

The SAN MATEO COUNTY ASTRONOMICAL SOCIETY

July – September • 2022 Issue

788th General Meeting: Sept. 2

789th General Meeting: Oct. 7

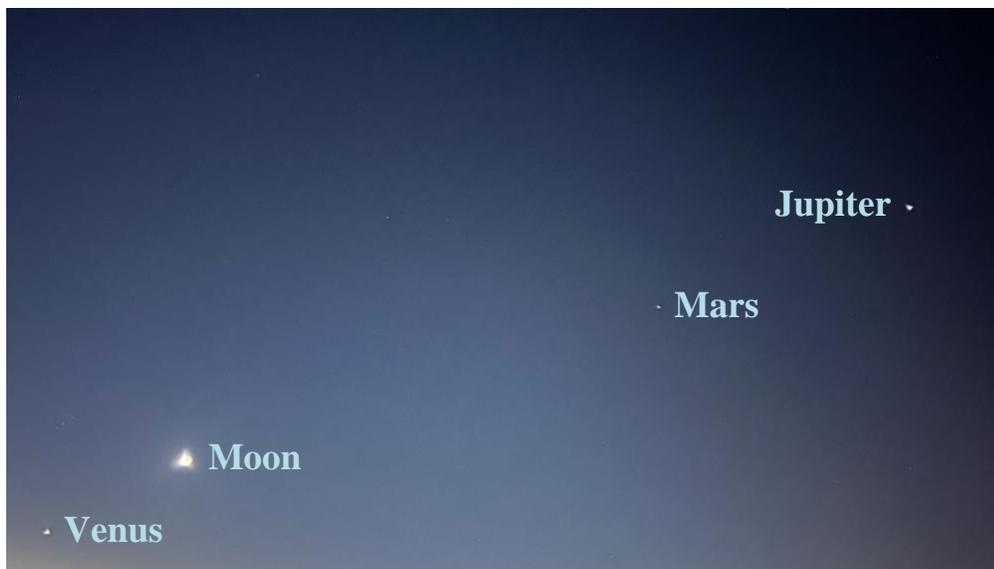
790th General Meeting: TBD



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, 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.



June's Planetary Parade with the Moon

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

Cover: Part of June’s planetary parade, June 25 at 4:27am from Vista Park, San Carlos. *Photo by Michelle Morales Torres.*

From the Prez

Hello All,

May 6 marked CSM's resumption of Professor Mohsen Janatpour's Art & Science lectures; his 31st since 1993. It doubled as a celebration of the 100th year since the founding of the College of San Mateo's original campus at Coyote Point. It was also the first event offering public access to the campus since the onset of COVID-19, at the beginning of March 2020.

As we traditionally have, our Society supported the event with telescopes. Unfortunately, the skies did not cooperate, as clouds blocked our efforts. But, we've been fortunate to enjoy generally better weather at our other outreach star party events.

We normally skip general meetings during the summer months of July and August. This year, we also had to cancel our June meeting, when our speaker had a conflict too late for us to find a new presenter. Our next scheduled general meeting program is planned for September 9. CSM is working to bring public events back to CSM starting fall semester. If that happens, we'll be able to bring our meetings back to the Integrated Science Center, and to the Planetarium. Otherwise, the meeting will likely be virtual over ZOOM.

We enjoyed, for many years, the membership and companionship of a consummate gentleman named Bob Black. As he aged, he moved from his house in San Carlos to an assisted-living community called the San Carlos Elms in downtown. Then, he was moved by his family to a location the San Carlos Elms would not disclose. But, Ken Lum recently heard from Richard Black, Bob's son. He told us that his father had passed away this past January in Chula Vista, California, at the age of 96.

Some of us knew Bob for many years and miss him deeply. He and I were photographed together during his final visit to an SMCAS

general meeting at CSM, on February 1, 2019. Richard Black has planned a Celebration of Bob's Life, and invited those of us who knew him, as well as those who knew of him, in Bay Area astronomy.

Richard has arranged the event for Sunday, July 17, from 11am to 3pm, at Kincaid's Restaurant in Burlingame. Those interested to attend can message Richard, to say how many are coming at s34q@yahoo.com or text him at (219) 865-0222. Richard has asked that those who attend bring any photos, mementos and 'tall stories' they can share with others at the event.

Also in May, our Board opened nominations for the upcoming election of directors and officers in the coming year. Because we can't hold in-person meetings, the Board did so via Zoom.

We've chosen to do two things differently this election cycle. First, on behalf of the Board, I've solicited volunteers and nominees over the May-June interval. Some were nominated by name. But, if you've kept up with our member newsgroup emails, you saw my messages inviting any SMCAS member to volunteer for a Board position.

Secondly, the leadership decided to accept onto the Board any Society member-in-good-standing who volunteered or accepted nomination, without the need for competitive election, even if it created a Board larger than that described in the By-Laws. We decided that Society progress and vitality made it more important to engage as many willing, capable members as possible, even if it meant bending the rules we'd followed for more than 60 years. To that end, we have brought back a former at-large director, as well as two members serving on the Board for the first time.

Our new Board was constituted and elected dur-

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From the Prez (cont'd)

ing our Zoom Board meeting of June 22. In addition, Michael and Lisa Cooke will share the position of President, Ed Pieret will continue as Vice President, Karen Boyer will continue as Treasurer, and Marion Weiler will continue as Secretary. The Officers and Board will be installed at our traditional Crestview Potluck Picnic StarBQue and Star Party. This year, that falls on Saturday, July 30. The potluck picnic starts at 6pm and the Installation follows at roughly 7pm. With sunset around 8:30, the scheduled Star Party can begin soon after 9pm.

I invite any among you to contact me, or another Board member, if you have any questions, or if we can assist you in any way. Thanks again for supporting the San Mateo County Astronomical

Society, and for helping our Club to enrich the outreach experience for the public. We wish you, your families and dear friends all health, happiness and success in the future. Take care all.

Mike Ryan, retiring
President SMCAS

(650) 678-2762

jmraastro@yahoo.com



Setting up for a Star Party



Ken Lum sets up for the April 23 Star Party.

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, July 2: Star Party – at sunset (8:35pm) – Crestview Park, 1000 Crestview Drive, San Carlos, CA 94070. See page 23 for directions and guidelines.

Sunday, July 17: A Celebration of Bob Black’s Life – July 17, 11am. See page 6 for more details.

Saturday, July 23: Star Party – at sunset (8:26pm) – Crestview Park

Saturday, July 30: Star Party – at sunset (8:19pm) – Crestview Park

Saturday, August 20: Star Party – at sunset (7:56pm) – Crestview Park

Saturday, August 27: Star Party – at sunset (7:45pm) – Crestview Park

Saturday, September 19: Star Party – at sunset (7:15pm) – Crestview Park

Saturday, September 24: Star Party – at sunset (7:03pm) – Crestview Park

Friday, September 9: Presentation: Dr Fedja Kadribasic, Stanford post-doc researcher at Kavli Institute for Particle Astrophysics and Cosmology. It is an independent joint laboratory of Stanford University and the SLAC National Accelerator Laboratory. Check back for additional details.



A Celebration of Bob Black's Life – July 17, 11am

By Ken Lum



Yours truly (left) with Bob Black (right) atop Fremont Peak after a star party the previous night in 2014 and after I rode my bike to the top of the mountain.

Recently, I was informed that one of our long-time members, Bob Black, passed away on January 18. He was 95 years old. I had known Bob since the early 1990s when I got involved in amateur astronomy with both the Peninsula Astronomical Society at Foothill College and also the SMCAS. We spent a great deal of time together at many astronomical meetings and Star Parties at various local venues. He was also a vice-president for the Fremont Peak Observatory Association from the 1990's to the early 2000s. In his later years, Bob and I were part of a small group including Ed Ching, Bob Fies, and Bud Wittlin who went around attending many local science events and lectures covering many different astronomical and non-astronomical topics. It's a great perk of living in the Bay Area. We also often went out for dinner together and we sure had lots of fun sharing stories, telling jokes, and, above all, learning about the latest and greatest discoveries in science.

I have to confess I did not ask him too much about his earlier life but did learn that he had served in the US Navy in WW II and worked for Aerojet Rocketdyne where he worked with a nuclear reactor. He was already retired when I met him. I did have the pleasure of meeting his family at the Solar Eclipse of 2017 when we went to Yellowstone and Grand Teton National Parks in Wyoming to observe it.

As he advanced in age, he ended up selling his house and moving to the retirement home at the San Carlos Elms in downtown. Then, in 2020, he disappeared from the Elms, and I assumed his family took him down to where they live in Chula Vista near San Diego. Then, in April, his son, Richard, called me to say he had peacefully passed away in January. Richard Black said he was interested in coming up here with his family to have a memorial banquet in Bob's honor

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A Celebration of Bob Black's Life (cont'd)

at Kincaid's Restaurant, 60 Bay View Place, Burlingame. The date is set for Sunday, July 17 from 11am to 3pm. All are invited whether you knew Bob or not. Please send your interest in attending and how many intend to come with you to Richard Black at s34q@yahoo.com. You can also text him at (219) 865-0222. Richard invites all to bring photos and tall stories about Bob to the party. Some members of the Fremont Peak Observatory Association may also come by

so we can hear about Bob from their perspective as well.

Bob was a kind, generous, and very knowledgeable person who donated much of his expertise and time to educating our community about astronomy. We will greatly miss him. I would also like to dedicate the SMCAS Star-B-Que and Star Party scheduled for July 30 to the memory of Bob, the sweetest of people. ♦

Annual SMCAS Star-B-Que Saturday, July 30!

By Ken Lum

With the coming of summer, we will have another opportunity to enjoy the season with our annual Star-B-Que picnic and Star Party at Crestview Park in San Carlos! This year, we will hold our picnic on Saturday, July 30 at 6pm. As in recent years, due to fire risk, we will cook our hamburger, veggie burger patties, and sausages at Ken Lum's house near the park and bring everything up to distribute to participants at the park. The City of San Carlos has removed the grills that were once located at the park, so no cooking facilities are now available. But the picnic tables remain.

Crestview Park is located at 1000-A Crestview Drive in San Carlos within a quarter-block long driveway up in the San Carlos Hills just north of Brittan Ave. Directions to Crestview Park from various Bay Area locations can be found in the Event Horizon newsletter.

Everyone is encouraged to bring a favorite potluck dish to provide salads, desserts, and



Participants at a past Star-B-Que. *Photo by Ed Ching.*

side dishes. Soft drinks and juices are also requested. Alcoholic beverages are discouraged.

Following the Star-B-Que, we will all clean up and begin setting up telescopes and binoculars for the evening's scheduled star party. The moon will be a very thin waxing crescent so the sky should be pretty dark. Sunset is at 8:19 pm.

Please let Ken Lum know by email at lum40@comcast.net if you are coming and how many guests you intend to bring so he will know how much meat and buns to purchase. Looking forward to seeing everyone there! ♦

Introduction to Astrophotography: Post-processing

By Frank Seminaro

Welcome to Summer 2022! The recent weather has not been kind to astrophotography. Hopefully, visibility will improve this month as the 2022 Golden State Star Party (GSSP) takes place in Adin, California (June 29 through July 3). GSSP is the rare chance to take advantage of completely dark skies for imaging. The first time I looked through my Dobsonian telescope during the 2014 GSSP, I was able to clearly see the spiral structure of the Whirlpool Galaxy (M51). The Milky Way is so bright at this location, it is visible from horizon to horizon. I hope to return from the event with plenty of images for next quarter's edition of EH.

In this quarter's column, I am going to introduce astrophotography post-processing. At this point in your astrophotography journey, you have selected and purchased an imaging rig setup, learned how to use it, and finally took some pictures. You go to look at the image files and realize you can't even open them on your computer. You need specialized software. Welcome to imaging post-processing.

There are a number of post-processing software packages out there. Most run on a PC, a few on the Mac, and just a couple on both. Just make sure you have a computer and monitor worthy enough to run the software and visualize the images. I am going to discuss the most widely adopted post-processing software – PixInsight by Pleiades Astrophoto headquartered in Spain. You don't need to travel to Spain to acquire the software. Pleiades has an excellent website

(pixinsight.com) that manages all software downloads, updates, licensing, and payment. They even have online tutorials to help you through the learning process. Here's the difficult part. It costs \$230 (euros) That's \$247 USD. I have been asked, "Is it worth it?" I think it is. However, I have a love/hate relationship with PixInsight. I have used a few other software packages – Maxim DL, Nebulosity, Photoshop Astro Tools, etc. None of them even come close to the abilities of PixInsight and this is the hate part of my relationship with it. It is bloated with complexity. There are an overwhelming number of processing tools within PixInsight that have obscure names not even related to what they do. Examples include, ACDNR (removes green because all astro images seem to be green), Morphological Transformation (Huh?), and the Multiscale Linear Transformation (Not to be confused with the Multiscale Median Transformation or HDR Multiscale Transformation ... sarcasm). Additionally, each tool has a dizzying number of submenus with all kinds of settings to tweak each tools impact. It's total overkill for an amateur unless you are trying to win the Astronomy Picture of the Day contest (apod.nasa.gov).

However, even with the complexity, this is the software package to own. Just learning a few tools to get through a basic post-processing workflow yields amazing results.

Let's go back to your first imaging night because you need to capture a number of different imaging file types to prepare to take

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Introduction to Astrophotography: Post-processing (cont'd)



M13 taken at June 25's Star Party by Frank Seminaro.

on post-processing in PixInsight. On my Hyperstar rig, I usually select a target (e. g., M42 Orion Nebula) and take a 30-second exposure 20 times. The key here is to take multiple images of the same object. The more images you take, the more detail will be present for post-processing to bring out. This is accomplished later by combining all these images together. This is referred to as stacking your images. The 20 images of M42 are now referred to as "light frame exposures". In every imaging rig setup, there are unique aberrations in the imaging light path to the camera sensor. To remove these, you need to capture three other types of images. The data captured, will allow PixInsight to remove the aberrations from your final image. Here are the file types you need to capture:

Bias Frames – These take care of the readout noise of your camera sensor. This is the electronic noise the sensor produces when reading the value of each pixel. For this image, you need to only place the end cap on your scope so there is no light going to the camera sensor and set your image time to a

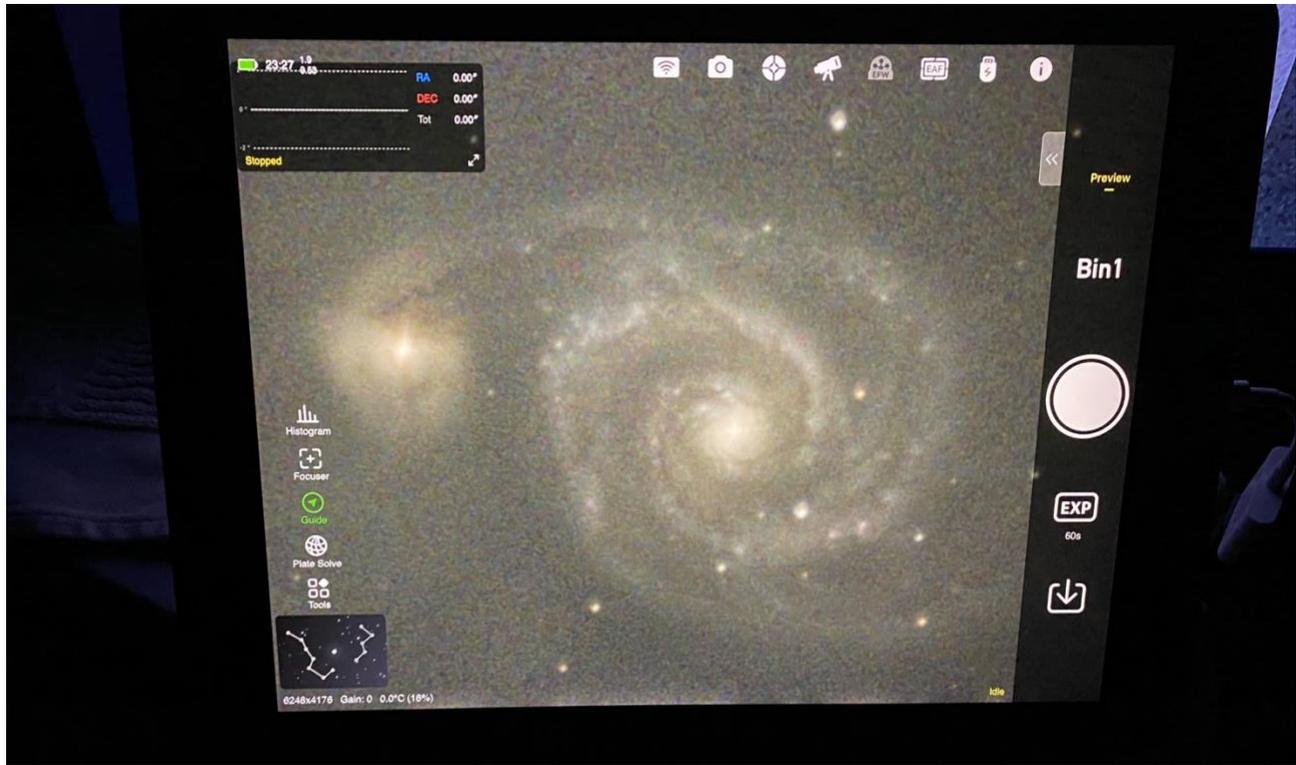
fraction of a second. I usually take 10 of these.

Dark Frames – These are used to record the electronic noise your camera produces during the capture of an image. The noise will depend on the length of the exposure and temperature of the sensor (thermal noise). It also captures any hot pixels (sensitivity too high) or cold pixels (dead pixels). It also captures the readout noise found in the Bias Frames. Dark Frames are captured in the same manner as Bias Frames, but with the same exposure time and gain and offset settings (or ISO settings for DSLR cameras) as your Light frames. In our M42 example, this would be 30 seconds. I usually take 10 dark frame exposures.

Flat Frames – These are the most difficult to take. They are used to cure issues in your rig's setup that can alter the uniformity in the brightness of your image. There is no fixed exposure length for flats. Instead, you use a histogram in your camera imaging software to tune to a prescribed brightness. This is achieved by changing the brightness of light entering your telescope (hence, the difficulty comment). Some astronomers use t-shirts over the end of their scope while it is pointed at a twilight sky before an imaging session. They layer on the t-shirts until their flat frame value is achieved. Unless you plan on bringing your laundry to Crestview, there are other ways. Some astronomers will forego the laundry method and simply take pictures of the twilight sky until mother nature gives the right brightness. Personally, I use a tracing light board. This is basically a

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Introduction to Astrophotography: Post-processing (cont'd)



Frank's system displaying M51 live at June 25's Star Party.
Photo by Frank Seminaro.

large flat and lightweight uniform brightness LED panel that has a brightness control. This allows you to take the pictures at any time during an imaging session. I adjust the panel brightness until I get the proper setting. The ZWO camera software I use will detect the value of pure white. The goal is to adjust the brightness and shutter speed until you reach half the value of pure white which is flat grey. Once the target is met, I will take ten flat frames.

You should now have 20 M42 Lights, 10 Bias, 10 Darks, and 10 Flats. The good news is the

Bias, Darks, and Flats can be used with other Light frames subjects. So, if you slew to a nearby galaxy and take new light frames, you can use the same bias, darks, and flats for post-processing. You do not need to re-take them.

By the time you complete taking all the above frames, everyone has left the Crestview Star Party. You are now alone at Crestview aside from the curious racoon or two. Time to pack up and head home to do battle with PixInsight post-processing. ♦

Planetary Alignment on June 25

By Michelle Morales Torres



Part of June's planetary alignment. From lower left to upper right are Venus, the moon, Mars and Jupiter. Mercury was below the horizon and Saturn wouldn't fit into the frame. *Photo by Michelle Morales Torres.*

I'm sure you heard about the historical planetary lineup that's been taking place, but it's only visible just before dawn. Some are even referring to it as a planet parade because you'll be able to see Mercury, Venus, Mars, Jupiter and Saturn, all with the naked eye! This is the order they should appear going from east to west. They actually go from east to south but it looks like east to west from the ground. Even Uranus and Neptune are out but a telescope is needed to see them. This is special and historical because this is the order of the solar system and the last time they were seen in this order was in 2004.

According to Almanac.com, the best days to see them were June 23 and June 24. I made it outside on June 24 but not until about 5:20am. By then it was already pretty bright.

Almanac.com calls it Civil Twilight. I'm not sure if it was too bright to see Mercury since I didn't have an obstructed view of the east. However, I was very impressed that I could see Venus, Mars, Jupiter and Saturn still. Saturn was farther out than I expected and tough to make out. With the help of a star app on my phone, I was able to locate it.

Then I decided it was time to look at everything through my telescope. The Society was kind enough to lend an Astroscan to me. It's a 4-inch reflector telescope. I'm still getting used to moving it the opposite way to line things up because of the mirror. The best part about setting up was all I had to do was step out on to my balcony to see everything,

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Planetary Alignment on June 25 (cont'd)

but Mercury. I was so excited. It was the first time observing planets through the Astroscan. I decided to start with Jupiter. It looked so big that I thought I could make out faint lines on the surface. I looked at it for what seemed quite a while. I think it was just because the daylight was growing stronger and stronger. Finally, I decided to move on to another planet but unbeknownst to me, I had bumped the finder and suddenly couldn't find anything in the sky. And that's how the morning ended. I think I could still see the Venus, the moon and Jupiter when I finally stepped back inside. I'm not sure what time it was. It was really bright but I don't recall the sun. I was determined to try again the next morning.

I decided I would go to Vista Park for that unobstructed eastern view. I wasn't able to make it there for the lunar eclipse but another member said he possibly would go. This time I arrived at the park at a little after 4pm. Again, along the ecliptic I could see Venus, the moon, Mars, Jupiter and Saturn. According to my app, Mercury was below the horizon. I was disappointed but was still happy to have more time to do more planet viewing through the telescope. I took photos not too long after we arrived and then I ran back to the car to get the telescope. I was concerned though because the previous morning ended with me not being able to find anything through the telescope and I was sure to have the same problem. Sure enough, I did. I stopped and looked at the telescope carefully and realized the aimer had pulled away from the telescope. Once I put it back in place, I was able to locate things again.

Again, I started with Jupiter since it's easier to find but it wasn't as clear as it was the morning before. It was just a bright ball of fire. I couldn't make out anything on the surface. Next, I went to Saturn especially since I didn't look at it the morning before. It looked elongated so you could tell there were rings around it but it wasn't like you could make out any individual rings.

It was around this time that the Society's out-going President, Mike Ryan and his wife, Lilly arrived. I shared the views of Saturn with them. Then I moved on to Mars and Venus, which all looked like big balls of fire. I expected Mars to look redder but Mike said it usually looks more orangish than red. My app continued to say that Mercury was below the horizon. My app also said that Neptune was near Jupiter so I went back to Jupiter and we could see a line of bright stars next to it through the telescope so I assumed one of them was Neptune.

Slowly the stars began to fade away as daylight grew stronger and stronger. I finished with looking at the sliver of the moon. As 6am rolled around, I could tell my husband, Brandon, was getting really sleepy so we packed up and left. He's doesn't usually attend the Star Parties but was thrilled to see the alignment, as was his friend.

Our friend, Eddie, really enjoyed talking with Mike. He had the same compliments that I often hear about speaking with members of the Society – "I was able to ask any question without feeling stupid!" ♦

Second Saturday in June Gamble Garden Success!

By Marion Weiler



A line starts to form for Mike Ryan for bringing a Celestron C90 Maksutov Catadioptric telescope on a camera tripod with a glass solar filter. *Photo by Lily Ryan.*

We had a successful summer solstice event at Gamble Garden on June 11. It started at 10am and went until noon. It started off slowly with the occasional visitor but then became very busy between 10:45am and 11:45am where it seemed like visitors were almost nonstop and a few lines began to form at the telescopes. We had a lot of fun explaining things to the inquisitive minds of both children and their parents. There were a few astronomy buffs among them. Fortunately, the event ended before the heat became too unbearable.

“June(’s) Second Saturday drew a great attendance, considering the heat, of 180 people. (Last year attendance for this event was over 200.) Gamble Garden loved partnering with SMCAS. The garden lends itself very well to exploring the sun, photosynthesis, and how leaves use the power of the sun – a perfect topic at the summer solstice. The participation by the Astronomical Society volunteers made this day very special. Please convey our sincere

gratitude,” Mary Powell, Gamble Garden solstice event committee chair, said in an email.

Special thanks to our SMCAS volunteers and the items they brought: Ed Pieret for bringing a banner, eclipse glasses to allow direct viewing of the sun safely, UV sensitive beads that show ways to be protected from the sun and a demonstration of sunspots, and some materials for “Our Magnetic Sun” activity set provided by the Night Sky Network. Ken Lum for assisting Ed with his displays and activity. Mike Ryan for bringing a Celestron C90 Maksutov Catadioptric telescope on a camera tripod with a glass solar filter and an album of photos taken at a total solar eclipse he attended in 1979. Lily Ryan who was the unofficial photographer and assisted Mike with his displays. Michelle Morales Torres brought an Astroscan and projected the sun onto some cardstock. In addition to me,

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Second Saturday in June Gamble Garden Success! (cont'd)



Marion Weiler, who brought a 25-power terrestrial spotting scope to allow telescope viewing of terrestrial objects such as distant street signs. It demonstrates the power of telescope magnification, and also shows how terrestrial telescopes invert the image so it is viewed right side up. Demonstrating the terrestrial telescope was the last part of the activity I ran called “How a Telescope Works.” ♦

Marion Weiler demonstrates a Show-N-Tell for the crowd of visitors. *Photo by Lily Ryan.*

May's Spring Equinox Dinner!



After unsuccessfully attempting to hold this event on March 19, the Society's Spring Equinox dinner was held on May 14, at our usual meeting place – the Fireside Room at the Crystal Springs United Methodist Church, San Mateo. Not as many members attended as they have in the past but a great time was still had by all that we're there.

Extraterrestrial Life and Where to Find It

By Ed Ching

Without a doubt one of the most compelling motivations for humans to explore space is to find extraterrestrial life. By that we mean life that has an independent origin outside of the Earth. (See Figure 1.) Answering the question, “Are We Alone?” remains a top priority for all astronomers and space scientists. The search to answer this question has even spawned its own discipline known as **astrobiology** despite the lack of any discovery of extraterrestrial life to date. To explain how scientists are going about this search, **Dr. Xinnan Du** of the **Kavli Institute of Particle Astrophysics at Stanford** came, in April, to give an explanation of their approach.



Figure 1 – Earth, the living planet, seen from space. (NASA)

To start with, Dr. Du asked some basic questions and how scientists have gone about answering them.

- 1. Where do we come from?** Answering this question requires study of the formation of the Universe, galaxies, stars, and the origin of life.
- 2. What are we?** This question requires a definition of life and intelligence.
- 3. Where are we going?** Answering this requires a study of the evolution of life, environment, and the Universe.

A. What is Life?

In order to search for extraterrestrial life, we must first list the properties of life as we find it here on Earth, so that we can search for entities with similar properties in extraterrestrial environments. Some of these properties include, a state of order, the ability to reproduce, growth and development, a requirement for energy, adaptability to the environment and through evolution.

1. The Chemistry of Life.

All life on Earth is chemically based on carbon and the many types and sizes of molecules this element can produce in combination with hydrogen, oxygen, and nitrogen, which are all very abundant in protoplanetary disks. This has resulted in what is the most highly varied suite of chemical reactions to be found associated with any element. Life requires this kind of chemical variety to exist and any search for extraterrestrial life is presumed to have markers of this chemical complexity. (See Figure 2 on page 17.)

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Extraterrestrial Life and Where to Find It (cont'd)

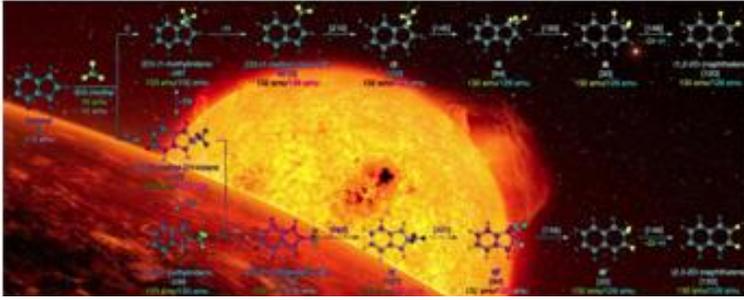


Figure 2 – Complex carbon molecules found near an exoplanet going around a red giant star. (*European Space Organization*)

Aside from this material basis, life also needs **energy** that comes from the **sun or other energy source (thermal or chemical)**, **chemicals** with energetic molecular bonds, and **internal energy** from accretion, material differentiation, and radioactive decay. There is also a need for a solvent, e.g., **liquid water**, kept at favorable temperatures which allow many kinds of molecules to assemble and

react with each other in ways not possible with other liquids. This has led NASA to “**Follow the Water**” in prioritizing the goals of its scientific exploration missions.

2. Other Characteristics.

Astrobiologists are searching for extraterrestrial life forms that are both of a basic nature and more complex forms which may also possess what we call “intelligence.”

B. What makes a planet habitable?

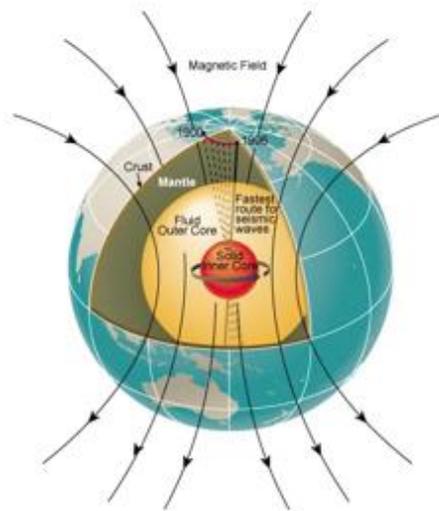


Figure 3 – Earth with its hot core, atmosphere, and magnetic field. (*Paul Richards, Lamont-Doherty Earth Observatory*)

1. **Stable internal heat source** – Earth is habitable because it is big enough to maintain an internal source of energy from radioactive elements in the core which drives plate tectonics and a carbon dioxide cycle that provides a homeostatic regulation of the climate. This keeps it constant enough to enable life to evolve and survive. A planet which is too small would cool too fast to allow enough time for life to develop. Perhaps this has happened to Mars.
2. **Atmosphere** – Another factor enabling habitability is the planetary atmosphere which arises from outgassing from the interior. Its presence enables water to remain liquid and not evaporate or escape into space.
3. **Magnetic Field** – This is induced by the rotation of the planet and core heat radiation driving the circulation of molten metal (mostly iron) in the mantle which serves as a dynamo inducing the magnetic field around the planet. The magnetic field then protects the planet from most of the destructive effects of radiation from the solar wind. (See Figure 3.)

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Extraterrestrial Life and Where to Find It (cont'd)

C. Potentially habitable places in the Solar System.



Figure 4 – Perseverance rover looking for signs of life on Mars. (NASA)



Figure 5 – Venus under total planetary cloud cover. (NASA)

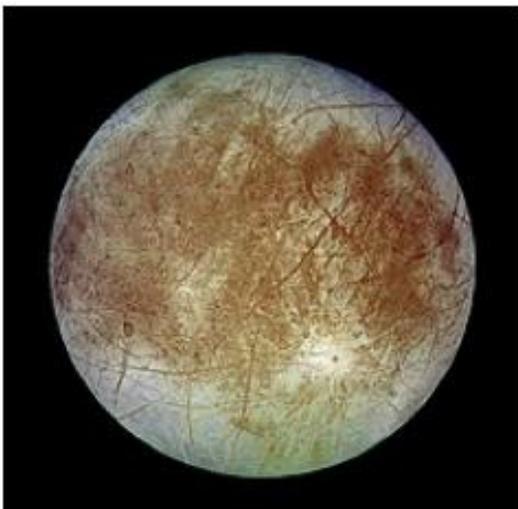


Figure 6 – Jupiter's moon, Europa, covered in water ice. (NASA)

1. Mars – This planet has very convincing evidence of having had a large amount of liquid water in the past with many geologic features similar to that found on Earth caused by liquid water. Mars also has been found to have small amounts of atmospheric methane which could have come from either biologic or non-biologic sources. This planet has received an extensive suite of exploratory space probes looking for evidence of life. Anticipated sample return missions will help better define whether Mars ever had any life forms. (See Figure 4.)

2. Venus – Venus has similar size and mass, but has an extremely hot, toxic atmosphere of carbon dioxide and sulfuric acid making it unlikely to harbor life. (See Figure 5.) The recent discovery of phosphine in the Venusian atmosphere raised some speculation about its production originating from some kind of unusual extremophiles, but this also is considered highly unlikely.

3. Europa – This moon of Jupiter has drawn the attention of astrobiologists because of the possibility of a subsurface ocean of liquid water that could harbour life. (See Figure 6.) NASA is considering an orbiter called the **Europa Clipper** to explore Europa tentatively scheduled for a 2024 launch. Also, the European Space Agency is proposing its own probe called **JUICE (JUperiter ICy moons Explorer)** to explore **Europa, Callisto, and Ganymede**.

(continued on page 18)

Extraterrestrial Life and Where to Find It (cont'd)

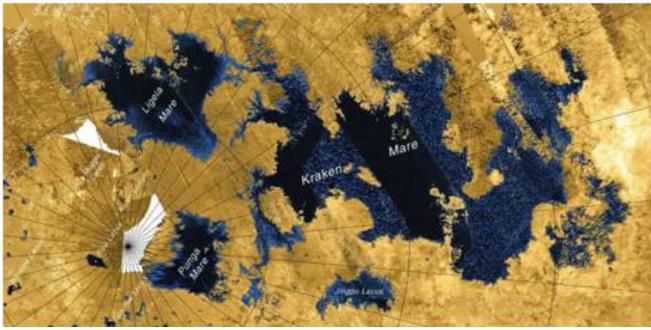


Figure 7 – The surface of Titan containing hydrocarbon lakes. (NASA)



Figure 8 – Robert C. Byrd Green Bank Telescope. (National Radio Astronomy Observatory)

4. **Titan** – Titan is a large moon of Saturn which has an unusually dense atmosphere with a surface pressure about 1.6 times that of Earth's. It consists mostly of nitrogen (N_2) with a mixture of many types of hydrocarbons. The moon's surface is covered in many places with lakes and rivulets containing a variety of liquid organic hydrocarbons such as methane and ethane. (See Figure 7.) Preliminary exploration of Titan and Saturn has been accomplished with the NASA **Cassini** spacecraft and its **Huygens** lander to Titan. Another lander in the form of a drone called **Dragonfly** is scheduled for launch in 2026 with arrival in 2034 said to look for signs of life.

5. **Search for life on exoplanets** – The recently launched **James Webb Space Telescope** will be looking for biochemical signatures in the atmospheres of exoplanets. Carbon dioxide, methane, water, and free oxygen could be strong signatures of life.

D. Potentially suitable stars for habitable planets.

1. Should contain at least 0.5% heavy elements (The sun has around 2% elements heavier than helium).
2. Should have a mass less than or equal to the solar mass to have a long enough stellar lifetime providing enough time for life to develop. Some 97% of stars in the Milky Way would qualify.
3. Should have an energy output steady enough to establish a stable habitable zone around the star.

E. Is intelligent life common in the Universe?

Completely unknown thus far. SETI continues to search mostly by searching for and sending out radio signals. (See Figures 8.)

A recording of Dr. Xinnan Du's SMCAS presentation can be found on our YouTube channel here: <https://www.youtube.com/watch?v=UB5TTO6Hbo>. ♦



NASA Night Sky Notes

Find Hercules and His Mighty Globular Clusters

By David Prosper

Hercules is one of the standout heroes of Greek mythology, but his namesake constellation can be surprisingly hard to find – despite being one of the largest star patterns in our night skies! Once you find the stars of Hercules, look deeper; barely hidden in the space around his massive limbs and “Keystone” asterism are two beautiful globular star clusters: M13 and M92!

Since the constellation itself is relatively dim but bordered by brighter constellations, you can find the stars of Hercules by looking between the bright stars Vega and Arcturus. They are fairly easy to identify, and we have tips on how to do so in previous articles. Vega is the brightest star in the constellation Lyra and one of the three stars that make up the Summer Triangle (June 2020: Summer Triangle Corner: Vega). Arcturus is the brightest star in the constellation Boötes and can be found by “arcing to Arcturus” from the handle of the Big Dipper (May 2021: Virgo’s Galactic Harvest). You may be able to Hercules’s “Keystone” asterism first; this distinct pattern of four stars is traditionally shown as the torso of the great hero, though some illustrators prefer marking the Keystone as the head of Hercules. What pattern do you see in the stars of Hercules?

Globular star clusters appear “fluffy,” round, and dense with stars, similar to a dandelion gone to seed, in contrast to the more scattered and decentralized patterns of open clusters. Open clusters are generally made up of young stars that are gradually



Composite image of the dense starry core of M92 imaged in multiple wavelengths. While your own views of these globular clusters won’t be nearly as crisp and detailed, you might be able to count some of its member stars. *Credits: ESA/Hubble & NASA; Acknowledgment: Gilles Chapdelaine.*

spreading apart and found inside our Milky Way galaxy, while globular clusters are ancient clusters of stars that are compact, billions of years old, bound to each other and orbit around our galaxy. Due to their considerable distance, globular clusters are usually only visible in telescopes, but one notable exception is M13, also known as the Great Cluster or Hercules Cluster. During very clear dark nights, skilled observers may be able to spot M13 without optical aid along the border of

(continued on page 20)



NASA Night Sky Notes

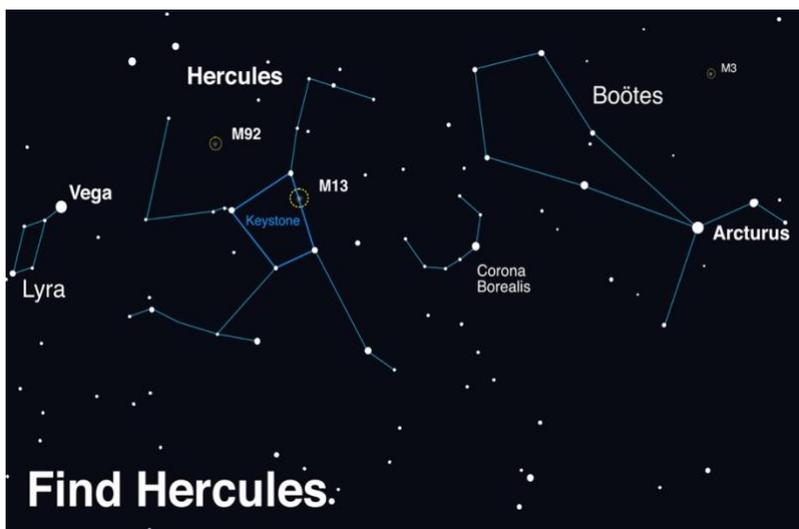
Find Hercules and His Mighty Globular Clusters (cont'd)

the Keystone, in between the stars Zeta and Eta Herculis - and a bit closer to Eta. Readily visible as a fuzzy “star” in binoculars, in telescopes M13 explodes with stars and can fill up an eyepiece view with its sparkling stars, measuring a little over half the diameter of a full Moon in appearance! When viewed through small telescopes, globular clusters can appear orblike and without discernable member stars, similar in appearance to the fuzzy comae of distant comets. That’s why comet hunters Edmund Halley and Charles Messier discovered and then catalogued M13, in 1714 and 1764 respectively, marking this faint fuzzy as a “not-comet” so as to avoid future confusion.

While enjoying your view of M13, don’t forget to also look for M92! This is another bright and bold globular cluster, and if M13 wasn’t so spectacular, M92 would be known as the top celestial sight in Hercules. M92 also lies on the edge of naked-eye visibility, but again,

binoculars and especially a telescope are needed to really make it “pop.” Even though M92 and M13 appear fairly close together in the sky, in actuality they are rather far apart: M13’s distance is estimated at about 25,000 light years from Earth, and M92’s at approximately 27,000 light years distant. Since M13 and M92 appear so close together in our skies and relatively easy to spot, switching between these two clusters in your scope makes for excellent star-hopping practice. Can you observe any differences between these two ancient clusters of stars?

Globular clusters are closely studied by astronomers for hints about the formation of stars and galaxies. The clusters of Hercules have even been studied by NASA’s space telescopes to reveal the secrets of their dense cores of hundreds of thousands of stars. Find their latest observations of globular clusters - and the universe - at nasa.gov. ♦



Scan between Vega and Arcturus, near the distinct pattern of Corona Borealis. Once you find its stars, use binoculars or a telescope to hunt down the globular clusters M13 and M92. If you enjoy your views of these globular clusters, you’re in luck - look for another great globular, M3, in the nearby constellation of Boötes. *Image created with assistance from Stellarium: stellarium.org*

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.



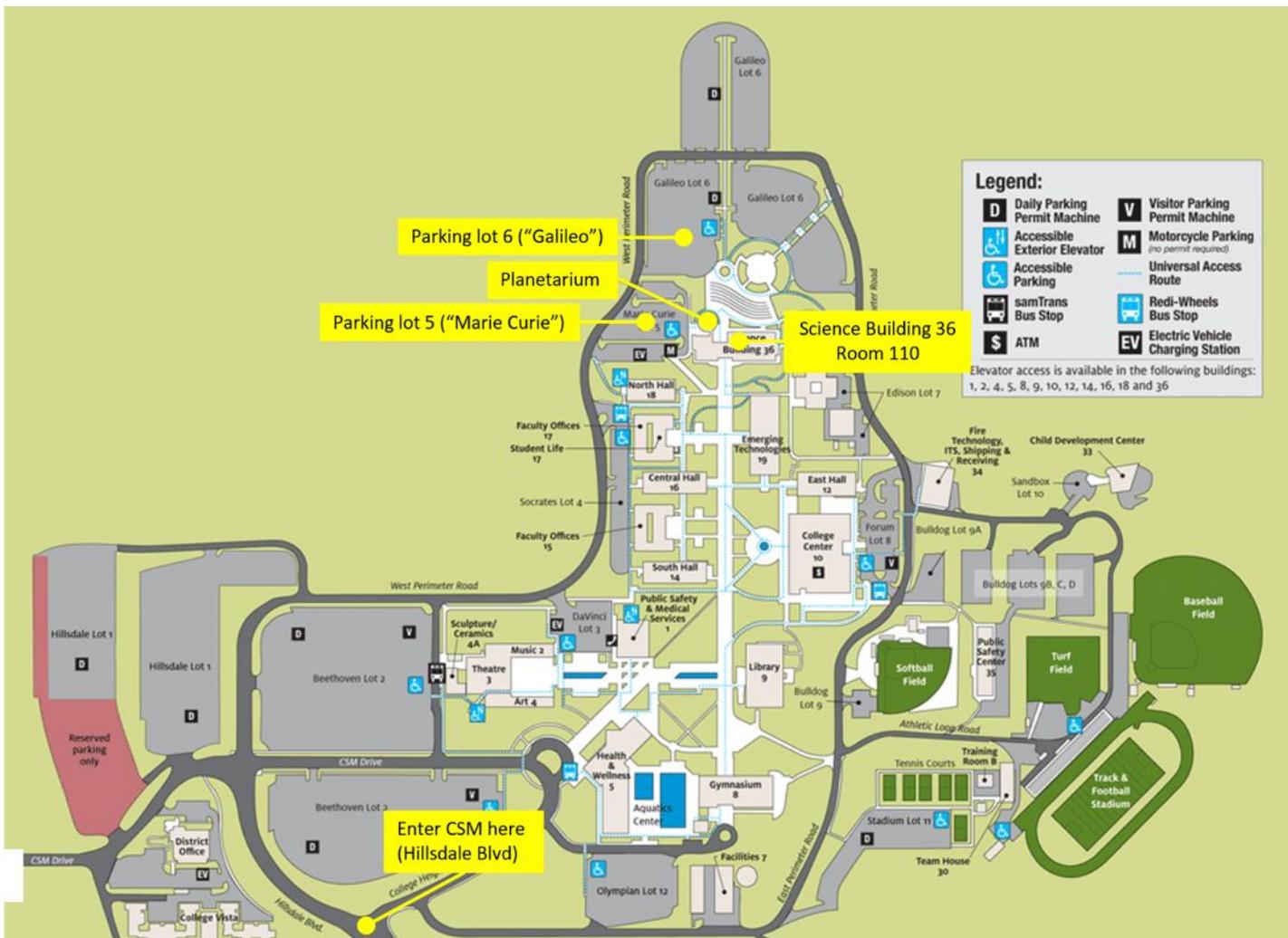
Directions to SMCAS Meetings at The College of San Mateo:

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

rev 02272020

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

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: _____