

Reflector

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Vol. 66, No. 3

June 2014



Laud of the Rings—Frodo Never Saw These
2014 National Young Astronomer Awards
Deep Sky Objects: The Dumbbell Nebula
Christiaan Huygens—So Many Contributions

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Our cover: David Doctor, member of the Astronomical Society of Las Cruces, took this image of the Crab Nebula (M1) from Doña Ana County, New Mexico, about 10 miles east of Las Cruces. He used a 10-inch Astro-Tech Ritchey-Chrétien f/8 on a Paramount mount. The camera was an SBIG ST-8XME, 1530 x 1020 pixel array for the imaging chip with 9-micron pixels, TC-237 guide chip. Image scale is 0.93 arcseconds per pixel with this system. An SBIG CFW9 filter wheel held Astrodon E-Series LRGB filters and an Astronomik 14 nm H-alpha filter. The focuser was a 2.5-inch MoonLite CSL with a camera rotator operating on the ASCOM Platform. Images were captured over four weeks from December 29, 2013, through January 26, 2014. Calibration was achieved with dark frames (matched for time, temperature, and binning) and sky flats (matched for rotation using the null point in the twilight sky). Processing, including calibration, stacking, and post-processing, was done in PixInsight. The H-alpha channel was combined with the red channel.

To our contributors: The copy and photo deadline for the September 2014 issue is July 15. Please send your stories and photos to our magazine editor, Ron Kramer (editor@astroleague.org), by then.

The Astronomical League invites your comments regarding the magazine. How can we improve it and make it a more valuable resource for you, our members? Please respond to the editor's email address above.

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Peter Kurtz, Cape Cod Astronomical Society

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Chris Ragaisis, on CloudyNights

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Joe Lalumia

"Four-for-four, Birren's work bats 1000."
Jim Barnett, review on CloudyNights

Reflector

The Astronomical League Magazine

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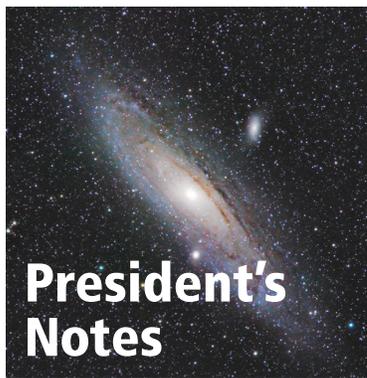
Winter Star Party 2014

It was my honor to represent the Astronomical League at the Winter Star Party in February.

What a treat to have such good observing conditions and warm temperatures in the middle of winter. Thanks to the entire staff of the Southern Cross Astronomical Society and the Winter Star Party for their wonderful hospitality.

I enjoyed renewing old friendships and making new ones, including a friendship with the founder of the Winter Star Party, Tippy D'Auria.

It was a pleasure to join several of the League's longtime supporters and Winter



President's Notes

myself; Scott Roberts, founder and CEO of Explore Scientific; and Dr. Don Parker, who has studied the Solar System for over fifty years, lectured at countless events across the country, and is currently assistant coordinator (CCD/video imaging) for the Mars section of the Association of Lunar and Planetary Observers (ALPO).

International Memberships

For the past several months, the League has been entertaining the idea of extending membership to include international societies. In response to requests from several international groups, we have looked at cost-effective ways of offering this service, considering the higher rates for international postage. The introduction of an electronic version of the *Reflector* magazine has made this more practical from an economic point of view. One of the major reasons most of these groups have requested League membership is the vast array of observing programs that we offer. Other issues remain to be sorted out, but we are close to starting a trial with one of the groups.

League Regional Leader Visits the National Office

It was my pleasure recently to welcome Wayne Green, chairman of the Mountain Astronomical Research Section (MARS) region, to the League's national office in Kansas City. While in town, Wayne, his wife Christine, and I enjoyed some fine barbeque at one of the area's best-known establishments.

Thanks to Wayne and all our fine regional officers who continue to make the League stronger.

ALCON 2014 in San Antonio

The dates are July 10–12. The planning is coming along very nicely for ALCon 2014, the annual convention of the Astronomical League. The League and the San Antonio Astronomical Association have an exciting

conference planned in conjunction with the 40th anniversary of the SAAA. A special lodging rate of \$99 per night is available for our guests at the convention hotel, the Hilton San Antonio Airport.

Great Skies!

Carroll Jorg



Star party attendees for lunch at the No Name Pub in Big Pine Key. These included (left to right in the photo below) Paul and Cathy Anderson, members of the Tucson Amateur Astronomy Association and longtime goodwill ambassadors for amateur astronomy; Terry Mann, immediate past president of the Astronomical League and a fabulous astrophotographer; Dr. Barbara Harris, an active member of AAVSO, who has done extensive research with exoplanets;

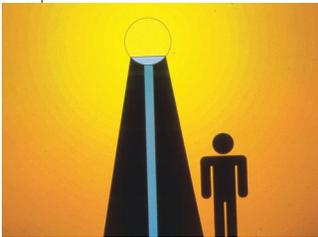
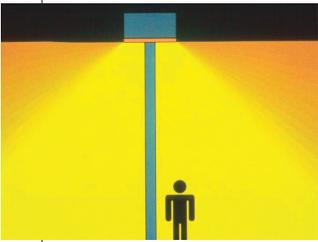


Good Lighting Is Easy

By Bob Gent

While many astronomers care deeply about preserving our magnificent night skies, the issue of light pollution reaches far beyond that. Light pollution is caused by aiming lights into the sky, blinding people with glare, or by leaving lights on when and where they are not needed. When we allow bad lighting at night, we waste an enormous amount of energy and endanger our own health and safety as well as those of many animals. Fortunately, good lighting is easy.

Crime—Bright lights at night can give us a false sense of security. What we need is better situational awareness coupled with better designs. Most crime actually occurs during the day, and nighttime lighting by itself does not ensure safety. A recent U.S. Department



Top: A better way to light is to aim light downward, and only when it's needed.

Bottom: an illustration showing light going everywhere except where it's needed. Images courtesy International Dark-Sky Association, Inc.

of Justice report to Congress concluded that improved nighttime lighting may not deter crime, "particularly since we do not know if offenders use lighting to their advantage. . . . In short, the effectiveness of lighting is unknown." Many of us are afraid of the dark, and we feel safer with bright lights. But are we really? Do criminals need light to see to commit crime? Could they, too, be afraid of the dark?

Safety—Bright lights cause glare that decreases visibility. When lights shine in our eyes we can't see much except the light source. We can't see the steps or handrails leading to a doorway. We can't see the bad guy lurking behind the light. And you know what it's like to have drivers shine their



Here's a photo of the Great Orion Nebula by the author. Photos like these are possible only from areas protected from light pollution, like Cochise County, Arizona.

immune system. Medical doctors are also studying the link between cancer and melatonin suppression from lights at night.

Wildlife—Light pollution also adversely impacts many forms of nocturnal wildlife. Florida's sea turtles have been facing a major threat from bright lights. Endangered sea turtles emerge from the surf to deposit eggs in sand nests; later, tiny hatchlings struggle from their nests to return to the ocean. The turtles instinctively look for moonlight reflecting off the ocean to guide them to the water, but can mistake man-made lights for moonlight, crawl away from the ocean, and die. Similarly, many species of birds, especially small insect-eaters, migrate at night. Guided in part by starlight, they are attracted to lights shining from skyscrapers, broadcast towers, lighthouses, monuments, and other tall structures. Some birds either flutter about until they drop from exhaustion, or actually collide with the lit structure and die.

Property Rights—Light trespass is another serious problem. Light at night can be as offensive as neighbors driving across your yard or parking on your property. When a person aims bright floodlights at their neighbor's yard, light invades the neighbor's property and destroys a good night's sleep as well as the neighbor's ability to see the sky.

high-beams into your eyes. It takes awhile to recover your night vision. This doesn't make you safer—quite the contrary.

Human Health—For billions of years, life on Earth evolved with day and night. Now, we are turning the night into day with unintended consequences. Ongoing research indicates there may be serious impacts on human health from overly bright lights. When we sleep with lights around us, or invading through our bedroom window, we suffer something called melatonin suppression. This adversely affects our circadian rhythm—our sleep pattern—and our

immune system. Medical doctors are also studying the link between cancer and melatonin suppression from lights at night.

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Monetary Investments—In Cochise County, Arizona, astronomy is a major investment. By our estimate, there are over 50 astronomical observatories here. In addition, there are hundreds of millions of dollars in professional astronomical observatories near Cochise County. Although we have good lighting codes in place, bad nighttime lighting has adverse impacts on professional and amateur astronomical research. We need everyone's help to protect this research. Your local astronomers may be the ones to spot an asteroid headed for Earth!

Good Lighting is Easy—Our current city and county lighting codes are designed to help achieve the goals of good lighting. In a nutshell, the key to high quality nighttime lighting is to follow a few simple rules. First, ensure that glare is minimized. Most glare comes from unshielded light fixtures and bad lighting design. You should never see a light bulb. Shine the light down and only when and where it is truly needed. Don't light up trees or walls. Next, use time controls to ensure that light is on when it's needed, and off when it's not. Lights should only be on when there is a person in the area. Motion-activated lights are available, too. As an added bonus, your pocketbook



Bob visiting the McDonald Observatory in Texas.

will benefit if you use these energy efficient controls.

Preserving Our Heritage—Light in the sky is called sky glow. It's a bright nighttime dome over most cities. It destroys our view of the Universe. Go outside on a cloudless night. Under a dark sky, you can still see the structure, shape, and density of our own galaxy, the Milky Way. This is a privilege that very few Americans still have. It is priceless. Across the

country and around the world, people are losing touch with the night. This means our children, and generations to come, are in danger of losing their God-given right to experience the grandeur of the Universe. That would be a tragedy! Let's not let that happen. ☀

About the author: Lt. Col. Bob Gent is a retired U.S. Air Force space systems officer, and he is the past president of the Astronomical League, an educational federation of more than 250 astronomical societies and 15,000 members. He is also the past president of the board of the International Dark-Sky Association. IDA has thousands of members from over 70 countries. He and his wife Terrie built and operate the Cochise Skies (Astronomical) Observatory in Mountain Shadows, Arizona.

Reflector

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Dear Editor:

Hello. My name is Paolo Morini, I live in Italy and I am a member-at-large of the Astronomical League. I write you to give an answer to the letter of Sue Wheatley, published in the December 2013 *Reflector*.

In my opinion, astronomy has become boring only to elder amateurs: after the fifth or sixth telescope, they realize that nothing can give the thrill of the first observation of the Moon and Saturn, and they become tired of plugging in cords and switching eyepieces.

Another bug is the following: it's hard to have fun with high-tech astronomical gear without having the right background. How can you picture yourself having fun taking spectra, measuring cloud speeds on Jupiter and double star relative motion, if you are not an astronomer or something similar?

Years ago, at an Italian astronomy fair, a very famous amateur astronomer, who was quite advanced in age, looking at beautiful telescopes in the 16- to 24-inch range told me, "We can observe much better things that are very hard for us to understand."

When I was a teenager, some people—a Franciscan friar, an English teacher, and a chemist—spent evenings and evenings showing the Moon and Saturn to young people with



their telescopes and binoculars. Now I do the same in my astronomy club and through the planetarium in my town. I have a lot of fun and it's like a debt to repay to my past mentors.

The thrill of wonder in young people, today, is the same that hooked me in astronomy, at the beginning of the 1970s.

Of course, today's youngsters have a lot of things to do: school is more

demanding, their spare time is full of activities, and they are used to concentrating on a single thing for a brief time and getting some immediate result. Probably astronomy, as a hobby, is not tuned in with teenagers' everyday life. But the thrill of the very first observations is always the same.

I think that the best thing to be done, as adult amateur astronomers, is to meet people, especially young people, and offer them the chance to see a bit of Universe and think about what they are looking at.

The main reason I became a member of the Astronomical League is because here there is a whole world of clubs, planetariums, and organizations involved in astronomy popularization and outreach.

Best Regards, Paolo Morini

Via Valeri 9, 48121 Ravenna, Italy

Space Place Prime is now available on Android!

A spinoff of NASA's popular kids' Space Place website, spaceplace.nasa.gov, Space Place Prime has timely, educational, and easy-to-read articles and activities from the Space Place and other science websites, the latest and most impressive NASA space and Earth imagery, and a wide array of informational movies. There is plenty to keep everyone occupied and informed. Content is updated daily. The Space Place Prime Android app can be found at tinyurl.com/lyqme53.

Attention ALCors

Annual society ballots and dues statements were emailed in April from our national office. Please return your ballot by June 15 to the national office. Please return your ballot by June 15 to the national office. Dues payments should be sent separately to the treasurer by June 30.

The Sky This Week

To find out what's happening
in the sky the coming week, take
a look at, "The Sky This Week"

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comets, and interesting
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The Dumbbell Nebula, M27, is perhaps the best planetary nebula visible in northern skies. Shining at magnitude 7, the Dumbbell Nebula is one of the brightest planetary nebulae. The discovery of M27 is credited to Charles Messier who recorded seeing it in 1764. M27 was the first planetary nebula to be discovered.

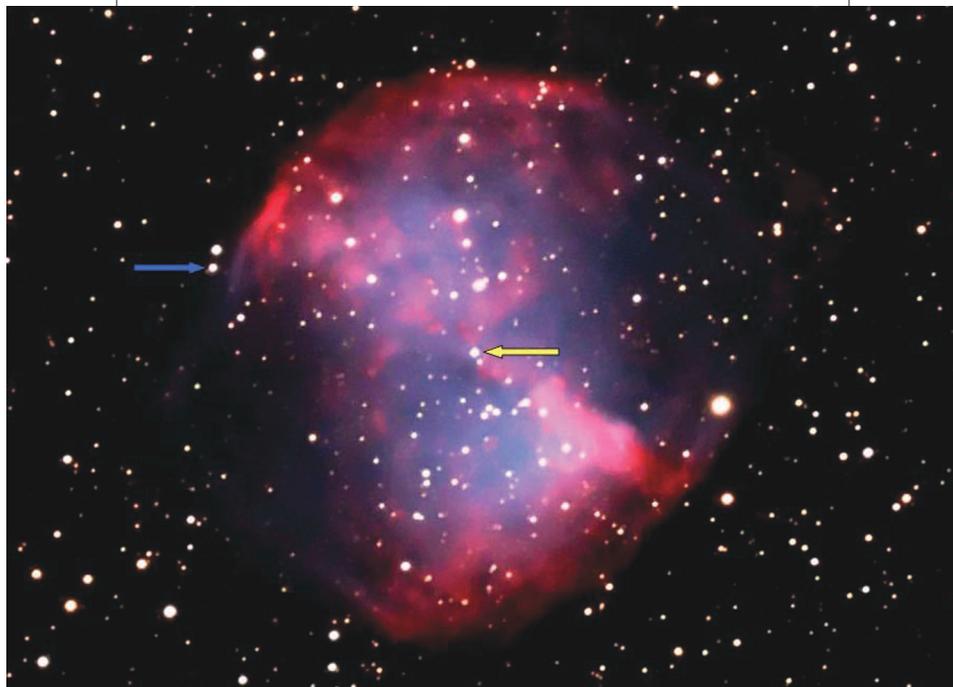
The Dumbbell Nebula is relatively easy to find. Although it is located along the Milky Way in the constellation Vulpecula, I usually star hop to it from the constellation Sagitta. To find M27, locate Gamma Sagittae, the head of the little arrow. M27 is 3° north of Gamma, about the same span as the shaft of the arrow—Delta to Gamma Sagittae—not counting the arrow's tail.

Planetary nebulae were named for their fairly round, planet-like appearance in the eyepiece, and many of the brighter ones are tens of arcseconds to several arcminutes in diameter, in the same angular size range as the planets Jupiter and Saturn. A planetary nebula is essentially the outer layers of a star that have been blown off by the intense radiation pressure from the star's core, after the star exhausted its hydrogen fuel and heated up tremendously. Radiation from the remaining star, now fusing helium, excites the atoms in the expanding shells of stellar gas causing them to glow: a planetary nebula is born. In many planetary nebulae, the star that gave rise to the nebula is visible at the nebula's center. Our Sun may become a planetary nebula in another five

DEEP-SKY OBJECTS

THE DUMBBELL NEBULA

By Dr. James R. Dire, Kauai Educational Association for Science & Astronomy



billion years, losing about half its mass in the process. Planetary nebulae are short lived compared to the lifetimes of stars, as the expanding gases of planetary nebulae quickly dissipate into the interstellar medium.

The Dumbbell Nebula has a diameter of about 8 arcminutes. It lies approximately 1400 light years away and has a real diameter of approximately 3 light-years. M27 has two bright, triangular lobes on its north and south sides, which give rise to

its name. The nebula is expanding at a rate of about 2.3 arcseconds per century, and it is between 10,000 and 15,000 years old. The central star (yellow arrow) is a white dwarf. It is 5% of the Sun's diameter and 56% of the Sun's mass. The star shines at magnitude 13.5. Our Sun may be similar in size if it reaches the same stage during its demise.

M27 can be seen in binoculars under ideal conditions, but it looks like a tiny fuzzy spot. Small telescopes begin to show

the two bright lobes, while larger scopes reveal bright and dark regions within the lobes. Under the best conditions with high quality optics, the central star might be spied using 4- to 6-inch telescopes. But I would recommend using an 8-inch or larger piece of glass to have the best chance of glimpsing it.

I took the accompanying image of M27 with the 20-inch Ritchey–Chrétien Cassegrain telescope at the U.S. Coast Guard Academy astronomical observatory in Stonington, Connecticut. The exposure was 20 minutes using an SBIG ST-2000XCM CCD camera. The brightest star in the field of view, just on the visible edge of the nebula below the three o'clock

position, is magnitude 11.2. The faintest stars in the image are magnitude 18. The bright red and blue hues in the image are close to the true colors emitted by the nebula's gases, but our eyes cannot perceive color (with the occasional exception of green) at the eyepiece at these low light levels. Regardless, the view is indeed rich, especially at higher magnifications.

The star in the image marked with the blue arrow is a variable star. My image caught it near its maximum brightness. At

minimum, the star is several magnitudes fainter. Based on the many Dumbbell Nebula images I have examined, I would guess its range falls between magnitudes 13.5 and 16. For some observers, tracking this challenging variable star may be another reason to keep returning to this beautiful planetary nebula. ☼

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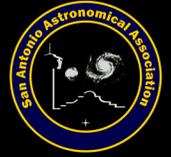
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SO MANY SUNS, S

By Katherine Kornei, Ph.D.

Science is indebted to **Christiaan Huygens**, an accomplished mathematician, philosopher, and astronomer whose name was lent to a recent mission to explore the Saturnian system. Huygens made fundamental contributions to studies of Saturn's rings and discovered the planet's largest moon, Titan, while also conducting detailed investigations of optics, probability, and periodic motion.

Christiaan Huygens was born in 1629 to a prominent Dutch family. As was the custom for wealthy families at the time, young Huygens studied at home with a variety of tutors. After completing studies at the University of Leiden and the College of Orange in the southern Netherlands, Huygens had a short career as a diplomat, but then returned to his family's home in The Hague to pursue mathematical and scientific research. Huygens developed an interest in telescopes and studied spherical lenses for several years before grinding his own glass mirrors in 1654, at the age of 25. Several decades earlier, Galileo Galilei had first turned a telescope skyward.

In 1655, Huygens pointed his telescope toward Saturn with the goal of observing what we now know to be the planet's rings. However, in addition to the rings, Huygens saw a bright point of light near the planet. He had discovered Saturn's first moon, now known as Titan. Johannes Hevelius, a Polish astronomer, had observed Titan years earlier, although he had

mistaken it for a star. Huygens conveyed his discovery of Titan to mathematicians in Paris, including his friend Ismael Boulliau, who would later act as a confidant and mentor to young Huygens. Several more years would elapse until Saturn's next largest moons—Iapetus, Rhea, Tethys, and Dione—were discovered by Giovanni Domenico Cassini.

Huygens continued his observations of Saturn, now using a 50-power refracting telescope. In 1656, he published a short pamphlet documenting his hypothesis regarding the rings of Saturn: "a thin, flat ring, nowhere touching, and inclined to the ecliptic." When Huygens shared his ring hypothesis with Boulliau in Paris, his mentor replied: "You establish your hypothesis very well, and it proceeds regularly, provided you can persuade how this ring can become invisible however small its consistent thickness. I know that nature has been able to make a ring around this said body, and that by [the same] reason that the Earth is suspended; in the open air, a



An engraving of Christiaan Huygens, completed between 1684 and 1687.

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ring can also be suspended: nevertheless, you still need some experiments in order to demonstrate absolutely that which you propose."

Support for Huygens's ring hypothesis came in the form of the *Accademia del Cimento* (Academy of Experiment), an Italian scientific society founded by Prince Leopoldo de' Medici. Members of the *Accademia del Cimento* constructed a model of Saturn that included rings according to Huygens's theory

and placed the model at the end of a long hallway. The society members then observed the system using telescopes. The *Accademia del Cimento* ultimately concluded that Huygens's ring hypothesis was consistent with their observations of the model.

Around the same time, Huygens studied probability theory and wrote *On Reasoning in Games of Chance* in 1657. He postulated expected values and later expanded his study, with

O MANY EARTHS

his brother Lodewijk, to estimates of human life expectancies.

Two years later, in 1659, Huygens published *Systema Saturnium*, in which he calculated the orbital period of Titan (15 days, 23 hours, and 13 minutes) and presented evidence for his hypothesis that Saturn was surrounded by a ring. Huygens dedicated the manuscript to Prince Leopoldo de' Medici, the founder of the *Accademia del Cimento*. *Systema Saturnium* ends with Huygens's observations of all the planets in the Solar System known at the time (Mercury, Venus, Earth, Mars, Jupiter, and Saturn) and his calculations of their sizes relative to the Sun.

In 1675, Huygens's model of a thin, flat ring around Saturn

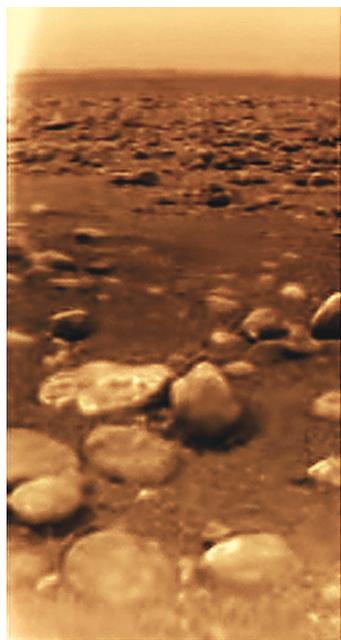


Image of Titan's surface taken by the Huygens probe. The rocks in the foreground measure approximately six inches across.

suffered a blow from observations by Cassini. A gap in the supposedly solid ring had been discovered and Cassini purported that the ring was composed of numerous small satellites. Over one hundred

years later, treatises by Pierre Simon Laplace and James Clerk Maxwell showed that solid rings orbiting Saturn were mathematically unstable. However, it was Huygens's pioneering observations that helped to prompt the study of Saturn's rings, finally revealing the true nature of the "ears" that Galileo has noted decades earlier.

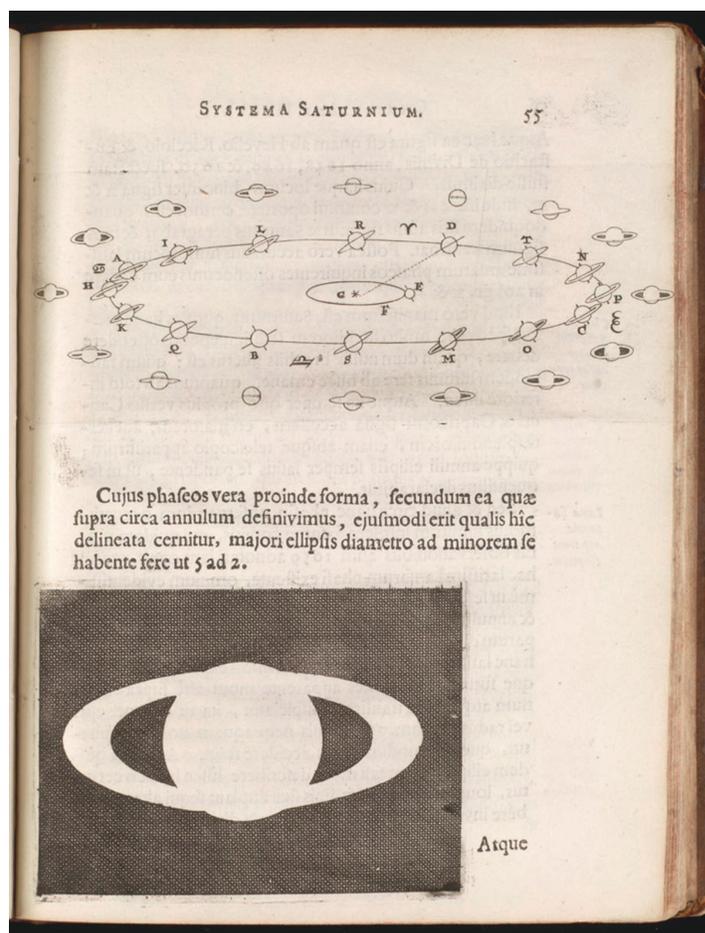
Huygens also studied periodic motion and was the first person to derive the period of an ideal pendulum, where the mass of the cord suspending the weight is assumed to be massless. He deduced the formula that is now familiar in high school textbooks:

$$T = 2\pi \sqrt{\frac{l}{g}}$$

where T is the period of the pendulum, l is the length of the massless cord, and g is acceleration due to gravity. Two pendulums, suspended from cords that differ in length by factor of four, will have periods that differ by a factor of two (regardless of the masses of the pendulums themselves).

Near the end of his life, Huygens compiled his *Cosmotheoros*, in which he discussed the possibility of extraterrestrial life. In a passage that seems prophetic given the over one thousand extrasolar planets currently known, Huygens suggests that a multitude of planets populate the Universe:

"What a wonderful and amazing Scheme have we here of the magnificent Vastness of the Universe! So many Suns, so many Earths, and every one of them stock'd with so many Herbs, Trees and Animals, and adorn'd with so many Seas and Mountains! And how must our wonder and admiration be increased when we consider the prodigious



A diagram from *Systema Saturnium* illustrating how Saturn's rings appear to change shape over time.

distance and multitude of the Stars?"

Cosmotheoros was published posthumously in 1698, three years after Huygens's death.

Nearly 300 years later, Huygens's name would be carried by a space probe bound for Titan. The *Huygens* probe, a joint project completed by NASA, the European Space Agency, and the *Agenzia Spaziale Italiana* (Italian Space Agency), launched in 1997 and landed on Titan in 2005. Since the surface conditions of Titan were thought to include both solid ground and oceans of methane and ethane, *Huygens* was designed for an amphibious landing. Signals from *Huygens* were sent for about 90 minutes following touchdown

and were detected by ground-based telescopes on Earth.

Huygens beamed back images of channels, thick haze, and a clay-like material on the surface. The *Huygens* probe holds the honor for the most distant landing on another Solar System object.

Christiaan Huygens's impact on science has been widespread and fundamental. His contributions to Solar System studies, physics, and probability will continue to form the basis of future investigations. ☼

Katherine Kornei is the Youth Director of the Rose City Astronomers in Portland, Oregon, where she works as a science educator and writer. She received her Ph.D. in astronomy from the University of California, Los Angeles in 2012.

LAUD OF THE RINGS

By Dave Tosteson

*O, for a muse of light
The brightest invention of Heaven...*

The Universe is in constant change

Stars shimmer and sacrifice

For the alter of our generation

Galaxies all are whirled

Across a stage of mirror plays

In time we see what was

And now is then

Shall verity in rooted thought

The sway of light unearth

What scene is spent

Nothing in our Cosmos ever stays the same. Even black holes evaporate. Powerful forces create a place where not everything is what it seems; allusion to order, and fiction to form. We can, from our unique perspective in space and time about the panoply that crowns our sky, imagine airy rings. Let's journey from the nearest star to lensed and magnified galaxies eleven billion light-years away to see how direct visual observation of these wonders in our telescopes is possible, and how their pursuit repays, with interest, a deepened understanding.

One of the closest astronomical objects to us that displays a "ring" under special circumstances of geometry and alignment is

our Sun, bestowing the most magnificent display of natural beauty in the heavens, a total solar eclipse. Its corona, or outer atmosphere, cannot be seen in normal daylight, as its relative faintness compared to the photosphere makes it invisible until the Moon's silhouette reveals its diaphanous diapason as a ring. The last bit of our Sun's face lights a single alpine valley, sparkling like the engaging offering that it is, and invites us to evanescence. My wife and I have been fortunate to see all four solar eclipses to which we have traveled.

Many observers mark Saturn and its glorious rings as the most beautiful object visible in a telescope, but half a century was needed after their discovery to

appreciate the subtleties of orbital mechanics and presentation they proffer. The Cassini spacecraft has given us images of this system so detailed and varied as to keep us in study and appreciation for decades.

Sailing outside our solar system, the objects best known for toric shapes are planetary nebulae, end products of stars similar in mass to or slightly more massive than our Sun. Enriching their surroundings with heavy elements, the variety on display is partly related to the binary nature of some of their central stars, which, along with magnetic forces, constrain their outflows into hourglasses, cylinders, and spiraling jets. They vary from simply spherical, as with **Kronberger 61**, to the complex, multilayered structures seen in the **Cat's**

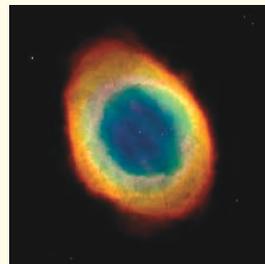


Kronberger 61



Cat's Eye Nebula

Eye Nebula, NGC 6543. The apparently simple **Ring Nebula** in Lyra is a geometric deception, its cylindrical shape appearing



Ring Nebula

ringlike only from our axial perspective looking down its length. Sun Kwok's book *Cosmic Butterflies* explains how varied shapes and structures of planetaries can be produced, and how illumination and orientation manifest in myriad ways.

One of the largest-appearing and nearest planetaries is the **Helix Nebula**, NGC 7293. Located



Helix Nebula

in Aquarius, it seems initially more than half the angular size of the full Moon. But it possesses outer layers more than double that size, and under very dark skies I have used large telescopes to observe these faint, capreolate shells, the product of earlier stellar winds, not fully fluoresced by the ultraviolet radiation from the central star. The last two decades have seen extensive

study of these epigenous, pre-planetary wreaths whose subtle detail can be noted at the eyepiece using filters that allow the light of doubly ionized oxygen (O-III) to pass, enhancing contrast between their faint outer tendrils and the background sky.

The aptly named **Necklace Nebula** in Sagitta is the



Necklace Nebula

remains of a star whose cinctures were lost in a stellar dance, flung to a diameter of two light-years and set aglow by the intense ultraviolet radiation of the central stars. Known also as PN G054.2-03.4, its denser portions are seen as pearls on the "necklace." It was visible in my 32-inch scope as an oval elongated east-west and 15 to 20 arcseconds in length, but individual pieces could not be distinguished.

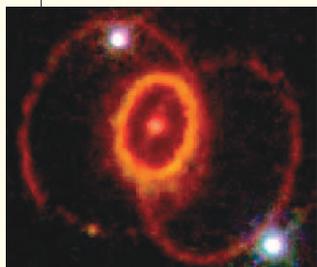
Toward the ends of their lives, stars much larger than our Sun throw off a different type of structure. Those starting with over thirty solar masses evolve to shed large amounts of their hydrogen-rich outer layers, later lit by short-wavelength radiation produced by the hot and still-massive central star before its supernova denouement. The **Crescent Nebula** in central Cygnus, NGC 6888, is such a structure, and its intricate



Crescent Nebula

detail visible through a large telescope in a dark sky nearly defies description. The central Wolf-Rayet star loses mass at a very high rate, creating a feast for the eye. My 32-inch reflector with an O-III filter gave unforgettable views of its bright outer ring and delicate filigree inner regions at a recent Okie-Tex Star Party.

The tiny remnant of **supernova 1987A** in the Large Magellanic Cloud is only 1.6 arcseconds across,



Supernova 1987A remnant

so resolution of its ring or beadlike structures awaits amateur adaptive optics or a view from atop the Andes, but a template for its possible future structure is the **Veil Nebula** in Cygnus. Recent ultraviolet imaging by



Veil Nebula

the GALEX satellite has enhanced understanding of some of its central areas. The two arc-shaped regions to its southwest and northeast, NGC 6960 and 6992, respectively, hint at what may be in store for the Large Magellanic Cloud supernova remnant in a few tens of thousands of years. A glorious amount of nebulosity and detail were unveiled within its outer shell using my 32-inch from a dark site using an O-III filter. Inspired by Alan Whitman's September 2011 *Sky &*

Telescope article, I was able to recover all the nebulosity seen in Michael Mayda's Veil Nebula print, seeing even his faintest, imaged wisps throughout the region. A much fainter supernova remnant, Simeis 147 in Taurus, is not unlike the planetary Kronberger 61 in shape or detail, though on a completely different scale. Pieces of the former are visible in my large reflectors, but even though the planetary's central star is visible, its nebulosity has twice defied visual recovery.

Though not strictly a "ring," the tidal streams recently found surrounding some large spiral galaxies are echoes of entwinement between galaxies of unequal mass. The dwarf galaxies that orbit and are frequently ingested by their larger parent galaxies leave traces of their history in the form of stellar streams with gas and dust spread along their orbital paths. The Sloan Digital Sky Survey has revealed stars orbiting and within our own galaxy that are part of some of these tidal structures, similar to the Magellanic Stream of the eponymous Clouds. In a few cases, such as **NGC 5907** in Draco, deep imaging has revealed their presence, and



NGC 5907

large aperture telescopes can show them in the eyepiece. I was able to view several fragments of this in NGC 5907 using my 32-inch reflector from the dark West Texas skies in 2009, and have observed several other galaxies showing similar intimations of interaction. In



NGC 474

certain instances, newly born "tidal dwarf galaxies" created from this gravitational intercourse can be viewed, as in the Antennae and Stephan's Quintet.

NGC 474, a galaxy in southern Pisces with concentric shells reverberating from a recent gravitational encounter, presents an interesting case. It is likely associated with either NGC 470 or 467 to its west. A 1999 study found that NGC 470, the adjacent spiral, has a redshift similar to that of NGC 474. In viewing deep images of NGC 474 and 467 further to its west, one is struck by their similar colors and disturbed morphology, despite different redshifts in the RC3. NGC 470 is much bluer, has intact spiral arms, and is relatively undisturbed compared to NGC 474. These galaxies can all be seen quite easily in 6- to 8-inch scopes, but the circinate "shells" that define this resonating galactic bell epoch require a much larger instrument under very dark skies.

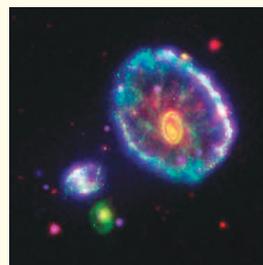
Hoag's Object, PG 54559 in Serpens, was discovered in 1950 by Arthur Hoag on a Palomar Sky Survey Schmidt plate, which he described as a circular, 17-arcsecond object of



Hoag's Object

uncertain nature, though he correctly speculated that it could be a peculiar galaxy. Found by later study to be the most perfect example of a face-on ring galaxy, its inner portion is dominated by older yellow and red stars, and the outer portion is rife with dust, nebulae, and the young, blue stars of recent formation. Ring galaxies may represent the intermediate case of mass inequality in interactions, where a perpendicular, central collision by a medium-mass galaxy with a larger spiral creates shock waves and a ring of new star formation, with the original stars collapsing gravitationally back into the core. In the case of Hoag's galaxy, at the eyepiece, its two portions can be differentiated, but the fortuitously placed "mini-Hoag" ring galaxy in the gap at the one o'clock position on the Hubble Space Telescope's spectacular image remains an elusive target.

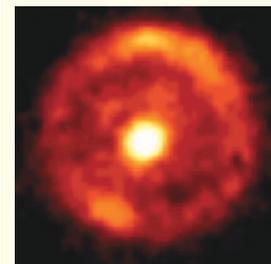
The **Cartwheel Galaxy**, ESO 350-40 in central Sculptor, is a striking ring



Cartwheel Galaxy

galaxy, with "spokes" radiating from its central area toward the outer edge. Several smaller galaxies lurk nearby, one of which is the likely interloper disrupting the structure of what was once a classic spiral. I have seen the Cartwheel several times but its detailed structure has defied observation. Its declination inclines a trip to Southern Hemisphere skies to visit Aunt Neah and claim its bespoken treasure.

The first complete gravitationally lensed "Einstein Ring" seen in the visual spectrum was the prosaically named **B1938+666**. It was first found in radio waves by the



B1938+666

MERLIN array and then imaged by the Hubble Space Telescope in 1998. Named after Albert Einstein, who in 1912 first predicted that gravity could bend light, this lensing was confirmed to spectacular acclaim in 1919 during the total solar eclipse over Principe, an island near the coast of Africa. The first person to suggest in the physics literature this phenomenon could result in a ring was Orest Khvolson, in 1924. I was able to view an extremely faint, stellar object at the position of B1938+666 using my 32-inch f/4 reflector at 929x at the September 2006 Okie-Tex Star Party. It sat between two 16.5- to 17th magnitude stars, each about 15 arcseconds away to the southeast and northwest.

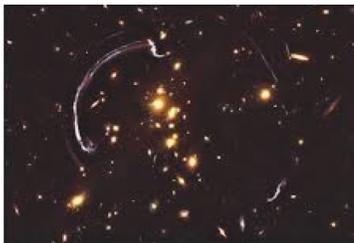
In 2008, Hubble was again used to find the first "Double Einstein Ring," wherein the optical alignment of three



Double Einstein Ring

galaxies was so precise as to cause the two distant galaxies to appear as ringlike structures around the foreground lensing galaxy. The three are 3, 6, and 11

billion light-years away, respectively. The middle galaxy is lensed into a nearly complete arc, 310 degrees long, with the distant galaxy split into three circumferential arcs, one longer and two shorter, fainter than the inner ring. On the POSS II red plate this system appeared stellar, with a hint on the POSS II blue plate of a ring arc. I was able to spot this 18.6-magnitude object from my home in April 2011, and in the eyepiece of my 32-inch reflector it appeared stellar.

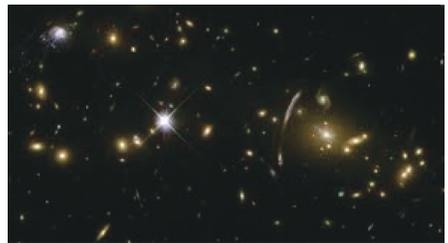


RCS2 032727-132623

presented in journal images, were not visible at all on the POSS I or II plates. Then in 2010 along came **RCS2 032727-132623**, a galaxy cluster studied by Eva Wuyts of the University of Chicago, showing a very blue, 90-degree arc that appeared to me to be the brightest arc yet discovered. It is invisible on the POSS II red plate. But, Cheshire-cat-like, its inverted smile appears clearly when examining the blue companion image. Though rather low in my Minnesota sky, I still felt I had a shot from my driveway, as I rolled my 32-inch behemoth down

For the last fifteen years I have been searching the professional literature in regard to gravitationally lensed arcs possibly visible in my equipment. Almost all the arcs (except AGC 2667, below) noted in professional instruments, and nicely

the rippled tar, sacrificing collimation to optimize culmination. On each of three cold mornings I spent nearly an hour at the eyepiece, hand



AGC 2667

guiding to no avail, as this prey eluded all tricks to view it. My friend Jimi Lowrey had a similar result from the more southerly and temperate climes of West Texas, even using his 48-inch telescope at over a mile of elevation. Its invisibility must stem from its wavelength. I have a plan to recruit a colleague, post cataract surgery, whose implants allow perception well into the deep blue, as I noted during the transit of Venus when he was the only one seeing well through the calcium solar instrument.

Though not a complete Einstein Ring, the bright arc

surrounding **AGC 2667** in northern Sculptor is one of the brightest lensed structures in the sky. It is bluer than the cluster galaxies of Abell 2667, but has elements of red and yellow and, unlike the RCS2 object, appears on both the red and blue POSS II plates. Though distinctly brighter in the blue, this wavelength difference is what I think

made the arc visible to me after ninety minutes of searching with my 32-inch scope at the 2008 Okie-Tex Star Party. Einstein was often

spectacularly right, but in this case we recall his prediction in regard to the visibility of gravitationally lensed light: "of course, there is no hope of observing this phenomenon directly." As did the mountains of Mordor, the sky forges rings from powerful forces offering untiring adventure and rounded memory. ☀

*...Forge of darkness
O'pen the deep*

Data:

Necklace Nebula: 19h 43m 59.5s, +17° 9m 1s; APOD 11-3-10
First Complete Einstein Ring, B1938+666: 19h 38m 25.29s, +66° 48m 52.9s

Double Einstein Ring: 9h 46m 56.6s, +10° 6m 52.6s

Albert Einstein quote, *Science*, vol. 84, p. 506, 1936.

Dave Tosteson, Chisago City, Minnesota; djtost1@gmail.com

Set Some New Observing Goals this Year

By Mike Hotka

Years ago, I learned of an amateur's goal of observing 5,000 unique objects in the Universe. I thought this was a commendable goal, so I adopted it for myself. To date, I have observed 3,432 unique objects towards my goal.

This single goal drives my thirst to find new objects each time I go out observing. I never tire of old Messier favorites, but am always looking for objects off the beaten path. While completing 37 of the Astronomical League's observing programs, I was provided with list after list of objects I had never seen. There are generally more objects on an observing program list to observe than are required for the certificate. After looking at the required number for the certificate, I will continue to observe the remaining

objects on the list. All these new objects contribute to my 5000 unique objects observed goal.

When looking for observing programs to try, I look for programs that interest me. Recently, two new programs were added that caught my eye: the Hydrogen Alpha Solar Observing Program and the Bright Nebulae Observing Program.

Hydrogen alpha solar observing was something I had wanted to do for years. When I found this new program, I started looking for a H-alpha solar telescope. I really did not want to spend almost \$500 for a Coronado PST telescope. I made a couple of inquiries and learned my local astronomy club had a PST I could check out. I was then ready to complete this program.

I have always liked looking

at bright nebulae. The Bright Nebulae Observing Program gave me the push I needed to start observing more of these beautiful objects. I used my 8-inch f/6 Newtonian for this program. With eyepieces giving magnifications of 51x, 81x, and 122x, along with my ultra-high contrast and O-III filters, I was able to complete the required 100 observations. I found the objects on the list easy to find and observe.

When not working on observing programs, I observe double stars on Dave Mitsky's Double Star list. I am also looking at all the Herschel objects that William Herschel looked at. After reading the article "The Herschel Project" by Robert Naeye in the June 2012 *Sky & Telescope* magazine, I was hooked on observing these objects. I have read books about William and Caroline Herschel, which adds to my

viewing enjoyment. All these Herschel objects will add to my 5,000 unique objects observed goal.

I really appreciate the Astronomical League and all that it does for us amateur astronomers. Their observing programs are a great resource, for not only do they take you off the beaten Messier path, but you learn new observing techniques with every program you complete. These techniques allow you to see fainter objects with a telescope, introduce you useful astronomical resources that you can use in the field, teach you to *study* the object you just found in the eyepiece, and have you observe a breadth of different kinds of objects, just to name a few.

Set your first 2014 goal to complete the Messier Observing Program. Once you complete it, you will have a good command of the sky and be able to navigate amongst the constellations. While

looking at the Messier objects, note which ones you like the best. Your next goal should be to see more of these kinds of objects. The League has an observing program that will help you achieve this next goal. For example, if you liked galaxies, choose the Herschel 400 and Herschel II Programs. Similar observing programs exist for every other kind of object in the Messier list: bright nebulae, planetary nebulae, globular clusters, and open clusters.

Start out 2014 by setting some personal observing goals. Then look to the Astronomical League's observing programs to help you achieve these goals. ☀

Mike Hotka has been an Astronomical League member since 1986. He has completed 37 of the League's observing programs. His website, mikehotka.com, contains a wealth of observing information. Contact Mike at astroleague.org/roster/contact/383.

WHY AND HOW TO GET INVOLVED IN OBSERVING PROGRAMS

By Bill Bogardus, Master Observer

The Astronomical League's observing programs—formerly called observing clubs—have been one of the foremost and obvious benefits of being a League member. They have been in place for as long as I have known the League, and have been an enormous influence on my personal involvement in astronomy. What is it about observing programs that makes them so attractive and beneficial?

The answer may vary from one person to another because these programs are varied and may mean different things to different people. Do the words “challenging,” “inspiring,” “learning,” “teaching,” “sharing,” and “rewarding” come to mind? They do for me. Perhaps I should take a step back in time and tell my story.

I got my start in astronomy in middle school. My seventh-grade teacher invited students out to the playground behind the school to look at the night sky through a 4.5-inch Edmund Scientific f/8 Newtonian telescope. I'll bet that you still remember where you were the first time you saw Saturn. Well, that's where I was, right between the monkey bars and the merry-go-round. It was awesome.

Every time I do outreach, I get to relive that moment when kids from seven to seventy say “wow!” at the eyepiece while looking at that same sight. If you feel the same way, the **Outreach Program** is just the thing for you. All you have to do is build up your hours and log your events to qualify for the **Outreach Award**. Do that more often and there are higher levels to attain as well. Nothing is as rewarding as giving and sharing with others. Maybe that's why the Outreach Program is one of the most popular.

A few years later, at Scout camp, I was lucky enough to have a counselor who knew enough about astronomy to show me some of the constellations as part of the astronomy merit badge. That was



the next big step, and the first one along a journey. Knowing the constellations is like finding your way first around the neighborhood, then along all the streets and roads in town. It's like that in the sky. Learning the constellations allows one to find things. For instance, if you know of something interesting in Cygnus, you can identify Cygnus and start looking there.

One way to get proficient at finding your way around the sky is to sketch the stars, connecting the major ones with lines. There's a program for that, too. It's the **Constellation Hunter Program**, and all you have to do is sketch the northern or southern set of constellations. It doesn't matter if you're an art student or if your art is more on the kindergarten level; just do it, as they say.

Practice, Practice, Practice Here's one more thing about that. When you look back at your first few drawings, you may be amazed to find that you've gotten better at it. After completing a fair number of the observing programs, whether it's sketching, describing, measuring, listing, estimating, or finding, *you get better*. All that practice improves your ability, and that's one of the benefits of participating in the programs.

As an example, a group of folks in my club traveled to an excellent observing site one night and we set up our telescopes. We were hunting for galaxies that night and

one friend shared that he'd found three in the same field of view. I took a look, saw that there were more, and pointed them out. My friend learned on the spot and improved his observing skills.

Core Observing Programs

Which observing programs should you do? Whichever ones you like. There are a few, though, that have historically taken center stage. There are five core programs that are required for the **Master Observer Program**.

Personal experience has taught me that the **Messier Program** is a great one to begin with. Messier's list of things not to be mistaken for comets turns out to be a smorgasbord of supernal delights that are easily observed. With practice, the Messier objects make a great menu of things to show others during outreach events. To complete the program, you only need to record the information involved with each of your observations. Many other programs have the same requirements. Want a challenge? See if you can observe most or all of them in one night in a “Messier marathon.” I bagged over 100, and I hand it to those who have found all 110. It really is a marathon!

Furthermore, there is the **Deep-Sky Binocular Program**. It is good to be able to use binoculars and find these delights. The **Lunar Program** is a great one to get to know the Moon. It's amazing that here is a celestial body so nearby

that we can study its surface features in detail.

The last two of the core five take more persistence. The **Double Stars Program** requires good searching techniques, and, in some cases, pretty keen eyesight. The last is the real bear: the **Herschel 400 Program** has the longest list—400 faint fuzzies to find. You've gotta have a lot of perseverance to make it through this one!

Most of these have follow-up programs too. There is the **Lunar II**. There is the **Herschel II** (I've heard it said that you've got to be a glutton for punishment to search for its 400 faint objects). Did you like the **Messier Program**? Follow that with the **Caldwell** and **Binocular Messier**. Or, if you liked a particular type of Messier object, you can look for many more examples of each. Choose globular clusters, open clusters, bright nebulae, or planetary nebulae—there's a program for each. If you like galaxies, there are even more programs, including **Flat Galaxies**, **Local Galaxies**, **Galaxy Groups and Clusters**, and **Arp Peculiar Galaxies**.

If you didn't get enough hunting to suit your fancy, take a trip to the Southern Hemisphere and go for more. There are several southern programs.

Perhaps you prefer to find new and changing things. If so, you can watch for comets, meteors, near-Earth objects, occultations, variable stars, asteroids, or sunspots. There is a program for each, and some offer the possibility of doing real astronomical science.

It's obvious that the Astronomical League has devoted a great deal of its resources to offer observing programs that challenge amateur astronomers and improve their observing skills. No matter whether it's the thrill of the hunt, the delight of discovery, or the love of learning, we hope that you will take advantage of the opportunity to get involved in observing programs. Clear skies! ☀

2014 NATIONAL YOUNG ASTRONOMER AWARDS

By John Jardine Goss, *Astronomical League Vice President*

The **Astronomical League** is pleased to announce the top finishers for the 2014 National Young Astronomer Award program. Thousands of high school students from across the country were eligible to compete for this year's award. Our national judges, all noted astronomers, were Dr. David Hans Hough, professor at Trinity University, San Antonio, Texas; Dr. Robert Stencel, professor at the University of Denver, Colorado; and Dr. Kaitlin Kratter, assistant professor at the University of Arizona in Tucson. We appreciate their valuable contributions to this program.



Pranav Sivakumar

All top finishers receive a complimentary membership in the **International Dark-Sky Association**. The first- and second-place finishers each receive an all-expenses-paid trip to the **2014 ALCon**, "The Stars are Bright, Deep in the Heart of Texas," in San Antonio. The League would also like to recognize **Explore Scientific**, the sponsor of the program, for generously donating one of its fine telescopes to the first place finisher. **First Place: Pranav Sivakumar** A freshman at Barrington High School in Barrington, Illinois, Pranav Sivakumar is awarded first place in the 2014 NYAA competition for his work, "Morphological Identification of Wide-Separation Gravitationally Lensed Quasars." Well over 300,000 quasars are known, and some of them are gravitationally lensed by intervening galaxies. This project developed a technique for identifying gravitationally lensed quasars.

The project's hypothesis was "if multiple objects in an SDSS image meet both photometric and spectral

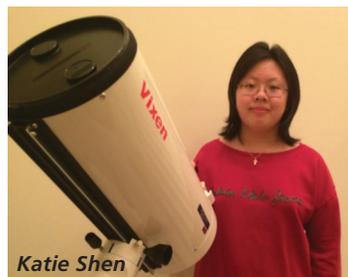
criteria, then these objects are high-probability gravitationally lensed quasar candidates because they are virtual images of the same quasar." Pranav developed an algorithm that examined the class, spectral color, and redshift of each candidate quasar, then, using an iterative and statistical process, determined whether they were duplicates of other, neighboring quasars. It was tested on a set of known lensed quasars to determine the procedure's validity.

Pranav's conclusion: "A comparison of the lensed quasar candidates identified by the present research and the

lensed quasars reported in the literature leads to the conclusion that the original hypothesis of this project is well supported." He also found that the morphological approach used in his research is effective in identifying lensed quasar candidates.

Second place: Katie Shen

Katie Shen, a junior at the Loudoun Academy of Science in Sterling, Virginia, is the 2014 NYAA second-place finisher. In her "Census of H-II Regions in SDSS," she created a catalog of H-II regions that are misclassified in the Sloan Digital Sky Survey.



Katie Shen

Using SQL (structured query language), Katie obtained the necessary candidate H-II data: color images, spectral lines, and X-ray emissions. These allow her to eliminate galactic nuclei using information provided by the ROSAT X-ray survey. In future work, Katie hopes to filter out objects with characteristics similar to those of H-II regions, such as planetary nebulae. ☀

10, 25, and 50 Years of the Astronomical League's Newsletter

By Mike Stewart

June 1964—N.M.I.M.T. Announces New Project

The observatory of the New Mexico Institute of Mining and Technology may get an image-orthicon (closed circuit TV) if the College Astronomy Club is able to raise the funds for the materials involved.

Richard Estock, president of the club, said that the spring field trip of the organization Saturday, May 2, to the Organ Mountain Laboratory near Las Cruces had as one of its purposes the study of details of the construction of the image-orthicon at the Organ installation.

The Organ station has a TV camera placed against the eyepiece of a 12-inch f/16 Cassegrain telescope to photograph the activity in the sky. By employing this method, the Organ station has matched their instrument against a 40-inch telescope.

Estock said that if the club can get the funds, it will sponsor and build a similar installation at New Mexico Tech. . . .

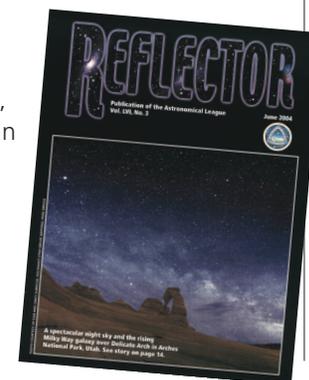
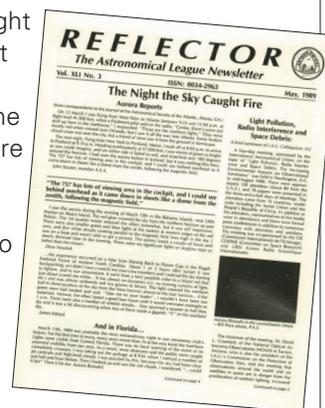
May 1989—The Night the Sky Caught Fire

On 12 March [1989] I was flying from West Palm to Atlanta between 9:25 and 11:04 p.m. at flight level 41,000 feet, when a Piedmont pilot said on the radio, "Center, there's some red stuff up here in the northwest." I responded: "Those are the northern lights." They were mostly red when viewed over Orlando, but I saw it all the way into Atlanta. Some broken cloud cover was over the city, but a friend of mine saw it from the ground in Kennesaw.

The next night, flying from New York to Portland, Maine, I took off at 8:04 p.m. to arrive in Portland at 9:10 p.m. Heading northeasterly at 37,000 feet, I saw sheets of green as bright as you could imagine, and on either side it faded to red, and stretched over 180 degrees around the horizon. I had seen the aurora before in Iceland, but it was nothing like here. The 757 has lots of viewing area in the cockpit, and I could see behind overhead as it came down in sheets like a dome from the zenith, following the magnetic field.

June 2004—In Search of the Perfect Club

A retreat for astronomy club officers, sponsored by the Central Appalachian Astronomy Club and the Mid East Region of the Astronomical League, was held at the National Radio Astronomy Observatory in Green Bank, WV, March 19–21, 2004. Interested people were brought together for sharing methods that



would make their clubs stronger and function more smoothly. . . .

Clubs are not perpetual motion machines; without constant input, they can slow down and lose member and community support. One specific revitalization program that resulted in substantial member growth was chronicled. In another session, the group arrived at over fifteen ways to raise needed funds and another fifteen to promote their clubs to the public. The importance of young people to our hobby was not neglected.

With all the ideas and suggestions put forth over the weekend, it was no surprise that people left Sunday knowing that their clubs can achieve their goals, fulfill the promises of their charters, and be successful. ☀

League Seeks Archival Material

The Astronomical League seeks donations of correspondence, meeting minutes, conference proceedings, and other printed material to expand our archives. Photographs are also welcome, particularly those that identify date, place, and the individuals or activity depicted.

In particular, the League would like to find original copies of four newsletter issues. In the past year, the League, through the very generous assistance and technical expertise of Michael Radencich, has digitized the newsletter. Unfortunately, our collection does not include four issues: March–April 1958, May–June 1958, November–December 1961, and November 1980. If you have these issues, the League would appreciate their donation or loan so that we may complete our physical and digital sets.

If you would like to donate archival materials, please contact the League historian, Mike Stewart, AL_Historian@kc.rr.com, or the national office, leagueoffice@astroleague.org.

In recognition of Astronomy Day, *TIME Magazine* posted in their photo gallery astrophotographs imaged by Astronomical League members. View them at <http://ti.me/1jJm0tp>

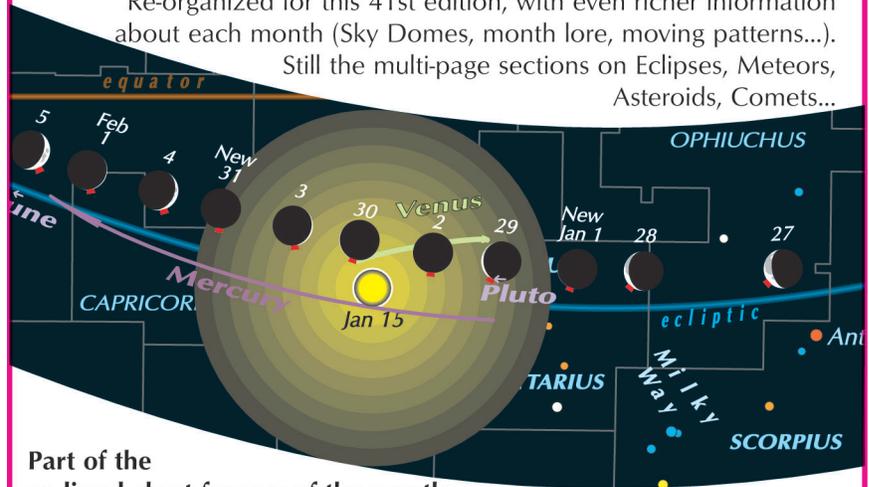
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 Assistant Astronomy Day Coordinator
 810-853-7827
garry@beckstromobservatory.com

A MEMBER BENEFIT FROM McDONALD OBSERVATORY

StarDate, the bi-monthly publication of the nonprofit McDonald Observatory, is offering our members a 25% discount. Their magazine provides easy-to-read articles on the latest astronomy research, skywatching, the history of astronomy, and many other topics. *StarDate* also offers starcharts for each month, a sky calendar, and Merlin's answers to reader questions. The discounted rate is \$19.50 for members in the continental USA, \$22 for Canada, and \$30 to other foreign countries. Members-at-Large should send their check (payable to the Astro League) to Astronomical League Office, 9201 Ward Parkway, Suite 100, Kansas City, MO 64114. For members Societies, the appointed person in each club should gather the subscriptions, and send the appropriate amount to *StarDate* Magazine, c/o Paul Previte, 1 University Station A2100, Austin, TX 78712. You can read more about *StarDate* at www.stardate.org. If you have any questions, please contact the League's National Office at leagueoffice@astroleague.org



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Star 'N Space Books, 324 W. Gurley St., Prescott, AZ 86301

You should receive your order within two to three weeks.

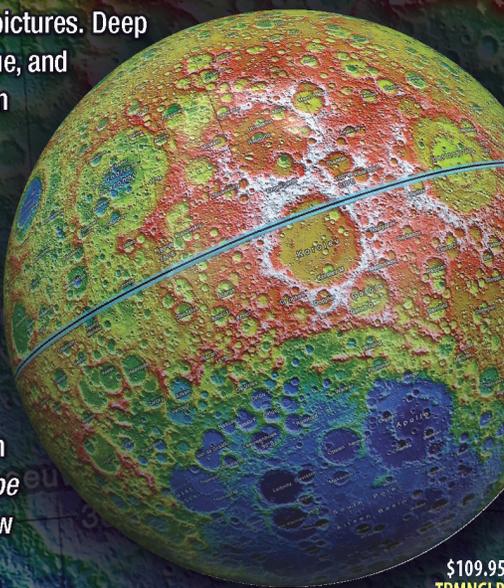
This benefit is made possible by the efforts of League volunteer Marilyn Unruh, proprietor of Star 'N Space Books. She is also an avid amateur astronomer. Like many of the League's members, she desires to help others enjoy our fascinating avocation. Marilyn notes, "This service allows me to give back to the astronomical community by doing something that I love to do – deal in books!"

For members who are looking to add to their library, the Book Service is definitely the place to go!

The new *Sky & Telescope* Topographic Moon Globe shows our home planet's constant companion in greater detail than ever before. This globe is color-coded to highlight the dramatic differences in lunar elevations — differences that are less obvious when seen in pictures. Deep impact basins show up clearly in blue, and the highest peaks and rugged terrain show up as white, red, and orange.

This new globe is based on data from NASA's Lunar Reconnaissance Orbiter. The globe incorporates 4½ billion measurements and shows details less than a mile across.

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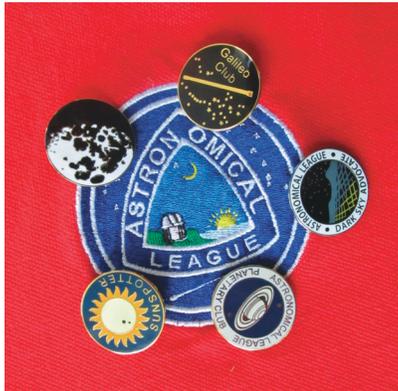
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Observing under Light-Polluted Skies

When many people think of the Astronomical League's observing programs, the **Messier**, the **Double Star**, and the **Herschel Observing Programs** come to their minds. The objects included in those popular lists generally require dark skies to locate and to fully appreciate. This is great for members living away from light-polluted skies, but what about those living under the pallor of bright sky glow?



Does the Astronomical League have observing clubs suitable for them, lists that urban and suburban observers can not only attempt, but enjoy completing?

The answer is a resounding "yes!" Nine programs present their own challenges. Some are directed at new observers, while others are geared toward the more advanced.

Two clubs have strictly daytime activities. The **Analemma Program** is not a typical observing program: only the Sun is followed, and no telescopic observations are needed. It educates amateurs about Earth's annual orbit around our parent star. The other club, the **Sunspotters Program**, requires proper filters to examine sunspots and other solar features.

Just because the Moon is the brightest evening object and is visible from just about any place doesn't mean it is easy to study. The **Lunar** and **Lunar II Programs** offer challenges for observers at any experience level.

Many of the activities in the **Dark-Sky Advocate** and **Outreach Programs** go beyond telescopic observations—both programs can directly benefit your community.

The **Galileo**, **Solar System Observer**, and **Urban Observing Programs** all require either binoculars or telescopes. However, they don't generally require dark skies. In fact, the **Urban Program** can't be completed where the Milky Way is visible.

Want to observe in the city? No problem! The Astronomical League has you covered.

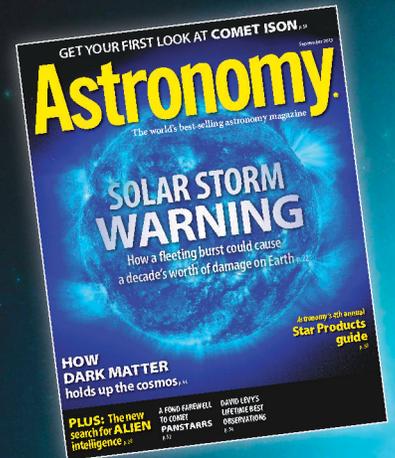
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Editor's Note: Congratulations to all these outstanding astronomical observers! All awards, except the Herschel 400, require current Astronomical League membership for eligibility. If you have questions about an award, please contact the corresponding Observing Program chair. Their contact information can be found on the Observing Program website at www.astroleague.org/observing. If further assistance is required please contact either of the national Observing Program coordinators.

Arp Peculiar Galaxies Award

No. 28-C, Eric Dose, Member-at-Large; No. 78-V, Kevin Mayock, Whatcom Association of Celestial Observers; No. 79-V, Vincent R. Scheetz, Delaware Valley Amateur Astronomers

Asterism Award

No. 11, Bob Scott, Island County Astronomical Society

Binocular Double Star Award

No. 63, Martin Dukeshire, Yakima Astronomical Society; No. 64, Larry E. Madison, all 120 objects, Member-at-Large; No. 65, Nora Jean Chetnik, Member-at-Large; No. 66, Frank Marchese, Atlanta Astronomy Club

Binocular Messier Award

No. 1003, Doug Lively, Raleigh Astronomy Club; No. 1004, Mary Jimenez,

Northern Virginia Astronomy Club; No. 1005, Thomas Rocco Pennino, Amateur Observers' Society of New York and Astronomical Society of Long Island; No. 1006, Paul Lewis, Member-at-Large; No. 1007, Stephen Tzikas, Northern Virginia Astronomy Club; No. 1008, Nora Jean Chetnik, Member-at-Large

Bright Nebula Award

No. 3, Brad Young, Astronomy Club of Tulsa; No. 4, Al Lamperti, Delaware Valley Amateur Astronomers

Caldwell Award

No. 206, Denise Terpstra, Member-at-Large

Carbon Star Award

No. 47, Daniel Otte, Member-at-Large; No. 48, Wayne E. Frey, Central Florida Astronomical Society

Comet Award

No. 72, Frank Smith, Silver, Member-at-Large; No. 73, Jim Kvasnicka, Silver, Prairie Astronomy Club

Constellation Hunter

Northern Skies Award

No. 139, Fred Gassert, Kansas Astronomical Observers

Deep-Sky Binocular Award

No. 352, Kevin Nasal, Neville Public Museum Astronomical Society; No. 353, Karlis Lubkans, Member-at-Large

Double Star Award

No. 508, Brian Morton, Stillwater Stargazers; No. 509, Rex L. Kindell, Stillwater Stargazers; No. 510, Ken Pryor, Oklahoma City Astronomy Club; No. 511, Nina Chevalier, San Antonio League of Sidewalk Astronomers; No. 512, Mark Prouty, Olympic Astronomical Society; No. 513, Stephen L. Snider, Albuquerque Astronomical Society; No. 514, Kevin Johnson, Minnesota Astronomical Society; No. 515, Mathew J. Wedel, Pomona Valley Amateur Astronomers; No. 516, Les Rudy, Charter Member-at-Large; No. 517, Daniel Otte, Member-at-Large; No. 518, Bill Smith, Member-at-Large; No. 519, Emory Horvath, Member-at-Large; No. 520, Nick Anderson, Back Bay Amateur Astronomers; No. 521, Pamela Lubkans, Member-at-Large; No. 522, Stephan A. Tzikas, Northern Virginia Astronomy Club; No.



523, Mark Simonson, Everett Astronomical Society; No. 524, Yanzhe Liu, TAC-AL; No. 525, Mike Fowler, Atlanta Astronomy Club; No. 526, Jake Hairell, Minnesota Astronomical Society; No. 527, Douglas Wiese, High Desert Astronomical Society

Galaxy Groups and Clusters Award

No. 35-DA, John Kutney, Astronomical Society of Las Cruces; No. 36-DA, Dick Francini, Neville Public Museum Astronomical Society

Globular Cluster Award

No. 251, Patrick R. Rader, West Kentucky Amateur Astronomers; No. 252, Fred Gassert, Kansas Astronomical Observers

Herschel 400 Award

No. 506, Steve Boerner, Astronomical Society of Eastern Missouri; No. 507, Terry N. Trees, Amateur Astronomers Association of Pittsburgh; No. 508, Denise Terpstra, Member-at-Large; No. 509, Pamela Lubkans, Member-at-Large; No. 510, Mark Johnston, Austin Astronomical Society; No. 511, Dean M. Johnson, Rochester Astronomy Club; No. 512, Melinda Hopper, Astronomical Society of Kansas City; No. 513, Melissa Adams, Member-at-Large

Herschel II Award

No. 87-M, Ralph Marple, Northern Virginia Astronomy Club

Hydrogen Alpha Solar Award

No. 8, Cindy L. Karachi, Haleakala Amateur Astronomers; No. 9, Anthony Kroes, Neville Public Museum Astronomical Society; No. 10, Willie K. Yee, Amateur Observers' Society of New York

Lunar Award

No. 853, J.J. Bjordahl, Rose City Astronomers; No. 854, Andrea L. McCann, Member-at-Large; No. 855, Greg Moore, Member-at-Large; No. 856, Darrel Roberts, Jr., Central Arkansas Astronomical Society; No. 857, Rich Tennis, Peoria Astronomical Society; No. 858, Stephen Jones, Houston Astronomical Society; No. 859, Jean Napp, Iowa County Astronomers; No. 860, Jim Kaminski, Member-at-Large; No. 861, Nora Jean Chetnik, Member-at-Large; No. 862, Jeffery Rebitzke, Texas Astronomical Society; No. 863, Kieran Rebitzke-Brown, Texas Astronomical Society

Lunar II Award

No. 56, Thomas Pennino, Amateur Observers' Society of New York and Astronomical Society of Long Island

Master Observer Award

No. 142, Chris Lamer, Kansas Astronomical Observers; No. 143, Nick Anderson, Back Bay Amateur Astronomers; No. 144, Gil Raineaul, Member-at-Large; No. 145, Terry N. Trees,

Amateur Astronomers Association of Pittsburgh; No. 146, Mark Johnston, Austin Astronomical Society; No. 147, Denise Terpstra, Member-at-Large; No. 148, Mark L. Simonson, Everett Astronomical Society; No. 149, Steve Boerner, Astronomical Society of Eastern Missouri; No. 150, Larry E. Madison, Member-at-Large; No. 151, Melissa Adams, Member-at-Large; No. 152, Melinda Hopper, Astronomical Society of Kansas City; No. 152; Nelson Walker, Member-at-Large

Messier Award

No. 2656, Jeremy Naethe, Honorary, Member-at-Large; No. 2657, Tom Bureson, Jr., Honorary, Von Braun Astronomical Society; No. 2658, Paul Sanders, Honorary, Kansas Astronomical Observers; No. 2659, Stephen Tzikas, Honorary, Northern Virginia Astronomy Club; No. 2660, Billye Cheek, Regular, Texas Astronomical Society of Dallas; No. 2661, Doug Oines, Honorary, Minnesota Astronomical Society

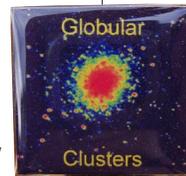
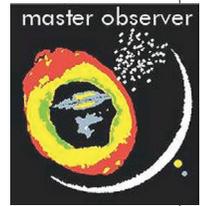
Meteor Award

No. 166, Thomas P. Mozingo, 18 hours, Barnard Astronomical Society; No. 167, Dick Francini, 6 hours, Neville Public Museum Astronomical Society

Outreach Award

No. 247-M, Mike Stewart, Astronomical Society of Kansas City; No. 269-M, Dwight Harness, Flint River Astronomy Club; No. 467-M, Steven Bellavia, Amateur Observers' Society of New York; No. 468-S, Jeremy Naethe, Member-at-Large; No. 532-O, John Whisenhunt, San Antonio League of Sidewalk Astronomers; No. 533-O, Richard Karohl, San Antonio League of Sidewalk Astronomers; No.

534-O, Erik Erikson, Flint River Astronomy Club; No. 535-O, Jessie Dasher, Flint River Astronomy Club; No. 536-O, Steve Arthurton, Oklahoma City Astronomy Club; No. 537-O, Karole Barker, Oklahoma City Astronomy Club; No. 538-O, Shane Barker, Oklahoma City Astronomy Club; No. 539-S, Mike Brake, Oklahoma City Astronomy Club; No. 540-O, R. Christian Bruggeman, Oklahoma City Astronomy Club; No. 541-O, Brad Ferguson, Oklahoma City Astronomy Club; No. 542-O, Eileen Grzybowski, Oklahoma City Astronomy Club; No. 543-O, David Huntz, Oklahoma City Astronomy Club; No. 544-M, Ida Huntz, Oklahoma City Astronomy Club; No. 545-S, Mike Madden, Oklahoma City Astronomy Club; No. 546-O, Maurice Massey, Oklahoma City Astronomy Club; No. 547-O, William Murrell, Oklahoma City Astronomy Club; No. 548-O, J.B. Sims, Oklahoma City Astronomy Club; No. 549-O, Chris Taylor, Oklahoma City Astronomy Club; No. 550-O, Gerald Taylor, Oklahoma City Astronomy Club; No. 551-O, Jerry Taylor, Oklahoma City Astronomy Club; No. 552-O, Marilyn Taylor, Oklahoma City Astronomy Club; No. 553-O, Ramona Taylor, Oklahoma City Astronomy Club; No. 554-O, Jeff Thibodeau, Oklahoma City Astronomy Club; No. 555-O, David Winfrey, Oklahoma City Astronomy Club; No. 556-O, Bill Wilburn, Oklahoma City Astronomy Club; No. 557-O, John Hannah, Oklahoma City Astronomy Club; No. 558-O, Donna Pryor, Omaha Astronomical Society; No. 559-O, Rob Lentini, Northern Virginia Astronomy Club; No. 560-O, Robert C. Pettengill, Jr., Austin Astronomical Society; No. 561-O, Bob Hoover,



LUNAR CLUB



TITLE PHOTOGRAPH: IM64, THE BLACK EYE GALAXY; NASA AND THE HUBBLE HERITAGE TEAM (AURA/STSC)

Huachuca Astronomy Club; No. 562-O, Wilson Gonzalez, Austin Astronomical Society; No. 563-O, Dean Giangregorio, Back Bay Amateur Astronomers; No. 564-S, Douglas D. Hoople, Seattle Astronomical Society; No. 565-O, Leonard Ward, Central Florida Astronomical Society; No. 566-M, David Falkner, Minnesota Astronomical Society; No. 566-O, Josie Landress, Charlottesville Astronomical Society; No. 567-O, Larry Landress, Charlottesville Astronomical Society; No. 568-M, William R. Carney, Twin Cities Amateur Astronomers

Planetary Nebula Award

No. 27, Steve Boerner, Basic, Astronomical Society of Eastern Missouri

Sky Puppies Award

No. 39, Terra Emerson, Austin Astronomical Society

Southern Skies Telescopic Award

No. 41, William Bogardus, Amateur Observers' Society of New York; No. 42, Howard Knytych, Rose City Astronomers; No. 43, Jim Pedersen, Longmont Astronomical Society; No. 44, Willie K. Yee, Amateur Observers' Society of New York

Sunspotter Award

No. 160, Anne Kochendorfer, Astronomical Society of Long Island; No. 163, Leonard Ward, Central Florida Astronomical Society; No. 164, Richard Schoenberger, Astronomical Society of Kansas City

Universe Sampler Award

No. 112, Steve Boerner, Telescope, Astronomical Society of Eastern Missouri



Urban Observing Award

No. 157, Nina Chevalier, San Antonio League of Sidewalk Astronomers



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Compiled by

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May 29–June 1
Wisconsin Observers Weekend

Hartman Creek State Park, Waupaca, Wisconsin
www.new-star.org

May 30–June 1

2014 Bootleg Astronomy Star Party
Green River Conservation Area, Harmon, Illinois
www.bootlegastronomy.com

June 6–8

MSRAL 2014 Convention
Washington University
Saint Louis Science Center, Saint Louis, Missouri
www.slsonline.org/msral2014.html

June 14

44th Annual Apollo Rendezvous
The Boonshoft Museum of Discovery
Dayton, Ohio
www.mvas.org

June 21–28

2014 Grand Canyon Star Party
South Rim: Tucson Amateur Astronomy Association, Arizona
North Rim: Saguaro Astronomy Club of Phoenix, Arizona
www.nps.gov/grca/planyourvisit/grand-canyon-star-party.htm

June 25–29

Rocky Mountain Star Stare 2014
Colorado Springs Astronomical Society, Gardner, Colorado
www.rmss.org

June 25–29

Golden State Star Party
Frosty Acres Ranch, Adin, California
www.goldenstatestarparty.org

June 25–28

Green Bank Star Quest XI
Green Bank National Radio Observatory, West Virginia
www.greenbankstarquest.org

June 26–29

Cherry Springs Star Party
Cherry Springs State Park, Pennsylvania
www.cherrysprings.org

June 27–28

Craters of the Moon Star Party
Craters of the Moon National Monument, Arco, Idaho
www.ifaastro.org

June 27–28

Stars Over Yellowstone
Madison Campground
Yellowstone National Park, Wyoming
www.smasweb.org/?page_id=546

July 10–12

Astronomical League Convention
Association of Lunar and Planetary Observers
San Antonio Astronomical Association
Hilton San Antonio Airport, San Antonio, Texas
alcon2014.astroleague.org

July 22–26

Table Mountain Star Party
Eden Valley Ranch, Oroville, Washington
www.tmspa.com

July 23–27

Mason Dixon Star Party
Private Footlight Ranch, Wellsville, Pennsylvania
www.masondixonstarparty.org



July 24–27

Indiana Family Star Party
Camp Cullom, Frankfort, Indiana
www.indianastars.us/starparty

July 24–27

Stellafane
Breezy Hill, Springfield, Vermont
www.stellafane.org/convention

July 25–26

Stars Over Yellowstone
Madison Campground
Yellowstone National Park, Wyoming
www.smasweb.org

July 27–August 1

Nebraska Star Party
Merritt Reservoir, Valentine, Nebraska
www.nebraskastarparty.org

August 19–24

Oregon Star Party
Ochoco National Forest, Prineville, Oregon
www.oregonstarparty.org

August 21–24

Stars Over Yellowstone
Madison Campground
Yellowstone National Park, Wyoming
www.smasweb.org/?page_id=546

August 21–24

Julian StarFest
Menghini Winery, Julian, California
www.julianstarfest.com

August 21–24

Northwoods StarFest
Hobbs Observatory, Beaver Creek Reserve
Fall Creek, Wisconsin
www.cvastro.org

August 21–25

Iowa Star Party
Whiterock Conservancy, Coon Rapids, Iowa
www.iowastarparty.com

August 22–23

Maine State Star Party
Cobscook Bay State Park, Edmunds, Maine
www.downeastaa.com/maine_state_star_party_2014

August 22–23

Connecticut River Valley Astronomers Conjunction
Northfield Mountain Recreation and Environmental Center
Northfield, Massachusetts
www.philharrington.net/astroconjunction

August 22–24

Black Forest Star Party
Cherry Springs State Park, Pennsylvania
www.bfsp.org

August 22–26

Almost Heaven Star Party
Spruce Knob, West Virginia
www.ahsp.org

August 27–31

Northern Nights Star Fest
Long Lake Conservation Center, Minnesota
www.mnastro.org/NNSF

August 28–31

South Dakota Star Party
Wally's Corner, South Dakota
www.sdsp.org

September 18–21

Great Lakes Star Gaze
River Valley RV Park, Gladwin, Michigan
www.greatlakesstargaze.com

September 18–21

Prairie Skies Star Party
Camp Shaw, Bourbonnais, Illinois
www.prairieskies.org

September 19–21

Idaho Star Party
Bruneau Dunes State Park, Idaho
www.boiseastro.org

September 20–28

Okie–Tex Star Party

Kenton, Oklahoma
www.okie-tex.com

September 24–27

Enchanted Skies Star Party

Socorro, New Mexico
www.enchantedskies.org

September 24–28

Brothers Star Party for Oregon Observatory
Brothers, Oregon
www.mbsp.org

September 25–29

Acadia Night Sky Festival
Acadia National Park, Bar Harbor, Maine
www.acadianightskyfestival.org

September 24–28

Jersey StarQuest
Hope Conference Center, Hope, New Jersey
www.princetonastronomy.org/sqmainpage

October 17–19

Bays Mountain StarFest
Bays Mountain Park, Kingsport, Tennessee
www.baysmountain.com/astronomy/astronomy-club/?GTTabs=4

October 18–25

Twin Lakes Star Party
Pennyrile Forest State Park, Kentucky
www.wkaa.net/starparty.php

October 20–25

Eldorado Star Party
X-Bar Ranch, Eldorado, Texas
www.eldoradostarparty.org

October 22–26

Deep South Regional Star Gaze
Feliciana Retreat Center, Norwood, Louisiana
www.stargazing.net/dsrsg

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trim, navy w/stone trim;
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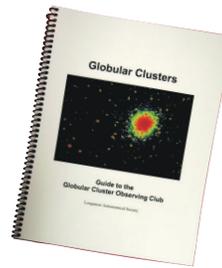
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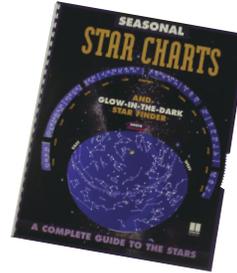
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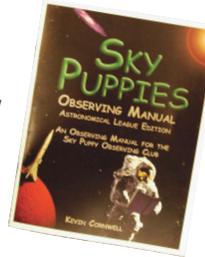
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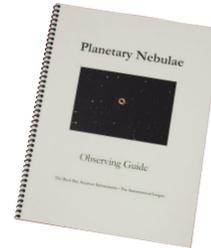
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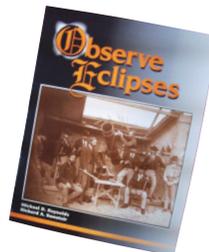
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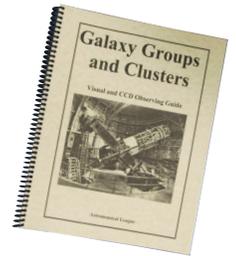
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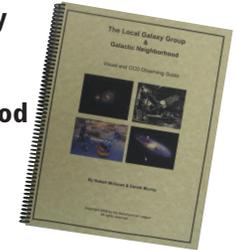
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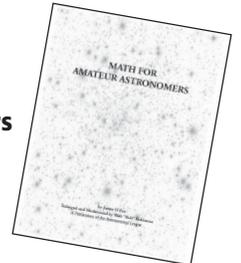
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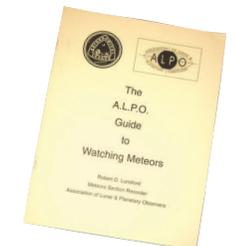
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This image of the May 20, 2012, annular eclipse was taken from Albuquerque, New Mexico, which was practically on the centerline, hence the beautiful centering of the Sun and Moon. The image is a 1/100 second exposure at ISO 100, taken on a Canon EOS Rebel T2i DSLR through an 8-inch Celestron NexStar SE with a solar filter. Si Simonson is a member of the Fort Worth Astronomical Society in Texas.

The Astronomical League invites its members to submit astrophotography for publishing in the *Reflector*. When sending photos, please include a brief explanation telling us when and where the photo was taken, your club affiliation, what equipment was used, and any computer processing that was involved.

