# THE OBSERVER

The Astronomy Club of Tulsa's Newsletter Published Since 1937

RON WOOD NETA APPLE SCOTT ROKEBY JACK EASTMAN JENNIFER LAND BRAD YOUNG ANN BRUNN JOHN LAND


www.astrotulsa.com
The Astronomy Club of Tulsa.
DECEMBER 2011

# INSIDE NOTES

## THE COVER


Here we are at the end of the year again. I don't have much to say here, as we have 40 pages this month that I think, may be in the running for one of our best issues. I hope you all enjoy the Observer this month and I want to thank a few of my best contributors this past year, without whose help I could not do the observer. John Land, Ann Bruun, Ron Wood, Neta Apple, Jack Eastman, Brad Young, and photo contributions from Tamara Green and Rod Gallagher. Many others help as well and if I left your name off please accept my apologies as I will make a big deal out of you in another issue. You won't be forgotten.

## ASTRONOMER OF THE MONTH (COVER)

**This month we go way back and celebrate Anaximander (611-547 B.C., Ionian) who was a Greek philosopher who made the first detailed maps of the Earth and the sky. He knew that the Earth was round, and believed that it was free-floating and unsupported. He measured its circumference, and was the first to put forward the idea that celestial bodies make full circles in their orbits. One of his greatest contributions was the fact that he was the first to conceptualize space as having depth.**

**Cover background is the Christmas Tree Nebula from Astronomy Picture of the Day. Think about a tree laid down from left to right.**

## To Submit to the Observer:

**Email your article or content with pictures to jerrym@pantherenergy.us please put newsletter in the subject or it might not show up.**

## NEW MEMBER CORNER

1. **Joey Woodson**
2. **Ned Skinner**
3. **Marilyn Leaman**

**THE OBSERVER IS PUBLISHED BY: JERRY MULLENNIX**

# FEATURES


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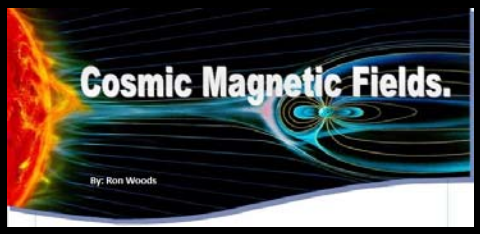


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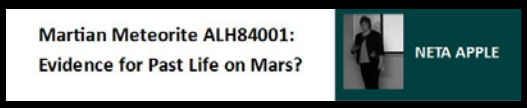


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**MIRA: A Real Shooting Star**

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# Guest Speaker


Come join the Astronomy Club of Tulsa as we welcome George Flickinger. George is Meteorologist with many years in the field. George now works for KJRH channel 2 where I am sure we have all seen him as he alerts us to Tornado conditions and other weather conditions that play such a huge part of Astronomy.

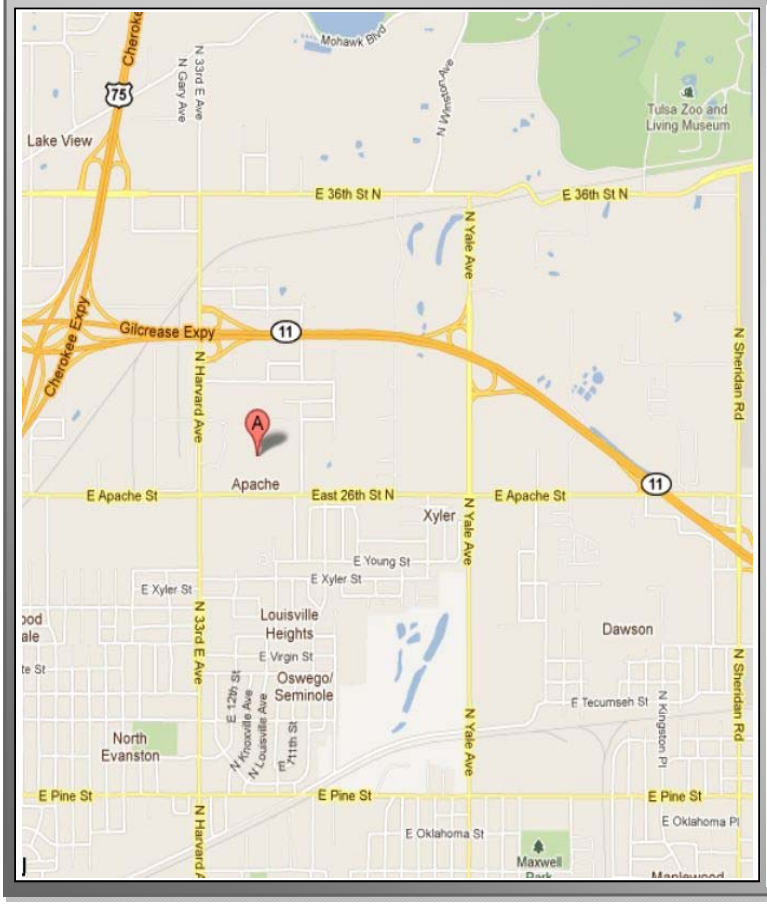
**Friday December 9, 2011 at 7:00 PM**

**Jim "O'Toole" Millers Astro Words of Wisdom:**

**"Cooking ants on the sidewalk using the sun and your eyepieces are bad for the coatings"**

## 3727 East Apache, Tulsa, OK 74115

## Room 1603 Building #2 Student Union




# PRESIDENTS MESSAGE

Ann Bruun

It's that time of year again when the weather turns cold, and the wind stings your skin. But it's also the time of year when the there are more hours of night and the skies turn crystal clear. We are lured out into the chill by the beautiful sights available only during the coldest months. I love seeing Orion lounging on the eastern horizon in the evening. That means the Pleiades are already up and the open clusters of Auriga are waiting for us. Yes the weather is harsh but amateur astronomers are a special breed. We put up with the discomfort often without even noticing because we are so captured by the mysteries we discover through our telescopes.

I hope everyone can make it out to the Meeting at TCC Northeast Friday, Dec. 9th. George Flickinger is going to give us a meteorologist's eye view of the Joplin tornado. Followed by an Astronomy 101 tour of some popular and useful websites. We have Sidewalk astronomy at Bass Pro Saturday Dec. 10th. There is a full moon that night so it should be gorgeous.

The results of the survey that was handed out at the dinner meeting have been tabulated. I would like to thank Catherine for putting the survey together and also thank everyone who participated. Look for a summary in this or the January newsletter. Many of you commented you would like to see more Astronomy 101s at the meetings. I agree. But, in order to keep up the Astro 101s we need volunteers to present them. You don't have to be an expert at something to talk about it. Just pick a topic you are interested in and do a little investigating. When I picked Globular clusters to talk about a couple of years ago I didn't know anything about them except that I like them. Please consider picking a topic and presenting an Astronomy 101. If you'd like to volunteer contact me at: act_pres@astrotulsa.com

I hope everyone has a wonderful holiday season and you all get the astronomy toys you are hoping for!

Ann Bruun

ACT President

## Lasers and Astronomy

By: Jerry Mullennix

I am sure most of you remember when we used to just point to an area of the sky with a finger to teach astronomy. Along came the green laser and from our perspective much changed in pointing our scopes and teaching astronomy. Although, I really wonder sometimes, how much astronomy we really teach when we turn them on and point them? It seems to me if the group is too young they lose all interest in astronomy and the questions turn to the laser itself. Sometimes it happens with much older groups.

I am writing this note because in the past week there were two incidents in the area of our observatory of lasers being pointed at aircraft. I seriously doubt any of our group had anything to do with these events, but It still does not hurt to point out the seriousness of such action anyway. **IT IS A FEDERAL CRIME TO POINT A LASER AT OR IN THE VICINITY OF ANY AIRCRAFT.** I can assure you the FBI does not take this lightly either, as they have contacted us in regards to finding the individual responsible.

One of my favorite things to do when I have time is read newspapers from other parts of the world to gain perspective. One article I read in a Russian newspaper had an article about a pilot on approach at night when he was hit with a green laser. It was the best description I've read of what happens in an aircraft when a laser shines in.

He said "because the cockpit is lights out except for instrumentation, when the laser shined in all of us in the cockpit saw nothing but the green glare that lit the cabin and it was extremely difficult to read my panel as I landed the plane. Some instruments went blank because they are green lit as well and could not be seen"

As astronomers we are acutely aware of how sensitive the pupil is to light and how long it takes the human eye to recover from light glare and build more purple visual, let alone if the pilot had been hit in the eye with a laser. It might never recover.

You couple this with the fact he has hundreds of lives depending on him to land that plane safely and it makes perfect sense the FBI would be hunting violators down as vigorously as if they had robbed a bank. Use lasers responsibly people's lives and freedom depend on it.


# Northern Lights and Astronauts!

By: Scott Rokeby

It was a dark a stormy night...well dark and windy any way, Kansas, so it was expected. Quite clear actually. I had drove to Wichita Sunday the 23rd of October with my friend Stephen for business, planning to stay through the week. Having checked my dark sky map I knew just east was some good dark sky viewing, so I brought my old 6 inch Meade while my friend lugged his 14" SCT (I am still trying to explain the concept of "portable" to him!). We hadn't really put together a plan for viewing, preferring to play it by ear, nor did either of us guess at the unexpected spectacle waiting to unfold for us Monday night.

After Monday's work was through we drove east for 60 miles looking for our chosen viewing spot, and eventually found a side road that we had scouted out the day before to set up the telescopes. We found our way back to it just after dark, but set up was never the less none to difficult. And we set about comparing views, his Meade 14 inch SCT against my Meade 628. It bugs him quite a bit that my 6 inch telescope provides views almost on par with his MUCH larger and MUCH more technical, ...and MUCH more expensive telescope! Great optics those 628s have!

It went this way for about an hour, until around nine o'clock with the occasional satellite passing overhead providing most of the excitement. And then....a light.

I can't really say "lights" as it was truly one light in the beginning, starting at the northern horizon and climbing to about 60 degrees in to the sky, extending from the east horizon to the west horizon. Soft at first, then gradually, over the course of 15 minutes getting brighter and brighter, a very deep red. Much like the red seen in pictures of the Orion Nebula. Gradually, through the next hour, an equally deep green began to rise from the northern horizon, eventually over taking half the red, and separated by a thin very pale white stripe going east to west! At one point I thought to myself, this must be what a Christmas present sees, wrapped in reds and greens with a white bow! And what an unexpected gift it was!

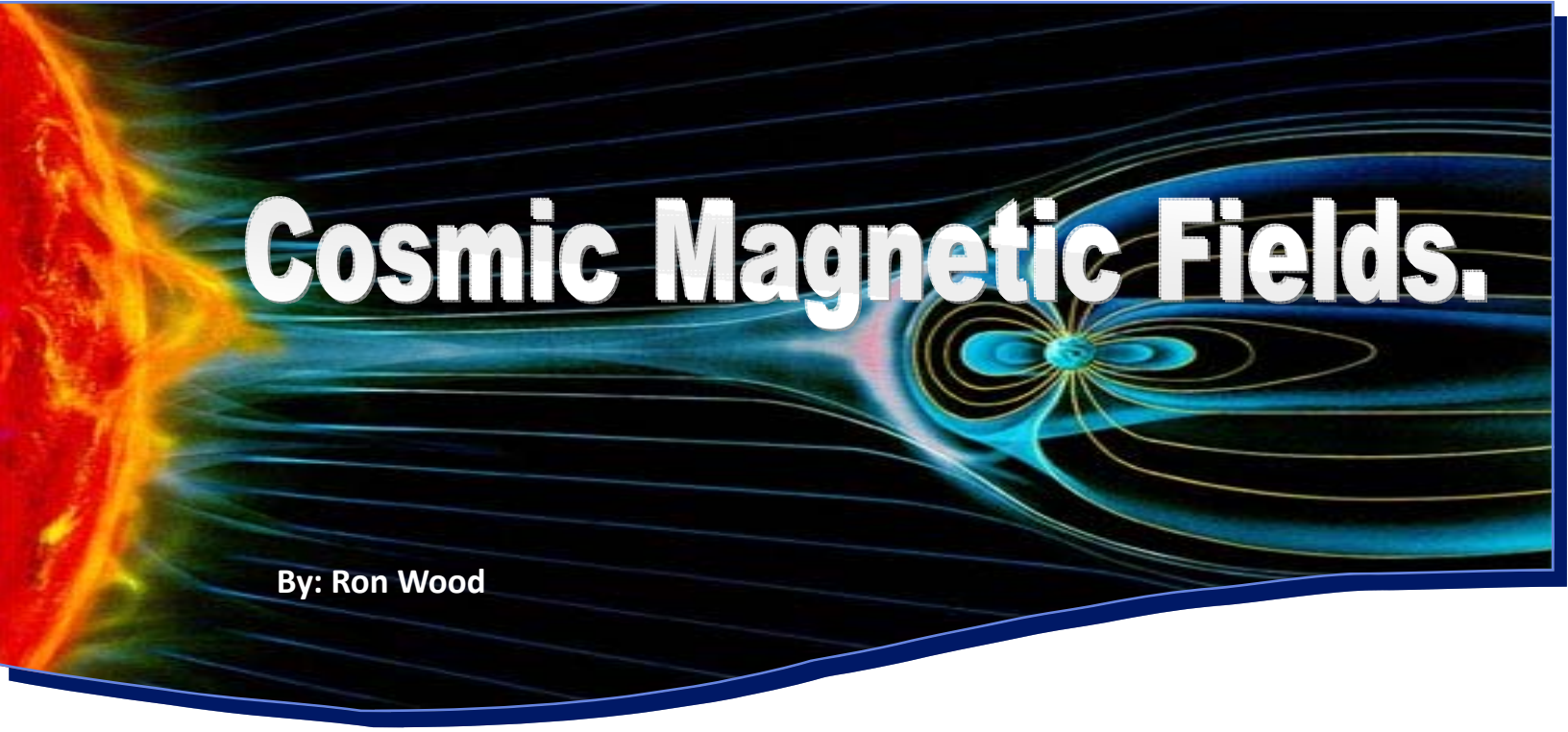
To be honest I truly couldn't believe my eyes, I kept running different reasons for the light through my head trying to find a more plausible explanation to what I was seeing. After eliminating car lights, afire of some kind, city lights reflected by an incoming fog bank and many more ideas, all I was left with was the Northern Lights!

As I said it was just happenstance that I was able to get out at all, so all I had with me was my cell phone for taking pictures and sadly, it simply wasn't up to the task. So instead, I simply craned my neck back and stared in amazement. Soaking in this extraordinary encounter with the primal force of a star. As unexpected as it was, and since there was only one other person with me, it seemed then and still does today, as if it was a show provided just for me! Of course I know millions saw it besides me, but there weren't millions there that night, just me and a fellow observer.

To sum up this experience is difficult. I didn't know I would see them that night, nor do I know when I'll see them again. But, as it is with many things we observe when we point our eyes up, the Northern Lights were both grand in their scale and simple in their beauty.

P.S. I may have exaggerated *slightly in comparing my 628 to the 14", just ever so slightly.*

*Note: Scott, be patient with your friend as those of us with severe aperture fever still see 14" as portable. Great article. Jerry*



# Cosmic Magnetic Fields.

By: Ron Wood

## IMPORTANCE OF MAGNETIC FIELDS

Magnetic fields are a dynamic component of the interstellar medium (ISM) in spiral, barred and irregular galaxies. They affect the gas flow in galaxy discs and halos. The reconnection of magnetic fields is a possible source of heating for the ISM. Magnetic braking is essential to star formation by enabling the removal of angular momentum from the collapsing protostellar cloud.

They contribute significantly to the total pressure which balances the ISM against gravity and they control the density and distribution of its cosmic rays. Magnetohydrodynamic turbulence distributes the energy from supernovas throughout the galaxy.

With the advent of increasingly powerful computers and new radio telescopes, amazing discoveries are being made at a rapid rate. Magnetars were recently discovered with an energy-to-mass field energy density 10^4 times greater than lead! In 2010 the discovery of the long sought primordial magnetic field dating to the Big Bang was announced! And this appears to be just the beginning.

## DEFINITION OF A MAGNETIC FIELD

Masses produce gravitational fields, charges produce electric fields and moving charges (currents) produce magnetic fields. All three of these fields are vectors meaning that they have a magnitude and a direction. In short they can be represented by arrows showing direction and magnitude similar to the wind velocity field on a weather map.

A magnetic field is said to exist at a point in space if an electric current placed there experiences a force. Magnetic fields are symbolized by the letter "B" usually printed in boldface indicating it is a vector quantity. This is the same B seen in Maxwell's equations. The common units of measurement for B are the "gauss" (G) and the "tesla" (T) which is equal to 10^4 G. The "E" seen in Maxwell's equations represents the electric field and is measured in units of "newtons/coulomb ."

## METHODS OF OBSERVATION

The study of cosmic magnetic fields is still in its early stages. The technology necessary for data gathering has become available only in recent years and the techniques used are limited and subtle. Many amateurs may be unfamiliar with these techniques so a brief survey seems in order.

Much of what is known about cosmic magnetic fields is based on the phenomenon of polarization. Most amateurs are familiar with the fact that electromagnetic waves consist of sinusoidally oscillating E and B fields oriented perpendicular to

each other and to the direction of propagation of the wave. If the E vector is confined to a plane then the wave is said to be plane polarized. In other cases the E vector may rotate around the direction of propagation producing circularly or even elliptically polarized light.

Light generated by the thermal motion of charged particles, as in ordinary starlight, is un-polarized, meaning that it contains a mix of waves with E fields randomly oriented in all directions. Such light, when passing through magnetic fields, can become polarized to a greater or lesser degree thus carrying information about the polarizing field to an observer.

Magnetic fields in our galaxy can be observed in the optical range via starlight, which becomes polarized by interstellar dust grains in the foreground. These grains are elongated and are aligned by the magnetic field perpendicular to the field lines. Such polarization measurement of many stars reveals a general picture of our galactic magnetic field near the Sun.

Aligned dust grains also emit polarized infrared emission, which is very useful to show magnetic fields in dust clouds in the Milky Way. Polarization observations with the forthcoming large radio telescopes will open a new era in the observation of cosmic magnetic fields and help us understand their origin.

A second important observational technique is based on the Zeeman effect. Most atoms have several electron configurations with the same energy so that transitions from all of these configurations to some other one correspond to a single spectral line. When a B field is present it interacts differently with electrons having different quantum numbers slightly modifying their original energy levels producing several closely spaced spectral lines where there was only one before. Since the distance between the Zeeman sub-levels is proportional to the magnetic field, this effect can be used by astronomers to measure the field strength of the Sun and other stars. Zeeman splitting of radio spectral lines allows for the measurement of relatively strong fields in nearby dense gas clouds in the Milky Way. A direct way of measuring the strength of a uniform magnetic field in the ISM is to measure Zeeman splitting of a radio transition in the interstellar gas.

A third technique for studying magnetic fields is based on the phenomenon called "Faraday rotation," which is an interaction between a polarized electromagnetic wave and a magnetic field causing a rotation of the plane of polarization. Measuring the angle of rotation of the plane is called a rotation

| TABLE OF REPRESENTATIVE FIELDS | |
|---|---|
| Smallest field measureable | 10^-22 G |
| Human brain | 10^-8 G |
| Intracluster fields. | 10^-6 G |
| Galactic field | .00001 G |
| Solar wind | .00005 G |
| Molecular cloud | .001 G |
| Earth surface | .5 G |
| Earth's core | 25 G |
| Refrigerator magnet | 50 G |
| Massive star | 1000 G |
| Sunspot | 1000 G |
| Jupiter | 1000 G |
| Rare earth magnet | 2000 G |
| MRI imaging | 15,000- 30,000 G |
| White dwarf | 10^6 G |
| Strongest artificial field (1998) | 2.8 X (10)^7 G |
| Neutron star | 10^12 G |
| New magnetar | 10^15 G |
| Neutron star upper limit | 10^17 G |

measurement (RM) and it indicates the field strength. Beginning in the 1960s, RMs from polarized extragalactic radio sources such as pulsars, led to the discovery that a large scale, organized magnetic field permeates the disk of our galaxy. This effect can be used to map fields in nearby galaxies by a rotation measurement on the polarized radiation from distant quasars which lie behind the galaxy being observed.

A fourth method of detection and measurement of magnetic fields is by observing the intensity and polarization of synchrotron radiation. When a charged particle enters a magnetic field it is forced into a circular or spiral path around the field lines. Curved motion is accelerated motion, and an accelerated charge radiates energy. For charges moving at relativistic speed this is called synchrotron radiation, and the radiated energy is proportional to the fourth power of the particle velocity. This radiation is highly polarized and its intensity and frequency depend on the strength of the magnetic field. It has a unique spectrum unlike black-body radiation and is referred to as a non-thermal source.

To maintain synchrotron radiation, a continual supply of relativistic electrons is necessary. Typically, these are supplied by very powerful energy sources such as neutron stars, quasars, or other forms of active galaxies. Synchrotron radiation at radio frequencies, sometimes called cyclotron radiation, is emitted by lower energy electrons as they spiral through magnetic fields such as those around Jupiter.

**IN THE FUTURE**

Many fundamental questions about the origin and evolution of cosmic magnetic fields remain unanswered, but the next generation of radio telescopes, such as LOFAR (Low Frequency Array) and the SKA (Square Kilometer Array) will supply a wealth of new data. LOFAR opens the window to the so-far unexplored low-energy synchrotron radio waves, emitted by cosmic-ray electrons in weak magnetic fields.

Very little is known about the origin and evolution of cosmic magnetic fields. The space around galaxies and between galaxies may all be magnetic, and LOFAR may be the first to detect weak radio emission from such regions. LOFAR will also measure the Faraday rotation to detect weak magnetic fields.

The Square Kilometer Array (SKA) is a radio telescope under development, which will have a total collecting area of approximately one square kilometer. It will operate over a wide range of frequencies and its size will make it 50 times more sensitive than any other radio instrument. It will be able to survey the sky more than ten thousand times faster than ever before. SKA will be built in the southern hemisphere, in either South Africa or Australia, where the view of our own galaxy is best and radio interference least. Construction of the SKA is scheduled to begin in 2016 with initial observations by 2019 and full operation by 2024.

# Dark Sky Site Committee

## Dark Sky Site Committee Update

Report By: Brad Young

Thanks to everyone who has helped get this committee moving. Jerry Mullennix, Steve Chapman, Lee Bickle, and I are the committee members, and will report occasionally on our progress.

The ACT Board has voted to have us perform the search, based on the proposal in last month's Newsletter. We are currently in the process of contacting the Bartlesville Club to see if there is any interest in sharing in the search.

Jerry and Steve have been out looking at various areas, typically north and west of Tulsa, in a preliminary search. I have not been much use to them yet, as I had shoulder surgery earlier this month and can't drive. Next month, I should be able to help more.

If you have any questions or suggestions, feel free to contact me, or post to the Yahoo Group board.

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## GINGERBREAD ASTRONOMERS

**Contributed By: Catherine Kahbi**

**Ingredients**

- 3 cups flour
- 2 teaspoons ground ginger
- 1 teaspoon ground cinnamon
- 1 teaspoon baking soda
- 1/4 teaspoon ground nutmeg
- 1/4 teaspoon salt
- 3/4 cup butter, softened
- 3/4 cup firmly packed brown sugar
- 1/2 cup molasses
- 1 egg

1 teaspoon vanilla extract

**Directions**

Mix flour, ginger, cinnamon, baking soda, nutmeg and salt in large bowl. Beat butter and brown sugar in large bowl with electric mixer on medium speed until light and fluffy. Add molasses, egg and vanilla; beat well. Gradually beat in flour mixture on low speed until well mixed. Press dough into a thick flat disk. Wrap in plastic wrap. Refrigerate 4 hours or overnight.

Preheat oven to 350 degrees F. Roll out dough to 1/4-inch thickness on lightly floured work surface. Cut out as for gingerbread men, stars, etc. with cookie cutters. Place 1 inch apart on ungreased baking sheets.

Bake 8 to 10 minutes or until edges of cookies are set and just begin to brown. Cool on baking sheets 1 to 2 minutes. Remove to wire racks; cool completely. Decorate cooled cookies as desired. Store cookies in airtight container up to 5 days.

Makes 24 cookies


# Jack Eastman and Okie-Tex 2011

Yes, it happened again, a trek to the Southeast to Kenton OK again for the 2011 Okie-Tex starparty. My first contact with this group was in 2009, and it was, indeed, a thoroughly enjoyable experience and I'm afraid I'm addicted!

This time I decided to try Joe Gafford's route, East across town to I-225 then I-70 East to Limon CO then 287 South all the way to Boise City, OK. From there, it's 35 miles back Northwest to Camp Billy Joe, just outside Kenton. The trip proved very relaxed, the traffic was light, the trip just under 6 hours. As before I arrived in time for dinner, in spite of the time change (they're on Central, although Kenton, about a quarter mile West is on Mountain). A great meal, then make camp. The weather was hot and dry. Very dry. Joe Gafford, who went a day early to help set up the camp said when putting down the chalk lines for the "roads" he only needed to follow the ones from last year. Yes, very dry, indeed. The days were hot, upper 80s maybe into the 90s. The nights were comfortable, mostly in the upper 40s for the nighttime lows, usually still in the lower 50s during the first part of the evening and no dew. Thursday night it got down to 34, the next day was cool. One of the participants, a meteorologist, who was mentoring a bunch of students from Norman OK, said a front was coming through with the wind strong out ot the North then the next day, out of the South. He was right on! The skies were generally clear most of the night with just enough clouds occasionally rolling by to allow guilt-free trips to the "Cosmic Cafe" for coffee and maybe a late night snack. Also guilt-free catnaps during the night. The front was supposed to blow all the clouds out, not entirely, but it did bring significant cooling for that day (the 34-degree night)

As before, the atmosphere was very laid back, lots of free time to hobnob with all the really great attendees and, perhaps, get a nap or two after a night of observing. Although the skies were brighter than last year, the milky way arching overhead was truly spectacular. We can only hope that many of the students that were in attendance were suitably impressed (and will join the fight against light pollution!) It is really great that a number of high school and college students come for a few nights under truly dark skies.

This year the skies were noticeably brighter than last, Sky Quality Meter (SQM) readings mostly around 21.35 to 21.5, as opposed to the 21.8 that were observed last year. Even so, old friends, nearly impossible to see from the city, the Helix nebula in Aquarius, M33, the second (?) nearest spiral galaxy, in Triangulum were easily visible. M31 Andromeda was spectacular in the little 6-inch comet hunter at 36X with the Explore 20mm 100-degree eyepiece, (FOV 2.8 degrees on the sky) and nearly as good in the 6" Clark at 31X using its "comet" eyepiece (1.2 degrees on the sky). The seeing was, for the most part, good and it seemed like a bit of sacrilege to use such dark skies for looking at Jupiter and brighter double stars, but the views were worth it. Double stars, Zeta Aquarii was an easy split, nearly equal magnitudes at a separation of 2.2 arc seconds. Then it was a try for Alpha Piscium. Isn't "alpha" the brightest star in a given constellation? Most of the time, "yes". So I aimed the 'scope (6" Refractor, 186x) at what appeared to be the star in question, and couldn't split it, not even close. I checked the chart, and something seemed fishy, the star was plotted wrong. I even held the chart up to the sky and looked very carefully. Star plotted wrong! Then I looked closer. At the position of the suspect star was a circle on the chart labeled "Mira". Someone had mentioned that Mira, a long period variable with a range about 8 magnitudes, was near a brighter than usual maxi-

mum at about mag. 2.3. Mystery solved, I found Alpha Psc, much fainter than I expected, and it split nicely at a separation of 1.8 seconds. When I was shown the position of Comet Garradd I was able to locate it in the comet hunter, which really oughtta be used for comet hunting, right between two trees about a quarter degree above the rocks to the West. It was a bit farther from the horizon in the refractor, and the next night I got it earlier, no trees in the field this time. As last year, just poking through the Milky Way with the comet hunter with the wide field eyepiece was spectacular, and not too shabby with the 6" F/15 refractor with its 75mm (31x) "comet" eyepiece. David DeLassus, one of our newer members, spent time tracking down numerous faint and elusive globular clusters, logging in 56 objects, three of which he said weren't detected. Our own Joe Gafford, in addition to his great imaging was also able to do some real science, obtaining positions of several asteroids. I was amazed by the brilliance of the Zodiacal Light, rising almost vertically before dawn, looking much like a light pollution dome over a large city. The Gegenschein, the antisolar brightening of the Zodiacal Band, was easily visible below the Great Square of Pegasus. It added about 0.07 magnitude to the Sky Quality Meter readings. I was surprised by how large it was, nearly as long as the Great Square itself.

There were the order of 350 attendees, down a bit from last year, but still a good turnout. Colorado had a fair share of participants, It was interesting that the Denver Astronomical Society outnumbered those from Oklahoma City, the folks who sponsor Okie-Tex. DAS had 20, OK City, 14. The state of Oklahoma had 60, Texas, 45 and Colorado come in third at 34. I was joking with Mike Madden, from Oklahoma City and he said maybe they oughtta call this starparty "Okierado", also noting that Denver is closer to Kent than Oklahoma City.

Telescopes ranged from several very large Newtonians, on Dobsonian mounts, in the 30-inch range, all the way down to my 0.04m Newtonian, I still had the smallest Newtonian at Okie-Tex. Our own John Anderson had his superb Solar Observatory, telescopes for "white" light (sunspots, faculae and the like) as well as Hydrogen Alpha (Prominences, flares and such), and an excellent spectroscope, showing a very detailed solar spectrum. A test of resolution of such an instrument is to see the faint line, due to nickel, between the two strong sodium lines in the yellow at 589.6 and 589.0nm. John's will show this! Perhaps one of the more spectacular instruments was a pair of 6-inch binoculars, built by Tim Havens, also a Denverite. Not just ordinary "big" binoculars, these were a pair of Takahshi FS-152 apo refractors, on a very heavy and precision platform, allowing effortless adjustment of interpuillary distance and maintaining accurate collimation. These were mounted on a dobsonian-like mount, a superb example of the woodworker's art, and equipped with Go-To and accurate tracking capability. The views with the Ethos eyepieces of the Milky Way, nebulae and star clusters were truly spectacular, the only downside was the limitation due to getting large eyepieces close enough together, and some danger of pinching off one's nose!

A young fellow, Dano Black, of Lampblack Media LLC, had come to shoot a documentary about light pollution and was going around interviewing many of us, including several International Dark Sky (IDA) members, who told of the effects of light pollution and some of their many experiences in fighting this scourge. I wish him all the luck in the world with his film.

Wednesday afternoon the "formal" talks began, but not without some consternation with the computers. There was a great deal of noise on the audio, which seemed to defy all attempts at a cure. A second machine was pressed into service, but wouldn't talk to the projector. Machine #3 seemed unable to deal with PowerPoint, and the download of a fix was taking forever (estimated time to complete 5.8 hours and getting longer by the minute) Our own Mike Hotka to the rescue, his machine saved the day! First on the agenda was a great presentation by Bill Faatz "E. E. Barnard's Life and a Photographic Atlas of Selected Regions of the Milky Way". A very interesting in depth look at Edward Emerson Barnard (1857-1923) and his superb photographic work carried out in the early years of the 20th century. Bill showed some pictures of the 10-inch Bruce astrograph, used

by Barnard, that had been on a short loan to Mt. Wilson from Yerkes Observatory. Turns out the telescope was returned to Yerkes after only a 9 month stay at Mt. Wilson in 1905. I told him that I'd seen, fondled and admired that 'scope in the 1950s when I used to frequent Mt. Wilson. He said that was not possible, as the instrument was returned to Yerkes, long before I was born, where it stayed forever after. Thanks to John Briggs, this mystery was solved. It seems Mt. Wilson built a nearly identical camera that was used on the mountain, then later on was sent to Chile where it was used, among other things, to photograph the discovery of supernova SN1987A. That was the telescope I saw at Mt. Wilson. After Bill's presentation came Jim Edlin's "Amateur Spectroscopy Equipment", a description of some of the more affordable spectrographs on the market and the work that can be accomplished with these. He mentioned that great diligence must be taken to remove all motion of the observer, Earth's rotation and revolution about the Sun for example, that will be sources of error in the final data. Truly amazing that with a relatively small telescope amateurs today can do work that the pros could only dream about 20 or so years ago. This was followed by some furry faced old buzzard from Colorado, Yours Truly, talking about the Chamberlin Observatory and last year's removal, disassembly and cleaning of the 20-inch Clark objective. The evening talk was Ron Dilulio, "Are we Alone?" a discussion what constitutes "life" and of life elsewhere in the universe. Some of the criteria for defining "life" he mentioned were: 1) All life forms contain deoxyribonucleic acid, (DNA), 2) All life forms have a method by which they extract energy from their surroundings and convert it into energy that sustains them. 3) All life forms can sense changes in their surroundings and respond to those changes. and 4 )All life forms reproduce. Ron returned to open Thursday's program with "Here comes the Sun" about the importance of the Sun, some of the early mythology about it and a bit of the physics of the nearest and brightest star. Ron was followed by Mike Lockwood with a comprehensive discussion of optical testing methods, Foucault, Ronchi, Interferometry and the like, followed by a look at how he had made improvements to his Newtonian telescope. The evening talk was Bill Moore "Oklahomans in Space" with interviews of many of the folks from Oklahoma active in the space program. I was surprised to see among them our own Ben Clark, recently retired from Lockheed Martin. Then came the first of the two door prize drawings, and it seemed that all us Coloradoans went away with the lion's share of the prizes. Friday's program, again following a great night of observing, opened with our own Mike Hotka discussing the evolution of his 12.5-inch F/8 Newtonian, which went through many incarnations ending up as a Dobsonian mounted monster. Rod Gallager then gave a talk on Digital Imaging Techniques followed by John Love "Going Mobile" a fun filled expose' of his travels in search of the perfect observing sites, complete with descriptions of his encounters with less than good weather and repeated windblown losses of his awning, a story in itself. Saturday, after lunch was the swap meet, part II, I couldn't resist, picked up a 40mm Koenig eyepiece. Our own Bruce Heath bagged one at the first session, and I sort of kicked myself for not grabbing it myself, as if I really need another eyepiece! Well, another one showed up Saturday. The talks began with Ed Wiley "Visual Double star research for amateurs" again proving, yet again, that with the techniques available to the amateur astronomer today we can make serious contributions to the science. Ed described some of these techniques for measuring doubles, including speckle interferometry, where the speckly blob of an image can be deconvolved into useful data (!) Ed mentioned that there is much to be done in the study of doubles, not the least of which is the list of "forgotten doubles" in the Washington Double Star catalog (WDS). The final presentation was a technical discussion of the imaging from the Hubble Telescope. Finally, the door prize drawing, part II, several more of us DAS members were drawn, but had left early. I was lucky enough to bag a Pentax 8.5mm eyepiece, then it was one more beautiful night under the stars.

All too soon, it was over. Pack up and be gone by 10AM Sunday The Cimarron Heritage Center volunteers, the folks who put on the great meals, said their museum in Boise City would be open Sunday for those of us Okie-Texers that would want to see it. I thought I'd spend a half hour or so, but finally got on the road more than a couple of hours lat-

er. There was a great deal of the history of the area, the Santa Fe Trail, many restored tractors, farm implements and vehicles. Also Boise City's original railroad depot, with all the relevant stuff, including the blacksmith shop There was also on display was a one-room schoolhouse from the era as well as a "dugout", a shelter literally dug into the ground. The band REO Speedwagon? Yep, there was a beautifully restored great old delivery truck, the REO Speedwagon, circa 1919. Learn something new (almost) every day. Finally it was North, the same route from Boise city, up 287 to Limon, and on in to the metro area on I-70. Home at last.

It was a truly great gathering, and I'm afraid I'm truly hooked. I'll do this one again!

*Sure, "Go to Mars find strange exotic life, see red vista sun sets., swim in pristine underground pools" This is the last free trip I take without reading the fine print.*

**By: Jerry Mullennix**

Venus is the hottest place in our solar system outside the sun with temps in excess of 900 degrees F. Led would melt and if this is not enough to keep you away the pressure at the surface is 100 times greater than Earth.

Saturn is not the only Planet with Rings: Jupiter, Neptune and Uranus all have a ring system, they are just not as pronounced as the ones around Saturn.

Because we are tidily locked with the moon, only one side of the moon faces the Earth.

No matter how slow you think you are keep in mind you are traveling about 67,000 mph around the sun. Do some research here, that is not the end of the story, the sun is not stationary, nor is the Milky Way our sun travels around.

If you had a bath tub big enough to put Saturn in it, it would float .

Currently Betelgeuse, the bright Orange star in Orion is so big If placed where the sun is it would extend beyond Jupiter's orbit. Much larger stars have been found outside the Milky Way.

Light from the sun takes approx. 8 minutes to arrive here on earth as the sun is approx. 93 million miles away and light travels at 186,232 miles per second.

Jupiter has more mass than all of the other planets and moons put together. Still the sun makes up about 98.5% of all the mass in our solar system.

A thimble full of material from a neutron star would weight about 120 million tons.

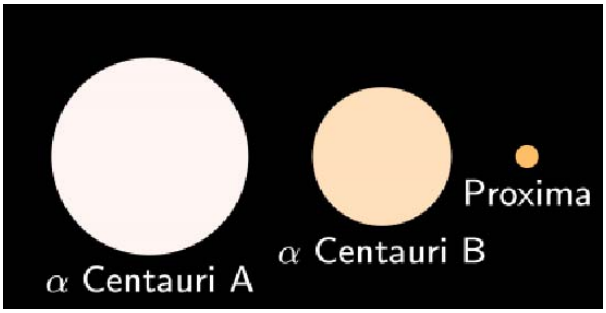
Nothing in the night sky is as it appears to us. Andromeda is 2.2 million light years away, which means that what you are seeing is as it looked 2.2 million years ago. The further from earth an object is the further back in time you are looking. This is exactly what they mean when the tell you Hubble can see almost back to the beginning of the universe, some 13.7 billion light years.

What is the closest star to the earth?

A: Proxima

B: Centauri A

C: Centauri B




Answer: none of the above. The sun is the closest star to earth the next nearest is the three star system above (A, B and C) at about 4.27 light years. Don't run out looking for them, as they cannot be seen from Oklahoma.

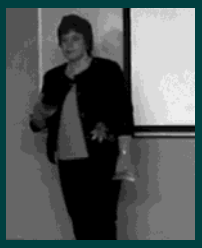
Sirius is the second brightest star seen from Earth behind the sun, with a magnitude of –1.46 and a distance of 8.6 light years. It is almost twice as bright as the next brightest Canopus. The sun is –26 mag and the moon is –12 mag.

If the sun were a big empty ball it would take about 1.3 million earths to fill it up.

If you'd like to do the calculation yourself, here are your numbers. The volume of the Sun is $1.412 \times 10^{18}$ km$^3$. And the volume of the Earth is $1.083 \times 10^{12}$ km$^3$. So if you divide the volume of the Sun by the volume of the Earth, you get 1,300,000.

About this page: this is the last page I did this month and because when I print the Observer it must be equal to a factor of 4 pages. I say this because I have resisted printing astronomy facts for many years as it seems to change almost as fast as we learn it now. I did much of this page from memory so I beg forgiveness if I have any of this wrong. I will correct it next month. Jerry

# Martian Meteorite ALH84001: Evidence for Past Life on Mars?



NETA APPLE

On August 7, 1996, at a press conference held on the South Lawn of the White House, President of the United States Bill Clinton read a statement that stated investigators at NASA's Johnson Space Center had "found evidence that strongly suggests primitive life may have existed on Mars more than 3.6 billion years ago." Following was a sensational announcement of results of a two-year study of a meteorite of martian origin, ALH84001, which contains structures resembling bacteria-like organisms, and chemical compounds and minerals that were interpreted as indicative of signs of ancient life on Mars. But soon it became evident that this evidence was far from conclusive.

Scientists have been involved in an energetic dialog regarding the interpretation of the mineralogical evidence contained within the meteorite. The evidence fails to provide a definitive answer either for or against the existence of past life on Mars, but may provide guidance for the search to determine if life existed or does exist on Mars.

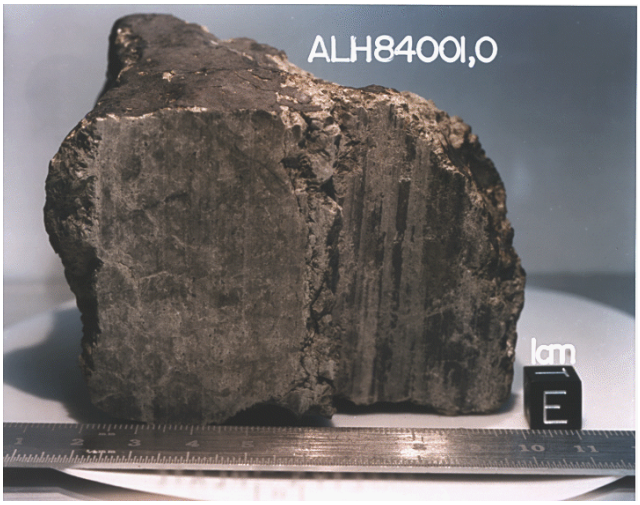



Figure 1 ALH64001, the 4.5 Gy meteorite thought to be from Mars. From

http://www.nasa.gov/centers/johnson/about/history/jsc40/jsc_gallery_center18.html

Annually, a group of scientists goes to Antarctica to search for meteorites due to the ease of finding them on the ice fields. On December 27, 1984 a pale greenish-gray, softball sized meteorite was collected from the Allan Hills region of Antarctica south of New Zealand (Knoll, 1998). Named ALH84001, indicating where it was found and that it was the first for the year of 1984, the rock (see Figure 1), which is igneous, was radiometrically dated to be about 4.5 Gy old. It is one of twelve meteorites thought to have come from Mars. While the other eleven are much younger igneous rocks, all twelve show indications of having been ejected from a planetary- size object, and all have similar chemical compositions that are different from that of other meteorites.

Gas bubbles in one of these younger meteorites match the composition of the current Martian atmosphere that was analyzed by the Viking Landers, thus indicating that it and the other meteorites by association of their chemical compositions were ejected from Mars by impact (NASAweb).

Analysis of the isotopes He3, Ne21 and Ar38 indicates that ALH84001 was in space for some 16 million years before falling to Earth where it then spent 13,000 years in the Antarctic, according to C14 dating (Jull, A., 1998, Gibson & McKay, 1997). ALH84001 is classified petrologically as a unique member of the SNC (shergottite, nakhlite, chassigny) class (Mittlefehldt, 1993).

Scanning electron microscope investigations revealed carbonate globules along fissures and cracks inside the rock (see Figure 2). The globules appear orange in images and are not present on the outside or in layers that might have been affected by heat during the passage of the meteorite through Earth's atmosphere. Note also that cracks run through the carbonate granules (McKay et. al., 1996), and that they have black and white layered rims (Gibson et. al., 2001). Transmission electron microscopy shows these rims contain alternating iron-rich and magnesium-rich bands. The iron-rich bands contain very pure magnetite crystals with no structural defects. The cores of the carbonate granules were found to be rich in calcium. Sulfur was also found in conjunction with the iron and in patchy areas throughout the globules (McKay, et. al., 1996).

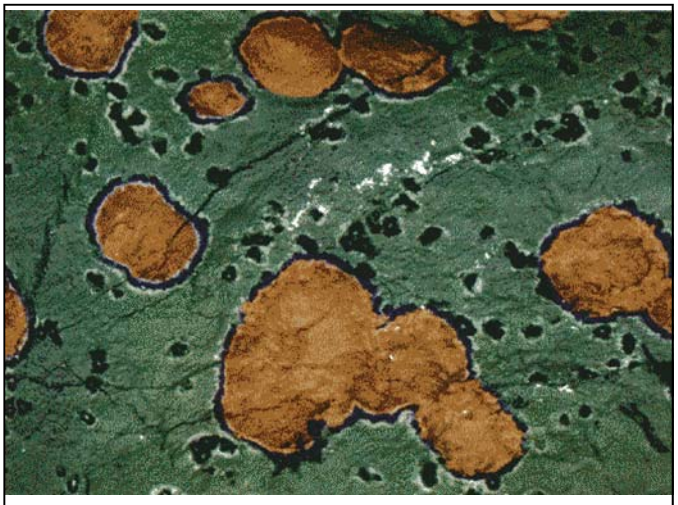


Figure 2. Carbonate globules in ALH84001. From http://www.ndsu.nodak.edu/instruct/kurtze/phys110/news/

In the center of the carbonate spherules and separate from the rim are more magnetite crystals and iron sulfides. According to McKay et. al. (1996), the area around these centrally located magnetite crystals shows dissolution of the carbonate and is thus more porous. Additionally, McKay et. al. (1996) reported that the areas of partial dissolution of carbonates are rich in iron sulfides that do not appear to have been dissolved. The surface of some of the granules, near their centers, exhibit a grainy texture with small regular shaped "ovoid and elongated forms" (McKay et. al., 1996) ranging in size from 20 - 100 nm.

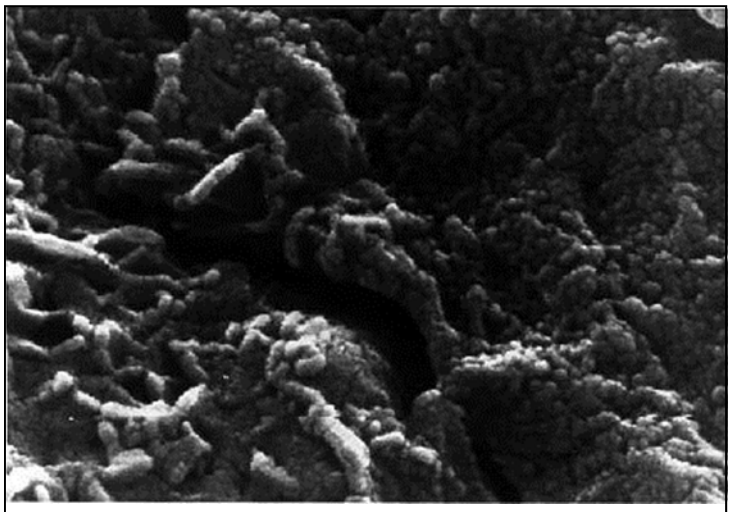


Figure 3. High resolution image showing texture of surface of carbonate granules. From http://seds.org/~spider/spider/Mars/Marsrock/marsrocks.html

Analysis for organic chemical components of the meteorite showed the presence of polycyclic aromatic hydrocarbons (PAHs) (Gibson, et. al., 2001). PAHs are molecules composed entirely of carbon and hydrogen with the carbon atoms arranged in fused rings containing six atoms. PAHs are often produced by the breakdown of fossilized organic matter. They are found in petroleum, coal, automobile exhaust and the sooty build up on barbecue grills. PAHs are sometimes taken as indications of life on Earth, but it should be noted they are very common in some regions of space (Spitzerweb and Lal, 2008), indicating they can be produced abiogenically.

Indications of Past Life on Mars?

Arguments presented in support of the presence of past life on Mars are not based on any one particular piece of evidence but rather on a combination of circumstantial evidence (Gibson & McKay, 1997). McKay et. al. (1996) have three kinds of evidence that they feel taken together are highly suggestive of past life on Mars.

Presence of PAHs.

Presence of the carbonate globules that contain minerals such as magnetite and iron sulfide, which are known to be formed by bacteria on Earth.

Presence of very small ovoid and elongated forms that have the general morphology of bacteria.

Of the three only the presence of fossil bacteria could be taken as definitive evidence of past life on its own while the other two lines of evidence represent presumptive tests.

According to McKay et. al. (1996) ALH84001 contains evidence of at least two distinct shock events, the first of which is dated as being about 3.6 - 4 Gya, after which annealing occurred. The carbonate globules were formed somewhere between 1.3 and 3.6 Gya (Gibson and McKay, 1997) in the resulting cracks and fissures of the rock during seepage of ground water. This assumes Mars to have been warmer and wetter in the past. They argue based on the evidence of the apparent cracks in some of the carbonate granules that the second impact was most likely that which lead to ejection of ALH84001 into space.

This interpretation is controversial because it depends upon low temperature formation of the carbonates. According to Scott, Krot and Yamaguchi (1998), all the carbonates in the

sample are of the same origin and could not have formed at low temperatures due to unique chemical zoning patterns indicative of formation at high temperatures such as during shock melting. Eiler et. al. (2002) indicate that there are two populations of carbonates, one of which could have been formed through inorganic precipitation as water seeped through the rock on Mars, and a second population consistent with shock melting of the first population. The idea of two origins for the carbonates is supported by oxygen isotope measurements by Farquhar, Thiemens, and Jackson (1998) who suggest this is possibly due to interaction with ozone in the Earth's atmosphere.

Through highly sensitive analysis, a limited number of PAHs were found to be concentrated in the carbonate-rich areas inside the meteorite (Gibson and McKay, 1997). No PAHs were found on the fusion crust or in a zone just interior to it where presumably heat produced by passage through Earth's atmosphere would have destroyed any PAHs present. Controls and contamination checks indicated that the PAHs were indigenous to the meteorite (Gibson and McKay, 1997, Gibson et. al., 2001) thus supporting the idea that both the carbonates and the PAHs were of nonterrestrial origin and are fossil chemical evidence of previously living organisms (McKay et. al., 1996).

As previously mentioned, PAHs are found in a number of places as the results of abiogenic processes (Gibson and McKay, 1997, Schopf, 1999) and are not considered to be biogenic markers when considered alone. The PAHs are not distinguishable from terrestrial matter (Becker et al, 1999), and isotopic evidence suggests that all (Jull et. al., 1998), or some of the PAHs, might be terrestrial in origin (Grady, Wright & Pillinger, 1998) resulting from contamination during the meteorite's 13,000 year stay in Antarctica.

On Earth some strains of bacteria are known to produce the same iron and sulfur minerals found inside the carbonate globules and in their colored rims. Magnetotactic bacteria are known to produce highly pure magnetite crystals with definite shapes, known as magnetosomes, that are carried in their bodies apparently aiding them to find essential living conditions (Friedmann, et. al., 2001, McKay et. al., 2003, Taylor, Barry & Webb, 2000). McKay et. al. (1996) asserted that the minerals found in the rims of the carbonate globules and the magnetite crystals found in the globules are consistent with minerals and magnetite crystals produced by strains of bacteria on Earth, suggesting the presence of organisms similar to magnetotactic bacteria in Mars' past. Thomas-Keprta et. al. (2001) indicate that about 25% these magnetite crystals share five of six defining characteristics with magnetite crystals produced by the magnetotactic bacterial strain MV-1.

Both are single domain

Both are chemically pure

MV-1 crystals have very few crystallographic defects, and those from ALH84001 were flawless

Both are characterized by having a specific shape

Both are elongated along the same axis

MV-1 magnetites are aligned in chains in living cells, while those of the meteorite are not. This can be explained by the known disalignment of such crystals after death of the organisms.

Other magnetite crystals in the meteorite are distinctly different chemically and physically, only matching one to two of the above criteria (Thomas-Keprta et. al., 2001). Golden et. al. (2004) argue that crystal morphology is not conclusive for biogenic origin of the crystals because similar crystals may be formed through abiogenic processes.

Finally, there are the small ovoid and elongated shapes indicated by McKay et. al. (1996) to have morphology similar to bacteria. While having the most potential for confirmation of past life on Mars, this seems to be the weakest of the three arguments because the purported fossils are comparable in size to organelles inside known bacteria rather than bacteria themselves (Schopf, 1999). While the shape and distribution of the rod-like objects are suggestive of bacteria in colonies, as any geologist or paleontologist will confirm, morphology is not indicative of origin. Complex abiogenic crystal aggregates with shapes suggestive of biogenic origins (see Figure 4 for an example) are not unknown (Wilson, 2009), and are produced due to changing pH and concentrations in solution during precipitation. Without further evidence such as cell walls or confirmation of chemicals of life such as DNA or RNA, the shapes in ALH84001 cannot be confirmed to represent fossilized bacteria. Thus, what could be the strongest evidence for past life on Mars becomes the

weakest of the three "proofs" offered.

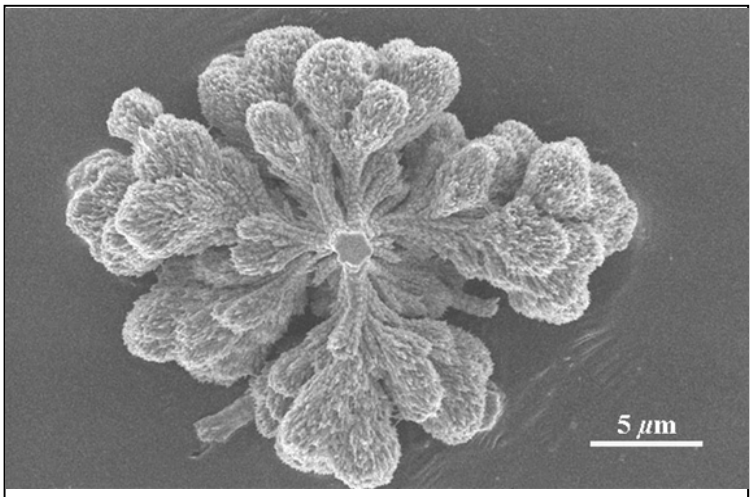



Figure 4. Crystal aggregates such as this one might be mistaken for evidence of biogenic activity. From http://ptonline.aip.org/journals/doc/PHTOAD-ft/vol_62/iss_3/17_1.shtml

Clearly, no statement about the presence of life on Mars can be made from the proposed arguments. The discussion does point out that the best approach to the question of life on Mars may be to look for microorganisms or their fossils. Such organisms are thought to be among the oldest on Earth and are widespread, living in conditions hostile to most other forms of life. It is possible that such organisms might have once lived on Mars also, though complex life may not have arisen.

## Conclusions

In conclusion, it has been shown that the arguments for past life on Mars in ALH84001 are highly controversial and therefore suspect due to their presumptive nature. While PAHs and magnetite crystals are known on Earth to be products of living organisms, it is previously well established that life exists on Earth. No such fact has been established on Mars, thus presumptive evidence alone is insufficient for proving life existed. The evidence in ALH84001, while intriguing, cannot be taken as proof of past life on Mars, however, it has served to point out that future searches for evidence of life on Mars might be best carried out by looking for microorganisms or their fossils.

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# The Dome Turns 5A

By: Jerry Mullennix

JPL SpacePlace

What is SpacePlace and how does it benefit the Astronomy Club of Tulsa? Those are the two questions that come to mind when I began exploring the possibility of our participation. After spending just a few minutes on their website I knew this had great potential for helping us associate our club with the young people in our community. The site is loaded with games, iPhone apps and trivia challenges'. All of these are space related and written to inspire young people to channel their enthusiasm towards space.

SpacePlace is not solely for the young, it also offers many great articles about our Universe that will benefit all levels of astronomy.

JPL and NASA have done a great job at tailoring this site to fit …..

Over the last eight or nine months our newsletter has really taken some radical turns and our articles are first rate. I fell we still have a long way to go but SpacePlace will be a great addition.

This month they begin by recommending three sites for kids.

http://climate.nasa.gov/kids




http://scijinks.gov

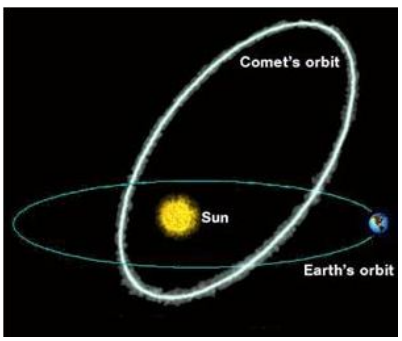
http://spaceplace.nasa.gov

Site images to the left.

Jerry

If you have one of those young astronomers you will find these sites great for filling their minds with all things astronomy.

Have you ever wondered how astronomers can predict when there's going to be an abundance of shooting stars in the night sky? Showers of meteors, the scientific name for "shooting stars," occur predictably several times a year, usually peaking within the same two - or three-day period. So what causes them? Why do they seem to come from the same part of the sky? What's the best way to see them? Visit http://spaceplace.nasa.gov/meteor-shower and get ready to enjoy the next show.



National Aeronautics and Space Administration

# Mira: A Real Shooting Star!

SpacePlace

When people say they see a shooting star after noticing a momentary streak of light in the night sky, what they really are meteors burning up as they enter the Earth's atmosphere—nothing to do with stars at all.

However, Mira, the star on this poster, really *is* a shooting star—traveling at supersonic speed and trailing a glowing tail. Go ahead make a wish. You have some time to come up with a good one. The length of the tail and the speed of the star means it has been doing this for at least 30,000 years.

Mira (pronounced "my-rah") is also known as Omicron Ceti. Mira is the only normal star known to have a tail. You can't even see Mira very well in the image because it is tiny compared to the tail. Mira is 350 light years from Earth. If you could see the star and its tail with your naked eyes, it would be as long as the width of four full Moons! The tail stretches an astonishing 13 light-years. If our Sun had a tail like this, it would reach far beyond the edge of the solar system and extend nearly three times further than Proxima Centauri, the closest star to the Sun. In fact, the 20 nearest stars to the Sun are closer than the length of Mira's tail.

## *The Tale of the Tail*

So what is going on? In a nutshell, two things:

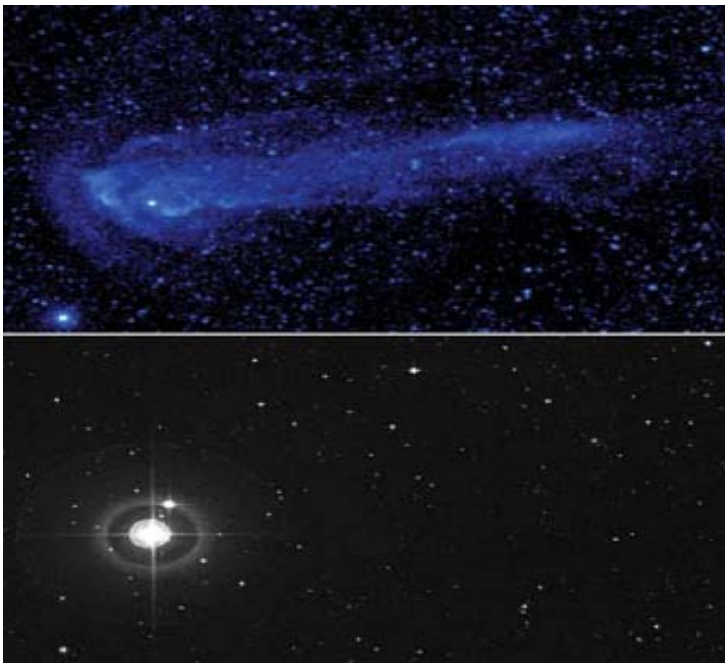
(1) Mira is traveling through space at a very high speed, and
(2) It is shedding large quantities of gas in what is called a stellar wind.

Like the bow wave of a boat traveling through water, a bow shock forms ahead of the star in the direction of its motion (toward the right in the poster image). Gas in the bow shock is heated. The heated gas then mixes with the cooler gas in the stellar wind as it flows around and behind the star, forming a wake—again, like a fast boat moving through water.

Why has the tail not been seen before? Mira has been thoroughly studied for more than 400 years, so you might think someone would have noticed. Well, the hot gas from the bow shock, mixing with the cooler gas in the tail, causes the gas to emit a special kind of light when it cools off. This light is called **far-ultraviolet light**. Your eyes and ordinary telescopes cannot see ultraviolet light. Even if you could see it, far-ultraviolet light is absorbed by the Earth's atmosphere. What you would need is a telescope not only sensitive to far-ultraviolet light, but up in space, orbiting above Earth's atmosphere.

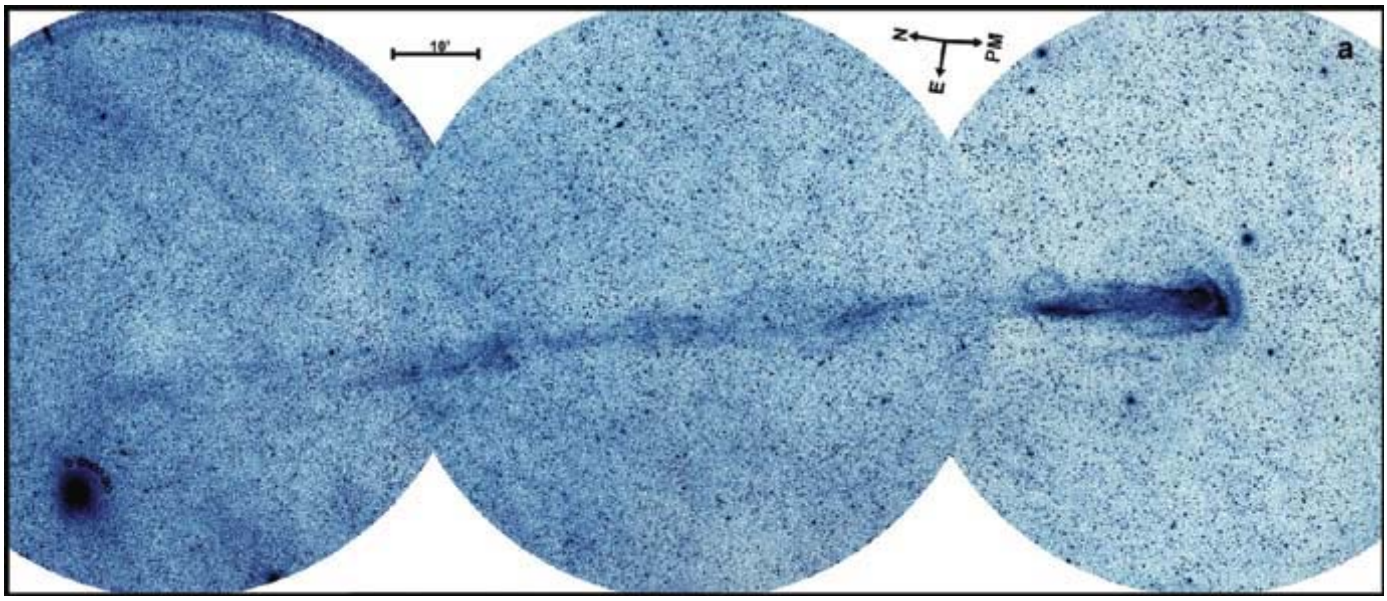
## Well, NASA has one!

The orbiting telescope is called the Galaxy Evolution Explorer. It's small compared to some of its cousins, like the Hubble Space Telescope, the Spitzer Space Telescope, and the Chandra X-ray Observatory. Nonetheless, Galaxy Evolution Explorer collects vast quantities of data.



*On the top is Mira in far-ultraviolet light. On the bottom is Mira in visible light. (Credit: GALEX and Digitized Sky Survey.)*

The picture above compares two images of Mira. The one on the top is the brightest part of Mira's tail in the far ultraviolet taken from space by Galaxy Evolution Explorer. The one on




*The Galaxy evolution Explorer captured the image of Mira and its tail in just three "frames." (The bright star near the faintest end of the tail on the left was removed for clarity on the poster image.) The three images span 13 light-years, and take up four full Moon-widths of the sky. (Credit: Martin, Seibert, Neill et al., Caltech/Carnegie Institute, 2007.)*

the bottom is a visible light image taken from the ground. Mira is much brighter in visible light than it is in ultraviolet because it has a surface temperature of only 3,000 degrees Kelvin, which is about 5,000 degrees Fahrenheit—quite cool for a star. If it were hotter, it would shine more brightly in ultraviolet than it does.

Mira's tail offers a unique opportunity for astronomers to study how stars like our Sun die and leave material behind that can seed new solar systems. As Mira hurtles along, its tail sheds carbon, oxygen and other important elements needed for new stars, planets, and possibly even life to form.

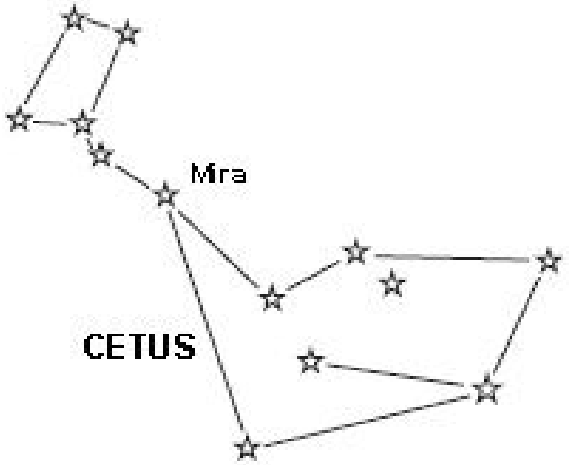
At this stage in Mira's life, it ejects enough material to make a new Earth every 10 years. It has released enough material over the past 30,000 years to seed at least 3,000 Earth-sized planets or nine Jupiter-sized planets!

***The Tale of the Star***

Mira was discovered by David Fabricius in 1596. Mira is a **periodic variable star**. That means it changes brightness on a regular "schedule." In Mira's case, its brightness cycle takes 332 days. The variability occurs because it physically expands and contracts (pulsates) every 332 days.

For several months, it is bright enough to see with the naked eye. But then it dims to about 1/1500th of its former brightness to become invisible. Because it appeared to turn on and off, it was given the name Mira (Latin for The Wonderful).

When it is bright, you can see Mira for yourself without a telescope or binoculars while the constellation **Cetus** (the whale) is visible, which is around October through February in the Northern Hemisphere. You won't be able to see Mira's tail from the ground. Mira itself is visible for at least one and one-half months before it reaches maximum brightness (for example on January 1, 2008), and for and two and one-half months after maximum brightness. Cetus is most easily seen during November. So look for Mira in mid-November.




*Mira is found in the tail of the whale that is the Cetus constellation*



EW-2007-11-037-JPL

Fittingly, Mira is located in the tail of the whale. It may sound like a whale of a tale, but in the tail of the whale is a star with a whale of a tail.

Mira is about the same mass as the Sun. Mira is an old, **red giant star.** Someday (in about 5 billion years) the Sun will reach this stage of its long life and also become a red giant. As a red giant, Mira sheds a lot of mass in the form of dust and gas in a fairly gentle wind. It has swollen up to over 400 times the size of the Sun, despite having about the same amount of mass as the Sun. If Mira were located at the Sun's position, it would swallow Mars—and Earth too, of course.

Mira is also a **binary star.** It has a sister, although not a twin by any means. The two are bound together by gravity. The dominant red giant star is called Mira A and its much fainter companion (possibly a white dwarf) is called Mira B. When we say "Mira," we mean Mira A. The distance between them is 70 times the Earth-Sun distance or more than twice the average Earth-Pluto distance. It takes about 500 years for the pair to orbit each other. Mira B is too close to Mira A and too faint to be seen in the GALEX image.

***The Tale of the Picture***

The image on the poster was made from a mosaic of just three images from the Galaxy Evolution Explorer. (See picture at the top of Page 2.) This space telescope sees a much bigger piece of the sky at once than do the Hubble and Spitzer Space Telescopes and the Chandra Xray Observatory. Because of its **wide fi eld of view**, Galaxy Evolution Explorer was able to capture a large portion of Mira's tail in one frame. The images were taken in November and December of 2006.

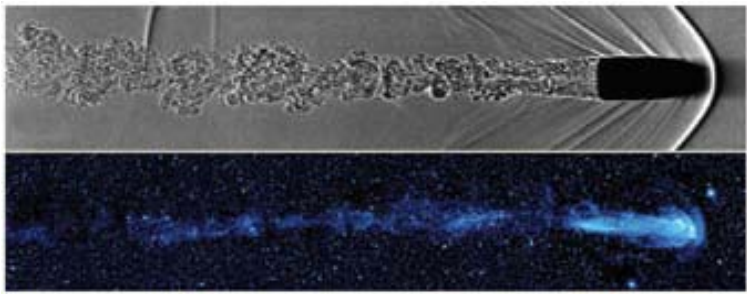
Five new features around Mira that were discovered in this image are:

The 13 light-year long extended tail seen in far ultraviolet light.
The brighter region of the tail closer to the star.
A fascinating loop extending off the near-tail.
A bow-shock detected in both the far and near ultraviolet, but more extended in the far-ultraviolet.
Knotted streams extending from Mira visible in both the far and near-ultraviolet.

Mira is traveling at a very high speed. In calculating Mira's speed, astronomers must take into account the motion of our whole local region of space as it rotates around the center of the galaxy. But even within that space, Mira is zipping along at 291,000 miles per hour. This is 10 times faster than the Sun travels.

The space through which Mira travels is not entirely empty. It contains very thin gas and dust that floats around in space between the stars. This space space matter is called the **interstellar medium**. Mira's high velocity relative to the interstellar medium compresses the gas and dust ahead of it, forming the bow shock.

Mira's tail forms because its stellar wind, laden with dust and gas, mixes with the hot, compressed interstellar medium in the bow shock, and then flows around and behind Mira. Mira's wind flow becomes turbulent (or chaotic) instead of remaining laminar (or smooth). Indeed, the extended tail of Mira looks very much like a turbulent wake.



*Mira vs. a speeding bullet. Mira is over 250 times faster! (Credit: Bullet shadowgraph —A Davidhazy/Rochester Institute of Technology; Mira — Martin, Seibert, Neill et al., Caltech/Carnegie Institute,*

The picture above is a fun comparison between Mira and a shadowgraph* of a speeding bullet. The bullet is traveling at 1.5 times the speed of sound. The bullet forms a leading shock wave in the same way Mira forms a bow shock. Trailing behind the bullet is a classic turbulent wake.

***The End of the Tale (Tail?)***

What does the future hold for Mira? In less than one million years, Mira will eject the rest of its outer gas envelope (10% -20% of it's total mass) into space, leaving only the dense, hot core, made of carbon and oxygen. The newly glowing core will cause the ejected envelope material to glow as a **planetary nebula**. Instead of a being perfectly round like a sphere, Mira's planetary nebula will likely become highly

* A shadowgraph is a photo of the shadows caused by the differences in density of air, water, or something else transparent. The shadows are cast because light travels at different speeds through the substance, depending on its density.

distorted due to Mira's high space velocity. It might look something like the planetary nebula Sharpless 2-188 shown here.

*Planetary nebula Sharpless 2-188. Will Mira end up like this? (Credit: Chris Wareing/University of Leeds.)*

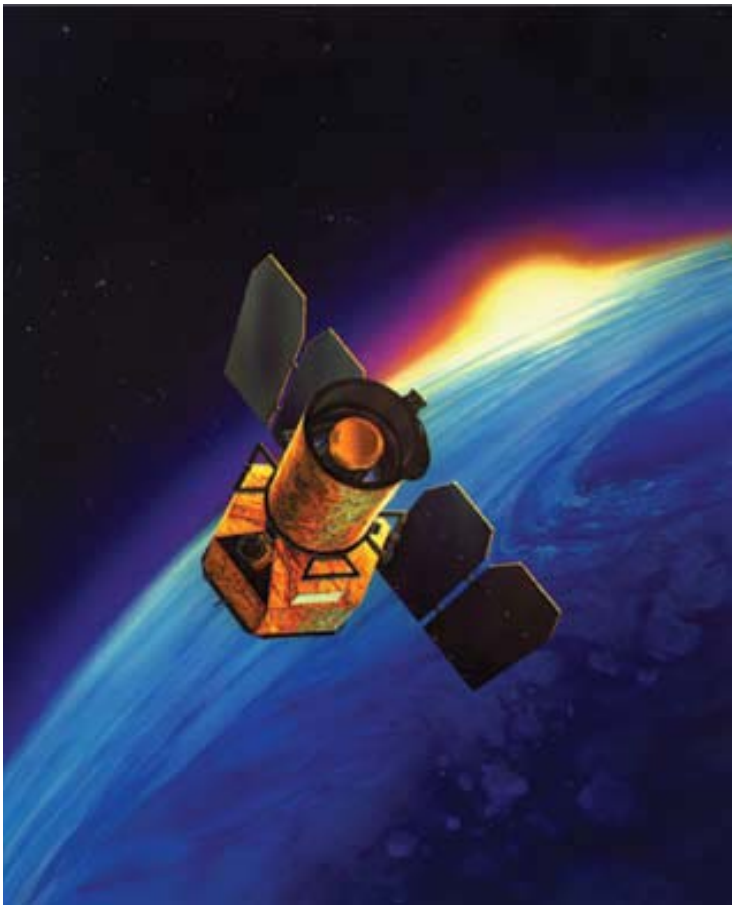
After a few tens of thousands of years, the nebula will disappear. The carbon-oxygen core will rapidly cool, contract, and fade as it becomes a **white dwarf**—a bizarre ball of ultradense material containing half the mass of the Sun in an object about the size of Earth.

## *The Tale of the Telescope*

Galaxy Evolution Explorer has been orbiting Earth since 2003. The telescope observes galaxies in ultraviolet light. Because Earth's atmosphere blocks most ultraviolet light, an ultraviolet telescope must be above the atmosphere.

This special telescope is looking at tens of millions of galaxies spanning much of the universe. A galaxy is a grouping of stars, gas, dust, planets, moons, and various strange objects such as black holes all held together by gravity. All but a few stars in the universe live in galaxies. Our Sun is just one of at least 200 billion stars in our own Milky Way Galaxy. The entire universe probably contains over 100 billion galaxies. Stars, planets, galaxies, clouds of dust and gas, and other matter in space are sending out energy all the time. This energy, called **electromagnetic energy,** travels in **waves**. Like waves traveling through the ocean, electromagnetic waves can be very long, very short, or anything in between. Therefore, the light we see from the Sun and other stars—the visible light—tells only a small part of the story of the stars. To get the complete picture, we must extend our vision to include other wavelengths or energies of light. That is why scientists and engineers have invented different kinds of telescopes. For example, we have special telescopes for the long radio waves; special telescopes for the infrared waves that we cannot see but rather feel as heat; and we have special telescopes such as Galaxy Evolution Explorer for detecting invisible ultraviolet waves.

Galaxy Evolution Explorer can detect stars and galaxies that are about 40 million times fainter than ones we can see with our unaided eyes from even the darkest skies here on Earth. It is the first mission to map most of the sky in ultraviolet light at a great enough distance to survey galaxies outside our own galaxy. Its all-sky map will also help astronomers find the most interesting looking galaxies for future study in detail using other telescopes.
The Galaxy Evolution Explorer mission is managed by the Jet Propulsion Laboratory and the California Institute of Technology. See some of the other amazing images from the Galaxy Evolution Explorer at www.caltech.edu.



*Artist's rendering of the Galaxy Evolution Explorer in Earth orbit.*

***To Learn More***

Galaxy Evolution Explorer Web site: *www.galex.caltech.edu*
How far is a light-year? *starchild.gsfc.nasa.gov/docs/StarChild/questions/question19.html*
Ultraviolet light and the electromagnetic spectrum:*spaceplace.nasa.gov/en/kids/cosmic*
Constellations: *spaceplace.nasa.gov/en/kids/st6starfi nder/st6starfi nder.shtml* (activity also)
White dwarfs: *imagine.gsfc.nasa.gov/docs/science/know_l2/dwarfs.html*
Binary stars: *imagine.gsfc.nasa.gov/docs/ask/astro/binary.html*

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## Partial Lunar Eclipse


By: John Land

Early morning risers on Saturday Dec 10 will have an opportunity to see a partial Lunar eclipse.

You'll need a good view low to the horizon in the NW as the moon will only be 4 degrees above

the horizon when the eclipse begins at 6:48 AM Yes that's AM ! You'll have to up be up an out the door by 6:30 AM to get a good seat for the show. The Full Moon will be low in the NW.

Look for the Earth Shadow, called the Umbra, to start appearing near the top of the moon. Although the eclipse will be visible to the unaided eye, a pair of binoculars may make improve the view. As the sky in the east brightens near sunrise the moon will sink lower to the horizon. As the moon sets about 7:20 AM the umbra will cover the upper 1/3 of the moon looking like a big bite has been taken out of the moon.

Viewers in the western 1/3 of the USA will get to see the last Total Eclipse of the moon visible from the USA until 2014. Article and video links at

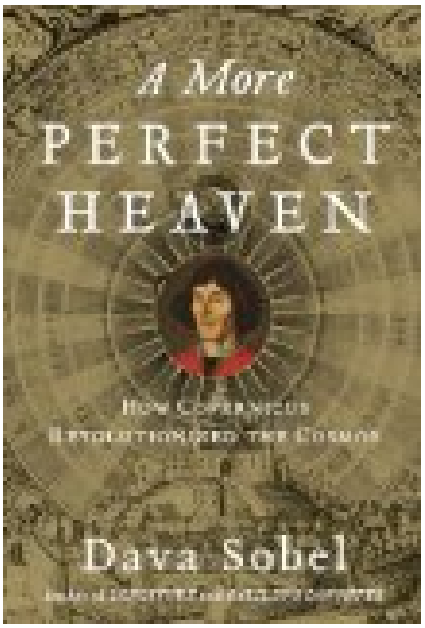
http://science.nasa.gov/science-news/science-at-nasa/2011/02dec_lunareclipse/

Partial Lunar Eclipse

Sat Dec 10 6:48 AM to 7:20 AM

Low in the NW near the horizon.

# BOOK REVIEWS




Jennifer Land, Member of the Tulsa Club, sends this book review from her library

Dava Sobel also wrote Longitude and Galileo's Daughter

Both are compelling historical books weaving a web of science and astronomy into the lives of the people

who ventured forward beyond to boundaries of the universe known in their time.

During the 1530s, rumors began to spread throughout Europe of a potentially revolutionary theory of how the heavens worked emanating from a small city in Poland. Its architect was a Polish cleric named Nicolaus Copernicus. Around 1514, Copernicus had written and hand-copied an initial outline of his heliocentric theory-in which he placed the Sun, not the Earth, at the center of our universe, with the planets, including the Earth, revolving about it. Titled his *Commentariolus*, it circulated among a very few astronomers.

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# CLUB PROMO ITEMS


2012 Astronomy Wall Calendars for only **$ 10** Twelve months of Deep Sky photos packed with information on astronomical happenings for the year. Our supply will go fast so bring exact change or a check to the meeting. Sneak Preview at

http://lib.store.yahoo.net/lib/yhst-22106725251441/68165spread.pdf

## Digital Astronomy publications – Both Astronomy and Sky & Telescope magazines

have digital subscriptions available for computer, IPad or smart phones. If you already subscribe to their print versions through the club discount, go to their websites to see how to add a digital version to your subscription. Our you may chose an all digital subscription.

Club rates for print versions are $ 33 Sky & Telescope $ 34 Astronomy

The club also received a **promotion notice from Sky & Telescope** Magazine For renewing or starting a subscription by December 9 at the club member rate of $ 33 You will receive a Mars DVD - - 2012 Sky Starter Pack with Almanac Messier and Caldwell cards - - Let's Go Star Gazing booklet - - Sky & Tel Decal

# 2112 Astro Calendar

## From Our Friends at seasky.org  Thanks

January 3, 4 - Quadrantids Meteor Shower. The Quadrantids are an above average shower, with up to 40 meteors per hour at their peak. The shower usually peaks on January 3 & 4, but some meteors can be visible from January 1 - 5. The near first quarter moon will set shortly after midnight, leaving dark skies for what should be a good show. Best viewing will be from a dark location after midnight. Look for meteors radiating from the constellation Bootes.

January 23 - New Moon. The Moon will be directly between the Earth and the Sun and will not be visible from Earth. This phase occurs at 07:39 UTC.

February 7 - Full Moon. The Moon will be directly opposite the Earth from the Sun and will be fully illuminated as seen from Earth. This phase occurs at 21:54 UTC.

February 21 - New Moon. The Moon will be directly between the Earth and the Sun and will not be visible from Earth. This phase occurs at 22:35 UTC.

March 3 - Mars at Opposition. The red planet will be at its closest approach to Earth and its face will be fully illuminated by the Sun. This is the best time to view and photograph Mars.

March 14 - Conjunction of Venus and Jupiter. The two bright planets will be within 3 degrees of each other in the evening sky.

March 20 - March Equinox. The March equinox occurs at 05:14 UTC. The Sun will shine directly on the equator and there will be nearly equal amounts of day and night throughout the world. This is also the first day of spring (vernal equinox) in the northern hemisphere and the first day of fall (autumnal equinox) in the southern hemisphere.

March 22 - New Moon. The Moon will be directly between the Earth and the Sun and will not be visible from Earth. This phase occurs at 14:37 UTC.

April 15 - Saturn at Opposition. The ringed planet will be at its closest approach to Earth and its face will be fully illuminated by the Sun. This is the best time to view and photograph Saturn and its moons.

April 21 - New Moon. The Moon will be directly between the Earth and the Sun and will not be visible from Earth. This phase occurs at 07:18 UTC.

April 21, 22 - Lyrids Meteor Shower. The Lyrids are an average shower, usually producing about 20 meteors per hour at their peak. These meteors can produce bright dust trails that last for several seconds. The shower usually peaks on April 21 & 22, although some meteors can be visible from April 16 - 25. With no moon to get in the way this year, this really should be a good show. Look for meteors radiating from the constellation of Lyra after midnight.

April 28 - Astronomy Day Part 1. Astronomy Day is an annual event intended to provide a means of interaction between the general public and various astronomy enthusiasts, groups and professionals. The theme of Astronomy Day is "Bringing Astronomy to the People," and on this day astronomy and stargazing clubs and other organizations around the world will plan special events. You can find out about special local events by contacting your local astronomy club or planetarium. You can also find more about Astronomy Day by checking the Web site for the Astronomical League.

May 5, 6 - Eta Aquarids Meteor Shower. The Eta Aquarids are a light shower, usually producing about 10 meteors per hour at their peak. The shower's peak usually occurs on May 5 & 6, however viewing should be good on any morning from May 4 - 7. The full moon will probably ruin the show this year, washing out all but the brightest meteors with its glare. The radiant point for this shower will be in the constellation Aquarius. Best viewing is usually to the east after midnight, far from city lights.

May 20 - New Moon. The Moon will be directly between the Earth and the Sun and will not be visible from Earth. This phase occurs at 23:47 UTC.

May 20 - Annular Solar Eclipse. The path of annularity will begin in southern China and move east through Japan, the northern Pacific Ocean, and into the western United States. A partial eclipse will be visible throughout parts of eastern Asia and most of North America.

June 4 - Full Moon. The Moon will be directly opposite the Earth from the Sun and will be fully illuminated as seen from Earth. This phase occurs at 11:12 UTC.

June 4 - Partial Lunar Eclipse. The eclipse will be visible throughout most of Asia, Australia, the Pacific Ocean, and the AmericasJune 5, 6 - Transit of Venus Across the Sun. This extremely rare event will be entirely visible throughout most of eastern Asia, eastern Australia, and Alaska.

**Much more about transit in the months to come. Get your scopes ready now! Jerry**

# Constellation of the Month

# ORION

SEASKY.ORG

Orion is the brightest and probably best known constellation in the sky. In the Northern Hemisphere, look toward the south in winter to find Orion. The three stars in Orion's belt are a well known pointer to other nearby constellations. The upper part of Orion lies within the Milky Way. Orion's belt runs through the celestial equator, the midpoint in the sky, so his figure is known to observers north and south of the Earth's Equator.

Orion is seen marching across the winter sky, with his dogs, Canis Major and Canis Minor, following behind. Sirius, the brightest star in the sky, lies just southeast of the hunter.

**History and Mythology**

Orion, the famous Hunter with club in hand, has an ancient mythology. Orion was known as a god, hero, warrior, and hunter by many cultures that named stellar groups. In the 11th book of the Odyssey, Homer speaks of Orion as the lover of the rose-fingered Aurora. He was already named Orion by 425 BC.

In Greek Mythology, Orion was Poseidon's son, and the most handsome man who ever lived. He was a giant, so tall he could wade through any sea with his head above the water. He fell in love with Merope, the daughter of Oenopion. Her father was not in favor of their marriage, so he gave Orion the task of ridding their island of all wild beasts, after which he would give Orion his daughter's hand. Since Orion was fond of hunting, he eagerly took on the task. Soon Orion returned to tell Oenopion that he had cleared the island of all wild beasts. He brought back skins to prove to the king that he had accomplished his task. After talking to the king, Orion realized that he would never give his permission for the marriage. He made plans to carry Merope away by force, but Oenopion learned of his plan and condemned Orion to be blinded and cast out on the seashore. Eventually, Orion regained his sight by looking at the goddess of dawn, Aurora.

Another myth tells us that Orion was a great braggart. He would boast that no game could ever escape him. This angered the goddess Juno, who sent a scorpion to sting the hunter and kill him. Aesculapius, a famous doctor, was called to bring Orion back to life. The god Pluto (or Hades), King of the Dead, heard this news and became worried that doctors awakening the dead would destroy his kingdom. He complained to his brother Zeus, who then threw a thunderbolt at Orion, killing both Orion and the doctor Aesculapius. When these characters were placed in the sky, Sagittarius, the Archer, was posted near the Scorpion as a precaution. Orion and the Scorpion were placed on opposite sides of the sky. Orion shines in winter, Scorpius in the summer; and when one rises, the other sets.

PHOTO CREDIT: ASTRONOMY PICTURE OF THE DAY.

**Explanation From APOD:** The Great Nebula in Orion, also known as M42, is one of the most famous nebulae in the sky. The star forming region's glowing gas clouds and hot young stars are near the center of this colorful deep sky image that includes the smaller nebula M43 and dusty, bluish reflection nebulae NGC 1977 and friends on the left. Located at the edge of an otherwise invisible giant molecular cloud complex, these eye-catching nebulae represent only a small fraction of this galactic neighborhood's wealth of interstellar material. Captured with very modest equipment, the gorgeous skyscape was awarded Best in Show at the 2009 Starfest International Salon of Astrophotography. Judges commented that the detail and shading were exquisite in this version of a classic astronomical image. The field spans nearly 3 degrees or about 75 light-years at the Orion Nebula's estimated distance of 1,500 light-years.

Sailors believed that the rising of Orion's head above eastern oceans marked the start of winter, and brought bad weather in the Northern Hemisphere. The Aborigines of northern Australia saw Orion's belt as three fishermen in a canoe. They broke the fishing laws of their tribe, and they were placed in the heavens as a reminder to anyone who would think of doing the same. The Mayans of Mexico thought that the stars in Orion's belt represented a turtle. In Babylon, Orion was worshipped as the god who created precious stones. Perhaps this is how Betelgeuse was named, because the star is topaz-colored.


**Explanation From APOD:** The dark Horsehead Nebula and the glowing Orion Nebula are contrasting cosmic vistas. Adrift 1,500 light-years away in one of the night sky's most recognizable constellations, they appear in opposite corners of the above stunning mosaic. The familiar Horsehead nebula appears as a dark cloud, a small silhouette notched against the long red glow at the lower left. Alnitak is the easternmost star in Orion's belt and is seen as the brightest star to the left of the Horsehead. Below Alnitak is the Flame Nebula, with clouds of bright emission and dramatic dark dust lanes. The magnificent emission region, the Orion Nebula (aka M42), lies at the upper right. Immediately to its left is a prominent bluish reflection nebula sometimes called the Running Man. Pervasive tendrils of glowing hydrogen gas are easily traced throughout the region.

**Notable Stars**

Orion has two first magnitude stars. Betelgeuse is in the left shoulder of the hunter, and Rigel is located in Orion's right foot or knee.

Alpha Orionis, or Betelgeuse, is the 11th brightest star in the sky. The origin of its name is uncertain, but its red color is easily seen. Betelgeuse is the nearest red supergiant star to our solar system, 425 light years away. Betelgeuse pulsates irregularly between magnitudes 0.4 and 1.3 over a period of several years, but this is not noticeable to the casual observer. Its diameter also varies, from 300 to 500 times the Sun's. This instability shows that Betelgeuse is nearing the end of its life, and is due to explode as a supernova at any time - or may have done so already.

Beta Orionis, or Rigel is a bluish, 0.18 magnitude star near Orion's foot; in fact, Rigel means "foot" in Arabic. It is the brightest star in Orion, and the 7th brightest star in the sky. This blue white giant is about 900 light-years away. It has a magnitude 6.7 companion star appearing 9 arcseconds away, but is difficult to observe because of Rigel's brilliant glare.

Gamma Orionis or Bellatrix, "the left shoulder" of Orion, is magnitude 1.6 and about 240 light-years away. It is one of the hotter naked eye stars, and radiates 6400 times the Sun's luminosity.

Three bright stars - Epsilon, Zeta, and Delta Orionis - make up Orion's belt. They are traditionally named Alnilam, Alnitak and Mintaka. Legend claims these stars are the Magi, the Three Wise Men from the East, who traveled west to the Holy Land, following the star which marked the birth of Christ. Second magnitude Mintaka is a multiple star system. A small telescopes reveals companions of magnitude 4.2 and 6.9. The star Alnitak, meaning "belt" in Arabic, is the eastern star in the belt. The third star is Alnilam, meaning "string of pearls" in Arabic, and it is magnitude 1.7.

Kappa Orionis, which has the traditional name Saiph, meaning "sword" in Arabic, and is the sixth-brightest star in the constellation. It is a hot blue supergiant 720 light years away, and marks Orion's lower left foot.

Sigma Orionis is an attractive quintuple star system, whose five stars shine together at magnitude 3.6 just south of Alnitak in Orion's belt. Amateur telescopes show a quartet of stars, the brightest of which is also a close double. This system is about 1150 light years away, and is part of the Orion OB1 Association of young stars which includes many others in the constellation. **Clusters, Nebulae, and Galaxies**

There are many famous nebulae in Orion, but the most celebrated is the Great Orion Nebula,. It is located in Orion's sword, and it includes both M

42 and M 43. This huge nebula of gas and dust is one of the finest diffuse nebulae in the sky. It is 1400 light years away, and 25 light-years across. Many new stars are constantly being formed in the swirling cloud. The ultraviolet light of these hot stars causes the gas cloud to glow in a fluorescent manner.

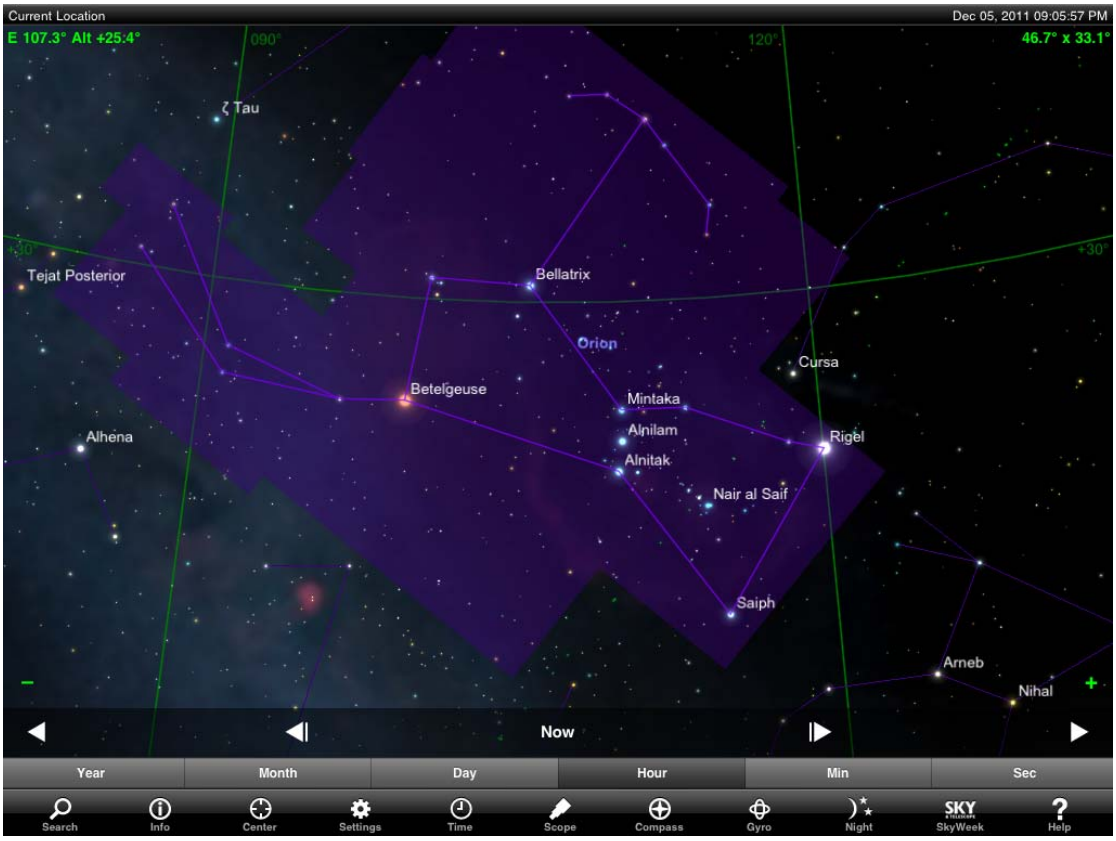
The naked eye sees M 42 as a hazy cloud, and a small telescopes show wreaths and swirls of gas. To the eye the nebula appears somewhat greenish; its colorful red and pink colors are only visible in photographs. With a small telescope, one should be able to see the Trapezium, the four tightly grouped stars near the center of the nebula that are responsible for most of the energy that makes it glow. The Trapezium stars are also catalogued as Theta[1] Orionis.

The beautiful grouping of reflection nebulae NGC 1973, NGC 1975, and NGC 1977 are often overlooked in favor of the better known Orion Nebula. But this bright nebulous complex is interesting in its own right, and is one of the brightest reflection nebulae in the sky. NGC 1981 is anon cluster one degree north of the Great Orion Nebula, at the northern edge of the NGC 1973-75-77 complex. This bright, scattered cluster contains 40 stars covering a 1/2-degree area.

The Flame Nebula, NGC 2024, is a cloud of hot gas near Alnitak that appears reddish. Stretching down from Alnitak is the dark Horsehead Nebula, Barnard 33, which is silhouetted against the bright red background of the emission nebula IC 434. In very dark skies, the Horsehead can be seen in a 6 inch or even smaller telescope. The Horsehead is best seen with long exposure photographs.

Northwest of Alnitak is the reflection nebula M 78. This is the brightest reflection nebula in the sky, visible in binoculars unders good conditions. It is a patch of cold dust illuminated by reflected starlight from nearby stars, and appears comet-like in small telescopes.

All of these nebulae are part of the Orion Molecular Complex, a huge region of gas and dust that envelops the constellation. The Orion Molecular Complex is one of the nearest large star-forming regions to our Solar System. Barnard's Loop is a huge emission nebula surrounding this entire region. Difficult to identify visually, its discovery is generally credited to E. E. Barnard who captured it on long-duration film exposures in 1895.



# ASTRONOMY CLUB OF TULSA – MINUTES - BOARD MEETING SAT NOV 5,

The meeting was held at the Broken Arrow Library, 300 W. Broadway, Broken Arrow, OK.

President Ann Bruun called the meeting to order at 10:15 AM.

Tamara read the mintues from the last board meeting, which was on September 10, 2011.

**Action Item No. 1 – Alternate Dark Sky Site**

There was discussion about finding a dark sky site for the membership, with pros, cons, cost, maintenance, convenience for members, terrain, darkness of sky, etc. being brought into consideration and about forming a committee to investigate possibilities. Ann would like for a committee to bring forth 3 possible sites for consideration. Tony suggested 5. Tom suggested a deadline of June 1. Ann made a proposal to form the committee. ***Tony made motion to allow a committee to form to look into possible dark sky sites and offer chairmanship to Brad Young. Catherine seconded, all in favor, motion carried.***

**From the Treasurer:**

John had to leave at 11, so he went over the Club papework for the officers to sign. ***John made a motion to approve the changes to the signers on Wells fargo account to include Ann Bruun, , President, Lowell A. White, Vice President, and John Land , Treasurer. Bill seconded. All in favor, motion carried.***

There was also discussion about the Nov 11 dinner. Ann suggested just buying bagged salad and dressings to add to the meal. John said that 57 people signed up for the dinner, 64 seats have been reserved. There was also a suggestion about name tags.

***John made motion to invite Ron and Maura Wood to be lifetime members, Tony seconded. All in favor, motion carried.***

**Action Item No. 2 – Observatory Opening and Closing Procedures for All Star Parties**

After discussion about offering keys to our new members after walking them through the opening and closing procedures, Chris said that he will write up the procedures. He also has a new AT&T key and it works.

**Action Item No. 3 – Logistics During Public Star Parties**

Chris needs about 5 people to efficiently run a public star party. He has spoken to the lady who is in charge of student community service at Cascia Hall and Chris can get students to take money, walk the grounds, and do whatever else needs to be done. This gives the kids their community service hours as well as helping us. Catherine said her high-school aged daughter and her classmates could possibly help as well. Chris needs one member to relieve him on the telescope. Tamara volunteered. Chris' dome shows are typically 6 objects and take about 30 minutes. ***The board decided to allow Chris to have Cascia Hall students assist with logistics.*** Also, there will be a scope class for officers.

On the subject of our 75th Anniversary, Chris suggested for our public events that we trailer-mount the old 16 inch telescope, attach a CCD camera and laptop, and we can transport the telescope and use it at public events. ***Chris asked for board's approval to move forward with it. After more discussion, the board decided to allow him to do this.***

**Action Item No. 4 – Sidewalk Astronomy and TASM Events**

***After discussion about events at TASM and Bass Pro, the board decided to continue to do both, and to have sign up sheets for members to commit to public outreach events***. Chris also does not feel we should charge ACCREDITED schools to come to our public events, as that falls under the outreach and education part of what we do. Catherine will bring sign up sheets for our public events to the dinner on Nov. 11.

**Action Item No. 5 – ACT 2012 Events Calendar**

We went over the 2012 calendar. The Messier Marathon is on March 24. Ann had a list of suggestions from John about some of the dates, which she shared with the board. Easter is on April 8, so we could move the ACT TCC meeting to March 30. November 16 was suggested for the 2012 dinner meeting. Another item on that list was either moving the date for the December meeting, but after discussion among the board, it was decided that we just skip the meeting due to its close proximity to the holidays.

There was no other business, so Ann adjourned the meeting at 12:05 PM.

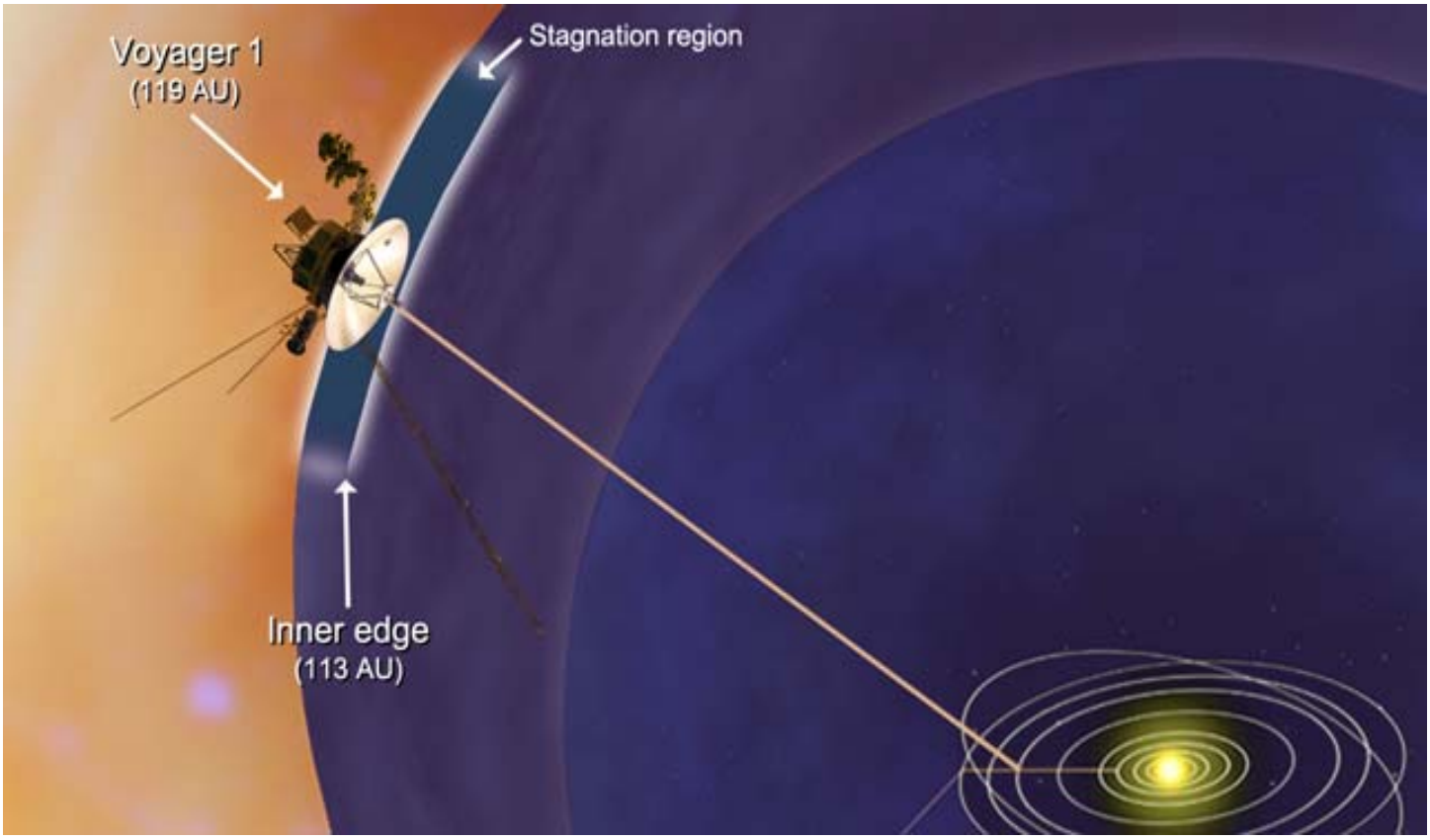
NASA News
JET PROPULSION LABORATORY
CALIFORNIA INSTITUTE OF TECHNOLOGY

# NASA's Voyager Hits New Region at Solar System Edge

PASADENA, Calif. -- NASA's Voyager 1 spacecraft has entered a new region between our solar system and interstellar space. Data obtained from Voyager over the last year reveal this new region to be a kind of cosmic purgatory. In it, the wind of charged particles streaming out from our sun has calmed, our solar system's magnetic field is piled up, and higher-energy particles from inside our solar system appear to be leaking out into interstellar space.

"Voyager tells us now that we're in a stagnation region in the outermost layer of the bubble around our solar system," said Ed Stone, Voyager project scientist at the California Institute of Technology in Pasadena. "Voyager is showing that what is outside is pushing back. We shouldn't have long to wait to find out what the space between stars is really like."

Although Voyager 1 is about 11 billion miles (18 billion kilometers) from the sun, it is not yet in interstellar space. In the latest data, the direction of the magnetic field lines has not changed, indicating Voyager is still within the heliosphere, the bubble of charged particles the sun blows around itself. The data do not reveal exactly when Voyager 1 will make it past the edge of the solar atmosphere into interstellar space, but suggest it will be in a few




NASA's Voyager 1 spacecraft has entered a new region between our solar system and interstellar space, which scientists are calling the stagnation region. In the stagnation region, the wind of charged particles streaming out from our sun has slowed and turned inward for the first time, our solar system's magnetic field has piled up and higher-energy particles from inside our solar system appear to be leaking out into interstellar space. This image shows that the inner edge of the stagnation region is located about 113 astronomical units (10.5 billion miles or 16.9 billion kilometers) from the sun. Voyager 1 is currently about 119 astronomical units (11 billion miles or 17.8 billion kilometers) from the sun. The distance to the outer edge is unknown.

months to a few years.

The latest findings, described today at the American Geophysical Union's fall meeting in San Francisco, come from Voyager's Low Energy Charged Particle instrument, Cosmic Ray Subsystem and Magnetometer.

Scientists previously reported the outward speed of the solar wind had diminished to zero in April 2010, marking the start of the new region. Mission managers rolled the spacecraft several times this spring and summer to help scientists discern whether the solar wind was blowing strongly in another direction. It was not. Voyager 1 is plying the celestial seas in a region similar to Earth's doldrums, where there is very little wind.

During this past year, Voyager's magnetometer also detected a doubling in the intensity of the magnetic field in the stagnation region. Like cars piling up at a clogged freeway off-ramp, the increased intensity of the magnetic field shows that inward pressure from interstellar space is compacting it.

Voyager has been measuring energetic particles that originate from inside and outside our solar system. Until mid-2010, the intensity of particles originating from inside our solar system had been holding steady. But during the past year, the intensity of these energetic particles has been declining, as though they are leaking out into interstellar space. The particles are now half as abundant as they were during the previous five years.

At the same time, Voyager has detected a 100-fold increase in the intensity of high-energy electrons from elsewhere in the galaxy diffusing into our solar system from outside, which is another indication of the approaching boundary.

"We've been using the flow of energetic charged particles at Voyager 1 as a kind of wind sock to estimate the solar wind velocity," said Rob Decker, a Voyager Low-Energy Charged Particle Instrument co-investigator at the Johns Hopkins University Applied Physics Laboratory in Laurel, Md. "We've found that the wind speeds are low in this region and gust erratically. For the first time, the wind even blows back at us. We are evidently traveling in completely new territory. Scientists had suggested previously that there might be a stagnation layer, but we weren't sure it existed until now."

Launched in 1977, Voyager 1 and 2 are in good health. Voyager 2 is 9 billion miles (15 billion kilometers) away from the sun.

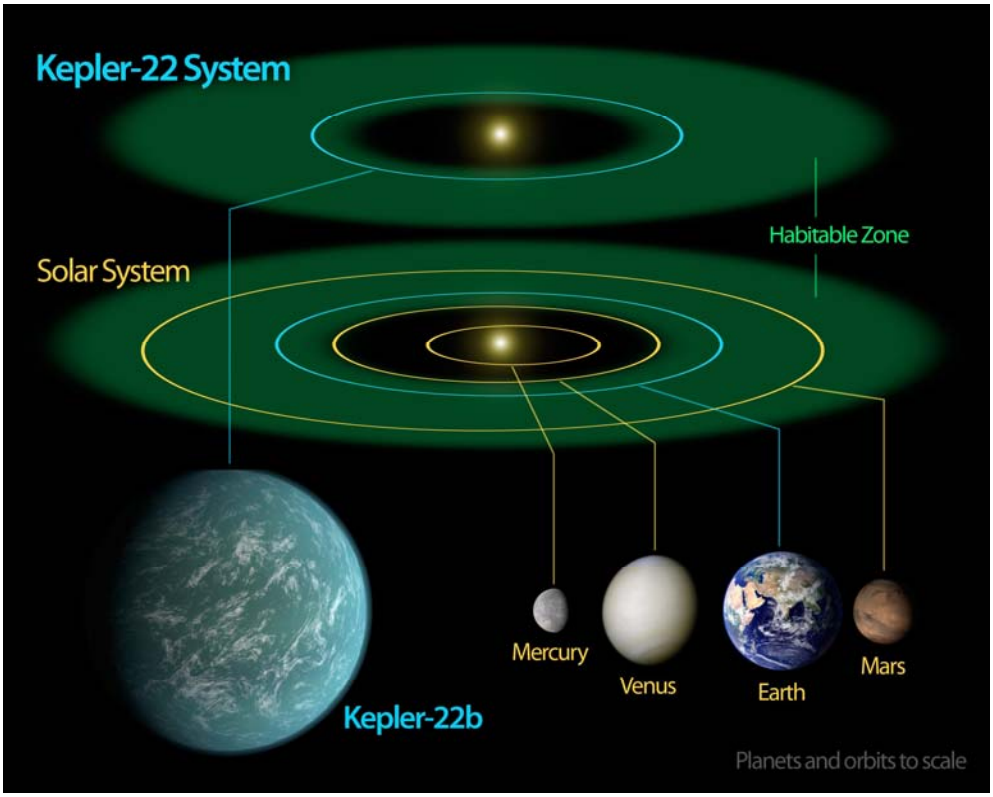
The Voyager spacecraft were built by NASA's Jet Propulsion Laboratory in Pasadena, Calif., which continues to operate both. JPL is a division of the California Institute of Technology. The Voyager missions are a part of the NASA Heliophysics System Observatory, sponsored by the Heliophysics Division of the Science Mission Directorate in Washington. For more information about the Voyager spacecraft, visit: **http://www.nasa.gov/voyager**

For more information about NASA media events at the American Geophysical Union meeting, visit: **http://www.nasa.gov/agu** .

NASA News
JET PROPULSION LABORATORY
CALIFORNIA INSTITUTE OF TECHNOLOGY

# NASA's Kepler Confirms Its First Planet In Habitable Zone

PASADENA, Calif. -- NASA's Kepler mission has confirmed its first planet in the "habitable zone," the region around a star where liquid water could exist on a planet's surface. Kepler also has discovered more than 1,000 new planet candidates, nearly doubling its previously known count. Ten of these candidates are near-Earth-size and orbit in the habitable zone of their host star. Candidates require follow-up observations to verify they are actual planets.




This diagram compares our own solar system to Kepler-22, a star system containing the first "habitable zone" planet discovered by NASA's Kepler mission. Image credit: NASA/ Ames/JPL-Caltech

The newly confirmed planet, Kepler-22b, is the smallest yet found to orbit in the middle of the habitable zone of a star similar to our sun. The planet is about 2.4 times the radius of Earth. Scientists don't yet know if Kepler-22b has a predominantly rocky, gaseous or liquid composition, but its discovery is a step closer to finding Earth-like planets.

Previous research hinted at the existence of near-Earth-size planets in habitable zones, but clear confirmation proved elusive. Two other small planets orbiting stars smaller and cooler than our sun recently were confirmed on the very edges of the habitable zone, with orbits more closely resembling those of Venus and Mars.

"This is a major milestone on the road to finding Earth's twin," said Douglas Hudgins, Kepler program scientist at NASA Headquarters in Washington. "Kepler's results continue to demonstrate the importance of NASA's science missions, which aim to answer some of the biggest questions about our place in the universe."

Kepler discovers planets and planet candidates by measuring dips in the brightness of more than 150,000 stars to search for planets that cross in front, or "transit," the stars. Kepler requires at least three transits to verify a signal as a planet.

"Fortune smiled upon us with the detection of this planet," said William Borucki, Kepler principal investigator at NASA Ames Research Center at Moffett Field, Calif., who led the team that discovered Kepler-22b. "The first transit was captured just three days after we declared the spacecraft operationally ready. We witnessed the defining third transit over the 2010 holiday season."

The Kepler science team uses ground-based telescopes and NASA's Spitzer Space Telescope to review observations on planet candidates the spacecraft finds. The star field that Kepler observes in the constellations Cygnus and

Lyra can only be seen from ground-based observatories in spring through early fall. The data from these other observations help determine which candidates can be validated as planets.

Kepler-22b is located 600 light-years away. While the planet is larger than Earth, its orbit of 290 days around a sun-like star resembles that of our world. The planet's host star belongs to the same class as our sun, called G-type, although it is slightly smaller and cooler.

Of the 54 habitable zone planet candidates reported in February 2011, Kepler-22b is the first to be confirmed. This milestone will be published in The Astrophysical Journal.

This artist's conception illustrates Kepler-22b, a planet known to comfortably circle in the habitable zone of a sun-like star. Image credit: NASA/Ames/JPL-Caltech

The Kepler team is hosting its inaugural science conference at Ames Dec. 5-9, announcing 1,094 new planet candidate discoveries. Since the last catalog was released in February, the number of planet candidates identified by Kepler has increased by 89 percent and now totals 2,326. Of these, 207 are approximately Earth-size, 680 are super Earth-size, 1,181 are Neptune-size, 203 are Jupiter-size and 55 are larger than Jupiter.

The findings, based on observations conducted May 2009 to September 2010, show a dramatic increase in the numbers of smaller-size planet candidates.

Kepler observed many large planets in small orbits early in its mission, which were reflected in the February data release. Having had more time to observe three transits of planets with longer orbital periods, the new data suggest that planets one to four times the size of Earth may be abundant in the galaxy.

The number of Earth-size, and super Earth-size candidates, has increased by more than 200 and 140 percent since February, respectively.

There are 48 planet candidates in their star's habitable zone. While this is a decrease from the 54 reported in February, the Kepler team has applied a stricter definition of what constitutes a habitable zone in the new catalog, to account for the warming effect of atmospheres, which would move the zone away from the star, out to longer orbital periods.

"The tremendous growth in the number of Earth-size candidates tells us that we're honing in on the planets Kepler was designed to detect: those that are not only Earth-size, but also are potentially habitable," said Natalie Batalha, Kepler deputy science team lead at San Jose State University in San Jose, Calif. "The more data we collect, the keener our eye for finding the smallest planets out at longer orbital periods."

NASA's Ames Research Center manages Kepler's ground system development, mission operations and science data analysis. NASA's Jet Propulsion Laboratory in Pasadena, Calif., managed Kepler mission development.

Ball Aerospace and Technologies Corp. in Boulder, Colo., developed the Kepler flight system and supports mission operations with the Laboratory for Atmospheric and Space Physics at the University of Colorado in Boulder.

The Space Telescope Science Institute in Baltimore archives, hosts and distributes the Kepler science data. Kepler is NASA's 10th Discovery Mission and is funded by NASA's Science Mission Directorate at the agency's headquarters.

For more information about the Kepler mission and to view the digital press kit, visit http://www.nasa.gov/kepler

NASA News
JET PROPULSION LABORATORY
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# NASA Probe Data Show Liquid Water Evidence on Europa

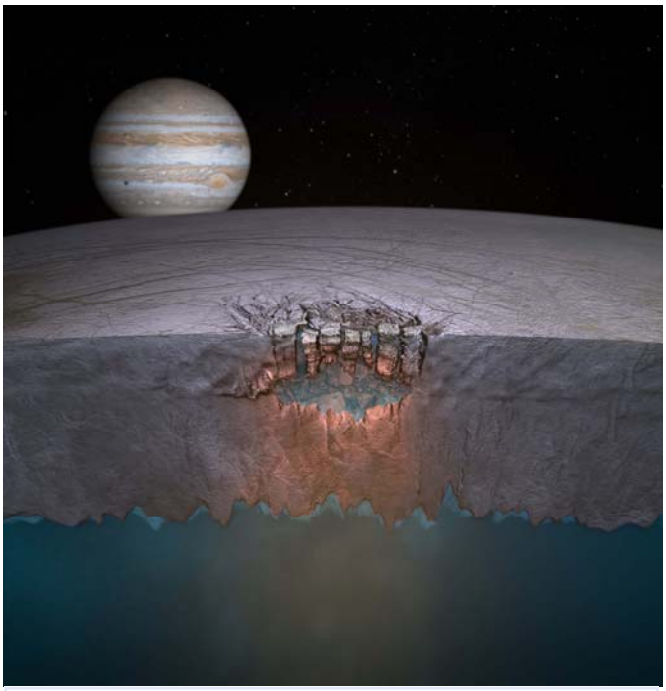
PASADENA, Calif. -- Data from a NASA planetary mission have provided scientists evidence of what appears to be a body of liquid water, equal in volume to the North American Great Lakes, beneath the icy surface of Jupiter's moon, Europa.

The data suggest there is significant exchange between Europa's icy shell and the ocean beneath. This information could bolster arguments that Europa's global subsurface ocean represents a potential habitat for life elsewhere in our solar system. The findings are published in the scientific journal Nature.

"The data open up some compelling possibilities," said Mary Voytek, director of NASA's Astrobiology Program at agency headquarters in Washington. "However, scientists worldwide will want to take a close look at this analysis and review the data before we can fully appreciate the implication of these results."

NASA's Galileo spacecraft, launched by the space shuttle Atlantis in 1989 to Jupiter, produced numerous discoveries and provided scientists decades of data to analyze. Galileo studied Jupiter, which is the most massive planet in our solar system, and some of its many moons.

One of the most significant discoveries was the inference of a global saltwater ocean below the surface of Europa. This ocean is deep enough to cover the whole surface of Europa and contains more liquid water than all of Earth's oceans combined. However, being far from the sun, the ocean surface is completely frozen. Most scientists think this ice crust is tens of miles thick.

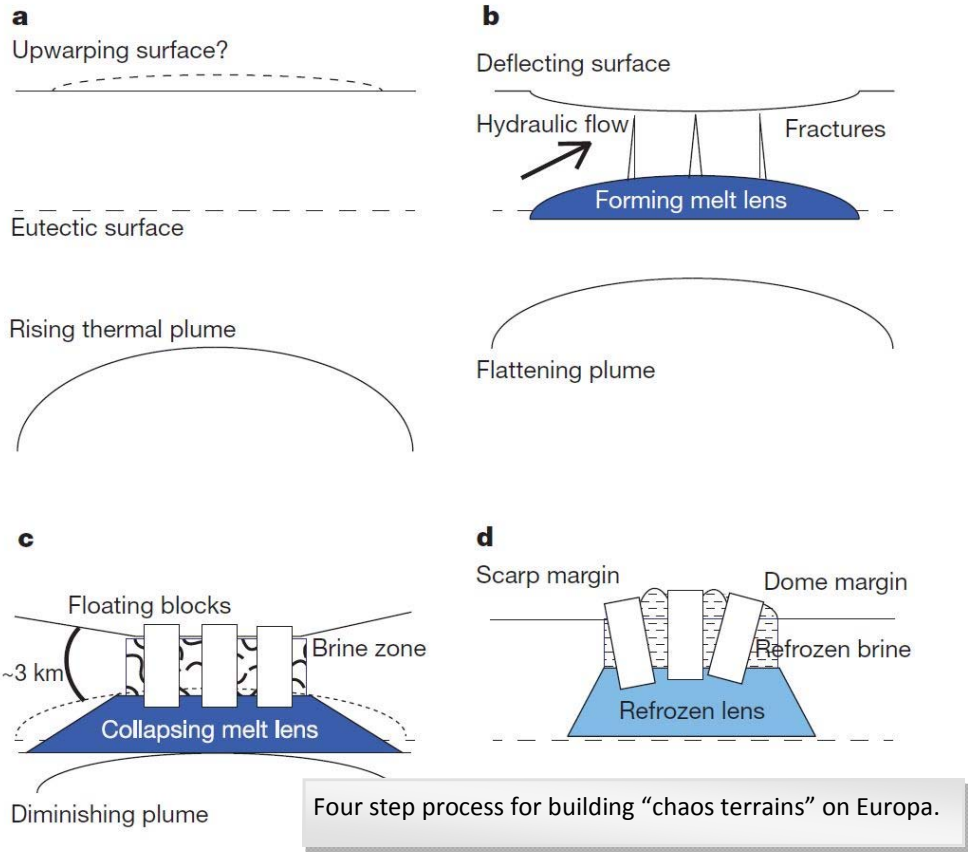


Europa's "Great Lake." Scientists speculate many more exist throughout the shallow regions of the moon's icy shell. Credit: Britney Schmidt/Dead Pixel VFX/Univ. of Tex-

"One opinion in the scientific community has been if the ice shell is thick, that's bad for biology. That might mean the surface isn't communicating with the underlying ocean," said Britney Schmidt, lead author of the paper and postdoctoral fellow at the Institute for Geophysics, University of Texas at Austin. "Now, we see evidence that it's a thick ice shell that can mix vigorously and new evidence for giant shallow lakes. That could make Europa and its ocean more habitable."

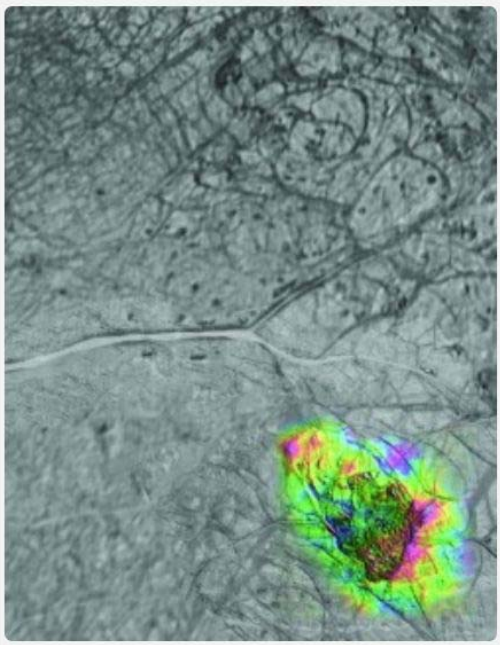
Schmidt and her team focused on Galileo images of two roughly circular, bumpy features on Europa's surface called chaos terrains. Based on similar processes seen on Earth -- on ice shelves and under glaciers overlying volcanoes -- they developed a four-step model to explain how the features form. The model resolves several conflicting observations. Some seemed to suggest the ice shell is thick. Others suggest it is thin.

This recent analysis shows the chaos features on Europa's surface may be formed by mechanisms that involve significant exchange between the icy shell and the underlying lake. This provides a mechanism or model for transferring nutrients and energy between the surface and the vast global ocean already inferred to exist below the thick ice shell. This is thought to increase the potential for life there.




Four step process for building "chaos terrains" on Europa.

The study authors have good reason to believe their model is correct, based on observations of Europa from Galileo and of Earth. Still, because the inferred lakes are several miles below the surface, the only true confirmation of their presence would come from a future spacecraft mission designed to probe the ice shell. Such a mission was rated as the second highest priority flagship mission by the National Research Council's recent Planetary Science Decadal Survey and is being studied by NASA.



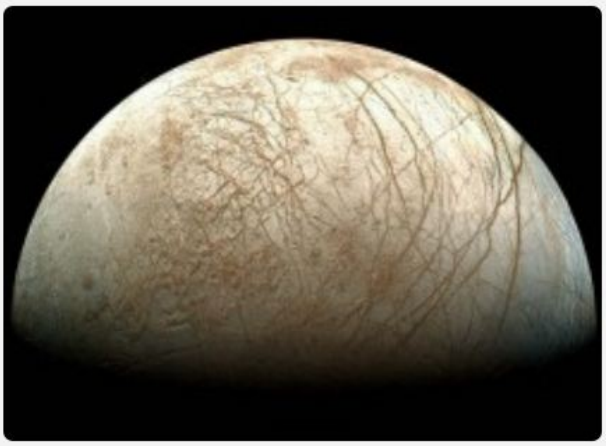
Thera Macula (false color) is a region of likely active chaos production above a large liquid water lake in the icy shell of Europa. Color indicates topographic heights relative to background terrain. Purples and reds indicate the highest terrain. Credit: Paul Schenk/NASA

"This new understanding of processes on Europa would not have been possible without the foundation of the last 20 years of observations over Earth's ice sheets and floating ice shelves," said Don Blankenship, a co-author and senior research scientist at the Institute for Geophysics, where he leads airborne radar studies of the planet's ice sheets.

Galileo was the first spacecraft to directly measure Jupiter's atmosphere with a probe and conduct long-term observations of the Jovian system. The probe was the first to fly by an asteroid and discover the moon of an asteroid. NASA extended the mission three times to take advantage of Galileo's unique science capabilities, and the spacecraft was put on a collision course into Jupiter's atmosphere in September 2003 to eliminate any chance of impacting Europa.

The Galileo mission was managed by NASA's Jet Propulsion Laboratory in Pasadena, Calif., for the agency's Science Mission Directorate.

JPL is managed for NASA by the California Institute of Technology in Pasadena.



Europa, as viewed from NASA's Galileo spacecraft. Visible are plains of bright ice, cracks that run to the horizon, and dark patches that likely contain both ice and dirt. Image reprocessed by Ted Stryk.

# SURVEY RESULTS

By: **Catherine Kahbi**

A survey was passed around at the ACT annual dinner on Nov. 11, twenty-two members completed surveys.

The vast majority of members surveyed indicated what they liked best about ACT is the people, and having an opportunity to get to know others with an interest in astronomy. The next most liked thing is the opportunity for learning, the variety of programs, and the newsletter. The most common response to "what could the club improve on" was a request for darker skies, followed by having meetings on a night other than Friday, due to conflicts with work schedules. Speakers or topics requested for our meetings included astronomy 101 topics, presentations on planets, nebulae, globular clusters, asteroids, cosmology, etc.; professors from universities, astrophotography, telescope making, and presentations using NASA imagery.

The majority of members surveyed stated they went to the observatory six or more times each year, with many indicating they go every time it's open. A few go zero to two times per year. Likewise, the majority of members surveyed attend ACT meetings six or more times per year, and a few indicated they rarely attend or attend only if they are interested in the topic.

Our question regarding our present meeting location at TCC NE Campus had a very mixed response: ten members said the TCC NE campus is convenient for the meetings; seven said it's not convenient, three indicated they preferred downtown, four preferred a south location, and one preferred TU. Two felt it is too far, one said it's far but not difficult to get to, etc.

The survey asked beginners and new members if they were getting the support they needed, most said yes, with some wanting more help in selecting and locating equipment to purchase.

Members also gave great ideas for fund raisers, and had many positive comments about the club and its activities.

2012 Annual Club Dinner at the Tulsa Air and Space Museum.

# CLUB OFFICERS

| | | |
|---|---|---|
| **President** | **Ann Bruun** | **918-231-0301** |
| **Vice-President** | **Tony White** | **918-258-1221** |
| **Treasurer** | **John Land** | **918-357-1759** |
| **Secretary** | **Tamara Green** | **918-581-1213** |

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|---|---|
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| **Teresa Davis** | **918-637-1477** |
| **Tim Davis** | |
| **Bill Goswick** | **918-742-6146** |
| **Catherine Kahbi** | **918-230-8480** |
| **Tom McDonough** | **918-851-2653** |

# APPOINTED STAFF

| | | |
|---|---|---|
| **Newsletter Editor** | **Jerry Mullennix** | |
| **Facility Manager** | **Chris Proctor** | **918-810-6210** |
| **Membership Chair** | **John Land** | **918-357-1759** |
| **Observing Chair** | **Chris Proctor** | **918-810-6210** |
| **Group Director** | **Tamara Green** | **918-581-1213** |
| **Webmaster** | **Jennifer Jones** | |
| **Night Sky Network** | **Teresa Davis** | **918-637-1477** |

# MEMBERSHIP INFO

Astronomy Club of Tulsa membership ($45/year) includes membership in the Astronomical League and subscription to ACT's "Observer" and AL's "Reflector". "Astronomy" ($34/year) and "Sky and Telescope" ($33/year) are also available through the club. For more information contact John Land at 918-357-1759. 

# NOTICES

Monthly Star Party Gates open at 6:00 PM Sunset 5:14 PM (See directions and map link at end)

If the weather looks a bit iffy be sure and check the Yahoo! Group for cancellation. http://tech.groups.yahoo.com/group/AstroTulsa/

I will also post on the AstroTulsa Facebook page if we have to cancel.

Our Monthly Star party is open to individuals and families. Guest Admission is $ 2.00 per person. You can help us out by bringing correct change and pay at the gate or classroom. ( groups need to make separate reservations ) For safety Do Not turn off your headlights but please use low beam.

# THE ASTRONOMY CLUB OF TULSA

## FRONT ROW SEATS TO THE BATTLES OF WINTER AT AN ASTRONOMY CLUB OF TULSA STAR PARTY!

## OPEN TO THE PUBLIC!

**For More Information Please Visit**

**www.astrotulsa.com**

The Observer is a publication by the Astronomy Club of Tulsa (ACT). ACT is a 501C non profit organization open to the public. ACT started in 1937 with the single mission to bring the joy and knowledge of astronomy to the community of Tulsa, Oklahoma and the surrounding area. Today our mission remains exactly the same . We travel to local schools, churches and many other venues with scopes and teachers. Our observatory is located in Mounds where many public programs are offered. To join the Astronomy Club of Tulsa please visit www.astrotulsa.com where you will find all the information necessary to become a member.

Night Sky Network

Astronomy Clubs bringing the wonders of the universe to the public