

First Light Lite

October 1, 2020

Jim Lynch – Editor

Message from the CCAS President

As always during this pandemic, I hope that all of you reading this are well and are staying as safe as possible.

And, if you have read our previous issues of FLL, you will have noticed that a good amount of the “activities description” material below has been recycled from month to month. That is because the pace of new events has slowed considerably. My apologies for this – I will definitely stop doing this once the pandemic is under control, and we can all meet up in person again!

As mentioned previously, we’ve halted our in-person activities until we can operate them safely, and we’ve gone to “virtual world” wherever we can. We are all *very* tired of this after more than half a year, but it will continue as the status quo for at least another few months. A positive development is that small crews of our senior members can now get back into Werner Schmidt Observatory (WSO) to realign the telescope, inventory our equipment, and start preparations for some webcam virtual star parties originating from the WS Observatory.

The current status of our three main activities, i.e. lectures/meetings, star parties, and interactions with DYHS and other Cape schools is as follows:

Re lectures, we remain in good shape. We have some wonderful scientists lined up to speak with our club over GoToMeeting this fall, and I will be describing last month’s and the coming month’s talks in this letter.

As regards star parties, club member George Silvis has made his private observatory a star party Zoom broadcast site on an “as available” basis to people who sign up with him. If you are not yet part of this group and are interested, you can ask George for an invitation via me at jlynch@whoi.edu. The group is called “Mashnee Virtual Observers,” and again we thank George for this individual

effort. (His last star party ferreted out about eight different interesting objects in less than an hour. Lots to see!) And, as I said above, we also will be working to have some virtual star parties from WSO in the not-too-distant future.

Regarding our educational/mentoring interaction with DYHS and other schools on the Cape, we are still in the discussion phase. We DO plan to have some interactions via projects and lectures, but need to coordinate this with the instructors. If there is any word that best describes this year's interactions with staff and students, it is "uncertainty."

Werner Schmidt

It is hoped that we can hold a memorial service for Werner Schmidt outside the WSO sometime soon. We will discuss this with Sandy Cashen and DYRSD.

Invitations to our virtual meetings

To date, we have been inviting people to the CCAS virtual meetings (via providing a link and a password through email the morning of the meeting) using a recent members list, and also by creating a list of people on this FLL mailing list who have contacted me (at jlynch@whoi.edu) stating that they wanted to log into the meetings. The offer to be put on our "meeting login list" remains open, and anyone who is interested, but has not received a previous invitation only needs to contact me and express interest. We have some excellent speakers enlisted for the entire rest of the year, and plenty of room in our virtual lecture hall for a bigger audience! Please consider this offer!

We also plan to broaden our outreach to the public soon, so as to expand the list of people who can attend our virtual meetings, star parties, etc. That effort is awaiting the disposition of other matters, but it should happen soon.

Website

Our upgrade of the website is one project that can be done easily enough during the current pandemic, and again, we hope to get back to it soon.

Miscellaneous talks and resources

I would (again) like to remind people that there are many other organizations that offer excellent Zoom seminars to the public. Check the latest listings of (for example): the American Association of Variable Star Observers (AAVSO), the Maria Mitchell Observatory, and the Harvard Smithsonian Center for Astrophysics. These, and other programs, have very interesting web-based talks available.

Also, I will be giving a series of four weekly talks on amateur astronomy in October via the Falmouth Library's "Joy of Learning" series, which I will make sure can be available to our club. The talks scheduled are on October 6, 13, 20 and 27 at 2-3 PM. They are:

- 1) Backyard Astronomy (Equipment, the Solar System and Deep Sky Objects visible, Web Resources, Books, Apps)
- 2) Exoplanets, Extraterrestrial Life and the Drake Equation (Fascinating and just a bit scary)
- 3) Black Holes, Their Ins And Outs (One of the most popular topics, covering a lot of the recent work done)
- 4) The Big Bang and Cosmology (Science at "The Outer Limits.")

Binoculars

And finally (again), despite there currently not being "in person" CCAS star parties where we can make telescopes and laser pointer sky tours available to the public, there is a LOT you can see this fall by yourself with an inexpensive, standard pair of binoculars and a simple star chart that shows the constellations and the "Messier Objects." The latter are bright and easy to see astronomical objects, and the late summer and early fall sky has many of them to offer, especially around the Milky Way in Sagittarius.

Some hints for using binoculars: 1) they can "jitter" the image a lot unless you brace them, preferably against something solid, 2) they can get heavy in your hands after a while, especially bigger pairs, and 3) if you are looking high in the

sky, get a reclining patio chair or similar to lay down in! You will have little or no success looking up past 45 degrees otherwise!

Last month's speaker

September 3 , 2020

Speaker: Dr. Charlie Lada, Senior Astrophysicist, HSCfA

Topic: “Adventures in Exploring Star Birth in the Uncharted Realm of the Cold Universe: 1970-1990.”

Precis:

With the development of atomic and nuclear physics in the 1920s and 1930s, a coherent theory of stellar structure was made possible. By 1939, Eddington and Chandrasekhar had published substantial textbooks on the detailed theory of stellar structure, i.e. how already formed stars live and die. And although the theory has evolved greatly since then, the basics were there. Moreover, observational evidence, e.g. optical stellar spectra, was available from early in the 20th century (the Harvard women astronomers and Pickering being a well-known example.) So, all in all, the stars were a tractable problem.

But knowledge of how the stars formed from interstellar gas and dust – that came later. Though astronomers knew what the raw materials were by looking at the stars, how much of it there was, where it was, and how it was distributed would largely have to wait for the maturity of radio astronomy, a field that started to flower in the 1960's. This is where Charlie Lada's talk comes in.

Charlie's talk was a retrospective both of his career as an astronomer and of a pioneering era (1970's to present) in his field, star formation. Both the science and the historical perspective were fascinating.

Charlie and I (JFL) are both close in age, so that our experiences as nascent scientists were in many ways similar. Popular astronomy books by Fred Hoyle, George Gamow, and others launched many a 1950's – 1960's science career. And these also were years where the US greatly encouraged science.

Coming to his undergraduate years, Charlie pointed out the Steady State Universe theory (Fred Hoyle) versus the Big Bang Theory (almost everyone else) controversy as one of that era's most memorable debates. As we all know, Hoyle lost that debate badly, but he did coin the phrase "Big Bang Theory," which has gained more public notoriety than Hoyle could ever have dreamed of.

Charlie then went on to his detailed research. In the 1960's, HII (ionized hydrogen) regions were considered prime candidate sites for star formation. Radio telescopes picked up interstellar molecules near them, and infrared observations revealed the first protostar near the Orion Nebula. The "modern era" of experimentation for star formation had begun.

As opposed to the Big Bang, where everything was in a "hot dense state," stars do a "cold start" from extremely frigid interstellar gas, molecules, and dust. Only such cool gas clouds can condense enough from the interstellar medium to form stars. (The thermal pressure from hot gas prevents gravity from condensing it adequately.) In the cold, high density regions where stars form, most of the gas is in the form of molecular hydrogen (H₂), which due to some fussy quantum mechanics called "selection rules," doesn't radiate very efficiently, and so would, by itself, tend to stay warm. Moreover, since the dominant H₂ gas doesn't radiate appreciably, it is not a very good tracer for the gas cloud structure. Enter the recently found molecules, and in particular carbon monoxide (CO), and Charlie Lada's graduate school work in Texas.

The University of Texas had, at that time, a radio telescope that could, with a bit of electronics ingenuity, be adapted to do millimeter wavelength astronomy (sensitive to CO), and so Charlie was dispatched by a generous advisor from Harvard to Texas to "do good stuff."

Charlie's description of the gear available at the observatory at that time was a treat for both young and old. For the young, seeing the punched computer tapes and ancient TeleType machine terminals was probably an "OMG" moment. For the older generation, well, it looked pretty familiar.

With gear in place, and a free hand from his advisor, Charlie went to work on mapping the region of M17, as this seemed to be a good candidate for "where the action was" in forming young stars. Using CO as the tracer for H₂ molecules,

as it was part of the gas and had detectable millimeter radiation, Charlie struck paydirt. CO indeed traced the otherwise invisible H₂ gas very well, allowing him to create (hand drawn!) contour maps of the clouds around M17. A new, powerful window had opened up on the gas clouds that form the stars. More molecules were soon added to the mix of tracers (HCN, H₂O, and SO for example), and the cloud mapping campaign was begun in earnest.

The Giant Molecular Cloud (GMC) revolution started by this mapping goes on to the present day. As Charlie pointed out, GMC's are: 1) the largest objects in the Milky Way, 2) the coldest objects in space (thanks to H₂ transferring energy through collisions to the dust and other molecules which act as coolants), 3) rival globular clusters as the most massive objects in the Milky Way (MW), and 4) are the sites of all star formation.

Charlie then "fast forwarded" to 2020, with pictures of the ALMA radio telescope array imaging clouds 1.8 Megaparsecs away, not exactly next door!

Jumping back to the 70's and 80's, Charlie next discussed "sequential star formation," a domino effect where one initial event causes others, and the surprising discovery of "outflow jets."

Infrared astronomy came next, as this is where "warmish" protostars (incipient stars) radiate. ALMA could be pushed to these wavelengths, and using it, beautiful images of protostars and protoplanetary disks were produced. From these, the current theory followed.

Infrared astronomy has a wonderful "superpower" – it can look right through dark clouds of dust and gas in space, revealing the goodies beyond. Charlie showed some great examples of this, as well as discussing how you could determine distances knowing the "extinction" of light due to the clouds.

Let me conclude with Charlie's answer to a post-talk question: what is the most challenging problem in your area today? Charlie's answer surprised me: "We don't have a complete theory of star formation." Given the beautiful experimental results we had been shown, we could easily have believed that only dotting the I's and crossing the T's remained. Nope. There are multitudes of things/mechanisms going on simultaneously in this problem, and many of them remain hard to

measure or even compute. (Rather reminiscent of the climate change problem here at home.)

For any interested folks with a science background, the book “Star Formation” by Krumholz will give you a flavor of just how complex the problem really is. To quote the movie title, “It’s Complicated!”

Coming speakers this fall

October – Dr. James Head, “The Apollo Lunar Exploration Program.”

November - Dr. Larry Marschall, “An Astronomer Looks at Climate Change.”

December – Dr. Frank Primini, “The Chandra Source Catalog”

This month’s speaker - details

October 1st, 2020

Dr. James Head, Brown University

Topic: “The Apollo Lunar Exploration Program.”

Precis: The Apollo Lunar Exploration Program accomplished six successful lunar landings. Each succeeding Apollo mission was characterized by increasing exploration capabilities (landing accuracy, stay time, EVAs, mobility, experiments, tools, etc.). We present a brief review of the landing sites, surface operations and science return of each succeeding Apollo mission and show how *science and engineering synergism* resulted in a rapid transition from achieving a national goal (Apollo 11) to sophisticated scientific expeditions targeted to areas critical to understanding the origin and evolution of the Moon.