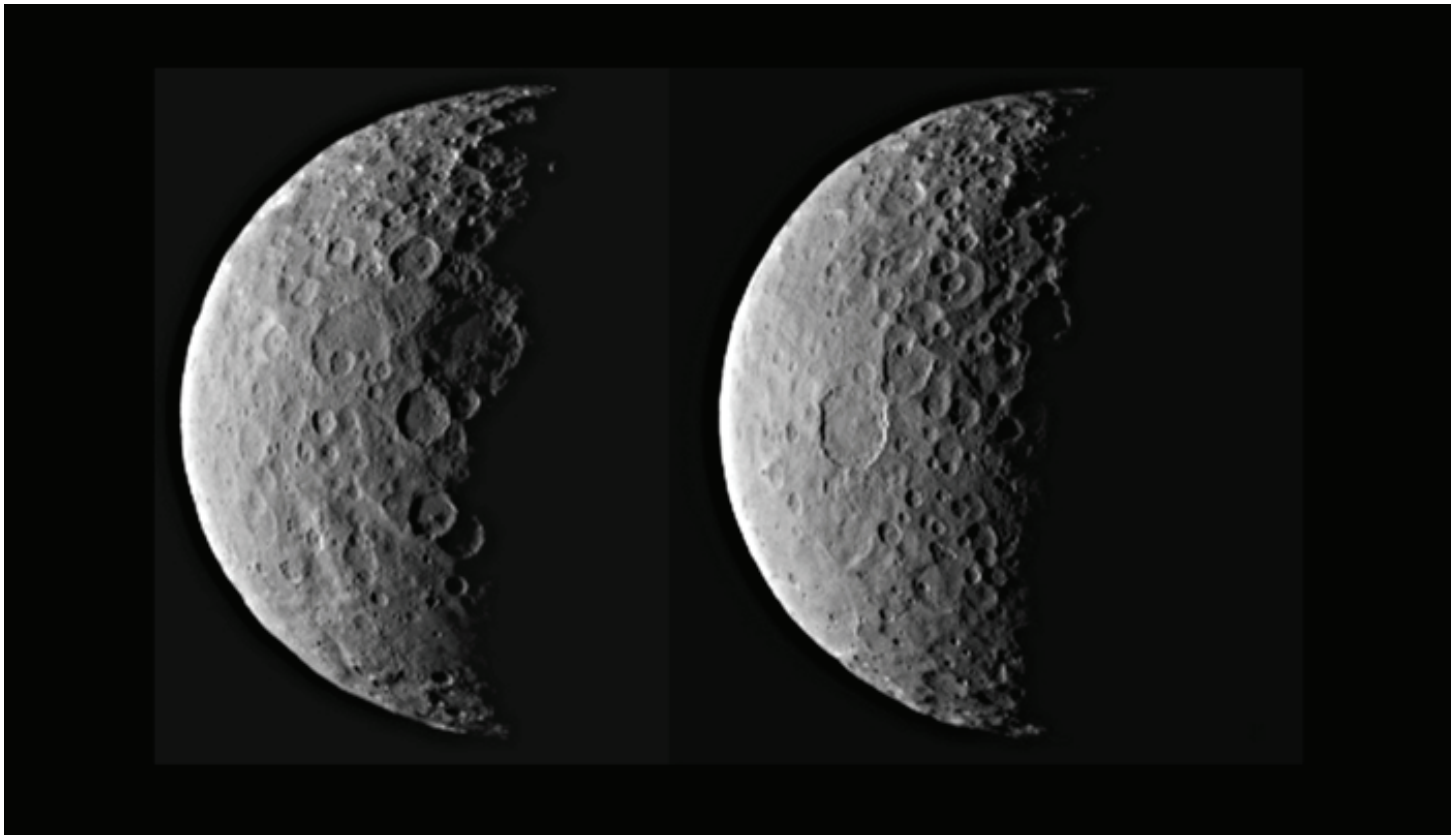
SIRIUS ASTRONOMER

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

April 2015 *Free to members, subscriptions $12 for 12 issues* **Volume 42, Number 4**



NASA's Dawn spacecraft arrived at dwarf planet Ceres on March 6, revealing the surface of the largest unexplored body in the inner Solar System for the first time. These images were taken from 40,000 kilometers (25,000 miles) from Ceres on February 25th. Over the course of the next year we will learn much more about this fascinating and important member of our solar system! (*Image credit: NASA/JPL-Caltech/UCLA/MPS/DLR/IDA)*

OCA CLUB MEETING

The free and open club meeting will be held April 10 at 7:30 PM in the Irvine Lecture Hall of the Hashinger Science Center at Chapman University in Orange. This month's speaker is Dr. Brendan Bowler of Caltech, who will discuss Imaging Extrasolar Planets.

NEXT MEETINGS: May 8, June 12

STAR PARTIES

The Black Star Canyon site will open on April 11. The Anza site will be open on April 18 Members are encouraged to check the website calendar for the latest updates on star parties and other events.

Please check the website calendar for the outreach events this month! Volunteers are always welcome!

You are also reminded to check the web site frequently for updates to the calendar of events and other club news.

COMING UP

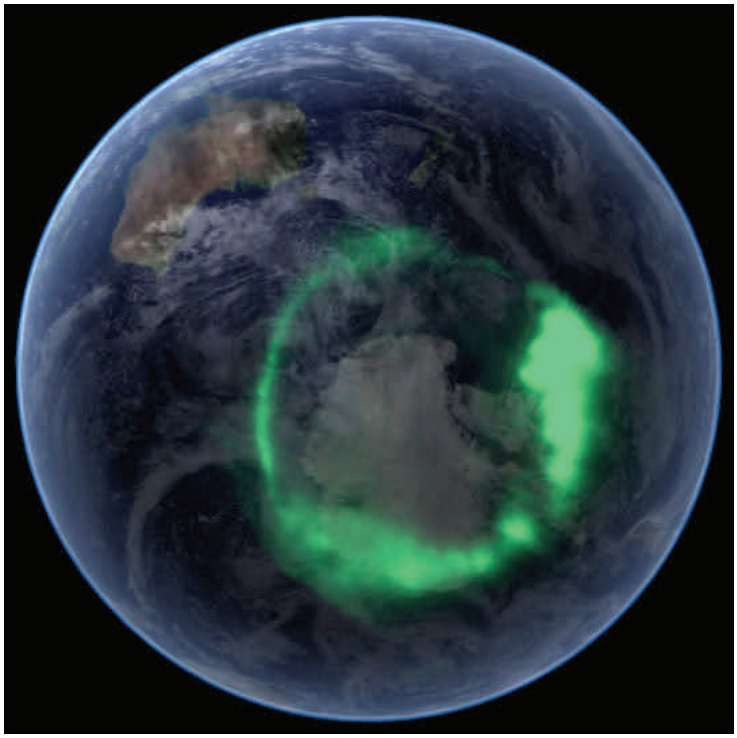
The next session of the Beginners Class will be held at the Heritage Museum of Orange County at 3101 West Harvard Street in Santa Ana on April 3. The following class will be held May 1.

GOTO SIG: TBA
Astro-Imagers SIG: Apr. 14, May 12
Remote Telescopes: TBA
Astrophysics SIG: Apr. 17, May 15
Dark Sky Group: TBA

The Cold Never Bothered Me Anyway

By Ethan Siegel

For those of us in the northern hemisphere, winter brings long, cold nights, which are often excellent for sky watchers (so long as there's a way to keep warm!) But there's often an added bonus that comes along when conditions are just right: the polar lights, or the Aurora Borealis around the North Pole. Here on our world, a brilliant green light often appears for observers at high northern latitudes, with occasional, dimmer reds and even blues lighting up a clear night.



Auroral overlays from the IMAGE spacecraft. Image credit: NASA Earth Observatory (Goddard Space Flight Center) / Blue Marble team.

We had always assumed that there was some connection between particles emitted from the Sun and the aurorae, as particularly intense displays were observed around three days after a solar storm occurred in the direction of Earth. Presumably, particles originating from the Sun—ionized electrons and atomic nuclei like protons and alpha particles—make up the vast majority of the solar wind and get funneled by the Earth's magnetic field into a circle around its magnetic poles. They're energetic enough to knock electrons off atoms and molecules at various layers in the upper atmosphere—particles like molecular nitrogen, oxygen and atomic hydrogen. And when the electrons fall back either onto the atoms or to lower energy levels, they emit light of varying but particular wavelengths—oxygen producing the most common green signature, with less common states of oxygen and hydrogen producing red and the occasional blue from nitrogen.

But it wasn't until the 2000s that this picture was directly confirmed! NASA's Imager for Magnetopause-to-Aurora Global Exploration (IMAGE) satellite (which ceased operations in December 2005) was able to find out how the magnetosphere responded to solar wind changes, how the plasmas were energized, transported and (in some cases) lost, and many more properties of our magnetosphere. Planets without significant magnetic fields such as Venus and Mars have much smaller, weaker aurorae than we do, and gas giant planets like Saturn have aurorae that primarily shine in the ultraviolet rather than the visible. Nevertheless, the aurorae are a spectacular sight in the evening, particularly for observers in Alaska, Canada and the Scandinavian countries. But when a solar storm comes our way, keep your eyes towards the north at night; the views will be well worth braving the cold!

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

Once again I would like to report on the activities of the WAA over the last year or so. We had a very productive board meeting on February 7, this time at the Chabot Space and Science Center and Observatory overlooking Oakland and the SF Bay Area. As you will recall, WAA is an umbrella organization whose members are astronomy clubs. It exists for the main purpose of collaboration between member clubs, promoting amateur astronomy, providing awards to individuals for outstanding contribution to the hobby, and hosting or sponsoring the occasional astronomy conference.

Eight member clubs were represented at this meeting, including one, Tri-Valley Stargazers (based in Stockton), which has not been active in WAA for many years. We welcome them back. The other clubs, OCA, Los Angeles Astronomical Society, Mt. Diablo Astronomical Society and Mt. Diablo Observatory Association, China Peak Astronomical Society, East Bay Astronomical Society, and Chabot Telescope Makers' Workshop are regulars at this winter meeting.

WAA's most noteworthy regular action at the winter meetings is selection of a recipient for the highly prestigious G. Bruce Blair award, given to a living individual who has made outstanding contributions to amateur astronomy. This year's award is to be presented to Timothy J. Thompson, a retired JPL scientist and president emeritus of LAAS who is being so honored, not only for his four decades of service to LAAS, but for initiation of the docent training program at Mt. Wilson Observatory, leading public outreach there and at Griffith Observatory for many years, as a prolific speaker for astronomy clubs, civic groups, and private functions, both as an amateur astronomer and JPL space scientist. As in the last several years, the award will be presented at the Riverside Telescope Makers conference on Memorial Day weekend.

The Blair medal itself is quite an involved production effort, which has been done personally by former WAA president Jack Borde. This task, which involves deep chemical etching on a bronze plate using an AutoCad digitized rendering of the original artwork, cutting out the medal itself from the plate, lathe turning, edge knurling, engraving with the recipient's name and finally being gold plated and presented in a hand-crafted wood display case. This task has now been turned over to the Telescope Makers' Workshop, which has a combination of professional contacts and in-house expertise for all but production of the case. Any woodworkers out there interested in donating some time to this last task? Let me know.

Two new issues of our New Pacific Stargazer newsletter were issued during this last year. The goal of quarterly issues was not possible, but the semiannual publication has worked well. The Fall 2014 and all other issues can be found from links at the WAA's web site, http://www.waa.av.org.. We are still looking for material for publication in future issues and are happy to accept articles of astronomical interest from individual club members. Contact me (see back page of the Sirius Astronomer) or editor Don Saito, donsaito@yahoo.com. Republication from other sources, such as this one, is okay as well, and will reach a more geographically wide audience. Speaking of which, the SA could really benefit from additional material from OCA members. This august publication is routinely dominated by only a few repeating authors, and would be of greatly enhanced benefit to members with the addition of material from the rest of you. Surely in a club of nearly 800 members there are a few thoughts, personal projects, ideas, insights or reports from astronomically-related trips that could be offered from this audience. Give it some thought and send something in.

But I digress. Another continuing effort within WAA is to get a new, updated web page on line. I can't offer excuses why this has taken so long (at least two years in the works), but I can say we have universal agreement on getting this launched as soon as possible, hopefully before RTMC.

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

AstroSpace Update

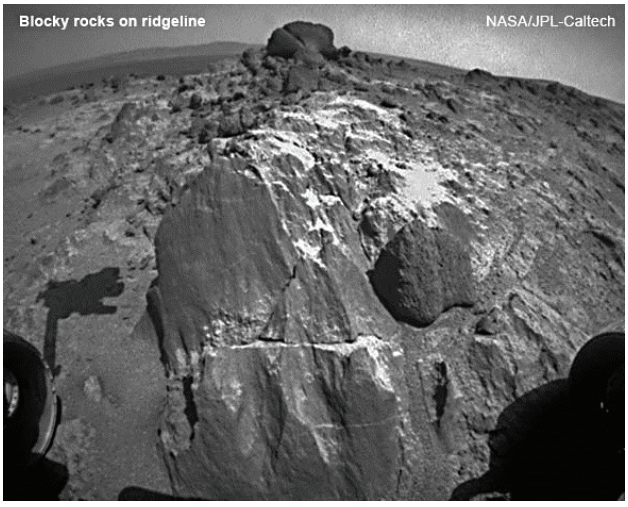
April 2015

Gathered by Don Lynn from NASA and other sources

Solar System visitor – Astronomers have measured the motion of a nearby star and found that it passed through the Oort Cloud of comets that surrounds our Solar System just 70,000 years ago. The star, known as Scholz's Star, is now 20 light-years away, but at closest approach it was 0.8 light-years. The star is a small dim red dwarf star, so was only about magnitude 11 when nearest. The star has a binary companion, which is a brown dwarf that is even dimmer. There seems to be no evidence that the close passage disturbed the Oort Cloud enough to cause a noticeable increase in comets.

Unusual exoplanet – Astronomers have discovered an unusual planet in Kepler (planet finding space telescope) data, which has an elongated orbit. This causes its temperature to change dramatically during each orbit. Its year is 52 Earth days, and during this time the temperature ranges from 900-1800°F (500-1000°C). The planet, dubbed Kepler-432b, is one of the densest and most massive planets known. It has about 6 times the mass of Jupiter, but is about the same diameter. It is orbiting a red giant star, which will likely swell up and engulf the planet within 200 million years. The majority of planets orbiting giant stars have larger and more circular orbits than Kepler-432b.

Dawn (asteroid mission) took closer images of Ceres as it approached to go into orbit about that dwarf planet. In particular, the bright spot discovered by the Hubble Space Telescope years ago was resolved into 2 bright spots, one larger and brighter than the other. Both lie inside an impact crater, with the brighter being closer to the crater center. Dawn's observations have shown that the bright spots are merely highly reflective of sunlight, not light sources on their own. Previous observations have shown that Ceres is darker (less reflective) than asphalt, on average. Speculation is that the bright spots (and some other similar bright spots scattered about Ceres) are ice or salts or lighter colored rock, caused either by an impact or volcanic activity. However volcanic activity should raise a mound and impact should leave a crater, neither of which has been seen. Other possibilities include levitated dust or sublimating gases lifting dust clouds. Further observations should settle this. The closer images show that the impact craters tend to be relaxed, that is, flattened out by the pull of gravity slowly squashing the icy surface. Ceres is known to be rich in water-ice, so it should be much different from the dry Vesta, which Dawn previously visited. Last year the Herschel infrared space telescope detected water vapor being emitted by Ceres. So relaxed craters were expected. Dawn entered orbit March 6, as planned. This isn't like firing a chemical rocket to enter orbit, where a few minutes of firing puts the spacecraft into orbit. Dawn has an ion engine, which puts out all the force of a sheet of paper being dropped on your desk, but the ion engine runs for years without running out of fuel, so great things are accomplished, but slowly. It actually takes weeks for the ion engine to achieve orbit about Ceres. The moment on March 6 simply represented the time when mathematically the spacecraft had slowed enough that it would gravitationally follow Ceres, even if the engine were turned off. But it would be too high of an orbit for good observations, so the ion engine continues to operate for weeks to get the desired orbit.



Opportunity (Mars rover) in February climbed to an overlook for surveying "Marathon Valley", a science destination chosen because spectrometer observations from orbit indicate clay minerals. Near the overlook, it found dark gray blocky rocks along a ridgeline unlike any previously examined on Mars. Spectra of the rocks shows the group higher on the ridge is slightly bluish, and the other group slightly purplish. They have relatively high concentrations of aluminum and silicon, and an overall composition not observed before by the rovers. Features in this area are being named after Lewis and Clark expedition members, such as "Sergeant Charles Floyd". The Opportunity team decided to spend more time investigating these rocks, delaying advancing to Marathon Valley.

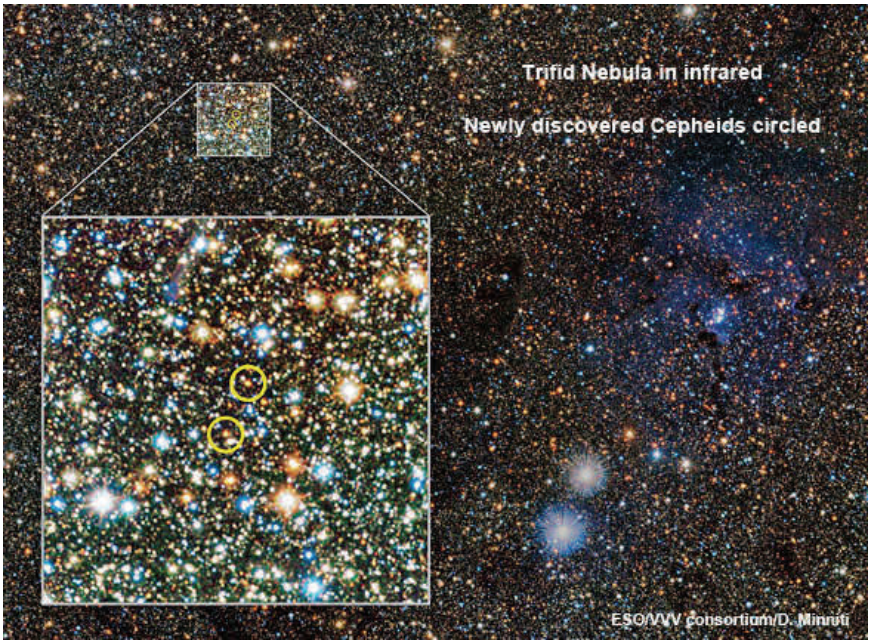
Martian ocean – Scientists have determined that Mars has lost to space 87% of the water it once had, which likely means that the Red Planet had an ocean covering the northern low lands billions of years ago. The scientists measured the isotopes of hydrogen in the water vapor in Mars's atmosphere using ground-based telescopes. Since water containing ordinary hydrogen and heavy hydrogen (isotope with an extra neutron) are lost to space at different rates, it is possible to calculate how much was lost from the current abundances of those isotopes. The study mapped the isotopes over the surface of Mars during nearly 6 Earth years. They found seasonal changes and micro isotope climates. They calculated the lost water would cover 19% of Mars's surface and reached depths of more than a mile (1.6 km). It would have held more water than Earth's Arctic Ocean. They also calculated that the ocean would have persisted somewhat longer than previous estimates of Mars's wet period, made from completely different data.

Martian plume – In March 2012, several amateur astronomers observed a cloud or plume high above the limb of Mars. It rotated with the planet, and persisted for several days, then disappeared, only to reappear weeks later. Examination of old images show that such a plume had occurred before. Professional astronomers have just announced the results of their study of the plumes: they don't know what they are, but have 3 theories that don't fit well. Such plumes might be dust, ice crystals, or aurora. If they are aurora, they would have to be twice as high as any other aurora observed on Mars, 1000 times as bright as any aurora seen on Earth, and longer lasting than any known Martian aurora. But the plumes were seen over areas where aurora has been seen previously on Mars. If dust or ice crystals, then the plumes would have to be much higher than either dust or ice has been seen above Mars. It would be difficult for dust to appear so bright, though ice crystals might. So the least objectionable theory is ice crystals. But more observations of such plumes are needed to decide among the theories, in particular to show how any kind of plume could rise so high.

Cassini (Saturn mission) has provided evidence that Saturn's moon Enceladus has current hydrothermal activity at the bottom of its ocean. Hydrothermal activity occurs when seawater infiltrates and reacts with a rocky crust and emerges as a heated, mineral-laden solution, a natural occurrence in Earth's oceans. Microscopic grains of rock, rich in silicon, detected by Cassini, measured at 6-9 nanometers (250-380 billionths of an inch) in size, have undergone a 4-year analysis. Computer simulations show that they most likely were formed when hot water containing dissolved minerals from Enceladus's rocky interior traveled upward, coming into contact with cooler water. The extremely small size of the particles suggests they travel upward relatively quickly from their hydrothermal origin to the near-surface sources of the moon's geysers. From seafloor to outer space, a distance of about 30 miles (50 km), the grains spend a few months or years in transit, otherwise they would grow much larger. Cassini's gravity measurements suggest the moon's rocky core is quite porous, which would allow water from the ocean to percolate into the interior. Another team found that the methane in the plume of gas and ice particles that erupts from Enceladus likely comes from hydrothermal activity also.

Ganymede ocean – The Hubble Space Telescope has the best evidence yet for an underground saltwater ocean on Ganymede, Jupiter's largest moon. The subterranean ocean is thought to have more water than all the water on Earth's surface. Ganymede is the only moon in the Solar System with its own magnetic field. The field causes aurora which is ribbons of glowing, hot electrified gas, in regions circling the north and south poles of the moon. Because Ganymede is close to Jupiter, it is also embedded in Jupiter's magnetic field. When Jupiter's magnetic field changes, the aurora on Ganymede also changes, rocking back and forth. By watching the rocking motion, scientists were able to determine that a large amount of saltwater exists beneath Ganymede's crust, affecting its magnetic field. Computer simulations show the rocking would be 3 times as large without an ocean. Scientists 1st suspected an ocean in Ganymede in the 1970s, based on computer models of the moon. The Galileo mission measured Ganymede's magnetic field in 2002, which fit the predictions if the ocean was present. Scientists estimate the ocean is 60 miles (100 km) thick, and is buried under a 95-mile (150-km) crust of mostly ice. The new observations were made in ultraviolet, and could only be accomplished with a space telescope above the Earth's atmosphere, which blocks most ultraviolet light.

Yutu (Chinese Moon rover) initial science results have been released. The ground-penetrating radar found at least 9 distinct rock layers beneath its wheels, indicating that the area has been surprisingly geologically active. The oldest layer was dated at 3.3 billion years ago. The Moon's "seas" were known to be basaltic lava, but Yutu also found pyroclastic rocks, which are formed by explosive volcanic activity. The top 2 layers appear to be rubble thrown out by a nearby impact crater, which formed somewhere in the range of 27-80 million years ago. Large buried boulders were detected, probably also thrown out by the crater formation. Rover observations indicate that the composition where it landed was quite different from that found by the Apollo missions and the Soviet Union's Luna landers. Yutu landed in December 2013, the 1st soft landing on the Moon since 1976.



VISTA (4-meter wide-field telescope in Chile) is being used to take images of the entire central region of the Milky Way in infrared light, which penetrates the dust found there. One discovery is a pair of Cepheid variable stars that were hidden behind the dust in the Trifid Nebula. Both lie near the far side of our galaxy. These are the only known Cepheids on the far side near the galaxy's plane. Others must exist, but are hidden by dust, at least so far. The distance to Cepheids can be accurately determined because their absolute brightness can be calculated from the period of their variability. 2 other teams using VISTA are surveying the entire Milky Way in infrared, looking for variable stars, including Cepheids. By the time they finish their survey, they expect to find hundreds of Cepheids, which will allow making a better map of the Milky Way's arms. Another astronomer found 4 Cepheids almost 300,000 light-years away, which puts them outside the Milky Way's disk. They are probably at the location where a companion dwarf galaxy was predicted, based on radiotelescope observations. It is possible that they are in front of the predicted dwarf galaxy if they are not standard (classical) Cepheids, so further observations are needed to rule out other types of variables that have different brightnesses than classical Cepheids.

Quasar winds – Observations by NuSTAR and XMM-Newton (X-ray space telescopes) show that the fierce winds known to emanate from supermassive black holes blow outward in all directions, not in jets or beams. Theorists had thought this to be true, but no observations had been made to support it. Such winds travel at up to 1/3 the speed of light. In the new study, astronomers determined that PDS 456, an extremely bright black hole known as a quasar more than 2 billion light-years away, sustains winds that carry more energy every second than is emitted by a trillion suns. This shows that quasar winds significantly contribute to galaxy mass loss, which depletes fuel for star formation. The 2 telescopes are sensitive to different wavelengths of X-rays, so observations from both had to be combined to show the whole picture of this quasar's winds.

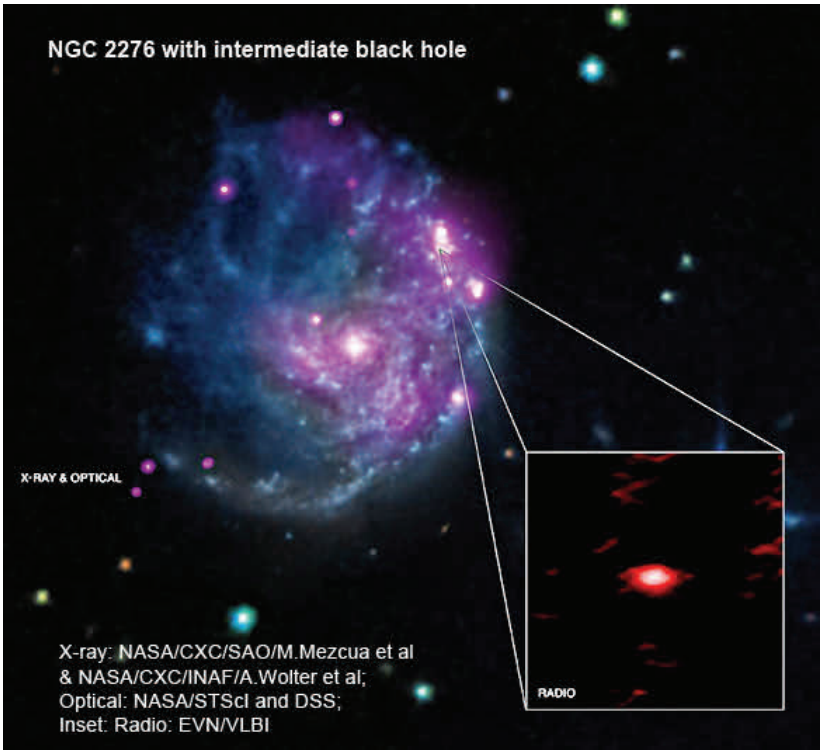
Black hole mass – Every massive galaxy seems to have a black hole at its center, and the more massive the bulge of stars in the galaxy, the more massive is its black hole. A new study measured how the mass of a central black hole correlates with the mass of dark matter surrounding its galaxy. The study looked at more than 3000 elliptical galaxies. They used star motions to calculate the masses of the central black holes. X-ray measurements of hot gas surrounding the galaxies helped determine the mass of dark matter, because more dark matter holds onto more hot X-ray emitting gas gravitationally. The correlation was found to be stronger than that between black hole mass and the galaxy's stars. This probably means that the mass of dark matter is the cause and both black hole mass and galaxy star mass are effects. More work is needed to verify this.

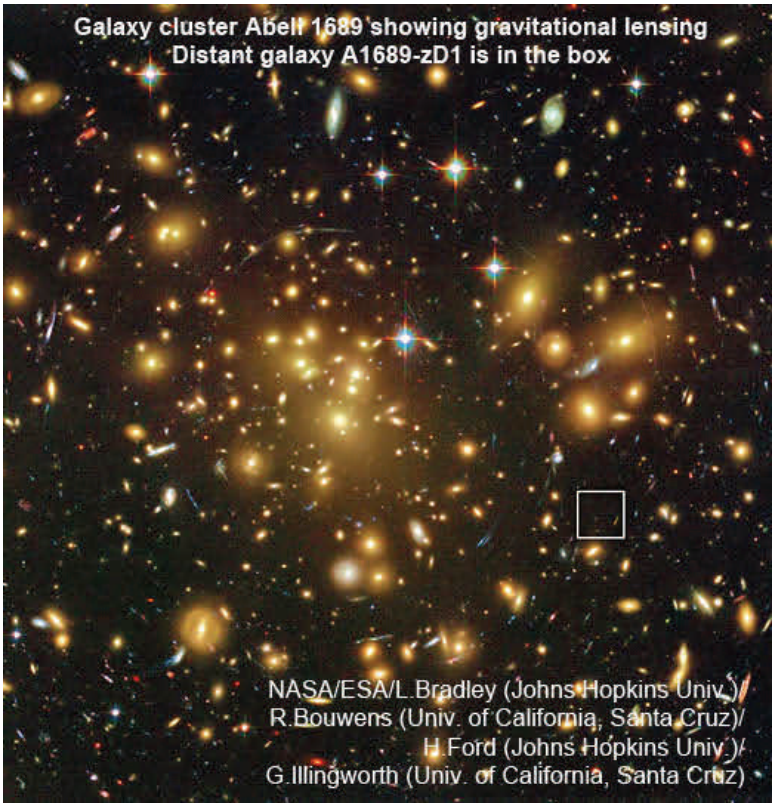
Brilliant quasar – Astronomers have discovered one of the brightest quasars in the early Universe, dubbed SDSS J010013.02+280225.8. Its redshift was found to be 6.3, which means it is so distant that light left it 12.8 billion years ago. It is the quasar with the greatest absolute brightness among known ones more distant than redshift 6. There are about 40 quasars known this far away. Its luminosity is 420 trillion times that of the Sun. It was found in a survey that uses visible and infrared data from the SDSS, 2MASS and WISE surveys. 2 methods were used to estimate the mass of the black hole in the quasar, and the result is 12-13 billion solar masses. Since we are seeing it as it was only a billion years after the Big Bang, it must have grown at the maximum accretion rate for most of its existence to reach this mass. Somehow it must have avoided the processes that should shut down black hole growth. Or perhaps the theory applies here that huge amounts of mass can collapse directly to a black hole without need of growing over time up to a huge mass.

Molecules around black holes – Researchers using ALMA (submillimeter radiotelescope array) have discovered regions where certain carbon (organic) molecules somehow endure the intense radiation near the supermassive black hole at the center of galaxy M77.

Such complex molecules should be easily obliterated by the strong X-rays and ultraviolet light that permeate the area surrounding supermassive black holes. The new ALMA data indicate, however, that pockets of calm exist in this region, most likely due to dense areas of dust and gas that shield molecules from otherwise lethal radiation. The new observations showed distributions of 9 types of molecules, in both the inner ring ("circumnuclear disk") and outer ring ("starburst ring") surrounding the black hole. The distribution varies according to the type of molecule. Carbon monoxide is distributed mainly in the starburst ring, but 5 other molecules including cyanoacetylene are found primarily in the circumnuclear disk. Other molecules, including methanol, are found in both places.

Intermediate black hole – Lots of black holes of stellar mass (that is, with the mass of a large star) and lots of supermassive black holes (millions of stellar masses) are known, but ones of intermediate mass (100-100,000 times the Sun's mass) are practically unknown. Astronomers have discovered what appears to be one of these intermediate mass black holes in the arm of NGC 2276, a spiral galaxy 100 million light-years away. The object is shooting out a powerful radio jet 6 light-years long, with more radio emission extending out 2000 light-years. An inner region 1000 light-years long seems to be missing young stars, suggesting the jet impacted star-forming. The mass was estimated at about 50,000 solar masses using known relationships between mass and X-ray and radio brightness. Further confirming observations need to be made to rule out possibilities other than an intermediate black hole, such as stellar mass black hole with incredibly strong jets. Another team of astronomers has proposed that this black hole is the result of a collision of a dwarf galaxy with NGC 2276, and the black hole was the dwarf galaxy's central black hole, which had not reached supermassive size because the dwarf galaxy was so small.

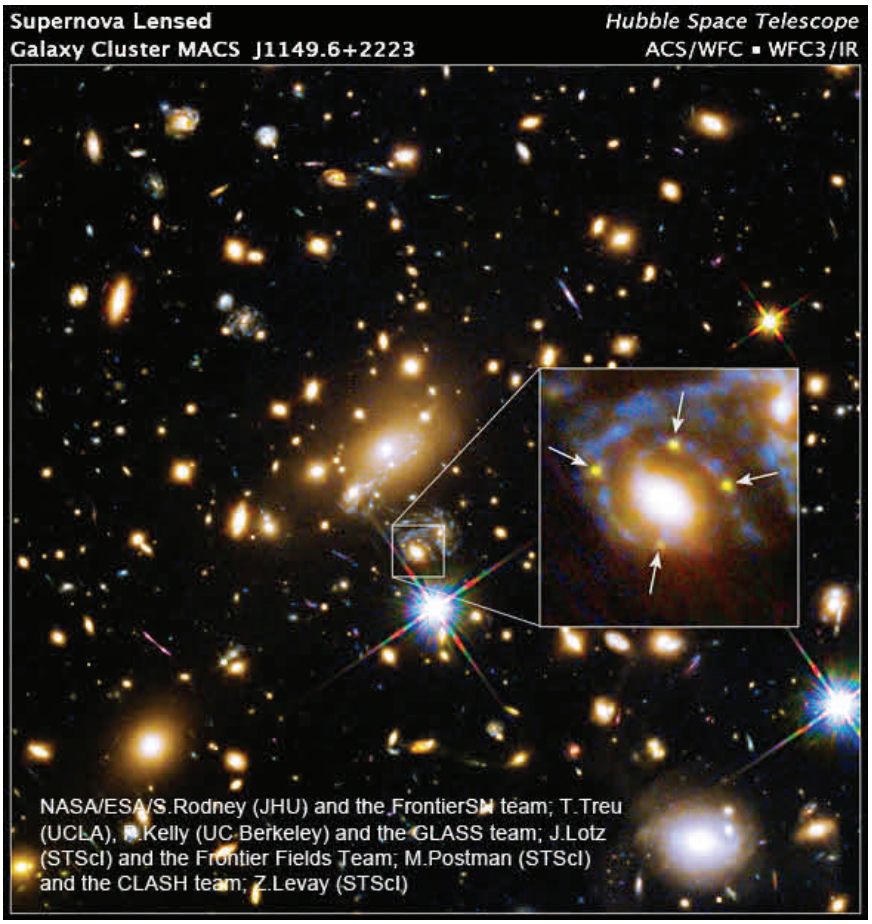




Distant galaxy – One of the most distant galaxies known has provided astronomers with the 1st detection of dust in such a remote star-forming system. The new observations have used ALMA to pick up the faint glow from cold dust in the galaxy A1689-zD1 and used the Very Large Telescope (8-meter optical telescope in Chile) to measure its distance. It is one of the youngest galaxies observed (because its light took over 13 billion years to reach us, it was young when the light left), and astronomers were surprised to discover a far more evolved system than expected. It had a fraction o dust similar to a very mature galaxy, such as our Milky Way. The galaxy is observable only by virtue of its brightness being amplified more than 9 times by a gravitational lens from the galaxy cluster Abell 1689 lying in front of it. If it formed 560 million years after the Big Bang, and consistently formed stars at a moderate rate, then it would have reached the state we observe. If it formed later, then it would have had to pass through a period of extreme starburst.

Star formation by a black hole – Astronomers used the Very Large Array radiotelescope to image the Milky Way's center. They discovered 44 planet-forming protoplanetary disks surrounding low-mass stars within 2 clouds. The clouds lie only 2 and 2.6 light-years from the supermassive central black hole. Massive stars have previously been found to form near that black hole, which was a surprise. The new observations show low-mass stars also form there, and apparently form planets too. It appeared that stars are being formed continuously, not just in one anomalous burst. Intense ultraviolet and stellar winds shape the disks into comet shaped masses, but have not destroyed them. The star clusters within the 2 clouds are between 10,000 and 100,000 years old.

Lensed supernova – A number of galaxies and quasars have been found gravitationally lensed, but never a supernova, until now. The supernova exploded in a distant galaxy directly behind a massive galaxy, which is embedded in a really massive cluster of galaxies, so it was doubly lensed by the masses bending the supernova light. The supernova showed up as 4 points of light surrounding the massive galaxy. Computer models of the mass concentrations within the galaxy cluster predict that another image already reached us 20 years ago, and yet another will show up in 1-5 more years. The 4 points showed up within days of each other. All the time differences are caused by light taking longer or shorter paths, depending on how much the light was bent. The lensing galaxy cluster is known as MACS J1149.6+2223, and is located more than 5 billion light-years away. The supernova's light took 9 billion years to reach us. The lensing brightened the supernova by about 20 times. About 50 years ago the astronomer Sjur Refsdal proposed that measuring the time delay between images of a lensed supernova would allow us to measure the expansion of the Universe, and so astronomers have been looking for such an occurrence ever since.



Galaxy growth – Using Chandra (X-ray space telescope), astronomers have found that the growth of galaxies containing supermassive black holes can be slowed down by a phenomenon refereed to as cosmic precipitation. This is a mechanism that allows hot gas to produce showers of cool gas clouds that fall into a galaxy. Researchers have analyzed X-rays from more than 200 galaxy clusters, and believe that this gaseous precipitation is key to understanding how giant black holes affect the growth of galaxies. The new observations showed evidence of slowing down star formation. It has long been known that central black holes influence the growth of galaxies, but the mechanism has remained a puzzle. The study looked at some of the largest known galaxies that lie in the middle of galaxy clusters. These galaxies are embedded in enormous atmospheres of hot gas. This hot gas should cool and many stars should then form (stars are known to form only from cool gas). But something is hindering the process. The Chandra data was used to estimate how long it should take for the gas to cool at different distances from black holes. They found that some clouds fall into the black hole, triggering jets of particles that push against falling gas and reheat it. This limits the amount of cool gas and star formation. The Chandra data indicates this process has been going on at least the last 7 billion years. Future studies will test whether this process also regulates star formation in smaller galaxies.

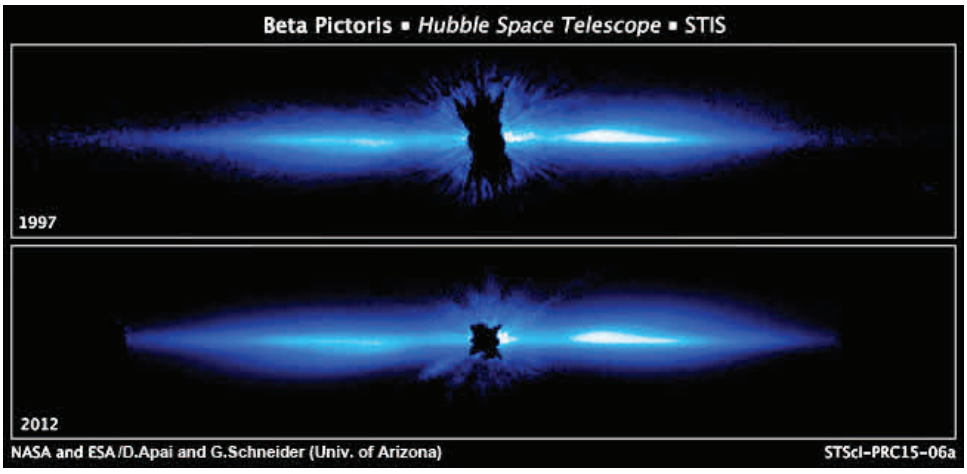
Star formation – Half of all Sun-like stars belong to multiple star systems, and for more massive stars, the fraction is even larger. Astronomers would like to catch multiple stars in the act of forming to determine which theory of multiple star formation is correct. Such theories include: 1) a cloud of gas splits into pieces before it collapses into stars; 2) after a cloud collapses into a disk, it becomes unstable and splits into pieces; 3) newly formed stars gravitationally capture each other; and 4) filaments of gas break into pieces before forming stars. New observations of the Perseus star-forming region in radio and submillimeter light have caught such a system forming 815 light-years away. They show filaments of gas crumbling, supporting theory 4. One such filament contains a pro-

tostar (star still forming) and has 3 gas clumps nearby with enough gas to form more stars within about 40,000 years. The 3 clumps have distances from the protostar of 3,300 to 11,400 AU (one AU is the Earth's distance from the Sun). Gas will probably continue to flow from the filament into the clumps as they continue their collapse toward forming stars. The clumps are smaller than would theoretically result from pure gravitational collapse, but better match the size of clumps produced by turbulence within a filament.

More star formation – Astronomers using data from WISE (infrared space telescope) found giant molecular clouds (GMCs), which is where new stars form, thousands of light-years above and below the Milky Way's disk, and one of them contained 2 clusters of stars. This is the 1st time astronomers have found stars forming in such a remote location. There are 2 theories to explain this: 1) material thrown out by supernovas is falling back toward the galaxy and forming GMCs, 2) interaction with the Magellanic Clouds, our neighbor galaxies, is disturbing gas that falls into our galaxy to form GMCs. The new work shows that the space around the Milky Way is a lot less empty than thought.

Multi-star planets – Astronomers have discovered the 2nd known case of a planet residing in a quadruple star system (30 Ari). The planet was known before, but was believed to be in a triple star system, and then another companion star was found. The star discovery was made with adaptive optics systems at Palomar Observatory. The same study also found a triple star system with a planet. The quadruple has an enormous planet, 10 times Jupiter's mass, orbiting its primary star every 335 Earth days. The primary star has a relatively close partner star, which the planet does not orbit. This pair, in turn has a long-distance orbit with another pair about 1670 AU away. From this world, the 4 parent stars would look like 1 small sun with 2 very bright stars that would be visible in daylight. One of those stars by telescope would be seen to be a binary star. The triple star system has a hot Jupiter orbiting its primary star tightly, with its year only 3 Earth days long. The 2nd star was known to orbit 44,000 AU away, and the new work found the 3rd star at 23 AU away, close enough that it may have influenced the planet's formation and orbit.

Extreme binary stars – Astronomers have identified 18 extreme mass-ratio binaries in the Large Magellanic Cloud, our neighbor galaxy. They were caught in formation, with 1 star fully formed and the other still in its infancy. These systems represent a new class of binary stars. It is unusual for binary stars to differ greatly in their masses. It has been difficult to find these unusual extremes because the glare of the brighter star hides the dimmer one. The new study caught the dimmer stars when they passed in front of (transited) the brighter companion, blocking some of its light. The newly found binaries orbit in periods of 3-9 days. The more massive stars are 6-16 times the Sun's mass, while the less massive companions are 1-2 times the Sun's mass. The data indicated that the fainter stars showed illumination phases, like our Moon, meaning that the more massive and brighter companions were lighting up the surfaces of the fainter stars like the Sun lights up our Moon. When the fainter stars have fully formed, they will be bright enough and also smaller, so as to hide this phase effect.



Hubble Space Telescope has re-observed the disk surrounding the star Beta Pictoris, which it did previously in 1997. The coronagraph inside Hubble's imaging spectrograph was used, which blocks out the bright star to enable seeing the faint disk. Detail of the disk closer to the star was seen than previously. It confirmed computer simulation predictions that structures in the disk material would be found in close. In general, the distribution of dust has changed little since 1997. Since the whole disk has rotated considerably, this shows the disk is smoothly continuous. A massive planet is known to orbit within the disk, and once again the observations showed distortions in the disk caused by the planet.

Escaped star – Scientists have discovered a star that is being ejected from our Milky Way at the fastest speed observed for such expulsion. It is moving 2.7 million mph (1200 km/sec). The other known ejectees (called hypervelocity stars) are thought to have been thrown out by encounters with the central black hole, but this one was the binary companion to a star that exploded as a supernova, which threw this star away at such high speed. The new discovery had its motion measured in 3 dimensions, and its past path came nowhere near the central black hole. Unlike other hypervelocity stars, this one is rapidly rotating and a compact helium star. Close interaction with its former binary likely made these characteristics.

MUSE, a new instrument on the Very Large Telescope in Chile, has produced the most detailed 3-D view yet of a small piece of the deep Universe. MUSE captures high-resolution images and breaks down the light spectroscopically. It produces redshifts, and therefore distances, for all the objects in its field of view. It started operating last year. It has found and studied 26 objects too dim to show up in the Hubble Deep Field images. In the 20 years since the 1st Deep Field images, only 18 objects have been studied in detail by all ground-based telescopes. MUSE determined the distances of 189 Deep Field objects in just 27 hours of observation made over 4 nights.

Matter – Scientists have long puzzled why the Universe consists almost entirely of matter, not antimatter, even though most laws of nature treat particles and antiparticles equally. A new theory proposes that this asymmetry could be related to the Higgs boson. The Higgs field, which is associated with the Higgs boson, could have made the masses of particles different than antiparticle masses temporarily at the beginning of the Universe. This could result in more particles than antiparticles.

Rosetta (comet mission) – As reported here earlier, the Rosetta lander, named Philae, came to rest in a rather shaded location on the nucleus of Comet 67P. So it went to sleep after the internal battery ran down, since sunlight was insufficient to recharge it. It was calculated to be receiving twice as much sunlight now, so Rosetta was commanded to listen for Philae. The lander was programmed to turn back on and hail Rosetta if charging exceeds 5.5 watts and the internal temperature reaches minus 49°F (-45°C). Charging has to reach 19 watts before full functionality can resume. So far Rosetta has not heard Philae. The lander should continue to get more sunlight until August. Even if harsh conditions kill the rechargeable battery, Philae can operate in bright sunlight without the battery.

Instant AstroSpace Updates

MMS 4-spacecraft fleet was launched March 12 to fly formation through magnetic reconnection events in the Earth's magnetosphere to try to understand how these events work, releasing huge amounts of energy. Magnetic reconnection also happens in the atmosphere of the Sun and other stars, in the vicinity of black holes and neutron stars, and at the boundary of our Solar System's heliosphere.

A solid rocket booster (SRB) for the under-development SLS rocket was (successfully) **test fired** for the 1st time strapped down to the ground with more than 500 instrumentation devices attached. It is a more powerful version of the SRB from the Space Shuttle, and is scheduled to help lift off an SLS Block 1 (77 ton [70 metric ton] to orbit version) by November 2018.

The landing site for the **InSight** Mars mission, scheduled to launch from California next March, has been narrowed to a single site in Elysium Planitia. The mission has a seismograph, a ground-heat-flow device, a robotic arm, a magnetometer, a weather station, and an experiment to measure the wobble in Mars's rotation.

Congratulations to the Cub Scouts of Pack 526 (Anaheim, CA) for earning their Astronomy Beltloop Award on February 3 of this year! OCA member (and friendly newsletter editor) Steve Condrey along with Terry Shelley, a parent of one of the Scouts, brought telescopes for viewing the Moon and Jupiter after a brief presentation on celestial objects. A very enthusiastic question-and-answer session followed the viewing. Perhaps one (or more) of these fine young boys will join us in our hobby!

Aristoteles (top) and Eudoxus (bottom) are greeted by the lunar dawn in this picture by Bill Hall taken on March 26th from Yorba Linda. Bill used a NexImage 5 with a C8 on a Super Polaris mount to create this image. 1200 images were stacked to create this picture.

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	Jim Benet	jimbenet@pacbell.net	714-693-1639
Sirius Astronomer Editor	Steve Condrey	startraveler68@yahoo.com	714-699-1243
Telescope Loaner Program	Don Stoutenger	dstouten@yahoo.com	714-271-2646
WAA Representative	Tim Hogle	TimHogle@aol.com	626-357-7770
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