The Rochester VHF Group

The VHF Journal

Volume 64, Issue 2		October 2011

The next regular meeting of the Rochester VHF Group will be Friday, October 14th 2011 at 7:30 PM

Spencerport Wesleyan Church
2653 Nichols St., Spencerport

Map and directions in back

In this issue:

Topics: "PropNET: A 6 Meter Multifunction Service" by W2EV

The Chairman Speaks!
John Stevens WB2BYP

Groupers: The big topic of discussion at the moment is the possibility of hosting the Microwave Update in Rochester, in October (or November) of 2012. Many of you may remember the 1992 Microwave Update sponsored by the RVHFG. This event is a yearly conference, attracting a national audience of serious UHF and Microwave experimenters. This year's 2011 MUD (as it is called...) is being sponsored by our eastern bretheren, the North East Weak Signal Group (N.E.W.S) in Enfield CT over the weekend of 13-15 October 2011. A variety of interesting topics are being covered, and it is being run simultaneously with the East Coast VHF/UHF Conference. Myself, Dave Hallidy K2DH, Bob Nezelek W2CNS and Ken Kent KA2LIM will be there, with hopefully good things to report on in next month's newsletter. While we are there the pitch will be made to the scheduling committee. While we have . …**Continued....**

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The Chairman Speaks! Continued…

…experience with an event like this, there will be a lot of "eyes open" to see how the N.E.W.S Group team is accomplishing the task, and learn what is needed to make the event a success.

Here is a link to the 2011 Microwave Update: http://www.microwaveupdate.org/

Take a look at the link and see just how big a deal this is! A considerable amount of homework is being done at this time to research the costs of hosting the event. Three potential conference sites have been contacted, costs of events solicited for comparison and a draft team has been forming. If you would like to be involved in any capacity, from presentation of topic, technical assistance making events happen, logistics support, organization of volunteers, family event scheduling, database creation and maintenance, website creation and maintenance, please come forward and volunteer! See myself or any other board member. This is a fabulous opportunity to draw some of the most interesting updates in amateur microwave technology, and to showcase our community and the profile of the Rochester VHF Group in the national circuit.

In October, Ev Tupis W2EV will present a talk titled: "PropNET: A 6 Meter Multifunction Service (alternatively "If the band is open and nobody TX's, does anybody hear it?"). In November, we will have our meeting at the AWA, with a tour of the Museum (thanks go to W2CNS for organizing). In December we will have our yearly Tune-Up Clinic, with test equipment and experts ready to check-out preamps and transverters for the upcoming January Contest.

Watch the newsletter, save the RVHFG website in your favorites and check in to the Monday and Thursday night Rochester VHF Group SSB nets at 2100L on 144.260 USB for the latest info and updates.

As always, I welcome one and all of you to come forward and give me your ideas, constructive criticism and energy. Send me email at ***wb2byp at arrl.net*** or you can phone me up at 585-415-4973, or better yet find me on the air for a chat.

I urge you all to come out for the meetings, and get on the air, and share your results and experiences with the group. The RVHFG has an emphasis on VHF/UHF/SHF but is ever open to the interesting and curious topic, be it MF/HF through Light wavelengths, AM/CW/SSB/FM and Digital Modes . Come show us what you have been up-to, and send something into the website or the journal to pass around.

Hope to work you on the bands.

John, wb2byp

Secretary Report

Tom Jennings, KV2X

Rochester VHF Group Meeting Minutes for September 2011

John, WB2BYP, brought meeting to order at 1943. John welcomed everybody asked every one attending to introduce themselves and what they did over the summer ham radio wise.

K2MTH made a motion to accept the May minutes as published in the Journal. W3OAB second the motion. N2DH made a motion to accept treasurer's report as published in the Journal. K2MTH seconded the motion,

Attendees

AF2K, K2MTH, W3OAB, K2DH, W2CNS, K2DB, W2UAD, K2OS, N2VTC, Gloria Butterworth, WB2BYP, K2TER, KV2x

Old business

Beacon: John WB2BYP and W3OAB wants to get a work party together to get the beacons installed at N2PA site. 6, 2 and1296 beacon to be installed and 432 will be later.

New business

Ken, W2UAB, noticed a signal appearing at 144.2 MHz and was wondering what it is. One possible cause is cable leakage. Ken will further investigate.

W3OAB mentioned that the church would like us to run an Ethernet cable with USB repeater for them. It was suggested that next meeting we can form a work group to run the cable before starting the next meeting.

K2DH asked if members would be willing to host the 2012 MUD (Microwave Update). It would take 5 or 6 people to pull it off successfully. We need to decide within the next week or two.

W2UAD suggested that the Oakville Do may be a good idea to have in conjunction with the MUD. WB2BYP said if he would investigate if it Oakville Do people would help out. WB2BYP will spear-head discussions to find out what would be involved in hosting MUD.

K2DH made a motion to adjourn and K2DB seconded it.

Rochester VHF Group
Treasurer's Report –

CHECKING ACCOUNT

Previous Balance (as of 09/06/2011):		**$1,932.09**
Income:		
Dues	70.00	
		$ 70.00
Expenses:		
None		
Current Balance		**$2,002.09**

Respectfully submitted,
Tom Jennings, KV2X, Treasurer

Vice Chairman Report

Fellow Groupers: I am excited to have Ev Tupis, W2EV, our local PropNet expert, here to give a talk on this subject this Friday 14 Oct 2011: "PropNET: A 6 Meter Multifunction Service". Please consider joining us for what is sure to be an informative treatment of this topic. Maybe you can put this capability to practice in your shack and be on the air when there are openings. Some of our members will be at the Microwave Update this weekend; I can't wait to hear what they will bring back with them.

This weekend is the New York QSO Party (NYQP) sponsored by our sister club, RDXA. Tom, KV2X, and I will be operating in the new rover class 80-2Meters from a number of local counties. Please consider getting on the air to support this contest, who knows you may win an award. For more details check out: www.nyqp.org.

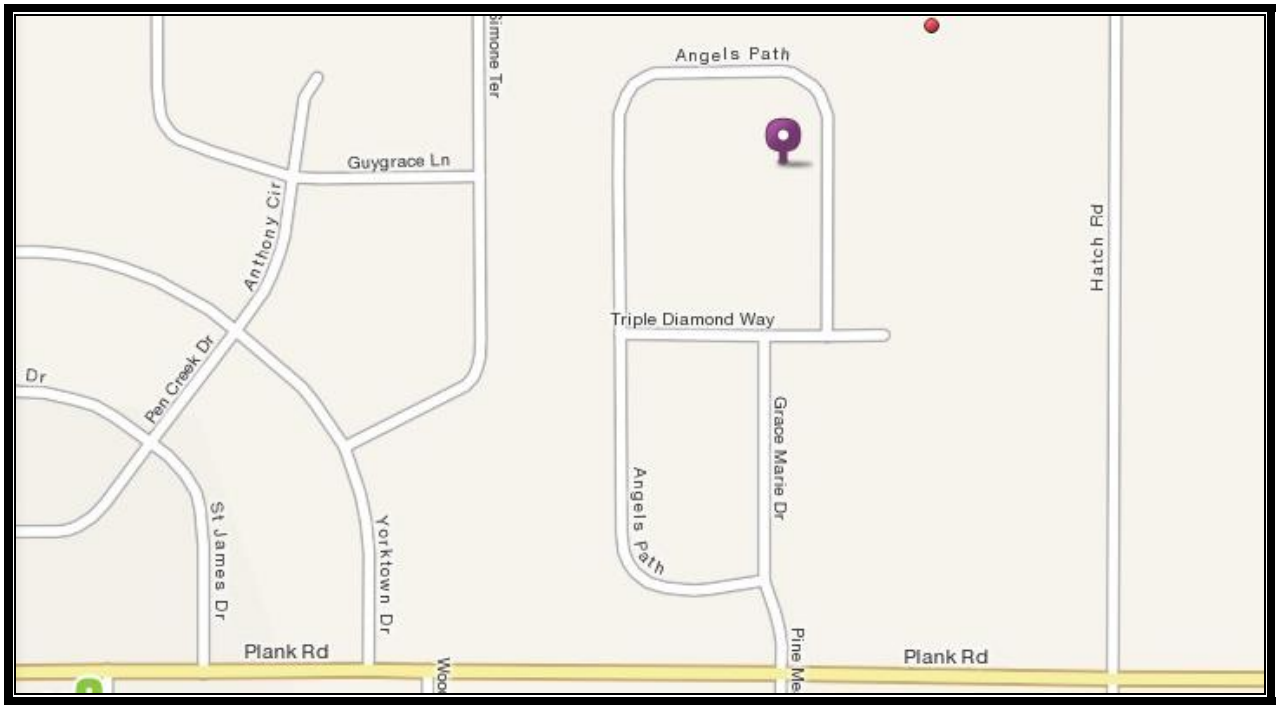
New meeting venues

We'll be at the AWA for the November meeting this year including a tour of the Museum. A special thanks to Bob Nezelek, W2CNS for making special arrangements for our visit!

We're going to try something new this year for the December Meeting/Tune-up Clinic. I will be hosting it at my new house, don't worry there's room for your gear. ☺ We'll have the traditional equipment

available and more time to set it up before hand. We'll be ready to check your preamps and transverters as well as your other gear. I guess I will have to finally unpack the boxes in my lab!

My Address is 130 Angels Path, Webster, NY 14580



Of course October's meeting will be held at the regular meeting location: Spencerport Wesleyan Church, 2653 Nichols St, Spencerport, NY

73,

Bill Rogers, K2TER

Vice Chairman, RVHFG

Howard Clark, K2AN SK
(September 29, 1922 - September 6, 2011)

Howard C. Clark, age 88, of LaGrange Road, Wyoming, passed away Tuesday, September 6th, 2011 at his own home. He was born in Perry, September 29th, 1922, the son of the late Hollis and Frances Withey Clark. A lifetime resident of Wyoming County, 1941 graduate of Perry High School and student of Cornell University, Howard worked all his life as a dairy and crop farmer at his farm on LaGrange Road, Wyoming. He was a member of the Silver Lake Mennonite Church of Burke Hill Road and the Upstate Milk Cooperative. Howard was a passionate Ham Radio Operator and was a member of the American Amateur Radio League, the National Traffic System and the Air Force MARS with whom he helped with passing messages under the call sign "K2AN". He is predeceased by his first wife, Roberta Clark; and a brother, Herbert Clark who passed away in 2010. Survivors include his wife Loretta Kelley Clark whom he married June 21st, 1980; 2 sons, Howard (Virginia) Clark Jr. of North Tonawanda and Ronnie (Laurie) Hull of Castile; 2 daughters, Cheryl (George) Dovolos of Silver Lake and Debbie (Tim) Veazey of Geneseo; 8 grandchildren, 1 great grandchild, and a nephew Stephen (Elizabeth) Clark of Warsaw. A memorial service took place at the funeral home following visitation with Rev. Christopher Dienner and Rev. Stephen Clark as celebrants. Burial will follow the service privately in the LaGrange Cemetery.
Obituary provided by Vince Harzewski

!!! CQ NYQP !!!
2011 NYQP - October 15, 2011
1400 UTC thru Oct. 16, 0200 - 12 Hours
10:00 AM to 10:00 PM EDST
(third Saturday in October)

NYQP is just 4 days away, get ready for the best state QSO Party ever! The 2011 NYQP has 44 plaque award sponsorships. This is a record number of generous supporters of the NYQP.
Check out http://nyqp.org/sponsorship-information We are sure there is a plaque category you are eligible to win !!
With only 4 days to go we hope you are planning to be active. Get those chores out of the way and your stations, mobiles, rovers, antennas and equipment ready to rock & roll.
From home or mobile, there will be fun for all. If you plan on going mobile or rover, check everything out ahead of time. Consider taking a friend to share the driving and the fun! There is a new entry class this year for our four wheeled friends, we have added a Rover class. The NYQP rules spell out the differences.
Not a regular contester? Check out the N1MM set-up procedure posted on the NYQP web at

http://nyqp.org/downloads/N1MM_for_NYQP_Tutorial.pdf

Also, the FAQ page is loaded with useful information.
Rovers and Mobiles should check out the NYQP County Activity Map to see if any of those sparsely populated counties can be activated! Check out www.nyqp.org for all details! Also, we have the NYQP Forum, register and let us know your plans at

http://forum.nyqp.org .

Late breaking news! We have added two plaques to our Sponsorship page, intended for our younger 'youth' amateurs. If you know of any youth's, please advise them that NYQP has 2 plaque's especially for them.
Brent KC2QLJ, 2011 NYQP Coordinator
Paul K2DB, NYQP Advisor

Questions? Email info@nyqp.org NYQP Web: www.nyqp.org

VHFers: K2TER/R will be QRV for the NYQP and will activate 6 counties. The plan is to operate 80 thru 2 meters both SSB and CW and be active for the entire 12 hour duration of the QSO Party. K2TER and KV2X will be the ops.

New Auction Site!

Steve, K2HQ wants to get the word out to all Ham Radio Clubs. He has launched a new Ham Radio Auction site. The site is www.HamRadioHQ.Com , it opened its doors on Sat. Sept17th. He is trying to re-engineer his career and could use the support of our group. Please take a look!

What's Going on with the Sun?

By Paul Harden, NA5N

Recently, Paul, NA5N, wrote an interesting posting to the QRP-L mail reflector regarding what is going on with the sun and I feel what he wrote would be of great interest to the VHF'ers. Paul has been a ham since 1963. 1969-1977, ET1 (ss) on USS Robert E. Lee, SSBN601 (G) Polaris Submarine, 10 patrols. 1977 to present, work at the Very Large Array (VLA) - world's largest radio telescope near Socorro, New Mexico; design/build/test microwave up and down converters, 1-40GHz to 8-12GHz IF. Hobbies/interests: QRP CW and homebrew ham/QRP gear. Amateur radio astronomy and solar activity & propagation. Author of New Mexico and South-west history. (from qrz.com).

As most of you know, I've worked at the Very Large Array (VLA) radio telescope, now for 34 years. Let me share a few things I know about what's going on with the sun and solar observing efforts. Keep in mind, these are my personal opinions and experiences, and I'm not representing the obser-vatory.

This description is fairly long, as I want as many as possible to understand some of the complicated aspects of solar physics, and why this prolonged solar minimum has been so hard to predict.

Let me first add that over the years, I have shared posts, charts and graphs posted by hams on solar related HF propagation with our scientific staff, the PhD astronomers. They have always marveled that a bunch of hams (mostly QRPers) have such an interest in "Solar Weather" and have bothered to learn some of the solar physics required to understand it as a hobby especially when hams share sto-ries of when a solar flare or geomagnetic storm hit or rudimentary "S-meter" measurements, and strange skip conditions. They are impressed. Solar physics is a VERY small group of people. Hams are well recognized by this small group.

Here's the main problem: what really causes sunspots, flares, CMEs, the solar cycle, etc. is not well understood. It is known that they are probably linked to magnetic fields and other phenomenon going on inside the photosphere or underneath it (inside the sun's interior), and magnetic processes and plasma physics in the hot corona. The photosphere is the "surface" of the sun where light originates. The corona is the solar "atmosphere" above it.

Solar astronomers have numerous problems trying to figure out solar physics.

First, information to see or map (make images) of magnetic and plasma physics are more dominant at relatively low frequencies, defined here as below 1 GHz, in the 100s of MHz in the meter wave-lengths, in the 10s of MHz - the decameter wavelengths, and even down to the 10s of KHz.

In optical astronomy, including our own eyes, we see light emitted from the sun from both the pho-tosphere and from the corona. The corona is very bright, and that is why you can't see the actual so-lar disk (the photosphere) without special filters or equipment. You've probably seen photos of the sun during a total eclipse with all the splinters of light extending outward when blocked by the moon at totality. This is one of the few cases where you can see just the corona while the moon is blocking the photosphere. Otherwise, the sun is just a big, fuzzy ball of bright light, hard to discriminate the photosphere from the corona.

We can penetrate the bright corona to see the photosphere at very short wavelengths, in the 10s of GHZ region with radio, and shorter wavelengths in the optical or near-optical domain. This reveals the thermal processes going on at the surface of the photosphere, but not the non-thermal, magnetic or some plasma processes going on.

To “see” what is going on near the photosphere with magnetic fields and other physics, or to look at what are called the electron plasma and electron cyclotron frequencies, we need to observe at low frequencies (LF), typically around 400 MHz to around 10 MHz. Also remember, that the MUF (maximum usable frequency), below which our HF signals bounce back to earth, works in reverse … low frequency emissions from the sun lower than the MUF are also bounced off the E-F layers back into space and do not reach earth borne instruments. So our MUF tends to be the lower radio limit of observing the sun. What we call the MUF; astronomers call the “plasma frequency.” Some LF solar emissions, in the KHz region, also manage to penetrate our ionosphere.

So the obvious question is “so why don't you build a low frequency radio telescope to peer deep inside the sun?”

Such low frequency solar arrays have been built since the late 1950s, limited in use by the technology of the time. Most have been built by universities with limited budgets yielding instruments with resolutions of 10 arc minutes or worse (making fairly course contour lines for a fairly crude map), and using very narrow bandwidths to avoid RFI. Still, they have produced some useful science. The Clark Lake Radio Telescope in California, designed and built by Dr. Bill Erickson, was the first major science-producing solar array – though long since decommissioned and dismantled. Most LF arrays, once used for solar science, are all gone due to the limited science they produced and lack of funding. Only the Culgoora array in Australia and the Nancay Array in France remain operational at low frequencies, though mostly used for deep space science over solar observing. The Giant Meterwave Radio Telescope (GMRT) in Pune, India also has capabilities at 50, 153, 233, 325, 610 and 1420 MHz, though also seldom used for solar observing. The Owens Valley Radio Observatory (OVRO) in California also did some solar burst work until recently.

General view of some VLA antennas, showing the "legs" that hold up

You can do a search on the above observatories for more information.

Far more useful science is derived in the microwave frequencies than at LF, such that this is where the money has gone into instruments over the past 40 years. Basically, bigger bang for the buck. As a result, LF astronomy has been almost totally neglected, and astronomers are beginning to complain about this situation.

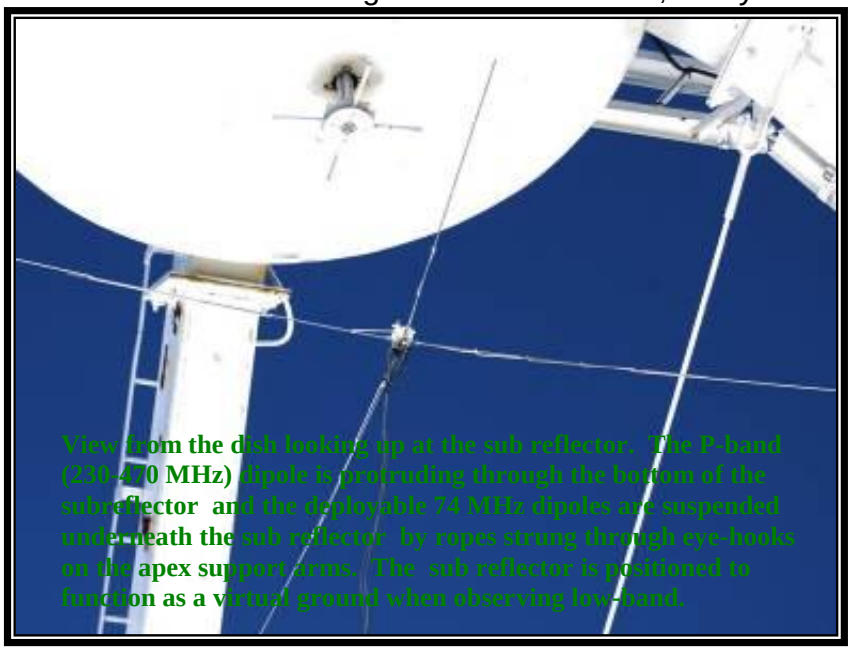
There are some recent projects to build some LF instruments such as the Long Wavelength Array (LWA), for which two arrays are now built and operating on a limited basis at the VLA, the Frequency Agile Solar Radio telescope (FASR – pronounced “phasor”) though currently un-funded, and a couple of others on the drawing board. These are years away from producing science.

So what about the VLA? Why don't we add a low frequency component to the VLA dishes? Actually, we have and it produced some very useful science, including the first ever low frequency sky survey conducted at 74 MHz and mapping the sun's Faraday rotation. The antenna was a cross-polarized dipole (2 dipoles at right angles to sense differences in linear polarization) suspended between the quadrapod legs that hold up the apex and subreflector. They were positioned in an attempt to "focus" the dipoles between the dish and using the subreflector as a virtual ground. Using the 88-foot diameter VLA dishes as a giant reflector, these basic wire antennas produced about 26dB of gain at 74 and 327 MHz!

A photo of VLA technician John M. opening the enclosure for the old circa. 1985 74 MHz receiver, located inside the VLA antenna Vertex (equipment) room. All the low-band receivers will be replacedby a newer, single wideband receiver. Thecryogenically cooled X-band (8-12 GHz) receiver and feedhorn is shown in the rear. The "blur" on the right is part of the S-band (2-4 GHz) feedhorn. A slightly tight fit, though working on the X-band receiver is worse!

In 2007, we began a major upgrade to the original 1975 VLA electronics, converting the old narrow band receivers to wide band cryogenic receivers cooled to 15K, a completely new suite of receiver feed horns, going from a 50 MHz IF to a 4 GHz IF, with a 4 GHz sampler and correlator, fiber optic interfaces, etc. Converting all 28 antennas, without interrupting observing, was completed in January of this year (2011). This project is called the EVLA – Expanded Very Large Array. We now have complete coverage from 1-50 GHz with a suite of 8 cryo cooled receivers and greatly enhanced sensitivity and resolution. The receiver bands are the entire L, S, C, X, Ka, K, Ku and Q bands.

Unfortunately, the EVLA transition electronics (2007-2011), and the final EVLA configuration, was not compatible with the old 74 MHz and P-band (300-400 MHz) receivers. As a result, we pulled the dipoles and receivers off the antennas during the EVLA retrofits and ceased accepted LF observing proposals at the end of 2006. There has been no LF solar observing since. Even worse, many of the older solar LF arrays also ceased operation during this time, leaving the astronomical community with virtually no low frequency solar imaging instruments to this day.



View from the dish looking up at the sub reflector. The P-band (230-470 MHz) dipole is protruding through the bottom of the subreflector and the deployable 74 MHz dipoles are suspended underneath the sub reflector by ropes strung through eye-hooks on the apex support arms. The sub reflector is positioned to function as a virtual ground when observing low-band.

So, why not design a new set of LF receivers to be compatible with the EVLA? Well, actually, that's what we're doing right now. In fact, this is the project I'm now working on called LBR for Low Band Receiver. It is a joint project between us (National Radio Astronomy Observatory, NRAO) and the Naval Research Laboratory (NRL). I am designing the NRAO portion and I should have the first receiver prototype built in about a month. It is a 4-channel receiver (times two polarizations) and will have continuous coverage from 50-500 MHz with selectable filters, both analog and digital, for filtering out RFI. It also has a switching noise source for con-

stantly calibrating the noise temperature of the electronics to derive the actual temperature of the signal. For now, we'll be using the same old dipoles hung on the dishes. A great ham radio project, and I'm getting paid to do it :-)

We're hoping to have all 28 receivers built and installed on the VLA antenna, and tested with our new correlator, when we go to the A-array in September 2012. The A-array is the most spread out antenna configuration, with antennas extending out the full 13 miles on each of the three arms of the VLA. We need this wide separation between antennas to properly “fringe” the antennas at these low frequencies to act as an interferometer. It is expected the resolution of this configuration will be in the 10s of arc SECONDS for making fairly detailed images. I don't think any LF solar instrument has anything better than an arc-MINUTE resolution, so this will be an improvement by an order of magnitude.

The LBR will be used for solar physics and deep space science. For deep space science, mapping the low frequency plasma and magnetic fields at the center of our galaxy, a black hole, is one of the goals. Finding magnetic fields with no optical counterpart could identify planets around other suns.

Another goal is to detect the “Epoch of Reionization.” This is theoretically where the fast moving electrons from the big bang are slowing down, if not halting, to form a giant wall of electrons some 13.7 billion light years away. These slowing free electrons would then be recombining to form ionized hydrogen molecules (hence, "reionization"). Theoretical astronomers estimate the 1432 MHz spectral line of hydrogen has been red shifted down to about 196 MHz in this region. Now that is a major red shift and would be a significant scientific discovery. If detected, it might answer the age old question if our universe is still expanding. Of course, these signals would be extremely weak, probably in the order of 20K, or 0.3dB above the galactic background. (Hint: 1dB noise figure (NF) = 75 degrees Kelvin of noise temperature). If the LBR system on the VLA can't detect it, there is currently no other instrument on Earth capable of detecting it either.

And finally, of interest to QRPers, one purpose of the LBR on the VLA will be to look through the ionosphere at a bright, distant calibrator source, such as Cas A, and using interferometry of the 28 VLA antennas, measure the exact stratified layers of electron densities of our ionosphere. In other words, it is hoped this will produce dynamic, real time 3D images of our ionosphere … including exactly where the E and F layers are currently at (their heights above ground for skip distance and where signals would likely land), their electron densities (for coefficient of reflection at different frequencies) and the plasma frequency (i.e., the MUF). The LWA project will be able to do the same ionospheric imaging. At present, our scientists are excited about this capability, but believe it has little outside interest. I am certainly encouraging the folks upstairs that if successful, please make the data available online in real time! At least for us QRPers -hi.

BACK TO THE SOLAR STUFF

We are experiencing a very unusual solar cycle best described by four-letter words. It is not known why this very quiet and prolonged solar cycle is occurring. One of the reasons, is there are currently no low frequency solar imaging radio telescopes “on line,” leaving a fairly large hole in studying the sun during this unusual cycle.

Scientists are doing their best using existing instruments, but these are almost exclusively high frequency radio (>1 GHz) and optical and near optical instruments. Satellites also provide gamma and x-ray emissions, measure the solar wind, electron and proton emissions, and image the sun at various wavelengths. Just about every wavelength you can image, except the long wavelengths. From this information, they infer what must be going on in the magnetic and plasma domains. But so far, with an absence of real, quantitative data, nothing has been found to suggest why the sun is so inactive, nor any history to compare it with.

Even when the LBR receivers at the VLA become operational, and the LWA array, there are still some problems in doing solar science for what astronomers would like to see.

First, with much of the interest in solar imaging for the magnetic dynamo and plasma physics in the low frequencies, finding a “clear channel” to observe in the 10-400 MHz or so is difficult. These frequencies are filled with manmade transmissions. RFI is not only a problem in finding clear frequencies, but also many earth generated transmissions in this spectrum are “loud” and can easy saturate the sensitive receivers.

For some of this science, the widest bandwidth one can find is needed. We're certainly hoping to exploit the old analog TV band, now vacant, for as long as that condition exists.

And finally, the biggest problem of all: I will quote from an internal proposal regarding observing in the 10-400 MHz spectrum. “Coronal magnetic fields have heretofore been inaccessible to quantitative study (i.e., ability to make direct measurements). Quantitative knowledge of coronal magnetic fields is crucial to virtually all solar physics above the photosphere, including the structure and evolution of active regions, flares, filaments, and coronal mass ejections. … Radio observations provide the means of both directly and indirectly measuring magnetic fields in the corona. However, such measurements require a broadband imaging capability."

Now the kicker: “One of the fundamental questions in solar physics is how the solar corona maintains its high temperature of several million degrees Kelvin above a surface of [only] 6000 K.” It is not known where the power needed to produce this heating comes from, with things like nano-flares to some sort of resonant wave heating being suspected.

This is why it is so important to attempt to look inside this hot corona at low frequencies where the plasma physics is taking place. This is where the extreme heat ionizes electrons, and further heating generates the plasma. But, as stated above, it is not known what physics keeps the corona so darn hot. What causes the transition of electrons to plasma, other than heat? What are the magnetic fields doing? Might it have something to do with the stalled solar minimum? Plus, of course, trying to image these same things on the photosphere.

Again, the main problem is to see the photosphere, magnetic fields, etc., basically sitting at 6000 degrees Kelvin, when you have to look through a two million degree furnace first. Kind of like trying to see that oncoming car when you're driving into a blinding sun – and trying to read the car's license plate number. It is hoped the new LF receivers, the wide spacing of the VLA antenna, and new techniques when correlating the signals, will allow us to probe deeper into the corona and hopefully resolve the photosphere. And of course, to provide new information that can be used to predict solar behavior.

I know all of this discussion does not explain why our solar cycle is such a dud. But hopefully, it will explain why nobody else is offering explanations either. There was just an unfortunate chain of events that left solar scientists with a lack of instruments that might be offering a clue. And the excellent instruments that are being used are, as of yet, not sensing anything unusual. And lastly, letting you know there are new exciting instruments that will hopefully be operational in about a year, and hopefully those instruments will be available to perform a new level of solar observing, and making the data and images available to the public real time – especially the 3D imaging of our E and F layers. There is no doubt QRPers will learn to interpret such information to our advantage when it becomes available. We'll share it with the solar astronomers! If anything does crop up within scientific circles that might explain our current solar inactivity, I will certainly pass it on. But otherwise, I am as much at a loss to explain it as you. We can only hope it improves.

For what it's worth … best DX :-(

72, Paul NA5N, Socorro, NM
Photos by NA5N

New Method Predicts Sun Spots

From Stanford University News Release

Now Stanford researchers have developed a method that allows them to peer deep into the sun's interior, using acoustic waves to catch sunspots in the early stage of development and giving as much as two days' warning. "Many solar physicists tried different ways to predict when sunspots would appear, but with no success," said Phil Scherrer, a professor of physics in whose lab the research was conducted. The key to the new method is using acoustic waves generated inside the sun by the turbulent motion of plasma and gases in constant motion. In the near-surface region, small-scale convection cells – about the size of California – generate sound waves that travel to the interior of the sun and are refracted back to the surface.

Using the masses of data generated by the two imagers, SOHO and NASA's Solar Dynamics Observatory satellite, Stathis Ilonidis, a Stanford graduate student in physics, was able to develop a way to reduce the electronic clutter in the data so he could accurately measure the solar sounds. This enabled Ilonidis to detect sunspots in the early stages of formation as deep as 65,000 kilometers inside the sun. Between one and two days later, the sunspots would appear on the surface. Ilonidis is the lead author of a paper describing the research , published in the Aug. 19 edition of *Science*.

The principles used to track and measure the acoustic waves traveling through the sun are comparable to measuring seismic waves on Earth. The researchers measure the travel time of acoustic waves between widely separated points on the solar surface. "We know enough about the structure of the sun that we can predict the travel path and travel time of an acoustic wave as it propagates through the interior of the sun," said Junwei Zhao, a senior research scientist at Stanford's Hansen Experimental Physics Lab. "Travel times get perturbed if there are magnetic fields located along the wave's travel path." Those perturbations are what tip the researchers that a sunspot is forming. By measuring and comparing millions of pairs of points and the travel times between them, the researchers are able to home in on the anomalies that reveal the growing presence of magnetic flux associated with an incipient sunspot.

They found that sunspots that ultimately become large rise up to the surface more quickly than ones that stay small. The larger sunspots are the ones that spawn the biggest disruptions, and for those the warning time is roughly a day. The smaller ones can be found up to two days before they reach the surface.

One of the big goals with forecasting space weather is achieving a three-day warning time of impending solar storms. That would give the potential victims a day to plan, another day to put the plan into action and a third day as a safety margin.

Alexander Kosovichev, a senior research physicist in Scherrer's research group, also participated in the research. Funding for the research came from NASA's Living with a Star program. See http://news.stanford.edu/news/2011/august/sunspot-081911.html for full text by Louis Bergeron.

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Classified Listings

None this month

Meeting Location and Directions

Spencerport Wesleyan Church on 2653 Nichols St. (actually Hwy. 31).

Directions from Rochester:

531W exit RT. to 259N

259N turn Rt. on 31E (first Rt. at traffic light)

Look for Spencerport Schools Bus Garage on left

Take first Rt. on Sheldon at A-framed church, park in rear lot.

Enter gray metal door under fire escape.