



While film photography has pretty much gone by the wayside with the advent of digital imagery, some observers still take traditional photos and the results are very satisfactory. Sam Pitts took this photo of Comet Icke-Zang next to the Andromeda Galaxy from Veneta, Oregon on September 23rd. Sam used a Canon F1 with a 100 mm lens at f/2.8 and E200 film piggy-backed to a G11 FS78 refractor to capture this image

OCA CLUB MEETING

The free and open club meeting will be held October 14 at 7:30 PM in the Irvine Lecture Hall of the Hashinger Science Center at Chapman University in Orange. This month, Dr. Will Grundy of NASA will discuss the Surprises from the Pluto System: Better Geology Through Chemistry

NEXT MEETINGS: Nov. 11, Dec. 9

STAR PARTIES

The Black Star Canyon site will open on October 22. The Anza site will be open on October 1 and October 29. 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 7. The following class will be held November 4.

NEW! Youth SIG: contact Doug Millar
Astro-Imagers SIG: Oct. 11, Nov. 8
Remote Telescopes: contact Delmar Christiansen
Astrophysics SIG: Oct. 21, Nov. 18
Dark Sky Group: contact Barbara Toy



One Incredible Galaxy Cluster Yields Two Types of Gravitational Lenses

By Ethan Siegel

There is this great idea that if you look hard enough and long enough at any region of space, your line of sight will eventually run into a luminous object: a star, a galaxy or a cluster of galaxies. In reality, the universe is finite in age, so this isn't quite the case. There are objects that emit light from the past 13.7 billion years—99 percent of the age of the universe—but none before that. Even in theory, there are no stars or galaxies to see beyond that time, as light is limited by the amount of time it has to travel.

But with the advent of large, powerful space telescopes that can collect data for the equivalent of millions of seconds of observing time, in both visible light and infrared wavelengths, we can see nearly to the edge of all that's accessible to us.

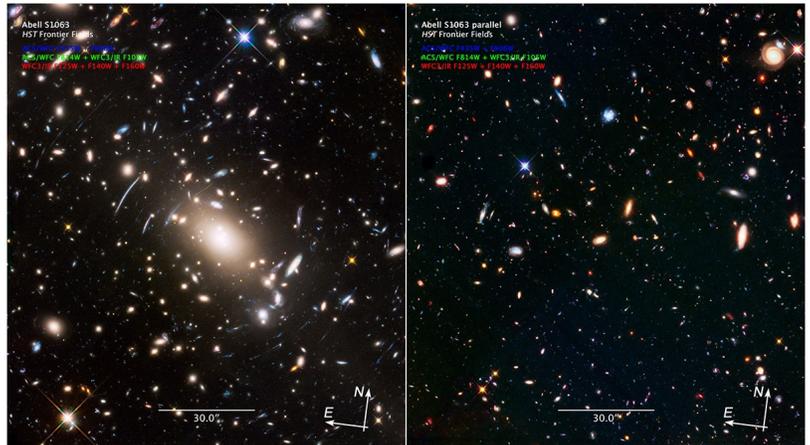
The most massive compact, bound structures in the universe are galaxy clusters that are hundreds or even thousands of times the mass of the Milky Way. One of them, Abell S1063, was the target of a recent set of Hubble Space Telescope observations as part of the Frontier Fields program. While the Advanced Camera for Surveys instrument imaged the cluster, another instrument, the Wide Field Camera 3, used an optical trick to image a parallel field, offset by just a few arc minutes. Then the technique was reversed, giving us an unprecedentedly deep view of two closely aligned fields simultaneously, with wavelengths ranging from 435 to 1600 nanometers.

With a huge, towering galaxy cluster in one field and no comparably massive objects in the other, the effects of both weak and strong gravitational lensing are readily apparent. The galaxy cluster—over 100 trillion times the mass of our sun—warps the fabric of space. This causes background light to bend around it, converging on our eyes another four billion light years away. From behind the cluster, the light from distant galaxies is stretched, magnified, distorted, and bent into arcs and multiple images: a classic example of strong gravitational lensing. But in a subtler fashion, the less optimally aligned galaxies are distorted as well; they are stretched into elliptical shapes along concentric circles surrounding the cluster.

A visual inspection yields more of these tangential alignments than radial ones in the cluster field, while the parallel field exhibits no such shape distortion. This effect, known as weak gravitational lensing, is a very powerful technique for obtaining galaxy cluster masses independent of any other conditions. In this serendipitous image, both types of lensing can be discerned by the naked eye. When the James Webb Space Telescope launches in 2018, gravitational lensing may well empower us to see all the way back to the very first stars and galaxies.

If you're interested in teaching kids about how these large telescopes "see," be sure to see our article on this topic at the NASA Space Place: <http://spaceplace.nasa.gov/telescope-mirrors/en/>

This article is provided by NASA Space Place. With articles, activities, crafts, games, and lesson plans, NASA Space Place encourages everyone to get excited about science and technology. Visit spaceplace.nasa.gov to explore space and Earth science!



Galaxy cluster Abell S1063 (left) as imaged with the Hubble Space Telescope as part of the Frontier Fields program. The distorted images of the background galaxies are a consequence of the warped space due to Einstein's general relativity; the parallel field (right) shows no such effects. Image credit: NASA, ESA and Jennifer Lotz (STScI)

AstroSpace Update

October 2016

Gathered by Don Lynn from NASA and other sources

Proxima planet – Astronomers have found clear evidence of a planet orbiting the closest star to the Sun, Proxima Centauri, just over 4 light-years away. The radial velocity technique was used for the discovery. The search at this star has gone on for many years, but the small mass of the planet and the interference from activity on the surface of the star has prevented discovery until now. The new observations showed that the planet tugs the star at walking speed, detectable by only the most sensitive of spectrometers, and measurements during stellar activity were discarded. The planet orbits Proxima every 11 Earth days. This may sound like an extremely close orbit, but for a dim red dwarf star, the temperature that close is in the habitable zone, that is, where the planet's temperature would allow liquid water to exist. The planet is a little more massive than the Earth, at least 1.3 times. However conditions on the planet may not be so Earth-like due to the strong ultraviolet and X-rays emitted during stellar activity. Being so close to Proxima, the planet may be tidally locked, that is, keeping the same side towards its star, or may have a resonance, rotating a little different than the orbital period. Unless water is ruled out by further observations, this planet will be a target for the search for life elsewhere. There is no evidence that the planet transits Proxima, though some astronomers are still looking, so there is no way yet to determine if the planet has an atmosphere.

Crowded exoplanets – A recently discovered planetary system is quite crowded: it is a binary star system, one star with 2 planets and the other star with 1. It is the closest known binary star in which both stars have planets. The 2 planets are about Jupiter mass, and the single is at least 2.5 times that of Jupiter. It is also unusual in that the stars are poor in heavier elements (heavier than helium), and that all 3 planets have eccentric (highly elliptical) orbits. Most stars with giant planets are rich in heavier elements.

Unique binary star – Last year a group of amateur astronomers observing the star AR Scorpii found that its behavior did not fit any class of variable star, and brought it to the attention of professional astronomers. Follow up observations showed that it is actually a binary star consisting of a red dwarf star closely orbiting a white dwarf. The latter is rapidly spinning, and is spewing high-energy electrons. Every time the electrons hit the red dwarf (about every 2 minutes), it pulses brighter in wavelengths from ultraviolet to radio. No other white dwarf system is known to show such behavior in radio. It takes 3.6 hours for the 2 stars to orbit each other. The source of the electrons is under debate.

Star formation, or not – An international collaboration known as SpARCS has discovered 4 of the most distant clusters of galaxies ever found, so far away that we are seeing them as they were when the Universe was only 4 billion years old. The SpARCS team has developed techniques for finding galaxy clusters in infrared data from the Spitzer Space Telescope. It is known that galaxies in clusters stopped forming stars earlier in the history of the Universe than galaxies far away from such clusters. The newly discovered clusters let astronomers quantify this. The newly discovered clusters showed that 30% of galaxies which would normally be forming stars had stopped star formation due to the effects of being in a cluster of galaxies, while the corresponding number in galaxies today is 50%. These numbers will help determine how long the process of stopping star formation takes, and may lead to understanding the process. There are several theories on how this process works, including: hot gas in galaxy clusters could prevent gas from becoming cool enough to collapse into stars, gravitational disturbances from nearby galaxies could strip star forming material, merging of galaxies could disturb star formation.

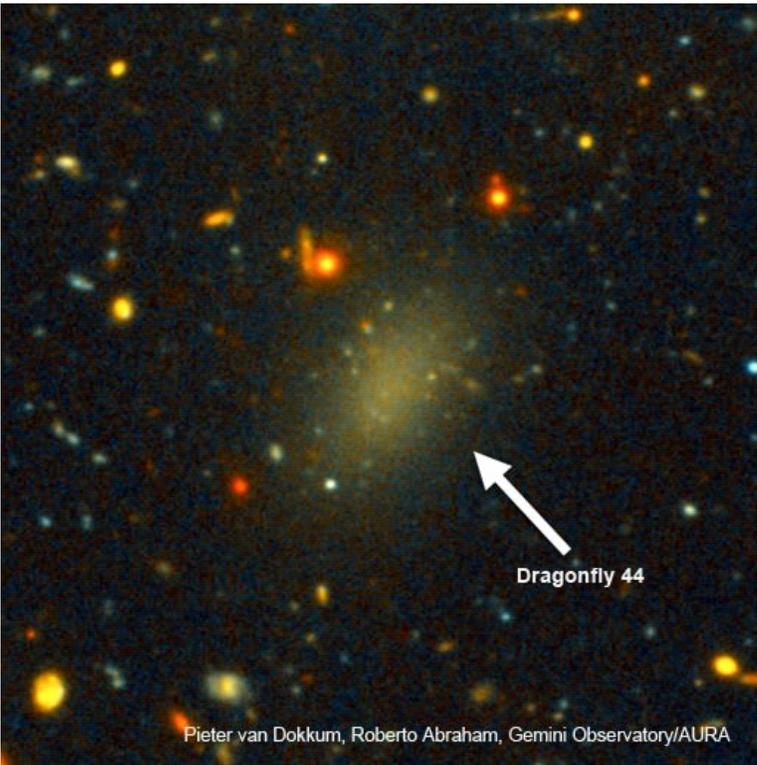
Blazars are active galaxies with jets that happen to point at us. They are often identified by their high level of gamma rays. A new study using data from the WISE infrared space telescope found that the gamma-ray activity correlates with infrared activity. This was unexpected, because infrared and gamma rays have vastly different wavelengths, and so are usually generated by different mechanisms. Further, the WISE data showed 130 more objects with similar infrared activity which are potential blazars. Work will continue to identify more blazars through infrared.

Isotropy – One of the 1st things taught in cosmology is that the Universe is assumed to be isotropic, that is, on large scales the same kind of stuff is seen in any direction. Scientists have not been able to find exceptions to this, so it seems a good assumption. A new study found a more precise way to test this, by looking for patterns in the temperature or polarization of the Cosmic Microwave Background, as measured by the Planck spacecraft, which might indicate different expansion of the Universe in different directions. No break in isotropy was found, so we need not rewrite the cosmology textbooks.

Milky Way past activity – About 6 million years ago, the black hole at the center of the Milky Way was much more active, consuming large amounts of material. Evidence for this was found by astronomers looking for missing ordinary mass (not dark matter mass) in the Milky Way. Much of the ordinary matter not in stars is found in hot gas, visible in X-rays, so the astronomers were look-

ing at X-ray data. They looked not only at gas that emitted X-rays, but also at gas that absorbs X-rays from more distant sources. They indeed found enough hot gas to add up to the expected mass of ordinary matter in our galaxy. But they also found a hole or bubble in the hot gas, centered on the galaxy's center, and extending 2/3 of the way toward our location. Quasar level black hole activity lasting from 4-8 million years would have the energy to clear out a bubble of this size. This period of activity is also supported by a known population of stars 6 million years old near the center of the galaxy, likely born as a result of shock from the black hole activity.

Star ages – Blue Horizontal Branch stars (BHBs) have a definite relation between their color and their age. So a team of astronomers perused the archived Sloan survey data to find 130,000 BHBs in our Milky Way and made a map of the ages of various parts of our galaxy. The map confirms what theories predicted: the oldest Milky Way stars are in the center, and the galaxy grew by accreting chunks of gas, dust, stars and small galaxies.



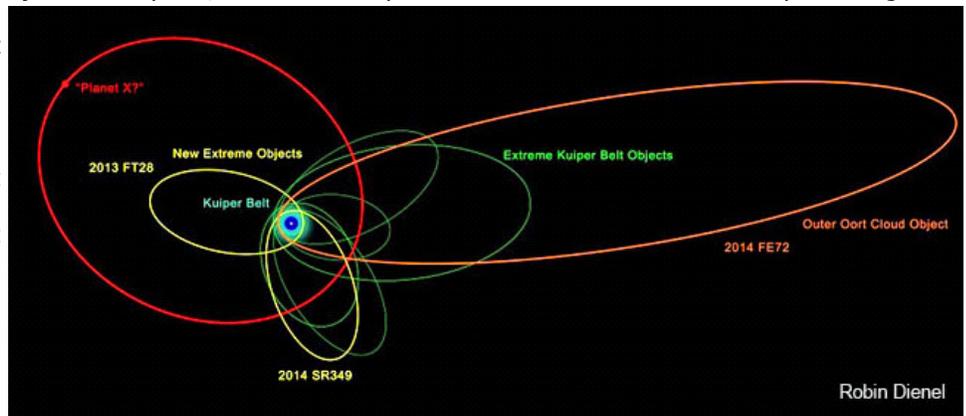
Dark galaxy – Dragonfly is an array of stock cameras with telephoto lenses on telescope mounts. Its mission is to image the outskirts of galaxies. An unexpected find, known as Dragonfly 44, is a galaxy the mass of the Milky Way with only 1% as many stars. It has to be made almost entirely of dark matter. Several dwarf galaxies have been previously found that are almost entirely dark matter, but this is the 1st one to be found so large. Dragonfly 44 is 300 million light-years away. Astronomers are hoping to find a similar galaxy closer, since that would allow much more detailed study. It is even possible that the faint interaction of dark matter with ordinary matter that many scientists believe exists would be visible in such a concentration of dark matter with little interference from starlight.

Spiral arms – It has long been known that the arms of spiral galaxies are density waves. They are areas where stars are close together, even though the stars are orbiting through the arms, in one side, out the other. It is like cars in a freeway slowdown; different cars are in the crowded area at different times, but the crowded area remains. However, the galaxies are more complicated, because the shorter orbital periods of stars nearer the galactic center will wind up the interior of galaxy arms faster than the outer parts. Also, new stars are preferentially formed in crowded areas. So

theoretically, the location of the arms as seen in young stars should be offset a bit from the arms seen in old stars. A new study measured this effect, and the result supported theory. Far infrared and ultraviolet observations were made to find star forming regions, and visible light and near-infrared were used to find old stars. The new study looked at 28 spiral galaxies.

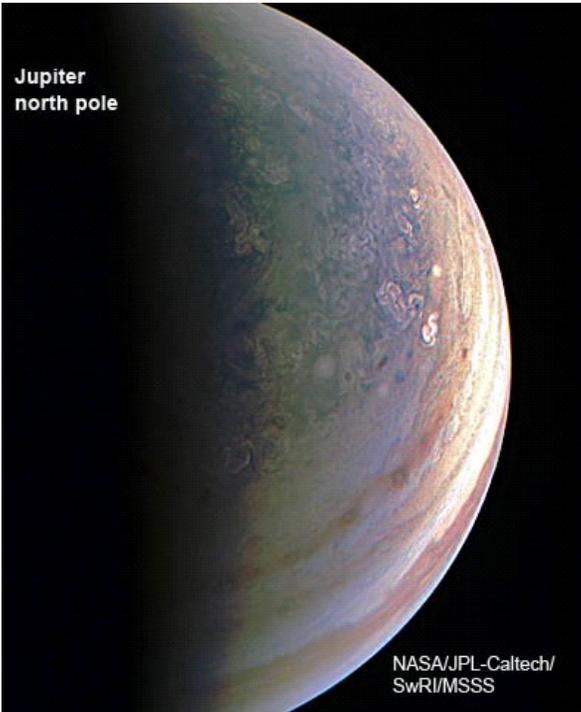
Strange asteroid – The orbit of a Centaur (asteroid that orbits among the outer planets) named 2011 KT₁₉ has recently been determined, and surprisingly it is retrograde, that is, orbiting backwards from nearly every body in the Solar System. Making a guess at its reflectivity, it is probably 40-120 miles (70-200 km) across. It also orbits highly inclined (70° out of the plane of the planets), also unusual. Now for the REALLY strange: the only other retrograde trans-Neptunian object known (2008 KV₄₂) has its orbit in the same plane. You might guess that they are 2 pieces of an object that broke apart. But NO; there are 4 other Centaurs with orbits in the same plane, and they orbit prograde, not retrograde! It is not possible to break into pieces, some of which reverse direction. Perhaps an undiscovered more massive object is pushing these Centaurs into the same plane. This is the hypothesis recently announced for Planet 9, which is supposed to be pushing objects into a plane, but a different plane than 2011 KT₁₉. This would require a large undiscovered object, other than Planet 9. And nobody has as yet run a simulation that shows the grouping around 2011 KT₁₉, particularly with 2 retrogrades. So it remains a mystery.

Unusual asteroids – Speaking of Planet 9, astronomers searching for this theoretical body have discovered several distant Solar System objects that are not Planet 9, but nevertheless interesting. One new object, named 2014 SR₃₄₉ adds to the group of unusual orbits that can be explained by the presence of Planet 9 exerting its gravi-



tational influence to push around orbits of small bodies. Another, 2013 FT₂₈, shares some orbital characteristics with that group. Yet another, 2014 FE₇₂, is the 1st known Oort Cloud object that has its orbit entirely outside that of Neptune.

Oldest fossils – Scientists searching in Greenland have found the oldest fossils of formerly living things, in this case stromatolites, and dated them at 3.7 billion years old. The previous record was 3.5 billion. What does this mean? 1. Life formed a little faster on Earth than thought. 2. Life is more likely than previously thought to have formed on Mars, since it is believed to have been still warm and wet at about 3.7 billion years ago.



Eclipse weather – There have long been stories about weather changes during total solar eclipses. A group in the UK decided to measure them and organized a project called NEWEx, in which citizen scientists measured and reported air temperature, wind speed, wind direction and cloud cover during an eclipse. Data from weather bureau stations and highway weather units were also collected. The results: atmosphere cooled, warm air rising from the ground stopped, causing winds to decrease and change direction, and cloud cover decreased (contradicting my own personal observations of cloud cover increasing). 16 scientific papers and reports were published from NEWEx.

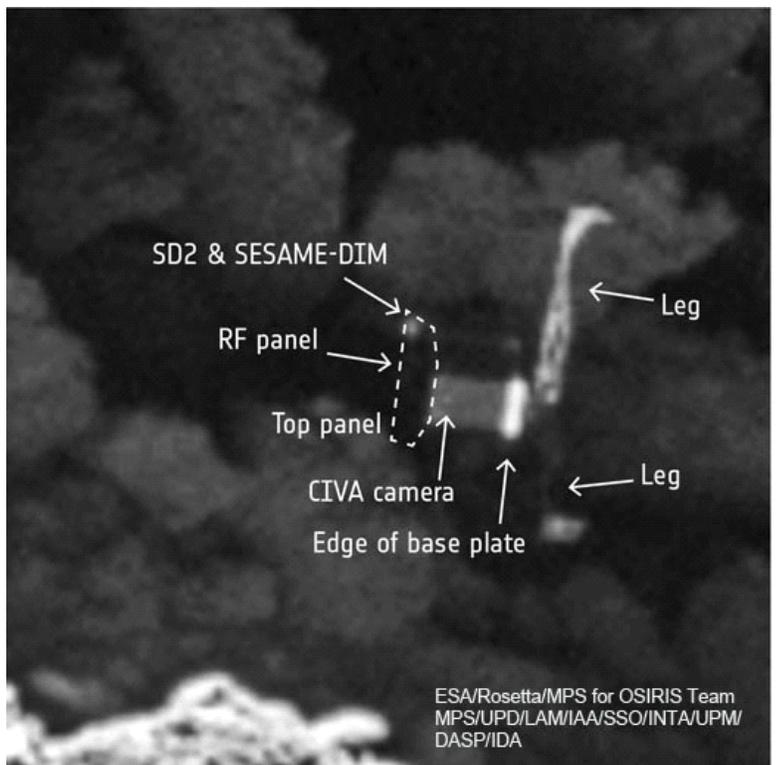
Juno made a close pass to Jupiter in late August, obtaining the 1st ever close up images of Jupiter's poles. The north pole has many storms, is bluer, and has no signs of horizontal (latitudinal) bands, unlike any other place in the Solar System. The WAVE instrument captured sounds in the planet's plasma. The auroral ring near the south pole showed up brightly in infrared images.

Spitzer (infrared space telescope) has just started another extended mission, for 2.5 more years, known as the "Beyond" phase. Launched 13 years ago, Spitzer was expected to observe for 2.5-5 years. Spitzer is making observations of objects not even thought to be observable in infrared when the space telescope was designed and built. These include extremely distant galaxies, the black hole at the center of the Milky Way, microlensing, and exoplanets. When designed, it was believed Spitzer might see galaxies so distant

that their light took 12 billion years to reach us, but Spitzer's distant galaxy record is now 13.4 billion. The Beyond phase should overlap the beginning of observations with the Webb Space Telescope, so Spitzer may be finding objects for closer scrutiny by Webb.

Rosetta (comet orbiter) was finally able to take a picture of its lander Philae, which had been lost since its anchor failed in its landing attempt in November 2014, and it bounced about the comet nucleus for a couple of hours. Its location deep in a crack explained why it did not get enough sunlight to charge its batteries, and why communication with it was difficult even before the batteries ran down. By the time you read this Rosetta will have slowly lowered itself to the comet surface, taking data and images all the way down. This is how the mission is planned to end, shortly before the comet gets too far from the Sun for the spacecraft's solar arrays to keep it in power. Rosetta is planned to land in one of the pits from which material was spewed when the comet was warmed by being close to the Sun. The landing is likely to damage Rosetta, but mission planners are happy just to get the data on the trip down.

STEREO-B found – In 2006, the pair of solar observing spacecraft known as STEREO was launched. One orbit let it drift slowly ahead of Earth in the same orbit about the Sun, and the other drifts slowly behind Earth. This allowed imaging the Sun, and particularly its coronal mass ejections, from 2 viewpoints, so that 3-D pictures could be constructed. They were designed to operate for 2 years (until 2008), but



both were working fine until late 2014 when they had drifted halfway around the orbit, and were about to pass behind the Sun, as seen from Earth. Radio communications are interrupted by the Sun, so both spacecraft were told to ignore the loss of radio contact for nearly 4 months. STEREO-A took the advice well, but STEREO-B did not. For still unknown reasons, it started tumbling and never resumed contact after the Sun's communications interruption ... until this past August 21, when it answered radio contact 18 months late. It probably had drifted to where the solar panels were receiving enough light to recharge its batteries. As I write this, spacecraft controllers are still trying to get the spacecraft to stop tumbling (it has slowed in response to sent commands), but hopes are high that it may resume science operations soon.

OSIRIS-REx launched September 8, to spend about 2 years studying and sampling the asteroid Bennu, then return the sample(s) to Earth in 2023. It will use an Earth flyby about a year from now in order to reach Bennu's orbit. It is thought that the asteroid is a little-changed remnant for the formation of our Solar System, and study of the sample should help scientists understand the planet formation processes. Bennu is the size of a small mountain. It approaches Earth more nearly than most asteroids, so is relatively easier to get to and from. This will be the largest sample (expected between 2 oz and 4 lbs [60-2000 g]) returned by any spacecraft since the Apollo and Soviet lunar samples decades ago. The Japanese spacecraft Hayabusa is the only one to previously sample an asteroid, and it got only microscopic specs, though much good science was done despite the small amount.

Instant AstroSpace Updates



Over 100 tons of meteorites have been recovered since 1576 from the **Campo del Cielo** meteorite find, which fell in Argentina about 4000-5000 years ago. Another 30 ton chunk of iron was just found, which makes it the 2nd largest piece.

It has been known for a few years that **Terzan 5**, unlike most other globulars, has 2 kinds of stars, with different ages and different heavy element content. A new study showed that these properties closely resemble stars found in the Milky Way's central bulge, so Terzan 5 may be a remnant of the bulge formation.

Astronaut Jeff Williams just broke Scott Kelly's **record** for longest accumulated time in space (now 534 days) for a NASA astronaut, though several cosmonauts exceeded this. His record won't last for long since Peggy Whitson is scheduled to beat this in 2017.

NASA has approved a landing date of November 26, 2018 for **InSight**, which will probe Mars' interior with a seismometer and drill. InSight was to have launched earlier this year, but the seismometer leaked (even after 1 repair was made) and so was not ready for launch.

GAIA, the spacecraft to map the locations (including distances) and motions of a billion stars, has released a map of 2 million stars, and announced the team is on track to release the billion stars by the end of next year. GAIA is producing positions 200 times more accurate than the best previous catalog.

Black Star Canyon Star Party Recap

September 24th, 2016

Steve and Bonnie Short

The sky was warm & fairly clear throughout Orange County so when we opened the gate about 6:15 pm, we were not surprised to see there were at least 10 cars waiting at the gate. Quite a few more came in while all were being parked totaling 20 by sunset. By the end of the clear night, we had counted a total of 23 cars that had come to the BSC star party and over 30 people.

The first object that became visible after the Sun set was Venus low on the western horizon. Later Mars & Saturn became visible behind the Scorpion's 3-star head. By the end of the evening, some of us even viewed Uranus & Neptune. But unlike last month, we were not able to see Mercury or Jupiter.

We set up in the usual spot by the middle picnic table and Sam set up next to us by the 3rd table. He was quick to view Venus, then later share views of the Ring Nebula and M31. Robert Cunningham set up a bit farther along with his guest David Kim. Vittal was out again and showed Bonnie the Swan Nebula through his 8" DOBS. He even showed her Omega Centauri low in the west, the largest known globular cluster. Dave Murphy also set up in that area.

We had many people set up scopes across the way including George & Peggy Robinson who looked at many objects and took images of Pluto I think Roger Cotton, was also on that side. Rob McKenzie set up his 11" scope past the 2nd gate and showed stunning views of M57, M13, M92 & Albireo. Later he was showing the small disc of Uranus & Neptune. Rob & his wife also had two guests.

Ves set up his 8" Meade LS next to Rob and Don McClelland set up next to Ves. He tried to run his scope from his new hybrid but the battery would shut down every hour. Also on that side, Matt Dahms set up his 18" DOBS and showed me Mars that was huge and shimmering.

Also attending was Marcelo Reginato, David Murphy, and Erick Seavey with his 11" Celestron. Victor Tanious and his guest Mostafa Sobaih had fun as did Alvin Bishop & his guest Burt Hermey. Bill Johnson brought his big Celestron 11" in his "Best A/C & Heating" truck. He showed me a nice view of M31. Rashad & Veronica enjoyed the star party as our guests as did Ed Rosenblatt. We also had special guests, Bonnie's son Scott & his son Kevin down from Washington. Andy David showed up late after her dinner engagement bestowing honors on her volunteer outreach activities.

We were lucky to have clear skies all evening long and it stayed very comfortable. I closed the gate at midnight and the temperature was 60 F. We felt this was another one of the best BSC star parties we have ever held.

Please forgive us if I missed anyone or we got your names spelled wrong. Bonnie tries hard to log in everyone and get your names right.

Steve & Bonnie

**Musco Center Arts and Lecture Series Presents:
An Evening with Scott Kelly, NASA Astronaut
Wednesday, November 16, 2016 at 7:30pm**



Scott Kelly made history in 2016 by completing the longest-duration American space flight ever, a record-breaking 340 days aboard the International Space Station. He'll speak about his experience, share his beautiful photos of our blue planet, and discuss how the human body reacts to long-term space flight and the implications of this for human travel to Mars and beyond.

Tickets available at \$65, \$55, \$40, \$30. Chapman student discount \$10 off; Chapman staff and faculty discount \$5 off.

A limited number of premium tickets is available for \$250. Each includes a VIP dinner with Scott Kelly.

Contact 844-626-8726 or visit http://chapman.universitytickets.com/user_pages/event.asp?id=1190&cid=68 for details.



The Helix Nebula (NGC 7293) is a large planetary nebula located 700 light-years from Earth in Aquarius. The nebula is believed to have formed within the past 6,000-12,000 years, putting its formation within recorded history, and at magnitude 7.3 is a fairly easy object for amateurs. Eric Seavey created this image on September 25th using a Skywatcher BK MN190 DS (Maksutov Newtonian) and a Pentax K5 imager.

WINTER OVRO TRIP PLANNED FOR DEC. 16-17

I am planning a winter trip to Owens Valley Radio Observatory facility this December on Dec.16-17.

The trip is for young and old. We would like people to bring their telescopes and help us with observing. The winter skies up there are excellent.

We will have a great warming room. We will have the usual fun activities like a tour of the facilities and experiments with liquid nitrogen, snow play and great pizza.

There is no cost involved, but you need to arrange your own transportation, lodging and meals. The observatory is a few miles East and North from Big Pine, Ca. along Highway 395.

Please let me know if you would like to go via email or phone, and I will send you more details.

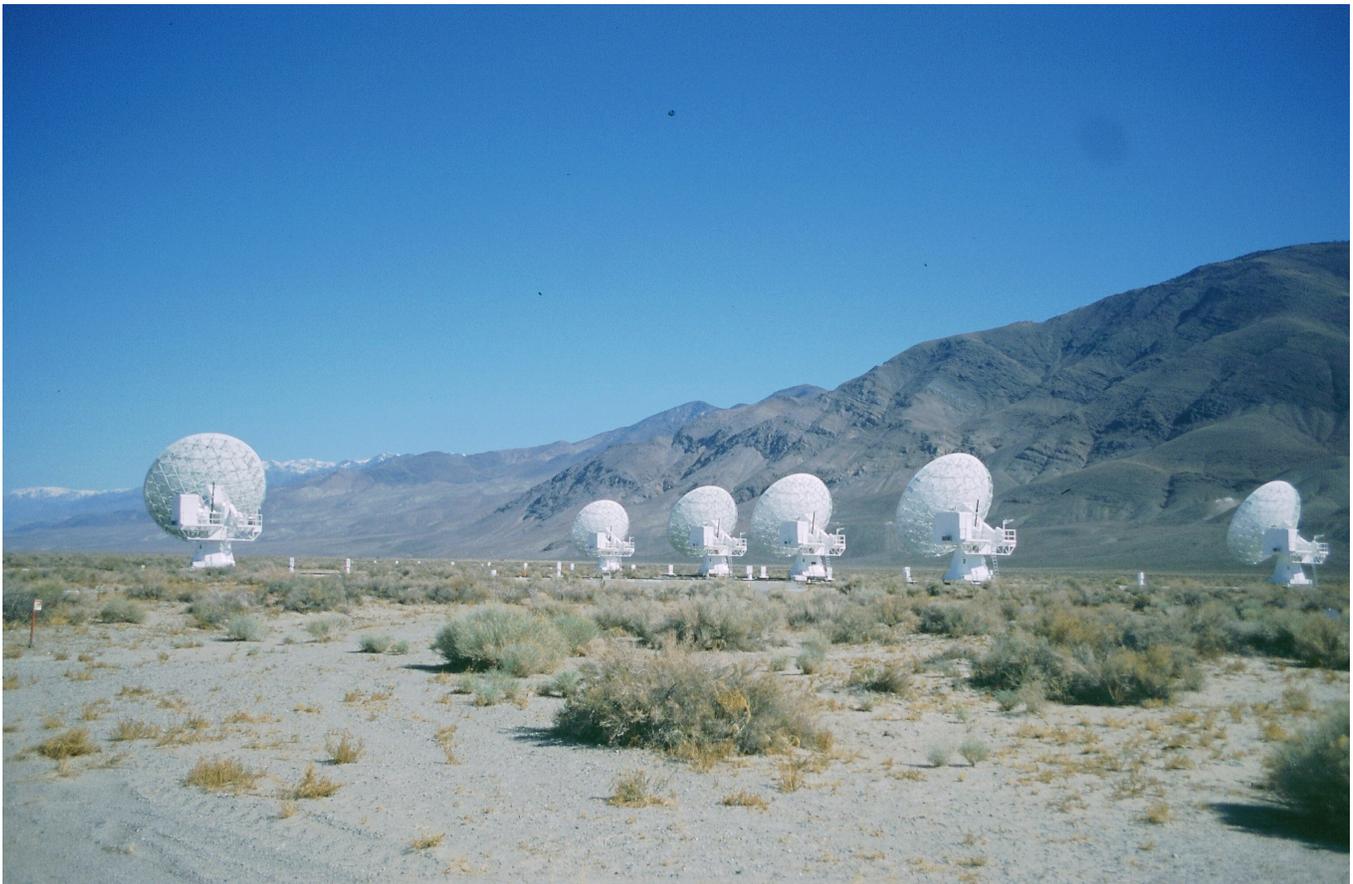
Hope you can join us,

Dr.Doug Millar EdD.

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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 14th**. 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.

Jupiter Ridge #4 Pad for sale: This pad includes a good steel pier and a table that's in good condition. As with all Jupiter Ridge pads, the parking is excellent. \$1,500. Either see me at JR#7 (the warming hut), or call or text me at 951-225-5920. Ray Stann

Astro Physics Mount for Sale

- 1. AP 1200 GTO Mount with keypad**
- 2. 1200 Precision-Adjust Rotating Pier Adapter with Azimuth Bearing (1200RPA) for 10" ATS Pier.**
- 3. One 18 pound Counterweight for 1.875" Diameter Shaft**
- 4. 16" Mounting Plate**
- 5. Losmandy Polar Alignment Scope - (PASILL4)**
- 6. Polar Alignment Scope Cover - (Q12700)**

\$6,500.00

Contact Rick at 310-489-8561

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

RETURN SERVICE REQUESTED

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