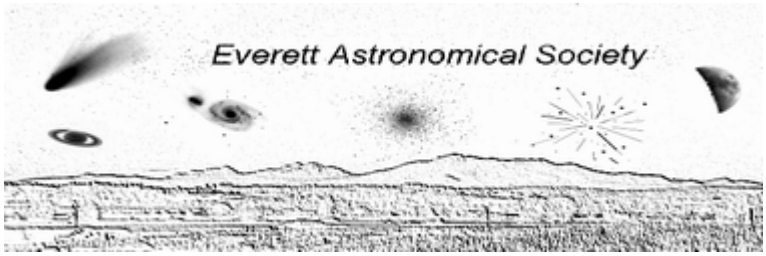
Volume MMIV. No. 8




# The Stargazer

August 2004


| | | | |
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## EAS BUSINESS…

### RECAP OF JULY MEETING

**Bill Cook from Captain's Nautical, came to speak on 'The History of the Telescope'.**

### NEXT EAS MEETING - SATURDAY AUGUST 28TH 7:00 PM - PROVIDENCE PACIFIC CLINIC (916 PACIFIC AVENUE) IN THE MONTE CRISTO ROOMS ON THE MAIN FLOOR.

***Aug 28th – EAS Meeting –*** *Dr. Julie Lutz, UW Astronomy –* ***"Solar Cookies and Comets on a Stick"*** *– 7:00 PM*

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

**Scheduled Meeting Dates:**

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

### MEMBER NEWS

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

### CLUB STAR PARTY INFO

**Upcoming star party schedule:**

Sep 17-19th – OAS Sun Lakes Camp Delaney Star Party (see registration form)
Sep 16-18th – 10th Annual Orion Nebula Star Party (at Table Mt.) is going to be big this year, with door prizes from JMI, Kendrick, Tele Vue, Orion and Hardin Optical, so far, as well as from Jim Bielaga. A Hardin 6" f/8 telescope will be a major doorprize this year. Work is underway on hand painted Orion Nebula t-shirts that glow in the dark. Jim is also working on an observing list, talks, and scale model of the planets. More info at http://seattleastro.org/orionnebsp.html

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

### FINANCIAL HEALTH

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

### CLUB SCOPES' STATUS

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

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

## ASTRO CALENDAR

**August 2004**
Aug 01 - Alpha Capricornids Meteor Shower Peak
Aug 06 - Southern Iota Aquarids Meteor Shower Peak
Aug 06 - Neptune At Opposition
Aug 12 - Perseids Meteor Shower Peak
Aug 25 - Northern Iota Aquarids Meteor Shower Peak
Aug 27 - Uranus At Opposition
**Aug 28 - EAS Meeting – Dr. Julie Lutz from UW Astronomy**
Aug 31 - Venus Passes 1.9 Degrees From Saturn
Aug 31 - Start of Mars Solar Conjunction

**September 2004**
Sep 22 - Autumnal Equinox, 16:30 UT
**Sep 25 - EAS Meeting – 7:00 PM – Greg Donahue – Celestial North**
Sep 27 - Mars Passes 0.2 Degrees From Jupiter
Sep 29 - Mercury Passes 0.6 Degrees From Jupiter
Sep 29 - Mercury Passes 0.8 Degrees From Mars

**October 2004**
Oct 09 - Draconids Meteor Shower Peak
Oct 13 - Moon Occults Mars
Oct 14 - Moon Occults Mercury
Oct 21 - Orionid Meteor Shower Peak

Oct 28 - Lunar Eclipse visible from entire US !
**Oct 30 - EAS Meeting – 7:00 PM**
Oct 31 - Daylight Saving - Set Clock Back 1 Hour

## OVER THE AIRWAVES

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

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

## EAS LIBRARY – BOOK & VIDEO LIST

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

## MEMBERSHIP BENEFITS & INFORMATION

Membership in the **Everett Astronomical Society** (EAS) will give you access to all the material in the lending library. The library, which is maintained by Scott Gibson, consists of several VCR tapes, many books, magazines, and software titles. Membership includes invitations to all of the club meetings and star parties, plus the monthly newsletter, ***The Stargazer.*** In addition you will be able subscribe to ***Sky and Telescope*** for $7 off the normal subscription rate, contact the treasurer for more information. **When renewing your subscription to *Sky & Telescope* you should send your S&T renewal form along with a check made out to Everett Astronomical Society to the EAS address.** The EAS treasurer will renew your *Sky and Telescope* subscription for you. **Astronomy** magazine offers a similar opportunity to club members.

EAS is a member of the **Astronomical League** and you will receive the Astronomical League's newsletter, ***The Reflector***. Being a member also allows you the use of the club's telescopes, an award winning 10 inch Dobsonian mount reflector, built as a club project or the 60mm refractor. Contact Bob Lyons (425) 337-1510 to borrow a telescope. EAS dues are $25. Send your annual dues to the **Everett Astronomical Society**, P.O. Box 12746, Everett, WA 98206. Funds obtained from membership dues allows the Society to publish the newsletter, pay Astronomical League dues and maintain our library.

# OBSERVER'S INFORMATION…

## LUNAR FACTS

| | |
|---|---|
| Aug 16 | New Moon |
| Aug 23 | First Quarter Moon |
| Aug 30 | Full Moon |
| Sep 06 | Last Quarter Moon |
| Sep 14 | New Moon |
| Sep 21 | First Quarter Moon |
| Sep 28 | Full Moon |

**Digital Lunar Orbiter Photographic Atlas of the Moon**

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

## UP IN THE SKY -- THE PLANETS

| Object | Rises | Transits | Sets | Constellation |
|---|---|---|---|---|
| **Sun** | **6:19 am** | **13:11** | **20:02** | **Leo** |
| **Mercury** | Daylight | Daylight | Daylight | **Leo** |
| **Venus** | **2:28 am** | Daylight | Daylight | **Gemini** |
| **Mars** | Daylight | Daylight | **20:20** | **Leo** |
| **Jupiter** | Daylight | Daylight | **22:47** | **Virgo** |
| **Saturn** | **2:46 am** | Daylight | Daylight | **Gemini** |
| **Uranus** | **20:01** | **1:21 am** | **6:37 am** | **Aquarius** |
| **Neptune** | Daylight | **23:53** | **4:43 am** | **Capricornus** |
| **Pluto** | Daylight | Daylight | **1:08 am** | **Ophiuchus** |

(times local time for Everett PDT)

### NOAA SUN CALCULATOR

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

## INTERNATIONAL SPACE STATION – VISIBLE SEATTLE PASSES

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

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

## CONSTELLATIONS OF THE MONTH

**PEGASUS:** (The Winged Horse). With a midnight culmination date of September 1st, Pegasus is well-placed for late summer and Fall viewing. Pegasus borders on the constellations of Andromeda, Aquarius, Cygnus, Delphinus, Equuleus, Lacerta, Pisces, and Vulpecula, and contains the well-known asterism of The Great Square (composed of the famous stars of Markab, Scheat, Algenib, and Alpheratz), and the lesser known asterisms of The Baseball Diamond and another dipper known as The Large Dipper (as opposed to the Big Dipper of Ursa Major). Pegasus ranks 75th in overall brightness among the constellations, but 7th in size: it takes up approximately 1120.8 square degrees of the sky (2.717%). Pegasus contains two known meteor showers: the Xi Pegasids (July 9) and the Pegasids (November 12). Pegasus contains one Messier object: M-15. M-15 is the most easily found deep-sky object in Pegasus for amateur astronomers, and is a bright (7th magnitude) globular cluster. M-15 is the only known globular cluster containing a planetary nebula (almost 15th magnitude; one second of arc in diameter). M-15 is located 40,000 light-years away from Earth, and itself has a diameter of 12 minutes of arc. M-15 contains many variable stars, and is one of the richest globulars with respect to variable stars, most of which are RR Lyrae stars. M-15 is a very unusual globular cluster for several reasons: in addition to the planetary nebula and the high concentration of variable stars as mentioned above, M-15 also is an intense X-ray source, leading astronomers to speculate that it contains a central black hole, which is postulated to be the cause of one of the most concentrated and bright cores of any of the globular clusters in the night sky. Pegasus is completely

visible from latitudes North of –54 degrees, and completely invisible from latitudes South of –88 degrees. It has 57 stars brighter than magnitude 5.5, and its central point is at RA=22h39m, Dec.= +19 degrees. The solar conjunction date of Pegasus is March 2nd. Pegasus contains many other interesting objects as well as M-15. A few of them are listed as follows: AG Pegasi (one of the brightest symbiotic stars, containing both a Wolf-Rayet star and an M-giant star); NGC-7331 (10th magnitude Sb-type spiral galaxy); NGC-7217 (a magnitude 10.2, Sb-type nearly face-on spiral with relatively high surface brightness); NGC-7332 (11th magnitude elliptical (E7) galaxy with a visible lens-shape); NGC-7448 (11.7 magnitude Sc spiral exhibiting a bright nucleus encircled by a irregular dim haze); NGC-7479 (11th magnitude, beautiful barred spiral); and NGC-7619 and NGC-7626 (two of the brighter members, and both ellipticals, of the Pegasus-I galaxy cluster). Perhaps the next famous deep-sky object of Pegasus after M-15 is actually a combination of five galaxies – Stephan's Quintet. The brightest member (magnitude 12.7 spiral) of the Quintet is NGC-7320; the others are all 13th magnitude galaxies: NGC-7317 (elliptical), NGC-7318-A (peculiar elliptical), NGC-7318-B (peculiar barred spiral), and NGC-7319 (peculiar barred spiral). This assemblage of galaxies all lie along the same line of sight; however, while the brightest of the five (NGC-7320) lies 13 megaparsecs away, the remaining four all lie at a distance of 90 megaparsecs!!

There are some other interesting facts about Pegasus which should not be overlooked for the amateur astronomer. The first object in the New General Catalog (NGC-1), lies within Pegasus. NGC-1 is a faint, 13th magnitude galaxy which shows minimal detail in most amateur scopes. A good test of vision and darkness for a dark-sky observing site is to count the stars within the Great Square; 30-50 stars have been reported, and the closer towards 40 or 50 stars, obviously the better the observing. Finally, the constellation of Pegasus contains a good example of what is known as a "shared star": Alpha Andromedae had been known as Delta Pegasi on some ancient maps, but was assigned to Andromeda permanently by the IAU in 1928; i.e., it was "shared" by more than one constellation before 1928. Be sure to make the wonders of Pegasus an integral part of your late Summer and Fall observing.

## YOUNG ASTRONOMER'S CORNER

**TOPIC:** ***ARE ALL THE STARS THE SAME?*** Although most stars, to the naked eye, look fairly similar in appearance if not in brightness, we will address the fact that indeed they are not. (This is a repeat, but modified, column first published in the *Stargazer* in 1998. There is often confusion regarding the fact that all stars indeed are not the same: there are many different properties of stars, such as temperature, that distinguish one from the other. As a result of this confusion, this column is worth repeating for all the new "Young Astronomers" readers.)

If you've studied any Astronomy in school, perhaps you've seen the letters ***OBAFGKM,*** all in a row and listed exactly like that. What does this mean??? Perhaps you recall that in several previous Young Astronomer's Corners we've talked about the fact the even though most stars look like white dots from earth, there ARE some that are unusual looking, even from earth. Vega and Sirius are very bright and bluish-white, while Arcturus and Betelgeuse are yellowish-orange, even to the naked eye. These are OBVIOUSLY different, even without the aid of binoculars or telescopes. What's causing this distinct difference? By looking closely at the light from these stars, such as through an instrument utilizing a slit and a prism (a spectroscope; you've probably seen the resulting "rainbow of light" when light passes through a crystal, or even through millions of raindrops, forming (you guessed it!)…….a rainbow!!), we can see that the pattern formed is a continuous spectrum of colors (the different wavelengths of light, or 'colors'), on which are superimposed darker (absorption) and brighter (emission) lines. Believe it or not, this is a tremendous amount of information (i.e., star color) that relates closely to the surface temperature of the star, and, as a result, enables astronomers to figure out many basic properties of the star itself. The traditional way to remember the letters above are "**O**h **B**e **A F**ine **G**irl (or **G**uy) **K**iss **M**e"; these letters are still used today. The colors of the stars closely relate to the surface temperatures and chemical makeup of the stars, which frequently relate to the mass and life cycle stage of the star. Red Giants, Blue Supergiants, Red Dwarfs, White Dwarfs, and various and sundry Yellow Stars all have their place in a spectroscopic chart of the stars, and the color / temperature of the star can be charted against the absolute magnitude (brightness) of the star to learn much about its stage of evolution, or where it is in its life cycle. That is, its age and relative size and temperature, and what chemicals it is composed of (different chemicals in the stars "give off" different colors upon analysis of their starlight), can be compared to other stars in the sky. On such a chart, the "O" in our saying above generally corresponds to the hotter and younger stars, while the "M" generally corresponds to older, cooler stars. Our own sun, if viewed from very far away outside our own solar system, would be an unspectacular yellow dwarf "G" star. But all things are relative, because from earth, the sun is by far the most spectacular natural object around, and we cannot live without it! So then, with respect to temperature and color, size and mass, magnitude or brightness, chemical composition or makeup, and life-stage and age, one star can be **VERY** different from another….that is, they are ***NOT*** all the same!

## PLANETARY FOCUS

**"Planetary Focus"** is published on a bi-monthly basis in the EAS "Stargazer". If you have a favorite planet that you would like information and/or statistics on, please contact newsletter co-editor Bill O'Neil. The planetary focus of this month's column is "Saturn", now an early morning object also much in the news lately because of fascinating and important Cassini probe activity.

**Rotation around the Sun:** every 29.46 years

**Orbit:** from 9.01 (closest or 'perihelion') to 10.04 (furthest or 'aphelion') Astronomical Units (AU)*; this is an orbit that varies between approximately 838 and 934 million miles from the sun. (*Note: One AU equals approximately 93 million miles).

**Inclination of Orbit to Ecliptic:** 2.5 degrees.

**Mean Orbital Velocity:** 9.65 km/sec.

**Diameter at Equator:** 120,537 kilometers (or 75,335 miles).

**Mass:** 95.16 (approximately 95 times more massive than earth); (5.9742 x (10 e24 (10 to the 24th power)) kilograms = 1 Earth Mass)**.**

**Density:** 0.7 times that of water (global density); Saturn is the only planet with an overall density less than 1 (water = 1).

**Surface Gravity (Earth = 1):** 1.08

**Period of Rotation on its own axis:** approximately 10 hours, 39 minutes.

**Axis tilt:** 26.73 degrees.

**Satellites (moons):** 18, as well as the most famous of all planetary rings.

***Special Notes About Saturn:*** Saturn is the second largest planet in the solar system. It has a polar diameter of 107,500

kilometers, and, as such, has the highest oblateness of any planet: 0.108. (Oblateness is the "elliptical" nature or "flattening" of a celestial body; i.e., the degree to which that body differs from a true sphere). The appearance of Saturn in a telescope is dominated by its ring system that lies in the plane of Saturn's equator; the axis of Saturn is tilted by approximately 27 degrees with respect to the plane of its orbit. This phenomenon leads to opposite ring faces being tilted toward the sun and Earth by up to 27 degrees. Approximately every 15 years, the rings of Saturn (which are at most only about 2 kilometers thick!) become "edge-on" to Earth observers and virtually disappear. The ring system, which is about 270,000 kilometers across, adds to the average apparent magnitude (approximately 0.7) of Saturn at opposition. We will talk more about the ring system below.

Saturn's disk appears similar to that of Jupiter, as it too is crossed by yellowish dark (belts) and light (zones) cloud bands which run parallel to the equator. These bands are not as striking as those of Jupiter, although they too contain anticyclonic (counterclockwise-rotating) "spots" or "weather systems", (although they are less common and generally less dramatic (e.g., compared to Jupiter's Great Red Spot). Like Jupiter however, these spots are probably caused by different rotation speeds of the planet between the equator and the poles. Saturn in the past has been studied by the Pioneer 11 and Voyager probes; the Cassini probe is on its way. (Note: The Cassini probe was launched in late 1997, and is scheduled to arrive at Saturn in July of 2004, at which time it will begin a four-year exploration of Saturn and its moons. However, along the way, the probe has been engaged in some imaging studies. For example, on February 11, 2000, the Jet Propulsion Laboratory in California released images of the asteroid named Masursky, which Cassini snapped on January 23, 2000, on its way through the asteroid belt between Mars and Jupiter. It will fly by Jupiter this coming December. Asteroid Masursky has not been extensively studied from Earth, and Cassini's information could shed light on several parameters, including the asteroid's size and rotation period.). The early probes helped to determine that Saturn, like Jupiter, most likely has an internal heat source that helps drive its convection-weather systems; Saturn also, like Jupiter, emits more radiation than it absorbs from the Sun. These convective weather systems give rise to the cloud banks that are observed and most likely composed of ammonia crystals; the weather systems are also, like Jupiter, somewhat dependent on the zones they are located in (i.e., equator winds are comparatively stronger). Further studies show that the bulk of Saturn's mass and atmosphere is more than likely hydrogen, with methane and ethane present in the upper atmosphere. Internal composition models for Saturn indicate an iron-rich rock core, surrounded by ammonia, methane and water, which is further surrounded by liquid metallic hydrogen and then liquid molecular hydrogen, and finally the atmosphere as described above. Saturn has a magnetic field that is approximately 20 times weaker than that of Jupiter. Pioneer also found radiation belts (composed of electrons and protons). These energetic particles interact in the magnetic field and contribute to the emission of radio waves from Saturn; they also interact with the ring system, contributing to the brightness and "spoking" pattern seen especially in one of the rings (ring B); lightning discharges have also been noted in this region of the ring system.

The most famous part of Saturn to most folks is indeed its ring system. They were first seen (but not clearly) by Galileo in 1610, and recognized as a true ring system later by Huygens in 1656. The rings are now known to be composed of literally thousands of smaller "ringlets" containing innumerable individual particles: all of these particles (maximum size is probably just a few meters in size; most are much smaller) are actually each an individual satellite of Saturn!! There are several distinct ring separations (divisions or gaps), creating distinctly appearing larger rings. These larger rings have been named (for example, the D-ring is closest to the planet itself, and may even interact with the upper atmosphere of Saturn). Other rings (heading outward from the planet) are the, C-ring (the "Crepe" ring, with a large number of distinct ringlets within its grooved confines), and the B-ring (see above), and then the A, F, G, and E-rings. There are significant gaps between several of these larger, more distinct rings. The most noticeable and well known of these gaps is also the largest (4,200 kilometers), and has been named the Cassini Division; with appropriate optical aid, it, and the larger rings, are easily visible from Earth by amateur astronomers. It is theorized that the Cassini Division, which separates the B and A rings, was probably formed from the disturbances from the orbit of one of Saturn's moons (Mimas), as well as the effect of the energetic particles in ring-B (see above).

Briefly, some of Saturn's moons are interesting in their own right. In addition to **Mimas** as mentioned above, at least two other moons bear mention: **Titan and Tethys**. **Titan** is the second largest moon in the entire solar system at 5,150 kilometers (Earth's moon = 3,476 kilometers), and it appears reddish-orange in color. Its atmosphere is mostly nitrogen, with traces of other molecules such as methane and hydrogen cyanide; it has enough of an atmosphere with the right gases to be warmed by a small greenhouse effect. Atomic and molecular hydrogen formed by photochemical reactions on this moon of Saturn probably lead to the formation of the doughnut-shaped ring around this moon as these types of hydrogen easily escape from its atmosphere. The interior is probably rock and water-ice, and the surface may have some very large methane "oceans". Titan will be visited by the Huygens "sub"-probe of the Cassini mission detailed above. **Tethys** is interesting not only as the largest of the inner moons of Saturn, but also because of an unusual and enormous canyon network that extends from its north to almost its south pole; this is known as the Ithaca Chasma, and it averages 100 kilometers wide and 4-5 kilometers deep. There is also a huge crater called Odysseus, which is 400 kilometers in diameter, a diameter that is fully 40% that of this moon's entire diameter! Substantial craters noted elsewhere on this moon of Saturn, indicates that Tethys has suffered considerable bombardment by large debris in its history.

## ASTRONOMY FUN FACTS & ASTRONOMY & TELESCOPE LINGO

These two columns will be taking a summer break and will return in September. Get in some good telescoping and stargazing in these waning summer weeks!!

## "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. ***Note: "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.*** New "Mirror Images" content will appear in the November issue of this newsletter.

**CLASS OF OBJECT: ELLIPTICAL GALAXIES:** Galaxies are large aggregates of stars, gas, and dust. Unlike other types of

galaxies such as spirals, elliptical galaxies have no disc component, rather appearing in photographs only as fuzzy elliptical (which can however range from almost circular in shape to those which are more narrow) patches, or bulges, of light; these bulges decline smoothly in brightness from the center outward. Most ellipticals however are probably triaxial ellipsoids, with each of the three axes being of different length. The shape of any galaxy outline is the basis for the Hubble classification of galaxies: elliptical galaxies are denoted by the letter 'E' followed by a number from 0 to 7 (the larger the number, the more the degree of flattening or elliptical shaping). The E-0 galaxies are almost (but not perfectly) circular in shape, and the E-7 galaxies are the most elliptical, with a semimajor to semiminor axis ratio of approximately 3:1. Elliptical galaxies were originally thought to be without interstellar gas, but more recent X-ray and radio observations have demonstrated sizeable and intricate interstellar mediums, with very hot gas existing concurrently with clouds of neutral hydrogen; some ellipticals show low-level emission-line activity, and most elliptical galaxy stars are older in age, with spectral types generally of type K or M. Generally, elliptical galaxies (along with S-0 galaxies) are the most red of all the galaxies; ellipticals are also, on average, dimmer than spiral or irregular galaxies. Elliptical galaxies demonstrate the greatest variation in total mass, extending down to extreme dwarfs which are no brighter than very bright globular clusters. Of all the very brightest of galaxies, only about 20% are ellipticals; however, when dwarf galaxies are included in the total population, the percentage of ellipsoid galaxies is approximately 60%.

**REPRESENTATIVE NORTHERN HEMISPHERE OBJECT: *M-105 (NGC-3379):*** M-105 in Leo measures approximately 2.1' x 2.0' across, and shines at magnitude 10.6. M-105 has a relatively high surface brightness, but detail is lacking in telescopic observations. M-105 lies approximately 139 kiloparsecs from Earth. M-105 is an E-1 elliptical, and together with the fainter galaxies of NGC-3384 and NGC-3389, forms a triangle measuring about 8' on a side between each of the three objects.

**REPRESENTATIVE SOUTHERN HEMISPHERE OBJECT: *NGC-6776:*** A galaxy within the southern constellation of Pavo (see last month's Stargazer for detailed information about Pavo), NGC-6776 is an E-2 elliptical with a magnitude of 12.8, and measures 0.7' x 0.6'. It is relatively small, appearing in backyard scopes similarly to an unresolved globular cluster. NGC-6776 has a condensed center which is noticeably brighter than the remainder of the galaxy, but otherwise offers no detail in amateur telescopes.

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

### NEW THEORY LINKS NEUTRINO'S SLIGHT MASS TO ACCELERATING UNIVERSE

Two of the biggest physics breakthroughs during the last decade are the discovery that wispy subatomic particles called neutrinos actually have a small amount of mass and the detection that the expansion of the universe is actually picking up speed. Now three University of Washington physicists are suggesting the two discoveries are integrally linked through one of the strangest features of the universe, dark energy, a linkage they say could be caused by a previously unrecognized subatomic particle they call the "acceleron." Dark energy was negligible in the early universe, but now it accounts for about 70 percent of the cosmos. Understanding the phenomenon could help to explain why someday, long in the future, the universe will expand so much that no other stars or galaxies will be visible in our night sky, and ultimately it could help scientists discern whether expansion of the universe will go on indefinitely. In this new theory, neutrinos are influenced by a new force resulting from their interactions with accelerons. Dark energy results as the universe tries to pull neutrinos apart, yielding a tension like that in stretched rubber band, said Ann Nelson, a UW physics professor. That tension fuels the expansion of the universe, she said. Neutrinos are created by the trillions in the nuclear furnaces of stars such as our sun. They stream through the universe, and billions pass through all matter, including people, every second. Besides a minuscule mass, they have no electrical charge, which means they interact very little, if at all, with the materials they pass through. But the interaction between accelerons and other matter is even weaker, Nelson said, which is why those particles have not yet been seen by sophisticated detectors. However, in the new theory, accelerons exhibit a force that can influence neutrinos, a force she believes can be detected by a variety of neutrino experiments already operating around the world. "*There are many models of dark energy, but the tests are mostly limited to cosmology, in particular measuring the rate of expansion of the universe. Because this involves observing very distant objects, it is very difficult to make such a measurement precisely*," Nelson said. "*This is the only model that gives us some meaningful way to do experiments on earth to find the force that gives rise to dark energy. We can do this using existing neutrino experiments*." The new theory is advanced in a paper by Nelson; David Kaplan, also a UW physics professor; and Neal Weiner, from UW physics. The researchers say a neutrino's mass can actually change according to the environment through which it is passing, in the same way the appearance of light changes depending on whether it's traveling through air, water or a prism. That means that neutrino detectors can come up with somewhat different findings depending on where they are and what surrounds them. But if neutrinos are a component of dark energy, that suggests the existence of a force that would reconcile anomalies among the various experiments, Nelson said. The existence of that force, made up of both neutrinos and accelerons, will continue to fuel the expansion of the universe, she said. Physicists have pursued evidence that could tell whether the universe will continue to expand indefinitely or come to an abrupt halt and collapse on itself in a so-called "big crunch." While the new theory doesn't prescribe a "big crunch," Nelson said, it does mean that at some point the expansion will stop getting faster. "*In our theory, eventually the neutrinos would get too far apart and become too massive to be influenced by the effect of dark energy any more, so the acceleration of the expansion would have to stop," she said. "The universe could continue to expand, but at an ever-decreasing rate*."

### SHARPEST IMAGE EVER OBTAINED OF A CIRCUMSTELLAR DISK REVEALS SIGNS OF YOUNG PLANETS

The sharpest image ever taken of a dust disk around another star has revealed structures in the disk which are signs of unseen planets. Dr. Michael Liu, has acquired high resolution images of the nearby star AU Microscopii (AU Mic) using the Keck II Telescope, the world's largest infrared telescope. At a distance of only 33 light years, AU Mic is the nearest star possessing a visible disk of dust. Such disks are believed to be the birthplaces of planets. "*We cannot yet directly image young planets around AU Mic, but they cannot completely hide from us either. They reveal themselves through their gravitational influence, forming patterns in the sea of dust grains orbiting the star*," said Dr. Liu. A dust disk ordinarily would appear relatively featureless and symmetric, because any disturbances would be smoothed out as the material orbits the star. However, this is not observed in the case of AU Mic. Instead, Dr. Liu has found its disk is uneven and possesses clumps. These structures arise and are maintained due to the gravitational influence of unseen planetary companions. The

clumps in AU Mic's disk lie at separations of 25 to 40 Astronomical Units away from the central star (where one Astronomical Unit is the distance from the Earth to the Sun), or about 2 to 4 billion miles. In our own solar system, this corresponds to the regions where Neptune and Pluto reside. AU Mic is a dim red star, with only half the mass and one-tenth the energy output as the Sun. Previous studies have shown that AU Mic is about 12 million years old, an epoch believed to be an active phase of planet formation. In comparison, our Sun is about 4.6 billion years old, or about 400 times older, and planet formation has long since ended. "*By studying very young stars like AU Mic, we gain insight into the planet formation process as it is occurring. As a result, we learn about the birth of our own solar system and its planets*," said Liu. The images alone cannot yet tell us what kinds of planets are present, only that the planets are massive enough to gravitationally alter the distribution of the dust. However, many structures in the AU Mic disk are observed to be elliptical (non-circular), indicating that the planetary orbits are elliptical. This is different than in our own solar system, where most planets follow circular orbits. Images of disks around nearby stars are very rare. Earlier this year, Dr. Liu and colleagues announced the discovery of the large dusty disk around AU Mic. The light from AU Mic's disk arises from small dust particles which reflect the light of the central star. The new images are 30 times sharper than the earlier ones, enabling discovery of the clumps in the inner disk of AU Mic. Dr. Liu used the Keck II Telescope located on Mauna Kea, which are the largest infrared telescopes in the world, each with a primary mirror of 10-meter (33 feet) in diameter. The telescopes are equipped with adaptive optics, a powerful technology which corrects astronomical images for the blurring caused by the Earth's turbulent atmosphere. The resulting infrared images are the sharpest ever obtained of a circumstellar disk, with an angular resolution of 1/25 of an arcsecond, about 1/500,000 the diameter of the full moon. If a person's vision were as sharp as the Keck adaptive optics system, he would be able to read a magazine that was one mile away. In the case of AU Mic, the Keck images can see features as small as 0.4 Astronomical Units, less than half the distance from the Earth to the Sun. "*It is remarkable how quickly Adaptive Optics at Keck has come from being an exotic demonstration technology to producing scientific results of unprecedented quality*," said Dr. Frederic H. Chaffee, the director of the Observatory. "*We are entering a new age of high resolution imaging in astronomy. Dr. Liu's breathtaking images of possible planets in formation around AU Mic would have been unimaginable from any telescope -- space-based or on Earth -- a few short years ago. This is an exciting time for us all*."

### SCIENTISTS DISCOVER GANYMEDE HAS A LUMPY INTERIOR

Scientists have discovered irregular lumps beneath the icy surface of Jupiter's largest moon, Ganymede. These irregular masses may be rock formations, supported by Ganymede's icy shell for billions of years. This discovery comes nearly a year after the orchestrated demise of NASA's Galileo spacecraft into Jupiter's atmosphere and more than seven years after the data were collected. The findings have caused scientists to rethink what the interior of Ganymede might contain. The reported bulges reside in the interior, and there are no visible surface features associated with them. This tells scientists that the ice is probably strong enough, at least near the surface, to support these possible rock masses from sinking to the bottom of the ice for billions of years. But this anomaly could also be caused by piles of rock at the bottom of the ice. "*The anomalies could be large concentrations of rock at or underneath the ice surface. They could also be in a layer of mixed ice and rock below the surface with variations in the amount of rock*," said Dr. John Anderson, lead author. "*If there is a liquid water ocean inside Ganymede's outer ice layer there might be variations in its depth with piles of rock at the ocean bottom. There could be topographic variations in a hidden rocky surface underlying a deep outer icy shell. There are many possibilities, and we need to do more studies*." Dr. Gerald Schubert, co-author, said "*Although we don't yet have anything definitive about the depth at this point, we did not expect Ganymede's ice shell to be strong enough to support these lumpy mass concentrations. Thus, we expect that the irregularities would be close to the surface where the ice is coldest and strongest, or at the bottom of the thick ice shell resting on the underlying rock. It would really be a surprise if these masses were deep and in the middle of the ice shell*." Ganymede has three main layers. A sphere of metallic iron at the center (the core), a spherical shell of rock (mantle) surrounding the core, and a spherical shell of mostly ice surrounding the rock shell and the core. The ice shell on the outside is very thick, maybe 800 kilometers (497 miles) thick. The surface is the very top of the ice shell. Though it is mostly ice, the ice shell might contain some rock mixed in. Scientists believe there must be a fair amount of rock in the ice near the surface. Variations in this amount of rock may be the source of these possible rock formations. Scientists stumbled on the results by studying Doppler measurements of Ganymede's gravity field during Galileo's second flyby of the moon in 1996. Scientists were measuring the effect of the moon's gravity on the spacecraft as it flew by. They found unexpected variations. "*Believe it or not, it took us this long to straighten out the anomaly question, mostly because we were analyzing all 31 close flybys for all four of Jupiter's large moons," said Anderson. "In the end, we concluded that there is only one flyby, the second flyby of Ganymede, where mass anomalies are evident*." Scientists have seen mass concentration anomalies on one other moon before, Earth's, during the first lunar orbiter missions in the 1960s. The lunar mass concentrations during the Apollo moon mission era were due to lava in flat basins. However, scientists cannot draw any similarities between these mass concentrations and what they see at Ganymede. "*The fact that these mass anomalies can be detected with just flybys is significant for future missions*," said Dr. Torrence Johnson. "*With this type of information you could make detailed gravity and altitude maps that allow us to actually map structures within the ice crust or on the rocky surface. Knowing more about the interior of Ganymede raises the level of importance of looking for gravity anomalies around Jupiter's moons and gives us something to look for. This might be something NASA's proposed Jupiter Icy Moons Orbiter Mission could probe into deeper*."

### GLOBULARS MAY BE LEFTOVERS OF SNACKING GALAXIES

Globular star clusters are like spherical cathedrals of light -- collections of millions of stars lumped into a space only a few dozen light-years across. If the Earth resided within a globular cluster, our night sky would be alight with thousands of stars more brilliant than Sirius. Our own Milky Way Galaxy currently holds about 200 globular clusters, but once possessed many more. According to the hierarchical theory of galaxy formation, galaxies have grown larger over time by consuming smaller dwarf galaxies and star clusters. And sometimes, it seems that the unfortunate prey is not swallowed whole but instead is munched like a peach, stripped of its outer layers to leave behind only the pit. New research by Paul Martini and Luis Ho shows that some globular clusters may be remnants of dwarf galaxies that were stripped of their outer stars, leaving only the galaxy's nucleus behind. Their findings hint at an important yet puzzling connection between the largest globular clusters and the smallest dwarf galaxies. "*Star clusters and galaxies are quite different*

*from a structural standpoint -- star clusters are much more centrally concentrated, for example -- and so the mechanisms that form them must be quite different. Identification of star clusters in the same mass range as galaxies is a very important step toward understanding how both types of objects form*," says Martini. For their investigation, the team studied 14 globular clusters in the large elliptical galaxy Centaurus A (NGC 5128) using the 6.5-meter-diameter Magellan Clay telescope at Carnegie's Las Campanas Observatory, Chile. The clusters were selected for their brightness, and since brighter clusters tend to contain more stars and more mass, were expected to be massive. Yet their results surprised even Martini and Ho, showing that the globular clusters of Centaurus A are much more massive than most globulars in the Local Group of galaxies (which includes the Milky Way and the Andromeda Galaxy). "*The essence of our findings is that these 14 globulars are 10 times more massive than the smaller globulars in our neighborhood, and whatever process makes them can produce some really huge objects - they begin to overlap with the smallest galaxies*," says Martini. Martini also points out the recent discovery of a suspected intermediate-mass black hole in the Andromeda Galaxy globular cluster known as 'G1', which offers further evidence linking globular clusters to dwarf galaxies. The presence of a moderate-sized black hole is more understandable if it once occupied the center of a dwarf galaxy -- a galaxy that lost its outer stars to the pull of Andromeda, leaving it only a shadow of its former self. Ho, a co-discoverer of the intermediate-mass black hole in G1, adds, "One of the most surprising findings is that the black hole in G1 *obeys the same tight correlation between black hole mass and host galaxy mass that has been well established for supermassive black holes in the centers of big galaxies. This puzzling result is more understandable if G1 was once the nucleus of a larger galaxy. A very interesting question is whether some of the massive clusters in Centaurus A also contain central black holes*." Although most of our Galaxy's globular clusters are much smaller than those of Centaurus A, the largest Milky Way globulars (such as the omega Centauri star cluster) rival those of the elliptical galaxy. The similarities between massive globulars in both galaxies may point to similar formation mechanisms. Future studies of these most massive globular clusters will explore connections between the formation processes for star clusters and galaxies. Centaurus A is located approximately 12.5 million light-years away. It is about 65,000 light-years across and is more massive than the Milky Way and Andromeda galaxies put together. Centaurus A possesses a total of about 2000 globular clusters -- more than all of the galaxies in the Local Group combined. Recent Spitzer Space Telescope observations of Centaurus A uncovered evidence that it merged with a spiral galaxy about 200 million years ago. http://www.cfa.harvard.edu/press/pr0426image.html

### How Old is the Milky Way ?
### When Did the First Stars in Our Galaxy Ignite?

A proper understanding of the formation and evolution of the Milky Way system is crucial for our knowledge of the Universe. Nevertheless, the related observations are among the most difficult ones, even with the most powerful telescopes available, as they involve a detailed study of old, remote and mostly faint celestial objects. Globular clusters and the ages of stars - Modern astrophysics is capable of measuring the ages of certain stars, that is the time elapsed since they were formed by condensation in huge interstellar clouds of gas and dust. Some stars are very "young" in astronomical terms, just a few million years old like those in the nearby Orion Nebula. The Sun and its planetary system was formed about 4,560 million years ago, but many other stars formed much earlier. Some of the oldest stars in the Milky Way are found in large stellar clusters, in particular in "globular clusters", so called because of their spheroidal shape. Stars belonging to a globular cluster were born together, from the same cloud and at the same time. Since stars of different masses evolve at different rates, it is possible to measure the age of globular clusters with a reasonably good accuracy. The oldest ones are found to be more than 13,000 million years old. Still, those cluster stars were not the first stars to be formed in the Milky Way. We know this, because they contain small amounts of certain chemical elements which must have been synthesized in an earlier generation of massive stars that exploded as supernovae after a short and energetic life. The processed material was deposited in the clouds from which the next generations of stars were made. Despite intensive searches, it has until now not been possible to find less massive stars of this first generation that might still be shining today. Hence, we do not know when these first stars were formed. For the time being, we can only say that the Milky Way must be older than the oldest globular cluster stars. But how much older? What astrophysicists would like to have is therefore a method to measure the time interval between the formation of the first stars in the Milky Way (of which many quickly became supernovae) and the moment when the stars in a globular cluster of known age were formed. The sum of this time interval and the age of those stars would then be the age of the Milky Way. New observations with the VLT at ESO's Paranal Observatory have now produced a breakthrough in this direction. The magic element is "Beryllium"! Beryllium is one of the lightest elements -- the nucleus of the most common and stable isotope (Beryllium-9) consists of four protons and five neutrons. Only hydrogen, helium and lithium are lighter. But while those three were produced during the Big Bang, and while most of the heavier elements were produced later in the interior of stars, Beryllium-9 can only be produced by "cosmic spallation". That is, by fragmentation of fast-moving heavier nuclei -- originating in the mentioned supernovae explosions and referred to as energetic "galactic cosmic rays" -- when they collide with light nuclei (mostly protons and alpha particles, i.e. hydrogen and helium nuclei) in the interstellar medium. The galactic cosmic rays traveled all over the early Milky Way, guided by the cosmic magnetic field. The resulting production of Beryllium was quite uniform within the galaxy. The amount of Beryllium increased with time and this is why it might act as a "cosmic clock". The longer the time that passed between the formation of the first stars (or, more correctly, their quick demise in supernovae explosions) and the formation of the globular cluster stars, the higher was the Beryllium content in the interstellar medium from which they were formed. Thus, assuming that this Beryllium is preserved in the stellar atmosphere, the more Beryllium is found in such a star, the longer is the time interval between the formation of the first stars and of this star. The Beryllium may therefore provide us with unique and crucial information about the duration of the early stages of the Milky Way. So far, so good. The theoretical foundations for this dating method were developed during the past three decades and all what is needed is then to measure the Beryllium content in some globular cluster stars. But this is not as simple as it sounds! The main problem is that Beryllium is destroyed at temperatures above a few million degrees. When a star evolves towards the luminous giant phase, violent motion (convection) sets in, the gas in the upper stellar atmosphere gets into contact with the hot interior gas in which all Beryllium has been destroyed and the initial Beryllium content in the stellar atmosphere is thus significantly diluted. To use the Beryllium clock, it is therefore necessary to measure the content of this element in less massive, less evolved stars in the globular cluster. And these so-called "turn-off (TO) stars" are intrinsically faint. In fact, the technical

problem to overcome is three-fold: First, all globular clusters are quite far away and as the stars to be measured are intrinsically faint, they appear quite faint in the sky. Even in NGC-6397, the second closest globular cluster, the TO stars have a visual magnitude of ~16, or 10000 times fainter than the faintest star visible to the unaided eye. Secondly, there are only two Beryllium signatures (spectral lines) visible in the stellar spectrum and as these old stars do contain comparatively little Beryllium, those lines are very weak, especially when compared to neighboring spectral lines from other elements. And third, the two Beryllium lines are situated in a little explored spectral region at wavelength 313 nm, i.e., in the ultraviolet part of the spectrum that is strongly affected by absorption in the terrestrial atmosphere near the cut-off at 300 nm, below which observations from the ground are no longer possible. It is thus no wonder that such observations had never been made before, the technical difficulties were simply unsurmountable.

### GAMMA-RAY BURST DECEMBER 3 WAS NEW TYPE EXPLOSION

Astronomers have identified a new class of cosmic explosions that are more powerful than supernovae but considerably weaker than most gamma-ray bursts. The discovery strongly suggests a continuum between the two previously-known classes of explosions. Astronomers have announced discovery of the explosion, which was first detected on December 3, 2003, by the European-Russian Integral satellite and then observed in detail at ground-based radio and optical observatories. The burst, known by its birthdate, GRB031203, appeared in the constellation Puppis and is about 1.6 billion light-years away. Although the burst was the closest gamma-ray burst to Earth ever studied (all the others have been several billion light-years away), researchers noticed that the explosion was extremely faint -- releasing only about one-thousandth of the gamma rays of a typical gamma-ray burst. However, the burst was also much brighter than supernovae explosions, which led to the conclusion that a new type of explosion had been found. Both supernovae and the rare but brilliant gamma-ray bursts are cosmic explosions marking the deaths of massive stars. Astronomers have long wondered what causes the seemingly dramatic differences between these events. The question of how stars die is currently a major focus of stellar research, and is particularly directed toward the energetic explosions that destroy a star in one cataclysmic event. Stars are powered by the fusion ("burning") of hydrogen in their interiors. Upon exhaustion of fuel in the interior, the core of massive stars collapse to compact objects -- typically a neutron star and occasionally a black hole. The energy released as a result of the collapse explodes the outer layers, the visible manifestation of which is a supernova. In this process, new elements are added to the inventory of matter in the universe. However, this nuclear energy may be insufficient to power the supernova explosions. One theory is that additional energy is generated from the matter falling onto the newly produced black hole. Many astronomers believe that this is what powers the luminous gamma-ray bursts. But the connection between such extreme events and the more common supernovae is not yet clear, and if they are indeed closely related, then there should be a continuum of cosmic explosions, ranging in energy from that of "ordinary" supernovae to that of gamma-ray bursts. In 1998, astronomers discovered an extremely faint gamma-ray burst, GRB 980425, coincident with a nearby luminous supernova. The supernova, SN 1998bw, also showed evidence for an underlying engine, albeit a very weak one. The question that arose was whether the event, GRB 980425/SN 1998bw, was a "freak" explosion or whether it was indicative of a larger population of low-powered cosmic explosions with characteristics in between the cosmological gamma-ray bursts and typical supernovae. "*I knew this was an exciting find because even though this was the nearest gamma-ray burst to date, the gamma-ray energy measured by Integral is one thousand times fainter than typical cosmological gamma-ray bursts*," says Sergey Sazonov, an author on the papers. The event was studied in further detail by the Chandra X-Ray Observatory and the Very Large Array radio telescope facility in New Mexico. "*I was stunned that my observations from the Very Large Array showed that this event confirmed the existence of a new class of bursts*," says graduate student Alicia Soderberg, who is the principal author of the other paper. "*It was like hitting the jackpot*." There are several exciting implications of this discovery, including the possible existence of a significant new population of low-luminosity gamma-ray bursts lurking within the nearby universe, said Shrinivas Kulkarni. "*This is an intriguing discovery*," says Kulkarni. "*I expect a treasure trove of such events to be identified by NASA's Swift mission scheduled to be launched this fall from Cape Canaveral. I am convinced that further discoveries and studies of this new class of hybrid events will forward our understanding of the death of massive stars*."

## FROM THE EDITOR'S TERMINAL

***The Stargazer*** is <u>your</u> 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.

# 13th ANNUAL FALL CAMP DELANEY STAR PARTY!

## SEPTEMBER 17TH –19TH

Come join us for the wonder of the fall sky! Enjoy gazing at the Andromeda galaxy and other awesome sights.
Challenge yourself to stay up until Orion comes up over the buttes of Dry Falls at around 2:00 AM!
We arrive at Camp Delaney on Friday, Sept 17th no earlier than 1:00 P.M.
and check out time is on Sunday, Sept 19th by 11:00 A. M. Some of the particulars are as follows:

- No alcohol.
- Pets must be on a leash at all times and are not allowed in the cafeteria or the telescope field. It is imperative that all waste be picked up and disposed of.
- Cost: $25.00 per member; $28.00 per non-member if paid before September 13th
- After September 13th, the cost goes up to $40.00 for both members and non-members.
- Space is limited so it is a first come, first serve basis.
- If you stay in the bunkhouses, please plan on sweeping them out.

**CAMP DELANEY IS A WONDERFUL STAR PARTY THAT IS SPONSORED BY THE OLYMPIC ASTRONOMICAL SOCIETY.**

**IT'S SUCCESS IS DUE TO TEAMWORK FROM ALL THOSE THAT ATTEND.**

**THIS YEAR, THERE WILL BE SIGN UP FOR DIFFERENT NEEDS DURING THE WEEKEND.**

**PLEASE MAKE 3 CHOICES FOR JOBS.**

**WE ARE IN PARTICULAR NEED FOR SUNDAY MORNING AS IT IS A PUSH TO GET CHECKED OUT BY 11:00.**

**REMEMBER TO GIVE YOUR CHOICES, OR WE WILL HAVE TO ASSIGN JOBS! WE THANK YOU IN ADVANCE FOR YOUR TEAM EFFORT.**

We are looking forward to an enjoyable weekend of clear skies and we hope to see you there.

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| Friday Dinner: | Saturday Lunch: | Sunday Breakfast: |
|---|---|---|
| Cooking____ | Set up____ | Set up____ |
| Cleanup____ | Cleanup____ | Cleanup (Kitchen)____ |
| **Saturday Breakfast:** | **Saturday Dinner:** | **Sunday Cleanup:** |
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## In August's Stargazer:



**The next EAS Meeting is 7:00 P.M. Saturday, August 28th at the Providence Pacific Clinic – 916 Pacific Avenue in Everett.**