SIRIUS ASTRONOMER

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Jeff Horne created this image of the crater Copernicus on September 13, 2005 from his observing site in Irvine. September 19 is International Observe The Moon Night, so get out there and have a look at a source of light pollution we really *don't* mind!

OCA MEETING

The free and open club meeting will be held September 18 at 7:30 PM in the Irvine Lecture Hall of the Hashinger Science Center at Chapman University in Orange. This month, JPL's Dr. Dave Doody will discuss the Grand Finale of the historic Cassini mission to Saturn in 2017!

NEXT MEETINGS: October 9, November 13

STAR PARTIES

The Black Star Canyon site will open on September 5. The Anza site will be open on September 12. 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 September 4. The following class will be held October 2.

GOTO SIG: TBA
Astro-Imagers SIG: Sept. 8, Oct. 13
Remote Telescopes: TBA
Astrophysics SIG: Sept. 11, Oct. 16
Dark Sky Group: TBA

Solar Wind Creates—and Whips—a Magnetic Tail Around Earth

By Ethan Siegel

As Earth spins on its axis, our planet's interior spins as well. Deep inside our world, Earth's metal-rich core produces a magnetic field that spans the entire globe, with the magnetic poles offset only slightly from our rotational axis. If you fly up to great distances, well above Earth's surface, you'll find that this magnetic web, called the magnetosphere, is no longer spherical. It not only bends away from the direction of the sun at high altitudes, but it exhibits some very strange features, all thanks to the effects of our parent star.

The sun isn't just the primary source of light and heat for our world; it also emits an intense stream of charged particles, the solar wind, and has its own intense magnetic field that extends much farther into space than our own planet's does. The solar wind travels fast, making the 150 million km (93 million mile) journey to our world in around three days, and is greatly affected by Earth. Under normal circumstances, our world's magnetic field acts like a shield for these particles, bending them out of the way of our planet and protecting plant and animal life from this harmful radiation.

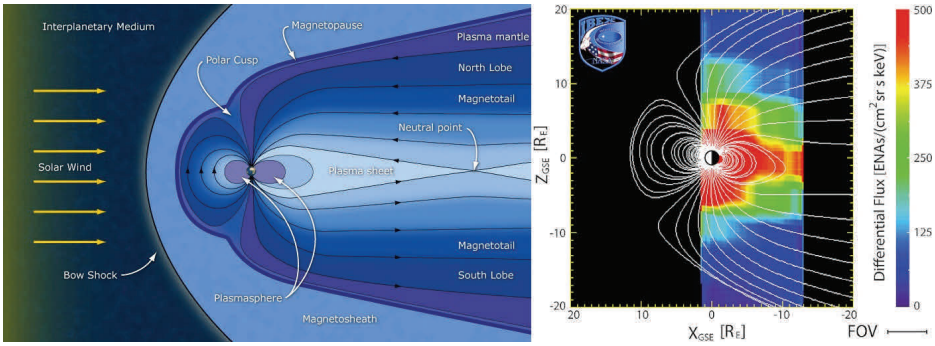


Image credit: ESA / C. T. Russell (L), of Earth's magnetic tail and its cause: the solar wind; Southwest Research Institute / IBEX Science Team (R), of the first image of the plasma sheet and plasmasphere created around Earth by the solar wind.

But for every action, there's an equal and opposite reaction: as our magnetosphere bends the solar wind's ions, these particles also distort our magnetosphere, creating a long magnetotail that not only flattens and narrows, but whips back-and-forth in the onrushing solar wind. The particles are so diffuse that collisions between them practically never occur, but the electromagnetic interactions create waves in Earth's magnetosphere, which grow in magnitude and then transfer energy to other particles. The charged particles travel within the magnetic field toward both poles, and when they hit the ionosphere region of Earth's upper atmosphere, they collide with ions of oxygen and nitrogen causing aurora. Missions such as the European Space Agency and NASA Cluster mission have just led to the first accurate model and understanding of equatorial magnetosonic waves, one such example of the interactions that cause Earth's magnetotail to whip around in the wind like so.

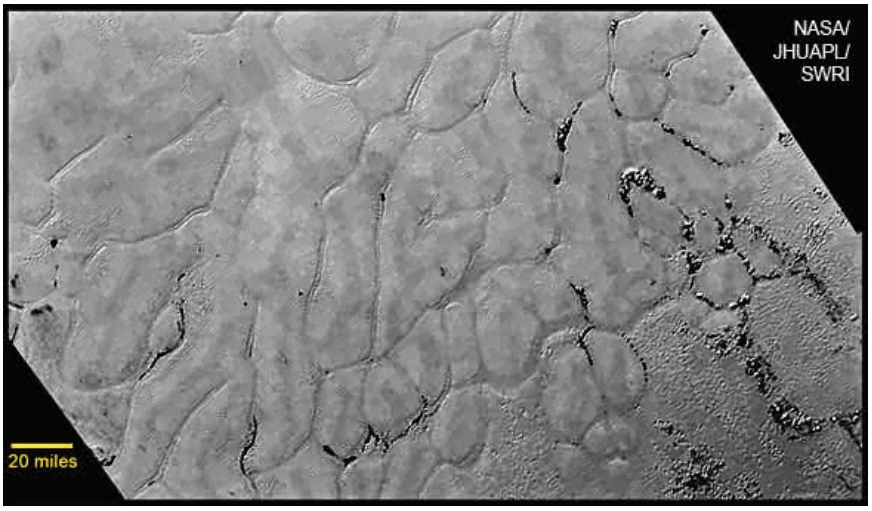
The shape of Earth's magnetic field not only affects aurorae, but can also impact satellite electronics. Understanding its shape and how the magnetosphere interacts with the solar wind can also lead to more accurate predictions of energetic electrons in near-Earth space that can disrupt our technological infrastructure. As our knowledge increases, we may someday be able to reach one of the holy grails of connecting heliophysics to Earth: forecasting and accurately predicting space weather and its effects. Thanks to the Cluster Inner Magnetosphere Campaign, Van Allen Probes, Mars Odyssey Thermal Emission Imaging System, Magnetospheric Multiscale, and Heliophysics System Observatory missions, we're closer to this than ever before.

Kids can learn about how solar wind defines the edges of our solar system at NASA Space Place. http://spaceplace.nasa.gov/interstellar

AstroSpace Update

September 2015

Gathered by Don Lynn from NASA and other sources



New Horizons (Pluto mission) – More science results from the recent flyby: Pluto has an ionized tail like a comet produced by nitrogen from its thin atmosphere leaking into the solar wind. Preliminary estimates are as high as 500 tons (450 metric tons) of gas are escaping into space every hour. Sputnik Planum, a very flat region of the "Heart" shape on Pluto, is covered by broken irregularly-shaped segments, roughly 12 miles (20 km) across, bordered by shallow troughs. So far, scientists have come up with 2 theories of how these segments form: contraction of surface materials, or convection of material rising up to the surface. Pluto's icy plains have some dark streaks a few miles long. Since they seem to align, they may have been made by prevailing winds blowing material across. Atmosphere (thin) has been observed as high as 1000 miles (1600 km), farther than expected. The large moon Charon is more cratered than Pluto, but still has fewer than predicted. This means that Charon, as well as Pluto, are subject to forces that are resurfacing them, in spite of predictions that there should be no substantial resurfacing forces there. Charon has cliffs running 600 miles (1000 km). It also has what looks like a sunken mountain, a sharp peak surrounded by a wide moat. It does not look like a central peak in a crater. It is unknown what would form such a feature. Another moon, Nix, was found to roughly jelly bean shaped, with a size of about 26x22 miles (42x36 km). Nix's surface is neutral gray, except for a region with a red tint. Yet another moon, Hydra, was found to be decidedly lopsided and lumpy, with a size of 28x19 miles (45x31 km), at the small end of estimates made previously by the Hubble Space Telescope. This means it is a little more reflective than thought, probably due to more ices on its surface. It appears to have some large impact craters. New Horizons has sufficient propellant remaining to visit another Kuiper Belt Object, provided funding for such is approved. There are a few known objects in the direction the spacecraft is headed.

Titan lakes – A new study using radar images from Cassini of Saturn's moon Titan suggests that many of the lakes on Titan are sinkholes that filled with the liquid methane and ethane that rain there. The larger lakes or seas on Titan are not of this type. The new theory is that the liquid slowly dissolves some kinds of rock on Titan, and after millions of years a sinkhole forms. On Earth, similar results occur when water dissolves certain types of limestone and gypsum. There are also empty holes (no liquid) on Titan, which are also probably such sinkholes. The lower rainfall that occurs in equatorial regions of Titan would slow the rate of forming sinkholes, and this matches observations that show a relative absence of them in low latitudes.

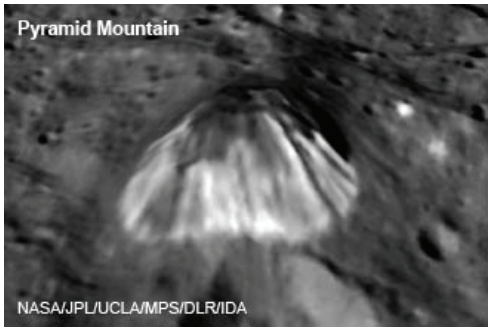
More Titan lakes – Evaporated material has been found in 28 regions on Titan, like rings on a bathtub, indicating that the lakes dry up partially or completely sometimes. Some of these are in the equatorial regions where there are no lakes currently. On Earth such material is composed of salts that were dissolved in water that dried up, but on Titan the material is probably hydrocarbons and nitriles that were dissolved in liquid methane and ethane. Changing of seasons on Titan appears to explain some of the drying up, but not all. Long-term changes in tilt or orbit or changes in Titan's atmosphere might explain the remainder.

Tethys arcs – New enhanced-color images of Saturn's moon Tethys show unexplained arc-shaped reddish streaks. The new images are the 1st to show well northern areas of the moon as the seasonal lighting changes. Such color is rare on Saturnian moons, except for the tint of a few craters on Dione. The streaks are geologically young, since they cross over craters. Follow-up observations are planned to try to understand these streaks.

Near-Earth asteroids – A study using NEOWISE (infrared space telescope) has traced the origin of many near-Earth asteroids to the Euphrosyne family. That family consists of more than 1000 asteroids with similar highly inclined orbits and similar colors, thought to be remnants of a collision that occurred about 700 million years ago. The asteroid Euphrosyne is the largest fragment at about 156 miles (260 km) across, and so lent its name to the family. What has happened is that encounters with Saturn over millions of years deflected some of the asteroids from orbits like Euphrosyne into near-Earth orbits.

Dawn (asteroid mission) team has released a map of asteroid Ceres, showing that it most resembles Saturn's icy moons Dione and Tethys in depth of cratering and height of mountains. Both those moons are about the same size and density as Ceres. Some of the more prominent features now have IAU approved names. The crater with the mysteriously bright spots in it has been named Occator, after the Roman god of harrowing (the agricultural process, not the "distressing" meaning). The theme of naming places on Ceres is agriculture mythology.

More Dawn – Ceres was found to be slightly ellipsoidal, measuring 600x554 miles (965x891 km). That's just slightly smaller than previous estimates, so its overall density must be 2.16 (where water is 1), about 4% higher than previous estimates. This slightly changes the assumed percentage of water. The tilt of its axis was found to be about 3°, just what was previously estimated, but it is tilted away instead of toward, so the opposite hemisphere from what was thought is having summer. But since the tilt is so small, the difference between seasons is small. There is a lonely mountain, dubbed "The Pyramid". It measures 19 miles (30 km) across its base and 3 mile (5 km) high. Some sides are stained white. Craters are the dominant land form on Ceres.



Rosetta (comet mission) team has released results of studying how comet 67P/Churyumov-Gerasimenko interacts with the solar wind. As the comet approaches the Sun in its orbit, the number of water ions has increased, as expected. The average rate of such ions has increased by a factor of 10,000 in 7 months. The comet is throwing off water as it heats, and ultraviolet sunlight is stripping off electrons to change the water molecules into ions. The electrical properties of the solar wind then accelerate the ions to make the ion comet tail. This process has been generally understood, but the new data quantify how this happens. Some solar wind makes its way through the material surrounding the comet nucleus, hits that nucleus, causing atoms to be knocked into space, in a process called sputtering. Material thrown off the comet was found to include sodium, potassium, silicon and calcium. These elements are also found in the type of meteorite called carbonaceous chondrite, but in different amounts in this comet. Most of the sputtered material comes from the winter side of the comet, that is, the pole pointed away from the Sun. This shows that the solar wind is being deflected during interaction with the comet's ions.

Rosetta observed an outburst of material from the comet nucleus lasting several minutes on July 29. Besides imaging it, the spacecraft also saw a change in the structure and composition of the gaseous coma, detected increased levels of dust, and observed the outburst pushing away the incoming solar wind. Briefly the outburst was brighter than the nucleus. Previous outbursts have not even approached these levels. Apparently heat from the Sun reached a pocket of material that was evaporated in this outburst, drawing dust along with the gases.

Philae (Rosetta's comet lander) – When the lander bounced (last November) instead of landing and attaching as planned, it was actually good for science, since many measurements were made at 2 (or 3) sites instead of 1. The 1st and final sites were quite different. Agilkia (as the 1st touchdown site was named) is a relatively soft surface, covered with a layer of granular material about 0.8 ft (.25 m) deep. Abydos (final site) is much harder. Images showed a fractured boulder-studded terrain with a variety of grain sizes and reflectivities.

The soft comet dirt is up to 6.5 ft (2 m) deep in some places and nonexistent in others. Pictures also showed a boulder about 16 ft (5 m) wide, which is partly surrounded by a depression resembling a "wind tail", an erosional feature seen on Mars and Earth, caused by wind. Rosetta found 17 such wind-tail-like features. These may be caused by particles hitting the comet nucleus and abrading its surface. Philae found daytime temperatures in the range minus 226-298 °F (minus 143-183 °C). The temperatures must have risen since then because the comet is nearing the Sun. Closest approach was August 13. Philae instruments found 16 different organic (carbon) chemicals, including 4 that had never been seen on or around a comet. The material was mixed with lots of water and carbon dioxide, as expected. Philae probed the interior of the comet with radio waves from Rosetta. The "head" of the rubber-duck-shaped comet nucleus is internally homogeneous of the scale of a few tens of yards (m) and extremely porous, with open space making up 75-85% of its volume. Philae is angled up against a cliff face. Images reveal fractures in the comet's cliff walls that are ubiquitous at all scales. The lander woke when struck by sufficient sunlight in mid-June, but communications with Philae remain very spotty.

Sedna is a fairly large (about 600 mi = 1000 km) object in the outer reaches of the Solar System with an extremely eccentric orbit. Its closest point is about 2.5 times as far as Neptune, while the farthest point is 12 times farther still. A recent study, using computer simulations, shows that it may have been stolen from its orbit about another star when that star passed close to the Sun. This probably happened before the Sun got far from its birth cluster, perhaps 4 billion years ago. Only one other object (2012 VP113) is known with a similar orbit, but the simulations predict there are hundreds of them. We were lucky to have discovered Sedna when it was comparatively quite near the Sun, and therefore at its brightest.

Black hole growth – Astronomers believe they have finally uncovered the mechanism that causes the masses of supermassive black holes to almost always be a certain fraction of the masses of the central bulge of the galaxies containing the black holes. It appears that something is regulating both the growth of the black hole and the star formation, and many years of searching for this have not produced a definitive theory. The new work shows that: 1) jets of material thrown out from near the black hole grow and shrink according to the amount of cool gas falling toward the black hole, 2) more active jets heat the surrounding gas, and hot gas cannot fall toward the black hole, so 3) these act like a thermostat to regulate the rate at which gas falls in, 4) the rate of that same cool gas falling in restricts how many stars can form. The study that developed this theory involved observations from the Hubble, Galaxy Evolution Explorer (ultraviolet), Herschel (infrared and submillimeter), Spitzer (infrared), Chandra (X-ray), and XMM-Newton (X-ray) space telescopes, the Jansky Very Large Array radiotelescope, the 3.5-meter WIYN optical telescope (Arizona), and the 6.5-meter Baade optical telescope (Chile). More work needs to be done to verify that the correct theory has finally been found.

Most luminous supernova has been discovered by an all-sky survey known as ASASSN, which is designed to discover supernovas. Follow-up observations showed that it shines as luminous as 572 billions Suns. It is about 2.8 billion light-years away. Its spectrum lacks hydrogen features, which means the star had lost its outer hydrogen layers before exploding (common for some types of supernova). A few other superluminous supernovas have been seen, that is, ones 10-100 times as bright as normal, but this is the brightest one yet.

Brightest flare – In June, the blazar 3C 279 gave off the brightest flare in gamma-rays ever seen. 4 days later, it had returned to normal brightness. A blazar is an active supermassive black hole that happens to have its jet aimed at us. Considering that 3C 279 is 5 billion light-years away, the flare must have been awfully luminous. The same object in 1991 set the records then for most luminous and most distant gamma-ray flare. The recent one was 10 times brighter.

Black hole awakening – V404 Cygni is a binary system with a black hole and a Sun-like star. Material from the normal star is falling toward the black hole, forming a disk about it. Every so often the disk becomes unstable and a piece falls into the black hole. In June, it did so for the 1st time since 1989, producing over 70 flares

in one week. Observations are being made in many wavelengths to better understand such events. In X-rays light echoes are observed, caused by the expanding sphere of light from a flare hitting surrounding material. V404 is about 8000 light-years away.

Another awakening – Another team observed a much more distant black hole awakening, this one in galaxy NGC 660, 42 million light-years away in Pisces. This one was seen to brighten in radio light by hundreds of times over a few months. Using separate radiotelescopes combined as an interferometer, the bright source was found to be at the center of the galaxy, and therefore must be the central black hole. The highest resolution radio images showed that a jet has formed near the black hole, containing material traveling at about 10% the speed of light. Archived radiotelescope data for this galaxy was examined, and no previous comparable brightening was found.

Giant black hole – A team of astrophysicists has discovered a gigantic black hole, one of the largest known at about 7 billion times the Sun's mass, in a normal-sized galaxy, using the Keck I Telescope in Hawaii. Most supermassive black holes are about 0.2-0.5% the mass of their host galaxy, but this one is 10% the mass. This will require re-examining our theories of how black holes and galaxies grow. The galaxy is so distant that its light took over 11 billion years to reach us. The galaxy is dubbed CID-947.

Smallest giant black hole – Chandra X-ray space telescope and the 6.5-meter Clay Telescope in Chile have identified the smallest supermassive black hole ever detected in the center of a galaxy. This oxymoronic object could provide clues to how larger black holes formed along with their host galaxies 13 billion years ago. Astronomers estimate this supermassive black hole is about 50,000 times the mass of the Sun. This is about half the mass of the previous smallest black hole at the center of a galaxy. The new black hole is in the center of a dwarf disk galaxy, called RGG 118, located about 340million light-years away, and was originally discovered in the Sloan Digital Sky Survey. Researchers estimated the mass of the black hole by studying the motion of cool gas near the center of the galaxy using visible light data from the Clay Telescope. They used the Chandra data to figure out the X-ray brightness of hot gas swirling toward the black hole. The black hole in RGG 118 is nearly 100 times less massive than the supermassive black hole found in the center of the Milky Way. Astronomers are trying to understand the formation of billion-solar-mass black holes from less than a billion years after the big bang, but many are undetectable with current technology. This black hole gives astronomers an opportunity to study a nearby small supermassive black hole as a substitute for the more massive ones before they grew large. There are 2 theories of how supermassive black holes begin: a huge cloud collapses into a black hole of thousands of solar masses, or a star collapses during a supernova to a much smaller black hole, which then grows to thousands of solar masses by consuming other mass. Finding such small supermassive black holes as RGG 118 may help settle which theory is correct.

Densest galaxies – 2 undergraduate college students have discovered 2 galaxies that are the densest known. Similar to globular star clusters, but far brighter, the new systems have properties intermediate in size and luminosity between galaxies and star clusters. The 1st system, M59-UCD3, has a width 200 times smaller than our Milky Way and a density of stars 10,000 times that of the Sun's neighborhood. An observer at its core would see a million stars at night. Both systems belong to the class of galaxies known as ultra-compact dwarfs (UCDs). The study used imaging data from 3 ground-based telescopes and the Hubble Space Telescope. The system is associated with a larger host galaxy: M59. The nature and origins of UCDs are mysterious. They may be remnant nuclei of tidally stripped dwarf galaxies or merged super star clusters, or galaxies that just formed with might densities. Some UCDs have overweight supermassive black holes, which may indicate that they were larger galaxies that were stripped. The known UCDs are found near massive galaxies that could have done the stripping. The team will follow up by investigating the motions of stars at the heart of M59-UCD3 and hunting for more UCDs.

Globular ages – Using a new age-dating method, a team of astronomers has determined that ancient globular star clusters formed in 2 distinct times: 12.5 billion years ago and 11.5 billion years ago. Although the clusters are almost as old as the Universe itself, these age measurements show the globulars are actually slightly younger than previously thought. They appear to have formed alongside galaxies, not before galaxies. The ages were determined by comparing the chemical composition of the globulars with the changing chemical composition of the Universe over time.

Quintuple star – New spectroscopic study of a quadruple star discovered 2 years ago showed that there is a 5th star in the system. The original 4 consist of 2 eclipsing pairs. That happens only when their orbits are edge-on to our view, so the stars pass in front of

their companions instead of above or below them. The orbital periods of the pairs are 6 hours and 31 hours. One pair is a contact binary; that is, they are so close that their atmospheres touch. Either the 5 stars or double eclipsing variables would make this an unusual system. Only 5 other double eclipsing binaries are known. It will undoubtedly be further studied for years. It is being called 1SWASP J093010.78+533859.5, and is located in Ursa Major. It is thought to be 9-10 billion years old. If any of the 5 stars has a planet, night on that planet would be rare, since it requires all 5 stars to set.

Rare binary – A team of researchers, assisted by amateur astronomers, has discovered a unique binary star system: the 1st known cataclysmic variable that is in an eclipsing pair. A cataclysmic variable is a white dwarf that flares up when material falls on it from its companion star. The pair is named Gaia14aae (since the Gaia spacecraft found it when it got 5 times brighter in a day), and is 730 light-years away in Draco. The pair is so close that they orbit in about 50 minutes. Their spectrum shows no hydrogen, meaning that both stars have lost their hydrogen outer parts, leaving their helium cores. Measuring the eclipses of any eclipsing binary allows calculating sizes and mass of the stars, so finding this pair is important to understanding hydrogen-free cataclysmic variables.

Binary star exoplanet – A planet, dubbed Kepler-453b, that orbits both of a pair of stars, has been discovered. This is the 10th such planet known. The 1st was discovered just 4 years ago. Kepler-453b is the 3rd circumbinary exoplanet found to lie in the habitable zone of the pair, that zone where temperatures exist that allow liquid water on the surface of a planet. The high fraction of habitable zone planets among those orbiting 2 stars is explained by the restricted area in which planet orbits are stable despite the destabilizing effect of 2 stars. Since Kepler-453b is a gas giant, it doesn't have an accessible surface, so would not have liquid water, even though in the habitable zone. It was surprising to find that the tilt of the orbit of Kepler-453b wobbles over a period of 103 years, and is aligned for transits, that is, passing in front of its star (by which it was discovered), for only about 9 years out of those 103. It was fortunate that the transits happened to be occurring during the life of the Kepler planet-finding telescope. The planet has a diameter 6.2 times that of Earth, and takes 240 (Earth) days to orbit its pair of stars, while the stars orbit each other every 27 days. The planet's mass was not able to be measured, but is likely to be less than 16 times that of Earth. The system is 1400 light-years away and is estimated to be between 1 and 2 billion years old, much younger than our Solar System. With 10 known circumbinary exoplanets, astronomers can now begin comparison and trend studies of these.

Most Earth-like planet – The Kepler (planet-finding space telescope) mission has confirmed the 1st known near-Earth-sized planet in the habitable zone around a Sun-like star. Previous habitable-zone finds have orbited a tiny star or have been much larger than Earth. The habitable zone is the distance from a star where temperatures exist that support liquid water on a planet. The newly found planet, designated Kepler-452b, is 60% larger in diameter than Earth. This size is usually found only on rocky planets, though the possibility of a small gas giant has not yet been ruled out. The planet orbits a star 20% brighter than our Sun, and has a 385 Earth-day year. The star and the planet are 6 billion years old, as compared to the 4.5 billion year age of the Earth. They are 1400 light-years away in Cygnus. About a dozen planets are known with diameters less than 2 times Earth's orbiting in habitable zones. The SETI Institute has begun searching for radio signals from 452b, but has not heard anything.

Most Jupiter-like planet – A team of astronomers using the 3.6-meter telescope in Chile has identified a planet like Jupiter orbiting at the same distance from a Sun-like star. The existence of a Jupiter-mass planet in a Jupiter-like orbit around a Sun-like star may have shaped the planetary system there more like our Solar System. The star is HIP 11915, which is visible in binoculars.

Young Jupiter-like planet – A team of astronomers discovered a Jupiter-like planet within a young system, using the Gemini South Telescope in Chile, and confirming with the Keck Telescope in Hawaii. The new planet, 51 Eridani b, is 1 million times fainter than its parent star, yet was imaged with adaptive optics in infrared. It shows the strongest methane signature ever detected on an exoplanet, which should yield additional clues as to how the planet formed. This is the 1st planet discovered with the Gemini Planet Imager. The longer wavelength infrared used by the Keck helped measure the properties of the clouds on the planet. The host star, 51 Eri, is very young, a mere 20 million years old, and is slightly hotter than the Sun. The exoplanet, whose mass is estimated to be roughly twice that of Jupiter, appears to orbit its host star at a distance of 13 AU (where the Earth orbits 1 AU from the Sun). In addition to being the lowest mass planet ever imaged, it's also one of the coolest (800°F = 425°C), where other young planets are around 1200° F (650°C). Previous Jupiter-like exoplanets have shown only faint traces of methane, far different from the heavy methane atmospheres of the gas giants in our Solar System.

Spitzer (infrared space telescope) has confirmed the discovery of the nearest rocky planet outside the Solar System. It is 21 light-years away. There is an exoplanet known at 14.8 light-years, but it is not known to be a rocky planet. The newly confirmed planet is dubbed HD 219134b, and is also the closest exoplanet seen to transit (pass in front of) its star. It was discovered by the radial velocity technique, but was later found to transit also. This means it can be studied in many ways. The diameter is about 1.6 times Earth's, has a mass 4.5 times Earth's, and has a density of 6, somewhat more than Earth's. It is close to its star, so is too hot for life. 3 more planets have been found orbiting this same star. 2 are small and not far from their star.

Distantly orbiting planet – Teams using the Keck Telescope in Hawaii and the Hubble Space Telescope have made independent confirmations of an exoplanet orbiting far from its central star. The planet was discovered through gravitational microlensing. This is caused by the gravity of the planet (and its star) passing in front of another star. This happens, for a given planet, only once in a million years (literally), so there has never been a follow-up on a planet discovered by this technique, until now. Microlensing can find more distant and colder planets in long-period orbits that other methods cannot detect. The new results show the system consists of a Uranus-sized planet orbiting about 370 million miles (590 million km), slightly less than the distance between Jupiter and the Sun. The host star is about 70% as massive as our Sun. The Keck and Hubble telescopes were able to detect the faint host star of the planet after it passed far enough away from the star that it lensed. The planet is probably an example of a failed-Jupiter planet, an object that begins to form a Jupiter-like core, but doesn't grow enough, ending up with a mass more than 20 times smaller than Jupiter. The new observations, when combined with the information from the microlensing, reveal the masses and orbital separation of the planet and its host star, as well as the distance of the planetary system from us.

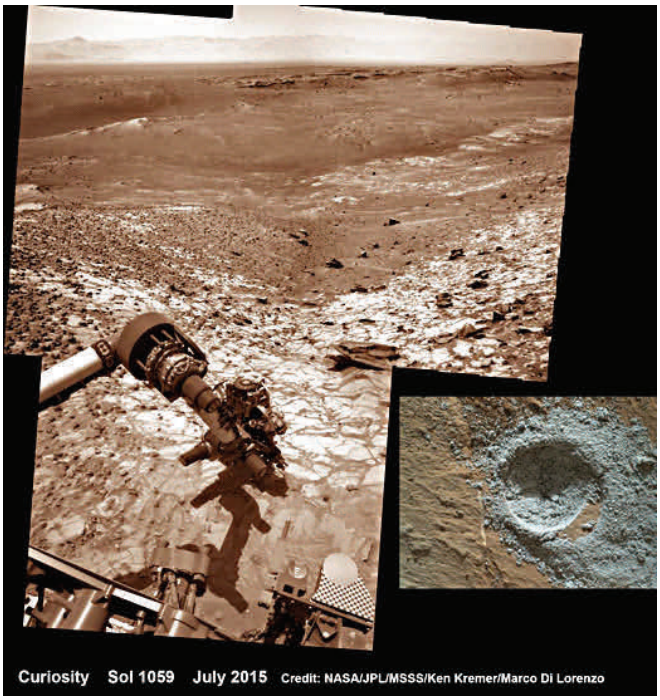
Lost Dragon – The cause of the failure of the SpaceX Falcon 9 rocket in June, which was to have resupplied the International Space Station, has been preliminarily designated as the failure of a strut that holds one of the helium pressurization tanks inside the 2nd stage fuel tank. This broke open the fuel tank. The strut apparently broke at 5 times less force than it should have been able to withstand. Tests on copies of the strut showed some failed similarly. The failure occurred while the 1st stage was still firing, before the 2nd stage was ignited. SpaceX has stated that they expect to find a new vendor from which to buy their struts. The Dragon cargo capsule actually survived the rocket explosion, but was destroyed when it hit the ocean. It would have survived the ocean hit also if its parachute had opened, but the control computer was programmed to only deploy parachutes on trips down from the space station, not trips up. SpaceX is updating the program. This was the 1st failure of a Falcon 9 after 18 straight successes.

SETI (search for extraterrestrial life) – Russian tycoon Yuri Milner has donated $100 million to SETI. This will fund a search, dubbed Breakthrough Listen, using the Green Bank and Parkes radiotelescopes hooked up to new receivers and processors. It will listen to billions of frequency channels while examining the nearest million stars and the 100 nearest galaxies. Also, the entire plane of the Milky Way will be observed, and an optical search will use the Lick Observatory's Automated Planet Finder telescope. The result will search for intelligent signals 100 times faster than recent searches.

Instant AstroSpace Updates

A 21-year study of a pulsar orbiting a white dwarf 3750 light-years away shows that to extreme precision the **strength of gravity** there is constant over time and exactly equal to the strength measured in the Earth-moon system. This negates the possibility of certain alternate gravity theories that expect gravity to change with place or time.

Curiosity (Mars rover) has drilled a sample out of a silica-rich rock that is unlike anything the rover has studied before. It is in an area where 2 rock types come together: pale mudstone and darker sandstone. The drill previously had problems with a short circuit, but seems to be working fine now.



A new study found auroras giving off radio waves on a **brown dwarf**, a star too small to sustain nuclear fusion. The aurora appeared more planet-like than star-like in its magnetic/aurora behavior, though it was hundreds of thousands of times more powerful than local aurora.

Kepler (planet-finding space telescope) team has released the results of analyzing further spacecraft observations made by 2013, resulting in 521 more planet candidates (for a total of 4696), which must now be confirmed with other types of observations. The next release will finish analyzing all observations made by Kepler before 2 of its gyros failed (though observations of other target areas have continued with the K2 mission, which doesn't use all gyros to point).

During July, 3 **asteroids** that were passing near Earth were imaged using radar. One of those, 2011 UW158, was found to have a very odd shape and it spins once every 37 minutes, confirming optical observations of its fast rotation, and another (1999 JD6) has a peanut shape.

Dawn (asteroid mission) experienced a problem with one of its engine gimbals, and went into safe mode, but was put back into full operation (using another of its 3 engines) within a couple of weeks to resume mapping Ceres.

Diffuse interstellar bands, discovered in 1922, are more than 400 spectral lines seen in interstellar dust, which have not been identified with any known substance. 2 of the lines have now been found to be caused by ionized buckyballs, molecules of 60 carbon atoms in a soccer-ball-shaped cage.

Cassini (Saturn mission) made its 5th and final close flyby of the moon **Dione** on August 17 to measure its internal structure, take high-resolution images, and look for possible geological activity.

Science team members for **Mars Reconnaissance Orbiter** are asking for citizen scientists to analyze exotic features imaged near the south pole of Mars, as a part of the online Zooniverse project. The features, with such informal names as spiders and Swiss cheese, are formed by seasonal freezing and thawing of carbon dioxide ice.

International Observe the Moon Night

September 19, 2015 is International Observe the Moon Night (InOMN) sponsored by NASA. The event is held each year to encourage observation, appreciation and understanding of our Moon. See http://observethemoonnight.org/

This year the Orange County Astronomers will be conducting an Outreach program at the Nix Nature Center, 18751 Laguna Canyon Road in Laguna Beach. The program begins with a lecture by Chris Butler at 7:00 PM and viewing the moon through the telescopes of the OCA Outreach volunteers at 8:00 PM. Everyone is invited to come to hear Chris and to observe the moon.

Chris Butler is extremely knowledgeable about the moon. He grew up during the days of the Apollo missions to the moon. In fact his father worked on one of the teams that built the hardware that NASA used to put the men on the moon.

The moon will be in its first quarter phase, which is perfect for viewing. At that phase the walls of the craters cast shadows onto the floor of the crater thus providing a quasi-three dimensional view of the moon. The length of the shadows inside the basin give an indication of the height of the crater walls.

This is a open event and the general public is welcome to attend. Please spread the word about this event as it is an excellent way to promote interest in astronomy and in the OCA.

Event: International Observe the Moon Night

Host: Laura Cohen, Resource Specialist, Orange County Parks Department

Date: Saturday, 9/19/2015

Time: Chris Butler Lecture at 7:00 PM

Viewing the moon at at 8:00 PM

Place: Nix Nature Center, 8751 Laguna Canyon Rd; Laguna Beach (33°36'30"N, 117°45'48"W)

Directions: Take CA-55 S to I-5 South. Take exit 11A to merge onto I-5 South; go 7.7 mi. Take exit 95 for State Hwy 133 South. Merge onto CA-133 S; go 5.4 mi. Nix Nature Center is on the right (west side of the street).

SCAE OPT – July 25, 2015

This year OPT (Oceanside Photo & Telescope) held another big Southern California Astronomy Exposition in the parking lot of their store on Mission Street in Oceanside. It was a one-day event with lots of vendors and great sales along with some nice free give away prizes.

Solar scopes were set up and people were amazed at the views of the Sun right from the parking lot. They had thousands of people pass through and OPT generously provided OCA with a free booth. We were the only Astronomy club with a booth this year which Steve & Bonnie Short set up in the afternoon. Kyle Cooker also came by for awhile but next year we would like to see more OCA member volunteers sit at the booth and hand out OCA brochures and tell people about the club.

The OCA booth stayed open until the last raffle and passed out a lot of brochures. Bonnie logged 36 people that stopped by and many were very interested in joining the club.

Cops mistake telescope for rifle, accost stargazers

FARGO, N.D. - Two North Dakota State University students got a scare when armed police officers mistook their telescope for a rifle.

WDAY-TV reports that Levi Joraanstad and Colin Waldera were setting up the telescope behind their Fargo apartment Monday night when they were blinded by a bright light and told to stop moving.

They couldn't see who was shining the light and presumed it was a prank by other students.

An officer on patrol had spotted the two and thought the telescope was a rifle. He also thought Joraanstad's dark sweater with white lettering on the back looked like a tactical vest. He called for backup and the officers confronted the students.

According to WDAY, Joraanstad said at first the pair didn't take the situation seriously, certain it was just some friends fooling around.

Photo Credit: AP/Andres Guttierez

"... we were kind of wondering, what the heck's going on? This is pretty dumb that these guys are doing this. And then they (police) started shouting to quit moving or we could be shot. And so at that moment we kind of look at each other and we're thinking we better take this seriously."

Police say the two were never in any danger and that it was a situation of "better safe than sorry." Joraanstad says the officers were very apologetic when they realized their mistake, and that they explained what had happened.

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.

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