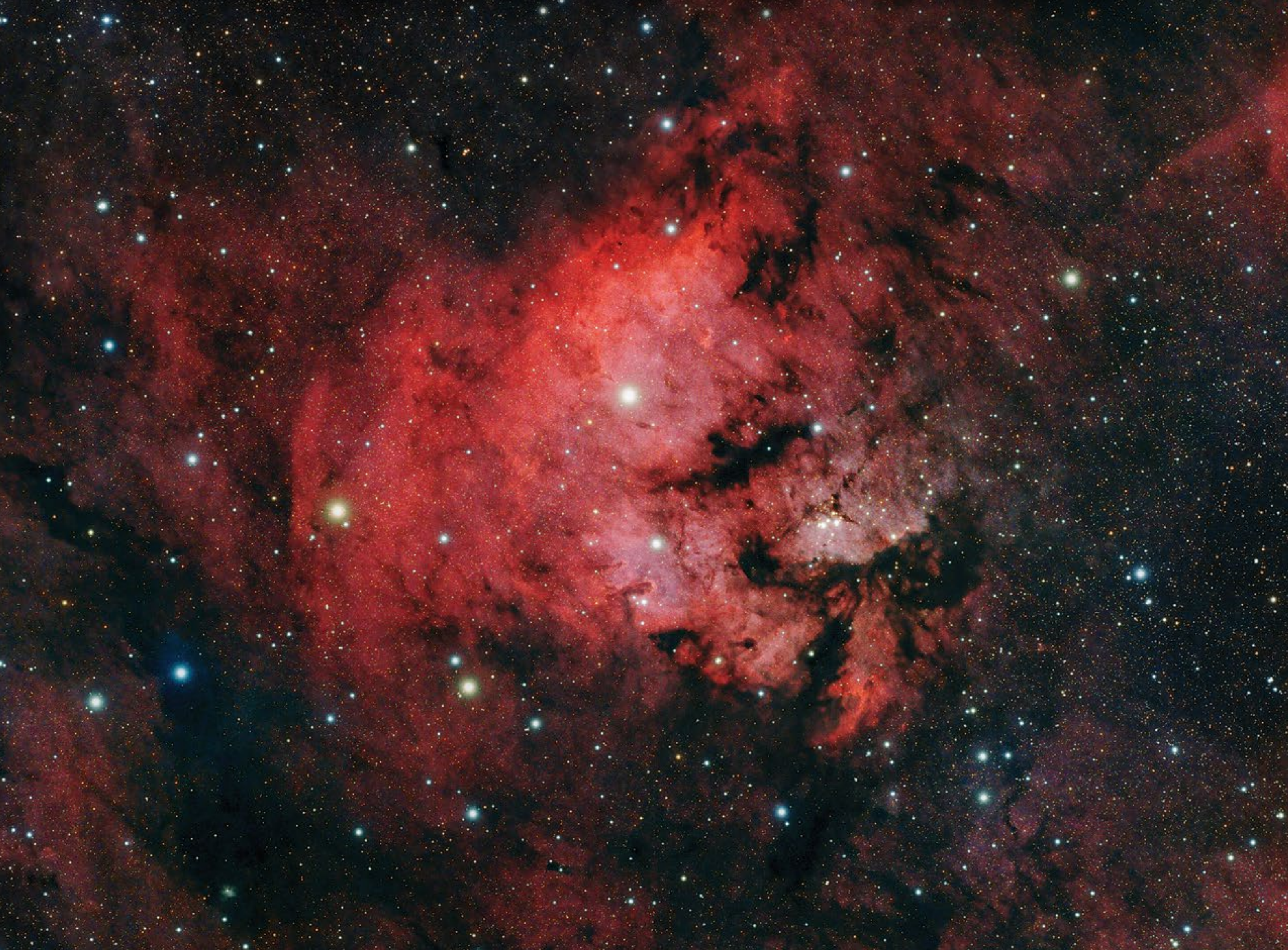
Published by the Astronomical League
Vol. 71, No. 3 June 2019

Reflector



MARTIAN ICE

HOW ONE NEUTRINO CHANGED ASTROPHYSICS

REMEMBERING TWO FORMER LEAGUE PRESIDENTS

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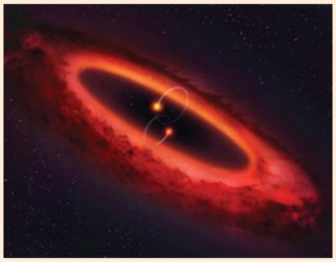
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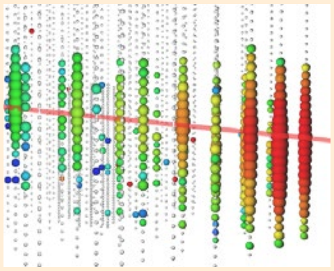
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Cover image: *Terry Hancock (Western Colorado Astronomy Club) took this fantastic image of NGC 7822 from his Grand Mesa Observatory using a Takahashi FSQ-130 with a QHY color CMOS camera. The image is shown rotated 90° from its original presentation and cropped to fit our cover format.*

Reflector

The Astronomical League Magazine

Vol. 71, No. 3 • ISSN: 0034-2963 • June 2019

A FEDERATION OF ASTRONOMICAL SOCIETIES
A NON-PROFIT ORGANIZATION
To promote the science of astronomy

- By fostering astronomical education,
- by providing incentives for astronomical observation and research, and
- By assisting communication among amateur astronomical societies.

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Reflector

QUARTERLY PUBLICATION OF THE ASTRONOMICAL LEAGUE

Issued by the Astronomical League in March, June, September, and December, *Reflector* (ISSN: 0034-2963) is sent directly, either by postal mail or via a digital link, to each individual member of its affiliate societies and to members-at-large as a benefit of League membership. Individual copies of *Reflector* are available at the following subscription rates, payable to the League's national office.

PAPER SUBSCRIPTIONS:

USA & possessions: $3.00 each or $10.00 per year (4 issues)
Canada: $5.00 each or $16.00 per year
Mexico: $6.00 each or $22.00 per year
Other countries: $7.00 each or $25.00 per year

DIGITAL SUBSCRIPTIONS:
All countries, possessions, and territories: $10.00 per year

***REFLECTOR* AND CLUB ROSTER DEADLINES**

March issue	January 1
June issue	April 1
September issue	July 1
December issue	October 1

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President's Corner

I cannot remember the last time I attended the Northeast Astronomy Forum (NEAF), but it must have been at least 25 years ago. Having lived outside the United States for most of the years between 1974 and 2000, there were few opportunities to attend the conference, and frankly, on most of my travels back to the USA, the focus was on my job with Royal Dutch Philips, the European electronics conglomerate. There was very little time for side trips.

Finally, this past April, the spell was broken. NEAF was an event that can truly be classified as amazing. With more than 100 vendors, a great group of speakers, and tons of "astrobuffs" looking for the latest and greatest "astrogizmos," I doubt that too many were disappointed.

For me, it was also a time to reconnect with old friends. Having lived in Brooklyn until 1968, I remembered many people. Whether or not they remembered me was another story altogether. There was some disappointment. The only old colleague I ran into was John Pazmino, and after a short talk, we determined we had not seen each other for more than 50 years! We hoped to spend more time together, but he had a booth to take care of, as did I.

Several hundred people visited the Astronomical League booth, many of whom were present or former members. Amazingly, almost half had never heard of the League. These unfortunate souls were given the full treatment about what we are, our history, and an open invitation to join. Most left with loads of information about us and a promise to join our ranks.

We are presently putting the finishing touches on preparations for ALCon 2019, to be held in Florida. On Wednesday, July 24, we will have our annual council meeting. Thursday will have a special tour of Kennedy Space Center, the Star-B-Que, and the presentation by our keynote speaker. On Friday we board the ship, Mariner of the Seas, for a three-day cruise to the Bahamas. Saturday includes the League business meeting, National Young Astronomer Award winner presentations, time to visit Nassau, welcome remarks, a presentation by Dawn Davies, and binocular viewing on the helicopter pad.

Sunday will find us at CocoCay, a private island developed by Royal Caribbean, which includes a variety of water-related activities. Or, if you prefer, you can stay onboard and listen to presentations (Night Sky Network and a discussion by Al Lamperti on a 3-D tour of the Universe) and panel discussions (How to Gain and Keep Members, Improving Diversification with the League and Clubs). We leave CocoCay at 5 p.m., with dinner and presentations by National Young Astronomer Award winners. The ship returns to Port Canaveral on Monday morning, signaling the end of ALCon 2019.

We then continue the planning for ALCon 2020, scheduled for Albuquerque, plus a new ALCon Jr. STEAM Conference event aimed at the younger astronomers. More news to follow.

HELP WANTED

We still need to fill a few volunteer positions. First, our webmaster has decided to retire (to get back to observing) and we need a replacement, or several replacements. There is an immediate opening for his position. If you wish to support your League, contact me at *president@astroleague.org*.

Second, we are looking for a volunteer who has experience in securing grants to work on funding additional programs within the League. This program is not yet finalized, but we are already looking for someone with successful experience in grant writing at the local, regional, and national levels. If you have this unique talent, please let me know at *president@astroleague.org*. We want to discuss this further at the upcoming council meeting on Wednesday, July 24.

Details and requirements for this position is in the "Help Wanted" ad on page 11.

Keep looking up.

—Ron Kramer

All Things Astronomical

DOUBLE STAR SYSTEM FLIPS PLANET-FORMING DISC INTO POLE POSITION

New research led by an astronomer at the University of Warwick has found the first confirmed example of a double star system that has flipped its surrounding disc to a position that leaps over the orbital plane of those stars. The international team of astronomers used the Atacama Large Millimeter/Sub-Millimeter Array (ALMA) to obtain high-resolution images of the asteroid belt–sized disc.

The overall system presents the unusual sight of a thick hoop of gas and dust circling at right angles to the binary star orbit. Until now this set-up only existed in theorists' minds, but the ALMA observation proves that polar discs of this type exist, and may even be relatively common.

The new research was published on January

14 by Royal Society University Research Fellow Dr. Grant M. Kennedy of the University of Warwick's Department of Physics and Centre for Exoplanets and Habitability, in *Nature Astronomy.*

The paper was entitled "A circumbinary protoplanetary disc in a polar configuration." According to Dr. Kennedy,

> Discs rich in gas and dust are seen around nearly all young stars, and we know that at least a third of the ones orbiting single stars form planets. Some of these planets end up being misaligned with the spin of the star, so we've been wondering whether a similar thing might be possible for circumbinary planets. A quirk of the dynamics means that a so-called polar misalignment should be possible, but until now we had no evidence of misaligned discs in which these planets might form.

Dr. Kennedy and his fellow researchers used ALMA to pin down the orientation of the ring of gas and dust in the system. The orbit of the binary was previously known, from observations that quantified how the stars move in relation to each other. By combining these two pieces of information they were able to establish that the dust ring was consistent with a perfectly polar orbit. This means that while the stellar orbits orbit each other in one plane, like two horses going around on a carousel, the disc surrounds these stars at right angles to their orbits, like a giant Ferris wheel with the carousel at the center.

Dr. Kennedy added:

> Perhaps the most exciting thing about this discovery is that the disc shows some of the same signatures that we attribute to dust growth in discs around single stars. We take this to mean planet formation can at least get started in these polar circumbinary discs. If the rest of the planet formation process can happen, there might be a whole population of misaligned circumbinary planets that we have yet to discover, and things like weird seasonal variations to consider.

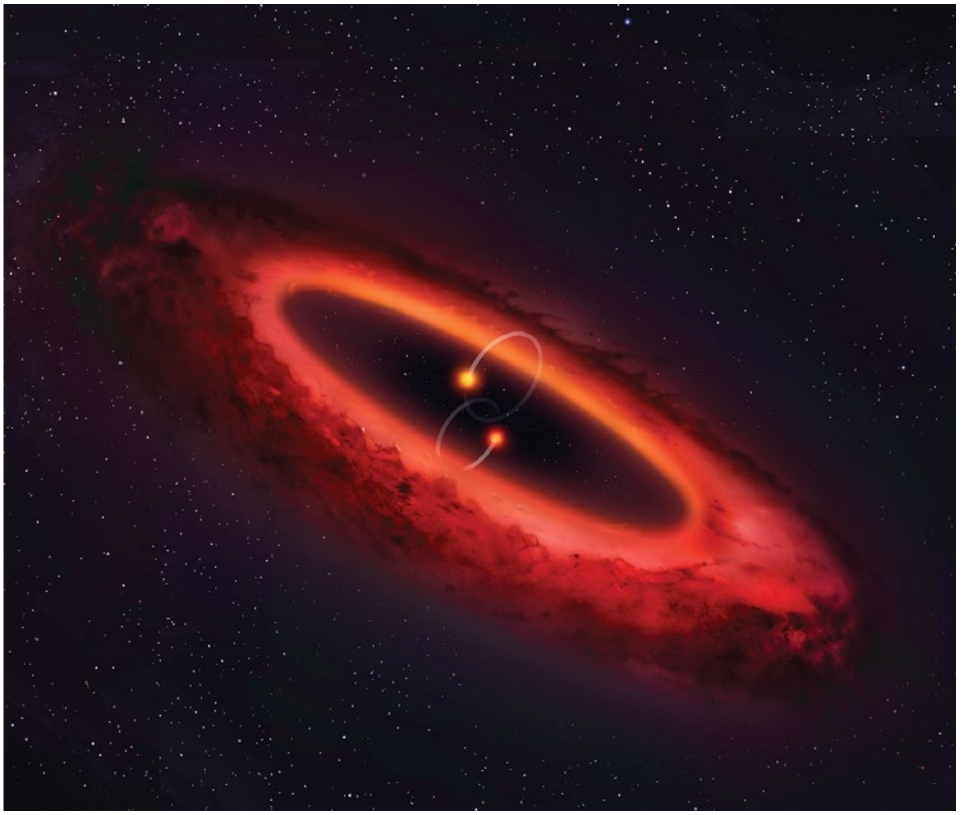
If there were a planet or planetoid present at the inner edge of the dust ring, the ring itself would appear from the surface as a broad band rising almost perpendicularly from the horizon. The polar configuration means that the stars would appear to move in and out of the disc plane, giving objects two shadows at times. Seasons on planets in such systems would also be different. On Earth they vary throughout the year as we orbit the Sun. A polar circumbinary planet would have seasons that also vary as different latitudes receive more or less illumination throughout the binary orbit.

Co-author Dr. Daniel Price of Monash University's Centre for Astrophysics (MoCA) and School of Physics and Astronomy said:

> We used to think other solar systems would form just like ours, with the planets all orbiting in the same direction around a single sun. But with the new images we see a swirling disc of gas and dust orbiting around two stars. It was quite surprising to also find that that disc orbits at right angles to the orbit of the two stars.
>
> Incredibly, two more stars were seen orbiting that disc. So if planets were born here there would be four suns in the sky!
>
> ALMA is just a fantastic telescope, it is teaching us so much about how planets in other solar systems are born.

The research is supported by the Monash Warwick Alliance, established by the University of Warwick in England and Monash University in Australia in 2012. The full research team for this paper were lead author Dr. Grant M. Kennedy; Luca Matrà and David J. Wilner of the Harvard-Smithsonian Center for Astrophysics; Stefano Facchini of the Max-Planck-Institut für Extraterrestrische Physik; Julien Milli of the European Southern Observatory; Olja Panić of the School of Physics and Astronomy, University of Leeds; Daniel Price of Monash University's Centre for Astrophysics and School of Physics and Astronomy; and Mark C. Wyatt and Ben M. Yelverton of the Institute of Astronomy, University of Cambridge.

—from Warwick University press release



Artist's view of the double star system and surrounding disc. Images this page ©University of Warwick/Mark Garlick

Full STEAM Ahead

CONVERSATIONS AT A STAR PARTY

My first time at the Winter Star Party was this February, and it was in one of our (hubby and my) favorite spots – the Florida Keys. It was a new crowd for us. The atmosphere did not disappoint: warm ocean water, light cool breezes for our 70- to 80-degree days. Although there had been some serious hurricane damage to the buildings at Camp Wesumkee, you could tell the WSP crowd called this location home. We checked in, and I realized my hubby listed me as the Astronomical League STEAM and accessible outreach coordinator. A conversation ensued right away, and I explained how I had taken over the League's youth coordinator position.

The WSP volunteer mentioned that in the not-so-distant past this star party had a regular group of kids and families. The woman who led the youth activities was a teacher, to the degree that the week's activities fit the educational standards, so the kids were on a "field trip" instead of an "unexcused absence." Pretty smart! But when her children moved on to higher education, this left a vacancy in the Winter Star Party offerings. He continued to say that they want to bring this back, but how do you attract families? And immediately (like that download scene from *The Matrix*) I started to share four or five ideas with him, and he asked if I could write them down. I gave him my card, and he said he would make sure that it got to the outreach coordinator if she was interested. I offered to come back and conduct a couple of activities at next year's star party if they needed help.

Not long after, I encountered a couple who help coordinate another star party we attend that has lots of elementary-aged kids (about two to three dozen). So, with the WSP conversation fresh in my mind, I asked them why nothing is planned for the elementary kids during the day – all the attention is on high school students for the weekend. I suggested coming up with STEAM activities for this particular star party and added that I would be happy to help. Crickets. Not even a response! Are we missing a key opportunity to make an impact at the elementary student levels? Don't get me wrong – this particular star party goes out of its way to prepare gift bags and prizes for every one of those children. But what about meaningful engagement?

As the week continued, I listened to folks talk about outreach, even several of the vendors, all passionate, dedicated, and energetic folks who love the art of engaging the public. It was funny how those of us who are fans of John Dobson roll with spontaneity and have organic and fun encounters. Several shared how their clubs worked together to come up with new and fresh ideas, which were very inspiring, to say the least. One fellow RVer from Naples, Florida, said he knew of three clubs that are either circling the drain or are no longer around due to unwillingness to rethink how they do things. It seems a lengthy business meeting was their priority, instead of developing a program or talk geared to the families and novices attended every month. The families and novices soon left for lack of connection. Another neighbor commented how people in his club hold positions but don't support the outreach plans of the club because of their "this is the way we have always done it" mentality. He further stated sadly that it created schisms and zero teamwork. The lack of rotating positions in the club (basically others stepping up and taking their turn) has caused some to be "stuck" doing a job that has taken a lot of time of (and caused an energy drain on) these members for multiple years with no one giving them a reprieve.

Let's team up to initiate a paradigm shift that will allow us to have what we have never had before, because we did what we have not done before. It's called "thinking outside of the box!" Why are people so afraid to change the way they think for the betterment of the whole? Why do we struggle to attract, motivate, and keep newbies so we can train them and then pass the torch to them? I know from personal experience that being a right-brained, out-of-the-box thinker and problem solver scares most folks. But what if, for the sake of passing on the legacy of the hobby we dearly love, we simply just come together and "get 'er done?"

So, here are my ideas for student STEAM activities at star parties to begin a paradigm shift.

1.If you are at a state or national park with a naturalist or ranger on site, enroll it to become an IDA Urban or Dark Sky Park. You now have a partner with the naturalist or ranger to run a few sessions like the biology/botany/zoology part of the park by conducting a night hike or nature walk, bird watching, etc. during the day. Of course, running the IDA ranger program would be a shoo-in. This provides a good start for star party STEAM family activities.

2. Conduct the GLOBE @ Night monthly star counts. This ties into idea 1 beautifully and should be marketed as a "citizen scientist" program where help is needed to provide national and international data on light pollution encroachment. Talk about advocacy and the impact on local wildlife and biomes and how people can change their local community.

3. Have solar observing where there is sketching and logging of sunspots and prominences. With iPhone adaptions or running a scope with an iPad, let the students take pictures. We have done this with the Moon and they post the pictures to their Facebook pages with such excitement. Note: make sure that safety is your top priority!

4. Conduct a constellation or asterism recognition or identification session where guests are encouraged to log and sketch what they see. Provide black sketching paper on a clipboard and white pastel art pencils then let them loose. You could have giveaways or certificates for this.

5. This can be tied into idea 4 – have a star lore night. Wouldn't it be great to bring in someone who knows the history of the area and can tap into the culture and ancient history of the area? Does the location have an archeoastronomical connection? Combine this with a night hike, with special speakers or performers (storytellers).

6. My favorite quick, hands-on activity is the *Sky & Telescope* star wheel – such a great tool. Plus, I use *skymaps.com*, which shows where the planets are on the ecliptic, and lists objects categorized as naked-eye, binoculars or small telescope, and larger apertures. Families will not only have a great beginner observing list but maybe a kick-start to developing astronomy as their hobby.

7. For families and students, generate a reasonably easy or moderate observing list and run a cosmic scavenger hunt. Give them the full week to complete it, with a certificate and maybe a cool prize for different levels of achievement like 20 out of 20, 15 out of 20, and so on.

8. Dig out your Night Sky Network kits – why struggle to reinvent the wheel? These kits are generated to help people who are not educators to teach astronomy concepts. You can plug in a willing new helper, because there is an actual script and the kids won't care if you are following notes or not.

9. Look through NASA's Space Place for kids *(spaceplace.nasa.gov)* where there are countless ideas, most of which are geared to the elementary level. There are also are myriad websites and books available to help. My latest discovery is the book *Astronomy Lab for Kids: 52 Family Friendly Activities* by Michelle Nichols.

Promoting your family-centered star party activities can be as simple as making a half-sheet flier or bookmark. Make sure your club's name, information, and website address are prominently included. Include an invitation such as "please join us," or "you are cordially invited to," followed by a list of offerings such as naturalist talks, nature walks and star lore, citizen science programs, dark-sky advocacy training, STEAM activities, nighttime observing training, and giveaways. Make sure you get these fliers and bookmarks into the local schools and library system! Some local community papers just for families will also list kids' activities for free.

The world of amateur astronomy is at the apex of a "make it work" moment in time, not only to pursue the next generation of future astronomers, but to keep our veteran astronomers and the new "relief pitchers" as connected and engaged as possible. So, I guess it boils down to a choice – do we stay stuck in the comfort of the past, or step up and spark a paradigm shift for the future? You know me, I'm full STEAM ahead!

—Peggy Walker

Night Sky Network

CREATING A CULTURE OF OUTREACH IN YOUR CLUB

Public outreach is rewarding, fun, and vital to club membership, but if just a few members participate, you run the risk of burning them out. It's the curse of success partnered with enthusiasm; it may even have happened to your club! The Night Sky Network has done research on astronomy club culture across the United States and found that this and related issues occur across clubs of all sizes. These difficult problems can be addressed by creating a culture of outreach within clubs. By nurturing an outreach-friendly culture, a club can help prevent burnout while simultaneously recruiting new people into their programs. A culture of outreach coexists with a strong volunteer spirit, helping your club become a dynamic place where members want to contribute. Four techniques that can help your club thrive are setting limits, recruiting inside and out, simplifying roles, and recognizing work.

Setting limits for club activity is essential to creating and maintaining a volunteer-rich club culture. We'll address two types of limit-setting here: term limits and outreach limits.

Term limits keep club leadership dynamic and members engaged and interactive with the club's activities. New officers offer fresh perspectives on club matters and can try out new ideas and activities while still celebrating established traditions. If your club has a history of long-running officers, it can be understandably difficult to break with this practice, especially if they are great at their jobs. On the flip side, other members may find that they appreciate the work done by the club much more once they take their turns recording meetings, updating social media, or finding speakers. With clear job responsibilities outlined for each position, the transfer can be relatively painless and distribute the burden of administration.

If your club receives more requests for outreach events than it can handle, don't be afraid to turn folks down! It is great to be wanted, but don't burn yourself and fellow club members out by overcommitting. Limits are your friend here, too. Suggest that interested scout or school groups attend one of your already scheduled public events. While you want to please everyone, you will end up pleasing no one when members get overwhelmed and stop wanting to participate. It's okay to set limits, and people are usually very understanding. Of course, with more volunteers, your club will be able to participate in more events, bringing us to...

Recruiting is like tending a garden: it never ends, but attentive work pays dividends. Clubs need to focus not only on recruiting new members at public outreach events, but on encouraging those new members – along with established members – to take on support roles within the club. While an announcement at a club meeting or newsletter may sometimes help fill these roles, the strongest connections are often made in person. Have you noticed a club member who takes notes at every meeting? They may make a great secretary or club archivist! Don't be afraid to ask, but be ready when you do. A one-on-one conversation combined with a realistic job description and easy training techniques greatly eases the task of finding great volunteers within the club.

Simplify club roles where you can! You may find that one person had performed several different tasks in their role. For some individuals and clubs this may be okay, but always make sure to note if one person is taking on the lion's share of duties. A good rule of thumb is that club administrative work should take three to six hours a month. Roles demanding more work may require splitting of duties to help out. For example, the club president or treasurer may need a membership coordinator to keep up with dues.

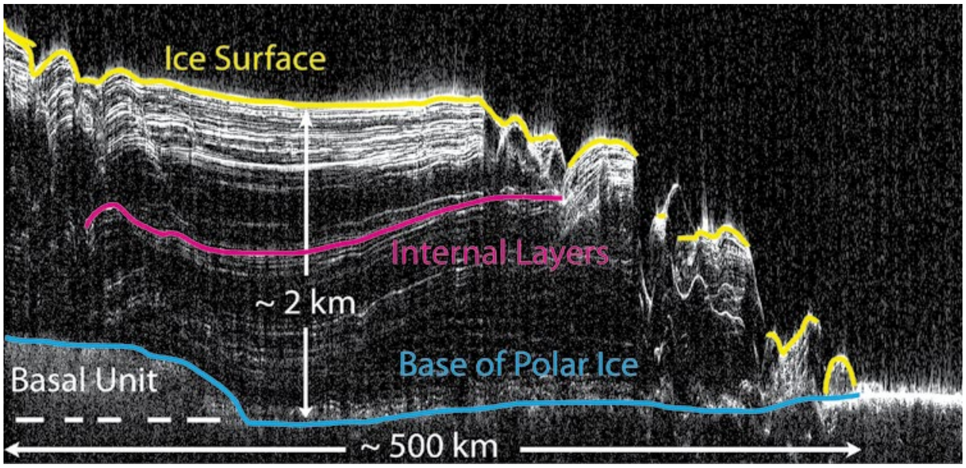
Recognizing your fellow club members' great work is vitally important, and of all these practices, it's the most fun. Many clubs have annual award ceremonies where their volunteers are recognized for their hard work throughout the year. Honor the club members who earn the Astronomical League's Outreach Award! Many clubs give the Night Sky Network's annual award pins and certificates to their volunteers for their for outreach efforts every year. Always remember to thank your fellow volunteers at events, including members working behind the scenes: it can have a big impact on their well-being.

Research through a National Science Foundation grant led longtime club members and educators at the Astronomical Society of the Pacific to create a handy tip sheet and companion video about "Cultivating Volunteers." You will find these and other club-tested ideas for growing your astronomy club at *bit.ly/GrowYourClub*. (Note that the URL is case-sensitive.)

Good luck, and may your club thrive!

—Dave Prosper

Wanderers in The Neighborhood



Mars Reconnaissance Orbiter's Shallow Radar (SHARAD) instrument's data shows a cross-section of a portion of the North polar ice cap of Mars. The radar beam is reflected off the ice layer boundaries, causing them to be represented in the image by horizontal white lines. This polar ice pack is 1.2 miles thick and 155 miles across. Images such as this allow researchers to understand how the polar ice cap formed over time by analyzing the individual layers. Image Credit: NASA/JPL-Caltech/ASI/UT

THE RED PLANET

This year has seen one of the closest approaches of Mars to the Earth since 2003 and it will not be this close again until 2035. At its closest, the Red Planet had a disk that was 24.30 arcseconds across, reaching magnitude –2.78. This is brighter than Jupiter, which is usually the second-brightest planet in our sky. It was a red beacon shining in our summer sky.

Mars has always been a particularly interesting planet in our Solar System, at least in the public's mind. Even in ancient times, the bright moving star that was the color of blood became the god of war. Once the telescope was invented, the visible surface of Mars became the backdrop for many fantasies and science fiction.

Whether John Carter was rescuing Dejah Thoris or Tom Corbett, Space Cadet, and his crew was trudging across the dry martian desert toward a canal after their rocket crashed, Mars has been the locale of many adventures. One of the most recent is the realistic 2015 film *The Martian*, in which an astronaut is accidentally left to fend for himself on Mars.

Early telescopic observations of Mars revealed areas that appeared to be greenish – thought at the time to possibly be vegetation. The early maps of canals on Mars actually resulted from a mistranslation of the Italian *canali* into "canals," rather than the correct "channels." Canals were assumed to be made by intelligent beings. Once the word got out that there were canals on Mars, people's imaginations went wild. Some observers even reported people wandering around in oases near the canals.

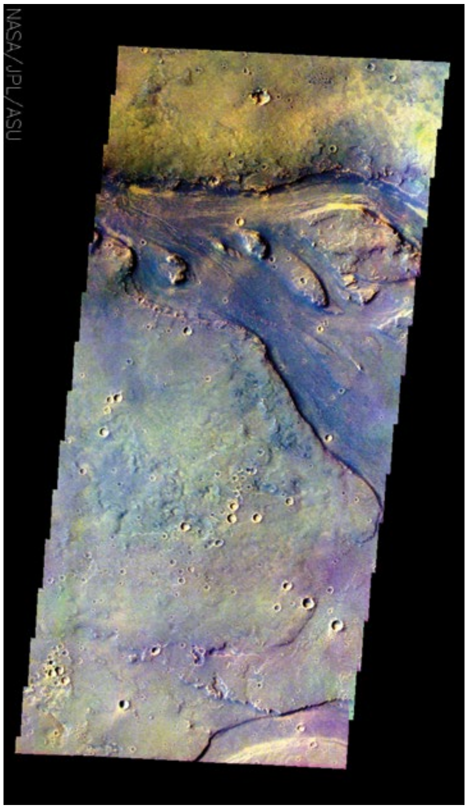
This fascination with Mars has led the spacefaring nations of Earth to send many spacecraft to the planet. The first spacecraft to take closeup images of the surface of Mars was NASA's Mariner 4, which flew past the planet on July 14, 1965, imaging a small swath of the surface. The resulting images showed no canals (or even channels) on Mars, but a surprising multitude of craters. Later it was discovered that Mariner 4 had imaged one of the few ancient areas of the surface. Much of Mars is devoid of craters, and the canals drawn by early observers were just differences in the reflectivity of the surface (called albedo features), mixed with bad seeing and vivid imaginations.

Since then, spacecraft have orbited Mars and landed on its surface. The first spacecraft to land was Viking 1, landing July 20, 1976. The instruments on Viking 1 (and its sister vehicle Viking 2) were thought at first to have shown chemical evidence of microscopic life, but later it became clear that the chemical reactions were caused by inorganic material in the soil. Since the images from Viking did not show any little green people walking around, the results were inconclusive, but disappointing

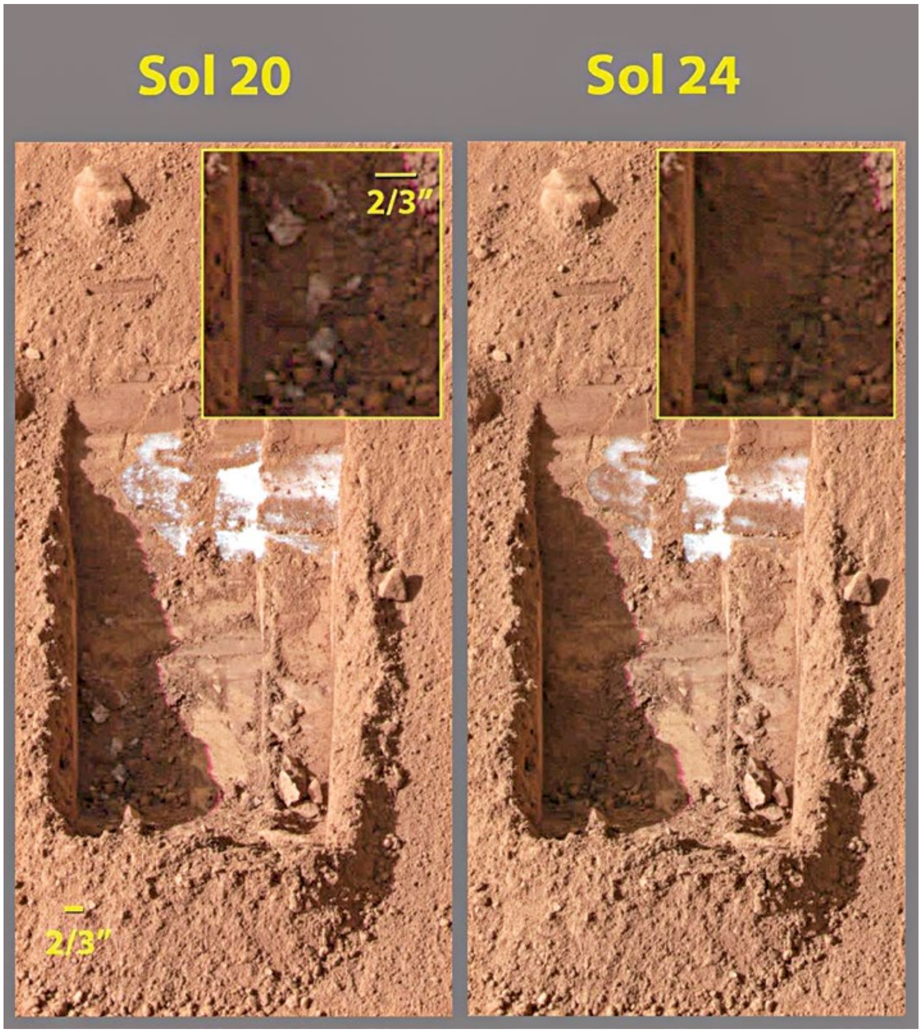
Other spacecraft have searched for life, but the extremely thin atmosphere and the lack of water on the surface make Mars very inhospitable to life. The atmosphere has a surface pressure just 0.6 percent of the pressure here on Earth. Combined with the subfreezingly cold temperatures, liquid water cannot remain on the surface for very long. Without a protective magnetic field and an ozone layer, ionizing radiation pours down, destroying any life that may have been on the surface at one time. Since it became clear that life would not be found above ground, the focus of the spacecraft missions slowly changed from finding life to finding water to support a human colony on Mars.

Human-built orbiters have been circling the planet for over 47 years, since Mariner 9 entered orbit in 1971. They have imaged and scanned the surface with various instruments in the infrared, visible, and ultraviolet wavelengths and with radar. A huge canyon now named Valles Marineris (Mariner Valley) stretching over 2,500 miles was an early discovery. The giant Olympus Mons volcano and the three nearby Tharsis Plateau volcanoes were more surprises. The outflows from this volcanic activity reshaped the surface, covering and erasing the ancient cratered surface with smooth lava plains.

Almost anywhere astrogeologists have looked on Mars, a new discovery awaited. Among the geological features were clear signs that a liquid, most likely water, flowed across the martian surface in the ancient past. Floods cut vast outflow channels were cut into the surface.



Major floods of liquid water across the surface of Mars caused the erosion features depicted in this image of the Tinjar Vallis (Latin for valley). The flow came from the sudden release of underground water, either from seismic activity or a meteorite impact that broke a natural dam. This image was taken during the northern martian spring by the Thermal Emission Imaging System (THEMIS) VIS camera on the Mars Odyssey orbiter on October 20, 2002. NASA/JPL-Caltech/Arizona State University.



NASA's Phoenix lander was the first spacecraft to directly image water ice on the martian surface. The spacecraft's claw dug this shallow trench uncovering the ice just below the surface. The trench, informally called "Do-do-Goldilocks," not only revealed the ice, but some lumps in the lower left corner of the left image sublimated (changed state from ice directly to water vapor) over the four days between images (June 15 and 19, 2008). Image credit: NASA/JPL-Caltech/University of Arizona/Texas A&M University.

These outburst floods appear to be episodic but rare. When they occur, huge volumes of liquid water are released to flow across the surface. These are comparable to the largest floods here on Earth. The water came from subsurface aquifers sealed by ice that were ruptured by a meteor impact or volcanic activity.

These outflow channels are different than the valley networks, which are more like terrestrial rivers. Drainage basins where smaller channels merge into larger channels which then merge into a large channel mimic terrestrial river basins. There are also river deltas and lakebeds visible from orbit. In addition, surface studies by landers have found minerals that could only have formed in the presence of water.

Other features on the surface suggest that ground ice is still just below the surface. Gullies and slope lineae (long, straight marks) along cliffs and crater walls are more recent, which suggest that water flowing on the surface still alters the martian surface, but much less than in the ancient past.

While the polar caps on Earth are made of frozen water, on Mars, where the temperature can get as low as –226 °F, they are mostly frozen carbon dioxide. However, fifteen percent of the visible polar caps are water ice. The martian poles become larger in winter as carbon dioxide from the atmosphere freezes onto the surface; it then sublimates (changes directly from solid to gas) back into the atmosphere in the summer.

Underlying the visible polar caps is a layer of ice. At the south pole it has been measured to be 2.3 miles thick – this may be the remains of an ancient ice sheet that covered the pole. Near the north polar cap, the Phoenix lander was able to scrape away dirt on the ground surface to reveal the top of an ice layer, providing the first visible proof of water on Mars. There may even still be liquid water below the ice layer of the polar cap. If all the water in both polar ice sheets melted, it would cover the surface of Mars to a depth of 29 feet.

Colonization of Mars would be a difficult and dangerous undertaking. The environmental factors that prevent life on the surface would also kill any human inadvertently exposed to them. Nevertheless, one of the most critical factors for establishing a colony – water – is available in abundance on Mars. Maybe one day we will see some of those science fiction tales become science fact.

—Berton Stevens

Deep Sky Objects

HARP ON NGC 6791

Lyra is one of the smaller boreal constellations of the 88 that adorn the heavens. However, it is vastly more recognizable than other nearby small constellations such as Sagitta and Vulpecula. Sagitta and Vulpecula lie within the milky swath that is the plane of our home galaxy. Their brighter stars are all but lost in our galactic glow. Lyra, on the other hand, lies just above the Milky Way's main glow. This gives its brighter stars greater contrast against a darker background.

Lyra is also well known because it contains the fifth brightest star in the nighttime sky, Vega, which shines at zero magnitude. The stars Vega, Epsilon Lyrae, and Zeta Lyrae form a equilateral triangle. The four stars Zeta, Delta, Gamma, and Beta Lyrae form a distinct naked-eye parallelogram. These geometric formations aid star hoppers finding two popular objects in Lyra: the Ring Nebula, a.k.a. M57, located almost midway between Gamma and Beta, and the double-double star, Epsilon Lyrae. M57 is one of the most viewed planetary nebulae in the northern hemisphere. Epsilon Lyrae is a fantastic quadruple star system that can be resolved by a 3-inch refractor at 100x if seeing conditions are excellent. Lyra is also home to a small globular star cluster, M56. But in this column, instead of featuring the globular star cluster, I want to concentrate on Lyra's best open star cluster, NGC 6791.

NGC 6791 is located approximately 8.5 degrees east and slightly south of Vega. It is also one degree east-southeast of the fourth-magnitude star Theta Lyrae. The outer Milky Way crosses the eastern edge of Lyra. In skies free of moonlight and light pollution, NGC 6791 appears within the Milky Way's chalky glow.

My image of NGC 6791 was taken with a Stellarvue 102 mm f/7.9 refractor with a 0.8x focal reducer and field flattener to yield f/6.3. The exposure was 40 minutes using an SBIG ST-2000XCM CCD camera. In the image north is up and east is to the left. The brightest star in the image is 6.2-magnitude SAO 68129 located in the lower right corner. The faintest stars in the image are dimmer than magnitude 18.

NGC 6791 lies 13,000 light-years away. The cluster is thought to contain a mass equal to 5000 suns. The cluster orbits the center of the galaxy at a radial distance of 26,000 light-years, placing it about the same distance from the galactic center as us. Visually, the cluster is magnitude 9.5 and spans a diameter of nearly 16 arcminutes. The cluster is easily resolved into hundreds of stars with an 8-inch telescope. The main part of the cluster is contained within a ten-arcminute area. Outside that area, it is visually difficult to distinguish the cluster's stars from foreground or background stars.

At first glance in a small telescope, NGC 6791 might appear to be a sparse globular cluster, but it is not. A few summers ago, I viewed this cluster on Kauai with Paul Jardin and Bob Kuzy using Paul's 20-inch Dobsonian reflector. This behemoth Dob resolved the cluster into what appeared to be thousands of stars down to nearly 17th magnitude. But the cluster contained neither the dense core nor the glow of hundreds of thousands of unresolved stars seen in globular star clusters. I cannot recall ever seeing an open star cluster with so many stars!

Based on studies of its stars, NGC 6791 is estimated to be eight billion years old. This is extremely old for an open star cluster. The stars in the cluster have about twice the iron to hydrogen ratio as our Sun, another oddity for a star cluster of that age. NGC 6791 is indeed a unique open star cluster and should be on everyone's list of objects to view this summer while exploring the constellation Lyra.

—Dr. James R. Dire
Kauai Educational Association for Science and Astronomy

HELP WANTED

After 12 years, our **IT MANAGER** is retiring. We have immediate openings for people with experience in:

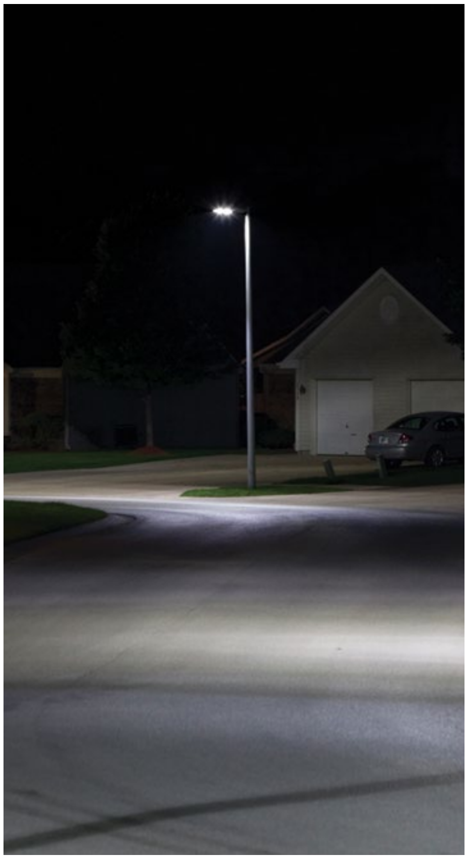
- Unix and the Ubuntu operating system
- Configuring firewalls and host intrusion detection system (HIDS) software
- Apache web server configuration and SSL certificates
- Administration of a Drupal content management system and programming Drupal modules

HELP WANTED

In addition, we have a new volunteer position: **GRANT WRITER.** The qualified person will have experience in successfully writing and securing financial grants at the local, regional, corporate, and national levels. These grants will enable your League to develop additional programs in outreach, observing programs, expansion of the *Reflector,* STEAM, and a host of other projects. The League does many great things with an annual budget of about $100,000. Imagine what we could do with an additional $25,000 or $50,000 per year. Literally, the sky is the limit.

NOTE: THESE ARE VOLUNTEER POSITIONS. Contact *president@astroleague.org* if you are willing to take on either challenge.

The International Dark-Sky Association



LED PRACTICAL GUIDE

Light-emitting diode (LED) technology has changed how we use outdoor nighttime lighting. Several previous columns have discussed this technology and its potential effect on the night sky. LEDs are tiny light bulbs that don't have a filament to burn out, and they don't produce much heat. They are fairly energy efficient, and multiple tiny LEDs are fitted into a matrix and placed into a luminaire for lighting. They have the advantage of not requiring a warm-up period, and they can be easily dimmed and remotely controlled via a computerized system. Thus, LED streetlighting could be dimmed or turned off later in the evening as traffic decreases. A significant feature of LED lighting is its long life, with no major decrease in light output as the LEDs age.

Ideally, LED technology coupled with modern luminaire design means nighttime outdoor safety, security, and recreation could be achieved with reduced illuminance, energy savings, and reduced carbon emissions from decreased electricity use. Unfortunately, initial experience with LED lighting in some communities has shown a rebound effect in which the cost savings have led to increased LED installations, since one can now get more lighting for the same cost. This is one of many instances in the history of technology where improved efficiency for use of a resource has been cancelled by an increased consumption of the same resource due to increasing demand brought about by the reduced cost of the resource.

IDA has long recognized the promise and challenges of LED lighting. On the IDA website is an LED Practical Guide: *darksky.org/our-work/lighting/lighting-for-citizens/led-guide*. This is written well and is and a good starting point for learning about LED lighting (both its upside and its downside).

I recommend readers of this column study the LED Practical Guide. I will mention only a few highlights of that article so as to not plagiarize it too badly and to keep this column to a reasonable length. All fixtures should be fully shielded with no upward-directed light. "Warm" LEDs should be installed with a correlated color temperature (CCT) of less than 3000 Kelvin or the equivalent. Ideally, all installed products, particularly streetlighting, should have adaptive controls—dimmers, timers, and possibly motion sensors—so lights can be dimmed or turned off as the evening advances.

Probably the most important recommendations are for outdoor lighting to be placed only where it is needed, using only the amount of light necessary for the task, and for any lighting to be turned off when not needed. Some of the recommendations in the IDA LED Practical Guide are detailed and technical but most are simply common sense and what IDA has been recommending for years. Let's hope the promise of LEDs is fulfilled and its pitfalls can be avoided.

—Tim Hunter
Co-founder IDA
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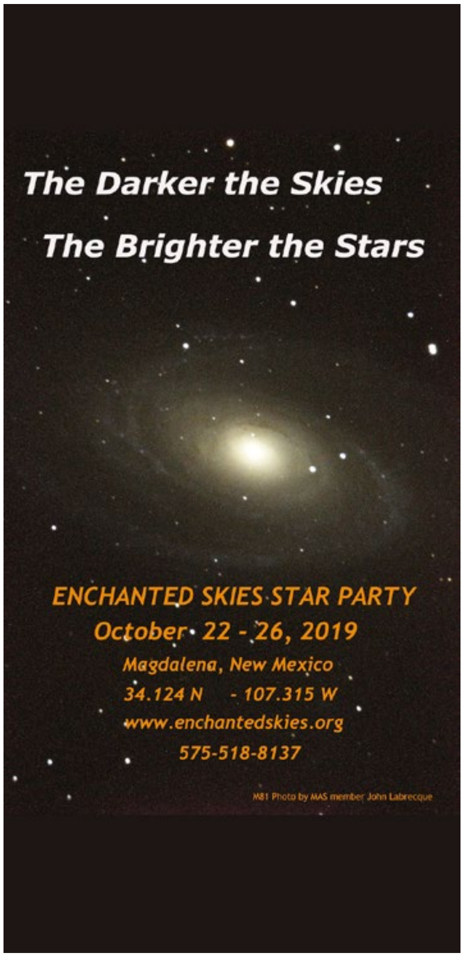


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Fire & Ice

HOW ONE NEUTRINO CHANGED A FIELD

The above-surface laboratory of the IceCube Neutrino Observatory, near the South Pole in Antartica. Photo: Erik Beiser, IceCube/NSF

By Dave Tostesen

The most powerful force in the Universe is manifest within its least. A black hole at the heart of a galaxy nearly four billion light-years away cannot swallow all it is trying to eat, and gravity and magnetism combine to accelerate this excess into jets aimed right at Earth. Adroit astronomers, only recently so well prepared to receive it, have gathered its signals to unravel and decode a mystery long pondered. Its multi-messenger pulses include ones visible to the curious.

In 1930, the brilliant physicist Wolfgang Pauli was puzzled. Certain interactions and energies of subatomic particles did not add up, and he knew something was missing. When two particles collided, the debris did not account for all that should have been present; or when one decayed, a piece that had to be there could not be found. He proposed what he called a “desperate remedy” in the form of a new particle to conserve energy within these reactions. Three years later his colleague Enrico Fermi formulated a theory of particle interactions and named this undetected member a “neutrino,” Italian for “little neutral one.” It had to be, they said, very light and almost completely asocial. It was so elusive that the first evidence for it took over twenty years to find, in a scintillator built near a fission reactor at Los Alamos, New Mexico.

Refined theory suggested this wraith oscillated between subtypes, and a few years later, in 1962, experiments confirmed the electron and muon neutrinos. A third subtype, tau, was discovered in the mid-1970s, and a dozen years after that, several subterranean detectors recorded neutrinos from the first extrasolar source, Supernova 1987A. This was touted as the first instance of “multi-messenger” astronomy: the detection of an event using different types of particles, though I suppose simultaneously arriving photons and protons in a sunrise aurora could be considered.

Neutrinos are notoriously hard to detect, and they can pass unaffected through long stretches of space and even through the center of the Earth. Neutron stars might give them pause, and black holes would be opaque to them. They are electrically neutral and thus not deflected in their course by electric or magnetic fields, and these qualities make them unequalled in finding their origin. The only issue is how to observe them.

In the first decade of the new millennium, a new detector was conceived and built at an unusual location, the South Pole. Near the Amundsen–Scott station, 86 holes were drilled and melted into the extremely clear ice 125 meters apart to a depth of nearly a mile. Into their lengths were strung over five thousand photomultiplying detectors in a volume totaling one cubic kilometer. Called the “IceCube Neutrino Observatory,” this state-of-the-art facility was built to find high energy neutrinos and quickly relay their direction of origin to terrestrial and space-based observatories to help identify their sources. The generators of these powerful neutrinos were unknown before IceCube was completed in 2010, and researchers were hot to find their extraterrestrial engines.

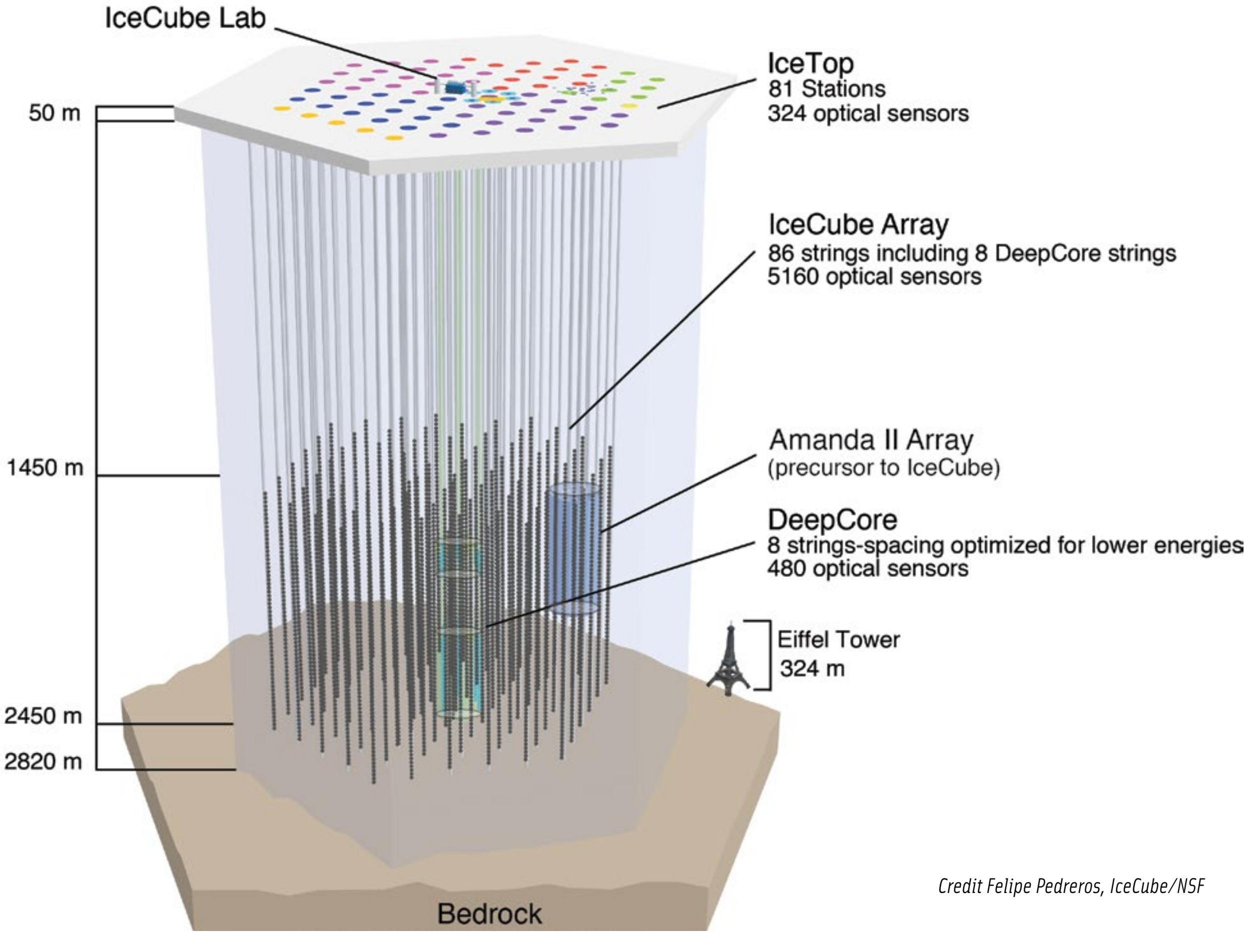
Since neutrinos are not perfectly massless, they cannot travel at exactly the speed of light. That would require infinite energy. But they come close. The higher the initial energy imparted to them, the faster they can go and the greater impact they will have when they do interact. The reason they are so able to penetrate matter is they only interact through gravity and the weak nuclear force. The range over which the latter force operates is very small, only within an atomic nucleus. Specifically, the uncertainty principle of quantum physics requires this to be 10^{-18} meters, or only 0.1 percent the diameter of a proton! So these very tiny particles see atoms as mostly empty space.

Only when there is a direct hit on the center of a nucleon will they tango. The energy of that process produces a particle called a muon, which can travel through air and ice faster than the speed of light within those materials, causing it to emit a blue-wavelength light called Cherenkov radiation. The photo-detectors in the IceCube observatory were constructed to see this light. Because of the three-dimensional nature of its design, scientists are given a fairly narrow field of a little over one square degree (for "track-like" detections with a dominant linear topology) to search for the source of the original neutrino. An automated notification system sends an alert to network observatories within one minute of detection.

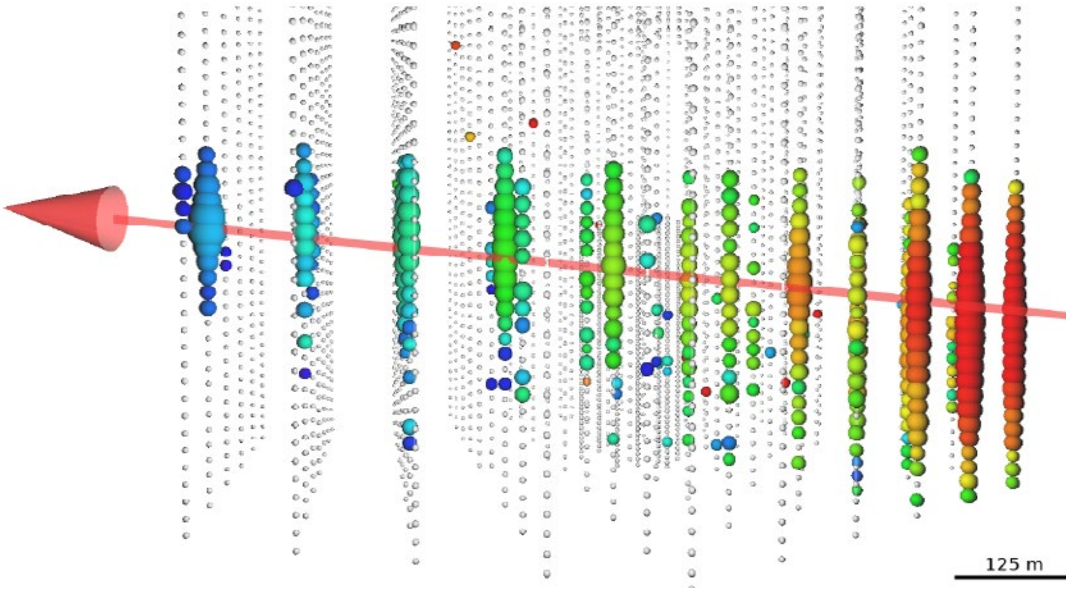
Astronomers know neutrinos can be produced within stars. There was a mystery for many years in regard to a dearth in those seen coming from the Sun. Only about one-third of the expected numbers were being found. The very interesting solution to this conundrum was that neutrinos continuously switch between their three types on the way from the Sun to the Earth, as they exist in what is known as a superposed quantum state. Trillions of these particles pass through our bodies every second, but they are relatively low energy and, fortunately, do not often interact with us.

Terrestrial sources of production include beta decay within radioactive elements, nuclear reactors, nuclear bombs, and particle accelerators. Cosmic neutrinos can be made by a number of processes including supernovae, neutron stars, and cosmic-ray impacts. Within the jets of quasars, a high energy pion can be produced by cosmic-ray interactions within the jet. This particle quickly decays into a lepton and a corresponding neutrino, and the latter then escapes to fly unimpeded for billions of years at nearly light speed until it hits the nucleus of an ice atom near the detector. Its ability to travel near light speed is important to help correlate its origin in time to photons collected at various wavelengths by the radio, infrared, optical, and gamma-ray observatories integrated into the research network.

On the first day of Antarctic "spring" in 2017, when its six-month-long night was morphing into an equally long day, an event was recorded in the IceCube Observatory's detectors. Called EHE (for extremely high energy) 170922A (for the date), it suggested a neutrino with a million times more energy than any previously identified source. Its 290 TeV (tera–electron volts, 10^{12} eV) worth of energy dwarfed the most powerful seen from the Sun, 18 MeV (mega–electron volts, 10^{6} eV). A high-energy neutrino had impacted an atom within the



Credit Felipe Pedreros, IceCube/NSF



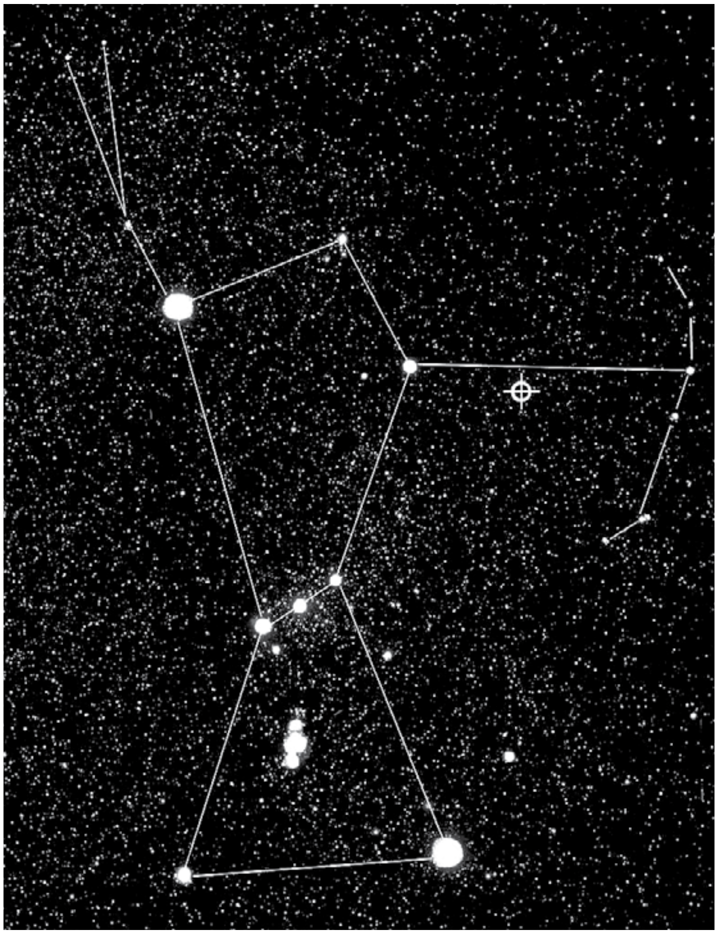
In this representation of the IceCube-170922A event, the size of the colored spheres represents the logarithm of the amount of light detected; the color gradient from red to blue corresponds to the time of detection, earliest at red and latest at blue. The total duration of the event is about 4000 ns. The best fit track direction is represented by the arrow, consistent with Orion Blazar identified as its source. Source: IceCube Collaboration/NSF

ice near the detector to produce a muon that flew across the detector's field, leaving a trail of blue light.

On this night, I was celebrating a sexagesimal event with a close friend, and at the time was unaware Scott's birthday would mark the day of discovery for a mystery that had confounded science for over a century. The origin of cosmic rays had been pondered since their discovery in 1912 by Victor Hess during a high-altitude balloon flight. As he ascended toward 17,000 feet with no supplemental oxygen, his electroscope discharged more rapidly the higher he went. He correctly assumed that particles from outer space were the source, and that the denser atmosphere nearer the ground was blocking them. Because most cosmic rays are protons, and almost all are small charged atomic nuclei, galactic and intergalactic magnetic fields alter their paths to preclude identifying their sources. Articles written in 2012 commemorating the centenary of this discovery lamented the lack of progress in finding their origin.

Many ideas were presented at a conference in Germany that year at the site of Hess's landing in Brandenburg. They could not have known then that the clue that would help solve this puzzle was nearing its final, frigid destination. Having traveled since just after the Solar System's Late Heavy Bombardment, at the time when single-celled life was just emerging on our planet, this high-energy neutrino was only a few light-years away from making history. The South Pole observatory had discovered a diffuse flux of high-energy astrophysical neutrinos in 2013, including ones with energy of a few PeV (peta-electron volts, 10^{15} eV), but had not identified their individual sources.

With all the pieces in place that would allow such a discovery, this subatomic tombolo, this conceptual stream that would connect theory with fact, slammed a neutrino into the ice on that equinox to sound an alert on the Astrophysical Multimessenger Observatory Network (AMON) at 20:15:13 Universal Time on September 22, 2017. This set into action a diverse array of telescopes and, true to its name, the Swift X-ray satellite was the first to identify a blazar in Orion as the possible source. This was quickly followed by data from Fermi in gamma rays showing a brightening of the same source which had shown increased activity since April 2018. It was then confirmed by the ground-based MAGIC instrument (Major Atmospheric Gamma-Ray Imaging Cherenkov Telescope) in the Canary Islands. By a month after the IceCube detection, two dozen instruments had studied this area across the electromagnetic spectrum.
The object they found, now known as TXS 0506+056, was first identified in 1983 as a strong radio source, and was in the top one percent in power of all radio emitters. Further study identified it as an active galactic nucleus (AGN) with one of its jets pointed right at us, which is the definition of a blazar (named for the BL Lac subtype of quasars). In our sky it is well placed for observation from both hemispheres, near the



TXS 0506+056 is located in the constellation Orion at 05h 09m 25.96s, +05d 41m 35.3s credit: Silvia Bravo Gallart/ Project_WIPAC_Communications celestial equator in western Orion, just under the arm that holds the shield or bow. Its redshift indicates its light has traveled 3.8 billion years to reach us and, even at that great distance, shines at a respectable 14.8 magnitude in the visual, well within reach of amateur equipment.

Padovani studied this object and found its peak luminosity to be about 10^{47} ergs per second at the very high energy of 10 GeV (giga-electron volts, 10^{9} eV). This AGN is one of the strongest known emitters of such VHE gamma rays, in the top 4 percent of such galaxies. Simona Paiano and their group from Italy and Spain used the 10.4-meter Gran Telescopio Canarias near the MAGIC observatory to pinpoint its redshift at 0.3365. Data from gamma-ray instruments showed this blazar to be flaring in that high-energy radiation at the time of the neutrino detection. The many wavelengths of radiation studied along with the neutrino findings allowed competing models of energy production within the blazar jets to be tested.

It is likely too early for definitive conclusions, but there is consensus building toward what is called the “lepton-hadronic” model, with powerful high-speed electrons in the jets interacting with photons to accelerate them to gamma-ray energies via a process called inverse Compton scattering. Cerruti suggested high-energy neutrinos were generated as part of a “pion decay chain” within a “magnetized, compact region inside the relativistic jet.” In his presentation at a National Science Foundation press conference on July 12, 2018, Dr. Razmik Mirzoyan of the Max Planck Institute for Physics, spokesperson for the MAGIC collaboration, offered that the neutrino found by IceCube, as a product of proton and cosmic ray interaction within the blazar jets, represented the initial detection of a source for these high-energy objects.

Retrospective studies of nine years of previous IceCube neutrino data revealed over a dozen increased-emission events between September 2014 and March 2015, offering more evidence for the collaborators to suggest blazars were the “first identifiable sources of the high-energy astrophysical neutrino flux.”

Researchers including Francis Halzen of the University of Wisconsin, the developer and principal researcher of the IceCube observatory, predicted this event and discovery will be a vanguard for a new field of study.

With all this as background, I took my 32-inch f/4 reflector out on St. Patrick’s night, 2018, at my home in east-central Minnesota. I used a 9 mm eyepiece in moderately good conditions at 10 p.m. to spot this stellar-appearing object, also known as PMN J0509+0541. It had no nebulosity and, in that large instrument at 14th magnitude, was easily seen with direct vision in a moderately crowded starfield. I find it intriguing to have been hunting within the Hunter to see something wherein both the most powerful and least accessible things in our Universe were produced together. Though some scientists caution about premature conclusions, such as Penn State’s Kohta Murase as quoted in *Sky & Telescope,* many are optimistic another important messenger has been added to the toolbox of cosmic inquiry. ★

Remembering Two Former Astronomical League Presidents

Jerry Sherlin, Astronomical League President 1982–1984

Jerry Sherlin, 22nd president of the Astronomical League, passed away on December 31, 2018.

His service to the Astronomical League was far-reaching and began at a time when the organization was growing and evolving into what it is today. Jerry applied his leadership and organizational skills as chair of MARS and as a regional representative of MARS and MSRAL. He was the AL Book Service chair for a number of years. In an unusual order of ascension through national offices, he served first as Astronomical League executive secretary for one year in 1977, then as president from 1982 to 1984, and finally as vice president from 1988 to 1991.

Because of his extensive League work, much of it behind the scenes, Jerry was presented with the G.R. Wright Service Award in 1992. He continued his contributions by chairing the wildly successful Copper Mountain, Colorado, ALCon in 1997. He played an important early role in the League's efforts at encouraging youth in astronomy.

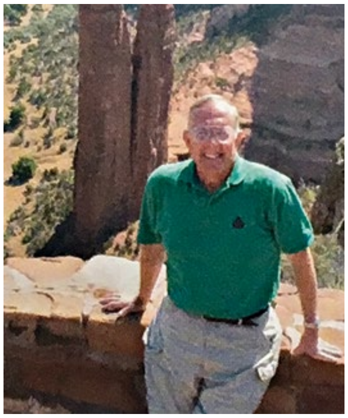
Jerry was a meteorologist for the U.S. Air Force, where he specialized in space weather, and later was a research assistant at Sacramento Peak Solar Observatory near Cloudcroft, New Mexico. After retiring from the Air Force in 1981, then NOAA in 1999, he taught astronomy at Arapahoe Community College in Littleton, Colorado, and the Community College of Aurora in Colorado.

He was active in many astronomy-related organizations including:

- Fellow of the Royal Astronomical Society (emeritus)
- Professional member of the American Astronomical Society
- American Association for the Advancement of Science
- American Association of Variable Star Observers
- Association of Lunar and Planetary Observers
- Denver Astronomical Society
- Astronomical League

Jerry's vitality and enthusiasm pursuing astronomy, professional or amateur, will be missed. ★

Bob Gent, Astronomical League President 2002–2006



It is with great sadness that we must report that Robert L. Gent, 30th president of the Astronomical League, passed away on Saturday, March 23, 2019. He resided in Wadsworth, Ohio, with his wife, Terrie.

During his many years of involvement with amateur astronomy and the Astronomical League, he chaired three national conventions (1995 in San Antonio, Texas; 2001 in Frederick, Maryland, and 2010 in Tucson, Arizona), and received the League's prestigious G. R. Wright Award and President's Award. He was Astronomical League vice president from 1998 to 2002 and president from 2002 to 2006.

During his League presidency, the AL national office was instituted, the youth awards advanced, the observing programs increased dramatically in number, and the *Reflector* began being published in a full-color, glossy format.

Bob was also the past president of the International Dark-Sky Association, and, in this role, traveled domestically and internationally, speaking with citizens and government officials about light pollution and the preservation of dark skies. In recognition of all his efforts, in 2001 he was presented the first IDA Hoag-Robinson award. In 2000, the minor planet 10498 Bobgent was named in his honor.

He was a retired U.S. Air Force lieutenant colonel and a former space systems officer. Bob earned degrees in mathematics, astrophysics, and international relations. He was a member of the American Astronomical Society, the Webb Society, the International Occultation Timing Association, the American Association of Variable Star Observers, the Richland Astronomical Society, and, of course, the Astronomical League.

Bob's absence in astronomy will be keenly felt. His star will shine brightly in our hearts. ★

Lunar occultation of Venus, by Bob Gent

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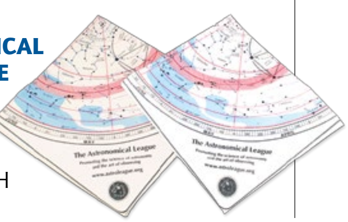

ASTRONOMICAL LEAGUE BASEBALL HAT
EMBROIDERED LOGO, ADJUSTABLE; ROYAL BLUE, MAROON, KHAKI, NAVY;
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"GUIDE TO THE STARS" 16-INCH PLANISPHERE
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A JOURNEY THROUGH THE UNIVERSE FOR THE BEGINNER
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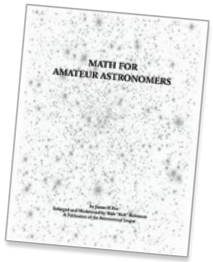

MATH FOR AMATEUR ASTRONOMERS
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CARBON STARS
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HANDBOOK FOR ASTRONOMY EDUCATORS
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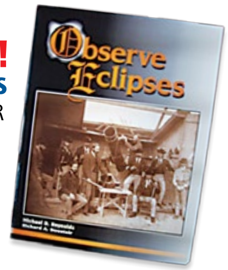

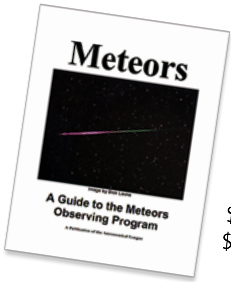

METEORS–
A GUIDE TO THE METEORS OBSERVING
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RASC EXPLORE THE UNIVERSE GUIDE
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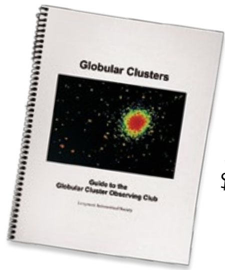


GLOBULAR CLUSTERS
$14 PLUS
$3 S&H

PROMOTE AMATEUR ASTRONOMY, LEARN NEW ASTRONOMY LORE, AND SUPPORT THE LEAGUE WITH YOUR PURCHASE!

Coming Events

July 23–28
Indiana Family Star Party
Camp Cullom, Frankfort, Indiana
indianastars.com/starparty

July 25–29
Astronomical League Convention
Kennedy Space Center, Florida, and cruise to the Bahamas
alcon2019.astroleague.org

July 28–August 2
Nebraska Star Party
Merritt Reservoir, Valentine, Nebraska
nebraskastarparty.org

July 30–August 3
Table Mountain Star Party
Eden Valley Ranch, Oroville, Washington
tmspa.com

July 30–August 4
Oregon Star Party
Ochoco National Forest, Prineville, Oregon
oregonstarparty.org

August 1–3
Julian Starfest
Menghini Winery, Julian, California
julianstarfest.com

August 1–4
Stellafane Convention
Breezy Hill, Springfield, Vermont
stellafane.org/stella-fane-main/convention

August 24–25
Connecticut River Valley Astronomers Conjunction
Northfield Mountain Recreation and Environmental Center, Massachusetts
philharrington.net/astroconjunction

August 27–September 2
Northern Nights Star Fest
Long Lake Conservation Center, Minnesota

August 28–29
Maine State Star Party
Cobscook Bay State Park, Edmunds, Maine
facebook.com/Downeastaa

August 30–September 3
Almost Heaven Star Party
Spruce Knob, West Virginia
ahsp.org

September 21–29
Okie-Tex Star Party
Kenton, Oklahoma
okie-tex.com

September 25–29
Acadia Night Sky Festival
Acadia National Park, Bar Harbor, Maine
acadianightskyfestival.org

September 26–29
2019 Bootleg Astronomy Star Party
Green River Conservation Area, Harmon, Illinois
bootlegastronomy.com

September 27–29
Black Forest Star Party
Cherry Springs State Park, Pennsylvania
bfsp.org

GALLERY

MEMBER SHOTS OF THE JANUARY 2019 LUNAR ECLIPSE

This page: Kristopher Setnes (Minnesota Astronomical Society) managed to catch the lunar meteroid impact during the recent eclipse using a 6-inch Orion Starblast with a Fujifilm X-T20 camera.

Right: Joe Abraham (Houston Astronomical Society) took this sequence of images during the recent eclipse using a Takahashi TSA-102 refractor with a Nikon D700 camera.

All photos © 2019 by their respective creators.

GALLERY

MEMBER SHOTS OF THE JANUARY 2019 LUNAR ECLIPSE

Top: Mike Carlin (Rochester Astronomy Club) made this eclipse mosaic with a Celestron 8SE with f/6.3 focal reducer and a Canon 70D camera.

Bottom: Steven Bellavia (Amateur Observers' Society of New York) made this composite image of the recent eclipse over two nights using a generic 90 mm f/5.5 refractor with a Canon EOS SL1 camera.

Observing Awards

Active Galactic Nuclei Program
No. 17-I, **Marie Lott,** Atlanta Astronomy Club

Arp Peculiar Galaxies Northern Observing Program
No. 92-V, **Bob Scott,** Island County Astronomical Society

Beyond Polaris
No. 22, **Scott G. Kranz,** Astronomical Society of Kansas City; No. 23, **Blake Hulburt,** San Antonio Astronomical Association; No. 24, **Tamara Stowe,** San Antonio Astronomical Association; No. 25, **Amanda L. Grzyb,** Member-at-Large; No. 26, **Douglas L. Smith,** Tucson Amateur Astronomy Association; No. 27, **Chris Leake,** Astronomical Society of Kansas City

Binocular Double Star Observing Program
No. 143, **Bernie Venasse,** Member-at-Large; No. 144, **Alan Scott,** Albuquerque Astronomical Society; No. 145, **Peter Detterline,** Member-at-Large; No. 146, **Gus Gomez,** Tucson Astronomical Association

Binocular Messier Observing Program
No. 1158, **Mike Reitmajer,** Rose City Astronomers; No. 1159, **William A. Kast,** Denver Astronomical Society; No. 1160, **Janet Pullen,** Island County Astronomical Society; No. 1161, **Kevin Kirk,** Northeast Florida Astronomical Society

Caldwell Observing Program
SILVER AWARDS
No. 256, **James Bruce McMath,** Central Arkansas Astronomical Society; No. 257, **Jarret Lingle,** Mason Star Gazers; No. 258, **Robert B. Harrison,** Patron Member

Comet Observing Program
No. 104, **Cindy L. Krach,** Silver, Haleakala Amateur Astronomers; No. 105, **Alan Snook,** Silver, Member-at-Large; No. 106, **Will Young,** Silver, Astronomical Society of Southeast Texas; No. 107, **Stanley Davis,** Silver, Astronomy Club of Tulsa; No. 108, **Marie Lott,** Silver, Atlanta Astronomy Club; No. 42, **Bernard Venasse,** Gold, Member-at-Large; No. 43, **Mark Lang,** Gold, Raleigh Astronomy Club

Galileo's T.O.E.S.
No. 1, **Bernie Venasse,** Member-at-Large

Globular Cluster Observing Program
321-V, **Jeffrey Corder,** Ancient City Astronomy Club; 322-I, **Brad Young,** Astronomy Club of Tulsa; 323-V, **Charles E. Allen III,** Evansville Astronomical Society; 324-I, **Peter Detterline,** Member-at-Large

Herschel 400 Observing Program
No. 600, **Alfred Schovanez III,** Astronomical Society of Eastern Missouri; No. 601, **Lario Yerino,** Astronomical Society of Kansas City

Herschel II Observing Program
No. 105, **Dan Crowson,** Device-Aided, Astronomical Society of Eastern Missouri

Hydrogen Alpha Solar Observing Program
No. 43, **Jonathan Poppele,** Minnesota Astronomical Society; No. 44, **Jeffrey M. Padell,** Member-at-Large

Local Galaxy Group & Galactic Neighborhood Observing Program
No. 38M, **Kevin Mayock,** Rose City Astronomers; No. 39M, **David Whalen,** Atlanta Astronomy Club

Lunar Observing Program
No. 1047, **Denise Moser,** Astronomical Society of Kansas City; No. 1048, **Kevin Kozel,** Member-at Large; No. 1049, **Steve Cariddi,** Member-at-Large; No. 1050, **David Collings,** Echo Ridge Astronomical Society; No. 1051, **Eric Rachut,** Central Texas Astronomical Society; No. 1052, **Robert F. Taylor Jr.,** Keene Amateur Astronomers, Inc.; No. 416-B, **Paul Byrne,** Member-at-Large; No. 964-B, **Russell F. Pinizzotto,** Southern Maine Astronomers, No. 1050-B, **David Collings,** Echo Ridge Astronomical Society

Master Observer Award
OBSERVER:
Alfred Schovanez III, Astronomical Society of Eastern Missouri; **Marilyn Perry,** Member-at-Large

MASTER OBSERVER:
No. 217, **Benjamin Jones,** Albuquerque Astronomical Society; No. 218, **Michael C. Neal,** Echo Ridge Astronomical Society; No. 219, **Will Young,** Astronomical Society of Southeast Texas; No. 220, **Chris Slotten,** Olympic Astronomical Society; No. 221, **Alan Scott,** Albuquerque Astronomical Society; No. 222, **Alfred Schovanez III,** Astronomical Society of Eastern Missouri

ADVANCED OBSERVER:
Valorie Whalen, Atlanta Astronomy Club; **Stephen Tzikas,** Northern Virginia Astronomy Club

BINOCULAR MASTER OBSERVER:
Steve Boerner, Member-at-Large; **Nora Jean Chetnik,** Member-at-Large; **Rakhal Kincaid,** Haleakala Amateur Astronomers; **Al Lamperti,** Delaware Valley Amateur Astronomers; **David Whalen,** Atlanta Astronomy Club

Messier Observing Program
No. 2798, **Tim Clark,** Honorary, Stockton Astronomical Society; No. 2799, **Gary Dietz,** Regular, Astronomy Enthusiasts of Lancaster County; No. 2800, **Alan Snook,** Regular, Member-at-Large; No. 2801, **Francis Graham,** Honorary, Member-at-Large; No. 2802, **Donald Knabb,** Regular, Chester County Astronomical Society; No. 2803, **Richard S. Eisenberg,** Honorary, Ventura County Astronomical Society; No. 2725, **Bryce Heiniger,** Honorary, Twin City Amateur Astronomers; No. 2804, **Paul Pulaski,** Regular, Albuquerque Astronomical Society; No. 2805, **Kiefer Iacaruso,** Regular, Member-at-Large; No. 2806, **Edgar G. Fischer,** Honorary, Albuquerque Astronomical Society

Meteor Observing Program
No. 67, **Pamela Lubkans,** Honorary, Member-at-Large

NEO Observing Program
No. 18, **Dan Crowson,** Advanced, Astronomical Society of Eastern Missouri

Outreach Observing Award
No. 565-M, **Leonard Ward,** Central Florida Astronomical Society; No. 657-M, **Mark Simonson,** Everett Astronomical Society; No. 684-S, **Naveen Vetcha,** Von Braun Astronomical Society; No. 778-M, **Matt Lochansky,** Raleigh Astronomy Club; No. 806-M, **Barbara Hassett,** Fort Bend Astronomy Club; No. 807-M, **Scott Hassett,** Fort Bend Astronomy Club; No. 847-S, **Mark Hodges,** Roanoke Valley Astronomical Society; No. 849-S, **Rand H. Bowden,** Roanoke Valley Astronomical Society; No. 894-M, **James King,** Houston Astronomical Society; No. 897-S, **Anthony Bryan,** Evansville Astronomical Society; No. 917-S, **Wayne Frey,** Central Florida Astronomical Society / Imperial Polk Astronomical Society; No. 1006-S, **Mike Reitmajer,** Rose City Astronomers; No. 1019-M, **Dewey Barker,** Escambia Amateur Astronomers Association; No. 1041-S, **Richard S. Wright Jr.,** Central Florida Astronomical Society; No. 1069-M, **Charles E. Allen III,** Evansville Astronomical Society; No. 1031-M, **Brian McGuinness,** Northern Colorado Astronomical Society; No. 1070-S, **Sonny Manley,** Fort Bend Astronomy Club; No. 1071-O, **Jane Lim,** Fort Bend Astronomy Club; No. 1072-O, **Daniel Roy,** Fort Bend Astronomy Club; No. 1074-S, **David Decker,** San Diego Astronomy Association; No. 1083-S, **Richard Mannarino,** Escambia Amateur Astronomers Association; No. 1109, **Eric J. Hoin,** Central Florida Astronomical Society; No. 1110-O, **Jeffrey Padell,** Skyscrapers; No. 1111-O, **Marla C. Smith,** Flint River Astronomy Club; No. 1112-O, **Rick Johnston,** Escambia Amateur Astronomers Association; No. 1113-M, **Cleveland Carter,** Imperial Polk Astronomical Society; No. 1114-M, **Dennis Wardell,** Texas Astronomical Society of Dallas; No. 1115-M, **Steven S. Conner,** Evansville Astronomical Society; No. 1116-O, **Raymond Whatley,** Northeast Florida Astronomical Society; No. 1117-S, **Jack Lochnasky,** Raleigh Astronomy Club; No. 1118-S, **Corrie Ann Delgado,** Echo Ridge Astronomical Society; No. 1119-O, **Christopher Leake,** Astronomical Society of Kansas City; No. 1120-O, **Jim Lim,** Fort Bend Astronomy Club; No. 1121-O, **Daniel Roy,** Fort Bend Astronomy Club; No. 1122-O, **Pamela Shivak,** Member-at-Large; No. 1123-M, **Bryan Simpson,** Cincinnati Astronomical Society

CORRECTED FROM THE LAST ISSUE:
No. 1066-O, **Robin Jones,** Roanoke Valley Astronomical Society; No. 1066-O, **Josh Jones,** Roanoke Valley Astronomical Society

Planetary Nebula Observing Program
No. 74, **Alfred Schovanez III,** Advanced Manual, Astronomical Society of Eastern Missouri; No. 75, **Kevin McKeown,** Advanced, Member-at-Large; No. 76, **Will Young,** Advanced Manual, Astronomical Society of Southeast Texas; No. 37 **Roy Troxel,** Member-at-Large

Sky Puppy Observing Program
No. 58, **Antonio Santacroce,** Kansas Astronomical Observers; No. 59, **Noelle Fordham,** Kansas Astronomical Observers; No. 60, **Emily Kiesel,** Northern Virginia Astronomy Club

Stellar Evolution Observing Program
No. 62, **Terry N. Trees,** Amateur Astronomers Association of Pittsburgh; No. 63, **Ken Boquist,** Popular Astronomy Club (Rock Island); No. 64, **John L. Goar,** Olympic Astronomical Society; No. 65, **Jim Pryal,** Seattle Astronomical Society; No. 66, **Steve Boerner,** Member-at-Large; No. 67, **Kevin Nasal,** Neville Public Museum Astronomical Society (Green Bay); No. 68, **Rakhal Kincaid,** Haleakala Amateur Astronomers; No. 69, **Rob Ratkowski,** Haleakala Amateur Astronomers

Universe Sampler Observing Program
No. 135, **Alfred Schovanez III,** Telescope, Astronomical Society of Eastern Missouri; No. 136, **Robert J. Olsen,** Telescope, Member-at-Large; No. 137, **Robert Fish,** Telescope, Boise Astronomical Society.

NATIONAL YOUNG ASTRONOMER AWARD WINNERS – WHERE ARE THEY NOW?

The Astronomical League started issuing National Young Astronomer Awards in 1993. Have you ever wondered what became of these young folks and where are they now? Below is Andrew Hitchner's short autobiography. He won the award at ALCon 2010 in Tucson, Arizona. Hopefully his history will spur others to write similarly.

–Al Lamperti, Delaware Valley Amateur Astronomers

By Andrew Hitchner

Andrew Hitchner, a member of the Delaware Valley Amateur Astronomers, won first place for the National Young Astronomers Award in his junior year of high school in 2010. His project, "A Study in Stellar Spectroscopy," followed in the footsteps of Annie Jump Cannon and the astronomers of Harvard in measuring the differences in stellar spectra and finding a relationship between the temperature of the stars and the strength of the hydrogen absorption lines in the stars' spectra. His project was completed using only modest equipment available to the amateur astronomer and featured an 8-inch Meade Schmidt-Cassegrain, a Canon DSLR, and a Rainbow Optics grating. Andrew confirmed that there is an optimal temperature for hydrogen absorption, and this is found in A-type stars. O- and B-type stars are too hot for strong hydrogen absorption, while F through M stars are too cool for strong hydrogen absorption.

After graduating from Methacton High School in Eagleville, Pennsylvania, Andrew went on to pursue a degree at the Rochester Institute of Technology, with the hope of turning his hobby of amateur astronomy into a career. During his first year at RIT, he became the teaching assistant for the astronomy course at the RIT Observatory, and he continued to do this for all four years of his studies. As the teaching assistant, Andrew helped students with indoor labs, such as identifying planetary features, learning Kepler's laws of planetary motion, graphing the HR diagram, and identifying gases using handheld spectroscopes.

If a class occurred on a rare clear Rochester night, an outdoor lab would take place, which involved having the students observe planets and deep-sky objects. Andrew would help point the observatory's various telescopes and would describe what the students should be looking for. He also helped students prepare for their oral exams of identifying ten stars and constellations. While he did not get to do much of his own observing at RIT, he was grateful that the position of teaching assistant allowed him to continue what he thinks is the best part of this hobby: sharing it with others. During his sophomore year, Andrew decided he wanted to get his degree in imaging science. The imaging science program at RIT is designed around the science behind the end-to-end image formation process, called the imaging chain. This includes the entire process from the photons leaving the Sun, to then being reflected into a camera through its optics, being captured on the focal plane, being displayed for viewing, and finally processed by the human eye.

Andrew greatly enjoyed his studies in the imaging science department. He was excited for each class he took and is amazed by how much he learned. His professors were friendly and supportive, and his classmates became his good friends. Some of his favorite classes were Remote Sensing Systems, Radiometry, Focal Plane Array Design, and Environmental Applications of Imaging Science. It was during this time that Andrew realized he had found his passion and what he wanted to do for his career. In the summer between his sophomore and junior year at RIT, Andrew participated in a Research Experience for Undergraduates program in the imaging science department. His work involved designing new labs for the Radiometry class that included measuring the intensity of different light sources, using professional radiometric equipment such as a radiometer and integrating sphere, and comparing the efficiency of different light sources.

During this time he also met his future wife, a visiting student in the program from Allegheny College. During his senior year, Andrew worked on his thesis project that involved measuring the height of clouds using Landsat 8 imagery, and he graduated with a BS degree in imaging science in spring 2015.

Andrew's tenure at RIT involved more than just academics. His other main activity was his involvement with the RIT pep band, which let Andrew de-stress from his coursework and resulted in lasting friendships.

After RIT, Andrew found a job back home in King of Prussia, Pennsylvania, as a sensor engineer with Perspecta Inc. He is now in his third year with the company and enjoys his work and coworkers. His job has provided him opportunities to travel around the country and to continue to develop the skills that he learned at RIT. It has also allowed him to continue his education. He is currently enrolled in an online MS program at the Stevens Institute of Technology, studying microelectronics and photonics.

Andrew continues to enjoy amateur astronomy and has found that the best way of doing this is to be more involved with his local club, the Delaware Valley Amateur Astronomers. He is DVAA's observing chair, coordinating the public star parties and giving a short presentation during the monthly meetings. Andrew also goes out with members of the club to do dark-sky observing and has participated in a few of the club's camping trips.

In addition to astronomy, Andrew enjoys numerous other hobbies in his free time. He performs with the Montgomery County Concert Band and Jazz Band, is a member of a men's hockey team, and likes to bake bread and desserts for his friends and family. For astronomy, he plans on continuing as the observing chair for the DVAA and completing more Astronomical League Observing Programs. Currently, he is working on the Double Star and Open Cluster Programs. He also plans on doing more outreach with the club to continue sharing his knowledge and passion with members of the community, the part of his hobby he most thoroughly enjoys. ★

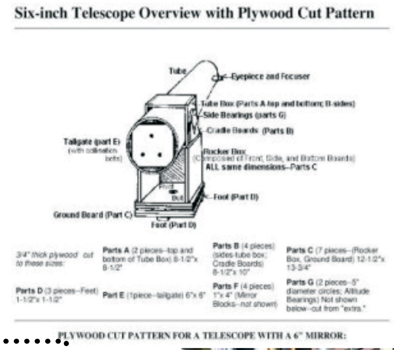
ALCon Jr. 2020 STEAM Conference

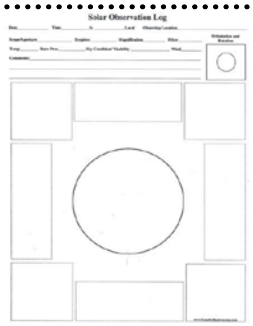
for families and students

(activities in the works)

Observing and sky advocacy activities

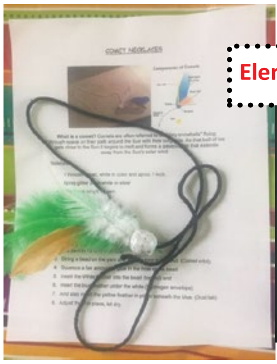
Telescope Making Workshop with Rob Teeter of Teeter's Telescopes

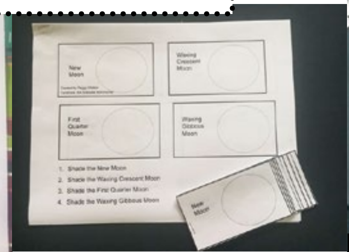


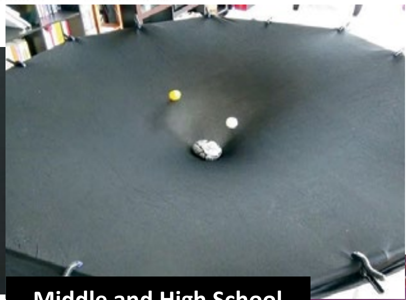


Globe @ Night

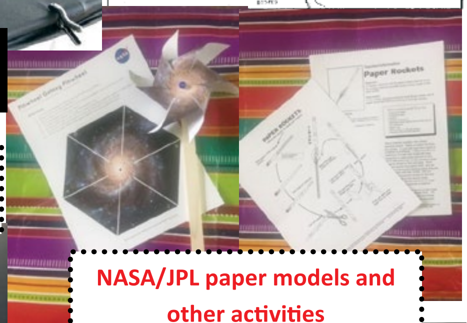
Elementary activities







Middle and High School activities



Tactile activities for other abled attendees

dome movies

Astro Graphic Novels - Comic Books

NASA/JPL paper models and other activities

HELP FUND ALCon Jr. 2020 by buying your AL 2020 calendar!

2020 Calendar features AL Members, Special Imagers or Sketchers:

*Moon Phases *Meteor Showers *Planetary Oppositions *Planetary Elongations *Eclipses *Astronomy & Space Trivia *Some Star Parties *Fall and Spring Astronomy Days *Some Regional Meetings *Dues and AL Award Submission Reminders *ALCON 2020 and *ALCon Jr. Information *AL Observing Program Progression Guidelines *Executive Board Contact Information and *Regional Representative Information

ALCON JR. WILL BE HELD IN ALBUQUERQUE, NEW MEXICO IN 2020. WATCH UPCOMING ISSUES OF *REFLECTOR* FOR MORE INFORMATION

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