

# The Stargazer

September 2005

President: Mark Folkerts (425) 486-9733  
 VP & Librarian: Mike Locke (425) 259-5995  
 Treasurer: Carol Gore (360) 856-5135  
 Newsletter co-editor: Bill O'Neil (774) 253-0747  
 Web assistance: Cody Gibson (425) 348-1608

folkerts at seonet.com  
 mlocke at lionmts.com  
 janeway7C at aol.com  
 wonastrn at seonet.com  
 sircody01 at comcast.net  
 (change 'at' to '@' to send email)

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

See EAS website at:

[http://members.tripod.com/everett\\_astronomy](http://members.tripod.com/everett_astronomy)

## EAS BUSINESS...

**NEXT EAS MEETING - SATURDAY SEPTEMBER 24<sup>TH</sup>  
 AT 3:00 PM AT THE EVERETT PUBLIC LIBRARY, IN  
 THE AUDITORIUM (DOWNSTAIRS)**

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>

### Scheduled Meeting Dates:

**September 24th - EAS Meeting – Saturday 3:00 PM**

Presenter not confirmed

**October 29th - EAS Meeting – Saturday 3:00 PM**

Dr. Paula Szkody – UW Astronomy.

**November 19th - EAS Meeting – Saturday 3:00 PM**

Curtis Snow – Mars Society 'Changes in perspective /  
 "discoveries" from our recent exploration of Mars'

## CLUB STAR PARTY INFO

### Upcoming star party schedule:

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 Mike Locke at (425) 259-5995 for info or check the EAS website.) Members contact Mike Locke for scope borrowing.

### Orion Nebula Star Party – At Table Mt. - Sep 28<sup>th</sup> – Oct 2<sup>nd</sup>

"The Orion Nebula Star party is set Wednesday September 28th through Sunday October 2nd AM. We will go up and freeze, and hopefully this year it won't snow! There are going to be some low-key door-prizes, and t-shirts for sale \$19.00 each. Reserving those shirts ahead of time is best, as I am low on sizes. Again, free snack area and hot drinks. If it is cloudy - DVD movie night - bring your favorite movie to share. If not – there is the 29.25 inch - "Almost 30" telescope to view through. Hope you all can attend, and that the weather cooperates. (Remember, dress warm, and subtract 18-20 degrees for Table Mtn.)"

<http://www.buytelescopes.com/product.asp?t=&pid=8129&m=118>

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

- Jim Bielaga

(360) 293-9509 email [JimBielaga@aol.com](mailto:JimBielaga@aol.com)



**Klickitat County Star Party** <http://klickitatstarparty.net/>

Five miles NE of Goldendale, WA. Sept 30th - Oct 2nd, 2005

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

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

## CLUB SCOPES

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

EAS members: contact Mike Locke at (425) 259-5995 or 'mlocke at lionmts.com' to borrow a scope.

## ASTRO CALENDAR FOR 2005

### September 2005

Sep 01 - Uranus at opposition

Sep 22 - Autumnal Equinox (22:23 UT) – 1<sup>st</sup> day of autumn N hemisphere

**Sep 24 - EAS MEETING - Saturday 3:00 PM at Everett Public Library**

### October 2005

Oct 01 - Potential Saturday EAS star party night, location TBD

Oct 03 - New Moon

Oct 03 - Annular Solar Eclipse, Visible From Africa

Oct 04 - Moon occults Mercury

Oct 05 - Mercury passes 1.3 degrees From Jupiter

Oct 09 - Draconids meteor shower Peak

Oct 16 - Venus occults PPM 265560 (7.7 Magnitude Star)

Oct 17 - Partial Lunar eclipse  
 Oct 21 - Orionid meteor shower peak  
**Oct 29 - EAS MEETING - Saturday 3:00 PM at Everett Public Library**  
 Oct 30 - Daylight Saving - set clock back 1 Hour

### November 2005

Nov 01 - New Moon  
 Nov 05 - Potential Saturday EAS star party night, location TBD  
 Nov 03 - Taurids meteor shower peak  
 Nov 03 - Mercury at its Greatest Eastern Elongation (23 Degrees)  
 Nov 03 - Venus at its Greatest Eastern Elongation (47 Degrees)  
 Nov 07 - Mars at opposition  
**Nov 19 - EAS MEETING - Saturday 4:00 PM at Everett Public Library**

### December 2005

Dec 02 - 10th anniversary (1995), SOHO Launch  
 Dec 12 - Moon occults Mars  
 Dec 12 - Mercury at its Greatest Western Elongation (21 Degrees)  
 Dec 13 - Geminids meteor shower peak  
 Dec 21 - Winter Solstice, 18:35 UT  
 Dec 22 - Ursids meteor shower peak  
**Dec 10<sup>th</sup> or 17<sup>th</sup> - EAS Dinner - Saturday 7:00 PM**

### UW Astronomy 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).

### OVER THE AIRWAVES

"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 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@lioninc.com](mailto:mlocke@lioninc.com), to borrow or donate any materials. See list here: [http://members.tripod.com/everett\\_astronomy/eas\\_library.htm](http://members.tripod.com/everett_astronomy/eas_library.htm)

### 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 Mike Locke, 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 to subscribe to *Sky and Telescope* for \$7 off the normal subscription rate, contact the treasurer for more information. Link to registration form: [http://members.tripod.com/everett\\_astronomy/application.htm](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 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. Contact Mike Locke (425) 259-5995 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

Sep 11	First Quarter Moon
Sep 18	Full Moon
Sep 25	Last Quarter Moon
Oct 03	New Moon
Oct 10	First Quarter Moon
Oct 17	Full Moon
Oct 25	Last Quarter Moon
Nov 02	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](http://www.lpi.usra.edu/research/lunar_orbiter)

### UP IN THE SKY -- THE PLANETS

Object	Rises	Transits	Sets	Con	Mag
<b>Sun</b>	<b>6:53 am</b>	<b>13:02</b>	<b>19:10</b>	<b>Vir</b>	<b>-27</b>
Mercury	Daylight	Daylight	<b>19:21</b>	Vir	-1.5
<b>Venus</b>	Daylight	Daylight	<b>20:29</b>	<b>Lib</b>	<b>-4.1</b>
<b>Mars</b>	<b>21:14</b>	<b>4:34 AM</b>	Daylight	<b>Ari</b>	<b>-1.4</b>
Jupiter	Daylight	Daylight	Daylight	Vir	-1.7
<b>Saturn</b>	<b>2:22 am</b>	Daylight	Daylight	<b>Can</b>	<b>+0.3</b>
<b>Uranus</b>	Daylight	<b>23:48</b>	<b>5:13 am</b>	<b>Aqr</b>	<b>+5.7</b>
<b>Neptune</b>	Daylight	<b>22:19 am</b>	<b>3:10 am</b>	<b>Cap</b>	<b>+7.8</b>
<b>Pluto</b>	Daylight	Daylight	<b>23:28</b>	<b>Ser</b>	<b>+13.8</b>

(times local time for Everett PDT)

### Transit times for Jupiter's Great Red Spot in 2005

[http://skvandtelescope.com/observing/objects/planets/article\\_107\\_2.asp](http://skvandtelescope.com/observing/objects/planets/article_107_2.asp)

### NOAA SUN CALCULATOR

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

### INTERNATIONAL SPACE STATION – VISIBLE SEATTLE PASSES

#### ISS Visibility –

<http://spaceflight.nasa.gov/realdata/sightings/ISSapplications/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>

## MEMBER NEWS

### Seattle Astro Society Trying To Get a Dark Sky Site

"We feel that we need to raise \$25,000 in order to buy something appropriate on the other side of the mountains. We are making good progress within SAS. The deal basically is \$250 for dark sky membership, and some relatively nominal sum for annual dark sky dues. One would have to be a SAS member to do this, but that is a rather nominal charge. We were wondering if anyone in your club would be interested in taking part. I personally think that the dark sky site is a necessary thing for SAS to do; otherwise, the club really has little tangible to offer its members. With a dark sky site, even city-bound members would have a place within a few hours where they could view from a dark site; even us suburban folks would benefit, I think. Thanks for your consideration."

-- Mark de Regt, SAS.

### TELECON 6 PM September 29th: Dr. Steven Squyres, Chief Scientist for the (MER) Mars Exploration Rovers

Mars will be in the eyepiece for the Mars Opposition in early November. To prepare, Dr. Steven Squyres, the principal scientist for the twin Mars rover missions, will share a one-hour teleconference with the members of the Night Sky Network on Thursday, September 29, 2005 at 6 pm Pacific (PDT).

Dr. Squyres will provide an up-to-date summary of the mission of Spirit and Opportunity, from their initial conception through their launch, landing, and operations on the surface of Mars. His talk will be followed by an "opportunity" for you to ask questions of Dr. Squyres about his amazing experiences.

Call in anytime after **5:45 pm PDT on September 29, 2005**. Toll-free conference call line: **1 (877) 917-1549**. An operator will answer and:

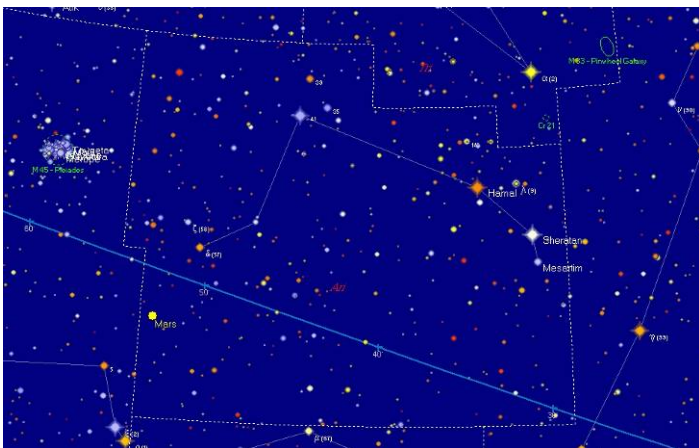
\* You will be asked for the passcode: **NIGHT SKY NETWORK**

\* You might be asked for the call leader: **MICHAEL GREENE**

\* You will be asked to give your **NAME**, the **CLUB** you belong to, and number of people listening with you.

All your club members are welcome to join the telecon. There will be no PowerPoint for this telecon: Dr. Squyres is looking forward to talking with you and discussing your questions. For more details, see the article on the Night Sky Network after you log in: <http://nightsky.jpl.nasa.gov/>

## CONSTELLATIONS OF THE MONTH: ARIES



**ARIES:** "The Ram". This zodiacal constellation borders on the constellations of Cetus, Perseus, Pisces, Taurus, and Triangulum. It ranks 53<sup>rd</sup> 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 39<sup>th</sup> 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 30<sup>th</sup>. It also contains one star asterism known as the "Northern Fly".

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. 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.

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.

Aries contains many interesting galaxies. NGC-772 is the largest and brightest galaxy in Aries. It is a magnitude 10.3 spiral, measuring 7.1' by 4.5' across. NGC-770 has a much dimmer bluish color, and is of magnitude 14.1; it is an elliptical galaxy only 1.3' by 1.0' across. NGC-821 is another elliptical galaxy in Aries; this one has a magnitude of 10.0 and measures 3' by 2' across. About halfway between NGC-772 and NGC-821 lies NGC-803, an Sb-type spiral which shines at magnitude 12.4 and measures 3.3' by 1.5' across. NGC-697 is a highly-tilted barred spiral with a photographic magnitude of 12.7; it lies in the northwestern corner of the constellation; NGC-691 also resides in this region of Aries. NGC-691 is a spiral galaxy glowing at magnitude 12.4 with a bluish hue, and measures 3.5' by 2.7'. In the north-central area of Aries, NGC-976 glows at magnitude 12.4 and measures 1.7' by 1.5'. NGC-1156 is an interesting galaxy, as it shows mottled detail and sits within a rich starfield visible in small telescopes. Finally, NGC-972, lying in the northern areas of Aries, is an 11<sup>th</sup>-magnitude, highly-inclined spiral which measures 3.6' by 2.0'. If you are able to get to a dark sky site this fall, try to discover some of the lesser-known wonders of Aries for yourself.

## YOUNG ASTRONOMER'S CORNER

The Young Astronomer's Corner will talk a bit this month, giving some very basic information, about Supernovae, Neutron Stars, and Black Holes: many people always ask the basic differences between these three types of objects...not just young astronomers!!

**Supernovae, Neutron Stars, and Black Holes:** What happens (when a star "dies") if that star is bigger or more massive than the sun to begin with? If a star is anywhere from at least 1.1 to about 1.4 times as large (more massive) than the sun, it will generally undergo a more violent and spectacular end. Actually, a star with a mass of about 10 times that of the sun will probably end up as a supernova. As with the red giant stage of a smaller star, there is a similar collapse due to gravity, more nuclear fusion and a

change in production to heavier elements, a rise in temperature, and then a halt in the collapse. These cycles of collapse, rise in temperature, expansion (opposite of collapse), and collapse again, continue until iron is produced in these reactions as the ultimate “heavy” element: iron does not release energy in nuclear reactions, but requires it. When the star builds an iron core and collapses again and cannot be compressed anymore, it explodes violently, (it is no longer able to resist the force of gravity). This is a **supernova**. The expanding shell or blanket of gas and dust forms what is known as a supernova remnant, and it is this gas and dust which is the “star stuff” that we are all made of.

Present in the core of a supernova is the remainder of the collapsed star; this is called a **neutron star**. It is composed of tightly packed neutrons, and is even more dense than a white dwarf; a neutron star also spins very rapidly. Either light or radio waves from these stars can be detected on earth in pulses; these rapidly spinning neutron stars are therefore also known as **pulsars** (the fastest of which can rotate at almost 1,000 times per second).

Finally, if a star is very big or massive (generally **over** 10 times as big as the sun), it will become a **black hole**. A black hole is an object so dense and collapsed that not even light can escape (that is, we can’t “see” it; we can detect it however by what it releases (X-rays, for example), from its effect on other nearby objects.). Also, a supernova that leaves a central core greater than three times the size of the sun is too large to remain either a white dwarf or a neutron star (pulsar); it too will become a black hole.

#### ASTRONOMY AND TELESCOPE LINGO

**ASTRONOMY LINGO: GRAVITY ASSIST:** An astronomical method whereby a spacecraft assumes a very small fraction of the orbital energy of a planet that it is flying by. This allows the spacecraft to change both direction and speed. Recently, the Cassini Spacecraft bound for Saturn used Earth’s orbital energy in this manner, and gravity assist has been used in many other space probe missions as well.

**TELESCOPE LINGO: TELECOMPRESSOR:** Also known as a rich-field adapter, a telecompressor is a converging achromatic lens inserted within the focus of a telescope. This allows the effective focal length to be reduced, which augments the telescope’s field of view.

#### PLANETARY FOCUS

This column occasionally appears in the EAS Stargazer. If you have a favorite planet that you would like information on, please call or e-mail newsletter co-editor Bill O’Neil. This month, the focus of this periodic column is our outer neighbor MARS:

**Rotation around the Sun:** every 686.98 days

**Orbit:** from 1.38 (closest or ‘perihelion’) to 1.67 (furthest or ‘aphelion’) Astronomical Units (AU)\*; this is an orbit that varies between approximately 128.3 and 155.3 million miles from the sun. (\*Note: One AU equals approximately 93 million miles).

**Inclination of Orbit to Ecliptic:** 1.9 degrees.

**Diameter at Equator:** 6,795 kilometers (or 4,077 miles).

**Mass:** 0.11 (approximately one-tenth as massive as the Earth); (5.9742 x (10 e24 (10 to the 24<sup>th</sup> power)) kilograms = 1 Earth Mass).

**Density:** 3.9 times that of water (global density).

**Period of Rotation on its own axis:** 24 hours, 37.4 minutes.

**Axis tilt:** 25.19 degrees.

**Satellites (moons):** two (Phobos and Deimos).

**Special Notes About Mars:** Mars is the nearest superior (outside of Earth’s orbit) planet to the Earth. Some of Mars’ physical characteristics (such as period of rotation and axis tilt), make it similar to Earth in some respects. Mars has an orange-red surface, and white polar ice caps that expand and contract with the Martian change of seasons. The Martian surface has what are known as “maria” (seas); the maria have been shown to be areas of darker bedrock, upon which Martian winds deposit varying amounts of lighter-colored dust; this contributes to some of the changing faces of Mars that are observable through telescopes. Not very long ago, many people (including famous scientists such as Percival Lowell) thought that Mars had “canals” that were constructed instead of natural (which contributed to the myth of actual “Martians” who built them as “irrigation ditches”). Visiting spacecraft however, have never found evidence of any such canal construction.

The Martian atmosphere has a surface pressure of about 7 millibars, much less than that of the Earth (average sea level atmospheric pressure for Earth is 1013.25 millibars). The atmosphere of Mars extends out to include an ionosphere located at between 100 and 300 kilometers. Daytime temperatures seldom exceed zero degrees Celsius on most of the planet, and most areas experience minimum temperatures as low as minus 140 degrees Celsius before sunrise. Viking spacecraft tests in 1976 showed the Martian atmosphere to be mainly carbon dioxide (about 95%), with smaller percentages of nitrogen, argon, oxygen, water vapor, carbon monoxide, krypton, and xenon. This water vapor sometimes freezes to form ice crystal clouds or fog in lower-lying areas. Global dust storms on the planet are not unusual, but apparently do not manifest themselves every year. Mars has no radiation belts, and has only a weak magnetic field. This latter fact suggest that Mars lacks a molten nickel-iron core such as that present in the Earth. Impact craters dominate Mars’ southern regions, but are less prevalent over the younger, more volcanic northern regions of the planet.

Two very famous surface features of Mars should be mentioned. **Valles Marineris** is a vast equatorial canyon system, which measures 4500 kilometers from east to west, and 150 to 700 kilometers from north to south. Some canyons within this system can be up to 200 kilometers wide and 7 kilometers deep (Arizona’s Grand Canyon is only 28 kilometers wide and 2 kilometers deep by comparison!). These canyons appear to result from faults in, and collapse of, the Martian surface. The Tharsis Ridge and Elysium Planitia are the two main areas of Martian volcanic activity, but **Olympus Mons**, lying to the NW of the Tharsis Ridge, is the largest volcano on Mars, and is possibly the largest in the solar system. Its base is over 600 kilometers across, and it rises to a caldera that is 90 kilometers across, at a height of 28 kilometers above the surrounding plains. The volcanoes on Mars are shield-type volcanoes, (such as those found in Hawaii), and have long gently-sloping sides.

Many probes (from the U.S. and the former Soviet Union) down through the years have explored Mars. Some of the more famous ones (successful or failed) include Mars Observer, Viking 1 and 2, several of the Mariner probes, Mars Pathfinder, and the Mars Global Surveyor.

#### ASTRONOMY FUN FACTS

★★ A part of the Sun’s radiation continues to shine on the earth at night, even when the Sun is on the other side of the planet. Neutrinos, which are produced deep in the Sun’s core from

nuclear reactions, can travel through anything without being impeded, including the earth itself; that is, they can shine 'up' at us during the night!!

★★ How hot is the Sun's core? Hot enough that a cube of this core, one mile on each side, (and if placed on the Earth), has enough heat and energy to melt the Earth's polar ice-caps, and then boil all the water of the oceans, lakes, and rivers on the Earth!!!

★★ If the Sun had originally been composed of predominantly oxygen and carbon, (instead of hydrogen and helium to form the nuclear reactions which give us the heat and light for warmth, comfort, and plant growth), there would not be people on this planet, let alone an Astronomy newsletter for them to read on a rainy October day!! \*\* The interstellar dust in our Galaxy alone is equivalent to the mass of over 450 trillion planet Earths!!

★★ More interstellar dust grains can fit into about 12 cubic inches than there are stars in the entire Milky Way Galaxy (i.e., far more than 100 billion dust grains!).

★★ The central regions of the Milky Way Galaxy are obscured from visual astronomers by almost 30,000 light-years' worth of interposing gas and dust. If one were to optically view the center of the Galaxy, it would be similar to viewing the Sun through clouds so dense that any sunlight which is able to penetrate would only give off 1,000<sup>th</sup> as much light as the full Moon. Looking at this another way, the light reduction would be similar to the attenuation effect that several thousand feet of ocean water would have on the Sun's light!

★★ Sirius B (a companion of the brightest star in all the sky after the Sun: Sirius) is the first white dwarf to be discovered, and lies at a distance from Earth of about 9 light-years. Even though smaller than Earth, all its matter weighs almost as much as the Sun...as a matter of fact, just a handful of its matter would weigh about 500 tons!

#### 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 is first defined below, and then a representative object from each hemisphere is described. [**"MIRROR" IMAGES" is strictly the name of this column, and is not intended to imply that there is optical mirror symmetry between the two representative objects.**]

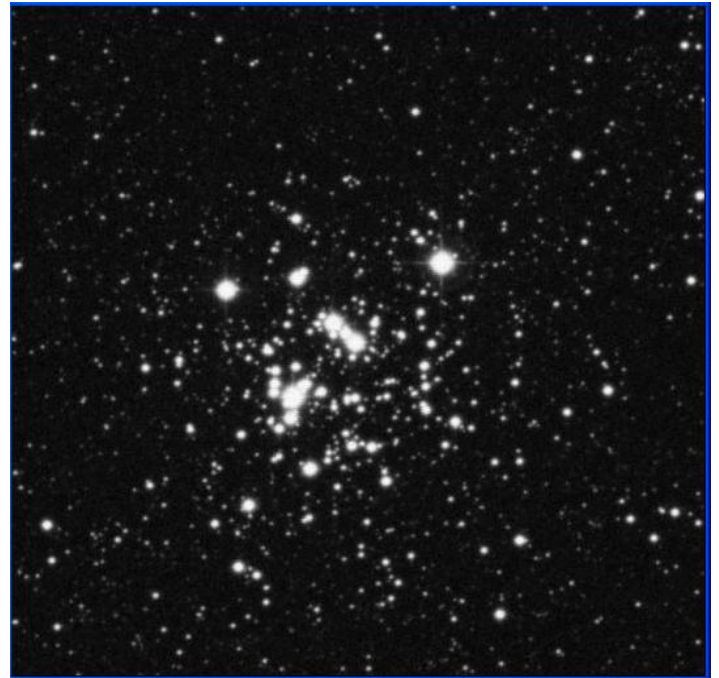
**CLASS OF OBJECT: OPEN CLUSTER:** A loose grouping or cluster of stars that may contain as many as a few thousand, or as little as twenty, stars. Approximately 1200 such clusters are known, and are composed of population I stars (young and metal-rich); these clusters occur in or relatively close to the plane of the Milky Way galaxy. The brightest stars in these systems can be either red or blue giants, depending on the cluster's age. Being more loosely bound than globular clusters, they tend to disperse over time (millions of years mind you) from the effects of differential rotation about the galaxy, and disturbances due to close encounters with clouds in the interstellar medium. Most open clusters are young systems, with their component stars being younger than our own sun (younger than approximately 4.6 billion years old); the youngest clusters are frequently still the sites of active star formation.

**REPRESENTATIVE NORTHERN HEMISPHERE OBJECT:** The Pleiades (M45; NGC1432; Subaru): This very famous, and relatively young, open cluster is about 120 parsecs away, and is

located in the constellation Taurus. It contains about 3,000 stars, but only six are visible to the naked eye. These blue-white, very luminous stars are Alcyone, Maia, Atlas, Electra, Merope, and Taygeta. Surrounding gas and dust (around these brighter stars) produces a dim reflection nebula. The total magnitude of the Pleiades is 1.2, and the cluster is about 110 arc minutes in size.



**REPRESENTATIVE SOUTHERN HEMISPHERE OBJECT:** The Jewel Box (NGC 4755): Also very famous, and very young (about 10 million years old), this is a brilliantly colored open cluster in the constellation of Crux (the Southern Cross). It contains about 100 stars of various colors (hence its name); the brightest one is 6<sup>th</sup> magnitude Kappa Crucis, which is a blue supergiant. The Jewel Box is about 2400 parsecs away from us. The total magnitude of the Jewel Box is 4.2, and is about 10 arc minutes in size.



#### ASTRONOMICAL NOTES -- ON & OFF THE NET...

##### MAUNA KEA'S GIANT EYES REUNITE COMET FAMILIES

When the Deep Impact mission ploughed into comet 9P/Tempel 1 on July 4th of this year, the giant telescopes on Mauna Kea had

a unique view of the massive cloud of dust, gas and ice expelled during the collision. Previous release. <http://www.gemini.edu/index.php?option=content&task=view&id=139>

A series of coordinated observations, made under ideal conditions by the world's largest collection of big telescopes, delivered surprising new insights into the ancestry and life cycles of comets. Specifically, materials beneath the comet's dusty skin reveal striking similarities between two families of comets where no relationship had been suspected. The observations also allowed scientists to determine the mass of material blasted out by the collision, which is estimated to be as much as 25 fully-loaded tractor-trailer trucks. The findings are based on the composition of rocky dust detected by both the Subaru and Gemini 8-meter telescopes, and ethane, water and carbon-based organic compounds revealed by the 10-meter WM Keck Observatory. The results from these Mauna Kea observations were made available in the September 16, 2005 issue of the journal Science highlighting results from the Deep Impact experiment.

Comet Tempel 1 was selected for the Deep Impact experiment because it circles the Sun in a stable orbit that allows its surface to be gently baked with solar radiation. As a result, the comet has an old, weathered protective layer of dust that covers the icy material beneath - much like a snowbank builds up dirt on its surface as it melts in the springtime sunlight. The Deep Impact mission was designed to dig deep beneath this crusty exterior to learn more about the true nature of the comet's underlying dust and ice components. *"This comet definitely had something to hide under its veneer of rock and ice and we were ready with the world's biggest telescopes to find out what it was,"* said Chick Woodward, part of the Gemini observing team. The combined observations show a complex mix of silicates, water and organic compounds beneath the surface of the comet. These materials are similar to what is seen in another class of comets thought to reside in a distant swarm of pristine bodies called the Oort Cloud. Oort Cloud comets are well preserved fossils in the frozen suburbs of the solar system that have changed little over the billions of years since their formation. When they are occasionally nudged gravitationally toward the Sun they warm up and release a profuse amount of gas and dust on a one-time visit to the inner solar system.

Returning comets like Tempel 1 (known as periodic comets) were believed to have formed in a colder nursery distinctly different from the birthplaces of their Oort Cloud cousins. The evidence for two distinct "family trees" lies in their vastly different orbits and apparent composition. *"Now we see that the difference may really be just superficial: only skin deep,"* said Woodward. *"Under the surface, these comets may not be so different after all."* This similarity indicates that both types of comets might have shared a birthplace in a region of the forming solar system where temperatures were warm enough to produce the materials observed. *"It is now likely that these bodies formed between the orbits of Jupiter and Neptune in a common nursery,"* said Seiji Sugita team member. *"Another question that the Mauna Kea telescopes were able to address is the amount of mass ejected when the comet was impacted by the chunk of copper about the mass of a grand piano from the Deep Impact spacecraft,"* Sugita commented. At the time of impact, the spacecraft was traveling at about 23,000 miles per hour or nearly 37,000 kilometers per hour.

Because the spacecraft was unable to study the size of the crater created after it was formed, the high-resolution Mauna Kea observations provided the necessary data to get a firm estimate

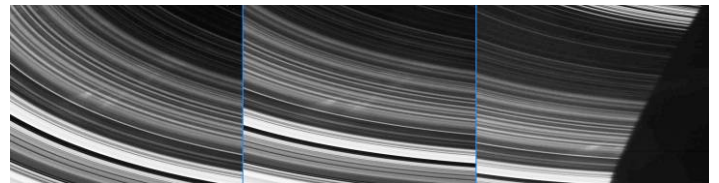
of the mass ejection which was about 1000 tons. *"To release this amount of material, the comet must have a fairly soft consistency,"* Sugita said. *"The splash from NASA's impact probe freed these materials and we were in the right place to capture them with the biggest telescopes on Earth,"* said W.M. Keck Director Fred Chaffee. *"The close collaboration among Keck, Gemini and Subaru assured that the very best science was done by the best telescopes in the world, demonstrating that the whole is often greater than the sum of its parts."*

All three of Mauna Kea's largest telescopes observed the comet in the infrared part of the spectrum which is light that can be described as "redder than red." The Deep Impact spacecraft was not designed to observe the comet in the mid-infrared (or thermal infrared) part of the spectrum, which is what Subaru and Gemini were able to do. The Keck observations used a near-infrared, high-resolution spectrograph. Large instruments of this sort would have been impossible to fit on the Deep Impact spacecraft. *"These observations give us the best glimpse yet at what's under the dusty skin of a comet,"* said David Harker who led the Gemini team. *"Within an hour of impact the comet's glow was transformed and we were able to detect a whole host of fine dusty silicates propelled by a sustained gas geyser from under the comet's protective crust. These included a large amount of olivine, similar in composition to what you would find at the beaches below Mauna Kea. This data was really a gift from Mauna Kea!"*

#### GHOSTLY 'SPOKES' IN SATURN'S RINGS SPOTTED BY CASSINI

Delighted scientists on the Cassini imaging team will be breaking out the champagne in celebration of the first Cassini sighting of spokes, the ghostly radial markings discovered in Saturn's rings by NASA's Voyager spacecraft 25 years ago.

A sequence of images taken on the un-illuminated side of the rings has captured a few faint, narrow spokes in the outer B ring, about 3,500 kilometers long and about 100 kilometers wide (2,200 miles by 60 miles). The images show the spokes as they march into the shadow of the planet on the rings due to their orbital motion.



Dr. Carolyn Porco, Cassini imaging team leader and one of the first individuals to study spokes in Voyager images, was attending the Division of Planetary Sciences meeting in Cambridge, when she was informed of the discovery by her staff members. *"This is really a joy, and very unexpected,"* she said. *"It takes me back to my early days on the Voyager mission."* New images: <http://ciclops.org>, <http://saturn.jpl.nasa.gov> & <http://www.nasa.gov/cassini>.

According to the latest ideas, the visibility of spokes is believed to depend on the elevation of the Sun above the rings, the less sunlight, the more visible the spokes. For this reason, scientists weren't expecting to see spokes until later in the mission when the sun angle is low. *"We had convinced ourselves that conditions wouldn't be right for seeing spokes on the lit side of the rings until about 2007,"* Porco said. *"But this finding seems to be telling us that conditions on the dark side of the rings are almost as good right now for seeing spokes."*

In Voyager images from 25 years ago, these narrow wedge-shaped features typically extended 10,000 to 20,000 kilometers (6,200 to 12,400 miles) radially outward across Saturn's B ring. When seen at low phase angles, spokes appeared dark; when seen at high phase angles, they appeared bright. This behavior indicated they were comprised of very small icy particles, about the size of the wavelength of light. Since Voyager days, spokes had been seen in images taken by NASA's Hubble Space Telescope. The new Cassini images were taken at very high solar phase angles, where small particles can brighten substantially, making them more visible. Porco's analysis of spokes in the early 1980s found that these narrow arrangements of small particles came and went with a period equal to that of the powerful bursts of radio waves, called Saturn Kilometric Radiation (SKR), discovered by Voyager and coming from Saturn's magnetic field. This association indicated that spokes were a phenomenon involving electromagnetic effects and partly connected to Saturn's magnetic field.

Of intense interest will be a Cassini determination of the periodicity in the appearance of spokes. This will require monitoring spoke activity from a variety of geometries over several years. "Cassini has found that the SKR period has changed since Voyager, which though hard to believe, may mean that the rotation of Saturn's interior has changed," said Porco. "That would be a finding of enormous consequence, so, we'll be looking very closely to see if the frequency of spoke activity has changed too." There is no commonly accepted theory for the creation of spokes. Some ideas suggest that spokes result from meteoroid impacts onto the rings; others suggest that they are created by instability in the magnetosphere near the rings. Whatever the cause, imaging team members will study the new spoke images and maintain their vigil for additional spoke sightings. Viewing conditions on the dayside are expected to improve toward the end of Cassini's nominal four-year mission, as Saturn continues in its nearly 30-year orbit and the Sun's angle above the rings continues to drop.

### **SOLAR MINIMUM IS LOOKING STRANGELY LIKE SOLAR MAX**

September 15, 2005: Just one week ago, on Sept. 7th, a huge sunspot rounded the sun's eastern limb. As soon as it appeared, it exploded, producing one of the brightest x-ray solar flares of the Space Age. In the days that followed, the growing spot exploded eight more times. Each powerful "X-flare" caused a shortwave radio blackout on Earth and pumped new energy into a radiation storm around our planet. The blasts hurled magnetic clouds toward Earth, and when they hit, on Sept 10th and 11th, ruby-red auroras were seen as far south as Arizona.

So this is solar minimum? Actually, solar minimum, the lowest point of the sun's 11-year activity cycle, isn't due until 2006, but forecasters expected 2005, the eve of solar minimum, to be a quiet year on the sun. It has not been quiet. 2005 began with an X-flare on New Year's Day--a sign of things to come. Since then we've experienced 4 severe geomagnetic storms and 14 more X-flares. "That's a lot of activity," says solar physicist David Hathaway of the National Space Science and Technology Center in Huntsville, Alabama. Compare 2005 to the most recent Solar Max: "In the year 2000," he recalls, "there were 3 severe geomagnetic storms and 17 X-flares." 2005 registers about the same in both categories. Solar minimum is looking strangely like Solar Max.

Scientists like Hathaway track the 11-year solar cycle by counting sunspots. When sunspot numbers peak, that's Solar Max, and when they ebb, that's solar minimum. This is supposed to work because sunspots are the main sources of solar activity:

Sunspot magnetic fields become unstable and explode. The explosion produces a flash of electromagnetic radiation--a solar flare. It can also hurl a billion-ton cloud of magnetized gas into space--a coronal mass ejection or "CME." When the CME reaches Earth, it sparks a geomagnetic storm and we see auroras. CMEs can also propel protons toward Earth, producing a radiation storm dangerous to astronauts and satellites. All these things come from sunspots. As expected, sunspot numbers have declined since 2000, yet solar activity persists. How can this be? Hathaway answers: "*The sunspots of 2005, while fewer, have done more than their share of exploding.*" Consider sunspot 798/808, the source of the Sept 7th superflare and eight lesser X-flares. All by itself, this sunspot has made Sept. 2005 the most active month on the sun since March 1991.

Weird? Much about the sun's activity cycle remains unknown, Hathaway points out. "X-ray observations of flares by NOAA's Earth-orbiting satellites began in 1975, and CMEs were discovered only a few years earlier by the 7th Orbiting Solar Observatory. Before the 1970s, our records are spotty." This means we don't know what is typical. Scientists have monitored only three complete solar cycles using satellite technology. "It's risky to draw conclusions" from such a short span of data, he says. David Hathaway, NASA / NSSTC offers a cautionary tale: Before 2005, the last solar minimum was due in 1996 and the sun, at the time, seemed to be behaving perfectly: From late-1992 until mid-1996, sunspots began to disappear and there were precisely zero X-flares during those long years. It was a time of quiet. Then, in 1996 when sunspot counts finally reached their lowest value - bang! - an X-flare erupted. "The sun can be very unpredictable," says Hathaway, which is something NASA planners must take into account when they send humans back to the Moon and on to Mars. Returning to 2005: is this year an aberration--or a normal rush to the bottom of the solar cycle? "We need to observe more solar cycles to answer that question," says Hathaway. "And because each cycle lasts 11 years, observing takes time." Meanwhile, Hathaway is waiting for 2006 when solar minimum finally arrives. Who knows what the Sun will do then?

### **ASTEROIDS CAUSED EARLY INNER SOLAR SYSTEM CATAclysm**

Scientists are convinced that evidence at last settles decades-long arguments about what objects bombarded the early inner solar system in a cataclysm 3.9 billion years ago. Ancient main belt asteroids identical in size to present-day asteroids in the Mars-Jupiter belt -- not comets -- hammered the inner rocky planets in a unique catastrophe that lasted for a blink of geologic time, anywhere from 20 million to 150 million years. However, the objects that have been battering our inner solar system after the so-called Late Heavy Bombardment ended are a distinctly different population, Robert Strom and colleagues report in the article, "The Origin of Planetary Impactors in the Inner Solar System." After the Late Heavy Bombardment or Lunar Cataclysm period ended, mostly near-Earth asteroids (NEAs) have peppered the terrestrial region. Strom has been studying the size and distribution of craters across solar system surfaces for the past 35 years. He has long suspected that two different projectile populations have been responsible for cratering inner solar system surfaces. But there's been too little data to prove it. Until now.

Now asteroid surveys conducted by Spacewatch, the Sloan Digital Sky Survey, Japan's Subaru telescope and the like have amassed fairly complete data on asteroids down to those with diameters of less than a kilometer. Suddenly it has become

possible to compare the sizes of asteroids with the sizes of projectiles that blasted craters into surfaces from Mars inward to Mercury. "When we derived the projectile sizes from the cratering record using scaling laws, the ancient and more recent projectile sizes matched the ancient and younger asteroid populations smack on," Strom said. "It's an astonishing fit." "One thing this says is that the present-day size-distribution of asteroids in the asteroid belt was established at least as far back as 4 billion years ago," planetary scientist Renu Malhotra, a co-author of the paper, said. "Another thing it says is that the mechanism that caused the Late Heavy Bombardment was a gravitational event that swept objects out of the asteroid belt regardless of size."

Malhotra discovered in previous research what this mechanism must have been. Near the end of their formation, Jupiter and the other outer gas giant planets swept up planetary debris farther out in the solar system, the Kuiper Belt region. In clearing up dust and pieces leftover from outer solar system planet formation, Jupiter, especially, lost orbital energy and moved inward closer to the sun. That migration greatly enhanced Jupiter's gravitational influence on the asteroid belt, flinging asteroids irrespective of size toward the inner solar system. Evidence that main belt asteroids pummeled the early inner solar system confirms a previously published cosmochemical analysis by planetary scientist David A. Kring and colleagues. "The size distribution of impact craters in the ancient highlands of the moon and Mars is a completely independent test of the inner solar system cataclysm and confirms our cosmochemical evidence of an asteroid source," Kring, a co-author of the paper, said.

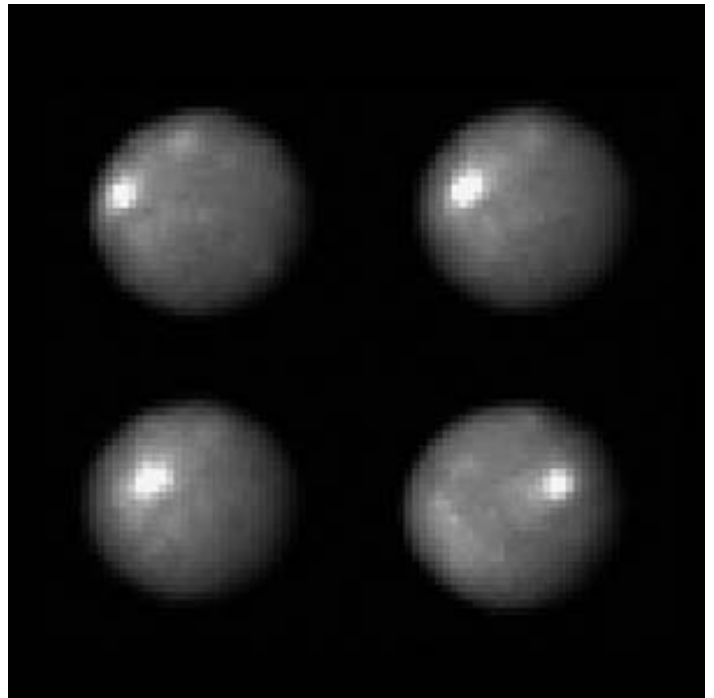
Kring was part of a team that earlier used an argon-argon dating technique in analyzing impact melt ages of lunar meteorites -- rocks ejected at random from the moon's surface and that landed on Earth after a million or so years in space. They found from the ages of the "clasts," or melted rock fragments, in the breccia meteorites that all of the moon was bombarded 3.9 billion years ago, a true global lunar cataclysm. The Apollo lunar sample analysis said that asteroids account for at least 80 percent of lunar impacts. Comets have played a relatively minor role in inner solar system impacts, Strom, Malhotra and Kring also conclude from their work. Contrary to popular belief, probably no more than 10 percent of Earth's water has come from comets, Strom said. After the Late Heavy Bombardment, terrestrial surfaces were so completely altered that no surface older than 3.9 billion years can be dated using the cratering record. Older rocks and minerals are found on the moon and Earth, but they are fragments of older surfaces that were broken up by impacts, the researchers said. Strom said that if Earth had oceans between 4.4 billion and 4 billion years ago, as other geological evidence suggests, those oceans must have been vaporized by the asteroid impacts during the cataclysm. Kring also has developed a hypothesis that suggests that the impact events during Late Heavy Bombardment generated vast subsurface hydrothermal systems that were critical to the early development of life. He estimated that the inner solar system cataclysm produced more than 20,000 craters between 10 kilometers to 1,000 kilometers in diameter on Earth.

Inner solar system cratering dynamics changed dramatically after the Late Heavy Bombardment. From then on, the impact cratering record reflects that most objects hitting inner solar system surfaces have been near-Earth asteroids, smaller asteroids from the main belt that are nudged into terrestrial-crossing orbits by a size-selective phenomenon called the Yarkovsky Effect. The effect has to do with the way asteroids unevenly absorb and re-radiate the sun's energy. Over tens of millions of years, the effect is large enough to push asteroids

smaller than 20 kilometers across into the Jovian resonances, or gaps, that deliver them to terrestrial-crossing orbits. The smaller the asteroid, the more it is influenced by the Yarkovsky Effect. Planetary geologists have tried counting craters and their size distribution to get absolute ages for surfaces on the planets and moons. "But until we knew the origin of the projectiles, there has been so much uncertainty that I thought it could lead to enormous error," Strom said. "And now I know I'm right. For example, people have based the geologic history of Mars on the heavy bombardment cratering record, and it's wrong because they're using only one cratering curve, not two." Attempts to date outer solar system bodies using the inner solar system cratering record is completely wrong, Strom said. But it should be possible to more accurately date inner solar system surfaces once researchers determine the cratering rate from the near-Earth asteroid bombardment, he added.

### LARGEST ASTEROID CERES MAY BE 'MINI PLANET' WITH WATER ICE

Observations of 1 Ceres, the largest known asteroid, have revealed that the object may be a "mini planet," and may contain large amounts of pure water ice beneath its surface. The observations by the Hubble Space Telescope also show that Ceres shares characteristics of the rocky, terrestrial planets like Earth. Ceres' shape is almost round like Earth's, suggesting that the asteroid may have a "differentiated interior," with a rocky inner core and a thin, dusty outer crust. "Ceres is an embryonic planet," said Lucy A. McFadden, a member of the team that made the observations. "Gravitational perturbations from Jupiter billions of years ago prevented Ceres from accreting more material to become a full-fledged planet."



Ceres is approximately 580 miles (930 kilometers) across, about the size of Texas. It resides with tens of thousands of other asteroids in the main asteroid belt. Located between Mars and Jupiter, the asteroid belt probably represents primitive pieces of the solar system that never managed to accumulate into a genuine planet. Ceres comprises 25 percent of the asteroid belt's total mass. However, Pluto, our solar system's smallest planet, is

14 times more massive than Ceres. Besides being the largest asteroid, Ceres also was the first to be discovered, in 1801.

The astronomers used Hubble's Advanced Camera for Surveys to study Ceres for nine hours, the time it takes the asteroid to complete a rotation. Hubble snapped 267 images of Ceres. From those snapshots, the astronomers determined that the asteroid has a nearly round body. The diameter at its equator is wider than at its poles. Computer models show that a nearly round object like Ceres has a differentiated interior, with denser material at the core and lighter minerals near the surface. All terrestrial planets have differentiated interiors. Asteroids much smaller than Ceres have not been found to have such interiors. The astronomers suspect that water ice may be buried under the asteroid's crust because the density of Ceres is less than that of the Earth's crust, and because the surface bears spectral evidence of water-bearing minerals. They estimate that if Ceres were composed of 25 percent water, it may have more water than all the fresh water on Earth. Ceres' water, unlike Earth's, would be in the form of water ice and located in the mantle, which wraps around the asteroid's solid core. Besides being the largest asteroid, Ceres also was the first asteroid to be discovered. Sicilian astronomer Father Giuseppe Piazzi spotted the object in 1801. Piazzi was looking for suspected planets in a large gap between the orbits of Mars and Jupiter. As more such objects were found in the same region, they became known as "asteroids" or "minor planets."  
<http://hubblesite.org/newscenter/newsdesk/archive/releases/2005/27/>

#### CHEMICAL PROOF FOR TWO WET SCENARIOS ON MARS

A large team, led by earth and planetary scientists details the first solid set of evidence for water having existed on Mars at the Gusev crater, exploration site of the rover Spirit. Using an array of sophisticated equipment on Spirit, Alian Wang, senior research scientist in earth and planetary sciences, and the late Larry A. Haskin, and Ralph E. Morrow, found that the volcanic rocks at Gusev crater near Spirit's landing site were much like the olivine-rich basaltic rocks on Earth, and some of them possessed a coating rich in sulfur, bromine, chlorine and hematite, or oxidized iron. The team examined three rocks and found their most compelling evidence in a rock named Mazatzal. The rock evidence indicates a scenario where water froze and melted at some point in Martian history, dissolving the sulfur, chlorine and bromine elements in the soil. The small amount of acidic fluids then react with the rocks buried in the soil and formed these highly oxidized coatings.

During its traverse from landing site to Columbia Hills, the rover Spirit dug three trenches, allowing researchers to detect relatively high levels of magnesium sulfate comprising more than 20 percent of the regolith -- soil containing pieces of small rocks -- within one of the trenches, the Boroughs trench. The tight correlation between magnesium and sulfur indicates an open hydrologic system -- these ions had been carried by water to this site and deposited.

Spirit's fellow rover Opportunity earlier had detected a history of water at another site on Mars, Meridiani planum. This study (by Haskin et al.) covered the investigation of Spirit rover sols (a sol is a Martian day) 1 through 156, with the major discoveries occurring after sol 80. After the findings were confirmed, Spirit traversed to the Columbian hills, where it found more evidence indicating water. The science team is currently planning for sol 551 operation of Spirit rover, which is only 55 meters away from the summit of Columbia Hills. Spirit was on sol 597 on Sept 6 and on the summit of Husband Hill. *"We will stay on the summit for a few weeks to finish our desired investigations, then go downhill to*

*explore the south inner basin, especially the so-called 'home-plate,' which could be a feature of older rock or a filled-in crater,"* Wang said. *"We will name a major geo-feature in the basin after Larry."* (The paper was the last one that lead author Haskin, a highly regarded NASA veteran and former chair of earth and planetary sciences at WUSTL, submitted before his death on March 24, 2005.)

*"We looked closely at the multiple layers on top of the rock Mazatzal because it had a very different geochemistry and mineralogy,"* said Wang. *"This told us that the rock had been buried in the soil and exposed and then buried again several times over the history. There are chemical changes during the burial times and those changes show that the soil had been involved with water. The telltale thing was a higher proportion of hematite in the coatings. We hadn't seen that in any previous Gusev rocks. Also, we saw very high chlorine in the coating and very high bromine levels inside the rock. The separation of the sulfur and chlorine tells us that the deposition of chlorine is affected by water."* While the multilayer coatings on rock Mazatzal indicates a temporal occurrence of low quantity water associated with freezing and melting of water, the sulfate deposition at trench sites indicates the involvement of a large body of water. *"We examined the regolith at different depths within the Big Hole and the Boroughs trenches and saw an extremely tight correlation between magnesium and sulfur, which was not observed previously,"* Wang said. *"This tells us that magnesium sulfate formed in these trench regoliths. The increasing bromine concentration and the separation of chlorine from sulfur also suggests the action of water. We don't know exactly how much water is combined with that. The fact that the magnesium sulfate is more than 20 percent of the examined regolith sample says that the magnesium and sulfur were carried by water to this area from another place, and then deposited as magnesium sulfate. A certain amount of water would be needed to accomplish that action."*

#### NEW LOOK AT MICROWAVE BACKGROUND MAY CAST DOUBTS ON BIG BANG THEORY

A new analysis of 'cool' spots in the cosmic microwave background may cast new doubts on a key piece of evidence supporting the big bang theory of how the universe was formed. Two scientists looked for, but couldn't find, evidence of gravitational "lensing" where you might expect to find it, in the most distant light source in the universe -- the cosmic microwave background. Results of this research by Dr. Richard Lieu and Dr. Jonathan Mittaz, were recently published in the "Astrophysical Journal." In the same paper, Albert Einstein's 1917 theory that at a certain "critical" density the counteracting forces of gravity and expanding space can result in a "flat" universe no matter how irregular the distribution of matter might be, is proven mathematically for the first time.

Proving Einstein right might become a problem for the standard cosmological model of how the universe was formed because Einstein's theory also predicts that the cosmic microwave background shouldn't look the way it does, according to Lieu. The problem, he says, is that cool spots in the microwave background are too uniform in size to have traveled across almost 14 billion light years from the edges of the universe to Earth. *"Einstein's theory of how gravity attracts light, coupled with the uneven distribution of matter in the near universe, says you should have a spread of sizes around the average, with some of these cool spots noticeably larger and others noticeably smaller,"* he said. *"But this dispersion of sizes is not seen in the data. When we look at them, too many cool spots are the same size."*

The cosmic microwave background is believed to be the afterglow of hot gases that filled the fledgling universe immediately following the big bang. These microwaves permeate the sky, coming to Earth from every direction in a nearly homogeneous blanket of weak radiation. Nearly homogeneous because some spots are slightly cooler than the average "temperature" of less than three Kelvin -- three degrees Celsius above absolute zero. Cosmologists have theorized that these cool regions in the microwave blanket are the birthmarks of galaxies and clusters of galaxies that condensed out of the primordial plasma a few eons after the big bang. Based on theories about disturbances in gases that existed for millennia after the big bang, cosmologists developed detailed estimates of how big these cool spots should have been when they emitted the radiation reaching us as microwaves today. These cool spots were studied in detail by the Wilkinson Microwave Anisotropy Probe (WMAP), which found that the average spot is about the size that had been forecast for a flat, smooth universe. The problem, says Lieu, is that not only is the average about right, but far too many of the spots themselves are "just right" with too little variation in sizes. Given the uneven distribution of matter in an expanding universe, he says, we should see a broader size distribution among the cool spots by the time that radiation reaches Earth.

The distribution of matter and the expanding universe are important because they have opposite effects on the "shape" of space and the paths taken by light, microwaves and other radiation as they zip through the cosmos. An expanding universe would tend to "stretch" space, causing radiation to disperse as it flies through. That dispersion would make objects appear to an observer to be smaller than they really are, as if the light went through a concave lens. "As far as we know," said Lieu, "the expansion takes place smoothly everywhere. When the universe reaches a certain age all points in space at this moment expand in the same way." Matter -- or more specifically gravity -- tends to constrain space. And because matter is distributed unevenly across the universe, so are its gravitational effects. If you have enough matter in one small place, such as a galaxy or cluster of galaxies, that super concentration of gravity can act like a convex lens, bending inward both space and any light traveling through it. When light from a distant galaxy is bent by gravity as it passes another galaxy or galaxy cluster, these distortions can appear as Einstein rings or weak lensing shear effects. If the object emitting light is like a cool spot in the microwave background, the focusing effect of galaxy clusters or groups of galaxies between those spots and Earth might make the spots appear to be larger than they really were.

A large portion of the mass in the nearby universe is concentrated in small volumes of space. These are galaxies and massive galaxy clusters, which are surrounded by vast empty voids of intergalactic space. If the standard big bang model is correct, that means the microwave radiation from some cool spots would travel through mostly empty space, would be dispersed by the expanding universe and would look small by the time that radiation reached Earth. Radiation from other cool spots, however, would pass around or near massive gravity lenses. These focused spots would appear to be larger than the average cool spot. "But you don't see this fluctuation," said Lieu. "There appear to be no lensing effects whatsoever. This lack of variation is a serious problem." In his "Cosmological Considerations of the General Theory of Relativity," Einstein theorized that the net effect of the counteracting forces of expansion and gravity should remain the same if the amount of matter in the universe stays the same. While Einstein developed this theorem based on a universe where the distribution of matter is "smooth," the mathematical work shows for the first time that the net effect on

the propagation of light doesn't change even if the universe is "clumpy." If the cool spots are too uniform to have traveled to Earth from near the beginning of time, Lieu says cosmologists are left with several alternative explanations.

The first is that the cosmological parameters (including the Hubble constant, the amount of dark matter, etc.) used to predict the original, pre-lensed sizes of the cool and hot spots in the microwave background might be wrong. These parameters could be adjusted to predict a narrower range of sizes on either side of the "pre-lensed" average. Then, after the effect of gravitational lensing is folded in, the resulting average size and size dispersion would agree with what WMAP actually saw, said Lieu. "This approach is the most conservative, but would still result in an overhaul of the standard model."

"Or, could it be that although the radiation itself is from far away, some of these cool spot structures are caused by nearby physical processes and aren't really remnants of the universe's creation?" Lieu asked. "Could they have been imprinted locally and aren't cosmological at all? Given that we find no lensing, that might be one possibility."

"Or is it possible that as light goes through the vast areas of space there is some other, unknown factor damping the effects of dispersion and focusing? There is certainly plenty of room for unknowns."

The most contentious possibility is that the background radiation itself isn't a remnant of the big bang but was created by a different process, a "local" process so close to Earth that the radiation wouldn't go near any gravitational lenses before reaching our telescopes.

Although widely accepted by astrophysicists and cosmologists as the best theory for the creation of the universe, the big bang model has come under increasingly vocal criticism from scientists concerned about inconsistencies between the theory and astronomical observations, or by concepts that have been used to "fix" the theory so it agrees with those observations. These fixes include theories which say the nascent universe expanded at speeds faster than the speed of light for an unknown period of time after the big bang; dark matter, which was used to explain how galaxies and clusters of galaxies keep from flying apart even though there seems to be too little matter to provide the gravity needed to hold them together; and dark energy, an unseen, unmeasured and unexplained force that is apparently causing the universe not only to expand, but to accelerate as it goes. In earlier research, Lieu and Mittaz found that evidence provided by WMAP point to a slightly "super critical" universe, where there is more matter (and gravity) than what the standard interpretation of the WMAP data says. This posed serious problems to the inflationary paradigm. Recent observations by the new Spitzer space telescope found "old" stars and galaxies so far away that the light we are seeing now left those stars when (according to big bang theory) the universe was between 600 million and one billion years old -- much too young to have galaxies with red giant stars that have burned off all of their hydrogen. Other observations found clusters and super clusters of galaxies at those great distances, when the universe was supposed to have been so young that there had not been enough time for those monstrous intergalactic structures to form.

### HOW TO BUILD A BIG STAR – AS BIG AS 100 SUNS

The most massive stars in our galaxy weigh as much as 100 small stars like the Sun. How do such monsters form? Do they grow rapidly by swallowing smaller protostars within crowded star-forming regions? Some astronomers thought so, but a new

discovery suggests instead that massive stars develop through the gravitational collapse of a dense core in an interstellar gas cloud via processes similar to the formation of low mass stars.

*"In the past, theorists have had trouble modeling the formation of high-mass stars and there has been an ongoing debate between the merger versus the accretion scenarios."* said astronomer Nimesh Patel. *"We've found a clear example of an accretion disk around a high-mass protostar, which supports the latter while providing important observational constraints to the theoretical models."*

Patel and his colleagues studied a young protostar 15 times more massive than the Sun, located more than 2,000 light-years away in the constellation Cepheus. They discovered a flattened disk of material orbiting the protostar. The disk contains 1 to 8 times as much gas as the Sun and extends outward for more than 30 billion miles -- eight times farther than Pluto's orbit. The existence of this disk provides clear evidence of gravitational collapse, the same gradual process that built the Sun. A disk forms when a spinning gas cloud contracts, growing denser and more compact. The angular momentum of the spinning material forces it into a disk shape. The planets in our solar system formed from such a disk 4.5 billion years ago.

Evidence in favor of high-mass accretion has been elusive since massive stars are rare and evolve quickly, making them tough to find. Patel and his colleagues solved this problem using the Submillimeter Array (SMA) telescope in Hawaii, which offers much sharper and highly sensitive imaging capabilities compared to single-dish submillimeter telescopes. SMA is currently a unique instrument that makes such studies possible by allowing astronomers to directly image the dust emission at submillimeter wavelengths and also to detect emission from highly excited molecular gas. The team detected both molecular gas and dust in a flattened structure surrounding the massive protostar HW2 within the Cepheus A star formation region. SMA data also showed a velocity shift due to rotation, supporting the interpretation that the structure is a gravitationally bound disk. Combined with radio observations showing a bipolar jet of ionized gas, a type of outflow often observed in association with low-mass protostars, these results support theoretical models of high-mass star formation via disk accretion rather than by the merging of several low-mass protostars. *"Merging low-mass protostars wouldn't form a circumstellar disk and a bipolar jet,"* said co-author Salvador Curiel. *"Even if they had circumstellar disks and outflows before the merger, those features would be destroyed during the merger."* The team plans more detailed observations using the SMA and the National Radio Astronomy Observatory's Very Large Array, which initially detected the bipolar jet.

### **FASTEST PULSAR SPEEDING OUT OF GALAXY**

A speeding, superdense neutron star somehow got a powerful "kick" that is propelling it completely out of our Milky Way Galaxy into the cold vastness of intergalactic space. Its discovery is puzzling astronomers who used the Very Long Baseline Array (VLBA) radio telescope to directly measure the fastest speed yet found in a neutron star. The neutron star is the remnant of a massive star born in the constellation Cygnus that exploded about two and a half million years ago in a titanic explosion known as a supernova. Ultra-precise VLBA measurements of its distance and motion show that it is on course to inevitably leave our Galaxy. *"We know that supernova explosions can give a kick to the resulting neutron star, but the tremendous speed of this object pushes the limits of our current understanding,"* said Shami Chatterjee. *"This discovery is very difficult for the latest models of supernova core collapse to explain,"* he added.

Chatterjee and his colleagues used the VLBA to study the pulsar B1508+55, about 7700 light-years from Earth. With the ultrasharp radio "vision" of the continent-wide VLBA, they were able to precisely measure both the distance and the speed of the pulsar, a spinning neutron star emitting powerful beams of radio waves. Plotting its motion backward pointed to a birthplace among groups of giant stars in the constellation Cygnus -- stars so massive that they inevitably explode as supernovae. *"This is the first direct measurement of a neutron star's speed that exceeds 1,000 kilometers per second,"* said Walter Brisken, an NRAO astronomer. *"Most earlier estimates of neutron-star speeds depended on educated guesses about their distances. With this one, we have a precise, direct measurement of the distance, so we can measure the speed directly,"* Brisken said. The VLBA measurements show the pulsar moving at nearly 1100 kilometers (more than 670 miles) per second -- about 150 times faster than an orbiting Space Shuttle. At this speed, it could travel from London to New York in five seconds.

In order to measure the pulsar's distance, the astronomers had to detect a "wobble" in its position caused by the Earth's motion around the Sun. That "wobble" was roughly the length of a baseball bat as seen from the Moon. Then, with the distance determined, the scientists could calculate the pulsar's speed by measuring its motion across the sky. *"The motion we measured with the VLBA was about equal to watching a home run ball in Boston's Fenway Park from a seat on the Moon,"* Chatterjee explained. *"However, the pulsar took nearly 22 months to show that much apparent motion. The VLBA is the best possible telescope for tracking such tiny apparent motions."* The star's presumed birthplace among giant stars in the constellation Cygnus lies within the plane of the Milky Way, a spiral galaxy. The new VLBA observations indicate that the neutron star now is headed away from the Milky Way's plane with enough speed to take it completely out of the Galaxy. Since the supernova explosion nearly 2 and a half million years ago, the pulsar has moved across about a third of the night sky as seen from Earth. *"We've thought for some time that supernova explosions can give a kick to the resulting neutron star, but the latest computer models of this process have not produced speeds anywhere near what we see in this object,"* Chatterjee said. *"This means that the models need to be checked, and possibly corrected, to account for our observations,"* he said. *"There also are some other processes that may be able to add to the speed produced by the supernova kick, but we'll have to investigate more thoroughly to draw any firm conclusions,"* said Wouter Vlemmings. The observations of B1508+55 were part of a larger project to use the VLBA to measure the distances and motions of numerous pulsars. *"This is the first result of this long-term project, and it's pretty exciting to have something so spectacular come this early,"* Brisken said. The VLBA observations were made at radio frequencies between 1.4 and 1.7 GHz. The VLBA is a system of ten radio-telescope antennas, each with a dish 25 meters (82 feet) in diameter and weighing 240 tons. From Mauna Kea on the Big Island of Hawaii to St. Croix in the U.S. Virgin Islands, the VLBA spans more than 5,000 miles, providing astronomers with the sharpest vision of any telescope on Earth or in space.

### **EVIDENCE SOME COMETS MAY HAVE BECOME ASTEROIDS**

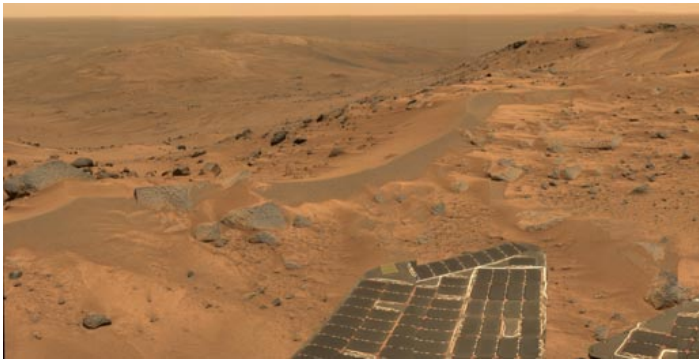
Some asteroids that have comet-like orbits may actually be comets that have lost gases and other easily vaporized substances, according to a NASA research team. *"Several objects classified as asteroids have orbits that are dynamically similar to those of comets,"* said Dale Cruikshank, a member of the team. These asteroids may be comets that have lost gases and other materials by repeated passages through the inner solar

system, according to Cruikshank. The team studied infrared light from 55 asteroids using the Spitzer Space Telescope to "better understand possible links between asteroids and comets," according to the authors. In addition to co-author Cruikshank, Joshua Emery is the principal author; and Jeffrey Van Cleve, is the other co-author.

"The suggestion that some asteroids originated as comets has been made before, but the new Spitzer Space Telescope observations provide the first chance to really test this suggestion," Emery noted. "Most of the objects observed in our program appear to be typical asteroids, but a few have surface compositions and textures that are more similar to comets," Emery added. "The infrared light we are studying gives us information about the composition and surface textures of solid bodies in the solar system." Cruikshank said. The team reports that some of the asteroids have very fine-grained surfaces. "We think this fine-graininess is a characteristic of comets," Cruikshank explained.

### SPiRiT SENDS INTRIGUING NEW IMAGES FROM MARS HILLTOP

Working atop a range of Martian hills, the Spirit rover is rewarding researchers with tempting scenes filled with evidence of past planet environments. "When the images came down and we could see horizon all the way around, that was every bit as exhilarating as getting to the top of any mountain I've climbed on Earth," said Chris Leger, a rover planner.



The summit sits 82 meters (269 feet) above the edge of the surrounding plains. It is 106 meters (348 feet) higher than the site where Spirit landed nearly 20 months ago. Spirit and twin rover, Opportunity, successfully completed their three-month prime missions in April 2004. They have inspected dozens of rocks and soil targets since then, continuing their pursuit of geological evidence about formerly wet conditions on Mars.

"Spirit has climbed to the hilltop and looked over the other side, but NASA did not do this just to say we can do it. The Mars rovers are addressing fundamental questions about Martian history and planetary environments," said Mars Exploration Program Director Doug McCuistion. The crest of "Husband Hill" offers Spirit's views of possible routes into a basin to the south with apparently layered outcrops. Shortly after Spirit landed, it observed a cluster of seven hills about 3 kilometers (2 miles) east of its landing site. NASA proposed naming the range "Columbia Hills" in tribute to the last crew of Space Shuttle Columbia. The tallest of the hills commemorates Rick Husband, Columbia's commander.

Volcanic rocks covering the plain Spirit crossed on its way to the hills bore evidence of only slight alteration by water. When Spirit reached the base of the hills five months after landing, it immediately began finding rocks with wetter histories. "This climb was motivated by science," said Steve Squyres, principal

investigator for the rovers' science instruments. "Every time Spirit has gained altitude, we've found different rock types. Also, we're doing what any field geologist would do in an area like this: climbing to a good vantage point for plotting a route," he added. Researchers are viewing possible routes south to apparently layered ledges and to a feature dubbed "home plate," which might be a plateau of older rock or a filled-in crater. The landing site and the Columbia Hills are within Gusev Crater, a bowl about 150 kilometers (95 miles) in diameter. It was selected for the Spirit mission because the shape of the terrain suggests the crater once held a lake. Volcanic deposits appear to have covered any sign of ancient lakebed geology out on the plain, but scientists say the hills expose older layers that have been lifted and tipped by a meteorite impact or other event. "We're finding abundant evidence for alteration of rocks in a water environment," said Ray Arvidson, deputy principal investigator for the rovers' science instruments. "What we want to do is figure out which layers were on top of which other layers. To do that it has been helpful to keep climbing for good views of how the layers are tilted to varying degrees. Understanding the sequence of layers is equivalent to having a deep drill core from drilling beneath the plains," he added.

Both Spirit and Opportunity have been extremely successful. Their solar panels are generating plenty of energy thanks to repeated dust-cleaning events. Spirit has driven 4,827 meters (3.00 miles), and Opportunity 5,737 meters (3.56 miles). [http://www.nasa.gov/vision/universe/solarsystem/mer\\_main.html](http://www.nasa.gov/vision/universe/solarsystem/mer_main.html)

### FIGURING OUT WHAT DRIVES JOVIAN JET STREAMS

Turbulence driven by sunlight and thunderstorm activity may explain the multiple east-west jet streams on Jupiter and Saturn and even produce strong winds extending hundreds or thousands of kilometers into the interior, far below the altitudes where the jets are driven. Scientists have been trying to understand the mechanisms that form the jet streams and control their structure since the first high-resolution images of Jupiter were returned by the Pioneer and Voyager spacecraft in the 1970s. On Earth, the jet streams -- narrow currents of air flowing from west to east in the mid-latitudes -- form a major component of our planet's global circulation, and they control much of the large-scale weather experienced by the United States and other countries outside of the tropics. Similar east-west jet streams dominate the circulation of the giant planets Jupiter, Saturn, Uranus, and Neptune, reaching up to 400 miles per hour on Jupiter and nearly 900 miles per hour on Saturn and Neptune. The question of what causes these jet streams and how deep they extend into the interior of the giant planets remain some of the most important unsolved problems in the study of planetary atmospheres. Adam Showman, Yuan Lian, and Peter Gierasch explained how cloud-layer turbulence can drive deep jets. Lian, Showman, and Gierasch performed computer simulations showing that horizontal temperature contrasts -- generated by sunlight or differences in thunderstorm activity -- can produce multiple jet streams that penetrate deep into the interior of a giant planet. In the simulations, the temperature contrasts induce deep-penetrating circulation cells that in turn drive the deep jets. The study, which uses an advanced three-dimensional computer model, is among the first that allows an assessment of how jets formed near the top of the atmosphere interact with the interior. "Most planetary scientists have assumed that jets pumped near the top of the atmosphere will remain confined to those shallow layers, and we've shown that this is not a valid assumption," Showman said. The Galileo Probe, which parachuted through Jupiter's atmosphere in 1995, was intended in part to help answer the question of how deep the jet

streams extend. The probe found strong winds extending at least 150 kilometers (almost 100 miles) below the clouds. Planetary scientists have widely interpreted this measurement as evidence that the jets are driven from deep inside Jupiter's interior. The new study challenges this interpretation. *"We still don't know whether the jets on the giant planets are driven from the top or within the deep interior,"* Showman said. *"But our study shows that the deep winds measured by the Galileo probe could just as easily result from shallow cloud-layer turbulence as from turbulence deep inside Jupiter's interior."* *"This result contradicts a long-standing assumption on the part of many planetary scientists."* The new study also shows that, under realistic conditions, the turbulence can produce not only numerous jet streams but a strong eastward flow at the equator, as observed on Jupiter and Saturn. Such flows are notoriously difficult to produce in atmospheric models, Showman noted. <http://www.lpl.arizona.edu/people/faculty/showman.html/>

### SPITZER & DEEP IMPACT BUILD RECIPE FOR COMET SOUP

When Deep Impact smashed into comet Tempel 1 on July 4, it released the ingredients of our solar system's primordial "soup." Now, astronomers using data from the Spitzer Space Telescope and Deep Impact have analyzed that soup and begun to come up with a recipe for what makes planets, comets and other bodies in our solar system. *"The Deep Impact experiment worked,"* said Dr. Carey Lisse. *"We are assembling a list of comet ingredients that will be used by other scientists for years to come."* Lisse is the team leader for Spitzer's observations of Tempel 1. Spitzer watched the Deep Impact encounter from its lofty perch in space. It trained its infrared spectrograph on comet Tempel 1, observing closely the cloud of material that was ejected when Deep Impact's probe plunged below the comet's surface. Astronomers are still studying the Spitzer data, but so far they have spotted the signatures of a handful of ingredients, essentially the meat of comet soup. These solid ingredients include many standard comet components, such as silicates, or sand. And like any good recipe, there are also surprise ingredients, such as clay and chemicals in seashells called carbonates. These compounds were unexpected because they are thought to require liquid water to form. *"How did clay and carbonates form in frozen comets?"* asked Lisse. *"We don't know, but their presence may imply that the primordial solar system was thoroughly mixed together, allowing material formed near the Sun where water is liquid, and frozen material from out by Uranus and Neptune, to be included in the same body."* Also found were chemicals never seen before in comets, such as iron-bearing compounds and aromatic hydrocarbons, found in barbecue pits and automobile exhaust on Earth. The silicates spotted by Spitzer are crystallized grains even smaller than sand, like crushed gems. One of these silicates is a mineral called olivine, found on the glimmering shores of Hawaii's Green Sands Beach. Planets, comets and asteroids were all born out of a thick soup of chemicals that surrounded our young Sun about 4.5 billion years ago. Because comets formed in the outer, chilly regions of our solar system, some of this early planetary material is still frozen inside them. Having this new grocery list of comet ingredients means theoreticians can begin testing their models of planet formation. By plugging the chemicals into their formulas, they can assess what kinds of planets come out the other end. *"Now, we can stop guessing at what's inside comets,"* said Dr. Mike A'Hearn, principal investigator for the Deep Impact mission. *"This*

*information is invaluable for piecing together how our own planets as well as other distant worlds may have formed."*

### COMET COLLISION 'ARMAGEDDON' ODDS UNLIKELY - BUT GREATER THAN WINNING A LOTTO JACKPOT

The chances of the Earth being hit by a comet from beyond Pluto - a la Armageddon - are much lower than previously thought, according to new research by an Australian astronomer. Using computer simulations and data from an American military telescope, Dr Paul Francis, at Mt Stromlo observatory, has found there are seven times fewer comets in our solar system than previously thought. *"I calculate that small comets, capable of destroying a city, only hit the Earth once every 40 million years or so,"* Dr Francis said. *"Big continent-busting comets, as shown in the movies Armageddon and Deep Impact, are rarer still, only hitting once every 150 million years or so. So I don't lose sleep over it, but you're still more likely to be killed by a comet than to win the jackpot at Lotto."* Previous estimates of the number of comets were based on the work of amateur astronomers, who for hundreds of years have been scanning the skies, looking for new comets. Previously, it was believed that these amateur astronomers were only spotting three per cent of the comets passing close to the Earth: the rest were thought to be missed because they were in the wrong part of the sky or were too faint. But Dr Francis found that the amateurs were doing better than anyone had realized - they were actually spotting 20 per cent of comets. There are therefore far fewer undiscovered comets. *"The new data allowed us to count the number of faint and far-away comets that the amateurs had missed. And we found that they were pretty rare,"* Dr Francis said. These results apply to comets coming from beyond the orbit of Pluto, which is where most comets live. The Earth is still at risk of being hit by asteroids, and by so-called short-period comets - ones that come past repeatedly, like Halley's comet. *"But asteroids and short-period comets come past again and again, so if we're clever enough we can find them all and predict which, if any, will hit the Earth,"* said Dr Francis. *"If we find one on a collision course with the Earth, we would normally have hundreds of years warning in which to do something about it, like deflecting the asteroid."* *"The comets coming from beyond Pluto, so called long-period comets, are nastier, as they are totally unpredictable, and if we see one on a collision course we'd have at best one or two years warning - not long enough to do anything."*

Dr Francis' research was based on computer simulations, published data from the Lincoln Near Earth Asteroid Research Project at White Sands Missile Range in New Mexico, and on data from amateur astronomers around the world. Background material - <http://www.mso.anu.edu.au/~pfrancis/comets/>

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

### **In September's Stargazer:**

- \*\*\*\* **OBSERVER'S INFORMATION**
- \*\*\*\* **ASTRO CALENDAR**
- \*\*\*\* **CONSTELLATIONS OF THE MONTH:**
- \*\*\*\* **ASTRONOMY FUN FACTS**
- \*\*\*\* **YOUNG ASTRONOMER'S CORNER**
- \*\*\*\* **ASTRONOMY AND TELESCOPE LINGO**
- \*\*\*\* **MAUNA KEA'S GIANT EYES REUNITE COMET FAMILIES**
- \*\*\*\* **GHOSTLY 'SPOKES' IN SATURN'S RINGS SPOTTED BY CASSINI**
- \*\*\*\* **SOLAR MINIMUM IS LOOKING STRANGELY LIKE SOLAR MAX**
- \*\*\*\* **ASTEROIDS CAUSED EARLY INNER SOLAR SYSTEM CATAclysm**
- \*\*\*\* **LARGEST ASTEROID CERES MAY BE 'MINI PLANET' WITH WATER ICE**
- \*\*\*\* **CHEMICAL PROOF FOR TWO WET SCENARIOS ON MARS**
- \*\*\*\* **NEW LOOK AT MICROWAVE BACKGROUND MAY CAST DOUBTS ON BIG BANG THEORY**
- \*\*\*\* **HOW TO BUILD A BIG STAR – AS BIG AS 100 SUNS**
- \*\*\*\* **FASTEST PULSAR SPEEDING OUT OF GALAXY**
- \*\*\*\* **EVIDENCE SOME COMETS MAY HAVE BECOME ASTEROIDS**
- \*\*\*\* **SPIRIT SENDS INTRIGUING NEW IMAGES FROM MARS HILLTOP**
- \*\*\*\* **FIGURING OUT WHAT DRIVES JOVIAN JET STREAMS**
- \*\*\*\* **SPITZER & DEEP IMPACT BUILD RECIPE FOR COMET SOUP**
- \*\*\*\* **COMET COLLISION 'ARMAGEDDON' ODDS UNLIKELY – BUT BETTER THAN LOTTO**

<p><b>The next EAS Meeting is 3:00 P.M. SATURDAY, September 24<sup>th</sup>  at the Everett Public Library Auditorium.</b></p>
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