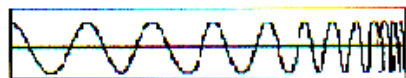


TAOSON



SIGNAL.

Issue No. 5 January, 2009

TAOSON Director-- David Fields N4HBO
Newsletter Editor --Bill Seymour KM4YL

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I. Welcome

Welcome to the **Tamke-Allan Observatory Solar Observation Network**. **TAOSON** was conceived in 2007 and operated for its first year as a student group at TAO with members Tyler Moore, Heather Fries and David Fields. In 2008 we opened up the group to the larger local amateur radio astronomy community.

The primary purpose of TAOSON is to keep local radio astronomers in touch and help coordinate their activities as they maintain their radio astronomy research sites. To this end we maintain a server for storing and sharing data, schedule meetings each month, and assist each other when needed. Most members support the Society of Amateur Radio Astronomers (see www.radio-astronomy.org).

TAOSON participates in the TAO Academic Associates of colleges and universities where members share research and scientific goals. This is both science and a humanistic endeavor that encourages cultural exchange. TAOSON also helps advise the TAO Space Explorer Groups with a common goal of developing capable and motivated human beings that will serve the community and become future scientists and contributors to a better world.

Membership is free if you're actively doing radio astronomy. Otherwise, membership is still free and you are invited to help with our projects.

II. Meetings

TAOSON

Meetings will be called as the need arises.

Meeting format will usually include a brief tutorial on a radio astronomy topic of interest, a work session on some chosen task or topic, a meal or refreshments, and a brainstorming session about projects. TAOSON had a local meeting on January 24 in Loudon, TN which turned out to be primarily social. TAOSON will have its next meeting on February 8 in Athens, TN.

Area Optical Astronomy Groups

Oak Ridge Isochronous Observation Network (Orion) meets at 7:00 P.M. on the first Wednesday of each month The Club Room, Oak Ridge Civic Center. See www.roanestate.edu/obs and www.orioninc.org

Tennessee Light Conservation holds its meeting on the first Monday of the month. The next meeting will be on Feb. 2 at 1600 h (6 PM) at Earth Fare in Turkey Creek, Knoxville. See www.SaveRoaneStarrySkies.org

Barnard Astronomical Society (BAS) meets at 7:00 P.M. on the second Thursday of each month at the UT Chattanooga Clarence Jones Observatory. See BAS@chattanooga.net.

Upcoming Events

- Jan. 28 Jovian planets, moons and Radio Emissions lectures at TAO. RA people invited.
- Jan. 29 Soldering demo and Antenna performance lectures at TAO. RA people invited.
- Feb. 2 Tennessee Light Conservation meeting at Earth Fare. Public invited.
- Feb. 7** Ham Radio Class at TAO at 6 P.M.
Public Stargaze at TAO at 7 P.M. Bring a dish to share.
- Feb. 8 TAOSON meeting in Athens. Local RA people invited.

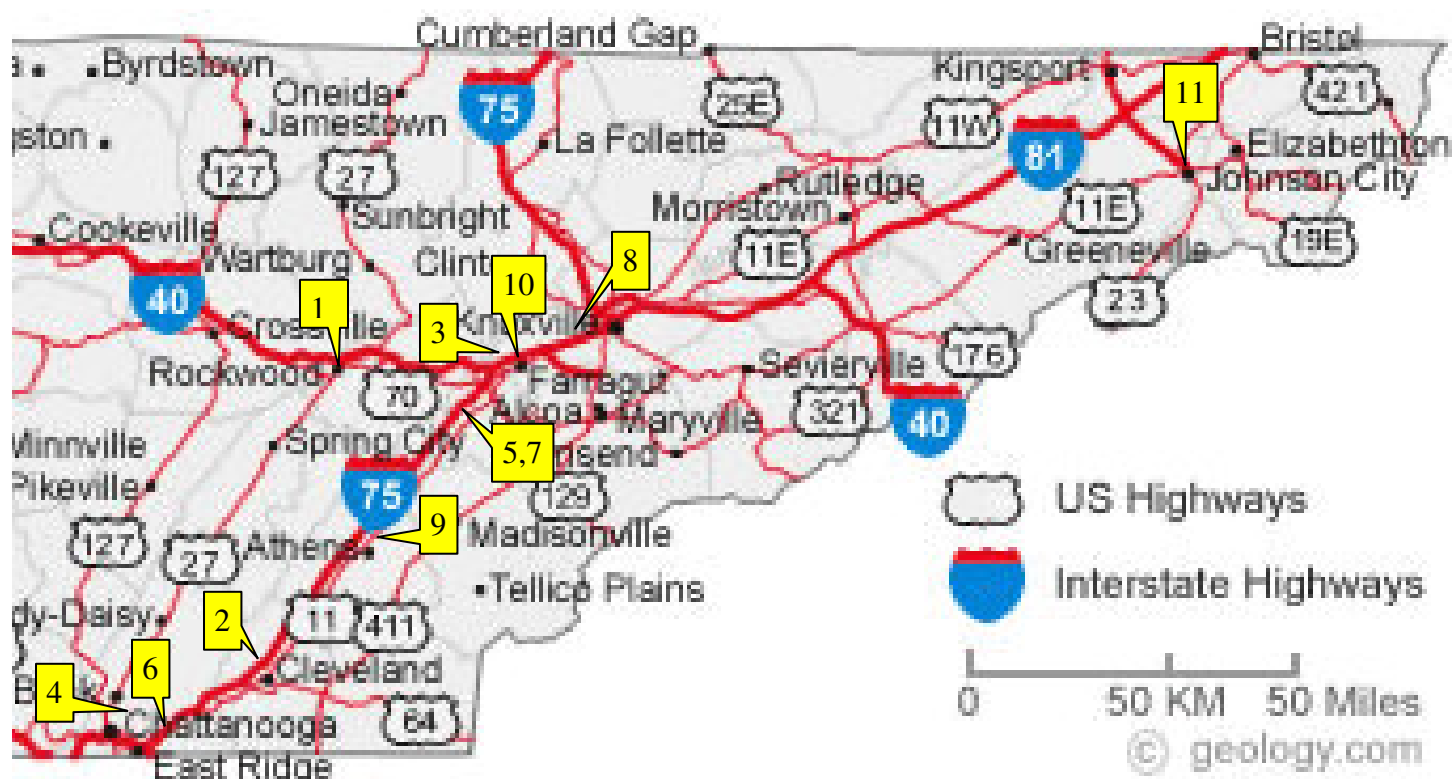
III. The TAOSON Signal

Our newsletter, the TAOSON Signal, will be published on a periodic basis as sufficient articles and other written contributions are received. Every effort will be made to protect the e-mail addresses on the distribution list and the privacy of their owners. Feel free to circulate and share copies of the Signal.

Items for the newsletter may be submitted by e-mail to Editor Bill Seymour at swafseymo@bellsouth.net and to David Fields at fieldsde@aol.com. We encourage each active member to submit at least a paragraph that summarizes site activities, goals, and ideas. Members are also invited to submit questions to the Editor to be considered in the newsletter and at meetings.

IV. Research Site Locations and Capabilities

TAOSON sites include those shown on the following map and identified in the following FACILITIES DIRECTORY.



Site Location	Site Name	Code	Control Operator	Lat Long	Telephone	Operations
1 Rockwood	TAO	TAO	David Fields	35.8322 84.6175	865-376-1362	21 cm, 15m, optical, Ku, Spectracyber, Interferometer, IBT, FM meteor detection
2 Cleveland	SkyNet	SN	Bill & Melinda Lord	35.2427 84.8783	423-478-9043	21 cm, 15m, optical, Ku, Spectracyber, VLF (SID), FM Meteor, IBT
3 Solway	Solway	SOL	David Fields	35.9641 84.2021	865-927-5155	15m, Ku, optical, VLF, H-alpha
4 Hixson	Riverbend	RB	Dick Castle		423-870-4398	15m
5/7 Lenoir City	Lenoir City	LC	Aaron Haun		865-986-7153	Server
6 Signal Mtn.	Mountain	MT N	Bill Seymour		423-870-8552	15m, optical, Ku, VLF (SID), IBT
8 Blue Meadow	Blue Meadow	BL M	Linda Fippin		865-539-0826	VLF
9 Niota	Niota	CL	John Mannone		423-337-2197	Optical, IBT
10 Karns	Karns	KA	Carl Lyster			Spectracyber, VLF
11 Johnson City	Johnson City	JC	Heather Fries			Quantitative optical, VLF (SID) planned
12 Scotland	Scotland	SC	Wanda Diaz			15 m, Spectracyber
13 UNAM, MX	Mexico	MX	Stan Kurtz			15m, Spectracyber, Homebrew IBT, SRT

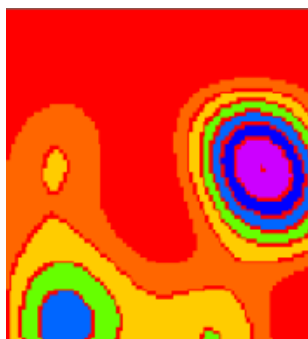
V. Basic Research Activities at Tamke-Allan Observatory

See www.roanestate.edu/obs . Free Public Skygazes are conducted on the 1st and 3rd Saturday evenings of each month and TAOSON members are invited. Ham classes are now being given, and presentations are made by staff and visitors at each Stargaze. Bring food to share and have fun.

TAO is our primary meeting and workshop site. Capabilities include SpectraCyber, Jove system, IBT, Ku interferometer, and meteor bounce, plus optical equipment that includes an 8” refractor, 12” reflector scopes, Sky Scout, and spectrometers. SpectraCyber was built by Carl Lyster and used by Heather Fries last year for mapping.

Our 15m receiver is now serving data through the firewall, and our lightning protection system seems to be doing its job.

The Ku band interferometer has also been used recently for mapping – this plot (below left) shows the Ku emission from the sun and a near Clarke Belt satellite. Meteors are enjoyed by trying to detect the reflection of FM radio signals from their ionized tails. The photo (below right) shows the beautiful night sky during the Perseid shower at 4 AM on August 12.



VI. TAOSON Projects

Radio Jove

Dick Castle, Jove Coordinator, K2IMH

Welcome to the Radio Jove portion of the newsletter. Radio Jove is a NASA sponsored project to monitor the Sun and Jupiter at 20.1 MHz. It is teaching tool for radio astronomy for middle /high school, college students, amateurs and research groups. You build your own receiver and dual dipole antenna. Radio Jove web site is: radiojove.gsfc.nasa.gov.

The TAOSON group presently has 3 systems on-line with another being built. Sites are:

1. Harriman, TN - Tamke Allen Observatory- David Fields, serving to Internet.
2. Cleveland, TN - Skynet -Bill and Melinda Lord
3. Chattanooga, TN- Riverbend- Dick Castle
4. Hixson, TN –Signal Mountain; Being built; expected to be operational in 2009 - Bill Seymour

Our objective is to monitor the Sun/Jupiter and see how the ionosphere affects the signals in different locations in close proximity. Data will be collected via Skypipe and sent to a server to be stored for analyses. TAO and Riverbend sites have been on-line intermittently since 2004. The Skynet Jove receiver has recently gone on-line.

TAOSON has people who concentrate on different areas of radio astronomy. Some of us are builders, some are experimenters, and some are writers. We're all working together, contributing with

Itty Bitty Telescope (IBT)

Tom Crowley

[Several TAOSON members are members of the Society of Amateur Radio Astronomers (SARA) and take part in the SARA Navigator Project. Through this project, TAOSON has borrowed SARA IBTs, Ku band radio telescopes. Tom Crowley, SARA President and Navigator Coordinator, has agreed to be TAOSON project coordinator for our IBTs.]

SARA is developing a **new** Itty Bitty Radio Telescope (IBT) for the International Year of Astronomy (IYA) 2009. Initial tests have shown the new instrument is capable of a 90% meter deflection when looking at the Moon with an 18-inch dish. Now that's radio astronomy! We are planning on developing two versions, one will be able to do a level of real science and the other will cost much less and make a great intro or demo telescope.

So just what is an IBT you ask? It consists of a direct TV satellite dish and LNB, with the advent of High definition satellite broadcast many of these small dishes are being discarded. You or your neighbor may have a dish that's ready to be tossed, and may well do the "green" thing and recycle it to an IBT. You simply add a satellite detector from Ebay or Radio Shack or order a Channel Master 1040IFD tuning meter for under \$80 on the web, build a base and you are ready to go.

If you are interested in building your own IBT check out:
<http://www.aoc.nrao.edu/epo/teachers/ittybitty/procedure.html>

For more information on the International Year of Astronomy check out:
<http://astronomy2009.us>

VII. Reports from The Sites

TAO Site Report

Introduction

One interesting phenomenon available for study is gamma ray bursts. A lot of progress has been made in identifying various types of bursts with supernovae, hypervolcanoes, neutron star quakes, etc. Still, the field is interesting. One aspect valuable to amateurs is that satellite reports of gamma ray bursts are available in almost real-time.

The topic of weak radio bursts is one that hasn't received nearly enough attention. However, this report shows interest by several of us -- David Fields, Rodney Howe, Rob Davis, Wanda Diaz and Stan Kurtz. I suspect that some of these are associated with gamma bursts, and this correlation, if it exists, is one where we might have some fun and make a contribution. The question of what we might learn is further considered in the conclusion.

Observation of a gamma ray burst on Dec. 26

Satellite detectors presented us with a delayed Christmas present about 05:13 EST on Dec. 26 -- a significant gamma burst (about 11 times background). I sent an email to the TAOSON list to see if anyone has noticed a correlated radio pulse. The time of the third processed announcement was 12:16:27 UT (05:16 EST):

GRB_TIME: 43999.20 SOD {12:13:19.20} UT

GRB_DATE: 14826 TJD; 361 DOY; 08/12/26

The direction of the incoming gamma pulse was from constellation Phoenix well below our southern horizon as seen from Tennessee, but of course any ionospheric effects might have been noted over a wide area.

I asked people who were actively taking radio data to check their data (VLF especially) and send me a note if you detected anything.

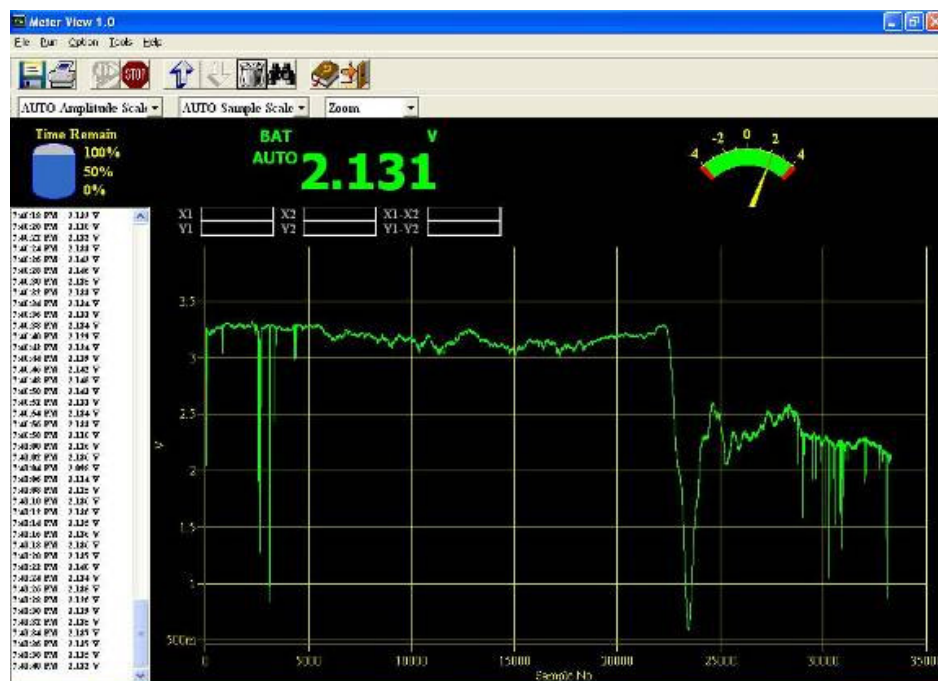
Replies were received from Rodney, Rob, Wanda and Stan -- Thanks!

Rodney's VLF data

Rodney saw nothing at 12:13 UT which would be just a little after the sunrise drop in this scan. He wrote, "There have been many 'dropouts' the last few days, as you can see, which I believe to be a result of these storm fronts passing through. I would doubt the northern hemisphere would detect any burst from so far 'down-under' as it seems these events have to be overhead, and need to be long hard bursts.

But it's always good to be checking..."

Here's Rodney's signal during the BAT trigger, with timestamps:

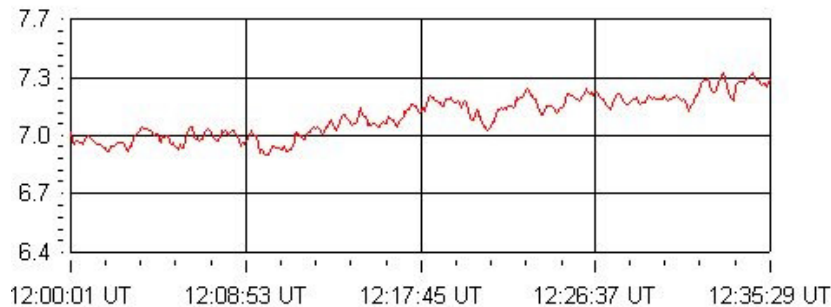


Rodney has only detected those events that have been soft X-ray events with a long duration, i.e. > than 100 seconds -- enough time, perhaps, to actually influence the ionosphere if the signal is 'fairly' weak. So, these data are at a 2 second capture interval. Detection during the night-time, which was the case in this event here in Colorado, is even more difficult. Although, the signal during this event was pretty stable, with little variance, detection seems more promising when the sun is in the sky and the daytime signal is suppressed. That way there is a 'reionization' which may be easier to detect.

He says that perhaps increasing the capture rate to 10's of milliseconds would improve sensitivity; however, he'd have to invest in some software designed radio and capture about 30 MB of data a day. He thinks that it might be worth it if we could prove a significant improvement in detectability.

Rob's VLF Data

Rob sent me a link to his VLF data of the 26th:

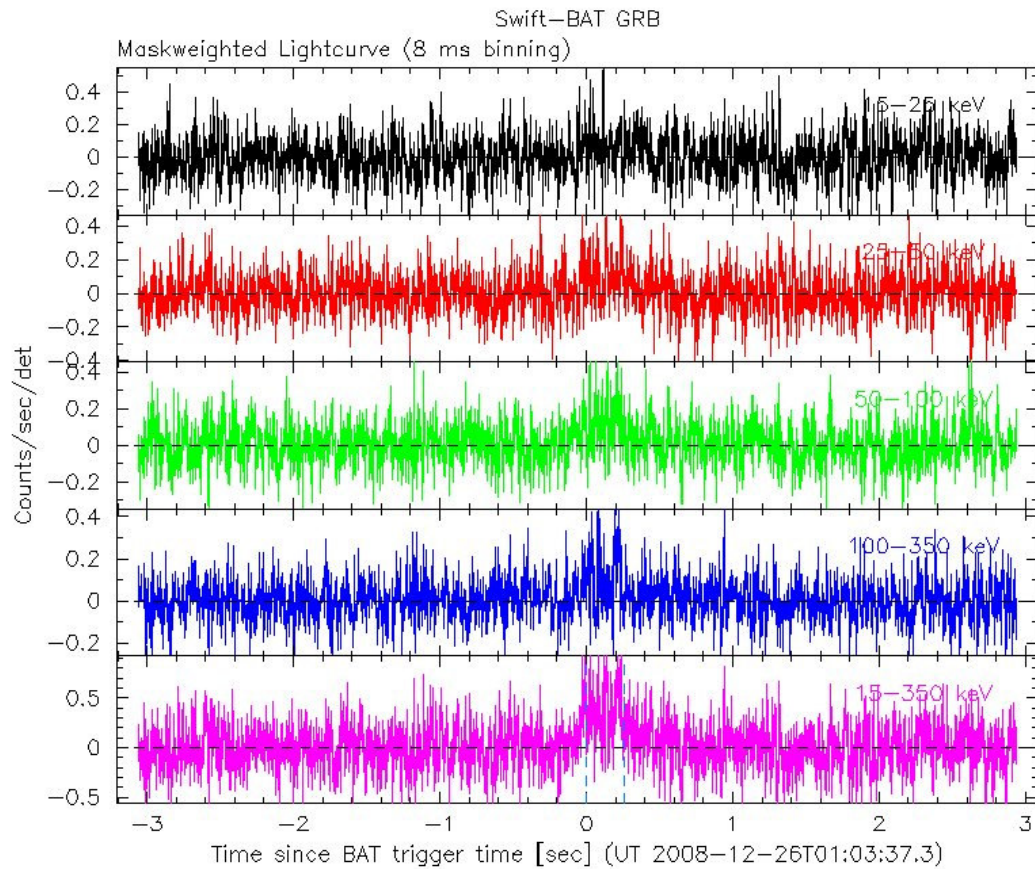


Rob stores all his data in compressed format – a nice way to go, and I was able to extract the data shown above, which contains the period (but not the event) of interest.

Wanda's Question and the reply

Wanda asked if it was possible to get the light curve or any numbers to hear it?

That is an Interesting question -- this was one of the short events -- it was about 0.4s in duration. I found plots of the light curves at http://gcn.gsfc.nasa.gov/notices_s/338177/BA/ and of the available data, and the following set of light curves appears to best show the time development of the energy. From top to bottom, the curves are 15-25 kev gamma energy, then 25-50 kev, 50-100 kev, 100-350 kev and finally 15-350 kev. I find more information in the last summary plot one, at 15-350 kev/



Summary and Discussion

In conclusion, this writeup shows how amateur data can begin to be utilized to form a unified picture of the electromagnetic environment during a significant astronomical event. We in TAOSON can perhaps, for future events, document the temporal profile of selected events across various frequencies.

What might this tell us? Many things, including the following: The presence of radio data at different sites will tell us the direction of the emission, just as satellites give us data on the direction of the gamma pulse itself. The relative timing could indicate if cosmic dispersion is present and if so, the distance to the source. The profiles could suggest the nature of the source and the physical processes involved. Finally, comparison of our data to data from more sensitive monitors could demonstrate and improve our ability to detect and understand extraterrestrial radio sources.

This is a good project to which all TAOSON people might contribute.

David Fields, Rodney Howe, Rob Davis, Wanda Diaz, and Stan Kurtz

Niota

Though I don't have much to report this month concerning radio astronomy observations, there is much to think about in the coming year. There is much excitement in the air about the Sun, its awakening into the next solar cycle, auroras from solar flares sending their cosmic streams to squish our magnetosphere, and new mechanisms proposed for this mass and energy transfer stemming from the discovery of magnetic ropes with NASA's THEMIS project launched in the spring of 2007. (See <http://news.nationalgeographic.com/news/2007/12/071211-northern-lights.html> among many other references.)

The resulting effects on our ionosphere will delight novice and seasoned amateur radio astronomers when we monitor natural radio, build a whip antenna for VLF spherics, or use a SID monitor.

So this month is a time of reflection. In that spirit, I'll share a short poem I had written in October 2006, called *Dandelion Stars*.

*Dandelion stars
Whispered by wind soft as light
on gossamer threads*

Hope you enjoyed a Merry Christmas and will prosper in a Happy New Year!

John C. Mannone

Riverbend

Activity this month was focused on working with Bill Lord at SkyNet Observatory. We are building a FM Radio Meteor project. Bill purchased a Chrysler FM car radio from the early 1990's (model 4469088). We had a couple problems with the radio in the volume and power on circuitry. With a little troubleshooting we resolved the problems and the radio performs excellent. The next phase will be building a 6 element yagi antenna for the FM lower band portion (88-92 Mhz). We will capture data by using Skypipe software.

Dick Castle- K2IMH

Solway

This site report is mostly a conversation between me and Dick Flagg about our ability to monitor signals from Jupiter during the current period of finding Jupiter in the skies during the daylight hours.

Question: Can we detect Jupiter emissions outside of the “Jupiter observing season”?

My answer is of course that theoretically we can do this, and I think that there is some hope. I started a discussion on the SARA web mail circulation by the following post:

I hope to see mention in the Journal of the coming opportunities to hear Jupiter emissions. The sun is still relatively quiet, and February will bring us some high-probability times to hear signals from the Jupiter/Io system.

Dick Flagg responded:

Recall that Jupiter and the sun are presently very close in the sky. The earth's ionosphere will likely be opaque during daytime hours (when Jupiter is above the horizon) and predicted Jupiter emissions will not be received. Although there may be exceptions this is not considered to be part of the "Jupiter observing season". Signals are best received for several months around opposition and we are currently near conjunction.

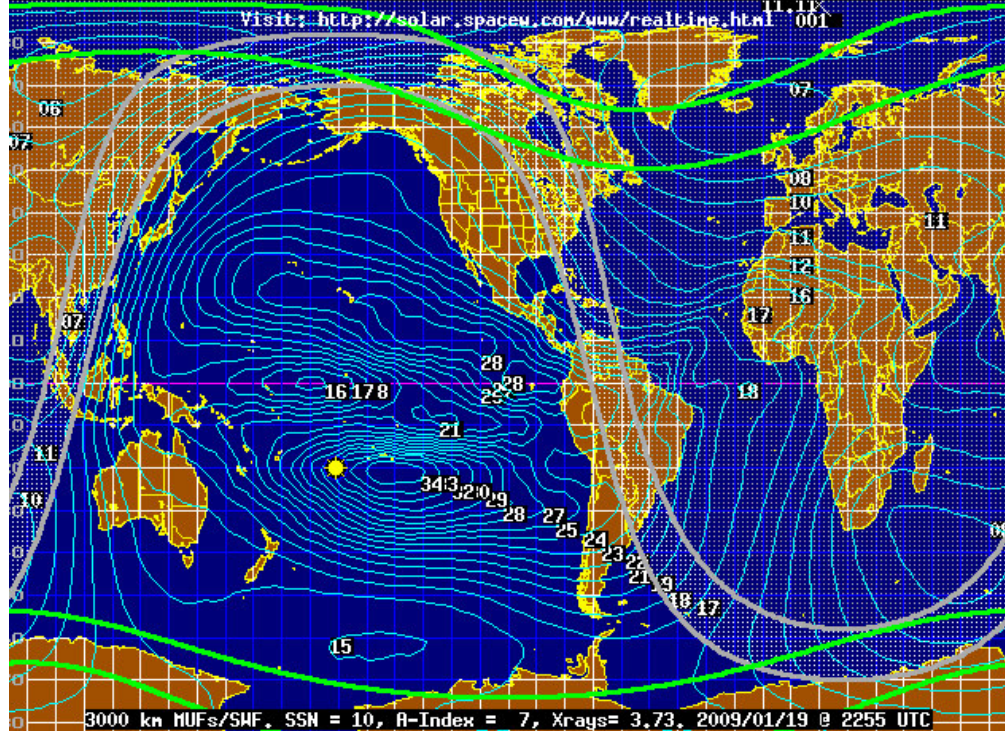
My reply:

I agree that we are not in prime season for observing Jupiter. Still, I think that we have a chance, based on the following discussion. Please correct me if I'm in error here.

I'm assuming that we can hear Jupiter provided

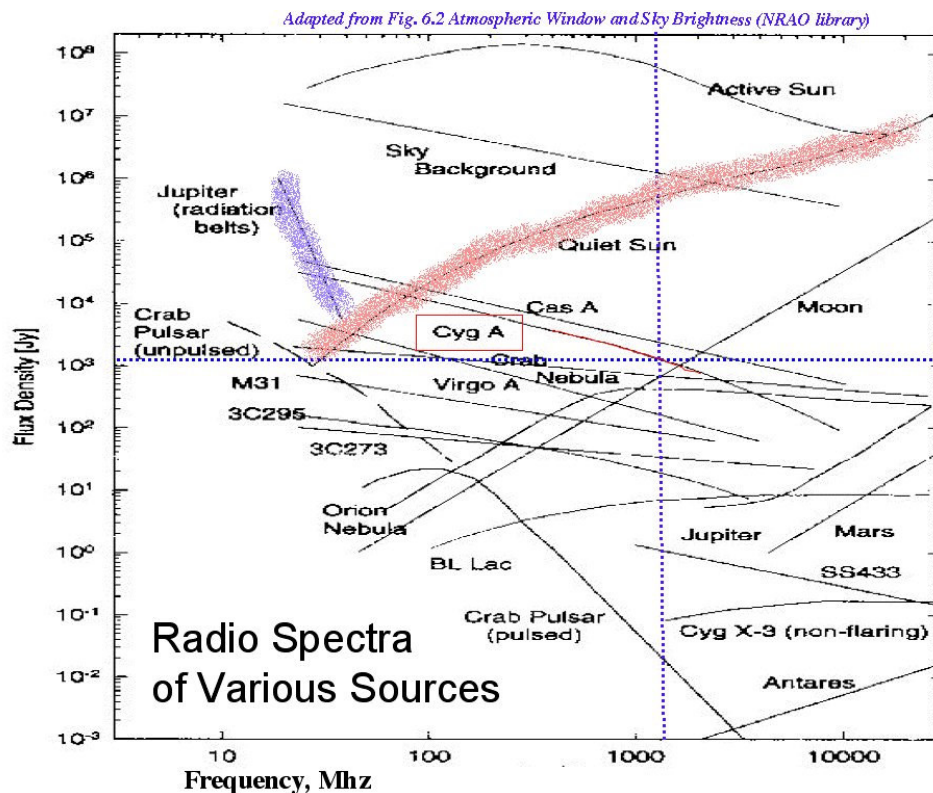
- Jupiter is above the horizon;
- Jupiter radiation is passed by the ionosphere;
- Jupiter radiation is not overwhelmed by solar radiation;
- Jupiter radiation is not overwhelmed by local storms; and
- Jupiter radiation is not overwhelmed by QRM (ham and commercial traffic).

I think that we can receive Jupiter if we listen above the MUF, and as seen from the TAO web page, the morning hours give some hope down to perhaps 17 MHz. This plot (just grabbed via the Internet) shows graphically how the morning hours with a more night-time ionosphere, are much preferred and how the 17-20 MHz window might be useful. [On second thought, this is too restrictive a limitation, since the MUF (Maximum Useable Frequency) is based on one signal hop, so I think that 20 MHz is a more reasonable value.]



The sun is a primary source of interference. At quiet sun times, such as we have presently, the sun produces more continuum radiation while Jupiter transmits more structured and very dynamic signals, giving me some hope that we might hear Jupiter even with S/N below unity.

John Kraus, radio astronomy experimenter extraordinaire, graphed the radio intensity of various sources as a function of frequency. In the following plot, I've marked the quiet sun radiation in red and for contrast, the Jupiter radiation in blue.



This suggests that below perhaps 19 MHz (log scale), Jupiter emissions would predominate.

There is QRM. We can avoid the ham bands if we stay between, 14.4 MHz and 21 MHz. There are still commercial stations to avoid.

Dick Flagg pointed out the problem with Galactic Radiation and I responded:

(David) Thanks for your very helpful comments.

(Dick) The ratio of Jupiter signal strength to the galactic background in a quiet location with a small antenna is seldom above 10 dB - even for a very strong Jupiter storm. Most storms are several dB weaker than this. Every dB of signal to noise lost due to ionospheric attenuation and background noise makes success less likely.

(David) Good point - thanks for mentioning this. I don't have a plot of galactic background at 20 MHz. Do you have a good reference? Jupiter is now about 15 degrees away from the galactic disk and 35 degrees from the center, so using antenna directionality should help.

(Dick) I am not sure how the MUF map relates to transmission of extraterrestrial signals to the earth's surface - in terms of absorption and reflection. These factors probably both vary with zenith angle at the receiving site.

(David) The MUF map applies to single bounce transmissions. Signals are refracted strongly below the MUF value so if Jupiter is off the meridian, then I think that its signals will bounce back into space. Lots to consider.

Let's plan a coordinated measurements session

What do you think? Have we a chance for detection if we listen between 14.4 and 20 MHz?

Plans

I found grants to get a Jove receiver for Misty to use. The receiver has arrived.

I scheduled a soldering workshop for anyone interesting, to be held the evening of Wed. Jan. 29 at TAO. Doug Campbell and I will handle this. I'll lecture about radio astronomy and on Jove monitoring.

I've been monitoring for a couple of months. Based on the measurements, we'll plan a program to monitor with some antenna directionality.

David Fields N4HBO

VIII. Radio Astronomy Basics

Measuring Spectral Indices of Thermal and Non-Thermal Sources

Radio sources fall broadly into two main categories—thermal sources and non-thermal sources. The mechanism for creating the radio emission is different in these two categories. In the case of thermal sources, one emission mechanism is the blackbody radiation of the source. If a source is at a particular temperature, then

its frequency spectrum is defined by the blackbody equation. By measuring the intensity of emission from the source at several frequencies, the slope of the blackbody curve can be measured. Non-thermal emission mechanisms are usually from motion of electrons around magnetic field lines (cyclotron). If the motions are relativistic the phenomenon is called synchrotron. Synchrotron emission has characteristic frequency dependence. Most of the non-thermal emissions from radio sources are due to synchrotron effects.

Spectral line emission from the rotation of molecules also causes radio emission. Most spectral line emission is thermal in nature, although there are some types of emission such as maser emission which are non-thermal. The best thermal sources for observation are planets [this was written for users of the 37 m radio telescope, and amateurs with smaller instruments might think differently – DEF]. Strong non-thermal sources are supernova remnants or some quasars. The data from the planets can be placed on theoretical blackbody curves to determine the blackbody temperature. The non-thermal sources can be studied to understand the nature of the emission-causing mechanisms and the physical properties of the source that would cause this kind of emission.

Ammonia as a Temperature Probe in Star Forming Regions

Molecules in the interstellar medium have been used as probes of some of the physical and chemical conditions in the medium. The radio spectra of these molecules, which are typically caused by the rotation of the molecule and its collision with hydrogen molecules, are especially good tools for this. The radio spectral region is also rich in spectral lines of more than 100 molecular species.

Ammonia (NH₃) was the first polyatomic molecule discovered in interstellar space. This molecule has a rich rotation-inversion spectrum with a large number of transitions probing a wide range of excitation conditions. In molecular clouds, these transitions are excited in collisions mainly with molecular hydrogen, and their relative Intensities reflect the kinetic temperature of the emitting medium.

Ammonia is, thus, an invaluable tool in measuring the physical conditions in molecular clouds. Temperature determinations from NH₃ have been used extensively in studies of star formation since ammonia emission has been found in regions of massive as well as low mass star formation. Such studies have proven useful in determining the conditions in molecular clouds that are necessary for star formation.

Source: MIT Haystack Observatory; 37-Meter Radio Telescope
User's Guide.

IX. Notable Quote

“What is it that breathes fire into the equations and makes a universe for them to describe...Why does the universe go to all the bother of existing?”

Stephen Hawking, A Brief History of Time; 1988

X. Links to Radio Astronomy Resources

From Jim Brown, SARA Mentor

Something new folks might like to listen in to.

SOMETHING NEW: For the new year, Spaceweather.com is pleased to announce a new service: Space Weather Radio, broadcasting live "sounds from space" around the clock. Today you can listen to the Air Force Space Surveillance Radar in Texas. When a meteor passes over the facility--ping!--there is an audible echo. (Activity should be high during the Quadrantid meteor shower this weekend.) In the near future we'll be adding broadcasts of solar radio bursts and VLF signals from the ionosphere. The streams are punctuated by Daily Space Weather Updates from Dr. Tony Phillips. Click here to begin listening:
<http://SpaceweatherRadio.com>

Happy New Year.

From Cliff Bates KC7PPM crcwnet.com

A Basic Primer on Setting Up An Amateur Radio
Radio Telescope; 17 Pages

“This is a primer about getting started in Amateur Radio Astronomy (RA), and is mostly based on the school of hard knocks and mistakes I have made over the last 4 years since I have been interested in RA. Hopefully, after reading this, those of you who are up and coming will not repeat my mistakes and thus save yourselves not only a bit of frustration, but considerable money.”

(Copies available from Bill Seymour upon request)