SIRIUS ASTRONOMER

www.ocastronomers.org

The Newsletter of the Orange County Astronomers

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The Rosette Nebula is seen in this exposure from 11/30/14 created by Bill Hall from Yorba Linda, CA. Bill used an H-alpha filter and composited 12 10-minute exposures to generate this fantastically-detailed image!

OCA CLUB MEETING

The free and open club meeting will be held December 12 at 7:30 PM in the Irvine Lecture Hall of the Hashinger Science Center at Chapman University in Orange. This month's speaker is Dr. John Kenney of Concordia University, who will discuss Astronomical Spectroscopy: The Royal Portal to the Heavens

NEXT MEETINGS: January 9, February 13

STAR PARTIES

The Black Star Canyon site will open on December 13. The Anza site will be open on December 20. 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 December 5. The following class will be held February 6.

GOTO SIG: TBA
Astro-Imagers SIG: Dec. 9, Jan. 13
Remote Telescopes: TBA
Astrophysics SIG: Dec. 19, Jan. 16
Dark Sky Group: TBA

Where the Heavenliest of Showers Come From

By Dr. Ethan Siegel

You might think that, so long as Earth can successfully dodge the paths of rogue asteroids and comets that hurtle our way, it's going to be smooth, unimpeded sailing in our annual orbit around the sun. But the meteor showers that illuminate the night sky periodically throughout the year not only put on spectacular shows for us, they're direct evidence that inter-planetary space isn't so empty after all!

When comets (or even asteroids) enter the inner solar system, they heat up, develop tails, and experience much larger tidal forces than they usually experience. Small pieces of the original object—often multiple kilometers in diameter—break off with each pass near the sun, continuing in an *almost* identical orbit, either slightly ahead-or-behind the object's main nucleus. While both the dust and ion tails are blown well off of the main orbit, the small pieces that break off are stretched, over time, into a diffuse ellipse following the same orbit as the comet or asteroid it arose from. And each time the Earth crosses the path of that orbit, the potential for a meteor shower is there, *even after* the parent comet or asteroid is completely gone!

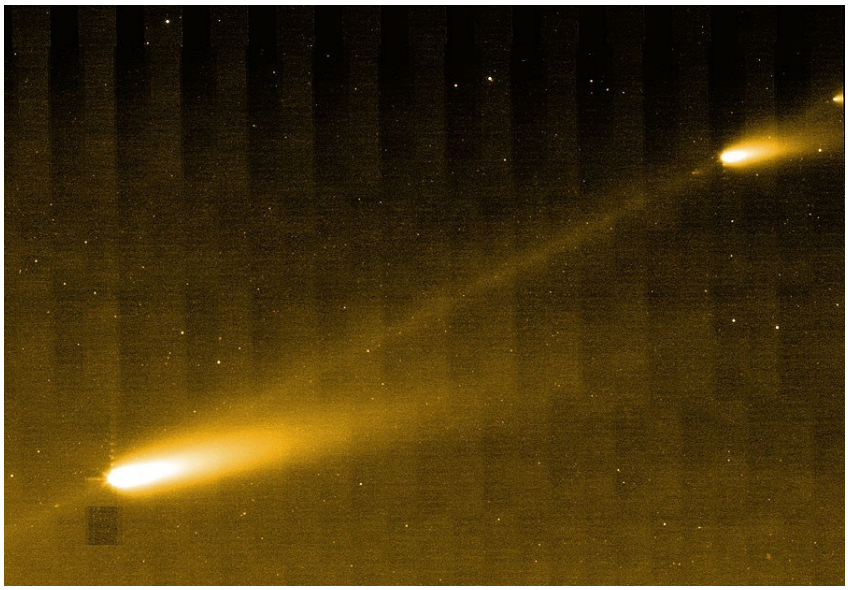


Image credit: NASA / JPL-Caltech / W. Reach (SSC/Caltech), of Comet 73P/Schwassman-Wachmann 3, via NASA's Spitzer Space Telescope, 2006.

This relationship was first uncovered by the British astronomer John Couch Adams, who found that the Leonid dust trail must have an orbital period of 33.25 years, and that the contemporaneously discovered comet Tempel-Tuttle shared its orbit. The most famous meteor showers in the night sky all have parent bodies identified with them, including the Lyrids (comet Thatcher), the Perseids (comet Swift-Tuttle), and what promises to be the best meteor shower of 2014: the Geminids (asteroid 3200 Phaethon). With an orbit of *only* 1.4 years, the Geminids have increased in strength since they first appeared in the mid-1800s, from only 10-to-20 meteors per hour up to *more than 100* per hour at their peak today! Your best bet to catch the most is the night of December 13th, when they ought to be at maximum, before the Moon rises at about midnight.

The cometary (or asteroidal) dust density is always greatest around the parent body itself, so whenever it enters the inner solar system and the Earth passes near to it, there's a chance for a **meteor storm**, where observers at dark sky sites might see *thousands* of meteors an hour! The Leonids are well known for this, having presented spectacular shows in 1833, 1866, 1966 and a longer-period storm in the years 1998-2002. No meteor storms are anticipated for the immediate future, but the heavenliest of showers will continue to delight skywatchers for all the foreseeable years to come!

What's the best way to see a meteor shower? Check out this article to find out: http://www.nasa.gov/jpl/asteroids/best-meteor-showers.

Kids can learn all about meteor showers at NASA's Space Place: http://spaceplace.nasa.gov/meteor-shower.

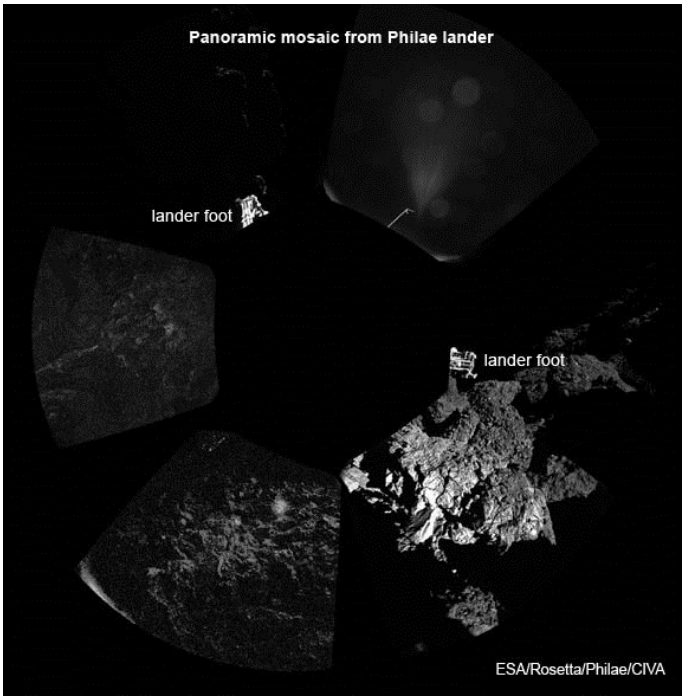
AstroSpace Update

December 2014

Gathered by Don Lynn from NASA and other sources

Rosetta (comet orbiter) has sniffed the gas surrounding comet 67P/Churyumov-Gerasimenko and found hydrogen sulfide, ammonia, formaldehyde, hydrogen cyanide, methyl alcohol, sulfur dioxide and carbon disulfide. These are only in small amounts, since the main constituents are water, carbon dioxide and carbon monoxide. It probably smells pretty bad. It is something of a surprise to find so many gases so soon, as the comet is not close enough to the Sun yet to produce much heating.

The landing site for the Philae lander of the **Rosetta** spacecraft on comet 67P/C-G was named Agilkia. That was the winning entry in the naming contest. The Rosetta stone was found in Egypt in 1799. Its inscription in hieroglyphics and 2 other languages allowed researchers to understand hieroglyphs. Another multi-language inscription was later found on the island of Philae in southern Egypt. The ancient temples of Philae were moved to Agilkia when Philae was flooded by the Aswan Dam about ½ century ago. The Rosetta spacecraft is allowing researchers to understand comets. Philae landed on Agilkia November 12. And that's how these names are meaningful.



The 2 harpoons that were supposed to fire into the comet and anchor **Philae** to the surface failed to fire, and so the lander bounced. Due to the comet's low gravity at the surface (about 100,000 times less than Earth's, Philae bounced about .6 mile (1 km), remaining aloft about 2 hours. It then bounced again, this time only a short distance off the surface, and settled down a few minutes later. Only 2 of the 3 lander feet registered contact with the surface at the final location, which means it is likely tilted over on its side. It returned a panoramic picture from the landing spot, much of which is in shadow. The other of the 10 instruments, except the drill and one spectrometer (which require anchoring to the surface), are all working properly sending data. During the first rotation (day) of the comet after landing, only about 1.5 hours of sunlight hit the solar panels. Philae is designed to run for 64 hours on its internal battery, then switch to a battery that recharges from the solar panels. This little sunlight on the panels will probably restrict its mission substantially after the initial 64 hours.

Rosetta's comet has been singing at a frequency of 40-50 millihertz, much lower than the range of human hearing. The spacecraft's magnetometer and plasma instrument have been detecting the sounds since August. They are thought to be oscillations in the magnetic field and clouds of ionized material around the comet.

Hubble Space Telescope (HST) has discovered 3 Kuiper Belt objects (KBOs) that the New Horizons spacecraft could visit after it flies by Pluto in July 2015. For the past few years, some of the largest ground-based telescopes have been searching for KBOs in the area where New Horizons is headed in order to add more flyby science to the mission beyond Pluto. But the search came up empty, so astronomers applied for time on HST to extend the search, and came up with these 3 finds. The Kuiper Belt is a vast ring of primordial debris encircling our Solar System beyond Neptune. Unlike asteroids, KBOs have not been heated by the Sun and are thought to represent a pristine well-preserved sample of what the outer Solar System was like when it formed 4.6 billion years ago. The newly found objects are in the range of 15-34 miles (25-55 km) across and are about a billion miles beyond Pluto. These are larger than typical comets, but far smaller than Pluto. New Horizons can reach any 1 of the 3 objects 3-4 years after Pluto encounter.

HST also found one of the farthest galaxies ever seen, whose light is estimated to have taken 13.3 billion years to reach us. It was seen magnified and brightened by a gravitational lens during a study called Frontier Fields, which is observing large galaxy clusters. The foreground galaxy cluster is Abell 2744, nicknamed Pandora's Cluster, and it produced 3 images of the distant galaxy, each about 10 times brighter than it would be without the lensing effect. The galaxy is only 850 light-years across, far smaller than out Milky Way galaxy, and is estimated to have a mass of only 40 million Suns. The astronomers believe galaxies such as this one are probably small clumps of matter that started to form stars and shine, but do not yet have the structure of a galaxy. It is possible that HST is seeing only the brightest part of the object, which might actually be larger. It was too dim to get a spectrum, which would reveal its redshift, and therefore distance, so the distance was estimated by its color, which is affected by redshift. The angular distance between the 3 images, which depends on its distance, was also consistent with the color-determined distance. Its redshift is about 10.

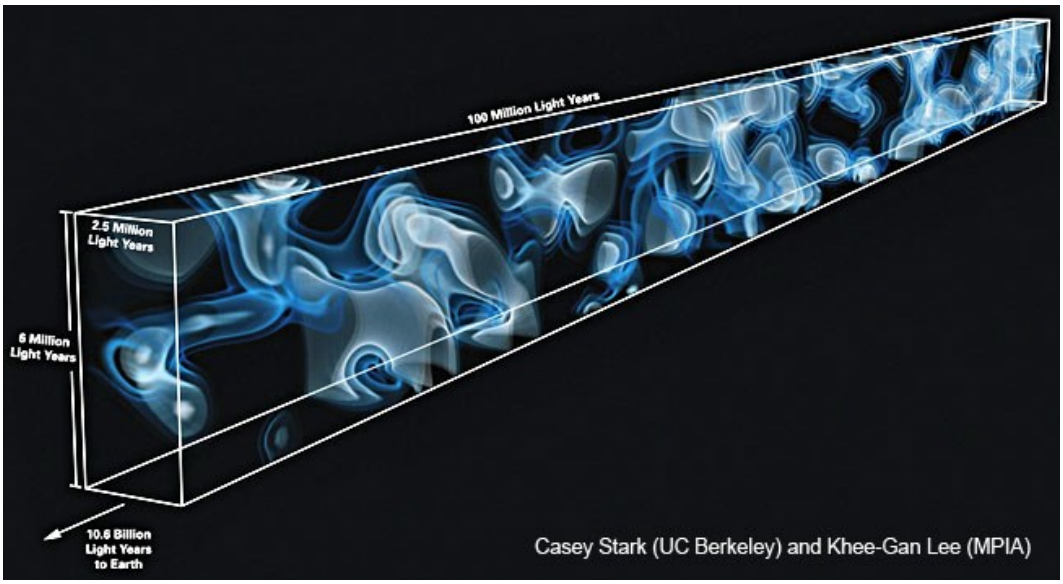
More HST – Astronomers were able to separate the light (visible and infrared) of the galaxies in Pandora's Cluster from the HST observations, leaving what is called intracluster light. This intracluster light is believed to be emitted by stars thrown out of their originating galaxies by gravitational effects during galaxy encounters. Stars thus thrown out are sometimes called ghost stars or orphan stars. The color of the intracluster light showed that it is bluer than light from stars within their galaxies. This is interpreted to mean that the ghost stars have higher levels of heavier elements and are younger stars. The total mass of the ghost stars was estimated to be 6% of the galaxies' total mass. This is 4-6 times the mass of our Milky Way galaxy. The astronomers plan to observe Pandora's Cluster in ultraviolet to extend their findings.

Infrared background – There is about as much infrared light coming from the dark spaces between galaxies as there is from the galaxies themselves. There has been debate whether this light comes from orphan stars or from the 1st generations of galaxies, too dim and distant to be resolved individually. A sounding rocket called CIBER, which took infrared data for the 7 minutes of its flight that was in space, has apparently settled the question. Orphan stars would produce a spectrum increasing toward shorter wavelengths, while early galaxies would produce a spectrum increasing toward longer wavelengths. CIBER's spectrum says it's orphan stars. Follow-up observations will try to locate the stronger areas of this background infrared emission, and measure how it has changed over cosmic history.

Low star-formation galaxies – A study of nearby small galaxies has found that 2 of them, Sextans A and ESO 146-G14, are producing new stars at a very slow rate, and have very small concentrations of heavier elements. In these respects they resemble many galaxies that formed soon after the Big Bang. So study of these 2 close galaxies can tell us what conditions were like in the early history of our Universe. The study made use of data from the Herschel infrared space telescope and 2 radiotelescopes, and archived observations from the Spitzer infrared space telescope and GALEX ultraviolet space telescope. It is believed that the low concentration of heavy elements is both a cause and effect of low star formation rates. Heavy elements appear to aid the cooling and collapse of gas clouds into stars. All elements heavier than lithium can only be formed in stars, and are believed to be distributed about galaxies by supernova explosions. Studying these 2 nearby galaxies may help quantify these effects.

Distant Universe map – A team of astronomers has created a 3-dimensional map of a little swath of the Universe out to farther distances than ever before. The farthest objects mapped are so far that the light left them just 3 billion years after the Big Bang. Previous such maps have been made by observing all the hydrogen spectral lines imposed by gas clouds through which the light of distant quasars have passed. The new map did the same thing, but using the light of distant galaxies, which are about 100 times more numerous than quasars. The redshift of the spectral lines gives the distance of each hydrogen cloud. It had been thought that really distant galaxies would not provide enough light for the technique, but use of a very large telescope (the Keck 10-meter) and a low-dispersion spectrograph (which operates on less light) made the technique work.

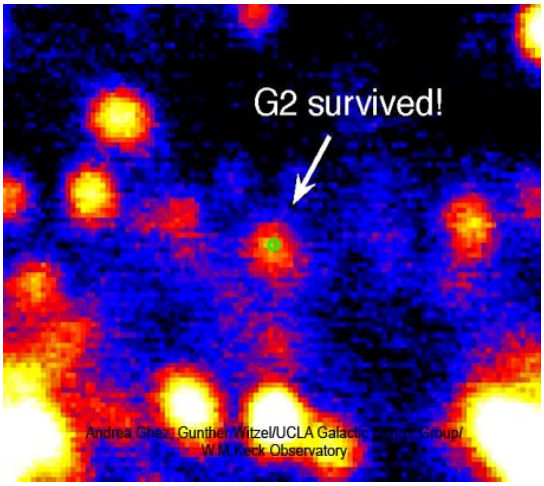
Star formation – Astronomers using the APEX submillimeter radiotelescope array to probe a huge cluster of galaxies that is forming in the early Universe showed that much of the star formation is taking place in areas hidden by dust, and is also occurring in unexpected places. The forming cluster surrounds the Spiderweb Galaxy (MRC 1138-262) and is so distant that we are seeing it as it was 10 billion years ago. The wavelengths of radio light used peer right through most of the thick dust clouds. Astronomers were expecting the star formation regions to lie on the large filaments connecting galaxies. Instead, they found it concentrated mostly in a single region, which is not even centered on the central galaxy of the forming cluster.



More star formation – The same phenomenon that causes bumpy airplane rides, turbulence, may be the solution to a long-standing mystery about star formation or the absence of it. Galaxy clusters are immersed in gas with temperatures of millions of degrees. This hot gas glows brightly in X-rays. Over time, the gas in the centers of galaxy clusters should cool enough to form stars. But many galaxy clusters do not. New X-ray observations by the Chandra space telescope found evidence that heat is channeled from heat sources near the central supermassive black hole by turbulent motions, keeping the gas from cooling. Chandra found fluctuations in the density of the gas in the Perseus and Virgo galaxy clusters, which indicates turbulence. The best theory of what produces such turbulence it is outbursts from the black holes, though mergers between galaxies could be the cause.

Ultraluminous X-ray sources (ULXs) have been the subject of debate for many years. They appear to be very hot accretion disks around black holes, but are too bright to be stellar mass black holes. They are so bright that the X-rays should push material away, reducing the amount of infalling material, and therefore the brightness down to what is called the Eddington Limit (where gravity balances light pressure). The only way seen around this was if the black hole is much more massive than just a stellar mass, so its larger gravity could pull material in faster, feeding the accretion disk to greater brilliance. But ULXs are not at the centers of galaxies, where supermassive black holes are found. Black holes of intermediate mass (between stellar mass and supermassive) appear to be quite rare, so there shouldn't be enough of them to be the ULXs. 2 new studies have been made to try to get to the bottom of this dilemma. The 1st new study determined the mass of a ULX in the spiral galaxy NGC 7793 (by measuring its orbital period about a companion) and found it is merely stellar mass (less than 15 times the Sun's mass), and exceeds the Eddington Limit in brightness by about a factor of 2. This means some force other than gravity and light pressure is at work, or something is shielding some of the infalling mass from the X-ray light. The 2nd study found that the object at the center of a ULX in galaxy M82 is pulsing, and is therefore a pulsar, not a black hole. Since the mass of a pulsar is even less than any black hole, this ULX exceeds the Eddington Limit by even more, perhaps a factor of 100. Since an intermediate mass black hole has not been ruled out for some of the ULXs, we now have at least 3 different kinds of ULXs. Much more study is required to determine what the mix of these 3 types is among ULXs.

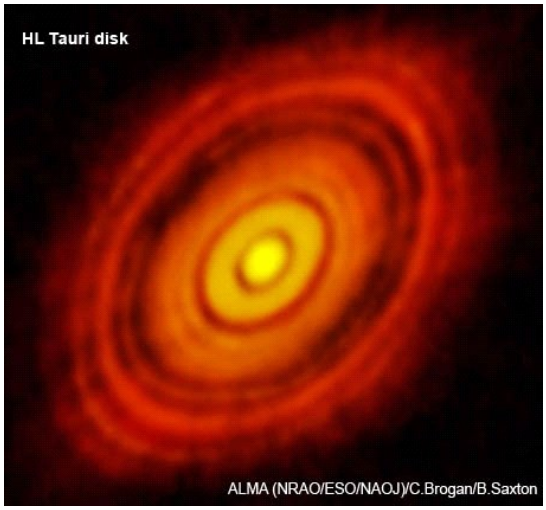
Fermi (gamma-ray space telescope) in 2009 detected a "storm" of high-energy blasts from a magnetar (highly magnetized neutron star). Analysis has discovered signals in the observations related to seismic waves rippling throughout the magnetar. Because a neutron star's solid crust is locked to its intense magnetic field, a disruption of one immediately affects the other. A fracture in the crust will reshuffle the magnetic field, or a sudden reorganization of the magnetic field may crack the surface. Either way, the changes trigger a sudden release of stored energy via powerful bursts that vibrate the crust and imprint this on the gamma-ray and X-ray signals. Scientists calculate that a starquake on a neutron star releases the energy of a magnitude 23 earthquake (no earthly quakes have exceeded magnitude 10 yet).



G2 – In 2011 a gas cloud was discovered (and named G2) moving in an orbit that would take it very close to the black hole at the center of our Milky Way galaxy. Astronomers over a year ago reported (and I repeated it here September last year) seeing the cloud being torn apart by tidal forces, as expected, as it made its closest approach to the black hole. But later observations showed that it didn't get torn completely apart, but merely stretched some. It was no ordinary gas cloud. A team

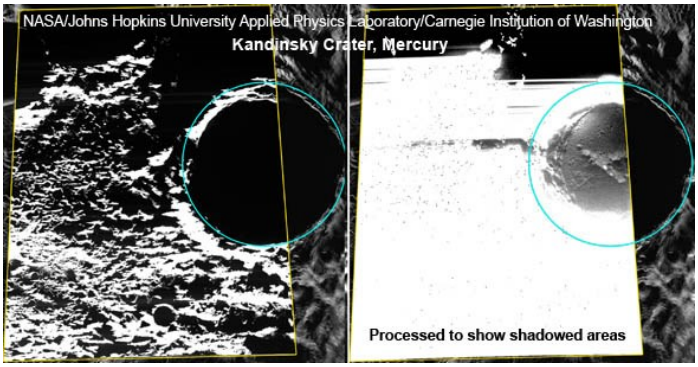
led by Andrea Ghez of UCLA has announced that it is a pair of massive stars that are merging into a very massive star, and that they were hidden inside the observed cloud. Their gravity held the cloud together when tidal forces were expected to rip the cloud apart. This merging may take place often near the center of a galaxy; most stars there are both massive and binary stars.

Double disk – Researchers using ALMA (radiotelescope array) have detected for the 1st time a streamer of gas flowing from a massive outer disk toward and inner disk in a binary star system. The inner disk has a mass roughly equal to that of Jupiter. It has persisted even though it is losing mass at a rate that should have depleted it long ago. The resupplying from the outer disk now explains its persistence. The inner disk (as well as the outer) could be forming planets.

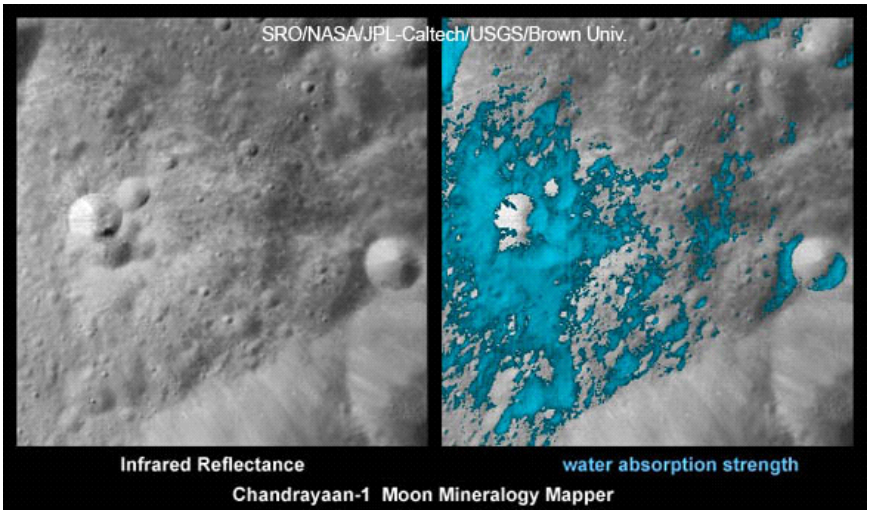


ALMA also observed HL Tauri, which has a planet-forming disk inside a cocoon of dust and gas that prevents visible light observations. ALMA used a wavelength of 1.3 mm to cut through the dusty veil. ALMA images made out details as find as 35 microarcseconds across, the equivalent of 5 AU (where 1 AU is the Earth's distance from the Sun) at HL Tauri's distance of 450 light-years. Gaps in the disk are seen at about 20-30 AU and at 70 AU. Other gaps are found farther out. Planets were not directly seen by ALMA, but planets are the likely cause of the gaps. The discovery of disk gaps around a star less than 1 million years old is surprising; planets aren't supposed to form so fast.

IRIS (solar space telescope) launched last year, has already made 5 major discoveries: 1) found heat pockets of 200,000°F (110,000°C) lower in the Sun's atmosphere than previously known; 2) found small, low-lying loops of solar material in the interface region; 3) discovered structures resembling mini-tornados occurring in solar active regions, moving as fast as 12 miles per second (20 km/s); 4) found evidence for high speed jets at the root of the solar wind; 5) found high energy particles generated by nanoflares.



MESSENGER (Mercury orbiter) has imaged ice patches in visible light for the 1st time deep in the shadowed polar craters of Mercury. Radar 1st found evidence of the ice about 2 decades ago, and the ice was found later in infrared and neutron spectrometry. The new observations were made with long exposures using the faint light reflected off the rim of the crater Prokofiev. One ice patch exhibited a cratered texture that indicated the ice was deposited fairly recently. Some ice patches were found to be covered by a thin layer of dark material inferred to be frozen organic-rich compounds. The dark covering has sharp boundaries, which indicates it is relatively young. The patches looked different than the ice patches found in permanently shadowed craters on our Moon, which may mean the ice was deposited by different means or at different times.



Lunar water source – Numerous observations over the past 5 years have found water on the surface of our Moon, both as ice and combined chemically in minerals. New observations made of the isotopes in mineral-bound lunar water show that most (at least 85%) of it was formed by hydrogen nuclei in the solar wind striking oxygen on the Moon's surface, combining to form water. The other 2 theories of the origin of lunar water, that it was

brought by comets or asteroids striking the Moon, must therefore have contributed little water. The results apply only to surface mineral-bound water, and it is possible that water brought by comets and asteroids may lie deeper within or elsewhere on the Moon.

Comet at Mars – Preliminary results are in from observing Comet C/2013 A1 Siding Spring by all 7 of the operating spacecraft at Mars as the comet made its extremely close pass by the red planet. MAVEN found that debris from the comet added a temporary very strong layer of ions to the Martian ionosphere. The MRO subsurface radar detected a smearing of the surface signal during this time due to looking through the ion layer. The comet was known to be from the Oort Cloud, rather than from the closer-in Kuiper Belt. So effectively it brought a free sample of the Oort Cloud to our spacecraft at Mars. Scientists estimated that the comet produced a strong meteor shower at Mars, though the strength would depend on the distribution of various sizes of particles in the comet tail, which is not well measured. Spectrographic measurements detected 8 different metals, including sodium, magnesium and iron, being deposited into the Martian atmosphere, then dissipating over about 2 days. It was determined that the comet nucleus is smaller than the predictions of 1.2 miles (2 km), though the exact size was not determined since it took up so few pixels in even the highest resolution images. The part of the comet tail that struck the Martian atmosphere was definitely dustier than predicted. The Curiosity rover appears to have barely picked up the comet as perhaps a single pixel; the difficulty is probably due to the always-dusty Martian atmosphere. Opportunity rover got several shots of the comet, but none were able to distinguish the nucleus from the surrounding coma.

Great Red Spot (GRS) – The color of Jupiter's Great Red Spot is likely a product of ammonia and acetylene, chemicals known to exist on Jupiter, being broken apart by ultraviolet sunlight in the planet's upper atmosphere. This conclusion was reached by a new study using a combination of data from Cassini's flyby in 2000 and laboratory experiments breaking down various chemicals found on Jupiter. One chemical, ammonium hydrosulfide, produced a Great Green Spot in the laboratory. But a mixture of ammonia and acetylene produced chemicals that matched the color and spectrum of the GRS. The result contradicts the other main theory of the Red Spot's color: that it was from chemicals welling up from beneath the planet's clouds. The study suggests that the color exists only in the highest parts of the GRS, so that it is pretty bland in lower parts. This explains why the red color is seen in few other places on the planet: most of the planet does not have such high-altitude clouds as are found in the GRS.

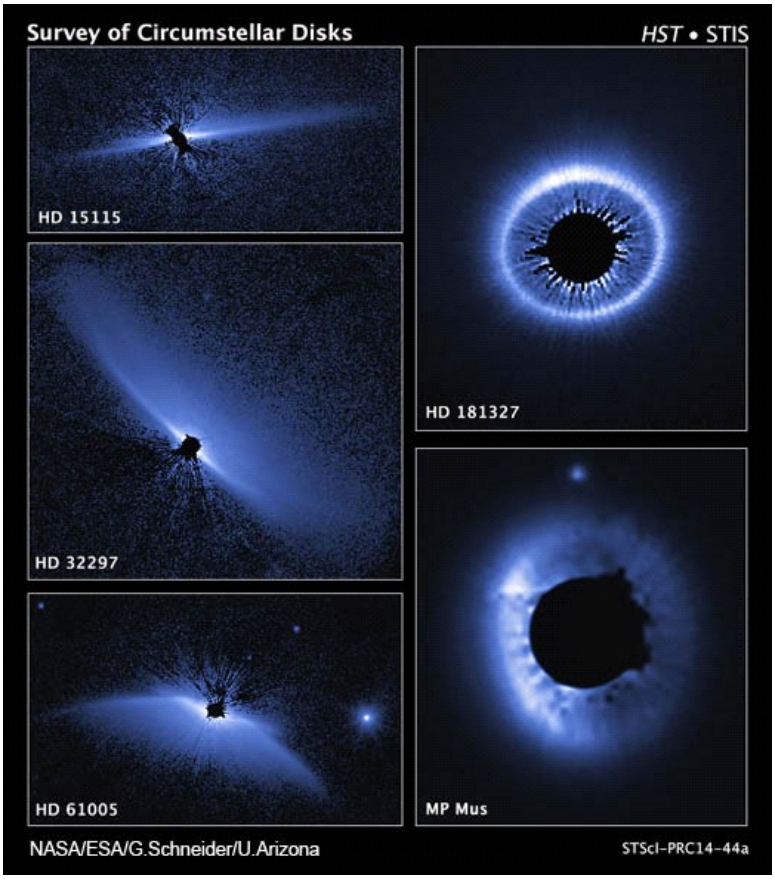
ALMA (radiotelescope array) in a 3-minute observation of Saturn's moon Titan, found zones of organic molecules somewhat away from the polar areas where such is expected. Titan's winds should smear out such zones into rings around the poles. Specific molecules observed were hydrogen isocyanide (HNC) and cyanoacetylene (C_3HN). The researchers are looking at chemical, thermal, magnetic, or peculiar circulations to explain the observations.

Possible Mimas ocean – A new study of images of Saturn's moon Mimas show that it librates (appears to wobble) more than predicted. This could be caused by either a liquid ocean below the icy surface or a non-spherical shape to its core. Either is unexpected. The surface of Mimas does not display any signs of geological activity and is too small to have retained heat from its formation, so an ocean would be a surprise. A strange-shaped core should show signs on the surface, but none are seen.

Titan clouds – Scientists have identified in Cassini data an unexpected high-altitude (stratosphere) methane ice cloud in the winter cap of clouds above the north pole of Saturn's moon Titan. Ethane ice had previously been seen there. Methane clouds were previously seen only at low altitudes of Titan. Temperature measures of the stratosphere showed it is too warm for methane clouds to form at that altitude. However, new measurements have shown sufficient stratosphere temperature variations (of about 11°F = 6°C) to allow methane clouds.

Cassini has imaged another "disappearing island", this time in both radar and infrared images. The newly found one is in Kraken Mare, Titan's largest methane sea, while the previous one was in Ligeia Mare. The best guesses as to what these objects are: waves or floating debris. This flyby of Titan was also radaring a strip across Kraken Mare to determine its depth. The sea floor shows up nicely in the area where a large flooded river valley empties into the sea. The depth ranges from 66-115 feet (20-35 m). Some areas of the sea did not show the sea floor, which probably means it is deeper than the radar penetrates liquid methane.

Exocomets (comets outside our Solar System) – A spectrograph on the 3.6 meter telescope in Chile, which was designed to detect exoplanets, has been used to observe exocomets that are transiting the star Beta Pictoris. That star is only about 20 million years old and is about 63 light-years away. Analysis of 1000 observations over 8 years showed the presence of 493 comets. They were found to be of 2 families: older comets whose orbits are controlled by a massive planet, and another family probably arising from the recent breakdown of 1 or a few bigger objects. The known planet Beta Pictoris b could be the controlling object in the 1st family of comets. The age of the comet families was determined by the level of gas and dust production.



Exozodiacal light – Using the Very Large Telescope Interferometer, a team of astronomers has discovered exozodiacal light close to the habitable zones around 9 nearby stars. This light is starlight reflected from dust created from collisions between asteroids and the evaporation of comets. The presence of such large amounts of dust around some stars may pose an obstacle to the direct imaging of exoplanets. The team observed 92 nearby stars and found zodiacal light bright enough to be detected at 9 of them. Zodiacal light is dust created after planetary formation; dust before planets form has been observed numerous times. However, exozodiacal light has been detected a few times before, but not systematically studied until now. Most of the dust detected in the new study was found around older stars, which was surprising. Dust production should diminish over time. The sample included 14 stars for which exoplanets have been previously reported. The exozodiacal light detected in this survey is about 1000 times brighter than the zodiacal light seen around our Sun. So there are probably large numbers of stars with zodiacal light too dim to yet be detected. The new study found a number of previously unknown companion stars. This means that we may be underestimating the fraction of stars that are binary. Another study of debris dust disks, made by Hubble (HST), observed stars ranging in age from 10 million years to over 1 billion years, and found disks that were unexpectedly diverse in structure, with no 2 disks looking the same. This suggests that they are being gravitationally affected by unseen planets. The shapes could also result from stars passing through interstellar material.

Rocket failures – Two privately developed rockets failed within a week in October. First the Orbital Sciences Antares rocket carrying about 5000 lbs (2200 kg) of supplies to the International Space Station (ISS) exploded seconds after liftoff. The preliminary assessment is that the turbopump in one of the 2 first-stage rocket engines failed. With reduced thrust, the rocket settled back down on the launch pad, burst, and exploded. This extensively damaged the launch pad. The engines are upgraded Soviet rocket engines left over from the race to the Moon in the 1960s. Orbital Sciences has announced that their recovery plan is to buy a rocket or 2 from their competition to deliver loads to ISS over the next months, then use their planned upgraded Antares rocket (with a new type of engine) to continue delivering on their contract with NASA to supply ISS. NASA says that the crew of ISS is in no danger of running out of any critical supplies. One-of-a-kind scientific experiments were lost, and will have to be built again, including some student supplied ones. The second failure was Virgin Galactic's SpaceShip Two, which broke up during a test flight over the Mojave Desert. One crewman survived by parachute, though seriously injured, but the other did not survive. The incident occurred shortly after the space plane fired its rocket motor following a high-altitude drop from the WhiteKnightTwo mothership airplane. The flight was to test a new version of the rocket motor, using a new kind of solid fuel. The new motor and fuel had been thoroughly tested on the ground. If this and succeeding tests had gone well, Virgin Galactic would have been taking passengers on short rides into space next year. A thorough investigation will determine the cause of the accident.

Observatories in financial trouble – The University of Hawaii has assumed ownership of the UKIRT infrared telescope on Mauna Kea, since the UK Science and Technology Facilities Council stopped their funding. The University of Arizona and Lockheed Martin Space Technology Advanced Research and Development Laboratories are partnering with the University of Hawaii in this effort. This is probably the most productive telescope ever threatened to be closed over funding issues. The 15-meter James Clerk Maxwell submillimeter telescope, also on Mauna Kea, is being taken over by the University of Hawaii and the East Asian Core Observatories Association, since its funding from Canada was dropped. The Green Bank radiotelescope had its funding cut off by the National Science Foundation (NSF). It is being run by West Virginia University, but further support will soon be needed. NSF also pulled its support of the Very Long Baseline Array radiotelescope. Recently the University of California announced its intention to stop funding the Lick Observatory by 2018, but later reversed its decision. This rash of funding issues may be the result of organizations building new observatories to take advantage of the latest technologies, and then finding out they do not have sufficient funds to also run their old observatories.

Gaia (astrometry space telescope), while scanning the sky to measure the positions, motions and spectra of stars in our galaxy, has been predicted to become the most prolific planet finder ever. A new study estimates that Gaia will discover about 21,000 exoplanets of Jupiter mass and larger during its planned 5-year lifetime. Such planets should be detectable by Gaia out to about 1600 light-years away. To date, only about 2,000 exoplanets have been discovered and confirmed by all other means. Of the 21,000, it is expected that about 50 of them will transit their star. If Gaia's mission gets extended to 10 years, the predicted number of planet discoveries rises to about 70,000.

Instant AstroSpace Updates

In late October, China sent a spacecraft once around the Moon, then it returned to Earth and soft-landed in Inner Mongolia. It was named **Chang'e-5 T1**, nicknamed Xiaofei, and its goal was to test technologies for the Chang'e-5 mission, which is planned to return samples from the Moon in 2017.

A new analysis of data from a 2005 Cassini flyby of Saturn's moon **Hyperion** showed that the spacecraft was briefly bathed in a beam of electrons coming from that moon, indicating that Hyperion is electrically charged. Ultraviolet light or charged particles in space likely cause the moon to be charged.

A team of astronomers has discovered the largest known carbon molecules outside our Milky Way with **LOFAR** (low-frequency radiotelescope array). They were found in the heart of the starburst galaxy M82.

Infrared images taken with the Keck Telescopes, using adaptive optics, show that the normally bland face of **Uranus** has become quite stormy, with enormous clouds that amateur astronomers are seeing in visible light. This activity now is a surprise, since it was expected from solar heating at the equator during the equinox, but that was 7 Earth-years ago.

Experiments with a hyper-speed gun shooting at plastic spheres confirms the theory that the grooves around the equator of **Vesta** were likely caused by the impact that knocked off most of the south polar region of that asteroid. The impactor would have had to hit at about a 40° angle at about 11,000 mph (18,000 km/h) to duplicate the grooves on Vesta.

Ground was broken to start construction of the **Thirty Meter Telescope** atop Mauna Kea in Hawaii. Its primary mirror is to be made up of 492 smaller (about 4-ft = 1.2 m) hexagonal mirrors, comprising 9 times the light-gathering power of either Keck Telescope, currently the most powerful optical telescopes.

For Sale:

Telescope: Celestron C-11 NexStar GPS Go-To Schmidt-Cassegrain telescope with Star-Bright Coatings, carbon fiber tube with heavy duty Celestron tripod

Includes: (original equipment was: 1 ¼" star diagonal with 1 ¼" eyepiece; 9x50 finderscope, straight through).

UPGRADES INCLUDED:

Parks 2" diagonal; Orion SkyGlow Broadband light pollution filter (Schmidt-Cassegrain); Orion UltraBlock Narrowband light pollution filter (Schmidt-Cassegrain); 50 mm finder with 1 ¼" diagonal mounted on rings and standoff to shoe to C- 11 with crosshair eyepiece in diagonal; additional Celestron 1 ¼" illuminated eyepiece; Kendrick Quick Focus mask; original dust cover replacement, (remove three plastic hole covers to use as Quick Focus); Metal dew shield for C-11; RoboFocus mounted on C -11 to work with the Feathertouch focuser, attached with sticky pads; Belsico Skyan wireless telescope control unit;

Underside rail and counterweight for balancing the C-11; JMI Medium Size Universal Wheeley Bars; JMI CASEOTA11 JMI carrying case for the Optical Tube Assembly (OTA) ONLY includes two lockable latches, three steel-reinforced handles, a 2" by 30" steel hinge and die-cut foam lining for the telescope optical tube. It can be carried by two people using the two handles on either end or pulled using the attached Kryptane® wheels. The diagonal must be detached (from Celestron scopes) and inserted in a foam cutout inside the case. The wheels must be attached to the case by the customer which is easily accomplished in a few seconds with two 7/16" wrenches. An optional Large-Wheel Upgrade is available.

Software: Celestron NexRemote remote control software for C-11 GPS v1.6.14 on original CD.

Asking Price for telescope package: $3000

CCD Camera and HyperStar 11 for C-11:

SBIG ST-237A CCD Complete with COLOR WHEEL: This is a complete Santa Barbara Imaging Group ST-237A CCD camera system in the original box with all original cables, accessories, and software. The camera has the optional CRW5C Internal Color Wheel with I/R Blocking Dichroic Filters already installed, and the original Integral Shutter Wheel for B/W operation is also included. This is a 16 bit A/D camera based on the Texas Instruments TC237 CCD with 657 X 495 pixels that are 7.4 microns square, and features on-board thermoelectric cooling for reduced thermal noise. This system can be used for B/W imaging, color imaging, and for autoguiding. Included software is CCDSoftV5, CCDOPS for Windows, and CCDSharp for Windows. Updated software is available free from SBIG at their website.

Asking Price for the CCD/HyperStar 11: $1100

CONTACT:

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For Sale: Losmandy G11 German Equatorial Mount. This mount is the digital drive (non-Gemini GOTO) version. It has encoders, a Robin Casady dovetail saddle, and many extras. It has a payload capacity of 60 pounds, plus counterweights. If interested, contact John Fisanotti at jfisanotti@sbcglobal.net or 818-957-2605 and he will send you an eight-page brochure with further details and many more photos. Asking $2400 and will deliver to a local (within Southern California) buyer.

FOR SALE: 2 Meade Maksutovs. Take your choice or buy both - excellent optics, rarely used.

ETX-125 5" $575

LX-200 7" $1500

Contact Rick Hull email hull3@cox.net

Pat Knoll created this image of Uranus on November 23 using a 10-inch LX-200 Classic with a 4X Powermate. Three of Uranus' largest moons are seen here: Oberon (lower left), Ariel (fainter object to right) and Titania. Pat used an ST-402 imager to capture the moons and a ZWO AS120MC for the planet. Three 30-second exposures were composited for the moons and three 3-minute video clips were composited for the planet. Images of Uranus by amateur astronomers are comparatively rare (only five are in the OCA Image Gallery, including this one); this one has the added distinction of having been created from Kearny Mesa, CA, deep within San Diego's light dome.

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