NORTHERN LIGHTS

NORTH CENTRAL REGION OF THE ASTRONOMICAL LEAGUE

Spring 2021 – Volume 5, Number 4

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NCRAL CHAIR'S MESSAGE

By now, I'm sure that nearly everyone has heard the news that **NCRAL 2021 has been canceled**. In a phone conversation on January 28th, Convention Chair Gerry Kocken informed me that it was necessary to cancel the event. In addition to the problems with face-to-face encounters during these days of pandemic, logistics for our venue – St. Nobert's College in De Pere – had become untenable. The site planned for our convention is currently being used for classroom space and the college's academic year won't end until three weeks *after* our planned convention. The decision of the Neville Public Museum Astronomical Society (NPMAS) to cancel this year's convention is completely understandable and has my full support. I'm greatly disappointed with this turn of events but this was beyond anyone's control.

As you probably already know, I have decided to step down at the end of my current term as Regional Chair. I have completed two terms as Regional Chair (2017-2021) and before that served briefly as Regional Rep. As noted in my last Chair's Message, I have growing health problems. I am finding it increasingly difficult to travel due to back pain. I have already canceled an international trip as a result. I'm willing to continue serving as ***Northern Lights*** newsletter editor if the new Regional Chair deems that desirable.

The Region needs individuals willing to stand for election to the following positions for our May election: **Chair** and **Vice Chair**. The terms of the current office holders – yours truly and Bill Davidson, expire on May 8th. Our present **Secretary-Treasurer**, Roy Gustafson, is willing to stand for election to complete the term to which he was appointed last spring after NCRAL 2020 was postponed. Others may stand for election to this office too if they are desirous of completing the one-year unexpired term of the current office holder. Bill Davidson, our **Regional Representative** to the Astronomical League, continues in this position unless he should become Chair.

This year's elections will be conducted electronically with special electors. I sent out an email notice on February 22nd about the election procedures to be followed in the event of not holding an annual business meeting. (That email is repeated starting on page 2 of this newsletter.) Procedures are stipulated by the Region's Bylaws. Things should work out well. My only concern is not having the necessary candidates to fill open positions. Please consider nominating someone for an open position; please self-nominate if you are willing to run for office. See the Call for Nominations later in this issue of ***Northern Lights*** for procedures.

Let's also not forget to nominate worthy candidates for the 2021 **Region Award** and **Newsletter Editor Award**. This year's winners will be announced online on May 8th even though we will not be having an annual business meeting. The Region Award plaque and Newsletter certificate, like those associated with NCRAL 2020, will be presented at NCRAL 2022. The NCRAL mini grants, of which there are two types, will be distributed without delay as was the case earlier. Again, see the guidelines for these awards and grants later in this issue of the newsletter.

This will be my last newsletter communication with you as Regional Chair. We have made significant changes during my two terms. We have added the NCRAL Newsletter Editor Award, developed and awarded our first membership- and affiliate-recruitment mini-grants, established the seasonal NCRAL Messier Mini Marathons, published 16 issues of ***Northern Lights*** (378 pages, and over 200,000 words!), and hosted two Regional conventions. These accomplishments and more have been documented in our **Region Reports** to the Astronomical League. Who knows what more we might

have accomplished had we not canceled our Regional conventions of 2020 and 2021.

There are plenty of talented individuals within NCRAL to lead the Region to greater heights. It seems that the words of my article about club leadership needed for our time, and that appeared in the last issue of this newsletter, were prescient. I hope that everyone will go back and read the article if they have forgotten what I said. Regardless of my departure from office, I hope to "hang around" to assist the new Chair with duties if desired, prepare this newsletter, and help write the annual Region Report for 2020-2021 if requested.

My four years as Regional Chair and one year as Regional Representative have been fun and informative. Worthy of note have been our regional conventions and business meetings. Not to be forgetting is the AL nation convention held within our Region. I'm deeply indebted to our regional hosts (RAS, DPAS, PAS, NCSF, NPMAS) and national host (MAS) – actual or intended – during my time as Chair. I can't tell you how disappointed I was by the cancellations of NCRAL 2020 and NCRAL 2021. They would have been wonderful. Even our club events were cancelled across the Region due to the constraints imposed by the pandemic.

I'm looking forward to attending and seeing everyone at NCRAL 2022 in Port Washington, Wisconsin, if my health does not preclude the travel required for me to get there. If not, I hope to see everyone at NCRAL 2023 when the Twin City Amateur Astronomers (TCAA), my local astronomy club, will be hosting. We have already begun planning this event.

I thank my fellow officers and aides… John Attewell (Vice Chair, my first term), Bill Davidson (Vice Chair, my second term and Region Rep. throughout), Roy Gustafson (Secretary-Treasurer), Jeff Setzer (webmaster), and Jim Gibbs (newsletter-coeditor who helped to launch this new iteration of ***Northern Lights*** during the summer of 2016). Additionally, I would be remiss were I not to thank all those who contributed many magnificent articles to this newsletter since the summer of 2016. Thank you!

Carl J. Wenning
NCRAL Chair (2017-2021)
carlwenning@gmail.com

NCRAL Elections Online May 7-8, 2021

NCRAL Members,

Because NCRAL's 2021 convention has been cancelled, elections for Regional officers will be held online May 7-8, 2021. Elections must be held for the following officer positions: Chair (term: 2021-2023), Vice Chair (term: 2021-2023), and Secretary-Treasurer (filling the unexpired portion of the 2020-2022 term). A second election might need to be held after the officer election to fill the position of Regional Representative. Our Vice Chair is currently serving in this capacity.

We must now begin the processes of nominating and electing officers for the Region. A review of the **Region's Bylaws** shows the following in relation to these matters:

ARTICLE II OFFICERS
Section 1.
The NCRAL officers shall be the Chair, Vice Chair, and Secretary-Treasurer.

ARTICLE V - ELECTIONS
Section 1.
The NCRAL Officers shall be elected by a majority vote of the members present at the Regional Business Meeting of the NCRAL or, if none is held in a given year, by a majority vote of the Council.

ARTICLE III COUNCIL
Section 1.
The affairs of the NCRAL shall be administered by a Council, consisting of the Regional officers, the Representative to the National Council, the President or the Presidents proxy from each society, a second representative from each society, and one representative selected from and by the members-at-large in the NCRAL who are in attendance at the meeting.

So, in compliance with the Region's Bylaws, the following **electors** will cast ballots during the upcoming election of officers given the current circumstances:

- Regional Officers (Chair, Vice Chair, and Secretary-Treasurer)
- Representative to the National Council (Regional Rep.)
- Presidents (or a proxy) from each NCRAL affiliate
- A second representative from each NCRAL affiliate

Electors should contact the Regional Chair (carlwenning@gmail.com) immediately to obtain voting credentials (a voter passcode) for online balloting.

Every affiliates' president should designate a second representative from their clubs and forward that person's name, club, and email address to me so that credentials can be prepared.

Notifications about officer candidates and voting procedures for **electors** should be subscribed to NCRAL's member database that is used to disseminate the ***Northern Lights*** newsletter. This database will be used to distribute election-related notifications in early May. Electors may go to the following case-sensitive URL now to add their contact information to NCRAL's database at https://goo.gl/gsS8SF if they are not already subscribed and desire to vote.

Nominations are needed for officer positions. The Chair is required to appoint a nominating committee chair according to the Region's Bylaws:

ARTICLE V ELECTIONS
Section 2.
The NCRAL Chair shall appoint a nominating committee chair who will not be eligible to stand for election to any NCRAL office. The nominating committee chair shall select, from among the NCRAL membership, one or more candidates for each office to be elected… Additional nominations may also be made by any NCRAL member to the committee chair…

If NCRAL members are willing to serve on a nominating committee or to chair of such a committee, those persons should contact me immediately at carlwenning@gmail.com. I currently have one volunteer. I also am willing to sit on this committee as I am not running for elective office.

Here is a summary of **critically important information** pertaining to the election:

- A nominating committee chair must be appointed by March 1st; please volunteer if you are willing to serve.
- All nominations must be forwarded to the Regional Chair no later than May 1st.
- Only designated electors will be permitted to cast ballots in this election.
- A unique voter passcode will be required for each elector to help ensure election integrity.
- Designated electors should email NCRAL Chair at carlwenning@gmail.com no later than Monday, May 3rd to obtain a voter passcode.
- The election will take place online on a website to be announced; the voter passcode must be entered at this time.
- Online voting will be open from 6:00 AM on Friday, May 7, 2021 through 6:00 PM on Saturday, May 8, 2021.
- Results of the election will be broadcast via NCRAL's email database and via its Facebook page by 9:00 PM on Saturday, May 8.

Contact me by email now if you are willing to assist, make a nomination, self-nominate, or have any questions or concerns.

Carl J. Wenning
NCRAL Chair (2017-2021)

BASIC NCRAL OFFICER JOB RESPONSIBILITIES

The following list is a ***general and unofficial*** description of job responsibilities associated with elected positions within NCRAL. This list will assist prospective candidates decide whether to run for office. It is being provided by request. An official and detailed listing is available in the Region's Bylaws.

Chair: The Chair serves as Regional leader. The Chair must:
- be familiar with and conduct the Region's affairs in compliance with its Bylaws;
- appoint individuals to serve as webmaster, newsletter editor, and observing programs coordinator;
- set the agenda and conduct annual business meetings at annual conventions of the Region;
- Prepare a Region Report and submit it to the national office each June; and
- participate as a member of the AL's national council to the extent possible.

Vice Chair: The Vice Chair works to assist the Chair in the discharge of his or her duties and serves in place of the Chair when that person is unable or unwilling to fulfill the duties of that office. In addition, the Vice Chair must:
- oversee the Region's award processes; and
- oversee the Region's mini-grant application processes.

Secretary-Treasurer: The Secretary-Treasurer must:
- prepare minutes of annual business meetings for dissemination to the membership;
- maintain the Region's funds and fiscal accounting, providing regular reports to the leadership; and
- disperse funds as directed by the Chair.

Regional Representative: The Regional Representative is one of two "voices" on the national council of the Astronomical League, the other being the Regional Chair. The Regional Representative must:
- attend annual Board meetings of the AL when possible or seek an alternate in cooperation with the Region's Chair; and
- represent the Region's interests at national board meetings.

NCRAL Financial Statement Winter 2021

~ Reported by Treasurer Roy Gustafson ~

Check #	Date	Description	Check Amount	Deposit	Daily Balance	Monthly Balance	
	30-Nov-2020					$8,668.81	Nov
	31-Dec-2020					$8,668.81	Dec
	31-Jan-2021					$8,668.81	Jan
1016	12-Feb-2021	Carl Wenning (reimbursement for shipping Mini Messier Marathon resources)	$20.55		$8,628.26		
	28-Feb-2021					$8,628.26	Feb

Pike River Starfest

The Pike River Starfest is entering its 7th year. This starfest is located in northern Wisconsin. It boasts the darkest skies at any starfest in the State of Wisconsin. Last year, a reading of 21.85 on the Sky Quality Meter at 11:30 PM two nights in a row. The starfest will take place on Wednesday night July 7th thru Sunday morning July 11th. The site is located at N14720 US Hwy 141, Amberg, Wisconsin.

The site can accommodate approximate 30 camp sites. Tents and mobile homes are welcome. The site will have portable toilets on site. There is no power to the sites themselves; however, there is power at the building for charging batteries and if a person chooses to camp next to the building, power will be supplied. There will be three picnic tables available. Water and soap for doing dishes, clean water for rinsing along with clean towels will be supplied. A camp stove and grill also will be available. Midnight snacks will be served similar to Northwoods Starfest. In the event of cloudy weather, a fire pit for a bonfire is available. In event of rain, we have a conference room with a full library of astronomy books available and TV with a DVD player. The conference room will also be used for serving midnight snacks.

During the days, hiking, tubing on the Pike River, trout fishing on the Pike River (Class a Trout stream) golf, white water rafting on the Menominee River or Peshtigo River within in a 35-minute drive, Iron Mountain Iron Mine in Norway, which is a 25-minute drive, or tour any or all of Marinette County's 15 waterfalls. Dave's Falls is within

walking distance of the camp sites, ½ mile. There is a daily fee charged to enter county parks, which allows as many parks you want to visit in one day. There are also several history museums in which you can visit in the area. There are two hotels in the area, 9 miles south in Wausaukee and 9 miles north in Pembine. Showers are available 2 blocks north at the Italian Inn for $5.00.

Registration is $10.00 per night per person. Pre-registration is required. Fees will not be returned in event of weather or cancellation. When campsites are filled registration will be halted. First come, first served. Registration is due by June 15th. After that dues will increase to $15.00 per night per person until June 30th. Please indicate what nights you plan on attending and how many individuals in your party. Registration fees should be sent to Gerry Kocken, PO Box 142, Amberg, Wisconsin 54102. For additional information or questions, please contact me at gerryk@kockenwi.com or phone (920) 676-6363.

Standard rules for star parties will be enforced.

CALL FOR 2021 NCRAL NOMINATIONS & APPLICATIONS

CHAIR/VICE CHAIR/SECRETARY-TREASURER/REGION AWARD/NEWSLETTER EDITOR AWARD/MINI-GRANTS

The terms of Regional Chair and Vice Chair end with the next Regional Business Meeting when we elect officers for two-year terms. Our Secretary-Treasurer is serving during the interim until such time as he or his replacement can be found to complete the second year of a two-year term. See this issue's message from the Regional Chair for details.

It's never too early to start thinking about nominations for the NCRAL Region Award. Do you know someone who has dedicated his or her time and energy to promoting astronomy? Wouldn't you like to let them know they are appreciated for their hard work? This is your chance! This award recognizes exceptional individual effort and meritorious service to amateur astronomy through the member's local astronomy club, public outreach, the NCRAL, or the Astronomical League.

The Regional is now calling for nominations for the 2021 Region Award. Using the guidelines and submission forms below, we have made it easier than ever to nominate someone you feel deserves this award. This award will be presented in a ceremony concluding the dinner banquet of the next Regional convention, NCRAL 2021, to be held at De Pere, WI, the second weekend of May.

The Rules for nomination are as follows:

1. The individual must be a member in good standing, either through an AL/NCRAL-affiliated club, association, or society or as a current member-at-large in the North Central Region.
2. The three current regional officers and the regional representative are NOT eligible for this award. Past winners are also ineligible for this award.
3. The regional officers are the voters and will base their decision on the information provided. Past winners of this award will be asked to assist in the case of a tie vote. Each member votes independently and will use his/her best judgment. All decisions are final.
4. The winner will be contacted not less than 21 days in advance of the NCRAL meeting at which the award will be presented. The winner will not be publicly revealed until the time of the presentation. Those nominated but not selected will not be revealed.
5. All non-winning nominations will be kept on file for two years after initial submission. After such time, a new nomination needs to be competed. Nominations for the 2021 Region Award MUST BE RECEIVED by March 31st. Any nominations received after this date will be kept on file for 2022.

There are many deserving candidates within NCRAL. We look forward to receiving your nomination(s). If there are any questions, please contact Vice Chair Bill Davidson via phone or email using the contact information found below.

Submission Form for the NCRAL Region Award

Nominee's name (as it will appear on plaque) _____

Nominee's email address _____

Street address _____

City _____ State _____ Zip _____

Club affiliation _____

Nominator's name _____

Club affiliation _____

Street _____

City _____ State _____ Zip _____

Phone _____

Email _____

Submission Guidelines

Prepare a *statement of the nominee's accomplishments* in one or more of the areas listed under the criteria described in first paragraph on page 1. This statement should:

- Not exceed 3 double-spaced pages (1,000 words). Length does not necessarily equal strength.
- Include the number of years in office or committee membership.
- Include the dates of said membership.
- Include the length of time participating in public education, number of presentations, etc.

and should include *supporting data:*

- Any relevant newspaper clippings, photos, and other articles that support the nomination.
- For service to groups such as schools, scouts, etc., it would help the committee if you could obtain a brief statement from the teacher, leader, chair etc. on the usefulness of the presentation.

All nominations must be sent via email to Bill Davidson, NCRAL Vice Chair, at rochesterskies@outlook.com

Let's not forget about the **NCRAL Newsletter Editor Award**. It is expected that the next award will be conferred at the NCRAL 2021 meeting. Submission Guidelines: The president of the club/society/association should email a copy of the designated issue of the associated newsletter in Adobe Acrobat pdf file format to NCRAL Vice Chair Bill Davidson (rochesterskies@outlook.com), along with a cover letter of recommendation in the same file format. In addition, complete contact information of the editor must be included. A photo of the newsletter editor, preferably in an astronomical-type setting, must be received electronically in jpg format to the same email address by March 31st.

Lastly, don't about the two **NCRAL mini-grants**. A mini-grant will be awarded following a successful written proposal originating with the president of an NCRAL affiliate. The focus of a mini-grant must be oriented to an increase in either: (1) an affiliate's membership whose mini-grant proposal must focus on both recruitment and retention (Member Recruitment & Retention Mini-grant), or (2) an increase in the number of A.L.-affiliated clubs, societies, or associations within the North Central Region (Non-affiliate Recruitment Mini-grant). A unified online mini-grant application must be completed by the deadline noted below. The application link may be found at the following URL: http://bit.ly/2W2pdeA Deadline: The application deadline for all mini-grants is March 31st. Mini-grants, if approved, will be announced at NCRAL 2021. *An extension of time to complete the grant activities will be automatically granted for 2021/2022 due to the pandemic, so don't hesitate to apply.*

NCRAL Seasonal Messier Marathon Awards – Winter 2021

The following individuals have qualified for NCRAL's **Winter Mini Messier Marathon** certificate and pin. The letter "U" indicates unassisted. Pins and certificates will be distributed shortly. Congratulations to our successful observers!

#7. Lisa Wentzel, TCAA (Jan 18-19), U

Noteworthy!

The following NCRAL members were recognized in the March 2021 issue of the Astronomical League's ***Reflector*** magazine for having completed observing programs. Congratulations to all for their many and varied successes!

Beyond Polaris Observing Program:
Eric Edwards, Minnesota Astronomical Society
Kevin C. Carr, Minnesota Astronomical Society

Binocular Variable Star Observing Program:
Lisa Wentzel, Twin City Amateur Astronomers

Double Star Observing Program:
Ron Ziss, Minnesota Astronomical Society

Galileo Observing Program:
Antone Gregory, Binoculars, Minnesota Astronomical Society

Herschel 400 Observing Program:
Don Gazdik, Minnesota Astronomical Society

Messier Observing Program:
Stephen Paveda, Honorary, La Crosse Area Astronomical Society

Open Clusters Observing Program:
Lisa Wentzel, Twin City Amateur Astronomers

Stellar Evolution Observing Program:
Antone Gregory, Minnesota Astronomical Society

Urban Observing Program:
Dave Osenga, Twin City Amateur Astronomers

A Homebuilt Solar Wind Magnetometer

~ By Tim Stone, Twin City Amateur Astronomers ~

A few months ago, I became aware of an intriguing citizen science project. Tom Field, the gentleman who wrote the Rspec software I use for processing stellar spectra, referred me to a video on YouTube demonstrating how one can monitor the strength of the solar wind magnetic field using common or inexpensive components. Created by Dr. Shawn Carlson who some would recognize as a regular contributor to *Scientific American* magazine's "Amateur Scientist" monthly feature (back in the day), the video was based on an article he wrote for the January 1999 issue of that magazine. I was completely unaware that of the article and if you had asked me if a homebuilt magnetometer to monitor the solar wind was possible for someone without a sizeable grant, I would have laughed and said, "No way!" This video showed how it is done, and I was instantly hooked.

The instrument is surprisingly simple and easy to build. Using neodymium magnets holding each other onto a microscope slide cover slip and suspended on a single strand of nylon, it is possible to build a magnetometer of astonishing precision. Using a nylon strand in this arrangement is called a "torsion balance."

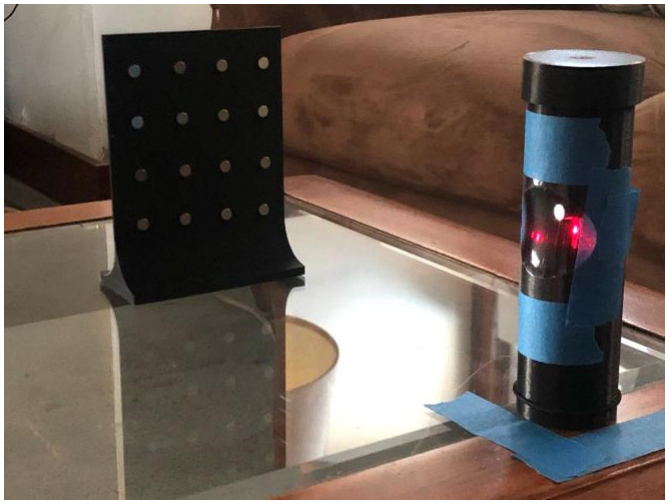
Properly constructed, torsion balances are among the most sensitive scientific instruments we know how to construct. The strand of nylon is pulled from a nylon kite string. Fortunately, as a kite-lover, I have some of that laying around the house. The microscope slide cover slip acts as a reflector for a laser pointer beam. Also, fortunately, I have a microscope, slides and cover slips in my office. (I do have interests other than astronomy!) Stretching the nylon with the affixed cover-slip-and-magnets assembly between two supports finishes the sensor. With this arrangement, as the magnetic field shifts, the sensor rotates to align with it, thus deflecting the laser beam by a measurable amount.

My friend, Jeff, designed and 3D printed an enclosure for my instrument, and the sensor was installed in short order. Next, I needed a laser pointer that could run continuously, so a battery operated one was not suitable. After searching a while, I decided to just buy a laser diode and make my own, powered by a Walmart-style power adapter. That required some external electronics to operate correctly; normally, these electronics are built into our laser pointers. I looked online for circuits to drive LED lasers, and found one that looked simple enough. After purchasing the needed components online for a few dollars, Jeff supervised as I constructed the circuit and turned it on. The laser lit and the second component of my magnetometer was complete.

The third component was a 4x4 grid of magnets. This grid is positioned near the sensor to precisely cancel out Earth's magnetic field. Without this nulling array, the sensor is nothing more than a simple compass, always pointing to magnetic north. The solar wind magnetic field is thousands of times weaker than Earth's but fortunately cancelling it out is simple. Jeff 3D printed me a stand for my magnet array and following the instructions on the video resulted in an effective nulling of the powerful magnetic field of our planet.

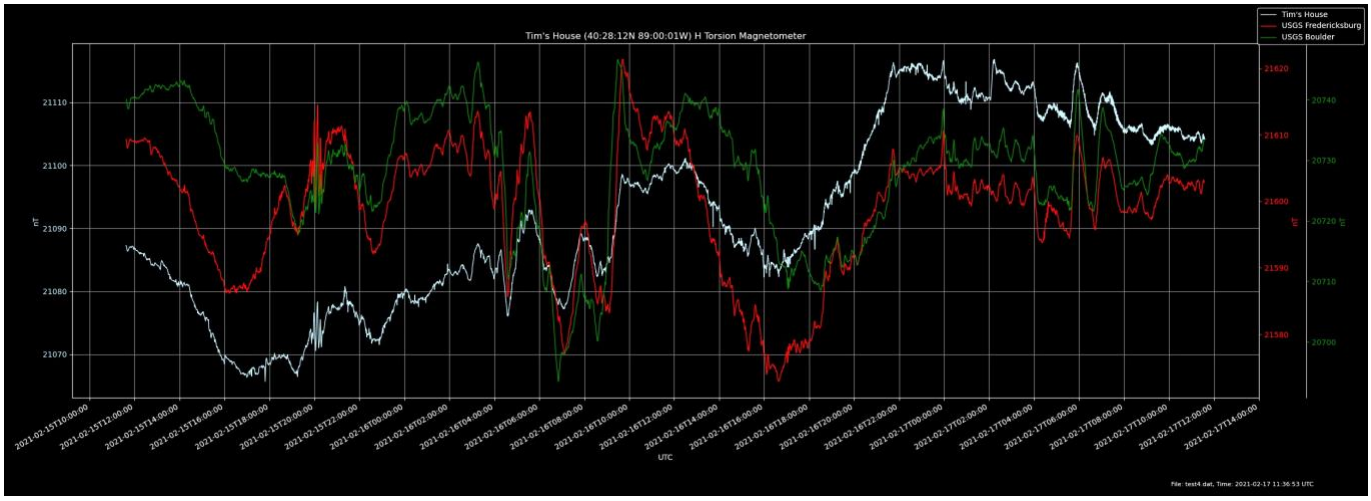
The reflected beam shows on a white card, where the deflection can be measured. Measurement can be done manually with a scale printed onto the card, or with a computer running a program that watches the position of the dot using a webcam. In addition to Rspec, Tom Field has also written a program to monitor and record the position of a laser dot on a screen for just this purpose, and he kindly gave me a copy of that program. With the placement of a white card to make the reflected laser dot visible, and a web camera and an old laptop with a Chinese keyboard (it belonged to our Taiwan exchange student), the instrumentation was complete. Note: the Chinese keyboard is not required for this project to work.

The initial results were hard to understand, so much so that I thought the instrument wasn't even working. The sensor wouldn't stop oscillating back and forth, and there were large, seemingly unpredictable deflections of the sensor. After consulting Dr. Carlson, who has been EXTREMELY helpful, and working to understand what was going on, I identified some tweaks I needed to implement. The first was to shield the sensor from air movement. While I couldn't *feel* any air movement, it turns out even the slightest movement of air is enough to disturb this sensitive sensor. Covering the sensor housing in clear plastic wrap cleaned things up a LOT. The oscillations settled down nicely, albeit slowly. To dampen these oscillations even further, I taped a copper penny, dated 1944 to be exact, to the back of the housing. The interaction of the magnets with the copper induces currents in the copper which oppose the movement of the magnets, helping them reach equilibrium alignment with the solar wind magnetic field much more quickly.



The next thing I noticed was the seeming correlation between some of the relatively large deflections and the presence or absence of my car in the driveway. Some experimentation confirmed the correlation, demonstrating to me that the magnetometer is sensitive enough to easily detect the comings and goings of my car from 50 feet away. Some of the craziness turned out to be due to variations in lighting in the room. As the sun angle lowered in the afternoon, the room would brighten and the computer would try to compensate for this, sometimes losing the dot entirely. A cardboard cover for the webcam and the screen (not in the picture) solved that problem. There are other brief but large deflections I haven't identified as of yet, but my house is a magnetically noisy environment. Vehicles driving by the house, an airplane flying over, a vacuum cleaner somewhere close, or anything like that is enough to make the sensor twitch. It is fascinating to watch.

I've run my magnetometer for some time now. To see its data, I wrote a program in Python to plot the data coming from my sensor. The program also plots data from USGS stations in Boulder, Colorado and Fredericksburg, Virginia. The similarity between my data and that of the USGS stations is striking and validates to me that my instrument is working well.



A comparison of sensor readings. The author's readings are shown in pale teal. Red and green are Fredericksburg and Boulder respectively.

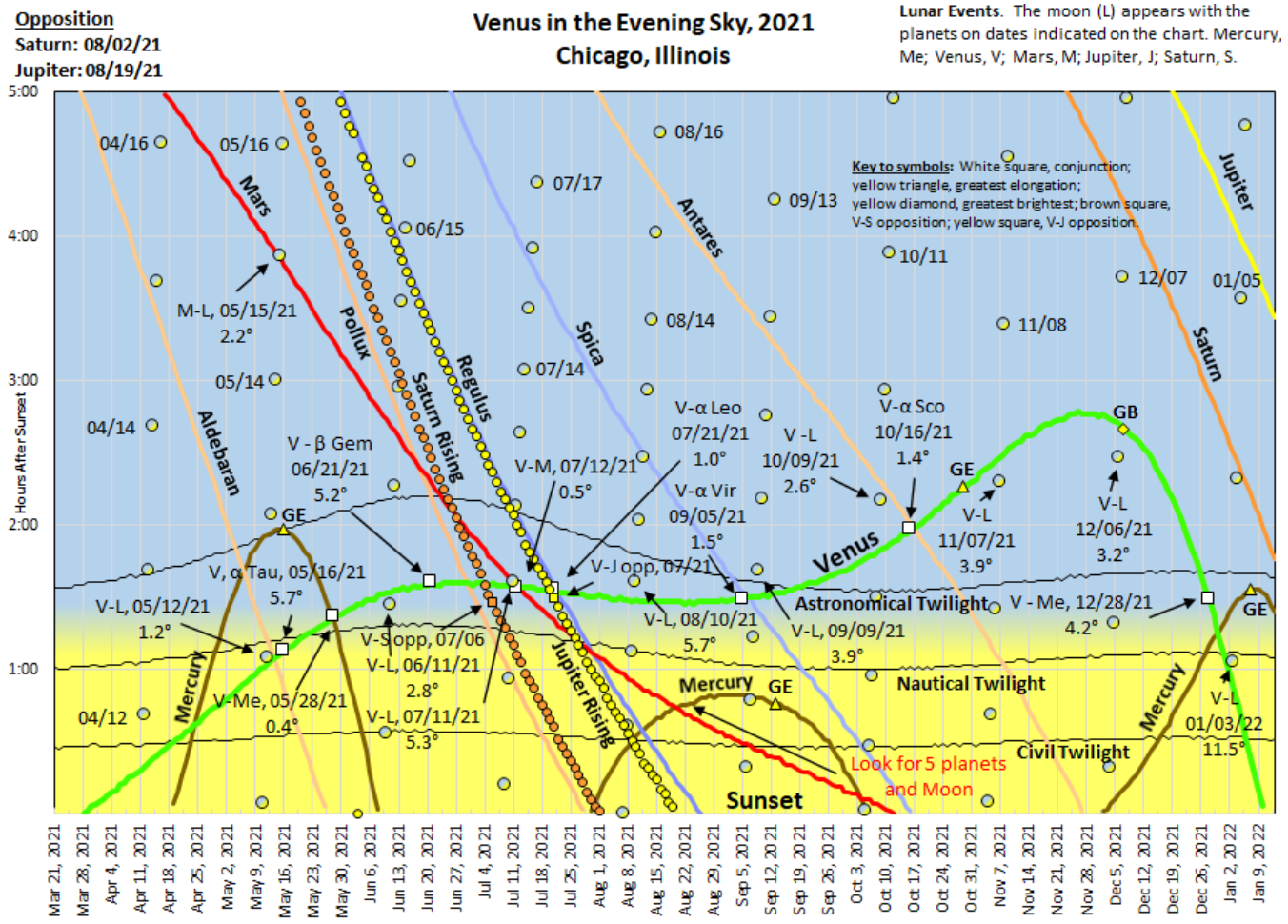
The above image shows one of the most interesting plots from my station. It was February 15, a very geomagnetically active day, which started with an energetic event at 20:00 universal time. This event coincided with an abrupt drop in the density of the solar wind. A high-density solar wind compresses the magnetic field between the earth and the sun. Since this was during the day, my station was right underneath the compressed field. With the abrupt change in the solar wind density, the magnetic field rebounded like a plucked string, ringing for thirty minutes or so. It was spectacular to watch it as my program traced the rapidly changing field strength! With the solar cycle picking back up, I know there will be plenty more. This event showed on the NOAA Planetary K Index monitor as a K5 event, not the most powerful by any means, but significant, nonetheless.

As you can see, there's a considerable amount of painter's tape involved at this time. To me, this is just a prototype. All-in I've shelled out about $30. Jeff and I are in the process of designing the second version of the sensor instrument. With the improvements we plan, I will be able to calibrate my instrument so I can transform the deflection amount in pixels to magnetic field strength units of measure. I hope to run this instrument for years, so I can watch the levels of activity as they change throughout the solar cycle. I want to locate the magnetometer in a magnetically quiet place (does anyone know of a place that would be suitable?). I hope to be able to monitor the sun at radio frequencies to correlate radio bursts to solar wind events, to calculate the speed of the solar wind. Perhaps, because I'm monitoring in real-time, I can issue alerts to the radio club for potential or occurring magnetic events that could aid (or hinder) amateur radio at certain frequencies, or to the TCAA to watch for possible auroral activity.

You might ask why anyone would have such an instrument at home. Sure, there are satellites to measure the solar wind magnetic field with a great deal of precision. The USGS and consortiums of other nations have their own ground-based networks of precision magnetometers. Of course, the answer to the question is the same as to the question "Why would anyone have their own telescope?" There is value in hands-on science! I've learned SO much already about the magnetic environment of our planet's neighborhood. I can't wait to learn more. As I do, I'm sure I'll identify plenty of projects involving my magnetometer. For now, though, I'm just happy to see a little red dot moving across a white card and to know: the solar wind is doing that!

VENUS: EVENING STAR 2021

~ by Jeffrey L. Hunt ~



This chart displays the setting time intervals for the bright planets, moon, and bright stars near the ecliptic compared to sunset. Conjunctions with Venus and groupings with the moon are identified.

After the vernal equinox, Venus begins an evening apparition that is difficult to observe during the first three months. The planet's visibility seems to lag after its superior conjunction on March 26, 2021. Nearly a month later, it sets at Civil Twilight, coinciding with its first evening appearance in the west-northwest.

During the apparition, the planet first appears farther north along the horizon and then gently moves southward during the summer and early autumn. It sets at its farthest north point during late May and continues leaving the sky there for nearly three weeks. Afterward, the setting azimuth moves southward about 1° every two days. Until about the autumnal equinox, the planet is only about 10° up in the sky around 45 minutes after sunset. This long duration of low altitudes is partly from the long twilight periods of summer, and the shallow angle of the ecliptic.

Beginning a few days before Halloween, Venus sets at its most southerly azimuth until mid-November. Even as the planet is at its greatest elongation and nears its greatest illuminated extent near year's end, Venus sets less than three hours after sunset.

Venus moves eastward along the ecliptic compared to the starry background until December 18. During the next three weeks, until the planet's inferior conjunction, Venus loses 134 minutes of setting time, over 6 minutes each evening.

Highlights of the planet's evening appearance include three Mercury conjunctions, and conjunctions with Pollux, Mars, Regulus, Spica, and Antares. While a challenge, Venus appears near the Beehive star cluster (July 2). Near mid-August a difficult view of the five bright planets is possible, although Mercury and Mars are very low in the western sky

during bright twilight. Venus' low celestial latitude places it among the stars of the classic Scorpion and the Teapot of Sagittarius later in the year.

During this apparition the crescent moon appears nine times with Venus. The closest (1.2°) occurs on May 12. The second closest (2.6°) occurs on October 9. The widest (11.5°) occurs January 3, 2022, five days before the Venusian planet's inferior conjunction. The December 6 Venus – moon grouping (3.2°) should be very attractive to photographers with the moon only 10% illuminated near a dazzling Venus, during its interval of greatest brightness.

The chart above displays the setting time of Venus (green curve) compared to sunset. The three phases of twilight are displayed as well. The setting time differences are displayed for bright stars near the ecliptic as well as other bright planets. The moonset interval is displayed with circles. The rising time difference – compared to sunset – is displayed for Jupiter and Saturn as well. When the planets rise at sunset, they are at opposition.

Saturn's opposition with Venus is displayed as a brown box on the Saturn Rising line. A yellow box on the Jupiter Rising line indicates a similar event, Venus – Jupiter opposition. In the evening, when two planets are at opposition, opposite sides of Earth, one is rising as the other sets. A week or so after these dates Saturn, then Jupiter, appear in the eastern sky as Venus shines from the west. In this study of Venus, this trio is in the sky together during evening hours until nearly the end of its evening appearance during early 2022.

When the Venus curve crosses another line, Venus and that celestial object set at the same time. Conjunctions occur near this date. White boxes on the charts indicate conjunctions with stars and other planets. The yellow triangle, with the letters "GE," indicates the greatest elongation dates of Venus and Mercury.

The setting chart is from data by the U.S. Naval Observatory's Multiyear Interactive Computer Almanac (MICA) for Chicago, Illinois. Make any appropriate adjustments for different latitudes. Time intervals after sunset are used in the following notes for observers to determine the appropriate observing clock time at their locations.

For the notes that follow, each entry tracks the planet's magnitude, angular diameter, phase as the percent of the planet that is illuminated, its distance from Earth in Astronomical Units (AU) and the interval it sets after sunset – expressed in minutes (m). When the moon is included in a note, its age in days (d) and fraction illuminated as a percent are listed. The time interval for the first four observations on the list is 30 minutes after sunset. Then, the window shifts to 45 minutes after sunset.

Into Bright Twilight

After inferior conjunction (March 26, 2021), Venus slowly emerges into the evening sky during bright twilight. The closest Venus – moon grouping occurs on May 12. Venus is moving eastward in Taurus.

- **April 19**: (−3.9, 9.7", 99%, 1.71 AU, 30m) Venus sets at Civil Twilight. During the next few evenings, begin looking for Venus about 2° above the west-northwest horizon at about 20 minutes after sunset. Use a binocular to first locate it. It is making its first evening appearance of this apparition.

May 12: The closest Venus – moon grouping of the apparition occurs this evening. Thirty minutes after sunset in the west-northwest, use a binocular to observe Venus, 1.2° to the right of the crescent moon.

- **May 12**: (−3.9, 10.0", 98%, 1.67 AU, 62m) Venus – about 5° up in the west-northwest – is 1.2° to the right of the crescent moon (1.3d, 1%). This is the closest Venus – moon grouping for this apparition.
- **May 16**: (−3.9, 10.3", 97%, 1.66 AU, 68m) Venus – 6.0° up in the west-northwest – is 5.7° to the upper right of Aldebaran (α Tau, m = 0.8). This is a challenging observation as the star is only 3.0° in altitude. Use a binocular to see the scene.
- **May 21**: (−3.9, 10.1", 97%, 1.65 AU, 74m) Venus sets at Nautical Twilight.

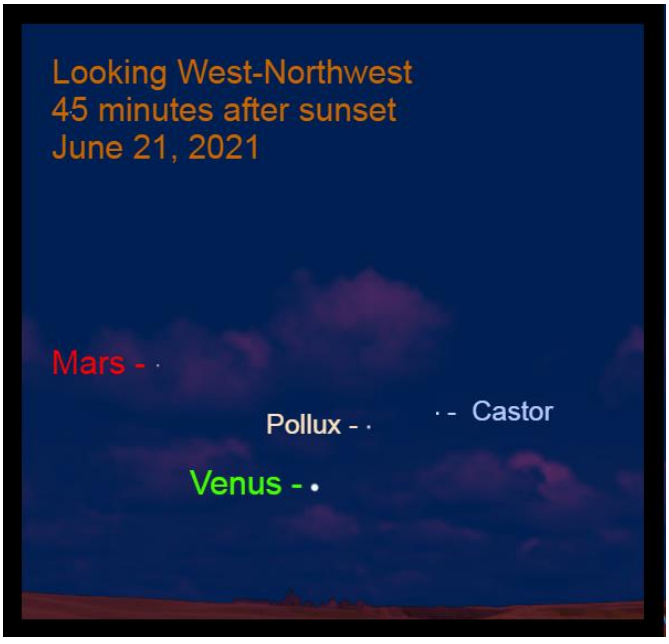
From Taurus into Gemini

The time interval shifts to 45 minutes after sunset. Mid-twilight does not occur until over an hour after sunset at this season. Evening twilight is already over two hours long, and it continues to lengthen nearly another 10 minutes until the summer solstice at Chicago's latitude. A binocular is needed to track the planet through the starfields. Further, it is important to state that some of the objects of dimmer magnitudes might be lost in the bright twilight, even with optical aid. Venus begins this observing sequence between the horns of Taurus then steps into Gemini. It reaches is most northerly setting point, then sets farther southward as spring becomes summer.

- **May 27**: (−3.9, 10.2", 96%, 1.63 AU, 80m) Venus – over 5° up in the west-northwest – is 4.6° to the lower left of Elnath (β Tau, m = 1.6) and 3.4° to the right of Zeta Tauri (ζ Tau, m = 3.0). Venus is 1.2° to the lower right of Mercury (m = 2.0). This evening Venus is below a line that connects ζ Tau and β Tau. Venus sets at its most northerly azimuth, 304°, through June 14.

May 28: Thirty minutes after sunset, observe Venus, nearly 6° up in the west-northwest. It is 0.4° to the upper right of Mercury.

- **May 28**: (−3.8, 10.2", 96%, 1.63 AU, 82m) Venus, nearly 6° up in the west-northwest, is 0.4° to the upper right of Mercury (m = 2.2). At this time the brilliant planet is 3.0° to the upper right of ζ Tau and 4.9° to the lower left of Elnath, but slightly above a line that connects the horns of Taurus.
- **June 2**: (−3.8, 10.3", 95%, 1.61 AU, 86m) Venus – 6.0° up in the west-northwest – moves into Gemini, 3.5° to the lower right of Eta Geminorum (η Gem, m = 3.3).
- **June 3**: (−3.8, 10.4", 95%, 1.61 AU, 87m) While a challenge to see the sideral background, Venus – 6.5° up in the west-northwest – is 0.3° to the lower right of the star cluster M35 (NGC 2168).
- **June 4**: (−3.8, 10.4", 95%, 1.60 AU, 87m) Venus – 6.5° in altitude above the west-northwest horizon – passes 2.0° to the upper right of η Gem.
- **June 6**: (−3.8, 10.4", 95%, 1.60 AU, 89m) Venus – nearly 7° up in the west-northwest – passes 1.9° to the upper right of Mu Geminorum (μ Gem, m = 2.8).
- **June 10**: (−3.8, 10.5", 94%, 1.58 AU, 92m) Venus – over 7° up in the west-northwest – passes 0.8° to the lower left of Epsilon Geminorum (ε Gem, m = 3.0).
- **June 11**: (−3.8, 10.5", 94%, 1.58 AU, 92m) Over 7° up in the west-northwest, Venus is 2.8° to the upper left of the crescent moon (1.6d, 2%) and 1.6° to the upper left of ε Gem.
- **June 17**: (−3.8, 10.7", 93%, 1.55 AU, 95m) Nearly 8° up in the west-northwest – Venus passes 1.6° to the upper right of Delta Geminorum (δ Gem, m= 3.5). At this time Venus is 6.9° below Pollux (β Gem, m = 1.2).



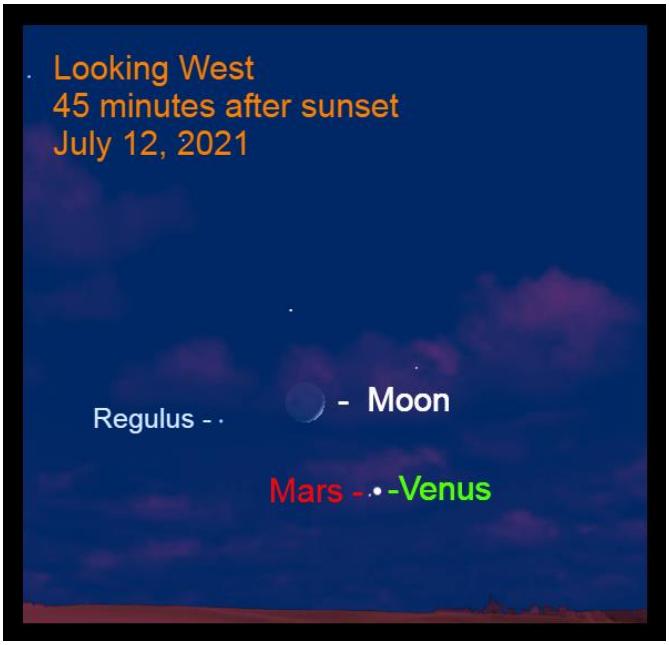
June 21: Venus passes 5.2° to the lower left of Pollux.

- **June 21**: (−3.8, 10.8”, 92%, 1.53 AU, 96m) Over 8° up in the west-northwest, Venus passes 5.2° to the lower left of Pollux and 1.5° to the lower left of Kappa Geminorum (κ Gem, m = 3.6).
- **June 24**: (−3.8, 10.9”, 91%, 1.52 AU, 96m) Below a line from Castor (α Gem, m = 1.6) and Pollux, Venus is 6.4° to the lower left of Pollux. Look for Venus over 8° above the west-northwest horizon.

Mars Joins Venus

Still low in the sky during brighter twilight, brilliant Venus moves through Cancer and Leo. Mars enters the scene (within 10°) as it moves toward its solar conjunction. As the ecliptic’s angle with the western horizon decreases, the Venusian setting time interval shrinks several minutes until late August. Venus passes the Red Planet (July 12) and Regulus (July 21). A binocular is needed to make observations of conjunctions with the dimmer stars.

- **June 25**: (−3.8, 11.0”, 91%, 1.52 AU, 96m) Over 8° up in the west-northwest, Venus – now in Cancer – is 7.2° to the left of Pollux and 10.3° to the lower right of Mars (m = 1.8).
- **July 1**: (−3.8, 11.2”, 90%, 1.49 AU, 95m) Venus – nearly 7° up in the west-northwest – passes 0.2° to the upper left of Eta Cancri (η Cnc, m = 5.3). The Venus – Mars gap is 6.7°.
- **July 2**: (−3.8, 11.2”, 90%, 1.48 AU, 96m) Nearly 9° up in the west-northwest, Venus is 0.4° to the right of the Beehive star cluster (M44, NGC 2632). The cluster’s low altitude makes this a challenge. Mid-twilight is still 20 minutes away. Mars is 6.1° to the upper left of Venus.
- **July 3**: (−3.8, 11.3”, 89%, 1.48 AU, 96m) Venus – about 9° up in the west-northwest – passes between Gamma Cancri (γ Cnc, m = 4.6) and Delta Cancri (δ Cnc, m = 3.9). The stellar pair is 3.3° apart and Venus is nearly midway between them. The Venus – Mars gap is 5.5°. The gaps during early July: **07/04**, 4.9°; **07/05**; 4.4°; **07/06**, 3.8°; **07/07**, 3.2°; **07/08**, 2.6°; **07/09**, 2.0°; **07/10**, 1.5° (Mars in Leo).
- **July 6**: (−3.9, 11.4”, 88%, 1.38 AU, 96m) Today is the Venus – Saturn opposition. The two planets are on opposite sides of Earth, 180° apart. Venus sets as Saturn rises. Look for them in the sky at the same time during the next several days and throughout the Venusian apparition. Nearly 9° up in the west-northwest, Venus is 3.8° to the lower right of Mars.
- **July 11**: (−3.9, 11.6”, 88%, 1.43 AU, 95m) Over 8° up in the west-northwest, the moon (2.0d, 4%) is 5.3° to the right of Venus. The Venus – Mars gap is 0.9°. Venus is in Leo.



July 12: Venus – over 8° up in the west-northwest – passes 0.5° to the upper right of Mars. The moon is 6.7° to the upper left of Venus.

- **July 12**: (−3.9, 11.6”, 87%, 1.43 AU, 94m) Venus – over 8° up in the west-northwest – passes 0.5° to the upper right of Mars. The moon (3.0d, 9%) is 6.7° to the upper left of Venus. The Venus – Mars gaps after the conjunction: **07/13**, 0.5°; **07/14**, 1.0°; **07/15**, 1.5°; **07/16**, 2.1°; **07/17**, 2.6°; **07/18**, 3.2°; **07/19**, 3.8°; **07/20**, 4.6°.
- **July 13**: (−3.9, 11.7”, 87%, 1.42 AU, 94m) Low in the west-northwest, Venus is 0.5° above Mars. The gap is slightly larger than last night. Venus is 9.7° to the lower right of Regulus (α Leo, m = 1.3).
- **July 17**: (−3.9, 11.9”, 86%, 1.40 AU, 93m) Over 8° in altitude in the west-northwest, Venus is 4.9° to the lower right of Regulus. Mars is 2.6° to the lower right of Venus. Venus – Regulus gaps: **07/18**, 3.8°; **07/19**, 2.6°; **07/20**, 1.6°.

July 21: Venus passes 1.0° to the upper right of Regulus. Mars is 4.9° to the lower right of the brilliant planet.

- **July 21**: (−3.9, 12.1", 85%, 1.38 AU, 93m) Venus and Jupiter are at opposition. They are 180° apart in the sky. Jupiter rises as Venus sets. After this date, look for the two planets in the sky at the same time, in addition to Mars and Saturn. Venus appears in the evening sky with Jupiter and Saturn until the inner planet reaches its inferior conjunction. Jupiter's opposition with the sun is August 2. Nearly 9° up in the west-northwest, Venus passes 1.0° to the upper right of Regulus. The Venus – Mars gap is 4.9°. Mars is to the lower right of the brilliant planet. The Venus – Regulus gaps after the conjunction: **07/22**, 1.5°; **07/23**, 2.5°; **07/24**, 3.7°; **07/25**, 4.8°.
- **July 27**: (−3.9, 12.4", 83%, 1.34 AU, 91m) Over 8° up in the west, Venus is 1.4° above Rho Leonis (ρ Leo, m = 3.8).
- **July 29**: (−3.9, 12.5", 83%, 1.33 AU, 90m) Over 9° up in the west, Venus is 9.5° to the upper left of Mars and Regulus, Mars is 0.6° to the upper right of the star, although the pair is only 3° above the horizon. Use a binocular.
- **August 2**: (−3.9, 12.7", 82%, 1.30 AU, 90m) Over 8° up in the west, Venus passes 0.3° to the lower right of Chi Leonis (χ Leo, m = 4.6).
- **August 6**: (−3.9, 13.0", 81%, 1.28 AU, 90m) With an altitude over 8° above the western horizon, Venus passes 0.6° to the lower left of Sigma Leonis (σ Leo, m = 4.0).
- **August 8**: (−3.9, 13.1", 80%, 1.26 AU, 89m) At an altitude of 8.0° above the western horizon, Venus passes 11.2° to the lower left of Denebola (β Leo, m = 2.1).

Venus Moves Through Virgo

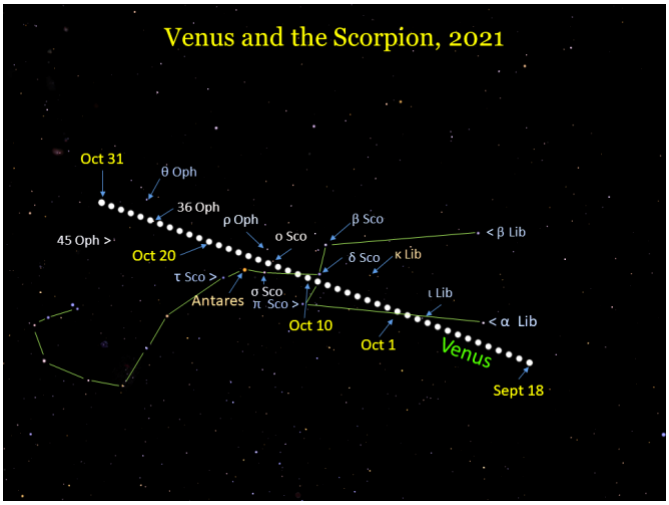
Still visible low in the western sky during evening twilight, Venus treks through Virgo during 39 evenings. During mid-August attempt to view five planets in the sky simultaneously. The challenging view is with Mercury and Mars that are low in the western sky during very bright twilight. Venus passes Spica on September 5. A nice grouping of Venus, the moon, and Spica occurs on September 9. Near mid-month, Venus begins to rapidly close on Earth when the gap is 1.0 AU. The planet quickly brightens in the sky. After late September, Venus begins to set after the end of evening twilight.

- **August 10**: (−3.9, 13.3", 80%, 1.25 AU, 89m) Venus moves into Virgo. Appearing only about 8° up in the west, the crescent moon (2.5d, 7%) is 5.7° to the right of the planet. Venus is 3.5° to the lower right of Beta Virginis (β Vir, m = 3.6).
- **August 13**: (−3.9, 13.5", 79%, 1.23 AU, 88m) Only 8.0° up in the west, Venus passes 0.1° above β Vir.
- **Beginning in three evenings**, look for the 5 bright planets and the moon. Use a binocular for Mercury and Mars in a very close conjunction during bright twilight. Their closest approach is on August 18.
- **August 19**: (−4.0, 13.9", 77%, 1.19 AU, 88m) Less than 8° in altitude, Venus passes 1.0° below Eta Virginis (η Vir, m = 3.9).
- **August 24**: (−4.0, 14.3", 75%, 1.16 AU, 87m) Over 7° in altitude in the west-southwest, Venus passes 2.5° to the lower left of Gamma Virginis (γ Vir, m = 3.4).
- **August 29**: (−4.0, 14.8", 74%, 1.12 AU, 88m) Venus moves south of the ecliptic. Over 7° above the west-southwest horizon, Venus is 8.0° to the right of Spica (α Vir, m = 1.0).
- **August 31**: (−4.0, 15.0", 73%, 1.10 AU, 89m) Less than 8° in altitude in the west-southwest, Venus passes 1.9° to the lower left of Theta Virginis (θ Vir, m = 4.4). The planet is 5.8° to the right of Spica. Venus – Spica gaps leading up to the conjunction: **09/01**, 4.7°; **09/02**, 3.6°; **09/03**, 2.6°; **09/04**, 1.8°.

September 5: Venus passes 1.5° to the upper right of Spica.

- **September 5**: (−4.0, 15.5”, 72%, 1.07 AU, 90m) Nearly 8° in altitude in the west-southwest, Venus passes 1.5° to the upper right of Spica. Venus – Spica gaps after the conjunction: **09/06**, 2.0°; **09/07**, 2.9°; **09/08**, 3.9°; **09/09**, 5.0°.
- **September 9**: (−4.1, 15.9”, 70%, 1.04 AU, 90m) Less than 8° above the west-southwest horizon, Venus is 3.9° to the lower left of the moon (3.0d, 11%). Notice Spica, 5.0° from Venus, makes a nice triangle with the planet and the moon. Spica is 4.8° below the moon.
- **September 10**: (−4.1, 16.0”, 70%, 1.04 AU, 90m) The moon (4.0d, 20%) is nearly 11° to the upper left of Venus that is about 8° up in the west-southwest. The brilliant planet is 6.1° to the upper left of Spica. Pick a clear horizon as the star is over 5° up in the west-southwest. The moon, Venus, and Spica are nearly in a line along the ecliptic.
- **September 14**: (−4.1, 16.5”, 68%, 1.00 AU, 92m) Venus is 1.0 AU from Earth. In the sky, Venus, over 8° up in the west-southwest, is 4.0° to the lower left of Kappa Virginis (κ Vir, m = 4.2).
- **September 16**: (−4.1, 16.8”, 68%, 0.99 AU, 93m) Eight degrees up in the west-southwest, Venus is 1.7° to the lower left of Lambda Virginis (λ Vir, m = 4.5).

Venus and the Scorpion



Venus and the Scorpion: Venus moves through the classic Scorpion (Libra, Scorpius, and Ophiuchus) from September 18 through Halloween. At a more southerly celestial latitude, it passes closely to stars below the ecliptic.

Venus moves through the classic Scorpion (Libra, Scorpius, and Ophiuchus) during the next 46 days. The planet is south of the ecliptic, appearing in regions of the constellations that we might not expect to see it. Venus closes in on Earth. The observing interval occurs at nearly mid-twilight so that dimmer stars are easier to see than earlier in the apparition. Venus sets later each evening and brightens in the sky. On October 9, the moon is near Venus and Delta Scorpii. A week later, Venus passes Antares. Look for an evening half phase through a telescope near the end of October and the evening greatest elongation.

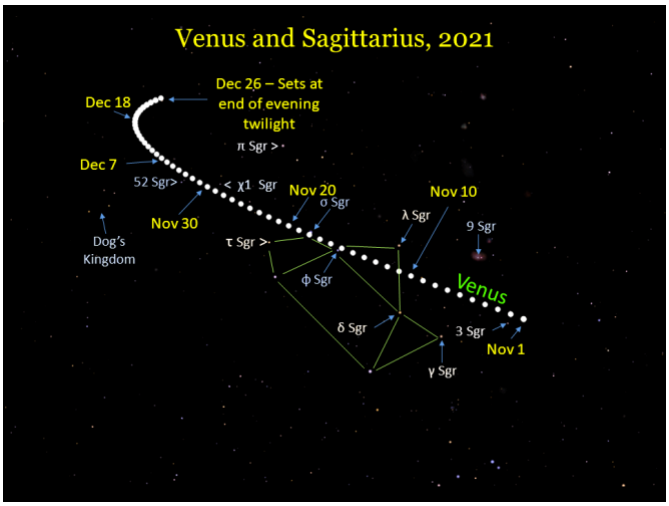
- **September 18**: (−4.2, 17.0”, 67%, 0.97 AU, 94m) Venus sets at the end of evening twilight. It sets after the end of evening twilight until December 26. This evening it is in Libra, 6.2° to the lower right of Zubenelgenubi (α Lib, m = 2.8).
- **September 23**: (−4.2, 17.7”, 65%, 0.94 AU, 96m) Over 8° up in the southwest, Venus passes 2.0° below Zubenelgenubi.
- **September 29**: (−4.2, 18.6”, 63%, 0.90 AU, 101m) Nearly 10° up in the southwest, Venus passes 0.5° to the lower left of Iota Librae (ι Lib, m = 4.5).
- **October 5**: (−4.3, 19.6”, 60%, 0.85 AU, 106m) Over 9° up in the southwest, Venus passes 2.5° to the lower left of Kappa Librae (κ Lib, m = 4.8).
- **October 7**: (−4.3, 19.9”, 60%, 0.83 AU, 107m) Venus moves into Scorpius. Choose your favorite stars to watch as

Venus moves through the starfield. This evening, Venus – over 9° up in the southwest – is 2.3° to the lower right of Delta Scorpii (δ Sco, m = 2.3).

October 9: The moon is 2.6° to the upper left of Venus. The brilliant planet is 0.7° to the lower left of Delta Scorpii (δ Sco).

- **October 9**: (−4.3, 20.3”, 59%, 0.82 AU, 110m) The moon (3.5d, 17%) is 2.6° to the upper left of Venus that is nearly 10° in altitude in the southwest. The brilliant planet is 0.7° to the lower left of δ Sco.
- **October 10**: (−4.3, 20.5”, 58%, 0.81 AU, 111m) Venus – over 9° up in the southwest – passes 2.7° to the upper right of Pi Scorpii (π Sco, m = 2.9).
- **October 14**: (−4.4, 21.2”, 57%, 0.78 AU, 116m) Venus – 10.0° up in the southwest – is 0.5° to the lower left of Omicron Scorpii (o Sco, m = 4.5) and 1.0° to the upper right of Sigma Scorpii (σ Sco, m = 2.8).
- **October 15**: (−4.4, 21.5”, 56%, 0.77 AU, 116m) Venus skips across a corner of Ophiuchus this evening. The brilliant planet is about 10° up in the southwest – 1.4° to te lower left of Rho Ophiuchi (ρ Oph, m = 4.6). While not well-positioned for observing, the globular cluster Messier 4 (NGC 6121) is 1.8° below Venus. Notice that Venus, Antares (α Sco, m = 1.0), and σ Sco make a triangle.
- **October 16**: (−4.4, 21.7”, 56%, 0.76 AU, 118m) Over 11° up in the southwest, Venus is 1.4° to the upper right of Antares. Use a binocular to see the planet 0.2° to the upper left of 22 Scorpii (22 Sco, m = 4.8).
- **October 18**: (−4.4, 22.1”, 55%, 0.75 AU, 120m) Venus is 2.9° above Tau Scorpii (τ Sco, m = 2.8). Forty-five minutes after sunset, it is nearly 12° up in the south-southwest.
- **October 21**: (−4.4, 22.8”, 54%, 0.73 AU, 124m) Venus is in Ophiuchus. Forty-five minutes after sunset, it is nearly 11° up in the southwest, 6.3° to the lower right of Theta Ophiuchi (θ Oph, m = 3.2).
- **October 26**: (−4.5, 24.1”, 51%, 0.69 AU, 132m) Forty-five minutes after sunset, find Venus, over 11° up in the southwest, 0.4° to the upper left of 36 Ophiuchi (36 Oph, m = 5.0).
- **October 27**: (−4.5, 24.3”, 51%, 0.68 AU, 133m) Over 11° in altitude above the southwest horizon, Venus is 1.7° to the lower left of θ Oph. The planet sets at its most southerly azimuth (233°) through November 16.
- **October 29**: (−4.5, 24.9”, 50%, 0.67 AU, 136m) Venus is at its Greatest Eastern Elongation (47.0°). See the yellow triangle on the setting chart above. In the starfield it is 3.0° to the upper right of 45 Ophiuchi (45 Oph, m = 4.2). Through a telescope, the planet is at its evening half phase.

Into Sagittarius and Toward Inferior Conjunction



Venus and Sagittarius: Brilliant Venus moves through Sagittarius beginning November 1. The chart shows its place in the sidereal background until December 26, when it sets at the end of evening twilight.

While south of the ecliptic, Venus moves eastward among the stars of Sagittarius. During early December, it reaches its greatest illuminated extent. It is very bright in the southwestern sky after sunset. On November 7, the moon joins Venus. A second grouping occurs on December 6. The planet and the moon appear together in likely their best show

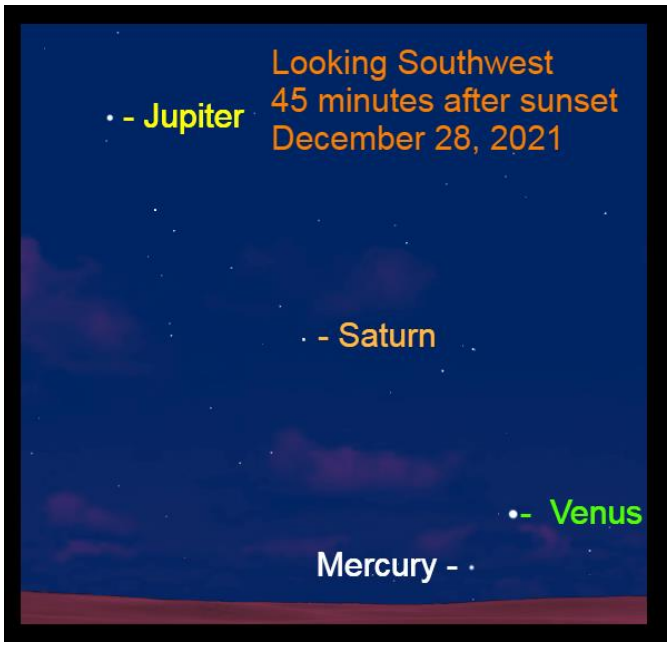
of the apparition. Venus is very bright with a crescent moon under it. The planet stops moving eastward after mid-December and begins its rapid descent from the evening sky.

- **November 2**: (−4.6, 26.1", 48%, 0.64 AU, 142m) Venus is in Sagittarius; it is over 12° in altitude in the south-southwest, and 0.6° to the upper right of 3 Sagittarii (3 Sgr, m = 4.5).
- **November 6**: (−4.6, 27.4", 45%, 0.60 AU, 147m) Nearly 13° up in the south-southwest, Venus is 3.1° to the upper right of Gamma Sagittarii (γ Sgr, m = 3.0) – the star at the end of the spout of the Teapot of Sagittarius. Additionally, the planet is 2.9° to the lower left of 9 Sagittarii (9 Sgr, m = 5.9) that is in the Lagoon Nebula (M8, NGC 6523). Another star in the cloud is 7 Sagittarii (7 Sgr, m = 5.3), 0.2° to the right of 9 Sgr. Near mid-twilight, the wonders of the Sagittarius region are washed out by the illuminated sky and the low altitude.
- **November 7**: (−4.6, 27.7", 45%, 0.60 AU, 148m) Venus is 13.0° up in the west-southwest. The crescent moon (3.1d, 13%) – nearly 12° in altitude in the southwest – is 3.9° to the lower right of Venus.
- **November 10**: (−4.7, 28.8", 43%, 0.58 AU, 153m) Venus is nearly 14° in altitude in the south-southwest. It is 2.6° to the upper right of Delta Sagittarii (δ Sgr, m = 2.7).
- **November 12**: (−4.7, 29.8", 41%, 0.56 AU, 158m) Nearly 14° up in the south-southwest, Venus is 1.7° to the lower left of Kaus Borealis (λ Sgr, m = 2.8), the star at the top of the lid of the Teapot.
- **November 16**: (−4.7, 31.2", 39%, 0.53 AU, 159m) Venus, over 14° up in the south-southwest, is 0.2° to the upper right of Phi Sagittarii (ϕ Sgr, m = 3.2).
- **November 19**: (−4.8, 32.6", 37%, 0.51AU, 162m) Venus, nearly 15° up in the south-southwest, is 0.2° to the lower left of Nunki (σ Sgr, m = 2.0), in the handle of the Teapot
- **November 22**: (−4.8, 34.0", 35%, 0.49 AU, 164m) Venus is 15° up in the south-southwest, 1.5° to the upper right of Tau Sagittarii (τ Sgr, m = 3.3), in the handle of the Teapot.
- **November 25**: (−4.8, 35.9", 33%, 0.46 AU, 166m) Over 15° in altitude in the south-southwest, Venus is 0.4° to the lower left of Psi Sagittarii (ψ Sgr, m = 4.8).
- **November 27**: (−4.8, 36.2", 32%, 0.45 AU, 166m) Nearly 16° in altitude above the south-southwest horizon, Venus begins its interval of greatest brightness (November 27 – December 14). While photometrically the Venusian brightness increases slightly, this is likely outside human perception. The mid-point is December 7 and marked by a yellow diamond on the Venus setting chart above. Among the stars, Venus is 1.2° to the lower right of Chi1 Sagittarii (χ1 Sgr, m = 5.0).
- **December 4**: (−4.9, 41.0", 26%, 0.40 AU, 164m) Venus is at its greatest illuminated extent. The illuminated portion of the planet covers the largest area of the sky. (For a semi-technical explanation see https://bit.ly/venus-greatest-illuminated) One hour after sunset. Venus is nearly 16° up in the south-southwest, 0.8° above 52 Sagittarii (52 Sgr). Through a telescope notice that the Venusian phase is about 25%.

December 6: Venus is 3.2° above the crescent moon.

- **December 6**: (−4.9, 42.4", 24%, 0.39 AU, 162m) About 16° up in the southwest, Venus is 3.2° above the crescent moon (2.6d, 10%). This is likely the most-photogenic grouping of Venus and the moon during this apparition. A brilliant Venus gleams above a thin crescent moon. For the remainder of the apparition, through a telescope, observe the larger diameter, but thinning, evening crescent phase as the planet nears Earth.
- **December 18**: (−4.8, 51.9", 13%, 0.32 AU, 134m) Venus stops moving eastward along the ecliptic and begins to retrograde. In the early evening sky, find it nearly 13° up in the southwest.
- **December 20**: (−4.8, 53.1", 11%, 0.31 AU, 127m) Venus crosses the ecliptic moving northward. Look for it 12° up in the southwest. Through a telescope observe the thin Venusian crescent, about 10% illuminated.

- **December 26**: (−4.5, 58.0”, 6%, 0.29 AU, 99m) Venus sets at the end of evening twilight. During the remainder of the apparition, the planet sets earlier during twilight, losing about 7 minutes of setting time each evening.



December 28: Venus appears 4.2° to the upper right of Mercury. Jupiter and Saturn are entering the scene as Venus moves toward its inferior conjunction.

- **December 28**: (−4.5, 59.0”, 5%, 0.28 AU, 89m) Standing 7.0° up in the southwest, Venus is 4.2° to the upper right of Mercury (m = −0.7).
- **January 3, 2022**: (−4.4, 60.1”, 3%, 0.27 AU, 51m) Less than 4° up in the west-southwest, Venus is over 11° to the right of the moon (1.2d, 2%).

Into Bright Twilight and Inferior Conjunction

Venus sets at Nautical Twilight on New Year’s Day 2022. It is rapidly moving between the earth and sun, setting about 7 minutes earlier each evening. In only five days it sets at Civil Twilight and then passes inferior conjunction at 6:48 p.m. CST on January 8, 2020. The first morning visibility of Venus starts 3-4 days after the conjunction. It’ll appear about 4° in altitude above the east-southeastern horizon during late morning twilight.

For updates and edits of this article see: http://bit.ly/venus_2021

ASTRONOMICAL LEAGUE 75TH ANNIVERSARY COMING!

The beginning of the Astronomical League dates to 1939 when members of eleven amateur astronomical societies met at the American Museum of Natural History in New York City. Similar meetings followed in Pittsburgh, 1940, Washington D.C., 1941, and Detroit, 1946.

At the last meeting, final plans laid the foundation for a permanent organization constituting a nationwide federation of societies. The next convention took place in Philadelphia, July 4, 1947, where the federation came into being with the adoption of bylaws, the election of officers, and the name *Astronomical League* selected. Shortly thereafter, the entity was incorporated as a non-profit organization.

Source: https://en.wikipedia.org/wiki/Astronomical_League

Purchase your AL 2021 calendar through the Astronomical League Store now for only $13.00 plus S&H. Proceeds will support the ALCon Jr. Conference program.

FUTURE NCRAL CONVENTIONS

During NCRAL's annual business meeting the Region receives offers for hosting upcoming conventions. The following affiliates have agreed to hosting future conventions. We are in need for hosts for 2024 beyond. It's never too early to start planning to host.

- 2021 **CANCELED**
- 2022 Port Washington, WI: Northern Cross Science Foundation (dates TBD)
- 2023 Bloomington-Normal, IL: Twin City Amateur Astronomers (dates TBD)
- 2024 **OPEN**
- 2025 **OPEN**

If your club has never hosted an NCRAL Regional convention, please consider doing so in 2024 or later. While hosting a Regional convention is a considerable amount of work, it can be quite rewarding – even fun. It provides an opportunity to showcase your group's facilities and accomplishments, build club camaraderie, and to get to personally know interesting guest speakers. You can also use such an event to grow your club's membership.

Remember, NCRAL now has its own convention planning guide. The ***NCRAL Convention Planning Guide*** has three sections. To download the planning guide, visit the following URL: https://ncral.wordpress.com/conventions/. Look for the link at the bottom of the page.

Please contact the NCRAL Chair should you have any questions or wish to toss your hat into the ring for hosting a future NCRAL convention.

NCRAL SEASONAL MESSIER MINI MARATHON OBSERVING PROGRAM

The NCRAL Seasonal Messier Mini Marathon program is intended to serve as motivation to get NCRAL-affiliated members out under the stars to observe. The program permits the use of goto telescopes to find objects and, as such, the program must not be considered proof of observing prowess. The Astronomical League's Messier observing program serves that purpose. Still, NCRAL observing certificates include the words "assisted" or "unassisted." Certificates and pins are now being distributed on the equinoxes and solstices along with ***Northern Lights*** by the program administrator. NCRAL Secretary-Treasurer Roy Gustafson is now serving as program administrator. Please send observing records to Roy at astroroy46@gmail.com.

Up-to-date details about the Region's four observing program and helpful observing record sheets can now be found on the NCRAL website: https://ncral.wordpress.com/awards/. Below are the seasonal observing lists followed by some helpful observing notes.

Autumn: M55, M69, M70, M75, M11, M26, M56, M57, M71, M27, M29, M39, M2, M72, M73, M15, M30, M52, M103, M31, M32, M110, M33, M74, M77, M34, and M76. (27 objects)

Winter: M1, M45, M36, M37, M38, M42, M43, M78, M79, M35, M41, M50, M46, M47, M93, M48, M44, M67, M40, M81, M82, M97, M101, M108, M109, M65, M66. (27 objects)

Spring: M95, M96, M105, M53, M64, M85, M88, M91, M98, M99, M100, M49, M58, M59, M60, M61, M84, M86, M87, M89, M90, M104, M3, M51, M63, M94, M106, and M68 (28 objects)

Summer: M83, M102, M5, M13, M92, M9, M10, M12, M14, M19, M62, M107, M4, M6, M7, M80, M16, M8, M17, M18, M20, M21, M22, M23, M24, M25, M28, and M54. (28 objects)

OBSERVING NOTES:

- ***Autumn:*** This season's objects span a wide range of right ascension and declination. With several objects located in Sagittarius and disappearing into the glare of the sun by mid-autumn (M55, M69, and M70), it is best to complete the autumn observing program before the end of October. After that they will be too near the sun to observe during late autumn evenings.

- ***Winter:*** It probably would be best to begin the winter Marathon around mid-February or later. Any earlier in the year, observers will have to wait until late into the night for all winter objects to have risen high enough in the sky to observe. With winter weather moderating in March, it wouldn't be too late to start then so long as observations are completed by the March equinox.
- ***Spring:*** This season's objects span a rather narrow region of right ascension, with most of the objects being associated with or in proximity to the Virgo-Coma cluster of galaxies. At the start of spring, an observing run beginning near the end of astronomical twilight should allow observers to view all objects by around 10:30 PM. By mid-April, all objects should be well enough placed at the end of astronomical twilight allowing for their fastest possible observation.
- ***Summer:*** All summer Marathon objects are above the horizon at the end of astronomical twilight on the first day of summer through the last day of summer. They are nearly all tightly clustered around the galactic center and most are globular clusters with a few notable exceptions.

Add Your Email Address to the NCRAL Member Database

Did you know that only about 450 of our Region's 1,900 members are receiving this newsletter via email? That's less than one-fourth of the membership. Please help NCRAL get its newsletter out to the membership by encouraging fellow club members to add their email addresses to the NCRAL member database. Editors, please include this information in your affiliate's newsletter.

When one adds his or her email address to the NCRAL member database, he or she will receive direct notifications about the availability of ***Northern Lights***. In addition, subscribers will receive important and timely announcements about Regional conventions, elections, star parties, and so forth. Only blind addressing (Bcc:) will be used with this email list so that others will not see subscribers' email addresses. Email addresses will never be shared with or sold to outside entities.

No one will add your email address to this list for you, so you'll need to do it yourself. Sign-up takes only about a minute. You'll need to provide your name, email address, astronomy club affiliation (or indicate A.L. membership-at-large) and let us know if you hold specific positions within your club. Go to the following case-sensitive URL to add your information to our database at https://goo.gl/gsS8SF today so you won't miss important future communications.

NCRAL Website

~ by Jeff Setzer ~

Did you know that NCRAL has its own website? Point your browser to ncral.wordpress.com and you'll see a central repository for information about our Region and affiliates, the Region's Bylaws, back issues of ***Northern Lights***, information about observing programs, awards, and grants, and much more. Will the website progress from an occasionally used reference to something more? That's entirely up to you, dear reader. If you have ideas or submissions, contact me at astrosetz@hotmail.com

REGIONAL OFFICER & LEADER CONTACT INFORMATION

Chair (2-year term): Carl Wenning (term expires Spring 2021, in second term)

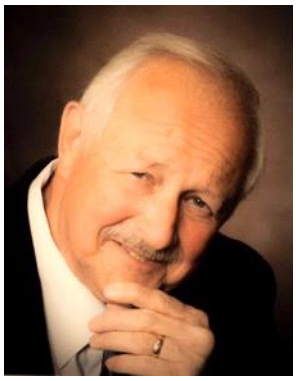
Bio: Carl has been an amateur astronomer since being introduced to the sky by his grandfather during July 1957. Today he is an A.L. Master observer. He has been involved with the Twin City Astronomers of Bloomington-Normal (Illinois) since September 1978. He currently serves as the club's secretary, historian, and editor of ***The OBSERVER*** newsletter for which he received the AL's 2017 *Mabel Sterns Newsletter Editor Award*. He also serves as the ***Northern Lights*** newsletter editor. Carl was planetarium director (1978-2000) and physics teacher educator (1994-2008) at Illinois State University. He continues to teach physics education courses in retirement. He is currently finishing his 43rd year of college teaching.

Contact: carlwenning@gmail.com

Vice Chair (2-year term): Bill Davidson (term expires Spring 2021, in first term) and
Region Representative (3-year term): Bill Davidson (term expires Spring 2022, in second term)

Bio: In the days of the Apollo missions, Bill first observed the moon (and sunspots!) with a 50x, 60mm JC Penny's refractor telescope. Not discouraged, 40 years later, he built and observes with a 6.25-inch achromatic doublet objective, f/10, 1600 mm focal length refracting telescope. He recently retired as a college mathematics instructor, has been a member of the Rochester Astronomy Club (Minnesota) for 20 years, and serves as editor of the club's award-winning newsletter *RochesterSkies.*

Contact: rochesterskies@outlook.com



Secretary-Treasurer (2-year term): Roy Gustafson (Interim 2020-2021)

Bio: Roy, a member of Popular Astronomy Club (Quad Cities), got interested in astronomy when visiting the Adler Planetarium in Chicago when he was in 2nd Grade. The stars projected by the Zeiss Projector hooked him and started him on the path of astronomy. He has been active in outreach and has presented astronomy programs to over 20,000 people. He was awarded the Master Outreach award from the Astronomical League. Roy travels with his telescopes and has observed both Transits of Venus and last year the Total Solar Eclipse. Roy also taught astronomy at Black Hawk Junior College in Moline, IL. Roy retired from John Deere & Company after 32 years of service.

Contact: astroroy46@gmail.com

NCRAL Webmaster: Jeff Setzer (appointed)

Bio: Jeff has been an amateur astronomer since 1984 and has been part of the Northern Cross Science Foundation (Wisconsin) since that time. He is a longtime member of their Board of Directors, has held several office positions, and is currently their President. He has completed several Astronomical League observing programs, made his own telescopes and optics, and is a self-described telescope nut. You will often find him at star parties with his 22" Starmaster and TeleVue 85 telescopes.

Contact: astrosetz@hotmail.com

