SIRIUS ASTRONOMER

www.ocastronomers.org

The Newsletter of the Orange County Astronomers

February 2011 *Free to members, subscriptions $12 for 12 issues* **Volume 38, Number 2**

The Double Cluster in Perseus consists of two star clusters: NGC 884 and NGC 869. While they appear in close proximity to each other when viewed from Earth, they are in reality approximately eight hundred light-years distant from one another. These easy-to-find objects are great crowd pleasers at any star party or outreach! (photo by Vittal N. Badithe)

OCA CLUB MEETING

The free and open club meeting will be held February 11th at 7:30 PM in the Irvine Lecture Hall of the Hashinger Science Center at Chapman University in Orange. This month, Dr. Tyler Nordgren will discuss astronomy from our national parks in his talk, 'Stars Above, Earth Below'

NEXT MEETING: March 11

STAR PARTIES

The Black Star Canyon site will be open on February 26th. The Anza site will be open on February 5th. Members are encouraged to check the website calendar, for the latest updates on star parties and other events.

Please check the website calendar for the outreach events this month! Volunteers are always welcome!

You are also reminded to check the web site frequently for updates to the calendar of events and other club news.

COMING UP

The next session of the Beginners Class will be held on Friday, January 7th at the Centennial Heritage Museum at 3101 West Harvard Street in Santa Ana. Next month the class will be offered on February 4th.

GOTO SIG: TBA

Astro-Imagers SIG: Feb. 15th, Mar. 15th

Remote Telescopes: TBA

Astrophysics SIG: Feb. 18th, Mar. 18th

Dark Sky Group: TBA

February 2011 President's Message

Hello fellow members! It's been a couple of months since I graced the pages of the Sirius Astronomer with my president's message and for that I apologize. But sometimes things get away from me.

Quite a few things have been going on with the OCA since you last heard from me. For one the OCA election season was held and is now over. All of the board members from 2010 remain in office for 2011.

Your board is :	**Trustees:**
Craig Bobchin – President	Barbara Toy
Reza AmirAjomand – Vice President	Alan Smallbone
Bob Buchheim - Secretary	Gary Schones
Charlie Oostdyk - Treasurer	Steve Short
	Sheila Cassidy
	Kyle Coker
	Greg Schedcik

All of us board members have busy lives outside of the OCA in addition to our board member duties. But our running of the club is open to any member that wants to attend the board meetings all you have to do is contact a board member and we'll make sure you get direction to the location of the board meeting. We also maintain an open door policy, if any member has any concerns about the way the club is being run, or the way the board members are handling their duties, please do not hesitate to let us know.

We are now heading into spring, and by the time you read this, the February star pasrty will be over and that brings us to the March Star Party. The March Star party is the club's official Messier Marathon where we have the opportunity to see all 110 (or 109 depending on which list you use) Messier Objects in one night. This year's marathon presents a couple of challenges, the March star party is a little earlier than we usually do it this year but as the equinox falls immediately after the full moon (which is NOT good for looking for faint fuzzies!) putting the marathon later in the month is not a good idea. The April star party is the back up, but the nights will be shorter then than in early March, making it more of a challenge to get the 1st and last objects as those will be in twilight murk.

As is our custom, the club offers certificates for those who complete the form and turn it in to a board member. The certificates will be presented at the general meeting following when you turn in your completed form. The form is available on the OCA web site and there will be copies available at Anza the nights of the star parties. You can do the marathon either visually or photographically. If you do try to image all 110 objects your images will be short 30 seconds to one minute in length before you have to move to the next object.

As someone who has partaken of the marathon every year for the last ten years, I can say it is a fun treasure hunt. I have yet to get all objects in one night through imaging, but I have dome it visually several times.

Speaking of Anza, the club now owns 7 pads: (4 on the "lower pads" area, and one each on Mars Hill, Ten-pad alley, and Upper pads) that have been donated by members that for one reason or another no longer wanted their pad.

The Board has decided to offer a "limited license" option for the club-owned pads. The rules are as follows:

- The limited license fee is $360/year, payable in advance
- No "purchase price" or down payment beyond the annual limited license fee.
- The ownership remains with the club – the licensee has no ownership beyond the annual limited license, and the limited licensee may not transfer the pad license, except for returning it to the club.
- The limited license may be terminated by the limited licensee at any time, in which case the club will refund a pro-rated amount of the annual fee.
- The club may terminate the limited license, upon 3 months notice to the limited licensee.

For more information about the pads or to take on a limited licence Please contact Barbara Toy or Charlie Oostdyk.
We are also going to be having an Anza site cleanup for May 7, as part of the annual weed-reminder letters to Pad and Observatory holders. The Board is looking into having a dumpster on site that weekend to simplify the trash removal task.
Repairs and Upgrades: There is still a need for several major repair/upgrade tasks at Anza house including:

- Removing the carpet and replace it with linoleum
- We want to remove 2nd kitchen and turn it into office area.

Similarly, the Observatory needs several major projects done, including:

- Remove and replace carpeting
- Renovate warming room

We are looking for Volunteers for these specific tasks at Anza. If you want to help out contact one of the board members listed above. Remember that Anza and all it includes are our clubs largest material asset and we all need to help maintain it.

That's all for this month. Clear skies!

TOP TWENTY THINGS AN ASTRONOMER SHOULD SEE

#8 A Really Great Meteor Shower

By Helen Mahoney

"I've seen it rainin' fire in the sky." I once heard that the Perseid meteor shower inspired John Denver to write those words in his song "Rocky Mountain High." I know how he felt. Seeing an individual meteor streak across the sky is always exciting, but watching a really great meteor shower is truly inspiring.

Dave Kodama captured this image of a bolide from the Anza site during the Perseid shower on August 11, 2005.

The word meteor comes from the Greek word *meteoros,* meaning "high in the sky", the same root as for Meteorology. Meteors have been called "shooting stars" or "falling stars", because they look like one of the stars has lost its attachment to the sky and is falling down. We now know that what we see as meteors are actually small rocky bodies (called meteoroids) burning up as they enter the earth's atmosphere. The earth is traveling at 18.5 miles per second around the sun, and the friction of the meteoroid hitting the atmosphere at that speed heats it up enough to cause melting and even evaporation of the meteoroid, leaving a glowing streak in the sky that usually doesn't last long enough to say "Look!"

Very large and bright meteors are called "bolides" from the Greek *bolis* meaning "missile" or "flash." Often, they cast shadows and leave trails which glow for several seconds or minutes. Some of the larger meteoroids are big enough that part of them survives the trip through the atmosphere, and they hit the earth as meteorites. A few exceptionally big ones leave craters, such as the Meteor Crater in Arizona.

Usually, meteoroid hits are random, although there are many small ones hitting the earth every day. When the earth's orbit takes it through the left-over particles of a passing comet, it is like driving through a swarm of bugs. The particles splatter against the atmosphere like the bugs on the windshield. That is what causes a meteor shower. A time exposure photograph allows you to see the spot from where the meteors seem to be radiating. The background constellation where they seem to be originating is what gives the particular meteor shower its name. For example, the meteor shower that apparently radiates from the constellation Perseus is called the Perseid meteor shower. Its particles come from dust ejected from comet Swift-Tuttle. Since the particles are of a wide variety of sizes, from grains of sands to boulder-size, the brightness of the meteors will range from faint to very bright. Although some meteors in a shower are bright enough to see from a city, as with viewing the Milky way, a darker sky will allow you to see fainter meteors, so the darker the sky, the more meteors you will see.

In the 1980's, we went up to the White Mountains near Bishop, California, the same location where I had my best view of the Milky Way. We were there in August for the Perseid shower. Close to midnight we saw a meteor, then another, and soon they were coming at a rate of greater than one per minute. We sat on top of the hoods of our cars, watching for hours. It was the best meteor display I would see until the great Leonid meteor shower of 2001.

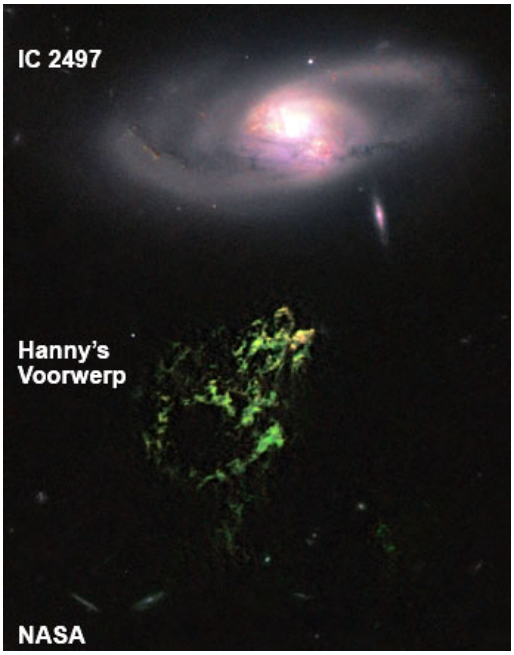
The Leonid showers occur in November, and are caused by the ejecta dust of comet 55P/Tempel-Tuttle. The earth passed through a particularly abundant dust trail of the comet in 2001. We heard that it was going to be good, so we made plans to see it from a dark sky. Weather forecasts showed Anza to be "iffy," so we decided to head out instead to friend's house in Inyokern in the Mojave Dessert.

The peak was scheduled to be at 2 am local time, so we arrived at our friend's house about 11 pm. Just as we arrived, a bolide shot across the whole sky. It was a good omen. One of our friends decided to count them, and I am glad he did. They started coming, then came faster and faster until they looked more like fireworks than any meteor shower I had ever seen. When Leo was overhead, the meteors truly fell from the sky, sometimes coming 3 or 4 at once. For a while it was actually frightening to look up and see these fireballs falling toward you. But it was also very beautiful. With so many meteors, there were a great number of bolides, leaving trails for seconds and even minutes. They slowed down about 3 am, but a couple of us die-hards continued to watch until the dawn began to lighten the sky. My friend who counted them reported his total—1700 meteors in 4 hours!

They are predicting that the glory days of the Perseids and Leonids are over for the time being, but that the Geminids are going to be the next showers to watch for great displays. Great meteor showers don't take expensive equipment — just eyeballs, and maybe a comfortable chair. Don't miss the next one. It may inspire you to write a song about it. ■

AstroSpace Update

February 2011
Gathered by Don Lynn from NASA and other sources

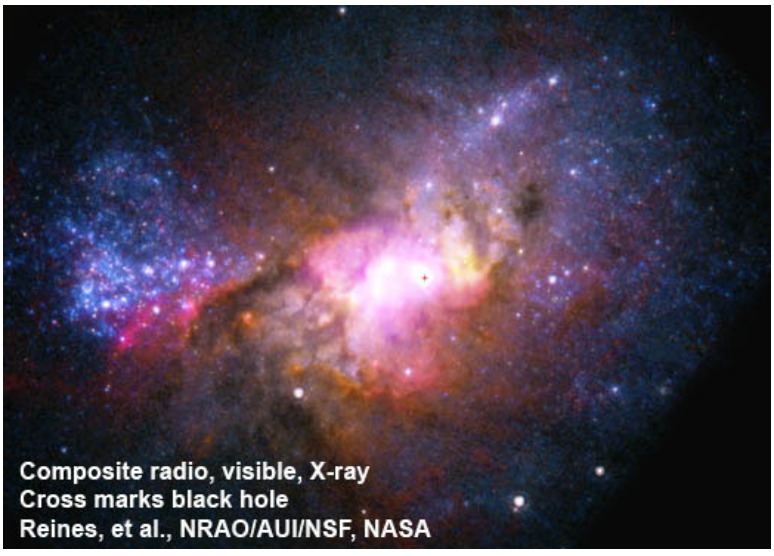


Hanny's Voorwerp – If you have been following this story here, you know that Hanny van Arkel, a school teacher in the Netherlands, noticed a huge green glowing blob of gas, as large as our Milky Way, near the galaxy IC 2497, while she was working on the Galaxy Zoo, which has volunteers classify the million galaxies they have photographed. It came to be known as the Voorwerp ("object" in Dutch), and has been the subject of a great deal of study, since it looks like no other object in the sky. Some astronomers finally got time on the Hubble Space Telescope to study the Voorwerp, and those results combined with observations in many other wavelengths have resulted in an explanation for it. A gas-rich dwarf galaxy collided with IC 2497 about a billion years ago, which resulted in tidal forces pulling out a huge (300,000 light-years long) streamer of gas that wraps around the galaxy. The streamer is not visible in ordinary light, because nothing lights it up, though it has been seen in radio light. Then the black hole at the center of IC 2497 burst into quasar mode, sending out 2 jets, one of which struck a piece of the gas streamer. This quasar action may have been caused by the collision with the dwarf galaxy throwing matter into the central black hole. The jet excited the oxygen in one section of the streamer, causing it to glow green, and that is the Voorwerp. The quasar turned off no more than 200,000 years ago, so the Voorwerp is still full of excited gas. The new Hubble images for the first time had the resolution to show that one part of the gas cloud is forming stars, so the Voorwerp is not totally devoid of stars, as had been believed from previous observations. There is a dark spot in the Voorwerp, and the new images seem to show that it is a shadow caused by something that blocked the quasar beam.

M87 – A new measurement of the mass of the black hole at the center of the giant galaxy M87 has found it to be about twice the mass of previous measurements. It is believed that the new measurement is more accurate. The result is about 6.6 billion times the mass of the Sun. The size of the event horizon (the "edge" of the black hole) is larger than the orbits of the planets in our solar system. The new result is based on tracking the motions of stars careening around the black hole and on measuring the effects of the dark matter halo around the galaxy. The star motions were obtained with far greater resolution than previously by using the adaptive optics on the Gemini 8-meter telescope in Hawaii. The halo observations were made at the McDonald Observatory in Texas.

Merging black holes – New research has found 16 pairs of close black holes destined for collision as their host galaxies merge, the largest group of such objects found as a result of a systematic search. Each pair is separated by just a few thousand light-years, a hundred to a thousand times closer than black hole pairs that have been observed previously. Even smaller separations are believed to exist. Candidates for these pairs were selected from the Sloan Digital Sky Survey, though that survey could not resolve such pairs, but on the basis of double emission lines in their spectra. The candidates were then observed using adaptive optics on the Keck 10-meter telescopes in Hawaii. It will take only a few million years for such close black holes to collide. Galaxy mergers have planed an important role in the evolution of the Universe, combining to make larger galaxies. All sizable galaxies are believed to have a central black hole.

Supermassive black hole – It has been known for some years now that the mass of a black hole at the center of a galaxy is generally a fixed percentage of the mass of the central bulge of the galaxy. Some very distant galaxies have been found to break this rule, but now one has been found nearby. A small irregular galaxy known as Henize 2-10, which has no central bulge, has been found to have a black hole with a million times the mass of the Sun. It is only about 30 million light-years away, and is only about 3% the size of our Milky Way. Scientists think it may greatly resemble some of the small galaxies seen at great distances that formed early in the history of the Universe. So we may be able to learn about those distant galaxies by studying this relatively nearby one. This discovery supports the theory that supermassive black holes form first in primitive galaxies, then the bulge grows to a size proportional to the black hole mass. The observations that indicated the presence of the black hole were made with the Very Large Array radiotelescope, the Hubble Space Telescope and the Chandra X-ray space telescope.



Black hole activity – For years collisions of galaxies have been believed to trigger violent outbursts from the black holes at the centers of galaxies. A new study has shown that galactic mergers do not usually trigger such outbursts. While most galaxies have black holes at their centers, only a few are taking in vast amounts of matter that cause them to shine violently, and become what is known as active galactic nuclei (AGN). The new study compared 140 AGN galaxies with a group of 1200 similar but non-active galaxies. They found there was no significant correspondence between evidence of past merger activity and active nuclei. This means other phenomena must instead be to blame for triggering black holes to become AGN. This study was made possible by the large sample of galaxies now available in Hubble Space Telescope images, with the detail to show evidence of past merger activity. AGN were identified from X-ray data. Ten galaxy experts independently assessed whether there was evidence of past merger activity by examining Hubble images from which the nuclei had been removed (so AGN could not be recognized). None of the expert's merger assessments correlated with AGN. Statistically, at least 75% of AGN, and possibly all AGN, must be triggered by some cause other than merger activity. It is believed that merger activity as far back as 8 billion years was found. Further study will try to extend this to merger activity even longer ago.

Black hole growth era – Astronomers have measured when in the history of the Universe the era of fast growth of galactic central black holes began. The result was 1.2 billion years after the Big Bang, earlier than had been previously thought. The supermassive black holes that most galaxies have now vary in mass from about 1 million to 10 billion times the mass of our Sun. To find them, astronomers look for the enormous amount of radiation emitted by material falling into them during periods that they are active. Such infall of material is believed to be the means by which the supermassive black holes grow. The black holes that were active at the beginning of the fast growth era average about 10 times smaller mass than those seen at later times. The very first black holes found, even before this era, were found to be even smaller, having masses only 100-1000 times the Sun's mass.

Star birth rate – Astronomers have measured when in the history of the Universe the rate of star birth peaked. This occurred about 11 billion years ago. The rate of star birth at that time was faster than had been predicted. This meant that galaxies at that time were hotter than predicted, because more stars heated them. The hotter brighter galaxies could be seen in infrared, where they had often been obscured by gas and dust in visible light. The observations were made with the European Herschel infrared space telescope, focusing on very distant galaxies in an area of Ursa Major. They were seen as they were when the light left them billions of years ago.

Active black holes – A new study using Chandra X-ray Observatory data tells how often the largest black holes have been active over the last few billion years. The study found that only about 1% of galaxies with masses similar to the Milky Way contain AGN, that is, black holes in their active phase. About 100,000 galaxies were involved in the study. The X-ray data was compared with visible light images from the Sloan Digital Sky Survey. Primarily field galaxies (those not in clusters) were used in the study. But the percentage of AGN agreed with studies of cluster galaxies. The study found that the larger galaxies are, the higher percentage of them are active. The percentage of AGN was found to be gradually decreasing with cosmic time, which agrees with previous work.

Most distant proto-cluster – Astronomers have found the most distant known galaxy proto-cluster, a grouping of areas of extreme bursts of star formation, an enormous feeding black hole and some surrounding dimmer galaxies, which later should have developed into a cluster of galaxies like the ones we see today. It is so distant that the light took 12.6 billion years to get here, so we are seeing it as it was then, just over 1 billion years after the Big Bang. It was discovered and characterized by observations with the Spitzer, Chandra and Hubble space telescopes and the Keck, Maxwell and Subaru telescopes in Hawaii, and 3 radiotelescopes. The combined mass of the objects in the proto-cluster was measured to be 400 billion times that of the Sun. The black hole had a mass of about 30 million Suns.

Gravitational lensing – Astronomers have long known that gravitational lensing, where gravity bends light like a lens, once in awhile brightens distant galaxies that happen to lie behind nearby massive objects. Einstein predicted gravity would bend light nearly a century ago. But new research shows that for distant galaxies, gravitational lensing occurs much more often, with as much as 20% affected of all distant galaxies seen. The new research was begun to determine why galaxies in the Hubble Ultra Deep Field (HUDF) image tend to bunch up, with pairs consisting of a distant and a closer galaxy. There was not enough distortion or other evidence of gravitational lensing to determine which galaxies in the HUDF were being lensed, but a statistical study was made of the positions, and that implied 20% of the distant galaxies were being lensed. So in the area around closer galaxies, we are seeing dimmer distant galaxies due to the lensing, which means we are seeing more galaxies in those regions, ones too dim to be detected without lensing. The 20% result depends on estimates of some poorly known factors, such as average brightness of galaxies and average density of galaxies, so this number could change with further research. The researchers suggested that when the future James Webb Space Telescope is used to search for very distant galaxies, the odds of finding such can be raised by searching next to massive foreground objects. They also suggested that surveys of the properties (including brightness) of distant galaxies will have to take into account the effects of gravitational lensing, since it affects a substantial fraction of those galaxies.

Planck (European cosmic microwave background [CMB] space telescope) has released its first map of the entire sky. In order to achieve its primary goal of measuring the CMB, Planck scientists must peel back the layers of foreground objects, both within our Milky Way and in external galaxies, that emit microwaves (short wavelength radio). The new map is the first cut at what foreground objects have been peeled off. The CMB scientists' trash becomes a goldmine for other astronomers studying foreground objects. The CMB is the light left over from soon after the Big Bang, redshifted by the expansion of the Universe into microwave light, which tells us a great deal about how our Universe formed and what it is made of. In the new map are 21 confirmed new discoveries of

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galaxy clusters, galaxies producing stars at rates up to 1000 times faster than our Milky Way today, energetic galaxies with radio jets, pools of hot gas permeating galaxy clusters, and 10,000 extremely cold regions, called cold cores, thousands of them never seen before. The data has explained a previously unknown source of microwaves coming from within our own galaxy. Rapidly spinning grains of interstellar dust were found to give off a glow in a process called electric dipole radiation. The high-frequency instrument on Planck is scheduled to keep taking data until about the end of 2011, at which time its liquid helium coolant should run out, but the low frequency instrument should continue working through 2012. The final map of the CMB is expected in about January 2013. Planck sweeps over the entire sky at 9 wavelengths of light ranging from infrared to radio.

Crab Nebula glows very consistently bright over many wavelengths of light. The largest known variation was found in X-rays, at about 3.5 %. But last September, it suddenly brightened in gamma rays. Except for a very small knot seen in X-rays, no changes in brightness were observed in other wavelengths during the gamma ray event. If the gamma rays had come from the pulsar at the center of the nebula, then it should have brightened in other wavelengths. So the gamma rays are thought to have come from the nebula itself. One suggestion is that the gamma rays are a result of the pulsar jet interacting with the magnetic field of the nebula. This would, however, require the highest energy of accelerated electrons ever seen in the sky. Two previous gamma ray flares have ever been seen in the Crab Nebula, and those are poorly explained also.

Dark gamma-ray bursts – Although gamma-ray bursts (GRBs) are among the most energetic events, some of them do not show up in visible light, or are very faint. These have been termed dark GRBs. The mystery of why some are dark in visible light has apparently been solved. A new study using a 2-meter telescope in Chile has found that dust obscuring the visible light is the chief cause. The telescope is programmed to automatically observe GRBs as soon as they are reported discovered by the Swift gamma-ray space telescope. The amount of obscuring dust can be calculated by observing through filters passing various wavelengths of visible and infrared light. The study found that the farther away the burst, the more visible light is obscured, on average. The distances were obtained from spectra taken with the 8-meter Very Large Telescope in Chile.

SDSS – The biggest astrophoto ever, in terms of pixels, has been released by the Sloan Digital Sky Survey (SDSS). It is a mosaic of millions of images taken for the survey over the past 12 years, resulting in a color image of more than a trillion pixels. The team also released the most complete map ever of the stars in the Milky Way's halo. SDSS data has been used to discover nearly a half billion astronomical objects, including asteroids, stars, galaxies and quasars. The original 138-megapixel SDSS camera will soon be retired and sent to the Smithsonian, but the survey will continue with new instruments to measure the distances to over a million galaxies, take the spectra repeatedly of 8500 nearby stars to find planets that might be orbiting them, and make a systematic study of stars throughout our galaxy, done in infrared.

Red dwarfs – A study that monitored over 200,000 stars for a week with the Hubble Space Telescope in order to find planets orbiting them has also yielded great results about the nature of red dwarf stars. Red dwarfs are the most abundant stars in the Universe. It was known that young red dwarfs erupt with flares often, but this study found that old red dwarfs flare also, but about 15 times less frequently. Variable stars, ones that periodically oscillate in brightness, suffered flares 1000 times more frequently. The variable stars were found to be rotating fast. The variability may be due to large areas of starspots rotating into and out of view. If so, the area covered by spots must be far larger than that of our Sun. Flares were found to cause the total brightness of red dwarfs to increase as much as 10%, far more than flares on our Sun. The flares observed lasted as long as 15 minutes. Life could be rough on any planets that might orbit red dwarfs because the flares are violent enough to possibly tear atmosphere away from a planet. It is thought that the deeper convection zones of red dwarfs, where hot gas bubbles to the surface, generate more magnetic instability, which causes the more violent flares.

Early star remnant – A team of researchers is using light emitted from quasars to light up gasses released by a star that exploded billions of years ago. The clouds of gas impress their spectral lines on the quasars spectrum. Among the thousands of gas clouds found this way, a cloud has been found that, judging by its composition, is a remnant of a star that exploded as much as 13 billion years ago. Tiny amounts of elements present in the cloud were found in proportions that are very different from those in normal stars today. These proportions showed that the star was about 25 times the mass of the Sun and originally consisted of only hydrogen and helium, and hence was in the first generation of stars that formed after the Big Bang.

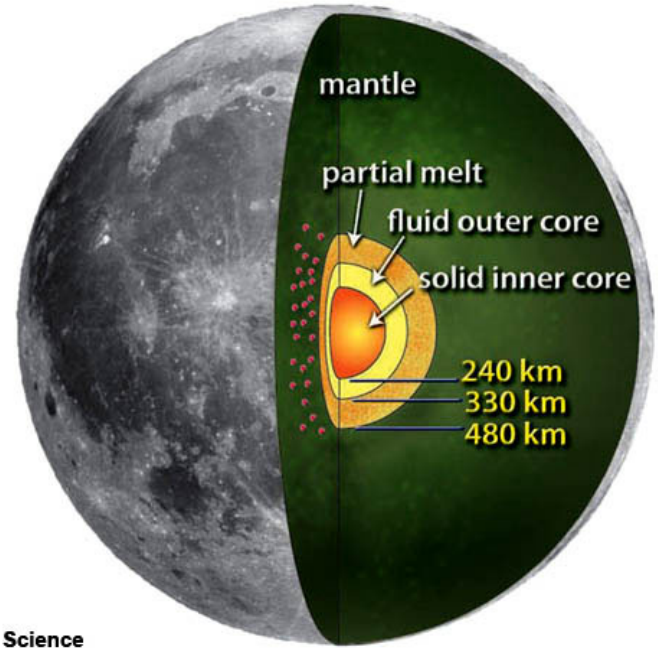
Cepheid winds – Astronomers have measured the shock created by the stellar wind of Delta Cephei hitting the surrounding interstellar matter. From this they have calculated the strength of the stellar wind, and it is much greater than had been estimated. Further observations showed that ¼ of similar variable stars also showed comparable stellar wind. This means that some, but not all, Cepheid variable stars are losing mass at a substantial rate, which may require rewriting a bit of stellar evolution theory. This is worrisome if it affects the relation of brightness to period of oscillation, since all cosmic distances are based on this relationship.

Tau Scorpii appeared to be like no other star. It is a massive class B0 star with an unusually complex magnetic field, much more tangled than most stars. It has a weaker stellar wind than most B0 stars and has spectral features that are both characteristic of main sequence stars and young giants. It is a very slow rotator. But now 2 stars (HD 66665 & HD 63425) have been found that are similar to Tau Scorpii, so astronomers are proposing that the star should define a new class of star.

Kepler (planet-searching space telescope) has discovered its first definitely rocky exoplanet (planet outside our solar system), named Kepler-10b. Most exoplanets known are gas giants. It has 1.4 times the diameter of Earth, the smallest exoplanet known, other than some pulsar planets. It orbits its star in only 20 hours and is more than 20 times closer to its star than Mercury is to our Sun. The proximity heats it to about 2800° F., enough to melt its rocky surface. Its mass is 4.6 times that of Earth and its density

is huge: 8.8 times that of water, which is about that of iron. It is 560 light-years from us. The planet was confirmed by star wobble measurements made with the Keck Telescope in Hawaii.

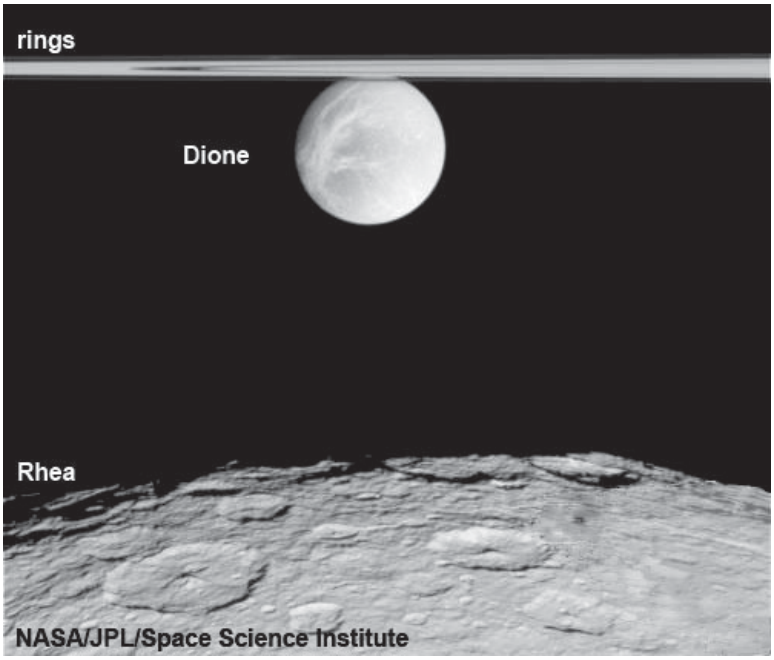
Exoplanet composition – A new way has been found to study an exoplanet's composition: wait until falls into its star, and then analyze the spectrum of the star. White dwarf stars are known the have convection that carries heavier elements down into the star. So any heavier elements found on the surface must have been deposited there recently. A new study of a white dwarf known as GD61 has found that in order of decreasing abundance, the star contained helium, hydrogen, oxygen, silicon, and iron. To produce the amounts seen, the object recently consumed by the star had to have had the volume of an asteroid at least 60 miles (100 km) across. This could have been multiple objects with this total volume, but then oxygen would not have been so plentiful. There was too much of it to have been bound up with silicon, iron, carbon or other trace elements, and oxygen by itself would not have survived the red giant phase that all white dwarfs have previously pass through, so it must have been in the form of water. The only way for water to have survived the red giant phase is if it was buried deeply inside a large solid body. So the conclusion is that the white dwarf ate an asteroid with substantial water. A disc of warm dust close to the star supported that a body had passed too close, been torn apart and mostly consumed.



Science

Lunar core – Using new techniques, the data from the Apollo seismographs placed on the Moon has been reanalyzed. The result is that the Moon possesses a solid, iron-rich inner core with a radius of nearly 150 miles and a fluid, primarily liquid-iron outer core with a radius of roughly 205 miles. It differs from Earth's core in having a partially molten boundary layer around the core estimated to have radius of nearly 300 miles. The core contains a small percentage of light elements such as sulfur, as does the Earth's core. Researchers previously had inferred the existence of a lunar core, based on other data, but there was disagreement on its size and composition. The GRAIL mission, set to launch this year, should provide more data on the interior of the Moon.

Lunar water – When the Apollo mission moon rocks were first examined in the early 1970s, it was thought that the traces of water contained in them was contamination from Earth, since most of the boxes used to bring the rocks leaked. But the recent findings of abundant lunar water by the LCROSS impactor, the Chandrayaan-1 spacecraft and lunar flybys by Deep Impact and Cassini have caused scientists to reject the old dry-Moon theory. A new study of the ratios of isotopes of elements in the water found in Apollo moon rocks has found that those isotopes match that found in water seen from 3 comets: Hayakutake, Hale-Bopp and Halley. The isotopes differ from those found in water on Earth. The theory that best explains this is that most of the water in lunar rocks was delivered to the Moon shortly after it formed by a bombardment of comets. There are some variations in isotope ratios in lunar rocks, so a small portion of the lunar water may have come from other sources, such as original lunar mantle water or solar wind hydrogen.



Cassini (Saturn orbiter) has produced very high resolution images of fractures and craters on Saturn's 2nd largest moon Rhea after a close (about 60 miles or 100 km) flyby. Scientists have thought that Rhea and Dione might be close cousins, differing only a little in size and density. But the new images show they are so alike they might be twins. This is probably due to their forming near each other. During the flyby Cassini searched for a ring around Rhea, since some indirect evidence implied one, but none was found. The wispy markings on Rhea were definitely shown to be cliffs of freshly exposed ice from tectonic activity, ruling out other theories. 3-D images were made of some of the Rhea terrain. The densely cratered regions of Rhea have apparently not experienced much internal activity since the moon's formative days, though some areas have ruptured in response to tectonic stress more recently. Troughs and other fault features cut through the 2 largest

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(continued from page 7)
craters seen. These 2 craters contain few smaller craters, so are likely fairly young. A false-color view of the entire hemisphere facing Saturn shows a slightly bluer area, likely related to different surface composition or to different sizes or textures of the surface. Cassini flew very close to Rhea on January 11, so more details of Rhea should be available soon.

Spirit – NASA is stepping up efforts to contact the Mars rover Spirit: more commands, more listening time and more frequencies, both from Earth and from the orbiting spacecraft. The rover went into low power hibernation last March, caused by the low winter Sun angle on the solar panels, combined with a bad tilt due to being stuck in powdery sand. The Sun angle will continue to improve power generation in the solar panels until well into March, but efforts to contact the rover will continue long after that if necessary. In hibernation mode, internal heaters are turned off, so it is possible that this past Mars winter cold has damaged some parts of the rover. If contact is made with Spirit, hopes are high that it can be unstuck from its sand trap. The last few attempts to move Spirit before it went into hibernation had moved it more than a foot (34 cm).

Stardust-NeXT, a repurposed spacecraft, is scheduled on February 14 to flyby Comet Tempel 1, which was previously visited and impacted by the Deep Impact spacecraft. The goal is to see how one orbit by the Sun has changed the surface, and see the (Deep) impact crater. This is the first time any comet has been visited twice by spacecraft. Because Stardust is running a bit low on fuel and the comet is a bit dimmer than expected, the schedule of spacecraft trajectory correction maneuvers has been modified to reduce fuel consumption and take more closer images for navigation. Science observations will begin a week before flyby. Stardust completed its first mission of sampling comet material (from Comet Wild 2) and returning it to Earth in 2006.

Sundiving comets – The Sun experienced a storm of comets between December 13 and 22. During that time the Solar and Heliospheric Observatory (SOHO), which constantly images the Sun and its surroundings, detected 25 comets diving into the Sun. Sundiving comets are nothing new; SOHO typically sees 1 every few days, but 25 comets in 10 days is unprecedented. They were small as comets go, about 10 yards (10 meters) across. SOHO has discovered more than 2000 comets since it was launched in 1996. Some experts are predicting that the December comet storm is a predecessor to a large comet, off of which these pieces broke.

WISE (infrared space telescope) – NASA has extended funding for WISE to finish a 2nd full sky scan. Its coolant has run out, but 2 of the detectors still work without coolant. The 2nd scan can be compared to the 1st to find anything that moved or changed brightness. This is likely to find a substantial numbers of asteroids, particularly near-Earth ones. After the 2nd scan, WISE will be put in hibernation mode, ready to use again if someone decides to fund further use.

Meteorites – Results have been announced from studying the meteorites collected where in eastern Africa the tiny (13 foot or 4 meter) asteroid 2008 TC3 fell to Earth hours after it was discovered. Since the meteorites are all known to come from the same asteroid, they were expected to be similar. But instead they represent at least 10 different types. What this means is that asteroids must exchange much material during the collisions that they are known to suffer during billions of years of orbiting the Sun. The various meteorite types shared polycyclic aromatic hydrocarbons (or PAH, a material much like soot) and amino acids. Surprisingly these were found even in areas that apparently had been heated, which should destroy such chemistry. The recovered material consisted of 600 meteorites weighing a total of 23 pounds (10 kg). The asteroid probably weighed 59 tons, but most was burnt up or pulverized when it hit our atmosphere. Most of the 600 meteorites are a rare type known as ureilites. Less than 10 ureilites had previously been found. The ureilites in this find showed widely varying amounts of the minerals olivine and pyroxene. It is believed that all ureilites originated from the same parent asteroid, which was probably fragmented by asteroid collisions. The majority of non-ureilites in this find are the more common chondrite type.

Corona – The mystery of the Sun's corona may finally be solved. For years scientists have known, and wondered why, the Sun's outer atmosphere, or corona, is considerably hotter than the surface that heats the corona. NASA's Solar Dynamics Observatory and Japan's Hinode satellite have directly observed jets of plasma shooting off the Suns' surface, heating the corona to millions of degrees. The jets are called spicules. They have long been known. But this is the first time that some of them have been observed to be millions of degrees. Apparently there is a class of hot spicules that move much faster and are shorter lived than ordinary ones. Higher resolution in space and time allowed the new observations.

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FIRST ANNUAL VOICE OF THE CUSTOMER SURVEY

In an effort to keep the newsletter fresh and relevant to the membership, I'm soliciting feedback from the membership as to what you would like to see in the newsletter. Please feel free to contact me by phone or e-mail (my contact information is on the back) and let me know what you think! How can the Sirius Astronomer be more useful to you as a member, an educator, or an observer? This is your newsletter, so let me know what you'd like to see! Please have your feedback to me by February 20, 2011 and I will attempt to address your suggestions in the March issue. Include the tag [VOC-SA] in your e-mail subject line to avoid the spam filter. All constructive comments will be considered. I look forward to hearing from you! -- Steve Condrey, Editor

Society for Astronomical Sciences

For Immediate Release: Wednesday, January 19, 2011 **Release No.** SAS 11-01

INVITATION AND CALL FOR PAPERS: 30TH ANNUAL "SYMPOSIUM ON TELESCOPE SCIENCE"

Invitation:

Amateur and professional astronomers, astronomy educators, and students are invited to attend the 2011 "Symposium on Telescope Science", on May 24-25-26, 2011 at Big Bear, CA. This Symposium will mark the 30th anniversary of the Society for Astronomical Sciences. The agenda will feature half-day Workshops, and two full days of technical papers. The keynote lecture will be given by Dr. Petrus Jenniskens on "The impact and recovery of asteroid 2008 TC3".

A Workshop on "Developing and Using Your Remote Observatory", presented by Tom Krajci and Tom Smith, has been confirmed. A Workshop on a second topic is also planned.

The Symposium is the premier opportunity for non-professional researchers to present their projects and results, receive advice from other backyard scientists and professional astronomers, and disseminate knowledge about methods, results, and opportunities for pro-am collaboration in small-telescope astronomical research. This annual gathering provides a unique venue for networking among the small-telescope research community, both amateur and professional.

For additional information, including Registration and Accommodations, refer to the SAS website (www.SocAstroSci.org). We look forward to seeing you there!

Call for Papers

Submissions of both Papers and Posters are now being accepted for the SAS 2011 Symposium on Telescope Science. Topics of interest include small-telescope science results, instrumentation and methods; pro-am collaboration; science education; and special uses of astronomical data. Examples of previous-years papers and presentations are available on the SAS website (www.SocAstroSci.org). Proceedings from previous years can be downloaded from the PUBLICATIONS tab. Videos of Paper presentations given at the 2010 Symposium are also available for download.

Abstracts of proposed papers should be sent to the Program Committee at program@SocAstroSci.org. Deadlines are:

Abstract submission: March 12, 2011

Final Papers due: April 16, 2011

Abstracts may be submitted in plain text format or MS Word. The formatting requirements for Final Papers -- including an MS Word template – are available on the SAS website.

About the SAS: The Society for Astronomical Sciences facilitates collaborative astronomical research between amateur, student, and professional astronomers. SAS workshops provide amateur and student astronomers with solid grounding in observational procedures and data-reduction methods. The annual "Symposium on Telescope Science" is the premier forum for presentation of the results of small-telescope research and professional-amateur astronomical collaborations. For more information, see: http://www.SocastroSci.org

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Press contact: LeRoy Snyder, e-mail: lsnyder@socastrosci.com

Time to Go

By Tom Koonce

The history of astronomy has always been tied closely to the accurate measurement of time. We take it for granted that even the least expensive digital watch keeps better time than the finest timepiece of a few hundred years ago. Even so, anyone who has put up with jet lag during a long trip knows how difficult it is to keep track of the local time. If we could all think in Universal Time, I suppose it would still be a struggle to get an idea of local sunrise and sunset times. These days, dual time-zone watches make it easier, but before pocket watches and other portable clocks, it must have been impossible for the Renaissance-period road warriors to track, right? At least I thought so until a recent visit to a museum where I saw ingenious portable timepieces dating from c. 1600.

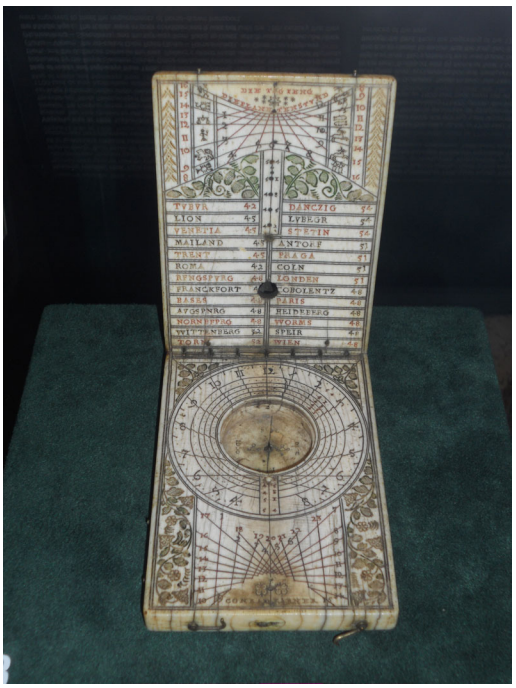

Figure 1 – Ivory Portable Timepiece; c. 1600.

A "Traveler" timepiece was a portable sundial with a magnetic compass built in to allow for its initial alignment. The models that I saw were made of ivory or brass (in later models) and consisted of a base with small embedded compass, a hinged "lid", and either a small hole in the lid (*Figure 1*), or a string that connected base and lid at a 45 degree angle (*Figure 2*). Note the listing of cities on the underside of the lid in *Figure 1.*

After aligning the Traveler sundial with magnetic north and correcting for magnetic declination, the user used the shadow cast by the Sun on the string or the spot cast by the hole in the lid to determine the time on the scale marked on the base in the manner of sundials. Despite the small size of the unit and the user's likely errors in alignment, the instrument still gave times accurate to within an hour or so. The accuracy depended on the time of year, time of day, and the 2 axis leveling of the Traveler. And of course, if it was a cloudy day, the user was simply out of luck.

Figure 2 – Brass Portable Timepiece; c. 1650.

Figure 3 – Outer Lid of a Traveler timepiece; c. 1621. (Photos by author, Finland National Museum)

The workmanship on the pieces that I photographed for this article were finely detailed and carefully inscribed. These instruments were not inexpensive, nor were they something that everyone of the period needed to have. But portable spring powered clocks of the day were unreliable on long trips because of their constant need of winding. After one forgetful day or night and the owner would be left with a temporarily useless timepiece, but on a sunny day, the Traveler sundial timepiece was always reliable. People of means such as scholars and business men who traveled far and regularly enough to make this instrument a necessity would have been the primary consumers. While I won't trade in my quartz watch anytime soon, I think these instruments are cool enough, even now, that I'd like one to demo before a star party.

Interesting Fact: First Wrist Watch. In 1504, the first portable (but not very accurate) timepiece was invented in Nuremberg, Germany by Peter Henlein. The first reported person to actually wear a watch on the wrist was the French mathematician and philosopher, Blaise Pascal (1623-1662). With a piece of string, he attached his pocket watch to his wrist.

Reference: **http://inventors.about.com/od/cstartinventions/a/clock.htm**

Clear Skies!

Tom

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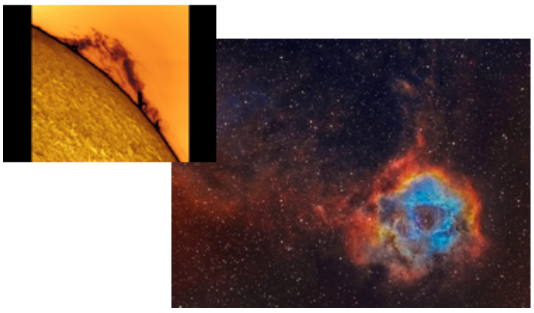

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