SIRIUS ASTRONOMER

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The Newsletter of the Orange County Astronomers

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In honor of Sir Patrick Moore, who passed away last month, this month's cover photo is Caldwell 63, also known as the Helix Nebula. At 700 light-years from Earth in the constellation Aquarius, this is one of the closest planetary nebulae to Earth. John Castillo imaged the nebula on December 10 (the day after Moore's death) compiling RGB, H-alpha, and O3 images taken over an eight-hour period. For more on the life and work of Sir Patrick Moore, see page 10.

OCA CLUB MEETING

The free and open club meeting will be held January 11 at 7:30 PM in the Irvine Lecture Hall of the Hashinger Science Center at Chapman University in Orange. This month Dr. Brian Hart will present his film, 'Galaxy Clusters: Giants of the Universe'.

NEXT MEETINGS: February 8, March 8

STAR PARTIES

The Black Star Canyon site will not be open this month. The Anza site will be open on January 12. Members are encouraged to check the website calendar for the latest updates on star parties and other events.

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

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

COMING UP

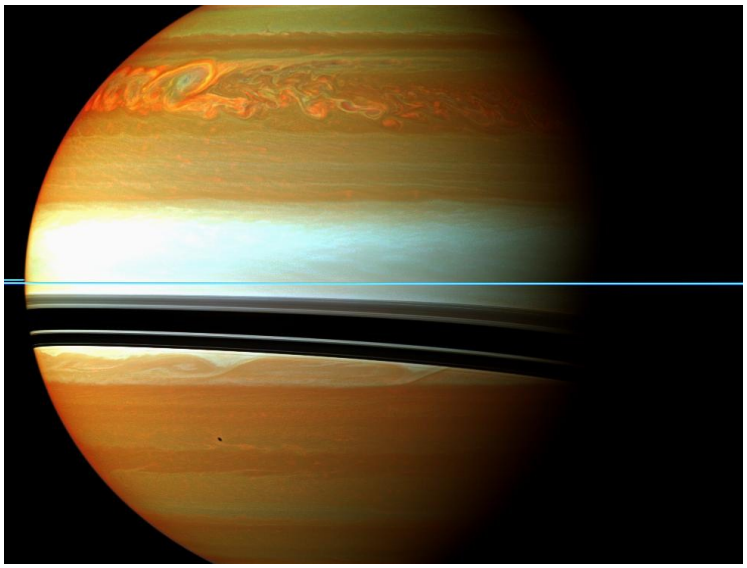
The next session of the Beginners Class will be held at the Heritage Museum of Orange County at 3101 West Harvard Street in Santa Ana on a date to be announced.

GOTO SIG: TBA
Astro-Imagers SIG: Jan. 15, Feb. 19
Remote Telescopes: TBA
Astrophysics SIG: Jan. 18, Feb. 15
Dark Sky Group: TBA

Partnering to Solve Saturn's Mysteries

By Diane K. Fisher

From December 2010 through mid-summer 2011, a giant storm raged in Saturn's northern hemisphere. It was clearly visible not only to NASA's Cassini spacecraft orbiting Saturn, but also astronomers here on Earth—even those watching from their back yards. The storm came as a surprise, since it was about 10 years earlier in Saturn's seasonal cycle than expected from observations of similar storms in the past. Saturn's year is about 30 Earth years. Saturn is tilted on its axis (about 27° to Earth's 23°), causing it to have seasons as Earth does. But even more surprising than the unseasonal storm was the related event that followed.



This false-colored Cassini image of Saturn was taken in near-infrared light on January 12, 2011. Red and orange show clouds deep in the atmosphere. Yellow and green are intermediate clouds. White and blue are high clouds and haze. The rings appear as a thin, blue horizontal line.

First, a giant bubble of very warm material broke through the clouds in the region of the now-abated storm, suddenly raising the temperature of Saturn's stratosphere over 150 °F. Accompanying this enormous "burp" was a sudden increase in ethylene gas. It took Cassini's Composite Infrared Spectrometer instrument to detect it. According to Dr. Scott Edgington, Deputy Project Scientist for Cassini, "Ethylene [C_2H_4] is normally present in only very low concentrations in Saturn's atmosphere and has been very difficult to detect. Although it is a transitional product of the thermochemical processes that normally occur in Saturn's atmosphere, the concentrations detected concurrent with the big 'burp' were 100 times what we would expect." So what was going on?

Chemical reaction rates vary greatly with the energy available for the process. Saturn's seasonal changes are exaggerated due to the effect of the rings acting as venetian blinds, throwing the northern hemisphere into shade during winter. So when the Sun again reaches the northern hemisphere, the photochemical reactions that take place in the atmosphere can speed up quickly. If not for its rings, Saturn's seasons would vary as predictably as Earth's. But there may be another cycle going on besides the seasonal one. Computer models are based on expected reaction rates for the temperatures and pressures in Saturn's atmosphere, explains Edgington. However, it is very difficult to validate those models here on Earth. Setting up a lab to replicate conditions on Saturn is not easy!

Also contributing to the apparent mystery is the fact that haze on Saturn often obscures the view of storms below. Only once in a while do storms punch through the hazes. Astronomers may have previously missed large storms, thus failing to notice any non-seasonal patterns. As for atmospheric events that are visible to Earth-bound telescopes, Edgington is particularly grateful for non-professional astronomers. While these astronomers are free to watch a planet continuously over long periods and record their finding in photographs, Cassini and its several science instruments must be shared with other scientists. Observation time on Cassini is planned more than six months in advance, making it difficult to immediately train it on the unexpected. That's where the volunteer astronomers come in, keeping a continuous watch on the changes taking place on Saturn.

Edgington says, "Astronomy is one of those fields of study where amateurs can contribute as much as professionals."

Go to http://saturn.jpl.nasa.gov/ to read about the latest Cassini discoveries. For kids, The Space Place has lots of ways to explore Saturn at http://spaceplace.nasa.gov/search/cassini/.

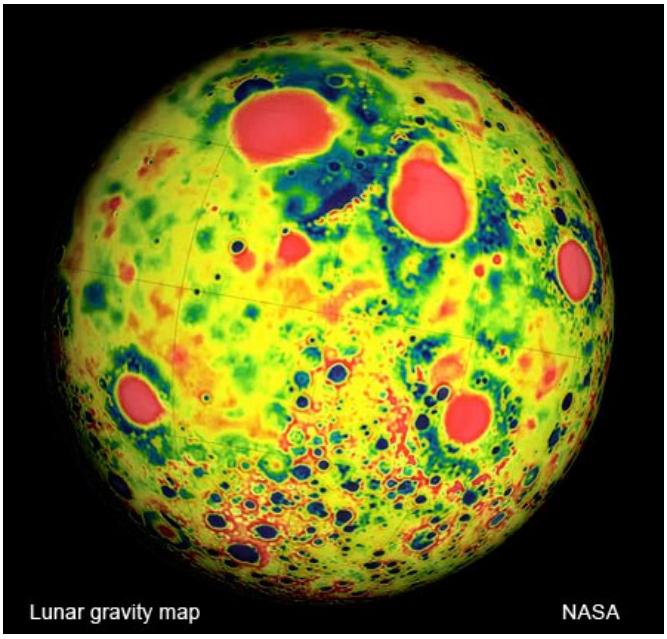
This article was provided by the Jet Propulsion Laboratory, California Institute of Technology, under a contract with the National Aeronautics and Space Administration.

AstroSpace Update

January 2013

Gathered by Don Lynn from NASA and other sources

Ebb & Flow, the twin GRAIL mission spacecraft that have been in orbit about our Moon since January 2012, mapping the gravity, have completed their mission and their extended mission. The extension involved orbiting at only 14 miles (23 km) above the surface, which required quite frequent (as often as 3 times per day) orbit-correction rocket burns to prevent crashing. The last gravity measurements were made of the Orientale Basin at extremely low altitude, missing the mountain tops by only 1.2 miles (2 km). The lower the altitude, the greater precision in measuring the gravity. Even the primary mission at highest altitude resulted in the best gravity map of any celestial body, including Earth. Results from the extended mission will be available in a few months, and should prove even more spectacular. But the spacecraft are about out of fuel, so they are being crashed into a mountainside near the lunar north pole on December 17. The Lunar Reconnaissance Orbiter (LRO) is taking images of the crash, though it may be too dim to see, even in ultraviolet. LRO pictures will also be taken days later when daylight is optimal to image the craters made by Ebb & Flow.



The **GRAIL** gravity map was processed into 2 forms: the 1st shows the strength of gravity at each location. Then the gravity of every surface feature was calculated and subtracted to give the 2nd form, which shows only the gravity that results from subsurface features. This shows in great detail the mass concentrations that exist below. Mass concentrations have been known in rough form since the Apollo days. Surface features had much more effect on the gravity measured than subsurface features. The new maps show that the Moon's crust is almost completely pulverized by the bombardment of asteroids the Moon has endured, mostly during the first billion years of its life. All the terrestrial planets and moons probably received similar bombardment, but worlds with weather have obliterated the evidence. The thickness of the Moon's crust was measured from the gravity data, and it ranged from 21-27 miles (34-43 km), much thinner than estimated previously. The deepest impacts probably punched all the way through it to the mantle. The density of the Moon's highland crust is substantially lower than generally assumed. The subsurface map showed many long, linear structures of denser material, which are believed to be dikes, geological features formed by melted rock welling up in cracks. These do not extend all the way to the surface, so had not been detected before. The pattern of these indicates that the Moon's core expanded early in its history, causing the cracks, which later filled.

Herschel (infrared space telescope), however, will not be crashed into the Moon when it completes its mission. This will happen when it runs out of liquid helium coolant, probably at the end of March. None of the instruments will operate without coolant. The possibility of a lunar crash was considered, but it will be cheaper to push it into an orbit about the Sun with long-term stability.

More Herschel – Looking at a small portion of the sky in far infrared, Herschel found 767 galaxies that were undergoing starbursts, where stars were forming at hundreds to thousands of times the rate that stars form in our Milky Way galaxy. The Keck telescopes in Hawaii were used to take spectra of these so that their redshifts, and therefore distances, could be determined. They were so far that their light took from 2.6 to 10.2 billion years to reach us. This should allow a history of star formation to be developed for a large portion of the history of the Universe. Many of these galaxies were so dusty that other wavelengths of light do not see the starbursts. So the numbers of starbursts seen was surprisingly high. Some of the galaxies found in this survey are among the brightest infrared galaxies yet discovered. It remains to be seen whether the principle cause of starbursts is galaxy collisions or greater availability of gas with which to form stars.

Hubble Space Telescope has imaged the area of the Hubble Deep Field image in 4 infrared colors to look for extremely red-shifted, and therefore extremely distant, galaxies. 7 such galaxies were found which are so distant that their light took 13.1-13.3 billion years to reach us. One of these is probably the most distant galaxy yet discovered, and is seen as it appeared only 380 million years after the Big Bang. The scientifically important reason to look for these distant galaxies is to learn how galaxies formed and developed in this early time. These 7 show that the number of galaxies grew during this early time span. The data support the theory that the first galaxies to form after the Big Bang gradually ionized (knocked the electrons off) the surrounding hydrogen gas, taking hundreds of millions of years to finish ionizing most gas. This ionization was underway at the time seen in the most distant galaxy. Galaxies that formed earlier could undoubtedly be imaged, but they would be red-shifted farther into the infrared, beyond the wavelengths that Hubble can record. The James Webb telescope, scheduled for 2018 launch, is specifically designed to reach farther into the infrared for this reason.

Green bean galaxies – A new class of galaxy has been identified using observations from several ground-based telescopes. They are green colored and larger than the green pea galaxies recently identified, so are being called green bean galaxies. The color is a result of emission from a black hole exciting gas in much of the galaxy, causing it to glow green. They do not seem to have active black holes, so it is assumed that the black hole activity recently turned off, after exciting the gas. A single example was at first found in images taken by the CFHT telescope in Hawaii. A search of data on nearly a billion galaxies found 16 more with similar properties, so they are quite rare. This is probably because the green glow does not last long after the black hole shuts down.

Planck (space telescope) has made the 1st conclusive detection of a bridge of hot gas connecting a pair of galaxy clusters across 10 million light-years of space. Planck's primary task is to observe the Cosmic Microwave Background (CMB). But the CMB interacts with hot gas in what is called the Sunyaev-Zel'dovich effect. Planck was able to see this effect and determine where there is a huge gas cloud, which connects 2 galaxy clusters, Abell 399 and 401, each containing hundreds of galaxies and located about 1 billion light-years away. This bridge was hinted at by X-ray data, but this observation confirms it. By combining with other observations, the temperature of the gas bridge was calculated at about 140 million °F (80 million °C), similar to the temperature of the gas in the clusters.

Galaxy clusters – A new study has measured precise distances to a large sample of clusters of galaxies. This will allow putting together a history of how galaxy clusters evolved over this life of the Universe. This history will be strongly affected by dark energy, the force that is accelerating the rate at which the Universe is expanding. So knowing the history of galaxy clusters will allow calculation of the strength of dark energy over the life of the Universe. The new study used the South Pole Telescope to identify galaxy clusters, then used the 4-meter Blanco Telescope in Chile to measure their distances. The clusters ranged from nearby to 2/3 of the way back to the Big Bang.

Giant black hole – A group of astronomers has discovered a black hole at the center of a galaxy (NGC 1277) that is far larger than expected. It has long been known that black holes at the center of galaxies seem to have masses about 0.1% of the mass of the galaxy's central bulge of stars. This black hole is 14 % of the galaxy. The black hole mass is 17 billion times the mass of the Sun, with uncertainty of about 3 billion. Depending on how this uncertainty works out on this and the current record holder, this may be the largest known black hole. Yet it lies in a fairly small galaxy. As a percent of the galaxy, this newly discovered black hole is 10 times the previous record holder. The team has identified 5 other galaxies that seem to have too-large black holes, but precise measurements have not yet been completed. It is looking like there is a class of galaxies with over sized black holes. NGC 1277 is about 8

billion years old, and does not appear to have changed much since then. Whatever cause this giant black hole happened a long time ago. It is 220 million light-years away in Perseus.

Chandra (orbiting X-ray telescope) has detected a jet of X-rays from a supermassive black hole so distant that its light took 12.4 billion years to reach us. This is the most distant X-ray jet ever observed. Few X-ray jets are known so far that we see them as they were in the early Universe. The X-rays are produced when fast-moving electrons from the jet collide with photons of the CMB. The Universe was far smaller when the X-ray light left the jet, so the CMB was 1000 times denser, making the X-ray emission much brighter than jets later. The length of this jet is at least 230,000 light-years. Though there is probably a pair of jets, only the one pointed toward us has been detected. In radio observations, a 2nd much smaller jet has been found, also pointing toward us.

Quasar outflow – Astronomers using the Very Large Telescope in Chile have discovered a quasar (cataloged as SDSS J1106+1939) with the most energetic outflow ever seen, larger by a factor of 5 than any previously known. This is good news for theorists who have been predicting that quasars should have huge outflows. Those outflows are thought to play a major roll in controlling how galaxies evolve over their lifetimes. Quasars are supermassive black holes whose accretion of material generates extremely bright light. That light, or perhaps magnetic effects, pushes surrounding gas and dust to flow outward. The newly measured outflow amounts to a mass of 400 Sun's masses per year flowing out at 5000 miles/sec (8000 km/s). The team of astronomers is now measuring the outflow of a dozen similar quasars to see if this finding is typical.

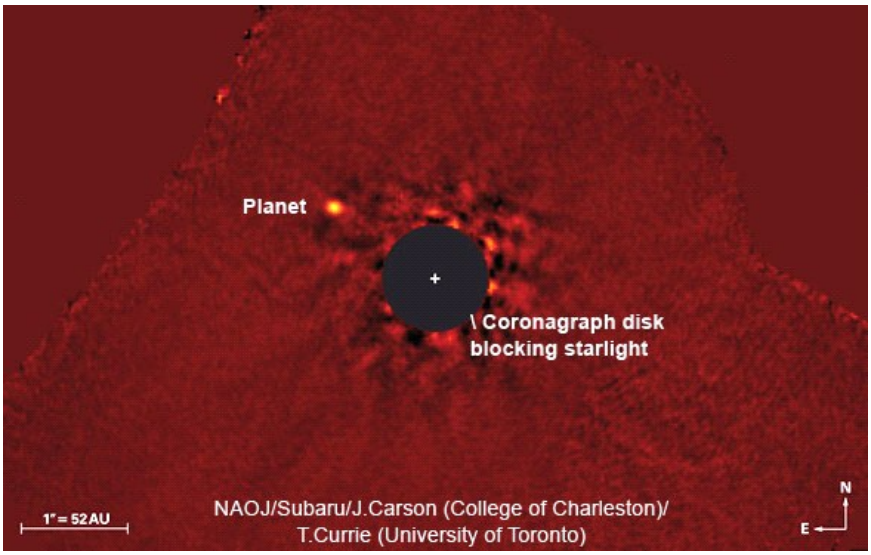
Microquasar – Astronomers have found in the Andromeda Galaxy the 1st microquasar known outside the Milky Way. A microquasar is a stellar-mass black hole pulling in material from a companion star, and throwing some of that material out in jets. Scientists hope to find others in nearby galaxies. XMM-Newton (orbiting X-ray telescope) found the object last January, and follow-up observations in radio and other wavelengths confirmed its nature. The black hole is estimated at 10 times the mass of our Sun. Because they work similarly, but on a small scale, studying microquasars is telling us how quasars work.

Black holes – Astronomers are studying different types of galaxies to see which ones generate the most stellar-mass black holes. Theoretical work suggests that galaxies with low levels of heavy elements should form more very massive stars that lose less mass from stellar winds, which then should end their lives as more black holes. Initially this theory looked good with study of a galaxy (Cartwheel Galaxy) with only 30% of the heavy elements as our Sun, since it did have more black holes than usual. However, study of another galaxy (NGC 922) with heavy elements comparable to our Sun also showed similar high numbers of black holes. A galaxy with extremely low heavy elements will be studied next to see if that affects the number of black holes.

Orion – Using images from the 340-megapixel MegaCam on the CFHT telescope in Hawaii, as well as infrared and X-ray images from space, astronomers were able to separate the stars in the Orion Nebula into 3 different open star clusters. The stars designated as NGC 1980 are mostly in front of the nebula, not in it, and are older than stars in the nebula. Another separate cluster is designated L1641W. Some stars had been known to be in front of the nebula since the 1960s, but the new study found many more.

Fermi (gamma-ray space telescope) has been reprogrammed so that it is 10 times better at finding gamma rays given off by thunderstorms, known as terrestrial gamma-ray flashes (TGFs). They last a few thousandths of a second, but their gamma rays are among the highest-energy light that naturally occurs on Earth. Study of hundreds of TGFs observed since the upgrade shows that strong radio bursts occur simultaneously with the gamma rays, though lightning produces weaker radio bursts before and after the flash. Scientists suspect TGFs are caused by strong electric fields near the tops of thunderstorms when the fields become strong enough to drive an upward avalanche of electrons. Scientists estimated that about 1100 TGFs occur each day around the world, but only 2 or 3 of them near Fermi are being detected each day, even with the upgrade.

Exoplanet imaged – Astronomers using adaptive optics (to increase resolution), a coronagraph (to block star glare) and computer subtraction of starlight, the Subaru Telescope in Hawaii has taken an infrared picture of a super-Jupiter planet orbiting the star Kappa Andromedae. The newly found object has a mass about 12.8 times that of Jupiter. This puts it very near the line between planets and brown dwarf stars. The age and orbit size tend to support that the object formed in a planet-forming disk rather than as a companion



star. Its distance from its star is 1.8 times Neptune's distance from the Sun, or farther if the orbit is tilted to our line of sight. Infrared images at 4 wavelengths show similar colors to a few other gas giant planets successfully imaged. Of the more than 800 known planets, only about 30 have been directly imaged, due to their dimness and closeness to glaringly bright stars. Kappa has 2.5 times the mass of our Sun. This demonstrates that stars that large are capable of producing planets, something that has been questioned by some planet formation theory. Kappa has an estimated age of 30 million years, far younger than our Sun, and lies 170 light-years away. The super-Jupiter has a temperature of about 2600°F (1400°C).

Infant planetary system – Astronomers have found the youngest still-forming system of planets yet seen, an infant star surrounded by a swirling disk of dust and gas about 450 light-years away in Taurus. The star currently has about 1/5 the mass of the Sun, but scientists expect it will pull in material to eventually match the Sun's mass. The disk surrounding the young star contains at least enough mass to make 7 Jupiters. The system is no more than 300,000 years old. Doppler shift of radio waves show that the rotation speed in the disk changes with distance from the star in the manner that orbital speeds of planets change with distance. This is the youngest protostar found with a disk rotating like this.

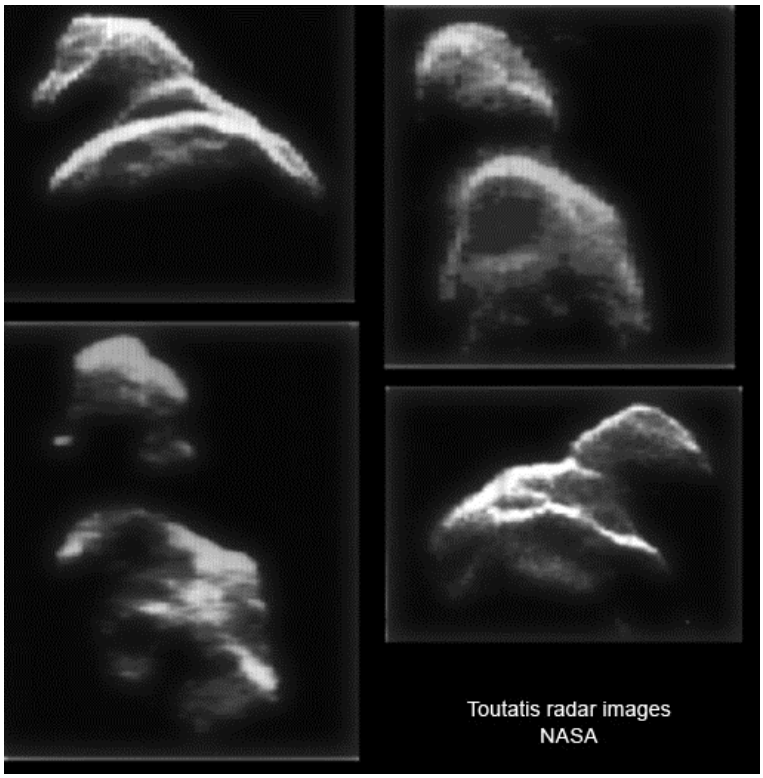
Brown dwarf disk – Astronomers using the ALMA radiotelescope array in Chile have for the 1st time found a dusty disk of larger (millimeter sized) grains around a brown dwarf. This implies brown dwarfs can form rocky planets like stars do. The observations also detected carbon monoxide clouds in the disk, a 1st for a brown dwarf. The size of the grains is determined by how they emit various wavelengths of radio waves. ALMA will be completed later in 2013, but has been used for 2 about years with only part of the antenna array completed.

Planet habitability – A new study of 8 nearby stars similar to our Sun found that 7 of them have higher amounts of radioactive elements, such as uranium and thorium. If these are representative of stars in our galaxy, then most planetary systems would form with higher levels of radioactive elements than did Earth. This would keep the planets hotter longer than Earth, and would support plate tectonics (which is driven by internal heat) longer than Earth. It is thought that life would have difficulty developing without plate tectonics, so the new finding implies that most Earth-like planets might be more likely to develop life. The amounts of radioactive elements in a star are believed to depend on how recently a supernova has exploded nearby at the time that the star formed.

Exocomets – Observations using the Herschel space telescope of 2 nearby planetary systems have found them to contain vast amounts of cometary debris, which implies large numbers of comets crowded enough that they often collide. Both systems have planets only in the Earth-to-Neptune size range, no Jupiter-sized. A study of this claims this is not coincidence: lack of Jupiters promotes large reservoirs of comets. The theory goes that gas giants like Jupiter or Saturn gravitationally disrupt belts of comets, depleting them considerably. The amount of cold (-328°F = -200°C) dust seen in the 2 systems implies 10 times the number of comets found in the Kuiper Belt of our own solar system. The stars in these 2 systems are Gliese 581, a red dwarf star, and 61 Vir, a main sequence (G-type) star.

Wide binary stars – Computer simulations of multiple stars have explained why many binary stars are found orbiting at greater distances than that at which they could have originally formed from a cloud of gas. Closer triple stars can often end up as widely separated binary stars. One of the triple is either ejected or more often merged with another star, while forces on the smallest star of the triple move it farther away. Sometimes the small star escapes, but often is left in a distant orbit. Alpha Centauri, our nearest neighbor, may be an example of such interactions; it is a triple in which the smallest star is quite distant from the other 2.

Dud supernovas – Supercomputer simulations of exploding stars have revealed that observations of oddly dim supernovas can be explained by occasional failures to fully ignite the explosion. About 20 Type Ia supernovas that are 10-100 times dimmer than normal have been seen. Simulations of a normal Type Ia show that detonation of the core floats out to the surface, expands in a wave about the outside of the star, collides with itself on the opposite side, and the collision causes the whole star to detonate. The new simulations show that occasionally the star expands too much from the core detonation, and the surface detonation then fails. This failure in the simulations matches what has been observed in the dim supernovas. These failed supernovas can result in the star being kicked away at high speed, due to strongly off-center explosion. Our observations of these failures can look quite different as seen from different angles in relation to the kick direction. So it is thought that astronomers may be missing identifying some of these. The new simulations also show that these failures generate large amounts of several heavy elements, where normal ones generate mostly just carbon and oxygen.



Toutatis radar images
NASA

Toutatis (asteroid) approaches the Earth closely every 4 years, and the latest pass was on December 12, at about 18 times the Moon's distance. The best images ever of the asteroid were made by radar. It is considered a potentially hazardous asteroid, though it is known that it will not hit the Earth for at least hundreds of years. The radar measurements should pin down its exact location to enable extending orbit predictions much farther into the future. It is about 2.8 miles (4.5 km) long, with 2 lobes sticking out at an odd angle. Rather than rotating like most astronomical bodies, Toutatis tumbles like a badly thrown football. The radar observations show that the smaller lobe is about 15% denser than the big lobe. There are cores inside each lobe about 20-30% denser than the rest. This raises the possibility that it is actually a mash-up of smaller asteroids.

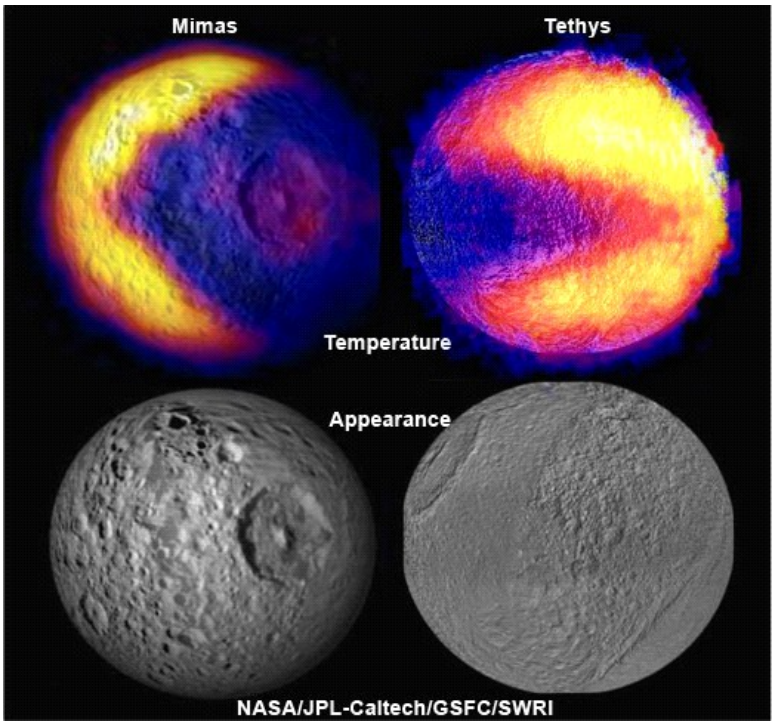
Mars rover Curiosity used its full array of instruments to analyze Martian soil for the first time in early December. Water, sulfur and chlorine-containing substances, among other ingredients, showed up. Some carbon-chlorine compounds were found, but they may have been formed during baking of the soil, so the scientists are cautiously claiming that organic (carbon-containing) compounds have not been definitively detected. Not surprisingly, the elemental composition was similar to that seen by the other Mars rovers in soil at distant locations on the planet. The water found was probably chemically bound to minerals, not free water or ice. Perchlorate was found, as it had been previously by the Phoenix Mars lander. Before the press conference announcing these results, enthusiasm over their importance by project scientists had prompted news media to speculate that life had been found on Mars, as unlikely as that is in the sterilizing conditions on the Martian surface.

Mars program – NASA has announced further plans for its Mars program. It now includes another rover using the same plan as Curiosity, but with different instruments, to be launched in 2020. Reusing the design is expected to save cost. It's still going to cost $1.5 billion. Also newly announced are plans to participate with radios and instruments aboard Europe's ExoMars launches of 2016 and 2018. This was surprising considering that just last February NASA entirely backed out of its planned major participation in ExoMars, including launches on NASA rockets, due to NASA budget cuts. In related news, the Russian space agency announced they will provide launch rockets, and increase their instrument participation in ExoMars. Previously announced parts of NASA's Mars program were the MAVEN orbiter to study Martian atmosphere, and InSight lander to probe the interior with instruments including a seismograph.

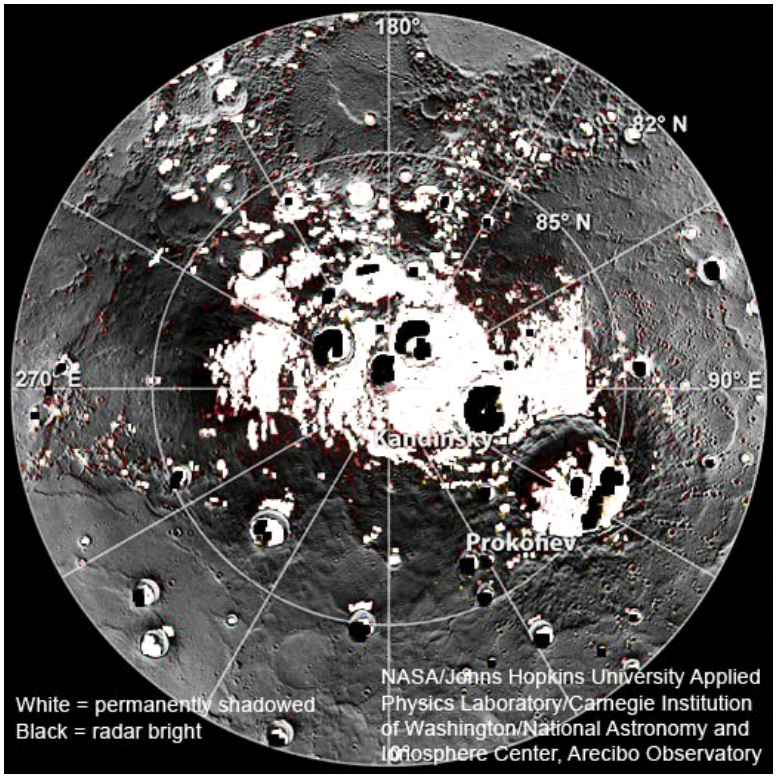
Cassini (Saturn orbiter) – Analysis of topographic and gravity data taken during Cassini's flybys of Titan show that the icy outer crust of Titan is twice as thick as had been previously thought. Scientists have long suspected that an ocean exists under the crust. The new study also determined the primary source of heat that keeps that ocean from freezing: tidal flexure from Saturn and its moons. The new crust measurement gives this picture of the inside of Titan: a core of rock and ice about 1250 miles (2000 km) in radius, an

ocean 140-190 miles (225-300 km) thick, and an ice crust 125 miles (200 km) thick. The density of material under the poles is slightly greater than under the equator, implying the ice at the poles must be thinner and the water thicker, than at the equator. Heat generated by tidal effects would support this distribution, but a heat source in the core would not.

Cassini data showed a warm spot on the moon **Tethys** shaped like the video game icon Pacman, which resembles a feature found earlier on neighboring moon Mimas. Scientists theorize that the shape occurs because of the way high-energy electron bombard low latitudes on the side of the moon that faces forward as it orbits. The bombardment turns that part of the fluffy surface into hard-packed ice, which resists temperature drops at nightfall longer than the fluff. Tethys, unlike Mimas, is bombarded by icy particles thrown off by Enceladus, which refluff the surface. That the warm spot exists on Tethys shows that the hardening by electrons occurs faster than the icy particles fall. The temperature difference of the warm spot was measured at about 28°F (15° C), but both the warm and cold regions are more than 300°F (180°C) below zero. Traces of the Tethys warm spot can be seen barely in visible light images taken as far back as 1980 by Voyager.



Cassini data shows a wholesale reversal, at unexpected altitudes, in the circulation of the atmosphere of **Titan** that occurred at the equinox (change of season). At the south pole, sinking air has taken the place of upwelling. It was surprising how rapid the changes were, since a year at Saturn (as well as Titan) is over 29 Earth years. Data came from the infrared spectrometer, which is tracking changes in atmospheric temperature and the distribution of gases, including benzene and hydrogen cyanide. Cassini also detected complex chemical production in the atmosphere at up to 400 miles (600km) above the surface, revealing the atmospheric circulation extends about 60 miles (100 km) higher than previously known. Compression of sinking air produced a hot spot above the south pole. Some gases were found to increase in abundance 100-fold within 2 years of equinox. Chemistry changes and vertical atmospheric movement were detected even above the famous "detached haze layer" thought at one time to be the top of atmospheric activity. Continued observation is looking for a buildup of the south polar vortex similar to the north vortex seen in the previous season.



Messenger (Mercury orbiter) data shows that the long hinted-at water ice does indeed exist at places near Mercury's north pole. Presumably such also exists near the south pole, but data have not yet been taken there to confirm. Given temperatures over 750°F (400°C) on the planet, it would seem an unlikely place to find ice. But parts of some craters near the poles are in eternal shadow, resulting in temperatures hundreds of degrees below zero. The first hints of ice were shiny patches 1st seen by radar in 1991. Messenger data mapped hydrogen, probably as a component of water, and then located the permanently shadowed areas, and they almost corresponded. But some hydrogen existed in areas that got a little sunlight. Further data showed that those hydrogen areas in sunlight were exceptionally dark! Scientists figured out that the comets or asteroids that crashed and delivered ice to Mercury would also deliver dark organic (carbon-containing) materials that matched the characteris-

tics of the dark areas. So the organics form an insulating layer that preserves ice underneath in areas that get only a little sunlight. The total amount of ice was calculated from the hydrogen detections, and the scientists announced that it was enough ice to cover Washington, D.C. to a depth of 2 miles. It is not clear to me why they chose to make an example of Washington, but perhaps it has to do with NASA budget cuts.

Voyager 1 (outer planet mission) – Scientists had expected that Voyager 1 would leave the solar system about now, but instead they announced that they had discovered another layer of the solar system that Voyager 1 had entered, and still had to cross. Theorists had predicted that upon leaving the solar system 3 effects would be seen: the particles from the Sun would nearly stop, the cosmic ray particles from outside would increase, and the magnetic field would switch from the Sun's direction to interstellar directions. The catch was that the particle changes occur at a different place than the magnetic changes, so there is a new layer between. This new layer is being referred to as a magnetic highway because the inside and outside particles are traveling in opposite directions along magnetic field lines there. The strength of the magnetic field changed when the spacecraft entered the new layer, but the direction did not change. The best guess is that Voyager 1 will take between a few months and a couple of years to cross this new layer.

Makemake (dwarf planet) – Astronomers using 3 telescopes in Chile observed Makemake as it passed in front of a distant star. This showed no evidence of an atmosphere, which would have made the occultation more gradual. Pluto, a similar body, does have a thin atmosphere, while Eris, also similar, does not. The size, shape, density and albedo (reflectivity) of Makemake were refined by these observations. It is 77% reflective, higher than Pluto but lower than Eris. The density is 1.7 (where water is 1), with uncertainty of 0.3. It is a sphere slightly flattened at the poles, with diameters of about 889 and 933 miles (1430 and 1502 km).

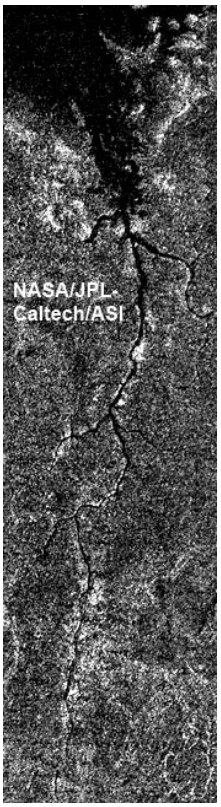
Update Updated

Dark matter anomaly resolved – I reported here in April that measurements of the dark matter in a merging cluster of galaxies known as Abell 520 did not match theory. The dark matter and the stars of the galaxies (but not gas clouds) should pass through each other without appreciable friction, so the dark matter clumps should be in the same places as the starlight of galaxies. But the study in April showed lots of dark matter in the center of the merger, but hardly any starlight. Another group of astronomers took higher resolution images of Abell 520 with the ACS camera on the Hubble Space Telescope, recalculated where the dark matter is (from its gravitational lensing of background objects), and came up with little dark matter where there is little starlight. The new study also took images in 3 colors to help distinguish foreground from background objects. So theorists don't have to revise their dark matter theories.

Instant AstroSpace Updates

Scientists using Cassini images have found the largest (over 200 mi or 400 km) river valley off the Earth on Saturn's moon **Titan**. It appears to generally follow a fault, as do other (liquid hydrocarbon, not water) river valleys on Titan.

A new study of gamma-ray bursts has found that massive-star supernovas give off an X-ray burst from the shock of explosion breaking through the surface of the star, before other manifestations of a **supernova**. So X-rays might be used to discover supernovas days earlier, if this burst can be distinguished from other sources of X-rays from the star about to explode.



NASA and the Russian space agency have agreed to send a 1-year mission to the **International Space Station** (ISS) in 2015, by far the longest mission there (though 3 missions to the Russian Mir space station were over 364 days). Scott Kelly and Mikhail Kornienko were chosen and have begun training.

ISS was turned from its usual orientation for 10 days in early December in order to allow the SOLAR instrument to continuously monitor the Sun for a full solar rotation of 25 days, something that has not happened in the nearly 5 years that instrument has been operating. Antennas, solar panels and other instruments had to be adjusted to accommodate.

New computer simulations of **black holes** find that jets of material thrown out tend to align with the spin axis of the black hole itself, at least for nearby jet material, and further that disks of material orbiting align perpendicularly to that axis, due to magnetic effects.

Scientists using the Subaru Telescope in Hawaii have captured a clear image and polarization measurements of the disk about the star UX Tauri A, showing the dust grains appear to be in the process of **forming planets**. The dust was shown to be large, irregular, colliding and adhering.

NuSTAR (orbiting X-ray telescope) in some of its 1st observations happened to catch the black hole at the center of the Milky Way swallowing material, possibly asteroids.

Sir Patrick Moore, CBE, FRS, FRAS (1923-2012)

One of the great voices in our hobby passed away last month at 89 years old after a series of illnesses. Sir Patrick Moore was the author of over 70 books on amateur astronomy, the host of the BBC's influential program *The Sky At Night* for over fifty years, and a past president of the British Astronomical Association. His efforts to promote and popularize amateur astronomy extended beyond his native Britain throughout the world.

Moore first developed his interest in astronomy at the age of six. By the age of eleven he had joined the BAA, and by age fourteen he had been invited to run a small observatory after his mentor had been killed in a car accident.

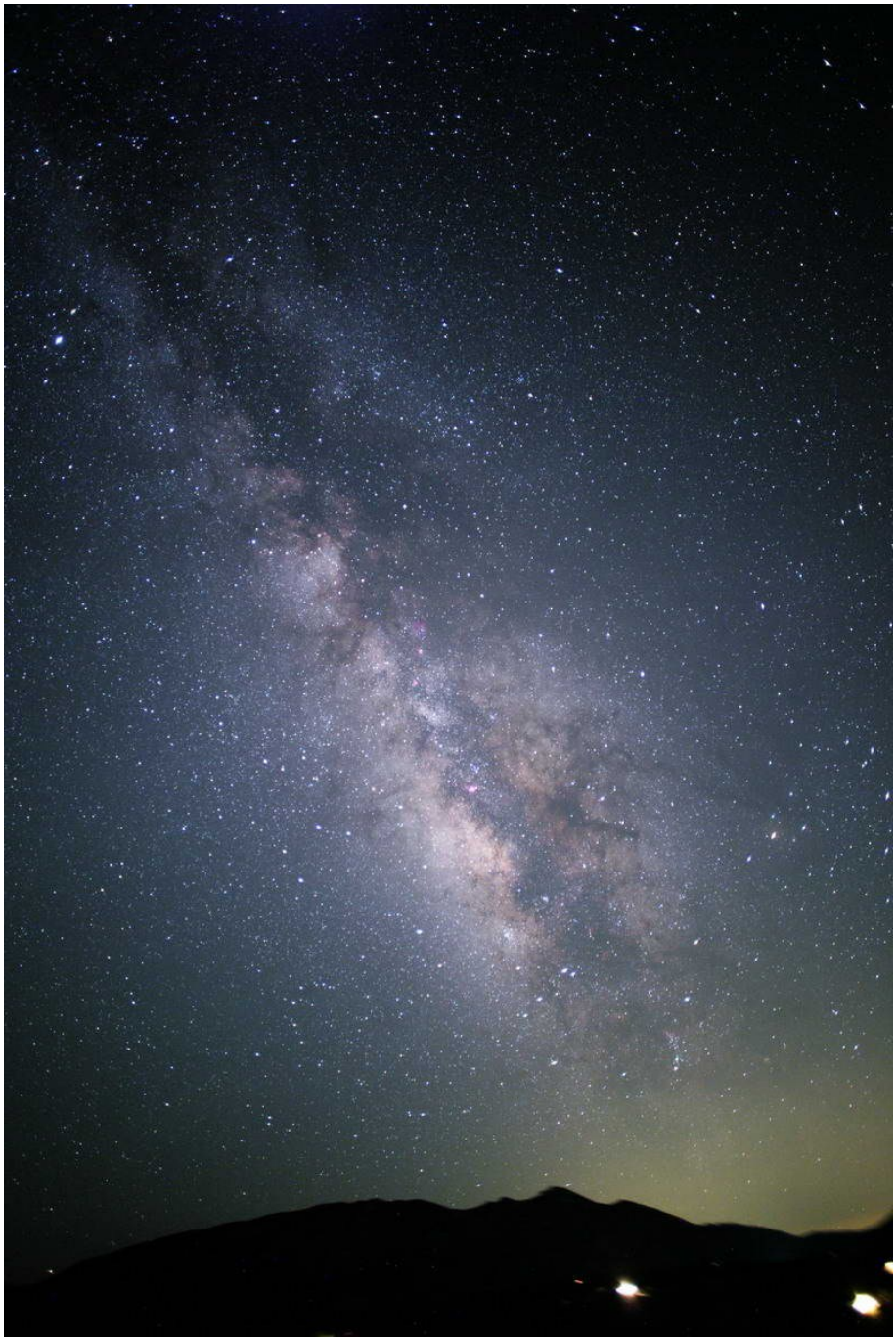
Lying about his age, Moore joined the RAF at the age of 16 to fight in World War II as a navigator in Bomber Command. During his training in Canada he had the opportunity to meet both Albert Einstein and Orville Wright, experiences which had a profound effect upon his future career trajectory. After the war, he rejected a grant to study at Cambridge but nonetheless began writing his first astronomy books in the postwar period. His popularity was such that he was invited to participate in a televised debate on the existence of UFOs in the 1950's; subsequently, his regular TV series *The Sky At Night* began airing in 1957. Moore hosted the show continuously until his death, missing only one broadcast in 55 years due to a bout of food poisoning. Later editions of the show are noteworthy for being broadcast from Moore's home, as arthritis and an old spinal injury made it difficult for him to travel to the studio (he had ceased observing due to these ailments early in 2012).

Moore was a frequent guest commentator for NASA, and in 1959 was the first Western astronomer allowed to present the data from Luna 3, the Soviet space probe that was first to photograph the lunar far side. In a trip to the Soviet Union, Moore met cosmonaut Yuri Gagarin—Moore would later comment that he was probably the only person to have met Orville Wright (the first man to fly), Yuri Gagarin (the first man in space), and Neil Armstrong (the first man on the Moon).

Among Moore's observational contributions were the first formal description of Transient Lunar Phenomena (TLPs) in 1968, a topic of considerable controversy in that TLPs are rarely independently observed or recorded although some verifiable incidents have been reported. Additionally, Moore was noteworthy for creating the Caldwell Catalog of 109 deep-sky objects as an complement to the Messier Catalog; these objects were neglected by Messier but constitute some of the brightest and well-known deep-sky objects. A tireless proponent of amateur astronomy, Moore worked throughout his life to promote the hobby around the world.

In addition to his astronomical pursuits, Moore was also a very talented musician, playing the piano and xylophone and writing two operettas (one of which was later adapted into a ballet). He also was active in Britain's animal-rights movement and made several appearances as himself in roles outside *The Sky At Night*, including the BBC adaptation of *Independence Day* and an episode of *Doctor Who*.

Per his wishes, he was buried in a private ceremony, but a public remembrance of his life will be held on what would have been his 90th birthday on March 4th.



Using a 20mm telescope and a Canon 5d imager, Jeff Malmrose created this panoramic image of the Milky Way over the hills near our Anza site on July 15, 2012.

FOR SALE

Skywatcher 100ED f9 Refractor with Celestron CG-4 mount. Scope comes with a hard case, 8x50mm finder; 2 LET eyepieces, 2-inch dielectric diagonal; Baader solar filter. CG-4 mount has motor drives on both equatorial and declination axes. All in excellent shape for $650 or best offer.

Celestron Sky Prodigy 90mm Maksutov with all attachments, $375.

Vixen Porta II Altazimuth Mount, $100; Telrad finder, $25.

Contact Val Akins (949) 382-1869

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