RADIO ASTRONOMY

Journal of the Society of Amateur Radio Astronomers
July-August 2024

SARA 2024 Eastern Conference and Global Symposium

Dr. Richard A. Russel
SARA President and Editor

Bogdan Vacaliuc
Contributing Editor

Radio Astronomy is published bimonthly as the official journal of the Society of Amateur Radio Astronomers.

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:
Gary Memory

Contents

President's Page

Elections were completed with the following results for 2025-2026

President: Richard Russel
Vice President: Marcus Fisher
Board: Don Latham
Board: Dennis Farr
Board: Steve Tzikas
Board: Jay Wilson

The 2025 Western Conference Co-Chairs are: Ken Redcap and Dr. Wayne McCain.
The 2025 Eastern Conference Chair is: Marcus Fisher.

Special note: Marcus Fisher has started a new section in the journal covering radio astronomy software called: ***The Byte***

Special thanks to outgoing board members: Ed Harfmann, Bob Stricklin, David Westmann and Jay Wilson for their significant contributions to SARA over the years!

I would like to congratulate SARA VP, Jay Wilson, on another well organized and exemplary conference.

I would also like to give special recognition to the conference committee: Ken Redcap, Tom Hartman, Kammie Russel, Dave Lacko, Gary Memory and Tom Jacobs.

Also, we would like to recognize the key GBO staff:

Sue Ann Heatherly, who makes SARA conferences at GBO possible;
Mark Barnes for business accounts and housing;
Doug Honnor for cafeteria arrangements;
the IT staff for conference room Zoom integration.

During the conference, SARA donated $10,000 to the Green Bank education group and inducted Dr. Jay Lockman as an Emeritus SARA member.

Membership renewals for 2025 are due. Be sure to renew for 2025.

Rich

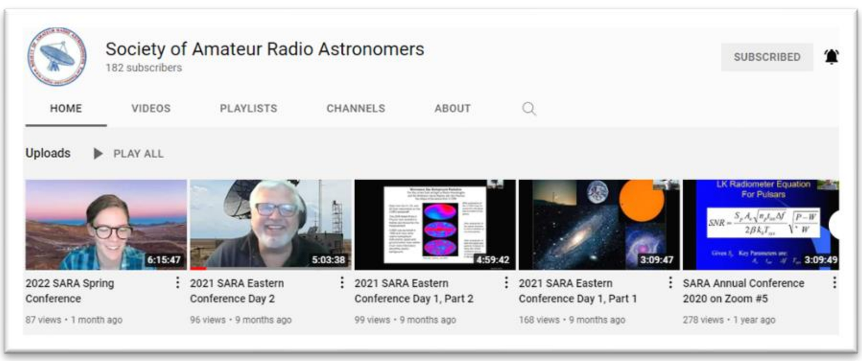
SARA President

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

SARA NOTES

NEW The BYTE

A new section is being added to the bimonthly SARA journal focused on system software applicable for amateur radio astronomy (RA).

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@hotmail.com .
Tom Crowley - SARA Grant Program Administrator

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. 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.

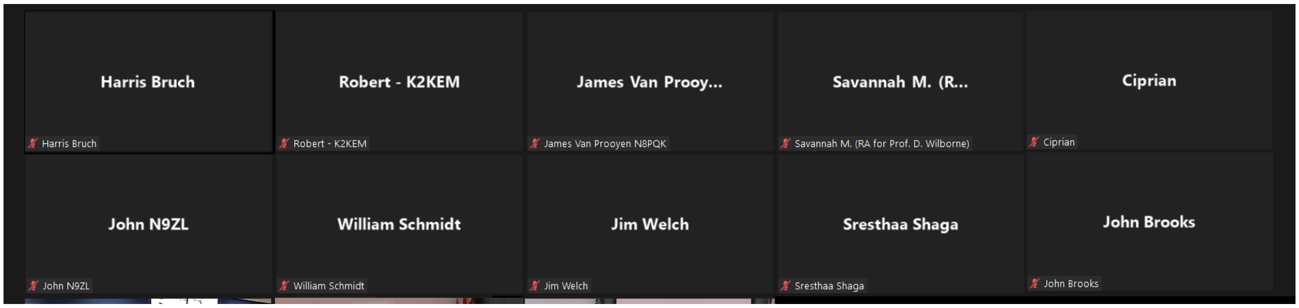
Drake's Lounge

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.

Eastern Conference Recap

Jay Wilson



The 2024 SARA Eastern Conference and International Radio Astronomy Symposium was held at Green Bank, West Virginia August 4-7. This was a joint in-person and online event. Forty-eight conferees met at Green Bank; 36 participated online; and 24 presenters from six international locations presented topics ranging from beginner-level through advanced radio astronomy.

Many presentations were recorded, and the Conference Proceedings will be available by the end of August.

The capstone presentation was by Dr. Jay Lockman from the Green Bank Observatory. He gave an informative and inspiring presentation on the history of radio astronomy and the many interesting individuals responsible for development of the field, and a broad view of new developments in the field of radio astronomy as well as the ethics and challenges of science.

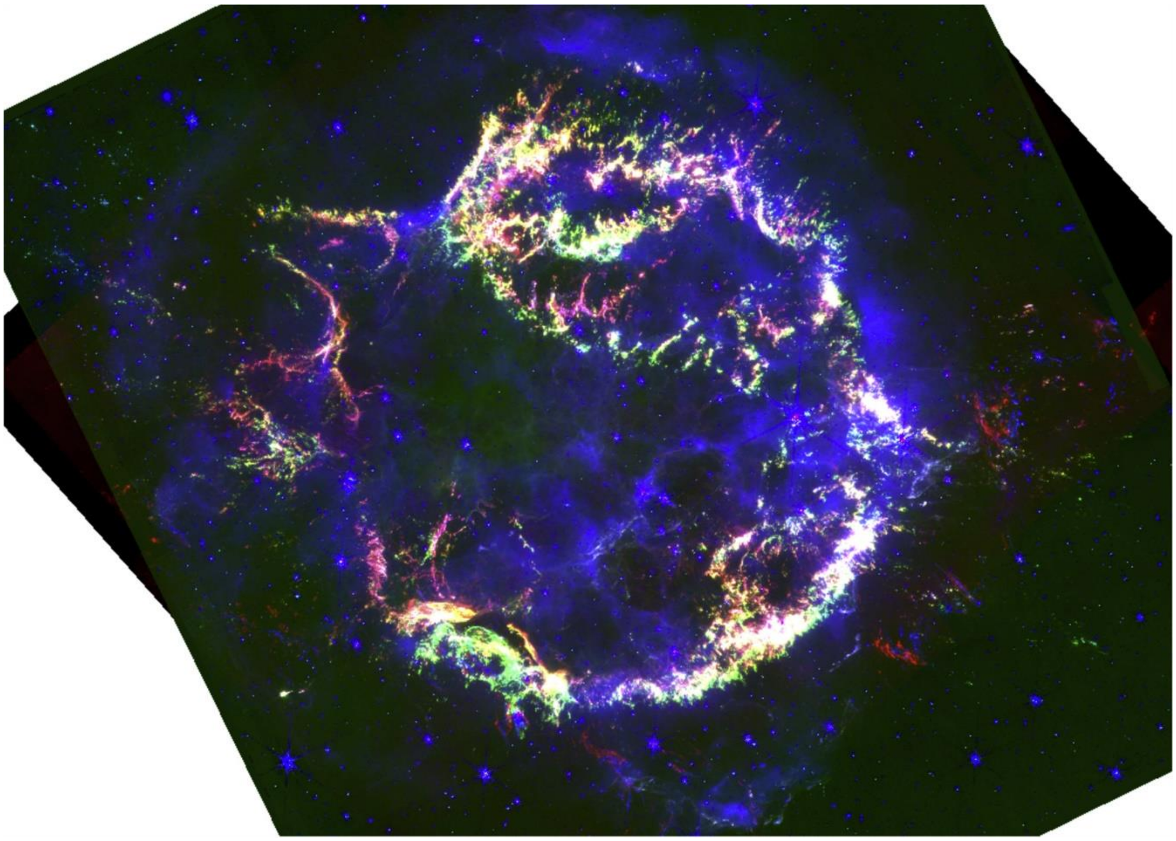
A highlight of the conference was the screening of the documentary “Small Town Universe” which featured many people and places at Green Bank that are familiar to SARA members.

Attendees at Green Bank had the opportunity to use the 40 foot telescope under the guidance of Skip Crilly and set up outdoor hands-on exhibits and experiments. Skip Sufitchi demonstrated meteor detection; Gary and Carla Memory set up a Radio Jove installation; Mike Otte demonstrated interferometry using a variety of antennas; and Glen Langstrom brought a 21cm horn antenna and receiver for hydrogen. Steve Tzikas provided training on the use of the 20 meter dish receiver.

The conference concluded with a tour of the Green Bank Telescope, including ascent to the receiver room and horn deck, courtesy of Sue Ann Heatherly.

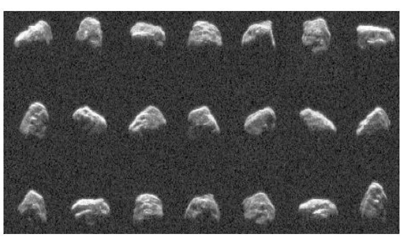
Next year’s conference will be Saturday to Wednesday, June 7-11. SARA Vice President Marcus Fisher will be conference coordinator.

News: (July - August 2024)



Kerry Hensley ~ Featured Image: A New Portrait of Cassiopeia A - AAS Nova
https://aasnova.org/2024/07/01/featured-image-a-new-portrait-of-cassiopeia-a/
https://doi.org/10.3847/2041-8213/ad5186
Citation: J. Rho et al 2024 ApJL 969 L9

Ian J. O'Neill ~ NASA's Planetary Radar Tracks Two Large Asteroid Close Approaches
https://www.jpl.nasa.gov/news/nasas-planetary-radar-tracks-two-large-asteroid-close-approaches



Credit NASA/JPL-Caltech

Harry Baker ~ Earth's gravity knocked pyramid-size asteroid off course during recent ultra-close flyby, NASA images reveal

https://www.livescience.com/space/asteroids/earths-gravity-knocked-pyramid-size-asteroid-off-course-during-recent-ultra-close-flyby-nasa-images-reveal

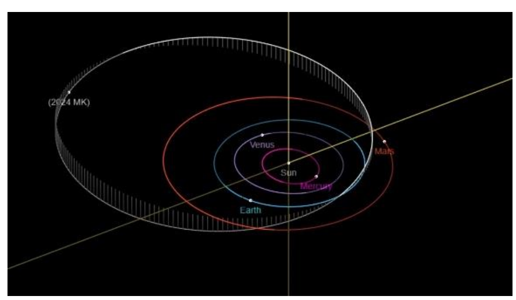


Image credit: NASA/JPL/Small-Body Database Lookup

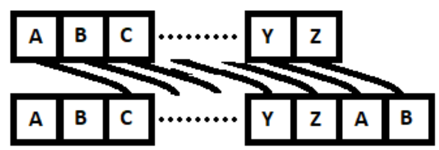
Jean-Luc Aufranc ~ $20+ NanoKVM is a tiny low-power RISC-V KVM over IP solution
https://www.cnx-software.com/2024/07/08/20-nanokvm-is-a-tiny-low-power-risc-v-kvm-over-ip-solution/

https://github.com/sipeed/NanoKVM/releases
Binaries only. Closed source

(the open-source development referenced here)
https://www.cnx-software.com/2021/09/22/pikvm-v3-raspberry-pi-hat-offers-kvm-over-ip-on-the-cheap/
https://www.kickstarter.com/projects/mdevaev/pikvm-v3-hat/description
https://github.com/pikvm/pikvm?tab=readme-ov-file#variants (*includes newest hardware for purchase)*

Daniel Ramnath ~ Breaking Vigenère cipher with C++
https://www.codeproject.com/Tips/5384760/Breaking-Vigen-re-cipher-with-Cplusplus

MESSAGE := ILOVEYOU
CIPHERTEXT (+1) := JMPWFZPV
DECODE := IIOTEYLU



[Editor's Note: I tried this with a simple phrase encoded with a +1 cipher and it DID NOT WORK. I reference the article and code because it is intriguing...]

Credit: Daniel Ramnath

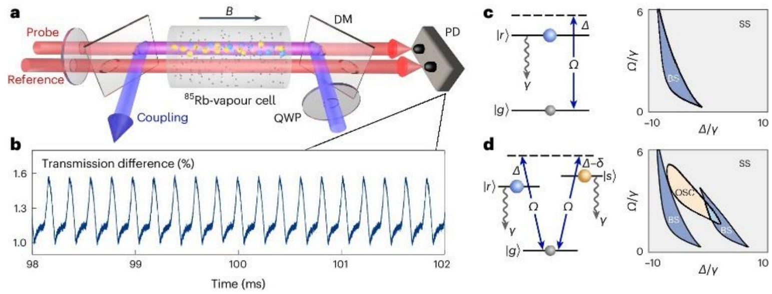
E	T	A	O	I	N	S	H	R	D	L	C	U
12.702%	9.056%	8.167%	7.507%	6.966%	6.749%	6.327%	6.094%	0.0599	4.253%	4.025%	2.782%	2.758%

M	W	F	G	Y	P	B	V	K	J	X	Q	Z
2.406%	2.36%	2.228%	2.015%	1.974%	1.929%	1.492%	0.978%	0.772%	0.153%	0.002	0.001	0.0007

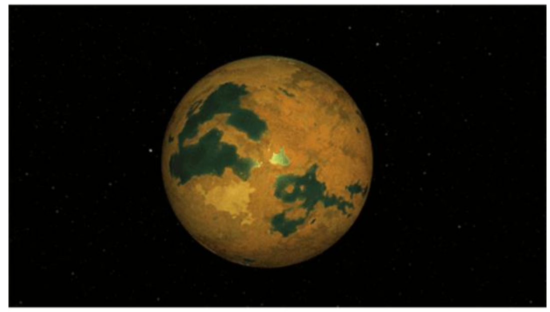
Vienna University of Technology ~ Scientists successfully create a time crystal made of giant atoms
https://phys.org/news/2024-07-scientists-successfully-crystal-giant-atoms.html

https://arxiv.org/html/2305.20070v3
https://dx.doi.org/10.1038/s41567-024-02542-9

Credit: Nature Physics (2024). DOI: 10.1038/s41567-024-02542-9



Pat Brennan ~ Discovery Alert: Spock's Home Planet Goes 'Poof'
https://science.nasa.gov/universe/exoplanets/discovery-alert-spocks-home-planet-goes-poof/
https://iopscience.iop.org/article/10.3847/1538-3881/ad34d5



Credit: Artist's concept of a previously proposed possible planet, HD 26965 b, JPL-CALTECH

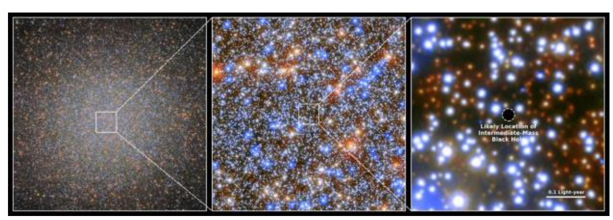
Liu Shuyan ~ 'Motion-picture' method reveals shape of the Milky Way's dark matter halo
Keith Cooper ~ Astronomers measure 'warp speed' of Milky Way galaxy
https://phys.org/news/2024-07-motion-picture-method-reveals-milky.html
https://www.space.com/milky-way-galaxy-warp-dark-matter-halo

https://www.nature.com/articles/s41550-024-02309-5

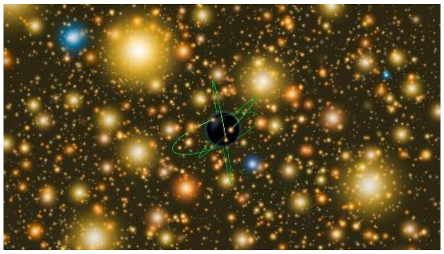
Credit: An artist's impression of the warped disk of the Milky Way, surrounded by a slightly flattened dark matter halo. (Image credit: Kaiyuan Hou and Zhanxun Dong (School of Design, Shanghai Jiao Tong University))

Logan Stefanich ~ Here's how U. astronomers helped make a galactic discovery 'on the level of Bigfoot'
https://www.ksl.com/article/51066633/heres-how-u-astronomers-helped-make-a-galactic-discovery-on-the-level-of-bigfoot

https://www.nature.com/articles/s41586-024-07511-z
Credit: ESA/Hubble; NASA, Maximilian Häberle (MPIA)



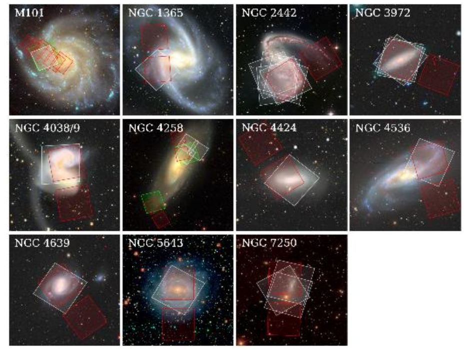
Ethan Segal ~ Strongest "missing link" in black hole physics discovered at last



https://bigthink.com/starts-with-a-bang/missing-link-black-hole/

Credit: Lynette Cook/Gemini Observatory

James Webb Telescope May Have Finally Solved the Crisis in Cosmology
https://scitechdaily.com/james-webb-telescope-may-have-finally-solved-the-crisis-in-cosmology/



https://arxiv.org/abs/2408.06153
Wendy L. Freedman, Et. Al., "Status Report on the Chicago-Carnegie Hubble Program (CCHP): Three Independent Astrophysical Determinations of the Hubble Constant Using the James Webb Space Telescope, Fig. 1", arXiv:2408.06153 [astro-ph.CO]

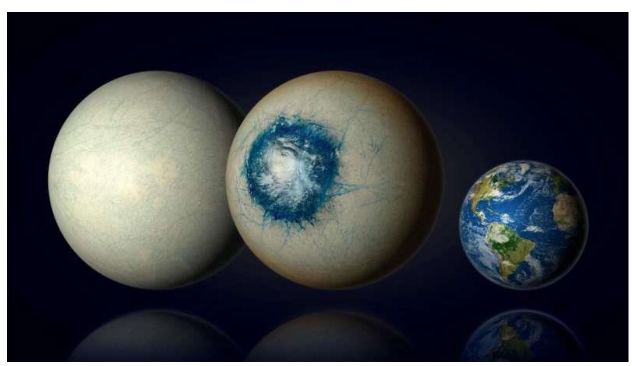
Joseph Shavit ~ For the first time ever, researcher reveals that gravity can exist without mass
https://www.thebrighterside.news/post/for-the-first-time-ever-researcher-reveals-that-gravity-can-exist-without-mass/

Dark matter, a mysterious substance thought to make up most of the universe's mass, has puzzled scientists for nearly a century. (Image credit: Creative Commons)

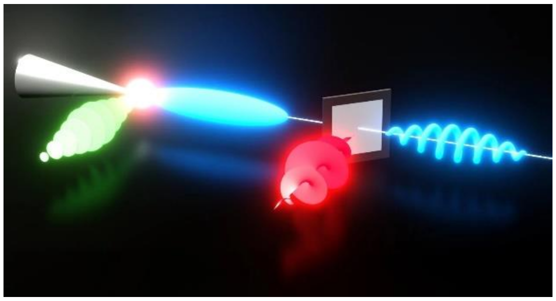
https://academic.oup.com/mnras/article/531/1/1630/7673084?login=false

Nathalie Ouellette, Université de Montréal ~ Astronomers find surprising ice world in the habitable zone with JWST data
https://phys.org/news/2024-07-astronomers-ice-world-habitable-zone.html
https://nouvelles.umontreal.ca/en/article/2024/07/08/found-with-webb-a-potentially-habitable-world/
https://arxiv.org/abs/2406.15136

Credit: B. Gougeon/Université de Montréal



How a Twist in Physics Could Change Technology Forever

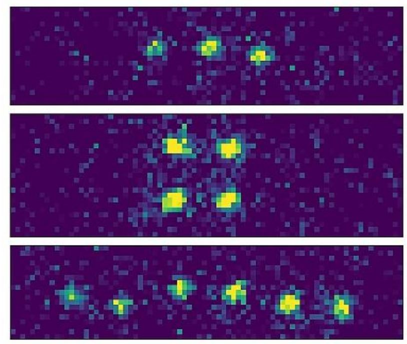


https://scitechdaily.com/how-a-twist-in-physics-could-change-technology-forever/

https://doi.org/10.1126/science.adp9143

Schematic representation of the experimental setup used to shape electrons into chiral coils of mass and charge. Credit: Dr. Yiqi Fang, University of Konstanz, edited by SciTechDaily

Katharina Jarrah, Max Planck Society ~ Securely propagating entanglement at the push of a button
https://phys.org/news/2024-07-propagating-entanglement-button.html
https://dx.doi.org/10.1126/science.ado6471

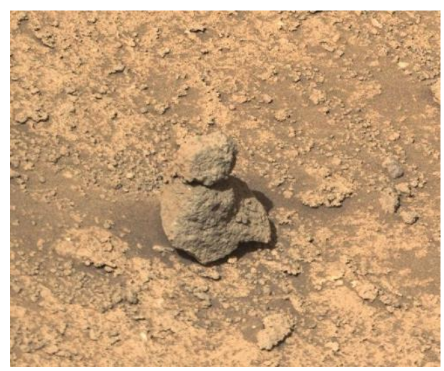


Credit: Max Planck Society

Jet Propulsion Laboratory ~ NASA's Curiosity Rover Discovers a Surprise in a Martian Rock - NASA

Credit: NASA/JPL-Caltech/MSSS

https://www.nasa.gov/missions/mars-science-laboratory/curiosity-rover/nasas-curiosity-rover-discovers-a-surprise-in-a-martian-rock/

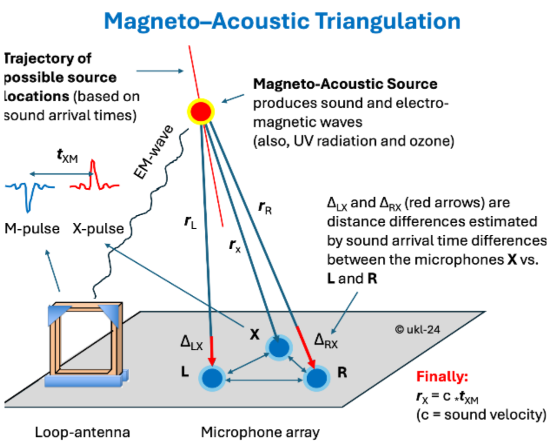


Credit: NASA/JPL-Caltech/ASU

Meredith Garofalo ~ Little Mars 'snowman' spotted by NASA's Perseverance rover (photo)
https://www.space.com/snowman-rock-perserverance-mars-rover

Elizabeth Gamillo ~ Folklore meets science in this search for the 'sounds' of the northern lights
https://www.astronomy.com/science/folklore-meets-science-in-this-search-for-sounds-northern-lights/

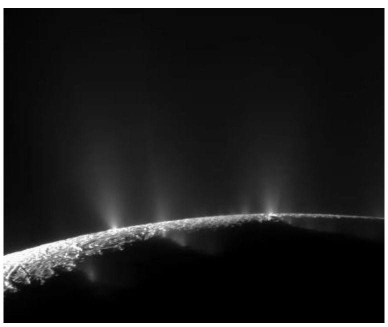
Credit: Elizabeth Gamillo



Credit: Unto K. Laine, "Magneto-acoustic triangulation method for electric discharge localization in the atmosphere, Fig. 1", Pg. 66-71 Proceedings of the Baltic-Nordic Acoustic Meeting, May 22-24, 2024, Espoo, Finland

https://www.bnam2024.net/assets/BNAM2024_proceedings.pdf

William Steigerwald ~ NASA: Life Signs Could Survive Near Surfaces of Enceladus and Europa

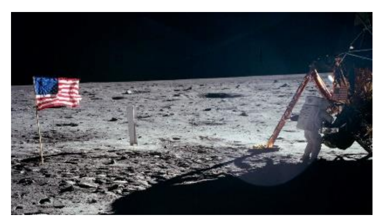


https://science.nasa.gov/science-research/planetary-science/astrobiology/nasa-life-signs-could-survive-near-surfaces-of-enceladus-and-europa/

Credit: NASA/JPL/Space Science Institute

Leonard David ~ What became of the flags Apollo astronauts left on the moon?
https://www.space.com/apollo-program-flags-moon

Credit: NASA



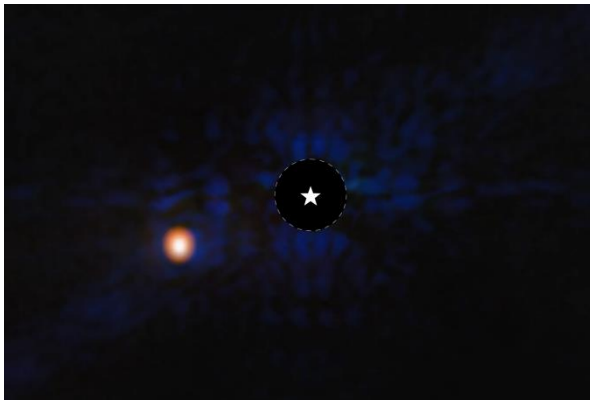
https://historycollection.jsc.nasa.gov/JSCHistoryPortal/history/flag/flag.htm

Mike Wall ~ What will happen in spaceflight over the next 25 years?
https://www.space.com/spaceflight-evolution-next-25-years-moon-mars

Artist's illustration of a human settlement on Mars, with SpaceX Starships in the background. (Image credit: SpaceX logo, Hannah Rose Brayshaw-Williams)

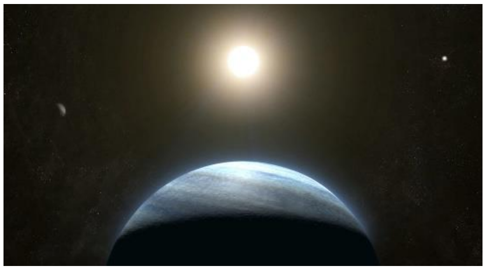
Mark Kaufman ~ Webb telescope snapped photo of huge world — in a distant solar system
https://mashable.com/article/james-webb-space-telescope-exoplanet-direct-image

https://www.nature.com/articles/s41586-024-07837-8



Epsilon Indi Ab is the orange object in this James Webb Space Telescope image. Credit: NASA / ESA / CSA / STScI / E. Matthews (Max Planck Institute for Astronomy)

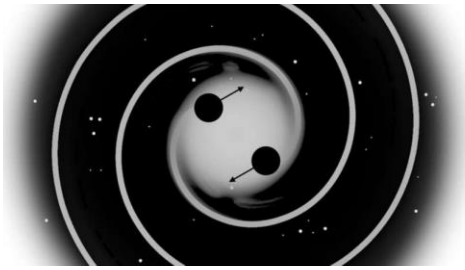
Simons Foundation ~ New Habitable Zone Planet Found in Unusual Star System



https://scitechdaily.com/new-habitable-zone-planet-found-in-unusual-star-system/
https://doi.org/10.3847/1538-3881/ad1d5c

Credit: Ed Bell for the Simons Foundation

Tejasri Gururaj ~ New study uses self-interacting dark matter to solve the final parsec problem
https://phys.org/news/2024-07-interacting-dark-parsec-problem.html
https://phys.org/news/2024-07-astrophysicists-uncover-supermassive-black-holedark.html
https://link.aps.org/doi/10.1103/PhysRevLett.133.021401



Credit: Original image: NASA science.nasa.gov/resource/spiral-galaxy-blue/. Modified by Alvarez, Cline, and Dewar.

Joseph Shavit ~ Revolutionary theory finally unites quantum mechanics and Einstein's theory of general relativity

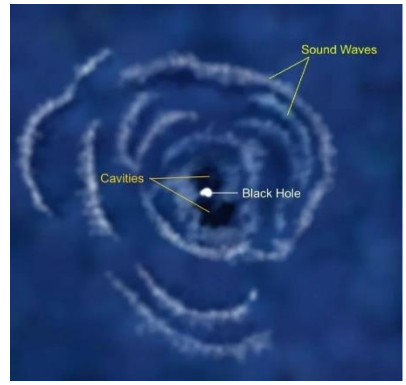
https://www.thebrighterside.news/post/revolutionary-theory-finally-unites-quantum-mechanics-and-einsteins-theory-of-general-relativity/

https://journals.aps.org/prx/abstract/10.1103/PhysRevX.13.041040

Jonathan Oppenheim, Photo Credit: Philipp Ammon

"This postulate, which has long perplexed physicists, posits that measurements collapse quantum superpositions into definite states. In the new theory, quantum superpositions naturally localize through their interaction with classical spacetime, obviating the need for this postulate."

Royal Astronomical Society ~ Black Holes: Not Destroyers but Protectors



https://scitechdaily.com/black-holes-not-destroyers-but-protectors/
https://doi.org/10.1093/mnras/stae1498

The sound waves (ripples) in the hot gas that fills the Perseus cluster are shown in this artist's impression. They are thought to have been generated by cavities blown out by jets from a supermassive black hole (bright white spot) at the center of the galaxy. Credit: NASA/NASA/CXC/M.Weiss

Wayne Lewis, University of California, Los Angeles ~ Layered superconductor coaxed to show unusual properties with potential for quantum computing

https://phys.org/news/2024-07-layered-superconductor-coaxed-unusual-properties.html
https://www.nature.com/articles/s41586-024-07625-4
https://dx.doi.org/10.1038/s41586-024-07625-4

Conceptual illustration showing a pair of electrons spinning in opposite directions. Credit: Duan Research Group/UCLA

Microwave popcorn to particle accelerators: Magnetrons show promise as radiofrequency source
https://phys.org/news/2024-08-microwave-popcorn-particle-magnetrons-radiofrequency.html
https://phys.org/partners/thomas-jefferson-national-accelerator-facility/

Credit: Jefferson Lab photo/Aileen Devlin

Ivan Hrinko ~ Breathtaking timelapse of the Milky Way takes 10 years to create
https://universemagazine.com/en/astrophotographer-spends-10-years-to-create-a-spectacular-8k-timelapse-of-the-milky-way/

Credit: Mattia Bicchi

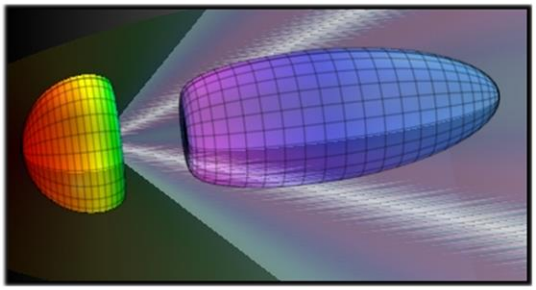
https://youtu.be/vX6p1H7F9as

Take a walk on the wild side…

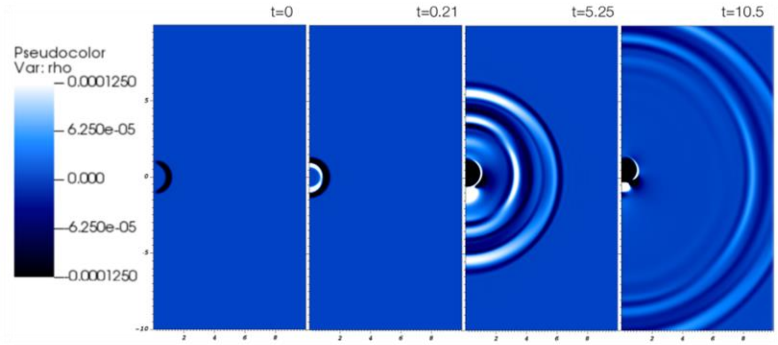
University of Warsaw ~ Physicists suggest tachyons can be reconciled with the special theory of relativity
https://phys.org/news/2024-07-physicists-tachyons-special-theory.html

https://dx.doi.org/10.1103/PhysRevD.110.015006
https://dx.doi.org/10.48550/arxiv.2308.00450

Credit: TxAlien, licensed under the Creative Commons Attribution-Share Alike 3.0 Unported license



Queen Mary University of London ~ New study simulates gravitational waves from failing warp drive
https://phys.org/news/2024-07-simulates-gravitational-warp.html
https://astro.theoj.org/article/121868-what-no-one-has-seen-before-gravitational-waveforms-from-warp-drive-collapse
Katy Clough, Tim Dietrich, Sebastian Kahn, "What no one has seen before: gravitational waveforms from warp drive collapse, Fig. 3", arXiv:2406.02466 [gr-qc], Jul 2024, https://dx.doi.org/10.48550/arxiv.2406.02466



Technical Knowledge and Education: (July - August 2024)

Kelly McGonigal, PhD ~ The Willpower Instinct: How Self-Control Works, Why It Matters, and What You Can Do to Get More of It

https://www.goodreads.com/book/show/10865206-the-willpower-instinct
https://kellymcgonigal.com/books
https://www.amazon.com/gp/customer-reviews/R1D5WQAJ1IRH1G

Astronomers ask public to help find newly formed black holes

https://phys.org/news/2024-08-astronomers-newly-black-holes.html
https://www.blackholefinder.org/

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*

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.

SID Monitor Distribution
1078 instruments
82 countries
7 continents

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 - 57	Taiwan - 4
Bolivia - 1	Guyana - 1	Pakistan - 4	Thailand - 5
Bosnia-Herzegovina - 2	Hungary - 1	Peru - 10	Tunisia - 9
Brazil - 11	India - 33	Philippines - 3	Turkey - 2
British Virgin Islands - 1	Indonesia - 2	Poland - 2	Uganda - 5
Bulgaria - 2	Iran - 4	Portugal - 3	UK - 32
Burkino 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
Cypress - 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.

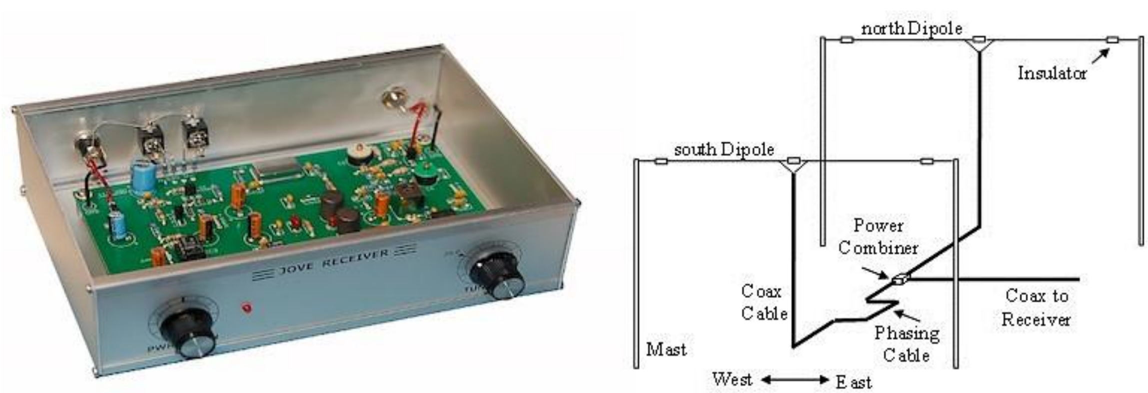

Figure 1. A Radio JOVE RJ1.1 receiver and a schematic of the dual-dipole antenna.

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).

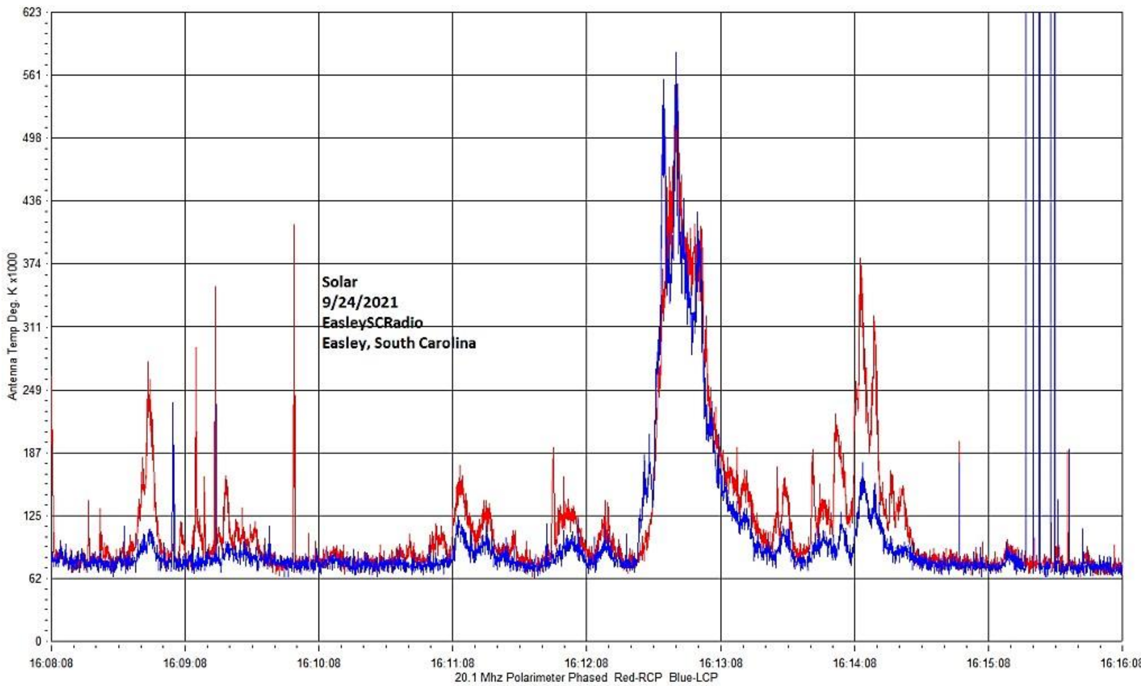

Figure 2. A SkyPipe strip chart showing multiple solar bursts using a JOVE receiver. John Cox, SC.

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.

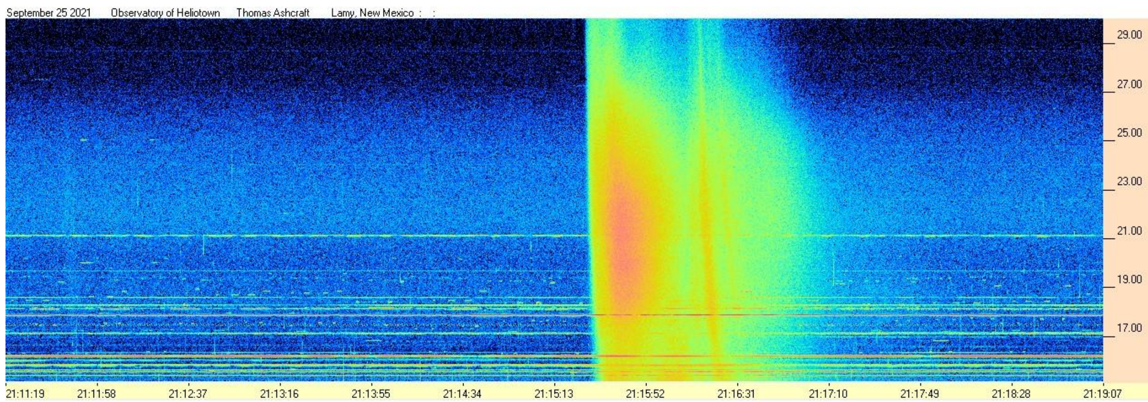

Figure 3. Radio spectrogram showing multiple solar bursts received by Tom Ashcraft in New Mexico. Horizontal scale is time, and the vertical scale is frequency. Amplitude is displayed using different colors corresponding to the strength of signals.

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!

BAA
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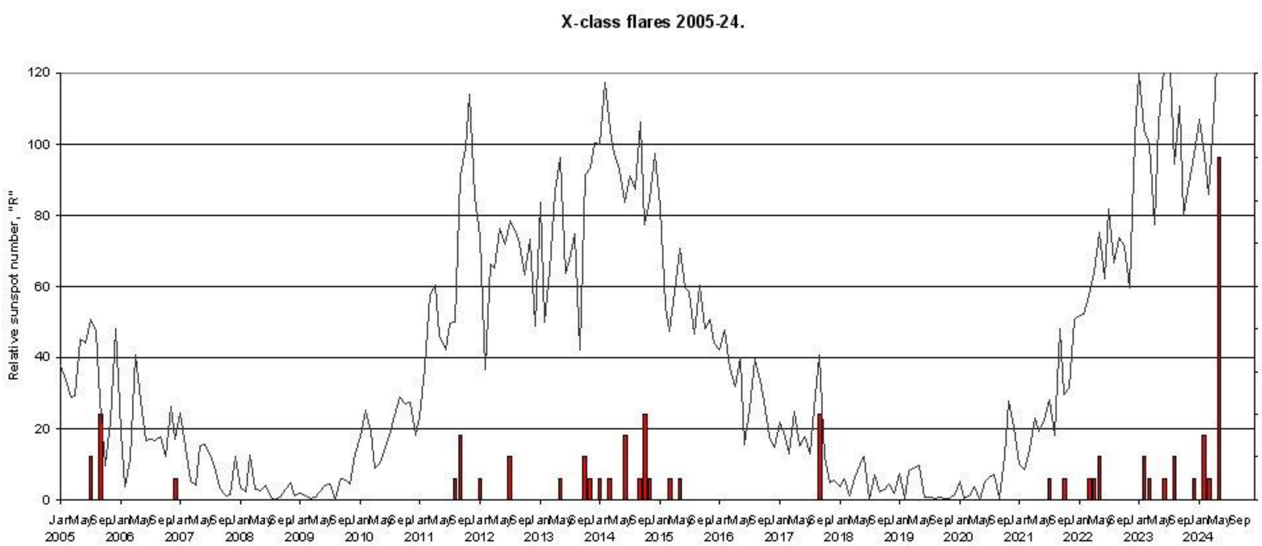
PO Box 702, Tonbridge, TN9-9TX 020-7734 4145
www.britastro.org

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

BAA Radio Astronomy Section, Director: Paul Hearn

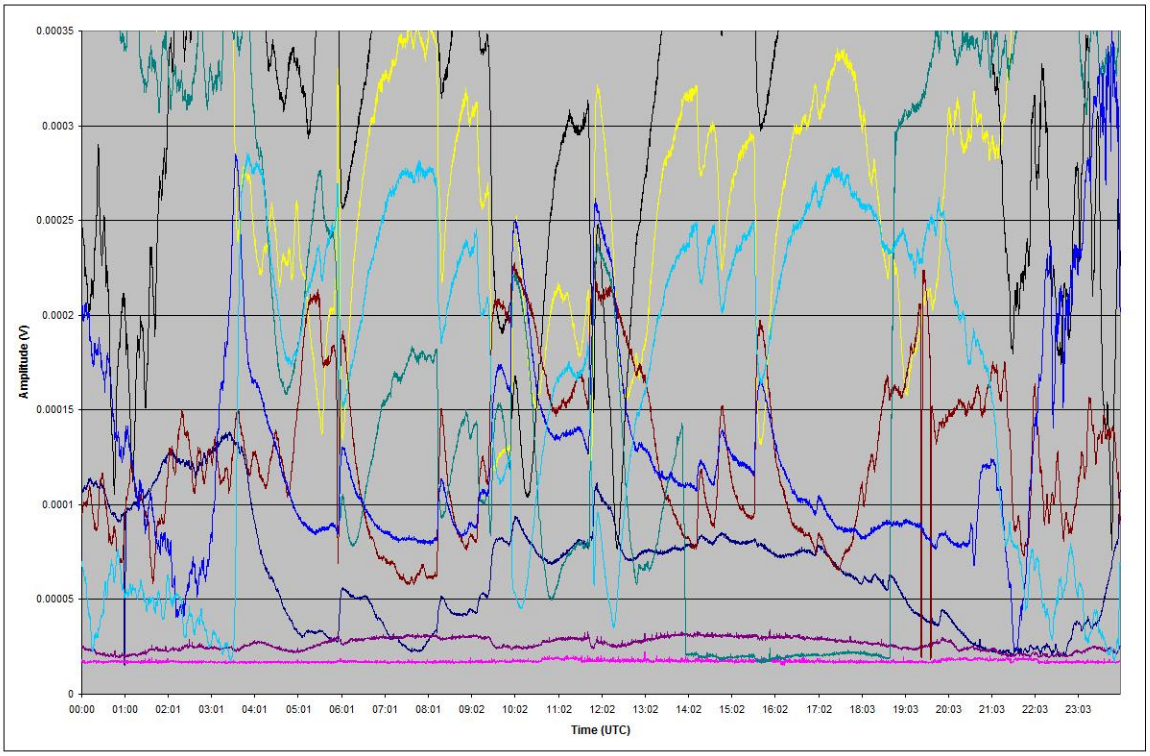
RADIO SKY NEWS **2024 MAY**

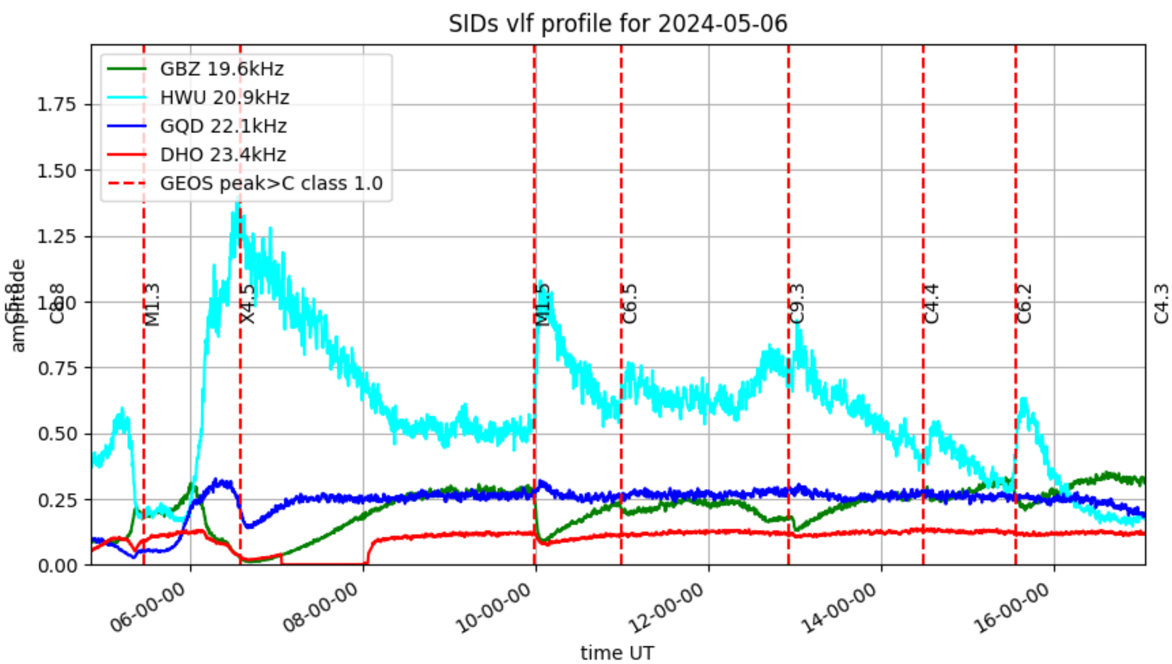
VLF SID OBSERVATIONS



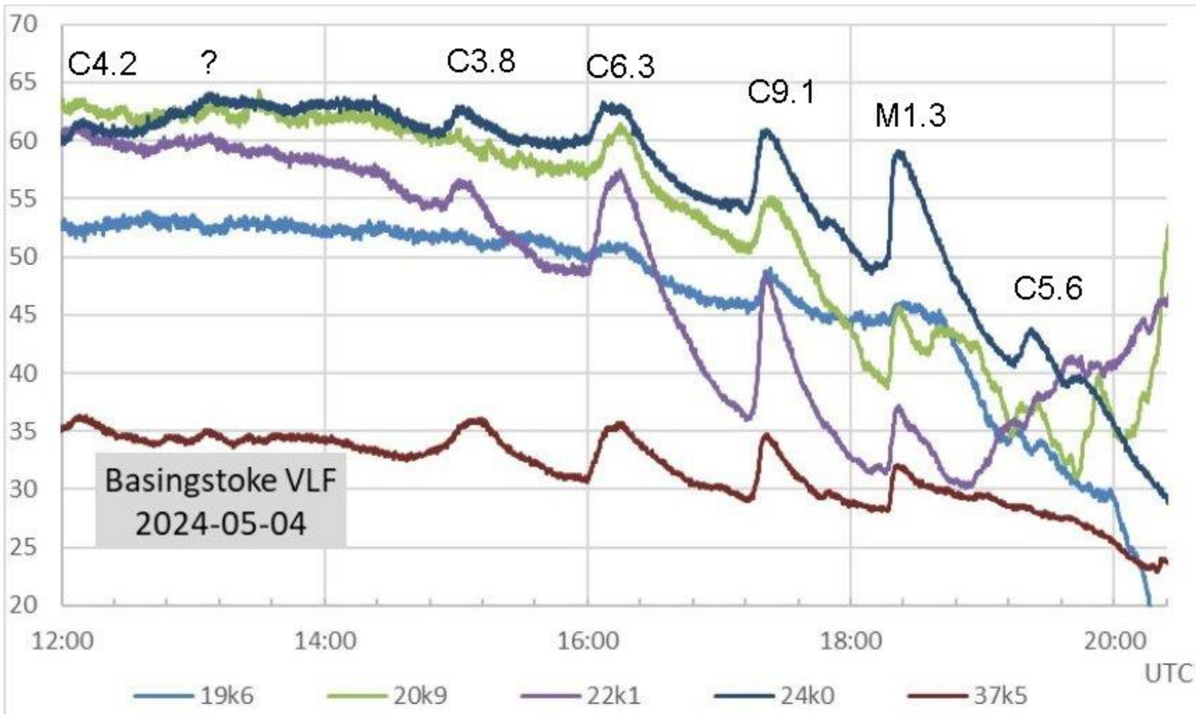
This chart shows the number of X-class flares that we have recorded since 2005 May, with the solar section's relative sunspot number added to highlight the solar cycles. The 16 X-flares recorded in 2024 May dominates the chart. The activity chart on page 12 also shows a new peak in the total number of flares recorded. The most energetic flare that we have recorded so far was the giant X17 in 2005 September. The designation is correct, as it exceeded X9.9, the top of the official classification system. We also had an X9.3 flare in 2017 September. Cycle 25 seems to be far stronger than the original predictions made about five years ago. Since then, new methods of predicting activity have emerged that have suggested a stronger cycle. We are at the mid-point in the cycle, with a peak predicted later this year or early 2025.

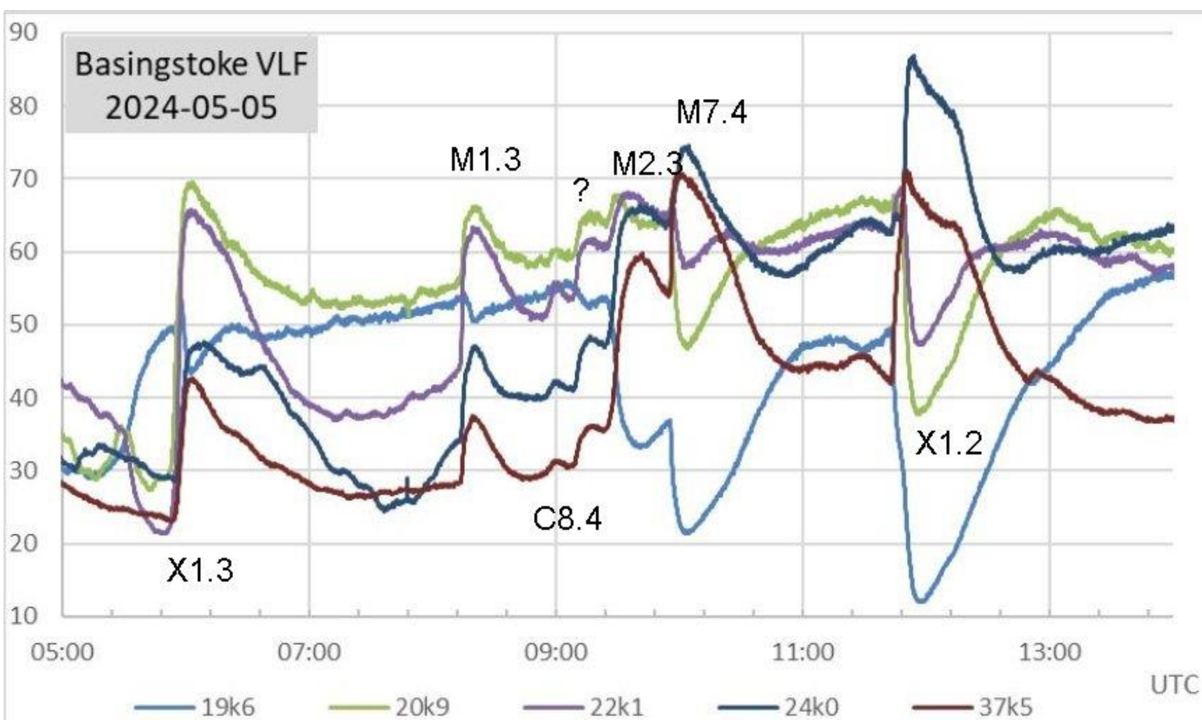
It has been very difficult to identify individual flares in our recordings as they have occurred so fast that even some of the stronger M-class flares have been hidden by adjacent events. To add further to the confusion, the high level of magnetic activity has produced some SIDs even on the European signals. A great auroral display to go with that of course! Mark Edwards has provided a recording from the 6th that shows just how complex the analysis has been. Having several signals to compare usually helps, but here it just makes it harder:





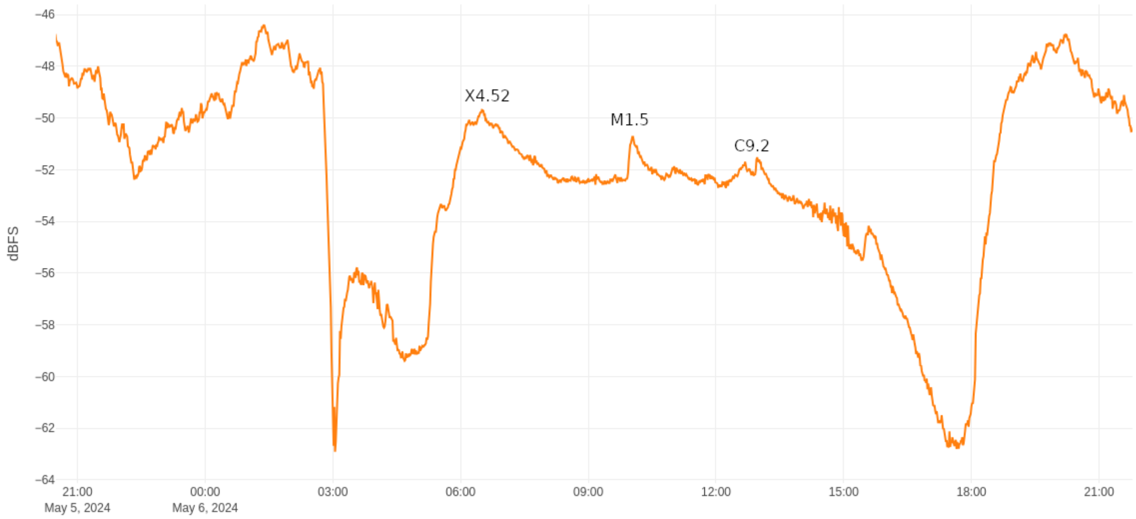
Mark Prescott's recording is easier to follow, clearly showing the X4.5 flare at about 06:40UT. The French 20.9kHz signal also shows the rest of the SIDs merging into each other, the end timings more difficult to determine. The C4.4 and C6.2 flares are particularly interesting, as the satellite data lists them as both being from the same active region (AR13663), with simultaneous peaks. The C4.4 starts much earlier, with a rise time of over an hour, while the C6.2 has a more normal rise time of about 12 minutes. The C4.4 peak is listed at 15:28, the C6.2 at 15:34.



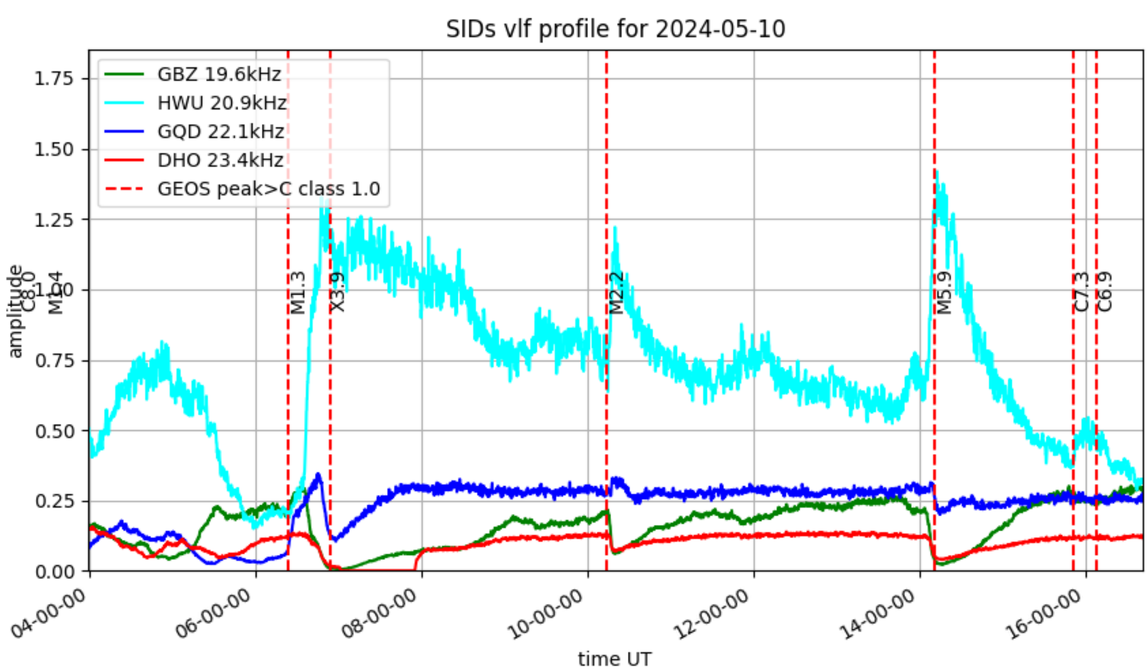


These two recordings by Paul Hyde show activity on the 4th and 5th. The afternoon SIDs on the 4th are again merging into each other, running into the sunset. The longer day length in May has helped us to catch this activity and does of course influence the number of events recorded compared with the shorter winter days. The morning of the 5th starts with a clean SID on all frequencies from an X1.3 flare, 19.6kHz showing an inverted SID. After the M1.3 flare there is a rapid succession of smaller peaks, including from the M2.3 flare, merging together. The M7.4 and X1.2 flares have produced more complex SIDs, some signals showing a spike and wave response. The afternoon continued with plenty more M and larger C-class flares.

Strong flaring continued over the next few days, Thomas Mazzi recording activity on the 6th at 26.7kHz. This signal is from Turkey, providing Thomas in Italy with a good path:

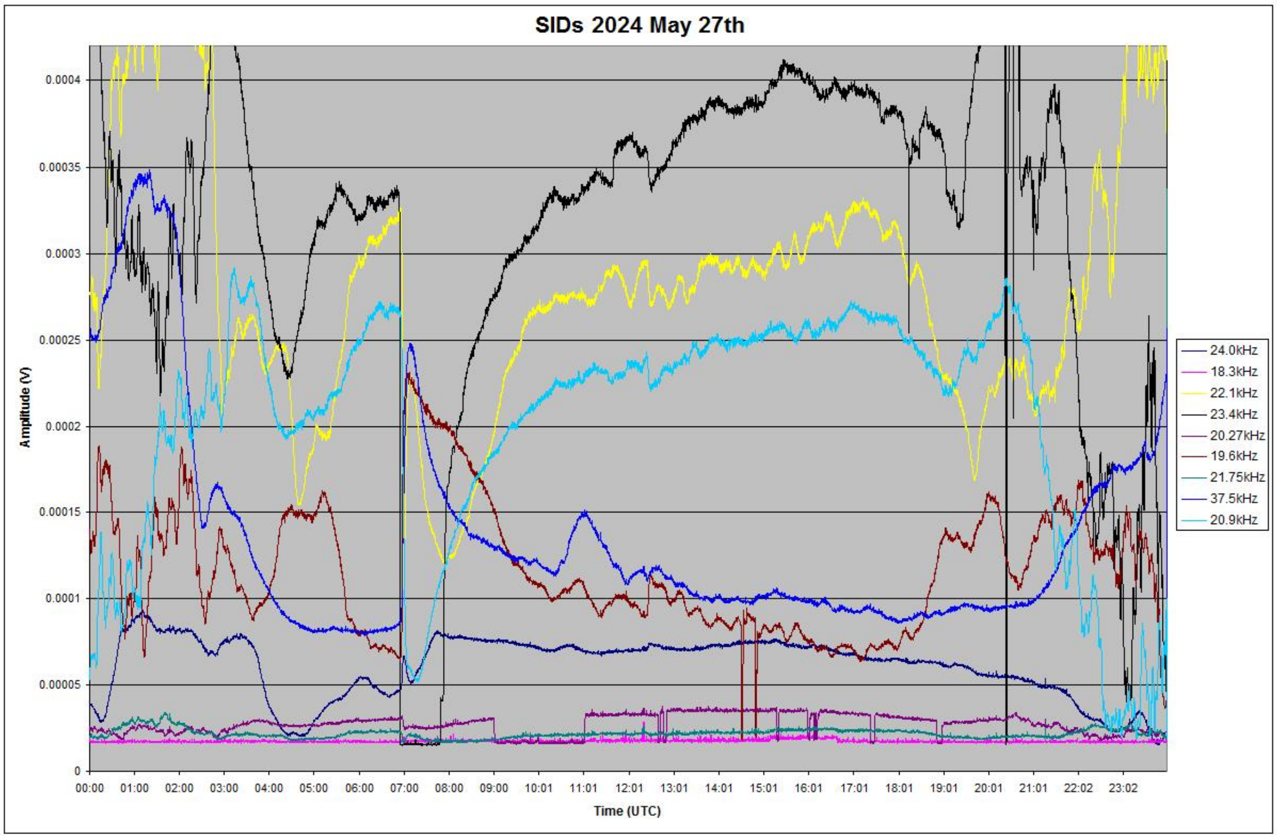


All this strong activity produced plenty of CMEs, culminating in a magnificent auroral display seen throughout Europe on the night of the 10th/11th May. Flaring on the 10th remained strong, shown here by Mark Prescott:

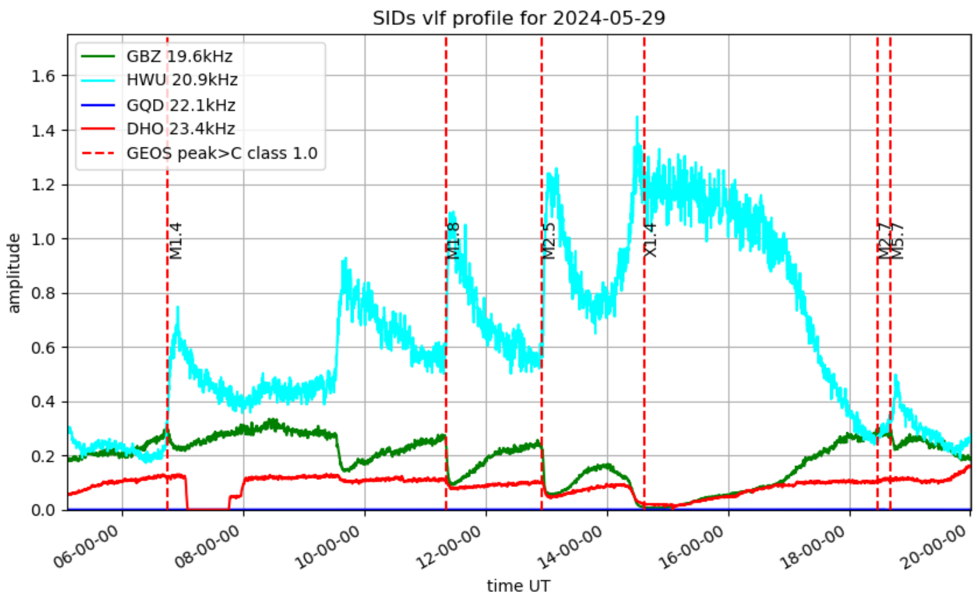


20.9kHz has again produced clean SIDs for the major flares, the X3.9 early in the morning showing a very long fade through the day. There is also evidence of the unlisted flare at 12UT on 20.9kHz and 19.6kHz.

The frequency of very strong flares did reduce a little in the second half of May, although there were still some strong X-flares recorded. Mark Edwards' recording from the 27th shows some interesting activity:

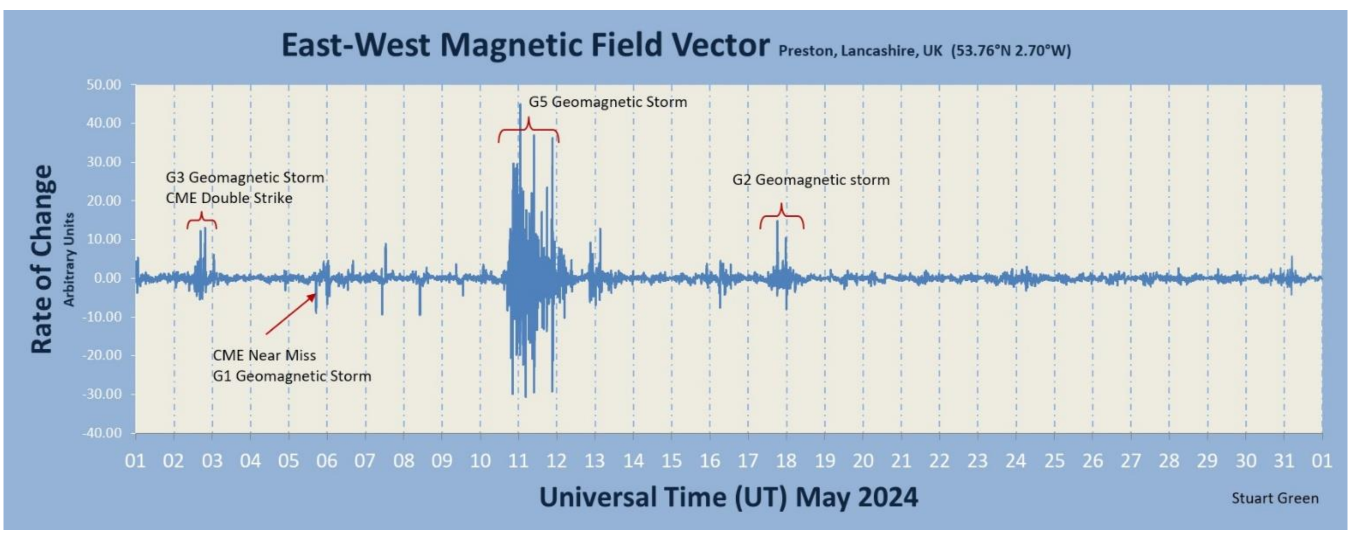


The early morning break in the 23.4kHz signal looks like a giant SID, particularly as it exactly matches the X2.8 flare starting just before 07UT. 22.1kHz shows a good spike and wave SID, most of the other signals showing a simple shark's fin SID. The recovery time varies between the various signals, several of which then show some strong oscillations. 22.1kHz and 19.6kHz show the clearest effect, while it is much weaker at 24kHz and 37.5kHz.

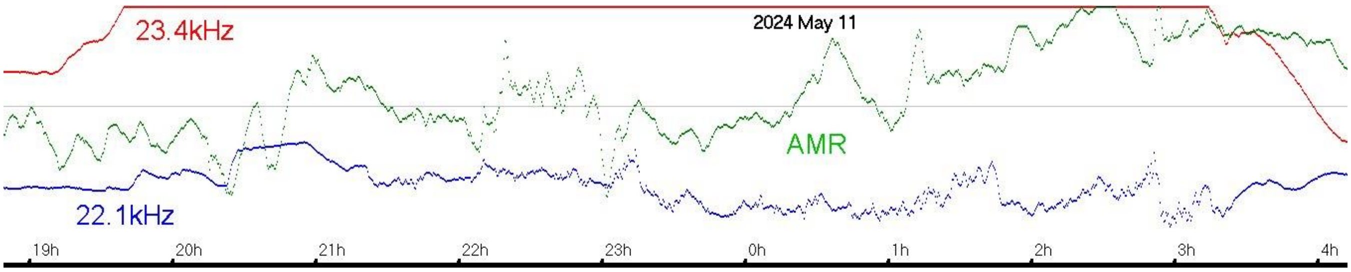


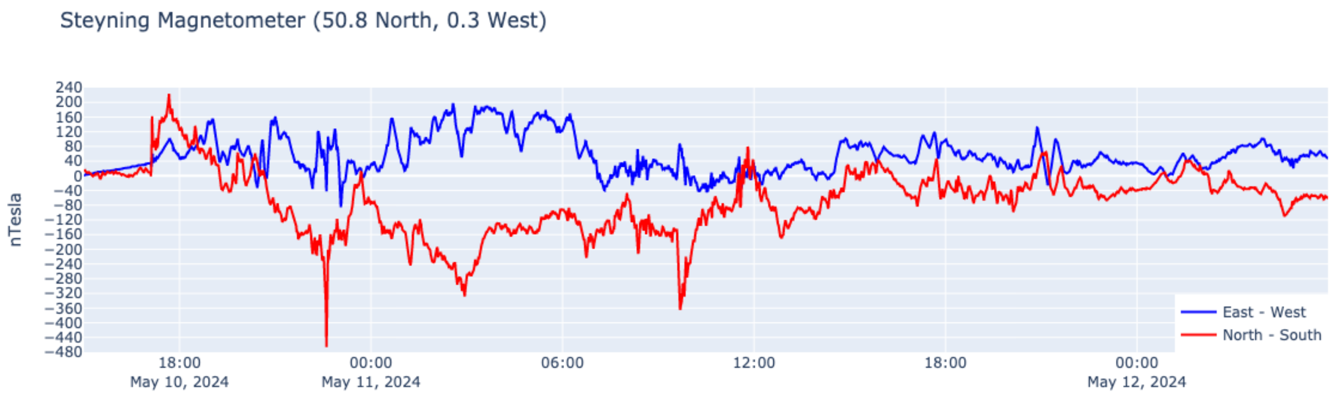
Mark Prescott's recording from the 29th shows the last of the X-flares, along with some of the M-flares. The unmarked SID around 09:30 is from the C8.2 flare. This selection of charts hardly does justice to the array of flares recorded, but I hope that it shows some of the variety and analysis problems.

MAGNETIC OBSERVATIONS

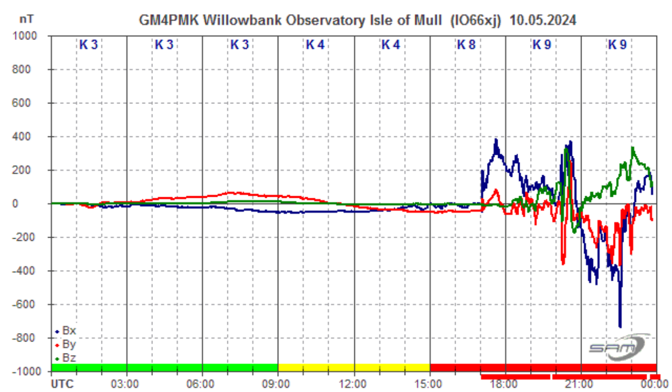


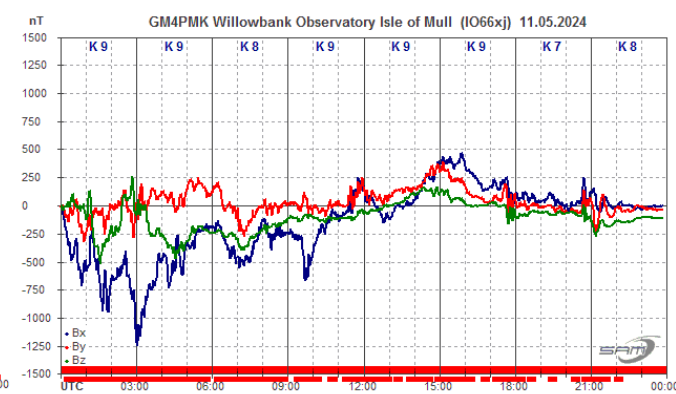
Stuart Green's chart of magnetic activity looks quiet for most of the month, the magnetic storm of the 10th – 12th standing out as the only significant activity. The vertical axis has however been re-scaled compared to previous months, with a scale of +/- 50 compared to +/- 30. These are arbitrary units, as the chart shows rate of change rather than magnetic strength. The increased range does however show that the big storm had some of the most rapid fluctuations in magnetic field strength that we have seen. My own recording shows just how intense the turbulence was from 19UT on the 10th to 04UT on the 11th. The green trace is the magnetometer, red and blue are the VLF signals. The magnetic turbulence can be seen reflected in the 22.1kHz signal after midnight, while 23.4kHz has saturated the receiver.



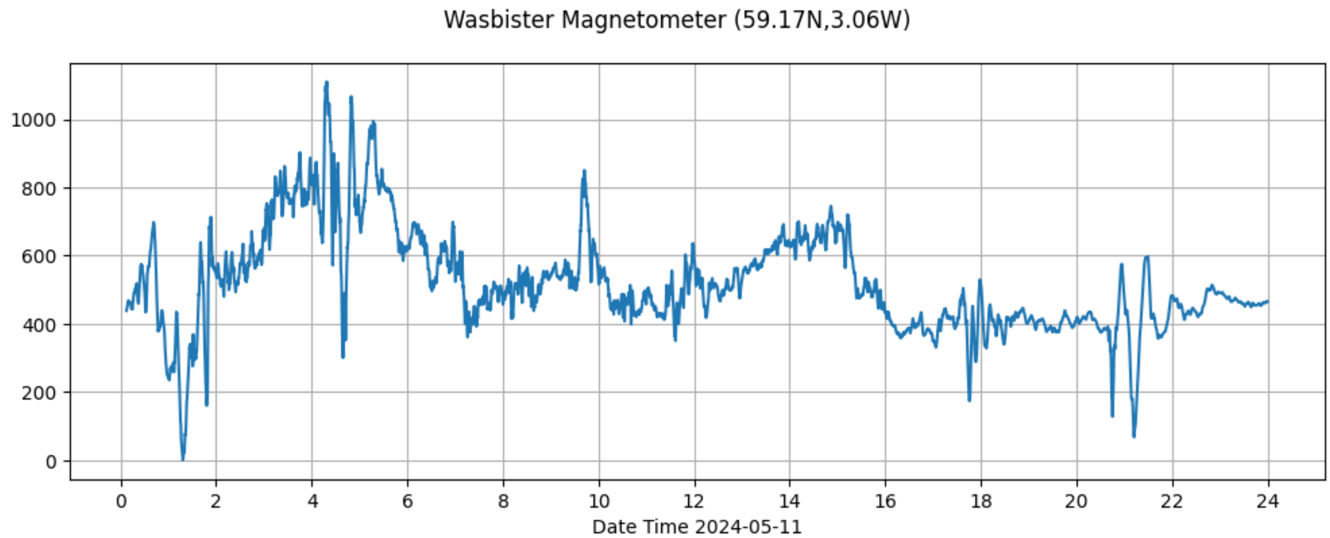


Nick Quinn's recording covers more of the activity, including the sudden start at 17:00UT. The amplitude range is +240/-480nT, recorded from near the south coast.

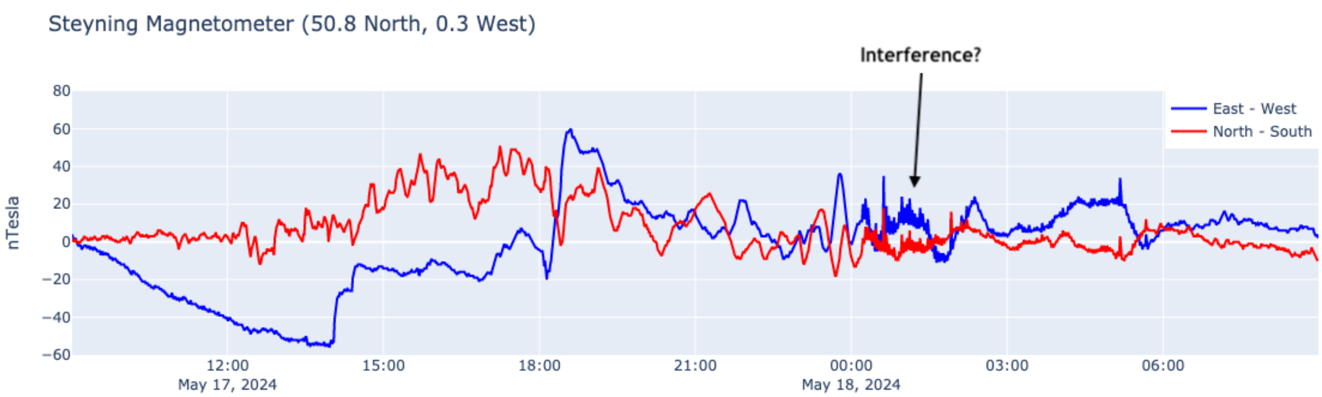




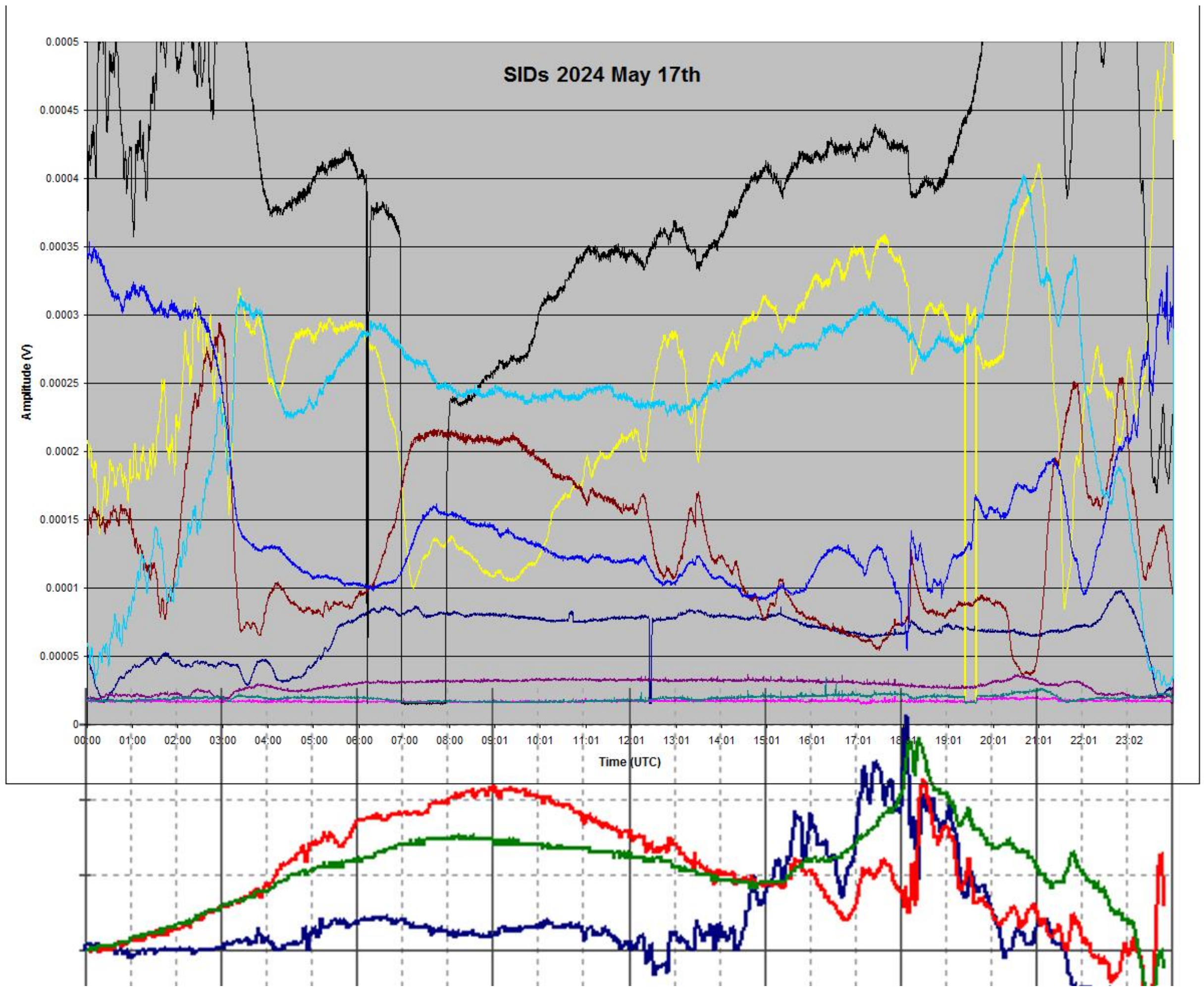
Roger Blackwell's Mull recordings of the storm also have increased the vertical axis magnetic strength, +/-1000nT on the 10th and +/-1500nT on the 11th. The sudden start at 17:00 appears to be from a barrage of CMEs related to the multiple strong flares recorded over the previous days. There may also have been SFEs associated with these flares, but the strong activity has hidden them.



Callum Potter in Orkney has also re-scaled his recordings, this one showing the 11th. The sensors used in these recordings all have slightly different orientations and sensitivities, but they do show the severity of the storm, the background to the best auroral display seen here in the UK for a long time. Reports seen online show that it was also visible across most of the world, light pollution permitting.



Nick Quinn's recording from the 17th shows further complex magnetic activity from midday through to around 06UT on the 18th.



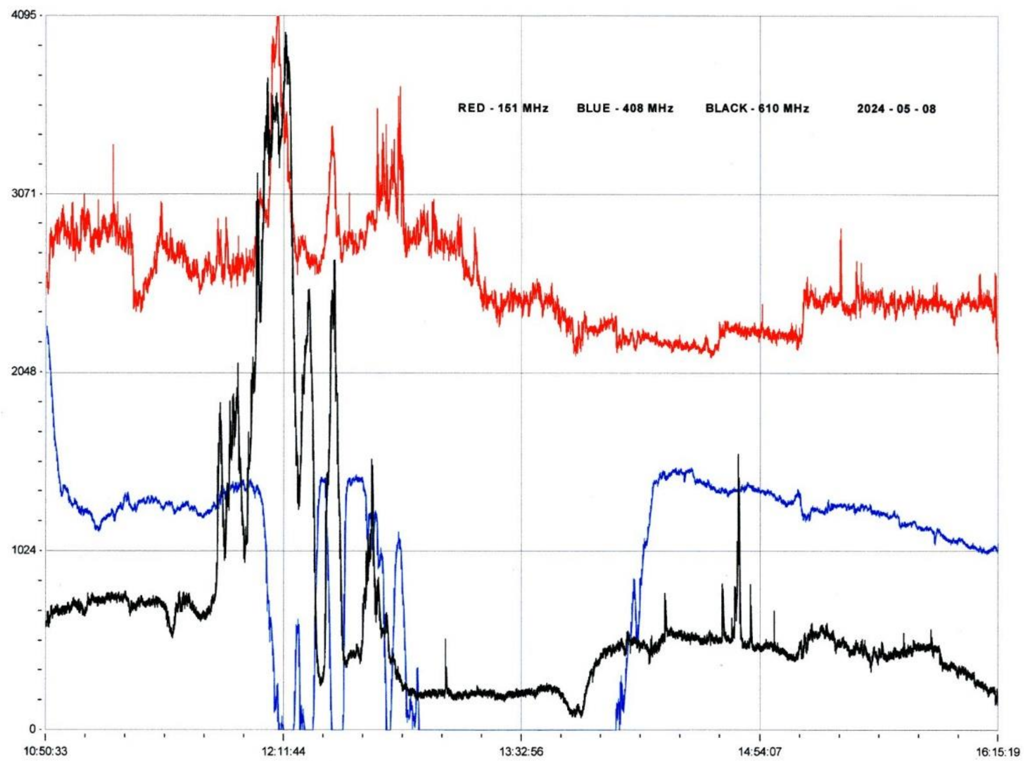
Mark Edwards' has added Roger Blackwell's magnetic chart to his VLF recording of the 17th, showing how the afternoon VLF signals have been influenced by the magnetic turbulence. The space weather web site also shows a proton event early in the morning of the 18th, a source of the activity that Nick Quinn has indicated as interference on his recording. It is quite possible that some of the other SIDs recorded during this very stormy month also have magnetic or precipitation links.

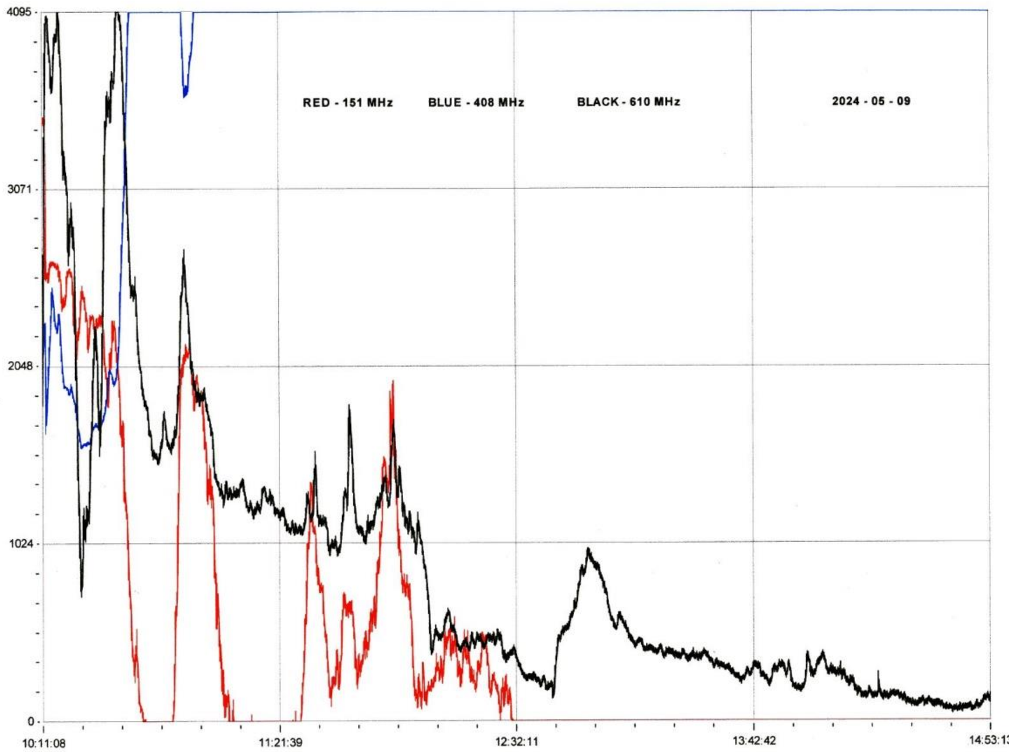
Thomas Mazzi recorded the magnetic storm on the 2nd. This had a sudden start at 14UT, probably from another CME impact. The STCE suggest that a flare on April 29th could be the source. The Mull magnetometer shows +/- 150nT, Callum Potter in Orkney recorded a 200nT swing. Most days in May showed some activity, but very mild compared to these storms.

Magnetic observations received from Roger Blackwell, Andrew Thomas, Thomas Mazzi, Callum Potter, Nick Quinn, and John Cook.

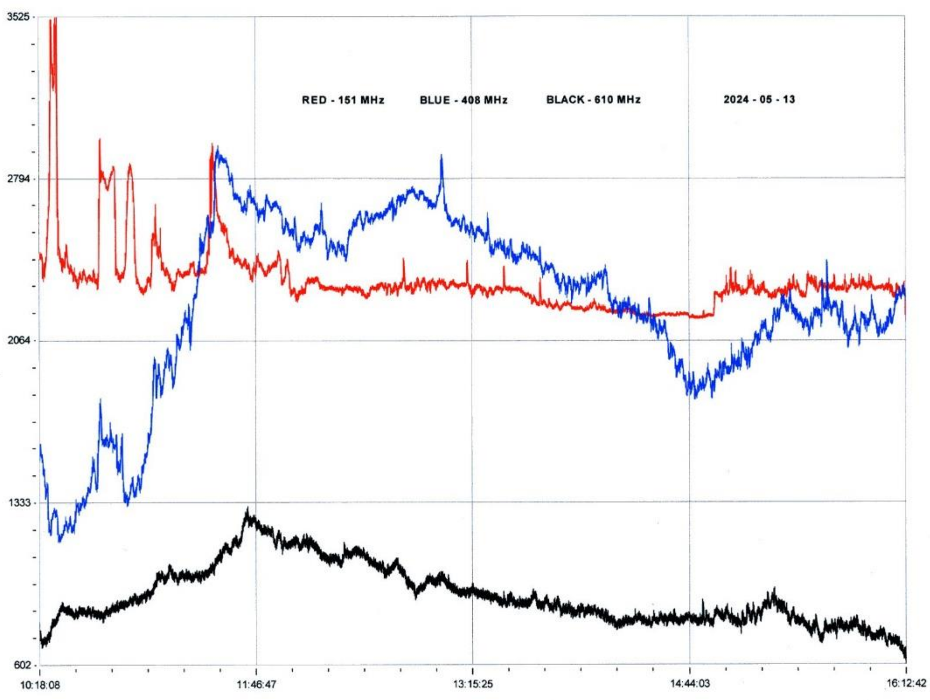
SOLAR EMISSIONS

Colin Clements recorded some strong solar emissions on the 5th, 6th, 8th, 9th, 12th, and 13th, following the intense flaring activity. Recordings from the 8th and 9th show activity leading up to the storm on the 10th.



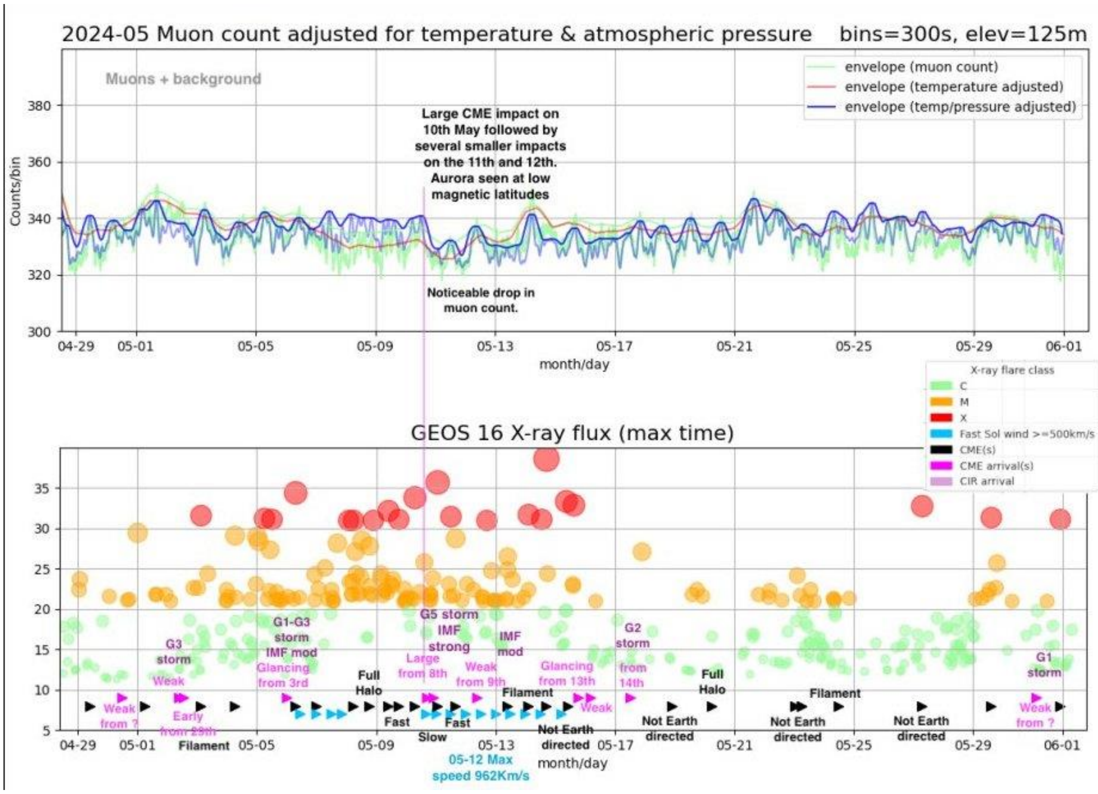


The M4.1 flare at 12UT on the 8th has produced a very strong noise burst at 610MHz (black) and a less intense burst at 151MHz (red). The 408MHz (blue) behaviour is very strange, with reduced activity following the flare. This may be due to a stronger response to the earlier flares not shown on this chart. On the 9th both 151 and 610MHz can be seen falling in activity, while 408MHz rises and remains off scale for the rest of the recording. The X2.2 flare at 09:15 and subsequent M-flares appear to be responsible.



The sequence of M-flares on the 13th seems to have produced several hours of 408MHz activity, as well as a shorter peak at 610MHz. 151MHz is showing activity from the earlier M6.6 flare that is less evident at 408MHz. There were also some strong noise bursts on the 5th, 6th, and 12th.

MUONS

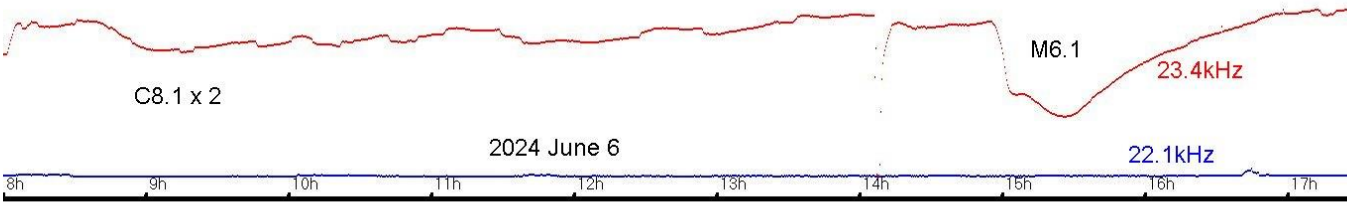


Mark Prescott's chart of Muon activity shows a distinct Forbush decrease in the temperature / pressure corrected count matching the storm on the 10th and 11th. The strong magnetic activity has prevented cosmic rays from entering the atmosphere to produce the Muons. The top portion of Mark's chart shows a gentle recovery over the next week. The lower portion of the chart is a very good summary of the flare and magnetic activity in the days leading up to the storm.

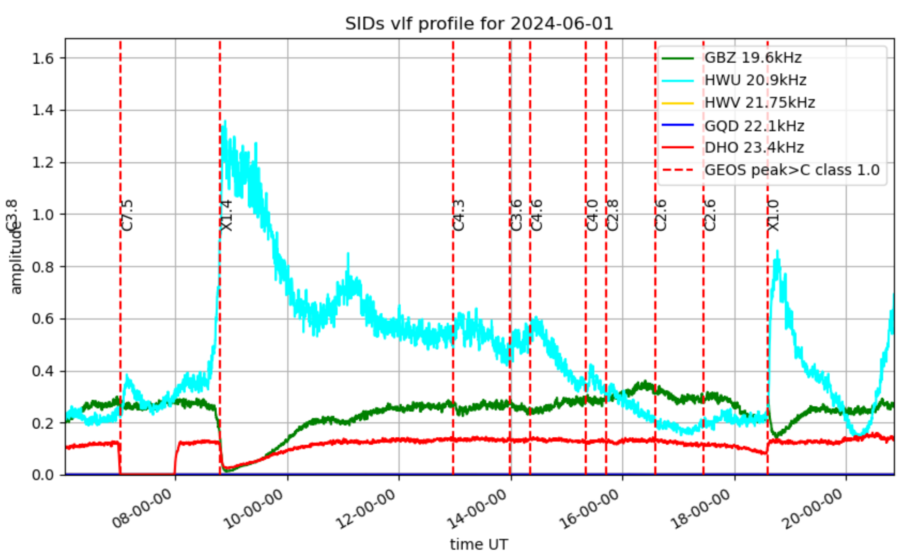
AR13664 was the main culprit in this activity, although several nearby groups also produced some of the flares. It was a very large and complex sunspot group, the 12th largest recorded in 150 years of Greenwich observatory recording. It has been compared in size to the famous 1859 group recorded by Carrington, although there does not appear to have been a 'white light' flare from this one. It could well survive its time as it rotates out of view, making a return visit after a couple of weeks.

VLF SID OBSERVATIONS

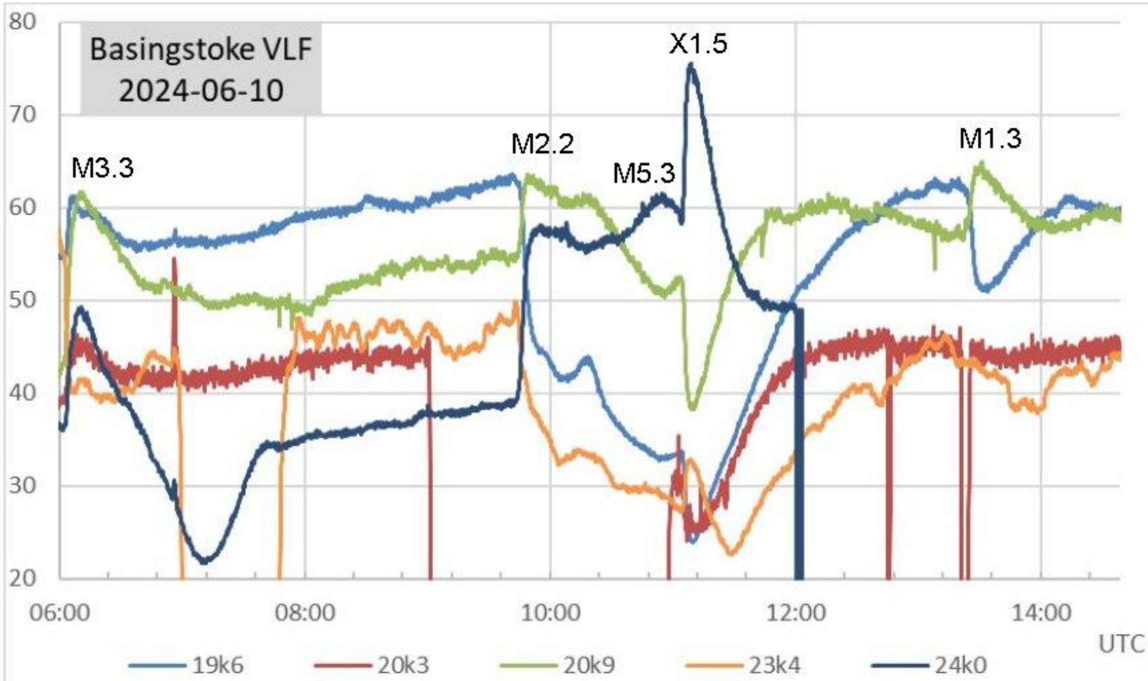
The total number of classified SIDs in June was slightly lower that in May, 161 compared with 178. They were also dominated this time by C-class flares, the number of X-flares reduced from 16 to just 3. That has not made analysis any easier, as there were some more simultaneous flares as well as many that overlapped. This has affected the allocation of some SIDs with their source flares, particularly where the overlapping is so tight that a single SID has been produced. During June, the sun reaches its highest daytime altitude in the northern hemisphere, giving the longest day length and the opportunity to record more of the solar activity.



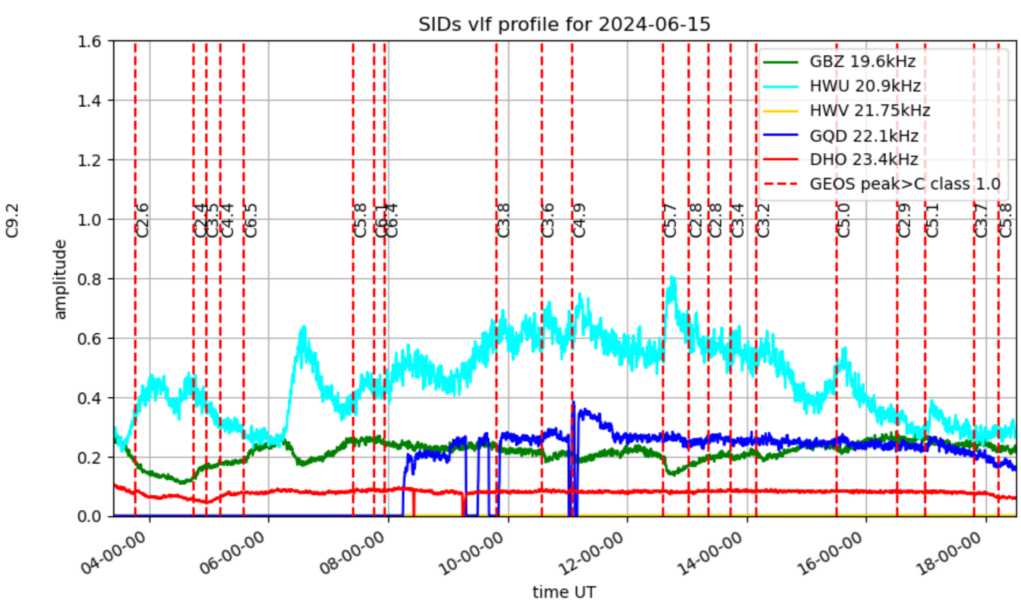
This is my own recording from the 6th showing the double C8.1 flare, X-ray flux peaks listed at 08:50 and 08:58 in the SWPC data. They were both from the same active region, AR13697. There are some non-solar disturbances in the 23.4kHz signal, but it does show a single SID with quite a long recovery time, 22.1kHz was off at the time. The chart also shows the later M6.1 flare with a small 'spike and wave' response.



This recording from Mark Prescott shows the two X-flares on the 1st, continuing the strong activity at the end of May. It also highlights the longer summer recording period, the X1.0 flare peaking at about 18:40UT. The 20.9kHz signal responds very strongly to the activity, 19.6kHz showing a smaller response to both X-flares. The unclassified flare at about 11:00 has also produced a small SID on both signals.



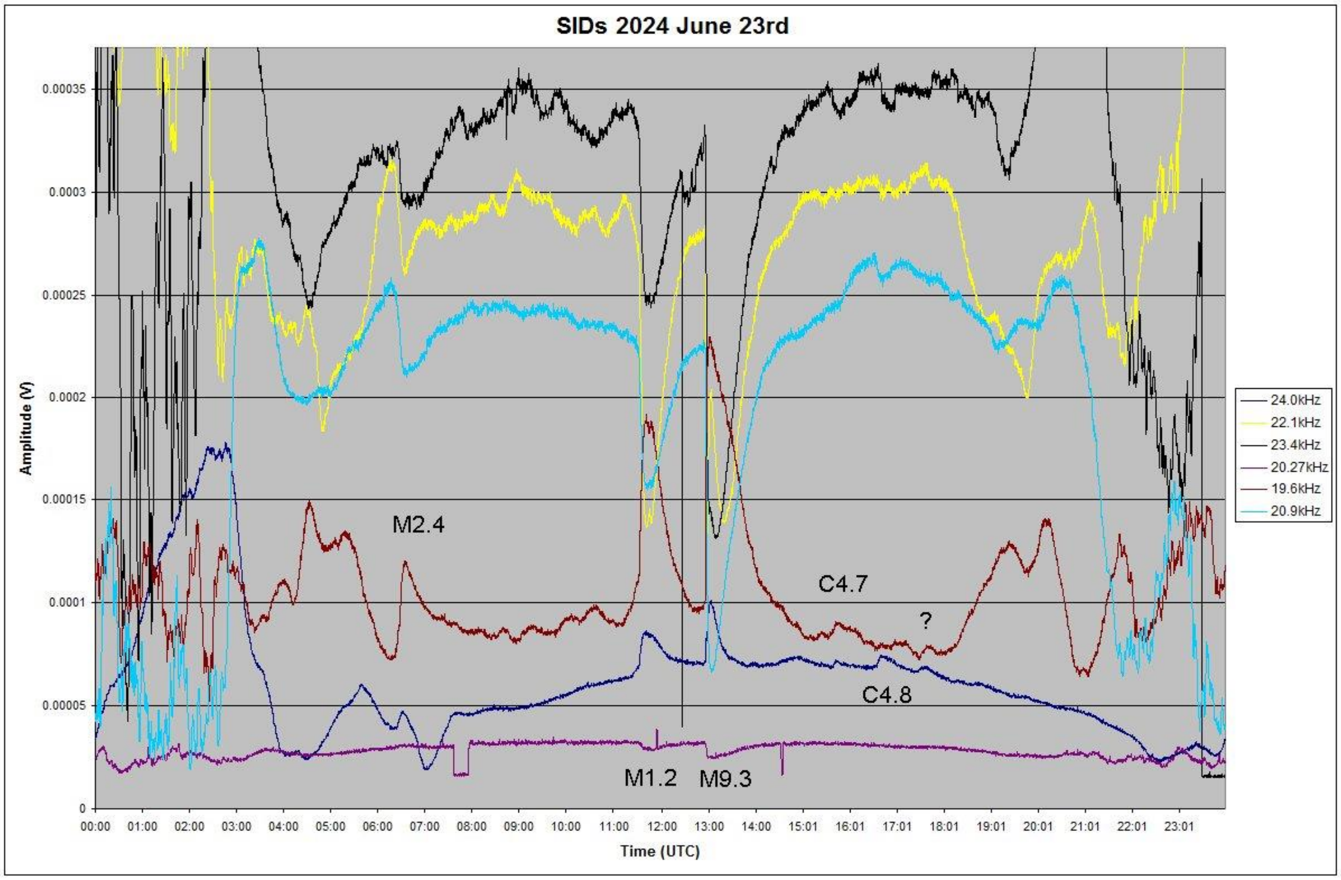
Paul Hyde's recording from the 10th shows one of the more complex days to analyse. The flares between 09:30 and 12:00 have merged into a single 'SID,' the 24kHz signal went off-air at 12:00, leaving the decay period after the peaks incomplete. 20.3kHz also has a break during this period. The combination of 19.6 and 20.9kHz are easier to follow, with mirror image SIDs during the day. They do both show the same response to the M3.3 flare just after 06UT, probably because it is so close to the different sunrise times over these north and south paths.



The flare strength reduced through the middle of June, although the number of flares remained very high. This recording by Mark Prescott from the 15th shows another very difficult set of SIDs to untangle. There was an

M1.3 flare about 06:30 in the morning, but not labelled on the chart. 23.4kHz has remained very unresponsive, 20.9kHz showing most of the activity.

Flare strengths increased again later in June, shown in Mark Edwards' recording from the 23rd:

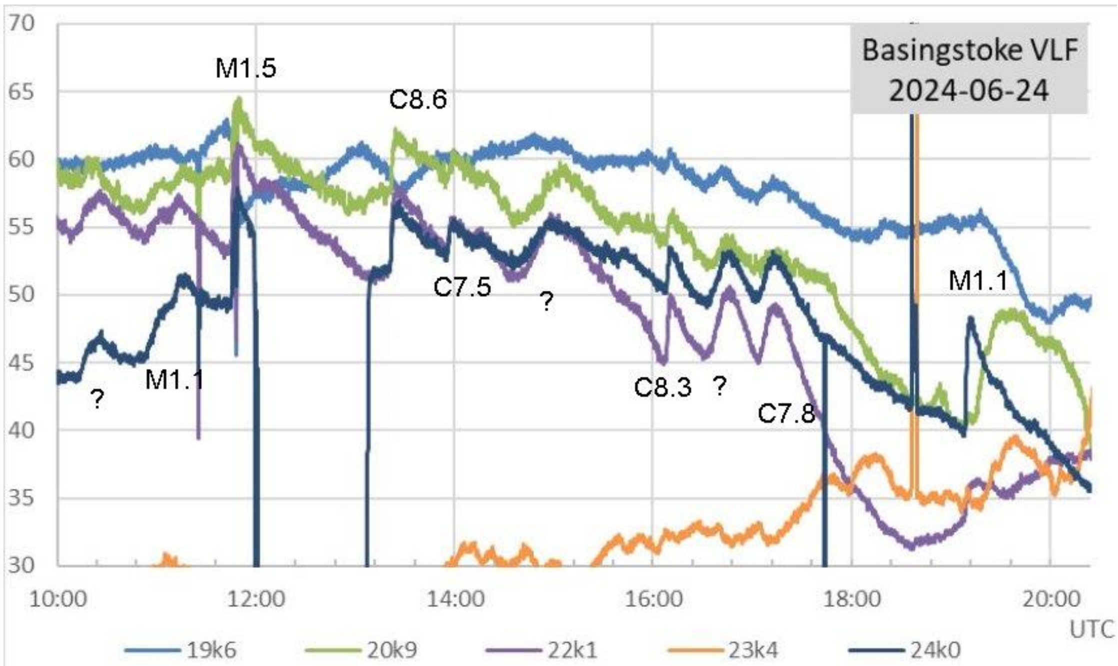


The M9.3 flare peaking at 13:09UT just missed the X-category and produced some very large SIDs. All signals show the simple 'sharks-fin' shape, although 23.4kHz has been distorted slightly by a large negative spike around 12:30.

Four flares within 35 minutes on the 20th have made analysis difficult. The SWPC bulletin lists their peak times as follows:

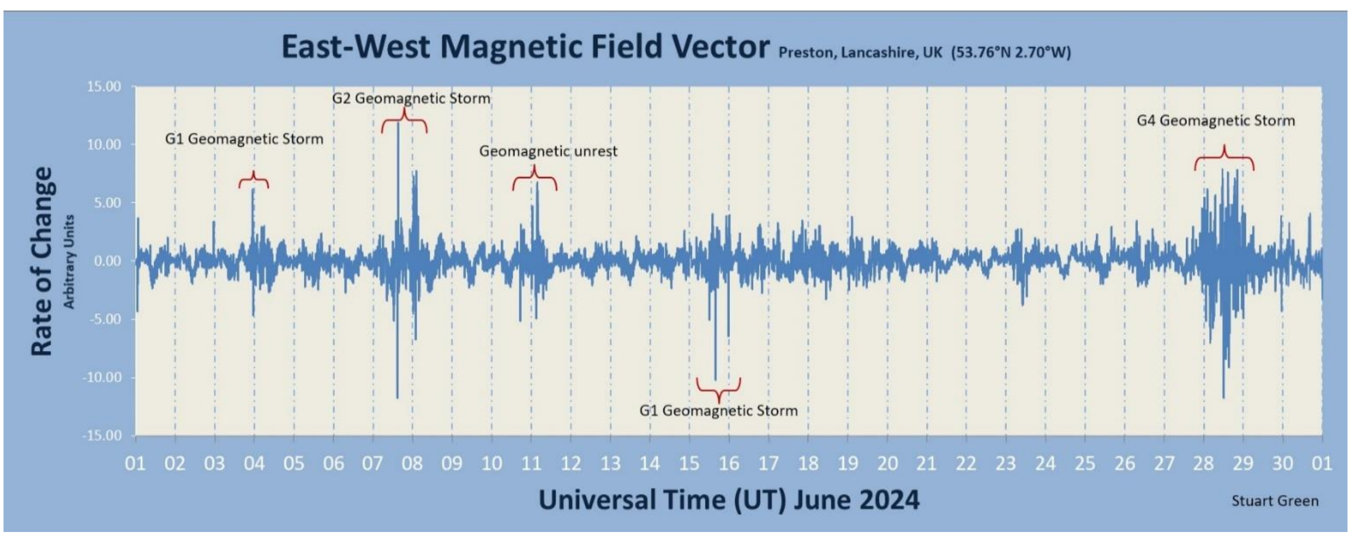
Unclassified: 15:00
M1.1 15:18
Unclassified: 15:35
C8.2 15:15

They are listed in the order of their start times. The M1.1 flare seems to have produced a clean SID, but the SID timings for the C8.2 show the combined effect of the C8.2 and previous unclassified flare. Our timings are all around 16:00UT, due to the long decay time of the unclassified flare.



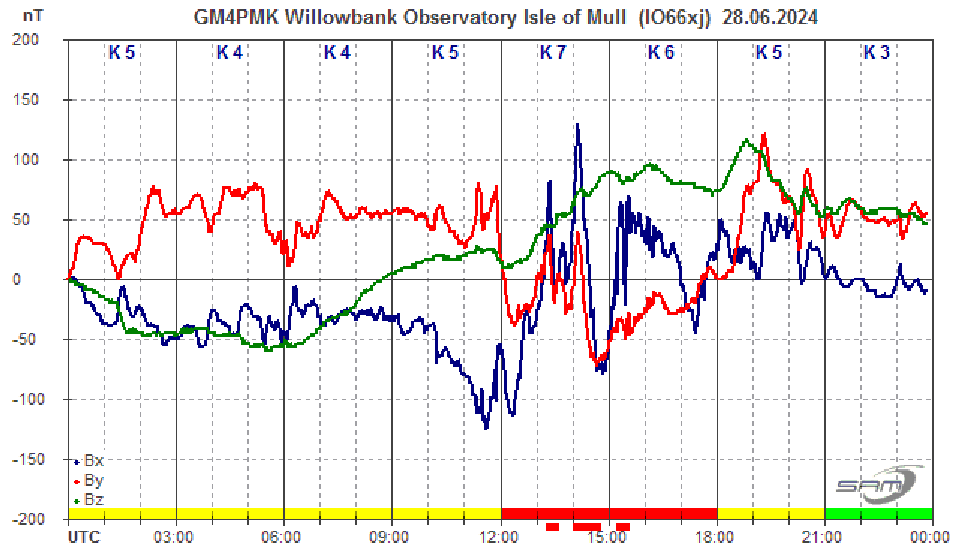
Paul Hyde's recording from the 24th shows more of these unclassified events along with some stronger flares. The SID from the M1.5 flare at midday has a long decay time, including a small secondary peak. The C8.3 peaking at about 16:15 is followed by two more in just over an hour. 24kHz also shows a strong SID from the M1.1 flare just after 19:00.

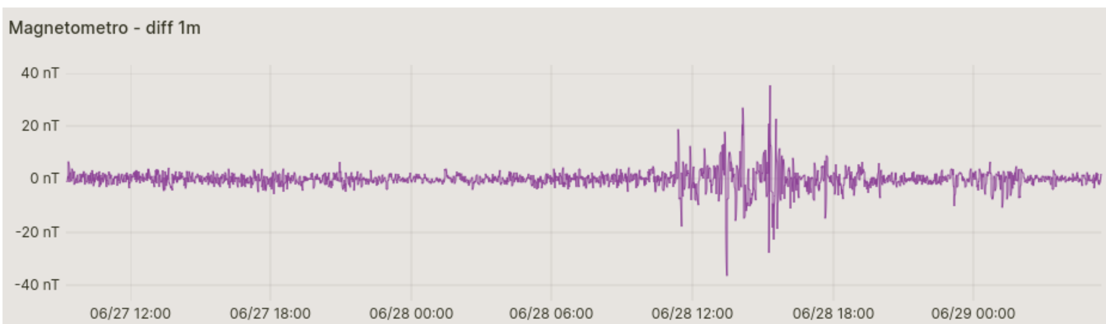
MAGNETIC OBSERVATIONS



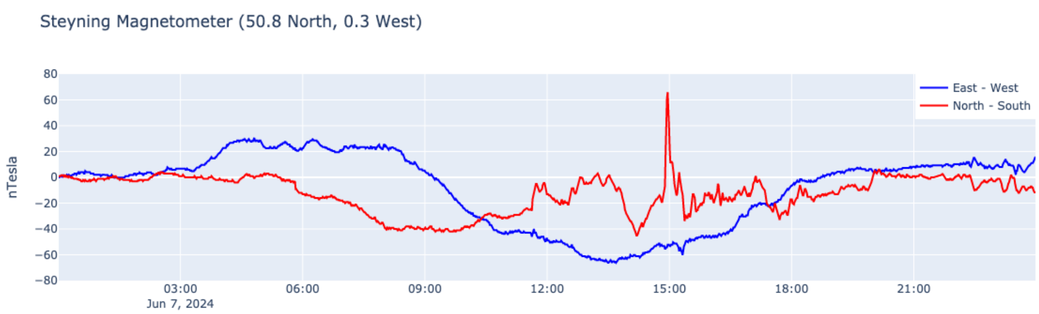
Stuart Green's monthly summary of magnetic activity shows several periods of mild disturbance in the first half of June, along with a much stronger disturbance on the 28th. The background also shows some very mild activity between these events. Many of the strong flares recorded had associated CMEs, but most seem to have been weak or not Earth-directed. The solar wind was also reported as being quite turbulent at times, with some minor coronal holes reported in the STCE bulletin. The most active period shown in our recordings was on the

28th, the effects of several CMEs combining to produce the G4 magnetic storm. Roger Blackwell's recording shows the activity recorded from Mull:

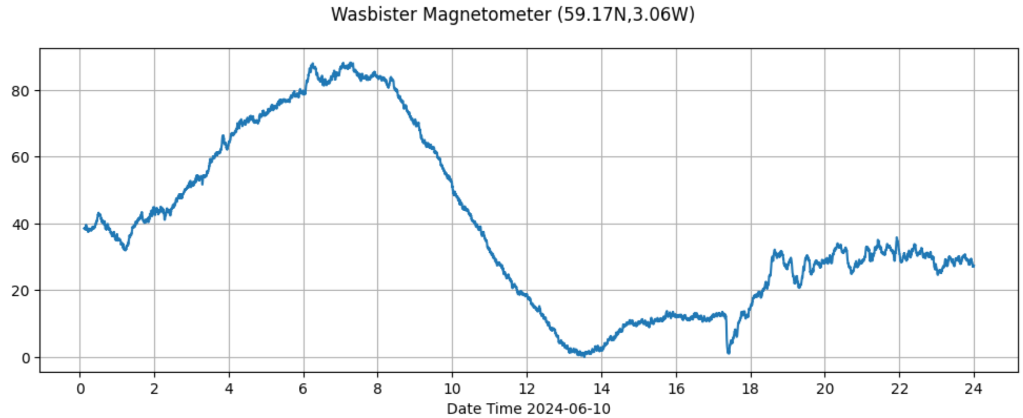




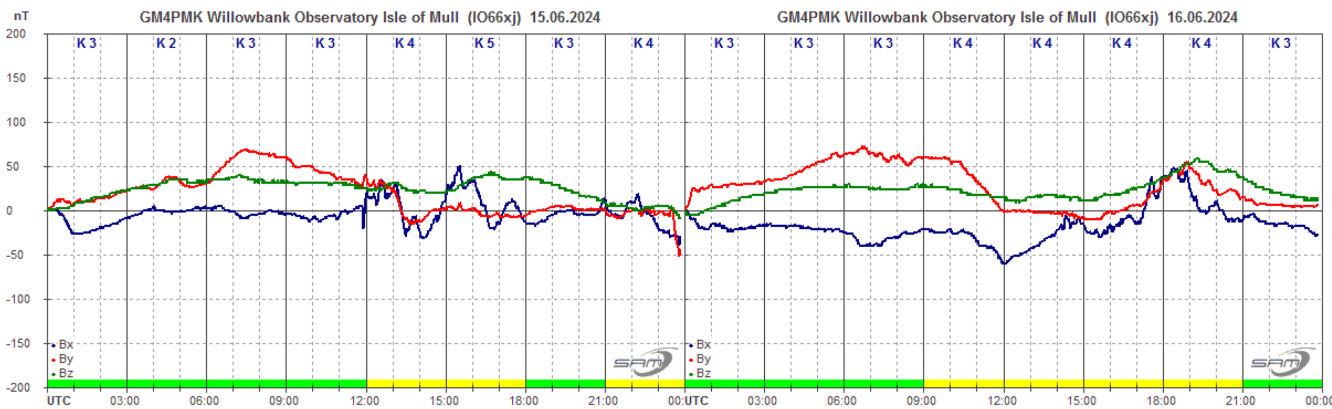
Thomas Mazzi's recording from Renazzo, Italy shows the strongest part of the activity during the afternoon. Mild activity is also present in the early morning of the 29th, but the 27th was very quiet.



Nick Quinn's recording on the 7th shows a very strong spike at 15UT, a feature also seen in recordings from Callum Potter and Roger Blackwell, and so not transient interference. It looks like a CME impact, although I cannot identify a source. There were plenty of strong flares in the preceding days.

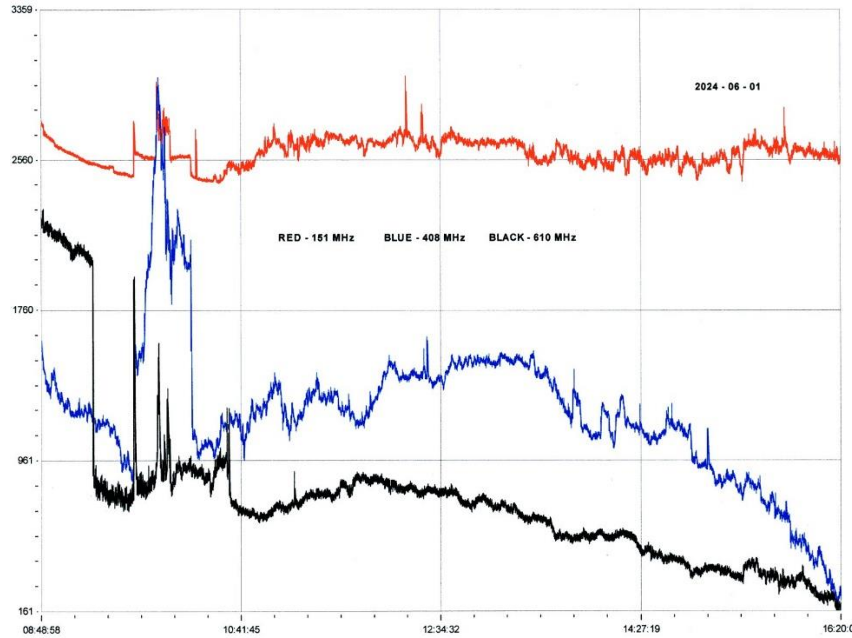


Another CME impact is seen at about 17:30 in Callum Potter's recording from June 10th. It is also evident in other recordings, and so is genuine. The resulting disturbance was very mild, fading out by 06UT the following morning. Mild activity started again on the 15th, with another potential impact at 12UT, shown in Roger Blackwell's recording. This continued right through to the 19th followed by another quiet period before the storm on the 28th.

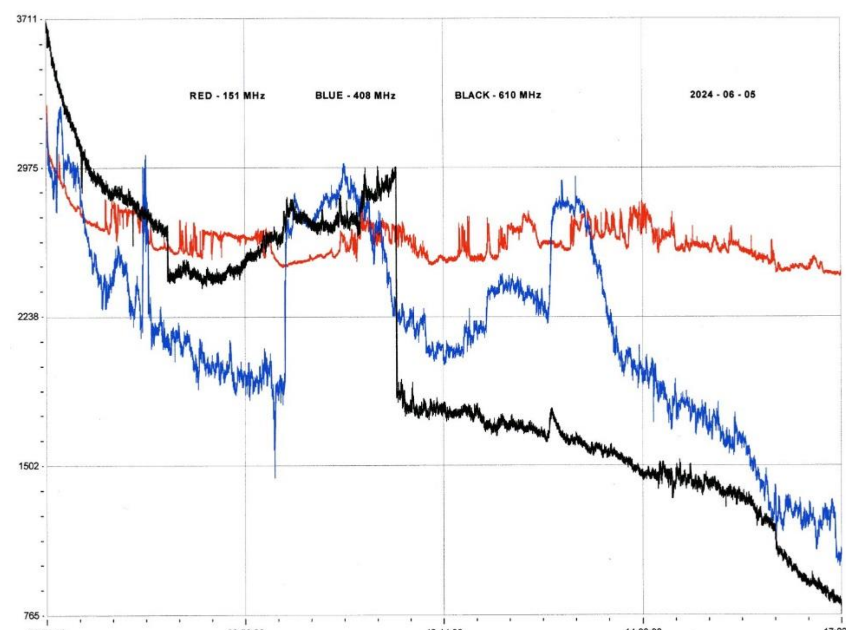


Magnetic observations received from Roger Blackwell, Thomas Mazzi, Callum Potter, Nick Quinn, and John Cook.

SOLAR EMISSIONS

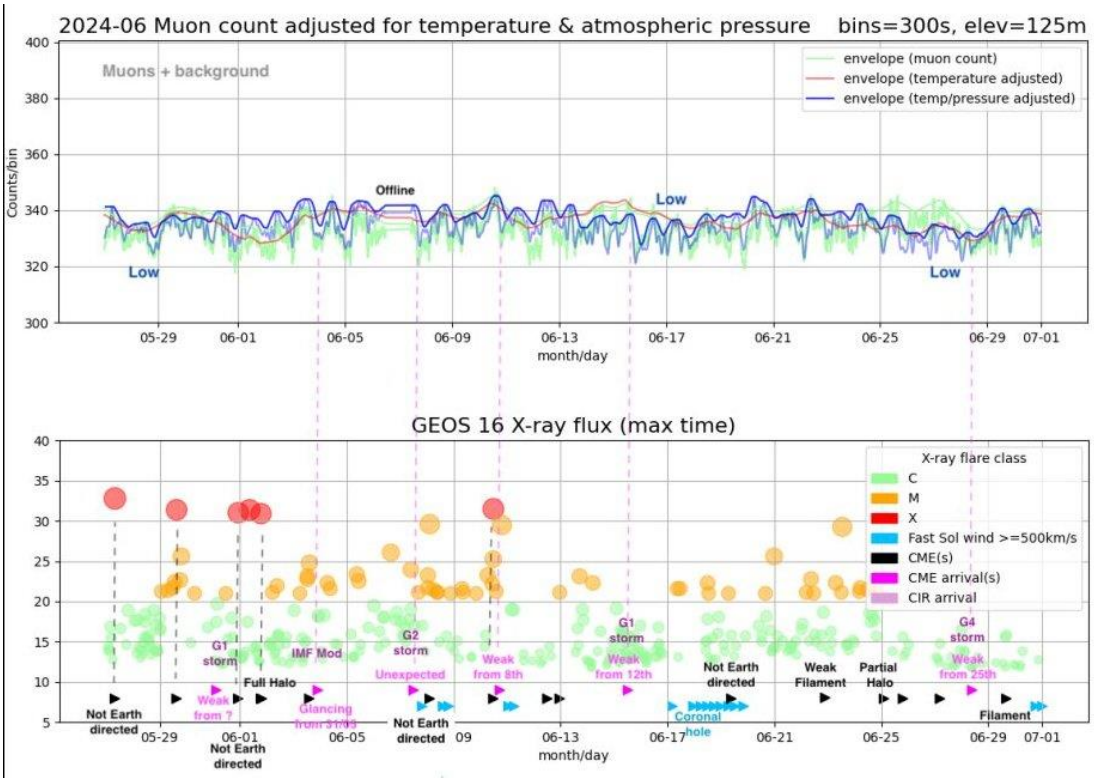


The X1.4 flare recorded on June 1st has produced a significant 408MHz noise burst, recorded by Colin Clements. 151MHz and 610MHz also show smaller bursts. The numerous smaller flares through the middle of the day seem to have produced a high noise level on 408MHz and 610MHz, while 151MHz again shows a similar pattern, but with much less amplitude.

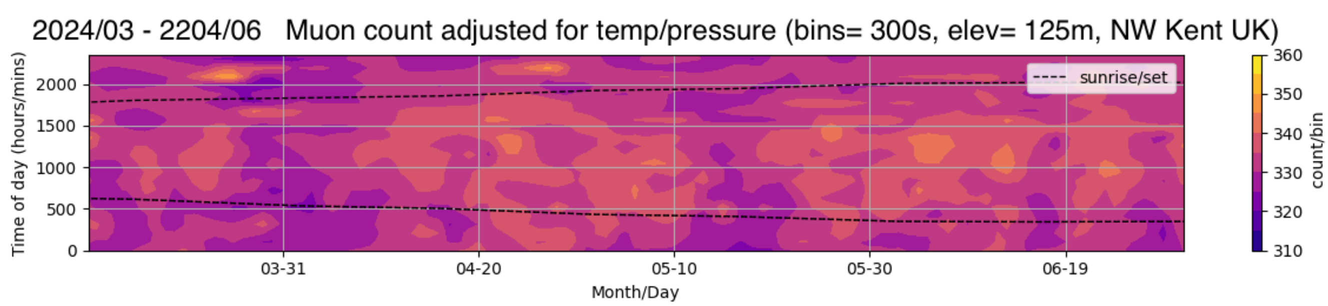


Colin's recording on the 5th is harder to analyse. The M3.4 and M2.6 flares in the morning may be seen in the 408MHz signal, again with contributions from the smaller afternoon flares. 151Mhz seems to be far more random. Recordings from the 7th were even more confusing, with 408MHz saturating after 10UT until well into the afternoon. There was an M4 flare at 09:16, but the link is not clear.

MUONS

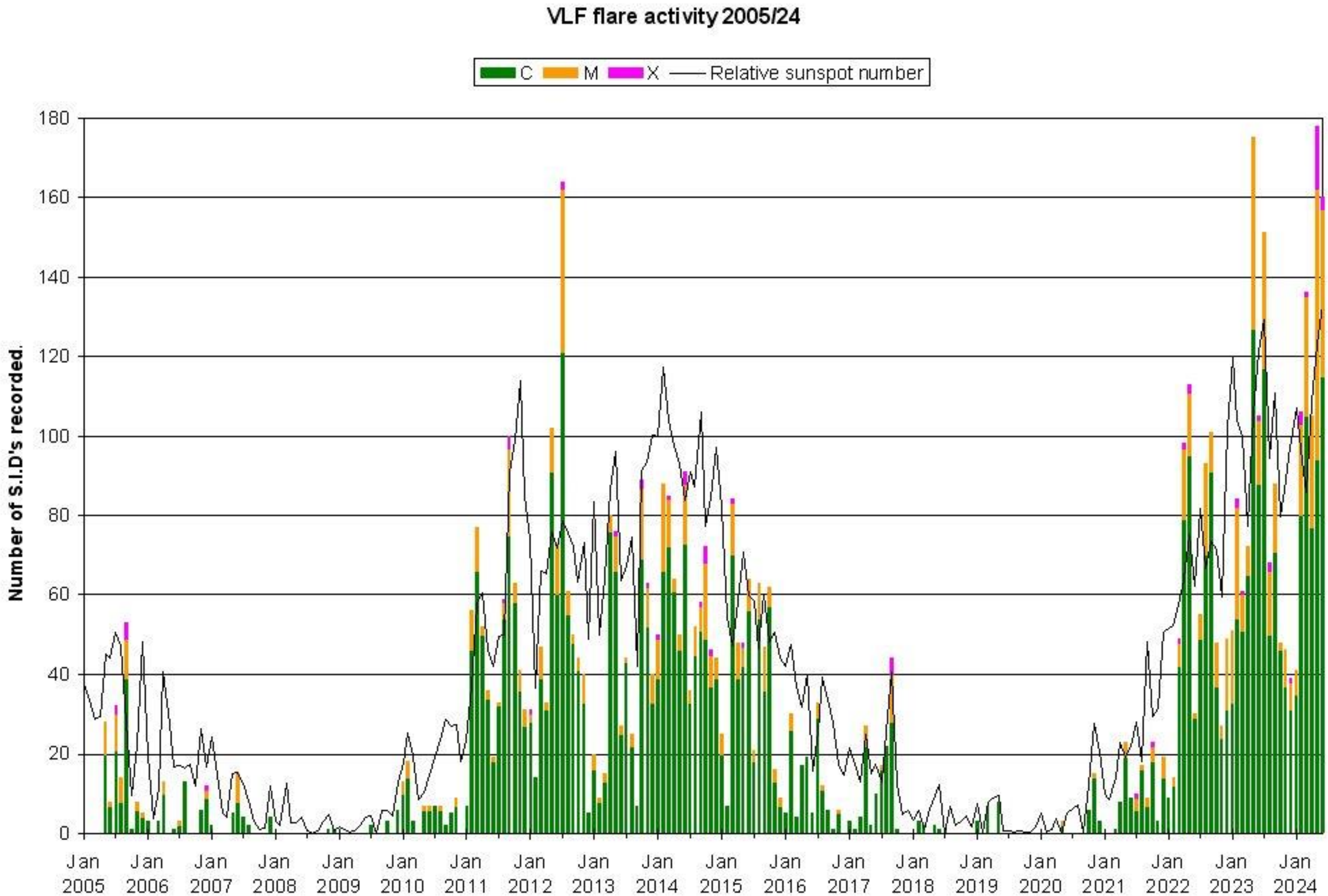


Mark Prescott’s Muon recordings from June were interrupted by a short period offline, but still shows plenty of interesting activity. There is a general drop in Muon counts at the end of May and into early June from the stronger flares. CMEs and solar winds have also produced lower counts around the 17th and 28th. The diurnal trend is also visible between these events.



Mark has produced this chart showing how the counts have changed over the last four months, the sunrise and sunset times added. The counts tend to be higher during the day, midday running along the centre of the chart. There are two periods where the daytime counts are low, around March 31st and after May 10th. These follow periods when the solar wind was particularly active. A strong X-flare in late March caused a CME to join the solar wind, reported in our March report. Events leading up to May 10th were reported in our May report, leading to a magnetic storm that I’m sure we will all remember! The smaller gaps in June match the dips shown in the chart on the previous page.

BARTELS CHART


VLF flare activity 2005/24
C
M
X
Relative sunspot number
Number of S.I.D's recorded.
180
160
140
120
100
80
60
40
20
0
Jan 2005
Jan 2006
Jan 2007
Jan 2008
Jan 2009
Jan 2010
Jan 2011
Jan 2012
Jan 2013
Jan 2014
Jan 2015
Jan 2016
Jan 2017
Jan 2018
Jan 2019
Jan 2020
Jan 2021
Jan 2022
Jan 2023
Jan 2024

British Astronomical Association

Supporting amateur astronomers since 1890

Radio Astronomy Section

Director: Paul Hearn

The Radio Astronomy Section aspires to encourage and support the construction of radio telescopes by amateurs, their use for observing programmes, and the development of a deeper understanding of the science underlying what is being observed. Programmes can be aimed at any radio astronomical phenomenon, at any radio frequency. This encouragement will be through the operation of continuing group programmes, and through building communication and information exchange between individuals and groups pursuing their own projects. The main purpose of the Group is to act as a reservoir and clearing house for information on radio telescope design, construction and debugging, and how to use these instruments effectively. This will include the discussion of observing techniques and data analysis. Members should be able to exchange ideas, give advice and help each other. Establishing a pool of design information and software suitable for use in observing and data processing is a priority.

BAA Radio Astronomy Section Seminar programme.

Friday 6th September 19:30 BST (18:30 UTC)

Active G*alactic* Nuclei – AGN – A LOFAR investigation.

Dr Jonathon Pierce University of Hertfordshire and Dr Luke Holden University of Sheffield

Monday 30th September 19:30 BST (18:30 UTC)

Features and results of the Sao Giao Radio Telescope

Michiel Klaassen - Portugal Amateur Radio Astronomy Centre

Friday Nov 8th 19:30 BST (19:30 UTC)

Binary Stars and Stellar Cannibalism

Dr. Noel Castro-Segura University of Warwick Astronomy and Astrophysics Group

Stars are the building blocks of the universe. The majority of the stars in our galaxy spend their lives associated with a stellar companion, bound by the gravitational pull between them. The population of so-called binary stars encompasses up to 80% of the stars in the galaxy, and approximately half of these systems have an orbital period short enough to induce mass transfer between the two celestial objects at some point in their evolution.

Many of these interacting binaries contain a compact stellar remnant, which accretes material stripped from the surface of its companion star, thus providing an ideal laboratory to study physical bodies with extreme gravity such as white dwarfs and neutron stars. Furthermore, they offer a unique opportunity to infer the presence of one of the most exotic objects in the universe: black holes. This allows us to learn how they interact with their environment while shaping the universe we observe.

Here, I will review the basics of binary evolution and provide an overview of the phenomena observed in these systems. Additionally, I will highlight how amateur astronomers and citizen scientists can contribute to advancing science.

Friday 1st November 19:30 (19:30 UTC)

Cosmic ray muon measurement at a global scale and the associated applications

Professor Xiaochun He - Department of Physics & Astronomy, Georga State University

The development of a global network for Cosmic ray muon detection is described. The focus of the presentation will be on the detector development and the expansion of the detector network worldwide which will be mainly used for monitoring the dynamic changes in the space and terrestrial weather in real-time at global scale

SARA are always invited, anyone not on the mailing list can contact me – paul@hearn.org.uk

Videos

- Python for Muons #4 – Presenting findings using Jupyter notebooks and the web.
  2024 May 16
- SKA precursors, the Zooniverse and some machine learning...
  2024 May 7
- Python for Muons #3 – Analysis & Charting muon data using python.
  2024 May 7
- Python for Muons #2 – Reading muon data using python.
  2024 Apr 23
- The October 14, 2023, Solar Eclipse Effects on VLF Radio Propagation Observed in Alaska
  2024 Apr 16

More Videos

- Contact the Director

Section Pages

- RAZoom Programme 2024
- Radio Astronomy Basics
- Current Projects Observations
- VLF Archive Reports - 2005-2024
- BAA RA Zoom Conference Meetings Archive
- BAA RA Training Workshops & Archive
- BAA RA 21 Day Conference - Saturday, 2021, October 16 - 10:00 to 17:00
- Resources
- Archived RAGazine and Circulars
- Muon Project

The Byte

The BYTE Society of Amateur Radio Astronomers Bimonthly Journal	01010011 01101111 01100011 01101001 01100101 01110100 01111001 00100000 01101111 01100110 00100000 01000001 01101101 01100001 01110100 01100101 01110101 01110010 00100000 01010010 01100001 01100100 01101001 01101111 00100000 01000001 01110011 01110100 01110010 01101111 01101110 01101111 01101101 01100101 01110010 01110011

A new section is being added to the bimonthly SARA journal focused on system software applicable for amateur radio astronomy (RA). Given that it is SARA's mission to facilitate the flow of information, promote observing programs, enhance the technical abilities of its members, to name just a few, we feel it is pertinent to dedicate a section of the journal around software articles that enables our members and pushes us forward as a group.

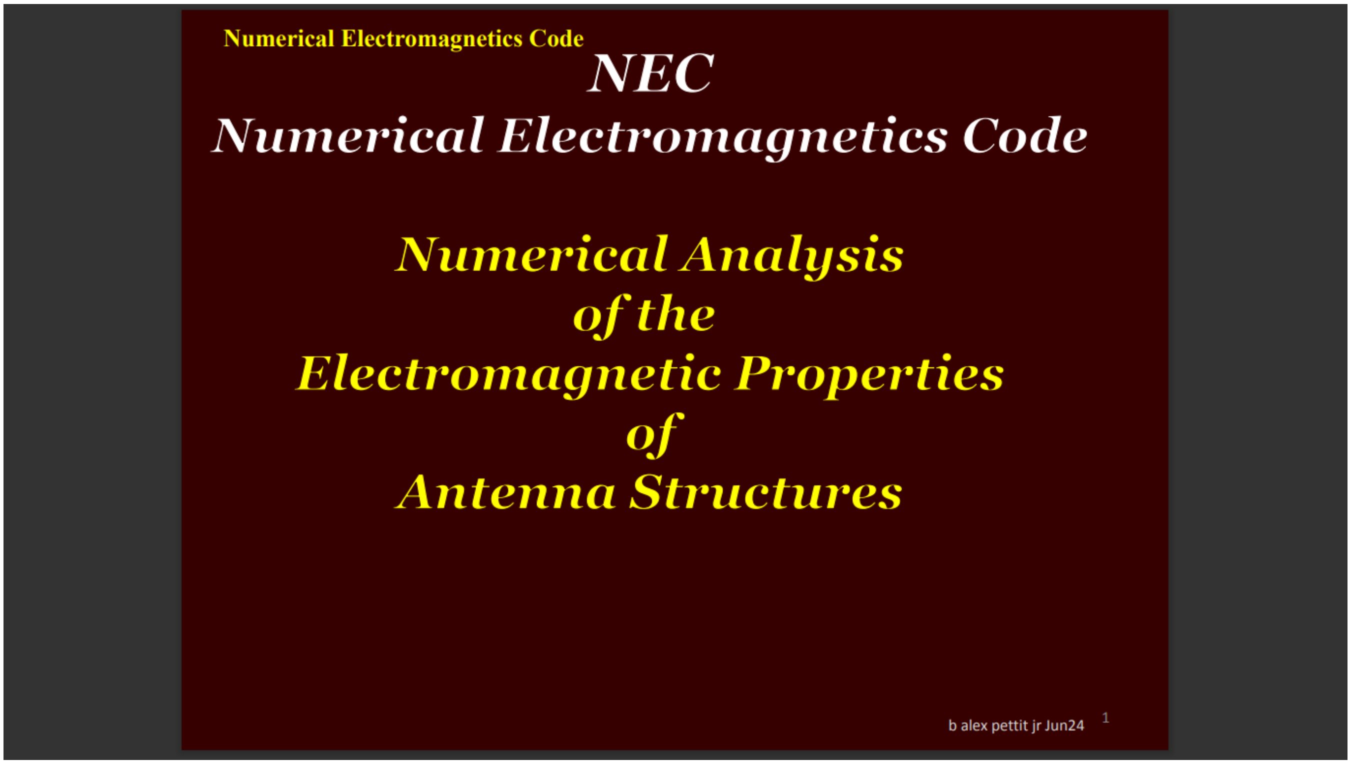
Considering the entire radio astronomy landscape, from design and building the system, to making observations and controlling/tracking the objects being observed, to data processing and analysis various system software is utilized to help make our endeavors more efficient and effective. As such, we plan to use this section of the journal to report on software topics of interest such as:

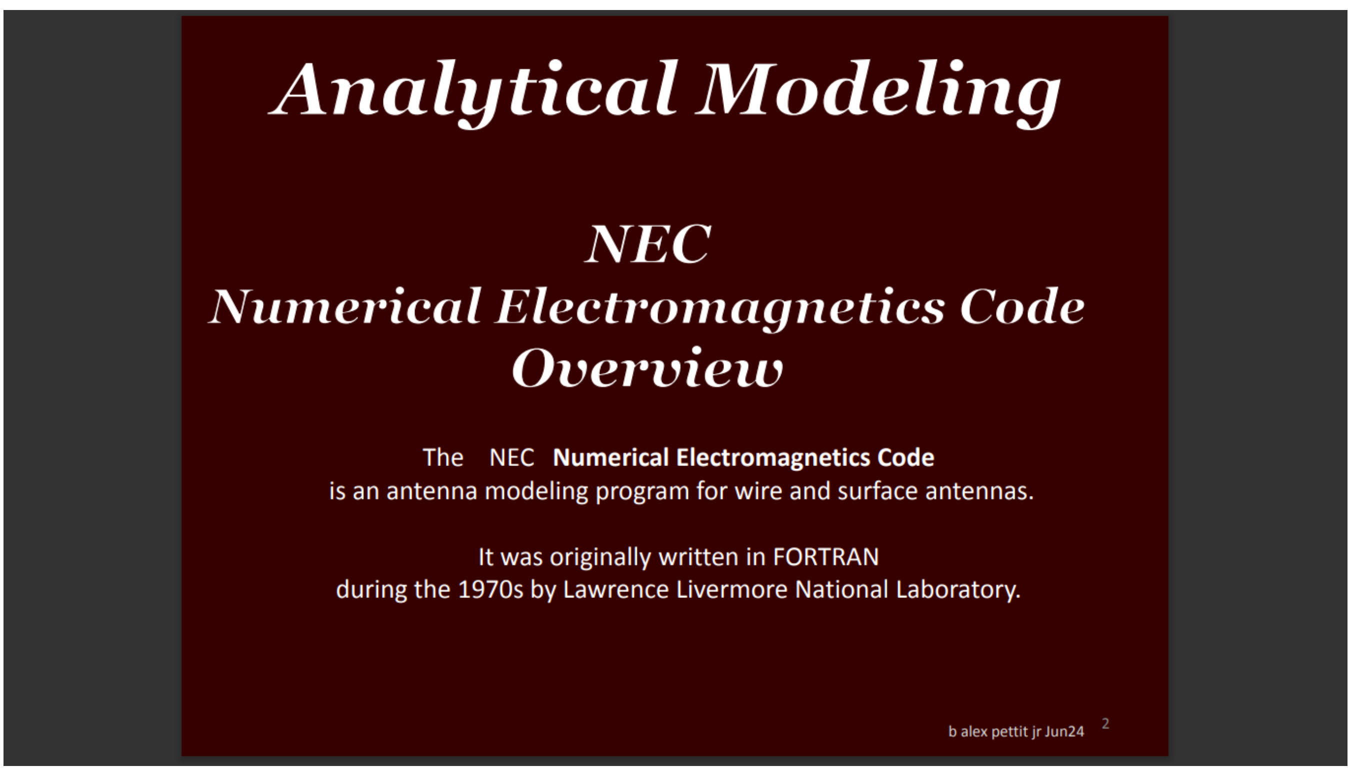
- Programming embedded systems
- Programming languages
- Planning observations
- Control systems and tracking
- Data analysis and processing
- Testing software
- Use of Artificial Intelligence (AI) and Machine Learning (ML)

As an example, some discussions at the conference and on Google forums about using an Inertial Measurement Unit (IMU) and an Arduino as part of the system for guiding an antenna's tracking system. As such, this would be a good topic for our software section of the journal in which we write about interfacing an IMU breakout board to an Arduino and ways to test it in order to understand the noise/drift of the accelerometer/gyro/magnetometer. This was simply an example, certainly open to ideas for topics and articles to be written by you all so put on your thinking caps and let the bits start processing.

Marcus Fisher

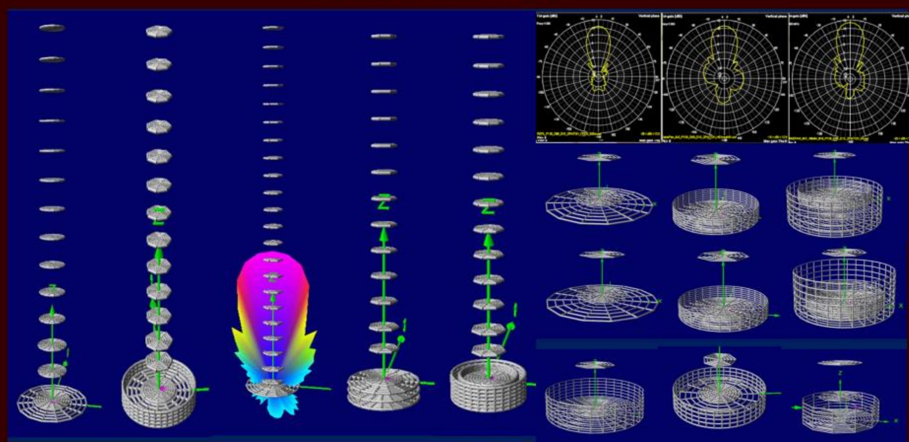
Featured Articles





Numerical Electromagnetics Code

NEC
Numerical Electromagnetics Code
Overview



b alex pettit jr Jun24 3

Numerical Electromagnetics Code

Antenna Modeling via Arie Voors' 4NEC2

An Overview of
Numerical Electromagnetics Code
Antenna Modeling

Many variations of the antennas were modeled to compare performance parameters.

The intent of the next few slides is to show what can be done with NEC Modeling highlighting some basic concepts

I recommend you gain experience in NEC Modeling :

https://www.qsl.net/4nec2/

You can't *guess* and expect optimal results
Learn to *use* a nanoVNA analyzer !

b alex pettit jr Jun24 4

Numerical Electromagnetics Code

Antenna Modeling via Arie Voors' 4NEC2

The **Numerical Electromagnetics Code**
is an antenna modeling program
for wire and surface antennas.
It was originally written in FORTRAN
during the 1970s by
Lawrence Livermore National Laboratory.

The NEC-2 Engine used by the
4NEC2 software is the original
(now public domain)
Lawrence Livermore Code.

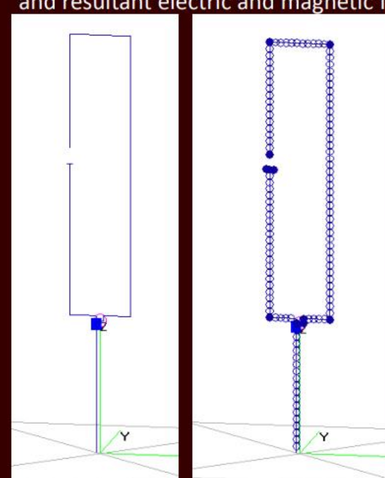
It performs an analysis of an antenna by
Finite Element Analysis Techniques
which divides wires into a number of
small elements and computes their currents
and resultant electric and magnetic fields

b alex pettit jr Jun24 5

Numerical Electromagnetics Code

Antenna Modeling via Arie Voors' 4NEC2

NEC Modeling
performs an antenna analysis by
Finite Element Analysis techniques
which divides wires into a number of
small elements and computes their currents
and resultant electric and magnetic fields

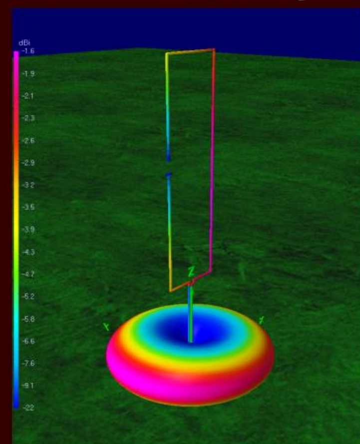


6
b alex pettit jr Jun24

Numerical Electromagnetics Code

Antenna Modeling via Arie Voors' 4NEC2

NEC Modeling
performs an antenna analysis by
Finite Element Analysis techniques
which divides wires into a number of
small elements and computes their currents
and resultant electric and magnetic fields

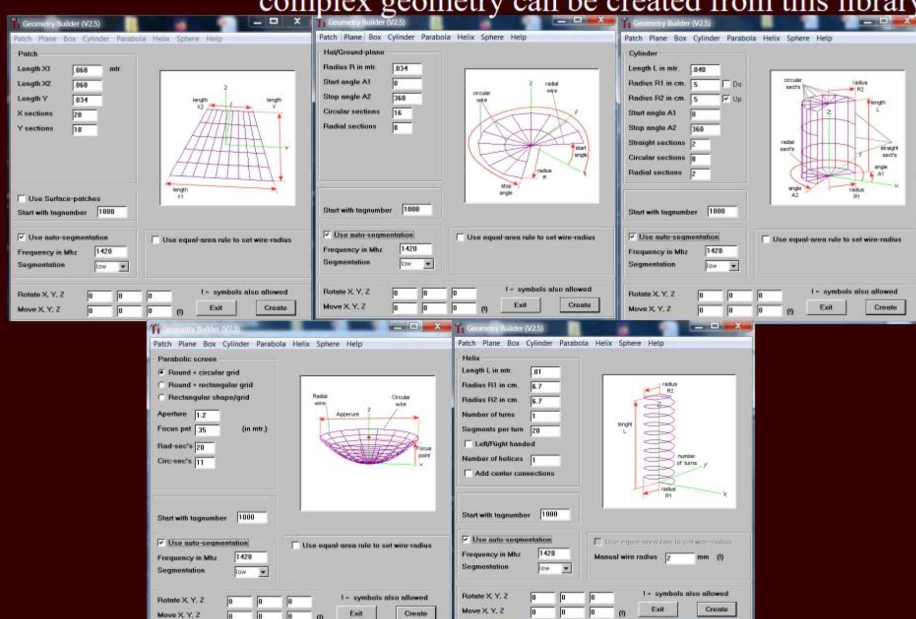


b alex pettit jr Jun24 7

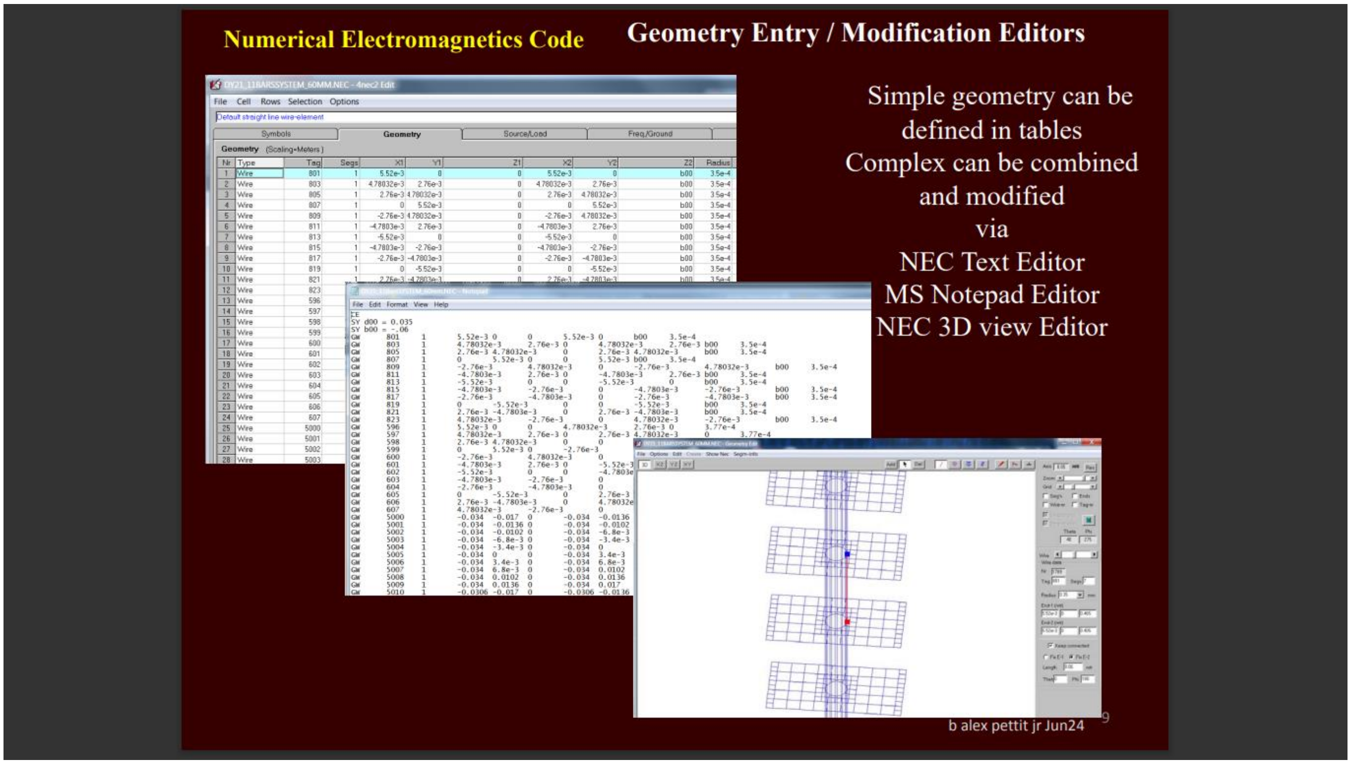
Numerical Electromagnetics Code

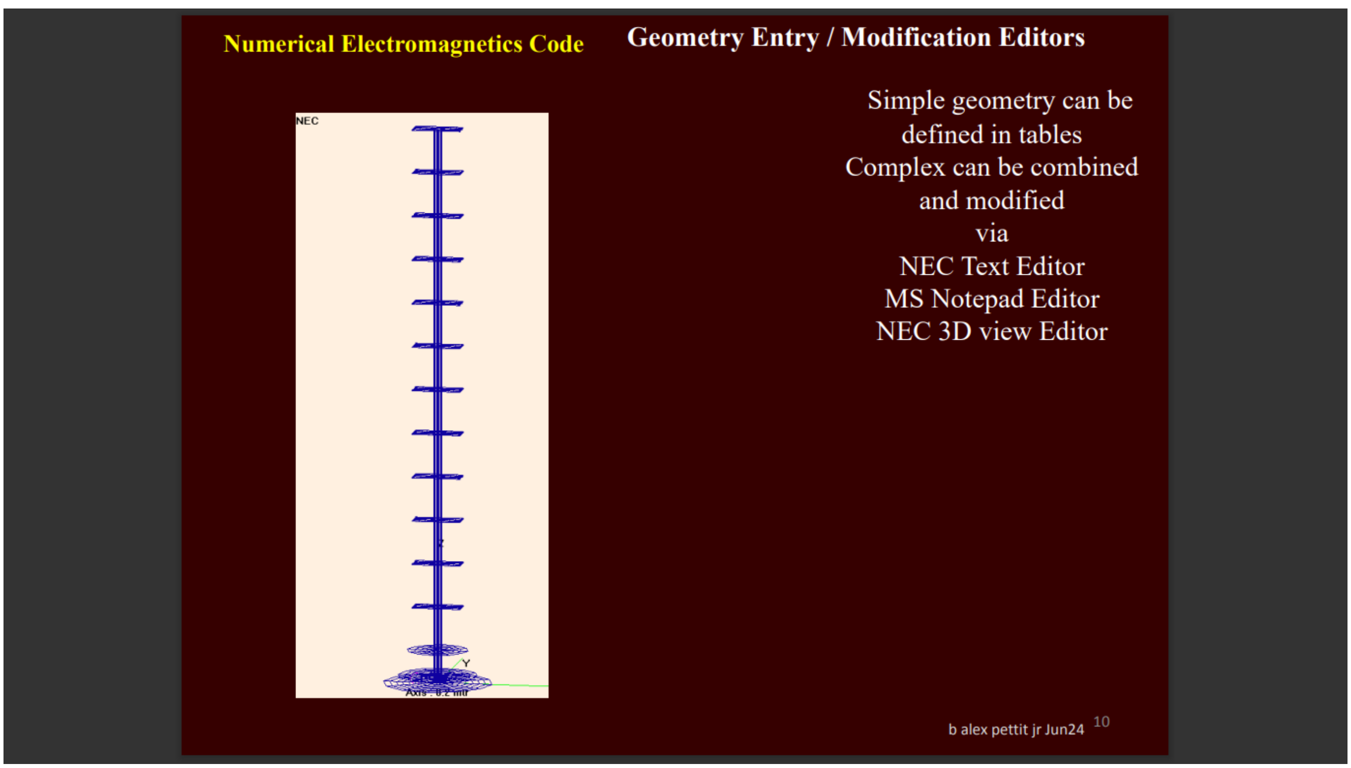
Complex Structure Geometry Builder

complex geometry can be created from this library



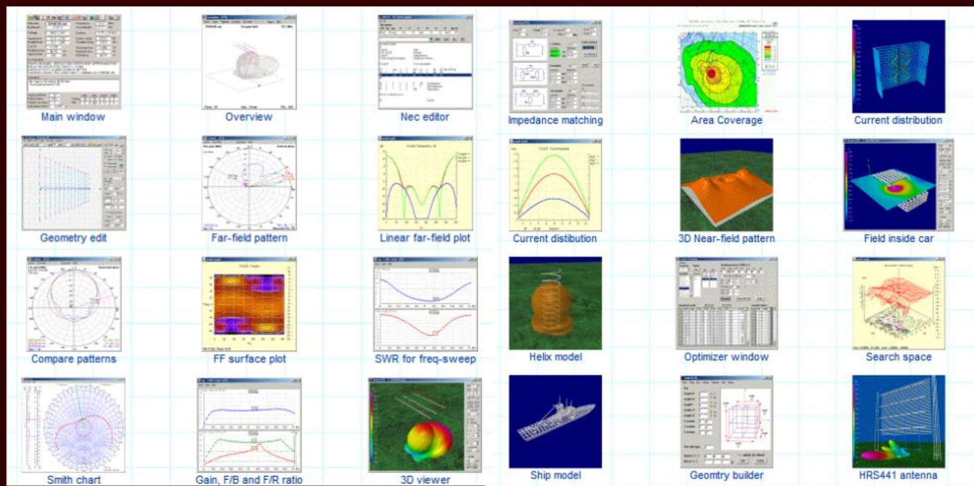
b alex pettit jr Jun24 8


Numerical Electromagnetics Code
Geometry Entry / Modification Editors
Simple geometry can be
defined in tables
Complex can be combined
and modified
via
NEC Text Editor
MS Notepad Editor
NEC 3D view Editor
b alex pettit jr Jun24
9


Numerical Electromagnetics Code
Geometry Entry / Modification Editors
NEC
Simple geometry can be
defined in tables
Complex can be combined
and modified
via
NEC Text Editor
MS Notepad Editor
NEC 3D view Editor
b alex pettit jr Jun24
10

Numerical Electromagnetics Code

Screenshots of 4NEC2 Analysis Capability

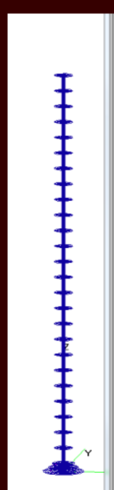


b alex pettit jr Jun24 11

Numerical Electromagnetics Code

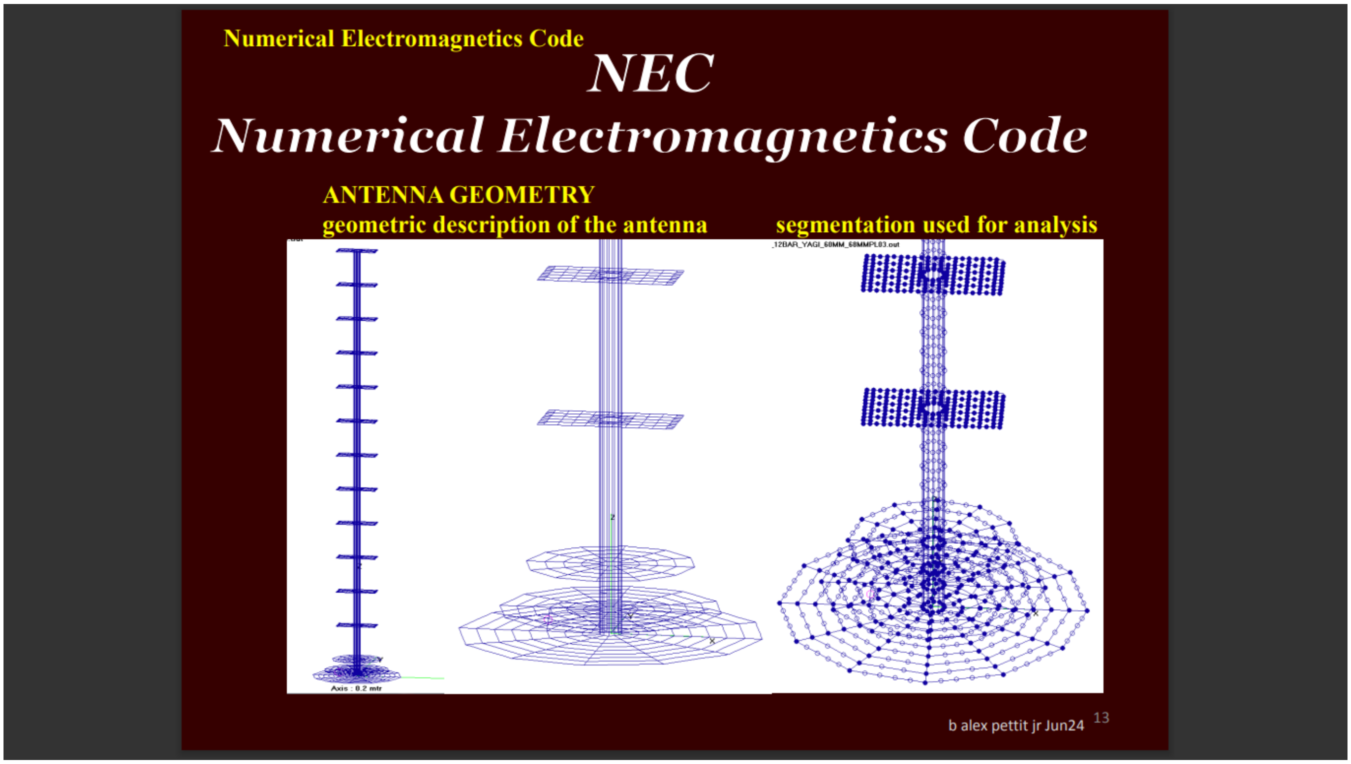
NEC
Numerical Electromagnetics Code

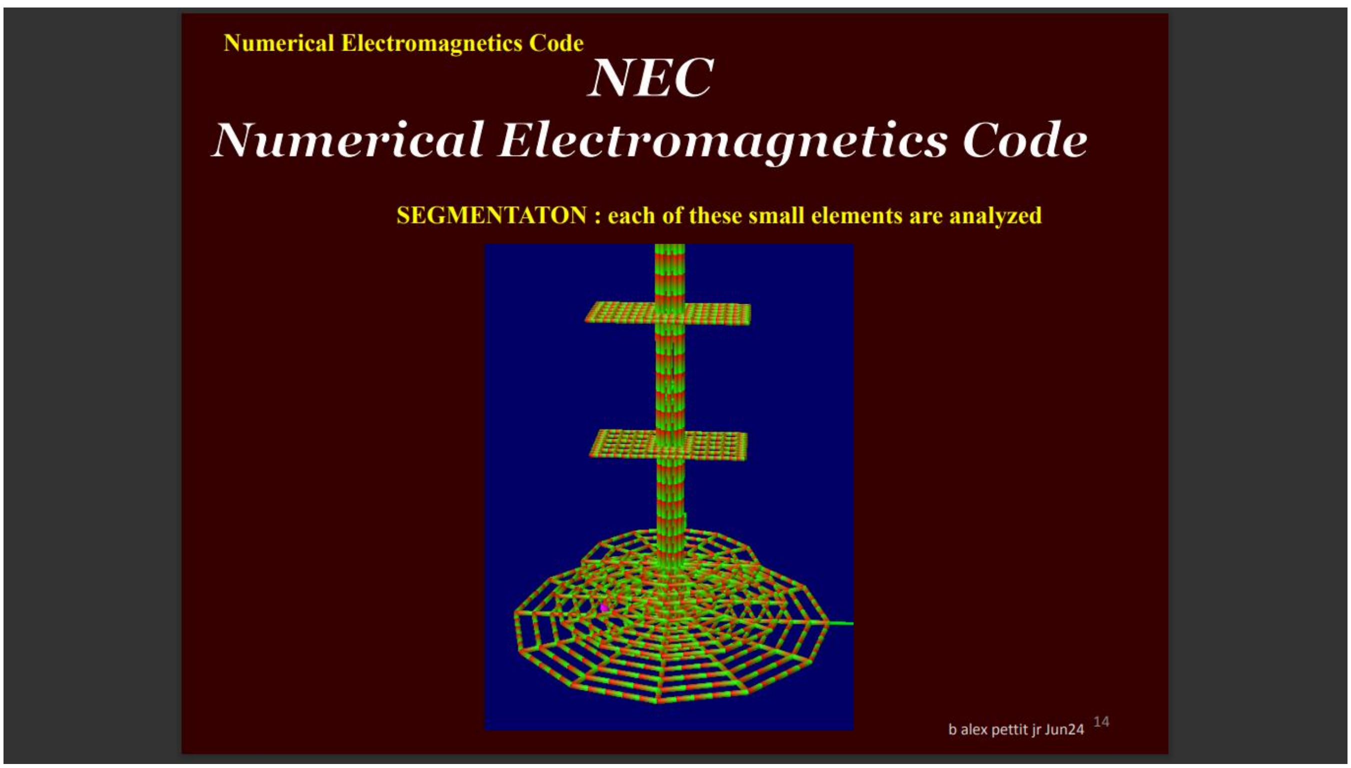
WIRE LIST geometric description of the antenna

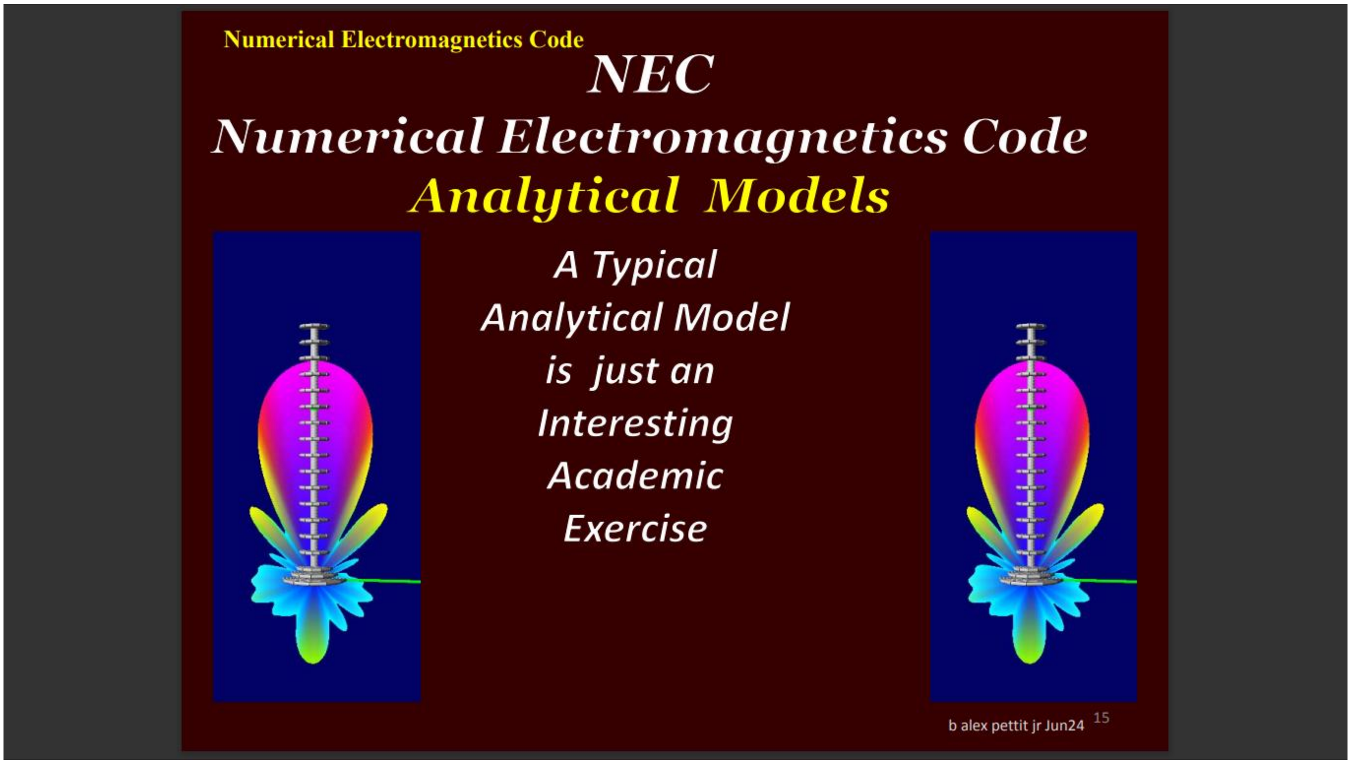


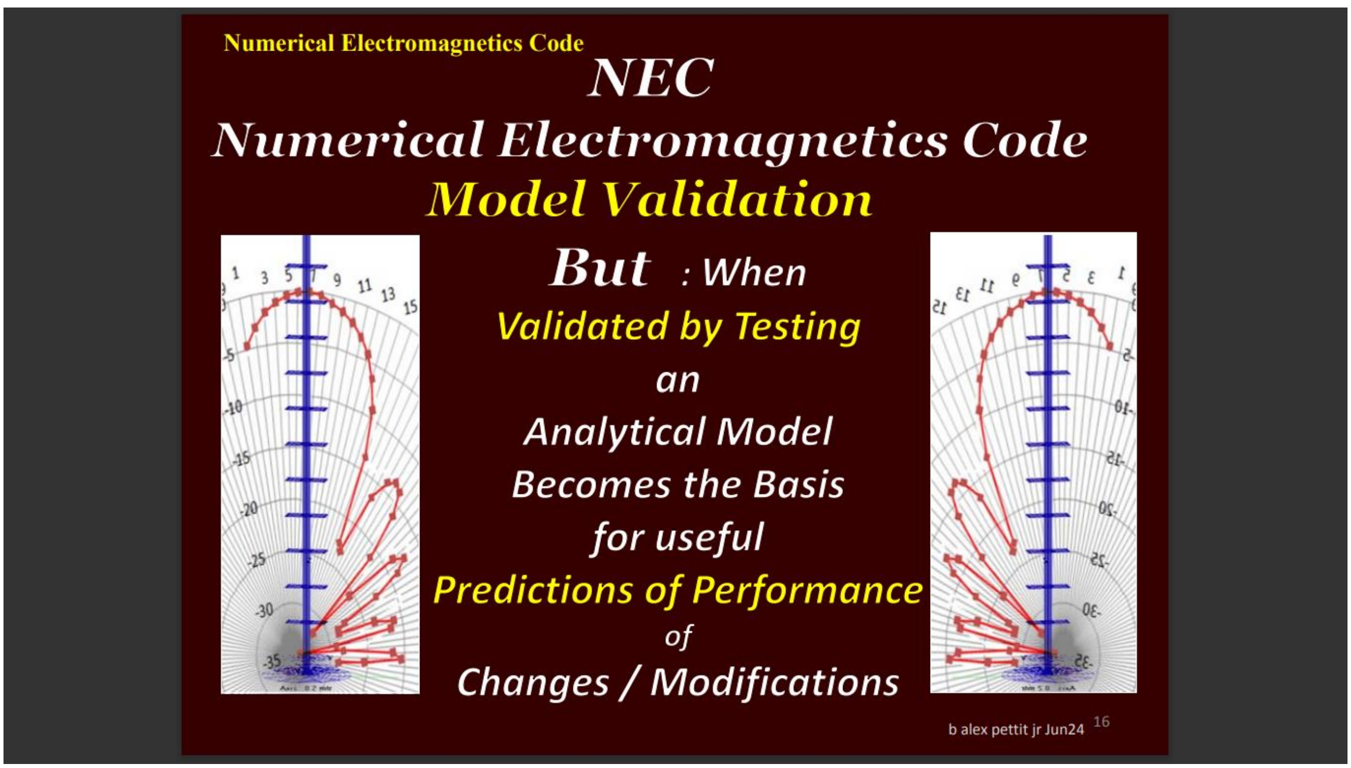
Nr	Type	Tag	Segs	X1	Y1	Z1	X2	Y2	Z2	Radius
44	Wire	143	2	-.032043	-.0185	0	-.0185	-.032043	0	.001068
45	Wire	144	2	-.0185	-.032043	0	0	-.037	0	.001068
46	Wire	145	2	0	-.037	0	.0185	-.032043	0	.001068
47	Wire	146	2	.0185	-.032043	0	.032043	-.0185	0	.001068
48	Wire	147	2	.032043	-.0185	0	.037	0	0	.001068
49	Wire	148	1	.026667	0	0	.023094	.013333	0	.000941
50	Wire	149	1	.023094	.013333	0	.013333	.023094	0	.000941
51	Wire	150	1	.013333	.023094	0	0	.026667	0	.000941
52	Wire	151	1	0	.026667	0	-.013333	.023094	0	.000941
53	Wire	152	1	-.013333	.023094	0	-.023094	.013333	0	.000941
54	Wire	153	1	-.023094	.013333	0	-.026667	0	0	.000941
55	Wire	154	1	-.026667	0	0	-.023094	-.013333	0	.000941
56	Wire	155	1	-.023094	-.013333	0	-.013333	-.023094	0	.000941
57	Wire	156	1	-.013333	-.023094	0	0	-.026667	0	.000941
58	Wire	157	1	0	-.026667	0	.013333	-.023094	0	.000941
59	Wire	158	1	.013333	-.023094	0	.023094	-.013333	0	.000941
60	Wire	159	1	.023094	-.013333	0	.026667	0	0	.000941
61	Wire	160	1	.016333	0	0	.014145	.008167	0	.00074
62	Wire	161	1	.014145	.008167	0	.008167	.014145	0	.00074
63	Wire	162	1	.008167	.014145	0	0	.016333	0	.00074
64	Wire	163	1	0	.016333	0	-.008167	.014145	0	.00074
65	Wire	164	1	-.008167	.014145	0	-.014145	.008167	0	.00074
66	Wire	165	1	-.014145	.008167	0	-.016333	0	0	.00074
67	Wire	166	1	-.016333	0	0	-.014145	-.008167	0	.00074
68	Wire	167	1	-.014145	-.008167	0	-.008167	-.014145	0	.00074
69	Wire	168	1	-.008167	-.014145	0	0	-.016333	0	.00074
70	Wire	169	1	0	-.016333	0	.008167	-.014145	0	.00074
71	Wire	170	1	.008167	-.014145	0	.014145	-.008167	0	.00074
72	Wire	171	1	.014145	-.008167	0	.016333	0	0	.00074
73	Wire	172	1	.006	0	0	.005196	.003	0	.00038
74	Wire	173	1	.005196	.003	0	.003	.005196	0	.00038
75	Wire	174	1	.003	.005196	0	0	.006	0	.00038
76	Wire	175	1	0	.006	0	-.003	.005196	0	.00038
77	Wire	176	1	-.003	.005196	0	-.005196	.003	0	.00038
78	Wire	177	1	-.005196	.003	0	-.006	0	0	.00038
79	Wire	178	1	-.006	0	0	-.005196	-.003	0	.00038
80	Wire	179	1	-.005196	-.003	0	-.003	-.005196	0	.00038
81	Wire	180	1	-.003	-.005196	0	0	-.006	0	.00038
82	Wire	181	1	0	-.006	0	.003	-.005196	0	.00038
83	Wire	182	1	.003	-.005196	0	.005196	-.003	0	.00038

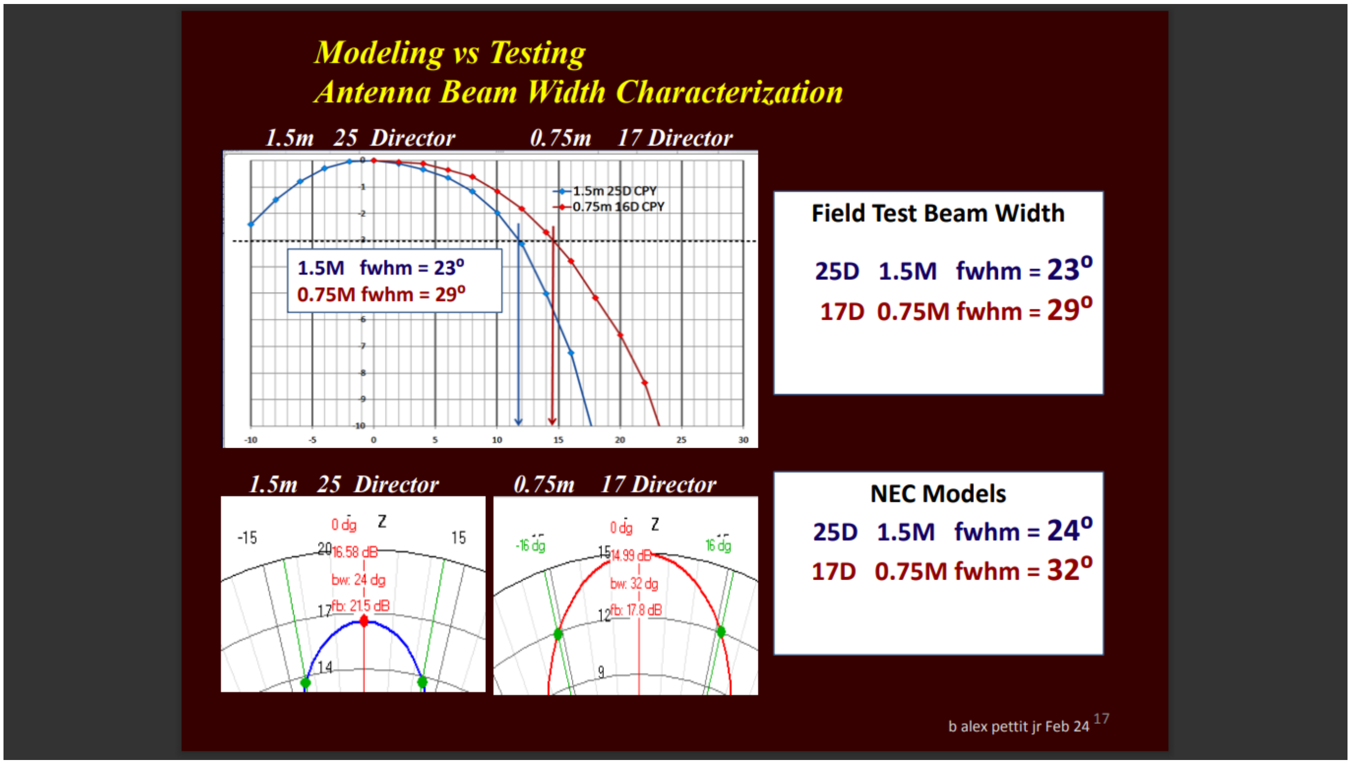
b alex pettit jr Jun24 12

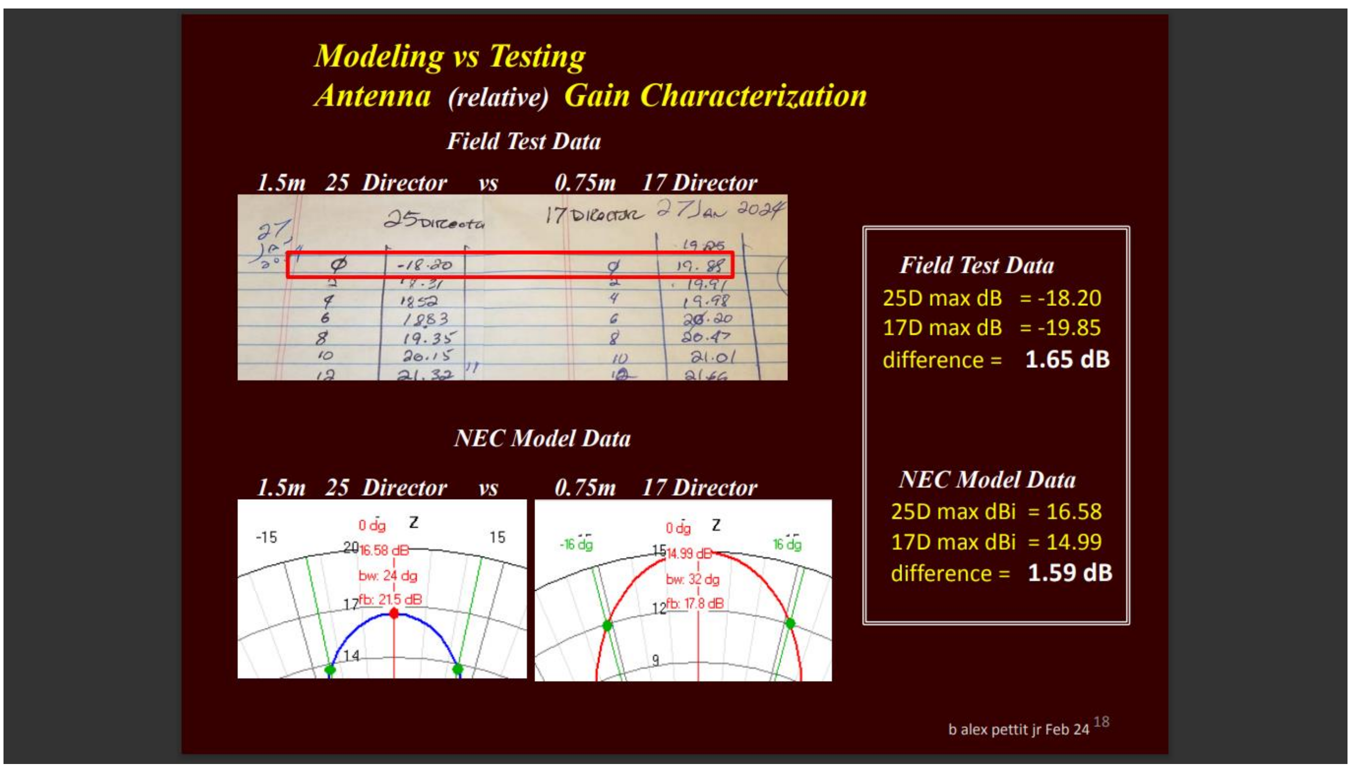

Numerical Electromagnetics Code
NEC
Numerical Electromagnetics Code
ANTENNA GEOMETRY
geometric description of the antenna
segmentation used for analysis
b alex pettit jr Jun24
13

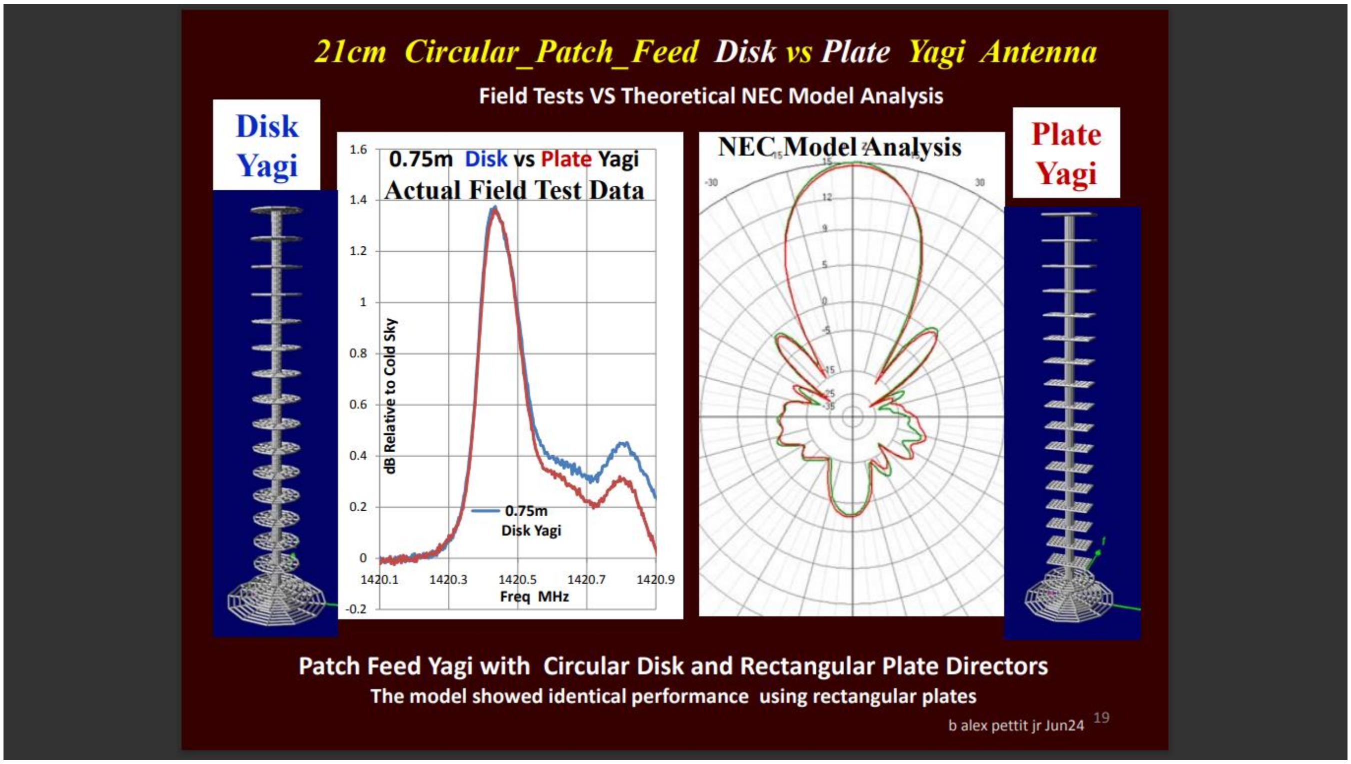

Numerical Electromagnetics Code
NEC
Numerical Electromagnetics Code
SEGMENTATON : each of these small elements are analyzed
b alex pettit jr Jun24
14

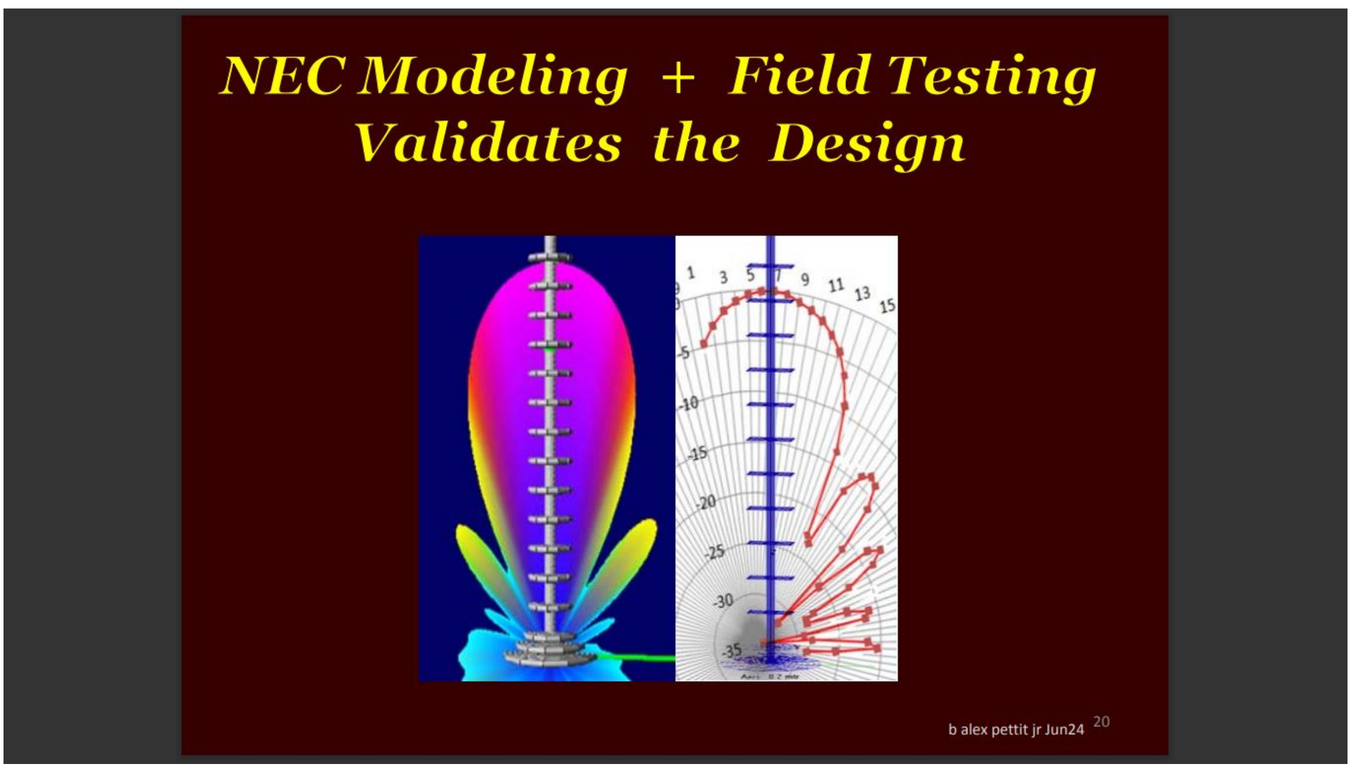

Numerical Electromagnetics Code
NEC
Numerical Electromagnetics Code
Analytical Models
A Typical
Analytical Model
is just an
Interesting
Academic
Exercise
b alex pettit jr Jun24
15


Numerical Electromagnetics Code
NEC
Numerical Electromagnetics Code
Model Validation
But : When
Validated by Testing
an
Analytical Model
Becomes the Basis
for useful
Predictions of Performance
of
Changes / Modifications
b alex pettit jr Jun24
16


Modeling vs Testing
Antenna Beam Width Characterization
1.5m 25 Director 0.75m 17 Director
1.5m 25D CPY
0.75m 16D CPY
1.5M fwhm = 23°
0.75M fwhm = 29°
Field Test Beam Width
25D 1.5M fwhm = 23°
17D 0.75M fwhm = 29°
1.5m 25 Director 0.75m 17 Director
0 dg Z
-15
15
16.58 dB
bw: 24 dg
fb: 21.5 dB
0 dg Z
-16 dg
16 dg
14.99 dB
bw: 32 dg
fb: 17.8 dB
NEC Models
25D 1.5M fwhm = 24°
17D 0.75M fwhm = 32°
b alex pettit jr Feb 24 17


Modeling vs Testing
Antenna (relative) Gain Characterization
Field Test Data
1.5m 25 Director vs 0.75m 17 Director
25 Director
17 Director 27 Jan 2024
Ø -18.20 Ø 19.88
4 18.52 4 19.98
6 18.83 6 20.20
8 19.35 8 20.47
10 20.15 10 21.01
Field Test Data
25D max dB = -18.20
17D max dB = -19.85
difference = 1.65 dB
NEC Model Data
1.5m 25 Director vs 0.75m 17 Director
0 dg Z
-15
15
16.58 dB
bw: 24 dg
fb: 21.5 dB
0 dg Z
-16 dg
16 dg
14.99 dB
bw: 32 dg
fb: 17.8 dB
NEC Model Data
25D max dBi = 16.58
17D max dBi = 14.99
difference = 1.59 dB
b alex pettit jr Feb 24 18

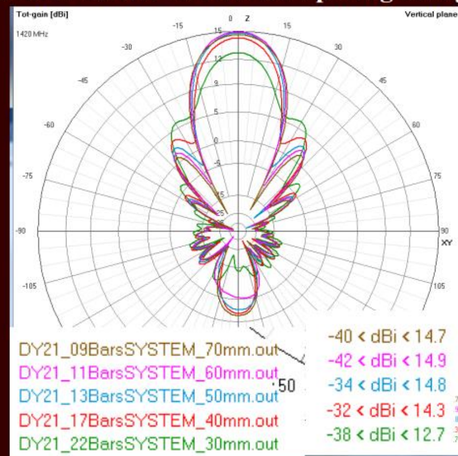

21cm Circular_Patch_Feed Disk vs Plate Yagi Antenna
Field Tests VS Theoretical NEC Model Analysis
Disk Yagi
0.75m Disk vs Plate Yagi
Actual Field Test Data
dB Relative to Cold Sky
Freq MHz
0.75m Disk Yagi
NEC Model Analysis
Plate Yagi
Patch Feed Yagi with Circular Disk and Rectangular Plate Directors
The model showed identical performance using rectangular plates
b alex pettit jr Jun24 19


NEC Modeling + Field Testing
Validates the Design
b alex pettit jr Jun24 20

NEC Validated Model =

Predictions of Performance of Changes / Modifications

Beam Pattern vs Director Spacing Study

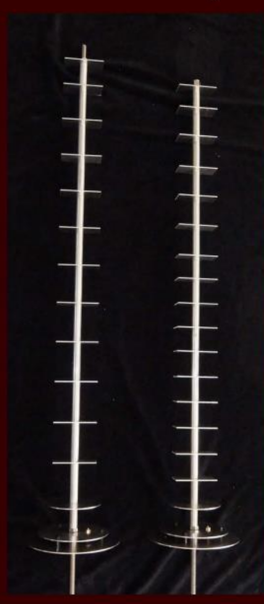


an NEC Study was performed to optimize the Front/Back Gain
60mm Director Spacing was selected

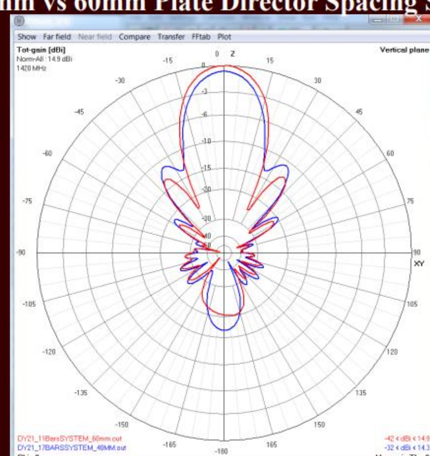
b alex pettit jr Jun24 21

NEC Validated Model =

Predictions of Performance of Changes / Modifications

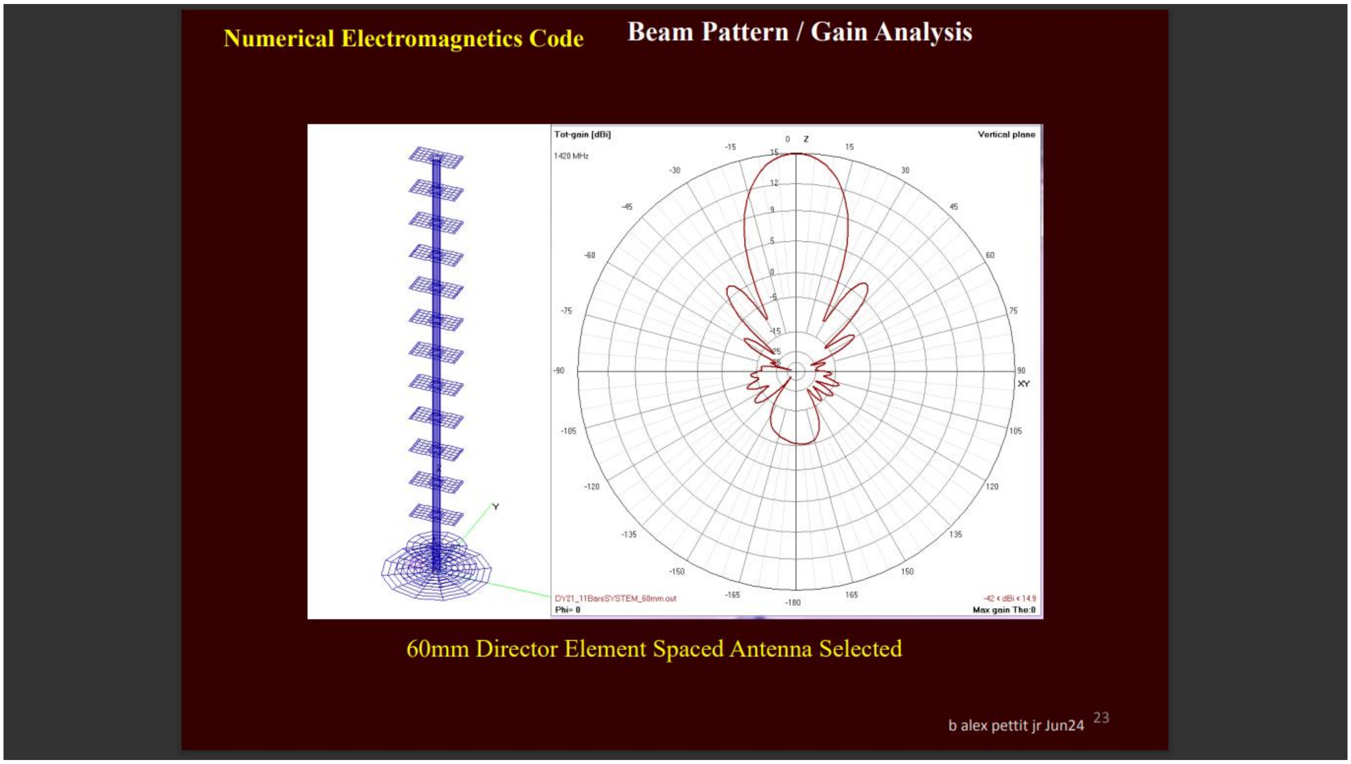


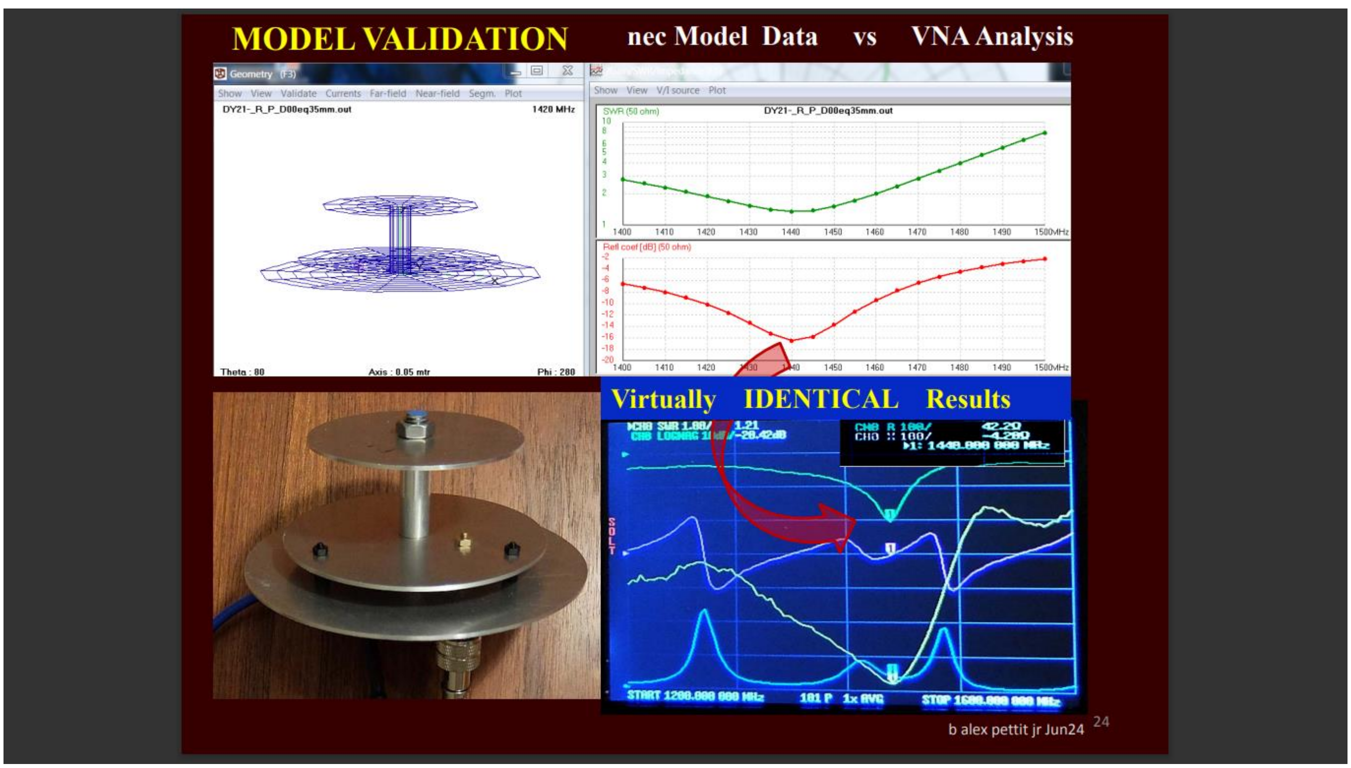
40mm vs 60mm Plate Director Spacing Study



40mm and 60mm Director Spaced Antennas
were modeled, fabricated, and tested
to verify NEC model results

b alex pettit jr Jun24 22


Numerical Electromagnetics Code
Beam Pattern / Gain Analysis
Tot-gain [dBi]
Vertical plane
1420 MHz
DY21_11BarsSYSTEM_60mm.out
Phi= 0
-42 < dBi < 14.9
Max gain Tho:0
60mm Director Element Spaced Antenna Selected
b alex pettit jr Jun24 23


MODEL VALIDATION
nec Model Data vs VNA Analysis
Geometry (F3)
DY21-_R_P_D00eq35mm.out
1420 MHz
Theta : 80
Axis : 0.05 mtr
Phi : 280
SWR (50 ohm)
Refl coef [dB] (50 ohm)
Virtually IDENTICAL Results
START 1200.000 000 MHz
181 P 1x AVG
STOP 1600.000 000 MHz
b alex pettit jr Jun24 24

Field Tests

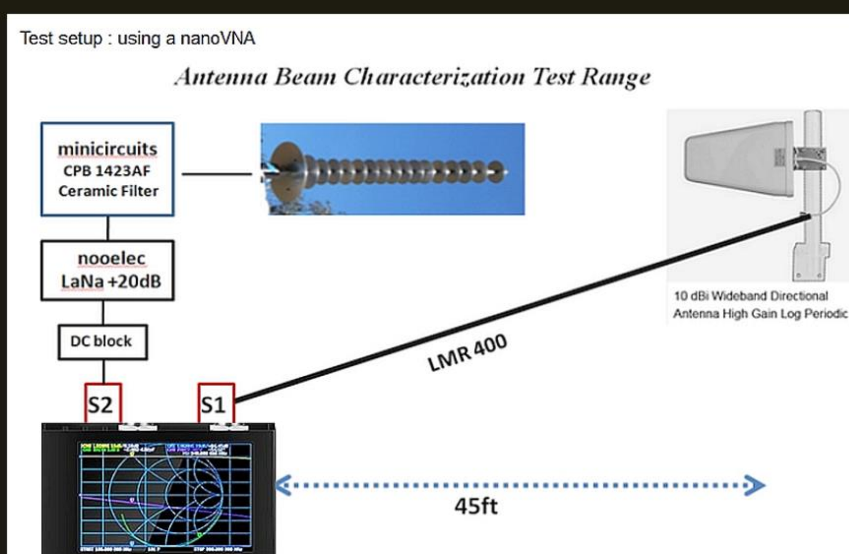
A series of tests was performed to physically

1) measure the beam-width of the antenna by incrementally rotating the antenna through a remote RF source and recording the Rx signal level

2) characterize the antenna's relative S/N by measuring the Hydrogen Spectra Peak at a reference point (declination + 40 dg right_assension 20:30 hrs) vs background 'Cold_Sky' signal level

b alex pettit jr Jun24 25

Antenna Beam Pattern Characterization Tests

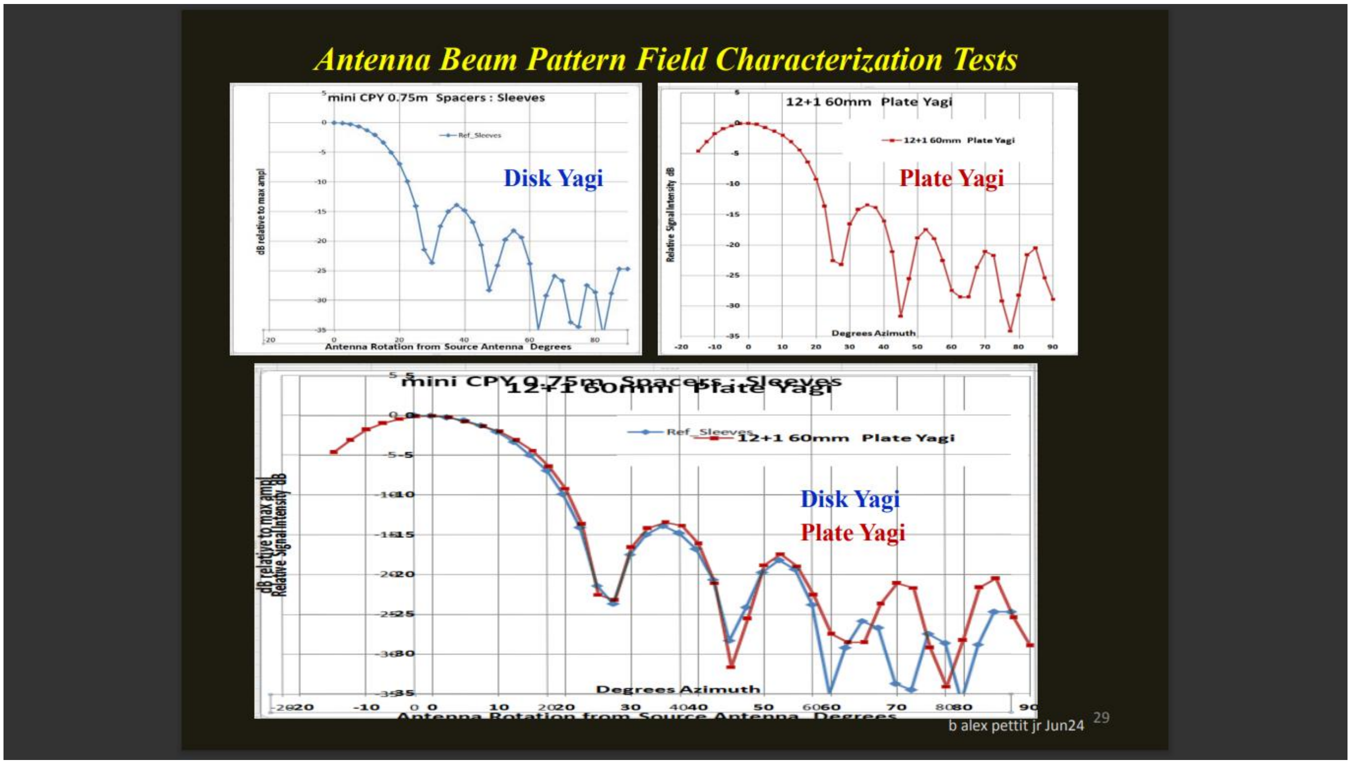


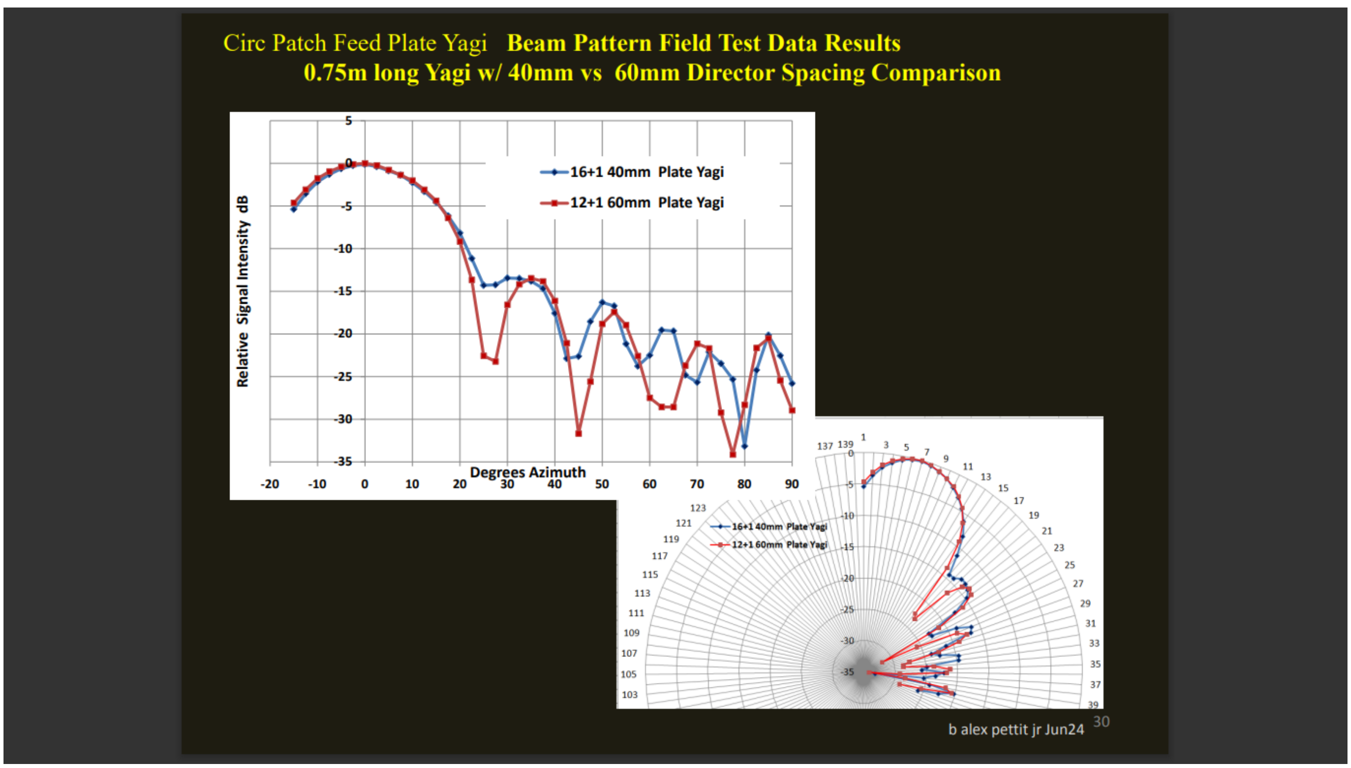
A Test Range was designed based on a nanoVNA to characterize the antenna's BEAM PATTERN

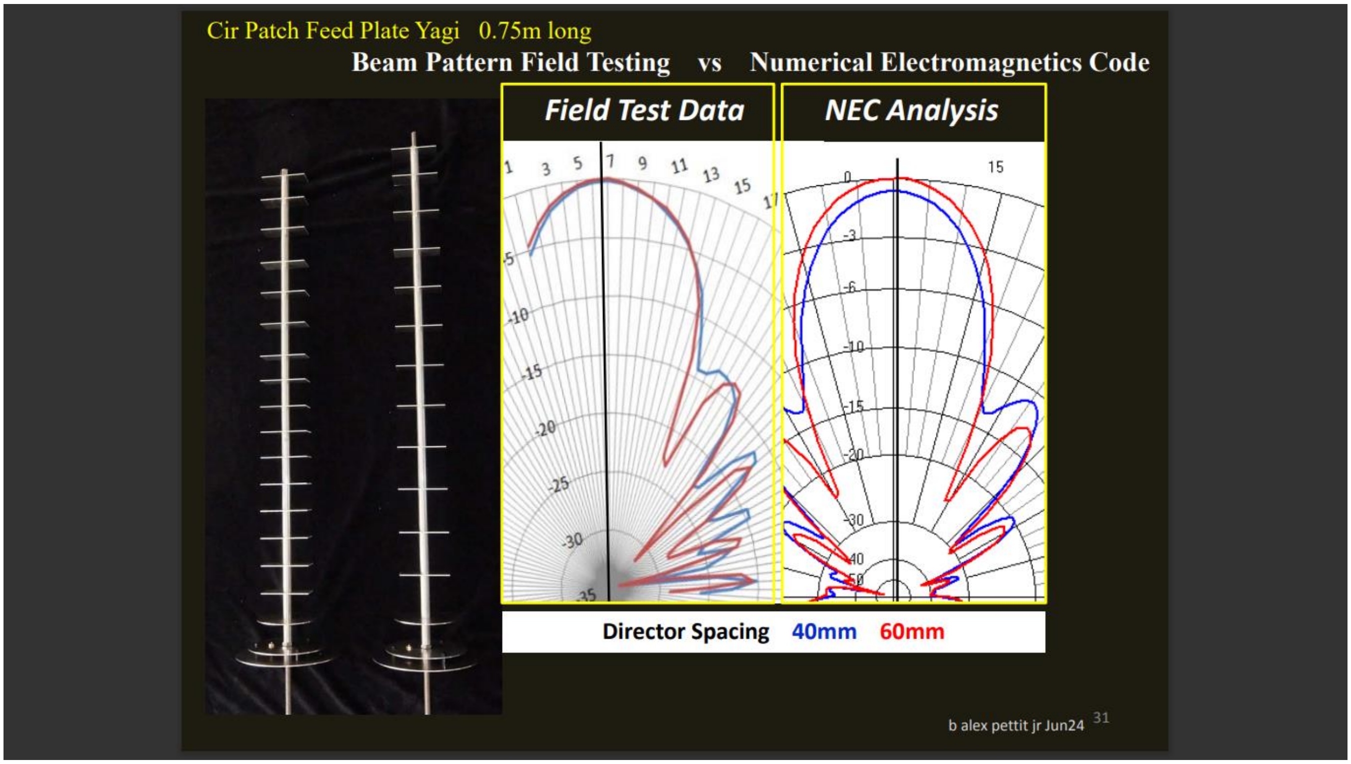
b alex pettit jr Jun24 26

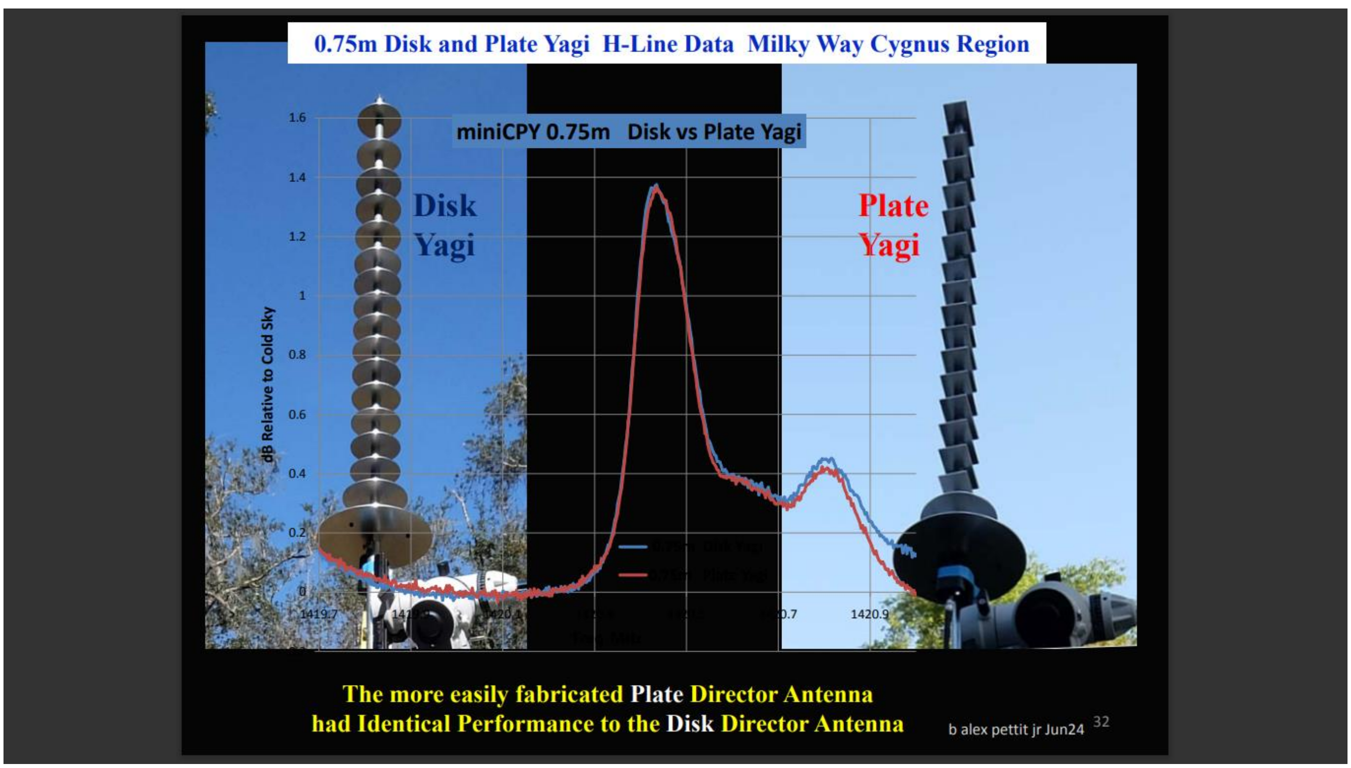

Circ Patch Feed Plate Yagi Beam Pattern Field Testing Setup
The Explore Sci EQ3 mount can be positioned into Az / El
The manual vernier control allowed
the antenna to be rotated through
Azimuth in 2.5 degree increments
b alex pettit jr Jun24
27

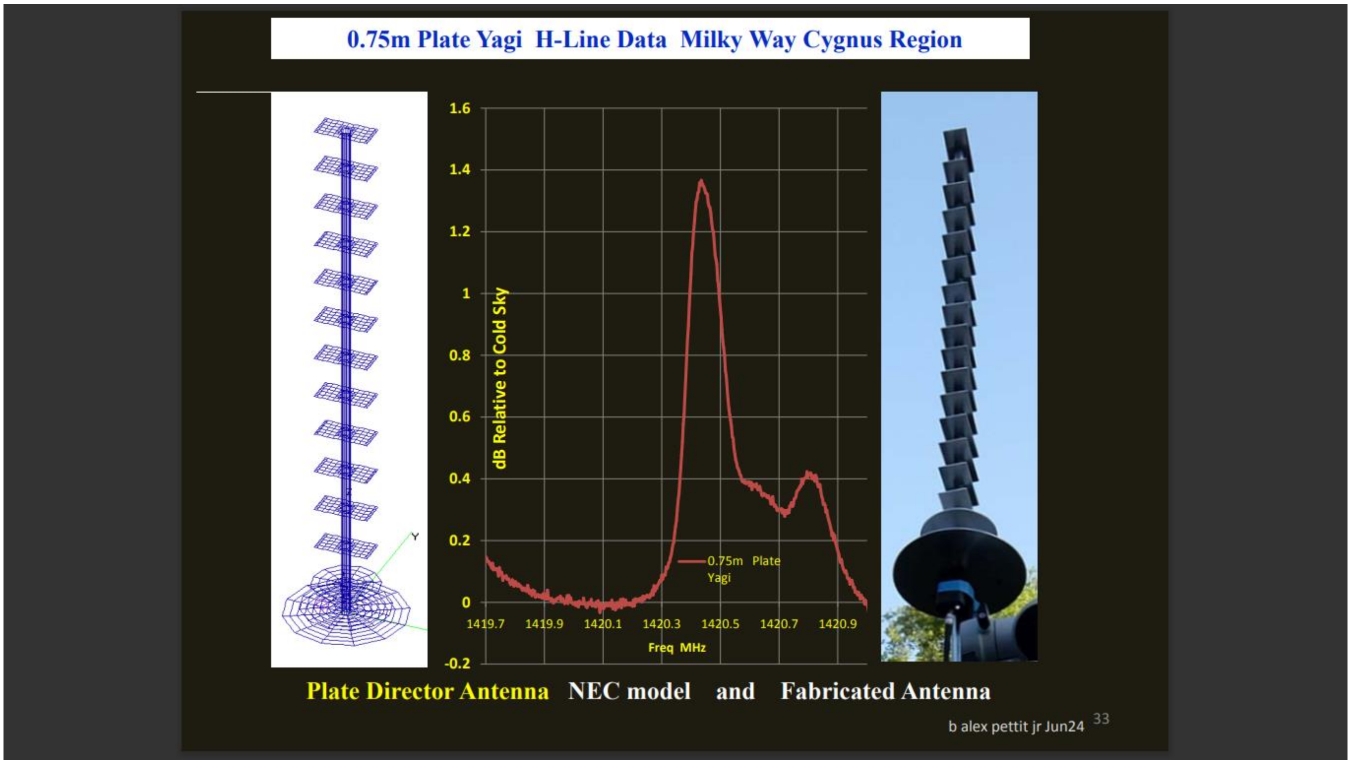

Circ Patch Feed Plate Yagi Beam Pattern Field Testing Setup
Tx Antenna
UUT
manual
vernier
nano VNA
BP filter
20dB LNA
Mount in Az El Mode
b alex pettit jr Jun24
28

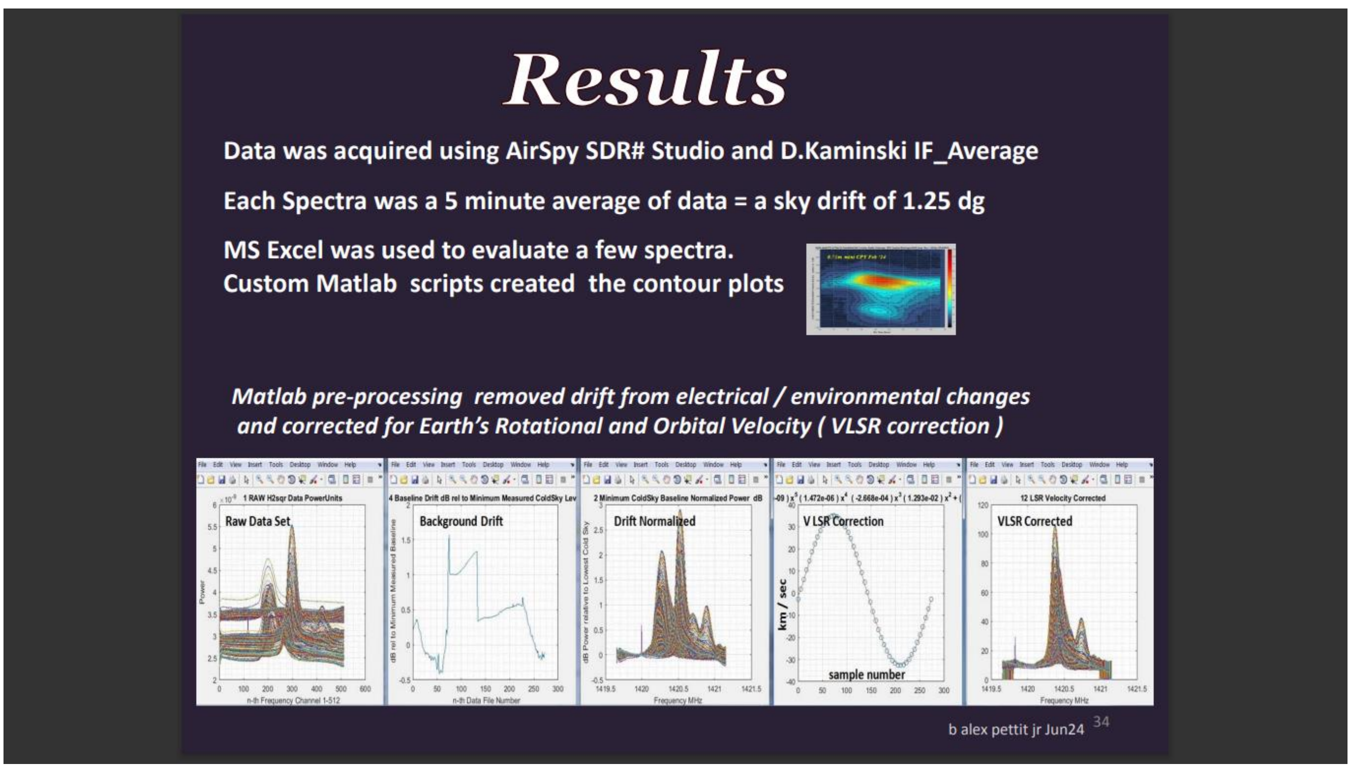

Antenna Beam Pattern Field Characterization Tests
mini CPY 0.75m Spacers : Sleeves
Disk Yagi
12+1 60mm Plate Yagi
Plate Yagi
Antenna Rotation from Source Antenna Degrees
Degrees Azimuth
Disk Yagi
Plate Yagi
b alex pettit jr Jun24
29

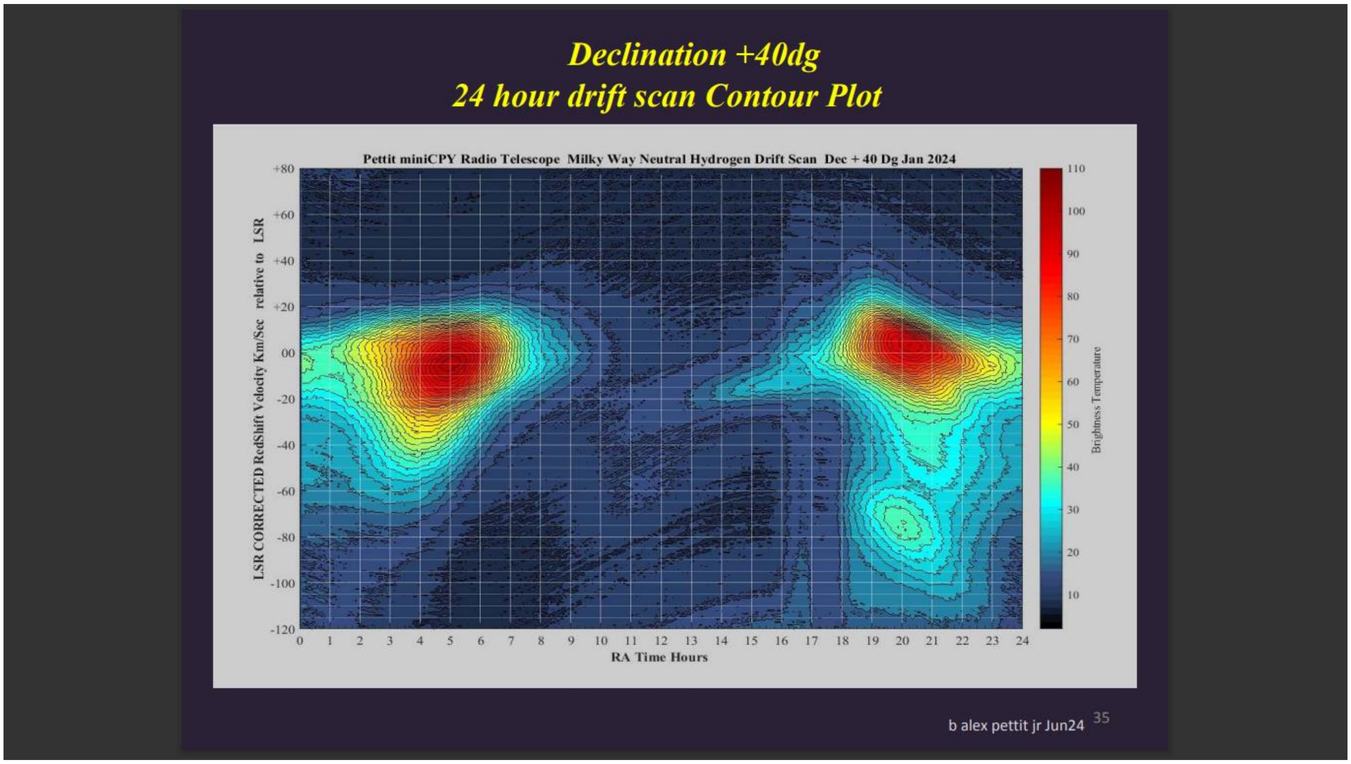

Circ Patch Feed Plate Yagi Beam Pattern Field Test Data Results
0.75m long Yagi w/ 40mm vs 60mm Director Spacing Comparison
16+1 40mm Plate Yagi
12+1 60mm Plate Yagi
Relative Signal Intensity dB
Degrees Azimuth
b alex pettit jr Jun24
30


Cir Patch Feed Plate Yagi 0.75m long
Beam Pattern Field Testing vs Numerical Electromagnetics Code
Field Test Data
NEC Analysis
Director Spacing 40mm 60mm
b alex pettit jr Jun24 31


0.75m Disk and Plate Yagi H-Line Data Milky Way Cygnus Region
miniCPY 0.75m Disk vs Plate Yagi
Disk Yagi
Plate Yagi
dB Relative to Cold Sky
The more easily fabricated Plate Director Antenna
had Identical Performance to the Disk Director Antenna
b alex pettit jr Jun24 32


0.75m Plate Yagi H-Line Data Milky Way Cygnus Region
dB Relative to Cold Sky
Freq MHz
0.75m Plate Yagi
Plate Director Antenna NEC model and Fabricated Antenna
b alex pettit jr Jun24 33


Results
Data was acquired using AirSpy SDR# Studio and D.Kaminski IF_Average
Each Spectra was a 5 minute average of data = a sky drift of 1.25 dg
MS Excel was used to evaluate a few spectra.
Custom Matlab scripts created the contour plots
Matlab pre-processing removed drift from electrical / environmental changes
and corrected for Earth's Rotational and Orbital Velocity (VLSR correction)
Raw Data Set
Background Drift
Drift Normalized
V LSR Correction
km / sec
sample number
VLSR Corrected
b alex pettit jr Jun24 34


Declination +40dg
24 hour drift scan Contour Plot
Pettit miniCPY Radio Telescope Milky Way Neutral Hydrogen Drift Scan Dec + 40 Dg Jan 2024
LSR CORRECTED RedShift Velocity Km/Sec relative to LSR
RA Time Hours
Brightness Temperature
b alex pettit jr Jun24
35


21cm Circular_Patch_Feed
Plate_Director Yagi Antenna
The End
36
b alex pettit jr Jun24

Sudden Frequency Deviations with Magnetic Effects Observed at Anchorage, Alaska
Whitham D. Reeve

Introduction: I previously reported an observation for 1 June 2024 of sudden frequency deviations (SFD) and radio blackout at 15 and 20 MHz (figure 1) {Reeve24}. These were produced by an X1.0 x-ray flare. An X1.2 x-ray flare 43 days later on 14 July produced SFDs at the same frequencies but no radio blackout (figure 2); the D-Region Absorption Prediction (D-RAP) plot shows the absorption too far west to affect the radio circuits (figure 3). The 14 July flare also produced geomagnetic effects described later. An M7.3 x-ray flare another 20 days later on 3 August produced strong SFDs (figure 4) and relatively minor radio blackout effects (figure 5). The principles of sudden frequency deviations may be found in {Reeve15}.

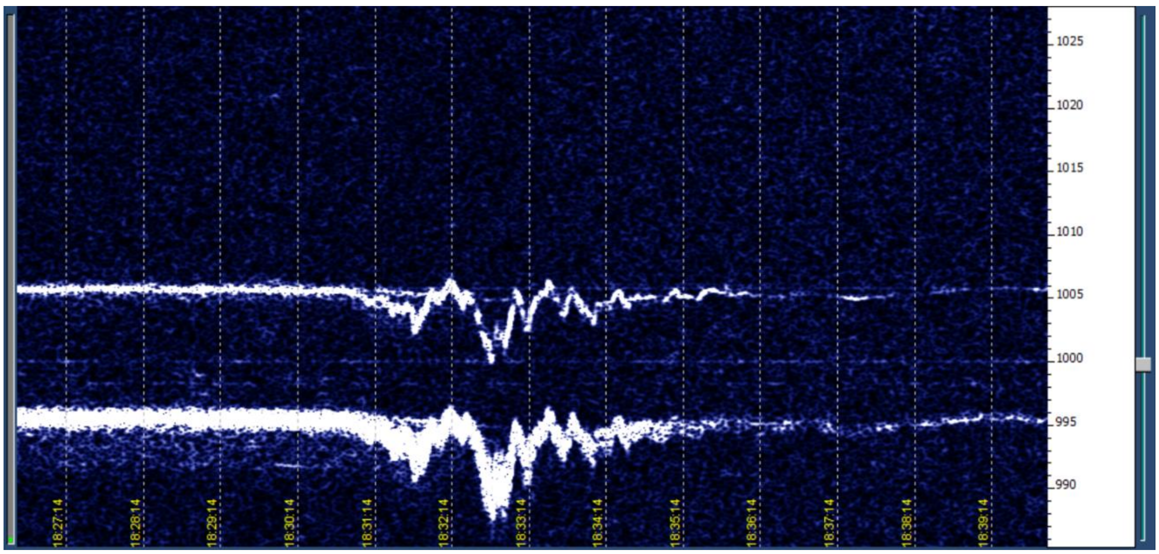


Figure 1 ~ Narrowband waterfall spectra from 1827 to 1840 UTC on 1 June observed at Anchorage, Alaska. The SFD starts at 1831 at both frequencies with a maximum peak-to-peak deviation of approximately 9 Hz at 15 MHz and 5 Hz at 20 MHz. The fainter traces following the SFDs indicate the onset of the radio blackout and reduced received signal levels. See text for a description of Argo plot features.

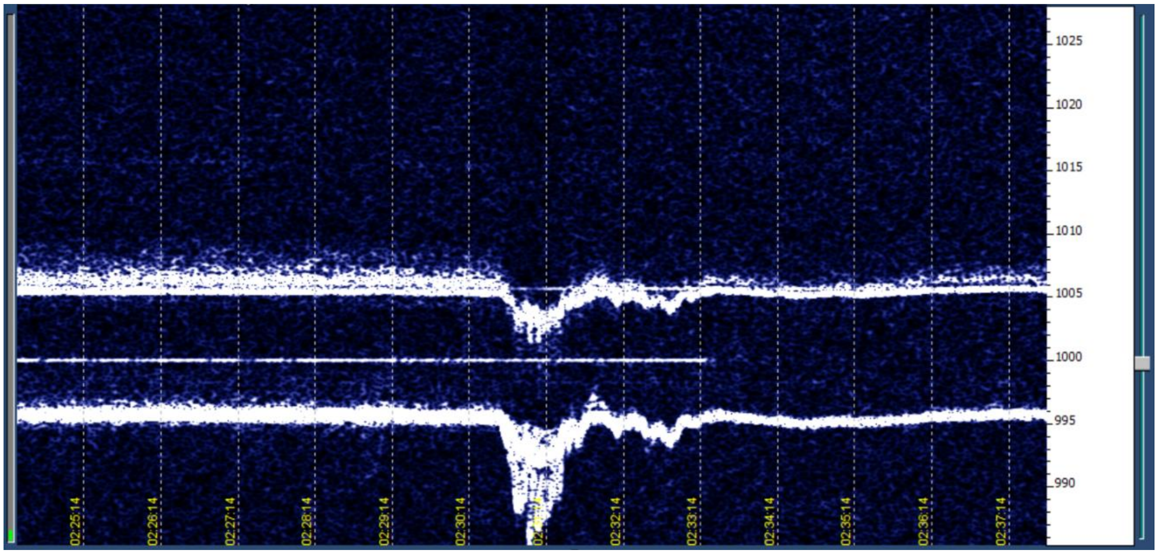


Figure 2 ~ Narrowband waterfall spectra from 0224 to 0238 UTC on 14 July observed at Anchorage, Alaska. The SFD starts just before 0231 at both frequencies with a maximum peak-to-peak deviation of at least 12 Hz at 15 MHz (lower trace) and 4 Hz at 20 MHz (upper trace). The thin trace at 1000 Hz is spurious but curiously ends at the time the SFDs end.

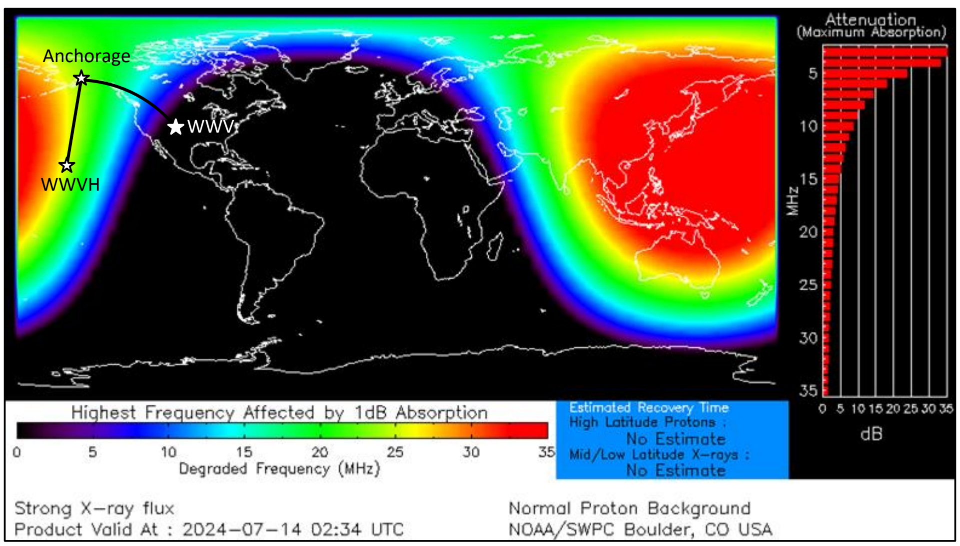


Figure 3 ~ Annotated D-RAP image for 0234 on 14 July shows that 20-26 MHz (green-yellow) are the highest frequencies to experience 1 dB absorption on southerly and westerly propagation paths to Anchorage at upper-left in southwestern Alaska from the WWVH in Hawaii and WWV in Colorado, respectively. Both path lengths are roughly 4000 km. Generally, lower frequencies experience more absorption (see histogram at right) but, in this case, absorption loss at 15 and 20 MHz was not apparent in the waterfall spectra shown above. Underlying image source: https://www.swpc.noaa.gov/products/d-region-absorption-predictions-d-rap

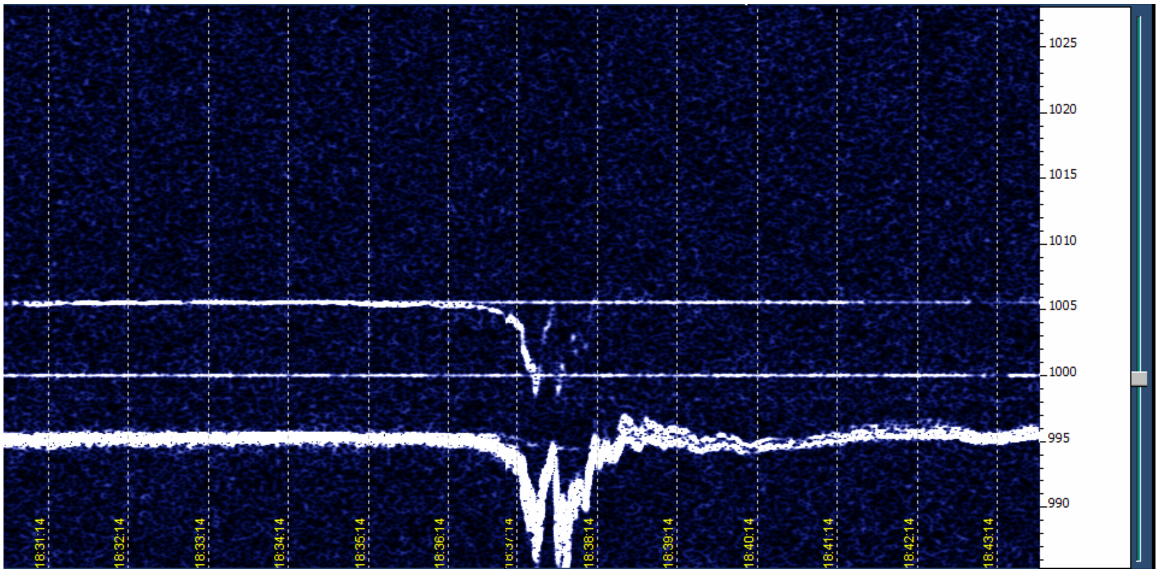


Figure 4 ~ Narrowband waterfall spectra from 1831 to 1844 UTC on 3 August observed at Anchorage, Alaska. The SFD starts at 1837 at both frequencies with a maximum peak-to-peak deviation of at least 12 Hz at 15 MHz (lower trace) and 6 Hz at 20 MHz (upper trace). The 20 MHz trace is relatively weak and appears to be an overlay of two signals but, since only WWV operates at 20 MHz, the straight thin trace probably is spurious. The thin trace at 1000 Hz is spurious. The double-peak may be caused by rapid expansion or contraction of the enhanced electron density slab or heating effects produced by the solar flare radiation. Real-time Argo plots are posted at: https://reeve.com/Meteor/Meteor_simple.html .

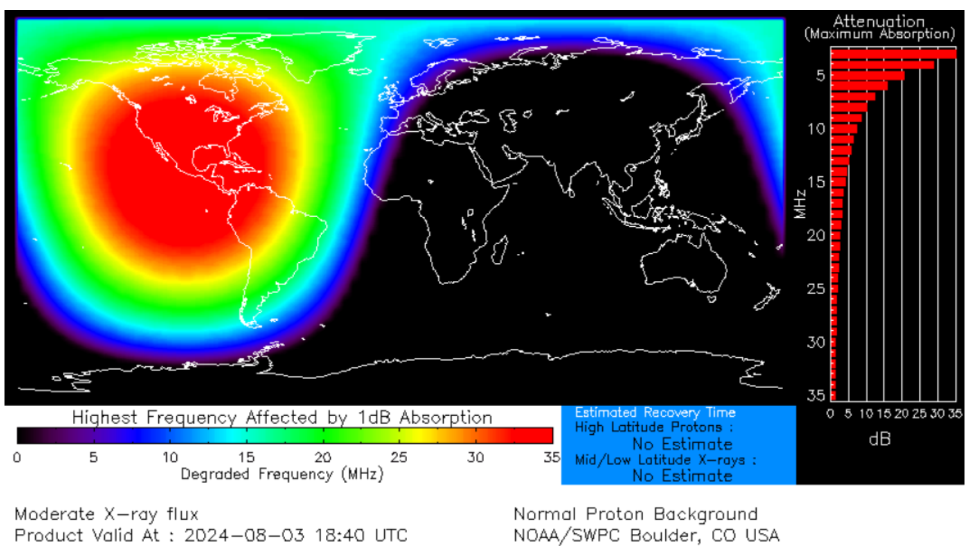


Figure 5 ~ D-RAP image for 1840 on 3 August shows 1 dB absorption at relatively high frequencies (26-35 MHz) with modest absorption at 15 and 20 MHz on the two radio paths to Anchorage. Image source: https://www.swpc.noaa.gov/products/d-region-absorption-predictions-d-rap

Geomagnetic effects: The 14 July flare produced a Solar Flare Effect (SFE), or Magnetic Crochet (so called because of its hook shape), that was detected by the Anchorage and HAARP SAM-III magnetometers (figure 6). No SFE was detected for the 3 August event.

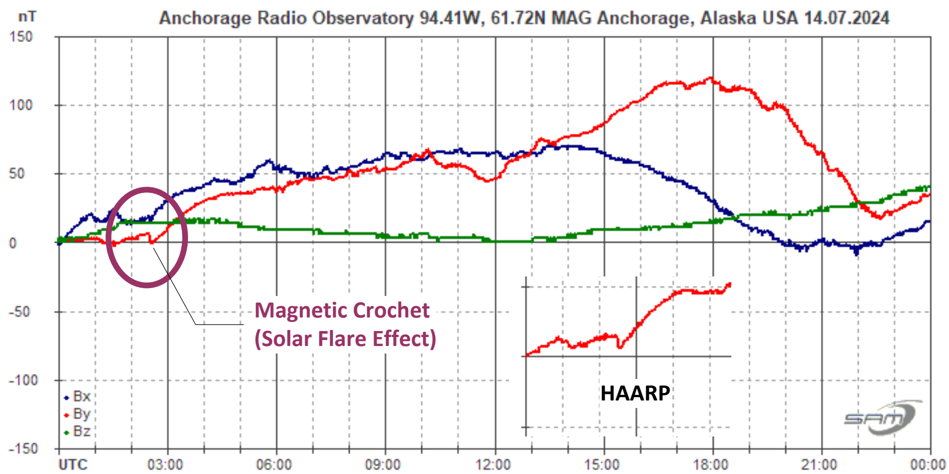


Figure 6 ~ Anchorage magnetogram for 14 July shows a Magnetic Crochet (circled). The effect, about 5 nT seen at 0230, is obvious only in the Y-component (east-west, red trace) of the local geomagnetic field. The local solar time was 4:30 pm. Inset shows the Y-component at the same scale observed by the SAM-III magnetometer at HAARP about 290 km east-northeast of Anchorage.

SFEs are very rare and are produced when a strong solar flare peaks very quickly. The rapid increase in x-ray radiation increases the electron density and conductivity in the ionosphere's D- and E-regions, quickly enabling higher current flow at those altitudes. The current produces a magnetic field that enhances or reduces Earth's ambient magnetic field at ground level depending on the magnetometer location with respect to the current. As the flare subsides, the ionosphere, electric currents and magnetic field return to their preflare conditions. Here, the rapid change in the external magnetic field momentarily opposed the local ambient field, reducing its east-west component by about 5 nT. For reference, the east-west component of the ambient field on 14 July at Anchorage was 3836 nT and 3932 nT at HAARP (values based on the *International Geomagnetic Reference Field, IGRF*, see {NOAA}).

SFEs are most often detected by magnetometers close to the sub-solar point, which is the point on Earth where the Sun is overhead and its radiation penetrating to the ionosphere is the strongest; however, in this case, the Sun was around 30° elevation and 4.4 hours west of Anchorage and 4.7 hours west of HAARP. The time offset is also seen in the first D-RAP image above (the Sun is at the center of the red area over the western Pacific).

Instrumentation: Icom R-8600 Communications Receivers were used at Anchorage Radio Observatory (figure 7). The receivers were connected through a receiver multicoupler to a rotatable KMA-1832 log periodic dipole array pointed south. The receivers were tuned nominally 1 kHz above the carrier frequency and set to the Lower Sideband (LSB) mode. This configuration demodulates as a nominal 1 kHz tone when the carrier is received. The demodulated audio outputs were connected to the PC soundcard Line In jack through a 6-port analog audio mixer.

The narrowband horizontal waterfall plots were produced by Argo software (see previous images). In the Argo plots, time is indicated left-to-right with 1 minute tick-marks (dotted vertical yellow lines). The frequencies of the demodulated carriers are indicated on the right vertical scale from 985 to 1030 Hz. The lower trace at 995 Hz corresponds to a 15 MHz carrier frequency (WWV and WWVH), and the trace at 1005 Hz near the middle of the frequency scale corresponds to a 20 MHz carrier frequency (WWV). Not seen in the plots is a trace at 1015 Hz corresponding to a 25 MHz transmitter (WWV), which was not being received at the time of the SFDs.

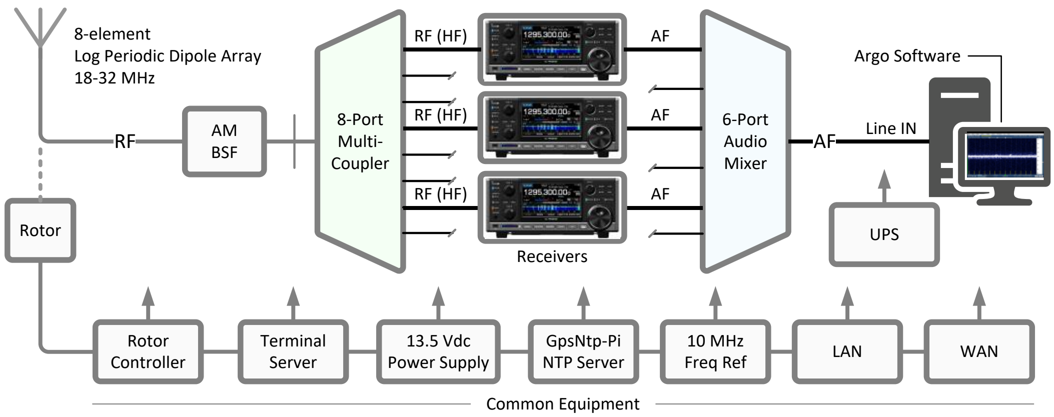


Figure 7 ~ Partial radio system block diagram. Only receivers, antenna and common equipment used in the present observations are shown here; additional receivers and antennas are equipped and assigned to projects as needed. The R8600 receivers are individually tuned to the desired carrier frequencies and offsets and the antenna is rotated south except when needed for other purposes. The horizontally polarized antenna has 8 elements and a design frequency range of 18 – 32 MHz but it is used over a much wider frequency range. A GNSS disciplined oscillator provides a 10 MHz reference frequency to the receivers, and a GNSS disciplined Network Time Protocol (NTP) server ensures accurate real-time clock and timestamps in the PC that runs the Argo software and other PCs on the LAN.

Geomagnetic observations were obtained from the SAM-III magnetometer at Anchorage Radio Observatory (figure 8). The SAM-III magnetometer at HAARP near Gakona provided confirmation of the SFE reported above. At Anchorage, the magnetometer sensors are remotely located approximately 30 m from the controller and 15 m from the LPDA antenna tower. To reduce temperature effects the sensors are buried 1 m below the ground surface in an area shaded by foliage. The three magnetic field sensors are configured in the *geocentric coordinate system* with the X-component sensor oriented +north, Y-component +east and Z-component vertical +down. The magnetometer has been in-service since 2009. Real-time magnetograms for Anchorage are posted at: https://reeve.com/SAM/SAM_simple.html .

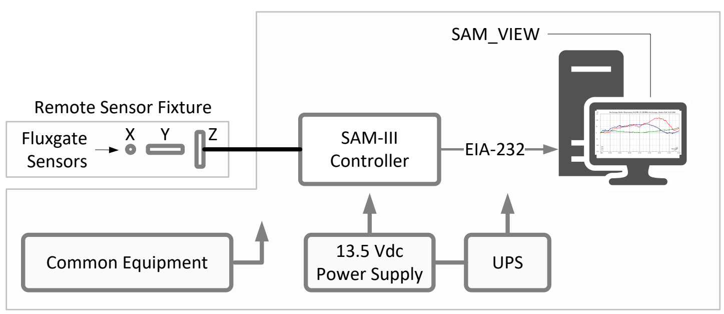


Figure 8 ~ SAM-III magnetometer block diagram. The magnetometer is configured to sample the three magnetic field components at 0.1 Hz rate. It displays the components in variometer mode, but it also records absolute magnetic flux density measurements. The SAM-III uses some of the same common equipment as the radio equipment shown above (for example, NTP time server, LAN and WAN), but the controller is in a different physical location and the SAM_VIEW software runs on a different PC.

References:

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Cepheus A 6.7 GHz methanol maser variability from summer 2023 data, a year after

by Dimitry Fedorov UA3AVR

One year ago, I published observation data of Cepheus A methanol maser, line 6.7 GHz obtained by small single dish 1.8 m telescope in June-August 2023 [1]. Ibaraki iMet database has published recently this maser data up to March 2024 [2] including the same period of 2023. Both sets of data are of somewhat different structure, and June-August 2023 data have a low signal-to-noise ratio (S/N); nevertheless, a possibility to compare them is present. Masers are interesting by their variability, and we can compare the variability parameters for both sets of data.

Data sets and variability calculations

Variability characteristics of masers can be estimated from low S/N data, but parameters of the background noise have to be taken into account. Low S/N data for Cepheus A maser were obtained in June-August 2023 [1]. This maser has a number of features with different velocities [3]. In the maser spectrum they can be grouped into two clusters: red and blue shifted spectral parts 2], see a sample spectrum at Figure 1. These parts show the negatively correlated (anti-correlated) behavior, what can be explained by theories with Keplerian rotation of the methanol disk-shaped cloud around the excitation center [4]. Graphical set of data in 2023 is shown on **Error! Reference source not found.** for all 16 observation days (16 points) from 2023-06-08 to 2023-08-06. As one can see, the noise can contribute significantly, and it has to be taken into account in variability estimations.

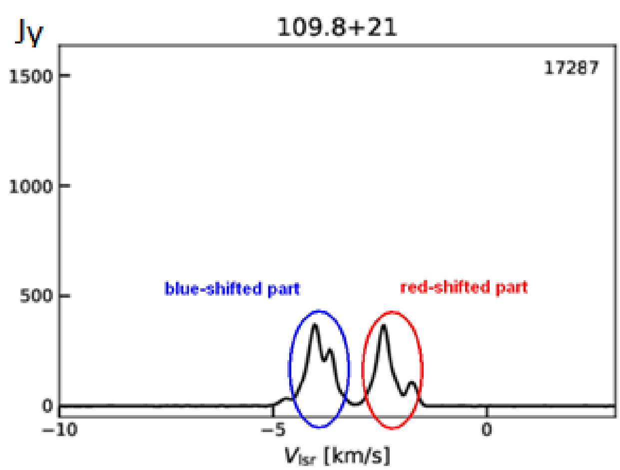
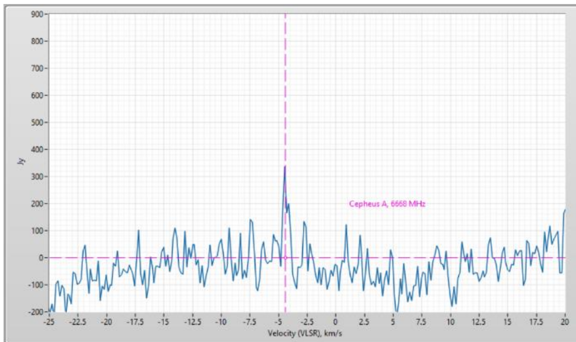
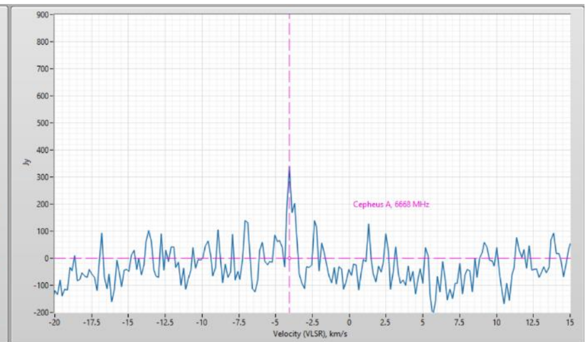


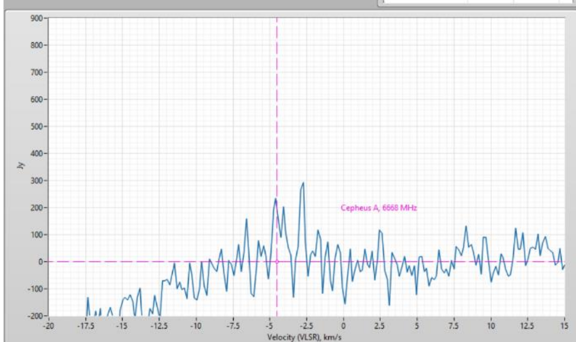
Figure 1. Cepheus A maser parts, sample spectrum is taken from [2].



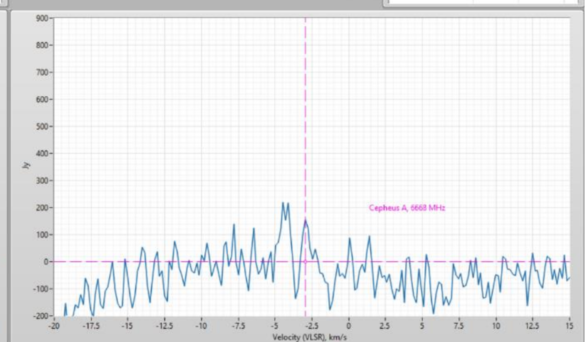
2023-06-08, int. 2 hours



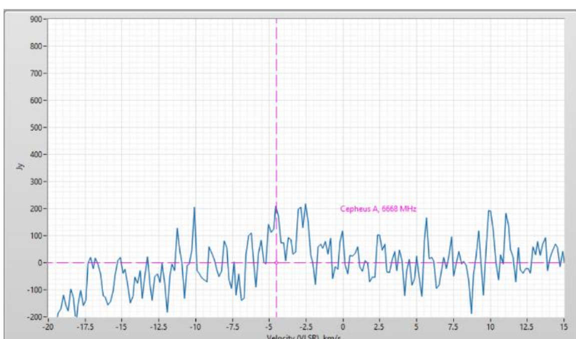
2023-06-12, int. 2 hours



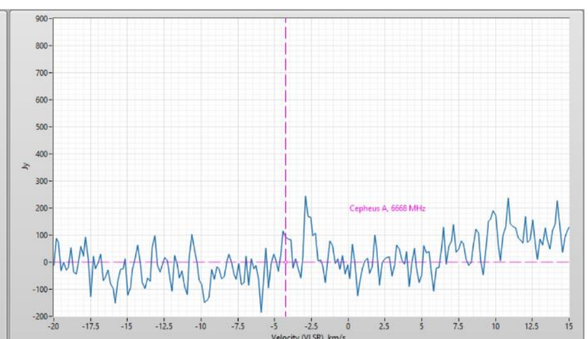
2023-06-17, int. 2 hours



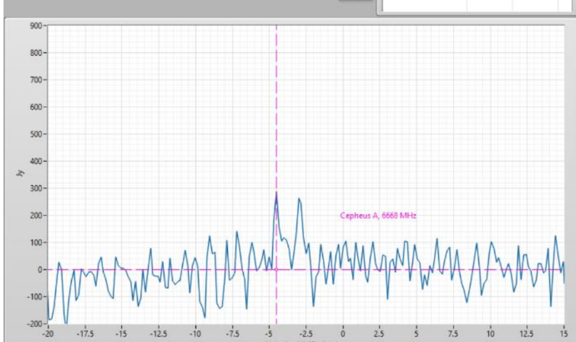
2023-06-26, int. 2 hours



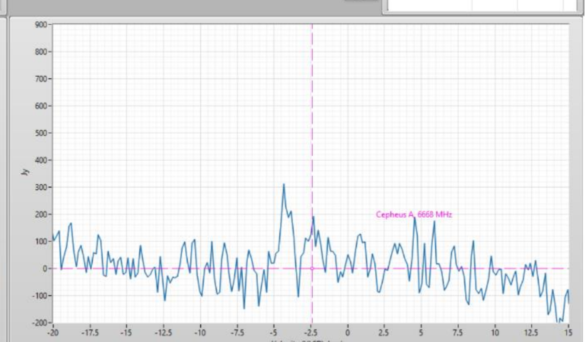
2023-07-02, int. 2 hours



2023-07-05, int. 2 hours



2023-07-09, int. 2 hours



2023-07-12, int. 2 hours

Figure 2. Cepheus A maser data (4 pictures up), June - August 2023 [1], integration time – 2 hours, background integration – 3 hours without fitting.

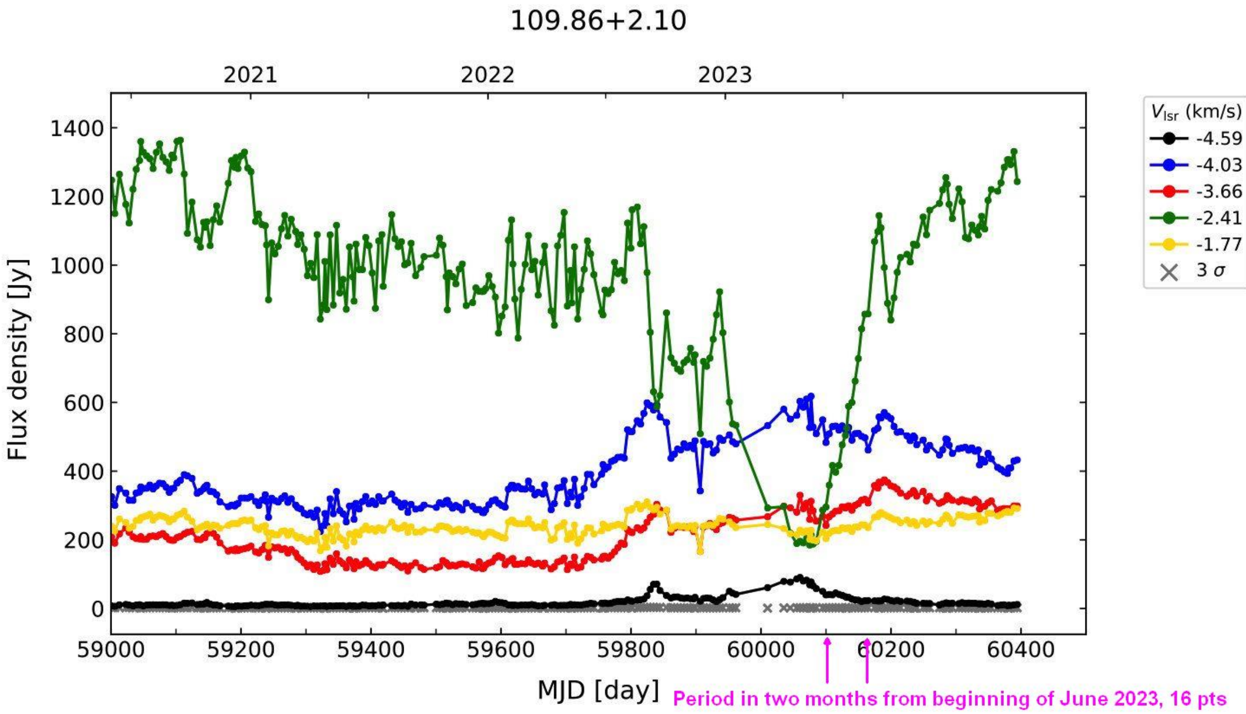


Figure 2. Cepheus A data from Ibaraki iMet database up to 31 March 2024, picture from [2].

Fresh data from iMet Ibaraki [2] are shown at Figure 2; the period in two month from the beginning of June 2023 is also marked on the picture. As one can see, this period is of significant changes in this maser.

These data are given for 5 different Cepheus A features, see Figure 2. For comparison to two-part low S/N data, I have grouped the features with VLSRs -1.77, -2.41 km/s into the red part, and with -3.66, -4.03, -4.59 km/s into the blue part; the flux densities in each group are summed together. It is assumed the Ibaraki iMet data for Cepheus A almost not contain the noise; they give also 16 points for every feature and for red and blue parts after grouping.

The variability index **VI** for low S/N is calculated like in [4,5]. Following formulas are applied for each of blue and red parts,

$$\mathrm{VI_i} = \frac{\sqrt{\mathrm{S_i^2} - \sigma^2_{\mathrm{Noise}}}}{\langle \mathrm{P} \rangle_\mathrm{i}}, \quad \langle \mathrm{P} \rangle_\mathrm{i} = \frac{1}{\mathrm{L}} \sum_{\mathrm{k}=1}^{\mathrm{L}} \mathrm{P_{i,k}}, \quad \mathrm{S_i^2} = \frac{1}{\mathrm{L}-1} \sum_{\mathrm{k}=1}^{\mathrm{L}} \left(\mathrm{P_{i,k}} - \langle \mathrm{P} \rangle_\mathrm{i}\right)^2, \quad \mathrm{i} = \text{blue, red}. \tag{1}$$

Here $\mathbf{P_{i,k}}$ is the peak value in Jy of i = blue or red parts and for **k**-th day of observations, **L**=16 – is the number of observations (one result per a day), $\langle \mathrm{P} \rangle_\mathrm{i}$, $\mathrm{S_i^2}$ – are the statistical means and variances for the blue or red parts, corresponding deviations are $\mathrm{S_i} = \sqrt{\mathrm{S_i^2}}$, $\sigma^2_{\mathrm{Noise}}$ – is the variance of background noise, corresponding value of the deviation $\sigma_{\mathrm{Noise}} = \sqrt{\sigma^2_{\mathrm{Noise}}}$. As one can see, the variability indexes $\mathbf{VI_i}$ were composed from the parts variations $\mathrm{S_i^2}$ and the background noise variation $\sigma^2_{\mathrm{Noise}}$; each part and the background noise are assumed statistically independent.

The noise deviation σ_{Noise} is estimated approximately 1/3 of seen noise peaks from the data plots and can be in 50-70 Jy range for low S/N data **Error! Reference source not found.**. For Ibaraki iMet data $\sigma_{\mathrm{Noise}} \approx 0$, $\sigma^2_{\mathrm{Noise}}$ in variability index formulas (1) is taken =0.

The results for mean values, deviations and indexes **VI**$_i$ are collected in Table 1:

Table 1. Cepheus A variability characteristics according to low S/N data and Ibaraki iMet data [2], June-August 2023.

Means	Deviations	Variability indexes, σ_{Noise} = 50 Jy	Variability indexes, σ_{Noise} = 70 Jy	Variability indexes, Ibaraki iMet data
$\langle P \rangle_{blue}$ = 261.5 Jy	S_{blue} = 70.3 Jy	VI_{blue} = 0.19	VI_{blue} = 0.02	VI_{blue} = 0.03
$\langle P \rangle_{red}$ = 285.3 Jy	S_{red} = 102.9 Jy	VI_{red} = 0.32	VI_{red} = 0.26	VI_{red} = 0.25

As it follows from obtained **VI**$_i$ values in table Table 1, the red part variability is higher than for the blue part.

The variability indexes by (1) for Ibaraki iMet data with σ^2_{Noise} =0 for 16 points in period of two months from beginning of June 2023 are in right column of Table 1. Good coincidences with the low S/N results were obtained, especially for noise parameter σ_{Noise} =70 Jy.

The correlation coefficient of the spectrum parts is calculated by

$$r = \frac{1}{S_{blue}\, S_{red}\, (L-1)} \sum_{k=1}^{L} \left(P_{blue,k} - \langle P \rangle_{blue}\right)\left(P_{red,k} - \langle P \rangle_{red}\right). \quad (2)$$

The correlation coefficient does not contain adjustment parameters. The result **r** = –0.104 is negative as expected; calculations from Ibaraki iMet data give **r** = –0.099, i.e. very close to correlation coefficient from low S/N data. For calculations by (2) from Ibaraki iMet data 5 features are grouped as above for the variability indexes.

Discussion and concluding notes

Variability characteristics of masers can be obtained from low S/N data; parameters of the background noise should be taken into account. The deviation of the background noise σ_{Noise} was used as a noise parameter. The variability indexes were calculated for Cepheus A maser, data from June-August 2023; the value of σ_{Noise} can be estimated about 1/3 of seen peaks of the background noise. The negative correlation for blue and red parts of Cepheus A maser was obtained. Comparisons to corresponding Ibaraki iMet data give a good coincidence for the variability indexes as well as for the correlation coefficient of blue and red parts. As one can see from iMet data plots, analyzed period is of significant changes in this maser.

I initially expected higher absolute values of the correlation coefficient **r**. When the median feature in iMet data -3.66 km/s is moved from the blue part to the red part, the correlation coefficient becomes **r** = – 0.702, i.e. about the initially expected value. Really, this feature belongs to the blue part definitely, and close correlation coefficients **r** for both sets of data confirms this. As a conclusion, the movement in the Cepheus A molecular cloud is more complex than can be imagined form anti-correlated two spectral parts, which are well visible from low S/N data.

References

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[2] Ibaraki methanol maser line 6.7 GHz database iMet, http://vlbi.sci.ibaraki.ac.jp/iMet/data/109.8+21/, Cepheus A data.

[3] Koichiro Sugiyama et al, *A Synchronized Variation of the 6.7 GHz Methanol Maser in Cepheus A*, arXiv:0804.4623v1 [astro-ph] (2008).

[4] M. Szymczak et al, *6.7 GHz methanol maser variability in Cepheus A*, MNRAS **439**, pp 407–415 (2014).

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Observation Reports

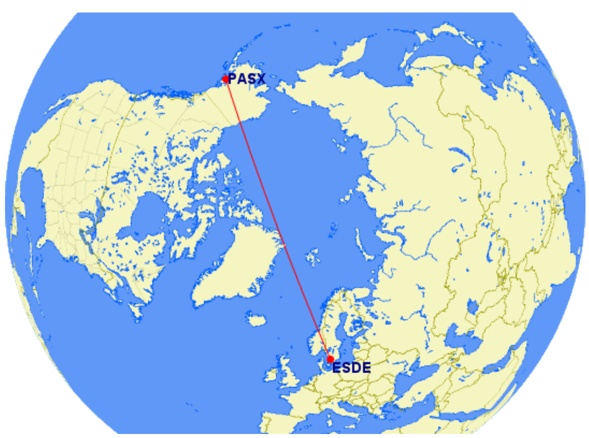
SAQ Reception at Cohoe, Alaska on 30 June 2024

Whitham D. Reeve

Introduction: The very low frequency band (VLF, 3 – 30 kHz) is used mostly for military undersea naval communications, but it has non-military uses as well. Here, I report the commemorative transmissions on 17.2 kHz by the historic civilian station SAQ. The transmissions take place three or four times each year. I first attempted to receive them at Cohoe Radio Observatory on 1 July 2018 (Reeve18} and have successfully received almost all of them to date. SAQ uses its original *Alexanderson System* radio frequency alternator (rotary transmitter), which is operated and maintained at Grimeton in Sweden by the Alexander Grimeton Friendship Association. See {SAQ} for more information on the station.

This article describes the reception at Cohoe on 30 June 2024 of the Alexanderson Day transmissions commemorating the station's 100 year anniversary (the station and associated transmitter originally entered commercial service on 1 December 1924). The anniversary transmissions consisted of identical Morse code messages at 0900 and 1200 UTC; the duration of each transmission was almost 10 minutes.

Propagation path: SAQ is located on a true azimuth of 009° and a distance of 6900 km from Cohoe. The great circle path nearly passes over the Magnetic North Pole (figure 1). According to sea ice maps for June and July 2024 (https://nsidc.org/arcticseaicenews/2024/), the path from Grimeton was over open water to the northern coast of Greenland and over ice from there to the northern coast of Alaska. The remaining distance was over land to Cohoe.



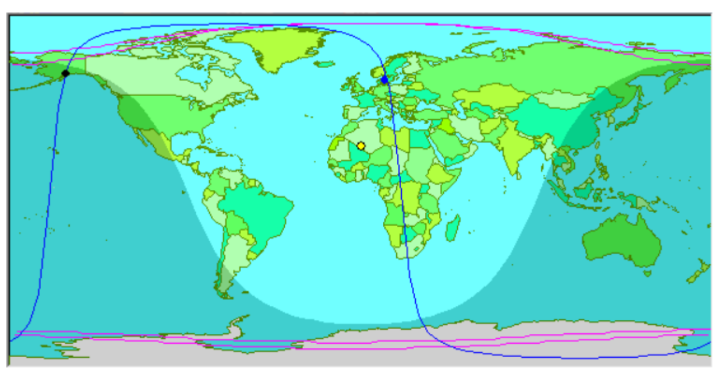


Figure 1 ~ Left: Map showing the great circle path between the airports nearest Cohoe and Grimeton. Image source: http://www.gcmap.com/mapui?P=PASX-esMT&MS=wls&DU=mi ; Right: Solar terminator map for 30 June 2024 at 0900. The short and long propagation paths are shown by the blue line and the Sun is the yellow circle over northwest Africa. It is seen that almost all of the path and the SAQ station were sunlit at 0900. Both stations and the path were sunlit for the later transmission at 1200, which may explain the slightly weaker received signal at that time. Image source: DXView

Instrumentation: The Cohoe instrumentation consisted of a shop-built, rotatable, passive, untuned, square loop antenna with 1.2 m diagonal dimension described at {Loop} and {Cohoe}, a shielded twisted pair transmission line and an SDRPlay *SDRduo* software defined radio (SDR) receiver with *SDRuno* software. The antenna was rotated to 000° true azimuth. The SDR sampling rate was set to 2 MHz with 32X decimation, giving an effective rate (and maximum displayed spectrum width) of 62.5 kHz. The receiver was set to the Zero IF (ZIF) mode with the local oscillator (LO) set to 31 kHz. The software was scheduled beforehand to record the receiver I-Q data streams for later analysis because the transmissions were to take place at 1 am and 4 am local Alaska Daylight Time. The recorded data were retrieved several hours later and then played back to produce the spectrum waterfall displays shown below.

Spectrum waterfall displays: The following screenshots (figure 2) were taken from the recorded I-Q data streams. The timestamps shown in the waterfalls are actual. No FFT averaging was used.

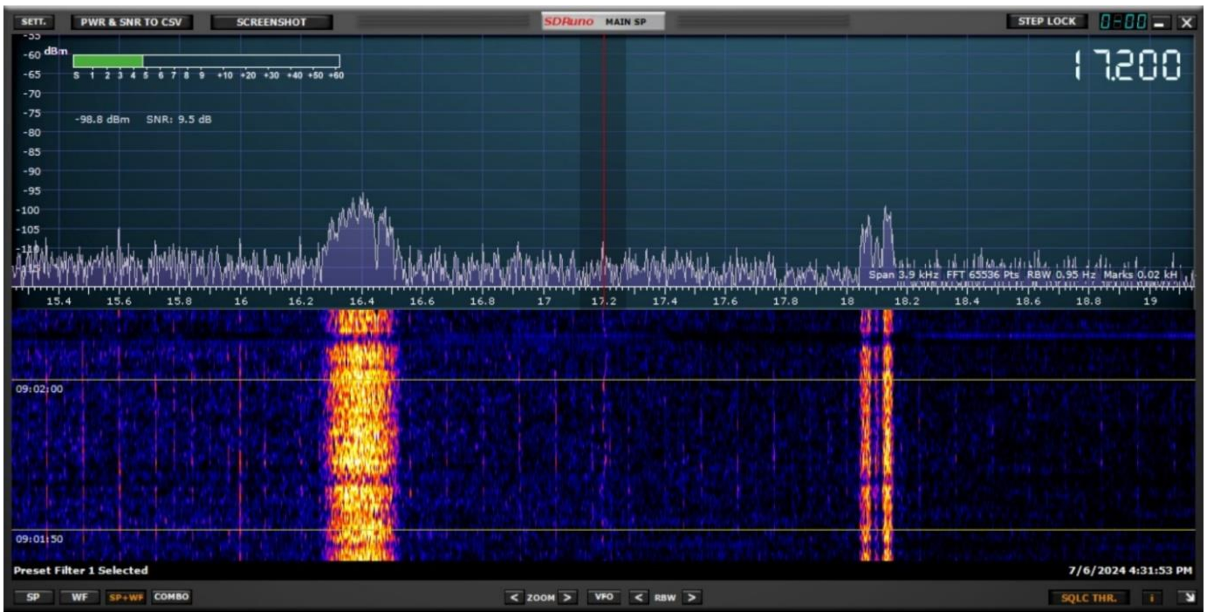


Figure 2.a ~ Waterfall spectra from 15.3 to 19.1 kHz with the SAQ signal at 17.2 kHz in the middle. Relative received signal power level is shown in dB on the left-vertical scale and frequency in kHz is shown along the middle-horizontal scale. The signal is very weak and indiscernible in the spectra but visible in the waterfall. The vertical lines in the waterfall are powerline harmonics at 120 Hz intervals. The brighter signal on the left is the Norwegian VLF station JXN at 16.4 kHz and the two signals to the right centered on 18.1 kHz are thought to be a Russian VLF station.

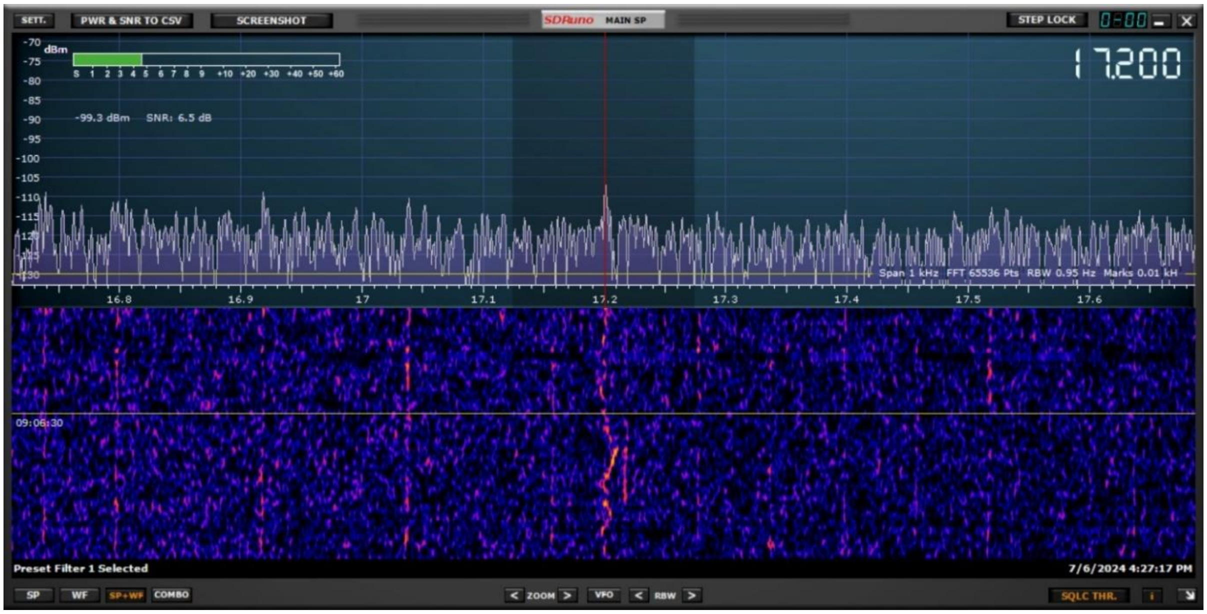


Figure 2.b ~ The displayed frequency range has been reduced to show 16.7 to 17.7 kHz. The SAQ signal near the middle is very weak but visible in the spectra and in the waterfall along with powerline harmonics at 120 Hz intervals. Rapid frequency drifts of around 5 Hz are visible just before the timestamp at 0906:30.

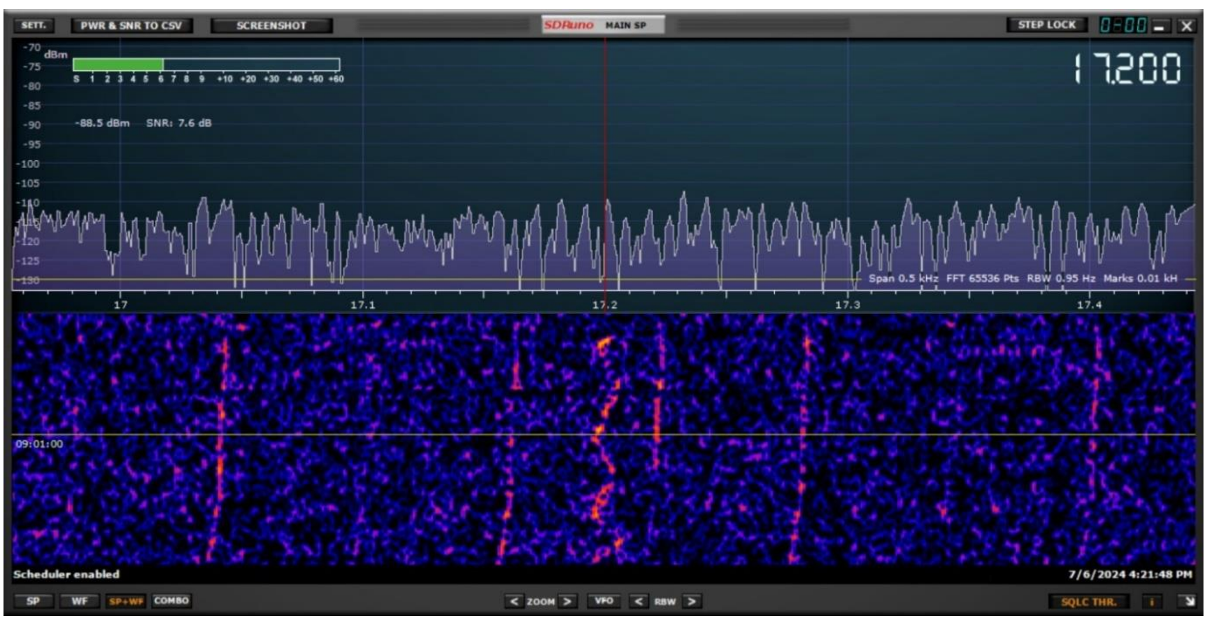


Figure 2.c ~ The waterfall spectra range has been changed to show the range 16.95 to 17.45 kHz. The SAQ signal is clearly visible near the middle of the waterfall, but its associated spectrum is indiscernible at the time of this screenshot. Rapid frequency drifts of around 10 Hz are visible for the duration of the waterfall (about 15 s).

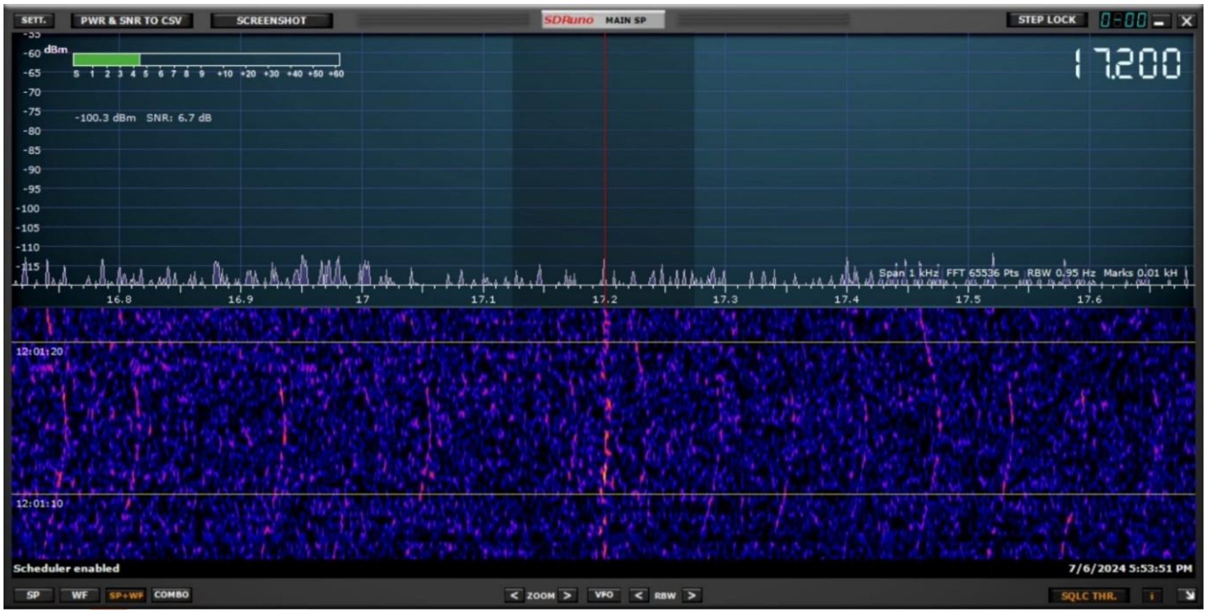


Figure 2.d ~ This display shows the second transmission at 1201 with a displayed frequency range from 16.7 to 17.7 kHz. The SAQ signal is much more stable than the first transmission a few hours earlier but is slightly weaker.

Discussion: The durations of the transmissions were 9 min 20 s for the transmission at 0900 and 9 min 15 s at 1200. The first transmission showed some frequency instability with rapid fluctuations between 17.200 kHz and 17.210 kHz (spectrum resolution bandwidth was 0.95 Hz); the second transmission was more stable. All waterfalls show powerline harmonics at 120 Hz intervals but none of the harmonics fell on 17.2 kHz.

The received signal levels for both transmissions on 30 June 2024 were very weak but the carriers were clearly visible in the spectrum waterfalls. The second transmission at 1200 was marginally weaker than the first one at 0900. I could hear the demodulated CW only occasionally above the background noise during each transmission, but it was never clear enough to decode.

A first-order estimate of the receiver input signal power at Cohoe was made for the Alexanderson Day transmissions in 2018 {Reeve18}. That estimation method was based on a couple broad conditions: 1) Whether the path was on the day or nightside of Earth; and 2) Whether the path was over land or water. Both conditions were the same in 2018 and 2024. However, the sunspot cycle was near minimum in 2018 and near maximum in 2024, and the estimation did not specifically account for any effects that the sunspot cycle might have on propagation and the signal level.

The estimated receiver input signal power in 2018 was –112 dBm. It is seen from the above spectrograms that the 6 year old estimate was close to actual in 2024. However, the displayed noise floor during the 2018 transmissions was 10 – 15 dB lower and the demodulated signals were more readable. I also successfully received the SAQ transmissions on Alexanderson Day in 2019 {Reeve19}, very close to the solar cycle minimum. The signal levels were about 8 – 10 dB higher but still reasonably close to the first order estimate made the year before. The noise floor in 2019 was about 7 – 8 dB lower than in 2024 but not as low as in 2018.

In addition to the possible solar cycle effects, there may be other reasons for the differences in the noise floors in 2018, 2019 and 2024. In particular, powerline noise and other local noise sources at Cohoe are known to change on both short and long time scales and may have contributed to the differences.

The signals received at Cohoe from SAQ were much stronger during the UN Day commemorative transmissions on 24 October 2023. The SAQ signals presumably followed the same physical path over the North Pole to Cohoe as they did in 2024 (VLF signals do not necessarily follow great circle paths), so the main variable, in this simple first-order comparison, is whether the path was sunlit or dark. During the October 2023 transmissions, the propagation path was almost entirely dark as opposed to almost entirely sunlit during the June 2024 transmissions. VLF signals experience more absorption loss on sunlit paths because of the increased ionization in the lower ionosphere, so the received signal levels usually are lower, possibly explaining the weaker signals in 2024 compared to 2023.

References:

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{Loop} Reeve, W., Square VLF Loop Antenna, 1.2 m Diagonal ~ Mechanical and Electrical Characteristics and Construction Details: https://reeve.com/Documents/Articles%20Papers/Reeve_SquareLoopAntenna1.2m.pdf

{Reeve18} Reeve, W. Reception of SAQ Transmissions at Cohoe Radio Observatory on 1 July 2018: https://reeve.com/Documents/Articles%20Papers/Reeve_SAQ-Jul2018.pdf

{Reeve19} Reeve, W. Reception of SAQ Transmissions at Cohoe Radio Observatory on 30 June 2019: https://reeve.com/Documents/Articles%20Papers/Reeve_SAQ-Jun2019.pdf

{SAQ} The Alexander Association, Grimeton SAQ veteran radio friends: https://alexander.n.se/?lang=en

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Paris, 04 July 2024

Bulletin C 68

To authorities responsible for the measurement and distribution of time

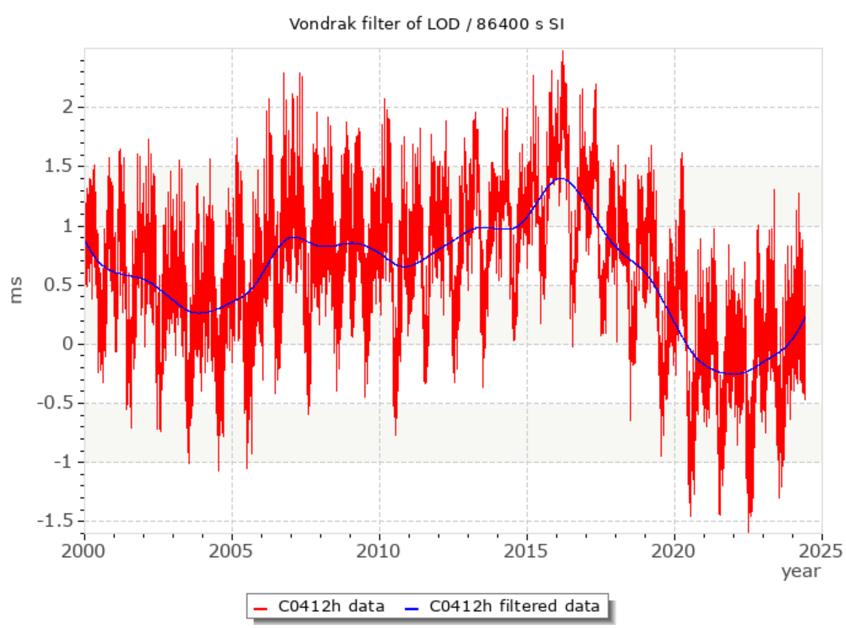
INFORMATION ON UTC - TAI

NO leap second will be introduced at the end of December 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



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 present (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 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: Marcus Fisher, 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

Name	**Term expires**	**Email**
Dennis Farr	2026	dennisfarr@verizon.net
Dr. Wolfgang Herrmann	2025	messbetrieb@astropeiler.de
Paul Butler	2025	paul.butler.melbourne@gmail.com
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Ted Cline	2025	TedClineGit@gmail.com
Jay Wilson	2026	jwilson@radio-astronomy.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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Grant Committee	Tom Crowley	grants@radio-astronomy.org
Membership Chair	http://www.radio-astronomy.org/contact/Membership-Chair	
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.net/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.net/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	https://www.csiro.au/ There's a wealth of info on this site of the Australian National Science Agency. It's much more than just radio astronomy. Looking under "Research" opens a real family tree of interesting pages of things they are involved with.

Found an interesting Grote Reber link: https://www.utas.edu.au/groterebermuseum Their gallery is interesting, but sure wish they had some captions to indicate who and what some of it is about. I can guess, knowing some of Grote's stories, but others might need more info. Several pictures show the University of Tasmania 26m dish that was once one of the NASA worldwide Satellite Tracking and Data Network (STDN) dishes like the ones at the Pisgah Astronomical Research Institute (www.pari.edu). PARI's dishes were the first qualification units for that network.

For Sale, Trade and Wanted

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

New on-demand store for SARA SWAG! https://saragifts.org/

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

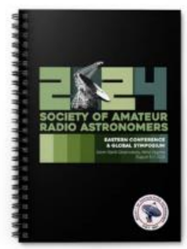
radio-astronomy.org/store.

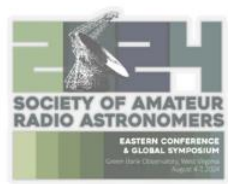
The Journal archive covers the society journal "Radio Astronomy" from the founding of the organization in 1981 through the present. Articles cover a wide range of topics including cosmic radiation, pulsars, quasars, meteor detection, solar observing, Jupiter, Radio Jove, gamma ray bursts, the Itty Bitty Telescope (IBT), dark matter, black holes, the Jansky antenna, methanol masers, mapping at 408 MHz and more.

New! **SARA On-Demand Store: https://saragifts.org**

These are the current items – more to come in the future!

(Note: No returns or refunds possible because of the on-demand production approach)













EST. 1981






SOCIETY OF AMATEUR RADIO ASTRONOMERS
EST. 1981


SARA Brochure

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.

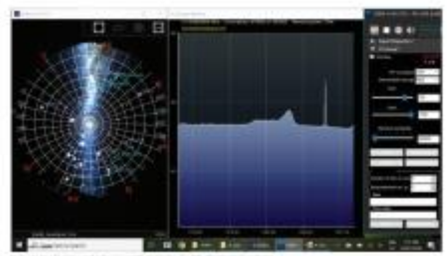
For further information, see our website at:

http://radio-astronomy.org/membership

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.

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.



http://radio-astronomy.org

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

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)