SIRIUS ASTRONOMER

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The Newsletter of the Orange County Astronomers

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To celebrate the coming vernal equinox on March 21st, we offer this photo of a rainbow at San Onofre State Park taken by Hans Strupat on February 10th. Hans used a Canon Powershot Q12 to create a panorama from three separate images. March is also the month in which St. Patrick's Day is celebrated, although there appears to be no pot of gold at either end of this rainbow. However, it is the month of our annual Messier Marathon, which takes place (weather permitting) on March 9th. You can always find your pot of gold in the stars with this challenging observing event!

OCA CLUB MEETING

The free and open club meeting will be held March 8 at 7:30 PM in the Irvine Lecture Hall of the Hashinger Science Center at Chapman University in Orange. This month, science journalist and astronomical artist Michael Carroll will discuss "Alien Seas"

NEXT MEETINGS: April 12, May 10

STAR PARTIES

The Black Star Canyon site will open on March 2. The Anza site will be open on March 9. 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 at the Heritage Museum of Orange County at 3101 West Harvard Street in Santa Ana on March 1. The following class will be held April 5.

GOTO SIG: TBA
Astro-Imagers SIG: Mar. 19, Apr. 16
Remote Telescopes: TBA
Astrophysics SIG: Mar. 15, Apr. 19
Dark Sky Group: TBA

Western Amateur Astronomers Board Meeting Notes

Tim Hogle, WAA Vice President and OCA Representative

The Western Amateur Astronomers (WAA), an umbrella organization of astronomy clubs in the western USA, of which OCA has been a member for many years, held its regular winter board meeting on January 26th. This year the meeting was in Southern California for the first time since the mid-1990s. Los Angeles Astronomical Society and Griffith Observatory were hosts, with the meeting at the latter facility – a grand place for a meeting of astronomers. Clubs represented include Los Angeles Astronomical Society, China Lake Astronomical Society, Eastbay Astronomical Society, Astronomical Association of Northern California, Chabot Telescope Makers Workshop, Mount Diablo Astronomical Society, Mount Diablo Observatory Association, and Stony Ridge Observatory.

WAA's purpose as an umbrella organization is to promote communication between astronomy clubs for their mutual benefit, to give awards for recognition of outstanding achievement in the world of amateur astronomy and to promote astronomy in general. One of WAA's most well-known functions is to select and present the G. Bruce Blair award and medal, a very prestigious honor for someone who has made truly outstanding contributions to amateur astronomy over a significant period of time. The Blair Award has a history going back to 1954; the list of recipients (many of whom are very well known) is posted on the WAA web site at http://www.waa.av.org.

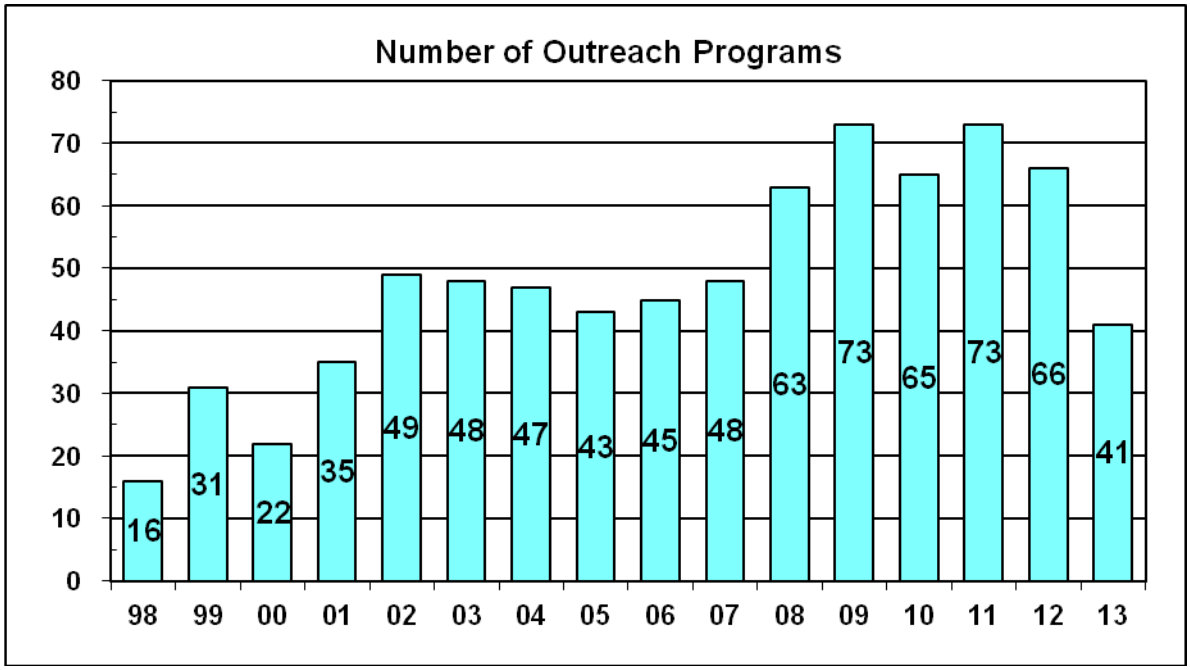
This year's awardee is to be Albert Highe, PhD, a Northern California amateur astronomer and telescope designer and maker. Albert has a great deal of knowledge in electrical and mechanical engineering, and materials science, and a wide variety of other technical skills. He is a prolific inventor and enthusiastic mentor to anyone interested in pursuing his telescope designs. He has made many telescopes up to 24" and has published a massive and well-received book on telescope making, *Engineering, Design and Construction of Portable Newtonian Telescopes,* published by Willman-Bell. Albert's novel designs have appeared in Sky and Telescope and other magazines. His unique three-parallel-strut tube design has been used extensively by amateur and commercial telescope makers. Albert has a neuromuscular disease which keeps him closely dependent on a wheelchair. But rather than this being an impediment to astronomy and telescope making, it has allowed him to focus on telescopes designed for light weight and optimal ergonomics and comfort – a potential benefit to all. Because of his disability and extreme difficulty traveling, WAA has made an exception to the rule that a Blair recipient must be present at the awards ceremony to accept it. A family member will accept the award for Albert at RTMC this coming Memorial Day weekend.

Years ago, WAA published a regular printed newsletter for members called the Pacific Stargazer, which contained articles of interest to and about the activities of other amateurs and clubs. Interest waned with increasing popularity of other publication means and was discontinued because of a perceived of lack of interest. Unfortunately, doing so caused a reduction in contact between member clubs and a general decline in awareness of WAA's activities. So we have been working toward restarting this venerable publication. Watch for it. Other items of business from the WAA meeting include reports from member clubs in attendance about their activities and concerns, discussion about possible expansion of WAA's service to members, and an initial discussion about the possibility of a merger with another California-based umbrella organization with many of the same goals as WAA. Discussion is very preliminary, so I won't say more than to watch for updates. Other possible enhancements include improving communications between club representatives, providing notification of events of mutual interest to member clubs, and to become more actively engaged in outreach.

The list of specific activities being considered will require significant effort, and we on the WAA board recognize the need for help. We can't do it all by ourselves, and as a result, progress has been slow. Assistance will ultimately need to come from individuals in WAA member clubs. So if any of you are interested in getting involved in these activities and have experience in newsletter publication, electronic communications enhancement, web page development or other communications arts fields, we would welcome your assistance. Please contact me if you might have an interest; even ideas without commitment are welcome. My contact information is always on the back of the Sirius Astronomer, and I regularly attend OCA general meetings. WAA will again have an information booth at RTMC this year, probably near the snack bar. Stop by and say hello. For more info about WAA, log on to the Web site shown above.

OCA Outreach Programs

By Jim Benet



I want to update everyone on where we stand on our Outreach programs. Last year we conducted 66 programs at schools, parks and libraries. Forty-seven of these were at elementary and middle schools. The total was down a bit from the previous year due to cancellations because of unfavorable weather conditions. We have forty-one events planned so far for this year.

OCA members who helped with the Outreach programs this year include: Jim Benet, Maury Bennett, DeAnna Burghart, Martin Christensen, Roger Cotton, Tom Drouet, Joe Ewach, Bill Gabris, Attilio Giolli, Paul Gracey, Keith Hoffman, Rick Hull, Thomas Klump, Rob MacKenzie, Jim and Ellie Monroe, Bob Shanta, Steve and Bonnie Short, Ves Snelson, Richard Stember and Don Stoutenger. I extend my thanks and appreciation to all of you.

Unfortunately, six volunteers had to drop out of our group: three for health reasons, two moved away, and one passed away. We need to get some new volunteers to take their place. Please help us if you can. Thanks.

Upcoming Outreach Programs

3/1	Beatty Elementary School; 8201 Country Club; Buena Park
3/4	Brywood Elementary School; 1 Westwood; Irvine
3/5	Buena Park Junior High; 6931 Orangethorpe Ave; Buena Park
3/7	Brookhurst Elementary School; 9821 Catherine Avenue; Garden Grove
3/14	Shoreline Christian School; 10350 Ellis Ave.; Fountain Valley
3/15	Utt Middle School; 13601 Browning Ave.; Tustin
4/2	Laguna Woods; Clubhouse 5, 24262 Punta Alta; Laguna Woods
4/4	Garden Grove Library; 11200 Stanford Avenue; Garden Grove
4/13	Riley Wilderness Park; 30952 Oso Pkwy; Coto de Caza
4/16	Biola University; 13800 Biola Avenue; La Mirada
4/20	Crystal Cove State Park; PCH at School Rd; Laguna Beach

Report from Maui International Double Star Conference

Bob Buchheim

I was at the Maui International Double Star conference last month in Maui (oh, the sacrifices I make for astronomy!) The University of Hawaii's Institute for Astronomy in Pukalani hosted the meeting, which was attended by about 35 people. Most were from USA, but we also had several Canadians and two Russians in attendance. Attendees included Dr. R. Kent Clark (editor of the Journal for Double Star Observations), Dr. William Hartkopf (US Naval Observatory), Dr. David Dunham (International Occultation Timing Association) and Dr. Gerard van Belle (Lowell Observatory).

Amateur astronomers know that a resolved, color-contrast double star can be a pretty sight. You probably also know that it is not obvious, from a single observation, whether the pair is gravitationally bound (a "binary") or just a chance alignment of the two stars. The gravitationally bound systems are important, because if you can determine their orbital parameters, then you can derive the mass function -- one of the few unambiguous ways to determine stellar masses. The standard way to follow the star's relative motion is astrometry: measure their separation and orientation ("position angle") over time. If they are, indeed, a bound system (and if their orbital period is short enough), then the series of measurements will display the characteristic path of an elliptical orbit. "Short enough" is a flexible concept: some systems have been observed – and measured – regularly for over a hundred years in order to map out their motion. That is obviously a job for several generations of astronomers. Some systems have periods as short as a dozen years, so that you can "see" their orbit in the course of a decade.

The first day's theme was "Student Research and Education". The activity of measuring a double star's separation and position angle using visual observations with an astrometric eyepiece provides high school and college students with a "hands on" astronomy exercise that gives them a real-world application of observation, measurement, algebra, and statistics. A paper documenting the results can be accepted for publication by the Journal for Double Star Observations (JDSO). This provides the students with some valuable experiences. Several students described their discovery that writing the paper was the most challenging part of the project. One or two evenings of observation lead to a couple of days of calculations to determine the separation and position angle; then to several weeks of writing, and revising the paper before it was ready for peer-review; and then more revising to incorporate the reviewer's concerns. The resulting paper, if accepted by the JDSO, provides the first peer-reviewed publication on the student's resume – a rare accomplishment that can make quite a difference when the student is applying for admission, scholarship, or employment. Finally, measurements that are published in the literature are entered into the Washington Double-Star Catalog (WDS), giving the measurement and the observer a sort of immortality, that one student noted was "surpassingly cool".

The theme of the second day was "Double Star Astrometry". It was interesting to see how the methods used by amateurs are following in the footsteps of professional researchers. For the past couple of decades, the dominant method used by small-telescope researchers has been CCD astrometry – basically, taking an astro-image of the double and measuring their separation and position angle on of the image. Modern, commercially-available software makes this a straightforward project, and CCD astrometry provides excellent accuracy on pairs whose separation is larger than a few arc-seconds. Video cameras are used by both amateur and professional observers. The short exposure (30 msec or less) effectively freezes the atmospheric turbulence, and by making hundreds of images (which takes only a few minutes, at video rates), you can search through the archive for the handful of "lucky images" that provide nearly diffraction-limited resolution. This is the same method that astro-imagers are using to create remarkably detailed images of planets. Backyard-scale telescopes using "lucky imaging" can resolve pairs as an arc-second, sometimes closer. This opens up pairs whose orbital periods may be short enough to "see" in a lifetime; and enables the backyard researcher to make a much-needed contribution to double-star science by keeping the WDS "neglected pairs" under surveillance. There are several thousand such neglected pairs, that haven't been measured for a decade or longer.

The third day was devoted to "Advanced Techniques". These fell into two categories. The first was "speckle interferometry". With this method, a large set of very-short-exposure images are analyzed to reconstruct the diffraction-limited image. When

first developed by professional astronomers, this entailed pretty terrifying mathematical manipulations with custom codes on large computers. Now, however, the necessary computations are nicely handled by a PC, and there is a readily-available, user-friendly software package that makes the process pretty straightforward. Several amateur astronomers presented very impressive results, obtained with backyard-scale telescopes, low-cost video cameras, and the software package "Reduc" (shareware by Florent Losse).

The second method described – multiple-aperture interferometry – seems to be confined to professional observatories such as the CHARA array at Mt. Wilson. Combining light beams from multiple telescopes provides an interferometric baseline of several hundred meters; and this can provide resolution as fine as 10 milli-arc-seconds, displaying orbital motion of close pairs in just a few years.

Double star measurements are a much-neglected area of stellar research, and amateur astronomers can make a real contribution in this area. If you'd like to learn more, there are two resources that may be of interest: (1) Bob Argyle's book "Observing and Measuring Visual Double Stars" has just been released in an updated second edition, and (2) the videos of most of the technical presentations form the Maui International Double Star Conference will soon be available (free) on the website www.altazinitiative.org.

AstroSpace Update

March 2013

Gathered by Don Lynn from NASA and other sources

Fermi (gamma-ray space telescope) has proved a source of cosmic rays to be supernova remnants, those expanding clouds of matter thrown out by supernova explosions. Cosmic rays, high speed protons or other subatomic particles that bombard Earth from space, were discovered over a century ago, but their source or sources have remained a subject of great debate. Magnetic fields deflect cosmic rays, so it is not possible to tell where they came from. The new observations were made of 2 supernova remnants, known as IC 443 (Jellyfish Nebula) and W44. These remnants are expanding into cold dense clouds of interstellar gas. Particles escaping the supernova remnant collide with the surrounding gas and emit gamma rays. The energies observed in the gamma rays showed that they were caused by protons from the supernova striking protons in the interstellar gas, which create pions that decay into the gamma rays observed. The protons from the supernova remnants that do not strike interstellar matter become the cosmic rays. It is thought that magnetic effects accelerate the protons to high speeds in the supernova remnants, but details of how are still under study. IC 443 is located 5,000 light-years away in Gemini and is though to be about 10,000 years old. W44 lies about 9,500 light-years away in Aquila and is estimated to be 20,000 years old.

Black holes' growth – How the supermassive black holes at the centers of galaxies grow has long been a subject of hot debate. One leading theory is that galaxy collisions cause matter to fall into the central black holes, making them grow. However, recent observations with the Hubble Space Telescope have shown that substantial material is falling into the central black holes in spiral galaxies that are isolated from others, and therefore are not involved in collisions. A new study observed galaxies that were selected on the basis of their showing moderate activity in X-rays due to material falling into the central black holes. Galaxy merger activity was found to be no more frequent than with non-active central black holes. This implies that galaxy collisions cannot be the principal cause of central black hole growth.

Flashing star – Observations from the Spitzer and Hubble space telescopes have uncovered an infant star that unleashes a burst of light every 25.34 days. Only 2 other young stars are known to flash like this, but the new one is brightest. Astronomers propose that the flashes are caused by periodic interactions between a binary pair of young stars. When they come close, material is dumped onto the growing stars. The young star pair is known as LRLL 54361 and is inside the star-forming region IC 348, located 950 light-years away, and is estimated to be no more than a few hundred thousand years old. Hubble observations show a dusty disk hiding the stars themselves, with a cavity cleared out above and below the disk. However, the flashes can be seen in visible light as they reflect off surrounding material. Infrared observations showed evidence of the star pair within. Systems like this are rare, in that only a few percent of stars form as close binaries, and the period of star growth does not last long cosmically.

Possible gamma-ray burst – Last year a scientist announced finding high levels of carbon-14 and beryllium-10 in tree rings that grew in the year 775, suggesting that a burst of radiation struck Earth in that year or the previous one. Other research has ruled out the possibility of a nearby supernova or solar flare causing the radiation. A new theory is that a relatively nearby gamma-ray burst caused the radiation. It would have been of the short burst type, which is believed to be caused by merging of black holes or neutron stars. It would have had to be between 3,000 and 12,000 light-years away to cause the correct amount of radiation. To confirm this, astronomers will look for a black hole or neutron star of the right age and distance.

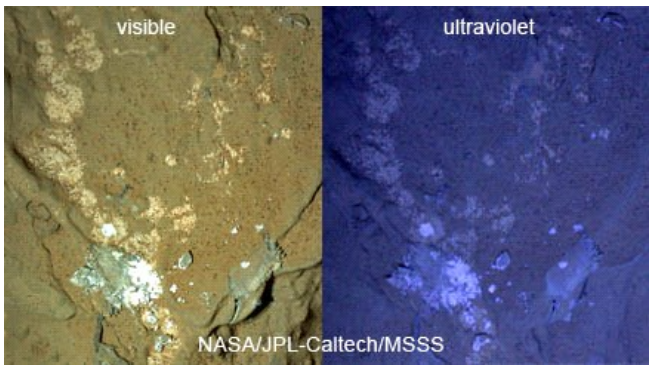
Deep Impact just keeps taking on new missions since its original one of observing up close a collision between an impactor spacecraft and Comet Tempel 1 in 2005. The latest project was taking images of the newly discovered Comet ISON, though from a distance. Other previous post-mission projects were a close flyby of Comet Hartley 2 and distant observations of Comet Garradd. ISON may become so bright as to be visible in the daytime late this year. Even though ISON is still in the outer solar system, it has be-

come active enough to display a sizable coma and a tail over 40,000 miles (64,000 km) long. ISON will pass quite close to Mars, so should be observable by Mars orbiters and rovers. Even the lunar orbiter (LRO) should get a shot at it. Deep Impact will also take spectra of ISON.

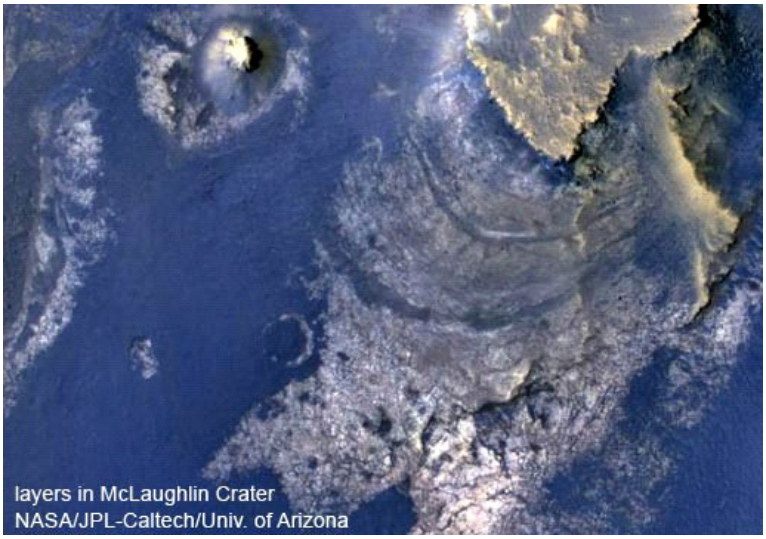
XMM-Newton (X-ray space telescope) has completed the most detailed study ever of the fierce wind from a giant star, showing for the 1st time that it is not a smooth wind, but is highly fragmented. Massive stars lose a significant fraction of their mass through fierce winds of gas emitted. Such winds are at least 100 million times stronger than the Sun's solar wind. Observations of the giant star Zeta Puppis, one of the nearest massive stars, extend over a decade. Though the wind cannot be resolved, its nature can be figured from its total variability. Small features will contribute little in variation, while large features will contribute much. The variation observed showed that the wind is fragmented into 100s of thousands of pieces, but with a few large features superimposed. These latter could be spiral-arm-like features. This is the 1st time such measurements on a giant stellar wind have been made, and the fragmentation was far more than expected.

More XMM-Newton – A few pulsars are known to occasionally switch off their radio pulses for a time, then resume hours later. XMM-Newton was used to observe one of these, simultaneously with a radiotelescope, to see if the X-rays also switched off when the radio pulses did, even though no pulsar in X-rays had ever been observed switching off. The opposite was found: The X-rays switched on when the radio switched off, and vice versa. No current theories of how the radio and X-ray pulses are formed can explain this. Obviously the theorists need to do more work. The switching on or off occurs quickly, within a few seconds. Previous observations of switching radio pulsars have caught them sometimes slowing their rotation (and pulsing) rate very slightly at the time of switching. This may be a clue for the theorists. The particular pulsar in the new observations (PSR B0943+10) is unusually old (about 5 million years) to be bright in X-rays. Most older pulsars have faded in X-ray emission. Another known switching radio pulsar will be observed in X-rays later this year to follow up.

The IBEX ribbon – After 3 years of puzzling over a striking ribbon of particles discovered by the IBEX spacecraft out at the edge of our solar system, scientists have a theory that explains all the observations. Called the "retention theory", it proposes that the ribbon exists in a location where neutral hydrogen atoms from the solar wind move across the local galactic magnetic field. Neutral atoms are not affected by magnetic fields, but when their electrons get stripped away, they become charged and begin to gyrate rapidly around magnetic field lines. That rapid rotation creates waves in the magnetic field, and the charged particles then become trapped by the waves. This creates the ribbon. More than a dozen theories have been proposed to explain the ribbon, but this is the 1st that fits all the observations. To test the retention theory, scientists will watch how the ribbon changes in step with observed changes in the solar wind.



Curiosity (Mars rover) has for the 1st time used the hammer drill at the end of its robotic arm to bore into a rock to collect a sample from inside the rock. The drilling site was chosen because it was geologically unusual in that it is fractured and that night-time temperature measurements show that it cools more slowly than most Martian surface. It is much different terrain than the landing area, which was an ancient streambed. The powder from the drilling is then put into the 2 analyzers to determine the makeup of the sample. The hole is 0.63

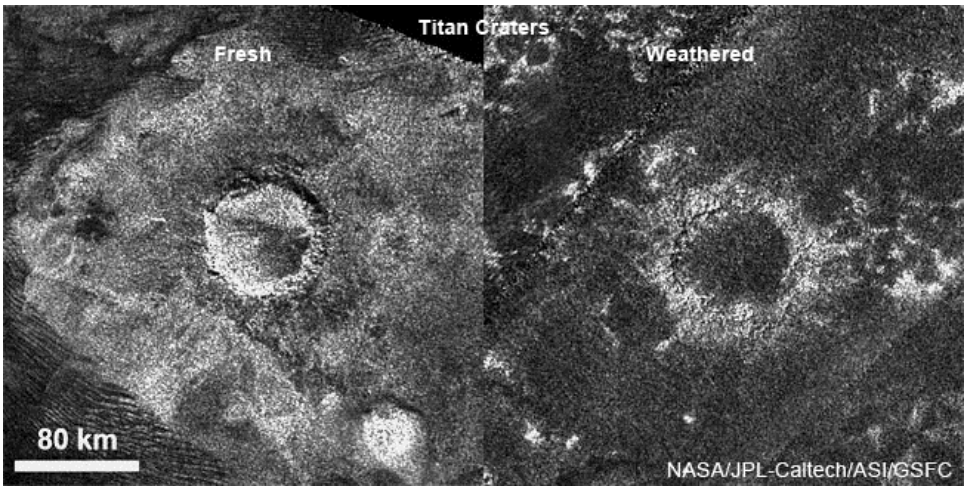


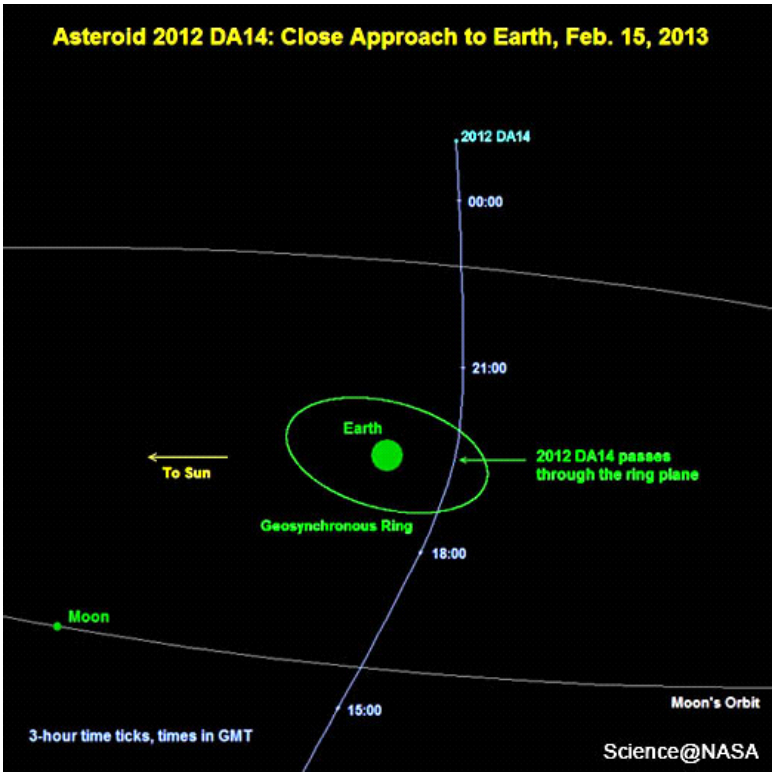
inch (1.6 cm) wide and 2.5 inches (6 cm) deep in a patch of fine-grained sedimentary rock with veins of hydrated minerals, which proved to be hydrated calcium sulfate (gypsum or a near relative), from laser spectrometer data. On Earth, this forms from mineral-rich water circulating in fractures. The rover also zapped the drill dust with the laser spectrometer and placed the Alpha Particle X-ray Spectrometer on the dust, for further analysis. The drill was the last of the rover's 10 science instruments to be used on Mars. Preparations for this 1st use included drilling test holes, and testing stresses placed on the arm by temperature changes while the arm was pressed against the surface. Curiosity snapped the 1st night-time images of Martian rocks. They were illuminated by the rover's white LEDs, and then by its ultraviolet LEDs. The latter were looking for minerals that fluoresce under UV.

Mars Reconnaissance Orbiter has observed McLaughlin Crater with its spectrometer. That impact crater is 57 miles (92 km) across and 1.4 miles (2.2 km) deep. The crater was found to have layered, flat rocks containing carbonate and clay minerals that form in the presence of water. However, there are no large inflow channels, so the water would have to have fallen as rain or seeped out from ground water. Small inflow channels on the walls of the crater stop at a particular level, indicating that was once the surface of a lake. This would have occurred when Mars was warmer and wetter billions of years ago. McLaughlin Crater is in a low area of Mars. Groundwater-fed lakes on Earth occur at low regions, so the Martian crater was likely a groundwater-fed lake for a long enough time period for lots of layered carbonates and clays to have formed in it.

Venus Express has measured the ionosphere of Venus during a lull in the solar wind and found that it stretches out in less than an hour into a teardrop shape, much like an ion tail of a comet. Earth's strong magnetic field keeps its ionosphere fairly stable under a range of solar wind conditions. But Venus does not have its own internal magnetic field, so its ionosphere behaves differently. The Stereo spacecraft measured a drop in solar wind density to about 50 times lower than normal, and that persisted for 18 hours. It was during this time that Venus Express saw the changes at that planet. Similar changes are expected at Mars, which also has no general magnetic field.

Cassini (Saturn orbiter) – Analysis of Cassini images of the storm that raged for 267 days in the north latitudes of Saturn show that its demise was when it wrapped entirely about the planet and collided with itself. It stretched 190,000 miles (300,000 km). It





spawned a clockwise-spinning vortex. It featured lightning and thunder. It was the longest running northern hemisphere Saturnian storm, though one in the southern "Storm Alley" latitude lasted 334 days.

More Cassini – While most of Saturn's moon display thousands of impact craters, Titan has few, indicating that the craters are being erased. New research using the Cassini radar images of Titan shows that the craters are not so much being eroded as being filled with sand. Other forms of crater weathering were ruled out by careful measurements of crater depth and shape, and comparisons made to similar craters on Jupiter's moon Ganymede, where essentially no weathering takes place. The half of Titan's surface that has been carefully searched in radar images yields only about 60 craters. The sand is believed to be hydrocarbons, not silicon or calcium sand as found on Earth. Those hydrocarbons are formed by chemical action high in Titan's atmosphere, powered by sunlight. So it probably rains sand on Titan, at least occasionally. The study also found a scarcity of craters in higher latitudes. The researchers posited that the polar regions of Titan have liquid (methane) saturated ground, so that impact craters there immediately sag back to level ground.

Close flyby – An asteroid 150 feet (45 m) across, denoted 2012 DA14, orbited by Earth February 15 at a distance of only 17,200 miles (27,700 km). That's closer than many communications satellites. It was known for some time ahead that it posed no danger of striking Earth. The asteroid that caused Meteor Crater in Arizona was about this size. This is the closest recorded approach of an asteroid of this size. Astronomers around the world are taking advantage of the close pass to study it in detail, particularly by radar. Scientists have estimated that an asteroid of this size will fly by the Earth this close every 40 years, and will strike Earth once every 1200 years.

The same day as the (predicted) close passage of asteroid 2012 DA14, an unexpected smaller asteroid scored an **impact** on Chelyabinsk, a city in Russia, breaking windows and knocking down some walls with its shock wave. Over 1000 people were injured, mostly from flying window glass. From its direction of approach, it was not related to DA14. Meteorite hunters immediately began looking for pieces. It was probably the largest object to impact Earth since the 1908 incident at Tunguska.

Gassy super-Earths – Our solar system is sadly lacking in planets larger than Earth and smaller than Neptune. It is quite a gap in both diameter and mass. This range has been termed super-Earths, and among exoplanets (those not orbiting our Sun) such are common. The question is whether they are large rocky planets like Earth or small gassy ones like Neptune. A new study suggests they are surrounded by a lot of hydrogen. The study looked at the impact of radiation on the upper atmospheres of 3 known super-Earths, those orbiting the stars Kepler-11, Gliese 1214, and 55 Cancri. All orbit close to their stars, so should be subject to much radiation, and all by their sizes must have a substantial gas envelope, probably hydrogen. Though it was shown that hydrogen escapes at a high rate, due to the radiation, many super-Earths will never get rid of their hydrogen altogether. So they probably resemble Neptune more than Earth. The observed planets are closer to their stars than the habitable zone (where temperatures allow liquid water to exist). At farther distances, the loss of hydrogen would be even slower, so super-Earths in habitable zones are probably even more Neptune-like.

Retrograde planet – Astronomers using the Subaru Telescope in Hawaii showed that the HAT-P-7 system includes at least 2 giant planets (only 1 previously known) and a companion star. This suggested an explanation for the fact that the 1st known planet in the system was found to orbit retrograde, that is, in the opposite direction from the star's rotation. The Kozai effect explains how one

orbiting body can change the orbit of another. This effect is able to allow the companion star to steeply raise the tilt of the outer planet, and in turn the effect allows a steeply tilted planet to reverse the direction of orbiting of the inner planet.

Kepler (planet finding space telescope) data has been analyzed with regard to planets orbiting red dwarf stars. Red dwarfs outnumber all other types of stars combined. Yet none are visible to the naked eye, since they are so dim, typically giving off 1000 times less light than our sun. The new study identified 95 planet candidates orbiting red dwarfs in the Kepler data, of which 3 lie in the stars' habitable zone. Statistically this says that 60% of red dwarfs have planets smaller than Neptune. Odds are that at least one Earth-sized planet orbits within the habitable zone of a red dwarf within 13 light-years of Earth. This is much nearer than previous estimates, which did not take into account the abundance of red dwarfs. Earth-sized planets orbiting a red dwarf in its habitable zone might be far different than Earth, particularly since they would likely be tidally locked to their star, so that one side of the planet would have eternal daytime. But a thick atmosphere or ocean could distribute heat about the planet to mediate the too-hot/too-cold temperatures that would result.

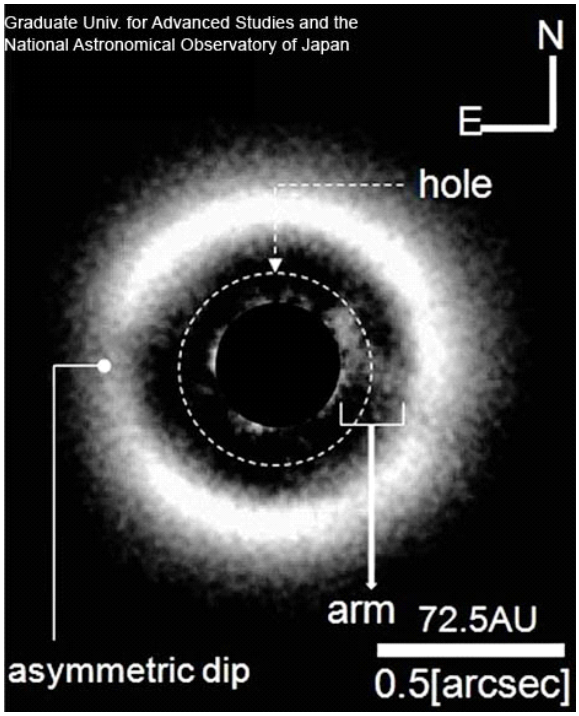
Kepler safe mode – The spacecraft was placed in safe mode for 10 days, taking no data, in order to give the reaction wheels a rest. The reaction wheels are required to point the spacecraft very accurately at the star field that it watches to detect transits of planets in front of the stars. Kepler was supplied with 4 of the wheels, and 3 are required to be running. One has already failed, and a second was registering increased friction. The rest time is expected to cool down bearings and redistribute lubrication. Kepler resumed science operations and the 3 good wheels appeared to working normally. To complete its mission, Kepler has to operate for 3 more years. The symptoms of the misbehaving reaction wheel are different than those exhibited just before the other one failed, so it is not expected that a similar failure is imminent. Engineers are also running the wheels at warmer temperatures and alternating their spin direction in efforts to prolong their life.

Green Bank radiotelescope has been observing the planet candidates found by Kepler, and so far 86 (of 2740) have been listened to for radio signals from intelligent life. The 86 were chosen for having multiple planets or planets in the habitable zone. Based on the fact that no signals were yet found, it was calculated that less than 1 in a million stars could possibly harbor a planet with an advanced civilization that uses radio. But that still means that 100s of thousands of such civilizations could exist in our Milky Way, due to the huge number of stars in our galaxy. It should be noted though that the search covered a limited range of wavelengths, spent only minutes on each star, and most stars were too distant to pick up anything but hugely powerful signals or ones beamed in our direction. To increase the odds of discovering such a signal, the study will target stars with multiple known planets when the planets reach a line-of-sight with Earth. Then radio communications between those planets would be beamed toward Earth, making their detection much more likely.

Herschel (infrared space telescope) has measured the mass of the disk surrounding the star TW Hydrae and found that it has sufficient gas to make many gas giant planets, in fact about 50 Jupiters. This is surprising because the star is past the age at which formation of gas giants is thought to end, due to gas in planet-forming disks dissipating. It is about 10 million years old and lies 176 light-years away. The new observations used a new method of determining the mass of a disk; spectroscopic measurements were made of molecules of hydrogen containing deuterium, a heavier isotope of hydrogen. Ordinary hydrogen does not produce spectral lines in the range of Herschel's spectrograph. But since deuterium occurs in known ratios, its measurement allows calculating the full mass of hydrogen gas.

Euclid – The European Space Agency has signed up NASA to participate in the Euclid mission, to be launched in 2020 to study dark matter and dark energy. It will do this by measuring weak gravitational lensing, in which gravity from dark matter (as well as seen matter) distorts the shape of galaxies behind, and by measuring the clustering of galaxies as it changed over the last several billion years. This will involve observing up to 2 billion galaxies in a survey of more than 1/3 of the sky. Planned NASA activities are to supply and test the infrared imagers, plan science, and analyze the resulting data.

Instant AstroSpace Updates



The Subaru Telescope has used its adaptive optics to image in near infrared the **planet-forming** dust ring about a young star, and found a curved arm reaching across the gap inside the disk. Computer simulations showed that an unseen planet could cause this arm.

A green meteorite known as NWA 7325 has been analyzed and found to nearly match measurements of the surface of Mercury made by the Messenger spacecraft orbiting that planet, prompting scientists to suggest that the meteorite was knocked off of **Mercury** into space by an impact. Other types of meteorites have been positively identified as being pieces of the Moon, Mars, and asteroid Vesta.

The **Hi-C** solar telescope was launched last July from White Sands in New Mexico on a 10 minute suborbital flight and obtained the highest resolution images ever of the solar corona, and analysis now shows that it observed magnetic field reconnection for the 1st time ever in high resolution. That process is believed to be the means that heats the corona to as much as 7 million °F (3.9 million °C).

An experiment aboard the International Space Station has shown that the robot arm can remove the seals on a typical satellite fuel container and **refuel** it, even though it was not designed to be refueled. This technology could extend the life of many satellites.

Mars rover **Opportunity** completed 9 years of operation on Mars in late January, and is still going strong. It is exploring clay-bearing strata, which is different geologically from anything seen by any of the rovers.

Astronomers using an Australian radiotelescope have measured the temperature of an isolated gas cloud, which should be the same as the **temperature of the Cosmic Microwave Background** (CMB) because it heats the cloud, which is so distant that the radio light left there 7.2 billion years ago. The temperature exactly matched what Big Bang theory says the CMB temperature should have been 7.2 billion years ago.

FOR SALE

Skywatcher 100ED f/9 Refractor with Celestron CG-4 mount. Scope comes with a hard case, 8x50mm finder; 2 LET eyepieces, 2-inch dielectric diagonal; Baader solar filter. CG-4 mount has motor drives on both equatorial and declination axes. All in excellent shape for $650 or best offer. Celestron Sky Prodigy 90mm Maksutov with all attachments, $375. Vixen Porta II Altazimuth Mount, $100; Telrad finder, $25. Contact Val Akins (949) 382-1869

Meade Model ETX-90EC Maksutov-Cassegrain with AutoStar; 90mm objective, f/13.9 with 8X25 right-angle viewfinder, Rigel Quik Finder, electric focuser, 26mm eyepiece, 2X Barlow, and Meade rigid carry case. $300. Contact Don at (714) 996-5138 or dgrconsult@roadrunner.com

INTES 66 6-inch Maksutov-Cassegrain on a Celestron 6/8-inch NexStar GoTo mount/tripod with 2-inch star diagonal, dovetail, 50mm finderscope, full aperture solar filter, AC/DC power adapter, PC cable, and soft telescope case. Paid $1800; will sell for $850 OBO. Equatorial mount/tripod with manual hand controls and cables suitable for scopes up to 15 lbs. $35 OBO. Contact Dave at (949) 492-5342

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