RADIO ASTRONOMY

Journal of the Society of Amateur Radio Astronomers
January - February 2024

Job Geheniau, SK

Dr. Richard A. Russel
SARA President and Editor

Bogdan Vacaliuc
Contributing Editor

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It is the mission of the Society of Amateur Radio Astronomers (SARA) to: Facilitate the flow of information pertinent to the field of Radio Astronomy among our members; Promote members to mentor newcomers to our hobby and share the excitement of radio astronomy with other interested persons and organizations; Promote individual and multi station observing programs; Encourage programs that enhance the technical abilities of our members to monitor cosmic radio signals, as well as to share and analyze such signals; Encourage educational programs within SARA and educational outreach initiatives. Founded in 1981, the Society of Amateur Radio Astronomers, Inc. is a membership supported, non-profit [501(c) (3)], educational and scientific corporation.

Cover Photo:
Anthony Fuller

Contents

Tribute to Job Geheniau

By Anthony Fuller

"It is with great sadness that I have learned that Job Geheniau has passed away on December 29th.
I am sure you all remember his many contributions to this forum and his excellent work on maser detections. We will certainly miss this."

Wolfgang

Job Geheniau's career demonstrates a rich and varied experience in video production, editing, teaching, and live performance support. This experience, combined with his passion for amateur radio astronomy, paints the picture of a multifaceted individual with a diverse skill set and interests. His contributions to both video arts and radio astronomy are significant and highlight his talent and dedication to his work.

It was clear that Job Geheniau had extensive experience in video and related fields. From **Videoartiest at MILES!, LOUIS!, and I'M A SOULMAN (Legendsofmusic.nl)**:

From September 2014 onwards, he worked in video artistry for various theater productions, including tributes to Miles Davis and Louis Armstrong.

Teacher of Camera/Video Editing/3D & Color Correction +VJ mapping at Grafisch Lyceum Rotterdam: Since August 2008, he taught various aspects of video production, including camera work, video editing, audio, 3D camera technology, robotics, and color correction. This was an indication of a deep knowledge and skillset in the technical aspects of video production.

VJ-Editor at Vito Brothers and Motion Unlimited: His role as a VJ-Editor since January 2004 involved designing video graphics and live video mixing for events and performances.

Program Creator AV productions at Bis AV productions: From 2004 to 2008, he participated in creating audiovisual productions, which included both the conceptual and practical aspects of video production.

Video Editor at Studio A mediamelange: From 2001 to 2004, he worked as a video editor, a role that typically involves editing video footage to create a final product for various media.

ICT Professional at CMG and Editor Audio at Sonotech: His earlier roles in ICT and audio editing, from 1994 to 2001, suggest a solid foundation in technical aspects of media production.

Job Geheniau's journey into the realms of amateur radio astronomy in 2017 marked a significant pivot in his illustrious career. His foray into this field was not just a pursuit of knowledge but a manifestation of his undying curiosity and desire to explore the unknown.

His work, particularly in pulsar detection, not only added valuable insights to the field but also served as a beacon of inspiration for many, including myself. Many of us remember reading one of Job's earlier articles of October 6, 2020 in rtl-sdr.com, on Dark Matter and Job using his 1.5-meter radio telescope to measure the Hydrogen line power at specific sections of our galaxy, a pioneering effort that can be explored in detail here.

One of my favorite rtl-sdr.com on October 25, 2021 an articles on Job was his imaging of the cygnus star forming region with his Job 1-5 – 1.9-meter radio telescope, you can read about it here. There are many previous post, one post on June 11, 2020 Job was mentioned in scanning the entire Milky Way galaxy in one month, details can be explored here. There are multiple article continuations on hiis work scanning and mapping our galaxy, you can read details here.
One of Job's past achievements was using just a 1.5-meter dish that could be extended to 1.9-meters, connected to an RTL-SDR and a custom filter of his design with a tracking system, used to observe a W3 star forming region at Hydroxyl (OH) at a frequency of 1665.405 MHz, or a Maser! I remember back October 4th, 2022, Eduard Mol and Marcus Leech giving Job recognition for the detection of pulsar B0329 +54.

His remarkable detection of pulsar B0329 +54 in October of 2022, with a modest 1.9-meter dish, stands as a testament to his ingenuity and expertise. To those new and old in amateur radio astronomy, you can explore Job's work on his personal website here.

The last SARA message from Job, that I remember was, 'And… I am BACK!', dated April 15, 2022, echoes in our memories, a poignant reminder of his resilience and spirit. His AZ engine broke off the rotor on his infamous 1.5-meter radio telescope but even with his health conditions, Job still had the passion for radio astronomy!

Though we may never fully know the extent of the challenges he faced, especially with his health, one thing is certain - his absence leaves a void in the hearts of his fellow SARA members and all who had the fortune to cross paths with him. Job Geheniau, a true pioneer, and an enduring inspiration will be deeply missed!

President's Page

Welcome to a new year of radio astronomy!

This year SARA members will achieve new observational tools to map galactic hydrogen with:

- EzRA software
- Disk yagis
- Two-antenna interferometers

Maser measurements are being made with 1 meter dishes.

Jupiter measurements are being made using new software and SDRplay receivers.

Astropeiler Stockert has regularly been observing magnetars and repeating Fast Radio Bursts.

Pulsars are being observed with yagis as well as some of the big amateur dishes at Astropeiler Stockert and the Deep Space Exploration Society dishes.

The Australian amateur community has been contributing significantly with hydrogen measurements, and scientific analysis that can be used by all amateurs.

Remember to sign up for the online Western Conference!

Job Geheniau will be missed!

Rich

SARA President

Editor's Notes

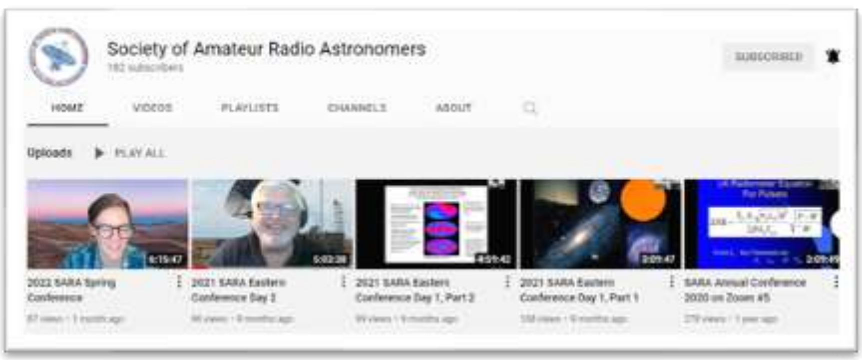
We are always looking for basic radio astronomy articles, radio astronomy tutorials, theoretical articles, application and construction articles, news pertinent to radio astronomy, profiles and interviews with amateur and professional radio astronomers, book reviews, puzzles (including word challenges, riddles, and crossword puzzles), anecdotes, expository on "bad astronomy," articles on radio astronomy observations, suggestions for reprint of articles from past journals, book reviews and other publications, and announcements of radio astronomy star parties, meetings, and outreach activities.

Subscribe to the SARA YouTube Channel

SARA has a YouTube channel at: https://www.youtube.com/@radio-astronomy

Don't forget to LIKE the videos! It helps with the YouTube distribution algorithm.

We are also looking to add content to the site. Anyone who wants to help produce a series of 5 - minute videos relating to radio astronomy technology or observations please contact me. (drrichrussel@netscape.net)



Observation Reports

We are now accepting 1-2 page observation reports. These reports should include the astronomical object's RA/DEC plus UTC of the observation. Also include the telescope configuration, process used to observe the object and results. Picture of the setup and plots of the observation are a plus to the report.

If you would like to write an article for Radio Astronomy, please follow **the newly updated Author's Guide** on the SARA web site:
http://www.radio-astronomy.org/publicat/RA-JSARA_Author's_Guide.pdf.

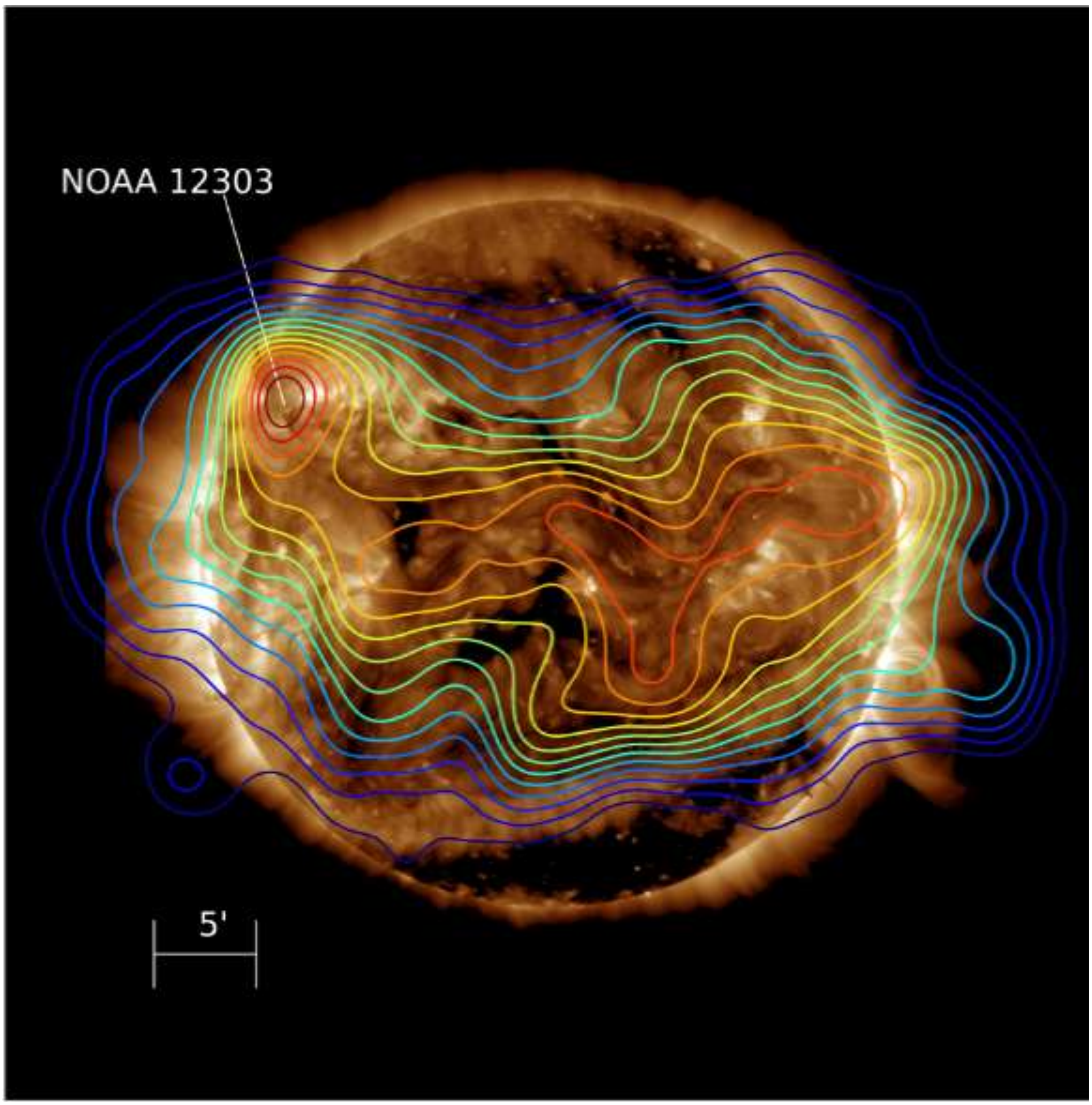
Let us know if you have questions; we are glad to assist authors with their articles and papers and will not hesitate to work with you. You may contact your editors any time via email here: edit@radio-astronomy.org.

The editor(s) will acknowledge that they have received your submission within two days. If they do not reply, assume they did not receive it and please try again.

Please consider submitting your radio astronomy observations for publication: any object, any wavelength. Strip charts, spectrograms, magnetograms, meteor scatter records, space radar records, photographs; examples of radio frequency interference (RFI) are also welcome.
Guidelines for submitting observations may be found here: http://www.radio-astronomy.org/publicat/RA-JSARA_Observation_Submission_Guide.pdf

2024 SARA Western Conference
Dallas, Texas, USA on 8 and 9 April, 2024

The 2024 SARA Western Conference will be held at Dallas, Texas at the University of Texas campus on Monday and Tuesday, 8 and 9 April, 2024. A total solar eclipse will be visible from the Dallas area on the afternoon of April 8, and observation of the eclipse will be a main event of the conference.



2015 Solar Eclipse LOFAR contours: LOFAR contours 50-95% (blue to red) of the peak intensity on top of a Solar Dynamics Observatory/Atmospheric Imaging Assembly 193 Å image. The contours are from a multifrequency LOFAR map (140-160 MHz) and the 193 Å EUV image is from 11:05 UT, during 2015 March 20 partial solar eclipse in Europe, 80% totality.

Call for papers: Papers are welcome on subjects directly related to radio astronomy including hardware, software, education and tutorials, research strategies, observations and data collection and philosophy. If you wish to present a paper please email a letter of intent, including a proposed title and abstract to the conference coordinator at westernconf@radio-astronomy.org no later than 1 February 2024.
Be sure to include your full name, affiliation, postal address, and email address, and indicate your willingness to attend the conference either in person or virtually to present your paper. Submitters will receive an email response, typically within one week. Final advance presentations should be submitted to the Western Conference coordinator for inclusion in the proceedings no later than March 15, 2024. Due to the work required to prepare the proceedings, this should be considered a hard deadline.

Presentations and proceedings: In addition to presentations by SARA members, we will have a keynote speech by Dr. Lindsay King of the University of Texas Physics and Astronomy Dept., who will be hosting the conference. They have arranged a National Science Foundation grant to support it.

Basic schedule: The conference will be held entirely on the University of Texas Dallas campus. Virtual attendance at the conference using Zoom will be possible at a reduced rate for those who cannot attend in person.

Contact: Please contact conference coordinator David Westman if you have any questions or if you would like to help with the conference: westernconf@radio-astronomy.org.

Getting there: Many major airlines have flights to Dallas/Ft. Worth International Airport.

Registration: Registration for in person attendance at the 2024 Western Conference is just US$75.00 ($20 sale price). The reduced rate to attend the conference online using Zoom is $15 ($10 sale price). You must be a SARA member to register for the conference. The in-person conference rate will include lunch at the conference site on Monday and Tuesday. Payment can be made through PayPal, www.paypal.com by sending payment to treas@radio-astronomy.org. If you need to send a check for registration, please send it to:

SARA Treasurer
c/o Thomas Jacobs
P. O. Box 4245
Wilmington, NC 28406.

Please include in comments that the payment is for the **2024 Western Regional Conference**.

Hotel reservations: Hotel reservation discounts have been arranged with the Hilton Richardson Dallas hotel, 701 E Campbell St. This link should be used to arrange the booking:

Link: https://www.hilton.com/en/book/reservation/deeplink/?ctyhocn=DALBEHH&corporateCode=N2994855.
They are able to extend the UTD rate of $119 plus tax for these April dates.

Monday night dinner: We will make a group dinner reservation at a local restaurant for Monday night.

Additional Information: Additional details will be published online at www.radio-astronomy.org and in the SARA journal, *Radio Astronomy*, as we get closer to the conference date.

SARA Western Conference Schedule

April 8-9, 2024

Conference Schedule (V = virtual speaker)

Time, CDT [UTC]	**Activity/Title**	**Presenter**	**Location**
Monday, April 8th			
8:00 – 9:00 [13:00]	Registration		
9:00 – 9:15 [14:00]	Introductions, etc.	David Westman (V), Bob Stricklin, Rich Russel (V)	UT Dallas Conference room
9:15 – 10:00 [14:15]	Keynote Speech:	Dr. Lindsay King, UTDallas	UT Dallas Conference room
10:00 – 10:45 [15:00]	Lunar Occultation Observation of Radio Sources	Wolfgang Herrmann(V)	
10:45 – 11:00 [15:45]	Prepare for lunch		
11:00 – 11:45 [16:00]	Lunch		
12:00 – 12:45 [17:00]	Prepare for eclipse viewing	Robert Lucas	UT Dallas lawn
12:45 – 2:15 [17:45]	Total Solar Eclipse		
2:15 – 4:45 [19:15]	*(Unscheduled Talk)*		
6:00 – [23:00]	Dinner at restaurant		
Tuesday, April 9th			
8:30 – 9:00 [13:30]	Preparatory activity		
9:00 – 9:45 [14:00]	Total beginners guide to attempting to get started in hydrogen line interferometry using very small dishes < 1m in size	Andrew M Thornett (V)	UT Dallas
9:45 – 10:30 [14:45]	A Novice's Guide to Amateur Radio Astronomy	Nathan Butts	UT Dallas
10:30 – 11:00 [15:30]	Morning Break		
11:00 – 11:45 [16:00]	IBT Eclipse Failure: A presentation of what NOT to do!	Bruce Randall	UT Dallas
11:45 – 12:45 [16:45]	Lunch		

12:45 – 1:30 [17:45]	Mapping the Milky Way by Cross Section Data	Felicia Lin	UT Dallas
1:30 – 2:15 [18:30]	Antennas for Radio Astronomy	Kent Britain, WA5VJB	UT Dallas
2:15 – 2:45 [19:15]	Afternoon Break, Group Picture		
2:45 – 3:30 [19:45]	Getting started in hydrogen line radio observing using. a military dipole array antenna	Andrew M Thornett (V)	UT Dallas
3:30 - 4:15 [20:30]	SARA Board Meeting	Rich Russel (V)	UT Dallas

Last update: 8-Feb-2024 DBW

ABSTRACTS

Getting started in hydrogen line radio observing using a military dipole array antenna.

Dr Andrew Martyn Thornett. (Virtual)
British Astronomical Association Radio Astronomy Group

Mapping the arms of Milky Way at 1420.405Mhz and determining the Milky Way's rotation curve has been achieved by many observers with a wide variety of instruments and antennae. The development of readily available, cheap radio equipment, excellent programs for inexperienced observers, and new beginner-friendly software, these observations are easier to achieve than ever before. This paper describes the author's journey and success in this field with the help of the SARA Scope in a Box package, a cheap commercial software defined radio, a repurposed UK military band 3 dipole array < 1m Square, and the ezRA (Easy Radio Astronomy) suite of software, from a radio-noisy urban environment in Staffordshire, England, UK, and how this has encouraged him to take up a wide range of other radio astronomy activities, and to become an advocate for radio astronomy amongst other amateurs without a radio or electronics background.

Total beginners guide to attempting to get started in hydrogen line interferometry using very small dishes < 1m in size

Dr Andrew Martyn Thornett (Virtual)
British Astronomical Association Radio Astronomy Group

Many newcomers to amateur radio astronomy have no background in amateur radio, electronics or engineering but do have passion and a desire to expand their horizons beyond observational astronomy and astrophotography. They are keen to explore the same kind of areas covered by professional radio observatories. Current professional observatories use interferometry to achieve larger resolutions that can be achieved with a single dish, and because many amateurs can only access smaller sized equipment, the idea of using similar techniques to achieve larger effective apertures is very enticing.

Radio astronomy forums and groups have members who successfully carry out interferometry experiments using dishes in the 3m range and often complex equipment. My aim was to build and successfully observe interferometry fringes on the Sun using cheap off the shelf components, purchased from everyday consumer websites, and dishes < 1m in size, also easily sourced from similar places. As I am hoping that any success that I have with this project can be expanded to hydrogen in the Milky Way, I opted to use 1420MHz. I will describe the ups and downs and then go on to discuss my results, whether I had a degree of success, and lessons I learnt from the experience, and to what extent I think that this can be achieved by other amateurs with limited knowledge and funds.

Lunar Occultation Observation of Radio Sources

Wolfgang Herrmann (Virtual)
Astropeiler Stockert e.V.

Lunar Occultations are events, when a radio source is obscured by the moon. This can happen for radio sources which are close to the ecliptic. For any particular radio source these are rare events which can be centuries apart.
In the talk I will report on the observation of occultation events of the radio galaxy 3C273, the crab nebula and the Sagittarius A region. It will describe how the events are predicted, how the observation strategy has been developed and what the results have been.

A Novice's Guide to Amateur Radio Astronomy

Nathan Butts
SOKY-RAD

You've fallen down an intellectual or engineering rabbit hole and you're thinking about taking up radio astronomy. Excellent choice! It's fun, it's challenging, it's rewarding, and most of all I've made lots of mistakes that you can learn from to help make your path a little bit easier (hopefully). If you've gotten this far in your own research, you know what radio astronomy is. In this work, we will discuss ***why*** you would you want to do radio astronomy, ***what*** to expect on your foray into RA (lessons learned and realistic expectations), its ***benefits*** over other forms of astronomy, and, importantly, ***how*** to get started on the right foot. My hope is to encourage incoming novices to be the kind of radio astronomer they want to be and to do the kind of radio astronomy they want to do.

IBT Eclipse Failure and Other Failed Observations: A presentation of what NOT to do!

Bruce Randall NT4RT

The Itty Bitty Telescope (IBT) is a popular demonstration radio telescope. Plans to use it to show change in 12 GHz solar flux during the partial eclipse of October 14, 2023 did not go as expected. In my area of South Carolina, sun coverage was about 43%, which would show a definite effect on solar flux. I had planned to have a demonstration at a public event at the local science museum.

A shadow device is used to aim the IBT. Final aiming is done with signal strength. A few days before weather was obviously going to be cloudy, so shadow aiming devices will not work. Setting circles were fabricated so that a compass heading would allow aim calibration.
The sun's path was too close to the Clarke belt. The IBT LNB is designed to receive satellites.
Other failed observations will also be discussed. If it can go wrong, there is a good chance it will!
The paper and presentation are on how to predict problems and hopefully, fix them.

Mapping the Milky Way by Cross Section Data

Felicia Lin

About 73% of all visible mass in the universe is made of hydrogen. In other words, wherever there is visible mass significant enough to be recorded, it is almost guaranteed to contain an abundant amount of hydrogen. By simply collecting data on hydrogen in our galaxy, we can figure out the shape of our galaxy by some programming and math. The intensity of hydrogen emission tells us the amount of mass, and its velocity computed from the Doppler effect describes its relative distance from the center of the galaxy. To collect data, we maneuver the antenna across the sky to particular regions, and the data is put into a program called ezRA to produce interpretable graphs. To fully understand these graphs, in depth knowledge of how the antenna, program, and the math incorporated is very important. Background knowledge of Newtonian and electrical physics is necessary for comprehensive conclusions to be drawn on the data collected. At the end of collecting, refining, and interpreting data, we concluded that our findings are similar to what NASA had published of the spiral shape of our galaxy, with spiral arms generally matching up. What is more, we found the galaxy having a warped shape instead of being completely flat, as with many other studies done by other people.

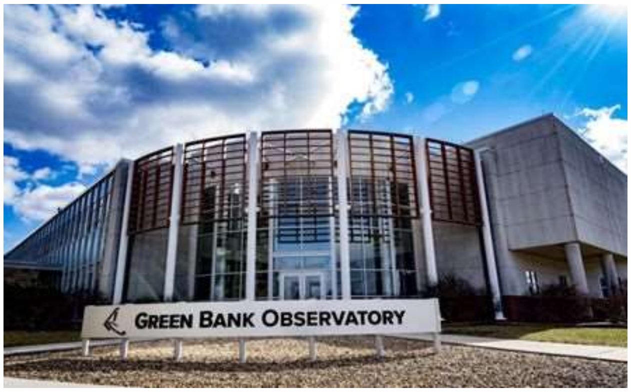
SARA 2024 Eastern Conference

2024 SARA Eastern Conference
and
Global Radio Astronomy Symposium
Green Bank Observatory
Green Bank, West Virginia, 2024
4-7 August 2024

The 2024 SARA Eastern Conference and Global Radio Astronomy Symposium will be held at the Green Bank Observatory, West Virginia, Sunday through Wednesday, 4-7 August 2024. The conference will also be available as a fully interactive online event.

With radio astronomy as its foundation, the Green Bank Observatory (GBO) is a world leader in advancing research, innovation, and education.

The first trailblazers of American radio astronomy called Green Bank Observatory home over 60 years ago. Today, their legacy is alive and well. Nestled in the mountain ranges and farmland of West Virginia, within the National Quiet Zone, radio astronomers are listening to the remote whispers of the universe, in order to discover answers to our most astounding astronomical questions.



Schedule: Conference meetings will be held in the main auditorium of the Jansky Laboratory at Green Bank Observatory with presentations by SARA members, GBO staff and distinguished speakers. Security and health restrictions permitting, tours of the facility, radio telescopes and laboratories will be conducted. Certain locations are open only to U.S. citizens who submit for a security review two weeks prior; however, most areas will be open to all attendees. ***Fully interactive online participation will be available for those who cannot attend in person.***

Key advantages of in-person attendance are training and hands-on use of the historical 40-foot radio telescope as well as user tutorial and supervised control of the 20 Meter radio telescope.

Sunday through Tuesday evenings, round table discussions and refreshments are scheduled in the Drake's Lounge, and there will be space outside for attendees to set up and display their own portable radio astronomy systems and optical telescopes.

Meals in the GBO cafeteria are included in the registration fee for in-person attendees.

Virtual online sessions are available for those who cannot attend in person.

Lodging is not included in the conference registration fee.

A small number of on-site dormitory rooms may become available for conference speakers, support staff and SARA officers. Other conference attendees may request rooms on a standby basis, but it is highly recommended that attendees arrange off-site accommodations.
RV/camping sites and a cabin are available at the nearby Boyer Station Campground. Call 1.304.456.4667 to inquire. The Elk Springs Resort is about 12 miles away. The Snowshoe Mountain area has several lodging facilities.

For other accommodations, please go to https://www.snowshoemtn.com/plan-your-trip/lodging .Numerous VRBO / Airbnb properties and private rentals are near GBO.

A list of many properties is at https://pocahontascountywv.com/lodging/ . Many chain accommodations are located about 30 miles away in Elkins, but that drive takes at least an hour due to mountainous roads.

Registration: Registration for in-person attendance by SARA members at the Conference is $250.00 (USD) if received by July 5, 2024, which includes meals but not lodging. The fee for family members or other guests who do not participate in conference sessions is $75.00, which includes meals and evening activities. Registration by July 5th for non-members is $270.00, which includes a year's membership in SARA. SARA members wishing to renew their membership at the same time as they register may also pay $270 and should include a renewal comment with their payment.

Late registration after July 5, 2024, is $300.00. Walk-in registration at the conference is $350.00.

Payment can be made through PayPal, www.paypal.com by sending payment to treasurer@radio-astronomy.org Please include in comments that the payment is for the **2024 Eastern Conference.**

Online registration will be available at the SARA Store in January 2024:

On-Site Participation or **Online Participation**

Proposals for papers, presentations, poster displays and working exhibits are welcome. Initial proposals for papers and presentations should be submitted by May 15, 2024. Abstracts of papers presentation outlines and display details must be submitted by June 1, 2024, with all final materials due on July 5, 2024 to meet publication deadlines. All proposals are subject to peer review and approval.

Presenters who cannot attend in person may be selected for remote video conference presentation. Submit abstracts and proposals to: jwilson@radio-astronomy.org by May 15, 2024.

What Green Bank Observatory Visitors Need to Know

COVID Restrictions. GBO reserves the right to impose requirements for vaccinations and masks. SARA will notify all registrants should GBO issue a policy statement. Should GBO policies adversely impact a conference registrant, they may change their registration from in-person to virtual / online and receive a refund for the difference. Should GBO close the campus for any reason, all registrations will be changed to virtual / online.

No Cellular Phone Service. GBO is in the National Radio Quiet Zone and there is no wireless phone service in the area. Use of wi-fi devices and satellite phones such as Iridium or Globalstar near the facility is not allowed, and severe restrictions are placed on digital cameras, although film cameras without electronic flash are allowed. There is a computer lab available during the day.

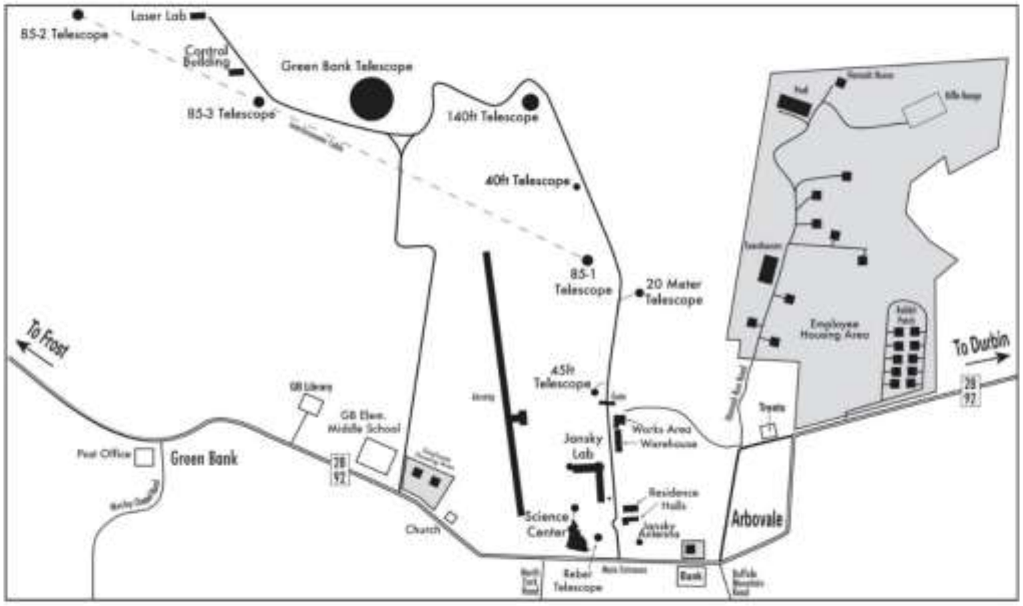
Pre-Conference Activities. Suggested pre-conference activities include free self-guided tours of the Green Bank Observatory Science Center and reasonably priced guided tours of the radio telescope area. Full details with a link for ticket purchase: https://greenbankobservatory.org/visit/
An overall guide to other activities and attractions in the area: https://pocahontascountywv.com/things-to-do/

Contact: Please contact the conference coordinator, B.J. Wilson, if you have any questions or if you would like to help with the conference: vicepresident@radio-astronomy.org

Additional Information: Additional details and updates will be published online at www.radio-astronomy.org and in the SARA journal, *Radio Astronomy*, as we get closer to the conference date.

National Radio Quiet Zone and Major Roads to Green Bank

Green Bank Observatory Site Map



SARA NOTES

SARA Student & Teacher Grant Program

All, SARA has a grant program that is, sad to say, very underutilized. We will provide kits or money to students and teachers including college students to help them with a radio telescope project. SARA can supply any of the following kits:

[1] SuperSID
[2] Scope in a Box
[3] IBT (Itty Bitty Telescope)
[4] Radio Jove kit
[5] Inspire
[6] Sky Scan

We can also provide up to five hundred dollars ($500.00 USD) for an approved radio telescope project.

We have on occasion provided more money based on the merits of the project and the SARA Grant Committee approval.

More information on the grant program can be found at the URL below.
SARA Student and Teacher Project Grants | Society of Amateur Radio Astronomers (radio-astronomy.org)

All that is required is the SARA grant request form be filled out and sent in. If it needs more work for approval, we will work with the students to help ensure their success.

Please pass the word that SARA will fund any legitimate radio telescope project anywhere in the world.

If you have a question, contact me at crowleytj at hotmail dot com.
Tom Crowley - SARA Grant Program Administrator

NEW Drake's Lounge Australia

This new zoom forum is geared to the Melbourne, Australia time zone (UTC+10) in order to improve coordination with our Australia, New Zealand, and Japanese members. The meetings are scheduled for the 4th Friday of every month, 9 AM Melbourne time (2000 UTC December 23). A zoom announcement will be sent out to all SARA members before the meeting.

Radio Telescope Observation Party (RTOP)

RTOP is designed to demonstrate how to take observations using various radio telescopes. It will also cover how to record and analyze data.

RTOP is every month on the 1st Sunday at 2 pm Eastern time (1800 UTC). ZOOM email notifications will be sent to all members.

Drake's Lounge

Join the SARA community as we discuss the latest astronomy and radio astronomy news. The lounge also provides a forum to share and get advice on your radio astronomy projects from very experienced amateur radio astronomers.

Drake's Lounge is every month on the 3rd Sunday at 2 pm Eastern time (1800 UTC). ZOOM email notifications will be sent to all members.

News: (January – February 2024)

This image shows half of the X-ray sky, projected onto a circle with the center of the Milky Way on the left and the galactic plane running horizontally. Photons have been color-coded according to their energy (red for energies 0.3-0.6 keV, green for 0.6-1 keV, blue for 1-2.3 keV). Credit: MPE, J. Sanders for the eROSITA consortium

Carolyn Collins Petersen ~ Half the Entire Sky, Seen in X-Rays
https://www.universetoday.com/165567/half-the-entire-sky-seen-in-x-rays
https://www.mpe.mpg.de/eROSITA

Michelle Starr ~ Black Holes May Lurk Much Closer to Earth Than We Realized

https://www.sciencealert.com/black-holes-may-lurk-much-closer-to-earth-than-we-realized

https://doi.org/10.1093/mnras/stad1925

Elisha Sauers ~ Webb finds molecule only made by living things in another world [*Dimethyl Sulfide*]

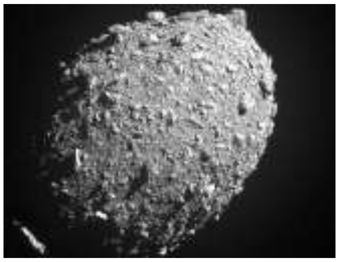
https://mashable.com/article/james-webb-space-telescope-exoplanet-discovery-1

https://webbtelescope.org/contents/news-releases/2023/news-2023-139?Tag=Exoplanets&page=1
NASA and the Space Telescope Science Institute (STScI)

Aaron Mok ~ AI chatbots were tasked to run a tech company. They built software in under 7 minutes — for less than $1

https://www.businessinsider.com/ai-builds-software-under-7-minutes-less-than-dollar-study-2023-9

https://arxiv.org/pdf/2307.07924v3.pdf



Carlyn Kranking ~ The Asteroid Hit by NASA Seems to Be Moving Strangely, High School Students Find

https://www.smithsonianmag.com/smart-news/the-asteroid-hit-by-nasa-seems-to-be-moving-strangely-high-school-students-find-180982874/

https://arxiv.org/pdf/2308.15488.pdf

Ethan Siegel ~ Ask Ethan: Why don't neutron stars decay?

https://bigthink.com/starts-with-a-bang/why-dont-neutron-stars-decay/

Ethan Siegel ~ JWST discovers the farthest gravitational lens ever

https://bigthink.com/starts-with-a-bang/jwst-farthest-gravitational-lens/

NASA ~ NASA's First Asteroid Sample Has Landed, Now Secure in Clean Room

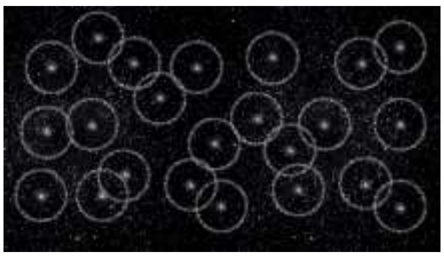
https://www.nasa.gov/news-release/nasas-first-asteroid-sample-has-landed-now-secure-in-clean-room/

Abbey A. Donaldson ~ NASA's Bennu Asteroid Sample Contains Carbon, Water

https://www.nasa.gov/news-release/nasas-bennu-asteroid-sample-contains-carbon-water/

William Steigerwald ~ Ten Things to Know About Bennu

https://www.nasa.gov/solar-system/ten-things-to-know-about-bennu/

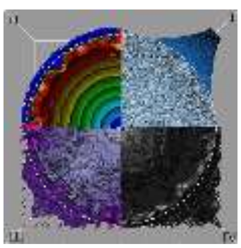


Ethan Siegel ~ Astronomers spot the first "bounce" in our Universe

https://bigthink.com/starts-with-a-bang/astronomers-bounce-in-universe/

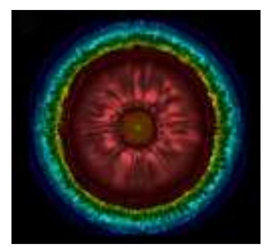
https://iopscience.iop.org/article/10.3847/1538-4357/aceaf3/pdf

Nancy Atkinson ~ This 3D Simulation of a Supernova Needed 5 Million Hours of Supercomputing



https://www.universetoday.com/163321/this-3d-simulation-of-a-supernova-needed-5-million-hours-of-supercomputing/

https://iopscience.iop.org/article/10.3847/1538-4357/ace968



GMTO Corporation ~ The Giant Magellan Telescope's final mirror fabrication begins

https://phys.org/news/2023-09-giant-magellan-telescope-mirror-fabrication.html

Matt Growcoot ~ Amateur Astrophotographer Captures Rare Jupiter Explosion

https://petapixel.com/2023/09/27/amateur-astrophotographer-captures-rare-jupiter-explosion/

Lucy Hattersley ~ Priority Boarding - get your Raspberry Pi 5 first
Kevin Purdy ~ Raspberry Pi 5, with upgraded everything, available for preorder today
Eben Upton ~ RP1: the silicon controlling Raspberry Pi 5 I/O, designed here at Raspberry Pi

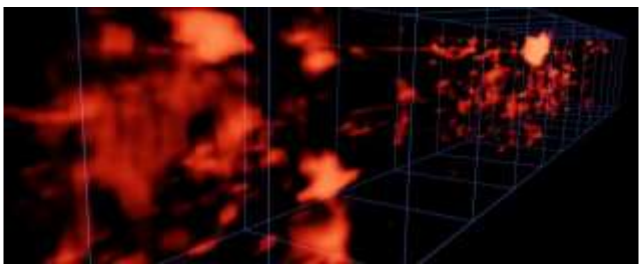
https://magpi.raspberrypi.com/articles/priorityboarding

https://arstechnica.com/gadgets/2023/09/raspberry-pi-5-available-for-preorder-is-faster-and-has-a-custom-i-o-chip/

https://www.raspberrypi.com/news/rp1-the-silicon-controlling-raspberry-pi-5-i-o-designed-here-at-raspberry-pi/

https://datasheets.raspberrypi.com/rp1/rp1-peripherals.pdf

Michelle Starr ~ Behold, The First Direct Images of The Cosmic Web in The Dark Reaches of The Universe



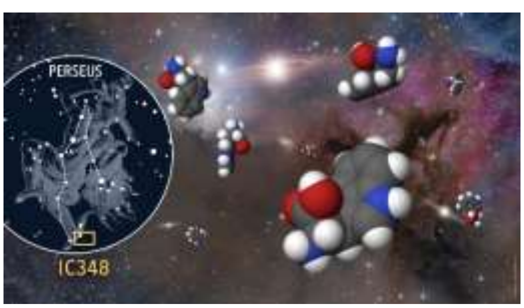
https://www.sciencealert.com/behold-the-first-direct-images-of-the-cosmic-web-in-the-dark-reaches-of-the-universe

https://www.nature.com/articles/s41550-023-02054-1

Laurence Tognetti ~ Solar Sails Could Reach Mars in Just 26 Days

https://www.universetoday.com/163333/solar-sails-could-reach-mars-in-just-26-days/

https://arxiv.org/abs/2308.16698



INSTITUTO DE ASTROFÍSICA DE CANARIAS (IAC) ~ Never Before Detected – Organic Molecule Essential for Life Found in Interstellar Space

https://scitechdaily.com/never-before-detected-organic-molecule-essential-for-life-found-in-interstellar-space/

https://doi.org/10.1093/mnras/stad1535

Matt Williams ~ Magnetic Fusion Plasma Engines Could Carry us Across the Solar System and Into Interstellar Space

https://www.universetoday.com/163348/magnetic-fusion-plasma-engines-could-carry-us-across-the-solar-system-and-into-interstellar-space/

https://arxiv.org/pdf/2309.11524.pdf

Ethan Siegel ~ JWST finds free-floating planets in the Orion Nebula?

https://bigthink.com/starts-with-a-bang/jwst-free-floating-planets-orion/

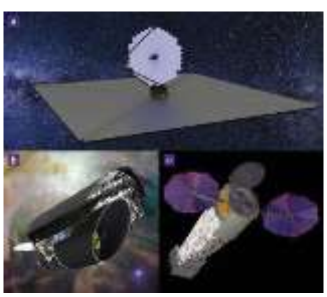
https://arxiv.org/abs/2310.01231

https://arxiv.org/abs/2310.03552

Jacob Knutson ~ Scientists use tree rings to find evidence of largest solar storm on record

https://www.axios.com/2023/10/12/solar-storm-earth-sun-ancient-tree-rings

https://royalsocietypublishing.org/doi/10.1098/rsta.2022.0206



Stephen Clark ~ Astronomers say new telescopes should take advantage of "Starship paradigm"

https://arstechnica.com/space/2023/10/astronomers-say-new-telescopes-should-take-advantage-of-starship-paradigm/

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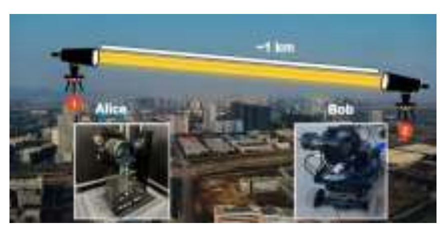
SPIE ~ Miniaturized free-space optical breakthrough unlocks high-speed wireless communication anywhere



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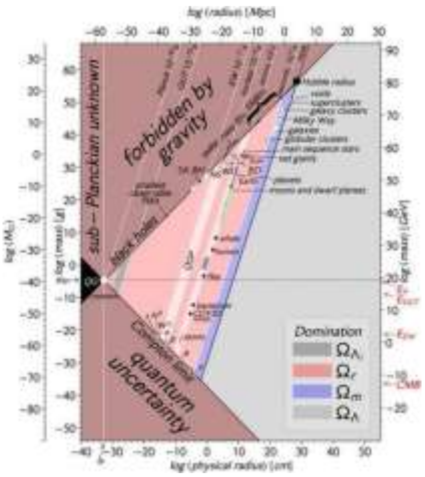


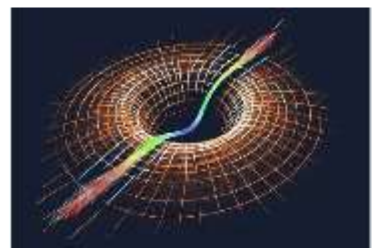
Stephen Luntz ~ The Observable Universe Might Be A Black Hole, Suggests A Chart Of Everything

https://www.iflscience.com/the-observable-universe-might-be-a-black-hole-suggests-a-chart-of-everything-71203

https://www.universetoday.com/163927/everything-in-the-universe-fits-in-this-one-graph-even-the-impossible-stuff/

https://doi.org/10.1119/5.0150209

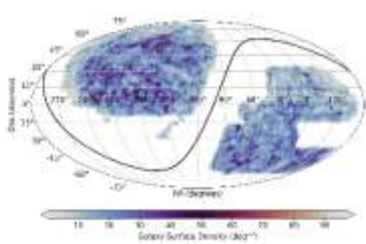
University of Eastern Finland ~ Accelerating waves shed light on major problems in physics



https://phys.org/news/2023-10-major-problems-physics.html

https://doi.org/10.1364/OPTICA.494630

Nancy Atkinson ~ Astronomers Release a Cosmic Atlas of 380,000 Galaxies in our Neighborhood



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https://sga.legacysurvey.org/

https://arxiv.org/abs/2307.04888

Adam Bluestein ~ How the new IMAX movie 'Deep Sky' launches you through the James Webb Space Telescope

https://www.fastcompany.com/90969465/deep-sky-imax-james-webb-space-telescope-director-nathaniel-kahn

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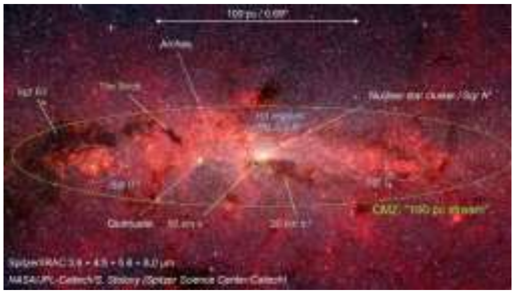


Evan Gough ~ Astronomers Want JWST to Study the Milky Way Core for Hundreds of Hours

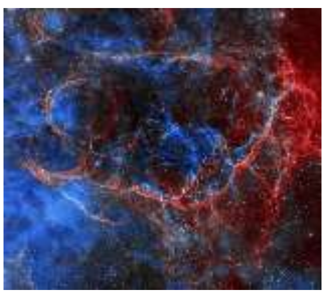
https://www.universetoday.com/163810/astronomers-want-jwst-to-study-the-milky-way-core-for-hundreds-of-hours/

https://arxiv.org/abs/2310.11912

Daniel Patrascu ~ NASA May Have Just Stumbled Upon the Mother of All Space Navigation Solutions

https://www.autoevolution.com/news/nasa-may-have-just-stumbled-upon-the-mother-of-all-space-navigation-solutions-223795.html

Goddard Image Analysis and Navigation Tool (GIANT)
https://software.nasa.gov/software/GSC-18758-1



Jennifer Willis ~ Ad astra per aspera

https://skyandtelescope.org/astronomy-blogs/to-the-stars-through-or-despite-hardship/

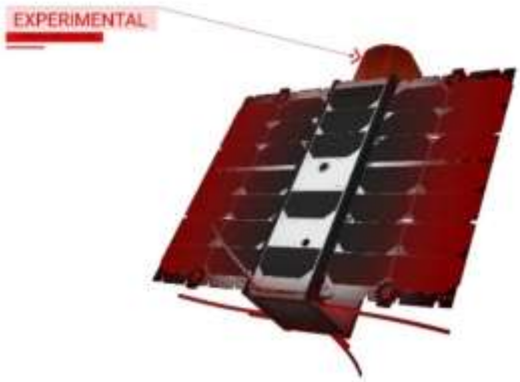
Eric Ralls ~ Saturn's majestic rings will vanish in 18 months

https://www.earth.com/news/saturns-rings-will-vanish-from-sight-in-2025/

Let's Take a Walk on the Wild Side …

David Hambling ~ Controversial Quantum Space Drive In Orbital Test, Others To Follow

https://www.forbes.com/sites/davidhambling/2023/11/17/controversial-quantum-space-drive-in-orbital-test-others-to-follow

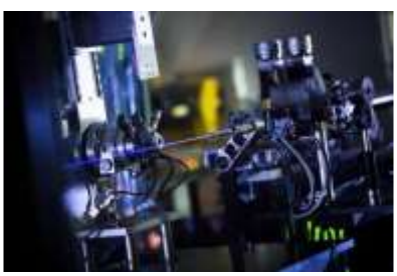


https://rogue.space/missions/barry-1/

https://www.reddit.com/r/IsaacArthur/comments/17xjuly/do_we_have_information_on_the_ivo_quantum_drive/

Lance Eliot ~ About That Mysterious AI Breakthrough Known As Q* By OpenAI That Allegedly Attains True AI Or Is On The Path Toward Artificial General Intelligence (AGI)

https://www.forbes.com/sites/lanceeliot/2023/11/26/about-that-mysterious-ai-breakthrough-known-as-q-by-openai-that-allegedly-attains-true-ai-or-is-on-the-path-toward-artificial-general-intelligence-agi



Christopher Plain ~ 'First Ever' Experiments to Measure Theoretical 'Quantum Flickering' in an Empty Vacuum Slated for 2024

https://thedebrief.org/first-ever-experiments-to-measure-theoretical-quantum-flickering-in-an-empty-vacuum-slated-for-2024/

https://www.hzdr.de/db/Cms?pNid=99&pOid=70692

https://journals.aps.org/prd/abstract/10.1103/PhysRevD.108.076005

Technical Knowledge and Education: (November-December 2023)

Larry Niven and Jerry Pournelle ~ The Mote in God's Eye

https://www.goodreads.com/book/show/100365.The_Mote_in_God_s_Eye

https://www.amazon.com/Mote-Gods-Eye-Larry-Niven/dp/0671741926

Royal Museums Greenwich ~ Why do we have special names for full moons?

https://www.rmg.co.uk/stories/topics/what-are-names-full-moons-throughout-year

SARA ~ ezRA – Easy Radio Astronomy Analysis Tutorials:

- *Simple Overview: https://youtu.be/sgid9zn9KkY*
- *Analysis 1- Introduction and Data Collectors*: https://youtu.be/ig_jPTuS8ZA
- *Analysis 2- Spreadsheet Analysis*: https://youtu.be/HkrIN9d6Hd8
- *Analysis 3- Signal Progression*: https://youtu.be/VIp7L6gIZPY
- *Analysis 4- More Plots and ezb file*: https://youtu.be/K02MADafOhc
- *Analysis 5- Interference Filters*: https://youtu.be/FeFk9EvITtc
- *Analysis 6- ezSky*: https://youtu.be/UNwS0f9X7kE
- *Analysis 7- AntXTVT and VLSR* : https://youtu.be/0ezig90GNBc
- *Analysis 8- ezGal*: https://youtu.be/i0St2X7ODKM

SARA ~ *Radio Astronomy Video Series: Constants, Variables and Formulas, Radio Astronomy Formulas:*

- *Introduction to Radio Astronomy: https://youtu.be/AOgvjRXnins*
- *Lesson 1- Parabolic Dish Gain*: https://www.youtube.com/watch?v=2bx5K9jUc_w
- *Lesson 2 -Parabolic Dish Half Power Beamwidth*: https://www.youtube.com/watch?v=XWOMRrwjkl8
- *Lesson 3 -Thermal Noise*: https://youtu.be/MMJ6Xvapt10
- *Lesson 4 -Focal Length and f/D*: https://youtu.be/Am6t06KqFPE
- *Lesson 5 -Feed Illumination Angle*: https://youtu.be/4RZzPzVBSJ4
- *Lesson 6 -Pointing Offset Gain Loss*: https://youtu.be/dQ8wAaTtm40
- *Lesson 7 -Measuring System Temperature (TSys)*: https://youtu.be/4gVUFFxra-U
- *Lesson 8 -Coax Attenuation Interpolation*: https://youtu.be/3B8hV6vFyo8
- *Lesson 9 -Pulsar math including electron density, distance, and age*: https://youtu.be/Bymdp--_3JU
- *Lesson 10 -Distance Math - AU, Parallax, Parsecs and Light Years*: https://youtu.be/6fo0y3fDOZs
- *Lesson 11 -Doppler Frequency and Relative Velocity Calculations*: https://youtu.be/8zKloAVpnJc
- *Lesson 12 -Pointing to the Milky Way using a Compass and Protractor*: https://youtu.be/33xeUSji94U
- *Lesson 13 -Radiometer Equation Basics*: https://youtu.be/vAyypJ8f2z8
- *Lesson 14 -Noise Figure and Noise Factor Calculations*: https://youtu.be/GD6wZhW5NPA
- *Lesson 15 -Interpreting Stokes Parameters*: https://youtu.be/wUVsbfURIsg
- *Lesson 16 -Velocity Factor, Speed of Light in a Coax Cable: https://youtu.be/WWuqRyb4Ad8*
- *Lesson 17 -Interferometry Fringe Spacing: https://youtu.be/rYhUKFn7IWg*

Announcements: (January – February 2024)

HamSCI Workshop 2024

Come join HamSCI at its seventh annual workshop! The workshop will be held March 22-23, 2024, at Case Western Reserve University in Cleveland, OH and seeks to bring together the amateur radio community and professional scientists. Anyone interested in this workshop is invited to join.

The workshop will focus on the theme of Alignments - between the Sun, Moon, and Earth; between collegiate amateur radio recreation and STEM curriculum; between data collection and analysis; between professional and citizen science. We are preparing for the solar eclipse of 8 April 2024, for which Cleveland will be in totality.

Registration

The HamSCI Workshop is a hybrid workshop with both in-person and virtual components.

In-Person Participant Registration

Registration for the in-person workshop is now open! Registration costs include all meals and refreshments for the workshop. If you are a presenter and need financial support to attend the workshop, please submit an abstract and request support there. Please do not use this registration link until you hear back regarding the status of your support request.

Register Here for In-Person Workshop

Program

HamSCI's chief area of interest is the use of amateur radio techniques for the characterization and study of ionospheric phenomena such as traveling ionospheric disturbances, sporadic E, response to solar flares, geomagnetic storms, the 2024 total solar eclipse other space weather events. In order to facilitate this science, continued development of the HamSCI Personal Space Weather Station and discussion of integration of amateur radio into the collegiate curriculum will also take place. We will also accept presentations relating to amateur radio and science, particularly space and atmospheric science, space weather, and radio astronomy.

Friday Keynote: Dr. Scott McIntosh, on Solar Cycle 25

Scott McIntosh is the deputy director of the National Center for Atmospheric Research (NCAR) and the former director of NCAR's High Altitude Observatory (HAO). McIntosh received his First Class Honors Degree in mathematics and physics and his Ph.D. in astrophysics from the University of Glasgow, Scotland. His research in the field of solar physics has focused on three main areas: the detection and impact of magnetohydrodynamic waves; the detection and understanding of ultraviolet and extreme ultraviolet radiation; and understanding the decadal evolution of the solar plasma.

McIntosh has authored or co-authored over one hundred and fifty articles in peer-reviewed journals, with fifty-two as first author, including twelve high-profile papers in journals like Nature and Science. His current “H- index” of forty-four [>8,200 citations] covers subjects in solar physics, space weather research, atomic physics, and instrument development. Recently McIntosh has examined the evolution of ubiquitous emission and magnetic features in the Sun's outer atmosphere that demonstrate a clear link to the processes which drive the quasi-periodic appearance of sunspots. Monitoring the evolution of these features can help us understand how the Sun's radiative, particulate, and eruptive output modulate on annual, decadal with a real insight into evolution across weekly, seasonal, decadal to the centennial scales that are pertinent to climate through the detection of magnetized Rossby waves in the sun's interior.

Invited Tutorial: Dr. Kate Zawdie, on HF Raytracing

Dr. Kate Zawdie is a Research Physicist in the Space Science Division at the US Naval Research Laboratory (NRL) in Washington, DC. She received a Ph.D. in Physics from the University of Maryland, College Park in 2015. Dr. Zawdie's main research interests are simulating mesoscale ionospheric phenomena and high frequency (HF) radio wave propagation in the ionosphere. Her ionospheric modeling work has focused on topics such as Large Scale Traveling Ionospheric Disturbances (LSTIDs), Medium Scale Traveling Ionospheric Disturbances (MSTIDs), Equatorial Spread F (ESF) and artificial HF heating. Part of Dr. Zawdie's work at NRL has also been to examine the effect of HF heating and plasma releases on ionospheric electrodynamics, using models to determine whether experiments can control the growth of natural ionospheric instabilities such as equatorial spread F (ESF). She has held significant roles in model development at NRL including major contributions to the MoJo-15 (Modernized Jones code) HF propagation model.

Invited Tutorial: Phil Karn, KA9Q, On KA9Q Radio

Phil Karn, KA9Q, is the developer of the KA9Q Software Defined Radio system and a board member of Amateur Radio Digital Communications (ARDC). He earned a bachelor's degree in electrical engineering from Cornell University in 1978 and a master's degree in electrical engineering from Carnegie Mellon University in 1979. From 1979 until 1984, Karn worked at Bell Labs in Naperville, Illinois, and Murray Hill, New Jersey. From 1984 until 1991, he was with Bell Communications Research in Morristown, New Jersey. From 1991 through to his retirement, he worked at Qualcomm in San Diego, where he specialized in wireless data networking protocols, security, and cryptography. Phil has been an active contributor in the Internet Engineering Task Force, especially in security, and to the Internet architecture. He is the author or co-author of at least 6 RFCs and is cited as contributing to many more. He is well known in the amateur radio community for his work on the KA9Q Network Operating System (NOS), named after his amateur callsign. He also created early 9600 bit/s FSK radio modems. In the early 2000's, Karn worked to introduce forward error correction into Amateur radio satellites, applying it to the 400 bit/s PSK telemetry from the AO-40 satellite. He won the 1989 Specific Achievement Award at the Dayton Hamvention.

Meeting Location and Parking

The Friday sessions and Saturday morning sessions will be held in Eldred Hall on the CWRU campus. The Friday evening banquet will be held at the Cleveland History Center. On Saturday afternoon, after lunch, the conference proceedings will continue at CWRU's think[box], a student manufacturing facility and makerspace that is open to the public. Attendees will participate in tours of think[box] facilities; tours of the Case Amateur Radio Club, W8EDU; and an amateur radio licensing session. There will also be time available for breakout sessions and committee discussions. The conference will close on Saturday evening with a screening of Frequency at CWRU Film Society. Tickets to the film are complimentary with a conference badge.

Paid parking is available near each venue. Near Eldred, participants are advised to park in the Veale Garage. Parking for the History Center is available behind the building. When visiting think[box] and the other destinations on the Case quad (W8EDU, Film Society), attendees may park in the Veale Garage and enter think[box] through Veale Center.

Breakfasts, Lunches, and Friday Banquet

Breakfasts, lunches, and coffee breaks are included with registration for both Friday and Saturday. Special dietary needs can be specified when registering.

The Friday Banquet Dinner will be hosted at the Cleveland History Center. Banquet tickets are included with Friday registration. Separate/additional banquet tickets may be purchased as needed.

Lodging

The primary hotel for the HamSCI workshop will be the Cleveland Courtyard by Marriott. Other nearby hotel options include Glidden House and the Tudor Arms Hotel, both within walking distance of the conference. Please ask for the CWRU rate when making your reservations.

Flight Information and Ground Transportation

Easy access to CWRU and the HamSCI meeting is available through the RTA Red Line, which connects directly to Cleveland Hopkins International Airport. If coming from the airport, take the Red Line to the University Circle station (quad) or Little Italy station (Marriott).

Talk-In Frequencies

Every party should have a call-in frequency; if you have an HT, check in en route to ask directions or say hello.

- Primary Simplex: 146.55 MHz
- Secondary Simplex: 432.10 MHz
- Repeater: KD8LDE/R 442.28750 MHz + 131.8 Hz

Local Organizing Committee

- Mr. Nathaniel Vishner, KB1QHX, Chair
- Mr. Matthew Canel, KE8NZR
- Dr. Kristina Collins, KD8OXT
- Mr. John Gibbons, N8OBJ
- Dr. David Kazdan, AD8Y
- Mr. Gary Mikitin, AF8A

Science/Program Committee

- Dr. Nathaniel Frissell, W2NAF, Chair, The University of Scranton (Assistant Professor)
- Dr. Kristina Collins, KD8OXT, Space Science Institute
- Mr. Jesse Alexander WB2IFS, NRAO
- Ms. Rachel Boedicker AC8XY, Case Western Reserve University
- Dr. Gareth Perry, KD2SAK, New Jersey Institute of Technology
- Mr. Bill Liles, NQ6Z, HamSCI Community (Diversity Recruitment Chair)
- Dr. Phil Erickson, W1PJE, MIT Haystack Observatory (Director of MIT Haystack Observatory)
- Mr. Gary Mikitin, AF8A

Questions?
If you have questions, please e-mail hamsci@hamsci.org. Logistics questions will be directed to Nathaniel Vishner KB1QHX (216-368-4580), and science/program questions will be directed to Nathaniel Frissell, W2NAF (973-787-4506).

The 2024 HamSCI Workshop is hosted by Case Western Reserve University in collaboration with the University of Scranton. We are grateful for the financial support of U.S. National Science Foundation Grant AGS-2404997 and Amateur Radio Digital Communications (ARDC).

ISSI Call for International Team Proposals

INTERNATIONAL SPACE SCIENCE INSTITUTE

Bern, Switzerland - www.issibern.ch

INTERNATIONAL SPACE SCIENCE INSTITUTE - BEIJING

Beijing, China - www.issibj.ac.cn

The International Space Science Institute (ISSI) in Bern (Switzerland) and ISSI-BJ in Beijing (China) invite proposals for establishing International Teams to conduct, at their respective meeting facilities, research in the Space and Earth Sciences.

To be eligible, research projects must involve the interdisciplinary analysis and evaluation of space mission data. They may also draw on complementary ground-based data and/or theoretical modelling where this adds scientific value.

This call is open to all scientists, regardless of nationality or institutional affiliation, who are actively involved in any of the following research fields:

- Space Sciences: Astrobiology, Astrophysics and Cosmology, Fundamental Physics in Space, Magnetospheric and Space Plasma Physics, Planetary Sciences, Solar and Heliospheric Physics, and Solar-Terrestrial Sciences.
- Earth Sciences using space data. This includes understanding and modelling Earth system processes, as well as climate change projections.

The deadline for proposals is March 14, 2024

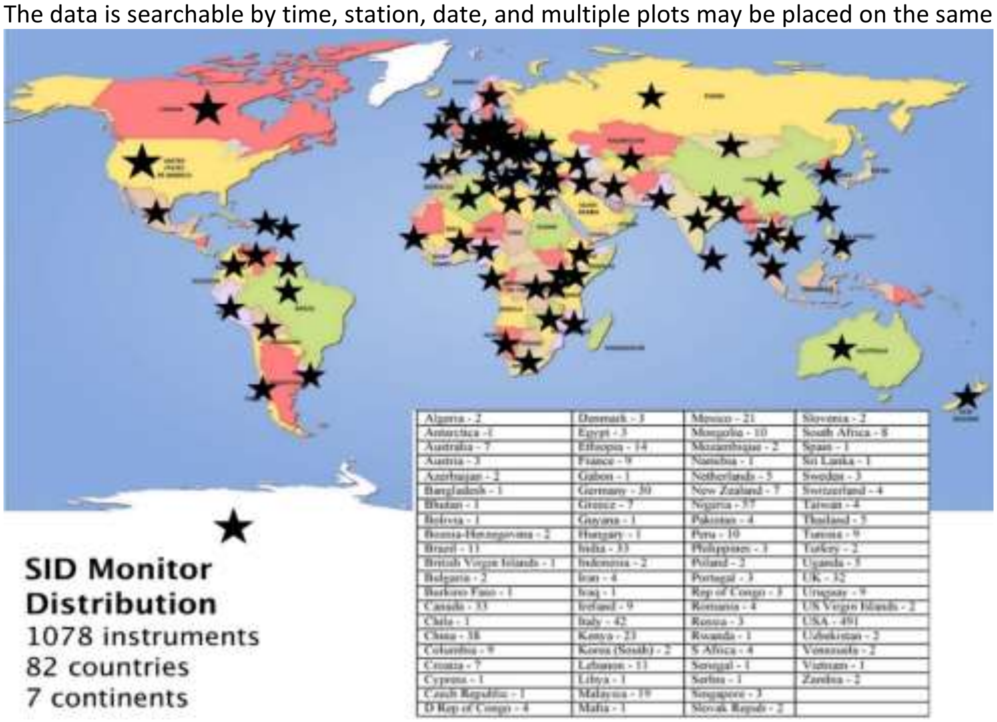
To download the complete Call for Proposals:
https://www.issibern.ch/docs/ISSI_ISSI-BJ_annual_call2024.pdf

For further information and questions please contact: Mark Sargent (mark.sargent@issibern.ch), ISSI Science Program Manager.

SuperSID

SuperSID
Collaboration of Society of Amateur Radio Astronomers and Stanford Solar Center

- Stanford provides data hosting, database programming, and maintains the SuperSID website
- Society of Amateur Radio Astronomers (SARA) sells the SuperSID monitors for 48 USD to amateur radio astronomers and the funds are then used to support free distribution to students all over the world (image below as of Fall 2017)
-
- Jonathan Pettingale at SARA is responsible for building and shipping the SuperSID monitor kits: SuperSID@radio-astronomy.org
- SuperSID kits may be ordered through the SARA SuperSID webpage: http://radio-astronomy.org/node/210
- Questions about the SuperSID project may be directed to Steve Berl at Stanford: steveberl@gmail.com
- Jaap Akkerhuis at Stanford is responsible for the SuperSID software and SARA has provided financial support for his efforts
- SuperSID website hosted by Stanford: http://solar-center.stanford.edu/SID/sidmonitor/
- SuperSID database: http://sid.stanford.edu/database-browser/
- The data is searchable by time, station, date, and multiple plots may be placed on the same graph for comparison.



Algeria - 2	Denmark - 3	Mexico - 21	Slovenia - 2
Antarctica - 1	Egypt - 3	Mongolia - 10	South Africa - 8
Australia - 7	Ethiopia - 14	Mozambique - 2	Spain - 1
Austria - 3	France - 9	Namibia - 1	Sri Lanka - 1
Azerbaijan - 2	Gabon - 1	Netherlands - 5	Sweden - 3
Bangladesh - 1	Germany - 30	New Zealand - 7	Switzerland - 4
Bhutan - 1	Greece - 7	Nigeria - 37	Taiwan - 4
Bolivia - 1	Guyana - 1	Pakistan - 4	Thailand - 5
Bosnia-Herzegovina - 2	Hungary - 1	Peru - 10	Tunisia - 9
Brazil - 11	India - 33	Philippines - 1	Turkey - 2
British Virgin Islands - 1	Indonesia - 2	Poland - 2	Uganda - 5
Bulgaria - 2	Iran - 4	Portugal - 3	UK - 32
Burkina Faso - 1	Iraq - 1	Rep of Congo - 3	Uruguay - 9
Canada - 33	Ireland - 9	Romania - 4	US Virgin Islands - 2
Chile - 1	Italy - 42	Russia - 3	USA - 491
China - 38	Kenya - 23	Rwanda - 1	Uzbekistan - 2
Columbia - 9	Korea (South) - 2	S Africa - 4	Venezuela - 2
Croatia - 7	Lebanon - 11	Senegal - 1	Vietnam - 1
Cyprus - 1	Libya - 1	Serbia - 1	Zambia - 2
Czech Republic - 1	Malaysia - 19	Singapore - 3	
D Rep of Congo - 4	Malta - 1	Slovak Repub - 2	

-

For official use only
Monitor assigned: ___________
Site name: _________________
Country: ___________________

SuperSID Space Weather Monitor

Request Form

	Your information here		
Name of site/school *(if an institution)*:			
Choose a site name: *(3-6 characters) No Spaces*			
Primary contact person:			
Email:			
Phone(s):			
Primary Address:	Name School or Business Street Street City State/Province Country Postal Code		
Shipping address, if different:	Name School or Business Street Street City State/Province Country Postal Code		
Shipping phone number:			
Latitude & longitude of site:	Latitude: ____________________________ Longitude: ___________________________		

I understand that neither Stanford nor the Society of Amateur Radio Astronomers is responsible for accidents or injuries related to monitor use. I will assure that a surge protector and other lightning protection devices are installed if necessary.

Signature: ____ **Date:** ______________________________

I will need:

What	*Cost*	*How many?*
SuperSID distribution USB Power	$48 (assembled)	
USB Sound card 96 kHz sample rate *(or provide this yourself)*	$40 *(optional)*	
Antenna wire (120 meters) *(or you can provide this yourself)*	$23 *(optional) with connectors attached and tested*	
RG 58 Coax Cable (9 meters) *(or provide this yourself)*	$14 *(optional) with connectors attached and tested*	
Shipping	US $12 Canada & Mexico $40 all other $60	
	TOTAL	$

____ **I have included a $_____________ check** (payable to SARA)

____ **I will make payment thru** www.paypal.com to treas@radio-astronomy.org

or

____ If you are a Minority-serving institution, in a Developing or economically deprived nation, and/or you are using the monitor with students for educational purposes, you may qualify for obtaining a monitor at reduced or no cost. Check here if you wish to apply for this designation. Then tell us how you want to use the SuperSID monitor. Include type of site, number of students involved, whether public or private school, grade levels, etc. and describe your program. The goal of the SuperSID project is to provide as many students with systems as possible. If you are able to pay for a system, even if you qualify for a free one, please do so and help support our goal.

____

____

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For more details on the Space Weather Monitor project, see: **http://sid.stanford.edu**

To set up a SuperSID monitor you will need:

1 Access to power and an antenna location that is relatively free of electric interference (could be indoors or out)

2 A **PC**** with the following minimal specifications:

a. A sound card that can record (sample) up to 96 kHz, or a USB port to connect such a sound card (for North and South America)
   i. All other countries can use AC97 sound card with 48 kHz record (sample) rate. Most computers made after 1997 will have AC97.
b. Windows 2000 or more recent operating system
c. 1 GHz Processer with 128 mb RAM
d. Ethernet connection & internet browser (desirable, but not required)
e. Standard keyboard, mouse, monitor, etc.

3 An inexpensive antenna that you build yourself. You'll need about 120 meters (400 feet) of **insulated** wire. Solid wire is easier to wind than stranded. Magnet wire will work but be more fragile. You can use anything from #18 to #26 size wire. The antenna frame can be made of wood, PVC pipe, or similar materials. We'll provide instructions. You can purchase the wire from us or obtain your own.

4 RG58 coax cable with a BNC connector at one end to run from the antenna to the SuperSID receiver. 9 meters is recommended, but the length will depend on where you place the antenna. You can purchase the coax from us or obtain your own.

5 Surge protector and other protection against a lightning strike

---

Return this form to: SuperSID@radio-astronomy.org
or mail to:

SARA Treasurer
c/o Thomas Jacobs
P. O. Box 4245
Wilmington, NC 28406.

Announcing Radio JOVE 2.0

The Radio JOVE Team

Radio JOVE students and amateur scientists from around the world observe and analyze natural radio emissions of Jupiter, the Sun, and our galaxy using their own easy to construct radio telescopes.

Our Project announces Radio JOVE 2.0, where participants assemble a 16-24 MHz radio spectrograph to observe solar, Jupiter, Galactic, and Earth-based natural radio emissions and share their observations with fellow participants.

In the Beginning

Radio JOVE started as a NASA sponsored educational outreach project in 1999. We developed a radio telescope kit suitable for receiving signals from Jupiter, the Sun, the Galaxy, and Earth-based radio emissions. The original kit comprised a radio receiver (RJ1.1) and a dual dipole antenna for 20.1 MHz. An important goal was to teach electronic principles including how to build, solder, and assemble the radio receiver and antenna.

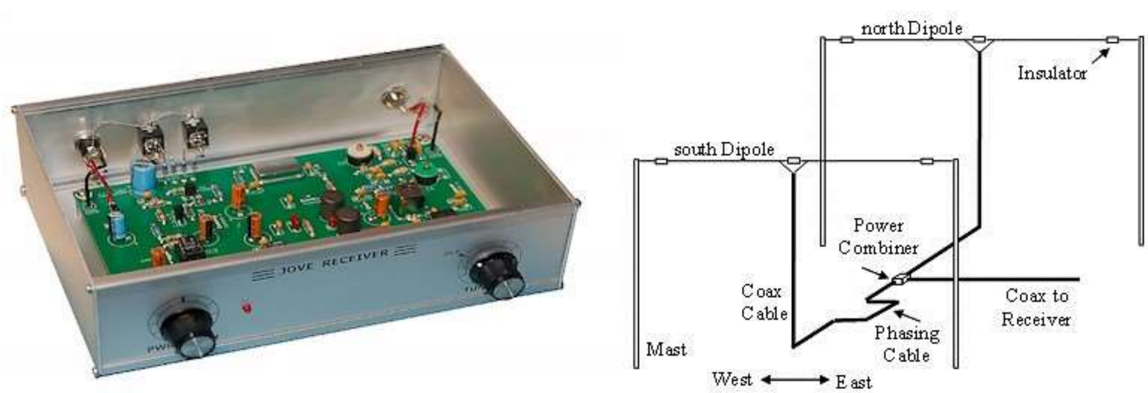

Figure 1. A Radio JOVE RJ1.1 receiver and a schematic of the dual-dipole antenna.

In addition to the hardware, three software packages were developed. These were Radio Jupiter Pro (Jupiter emission prediction program), Radio-SkyPipe (strip chart program) and Radio Sky Spectrograph (control and display of radio spectrograph data).

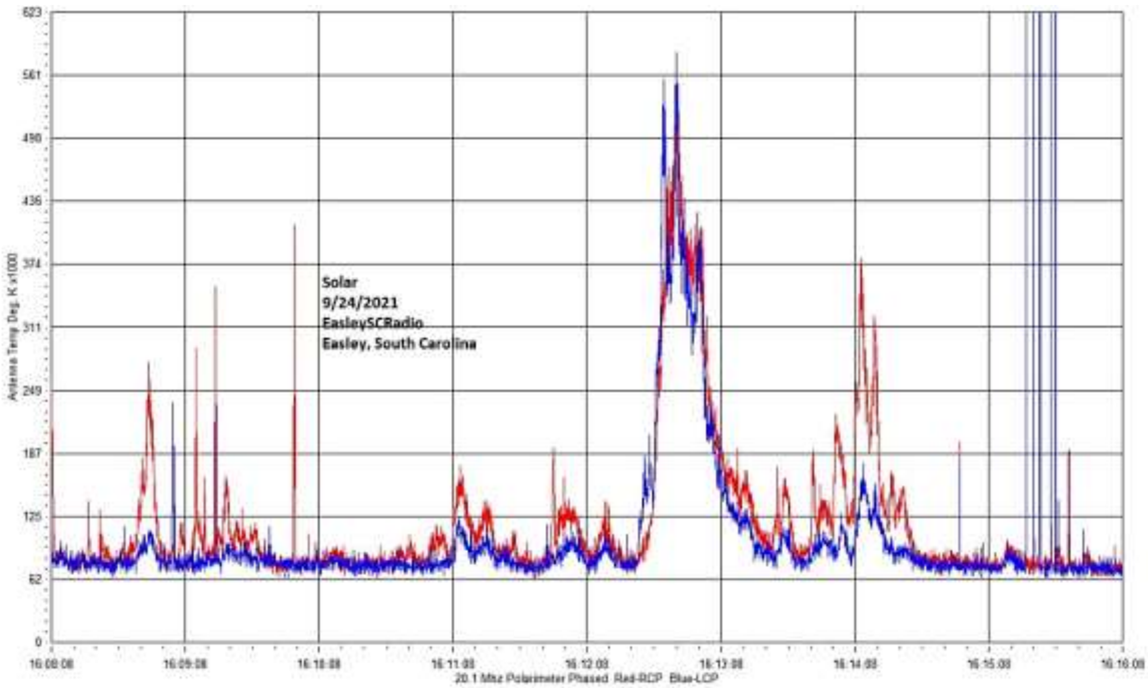

Figure 2. A SkyPipe strip chart showing multiple solar bursts using a JOVE receiver. John Cox, SC.

The Growth of Radio JOVE

As of Autumn 2021, over 2,500 kits have been sold at cost to schools and individuals around the world. Thousands of data submissions from observers have been made to the Radio JOVE data archive.

The Radio JOVE web site has always provided a wealth of information describing observation methods and various educational materials intended to teach radio astronomy techniques and scientific methods. Biannual newsletters are produced, and several telephone help sessions are held each year.

A sub-group of experienced observers known as the Spectrograph Users Group (SUG) evolved from the core JOVE group. These observers developed data collection and analysis techniques using more advanced equipment and techniques. SUG members have contributed to articles published in peer-reviewed scientific journals. This group remains active under the Radio JOVE listserv at https://groups.io/g/radio-jove/.

Moving Forward with New Technology

In the past, Radio JOVE provided the hands-on experience of building a radio kit. We have many RJ1.1 receivers in operation successfully contributing scientifically valuable data. It has, however, become increasingly difficult to obtain parts for the RJ1.1 receiver kits and we therefore decided to replace the RJ1.1 receiver with a new SDR-based design for the receiver portion of our radio telescope kits. While we continue to support the hardware and software for the original RJ1.1 receivers, the only kits now available for purchase from Radio JOVE contain this newly designed system.

In recent years, new technologies have made software defined radios (SDRs) ever more affordable. These radios can operate on a single frequency like the original JOVE receiver but can also generate spectrograms which depict radio activity as a function of both time and frequency. Such displays offer new insights into our studies of the Sun, Jupiter, the Galaxy, and both natural and artificial Earth-based radio emissions.

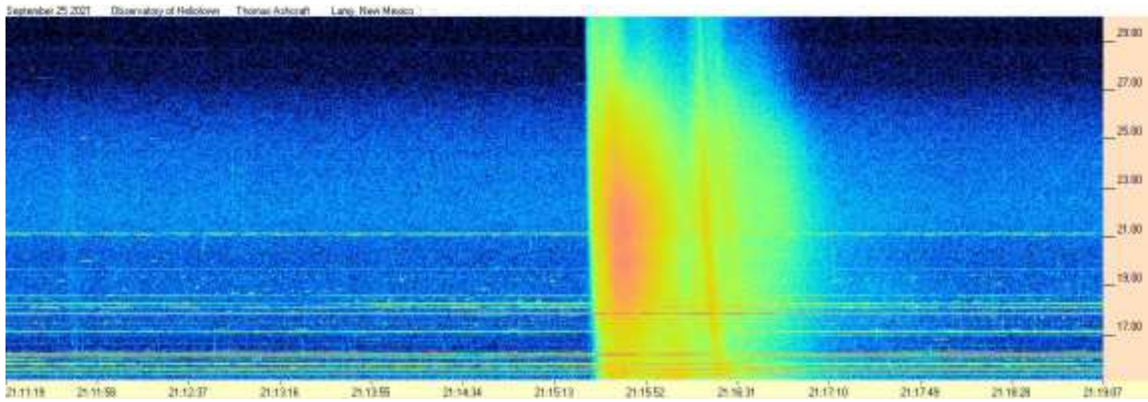

Figure 3. Radio spectrogram showing multiple solar bursts received by Tom Ashcraft in New Mexico. Horizontal scale is time, and the vertical scale is frequency. Amplitude is displayed using different colors corresponding to the strength of signals.

Radio JOVE continues to sell radio telescope packages including an antenna, receiver, and software; however, the receiver is now a commercially built SDR.

Figure 4. The JOVE team has had considerable success with the SDRPlay RSP1A unit and will provide support for using this instrument for our radio astronomy program. Not all SDR types can be supported, but it is our intent to provide support for some other SDRs as they become available during this period of rapid SDR development.

It continues to be our goal to introduce new observers to the scientific method and help them experience the thrill of receiving cosmic radio signals. Through a series of educational training modules and observing and analysis projects we aim to guide new observers to levels where they can contribute to Citizen Science projects.

We continue to support our large user base that uses JOVE RJ1.1 receivers – both in terms of technical support for the receivers but also with new and exciting observing projects for both RJ1.1 and SDR users.

We welcome both new and experienced observers to the JOVE 2.0 program as we share the excitement of receiving, studying, and understanding radio signals from our corner of the galaxy.

Please see the Radio JOVE web site at https://radiojove.gsfc.nasa.gov for more information.

RADIO JOVE 2.0 RADIO TELESCOPE KIT ORDER FORM

Order Online using PayPal™

* * * Please allow 2 to 3 weeks for delivery. * * *

IMPORTANT: Before you order the Jove receiver kit and/or the antenna kit, we suggest that you read the on-line manuals. You will need to provide additional materials and tools to complete the antenna. The cost of additional materials for the antenna support structure (masts, etc.) may be in the range of US$75 to US$100. Also note that the optimal antenna height can be up to 20ft, depending upon your latitude.

Item # RJK2u – Complete 2.0 Kit: Receiver + Unbuilt Antenna Kit + Software This kit includes an SDRplay RSP1A, USB Cable, SMA/BNC cable, F-adapter, unbuilt Antenna Kit (RJA), printed assembly manuals, and Radio-Sky Spectrograph (RSS) software. Note: Kit does not include antenna support structure. **Price: $215 + Shipping (See reverse for shipping)**	**Item # RJK2p** – Complete 2.0 Kit: Receiver + Professionally Built Antenna Kit + Software This kit includes an SDRplay RSP1A, USB Cable, SMA/BNC cable, F-adapter, Professionally Built Antenna Kit (RJA2), printed assembly manuals, and Radio-Sky Spectrograph (RSS) software. Note: Kit does not include antenna support structure. **Price: $384 + Shipping (See reverse for shipping)**
Item # RJA – Unbuilt Antenna Kit The RJA Radio JOVE Antenna Kit includes a printed construction manual, stranded copper easy-to-solder antenna wire, ceramic insulators, RG-59 easy-to-solder coax cable, screw-on F connectors, and a power combiner. Note: Kit does not include antenna support structure. Assembly requires a soldering gun and other tools. **Price: $90 + Shipping (See reverse for shipping)**	**Item # RJA2** – Professionally Built Antenna Kit The RJA2 Radio JOVE Antenna Kit includes a printed installation manual, two professionally assembled dipole antennas constructed of #14 Copperweld wire with Budwig center insulators and center support rope attachment points, high quality RG-6 coax with pre-installed commercial grade connectors, and a power combiner. Note: Kit does not include antenna support structure. **Price: $249 + Shipping (See reverse for shipping)**
Item # LTJ2 – Listening to Jupiter, 2nd Ed. by R. S. Flagg PDF download of Richard Flagg's book "Listening to Jupiter, 2nd Ed., 2005". The file is downloaded from a secure website. **Price: $10 + $0 shipping (PDF file download)**	**Item # RJR2** – Radio JOVE 2.0 Receiver-Only Kit This kit includes one SDRplay RSP1A SDR receiver, USB Cable, SMA/BNC cable, and F-adapter, printed assembly manuals, and Radio-Sky Spectrograph (RSS) software. **Price: $135 + Shipping (See reverse for shipping)**

RADIO JOVE 2.0 RADIO TELESCOPE KIT ORDER FORM (continued)

Order Online at https://radiojove.net/kit/order_form.html OR
Complete this form and mail with payment

Payment may be made by Credit Card via PayPal™, U.S. Check, U.S. Money Order, International Money Order in U.S. funds drawn on a U.S. bank, or Western Union Money Transfer made payable to **The Radio JOVE Project**. No bank-to-bank wire transfers are accepted. Purchase Orders are accepted from U.S. Institutions.

Send to: The Radio JOVE Project
1301 East Main St
MTSU Box 412
Murfreesboro, TN 37132, USA
email: chiggins@mtsu.edu
FEIN: 20-5239863

Item	Description	Quantity	Item Price	Shipping (see below)	Subtotal
RJK2u	Complete Radio JOVE 2.0 Kit Receiver + unbuilt Antenna		$215		
RJK2p	Complete Radio JOVE 2.0 Kit Receiver + Professionally Built Antenna		$384		
RJA2	Professionally Built Antenna-Only Kit		$249		
RJA	Unbuilt Antenna-Only Kit		$90		
RJR2	Receiver-Only Kit		$135		
LTJ2	Listening to Jupiter, 2nd Ed., by R.S. Flagg (PDF download)		$10	$0	
				Total:	

Shipping Fees for Radio JOVE: We ship all packages using USPS Priority Mail flat rate boxes.
U.S.A.: $17.00
Canada: $57.00
All Other International Shipping: $85.00

Ship to: (Please print clearly)

Name: ____

Address: ____

City, State, Postal Code: ____

Province, Country: ____

Email: ____

Visit the Radio JOVE web site and fill out the team application form at https://radiojove.net/sign_up_form.php even if you are just an interested individual so that you can receive important information about kit updates, online services, and activities within the project as they occur!

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Please send questions, reports, and observations to John Cook: jacook@jacook.plus.com

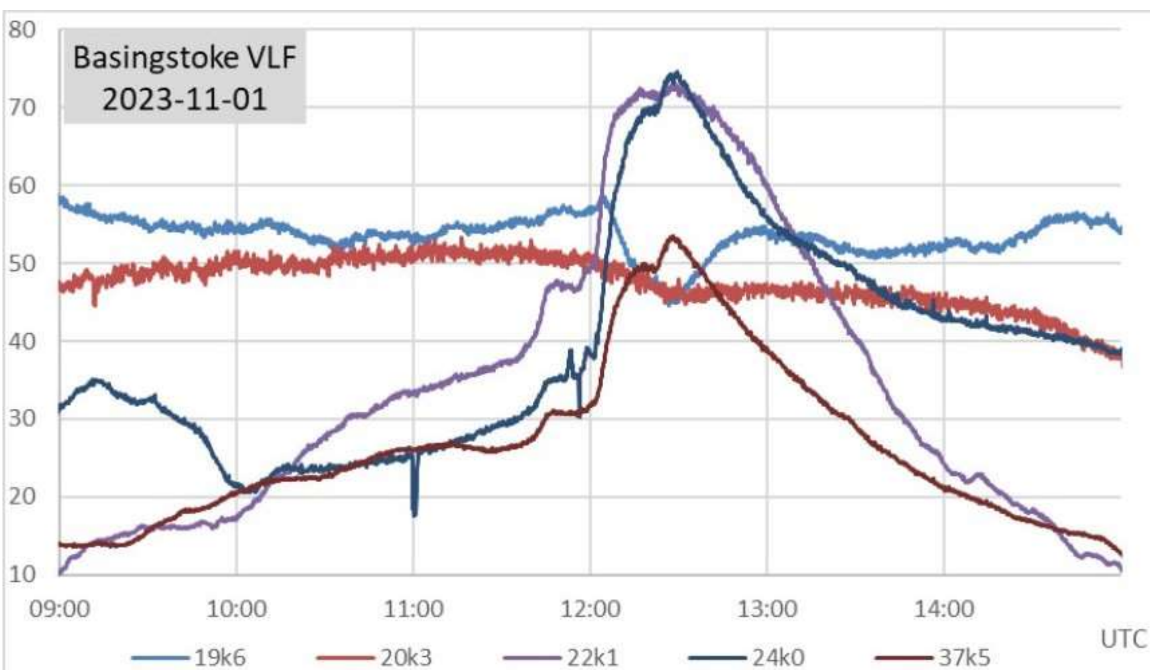
BAA Radio Astronomy Section, Director: Paul Hearn

RADIO SKY NEWS **2023 NOVEMBER**

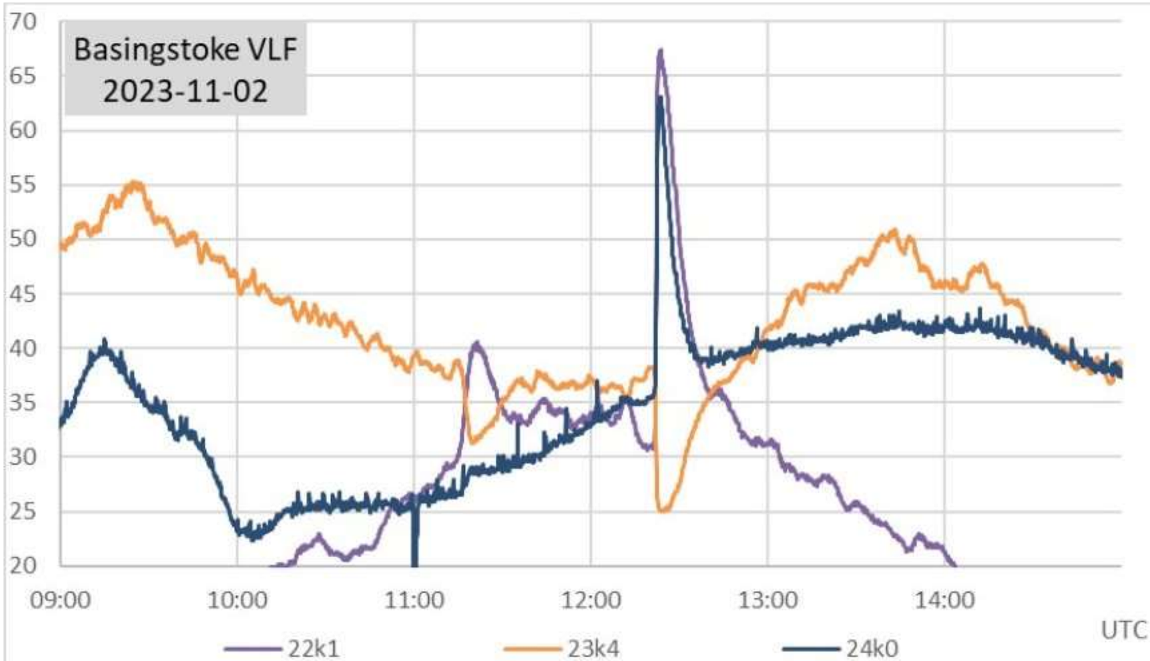
VLF SID OBSERVATIONS

Activity in November remained at a similar level to that recorded in October, although with fewer C-class flares and more of M-class. The volcanic activity in the Grindavik area of Iceland has led to 37.5kHz being off-air, I imagine that the ground movements could severely upset the aerial system as well as disrupting power supplies. A major increase in the strength of the 22.1kHz signal was widely recorded at 13UT on the 24th, my own receiver then saturating as the sunset took over. This seems to be a transmitter effect as no other signals were affected.

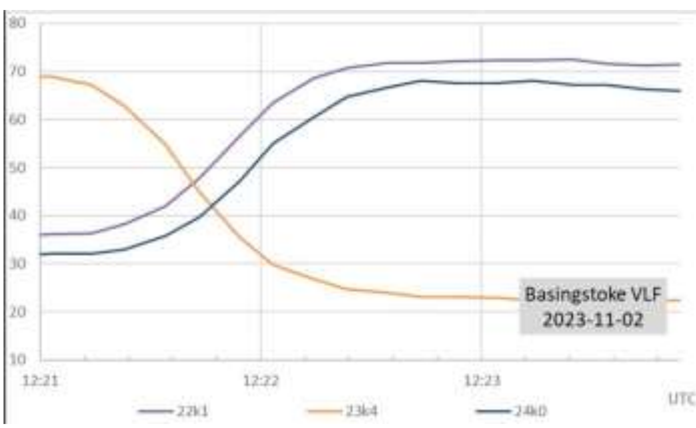
In the October summary I illustrated a small 'SID-like' feature in Paul Hyde's recording from October 24th. Detective work by Mark Edwards has shown that this was indeed a genuine SID from a flare of about C1 magnitude but omitted from the SWPC list.



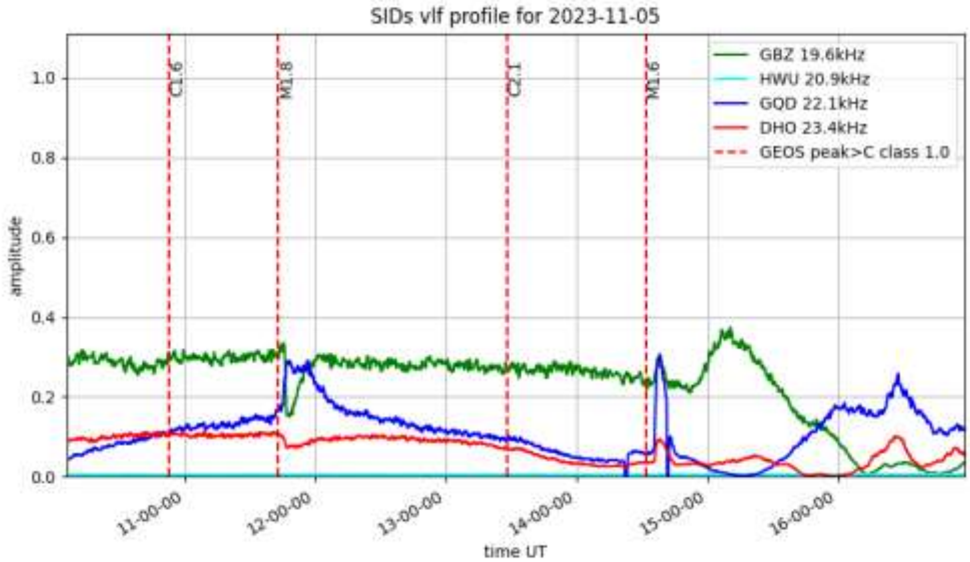
The M1.4 flare on November 1st produced a very complex array of SIDs. The GOES data shows a single event from 11:37 to 13:00UT, with a peak at 12:26. During this period we recorded five distinct SID peaks. This recording by Paul Hyde shows the complexity, with each signal showing slightly different responses. The 24kHz signal also shows a couple of interference spikes at 11:00 and just before 12:00.



In contrast, Paul's recording from the second shows the very narrow M1.6 flare at 12:24, along with the earlier C-flares. 24kHz again shows an interference spike at 11:00.



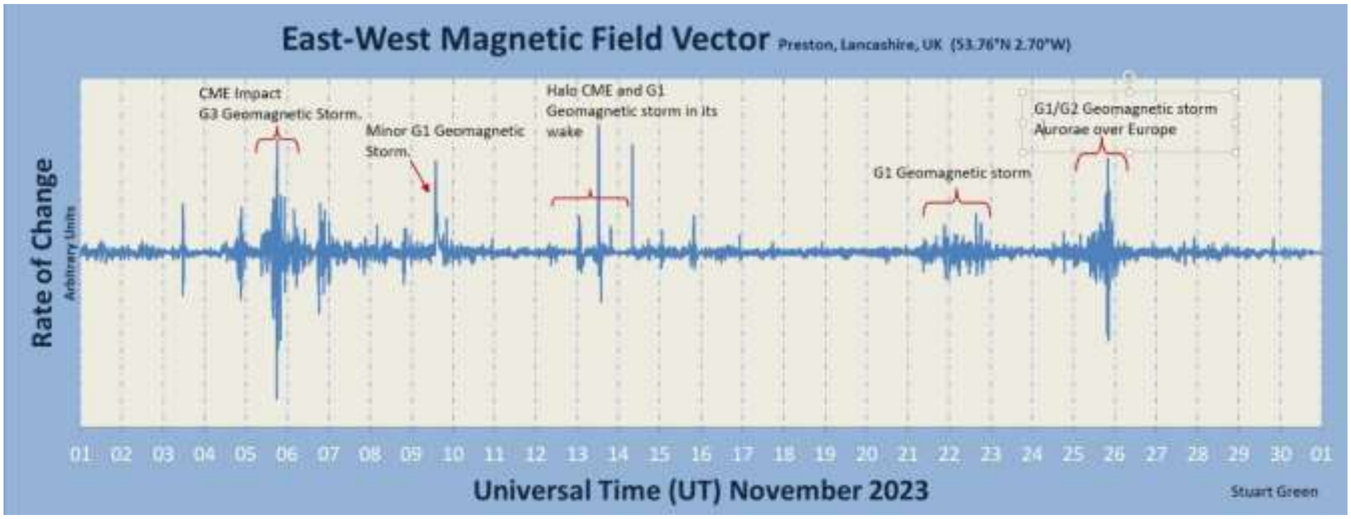
Paul re-scaled the rising stage of the M1.6 flare, showing that all three signals had a rise time of about 70 seconds, very rapid indeed. The GOES data gives timings of start: 12:18, peak: 12:22, end: 12:26, and an optical (H-alpha) class of "Brilliant".



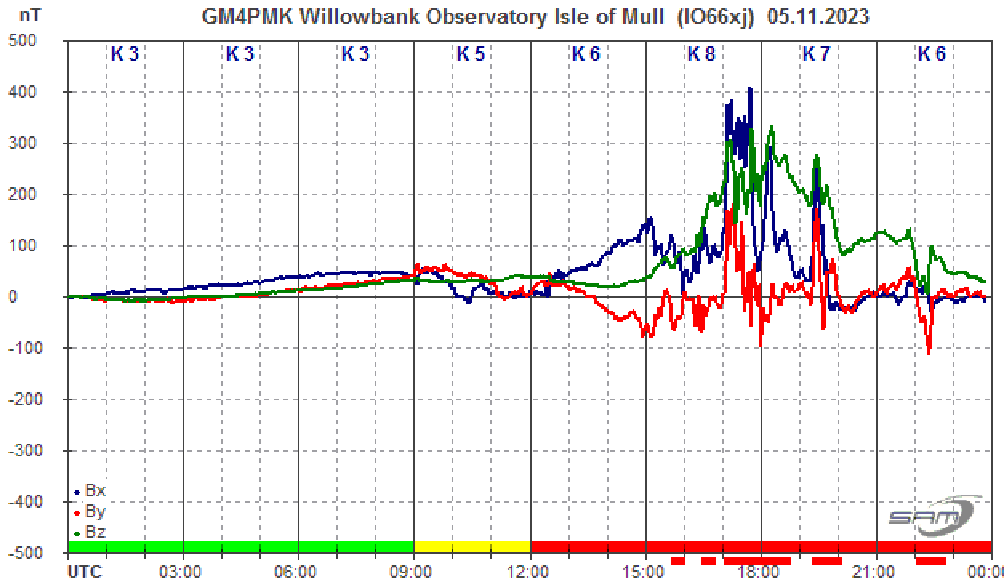
The strongest flare of the month was the M1.8 at 11:43 on the 5th, shown here by Mark Prescott. It was followed by an M1.6 flare at 14:34, both producing strong SIDs at 22.1kHz. Mark has indicated the timings of the two weak C-class flares, but they have not produced a clear VLF response. The effects of the early sunsets in November can be seen after 15:00.

Some very noisy days were recorded, Colin Clements' recording from the 20th being a very noisy example. I have marked the M1.2 and C8.0 flares, both fairly distinct at 23.4kHz, but barely discernible from the background at 21.75kHz. 37.5kHz was off at the time and shows just a few interference spikes.

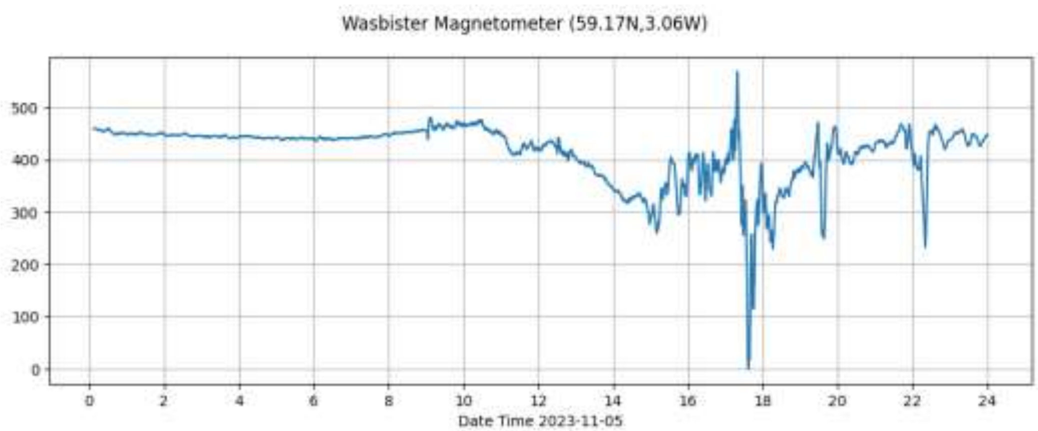
MAGNETIC OBSERVATIONS



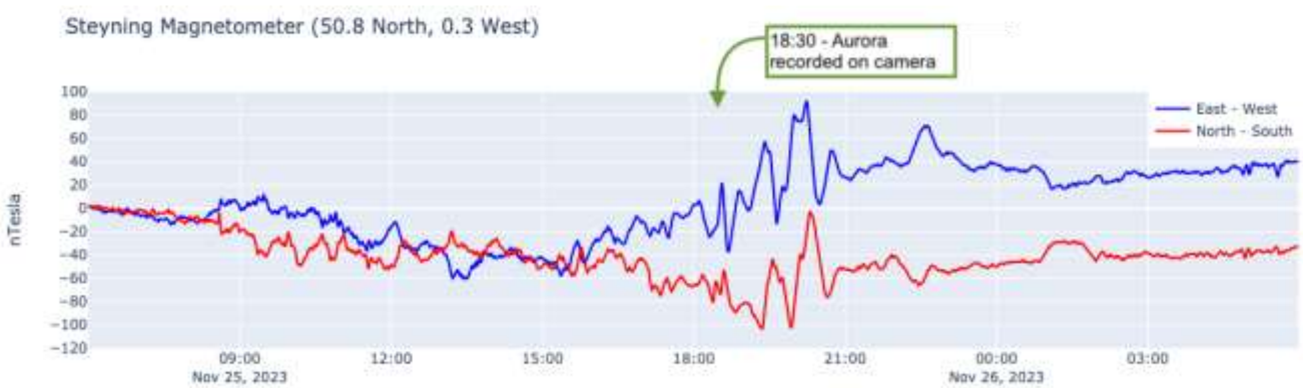
Stuart Green's monthly summary shows several periods of magnetic activity against a rather quiet background. The strong flaring at the start of the month produced a number of CMEs that combined to give a very active period starting on November 5th. Auroral 'fireworks' were seen widely in the UK and Europe. Nick Quinn near the south coast caught these on his cameras, and recorded the magnetic disturbance:



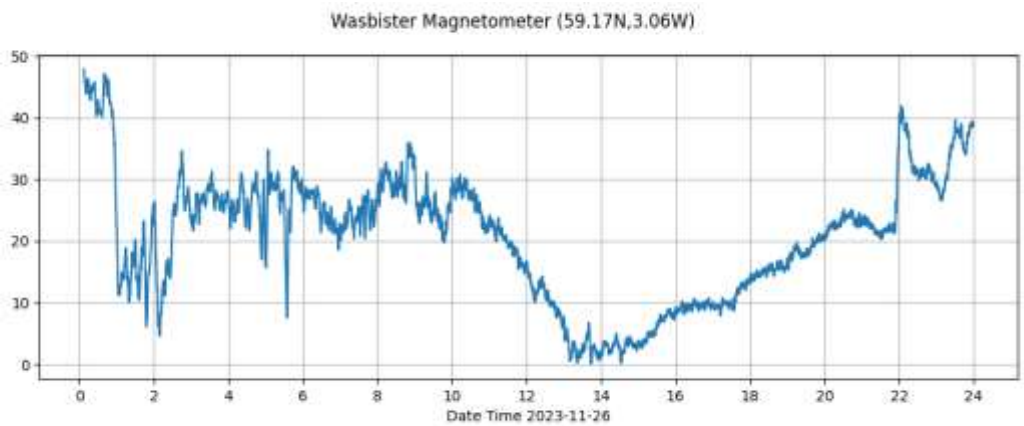
Roger Blackwell on the Isle of Mull recorded a stronger disturbance during the afternoon of the 5th, with a hint of CME impacts at 09:00 and 12:30 in the Bx (blue trace).

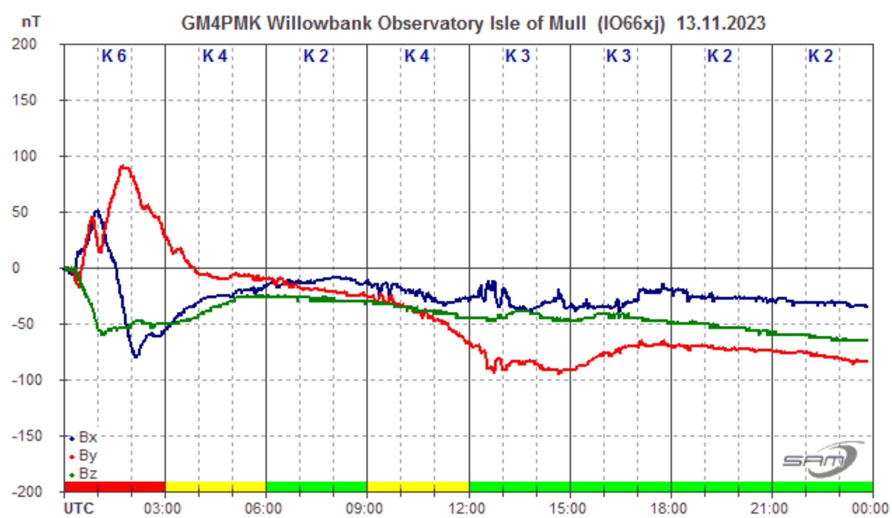


Callum Potter further north in Orkney recorded an even stronger disturbance around 17 to 18UT, and also the possible CME impacts.



Magnetic activity increased again towards the end of the month, with multiple CMEs and coronal hole winds contributing. Nick Quinn's recording from the 25th also shows that aurora were again recorded near the south coast. A possible CME impact is visible just before 09UT. The disturbance continued on the 26th, recorded by Callum Potter:

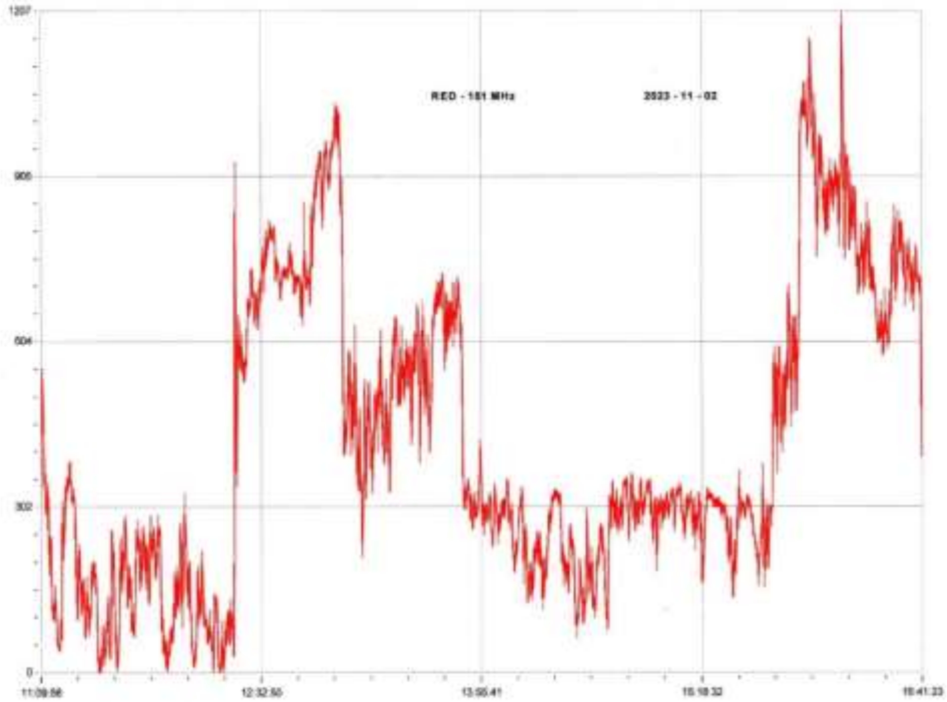


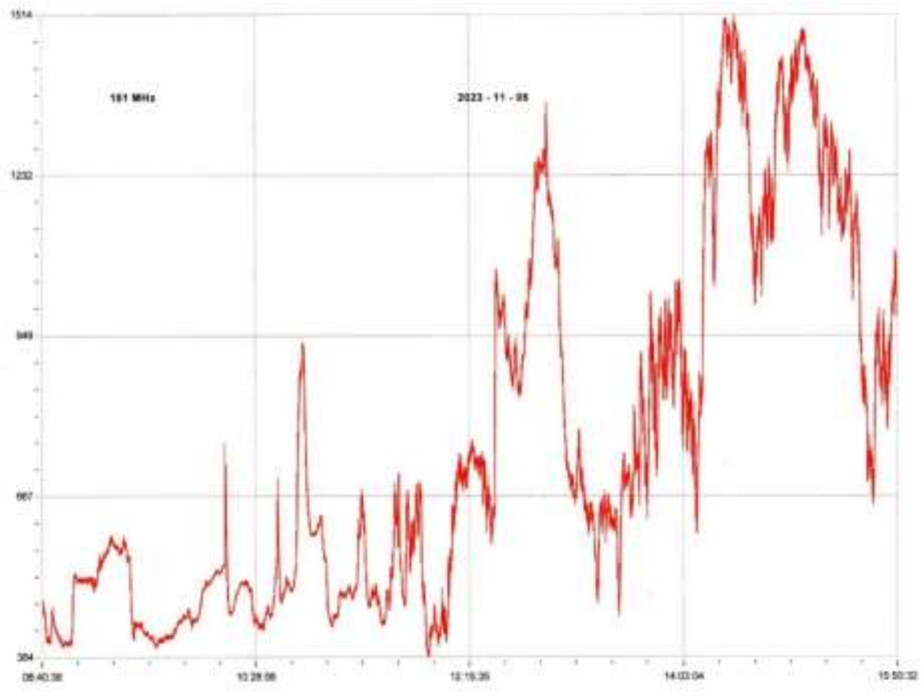


Activity on the 13th was much weaker and less turbulent, with no aurora reports. Roger Blackwell's recording shows an initial disturbance of about +/- 100nT compared with the 400...500nT seen earlier in the month.

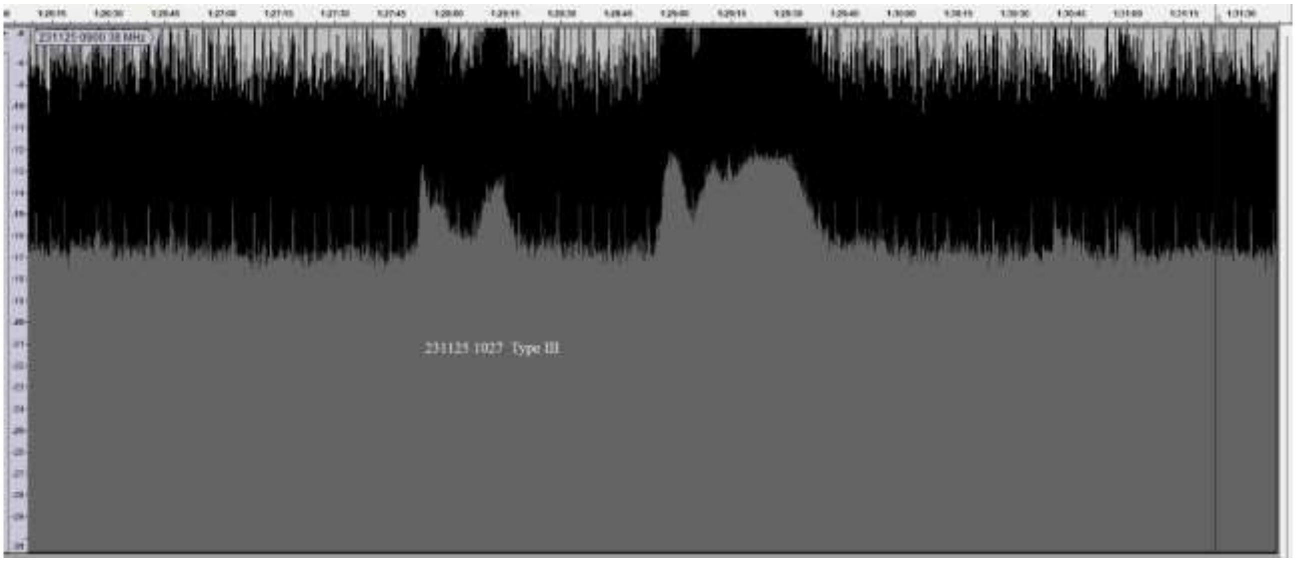
Magnetic observations received from Roger Blackwell, Stuart Green, Callum Potter, Nick Quinn, and John Cook.

SOLAR EMISSIONS



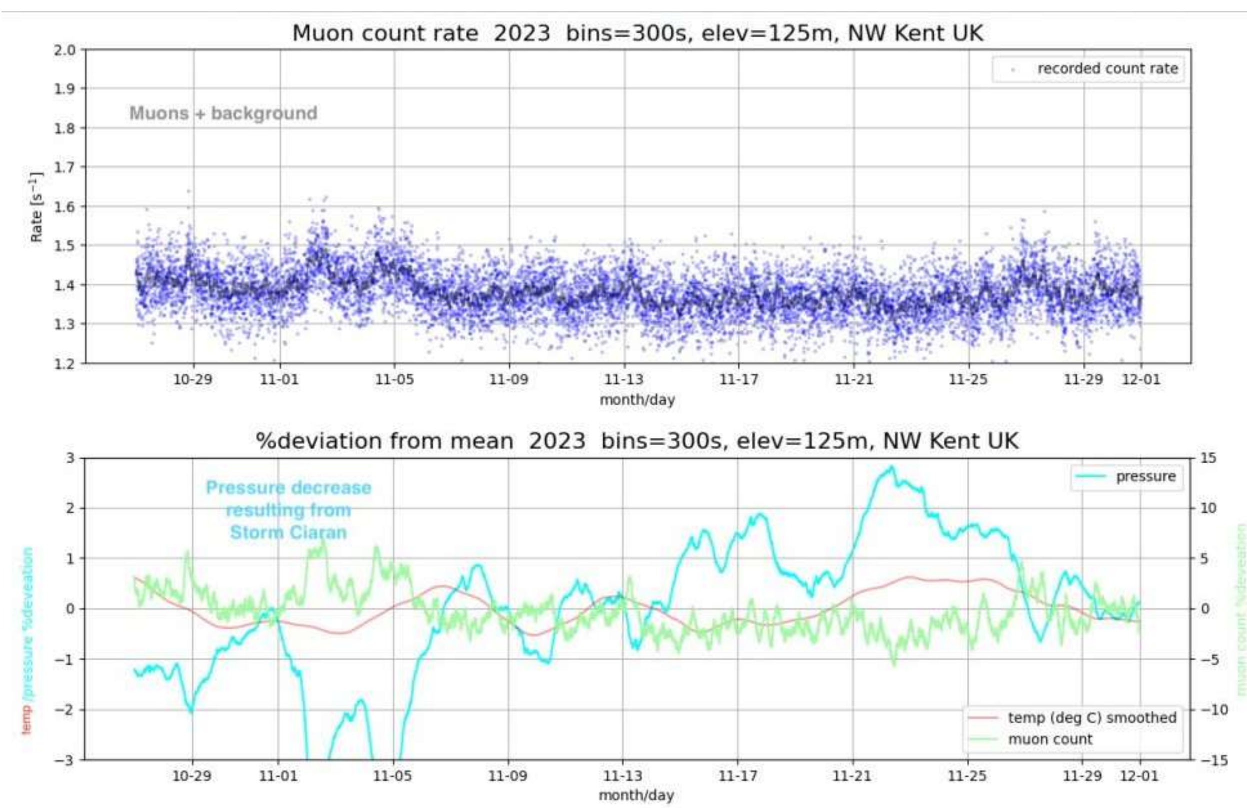


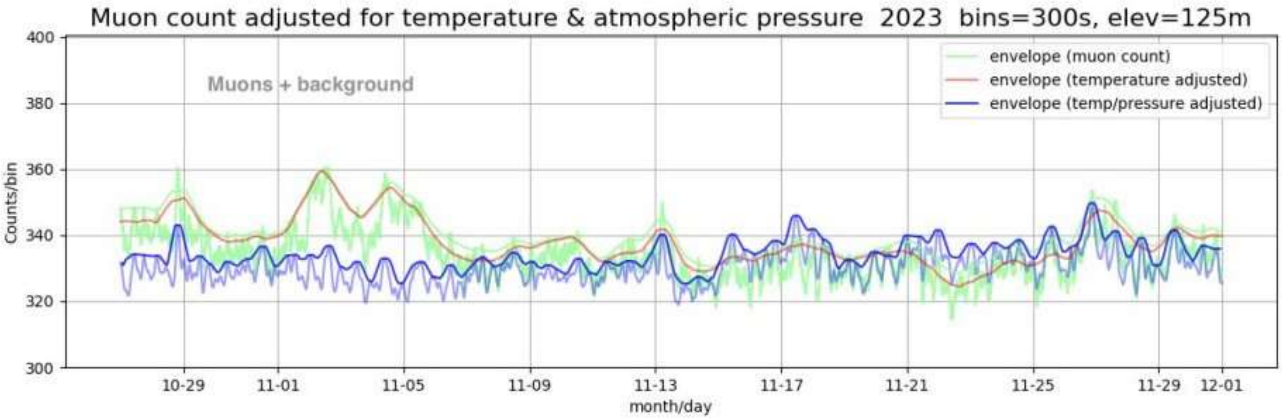
Colin Clements recorded some significant 151MHz solar noise during the strong flares on the 2nd and 5th. The aerial is now loft mounted and horizontally polarised, which seems to give a wider beam width for a fixed azimuth aerial. It is tricky to identify individual flares, as there were also plenty of smaller events that we did not record.

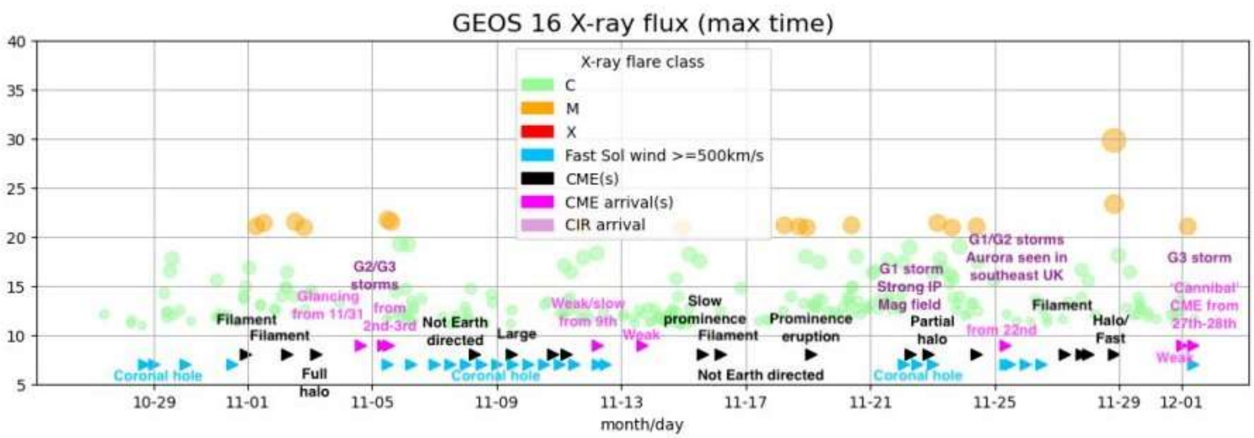


Colin Briden recorded a type III noise burst starting at 10:27 on the 25th. The SWPC does not list a flare at this time, but the recording is very distinct and does not appear to be interference. This was recorded at 38MHz, as the 28MHz band has become very noisy with other radio signals.

MUONS





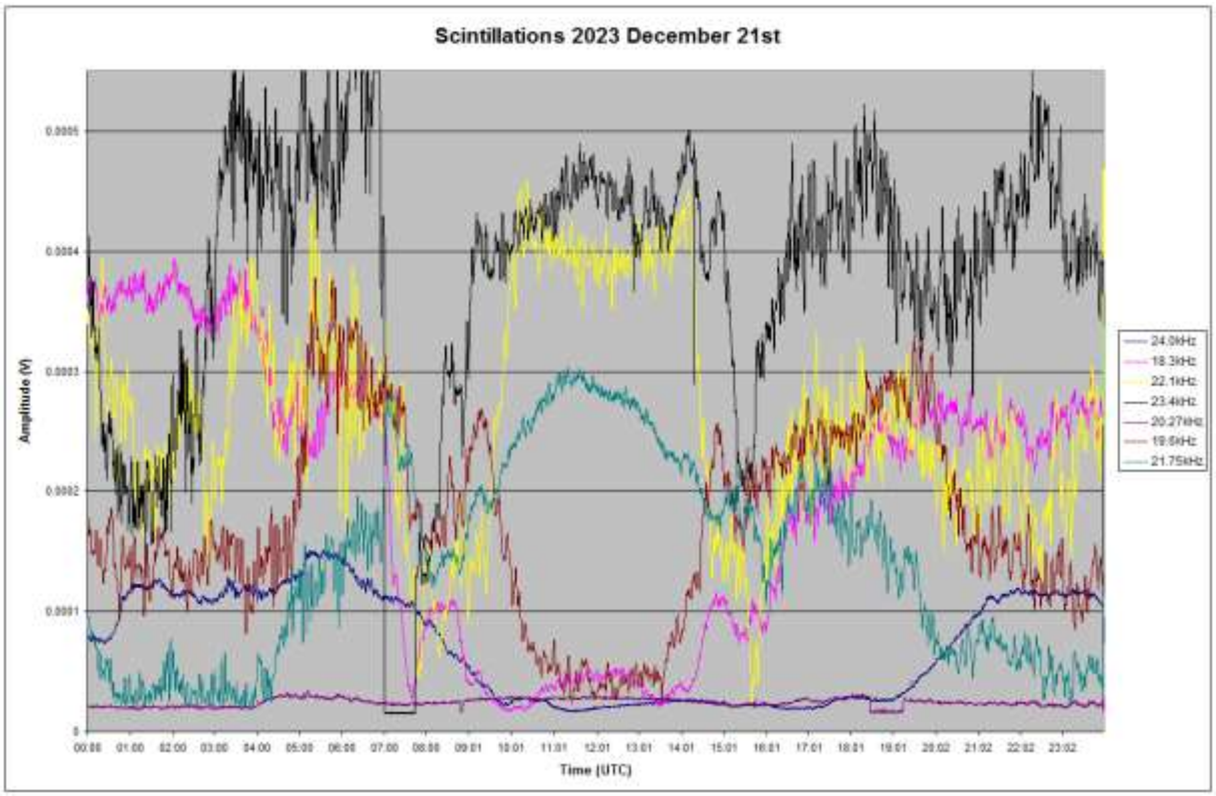


Mark Prescott has provided his muon counts for November. A very prominent feature is the very low atmospheric pressure recorded during storm Ciaran from the 1st to the 5th. My own barometer showed some of the lowest pressures that I have seen. Its effects on the muon count are clear in the top chart, the lower chart showing how effective the correction is. This was also the period of high solar activity, which may have been hidden by the storm. The CMEs towards the end of the month do seem to have increased the muon counts slightly.

Thank you for your continued support and contributions.

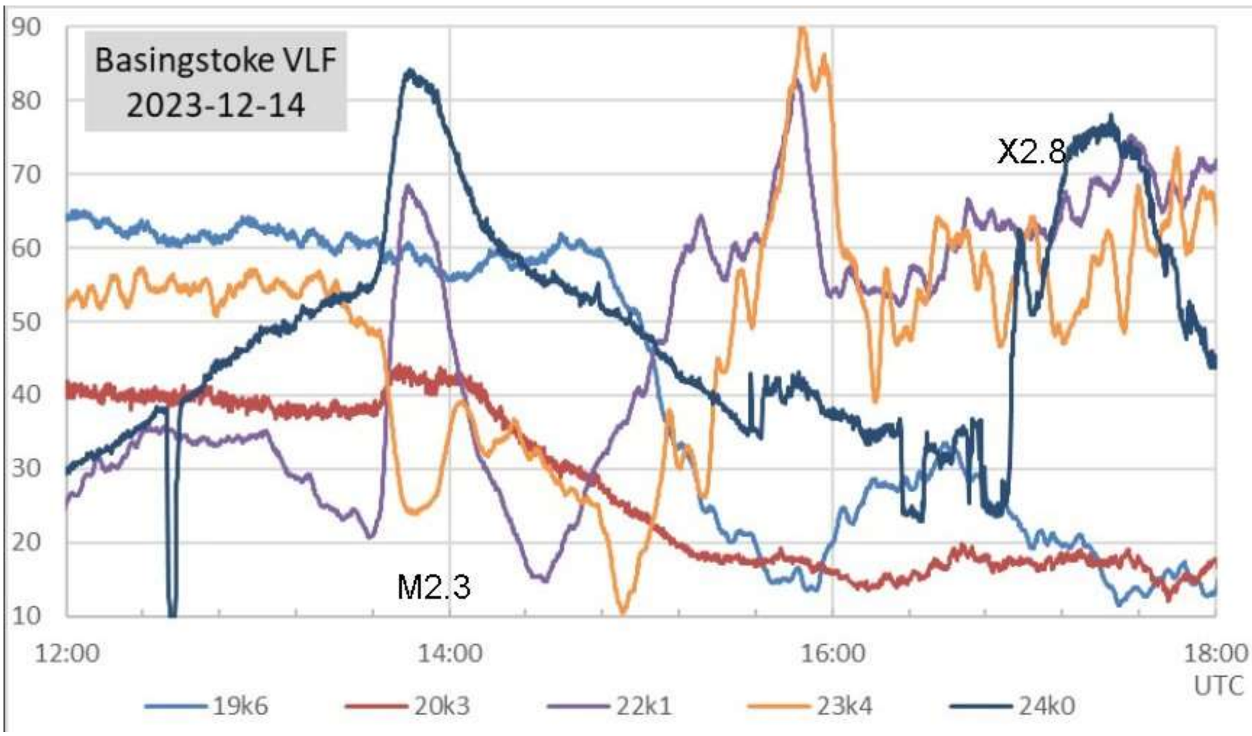
VLF SID OBSERVATIONS

December has been a difficult month to analyse. 37.5kHz has been off-air due to the Grindavik volcanic activity, and some signals showed only intermittent operation during the holiday period. Day length is at is shortest, and with the low altitude of the sun there has been a high level of general instability on most signals. The GOES satellite data shows that the background solar X-ray flux has also been fairly high for most of the month. This has hidden many of the smaller flares that we might otherwise detect. Mark Edwards shows the problem at its worst on the 21st:

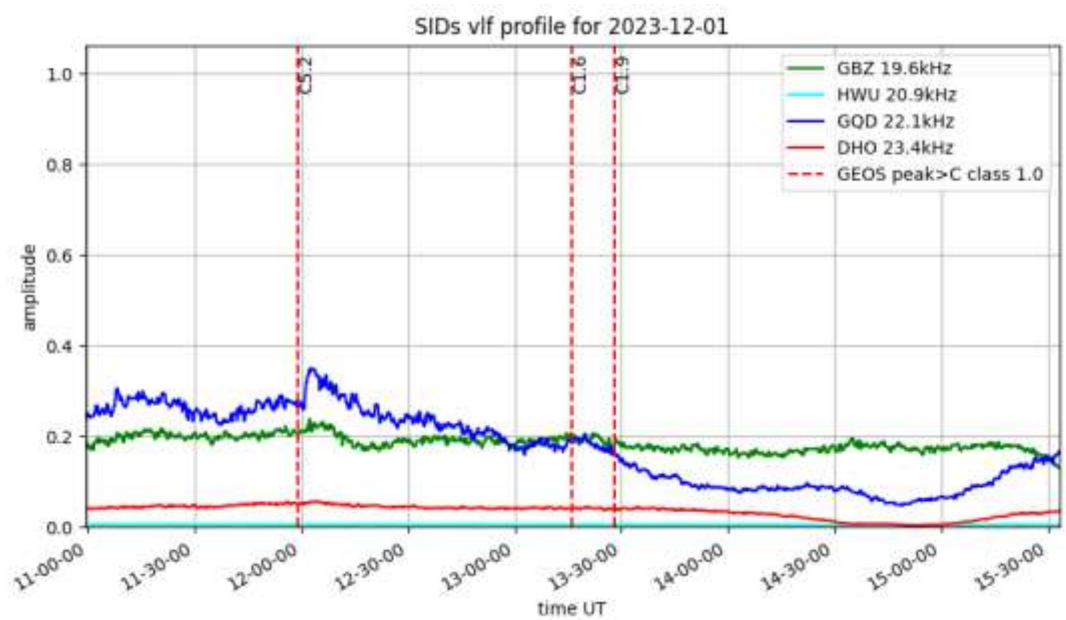


The SWPC bulletin lists four C2 class flares between 10:00 and 17:00UT, all well hidden by the noise.

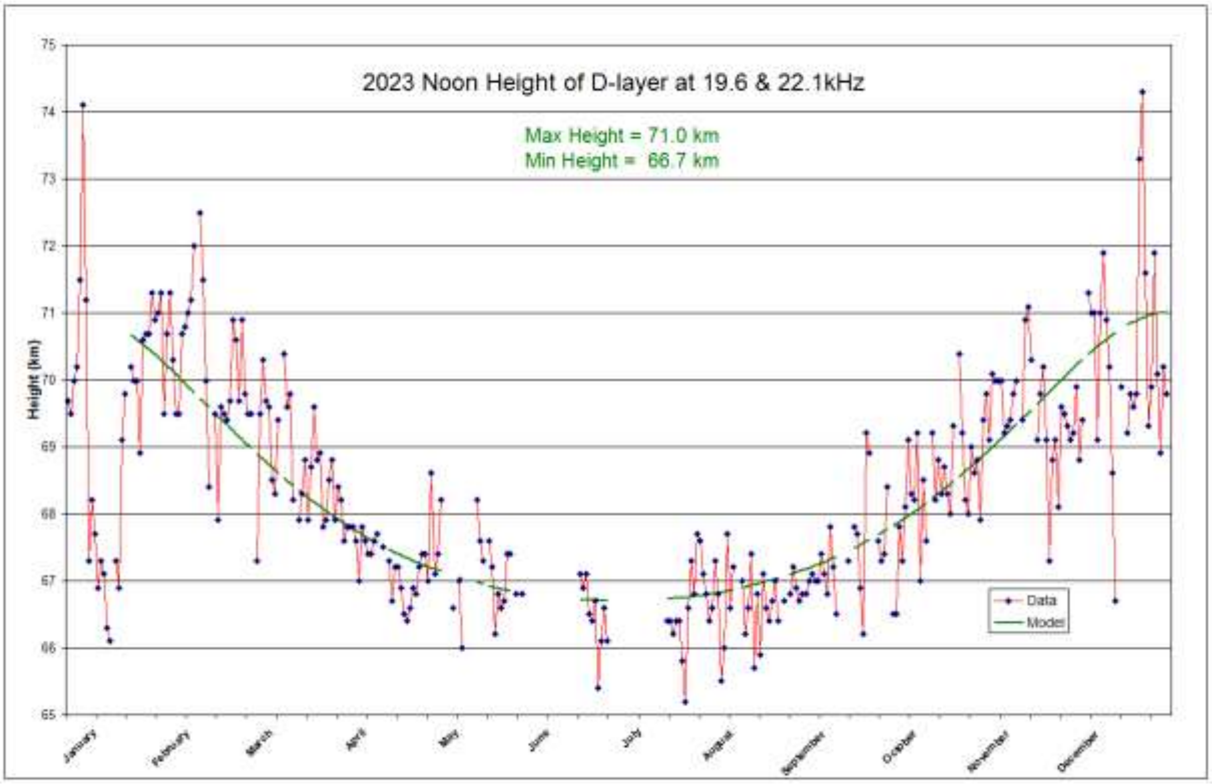
There were two X-class flares in the SWPC bulletins, an X5.0 flare at 22:00 on the 31st, (the strongest so far in this solar cycle), and an X2.8 flare at 17:00 on the 14th. We were lucky to catch this one at 24kHz, shown here by Paul Hyde:

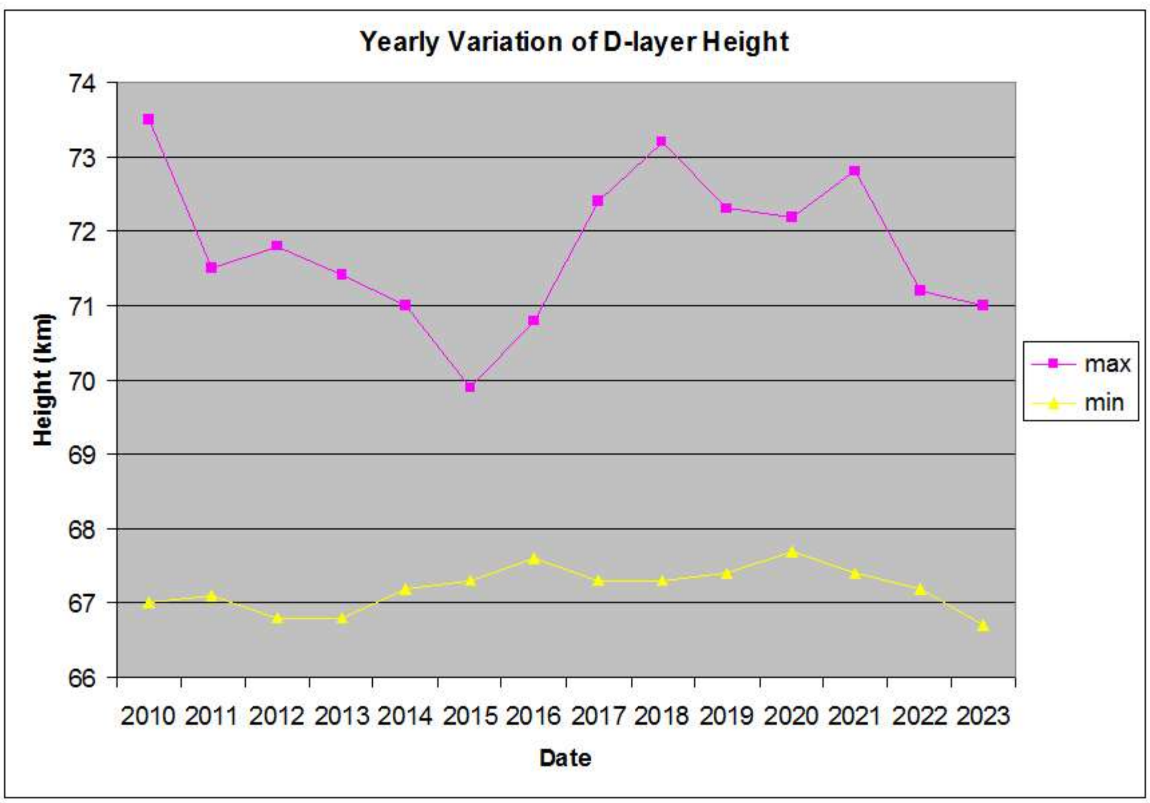


The M2.3 flare peaking at 13:47 is much clearer on most signals, although barely visible at 19.6kHz. The transmitter for 19.6kHz (Skelton) is fairly close to that for 22.1kHz (Anthorn), both near the Solway Firth, so the difference in effect is quite dramatic.



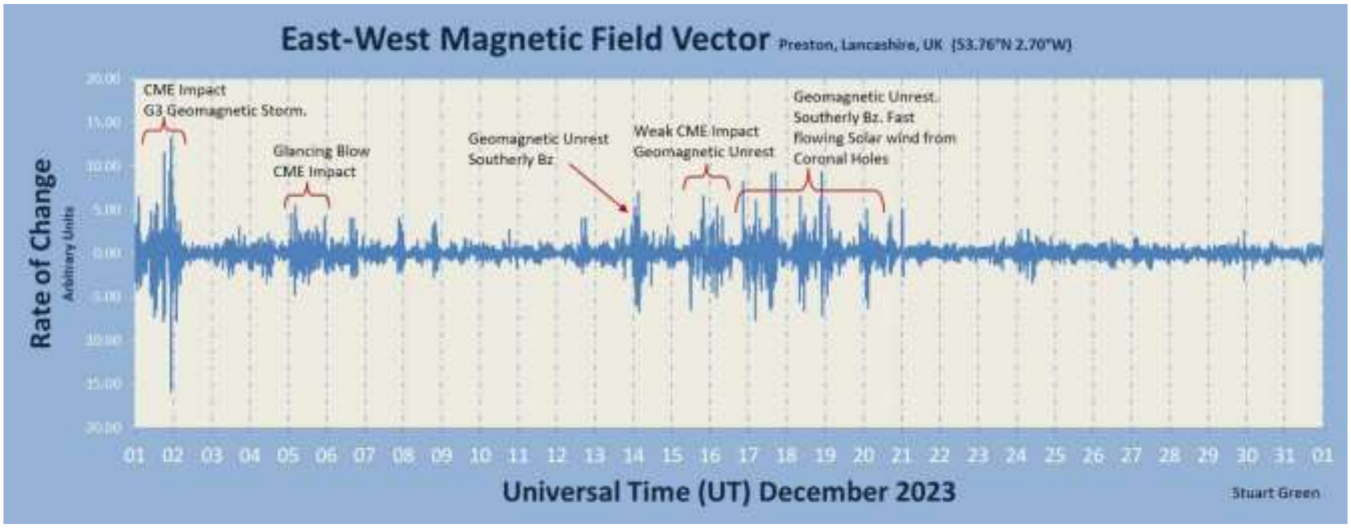
Mark Prescott's recording from the 1st shows a clear 22.1kHz SID for the C5.3 flare, again with a weaker response at 19.6kHz. The two weaker flares around 13:30 have not had much effect.



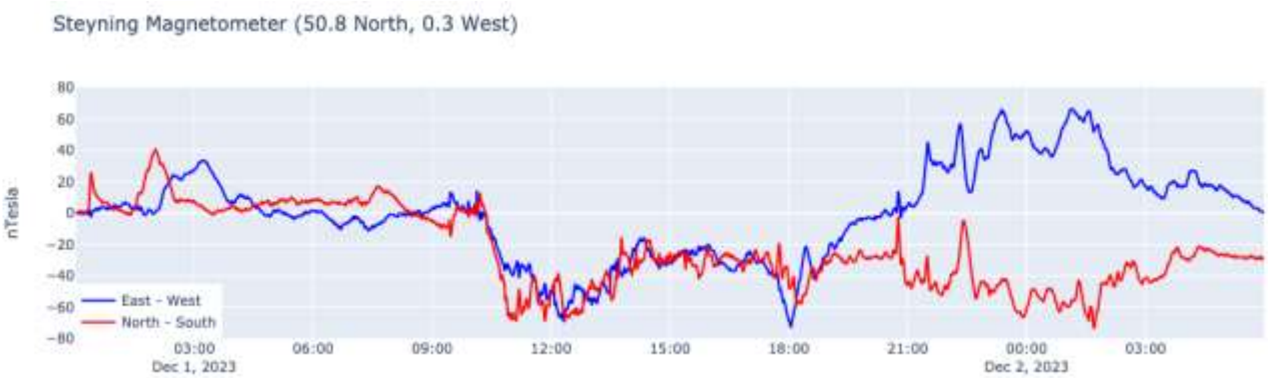


Mark Edwards has again provided his chart of D-region heights through the year, determined from the propagation at 19.6 and 22.1kHz. The winter months have less precise values due to the effects already mentioned. The lower chart shows how these values have changed over the last 14 years. Solar cycle 24 had two activity peaks, early 2012 and early 2014. Minimum was through 2018 – 2020. Cycle 25 peak had been predicted for 2025, but new predictions suggest that it is more likely in 2024.

MAGNETIC OBSERVATIONS

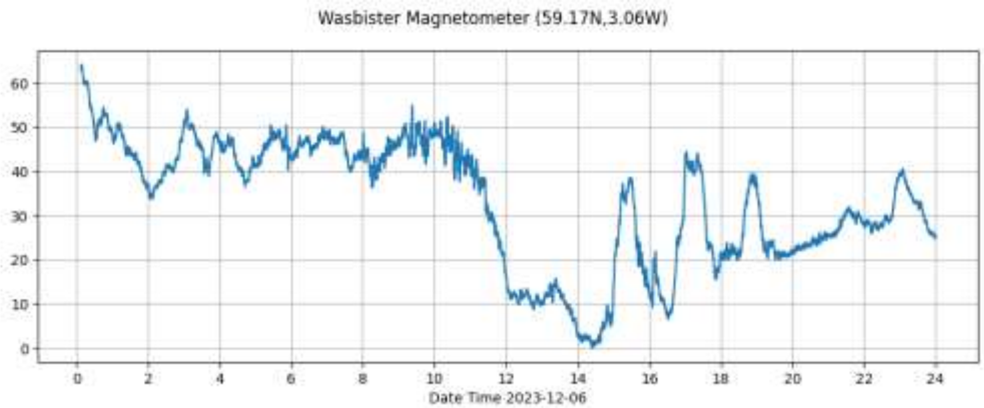


Stuart Green's chart of magnetic activity in December shows a very quiet end to the month, with just a few CME impacts in the first half.



The first of the CMEs arrived in the morning of December 1st, all of our recordings showing a small impact at about 09:30UT with a mild disturbance through the afternoon. It became much more active after 21:00, but then faded the following morning.

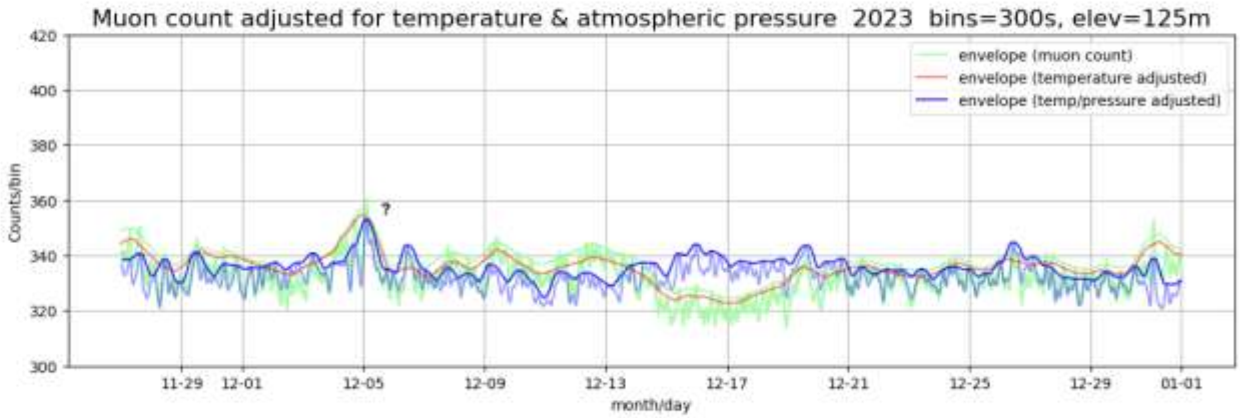
The glancing CME on the 5th produced some magnetic turbulence over several days, this recording by Callum Potter is from the 6th:

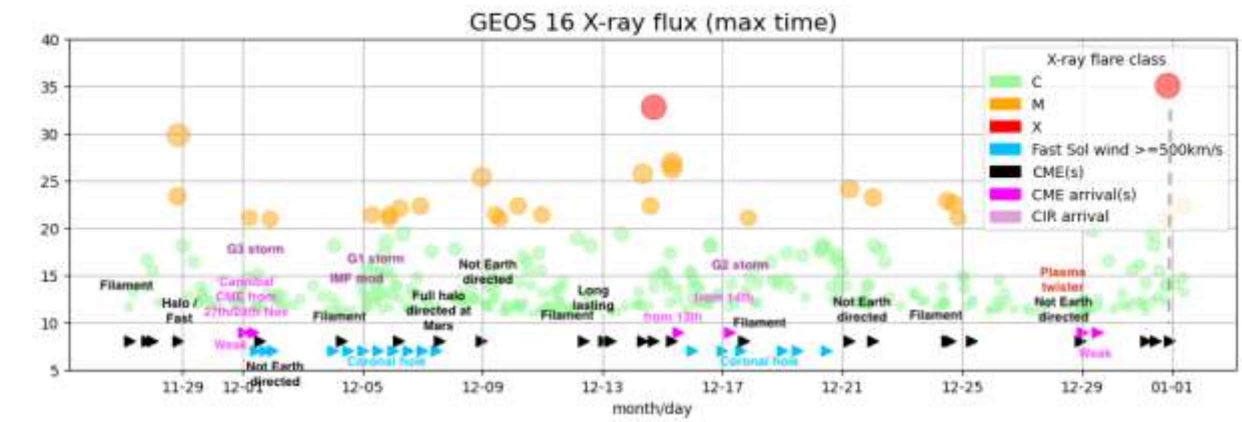


A combination of Solar wind and a mild CME produced a slightly stronger disturbance on the 17th and 18th, shown here by Roger Blackwell. This was preceded by a mild disturbance on the 16th, and then faded out over the next few days.

Magnetic observations received from Roger Blackwell, Stuart Green, Callum Potter, Nick Quinn, and John Cook.

MUONS

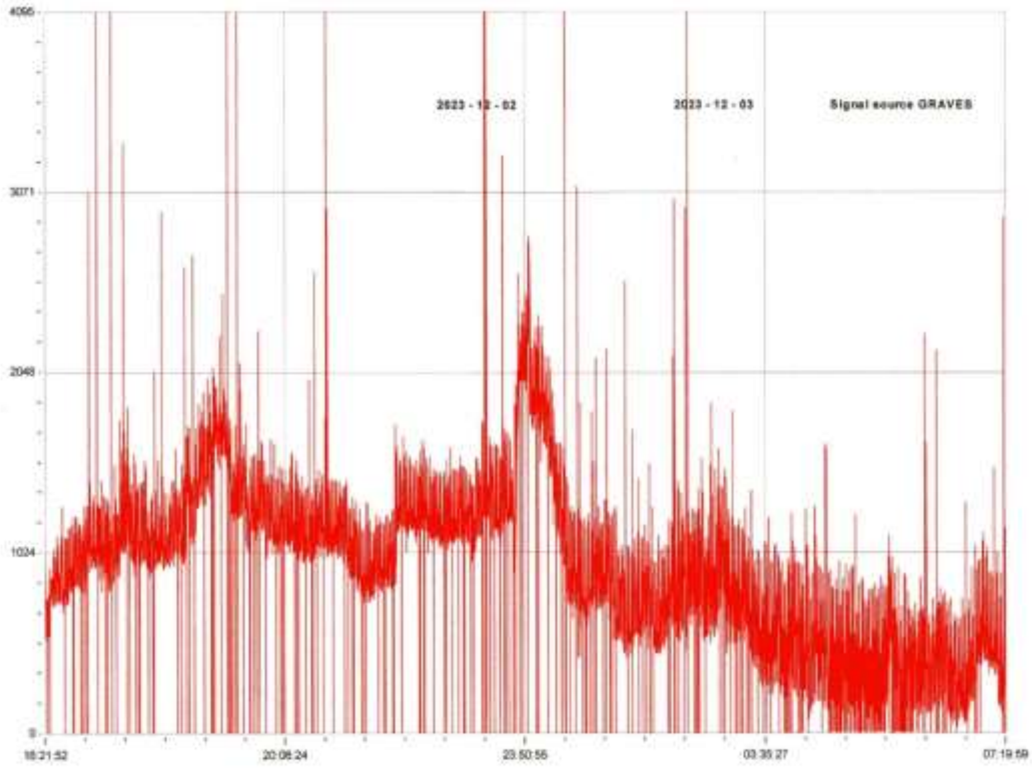


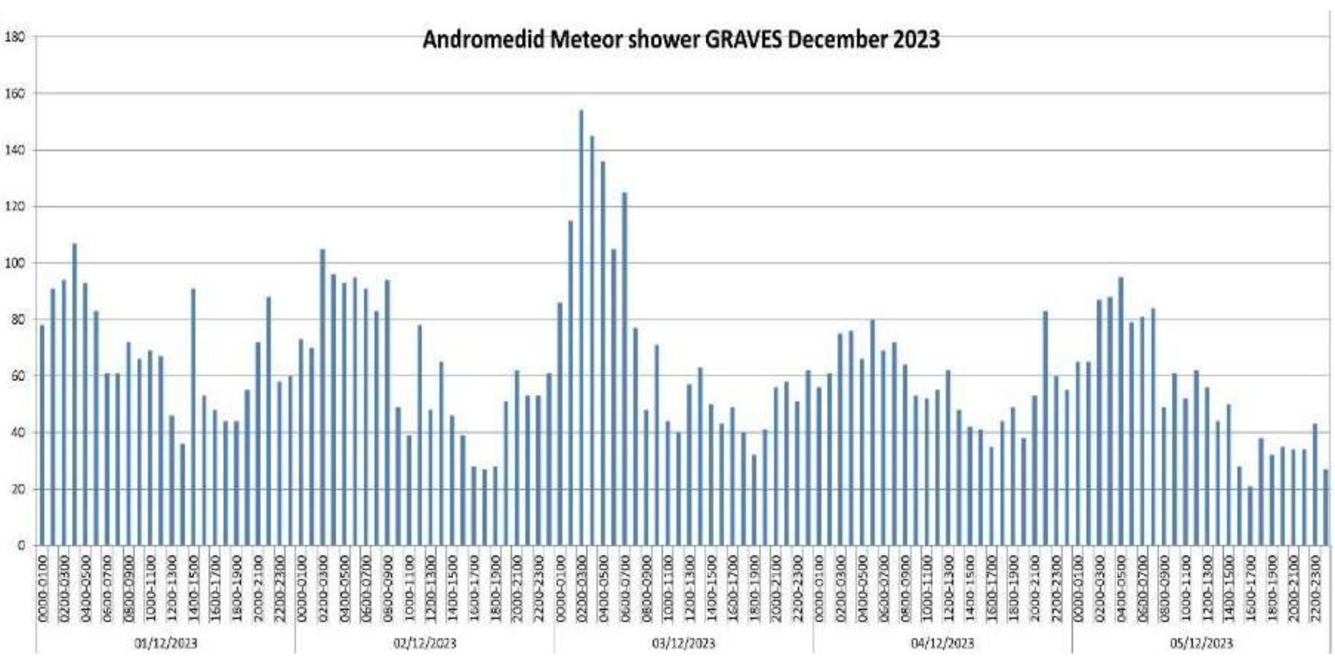


The pressure / temperature adjusted Muon chart from Mark Prescott shows a fairly quiet month, except for a small increase on the 5th. This may be due to the magnetic storm illustrated above although the stronger storm on the 1st has left no trace.

METEORS

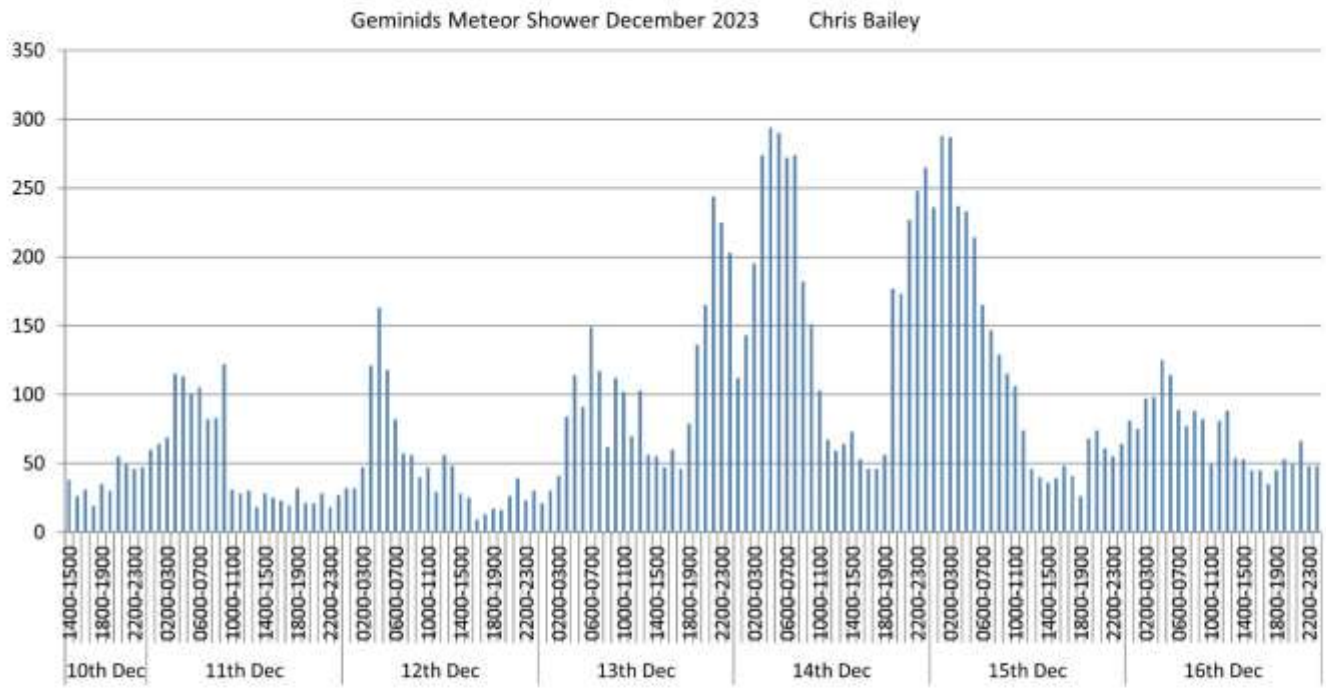
We have two showers to report this month, starting with the anticipated Bielid / Andromedid meteors mentioned last month.



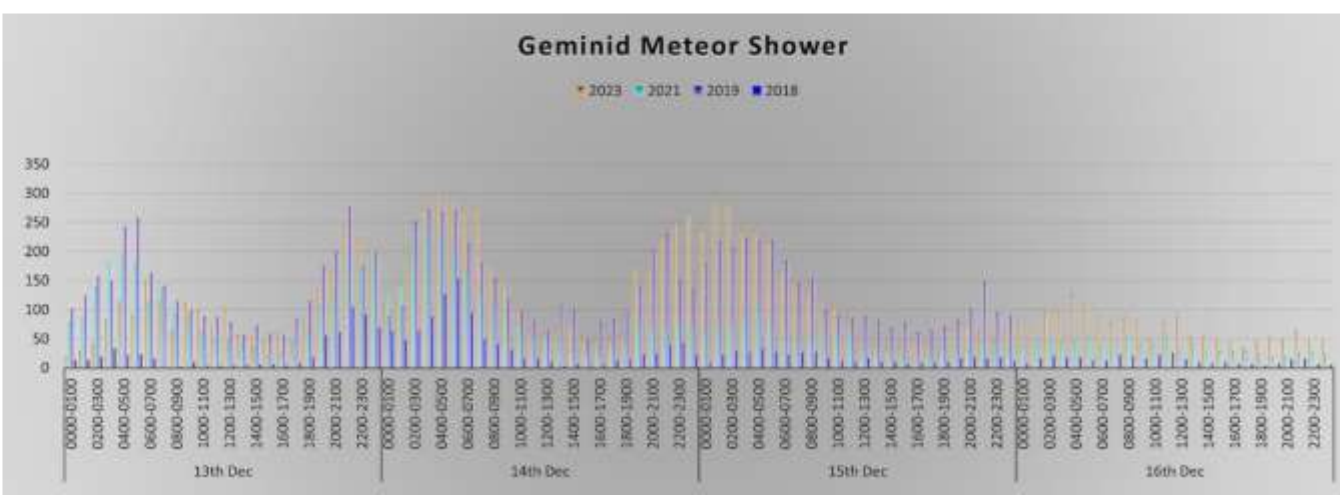


The first chart shows GRAVES echo counts between 16:22 on the 2nd and 07:20 on the 3rd, recorded by Colin Clements. Chris Bailey's chart shows counts from the 1st to the 5th. Both charts show a peak in activity, Colin's at around midnight, and Chris's a little later at 3AM on the 3rd. Chris also analysed shower activity by averaging the counts over the 5 days, and then subtracting this from the totals in each 2 hour period in the chart in an effort to remove the effects of sporadics. This also showed an excess count in the early hours of the 3rd. I hope that these results will help with future analysis of this shower.

The Geminids are more well known, and again produced some good results.

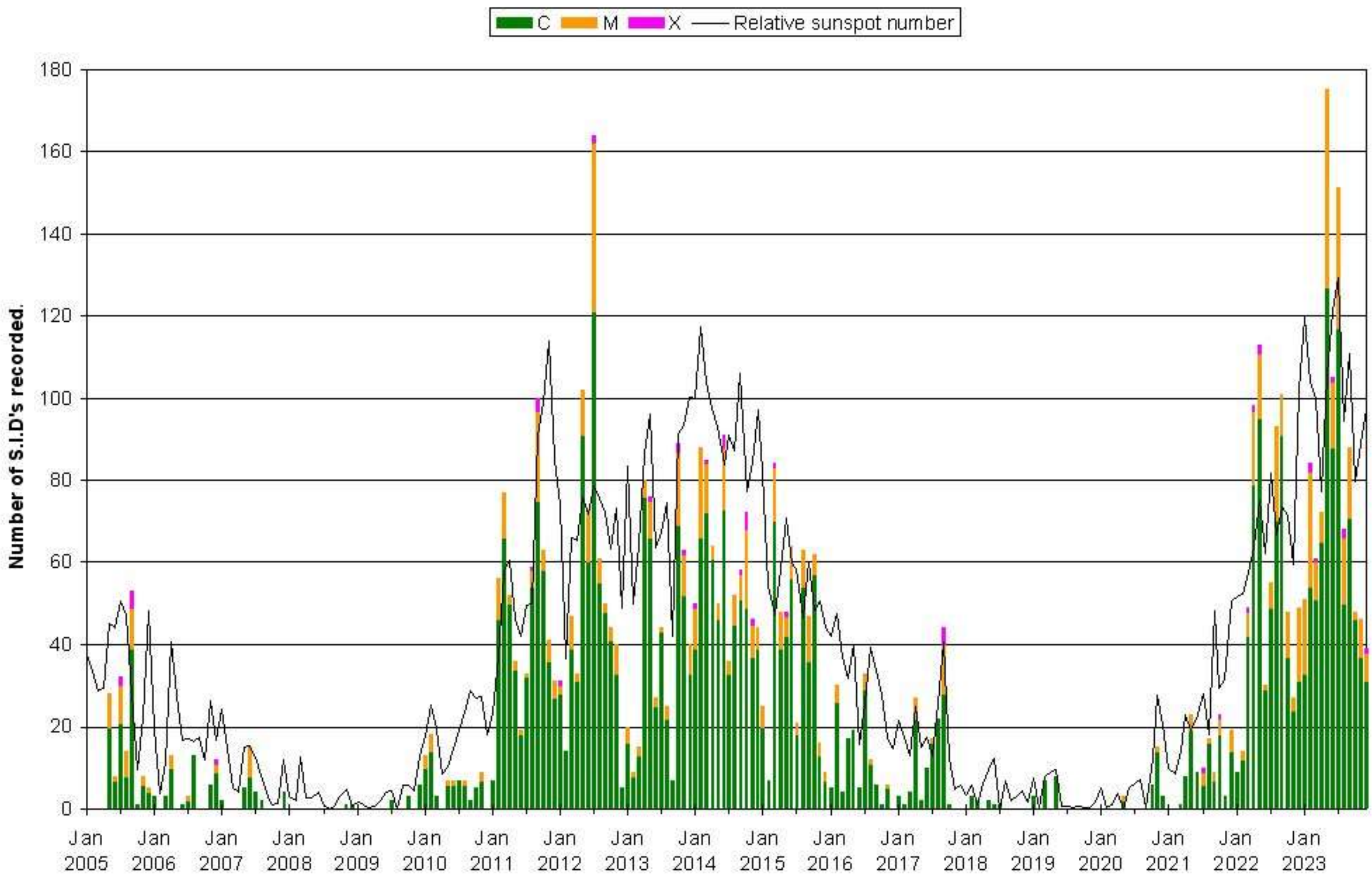


Chris Bailey's recording shows strong activity peaks overnight 13th / 14th and 14th / 15th, with counts double those seen in the Andromedids. Smaller peaks are seen on the 11th, 12th, and 15th. Chris has also produced a chart comparing his observations in 2018, 2019, 2021 and 2023. Recordings in 2018 were made with less sensitive equipment, and so are generally lower.



BARTELS CHART

VLF flare activity 2005/23



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Radio Astronomy Section

BAA RA Section programme 2024

Fri. Feb 2nd. 19:30 GMT (19:30 UTC)	**Marcus Leech** President. Canadian Centre for **Experimental Radio Astronomy**	**Amateur SDR based interferometry**, hardware and software. (Getting started)
Fri. Mar 1st. 19:30 GMT (19:30 UTC)	**Professor Peter Hargrave** Director of Innovation & Engagement, School of Physics & Astronomy, Cardiff University	LiteBIRD mission, unravelling the origins of our universe
Fri. Apr. 5th. 19:30 GMT (19:30 UTC)	**Whit Reeve**	The October 14, 2023 Solar Eclipse Effects on VLF Radio Propagation Observed in Alaska
Fri. Jun. 7th. 19:30 GMT (19:30 UTC)	**Professor Roger Deane** Director: Wits Centre for Astrophysics; Professor/SKA Chair in Radio Astronomy · University of the Witwatersrand	What next for Very Long Baseline observations

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Paul Hearn
BAA Radio Astronomy Section Director
UKRAA Trustee

Vintage SARA

Charles Osborne, SARA Historian

FRB's in the 90's

When I read Dave Hinzel's Fast Radio Burst article in the December 2023 SARA Journal I wanted to make some comments about how long SARA has been talking about FRBs. They were called High Energy Pulses (HEPs) at the time. Looks like they were rebranded as Fast Radio Bursts (FRBs) in 2007 to make them look like a new topic. A quick look through the most recent Journal Index shows a dozen articles in the 1980's and 1990's about HEPs.

Our Founder Jeff Lichtman wrote one of the first articles titled "Signal Processing of HEPs with a Tape Recorder" in the April 1983 Journal. Four articles in 1984 by Colin Clements and Gene Greneker K4MOG showed it to be a busy topic that year. Articles followed almost every year except a gap in 1987~1991 before resuming as an occasional topic through the 90's of interest almost every year till 2000.

A peak in interest occurred in 1999 with a NASA article mentioned in the Nov/Dec 1999 SARA Journal titled: "Amateur Astronomers Invited to Join in the Quest for Fireworks Accompanying Gamma Ray Bursts" in NASA News.

The Vintage SARA aspect of note is that in 1998 NASA invited: Jeff Lichtman, Tom Crowley, and me to the Marshall Spaceflight Center (MSFC) to discuss SARA involvement in trying to add radio data to the mystery of Gamma Ray Bursts. Dr. Gerald Fishman, Chief Scientist for the past 26 years at the Marshal Space Flight Center in Huntsville Alabama was the Project Leader for the Compton Gamma Ray Observatory (GRO) at the time and SARA's host. He still works at MSFC and has been on staff just over fifty years now.

The theory at the time was that the bursts being seen about once a day in a fairly random fashion were that they were from magnetars or neutron stars in our Milky Way Galaxy. However, the data was not supporting the pulsar repetitive nature of this. The more bursts captured showed an all-sky distribution with no real concentration in the plane of our galaxy [1]. That left the GRO team wanting to correlate the data with observations at optical and radio to acquire a dispersion measure (DM) to prove it was extra-galactic and at what range.

With enough small radio telescopes pointing at the sky the hope was that someone would be pointing at the right area to capture one. Certainly, SARA's history of talking about HEPs had caught NASA's attention as a good match. In the years that followed new on orbit instruments started feeding burst and transient ra/dec information to a real time email list server which would notify potential observers to slew to the coordinates and try to observe an optical afterglow and later a radio HEP also. Fully automated cameras were programmed to slew automatically speeding up the possible optical correlation.

BeppoSAX [2] working at X-Ray and the Burst and Transient Source Experiment (BATSE) at Gamma Rays were the follow-on instruments from 1997 forward. GRO lost gyro control and was deorbited in June 2000.

At the same time in the 2000s computing power and software defined receivers were beginning to allow finer time and frequency resolution observing. And today many of us use PCs with GPS or Network time corrections to under a second of accuracy. Still, most of SARA's data was using minutes of captures with long integration times compared to the µsec to second burst times. My 1420 MHz RTL-SDR and SDR# averages 720,800 measurements into a capture every 2 minutes. Not really compatible with seeing FRB/HEPs. The computing power and hard drive space and speed would probably be able to cull burst candidates out and save them out of the large averages. But I'm not sure anyone is doing that with small to medium size dishes less than 7m. And the potential mJy Fluxes put most transients out of amateur small dish range[3]. But still something pervasive started this discussion 40+ years ago in SARA.

1. https://heasarc.gsfc.nasa.gov/docs/cgro/cgro/
2. https://heasarc.gsfc.nasa.gov/docs/cgro/batse/
3. https://ned.ipac.caltech.edu/level5/March04/Piran/Piran2_2.html

System temperature T_{sys} by measurements the Moon radiation

by Dimitry Fedorov *UA3AVR*

Knowledge of the system temperature T_{sys} is important for assessment of radio telescope performance or when quantitative estimations of celestial sources flux is pursued. Main contributors to the system temperature are the antenna spillover temperature T_{spill} defined by antenna design and warm ground, other environments, and own noise temperature of the receiver T_{rcvr} defined by its Noise Figure NF, losses in interconnects etc.

The Moon is just a heated body in the sky; its radio emission is purely thermal. The lunar radiation has been well investigated nowadays and can be used as a standard source for calibration of radiometers and telescopes. It was used previously for low centimeter (>15 GHz) and millimeter waves [1,2], but it can be applied for lower frequencies too, at least for 1 GHz and higher.

The Moon radiates differently at different frequencies and illumination phases due to properties of the lunar soil (regolith). The lunar temperature is almost constant at low frequencies up to several GHz during all the lunation cycle with almost flat distribution across the disk; the phase-dependent variation of the temperature becomes stronger at higher frequencies.

At low frequencies the lunar radiation is formed mainly by deep layers under the Moon surface with almost constant physical temperature, but at higher frequencies, the radiation comes mainly from layers closer to the surface, whose temperature changes. The lunar brightness temperatures for low frequencies ≈ 220-250 K, see data collected in interactive tool by Joachim Köppen [3] with comprehensive references to experimental data. The distribution of temperatures across the lunar disk is noticeably uneven at higher frequencies and depends on the phase; see experimental lunar maps in [4] for mm-waves or modelled maps online for any frequency [5].

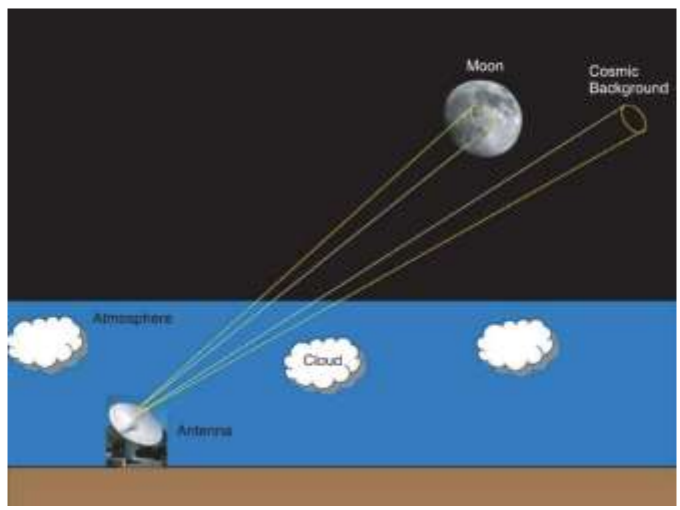

Figure 1. The Moon Y-factor measurement procedure. Picture was taken from [6].

A response of receiver to the Moon radiation in measurements is compared to the empty sky response (like in the picture Fig. 1). This gives the Moon Y-factor

$$Y_{moon} = P_{MOON}/P_{SKY} \quad (1)$$

as a ratio of received powers when antenna is pointed to the Moon – "hot source" and empty sky – "cold source" aside. Higher T_{sys} gives lower Y-factor and vice versa, lower T_{sys} gives higher Y-factor. The lunar value P_{MOON} is measured by adjusting azimuth and elevation of antenna seeking a maximum of received radiation.

The empty sky usually means that antenna sees the Cosmic Microwave Background (CMB) with temperature T_{CMB} = 2.7 K plus the atmosphere noise. Spectrum remnants of the galaxy noise also can contribute up to several GHz, but this contribution falls with frequency quickly. Up to several GHz one can find a good positioning of antenna to a cold area in the sky, for example, to the celestial pole. The same elevations for P_{MOON} and P_{SKY} measurements is significant for higher frequencies (especially for mm-waves) when the atmospheric losses and noise rather high and cannot be ignored. The atmosphere noise is small up to 6-7 GHz.

The measured Y-factor is used further to get a value of T_{sys}. Procedures and formulas described here require a knowledge of antenna parameters – the Main Beam Efficiency η_B or Aperture Efficiency η_A. Possible ways how to get them are discussed in Appendix A. For rude estimations they can be taken with typical value from ranges η_B = 0.65 – 0.8, η_A = 0.5 – 0.6.

Formulas for T_{sys} were derived from general one; it works at millimeter waves, and takes into account all influence factors. Described lunar approach could be checked additionally by a solar approach in centimeters, which also based on the Y-factor measurements and similar formulas, see Appendix B.

Typical values of T_{sys} for amateur radio telescopes may be in range 50-200 K for centimeters and up to 900 K for millimeters.

Low frequencies up to 2-3 GHz, small dishes

"Small dishes" means the Half Power Beam Width (HPBW) of antenna much greater the Moon angular size ≈ 0.5 deg. This case includes a most of amateur telescopes for Hydrogen H I line 1420 MHz. The atmospheric effects (attenuation and noise) are not taken into account; they are expected no more 2-3 K. The distribution of temperatures across the disk is supposed flat; actual temperature T_{moon} of the Moon can be retrieved in the online tool [3] or taken ≈ 230 K. The Y-factor measurements can be made in any time regardless the illumination phase. The system temperature T_{sys} for this case is obtained by formula

$$T_{sys} = \eta_B \frac{\ln 2 \ \delta_{moon}^2 \, T_{moon}}{\delta_{HPBW}^2 (Y_{moon} - 1)} - \eta_B \left(T_{CMB} + T_{gal}\right) . \qquad (2)$$

In this formula:

T_{moon} ≈ 230 K – the Moon brightness temperature;

T_{CMB} = 2.7 K – the CMB temperature, T_{gal} – the galaxy noise temperature. The sum T_{CMB} + T_{gal} does not exceed 10 K expectedly, but may contribute comparably in (2);

δ_{moon} ≈ 0.5 degrees – the lunar angular size. The disk size changes up to 10% in the lunation cycle with changes in the distance Moon-Earth;

δ_{HPBW} = 70 λ/D in degrees – Half Power Beam Width (HPBW) of antenna, λ - the wavelength, D – the dish diameter, $\lambda << D$;

Y_{moon} – the Y-factor from formula (1), it has to be >1. If the Y-factor comes from measurements in dB it has to be converted to linear units, $Y_{moon} = 10^{0.1\,Y(\mathrm{dB})}$;

η_B – the Main Beam Efficiency, has to be known *a priory*. It can be obtained from known Aperture Efficiency using their connection (see [7], chap. 5.3) or numerically $\eta_B \approx \eta_A$ / 0.75 [2]. In a first rough approximation η_B can be taken with its typical value in a range of 0.65 – 0.8. For other possible options, see Appendix A.

Frequencies up to 6-7 GHz, larger dishes

In this case, the atmospheric effects, CMB and galaxy noise are not included in, but now the angular size of the Moon ≈ 0.5 deg is comparable with antenna HPBW. The formula for T_{sys} becomes rather simple,

$$T_{sys} = \eta_B \frac{f_{BEAM}\, T_{moon}}{(Y_{moon} - 1)}. \tag{3}$$

In this formula:

T_{moon} – the Moon temperature, can be taken ≈ 230 K still or retrieved from [3];

f_{BEAM} – the filling factor of the Moon in the antenna beam, see [8], chapter 8.2.3 or [9]. Its value can be calculated by $f_{BEAM} = 1 - 2^{-\delta_{moon}^2/\delta_{HPBW}^2}$ derived for Gaussian beams [2], for δ_{moon} and δ_{HPBW} see comments to formula (2);

Y_{moon}, η_B – see comments to formula (2).

My results for 6.7 GHz telescope by formula (3) are below. The telescope was designed and applied for methanol masers observations, line 6.7 GHz, year 2023, see Fig. 2.

Dish size: D = 1.8 m, HPBW = 1.74 deg;

The Moon Y-factor: Y_{moon} = 0.4 dB;

System temperature: $T_{sys} \approx$ 115 K;

η_B = 0.85, η_A = 0.64, obtained by numerical calculations from previously modelled far field pattern of the dish feed, see Appendix A.

Other telescope characteristics: Sensitivity (G, forward gain) – 0.6 mK/Jy, obtained from Aperture Efficiency value η_A = 0.64, see [8], eq. (7.25) or [10], linear polarization.

Figure 2. Methanol maser telescope 6.7 GHz (2023).

The value T_{sys} = 115 K obtained here is noticeably lower than values from usual Y-factor method ($T_{sys} \approx$ 150 K) when environmental objects worked as a "hot source" [11]. The difference in values obtained by different methods is signaling about issues with uncertainty of T_{sys} in measurements.

Frequencies higher 7 GHz and millimeter waves, general case

This case takes into account the atmospheric losses and uneven distribution of the lunar temperature over the disk. Atmospheric losses and noise are calculated according ITU recommendations [12,13]. The temperature distribution over the disk is approximated by Gaussian with form-factor parameter σ,

$$T(\rho) = T_{moon}\, e^{-4\ln 2\, \sigma^2 \rho^2/\delta_{moon}^2}\ . \qquad (4)$$

Here ρ – is the angle from the disk center, and T_{moon} – denotes the temperature at the disk center whose value is taken from experimental data [3]. The approximation (4) works the best for illumination phases close to the Full Moon or somewhat later. For frequencies >10 GHz the center temperature T_{moon} can be calculated by fitting 1st harmonic formula [14]

$$\begin{aligned} T_{moon} &= T_0 + T_1 \cos(\Phi_M - \varphi)\ , \qquad T_0 = 213 \pm 6\ \text{K}, \\ & T_1 = (30 \pm 5)\ \lambda^{-0.67}\ \text{K}, \qquad \varphi = (\pi/5 \pm \pi/25)\ \lambda^{0.275}\ \text{radians}, \\ & \lambda = 0.1 \div 3\ \text{cm}. \end{aligned} \qquad (5)$$

Here Φ_M means a current lunation phase (in convention Φ_M = 0 for the Full Moon). The general formula for T_{sys} is

$$T_{sys} = \eta_B \frac{\left(\delta_{HPBW}^2\, \sigma^2/\delta_{moon}^2 + 1\right)^{-1} \left(1 - 2^{-\left(\delta_{moon}^2/\delta_{HPBW}^2\right) - \sigma^2}\right) T_{moon} - \left(Y_{moon} - 2^{-\delta_{moon}^2/\delta_{HPBW}^2}\right)\left(T_{CMB} + T_{gal}\right)}{\left(Y_{moon} - 1\right) L_{atm}} - \\ - \eta_B\, T_{atm}\left(1 - 1/L_{atm}\right)\ . \qquad (6)$$

It was derived by inverting eq. (22) from [2]. In this formula:

T_{moon}, σ – temperature at the disk center and distribution parameter;

T_{atm} – temperature of the atmosphere, T_{atm} = 37.34 + 0.81 (T_{amb} + 273.15) K, where T_{amb} is the ambient temperature in °C [12];

L_{atm} > 1 – the atmospheric attenuation for current surface weather calculated according [13]. Different elevations give different L_{atm}. Its value has to be calculated for every elevation and weather conditions. Clouds and weather with precipitations make calculations hardly predictable. A clear weather is the best for mm-wave measurements;

T_{CMB} = 2.7 K – the CMB temperature, contributes a minor;

T_{gal} – the galaxy noise temperature, contributes a minor. It is not considered in [2] at all, but here appears like CMB;

Y_{moon}, η_B, δ_{moon}, δ_{HPBW} – see comments to formula (2).

Formula (6) takes into account the shadowing of CMB and galaxy radiation by the Moon. Both (2) and (3) can be derived from (6) as special cases.

There are two practical projects in millimeter waves. Both did not include obtaining the system temperature directly by (3), but nevertheless give good examples what values of T_{sys} could be expected at millimeters.

For my 38 GHz solar radiometer [2], see Fig. 3, following characteristics were obtained:

Figure 3. 38 GHz solar radiometer (2014-2015).

Dish size: D = 0.9 m, HPBW = 0.6 deg;

The Moon Y-factor: Y_{moon} = 0.23 dB, lunation phase – 20 degrees after the Full Moon, clear dry weather, summer 2015;

Lunar temperature distribution parameter: σ = 0.72 according data from thermal map, λ = 8.6 mm, phase 11.7 degrees after the Full Moon, see [4];

System temperature: $T_{sys} \approx 809$ K;

η_B = 0.67, η_A = 0.5, obtained after correction according results of additional measurements of the ground noise, see details in [2];

Receiver Noise Figure: NF = 5.5 dB, T_{rcvr} = 739 K;

Spillover temperature: $T_{spill} = T_{sys} - T_{rcvr}$ = 70 K.

Figure 4. 80 GHz radiometer (2021-2022).

The next example is 80 GHz radiometer [15], see Fig. 4. Its characteristics are following:

Dish size: D = 0.9 m, HPBW = 0.3 deg;

The Moon Y-factor: Y_{moon} = 0.25 – 0.65 dB for different lunation phases and depends on the atmosphere condition, December 2021 – June 2022;

System temperature: $T_{sys} \approx 790$ K, depends on the ambient temperature T_{amb}, does not include the atmosphere noise;

η_B = 0.65, η_A = 0.49, a method similar to 38 GHz radiometer, see comments in [15];

Receiver Noise Figure: NF = 5.5 dB, T_{rcvr} = 739 K;

Spillover temperature: $T_{spill} = T_{sys} - T_{rcvr} \approx 50$ K.

Both radiometers works in linear polarization.

Concluding remarks

The Moon radiation can be used for system temperature T_{sys} measurements. Measurements use Y-factor method where the Moon plays a role of "hot source". Formulas for extracting T_{sys} from measured Y-factor were written out in a wide range of frequencies, - from Hydrogen line H I 1420 MHz and up to millimeter waves. Peculiarities of the Moon radiation, atmospheric effects, and the empty sky (as a "cold source") in considered frequency range are taken into account. Typical values of T_{sys} from my practical projects are given too.

Appendix A. About antenna efficiencies

The Main Beam Efficiency η_B can be calculated from its connections to known Aperture Efficiency η_A [7], chap. 5.3; I used the relation derived for Gaussian antenna beams $\eta_A \approx 0.75\ \eta_B$ [1].

Aperture Efficiency for centimeter waves can be obtained from solar measurements [16] and then recalculated to $\eta_B \approx \eta_A / 0.75$. Extraction of η_A requires a knowledge of current Solar Flux F_{sun} which significantly depends on the solar activity for centimeters [17] and has to be recalculated to needed frequency.

Other method used by me for Methanol maser telescope 6.7 GHz is based on numerical simulations. The aperture efficiency can be interpreted as a product of taper η_t and spillover η_S efficiencies, $\eta_A \approx \eta_t\, \eta_S$, see [7], chap. 4 or [18]. They are considered as main contributors defining an optimum in η_A; other components like Ruse term, cross-polarization efficiency or ohmic losses were not taken into account. The $\eta_t\, \eta_S$ value was calculated from known (*a priori* modelled) far-field pattern of the feed in Comsol Multiphysics, RF module according formula [18]

$$\eta_A \approx \eta_t\, \eta_S = \frac{1}{\pi}\cot^2\frac{\theta_0}{2} \cdot \frac{\left(\int_{Reflector\ View} \sqrt{F(\theta,\varphi)}\ \frac{\tan\theta/2}{\sin\theta}\ d\Omega\right)^2}{\int_{Full\ Sphere\ 4\pi} F(\theta,\varphi)\ d\Omega}, \tag{7}$$

where $F(\theta,\varphi)$ is the far-field pattern of the feed in linear power units, depends on polar θ and azimuthal φ angles, θ=0 corresponds to the feed pattern maximum, θ_0 – is a half of aperture angle from the feed location. Integrations are over the Reflector View solid angle from the feed location and over the Full Sphere. This formula was derived initially for prime focus dishes and, as I count on, it gives good values η_A for offset dishes too.

This method may give somewhat overestimated values for η_B and η_A because it ignores other components of the Aperture Efficiency like Ruse term, cross-polarization efficiency, ohmic losses, possible defocusing of the feed etc.

Appendix B. A solar approach in centimeters

One can note that formulas (2) and (3) have to work for the Sun instead the Moon with corresponding brightness temperature and Y-factor,

$$T_{sys} = \eta_B \frac{\ln 2\ \delta_{sun}^2\, T_{sun}}{\delta_{HPBW}^2 (Y_{sun} - 1)} - \eta_B\left(T_{CMB} + T_{gal}\right) \quad \text{(small dishes)},$$

$$T_{sys} = \eta_B \frac{f_{BEAM}\, T_{sun}}{(Y_{sun} - 1)} \quad \text{(larger dishes)}. \tag{8}$$

The solar radiation is measured in comparison to the empty sky noise background too. The measurements give the solar Y-factor,

$$Y_{sun} = P_{SUN}/P_{SKY} \tag{9}$$

as a ratio of received powers when antenna is pointed to the Sun and empty sky. The solar value P_{SUN} is measured by adjusting azimuth and elevation of the radiometer beam seeking a maximum of received Sun radiation.

It is assumed that the Sun also of the flat temperature distribution across the disk. The disk size for the Sun is approximately the same, $\delta_{sun} \approx 0.53$ deg; the filing factor f_{BEAM} has to be the same too. The brightness temperature T_{sun} can be obtained from the current flux F_{sun} as

$$T_{sun} = \frac{F_{sun}\,\lambda^2}{2\,k\,\Delta\Omega_{sun}}, \qquad \Delta\Omega_{sun} \approx \pi\frac{\delta_{sun}^2}{4}. \tag{10}$$

Here k – is the Boltzmann constant, k = 1.38 10^{-23} J/K, $\lambda=c/f$ - the working wavelength, c – velocity of light, f - frequency. F_{sun} is usually measured in so-called Solar Flux Units (SFU), 1 SFU = 10^4 Jy. The brightness temperature for 32' = 0.53 deg disk versus flux in SFU units will be inverting eq. (1) in [17] (see also Table 1 there)

$$T_{sun}\,[\mathrm{K}] = 4784.7\,F_{sun}\,[\mathrm{SFU}] \,/\, (f\,[\mathrm{GHz}])^2. \tag{11}$$

The formulas (8) give no new information about η_B or η_A, but the lunar approach with (2) and (3) could be checked additionally by solar one.

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About the author

Dimitry Fedorov was first licensed as radio amateur since 1982, as UA3AVR since 1983. In 1990 graduated as MS in electronics in Moscow Power Engineering University. Now works as research and development engineer in wireless industry, LTE/5G NR, RF and microwave modules development. Previous scientific experience in nuclear and particle physics, worked in Moscow State University, Institute of Nuclear Physics and Universität Tübingen, Institut für Theoretische Physik, see profile blog at https://www.researchgate.net/profile/Dimitry-Fedorov-2. Radio Astronomy hobby since 2012, mainly in applications for weak signals reception. You can contact the author at ua3avr@yandex.ru.

Observation Reports

Rosette Nebula Visibility

J. Abshier, Novi Michigan
January 2024

Detection of weak radio sources is generally easier with an interferometer than with a total power receiver. The interferometer is much less sensitive to receiver gain variations. However the interferometer can be limited in detecting extended sources when the source extends over multiple lobes of the interferometer fringes. An interferometer with a particular baseline casts a sinusoidal pattern of fringes on the sky. Unless the source size is small compared with a fringe lobe, the signal strength will be reduced. Source brightness over a positive half cycle of the fringe pattern will be reduced by source brightness over the negative half cycle. If the source size extends over one compete fringe cycle or more, the fringe data received can completely wash out. This phenomenon has been used as the basis for measuring source size. In optics the Michelson interferometer used this phenomenon to measure sizes of stars. The amateur radio astronomer hoping to detect weak (or even strong) radio sources should therefore consider source sizes when selecting an interferometer baseline. Ideally the baseline should be adjustable to allow optimization of detection capability.

To explore the effect of baseline length on fringe amplitude, an experiment was performed to make visibility measurements of the Rosette Nebula. The measurements were made with an interferometer operating at 1416 MHz with a bandwidth of about 4 MHz. One of the antennas is a 3 meter parabolic antenna and the other antenna is a grid parabolic antenna about 1 meter by 0.6 meters in size. The grid antenna is mounted on a tripod that can be moved to obtain various baselines. An image of the interferometer antennas is shown in Figure 1.

Figure 1. Interferometer Antennas

Fringe data collections were made using baselines of 2.4, 5.0, 6.9, and 8.7 meters in an east/west direction. Figure 1. shows the interferometer in the 2.4 meter baseline configuration. For each baseline, a total of 4 fringe data collections were made, and the fringe amplitude was averaged over the 4 data sets. Figure 2. shows plots of the fringe data for the 4 baselines.

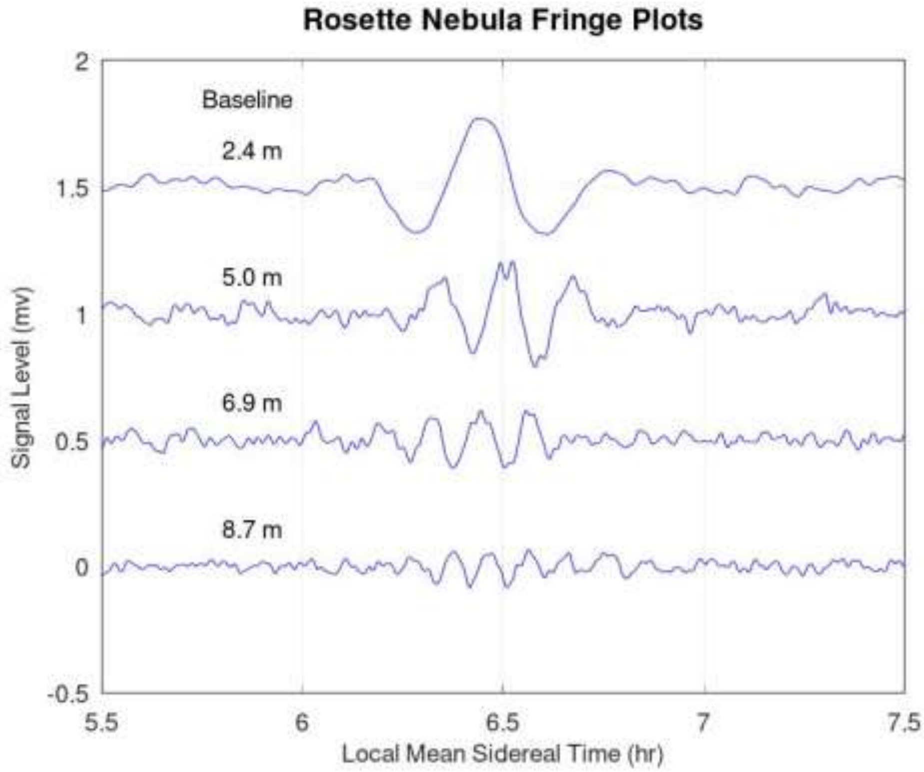


Figure 2. Fringe Data Plots

As can be seen in Figure 2. the fringe amplitude decreases with increasing baseline. This occurs because as the fringe frequency increases with increasing baseline, source flux beneath positive half cycles of fringes is reduced by flux beneath negative half cycles. For a symmetric shaped source of uniform brightness, the visibility will become zero when the source size is approximately the same as one fringe cycle. The baseline for which fringes disappear depends to some extent on the actual shape of the source and flux distribution over the source.

Amplitudes of fringes were plotted versus baseline length to produce a visibility profile. A line was fit to the visibility data to indicate the downward trend. The visibility profile obtained is shown in Figure 3. Data were, of course, not available for zero baseline, and space limitations prevented collections with baselines longer than about 9 meters.

The trend line suggests that fringes would disappear if the baseline was extended to about 11 meters. At this baseline, a fringe cycle size would be about the same size as the source. For an 11 meter baseline at 1416 MHz this would be about 1.1 degrees. This is close to the 1.2 degree value given for the size of the Rosette Nebula in a survey done at the Owens Valley Radio Observatory back in 1962. The results obtained in this experiment are therefore more or less consistent with professionally determined results.

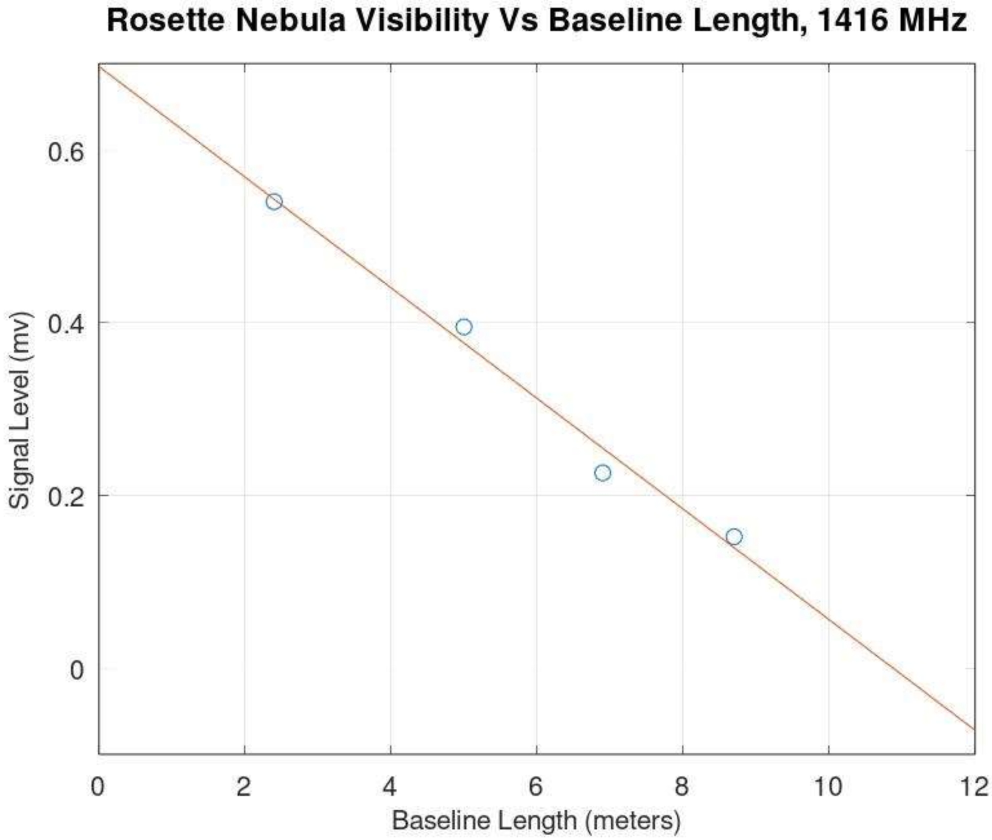


Figure 3. Rosette Nebula Visibility Vs Baseline Length

The results of this experiment illustrate a potential problem for amateur radio astronomers who are considering building an interferometer to detect weak sources. If the baseline selected for an interferometer is very long, detection of extended sources will be adversely affected. A very long baseline can also affect measurement of strong sources such as the Sun and Moon since they are both extended sources about 0.5 degrees in diameter. Source size should therefore be considered when selecting a baseline for an interferometer. An adjustable baseline would provide the capability to adapt the baseline length to the source size.

Bulletin C number 67

INTERNATIONAL EARTH ROTATION AND REFERENCE SYSTEMS SERVICE (IERS)

SERVICE INTERNATIONAL DE LA ROTATION TERRESTRE ET DES SYSTEMES DE REFERENCE

SERVICE DE LA ROTATION TERRESTRE DE L'IERS, OBSERVATOIRE DE PARIS, 61, Av. de l'Observatoire 75014 PARIS (France), Tel.: +33 1 40 51 23 35, e-mail: services.iers@obspm.fr, http://hpiers.obspm.fr/eop-pc

Paris, 08 January 2024

Bulletin C 67

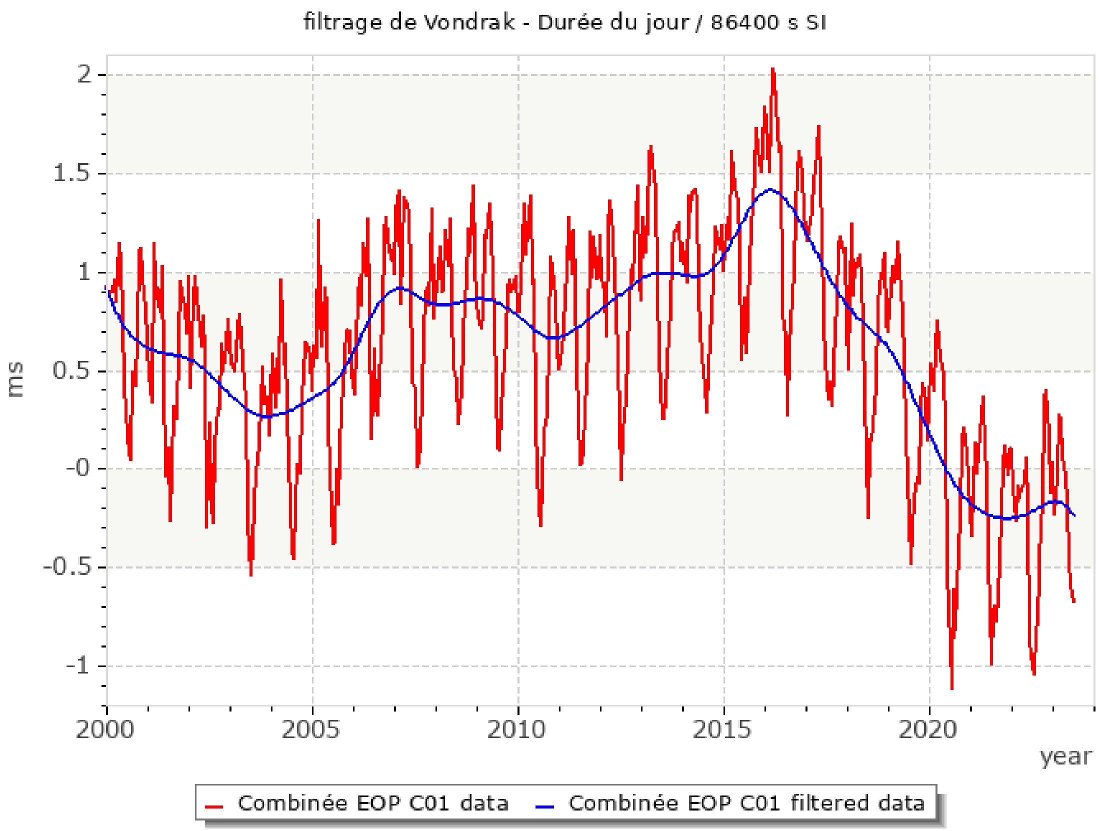
To authorities responsible for the measurement and distribution of time:

INFORMATION ON UTC - TAI

NO leap second will be introduced at the end of June 2024. The difference between Coordinated Universal Time UTC and the International Atomic Time TAI is: from 2017 January 1, 0h UTC, until further notice : UTC-TAI = -37 s

Leap seconds can be introduced in UTC at the end of the months of December or June, depending on the evolution of UT1-TAI. Bulletin C is mailed every six months, either to announce a time step in UTC, or to confirm that there will be no time step at the next possible date.

Christian BIZOUARD, Director, Earth Orientation Center of IERS, Observatoire de Paris, France



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ms
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Combinée EOP C01 filtered data

Observations with K4CSO

Charles Osborne, K4CSO

Busy Time for Radio Bursts

The past months have seen a nearly constant barrage of radio bursts. On December 14th, 2023, I happened to be capturing data at 1420 MHz at -30° declination and was watching the signal rise. I'd often seen this with the Sun a few degrees away. But that day it kept rising. If I was peaked on the Sun for a Sun noise measurement the rise would be about 11~12dB depending on Solar Flux at the time.

The notable issue that day was that I was 6-8° away from the Sun and the power continued to rise until it went off scale high. I normally have to adjust SDR#'s Offset down 10 dB to see the peak. But in this case, I had to go another 10 dB further in Offset. I was seeing between 16.9 ~ 18.6dB increase. And realizing I was in the sidelobes of the antenna pattern means it would have been more if I elevated the antenna. But I figured that would just add more confusion.

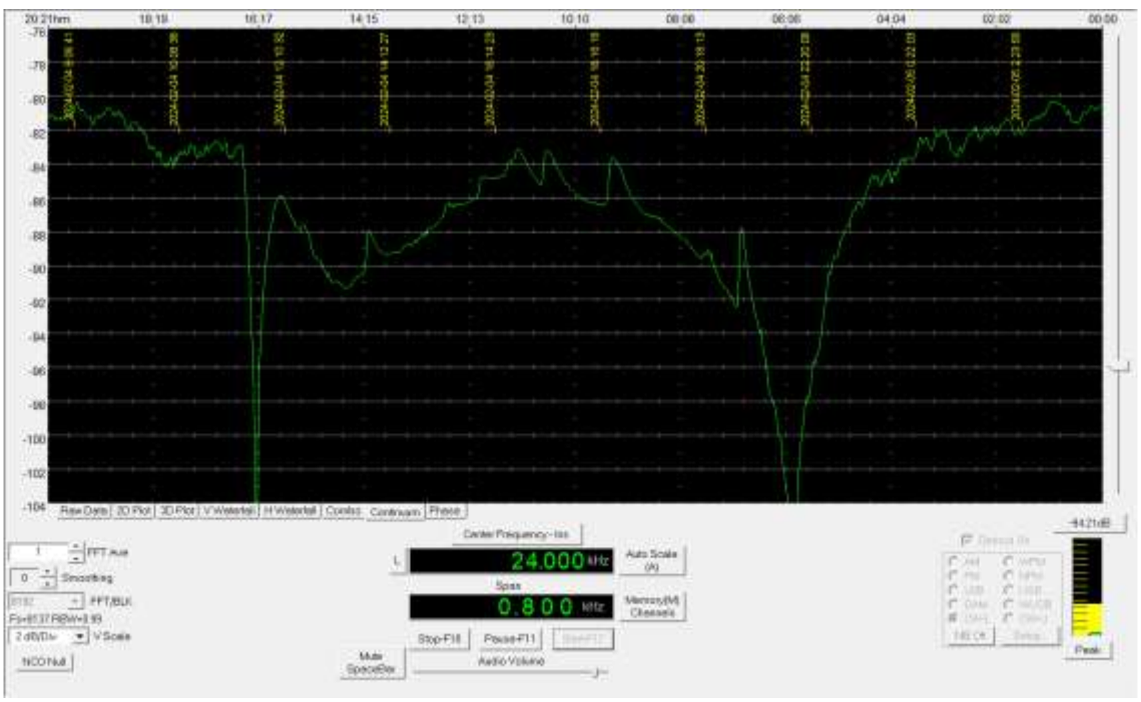
Normally at local noon I participate in an 1899 kHz midday propagation test led by Dexter McIntyre W4DEX for the past few years. https://groups.io/g/1899khz We all tend to watch the Space Weather real time updates to our cellphones. So, it wasn't long before we realized an X2.87 Flare, the largest of this solar cycle at the time, had occurred. Prior to that the Solar Flux was only 135.

One good thing I learned from this flare was that my 1420 MHz system had enough dynamic range to handle the almost 19 dB increase without saturating. Good to know.

VLF 24kHz

I've been meaning to build something SuperSID like. In mid January 2024 I got around to making the antenna. Noticing the outrageous price increases in PVC pipe I elected to use something I already had. It was an awning support I quit using. That gave me a 62" x 43" square 1 ¼" schedule 40 PVC frame. I had a 1000 foot roll of #22 AWG insulated stranded wire. Using 24 turns resulted in about 420 feet used. This is similar to the SuperSID antenna, only bigger in area. Using forty feet of shielded twisted pair audio cable I connected it to my RFSpace SDR-IQ running SpectraVue. I set the SDR to capture about 24 hours on screen. The averaging resulted in many solar flares showing up each day.

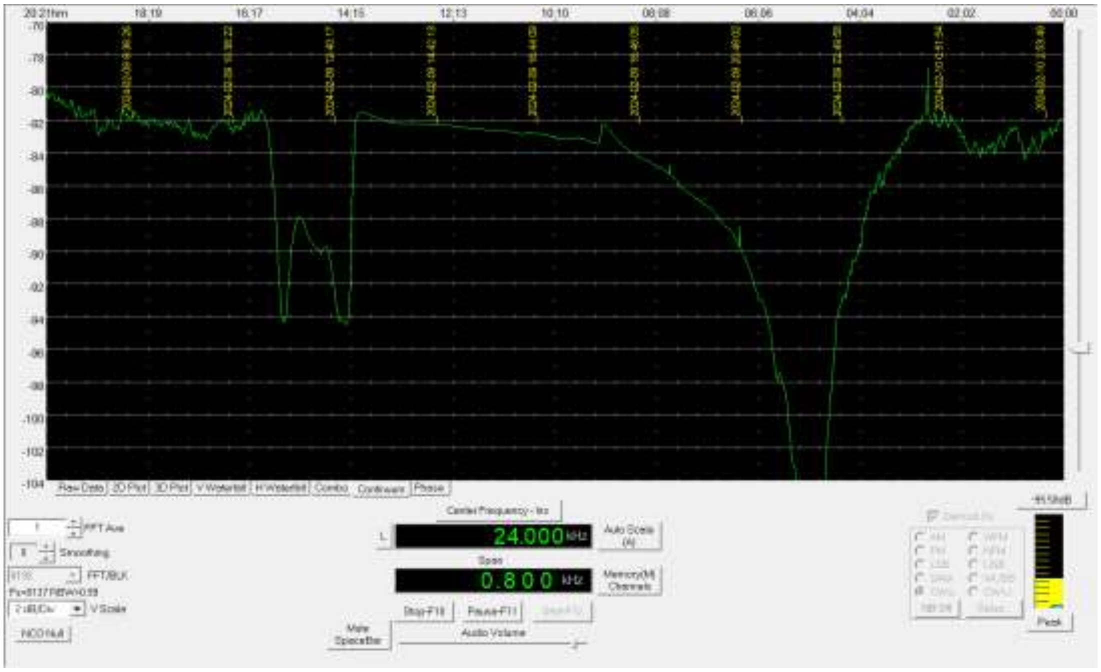
One interesting aspect is that this is inside my attic, and I have a metal roof. But it still seems to work well. I really expected more RFI given the Cat5, router, and dozen PCs Janis and I have. I'll just consider myself lucky and use it.



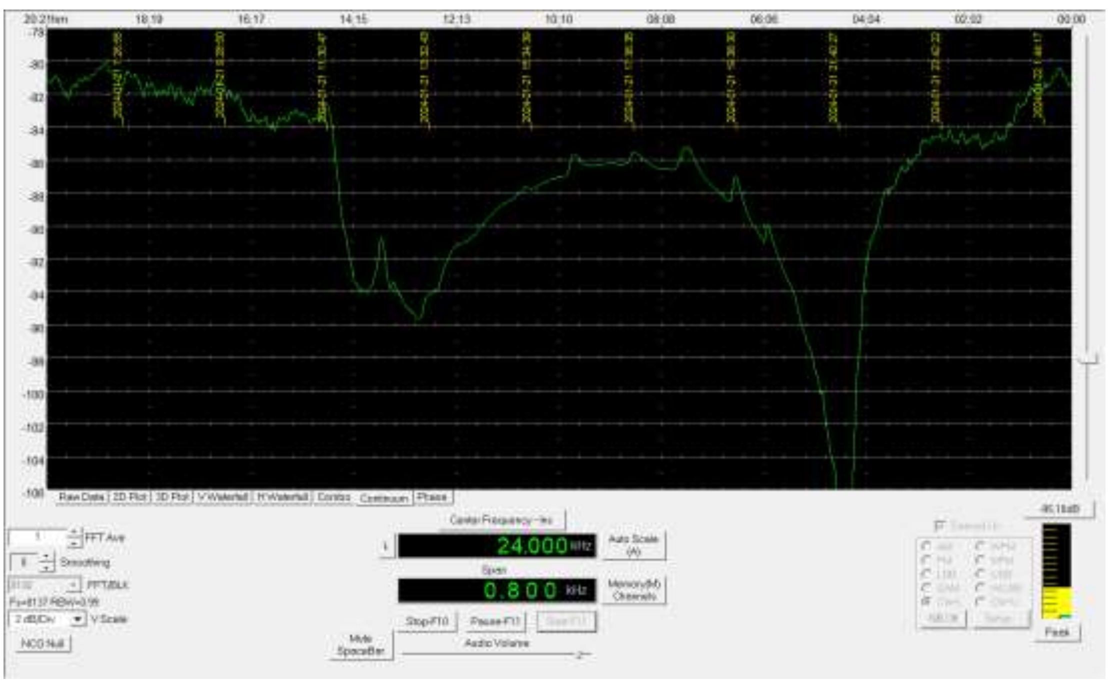
13:39 UTC C8.3 Flare
15:08 UTC C4.3 Flare
15:49 UTC C6 Flare
16:08 UTC C5.6 Flare
16:22 UTC M1.5 Flare

17:05 UTC M1.3 Flare
18:16 UTC M1.1 Flare
20:08 UTC C3.5 Flare
20:16 UTC C4.4 Flare
20:52 UTC M1.2 Flare

22:34 UTC M2.7 Flare



12:53~13:14 UTC X3.2 Flare
17:54~18:00 UTC M1.2 Flare



16:25 UTC C2.9 Flare
17:36 UTC C3.9 Flare
18:30 UTC C5.8 Flare
19:38 UTC C6.6 Flare
20:10 UTC C5.7 Flare

Journal Archives and Other Promotions

The rich and diverse legacy of member contributed content is available in the SARA Journal Archives. Table of contents for journals is available online at: SARA-Journal-Master-Index.xlsx (live.com)

The entire set of The Journal of The Society of Amateur Radio Astronomers is available by online download. It goes from the beginning of 1981 to the end of 2022 (over 6000 pages of SARA history!)

All SARA journals and conference proceedings are available through the previous calendar year.

SARA Store (radio-astronomy.org/store.)

SARA offers the above USB drives, DVDs, printed Proceedings and Proceedings on USB drive and other items at the SARA Store: http://www.radio-astronomy.org/e-store. Proceeds from sales go to support the student grant program. Members receive an additional 10% discount on orders over $50 US. Payments can be made by sending payment by PayPal to treas@radio-astronomy.org or by mailing a check or money order to SARA, c/o Brian O'Rourke, 337 Meadow Ridge Rd, Troy, VA 22974-3256

SARA Online Discussion Group

SARA members participate in the online forum at http://groups.google.com/group/sara-list. This is an invaluable resource for any amateur radio astronomer.

SARA Conferences

SARA organizes multiple conferences each year. Participants give talks, share ideas, attend seminars, and get hands-on experience. For more information, visit http://www.radio-astronomy.org/meetings.

What is Radio Astronomy?

Radio Astronomy is just what the name implies…. Astronomy observed at radio wavelengths instead of optical. But why do radio astronomy? Radio astronomy has expanded the knowledge of the universe about as much since its discovery in 1932 as optical has since humans first looked up at the sky. (The sky in the different frequencies or colors of radio are as different and varied as all of the flowers on Earth. Each frequency has its own information about what is happening in the universe.) This knowledge has been gained by both professional astronomers as well as amateurs, with amateurs contributing to this day.

Do I need a big dish and expensive equipment?
No. Complete beginner projects are available at the SARA store at very reasonable prices. You can monitor the Sun's effects upon our planet with SuperSID. This information is gathered for Stanford for research into our ionosphere and radio signal propagation. Another project is the detection the hydrogen line just like Dr. Ewen had done in 1951 for a fraction of the cost using the Scope in a Box kit.

That said, radio astronomy is like optical astronomy in that you can spend as much as you want to. Many amateurs push the lower boundaries of cost by using very low-cost receivers and low-noise low-cost amplifiers that were not available even a few years ago. (See the Scope in a Box kit in the store for examples of both.)

Is everything 'plug and play' and boring?
The kits mentioned above are a starting point which are mostly plug-and-play… that gets you started. After you have mastered the basics, where you go from there depends upon your interests. Monitoring pulsars is done by amateurs. (One even noticed a pulsar glitch before the professionals!) These amateurs are pushing the boundaries of what can be done. Papers are being published and discussions had about pulsar detection as well detection of a MASER with a 50-inch dish. Techniques on new detection methods are posted in the SARA forum and elsewhere. You are free to build your own equipment to receive the signals as well as software to collect and analyze the data.

What is SETI?
SETI is the Search for Extra-Terrestrial Intelligence. Some amateurs scan the sky and search for signals that might be from aliens. To date no one has received a definitive alien signal (professional or amateur), but the search continues. The search has resulted not just in better receiving equipment but also wide and lively discussions about how aliens might communicate and how they might be trying to contact us. Some of these techniques have interesting ideas for our own communication techniques here on Earth!

What should I do to get started?
You should start with reading our Introduction to Radio Astronomy and joining our online SARA Forum. Look at the SARA store to get a project to get your feet wet without much expense and minimal risk. We will work with you so you can succeed.

Administrative

Officers, directors, and additional SARA contacts

The Society of Amateur Radio Astronomers is an all-volunteer organization. The best way to reach people on this page is by email with SARA in the subject line SARA Officers.

President: Dr. Rich Russel, AC0UB, https://www.radio-astronomy.org/contact/President
Vice President: Jay Wilson, https://www.radio-astronomy.org/contact/Vicepresident
Secretary: Bruce Randall, NT4RT, https://www.radio-astronomy.org/contact/Secretary
Treasurer: Tom Jacobs, https://www.radio-astronomy.org/contact/Treasurer
Asst. Treasurer: Donna Hallin, https://www.radio-astronomy.org/contact/Treasurer
Past President: Dennis Farr
Founder Emeritus and Director: Jeffrey M. Lichtman, KI4GIY, jeff@radioastronomysupplies.com

Board of Directors

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Dr. Wolfgang Herrmann	2025	messbetrieb@astropeiler.de
Paul Butler	2025	paul.butler.melbourne@gmail.com
Charles Osborne	2025	k4cso@twc.com
Bob Stricklin	2024	bstrick@n5brg.com
Steve Tzikas	2024	Tzikas@alum.rpi.edu
Ted Cline	2025	TedClineGit@gmail.com
David Westman	2024	david.westman@engineeringretirees.org

Other SARA Contacts

All Officers	http://www.radio-astronomy.org/contact-sara	
All Directors and Officers	http://www.radio-astronomy.org/contact/All-Directors-and-Officers	
Eastern Conference Coordinator	http://www.radio-astronomy.org/contact/Annual-Meeting	
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Technical Queries (David Westman)	http://www.radio-astronomy.org/contact/Technical-Queries	
Webmaster	Ciprian (Chip) Sufitchi, N2YO	webmaster@radio-astronomy.org

Resources

Great Projects to Get Started in Radio Astronomy

Radio Observing Program

The Astronomical League (AL) is starting a radio astronomy observing program. If you observe one category, you get a Bronze certificate. Silver pin is two categories with one being personally built. Gold pin level is at least four categories. (Silver and Gold level require AL membership which many clubs have membership. For the bronze level, you need not be a member of AL.)

Categories include.
1) SID
2) Sun (aka IBT)
3) Jupiter (aka Radio Jove)
4) Meteor back-scatter
5) Galactic radio sources

This program is a collaboration between NRAO and AL. Steve Boerner is the Lead Coordinator and a SARA member.

For more information:
Steve Boerner
2017 Lake Clay Drive
Chesterfield, MO 63017
Email: sboerner@charter.net
Phone: 636-537-2495
http://www.astroleague.org/programs/radio-astronomy-observing-program

Radio Jove

The Radio Jove Project monitors the storms of Jupiter, solar activity and the galactic background. The radio telescope can be purchased as a kit, or you can order it assembled. They have a terrific user group you can join.
http://radiojove.gsfc.nasa.gov/

INSPIRE Program

The INSPIRE program uses build-it-yourself radio telescope kits to measure and record VLF emissions such as tweeks, whistlers, sferics, and chorus along with man-made emissions. This is a very portable unit that can be easily transported to remote sites for observations.
http://theinspireproject.org/default.asp?contentID=27

SARA/Stanford SuperSID

Stanford Solar Center and the Society of Amateur Radio Astronomers have teamed up to produce and distribute the SuperSID (Sudden Ionospheric Disturbance) monitor. The monitor utilizes a simple pre-amp to magnify the VLF radio signals which are then fed into a high-definition sound card. This design allows the user to monitor and record multiple frequencies simultaneously. The unit uses a compact 1-meter loop antenna that can be used indoors or outside. This is an ideal project for the radio astronomer that has limited space. To request a unit, send an e-mail to supersid@radio-astronomy.org

Radio Astronomy Online Resources

SARA YouTube Videos: https://www.youtube.com/@radio-astronomy	Pisgah Astronomical Research Institute: www.pari.edu
AJ4CO Observatory – Radio Astronomy Website: http://www.aj4co.org/	A New Radio Telescope for Mexico - ORION 2021 01 20. Dr. Stan Kurtz https://www.youtube.com/watch?v=Q9aBWr1aBVc
Radio Astronomy calculators https://www.aj4co.org/Calculators/Calculators.html	National Radio Astronomy Observatory http://www.nrao.edu
Introduction to Amateur Radio Astronomy (presentation) http://www.aj4co.org/Publications/Intro%20to%20Amateur%20Radio%20Astronomy,%20Typinski%20(AAC,%202016)%20v2.pdf	NRAO Essential Radio Astronomy Course http://www.cv.nrao.edu/course/astr534/ERA.shtml
RF Associates Richard Flagg, rf@hawaii.rr.com 1721-1 Young Street, Honolulu, HI 96826	Exotic Ions and Molecules in Interstellar Space -- ORION 2020 10 21. Dr. Bob Compton https://www.youtube.com/watch?v=r6cKhp23SUo&t=5s
RFSpace, Inc. http://www.rfspace.com	The Radio JOVE Project & NASA Citizen Science – ORION 2020.6.17. Dr. Chuck Higgins https://www.youtube.com/watch?v=s6eWAxJywp8&t=5s
CALLISTO Receiver & e-CALLISTO http://www.reeve.com/Solar/e-CALLISTO/e-callisto.htm	UK Radio Astronomy Association http://www.ukraa.com/
Deep Space Exploration Society http://DSES.science	CALLISTO software and data archive: www.e-callisto.org
Deep Space Object Astrophotography Part 1 -- ORION 2021 02 17. George Sradnov https://www.youtube.com/watch?v=Pm_Rs17KlyQ	Radio Jove Spectrograph Users Group http://www.radiojove.org/SUG/
European Radio Astronomy Club http://www.eracnet.org	Radio Sky Publishing http://radiosky.com
British Astronomical Association – Radio Astronomy Group http://www.britastro.org/baa/	The Arecibo Radio Telescope; It's History, Collapse, and Future - ORION 2020.12.16. Dr. Stan Kurtz, Dr. David Fields https://www.youtube.com/watch?v=rBZlPOLNX9E
Forum and Discussion Group http://groups.google.com/group/sara-list	Shirleys Bay Radio Astronomy Consortium marcus@propulsionpolymers.com
GNU Radio https://www.gnuradio.org/	SARA Twitter feed https://twitter.com/RadioAstronomy1
SETI League http://www.setileague.org	SARA Web Site http://radio-astronomy.org
NRAO Essential Radio Astronomy Course http://www.cv.nrao.edu/course/astr534/ERA.shtml	Simple Aurora Monitor: Magnetometer http://www.reeve.com/SAMDescription.htm
NASA Radio JOVE Project http://radiojove.gsfc.nasa.gov Archive: http://radiojove.org/archive.html https://groups.io/g/radio-jove	Stanford Solar Center http://solar-center.stanford.edu/SID/
National Radio Astronomy Observatory http://www.nrao.edu	

For Sale, Trade and Wanted

At the SARA online store: radio-astronomy.org/store.

Scope in a Box

radio-astronomy.org/store.

Kit of parts and software to build a working Radio Telescope to detect Hydrogen Line emissions. Available to USA addresses only at this time.

SuperSID Complete Kit
radio-astronomy.org/store.

SARA Publication, Journals and Conference Proceedings (various prices)
radio-astronomy.org/store.

SARA Journal Online Download
radio-astronomy.org/store.

The USB drive covers the society journal "Radio Astronomy" from the founding of the organization in 1981 thru 2020. Articles cover a wide range of topics including: cosmic radiation, pulsars, quasars, meteor detection, solar observing, Jupiter, Radio Jove, gamma ray bursts, the Itty Bitty Telescope (IBT), dark matter, black holes, the Jansky antenna, methanol masers, mapping at 408 MHz and more. This CD contains all of the above and more with over 4800 pages of articles on radio astronomy. Also included is a copy of Grote Reber's handwritten, 34-page document "Carriage and Mirror Detail" of his historic antenna now on display at the National Radio Astronomy Observatory (NRAO) in Greenbank, WV. You also get an electronic copy of the 109 page "Basics of Radio Astronomy" from JPL Goldstone-Apple Valley Radio Telescope. Also included is the NRAO 40-foot radio telescope "Operators Manual", which by the way, you get to operate if you attend the Eastern SARA conference in July.

SARA Advertisements

There is no charge to place an ad in Radio Astronomy; but you must be a current SARA member. Ads must be pertinent to radio astronomy and are subject to the editor's approval and alteration for brevity. Please send your "For Sale," "Trade," or "Wanted" ads to edit@radio-astronomy.org. Please include email and/or telephone contact information. Please keep your ad text to a reasonable length. Ads run for one bimonthly issue unless you request otherwise.

Membership Information

Annual SARA dues Individual $20, Classroom $20, Student $5 (US funds) anywhere in the world. Membership includes a subscription to Radio Astronomy, the bimonthly Journal of The Society of Amateur Radio Astronomers, delivered electronically (via a secure web link, emailed to you as each new issue is posted). We regret that printing and postage costs prevent SARA from providing hardcopy subscriptions to our Journal.

We would appreciate the following information included with your check or money order, made payable to SARA:

Name: ____________________

Email Address : ____________________
(required for electronic Journal delivery)

Ham call sign: ____________________ (if applicable)

Address: ____________________

City: ____________________

State: ____________________

Zip: ____________________

Country: ____________________

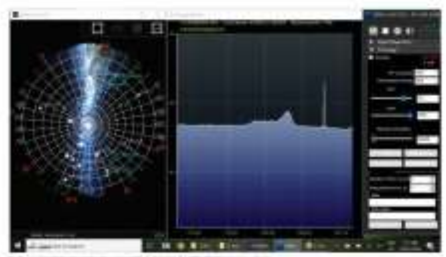
Phone: ____________________

Please include a note of your interests. Send your application for membership, along with your remittance, to our Treasurer.

For further information, see our website at:
http://radio-astronomy.org/membership

How to get started?

SARA has a made a kit of software and parts to detect the Hydrogen line signal from space. This is an excellent method to get started in radio astronomy. It teaches the principles of antenna design, signal detection, and signal processing. Read more about this and other projects on our web site.



Society of Amateur Radio Astronomers, Inc.
Founded 1981

Membership supported, nonprofit [501(c) (3)]
Educational and Radio Astronomy Organization

Knowledge through Common Research, Education and Mentoring

SARA members have been privileged to use this forty foot diameter drift-scan hydrogen line radio telescope every year at their annual meeting in Green Bank.

http://radio-astronomy.org

Why Radio Astronomy?

Because about sixty five percent of our current knowledge of the universe has stemmed from radio astronomy alone. The discovery of quasars, pulsars, black holes, the 3K background from the "Big Bang" and the discovery of biochemical hydrogen/carbon molecules are all the result of professional radio astronomy.

The Society of Amateur Radio Astronomers

SARA was founded in 1981, with the purpose of educating those interested in pursuing amateur radio astronomy.

The society is open to all, wishing to participate with others, worldwide.

SARA members have many interests, some are as follows:

SARA Areas of Study and Research:

- Solar Radio Astronomy
- Galactic Radio Astronomy
- Meteor Detection
- Jupiter
- SETI
- Gamma Ray/High Energy Pulse
- Detection
- Antennas
- Design of Hardware / Software

The members of the society offer a friendly mentor atmosphere. All questions and inquiries are answered in a constructive manner. No question is silly!

SARA offers its members an electronic bi-monthly journal entitled Radio Astronomy. Within the journal, members report on their research and observations. In addition, members receive updates on the professional radio astronomy community and, society news.

Once a year SARA meets for a three-day conference at the Green Bank Observatory in Green Bank West Va.

There is also a spring conference held at various cities in the Western USA. Previous meeting have been at the VLA in Socorro, NM and at Stanford University.

How do I get started?

Just as a long journey begins with the first step, the project you elect must start with a clear idea of your objectives. Do you wish to study the sun? Jupiter? Make meteor counts? Do you wish to engage in imaging radio astronomy? What you decide will not only determine the type of equipment you will need, but also the local radio spectrum.

How do amateurs do radio astronomy?

Radio astronomy by amateurs is conducted using antennas of various shapes and sizes, from smaller parabolic dishes to simple wire antennas. These antennas are connected to receivers and most of these receivers are software defined radios these days. Data from the receivers are collected by computers, and the received signals will be displayed as charts, graphs or maybe even sky maps. As diverse as the observed objects, so is are the instruments and tools used. SARA members will always be supportive to find good solutions for what one wishes to observe.

Is amateur radio astronomy instrumentation expensive?

Technical information freely circulated in our monthly journal helps amateurs to obtain good low noise equipment from off the shelf assemblies, or to build their own units. The actual cash investment in radio astronomy equipment need not exceed that of any other hobby.

What are amateurs actually looking for in the received data?

The aim of the radio amateur is to find something new and unusual. Just as an amateur optical observer hopes to notice a supernova or a new comet, so does an amateur radio observer hope to notice a new radio source, or one whose radiation has changed appreciably.

The Reber Telescope at NRAO. Constructed by Grote Reber in 1937 in his back yard in Wheaton, Illinois

SARA Members discussing the IBT (Itty Bitty Telescope)