REFLECTIONS / REFRACTIONS

University Lowbrow Astronomers Monthly Newsletter

September 2021, Vol 45, Issue 9

Inside this issue:

THE BUBBLE NEBULA (NGC 7635)

BY DOUG BOCK

On August 1-2, 2021, we had some decent weather to try out the ZWO asi2600MC PRO camera I recently purchased.

This month was nebula time, rendering the Bubble Nebula, also known as NGC 7635, Sharpless 162, or Caldwell 11, it is an H II region emission nebula in the constellation Cassiopeia. It lies close to the direction of the open cluster Messier 52. The "bubble" is created by the stellar wind from a massive hot, 8.7 magnitude young central star, SAO 20575. This object is about 11,000 light years from Earth, with a radius of 3.5 light years. Its apparent magnitude is 10, spanning 15' x 8'. This test image was compared to last year's version and appears to show more nebulosity with this camera. It is rated to be more sensitive than the asi071mc pro camera, and I think that proves to be true. More testing is in order.

Data Acquisition: 10" f/8 RC, ZWO asi2600MC PRO, 57 x 300-second subs, at a gain of 100, temp 0C, along with darks and flats. I also had the 300mm f/4 Canon lens piggybacked on the 10" using my ZWO asi071mc PRO camera centered on the Bubble Nebula as well.

This image contains identification of several other deep sky objects in the area: NGC 7538, near the more famous Bubble Nebula, is located in the constellation Cepheus. It is about 9,100 light-years from Earth. It is also home to the biggest yet discovered protostar which is about 300 times the size of the Solar System.

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(Doug Bock, continued from pg. 1 ...)

NGC 7510 is an open cluster of stars located around 11,400 light years away in the constellation Cepeus, near the border with Cassiopeia. At this distance, the light from the cluster has undergone extinction from interstellar gas and dust.

Messier 52 or M52, also known as NGC 7654, is an open cluster of stars in the northern constellation of Cassiopeia. It was discovered by Charles Messier in 1774. It can be seen from Earth under a good night sky with binoculars.

Photo taken at Brauer Preserve, *by Adrian Bradley*

LOOKING FOR ANOTHER OBSERVING LOCATION?

While the COVID-19 Delta variant continues to push regular access to Peach Mountain further down the road, members weigh in on other local spots for observing:

Adrian Bradley and David Cooke recommend the **Brauer Nature Preserve**, located off Parker Rd (which is off Scio Church Rd) west of Ann Arbor. (Address: S Parker Rd.)

Adrian notes, "At a Bortle scale rating that sits between 5 and 4, it has a surprisingly good open view of the night sky, especially to the north. If you walk further into the nature preserve you can avoid the lights of passing cars and only have occasional ambient animal sounds to listen to."

Doug agrees and points out that while it's not Peach Mountain, it's "...the best site I've found so far without traveling that distance. At the park entrance, there is a dirt path that goes up and over a small hill. If you are bringing large/heavy equipment, be prepared for the rough road. My case has roller blade wheels and made it over OK, but if you have a small dolly or luggage carrier with slightly larger wheels, it will make it easier. At the bottom of the hill there it opens up into a very large open area with good visibility of most of the sky."

It can be wet, though, so bring your bug spray!

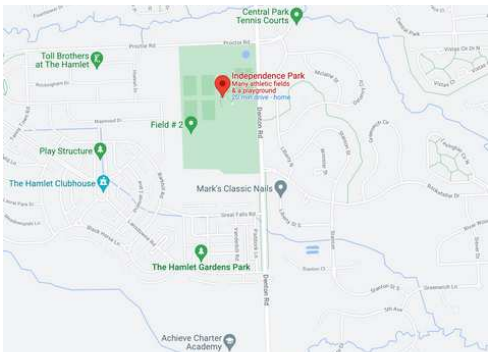
Doug Scobel recommends **Park Lyndon North**, another location northwest of Ann Arbor, situated on North Territorial further west from Peach Mountain, almost to M-52. (Address: 18801 N Territorial) >>>

"Really good views to the north, but you may have to contend with a car or two pulling into and out of the parking lot, just like any public park. Plus there's a transmission tower with flashing strobes to the SW.

But it's probably a little darker than Peach and a decent alternative. Don't confuse it with Park Lyndon South, which is a little to the east along N Territorial. It's mostly wooded IIRC."

East of Ann Arbor, Jeff Kopmanis recommends **Independence Park in Canton**, located on Denton Road between Gedds and Cherry Hill (Address: 1898 Denton Rd.)

"For urban locations, I found that Independence Park in Canton works well. As a soccer field, there are no trees, and the restroom build has power poles you can run extension cords from. We gathered to watch the ISS traverse the face of a full Moon at night and it worked well... Police seemed reasonable and were more concerned with our safety than about hanging around after park hours."



MY BIG BLUE DOB TRACKING SYSTEM

BY DON FOHEY

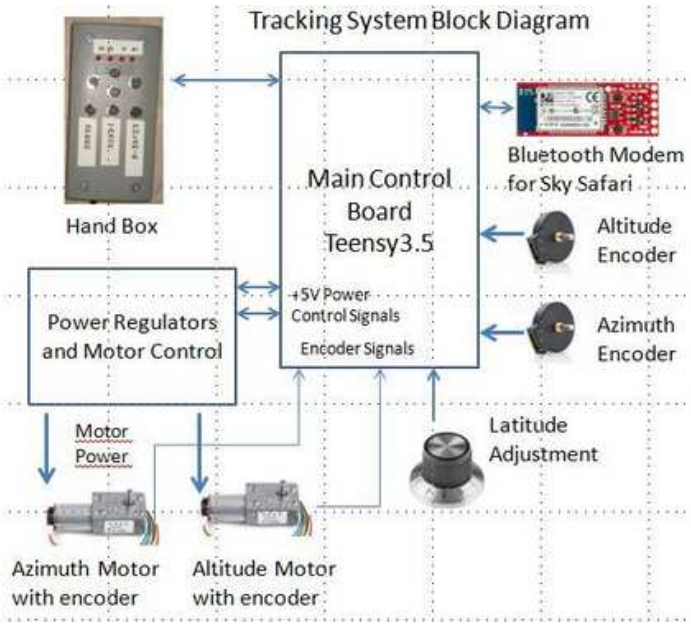
I designed and built a 14-1/4 inch f/4.1 Dobsonian telescope and I wanted to add a tracking system so that objects would remain in the eyepiece as the earth rotated. I would be able to enjoy longer views without nudging the telescope, especially when sharing views with others. I have no intention of tracking for photography.

SKY SAFARI

The system is integrated with Sky Safari which displays a cursor on its star chart at the pointing location of the telescope. The encoder signals are connected to interrupt inputs of the Teensy computer which keeps track of the encoder position. When Sky Safari requests a position, the computer sends the encoder counts via the Bluetooth modem to the device running Sky Safari. Sky Safari uses alignment stars during setup so that it can accurately track telescope position. This only works with Android devices.

HANDBOX

Operation is via a hand box controller. The two SS lights indicate one of four slewing speeds of the motors. The T light indicates the system is tracking. The P light indicates that an alignment of Polaris is to be performed. The Four buttons in the diamond pattern move the telescope Up, Down, Right or Left. The SPEED button cycles the manual slewing speeds from 00, to 01, to 10, to 11, and then back to 00. When the telescope is pointing to an object, push TRACK which starts the system tracking and lights the T light. A second push of TRACK stops tracking. Push POLARIS once to light the P light. Move the telescope to Polaris, push POLARIS a second time to initialize the tracking system. Operation is that simple. While tracking, the Up, Down, Right, or Left buttons change the tracking point by 0.0072 degrees (two encoder counts) which is useful to fine-adjust image centering. When either the AZ or ALT tracking error is greater than 0.0072 degrees, a motor is pulsed to adjust the image again to center. Typically this automatic nudge occurs every 5 to 15 seconds depending on which part of the sky the telescope is pointing.



The Handbox

MOTORS

12 Volt DC motors where used with a metal gear train. At full speed I calculated that I wanted a motor which would run at about 40 RPM. The smallest motion would then be determined by the smallest amount the motor would rotate with a short pulse. The motor speed is controlled by pulse width modulation. I found a smooth response with a pulse period of 75msec. The manual speed is controlled by adjusting the pulse width to obtain a desired speed measured by the motor encoder signal rate. I had grand ideas for the motor encoders, as it turned out I only used them to control manual motor slewing speed.

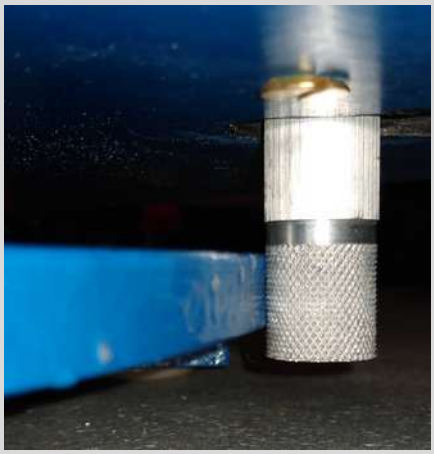
(Continued, p.4)

(Big Blue Dob Tracking System, continued from p. 3 ...)

AZ MOTOR INSTALLATION

The AZ motor runs a spindle against the circular ground board. It is engaged by a spring and disengaged by a knob on the outside of the mirror box which pulls the spindle away from the ground board. This is very typical of other systems that I have seen. The Lazy Susan ground board bearing has very little friction.

AZ Motor Inside Rocket Box



AZ Spingle Against Ground Board

AZ Spindle Disengage/Engage Knob

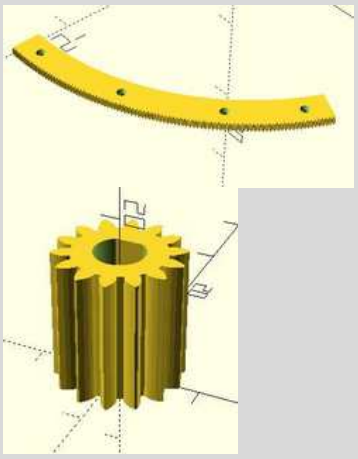
ALT MOTOR INSTALLATION

A 90-degree segment of a 20-inch diameter gear was attached to the ALT Bearing and a 1/2 inch diameter gear was attached to the motor shaft. The gears were designed with OpenSCAD and 3D printed. The motor bracket pivots to engage and disengage the gears. A block is raised to lock the motor in the engaged position.

ALT Segment Gear

ALT Motor Engaged

ALT Gears Engaged



OpenSCAD Gear Design

The 3D printed gears fit together perfectly. The ALT gear was printed in two pieces because of the limited bed size of the printer. PLA filament was used. Notice the flat on the inside of the motor gear.

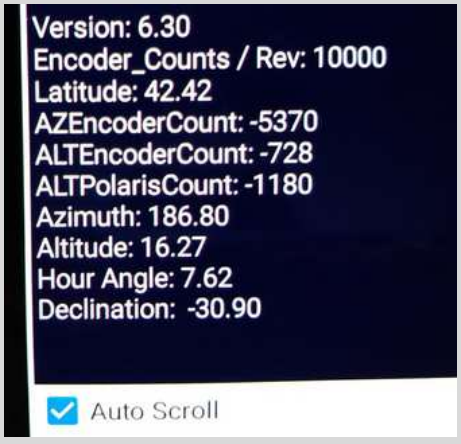
(Continued, pg. 5)

(Big Blue Dob Tracking System, continued from pg 4 ...)

I choose the Teensy 3.5 processor on a Spark Fun board because it had enough Input pins to handle all the encoders and multiple serial ports for the modem and hand box. The Teensy was programmed using the Arduino IDE, which I was already familiar with, in a C style language. The hand box has an Arduino Pro Mini to process button depresses and communicates with the controller via an AS-CII protocol over and RS232 interface (MAX202C chip). I implement the RS232 signals because I was worried about sending 3-volt logic levels over a long coiled telephone handset cable. The system works well. I used Eagle to design the electronics and OSH Park to make the PC boards.

The button battery in the photo powers the Teensy's real-time clock. I did not use the clock but could in the future. A GOTO object system would require actual time in order to compute RA.

There is a diagnostic system. A Bluetooth Terminal Emulator Application on the Android Tablet can also connect to the system. When the system receives a "d" from the emulator, it sends a parameter being used by the system to the tablet. I expect this feature to be useful to diagnose problems including encoder and cable failures. The system is powered by a 12V 6000 mah TalentCell Li-Ion battery. The control board voltage is provided by a switching regulator. Current requirements are 135ma while connected to Sky Safari and 350ma when driving a motor at full speed.



Screen Image of Diagnostics

Power and Control Boards

Latitude Setting Knob

The crux of the system is the tracking algorithm. There are many sources for the coordinate transformations equations between ALT/AZ and DEC/HA. None that I found address the domain issues with the arcos() functions and none actually describe a useful tracking algorithm. The algorithm I used is on the next page.

I am very pleased with how well the system works. I was pleasantly surprised at how much I like slewing the telescope with the hand controller to a Sky Safari chart location. I then push TRACK to start tracking. It works so easily and seamlessly. I was worried that the jerking of the image when a motor is pulsed would be too distracting. This turns out not to be annoying at all. It is comforting to see the image re-center in the field of view. I am thankful to Dave Jorgensen for fabricating the spindle and motor mounting plates. My costs were under $200. A successful project!!!!

See next page for Tracking Algorithm

(Big Blue Dob Tracking System, continued from pg. 5 ...)

TRACKING ALGORITHM

The system must know the observing **LAT**. A Dial Knob connected to a potentiometer is used to set the **LAT**. It connects to an A/D input pin of the Teensy. At startup, the value is read and **LAT** is set.

The next step is to determine the telescope **AZ** and **ALT**. This is accomplished by aligning on Polaris and setting **AZ = 0** degrees and **ALT = LAT.** As the telescope moves the encoders are used to update **AZ** and **ALT**.

When Tracking is started, set the tracking point.

1) Get **AZ** and **ALT** from encoders
2) Compute **Target DEC** from AZ and ALT and LAT
   sin(DEC)=sin(ALT)*sin(LAT)+cos(ALT)*cos(AZ)*cos(LAT)
   DEC range is -90 to 0 to +90, which is the domain of the arcsin
3) Compute **Start HA** from Target DEC, AZ and ALT
   cos(HA)={sin(ALT)sin(DEC)*sin(LAT)}/cos(DEC)*cos(LAT)
   HA range is -180 to 0 to +180. arccos domain is 0 to 180.
   If AZ <180 change the sign of HA
4) Save the **Start Time** at which tracking began.

ABBREVIATIONS

AZ Azimuth, North is 0 South is 180
ALT Altitude, Horizon is 0 Zenith is 90
DEC Declination, Ecliptic 0, North Star is 90
HA Hour Angle. North is -180/+180, East is -90, South is 0, West is +90
LAT Latitude in Degrees

Then compute the following every second.

1) **Target DEC** doesn't change during tracking. Nothing to do here.
2) Compute the **Target HA** by adding the time since start of tracking to the Start HA
   Target HA = Start HA + (Time Now - Start Time)
3) Compute **Target ALT**
   sin(ALT) = (sin(DEC)*sin(LA)+cos(DEC)*cos(LA)*cos(HA))
   ALT is 0 to 90 which is within the arcsin domain.
4) Compute **Target AZ**
   Equation 1 cos(AZ)={sin(DEC)-sin(LA)*sin(Alt)}/cos(LAT)*cos(ALT)
   Equation 2 cos(AZ)= -{sin(DEC)-sin(LA)*sin(Alt)}/cos(LAT)*cos(ALT)
   AZ ranges from 0 to 360. arccos domain is 0 to 180
   If the HA > 0 use equation 2
   If the HA < 0 use equation 1 and add 180 degrees.
5) Read AZ and ALT from encoders and compute errors
   AZ Error = Target AZ - Encoder AZ
   ALT Error = Target ALT - Encoder ALT
   If AZ Error > AZ Threshold, pulse AZ motor.
   If ALT Error > ALT Threshold. Pulse ALT motor.

The error threshold is set to the distance between two encoder counts. The encoders provide 10k counts per 360 degrees. Threshold = 2*360 /10000 = 0.0072 degrees = 4.32 minutes. A motor pulse width is selected to move the telescope about that same amount.

ASTROPHOTOGRAPHY TIP OF THE MONTH

BY AWNI HAFEDH

Shorter Subs and AstroPixelProcessor's Gradient and Color Calibration Can Make the Difference in Capturing A Challenging Target Like M104 - The Sombrero Galaxy

This is a super-challenging target as it never rises above 43deg to the South, and you can't image it for more than 3 hours here in MI, and having that nasty light pollution of Detroit makes it even more difficult. Over the past years, I tried different setups and methods and they were all very disappointing compared with people capturing the same target in the southern states or hemisphere as it goes higher in the sky and they get more time to capture it.

Thanks to a new technique that I learned from my friend, I only need to capture 1-min subs but get a lot of them -- which ended up being 314 subs. It took me 3 nights to capture those. The new ASI533 camera made all the difference to capture as much detail as possible (that was the first challenge), then came the stacking part. PixInSight had a lot of issues stacking the frames as it can't detect enough stars due to short exposure and for the heavy light pollution, and DSS didn't produce an image that I liked. But I was fortunate to know that AstroPixelProcessor can do a better job and it comes with a 30day trial -- and WOW, that software is amazing. Not to mention that the gradient and color calibration of APP did great work (that was the final challenge). I did use PixInSight to enhance and sharpen the image and I hope you like the final version.

Equipment used
Celestron 9.25" with 0.7x reducer
ZWO ASI533MC Camera
Astronomik Lum filter
iOptron CEM60 mount

UPCOMING MEETING SPEAKER SCHEDULE

SEPTEMBER 17: Professor John Monnier, U-M. Topic: ***Telescope Interferometry - Stars and Exoplanets***

OCTOBER 15: Associate Professor, Keren Sharon, U-M Astronomy. Topic: ***Gravitational Lensing***

NOVEMBER 19: Dr. Fred Adams, U-M. Topic: ***TBA***

DECEMBER 17: Don Fohey, Lowbrow member. Topic: ***The New Horizon Mission to Pluto***

JANUARY 21, 2022: Dan Durda, Southwest Research Institute, Boulder, CO. Topic: ***The Southwest Research Institute's Suborbital Research Initiative: First Flights with Virgin Galactic and Blue Origin***

FEBRUARY 18: Professor Claude Pruneau, WSU Physics Dept. Topic: ***What the LHC mini-bangs tell us about the Big Bang***

THE PERSEID METEOR SHOWER

BY CLUB MEMBERS

From **ADRIAN BRADLEY**: "On a fine August night at Alcona County Park and Campground, Dr. Brian Ottum and I watched quite a meteor shower. We saw everything from some small dim streaks to quite a few bright Perseids that crossed from north to south and left smoke trails! They streaked through many notable constellations and locations in the night sky. Both Ursa Major and Ursa Minor suffered some casualties as the meteors streaked around, by, and through them. Many Perseids landed in the 'river of milk', also known as the Milky Way. Still, others went after the planets, as Jupiter and Saturn were not safe from the barrage! The mighty Hercules suffered plenty of damage, as well as Draco - but both continued their battle with one another. Cygnus, who is used to dealing with meteors in general, had to avoid many smaller Perseids... only to get run through by a bright satellite!

Whenever I do imaging, my main focus is usually on the Milky Way. Fortunately for me, the Perseids tend to show up around my favorite target. It enabled me to capture just a few of the 50 or so that Brian and I saw if we put all of our observations together. On occasion, a meteor would not move in the proper direction that a Perseid is expected to move. I reasoned that it may be a stray Aquarid. The lesser Aquarid shower tends to follow the Perseids, and at this point, the two may be intermingling.

As I went home I continued to see bright Perseids streak across the sky. I glanced over at Orion, the mighty hunter, as he began to rise on the horizon. He shouted to the night sky that Fall was indeed coming. But then I watched in horror as the Perseids began ripping Orion to shreds! I counted 3 Perseids in a row, streaking in, around, and through one of the most recognizable constellations in our night sky.

Today as I write this short article, I am also eating crow, as I saw media outlets tell people to go out and watch the Perseids on this and the previous night. I expected many people to be duped and disappointed. Now granted, I was at a park that had a Bortle 3 rating for night sky darkness, and that is always going to produce a meteor or 2 each hour. But at this dark site, the Perseids did not disappoint. I wish for those who did heed the media's recommendation to go watch the shower, even after its peak, that they saw some bright Perseids as well. It was perhaps the best meteor shower I'd seen in a long time!"

From **DOUG SCOBEL**: "I was up in Calumet, MI during Perseid week and we were blessed with a beautiful, clear, cloudless and smoke-free sky the night of August 11-12. Following Brian Ottum's instructions in the August **Reflections**, I took about 200 15-second exposures before some clouds rolled in around 2:30 am. Though I captured a few sporadics and satellites, just one of the 200 had an actual Perseid in it. But one is better than none!
You may notice that the meteor left a multi-colored trace in the image. According to one of our most learned members, this is due to different gasses being ionized as the meteor penetrates into the upper layers of the atmosphere. For example, the green color is from oxygen.

This single (not stacked) image, roughly 73 degrees by 53 degrees, covers the Milky way from part of Cassiopeia at upper left, through Cygnus, to part of Aquila at the lower right. Lyra is at the upper right, and the Andromeda Galaxy is on the left edge below center, Collinder 399, better known as "The Coathanger" is near the right edge, also just below center. There are hints of the North America nebula at center.

Exposure details: Canon EOS 5D Mark IV DSLR, Canon 24-70mm lens set to 24mm. 15 seconds at f/4, ISO 5000. I processed the raw image using Adobe Photoshop Elements 2020."

(Perseid Meteor Shower Photos continued, p. 9)

From **AMY CANTU**, Wolf Lake, Manistee National Forest. Canon EOS 6D Mark IV DSLR, Rokinon 24mm lens, 10 seconds, ISO 1600. (Smaller meteors from earlier in the evening added in with PhotoShop.)

More Meteors!

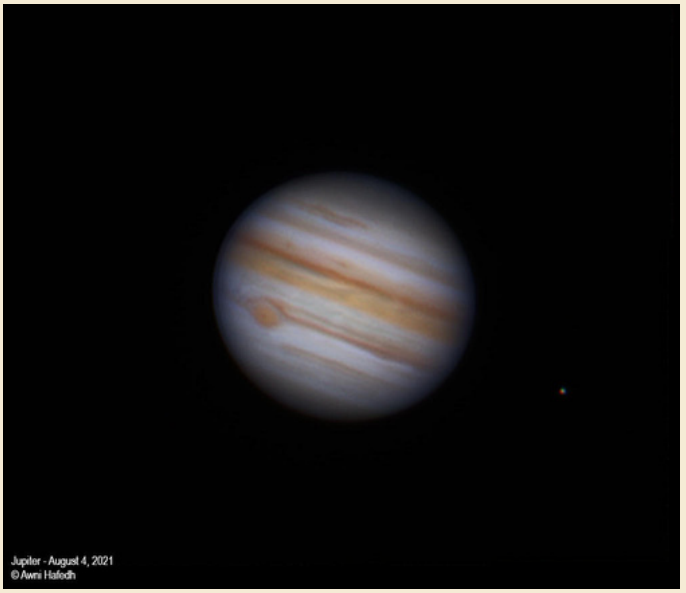
From **BRIAN OTTUM**

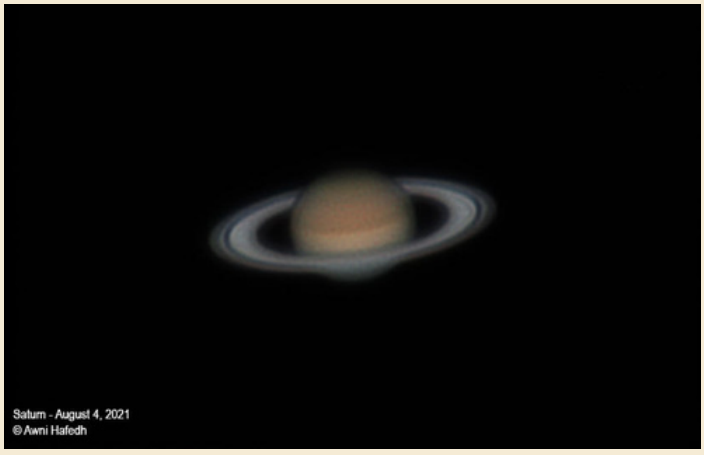
JUPITER & SATURN

BY AWNI HAFEDH

It was supposed to be Saturn's opposition that night. Lucky me, the sky was clear and the seeing was perfect, I took my time to set up my planetary scope, the mosquitos were not around after 1 am, and I really enjoyed the imaging session.

I started by slewing to Saturn and making sure everything was working fine and focused. I captured 2000 frames of IR pass, Red, Green, and Blue filter, and then slewed to Jupiter which was very impressive to image with Red, Green, and Blue. I decided to image it at 3:30 am --that's when the red spot came to view and it was beautiful. Then I simply covered everything and went to bed.





I stacked 15% of each filter using Autostakkert3 and sharpened/combined/enhanced it with Pixinsight with minimal processing, I must say the final results are very decent as you can see multiple rings around Saturn and a lot of surface details on Jupiter. (Note: That dot next to Jupiter is actually Io.)

Equipment used:
Telescope: Skywatcher 180Mak with 2.5x Televue barlow
Camera: ZWO ASI174MM with L,R,G,B,IR filterwheel
Mount: iOptron CEM25P

University Lowbrow Astronomers – Meeting Minutes August 20, 2021

President Charlie Nielsen opened the meeting at 7:39PM.

He introduced our speakers, fellow Lowbrows Jodi and Roy McCullough, who explained how to use Images Plus to process images. A lively Q and A followed.

Business Meeting:

- Charlie spoke a bit about our 2022 speaker schedule, and that we still have a few open slots.
- Newsletter Editor Amy Cantu asked about the list of upcoming speakers to include in the Newsletter.
- Member Jim Forrester mentioned that the 17.5 scope needs to be tested before use. Dave said we should schedule a convenient time.
- Treasurer Doug Scobel reported: We have 169 memberships. Ten of those are memberships that we have extended per our pandemic policy. We have $10,407.09 in the treasury. Our one major expense paid since the July meeting was our annual $100.00 donation to the International Dark-Sky Association.
- Observatory Director Jack Brisbin reported that 1) tree work has continued, 2) new fencing is being installed, 3) it is unlikely open house events can be held for the next several months, 4) Jack does regular activation of the McMath to keep it operational.
- Member Jim Forrester reminded us of the sale of Tom Reichel's astronomy equipment on Sept 18 and 19. He requested help in conducting the sale of the equipment.
- Member Norbert Vance mentioned that several sales of equipment are upcoming. He said the Star Gaze event is on for the weekend after Labor Day.

The meeting was closed at 9:08.

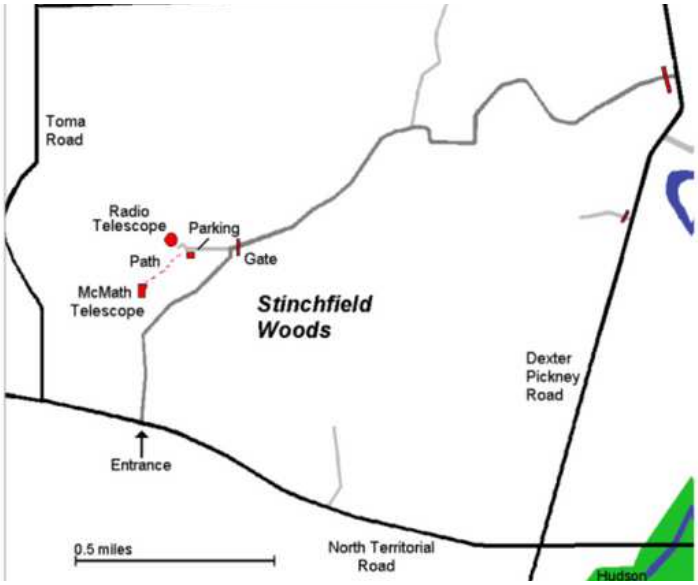
Submitted by David Jorgensen

Another Perseid at Alcona County Park and Campground, by Adrian Bradley

PLACES & TIMES

Monthly meetings of the University Lowbrow Astronomers are held the third Friday of each month at 7:30 p.m. The location is usually Angell Hall, ground floor, Room G115. Angell Hall is located on State Street on the University of Michigan Central Campus between North University and South University Streets. The building entrance nearest Room G115 is the east-facing door at the south end of Angell Hall.

Peach Mountain Observatory is the home of the University of Michigan's 25-meter radio telescope and McMath 24" telescope, which is maintained and operated by the Lowbrows. The entrance is addressed at 10280 North Territorial Road, Dexter MI, which is 1.1 miles west of Dexter-Pinckney Rd. A maize and blue sign marks the gate. Follow the gravel road to the top of the hill to a parking area south of the radiotelescope, then walk about 100 yards along the path west of the fence to reach the McMath Observatory.



PUBLIC OPEN HOUSE / STAR PARTIES

Public Open Houses / Star Parties are generally held on the Saturdays before and after the New Moon at the Peach Mt. Observatory but are usually canceled if the forecast is for clouds or temperatures below 10 degrees F. For the most up-to-date info on the Open House / Star Party status call: (734) 975-3248 after 4 pm. Many members bring their telescope to share with the public and visitors are welcome to do the same. Mosquitoes can be numerous, so be prepared with bug repellent. Evenings can be cold so dress accordingly.

MEMBERSHIP

Annual dues are $30 for individuals and families, or $20 for full time tudents and seniors age 55+. If you live outside of Michigan's Lower Peninsula then dues are just $5.00. Membership lets you access our monthly newsletter online and use the 24" McMath telescope (after some training). You can have the newsletter mailed to you with an additional $18 annual fee to cover printing and postage. Dues can be paid by Venmo, PayPal, or by mailing a check. For details about joining the Lowbrows, contact the club treasurer at: lowbrowdoug@gmail.com

Lowbrow members can obtain a discount on these magazine subscriptions:

Sky & Telescope - $32.95/year
or $65.90/2 years
Astronomy - $34.00/year, $60.00/2 years
or $83.00/3 years

Newsletter Contributions:
Members and non-members are encouraged to write about any astronomy-related topic. Contact the Newsletter Editor: Amy Cantu cantu.amy@gmail.com to discuss format. Announcements, article, and images are due by the 1st day of the month as publication is the 7th.

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	Jack Brisbin
	Charlie Nielsen
Webmaster:	Krishna Rao
Online Coordinator	Jeff Kopmanis

A NOTE ON KEYS: The Club currently has three keys to the Observatory and the North Territorial Road gate to Peach Mountain. University policy limits possession of keys to those whom they are issued. If you desire access to the property at an unscheduled time, contact one of the key-holders. Lowbrow policy is to provide as much member access as possible.

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STAMP