Highlights of the April Sky. . .

- - - 2nd - - -

AM: A waxing gibbous Moon is less than 4° to the upper right of Regulus before dawn in the western sky.

- - - 6th - - -

Full Moon @ 12:35 am EDT

PM: The Moon is less than 5° to the lower left of Spica, in Virgo, when they rise in east-southeast.

- - - 10th - - -

PM: A waning gibbous Moon is less than 1° from Antares when they rise in the southeast.

- - - 10th → 11th - - -

PM: Venus is 2½° left of the Pleiades the next two evenings.

- - - 13th - - -

Last Quarter Moon @ 5:11 am EDT

- - - 14th - - -

PM: Mars is less than ¼° (13′) left of Mebsuta (Epsilon Geminorum).

- - - 16th - - -

DAWN: A waning crescent Moon is less than 5° below Saturn low in ESE.

- - - 20th - - -

New Moon @ 12:13 am EDT

- - - 22nd - - -

DUSK: A young waxing crescent Moon is suspended equidistant between Venus and the Pleiades.

- - - 22nd → 23rd - - -

PM: The Lyrid meteor shower peaks at 9pm and is active all night.

- - - 23rd - - -

DUSK: The Moon is 5° above Venus.

- - - 25th - - -

DUSK: The Moon is 3° to Mars' right.

- - - 27th - - -

First Quarter Moon @ 5:20 pm EDT

PM: The Moon is about 4° above the Beehive Cluster (M44) in Cancer.

- - - 29th - - -

PM: A waxing gibbous Moon is 5° to the upper left of Regulus.

Prime Focus

A Publication of the Kalamazoo Astronomical Society

★ ★ ★ April 2023 ★ ★ ★

This Months KAS Events

General Meeting: Friday, April 14 @ 7:00 pm

Kalamazoo Area Math & Science Center • See Page 16 for Details

Observing Session: Saturday, April 15 @ 8:00 pm

Kalamazoo Nature Center • Visit Observing Page for Details

Observing Session: Saturday, April 29 @ 8:00 pm

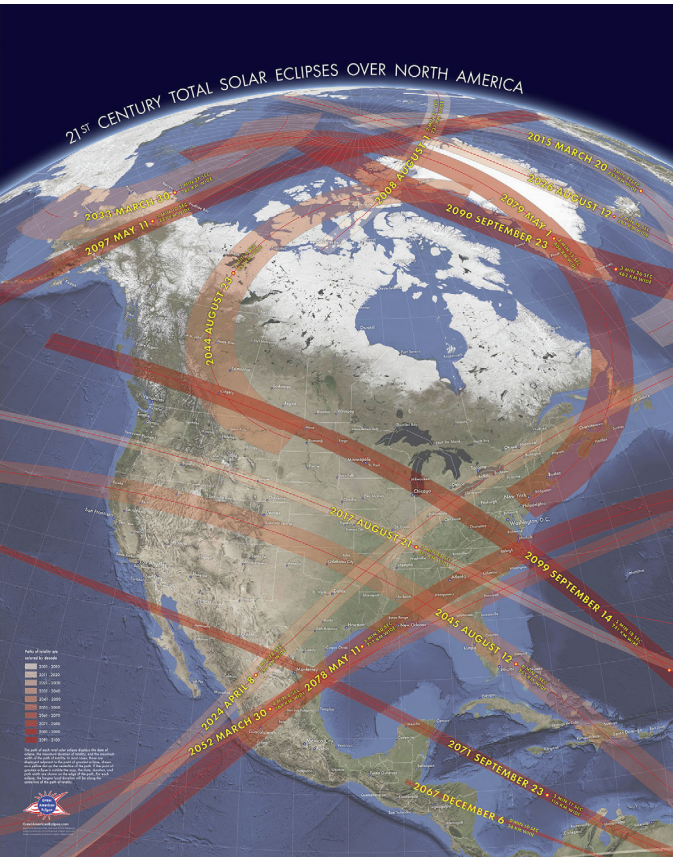
Kalamazoo Nature Center • Visit Observing Page for Details

Inside the Newsletter. . .

Observations by Richard S. Bell

ONE YEAR AWAY! The *Great North American Eclipse* takes place on **April 8, 2024**, and the Kalamazoo Astronomical Society is doing everything it can to get ready. I'll have more info on our plans *before* the eclipse soon. Our plans are already in place for the *day of* the eclipse. A special committee has selected Chalk Bluff River Resort and Park in Texas as the official KAS site to view the eclipse. They have adequate facilities for members (and their families) that plan to stay on site and have plenty of room for people visiting for the day. The weather prospects are very good, and they're less than 2 miles from the eclipse's centerline! If you missed it, I've rerun the article on our viewing site on page 5.

Several members have already made arrangements to stay at Chalk Bluff, and I'm hoping many more KAS members plan to join us. A BIG part of being a KAS member (at least for me) is sharing special events like this together. I knew that wouldn't have worked too well for the August 2017 eclipse. Yeah, several members did view the eclipse together near Sparta, Illinois. That eclipse took place at the height of summer vacation season, and most of us went our separate ways. I spent three weeks on the road and had a blast visiting national parks like Yellowstone and the Grand Tetons. I also attended ASTROCON in Casper, Wyoming.



The 2024 eclipse doesn't take place during vacation season, but at a time when we're all busy. The weather is also more unreliable. For those who *really* want to see the 2024 eclipse and stay in the U.S., then southern Texas is the place to go.

I've received some resistance or hesitancy when speaking to some members and encouraging them to go to Chalk Bluff. They don't want to set the time aside and travel all the way to Texas and stand in the shadow of the Moon for about 4½ minutes. On the surface, that does sound silly, but a few of our members get it. Over the past 20+ years we've had members travel to Africa, Antarctica, Aruba, Australia, Chile, Rapa Nui (Easter Island), and cruised out to the middle of the Pacific just to be in the Moon's shadow for a few minutes. Think about that, and tell me Texas is too far to travel!

For me, the biggest reason to share the 2024 eclipse is evident on the chart above. After 2024, the next total solar eclipse in the 48 contiguous states is in 2044! This will be our LAST CHANCE to do something like this together. Don't be a killjoy! Plan to view the 2024 eclipse at Chalk Bluff with your fellow members. If you still plan to take your chances and try viewing the eclipse in the northeast, then know this: if you get clouded out, I'm totally going to rub it in and say "Told you so!" Sure, there's no guarantee we'll have clear skies at Chalk Bluff, but at least we're playing the odds. Total eclipses are the ultimate version of "stopping to smell the roses." Do all you can to take the time to see one.

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March Meeting Minutes

A general meeting of the Kalamazoo Astronomical Society was held on Friday, March 3, 2023. President Richard Bell brought it to order at 7:05 pm EST. Due to a poorly timed Winter Storm Warning, which peaked right at the start of the meeting, we were forced to gather exclusively on Zoom again. Around 75 members and guests attended. (Adding insult to injury, roads were clear by the following afternoon!)

The featured speaker of the evening was our resident professional research astronomer, Dr. Kirk Korista. Kirk is a Professor of Astronomy at Western Michigan University and has been with the Department of Physics (and the KAS) since 1997. The title of Kirk's latest talk for us was *Sir Arthur Stanley Eddington: With Stars in His Eyes*.

Eddington was born on December 28, 1882 in Kendal, Westmorland (now Cumbria), in northwestern England. He was the son of Quaker parents, Arthur Henry Eddington, headmaster of the Quaker School, and Sarah Ann Shout. Arthur had one older sister, Winifred.

Upon the death of his father during the Typhoid epidemic of 1884, Sarah and her young children moved in with her mother. Their home was in the southwestern England town of Weston-super-Mare and was called Varzin. Today, it bears a plaque honoring Arthur.

Before Arthur could read, he tried counting words in the Bible and stars in the sky, and he knew his times-tables to 24×24. He obtained a 3-inch telescope at about age 10, sparking his lifelong study of the cosmos. Arthur was initially home-schooled by his mother, but entered Bryn Melyn School at age 11.

At 16, he enrolled at Owens College in Manchester on a scholarship, where he excelled in mathematics and English literature. In 1902, he entered Trinity College of Cambridge University and studied math, physics, and astronomy.

Kirk then described Eddington's "radical" approach to doing science. He drove his detractors, who practiced the (then) traditional incrementalist/mathematical approach to the scientific method based on certainty and completeness, to distraction.

Eddington, instead, relied on his physical intuition, his remarkable ability to simplify while retaining the essentials, and his "with stars in his eyes" optimism of science to take a leap of exploration from solid ground into terra incognita to ask "What if…?"

Debates ensued, withering sharp criticisms from Sir James Jeans. Eddington's responses were polite and deferential, yet he held up his end of the argument: that his "phenomenological approach opened up new avenues of investigation to astronomy."

The discovery Cepheid variable stars in the early 20th century set Eddington on the path to understand the luminosity of stars. Likely inspired by Horace Lamb (a former tutor from Owens College), he eventually proposed the first, and nearly correct, physical model for their pulsation in size to explain their variability in brightness.

He proposed a simple mechanism to describe anisotropic (preferred directions) energy flow by radiation in the atmospheres of stars. Today, this is called the *Eddington Approximation*.

Following up on work by Arthur Schuster (another former tutor at Owens College) and Karl Schwarzschild (of black hole fame), Eddington applied his approximation to predict the increase in temperature with depth within the star's surface layers. This helped explain the effect of limb darkening on stars. The Eddington Approximation also helped explain the strengths of a star's spectral absorption lines.

By 1917, we had reasonably good measures of stars' outer characteristics: distance, mass, effective surface temperature, luminosity, and radius. Many unknowns remained, such as their composition, internal structure and workings, the state of their interiors, and how energy was transported.

Stars were known to be in a state of force balance (hydrostatic equilibrium), where the net outward pressure exerted by matter balances against the inward pull of gravity. Any force imbalance would result in dramatic changes in structure.

Lord Kelvin and Hermann Helmholtz argued (correctly) that in lieu of some then unknown internal energy source, stars would slowly contract in the face of losing energy via their luminosity. This contraction hypothesis was in doubt because the resulting energy imbalance time scales for stars were found to be too short (10^5 – 10^8 years).

Eddington initially presumed something akin to the energy given off in radioactive decay, or matter annihilation into energy ($E = mc^2$), was balancing against the energy lost per second in its luminosity.

In 1920, Francis Aston found that a helium nucleus had 0.7% less mass than four hydrogen nuclei (protons). With

that news, Eddington became certain that stars maintained energy balance via the fusion of hydrogen into helium at a rate that is temperature-sensitive. This was way ahead of everyone in anticipating the origin of the main sequence of stars, and 18 years ahead of figuring out how that happens.

Eddington then went on to formulate his *Standard Model of Stars* as well as his *Mass-Luminosity relation*. This got rather involved (complete with equations) and would require more space and time to summarize here coherently. We encourage viewing Kirk's presentation on YouTube (linked at the end of the *Minutes*) or reading his excellent article, *Why Do Stars Shine?,* that appeared in the May 2020 issue of *Prime Focus*.

Kirk then briefly summarized some of Eddington's other notable contributions to science. Perhaps most famously, he led a total solar eclipse expedition in 1919 that ushered in general relativity's curved space-time in the presence of matter-energy to explain gravity, propelling Albert Einstein to fame.

Asked in 1919 whether it was true that only three people in the world understood the theory of general relativity, Eddington allegedly replied "Who's the third?"

In 1920, he published *Report on the Relativity Theory of Gravitation and Space-Time and Gravitation*, promoting the work of Einstein (a German national) to British and American scientists for the first time.

In 1923, he published what Einstein referred to as the best explanation of special and general relativity, *The Mathematical Theory of Relativity*.

Eddington was a major early contributor to applications of general relativity toward our understanding of the expanding universe. He also published *The Expanding Universe* (1933), a popular account. He also worked on the mystery of white dwarf and relativistic stars.

Eddington was continuing work on *Fundamental Theory* (to unify gravitation, quantum theory, and electromagnetism) when he died of cancer on November 22, 1944. He was only 61.

Sir Arthur Stanley Eddington never married, and his cremated remains were buried within his mother's grave (who died in 1924) in Cambridge, England. His sister, Winifred, lived until 1954, and she is buried in the same Parish of the Ascension burial grounds.

Kirk concluded his presentation by listing the numerous awards and accolades Eddington received during his remarkable life and career.

Richard gave his President's Report after Kirk's great presentation. He started by mentioning the "Great Michigan Ice Storm of 2023" on February 22nd. He was fortunate not to lose power, but didn't have internet/cable/phone for 5½ days. Mike Sinclair said he lost power for 98 hours.

Richard thanked Jim Bradshaw and Don Stilwell for volunteering at Family Science Night at the Hastings Public Library on February 8th. A brief report and images appeared in last month's newsletter (page 7).

In a final member renewal update, Richard said expired memberships will be removed from the roster on March 4th. Several responded positively to receiving their new membership cards in the mail.

Finally, Richard noted that another season of Public Observing Sessions at the Kalamazoo Nature Center begin on April 15th. Attendance by members is great, but **participation is crucial**! Please review the schedule and plan to share your telescope with the masses in the months ahead. We need you!

In observing reports, many members took advantage of the clear night on March 1st and enjoyed the Venus-Jupiter conjunction. (They were only ½° apart.) Mike Sinclair said "It was spectacular," while Kevin Jung noted "It was neat." Master wordsmiths! Pete Mumbower and his daughters enjoyed the close pairing through 7×50 binoculars and spotted a few of the Galilean moons. Eric Schreur headed over to Asylum Lake and snapped some pictures. (One is displayed on page 13.) Richard also took some conjunction images at Richland Township Park.

Pete and family also saw a compact trail of ***evil*** Starlink satellites pass over on February 12th. Jack Price also saw them, but was unable to attend the meeting. Karen Woodworth took advantage of the sunny day on February 26th and viewed sunspot group 3234 with her SUNoculars. (Read Karen's SUNocular review starting on page 6.)

In astronomical news, Pete said the Northeast Astronomy Forum (NEAF) is returning to an in-person event for the first time since 2019. NEAF is held in Suffern, New York at Rockland Community College. The dates are April 15th & 16th. Pete is also attending the Northeast Advanced Imaging Conference (NEAIC) on April 13th & 14th. Scott Macfarlane also plans to attend NEAF (along with Scott Jr.). We expect full reports in a future issue of *Prime Focus*!

Eric Schreur noted that the 13th annual Michiana Star Party will be held at the Dr. T.K. Lawless County Park from May 19th to the 21st.

Richard briefly covered upcoming activities such as the last AP-SIG meeting of the season on March 17th and the Messier Marathon on March 18th. (Note: the former was great, but the latter was clouded out.)

The March issue of *Prime Focus* received a little more praise than usual, and Richard noted this was due to actual member contributions. Imagine that!

Speaking of the newsletter, Richard gave an update on a project he's quietly been working on the past several years. He's been converting past issues of *Prime Focus* (prior to 2005) to PDFs and just completed scanning and cleaning up issues from his original run as Editor from 1996-2001. He shared his very first issue from January 1996. In time, he plans to convert issues from the 1970s and 80s to PDFs as well.

After previewing the April meeting, the March General Meeting concluded at about 8:49 pm.

This meeting can be viewed in its entirety on our YouTube Channel.

Kalamazoo Astronomical Society's

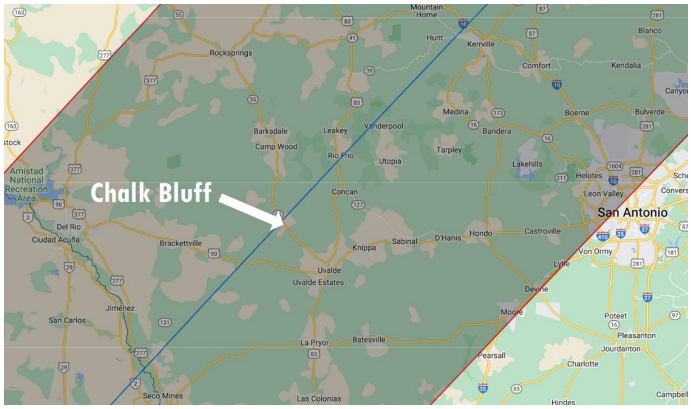
2024 ECLIPSE Viewing Site

After reviewing many potential viewing sites for the **April 8, 2024 Total Solar Eclipse**, we are pleased to announce the following location where members can gather and enjoy nature's grandest spectacle together:

Chalk Bluff River Resort and Park
1108 Chalk Bluff Rd.
Uvalde, Texas 78801
(830) 278-5515

Coordinates: 29.36302° N, 99.98416° W
Duration of Totality: **4-minutes 26-seconds**

Chalk Bluff River Resort is located about 17.5 miles northwest of Uvalde, 98.5 miles west of San Antonio, and **less than 2 miles from the centerline of the 2024 eclipse**:



Careful monitoring of this area the past few years has shown the weather to be consistently clear in early April. While there are no guarantees, we feel this is the best spot to view the eclipse as a group.

Chalk Bluff offers several different types of onsite accommodations. These include cabins, an RV court, and camping sites. Cabins come in a variety of styles and range between $129 to $189 per night. The prices are for four people. There is an additional charge of $15 per person. Some cabins can sleep up to six, but you may need to bring air mattresses or cots. Most cabins offer a barbecue grill, kitchenette with microwave, private bathroom, and an air conditioner. Guests must supply their own towels, kitchen utensils, and bed linens.

The RV court is located next to the Chalk Bluff office and offers full service 30amp and 50amp hookups for $50 per night. That price is for two people. Each additional person is $15 per night for the duration of the reservation, with a maximum of 10 people per site. There are 50 RV sites total and they are all in the open with no obstructions. Only one tent is allowed on an RV spot.

There are camping sites with and without electricity at Chalk Bluff. Primitive camping sites are $30 per night. Their website indicates primitive camping spots are on a first-come, first-served basis. Whether or not this will be the case during the eclipse is unclear. Camping with both electricity and water are $40 per night.

There are at least 50 campsites to our knowledge. However, only 21 of those are in open areas suitable for eclipse viewing. All others are in shaded areas. Members wishing to both camp and photograph the eclipse should call Chalk Bluff as soon as possible to reserve one of the camp sites with no obstructions.

If you would prefer to camp in the shade (or stay in a cabin), then there is at least 100 acres of open space in addition to 2 miles along the river front. Please be advised that Chalk Bluff will not provide electricity in the open space. If some members are unable to reserve a site with electricity and need it for eclipse imaging then hopefully other members would be willing to share.

Please note that there is a non-refundable deposit of approximately one-third the total cost of your reservation. If you change your plans, you could likely sell your reservation to another member or eclipse chaser.

For those members that end up staying offsite, Chalk Bluff does offer a day pass. The normal price is $15, but will likely be higher for the eclipse. They have yet to determine their special pricing. We will update the membership when it is announced.

Chalk Bluff does not offer any onsite dining options. We asked if they might provide food trucks during the eclipse weekend and they did not know for sure, but guessed they would not.

There are some special terms to stay at Chalk Bluff during the 2024 eclipse. First, there is a 3-night minimum stay. Secondly, there is a $200 surcharge for people staying onsite during the eclipse. Those planning to make reservations at Chalk Bluff for the eclipse must currently do so **over the phone**.

In addition to a total solar eclipse, there is plenty else for you and the whole family to do in April 2024. You can swim, fish, kayak, tube, hike, bird watch, visit the petting zoo, or sign up for a scenic hay ride. Be sure to visit the Chalk Bluff website to learn more.

Please let us know if you have any additional questions or learn anything new from Chalk Bluff. Good luck and see you in the shadow of the Moon!

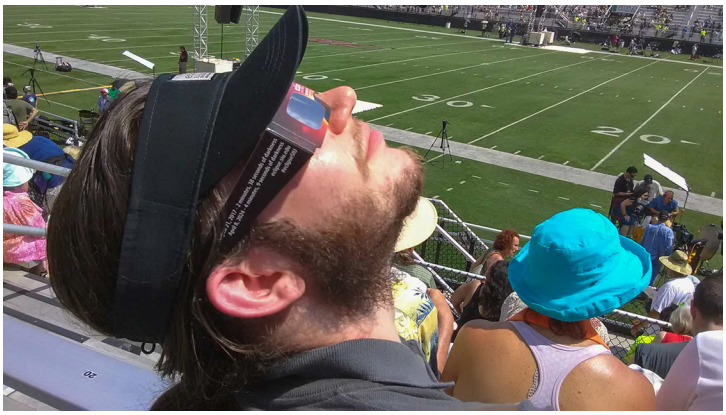
Eclipse Shades, Mini-SUNoculars, and SUNoculars

A Comparison

by **Karen Woodworth**

Because I'm at a point in my life in which it's difficult for me to stay awake at night for dark sky observing, I decided to try solar observing. I began with Lunt mini-SUNoculars and because I enjoy them, I got a pair of full-size Lunt SUNoculars as well. This article is a comparison of the two with reference to eclipse shades, since those were used by so many people in 2017. You will only be able to see the Sun with any of these viewing instruments; they cannot be used for any other type of viewing.

Eclipse shades provide no magnification and no adjustments for vision, therefore they must be worn with glasses or contact lenses if you're nearsighted like I am. Both the mini-SUNoculars and the SUNoculars can focus each eye individually, so I find that it works well to use them without my glasses. (I tried using them with my contact lenses but couldn't focus as well.) The focus mechanisms are different between the two instruments. The eyepieces on the mini-SUNoculars adjust the focus by turning clockwise or counterclockwise. You can adjust the space between your eyes for the best fit to your face simply by moving the barrels farther apart or closer. The space between your eyes can be adjusted on the full-size SUNoculars in the same manner. To focus the left lens on the SUNoculars, you close your right eye and turn the knob in the middle. Once your left lens is in focus, you open your right eye, close your left eye, and turn the ring on the base of the right eyepiece clockwise or counterclockwise to focus. The SUNocular eyecups can be made deeper or shallower by turning them.



Eclipse shades are an affordable way to safely view the Sun during a solar eclipse, but provide no magnification to check on daily solar activity (and should **NEVER** be used with binoculars or telescopes). Here, Arthur Woodworth views the August 21, 2017 solar eclipse from Saluki Stadium in Carbondale, Illinois.

Karen observes our local star with her Lunt Solar Systems 8×32 SUNoculars, dedicated binoculars that permit safe observation of sunspot activity, eclipses, and planetary transits.

The eclipse shades show you the Sun in an orange-yellow color. No sunspots will be visible due to the lack of magnification (unless they're *really* big). The mini-SUNoculars show you the Sun in the same orange-yellow color. I perceive the Sun as being about twice as big in the mini-SUNoculars as in the eclipse shades; their specifications are 6×30 so in reality their magnification is greater. (If you're not familiar with binocular measurements, the first number refers to magnification and the second number refers to the aperture or diameter of the lenses in millimeters.) Large sunspots will be visible as small black dots. On the solar image from spaceweather.com accompanying this article, I was able to see only sunspot 3234. The full-size SUNoculars show the Sun as white, but it is a comfortable image. (When the Sun is lower in the sky right after sunrise or before sunset, the color will be orange-yellow.) I perceive the Sun as being about twice as big with the SUNocu-

Lunt 8×32 SUNoculars

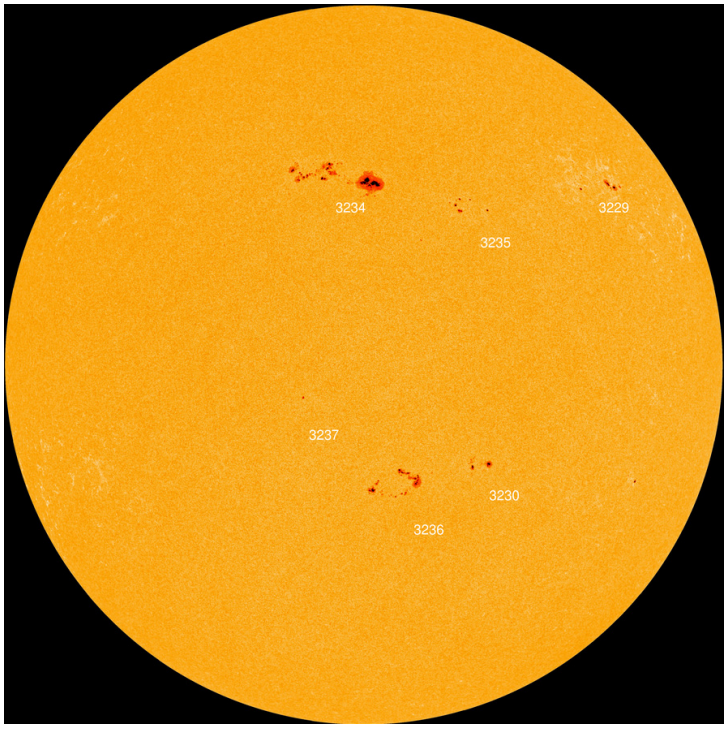
Prism Type:	Roof
Magnification:	8×
Aperture:	32mm
Eye Relief:	13.6mm
Eyecups:	Adjustable
Focus Type:	Center
Weight:	18 oz.
Price:	$94.95 – $99.95

Lunt 6×30 Mini-SUNoculars

Prism Type:	None
Magnification:	6×
Aperture:	30mm
Eye Relief:	~9.0mm
Eyecups:	Fixed
Focus Type:	Ind. Eyepiece
Weight:	<10 oz.
Price:	$19.95

lars as it was with the mini-SUNoculars, so around four times as big as with the eclipse shades. The full-size SUNoculars specifications are 8×32. Sunspots still show up as black dots, but they're a little bigger. Along with sunspot 3234 I was able to see two others, probably 3236 and 3230.

Is it difficult to find the Sun? It can be at first. The best method is to orient your body toward the Sun, put your head down, move the SUNoculars to cover your eyes, then raise your head until you see the Sun. You may need to turn your head left or right a little. The same method will work for the mini-SUNoculars, but it takes a little bit longer to find the Sun with them since the viewing field is smaller. If you stand in the same place to observe at the same time each day, you should get quicker at finding the Sun.



The Sun, as seen with the Helioseismic Magnetic Imager (HMI) aboard the Solar Dynamics Observatory, on February 26, 2023. Karen was only able to observe sunspot group 3234 with the mini SUNoculars.

The mini-SUNoculars come in red, yellow, or blue with a list price of $19.95. Lunt's website, luntsolarsystems.com, currently sells them only in blue or yellow, but other websites still have some of the red ones. The full-size SUNoculars come in black, red, yellow, or blue with a list price of $99.95 ($94.95 for the black ones). I chose red, the "danger" color, for both my SUNoculars and mini-SUNoculars. The SUNoculars come with a strap, removable rubber lens covers, a removable rubber eyepiece cover, a carrying case with a strap, a cleaning cloth, and an instruction booklet. The mini-SUNoculars have a string to wear them around your neck and nothing else. I keep mine in a gift box.

Whenever I have the chance to observe the Sun, I tend to use both the mini-SUNoculars and the full-size ones together, switching back and forth between the smaller orange and larger white views. I polled my family on their preferences. My husband, Klay, liked the orange-yellow color of the minis but found the full-size SUNoculars easier to use. My son Arthur preferred the full-size SUNoculars because he found the image to be brighter and the focusing to be more intuitive.

Any of these options will work to see solar eclipses; the eclipse will be biggest in the full-size SUNoculars but it will be white instead of orange-yellow. If you want to observe sunspots, you'll get the best view through a solar telescope or with solar filters for your telescope. However, I like the ease of picking up the SUNoculars for a quick peek at the Sun in the middle of the day.

My thanks to Richard S. Bell for recommending space-weather.com as a source for sunspot identification and for helping me to clarify the meaning of white light viewing (the type of viewing done by both sizes of SUNoculars).

Karen Woodworth (and family) have been members of the Kalamazoo Astronomical Society since 2010. She currently volunteers as the club librarian.

Solar Eclipses are Coming!

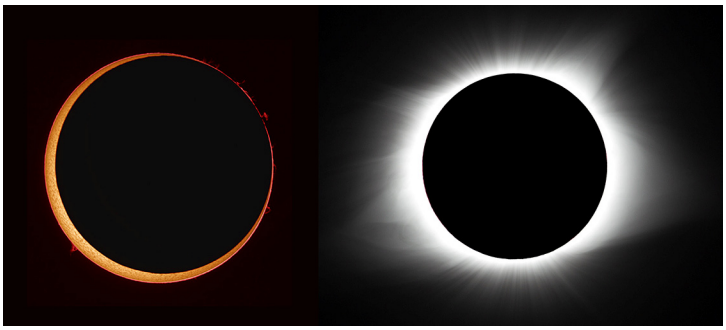
by **David Prosper**

Have you ever witnessed a total solar eclipse? What about an annular solar eclipse? If not, then you are in luck if you live in North America: the next twelve months will see two solar eclipses darken the skies for observers in the continental United States, Mexico, and Canada!

Solar eclipse fans get a chance to witness an **annular eclipse** this fall. On **Saturday, October 14, 2023**, the Moon will move exactly in front of the Sun from the point of view of observers along a narrow strip of land stretching across the United States from Oregon to Texas and continuing on to Central and South America. Since the Moon will be at its furthest point in its orbit from Earth at that time (known as *apogee*), it won't completely block the Sun; instead, a dramatic "ring" effect will be seen as the bright edge of the Sun will be visible around the black silhouette of the Moon. The distinct appearance of this style of eclipse is why it's called an annular eclipse, as *annular* means *ring-like*. If you are standing under a tree or behind a screen you will see thousands of ring-like shadows projected everywhere during maximum eclipse, and the light may take on a wan note, but it won't actually get dark outside; it will be similar to the brightness of a cloudy day. This eclipse must only be observed with properly certified eclipse glasses, or other safe observation methods like pinhole projection or shielded solar telescopes. Even during the peak of the eclipse, the tiny bit of the Sun seen via the "ring" can damage your retinas and even blind you.

Just six months later, a dramatic **total solar eclipse** will darken the skies from Mexico to northeast Canada, casting its shadow across the USA in a strip approximately 124 miles (200 km) wide, on **Monday, April 8, 2024**. While

This detailed solar eclipse map shows the paths of where and when the Moon's shadow will cross the USA for the upcoming 2023 annular solar eclipse and 2024 total solar eclipse, made using data compiled from multiple NASA missions. Where will you be? This map is very detailed, so if you would like to download a larger copy of the image, **you can do so** and find out more about its features. Credits: NASA/Scientific Visualization Studio/Michala Garrison; eclipse calculations by Ernie Wright, NASA Goddard Space Flight Center.



Photos of an annular total solar eclipse (left) and a total solar eclipse (right). Note that the annular eclipse is shown with a dark background, as it is only safe to view with protection — you can see how a small portion of the Sun is still visible as the ring around the Moon. On the right, you can see the Sun's wispy corona, visible only during totality itself, when the Moon completely — or totally - hides the Sun from view. A total solar eclipse is only safe to view without protection during totality itself; it is absolutely necessary to protect your eyes throughout the rest of the eclipse! Credits: Left, Annular Eclipse: Stefan Seip (October 3, 2005). Right, Total Eclipse, Richard Bell (August 21, 2017) .

protection must be worn to safely observe most of this eclipse, it's not needed to witness totality itself, the brief amount of time when the Moon blocks the entire surface of the Sun from view. And if you try to view totality through your eclipse viewer, you won't actually be able to see anything! The Moon's shadow will dramatically darken the skies into something resembling early evening, confusing animals and delighting human observers. You will even be able to see bright stars and planets - provided you are able to take your eyes off the majesty of the total eclipse! While the darkness and accompanying chilly breeze will be a thrill, the most spectacular observation of all will be the Sun's magnificent *corona!* Totality is the only time you can observe the corona, which is actually the beautiful outer fringes of the Sun's atmosphere. For observers in the middle of the path, they will get to experience the deepest portion of the eclipse, which will last over four minutes - twice as long as 2017's total solar eclipse over North America.

While some folks may be lucky enough to witness both eclipses in full – especially the residents of San Antonio, Texas, whose city lies at the crossroads of both paths – everyone off the paths of maximum eclipse can still catch sight of beautiful partial eclipses if the skies are clear. The Eclipse Ambassadors program is recruiting volunteers across the USA to prepare communities off the central paths in advance of this amazing cosmic ballet. NASA has published a fantastic Solar Eclipse Safety Guide which can help you plan your viewing. And you can find a large collection of solar eclipse resources, activities, visualizations, photos, and more from NASA.

The Virus of Misconception

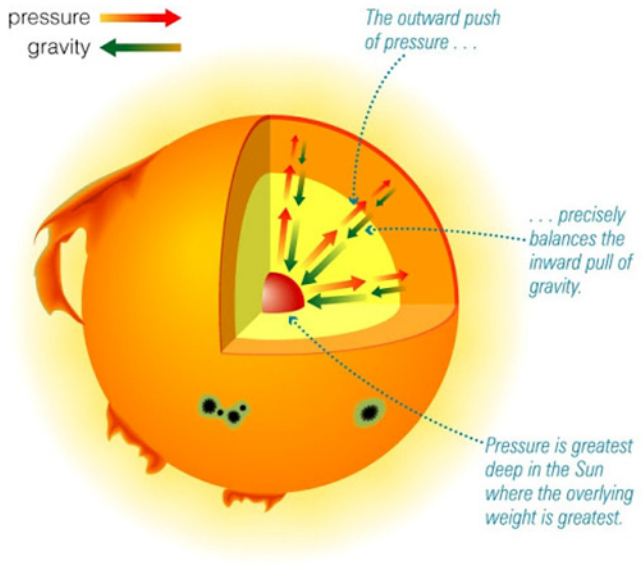
of pandemic proportions for stars

by **Dr. Kirk Korista**

Posted on *Astronomy Magazine's* website (and published in their July 2018 issue), the first 3 sentences of an article that addresses this question, "When does a star's size violate the laws of physics?" The response is confounding:

> *"The size of a star is a natural consequence of the balance between the inward pull of gravity and the outward pressure of radiation produced inside the star. When these two forces are balanced, the outer layers of the star are stable and said to be in hydrostatic equilibrium. In general, both the gravitational force and the energy generation rate are determined by the mass of a star."*

First, nowhere in the article does the responder assure that no such thing (violation of the laws of physics) ever happens in stars. Next, the first sentence of the response is simply wrong. Radiation pressure rarely contributes significantly to the total pressure in stars in opposition to the inward force of gravity (luckily, *gas* pressure is the workhorse). And when it does in very massive stars, it *acts to destabilize it*. Nor does pressure-gravity balance determine the star's size. The second sentence is muddled. Pressure-gravity force balance applies *everywhere within the star*. Otherwise, *rapid* adjustments in structure (inward or outward) result, often in minutes(!). The third sentence is too vague to communicate anything useful, likely pointing to misconceptions the responding author holds.



Stars are generally in a state of force balance, often referred to as hydrostatic equilibrium: the inward force of gravity is opposed by a net outward push by mainly ***gas*** **pressure**. Learn more about how stars work in an article Kirk wrote for the **May 2020** issue of *Prime Focus*.

The fusion energy generation rate is determined by the star's luminosity that is usually determined by its mass, and gravity is usually less effective in more massive stars.

This post in *Astronomy Magazine* illustrates the level to which the state of astronomy education as pertains to stars has been utterly gutted. **The above is only the tip of the iceberg**...the expanse of misconceptions about stars is breathtaking. This virus of misconception has been moving through and continues moving through populations of people: **astronomers** (yes, astronomers) who also teach the next generation of astronomers, some of whom end up writing textbooks to instruct the next generation of astronomers and science teachers..., also NASA and other observatory-based educational outreach sites, and science writers writing for astronomy magazines like this one. All are infected and then go about infecting others, such as the science writer, above, round and round, again and again, reinforcing to the point that misconception becomes truth.

While the virus has been drifting around for decades, the internet vector has served as a fantastic accelerant in spread and mutation. As for those astronomers who are experts in the field of stellar structure/evolution, many of them know better, or are at least less infected. But most are less than skilled in communicating – even many of those who write the specialized textbooks. Others either do not realize or do not care about the **importance of the choice of words and conceptual understanding** – they've got their models; perhaps you've heard the phrase, "just shut up and calculate!". Nevertheless, I suspect the virus has the potential to infect and impact the research field as well.

As I've mentioned, the useless information that appears in the first 3 sentences of that little article is just the tip of the iceberg of the breadth in infection. **I am unaware of any area of science education that has been so devastatingly infected with misconception, from grade school to *graduate* school.**

And full disclosure – I'm no different than anyone else. I've been infected by variants of this virus, via previous textbook sources and instructors. But over the past 15 or so years I've also done all I can to root it out and immunize myself against it. As scientists it is our job to understand the physical processes well enough to provide the appropriate translation of what science understands about stars to the appropriate audience – including our colleague non-practicing-scientist educators. Passing along scientifically useless, viral misconceptions that serve to confuse is antithetical to the scientific endeavor.

If the story doesn't matter, then what are we doing?

Dr. Kirk Korista is a professor of astronomy at Western Michigan University and has been a KAS member since October 1997.

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Venus-Jupiter Conjunction

March 1, 2023

↑ **Eric Schreur**

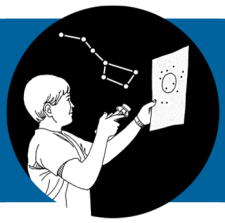
Asylum Lake · Nikon D5500 · 18mm @ f/3.5 · ¼-second · ISO 12800

↑ **Arya Jayatilaka**

Portage · Canon 60D · 65mm @ f/7.1 · 5-seconds · ISO 5000

↑ **Mike Melwiki**

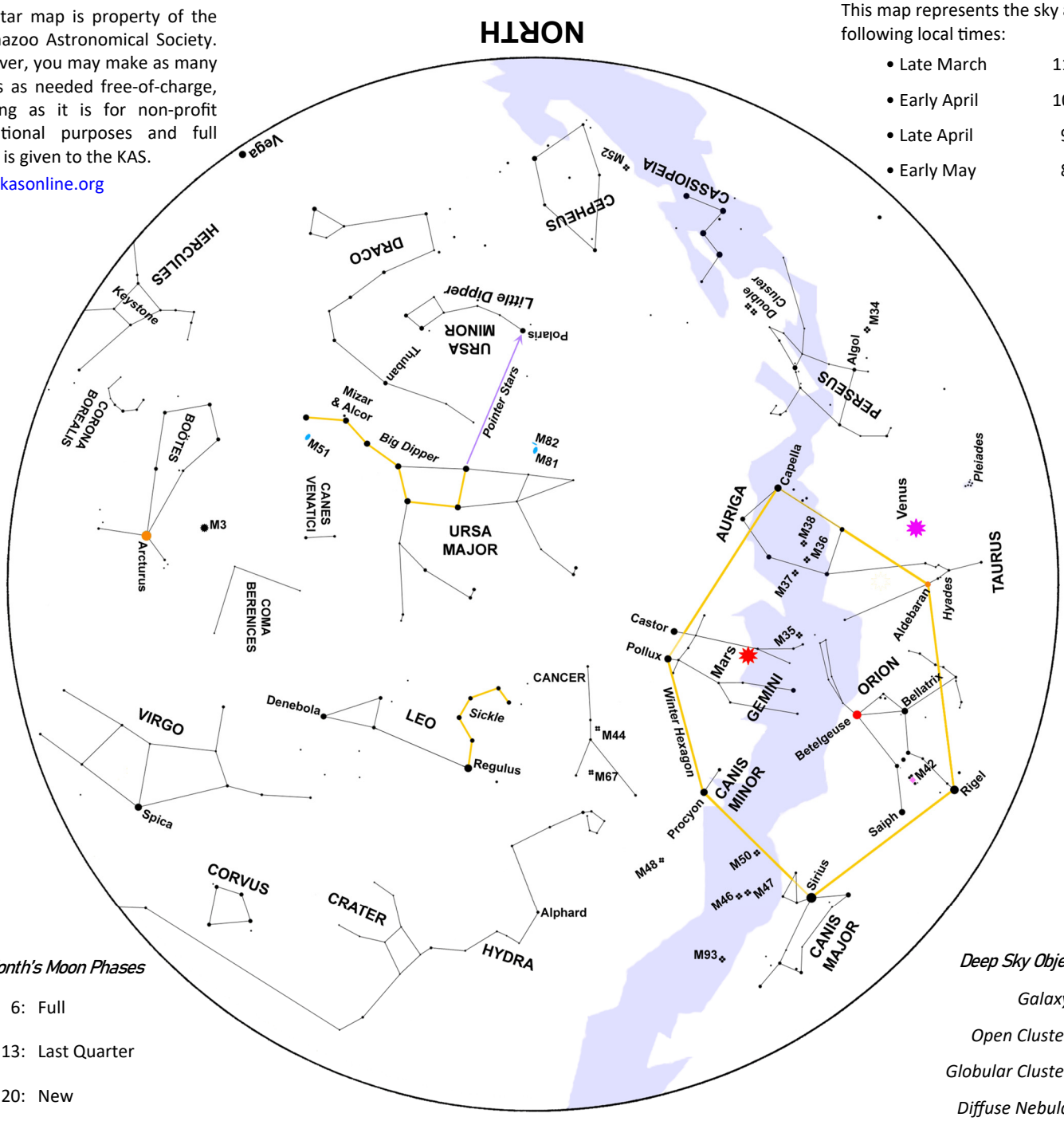
Plainwell · iPhone 14 · 10" f/6 Dobsonian w/ 27mm Panoptic eyepiece



April Night Sky

This map represents the sky at the following local times:

- Late March 11 pm
- Early April 10 pm
- Late April 9 pm
- Early May 8 pm



This Month's Moon Phases

- 6: Full
- 13: Last Quarter
- 20: New
- 27: First Quarter

Deep Sky Object Key

- *Galaxy*
- *Open Cluster*
- *Globular Cluster*
- *Diffuse Nebula*
- *Planetary Nebula*

A waning gibbous Moon and Antares, the heart of Scorpius, are less than 1° apart when they rise shortly before 1am EDT on April 10th. Grab some binoculars and check the pair out if you can stay up that late!

Venus visits the Pleiades on the evenings of April 10th and 11th. The brilliant Evening Star will be positioned 2½° to the lower left and left of the Seven Sisters, respectively. That's close enough to view together in 10×50 binoculars.

Mars is well-past opposition, but if you observe it through a telescope on April 14th you'll notice a bright star less than ¼° to the northwest. It's 3rd-magnitude Mebsuta, or Epsilon Geminorum. This stars represents the torso of the twin Castor.

On the evening of April 22nd you'll find a waxing crescent Moon equidistant between Venus and the Pleiades. A spectacle best-suited for the unaided eye!

The Lyrid meteor shower peaks on the night of April 22nd/23rd (at 9pm EDT). Moonlight will not interfere. Observers can expect up to 18 meteors/hour. Lyrids are fragments of the comet C/1861 G1 (Thatcher).

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Venus & Galaxies of the Virgo Cluster

April 29th
The Moon, Venus, & Double Stars of Spring

Gates Open: 8:00 pm | Observing Begins: 8:30 pm

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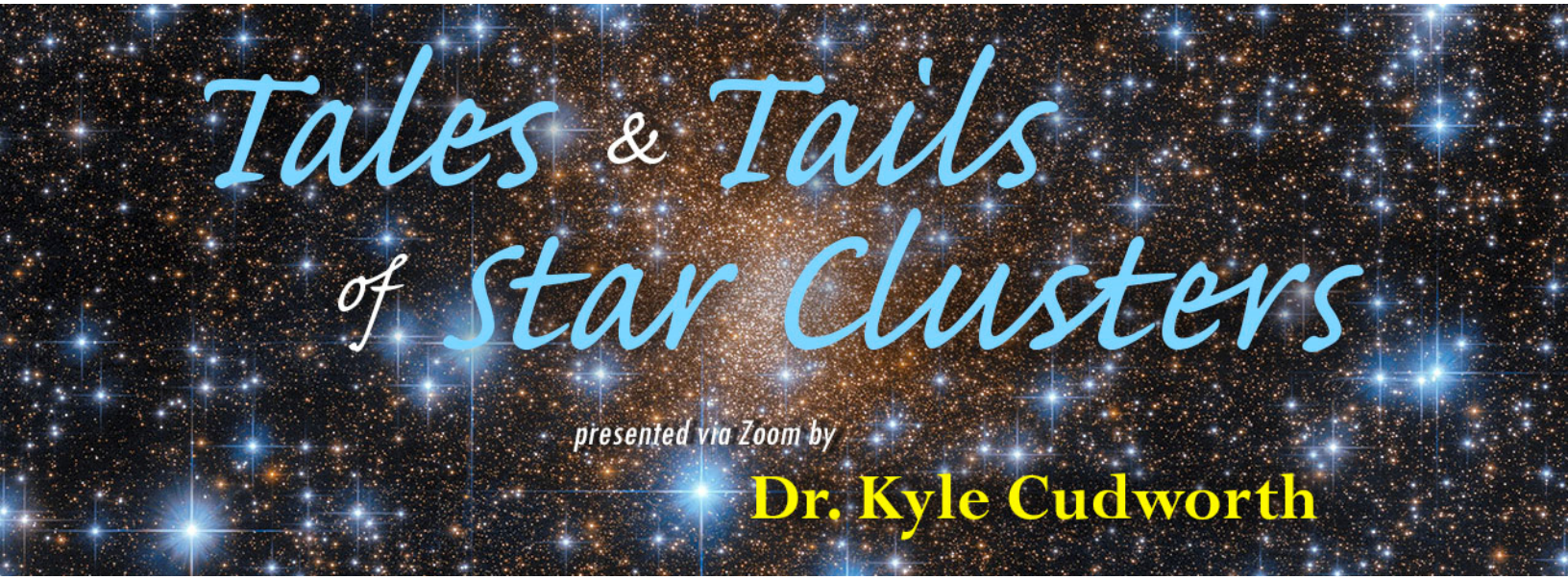
The KAS seeks a member for the volunteer position of Equipment Manager. Responsibilities include maintaining our small collection of astronomical equipment for loan and checking them in and out to members. See the Equipment for Loan web page for more information.

Any member interested in volunteering for the position must have a basic knowledge of amateur astronomy equipment and regularly attend KAS activities. Please contact us if you're interested in applying for the position.

General Meeting Preview



Star clusters have been critical to our studies of stars and of our galaxy, as well as other areas of astrophysics. Besides their scientific importance, many of us think they are also beautiful to look at through a telescope of any size. Dr. Cudworth will discuss various topics involving star clusters, with a number of examples from his research through about 50 years. Some examples he will discuss: How do researchers (not textbooks) usually distinguish between open and globular clusters? What connection might there be between open and globular clusters? Can a globular cluster grow a tail?

— About the Speaker —

Dr. Cudworth's interest in astronomy dates to learning a bit about constellations as a Boy Scout, and enjoying using the small telescope his parents gave him when he was in junior high school. He got a bachelor's degree in physics at the University of Minnesota and then went to grad school at the University of California Santa Cruz, the headquarters for Lick Observatory. He received my PhD there in 1974 (having spent close to 100 nights photographing planetary nebulae, star clusters, and other targets with the 36-inch refractor) and immediately joined the University of Chicago faculty at Yerkes Observatory. He became director of Yerkes in 2001 and served as director through the time of transition for Yerkes from over a century of being primarily a research facility to becoming primarily an education and outreach facility. After officially retiring in 2012, Dr. Cudworth continued some research and considerable involvement in education and outreach activities until Yerkes was closed by The University of Chicago in 2018. He has continued involvement with GLAS Education programs run by the former Yerkes education staff, largely away from the Yerkes site. He is also somewhat involved with the new administration at Yerkes.

Friday, April 14th @ 7:00 pm

Kalamazoo Area Math & Science Center

Use Dutton St. Entrance • Locked by 7:10 pm

Also held on Zoom • Click to Register