First Light Lite **BOO! ☺**

October 31st, 2018

Jim Lynch - Editor

Summer is well over, and fall's bite is in the air. We can expect some clearer nights soon, at the price of having to dress up in our bulky clothes!

This month was a good one overall, with an excellent speaker starting it off (see the write-up below), a two star party agenda (one night with clear skies, even!), and the DY HS astronomy honors program starting off for the fall (with fourteen students participating, and with a number of new projects being offered, designed to fit the skills of the volunteers as well as the needs of the students). As said last month, we really could use more CCAS volunteers for the DY program next semester, as we just barely filled our personnel needs this time.

I will outline last month's talk below, but I also would like to mention the speaker program in general. As President of CCAS, obtaining speakers is one of my primary tasks. But I am NOT the only one who should be doing this! Anyone in CCAS who knows of someone who would be a good speaker, or would like to give a talk themselves should contact me. It is not easy filling our speaker slate, and having all hands pitch in helps make it work! We have open spots from January on - time to fill next year's schedule!

As to star parties, Charlie is doing a great job keeping a two-party-per-month schedule going. But again, he needs help and participation. He will help train anyone who wants to man a small or large scope or binoculars, so please contact him if you would like to be part of this important CCAS activity.

Another thread that needs pursuing this year is recruitment of new members. This has been said many times, but we haven't acted upon this issue nearly as strongly as we could. Our other initiatives (both CCAS and CCAF) have come along nicely, and this is one of the biggest remaining ones - indeed, it is crucial to our continuation! I'll continue beating this drum further in the weeks to come!

Upcoming Speakers and Topics

November 1 - Dr. Martina Arndt, Bridgewater State University

The Beauty and Science of Total Solar Eclipses

Abstract

Total solar eclipses are not only beautiful, they are also excellent opportunities to do science. The Sun's surface (photosphere) is ~5,600 Kelvin, yet 2,500 km above the photosphere, in the corona, the temperature is over 1,000,000 Kelvin! This coronal heating problem is still one of the outstanding puzzles in solar physics. Since 1997, I have been part of a total solar eclipse research team known as the Solar Wind Sherpas. I have traveled with this group around the world to observe 11 total solar eclipses – we've been below the equator, above the Arctic Circle, to very remote islands, and most recently to the northwest US. In this presentation, I will share some expedition adventures as well as some of the science we have been able to do.

December 6 - Dr. Jim Lynch, CCAS.

The Solar System - Its Formation and Basic Dynamics.

Abstract

In this talk, I will first go through some of the basic concepts of solar system dynamics that are needed to explain the formation and development of the Solar System as we see it today. Kepler's Laws, Newton's Laws, Laplace and tides, resonances, nonlinear dynamics and chaos, and modern computer modeling will all be described using simple examples. With these mathematics and physics tools, astronomers have been able to piece together a plausible, if still somewhat incomplete, picture of how our Solar System formed, how it is evolving, and what its eventual fate may be.

October 4 CCAS Speaker Dr. Tony Stark, HSCfA

"The Cosmic Background"

Summary

When Dr. Tony Stark arrived, he was greeted with the usual stale jokes about "Iron Man". But, in defense of those jokes, Tony's postlude to his talk detailed the observing session that he was flying to Chile for the next day, after spending his remaining hours home working hard to prepare. After listening to the grueling work schedule that Tony was going to put in, I don't think anyone should feel bad about calling him by his Marvel character counterpart name!

Tony's talk was as impressive as his work schedule. Pretty much, he showed us where one of the premier efforts in modern astronomy/cosmology/particle physics is at, and what is to come. The CMB-S4 effort, which was a key part of his talk, is a huge collaborative effort that, if funded and successful, will answer many of the key physical science questions of our day. But I'm getting ahead of myself. Let me dial back, and go through his talk in sequence!

Tony started by noting that the "Cosmic Background" wasn't just the notorious microwave background, but included ALL possible wavelengths, with radio being one important piece. A nice example of a "broad spectrum" look at things was a simulated power spectrum of what the South Pole Telescope (SPT, one of his main projects, and which he founded) would see if it were looking at M82 with a high redshift. (The SPT doesn't see past DEC=-27, and M82 is a northern object; but as M82 is close and well known it made a good simulation object.) A plot of received power versus size (or equivalently versus wavelength) showed features ranging in size from molecules to stars.

However, cosmology is never far from center stage, and Tony then discussed how increases past the SPT's current sensor sensitivity could push things into the range where we could quickly answer one of the biggest questions around - what variant of inflation theory (or modified General Relativity) is correct? We're pretty sure that some variant of inflation theory is correct, and put the "bang" in the Big Bang, but which one?

After discussing our place in the Big Bang universe, Tony launched into his personal specialty - the advanced telescope and sensor technology that will hopefully answer this (and many other) big questions.

The SPT system was first described…a 10m, off axis Gregorian design system with 11,000 working bolometers as a sensor package, that looks at three frequencies and two polarizations, for a total of six possible "looks." In terms of power, it has four times finer resolution than the Planck satellite and sees thirty times deeper. This helps look at the finescale part of the cosmic microwave background (CMB) at spatial scales as fine as one arcminute. Tony then showed a SPT picture which (to the layman) had some seemingly mundane black and white dots on it. But when looked at by a professional astronomer, these dots turn out to be quasars (the white dots, magnified by weak gravitational lensing) and the black dots are (quoting Wikipedia, which phrases it much better than I can!) "the distortion of the cosmic microwave background radiation (CMB) through inverse Compton scattering by high energy electrons in galaxy clusters, in which the low energy CMB photons receive an average energy boost during collision with the high energy cluster electrons. Observed distortions of the cosmic microwave background spectrum are used to detect the density perturbations of the universe. Using the Sunyaev–Zel'dovich effect, dense clusters of galaxies have been observed." One of Tony's research interests is getting the mass of galaxy clusters from such gravitational lensing and scattering effects.

In correcting my draft of this writeup, Tony summarized the present SPT effort. To quote him (any italics are mine) : "The SPT-3G detector system is pretty much at the limit for SPT. That many locations in the focal plane is near the limit of what the basic optical design of the SPT can achieve. The much greater number of pixels on the sky of CMB-Stage4 will therefore require the construction of more telescopes, both of the 1-meter class and the 6-meter class. One point of controversy about the project is that none of the proposed CMB-Stage4 telescopes will be anywhere near the size of the 10-meter (plus 2 meters extra guard reflector) SPT, and will not, therefore, resolve Sunyaev-Zel'dovich spots of clusters further than redshift of about 0.5. We're now seeing (*with the SPT*) protoclusters at redshifts around 3. The good news for us in the SPT project is that we're currently operating, whereas CMB-Stage4 is years away….. There's nothing CMB-Stage4

can do that the SPT can't, but in a much longer time, perhaps decades (*which is* not practical)."

At this point, Tony launched into the CMB-S4 project that is currently proposed. You can read all about this project at: http://cmb-s4.org , and even if you just read the overviews and executive summaries, it is a site well worth visiting!

This project is next-generation science, both for astronomy and physics. If you take the time to read the executive summary of the science plan, you will see the amazing amount of questions that this "consortium science" proposal will address. Of course, the 800 pound gorilla for astronomy is cosmology and inflation, and Tony addressed that next.

If CMB-S4 is funded as requested, the bolometer array of 11,000 sensors would increase to 500,000-1,000,000 bolometers (at a price of about $2B) , though on new telescopes. And instead of 20-30 years of SPT data needed to resolve inflation model questions, a much shorter time (100 times shorter?) would be needed. Supercooled lens systems made of exotic materials were also discussed, showing how elaborate modern astronomy has become.

In answering CMB questions, the power spectrum versus l (small letter L, not 1!) is often plotted. Small l correspond to large (angular) scale features in the sky, whereas large l correponds to small features. (The big first spectral feature at l=200 is about one degree across.) Getting polarized data at lower and higher l is the goal of CMB-S4. Tony mentioned that getting good results at l=10 should solve the inflation problem. Results at high l should give information on galaxies and galaxy clusters.

There are other questions of great importance that the CMB-S4 project will be able to answer. An important one concerns the mass of neutrinos, which strangely can be constrained better by astronomical measurements than by particle accelerators! This is important for physics (since neutrinos can perhaps lead to new physics beyond the physics Standard Model) and astronomy (since ~4% of dark matter is to be found in neutrinos!)

There is more that Tony addressed, but as this writeup is already a bit long, let me just urge you again to look up the CMB-S4 reports. It will be time well spent!

Tony said he would be back next year, and I certainly hope that is true. His ongoing stories of the South Pole Telescope and cosmology have been intriguing, and I think the best is yet to come!

October Meeting Minutes and CCAS Business

Our October business meeting concentrated on the issues I talked about in the Introduction. Mike Hunter also gave an update on the status of our main observatory telescope replacement.

Star Parties

From September thru June, we will have two regularly scheduled Star Parties each month taking place at 7:30 -10:30pm on the *Saturday* closest to the date of First Quarter Moon (about 7 days old). This is an increase from our old schedule of one per month in the fall, winter, and spring.

From July through August, we have three regularly scheduled Star Parties each month taking place on *Thursdays* at 8:30-10:30pm.

When the moon is near its First Quarter, the terminator (the line dividing light from dark) is favorable for viewing sunlight or shadow on the sides of craters. This time is also favorable for observing the dark side of the moon occult (visually cover) stars in the sky as the moon moves in its orbit. Depending upon the calendar, we may also be able to observe planets and other celestial objects.

Here is the schedule for fall "Star Parties" up to December, 2018; **the public is cordially invited**:

November 10,17

December 8

POSSIBLE CANCELLATIONS for Star Parties: Cancellations will be very rare since we have lots to do "inside" as well as outside. Even if the forecast is "iffy"; the Staff Leader for the night may elect not to cancel in spite of possible clouds. If clouds arrive after staff and guests have convened, a virtual Star Party will usually take place indoors to include overviews of the sky for that night using computer simulations with our big screen TV, videos of interesting sky events recorded previously, demonstrations and/or training on the use of scopes and other equipment, and consultation/discussions on things astronomical, etc.

However, sometimes a solid forecast for overcast or rain or a storm will result in cancellation of a given Star Party. IF IN DOUBT ABOUT THE WEATHER AND THE STATUS OF A STAR PARTY, CALL THE OBSERVATORY AT 508-398-4765 AFTER 7:45 pm. No answer means the event has been cancelled.

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.

For meetings, drive in the south entrance road and go around behind the main building. Park in the lot about half way 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.

H&K directions

Please be reminded that Gus Romano or his delegate “host” a dutch-treat dinner gathering for members and friends each CCAS meeting night (before the meeting) at the South Yarmouth Hearth & Kettle restaurant at 5:45pm; (the meetings begin at 7:30 at D-Y.) The speaker for each meeting is always invited. Please join the group to dine and talk about all things interesting, including astronomy, each month 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).