



The Stargazer

October 2007

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

See EAS website at:

http://members.tripod.com/everett_astronomy

EAS BUSINESS...

**NEXT EAS MEETING – SATURDAY OCTOBER 13TH
 AT *4:00 PM* AT THE EVERETT PUBLIC LIBRARY,
 IN THE AUDITORIUM (DOWNSTAIRS)**

★★ **Saturday October 13th 4:00 pm MEETING** ★★
 The program will be Dr. Joanne Hughes Clark from the Seattle University physics department talking about "What Do Exploding Stars Tell Us About Our Universe and Ourselves?".

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

2702 Hoyt Avenue
 Everett, WA 98201

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

★ STAR PARTY INFO ★

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

EAS Star Party - Saturday October 13, following the EAS meeting - weather permitting.

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

Oct 13 - Saturday
Nov 10 - Saturday

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

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

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

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

CLUB SCOPES

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

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

EAS MEMBER NEWS

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

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

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

- Clear Skies, Jim Bielaga"

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.

Also, 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.



Aurora Astro

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

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

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

- Club established date (approx 1986 ?)
- Who started the club (Terry Bacon, et. al.)
- When club joined the Astronomical League.

ASTRO CALENDAR FOR 2007

October 2007

Oct 09 - Draconids Meteor Shower Peak
Oct 13 - **Saturday 4:00 pm, EAS meeting, Everett Public Library**
Oct 13 - **Saturday, EAS Star party at Ron Tam's**
Oct 14 - Dwarf Planet 136199 Eris Closest Approach To Earth (95.8AU)
Oct 21 - Orionids Meteor Shower Peak
Oct 31 - Halloween

November 2007

Nov 03 - Taurids Meteor Shower Peak
Nov 04 - End Daylight Saving time - Set Clock Back 1 Hour (US)
Nov 07 - **Wednesday 7:00 pm, EAS meeting, Everett Public Library**
Nov 10 - **Saturday, EAS Star party at Ron Tam's**
Nov 12 - Dwarf Planet Ceres Closest Approach To Earth (1.832 AU)
Nov 17 - Leonids Meteor Shower Peak
Nov 22 - Thanksgiving Holiday

December 2007

Dec 01 - **Saturday 3:00 pm, EAS meeting, Everett Public Library**
Dec 07 - **Saturday 7:00 pm, EAS holiday banquet meeting, Alf's Pizza (on Broadway)**
Dec 07 - 35th Anniv (1972), Apollo 17 Launch (Last Mission to Moon)
Dec 13 - Geminids Meteor Shower Peak
Dec 22 - Winter Solstice, 22:06 UT
Dec 22 - Ursids Meteor Shower Peak
Dec 24 - Mars at opposition
Dec 25 - Christmas Holiday

UW Astronomy Speakers Colloquium Schedule

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

Th Oct 18 4:00 A102	Bill Bottke , Southwest Research Institute <i>"New views on the Lunar Late Heavy Bombardment"</i>
Th Oct 25 4:00 A102	Marta Volonteri , University of Michigan <i>"Massive Black Holes from Early Times to the Present"</i>
Th Nov 1 4:00 A102	Andrew West , University of California, Berkeley <i>"Big Science from Little Stars: The Activity and Kinematics of Low-Mass Stars."</i>
Th Nov 8 4:00 A102	Richard Durisen , Indiana University <i>"Can Gas-Phase Gravitational Instabilities in Protoplanetary Disks Produce Gas Giant Planets?"</i>
Th Nov 15 4:00 A102	Janice Lee , Carnegie Observatories, Pasadena, California <i>"TBA"</i>
Th Nov 29 4:00 A102	Lauren MacArthur , California Institute of Technology <i>"Galaxy Bulge Formation: Observational Perspectives"</i>
Th Dec 6 4:00 A102	Gregory Rudnick , National Optical Astronomy Observatory (Tucson, Arizona) <i>"TBA"</i>

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

"Our group of radio script writers now consists of EAS and SAS members Jim Ehrmin, Greg Donohue, and Ted Vosk, who are now regularly writing and helping to produce our **astronomy radio show, "It's Over Your Head"** on radio station **KSER, FM 90.7**. The six-minute segment is broadcast **every Wednesday morning at approximately 7:20 A.M.** and gives a weekly look at what's up in the sky over Snohomish County, with other information. If you are a listener to the program, show your support by giving the program director of KSER a call!" Web page with lots of archives and other info is available at <http://www.itsoveryourhead.org/>

KPLU 88.5 FM National Public Radio has **daily broadcasts of "Star Date"** by the McDonald Observatory of the University of Texas at Austin, Monday through Friday at about 6:05 pm. The short 2 minute radio show deals with current topics of interest in astronomy. The University of

Washington TV broadcasts programs from NASA at 12:00 AM Monday through Friday, 12:30 AM Saturday, and 1:30 AM Sunday on the Channel 27 cable station.

EAS MEMBERSHIP BENEFITS & INFORMATION

EAS Benefits -

Membership in the **Everett Astronomical Society** (EAS) includes invitations to all of the club meetings and star parties, plus the monthly newsletter, *The Stargazer*. Currently, a 10% discount is also being offered to EAS members for purchases at Aurora Astro Products in Everett

Magazine Discounts -

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

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

Membership in the Astronomical League -

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

EAS Club Telescope Borrowing -

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

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

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

EAS Library -

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

Joining or Renewing with the EAS -

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

http://members.tripod.com/everett_astronomy/application.htm

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

OBSERVER'S INFORMATION...

LUNAR FACTS

Oct 19	First Quarter Moon
Oct 26	Full Moon
Nov 01	Last Quarter Moon
Nov 09	New Moon
Nov 17	First Quarter Moon
Nov 24	Full Moon
Dec 01	Last Quarter Moon
Dec 09	New Moon
Dec 17	First Quarter Moon

Dec 24	Full Moon
Dec 31	Last Quarter Moon
Jan 11	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	Sets	Con	Mag
Sun	06:23am	17:27	Vir	-27.5
Mercury	09:21am	18:46	Vir	+0.9
Venus	03:23am	16:48	Leo	-4.4
Mars	22:08am	14:06	Gem	-0.3
Jupiter	12:26	20:59	Oph	-1.8
Saturn	03:16am	17:05	Leo	+0.8
Uranus	17:17	04:23am	Aqr	+5.8
Neptune	16:18	02:02am	Cap	+7.9
Pluto	12:41	22:14am	Sag	+14.0

(times local time for Everett PDT)

Observing Jupiter's Moons - Java tool

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

Transit times for Jupiter's Great Red Spot in 2007

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

NOAA SUN CALCULATOR

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

<http://www.srrb.noaa.gov/highlights/sunrise/gen.html>

INTERNATIONAL SPACE STATION - VISIBLE SEATTLE PASSES

ISS Visibility -

<http://spaceflight.nasa.gov/realdata/sightings/ISSapplications/Post/SightingData/Seattle.html>

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 AND ARIES

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

YOUNG ASTRONOMER'S CORNER

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.

The Young Astronomer's Corner will return this month to its periodic 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, they 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 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.

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.

ASTRONOMY LINGO: FK COMAE STARS: A class of rapidly spinning giant stars, possibly examples of coalesced stars (which are a type of common envelope star (hypothesized giant stars that consist of two stellar cores orbiting within a large "common envelope" of gas)). Coalesced stars may spiral together and eventually fuse into a single core, instead of ejecting the common envelope of gas.

TELESCOPE LINGO: EQUATORIAL MOUNTING: A type of telescope mounting in which one axis (the polar axis) is parallel to the Earth's axis, while the remaining main axis (the declination axis) is at right angles to it. The main advantage of such a mounting is that when the telescope is locked in its declination axis (and the polar axis is driven to turn once in 24 hours in the direction opposite to that of Earth's rotation), then any celestial object will remain in the field of view. This facilitates (as examples) continued viewing, photography, or research.

ASTRONOMY "FUN FACTS"

★★ A very large comet could strike Earth, although the probability is low; given enough time however, the chances are increased. If such a collision were to occur, the impact speed would be about 179,000 miles per hour. At such a speed, the resulting impact explosion would lift a huge volume of Earth's atmosphere into space, with resulting disastrous consequences for life on Earth.

★★ Comets are often called celestial "fossils": solar system survivors from its formation almost 5 billion years ago. Since inner members of the solar system had their gaseous remnants essentially blown away by the sun's radiation pressure, the comets just outside the solar system were less affected by this pressure. As a result, they have been better able to maintain their "primordial cloud": their nucleus with its halo and tail of gas. This could very well be what the early planets (protoplanets) looked like as well, before the Sun's radiation pressure blew away much of their gaseous surroundings.

★★ Each time a comet swings around Earth, it loses a little bit of its mass. Assuming that famous Halley's comet loses just a millionth of its mass each time it swings around the Sun about every 76 years, (and also assuming that it has existed for the entire life of the solar system) its original size would have been larger than the Sun itself!!

★★ The closer that comets come to the Sun, the faster they go. In 1965, the great comet Ikeya-Seki traveled as close as 290,000 miles near to the Sun, and accelerated to over 1 million miles (1.6 kilometers) per hour as it did so!!!!

★★ Although throughout much of human history the sight of a comet was considered an omen of impending disaster, today the sight of one is considered a sign of good luck! Jan Oort (the Dutch comet authority of Oort cloud fame) calculates that only 1 in 100,000 comets can be observed by humans. However, even with this estimate, the chance of a human being seeing at least one large, bright comet during his lifetime is very, very good.....so good luck....in more ways than one!!

★★ Meteor showers happen when the Earth in its own orbit passes through the meteoroid stream left by a comet in an orbit of its own. The most impressive and spectacular display in more recent history happened on November 17th, 1966, when that year's Leonid meteor shower (the dust debris from Comet Tempel-Tuttle (1866-I)) sparkled at over 2,000 per minute during the shower's peak. At this rate, someone viewing the shower would miss seeing over 30 meteors with each blink of an eye!!

PLANETARY FOCUS

"Planetary Focus" is a periodic column that is published occasionally in the EAS "Stargazer". If you have a favorite planet that you would like similar information and/or statistics on, please contact newsletter co-editor Bill O'Neil. This column published last in September with information about Jupiter; it will return again with a different planet focus in November.

"MIRROR IMAGES"

"MIRROR" IMAGES": This column is intended as a bi-monthly column; it last appeared in September and will return in November.

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

A NEW LUNAR IMPACT OBSERVATORY

The Walker County Observatory recorded its first lunar impact on Sept. 19, 2007. NASA scientists are proving that you can go home again if you bring a telescope with you. "Home" is north Georgia's Walker County, where astronomers Bill Cooke and Rob Suggs have just set up a research-grade observatory for their old school system. Years ago, they won't say how many, Cooke and Suggs attended the same high school in Walker County and after school they volunteered at the Walker County Science and Technology Center. The center's telescopes fueled their fire for astronomy. They learned to operate the instruments, find their way around the night sky, and they took their first pictures of the Moon.

Now, photographing the Moon is something they do professionally for NASA. Cooke heads up the Marshall Space Flight Center Meteoroid Environment Office and Suggs leads the Space Environments team. Together with a half-dozen assistants and colleagues, they specialize in "lunar impact monitoring." In other words, they watch meteorites hit the Moon and explode. "We've recorded about 30 strikes this year so far," says Cooke. Keeping track of these numbers is important to NASA as the agency lays plans to return to the Moon. "We need to know the odds of habitats and spacecraft getting hit."

Which brings us back to Georgia. Installing a telescope in Walker County not only benefits the local Science Center but also it solves a thorny problem for the lunar monitoring team. Cooke explains: *"At our main observatory in Huntsville, we see a fair amount of man-made space junk passing between us and the Moon. If the junk is tumbling and catches sunlight, it looks like an impact flash."* *"But suppose you have two observatories separated by some distance, say, one telescope in Alabama and one in Georgia. Then we can tell the difference between a tumbling satellite and a genuine impact. A real impact flash would be seen by both telescopes at the same location on the Moon. A tumbling satellite, on the other hand, will glint differently at the two locations."* Using the internet, NASA will monitor Walker County telescope data remotely ten days each month when the Moon is properly situated for viewing impacts. The Science and Technology Center will use the telescope the rest of the time. *"It opens up a whole new world of potential science fair projects for them,"* says Cooke.

The Meteoroid Office chose this rural county as a home for the telescope because it was a perfect fit. For one thing, Cooke knew that the Science and Technology Center had won a Space Telescope Science Institute grant to help build a new planetarium. *"The old planetarium I used as a kid was bull-dozed,"* says Cooke. *"We felt the telescope would be a natural adjunct to the new planetarium."* *"The center also has beautifully flat horizons and no trees. It's all clear for viewing. And Rob and I have known the Walker County School District's Science and Technology Coordinator, Wayne Robinson, for years. He can fix the telescope if anything breaks down. It's a win-win situation."* Robinson agrees. *"Having the NASA lunar observatory at our center will pay tremendous dividends for years to come,"* he says. *"Images from the telescope will inspire our students to know more about space science and astronomy. We'll also project the images on to a 40 foot diameter dome, providing audiences with a combination of simulated night sky and real time images. If there ever was a win-win situation, this is it."*

The \$15,000 telescope has a 14-inch diameter mirror and will observe from within an 8-foot by 8-foot building with a roll-top roof. End of story? Not quite. Robinson won't let you go without sharing a tale about Cooke's younger days. *"We used to put on Christmas programs in the old planetarium,"* recalls Robinson. "I remember one in particular. The planetarium director turned on a black light to reveal wise men and camels. But the black lights revealed something else too. Bill and some other volunteers had secretly placed big signs that said, "Wise Men on Strike and Demand Better Camels." *"Needless to say, the event is legendary to this day."* - Warning to the next generation: Cooke is back, and he's bringing a telescope with him.*

SIGN OF 'EMBRYONIC PLANETS' FORMING IN NEARBY STELLAR SYSTEMS

Astronomers are pointing to three nearby stars they say may hold "embryonic planets" - a missing link in planet-formation theories. As scientists try to piece together how our own planet came to be, they look to the forming planets of other star systems for clues. But astronomers have been unable to find evidence for one of the key stages of planet development, a period early in the planet's formation when it is only as large as tiny Pluto.

In an attempt to reveal this hidden phase of a planet's life, Alice Quillen employed new Hubble Space Telescope imagery to measure the thickness of the dust disks that surround forming stars, and to calculate the size of the planets growing within. The results help paint a picture of a planet's earliest years, and tell us how our own small planet probably began its life, says Quillen.

Scientists have inferred the presence of nearly 250 planets in the last decade, but Quillen's method focuses on a unique aspect: the proto-planetary disk's thickness. Quillen explains that a disk of gritty dust usually surrounds forming stars, and provides the raw material for planet building. The cloud of dust thins as the system ages, but if enough dust has clumped together, the "embryonic planet," as Quillen calls it, will knock the dust and grit into ever-more eccentric orbits. Over time, this will cause an otherwise razor-thin disk to appear puffed up. *"We're able to determine for the first time how large the bodies must be in a disk to scatter the dust the way we've observed,"* says Quillen, one of the world's leading experts on the interaction between planets and stellar dust disks. Using new Hubble images, Quillen measured the "puffiness" of AU Microscopii, Beta Pictoris, and Fomalhaut - three nearby stars with young disks positioned edge-on toward Earth. All three stars displayed a thicker disk than conventional models anticipated, so Quillen stepped beyond those models. Dust disks have a lifespan determined by a balance of how quickly the solar wind blows the dust away, and how quickly the largest "grit clumps" replenish the dust through their collisions, says Quillen. Based on this balance, the size and age of a disk reveal how large the clumps inside must be. But the conventional theory doesn't take a disk's thickness into account because until the Hubble images, astronomers had no way to measure it. Thus, the largest "clump" the model could predict was about a kilometer wide - a far cry from the fully grown planets that emerge from such disks.

Armed with the new images and her own models of dust dynamics, Quillen estimated how much mass was required to gravitationally scatter the dust to the thicknesses she observed. *"Those calculations pushed us into Pluto-sized bodies,"* says Quillen. At roughly 1,000 kilometers in size - and owing to Pluto's recent demotion from planethood - Quillen dubbed these new bodies, embryonic planets. Quillen is now looking for more young star systems to investigate with her model, but the criteria for candidates is quite strict. The systems have to be young enough to still have their protostellar disks, but old enough to be forming the embryonic planets. The systems must also appear edge-on from Earth and be near enough that Hubble can accurately discern the thickness of their disks. At the moment, the three stars Quillen has already observed appear to be the only candidates that meet all the standards.

STAR WITH CONDITIONS 'JUST RIGHT' FOR BUILDING AN EARTH

An Earth-like planet is likely forming 424 light-years away in a star system called HD 113766, say astronomers using Spitzer Space Telescope. Scientists have discovered a huge belt of warm dust - enough to build a Mars-size planet or larger - swirling around a distant star that is just slightly more massive than our sun. The dust belt, which they suspect is clumping together into planets, is located in the middle of the system's terrestrial habitable zone. This is the region around a star where liquid water could exist on any rocky planets that might form. Earth is located in the middle of our sun's terrestrial habitable zone. At approximately 10 million years old, the star is also at just the right age for forming rocky planets. *"The timing for this system to be building an Earth is very good,"* says Dr. Carey Lisse. *"If the system was too young, its planet-forming disk would be full of gas, and it would be making gas-giant planets like Jupiter instead. If the system was too old, then dust aggregation or clumping would have already occurred and all the system's rocky planets would have already formed."* According to Lisse, the conditions for forming an Earth-like planet are more than just being in the right place at the right time and around the right star - it's also about the right mix of dusty materials.

Using Spitzer's infrared spectrometer instrument, he determined that the material in HD 113866 is more processed than the snowball-like stuff that makes up infant solar systems and comets, which are considered cosmic "refrigerators" because they contain pristine ingredients from the early solar system. However, it is also not as processed as the stuff found in mature planets and the largest asteroids. This means the dust belt must be in a transitional phase, when rocky planets are just beginning to form.

How do scientists know the material is more processed than that of comets? From missions like Deep Impact - in which an 820-pound impactor spacecraft collided with comet Tempel 1 - scientists know that early star systems contain a lot of fragile organic material. That material includes polycyclic aromatic hydrocarbons (carbon-based molecules found on charred barbecue grills and in automobile exhaust on Earth), water ice, and carbonates (chalk). Lisse says that HD 113766 does not contain any water ice, carbonates or fragile organic materials.

From meteorite studies on Earth, scientists also have a good idea of what makes up asteroids, the more processed rocky leftovers of planet formation. These studies tell us that metals began separating from rocks in Earth's early days, when the planet's body was completely molten. During this time, almost all the heavy metals fell to Earth's center in a process called "differentiation." Lisse says that, unlike planets and asteroids, the metals in HD 113766 have not totally separated from the rocky material, suggesting that rocky planets have not yet formed. *"The material mix in this belt is most reminiscent of the stuff found in lava flows on Earth. I thought of Mauna Kea material when I first saw the dust composition in this system; it contains raw rock and is abundant in iron sulfides, which are similar to fool's gold,"* says Lisse, referring to a well-known Hawaiian volcano. *"It is fantastic to think we are able to detect the process of terrestrial planet formation. Stay tuned; I expect lots more fireworks as the planet in HD 113766 grows,"* he adds. <http://www.jhuapl.edu/newscenter/pressreleases/2007/071003.asp>

ARGON CONCLUSION: REASSESSING THEORIES ON FORMATION OF EARTH'S ATMOSPHERE

Geochemists are challenging commonly held ideas about how gases are expelled from the Earth. Their theory could change the way scientists view the formation of Earth's atmosphere and those of our distant neighbors, Mars and Venus. Their data throw into doubt the timing and mechanism of atmospheric formation on terrestrial planets. Led by E. Bruce Watson, the team has found strong evidence that argon atoms are tenaciously bound in the minerals of Earth's mantle and move through these minerals at a much slower rate than previously thought. In fact, they found that even volcanic activity is unlikely to dislodge argon atoms from their resting places within the mantle. This is in direct contrast to widely held theories on how gases moved through early Earth to form our atmosphere and oceans, according to Watson.

Scientists believe that shortly after Earth was formed, it had a glowing surface of molten rock extending down hundreds of miles. As that surface cooled, a rigid crust was produced near the surface and solidified slowly downward to complete the now-solid planet. Some scientists have suggested that Earth lost all of its initial gases, either during the molten stage or as a consequence of a massive collision, and that the catastrophically expelled gases formed our early atmosphere and oceans. Others contend that this early "degassing" was incomplete, and that primordial gases still remain sequestered at great depth to this day. Watson's new results support this latter theory.

"For the 'deep-sequestration' theory to be correct, certain gases would have to avoid escape to the atmosphere in the face of mantle convection and volcanism," Watson said. *"Our data suggest that argon does indeed stay trapped in the mantle even at extremely high temperatures, making it difficult for the Earth to continuously purge itself of argon produced by radioactive decay of potassium."*

Argon and other noble gases are tracer elements for scientists because they are very stable and do not change over time, although certain isotopes accumulate through radioactive decay. Unlike more promiscuous elements such as carbon and oxygen, which are constantly bonding and reacting with other elements, reliable argon and her sister noble gases (helium, neon, krypton, and xenon) remain virtually unchanged through the ages. Its steady personality makes argon an ideal marker for understanding the dynamics of Earth's interior.

"By measuring the behavior of argon in minerals, we can begin to retrace the formation of Earth's atmosphere and understand how and if complete degassing has occurred," Watson explained. Watson's team, which includes researcher Jay B. Thomas and research professor Daniele J. Cherniak, developed reams of data in support of their emerging belief that argon resides stably in crystals and migrates slowly. *"We realized from our initial results that these ideas might cause a stir,"* Watson said. *"So we wanted to make sure that we had substantial data supporting our case."* The team heated magnesium silicate minerals found in Earth's mantle, which is the region of Earth sandwiched between the upper crust and the central core, in an argon atmosphere. They used high temperature to simulate the intense heat deep within the Earth to see whether and how fast the argon atoms moved into the minerals. Argon was taken up by the minerals in unexpectedly large quantities, but at a slow rate. *"The results show that argon could stay in the mantle even after being exposed to extreme temperatures,"* Watson said. *"We can no longer assume that a partly melted region of the mantle will be stripped of all argon and, by extension, other noble gases."*

But there is some argon in our atmosphere -- slightly less than 1 percent. If it didn't shoot through the rocky mantle, how did it get into the atmosphere? *"We proposed that argon's release to the atmosphere is through the weathering of the upper crust and not the melting of the mantle,"* Watson said. *"The oceanic crust is constantly being weathered by ocean water and the continental crust is rich in potassium, which decays to form argon."* And what about the primordial argon that was trapped in the Earth billions of years ago? *"Some of it is probably still down there,"* Watson said. Because Mars and Venus have mantle materials similar to those found on Earth, the theory could be key for understanding their atmospheres as well. Watson and his team have already begun to test their theories on other noble gases, and they foresee similar results. *"We may need to start reassessing our basic thinking on how the atmosphere and other large-scale systems were formed,"* he said.

SOHO DISCOVERS RARE PERIODIC COMET

The Solar and Heliospheric Observatory (SOHO) has discovered a rare periodic comet. SOHO has already discovered more than 1,350 comets during its mission, but this is the first time one of its discoveries officially has been designated periodic.

Many of the comets SOHO has discovered are believed to be periodic, meaning they follow their orbits around the sun more than twice and have orbital periods of less than 200 years. Thousands of comets have been seen by astronomers, but only around 190 are classified as periodic. The most famous periodic

comet is Halley's Comet, which returns every 76 years. It most recently passed close to the sun in 1986.

SOHO's new find has a much smaller orbit than Halley's Comet. It takes the comet approximately four years to travel once around the sun. It was first seen in September 1999 and then again in September 2003. In 2005, German PhD student Sebastian Hoenig realized that the two comets were so similar in orbit that they might actually be the same object. To test his theory, he calculated a combined orbit for the comet and consequently predicted that it would return on Sept. 11, 2007. Hoenig's prediction proved to be extremely accurate -- the comet reappeared in SOHO's Large Angle and Spectrometric Coronagraph camera right on schedule and has now been given the official designation of P/2007 R5 (SOHO). Credit for the original discovery and recovery of the object goes to Terry Lovejoy (Australia, 1999), Kazimieras Cernis (Lithuania, 2003) and Bo Zhou (China, 2007).

A puzzling aspect to P/2007 R5 (SOHO) is that it does not look exactly like a comet. It has no visible tail or coma of dust and gas, as is traditionally associated with the phenomena. Initially, this led some scientists to wonder if the object was actually an asteroid, a chunk of space-rock, rather than a chunk of space-ice. However, P/2007 R5 (SOHO) did exhibit some characteristics consistent with a comet. As scientists watched the object pass close to the sun, drawing to within 4.9 million miles, or around 5% of the distance between the Earth and the sun, they saw it brighten by a factor of around a million, which is common behavior for a comet. *"It is quite possibly an extinct comet nucleus of some kind,"* says Karl Battams, who runs SOHO's comet discovery program. Extinct comets have expelled most of their volatile ices and retain little to form a tail or coma. They are theorized to be common objects among the celestial bodies orbiting close to the sun. This comet faded as quickly as it brightened, and soon became too faint for SOHO's instruments to see. Estimates show that P/2007 R5 (SOHO) is probably only 100 to 200 yards in diameter. Given how small and faint this object is, and how close it still is to the sun, it is an extremely difficult target for observers on Earth to pick out in the sky. Now we know for certain that P/2007 R5 (SOHO) is there, astronomers will be watching closely for it during its next return in September 2011.

BLOWING A HOLE IN A COMET: TAKE 2

The flash! The dazzle! The front page of the New York Times! Two years ago, the Deep Impact spacecraft dropped an 820 lb copper projectile onto Comet Tempel 1, unleashing an explosion that made headlines around the world. Exploding comets tend to have that effect. But how many people know what happened after the blast? The surprising answer is none--not even NASA. Deep Impact's prime mission was to punch a hole in Tempel 1 and look inside, giving researchers their first glimpse of a comet's internal structure. But *"we were never able to see the crater because the cloud of debris was so thick,"* says Michael New. Why didn't Deep Impact wait until the dust cleared? It couldn't. The mission was designed from the beginning as a high-speed flyby, giving extra velocity to the "bullet." Orbiting was not an option. Carried by its own momentum, Deep Impact sailed away before the cloud had time to dissipate.

Take 2: NASA is going back for a second look - *"We're sending another spacecraft back to Tempel 1, the Stardust probe,"* says New. Stardust is famous for its January 2004 flyby of Comet Wild 2. Severely buffeted by jets of gas and debris flowing from the comet, Stardust nevertheless managed to snatch thousands of samples of comet dust and return them to Earth for analysis. *"Stardust is one of the great successes of the Discovery*

program," says New. (The Discovery program launches innovative, inexpensive spacecraft every 18-to-24 months on cutting edge missions. Deep Impact is also part of this program.) At first, Stardust was simply retired, sailing the void with nothing to - but now it is being recycled as "Stardust-NExT," short for New Exploration of Tempel 1. Planetary science professor Joe Veverka of Cornell is the mission's principal investigator. *"We're very excited to go back,"* says Veverka. *"Stardust is due to reach Comet Tempel 1 in 2011. By then the debris cloud will be long gone and we should get a clear view of the crater."* Peering into the crater, however, *"is only half the story,"* says Veverka. Before the cloud spoiled the view, Deep Impact's cameras recorded some surprising things: For one, the comet is ringed by a strangely-layered "sedimentary" terrain. There are no rivers on comets, so what causes these features? *"Good question,"* says Veverka. One possibility: comets might be formed in layers. *"Imagine two small proto-comets smashing into one another, sticking together and flattening like pieces of play-dough,"* he says. Or maybe the layers are created via some form of hot erosion when the comet swings past the sun every 6.5 years. *"We just don't know."*

Stardust will gather important clues. *"We're returning to the comet almost exactly one orbit--that is, one comet-year--after the first visit. This gives us a chance to see how solar heating might have altered Tempel 1's face."*

Another surprise was landslides. *"Deep Impact saw an enormous flow of smooth, powdery material"* completely covering about a kilometer of underlying terrain, says Veverka. This feature is as mysterious as the layers, but it could explain one thing: why Deep Impact's debris cloud was so troublesome. *"We might have hit a patch of deep powder,"* adds New. *"Fine particles tend to make big clouds that are hard to see through."* *"This is why we explore,"* adds Veverka. *"Tempel 1 is an amazing comet."*

Veverka notes that recycling a mission like Stardust is cheaper than sending a whole new spacecraft. *"Stardust-NExT costs less than 15% of a full-up Discovery mission."* *"Giving new assignments to veteran spacecraft represents not only creative thinking and planning, but also a prime example of getting more from the budget we have,"* agrees Alan Stern. Deep Impact is being recycled, too. *"We're using Deep Impact for two new projects,"* explains New. One is called DIXI (Deep Impact Extended Investigation): *"Deep Impact will fly by Comet Boethin in December 2008 for a close-up investigation of the comet's nucleus."* The second is EPOCH (Extrasolar Planet Observation and Characterization): *"Cameras on Deep Impact will target nearby stars with known giant planets. By watching these planets transit (pass in front of) their stars, Deep Impact will be able to determine whether they possess rings and/or moons."* For this work, EPOCH's sensitivity will exceed that of existing ground and space-based observatories, possibly leading to the discovery of new Earth-sized planets. - No crater? No problem. Says New: *"You can't keep a good Discovery mission down."*

A PLANET THAT OFFERS CLUES TO EARTH'S FUTURE

An international team of astronomers including Steve Kawaler has announced the first discovery of a planet orbiting a star near the end of its life. The news provides a preliminary picture of what could be the Earth's destiny in four to five billion years. That's when the sun will exhaust its hydrogen fuel, expand enormously as a red giant and expel its outer layers in an explosive helium flash.

The planet discovered by the researchers, "V 391 Pegasi b," has survived all those changes to its sun. The international research

team was led by Roberto Silvotti. They discovered the planet orbiting "V 391 Pegasi," a faint star in the constellation of Pegasus. *"The exciting thing about finding a planet around this star is that it indicates that planetary systems can survive the giant phase and the helium flash of their parent star,"* said Kawaler, a professor of physics and astronomy. *"It bodes well for the survival of our own Earth in the distant future. Before V 391 Pegasi lost its outer regions at the helium flash, the planet orbited the star at about the same distance that the Earth orbits our sun."* But, Kawaler said, *"We shouldn't take too much heart in this -- this planet is larger than Jupiter, so a smaller planet like the Earth could still be vulnerable."*

Kawaler helped the 23-member research team make its discovery by coordinating observations during a 2003 run of the Whole Earth Telescope, a worldwide network of cooperating observatories that allow astronomers to take uninterrupted measurements of variable stars that change in brightness. The discovery of V 391 Pegasi b was made by detailed measurements of the clocklike variation of the star caused by the planet tugging on it. Kawaler also advanced the project by doing theoretical calculations to make sure irregularities of the star's orbital motion were caused by the orbiting planet.

The astronomers found that at the present time, V 391 Pegasi b has an orbital distance 1.7 times the medium distance between the Earth and the sun. As stars age and reach their red giant phase, they undergo an enormous expansion (with their volume increasing by a factor of millions) that can easily reach and engulf their inner planets. *"The same will happen to the sun,"* Silvotti said. *"As far as our planets are concerned, we expect Mercury and Venus to disappear in the sun's envelope, whereas Mars should survive. The fate of the Earth is less clear because its position is really at the limit: it appears more likely that the Earth will not survive the red giant expansion of the sun either, but it is not for sure."* As is the case for almost all planets beyond our solar system, V 391 Pegasi b cannot be seen directly. Silvotti said it took seven years of observations and calculations to confirm the existence of the planet.
<http://www.nature.com/nature/journal/v449/n7159/full/nature06143.html>

MAGELLANIC CLOUDS ARE FIRST-TIME VISITORS

The Large Magellanic Cloud (LMC) and Small Magellanic Cloud (SMC) are two of the Milky Way's closest neighboring galaxies. A stunning sight in the southern hemisphere, they were named after Ferdinand Magellan, who explored those waters in the 16th century. For hundreds of years, these galaxies were considered satellites of the Milky Way, gravitationally bound to our home galaxy. New research by Gurtina Besla and her colleagues shows that the Magellanic Clouds are recent arrivals on their first visit to the Milky Way's neighborhood. *"We have known about the Clouds since the time of Magellan, and a single measurement has thrown out everything we thought we understood about their history and evolution,"* says Besla.

Although they look like glowing clouds to the unaided eye, the LMC and SMC are both irregular galaxies. The Large Magellanic Cloud is located approximately 160,000 light-years from Earth. It's about one-twentieth as large as our galaxy in diameter and holds about one-tenth as many stars. The Small Magellanic Cloud is located around 200,000 light-years from Earth. It's about ten times smaller than its companion and a hundred times smaller than the Milky Way.

Earlier this year, astronomers reported measuring the 3-d velocities of the Magellanic Clouds through space with greater accuracy than ever before. The velocities were anomalously high.

Two explanations were proposed: 1) the Milky Way is more massive than previously thought, or 2) the Magellanic Clouds are not gravitationally bound to the Milky Way. Further analysis by Besla and her colleagues verified the second explanation. The parabolic orbit they calculated for the Clouds, based on the observed velocities, shows that both are on their first pass by the Milky Way.

This result carries several implications. For example, as a spiral galaxy the Milky Way has a large gaseous disk intermixed with billions of stars. That gaseous disk is known to be significantly warped, extending about 10,000 light-years above and below the galaxy's plane. Astronomers theorized that gravitational tides due to previous passages of the Magellanic Clouds caused this warp. However, since the Clouds arrived only 1-3 billion years ago, they are not likely to be the source of the warp.

Another puzzle relates to the Magellanic Clouds themselves. A long trail of hydrogen gas called the Magellanic Stream extends behind the Clouds, spanning 100 degrees of the sky from the earth's viewpoint. Some astronomers suggested that the Magellanic Stream formed due to tidal interactions between the Clouds and the Milky Way. Others believed that hydrogen was stripped from the Clouds by gas pressure as they plunged through the extremely tenuous gas surrounding our galaxy. A first-passage scenario rules out both scenarios. *"We've been left with a real mystery,"* says Besla. *"One answer has led to many more questions."*

Finally, the star-forming history of the Clouds themselves must be revisited. Rather than forming stars continuously like the Milky Way, the Magellanic Clouds have undergone several bursts of star formation followed by long quiet periods. Astronomers thought that the starbursts coincided with previous close passes by the Milky Way. This explanation no longer holds true. Instead, interactions between the SMC and LMC may be the primary force driving star formation in both galaxies.

In the future, Besla and her colleagues intend to focus on the origin of the Magellanic Stream, conducting N-body simulations to puzzle out possible formation mechanisms. Other astronomers will make direct observations and survey the Stream. The combined power of observational and theoretical research may answer the questions generated by the current work.
http://www.cfa.harvard.edu/press/2007/pr200722_images.html

DEALING WITH THREATENING SPACE ROCKS

Every now and then a space rock hits the world's media -- sometimes almost literally. Threatening asteroids that zoom past the Earth, fireballs in the sky seen by hundreds of people and mysterious craters which may have been caused by impacting meteorites; all make ESA's proposed mission Don Quijote look increasingly timely. The recent uncertainty surrounding whether a meteorite impacted in South America highlights the need to know more about these pieces of natural space debris and their trajectories. ESA has always been interested in such endeavors and conducted a number of studies into how it might best help. Those studies showed that it is probably the smaller pieces of rock, at most a few hundred meters across, rather than the larger ones that we should be more worried about for the time being. A worldwide network of astronomers is currently cataloguing most of the larger objects, those above 1 km in diameter. A number of survey telescopes have taken up the challenge to detect as many as 90 percent of all near Earth objects down to a size of 140 meters by around 2020. Only after this time will we know whether space-based observatories will be needed to find the rest.

Part of the trouble with these small chunks of rock is fixing their orbits. From the ground, it is very difficult -- sometimes impossible -- to determine their trajectory with enough precision to rule out impacts with our planet in the years to come. So, ESA have been concentrating on a mission to actually 'mark a cross' on small asteroids and check the state of the art of our technology. The Don Quijote mission is a project based on two phases. In the first phase, a spacecraft would rendezvous with an asteroid and go into orbit around it. It would monitor the asteroid for several months, precisely determining its position, shape, mass and gravity field. In the second phase, another spacecraft would slam into the asteroid at a speed of around 10 km/s, while the first spacecraft watches, looking for any changes in the asteroid's trajectory. In this way, a mission involving two spacecraft would attempt to be the first to actually move an asteroid.

In preparation for dealing with small asteroids, Don Quijote is also starting small. In its current design, the first spacecraft, Sancho, could reach any one of 5 or 6 small, nearby asteroids. Each one is no larger than a few hundred meters in diameter. At present, the mission planners have chosen to concentrate on Apophis, a small asteroid that can swing dangerously close to Earth on the outwards stretch of its orbit around the Sun.

If it becomes a reality, Don Quijote could launch sometime early in the next decade. Sancho would take some 25 months to reach its target. Once there, it would begin its groundbreaking study -- both literally and metaphorically. *"The idea is to get the technology ready before you really need it,"* says Ian Carnelli, Technical Officer for the Don Quijote mission.

In 1908, a 20-meter asteroid impacted the uninhabited Tunguska forest in Siberia, toppling trees and causing total devastation over an area of two thousand square kilometers. Scientists predict this type of event to occur about every 150 years. Next year's 100th anniversary of that impact will be yet another reminder of the need to learn about and become ready to deal with asteroids -- even the small ones.
http://www.esa.int/SPECIALS/GSP/SEM8SUB1S6F_1.html

IMPACT LIKELY SOURCE OF SUDDEN ICE-AGE EXTINCTIONS

What killed the woolly mammoths? An international team of scientists, including Peter Schultz, suggests that a comet or meteorite exploded over the planet roughly 12,900 years ago, causing the abrupt climate changes that led to the extinction of the woolly mammoth and other giant prehistoric beasts.

At the end of the Pleistocene era, woolly mammoths roamed North America along with a cast of fantastic creatures - giant sloths, saber-toothed cats, camels, lions, tapirs and the incredible teratorn, a condor with a 16-foot wingspan. About 12,900 years ago, these mega-fauna disappeared from the fossil record, as did evidence of human remains. The cause of the mass extinction and the human migration is a mystery. Now a team of scientists, including planetary geologist Peter Schultz, provides evidence that an asteroid impact likely caused the sudden climate changes that killed off the mammoths and other majestic beasts of prehistory. The international team lays out its theory that the mass extinctions in North America were caused by one or more extraterrestrial objects - comets or meteorites - that exploded over the Earth or slammed into it, triggering catastrophic climate change. The scientists believe that evidence for these extraterrestrial impacts is hidden in a dark layer of dirt sometimes called a black mat. Found in more than 50 sites around North America, this puzzling slice of geological history is a mere three centimeters deep and filled with carbon, which lends the layer its dark color. This black mat has been found in archaeological digs

in Canada and California, Arizona and South Carolina - even in a research site in Belgium.

The formation of this layer dates back 12,900 years and coincides with the abrupt cooling of the Younger Dryas period, sometimes called the "Big Freeze." This coincidence intrigued the researchers, led by Richard Firestone, who thought that the black mat might be related to the mass extinctions. So the researchers studied black mat sediment samples from 10 archaeological sites dating back to the Clovis people, the first human inhabitants of the New World. Researchers conducted geochemical analysis of the samples to determine their makeup and also ran carbon dating tests to determine the age of the samples. Directly beneath the black mat, researchers found high concentrations of magnetic grains containing iridium, charcoal, soot, carbon spherules, glass-like carbon containing nanodiamonds and fullerenes packed with extraterrestrial helium - all of which are evidence for an extraterrestrial impact and the raging wildfires that might have followed.

Schultz, professor of geological sciences and an impact specialist, said the most provocative evidence for an extraterrestrial impact was the discovery of nano-diamonds, microscopic bits of diamond formed only from the kind of intense pressure you'd get from a comet or meteorite slamming into the Earth. *"We don't have a smoking gun for our theory, but we sure have a lot of shell casings,"* Schultz said. *"Taken together, the markers found in the samples offer intriguing evidence that North America had a major impact event about 12,900 years ago."*

Schultz admits that there is little decisive evidence about the actual details about the impact and its effects. Scientists suspect that a carbon-rich asteroid or comets were the culprits. The objects would have exploded over North America or slammed into it, or both, shattering and melting ice sheets, sparking extreme wildfires, and fueling hurricane-force winds - all of which could have contributed to changes in climate that led to the cooling of the Younger Dryas period. *"Our theory isn't a slam dunk,"* Schultz said. *"We need to study a lot more sediments to get a lot more evidence. But what is sobering about this theory of ours is that this impact would be so recent. Not so long ago, something may have fallen from the sky and profoundly changed our climate and our culture."*

CASSINI'S NEW VIEWS OF TITAN'S 'LAND OF LAKES' (AND SEAS)

Newly assembled radar images from the Cassini spacecraft provide the best view of the hydrocarbon lakes and seas on the north pole of Saturn's moon Titan, while a new radar image reveals that Titan's south polar region also has lakes. The southern region images were beamed back after an Oct. 2 flyby in which a prime goal was the hunt for lakes at the south pole. A new mosaic image, created by stitching together radar images from seven Titan flybys over the last year and a half, shows a north pole pitted with giant lakes and seas, at least one of them larger than Lake Superior. Approximately 60 percent of Titan's north polar region above 60 degrees latitude has been mapped by Cassini's radar instrument. About 14 percent of the mapped region is covered by what scientists interpret as liquid hydrocarbon lakes. *"This is our version of mapping Alaska, the northern parts of Canada, Greenland, Scandinavia and Northern Russia,"* said Rosaly Lopes, Cassini radar scientist at JPL. *"It's like mapping these regions of Earth for the first time."*

Lakes and seas are very common at the high northern latitudes of Titan, which is in winter now. Scientists say it rains methane and ethane there, filling the lakes and seas. These liquids also carve

meandering rivers and channels on the moon's surface. Now Cassini is moving into unknown territory, the south pole of Titan. "We wanted to see if there are more lakes present there and, sure enough, there they are, three little lakes smiling back at us. Titan is indeed the land of lakes and seas," said Lopes. "It will be interesting to see the differences between the north and south polar regions."

It is now summer at Titan's south pole. A season on Titan lasts nearly 7.5 years, one quarter of a Saturn year, which is 29.5 years long. Monitoring seasonal change helps scientists understand the processes at work there. Scientists are making progress in understanding how the lakes may have formed. On Earth, lakes fill low spots or are created when the local topography intersects a groundwater table. Lopes and her colleagues think that the depressions containing the lakes on Titan may have formed by volcanism or by a type of erosion (called karstic) of the surface, leaving a depression where liquids can accumulate. Karstic lakes are common on Earth. For example in parts of Minnesota and central Florida there are hundreds of such lakes. "The lakes we are observing on Titan appear to be in varying states of fullness, suggesting their involvement in a complex hydrologic system akin to Earth's water cycle. This makes Titan unique among the extra-terrestrial bodies in our solar system," said Alex Hayes, a graduate student who studies Cassini radar data. "The lakes we have seen so far vary in size from the smallest observable, approximately 1 square kilometer (0.4 square miles), to greater than 100,000 square kilometers (40,000 square miles), which is slightly larger than the Great Lakes in the Midwestern U.S.," Hayes said. "Of the roughly 400 observed lakes, 70 percent of their area is taken up by large "seas" greater than 26,000 square kilometers (10,000 square miles)."

Future radar flybys will image closer to the southern pole and are expected to show more lakes. <http://www.nasa.gov/cassini>
<http://saturn.jpl.nasa.gov>

DUST FOUND 'BLOWING IN THE WIND' OF BLACK HOLES

The hit song that proclaimed, "All we are is dust in the wind," may have some cosmic truth to it. New findings from Spitzer Space Telescope suggest that space dust -- the same stuff that makes up living creatures and planets -- was manufactured in large quantities in the winds of black holes that populated our early universe. The findings are a significant new clue in an unsolved mystery: where did all the dust in the young universe originate? "We were surprised to find what appears to be freshly made dust entrained in the winds that blow away from supermassive black holes," said Ciska Markwick-Kemper, the lead author of a new paper. "This could explain where the dust came from that was needed to make the first generations of stars in the early universe." Space dust is essential to the formation of planets, stars, galaxies and even life as we know it. The dust in our corner of the universe was piped out by dying stars that were once a lot like our sun. But, when the universe was less than a tenth of its present age of 13.7 billion years, sun-like stars hadn't been around long enough to die and make dust. So, what produced the precious substance back when the universe was just a toddler?

Theorists have long-postulated that short-lived, massive exploding stars, or supernovae, might be the source of this mysterious dust, while others have proposed that a type of energetic, growing supermassive black hole, called a quasar, could be a contributing factor. A quasar consists of a supermassive black hole surrounded by a dusty doughnut-shaped

cloud that feeds it. Theoretically, dust could form in the outer portion of the winds that slowly blow away from this doughnut cloud. "Quasars are like the Cookie Monster," said co-author Sarah Gallagher. "They are messy eaters, and they can consume less matter than they spit out in the form of winds."

Nobody has found conclusive proof that either quasar winds or supernovae can create enough dust to explain what is observed in the early universe. Markwick-Kemper and her team decided to test the former theory and investigate a quasar, called PG2112+059, located in the center of a galaxy about 8 billion light-years away. Although this particular quasar is not located in the early universe, because it is closer, it is an easier target for addressing the question of whether quasars can make dust. The team used Spitzer's infrared spectrograph instrument to split apart infrared light from the quasar and look for signs of various minerals. They found a mix of the ingredients that make up glass, sand, marble and even rubies and sapphires. While the mineral constituting glass was expected, the minerals for sand, marble and rubies were a surprise. Why? These minerals are not typically detected floating around galaxies, suggesting they could have been freshly formed in the winds rushing away from the quasar. For instance, the ingredient that makes up sand, crystalline silicate, doesn't survive for long free-floating in space. Radiation from stars zaps the minerals back to an amorphous, glass-like state. The presence of crystalline silicate therefore suggests something -- possibly the quasars winds -- is churning out the newly made substance.

Markwick-Kemper and her team say the case of the missing dust is not firmly shut. They hope to study more quasars for further evidence of their dust-making abilities. Also, according to the astronomers, quasars may not be the only source of dust in the early universe. "Supernovae might have been more important for creating dust in some environments, while quasars were more important in others," said Markwick-Kemper. "For now, we are very excited to have identified the different species of dust in a quasar billions of light-years away." <http://www.spitzer.caltech.edu/spitzer> <http://www.nasa.gov/spitzer>

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
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In October's StarGazer:

- **** **ASTRO CALENDAR – STAR PARTY SCHEDULE**
- **** **OBSERVER'S INFORMATION**
- **** **YOUNG ASTRONOMER'S CORNER**
- **** **ASTRONOMY AND TELESCOPE LINGO**
- **** **CONSTELLATION(S) OF THE MONTH**
- **** **ASTRONOMY 'FUN FACTS'**
- **** **SIGN OF 'EMBRYONIC PLANETS' FORMING IN NEARBY STELLAR SYSTEMS**
- **** **STAR WITH CONDITIONS 'JUST RIGHT' FOR BUILDING AN EARTH**
- **** **A NEW LUNAR IMPACT OBSERVATORY**
- **** **ARGON CONCLUSION: REASSESSING THEORIES ON FORMATION OF EARTH'S ATMOSPHERE**
- **** **SOHO DISCOVERS RARE PERIODIC COMET**
- **** **BLOWING A HOLE IN A COMET: TAKE - 2**
- **** **A PLANET THAT OFFERS CLUES TO EARTH'S FUTURE**
- **** **MAGELLANIC CLOUDS ARE FIRST-TIME VISITORS**
- **** **DEALING WITH THREATENING SPACE ROCKS**
- **** **IMPACT LIKELY SOURCE OF SUDDEN ICE-AGE EXTINCTIONS**
- **** **CASSINI'S NEW VIEWS OF TITAN'S 'LAND OF LAKES' (AND SEAS)**
- **** **DUST FOUND 'BLOWING IN THE WIND' OF BLACK HOLES**

The next EAS Meeting is *4:00 P.M.* Saturday October 13th at the Everett Public Library Auditorium.