SIRIUS ASTRONOMER

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The Newsletter of the Orange County Astronomers

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FIRE UP THE GRILL! ANNUAL STARBECUE JULY 26 AT ANZA!

NGC 6548 is a barred spiral galaxy in the constellation Hercules. At magnitude 11.5 it is a good photographic object for medium-sized telescopes. Chuck Edmonds obtained this image with his 16-inch f/6.7 and an ST10XME imager at Anza on May 11, 2007. 24 5-minute exposures were composited to create the image.

OCA CLUB MEETING

The free and open club meeting will be held July 11 at 7:30 PM in the Irvine Lecture Hall of the Hashinger Science Center at Chapman University in Orange. This month's speaker is Dr. Zak Staniszewski of Caltech, who will present BICEP 2: A Cold Telescope's View of the Infant Universe

NEXT MEETINGS: August 8, Sept. 5

STAR PARTIES

The Black Star Canyon site will open on July 19. The Anza site will be open on July 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 August 1. The following class will be held September 12.

GOTO SIG: TBA
Astro-Imagers SIG: July 8, Aug. 12
Remote Telescopes: TBA
Astrophysics SIG: July 18, Aug. 15
Dark Sky Group: TBA

A Glorious Gravitational Lens

By Dr. Ethan Siegel

As we look at the universe on larger and larger scales, from stars to galaxies to groups to the largest galaxy clusters, we become able to perceive objects that are significantly farther away. But as we consider these larger classes of objects, they don't merely emit increased amounts of light, but they *also* contain increased amounts of **mass**. Under the best of circumstances, these gravitational clumps can open up a window to the distant universe well beyond what any astronomer could hope to see otherwise.

The oldest style of telescope is the refractor, where light from an arbitrarily distant source is passed through a converging lens. The incoming light rays—initially spread over a large area—are brought together at a point on the opposite side of the lens, with light rays from significantly closer sources bent in characteristic ways as well. While the universe doesn't consist of large optical lenses, **mass itself** is capable of bending light in accord with Einstein's theory of General Relativity, and acts as a *gravitational* lens!

Abel 2218. Image credit: NASA, ESA, and Johan Richard (Caltech). Acknowledgement: Davide de Martin & James Long (ESA/Hubble).

The first prediction that real-life galaxy clusters would behave as such lenses came from Fritz Zwicky in 1937. These foreground masses would lead to multiple images and distorted arcs of the same lensed background object, all of which would be magnified as well. It wasn't until 1979, however, that this process was confirmed with the observation of the Twin Quasar: QSO 0957+561. Gravitational lensing requires a serendipitous alignment of a massive foreground galaxy cluster with a background galaxy (or cluster) in the right location to be seen by an observer at our location, but the universe is kind enough to provide us with many such examples of this good fortune, including one accessible to astrophotographers with 11" scopes and larger: Abell 2218.

Located in the Constellation of Draco at position (J2000): R.A. 16h 35m 54s, Dec. +66° 13' 00" (about 2° North of the star 18 Draconis), Abell 2218 is an extremely massive cluster of about 10,000 galaxies located 2 billion light years away, but it's *also* located quite close to the zenith for northern hemisphere observers, making it a great target for deep-sky astrophotography. Multiple images and sweeping arcs abound between magnitudes 17 and 20, and include galaxies at a variety of redshifts ranging from z=0.7 all the way up to z=2.5, with farther ones at even fainter magnitudes unveiled by Hubble. For those looking for an astronomical challenge this summer, take a shot at Abell 2218, a cluster responsible for perhaps the most glorious gravitational lens visible from Earth!

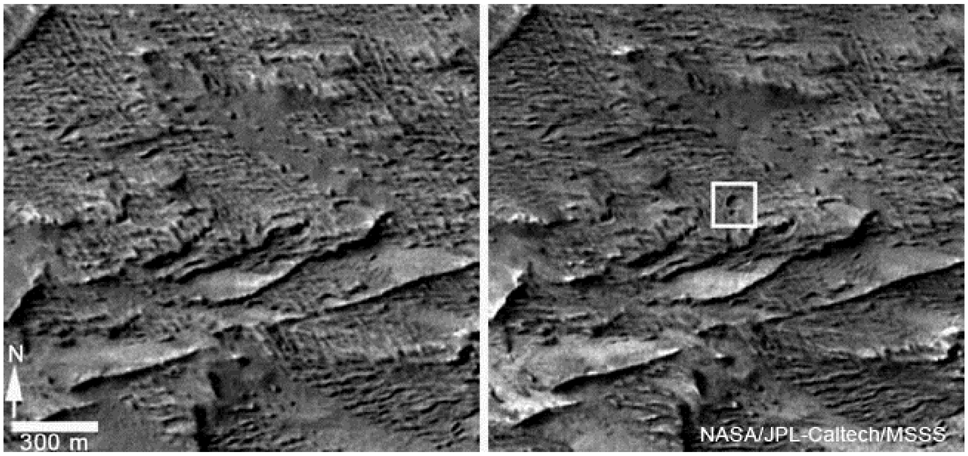
Learn about current efforts to study gravitational lensing using NASA facilities: http://www.nasa.gov/press/2014/january/nasas-fermi-makes-first-gamma-ray-study-of-a-gravitational-lens/

Kids can learn about gravity at NASA's Space Place: http://spaceplace.nasa.gov/what-is-gravity/

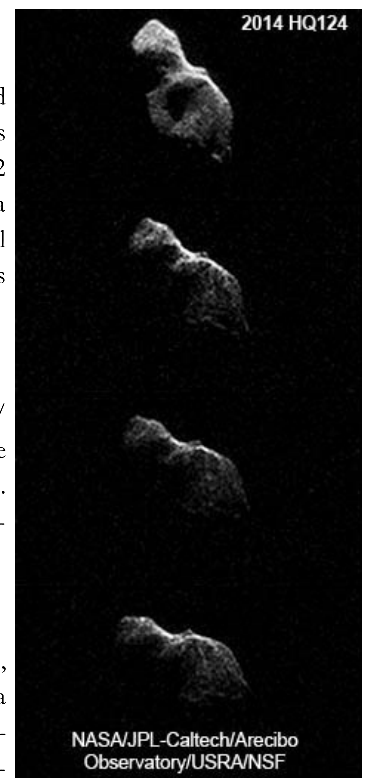
AstroSpace Update

July 2014

Gathered by Don Lynn from NASA and other sources



Martian crater – Researchers have discovered on Mars the largest fresh meteor-impact crater ever firmly documented with before and after images. The images were taken by the weather (wide angle) camera on Mars Reconnaissance Orbiter (MRO). The crater itself is half a football field in length, but a surrounding area about 5 miles (8 km) across was darkened. It probably exploded in the air before reaching the ground. Going back through weather images showed the dark spot was not present March 27, 2012, but was present March 28. The area was imaged in high resolution, which showed 2 large craters and more than a dozen smaller ones in the darkened area. The image also revealed many landslides in the surrounding area. The largest crater is quite shallow compared to other fresh craters that have been seen, and is slightly elongated. It is estimated that the impacting object was in the range of 10-18 ft (3-5 m). Because Mars has much thinner atmosphere than Earth, space rocks are more likely to penetrate to the surface of Mars. About 400 new craters have been spotted by MRO, but this is the only one found by the weather camera, apparently because it is the only one big enough to be seen in a wide-angle shot.



Asteroid imaged – Scientists used 3 radiotelescopes, 2 at a time, to radar a recently discovered asteroid named 2014 HQ124 as it zipped by Earth at somewhat over 3 times the Moon's distance. The results are some of the most detailed radar images of an asteroid ever obtained, showing features as small as 12 ft (4 m). It appears to be an elongated, irregular object that is at least 1200 ft (370 m) long. It may be a double object, with the pieces in contact. The images reveal a wealth of features, including a pointy hill near the object's middle. 21 radar images were made over a span of 4.5 hours, showing that it rotates about once per 24 hours. The asteroid was discovered by the NEOWISE infrared space telescope.

Comet imaged – The Arecibo radiotelescope in Puerto Rico took radar images of Comet 209P/LINEAR, only the 5th comet nucleus ever radar imaged. This is the comet that can be blamed for the very sparse new meteor shower, the Camelopardalids, which disappointed many the night of May 23. The radar results showed several features, perhaps ridges or cliffs. They refined the earlier optically obtained estimates of its size, at 1.5 by 1.8 miles (2.4 x 3 km). The rotation period is about 11 hours.

Consuming rocky planets – By carefully measuring the width of each dark band in a star's spectrum, astronomers can determine just how much hydrogen, iron, calcium and other elements are present in a star. A new computer simulation suggests that a G-class star with levels of elements like aluminum, silicon, and iron significantly higher than those in the Sun may have swallowed rocky planets. The simulation was used to analyze a pair of twin stars that both have their own planets. Stars consist of more than 98% hydrogen and helium. Astronomers have arbitrarily defined all the elements heavier than hydrogen and helium as "metals" and have coined the term metallicity to refer to the ratio of the relative abundance of iron to hydrogen in a star. Since astronomers developed the capability to detect exoplanets, there have been several studies that attempt to link star metallicity with planet formation. One such study argued that stars with high metallicities are more likely to develop planetary systems. A new study of the abundance of 15 specific elements, not just iron, examined a planet-hosting binary pair of stars designated HD 20781 and HD 20782. The stars should have condensed out of the same cloud of dust and gas, so both should have started with the same chemical compositions. This pair is the 1st one discovered where both stars are known to have their own planets. Both stars and G-class dwarf stars similar to the Sun. One is orbited closely by 2 Neptune-sized planets, and the other by a single Jupiter-sized planet that follows a highly eccentric orbit. The relative abundance of the studies elements was significantly higher than that of the Sun. They found that the higher the melting temperature of a particular element, the higher was its abundance, a trend that is a compelling signature of the ingestion of rocky planet material. They calculated that the star with the Jupiter-sized planet has swallowed an extra 10 Earth masses while the other star ate an additional 20. Rocky planets form in the region close to the star where it is hot, and gas giants form farther out where it is cold. However, gas giants can migrate inward, and as they do, their gravity tugs on the inner rocky planets, and can force them to plunge into the star. The 2 Neptune-sized planets are close to their star, closer than Mercury is to our Sun, and so is the Jupiter-sized planet at its closest approach. Planets this close to their stars should have cleared out any rocky planets, forcing many of them into their stars. Apparently the twin Neptunes were more efficient at this, since element levels indicated twice the rocky mass had been consumed. If this chemical signature proves widespread, it can be an indication that the rocky planets have been cleared out of the system. Astronomers looking for rocky planets should look at stars without the chemical signature.

Planet formation – Astronomers used archived data from the Kepler planet-finding space telescope to show that the types of exoplanets around a star depends on the star's content of heavier elements, usually termed metallicity. The team took spectra of 405 stars orbited by 600 exoplanet candidates. It was found not possible to predict what types of planets are orbiting a star just from its metallicity, but statistically there were trends. Planets smaller than 1.7 times the Earth's diameter tend to orbit stars of the same metallicity as the Sun. These planets are likely terrestrial, or rocky, planets, with an iron core and a compact atmosphere. Planets between 1.7 and 3.9 times the Earth's diameter tend to have stars of slightly higher metallicity. There are no such planets in our Solar System, and up until a few years ago, theorists were explaining why such planets should never form. But Kepler has found they exist in abundance orbiting other stars. It is believed that these are gas dwarfs, that is, with a rocky core and thick atmospheres of hydrogen and helium, but not nearly the size of gas giants. Planets above 3.9 times the size of Earth are more common around stars with an even higher metallicity (about 1.5 times that of our Sun). These are the gas giants (such as Jupiter) or ice giants (such as Neptune) that make up half our Solar System. Statistically the dividing lines in diameter between planet types were fairly clear, though the metallicity of the planet types varied considerably. It is clear from this study that some other factor or factors besides metallicity also affect the type of planet that forms.

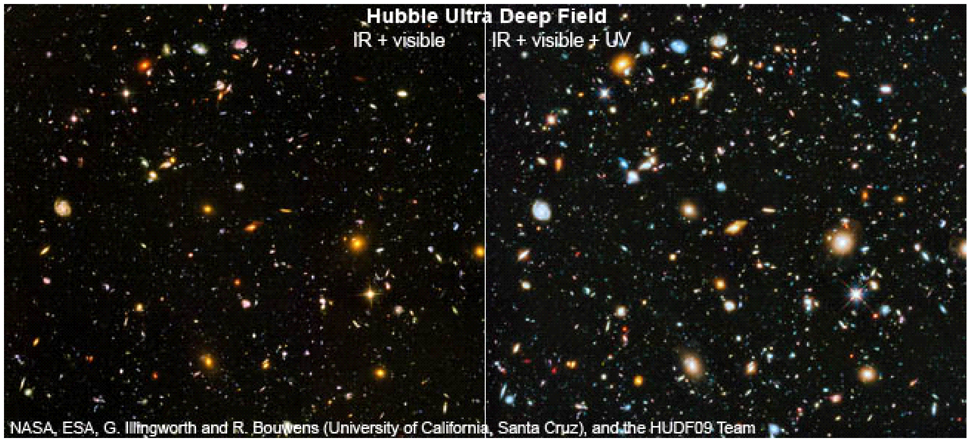
Huge rocky exoplanet – Astronomers have discovered a rocky planet that has 17 times the mass of Earth and is 2.3 times the diameter. Planet theorists cannot explain how such a massive planet could form without scooping up masses of hydrogen with its gravity. Its high density says it has no substantial fraction of hydrogen or any other gas. Observations indicate it should not have lost any substantial amount of gas either. The Kepler space telescope discovered the planet and measured its size, and follow-up observations by the Galileo Telescope in the Canary Islands determined its mass. The planet, known as Kepler-10c orbits a Sun-like star every 45 days. It is located about 560 light-years away in Draco. The system also hosts Kepler-10b, the 1st rocky planet discovered in Kepler data. The system's age, and therefore the planet's age, is about 11 billion years. Thus it formed earlier than some theoreticians thought rocky planets could form. Then they found 2 more of similar age.

Nearby exoplanets – A team of astronomers announced the discovery of 2 exoplanets orbiting Kapteyn's Star, the 25th closest star at only 13 light-years distance. The planets were discovered using radial velocity measurements. Kapteyn's Star was discovered by Jacobus Kapteyn during a survey of the southern sky in 1898. Until the discovery of Barnard's Star in 1916, Kapteyn's Star had the highest proper motion known at over 8 arc seconds per year. The star is a halo star, not orbiting with the disk of the Milky Way. Such stars are thought to have been left after a galaxy was shredded and absorbed by our Milky Way long ago. The stars, denoted Kapteyn b and c, are both suspected to be rocky super-Earths, with masses calculated at least to be 4.5 and 7 times Earth's. Kapteyn b orbits every 48.6 days at 0.168 AUs (where 1 AU is Earth's distance from the Sun), and Kapteyn c orbits in 122 days at 0.3 AU. Kapteyn b sits in the habitable zone, that is, where temperatures may allow liquid water to exist on its surface. Because red dwarf stars, such as Kapteyn's, are cooler than our Sun, the habitable zone is much closer in. Kapteyn's Star is estimated to be 11.5 billion years old, far older than our Sun and its planets.

Doomed planets – 2 planets, dubbed Kepler-56b and Kepler-56c, have been found to be orbiting fairly close to their star, and it is calculated that their star will swallow them in 153 and 155 million years respectively. The size of their star will enlarge as it gets older, which stars typically do, and the tidal forces between the planets and their star will cause them to move their orbits and rip apart. A 3rd (and more distant) planet in the system will remain safe through this.

Windy planets – Planets designated KOI 1422.02, KOI 2626.01 and KOI 584.01 have been found orbiting red dwarf stars, which are pelting them with intense stellar winds. It was calculated that even magnetic fields as strong as the one Earth has protecting us from solar wind, would be inadequate to protect these red dwarf planets. The winds should strip the atmosphere off these planets.

Hubble Space Telescope has imaged in ultraviolet the same area where a few years ago it took the Hubble Ultra Deep Field image in visible and infrared light. The composite image of ultraviolet over the older image shows that a few of the galaxies are far larger, with more detail, in ultraviolet. This is caused by massive formation of hot young stars, which emit ultraviolet copiously. About 10,000 galaxies are visible, extending back in time to within a few hundred million years of the Big Bang.



ALMA (radiotelescope array) was used to detect molecular gas and dust in the host galaxies where 2 previous gamma-ray bursts (GRBs) had occurred. It is believed that long GRBs (over 2 seconds long) occur when very massive stars collapse at the end of their short lives, so should theoretically happen in regions of gas clouds that have (astronomically) recently formed new stars. For over 10 years astronomers have been looking for gas clouds at the sites of GRBs, but until now have not detected them. The search has been difficult because GRBs tend to happen at huge distances from us, so the evidence would be dim. Surprisingly, the gas clouds found were in other parts of the host galaxies, not at the site of the GRBs. However, much dust was found at the GRB sites. The astronomers speculated that there was much gas and dust present when many massive stars formed, but the ultraviolet light that massive young stars emit profusely would break up the gas molecules, but would have little effect on dust. Further observations of GRB sites are planned.

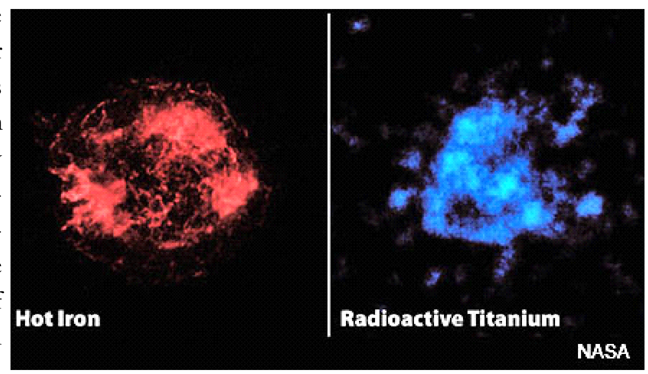
Active galactic nuclei (AGNs) generate their extreme brightness by swallowing material around them into the central black hole. It has long been debated whether 1) AGNs collapse surround gas clouds into forming new stars, or 2) disturb gas clouds to prevent forming stars. A new study of the AGN in galaxy Mrk 231 shows the AGN's winds pushing away nearby star-forming gas. This tends to support the 2nd theory. Yet a few other studies have seen evidence of theory 1. More work needs to be done.

Hidden black holes – The generally accepted theory explaining why some supermassive black holes are seen in visible light while others are difficult or impossible, is that a doughnut-shaped structure of material forms about the hole, and the visibility is a result of the tilt of that doughnut. A new study of more than 170,000 such black holes using the WISE infrared space telescope does not corroborate this theory. The researchers found that something other than the doughnut tilt is hiding some black holes in visible light. In the new study, computers located in WISE infrared images galactic nuclei that were feeding, or "active". They then measured the clustering of the galaxies containing these. They expected exposed ones and hidden (in visible light) to statistically have the same degree of clustering, but they did not; hidden black holes are more densely clustered than exposed ones. More theoretical work is needed to explain this. One possible explanation is that more highly clumped galaxies result in more galaxy collisions, which dump more obscuring material around black holes.

MAD jets – Astronomers still do not know exactly how jets form near black holes (and some other objects). The latest theory is known as magnetically arrested disk (MAD). A landmark theoretical study showed that a highly magnetized disk encircling a spinning black hole could power the jets. Hot ionized gas spiraling into a black hole can easily grow a magnetic field, which creates giant magnetic loops. As the black hole feeds on gas, it slurps in the loops too. In theoretical simulations, gas flows in, carrying with it more and more magnetic loops. Soon the pressure exerted by the magnetic field blocks more gas from flowing in. At this point the trapped gas gets launched outward, which becomes the jets. Observations have now been made to support this theory. We don't have the resolution to see the MAD effects directly, but we can test the MAD prediction of how the magnetic energy flowing through the jet should relate to the luminosity of the accretion disk. The jet magnetic energy and luminosity of the accretion disk were measure for a sample of 76 galaxies, each featuring a supermassive black hole and a radio-emitting jet, and the predicted relation matched the observations. There are reasons to believe that this relation might hold even without the MAD theory, so more work is needed before concluding MAD is confirmed.

Blazars – Astronomers studying 2 classes of blazars have found evidence that they represent different stages in the same objects. Blazars are the highest-energy form of AGN (feeding supermassive black holes), emitting light across the spectrum, from radio to gamma rays. Astronomers think blazars appear so intense because they happen to point our way, lining a jet nearly into our line of sight. The 2 types of blazars are: 1) the flat-spectrum radio quasar (FSRQ), showing strong emission from an active accretion disk, much higher luminosities, smaller black hole masses, and lower particle acceleration in the jets, and 2) BL Lac, named after the variable star BL Lacertae, which turned out to the a quasar, not a star; they are dominated by jet emission, with the jet particles reaching much higher energy and the accretion disk emission either weak or absent. The new study was to find out how the mix of these 2 types of blazar changed over cosmic history. To do this, one needs to know the distances to the objects, so as to know when the light left there, and therefore how far back in time one is looking. Not much data was available, so the team undertook an extensive program of visible light spectral observations of about 200 BL Lac objects that had been detected by the Fermi gamma-ray space telescope. The redshift in the spectra gave distances. The result is that starting around 5.6 billion years ago, FSRQs began to decline while BL Lacs increased in numbers. The rise is particularly noticeable among BL Lacs with the most extreme energies. Their conclusion is that this changeover represents blazars change from one style of extracting energy from the black hole to another. At first material falling into the black hole heats to extreme temperatures and emits light (and spins up the black hole), and the later stage uses the spin energy to accelerate particles in the jets to emit light. In effect, energy from material falling in during the early history is stored as increased spin and mass of the black hole, which is released to the jets later. A prediction made by this theory is the BL Lac objects should fade in luminosity as they lose spin energy. The team will test this idea next.

Possible quark star – Some theoreticians believe that if a neutron star is further condensed, it will form a quark star, an intermediate step before further forces could transform it to a black hole. Others believe quarks cannot exist like this. Duplicating this quark state is far beyond our technology, so this can't be tested unless we find a quark star. If quark stars exist, a new theoretical study says that they should form in a 2nd explosion days after the one that produces the neutron star. Large amounts of energy should be released, which should tear off the crust of the neutron star, creating ejecta consisting of heavy elements of that crust in addition to neutrons. The expanding gases of the supernova explosion would likely hide the 2nd detonation. But it should leave behind evidence in the form of where certain heavy elements are thrown. The new study suggests that such patterns of titanium and iron match the strangely different patterns of titanium and iron recently mapped from observations in X-rays of the supernova remnant Cas A. More work needs to be done, particularly in ruling out other explanations of the titanium pattern, before Cas A can be considered a quark star.



Chandra (X-ray space telescope) has shed new light on why giant elliptical galaxies have few, if any, young stars. This new evidence highlights the role that supermassive black holes play in the evolution of their host galaxies. Because star-forming activity in many giant elliptical galaxies has shut down to very low levels, these galaxies mostly house long-lived stars with low masses and red colors. Astronomers have therefore called these galaxies "red and dead". Previously scientists thought that these galaxies do not contain enough cold gas, the fuel for star formation. However, astronomers using the Herschel infrared space telescope find surprisingly large amounts of cold gas in some giant elliptical galaxies. In a sample of 8 galaxies, 6 contain large amounts of cold gas. To try to understand why this gas was not forming stars, astronomers studied the galaxies at other wavelengths, including X-rays and radio waves. The Chandra observations map the temperature and density of hot gas. For the 6 galaxies containing abundant cold gas, X-ray data provide evidence that the hot gas is cooling, providing a source for the cold gas seen by Herschel. A strong clue why this gas is not forming stars comes from the Chandra images. The hot gas in the center of the 6 galaxies appears to be much more disturbed than in the systems free of cold gas. This is a sign that material has been ejected from regions close to the central black hole. These outbursts are possibly caused in part by cold gas that has been pulled into the black hole. The other 2 galaxies in the sample are also forming few is any stars, but that is apparently because they have no cold gas. The hot gas in their centers is much smoother, apparently undisturbed by outbursts from the central black hole. In addition, the 2 have powerful jets of highly energetic particles, as shown in radio images. The jets created enormous cavities that are observed in the Chandra images, and the jets may heat gas, preventing it from cooling and forming the cold gas that is needed to form stars.

Magnetars are the bizarre extremely magnetic type of neutron stars left behind by some supernova explosions. Their magnetic fields are millions of times more powerful than the strongest magnets on Earth. A team of astronomers using the Very Large Telescope (VLT) in Chile believe that they have found for the 1st time a partner star of a magnetar. The leading theory of how magnetars form requires a partner star. The Westerlund 1 star cluster, located 16,000 light-years away in Ara, hosts 1 of the 2 dozen known magnetars in the Milky Way. Earlier work showed that the star that collapsed into the magnetar must have been about 40 times as massive as the Sun. But stars that massive should theoretically collapse into black holes at the end of their lives, not neutron stars. To solve this, astronomers had proposed that the magnetar formed from the interactions of 2 very massive stars orbiting each other very closely, but until now no companion star had been found. A runaway star was found that might have been kicked out of orbit by the supernova explosion. The star, known as Westerlund 1-5, has the velocity expected of a star recoiling from a supernova, and the low mass, high luminosity and carbon-rich composition that is found only in a star that interacted with a close companion star. The birth of the magnetar was then explained by: the more massive star of a pair begins to run out of fuel, transfers its outer layers to its less massive companion, causing it to rotate more and more quickly; the less massive star is now massive enough or perhaps spinning fast enough, to shed its outer layers; some of this lands back on the more massive companion; when the less massive star reaches the end of its life, it has lost too much mass to collapse to a black hole, and instead forms a neutron star; the rapid spin creates the intense magnetic field that makes it a magnetar. This mass exchange explains the unusual composition of Westerlund 1-5 also.

Supernova progenitor – New results from the Palomar Transient Factory team have identified a Wolf-Rayet (W-R) star as the likely progenitor of a recently exploded supernova. W-R stars are very large and hot, and theoretically should produce certain types of supernovas (IIb, Ib, or Ic). W-R stars are noted for having strong stellar winds and lacking hydrogen. Flash spectroscopy was used immediately after a type IIb supernova was discovered. This revealed the chemistry of the material blown off the star, and it seems to match that of a W-R star. It is expected that the evidence of the progenitor star's chemistry is wiped out by about a day after the supernova, so the spectroscopy had to be done immediately.

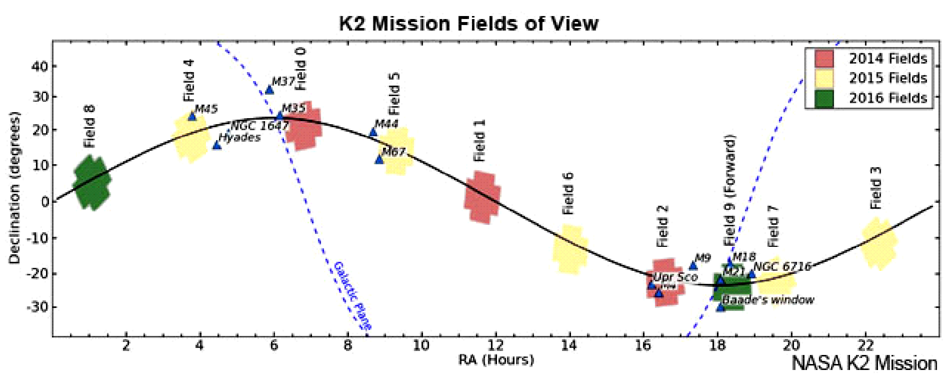
Spitzer (infrared space telescope) has imaged a supernova remnant, dubbed N103B, that exploded about 1000 years ago (time as seen on Earth, if anyone was looking) in the Large Magellanic Cloud, a satellite galaxy 160,000 light-years away. A spectrum shows that it was a Type Ia supernova. A number of recent previous studies of Type Ia supernovas have shown that they resulted from the collision of 2 white dwarf stars. However this new observation shows a surrounding cloud of gas that was likely thrown off by an old companion star, not a white dwarf. Previous studies of the Kepler supernova (the one seen by Johannes Kepler in 1604) remnant indicated it was caused by material thrown off by a red giant star onto a white dwarf, rather than by the collision of 2 white dwarfs. It's looking more and more like there are 2 causes of Type Ia supernovas, with white dwarf collision being the more common.

Star formation – Astronomers have found cosmic clumps so dark, dense and dusty that they throw the deepest shadows ever recorded. These were seen in infrared observations by the Spitzer Space Telescope. The clumps represent the darkest portions of a huge cosmic cloud of gas and dust located about 16,000 light-years away. A new study uses the shadows of these clumps to measure the cloud's structure and mass. A map was made of the structure of the cloud and it has helped pin down the cloud's mass at about 70,000 times the Sun's mass. It is packed in a region about 50 light-years across. Pockets of star-forming material within the cloud are so thick that they block not only visible light, but also almost all infrared light. These blobs will eventually collapse gravitationally to make hundreds of thousands of new stars. Clusters of low-mass stars are quite common and well-studied. But clusters giving birth to higher-mass stars, like this newly studied cluster, are scarce and usually distant. Astronomers are not sure exactly how a few stars accumulate masses of 10 to 100 times the Sun's mass without dissipating or breaking down into smaller stars. So it is important to study star-forming regions such as this.

More star formation – A team of astronomers is studying a cloud of gas and dust 18,000 light-years away that is displaying every stage of star formation. The process takes too long (millions of years) for astronomers to observe it, so the idea is to take snapshots of all stages and put them in the right order. It eliminates a lot of other variables affecting star formation when all the snapshots share the same distance, position in the galaxy, and some other properties. The new observations were made with the Very Large Array of radiotelescopes in New Mexico. 2 areas in the same cloud were found, 1 of which was full of protostars, and the other is quiescent, in order to compare the differences that apparently make star formation possible. They found that necessary ingredients to form very massive stars are: 1) clumpy filaments, and 2) turbulence.

Thorne-Zytkow star – What happens when a red supergiant star and a neutron star collide? You'd probably guess that they either collapse to a black hole or explode, but in 1975, Kip Thorne and Anna Zytkow predicted that nothing happens, except the neutron star spirals down to the center and the spectrum changes a little. Since then astronomers have been looking for a Thorne-Zytkow object (TZO), and it looks like they finally found one. The team used telescopes in New Mexico and Chile to take spectra of 24 red supergiants in the Milky Way, 16 in the Large Magellanic Cloud, and 22 in the Small Magellanic Cloud (SMC). One star, designated HV 2112, in the SMC showed excess rubidium, lithium and molybdenum just as predicted for a TZO. There are some minor inconsistencies in other elements from the predictions, so further work will have to be done to confirm this really is a TZO.

High-velocity hydrogen cloud hurtling toward the Milky Way appears to be encased in a shell of dark matter, according to a new analysis of data from the Byrd Green Bank radiotelescope. Astronomers believe that without this protective shell, the cloud, known as the Smith Cloud, would have disintegrated long ago when it 1st collided with the disk of our galaxy. If confirmed by further observations, a halo of dark matter could mean that the Smith Cloud is actually a failed dwarf galaxy. Previous studies of the Smith Cloud revealed that it 1st pass through our galaxy many millions of years ago. The Milky Way is swarming with hundreds of high-velocity clouds, which are made up primarily of hydrogen gas that is too rarefied to form stars in any detectable amount. The only way to observe these objects is with radiotelescopes which can detect neutral hydrogen. The Smith Cloud is about 8000 light-years away from the disk of our galaxy. It is moving toward the Milky Way at more than 150 miles (240 km) per second and is predicted to impact again in about 30 million years.

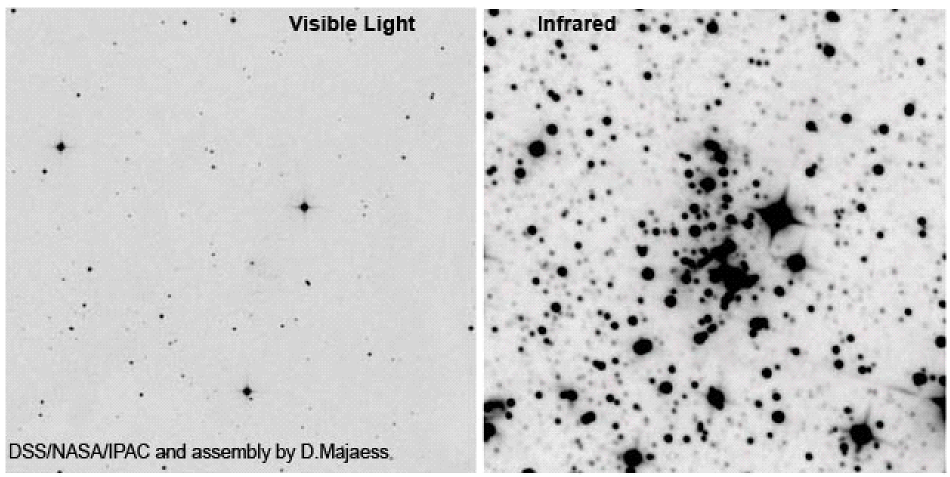


Kepler (planet-finding space telescope) is back in operation. As reported here last month, engineers found a way to stabilize the extreme pointing accuracy needed for observation even with 2 of the 4 reaction wheels broken. They have tested the method, using solar pressure in place of a needed 3rd wheel, and it works, and observations have resumed. The new mission is dubbed K2, while the original mission is now called Kepler Prime. The primary difference in K2 is that the orientation of the telescope cannot be kept on one spot for years, but must be pointed near the ecliptic plane, and moved every few months during its orbit about the Sun. The fields of view for the next 2 years have been chosen and they include very populous star fields in the Milky Way and star clusters such as the Pleiades and Hyades. K2 will not only search for planets, but study other types of astronomical objects, including AGNs. The Kepler team is inviting the general astronomical community to suggest targets to observe within the announced fields of view. The telescope must be given a list of objects to observe, even though it stares at its entire field of view, which is more than 10 degrees across, since it produces too much data to radio it all to Earth, and it discards everything not on its observing list. K2 will work about as well as Kepler Prime in finding planets orbiting red dwarf stars, since they typically orbit faster than the roughly 80-day stare time that K2 can accomplish. Some additional noise and some drift problems will degrade K2 slightly from Kepler Prime, but much of that can be compensated in data processing. If after 2 years K2 is going well and thruster fuel remains, the mission could be extended.

ISEE-3 – A team of volunteer engineers got permission from NASA to wake up and operate the ISEE-3 spacecraft, 15 years after NASA shut it down, after completing 3 missions. The current timing was chosen because every 30-something years (and this is the year), ISEE-3's orbit takes it near Earth, where it could be easily captured into a nearby orbit, if its engines still work. The volunteers raised money through online crowd sourcing, arranged for the use of 2 radio dishes, found the specifications of the spacecraft, got a suitable radio transmitter donated, and scavenged the equipment to control the spacecraft. ISEE-3 was awakened with a blast from the borrowed Arecibo radiotelescope, and as I write this the instruments on ISEE-3 are being checked out. NASA has allocated some time on their Deep Space Network to precision track ISEE-3, in order for the volunteers to calculate the engine burn necessary to capture it. Engine burn is scheduled for a few days around July 1. The spacecraft's 1st mission, starting in 1978, was to study the solar wind from the L1 gravitationally stable point about 1 million miles sunward of Earth. When funds fell through for a NASA mission to Comet Halley, ISEE-3 was diverted to an orbit that flew by Comet Giacobini-Zinner in 1985 (the 1st ever mission to a comet) and Comet Halley in 1986. The spacecraft carries no cameras, but has a good complement of instruments to measure charged particles, electromagnetic fields, etc. The volunteers intend to park ISEE-3 near Earth and continue its monitoring of the solar wind.

Instant AstroSpace Updates

A new study has discovered over 300 **new star clusters** in our Milky Way galaxy, which were largely overlooked previously because they were obscured by dust. The observations were made by the WISE infrared space telescope, since infrared penetrates most dust.



Mars rover Curiosity took images of Mercury passing in front of (transiting) the Sun June 3, the 1st solar transit of a planet ever seen from another planet. It is also the 1st time Mercury has been seen from Mars.

Measurements of radio emission from jets near supermassive black holes have allowed calculating of the magnetic field strength there, and it was found that **magnetic forces** there can be as strong as the gravitational force of the black hole.

The Long Wavelength Array (LWA), a low frequency radiotelescope, has detected a class of radio pulse that was found to occur when **fireball meteors** passed nearby. Meteors were thought to produce only higher frequency radio, typically above 100 MHz.

NASA has begun testing a new high-resolution mid-infrared spectrograph mounted on **SOFIA**, the world's largest flying telescope. SOFIA is a 2.5 meter (100-inch) telescope that flies on a modified 747 above 99% of the water vapor that absorbs infrared light.

RTMC versus the Starlight Festival

by Donald S. Lynn

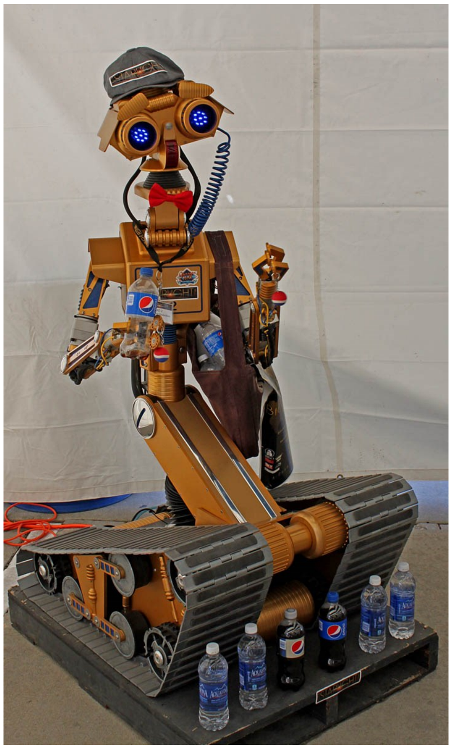
After about 40 years of the Riverside Telescope Makers Conference, later called RTMC Astronomy Expo, a bunch of the astronomy vendors apparently got tired getting their equipment (and personnel) dusty while set up in a field, and they decided this year to have their own astronomy festival in town, that is, Big Bear Lake village, about 10 miles from the RTMC location. It was scheduled for the Saturday and Sunday of RTMC, which ran from Thursday to Monday (Memorial Day) morning. It seemed like this Starlight Festival might steal the participants away from RTMC, but the websites for both events seemed at peace with each other. To quote one of them, “These two events serve different audiences” and “Come join the fun and learn about the universe your way.” So the Starlight Festival, billed as the First Annual, set up in the paved lot in front of the Northwoods Resort, in tents providing protection from the sun and wind, with no dust in sight. Talks and a few exhibits were located inside the Resort, in conference rooms. Admission was free (RTMC charges for admission).

My opinion, which was shared by a few others who attended both RTMC and Starlight, was that Starlight was aimed at kids and rank beginners, so likely did not take away much, if any, of RTMC's audience. Popular booths at Starlight were ones making compressed air rockets, building planets (from balls and glitter), taking your picture with an alien (looked right out of Roswell), a bounce house (astronomical relevance not clear), robots (from NASA), and solar viewing. There were telescopes set up for viewing after dark, but I did not stay through sunset (I returned to RTMC), so missed that viewing. I was impressed by a view of Jupiter during the daytime. There was a very short line, so I am not sure the rest of the crowd was impressed with seeing an ordinarily night-time object in the daytime.

There were a number of talks at Starlight, including Astronomy Without Borders, search for extraterrestrial life (Seth Shostak), astronaut Story Musgrave, comets (David Levy), and Bubbleology (astronomical relevance again unclear). RTMC talks included Comet ISON (Charles Morris), Cassini at Saturn (Linda Spilker), Kepler spacecraft discoveries (Steve Howell, keynote), and the 70-inch “portable” telescope (Mike Clements). By the way, the anticipated display at RTMC of the 70-inch did not happen; the telescope is operational, but the trailer to haul it is not yet.

Both Starlight and RTMC had tributes, provided by the Sidewalk Astronomers, to John Dobson, who died this past year. On display were many awards given to Dobson over the years, including one from the City of Los Angeles, misspelling him as “Dodson”. So do I have to call my telescope a “Dodsonian” when I use it in Los Angeles?

RTMC had a booth at Starlight, encouraging those unfamiliar with RTMC to go visit it. I don't think they had very many takers, but that was just my impression. It took me just over a half hour each way to drive between, so that distance and heavy traffic may have discouraged many. The original plan was to have a shuttle bus traveling between RTMC and Starlight, but negotiations with bus companies fell through.



Three of the major telescope vendors had booths at both RTMC and Starlight: OPT (Oceanside Photo and Telescope), Woodland Hills Telescope, and Explore. The other major vendors, such as Televue, Celestron, Lumicon, Planewave, and Lunt set up only at Starlight. I did not see Meade either place. A number of minor vendors, including several rock and meteorite sellers, stuck with RTMC. OCA's Wally Pacholka had a booth selling his spectacular images of the night sky in beautiful settings, such as Hawaii and national parks. His son ran the booth, since Wally was off taking more pictures.

It is possible that vendors may rethink things for next year, since sales at Starlight seemed to be just inexpensive stuff, with little interest being shown in the high-end telescopes. No one seemed to be looking at even eyepieces at Starlight. Some interest was shown in binoculars. RTMC attendees have in the past shown strong interest in high-end telescopes.

I heard second-hand, did not verify, that the Starlight attendance was over 3000, more on Saturday than Sunday. It appeared to me to be mostly people shopping at Big Bear Village who stumbled on the Festival. The RTMC attendance was announced, and I think I heard it as 515. It was claimed as somewhat larger than last year. My observation was that there were more people camping than last year (and more spread out over the grounds), but fewer one-day-only visitors (the one-day parking was not as full). The swap meet had the same stuff as every year; in fact, much of it was the SAME stuff as last year, not just the same KIND of stuff. There were 12 entries in the telescope making competition this year, as opposed to 5 last year. There were also more entries in the astro-image competition than last year. So I think RTMC is slowly recovering.

Even with the smaller attendance at RTMC the last few years (it was more like 2000 a decade ago), I found it a good place to share astronomy with other enthusiasts, and a lot of fun. It could have been even more enjoyable if more of my long-time OCA friends still attended.

Long-time OCA member Gerry Logan collected another RTMC Telescope Merit Award for a coma-free schmidt-cassegrain on a Springfield mount, which he built from scratch. I viewed M13 through it and was impressed by the sharp image to the edge of the field, where coma would normally intrude.

Starlight had arranged for tours of the Big Bear Solar Observatory every few hours. All openings were signed up for by early Saturday morning, so either that was very popular, or the group size was very small. Though I had toured the solar observatory before, I would have liked to see it again, since they have installed a new solar telescope since I was last there. The new one is 1.6 meters in aperture, and has adaptive optics. It appears to be producing the finest resolution solar images ever.

A local boat cruise company offered discounts on their starlight dinner cruises on Big Bear Lake. A few other local businesses had tie-in activities with Starlight.

Further information on Starlight is found at starlightfestival.com and on RTMC at www.rtmcastronomyexpo.org.

So it will be interesting to see the Second Annual Starlight Festival. Will the sponsors change things to better fit the audience? Will any of the major vendors return to RTMC? I intend to go see. And it will be interesting to see if the upward trend in attendance at RTMC continues next year, or will the lack of vendors this year affect the attendance?

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President	Greg Schedcik	gregsched@verizon.net	714-322-5202
Vice-President	Reza AmirArjomand	reza@ocastronomers.org	646-494-9570
Treasurer	Charlie Oostdyk	charlie@cccd.edu	714-751-5381
Secretary	Bob Buchheim	Bob@RKBuchheim.org	949-459-7622
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Trustee	Gary Schones	gary378@pacbell.net	951-687-7905
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Trustee	Alan Smallbone	asmallbone@earthlink.net	818-237-6293
Trustee	Amir Soheili	amirsoheili@yahoo.com	714-276-7766
Trustee	Barbara Toy	btoy@cox.net	714-606-1825
COMMITTEES, SUBGROUPS, AND OTHER CLUB VOLUNTEERS			
Anza House Coordinator	Doug Acrea	dougcarola@att.net	949-770-2373
Anza Site Maintenance	Don Lynn	donald.lynn@alumni.usc.edu	714-775-7238
Beginner's Astronomy Class	David Pearson	p.davidw@yahoo.com	949-492-5342
Black Star Canyon Star Parties	Steve Short	nightskytours@hotmail.com	714-771-2624
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Librarian	Karen Schnabel	karen@schnabel.net	949-887-9517
Membership, Pad Coordinator	Charlie Oostdyk	charlie@cccd.edu	714-751-5381
Observatory Custodian/ Trainer/Member Liaison	Barbara Toy	btoy@cox.net	714-606-1825
OCA Outreach Coordinator	Jim Benet	jimbenet@pacbell.net	714-693-1639
Sirius Astronomer Editor	Steve Condrey	startraveler68@yahoo.com	714-699-1243
Telescope Loaner Program	Don Stoutenger	dstouten@yahoo.com	714-271-2646
WAA Representative	Tim Hogle	TimHogle@aol.com	626-357-7770
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