

First Light Lite

Sept 1, 2023

Jim Lynch – Editor

Message from the CCAS President

The summer weather on Cape Cod has been very good for swimming, but only occasionally good for star party sky observing. Moreover, hourly forecasts are not 100% reliable (as one would expect, even given modern technology), so that when we gave the “all clear” for a star party on August 18th, we still knocked wood, crossed our fingers, rattled our worry beads, and stroked our lucky rabbits’ feet a bit. (Figuratively, anyway.) And sure enough, when the club members staffing the Observatory that night assembled at WSO, a dark gray bank of clouds had quickly gathered to greet us. Phooey!

But, in keeping with our traditions, we worked at making some lemonade out of the atmospheric lemons. We showed video images made at previous star parties, gave a tour of the main dome telescope, and demonstrated some of the smaller scopes and equipment that amateurs are interested in. Even when conditions go south/sideways/awry/whatever, we try to make sure that our guests get something interesting to look at!

And, lo and behold, about an hour into this, the sky gave us a break – a decent weather window where our guests could wander outside and see the actual summer sky and constellations. Our laser pointer sky tour and smaller scopes (including the 18” Dobsonian which isn’t exactly small!) were deployed, and to use the old phrase, I believe “a good time was had by all.” There’s just nothing like stars to make a star party successful! 😊

Besides our monthly star party, we also had a great, in-person “First Thursday” lecture at DYHS on August 3rd, together with a pre-lecture dinner at the H&K Restaurant around the corner from WSO. This event, like our star party, was well attended (also on Zoom), and attendees got to hear an excellent lecture on cosmology by HSCfA astronomer Dr. Tony Stark, who has been a long-time friend of our club. A writeup on Tony’s lecture appears further on in this newsletter, and

if anyone wants a copy of the PPT, Tony has given me one to distribute upon request.

Next, our club's core members (those most active in helping with planning, events and such) met for a mini-retreat at the Bobby Byrne's Restaurant on August 24th, to discuss the numerous initiatives that CCAS/CCAF is either currently engaged in or is considering. It also was well attended, and I think we have an enthusiastic group to get the club back to its pre-Covid activity level and beyond. (That is not to say we don't want or need more people to join this core! We certainly do!) This dinner discussion and its follow up will provide a strategic plan for CCAS over the next few years.

One very big item that the planning meeting discussed is the full automation of the WSO dome/scope system. Money has been appropriated by the CCAF Board to move this project forward, and we are hoping that in a year or so (or maybe less) we will be able to operate our scope whenever the sky clears from the comfort of our homes. This will enable us to do many new and exciting things with the students and among the club's members.

There were many other items discussed, but that would take up a whole newsletter on its own, and so I will save it for a later date!

Three last items: 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 September (15th-16th at CCNS and 18th-23rd 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 September is 18th – 23rd.

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.

This month also includes a special star party and lecture event in addition to our usual monthly CCAS star party and lecture. The National Park Service/Cape Cod National Seashore (NPS/CCNS) has again invited us to partner with them to produce this year's "Dark Sky Festival 2023," which will be held Friday/Saturday September 15-16. Talks will be given on astronomy topics geared towards the public on both days from 10:00 AM to 2:00 PM at their Salt Pond Visitor Center, 50 Nauset Road, Eastham MA. Speakers will be from both CCAS and the NPS. On the 15th (rain date September 16th), a star party will be held from 7:00 PM to 9:30 PM at the Marconi Beach parking lot, a very nice beachside, dark sky location. Please look at the formal NPS announcement on the Cape Cod National Seashore website, which is under www.nps.gov. Just browse for Cape Cod National Seashore, and make sure you're on the nps.gov website, and not booking a hotel by mistake! You'll see a very nice picture of a Falcon 9 launch on that site, taken at last year's event by CCAS member Mary Lou Ricci! Thanks in advance to all our members who are chipping in some significant time and effort to try to make this event as good as last year's was.

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 will be 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: Dr. Tony Stark, Senior Astronomer, Center for Astrophysics | Harvard & Smithsonian

Date: August 3rd, 2023

Title: The Golden Age of Observational Cosmology

Abstract: Thirty years ago, we knew there was almost certainly a "Big Bang", we thought the Universe was "open", and we had observations of a few objects at redshifts $z > 1$. Now the "Lambda Cold Dark Matter Big Bang" model parameters are known within a few percent, including the fact that it is "just closed", and we routinely observe the formation of galaxies at redshifts $z > 6$. We now understand in some detail the story of how the world came to be, from the first fraction of a second after the Big Bang until today, a story that involves the mysterious "Dark Matter" and "Dark Energy". Observational cosmology, a field of study driven by the revolution in technology, is the source of this new knowledge.

Biography: Dr. Antony Stark is a pioneer of Antarctic Astronomy and is a founder and designer of the South Pole Telescope (SPT), which is among the most important instruments for observational cosmology. He is PI and designer of the Parallel Imager for Southern Cosmology Observations (PISCO), a photometric camera on the Magellan Clay telescope for taking fast simultaneous g, r, i, and z band images. PISCO is being used to take the first images of galaxy clusters

discovered by the SPT to determine their mass by gravitational lensing analysis. PISCO is also in use by several groups from Magellan consortium institutions to study asteroids, galaxy formation, exoplanets, and X-ray sources. Stark is a member of the STO and GUSTO balloon-borne telescope teams for Milky Way and Magellanic Cloud TeraHertz spectroscopy surveys of the dominant cooling lines of the interstellar medium.

Precis: You can tell when someone is totally absorbed in their topic when they speak for almost two hours and then ask if they have time left in their (nominally) one hour lecture. Tony Stark talking about cosmology is one of those people, and nobody in the large audience listening to him objected in the least. Rather, the large group was treated to a masterclass in cosmology basics and current events.

But before giving my brief summary of what was discussed, let me note again that Tony has approved sharing his PPT with whoever might request it. It is a largish file, so I haven't posted it directly here, but it is available upon request to me via email. Please use cca@capecodastronomy.org and use "Stark Lecture" in the subject line.

Tony started his talk with a history of astronomy and cosmology, showing how they were spurred by both technological developments and innovation as well as individual genius and creativity. In the course of this discussion, he also mentioned some of the recent luminaries who were also his mentors during his career, including: Penzias and Wilson of Cosmic Microwave Background (CMB) fame, Martin Schwarzschild (son of Karl Schwarzschild), and Fritz Zwicky, whose name is inevitably preceded by "the irascible." Some rather amazing elbows to rub against!

Tony's summary slide taken from his rather extensive history told why he called the period from the 1980's onward "The Golden Age of Cosmology." It would be better to just show his slide here than paraphrase it, as it is very succinct and convincing.

"By 1980, all the elements for the Golden Age of Observational Cosmology were in place:

- The mathematics needed for the model.
- A Standard Model unifying particle physics, electromagnetism, and the strong and weak forces
- General Relativity, a highly accurate theory of gravity
- A model of the Universe based on physics.
- Electronic computers to acquire and manipulate the data.
- Nearly quantum-limited detectors at wavelengths from radio to X-ray
- Telescope designs at all wavelengths
- Capability for placing telescopes at remote sites and in space.”

This nicely says “we’ve come a long way” in some detail!

From there, Tony turned to our cosmological model of the universe. As we all know as interested amateurs, this starts with the basic foundation of Einstein’s equations of General Relativity (abbreviated GR, the use of which will make you look “in the know” regarding cosmology. 😊) When solving these equations, one first assumes a form of the metric (local “ruler”) that is adapted to the geometry underlying the system: the “Minkowski metric” for flat space, the “Schwarzschild metric” for stationary, spherically symmetric systems (stars, black holes), the “Kerr metric” for rotating black holes, and of interest here, the “Friedmann/Lemaitre/Robertson/Walker [FLRW] metric” for a homogeneous, isotropic, spherically symmetric universe which is expanding or contracting in time. The expansion/contraction factor is inserted into this metric as a coefficient $a(t)$ that you have to solve for via two differential equations called the “Friedmann Equations.” These equations are actually on the simpler side for differential equations, and their basic solutions for cosmology are discussed in detail in undergraduate physics books. (A great book for this for those with some physics background is: “Introduction to Cosmology”, second edition, by Barbara Ryden.) Tony’s talk went into some detail as to how these equations are treated and gave some attention to the “ingredients” of the universe, which are: radiation, normal matter, dark matter, and dark energy.

Continuing, Tony went on to the “state of the art” Λ CDM model of the universe, in which eight parameters pretty much tell you all you need to know. This

“cosmological constant” (the Λ , which seems to be a good model of dark energy) plus Cold Dark Matter (the CDM, with cold denoting non-relativistic)” model seems to fit our best modern data and is also consistent with the Friedmann Equations. Right now, it’s our best bet. This led to a discussion of the cosmological data, which is Tony’s particular area of expertise.

As seen in his bio, Tony is one of the founders of the South Pole Telescope (SPT), which is one of the facilities which focuses on obtaining microwave data for cosmology. Making deep, high-resolution maps of the microwave background is a forte of this instrument, and the idea now is to map a large area (outside the Milky Way’s galactic plane, which is just too noisy) to further narrow down the limits of the eight cosmological standard model parameters he discussed. Tony has shown us some beautiful results from this facility over the years, and this latest effort (which will hopefully thrive as a part of a major upcoming CMB-S4 experiment) will be part of answering some important questions such as “did inflation really occur, or is there another mechanism?”

Tony then turned to some of the other microwave background measurements, such as the WMAP (Wilkinson Microwave Anisotropy Probe) and Planck satellite experiments and showed how their resolutions compared to the SPT. SPT can “dig deeper” with high resolution than the satellites but does not cover nearly as much area.

Next, Tony addressed how the “scalar and tensor mode” ratio “ r ” can be used to describe the universe during inflation, depending on details of something called the “equation of state” which describes the relation between pressure and density. He showed what these “E and B” scalar/tensor modes (mathematically divergence and curl) look like graphically, and what they would look like in the actual CMB. He then showed how gravitational lensing, which is the astronomer’s friend in many circumstances, is not so friendly when it comes to sorting out the B modes and causes some noise/confusion. Other sources of noise were also discussed.

Finally, Tony arrived at how the “Great Eight” parameters are estimated. This looked a little more familiar to some of the ocean scientists in the audience – inverse theory and parameter estimation are “bread and butter” topics for almost all

science and technology nowadays. The next few slides showed how the parameter estimates stacked up from all the measurements available nowadays (and there are quite a few!). It turns out that Λ CDM is doing a good job, and that the various experiment's estimates are generally agreeable on the parameters.

But there is still more that's needed to be done to nail down large cosmic mysteries, and that is where CMB-S4 comes in. Inflation, dark matter and energy, the finite mass of neutrinos, and other fish remain to be fried, and this experiment will continue the efforts to nail down the relevant parameters to the accuracy needed to resolve these issues.

Let me conclude by thanking Tony for being a frequent summer visitor to CCAS and for sharing some of the latest results of microwave astronomy and cosmology with us. These are the forefront areas of modern astronomy *and* physics, and some of the most exciting areas of science as a whole.

Next Month's Speaker: Dr. Mansavi Lingam, Florida Institute of Technology

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.

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.