The SAN MATEO COUNTY ASTRONOMICAL SOCIETY

Aug. – Sept. • 2021 Issue

780th General Meeting: TBD
781st General Meeting: TBD
782nd General Meeting: TBD

EVENT HORIZON

Founded in 1960, the San Mateo County Astronomical Society is a 501(c)(3) non-profit organization for amateur astronomers and interested members of the public. In nonpandemic times, visitors may attend Society meetings and lectures on the first Friday of each month, September to June, and Star Parties two Saturdays a month. All events are free for visitors and guests. Family memberships are offered at a nominal annual cost. Detailed membership information is found at ***http://www.smcasastro.com/membership.html*** *where those who want can join via PayPal. Membership also includes access to our Event Horizon newsletter, discounted costs and subscriptions to calendars and magazines, monthly star parties of the Society and the College of San Mateo, use of loaner telescopes, field trips, social occasions and general meetings presenting guest speakers and programs. For additional information, please email us at* ***SMCAS@live.com*** *or call* ***(650) 678-2762****.*

Membership forms are available near the end of this newsletter. The Membership Application form is on the back page.

Star-B-Que August 7

After a very long hiatus, the SMCAS is resuming our annual Star-B-Que picnic at Crestview Park in San Carlos! Our next such event will be held Saturday, August 7 starting at 6 pm. Followed by Star Party at sunset.

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PLEASE NOTE: CSM is still closed due to the pandemic.

Cover: August 3, 2019, Star-B-Que. From left to right, Stuart M., Ken L., John C., the late Gene C., Darryl C. and Bill L.

From the Prez

Hi All. In our annual game of Board/Officer's Election of musical chairs, I again couldn't reach a seat before the music stopped so I am, once again, your president. I hope this finds you, and all those dear to you, healthy and doing well. Given all the reports of COVID resurgence, I'm gratified to note that our members, families and friends, as well as most in our local community, appear to have been only lightly touched by the negative conditions said to afflict so many others.

Thanks for your participation in our recent election. Most of those on the Board of Directors have returned. Ed Pieret is again VP, Marion Weiler is Secretary, and Directors-at-large Ed Ching, Bill Lockman, Ken Lum and Frank Seminaro will continue to serve. In addition, our talented Karen Boyer has returned as treasurer, and some skilled, enthusiastic new members have joined us as Directors; Michelle Morales Torres (also Event Horizon editor), as well as Michael and Lisa Cooke who share a seat.

Because San Carlos Parks & Recreation reopened Crestview Park this past July 3, we'll get to enjoy our traditional Installation of Officers and Star-B-Que event on Saturday August 7, starting 6 pm. It will feature a potluck picnic and live Star Party. They won't permit cooking there at present, but we'll bring prepared chicken, burgers and sausages, including some new heme-protein 'vegetarian meats'. Attendees are invited to add potluck dishes featuring pasta, salad, side dishes, snacks, drinks and desserts. Please respond by email to Ken Lum when you receive his invite sent via the SMCAS Newsgroup.

Nor will this be the only on-site Star Party coming up. We've already restarted our Crestview stargazing events as of July 3 and 10. And, for those who live too far away to easily attend in person, or who don't wish to drive at night, we hope to continue offering brief online Star parties in conjunction with monthly lectures.

We also plan to restart our Equinox spaghetti feeds and our end-of-year holiday potluck (likely in January) once we can return to the Crystal Springs United Methodist Church, 2145 Bunker Hill Dr, San Mateo, where we've often met in their Fireside Room. We have a reservation there for Saturday, September 18, from 6 pm to 9 pm.

We're not being charged for the room but will offer a donation. Under current guidelines, we can't cook in the kitchen, but can use it for limited washing and cleaning. So, our proper course will be to prepare our potluck contributions offsite and deliver them to the venue, later removing what remains.

It's going to be a while before we're able to resume our normal schedule of public outreach. The San Mateo County Community College District (SMCCCD) has elected to keep its campuses closed, at least through year-end, making the CSM Integrated Science Center (ISC), Planetarium and Observatory unavailable to us. The KIPAC facility at the Stanford Linear Accelerator Center (SLAC) has decided not to yet resume large public events that attract families with kids.

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From the Prez (cont'd)

They are thereby deferring their annual Community Day, along with our participation, until at least sometime in 2022.

However, some of our people, notably Marion & Colette Weiler, Ed Pieret and Ken Lum, recently showed the public the Sun at the Gamble Gardens Summer Solstice event in Palo Alto and we expect to soon begin reaching out to schools and youth programs to offer views and descriptions of the sky.

We also plan to participate in CSM's Family Science and Astronomy Day (FSAD) on Saturday, September 25. It will, unfortunately, again be a virtual event, without on-site participation, but at least we will be providing the Solar and Night Sky viewing with narrations. Watch your SMCAS newsgroup for details.

Incidentally, the FSAD will, this year, become the longest-running public outreach event in the history of the SMCCCD, surpassing the Jazz-On-The-Hill Festival that used to be held at CSM.

Our Society led Astronomy Day events since their origination by the now-defunct Astronomical Association of Northern California in about 1971. It led the event at CSM until the District closed the campus to the public in 1978, immediately following the passage of Jarvis-Gann's famous Proposition 13. Upon our return to the campus in 2000, we resumed leadership of public astronomy outreach, which later evolved to the FSAD, until the science facilities were remodeled and policies restructured in 2006. We have still continued to sponsor or support CSM's Astronomy public outreach programs ever since.

On another historical note, the College of San Mateo celebrates its 100th anniversary this year. CSM's College Heights campus was opened in 1963, 59 years ago, when the then-San Mateo Astronomical Society first began meeting and volunteering there, with the sponsorship of Dr. Claude Anderson.

Finally, I want to express my appreciation to our members, and guests, who've subscribed to and supported our activities during the past year, despite the shutdowns and difficulties of participation. We appreciate your interest and enthusiasm, and hope you'll continue to join us as things (hopefully) return to normal.

Feel welcome to contact me, or other members of the Board, if you have any questions, or if we can assist you in any way.

Thanks again for supporting the San Mateo County Astronomical Society. All the best.

Mike Ryan

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Upcoming Events

PLEASE NOTE: CSM is still closed due to the pandemic. SMCAS in-person Star Parties have resumed at Crestview Park. Click here to see the schedule.

Saturday, August 7: Star-B-Que – Our annual Star-B-Que returns! See below for more details.

Saturday, August 28: Star Party – In-person Star Party at Crestview Park at 9pm. See page 30 for additional details.

Saturday, September 18: Autumnal Equinox Dinner – In-person potluck spaghetti dinner, 6pm at Crystal Springs United Methodist Church, 2145 Bunker Hill Dr, San Mateo, in the Fireside Room. See page 4 for more details.

Saturday, September 25: CSM's 2021 Family Science and Astronomy Day (FSAD) –This year it will become the longest-running public event in the history of the College, surpassing the old Jazz on the Hill. Ken will do solar viewing and there should be a couple eVscopes. The keynote speaker has been selected and the topic will be Perseverance Mars mission.

SMCAS Annual Star-B-Que Resumes Saturday, August 7!

By Ken Lum

After a very long hiatus, the SMCAS is resuming our annual Star-B-Que picnics at Crestview Park in San Carlos! Our next such event will be held Saturday, August 7 starting at 6 pm. Due to the risk of fire, we will not be able to do any cooking on-site. Instead, I will cook hamburger patties, polish sausages, chicken legs, and veggie burgers at home and bring these items along with buns and condiments to the park for people to consume.

All other items such as side dishes, salads, desserts, and drinks will be brought to the park by participants as a pot-luck contribution. So, let me know if you are coming and how many people you are bringing to this event so I can know how much picnic meat to purchase.

Also, let me know what kind of potluck dish you plan to bring. You can let me know if you are coming via email at: lum40@comcast.net.

After the picnic, we will have our usually scheduled Star Party at the Crestview Park which is occurring near the dark of the moon. So bring your telescopes and binoculars as well if you have such items. Sunset for this date is 8:10 pm.

Our COVID policy is that masks are optional, social distancing, and vaccine immunization are highly recommended where possible, but we are not going to check and everyone participates at their own risk. But we believe the risks are low due to the event being held outdoors so we certainly hope most people will be able to come. See you all there!

Remembering Bill General

By Ron Cardinale

Former SMCAS member Bill General passed away on July 1, 2021. He was 91. A native of California, Bill lived most of his life in the Bay Area. Bill was in the U.S. Air Force assigned to a communication facility in the Philippine Islands during the Korean War. He rose to the rank of sergeant. After returning to civilian life, just over four years in the service, he decided to study electronics at the College of San Mateo.

Bill at an Equinox dinner on March 28, 2015, sitting on the left, in the blue sweatshirt with the three white stripes on the sleeve.

Over the years, he worked at several different companies in the Bay Area as a technician. We met when he was hired as a technician at the electronics company I was working at in Belmont. This is also where he met Betty, a widow, who would eventually become his second wife. Later he transferred to another department and became a technical writer.

He retired in 1993. He and Betty would sometimes make road trips mostly around the western US. She died in 2001.

Aside from an ongoing interest in astronomy, Bill enthusiastically pursued photography as a major hobby for much of his life and became quite good at it. In his younger days, he backpacked in the Sierras.

Bill is survived by his first wife and their son and daughter and four granddaughters, two nieces and their families and, I believe, five stepchildren. ◆

July 3 Star Party Highlights at Crestview Park

By Bill Lockman

Some of the attendees and their telescopes. *(Kevin Simpson)*

California relaxed many of its COVID-19 restrictions on June 15. Shortly thereafter, Ken Lum got the go-ahead from the city of San Carlos Recreation Coordinator Janet Guerry to commence holding Star Parties at Crestview Park. He organized the first such activity for July 3. My own expectation based on the weather pattern in Fremont over the past few days was that this event would be fogged out. I was pleased to see that the evening began not with fog but with a smattering of popcorn clouds, possibly ushered in by tropical air from southern California. (See photo on page 12.)

Ed Pieret stated, "I was very excited to see the attendance at the Star Party on July 3. I counted seven different scopes (four of which were eVscopes). That number of astronomers is larger than we usually had prior to the pandemic. Hopefully the Star Parties will continue to be well attended, the next one is next Saturday, July 10."

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July 3 Star Party Highlights at Crestview Park (cont'd)

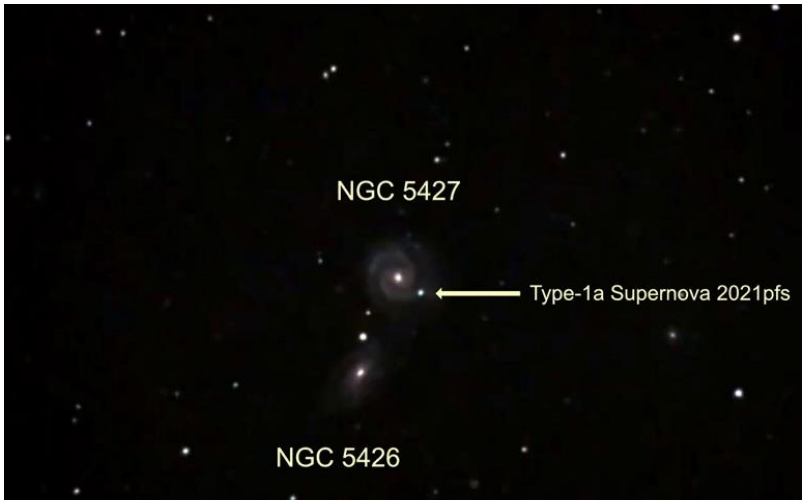
Michael Cooke, Ken Lum, Ed Pieret and I all brought our own eVscopes. The eVscope is a remarkably smart and very portable telescope developed and marketed by the French company, Unistellar. The eVscope is a 114 mm aperture f/4 Newtonian reflector which utilizes a Sony IMX224 sensor at prime focus to record and process color images of celestial targets. In just a few clicks of a button pushed by its operator, the eVscope aligns itself to the night sky, seeks out and centers a target, and records and enhances the target's image, all with little or no additional intervention required from the operator!

The first visible heavenly body appeared low in the west at sunset: Venus in gibbous phase. This provided those with conventional go-to mounts the first opportunity to perform their sky alignment procedure. Shortly after nautical twilight, the bright stars in the Summer Triangle asterism appeared, providing further alignment targets for improving the sky alignment accuracy.

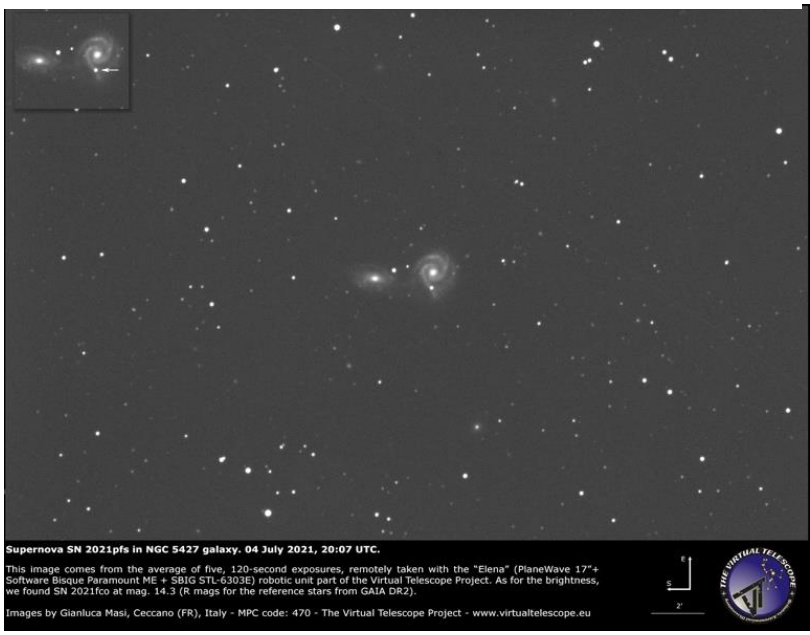
The highlight of the evening was the detection of Type 1a Supernova 2021pfs in the spiral galaxy NGC 5427. Supernova 2021pfs was discovered on June 9 at 02:18 UTC by the Zwicky Transient Facility (ZTF) (USA). A compilation of its parameters is found here.

This supernova event was brought to our attention by Michael Cooke, who shared its location with several of us. Ed Pieret pointed out that this is one good example of why Star parties are beneficial. They provide the forum for sharing information about interesting celestial events among the participating astronomers and their guests. This is astronomy outreach at its best.

Michael Cooke, Ken Lum and Ed Pieret all imaged the supernova with their eVscopes. Shown below is Michael's image of 2021pfs:



Type -1a Supernova 2021pfs in Galaxy NGC 5427. (Michael Cooke)



For comparison, Ed included an image from Sky & Telescope (above) that involved five 120-second exposures with a 17-inch telescope.

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July 3 Star Party Highlights at Crestview Park (cont'd)

Properties of observed globular clusters (from Wikipedia)

Messier (New General Catalog)	***Apparent Magnitude***	***Distance (light years)***	***Mass (Solar Masses)***	***Radius (light years)***	***Age (billion years)***
M12 (NGC 6218)	7.68	14,700 ly	87,000 $M_\odot$	37.2 ly	12.67 Gyr
M22 (NGC 6656)	5.1	10,600 ly	290,000 $M_\odot$	50 ly	12 Gyr

In Ed's opinion, "the eVscope image is as good and shows more color – amazing."

Michael Cooke and I gave an observing tour of globular clusters visible from the Cooke family residence during our June 12 SMCAS virtual Star Party, recorded here. One of the objects on the observation list was M12, a globular cluster in constellation Ophiuchus. M12 is also known as the "Gumball Cluster" and its properties are shown in the table at the top of the page. Apparently, we missed imaging M12 at our June 12 virtual Star Party, so I imaged it at this Star Party. It is shown in the following photo.

The globular cluster M22 (NGC 6656) is located in constellation Sagittarius. It is positioned in front of part of the Milky Way's galactic bulge and is therefore useful for its microlensing effect on those background stars.

M12 globular in Ophiuchus. *(Bill Lockman)*

Oliver Barrett suggested we image M22. As it turned out, the conditions were quite favorable for doing so. M22 is perhaps the brightest globular in the northern night sky at apparent magnitude 5.1. The properties of M22 are shown in the table for comparison with those of M12. One of the acquired images of this beautiful globular cluster is shown next.

M22 globular in Sagittarius. *(Bill Lockman)*

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July 3 Star Party Highlights at Crestview Park (cont'd)

Before the clouds moved in around midnight, I managed to capture about a 25-minute exposure of M20, the Trifid Nebula in Sagittarius. This nebula is unique in that it is composed of an H-alpha emission nebula (red), a dark nebula appearing to divide the red portion of the nebula into three zones, and a blue reflection nebula coming from the light of the embedded blue stars.

M20 (Trifid nebula) in Sagittarius. *(Bill Lockman)*

Karen Boyer, a former and recently re-elected SMCAS treasurer remarked, "That evening it was like dueling banjos except it was dueling eVscopes. Things got better and better as the darkness overcame light."

A first-time Crestview Star Party attendee, David Messerschmitt, a Roger Strauch Professor Emeritus of Electrical Engineering and Computer Sciences at the University of California, Berkeley, noted: "I enjoyed connecting with some members of the SMCAS. I also appreciated my first hands-on experience with the new Unistellar telescope technology."

Kevin Simpson's 10-inch Dobsonian telescope. *(Kevin Simpson)*

By Ed Pieret's tally, there were at least three non-eVscope telescopes in use at the July 3 Star Party as well. Pictured above is one of them, Kevin Simpson's 10-inch Dobsonian made by Orion.

It was first light under the stars at the July 3 Star Party for my new APM 100 mm 90 degree apochromatic binocular telescope with matching 18mm 65 degree apparent field of view (AFOV) eyepieces. These eyepieces are mounted at 90 degrees to the refractors' optical axes, making it comfortable to view astronomical objects, especially those near the zenith.

The focal length of the binocular telescope is 550 mm (f5.5). Using the 18 mm eyepieces produces a magnification of 30x and a real field of view of 2 degrees.

The mount I used with the binocular telescope at the July 3 star party is the altazimuth computerized go-to and tracking TTS-160 Panther mount made by the Danish company Track the Stars and shown in a photo on the following page.

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July 3 Star Party Highlights at Crestview Park (cont'd)

This mount has a payload capacity of about 48 pounds, so it easily handles the 16.8-pound binocular telescope together with the small additional weight of eyepieces and accessories.

Bill Lockman's APM 100 mm 90 degree apochromatic binocular telescope on top of an altazimuth TTS-160 Panther mount. *(Bill Lockman)*

The Panther's counterweight system straddles the mount head and the counterweights can be adjusted to balance the binocular telescope independent of the altitude angle. Viewing through the eyepieces is comfortable except when the binocular telescope is nearly horizontal. In this case, a step stool may be required to look through the eyepieces. For long exposure astrophotography, a de-rotator is available to counteract the field rotation present when tracking with an altazimuth mount.

This binocular telescope excels at viewing wide angle celestial fields. Despite its modest magnification, I was able to discern the M12 and M22 globular clusters through the binocular telescope as "faint fuzzies". This device should excel at observing the moon and planets, as well as large, bright nebulae such as the Orion, Eagle, Butterfly and Veil nebulae, bright planetary nebulae such as the Ring Nebula (M57), open clusters such as the Pleiades, Perseus Double Cluster and the Wild Duck Cluster (M11). In this sense, the uses of the binocular telescope listed above are complementary to those of the eVscope, which is optimized for viewing small deep-sky objects such as globular clusters and remote galaxies.

The binocular telescope can also be used with a manual mount instead of a computerized one. The manual mount I chose consists of a carbon-fiber tripod which has a 44-pound load capacity, and an Orion "U-mount" (i.e., fork mount) head. The telescope and mount are shown in the following photo.

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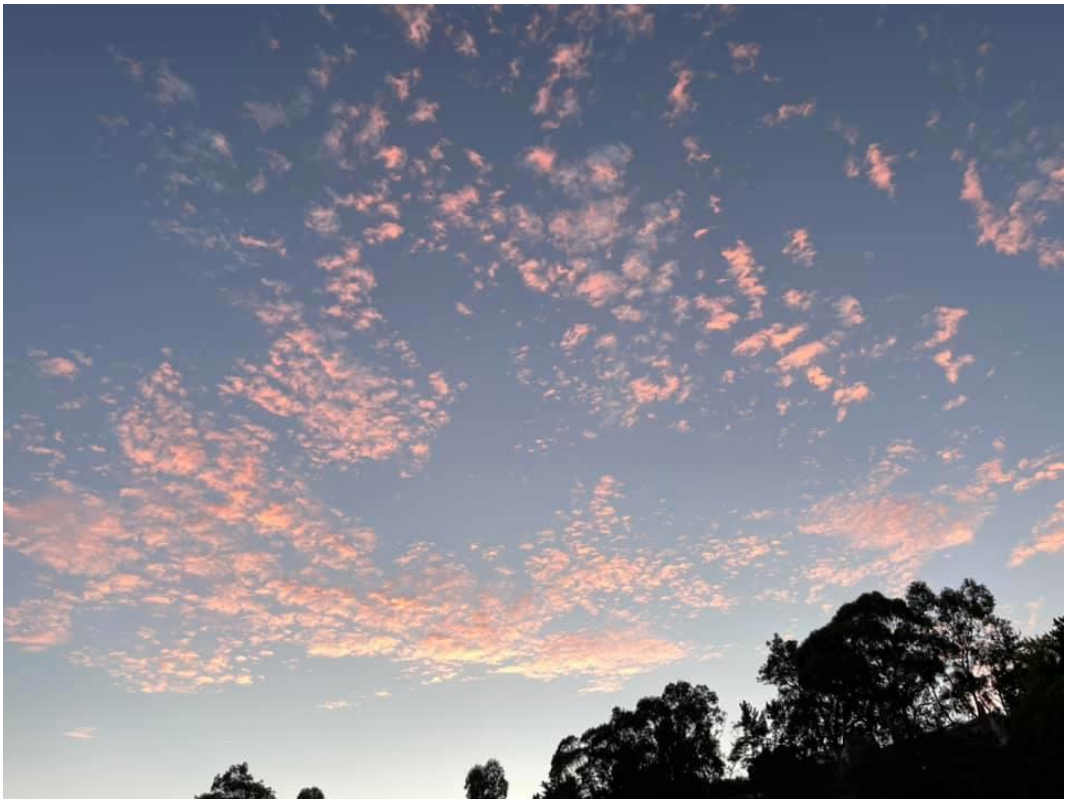
July 3 Star Party Highlights at Crestview Park (cont'd)

This grab-N-go manual mount and telescope can be quickly set up, is very stable and portable, and with the fork-mount, the telescope never tips over, nor collides with the tripod even when pointed directly upward. The manual mount is great for learning the lost art of star-hopping, especially when utilizing matching eyepieces each with a 3 degree or greater field of view. I also brought the binocular telescope and manual mount to the July 10 Star Party for attendees to try out. See page 18 for more details about that Star Party. ◆

Bill Lockman's APM Binocular telescope mounted on a Manfrotto carbon-fiber tripod with an Orion "U-mount" head. The legs can be extended to raise the telescope to about 5.5 feet. The weight of the tripod and head is about 17 pounds. *(Bill Lockman)*



Popcorn sky at July 3 Star Party. *(Kevin Simpson)*

Frank's Astrophotography Series: Equipment – Part 1

By Frank Seminaro

Last month I introduced my Event Horizon column on astrophotography. This month's article is going to cover my equipment – Part 1. Many of the items discussed can be used across many different imaging platforms. Hopefully, you find some inspiration to try this hobby.

Frank's astrophotography setup, showing, from bottom to top, the white AP1200 tripod and mount with counterweights attached, the large black C14 optical tube assembly with the black Hyperstar unit and red camera attached to its front, and top, the white guide scope and camera attached. *(Frank Seminaro)*

Since I now owned a Celestron C14 telescope and an Astro-Physics AP1200 mount, I needed to decide on what type of astrophotography I wanted to perform. Solar system objects require their own specialized equipment and process. Since we only can see planets at periodic intervals during the year, I chose to focus on non-planetary objects. These run the gamut of their own specialized requirements as some are very small (planetary nebula), very large (Andromeda Galaxy), very faint (Thor's Helmet nebula), or very bright (Orion nebula). The C14 has a very narrow field of view compared to other scopes given its very long focal length (3,910mm). On a good night in visual mode, you can pick apart the different sections on the Orion nebula in great detail, even seeing color. Given this fact, attaching a camera to the back of a C14 presented several challenges. The small field of view means there is a higher magnification of the object. Higher magnification is very sensitive to mount accuracy, wind, and something called flexure. Flexure is the micro movement (or lack of rigidity) of all the telescope/ mount/camera parts connected together. These issues are amplified by the C14's f11 focal ratio, otherwise known as the speed of the optics. It is calculated by dividing the focal length (light path) of the scope by the aperture (diameter). In the case of my C14, this would be 3,910mm/355.5mm = f11. The higher the focal ratio, the more magnified and dimmer the object. A focal ratio of f11

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Frank's Astrophotography Series (cont'd)

will require extreme mount accuracy, perfect seeing conditions and long camera exposure times. In my case, this would not work. I cannot see Polaris from my backyard, thus cannot accurately align my mount. I also am in a light polluted area that is not ideal for long exposures. This required a different solution. I decided to go with something called the Hyperstar manufactured by Starizona, located in Arizona. The Hyperstar is a multiple-lens corrector. It replaces the secondary mirror in the C14. It's unique since it sits in front of the C14. It's a bit nerve-racking to replace the mirror with the Hyperstar. Dropping either the secondary mirror or Hyperstar unit is an expensive proposition (i.e., disaster). Here is a picture of the secondary mirror removed from the C14 with the Hyperstar ready to install.

Frank's C14 telescope with its secondary mirror (front left) removed. When attached, the Hyperstar unit (front right) will change the focal ratio of the optical system from f11 to a much faster f2. *(Frank Seminaro)*

The Hyperstar reduces the C14 focal length to 710mm. So 710mm/355.5mm now gives the C14 an f2 focal ratio. What does this mean? First, you now have a much wider field of view. For you techies, it's now 3.45 degrees, about seven times that of the 0.5-degrees moon. By comparison, using a very low power eyepiece such as a Televue Panoptic 41 in the C14 gives a field of view of only 0.67 degrees. Second, and more importantly, the f2 focal ratio achieved with the Hyperstar dramatically reduces the required exposure time. A one-minute exposure using the Hyperstar at f2 is equal to 33.5 minutes at f11. The reduced exposure time allows more leeway for mount accuracy, seeing conditions, and light pollution. One of the keys to great finished astrophotos is the amount of data (exposure time) you collect. I usually take twenty consecutive 30-second exposures of the same object (10 minutes total) and then move to the next object. This equates to almost 6 hours of exposure at f11!

Just like the secondary that has been removed, the Hyperstar has adjustments for rotation and collimation of the image. Proper collimation ensures perfectly round stars across the entire field of view. I did not experience any significant issues to require tinkering with the collimation set to zero adjustment — yet. There is a filter drawer that allows you to experiment with various filters.

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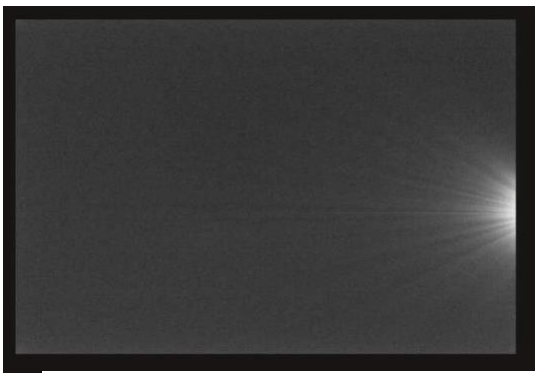
Frank's Astrophotography Series (cont'd)

Hyperstar unit. *(Frank Seminaro)*

Now that the Hyperstar is attached to the C14, the next piece of equipment is the very most important. The camera! As I mentioned in my first article, camera technology has changed dramatically in the past few years. Any of the digital camera choices (DSLR, CCD, and CMOS) would work with the Hyperstar and C14 combo. DSLR cameras are good but lack active cooling of the sensor and need to be modified to image nebulas emitting Hydrogen-alpha light. Active cooling on imaging sensors prevents the true enemy of astrophotography – background noise. CCD (Charged Coupled Device) and the newer kid on the block CMOS (Complementary Metal Oxide Semiconductor) cameras are almost identical except in price and how they work.

The simplest explanation is both cameras have sensors divided into pixels. Photons coming through your scope fall onto these pixels and are read by a register and converted into a signal. The CCD sensor has one large register for all its pixels and reads them one by one. The digital conversion happens outside the sensor where all the circuitry is located. This keeps any stray signal from interfering with the image (noise). The CMOS camera sensor is a bit different. Each pixel is its own individual unit hardwired to its own read-out register. Most all the circuitry is on the sensor. More importantly, each pixel is read individually and at the same time greatly increasing the speed of the camera. CMOS cameras are also less expensive to manufacture and have reached parity with the CCD sensor for astrophotography. The first generation of CMOS sensors suffered from something called 'amp glow'. CCD cameras also had this problem at a lesser factor. Since the CMOS sensors have all the circuitry on the chip, heat is generated and can show up in images as shown below. The latest generation CMOS cameras have all but eliminated amp glow. Below is an example of what amp glow looks like.



Amp glow. *(Frank Seminaro)*

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Frank's Astrophotography Series (cont'd)

Another feature of both CCD and CMOS cameras is the active cooling of the sensor to reduce noise. A sensor will have a thermoelectric cooler attached behind it to allow you to control the temperature of the sensor compared to the outside ambient temperature. All of this can be controlled via software.

The next big decision is color or monochrome camera. This is a 'religious' argument. Without going into much detail, I chose color. I have limited spare time and color cameras record the image, basically in color, earning the title of 'one-shot color camera'. This allows me to quickly take a photo and easily process the results into a final image. There is a downside. One-shot color cameras are not as sensitive as their monochrome cousin. Monochrome cameras require an entirely different approach to taking a picture. To create one image, you need to have the camera take four separate images in different light wavelengths. This is accomplished by inserting red, blue and green filters in front of the camera's sensor to record each of those colors separately, and by a "Luminance" filter to record the brightness detail over the visible part of the spectrum. This filter set is called "broadband" or true-color imaging as you are collecting the natural color of the object.

There is another set of filters that can be used. They are referred to as "narrow band" filters, which are manufactured to only pass light within a narrow bandwidth of certain spectral emission lines. Some common emission lines in the visible range coming from the de-excitation of ionized nebular gases are Hα (hydrogen hydrogen-alpha at 656 nm), OIII (doubly-ionized - oxygen at 496 and 501 nm) and SII (singly-ionized sulfur at 672 and 673 nm). When astrophotographers combine their narrowband monochrome images together to produce a "false-color" image, they often apply the following color association for each filter: SII – **red**, Hα – **green**, OIII – **blue,** known as the "Hubble Palette." This palette is famous for producing aesthetically beautiful images, and for bringing out detail that would otherwise be more difficult to discern in natural color broadband images.

So, now you have the added task of managing filters in the dark and three to four times the number of images you need to take compared to the one-shot color camera. You also have the added task of combining and balancing all these colors into the final image. The upside is monochrome images are much more detailed on dim objects. Some of the best images I have ever seen were taken by monochrome cameras. If you have the time and patience, monochrome may be for you.

I selected a one-shot color CMOS camera made by ZWO for a number of reasons. First, I needed to match the camera to the telescope setup I was using. Manufacturers make a wide array of cameras that have different size pixels, sensors, etc. There are multiple forums on Cloudy Nights that describe the selection process in a lot of detail. I 'cheated' and called Dean, the owner of Starizona, for a recommendation. He suggested the ZWO ASI533MC Pro. It is reasonably priced (if you don't tell your spouse),

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Frank's Astrophotography Series (cont'd)

has a 9-megapixel Sony IMX533 backlit sensor, has no amp glow, and a square sensor which is unique. The camera is cooled and has a thermal delta of up to -35 degrees C. It also has small pixels at 3.76 x 3.76 microns across the sensor's 1-inch size to bring in the detail. The camera has USB 3.0 ports for high-speed connectivity to your computer. To the right, is a picture of the camera and sensor. In the photo on the bottom, you may notice a connector to a small ring around the base of the camera. This is actually a heater band. In some conditions, the camera sensor cooling feature will fog up the glass covering the sensor. This heater prevents that from happening. Next month's article will be entitled – Wires, wires, everywhere.

I'll end this column with a picture taken while in Paso Robles this past June. ◆

ZWO ASI533MC Pro camera connector end (top) and square sensor (bottom). *(Frank Seminaro)*

The photo of M24 shows sharp, round stars throughout the entire field, indicating that the optical elements are well-collimated, and that tracking errors are minimized and proper focus is being maintained over the duration of the exposure. *(Frank Seminaro)*

July 10 Star Party Highlights at Crestview Park

By Bill Lockman

This was the second Star Party in the 2021 series of in-person Star parties at Crestview Park. "Last week (July 3) was a bit of a dry run and this week was a full court press," stated Kevin Simpson on Facebook. I noted that unlike last week, the Star Party was a shirt-sleeve affair and for the die-hards, the sky remained clear well past 1 am.

Kevin counted a total of 12 scopes in action, four of which were eVscopes, and his own was a 10-inch Dobsonian telescope shown in the July 3 Star Party article on page 10.

Kevin's friend and mentor Chanan Greenberg utilized his own 12-inch Dobsonian telescope, shown below:

Chanan Greenberg's 12-inch Dobsonian telescope. *(Kevin Simpson)*

"Chanan has been something of a mentor in astronomy for me and guided me in the purchase of my scope. Chanan and I worked closely together in the leadership at Model N for 15 years. It was great to see him in-person!" said Kevin Simpson.

"He also shared some finer points and checked my collimation and alignment techniques, which was helpful since I've basically been doing it with no other astronomer looking over my shoulder since I got my scope in the depths of the pandemic. Thanks, Chanan!

"We had at least two dozen folks come by from the area to peek through our scopes and it was nice to meet other members of the society." Kevin continued, "Besides the usual nebulae, star clusters, galaxies, planets, and a supernova — we were treated tonight to several very bright satellite passes — two super bright and at least half a dozen lesser episodes and the brightest meteor that I have seen in years. Looking forward to the next event.

"OH! (I) Almost forgot, my glowing step stool got heavy use by the kids and the glowing tape worked like a charm!"

Frank S. (left) with his C14 telescope modified to image at f2. Examining the setup is Chanan G. (right). *(Kevin Simpson)*

(continued on page 19)

July 10 Star Party Highlights at Crestview Park (cont'd)

Then there was our former president Frank Seminaro, with his "monster" Celestron C14 Schmidt-Cassegrain telescope shown on the previous page and described in a separate article beginning on page 13. Frank replaced the secondary mirror with a Hyperstar attachment, allowing him to image at a much faster focal ratio of f2 instead of f11. He also made use of an on-board computer which had software capable of enhancing images in real time using live stacking, much like the eVscopes running in enhanced vision mode.

Below is an image of M51, the Whirlpool Galaxy, that Frank took in live stacking mode.

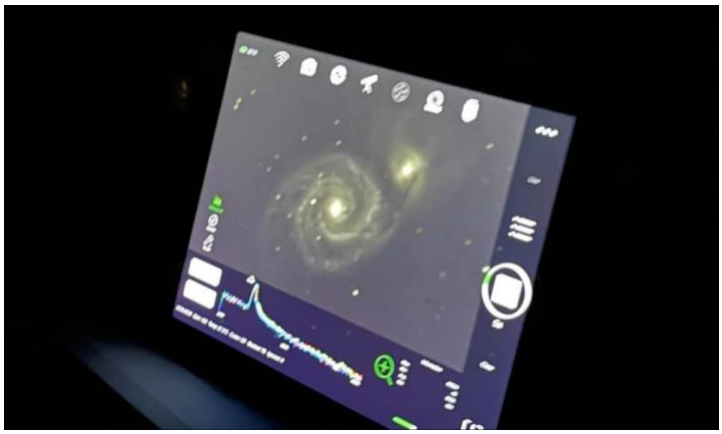


Image of M51 acquired in live stacking mode by Frank's C14 telescope operating with the Hyperstar unit attached. *(Kevin Simpson)*

The level of detail is very impressive.

The eVscope was described in the July 3 Star Party writeup on page 8. It is optimized for viewing small, dim deep-sky objects and works well even in an urban environment.

Four of us, Michael Cooke, Ed Pieret, Ken Lum and myself operated our eVscopes for public outreach. Michael, Ed and Ken spent much of the evening observing supernovae and galaxies.

Michael reported: "This July, there are four supernovae currently visible in our night sky: three type-1a supernovae and one type-II supernova. A type-1a supernova occurs in binary systems in which one of the stars is a white dwarf. The white dwarf's gravity steals material away from a nearby stellar companion. When the white dwarf reaches an estimated 1.4 times the current mass of the Sun, it undergoes a runaway nuclear reaction, releasing enough energy to cause a supernova explosion.[1]

"The first supernova I was able to find was Type-1a Supernova 2021pfs in Galaxy NGC 5427," said Michael. For details, see page 8.

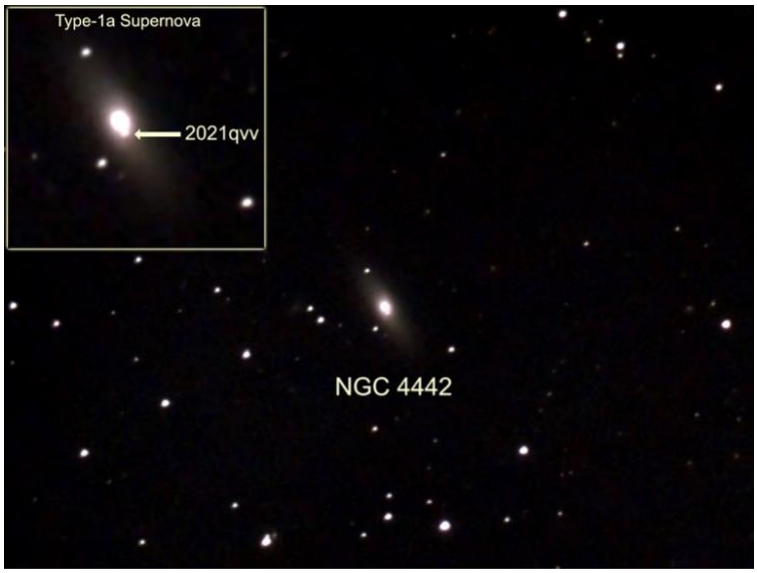
"The next supernova I observed was Type-1a Supernova 2021qvv at magnitude 13.3 in Galaxy NGC 4442. NGC 4442 is a lenticular galaxy in the Virgo constellation and is about 24 million light years away.

Footnote:

[1] Note from Wikipedia: "Because of the fixed critical mass at which it will explode, a type-1a supernova produces a fairly consistent peak luminosity in its observed light curve. This consistent peak luminosity allows these explosions to be used as standard candles to measure the distance to their host galaxies. The visual magnitude of a type-1a supernova, as observed from Earth, indicates its distance from Earth."

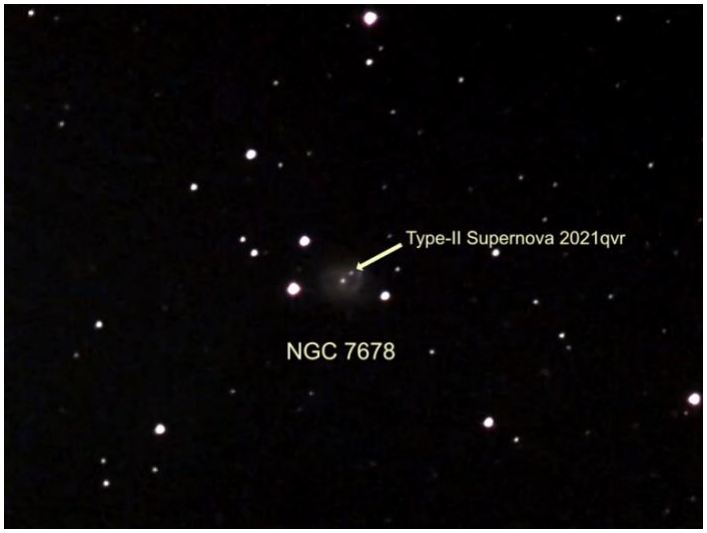
(continued on page 20)

July 10 Star Party Highlights at Crestview Park (cont'd)

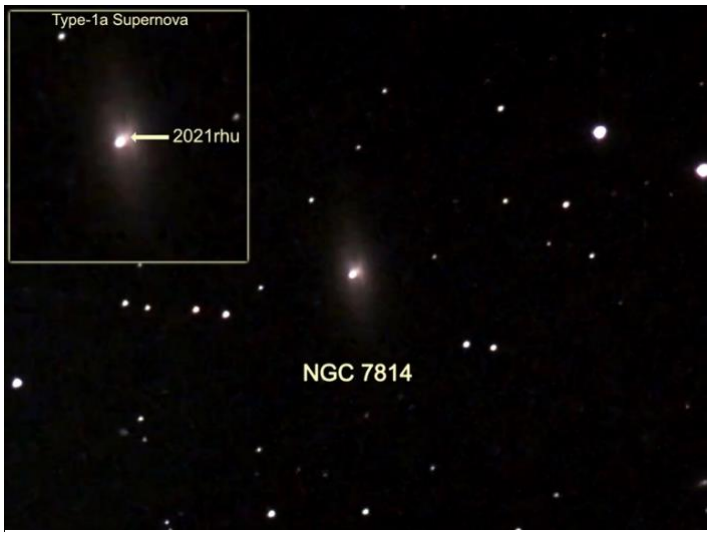


Type-1a Supernova 2021qvv near the core of Galaxy NGC 4442 (magnified view in inset). *(Michael Cooke)*

Supernova 2021qvv was discovered on 2021/06/23 by the Asteroid Terrestrial-impact Last Alert System (ATLAS). That supernova is very close to the galactic core of NGC 4442," said Michael.



Type-II Supernova 2021qvr in Galaxy NGC 7678 (ARP 28). *(Michael Cooke)*



Type-1a Supernova 2021rhu in Galaxy NGC 7814 (magnified view in inset). *(Michael Cooke)*

"The next supernova I observed was Type-II Supernova 2021qvr. A type-II supernova results from the rapid core collapse and subsequent violent explosion of a massive star. Supernova 2021qvr was discovered by ATLAS on 2021/06/22. Type-II Supernova 2021qvr is currently at magnitude 15.0 in Galaxy NGC 7678. Also known as Arp 28, this galaxy is a face-on spiral in Pegasus about 184 million light years away.

"Last, but not least, I located Type-1a Supernova 2021rhu at magnitude 14.5 in Galaxy NGC 7814. This galaxy, sometimes referred to as 'the little sombrero,' is a spiral galaxy 40 million light-years away in the constellation Pegasus. 2021rhu was discovered on 2021/07/01 by Zwicky Transient Facility. Like Supernova 2021qvv, 2021rhu is also near the galactic core.

"It was a lot of fun hunting down the latest supernovae. I used the site, Latest Supernova, to learn about the latest supernova discoveries," Michael concluded.

(continued on page 21)

July 10 Star Party Highlights at Crestview Park (cont'd)

Instead of observing supernovae, I decided to image a subset of Messier objects from an observing list I had compiled, based on an article in the August issue of Astronomy Magazine entitled "See Summer's Best Messier Objects," by Michael E. Bakich.

I had already imaged the first six objects on this list at our last two Star parties. So, I began with the remaining items on the list: M6, the Butterfly Cluster; M7 (NGC 6475), Ptolemy Cluster; M23 (NGC 6494), an open cluster in Sagittarius and four other objects described below.

The first of these is M8, the Lagoon Nebula. Located in constellation Sagittarius, it is just one of only two star-forming regions visible to the naked eye from mid-northern latitudes (the other is M42 in Orion).

Kevin's photograph of my iPad's image of M8 is shown below. The star-forming region is clearly visible in the center of the photograph.

M8, the Lagoon Nebula. *(Kevin Simpson)*

M16, the Eagle Nebula. The Pillars of Creation are just below center. *(Bill Lockman)*

The second object is M16 which appears in the constellation Serpens Cauda. Also called the Eagle Nebula, it lies some 7,000 light years away in the Carina-Sagittarius spiral arm of our galaxy. Near the center of M16 is a series of gas clouds known as "the Pillars of Creation", active star-forming regions famously imaged by the Hubble Space Telescope. In my eVscope's image of M16 shown below, the Pillars of Creation are the "elephant trunk" structures located beneath the star cluster. I slightly enhanced the red hues in the photo below to improve the visibility of the gas clouds emitting red hydrogen alpha (Hα) photons.

The third object, M17, or "Omega Nebula" in Sagittarius, is one of the brightest diffuse nebulae in the sky. The overall color of the Omega Nebula is reddish, due to light emitted from the hot hydrogen gas excited by the stars that have just formed within it.

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July 10 Star Party Highlights at Crestview Park (cont'd)

M17, the Omega Nebula. *(Bill Lockman)*

M11, the Wild Duck Cluster. (Bill Lockman)

However, the nebula's brightest region is actually white, apparently the result of light emission from the hottest gas, mixed with reflections of bright starlight from dust. I slightly enhanced the red hues in the photo below to improve the visibility of the gas clouds emitting red hydrogen alpha photons. The last object I imaged, M11, or "Wild Duck Cluster" in the Scutum constellation's star field, is one of the richest and most compact open clusters in the sky. It resembles the looser globular clusters, but is much younger, about 250 million years old and is shown in the color photo below.

Finally, Ron Cardinale and Oliver Barrett used my 100 mm binocular telescope on a manual mount as described in the July 3 Star Party report on page 12 to view some of the brighter deep-sky objects such as M13 and M8.

Summarizing my thoughts and feelings, this in-person Star Party was an incredibly enjoyable and informing community outreach event. Thanks to Ken Lum for organizing it. I'm looking forward to attending more of these events in the future.

Further information about upcoming SMCAS Crestview Park Star Parties can be found here. ◆

Searching for the Darkest Galaxies: Ultra-Faint Dwarfs as Dark Matter Laboratories

By Ken Lum

Figure 1 – The **Large and Small Magellanic Clouds** above the CTIO 4-meter **Victor M. Blanco** telescope. (CTIO, NSF)

Galaxies come in all kinds of shapes and sizes depending on the original local conditions of their formation. Due to their small size and faintness, dwarf galaxies' contribution to our understanding of how the Universe works has generally been underappreciated. As a result, Dr. Ethan Nadler of KIPAC and Stanford came this past April to show us what he has been doing to correct this oversight.

The Milky Way is a typical large spiral galaxy containing about 60 billion Suns worth of mass in stars. It is accompanied by a retinue of many smaller satellite dwarf galaxies the most prominent of which are the **large** and **small magellanic clouds** **(LMC** and **SMC**, respectively**).** LMC and SMC contain about three and one billion Suns worth of mass in stars. Figure 1 shows the SMC (upper left), the LMC (middle left) and the Milky Way (right) as seen in the sky above the **4-meter Victor M. Blanco Telescope** located at the **Cerro Tololo Inter-American Observatory** **(CTIO)** in Chile.

But with the advent of photo-imaging survey technology since the 20th century, many more even smaller and fainter such companions have been discovered. These are known as **ultra-faint dwarf galaxies**. The latest listing shows 59 companion dwarf galaxies within 1.4 million light years of the Milky Way.

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Searching for the Darkest Galaxies (cont'd)

Once these dwarf galaxies were examined in detail, it was found that they had much more mass-even compared to the Milky Way itself-than could be accounted for by the visible luminous mass. This observation meant that dwarf galaxies tended to be really dominated by large amounts of unseen or dark matter. This distinguishes them from other conglomerations of stars of similar size such as globular star clusters which have been found to have much less dark matter compared to their luminous matter. In this talk, Dr. Nadler discussed how he has used dwarf galaxy surveys to constrain the postulated physical characteristics of dark matter turning them into dark matter laboratories.

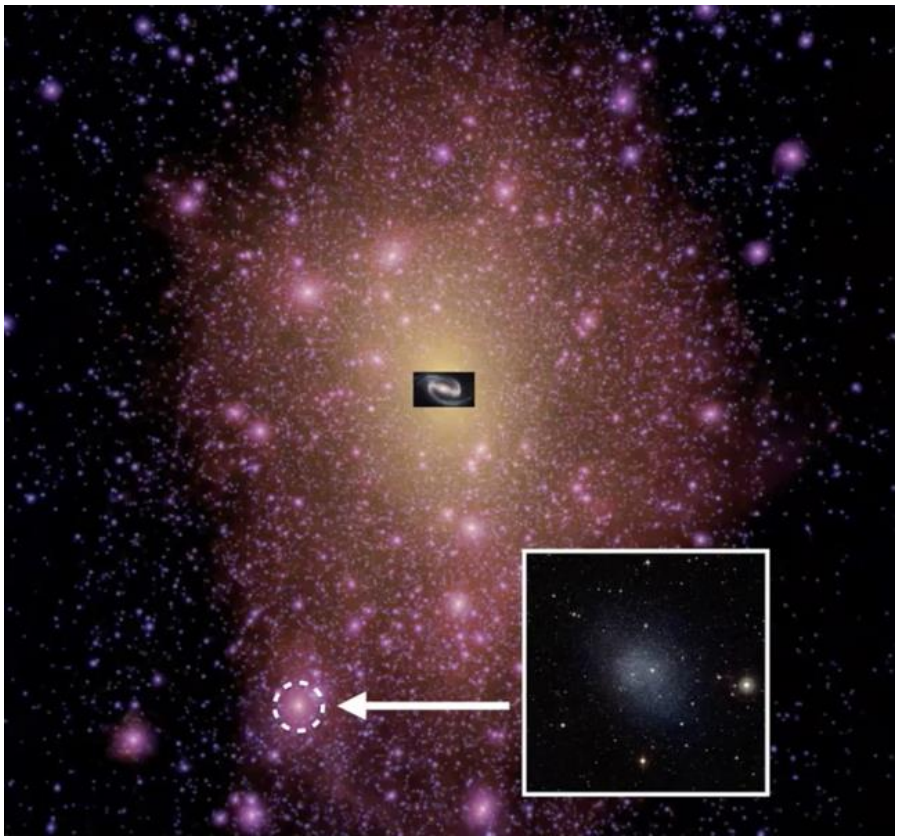

Figure 2 – Postulated dark matter halo surrounding the Milky Way galaxy (center) surrounded in turn by dark matter subhalos where dwarf galaxies have formed. *(Dr. E. Nadler)*

In his search for dwarf galaxies, Dr. Nadler participated in a project known as the **dark energy survey** which used a 520-megapixel digital camera with a 2.2-degree field of view attached to the **4-meter Victor M. Blanco telescope at CTIO**. The survey covered some 5,000 square degrees of the southern sky between 2012-18 down to 24th magnitude discovering more than 20 new dwarf galaxies. They were found to be of great diversity ranging from large objects such as the LMC which is still forming stars to small ultra-faint ones which have ceased star formation and only contain a few hundred stars.

At the present time, the nature of dark matter is unknown. While searches are underway to identify what dark matter is made of, it remains one of the deepest mysteries of modern physics. So far, it can only be detected via its gravitational influence on objects of ordinary visible matter. It is also very abundant perhaps making up around 85% of the mass content of the Universe. Currently, it is tentatively assumed that dark matter is made up of some kind of unknown and mostly undetectable subatomic particle or particles.

Computer simulations of the early Universe suggest that galaxies form within large clumps of dark matter that form halos where ordinary matter accumulates.

(continued on page 25)

Searching for the Darkest Galaxies (cont'd)

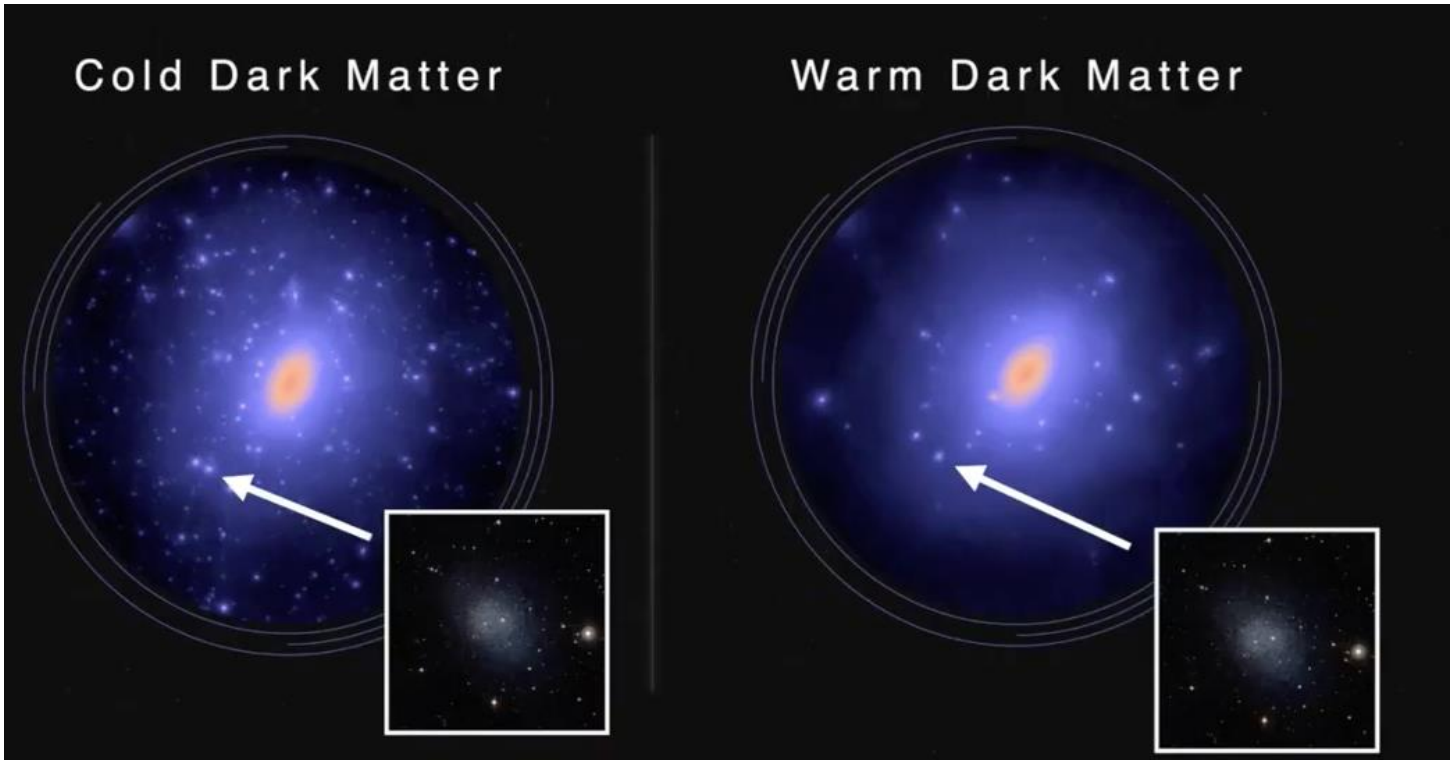

Figure 3 – More numerous dwarf galaxies form under the **cold dark matter** (left) hypothesis than under the **warm dark matter** hypothesis (right). Dwarf galaxies form within the small subhalos surrounding the large dark matter halo. *(Dr. E. Nadler)*

Smaller clumps called "subhalos" are where satellite dwarf galaxies form that eventually fall into orbit around larger host galaxies. (Figure 2) Without these dark matter halos and subhalos, galaxies cannot form.

Exploring these simulations further show that the number and distribution of dwarf galaxies can tell us a great deal about the characteristics of dark matter. Should the dark matter particles move at slow velocities as in what is called the **"cold dark matter"** model, we could expect galaxies to form that are surrounded by many subhalos that form many dwarf galaxies which is what we actually observe in the real Universe.

If dark matter particles move faster as in what is known as the **"warm dark matter"** model, we should expect fewer dwarf galaxies as the dark matter particles move too energetically to form enough subhalos to form as many dwarf galaxies. So fewer dwarf galaxies would be expected in this model. Given this, the actual number and distribution of dwarf galaxies that we observe suggests that the cold dark matter model of dark matter is more consistent with what we observe. (Figure 3)

Another characteristic of dark matter which we can surmise is that dark matter particles cannot interact with each other too much. If they do, then dark matter particles would bounce off each other too frequently to form

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Searching for the Darkest Galaxies (cont'd)

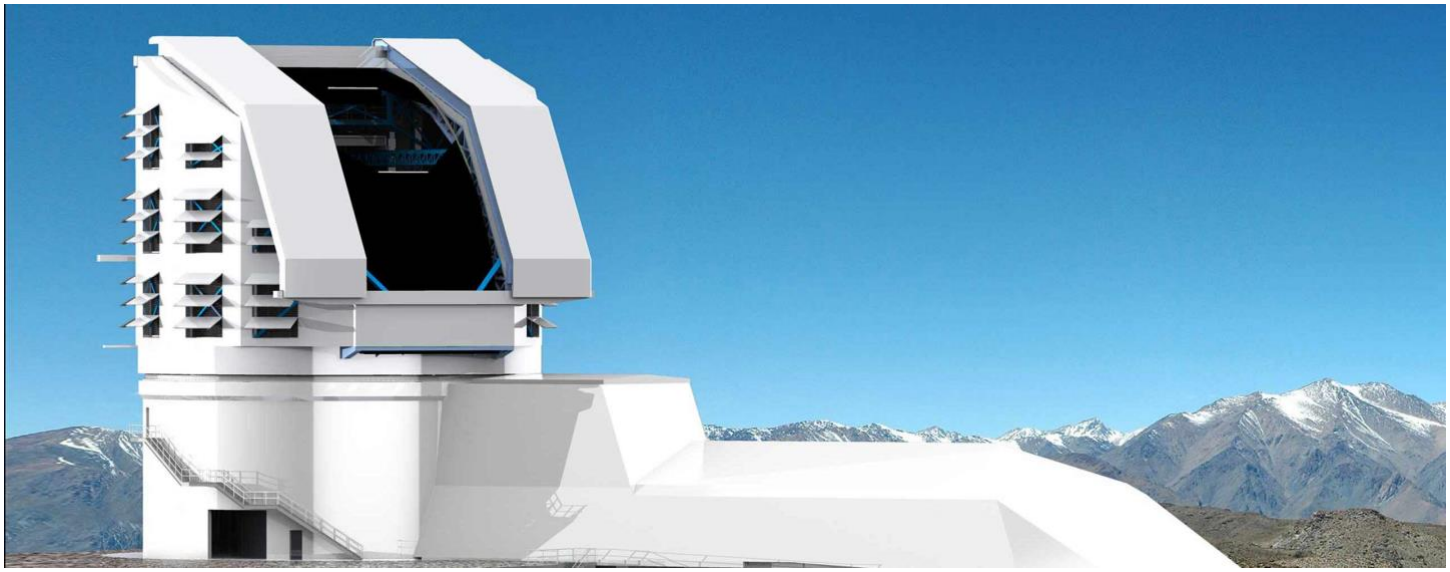

Figure 4 – The **Vera C. Rubin Telescope** in Chile. *(AURA/NSF)*

very many subhalos, and we would again see fewer dwarf galaxies. But observations of the frequency of dwarf galaxies are more consistent with a model of weak interaction between dark matter particles where subhalos are easier to form thus giving a higher number of dwarf galaxies which is what we observe.

Dark matter particles also cannot interact too much with ordinary matter particles other than through gravity as this would also reduce the number of dwarf galaxies below the number that we observe. So only weak interaction between dark matter and ordinary particles would give us the number of dwarf galaxies that we see.

Finally, dark matter particles cannot be too light in mass as this would inhibit the formation of subhalos leading to the formation of fewer dwarf galaxies. Such postulated light mass dark matter particles have come to be called **fuzzy dark matter** particles. So dark matter particles must have substantial mass, perhaps on the scale of protons rather than be something as light as neutrinos.

The next step in dwarf galaxy research is going to be to improve the sensitivity of the surveys to detect ever fainter dwarf galaxies. It is expected that this will be accomplished with the start of observations with the wide-field **Vera C. Rubin Observatory** formerly known as the **Large Synoptic Survey Telescope**, again in Chile. (Figure 4) This is expected to begin in earnest over the next few years. Knowing more precisely how many dwarf galaxies are out there will further help to constrain the postulated characteristics of dark matter.

For those interested in watching a video replay of this illuminating lecture, it can be found by clicking here. ◆

Perseid Meteor Shower

By Michelle Morales Torres

The biggest meteor shower of the summer, Perseid meteor shower, started July 17 and goes until August 24 but peaks between August 11 and 13. If you're able, those are the nights to make plans to go someplace dark since it's expected to produce a nominal rate of around 150 meteors per hour! In addition, the conditions for viewing will be ideal since there will be a new moon or in other words – no moon. Furthermore, the radiant point of the shower, Perseus constellation, is circumpolar, so meteors should be visible as soon as the sun sets. Perseus reaches its culmination at 7am so the other best time to look for meteors is right before dawn. Comet 109P/Swift-Tuttle is responsible for creating the Perseid shower.

Some fun facts about the meteor shower, according to Space.com, are:

⇒ It is the largest object known to make repeated passes near Earth. Its nucleus is about 16 miles across, roughly equal to the object that wiped out the dinosaurs.

⇒ Back in the early 1990s, astronomer Brian Marsden calculated that Swift-Tuttle and the Earth might experience a cosmic near miss (about a million miles) in 3044.

⇒ Perseid meteoroids (which is what they're called while in space) travel fast. They enter Earth's atmosphere (and are then called meteors) at roughly 133,200 mph. Most are the size of sand grains; a few are as big as peas or marbles. Almost none hit the ground, but if one does, it's called a meteorite.

⇒ When a Perseid particle enters the atmosphere, it compresses the air in front of it, which heats up. The meteor, in turn, can be heated to more than 3,000 degrees. The intense heat vaporizes most meteors, creating what we call shooting stars. Most become visible at around 60 miles above the Earth. Some large meteors splatter, causing a brighter flash called a fireball and sometimes an explosion that can often be heard from the ground.

⇒ Comet Swift-Tuttle was last seen in 1992, an unspectacular pass through the inner solar system that required binoculars to enjoy. Prior to that, it had last been seen in the year it was "discovered" by American astronomers Lewis Swift and Horace Tuttle, 1862, when Abraham Lincoln was president.

⇒ Swift-Tuttle's orbit has been traced back nearly 2,000 years and is now thought to be the same comet that was observed in 188 AD and possibly even as early as 69 BC.

⇒ Swift-Tuttle is due back in 2126 and astronomers think it might become a spectacular naked-eye comet like Hale-Bopp. If historical calculations are correct then the 2126 appearance will mark the comet's third millennium of human observation, assuming someone is in fact around to see it.◆

NASA Night Sky Notes
Corner the Great Square of Pegasus

By David Prosper

The Summer Triangle may be the most famous seasonal star pattern, but during early August evenings another geometrically-themed asterism rises: the Great Square of Pegasus. This asterism's name is a bit misleading: while three of its stars - Scheat, Markab, and Algenib - are indeed found in the constellation of the winged horse Pegasus, its fourth star, Alpheratz, is the brightest star in the constellation Andromeda!

August evenings are an excellent time to look for the Great Square, as it will be rising in the east after sunset. If not obvious at first, wait for this star pattern to rise a bit above the murky air, and remember that depending on your point of view, it may appear more like a diamond than a square. Look for it below the Summer Triangle, or to the southeast of nearby Cassiopeia at this time. As the Great Square rises in prominence during autumn evenings, it becomes a handy guidepost to finding more constellations, including some of the dimmer members of the Zodiac: Aries, Pisces, Aquarius, and Capricornus. Like the Summer Triangle, the Great Square of Pegasus is also huge, but Pegasus itself is even larger; out of the 88 constellations, Pegasus is 7th in size, and feels larger as the stars in its neighboring constellations are much dimmer.

There are many notable deep-sky objects found within the stars of Pegasus - ranging from easily spotted to expert level targets - making it a great constellation to revisit as your observing skills improve. Notable objects include the densely-packed stars of globular cluster M15, a great first target. The potential "Milky Way look-alike" galaxy NGC 7331 is a fun target for more advanced observers, and expert observers can hop nearby to try to tease out the much dimmer interacting galaxies of Stephan's Quintet. A fascinating (but extremely difficult to observe) object is a gravitationally-lensed quasar famously known as the Einstein Cross. Pegasus has quite a storied history in the field of exoplanet research: 51 Pegasi was the first Sun-like star discovered to be host to a planet outside our solar system, now officially named Dimidiam.

While observing Pegasus and its surroundings, keep your eyes relaxed and ready to catch some Perseids, too! August 2021 promises an excellent showing of this annual meteor shower. The crescent Moon sets early on the evening of the shower's peak on August 11-12, but you can spot stray Perseids most of the month. If you trace the path of these meteors, you'll find they originate from one point in Perseus - their radiant. Giant planets Jupiter and Saturn will be up all evening as well. Look south - they easily stand out as the brightest objects in the faint constellations Aquarius and Capricornus.

Pegasus truly holds some fantastic astronomical treasures! Continue your exploration of the stars of Pegasus and beyond with NASA at nasa.gov. ◆

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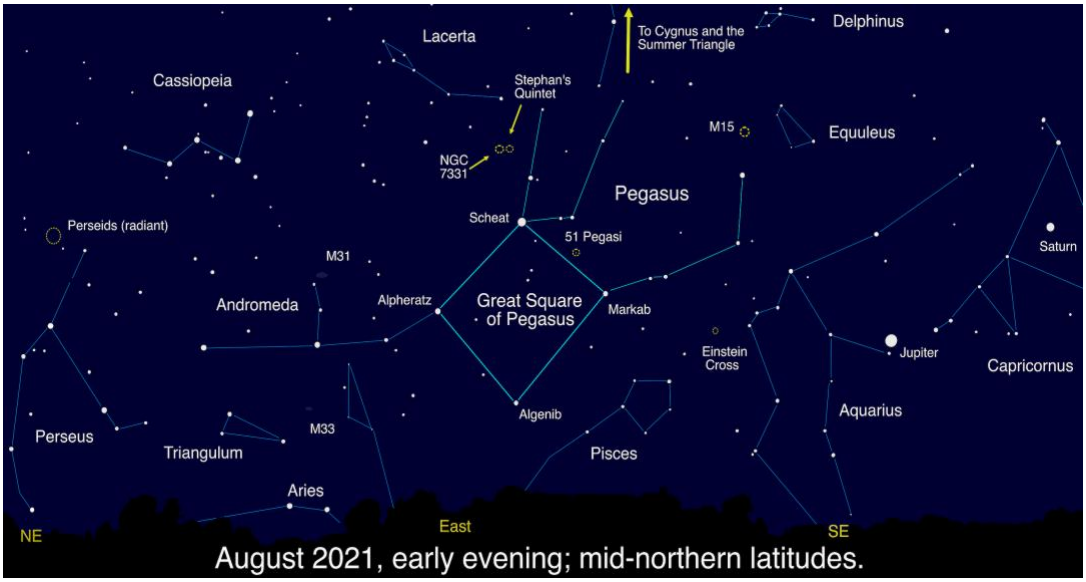
NASA Night Sky Notes
Corner the Great Square of Pegasus (cont'd)



While the stars of the Great Square of Pegasus are not as bright as those of the Summer Triangle, they still stand out compared to their neighbors, and make a great foundation for exploring this area of the night sky. Note that the brightness of the stars near the horizon is exaggerated in this picture.

Stephan's Quintet is one of the most famous deep-sky objects in Pegasus. First discovered in 1877, it contains the first galaxy group discovered (which includes 4 of the 5 galaxies making up the Quintet) – and has been studied extensively ever since. One day this group will merge into one supergalaxy! While famous, these galaxies are hard to spot in all but the largest backyard telescopes – but are a favorite target of astrophotographers. Take a virtual flyby of these galaxies with a tour created from Hubble data at: bit.ly/quintetflyby Credit: NASA, ESA, and G. Bacon, J. DePasquale, F. Summers, and Z. Levay (STScI)

Directions to SMCAS Public Star Parties (Weather Permitting)

From Hwy 101 or El Camino: take Brittan Avenue in San Carlos, west (toward the hills). Follow Brittan 2.3 miles (from El Camino) to Crestview Drive. Turn right on Crestview. In half-a-block, you will see a small, blue-posted sign with an arrow, indicating the entry road into Crestview Park. It lies between houses with addresses #998 and #1000 Crestview Drive.

From Highway 280: take Edgewood Road exit. Go east (toward the Bay) about 0.8 miles. Turn left at Crestview Drive. Go 0.5-mile uphill to where Crestview meets Brittan. Again, drive the half-block, to the small blue sign on the right, and the entry road on the left.

From Hastings and Club Drives: From Belmont, take Carlmont Drive to Hastings Drive. Follow Hastings about 1.5 miles, first uphill, then down, to San Carlos where it becomes Witheridge Road, then ends a block later at Club Drive. Turn right and climb Club Drive to Crestview Drive. Turn left and continue some 2 miles, first up, then down past Leslie Drive, to the small blue Crestview Park sign on the left. Turn right into the Crestview Park entry road.

Crestview Park - San Carlos

Come on out, and bring the kids, for a mind-blowing look at the Universe!

Bring your binoculars, telescopes, star guides, and lounge chairs for some informal star gazing at Crestview Park.

Dress warmly and wear a hat. Only visitors with telescopes should drive in. Others should park on the street and walk in or arrive before dark so that car headlights don't affect the observers' dark adaptation. Bring small flashlights only, covered with red cellophane or red balloon.

These measures avoid safety issues of maneuvering in the dark, as well as ruining the night vision of the viewers.

Please don't touch a telescope without permission. And parents, please don't let children run around in the dark.

Note: If bringing a telescope and arriving after dark, please enter the Park with your headlamps and white interior lights off. If you aren't bringing a telescope, whether before or after dark, please park along Crestview Drive, and walk in.

Crestview Park is residential, adjacent to homes and backyards. Before inviting potentially noisy groups, please call Ed Pieret at (650) 595-3691 for advice and advisories**. Call Ed also to check the weather and 'sky clock' and to see whether the Star Party is still scheduled.**

Crestview Star Party schedule is here:
http://www.smcasastro.com/crestview-park.html

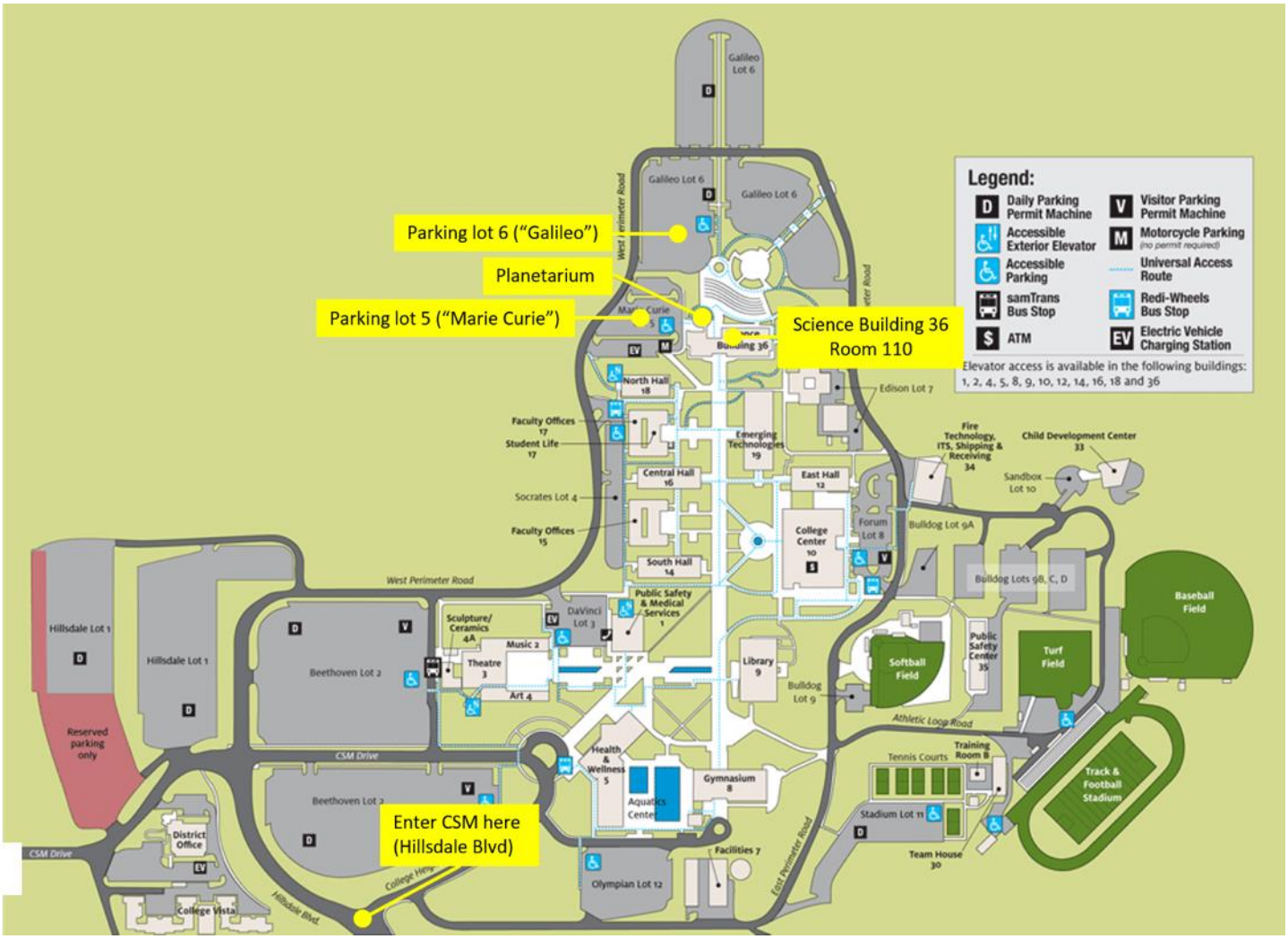
From San Carlos, take San Carlos Avenue to Club Drive, and climb to the 5-way intersection. Take the half-right to continue on Club Drive past Witheridge Road to Crestview Drive. Proceed as above to Crestview Park.

Directions to SMCAS Meetings at The College of San Mateo:

NOTE: CSM is closed due to the pandemic.

SMCAS events are online until further notice.

Directions to the CSM Planetarium for Meetings:
After exiting Hwy 92 at Hillsdale Blvd, climb the hill towards CSM, passing two traffic lights to the stop sign at the top of Hillsdale Blvd. Continue straight onto West Perimeter Road and follow it until you reach Lot 5, "Marie Curie", or Lot 6, "Galileo." Science (ISC) Bldg. (36) and the Planetarium lie straight ahead. Enter Bldg. 36 either through the door facing the lot or walk around the dome to the courtyard entrance. We meet in ISC room 110 for pizza and soft drinks one hour prior to the talk in the Planetarium (Pictured below.)



San Mateo County Astronomical Society
Membership Application

SMCAS@live.com; P.O. Box 974, Station A, San Mateo CA 94403; (650) 678-2762

rev 02272020

Become an SMCAS Member Today! Here's what you get:

- **Members Community**

Friendly advice and guidance from experienced recreational astronomers; access to SMCAS group emails, which provide general orientation information, announcements of astronomy events, file access and exchange.

- **SMCAS Events**

General meetings are held the first Friday of most months, at 7pm in the Integrated Science Center (ISC) Room and Planetarium in the Science Center (Bldg. 36) at the College of San Mateo (CSM), 1700 W. Hillsdale Blvd., San Mateo. Meetings include lectures and presentations on space science, an activity session, and refreshments (usually pizza).

We also offer stargazing two Saturdays a month, weather permitting. Visitors and those without telescopes are welcome; members are glad to share! SMCAS also has sponsored dark-sky campouts at Fremont Peak State Park, field trips to SLAC, KIPAC and Lick Observatory, plus **member-only events, including Star-B-Ques and quarterly potlucks.**

- **Subscriptions** (free with your membership)

The Event Horizon, SMCAS' newsletter, with SMCAS and member information, viewing tips and articles.

The Reflector, published quarterly by the Astronomical League, a national alliance of astronomy groups like SMCAS.

- **Significant Discounts on Equipment and Publications**

Discounts on purchases at Bay Area astronomical equipment retailer Orion Telescope Center, on sky calendars and ephemerides, and on such periodicals as *Sky & Telescope* and *Astronomy*.

- **Access to Loaner Equipment**

Use of SMCAS loaner telescopes and other astronomy equipment.

- **Sharing your Appreciation of Astronomy and Space Science with the General Public.**

Your SMCAS membership helps bring astronomy to interested lay people, especially students and children

Annual Dues: (SMCAS is a tax-exempt non-profit 501(c)(3). Dues may be tax deductible; consult your tax advisor):

$30 Regular Family Membership; $15 Student Membership

Every membership includes all members of your immediate family, (including your kids).

To join you can:

Send application (see reverse side), with payment, to: SMCAS, P.O. Box 974, Station A, San Mateo CA 94403.

- Bring the completed application and payment to a meeting or event and give it to any SMCAS officer.
- Go online at http://www.smcasastro.com, click on the Membership tab and pay via PayPal.

Membership Application on next page

San Mateo County Astronomical Society
Membership Application

SMCAS@live.com; P.O. Box 974, Station A, San Mateo CA 94403; (650) 678-2762

rev 02272020

Date: _____ Please check one: [ ] New Member or [ ] Renewal

[ ] $30 Regular Family Membership; [ ] $15 Student Membership

All members, please indicate areas of interest below. New members, please complete entire form. Renewing members, please provide your name and any information that has changed in the last year.

We will list your name, address, email address, and phone number(s) in our membership roster unless you have checked the box preceding that information. The membership roster is distributed to active members only.

Each member's name and mailing address must be provided to the Astronomical League (AL), SMCAS' umbrella organization. If you don't want AL to have your phone number and email address, indicate below.

[ ] Name(s) _____ [ ] Email Address _____

[ ] Address _____

[ ] City & Zip Code _____

[ ] Phone Number(s): _____ [ ] Do not provide my phone number(s) to the AL.

[ ] Don't provide my email address to the AL. (Checking this means you can ONLY get ***The Reflector*** by regular mail)

Please check one: send ***The Reflector*** [ ] by mail, or [ ] by email.

Areas of Interest:

SMCAS encourages member involvement. We invite you to provide additional information about your interests, skills, occupation and prior experience. Please identify SMCAS projects and functions that you might like to help facilitate.

_____

Please indicate which of the following activities might be of interest to you:

____ **Star Parties - Do you own a telescope you can bring: Yes ( ) No ( )**

____ **General Meetings - Finding (or being) a Speaker. Official greeter. Set up or take down ISC or refreshments.**

____ **Family Science Day & Astronomy Festival (Usually at CSM the first Saturday in October).**

____ **Social Events - Equinoctial and Summer Solstice potlucks, Summer Star-B-Que, Holiday Potluck.**

____ **SMCAS Membership and Promotional Drives**

____ **Communications – 'Event Horizon' Newsletter, Website(s), Facebook page, group email, Publicity posting.**

____ **Educational Programs – School, museum and library star parties, Bay Area Astro teacher assistants.**

Other/Comments: _____