



Here are a pair of nebulae, NGC7000 (the North America nebula) and IC5070 (the Pelican nebula) imaged by David Searle using narrow band filters. These were taken with a QSI683 camera through a Bork 371mm focal length refractor at the club's Anza site in March 2010.

Because of the COVID-19 crisis and ongoing efforts to reduce exposure to the virus:

- **All in-person club events are cancelled**
- **Use of the Anza site is discouraged**

Please read more about how OC Astronomers has modified its activities on page 2.

### Upcoming Events - free and open to the public

<b>Beginner's class</b>	Friday, 7 May at 7:30 to 9:30 PM The topic this month will be methods of finding objects in the night sky. Special topic is learning the constellations.	ONLINE
<b>Club Meeting</b>	Friday, 14 May at 7:30 to 9:30 PM "What's Up?": Chris Butler from OCA Main speaker will be Dr. Emily Levesque from University of Washington whose talk will be "The Last Stargazers?"	ONLINE
<b>Open Spiral Bar</b>	Saturday, 15 May at 10:00 to 11:30 PM Want to socialize? Grab your images, experiences, questions, or none and see your fellow Orange County Astronomers face-to-face.	ONLINE

**Please consult the calendar on the OCA website to RSVP (required)**

## Response to COVID-19 Crisis

COVID-19 continues to affect all our activities. All in-person club events remain cancelled through at least the spring of this year. Cancellation periods for specific events are detailed below. Please see the President's Message for additional information.

Any use of the club's Anza site by members is at their own risk as we have no way of cleaning or sanitizing the site to CDC standards. If you must go to the site, be sure to clean and sanitize surfaces you have contact with and make sure it is cleaner when you leave than it was when you arrived. You must bring cleaning supplies and sanitizer with you as it is not provided at the site. Be sure to take any trash that you generate or find on the site out with you, and please maintain social distancing if anyone else is out there.

If you have any questions, feel free to contact board members or post them to the email groups or through social media. We will do our best to respond, but please bear with us if there is a delay as we all have other responsibilities as well.

We hope you and your families and friends all remain safe and healthy, and best wishes to all of you!

### Summary of Cancellations of OCA In-Person Events

Due to the ongoing COVID-19 crisis, all in-person club events are cancelled through at least the following periods:

General Meetings	Cancelled until further notice; please try our virtual meetings instead
Anza Star Parties	Cancelled indefinitely
Orange County Star Party	Cancelled indefinitely, until allowed by Orange County Parks
Outreaches	Cancelled indefinitely
Beginners Astronomy Class	Cancelled indefinitely, please contact Dave Pearson to attend Zoom classes
SIG Meetings	Cancelled indefinitely, depending in part on availability of facilities and when meetings could go forward safely. Some may schedule Zoom events.

Please check the website, email groups and social media for updates.

## From the Editor

### Sirius wants photograph submissions from club members

If you would like your picture on the cover, please send it to me along with a brief description of the subject, where the image was taken, and the equipment used.

### Ideas for Future articles

The newsletter includes articles from members or about subjects suggested by our members. We seek ideas and writers to cover them. To contribute an article or work with the editor to produce one, please contact me at [newsletter@ocaastronomers.org](mailto:newsletter@ocaastronomers.org).

### Due dates for submission of articles, pictures and advertisements

<u>Issue</u>	<u>Due date</u>
June	22 May
July	19 June
August	22 July < new date
September	21 August

# President's Message

By Barbara Toy

This time of year it always comes as a bit of a surprise how fast the setting sun is moving north – intellectually I know the movement along the horizon is actually slowing before it stops and reverses direction at the summer solstice, but as of late April it still seems to be moving pretty fast (the same could be said of the rising sun along the dawn horizon, but I haven't felt compelled to get up and out that early to see it for myself).

It's an ongoing visual reminder of the changing of the seasons and effects of the earth's orbit around the sun. Our ancestors may not have understood that it was due to our orbit but they saw the movement, and it's nice to know that there were places where they demonstrably used it to determine important points in the year for their societies. The roots of astronomy run deep, as do the benefits of careful observations.

We also see the changing of the seasons in the night sky, where the winter constellations are changing over to those of summer, and the summer constellations are rising a bit earlier each night. It's reassuring that, with all that's been happening down here this last year, the constellations continue to follow their measured courses, the planets continue their dance, and the moon regularly washes them out as it hits the brighter part of its monthly cycle. This can be a comfort in difficult times, and these have been difficult times. Even if viewing or imaging isn't how you enjoy our hobby, I hope you've found some aspect that's been helpful in getting through whatever difficulties this last year has presented you.

## **Prospects on Covid:**

As I write this there are signs for cautious optimism that we may be getting Covid under control, at least in California, but moving back toward the lives and activities we had pre-Covid remains a cautious process. The Board continues to monitor the situation, and to assess the ongoing risks, options and our best course of action. This has been a significant topic at all Board meetings over the last year – I expect that will continue for quite some time.

For now, we still are not having formal star parties and not allowing groups to use the Anza site. Our next Board meeting is May 23, 2021, and I am hopeful that there will be enough improvement in the overall situation that we can set some tentative dates for when we can resume some of our in-person activities. In addition to our own concerns, many of these will depend on what other entities allow. Specifically, we can't restart our Orange County star parties before OC Parks allows us access for that type of group activity, we can't start in-person meetings for the Astrophysics SIG and Beginners Class until the Heritage Museum is able to allow us access to its facilities, and we can't have in-person general meetings until Chapman University is able to host outside groups again.

We've had some inquiries about whether we will be having a Starbecue this summer – they've usually been held as part of the July star party. At this point, even though things may be opening up a bit by July, we don't expect to have a Starbecue, as that generally is attended by a good-sized crowd of members, families and friends, and the point of the event is sharing food as well as camaraderie – for now, it's not a good idea to have pot lucks or large parties.

Even though we can't have our regular in-person activities at this point like we did before 2020, and there have been a lot of things we haven't been able to do over the last year, we've continued a lot of our activities in modified form and have learned a lot in the process. Our on-line general meetings have been very successful, and have allowed Reza AmirArjomand, our Vice President, to get some speakers for us who would never have been able to come to one of our meetings at Chapman in person because they are too far away. There are a number of people, including members and former members, who haven't been able to attend our meetings in person but have been able to attend the remote meetings. Even when we're able to have in-person meetings again, we're planning to continue with a remote component, as that has been so successful.

If you haven't attended any of our meetings via Zoom yet, it's easy to join them through the link on the "Meeting Info" page on the website. They're also streamed on YouTube and, I believe, Facebook – if you prefer to attend the meetings through something other than Zoom, Reza ([Reza@ocastronomers.org](mailto:Reza@ocastronomers.org)) can give you the details, though it's harder to send in questions for the speaker if you're on those platforms.

I've mentioned before that our Board meetings via Zoom have also been very successful, and we expect to continue them that way indefinitely. Zoom has solved the problem of finding good physical locations for the meetings, it saves Board members a lot of travel time, and allows those that may be out of the area at the time to participate in the meetings anyway (including from Anza). For club members who may want to attend a meeting – all members can do so if they want to, not just when they want to present something to the Board – it's a lot easier via Zoom than if you had to travel to a physical location.

One sad effect of the pandemic was that our extensive Outreach Program, where our volunteers visited various local schools for viewing sessions, had to shut down. Ceci Caballero, our current Outreach Coordinator, has put together a number of remote programs that have been well-received by schools as they've been reopening, helping to inspire young people with an interest in astronomy. As conditions allow us to return to more of our in-person outreach activities, she may continue to include these remote programs as well, as they can meet different needs than the viewing sessions.

### **Anza Reminder**

Although as I write this, a state-wide drought has not (yet) been declared, anyone who paid attention to the amount of rain we received in this last rainy season knows we're well below our usual average rainfall. Even in a dry year, we get grasses, mustard and other annual plants growing at the Anza site, and it's important for the safety of the facilities there that they be cleared away from any of the structures. Fire remains a serious concern out there, and having a zone cleared around the structures will help protect them and help firefighters defend them if we do get a fire.

Pad and observatory holders – if you haven't done so already, please clear the areas around your pads and observatories as soon as possible.

Everyone who uses the Anza site – please pitch in to clear the areas around Anza House and the club observatory when you are out there.

If you see a problem out at Anza that needs more work or expertise to resolve, please bring it to the attention of any of the Board members who may be out there or, if you can't find any, please call or email Charlie Oostdyk (Treasurer), Alan Smallbone (Secretary) or me.

And, if you go out to Anza, please continue to follow safety protocols for Covid 19 as recommended by the CDC and local health departments – we don't want to let our guard down this close to winning out over the pandemic. That includes using masks, keeping social distancing and washing your hands frequently. Again, please bring sanitizer and any other cleaning agents, wipes, etc. that you may need to clean surfaces you touch before and after touching them.

As we've said before, the club doesn't have the resources or personnel to sanitize the site at any time, including in response to Covid, and using the site is always at your own risk. Cleaning at the site has always been the responsibility of those who use the site, and we really appreciate those volunteers who help us all out by cleaning while they're out there. If you use the site, please contribute by cleaning up anywhere you see it's needed.

I hope, as the weather warms, that you're able to enjoy the night sky in comfort, and that you and all of those who are dear to you stay safe and healthy!

© Barbara Toy, April 2021

# AstroSpace Update

May 2021

Astronomy and space news summarized by Don Lynn from NASA and other sources

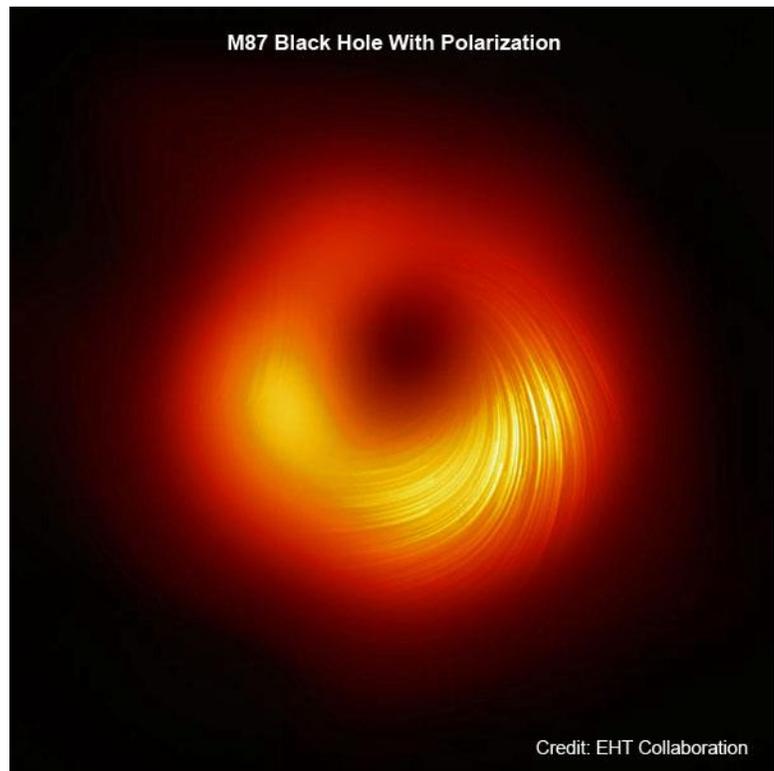
**Black Hole Magnetic Field** – Back in 2019, astronomers revealed the first ever picture of a black hole, the supermassive one at the center of galaxy M87, or more precisely, the material just outside that black hole. Further processing of that image data has now shown the polarization of the light there. This polarization is caused by electrons directed by magnetic fields, so the new image shows magnetic fields around that black hole. Astronomers expected the light around a black hole to be mostly polarized, but found it was only 15% polarized. From this they concluded that the magnetization is chaotic over small distances, which muddles much of the polarization.

**Double Quasars Found** – Quasars are supermassive black holes at the centers of galaxies that are feeding on massive amounts of material that glows brightly before falling past the black hole event horizon. When two galaxies collide, it can produce a double quasar, but such pairs are rare. A team of astronomers tested a new method of looking for these rarities. First they searched for quasars in data

from the Sloan Digital Sky Survey, then looked at the same objects in Gaia space telescope data to see if there were small variations among the multiple times Gaia measured position. Such variations can be caused by independent flaring of two quasars that are too close to resolve separately. Then these candidates were observed with the Hubble Space Telescope to see if its superior resolution saw a double quasar. Two new double quasars were found in the first trial of this method.

**Intermediate-Mass Black Hole** – Gamma-ray bursts occur randomly in time and location on the sky. Occasionally double bursts are seen, and it is believed that these are caused by the gamma rays happening to pass near a massive object that causes a gravitational-lens double image. A team of astronomers analyzed such a double burst and found that the massive object that lensed the burst had a mass of about 55,000 solar masses. This is apparently an intermediate-mass black hole. Such black holes have a mass between stellar-mass black holes formed by collapsing stars and supermassive black holes, which are found at the centers of galaxies. Extremely few of these intermediate-mass black holes are known. This is the first time one has been found by this gamma-ray burst method.

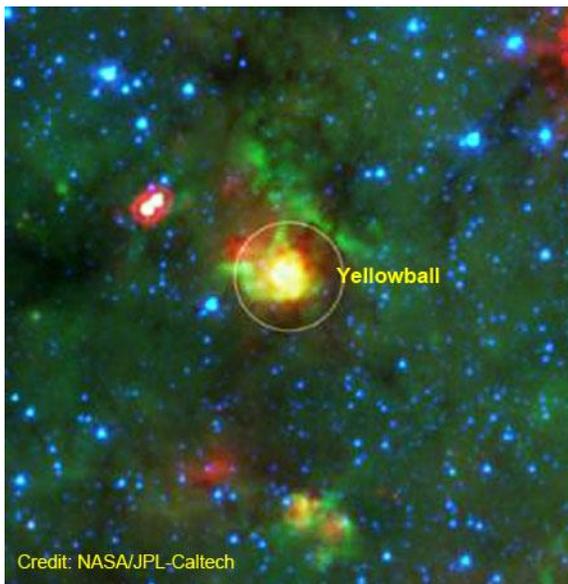
**Einstein Crosses** – When a quasar lines up perfectly behind a massive object, as seen from Earth, the quasar light is distorted by gravitational lensing into a perfect ring, known as an Einstein ring. But if not quite perfectly lined up, the quasar is often seen as 4 images, known as an Einstein cross. Only about 50 of these crosses are known. A team of astronomers trained a computer program to recognize Einstein crosses, and it found 12 new ones in Gaia space telescope data. WISE space telescope and ground-based spectroscopic observations were employed to confirm these 12 crosses. Einstein crosses can be used to calculate the Hubble constant (expansion rate of the Universe) and to determine the distribution of dark matter about a gravitationally-lensing galaxy.



**Yellowballs** – Citizens scientists tasked with identifying massive stars in the process of forming in infrared images have discovered a new type of astronomical object that astronomers are calling yellowballs. They appear yellow only because yellow was used to false color particular wavelengths of infrared light in the images searched. Yellowballs indeed indicate stars forming (of small or large mass), in fact at an early stage. This is a useful way to find star formation, since newly formed stars themselves are usually hidden within dusty clouds.

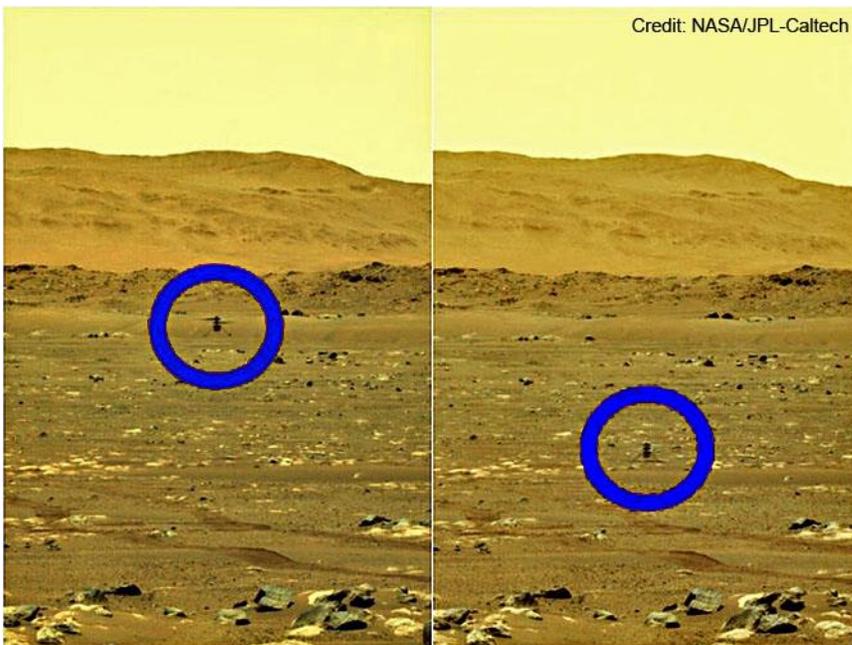
**Star Formation** – One theory of what ends the process of a gas cloud collapsing to form a star is that jets and stellar wind from the forming star blow away the remaining gas that hasn't yet collapsed. It is known that only about 30% of the gas in a collapsing cloud ends up in the final star, so some cause is stopping the star formation process.

A new study casts doubt on the theory that jets and winds end the process. Astronomers studied 304 forming stars of varying ages in the Orion Complex, using archived data from the Hubble, Spitzer and Herschel space telescopes, and found that the gas blowing away from jets and winds does not occur at the same time as the growth of the forming star ends. In fact, the jets and winds do not appear to ever blow away all the remaining gas. So now they are looking for a different theory as to what ends the formation process of new stars.



**GRPs in X-rays** – Some pulsars, which are spinning neutron stars, occasionally give off a really big pulse of radio waves, which has been dubbed a giant radio pulse (GRP). Astronomers have been searching for simultaneous pulses in wavelengths of light other than radio, but have come up empty-handed, with the exception of the Crab Nebula pulsar where visible light and radio pulses have been found correlated. The search has finally found X-ray pulses associated with GRPs. Surprisingly the X-ray pulses contained much more energy than the GRPs, so that means theorists have to find some process occurring at a neutron star that gives off pulses with perhaps hundreds of times more energy than the GRPs themselves indicate. The new observations did not show any relation between GRPs and the FRBs, fast bursts of radio energy, whose cause is also unknown.

**Ingenuity** – The Mars helicopter, named Ingenuity, failed its rotor-spinning test April 9. After controllers fixed a software problem in synchronizing two computers, the test succeeded on April 16, and was followed 3 days later by a flight to about 10 feet off the ground for over half a minute, making it the first powered flight on another planet. Rover Perseverance imaged the flight from a safe distance away. Ingenuity made its second flight 3 days later. This time it flew 16 feet high, turned to take pictures in specific directions, flew sideways, and spent nearly a minute in the air.



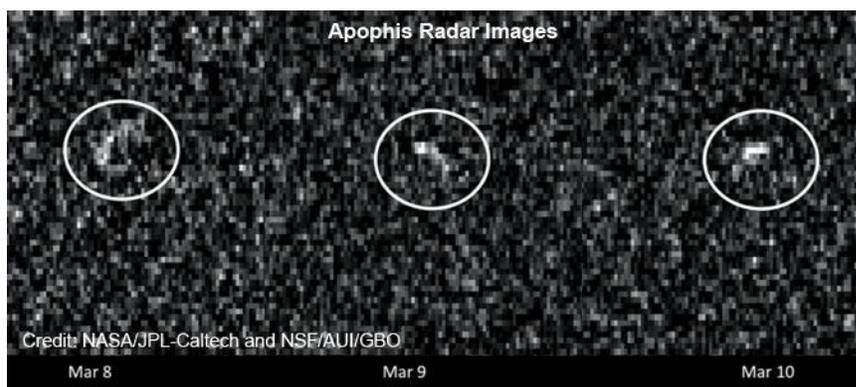
A total of 5 flights are planned, each testing more capabilities than the previous ones. Ingenuity is intended only to test the helicopter concept, and then the rover will leave the copter behind. But what is learned will allow the team to plan how a future helicopter can scout ahead for a rover or visit places a rover cannot go, such as canyons, caves or cliffs.

**Perseverance** is otherwise keeping busy taking pictures, monitoring the weather, and zapping rocks to determine their composition. It also made the first of at least 10 planned test runs of the MOXIE experiment. This device takes in carbon dioxide from the Martian atmosphere and splits it into oxygen and waste carbon monoxide. This test run produced only a fraction of an ounce of oxygen, but later runs should far exceed this. In the future, this process could provide oxygen for astronauts to breathe and for rocket propulsion to lift off Mars.

**Marsquakes** – Mars lander InSight detected 2 strong marsquakes in March, registering 3.1 and 3.3. Although the lander has detected over 500 quakes since deploying the seismometer more than 2 Earth years ago, only 2 previous ones have been as strong as this. The strong ones allow much more to be learned about the Red Planet than do the weak ones. All 4 of the strong ones originated from ground motion in an area of Mars named Cerberus Fossae. Also, all occurred in northern Martian summer. This may be a selection effect, though, since bad winter weather interferes with the seismometer. Controllers have begun using the lander's arm to scoop up soil and pile it on the cable between the seismometer and lander and on the seismometer shield, to help reduce weather interference.

**Unusual Martian Crater** – Scientists discovered a crater on Mars that shows signs of liquid water running within it long ago, but without any entry streambed and without any evidence of a groundwater source. They concluded that the water source ran into the crater on a glacier, thus not leaving a streambed in the soil. There are ridges in the crater that appear to show the presence of a glacier long ago. The crater was the only one of this type at the time of discovery, but further search by the scientists have found dozens of similar ones. These indicate that the times in the distant past when Mars had liquid water running on its surface may have been cold enough to also have glaciers.

**Apophis** – Do you remember a few years ago when astronomers said that asteroid Apophis was going to come awfully close to us in 2029 and possibly even collide with Earth? And then a few years later, after more precise tracking, they announced Apophis would definitely miss us in 2029, but might hit Earth in 2068? Well, you can rest easy now. The asteroid came reasonably near Earth in March, so astronomers were able to track it with radar, giving extremely precise positions. It is now certain that Apophis will not hit Earth in the next 100 years. Apophis is about 1100 feet across, large enough to do serious damage in a collision. The Goldstone, California, 230-foot radio dish was used to transmit the radar, and the Green Bank 330-foot dish in West Virginia received. This combination results in amazing resolution, so produced rough images of the surface features from more than 10 million miles distance.



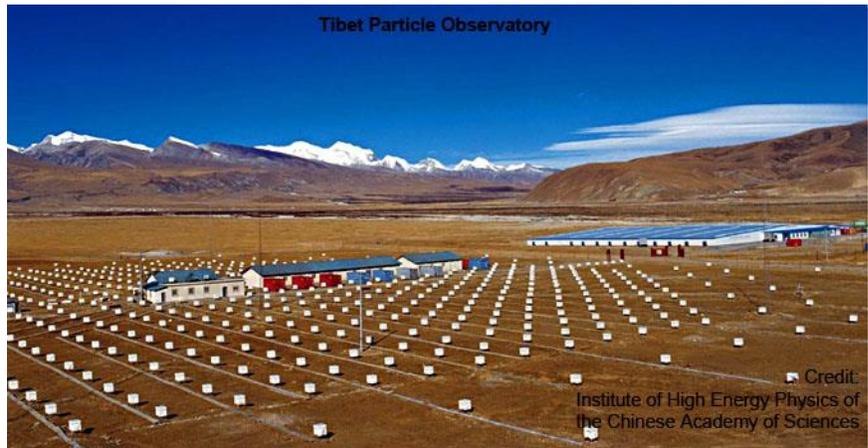
**Pristine Comet** – In late 2019, the second ever interstellar object was discovered and named Comet Borisov, after the amateur astronomer discoverer. Its speed as it approached the Sun was too great to have originated anywhere within the Solar System, and hence was declared an interstellar object. New analysis of observations of Borisov show that it probably had never been hot before, and therefore was making its first pass anywhere near any star. This likely makes it the most pristine comet ever observed, meaning its composition was unchanged by any radiation or stellar wind since it formed. The previous most pristine comet is generally believed to have been Comet Hale-Bopp, which was deemed to have made only one previous pass near the Sun.

**Talc Comet** – The nucleus of any comet is difficult to observe from Earth because when it comes near us, it is usually obscured by gas and dust forming the comet coma. Comet P/2016 BA<sub>14</sub> was particularly low in gas and dust emitted, apparently because much of its volatile surface material has been lost due to many passages near the Sun, and it passed quite close to Earth, giving astronomers an excellent opportunity to scrutinize it. Observations in infrared were made, which constituted the best view of a comet nucleus ever made from Earth. The surface was found to be covered with grains of phyllosilicate, similar to talcum powder. This is the first time this mineral has been found on a comet nucleus. The observations also showed that the nucleus was about 2600 ft in diameter.

**TESS Exoplanets** – The team operating the TESS planet-finding space telescope has released a new catalog of probable exoplanets, containing more than 2200 of them. So far about 120 have been confirmed to be exoplanets by other observations. The catalog is the result of finishing its mosaiced coverage of most of the sky, which took about 2 years. TESS is now beginning an extended mission where it will cover a similar pattern of nearly the whole sky, but offset a little to cover the gaps in coverage missed the first time around. Some of the most interesting planets in the catalog are: a planet called TOI 700 d that is Earth-sized and orbits in its star’s habitable zone; one called TOI 1338 b, the first planet found orbiting a pair of stars; LHS 3844 b, a large rocky planet that orbits so close to its star that its year is only 11 hours long; and TOI 1690 b, which survived its star swelling to a red giant and then collapsing to a white dwarf.

**Brown Dwarf Speed Limit** – Brown dwarfs are stars that don’t have enough mass to sustain fusion of hydrogen, which powers ordinary stars. Strangely they speed up their rotation as they age. This is caused by contraction with cooling, and is allowed because they have nearly zero friction to rotation. A new study of rotation speeds of brown dwarfs has found no such objects with rotation periods less than 1 hour. Apparently there is a limit to brown dwarf rotation speed. Theorists need to explain what causes this limit.

**Cosmic Ray Sources** – How do you find the source of cosmic rays with detectors on Earth? It’s difficult, because the cosmic rays collide with molecules in our atmosphere and never reach the surface. They do cause a shower of struck atmospheric particles, but tracing these back doesn’t indicate the source, because cosmic rays are charged particles that deflect every time they encounter magnetic fields on their trip from source to Earth. But scientists figured out that cosmic rays that collide with interstellar atomic nuclei near their source produce gamma rays that are undeflected by later-encountered magnetic fields, and so can be traced back to their source. But wait: gamma rays are also stopped by Earth’s atmosphere, causing showers of struck atmospheric particles that look like cosmic-ray showers, except that cosmic-ray showers contain lots of muons, and gamma-ray showers have few muons. In Tibet (because the high elevation of Tibet helps this process) scientists have built an array of atmospheric particle shower detectors, along with muon detectors, and a supercomputer that traces back the atmospheric showers to their sources in the sky while discarding the ones with large numbers of accompanying muon detections (which is most of the showers), and thus shows the sources of the cosmic rays that produced the gamma rays. Operation of this system has shown that the majority of really high-energy cosmic rays have sources in the plane of the Milky Way, so must be originating in our galaxy. But some of these originate from other directions, probably distant galaxies. These tend to have higher energies than Milky Way cosmic rays, suggesting that there may be two different mechanisms to produce high-energy cosmic rays.



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**Earth’s Core** – Researchers announced that the inner core of the Earth is actually two layers with different properties, perhaps due to a change in the structure of iron at higher temperature or pressure. So now the layers of Earth are: crust, mantle, outer core, inner core (outer part), and inner core (inner part).

**Crew Launch** – In late April, 4 astronauts launched to the International Space Station aboard a SpaceX Crew Dragon capsule atop a Falcon 9 rocket. This brings to 10 the number of astronauts launched into space on a privately developed rocket. Both the capsule and the rocket first stage were reused from previous flights (or as SpaceX likes to call them, flight-proven, rather than reused).

# We Made It Ourselves - Flat Field Light Box

Created by: Frank Kloer

Written by: David Pham



Pictured is a flat field light box used for capturing flat frames in astrophotography created by OCA member Frank Kloer. Taking flat field exposures helps to adjust for uneven illumination and vignetting by compensating for dust bunnies that can stick to the optics or the camera sensor's glass window. Frank created the light box for his Meade LX200R 8-inch SCT using foam boards that can be found at your local Hobby Lobby or Michael's and attaches it to his telescope via velcro dots. He mentions that purchasing a flat field light panel can be pretty expensive so a DIY light box project makes for a cost-effective alternative that can keep you occupied during cloudy nights.

Each piece of the light box was cut and assembled together using glue. The light panel shown on the right was made using a white acrylic plastic and LED light pads from Plasma LED that were both bought online. Frank installed a 10-turn 10K potentiometer outside the light box for brightness control, which can be purchased from Newark Electronics or Allied Electronics, and the box is powered by an external 12-volt power source. Refer to the top right image to see the interior wiring setup and the last image to see the external control knob and 12-volt jack that connects to the power source. The top of the box is removable so that components can be easily accessed and/or replaced if damaged. Frank says that it took him about 2-3 days in total to search for similar projects online, finalize his own design, and build the light box. No special tools are needed to complete this DIY project and he notes that the light box can be made to fit telescopes of different apertures. Since he made it, the flat field light box has gotten the job done without needing any upgrades or repairs.



# Borrego Springs August Star Party ~ Informal

Dear VCAS and OCA Members,

A few months ago I spoke of a group Star Party at the Borrego Valley Inn. That won't happen this year because Covid made it difficult to plan, however ... I've reserved a room for myself for the following dates:

Arrive: Tuesday August 10th, 2021.

Leave: Friday August 13th, 2021

Borrego Valley Inn

405 Palm Canyon Dr

Borrego Springs, CA 92004

**760-767-0311 for Reservations**

**I picked these dates** because it's the peak of the Perseid Meteor Shower and the moon sets around midnight. The Milky Way will be stunning.

**I'm not organizing an event this.** I'm telling you what I plan to do. I want to see what happens. If enough people decide to book a room around the same time then I'll organize something for 2022. But this time around it's completely informal.

**Before you make a reservation:** It's also the hottest part of the summer, 115+ degrees and most everything in town is closed. It might be difficult to find a restaurant. Also, plan your travel route carefully, it's easy to get lost.

**About the Borrego Valley Inn:** It's for adults only, 2 persons per room, only one bedroom per room. They serve goodies in the morning. There are 2 swimming pools (one is clothing optional). The lights to the swimming pools will be on all night, but you'll still get a great view of the Summer sky.

**Group Rates (for 2022):** If we reserve all 23 rooms we can get them to shut off the swimming pool lights just for us (but the pool will be closed after dark). Like I said, for 2022

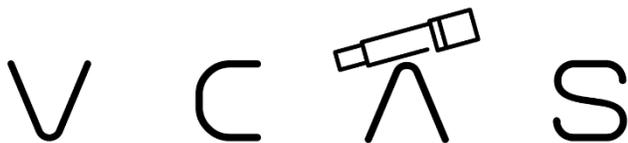
**If you're interested in learning more about group rates:**

541-435-4743 <> Allyssa Pearl

**Clear Skies**

**Keith Salvas, President and Publicity**

**Celebrating 50 Years of Bringing Astronomy to You**



Ventura County Astronomical Society

**1971 ~ 2021**

Science Blog – the Hellas Daily Herald

Written by Dr. Craig Jones (Sacramento, CA)

His blog, the *Hellas Daily Herald*, provides a daily digest of news on Mars science and exploration for a popular-academic readership: Subscribing to this blog can be done from the site below and is free.

<https://hellasdailyherald.substack.com/>

## Advertisements

Buy, Sell or Trade some of your gear? This is where club members can place advertisements. Please contact the editor at [newsletter@ocastronomers.org](mailto:newsletter@ocastronomers.org) to place an advertisement or to learn more about placing one. There is no cost to club members for non-commercial advertisements in the newsletter.

For Sale	contact	David Hobbs	<a href="mailto:david_hobbs714@yahoo.com">david_hobbs714@yahoo.com</a>	
<ul style="list-style-type: none"> <li>• 20" F5 Research grade early Coulter mirror and secondary mirror</li> <li>• Primary mirror is 2 3/4" thick, Secondary is 4" x 5 5/8"</li> </ul>				\$2800

For Sale	contact	Ron Choi	<a href="mailto:rongrace2@cox.net">rongrace2@cox.net</a>	
<ul style="list-style-type: none"> <li>• Orion StarShoot AutoGuider</li> <li>• Orion Mini 50mm Guide Scope</li> </ul>				reduced price \$ 220 reduced price \$ 50

### Want to See the April 2024 U.S. Total Eclipse? ...Why Not Make It Easy on Yourself? ... Let Us Do the "Heavy Lifting" ....

- Relax in plush, 5-star comfort along the Famous San Antonio Riverwalk
- Daily breakfast, post-eclipse celebration dinner, liquid refreshments provided at our exclusive observing site
- A reserved, sheltered/shaded viewing site, with fixed/permanent facilities/restrooms, and break rooms
- Access to set up and align your equipment the **day prior** to totality, with 24-hour security/guard protection on site
- Expert technical support and pre-eclipse guidance from a veteran of 21 prior totalities, with a 92% success rate!
- Transportation via motorcoach to/from the viewing site on the day of the eclipse
- Pre- and/or post-tour, reduced rate hotel accommodations available to all tour registrants
- If necessary, alternate viewing sites, due to weather. have been identified

**HURRY – Space is limited - we are almost SOLD OUT!!**  
**For more information, visit: [www.twilighttours.net](http://www.twilighttours.net)**  
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