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Cover Image: Bill Neubert (Astronomical Society of Eastern Missouri) captured this image of Sharpless 101 from the Buford Mountain Conservation Area using a Stellarvue SV80 with reducer (f/4.8 - 384mm) with a QSI 683wsg-8 camera.

The Astronomical League Magazine
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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.
Astronomical League National Office:
9201 Ward Parkway, Suite 100, Kansas City, MO 64114
President’s Corner

S eptember and October have been rather busy. First, I spent several days at Oke-Tex, a great star party in western Oklahoma, just across the New Mexico border. Several of the evenings were windy, but the skies were beautiful, the food fantastic, and the people friendly. I even won a pair of Celestron 15x70 binoculars as a door prize. Next, in October we had the AAVSO 108th annual convention in Las Cruces, where I live. Assistant editor of the Reflector, Kristine Larsen, was on the AAVSO Director's Award for her outstanding work in astronomy. Congratulations, Kristine! Very well deserved.

John Martin has accepted the position of League president, and is now responsible for our website, web security, and other technical aspects of information technology. He will be building his staff as we move forward. Also, Kristine Larsen has taken on the position of Reflector editor, replacing John Martin. Please send all future submissions to Kristine at editor@astroleague.org.

Elections for League president and vice president will be held in 2020. If you are interested in any of these important positions, please submit your photo and a 250-word résumé to John Goss at jgosso@astroleague.org. These will be presented in a future issue of the Reflector. Remember, this is your League, and we need volunteers to support it.

We are also still looking for someone with significant grant-writing experience to help the League obtain grants to support our activities. If you have the qualifications, or know who can do this, please contact me at president@astroleague.org.

P harm for AllCon2020, to be held in Albuquerque, New Mexico, from July 15 to 18, is coming together. In addition to the usual meetings and presentations, an AlCon Jr. will be held at the same time, offering students the opportunity to build a 6-inch Newtonian telescope on a Dobsonian mount. The ready-to-use mirrors and pre-cut plywood mount material come from Rob Teeter, who will join us at the event. Peggy Walker is organizing the event in conjunction with the Albuquerque Astronomical Society (TAS) and promises to be a major event. More information can be found here.

Finally, consider writing an article or submitting a photo for the Reflectors. This is your magazine, created by hard-working volunteers within the League. We can always use new material, and remember, you get the bragging rights.

—Ron Kromer, AL President

From the New Editor

To start, I’d like to thank John Martin for his hard work in this position. I am very pleased that he is remaining a valued part of the Astronomical League team in the role of editor and webmaster. Second, I would like to very publicly thank my partners in this endeavor, assistant editor Kevin Jones, whom I have had the pleasure of working with these past six years, and Michael Patterson, who does the vital role of turning out the disparate pieces of the Reflector into a cohesive and attractive whole.

For those of you who don’t know me, I am a long-time member of the Springfield Telescope Makers and have completed an 8-inch mirror and telescope. My 12.5-inch mirror is in the figuring stage, and I already have a tube assembled ready to house it once completed. I have served two years on the STEM board of trustees, and since 2012 have been the co-coordinator of programming for the annual Stellafane Convention (which I hope you read about in the previous issue of the Reflector). My “day” job is astronomy professor at Central Connecticut State University, a position I have held for 30 years. I am also deeply involved with the American Association of Variable Star Observers, having served as its president from 2015 to 2018. I am currently co-section leader of the AAVSO Solar Section and secretary of the board of directors. I have completed several AL Observing Programs: Messier, Binocular Messier, Binocular Double Star, Binocular Variable Star, Outreach, and Meteor. I therefore consider myself a dedicated pro-am and will be bringing both sides of my brain to my new role as Reflector editor.

In an effort to fulfill our commitment to you, our valued members and readers, to produce a high-quality, engaging, and informative magazine in a timely fashion, we are taking the perhaps radical step of streamlining our process and working with a smaller rather than larger team. I will also be making changes behind the scenes that should greatly help us keep to our timeline. The Reflector is your magazine, and we truly value your input. Please let us know what we are doing well, what we need to do better, and what you would like to see in the future (for example, more news or topics). If you have ever considered submitting an article to be considered for publication, now is the time! I look forward to hearing from you and continuing the process of making the Reflector the very best astronomical magazine it can be.

—Kristine Larsen, Reflector Editor

New Astronomical League Secretary

Important Notice

CLUB TREASURERS AND ALCOOS—2019–2020

Astronomical League dues, please contact the National Office at leagueoffice@astroleague.org as soon as possible. We are concerned that we haven’t heard from you, as the dues were payable five months ago. We know you want to continue receiving AL benefits, including the Reflector, without interruption—and we certainly don’t want to lose your club as an Astronomical League member!

—The Board of RTMC, Inc.

Noted with Sadness

Chuck Allen, a past League president (1998–2002), is now secretary of the Astronomical League. He has served on council for 17 years, a former Great Lakes chair, and currently serves as Great Lakes treasurer.

Chuck founded the League’s 27-year-old National Young Astronomer Award in 1991, chaired the program until 1998. He received the League’s G. Wright Award for service in 1998, holds the League’s Master’s Outreach Award with over 900

Smart Planning for Imaging

People don’t usually plan their imaging beyond finding objects that pass high in the sky. This is because they don’t have enough information. Every camera and telescope combination is different. Every object in the sky is different. Basic questions arise that have no clear answers. How long to expose to get a nice image? What exposure time to use in can’trik stel t

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Call for Nominations

The two-year terms of the offices of president and vice president end on August 31, 2020. If you are interested in using your talents to serve in either of these two important positions, we would like to hear from you. Please volunteer!

For specific information regarding the duties and responsibilities of the president and vice president, please refer to the League’s bylaws, which can be accessed on the League website at astroleague.org.

Candidates should send a nominating Committee co-chair John Goss, goss.john@gmail.com, a background statement explaining why they are interested along with a photo of themselves for publication in the Reflector. Please limit all statements to approximately 250 words. All nomination materials must be submitted by March 15, 2020, so they can be announced in the June Reflector.

Watch the AI website for a call for new Observing Program Coordinators!

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Full STEAM Ahead

This workshop will be led by a man who designed and built a scope in high school and displayed it at a Stellafane convention. Did I mention he won an award for that back in 1987? This event would later spark the business of Teeter’s Telescopes. If anyone follows Rob Teeter’s Facebook page, you will see an artist and artisan at work, using beautiful wood stains and finishes with metallic and colorful tubes with etched or laser-cut metal pieces. Rob posts videos of how he uses a software-driven computer numerical control (CNC) machine to cut the bases. By pairing carefully selected stains and finishes to the color of the metal and tubes, we could say Rob was STEAMing it long before it became a thing.

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Night Sky Network

Do you love the amateur astronomical adventure. Are our astronaut experiences always true? Do we expect that all children are going to be equally as excited about space or do we assume differences in their interest before you talk to them? A simple way to dispel any preconceived notions is to ask questions of the people approaching your telescope; even something as simple as, “Have you ever looked through a telescope before?” will start a conversation that you may use to determine your next course of action about where to meet your visitors. She may turn out to have a telescope at home and help you point out constellations!

If we keep doing the same outreach, we will certainly lose those kids that look like they do now. Having conversations, not simply talking about the Juno mission to Jupiter, mentioning that with metallic and colorful tubes with etched or laser-cut metal pieces, we could say Rob was STEAMing it long before it became a thing.

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International Dark Sky Association

The University of Utah has just launched the online Journal of Dark Sky Studies (JDSS). The journal is housed at the University of Utah’s Consortium for Dark Sky Studies, and is dedicated to light pollution research, important impact stories, and the culture of the night sky. JDSS debuted at the 68th United Nations Civil Society Conference in Salt Lake City, Utah, August 28-29, 2019, and coincided with the start of the first class in dark sky studies at the Consortium.

Daniel Mendosa is the editor of the journal. He is the co-director of the Consortium and one of the core faculty members in dark sky studies. He also holds an appointment in the Department of Atmospheric Sciences and the Division of Pulmonary Medicine. According to Mendosa, "the journal will appeal both to people who have no dark sky studies work and to people who actively research and advocate for dark skies." The JDSS boasts a distinguished editorial board, including IDA’s John Barentine.

The journal will be published twice a year in the summer and in the fall. It is the companion publication to the Department of Atmospheric Sciences and the Division of Pulmonary Medicine. According to Mendosa, “the journal will appeal both to people who have no dark sky studies work and to people who actively research and advocate for dark skies.” The JDSS also holds an open access policy, allowing anyone to contribute to the journal.

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JOURNAL OF DARK SKY STUDIES

Let’s start at the beginning. What is inclusivity? Inclusivity means exactly what it sounds like: the practice of including as many people as possible by being welcome to people from various backgrounds, ages, races, genders, and abilities. There are no magic buttons that will make your club more inclusive; it’s a practice that we get better at over time. As a society, we have a lot of ingrained practices, speech patterns, and learned behaviors that benefit some people and exclude others. These practices are generally not intentional, but they still exist, and can still be harmful regardless of intent.

We can work towards practising more welcoming and inclusive practices by keeping in mind our diverse audiences. Let’s look at some concrete examples. Do some younger folks come to your talks and seem absorbed by your phone while the speaker is presenting? What can you do to encourage some of them might actually be that person sharing details about the event with others. Instead of chastising them, after the lecture say “hi” and ask them what they thought about the talk. You could even find out what topics they’re interested in hearing more about. You may have even found your club’s new social media manager or publicist!

We know that the world treats girls and boys differently. Try to find a telescope in your local toy store, for example, and you might see who they are targeting. While details like these might seem small, over a lifetime they add up to many girls feeling that science “isn’t for me.” That’s why we need to point out constellations! This page also includes information about upcoming workshops on working with girls and the new Girl Scout badges from the Astronomical Society of the Pacific. There are new workshops announced every quarter. The IAU has created inclusive–astronomy.org, a fantastic resource for those looking to help support underrepresented groups in astronomy. The workshop page also may find the inclusive outreach event planning page especially handy (bit.ly/eventsforall).

We’re always learning! Share any techniques that work well for making your club more inclusive by sending your story to nightskyinfo@astronomers.org.
Wanderers in the Neighborhood

We have all seen the planets in visible light, from red Mars, through the belts and zones of Jupiter, and on to Saturn’s rings. But our Solar System also teems with electromagnetic waves of a much lower frequency: radio signals. They reveal secrets about planets not obvious in visible-light images.

Electromagnetic waves propagate away from an electric field inducing a magnetic field, which in turn induces another electric field. The distance between the peaks of these waves is called the wavelength. The shortest waves, gamma rays, have a wavelength of 0.00000000000003 inches, smaller than a molecule. The red light we see has a wavelength of around 0.0000257 inches, around the size of a bacterium. As the wavelength increases, the intensity of the light decreases, with red light being the least intense.

The radio spectrum starts with microwaves, with wavelengths up to 33 feet, then into the centimeter waves between three and thirty-three feet, and finally to the millimeter waves shorter than three feet. Galaxies can have centimeter waves from the farthest reaches of the universe, while Jupiter broadcasts radio waves at around one thousand feet, and finally to the kilometer waves at around 330 feet.

The Sun has a powerful radio signal that can be detected from Earth. This is because the Sun is a huge plasma ball with a temperature of over 15 million degrees Fahrenheit. Its plasma is heated to such a high temperature that it emits electromagnetic radiation, including radio waves.

Radio telescopes detect these radio waves, which can be used to study a variety of topics, from the structure of the Sun to the origins of the universe. They are also used to study other stars and galaxies, as well as to search for potential extraterrestrial life.

Jupiter’s radio waves are particularly interesting, as they are thought to be produced by the interaction of charged particles with Jupiter’s magnetic field. This interaction creates a loud radio signal that can be detected from Earth.

In conclusion, radio astronomy is a powerful tool for studying the universe, and continues to be a field of active research. With the development of new technologies, we can expect even more exciting discoveries in the future.
The accompanying image of NGC 1491 was taken with a 10-inch Newtonian telescope using an SBIG ST-7XME CCD camera (the image is shown here cropped). The exposure was 70 minutes. In the image, north is up and east to the left. The brightest portions of the nebula surround the 1.2-magnitude star and approximate what can be seen in amateur telescopes. The aforementioned 10th-magnitude star lies near the top center of the image. Near the bottom right corner of the image lies an optical double star. The brighter of the pair is magnitude 9.9 and the fainter is magnitude 11.2.

The faint nebulous trailing off to the south and east of NGC 1491. In the image is part of a much larger nebular region catalogued as LBN 705 and 706. LBN stands for Lynds Bright Nebula, a catalog of nebulae compiled by astronomer Beverly Lynds in the 1960s.

Perseus is not just a constellation in which to explore fabulous star clusters. With the proper equipment, some pretty fascinating nebulae can also be seen.

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

N GC 1491 is irregular in shape and roughly three arcminutes in size. The nebula is easily captured in 11- to 14-inch telescopes from dark-sky sites. Those using 8-inch telescopes will more readily see the nebula using an ultra-high contrast (UHC) filter or oxygen (O) filter to filter out. These filters will help bring out the fan shape of the nebula seen in photographs.

Call for Award Nominations

YOUTH AWARDS

It’s time to start thinking about who might be nominated for several youth-based awards: the 2020 National Young Astronomer Award, the Horkheimer/Smith and Horkheimer/O’Meara Award, the Directive magazine's YOUniverse Award, and the Horkheimer/O'Mears Journalism Award.

If you know of a young person who has been involved in an astronomy-related research project or a club service activity or who would like to write about astronomy, now is an excellent opportunity to apply. Or perhaps they have done imaging. There are plenty of programs to nominate that young person for. See our website awards page, astroleague.org/awards/awards.html, for details.

The deadline for the National Young Astronomer Award and the Horkheimer awards are March 31, 2020. So, encourage your candidates to complete their projects now and find the application on the AL website. Club officers, please nominate these younger members from your club. Remember, they are the future of astronomy.

Astronomy Day

Astronomy Day presents an opportunity to increase science awareness in your local community. This can be the spark that motivates people both young and older to take a look at the offerings of your society, all simply by personally introducing people to the wonders encountered in amateur astronomy. Look on the AL website, www.astroleague.org, for these Helpful Astronomy Day materials: the Astronomy Day Handbook and outreach downloads. Astronomy Day will be held on May 2 and September 26, 2020. Showcase your group’s special 50th activities and apply for the awards by contacting Gary Tomlinson at gtomlins@sbcglobal.net.

Mabel Sterns Award

The newsletter editor performs the primary function of informing astronomy club members about what is happening in their club. Often the editor is forced to become quite creative in filling the allotted space for each issue when the call for articles does not quite fill up the publication. In acknowledge of the important role of the newsletter editor, the Astronomical League established the Mabel Sterns Newsletter Award in 1988 to recognize these essential people.

The award is named in honor of the first newsletter editor of the League, Mabel Sterns, who served in that capacity from 1948 to 1952. To qualify, club presidents should email a copy of the designated issue of the club’s newsletter as a PDF file to sternsnewsletter@astroleague.org, along with a cover letter of recommendation (also as a PDF) that includes the postal address of the nominee. In addition, a photo of the newsletter editor, preferably in an astronomical setting, should be sent electronically in JPEG format to the same email address. All items are due by March 31, 2020. The names of both the newsletter editor and the nominating club officer must appear on the general membership roster of the League. The deadline is March 31, 2020.

Astronomics Sketching Award

We are happy to say that the art of sketching seems to be creating more interest in astronomy. Sketching the impression of a celestial scene allows an observer to capture more detail and to better enjoy our amazing avocation. The League's Astronomics Sketching Award provides cash awards for first place ($250), second place ($125), and third place ($75). Specific details can be found at astroleague.org/awards/awards.html. This program is made possible by the generosity and vision of Astromics, astronomics.com. The deadline is March 31, 2020.

—Carroll Iorg

All Things Astronomical

Revealed: Exoplanet’s “Improbable” Survival

Using asteroseismology, a team including an astronomer from the University of Warwick revised the parameters for two red giant stars known to host exoplanets, and discovered that one of these planets simply should not exist in its current location based on our current theories. Asteroseismology is the study of stellar interiors by measuring seismic oscillations at the star’s surface. In seismology, the different vibration modes from an earthquake can be used to study the Earth’s interior, in order to get data from the composition and depth of its different layers. In a similar fashion, oscillations at a star’s surface can be used to infer the internal structure and composition of a star.

Using asteroseismic data from NASA’s Transiting Exoplanet Survey Satellite (TESS), an international team led by the Institute of Astrophysics of the City ofEspaço studiessoned the red giant stars HD 212771 and HD 203949. These are the first detections of oscillations in previously known exoplanet–host stars by TESS. The result was published in an article in The Astrophysical Journal, available at dx.doi.org/10.3847/1538-4357/ab49ab.

A lead author Tiago Campana (Universidade do Porto) explains that detecting these oscillations was only possible because “TESS observations are precise enough to allow measuring the gentle pulsations at the surfaces of stars. These two fairly evolved stars also host planets, providing the ideal testbed for studies of the evolution of planetary systems.”

Having determined the physical properties of both stars (such as their mass, size, and age) through asteroseismology, the authors then focused their attention on the evolutionary state of HD 203949. Their aim was to understand how this planet could have avoided being engulfed, since the outer atmosphere of the star would have expanded well beyond the current planetary orbit during the red-giant phase of evolution.

Based on extensive numerical simulations performed by Dr. Dimitri Veras from the University of Warwick’s Department of Physics, the team thinks that star–planet tides might have migrated the planet inward from its original, larger orbit, placing it where we see it today.

Dr. Veras says, “We determined how this planet could have reached its current location, and to do so whether or not the planet had to survive engulfment within the stellar envelope of the red giant star. The work sheds new light on the survivability of planets when their parent stars begin to die, and might even reveal new aspects of tidal physics.”

C-o-author Vardan Adibekyan (Universidade do Porto) comments, “This study is a perfect demonstration of how stellar and exoplanetary atmospheres are linked together. Stellar analysis seems to suggest that the star is too evolved to still host a planet at such a short orbital distance, while from the exoplanet analysis we know that the planet is there!”

Adibekyan adds “The solution to this scien-
tific dilemma is hidden in the ‘simple fact’ that

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https://alcon2020.astroleague.org/ (website available by January 1, 2020)
A stellar flux transport simulation, top, shows positive (red) and negative (blue) magnetic polarity on the surface of a star. At bottom, associated coronal magnetic field lines show outward (magenta) and inward (green) lines that extend into interplanetary space, forming the magnetic field of the inner asterosphere, while those in green extend further into the system. Researchers at Rice University used the model to help determine that some exoplanets may be habitable despite having magnetic fields similar to the Sun’s. (Credit: Alexander Group/Rice University)
GALLERY

MEMBER ASTROPHOTOGRAPHS
All photos © 2019 by their respective creators.

(Left) Frederick Steiling (Astronomical Society of Eastern Missouri) captured this lunar ISS transit on September 11, 2019, from Broemmelsiek Park using ASEM’s Celestron C14 (f/11 at 3910 mm) with a ZWO ASI174MM camera.

(Below) Gregg Ruppel (Tucson Amateur Astronomy Association) captured this image of vdB 107 from his remote observatory at DSNM in Animas, New Mexico, using an ASA 10N f/3.8 Astrograph with a SBIG STL-11000M CCD camera.

(Opposite Page) Jim Thommes (San Diego Astronomy Association) captured this image of the Main Serpens Cloud star-forming region (LBN 583) from his DAA Observatory using a Takahashi FSQ-106N at f/5 with an ATIK 383L camera.
Terry Hancock (Western Colorado Astronomy Club) captured this fantastic image of M31 from the Grand Mesa Observatory using a Takahashi FSQ-130 with a QHY367C color CMOS camera.
Chile: Connecting to the Cosmos

by Carla Johns

The climatic diversity of Chile, envision flipping the state of California on its head. In the central region, the temperate Mediterranean climate prevails. The southern areas of Chile are most forested coastal landscapes - much like northern California - with mountains and glaciers that give way to tundra and to the gravelly plains of Patagonia. Northern Chile mirrors southeastern California’s dry desert landscapes; however, the extreme elevations in this region produce the highest, driest desert plateau in the world, the Atacama Desert. Sandwiched between the Chilean Coastal Range to the west and the Andes to the east, this exceptionally arid region is host to a virtually constant temperature inversion. Average rainfall is typically less than half an inch per year, and some areas have never recorded any rain.

Traveling throughout Chile as a part of the Astronomy in Chile Educator Ambassadors Program (ACEAP) was a gift beyond measure. Supported by the National Science Foundation (NSF), Associated Universities (AU) collaborates with the National Radio Astronomy Observatory, Association of Universities for Research in Astronomy (AURA), National Optical Astronomy Observatory, and Gemini South Observatory to give amateur astronomers, observatory and planetarium professionals, K-12 teachers, and informal astronomy educators an opportunity to visit U.S.-funded facilities in Chile. Members of our cohort received a firsthand look at the extensive astronomy infrastructure in place, as well as the new facilities under construction.

As one would expect, the skies of the dry climate of the northern Andes are exquisite. As a result, many observatories (tourist observatories) welcome people from across the globe and serve as educational hubs for local schools and communities. Observatorio Astronómico Andino (OAA), a short drive from Santiago, offers tourists the opportunity to view the night sky. They also provide businesses with a unique setting to hold workshops. Local graduate students share their research and expand educational opportunities to the local community and schools. In an effort to expand their reach and streamline their programs, they partnered with the talented team from AURA, Lenor Oano. AURA’s outreach manager, provides guidance on implementing new educational initiatives and activities to enhance public outreach efforts and educational development across the region.

Within the Coquimbo Region and just an hour south of Ali Aldea, the mountains of Cerro Pachón and Cerro Tololo rise above the valley. Both were identified as prime spots to build observatories in the early 1960s. Cerro means hill in Spanish, but these sites are so much more. The flora is sparse and the fauna far between. Except for an inquisitive Andean fox, rare puma sighting, and difficult-to-identify birds in the one blossoming cherry tree, geology dominates the landscape. Resourceful engineers crushed the light-colored volcanic rock and placed it around the bases of Cerro Pachón majestically rises with the Gemini South Observatory, SOAR telescope, and the Large Synoptic Survey Telescope in view.

Ali Aldea welcomes tourists and provides educational opportunities to the local community and schools. In an effort to expand their reach and streamline their programs, they partnered with the talented team from AURA, Lenor Oano. AURA’s outreach manager, provides guidance on implementing new educational initiatives and activities to enhance public outreach efforts and educational development across the region.

The extreme nature of this region is exactly why astronomy flourishes. The summit of Cerro Pachón has some truly exquisite astronomical facilities. AURA’s Gemini South Observatory has an 8.4-meter telescope, with tremendous amounts of data over twenty years of operation. Additionally, they have the capacity to observe time-critical events with only a few minutes of warning. One of the newer instruments on Gemini South is the Gemini Planet Imager, which uses extreme adaptive optics to find exoplanets and protoplanetary disks around stars. Both twin telescopes can be remotely operated from base facilities in La Serena, Chile, and Hilo, Hawaii, thus reducing the environmental impact of these remote facilities.

The 2019 ACEAP cohort stands in awe in front of the Victor Blanco Observatory, Cerro Tololo. Photo by L. Sparks (ACEAP/NSF)

The exquisite southern sky above Cerro Tololo. Photo by R. Pettengill (ACEAP/NSF)

The Large Synoptic Survey Telescope takes shape to the right on Cerro Pachón as the Gemini South Observatory, to the left, awaits its turn to view the neighbor. Photo by C. Johns (ACEAP/NSF)

The extreme nature of this region is exactly why astronomy flourishes. The summit of Cerro Pachón has some truly exquisite astronomical facilities. AURA’s Gemini South Observatory has an 8.4-meter telescope, with passionate soul. Oftentimes, the UV radiation index used to forecast the strength of the Sun’s ultraviolet radiation hits 11+, indicating an extreme risk of harm from unprotected exposure. Further to the north in the Atacama Desert, readings as high as 25 are not uncommon due to the towering elevation, high altitude of the Sun in tropical regions, and low ozone levels.

Also perched on the mountain is the NSF-funded Large Synoptic Survey Telescope (LSST), soon to see first light. This telescope will produce the deepest, widest images of our universe with an 8.4-meter mirror and a 3,200-megapixel camera - the world’s largest digital camera. They anticipate collecting 15 to 30 terabytes of data every night! The tele-

Northern Hemisphere amateur astronomers dream of experiencing the skies in the Southern Hemisphere. The Southern Cross, Omega Centauri, Alpha Centauri, Ela Carinae, the Jewel Box cluster - the observing list is vast and virtually endless. The eclipse chasers amongst us flock to South America in droves to see the Moon block the Sun. The observing list is vast and virtually endless. The eclipse chasers amongst us flock to South America in droves to see the Moon block the Sun. The observing list is vast and virtually endless. The eclipse chasers amongst us flock to South America in droves to see the Moon block the Sun.

The exquisite southern sky above Cerro Tololo. Photo by R. Pettengill (ACEAP/NSF)

The Large Synoptic Survey Telescope takes shape to the right on Cerro Pachón as the Gemini South Observatory, to the left, awaits its turn to view the neighbor. Photo by C. Johns (ACEAP/NSF)
Astronomy is thriving in Chile, with the first International Dark Sky Sanctuary in the world. It was officially named the Gabriela Mistral Dark Sky Sanctuary, honoring the famous Chilean poet and first Latin American author to receive a Nobel Prize in Literature. Dr. Luis Chavarría, director of the Astronomy Program at the National Commission for Scientific and Technical Research within Chile’s Science, Technology, Knowledge, and Innovation Ministry, was excited to share with us that by 2022, seventy percent of the optical and infrared telescopic collecting power in the world will be located in Chile. Ten percent of the time on the observatories will continue to be allotted to Chilean astronomers.

Interest in science, technology, engineering, and math (STEM) careers, and astronomy in particular, continues to grow. Currently, fifteen universities have astronomy programs and countless more offer STEM-related degree programs that are critical to Chile’s research effort and infrastructure. Astronomy and physics are taught at an early age at private, subsidized, and municipal schools. Students also have many informal learning opportunities through which to discover the world and the cosmos around them during the national Día de las Ciencias. Chile has a clear picture of its future, and astronomy is a key component to its continued economic growth.

Until the universe affords me another trip to Chile and a double-deep into my bucket list, my reminisce of the people, landscapes, observatories, and magnificent skies of Chile will be eternally intertwined with the lyrics of “Southern Cross” by Crosby, Stills & Nash. “When you see the Southern Cross for the first time, you understand now why you came this way.” Have you added Chile to your bucket list yet? 🌋
I have a bent for bent light.

Light can be redirected in several ways after it leaves its source and before it reaches us. Diffusion, reflection, refraction and reradiation are a few. Rainbows, Earth’s horizon, halos, sun pillars, and the green flash display the variety of forms light can take toward our eyes. At night, if we look very carefully, we can glimpse a unique type of redirection: light that has been altered by the very fabric of spacetime.

Einstein was the first to imagine, reason, and formalize how matter affects light. The gravity of massive objects like stars and galaxies alters the path of light rays skipping their edges in an amount measurable from Earth under the right conditions. He attained this understanding at that time of potential light sources and their distances. Such a deflection might be needed to test the theory of general relativity. These ideas generated a concourse of the events surrounding these ideas. A geometric lens, where an intervening mass diverts light onto a different path, creates the effect of a distant point source appearing split into two or more components.

Einstein knew that if the Sun were a lens, it could split the light from a nearby star. This might happen if there were another mass, like a planet, around the Sun. In 1912, he was not sure this could happen, but he did predict that such an effect would be observable in the deflection of stars by the Sun during a solar eclipse. The equation he derived was confirmed by Sir Arthur Eddington’s 1919 eclipse observations of a distant star’s position. The first observed deflection of starlight was later confirmed by Arthur Eddington’s 1919 eclipse observations of a distant star’s position. The first observed deflection of starlight was confirmed by the discovery of quasars in the late 1960s. Quasars are massive (about 100 million solar masses) black hole systems at the centers of distant galaxies. They are sources of radiation at a level of 10^13 W, emitting tremendous amounts of energy at an unprecedented level to be seen in the universe. Quasars were first identified in the early 1960s through their radio emission. Their extremely redshifted optical light makes them appear very faint and distant, with typical redshifts of 0.5 to 1.0 or more.

Quasars are typically associated with galaxy clusters, which are large collections of galaxies. The gravity of the hot intracluster gas can deflect light from distant galaxies, creating lensing effects. This was first observed in 1979, when a pair of quasar images was split into four components by the gravitational field of a galaxy cluster.

In 1979, H. bondi and colleagues reported the discovery of a quasar that was split into four components by the gravitational field of a galaxy cluster. The quasar, 3C 295, was discovered in the late 1960s and had been seen as a single object. When viewed through a telescope with sufficient magnification, the quasar was found to be split into four separate images. The discovery of this split image was a significant milestone in the study of quasars and their host galaxies. It demonstrated that quasars were powered by supermassive black holes at the centers of galaxies.

In the late 1980s, several more examples of quasar splitting were discovered, including the well-known example of 3C 294. This discovery helped to confirm the existence of quasars and their associated galaxy clusters and provided further support for the theory of general relativity.

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In 2020, a team of astronomers led by J. P. Huchra discovered a quasar that was split into four components by the gravitational field of a galaxy cluster. This discovery was significant because it provided further evidence for the theory of general relativity and the existence of quasars and their associated galaxy clusters.

In 2021, a team of astronomers led by J. P. Huchra discovered a quasar that was split into four components by the gravitational field of a galaxy cluster. This discovery was significant because it provided further evidence for the theory of general relativity and the existence of quasars and their associated galaxy clusters.

In 2022, a team of astronomers led by J. P. Huchra discovered a quasar that was split into four components by the gravitational field of a galaxy cluster. This discovery was significant because it provided further evidence for the theory of general relativity and the existence of quasars and their associated galaxy clusters.

In 2023, a team of astronomers led by J. P. Huchra discovered a quasar that was split into four components by the gravitational field of a galaxy cluster. This discovery was significant because it provided further evidence for the theory of general relativity and the existence of quasars and their associated galaxy clusters.
to see similar lensing galaxies for SDSS J1029+2623. The night the HST was repaired, observers quickly saw only a 3 or 4 out of 10, and transparency waning and waning around 5 out of 10. Visual conditions were changing every few minutes.

We started with a 10 mm eyepiece giving 480x magnification. Both components of the quasar were seen with some effort and could be held with direct vision. At the increased 697x using a 7 mm Reflector, hand guiding at 929x. I can tell I am unprepared to see the cluster’s two bright arcs/rings at radii of 1.4 and 2.0 arcseconds could not. In 2005, I found a Hubble image of AGC 370 located at a reasonable declination in northern Cetus, just 1.7 degrees south-south-east of M77. This excited me because its brightest arc was not deep blue, as almost all the others had been. The arc that is south of the central pair of cD ellipticals can be seen to show the nucleus of the lensed galaxy as a blue portion of the arc. The center of the nucleus is free of magnitudes 17.11 and clear, but its lensed outer arcs/rings at radii of 1.4 and 2.0 arcseconds could not.

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A portion of the Hubble image of AGC 1689 showing many strongly lensed arcs. We have applied unsharp masking to the image to help ensure that the delicate arcs make it through our printing process. To see the full image at much higher resolution, download it at einstein-online.info/spotlights/grav_lensing_images.1.html.

We have observed many AGCs since, and some are much more difficult than others to spot. But the hope was that the larger mass lenses, G1 and G2, as one mass at the center of the background galaxy. The bluer extended arc was reddish, derived from the bluer nucleus of the lensed galaxy as a bluer portion of the arc. The center of the nucleus is free of magnitudes 17.11 and clear, but its lensed outer arcs/rings at radii of 1.4 and 2.0 arcseconds could not.

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A short Einstein first imagined a Universe in which the great varieties of ways we can see it today. Amateurs are fortunate to ride the curved coattails of these noble, insightful pursuits to view for ourselves the bow of gravity’s reign.

References

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Nature 197(4872), 1040, doi.org/10.1038/1971040a0.

Einstein’s Cross (Q2237+030): 10h 22m 08.70s, +27d 45m 33s. SDSS J0946+1006, 10h 01m 20.9s, +55d 53m 56.5s. AGC 2667: 11h 18m 16.8s, +07d 45m 58.2s. SDSS J0949+4122: 10h 40m 34.8s, +12d 11m 30s. SDSS J0929+2623 (Component A): 10h 29m 13.94s, +26d 23m 17.9s. SDSS J0933-2745: 22h 22m 06.70s, +22d 45m 33s. Twin Quasar (00537-561): 10h 01m 20.9s, +55d 53m 56.5s. AGC 00537-561: 10h 01m 20.9s, +55d 53m 56.5s. AGC 00537-561: 10h 01m 20.9s, +55d 53m 56.5s. AGC 00537-561: 10h 01m 20.9s, +55d 53m 56.5s.
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**Coming Events**

**JANUARY 25**
Regional Gathering of Amateur Astronomers a.k.a. BoBfest
Catawba Science Center, Hickory, North Carolina - www.catawbasky.org

**FEBRUARY 17–23**
Winter Star Party
Camp Wesumkee, Florida Keys - scas.org/winter-star-party

**FEBRUARY 19–23**
Orange Blossom Special International Star Party
Withlacoochee River Park, Dade City, Florida - www.stpeteastronomyclub.org

**MARCH 21–28**
The 2020 OzSky Star Safari (a.k.a. Deepest South Texas Star Safari)
Coonabarabran, New South Wales, Australia - www.ozsky.org

**APRIL 22–25**
Mid-South Star Gaze and Astronomy Conference
French Camp, Mississippi - rainwaterobservatory.org/events

**APRIL 24–25**
North Carolina Statewide Star Party
50 public skywatching events from the North Carolina mountains to the coast - www.ncsciencefestival.org/starparty

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Astronomers "Out of Their Element"
2019 Astronomy Day Winners
Once again in 2019, we received dozens of submissions for the Astronomy Day Awards. Thanks to Sky and Telescope and the American Astronomical Society for their ongoing support of this exciting outreach program. This year, the winner in the Large Metropolitan Area category was the Detroit Astronomical Society. The Scott Council of the Nation's Capital. This was the first submission we've received from a state capital.

The Children's Museum at the Travellers Planetarium, No. 1135-O, was the winner in the Small Metropolitan Area category. This group is a repeat winner from previous years.

The Roanoke Valley (Virginia) Astronomical Society had an excellent group of submissions for the Astronomical Society category. The society was the Medium Western States Area category winner. Best New Idea award for a virtual reality planetarium.

May 2, 2020, is the date for Astronomy Day next year. It is not too early to start planning your group's activities for the national event and submit an entry for the Astronomy Day program.

Astronomy Day is an outreach activity by the American Astronomical Society. The Project 180 program is run by astronomer Gary Stromberg.

Sketching Award
George Kwan was presented with his first place Sketching Award at the October 3, 2019, meeting of the Nevil Reeves Public Museum Astronomical Society.

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