First Light Lite

October 7, 2024

Jim Lynch – Editor

Message from the CCAS President

Before getting to anything else, let me start with a brief round of explanations/apologies. This newsletter is late because my wife and I took a week off to see relatives the week before the end of the month. We avoided routine responsibilities as best we could, and so many things are now a week late. The Zoom link for the speaker last Thursday also came late (i.e. on the same day as the talk) because we hadn't noticed that we had exceeded the Outlook mailing list size limit when we sent the mailing out. We found that error Wednesday night and (hopefully) have corrected it. I was also late writing up the speaker precis from September ("last month's speaker") in that I had trouble opening a large ".key" file he sent me, which I use for notes. All in all, not my most successful month of communicating. ☹

The outcome re speakers and hybrid meetings was a bit brighter, however. Dr. Antonio Hales delivered a great talk on September 5th to an audience that was both on Zoom and live at DYHS (after an H&K dinner gathering.) And Dr. Kevin Hainline also delivered a wonderful talk to an even larger hybrid crowd at DYHS and on Zoom. The live interactions, which were missing during covid, and had been minimized afterwards by Zoom's success, were quite lively and refreshing. Clubs like CCAS need such interaction, and the hybrid experiment (aside from 1-2 technical glitches which can be fixed) has been a real success.

Which brings us to star parties. The score here was "two out of three" since our last newsletter.

Our first star party was an outreach event at the Cape Cod National Seashore's Marconi Beach. Nine CCAS members showed up as volunteers on what easily could have been a "clouded out" evening. We had a laser pointer/binocular sky tour ready, as well as a variety of member's personal telescopes. For a change, a break in the clouds favored us, just at the right time for the event. The skies cleared and given the absence of light pollution at the beach (which is two miles from the main road), people got a great view of the Milky Way and late summer sky. It was estimated by the park rangers that 300-350 people attended, and from our point of view, that might have been right, as we were very busy.

We also had a very successful outreach star party for the Waquoit Bay Estuarine Reserve on Monday, September 30th, with roughly 50 people attending a lecture and the star party afterward. Conditions were perfect, and the Milky Way put on another great show for the attendees.

But our Thursday, October 3rd party, which was to be held at WSO right after the DYHS hybrid talk that evening, didn't fare so well. The conditions were partly cloudy with a ground fog layer forming and a forecast of more clouds. So, the call was made to scrub the event that evening. The fact always is with us that we are highly weather dependent observationally on the Cape.

Given all the above, we have noted changes and improvements that need to be made in our public events, and hopefully we'll have smooth sailing for meetings and star parties in the future. We're planning our next star party window for October 28th to November 1st (excluding Halloween) and will make a good effort to ensure that our notification via both email and the website is fully operational!

Comet and Meteor News

A comet named C/2023 A3 Tsuchinshan–ATLAS is making an 80,000-year orbit around the sun. From mid-October, the 12th and a few days after that-- it should be visible on the Cape in the west just after sunset.

The first few days, it will be lower to the horizon, but gets higher for each day after that, as it fades out of the sun's light. People should detect it with the naked eye, but binoculars enhance it, and a small telescope is even better. Find a clear view, ideally a western facing beach, and enjoy the show!

As regards meteor showers, the Orionids will next peak on the nights of October 20-21, and the Leonids will be peaking November 17-18.

Small Telescope News

Regarding the new smart telescopes used at the last WSO star party, they put on an impressive display in cutting through relatively poor conditions, and so the CCAF Board has appropriated funds to purchase both a Seestar telescope and a Unistellar telescope. They have been ordered and we hope that they will be here soon. I would like our members who volunteer for star parties to learn how to use them when they do arrive. Brian Twohig has also generously donated an additional Seestar telescope to the club. The Unistellar and one Seestar scope will reside at WSO, and the other Seestar will be located in the Falmouth area to give members who are distributed across the Cape a chance to learn these systems.

Main Dome Scope News

Thanks to Charlie Burke and Gary Walker, our main scope is working again. While doing the troubleshooting, Gary and Charlie are also making a detailed "operator's manual" so that other club members can also learn to operate the scope (which is not totally a trivial chore.) When done with this, interested members are invited to "give it a go" using the manual. The more people who can use the scope the better. (That goes for all of our scopes…)

Upcoming Club Events

As mentioned, we are planning our October star party for the week of October 28th to November 1st (again, excluding Halloween). Stay tuned to our email and website for details. We also have a "lecture plus star party" event scheduled for October 30th for the Yarmouth Library and can use 1-2 volunteers. Maybe we can even use the new small scopes that we're ordering!

Initiatives and Committees

We have devoted some time (yet again) on committee structure, and currently are looking at the following committees: Outreach, Website, History, By-Laws, Speakers, Advertising and Publicity, Membership, and Member Technical Activities (Projects). We could particularly use help with: By-Laws, Advertising and Publicity, and Membership. These committees should not be overly strenuous as to workload, and hopefully you might be interested in engaging in one if you have not done so already!

Dues

This year, as we have resumed normal activities, we are requesting dues at a flat rate of $15 per family (or individual, if there is no family to consider. Dues are waived for any students.) Dues were due July 1st. If you have sent our treasurer (Dr. Ken Brink) dues in the last year (during 2024), 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. Thank you in advance!

Speakers

Last Month's Speaker, September 5th: Dr. Antonio Hales, National Radio Astronomy Observatory

Title: ALMA Studies of Eruptive Stars
CV: Antonio Hales is a scientist and the Deputy Manager of the North American ALMA Regional Center at the National Radio Astronomy Observatory (NRAO). He works in astrophysics, education, outreach, and the art-science relationship. Hales is also the lead of the Telescope Interface Group and his research interests include the formation and evolution of planetary systems, protoplanetary and debris disks, and episodic accretion in young stars.

Abstract: Stars are now believed to acquire a significant fraction of their mass in short episodes of accretion outbursts. This episodic accretion picture has replaced the traditional steady-state accretion model. It is changing our understanding of how stars gain their mass (and the origin of the Initial Mass Function), binary formation, planet formation, the luminosity spread in young clusters, disk chemistry, and snowline migration. Despite its relevance to the field, the physical mechanisms responsible for episodic accretion still need to be better understood. In this talk, I will present recent observational and modeling advancements aimed at constraining the physical properties of outbursting sources to help understand what drives this critical phase of star formation.

Precis: Most of us know that stars are born in Giant Molecular Clouds like the Great Orion Nebula (M42), a naked-eye deep sky object which will soon appear in our winter skies. But the details of how stars and planets are born are both complicated and, until recently, very hard to observe. (Instruments which can penetrate the infrared region and have high resolution are needed, such as the James Webb Space Telescope and the ALMA array [Atacama Large Millimeter/ submillimeter Array])

One such complicated young star system is FU Orionis (or FUor for short), a double star system that garnered special attention when it suddenly became 1000 times as bright as usual in 1936. Such sudden brightness changes are not uncommon in older stars but hadn't been observed before in younger stars. This system was the focus of Antonio's talk.

Before going into the details of FUor stars, however, Antonio showed an orientation slide which would be very good to review. It outlines a "standard history" of the birth of a young star and its solar system, which acts as a background for the more detailed study of FUor stars that he presented.

As mentioned above, the story starts with molecular clouds, which are large aggregations of atomic and molecular gas and dust that span about 200,000 AU across. (For those liking large numbers, an AU is 93 million miles. For people liking small numbers, divide AU by 63,240 to get light years. At 200,000 AU, the original cloud is about 3.3 light years across (as I like smaller numbers!)

This cloud collapses gravitationally in only a few thousand years, reducing to an object 10,000 AU across. (Now AU's will begin to make more sense.) At this point, the protostar system begins to evolve, becoming an object about 500 AU across in 10 to 100 thousand years. It has an envelope, a disk, and jets emitting from it.

The next phase is dissipation of the envelope to an object 100 AU across over a 0.1-to-3-million-year period. This object now includes the young star, a disk, jets, and a much smaller envelope. Planet formation comes next in an ~100 AU scale region, over a 3-to-50-million-year timeframe. The planets clear their paths, but there is still plenty of dust and debris around.

Finally, we come to an ~50 AU scale, fully developed solar system, which is roughly the size of ours. While 50 million years may seem like a long time, it is rather brief compared to the lifetimes of smaller stars like our own Sun, which is about 4.3 billion years old, and has at least that much time again to live.

But this is the tip of the iceberg as far as real, current research goes. FUor stars flare up over about a one-year period, and the outburst then lasts for many decades, with the star accreting (on average) about 1/10000 of a solar mass per year. "Episodic" versus steady accretion seems to be a good epitome of the situation. FU Orionis being a binary system, which was resolved by the ALMA array, makes the dynamics of the gas cloud "streamer" around the system that much more interesting. Using the fact that infrared and radio sensing can allow one to identify how individual molecules are distributed and interacting allowed the NRAO astronomers to identify how the streamers and the disc interacted and make modeling predictions that matched what was seen in the data.

This precis can do little justice to the intricacy of the overall story, so let me instead refer you to some much better material – the "ALMA Astronomy News" report Episode 61, which can be found on almaobservatory.org and also the recent Astrophysical Journal paper on the topic, entitled "Discovery of an Accretion Streamer and a Slow Wide-Angle Outflow Around FU Orionis." Its DOI is 10.3847/1538-4357/ad31a1 and it is open access available!

This month's speaker. October 3rd: Kevin Hainline, Arizona University

Topic: Distant galaxies (see note below from Kevin)

While my research topic is ostensibly black holes, in the last few years I've been heavily involved in looking for ultra distant galaxies, and we made a big splash by finding the current record-holder:

https://www.forbes.com/sites/jamiecartereurope/2024/05/31/profound-moment-as-webb-sees-most-distant-galaxy-close-to-big-bang/

https://news.arizona.edu/news/webb-telescope-spots-two-most-distant-galaxies-ever-seen-cosmic-dawn

I'll likely be discussing this at the lecture!

Precis: Astronomers and astrophysicists love the history of their subject, and Dr. Kevin Heinlein is no exception. In his talk about observing the most distant galaxies with the James Webb Space Telescope (JWST), he used that deep and rich history to show how the distance we can see into space kept increasing throughout history with better technology being employed by ingenious practitioners.

The advanced study of galaxies really started with William and Caroline Herschel, who used their (at the time) large telescope facilities to catalogue galaxies in both the North and South hemispheres. One of their most famous results is the New General Catalogue (NGC), which is well known to all amateur astronomers. (William was also a musician who produced some great classical music.)

Fast forward a century or so to the famous Harvard women astronomers who Harvard Observatory director William Pickering gathered as "cost efficient labor."

Apart from being inexpensive to hire, these women were brilliant, and three of them in particular (Annie Jump Cannon, Henrietta Swan Leavitt, and Cecelia Payne Gaposchkin) would be considered for Nobel prizes if they lived today. Of particular interest here is Henrietta Swan Leavitt, who discovered the period-luminosity law for Cepheid variables, which would be the keystone for initially finding the distances to galaxies.

Another key piece of information that would be needed to study galaxies – their radial velocities - could be inferred by the Doppler shifts of their spectral lines. From 1912 on, Vesto Slipher of Lowell Observatory began a serious study of these radial velocities, a fact well known to astronomers, but which sadly gets overshadowed by the work of his (decade later) successor, Edwin Hubble.

Hubble too was interested in galaxies and also had at his disposal the most powerful telescope at the time, the 100" reflector at Mount Wilson. Hubble was troubled by not knowing the distances to galaxies, but also realized that the period-luminosity law that Leavitt had discovered could provide that information if he saw one of the bright Cepheid variables in a galaxy. He found just that in the Andromeda Galaxy (M31), and so became the first person to show that many of the "Nebulae" that astronomers had observed were in fact distant galaxies far outside the Milky Way. Having both the distances and the radial velocities then allowed him to look at the relation between them, which was the straight line which we now call the Hubble Law, v=Hr. Getting distances to galaxies was off to the races. The "cosmic distance ladder" (see the Wikipedia article on this!) had its first rung.

It would be really hard to talk about cosmology in the 1920's without including Albert Einstein, but in Kevin's talk, Einstein was just "this guy standing next to Georges Lemaitre," the Belgian scientist/priest who first characterized the Big Bang in detail by tracking Hubble expansion backwards. The game for astronomers would become (and still is) how close to the Big Bang in time, and thus far in distance, can we see galaxies?

As telescopes and spectroscopy got better over the years, the distances to more and more galaxies grew, but were confined to low redshifts (a distance equivalent) of less than 1. A new "standard candle" was needed. Enter Maarten Schmidt in the 1960's.

Maarten Schmidt is credited as the discoverer of quasi-stellar objects (quasars) which were mysterious, very bright distant objects with a puzzling spectrum. Schmidt figured out that the unusual spectrum was in fact due to the highly redshifted spectrum of hydrogen. The redshift of 1.5 made these the most distant objects yet seen, billions of light years away. We now know that they are active galactic nuclei (AGN's), supermassive black holes in the centers of galaxies which are accreting infalling mass. Given that AGN's are not overly rare, a farther new distance marker had been found.

To get further galaxies, or equivalently to higher redshifts, another technique is needed, and a very useful one is using type 1a supernovae as a standard candle. These supernovae, which are due to the runaway explosion of a carbon-oxygen white dwarf star, are visible at huge distances and have highly reproducible signatures.

Both the quasar and supernova techniques rely on a similar thing – a very bright object embedded in the galaxy of interest. While these are great if present, one can't rely on them being there. If one has a faint galaxy which doesn't have these, another technique called the "Lyman break technique" can be used, which only depends on one getting a spectrum of the galaxy. This technique depends on the sharp break (drop) in the spectrum of galaxies at 912 angstroms while allowing longer wavelengths to go through, this being due to interstellar absorption. As the light from a distant galaxy travels to us, the expansion of the universe redshifts the break to longer wavelengths, which is measurable if one has filtered the spectrum. This technique was the one that Kevin exploited with the JWST.

Kevin's personal sifting of the JWST image data to find likely "high z" candidates showed that an experienced human scientist is still a vital ingredient in doing such research, though perhaps if the volume "candidate galaxies" for spectral analysis becomes high enough, a more machine-oriented process may be developed. (Of course, once a candidate is picked from visual images, training the JWST on it to take spectra takes additional time and effort.)

The curve of "highest z galaxy vs. calendar year that Kevin showed was particularly interesting, in that it looked very much like an exponential growth curve. Given the amount of resources and equipment power versus time, this is perhaps not surprising, but it is still striking. It should be noted that this curve will

only go up to 1100, and not infinity, as that is where the cosmic microwave background begins. Past there is optically opaque.

As a closing note, Kevin invited people to “zoom in to” distant galaxies using the software that is available on his website, which can be found at

https://
kevinhainline.github.io/

I would encourage you to take a look!

November 7th Speaker: Jim Lynch, WHOI/CCAS

Topic: A digital Higgs universe and the flow of time

Abstract: As many CCAS members know, I've been working over the past two years on some "just for fun" cosmology theory to present to our club as one of our First Thursday talks. The topic I looked at is: “What happens if you try to go faster than light?” In pursuing this, some very interesting results about the nature of space, time, and the evolution of our universe were produced. These results seem consistent and perhaps constitute a serious new look at cosmology. Maybe we live in a universe where the Higgs field produces more than just a very famous boson?!

December 5th Speaker: Dr. Mario Motta, Title TBA

https://www.mariomottamd.com/

CV: Mario is well known as an astronomer. Working with the American Association of Variable Star Observers, Harvard–Smithsonian Center for Astrophysics, and MIT, he has numerous observations and publications. In 2013, the International Astronomical Union named an asteroid in his honor. (asteroid *133537mariomotta)* In the astronomical community, Dr. Motta is well known for his large and completely homemade telescope and observatory including the optics, a 32-inch f6 telescope.

Directions to Dennis Yarmouth HS and Werner 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 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.