SIRIUS ASTRONOMER

www.ocastronomers.org

The Newsletter of the Orange County Astronomers

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Winter objects are now coming into view at a reasonable hour! Seen here in this image taken on October 22, 2011 by Jeff Malmrose is M45, better known as the Pleiades. The Pleiades are always spectacular regardless of the instrument used or the viewing conditions--an ideal object for the newbie!

OCA CLUB MEETING

The free and open club meeting will be held November 11th at 7:30 PM in the Irvine Lecture Hall of the Hashinger Science Center at Chapman University in Orange. This month is our annual Members' Night, during which OCA members will present on various topics (details inside!)

NEXT MEETINGS:

Dec. 9th, Jan. 13th

STAR PARTIES

The Black Star Canyon site will be open on November 19th. The Anza site will be open on November 26th. 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 on Friday, November 4th at the Heritage Museum of Orange County at 3101 West Harvard Street in Santa Ana. Next month the class will be offered on December 2nd.
GOTO SIG: TBA
Astro-Imagers SIG: Nov. 15th, Dec. 20th
Remote Telescopes: TBA
Astrophysics SIG: Nov. 18th, Dec. 16th
Dark Sky Group: TBA

Member Presentations Night - November 2011

Steve Condrey
Chemistry in the Interstellar Medium

This presentation is based upon undergraduate work in inorganic chemistry I did while at UC San Diego. At the time (1990) my conclusions were tentative, but the work itself was considered sound by my instructors. Since then, with the advent of data from the Hubble and Spitzer telescopes, along with radio telescope observations, evidence is tending to support my hypothesis that interstellar dust grains act as intermediaries in coupling reactions, allowing short-chain hydrocarbons to form. The hypothesis is further extended to cover the formation of more complex organic molecules observed in comets and other primordial bodies.

I have been a member of OCA since 1994; editor of Sirius Astronomer since 2003; on the OCA board of trustees 2006-2007; and a frequent What's Up? presenter. In addition I volunteered with the JPL Telescopes in Education program at Mt. Wilson Observatory from 2002-2004. I graduated from UC San Diego in 1991 with a BA in the history of science and minors in chemistry and mathematics. Currently pursuing an MS degree in quality assurance from CSU Dominguez Hills and the Certified Quality Engineer certification from the American Society for Quality. My background in quality assurance includes a strong emphasis on statistical tools that I hope to apply to astronomical data in the future.

Reza AmirArjomand
CERN and its particles

My research at the University of California, Irvine took me to the European Laboratory for Particle Physics in Geneva, Switzerland during the summer of 2010. In this talk I will be presenting a short overview of the science involved and the experiences I had.

I am the current vice president of the OCA and responsible for the variety of speakers we have had since the beginning of 2010. My undergraduate degree is in physics form UCI

(continued on page 10)

NASA's Space Place

The Gray Cubicle You Want to Work In

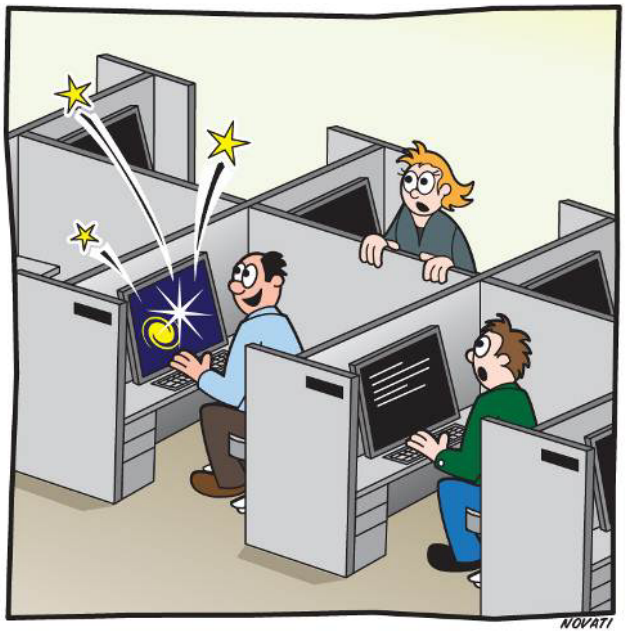
By Dr. Tony Phillips

It's another day at the office.

You're sitting in a gray cubicle, tap-tap-taping away on your keyboard, when suddenly your neighbor lets out a whoop of delight. Over the top of the carpeted divider you see a star exploding on the computer screen. An unauthorized video game? No, this explosion is real. A massive star just went supernova in the Whirlpool Galaxy, and the first images from Hubble are popping up on your office-mate's screen.

It's another day at the office ... *at NASA*.

Just down the hall, another office-mate is analyzing global temperature trends. On the floor below, a team of engineers gathers to decode signals from a spaceship that entered "safe mode" when it was hit by a solar flare. And three floors above, a financial analyst snaps her pencil-tip as she tries to figure out how to afford *just one more* sensor for a new robotic spacecraft.



Some of the employees of NASA's Science Mission Directorate may work in gray cubicles, but their jobs are anything but dull. They get to study Earth, the Sun, the Solar System, and the Universe!

These are just a few of the things going on every day at NASA headquarters in Washington DC and more than a dozen other NASA centers scattered around the country. The variety of NASA research and, moreover, the variety of NASA people required to carry it out often comes as a surprise. Consider the following:

NASA's Science Mission Directorate (SMD) supports research in four main areas: Earth Science, Heliophysics, Astrophysics, and Planetary Science. Read that list one more time. It includes everything in the cosmos from the ground beneath our feet to the Sun in the sky to the most distant galaxies at the edge of the Universe. Walking among the cubicles in NASA's science offices, you are likely to meet people working on climate change, extraterrestrial life, Earth-threatening asteroids, black holes or a hundred other things guaranteed to give a curious-minded person goose bumps. Truly, no other government agency has a bigger job description.

And it's not just scientists doing the work. NASA needs engineers to design its observatories and build its spacecraft, mathematicians to analyze orbits and decipher signals, and financial wizards to manage the accounts and figure out how to pay for everything NASA dreamers want to do. Even writers and artists have a place in the NASA scheme of things. Someone has to explain it all to the general public.

Clearly, some cubicles are more interesting than others. For more information about the Science Mission Directorate, visit science.nasa.gov. And for another way to reach the Space Place, go to http://science.nasa.gov/kids. ■

AstroSpace Update

November 2011
Gathered by Don Lynn from NASA and other sources

Reionization – About 380,000 years after the Big Bang, the Universe had expanded and cooled enough to allow neutral (without electrical charge) hydrogen gas to exist. Neutral hydrogen is transparent to visible light, while ionized (electrically charged) is opaque. The light released by this becoming transparent is known as the Cosmic Microwave Background, since expansion of the Universe has stretched the wavelength of this visible light into radio microwaves, which can be observed today looking any direction in space. However neutral hydrogen is opaque to certain ultraviolet light. So that ultraviolet light was still trapped until a much later time, at which the newly formed galaxies managed to heat and reionize the hydrogen that remained in clouds about galaxy clusters. The ionized hydrogen *is* transparent to ultraviolet. This event has become known as The Reionization. Astronomers wish they knew when Reionization occurred, and they wish they knew the exact mechanism by which the hydrogen was ionized. New observations have pinned down this time, at least roughly. A team of astronomers used the Very Large Telescope in Chile to observe 5 of the most distant galaxies known. They accurately measured the redshift of these and from this calculated their distances and the time that the light left there that we are now seeing. The light from 780 million years after the Big Bang encountered 10-50% of the hydrogen still neutral, while the light from 200 million years later encountered almost all ionized hydrogen. This is a shorter time period than theorists have been predicting for Reionization to take. The 2 leading theories for the cause of Reionization are the light from the 1st generation of stars ionized surrounding hydrogen, or that radiation emitted by active galaxy nuclei (matter glowing as it falls into supermassive black holes) instead caused the ionization. These new observations more strongly support that star light was the cause. Conclusive proof of the cause, however, will require more sensitive telescopes than exist today.

Dawn (asteroid mission) scientists have announced more findings about the large asteroid Vesta, gleaned from the 1st 3 months of observations from orbit. The mountain at the south pole is one of the largest in the solar system, at about 13 miles (21 km) high, possibly 2nd only to Olympus Mons on Mars. Observations at multiple wavelengths of light indicate the surface composition, which was found to be surprisingly diverse, particularly around craters. This probably indicates that the impacts that formed the craters punched through layers of differing composition. A set of huge equatorial troughs was found, and preliminary crater-count dating of the troughs indicates that they formed at the same time as one or the other of the 2 large impact craters near the south pole. The impacts may have fractured the entire asteroid, leaving troughs where the fractures intersect the surface. Areas of the southern hemisphere are roughly 1-2 billion years old, while the northern hemisphere is much older. Probably the 2 large craters at/near the south pole formed at different times, but both in the range of 1-2 billion years ago. Some scientists are calling Vesta "the smallest terrestrial planet" because it shares many features with Mercury, Venus, Earth and Mars: all have ancient basaltic lava flows on the surface and a large iron core; Vesta has tectonic features, troughs, ridges, cliffs, landslides, and hills. Vesta seems to have a rougher surface than most occupants of the main asteroid belt. Surprisingly no areas appear as old as 4 billion years, though this may be a result of the uncertain calibration between crater counts and age (it is based on an extrapolation from the Moon, lacking better data for the asteroid belt). A new system of Vestan longitude and latitude was defined to better match the rotational axis, now that it is better known. Many prominent features have been named. The large crater surrounding the south pole is now Rheasilvia (one of the Vestal Virgins of ancient Roman tradition). Dawn was commanded to lower its altitude in order to get higher resolution images, and reached 420 miles (680 km) height in late September. This is designated the High Altitude Mapping Orbit (HAMO), since plans call for a yet lower orbit later. HAMO is scheduled to last 30 days and will include observation by color camera, stereo imaging, mapping spectrometer, and gravity mapping. Study of Vesta will continue until next July, at which time Dawn will leave to travel to its 2nd target, asteroid Ceres.

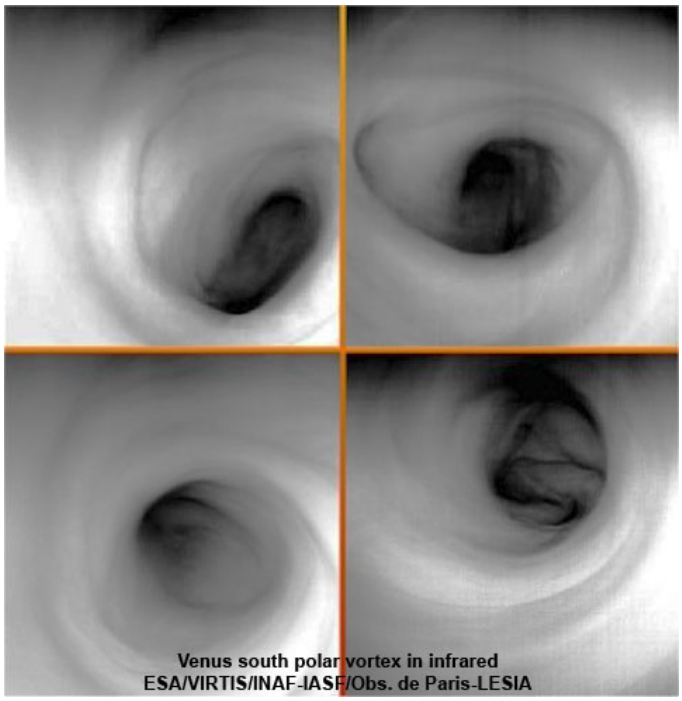
Nobel Prize in Physics for 2011 was shared by 3 leaders (Adam Riess, Saul Perlmutter, and Brian Schmidt) of the 2 teams of astronomers who discovered in 1998 that the expansion of the Universe is accelerating. The force that is causing this acceleration is still unknown, but has been named "dark energy". The discovery was made by observing Type Ia supernovas at various distances. Their distances were calculated by their apparent brightness, and the speed of expansion measured from redshift. Since the light takes longer to get here from more distant supernovas, we are seeing them at different times, so the expansion is being measured at different times, and hence change in expansion can be seen. The goal of the teams was to measure how much gravity is slowing the expansion, but it was shockingly found to be *not* slowing. Since 1998, several completely independent means of measuring the expansion of the Universe over time have all confirmed this strange result.

WISE (infrared space telescope) – NEOWISE, an observation campaign that observed the entire sky from WISE, with an emphasis on finding near-Earth asteroids, found that statistically there must be about 19,500 medium-sized (330-3300 feet across [100-1000 m]) asteroids in the near-Earth zone (within 120 million miles [195 million km] of the Sun). About ¾ of them have not been discovered, because no telescope of sufficient sensitivity has been looking the right place when they were near enough to detect. The 19,500 estimate is 44% lower than the previous best estimate. Previous estimates were made from visible light observations, and were extrapolated from counts of larger ones. Visible light is known to miss many dark and/or small asteroids, while infrared catches both dark and light colored ones equally well. The new estimate from NEOWISE for large (over 3300 ft [1 km]) near-Earth asteroids dropped by only 2%, however. It is believed that 93% of the large near-Earth asteroids have now been discovered, and all of the very large (over 6 miles [10 km]) near-Earth ones are known. NEOWISE observed more than 100,000 asteroids, of which 585 were near-Earth objects. Large asteroids would cause global damage if they were to strike Earth, while medium-sized ones could cause local devastation.

More WISE – The asteroid Baptistina has long been known to have been broken into a whole family of asteroids with similar orbits by a collision millions of years ago. The best estimate, made by analyzing the masses, reflectivity and orbits of the family members, was that the breakup occurred about 160 million years ago. A recent theory was that one of the Baptistina family fragments was the one that hit the Earth 65 million years ago, when the dinosaurs died out. New data from WISE refined the sizes and reflectivities of 1056 of the Baptistina family fragments, so a new calculation was made of the date of the collision, and it is only 80 million years ago. That does not leave enough time for a fragment to disperse such that one would hit Earth 65 million years ago (it takes several 10s of millions of years for such a dispersal to take place). So the dinosaurs will have to look for some other asteroid family to blame. The WISE data will be used to refine sizes, reflectivities and ages other families of asteroids.

Minerva is the 4th asteroid in the main belt known to possess 2 moons. It has been the subject of intense study since the moons were discovered 2 years ago. Results: Minerva is 97 miles (156 km) across, its shape has been approximately mapped and it is close to spherical (unusual for an asteroid of this size), its moons are roughly 3 miles (5 km) across, the mass was measured, the density found to be 1.9 (where water is 1), is probably composed of material like a carbonaceous chondrite meteorite, and has about 30% empty space (porosity) in it. This is higher density and lower porosity than other main belt asteroids that have been measured (essentially those with moons, which allow calculation of mass). Empty space within is a result of the asteroid forming by rubble conglomerating and not compacting well.

Venus weather – Venus has almost no tilt, so seasonal effects are negligible. Its orbit is more circular than Earth's, so the amount of sunlight doesn't change much. It is always completely cloud covered. It rotates so slowly and winds move so fast that there is little day-night temperature difference. The planet has lost its water, so there are no storms. The planet should therefore have practically no weather changes. A new study of old infrared data observing Venus' atmosphere has shown that it has weather anyway, but generally high in the atmosphere. The air high over the poles is usually cooler than over the equator, but sometimes it's warmer. Changes of up to 54° F (30° C) at places in the upper atmosphere were seen within a few Earth days. Long-term changes were also found: for example 1990 was warmer than 2009. This variability has many possible causes: turbulence in the upper atmosphere winds that flow at more than 200 mph (320 km/h) could exchange air from below and above, turbulence at the polar vortices could do the same, atmosphere above the clouds is subject to day-night effects, solar activity changes in sunlight, and latitude effects of sunlight. Further observations and study are needed to understand the causes of Venus weather.


Venus south polar vortex in infrared
ESA/VIRTIS/INAF-IASF/Obs. de Paris-LESIA

Venus Express has discovered an ozone layer high in the atmosphere of Venus. The discovery was made by watching stars with a spectrograph as they set, seeing them through the edge of the atmosphere. While ozone above Earth is created by the breakdown by sunlight of life-produced oxygen molecules (followed by chemical recombination), that of Venus (like Mars) is a breakdown product of carbon dioxide. The Venus ozone layer sits at an altitude of 60 miles (100 km), about 4 times higher than Earth's. The Venus ozone is 100 to 1000 times less dense than Earth's. Because ozone can be created by non-biological means, it cannot be used as an indicator of life if it is someday found about an exoplanet, unless the density is more like Earth's than like Mars' or Venus'.

Mars Express has found for the 1st time supersaturated water vapor in the atmosphere of that planet. Supersaturated vapor occurs when conditions are right for rain, but the atmosphere is lacking in particles on which the vapor can condense. The observation was made by analyzing sunlight through the atmosphere, at sunrise or sunset. Supersaturation was found to occur frequently in the middle atmosphere (altitudes up to 30 miles [50 km]) during the aphelion season, the period when Mars is farthest

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from the Sun. The finding has major implications for global climate and the transport of water between hemispheres. It also means more water is in the higher parts of the atmosphere where sunlight can break it apart into hydrogen and oxygen, which may then escape to space. This has implications for the rate at which the Mars' original water was lost to space.

Martian temperature – Researchers have directly determined for the 1st time the surface temperature of Mars in the distant past, and it is consistent with a warmer wetter past. Analyzing carbonate minerals in a meteorite from Mars showed that the minerals formed at about 64° F (18° C). Observations of Mars over the years have shown deltas, rivers, lakebeds and mineral deposits that require flowing water in the distant past. This implies the planet used to be warmer and wetter than now – the average Martian temperature is now is minus 81° F (-63° C). The meteorite analyzed was the same one that made headlines in 1996 when scientists thought they had found bacteria fossils in it. The object was knocked off the near-surface of Mars by an impact and eventually fell to Earth. The new analysis was made by measuring the amount of isotopes of carbon and oxygen in the carbonates, which are quite sensitive to temperature at the time the carbonate formed. Carbonates form in many processes, but all of those processes that operate at 64° happen in liquid water. So this supports a wetter Mars in the distant past, in addition to a warmer one. It is only 1 data point, since there is no guarantee that the conditions in which the carbonate formed were representative of Mars as a whole back then.

MESSENGER (Mercury mission) has released results of its 1st 6 months in orbit. Analyses of new data show: new evidence that flood volcanism has been widespread on Mercury, particularly in the north polar region, 1st close-up views of the strange "hollow" features, the 1st direct measurements of surface chemical composition, the 1st global inventory of plasma ions around the planet, and 1st good views of the polar regions. Analysis of the flood volcanism shows lava was as thick as 1.2 miles (2 km). The areas resemble huge lava flows in the Columbia River area of Earth. Those on Mercury appear to have poured out from long vents, some of which were later covered by the lava. It is possible such lava outpourings were common on early Earth, but have been much better preserved on Mercury due to lack of weather erosion. The hollows are areas typically on the floors of impact craters that are very bright and are slightly bluer in color. High resolution images show the areas are composed of small, shallow, irregularly shaped depressions that are often found in clusters. The hollows detected so far have few small impact craters, indicating that they are relatively young. The process that forms the hollows is unknown. The surface composition has a higher abundance of potassium than previously predicted. Ratios of potassium to thorium and abundance of sulfur indicate that Mercury resembles the other terrestrial planets and chondritic meteorites, but not the Moon. Sodium is the most important ion in the planet's extremely thin atmosphere that is contributed by the planet itself. Solar wind knocks sodium ions off the surface. Helium ions were found throughout the magnetosphere. Helium probably came originally from the solar wind, but likely spent time on the planet's surface. Mercury's weak magnetosphere was found to provide very little protection from the solar wind. Extreme space weathering must be occurring on the surface.

Earth's oceans – New measurements from the Herschel Space Telescope show that comet Hartley 2 contains water with the same isotope ratios as the Earth's oceans. All previous measurements of comets' water isotopes have shown sharp differences with Earth's water. Hartley 2 is believed to be the 1st comet for which such measurements have been made that originated in the Kuiper Belt – all others are probably Oort Cloud comets. The implications are: bodies in the Kuiper Belt formed with less heavy isotopes in their water than those in the Oort Cloud; water that formed the Earth's oceans likely came from a bombardment of Kuiper Belt comets soon after the Earth cooled from forming. Until this measurement, theorists had predicted that Kuiper Belt objects would have higher content of heavy isotopes, not lower.

Uranus' tilt , just 8° from being sideways, has long been attributed to a large impact early in its history. However, simulations of such an impact don't tilt the satellites correctly (which lie nearly in the planet's equatorial plane). A new simulation of various scenarios shows that 2 or more smaller impacts, if they happened when the surrounding disk had not yet formed moons, would explain the tilt of the planet and moons. A single impact at this time would tilt the planet, but send the moons into retrograde orbits. So 2 or more impacts are now the likely explanation of Uranus. Current planet formation theory has very low probability of multiple sizable collisions for the outer planets, so that theory may have to be modified.

Enceladus (Saturn moon) – Simulations of the ice particles thrown off by the geysers of Enceladus show that a portion should fall back onto the moon in 2 patches on opposite sides. Examination of images of the moon shows smooth areas of slightly different color that match the simulation. Analysis of slope changes at fractures on Enceladus show that the layers of fall-back material are up to 330 feet (100 m) deep. Accumulation of this depth would take a few 10s of millions of years. This indicates the heat and water source driving the geysers has changed little in this length of time. The particles are known to be very tiny, finer than talcum powder.

Supernovas – The largest survey to date of distant supernovas suggests that many, if not most, of the Type Ia supernovas result when 2 white dwarf stars merge. Traditionally it has been believed that a Type Ia occurs when a companion star dumps material onto a white dwarf. But evidence of the merge theory has been uncovered in recent years. The main goal of the survey was to measure the statistics of a large number of distant supernovas (distant enough to be seen at an early time in the history of the Universe). Merging of white dwarfs was found to better fit the statistics found. The survey was done with the Subaru Telescope in Hawaii and sampled 150 supernovas distant enough to have occurred 5 to 10 billion years ago. Type Ia supernovas were found to be 5 times more common in the sample than today, probably because there were more young stars back then evolving into white dwarfs. Another result of the survey was to more accurately determine the production of iron over cosmic time. The observations were made in 4 runs that each took very long exposures of a small area of sky. Each run found about 40 new supernovas among 150,000 galaxies. Follow up observations of the new supernovas and their galaxies were made with the Keck Telescopes, next door to the Subaru.

Crab Nebula – A team of astrophysicists unexpectedly discovered very-high-energy gamma rays coming from the pulsar in the Crab Nebula. The discovery was made with VERITAS, a gamma ray telescope in Arizona. It works, even though below the Earth's atmosphere which stops gamma rays, by watching the light made when gamma rays strike molecules in the upper atmosphere. Though lower energy gamma rays have been seen emanating from a pulsar, this is the 1st time that very-high-energy ones (over 100 billion electron volts) have been detected. Current understanding of pulsars has no way to create such high energy. VERITAS is more sensitive to high-energy gamma rays than other detectors that have observed the Crab pulsar.

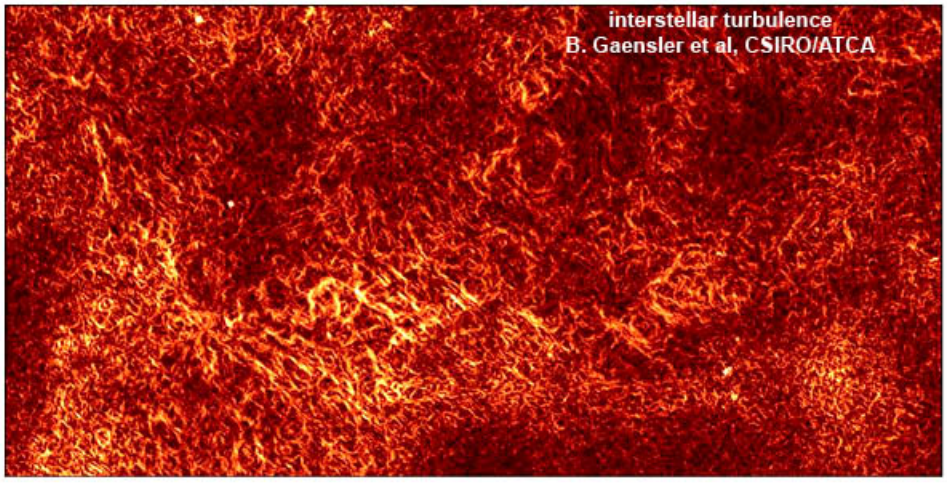
Carbon – A team of astronomers using the Subaru Telescope in Hawaii has detected carbon spectroscopically in the most distant radio galaxy known. Because it is so far, we are seeing it as it was very early in the history of the Universe, 12.5 billion years ago. Astronomers were surprised that so much carbon was produced so soon. Carbon, as well as all elements heavier than lithium, is made in stellar interiors and during supernova explosions. Thus there had to be a lot of star formation and/or supernovas very early to have produced this much carbon.

Black hole – The supermassive black hole at the center of galaxy Markarian 509 was monitored for 100 days by 5 space telescopes and 2 ground-based ones. That particular black hole, 500 light-years away, is known for its variations in brightness, indicating turbulent flow of material falling into it. Observations were made in X-rays, gamma rays, ultraviolet, visible, and infrared. Huge bullets of gas were seen being driven away at up to 430 miles/sec (700 km/s). The bullets were material stripped away from the dusty ring of matter waiting to fall in. The ring was found to be more than 15 light-years from the black hole, farther than astronomers thought it was possible for such bullets to originate. Typically Markarian 509 fluctuates by 25% in brightness, but one outburst during the monitoring hit a 60% increase in X-rays. Observations of synchronized ultraviolet and X-ray fluctuations show that the ring (accretion disk) has a skin of much hotter gas with a temperature of millions of degrees. This emits X-rays and gamma rays that drive more distant gas outward in bullets. The outflow of gas was found to have 14 different velocity components, so this is a complex phenomenon.

Supermassive black holes – Observations with the Hubble Space Telescope have found supermassive black holes growing in surprisingly small galaxies. These were very distant galaxies, so we are seeing them as they existed 10 billion years ago. Such does not exist today. Small galaxies have small or nonexistent black holes now. What this probably means is that black holes in the early Universe could sometimes grow large, and then the galaxy would also grow large. Or it could mean that now supermassive black holes in small galaxies are somehow hidden.

Relativity wins – A spectroscopic study of light from 8000 galaxy clusters has measured the redshift in the light caused by the gravity of the cluster, as predicted by General Relativity. This is the 1st time gravitational redshift has been measured on such a large scale. The masses of the galaxy clusters were measured by their effect on the speeds of individual galaxies. The redshift exactly agreed with Relativity, and disagreed with some of the alternate theories of gravity that try to avoid admitting that there is dark matter.

Relativity loses, maybe – A team of scientists measuring in Rome neutrinos being shot from Switzerland have found that the neutrinos are traveling at 100.002% the speed of light, which is of course impossible, unless there is something wrong with Special Relativity. The scientists admitted that their measurement was unlikely, but they couldn't find any mistakes made, and believed that the possible error in their method is .0004%. So they invited the world to find a mistake or repeat their experiment. It is a difficult measurement, since neutrinos are very difficult to detect, and the apparatus is quite complex. Other groups are planning or underway with experiments to measure the speed of neutrinos. One scientist has already replied, claiming that the clocks at the beginning and end were not synchronized properly, omitting a necessary correction (according to Special Relativity, ironically) for the motion of GPS satellites. If this argument holds up when reviewed by others, the speed of the neutrinos would be reduced to 99.9998% the speed of light, a believable result. More than 80 replies to the original experiment have already appeared in print, so this may take awhile to sort out.



Turbulence in the Milky Way's interstellar gas has been imaged for the 1st time by using polarized radio waves. By matching the observations with computer simulations, the speed of the gas was found to be about 43,000 mph (70,000 km/hr), relatively slow by cosmic standards. Studying such turbulence should help understand how stars form and why there are hot areas in the galaxy.

Globular study – Globular clusters about the Milky Way have been found to fall in 3 classes: old clusters distributed about the halo, clusters with higher heavy-element content in the disk and bulge, and younger clusters also about the halo. A new study of globulars found that the

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young class tend to be scattered farther and do not appear to be rotating the same way as the disk, while the old halo class do rotate with the disk. The young class was also found to cluster along a plane that is tilted from the plane of the galaxy by about 8°. It is already known that the dwarf galaxies around the Milky Way also cluster about a plane tilted by the similar amount. The new study concluded that the young class of globulars was stolen from the dwarf galaxies by the gravity of the Milky Way. The ages of the young class show large variation, implying the globulars were stolen from different dwarf galaxies at different times. One explanation for these observations is that a filament of dark matter existed where the dwarf galaxies and their (originally) globulars formed. But the way that the Sagittarius dwarf galaxy is being torn apart by the Milky Way suggests there is no dark matter concentration there. Another possible explanation is that the dwarf galaxies formed in some large structure before the Milky Way existed, but that structure has since broken up.

Brown dwarfs – A team of astronomers has discovered over 2 dozen new free-floating (not orbiting another star) brown dwarf stars that reside in 2 young star clusters (NGC 1333 and rho Ophiuchi clusters). Brown dwarfs are sometimes described as failed stars, ones without enough mass to sustain nuclear fusion, the source of energy for normal stars. One of those newly discovered brown dwarfs is only about 6 times the mass of Jupiter, so light that it might be considered a free-floating planet. This and other lightweight free floating brown dwarfs found imply that planet-mass objects can often form as stars form – by collapse of gas clouds – rather than as planets form – by coalescing around a newly formed star. 1 of the 2 clusters (1333) contains a surprising surplus of brown dwarfs, as many as normal stars. The observations were made with the Subaru Telescope in Hawaii and the Very Large Telescope in Chile. Very deep (long exposure) images in visible light and infrared were taken, and the brown dwarf candidates identified by their very red colors. Spectra were taken to confirm the candidates as truly being brown dwarfs.

Kepler (exoplanet hunting spacecraft) has discovered an unusual multiple-planet system containing a super-Earth and 2 Neptune-sized planets orbiting in resonance with each other. They are orbiting Kepler-18, a star similar to the Sun, slightly larger in diameter but smaller in mass. It may host more planets than the 3 announced so far. All 3 planets orbit much closer to Kepler-18 than Mercury does to the Sun. Planet b has 6.9 times the mass of Earth, twice the diameter, and takes 3.5 Earth days to orbit. Planet c is 17 times Earth's mass, 5.5 times the diameter, and orbits in 7.6 days. Planet d is 16 times Earth's mass, 7 times the diameter, and takes 14.9 days to orbit. C orbits twice for every orbit of d, but the times vary a little. Their interaction quickly proved to astronomers that they were indeed planets, not any of the other phenomena (such as star spots) that produce similar signals detected by Kepler. B was more difficult; further observations ruled out causes other than a planet to at least the 99.8% confidence level.

Tatooine – Kepler has also discovered a planet that orbits both of a pair of binary stars, much as the planet Tatooine is pictured in the movie Star Wars. Unlike the fictional one, Kepler-16b is a gas giant and is too cold for life. But it is the 1st unambiguous detection of a planet orbiting both stars of a binary. The stars eclipse each other as they orbit, as seen from Earth's angle. The planet is about the size of Saturn and probably made of about ½ rock and ½ gas. The stars are smaller than our Sun, 69% and 20% of the Sun's mass respectively. The planet orbits the pair of stars every 229 Earth days.

Exoplanet frequency – A statistical analysis of Kepler data, taking into account the types of stars, has found that about 1/3 of Sun-like stars (class F, G or K) should have a terrestrial planet in the habitable zone, that is, where temperatures would allow liquid water to exist on the planet. The precise result was 34%, with a margin of error of ±14%. Terrestrial was defined for this study as being between ½ and twice the diameter of Earth. From the list of 1235 planet candidates (most have not been verified as planets rather than star spots or something else), 159 F stars had candidates, 475 G stars did, and 325 K stars did. The uncertainty of this result should be refined after Kepler has finished searching for long period planets, which will take years. But it says that planets that might support life should be quite common, though we have yet to find a single exoplanet similar in size to Earth in the habitable zone of a Sun-like star.

Hubble Space Telescope (HST) – A re-analysis of archived Hubble images from 1998 found 2 exoplanets discovered by other means. This gives us the positions of the planets over a much longer time, so the orbits are more accurately known. The new analysis was done with a new technique for removing the glare of the star that the planet is orbiting. A 3rd planet had already been found in these images 2 years ago. The 3 planets have orbits that take about 100, 200, and 400 years. The new technique uses a large library of images of reference stars without planets, and those are used to remove the star's glare. Further contrast enhancement is then done. The astronomers plan to analyze 400 other stars in Hubble images with the same technique.

Dense exoplanet – Efforts to pin down the size and therefore density of exoplanet WASP 10b have been conflicting, so a new study was made using high precision observations from the Calar Alto telescope in Spain and analyzing the observations taking into account the effects of star spots. The new result is that WASP 10b is just slightly larger in diameter than Jupiter. It was already known to be 3 times the mass of Jupiter, so it is quite a dense planet. The timing of transits of the planet in front of its star has continued to vary slightly since discovery, indicating a 2nd planet is perturbing 10b.

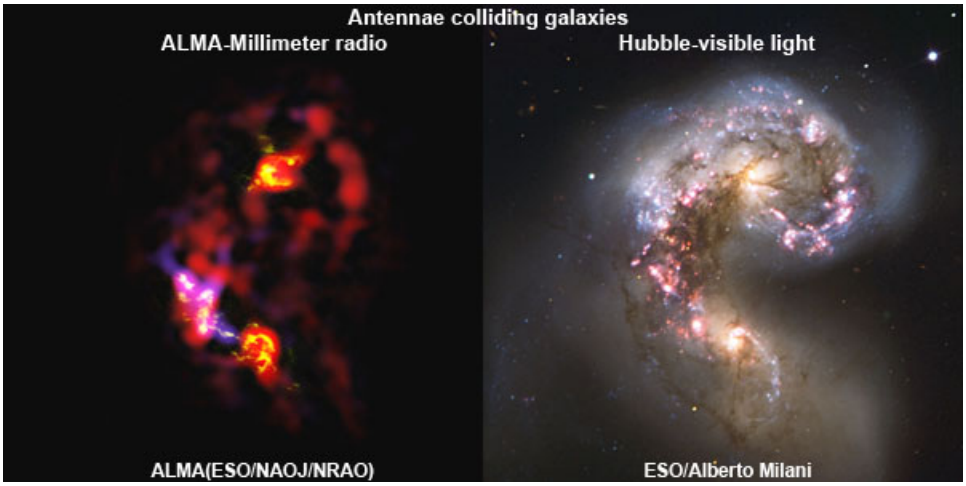
Evaporating exoplanet – Observations by Chandra (X-ray space telescope) and the Very Large Telescope in Chile show that the exoplanet CoRoT-2b is being blasted by high-energy radiation from its star, causing the planet to evaporate at the rate of about 5 million tons per second. The planet has 3 times the mass of Jupiter and orbits its star about 15 times closer than Mercury does to our Sun. The exoplanet is about 880 light-years from us. The star is between 100 and 300 million years old, which is old enough to have settled down from its youthful activity in X-rays, but it instead remains very active. It is thought that the very close orbiting planet is causing the star to speed its rotation, which would twist up its magnetic field and cause excessive X-ray activity. The planet is quite large for its mass. Probably the blasting radiation is causing this bloating, though the exact mechanism is not understood.

More exoplanets – Volunteers working for the Planet Hunters project have found 2 exoplanets, and have found 8 more candidates that are being checked out. Planet Hunters project asks the public, over the internet, to examine Kepler data to try to find evidence of exoplanets passing in front of their stars that might have been overlooked by the computer programs that try to find these. Kepler is watching more than 150,000 stars, so there is a huge amount of data. The same data are viewed by multiple volunteers, and several dozen of those flagged those 10 best candidates. The 2 verified planets orbit in 10 and 50 days, are 2.5 and 8 times the Earth's diameter, but do not lie in their star's habitable zone. The smaller one is probably a rocky planet.

China launched its 1st space station module, named Tiangong 1, September 29. It is designed to stay in space 2 years and will be visited by at least 3 missions, the 1st unmanned. That 1st mission is expected about 1 month later, and will test docking and various systems. The module will accommodate short visits by up to 3 astronauts, but not permanent occupation. The piloted missions visiting the station module are scheduled for 2012, and may include the 1st female Chinese astronaut.

Fobos-Grunt (Russian sample return mission to Phobos, Martian moon) (Grunt means "soil" in Russian) is scheduled to launch between November 5 and 25. It is huge, at 12 tons, since it includes a cruise stage, orbiter/lander, ascent stage, and Earth return (reentry) vehicle. Like NASA's Curiosity rover (scheduled for launch November 25 or soon after), Fobos-Grunt was prudently delayed from the originally planned 2009 launch to fix technical problems. Fobos-Grunt will arrive near Mars in October 2012, orbit for several months observing Mars and its 2 moons and searching for a landing site. Then it will attempt the 1st landing ever on Phobos. It will analyze the surface and collect up to 7 ounces (200 g) of soil and return it to Earth in August 2014. The sample reentry capsule will land without benefit of parachute. It will be the first sample return of larger than microscopic size since Luna 24 sampled the Earth's Moon in 1976. Russia last attempted a Mars mission in 1996, when an upper stage of the launch rocket failed and the spacecraft fell in the Pacific or possibly Bolivia. China is sending its 1st Mars mission piggy-back on the Russian mission, which will study magnetic and gravity fields and the Martian surface from orbit.

ALMA (radiotelescope array in Chile), humanity's most complex ground-based astronomy observatory, though still under construction, has released its 1st image, that of the Antennae Galaxies. The image reveals something that cannot be seen in visible light: clouds of dense cold gas from which new stars form. ALMA could accept only about 100 observation proposals for the 9-month early science phase, but 900 were submitted. By 2013 ALMA will have all 66 dishes in operation, spread over 10 miles (16 km), producing results far superior to its excellent 1st image.



New space missions (Europe) – The European Space Agency has selected to build a close orbiter to the Sun for launch in 2017, and a space telescope called Euclid to refine the expansion rate of the Universe over time for launch in 2019. Solar Orbiter will sample the solar wind and remotely observe the Sun's corona and atmosphere. Flybys of Venus will eventually tilt its orbit out of the plane of the planets to better observe the Sun's poles. Euclid will observe with a 3.9 foot (1.2 m) telescope from the L2 Lagrange point, about 1 million miles from Earth. Also in competition for funding was the Plato mission to find exoplanets; it will be reconsidered for funding in the next mission plan.

Instant AstroSpace Updates

New space missions (USA) – NASA has selected 11 proposals for further study, of which 3 or more in 2013 will be funded as space missions that would launch about 2016. The proposals are to study the Earth's atmosphere, ionosphere and magnetosphere, the Sun, the Milky Way, neutron stars and Earth-like exoplanets' atmospheres.

NASA has offered another **Centennial Challenge** prize for winning a competition to develop a new technology, this one up to $1.5 million for a robotic device that can locate and retrieve geologic samples from a wide variety of terrain without human control.

WISE (infrared space telescope) has observed flaring of material being ejected near a stellar **black hole** called GX 339-4 in unprecedented detail. The data allowed the best calculation of magnetic field strength near a black hole.

Computer simulations show that the **Sagittarius dwarf galaxy**, which is about to (in 10 million years) make its 3rd pass through our galaxy, each time being stripped of stars and material, probably on its first pass shaped the arms and ring structure that now exist in the Milky Way.

Star formation areas usually produce binary or multiple stars, yet about ½ of star systems in the Milky Way are **single stars**. Scientists are using computer simulations of star birth and dispersion of the stars to understand how many binaries lose their companions.

(continued next page)

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After stars form in open clusters, they disperse. A team of astronomers is searching the Eagle Nebula and cluster NGC 6357 for stars that are **leaving their birth cluster**, as evidenced by bow shocks as the star plows through nebulosity, to study how this happens.

Comet Elenin, discovered by a Russian amateur astronomer last December, has apparently broken apart, so did not live up to brightness estimates. This is the comet that internet rumors said would strike the Earth, though it was known since about the discovery time that it would miss by more than 20 million miles (30 million km).

A scientist has tracked spots in **Martian dust devils** in successive images taken by Mars Reconnaissance Orbiter in order to measure for the 1st time the wind speeds within. The results ranged from 45 to 100 mph (20-45 mps), with the high end being considered hurricane force on Earth.

A new study of active galactic nuclei (AGN) shows that many of them show ionization of nearby gas clouds, and the timing of radiation changes of the AGN and clouds can be used to determine the object's distance. This could be used to **determine distances** to objects too far for the Type Ia supernova method.

A team of astronomers has found supernovas that are magnified and brightened by their light passing through a gravitational lens formed by a massive galaxy cluster. This may extend the distances to which the Type Ia supernova method can **determine distances**.

(continued from page 2)

Larry McDavid
The Ralph Larkin Sundial and Its Connection to the Mt. Lowe Observatory

The Ralph Larkin Memorial Sundial located in nearby Claremont, California is an unusual analemmic equatorial dial that shows accurate civil time without the need for the usual EOT and longitude corrections. The dial is dedicated to the memory of Ralph B. Larkin, missionary and science educator, who grew up with a large Alvan Clark telescope because his father was Director of the Mt. Lowe Observatory.

Larry McDavid has long been interested in the history and design of sundials and is a long time member and Sundial Registrar for the North American Sundial Society. Larry often travels to give presentations on the science and construction of sundials. He is also a deep sky observer and maintains a permanent telescope pad at the Orange County Astronomers dark sky site at Anza. Larry chases eclipses and has traveled to distant locations to observe six solar eclipses.

Larry is active in the Microscopical Society of Southern California and uses compound and stereo microscopes as a hobby and to support his interests in home shop machining and electronics. He holds an Extra class amateur radio license and has been active on the HF and VHF ham bands for over 55 years. Larry builds much of his own equipment using a small home electronics shop and precision metal machine shop.

Larry is a retired electromechanical engineer and worked as Engineering Manager for Beckman Instruments, TRW and Molex for over 30 years. Larry has managed the development of Martian life detection instruments, Earth-orbiting instruments that detected the Antarctic ozone hole, medical monitors that enhanced the survival rate for very premature babies and automotive air bag crash sensors.

Jim Benet

A Look at the OCA Outreach Program

The OCA Outreach program has continued to grow from just 16 events in 1998 to 78 events for 2011. Over 80,000 people have peered through our telescope, half of them students. We have done to 175 schools, 24 parks and several libraries, clubs and youth groups. Over $9000 has been donated to the OCA as a result of the Outreach program.
We use a sophisticated Excel spreadsheet to keep track of all event and volunteer information. The file contains over a dozen macros which are used to automate many functions associated with coordinating the Outreach programs.

Our Outreach calendar is completely full for the next six months. That's why we really need additional help - yours.

Jim Benet has been a member of the Orange County Astronomers since 1994. He served two years (1997 and 1998) as an elected trustee of the OCA. He took over as coordinator of the Outreach program when John Sanford retired and moved to Springville in 1998. From that time, he has conducted over 640 Outreach programs on behalf of the OCA. Professionally, Jim has been an electronic engineer for over 41 years. He is now retired. But he is probably best known for the smoked barbeque beef briskets that he prepares each year for the annual OCA starbeque.

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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**	**$37.95**
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.**

The DEADLINE for subscribing at the club rates will be the October monthly meeting, October 7th. 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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