Capitol Skies

The Newsletter of the Madison Astronomical Society

Spring Equinox Issue, March 2025

The Dark Shark and Rotten Fish Nebulae. Photo by Carol Santulis

From the President's Desk

By Laurence Mohr

Spring is here, and if you're like me, you're looking forward to a season full of outdoor activities, fresh air, and lots of stargazing with friends! Be sure to stay tuned for announcements from MAS with opportunities for public outreach and other fun activities. We'll return to Donald Park in August and Monona Terrace this fall for public star parties. For other outreach opportunities, please participate in our Outreach Committee. Contact me or our Secretary, Dan Hyslop, by email to join.

Also, I would encourage early planning for the picnic at Yanna Research Station (YRS) on Saturday, September 20th. Any members who have ideas for other activities this year are encouraged to share a proposal or volunteer.

I'm pleased to announce a tentative schedule for this season's monthly star parties at Yanna Research Station. Each is the Saturday closest to the the new moon for the darkest sky possible. Here are the dates: March 29th, April 26th, May 24th, June 21st, July 26th, August 23rd, September 20th, and October 18th. November and December dates may be announced if the weather permits.

It's been pointed out that March 29th is an excellent opportunity for a Messer marathon. Yes, it's possible to view every Messier object in a single evening! For those of us who are new to the hobby and want to learn more about observing, the monthly star parties are a great opportunity to get started. Let's hope for clear skies and great fun this year!

MAS *Capitol Skies* Contributors:

For Upcoming Events See Page 14

Madison Astronomical Society
90th Anniversary Gala

When: Saturday, April 5th, 2025

Where: Usona Institute, Promega Corporation, 2881 Woods Hollow Rd, Fitchburg, WI 53711

All members should have received their email Gala invitation on February 14th. If you didn't, contact John Rummel immediately at darksky2500@gmail.com. **Due to extremely heavy demand and limited space, we've had to cap the number of seats available. If you haven't already registered, send it in now but you may end up on our waiting list.**

If you have sent in your registration and check already but have not received an email confirmation from John Rummel, please contact him at the email above!

A Note from the Editor

By Jack Fitzmier

My hope is that *Capitol Skies* provides a variety of interesting material for all MAS members. I want us to offer information about the night (and daytime) sky, information about how to observe it, and information about MAS itself. So in each issue you can count on some "standard" columns: reports from our Board leadership, our Member Spotlight, an introduction to an AL Observing Program, news about upcoming meetings, something on visual observing, and something on the tech side of things. But this quarter we add some new items: a book review, an equipment review, an article about the move from nighttime to daytime observing, a guide to an astronomical object — Markarian's Chain, and a story about how one of our members tackles AP challenges.

Other things are new as well. Notice that our masthead differs from last issue? We hope to offer a new look every quarter, each featuring a photo by an MAS member. This time we used a photo by Carol Santulis. Have a photo that might suit? Send it my way!

Alex Samuel's review of the Fiscus Red Light got the attention of John Rummel and Frank Ranallo, which resulted in collaborative piece on dark adaptation. And this issue debuts the first in a series of articles that will appear in coming quarters. Rick Wayne has offered to provide practical photography tutorials on a series of astro-related subjects. The initial focus (er, sorry) will be on getting started with entry level equipment and processing software, and then will move on to more advanced tools.

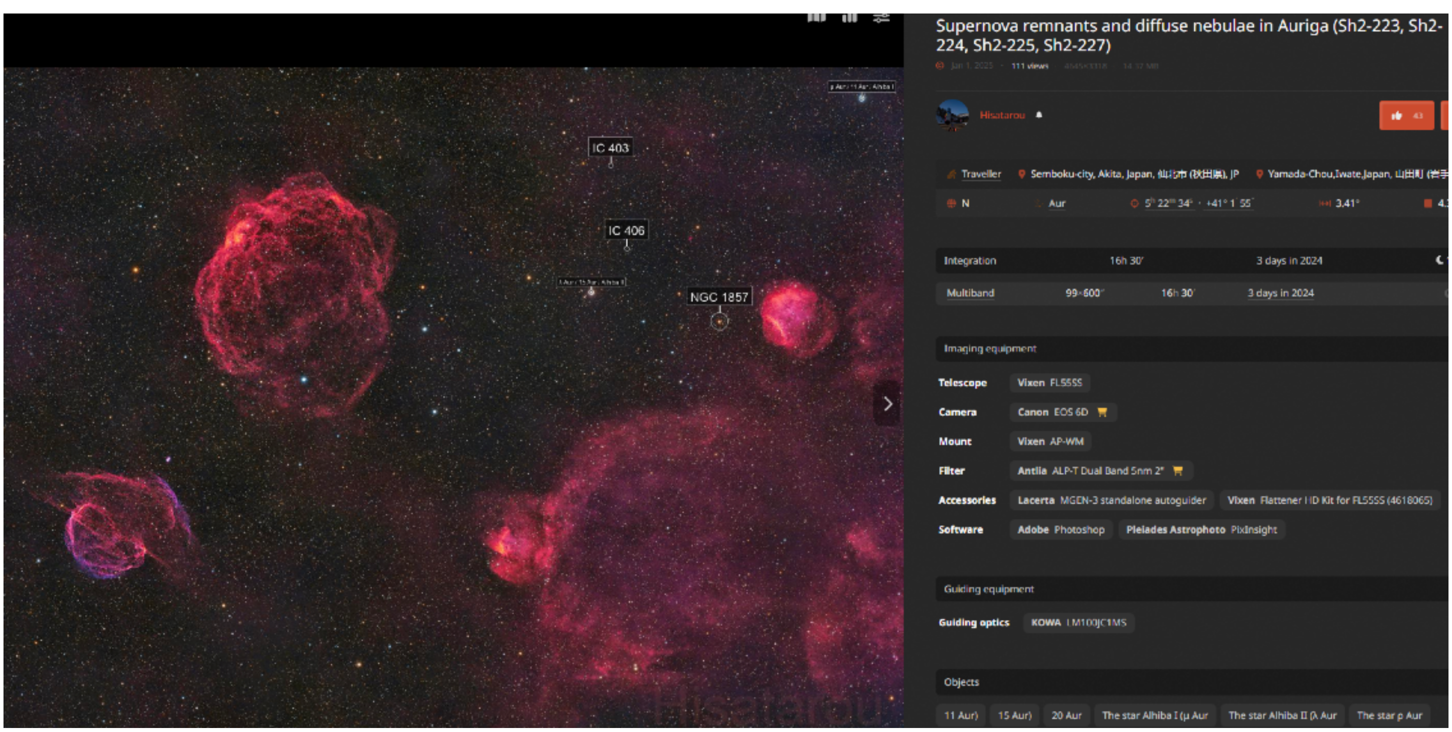
Enjoy!

Astrophotography, My Way

By Carol Santulis

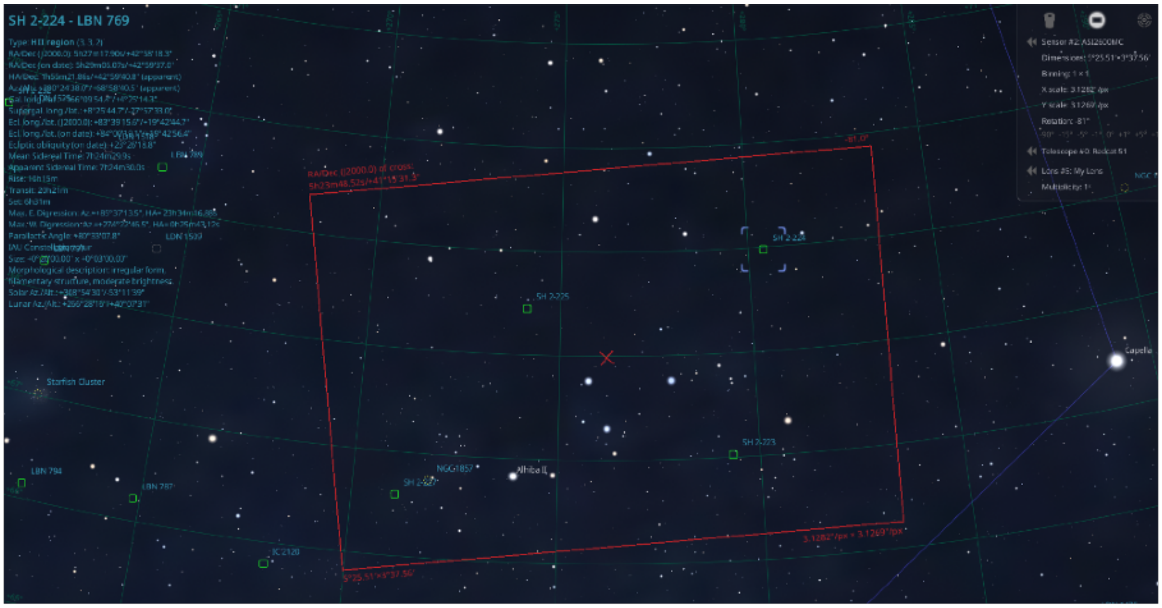
I am often asked how I acquire my astrophotography images. Everyone does the image processing differently and there are many workflows that yield good results. Here is how I do it. Before I even take one photo, I plan exactly how I want the image to look. Planning is the key. The effort (not time) I put into my images is 25% planning, 25% imaging, 50% post processing.

Planning Step 1: I go to Astrobin.com and search for my target (in this case, the Supernova Remnant Sh2-223), my scope, and my camera to see what can be captured with my equipment. I check out the nicer images for exposure times, filters, and framing. Even though I may not have identical equipment, if I like the framing I use the same filter and the overall integration time shown on Astrobin. In this case, I really liked the results obtained by Japanese photographer Iwate Yamada-Chou.



Iwate Yamada-Chou's shot from Astrobin, including technical details and camera info.

Planning Step 2: I find my target using the free application *Stellarium*. With my scope and sensor input in the Oculars panel (upper right in the image at right), I can plan the framing and rotation of my sensor and determine details like rising and setting times of my target.



Framing Information From Stellarium

Imaging: This can take 10-25 hours over several nights. This is the easy part, turn it on and let it run.

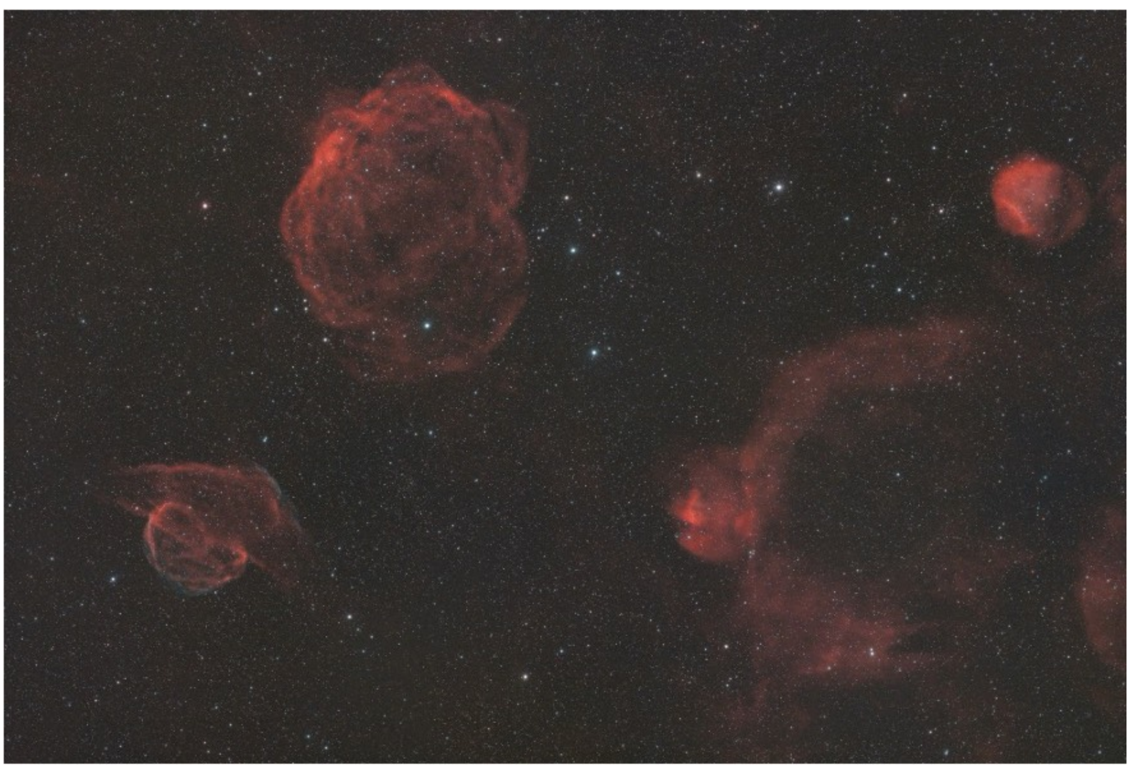
Post Processing: This is where I put in the most effort as it is not my strength. Trying to learn Pixinsight has been challenging for me. There many processing steps and the workflow may vary depending on the target. Pixinsight does everything from calibrating, debayering, registering, stacking, drizzling, and autocropping in one step. And if I enter the images correctly and choose the correct setting (of which there are MANY!) it rewards me with a master light file.

The next steps are on the master light file which involve

- gradient removal (for moon and light pollution),
- star color correction (based off of star catalogs),
- deconvolution (removing blur and sharpening),
- stretching, star removal (this results in a Star and Starless image to work on separately before recombining later).

At this point I can add an artistic and subjective spin on the image through curves (which lets you add contrast, saturation). Masks can help with applying these edits to only select locations of the image. This is the time to try to make a scientifically correct image or an artistic version. Either is correct. It is now personal taste for finishing the final edits. The file is saved in Tiff format and can be exported as a JPG for sharing to social media, emails, or for printing. After stacking and processing, the finished image is seen below.

***The Finished Product**: The Rice Hat Nebula, Sh2-224, and friends Sh2-223, 225, 227 in the constellation Auriga. Equipment: Redcat 51 telescope (250mm focal length) on a ZWO AM5 mount with a ZWO ASIair Plus controller; ZWO ASI2600MC Pro camera and an Antlia ALP-T dual narrowband (5nm) filter. Exposure: 16.5 hours of 5 minute subs taken over 3 nights. Processed in Pixinsight.*



Spring Galaxies: Markarian's Chain

By Christine Zeltner

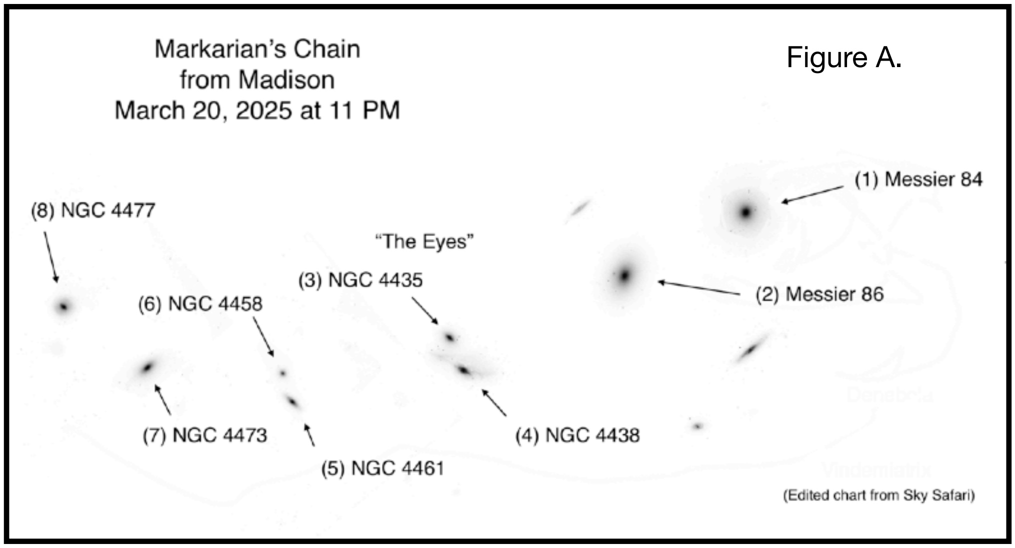
If you ask any amateur astronomer they will tell you that spring is galaxy season. In spring the Coma-Virgo galaxy cluster is high in the sky. This cluster contains about 2,000 known members. It is located in the constellations Virgo and Coma Berenices. A number of the galaxies can be seen in small scopes and about 160 can be found in a 6 inch scope. If you have a larger scope, you can find so many that it becomes more difficult to figure out which ones you are looking at. This all makes for a very fun and interesting night of observing.

In the middle of the Coma-Virgo Cluster is Markarian's Chain, which is a line of 8 galaxies. See Figure A. (1) Messier 84 is the southernmost of the Chain (on the right side of the chart). It is a magnitude 9 elliptical galaxy. Just northwest of it is (2) Messier 86, a magnitude 8 barred lenticular galaxy. These two are the brightest of the Chain, and the magnitude goes down as you work your way down the line. Next are (3) NGC 4435 and (4) NGC 4438, both magnitude 10 distorted spiral galaxies. They are called "The Eyes." (5) NGC 4461, a lenticular galaxy at magnitude 11 follows. Continuing on we find (6) NGC 4458, a magnitude 12 elliptical galaxy. The last two in the line are (7) NGC 4473 and (8) NGC 4477, both at magnitude 10: NGC 4473 is an elliptical and NGC 4477 is a barred lenticular.

Markarian's Chain is easiest to find by aiming your scope half way between Denebola in Leo and Vindemiatrix in Virgo. The galaxies run as a slightly kinky line from south to north. In a low power eyepiece they show up as an obvious chain. It is a good idea to start with a low power eyepiece, perhaps a 26mm, or better yet a 35mm. This will let you see a large part of the chain all at once.

Once you have found Markarian's Chain in your low power eyepiece, you can zoom in and see how much detail you can see in each of the galaxies. When I am using a higher power eyepiece to explore them, I find the pair called "The Eyes" to be a good landmark. They are close together and hard to mistake for something else.

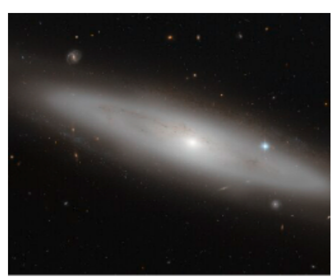
For me the hardest part of exploring this group of galaxies is that the weather in spring in Wisconsin is not as cooperative as I would like. So let us all hope for a spring with some good clear nights and temperatures above freezing that do not occur during a full moon.



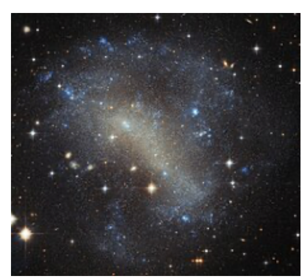
Editor's Note: *For additional information about Markarian's Chain, including links to Hubble Space Telescope photos of its elements, see here. For more on the various types of galaxies to which Christine refers, see below, and refer to this Wikipedia article.*

A **spiral galaxy** consists of a flat, rotating disk containing stars, gas and dust, and a central concentration of stars. Example: Messier 101

An **elliptical galaxy** is a type of galaxy with an approximately ellipsoidal shape and a smooth, nearly featureless surface. Example: Messier 59



A **lenticular galaxy** is a type of galaxy intermediate between an elliptical and a spiral. Lenticulars lack large arms. Example: NGC 4866



An **irregular galaxy** is a galaxy that does not have a distinct, regular shape unlike a spiral or an elliptical galaxy. Example: IC 4710

A Senior's Way to Better Seeing

By Jordan Konisky

I came to Madison in 1963 as a graduate student in Genetics and Molecular Biology. This led to an academic career that brought my wife, Judy, and me to New Haven, Champaign-Urbana and Houston. After a 40 year absence, we returned to Madison to retire. Fly fishing southwest Wisconsin's trout streams kept me occupied for awhile, but eventually the wear and tear of climbing down, then back up stream banks punished my aging lower back and knees, and fly fishing became a pursuit of the past.

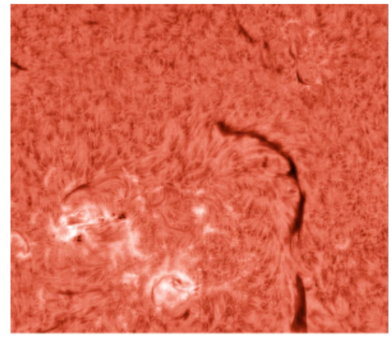
With a keen interest in astronomy, especially cosmology, I joined MAS in 2016. My very first telescope soon followed, a SkyWatcher Pro ED100 refractor, a 75th birthday gift from Judy. I joined the night time regulars at YRS taking full advantage of their expertise and helpfulness. But eventually, with ripening cataracts, several midnight encounters with deer in my headlights, and a loss of confidence in my driving after dark, YRS at night was declared a forbidden adventure. I adapted to the light of day.

The Winter Observatory

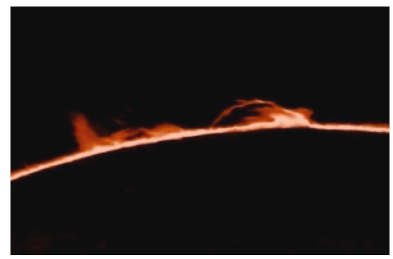
At an MAS Banquet, a table mate introduced me to the Coronado PST solar telescope. I was intrigued by the possibility of utilizing hydrogen-alpha filters to observe and image those wisps of hydrogen plasma displayed as surface features and limb prominences within the solar chromosphere layer. Three weeks later, I peered into my newly acquired PST and experienced a full disk with a modicum of solar surface structure and, sure enough, a few prominences. Yet, the PST never performed to match my ambition, and I looked to upgrade.

I combed through posts on the Cloudy Nights Solar Forum and elsewhere. Should I build on the flexibility of my birthday telescope which could accommodate a variety of solar filters or invest in a dedicated hydrogen-alpha telescope? With a decision made, I took delivery of a Daystar Quark hydrogen-alpha filter and a Lunt White-Light Wedge. Each performed superbly when paired with my birthday refractor, and I was able to produce some quality images and animations, one of which was selected a Celestron Solar Chat Forum Image of the Day.

But time has its way with us all, and as I approached my 83rd birthday, my setup was simply too heavy and awkward to manage. I needed to downsize. I put my refractor, equatorial mount and tripod (50 pounds) up for sale and replaced them with an Astro-Tech ED72ii refractor and a SWSolarQuest mount (14 pounds). What a relief!



Through the Window
Hydrogen-Alpha: Upper Chromosphere



Through the Window
Hydrogen-Alpha: Solar Prominences

This past winter, I adapted again - this time to the Wisconsin winter. In early December, a surprise - a *Cloudy Nights* Forum posting of a hydrogen-alpha solar image taken through a bedroom window in a town north of Detroit. A few weeks later, an inspired 83 year old, who was gifted his first telescope at age 75, set up his hydrogen-alpha rig and peered, then imaged, through his study window. It marked the beginning of a satisfying winter of seeing. Cold outside? Who cares?

Capitol Skies is the quarterly newsletter of the Madison Astronomical Society. Members of the Editorial Committee include Jack Fitzmier (Editor), Bob Hamers, Alex Langoussis, John Rummel, Alex Samuel, Rob Strabala, and Rick Wayne. Interested in contributing? We'd love to have you participate! Contribute an essay, an equipment review, a book review, or another piece of astronomy-related material. And feel free to send comments, feedback, or other ideas along as well. Contact Jack Fitzmier at jfitzmier@gmail.com for more information.

Book Review

The Glass Universe: How the Ladies of the Harvard Observatory Took the Measure of the Stars by Dava Sobel (New York: Viking, 2016)

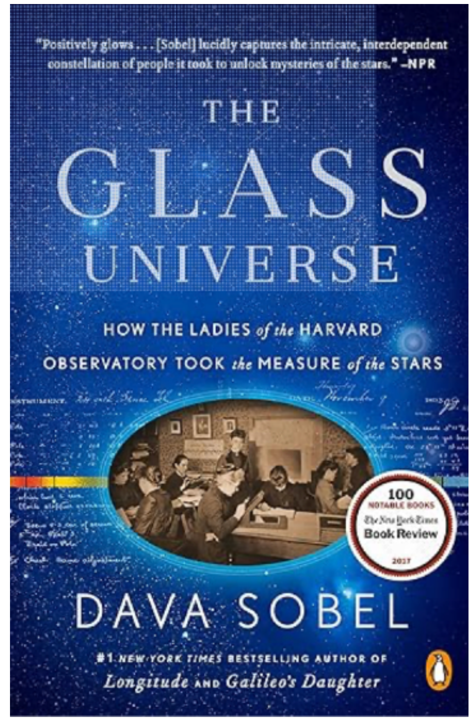
Reviewed by Veneta Boyanova Kovacs

I came across *The Glass Universe* a few years ago while browsing for books on the history of astronomy. History of science, more broadly, is one of my favorite subjects. I'm particularly interested in women's contributions to it. In her book, Dava Sobel illuminates the accomplishments of the female astronomers, who were then called "computers" at the Harvard College Observatory between the late 19th and early 20th century. The "glass Universe" refers to the collection of photographic glass plates on which images of stars were taken with then cutting-edge telescopes and photographic methods and techniques. These ladies meticulously studied and documented the data from the plates. They developed elaborate cataloguing systems of the stars, measured and classified their brightness, magnitude, temperature and chemical composition, and made significant discoveries about our knowledge of the universe.

> *"A little piece of heaven. That was one way to look at the sheet of glass propped up in front of her."*
> *Dava Sobel*

This past December, during an interesting and informative lecture presented at MAS on the evolution of the smart telescope I was reminded of their remarkable stories when one of the speakers mentioned the work of Annie Jump Cannon and Henrietta Swan Leavitt, two women who worked on stellar classification and measurement. Leavitt, a Radcliffe College astronomy student who started at the Harvard Observatory in 1895 as an unpaid assistant, went on to discover a groundbreaking relationship between the brightness of variable stars called Cepheids and the period of time they take to cycle through their brightness variations. Her discovery enabled other astronomers to decipher how to measure large scale cosmic distances. I was also amazed to learn that the *"Leavitt Law"* (p.262), as the period-luminosity relation has come to be called, was used as a base for Edwin Hubble's research on determining that the Universe is expanding. It is still being used today by astronomers to measure the Universe's rate of expansion. I'm inspired by the groundwork a woman astronomer laid out for this discovery.

What is the Sun primarily made out of? Hydrogen and helium – the two main components of stars. I knew that, but what I did not know is that this proportion of stars elements was discovered by a woman. Cecilia Payne, another remarkable female astronomer, focused on studying stellar spectra and chemical composition of stars through measuring their spectral lines and calculating their temperatures. Payne was Harvard's first recipient of a PhD in Astronomy and later on became the first female professor appointed on the faculty of the Astronomy Department. Her discoveries lead to the conclusion that the proportion of stars' chemical composition is dominated by hydrogen and helium, rather than initially assumed to have been similar to the proportions of elements found in Earth's crust. One of the leading male astronomers of the time, Henry Norris Russel told Payne that her theory was "clearly impossible" (p. 209). In the paper Payne later submitted for publication she *"tempered her conclusions"* and declared them *"almost certainly not real"* (p.210). We now



know, of course, that her theory was correct.

The book is a fascinating collection of stories about the women astronomers of the Harvard College Observatory and their contributions. Some of these women had higher education and training in the sciences, but others did not. Those who did not relied on their aptitude for math and their devotion to stargazing. With persistence and character, despite being underpaid and under-recognized compared to their male counterparts, and *"even before they won the right to vote,"* (p.xii) they questioned the boundaries of our knowledge of the stars. Their painstaking efforts and dedication to cataloging, studying, and measuring the stars led to advancements and discoveries that later facilitated even greater cosmic revelations. I appreciated and enjoyed learning about this unknown to me part of history of astronomy, and I genuinely recommend this book to anyone who is interested.

Astronomical League Observing Program: Double Stars

By Jack Fitzmier, Astronomical League Liaison

This quarter we feature the AL's Double Star Observing Programs. Staring into the heavens, you rarely see double stars with the naked eye. This might lead you to conclude that they are a celestial rarity. Not so. Astronomers estimate that greater than 60 percent of stars in our Milky Way are in binary systems!

Why observe doubles? First, their beauty. This is especially so when the stars in the pair are of distinctly different sizes and colors. Second, unlike deep sky objects such as galaxies and nebulae, you can observe doubles in light polluted skies, in moonlight, and with modest instruments. Finally, appreciating doubles requires a bit of technical knowledge and skill that can add to the challenge of any celestial hunt.

Getting up to speed with doubles will require you to learn some new terminology. Double stars are assigned a **WDS** designation, which is the abbreviation for the *Washington Double Star Catalog*. It was created and is maintained by the United States Naval Observatory in Washington, DC.

Double stars generally fall into two categories. **Binary doubles** are stars that are gravitationally bound and are relatively close together. **Optical doubles** are stars far distant from one another. They appear "next" to each other in the night sky because their lines of sight to an observer are nearly parallel, but one star is much closer to the observer than the other.

Cor Caroli (Alpha CVn) is now visible in the spring sky. It's a binary double whose stars differ in color. The **primary star** (the brighter of the two, at magnitude +2.8) has a distinctly blue cast while the **secondary star** (the dimmer of the two at +5.5) is yellow-white. Knowing the difference between the magnitudes (the "**delta mag**") helps you know what to expect at the eyepiece: Small delta mag? Expect the stars to be about the same size. Large delta mag? Look for a larger and brighter star with a smaller companion.

You'll also see lots of references to **Sep**, which is shorthand for "separation." This is the distance, measured in arc-seconds (denoted by the symbol "), between the primary and secondary star. *Cor Caroli's* sep is 19", which is fairly large, making it easy to identify each of its stars as separate points of light. That's called **splitting** the double. Some doubles in these AL programs have seps as small as 10". You may do some squinting at the eyepiece to split them!

> *At the eyepiece, the space between celestial objects is referred to as **angular separation** and is measured in **degrees, minutes**, and **seconds** of arc. So how small is an arc second?*
>
> *Hold your hand at arms length and hold up your small finger. That finger covers about one **degree** of arc. Every degree is divided into 60 **minutes** of arc, and every minute is divided into 60 **seconds** of arc.*
>
> *Do the math: an **arc second** would be about 1/3600 of the width of your little finger. That's pretty small!*

Perhaps the most baffling term for beginners is **PA**, which stands for "position angle." Imagine drawing a line from the primary star to the celestial North pole. Draw another line from the primary to the secondary. The angle between the lines, measured eastward, is the position angle.

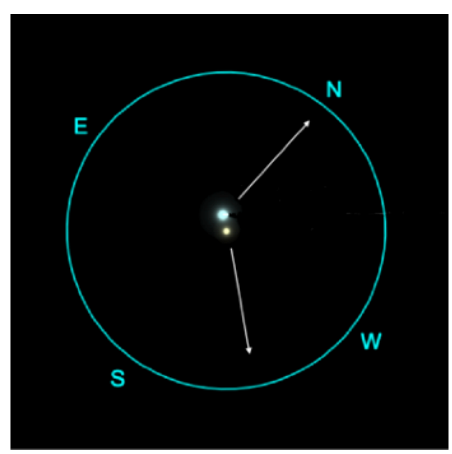
Now think of a compass rose — a circle divided into 360 degrees. Whether on the terrestrial sphere or on the celestial sphere, we count out the degrees eastward, from 0 to 360, going from North, to East, to South, to West. But because the celestial sphere moves *counterclockwise*, our celestial compass needs to be flipped, left to right. We still count out the degrees in the eastward direction, but now the left is labelled E and the right is labelled W.

At right is a diagram that might help. I turned on the celestial coordinates in Sky Safari and zoomed in on *Cor Caroli*. Notice where E and W are. I added the lines to show the PA. The top arrow points to the North celestial pole. The lower arrow points to the secondary at a spot somewhere between W (270 degrees) and S (180 degrees). Turns out that the exact PA is 229 degrees. Knowing how to use sep and PA is very helpful as you try to split doubles at the eyepiece.

The AL sponsors three double star programs. The Binocular Double Star Program is a really good place to start observing doubles. It requires you to observe and sketch any 50 double stars from a list of 120 candidates. If you have completed the basic program, you can tackle the Advanced Binocular Star Program. You must observe and sketch (a few in some detail) any 50 doubles from a list of 100. The Telescopic Double Star Program can be pursued visually or with imaging. It requires you to observe, sketch, or image all the doubles from a list of 100 targets.

Each program provides you with the information you need to get started: WDS designations, RA and Dec, magnitudes of the primary and secondary stars, sep, and PA. You don't need fancy equipment — modest binoculars or a scope with a 3 inch aperture will do just fine. Complete your logbook, submit it to the Coordinator, and if they deem it acceptable, you will receive a Certificate of Accomplishment and an attractive lapel pin.

Double star observing is very rewarding. I'd encourage you to give it a try. If you are interested in exploring one of these programs or have further questions feel free to contact me at jfitzmier@gmail.com.



Astroimaging from The Ground Up

By Rick Wayne

Hello members! This month I'm kicking off a series aimed squarely at those who would like to begin or bolster their astrophotography. Each article in the series will offer a step-by-step project that you can adapt to your own needs. Subsequent issues of *Capitol Skies* will showcase results from members.

We'll start with projects anyone can do, with the very simplest equipment, and work our way up in difficulty (and potential expense!) from there. Very broadly, we'll go from landscape astrophotography through some Solar System work and then on to deep sky. I'll lean heavily toward low-cost or free solutions for equipment as well as software.

Each article will cover six topics:

- Introduction to the project
- Choosing targets and planning your image
- Equipment
- Taking the picture
- Processing the data into a finished image
- Links to suggested equipment, software, and tutorials

Project 1: Moon and Sun Rise/Set

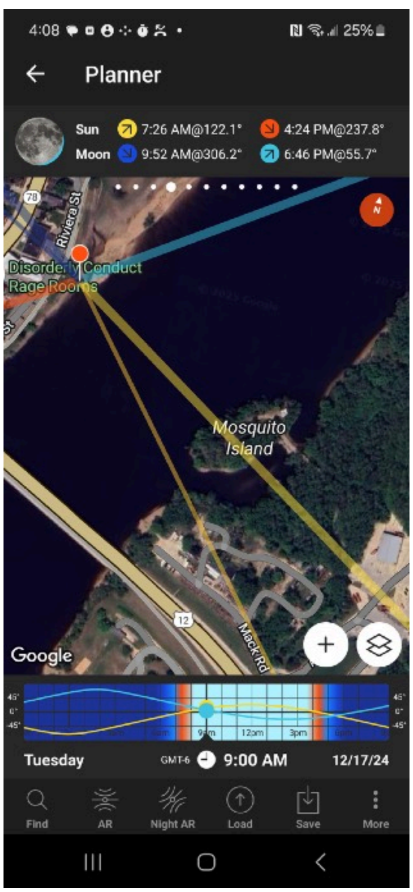
Anybody can shoot a sunset or moonrise. It hardly counts as astrophotography, right? I assure you that it has its own challenges, mastering some of which will be great practice for heavier lifts to come. In particular:

- Planning your shot can be the difference between "meh" and "marvelous"
- Exploiting advanced features of your camera can materially improve the result
- These scenes tend to have *high contrast*, which you'll need to manage in almost every future project you take on

Planning

I admit that planning for sunsets and sunrises is usually just "Oooh pretty! CLICK". But it's worth it to get ahead of the game. I'm going to highlight two software tools that I find indispensable: PhotoPills (an $11 phone app) and Stellarium, a free planetarium program available for phones or computers. (Sky Safari would also work for this.) For this example, we'll focus on planning a sunrise shot over the Wisconsin River in Sauk City.

PhotoPills can help you figure out the where and when, so can make sure you're in the right place at the right time. In the screen shot **at right**, imagine I am standing at the red "pin drop," near the Disorderly Conduct Rage Rooms (ha!). The thick yellow radial (the one over Mosquito Island) shows the direction of the sunrise. As you drag the time-bar left or right, a thin yellow radial tracks the sun's position. At 9:00 AM that thin line ends across Mack Rd.



PhotoPills Planner

To compose my shot, I wanted the tiny little peninsula in the foreground (see it coming in from the left in the photo?) to not *quite* intersect the sun's reflection path. (I find landscape images that exactly center or exactly overlap things to be boring; a finely judged asymmetry makes the picture less static with the illusion of motion.)

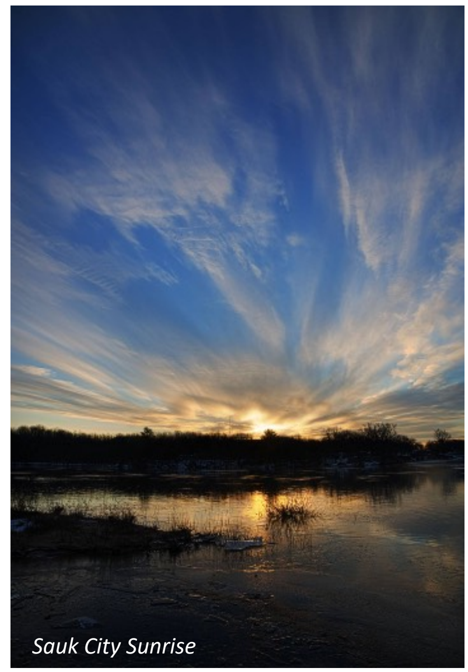
Stellarium's sky simulation capabilities can also help you visualize what you'll actually see in the sky. Set the date, time, and location and use the time-of-day slider to show where the sun will be at that exact moment. Once you're at your site, you can use PhotoPills's "AR" (augmented reality) feature to view the sun's location superimposed over the scenery your cell phone's camera sees (you have to try this to believe it).

Equipment

A tripod, monopod, or even a pillow atop your car will steady the shot.

A DSLR or mirrorless camera is best, but your cell phone can also take great shots if you are willing to explore its capabilities and don't just accept the first "cell phone look" JPEG it produces.

For best results, dig deep into your camera controls. Not all cameras will have all of these, but see what you've got before you go out in the field:



Sauk City Sunrise

- Manual focus
- Manual aperture and shutter speed
- ISO
- Image format (e.g. RAW, DNG, CR2)
- Image bracketing
- Remote triggering or self-timer
- Histogram display for images you've taken
- Live view through the sensor, and how to magnify it

Taking The Shots

Practice every camera setting you'll need *before* The Moment. The sweet spot for a sunset or moonrise might only give you seconds to react. Manually focus on whatever *has* to be sharp, whether that's the horizon or the foreground, using magnification of the live view display (don't rely on autofocus - it may fail in low light). Shoot multiple shots at different shutter speeds. You can make use of photos which may look too light or dark in post-processing.

If you're using a DSLR or mirrorless camera, you'll need to learn about setting your

Continued top of next page

aperture, ISO and so on, but that's too much to cover here. Experimentation and research is essential but your best bet might be to team up with a more experienced MAS photographer and tag along for one of their photo shoots.

Processing

For most astrophotos, processing is at least half the battle. For this first project, we've spent a lot of time on "getting-acquainted" stuff that we won't have to repeat. So just this once, processing is getting short shrift — I'll just name-check some programs and let you play.

Adobe Photoshop is the grandaddy of them all, but may not be the best price point or feature set for everyone. It's what I used to process my sunrise photo.

EasyHDR will let you combine your multiple images into a high-dynamic-range shot in seconds. It's super, super easy to use, just drag your RAW or JPG images onto its window and click "Generate HDR". The free version will watermark your images; the full version is $30. 16-megapixel raw images out of my DSLR gave good results in seconds.

Send Us Your Sunrises!

If you've stuck with me this long, you have the tools to produce great images of the two big celestial bodies in our sky. Everything we've covered about the Sun applies to the Moon — PhotoPills and Stellarium will let you plan, and you'll want to use HDR techniques to get detail in both the Moon and the landscape. (Remember, the Moon is just a sunlit object.)

If you submit images you've shot with these techniques along with a short note about when, where, and technical details, Jack will put them in the queue for future *Capitol Skies* editions.

Next time we'll focus on night landscapes, and spend more time on processing. See you then!

Tech Corner: Open Source, Free Software for Astronomy and Astronomical Image Processing

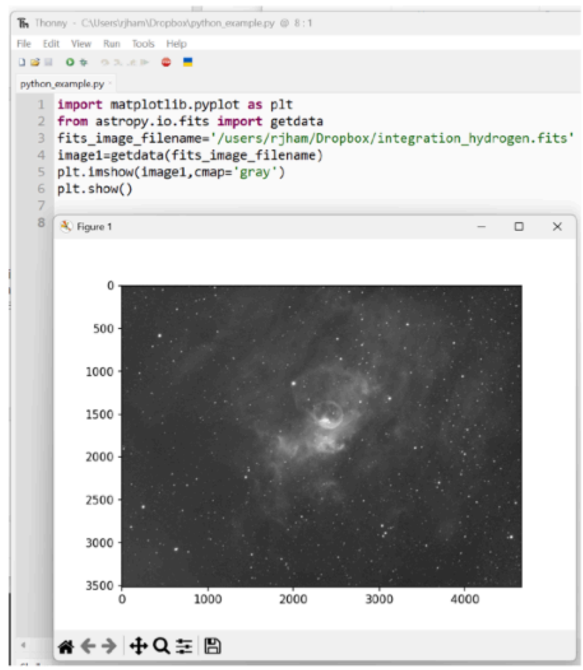
By Bob Hamers

Do you ever feel limited by the software you have available for astro-imaging or simply want to dig deeper? Did you know that there is a wealth of open-source, free software that you can use to extend the capabilities of whatever you are currently using? One of my long-time favorites is ImageJ. Originally developed by NIH for biomedical imaging, ImageJ can read and write most astronomy-related filetypes (TIFF, FITS) and lets you visualize them in 3D, lets you take cross-sectional cuts to see intensity profiles, and more. It's a comparatively small program so loads quickly and is also great for converting between different file formats. ImageJ has an even more full-featured version called Fiji.

An even more powerful set of tools is available based on Python, a free open-source programming language that has revolutionized the science and engineering community. If you know anyone doing robotics or DIY electronics projects these days, chances are good that they know Python. Python is easy to use, cross-platform (works on Mac, PC, Linux, Raspberry PI/Arduino, and more) and has a huge number of packages available for doing pretty much everything under the sun (and the stars, too!). Some of the programs you may already be using (SharpCap, Planetary System Stacker) are based on Python or allow you to add in python code to extend their capabilities.

What if you've never programmed before? One of the reasons why Python has caught on so widely is that it's very easy to use, even without prior programming experience. There are many free tutorials available targeted toward everyone from elementary school kids to AI developers, and with its big user base it's easy to get help when you need it.

How to get started: The easiest way to get started is to download one of the free, integrated development environments ("IDE") that has python built in. The two most common ones are Thonny and Anaconda. Thonny is great for beginners, while Anaconda has additional features and capabilities for more advanced users. If you're new at programming, I recommend starting with Thonny. Some people prefer to use a web-based platform called Jupyter. When you download Thonny or Anaconda, it will automatically install the latest version of Python. For doing anything related to astronomy images, you'll probably want to add in a few of the common (free) packages that extend the core capability. Astropy is an award-winning package specifically developed for astronomy and has easy-to-use commands for reading and writing files in FITS, TIFF, and other formats. Matplotlib lets you display images and graphs on your computer from within your python program. Numpy is a package for numerical processing that you'll almost certainly want (and is often required by other packages). Beyond that, Scipy and scikit-image are packages with incredible capability for image processing steps like image alignment and image sharpening. All of these packages add into the core Python environment and are managed by the IDE so everything works well in combination, making it easy to look at your hard-earned image data in new ways and to mix-and-match with your current image acquisition and analysis programs. And it's all free! If anyone is interested in learning more, I'm happy to help.



A screenshot from within the Thonny IDE, showing a 6-line program to read and display a FITS file.

Thonny: https://thonny.org/
Anaconda: https://www.anaconda.com/download
Matplotlib: https://matplotlib.org/
Astropy https://www.astropy.org/
Numpy: https://numpy.org/
Scikit-image: https://scikit-image.org/

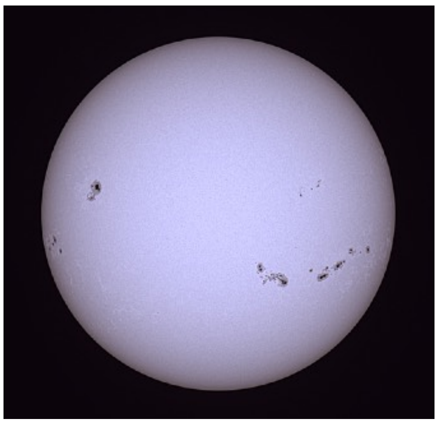
Visual Observing: Fun in the Sun!

By Alex Langoussis, FRAS

Tired of doing astronomy in the cold and dark? Observe in the daytime! Of course you can view the sun, but there are other targets of interest as well.

There are different ways to observe the sun. The simplest, and least expensive, is viewing it in white light. A mylar filter from a reputable dealer is safe, and gives an excellent view of sunspots, plages, and granulation. More expensive, but with outstanding contrast, a Herschel wedge is the best filter to use if your telescope is a small refractor.

A different way to view the sun is in the Hydrogen-Alpha wavelength. You can get a dedicated scope, or an add-on filter set. These are pricier, but the views are well worth it. This type of scope or filter shows you the sun's chromosphere with flares, filaments, and prominences.



Sunspots, during last October's aurora displays.

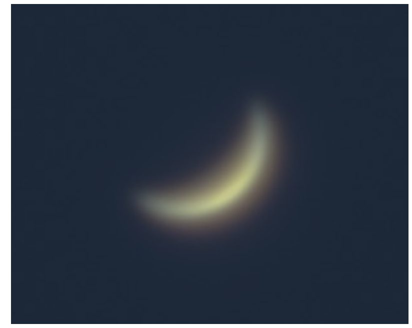
A spectroheliograph is yet another tool for solar, imaging in several different wavelengths. It is only recently that these have become more accessible to the amateur astro market. I have seen spectacular images produced by the SHG700 (from MLastro.com).

But, there is more to see! Venus is actually better seen in the daytime because it's higher in the sky, helping the seeing (air steadiness). If you know where to look (there are apps for that), it can often be seen with the unaided eye. Try using a building to block out the sun when doing this. In a small telescope the view is beautiful, with a crescent phase especially nice against the blue background. Use caution when doing this. **Viewing the sun through a scope without a proper solar filter can permanently damage your eyesight!** At low power, align your telescope on the sun (with solar filter attached!) and focus. Then, slew your telescope to Venus with go-to or setting circles, and only then remove the filter. With the scope already focused, it will be much easier to pick up Venus. Once found, you will find that Venus holds up at high magnification quite well. Try viewing Venus during the day once a week, and enjoy watching as it changes phases.

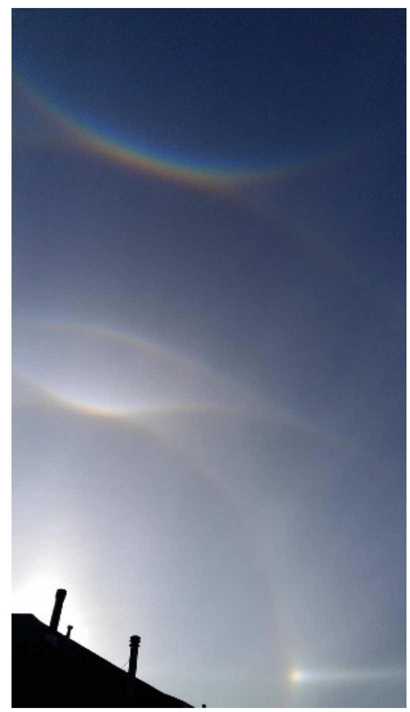
Other planets can be viewed during the day too. Jupiter is a bit tough, but the major cloud bands can be seen. Mars, when near opposition and viewed in the early morning, shows amazingly well, with the red planet, complete with markings and the polar cap, contrasting nicely with the blue background. And… yes, you can even see bright comets in the daytime. Using the same telescopic method used on the planets, you might detect a comet in the day if it's bright enough to be a naked eye object at night. It won't look like much, but it's still fun to track down. Years ago Hale-Bopp was a daytime comet, as was the recent C/2024 G3 (ATLAS).

Finally, when you have high cirrus clouds instead of clear sky, enjoy viewing atmospheric phenomena, such as sun dogs, arcs, and pillars. An online search for 'atmospheric arcs' will lead you to images that can help identify what you're seeing.

Double your astronomical fun by observing in the daytime too!



Venus on February 17, 2025, taken mid afternoon. (A little blurry, my first image with a real astro camera!)



Atmospheric arcs, caused by ice crystals refracting sunlight. Image by Andra Langoussis Pham.

MAS Member Spotlight: Zachary Holcomb

By Alex Samuel

Tell us about yourself.

My name is Zachary Holcomb and I live in Waunakee. I've lived here since 2019. I grew up on the east side of Madison on the edge of Cottage Grove and Sun Prairie. I went to the University of Wisconsin in Green Bay for undergrad and studied Biochemistry. I work as a biochemist for a pharmaceutical company and I oversee our injectables product development laboratory in Middleton and travel quite a bit to oversee other projects. I am married and we are expecting our first child in May.

How did you become interested in astronomy?

It started as an incidental interest; I was suffering from some insomnia and I started to look at the night sky when I couldn't sleep. I then wanted to take a picture of it and became interested in astrophotography and I've been seriously pursuing it for about 9 months.

How long have you been a member of MAS?

I joined right away and have been a member for about a year.

What is your favorite astronomical object or phenomenon?

I am interested in some of the diffuse supernova remnants. I think there's some really good opportunities to photograph some of these for the first time. As practice, I have been trying to get an image of one of the more recently discovered faint objects, which is the Oxygen III (OIII) emission nebula between Andromeda and the Milky Way. This was discovered a couple years ago by amateur astronomers in France. It shows you that there are still opportunity for amateurs to discover new things where professional grade telescopes have less utility than what we use as amateurs. I am excited to hopefully find something new someday, and in the meantime, observe some things that are known but have not been well photographed.

What equipment do you currently use for observations?

I use an Askar V on a Skywatcher EQM-35 mount with a ZWO EAF focuser and three cameras: a ZWO ASI2600MM Duo, a ZWO ASI533 MC-P, and a ZWO ASI120MM Mini for guiding with an Askar 32 at f/4. I have a ZWO EFW-7x2 filter wheel and use 2 inch Optolong filters: LRGB, SHO, and an L-Quad Enhance. I process with Photoshop, PixInsight, and DeepSkyStacker.

Do you have a favorite telescope or piece of equipment you like to use? What do you enjoy most about it?

I really enjoy the Askar V telescope system because of the modularity of the different options and flexibility it offers.

Have you had any memorable observing experiences or "wow" moments when stargazing?

The biggest WOW movement I've experienced in the last year was the eclipse. I went down to Cleveland with a friend of mine via Amtrak. It was a one-of-

The Heart Nebula. Photo by Zachary Holcomb

a-kind experience, and I'd recommend anyone who has to travel for it to do so in their life.

What was the most challenging or rewarding observation you've done?

The most rewarding observation I've done so far is the Heart nebula. I did a dual narrowband image of that, hydrogen alpha and OIII and I think that image came out spectacular. Most challenging has been trying to get this OIII emission nebula from Andromeda. I was doing 5-minute guided exposures and that was too short to capture how faint an object this is. I needed to go up to 10-minute exposures, so I collected 60 hours of 5-minute data on narrowband and I was seeing nothing. I then collected 40 to 50 hours, 10-minute exposures and I was starting to see what I wanted to see but I need to keep going to get the resolution I need on this faint object.

Are there any specific projects or goals you have in the world of astronomy that you're currently working on or that you would like to achieve?

I want to finish that Andromeda emission this summer. I want to discover something new and other than that, just have fun.

Outside of astronomy, what are your interests?

I recently started playing racquetball.

Do you have any advice for new members of MAS?

Dive in and ask questions. Everyone is really friendly. You never know where it will take you so keep an open mind and have fun with it.

Dark Adaptation in a World of Increasing Light

Input from three MAS members: John Rummel, Alex Samuel, and Frank Ranallo

Introduction

By John Rummel

Amateur astronomers have long struggled with issues of stray light and dark adaptation while observing. The situation has become immensely more challenging as our use of screens has increased. These days, everyone seems to have a laptop, phone, or tablet with them as they set up the scope or cameras (not to mention the LEDs on the back of your cameras). Even after you've spent time and effort getting yourself to an ideal observing location away from light pollution, the fight is far from over.

Dark adaptation takes time, and after you've carefully invested 30 minutes in letting your eyes adjust to the dark, a quick glance (even inadvertently) at a phone screen can set you back most or all of the way.

Keep your screens dimmed, converted to red-light in your settings, and covered with additional layers of red cellophane (widely available online) to dim them even more. Once your eyes are dark-adapted, it's amazing how little illumination you need to see your screens, or your surroundings.

To balance out this *Capitol Skies* feature, Frank offers some background on scotopic vision (dark adaptation) and Alex has an excellent review of a great red-light option!

Dim-watted: A Review of the Ken Fiscus Red Light

By Alex Samuel

People generally want to be considered bright and radiant rather than dim. The exception to this is when you are at a star party where darkness rules. I am sure we have all experienced that momentary and frustrating blindness when flashed by a bright light at a dark site after becoming fully dark adapted.

Please don't blame the *amateur* amateur astronomer too harshly. Let he who is without sin, cast the first counterweight. Too often newbies are tricked into making the wrong purchase by the mass manufacturers of cheap headlamps who market and promote the wrong features, especially for astronomical use, such as more colors ("Emits White! AND Red! AND Green! AND Yellow!") or more power ("Do you want to blast a supernova out of your forehead?! Get your millions of lumens right here!").

The Ken Fiscus Red Light stands in stark contrast to these options. For one, it is handmade in small batches by Ken Fiscus, a science teacher in Albert Lea, MN. Additionally, it ONLY emits red light and it is proudly one of the dimmest red lights you can purchase on the market. It is adjustable in brightness but is dimmer than nearly all other red lights at its maximum. The top half of the tiny bulb is shielded so that all of the light is emitted downwards and it runs on a pair of AA batteries that can be replaced.

It is not as convenient as a headlamp since it needs to rest on a flat surface but when you need to maintain as much dark adaptation as possible while using a red light, few other options are superior. Applications for which it is perfectly suited include reading paper star charts or sketching stellar objects. To order, simply message Ken on CloudyNights (username: kfiscus) and ask him if he has any for sale. Payment can be made by check or PayPal, price including shipping to Madison was $34.

Top, side, and front views of the Fiscus light. Dimensions: 82 mm X 52 mm X 36 mm; Weight: ~100 grams. Photos by Alex Samuel.

How do you see in the dark?

By Frank Ranallo

First, some important facts: The photo receptor cells in the retina of your eye are of 2 types: cones and rods. The cones require higher levels of light to function, they can see color (3 types of cones – red, green, and blue sensitive), and they can discern fine detail. The rods are sensitive to much lower light levels, cannot detect color, and cannot discern fine detail. The cones reside principally in the center of your visual field. The rods reside over the entire visual field but are mostly crowded out by the cones in your central vision. Bright light bleaches the light sensitive pigments in the cones and the rods; dark adaptation involves a regeneration of these pigments in the absence of light.

When you are in a bright environment your cones are used for your central sharp color vision and the rods for your more peripheral vision. This is called **Photopic Vision**.

If you then enter a dark environment, you initially are rather blind. Think of going from outside into a darkened room or from normal inside lighting to outside at night. After a while in the dark, your ability to see improves substantially. Initially your pupils dilate and then the cones dark adapt over about 5 to 8 minutes. At that point you can see a bit better in the dark. With the dark-adapted cones, you still can perceive color and fine detail in your central vision. This is the way we normally see at night and is called **Mesopic Vision.**

When we look directly at the stars at night, they appear sharp and we can see their colors because we are seeing them with the dark-adapted cones in our central vision. This is also how we are reading our star charts.

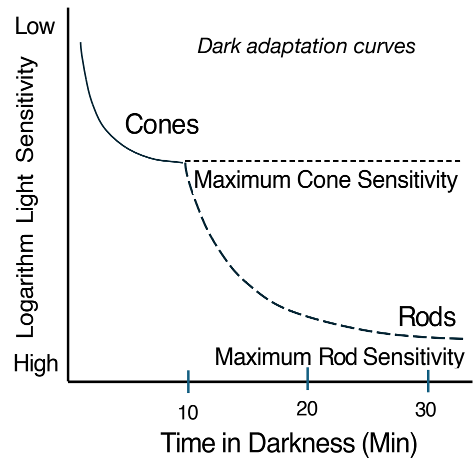
If we remain in a very dark environment, the rods can dark-adapt to detect much lower light levels than the cones. The rods contain a pigment called rhodopsin or visual purple that reacts to light from green to violet but is destroyed by even low levels of such light. In the absence of light, the rhodopsin in the rods regenerates over a period of about 30 minutes. After that period in the dark you are fully dark-adapted. This is called **Scotopic Vision**.

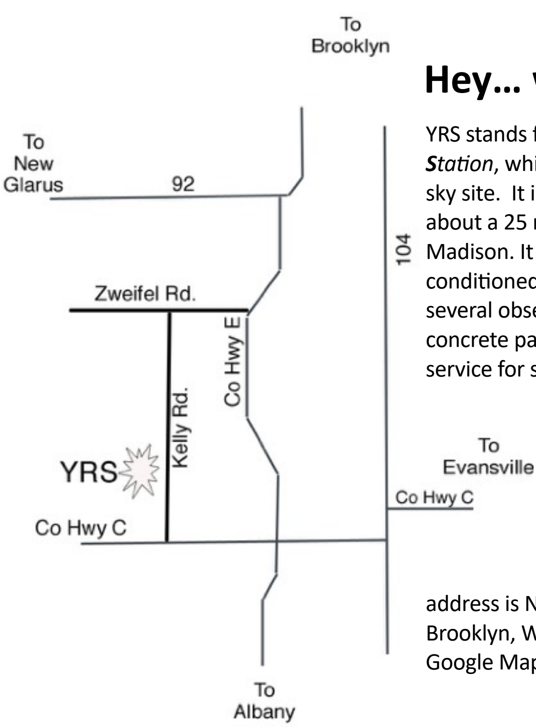
But to remain fully dark-adapted you must not look at any significant level of light from green to violet because this would degrade the rhodopsin. Luckily, rhodopsin is not sensitive to red light. So, to remain dark-adapted you can use red light that is bright enough to read using the dark-adapted cones, but not so bright as to significantly degrade the rhodopsin in the rods. We could also include low levels of green light providing some color perception. It is all a balance of having some sharp color vision while keeping the rods reasonably dark-adapted. As star gazers we are thus making use of both Mesopic and Scotopic vision. There is even a suggestion that to best accomplish this compromise it might be better to use an orange light rather than a red light to view star charts and to work with our equipment.

Some other interesting facts.

(1) Since there are not many of the low-light sensitive rods in your central vision, to detect the faintest stars you can use "averted" vision: do not look directly at the star, but a bit off to the side. With a greater density of rods away from your central vision, you can then detect fainter objects.

(2) If you have been "hunting" the aurora borealis, you might be disappointed that visually they have little color. But if you view them using a camera, even a cell phone camera, you may then see much brighter colors. There is no magic in this. The light sensors in a camera are always sensitive to color; but with your naked eyes you are mostly seeing the aurora using your color-blind rods. If the aurora become very bright, you can see them with your dark-adapted cones and then the colors are apparent.





Hey… what's YRS?

YRS stands for ***Y**anna **R**esearch **S**tation*, which is our Society's dark sky site. It is in Green County, about a 25 minute drive south of Madison. It has a heated and air conditioned clubhouse, a pit-toilet, several observatories, and plenty of concrete pads with electrical service for setting up equipment. There is no water available on site. It is for MAS members and their guests, and it is where we hold our star parties and other events. The address is N7847 Kelly Rd, Brooklyn, WI 53521 Click here for Google Maps directions.

Your MAS Leadership

Board of Directors

Laurence Mohr, *President* (dyremohr@charter.net)
Kevin Santulis, *Vice President* (ksantulis@gmail.com)
Jurgen Patau, *Treasurer* (jrpatau@wisc.edu)
Dan Hyslop, *Secretary* (dbhyslop@gmail.com)
David Leiphart, *YRS Director* (daveleiphart@gmail.com)
Jack Fitzmier, *At-Large Director* (jfitzmier@gmail.com)
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Non-Board Positions

John Rummel, *Program Coordinator* (darksky2500@gmail.com)
Chris Zeltner, *YRS Grounds Manager* (czeltner356@gmail.com)
Jack Fitzmier, *Astronomical League Liaison* (jfitzmier@gmail.com)

The Madison Astronomical Society was founded in 1935 as a "lay group with the common desire to know more about the mystery of the universe."

No special preparation is needed to join the ranks of the MAS. The only requirement is a genuine interest in any phase of astronomical observation or study. Our members are amateurs with skill levels from novice to experienced observers.

Madison Astronomical Society members are active in sharing the pleasures of astronomy with the public, acting as a resource for students and teachers, and exchanging information at Society meetings which occur monthly. The Society continues to pursue its original goal to "promote the science of astronomy and to educate the public in the wonders of the universe." For more information about the Society, please contact one of the officers or visit us on the web at madisonastro.org.

April 11, 2025 Meeting

About Terry Genske: I am member of the Madison Astronomical Society (MAS) and more recently, the Astronomical League through MAS. My wife and I live in a condo on the north side of Waunakee, WI. I have always loved looking up at the night sky, but only recently entered the world of astrophotography. I quickly became hooked on the thrill of capturing beautiful night-sky images from our suburban driveway.

Terry's description: Have you ever wondered what lies beyond the visible night sky? I want to take you on a tour of some of the more distant and enigmatic objects in the known universe including quasars, blazars, black holes, and other extreme objects. I will also discuss the equipment, process and challenges involved while attempting to image each of these objects.

Upcoming Meeting Presentations

MAS member **Daniel Bush** on "Old glass, new tricks"
—May 9, 2025

Juliette Becker, UW professor of astronomy, will talk about possible planets in our own solar system beyond the 8 we know
—June 13, 2025

Hannah Zanowski, UW professor of Atmospheric and Ocean Sciences, will give a talk on exo-oceans
— July 11, 2025

MAS Frequently Asked Questions

Where does MAS meet? We meet at UW Space Place, located in the Villager Mall (right behind the Goodman Library), a block north of the Beltline Highway at 2300 S. Park St., Madison.. Space Place is located downstairs on the lower level of the Atrium. Elevators are located on the left side of the lobby. Space Place has a classroom setting for our meetings as well as a museum that highlights the UW's role in space science and astronomy.

UW Space Place

Click for Space Place's website.

When does MAS meet? Our regularly scheduled meetings are on the 2nd Friday of each month. In addition, we schedule occasional star parties, outreach events, and special presentations that are open to the public.

What happens at MAS meetings? MAS meetings follow a pretty predictable routine. Most meetings start with a 'newcomers orientation' at 6:45, a social time for meet and greet from 7-7:15, announcements and welcome visitors at 7:15, and the main presentation at 7:30.

What are the presentations like? Our presentations are of two main types: talks by our own members about the stuff we do (observing, photography, gear, etc.) and presentations by astronomers and other professionals about their research.

Do I need any special knowledge to be a member? Not at all. Our members are men and women of all ages, from all walks of life, with education levels from "barely made it through high school algebra" to advanced degrees. All you need is a curiosity about the universe and a desire to learn.

What is MAS's address? You can find us on the web at **https://madisonastro.org/**. Mailing address is PO Box 5585, Madison, WI 53705.

2025 Star Parties!

March 29	July 26
April 26	August 23
May 24	September 20 & Picnic!
June 21	October 18

MAS star parties are weather dependent. In advance of a star party, keep an eye on the MAS Observers email list. Based on weather conditions, we will post a "Go" or "No Go" decision to the list on the afternoon of the date in question.