Short CIRCuits

October 2020

SERVING CENTRAL ILLINOIS AMATEUR RADIO SINCE 1921

IN THIS ISSUE

From The President

by Rick Suhadolc N9CKL

Thank You for all who helped out with our club testing last weekend: Keith Hanson AC9S, Ed Deutsch KC9GF, Dennis Mills KE9UA, and Duane Benjamin KC9PIM and anyone else that I may have missed. Thank You Duane Benjamin for holding the event in your machine shed party room. And congratulations to those that received licenses and license upgrades.

At least a form of normalcy again is starting after over 7 months of living with the Virus. We will get through this pandemic. Everyone stay healthy. Wear your Mask! The new SDR Radios continue to push down the prices of the old used radio market.

The SDR Icom 7300 HF thu 6 meters has continued to decrease in price . Down now to $1K.

This probably a good thing driving the prices of 20 year old radios well below $500 now. Next solar cycle 25 should peak 2022-2028, get those antennas and radios ready.

Networking with our friends is the best way to introduce future hams to our hobby. Have a safe upcoming Thanksgiving with Family.

Rick

N9CKL

Radio Astronomy

Provided by Jeff Lovell KC9QQM, article by Tim Stone

Preface – This was truly an interesting project; Tim really was the main driver. I figured the feedhorn calculations, laid it out on 24ga galvanized sheet metal an assembled it. Gave input as to the electronics needed and helped on mounting it all on the dish (donated by Grant Zehr AA9LC). This article also appears in the Observer, the newsletter of the Twin City Amateur Astronomers. Hope you all enjoy. Jeff-KC9QQM

Radio astronomy has been an interest of mine for nearly as long as my interest in astronomy itself. As a youngster, I would look at the huge radio dishes at Jodrell Bank, Arecibo, and Green Bank, and wonder why they called the 200" Hale telescope the largest in the world. Clearly, it was not as large as any of these telescopes! Now, all these years later, me fascination with these giant machines and the universe only they can see has not waned.

Some years ago, my lifelong friend and ham radio operator, Jeff Lovell, invited me to go with him to the Dayton Hamfest. Held every spring, it is one of the largest gatherings of ham radio aficionados in the world. The flea market of radio-related parts and equipment covers an area of several football fields. I readily agreed and enjoyed it very much. We've tried to make it to the event every year since then. While attending the 2017 event, we ran across a table from the Society of Amateur Radio Astronomers (https://www.radio-astronomy.org/). As I talked to the people attending the table, it became clear to me that radio astronomy was, in fact, being done by amateurs, and this discovery encouraged me to try my hand at it. Of course, knowledge of radio techniques, concepts, and equipment is necessary to do radio astronomy, so I asked Jeff if he would help me with this quest. He was interested in himself, so he agreed, and a project was born.

Sometime after that, Jeff located a 1.4m satellite dish someone in his club, the Central Illinois Radio Club of Bloomington (https://www.qsl.net/w9aml/), was going to throw away. We helped the member achieve that goal, and a dish came to my house shortly thereafter. It had mounting hardware, and with a few judiciously drilled holes and a 2" pipe driven into the ground; the dish was ready for outfitting.

He constructed the receiving hardware, and I purchased the needed electronics. Over the last couple of months, we finished the instrument, and I'm happy to report that we are receiving clear Hydrogen 21cm radio signals!

The amateur radio and amateur radio astronomy communities have been revolutionized by relatively recent technology.

Software Defined Radio (SDR) is an extremely sophisticated radio frequency signal processing hardware, originally designed to enable computers to be Digital Video Broadcasting receivers, essentially turning computers into television sets that receive broadcasts via an antenna rather than over the internet. Once this equipment was released to the market, amateur radio enthusiasts quickly realized it could be used to receive signals in a huge swath of the radio spectrum, typically from AM radio through low microwave frequencies. Software is all that is required to configure the hardware to receive a particular frequency range, along with an antenna capable of responding to signals in that same range. While one might think this hardware would be awfully expensive, a typical SDR looks like a thumb drive, plugs into a computer's USB socket, and costs about $30.

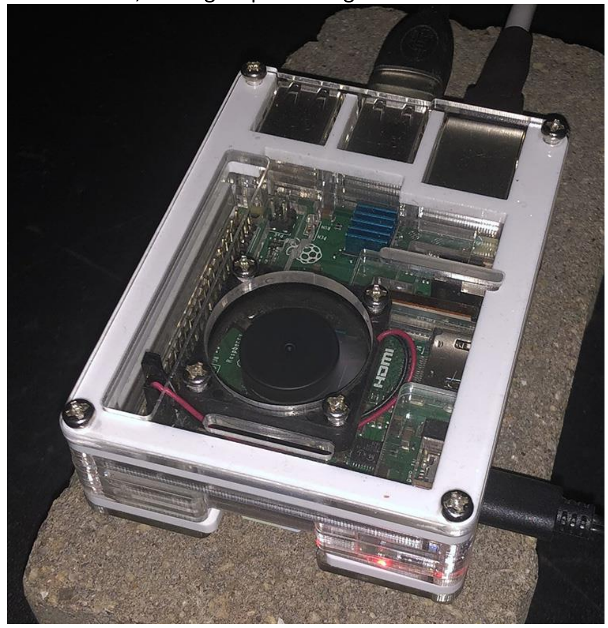
SDR quickly became all the rage in amateur radio, and amateur radio astronomers picked up on it very quickly as well. Where once radio astronomy required many hundreds or even thousands of dollars of specialized equipment, now with a couple of hundred dollars, a junk radio dish, some software, and some guidance, a bona fide radio telescope is entirely within reach.

My radio telescope consists of several components. The first and most visible one is, of course, the dish. It's made of aluminum and parabolic in figure. Its mount is intended to be equatorial, so it can be adjusted to the correct latitude and moved to point at a particular satellite in the geosynchronous band. I've modified it with a 45-degree elbow so it can operate as a transit, moving along the meridian and utilizing the earth's rotation to acquire data along a single line of declination every sidereal day.

Like the mirrors in our optical telescopes, the dish collects photons and concentrates them. Unlike optical telescopes, these photons are turned to electromagnetic signals by a simple antenna inside a structure called the feedhorn. The feedhorn serves to trap the collected photons in a resonant cavity so they can be detected by the embedded antenna and shield that antenna from unwanted radio frequency interference.

The antenna itself is just a short piece of bare copper wire, of the desired wavelength. In this case, the wavelength is 21cm, so the antenna is 5.25cm long. The electrical signals from the antenna are sent down a shielded coaxial cable to the next component, a multipurpose piece of hardware. It has a Low Noise Amplifier (LNA), which strengthens the extremely low-level signal from the antenna, a filter that passes a narrow band of wavelengths around 21cm, followed by a second LNA to further amplify the signal. I use a SAWbird+ H1m LNA from a US-based company named nooelec (https://www.nooelec.com/store/).

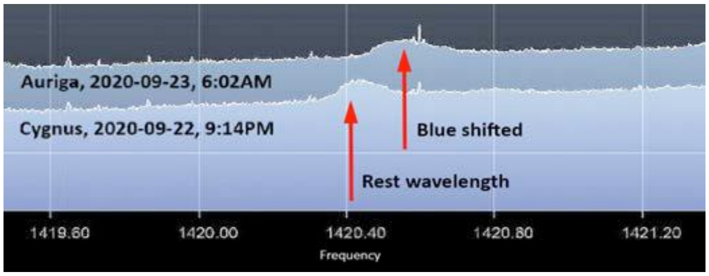
After the LNA/filter/LNA, the amplified signal goes to the Software Defined Radio. For that, I used the NESDR SMArTee V2 SDR, also from nooelec. Together the two pieces of hardware cost me $77, plus tax and shipping. I was in business for the cost of some pipe fittings, metal for the feedhorn, and signal processing hardware.



Nearly a decade ago, the technology industry was revolutionized by another breakthrough development: the development of small, inexpensive Single Board Computers (SBC). The first commercially viable general-purpose SBC, the Raspberry Pi, was released in 2012. It was produced by an open-source not-for-profit foundation in the United Kingdom, with the goal of providing low-cost computing capabilities to underserved populations around the world. Even before they achieved that goal, the rest of the world stood up and took notice. Almost overnight the promise and utility of these computers resulted in back order times of months. Today, Raspberry Pi computers are used all over the place and in all kinds of ways, one of them being Software Defined Radio. In a radio telescope, any attempt to move the faint signal from one point to another over a coaxial cable results in losing some of that signal. The trick is to digitize that signal as close to the antenna as you can, because digital signals can travel long distances with minimal loss. The SDR accomplishes this digitization, but USB itself has distance limits of 25' or so. A computer to receive the signal digitized by the SDR and turn it into an ethernet signal is needed, as ethernet signals can travel anywhere in the world.

Enter the Raspberry Pi. About the size of a deck of cards, and fully outfitted between $70 and $100, It is small and inexpensive enough to be used in an application where it will not be in the friendly confines of a house, yet powerful enough to handle the signal processing needed to put the SDR digital signal onto a network. The signal is then consumed by an indoor Windows-based computer, where the data is gathered, aggregated, processed, displayed, and stored for future analysis.

This simple radio telescope is completely capable of receiving 21cm signals from cold neutral Hydrogen (HI) present in the plane of our galaxy. To "see" this signal, the raw digital signal is averaged and integrated over several minutes. This improves the signal to noise ratio in the same way stacking multiple exposures does this with digital photography. In this case, though, we average hundreds of millions of individual observations. My SDR takes 2,048,000 samples *per second*. I integrate them for three minutes for each single observation. I do this over and over again, hour after hour, as the earth's rotation continually exposes my telescope to a slightly different patch of sky. The width of that patch for my antenna is 22 degrees, so this is not a high-resolution operation!



What I see as the plane of the galaxy passes through the middle of my beam is a bump in the otherwise flat, relatively featureless signal. It's not completely featureless, simply because the environment around my house is fairly noisy even at these microwave wavelengths. The HI bump is very noticeable and pronounced enough to be able to do red/blue shift calculations and map the coarse structure of the Milky Way's spiral arms, where most of this Hydrogen exists. When I turned this system on and pointed the dish at the zenith, I really expected to see nothing. Surely, I *must* have done *something* wrong, I thought. I was shocked to see the signal I had anticipated, at exactly the right place and time. I am very inspired and excited to work on my skills and improve my results. I'm also positive another dish or two is in my future. Just like with optical telescopes, larger dishes allow higher resolution and acquisition of fainter signals. With two dishes it is possible to do interferometry; there are amateurs doing this right now! Perhaps I will be one of them one of these days.

FIRST LOOK AT THE RESULTS

TIM STONE LATER WROTE: I thought I'd share this with you. It's an animation of the 21cm line as the Milky Way swept through my beam from Northern Cygnus to the Camelopardalis/Auriga border. The observations were five-minute integrations from 9:17 PM September 26 to 8:39 AM September 27. It's interesting to watch the Doppler shifts come and go and the signal strength varies over time. Enjoy! (Note that the link below will allow you to download a file for playing on your computer.)
https://1drv.ms/u/s!Ar5lrbJ1JIoSguMvusNsPjoQEB0TjQ?e=eqiNAJ

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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.

2020 dates;

11/4 Unknown at this time

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 inconvience. **

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Calendar of Events

Daily Coffee Klatch Monday thru Friday
**** The weekly Coffee Klatch has been moved to the 146.94 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 Thursday evening at 50.135 MHz at 7:00 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

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

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Vice-President: John Payne (AC9TN)
Secretary: Rob Cherry (N9TO)
Treasurer: Larry Gibson (W9BJG)
Member at large: Grant Zehr (AA9LC)
Newsletter Editor: Jeff Lovell (KC9QQM)

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

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