First Light Lite

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Jim Lynch – Editor

Message from the CCAS President

Summer appears to be making its exit over the last few days, with the temperatures dipping into the 50s, and even 40s at night. The evenings are now coming quicker, and the autumn constellations are rising higher in the sky after the Sun sets. Jackets and warm clothing are now mandatory for evening viewing. But viewing is still going on, and given the earlier sunsets, we can have our star parties earlier in the evening! Our next star party is slated for the window of 16 – 21 October. As usual, we will announce the event on the day of the event, given the notorious unpredictability of clear conditions on the Cape.

In the past few weeks, things have remained fairly active. Our September 20th star party was another good one, but again, we barely caught a favorable weather window! (And sadly, our Cape Cod National Seashore event with the National Park Service was cancelled due to Hurricane Lee.) Our activities with the schools have ramped up again, and we have at least four student advising/mentoring projects going on this fall. The main dome telescope automation project has begun its initial planning stages, with the money available and approved. We are continuing to try to find ways to serve our members, the schools, and the public and also enlist some new, active members. Our monthly speaker program also goes well. So, while things can always be improved, things are not bad at all and are generally on the upswing.

Three last items, repeated from last month: 1) for those contacting us on the web or by email, please give us a day or two to respond. Our mail is checked roughly every other day, and also on the days of star parties. We are still somewhat personnel limited! 2) for those asking for special star parties, please know that we can sometimes handle large group requests, but not always. We generally ask smaller groups to come to our regular star parties, where we are used to dealing with groups as well as individuals. 3) we will soon be offering some used gear we have acquired (some in mint condition) on our website and via email to our

members and friends. We can also loan this gear out to members if they are interested.

Star Parties for October (16th-21st at WSO)

As anyone who has been reading this newsletter knows, we have changed our modus operandi as regards star parties from what it was pre-Covid. Rather than having 1-2 definite dates per month for a star party, which more often than not were weathered out, we have gone to a six-day weather window centered around the New Moon, which gives us a reasonable chance of a dark, clear night. (And even with this, we've been weathered out a few times in the past few months.) But by and large this is a more workable strategy. Our "usual WSO star party" window for this October is the 16th – 21st.

We've also gone towards "binocular sky tour" and "smaller scope eyepiece viewing" outdoor activities, together with a "real time video image show" (through the main dome scope camera) in the lower level of WSO combined with a dome tour. This set of activities tends to give guests the best overall experience, and we will also continue to refine our format. We also welcome any suggestions you may have.

As to the big news as far as stellar events go, the eclipses in October and April have dominated the conversation. The October 14th "ring of fire" annular eclipse should be a great observing and photography opportunity, but unfortunately for us, will only show full annular behavior on a track from Oregon through Texas. We here on the Cape will see less than 20% coverage. That is something and worth viewing *if you have appropriate dark viewing glasses*, but we didn't think it would be sufficiently attractive to hold a full scale CCAS event. If you are interested in seeing it, it begins at 12:18 PM Eastern, peaks at 1:25 PM, and ends at 2:33 PM.

We WILL hold a full CCAS event for the April 8th event, which will be almost total from the Cape. (Please go see the full total eclipse if you can…we're very close to the totality path!) It starts at 2:15 PM Eastern, peaks at 3:29 PM, and ends at 4:39 PM. Just as a gloomy side note: the weather was cloudy on April 8th about 61% of the time in the past. ☹ But we fully expect it will be better next year! 😉

Before leaving the topic of eclipses, we should note that the wonderful talk about them given this October 5th by Dr. Martina Arndt will be discussed in next month's newsletter under the heading of "Last Month's Speaker." I'm just way behind this month in putting out FLL at the beginning of the month. (I'll just give "pretty busy" as my lame excuse.)

Dues

During Covid, we did not require dues, and left them to be entirely voluntary at $30 per family. This year, as we are resuming activities, we are requesting dues at a reduced flat rate of $15 per family (or individual, if there is no family to consider.) Dues were due July 1st. If you have sent our treasurer (Dr. Ken Brink) dues in the last year, you will be considered to have paid dues for this year. If not, we would ask you to submit them, as this money is used to support our activities with the schools and the public. (We don't buy equipment, as that is the Foundation's function.) Dues should be sent to: Dr. Ken Brink, 16 Greengate Rd., Falmouth, MA 02540. If you send your dues to the Observatory or DYHS, they will be delayed in their transmission to the CCAS Secretary.

I'd note that most CCAS activities will be available to those who do not pay dues, but when we eventually have remote observing online, that might be restricted to those who are dues paying members. Also, we plan to make our surplus and donated equipment available to members at a reduced rate. It is a small amount, and it is hoped you can pay if you wish to be active in CCAS.

Last Month's Speaker (September): Dr. Manasvi Lingam, Florida Institute of Technology

Date: September 7th, 2023

Title: Avenues for the regulation of planetary habitability by stellar processes

Biography: Manasvi Lingam completed his BS in engineering at the Indian Institute of Technology (Bombay), and his PhD in Physics at the University of Texas at Austin. He subsequently pursued postdoctoral research in astronomy and physics at Princeton University, Harvard University, and the Harvard-Smithsonian Center for Astrophysics. Prof. Lingam is currently an Assistant Professor of

Aerospace, Physics, and Space Sciences at the Florida Institute of Technology, and a Research Fellow at UT Austin.

His research interests include modeling of the habitability of planets and moons; high-energy processes in the Universe; and space exploration of the outer Solar System. Prof. Lingam has authored nearly 100 publications in international journals, as well as the comprehensive astrobiology textbook "Life in the Cosmos: From Biosignatures to Technosignatures" (with Prof. Avi Loeb) published by Harvard University Press. In 2022, was elected as a Fellow of the Royal Astronomical Society (FRAS) in the UK.

Abstract: With the rapidly expanding number of exoplanets, understanding the manifold factors that shape (exo)planetary habitability has become increasingly significant. Although habitability is regulated by many planetary parameters, there is growing evidence that the host star plays a major role in this context. I will outline the research undertaken with my collaborators in the following areas: (1) atmospheric escape mediated by stellar winds and space weather (flares and coronal mass ejections); (2) synthesis of building blocks of life by stellar energetic particles; and (3) potential characteristics of extraterrestrial photosynthesis. Along the way, I will sketch how some of our findings have already been confirmed by observations, and how others can be tested in the future.

Precis: Man has been interested in finding the signs of life on other worlds for centuries, and in recent years, this search has become more and more scientific. Dr. Lingam's talk fittingly started out with a definition of that science by the NASA Astrobiological Institute: "Astrobiology is the study of the origin, evolution, distribution, and future of life in the universe. This multidisciplinary field encompasses the search for habitable environments in our Solar System and habitable planets outside our Solar System . . ." This search includes studying how life evolved on Earth, the search for life on early Mars, examining the icy worlds of our Solar System, and looking for signatures of life on exoplanets.

Exoplanets have been a particularly hot topic of research, and after only a quarter century since their discovery, there are ~5000 known exoplanets, and more coming every day. Dr. Lingam initially looked at a few very promising exoplanets in

detail, with the first being Proxima Centauri b, discovered in 2016. It is 1.27 times the mass of the Earth and lies close to its small (0.12 solar mass), cool sun. Another promising system is the now well-known Trappist planetary system, which has seven Earth-sized planets orbiting its (also small, at 0.08 solar masses) sun.

Having found some Earth sized planets (which is *not* such an easy task), one then asks how many are habitable, with the habitable zone (HZ) being defined as the region around the host star where liquid water can theoretically exist on the planetary surface. On the order of 10% of all stars in the Milky Way are estimated to have an Earth-sized planet in the HZ.

Dr. Lingam then asked: why do we care about the host star so much? Or to put it differently, "can the properties of the host star influence the habitability and/or the origin(s) and evolution of life on planets and moons?" At this point, he started looking in detail at the characteristics of stars that are crucial to the evolution and existence of life. The first topic he addressed was electromagnetic radiation and photosynthesis.

The first point he made on this topic was that "Electromagnetic radiation from the host star influences habitability in numerous positive and negative ways (Lingam & Loeb 2019a." This is one of the many articles cited. I won't include all the rest)." The interaction of light with water (breaking it up to create free oxygen, enabling photosynthesis, desiccation of a water world, etc.) is particularly important, and Dr. Lingam showed a chart of the good and bad effects of electromagnetic radiation with emphasis on how this would work around an M type star (red dwarf), as these are the primary focus of exobiology work these days. The reason for this is that red dwarf stars are very common and very long-lived. Our Sun will live some 10 billion years – red dwarfs can last a trillion!

Photosynthesis is a big consideration for exobiology studies, as plants and plankton are the bases of our food web here on Earth. A simple form of photosynthesis is the reaction $6CO_2 + 6H_2O$ plus light → glucose + oxygen. The scientific question then becomes: Are low-mass stars capable of sustaining biospheres with productivity equal to Earth? Or: "How is the lighting?!" (And also, "are the other ingredients

available?") Drs. Lingam and Loeb have studied this and have developed criteria that a star's light needs to satisfy. In this case, the star has to be 0.21 times the mass of the Sun.

The next important item, as you might expect, is oxygen and ionized oxygen (ozone). Transmission spectra can show the lines of these molecules fairly readily given a deep enough atmosphere. A star of at least 0.13 solar masses is estimated to give enough oxygen to support life.

Aquatic photosynthesis is a topic that the oceanographers in the audience related to, and as there is plenty of water in the universe and likely some oceans created on exoplanets, this needs study. An important part of the study of aquatic systems is net primary productivity (NPP) which describes the net amount of (inorganic) carbon converted into biomass by photosynthetic organisms per unit time. Dr. Lingam showed results for these, using various low-mass type stars.

The next major topic was stellar winds and flares, and how these affect atmospheric escape. As most of us know, solar winds and solar flares send out flows of high speed charged particles (up to 300 miles/sec) as well as some nasty radiation (x-rays and gamma rays). Energy from these can be transferred to a planetary atmosphere through collisions, and also by electric fields which can accelerate charged particles to sufficiently high velocities to escape. Retention of an atmosphere is probably crucial for surface-based life and is required for liquid water and protection from solar radiation. How these escape mechanisms work on the Trappist planets was shown by Dr. Lingam as part of this topic.

The last major topic treated, and one perhaps less familiar to amateur astronomers, is the bio-effects of solar energetic particles (SEP's) that are produced in flares and shock waves. These particles could perhaps have powered chemical reactions for synthesizing the biomolecular building blocks on early Earth and Mars four billion years ago. Simulations show that this could also be a significant mechanism for M-type dwarf prebiotic chemistry. But SEP's effects are not all benign. SEP's have been confirmed to trigger the formation of nitrogen and hydrogen oxides, which are capable of causing ozone depletion. Also, SEP's can cause acid rain, temperature fluctuations, and radiation doses of varying severity. An even more

alarming possibility is that these events can be energetic enough to cause periodic extinctions.

The last bullet of Dr. Lingam's presentation summed things nicely: "The host star seemingly constitutes a major influence on the habitability of planets orbiting it." So remember to thank our Sun for being so nice to us, as well as Dr. Lingam for an excellent talk!

Next Month's Speaker: TBA

Directions to Dennis Yarmouth HS and Schmidt Observatory

For information on the location of our Dome behind Dennis-Yarmouth High School, click on the purple button "Old Website" and once there, click on "Meeting Location" viewing the two maps that are there: external for the Dome, and internal to locate the high school library where meetings are held. **NOTE:** We are redoing the website, so that this information may become dated soon. We intend to move any currently useful information to our new website.

For meetings, drive along the south entrance road and go around behind the main building. Park in the lot about halfway down the building and go in the back door and turn down the hall to your left to find the library.

For Star Parties at the Dome, drive in the north entrance road all the way past the north side of the main high school building, through a gate, and on to park near our Dome. You can (and should) park on the grass there.

H&K directions

CCAS hosts a dinner gathering for the speaker (if available), members and friends on meeting nights (just before the meeting) at the South Yarmouth Hearth & Kettle restaurant at 5:45pm (the meetings begin at 7:30 at D-Y.) Please join the group to dine and talk about all things interesting, especially astronomy, before our meeting. The H&K is at 1196 Rt 28, South Yarmouth, about a half mile west of the Station Avenue/Main Street intersection with Rt 28 (stop light). **NOTE:** Since Covid, we have a mix of fully remote and hybrid in-person + remote meetings.

Check the newsletter and/or website to see what the format is each month! There are no dinners when the meeting is fully remote.