Equinox Issue, September 2026

Capitol Skies

The Newsletter of the
Madison Astronomical Society

Image of the Very Large Array by John Rummel

President's Report to Members

By Kevin Santulis

MAS reached new records in membership! As of our annual picnic our membership is 163.

Based on feedback from members attending our monthly meetings, our new venue at Vel Phillips Memorial High School has been a success and we are also noticing attendance at record levels. Theater 300 gives us opportunities to produce more dynamic presentations than ever before. We continue to work out better sound and lighting for both the in person and on line audiences. The very fact I can make a statement that sounds like this is a professional production is a testament to the work already done by our unofficial AV crew including Terry Warnke, Jeff Bell, and Dave Leiphart working with our School district hosts Ben Senson and Annie Wilcox Panzer. I would be remiss in not extending a thank you to John Rummel for another season of excellent and engaging speakers at our meetings. Now that school is back in session, we had our first student attend our September meeting and enjoyed it so much we had two students come to our picnic. That reinforces our objective in our partnership the school district.

Dave Leiphart and Martin Mika did a great job of organizing the MAS picnic on September 12th. The camaraderie was as good as the food, which was fantastic. We held a swap meet at the picnic and a few items changed hands. I estimate at least 40 people were in attendance.

Thanks also to Rick Wayne and many volunteers on our Outreach Committee. We have greatly expanded our community engagement in creative ways in the last year. We actually have scheduled two outings at Devil's Lake State Park due to the success of the first. We have scheduled our second annual star party at Anderson Park in Oregon, another engagement at Korth Park in Lake Mills, a second antique train trip at the Mid-Continent Railway Museum in North Freedom, and have improvements planned for our largest event at Monona Terrace among many smaller events.

Our Donald Park event had to be cancelled due to cloud cover. Our partners at the Friends of Donald Park expressed their disappointment but understood. They told us how much their patrons look forward to this event coinciding with the Perseid

meteor shower each year. In an attempt to have greater success in the future, MAS suggested the Friends plan for a back up date on Sunday following the regular scheduled event on Saturday. This way they can make sure permits and required county staff are scheduled to give us the flexibility to have a back-up plan in case of bad Saturday weather. The Friends agreed that this will double our chance to beat the weather after being victims to cloud cover two years in a row.

In addition to serving as our Astronomical League ALCor, Jack Fitzmier conceived and executed an amazingly successful experiment in crowdsourcing many members electronic imaging equipment on a single zone of galaxies. You can read

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President, continued from previous page.

much more about the project in this issue (see page 9) and on our website under the heading "First MAS Seestar Collaboration." I am struck by this as an example of what MAS members are able to accomplish as a team. Participants are already working on a second target.

We appreciate the level of commitment and innovation we are seeing from our membership and expect the value of MAS to our members, partners and the community to only get better.

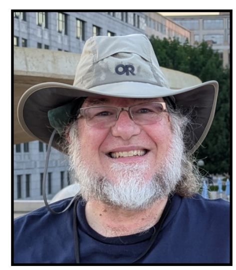
In that vein, I would ask everyone to seriously consider contributing your time and scopes to our largest and most logistically challenging event of the year, Moon Over Monona Terrace, which will take place on Friday, October 16. This event brought in almost 1,300 members of the public last year and is undoubtedly the one event that puts a spotlight on MAS. Please don't underestimate the value you might bring to this event. Rick Wayne is working to fill in his signup sheet for volunteer positions. If you want to volunteer, enter your information at this Google link.

It is also the most rewarding event in my estimation. Hope to see you there!

A Note From the Editor

By Jack Fitzmier

This issue of *Capitol Skies* marks the second full year of our Society's revised newsletter. Like MAS itself, *Capitol Skies* is stable and growing. I think this issue is proof of that! It contains our "regular" columns – Kevin's President's Report, Alex's Member Profile, Dave's YRS Update, and Rick's Outreach Report. It also contains reports on member activities like eclipse watching and our annual picnic. And this quarter, we feature four articles inspired by our Society's first collaborative observing effort, the results of which can be seen on our website. These four articles are introduced as a whole, and appear together beginning on page 9. Enjoy!



Outreach Update Fall 2026

By Rick Wayne

OK, wow. We had several good events planned for the summer, including a big family reunion that hired us, a reprise of the very successful Devils Lake event, and our time-honored Donald Park party.

Every one got weathered out. 0 for 3. Criminy!

But hey, we've seen *GalaxyQuest.* Never give up! Coming very soon is another repeat, the **Korth Park** public star party in Lake Mills. That's scheduled for **Wednesday, September 30th** with a rain date (yes, we *can* be taught!) of the next night, Oct. 1. Sunset is at 18:38, so plan to arrive to set up a bit before then.

Then we've got another perennial favorite, at the **Anderson Dog Park** south of Oregon quite near to YRS. That one is **Tuesday, October 6**. Great chance to practice for (DRUM ROLL)…

Moon Over Monona Terrace is **Friday, October 16** (rain date 10/23). If you're new to the club, this is The Big One, folks. Literally—last year we served over 1,300 attendees. There are a ton of kids and a lot of folks new to astronomy, and watching the fire kindle when they look at Saturn for the first time…I got no words. We could really use a few more visual scopes, so if you'd like to share your love for the sky, grab your scope and come on out. Do, however, register in advance first. We need to make a plan so that our guests can get in line confident that they'll see what they were promised, and we need a complete list of available people and equipment to do that. Don't have a scope? You can still help! There are plenty of non-observing roles that will make the experience better for everyone. Our website for the event is here: We will have more detailed guidance soon.

The last event we currently have planned is in **Sun Prairie on Thursday, October 22**. Details for that will be coming; watch the MAS_Outreach Google Group for more information. If you're not on that list, send a message to the club's email and put "outreach" in the subject.

We'll see you out there!

MAS Member Spotlight: Bob Aloisi

By Alex Samuel

Bob, tell us a little about yourself.

Since I was about 8, I have lived in Wisconsin. I lived in Eau Claire and met my wife Beth there. I finished a Chemical Engineering degree at the University of Wisconsin in Madison and worked in the paper industry for 30 years, first for Georgia Pacific and then for Rockline Industries in Sheboygan.

I was 53 and looking for some changes. So I thought hard for a long time about what I wanted to do, and I came up with going back to school for an astronomy degree. So I went to UW Milwaukee for two years and got a second major in Physics and a minor in Mathematics. I then applied to programs around the Midwest including Iowa State and UW-Madison.

I think if I'd had known the odds, I probably wouldn't have done it. This year, I think there were 3 students admitted to the Astronomy program at UW-Madison out of 350 applicants. Three people had to turn down the slot at UW-Madison before it became open for me. It was literally the last possible day I got my dream position. I started my PhD degree the first year of COVID and I graduated in July of this year.

What was your research about?

My thesis was on finding an exoplanet that was born outside the Milky Way.

When did you get interested in astronomy?

I was in my 40s or 50s when I got interested in astronomy. I joined the Sheboygan Astronomical Society and bought a 10-inch dob. And then I started doing outreach and found that I really liked doing stargazing parties and things like that.

What equipment do you use?

I own a Seestar S50 Pro and I recently purchased a 16" Pegasus RC and a 17" PlaneWave CDK telescope that are currently hosted in New Mexico. My goal with this remote observatory is something that I've done previously--providing students the opportunity to learn to observe because so many of them, even the graduate students, have never had an opportunity to plan their own observations. Additionally, beginning in October, MAS members can contact me if they want to rent imaging time on these telescopes.

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

I spent 8 nights observing at the Telescopio Nazionale Galileo (TNG) on the island of La Palma in the Canary Islands, Spain. There's a spectrograph called HARPS-N there that looks for exoplanets.

Are there any specific projects in the world of astronomy that you're currently working on?

I am currently building an observatory with a 12.5-foot Astrohaven Enterprises clamshell dome at my lake house on Lake Poygan. Additionally, I have two grants from the TESS space mission and I'm looking for planets around white dwarf stars. My advisor found the first planet around a white dwarf star and we did a research project where we examined 40,000 white dwarf stars looking for periodic transit signals. The exciting thing about white dwarfs is that they are only the size of the earth, so anything transiting in front of them blocks all of the light. If you're doing an observation, your star disappears for 15 minutes because it blocks all of the light and then comes back again.

Outside of astronomy, what are your interests?

I hunt and fish. Fly fishing in Montana is something I do every year.

How long have you been a member of MAS?

I've been a member since the beginning of 2026.

Do you have any advice for new members of MAS?

Go to star parties, you'll get hooked.

Bob with his newly purchased 17" Planewave CDK17 on a Software Bisque mount at Howling Coyote Remote Observatory in Pie Town, New Mexico. Either this scope or his 16" Pegasus 4000RC will eventually land in his home observatory here in Wisconsin.

YRS Notes: The Clubhouse Gets a Makeover

By Dave Leiphart, Observatory Director

Martin Mika and I hosted the MAS picnic this year and this seemed like a good time to update the clubhouse. For most members attending the picnic, this was the first look at the changes.

The clubhouse was a mess and had needed re-organization for many years. This was a priority project but had been competing with several other priority projects. Recent equipment donations and the need to organize equipment to support club activities pushed this issue forward. Several amusing comments were made about the changes, a common one being "Wow, the clubhouse has a floor!"

The layout of the clubhouse has completely changed.

- Several shelving units and two desks were purchased by MAS for the updates.
- Martin purchased and donated the wood shelving units now against the front south wall.
- The front part of the clubhouse has two work desks and a designated seating area with the couch and loveseat.
- The new desks are by the entrance running along the southeast wall.
- The previously inaccessible bookcase has been moved to the end of the desks along the east wall.
- The refrigerator and microwave are now against the west wall right beside the couch.
- The northwest corner has four rolling wire shelving units that hold lots of equipment.
- The northeast corner is now the "telescope corral" for dobs, SCTs, and other standing telescopes.

Several pieces of furniture were removed. This furniture took up lots of floor space but provided little storage or functionality. The large table was disassembled as soon as the new shelving was available. The table parts are available if anyone wants the table for their home :-) Other pieces of furniture have been disassembled or placed in storage. I will be photographing this furniture and some other things the club no longer needs and make them available to members for free. Any remaining furniture will be donated to charitable organizations.

Several people helped with this effort. I rearranged the clubhouse, assembled the desks, and disassembled unneeded furniture. Martin assembled the donated wood shelving located at the front corner of the clubhouse. Martin also brought three nice desk chairs from his workplace when they were remodeling the office. Alex Samuel helped assemble the new wire shelving. Jeff Western and Kardell Owen replaced the screen in the front storm door, cleaned and organized the bookcase, and helped straighten up the front area.

Martin and I took an initial pass at going through all the equipment. Eyepieces and small accessories have been consolidated and moved up front. Other small equipment like the Seestars and binoculars has also been moved to the front shelving.

The new desks are a particularly useful addition to the clubhouse. Members can set up laptops on the desks and wirelessly connect to their equipment outside. The desk area will also be used for equipment maintenance and repair. A wireless network is being installed at YRS that will offer additional options for laptop users.

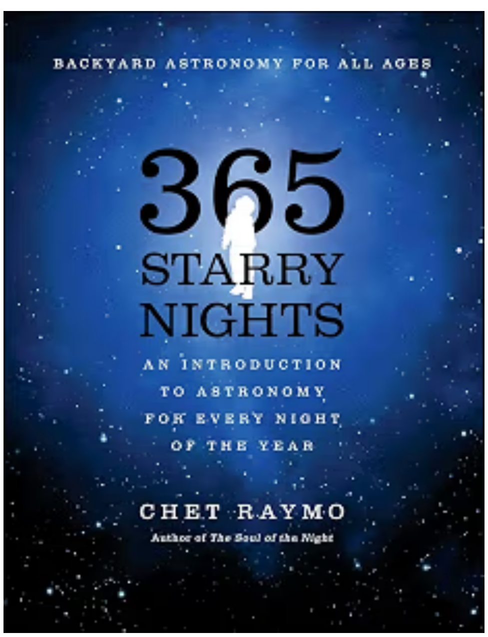
Much more needs to be done but this gets us a good way there. There is more furniture and clutter to be removed and this will free up additional space. Martin and I will go through all the equipment and work with other members to organize and repair it. Additional projects are underway and will be announced later.

Stay tuned.

Book Reviews: *365 Starry Nights* and *A Walk Through the Heavens*

Reviewed by Craig Jewell

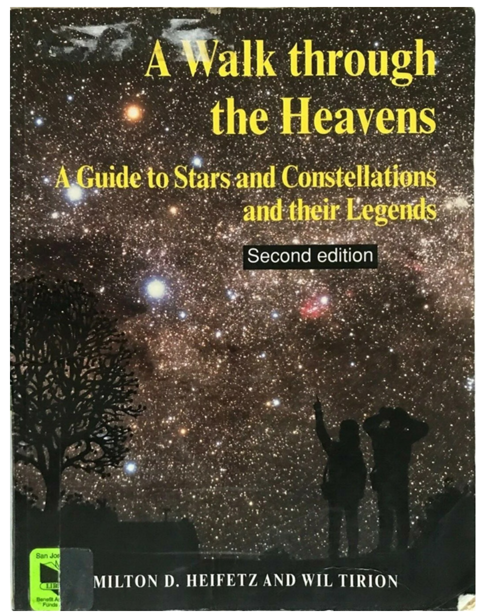
There are many books available to learn about the night sky. *Nightwatch* and *Turn Left at Orion* are perhaps the most well-known, and *The Stars* by H.A. Rey gets an honorable third place. I have all three of these books on my shelf and all three are very helpful resources. I'd like to highlight two lesser-known books that I found very accessible and quickly got me learning my way around the constellations. Both of these books excel at introducing the reader to the constellations and, to a lesser extent, the major stars in those constellations, with the goal of getting an overview of the night sky quickly. They work well together and have somewhat similar approaches to the seasonal changes of our night sky. They are *365 Starry Nights* by Chet Raymo and *A Walk Through the Heavens* by Milton D Heifetz and Wil Tirion.



365 Starry Nights, by Chet Raymo. Touchstone Books, 1990.

365 Starry Nights takes a new approach by covering one topic for each day of the year. Each page highlights two days, with a drawing and a few paragraphs. Starting on January 1 with Orion, Raymo steps through something we can find in the sky that night and introduces the myths behind the constellations with drawings and a few paragraphs for each day. The content builds on what came before, introducing more detail about that day's constellation and neighboring constellations, along with methods for finding and remembering them. Each day is a quick read that keeps the topic short and light, while enhancing the previous day's theme. This approach allows the author to cover information that might otherwise be missed and allows him to go on topical tangents that might not be covered elsewhere. He also keeps in mind that earlier information may be passed over if you start reading the book on September 21 rather than January 1. If a topic has been covered elsewhere, he tells you that date for reference. If he introduces a new term, it's in a bold font, and it's covered in more detail in the glossary at the back of the book. These may sound like textbook techniques, but Raymo adds a personal touch and keeps the information accessible enough that I find myself coming back to this book over and over. Chet Raymo is the author of 15 books, and this book is his first. If it interests you at all, I'd highly recommend picking up some of his other books, such as *The Soul of the Night*, or perhaps *An Intimate Look at the Night Sky*.

A Walk Through the Heavens looks at the night sky through the four seasons. After a quick chapter that introduces the idea of measuring visual distances of the night sky objects, it starts with the Big Dipper on a summer night. The next diagram shows how to use the pointer stars to find Polaris, and from there the little dipper and on to Cassiopeia. Since



A Walk Through the Heavens, by Milton Heifetz and Wil Tirion. Cambridge University Press, 2004.

these constellations are easy to find, they make a great starting point to discover other constellations and their brightest stars. Each page introduces neighboring constellations and memorable methods of hopping from and to and from those constellations. Over the next five charts, Lyra, Cygnus, Cepheus and Draco are introduced, and each diagram shows how to use the first three constellations of the Big Dipper, Little Dipper and Cassiopeia to locate

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the neighboring constellations. A few charts later, and we're taking the arc to Arcturus, and are introduced to Bootes, Corona Borealis, Hercules, and back to Lyra and Cygnus.

The charts will step you through the seasons and show how to quickly navigate from constellation to constellation, with enough seasonal overlap to give you a starting point. The text on the accompanying pages is kept to a minimum, with details on how to star hop and clarification on chart details. As a bonus, the authors include a chapter on the legends of the constellations. This is helpful if you enjoy sharing the stories behind the constellations when introducing someone to the night sky.

Both of these books are older and have been in print a long time. They can be found at Amazon, but Abe Books probably has them for a better price, and they're unlikely to be at your local bookstore. Since they're older, planetary charts will be out of date, but they can be found in many other books and apps. The real gem in these books is their approach to navigating the constellations. They're the best approach to learning star hopping that I've found so far.

August Lunar Eclipse at YRS

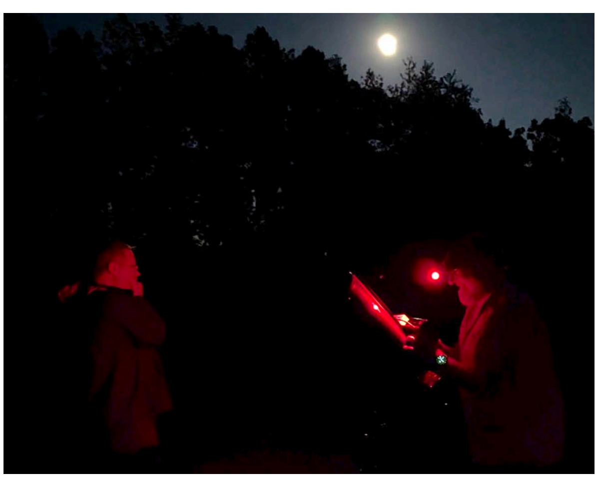
By Alex Samuel and Dave Leiphart

Approximately 15 members of the Madison Astronomical Society and their guests enjoyed watching the lunar eclipse on August 27th. Members brought a variety of telescopes, binoculars, and digital cameras. 85% of the group imaged the eclipse in one way or another. Unlike most nights at YRS, members did not setup on the concrete pads. The eclipsing moon first appeared through the tree branches to the southeast which led members to setup their equipment and chairs on the west side of the property, just south of the clubhouse facing east. Several faint meteors were spotted throughout the night. The event was very casual and involved as much chatting as observing.

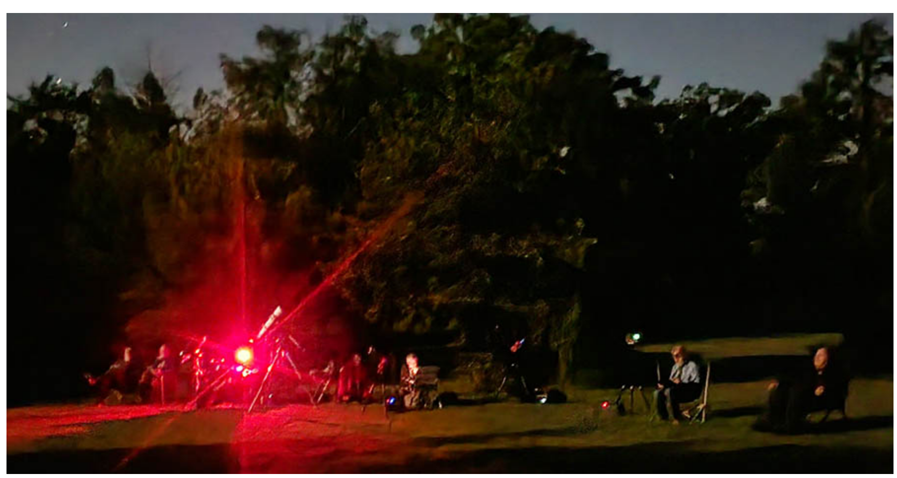
In addition to the members observing the eclipse from the southeast lawn, John Wunderlin set up his 10" Orion SkyQuest dob on a pad by Doc G and Dave Leiphart set up a 16" Starmaster dob on a middle pad. John was trying out his AstroHelm plate-solving setup. After making some adjustments the AstroHelm performed accurately and reliably. John and David shared views of Summer favorites like the Ring Nebula (M57), the Hercules Cluster (M13), the Lagoon Nebula (M8), and the Dumbbell Nebula (M27).

Lunar eclipse photo by Sam Warfel.

At the beginning of the eclipse around 9:30pm visual observing was poor and the moonlight washed out most deep-sky objects. As the lunar eclipse progressed, the sky got quite dark and visual observing was good. The eclipse reached the peak at 11:12pm with coverage around 96%. During this time conditions were close to a new moon with a clear sky.



MAS Members Stanley Howald and Rick Wayne enjoy the moonlight. Photo by Alex Samuel.



Various MAS members observe the lunar eclipse including Bernie Ripp, Wil Cox, Bob Hamers, and Rick Wayne. Photo by Dave Leiphart.

Panel Discussion:

"How has the hobby of amateur astronomy changed over your lifetime of observing?"

Compiled by John Rummel

> Note: The conversation reproduced here was compiled from an email exchange that took place over the spring and summer of 2026, with all participants responding to the question in the title. It was pieced together with minor editorial changes for stylistic consistency.

Eric Thiede: I became seriously interested in astronomy in 1965, at the age of 16. Since Sputnik had been launched only seven years before and the first moon landings were four years in the future, there was a lot of public interest in astronomy. I began to attend MAS meetings in 1966. It was a much smaller group compared to now. Those days were sort of the tail end of amateur telescope making, which included fabricating the optics, not just assembling a scope from purchased parts.

Jeff Shokler: It's a trend a number of folks have noted over the past half-century or more that I also experienced – the major shift from do-it-yourself telescope making to easy access to low-cost, commercially available telescopes, with Celestron, Meade, and eventually Orion leading that charge.

Dick Wieboldt: I grew up in rural Virginia, and I never had a telescope growing up. My only direct observing was while at Nature Camp every summer where Terry Richardson taught astronomy and brought a variety of his scopes. I caught the bug. I did have access to a 35mm camera and tried to take pictures of the night sky, but alas, even the fastest film – Tri-X – couldn't capture anything.

Alex Langoussis: Oh, early imaging was brutal! Think about film with slow ISO, such as Technical Pan film, ASA 25, with reciprocity failure bringing that down to effectively 1. You were guiding one shot by hand while freezing all night, only to have the shot ruined by jet trails. Later, the film was gas-hypered.

John Rummel: "Hand guiding" still makes me shudder. When I got into serious imaging in the late 90s, the state of the art was off-axis guiding – by eye and hand! Off-axis guiders were like a modified star diagonal. Most of the light would pass through to your camera, mounted on the back. In the optical path was a tiny "pick-off" prism that would capture a little bit of the light and redirect it up to a reticle eyepiece. You'd pick a guide star and then sit with your eye glued to the eyepiece and the hand controller in your hand. As your mount tracked, you'd be constantly making tiny corrections in RA and Dec to keep your star on the crosshairs. (We joked that you could calculate the periodic error of anyone's mount by timing the intervals between their outbursts of profanity). Guiding this way made 15 minutes feel like 15 hours! I'm convinced that off-axis guiding persuaded many astrophotographers to quit until the age of digital auto-guiding arrived!

Dick Wieboldt: In March 1968, my grandfather loaned me his fancy Polaroid camera with its amazing, fast ASA 3000 film. I propped this up on some rocks out in a field and aimed it at Orion. I opened the shutter for one minute, 15 seconds. After waiting for the chemical pod to develop and wiping it with the "fixing" swab, I was amazed to actually be able to see stars! OK, they were smeared from camera shake, but I could see the constellation and M42.

Eric Thiede: Equipment really was primitive. There were no GoTo scopes. If you wanted to see something, you had to consult a chart and star-hop your way to it. A few people with well-aligned equatorial mountings could use setting circles. As a result, people knew the sky much better than now. The observer had to spend time out under the actual sky and in the ambient weather to accomplish things. The smell and feel of the night air at times brings back memories of long-past observing sessions.

Alex Langoussis: I agree**.** I still fondly remember using my *Atlas of the Heavens* to locate my targets by star hopping. One felt a real closeness to the night sky. On the hardware side, we went from small refractors on equatorial mounts, then 6-to-8-inch reflectors on very heavy equatorial mounts, then the Celestron revolution and SCTs.

Avtar Roopra: I remember seeing the first examples of relatively affordable, relatively quality telescopes replacing the Argos catalogue varieties with boasts of 1000x magnification from a 40mm objective on tiny tabletop tripods. The availability of a 4.5" or 6" reflector with a real Plössl eyepiece instead of plastic Kellners changed everything. Instead of a blob with a diffuse band across it, I could see Jupiter with 2 cloud belts and a hint of a red spot!

Eric Thiede: When I see the telescope field at a modern picnic compared to what members had in the 1960s, I am amazed. Back then**,** people did look at faint fuzzies – I even have a guide to the Messier objects from that era – but we really had to wait for the era of big

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Dobsonians and nebula filters to get good views.

Alex Langoussis: Indeed, back in the day, observing was mostly lunar and planetary. Only when larger aperture scopes were in use – many being home-made – and Lumicon visual nebula filters became available, did "deep sky" become a thing. Followed by large Dobsonian mount reflectors with cheap optics – light buckets – then premium large GoTo reflectors on Dob mounts, and now, small triplet refractors. I would also add for visual, with the Dobsonian revolution, the development of wide-field and long-eye-relief eyepieces, led by TeleVue, also changed the game.

Eric Thiede: Visual planetary observing was a big thing then, because film was so bad at recording decent planetary images and CCDs did not yet exist. Spacecraft had not gone beyond Mars yet. I did a lot of Jupiter observing, first with a 6-inch reflector and eventually with the Washburn Observatory refractor, timing the transits of atmospheric features across the central meridian of Jupiter to derive rotation periods. It amazes me that with digital imaging now, people with very modest backyard telescopes can obtain images of Jupiter that show details we couldn't hope to perceive visually even on the best nights with a professional refractor.

Alex Langoussis: Then came the digital revolution with electronic cameras, GoTo mounts, and cameras to do the guiding. The development of stacking and computer processing was a huge game-changer, and aperture was no longer king. Now we have small and smart mounts, with the ability to be run remotely. Basically, visual and imaging are both SO much easier today!

Eric Thiede: It changed data collection, too**.** Another thing I did was observe occultations of stars by the moon for the US Naval Observatory. They would send us long, fanfold, computer-printed lists of predictions custom-made for our location that we would time by hand with a stopwatch and WWV radio time signals, hopefully to the nearest 0.1 second. We were sending men to the moon, so they wanted to know exactly where it was. Citizen science was more common, and dare I say more useful, back before computers and satellites took over. It was humans who were the discoverers of comets, supernovas, and variable stars. While today's new discoveries are exciting, it is harder, though still possible, for the amateur to make a difference.

Jeff Shokler: I think Eric's point about citizen science is a fascinating one. It had its heyday in terms of the actual contributions amateurs could and did make to scientific discovery a couple decades ago, but today the digital medium and automation for imaging has led to new versions of and paths to citizen science with exoplanet transit observations, lunar and planetary impact monitoring, etc.

Every technological innovation in our hobby that lowers the cost (technical and financial) of bringing the sky to people has only increased our ranks.
- Avtar Roopra

Avtar Roopra: Most major changes were accompanied by cries of how the change will be the end of amateur astronomy. Yet, the hobby not only has survived but has grown immensely in its reach – both in terms of the number of people who are touched by the hobby as well as the literal reach into deep space that we can see from our own backyards with our own equipment.

Jeff Shokler: The advent of powered equatorial mounts, GoTo mounts, the seismic shift from film to digital astrophotography, and today the rapid rise of affordable, push-button smart telescopes like the Seestar, have all served to make the hobby more accessible to more people. It has reduced the cost barrier for entry, arguably softened the learning curves, and changed the fundamental experiences of entering the hobby.

Avtar Roopra: Every technological innovation in our hobby that lowers the cost (technical and financial) of bringing the sky to people has only increased our ranks.

Jeff Shokler: I remember hearing the old codgers in the Texas Astronomical Society who did film astrophotography complaining about how GoTo mounts and later digital cameras would probably kill the hobby. The same thing is currently being said about the all-in-one smart scope renaissance that is underway right now. Surely these moments have been and are transformative, but the most important part of the hobby remains what the person brings to it – their interests, their curiosities, their skills, their desire for learning. If a person understands those things, no matter the era you stepped into the hobby, then you're going to have a fun time.

Avtar Roopra: It's astounding that we now we have complete GoTo imaging systems run on tablets and mobile phones. I personally have recommended Seestars to no less than 7 people who have had only a passing interest in the hobby. Now they are card-carrying amateur astronomers! For the cost of an expensive family night out at a fancy restaurant, they now enjoy deep sky images they could only have dreamt of a few years ago. These 7 people now regularly send me images and these devices are enjoyed by them as well as their friends and family.

Dick Wieboldt: Fast forward nearly six decades to a spring night in 2026. I joined friends out for some stargazing. I brought my camera, some binoculars, and a pair of constellation glasses. As night came on, our old friend Orion became visible. This time, I was able to capture it not as a single frame, but as a timelapse. As you all have said, the advances in technology are truly amazing. Yet the one constant is spending time under the night sky – just looking, listening, and soaking up the night. It's something you can treasure for a lifetime.

The First MAS Seestar Collaborative, Introduction

A Special Article Series

by Jack Fitzmier

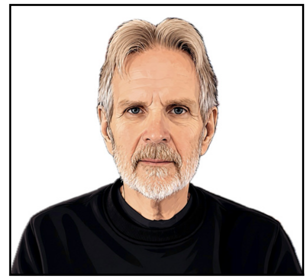
Last month we completed our Society's first collaborative observing effort. The project required us to give attention to several procedures and research tools, four of which get attention here. We required participants to run their Seestars in *equatorial mode*, which Wil Cox addresses below. John Rummel did our *post processing* (of some 21,000 exposures!) and he reports on that effort. I spent a lot of time using *plate solving tools*, which I discuss. And Bob Hamers did some terrific *post-project data analysis* that will be of interest to all Seestar users. Our series of articles starts on the next page. Enjoy!

A portion of the final image. NGC 6166 is the bright galaxy in the lower right. Other cluster galaxies are scattered throughout.

The First MAS Seestar Collaborative, Part 1

Polar Alignment: Taking Your Smart Telescope to the Next Level

By Wil Cox



If, like me, you own a Seestar, Dwarf, or similar smart telescope, you've probably discovered how remarkably easy it is to photograph the night sky. Point the telescope at a target, let it find the object, and your scope's computer takes care of tracking and stacking your images.

But have you ever noticed something strange happening around the edges or corners after a several hour acquisition? The target may look fine in the center, while the edges appear to rotate, producing gaps or distorted areas when the images are stacked.

What Is Polar Alignment?

Relative to the Sun, the Earth rotates once every 24 hours. Relative to the stars, the Earth rotates once every 23 hours, 56 minutes, 4 seconds. (To learn why these times are different, watch this video.)   As it rotates, the stars appear to move across the sky.

An equatorial mount, often referred to as a wedge, is designed to compensate for this movement by rotating around an axis aligned with Earth's rotational axis. Aligning that axis with Earth's axis is called polar alignment.

In the Northern Hemisphere, the mount is aligned toward the North Celestial Pole, which is located very close to Polaris, the North Star.

Your Seestar or Dwarf normally operates as an alt-azimuth (alt-az) telescope, moving up/down and left/right. But when mounted on an appropriate equatorial wedge or mount, it can track the sky using an equatorial orientation.

That's where polar alignment becomes important.

Two examples of field rotation in Seestar images without polar alignment. Notice the effects around the edges and corners of the image.

What Does It Do?

Polar alignment allows your telescope to follow the apparent motion of the stars more precisely.

With a normal alt-azimuth setup, your smart telescope tracks an object by moving in two directions. As it does so, the orientation of the sky slowly changes relative to the camera. That results in field rotation. Your telescope's software compensates for this by taking relatively short exposures and digitally aligning and stacking them.

When the telescope is mounted equatorially and properly polar aligned, its tracking axis follows Earth's rotation. The stars—and the entire image—remain in essentially the same orientation relative to the camera. That means you can use longer individual exposures while minimizing field rotation.

Why Do I Need It?

You don't need polar alignment to enjoy your Seestar or Dwarf. That's part of the beauty of these telescopes. But if you want to experiment with longer exposures, fainter targets, or more detailed images, polar alignment is worth trying.

The potential benefits include:

- Longer usable exposures
- Reduced field rotation
- Less image cropping
- Better tracking for extended imaging sessions
- Greater flexibility with faint deep-sky objects

Most importantly, you're learning a technique that forms the foundation of traditional deep-sky astrophotography.

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How Do I Do It?
Modern technology makes polar alignment much easier than it once was. You don't necessarily need to find Polaris or use a traditional polar scope. Camera-based systems can use plate solving to determine where the telescope is pointing relative to the celestial pole.

The basic process is:

1. **Set up your tripod and equatorial mount.** Make sure everything is stable.
2. **Set the mount's latitude.** Adjust its altitude to approximately match your observing location (approximately 43 degrees here in Madison).
3. **Point the mount generally north.** You don't have to be exact.
4. **Run the polar-alignment routine.** When dark enough, the software takes images of the sky and determines your alignment error.
5. **Adjust the mount—not the telescope.** Use the mount's altitude and azimuth controls until the alignment is sufficiently accurate.
6. **Start tracking and imaging.**

Once you've done it a few times, the process can take only a few minutes.

See It Done
For a practical, visual demonstration, take a look at this tutorial from Space Koala:

[Space Koala Polar Alignment Tutorial]

Seeing the procedure performed can make the process much less intimidating than simply reading about it. This alignment procedure can quickly become second nature, especially after seeing the improvements in your images.

Give It a Try
Polar alignment isn't something you have to do with your Seestar or Dwarf. That's one of the advantages of a smart telescope.

But if you've encountered the kind of rotated edges shown in the examples above, or you're ready to experiment with longer exposures, an equatorial setup and polar alignment can open a new level of astrophotography and expand your view into deeper skies.

Polar alignment isn't about making astronomy more complicated. It's about giving your smart telescope another tool to help you capture the universe.

Wil's equatorial mount with Seestar S50 Pro.

The First MAS Seestar Collaborative, Part 2

Processing the Data

By John Rummel

When Jack cooked up this collaborative project last spring, I was still relatively new to PixInsight but not new to astrophotography and image processing. I had been using PixInsight for only about 8 months, and primarily processing Seestar imagery. So I happily signed on to the project as the chief image processor. But I have to acknowledge the immense help of a number of other MAS members along the way, especially Bob Hamers.

Challenges unique to this project included:

1. Massive number of subframes:

Our 12 contributors shot nearly 21,000 20-second frames. Stacking such a large number of frames is challenging regardless of the software.

How we did it: PixInsight's Weighted Batch Pre-Processing (WBPP) script handles most of the steps involved in aligning and stacking individual frames. Image calibration is simplified with Seestar results compared to traditional astrophotography setups. Dark frame subtraction is done automatically as the camera acquires its images, and its small sensor and sealed optical design eliminate the vignetting and dust spots that flat frames usually correct.

WBPP automates bad pixel rejection (removing airplane or satellite trails, hot pixels, etc.), assigns weights based on quality, and efficiently aligns and stacks all frames. It helps PixInsight choose the best frames for stacking and minimizes flaws in bad frames. Since the Seestar automatically dithers, WBPP can "drizzle" to interpolate and up-sample images, potentially adding resolution and assisting with step 2.

WBPP is powerful, but it can't process 21,000 Seestar subframes in a single batch. Its processing capacity depends on the computer's RAM, disk space, and processor cores. On my Macintosh M4 Mini, I efficiently processed about 2,000 subframes at a time without risking system overload. Breaking down the subframes into batches meant running WBPP 10 times, resulting in 10

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stacked image files, each containing an integrated stack of those ~2,000 subframes.

2. Combining subframes from the S50 and S30 Pro:

Our 12 contributors shot with both the Seestar S50 and S30 Pro telescopes. These telescopes have different focal lengths, apertures, and sensor sizes, which initially worried us about integrating their subframes. However, we easily solved this problem by drizzling the S50 data x2 and the S30Pro data x3. This interpolation increased the pixel dimensions of the stacked images, and nearly equalized their area of overlap.

I created a single stack of the S30 Pro contributions (about 12.5% of the total frames) and 9 stacked images of the combined S50 data (87.5% of the ~21,000 total frames). These 10 stacked image files were star aligned and then combined using PixInsight's PixelMath process, which simplifies the weighted combination of multiple stacks.

3. Mixing shots obtained with the Seestar's LP (light pollution) filter on and off:

A small issue arose with the S30 Pro data. Two contributors shot with the Seestar's LP filter, which blocks most light except Oxygen-III and Hydrogen-alpha. It favors emission nebulae and allows shooting in light-polluted environments. For our target, it wasn't needed, but could we use the LP filter data? In PixInsight, we easily neutralized the color change and were able to combine the filtered and non-filtered frames.

4. Star removal didn't work!

Modern image processing software can easily separate stars from non-stellar features in astrophotos. Since faint nebula or other extended objects often have different processing needs than stars, separating the two opens up powerful image processing and enhancement avenues. For our image of a distant galaxy cluster, star separation seemed an obvious step to boost the detail of the many galaxies. But most of the visible galaxies in our 6166 field of view were small and faint, and Star-Xterminator (my tool of choice) struggled to remove foreground stars without also removing most of the galaxies, even objects that obviously were non-stellar! So we reluctantly gave up on star separation and had to rely on other ways to post-process the image.

Conclusion

Once I created the final stacked composite from the 10 sub-stacks, I processed it normally in PixInsight (gradient correction, color calibration, deconvolution, stretching, etc.) and applied finishing touches in Photoshop (curves correction, additional sharpening, etc.). Image touch-ups are more art than science, and everyone does it differently. We loved the result we obtained and hope you did too!

The entire dataset is available to our members. If you would like to work with the collected data, we'll make sure you get a copy.

The First MAS Seestar Collaborative, Part 3

What's on your plate? Plate Solving: Convenience, Annotation, and Research

By Jack Fitzmier

Unlike many of our MAS colleagues (see the Panel Discussion on page 7) my astronomy adventures began *after* the digital revolution changed the amateur scene. In 2012, go-to scopes and good tracking mounts were common. To get one set up, you had to align it. That meant centering your scope on one, two, or three pre-selected alignment stars, and then reporting that to the brains of the rig, usually a digital hand controller. Finding the alignment stars was easy but centering them was key. I obtained an eyepiece with a lighted reticle that helped, but even then, if you were off by just a bit your go-to and tracking functions degraded. I did countless alignment repeats!

In 2013, Celestron introduced Sky Sense, an accessory that used local plate solving. It was a camera that mounted like a finder scope, which was connected to a special hand controller. Level the mount, point it roughly north, and turn it on. The camera took a

What is an "astrometrically solved" photo?

A "solved photo" is one for which software has identified the exact section of sky shown in the image. Elements of the solution typically contain field of view, orientation of the image with respect to cardinal directions, Right Ascension and Declination data for each image pixel, and image scale – e.g. arcseconds per pixel. A computer can easily map known celestial objects (each of which have RA and Dec identifiers) onto a solved image (each pixel of which has been assigned an RA and Dec identifier.) Resulting coordinate information is often stored in the image as a World Coordinate System (WCS) solution.

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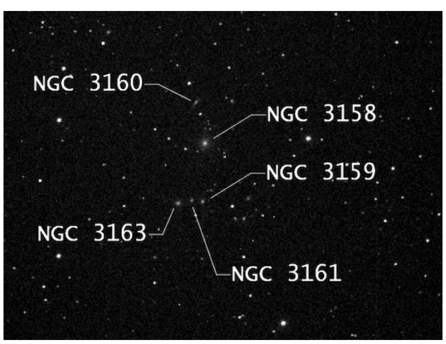
photo, solved the image, and determined where it was pointing. It slewed to other areas of the sky, repeated the process, and created a pointing model. Within minutes, the alignment was complete. Go-tos and tracking were spot on. What a convenience!

Celestron Star Sense camera.

But plate solving had more to offer. During Covid, I pursued a number of Astronomical League Observing Programs using remote scopes in Chile and the Canary Islands. One of the AL programs, Galaxy Groups and Clusters, requires the observer to identify particular galaxies within complex clusters of celestial objects. Sky Safari, helped identify target galaxies, but it felt like guesswork. A different challenge had presented itself: I wanted to know the names of the objects that appeared in my photo.

Enter the online solver, www.astrometry.net. Hosted by the Canadian Advanced Network For Astronomical Research, this service



The NGC 3158 galaxy group.

provides free plate solving. Upload an astro photo and in a few moments, you have its astrometric solution. The site also has an annotation feature that identifies celestial objects and marks them on a copy of the photo. The image above shows my annotations of the NGC 3158 galaxy group, based on solutions provided by astrometry.net.

Our Seestar Collaborative Project aimed a dozen Seestars at NGC 6166, the anchor to the Abell 2199 Galaxy Cluster. In terms of solving and annotation, it posed an even greater challenge. As John stacked thousands of exposures, he kept feeding me updates. With each iteration, more fuzzies became resolved. We knew the field was filled with galaxies, but which of the fuzzies were known galaxies, and which were stars? In particular, I wanted to know which of our fuzzies belonged to the Abell 2199 Cluster. Plate solving to the rescue again, but with more sophisticated software. Enter PixInsight. Unlike Astrometry.net, PixInsight's AnnotateImage script allows for an almost unlimited range of options. You can annotate from dozens of standard catalogs (NGC, IC, Tycho-2, etc.) but you can also create custom annotation catalogs. They need to be formatted as CSV files and must contain a minimum of four items: Object Name, RA, Dec, and Magnitude. I figured I had this in the bag: Find the Abell 2199 catalog, strip it down to the four minimum elements, and let PixInsight annotate our photo.

It turns out that bagging the Abell 2199 catalog was more difficult than I imagined. There are thousands of specialized astro catalogs, many of which are obscure, Abell 2199 among them. I searched in vain for a simple listing of the galaxies in Abell 2199. As a last resort, I turned to AI, specifically to Chat GPT. My simple request: Give me the data for every entry in the Abell 2199 Galaxy Cluster Catalog. After some digital bumping and grinding, the AI returned data (including the four bits I needed) on 406 galaxies.

I was impressed, but a bit disconcerted as well. My research had prepared me to find about 200 galaxies in 2199, not 406. But I had also learned that catalogs often list objects by category, such as "certain fit," "likely fit," and " possible fit" to a catalog's criteria. So catalogs can bloat. I decided to live with 406 entries. I built the CSV file and ran it in PixInsight using the AnnotateImage script. The Seestar FITS files worked perfectly and the resulting image, though a bit odd looking, was deeply gratifying. You can see it on the MAS website, here.

Why odd? Because the annotations are long. They are, in fact, the full names of the galaxies. Here is an example: SDSSCGB 13871.1.

Why gratifying? Because I was able to identify a dense named cluster of galaxies in an already dense field of galaxies!

Be it as a convenience, an annotation aid, or a research tool, plate solving is a powerful utility that has become fully accessible to amateur astronomers. Do a bit of experimentation with it yourself, and I am sure you will agree.

Software Resources

Astrometry.net is a great place to try your hand at solving images. It works with jpeg, gif, png, and fits images, and can be downloaded to run on your local machine. The downsides: the online version can be a bit slow on high traffic days, and it only annotates the better-known catalogs. Other packages include PixInsight (paid license, Win and Mac), Siril, ASTAP (free, Win and Mac), and Astro ImageJ (free, Win, Mac, and Linux). Note that some of these packages require you to download additional catalogs.

How does solving work?

It's Geometry 101. Software identifies stars – think of them as single points. It then "connects the dots," creating geometric shapes like triangles, rectangles, and quadrilaterals. It compares these shapes, including distances and angles, to known shapes that have established RA and Dec coordinates. When a match is found, the software assigns coordinates to that star. Then the software works out the coordinates of nearby objects based on the World Coordinate System (WCS).

The First MAS Seestar Collaborative, Part 4

A Statistical Approach to Analyzing Seestar Data

By Bob Hamers

Though nearly 21,000 total Seestar images were used in this collaboration, this analysis relies only on the frames that came from S50 telescopes—just over 18,500. Along the way, the project provided an opportunity to formulate and test different approaches to getting the best final image from the available data and identify ways to improve the overall data collection and analysis for future projects.

How did we evaluate "quality" of the frames? In forming a final image by stacking (integration), PixInsight weights each individual frame based on the frame's quality. A rigorous mathematical treatment shows that the highest signal-to-noise (S/N) ratio is obtained when each frame is weighted by $1/(S/N)^2$. However, there is no rigorous definition of what "signal" to use for evaluating astrophotography images, and no one number can adequately evaluate all aspects of image quality. PixInsight recommends using a measure called the "PSF Signal Weight" or "PSF-SW" which is based on a combination of factors including background noise level, number of stars observed, and the total intensity and sharpness of the stars as measured by the full-width at half-maximum (FWHM). To start with, we wondered whether it mattered which quality metric we used. The graphs at right (**fig 1**) show histograms of two important metrics: the PSF-SW (top) and the star width (bottom). Across the S50 frames there is a wide variation in the quality of the individual frames as measured by PSF-SW, but the distribution is not at all what I expected – instead of a bell-shaped curve, the data showed a large number of images with low PSF-SW clustered at the left end, with no obvious peak. Similarly, a histogram of the star width showed some stars with a width of only ~1.5 pixels, but an average of 2.5 pixels and with a long tail to higher values. In making the final image, PixInsight weighted the "best" frames highly, but either did not use or gave very little weight to the images with low PSF-SW

PixInsight's standard "PSF Signal Weight" uses intensities of the *stars* as the "signal" for quality evaluation since it has no way of knowing what specific object is of interest. To test whether we could directly measure the intensity of NGC 6166 in each frame to use instead, I wrote a python program that measured the intensity in a region surrounding the core of NGC 6166 in each star-aligned frame and instructed Python to use this "Signal" to weight the frames. This custom NGC 6166-specific approach yielded only a small improvement compared to PixInsight's default PSF-SW weighting. Based on this, John Rummel and I concluded that the default PSF-SW is a good measure of the image quality and used it for the final image of the collaboration.

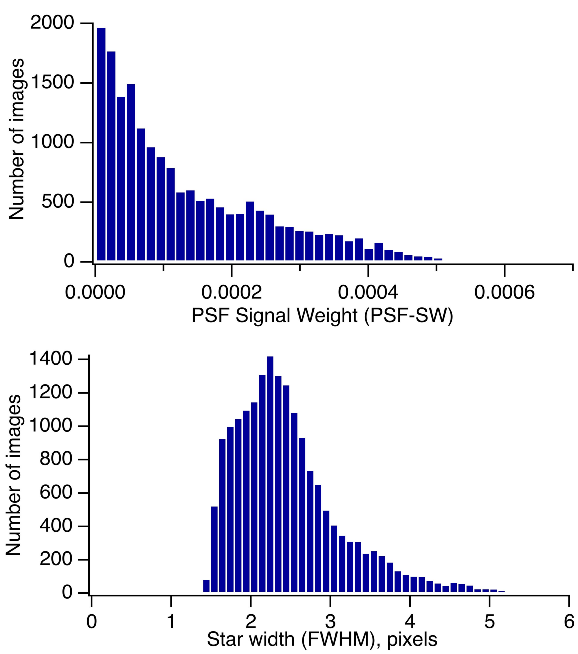


Figure 1: Histograms showing the distribution of PSF-SW (top graph) and of the star width (bottom graph) across the 18,590 frames submitted. Note the unexpected clustering of low-quality frames in the top graph.

Resolution and Drizzling: Astrophotography images usually benefit by increasing the number of pixels in the final image, giving stars a rounded, more pleasing shape. Two methods of doing this are (1) up-sampling and (2) drizzling. Upsampling increases the number of pixels by taking the values of adjacent pixels and estimating (by interpolation) the values at in-between points, while drizzling attempts to register the individual frames at sub-pixel resolution to estimate values at in-between pixels. Both methods improve the appearance by making stars look rounder. Drizzling has the potential advantage of being able to improve the actual resolution of the data, but this possible advantage is significant only if the raw data are *undersampled*—meaning that stars are focused to regions smaller than one pixel. To test whether drizzling gave improved resolution, we compared 2x-drizzled and 2x-upsampled images. We found

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that drizzling during integration led to negligible improvement compared to simply upsampling the final image, consistent with the fact that the raw images are not under-sampled. An alternative approach to improving resolution is to register (star-align) and integrate only the sharpest frames. Using this approach with the 1860 sharpest frames (10% of the total) gave a final image with noticeably sharper stars: only 1.87 pixels FWHM, significantly sharper than the ~ 2.4 pixels using the full data set. The improvement in resolution is most evident when looking at closely-spaced objects such as double stars. The figure below (**fig 2**) shows one example of closely spaced stars and the intensity profile over three images processed using PixInsight's default PSF-SW weighting (red), the result using my custom S/N-weighting described earlier (in blue), and the profile from the image using only with the 10% sharpest stars (green). The image using the 10% sharpest stars give a more

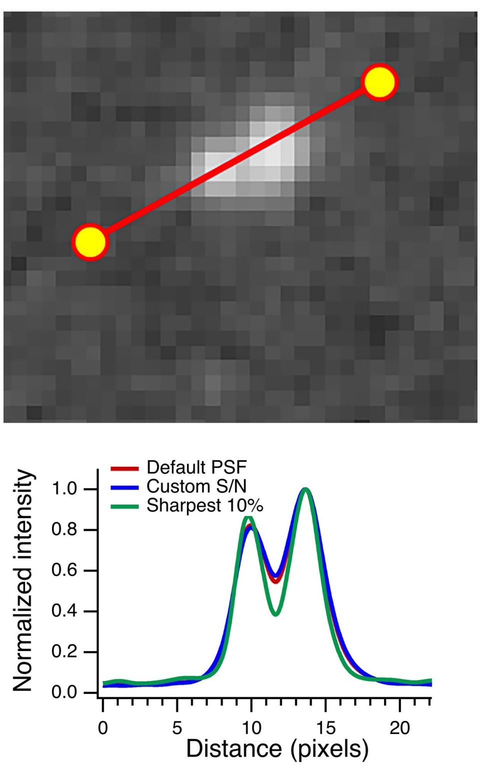

Figure 2: Image of barely-resolved stars, and intensity profiles for images processed in three different ways. Note the deeper dip between stars when using only the sharpest 10% of images. The image and profile were made on the linear images (before stretching).

distinct separation between the stars and overall higher resolution across the image. This shows that one can get a sharper image by selecting only the sharpest frames, but at the cost of a reduced S/N (i.e., noisier background) since fewer frames are being used.

What controls the quality of the images? A machine-learning analysis. Because of the wide variation in the PSF-SW across the dataset, I delved deeper into what factors control this variation. I combined the statistical information in PixInsight's Subframe Selector with the header information contained in each submitted FITS file, thereby linking PixInsight's statistical information about each image with the imaging conditions (telescope id, imaging location, sensor temperature, time of observation). As shown in the graph at right (**fig 3**), I noticed that across all imaging session, the PSF-SW was always best near 11:00 PM, and decreased steadily thereafter. My initial thought was the humidity or smoke might play a role, so I obtained archived humidity data from the WiscoNet weather station for Brooklyn (https://wisconet.wisc.edu/stations/brooklyn) and hourly column smoke data from the NOAA-HRRR smoke database. To analyze the data, I used a method known as random-forest analysis, a commonly used machine-learning method. Random-forest analysis uses a selected metric (e.g., PSF-SW) and a selected group of factors (e.g., changes in temperature, in humidity, in altitude of NGC6166, etc.) and determines how much of the changes in the PSF-SW are associated with each factor. The random-forest analysis showed that the changes in altitude of NGC 6166 accounted for almost all (83%) of the time-dependent changes in PSF-SW occurring on time scales of hours: as NGC 6166 goes lower in the sky and one is forced to image through more of the atmosphere, the image quality degrades and PSF-SW goes down. The other 17% of the time-dependent behavior was accounted for almost completely by the increase in humidity and high-altitude smoke. Changes in temperature of the Seestar's sensor had almost no impact.

What about the rest? Periodic noise. While the above factors accounted almost completely for how PSF-SW changes with time on hours-long time scales, they accounted for only about 15% of the total variability in PSF-SW across the entire 18,590 frames. Something else besides the time and weather was greatly influencing the quality of the data. One hint was that the random-forest analysis showed that the specific telescope being used was also important, even after accounting for the effects of altitude and weather. To flesh this out, I examined the data from each

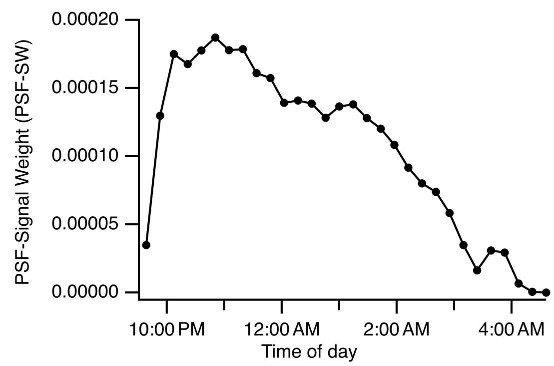

Figure 3: Graph showing how the PSF-SW varies with the time of acquisition, aggregated across all imaging sessions. The data were combined in 15-minute intervals.

telescope individually on a session-by-session basis and found that there were frequently large variations in PSF-SW occurring on a time scale of minutes, much faster than any weather or environmental changes considered in the random-forest analysis described above. Furthermore, much of this variation was periodic, with a period equal to the 10-minute period of the Seestar's internal worm drive, or sub-multiples of that (5 minutes, 3.33 minutes). To determine how important this was, I used a method known as a periodogram analysis, which identifies what periodic behavior is present and what fraction of the variability in the

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star width (FWHM) and the PSW-PF are due to the periodic error. The graph below (**fig 4**) shows one example of the variation in star FWHM; the blue points are the data, and the red curve represents the amount that can be attributed to periodic error. The periodogram analysis showed that in some cases the periodic error in the worm gear accounts for 50% or more of the total variability in PSF-FW between frames. Since frames with a large star diameter get reduced weight or are outright rejected during image processing, reducing the amount of periodic error could significantly increase overall quality of images after stacking.

Lessons Learned: PixInsight's default parameters in the weighted batch pre-processing (WBPP) script do a good job of optimizing the final image using the PSF-SW metric. Better resolution can be achieved by integrating only the sharpest frames, but with a reduced S/N (i.e., noisier background) due to the smaller number of frames. Overall there is a wide spread of image quality in the data set. A random-forest analysis shows that ~15% of the variations in PSF-SW come from changes in the altitude of NGC 6166 in the sky together with local humidity and smoke, with best quality when NGC 6166 is near the zenith. Even more significant is the short-time (few-minute) fluctuation in image quality, most likely associated with the periodic error of the Seestar's gearing mechanism. These errors lead to many frames having large and/or and eccentric stars, reducing their PSF-SW quality factor, and leading to these frames being given little weight or outright rejected during image stacking. The magnitude of the periodic fluctuations in FWHM are dependent on the specific telescope and vary with each imaging session, suggesting that there may be some user-specific ways to reduce the periodic errors and further improve the overall image quality.

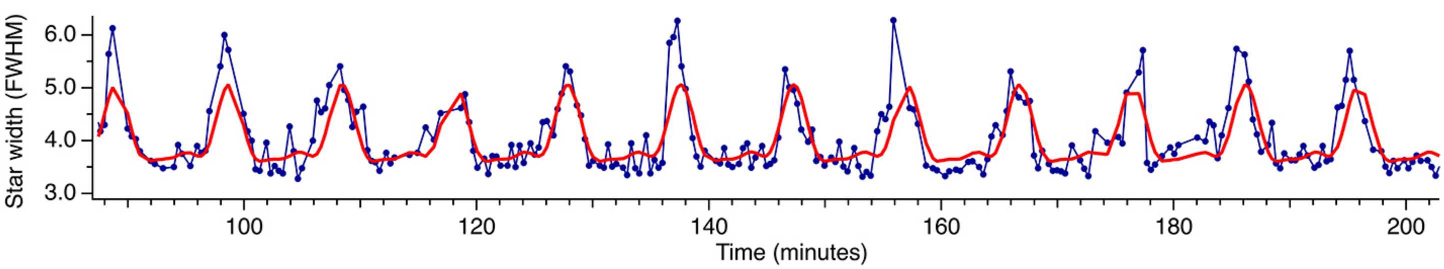


Figure 4: Experimental data showing periodic variation in star width (FWHM) from a Seestar used in this project. The blue points are PixInsight's FWHM extracted from the frames; the red curve is a periodogram output showing the periodic-only component (red). More than half of the changes in FWHM are due to the periodic error.

Next MAS Meeting

Friday, October 9, 2026
7 pm, Memorial High School
Theater 300

Richard Townsend

UW Madison, Astronomy Department

The Music of the Spheres: Peering Inside Stars with Asteroseismology

Looking further ahead

Nov 13	**Astrochronology**	Stephen Meyers, UW Professor of Geosciences
Dec 11	**"At the Edge of Time"**	Dan Hooper, UW Physics Department and the IceCube Project
Jan 8	**Book Talk: *Chasing the Stars***	Jim Lattis and Kelly Tyrell

Clockwise from left: Kevin Santulis provides some musical diversion to a receptive audience.

Kevin takes his turn as grillmaster.

Total attendance at the picnic was around 40. The weather was perfect.

All photos by Alex Samuel except for the one of Bernie's ice cream station, taken by Dan Hyslop.

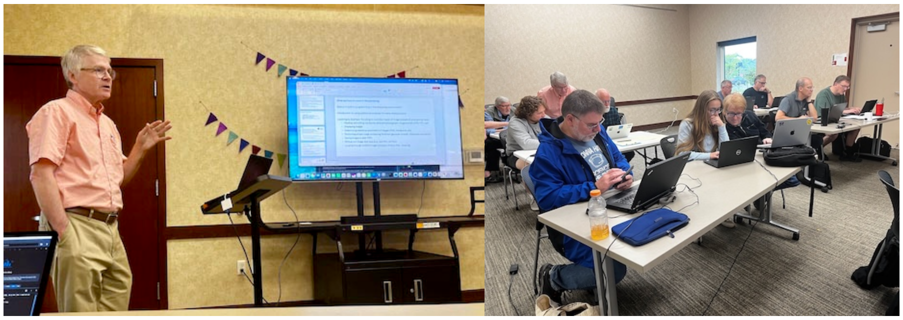
MAS Picnic at YRS, September, 12, 2026

Clockwise from left: Bernie Ripp brought his liquid nitrogen ice cream setup again, to the acclaim of all.

Some displays from the swap meet are still visible on the picnic tables.

Carol Santulis, Danny Glover, and Wil Cox enjoy the company and wait for it to get dark.

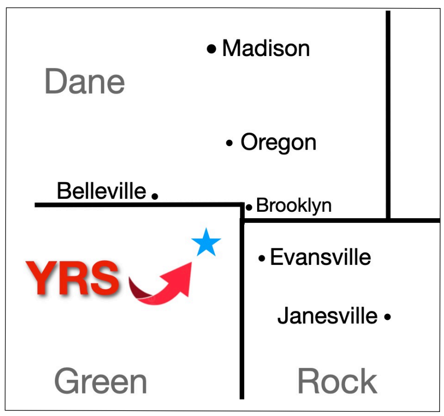
Python Programming Workshop



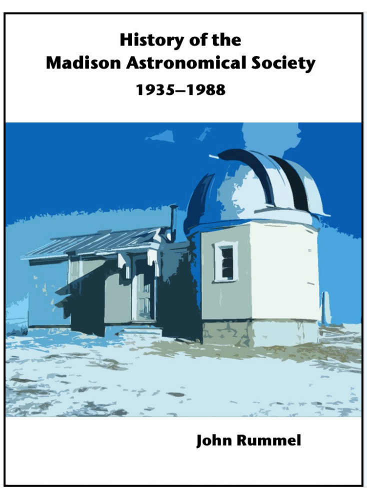
On Saturday, September 19th, Bob Hamers (with an assist from Rick Wayne) led a morning workshop on image analysis and processing using widely supported open-source tools based on the Python programming language. Approximately 15 MAS members attended. The workshop was held at the Alicia Ashman Library branch.

What is YRS?

YRS stands for ***Y**anna **R**esearch **S**tation*, which is our Society's dark sky site. It is in northeastern Green County, about a 30 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. If you'd like to visit, send a message to madisonastro.info@gmail.com.



The History of the Madison Astronomical Society



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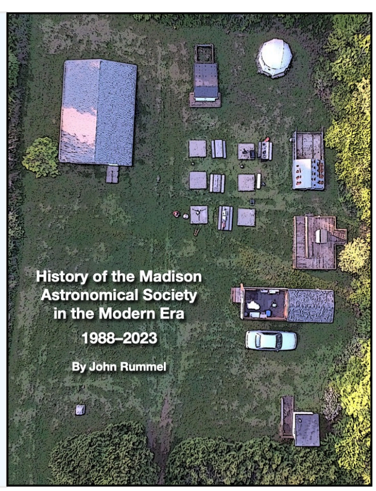

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Capitol Skies is the quarterly newsletter of the Madison Astronomical Society. Members of the Editorial Committee include:

Jack Fitzmier (Editor)
Bob Hamers
Alex Langoussis
John Rummel
Alex Samuel
Rob Strabala
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. Send comments, feedback, or other ideas along as well. Use the club's email and note "*Capitol Skies*" in the subject.