Sunset Astronomical Society

The Sunset Gazette

Serving the Tri-Cities since 1975

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Meeting Info:

Meetings are at the Delta Planetarium, Bay City , 100 Center Avenue The meetings will usually be on the 2nd Saturday of each month at 6:00 PM. Watch the newsletter for changes in dates and times. Membership is not required to participate in meetings and activities. See last Page for this month's meeting site.

Membership Info:

Our club has switched to e-mailing our newsletters. For those wishing to receive a hard copy mailed an additional dues of $10.00 per year is required.

New Membership Rates: 5$ per Year

Treasurer's address for renewals and subscriptions:

Laura Wade
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Composite image of the total lunar eclipse on October 8, 2014, photographed from the roadside west of Mount Pleasant.

Instrument: 8" f/4 Newtonian + Canon 6D. (c) Axel Mellinger

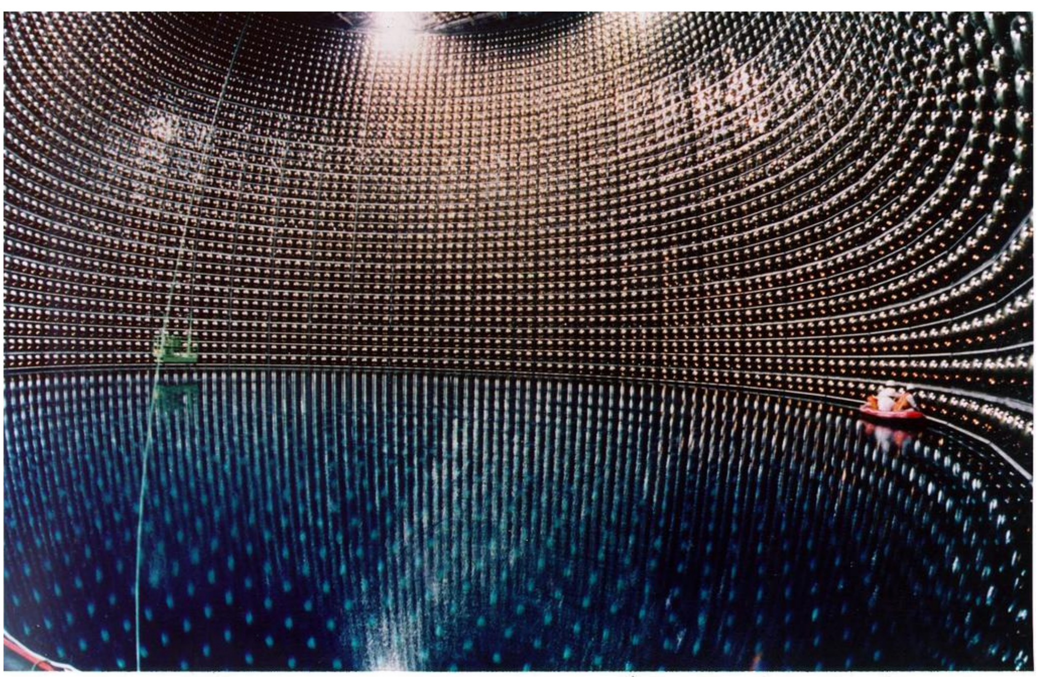
Neutrinos

This is the second part of a new series about neutrinos and the last issue of the SAS newspaper ended with the mystery of the solar neutrino. As you may remember the group around the physicist Raymond Davis had made their pioneering experiment to detect solar neutrinos in the Homestake-goldmine near Lead (South Dakota) but they only detected 1/3 of the neutrinos they should have found according to the theory of nuclear fusion process in our Sun. We learned that their experimental set using only allowed them to detect neutrinos which had energies above of 0.814 MeV and that additional experiments would be necessary to account for neutrinos with lower energies. Two such experiments were devised: GALLEX and SAGE situated in Italy respectively the former Soviet Union and both experiments were using gallium as the element to detect the solar neutrinos. Both experiments were set up deep underground to minimize the interaction of cosmic radiation but the principle ofr the neutrino detection was similar to that used in the Homestake mine. The neutrino interacts with the gallium forming a germanium nucleus which by itself is not stable but radioactive and decays back to the gallium with a half life of 11.43 days. The shorter half life compared to the Homestake experiments allowed a higher number of measurements but the extraction process for the germanium took significantly more effort. The outcome of both experiments were awaited with great anticipation by the scientific community the SNU (Solar Neutrino Unit). One SNU represents the neutrino flux producing 10^{-36} captures per target atom per second. According to the theoretic model the solar neutrino flux at the position of Earth should be 7.7 ± 1.2 SNU but the Homestake experiment only gave 2.56 ± 0.22 SNU. So their was huge interest in the two new experiments but the scientific community had be very patient because only over a long period of measurement time would the results be sound and convincing. The GALLEX experiment was active between 1991 and 1997 and was continued in an improved version (GNO) between 1998 to 2003 whereas the SAGE experiment started in 1990 and is still running (as of 2010). According the theory SAGE and GALLEX should have observed 131 ± 12 SNU. GALLEX/GNO observed 69.3 ± 5.5 SNU whereas SAGE detected 66.9 ± 5.3 SNU. Both experiments delivered data which was very close and ensured that there was no measurement error but the observed rate was only ca 1/2 of the theoretical predicted rate.

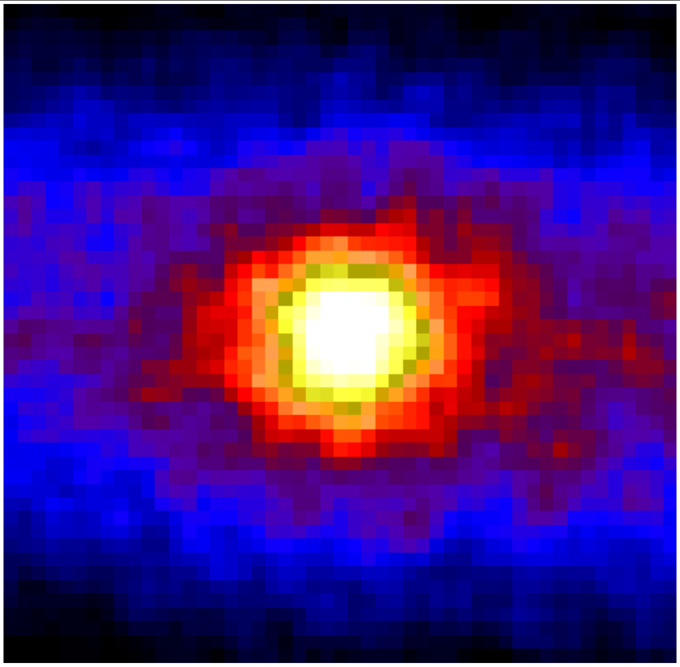
A model of the Kamiokande detector. Source Wikipedia.

The radio chemical experiments revealed one important fact: the gallium experiments were able to detect more of solar neutrinos due to its lower energy barrier of 0.238 MeV versus 0.814 MeV in the Homestake experiment. The effect which made part of the neutrinos invisible for the experiments seem to depend on the energy of these particle. All radio chemical experiments had one in common: They could only count the neutrinos but the only suggestion about their actual energy was from the detection limit. What was necessary was a method to determine the energy of each and every neutrino and to better compare the results a new measuring unit was introduced: what was needed was some sort of neutrino spectroscopy!

In 1987 a detector originally designed for the detection of the proton decay was put in place. It was situated at the Japanese Kamioka-Mozumi mine and named Kamiokande detector (**Kamioka Nucleon Decay Experiment**) and was practically a huge cylindrical tank of 3,000 tons of ultra clean water with 1,000 photomultiplier tubes attached to the inner surface. Its measuring principle was the detection of Cherenkov light which was generated every time when charged high energy particles with speeds above the light speed in water were passing through the tank. These particles generate a cone of light which propagates under a certain angle along the trace of the particle in the water. An analog would be propagation of sound waves when a plane breaks the sound barrier. The position of the light cone gives information about the direction where the particle came from and the light intensity correlates with its energy.


Maintenance work on the inside of the Super-Kamiokande detector.

Very soon it was realized that the Kamiokande detector could also been used for the detection and possible spectroscopy of neutrinos. The detection is based on the scattering of the neutrinos at the electrons of water molecules and the impulse transfer onto the electrons. If the energy is sufficient the electrons are accelerated almost exactly along the path of the incoming solar neutrinos.



The Sun, as seen in neutrinos by the Super Kamiokande telescope after 500 days of data-taking.

Hence the traces of the neutrino events should always point away from the position of the Sun providing proof that the signal really comes from solar neutrinos. To exclude and filter of gamma radiation and neutrons (from background radioactive decays) an inner detection volume of 680 tons of water was assigned where only solar neutrino would generate Cherenkov events. Nonetheless unwanted background events remained and the energy threshold was around 7 MeV and the solar neutrino flux was determined to be about 60 % of the theoretical flux.

Kamiokande was operational between 1987 till 1995 and in 1996 its successor experiment , the Super-Kamiokande was put in operation in the same mine. Optimizations were a larger body of ultra-pure water (50,000 tons), an addition detector to identify penetration cosmic radiation and a higher number of more sensitive photomultipliers(11,146). The results after 5 years confirmed the measurements with the Kamiokande detector but with a higher precision. On the upper right page you can see a picture of the Sun seen in neutrino generated Cherenkov light.

Continued in the next issue of the SAS newsletter!

President's Corner

Greetings, Sunset Astronomers! Starting with this edition of the newsletter, I'd like to establish a "President's Corner" to keep you informed of events around the club.

2014 has been an eventful year, both for the club and in the field of astronomy in general. After meeting at Auburn City Hall for several months we got the opportunity to move our meetings back to the planetarium, thanks to the support by Sue Montesi and Bill Mitchell. A first chance to fill the renewed collaboration between the planetarium and our club with life was the October 23 partial solar eclipse when several club members assisted the planetarium with their public outreach effort.

Our next milestone will be the celebration of the club's 40th anniversary in January 2015. We plan to host a public event in the foyer of the planetarium on Saturday, January 10 from 6-7 pm, with telescope exhibits, flyers, and free cookies. And, of course, a stack of membership applications! Bill Albe has volunteered to give a presentation on the history of the Sunset Astronomical Society. The annual potluck will also be held on the same day, right after Bill's talk.

I hope you all had a chance to see the exciting images returned by the Rosetta probe that is currently in orbit around comet 67P/Churyumov–Gerasimenko. Unlike previous fly-by missions, Rosetta will accompany the comet during its entire journey through the inner Solar System. Its lander Philae obtained the first images from a comet's surface; analysis of the data on the composition of the comet's surface is currently underway. We already know that the comet is not as fluffy as expected – under a layer of dust the surface turned out to be as hard as solid ice. You can follow the progress of the mission at the website of the European Space Agency, rosetta.esa.int.

Finally, a reminder that it's time to renew your club membership! You can pay your dues ($5 individual, $10 family) either in person, or send a check to our new treasurer, Laura Wade.

Well, that's about it for my first President's Corner. Mohammed will chair the December meeting, since I will be on my way to Germany to visit my family. So, it's time to wish you all Merry Christmas and a Happy New Year 2015!

Clear skies,

Axel Mellinger

SAS President

SUNSET ASTRONOMICAL SOCIETY
THE SUNSET GAZETTE
SERVING THE TRI- CITIES SINCE 1975

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This issue can be accessed in color on the website of the SAS!!!
http://www.sunsetastronomicalsociety.com

SAS Meeting

Start: 6:00 PM

Saturday Dec 13h, 2014

Delta Planetarium

Bay City

- **Meeting Call to Order**
- **Introduction of Guests**
- **Treasurer's Report**
- **Action item: Authorization of expenses related to 40th anniversary Celebration**
- **Black Holes (Mohammed Khan)**
- **More Discussion of Bylaws Revision**
- **Other topics**
- **Adjournment**

To be determined at the time of editing, check your e-mail!

Meeting Schedule can be found at:

http://www.sunsetastronomicalsociety.com/SASMeetingsCurrent.htm

What's up in the Sky

Dec 5 *Evening*: The Moon moves through the Hyades and is very close to Aldebaran. Best observed with binoculars or a wide field telescope.

Dec 11, 12 *Dawn*: Watch out for Jupiter shining above the waning gibbous Moon halfway up the southwestern sky.

Dec 6: Full Moon

Dec 13 - 14 *All Night*: The Geminid shower peaks this night and the best viewing chances are shortly before the last quarter Moon rises around midnight.

Dec 14: Last Quarter Moon

Dec 15 *Evening*: Algol can be observed at its minimum brightness for roughly two hours centered at 10:22 pm EST.

Dec 18 *Evening*: Algol can be observed at its minimum brightness for roughly two hours centered at 7:12 pm EST.

Dec 21: Longest night of the year in the Northern Hemisphere. Winter begins at solstice 6:03 pm EST.

Dec 21: New Moon

Dec 22 Dusk: Something a little bit more challenging: An extremely thin crescent Moon can be seen right to Venus very low in the west-southwest shortly after sunset. Binoculars needed!

Dec 23 Dusk: Watch out for Venus well below the Moon.

Dec 24 Evening: Mars can be observed to the left of the waxing crescent Moon.

Dec 28 Late Evening: Watch out for Uranus (greenish disk) very close to the Moon. Telescope needed. In Japan and parts of the Artic an occultation is visible.

Dec 28: First Quarter Moon

Jan 3, 4 *After Midnight*: Peak of the short-lived Quadrantid meteor shower between the two mornings in North America.

Jan 4: Full Moon

Jan 5 *Midnight*: Algol can be observed at its minimum brightness for roughly two hours centered at 12:07 am EST.

Jan 7 *Evening*: Algol can be observed at its minimum brightness for roughly two hours centered at 8:56 pm EST.

Jan 7 *Night*: Look out for bright Jupiter 5 deg from the waning gibbous Moon.

Jan 8 - 12 Dusk: Mercury and Venus can be found less than 1 deg from each other in the southwest sky in early evening.

Jan 13: Last Quarter Moon

Jan 16 *Before Dawn*: Look out for Saturn ca 2 deg from the waning crescent Moon.

Jan 20: New Moon

Jan 21 Dusk: Mercury, Venus and the hairline crescent Moon form a near equilateral triangle shortly after sunset. Binoculars!

Jan 22 Dusk: Waxing crescent Moon can be observed ca 4 deg to the right of Mars.

Jan 23, 24 *Night*: A rare triple shadow transit occurs on Jupiter from 1:27 to 1:52 am EST. Telescope needed!

Jan 26: First Quarter Moon

Jan 27 *Night*: Algol can be observed at its minimum brightness for roughly two hours centered at 10:42 pm EST.

Jan 30 *Evening*: Algol can be observed at its minimum brightness for roughly two hours centered at 17:31 pm EST.

UPCOMING EVENTS