SIRIUS ASTRONOMER

www.ocastronomers.org

The Newsletter of the Orange County Astronomers

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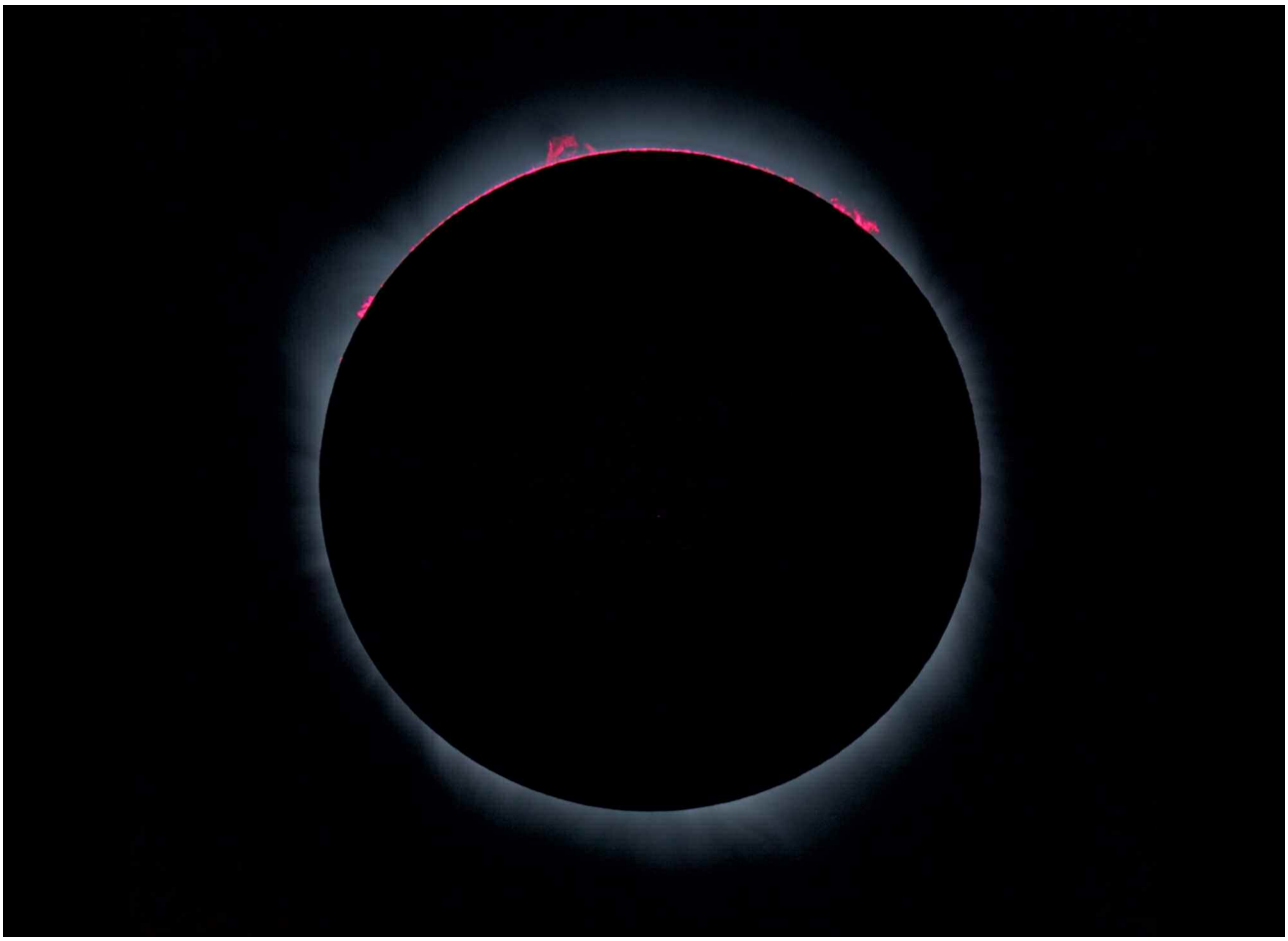


On August 21, 2017, the United States experienced a rare coast-to-coast total solar eclipse spanning from Oregon to South Carolina. Member Leon Aslan captured this image of totality from Madras, Oregon using a Canon EOS 6D through a Takahashi FSQ106. Stunning solar prominences can be seen on the upper half of the image.

OCA CLUB MEETING

The free and open club meeting will be held on September 8 at 7:30 PM in the Irvine Lecture Hall of the Hashinger Science Center at Chapman University in Orange.

This month, observational planetary astronomer David Jewitt will speak about active asteroids and why they are important in the context of the overall understanding of the solar system.

NEXT MEETINGS: October 13, November 10 (speakers TBA)

STAR PARTIES

Both the Black Star Canyon and Anza sites will be open on September 16. Members are encouraged to check the website calendar for the latest updates on star parties and other events.

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

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

COMING UP

The next session of the Beginners Class will be held on Sept 1 at Digital Media Center, 1300 S. Bristol Ave., Santa Ana, CA 92704

The following class will resume at Heritage Museum of Orange County at 3101 West Harvard Street in Santa Ana on October 6.

Youth SIG: contact Doug Millar
Astro-Imagers SIG:
Sept 12, Oct 10

Astrophysics SIG: Sept 15, Oct 20
Dark Sky Group: contact Barbara Toy

President's Message

By Barbara Toy

As I write this, it's Eclipse Time at long last! I'm actually writing this on the road to where Alan Smallbone and I hope to view the eclipse, as the realities of getting a newsletter to press and then distributed to our membership means that there's a necessary time lag between the writing of the content and when you receive it. While in many ways we're near the cutting edge in how we use technology in our hobby, we're still bound by the requirements of older technology in others – I find it kind of refreshing in a world of instant access to information (and misinformation) via the Internet to be involved in this slower paced, more contemplative approach to communication.

So, our deadline for submitting material for the Sirius Astronomer is the 20th of the month before the month of the issue (though submitting it earlier makes it easier for our editor), which means that material for the September issue needs to be in Pauline's inbox by August 20, the day before the eclipse. So, don't be surprised if the September issue of the Sirius Astronomer doesn't have anything about experiencing the eclipse itself – I expect there will be a lot of exchanges on the club's email groups (more about them below), at the September general meeting and the separate section meetings, but don't realistically expect any accounts of the experiences of different club members in the Sirius Astronomer until the October issue.

Whether you made it to the track of totality and experienced the total solar eclipse or enjoyed the partial solar eclipse closer to home, maybe sharing it with others, please write something up about your experience. It doesn't have to be very long or very detailed, it could be just enough to give the context and something about the experience that made it memorable for you. There will be a wealth of different experiences of this eclipse within the club, and having some type of written record of it would benefit all of us. So, send your account of your experiences to our editor, Pauline Acalin, so we can all enjoy it!

The Club's Email Groups

In case you haven't found them yet, and even though some people may think them archaic in this age of Facebook, Twitter and other social media, the club has two long-standing active email groups. Our more general group is ocastronomers@yahoogroups.com, which isn't limited to club members, so there are people on that group who aren't in the club in spite of the group address. This group is meant mainly for comments and conversations about astronomy and related topics generally, as well as club-related topics.

Our other active group, *AstroImagers@yahoogroups.com*, is primarily for people interested in imaging. Its membership is limited to club members, though there's no requirement that you actually be involved with imaging to join it. Many members of the AstroImage group within the club are also on that email group, so joining it can be a good way to get to know them as well as to get help with any imaging problems you might have, as well as just to learn more about imaging.

To join either or both of these groups, you need to sign up with Yahoo, then click on "join" for the group and give a brief explanation of why you want to join (this is to help weed out spammers and other problematic types). If you want to join the AstroImagers email group, you will need to give your name so your membership can be confirmed.

Although the focus of each group is different, both groups are forums for getting questions answered, sharing information and learning about current topics of interest. Often people on both lists will share information about plans to go out to Anza and conditions there, particularly if there have been storms or fires in the area, and weather forecasts and other information that can be helpful for a successful night under the stars.

If you join the groups, please be aware that we have a rule that the address for the Anza site is never posted on line outside of the Members area of the website, and directions should not be given via either of the email groups as well. That is to provide a bit of security for the site. If someone you know is a member needs that information, please provide it by private email only, not via the email groups.

These email groups also give us a way of contacting members directly about club-related emergencies, in addition to posting the information on our website. Some emergency notices we've had to get out recently include unexpected cancellation of section meetings, changes in meeting locations, and events at Anza such as the failure of the well that required closing of the site until the pump was replaced. So, there are practical reasons for joining these groups as well as the benefit of exchanges with fellow astronomers on matters of joint interest, and I urge you to join them if you're not yet on them.

Why We Had Recent Changes in Meeting Dates/Locations

Our AstroImage SIG has been meeting in the Digital Media Center for Santa Ana College over the last few years, thanks to an introduction by a club member who was associated with the Media Center at the time and to the generosity of Santa Ana College. Shortly before the July section meeting, however, the coordinator for the Media Center notified Alan Smallbone, the current chair of the AstroImage SIG, that the Media Center was closed for the summer because of budget cuts, so the regularly scheduled July meeting had to be cancelled and we were afraid the August meeting would be as well. Very fortunately, one of our members, Christina Hall, was able to arrange for access to a meeting room in a facility she is associated with for meetings in July and August, which was very generous of her particularly as she wasn't yet involved with the AstroImage group (though we hope she will be in the future). The meetings were able to go forward and were well attended in spite of the change in location as well as the new date for the July meeting.

Our Beginners Astronomy Class and Astrophysics SIG both meet regularly at the Heritage Museum; our club has a very long-standing and very good relationship with that museum, which has had a number of other names over the years but has always been in the same location in southern Santa Ana near Heritage Park. The current management of the museum has been doing a great job of expanding its programs, which unfortunately had an unexpected side-effect for the Astrophysics meetings in August and September and the September session of the Beginners Class.

The museum is to be the host for the Smithsonian exhibit on "Hometown Teams: How Sports Shaped America" from mid-August through the end of September, but arrangements for the trailer they were expecting to use for the exhibit fell through, and they had to use all of their meeting room/class room areas for it instead, leaving no place for our meetings during the exhibit. The August Astrophysics meeting had to be cancelled as we weren't able to find an alternate location, but Alan was able to arrange for both groups to meet at the Digital Media Center for their September meetings.

Fortunately, we don't have these issues very often, but they do happen, we try to give notice through the email groups and the website – though I just noticed that I failed to change the calendar entry for the August Astrophysics meeting to show that it was cancelled. My apologies to anyone who was misled by that and made a useless trip out to the museum for the meeting (and I really hope nobody actually did that!).

We have held our general meetings at Chapman University for many years thanks to the generosity of University in allowing us to use the facilities, and thanks to our faculty sponsor. However, there are times, it seems most often in October or November, when the University needs the lecture hall we use for one of its own programs, which, of course, takes priority. Usually we are able to reschedule the general meeting to the first or third Friday of the month, and we put out notice about the change as early and in as many ways as we can. That hasn't happened in a while, but it's good for our members to be aware that it can happen and to check the website and/or the email groups to be sure any meeting you plan to attend hasn't been changed for some reason.

Final Thoughts

With September, we get back into our regular routines, as the school year starts and summer ends. This summer has been a bit more eventful than many, even without the eclipse, I hope all of you have enjoyed it and are heading into autumn feeling refreshed and eager to get involved with new astronomical ventures!

Eclipse Post Script

I'm writing this on the evening of August 21, 2017, the long-awaited total eclipse has happened, and it seems that most people I know who were planning to see it had good skies and a great experience. We viewed it from the rodeo grounds in Weiser, Idaho, and our particular location didn't have a lot of people, which was great. For those who may wonder if it's worth it to deal with all the uncertainties and inconveniences of making the arrangements and traveling to see something that was only a bit over two minutes long – it WAS. Definitely! A totally satisfying and incredibly short two minutes, that left me with complete sympathy for those who chase total eclipses all over the world. I know I want to see the eclipse in 2024 even more than before, and hope for a chance to see others as well.

Whatever your viewing experience was on Eclipse Day, I hope you had good viewing and a great experience!

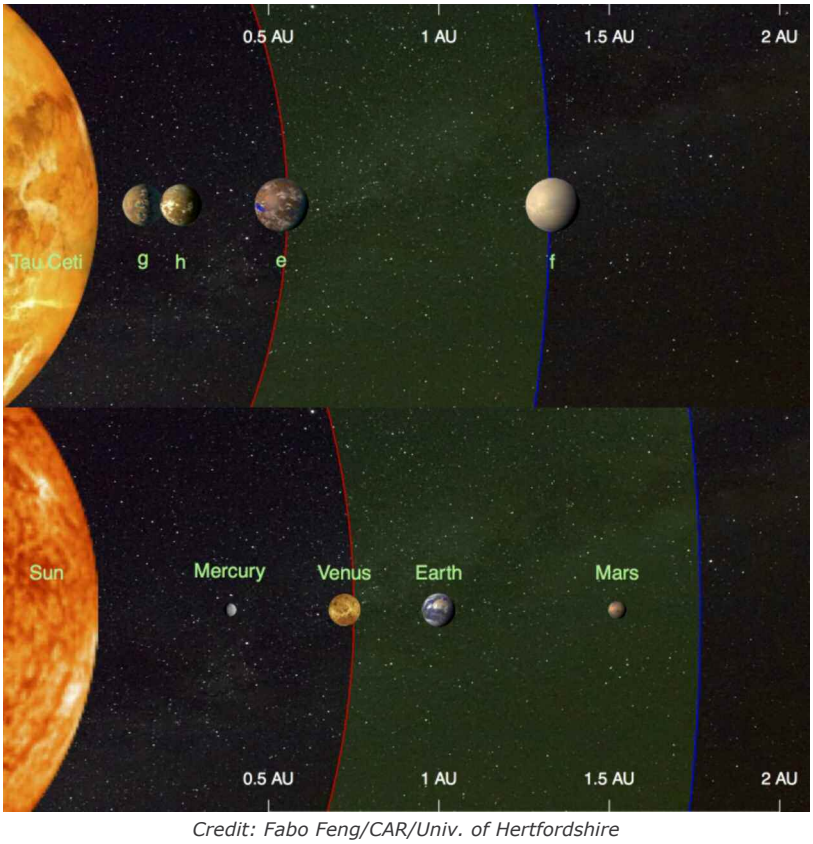
AstroSpace Update

September 2017
Gathered by Don Lynn from NASA and other sources

Exomoon – Kepler (planet finding space telescope) in its 4-year primary mission found more than 5000 probable exoplanets, about half of which have now been confirmed. But careful examination of Kepler data just produced its first probable moon. It appears to be orbiting planet Kepler-1625b, so has been dubbed Kepler-1625b I. The planet is a large gas giant that orbits its yellow star every 287.4 Earth days. They are about 4000 light-years away. The team had expected their technique of searching Kepler data to produce more moons; this may mean that moons orbiting planets close to their stars are rarer than theorized (Kepler finds are biased toward discovering more planets close to their stars). They could also be smaller than thought, and therefore Kepler isn't sensitive enough to detect them.

Exostratosphere – Observations with the Hubble Space Telescope have produced the best evidence yet for a stratosphere on an exoplanet. The planet in question is the hot Jupiter known as WASP-121b. A stratosphere is a layer of atmosphere in which the temperature goes up with increasing altitude instead of dropping. Hints of stratospheres on exoplanets have been previously found, but this is the one with the most solid evidence. The planet's mass is 1.2 times Jupiter's, and its diameter is 1.9 times Jupiter's. It is puffed up to this large size because it is so hot from orbiting close to its star. Close enough that it takes only 1.3 Earth days for its year. The system is about 900 light-years away. The evidence for the stratosphere is infrared spectra of hot water molecules. If the atmosphere's temperature decreased with altitude, the top layers would absorb this spectrum. In Earth's stratosphere, the increasing temperature is caused by ozone trapping ultraviolet sunlight. Stratospheres of Jupiter and Titan are caused by methane trapping sunlight. Possible causes for WASP-121b's stratosphere are vanadium oxide or titanium oxide trapping starlight, compounds which are common in brown dwarfs that have about the same temperature as this planet.

Closely orbiting exoplanet – A new discovery in Kepler data is a rocky planet that orbits a red dwarf star in only 4 hours and 20 minutes. This is only a few minutes longer than the record holder for a quickly orbiting planet. It is roughly 300 light-years away, distance not precisely known. It has been dubbed EPIC 228813918 b. To claim the discovery, multiple types of observations were made to prove that it was not a pair of stars eclipsing, since that might mimic a planet transiting (passing in front of) its star. The planet is roughly 89% the diameter of Earth. Lower limits on its mass imply it is very dense, maybe over half iron. This is nearly that of Mercury, the Solar System planet with the highest mass fraction of iron. The fact that the 2 exoplanets with the shortest years both orbit red dwarfs has theorists trying to show why that should be. One theory is that tidal forces on a planet very close to a larger star would pull the planet into the star, while small stars like red dwarfs would have much smaller such forces. In other words, larger stars eat closely orbiting planets.



Credit: Fabo Feng/CAR/Univ. of Hertfordshire

Very nearby exoplanets – About 4 years ago, radial velocity measurements of Tau Ceti, a sun-like star only 12 light-years away, indicated that there were 5 planets orbiting. Since then, astronomers have developed a new technique to distinguish the tugs of planets on a star from activity on the surface of the star; the activity behaves differently at different wavelengths of light. Applying this technique to new measurements of Tau Ceti showed that 2 of the previously suspected planets were actually surface noise. But another planet has been found, so now there are 4 planets believed to orbit there. After removing surface noise from the radial velocity measurements, motions as small as 1 ft/sec (0.3m/s) were seen, the most sensitive such measurements yet made. All 4 are super Earths, that is, somewhat more massive than Earth, but much smaller than Neptune. They range from about 1.7-4 times the Earth's mass. Two of them lie in the habitable zone, that is, the distance at which temperatures would allow liquid water on them. That doesn't necessarily make them inhabitable, since we know nothing of any atmospheres, and we do know that there is a massive debris disk orbiting the star, which likely throws asteroids and comets at the planets. Tau Ceti is a G-type star with 78% the mass of our Sun, making it the nearest sun-like star.

Loose planets – The OGLE project is monitoring almost 50 million stars to catch microlensing events, that is, when some object passes in front of a star and magnifies its brightness by gravitational lensing (bending of light rays by gravity). In 2011, the OGLE team announced that based on the few microlensing events so far observed that were caused by planet-mass objects not associated with stars, we could statistically say that there are up to a trillion planets without stars in our Milky Way galaxy (far more than the number of stars). Now that more than 5 times as many events have occurred (2617 of them counting objects of all masses) a new statistical analysis was made and the new estimate is only up to 75 billion planets without stars exist in the Milky Way (several times less than the number of stars). The new number likely includes many planets that happen to orbit quite far from their stars, so that the microlensing event missed the star. But it's still billions, a larger number of unattached planets than anyone would have guessed several years ago.

USPs – There is a class of planets known as ultra-short period (USP), which are distinguished by being roughly the mass of Earth and orbiting their stars in less than an Earth day. The chief theory of how these formed was that a hot Jupiter (gas giant orbiting close to its star) would get its gas blown away, leaving a roughly Earth-mass core. Hot Jupiters have been found to preferentially orbit stars with high metal content. So to test the USP formation theory, astronomers measured the metal content of 64 stars with USP planets. It didn't match the hot Jupiters' stars. It was similar to the metal content of stars with a class of planets called hot small planets (HSP). So now theorists are trying to work out how HSPs can transform into USPs.

Star formation – Astronomers have long had trouble understanding how a cloud of gas can lose its spin (or angular momentum) in the process of collapsing to form a star. The spin causes gas to orbit the center of mass of the cloud rather than falling into the center. New observations from ALMA (radiotelescope array in Chile) of a forming star (known as BHB07-11) have shown the process in the greatest detail ever. There is a dusty disk about the forming star. Material in the central plane of the disk was found to be falling into the star, while material slightly above or below was found to be thrown outward in a lopsided wind that took with it the gas cloud spin. That wind originates at the outer edge of the disk, about 90-130 AU from the forming star (where 1 AU is the Earth's distance from the Sun). This is the first time that the origin of such a lopsided wind has been seen. Magnetic forces are definitely involved in throwing out this material. The forming star studied is in the Pipe Nebula in Ophiuchus.

Star-forming galaxies – A collaboration of astronomers calling themselves SpARCS has combined observations from several space and Earth-based telescopes, all made of 3 of the most distant clusters of galaxies known. They are so far away that the light left there almost 10 billion years ago. In the 3 clusters, nearly a dozen galaxies were found that were forming stars at high rates. The team was surprised at the variety of shapes of those star-forming galaxies. Radiotelescope observations of those galaxies measured the amount of molecular gas in them, the material from which stars are formed. Then observations were made of similar field galaxies (those not lying within galaxy clusters). The galaxies in clusters were found to have more molecular gas for the amount of star formation than the field galaxies. This implies that some effect that happens only within a cluster reduces the amount of star formation. The SpARCS team will continue such studies on more galaxy clusters.

Ultra-diffuse galaxies – There is a class of galaxy known as ultra-diffuse (abbreviated UDG) which are large and spheroidal, but much dimmer than most galaxies their size. A new study of 2 UDGs using the Hubble Space Telescope reveals they are surrounded by a large number (62 & 74) of compact objects that are probably globular clusters. This is much more than the numbers of globulars around other dim galaxies with smaller diameters. This likely means that UDGs start to form as ordinary large galaxies, including forming globulars, but then some factor nearly completely stops star formation. This study does not support the other UDG theory, that they formed small, then something expanded them without adding more stars. Next the astronomers intend to measure UDG rotation speeds to determine if they have the mass of typical large galaxies

Relativity – For about 20 years astronomers have been tracking, using infrared adaptive optics, several stars as they orbit the supermassive black hole at the center of our Milky Way galaxy. One of these, known as star S2, has now been found to deviate slightly from a Newtonian orbit in just the way expected according to General Relativity. S2 is going to pass quite close to the black hole in 2018, giving astronomers a better measurement of this effect. S2 has 15 times the mass of our Sun, and revolves about the black hole every 15.6 years in a quite elliptical orbit. A similar but smaller deviation from Newtonian physics by the planet Mercury was the first evidence for General Relativity about a century ago.

Supernova map – Since 1987, astronomers have tracked the changes in the remnant left in the Large Magellanic Cloud from the nearest supernova to be seen exploding in recent history. A new study of it using ALMA (radiotelescope array in Chile) was able to penetrate obscuring dust and gas to reveal details not seen before. A 3-D map was made of the locations of various elements and molecules detected. Knots of carbon, nitrogen, oxygen, carbon monoxide, silicon monoxide, formylium and other materials were found.

Sun's core – Astronomers examining more than 16 years of data from the SOHO spacecraft believe they have found for the first time g-mode sound waves oscillating in the Sun's surface. This mode is strongly affected by rotation. From this finding, they have calculated the speed of rotation of the core of the Sun for the first time. It rotates every 7 days, 4-5 times faster than the surface turns. Data from Kepler (planet-finding space telescope) suggests that the core rotation speed of many stars differs from the surface, so this finding for the Sun was not surprising.

Martian Trojans – Trojans are asteroids that share the orbit of a planet, either about 60 degrees ahead or behind the planet. These are gravitationally stable areas known as the L4 and L5 Lagrange points. First seen in Jupiter's orbit, Trojans are now known in the orbits of 8 planets. There has long been debate over whether the Trojans formed in the Lagrange points or were

captured some time after formation in the asteroid belt. A new study of the spectra of Mars Trojans makes it very unlikely that they came from the asteroid belt. Many of the Mars Trojans were shown to be rich in the mineral olivine. That mineral is quite rare in the asteroid belt, but common on rocky planets. So the Martian Trojans likely formed from impact debris thrown off Mars and into the Lagrange points. Originating from their planet may or may not apply to Trojans at other planets; it is very unlikely for gas giant planets. More observations are needed.

Pristine asteroids found – A team of astronomers made a study of families of asteroids, using a new technique that finds the edges of families. The members of a family have similar orbits and similar types of material on their surfaces. The implication is that members of a family are fragments of the same original asteroid, broken up by a collision. The new study found a zone where there were no known families, and in fact, there were fewer asteroids than usual. What few there were appear to be relics of the original asteroid belt that have not been fragmented by collision. They have probably been there, relatively unchanged, since before the gas giants attained their current orbits, over 4 billion years ago. The astronomers plan to continue this study of asteroid families so as to cover the entire asteroid belt.

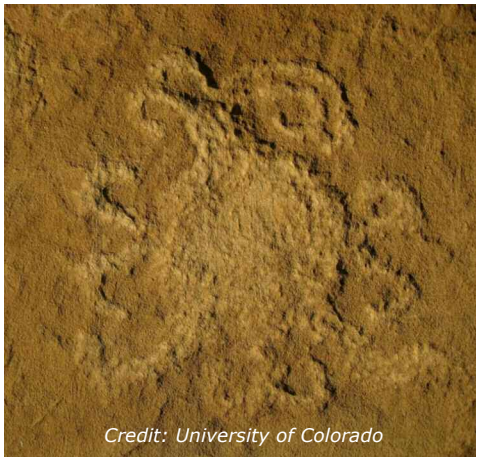
Cassini – Continues to make discoveries as it pursues its diving orbit between Saturn's cloud tops and its rings. The tilt of the planet's magnetic field with respect to its rotational pole was found to be smaller than Cassini can measure, less than 0.06°. This is what has made it so hard to pin down Saturn's rotational period (length of day). Since the clouds rotate at different rates, attempts to measure the period were made by timing when the magnetic pole rotated by, since the magnetic field is thought to be anchored to the deep interior. The lack of tilt is also making it difficult to explain how the magnetic field is sustained, since all theories of this require the field to be tilted. On these dives close to the planet, Cassini is actually collecting bits of the upper atmosphere to analyze in its mass spectrometer and dust analyzer instruments. We should soon have definitive measures of the composition of the upper atmosphere. The spacecraft is scheduled to plunge into the planet on September 15. It is too low on fuel to continue its mission past this date. This will burn up the spacecraft, eliminating any possibility of contaminating Saturnian moons with the few earthly microbes that likely live inside the craft.

Comet study – WISE spacecraft data, which covered the whole sky in infrared, was searched for comets. 7 times more long-period comets (those with orbits over 200 years) were found than previous estimates of the density of such comets, at least for those over 0.6 mi (1 km) across. Smaller ones than this were likely substantially undercounted, since they are getting too small for WISE to see. The long-period comets were also found to be twice the size on average compared to Jupiter family (shorter period) comets. This is to be expected, since many Jupiter family comets have passed close to the Sun many times and so have evaporated (sublimed) substantial mass. The long-period comets found showed some clustering in orbit directions, showing that some of them are likely fragments of originally larger comets.

Neutrino scattering – 43 years ago theorists predicted that neutrinos would scatter (bounce) off the nuclei of atoms. This has never been observed until now. Neutrinos have been observed scattering off individual protons, but not off the whole nucleus. The new experiment used a neutron generator known as SNS that happens to also produce huge amounts of low-energy neutrinos. The way to detect this scattering is to see an extremely small recoil by the nucleus, which is why it has been so hard to detect. It is important for astronomers to understand how neutrinos interact with matter because neutrinos are heavily involved in core-collapse supernovas and in neutron star formation.

Instant AstroSpace Updates

A scientist has announced he believes that a **petroglyph** (rock carving) in New Mexico depicts the solar eclipse seen there on July 11, 1097. It occurred during a period of very high solar activity, and the petroglyph resembles a drawing made of a solar eclipse in 1860, which also had a very high level of solar activity.


Credit: University of Colorado

Observations made in July as Kuiper Belt object **2014 MU69** (next target of the New Horizons spacecraft) occulted (passed in front of) a star showed it to be a long very thin object, possibly even 2 objects end-to-end. The reason it was missed on a previous occultation in June is that it appears to have passed the thin way between 2 observers.

A new study of the **TRAPPIST-1** system, which was recently found to have 7 planets, used 3 different methods to estimate the system's age, and pinned it down to 5.4-9.8 billion years. This is older than our Solar System and has implications as to how 7 closely-spaced planets could have formed and persisted so long.

The 25th anniversary of the launch of **Topex-Poseiden** occurred in August, marking 25 years of continuous precision monitoring of the heights of the Earth's oceans, including the contributions of the 3 Jason spacecraft that succeeded Topex. After filtering out tides, seasonal heating, El Niño, waves and other effects, the oceans have been found to rise 2.8 inches (7 cm) during this time.

Combining theories of star formation, stellar-mass black hole formation, binary black holes and their merging, and the number and mass of black hole mergings detected by LIGO (gravitational wave detector), astronomers have estimated that there are **tens of millions of stellar-mass black holes** in our galaxy, far more than previous estimates.

Greetings from Palmia Observatory

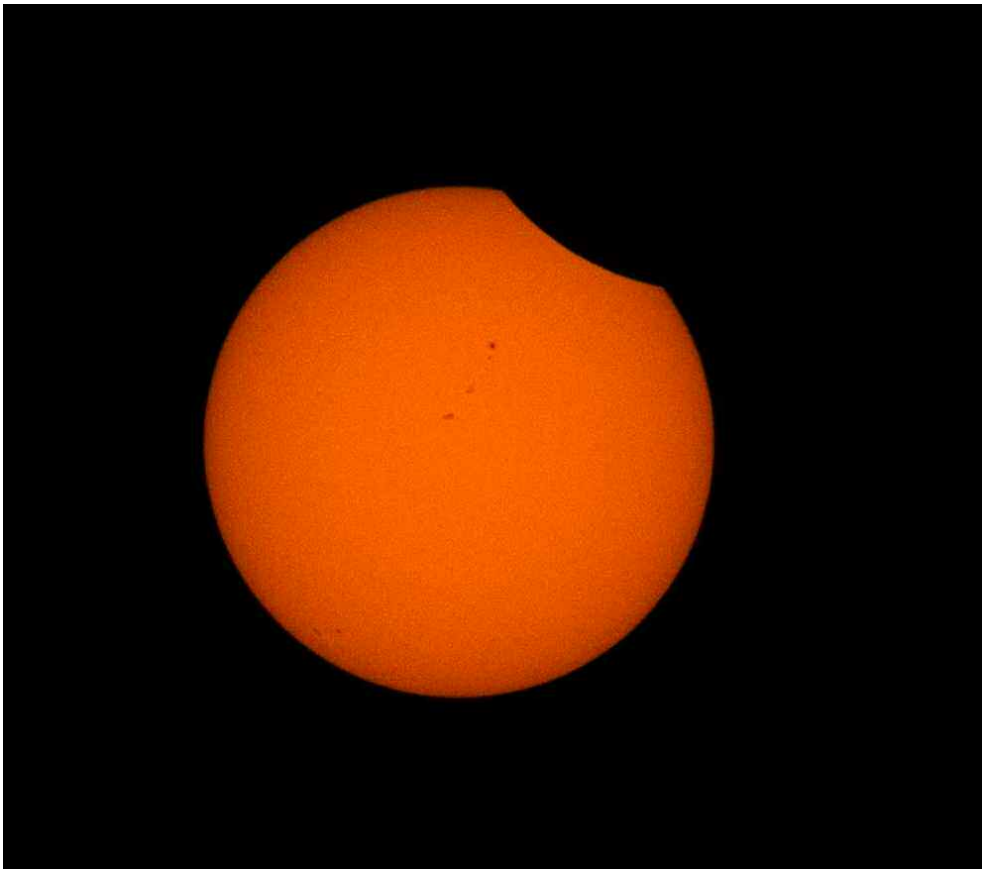
By George Robinson

August 21 total eclipse with night sky and solar images.

Well we are back at the observatory after a fantastic time going through Yellowstone National Park and then spending four days at Astrocon 2017 conference in Casper, WY and then to top that off, staying there to observe the night sky and the total solar eclipse on August 21. Wow, what an experience for we two first time total eclipse viewers.

Let's start first of all with one image of the night sky taken at 8000 feet in the mountains next to Casper. This 60-second image was taken with an 18mm DSLR lens on a non-tracking tripod. We are not used to being able to see the Milky Way at all unless we specifically go to a darker sky site, so this was a real treat and we just sat under the stars for a long time just enjoying the spectacle.

Dark sky sites not always necessary to see the Milky Way.
(This image was taken ouside of a B&B in Julian, CA)



Sunspots visible as the eclipse begins. 2x magnification, 300mm, 1/4000 sec, f11
(Source: Palmia Observatory)

Ok, now after spending four days with 940 other (amateur) astronomers at Astrocon, and then, spending the Monday at Casper College viewing site, with many of those attendees, observing the total eclipse, Wow, it was simply fantastic. We set up with our non-tracking mount and 300mm telephoto lens and waited it out as described in the previous August 21 blog post which presented the IPhone photos of the days events. Of special interest there was the before totality landscape view and the landscape view during totality. It was so neat to be standing in darkness and yet be able to see the lit sky in the distant horizon! We felt the temperature change but did not notice any strange animal behavior other than the ooh-ing and ahh-ing of the other astronomers near us.

The photo to the left shows the sun just a few minutes after first contact and the sun appears a bit excited by the whole thing and displays some sunspots.

Ok, finally totality arrives. I tried to take photos of the Diamond Ring and Baily's beads, but did not get any images. I did experience seeing the diamond ring but wasn't sure if I could see anything more and it was not captured in my camera. But the two camera images taken during totality are pretty neat! The first was taken at 1/30 second exposure to capture the near corona and the second was taken with 1/8 second exposure. There are many other things I probably should have done during totality but just over 2 minutes is not much time to do many things and still personally see and enjoy totality with your own eyeballs. There will be a next time and also many other more expert OCA members will have collected images using tracking mounts, higher power scopes and fully automated camera filter and exposure settings. It will be neat to see what they managed to capture.

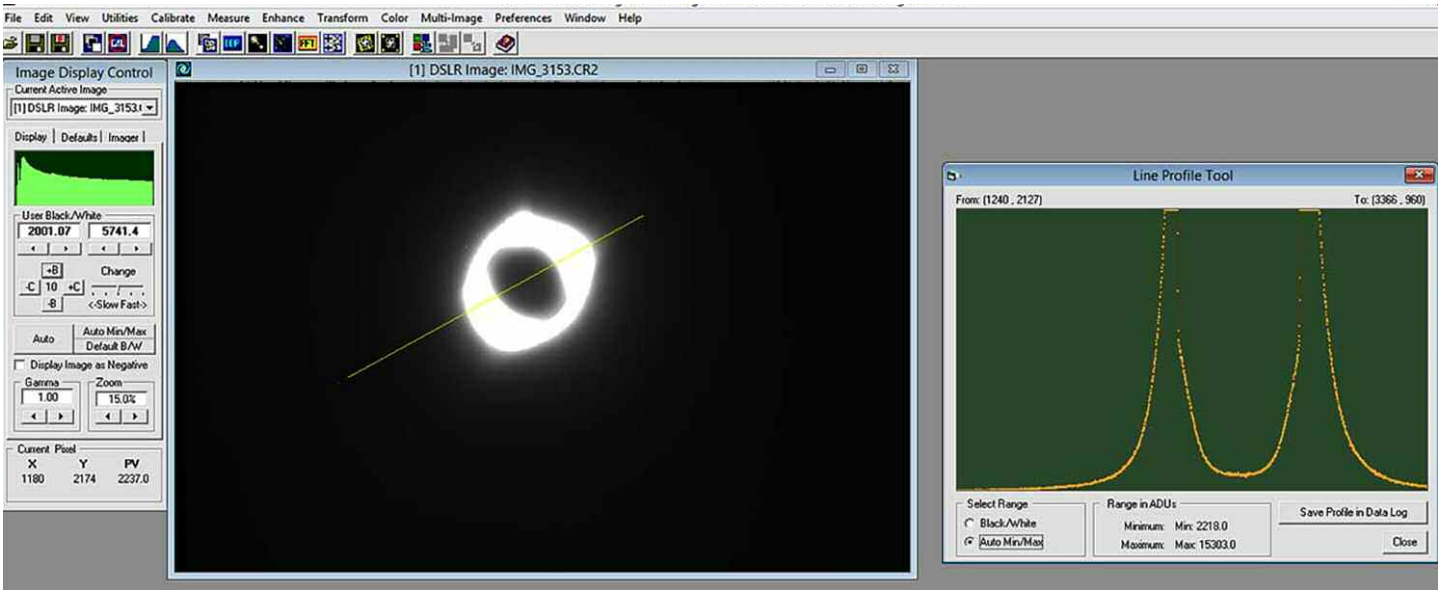
Sun corona visible during August 21 total eclipse, 300 mm, 1/30 sec (Source: Palmia Observatory)

Now, where are all the stars that are supposed to be visible during the total eclipse? Some visual observers reported seeing Venus and some other stars, but I did not see any such thing. I guess being busy and making sure that I captured at least a couple of images during totality and remembering to put the solar filter back on kept me pretty occupied and yet I did have a spare moment to look around and see what the darkened landscape looked like.

To see if any stars were visible in any of our captured images, the 1/8 second exposure of the totally eclipsed sun was imported into AIP4WIN for further analysis. See the screenshot on opposite page. Yes, there is a little bright dot in the lower left of the camera image that might just be Regulus, a magnitude 1.4 star that should be quite close to the sun.

Sun corona visible during August 21 total eclipse, 300 mm, 1/8 sec (Source: Palmia Observatory)

The camera field of view with the 300mm lens is about 2.8 by 4.8 degrees and the full screen image is shown below in the screenshot. The yellow profile line stars at the lower left, right next to Regulus?, and proceeds up to the right. Note how the profile of the solar corona is still so bright that many of the camera pixel are saturated with too much light, but that only one bright star shows up in the image.



AIP4WIN screenshot of 1/8 second exposure showing Regulus at left of profile line (Source: Palmia Observatory)

Let's do some image analysis using this image. The brightest pixel in the star is 2237 ADU and after subtracting the camera bias value of 2048, the pixel value is 189. The maximum pixel value in the corona is saturated at 15030. An analysis of the other corona image taken with 1/30 second exposure also had some pixels saturated at 15030, so the corona is very bright.

How much brighter is the corona than the little star, Regulus? Well, let's use a simplified estimate of the corona to be represented by a brightest pixel value of 15030 - 2048 = 12982, which accounts for the camera bias value. Then we can calculate the magnitude difference between the two objects: Regulus at 189 ADU at 1/8 second and corona at 12982 ADU at 1/30 seconds. So the magnitude difference between these two objects is equal to 2.5 * log (30 * 12982 / (8 * 189)) = 6.

Regulus has a reported magnitude of 1.4, so the estimated value of magnitude for the corona is 1.4 - 6 = -4.6. This value is a bit dimmer than the usual description of the solar corona as being as bright as the moon, which has visual magnitude = -8.3. But the measurement made here is based on just one estimate of the brightest pixels seen, so this estimate seems close enough for now.

Oh, by the way, are we sure that that little star is really Regulus? Check out the Sky Safari Pro screenshot which shows the same approximate filed of view for the position of the sun/moon during totality in Casper, WY. Yes, the position of Regulus does indeed seem to agree very well with the bright little dot in the camera image. The clock time in this screenshot was left at local California time and is one hour later than local time in Casper.

Sky Safari Pro screenshot adjusted for camera field of view in Casper, WY (Source: Palmia Observatory)

Now, the question that still remains is how is it possible to see dim stars right next to the sun given that the corona is so bright? How did Eddington and others verify the bending of light by looking at stars that were very much closer to the limb of the sun? I don't see what I could do with my little setup to see stars that lie within the region of the corona. Readers of this blog will recall how back in February 5, 2017, I took an image of the night sky centered on the exact location where the sun would be on August 21.

I hoped, or really just imagined, that I would be able to overlay these two images, one with the sun present and the other without the sun and pretend that I was also looking for the effects of the bending of light by the sun. Of course, my resolution would never be sufficient to actually do that test. In fact one of the presenters at Astrocon, Dr. Don Bruns, has spent many years analyzing how that measurement was done and how it is feasible now with modern amateur equipment to repeat that famous observation and perhaps even get higher accuracy that was ever done. Most professional astronomers have not used the Eddington approach now because there are other methods based on radio wave propagation that are much simpler and more accurate. It will be interesting to hear back how Dr. Bruns observations and analysis went.

So, now the only question remaining is whether to go the July 2019 total eclipse in Chile and see the southern sky or wait it out for the 2024 total eclipse in the USA. What are you planning to do? I'm voting for Chile, 2019 first. My chore is to get Resident Astronomer Peggy to agree, too! If you haven't experienced a total eclipse, now is the time to start to prepare!

Until next time,

Resident Astronomer George

If you are interested in things astronomical or in astrophysics and cosmology, check out my blog at ***www.palmiaobservatory.com***

New OCA Shop!

Orange County Astronomers has a new online shop! The icon link to the shop can be found on the homepage of the OCA website. The direct link is: **http://www.neatoshop.com/artist/Orange-County-Astronomers**

While this shop contains apparel and posters, a separate store is being created for other items such as pillows, mugs, etc. Shirts are a great way to advertise the club and will hopefully spark many a conversation about the cosmos. Hope you enjoy!

Below are snapshots of a few of the items available which include t-shirts (scoop and v-cut), hoodies, zip-up sweatshirts, long sleeves, tank tops and even shirts for your pet!

Support OCA and BUY A TEE!

The 2017 Solar Eclipse Across America

By Teagan Wall

On August 21st, the sky will darken, the temperature will drop and all fifty United States will be able to see the Moon pass—at least partially—in front of the Sun. It's a solar eclipse!

A solar eclipse happens when the Moon passes between the Sun and Earth, casting its shadow on Earth. Sometimes the Moon only covers up part of the Sun. That is called a partial solar eclipse. When the Moon covers up the Sun completely, it's called a total solar eclipse. As our planet rotates, the Moon's shadow moves across Earth's surface. The path of the inner part of this shadow, where the Moon totally covers the Sun, is called the path of totality.

The path of totality on August 21 stretches from Oregon to South Carolina. If you happen to be in that path, you will be able to experience a total solar eclipse! If you're in any of the 50 United States during this time, you can see a partial solar eclipse.

No matter where you'll be for the eclipse, remember that SAFETY is very important. Never look at the Sun when any part of it is exposed, like during a partial eclipse! It can hurt your eyes very badly. If you want to view the eclipse, you can buy special eclipse glasses. Go the **NASA 2017 Eclipse Safety** website to learn more about what glasses to buy.

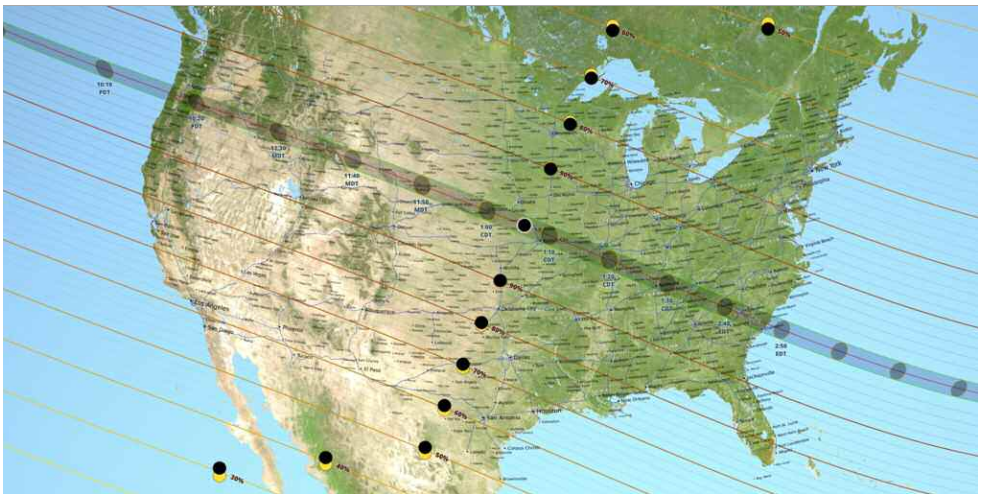
If you are in the path of the total eclipse, you may look directly at the eclipse only when the Moon has completely covered the Sun. This is called totality, and it lasts a very short time. You must be sure to put your eclipse glasses back on before the Sun peeks out from behind the Moon.

You won't be the only one watching this event! NASA scientists will use this eclipse to study our Sun. During a total solar eclipse, we can see the Sun's atmosphere, called the corona. Usually the Sun is so bright that we can't see the corona. However, when the Moon blocks out most of the Sun's light, we can get a glimpse of the corona.

The surface of the Sun is about 10,000 degrees Fahrenheit, but the corona is much hotter. It's about 2 million degrees Fahrenheit! The eclipse gives NASA researchers the chance to learn more about why the corona is so hot. In fact, while the eclipse will only last about two to three minutes in one place, scientists have found a way to have more time to study it.

NASA will use two research jets to chase the eclipse as it crosses the country. The jets will fly very high, and spend seven minutes in the shadow of the Moon. Researchers are using jets to help look for small explosions on the Sun, called nanoflares. These nanoflares may help to explain the corona's extreme heat.

Whether you're watching with eclipse glasses from the ground, or in a NASA jet from the sky, the 2017 eclipse should be quite a show! It's a fun reminder of our place in the solar system, and how much we still have to learn.



A map of the United States showing the path of totality for the August 21, 2017 total solar eclipse.
Image: NASA's Scientific Visualization Studio

To learn about what eclipse glasses to buy and other eclipse safety guidelines, visit:
https://eclipse2017.nasa.gov/safety

To learn more about solar eclipses, check out this NASA Space Place video:
https://spaceplace.nasa.gov/eclipse-snap

This article is provided by NASA Space Place. *With articles, activities, crafts, games, and lesson plans, NASA Space Place encourages everyone to get excited about science and technology.*
Visit ***https://spaceplace.nasa.gov/eclipse-snap*** *to explore space and Earth science!*

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HANDY CONTACT LIST

CLUB OFFICERS (to contact the entire board at once, send an email to board@ocastronomers.org)			
President	Barbara Toy	btoy@cox.net	714-606-1825
Vice-President	Reza AmirArjomand	reza@ocastronomers.org	646-494-9570
Treasurer	Charlie Oostdyk	charlie@cccd.edu	714-751-5381
Secretary	Alan Smallbone	asmallbone@earthlink.net	818-237-6293
Trustee	Andy David	andy@ocastronomers.org	410-615-2210
Trustee	Kyle Coker	kcoker@cox.net	949-643-9116
Trustee	Doug Millar	drzarkof56@yahoo.com	562-810-3989
Trustee	Sam Saeed	samsaeed4241@yahoo.com	714-310-5001
Trustee	Greg Schedcik	gregsched@verizon.net	714-322-5202
Trustee	Gary Schones	gary378@pacbell.net	951-687-7905
Trustee	John Hoot	jhoot@ssccorp.com	949-498-5784
COMMITTEES, SUBGROUPS, AND OTHER CLUB VOLUNTEERS			
Anza House Coordinator	Doug Acrea	dougcarola@att.net	949-770-2373
Anza Site Maintenance	Don Lynn	donald.lynn@alumni.usc.edu	714-775-7238
Beginner's Astronomy Class	David Pearson	p.davidw@yahoo.com	949-492-5342
Black Star Canyon Star Parties	Steve Mizera	mizeras@cox.net	714-649-0602
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
Mt. Wilson Trips	Michele Dadighat	mmpkb8@gmail.com	573-569-3304
Observatory Custodian/ Trainer/Member Liaison	Barbara Toy	btoy@cox.net	714-606-1825
OCA Outreach Coordinator	Adriane (Andy) David	outreach@ocastronomers.org	410-615-2210
Sirius Astronomer Editor	Pauline Acalin	pauline.acalin@gmail.com	617-515-0236
Telescope Loaner Program	Sandy and Scott Graham	Sandy2Scott@sbcglobal.net	714-282-5661
WAA Representative	Tim Hogle	TimHogle@aol.com	626-357-7770
Webmaster	Reza AmirArjomand	reza@ocastronomers.org	646-494-9570
SPECIAL INTEREST GROUPS (SIG's)			
AstroImagers SIG	Alan Smallbone	asmallbone@earthlink.net	818-237-6293
Astrophysics SIG	Bob Sharshan	RSharshan@aol.com	714-845-6573
Dark Sky SIG	Barbara Toy	btoy@cox.net	714-606-1825
Youth SIG	Doug Millar	drzarkof56@yahoo.com	562-810-3989

OCA WEBSITE: http://www.ocastronomers.org STARLINE 24-HR. Recording: 714-751-6867 ANZA OBSERVATORY: 951-763-5152