SIRIUS ASTRONOMER

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The Newsletter of the Orange County Astronomers

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The Sombrero Galaxy (M104) is a popular summertime deep-sky object in the constellation Virgo. One of the more prominent galaxies in the Virgo gathering, the distinctive dust lane of M104 is easily distinguished in moderately-sized telescopes under dark skies. Member Eric Seavey captured this image from the Anza observing site on May 6 using a Skywatcher Maksutov-Newtonian 190.

OCA CLUB MEETING

The free and open club meeting will be held June 9 at 7:30 PM in the Irvine Lecture Hall of the Hashinger Science Center at Chapman University in Orange. This month, Dr. Breann N. Sitarski of Aero will be presenting a topic yet to be announced as of press time.

NEXT MEETINGS: July 14, August 11 (speakers TBA)

STAR PARTIES

The Black Star Canyon site will open on June 17. The Anza site will be open on June 24. 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 sessions of the Beginners Class will be held at the Heritage Museum of Orange County at 3101 West Harvard Street in Santa Ana on June 2 and July 7.

Youth SIG: contact Doug Millar
Astro-Imagers SIG: June 13, July 11
Astrophysics SIG: June 16, July 21
Dark Sky Group: contact Barbara Toy

President's Message

By Barbara Toy

Welcome to Pauline Acalin as Our New Editor for the Sirius Astronomer!

I'm happy to report that Pauline Acalin has volunteered to become the next editor for the Sirius Astronomer, and, as I write this, is working with Steve Condrey to make the transition go smoothly.

Among her other activities, Pauline writes on space and astronomy related topics, and you can find a number of her articles at http://now.space/posts/author/pauline-acalin/. She also has a lot of experience in page layout and other areas that would be helpful for putting the newsletter together and getting it out to the printer each month – all of which we hope will make the job easier for her. It is going to be interesting to see how the Sirius Astronomer develops with her as the editor, and I hope we'll be seeing some of her articles in it, as well!

One constant challenge all of our editors have had is getting enough interesting content for each issue, and I expect that Pauline will have that challenge as well. We all would like to know about the astronomical activities and interests of our fellow club members, so do think about writing an article about something astronomical you are doing or that interests you for the Sirius Astronomer. That could include astronomy-related travels, viewing, imaging or research projects you are working on, pointers to help others, equipment reviews, experiences at RTMC, other regional star parties or astronomical events you may have gone to or participated in – amateur astronomy covers a wide range of interests, and I know a lot of you are involved in a lot of different types of astronomical activities, so please share them with us!

Many thanks to Steve Condrey for all of the hard work he's put into the newsletter over the years he's been our editor, and best wishes to him and his family in this new phase in their lives! And a warm welcome and many thanks to Pauline for volunteering to take on that position as our new editor!

Appreciating Our Southern California Latitude:

Alan and I spent the first two weeks of May in Northern Ireland, during a period when all the locals told us the weather was unusually clear, warm and dry. The last couple days we were there were overcast and rainy, much more typical of weather year round in those parts. Even though it was clear through most of our trip, we realized that, even if we'd been able to bring anything to view with, doing any viewing would have been difficult, as it didn't get dark until after 11:00 p.m. – and that was over a month before the summer solstice. I was never awake early enough to see when morning twilight began there, but any period of true dark must have been quite short, and would be even shorter for most of the summer.

If you look at a map, you can see that Northern Ireland is around the same latitude as the southern tip of Alaska and central Canada – a long way north of Southern California. Actually, the British Isles, along with France and Germany and the countries alongside or north of them, are all quite a bit north of us, with France at about the level of the state of Washington. For countries where summer pro-

vides better weather for viewing (or imaging), the short nights make that more of a challenge, and the fact that they get much longer nights during the winter, when the weather is more severe, doesn't seem to me to fully make up for it.

Our experience left me with even more respect for the challenges faced by European contributors to our body of astronomical knowledge (William and Caroline Herschel in England, Tycho Brahe in Denmark and Charles Messier in France are a few that come to mind). I always thought weather had to be a problem for them, but hadn't really appreciated how much the lengthening days of summer would cut into the time they had for their work. It's good to know that, despite the challenges of latitude and weather, both professional and amateur astronomy remain strong in Europe.

During our own summers, we grumble about our regular June Gloom (which hopefully won't extend beyond June this year) and the thunderstorms that tend to show up in August and September, but generally our weather is pretty good and, most years, we can rely on having a lot of nights of clear skies, a benefit of living in a semi-arid environment. We may complain about how long it takes to get dark enough to see/image deep sky objects, particularly in June and July, but, thanks to our latitude, we do get several hours of darkness, even around the summer solstice. It's not something most of us think about much, but is certainly a benefit of being an amateur astronomer in Southern California.

Weather permitting (we are, after all, coming out of an unusually wet year), I hope all of you will have many enjoyable nights under the stars this summer, taking full advantage of our latitude!

RTMC:

Last month I wrote a bit about RTMC but forgot to ask for comments from those of you who went on your assessment of it. The conference is attempting to evolve to meet the changing needs and interests of the amateur astronomy community, and I'd be interested in your comments on how you think they're doing and what you think could be done to improve the experience for you. Please send any comments you have to me at btoy@cox.net.

In Closing…

Generally when I've done these columns in the past, I've had the impression that I'd write them, they'd go into the Sirius Astronomer as mostly club-related filler, and that would pretty much be the end of it – they'd go into a some kind of literary black hole. After returning from my long vacation from writing for the newsletter, I've been pleased and touched by comments from several people that they find the columns useful for keeping them informed on various things going on in the club and are actually glad to have them back. For those who read these columns and those who have sent me comments – thank you! And, if there's any topic that any of you think I should address in one of these Messages, please let me know, preferably by email to btoy@cox.net.

AstroSpace Update

June 2017

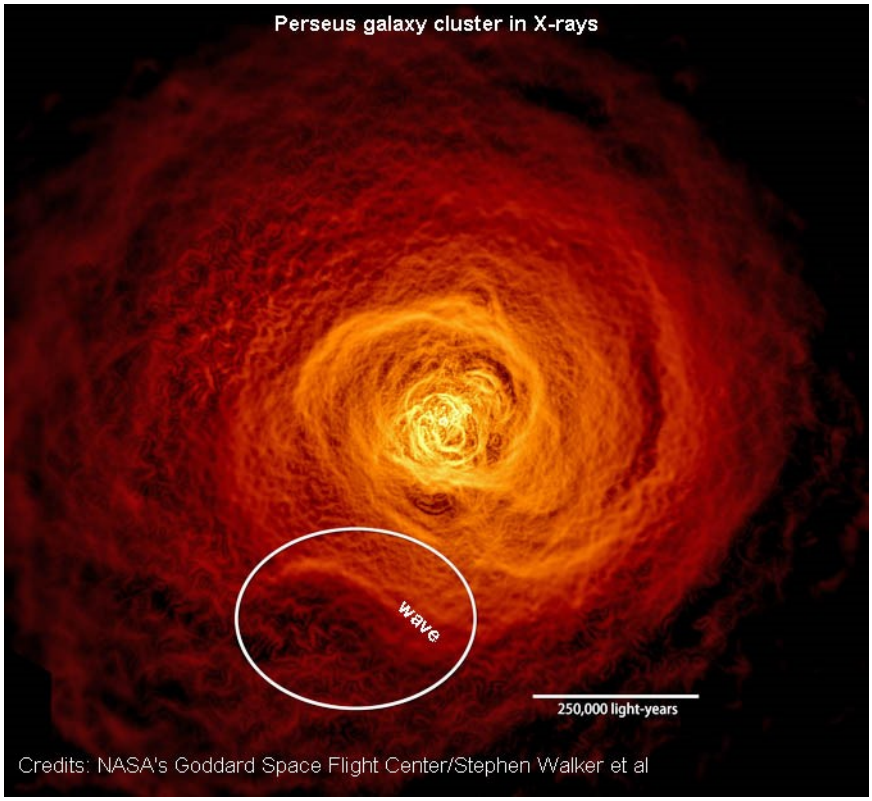
Gathered by Don Lynn from NASA and other sources

Black hole imaged – The radio data for the 1st resolved image of a black hole has been taken (actually of the surroundings of a black hole, since black holes suck in all light, not allowing them to be seen). But don't expect to see the image until next year, as it will take that long to process the data into a picture. A series of radiotelescopes across the globe took data simultaneously of the center of our Milky Way galaxy, where a supermassive black hole is known to reside. The combination of high frequency radio and huge telescope aperture (effectively the size of the Earth) will allow the data to be combined by computer into the highest resolution picture ever taken.

Pulsing black hole – A new study of galaxy NGC 4696, using X-ray, radio and visible light data, shows that the black hole at its center has been throwing energy and material outward at almost regular intervals of 5-10 million years. These blasts from the past show up because they are still interacting with the material between galaxies. Spectral data mapped out the elements present in the gas about the galaxy, and showed that elements that can only be generated in supernovas are being pushed far out of the galaxy by the actions of the central black hole.

SMG study – Sub-millimeter galaxies (SMGs) are galaxies seen brightly in sub-millimeter radio waves, but are difficult or impossible to see at other wavelengths, due to obscuring dust. SMGs are quite active in forming new stars, so give off plenty of light in many wavelengths, but are surrounded by dust. A new study examined 52 SMGs using the ALMA radiotelescope array in Chile. Results of the study: 1) median redshift was 2.65, which is equivalent to a light-travel time of 11 billion years, and only 4 of the galaxies were gravitationally lensed; 2) SMGs are larger and cooler than Ultra-Luminous Infrared Galaxies (ULIRGs), in contradiction to the theory that SMGs evolve into ULIRGs; 3) effectively all visible and near infrared light from SMGs is obscured by dust; 4) SMGs probably evolve into elliptical galaxies, not spiral of lenticular galaxies.

Hidden galaxy activity – A study using NuSTAR (high-energy X-ray space telescope) and 3 other space telescopes shows that during the merger of 2 galaxies, so much material falls toward the central black hole that the extremely bright activity there is hidden. It becomes progressively more hidden as the merger proceeds. The study observed 52 galaxies, half of them late in a merger with another galaxy. They found that only high-energy X-rays were penetrating the infalling material, while low-energy X-rays and other wavelengths were getting blocked in the mergers.



Wave in galaxy cluster – Observations with Chandra (X-ray space telescope) of the Perseus galaxy cluster have discovered a gigantic wave penetrating into the cluster. The area behind this wave is being called "the bay". Computer simulation of galaxy collisions shows that the wave was caused by a smaller galaxy cluster colliding somewhat off center. This happened about 2.5 billion years ago. The simulation showed that the size of the wave depends on the magnetic field within the galaxy cluster. This allowed calculation of the magnetic field strength. The Perseus galaxy cluster is about 11 million light-years across and 240 million light-years away.

Cosmic web – Diffuse gas left over from the Big Bang has, over the life of the Universe, gravitationally contracted into filaments known as the "cosmic web". In attempting to measure small ripples in this web, astronomers wanted to measure the web at 2 (or more) closely spaced points. But the web is only detectable by its effect on more distant light sources passing through it on the way to our observations. So they had computer programs search for the unlikely occurrence of quasars closely spaced on the sky. Then they observed each quasar pair found

with some of the largest telescopes on Earth, including the Keck Telescopes in Hawaii, and took spectra, looking for the imprint of the cosmic web on the quasar light. The differences found between close pairs matched statistically what computer simulations of the formation of the cosmic web showed. That says those simulations are getting the physics right.

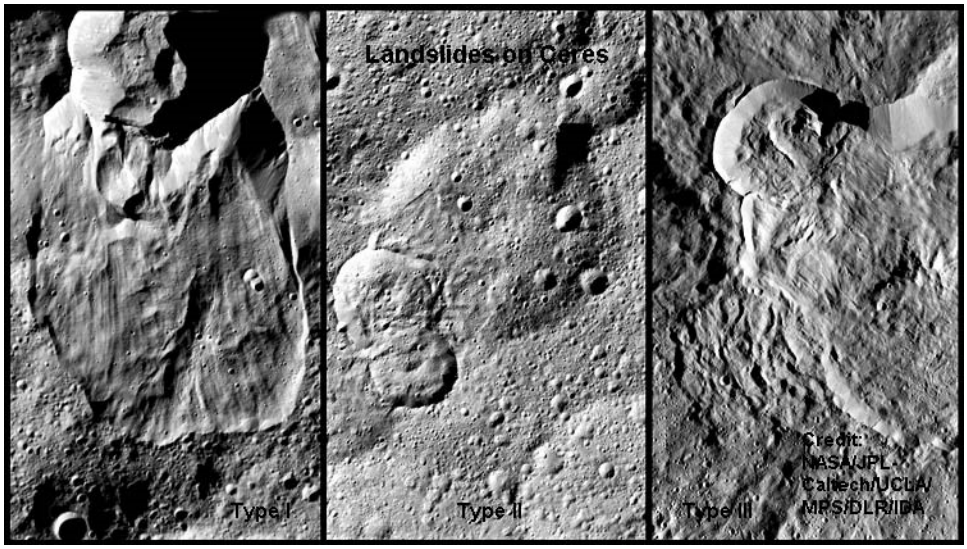
Interesting exoplanet – A newly discovered exoplanet is a prime candidate to be observed during its transits in front of its star to try to detect an atmosphere. Unfortunately it may be too dim to do this until the James Webb Space Telescope is launched next year. Since it was detected both by transiting and by its gravitational tug on its star, astronomers were able to calculate its diameter, mass and density. It is about 40% larger than Earth, 6.6 times Earth's mass, considerably denser than Earth, and therefore a rocky (rather than gas) planet. It orbits in the habitable zone, that is, where light from its star should keep the surface in the temperature range where liquid water can exist. Its star is much dimmer than our Sun, but orbits much closer to it. The star is at least 5 billion years old, and is designated LHS 1140; the planet is LHS 1140b. They are about 40 light-years away. Theoretically, small dim stars such as this are always so active soon after they form that they should blow away atmosphere from any close-in planets. But a planet larger than Earth, such as this one, should remain hot and outgassing longer than the star's active period, so could have an atmosphere.

Another – Combining observations from the Hubble and Spitzer space telescopes of an exoplanet named HAT-P-26b reveals that it has an atmosphere made almost entirely of hydrogen and helium, like our gas giant planets. It is 437 light-years away, orbiting a star roughly twice as old as the Sun. The atmosphere is relatively clear of clouds and contains a strong spectral signal of water vapor. The observations were made as the planet transited (passed in front of) its star, and the difference from the spectrum of the star alone was extracted to yield that of the starlight shining through the planet's atmosphere. The heavy element content of the atmosphere (termed metallicity by astronomers, though it involves everything heavier than helium, metal or not) was measured, and found to be more like that of Jupiter, even though its size is more like Neptune (which has much higher metallicity than HAT-P-26b or Jupiter). Planet formation theorists will have to go back to the drawing board to figure that one out.

Yet another – Gravitational lensing discovered another exoplanet as it passed in front of a star. It was named OGLE-2016-BLG-1195Lb, and is about 13,000 light-years away. It is about the same distance from its star as Earth is from the Sun and is about the same mass as Earth. But its star is much dimmer than the Sun (in fact it is on the borderline between a red dwarf and a brown dwarf), so the planet is probably a big ice ball. The OGLE project monitors hundreds of millions of stars in the center of the Milky Way and the Magellanic Clouds in order to find dark matter, and as a side effect occasionally finds planets.

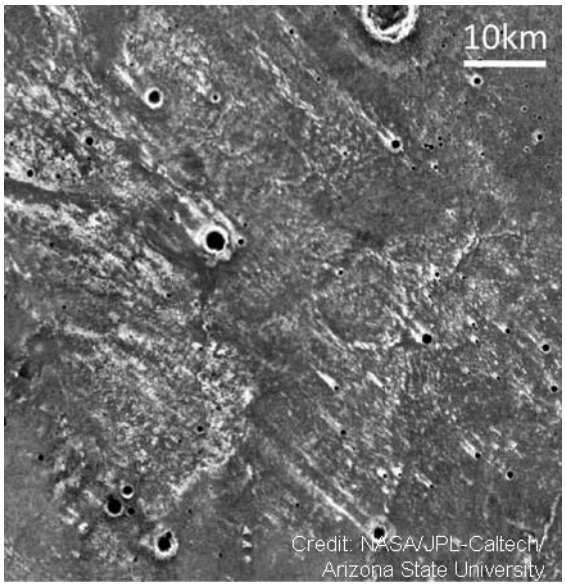
Epsilon Eridani disk – High-resolution observations using SOFIA (airplane-mounted infrared telescope) of the star Epsilon Eridani have confirmed the theory that its known disk is confined within the orbit of a Jupiter-like planet. Another theory had the disk spreading much farther. The disk is then roughly like our asteroid belt. Epsilon is only 10.5 light-years away. It has been mentioned in science fiction, including Babylon 5.

Threading Saturn's rings – Cassini (Saturn orbiter) took its 1st plunge (of 22 planned) through the gap between the innermost ring and Saturn's cloud tops. Mission managers thought that the area was fairly free of material, but just to be sure, they turned the spacecraft so that any such particles would hit the dish antenna rather than any sensitive instruments. Even less dust was encountered than when Cassini previously plunged through the ring plane just outside the outermost bright ring. The spacecraft hit that little bit of dust, none larger than smoke particles, at 77,000 mph (124,000 km/h), but suffered no damage. In fact, controllers plan not to lead with the dish on the remaining plunges, because there was so little dust this time. New science yet to come during the remaining plunges: radio occultations to probe the planet's atmosphere, sampling the upper atmosphere, mapping Saturn's gravitational field, scanning the rings with radar, and measuring the mass of the rings. The mission is planned to end on September 15 by crashing into the planet.



Landslides on Ceres – Researchers examining the images of Ceres from the Dawn spacecraft have classified landslides seen there into 3 categories: Type I, which resemble icy landslides on Earth; Type II, which are longer and thinner; and Type III, which appear to involve melting and always appear by large impact craters. Type II were found to be the most common, except near the poles, where Type I were more common. Since there is more ice near the surface in the polar regions, it is thought that more ice makes the difference in shape between the two types. Scientists were surprised how common landslides are on Ceres. The shape and frequency of

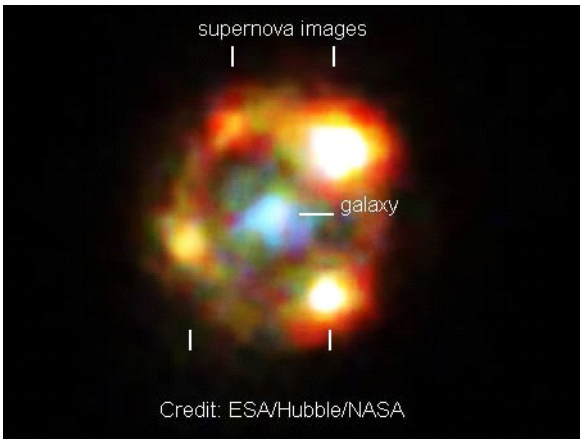
landslides were used to estimate that the upper 10s of yards (m) of the surface must contain 10-50% ice by volume. Vesta, the asteroid visited by Dawn before Ceres, did not have these kinds of landslides, apparently because its surface has no substantial ice content.

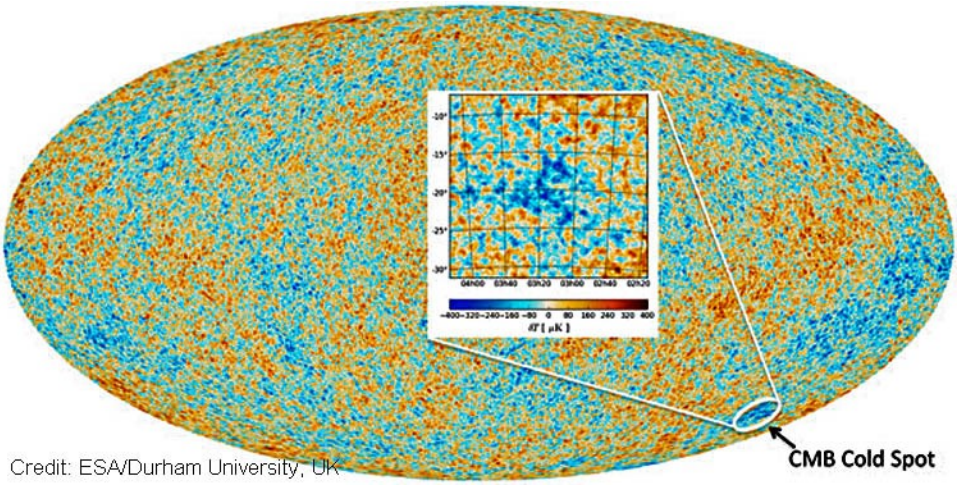


Martian infrared streaks – Infrared images taken of Mars at night by the Odyssey spacecraft show differences in the retention of daytime heat. A type of feature revealed in these are streaks near some large impact craters that do not show up in visible light like ordinary crater rays do. A new study offers an explanation. Experiments show that impacts will cause tons of vaporized material to form plumes that travel outward, but at some distance above the surface. But if the plumes hit an obstruction, such as another crater rim, it turns into a tornado -like vortex, which reaches down to the ground. This sucks away all the dust and smaller rocks in its path. The remaining large rocks retain daylight heat much longer than dusty areas; hence the streaks seen in infrared. And the streaks are found to align with smaller craters with rims that would obstruct the expanding plumes. Further work with these could date crater formation and so measure the erosion and dust deposition that has occurred since.

Comet oxygen explained – A chemical engineer who has been studying the effects of particles colliding with electronics has explained why the Rosetta spacecraft found unexpected amounts of molecular oxygen around comet 67P. Molecular oxygen usually disappears in space because it reacts with hydrogen or carbon to form other compounds. This means that the comet must have been releasing fresh oxygen. But oxygen should not have lasted over 4 billion years since the comet formed, even protected inside the comet nucleus. The new finding shows that water released by the comet becomes ionized by the Sun's ultraviolet light, then the water ions are swept up by solar wind, and then smash back into the comet's surface. There they react with surface material to release molecular oxygen. Now that we know molecular oxygen can be produced this way, it may not be as good an indicator of life as has been thought. This was based on the observation that almost all molecular oxygen in the Earth's atmosphere is known to be created by life.

Supernova and Hubble Constant – A Type Ia supernova has been discovered that happens to lie almost exactly behind a massive nearer galaxy, resulting in a gravitational lens yielding 4 images of that same supernova. This is the 1st time a Type Ia has been seen in a gravitational lens. The 4 images are seen with different time delays that depend on the geometry of the light paths and on the Hubble Constant (the expansion rate of the Universe). So astronomers are analyzing the observations of the supernova taken over time, and will soon have a new calculation of the Hubble Constant that is independent of any of the other methods of calculating it. This should be interesting, because two of the most reliable methods of calculating the Hubble Constant do not agree with each other by more than 7%, even though all known errors in measurement cannot account for this large of a discrepancy.



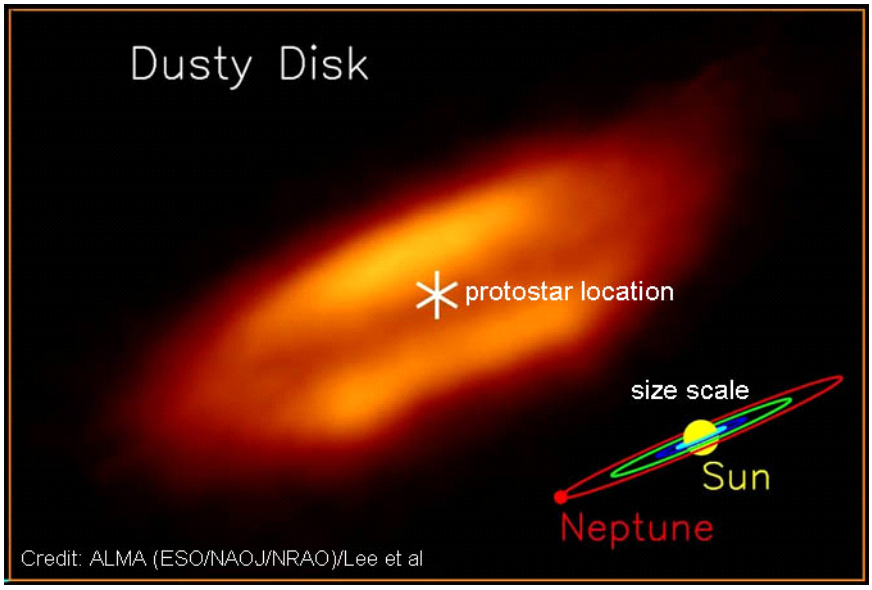


Cold spot still unexplained – The cosmic microwave background is the glow left over from the time about 380,000 years after the Big Bang at which the Universe cooled enough to become transparent. It has been measured very precisely by a series of spacecraft. One spot in the whole sky is 10-20 degrees across and is a bit colder (70 millionths of a degree) than anywhere else, and this has worried cosmologists for years. Statistically, it shouldn't happen. A leading theory to explain it is that there might be a huge void between filaments of the cosmic web, and that would make it colder. A new study of the area shows that there are 3 voids along that line of sight, but their sum explains only about 1/8 of the temperature drop in

the cold spot. The alternative theories are generally less believable than a void, but either some of those alternatives are true, or this latest study missed something.

Slow spinning pulsar – Observations by XMM-Newton (X-ray space telescope) have discovered an X-ray pulsar in the globular cluster B091D, which orbits the Andromeda Galaxy. It is believed to have captured a companion star about 1 million years ago, and is just starting a spin-up. Pulsars in close orbit with a companion star steal material gravitationally from the companion, and the material spiraling in adds to the spin of the pulsar. This is only the 2nd pulsar found outside our Milky Way and its satellite galaxies. Any farther ones are too dim to see. In fact new computer programs were written to find this pulsar in such a weak signal. It is the slowest spinning (at 1.2 seconds) X-ray pulsar known in a globular cluster. But that should change if we just wait 50,000 years or so for it to spin up. B019D is an extremely dense globular, and may be the remnant of what used to be a dwarf galaxy. It is due to this density that pulsars can capture companion stars there (as opposed to forming originally with a companion), though such capture is generally quite rare.

Protostar imaged – A new image of a protostar (star still in the formation process) made by ALMA (radiotelescope array in Chile) shows that protostar feeding on material gravitationally being pulled out of a surrounding disk. It is the 1st time that the resolution is good enough to show vertical structure in the disk about a star so young. This will help confirm if computer simulations of star formation have it right.



Eclipse stamp – On June 20 the U.S. Postal Service is releasing a new stamp depicting the upcoming August solar eclipse. It is actually a picture of the 2006 eclipse, since no one yet knows exactly how the Sun's corona will look in August. It is printed with thermochromic ink. That means if you warm it slightly by rubbing it, the black Moon blotting out the Sun turns into a bright Moon. So if you see people rubbing postage stamps (after June 20) they are not necessarily bonkers.

Space plane lands – The Air Force's X-37B unmanned space plane landed at the Kennedy Space Center in Florida to end its 4th flight ever, after 718 days in space. The Air Force admits the flight was testing long term exposure of materials to space and an electric propulsion thruster, but outside observers say it is probably also testing spy instruments. Previous landings have been at Vandenberg, California.

Instant AstroSpace Updates

Mars rover Curiosity is visually and chemically studying sand dunes with linear shape. The results will be compared to previous study of crescent-shaped dunes.

The Japanese space agency (JAXA) has announced that they plane to send a spacecraft named **MMX** to study Mars and its moons, including sampling the surface of a moon for return to Earth, launching in 2024.

Greetings from Palmia Observatory (March 4, 2017)

George Robinson

Well this week has found a few cloud free nights to try out the new 80mm refractor and look at the first light through that device, but first we should cover the recent lectures by Nobel Laureate, Art McDonald, and take a look at the mail.

I attended both the public lecture and the physics colloquium lecture the next day. The public lecture was pretty much to a full house at the Barclay theater where Professor McDonald reviewed the background of the neutrino experiments 2.5 km underground at a nickel mine in Sudbury, Canada and how the results found there and in conjunction with the results from the Kamiokande detector in Japan, established the finite mass of neutrinos, verified the solar neutrino flux models and oscillation from one neutrino type to the other two types. The public lecture was fun and full of anecdotal stories and the colloquium talk covered more of the technical details. Now I don't have enough of a background in neutrino physics to understand most of the talk, but one question I always had was answered. I wondered how you can tell that you are only measuring 1/3 of the all the electron neutrinos that were thought to have been generated in the sun and you were able to tell that the solar flux model was correct and that something happened to the electron neutrinos on there way from the sun to the detector on the Earth. Well the answer explained there is that following up on a recommendation by a UCI researcher, who proposed that the detector should be filled with heavy water, which is just like ordinary water but in which some of the hydrogen is not the normal light weight version, but the heavier version, deuterium, that the total number of neutrinos could be measured. Deuterium has the good property that it responds to electron neutrinos by emitting a photon of a particular wavelength and it responds to all three types of neutrinos by emitting a photon of a different wavelength. So, by counting the number of each type of emitted photon, the correct number of neutrinos could be measured. After hearing that key point, I got lost in the many of the other details.

So, now, let's look at the incoming mail, which includes a great reference pointing to a Youtube 2 minute video sent in by Still in Control, Expert Gene, who found this great video of 47 Tucanae. Recall, from the previous post reporting the discovery and finding a black hole in the center of 47 Tuc, and the sad lament that we observers in the northern hemisphere cannot see that globular cluster. We can see many other globular clusters, but now you can see 47 Tuc as well. Check it out at:

https://youtu.be/y5wGP6gMmFQ

This Hubble image pans across the globular cluster and the view is fantastic. I found myself just looking at the beautiful scene time after time. Thanks for that, Gene!

We also received an excellent review paper covering how astronomers have been pursuing for many years now, an alternate view of what constitutes dark matter, which could consist not of tiny microscopic particles, but large massive objects, one type of which are primordial black holes. The paper is very descriptive and reviews various studies and does not contain a lot of mathematics. Packing up and Moving to Vegas, Gravity Guy Ken, found this excellent review article and passed it on. Thank you for that, Ken! I am looking forward to going over the paper in more detail. A key point is how the various studies over the years have kept slicing off areas where these large objects could be hiding. Check out the graph below which shows how Primordial Black Holes (PBH) of the proper size, up to hundreds of solar mass, could be hiding and still explain the gravitational effects of dark matter and why they have not been found by other searches. Thus MACHOs, large Jupiter size dim objects are found not to be

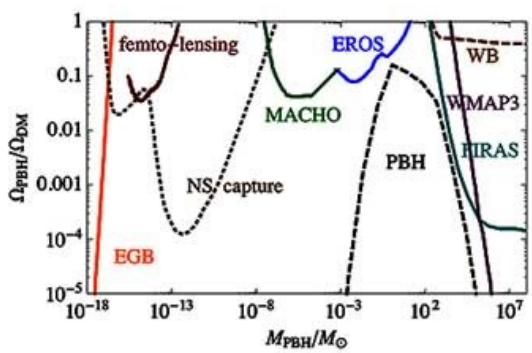


Figure 3. Limits on the abundance of PBH today, from extragalactic photon background (orange), femto-lensing (red), micro-lensing by MACHO (green) and EROS (blue), from wide binaries (light brown), and CMB distortions by FIRAS (cyan) and WMAP3 (purple). The constraints from star formation and capture by neutron stars in globular clusters are displayed for $\rho_{DM}^{Glob.Cl.} = 2\times10^3$ GeV/cm^3 (dark brown). The black dashed line corresponds to a particular realization of our scenario of PBH formation. Figure adapted from Ref. [9].

Closing off the regions where large objects, posing as dark mater, can hide (Source: arXiv:1702.08275v1, by Juan Garcia-Bellido)

Finally, let's take a look at some of the first images captured with the new 80mm refractor scope. Remember, that my new astronomical goal is not to collect more light with a larger and larger telescope but to minimize the pain and suffering of lugging out and setting up the larger scope. This new scope and much lighter, but higher quality goto mount, seems to fit the bill very well. So, what first showed up in the camera viewfinder?

First Light with new 80mm Refractor (1/60 second)

Well, I wanted to try getting a longer exposure of M1, The Crab Nebula, as we have discussed in previous posts, but, wouldn't you know it, I had problems right away with aligning the new mount. Just as the mount started slewing to the first alignment star, in this case Rigel, in Orion, the RA motor drive started some awful screeching and wouldn't finish the slew to that position. I found that one of the power cables was binding and preventing the proper rotation in the RA axis. More about that later, but, I didn't give up, after some last ditch efforts to reposition the tripod, I just resorted to driving the mount manually and just pointed the scope at the moon. So, that looked pretty good and since the mount was tracking for Earth's rotation, based on being set up in pretty close polar alignment, I pushed the command buttons to goto the area near Orion's nebula. I picked this object, because I could just barely see, in the polluted city lights viewing, where it was located. The image below is a 15 second exposure. So, I couldn't really naked eye see much of anything else, so I just called it a night. I knew I would have to fix the binding power cable before I could finish up a good alignment and then go back and try to get M1 and other objects.

You might be wondering why the power cable was binding up? Well, I didn't know I would need any special kind of cable from my battery to the mount, so I just used the power cable I had available, which is the one on the left hand side of this photo. This straight power connector is just too long and when the mount rotates around the RA axis, it can only go about 50 degrees, rather than the full 90 degrees. It turns out what I needed was a right angle power connector, like the one on the right. This power connector came with the mount, but it is permanently connected to the AC powered adapter, which I couldn't use because I didn't have any AC available power. Ok, ok, I found one on line and now with $20 + shipping and a couple of days waiting, we can try out the whole thing again.

Orion Nebula taken at Palmia Observatory with new 80mm refractor, 15 second exposure

I had a few other mishaps when I first turned the mount on. For some reason, the time offset from Greenwich Mean Time, was set to +480 minutes, rather than -480 minutes. This presented some interesting pointing errors as you might expect. Also after that correction, I found that I had inadvertently set the local time based on a 12 hour clock rather than in 24 hour format. All you amateurs already know about all these kinds of operator errors that we always need to be on the lookout for. Anyway, the new scope and mount are quite light weight and it was not a chore at all at getting it all transported and set up.

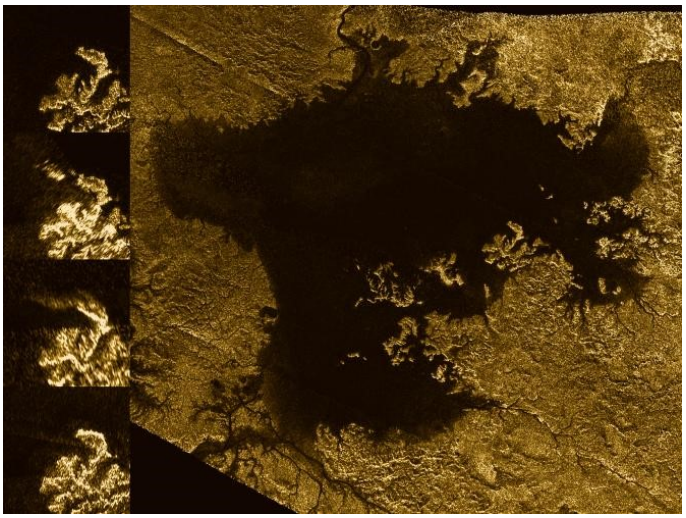
I might have one more chance this week, after the power cord shows up on the doorstep, if the weather forecast continues with clear skies latter in the week. I don't have much time this week because I have to be in Santa Barbara for the 33rd Pacific Coast Gravity Meeting. I went to the 30th PCGM in San Diego, 3 years ago, and found the meeting mostly way over my head, but I did learn some of the buzz words and what topics were being studied. Now after 3 more years of study I'm a little more prepared, but most of the titles of the presentations are still pretty much incomprehensible. Oh well, I guess its all just par for the course for all physicist wannabes. Until next time!

The Fizzy Seas of Titan

By Marcus Woo

With clouds, rain, seas, lakes and a nitrogen-filled atmosphere, Saturn's moon Titan appears to be one of the worlds most similar to Earth in the solar system. But it's still alien; its seas and lakes are full not of water but liquid methane and ethane.

At the temperatures and pressures found on Titan's surface, methane can evaporate and fall back down as rain, just like water on Earth. The methane rain flows into rivers and channels, filling lakes and seas.



Caption: Radar images from Cassini showed a strange island-like feature in one of Titan's hydrocarbon seas that appeared to change over time. One possible explanation for this "magic island" is bubbles. Image credits: NASA/JPL-Caltech/ASI/Cornell

Nitrogen makes up a larger portion of the atmosphere on Titan than on Earth. The gas also dissolves in methane, just like carbon dioxide in soda. And similar to when you shake an open soda bottle, disturbing a Titan lake can make the nitrogen bubble out.

But now it turns out the seas and lakes might be fizzier than previously thought. Researchers at NASA's Jet Propulsion Laboratory recently experimented with dissolved nitrogen in mixtures of liquid methane and ethane under a variety of temperatures and pressures that would exist on Titan. They measured how different conditions would trigger nitrogen bubbles. A fizzy lake, they found, would be a common sight.

On Titan, the liquid methane always contains dissolved nitrogen. So when it rains, a methane-nitrogen solution pours into the seas and lakes, either directly from rain or via stream runoff. But if the lake also contains some ethane—which doesn't dissolve nitrogen as well as methane does—mixing the liquids will force some of the nitrogen out of solution, and the lake will effervesce. "It will be a big frothy mess," says Michael Malaska of JPL. "It's neat because it makes Earth look really boring by comparison." Bubbles could also arise from a lake that contains more ethane than methane. The two will normally mix, but a less-dense layer of methane with dissolved nitrogen—from a gentle rain, for example--could settle on top of an ethane layer.

In this case, any disturbance—even a breeze—could mix the methane with dissolved nitrogen and the ethane below. The nitrogen would become less soluble and bubbles of gas would fizz out. Heat, the researchers found, can also cause nitrogen to bubble out of solution while cold will coax more nitrogen to dissolve. As the seasons and climate change on Titan, the seas and lakes will inhale and exhale nitrogen. But such warmth-induced bubbles could pose a challenge for future sea-faring spacecraft, which will have an energy source, and thus heat. "You may have this spacecraft sitting there, and it's just going to be fizzing the whole time," Malaska says. "That may actually be a problem for stability control or sampling."

Bubbles might also explain the so-called magic islands discovered by NASA's Cassini spacecraft in the last few years. Radar images revealed island-like features that appear and disappear over time. Scientists still aren't sure what the islands are, but nitrogen bubbles seem increasingly likely. To know for sure, though, there will have to be a new mission. Cassini is entering its final phase, having finished its last flyby of Titan on April 21. Scientists are already sketching out potential spacecraft—maybe a buoy or even a submarine—to explore Titan's seas, bubbles and all.

To teach kids about the extreme conditions on Titan and other planets and moons, visit the NASA Space Place: https://spaceplace.nasa.gov/planet-weather/

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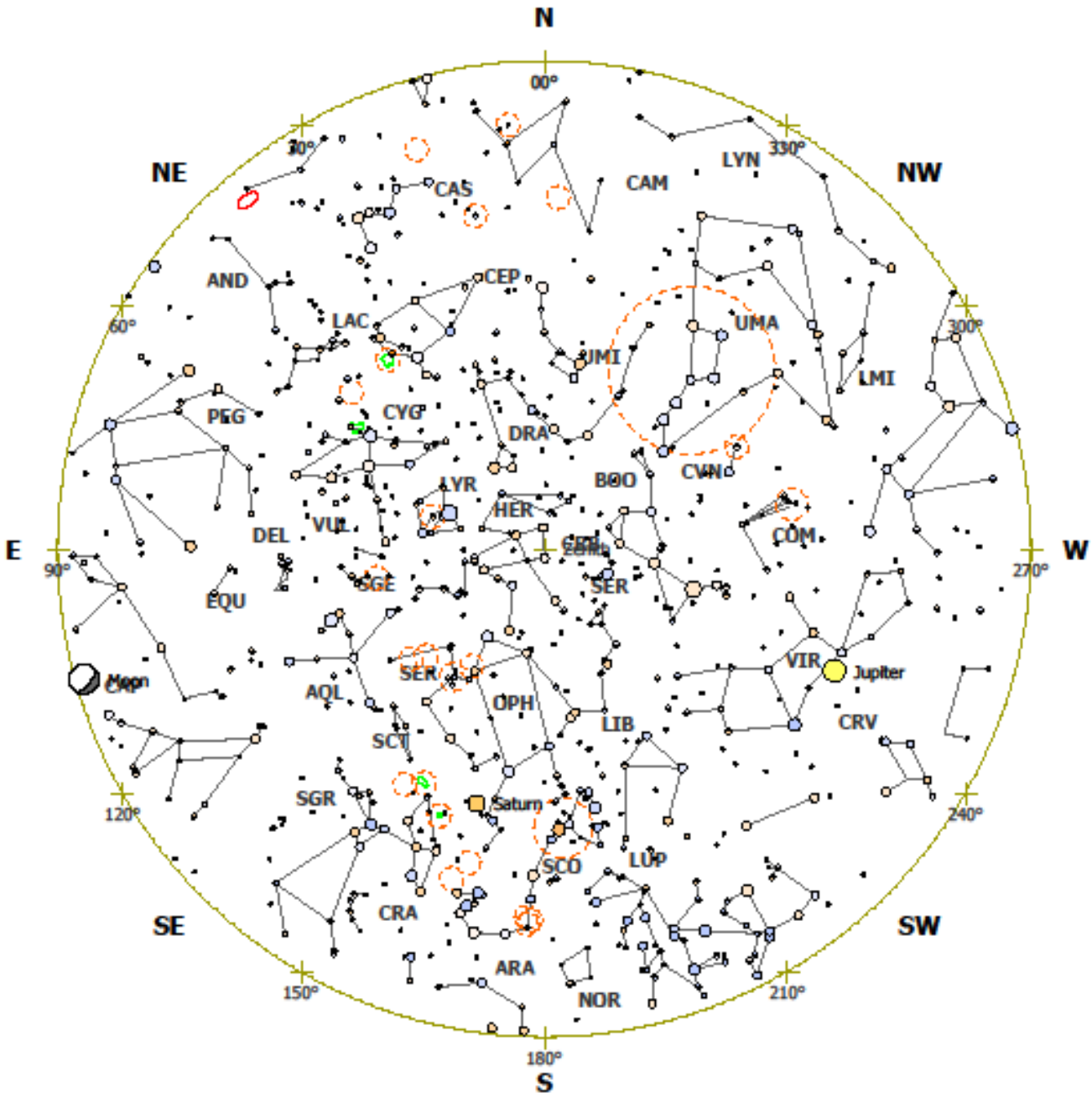
June 2017 Whole Sky Chart



Symbols

- Galaxy
- Quasar
- Globular cluster
- Open cluster
- Bright nebula
- Dark nebula
- Planetary nebula
- Supernova remnant
- Antisolar point
- Asteroid
- Comet
- Meteor shower

Magnitudes and temperatures (× 1000 K)

-6 -5 -4 -3 -2 -1 0 1 2 3 4 5

40 25 20 15 10 8 7 6 5 4 3 2

Location

United States, CA, Long Beach
Lon: 118° 11′ 18″ W, Lat: 33° 46′ 01″ N
Time zone: GMT-08:00
Elevation: 29 feet above sea level

Time

Local time: 2017-06-15 00:00:00
Universal time: 2017-06-15 07:00:00
Julian date: 2457919.79167
Sidereal time: 16h 42m 16s

View

Field of view: 200° 00′ 00″
RA: 16h 42m 15.95s, Dec: +33° 46′ 01.0″
Azi: 180° 00′ 00.0″, Alt: +90° 00′ 00.0″
Constellation: Hercules

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