SIRIUS ASTRONOMER
www.ocastronomers.org
The Newsletter of the Orange County Astronomers

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MESSIER MARATHON MARCH 29! HAPPY HUNTING! HANDY MARATHON FORM PAGES 9-10

As Mars approaches opposition on April 8, it is becoming a more interesting object for the eyepiece and imager. At magnitude –1.5 and roughly 15" in diameter, it won't be at its most impressive, but Mars will still be better than it's been in the past eight years. Bill Hall took this image using a Celestron C8 with NexImage 5 camera on February 22 from Yorba Linda. The dark triangular feature Syrtis Major dominates the image, along with the Hellas basin (bright area at top) and the north polar cap, which will be pointed 22 degrees toward Earth during this opposition.

OCA CLUB MEETING

The free and open club meeting will be held March 14 at 7:30 PM in the Irvine Lecture Hall of the Hashinger Science Center at Chapman University in Orange. The topic of this month's talk is yet to be announced, so watch the website for more details!

NEXT MEETINGS: April 18, May 9

STAR PARTIES

The Black Star Canyon site will open on March 29. The Anza site will be open on March 1 and March 29. 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 March 7. The following class will be held April 4.

GOTO SIG: TBA
Astro-Imagers SIG: Mar. 11, Apr. 8
Remote Telescopes: TBA
Astrophysics SIG: Mar. 21, Apr. 18
Dark Sky Group: TBA

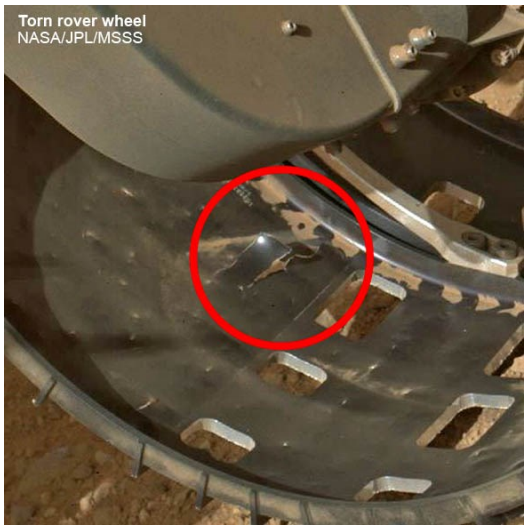
AstroSpace Update

March 2014

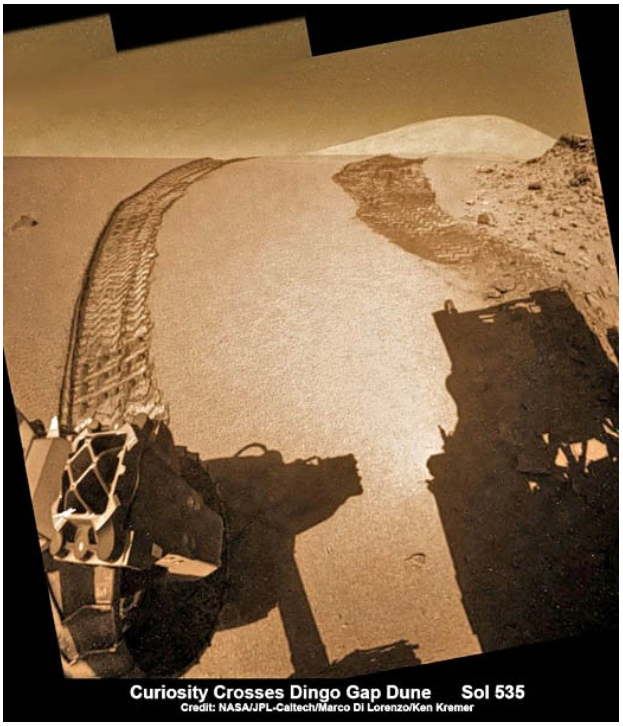
Gathered by Don Lynn from NASA and other sources

Martian jelly doughnut – A distinctive light-colored rock with a red spot on it showed up in images taken by the Mars rover Opportunity, which some have dubbed the jelly doughnut rock. The weird thing is that the rock was not there in an image taken 4 days earlier. But the mystery has been solved. Further images taken of the surroundings show a large rock that was run over by the rover wheels, and it has a light-colored broken spot that matches the jelly doughnut. So the rover wheel broke the doughnut off and flipped it where it was later found. After solving the mystery, the rover was commanded to proceed uphill toward some geologically interesting layered rocks.

Opportunity (Mars rover) – New findings from rock samples examined by Opportunity have confirmed an ancient wet environment on Mars with neutral water. Previous rocks examined by this rover showed ancient acidic water was present. This confirms and strengthens the ancient neutral water findings of the other operating Mars rover Curiosity. Neutral water would have been more favorable for microbial life to have developed. Opportunity was examining rocks in an area identified by the Mars Reconnaissance Orbiter as having clay minerals. Researchers believe that the clay, which is known as iron-rich smectite, was formed in wet conditions that existed before Endeavour Crater was formed by impact about 4 billion years ago. The area lies on the rim of that crater.



Curiosity (Mars rover) – Accumulation of punctures and rips in the rover's wheels in late 2013 caused by sharp-edged Martian rocks has prompted the rover team to drive with added precautions and thorough checks of the wheels. Continuing wheel damage forced engineers to seek a smoother pathway to KMS-9, the rover's next science destination. At KMS-9 there are 3 types of terrain exposed and a relatively dust-free surface. It is planned to do a rock drilling and analysis there. An area paved with smoother rocks was found, but on the opposite side of a yard-high (meter-high) dune, dubbed Dingo Gap. After carefully dipping its wheels into the dune, it was declared safe to drive over, and so the rover did. The valley on the other side has some interesting veins and mineral fractures visible just ahead. Curiosity has driven 3.04 miles (4.89 km) since its August 2012 landing. The rover also took its 1st image of Earth (just a dot), showing the Moon too.



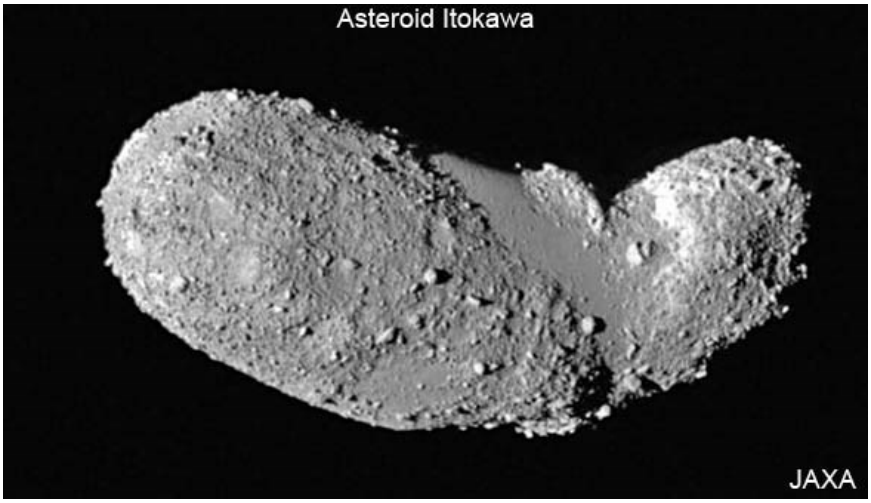
Possible Martian liquid water – Spacecraft orbiting Mars have returned images of features that are dark, finger-like marking that advance down some Martian slopes when temperatures rise seasonally. New clues about these features include corresponding seasonal changes in iron minerals on those same slopes and a survey of ground temperatures and other traits at those active sites. These support a suggestion that brines with an iron-mineral, such as ferric sulfate, which can act as an antifreeze, may flow as liquid seasonally. The observations did not find spectral signature of water

or salts. But the observations might miss seeing water because the resolution of the spectrographs is not sufficient to zero in on just the streaks, or because all observations were made in the afternoon, and water might be more abundant in mornings. However, Mars Odyssey, over the next year plus, is being moved from an afternoon orbit to a morning one in order to observe morning fogs, clouds, frost and ground temperatures, so it should be able to look for water flows in the morning. Scientists are still trying to rule out that the streaks form and disappear by some dry process. Many similar slopes (in latitude, temperature and direction) do not have the dark streaks, dubbed recurring slope lineae or RSL, which indicates additional factors play a crucial role. The RSLs are much more abundant some years than others.

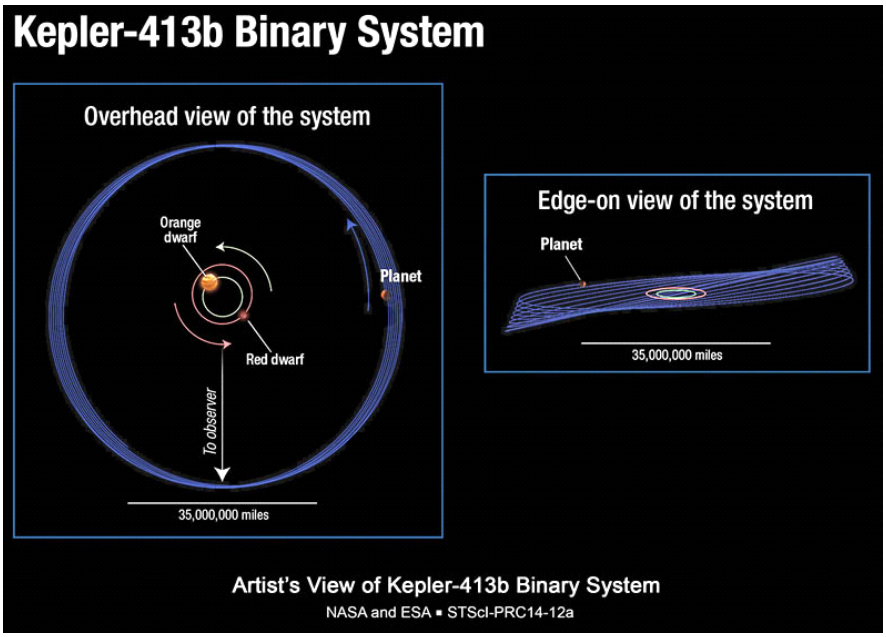
Yutu (Chinese lunar rover) failed to fold up properly to insulate itself from its 2nd cold lunar night, which lasts 14 Earth days. When Yutu failed to radio back to Earth after daylight returned, some feared it had frozen to death. But 2 days late, it finally answered. The spacecraft team is checking to see what damage it might have suffered. Meanwhile, the lander spacecraft off of which Yutu drove is in perfect operating condition. It was designed to last a year.

Water vapor at Ceres – Observations by the Herschel infrared space telescope have detected a thin water-vapor atmosphere about the largest asteroid Ceres. Plumes of water vapor are thought to shoot up periodically from Ceres when portions of its icy surface warm slightly. This is the 1st unequivocal detection of water vapor anywhere in the asteroid belt. The best theories, based on density, are that Ceres contains a rock interior with a thick mantle of ice, which contains more water than the fresh water on Earth. Only 4 out of the 5 observation by Herschel saw water vapor, and the strength of the detection varied over hours, weeks, and months. Scientists were able to correlate the strong signals with 2 dark areas on the surface. These areas might be more likely to outgas because their dark color would keep them warmer in sunlight. The Dawn spacecraft is on the way to arrive at Ceres in spring 2015. It will be able to investigate these features.

Asteroid density – The New Technology Telescope in Chile and other ground-based telescopes have made exquisitely precise rotation measurements over time of the asteroid Itokawa, which was visited by the Japanese spacecraft Hayabusa. The spin changes as a result of pressure from the heat of sunlight radiating away nonuniformly as infrared light. Itokawa changes the length of its day by only .045 seconds per year, but this was clearly measured. The measurements showed that the 2 ends of the asteroid have different densities (1.75 and 2.85), indicating different structures. This could be because the asteroid formed from the collision of 2 different kinds of asteroids.



Planets in star clusters – Astronomers have discovered 3 planets orbiting stars in the open star cluster M67. Although more than 1000 planets are confirmed, only a handful have been found in star clusters. This has led astronomers to wonder if there is something different about how planets form in star clusters. This would be odd, since most stars are believed to form in star clusters, though they usually escape after formation. The study used the radial velocity method, monitoring 88 selected stars in M67 for 6 years, looking for planets. The cluster lies about 2500 light-years away in the constellation Cancer, and contains about 500 stars. Most open clusters dissipate after a few tens of millions of years, but M67 has stuck together much longer, and is one of the oldest and most studied of such clusters. 2 of the discovered planets orbit Sun-like stars, one of those almost exactly like the Sun in mass, temperature and chemical abundances. The other orbits a red giant star. 2 of the planets have about 1/3 the mass of Jupiter, and orbit their host stars closely, taking only 5 and 7 Earth-days for each orbit. The other planet takes 122 days, and is more massive than Jupiter. All 3 are closer to their star (and therefore hotter) than the habitable zone. This shows that planets are roughly as common in M67 as planets orbiting non-cluster (isolated) stars.



Wobbling planet – A planet designated Kepler-413b has been found to wobble, or precess, wildly. The tilt of the spin axis can vary by as much as 30 degrees over 11 years, leading to rapid and erratic changes in seasons. Earth's precession takes 26,000 years to complete a circuit. Kepler-413b is located 2300 light-years away. It circles a close pair of stars every 66 days. It orbits slightly closer to its stars than the system's habitable zone, that area where temperatures allow liquid water to exist on a planet. Its orbit wobbles such that sometimes it transits its stars, as seen from Earth, and sometimes it instead passes above or below. Astronomers are still trying to explain why this planet is out of alignment with its stars. There could be other planets or a 3rd star nearby that tilted its orbit.

ALMA (radiotelescope array) has observed evidence of formation of a giant planetary system around a young star named HD 142527 in Lupus. By measuring the density of dust in the densest part of the ring about the star, the astronomers found that it is highly possible that gaseous or rocky planets are now being formed in that region. This region is far from the star, about 5 times larger than Neptune's orbit. This is the 1st firm evidence of planet formation found so far away from a star. Prior observations showed a gap inside the disk and a peculiar shape of the outer disk. The new observations showed the northern side of the disk is 30 times brighter than the other side in radio light. This can be interpreted as an indication that a large amount of material is accumulated on the bright side.

Fomalhaut – In recent years, the nearby (25 light-years) star Fomalhaut has been found successively to have 2 debris disks, a planet, and 2 companion stars. The latest discovery, made with the Herschel space telescope, is that the smaller companion star has its own debris disk. Debris disks are usually leftovers from planet formation. It is a small red dwarf star with 1/5 the mass of our Sun, and orbits about 2.5 light-years away from the primary star. This is on the 2nd system known in which disks are found around 2 separate orbiting stars. Herschel, because of the long wavelengths of light with which it operates, does not have the resolution to show any structure in the newly-found disk. The best estimate is that the disk is quite cold, around 24° K (minus 415° F), and pretty small (about the size of Saturn's orbit). It is likely similar to the primary star's disk in being bright, elliptical, and slightly offset from its star.

Black holes – A study made of dwarf galaxies in a large sky survey (the Sloan) has found more than 100 of them show characteristics indicating they probably contain a massive black hole at each ones core. Previous work had found black holes at the centers of nearly every large galaxy, but precious few in dwarf galaxies. This indicates that black holes in dwarf galaxies are much more common than thought. The galaxies studied were comparable in size to the Magellanic Clouds, dwarf satellite galaxies of our Milky Way. The newly found black holes were estimated to be roughly 100,000 times the Sun's mass, smaller than the millions or billions for the masses of black holes in full-sized galaxies.

Active black holes – A team of astronomers has conducted infrared observation of luminous, gas-rich, merging galaxies with the Subaru Telescope in Hawaii to study supermassive black holes (SMBHs) that are actively accreting mass. They found that at least one SMBH almost always becomes active. However, only a small fraction of the observed merging galaxies show multiple active SMBHs. This suggests that local physical conditions near SMBHs primarily determine whether SMBHs become active. Such observations are challenging, because dust and gas shroud events in merging galaxies. Using both K-band and L'-band (certain wavelengths of infrared), it was found possible to distinguish star formation light and SMBH accretion light. Of the 29 mergers observed, at least one SMBH was found in 28. Only 4 showed multiple SMBHs were actively accreting. Each of the merging galaxies of a pair should have a SMBH, but these observations show that usually only one of them becomes active.

Powerful black hole – Astronomers using the Chandra X-ray space telescope and radio telescopes have announced finding one of the most powerful black holes known. It is located in the center of a large elliptical galaxy that is in a galaxy cluster named RX J1532.9+3021, which is about 3.9 billion light-years away. The large amount of hot gas near the center of the galaxy cluster is a puzzle. Hot gas glowing in X-rays should cool, and the dense gas in the center of the cluster should cool the fastest. This should reduce the pressure in the central gas, causing gas further out to sink inward, which causes a burst of star formation. But the observations showed no evidence of a burst of star formation. This lack of star formation has been noted in many galaxy clusters, but this cluster is an extreme case. The new observations also show why star formation is suppressed in this case. Cavities in the hot gas were found on either side of the large central galaxy, which were caused by jets shooting out from the supermassive black hole in its core. These jets are essentially blowing away the material before it can form stars. The cavities are each about 100,000 light-years across, roughly the size of our Milky Way galaxy. Surprisingly the black hole producing these extremely powerful jets is not producing much in the way of X-rays. This is known to be possible if the black hole is extremely massive, or if it is spinning rapidly. A 3rd, more distant cavity was also found, which was apparently created in a previous outburst by the black hole's jets. Because it is not aligned with the other cavities, either the old cavity was been pushed aside by gas motion or the black hole jets have precessed.

Cosmic web imaged – Astronomers have obtained the 1st direct images of a portion of the cosmic web because it happens to lit by a nearby quasar that is acting like a cosmic flashlight. Supercomputer simulations predict that matter in the Universe is distributed in a network of filaments known as the cosmic web, made mostly of hydrogen atoms. The web connects clusters of galaxies and is thought to provide material to form new stars. This web has been probed before by the spectrum that it implants on quasar light passing through it, but this is the 1st time a large volume of web has been found illuminated. The amount of cool gas inferred from the new image appears to be substantially larger than predicted.

Gas flow – Using the Byrd Green Bank radiotelescope, an astronomer has discovered what could be a never-before-seen river of hydrogen flowing through space. This very faint tenuous filament of gas is streaming into the nearby galaxy NGC 6946 and may help explain how certain spiral galaxies keep up their steady pace of star formation. A leading theory is that rivers of hydrogen may be transporting hydrogen between galaxies, fueling star formation. But the hydrogen previously has been too diffuse to detect. The signal was too weak to be seen by most radiotelescopes. It is possible that the gas seen is instead the result of a close encounter with a neighbor galaxy, but this is unlikely because that should leave stars forming in its wake, and such stars were not seen.

Galaxy evolution – Astronomers using the Hubble and Herschel space telescopes and ground-based telescopes have pieced together the evolutionary sequence of compact elliptical galaxies that erupted and burned out early in the history of the Universe. Astronomers have assembled for the 1st time a representative sample of spectra of ultra-compact elliptical galaxies, whose star formation finished when the Universe was only 3 billion years old, less than ¼ its current age, and a sample of galaxies that are highly obscured with dust and undergoing rapid star formation, likely ignited by collision of gas-rich galaxies. Through the research, astronomers have determined the compact ellipticals voraciously consumed the gas available for star formation, to the point they could not create new stars, and then merged with smaller galaxies to form giant ellipticals. The stars in the burned-out galaxies were packed 10 to 100 times more densely than in equally massive elliptical galaxies seen today. When the team compared the 2 galaxy populations, it discovered an evolutionary link between the compact elliptical galaxies and star forming galaxies. The observations show that the violent starbursts had the same characteristics that would have been predicted for progenitors to the compact elliptical galaxies. The team calculated the intense starburst activity lasted only about 40 million years before the interstellar gas supply was exhausted.

Barred spiral galaxies – A citizen-science project by the Galaxy Zoo has examined spiral galaxies with a central bar at various distances such that we are seeing them as they were over about the last half of the life of the Universe. 8 billion years ago, 11% of spirals had bars, but by 2.5 billion years ago the percentage about doubled. Now 2/3 have bars. The more massive the galaxy, the more likely it has a bar. The new work also confirms that bars signify maturity for spiral galaxies and may play an important role in switching off the formation of new stars. For some of the most massive spiral galaxies, this happened relatively early in the life of the Universe.

Disk Detective – NASA and the Galaxy Zoo crew have created another citizen-science project, dubbed Disk Detective, to have the public look for disks surrounding stars among data collected by the WISE infrared space telescope. Computers have searched the data to find ½ million candidates ready for inspection by human eyes. They will weed out the stuff that the computers mistake for

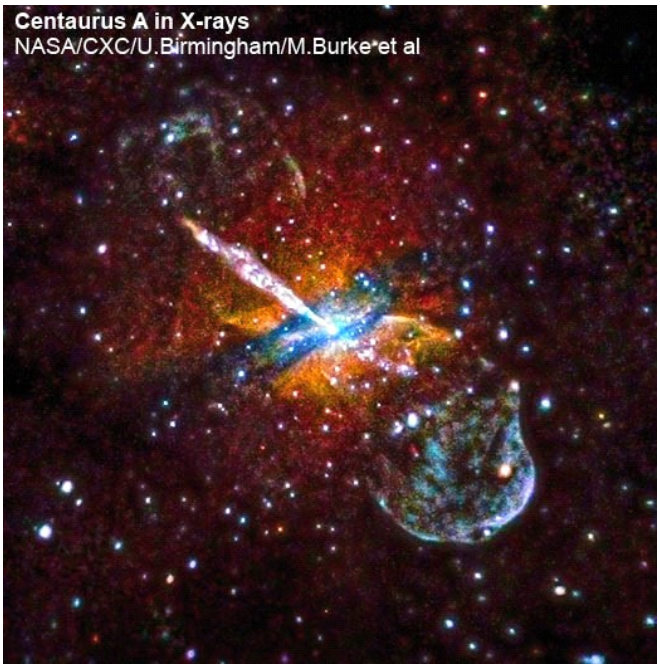
disks: galaxies, interstellar dust and asteroids. The project aims to find 2 types of disks: those found about young stars, which may produce planets in the future, and debris disks about older stars, which are usually remnants of planet formation.

John Dobson, inventor of what has become known as the Dobsonian telescope mount, has died at age 98. He made large Newtonian telescopes out of scrap materials and took them to the sidewalks and to National Parks to show the public the wonders of the Universe. Though many optical manufacturers make Dobsonian telescopes, Dobson never made any money from the design. He felt that the design should be shared with the world. He spoke at OCA some years ago, and presented at RTMC at Big Bear.

Dream Chaser – Sierra Nevada Corporation has announced that they plan in 2016 an unmanned test launch into orbit of their privately developed space plane, the Dream Chaser. An Atlas V rocket will be used, which Sierra Nevada has already purchased. The vehicle, which looks like a mini-space shuttle, will land on the Space Shuttle's runway in Florida. Flight with passengers could be as soon as 2017.

Cold Atom Lab – In space, gaseous matter routinely drops to 3° K (minus 454° F). Researchers are planning to create a spot 30 billion times colder inside the International Space Station (ISS). The Cold Atom Lab, an atomic refrigerator, is slated for launch to the ISS in 2016. At such low temperatures, ordinary concepts of solid, liquid and gas are no longer relevant. Atoms interacting just above the threshold of zero energy create new forms of matter that are essentially quantum. Experiments will begin with Bose-Einstein Condensates (BECs), predicted early in the 20th century by Albert Einstein and Satyendra Bose. BECs don't mix like gas; instead they can interfere like waves. ISS is the best place to do this research. Microgravity allows researchers to cool materials to temperatures colder than possible on the ground, and to make more sensitive measurements, free of gravitational interactions. Experiments should be able to assemble atomic wave packets as large as a human hair width, big enough to see with the unaided eye. Quantum physics will enter the macroscopic world.

Instant AstroSpace Updates



Chandra (X-ray space telescope) has taken very long exposures of the disturbed galaxy **Centaurus A**, showing a monster jet from the SMBH, a huge dust lane, and a number of neutron stars and stellar-size black holes. The smallest black holes are 5 times the mass of our Sun, which is telling us something about how such black holes form.

A team of researchers has directly imaged a rare very cool **brown dwarf** (T-type) using adaptive optics on the Keck Observatory in Hawaii. Since its distance happens to be precisely known, it can serve as a laboratory to study this type of star.

A brown dwarf star has been discovered with unusually **red skies**, caused by a thick layer of clouds made of mineral dust, such as enstatite and corundum.

Using data from the Sloan Digital Sky Survey, astronomers examined the compositions of thousands of asteroids within the main **asteroid belt**. They found that the belt is more diverse than previously realized, especially when looking at the smaller asteroids.

The 1000 foot (305 m) diameter radiotelescope at **Arecibo**, Puerto Rico, suffered a partially severed cable that supports the receiver above the dish due to a magnitude 6.4 earthquake on January 13. Temporary repairs are underway, as limited observations continue, and a permanent repair is being planned.

All 18 primary mirror segments and all instruments (cameras, spectrographs and fine guidance sensors) for the **James Webb Space Telescope** have been completed and delivered to Goddard Space Flight Center in Maryland for assembly into the telescope. It is still scheduled for launch in 2018.

LADEE (lunar dust mission) (pronounced "Laddy"; apparently it's a male spacecraft) has been given a month extension to its mission (until late April), since it has used less fuel than planned, and will spend the extra time at even lower altitudes, as low as about 3 miles (5 km) above the surface. It is expected that the extremely thin atmosphere and dust change composition very close to the surface.

The US Administration has announced that the mission of the **International Space Station** (ISS) has been extended until at least 2024. This will give scientists and foreign partners longer to plan their parts of ISS experiments and operations.

Wednesday, January 15, 2014

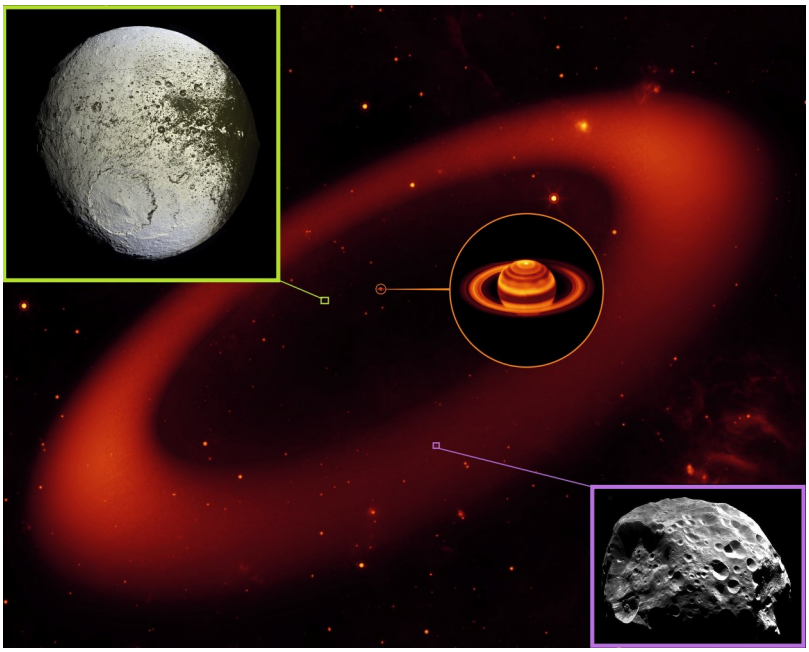
In Memoriam: John Dobson (1915 - 2014)

It is with heavy hearts that we must report the passing of John Dobson. He died peacefully this morning, Wednesday, January 15th, in Burbank, California. He was 98 years old. He leaves behind a son, numerous close friends, and fans and admirers worldwide. On March 8th, in honor of John, this year's ISAN (International Sidewalk Astronomy Night) will be dedicated to his memory. Amateur astronomers around the globe can join in and celebrate John's life and continue to carry the torch that he lit back in 1968 when he co-founded the San Francisco Sidewalk Astronomers.

David W. Ingram
Dark Skies Northwest
International Dark-sky Association
206-372-7292

A Two-Toned Wonder from the Saturnian Outskirts

By Dr. Ethan Siegel



Images credit: Saturn & the Phoebe Ring (middle) - NASA / JPL-Caltech / Keck; Iapetus (top left) - NASA / JPL / Space Science Institute / Cassini Imaging Team; Phoebe (bottom right) - NASA / ESA / JPL / Space Science Institute / Cassini Imaging Team.

Although Saturn has been known as long as humans have been watching the night sky, it's only since the invention of the telescope that we've learned about the rings and moons of this giant, gaseous world. You might know that the largest of Saturn's moons is Titan, the second largest moon in the entire Solar System, discovered by Christiaan Huygens in 1655. It was just 16 years later, in 1671, that Giovanni Cassini (for whom the famed division in Saturn's rings—and the NASA mission now in orbit there—is named) discovered the second of Saturn's moons: Iapetus. Unlike Titan, Iapetus could only be seen when it was on the west side of Saturn, leading Cassini to correctly conclude that not only was Iapetus tidally locked to Saturn, but that its trailing hemisphere was intrinsically brighter than its darker, leading hemisphere. This has very much been confirmed in modern times!

In fact, the darkness of the leading side is comparable to coal, while the rest of Iapetus is as white as thick sea ice. Iapetus is the most distant of all of Saturn's large moons, with an average orbital distance of 3.5 million km, but the culprit of the mysterious dark side is *four times* as distant: Saturn's remote, captured moon, the dark, heavily cratered Phoebe!

Orbiting Saturn in retrograde, or the opposite direction to Saturn's rotation and most of its other Moons, Phoebe most probably originated in the Kuiper Belt, migrating inwards and eventually succumbing to gravitational capture. Due to its orbit, Phoebe is constantly bombarded by micrometeoroid-sized (and larger) objects, responsible for not only its dented and cavity-riddled surface, but also for a huge, diffuse ring of dust grains spanning *quadrillions* of cubic kilometers! The presence of the "Phoebe Ring" was only discovered in 2009, by NASA's infrared-sensitive Spitzer Space Telescope. As the Phoebe Ring's dust grains absorb and re-emit solar radiation, they spiral inwards towards Saturn, where they smash into Iapetus—orbiting in the opposite direction—like bugs on a highway windshield. Was the dark, leading edge of Iapetus due to it being plastered with material from Phoebe? Did those impacts erode the bright surface layer away, revealing a darker substrate?

In reality, the dark particles picked up by Iapetus aren't enough to explain the incredible brightness differences alone, but they absorb and retain *just enough* extra heat from the Sun during Iapetus' day to sublimate the ice around it, which resolidifies preferentially on the trailing side, lightening it even further. So it's not just a thin, dark layer from an alien moon that turns Iapetus dark; it's the fact that surface ice sublimates and can no longer reform atop the leading side that darkens it so severely over time. And that story—only confirmed by observations in the last few years—is the reason for the one-of-a-kind appearance of Saturn's incredible two-toned moon, Iapetus!

Learn more about Iapetus here: http://saturn.jpl.nasa.gov/science/moons/iapetus. Kids can learn more about Saturn's rings at NASA's Space Place: http://spaceplace.nasa.gov/saturn-rings.

Orange County Astronomers
Messier Marathon Form

Date _____ Location _____

Name _____ Age* _____ Messier Objects Viewed _____ Photographed _____
Viewing Equipment: Telescope _____ Binoculars _____ Naked Eye _____ Camera _____
Location Method: Star-hopping _____ Setting Circles _____ Computerized System _____

Scope/Binocular/Camera Size and Description: _____

The following is a list of the Messier objects in the order you might want to view them. The first objects listed set the soonest. The first object is usually visible as the sun sets. Fill in the time at which each object was viewed. Place an "x" in the "P" column for objects that you photographed.

M	Time	P	RA	Dec	Con	Type	Mag
77			02:42.7	00°01'	Cet	Gx	8.9
74			01:36.7	15°47'	Psc	Gx	9.4
33			01:33.9	30°39'	Tri	Gx	5.7
31			00:42.7	41°16'	And	Gx	3.4
32			00:42.7	40°52'	And	Gx	8.1
110			00:40.4	41°41'	And	Gx	8.5
52			23:24.2	61°35'	Cas	OC	7.3
103			01:33.2	60°42'	Cas	OC	7.4
76			01:42.4	51°34'	Per	PN	10.1
34			02:42.0	42°47'	Per	OC	5.5
45			03:47.0	24°07'	Tau	OC	1.6
79			05:24.5	-24°33'	Lep	GC	7.7
42			05:35.4	-05°27'	Ori	DN	4
43			05:35.6	-05°16'	Ori	DN	9
78			05:46.7	00°03'	Ori	DN	8.3
1			05:34.5	22°01'	Tau	DN	8.4
35			06:08.9	24°20'	Gem	OC	5.3
37			05:52.4	32°33'	Aur	OC	6.2
36			05:36.1	34°08'	Aur	OC	6.3
38			05:28.4	35°50'	Aur	OC	7.4
41			06:46.0	-20°44'	CMa	OC	4.6
93			07:44.6	-23°52'	Pup	OC	6
47			07:36.6	-14°30'	Pup	OC	5.2
46			07:41.8	-14°49'	Pup	OC	6
50			07:03.2	-08°20'	Mon	OC	6.3

M	Time	P	RA	Dec	Con	Type	Mag
48			08:13.8	-05°48'	Hya	OC	5.5
44			08:40.1	19°59'	Cnc	OC	3.7
67			08:50.4	11°49'	Cnc	OC	6.1
95			10:44.0	11°42'	Leo	Gx	9.7
96			10:46.8	11°49'	Leo	Gx	9.2
105			10:47.8	12°35'	Leo	Gx	9.3
65			11:18.9	13°05'	Leo	Gx	9.3
66			11:20.2	12°59'	Leo	Gx	8.9
81			09:55.6	69°04'	UMa	Gx	6.9
82			09:55.8	69°41'	UMa	Gx	8.4
97			11:14.8	55°01'	UMa	PN	9.9
108			11:11.5	55°40'	UMa	Gx	10
109			11:57.6	53°23'	UMa	Gx	9.8
40			12:22.4	58°05'	UMa	Ast	8.4
106			12:19.0	47°18'	CVn	Gx	8.4
94			12:50.9	41°07'	CVn	Gx	8.2
63			13:15.8	42°02'	CVn	Gx	8.6
51			13:29.9	47°12'	CVn	Gx	8.4
101			14:03.2	54°21'	UMa	Gx	7.9
102			15:06.5	55°46'	Dra	Gx	9.9
53			13:12.9	18°10'	Com	GC	7.6
64			12:56.7	21°41'	Com	Gx	8.5
3			13:42.2	28°23'	CVn	GC	6.2
98			12:13.8	14°54'	Com	Gx	10.1
99			12:18.8	14°25'	Com	Gx	9.9

Messier Marathon Form
Page 2

M	Time	P	RA	Dec	Con	Type	Mag
100			12:22.9	15°49'	Com	Gx	9.3
85			12:25.4	18°11'	Com	Gx	9.1
84			12:25.1	12°53'	Vir	Gx	9.1
86			12:26.2	12°57'	Vir	Gx	8.9
87			12:30.8	12°24'	Vir	Gx	8.6
89			12:35.7	12°33'	Vir	Gx	9.8
90			12:36.8	13°10'	Vir	Gx	9.5
88			12:32.0	14°25'	Com	Gx	9.6
91			12:35.4	14°30'	Com	Gx	10.2
58			12:37.7	11°49'	Vir	Gx	9.7
59			12:42.0	11°39'	Vir	Gx	9.6
60			12:43.7	11°33'	Vir	Gx	8.8
49			12:29.8	08°00'	Vir	Gx	8.4
61			12:21.9	04°28'	Vir	Gx	9.7
104			12:40.0	-11°37'	Vir	Gx	8
68			12:39.5	-26°45'	Hya	GC	7.8
83			13:37.0	-29°52'	Hya	Gx	7.6
5			15:18.6	02°05'	Ser	GC	5.6
13			16:41.7	36°28'	Her	GC	5.8
92			17:17.1	43°08'	Her	GC	6.4
57			18:53.6	33°02'	Lyr	PN	8.8
56			19:16.6	30°11'	Lyr	GC	8.3
29			20:23.9	38°32'	Cyg	OC	7.1
39			21:32.2	48°26'	Cyg	OC	4.6
27			19:59.6	22°43'	Vul	PN	7.4
71			19:53.8	18°47'	Sge	GC	8.2
107			16:32.5	-13°03'	Oph	GC	7.9
12			16:47.2	-01°57'	Oph	GC	6.7
10			16:57.1	-04°06'	Oph	GC	6.6
14			17:37.6	-03°15'	Oph	GC	7.6

M	Time	P	RA	Dec	Con	Type	Mag
9			17:19.2	-18°31'	Oph	GC	7.7
4			16:23.6	-26°32'	Sco	GC	5.6
80			16:17.0	-22°59'	Sco	GC	7.3
19			17:02.6	-26°16'	Oph	GC	6.8
62			17:01.2	-30°07'	Oph	GC	6.5
6			17:40.1	-32°13'	Sco	OC	5.3
7			17:53.9	-34°49'	Sco	OC	4.1
11			18:51.1	-06°16'	Sct	OC	6.3
26			18:45.2	-09°24'	Sct	OC	8
16			18:18.8	-13°47'	Ser	OC	6.4
17			18:20.8	-16°11'	Sgr	DN	7
18			18:19.9	-17°08'	Sgr	OC	7.5
24			18:16.9	-18°29'	Sgr	Ast	4.6
25			18:31.6	-19°15'	Sgr	OC	6.5
23			17:56.8	-19°01'	Sgr	OC	6.9
21			18:04.6	-22°30'	Sgr	OC	6.5
20			18:02.6	-23°02'	Sgr	DN	9
8			18:03.8	-24°23'	Sgr	DN	6
28			18:24.5	-24°52'	Sgr	GC	6.8
22			18:36.4	-23°54'	Sgr	GC	5.1
69			18:31.4	-32°21'	Sgr	GC	7.6
70			18:43.2	-32°18'	Sgr	GC	7.9
54			18:55.1	-30°29'	Sgr	GC	7.6
55			19:40.0	-30°58'	Sgr	GC	6.3
75			20:06.1	-21°55'	Sgr	GC	8.5
15			21:30.0	12°10'	Peg	GC	6.2
2			21:33.5	00°49'	Aqr	GC	6.5
72			20:53.5	-12°32'	Aqr	GC	9.3
73			20:58.9	-12°38'	Aqr	Ast	9
30			21:40.4	-23°11'	Cap	GC	7.2

Types: OC=Open Cluster, GC=Globular Cluster, PN=Planetary Nebula, DN=Diffused Nebula, Gx=Galaxy, Ast=Asterism

Fill in the information at the top of the form. *Include age if under 18 years old. Please turn your completed form in to the Messier Marathon Coordinator or to Barbara Toy, or mail it to: Orange County Astronomers/Messier Marathon, P.O. Box 1762, Costa Mesa, CA 92628.

Jet Propulsion Laboratory
California Institute of Technology

4800 Oak Grove Drive MS 201-101
Pasadena, California 91109

December 23, 2013

Orange County Astronomers
Barbara Toy
PO Box 1762
Costa Mesa, CA 92628

Dear Barbara,

NASA's Space Place is pleased to award the Orange County Astronomers the enclosed certificate of appreciation. As an active Space Place partner, your organization encourages science and technology education throughout your community. Promoting the message that learning is fun is crucial and your organization plays a vital role in this endeavor. Through your public events, you not only educate, but you also inspire your audiences, both young and old. Through your use of hands-on activities and experiences for children, you play a key part in developing tomorrow's scientists. We thank you for your outreach efforts and look forward to continuing our partnership.

Please accept this certificate of appreciation with our gratitude.

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Laura K. Lincoln
Communication Coordinator

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Beginner's Astronomy Class	David Pearson	p.davidw@yahoo.com	949-492-5342
Black Star Canyon Star Parties	Steve Short	nightskytours@hotmail.com	714-771-2624
Explore the Stars OCA Contact	Bob Nanz	bob@nanzscience.com	760-751-3992
Librarian	Karen Schnabel	karen@schnabel.net	949-887-9517
Membership, Pad Coordinator	Charlie Oostdyk	charlie@cccd.edu	714-751-5381
Observatory Custodian/ Trainer/Member Liaison	Barbara Toy	btoy@cox.net	714-606-1825
OCA Outreach Coordinator	Jim Benet	jimbenet@pacbell.net	714-693-1639
Sirius Astronomer Editor	Steve Condrey	startraveler68@yahoo.com	714-699-1243
Telescope Loaner Program	Don Stoutenger	dstouten@yahoo.com	714-271-2646
WAA Representative	Tim Hogle	TimHogle@aol.com	626-357-7770
Webmaster	Reza AmirArjomand	reza@ocastronomers.org	646-494-9570
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