# SIRIUS ASTRONOMER

www.ocastronomers.org — The Newsletter of the Orange County Astronomers

**October 2015** *Free to members, subscriptions $12 for 12 issues* **Volume 42, Number 10**



An aerial shot of our recent Starbecue at the Anza observing site, courtesy of Alan Smallbone. If you haven't been out to Anza lately, now is a good time—not too hot, not too cold, and the winter stars are just starting to make their appearance!

### OCA MEETING

The free and open club meeting will be held October 9 at 7:30 PM in the Irvine Lecture Hall of the Hashinger Science Center at Chapman University in Orange. Our speaker this month is Dr. Douglas Leonard of San Diego State University, who will present 'Watching Stars Die: The Hunt for Supernova Progenitors'

NEXT MEETINGS: November 13, December 11

### STAR PARTIES

The Black Star Canyon site will open on November 7. The Anza site will be open on October 10. 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 October 2. The following class will be held November 6.

GOTO SIG: TBA
Astro-Imagers SIG: Oct. 13, Nov. 20
Remote Telescopes: TBA
Astrophysics SIG: Oct. 16, Nov. 10
Dark Sky Group: TBA

## Measure the moon's size and distance during the next lunar eclipse

By Ethan Siegel

The moon represents perhaps the first great paradox of the night sky in all of human history. While its angular size is easy to measure with the unaided eye from any location on Earth, ranging from 29.38 arc-minutes (0.4897°) to 33.53 arc-minutes (0.5588°) as it orbits our world in an ellipse, that doesn't tell us its physical size. From its angular size alone, the moon could just as easily be close and small as it could be distant and enormous.

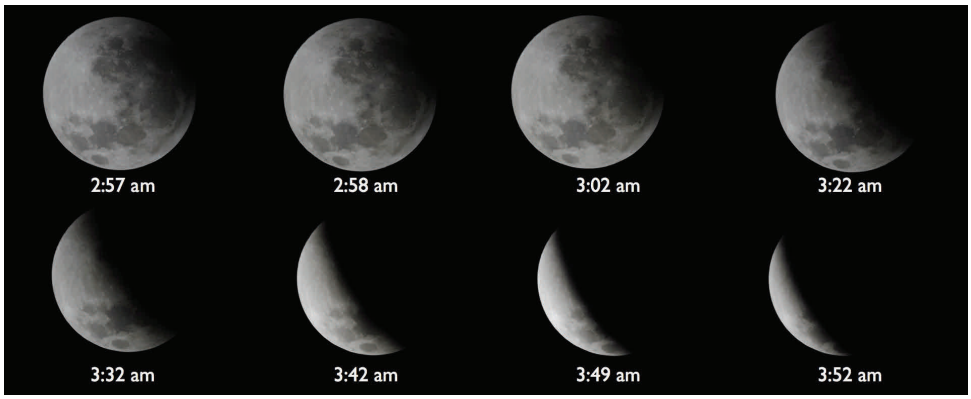



Image credit: Daniel Munizaga (NOAO South/CTIO EPO), using the Cerro Tololo Inter-American Observatory, of an eight-image sequence of the partial phase of a total lunar eclipse.

But we know a few other things, even relying only on naked-eye observations. We know its phases are caused by its geometric configuration with the sun and Earth. We know that the sun must be farther away (and hence, larger) than the moon from the phenomenon of solar eclipses, where the moon passes in front of the sun, blocking its disk as seen from Earth. And we know it undergoes lunar eclipses, where the sun's light is blocked from the moon by Earth.

Lunar eclipses provided the first evidence that Earth was round; the shape of the portion of the shadow that falls on the moon during its partial phase is an arc of a circle. In fact, once we measured the radius of Earth (first accomplished in the 3rd century B.C.E.), now known to be 6,371 km, all it takes is one assumption—that the physical size of Earth's shadow as it falls on the moon is approximately the physical size of Earth—and we can use lunar eclipses to measure both the size of and the distance to the moon!

Simply by knowing Earth's physical size and measuring the ratios of the angular size of its shadow and the angular size of the moon, we can determine the moon's physical size relative to Earth. During a lunar eclipse, Earth's shadow is about 3.5 times larger than the moon, with some slight variations dependent on the moon's point in its orbit. Simply divide Earth's radius by your measurement to figure out the moon's radius!

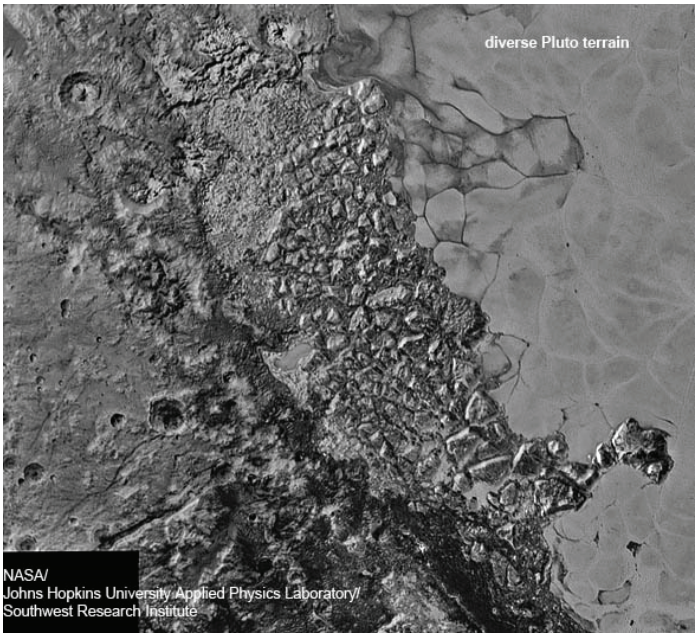
Even with this primitive method, it's straightforward to get a measurement for the moon's radius that's accurate to within 15% of the actual value: 1,738 km. Now that you've determined its physical size and its angular size, geometry alone enables you to determine how far away it is from Earth. A lunar eclipse is coming up on September 28th, and this supermoon eclipse will last for hours. Use the partial phases to measure the size of and distance to the moon, and see how close you can get! *(EDITOR'S NOTE: this article was submitted after the cutoff for the September issue, but the principles are still applicable to any lunar eclipse—Eratosthenes, who first measured the radius and circumference of the Earth as noted above, was the first to apply the method outlined here.)*

# AstroSpace Update

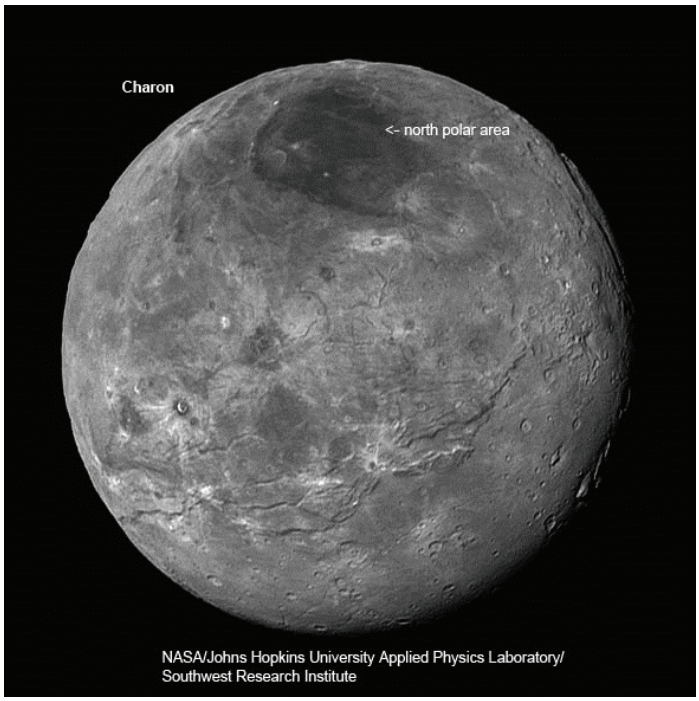
October 2015

Gathered by Don Lynn from NASA and other sources

**New Horizons** (Pluto mission) – Hundreds of tons of nitrogen have been detected escaping every hour from Pluto's thin atmosphere, yet the atmosphere remains there and almost entirely nitrogen. So scientists are looking for sources of nitrogen to replenish what is lost. There are not enough incoming comets to either leave their nitrogen on Pluto or excavate nitrogen from below Pluto's surface upon impact. So they are looking at how nitrogen could be released from within Pluto, such as geysers or ice volcanoes. So far neither has been found in the New Horizons data, but the search continues as that data is radioed to Earth over the next year or so.

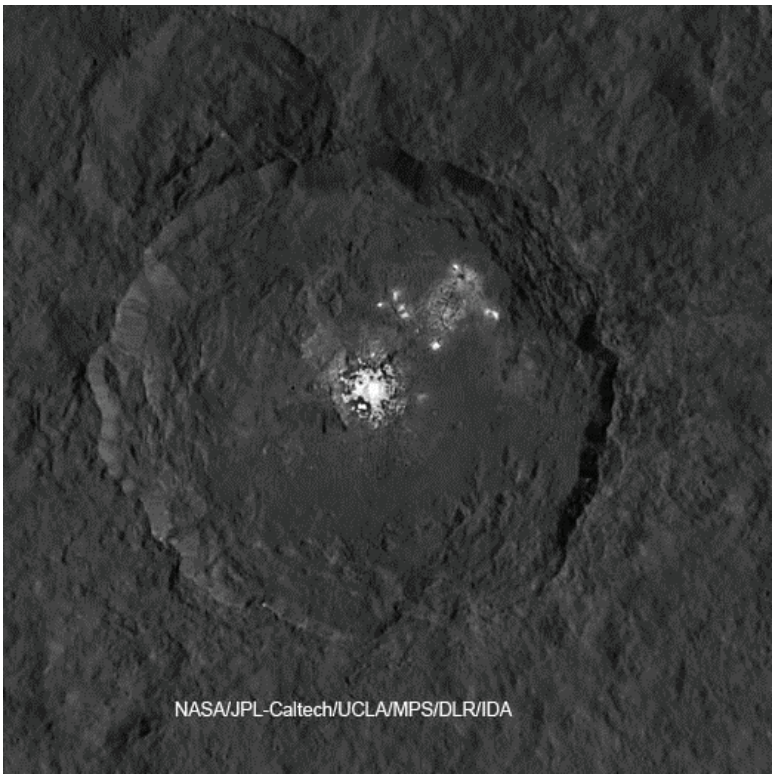



**New Horizons** images downlinked recently reveal new features of Pluto as diverse as nitrogen ice flows that apparently oozed out of mountainous regions onto plains, networks of valleys that may have been carved by material flowing, and parallel features that may be sand dunes. This would be a surprise because the atmosphere is too thin for winds that would create dunes. Either some other process is creating the dune-like features, or the atmosphere was thicker in the past. The new images show the most heavily cratered, and thus oldest, terrain yet seen, next to the youngest most crater-free icy plains. Images of the Pluto atmospheric haze reveal it has many more layers than previously realize, and that the haze actually creates a twilight effect that softly illuminates nightside terrain near sunset, making that terrain thought to be hidden by night faintly visible in images. Streak seen in the haze may be crepuscular rays (shadows cast on the haze by topography), similar to those seen on Earth. Images of Charon show it had a tortured geological past. Scientists are still working on why Charon's north polar region is darker and redder than the rest of the moon. The dark region appears to be a thin deposit. The leading theory is that material from Pluto's atmosphere is falling on Charon and is frozen by the cold near the pole. The material may be transformed into different chemistry by radiation, which would allow it to remain even through daytime or seasonal warming. The material may be a tholin, created by solar radiation reacting with Pluto's atmosphere.




NASA and the **New Horizons** science team have chosen the spacecraft's next flyby: 2014 $MU_{69}$, an icy body a billion miles past Pluto. It is estimated to be less than 30 miles (48 miles) in diameter. That's roughly 500 times smaller than Pluto, but it's the best object known in the direction the spacecraft is already heading. A somewhat larger object is known, dubbed 2014 $PN_{70}$, but it would take substantially more fuel to reach it. The New Horizons team has planned a series of maneuvers in October and November to direct the spacecraft toward the new target. NASA still has to approve funding for extending the mission until the arrival, planned for New Years Day, 2019.

**Cassini** (Saturn mission) – New research using Cassini data shows that the moon Enceladus has a global ocean lying beneath its icy crust. Scientists analyzed more than 7 years' worth of images of the moon, and carefully mapped the positions of features on Enceladus (mostly craters) across hundreds of images, in order to measure changes in the moon's rotation with extreme precision. The result is that Enceladus has a tiny, but measurable wobble as it orbits. Computer simulations show that if the moon were solidly frozen from surface to core, the wobble would be measurably larger. But the amount of wobble measured matches that predicted by computer simulations of Enceladus with a global ocean, so that the core can move with respect to the surface. The finding implies the fine spray of water vapor, icy particles and simple organic molecules Cassini has observed coming from fractures near the moon's south pole is being fed by this vast liquid water reservoir. Previous analysis of Cassini data other than the rotation measurements suggested the presence of a body of water only under the active geyser area, and later analysis showed the possibility of a global ocean, but did not until now clinch this possibility.



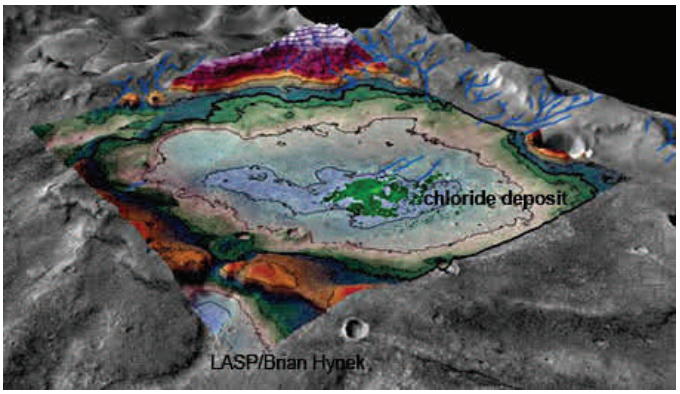

**Dawn** (asteroid mission) is continuing the study the bright spots seen on Ceres as the spacecraft moves into lower orbits for higher resolution observations. At first it was thought that the spots were so reflective that they could only be ice. But ice would sublime fairly quickly, so should not remain on the surface. Higher resolution observations show that the reflectivity of the spots is lower than originally thought, and could easily be salt deposits, not ice. One possibility is that ice or even liquid water has oozed up to the surface, then sublimed or evaporated, leaving dissolved salt. The Dawn camera with filters, the infrared spectrometer and the visible spectrometer will observe the spots to determine if they are salt or something else.

**Saturn's rings** turned edge-on to the Sun in 2009, and Cassini (Saturn mission) scientists were watching closely. The event provided an opportunity for the spacecraft to observe short-lived changes in the rings that reveal details about their nature. During equinox, which lasted only a few days, the rings began to cool. Data collected by Cassini's infrared spectrometer essentially took the rings' temperature. The scientists then compared the temperature data with computer models of the ring particles. For most of the expanse of the rings, the models correctly predicted how the rings cooled. But one large section, the outermost of the large main A-ring, was much warmer than predicted. To address this, the scientists performed a detailed investigation of how ring particles with different structures would warm up and cool down. Previous studies have shown Saturn's icy ring particles are fluffy on the outside, like fresh snow. This outer material is created over time as tiny impacts pulverize the surface of each particle. The team's analysis suggested the best explanation for the A ring's temperatures was for the ring to be composed largely of particles roughly 3 feet (1 m) wide made of mostly solid ice, with only a thin coating of fluff. A concentration of one kind of ring particles was unexpected, since ring particles spread out evenly within about 100 million years. This implies either the dense area in the A ring was created more recently, or something is confining the dense particles to this area. During the final series of close orbits to Saturn, Cassini will directly measure the mass of the main rings for the 1st time, using gravity science. This may help solve this mystery.

**Gas giant formation** – Researchers using new computer simulations of planet formation believe they have unraveled the mystery of how Jupiter and Saturn formed. The largest planets in the Solar System likely formed first. Jupiter and Saturn, which are mostly hydrogen and helium, presumable accumulated their gases before the solar nebula dispersed. Observations of young star systems show that the gas disks that form planets usually have lifetimes on only 1-10 million years, which means the gas giant planets in our Solar System probably formed within this time frame. In contrast, Earth probably took at least 30 million years to form and may have taken as long as 100 million years. So the mystery has been how the giant planets formed so fast. The most widely accepted theory for gas giant formation is the so-called core accretion model. In this, a planet-sized core of ice and rock forms first. Then an inflow of gas and dust attaches itself to the growing planet. However, this model has problems accumulating in only a few million years a core massive

enough (roughly 10 times Earth's mass) to pull in the gas. In the standard model of planet formation, rocky cores grow as similarly sized objects collide and accrete. However, this model is unable to produce planetary cores large enough fast enough to explain Jupiter and Saturn. The new calculations show that the cores of the gas giants could form in the right time frame if they grew by gradually accumulating a population of icy objects about a foot in diameter, termed planetary pebbles. Assisted by drag from gas, the planetary pebbles can spiral onto a protoplanet and assimilate. This works as long as the pebbles formed slowly enough that the growing planets have time to gravitationally interact. If the pebbles form too fast, then you get hundreds of tiny planets instead of one large core.

**Martian salt** – More than 600 areas of salt deposit are known on the surface of Mars, including an 18-square-mile one. A new analysis of this large one shows it most likely formed at the bottom of an ancient lakebed, about the time that Mars dried up billions of years ago. It may have been an impact crater that filled with water, then dried up, leaving dissolved salt as a deposit. The ages of the Martian salt deposits have been difficult to determine, since they are generally too small to perform crater counts on them, which is how most ages of planetary surfaces are determined. The new study on the large salt deposit used cross-cutting to determine age. That uses the fact that any feature cutting across another formed more recently. The best estimate from this study is that the lakebed is no more than 3.6 billion years old, about 100 million years newer than the time that Mars generally dried up. This implies that some lakes still existed, or temporarily existed, somewhat after the general drying. The new study determined that the amount of salt would have made the lake about 12 times less salty than Earth's oceans. Previous studies have shown that Martian salt deposits are mainly chlorides, such as sodium chloride and potassium chloride, the main salts found on Earth. The newly studied deposit has associated clay minerals that indicate the lake was not acidic. So this lakebed would have been a habitable place for simple life forms like bacteria, and would therefore be a good place to look for signs of ancient Martian life.

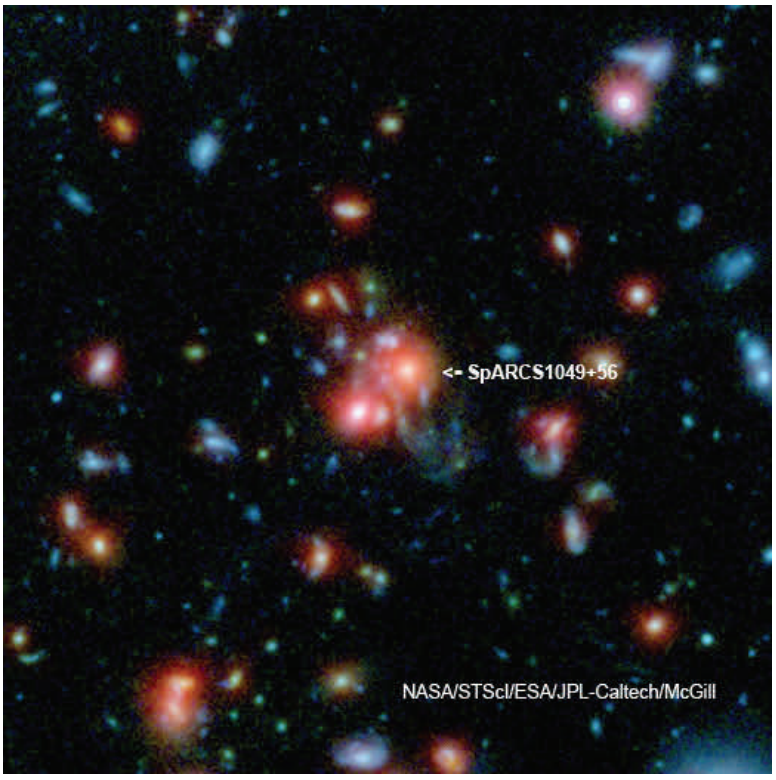



**Martian atmosphere** – A new analysis of the largest known deposit of carbonate minerals on Mars suggests that the original Martian atmosphere may have already lost most of its carbon dioxide by the era of valley network formation (the valleys were apparently formed by running water, which required a thicker atmosphere than now). The 2 main theories of how Mars lost its thicker carbon dioxide atmosphere are that 1) chemical reactions formed carbonate minerals, or 2) carbon dioxide escaped from the top of the atmosphere to space. This new study just about rules out the carbonate theory. Many scientists suspected this, since far less carbonate has been found on the surface of Mars than predicted by the carbonate theory. Using data from many spacecraft, the new study estimated how much carbon dioxide is locked up in minerals in a deposit in the Nili Fossae region and determined that at least 35 times as much carbonate would be required to lock up most of the atmosphere that must have existed at the time the river valleys formed. All the other known carbonate deposits combined fall far short of this amount. The MAVEN spacecraft currently orbiting Mars is studying atmospheric loss to space, so may substantiate that theory.

**Initial Mass Function** (IMF, not to be confused with the International Monetary Fund) is what percentage of stars form with each possible mass, from the smallest stars (1/12 the Sun's mass) to the largest (maybe 200 solar masses). It is difficult to measure because the very massive stars burn out quickly (millions of years) and because the smallest stars are so dim they can be seen only nearby. The IMF has been measured only for nearby stars within our Milky Way, until now. A new study using nearly 8000 Hubble Space Telescope images of our neighbor galaxy Andromeda has studied 2753 young star clusters and has come up with the IMF in the Andromeda galaxy. It was surprising that the new result was nearly the same as old results, and surprising in the way it differed. The IMF was the same regardless of cluster mass, location in the galaxy, or any other factors that you might think would affect what size of stars form. Curiously the most massive stars in Andromeda were 25% less common than in the locally determined IMF. This could affect estimates of distant galaxy mass and star formation rates, since they are based on the brightness of stars, particularly the most massive ones. This would also affect estimates of how fast galaxies in the early Universe created the heavier elements, which often are generated by very massive stars. The project used citizen scientists to classify star clusters in the Hubble images.

**Radio phoenix** – Astronomers have found evidence for a faded electron cloud coming back to life, much like the mythical phoenix, after 2 galaxy clusters collided. This radio phoenix radiates primarily at radio frequencies and is found in galaxy cluster Abell 1033. The system is located about 1.6 billion light-years away. Astronomers combined X-ray, radio and optical data. They think that the supermassive black hole close to the center of Abell 1033 erupted in the past. Streams of high-energy electrons filled a region hundreds of thousands of light-years across and produced a cloud of bright radio emission. This cloud faded over a period of millions of years as the electrons lost energy and the cloud expanded. The radio phoenix emerged when another cluster of galaxies slammed into the original cluster, sending shock waves through the system. These shock waves, similar to sonic booms, passed through the dormant cloud of electrons and compressed the cloud and re-energized the electrons, which caused the cloud to once again shine at radio frequencies. Astronomers think they are seeing the radio phoenix soon after it was reborn, since these sources fade very quickly when located close to the center of the cluster, as this one is. Because of the intense density, pressure, and magnetic fields near the center, a radio phoenix is expected to last only a few tens of millions of years.

**Binary black hole** – Astronomers using the Hubble Space Telescope have found that Markarian 231, the nearest galaxy to us that hosts a quasar, is powered by 2 central black holes furiously whirling about each other. The finding suggests that quasars, the brilliant cores of active galaxies, may commonly host 2 central supermassive black holes that fall into orbit about one another as a result of the merger between 2 galaxies. Hubble ultraviolet spectral observations infer the presence of 2 supermassive black holes. If only 1 black hole were present, the whole accretions disk made of surrounding hot gas would glow in ultraviolet. Instead, the ultraviolet glow of the disk abruptly drops off toward the center. This is evidence that the disk has a big doughnut hole encircling the central black hole. The best explanation for that, based on computer models, is that the center of the disk is carved out by 2 black holes orbiting each other. The smaller black hole orbits in the inner edge of the accretion disk and has its own mini-disk with an ultraviolet glow. The central black hole is estimated to be 150 million times the Sun's mass and the companion is 4 million. They orbit every 1.2 years. The smaller black hole is the remnant of a smaller galaxy that merged with Markarian 231. Evidence of a recent merger comes from the host galaxy's asymmetry and the long tidal tails of young blue stars. The result of the merger has been to make Markarian 231 an energetic starburst galaxy with a star formation rate 100 times greater that that of our Milky Way galaxy. The binary black holes are predicted to spiral together and collide with a few hundred thousand years. They are 600 million light-years away.




**Rare type of galaxy merger** – An international team of astronomers has discovered a distant massive galaxy cluster, designated SpARCS1049+56, with a core bursting with new stars. The discovery is the 1st to show that gigantic galaxies at the centers of massive clusters can grow significantly by feeding off gas stolen from other galaxies. Galaxies at the centers of clusters are called Brightest Cluster Galaxies and are quite massive. It is somewhat of a mystery exactly how they grow so massive. What is unusual about this cluster is that it is forming stars at a prodigious rate. Ground- and space-based observations were made for this discovery. The cluster was 1st identified by the SpARCS project, which has discovered about 200 new distant galaxy clusters. Spitzer and Herschel Space Telescopes used infrared to see hidden dusty regions of star formation. However higher resolution optical observations were need from the Hubble to reveal "beads on a string" at the center of the cluster, which occur when clumps of new star formation appear strung out like bead on filaments of hydrogen gas. This is a telltale sign of something known as a wet merger, which occurs when at least 1 galaxy in a collision is rich in gas, and this gas is converted quickly into new stars. The large amount of star formation and the "beads on a string" feature are likely the result of the Brightest Cluster Galaxy gobbling up a gas-rich spiral galaxy. Brightest Cluster Galaxies closer to us seem to grow by dry mergers, collisions between gas-poor galaxies that do not result in the formation of new stars. The new discovery is 1 of the only known cases of a wet merger at the core of a galaxy cluster, and the most distant example ever found. The team now aims to explore how common this type of growth is in galaxy clusters.

**Primordial galaxies** – Astronomers have generated the most accurate statistical description yet of faint, early galaxies as they existed in the Universe 500 million years after the Big Bang. The team used a new statistical method to analyze Hubble data captured during sky surveys. They were able to statistically estimate the number of small, primordial galaxies in the early Universe by subtracting the average noise in blank areas between the galaxies that were bright enough to see directly. The result is about 10 times the number of small galaxies as previously detected at this early time. The new study used 5 different wavelengths of infrared light. These astronomers think these primordial galaxies were very different from the well-defined spiral and disk-shaped galaxies currently visible in the Universe. They were more diffuse and populated by giant stars.

**Distances to stars** can be measured by astronomers by parallax, the amount the position seems to change as the Earth varies its viewpoint from one side of its orbit to the other, but only if the stars are quite nearby. Distances to everything beyond this rely on relative or indirect methods. An astronomer just came up with a new method of determining distances to stars. It was realized that any 2 stars that have identical spectra, to high precision, also have the same brightness. So for any star too distant for parallax, just find a nearby star with the exact same spectrum. Then the ratio of apparent brightnesses allows calculation of the relative distances. A study was made to test this, analyzing spectra of 536 Sun-like stars, and 175 pairs of identical spectra were found. The method agreed with previous distance measures within 7.5%, which isn't too bad. The accuracy does not drop for distant stars, up to the point that an individual star cannot be resolved. So the new method beats the old methods for distant stars.

**Antares (rocket)** – After the explosion of an Antares rocket last October, Orbital ATK, the maker of the rocket, bought an Atlas rocket from its competition to maintain schedule in supplying the International Space Station (ISS). Orbital's Cygnus cargo spacecraft has been fitted to the Atlas, and it is readying for launch in early December. Meanwhile, Orbital redesigned their Antares rocket to use RD-181 rocket engines instead of the AJ26 engine that apparently failed and caused the mishap. The AJ26 engines are reconditioned NK-33 engines, leftover from the abandoned Soviet moon landing program of the 1960s. Orbital is on track to launch an ISS resupply mission with the newer engines on an Antares in 2016. Repairs to the launch pad, damaged by the Antares explosion, are also on track for this date. The new RD-181 engines are not only expected to be more reliable, but they are more powerful and significantly increase the payload capacity of Antares.

**Proposed mission** – NASA's head of planetary sciences Jim Green announced the Jet Propulsion Laboratory (JPL) will study a flagship mission to Uranus and/or Neptune. If approved, it would be the next big mission after the next Mars rover and the Europa mission. The Space Launch System (SLS) rocket currently being designed and built is the only rocket powerful enough to send such a spacecraft without a gravity assist flyby of Jupiter. This is important because Jupiter will be out of position for a gravity assist for some years after 2020, and a Uranus/Neptune mission could not be ready until after 2020. Another problem with outer planet missions was that NASA had run out of plutonium to power spacecraft that are too far from the Sun for solar power, but NASA now has funding for plutonium development. After the study by JPL, the mission would have to be judged the best flagship mission proposal. Neptune's moon Triton, which is probably a captured Kuiper Belt object, and is known to have nitrogen geysers, would be a great place for science. So would Uranus's 5 large moons.

**Instant AstroSpace Update**

**SOHO** (solar space observatory) is, as I write this, about to discover its 3000$^{th}$ comet, far more comets than any other person or machine has discovered. Most have been found by amateurs watching the wide-angle coronagraph images as they are posted online to catch sun grazing comets entering the field.

**OCA Needs Your Help!**

The Orange County Astronomers is operated by volunteers, and it only works when people step up and offer to contribute some of their time and energy in service to the club. Here are two ways in which we urgently need help:

Beginner's Class set up: Our Beginner's Class has been quite popular and successful, with two dozen (or more) people attending each class. We need somebody who can handle the physical tasks of unlocking the classroom and rest rooms, arranging chairs and tables, etc. The sessions are held on the First Friday of each month, at 7:30PM in the Heritage Museum in Santa Ana (near Fairview & Warner). If you can take on this responsibility, please contact Steve Short.

Loaner Scope Coordinators: The OCA has an inventory of about 20 telescopes that are available for member's to borrow. Don Stoutenger and Steve Short have been handling this program for several years, and both of them need to "pass the baton" to other members who can manage this project and assets of the OCA. The key responsibilities are to coordinate the borrowing and return of the telescopes, and maintain appropriate records, and provide convenient storage. It would be especially wonderful if two of you would volunteer to do this – one in North County and one in South County – to spread the workload and make pick up and return convenient to our members. If you can take over as one of the Coordinators for this program, please contact Steve Short.

**Anza House Reminders:** The Anza House at our observing site provides a nice place for meals, conversation, and sleeping. Please remember – this is *your* house at your observing site, and it is your responsibility to keep it attractive! If you use it, please leave it in better condition than it was when you arrived. Clean up after yourself and tidy up anything that wasn't right when you arrived. (There is no maid service at Anza). Remove your trash when you leave, including anything that somebody else forgot to pack out (there is no trash service at Anza). If minor repairs are needed that you are capable of handling, please do; reasonable costs for supplies can be treated as a donation to OCA, or you can ask Charlie for reimbursement of your out-of-pocket expenses. If you see a major issue that you can't deal with, please take what corrective action that you can, and report the issue to Doug Acrea, our Anza House Coordinator.

# The Helix Nebula (NGC 7293)

Dr. James R. Dire, Kauai Educational Association for Science and Astronomy

(NOTE: this article previously appeared in the September 2015 issue of the *Reflector*, a publication of the Astronomical League)

The Helix Nebula (NGC 7293) is a famous planetary nebula noteworthy for being one of the largest and nearest celestial objects of its type. A Hubble Space Telescope composite image of the Helix Nebula appeared as the Astronomy Picture of the Day on May 10, 2003; the image soon thereafter started being referred to as the "Eye of God."

The Helix Nebula resides in the faint zodiacal constellation of Aquarius, 7.75 degrees southwest of the star Skat (Delta Aquarii, magnitude 3.3). One way to star hop to the Helix Nebula is to find the point one- third of the way from Skat to the star Deneb Algiedi (Delta Capricorni, magnitude 2.8) and pan 4.5 degrees to the south. Those are the two stars closest to the nebula brighter than 4th magnitude. The nebula also lies midway between the first- magnitude star Fomalhaut and Iota Aquarii (magnitude 4.3), two stars separated by nearly 20 degrees. Iota Aquarii is five degrees northeast of Deneb Algiedi. A beautiful remnant of a dying star, NGC 7293 contains a double ring structure not unlike two coils of a spring, which gives rise to its popular name, the "Helix Nebula."

A planetary nebula forms when thick stellar layers slowly expand away from a dying red giant star. When the core of such a star contracts into a white dwarf, high-speed stellar winds and ultraviolet light emanate from the white dwarf, colliding with and exciting the expanding gas layers and causing them to glow. The white dwarf at center of the Helix Nebula shines at magnitude 13.4, well within the reach of 12- to 14-inch telescopes. At magnitude 7.6, the Helix Nebula is the brightest planetary nebula in the sky. The nebula resides a mere 675 ± 25 light-years away. The bright portion of the main nebula spans 18 arcminutes, which means it extends 3.5 light-years across space. The fainter outer halo of the nebula spans 28 arcminutes, roughly the same angular diameter as the Moon!

The large size of the nebula results in a very low surface brightness. For this reason, Charles Messier never spotted the nebula. It was even missed by the keen observers William Herschel and his son John Herschel. NGC 7293's discovery is credited to the German astronomer Karl Ludwig Harding in 1824, twenty years after he discovered the asteroid Juno.

Most planetary nebulae have a bluish-green color at the eyepiece caused by emissions from doubly ionized oxygen. However, due the low surface brightness of the Helix Nebula, this color is not noticeable. Long-exposure color photographs of the nebula show myriad colors from deep red to blue.

The Helix Nebula appears as a faint, featureless, round disk in 50 mm or larger binoculars or small, rich-field refractors. The nebula is best viewed in rich-field 6- to 8-inch telescopes at low magnification. Through an 8-inch telescope, it appears as a slightly elliptical ring with two thick arcs on the northeast and southwest edges and a darker central region. An oxygen-III or ultra-high contrast nebula filter and averted vision will bring out more detail in the nebula's structure. The nebula is more challenging to view in larger telescopes since higher magnifications, as a result of longer focal lengths, spread the light out more, decreasing the apparent surface brightness.

The accompanying images of NGC 7293 were taken through a 190 mm f/5.3 Maksutov– Newtonian telescope with an SBIG ST-2000XCM CCD camera. The exposure was 80 minutes. The top shows the single-shot color camera's processed image. Variations in the color result from hotter regions of the nebula exciting different atomic emissions than cooler regions. Of course, the human eye cannot perceive color from faint sources. The bottom image is same as the top with the color removed to simulate what the nebula looks like when viewed telescopically. Even without color, the Helix Nebula is a fascinating object to study with any size telescope.

# Bringing Astronomy to the Long Gray Line


OCA Star Life members Trey McGriff and Pat Knoll were asked by OPT to install a Meade 16 -inch ACF scope, Paramount MEII, computer system and controlling software at the US Military Academy at West Point. All went well and they are planning a return trip to install astrophotography equipment and additional training for the astronomy instructor, Dr. Paula Fekete, who will in turn train the cadets. The West Point campus is located on the Hudson river in upstate New York. Established in 1802, it has a faculty of 580 instructors and a student body of 4,294 cadets who go on to receive commissions as second lieutenants in the United States Army after graduation. West Point cadets receive a balanced education in the arts, sciences, and military instruction. West Point ranks #4 in number of Rhodes Scholars produced; #7 in number of Marshall scholarships awarded; and #4 in number of Hertz Fellowships for Ph.D students in applied biological, physical, and engineering sciences. Its alumni include 2 U.S. Presidents; 3 foreign heads of state; 76 Congressional Medal of Honor awardees, and 18 astronauts (including five who walked on the Moon).

# Magazine Subscriptions

Subscriptions to the Astronomy magazines are now due for renewal, if you subscribed for one year or would like to subscribe at the club rate. You may also extend an existing subscription that does not end in December for one year at the club rate. Bring your check made out to the OCA to the meeting or mail it to:
**Charlie Oostdyk, Orange County Astronomers, PO Box 1762, Costa Mesa, CA 92628.**
***Checks made out to the magazine publishers cannot be processed and will be returned to you.***
If you already subscribe, please provide the mailing label or the billing invoice with your check.
One-year rates are as follows:

| | **Club Rate** | Regular Rate |
|---|---|---|
| Sky & Telescope* | **$33.00** | $42.95 |
| ASTRONOMY | **$34.00** | $42.95 |

***Sky & Telescope subscribers please note: Due to a change by the publisher, renewals of current subscriptions should now be made directly through Sky and Telescope! New subscriptions at the club rate must still be made through Orange County Astronomers and then renewed through the publisher.**

***Astronomy subscribers can now renew on-line with a credit card. E-mail Charlie@CCCD.EDU for special instructions and the renewal code.**

The **DEADLINE** for subscribing at the club rates will be the **October monthly meeting, October 9th.** The publishers will send expiration notices to all current club subscribers about November 1st even if you renew through the club. It takes the publishers a few weeks to process renewals.

SIRIUS ASTRONOMER
www.ocastronomers.org
The Newsletter of the Orange County Astronomers

Nonprofit Organization
U.S. Postage
**PAID**
Santa Ana, CA
Permit No. 1468

**NEWSLETTER OF THE**
**ORANGE COUNTY ASTRONOMERS**
**P.O. BOX 1762**
**COSTA MESA, CA 92628**

**RETURN SERVICE REQUESTED**

**DATED MATERIAL**
**DELIVER PROMPTLY**

## HANDY CONTACT LIST

| | | | |
|---|---|---|---|
| **CLUB OFFICERS (to contact the entire board at once, send an email to board@ocastronomers.org)** | | | |
| President | Steve Short | nightskytours@hotmail.com | 714-771-2624 |
| 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 |
| Trustee | Kyle Coker | kcoker@cox.net | 949-643-9116 |
| Trustee | Sam Saeed | sam@isismagna.com | 714-310-5001 |
| Trustee | Gary Schones | gary378@pacbell.net | 951-687-7905 |
| Trustee | Greg Schedcik | gregsched@verizon.net | 714-322-5202 |
| 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 |
| Explore the Stars OCA Contact | Bob Nanz | bob@nanzscience.com | 760-751-3992 |
| Librarian | Karen Schnabel | karen@schnabel.net | 949-887-9517 |
| Membership, Pad Coordinator | Charlie Oostdyk | charlie@cccd.edu | 714-751-5381 |
| Mt. Wilson Trips | Michele Dadighat | mmpkb8@gmail.com | 573-569-3304 |
| Observatory Custodian/ Trainer/Member Liaison | Barbara Toy | btoy@cox.net | 714-606-1825 |
| OCA Outreach Coordinator | Darshan Meda | darshan.oca@gmail.com | 202-643-2631 |
| Sirius Astronomer Editor | Steve Condrey | startraveler68@yahoo.com | 714-699-1243 |
| Telescope Loaner Program | Steve Short | nightskytours@hotmail.com | 714-771-2624 |
| WAA Representative | Tim Hogle | TimHogle@aol.com | 626-357-7770 |
| Webmaster | Reza AmirArjomand | reza@ocastronomers.org | 646-494-9570 |
| **SPECIAL INTEREST GROUPS (SIG's)** | | | |
| AstroImagers SIG | Alan Smallbone | asmallbone@earthlink.net | 818-237-6293 |
| Astrophysics SIG | Bob Sharshan | RSharshan@aol.com | 714-845-6573 |
| Dark Sky SIG | Barbara Toy | btoy@cox.net | 714-606-1825 |
| GoTo SIG | Mike Bertin | MCB1@aol.com | 949-786-9450 |

**OCA WEBSITE: http://www.ocastronomers.org STARLINE 24-HR. Recording: 714-751-6867 ANZA OBSERVATORY: 951-763-5152**