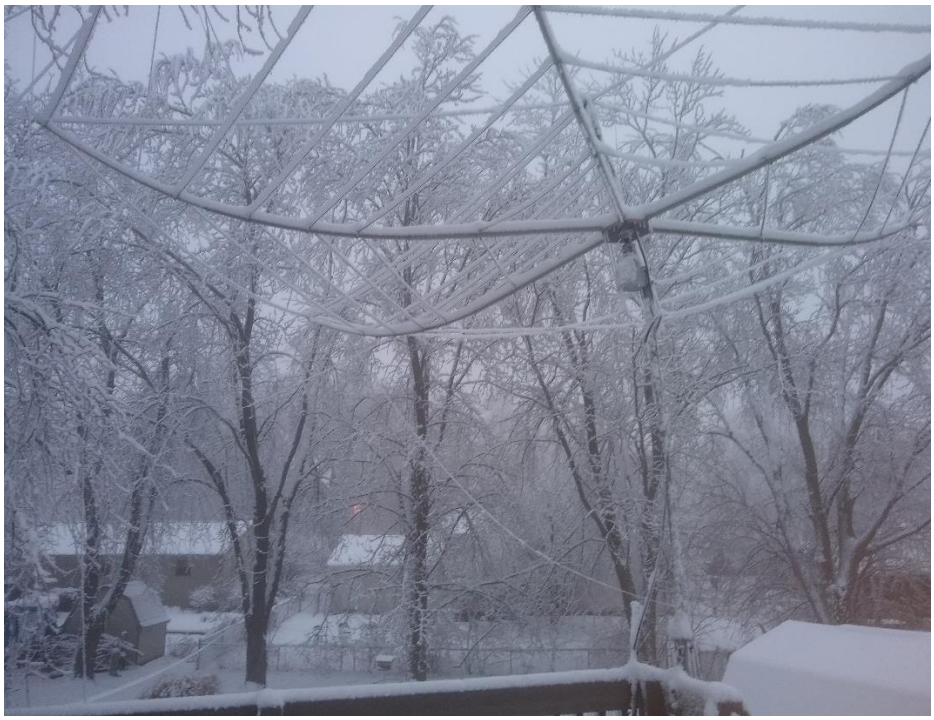

Short CIRCuits

February 2021

SERVING CENTRAL ILLINOIS AMATEUR RADIO SINCE 1921

IN THIS ISSUE

From The President

by Rick Suhadolc N9CKL

Presidents Day was this past week, and that means upcoming Cherry Pie Night at our February 24th Circ Meeting. I encourage all our members to have a slice of cherry pie while we enjoy our Circ Meeting this upcoming Wednesday night CIRC Zoom Meeting at 7pm. Jeff KC9QQM will post the Zoom URL for all to check in on.

Social distancing with our 2meter nets has been a great success. On Tuesdays at 9pm our CIRC 2meter net and with our remote DQ social informal 2meter net Monday thru Friday at 9am we have been able to keep everyone informed.

QST lists March 6-7th as the ARRL International DX Contest SSB.

Many of the International DX community is available for contacts for even the most modest radio set up. In the past I have operated even on a Ham Stick antenna and made great contacts.

The weather is warming up and we are through this Polar Vortex event.

I can't remember when we have had a string of days below freezing for this long.

I hope to hear you on March 6-7th in the SSB contest.

Stay warm and healthy Rick N9CKL

Magnetometer

Article by Tim Stone

Magnetometer

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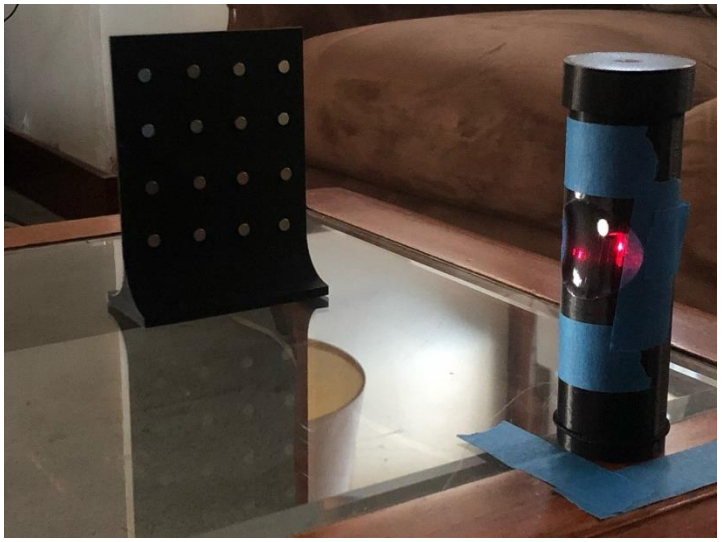
A few months ago, I became aware of an intriguing citizen science project. Tom Field, the gentleman who wrote the Rspec software I use for processing stellar spectra, referred me to a video on YouTube (https://www.youtube.com/watch?v=KMUgrQDbFNM) demonstrating how, using common or inexpensive components, one could monitor the strength of the solar wind magnetic field. 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 (http://www.uksmg.org/content/pulse.htm) 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 which 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 wall-wart 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.

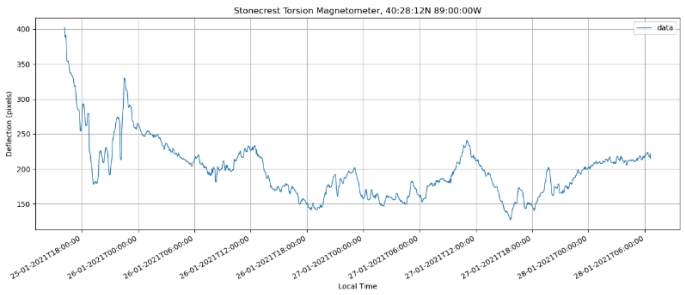
The reflected beam shows on a white card, where the deflection can be measured. Measurement can be done manually with a scale printed onto the card, or with a computer running a program that watches the position of the dot using a webcam. In addition to Rspec, Tom Field has also written a program to 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.



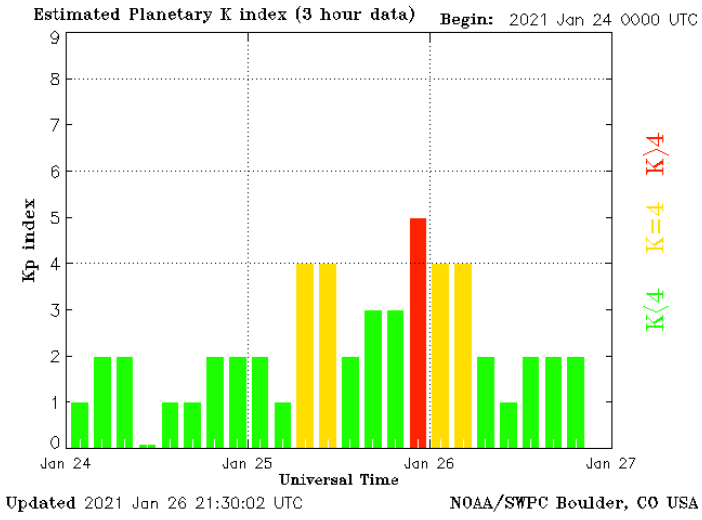
The initial results were hard to understand, so much so that I thought the instrument wasn't even working. The sensor wouldn't stop oscillating back and forth, and there were large, seemingly unpredictable deflections of the sensor. After consulting Dr. Carlson, who has been EXTREMELY helpful, and working 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 have now run my magnetometer continuously for a few days. By introducing corrections for the periods when my car was not in the driveway, I can now get a nice graph of the solar wind magnetic strength as it varies with time.



This is a plot starting in the 4:00PM hour of January 25. The left side of this graph is high, tailing downward with time. This was the back end of the largest solar wind event I've seen since running this instrument. I would have gotten the beginning, but it was so powerful it deflected the laser spot clear off the white card I use as a screen! While that was disappointing, 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!

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Central Illinois Radio Club
http://www.qsl.net/w9aml/
Bloomington, Illinois

AREA NETS

Tuesday 8:30 P.M. 28.450
CIRC Open 10 meter Net

Tuesday 9:00 P.M. 146.640 (156.7PL)
CIRC Open Net

Thursday 8:00 P.M. 28.450
Vertical polarization is encouraged but not required

Sunday 08:15 A.M. 1.915
Open 160 meter AM net

If you are wondering where all the nets are, it was brought to my attention that many of these are no longer in operation. I have left the ones the CIRC handles directly.

If you want another net listed, please send me an email directly and please verify it is a current net and I will add it to the list.

Jeff KC9QQm

Kc9qqm@gmail.com

AREA EXAM DATES

Following is the schedule for W5YI-VEC Amateur Radio exams for the year 2020. At the Community Room of the Bloomington Public Library located at the intersection of E. Olive St. and S. East St. Entrance off of S. East St.

Please bring two forms of identification. You must have an FCC issued FCC Registration Number (FRN) or Social Security Number. We cannot administer a test without your FRN or SSN. You will need a copy of your Current license plus any CSCE you want to apply.

2021 dates;

TBD

Exams' in Morton are held at the Morton Public Library, 315 West Pershing at 12:00 Noon the third Saturday of even numbered months and at the Peoria Superfest.

CIRC Meeting
Fourth Wednesdays of the month at 7:00 p.m. at the
American Red Cross
1 Westport Dr.
Bloomington, IL 61704
** Until further notice the meetings are virtual and only for members. We are sorry for any inconvenience. **

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Calendar of Events

Daily Coffee Klatch Monday thru Friday
**** The weekly Coffee Klatch has been moved to the 146.64 repeater for the time being. Remember the new PL is 156.7hz *****

9:00 a.m. at Dairy Queen Veterans at Cub's
XYL's Join the OM's Monday and Friday

Weekly 10 Meter Net
Every Tuesday evening at 28.450 MHz- at 8:30 p.m.

Weekly 2 Meter Net
Every Tuesday evening on the 146.640-repeater at 9:00 p.m.

Weekly 6 Meter Net
Every Wednesday evening at 50.135 MHz at 8:00 P.M.

Weekly 160 Meter AM Net
Every Sunday morning at 1.915 MHz at 8:15 A.M.

75 Meter HF Traffic handling nets

NET / TIME	FREQ khz
NORTH CENTRAL PHONE NET	
M-F 7:00 A.M. central time	3912
ILL. PHONE NET	
M-F 4:45 P.M. central time	3857
SUN. 8:00 A.M. central time	3940
ILLINOIS SIDEBAND NET	
M-SAT. 6:00 P.M. central time	3905
75 METER INTERSTATE SIDEBAND NET	
DAILY 0100 UTC	3985
ITN INDIANA TRAFFIC NET	3910
DAILY 1230 UTC	OR
2200 UTC	3912

CENTRAL ILLINOIS RADIO CLUB
P.O. BOX 993 BLOOMINGTON, IL 61702-0993

WEB PAGE
HTTP://WWW.QSL.NET/W9AML/

The CIRC is a not-for-profit ARRL special service club whose purpose is to advance the service of Amateur Radio. Located in Central Illinois, the CIRC and its members welcome all to use the 146.64 repeater and to attend club meetings.

Short CIRCuits

P.O. Box 993
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