SIRIUS ASTRONOMER

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The Newsletter of the Orange County Astronomers

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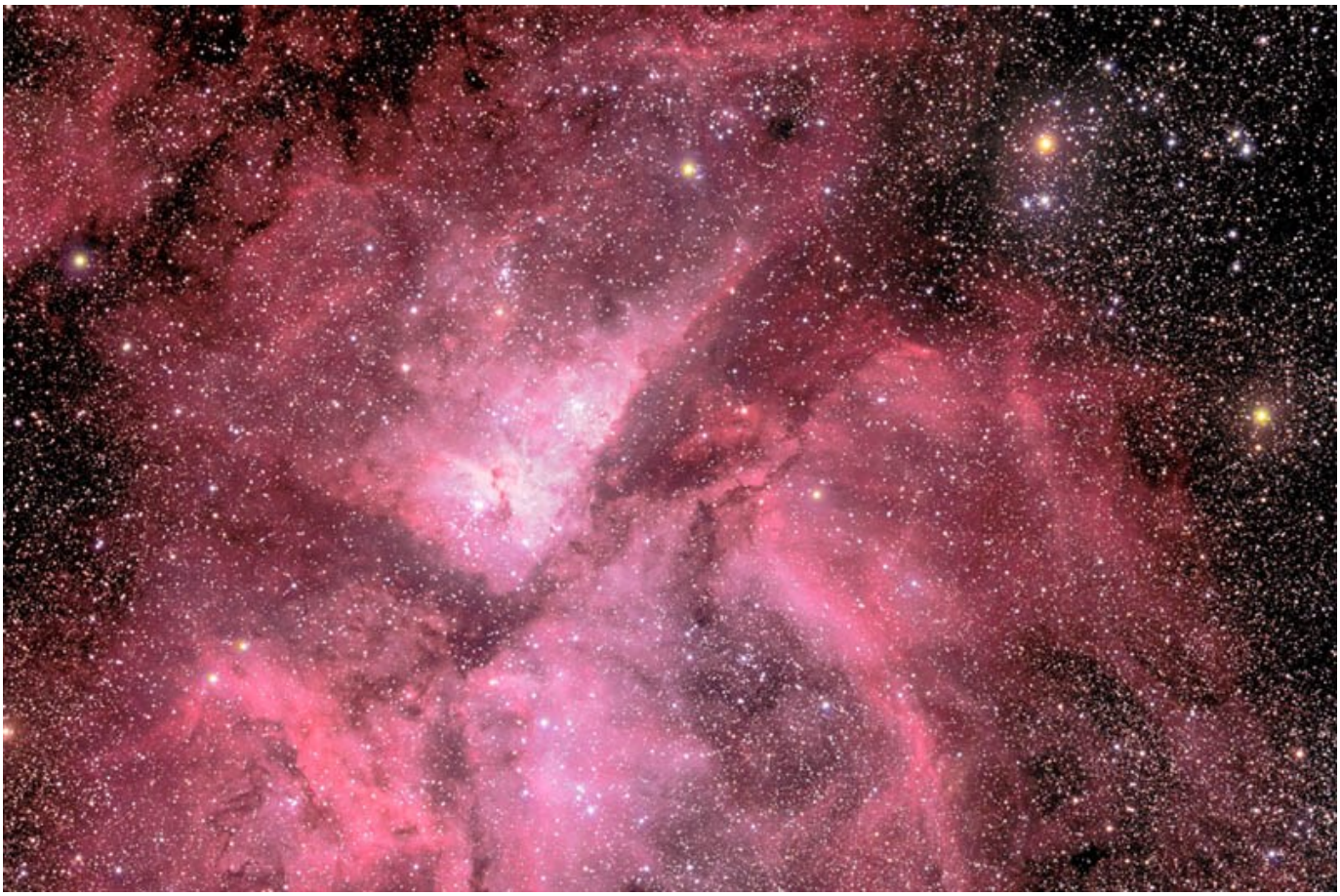


Although technically (and best known as) a southern hemisphere object, Eta Carinae has been successfully imaged with amateur scopes as far north as Vancouver, Canada. Our own Don Lynn used an Internet scope based in Australia to obtain this image on March 7, 2008, but this object is accessible to any Orange County-based observer who can get to darker skies.

OCA CLUB MEETING

The free and open club meeting will be held April 11 at 7:30 PM in the Irvine Lecture Hall of the Hashinger Science Center at Chapman University in Orange. This month Dr. Judy Cohen of Caltech will discuss '40 Years as a Woman in Astrophysics'!

NEXT MEETINGS: May 9, June 13

STAR PARTIES

The Black Star Canyon site will open on April 26. The Anza site will be open on April 26. 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 April 4. The following class will be held May .

GOTO SIG: TBA
Astro-Imagers SIG: Apr. 8, May 13
Remote Telescopes: TBA
Astrophysics SIG: Apr. 18, May 16
Dark Sky Group: TBA

AstroSpace Update

April 2014

Gathered by Don Lynn from NASA and other sources

715 new exoplanets – Kepler (planet-hunting space telescope) scientists announced the verification of 715 planet candidates, which are orbiting 305 stars. Possible transits of planets detected by Kepler are called planet candidates, since other phenomena may cause dips in starlight similar to that of transiting planets, and each must be verified by other types of observations. Of the 3600 Kepler planet candidates, only 246 had been verified before this announcement. Exoplanets found by all means stood at about 1000 before this announcement. The new method used to verify the 715 was to analyze probabilities of the other phenomena that mimic the dimming of transiting planets, including eclipsing binary stars, star spots and others. It was found that in multiple-planet systems, these probabilities are much smaller than in single-planet systems, in part because many of these other phenomena would affect all planets of a system. In cases where the probability of a mimic phenomenon was shown to be less than 1%, the planet candidate was declared verified. This technique can often be done on multi-planet systems with just the Kepler data, that is, no further observations. When applied to all Kepler data from the 1st 2 years of observation, the result was 715 new verifications. Among these were 4 planets in the habitable zone, that region where temperatures on the planet would allow liquid water to exist. All 4 were of super-Earth size, that is, about 2-2.5 times the diameter of Earth. It is not known if super-Earths are rocky or gassy or something else. Our solar system has no planets larger than the rocky Earth and smaller than gas giant Neptune, about 4 times the diameter of Earth. Among the 715, the smaller the planets were, the more common they tended to be. The newly verified planets tend to orbit in the same plane as each other within any given planet system.

Red dwarf planets – 8 new planets have been discovered orbiting nearby red dwarf stars by a team of astronomers using telescopes in Chile. Of the 8, 3 are in the habitable zone, all super-Earth sized. The study predicts statistically that virtually all red dwarfs have planets orbiting them. Red dwarfs make up about ¾ of all stars. They also concluded that at least ¼ of all red dwarfs have a planet in the habitable zone. The discoveries were made by spectroscopically measuring the wobble induced in a star by its planet's gravity. The results confirm Kepler findings that planets are quite common orbiting red dwarf stars. The new discoveries orbit stars between 15 and 80 light-years away and have orbital periods between 2 weeks and 9 years. Their distances from their stars range from about 1/20 to 4 times the Earth's orbital distance. There were only 17 planets known orbiting such low-mass stars before this announcement. The study also found 10 weak signals that will be followed up to see if they are also planets orbiting red dwarfs.

Exoplanet water vapor – Researchers developed a new technique to find water vapor in the atmospheres of exoplanets. They found water vapor at a Jupiter-mass planet orbiting the nearby star Tau Boötis. Scientists have previously detected water vapor on a handful of other planets, but these detections work only on planets that transit their stars or are very far from their stars and can be separately imaged. The new technique does not have these restrictions. It relies on the redshift of the planet differing from that of its star, so the shifting of spectral lines of the planet can be separated from that of its star, even though the star and planet are too close to resolve. A further advantage of this method is that the mass of the planet can be calculated by the amounts of the 2 redshifts. This differs from measuring just the redshift of the star as it is tugged by its planet, as that method allows calculation of only a lower limit on the planet's mass. So far the new method has functioned only on gas giants orbiting close to their stars, but plenty of those are known. Theoretically the largest current Earth-bound telescopes could reach super-Earth sized planets with this technique, but not Earth-sized.

Pulsar asteroids – Scientists using the Parkes radiotelescope in Australia and another telescope have found evidence that a tiny star (pulsar) called PSR J0738-4042 is being pounded by asteroids. One of these rocks appears to have had a mass of about a billion tons. The environment around a pulsar is especially harsh, full of radiation and violent winds of particles. If a large rocky body can form there, planets could form around almost any star. In 2008 it was calculated how an infalling asteroid would affect a pulsar: it would alter the slowdown of the pulsar spin rate and the shape of its radio pulse. The new observations matched this prediction. The pulsar radio beam zaps an infalling asteroid, vaporizing it. Asteroids could form around a pulsar by material blasted out from the supernova explosion that created the pulsar, which then falls back, forming a disk of debris, in which rocky bodies form.

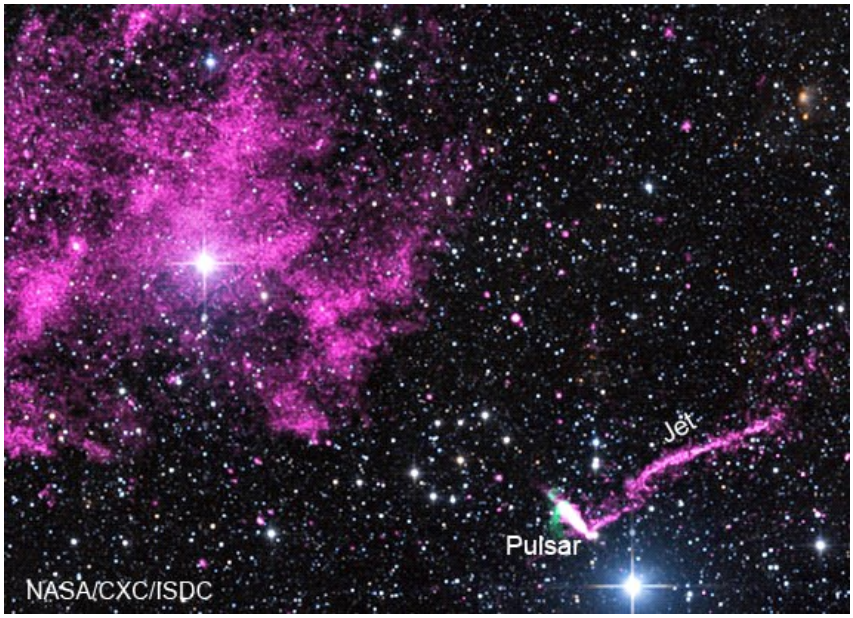
ALMA (radiotelescope array) has found an unexpected clump of carbon monoxide gas in the dusty disk around the star Beta Pictoris. Since this gas is destroyed by starlight, something is replenishing the gas as it is destroyed. The most abundant producer of the gas is collisions between icy bodies: comets and icy planets. The gas is commonly trapped in such bodies, and is released when they collide. It was calculated how much collisional activity must be present at Beta Pictoris to produce carbon monoxide as fast as the star destroys it, and the astounding answer is a comet collision every 5 minutes. This could occur only in a very dense swarm of comets. The gas clump is quite far from the star: 3 times Neptune's distance from the Sun. Only 2 theories have emerged on how a dense swarm of comets could form at this distance: 1) there is an undetected planet gravitationally herding the comets, or 2) a pair of icy planets, roughly the size of Mars, collided astronomically recently. There is already 1 planet known to orbit Beta Pictoris, but not at the right place to cause a comet clump, so another planet at the right place is quite plausible. Further work will likely be made to learn more about this unusual system.

Excess infrared explained – It has long been known that young stars emit more infrared than the stars alone should. This was at first attributed to disks of material surrounding the stars, from which planets are being formed. The disks glow in infrared. But careful calculations showed there was still infrared excess. The next theory was that the disks had faint halos of dust, which were also glowing in infrared. But still a little excess infrared remained unexplained. A new theory, based on computer models, shows that magnetic fields in the disks suspend particles above and below the disks, and these particles add to the infrared. This should finally explain the infrared excess from young stars.

Galaxy rotation – Astronomers have used the Hubble Space Telescope over a 7-year period to measure the individual motions of hundreds of stars in the Large Magellanic Cloud (LMC), our neighboring galaxy, 170,000 light years away. Plotting the movement of these stars over time shows that the galaxy takes 250 million years to rotate, coincidentally the same time it takes stars near our Sun to circle the Milky Way. This is the first time that galaxy rotation has been measured outside our galaxy by motions in the plane of the sky. Galaxy rotation rates have been measured for a century by redshift of their spectra, but that gives us motion only in one dimension (toward/away from us), so the rotation is not accurate if the galaxy is tilted adversely to the line of sight. The new measurements of the LMC, combined with redshift, give us full 3-dimensional motions. 22 fields of stars within the LMC were observed, each field containing a very distant quasar, and star positions were measured relative to the (unmoving) quasar. Next the team of astronomers plans to do the same for the Small Magellanic Cloud, a slightly more distant galaxy.

Merging galaxies – A leading theory has it that giant galaxies originated long ago after smaller dwarf galaxies crashed together. But the Hubble Space Telescope has yet to catch 2 dwarf galaxies in the distant Universe merging, and merging nearby galaxies are extremely rare. Astronomers have just uncovered evidence of such a collision nearby. A team of astronomers has analyzed measurements of the stars in the dwarf galaxy Andromeda II, the 2nd largest dwarf galaxy in our Local Group of galaxies, and discovered an odd stream of stars. Observations were made with the Keck II Telescope in Hawaii to measure the velocities of more than 700 stars in Andromeda II. Stars in large spiral galaxies move, on average, with the rotation of the disk of the galaxy. But the stars in dwarf galaxies don't; instead they move around at random. But a stream of stars roughly 16,000 light-years long and 980 light-years thick in Andromeda II were found to move in a stream, not at random. The stars in the stream are also colder, and therefore older, than the other stars (hot stars burn out before they get old). The astronomers concluded that the stream of stars once belonged to a different galaxy and remain as a remnant of the past collision, which likely occurred over 3 billion years ago. This is the smallest known example of 2 galaxies merging.

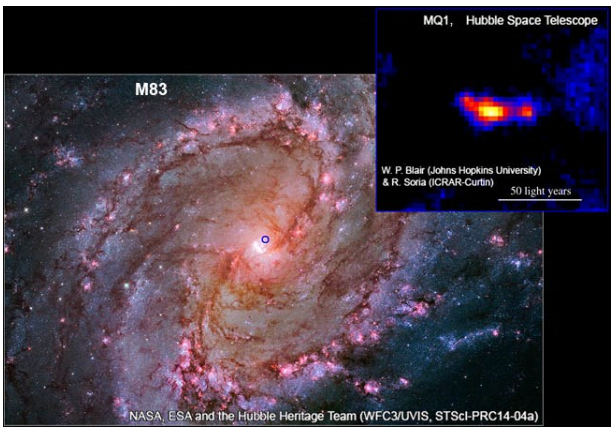
Chandra (X-ray space telescope) has seen a fast-moving pulsar escaping from a supernova remnant in Carina while the pulsar spews out a record-breaking jet of high-energy particles. The pulsar was originally discovered by the INTEGRAL gamma-ray space telescope. It is now seen about 60 light-years from the supernova remnant that gave birth to the pulsar. It has to be traveling 2.5-5 million mph (4-8 M km/h), making it one of the fastest pulsars ever observed. The jet has a distinct corkscrew pattern that suggests the pulsar is wobbling. The pulsar also is producing a cocoon of high-energy particles that enshrouds and trails behind it in a comet-like tail. Usually, the spin axis and jets of a pulsar point in the same direction as they are moving, but this ones spin axis and direction of motion are almost at right angles.



NuSTAR (high-energy X-ray space telescope) is shedding light on how supernovas explode. It has created the 1st map of radioactive material in a supernova remnant (Cassiopeia A). Since stars are spherical, one might think that when they explode that explosion would be a uniform ball expanding. But the new observations show how the explosion's heart is distorted, possibly because the inner regions slosh around before detonating. The NuSTAR map of titanium-44, an unstable isotope produced at the heart of the explosion, shows clumps at the remnant's center. When researchers simulate supernovas with computers, the main shock wave often stalls out and the star fails to shatter. The NuSTAR results suggest the exploding star sloshed around, re-energizing the stalled shock wave and allowing the star to complete the explosion of its outer layers. The new results cast doubt on theories that jets help complete a supernova explosion, since the titanium map did not show the pattern expected from jets triggering the explosion.

Black hole clouds – Astronomers see huge clouds of gas orbiting supermassive black holes at the centers of galaxies. Once thought to be relatively uniform ring, the accreting matter instead forms clumps dense enough to intermittently dim the intense radiation blazing from the matter heating as it swirls into the black hole. Evidence for the clouds comes from observations made over 16 years by the Rossi X-ray Timing Explorer. By sifting through records for 55 active galactic nuclei, astronomers found a dozen instances when the X-ray signal dimmed for periods of time ranging from hours to years. The clouds observed orbit a few light-weeks to a few light-years from the center of their black hole. One, in a spiral galaxy in Centaurus, appeared to be in the midst of being torn apart by tidal forces.

Black hole spin – Astronomers have used the Chandra and XMM-Newton X-ray space telescopes to show a supermassive black hole 6 billion light-years away is spinning extremely rapidly. This is the most distant black hole whose spin has been directly measured. Black holes are defined by just their mass and spin. Astronomers have long been able to measure black hole masses, but determining their spins has been much more difficult. Astronomers have ways of estimating spins for distant black holes, but the new method is more direct. The new study determined the spin of the supermassive black hole that is pulling in surrounding gas, producing an extremely luminous quasar known as RX J1131-1231. Because of fortuitous alignment, a giant elliptical galaxy along the line of sight is gravitationally lensing the quasar to magnify it. The magnification allowed the observations to get a detailed X-ray spectrum. The X-rays are produced when the swirling accretion disk of gas and dust that surrounds the black hole creates a multimillion-degree cloud, or corona. X-rays from this corona reflect off the inner edge of the accretion disk. The strong gravitational forces near the black hole alter the reflected X-ray spectrum. The larger the change in the spectrum, the closer the inner edge of the disk must be to the black hole. Spin of the black hole affects how close the accretions disk can be to the black hole. So the spin can be determined from the X-ray spectrum. It is not known whether black holes grow mainly from material falling in or from merging with other black holes. Merging black holes should spin up a black hole far more than material falling in (which should come from random directions). The extreme spin of this newly measured black hole suggests that it grew mainly by merging.



Powerful black hole – Astronomers studying nearby galaxy M83 have found a small (stellar sized) black hole, dubbed MQ1, which is emitting 10 times the power of the most powerful stellar black hole in our own galaxy. At first it was thought that this much power would require the black hole to be of intermediate size, not stellar sized. But recent measurements show that its mass is merely that of a collapsed star. MQ1 has huge jets, extending 20 light-years on either side. It is believed that more powerful stellar-

sized black holes were more common early in the history of the Universe, but they are definitely rare today. Discovery of this powerful one may help in understanding the influence of such powerful black holes in the early development of the Universe.

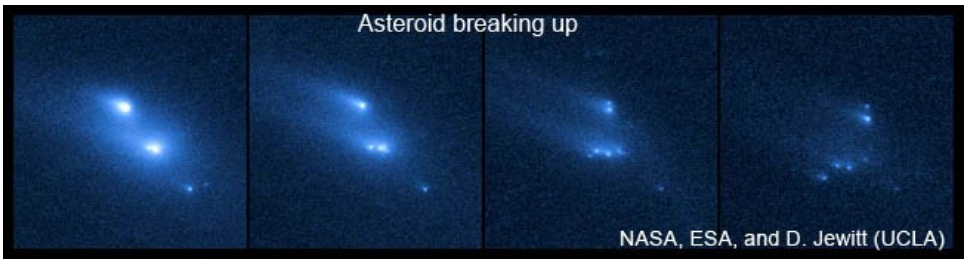
Herschel (far infrared space telescope) has discovered massive elliptical galaxies in the nearby Universe containing plenty of cold gas, even though the galaxies fail to produce new stars. Comparison with other data suggests that stars do not form because jets from the central supermassive black hole heat or stir up the gas, preventing it from turning into new stars. It was long believed that elliptical galaxies did not produce new stars because they had used up all their cool gas, but these new observations tell a different story, at least in some cases. The Herschel data looked at 8 giant elliptical galaxies and found that 6 abound with cold gas. Other than some giant ellipticals affected by their location at the center of a massive galaxy cluster, this is the 1st time that large amounts of cold gas have been found in giant ellipticals. Follow up observations on these galaxies in visible light and X-rays showed that in the 6 hot gas was cooling, which should replenish the supply to create new stars. In the other 2, hot gas was not cooling. The 6 galaxies were found to have moderately active black holes (that is, a moderate amount of material falling in), while the 2 had very active black holes. Jets from the black holes could then explain the lack of star formation and the varying amounts of cooling of gas.

Possible Martian microbes – A team of scientists has found evidence of past water movement throughout a Martian meteorite. Structures found deep within a 30-pound (14 kg) meteorite known as Yamato 000593 and compositional features suggest biological processes might have been at work on Mars hundreds of millions of years ago. This is based on micro-tunnels displaying curved, undulating shapes and very small spherules sandwiched between layers within the rock similar to microbe-altered features observed in certain Earth rocks. The authors of the study note that they cannot exclude the possibility that the features may be the product of non-life mechanisms. This will undoubtedly stir a lot of controversy, as did claims of life evidence made from a different Martian meteorite based on different features in 1996. Analyses found that the rock was formed about 1.3 billion years ago from a lava flow on Mars. Around 12 million years ago, an impact occurred on Mars which ejected the meteorite from the surface of Mars. The meteorite traveled through space until it fell in Antarctica about 50,000 years ago, and was found in 2000. It is classified as a nakhlite, a subgroup of Martian meteorites. Also found in the meteorite was evidence of water alterations in clay minerals, that is, evidence of running water on ancient Mars, a finding much less controversial.

Curiosity (Mars rover) has been commanded to drive backwards for awhile, the 1st time it has gone in reverse for any substantial distance. It is believed that this will minimize the damage to the wheels that has been observed from driving over sharp rocks, or at least will spread out the damage. The rover passed its reverse driving test with flying colors. The rover has also been directed to a smoother area, which should also reduce damage. Curiosity has driven 3.2 miles (5.2 km) and has taken over 118,000 pictures. The rover has about another 3 miles (5 km) to go to reach the foothills of Mount Sharp, its primary target.

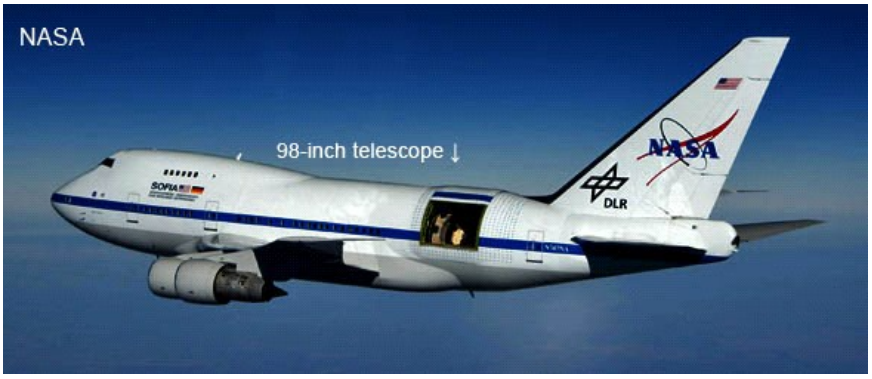
Trojan moon – After 8 years of observations, scientists have found an exotic orbit for the moon of the largest Trojan asteroid (624) Hektor. This is the only Trojan known to have a moon, and it was found in 2006. Data and observations from around the world suggest that the asteroid and its moon are products of the collision of 2 icy asteroids. Trojan asteroids are those that are trapped in regions (called Lagrangian points) 60° ahead or behind Jupiter in its orbit about the Sun. It takes a telescope like the Keck, huge with adaptive optics, in order to image Hektor's moon. The 7 mile (12 km) moon orbits the 155 mile (250 km) asteroid every 3 Earth days at a distance of 370 miles (600 km) in an ellipse inclined almost 45° with respect to the asteroid's equator. The moon's orbit is very different from other asteroids with moons seen in the main asteroid belt. Computer simulations of the orbit show that the moon's orbit is stable over billions of years. Hektor has long been known to spin rapidly (less than 7 hours) and to be extremely elongated with 2 lobes. The study team speculated that the moon could be ejecta produced by a slow collision that formed the 2 lobes. The study showed that Hektor could be made of a mixture of rock and ices, similar to some Kuiper belt objects. Hektor's moon is still unnamed, and the discoverers are open to suggestions that relate to Hector of ancient Trojan lore.

Asteroid breakup – The Hubble Space Telescope has imaged the breakup of an asteroid for the 1st time. The object was given a comet designation (P/2013 R3) when it was seen to have a comet-like glow about it. But curiously, its orbit was in the asteroid belt, not a comet-like orbit. Follow up observations with the Keck Telescope showed that it had broken into 3 parts, and the glow was from surrounding dust. This prompted further follow up with the greater capabilities of Hubble. Its images showed 10 fragments, each with a dust tail, not gas tails that comets typically have. It was determined that the asteroid began breaking up early in 2013, but pieces continued to emerge as later observations were made. An asteroid can break up from 1) tidal forces from the gravity of a nearby object, 2) collision, 3) force of evaporation of internal ice, or 4) centrifugal force from spinning too fast. Tidal was ruled out because there is no nearby massive object. Collision was ruled out because the pieces came off at different times, not all at once as a collision would produce. The asteroid is too far from the Sun to be evaporating. This leaves spin. It is known that absorbing sunlight and re-radiating it can cause forces that spin a body faster (or slower, depending on geometry).



No Planet X – There have long been theories that there is another planet in our Solar System, but we just haven't discovered it because it is too distant, and therefore too dim. Among the several names given to this hypothetical body is "Planet X". The WISE infrared space telescope surveyed the entire sky twice. So astronomers searched its data for planets. Conclusions: There are no objects at least the size of Saturn within 10,000 AU (where an AU is the Earth's distance from the Sun); there are no objects at least the size of Jupiter within 26,000 AU; it is unlikely that any large planet could form and remain orbiting even farther than the limits of this study. The study also ruled out a dim stellar companion orbiting the Sun, which has also been the subject of many theories. On the other hand, a separate search of the same WISE data for stellar objects found 3,525 stars and brown dwarfs in our neighborhood (within 500 light-years) that were previously unknown. The closest were a pair of brown dwarfs about 6.5 light-years away, too far to be orbiting the Sun.

SOFIA (airplane-mounted infrared telescope) has made extensive observations of the type Ia supernova that recently exploded in galaxy M82. SOFIA is able to fly above 99% of the water vapor in the Earth's atmosphere, which blocks most infrared light from being observed by ground-based telescopes. The supernova observations could also have been made with a space telescope (but not Earth based), but there is no space telescope with a spectrograph comparable to SOFIA's.



In an ironically related story, the proposed 2015 NASA budget includes a 1% overall cut in funds, and one of the cost savings proposed is **grounding SOFIA**. The airborne telescope was planned for 20 more years of operation. Education by NASA is proposed for a 24% cut. The Orbiting Carbon Observatory 3 is also slated to be eliminated. Support for continued operation of the Mars rover Opportunity is also missing. Since this is only a proposal, it is not final what NASA may cut. But the budget does not look good at this point.

Yutu (Chinese lunar rover) – The malfunction afflicting Yutu since the start of its 2nd lunar night has been identified as an inability to maneuver the solar panels. This means the rover does not get optimum charging from the panels, but more seriously, it prevents the rover from folding up to insulate the rover's interior from the extreme cold of lunar nights, which last 14 Earth days. During the 3rd lunar day, the rover was able to use its camera, radar and other instruments, since they survived the lunar night, but it was not able

to drive. As I write this, Yutu is nearing the end of its estimated life of 3 months. No word yet on whether it survived the 3rd night. The lander, off of which the rover drove, is still working perfectly.

Spacewalk mishap – The report has been released from the 1st of 2 investigations of the mishap during a spacewalk from the International Space Station (ISS) where the astronaut's helmet partly filled with water. The problem had actually occurred before, during the immediately previous use of the same space suit, but not as badly, and it had been attributed to leakage from the drink bag inside the suit. But the real cause was that tiny holes had become plugged within the device that separates water vapor from the air inside the suit. The aluminum compound material plugging the holes was identified, but how it got there has not yet been determined, though investigation continues. The report has a number of recommendations to improve procedures so as to reduce risks in spacewalks. The recommendations are scheduled to be implemented by June, in time for spacewalks this summer.

Instant AstroSpace Updates

A **yellow hypergiant** star in Centaurus has been studied with the Very Large Telescope in Chile and found to be the largest known of this star type. Compared to the Sun, it is 33 times as massive, 1300 times the diameter, a million times as bright, and has a fairly massive, very close companion star.

NEOWISE (infrared space telescope) has spotted its 1st comet since being brought out of hibernation last fall, and it is in an unusual retrograde orbit. The spacecraft discovered 21 comets (in addition to over 100,000 discoveries of asteroids, brown dwarfs, stars, galaxies, etc.) during its primary mission, before being put in hibernation.

Venus Express has imaged a **glory** in the sulfuric-acid-laced Venusian atmosphere for the 1st time. A glory is a small color-banded bright spot seen opposite the Sun.

Scientists are using an X-ray laser in a lab to instantly heat liquid hydrogen to temperatures and pressures comparable to that found in the **cores of gas giant planets** in order to understand hydrogen's properties in those planets.

Robonaut 2 (the robot now aboard ISS) is scheduled to have legs added soon, with grippers on the feet, so it can stand stationary to perform its tasks. Tests of task abilities will be performed over coming months, but all inside the station, until future upgrades allow the robot to venture outside for spacewalks.

A space observatory called **PLATO** to search for planets orbiting other stars has been selected as the European Space Agency's next medium-class mission, to be launched by 2024. It will follow up the search begun by Kepler, monitoring a million stars spread about the sky.

Dryden Flight Research Center on the edge of Rogers Dry Lake in Edwards Air Force Base in California is being renamed, by order of Congress, the **Armstrong Flight Research Center**, after Neil Armstrong, who worked there before and after his landing on the Moon. The adjoining test range will carry Dryden's name.

NASA is offering a $35,000 prize for the best computer program to **find asteroids** in sky images taken by ground-based telescopes. Challenges are to find really dim objects, and distinguish them from noise, variable stars and defects.

Old Tool, New Use: GPS and the Terrestrial Reference Frame

By Alex H. Kasprak

Flying over 1300 kilometers above Earth, the Jason 2 satellite knows its distance from the ocean down to a matter of centimeters, allowing for the creation of detailed maps of the ocean's surface. This information is invaluable to oceanographers and climate scientists. By understanding the ocean's complex topography—its barely perceptible hills and troughs—these scientists can monitor the pace of sea level rise, unravel the intricacies of ocean currents, and project the effects of future climate change.

But these measurements would be useless if there were not some frame of reference to put them in context. A terrestrial reference frame, ratified by an international group of scientists, serves that purpose. "It's a lot like air," says JPL scientist Jan Weiss. "It's all around us and is vitally important, but people don't really think about it." Creating such a frame of reference is more of a challenge than you might think, though. No point on the surface of Earth is truly fixed.

Artist's interpretation of the Jason 2 satellite. To do its job properly, satellites like Jason 2 require as accurate a terrestrial reference frame as possible. Image courtesy: NASA/JPL-Caltech.

To create a terrestrial reference frame, you need to know the distance between as many points as possible. Two methods help achieve that goal. Very-long baseline interferometry uses multiple radio antennas to monitor the signal from something very far away in space, like a quasar. The distance between the antennas can be calculated based on tiny changes in the time it takes the signal to reach them. Satellite laser ranging, the second method, bounces lasers off of satellites and measures the two-way travel time to calculate distance between ground stations.

Weiss and his colleagues would like to add a third method into the mix—GPS. At the moment, GPS measurements are used only to tie together the points created by very long baseline interferometry and satellite laser ranging together, not to directly calculate a terrestrial reference frame.

"There hasn't been a whole lot of serious effort to include GPS directly," says Weiss. His goal is to show that GPS can be used to create a terrestrial reference frame on its own. "The thing about GPS that's different from very-long baseline interferometry and satellite laser ranging is that you don't need complex and expensive infrastructure and can deploy many stations all around the world."

Feeding GPS data directly into the calculation of a terrestrial reference frame could lead to an even more accurate and cost effective way to reference points geospatially. This could be good news for missions like Jason 2. Slight errors in the terrestrial reference frame can create significant errors where precise measurements are required. GPS stations could prove to be a vital and untapped resource in the quest to create the most accurate terrestrial reference frame possible. "The thing about GPS," says Weiss, "is that you are just so data rich when compared to these other techniques."

You can learn more about NASA's efforts to create an accurate terrestrial reference frame here: http://space-geodesy.nasa.gov/. Kids can learn all about GPS by visiting http://spaceplace.nasa.gov/gps and watching a fun animation about finding pizza here: http://spaceplace.nasa.gov/gps-pizza.

Western Amateur Astronomers Board Meeting Notes
by Tim Hogle, WAA Vice President and OCA Representative

It's time once again for my annual note about the Western Amateur Astronomers (WAA) and our winter board meeting, this year on February 8th. As you will recall from my previous reports, WAA is an umbrella organization of astronomy clubs in the western USA, and OCA is a long time member club. This year the meeting was back in Springville, CA at the home of Monsignor Ron Royer, a longstanding OCA member, now officially retired from the Catholic Church but still just as active in astronomy and the Church in Springville as he was in Southern California. Clubs represented at the meeting included OCA, Los Angeles Astronomical Society, China Lake Astronomical Society, Eastbay Astronomical Society, Astronomical Association of Northern California, Chabot Telescope Makers Workshop, Mount Diablo Astronomical Society, and Mount Diablo Observatory Association.

A renewed accomplishment for WAA during this last year was publication of three issues of our newly resurrected newsletter, the New Pacific Stargazer, each of which can be accessed now from the WAA web site at http://www.waa.av.org. (I no longer have to provide a mile long URL for you to type into your browser, so I encourage each of you to take a look.) And we invite club members who have something they would like to publish that would be of interest to other amateurs within and outside OCA (astronomical projects, great ideas, subjects of astronomically- sensitive environmental concern, etc) to write it up and contact me. We do have a mechanism for submissions and are actively looking for material to publish, with full credit to the author. Contact me for details if interested (my contact info is on the back of the Sirius Astronomer). But I would also encourage you to submit articles to the Sirius Astronomer as well. Steve Condrey is always looking for new material.

One of WAA's most well-known functions is to select and present the very prestigious G. Bruce Blair award and medal to 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.

This year's Blair award recipient is Mr. Richard Ozer, a Northern California-based amateur astronomer and telescope designer and maker. Richard has been a strong leader for many years in the amateur community, specifically in the Telescope Makers Workshop at Chabot Space and Science Center, the Eastbay Astronomical Society, Mt. Diablo Observatory Association, Mt. Diablo Astronomical Society (different from MDOA), and Astronomical Association of Northern California. He was instrumental in setting up MDOA's 's Turn-Key Observatory on Mt Diablo, the annual Golden State Star Party, and a library for amateur astronomers at Chabot, to name a few specifics. The award will be presented at RTMC.

Other items of business from the WAA meeting include reports from member clubs in attendance about their activities and concerns, ongoing discussions about possible expansion of WAA's service to and improved communications between member clubs. The New Pacific Stargazer is a big step in this direction. Also being pursued is a transition in actual production of the G. Bruce Blair medal, which has been done for many years by our long tenured past WAA president Jack Borde. The process is quite involved, consisting of CNC and manual machine work on a solid copper blank, careful engraving of the recipient's name, polishing, gold plating, and construction of a fine wood display case. We are hopeful that the member club Telescope Makers' Workshop will take this over on a continuing basis.

WAA will again have an information booth at RTMC again this year, probably near the snack bar. Stop by and say hello. For more info about WAA, log on to the web site.

Telescope on a "Tricycle" mount

by Bob Buchheim (OCA Secretary)

I know that some of you use your driveway as your "observatory", and that you don't enjoy carrying the telescope kit from the garage to the driveway. This telescope may be the answer to your dreams. It was recently donated to OCA, but it isn't appropriate for our "Loaner" program, so we will be happy to sell it to an OCA member for a fair price.

The Optical Tube assembly is a Meade 8-inch f/6 Newtonian in a 9-inch ID fiberglass tube), with a Meade 2-inch rack & Pinion focuser that still runs quite smoothly. Both rubber end-caps are in excellent condition. It has the then-standard too-small Meade finder 'scope. The OTA is in a very smooth rotating-rings assembly; I don't know if this was a custom addition or Meade item, but it works nicely.

In any case, the real highlight of the 'scope is the custom mount, built by the owner (who was a mechanical engineer). In concept, it's a portable English-yoke type, sitting on a "tricycle" assembly. It is easy to wheel it out of the garage and onto the driveway with the OTA installed. Lift the north end to slip the wheels off and set it on its feet. Lift the south end, remove the wheels and slip in the fixed shaft, and you're done. (The shaft at the south end can be adjusted up/down for latitude adjustment, so it's not restricted to southern California's latitude).

Or, if you're not picky about polar alignment, you can even leave it on its wheels. They are stable enough for visual observing at modest power.

The mount has a manual fine-adjust for declination, which works nicely. It also has a motor drive for RA, but that isn't working. I suspect (but don't know for sure) that the problem is a fried AC synchronous motor. This could probably be replaced if you're a bit of a tinkerer.

The telescope is currently in my garage in south Orange County. I think $400 is a fair price for this unique instrument. Contact me via e-mail if you're interested (oca_bob@yahoo.com).

Not to be outdone by this month's Mars opposition, Jupiter always manages to put on a good show. Pat Knoll obtained this image on April 2 from Kearney Mesa, CA using a Meade 10-inch LX200 Classic with a ZWO ASI 120MC video camera. Shown are Ganymede, Io, and the shadow of Io in transit across the face of Jupiter. This exceptional image shows the coloration of both moons and surface detail on Ganymede.

Bill Hall was able to image Mars on March 23 (just two weeks before opposition) using a Celestron C8 at f/25 with a Super Polaris mount and the Celestron NexImage 5 camera. At the top center of the image are the Sinus Meridianii and Sinus Sabaeus features; the North Polar Cap is visible at bottom. These images are deliberately sized to depict the two planets' current relative sizes in the telescope eyepiece.

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