but there are still more than we expected. This result is giving us a big clue as to how stars form from invisible gas in the hierarchical model, which is something not well understood under current theories. Some*

new ingredient is required to make more stars form earlier in the big galaxies. But what that ingredient is, we don't yet know."

SEEING DOUBLE: SPITZER CAPTURES OUR GALAXY'S TWIN

What would our Milky Way galaxy look like if we could travel outside it and snap a picture? It might look a lot like a new image by NASA's Spitzer Space Telescope of a spiral galaxy called NGC 7331 - a virtual twin of our Milky Way.

The picture, which can be viewed at http://photojournal.jpl.nasa.gov/catalog/PIA06322, shows our twin as never before. Its swirling arms spin outward from a central bulge of light, which is outlined by a ring of actively forming stars.

"*Being inside our galaxy makes it difficult to see what's going on in the center*," said Dr. J.D. Smith, a member of the team that observed NGC 7331. "*By looking at a very similar galaxy, we gain a bird's eye-view of what the entire Milky Way might look like*." Such an outside perspective will teach astronomers how our own galaxy, as well as others like it, might have formed and evolved.

The latest observations are the first in a large-scale effort to observe 75 nearby galaxies with Spitzer's highly sensitive infrared eyes. Called Spitzer Infrared Nearby Galaxies Survey, the program will combine Spitzer data with that from other ground- and space-based telescopes operating at wavelengths ranging from ultraviolet to radio to create a comprehensive map of the selected galaxies.

The program's first target, NGC 7331, was chosen in part for its striking similarities to the Milky Way. While these so-called twin galaxies do not share the same parents, they have many features in common, including number of stars, mass, spiral arm pattern and star-formation rate of a few stars per year. Whether the Milky Way has an inner star-forming ring like that of NGC 7331 is not known. NGC 7331 is located about 50 million light-years away in the constellation Pegasus.

The new Spitzer image demonstrates the power of the telescope's infrared eyes to dissect galaxies into their various parts. Taken by the telescope's infrared array camera, the false-colored picture readily distinguishes NGC 7331's arms (brownish red), central bulge (blue) and star-forming ring (yellow). The composition of materials making up these regions was also revealed by the Spitzer observations: the central bulge consists primarily of older stars; the ring possesses a large amount of gas and dusty organic molecules called polycyclic aromatic hydrocarbons, which typically glow when illuminated by newborn stars; and the arms contain these same dust grains to a lesser degree. Polycyclic aromatic hydrocarbons are also found on Earth, on burnt toast and in car exhaust among other places.

Data from Spitzer's infrared spectrograph instrument were also used to show that the center of NGC 7331 harbors either an unusually high concentration of massive stars, or a moderately active black hole about the same size as the one lurking at the core of our galaxy.

These findings will appear in two papers in the September issue of a special supplement to the Astrophysical Journal. Dr. Michael W. Regan of the Space Telescope Institute, Baltimore, Md., is lead author of a paper detailing observations from the infrared array camera, and Smith is lead author of a paper on the infrared spectrograph results. The Spitzer Infrared Nearby Galaxies Survey project is conducted by a team of about 25 scientists from 12 institutions, and is led by principal investigator Dr. Robert C. Kennicutt.

Launched August 25, 2003, the Spitzer Space Telescope is the fourth of NASA's Great Observatories, a program that also includes the Hubble Space Telescope, Chandra X-ray Observatory and Compton Gamma Ray Observatory. Additional information about the Spitzer Space Telescope is available at http://www.spitzer.caltech.edu

TO GROW, STARS AND PLANETS NEED SPACE DUST… AND FORMALDEHYDE?

Scientists have found that a formaldehyde-based chemical is 100 times more common in parts of our galaxy than can be explained. The finding could change ideas about how organic molecules form in the universe, and how those molecules' critical interaction with dust causes stars and planets to form.

The scientists compared the results of experiments from an international team of chemists to telescopic measurements of the amount of methyl formate -- a product of alcohol and formaldehyde -- in the swirling dust clouds that dot our Milky Way galaxy. On Earth, methyl formate is commonly used as an insecticide.

Based on telescope data, if the gaseous methyl formate condensed into liquid form, a typical dust cloud would contain a thousand trillion trillion gallons of the chemical.

Interstellar dust clouds contain the chemical seeds of new stars and planetary systems, explained Eric Herbst. Most people are probably familiar with the dust cloud known as the Horsehead Nebula in the constellation Orion.

While scientists have long known that hydrogen is the most common chemical element in the universe, just 10 years ago Herbst -- a professor of physics, chemistry, and astronomy -- and his colleagues discovered that there were also large quantities of alcohol in dust clouds in space. The presence of methyl formate suggests that other molecules may play a more prominent role in star and planet formation than scientists ever suspected. "*Even using our best models of interstellar chemistry, we still don't fully understand how these molecules could have formed*," Herbst said. "*Clearly, something else is going on*."

Three groups of chemists from the United States, Canada, and Norway had previously conducted laboratory experiments to determine how alcohol and other molecules produce methyl formate. Herbst and researcher Helen Roberts used that data to construct a new model of how such reactions happen in space, and then used the model to predict how much methyl formate would be found in the typical interstellar dust cloud.

Next, the scientists consulted the radio spectrum of the dust clouds, which gives them the unique chemical signatures of the different molecules floating inside.

The spectra showed that the average ratio of hydrogen molecules to molecules of methyl formate was a billion to one. But the model that Herbst and Roberts derived had predicted only a fraction of that amount. "*We calculated the ratio to be 100 billion to one, so the model must be deficient*," Herbst said. Scientists will have to refine the models before they can truly know how stars and planets form, he said.

According to accepted theory, gas molecules floating in these clouds must join and nuclear reactions must begin before stars can form. Dust particles are key to the process because they provide a surface for reactions to take place.

Among their future goals, Herbst, Roberts, and their colleagues want to determine exactly what space dust is made of and what the surface texture is like, since both would affect chemical reactions -- a task that amounts to studying individual dust grains thousands of light years away.

Modeling such large, complex systems requires a great deal of computing power, and measuring the actual amounts of chemicals in these faraway clouds is difficult. Herbst said that supercomputers and telescopes are just beginning to advance to the point where such things are possible. In the future, he would like to form a consortium of researchers in molecular astronomy to pool ideas and resources.

CASSINI EXPOSES SATURN'S TWO-FACE MOON

The moon with the split personality, Iapetus, presents a perplexing appearance in the latest images snapped by the Cassini spacecraft.

One hemisphere of the moon is very dark, while the other is very bright. Scientists do not yet know the origin of the dark material or whether or not it is representative of the interior of Iapetus. Iapetus (pronounced eye-APP-eh-tuss) is one of Saturn's 31 known moons. Its diameter is about one third that of our own moon at 1,436 kilometers (892 miles). This image was taken in visible light with the Cassini spacecraft narrow angle camera on July 3, 2004, from a distance of 3 million kilometers (1.8 million miles) from Iapetus. The brightness variations in this image are not due to shadowing, they are real.

During Cassini's four-year tour, the spacecraft will continue to image Iapetus and conduct two close encounters. One of those encounters, several years from now, will be at a mere 1,000 kilometers (622 miles).

Iapetus was discovered by the Italian-French astronomer Jean Dominique Cassini in 1672. He correctly deduced that the trailing hemisphere is composed of highly reflective material, while the leading hemisphere is strikingly darker.

This sets Iapetus apart from Saturn's other moons and Jupiter's moons, which tend to be brighter on their leading hemispheres. Voyager images show that the bright side of Iapetus, which reflects nearly 50 percent of the light it receives, is fairly typical of a heavily cratered icy satellite. The leading side consists of much darker, redder material that has a reflectivity of only about 3 to 4 percent.

One scenario for the outside deposit of material has dark particles being ejected from Saturn's little moon Phoebe and drifting inward to coat Iapetus. One observation lending credence to an internal origin is the concentration of material on crater floors, which is suggestive of something filling in the craters.

Iapetus is odd in other respects. It is in a moderately inclined orbit, one that takes it far above and below the plane in which the rings and most of the moons orbit. It is less dense than many of the other satellites, which suggests a higher fraction of ice or possibly methane or ammonia in its interior.

For this and other images and information about the Cassini-Huygens mission, visit http://saturn.jpl.nasa.gov and http://www.nasa.gov/cassini Images are also available at the Cassini imaging team home page, http://ciclops.org

UNIQUE OBSERVATIONS OF NEWBORN STAR PROVIDE INFORMATION ON SOLAR SYSTEM'S ORIGIN

A new study has caught a newborn star similar to the sun in a fiery outburst. X-ray observations of the flare-up, which are the first of their kind, are providing important new information about the early evolution of the sun and the process of planet formation. The study is reported in the July 22 issue of the journal Nature.

Last January, Jay McNeil, an amateur astronomer in West Kentucky, discovered a new cloud of dust and gas in the Orion region. Previously the cloud, now named the McNeil nebula, was not visible from earth. But a new star inside the dark cloud had flared up in brightness, lighting up the surrounding nebula. Looking back at the images taken of this part of the sky revealed that a young star about the size of the sun had burst into visibility last November.

Despite the fact that hundreds of telescopes scan the sky nightly, the discovery of a new star is an extremely rare event, having occurred only twice in the last century. What made this star even more special was the fact that it appears to be an extremely young star -- far less than a million years old -- that is about the same mass as the sun. Astronomers know of fewer than a dozen of these stars, which they call FU-Orionis-type. Although this is the third FU-Orionis that has been caught in the act of flaring, it is the first that has occurred in modern times when its behavior could be monitored not only in visible light, but also in radio, infrared and X-ray wavelengths.

"*In FU-Orionis stars, these outbursts are very brief*," says Weintraub. "*They brighten by as much as 100 thousand times in a few months and then fade away over a number of months*."

Knowing that time was short, Kastner and Weintraub submitted an emergency request for viewing time on the orbiting Chandra X-ray observatory. Because X-rays are generated by extremely violent events, they provide a critical window for observing extreme stellar flare-ups of this sort. The astronomers were granted two viewing times in early and late March.

Using Chandra, the astronomers discovered that the star, which has been officially named V1647 Ori, was a very bright X-ray source in early March, but its X-ray brightness had decreased substantially by the end of the month before the star disappeared from view behind the sun. At the same time, the new star was fading in visible and infrared wavelengths.

In addition, the astronomers learned that Ted Simon from the Institute for Astronomy in Hawaii had taken some serendipitous X-ray images of the same area in 2002 for another purpose. These showed no X-rays coming from the V1647 Ori's location at that time, supporting the idea that the recent X-ray production was directly associated with the star's flare-up.

Kastner and Weintraub propose a novel mechanism to explain their observations. Many stars, including the sun, produce X-rays by a mechanism that depends on the star's rotation rate and convection depth. But the astronomers calculate that the temperature of the gas that is producing the X-rays at V1647 ORI is substantially higher than can be explained by this traditional mechanism.

Observations of V1647 Ori indicate that it possesses a "protoplanetary" disk -- a thin disk extending out from a star's equator that contains dust and gas left over from the star's formation and from which planets form. Kastner and Weintraub argue that the flare was touched off by a sudden avalanche of disk material falling onto the surface of the star and that this was the source of the intense X-rays as well as the other forms of radiation.

If their hypothesis is correct, X-ray observations may help discriminate between young stars that possess protoplanetary disks and those that don't, Weintraub says. There is a disagreement among astronomers about whether FU-Orionis stars undergo outbursts of this sort only once, several times or dozens of times before they settle into maturity. Other astronomers who have looked further back in the astronomical records for V1647 Ori have found that it also flared up in 1965, which provides added support for the multiple outburst theories.

Kastner and Weintraub have been awarded time to conduct additional observations on Chandra so that they can measure the X-ray activity of the new star beginning in October when it becomes visible once again.

SCIENTISTS EXPLAIN MYSTERIOUS PLASMA JETS ON THE SUN

Solar physicists have used computer modeling and some of the highest resolution images ever taken of the solar atmosphere to explain the cause of supersonic jets that continuously shoot through the low atmosphere of the Sun.

Their results, which appear as the cover story in tomorrow's issue of the journal Nature, directly address the origin of these jets, called spicules. The origin of spicules has been a mystery since their discovery in 1877. These findings may well lead to a better understanding of how matter is propelled upward into the solar corona to form the solar wind, a stream of particles continuously emitted by the Sun that sweeps past Earth's orbit. Disturbances in the solar wind can influence the upper atmosphere and space environment around the Earth and damage satellites in orbit.

"*The combination of computer modeling, new high resolution images taken with the Swedish 1-meter Solar Telescope (SST) on the island of La Palma, Spain and data taken simultaneously with two satellites in space, was crucial to figure out how spicules are formed*," said Dr. Bart De Pontieu, one of the main investigators on the study. "*We used a computer model to provide the missing link between observations of the surface of the Sun, taken with the MDI instrument onboard ESA/NASA's Solar and Heliospheric Observatory (SOHO) satellite, and observations of the jets in the low solar atmosphere taken with the SST and NASA's Transition Region and Coronal Explorer (TRACE) satellite*."

Spicules are jets of gas or plasma propelled upwards from the surface of the Sun. They shoot into its atmosphere or corona at supersonic speeds of about 50,000 miles per hour, and reach heights of 3,000 miles above the solar surface in less than five minutes. Although there are over 100,000 spicules at any time in the Sun's low atmosphere, or chromosphere, they remain largely unexplained, in part because observations are difficult for objects with so brief a lifetime (about five minutes) and relatively small size (300 miles diameter).

"*By simultaneously taking a series of high resolution images with the Swedish Solar Telescope, showing details down to 80 miles, and with the TRACE satellite, we discovered that these jets often occur periodically, usually every five minutes or so, at the same location*," said Professor Robertus Erdélyi von Fáy-Siebenbürgen, the other main investigator on the study, and professor in applied mathematics at the Solar Physics and upper-Atmosphere Research Group of the University of Sheffield, UK. "*We developed a computer model of the Sun's atmosphere to show that the periodicity of the spicules is caused by sound waves at the solar surface that have the same five minute period."*

The sound waves at the solar surface are usually damped before they can reach the Sun's atmosphere. However, De Pontieu, Erdélyi and Stewart James, a newly graduated Ph.D. under the supervision of Professor Erdélyi at the University of Sheffield, found that under certain conditions, the sound waves can penetrate through the damping zone and leak into the solar atmosphere. Their computer model shows that after the sound waves leak into the atmosphere, they develop into shock waves that propel matter upwards, forming a spicule.

De Pontieu and his colleagues measured actual waves and oscillations at the surface of the Sun, using these measurements to drive their computer model of the solar atmosphere, which then predicted when jets of gas should shoot up. They were pleasantly surprised to see that the model predicts very accurately when jets should be observed on the Sun with the SST and TRACE.

"*Spicules carry more than 100 times the mass into the Sun's atmosphere required to feed the solar wind*," said De Pontieu, "*which means that they are of huge importance for the balance of how much mass goes into and out of the corona*." With the origins of spicules revealed, it will be possible to study whether the mass that spicules carry into the solar corona contributes to the solar wind. Future studies will also focus on the role the shock waves may play in the higher solar atmosphere or corona. For additional information, visit our website: http://www.lockheedmartin.com JPEG image files and solar movies of the discovery are available at http://www.lmsal.com/Press/spicules2004/index.html

METEORITE FROM OMAN RECORDS ITS LUNAR LAUNCH SITE AND DETAILED HISTORY

Scientists have pinpointed the source of a meteorite from the moon for the first time. Their unique meteorite records four separate lunar impacts.

They are the first to precisely date Mare Imbrium, the youngest of the large meteorite craters on the moon. That date, 3.9 billion years ago, is a new key date for lunar and even terrestrial stratigraphy, the scientists say, because life on Earth would have evolved only after heavy meteorite bombardment ended.

Geologists who found the meteorite and scientists from Swiss, Swedish, German, British, and Arizona laboratories who analyzed the unique stone report their work in the July 30 issue of Science. Swiss geologist Edwin Gnos is first author of the article titled "*Pinpointing the Source of Lunar Meteorite: Implications for the Evolution of the Moon*."

Gnos, Ali Al-Kathiri and Beda Hofmann found the 206-gram (7-ounce) meteorite in Oman on Jan. 16, 2002. The geologists were on a joint meteorite search expedition sponsored by the Government of Oman, the Natural History Museum of Berne and the University of Berne.

"*The desert in Oman is the new place to find meteorites*," said A.J. Tim Jull. Jull directs the National Science Foundation - Arizona Accelerator Mass Spectrometry (AMS) Laboratory. He analyzed beryllium and carbon isotopes that told how long the meteorite was in space after it was launched from the moon and how long ago it fell to Earth at Oman.

Scientists who've acquired the special permits needed to search for meteorites in Oman and North Africa during the past half-dozen years have been amply rewarded, Jull said. Seven of the 30 known lunar meteorites have been found in Oman, and five

have been found in North Africa. One was found in Australia and the rest have been found in Antarctica. Hot or cold, arid climates preserve meteorites from quickly weathering, Jull noted.

Gnos, Al-Kathiri and Hofmann recognized in the field that the meteorite was of lunar or martian origin because it wasn't magnetic. Meteorites from planetary bodies don't contain metal. And, typical of lunar rocks, it was greenish colored and contained white angular feldspar inclusions.

But when they tested it with a Geiger counter, they found it was no typical lunar rock. They found it contained high levels of radioactive uranium, thorium and potassium. Gamma ray-spectroscopy lab tests told them that the ratios between these elements fit only one enigmatic group of lunar rocks called "KREEP," the acronym of K for potassium, REE for rare earth elements, and P for phosphate.

"*At that moment, it was clear that the rock had something to do with the large Imbrium impact basin, the right eye of the man in the moon*," Gnos et al. report on the Web at http://www.geo.unibe.ch/sau169 . The Imbrium impact basin on the lunar nearside is the only area where KREEP rocks are found. KREEP rocks are known both from samples returned by the Apollo missions and by NASA's Lunar Prospector Orbiter radioactivity survey in 1998-99.

The scientists conducted a battery of laboratory tests to piece together a detailed history of the meteorite, named Sayh al Uhaymir (SaU) 169. They summarize SaU 169's history:

★ At 3.909 billion years ago, plus or minus 13 million years; An asteroid collides with the moon, forming the 1160 km (720-mile) diameter Imbrium impact basin. Crushed and molten rocks mix and solidify to form the main rock type in meteorite SaU 169.

★ At 2.8 billion years ago - A meteorite hits the moon, forming the 25 km (15-mile) diameter Lalande crater south of the Imbrium basin. The impact blasts material, including the main rock type in SaU 169, from depth and deposits it as an ejecta blanket around the crater. The ejecta there mixes with other lunar soil.

★ At 200 million years ago - Another impact brings the rock that will become a meteorite to within a half-meter (20 inches) of the lunar surface.

★ At less than 340,000 years ago - Another impact hits the moon, producing a crater a few kilometers in diameter and ejects SaU 169 from the moon. The scientists studied NASA images and identified a young, 3 km (1.8-mile) diameter crater 70 km (43 miles) north-northeast of Lalande as the meteorite's likely launch site. Jull measured beryllium 10 in SaU 169 and determined the meteorite's moon-to-Earth transit time at around 300,000 years. He also measured carbon 14 in SaU 169, which shows the meteorite fell in present-day Oman around 9,700 years ago, plus or minus 1,300 years.

"*Without the Apollo and Luna sampling programs, and especially the huge advance in knowledge of the Moon acquired during investigations in the last 20 - 30 years, we would only be able to tell that SaU 169 is an exceptional lunar rock*," the scientists said on their Website. "*Without background information from such missions as Clementine and Lunar Prospector, we could never have linked ages and chemical data with lunar surface information*."

"*SaU is a rock which demonstrates impressively how rocks can travel, like a ping-pong-ball, from one body to another*," they said.

SaU 169 meteorite - http://illite.unibe.ch/sau169/ NSF - Arizona AMS Lab - http://www.physics.arizona.edu/ams/index.html

FROM THE EDITOR'S TERMINAL

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

The Star Gazer
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In July's Stargazer:

The next EAS Meeting is 7:00 P.M. Saturday, July 31st at the Providence Pacific Clinic – 916 Pacific Avenue in Everett.