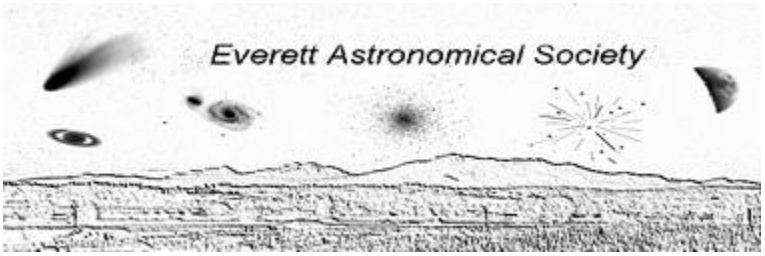
Volume MMX No. 1



The Stargazer

January 2010

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EAS BUSINESS…

NEXT EAS MEETING – SATURDAY JANUARY 16TH AT 6:00 PM, AT THE AURORA ASTRO PRODUCTS STORE

January meeting will be on January 16th at Aurora Astro Products. Attending members will be eligible for a monthly door prize. (We have several new nice books to choose from).

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

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

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

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

★ STAR PARTY INFO ★

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

No more star parties scheduled until spring (March), due to the frequent wet, cloudy weather. EAS member Ron Tam has offered a flexible opportunity to EAS members to come to his home north of Snohomish for observing on clear weekend evenings and for EAS starparties. Anyone wishing to do so needs to contact him in advance and confirm available dates, and let him know if plans change**.** **"***Our place is open for star parties any Saturday except weekends of the Full Moon. People can call to get weather conditions or to confirm that there is a star party. Our phone number is (360) 568-5152. They can e-mail me too (tam1951@verizon.net) but I don't check my email daily. They can email me for directions if they never have been out here."*
Listed below are proposed dates for **planned EAS star parties** at my [Ron Tam's] place, depending upon the weather, of course. Call Ron about spur-of-the-moment observing.

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

Other Western US Star Parties This Season

MARCH -

Mar 9-10 2010 - BAS Messier Marathon 2010 - Bruneau Dunes State Park, Eagle Cove Campground, ID

Mar 12-14 (tentative) 2010 - RCA 2010 Messier Marathon Star Party, Kah-Nee-Ta Resort and Casino, Warm Springs, OR - http://www.rca-omsi.org/sp/kahneeta.htm

Mar 27 2010 - OMSI-RCA Vernal Equinox Star Party, Rooster Rock State Park & Stub Stewart State Park, OR http://www.rca-omsi.org/sp/sp_schedule.htm http://www.rca-omsi.org/sp/r_rock.htm

Mar tba 2009 - OAS Messier Marathon Star Party, http://www.olympicastronomicalsociety.org

APRIL -

Apr 24 2010 - OMSI-RCA Astronomy Day Star Party, Rooster Rock State Park & Stub Stewart State Park, OR - http://www.rca-omsi.org/sp/sp_schedule.htm http://www.rca-omsi.org/sp/r_rock.htm

Apr tba - OAS Camp Delany Star Party, Sun Lakes SP - http://www.olympicastronomicalsociety.com/Documents/CAMPDELANY_Spring_2009_Sign-UpForm-new.pdf
http://www.olympicastronomicalsociety.org

MAY -

May 4-5 2010 - Farewell Bend Public Star Party, Farewell Bend State Park, Huntington OR - http://www.boiseastro.org

May 9-16 2010- Texas Star Party (TSP) 2010, Prude Ranch, Fort Davis, TX - http://www.texasstarparty.org/

May 15 2010 - OMSI-RCA Planet Parade Star Party 2010, Rooster Rock State Park & Stub Stewart State Park, OR http://www.rca-omsi.org/sp/sp_schedule.htm

May 15 2010 - RCA Prineville Reservoir Star Party, Prineville, OR - http://www.rca-omsi.org/sp/sp_schedule.htm http://www.prinevillereservoirstarparty.org/index.html

May tba - RCA Maupin Dark Sky Star Party, Maupin, OR - http://www.rca-omsi.org/sp/maupin.htm

May 12-16 2010 (Memorial Day) - Annual RTMC Astronomy Expo 2010, Riverside, CA **-** http://www.rtmcastronomyexpo.org/

May tba - Fire in the Sky – Rocket Launch & Star Party, Mansfield, WA - http://www.fireinthesky.org/ Tacoma Astronomical Society http://www.tas-online.org/calendar.php

JUNE -

Jun 05 2010 - OMSI-RCA Summer Solstice Star Party, Rooster Rock State Park & Stub Stewart State Park, OR http://www.rca-omsi.org/sp/r_rock.htm http://www.rca-omsi.org/sp/sp_schedule.htm

Jun 11-12 2010 Craters of the Moon Star Party 2010, Craters of the Moon Nat. Monument, ID - http://www.boiseastro.org/ Contact http://mvastro.org

Jun 5-12 2010 Grand Canyon Star Party (GCSP), On South Rim - http://www.tucsonastronomy.org/gcsp.html

Jun 9-13 2010 - The Rocky Mountain Star Stare (RMSS) 2010, Pike Nat Forest, Colorado Springs, CO http://www.rmss.org/

Jun 17-20 - Bryce Canyon Astronomy Festival, Bryce Canyon Nat. Pk, UT http://www.nps.gov/brca/planyourvisit/astronomyprograms.htm

Jun 19 Bogus Basin Star Party Bogus Basin

Jun tba - RCA Maupin Dark Sky Star Party, Maupin, OR - http://www.rca-omsi.org/sp/maupin.htm

tba - Stars Over Yellowstone Star Parties, Madison Campground Amphitheater - http://smasweb.org/

JULY -

Jul 9-11 2010 - Trout Lake Star Party Weekend, Trout Lake WA http://www.rca-omsi.org/sp/sp_schedule.htm http://www.rca-omsi.org/sp/pix/troutlake.pdf

Jul 10-14 2010 - Golden State Star Party (GSSP) 2010, Frosty Acres Ranch, Adin, CA **-** http://www.goldenstatestarparty.org/

Jul 15-18, 2010 - Mt Bachelor Star Party (MBSP) 2010, Sunriver (Bend) OR http://www.mbsp.org/

Jul 16 2010 - MVAS City of Rocks Star Party - Almo ID - contact http://mvastro.org

Jul 16-17 2010 - Ponderosa State Park Public Star Party - Ponderosa State Park, McCall ID http://www.boiseastro.org/

Jul 17 2010 - OMSI Lunar Viewing, Rooster Rock & Stub Stewart St. Parks, OR - http://www.rca-omsi.org/sp/sp_schedule.htm

Jul tba, 2010 - Island Star Party (ISP) 2010, Victoria Fish & Game Assoc - Holker Place, Malahat, (Near Victoria) BC, CA http://victoria.rasc.ca/events/StarParty/ http://www.starfinders.ca/starparty.htm

Jul tba - OMSI-RCA Summer Night Sky Star Party, Rooster Rock State Park & Stub Stewart State Park, OR http://www.rca-omsi.org/sp/sp_schedule.htm

Jul tba - Lava Hot Springs Star Party 2009, Lava Hot Springs ID - http://ifastro.org/web/index.php

Jul tba - OAS Hurricane Ridge Star Party, Hurricane Ridge, WA http://www.olympicastronomicalsociety.com/Documents/2009_OAS_calendar.pdf

AUGUST -

Aug 7-15 2010 - Mt. Kobau Star Party 2010 (MKSP), Mt. Kobau, near Osoyoos BC http://www.mksp.ca/

Aug 11-15 2010 - Oregon Star Party 2010 (OSP), Ochocco NF http://www.oregonstarparty.org/

Aug 12 2010 - OMSI-RCA Perseid Meteor Shower Star Party, Rooster Rock State Park & Stub Stewart State Park, OR http://www.rca-omsi.org/sp/sp_schedule.htm

Aug 12-15 2010 - Table Mt. Star Party (TMSP) 2010, Ellensburg WA http://www.tmspa.com/

Aug tba - SAS Brooks Memorial Park Star Party, SR 97 near Goldendale - http://www.seattleastro.org/events.shtml

Aug 4-6 2010 - 19th Annual 'Weekend Under the Stars' 2010, Foxpark WY - http://home.bresnan.net/~curranm/wuts.html

Aug tga - Deception Pass Star Party, Bowman Bay, Deception Pass, WA - http://squakmountain.org/deception_pass_star_party.htm http://squakmountain.org/events.html#upcoming

SEPTEMBER -

Sep 10-12 2010 - Idaho Star Party 2010, Bruneau Dunes State Park - http://ifastro.org/web/index.php (Boise AS) http://www.boiseastro.org/

Sep tba - OMSI-RCA Autumnal Equinox Star Party, Rooster Rock State Park & Stub Stewart State Park, OR - http://www.rca-omsi.org/sp/sp_schedule.htm

Sep 11-12 2010 - White Sands Star Party 2010, Alamogordo/White Sands, NM - http://www.zianet.com/wssp/

Sep 10-12 2010 - RCA Dark Sky Camp Weekend 2010, Camp Hancock, OR - http://www.rca-omsi.org/sp/sp_schedule.htm

Sep tba - OAS Camp Delany Fall Star Party, Sun Lakes SP - http://www.olympicastronomicalsociety.com/Documents/FALLCAMPDELANYSign-UpForm.pdf

Sep tba - CalStar, Lake San Antonio Park CA http://www.sjaa.net/calstar/ - http://www.sjaa.net/

Sep 11-12 2010 - Craters of the Moon Star Party 2010, Craters of the Moon Nat. Monument, ID http://ifastro.org/web/index.php http://www.boiseastro.org/

Sep 10-12 2010 - Alberta Star Party 2010, Starland Recreation Area Campground near Drumheller, Alberta, CA http://www.astronomycalgary.com/events/info/155 http://calgary.rasc.ca/asp2010.htm

(tba Sep) - **Orion Nebula 2009 Star Party,** Table Mt. (Ellensburg) WA http://www.seattleastro.org/orionnebsp.shtml

OCTOBER -

Oct 7-9 2010 - Sun River Star Party 2010, Brothers, OR http://www.rca-omsi.org/sp/sp_schedule.htm

Oct 6-10 2010 - The Enchanted Skies Star Party 2010, Socorro NM - http://enchantedskies.org/

(tba Oct) - **All Arizona Star Party** (near Arizona City, AZ) - http://www.eastvalleyastronomy.org/aasp.htm

NOVEMBER -

Nov 4-7 2010 - Nightfall 2010, Palm Canyon Resort, Borrego Springs, CA http://www.rtmcastronomyexpo.org/nightfall.htm

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

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

EAS MEMBER NEWS

2010 Officers – please welcome the new EAS officers !

Treasurer: (Jerry Galt) Collect club mail, and club dues, pay club bills, and maintain the club membership rolls.

Programs chairperson: (Ron Mosher) Contact potential speakers and invite them for monthly meeting, schedule the speakers, and introduce them at meetings.

Librarian: (Chris Dennis) Maintain the club books, movies, and software; and check materials out to members.

Astronomy Day chairperson: (Mike Kolzak) Reserve venues for annual Astronomy Day events, organize participants and publicity.

Star party organizer: (Ron Tam) Organize regular monthly suburban star parties March-November, and potentially other observing events as well.

Newsletter Co-editor #1: (Mark Folkerts) Organize and publish StarGazer newsletter on a monthly basis.

Still Vacant for 2010 -

President: Schedule & run the club monthly meetings.

Vice president: Run monthly meetings if President is absent, and store/loan club telescopes.

Newsletter Co-editor #2: Contribute columns or articles for the StarGazer on a regular basis.

Publicity chairperson: Contact news media, and e-mail and blog to raise public awareness of EAS activities.

Outreach chairperson: Coordinate requests from public for EAS member volunteers to conduct star parties or presentations at visits to schools, senior centers, scout meetings, etc. We often have requests for members of the EAS to come and help with an 'astronomy night' event from local schools, scout groups, senior homes, or similar groups. Usually this would be in the form of a star party at their gathering, or perhaps a short slide show or night sky talk. Providing education and support to the community about interest astronomy is one of the main missions of the EAS. A star party night can be a rewarding event for all involved. **Please email Mark Folkerts with your interest (or suggestions).**

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

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

* * *

[The EAS welcomes newsletter article contributions and submissions of all types from its members.]

In Everett Astronomical Society's Newsletter - The StarGazer "The Planetarium" - (Mid-January to Early February 2010) - By John W Goerger

A **New Moon** (moon not visible) was on the 15th (Thursday) of January 2010. Saturday, the 23rd, the moon will be First Quarter and on the 29th (Friday) we will see a Full Moon. However, we that live in the Pacific NW will only see overcast clouds and rain, but there is a lot of green foliage because of all the rain! Hopefully, there may be breaks in the clouds that allow a person to get a glimpse of the moon, the visual planets and those glittering multi-colored-diamond-like points of lights in the winter night sky.

Last month I wrote that Mars, which is very noticeable after sunset over in the East; NOTE: look for a fairly bright, orange-colored, star-like object over in the east but does not "twinkle" as a star does. Since a planet is closer to earth compared to the light year(s) stars (our sun excluded) are, the reflected light it shines with does not have that far (in distance) to travel, its light is rather concentrated and is generally not affected that much by the earth's atmosphere (bending/refracting) and appears fairly "steady". Of course, when very low to the earth's horizon, all planets will appear to have a "twinkling" colorized appearance. This is caused by the amount of the earth's atmosphere the light is travelling through (at least double the amount compared to when a planet is directly above you at night). Normally, the planets change position with the stars from night to night, moving eastward, but Mars is now changing its position with the stars, westward! Is there a problem? Is this a "sign" that the **movie 2012** is on to something; that the end of humankind is coming; NA, keep reading.

During the period of the Arab, Chinese, American (both North and South) Indians, Egyptian, Greek, Roman and other ancient cultures they had a bit of a problem trying to understand the very odd behavior of Mars, called **RETROGRADE**. Jupiter also showed this behavior as well as Venus but not as noticeable as Mars. These "Planets"; to the ancients, everything was considered a **"STAR"**---an object that was a point-of-light in the sky. Surprising the Sun and the Moon were also considered "planets"; but to their definition a **"PLANET(WANDERING STAR)"** was a light in the sky that changed its POSITON with the "Fixed Stars" (those are the stars that make up the "Constellations".

A **"Meteor"** was a **"Falling Star"**; a star suddenly appearing in the night (and sometimes in the daytime) glowing and racing across the sky then suddenly disappearing as quickly as it had appeared. We still use the term meteor/falling star but we know them to be small, most of them no bigger than a grain of sand, but others big enough to fall to earth and become a meteorite. Others, if larger can leave a hole in the ground (SEE METEOR CRATER IN ARIZONA) or can ruin a dinosaurs' weekend!

Then there are objects they called **NOVA**, a **"Guest Star"**. To us a Nova is a star that brightens greater than is its normal apparent brightness for a number of reasons (a White Dwarf pulling a companion star stuff onto its self or a star going Supernova). In the Ancients view this was suddenly a star appearing, remaining fixed with the other "fixed stars" but outshining the other stars for a few days or up to a couple of weeks.

Finally come **Comets**. For the folks in our distant past this was a word that described the appearance of the object---a **"Hairy Star"**! Think of someone with long hair walking into a windstorm; their hair is blown in the direction the wind is blowing; away from the direction they are walking. If the person were to be walking away from the windstorm then their hair would then be trailing in front of them; in the direction they are walking. Comets appear to do the same thing; when "falling into our solar system", the head of the comet is toward the sun and the trail of material is, like the person walking into a wind "behind the comet". As the comet circles the sun and then heads back out of the solar system the material coming off the comet is now, like the person walking away from the wind, going in the direction the person (comet) is heading.

Now we come to **RETROGRADE** which really messed up the Ancients Cosmology. Everyone had the view that everything orbited the Earth, with the Earth just sitting there, not rotating or revolving, just behaving itself and the "gods"; those were the planets, Moon, Sun, Mercury, Venus, Mars, Jupiter and Saturn (they did not have telescopes so Uranus, Neptune or Pluto were not known even though someone with 20/20 eyesight could have seen Uranus at times) and they were suppose to behave like a good god should; that is except Mars!

As stated, Mars is now "moving" westwards; changing position from night-to-night with the fixed (constellation) stars. If you were to have a clear view of the night sky for the next few weeks, you would see it moving westward as did the ancients. It should also be noted this was driving the folks of Galileo's time a lot of pain and frustration; if only they had listened to Galileo he had the answer. Anyway the Ancients and Galileo's contemporaries' had come up with a system that might explain Mars odd behavior---Epicycles. Mars orbited the Earth but it did not sit on that orbit but rather orbited that orbit.

By Galileo's time Mars had approximately 86 epicycles; yep, epicycles orbiting other epicycles with Mars on the 86th epicycles and I suspect more were to follow. It is amazing to realize that this month was 400 yrs ago when Galileo aimed his telescope at those twinkling multi, butterscotch, orange, colored diamonds in the night sky. The moon was not smooth as was dictated by the political power of the time, but was rough and had craters! There were star-like objects which were not twinkling and changing position from night-to-night around the object called Jupiter! Venus went though phases meaning it could not be in orbit about the earth, but the Sun! The planet Saturn had "ears" (his scope could not define the ring structure of Saturn) and additionally, the Sun had SPOTS!

Believe it or not Galileo continued to do his observations, not mentioning to anyone what he had discovered though the telescope until two years later! Talk about the "Day the Universe Changed" (See James Burke PBS series **CONNECTIONS** in the mid to late 1970's and Text)! Imagine EVERYTHING you know, WE KNOW was absolutely TOTALLY WRONG! That was the effect to society and the prevailing political/religious powerbrokers of that time period! How can they get this information to the public and not cause a major political chaos to happen? You see what was going on at the time was they were missing their High Holy Days and for a Religious/Political Leaders of the Period that was not a good thing---so they asked Galileo to try and find out what was going on! Certainly, the epicycles were working, there just had to be a reasonable solution to these on-going problems!

When Galileo gave them his data he discovered, they understood but were trying to figure how to "sugarcoat" the data so that the mass public could accept it (they could have but the leaders did not trust them). This frustrated Galileo and so he eventually published a book where he has several characters discussing cosmology, one of which is called (by our terms today) a simpleton---this is the person who thinks everything orbits about the earth and refuses to accept observational data; a second person who uses logic as we would understand it and deductive reasoning and of course the "average person on the street" trying to make "heads and tails" of the whole thing.

As you know poor Galileo was arrested and forced to recant his data but; even though he was under "house arrest" it is after that period that most of his other studies on falling bodies and related research into the physical world was released and published----in other parts of Europe! One more point; the year Galileo died, Isaac Newton is born in England, on December 25th.

With all the above you might still be wondering about our friend RETOGRADE. Well, all planets travel about the sun counterclockwise. So from our perspective, from the Earth the planets, Moon and the Sun move "Eastward" with respect to the stars. The Sun, on average, moves about ½ of a degree per day Eastward (that is actually the Earth's direction it is orbiting around the sun). When the Earth, in its orbit about the sun catches up with a planet who's orbit is farther from the sun then the earth's and passes that planet, to our line-of-sight it appears that that planet is backing up, or going "westward" with respect to the background stars.

Within a couple of weeks as you continue to observe that planet, it will appear to stop its westward motion and then start moving "Eastward", again with respect to the stars. Of course the daily rotation of the sky, with the Sun rising in the East and setting in the West is caused by the Earth' ROTATING on its axis; whereas the other movement is the earth's revolution about the sun. As a side note, if any readers have discovered UTUBE, all the James Burke Series, CONNECTIONS are there free for the watching---well worth your time and his humor is interesting!

Assuming you have a clear evening sky, Jupiter is in the west at sunset with a crescent Moon near it on the 17th/18th. Mars as mentioned previously is in the early evening eastern sky. Mars is in **OPPOSITION** (opposite the sun's position) by the 29th of January and is visible throughout the entire night. Mars has an apparent visual brightness of -1.0 and a diameter of 13.4" (arc seconds) by the 15th of February.

For **February 2010**, if those of us living in the Pacific NW are lucky, and we have some clear night sky, **Jupiter** at a -2.0 on the 1st will set around 1hr 40mins later after the sun on that date. Hoping you have a clear unobstructed western horizon, **Venus** is glittering at a -3.9 on the 10th, but is only 3 degrees above the horizon; 15 minutes after sunset.

Using binoculars look up about 5 degrees and Jupiter should be in your binocular-field-of-view. It gets better (assuming there are no stupid rain clouds around); Jupiter and Venus are 2 degrees in separation by the 14th, and on the 16th the two planets are within ½ degree from each other. In the late 1990's I was able to aim one of my scopes at this meeting of the two brightest planets in the night sky. One, earthlike in diameter but with a hellish surface; the other having a diameter of 12 earths and a miniature solar system in a sense, with the many and varied geology of its moons orbiting it, as do all the planets orbiting the sun.

My sources say, start observing about 20 minutes after sunset on that day, finding Venus first, with Jupiter to its upper right; but it does lie only 3 degrees above the horizon. This will be last time until mid-March 2010 when you will get to observe Jupiter, before sunrise. Venus will continue to hug the horizon being around 4 degrees above the horizon but by August of 2010 it will reach Greatest Elongation. From now to then Venus will become more noticeable, and by late spring of 2010 will have a good altitude above the western horizon.

For those wanting a challenge try locating **Uranus** at a 5.9 on the 15th. It is about 20 degrees above Jupiter on the 1st---good luck on this one and if we have cloud cover---never mind. **Mars** on the 1st is at a visual -1.3 but drops in brightness to -0.6 by the 28th. Its diameter will be 13.4" (arc seconds) and should reveal some good surface structure—assuming the idiot rain clouds stay away!

Also, it won't be until 2014 that Mars will be bigger and brighter than now. In my readings it mentions on the 6th and 7th Mars will be ~3 degrees north of the Beehive star cluster (M44); use binoculars to find this and given most field-of-view binoculars you should be able to see them both in the same field of view---cool ([M44] I don't think the U.S.S. ENTERPRISE ever went there; no females there for James T Kirk to rescue).

There is an asteroid at a visual 6.1 called **VESTA** which reaches opposition and its "peak visibility" is around the 17th and 18th. I suggest for you to go onto the net, type in "VESTA" and see what "pops up". Also, I suspect there are members of EAS that will have detailed information on where to look, specifically.

Finally, **SATURN** that graceful Ring-World of our Solar System, rises after 9:30 PM on the 1st. True, all the "Outer Planets" have "rings" but only Saturn's can be seen using a telescope from Earth. Also the ring, given our line-of-sight is now visible to us again! Its' diameter is about 19" (arc seconds) and at a 0.7 visual, it is almost as bright as Spica (1st) and will be within 2 degrees of it by month's end. Butterscotch-colored Saturn, such a lovely celestial jewel to observe though a telescope, and no matter how many times you allow the public to look though your telescope there will always be someone who will say; "you have a picture in the there"; either as a statement or as a question. More on Saturn and her friends next month!

Well, well, well. Guess who finally is showing up again! **MERCURY**! It glows at an apparent magnitude, a -0.2, about 7 degrees in elevation in the southeast on the 1st, 30 minutes before sunrise (hoping there are no pain-in-the-you-know-what clouds around) to observe this swiftest of our sun's planets. Mercury is at its' Greatest Western Elongation on the 27th, in the east before dawn (west of the sun). Those who do not have to contend with an overcast sky can check out Mercury's disk---6" (arc seconds) WOW! However, given its closeness to the eastern horizon, if using a telescope for your observations, keep it at low magnification to minimize the distortion caused by the earth's atmosphere. A thin crescent moon is 4 degrees of Mercury's left. Within a few days later this "Messenger of Zeus", swiftly descends into the glow of the Morning Sun, for those of us in the Northern Latitudes.

As of this writing STS 130 Space Shuttle Endeavor launch for February 7th is still a go. According to NASA, engineers have figured out a solution to an ammonia coolant hose leak issue which could have delayed the launch as well as impaired the goals of this mission. These ammonia jumper hoses supply cooling capacity to the new TRANQUILITY MODULE, by circulating the ammonia and transporting the heat created by the on board systems of the ISS. The astronauts have to connect these lines from Tranquility to the ISS cooling systems. Crew members are the following: Commander George Zamka, Pilot Terry Virts, Mission Specialists (Alphabetically) Robert Behnken, Kathryn Hire, Nicholas Patrick and Stephen Robinson.

Have you been sending letters, emails, phone calls to try to keep the Shuttle System active until America can get its "next generation" of human-rated space vehicles operational? Remember, including this mission there are only 5 missions for the Space Shuttle system, then the American Government will shut-down America's ability to launching and sending its Astronauts into space. For some the question might be; "do we need NASA or the ability to send Americans into Space?" Well I have a question for you; Do we need a NAVY, AIR FORCE, ARMY or a MARINE CORPS?

Again, all I can do is give you the information and data, it is up to you how you want to handle and deal with it. Recently I was watching on cable the third installment of Jurassic Park movie where the Paleontologist discusses with someone, what an astronomer does---studying the universe but not interacting with it. He was saying that astronomy (actually the writers of the movie had written the script and the actor portraying the paleontologist was saying his "lines") was a "passive science" unlike biologists, geologists, and those that study in the field, the bones of the past species of this planet, interact with their subject of study; the astronomer is just a passive observer. That is outrageous! Or is it? When you get down to it, just sitting and looking into an eyepiece and examining some object that are thousands if not billions of light years away, is in a sense kind of passive behavior.

However, we can put **ADVENTURE** and **PHYSICAL** activity into astronomy just as the above mentioned scientists! Astronomers will be needed to work the telescopes of lunar observatories or the mining operations on the lunar surface, Mars and the asteroids; they are called planetary scientists but with a background in astronomy. In fact the newly appointed Deputy Director of the HUBBLE SPACE TELESCOPE INSTITUTE was the "Main Man" who was responsible for repairing the HUBBLE on the last Space Shuttle's mission to the HUBBLE SPACE TELESCOPE.

Astronomers are to stars, galaxies and Cosmology as the Paleontologist is to studying dinosaurs. Both are studying the past---the astronomer is observing light that has originated from distant stars measured in light years, galaxies with distances measured in millions of earth years past, and clusters of clusters of galaxies (Super Clusters) whose light left billions upon billions of earth years ago; light that left before the earth and its sister planets even came into existence!

The Paleontologist studies the fossilized bones of creatures that were the first large sized animals to roam upon the surface of Earth. They also study the ancient cellular fossilized critters that made up the first forms of life on this driftwood in this cosmic ocean. The creatures which came before us are gone, just like the distant super clusters the astronomers/astrophysicists study and are puzzled by. Have they changed into something----else; their position is not where we see them as "now".....and what came before them, and what or where did they go or become? It is said the Universe is 13.5 billion Light Years, but that is where it was 13.5 billion years ago and given the Inflation of the Universe they or it are now an estimated 45 to 50 billion Light Years or further; so distant their images are, at present unobtainable and maybe, will always be so.

Yet, the photon that the astrophysicist gathers on the CCD chip, attached to the telescope, which came from the Super Clusters does not age---if you were that photon of light no time would have gone by for you. At the moment you left the Super Cluster of Galaxies the same moment, would be your arrival at the astrophysicist's CCD. However, the images created on the chip or seen through the telescope by the human eye would be a "ghost", an image without substance (see **The Stargazer** Volume MMVIV. No.7 "The Planetarium" May-July 2009). In a sense, a "fossilized" image of the past but not an image of the present; the astronomer/astrophysicist and the paleontologist are the same, both studying the past to understand where we (us and the universe), started but what about our, humankinds and other species which inhabit this planet, destiny? Is Astronomy a "passive science"? What do you think?

– *John Goerger*

EAS Membership Benefits & Information

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

Magazine Discounts –

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

Membership in the Astronomical League -

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

EAS Club Telescope Borrowing -

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

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

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

EAS Library -

Membership will give you access to all the material in the lending library. The library, consists of VCR tapes, DVDs, many books, magazines, and software titles. The EAS has a library of books, videotapes, and software for members to borrow, **located at Aurora Astro Products store**. We always value any items you

would like to donate to this library. You can contact a club officer to borrow or donate any materials, or **contact Jim Bielaga at Aurora Astro**. See library items list here: http://everettastro.org/eas_library.htm

Joining or Renewing with the EAS -

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

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

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

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

"Mention your EAS club membership at Jim Bielaga's astronomy store 'Aurora Astro Products' and receive a 10% discount on all purchases. This is an exclusive discount to current E.A.S. members only. I am proud to be able to offer this discount to Everett club members, and thanks for the support you have shown me on opening my new store. Also I have made great friends and learned a lot being a club member since 1991.

- Clear Skies, Jim Bielaga"

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

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Tuesday/Wednesday – Noon to 6:00 pm
Saturday – 10:00 am to 5:00 pm

$$ - Financial Health - $$

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

Club Scopes

Scope	Loan Status
13-inch thin-mirror Dob	Finishing Rehabilitation
10-inch Ward Dobsonian	Available
10-inch Sonotube Dobsonian	Available
8-inch Dobsonian	Available

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

Astro Calendar for 2010

January 2010

Jan 03 - Quadrantids Meteor Shower Peak
Jan 04 - Earth At Perihelion (0.983 AU From Sun)
Jan 15 - Annular Solar Eclipse, Visible in Africa, India & China
Jan 16 – EAS Meeting at Aurora Astro – 6:00 PM
Jan 20 - Buzz Aldrin's 80th Birthday (1930)
Jan 27 - Mercury At Its Greatest Western Elongation (25 Degrees)
Jan 28 - Mars Closest Approach To Earth (0.664 AU)
Jan 29 - Mars at Opposition

February 2010

Feb 14 - Chinese New Year
Feb tba – EAS Meeting
Feb 22 - Asteroid 4 Vesta Closest Approach To Earth (1.411 AU)

March 2010

Mar 14 - Daylight Saving - Set Clock Ahead 1 Hour (United States)
Mar 20 - Vernal Equinox, 17:32 UT
Mar tba – EAS Meeting
Mar 21 - Saturn At Opposition

April 2010

Apr 04 - Easter Sunday
Apr 08 - Mercury At Its Greatest Eastern Elongation (19 Degrees)
Apr 19-25 - Astronomy Week
Apr tba – EAS Meeting
Apr 22 - Lyrids Meteor Shower Peak
Apr 24 - Astronomy Day

May 2010

May 02 - Asteroid 2 Pallas Occults TYC 2026-01347-1 (11.9 Magnitude Star)
May 05 - Eta Aquarids Meteor Shower Peak
May 07 - Space Day
May tba – EAS Meeting at Aurora Astro – 6:00 PM
May 16 - Moon Occults Venus
May 26 - Mercury At Its Greatest Western Elongation (25 Degrees)

June 2010

Jun 11 - Asteroid 1 Ceres Occults TYC 6845-00708-1 (11.6 Magnitude Star)
Jun 12 - New Moon .
Jun 15 - Asteroid 1 Ceres Closest Approach To Earth (1.825 AU)
Jun 20 - Asteroid 1 Ceres Occults TYC 6832-00337-1 (11.3 Magnitude Star)
Jun tba – EAS Meeting
Jun 21 - Summer Solstice, 11:28 UT
Jun 25 - Pluto At Opposition
Jun 26 - Partial Lunar Eclipse

July 2010

Jul 06 - Earth At Aphelion (1.017 AU From Sun)
Jul 11 - Total Solar Eclipse, Visible in South Pacific, Chile
Jul tba - EAS Meeting
Jul 29 - South Delta-Aquarids Meteor Shower Peak

August 2010

Aug 01 - Alpha Capricornids Meteor Shower Peak
Aug 05 - Neil Armstrong's 80th Birthday (1930)
Aug 06 - Southern Iota Aquarids Meteor Shower Peak
Aug 07 - Mercury At Its Greatest Eastern Elongation (27 Degrees)
Aug 09 - New Moon

Aug tba – EAS Meeting
Aug 12 - Perseids Meteor Shower Peak
Aug 20 - Venus At Its Greatest Eastern Elongation (46 Degrees)
Aug 20 - Neptune At Opposition
Aug 25 - Northern Iota Aquarids Meteor Shower Peak

September 2010

Sep 14 - John Dobson's 95th Birthday (1915)
Sep 19 - Mercury At Its Greatest Western Elongation (18 Degrees)
Sep 21 - Jupiter at Opposition
Sep tba – EAS Meeting
Sep 21 - Uranus At Opposition
Sep 23 - Autumnal Equinox (03:09 UT)

October 2010

Oct 09 - Draconids Meteor Shower Peak
Oct 17 - New Horizons, Halfway to Pluto
Oct tba – EAS Meeting
Oct 21 - Orionids Meteor Shower Peak
Oct 31 - Michael Collins' 80th Birthday (1930)

November 2010

Nov 01 - Daylight Saving - Set Clock Back 1 Hour (United States)
Nov 03 - Taurids Meteor Shower Peak
Nov 05 - Moon Occults Venus
Nov tba – EAS Meeting
Nov 17 - Leonids Meteor Shower Peak
Nov 25 - Asteroid 2002 KL3 Near-Venus Flyby (0.031 AU)

December 2010

Dec 06 - Moon Occults Mars
Dec 13 - Geminids Meteor Shower Peak
Dec 21 - Total Lunar Eclipse
Dec tba - EAS Holiday Meeting
Dec 21 - Winter Solstice, 23:38 UTC
Dec 22 - Ursids Meteor Shower Peak

UW Astronomy Speakers Colloquium Schedule

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

'It's Over Your Head' – Astronomy Podcasts

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

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

OBSERVER'S INFORMATION…

Lunar Facts

Jan 07	Last Quarter Moon
Jan 15	New Moon
Jan 23	First Quarter Moon
Jan 30	Full Moon
Feb 05	Last Quarter Moon
Feb 14	New Moon
Feb 22	First Quarter Moon
Feb 28	Full Moon
Mar 07	Last Quarter Moon
Mar 15	New Moon
Mar 23	First Quarter Moon
Mar 30	Full Moon

Up In The Sky -- The Planets (and Pluto)

Object	*Rises*	*Sets*	*Con*	*Diam.*	*Mag*
Sun	***07:52 am***	***16:47***	***Sag***	***30'***	***-27.5***
Mercury	**06:22 am**	**15:15**	**Sag**	**10"**	**+4.7**
Venus	**08:05 am**	**16:47**	**Sag**	**10"**	**-3.9**
Mars	**17:57**	**09:20 am**	**Leo**	**13"**	**-1.1**
Jupiter	**09:29**	**19:40**	**Cap**	**35"**	**-2.1**
Saturn	**22:39**	**10:51 am**	**Vir**	**18"**	**+0.8**
Uranus	**10:13 am**	**21:50**	**Aqr**	**03"**	**+5.9**
Neptune	**09:13 am**	**21:16**	**Cap**	**02"**	**+8.0**
Pluto	**06:02 am**	**15:18**	**Sag**	**--**	**+14.1**

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

Digital Lunar Orbiter Photographic Atlas of the Moon

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

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

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

NOAA Sun Calculator

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

International Space Station – Visible Seattle Passes

ISS Visibility – Heavens Above:

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

Constellations of the Month: Leo Minor & Centaurus

LEO MINOR: The Lion Cub, as this small constellation is also known, borders on the constellations of Leo, Lynx, and Ursa Major, and ranks 52nd in overall brightness among the constellations, containing 15 stars brighter than magnitude 5.5. Its central point is located at RA=10h,11m and Dec.= +32.5 degrees. It is completely visible from latitudes North of –48 degrees, and completely invisible from latitudes South of –67 degrees; this constellation ranks 64th in overall size among the 88 official constellations. Leo Minor's only named star is Praecipua, and the nearest star to Earth within the borders of this constellation is the 11-Leo Minor A-B system, lying at 29.91 light years distance from Earth, with an absolute magnitude of 5.6 and 13.2 (for components A and B respectively; the apparent magnitudes are 5.4 and 13.0 respectively); this system is listed among the 200 nearest stars or star systems to Earth, coming in at number 157. Leo Minor has one associated meteor shower: the Leonis (or Leo) Minorids (24 Oct.), with a radiant of 10h48m and +37 degrees; its ZHR (zenithal hourly rate) is low at 3. Leo Minor has no associated Messier objects. Leo Minor does have two

relatively well known galaxies available to smaller scopes and amateur astronomers under good conditions. NGC-3344 is a magnitude 10.4 face-on spiral, measuring 6.0' x 5.1' across (an 8-inch scope can show a soft glow surrounding a stellar-like nucleus); NGC-3486 is a multi-armed spiral measuring 5.5' x 4.2', with a magnitude of 10.8, and it can appear in a similar telescope as a circular haze but with little additional detail of its central areas. There is also a well-known interacting pair of galaxies: NGC-3395 and NGC-3396. NGC-3395 is a 12.4 magnitude elongated Sc spiral, measuring 1.4' x 0.8', which Burnham states is considerably bright for being so small; NGC-3396 is classified as a 12.8 magnitude, somewhat elongated hybrid between an irregular and barred spiral galaxy, measuring 1.0' x 0.5' across. This interacting pair, which telescopically looks like a puffy reverse 'S' attached by a thin, faint cloud bridge to a somewhat smaller cumulus-looking cloud, is separated by 1.7'. Leo Minor also has several double and multiple star systems (such as F.G.W. Struve #'s 1344, 1374, 1375, 1405, 1406 and 1492; as well as Herschel 475 and 2517; Aitken 2142; and Hussey 631, 634 and 875). This small but jam-packed constellation also contains some well-known variable stars, such as R-Leonis Minoris (a long-period variable, with a visual magnitude variability from 6.3 to fainter than 13.0, a 372 day period, and spectral class varying from M7e to M8e), and U-Leonis Minoris (a semi-regular variable with a visual magnitude from 9.8 to fainter than 13.0, a 272 day period, and a spectral class of M6e). On a clear night in a dark location this winter, see if you can find some of these wonders in the constellation of Leo Minor.

CENTAURUS: The Centaur, as this constellation is also known, borders on the constellations of Antlia, Carina, Circinus, Crux, Hydra, Lupus, Musca, and Vela, and ranks 25th in overall brightness among the constellations, containing 101 stars brighter than magnitude 5.5. Its central point is located at RA=13h,01m and Dec.= -47.5 degrees. It is completely visible from latitudes South of +25 degrees, and completely invisible from latitudes North of +60 degrees; this constellation ranks 9th in overall size, taking up almost 2.6% of the entire sky. Two of Centaurus' most famous bright stars are Proxima Centauri (alpha Centauri C), and Rigel Kentaurus (alpha Centauri). Centaurus has one associated meteor shower: the alpha Centaurids (8 Feb.), and no Messier objects. Interestingly, the nearest star system to our own is Rigel Kentaurus (generally referred to as Alpha Centauri), at a distance of 4.39 light years. It is a triple star system, the brightest two forming a wonderful telescopic double. The dimmer of the three is actually Proxima Centauri, which lies about 0.1 light years closer than the other two stars, and is thus the closest star to our own sun. The entire triple star system is the third brightest of all the night-time stars, shining at a magnitude of –0.27. Because of the large proper motion of Alpha Centauri, in about 4,000 years, Alpha and Beta Centauri together will become a beautiful double star.

Perhaps most well known of all of the other features of this constellation is the Omega Centauri globular cluster, generally regarded as the finest and most beautiful in all of the sky. Also known as NGC 5139, the total visual magnitude of this cluster is 3.7 and it takes up a diameter of almost ½ degree , but its more southerly declination (-47 degrees) makes it a difficult object at latitudes above 35 degrees North. NGC 5139 has a surprising range of metal content as well as possibly age of its members; it is also an X-ray source. Centaurus also has some beautiful and famous galaxies to boast as well. NGC-4945 is a large, nearly edge-on barred spiral that may even be visible in some larger binoculars. This beautiful galaxy has a magnitude of approximately 9.2, and is generally classified as an SBc galaxy. It measures approximately 20.0' x 4.5'. NGC-4945 is located approximately 30' northeast of Xi Centauri. Another Centaurus galaxy is NGC-5128, a peculiar S0 galaxy, with a magnitude of 7.2, and measuring 10.0' x 8.0'. NGC-5128 is an active galaxy, demonstrating powerful and chaotic disruptions within its core, and is located 4 megaparsecs away from Earth, making it close enough for larger backyard scopes to show some structural detail regarding both NGC-5128's halo and dust lane. The dust lane, a broad equatorial band, bisects the galaxy, which brightens towards its center; the 'split' dust lane is thicker and twisted at opposites sides of the galaxy's edge, and the lane's bright edges show clumps of nebulosity, and more extensive and fainter nebulosity lying inside the dust lane. This latter nebulosity is composed of chains of O- and B-type stars, and is visible to Earth because it is projected in front of and against the dust band. NGC-5128 is identified with Centaurus-A, a very intense radio and X-ray source (as well as a source of both infrared and gamma radiation). The NGC-5128/Centaurus-A association is the nearest active galaxy to Earth. Its radio structure consists of essentially two large lobes approximately symmetrical about the central nucleus, from which a jet (broken up into several knots) extends toward one of the radio lobes. Centaurus-A is also a bright X-ray source, with variable time intervals of as low as a few days, which suggests that most of the X-ray emission is emitted from the nucleus. Einstein Observatory observations have also demonstrated an X-ray jet along the axis of the radio lobes. The constellation of Centaurus has a midnight culmination date of March 30th, so if you are planning on "snow-birding" very far south in the next few months, try to get out and enjoy some of the beauties of this constellation this late winter and spring.

YOUNG ASTRONOMER'S CORNER

QUESTION: WHAT IS A RED GIANT?

ANSWER: A big, old red star. Stars are not born this way however. A star like our Sun becomes a red giant when it uses up its main hydrogen fuel and begins to swell and expand. As such a star grows in size, its surface begins to cool off and turn red in color. (In star temperature colors, cool=red; warm=yellow; and hot=blue or white). When our Sun becomes a red giant a few billion years from now, it will grow and expand until it swallows Mercury and Venus and extends even out to the vicinity of the Earth, if not beyond. That is why it is also called a "giant".

QUESTION: How many stars can you actually see at night?

ANSWER: Although it may seem like "billions and billions"(!), what we can actually see on a clear night is "only" about 5,500. There are approximately 200 billion stars in the Milky Way Galaxy. However, even on the darkest of nights, human can only pick up less than 6,000 of these, and only again if you stay up all night to see them all (as the Earth rotates different stars will come into view). Human eyes are not sensitive enough to see the remaining 199+++ billion stars, because they are too faint. That is one reason why astronomers use telescopes!!

QUESTION: What is the difference between a meteor and a meteorite?

ANSWER: A meteor is a tiny sand grain or speck of dust or rock (which can be made of stone, iron, or both) from space, traveling through the Earth's atmosphere. If the rock is big enough and does not burn up in the Earth's atmosphere, it may land on the Earth's surface. At this point it is known as a meteorite. So the difference between the two is really not a matter of what they are composed of, but rather of how much matter they are composed of and, consequently, where they are ultimately seen and found.

QUESTION: Is there any difference between a "falling star", "shooting star", and "meteor"?

ANSWER: No. They are all different names for the same thing: a piece of dust or rock that burns up as it speedily enters Earth's atmosphere.

Further, "falling" or "shooting" stars are not stars at all: real stars are light-years away from Earth, and real stars are NOT hurling themselves into Earth's atmosphere to burn up. If a star were that close, it is we inhabitants of Earth who would "burn up" (literally!!), in addition to the nearby "space rocks" that enter Earth's atmosphere (that is, meteors).

QUESTION: Can the current Space Shuttle make a trip to the Moon?

ANSWER: No. The Space Shuttle was not designed for travel to the moon. The main engines and solid rocket boosters are not powerful enough to launch the Shuttle to the Moon, and the Shuttle as currently designed would be unable to carry all the extra needed fuel and supplies. The Space Shuttle was designed to fly in what is called "low-Earth-orbit", making the outer limit of the Space Shuttle's orbit about 600 miles above the Earth's surface. The Moon however, is an average distance of about 230,000 miles from Earth, almost 400 times further than the farthest possible orbit that the Shuttle is designed to function in right now!!

QUESTION: Why should we build a space station?

ANSWER: The simple answer is that if humans are going to explore outer space, we need to know a lot more information about it. Space has no air to breathe and a micro-gravity atmosphere. The space shuttle and space station missions allow astronauts and cosmonauts to conduct many useful experiments in the weightlessness of space; but because shuttle missions are only about 2 weeks in duration, the longer orbiting time for the space station would allow longer time for some important experiments to be conducted. These include the long-term effects of weightlessness on humans, certain medical and laboratory experiments (including crystal, food and plant growth) and the effects of living in close, cramped quarters over long periods of time. By studying issues such as these in space, we can prepare perhaps for a future colony on the Moon and perhaps on another planet, as well as gain a fuller appreciation and knowledge of our life here on Earth.

QUESTION: How long do stars live?

ANSWER: When a star is born from a large cloud of gas and dust, its size determines how long it will live. In general, the smaller the star, the longer it will live. Smaller stars with very low mass make helium from hydrogen (also known as fusion) very slowly. These stars tend to be cooler and thus redder in appearance, and burn for trillions (!) of years before they use all of their hydrogen found in the core. Medium sized stars, like our Sun, burn faster however. Because they are larger, there is more pressure from gravity in their cores, which causes nuclear fusion reactions to happen more quickly: they use up their hydrogen fuel more quickly. Stars such as the size of our Sun live for a few billion years. The most massive stars are generally the hottest and most unstable; they 'die' from processes such as a collapse from their own weight to form supernovae, neutron stars, and/or pulsars for example; these largest stars die within 'only' a few million years. In general, when it comes to stars, the bigger you are, the shorter your life.

QUESTION: Could we land a spacecraft on the planet Jupiter?

ANSWER: No, because Jupiter has no true "surface" to land on. Additionally, any spacecraft able to make it that far would sink through thicker and thicker "clouds", until the clouds were so thick that the pressure created would crush the spacecraft. The deeper you go inside Jupiter, the greater the crushing pressures.

QUESTION: Which planet has the largest moon?

ANSWER: Jupiter. The name of the moon is Ganymede, and it also happens to be the largest moon in the entire solar system. It is 3,166 miles in diameter, and is thus larger than the planets Mercury (2,930 miles diameter) and Pluto (1,380 miles diameter). By comparison, Earth's Moon is 2,086 miles in diameter.

PLANETARY FOCUS - MARS

"Planetary Focus" is a periodic column that is published occasionally in the EAS "Stargazer". For the month of February 2010, our guest planet is Mars - by mid-evening well up in the east - and these are the facts:

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 24th 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. The next favorable opposition of Mars will occur in 2003, when Mars will be very close to the Earth. Try to enjoy this beautiful planet when visible anytime, but most especially, as for any superior (outside) planet, at opposition.

ASTRONOMY & TELESCOPE "LINGO"

ASTRONOMY "LINGO": COSMOLOGY: The study of the origin, evolution, large-scale structure, and destiny of the Universe.

TELESCOPE "LINGO": COSMOS: A very versatile and automated plate-scanning equipment system located at the Royal Observatory in Edinburgh, Scotland. This system is used primarily for the extraction of data from the UK Schmidt and other research Schmidt telescopes.

ASTRONOMY "LINGO": NECTARIS BASIN: A large multi-ringed basin located on the southeastern nearside of Earth's Moon. It was flooded with lava to produce Mare Nectaris after the basin's initial formation about 3.9 billion years ago.

TELESCOPE "LINGO": SEPARATION: The angular distance (expressed in arc seconds (")) between each component of a visual binary or optical double star. Separation is measured using a filar micrometer placed in the eyepiece of a telescope.

ASTRONOMY "LINGO": COBE: An orbiting satellite launched by NASA in 1989 to study cosmic microwave background radiation. The acronym stands for Cosmic Background Explorer. The satellite was constructed with three detectors: DIRBE (the diffuse IR background experiment); FIRAS (the far-IR absolute spectrophotometer); and the DMR (the differential microwave radiometer). Measurements have shown that the background microwave radiation is not completely uniform, resulting from the real motion of the Milky Way Galaxy relative to the fixed background. Weak temperature fluctuations have also been detected, and are generally regarded as signatures of quantum fluctuations in the early universe (see "CAT" below).

TELESCOPE "LINGO": CAT: Also known as the Cosmic Anisotropy Telescope. CAT is a 3-element interferometer operating at frequencies between 13 and 17 GHz (on baselines of 1 to 5 meters.) CAT measures early, primordial temperature variations in the cosmic microwave background radiation, and is located at the Mullard Radio Astronomy Observatory in Cambridge, England.

ASTRONOMY "FUN FACTS"

★★ Jupiter is the fastest rotating planet in the solar system, spinning on its axis once every approximately 10 hours at its equator. A stationary object on Jupiter's equator would be traveling at considerably more speed (almost 28,000 miles per hour) than the escape velocity of our own planet Earth !

★★ The Moon's shadow (a dark disk almost 170 miles wide), travels across the Earth at 1,040 miles per hour during a total eclipse of the Sun. The longest possible time to observe a total solar eclipse from one location on Earth is 7 minutes, 40 seconds. However, following the Moon's shadow in a supersonic jetliner would enable the observer to see totality for approximately three and one-half hours!! But it would be an expensive eclipse indeed!

★★ Just one pound of hydrogen - converted into helium by nucleosynthetic processes in the core of the Sun - would release the same amount of energy as would ten tons (20,000 pounds) of coal here on Earth!

★★ Because of vast lava flows, the surface of the Jovian moon Io is less than 10 million years old, and Io is the only body in the Solar System that is turning itself inside out volcanically! On Earth, this "renewal" is accomplished not volcanically, but rather by earthworms!

★★ Sinope, one of the outermost moons of Jupiter, is only 9 miles in diameter and is 400 million miles from Earth – making it, among other things – a remarkable accomplishment that it was even discovered at all… and in no less than ***1914*** (by astronomer Seth Nicholson)!!

★★ Sinope is approximately 14.7 million miles from Jupiter, and it takes more than 2 years to orbit the giant planet. Sinope is thus about 61 times farther away from Jupiter than our Moon is to Earth, and it lies at about $1/6^{th}$ the Sun-Earth distance from Jupiter. Because of this distance, an Apollo spacecraft traveling at the average Earth to Moon velocity would take 6 months to travel from Jupiter to its tiny moon Sinope!

★★ On Venus, sunrise is in the west, and sunset in the east (opposite to that of Earth). That is, Venus rotates east to west (unlike the other 8 planets (the other odd rotator is Uranus, which is lying on its side(!) compared to the other planets)). This is called retrograde rotation. The rotation of Venus is thus unique in 2 ways: it is extremely slow (it rotates about once every 8 months; Earth rotates once per 24 hours), and it has retrograde rotation compared to the other planets.

★★ Venus, at its closest to Earth, is still about 106 times further away from Earth than is the Moon. At the average speed of an Apollo mission, it would still take a one-way manned mission about 1.5 years to reach the planet .

★★ Even with a manned mission however, Venus would be a very inhospitable place. The surface temperature of Venus is about 470 degrees Celsius, enough to make lead molten, and more than enough to make steel red hot; the surface temperature of Venus is essentially controlled by a runaway greenhouse effect. The three distinct cloud layers (with very high upper level winds) of Venus are all composed of sulfur and sulfuric acid, and the atmosphere itself is composed of about 96% carbon dioxide. The atmospheric pressure on the surface of Venus is about 90 times that of Earth's surface (about 1, 320 pounds per square inch); additionally, Russian and American space probes have detected far, far more lightning strokes per unit area than is found on Earth. Indeed, Venus appears to be the type of other world best left to the research done by mechanical probes

★★ T-Tauri stars, named after the first to be discovered in the constellation Taurus, are newly born or created stars, and are always associated with giant gaseous nebulae from which they arise. The luminosities of these stars vary erratically, most probably because they are still growing and accumulating material before they reach the more stable main-sequence state. The prototype star T-Tauri is expected to evolve to main-sequence status about 10 million years from now, at about the same time when a long succession of earthquakes along the

California San Andreas fault will have moved Los Angeles essentially to the latitude of San Francisco!!

★★ 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 1,000th 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!

★★ Although it has been known for almost 2,000 years, the largest globular cluster, Omega Centauri (NGC 5139), was thought to be a single star until Edmund Halley realized it was a cluster in 1677. This globular cluster, at 620 light-years diameter, is one of the most massive in our Galaxy, with a mass perhaps equal to 500,000 Suns. The actual number of component stars exceeds 1 million, and their collective light outshines our Sun by 1,000, 000 times. With an age of 13 billion years, it may also be the oldest of the globular clusters. The orbit of this cluster has a maximum distance of 21,000 light-years from the galactic center to its closest orbital point of 6,200 light years from the galactic center. With an assumed age of 13 billion years, Omega Centauri has orbited around the Milky Way Galaxy 50 times since the birth of the Sun, 6 times since corals and starfish appeared on Earth, and once since flowering plants appeared. In just one single Omega Centauri year, Earth will have orbited the Sun 100 million times!!

★★ Any globular cluster that contains 1 million stars would have more stars packed within its volume than anywhere else in the Galaxy except the galactic core. If each star in the cluster could be represented by a 1-inch diameter golf ball, the entire cluster could be contained in a spherical volume with a diameter of 10,000 miles, and the average separation between golf balls could still be 100 miles. Even in the most densely packed globular cluster cores, the golf balls would still have 33 miles separation between them. This is comparable to your next-door neighbor living 40,000 miles away (if the Earth were big enough!!).

"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: X-RAY BINARY: The most prevalent type of luminous galactic X-ray source. These systems involve a close binary system in which gas either flows (via the inner Lagrangian point) or discharges (from a strong stellar wind) from a normal (nondegenerate) star on to a more compact companion associate star. For the most luminous X-ray binaries, this companion is probably a neutron star or black hole; for less luminous sources, the associate star is probably a white dwarf. Gravitational energy activates these X-ray binary sources, with both luminosity and temperature proportional to the mass to radius ratio of the accreting (e.g. black hole, neutron star, or white dwarf) star. There are two main types of X-ray binaries: high-mass and low-mass. In high-mass binaries, the nondegenerate star (a star NOT composed primarily of degenerate matter such as electrons and neutrons stripped from atoms during gravitational collapse) is an early spectral type (O, B, or A) giant or supergiant; in low-mass binaries, the nondegenerate star is a middle or late main-sequence star with a mass approximately equal to that of our own Sun. Several X-ray binaries contain a pulsating X-ray source (which may be a magnetized, rotating neutron star), and the most luminous among them (such as Scorpius X-1 and Cygnus X-3) are also very strong variable radio sources which also sometimes emit radio flares.

REPRESENTATIVE NORTHERN HEMISPHERE ITEM: HERCULES X-1: A low-mass X-ray binary star in the constellation of Hercules (the low-mass optical companion (HZ Her) is of variable spectral type from A/F to B due to X-ray heating). Hercules X-1 exhibits regular (every 1.24 seconds) X-ray pulsations, binary companion star eclipses every 1.75 days, and longer-period modulations (35-day cycles) of X-ray intensity. Hercules X-1 was the first X-ray binary to be optically identified. The mass and rapid pulsations of the X-ray component suggest that it is a rotating neutron star; it is thus often referred to as an X-ray pulsar.

REPRESENTATIVE SOUTHERN HEMISPHERE ITEM: CENTAURUS X-3: The first X-ray binary to be discovered; it is located in the constellation Centaurus. It is a high-mass X-ray binary (the optical companion is a 13th magnitude spectral type O-6.5 supergiant), with regular X-ray eclipses observed every 2.09 days, with rapid pulsations of the X-ray source (a 4.8 second period), related to the rotation of a magnetized neutron star. Centaurus X-3 is thus also known as an X-ray pulsar.

CLASS OF OBJECT: IRREGULAR GALAXY: Galaxies are giant collections of stars, gases, and dust into which most of the visible matter in our universe is located. One type of galaxy is known as an irregular galaxy. Unlike spiral or elliptical galaxies, which have some discernable symmetry, irregular galaxies have no symmetry in either shape or structure. They are highly variable in shape, but all of them are below average galaxy size. These systems contain large amounts of interstellar matter and much gas; the dust concentrations among them can be very variable however. When dwarf galaxies are included in the calculations, only about 10% of the brightest galaxies are irregular. Irregular galaxies contain about 100 million to 30 billion solar masses, and have diameters from 5,000 to 30,000 light years. They are as luminous as 10,000,000 to 2 billion suns, and have an absolute magnitude of anywhere between –13 to –18; they contain both old and young stars. Some galaxies (which used to be classified as irregular) are now more finely classified as starburst, active, and interacting galaxies.

REPRESENTATIVE NORTHERN HEMISPHERE OBJECT: M-82 (NGC 3034): This irregular galaxy is the only one of its kind (irregular) to be named as a Messier object. Its year 2000 coordinates are RA=9h 56.2 min, and its Dec.= +69 degrees and 42 seconds. It is about 9x4 minutes of arc in area, and is of magnitude 8.8 visually and 9.4 photographically. M-82 is at about the same distance from earth as it is from its famous neighbor, the spiral galaxy M-81. An eight-inch telescope at high power and with good seeing will show M-82 with a very condensed nucleus, as well as dusty patches crossing its well-defined surface. It has a small spectral red shift of about 325 kilometers per second.

REPRESENTATIVE SOUTHERN HEMISPHERE OBJECT: Magellanic Clouds (Large (LMC) and Small (SMC)): Two relatively small irregular galaxies (some texts call the LMC a barred spiral) that are nearby residents to our own Milky Way; both are Southern Hemisphere (only) naked-eye objects. The LMC has a diameter of about 10,000 parsecs, and is at a distance of 50,000 parsecs in the constellation of Dorado. The SMC is about 60,000 parsecs away in the constellation Toucan, and has a diameter of about 6,000 parsecs. Both these galaxies are rich in population I stars (metal-rich), and contain proportionately much more gas than the Milky Way. They share a cloud of cooler neutral hydrogen; this extends into the narrow Magellanic Stream which extends over 100 degrees of the southern sky. The Magellanic Clouds may be gravitationally bound to the Milky Way, but that has not yet been determined, although there appears to be at least some gravitational influence of the Milky Way. The LMC contains the beautiful Tarantula Nebula and the LMC Lagoon, and the SMC contains the magnificent globular Tucanae 47 at its western edge.

CLASS OF OBJECT: PULSARS: A celestial body which emits short duration (periods range from about 1.56 milliseconds to 4 seconds) radiation pulses at very regular intervals (from a fraction of a second to about 10 seconds). Pulsars with very short duration periods (less than 0.01 seconds) are among the class noted as millisecond pulsars. Most pulsars are single, but binary pulsars are also known. They are thought to be rotating neutron stars, extremely dense stars which are generated from high mass stellar explosions such as supernovae; however, some pulsars may also be generated by other processes, such as the accretion of gas onto a white dwarf. Pulsars were originally discovered at radio wavelengths; a few others have been discovered at optical, gamma-ray, and X-ray wavelengths. These gamma-ray and X-ray pulsars will not be discussed in detail here. The first radio pulsar, PSR 1919+21, was detected by Antony Hewish and Jocelyn Bell during a study of atmospheric scintillation. More than 500 radio pulsars are now known; the Milky Way galaxy is thought to have about 100,000 of them. The received pulses occur when a beam of radio waves, emitted by a rotating neutron star, sweeps past Earth; this beam of radiation arises from electrons moving within the neutron star's strong magnetic field (the direction of which differs from that of the pulsar's rotational axis). The actual emission site of the beam (e.g., the magnetic poles; near the star, or further out) is still in some dispute. The period of all radio pulsars is gradually lengthening as the parent neutron star loses rotational energy. The central star of the Crab Nebula, the youngest known pulsar, is slowing at a rate of one part in a million per day. A steady slow down rate can also be interrupted or changed by rearrangements of the crust or core of the parent neutron star. The Crab and Vela pulsars' slow down rate are thought to be interrupted in this way; these two pulsars are optical radio pulsars.

REPRESENTATIVE NORTHERN HEMISPHERE OBJECT: CRAB NEBULA (M-1; NGC 1952) The star whose explosion produced the Crab nebula is an optical pulsar (Crab pulsar NP-0532; discovered in 1967). Its pulsations are also observed at radio, infrared, X-ray, and gamma-ray wavelengths; these pulsations have a period of only 0.0331 seconds. The energy loss by the highly energetic electrons mentioned above equals the total energy lost by the Crab nebula; ultraviolet aspects of this radiation ionizes the gas in the filaments, causing the atoms to fluoresce. It is associated with a supernova remnant; in fact, the Crab nebula is the prototype member of the class of filled supernova remnants, known as plerions.

REPRESENTATIVE SOUTHERN HEMISPHERE OBJECT: VELA PULSAR: The second optical pulsar discovered (1977). With a brightness of only 26 magnitudes, it is much fainter than the Crab pulsar, although it is 4 times nearer (about 500 parsecs). It is known to emit pulses of radio emission in a period of every 0.089 seconds, and gamma ray pulses twice every revolution (at gamma-ray wavelengths, it is the brightest object in the sky). The Vela pulsar is a young pulsar (about 10,000 years old). The associated supernova remnant (Vela-X) has been observed at X-ray, XUV, optical, and radio wavelengths.

CLASS OF OBJECT: B-STARS: Massive hot blue ultraviolet stars of spectral type B that have surface temperatures of about 10,000 to 28,000 Kelvin for main-sequence stars and up to 30,000 Kelvin for supergiants. Absorption lines of neutral helium (He-I) dominate the spectrum. Balmer lines of hydrogen intensify from B-0 to B-9, with lines of ionized magnesium and silicon also present. Some B-stars – the B-E stars - have emission lines emanating from a circumstellar shell of gas. B-0, B-1, and B-2 stars are found in OB associations (groups of highly luminous and massive main-sequence stars of spectral types O and B) found in the gas and dust-rich areas of the spiral arms of galaxies.

REPRESENTATIVE NORTHERN HEMISPHERE OBJECT: BELLATRIX: A remote very luminous blue-white giant that is the third brightest star in the constellation of Orion (as we face Orion and he "looks" at Earth, his sword (the Great Orion Nebula) hangs down on his right (our left); Bellatrix is thus the bright star we see in his opposite (to the sword), or left, shoulder (Betelgeuse is thus his right shoulder). Bellatrix has a visual magnitude of 1.6; spectral type B-2-III; and a distance of 110 parsecs.

REPRESENTATIVE SOUTHERN HEMISPHERE OBJECT: ALPHA CRUCIS: The brightest in the constellation Crux, this bright white star is actually a visual binary with a separation of 4"; both components are spectroscopic binaries. The visual magnitude of component A is 1.3; component B is 1.7; together their visual magnitude is 0.76. The spectral type of component A is B-1 (IV) and component B is B-1 (V); the distance to the system is 160 parsecs.

ASTRONOMICAL NOTES -- ON & OFF THE WEB…

NGC-4710'S BAFFLING BOXY BULGE

Just as many people are surprised to find themselves packing on unexplained weight around the middle, astronomers find the evolution of bulges in the centers of spiral galaxies puzzling. A recent Hubble Space Telescope image of NGC 4710 is part of a survey that astronomers have conducted to learn more about the formation of bulges, which are a substantial component of most spiral galaxies. When targeting spiral galaxy bulges, astronomers often seek edge-on galaxies, as their bulges are more easily distinguishable from the disc.

Still an astrophysical mystery, the evolution of the bulges in spiral galaxies led astronomers to the edge-on galaxy NGC 4710. When staring directly at the centre of the galaxy, one can detect a faint, ethereal "X"-shaped structure. Such a feature, which astronomers call a "boxy" or "peanut-shaped" bulge, is due to the vertical motions of the stars in the galaxy's bar and is only evident when the galaxy is seen edge-on. This curiously shaped puff is often observed in spiral galaxies with small bulges and open arms, but is less common in spirals with arms tightly wrapped around a more prominent bulge, such as NGC 4710. Image credit: NASA & ESA

This exceptionally detailed edge-on view of NGC 4710 taken by the Advanced Camera for Surveys (ACS) aboard Hubble reveals the galaxy's bulge in the brightly colored centre. The luminous, elongated white plane that runs through the bulge is the galaxy disc. The disc and bulge are surrounded by eerie-looking dust lanes. NGC 4710 is a member of the giant Virgo Cluster of galaxies and lies in the northern constellation of Coma Berenices (the Hair of Queen Berenice). It is not one of the brightest members of the cluster, but can easily be seen as a dim elongated smudge on a dark night with a medium-sized amateur telescope.

In the 1780s, William Herschel discovered the galaxy and noted it simply as a "faint nebula". It lies about 60 million light-years from the Earth and is an example of a lenticular or S0-type galaxy – a type that seems to have some characteristics of both spiral and elliptical galaxies.

Astronomers are scrutinizing these systems to determine how many globular clusters they host. Globular clusters are thought to represent an indication of the processes that can build bulges. Two quite different processes are believed to be at play regarding the formation of bulges in spiral galaxies: either they formed rather rapidly in the early Universe, before the spiral disc and arms formed; or they built up from material accumulating from the disc during a slow and long evolution. In this case of NGC 4710, researchers have spotted very few globular clusters associated with the bulge, indicating that its assembly mainly involved relatively slow processes. http://www.spacetelescope.org/news/html/heic0914.html

SMALLEST OBJECT EVER SEEN IN THE KUIPER BELT

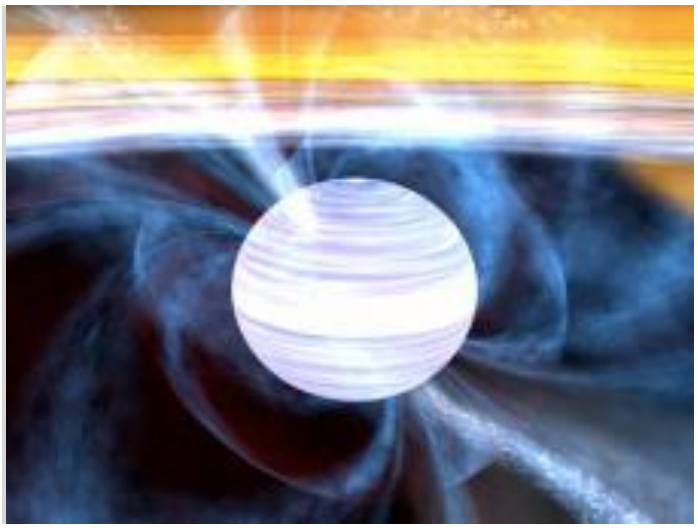
Hubble Space Telescope has discovered the smallest object ever seen in visible light in the Kuiper Belt, a vast ring of icy debris that is encircling the outer rim of the solar system just beyond Neptune. The needle-in-a-haystack object found by Hubble is only 3,200 feet across and a whopping 4.2 billion miles away. The smallest Kuiper Belt Object (KBO) seen previously in reflected light is roughly 30 miles across, or 50 times larger. This is the first observational evidence for a population of comet-sized bodies in the Kuiper Belt that are being ground down through collisions. The Kuiper Belt is therefore collisionally evolving, meaning that the region's icy content has been modified over the past 4.5 billion years. The object detected by Hubble is so faint — at 35th magnitude — it is 100 times dimmer than what Hubble can see directly. So then how did the space telescope uncover such a small body? Hilke Schlichting, and her collaborators report that the telltale signature of the small vagabond was extracted from Hubble's pointing data, not by direct imaging. Hubble has three optical instruments called Fine Guidance Sensors (FGS). The FGSs provide high-precision navigational information to the space observatory's attitude control systems by looking at select guide stars for pointing. The sensors exploit the wavelike nature of light to make precise measurement of the location of stars.

Schlichting and her co-investigators determined that the FGS instruments are so good that they can see the effects of a small object passing in front of a star. This would cause a brief occultation and diffraction signature in the FGS data as the light from the background guide star was bent around the intervening foreground KBO. They selected 4.5 years of FGS observations for analysis. Hubble spent a total of 12,000 hours during this period looking along a strip of sky within 20 degrees of the solar system's ecliptic plane, where the majority of KBOs should dwell. The team analyzed the FGS observations of 50,000 guide stars in total. Scouring the huge database, Schlichting and her team found a single 0.3-second-long occultation event. This was only possible because the FGS instruments sample changes in starlight 40 times a second. The duration of the occultation was short largely because of the Earth's orbital motion around the Sun. They assumed the KBO was in a circular orbit and inclined 14 degrees to the ecliptic. The KBO's distance was estimated from the duration of the occultation, and the amount of dimming was used to calculate the size of the object. "*I was very thrilled to find this in the data*," says Schlichting.

Hubble observations of nearby stars show that a number of them have Kuiper-Belt–like disks of icy debris encircling them. These disks are the remnants of planetary formation. The prediction is that over billions of years the debris should collide, grinding the KBO-type objects down to ever smaller pieces that were not part of the original Kuiper Belt population. The finding is a powerful illustration of the capability of archived Hubble data to produce important new discoveries. In an effort to uncover additional small KBOs, the team plans to analyze the remaining FGS data for nearly the full duration of Hubble operations since its launch in 1990.

PULSARS MAKE "GALACTIC GPS" POSSIBLE – HELP IN SEARCH FOR GRAVITATIONAL WAVES

Radio astronomers have uncovered 17 millisecond pulsars in our galaxy by studying unknown high-energy sources detected by Fermi Gamma-ray Space Telescope. The astronomers made the discovery in less than three months. Such a jump in the pace of locating these hard-to-find objects holds the promise of using them as a kind of "galactic GPS" to detect gravitational waves passing near Earth. A pulsar is the rapidly spinning and highly magnetized core left behind when a massive star explodes. Because only rotation powers their intense gamma-ray, radio and particle emissions, pulsars gradually slow as they age. But the oldest pulsars spin hundreds of times per second -- faster than a kitchen blender. These millisecond pulsars have been spun up and rejuvenated by accreting matter from a companion star. "*Radio astronomers discovered the first millisecond pulsar 28 years ago*," said Paul Ray. "*Locating them with all-sky radio surveys requires immense time and effort, and we've only found a total of about 60 in the disk of our galaxy since then. Fermi points us to specific targets. It's like having a treasure map*."



Pulsars slow down their rotation as they age and eventually cease their characteristic emissions. That can change if an aging pulsar is a member of a binary system containing a normal star. Gas flowing from the star can spin the pulsar up to hundreds of revolutions a second and allow it to resume its lighthouse-like beams of radiation. Credit: NASA

Millisecond pulsars are nature's most precise clocks, with long-term, sub-microsecond stability that rivals human-made atomic clocks. Precise monitoring of timing changes in an all-sky array of millisecond

pulsars may allow the first direct detection of gravitational waves -- a long-sought consequence of Einstein's relativity theory. "*The Global Positioning System uses time-delay measurements among satellite clocks to determine where you are on Earth*," explained Scott Ransom. "*Similarly, by monitoring timing changes in a constellation of suitable millisecond pulsars spread all over the sky, we may be able to detect the cumulative background of passing gravitational waves*."

The sources Fermi detected are not associated with any known gamma-ray emitting objects and did not show evidence of pulsing behavior. However, scientists considered it likely that many of the unidentified sources would turn out to be pulsars.

For a more detailed look at radio wavelengths, Ray organized the Fermi Pulsar Search Consortium and recruited a handful of radio astronomers with expertise in using five of the world's largest radio telescopes -- the National Radio Astronomy Observatory, Robert C. Byrd Green Bank Telescope in W.Va., the Parkes Observatory in Australia, the Nancay Radio Telescope in France, the Effelsberg Radio Telescope in Germany, and the Arecibo Telescope in Puerto Rico.

After studying approximately 100 targets, and with a computationally intensive data analysis still under way, the discoveries have started to pour in. "*Other surveys took a decade to find as many of these pulsars as we have*," said Ransom, who led one of the discovery groups. "*Having Fermi tell us where to look is a huge advantage*." Four of the new objects are "black widow" pulsars, so called because radiation from the recycled pulsar is destroying the companion star that helped spin it up. "*Some of these stars are whittled down to masses equivalent to tens of Jupiters*," said Ray. "*We've doubled the known number of these systems in the galaxy's disk, and that will help us better understand how they evolve*." For images and animations related to this release, visit: http://www.nasa.gov/fermi

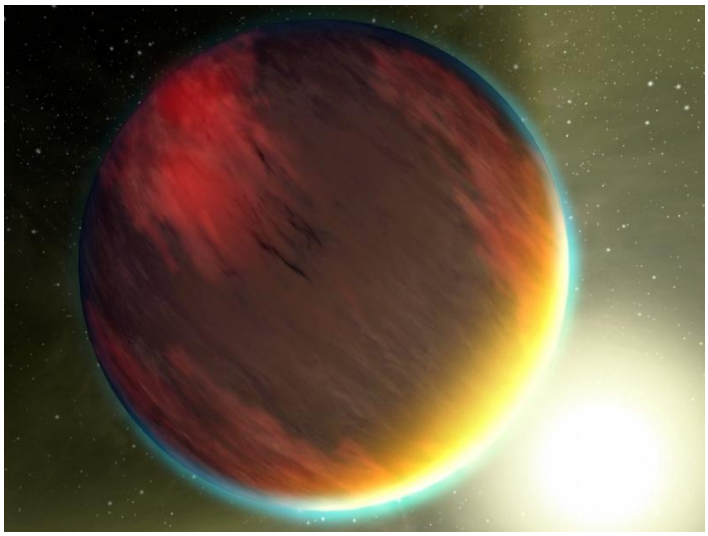
KEPLER SPACE TELESCOPE, DESIGNED TO FIND EARTH-LIKE PLANETS, DISCOVERS FIVE EXOPLANETS

The Kepler space telescope, designed to find Earth-size planets in the habitable zone of sun-like stars, has discovered its first five new exoplanets, or planets beyond our solar system. Kepler's high sensitivity to both small and large planets enabled the discovery of the exoplanets, named Kepler 4b, 5b, 6b, 7b and 8b. The discoveries were announced by the members of the Kepler science team during. "*These observations contribute to our understanding of how planetary systems form and evolve from the gas and dust disks that give rise to both the stars and their planets*," said William Borucki, the mission's science principal investigator. "*The discoveries also show that our science instrument is working well. Indications are that Kepler will meet all its science goals*."

Known as "hot Jupiters" because of their high masses and extreme temperatures, the new exoplanets range in size from similar to Neptune to larger than Jupiter. They have orbits ranging from 3.3 to 4.9 days. Estimated temperatures of the planets range from 2,200 to 3,000 degrees Fahrenheit, hotter than molten lava and much too hot for life as we know it. All five of the exoplanets orbit stars hotter and larger than Earth's sun.

"*It's gratifying to see the first Kepler discoveries rolling off the assembly line*," said Jon Morse. "We expected Jupiter-size planets in short orbits to be the first planets Kepler could detect. It's only a matter of time before more Kepler observations lead to smaller planets with longer period orbits, coming closer and closer to the discovery of the first Earth analog."

Launched in March 2009, the Kepler mission continuously and simultaneously observes more than 150,000 stars. Kepler's science instrument, or photometer, already has measured hundreds of possible planet signatures that are being analyzed. While many of these signatures are likely to be something other than a planet, such as small stars orbiting larger stars, ground-based observatories have confirmed the existence of the five exoplanets.



This artist's concept shows a cloudy Jupiter-like planet that orbits very close to its fiery hot star. NASA/JPL-Caltech/T. Pyle (SSC)

The discoveries are based on approximately six weeks' worth of data collected since science operations began on May 12, 2009. Kepler looks for the signatures of planets by measuring dips in the brightness of stars. When planets cross in front of, or transit, their stars as seen from Earth, they periodically block the starlight. The size of the planet can be derived from the size of the dip. The temperature can be estimated from the characteristics of the star it orbits and the planet's orbital period. Kepler will continue science operations until at least November 2012. It will search for planets as small as Earth, including those that orbit stars in a warm habitable zone where liquid water could exist on the surface of the planet. Since transits of planets in the habitable zone of solar-like stars occur about once a year and require three transits for verification, it is expected to take at least three years to locate and verify an Earth-size planet. According to Borucki, Kepler's continuous and long-duration search should greatly improve scientists' ability to determine the distributions of planet size and orbital period in the future. "*Today's discoveries are a significant contribution to that goal*," Borucki said. "*The Kepler observations will tell us whether there are many stars with planets that could harbor life, or whether we might be alone in our galaxy*." For more information about the Kepler mission, visit: http://www.nasa.gov/kepler

CENTURIES-OLD EPSILON AURIGAE MYSTERY COMING TO A CLOSE

For almost two centuries, humans have looked up at a bright star called Epsilon Aurigae and watched with their own eyes as it seemed to disappear into the night sky, slowly fading before coming back to life again. Today, as another dimming of the system is underway, mysteries about the star persist. Though astronomers know that Epsilon Aurigae is eclipsed by a dark companion object every 27 years, the nature of both the star and object has remained unclear. Now, new observations from Spitzer Space Telescope – in combination with archived ultraviolet, visible and other infrared data-- point to one of two competing theories, and a likely solution to this age-old puzzle. One theory holds that the bright star is a massive supergiant, periodically

eclipsed by two tight-knit stars inside a swirling, dusty disk. The second theory holds that the bright star is in fact a dying star with a lot less mass, periodically eclipsed by just a single star inside a disk. The Spitzer data strongly support the latter scenario. "*We've really shifted the balance of the two competing theories*," said Donald Hoard. "*Now we can get busy working out all the details*."

Epsilon Aurigae can be seen at night from the northern hemisphere with the naked eye, even in some urban areas. Last August, it began its roughly two-year dimming, an event that happens like clockwork every 27.1 years and results in the star fading in brightness by one-half. Professional and amateur astronomers around the globe are watching, and the International Year of Astronomy 2009 marked the eclipse as a flagship "citizen science" event. More information is at http://www.citizensky.org

Astronomers study these eclipsing binary events to learn more about the evolution of stars. Because one star passes in front of another, additional information can be gleaned about the nature of the stars. In the case of Epsilon Aurigae, what could have been a simple calculation has instead left astronomers endlessly scratching their heads. Certain aspects of the event, for example the duration of the eclipse, and the presence of "wiggles" in the brightness of the system during the eclipse, have not fit nicely into models. Theories have been put forth to explain what's going on, some quite elaborate, but none with a perfect fit. The main stumper is the nature of the naked-eye star -- the one that dims and brightens. Its spectral features indicate that it's a monstrous star, called an F supergiant, with 20 times the mass, and up to 300times the diameter, of our sun. But, in order for this theory to be true, astronomers had to come up with elaborate scenarios to make sense of the eclipse observations. They said that the eclipsing, companion star must actually be two so-called B stars surrounded by an orbiting disk of dusty debris. And some scenarios were even more exotic, calling for black holes and massive planets. A competing theory proposed that the bright star was actually a less massive, dying star. But this model had holes too. There was no simple solution.

Hoard became interested in the problem from a technological standpoint. He wanted to see if Spitzer, whose delicate infrared arrays are too sensitive to observe the bright star directly, could be coaxed to observe it using a clever trick. "*We pointed the star at the corner off our of Spitzer's pixels, instead of directly at one, to effectively reduce its sensitivity*." What's more, the observation used exposures lasting only one-hundredth of a second -- the fastest that images can be obtained by Spitzer. The resulting information, in combination with past Spitzer observations, represents the most complete infrared data set for the star to date. They confirm the presence of the companion star's disk, without a doubt, and establish the particle sizes as being relatively large like gravel rather than like fine dust.

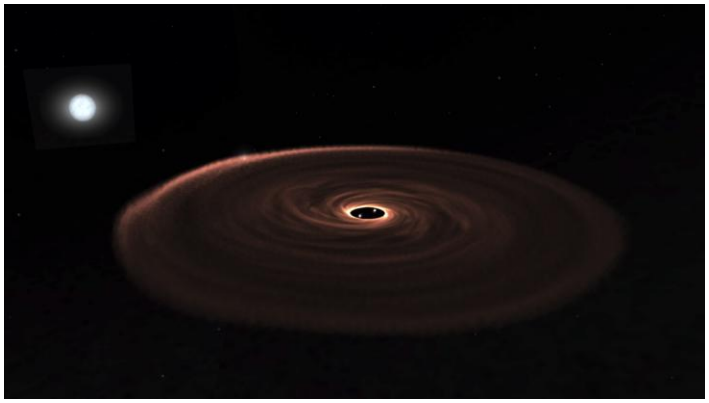
But Hoard and his colleagues were most excited about nailing down the radius of the disk to approximately four times the distance between Earth and the sun. This enabled the team to create a multi-wavelength model that explained all the features of the system. If they assumed the F star was actually a much less massive, dying star, and they also assumed that the eclipsing object was a single B star embedded in the dusty disk, everything snapped together. "*It was amazing how everything fell into place so neatly*," said Steve Howell. "*All the features of this system are interlinked, so if you tinker with one, you have to change another. It's been hard to get everything to fall together perfectly until now*." According to the astronomers, there are still many more details to figure out. The ongoing observations of the current eclipse should provide the final clues needed to put this mystery of the night sky to rest. http://www.spitzer.caltech.edu/spitzer and http://www.nasa.gov/spitzer

2010: The Year of the Baffling Epsilon Aurigae Eclipse

As 2010 begins, the first phase of a puzzling astronomical transformation comes to an end. In August 2009, amateur and professional astronomers reported that the bright star epsilon Aurigae had begun to lose brightness for the first time in 27 years. It is believed that the dimming of the star's light is caused by an eclipsing object of an unknown nature. The first phase of the eclipse involved a dramatic drop in brightness over the course of a few months beginning in August. Professional and amateur astronomers teamed up to monitor the eclipse and have announced that this critical phase just ended around New Years Day, 2009.

Under normal circumstances, the star is bright enough to be seen from even the brightest of cities with just the naked eye. During eclipse, it nearly disappears from the skies of a naked eye urban astronomer. One needs to be in a darker suburb to easily see it without helpful equipment such as binoculars. "*We have increasing evidence that a dark disk of material has moved in front of our view of epsilon Aurigae*," said Dr. Robert Stencel, Scientific Advisor for the project. "*But the exact shape and make-up of the disk has been unknown, but will be better defined soon. To make things even more challenging for us, some think there are multiple stars in the system, and perhaps planets spiraling into one of the stars*." Even during the eclipse, the star is so bright that sensitive equipment in professional observatories can have trouble monitoring it's brightness in the optical wavelengths. Furthermore, large telescopes cannot afford to monitor one star continuously. This is where amateurs and citizen scientists step in.

"*Amateurs are the ideal astronomers for this project. Either with their naked eye or with digital cameras, they have proven that they can record professional quality data. They are also distributed around the world, which helps eliminate problems such as bad weather and equipment breakdowns*," said Dr. Arne Henden, director of the American Association of Variable Star Observers (AAVSO) and Principal Investigator of the project.



Still from planetarium trailer video about epsilon Aurigae. Credit: The California Academy of Sciences Visualization Studio, and Citizen Sky (www.citizensky.org).

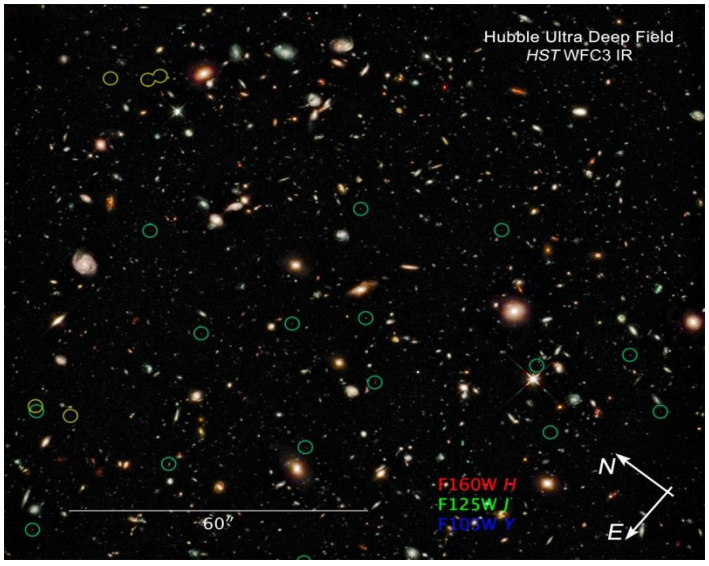
"*Just looking at the coverage in the visual data alone, I can already see interesting changes in the star that have never been seen so clearly before*," Stencel said. "Dr. Bob", as the amateur astronomy community knows him, studied the last event in 1982-84 while working at NASA. If past eclipses are any guide, then this dark stage will last nearly 18 months, followed by a rapid return to its normal brightness in the first half of 2011. However, the star's brightness will continue to vary a bit during this dark stage – so amateur and professional astronomers are needed to continue vigilant monitoring.

CitizenSky is recruiting, training, and coordinating public participation in this project. What makes this project different from previous citizen science projects is its emphasis on participation in the full scientific method. Participants are not being asked simply to collect data. They will also be trained to analyze data, create and test their own hypotheses, and to write papers for publication in professional astronomy journals. "*Since our launch in September 2009, over 2,000 participants have joined the project. Over 120 observers from 19 countries have submitted over 1,500 data points. However, most participants are participating in others ways. We have teams developing data analysis software, using robotic telescopes and even creating illustrations and diagrams to describe different models of the system*," Henden said.

HUBBLE REACHES "UNDISCOVERED COUNTRY" OF PRIMEVAL GALAXIES

The Hubble Space Telescope has broken the distance limit for galaxies and uncovered a primordial population of compact and ultra-blue galaxies that have never been seen before. The deeper Hubble looks into space, the farther back in time it looks, because light takes billions of years to cross the observable universe. This makes Hubble a powerful "time machine" that allows astronomers to see galaxies as they were 13 billion years ago, just 600 million to 800 million years after the Big Bang. The data from Hubble's new infrared camera, the Wide Field Camera 3 (WFC3), on the Ultra Deep Field (taken in August 2009) have been analyzed by no less than five international teams of astronomers. A total of 15 papers have been submitted to date by astronomers worldwide.

"*With the rejuvenated Hubble and its new instruments, we are now entering unchartered territory that is ripe for new discoveries*," says Garth Illingworth, Santa Cruz, leader of the survey team that was awarded the time to take the new WFC3 infrared data on the Hubble Ultra Deep Field (imaged in visible light by the Advanced Camera for Surveys in 2004). "*The deepest-ever near-infrared view of the universe — the HUDF09 image — has now been combined with the deepest-ever optical image — the original HUDF (taken in 2004) — to push back the frontiers of the searches for the first galaxies and to explore their nature*," Illingworth says.



Rychard Bouwens of, a member of Illingworth's team and leader of a paper on the striking properties of these galaxies, says that, "the faintest galaxies are now showing signs of linkage to their origins from the first stars. They are so blue that they must be extremely deficient in heavy elements, thus representing a population that has nearly primordial characteristics." James Dunlop, agrees. "*These galaxies could have roots stretching into an earlier population of stars. There must be a substantial component of galaxies beyond Hubble's detection limit*."

The existence of these newly found galaxies pushes back the time when galaxies began to form to before 500-600 million years after the Big Bang. This is good news for astronomers building the much more powerful James Webb Space Telescope (planned for launch in 2014), which will allow astronomers to study the detailed nature of primordial galaxies and discover many more even farther away. There should be a lot for Webb to hunt for.

The deep observations also demonstrate the progressive buildup of galaxies and provide further support for the hierarchical model of galaxy assembly where small objects accrete mass, or merge, to form bigger objects over a smooth and steady but dramatic process of collision and agglomeration. It's like streams merging into tributaries and then into a bay. These galaxies are as small as $1/20^{th}$ the Milky Way's diameter," reports Pascal Oesch. "*Yet they are the very building blocks from which the great galaxies of today, like our own Milky Way, ultimately formed*," explains Marcella Carollo. Oesch and Carollo are members of Illingworth's team. These newly found objects are crucial to understanding the evolutionary link between the birth of the first stars, the formation of the first galaxies, and the sequence of evolutionary events that resulted in the assembly of our Milky Way and the other "mature" elliptical and majestic spiral galaxies in today's universe.

The HUDF09 team also combined the new Hubble data with observations from Spitzer Space Telescope to estimate the ages and masses of these primordial galaxies. "*The masses are just 1 percent of those of the Milky Way,*" explains team member Ivo Labbe, leader of two papers on the data from the combined NASA Great Observatories. He further noted that "*to our surprise, the results show that these galaxies at 700 million years after the Big Bang must have started forming stars hundreds of millions of years earlier, pushing back the time of the earliest star formation in the universe*." The results are gleaned from the HUDF09 observations, which are deep enough at near-infrared wavelengths to reveal galaxies at redshifts from z=7 to beyond redshift z=8. (The redshift value z is a measure of the stretching of the wavelength or "reddening" of starlight due to the expansion of space.) The clear detection of galaxies between z=7 and z=8.5 corresponds to "look-back times" of approximately 12.9 billion years to 13.1 billion years ago."*This is about as far as we can go to do detailed science with the new HUDF09 image. This shows just how much the James Webb Space Telescope (JWST) is needed to unearth the secrets of the first galaxies*," says Illingworth. The challenge is that spectroscopy is needed to provide definitive redshift values, but the objects are too faint for spectroscopic observations (until JWST is launched). Therefore, the redshifts are inferred by the galaxies' apparent colors through a now very well-established technique.

The teams are finding that the number of galaxies per unit of volume of space drops off smoothly with increasing distance, and the HUDF09 team has also found that the galaxies become surprisingly blue intrinsically. The ultra-blue galaxies are extreme examples of objects that appear so blue because they may be deficient in heavier elements, and as a result, quite free of the dust that reddens light through scattering. A longstanding problem with these findings is that it still appears that these early galaxies did not put out enough radiation to "reionize" the early universe by stripping electrons off the neutral hydrogen that cooled after the Big Bang. This "reionization" event occurred between about 400 million and 900 million years after the Big

Bang, but astronomers still don't know which sources of light caused it to happen. These new galaxies are being seen right in this important epoch in the evolution of the universe.

Perhaps the density of very faint galaxies below the current detection limit is so high that there may be enough of them to support reionization. Or there was an earlier wave of galaxy formation that decayed and then was "rebooted" by a second wave of galaxy formation. Or , possibly the early galaxies were extraordinarily efficient at reionizing the universe. Due to these uncertainties it is not clear what type of object or evolutionary process did the "heavy lifting" by ionizing the young universe. The calculations remain rather uncertain, and so galaxies may do more than currently expected, or astronomers may need to invoke other phenomena such as mini-quasars (active supermassive black holes in the cores of galaxies) — current estimates suggest however that quasars are even less likely than galaxies to be the cause of reionization. This is an enigma that still challenges astronomers and the very best telescopes.

"*As we look back into the epoch of the first galaxies in the universe, from a redshift of 6 to a redshift of 8 and possibly beyond, these new observations indicate that we are likely seeing the end of reionization, and perhaps even into the reionization era, which is the last major phase transition of the gas in the universe*," says Rogier Windhorst, leader of one of the other teams that analyzed the WFC3 data. "*Though the exact interpretation of these new results remains under debate, these new WFC3 data may provide an exciting new view of how galaxy formation proceeded during and at the end of the reionization era*." Hubble's WFC3/IR camera was able to make deep exposures to uncover new galaxies at roughly 40 times greater efficiency than its earlier infrared camera that was installed in 1997. The WFC3/IR brought new infrared technology to Hubble and accomplished in four days of observing what would have previously taken almost half a year for Hubble to do.

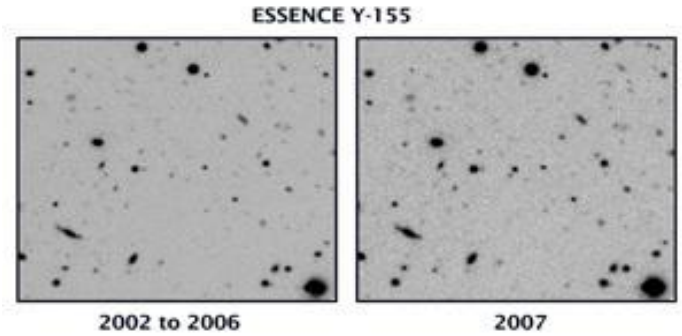
A SUPERNOVA STARTED BY RUNAWAY ANTI-MATTER EXPLOSION

Astronomer Peter Garnavich and a team of collaborators have discovered a distant star that exploded when its center became so hot that matter and anti-matter particle pairs were created. The star, dubbed Y-155, began its life around 200 times the mass of the sun but probably became "pair-unstable" and triggered a runaway thermonuclear reaction that made it visible nearly halfway across the universe. Garnavich and his collaborators discovered the exploding star during the ESSENCE supernova search that identified more than 200 weaker stellar explosions. "*ESSENCE found many explosions in our 6 years of searching, but Y-155 stood out as the most powerful and unusual of all our discoveries*," Garnavich said. Y-155 exploded about 7 billion years ago, when the universe was half its current age. It was discovered in the constellation Cetus (just south of Pisces) with the National Optical Astronomy Observatory's (NOAO) 4-m Blanco telescope in Chile in November 2007 during the last weeks of the six-year ESSENCE project. The Keck 10-m telescope in Hawaii, the 6.5-m Magellan telescope in Chile, and the MMT telescope in Arizona rapidly focused on the new star, revealing that the wavelengths of light emitted from the supernova were stretched or "redshifted" by 80 percent due to the expansion of the universe.

Once the distance to the explosion was established, Garnavich and his collaborators calculated that, at its peak, Y-155 was generating energy at a rate 100 billion times greater than the sun's output. To do this, Y-155 must have synthesized between 6 and 8 solar masses of radioactive nickel. It is the decay of radioactive elements that drives the light curves of supernovae. A normal "Type Ia" thermonuclear supernova makes about one tenth as much radioactive nickel.

"*In our images, Y-155 appeared a million times fainter than the unaided human eye can detect, but that is because of its enormous distance*," Garnavich said. "*If Y-155 had exploded in the Milky Way it would have knocked our socks off*."

Over 40 years ago scientists proposed that massive stars could become unstable through the production of matter/anti-matter particle pairs, but only recently have large-scale searches of the sky, like the ESSENCE project, permitted the discovery of these bright, but rare, events.



The supernova can be seen in the image on the right (labeled "2007") as the small "dot" in the center of the image. Note that this "dot" is not seen in the image labeled "2002 to 2006".

Most stars bigger than eight times the sun's mass lose their battle with gravity and produce a "core-collapse" supernova or directly form a black hole. But there is a range of masses, 150 to 300 times the mass of the sun, where the pair-instability is thought to operate. Such massive stars are expected to form in pristine gas that has not been polluted with elements heavier than hydrogen and helium by early generations of stars. Deep imaging with the Large Binocular Telescope in Arizona shows that Y-155 originated in a very low mass host galaxy. On average, small galaxies have a low abundance of heavy atoms, so are excellent locations for pair-instability explosions.

The ESSENCE project was a six-year NOAO Survey Program **led by Christopher Stubbs of Harvard University (previously at UW and EAS speaker)** and included an international team of astronomers. The project was designed to precisely map the expansion history of the universe by discovering type Ia supernovae and using them as distance markers. The ultimate goal is to understand the mysterious dark energy that is driving the accelerating expansion.

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 at least two weeks prior to the next upcoming scheduled EAS meeting.

If you wish to contribute an article or suggestions to ***The Stargazer*** please contact Mark Folkerts by email or by telephone (425) 486-9733 or co-editor Bill O'Neil, at (774) 253-0747.

The Star Gazer

P.O. Box 12746
Everett, WA 98206

In January's StarGazer:

The next EAS Meeting is 6:00 pm, Saturday January 16th at the Aurora Astro products store near Silver Lake in SE Everett