



***Lichfield Radio Observatory (LRO)
Setting up a radio observatory***

Dr Andrew Thornett, M6THO

www.astronomy.me.uk

LRO in the Snow
3/12/2023

***Talk for ASP Radioastronomy
meeting 21/1/24***

10-15 years ago, I had a remarkably unsuccessful time trying to do radio-astronomy.

This year, I was on sick leave between September and December 2023 and used this time to try again.....

IMPORTANT ADVICE FOR NEWBEEES WITH LITTLE KNOWLEDGE LIKE ME:

- Get support and advice from BAA/SARA members.
- Realize you need to dedicate lots of time to get it working.
 - Making mistakes and starting again is part of the fun.
 - Don't feel embarrassed that you do not know enough.
- If your kit works then do not get too worried when someone else says should be done differently – E.g. your aerial has too much ground noise/your dish isn't deep enough or too deep.
- Finally, do NOT estimate elevation and azimuth because your beamwidth seems large, *MEASURE IT!*



Windows Update Blocker v1.8



Windows Updates Option

- Enable Updates
- Disable Updates
- Protect Services Settings

Service Status



Apply Now

Menu

Is this really how you want to do astronomy when light pollution is of pandemic level?



This graphic is a true representation of me with my astrophotography setup

You can get into this aspect of the hobby for around RM1000 (£200). Especially with advent of SDRs



"Stop staring at my wife!"



I opted to concentrate on relatively out of the box projects for the less experienced amateur from UKRAA/BAA/SARA/other NASA-funded projects.

My PC tower in my shack!

- Multiple projects in one PC caused me lots of issues – maybe not for everyone else but if it can go wrong with me, it does!
- 2nd hand mini-PCs are very cheap - £85 buys off ebay Levono i5, 8GB RAM, 256GB SSD. A little extra increases RAM and SSD.
- RealVNC for remote connection – I opted for this rather than Remote Desktop as latter causes issues with audio inputs on remote computer – free RealVNC account gives three remote PCs per account – I now have three accounts!





Meteor radio scatter

- HB9CV type antenna usually recommended
- I am using a hand-cut Moxon (by Bill Watson, radio ham friend)
- From Graves
- 143.050MHz

Meteor detection by radio scatter from Grave's

GRAVES (Grand Réseau Adapté à la Veille Spatiale) = French radar-based space surveillance system, akin to the American Space Force Space Surveillance System.



FUNcube
Dongle **Pro**



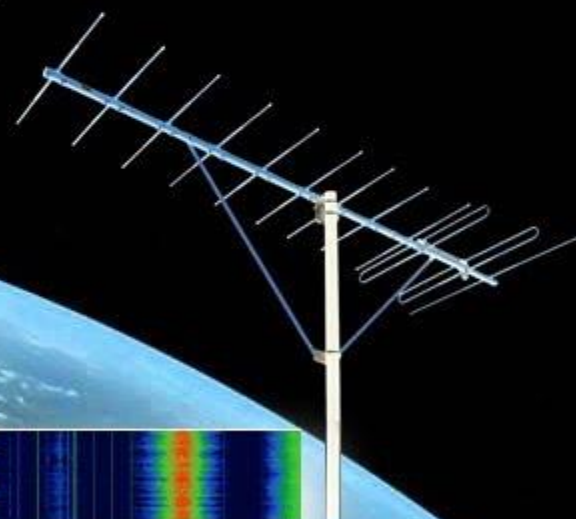
Meteor Trail



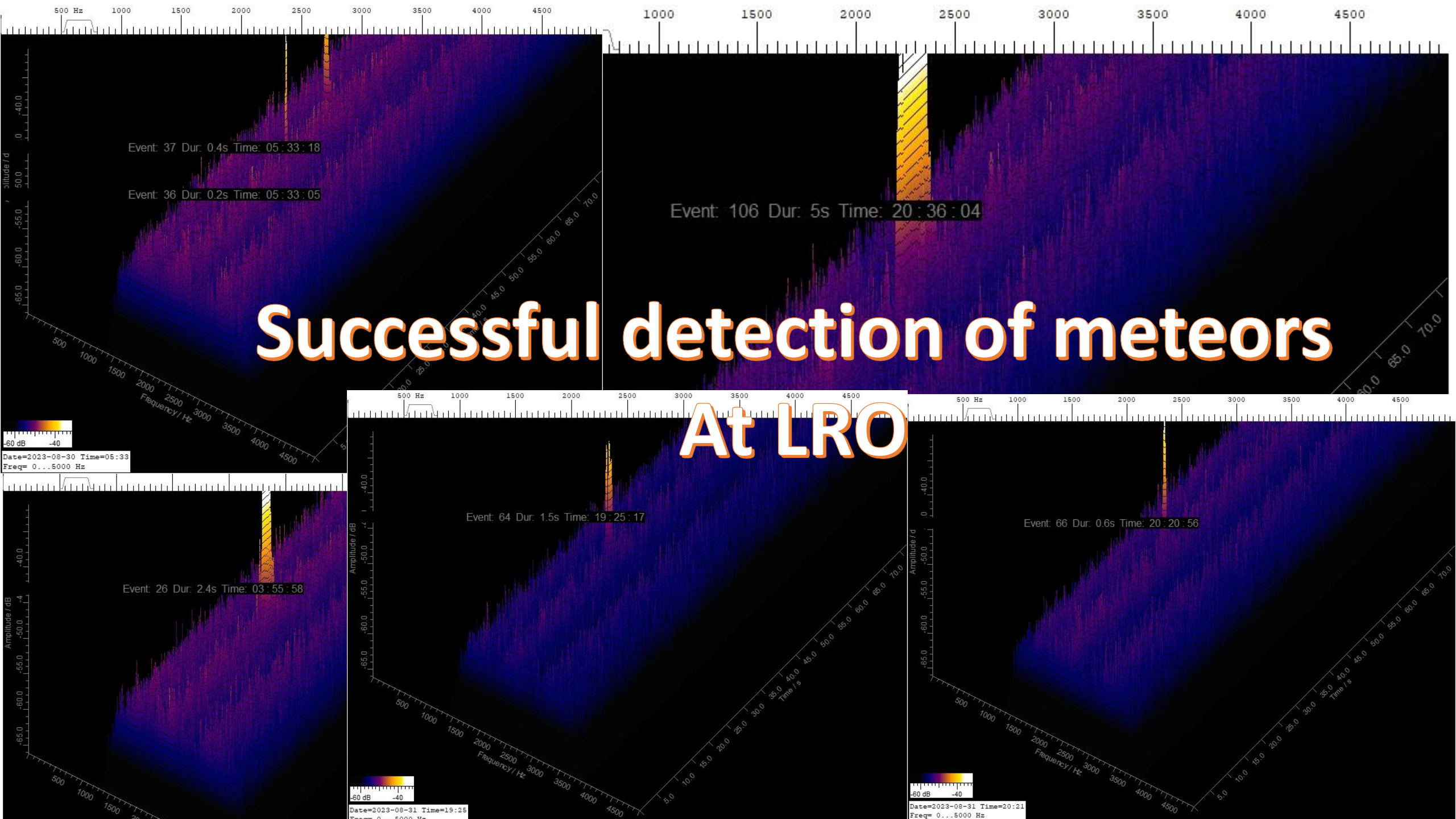
Transmitter



Receiver



crookedninja5



Successful detection of meteors At LRO

Event: 37 Dur: 0.4s Time: 05:33:18

Event: 36 Dur: 0.2s Time: 05:33:05

Event: 106 Dur: 5s Time: 20:36:04

Event: 26 Dur: 2.4s Time: 03:55:58

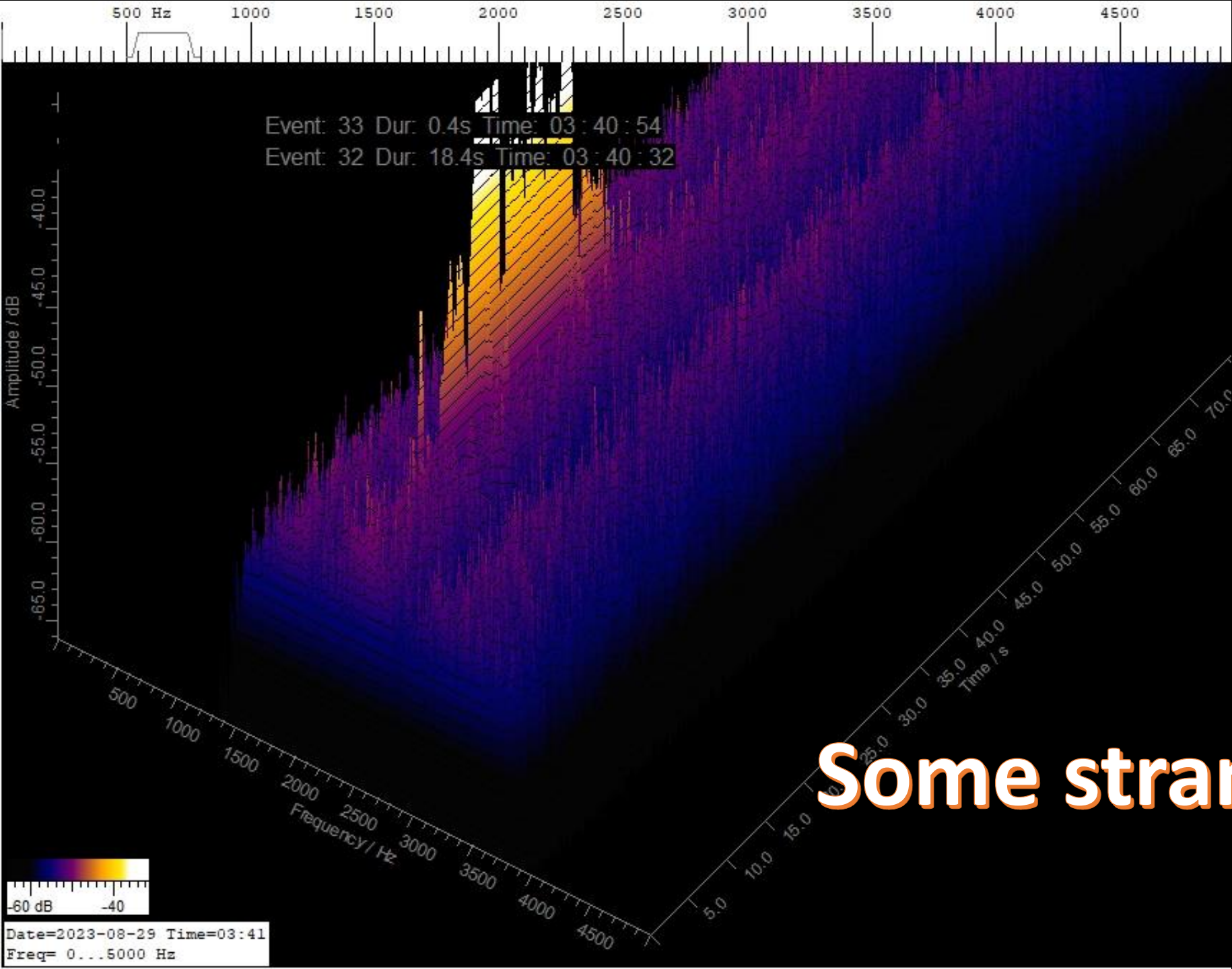
Event: 64 Dur: 1.5s Time: 19:25:17

Event: 66 Dur: 0.6s Time: 20:20:56

Date=2023-08-30 Time=05:33
Freq= 0...5000 Hz

Date=2023-08-31 Time=19:25
Freq= 0...5000 Hz

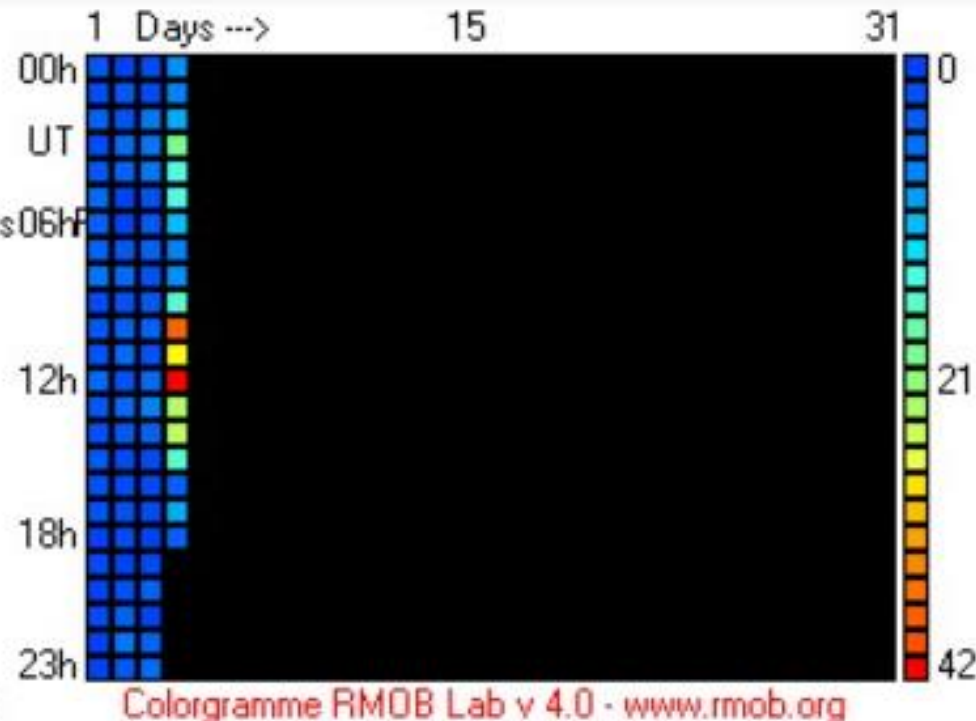
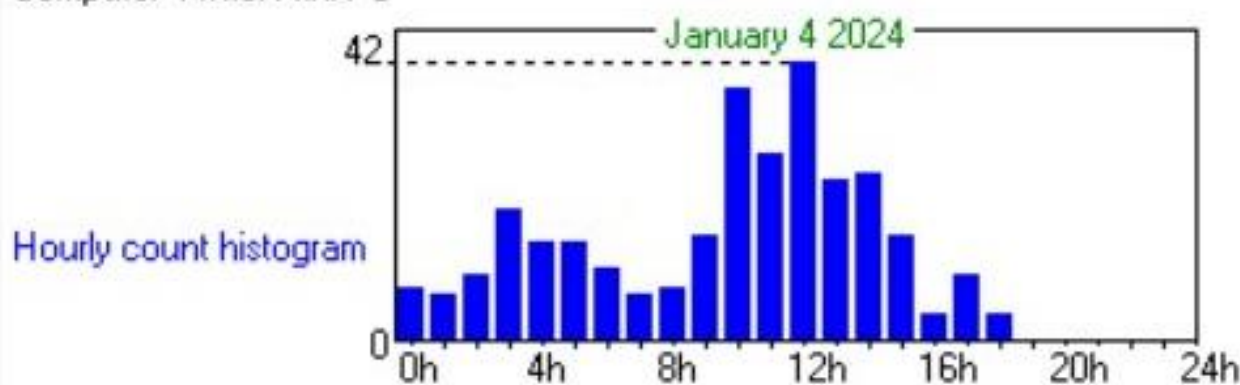
Date=2023-08-31 Time=20:21
Freq= 0...5000 Hz



Some strange traces

Observer : Andrew Thornett
Country : United Kingdom
City : Lichfield
Antenna : Moxon Az. : 120° El. : 10°
RF preamp. None
Obs. Method : Spectrum Lab
Computer : Intel Mini-PC

Location : 001°4932 West
052°4054 North
Frequency : 143.048MHz
Receiver : Fun Cube Dongle Pro Plus



RMOB Upload from LRO at end of 4/1/2024 suggests Quadrantids peaked at midday on 4th – does this reflect other observers' findings?

Making my live data visible on YouTube

The screenshot shows a web browser window displaying the homepage of the astronomy.network Lichfield Radio Observatory (LRO). The browser's address bar shows the URL 'astronomy.me.uk'. The page header includes the site name and contact information for Andrew Thornett. A red circle highlights a navigation menu with the following items: CONTACT ME, LINKS TO OTHER SID MONITORING SITES, LIVE DATA FROM UKRAA SUDDEN IONOSPHERIC DISTURBANCE MONITOR AT LRO (SIDS), LIVE MAGNETOMETER READINGS FROM LRO, LIVE RADIO METEOR OBSERVATIONS AND METEOR COUNTS FROM LRO, and PRIVACY POLICY. Below the navigation menu, there is a featured article titled 'First light on additive interferometer' with a 'Read More' button. To the right, there is a search bar and a 'Recent Posts' section listing several articles.

astronomy.network
Lichfield Radio
Observatory (LRO)

Andrew Thornett, Lichfield, England, M6THO,
andrew (at) thornett (dot) net

CONTACT ME LINKS TO OTHER SID MONITORING SITES LIVE DATA FROM UKRAA SUDDEN IONOSPHERIC DISTURBANCE MONITOR AT LRO (SIDS)
LIVE MAGNETOMETER READINGS FROM LRO LIVE RADIO METEOR OBSERVATIONS AND METEOR COUNTS FROM LRO PRIVACY POLICY

RADIO OBSERVATION IN HYDROGEN LINE (1420MHZ)
Admin December 3, 2023 0 Comments

First light on additive interferometer

Experiencing difficulties with my multiplying interferometer (which means it doesn't work yet!), I am trying a simpler additive interferometer using

Read More

Search posts

Recent Posts

- First light on additive interferometer
- Determining the galactic rotation curve of the Milky successfully with my 1420MHz array
- Interferometer test rig

16:13
03/12/2023

***Sudden Ionospheric Disturbance
(SID) monitoring***

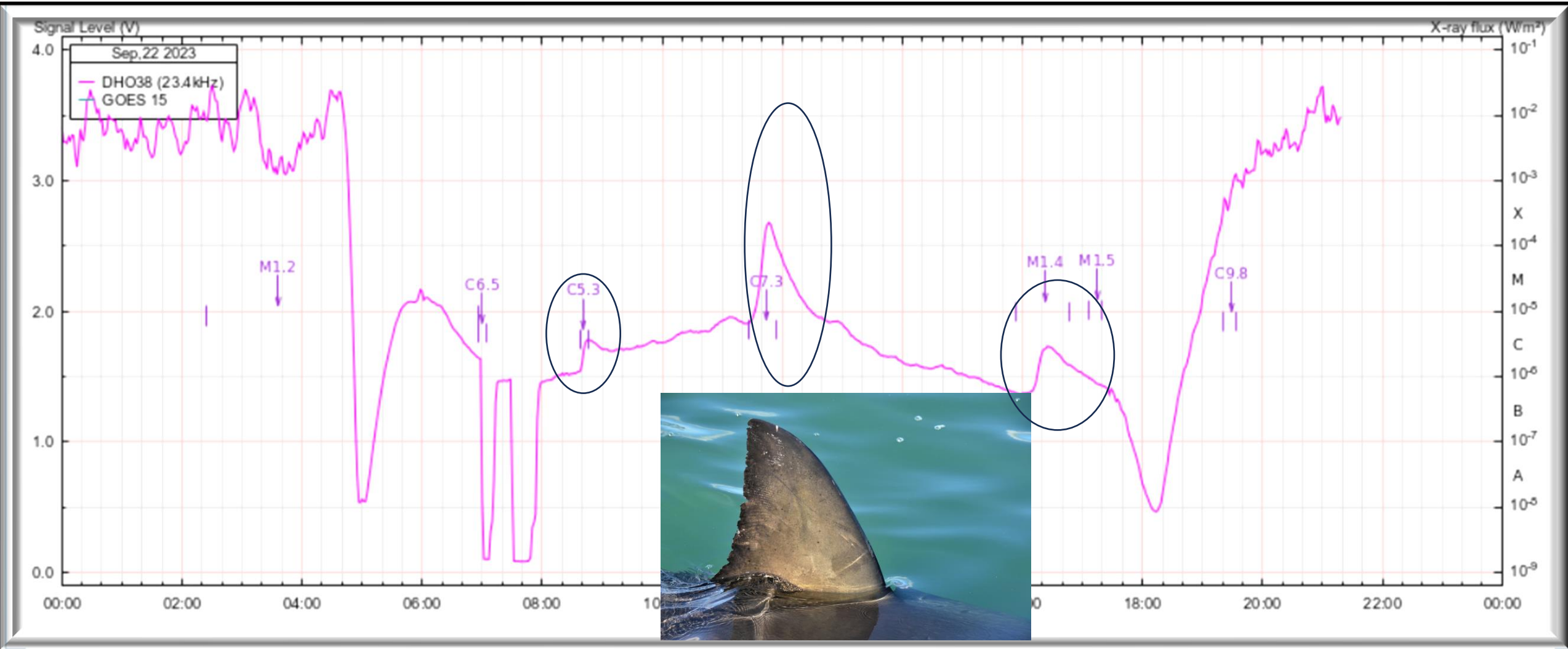
Sudden Ionospheric Disturbance (SID) monitoring

- UKRAA SID Receiver
 - 23.4Khz
 - Single channel
- SuperSID Monitor from Stanford Solar Observatory
 - Uses soundcard in PC as receiver, SuperSID is an amplifier
 - Covers large range – potential for multiple simultaneous stations monitored and confirming SID from 2nd or 3rd station.
 - However, amplification not as effective as UKRAA SID Receiver, and Signal to Noise ratio not as good.



*Detection of solar flares
that hit Earth (Sudden
Ionospheric
Disturbances, SIDs)*

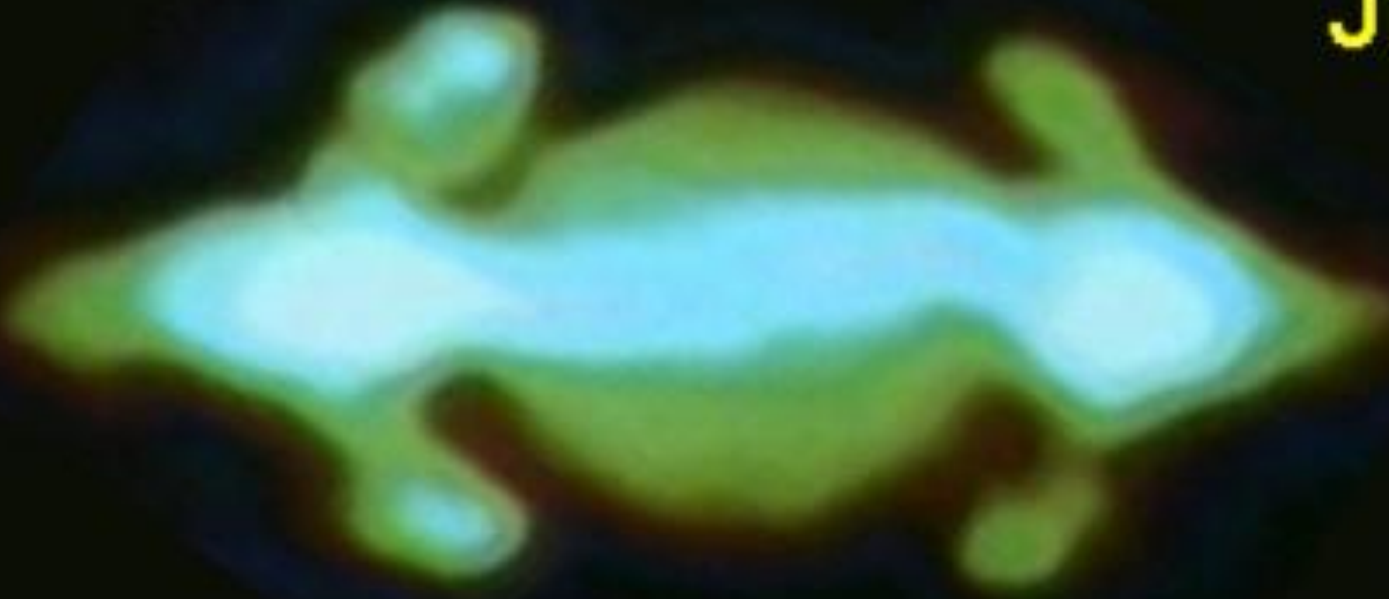
Not my data – this is from
<https://sidstation.loudet.org/home-en.xhtml>



Famous Shark's Fin pattern of SIDs

Radio Jove

Jupiter: radio
(21 cm)



Radio coverage sky vs visual coverage sky



Jupiter: visible



Radio Antenna



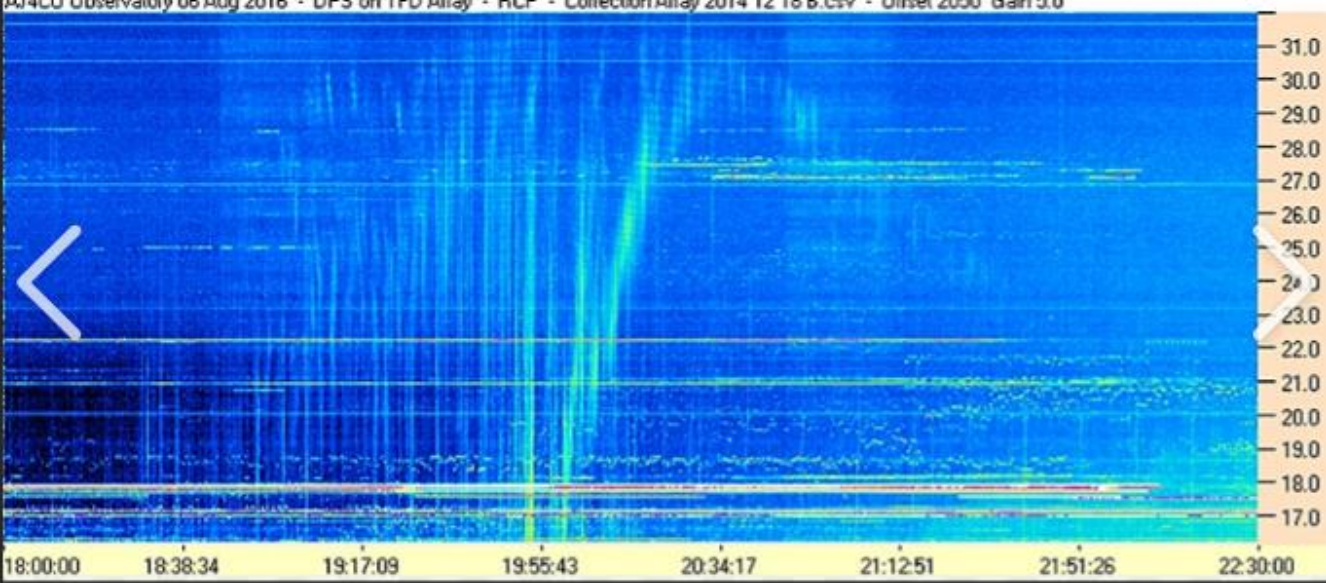
Radio Receiver



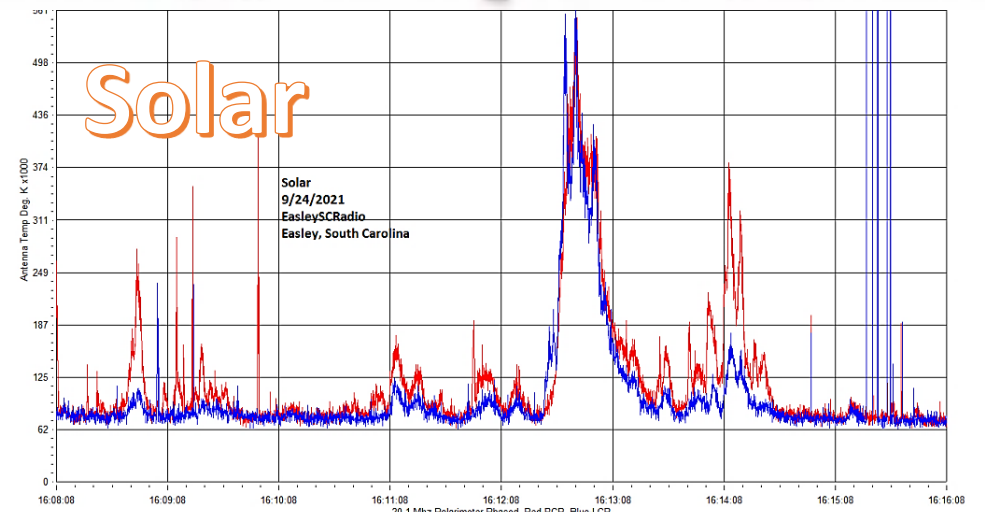
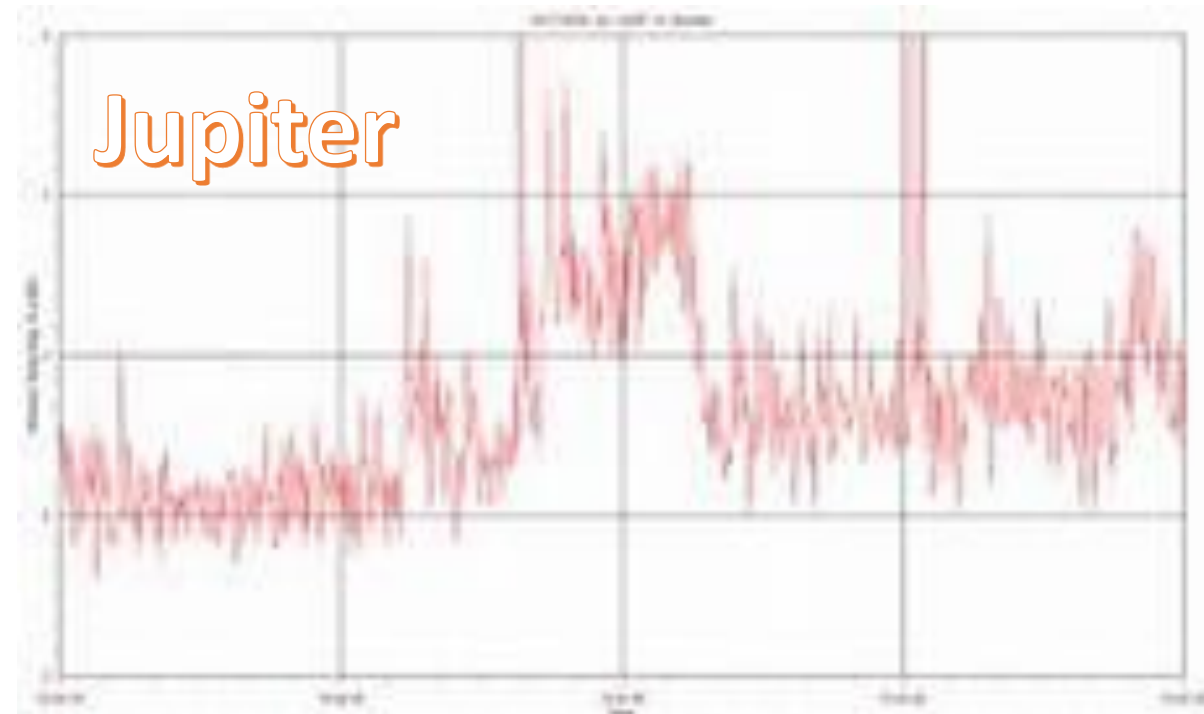
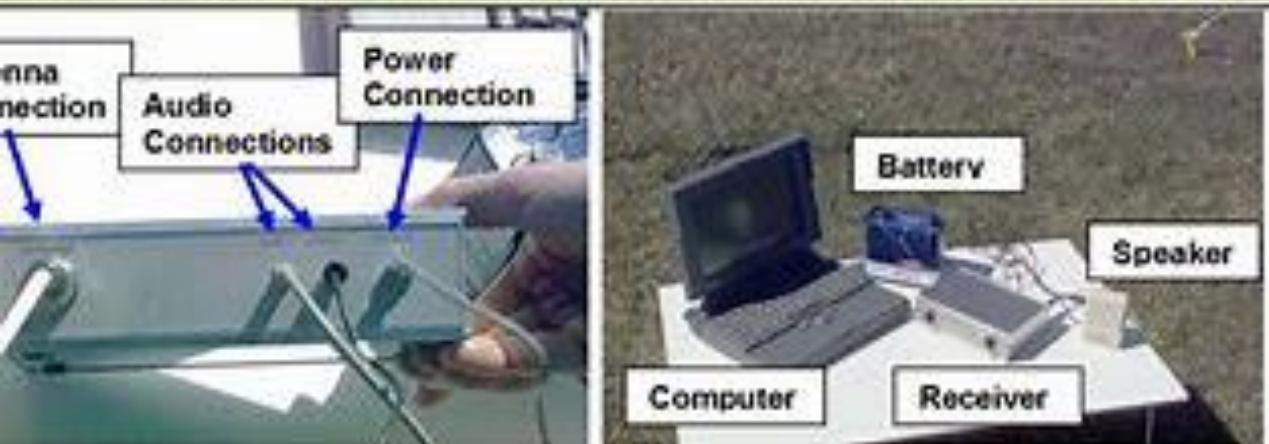
Recording Software



AJ4CO Observatory 06 Aug 2016 - DPS on TFD Array - RCP - Correction Array 2014 12 18 B.csv - Offset 2050 Gain 5.0

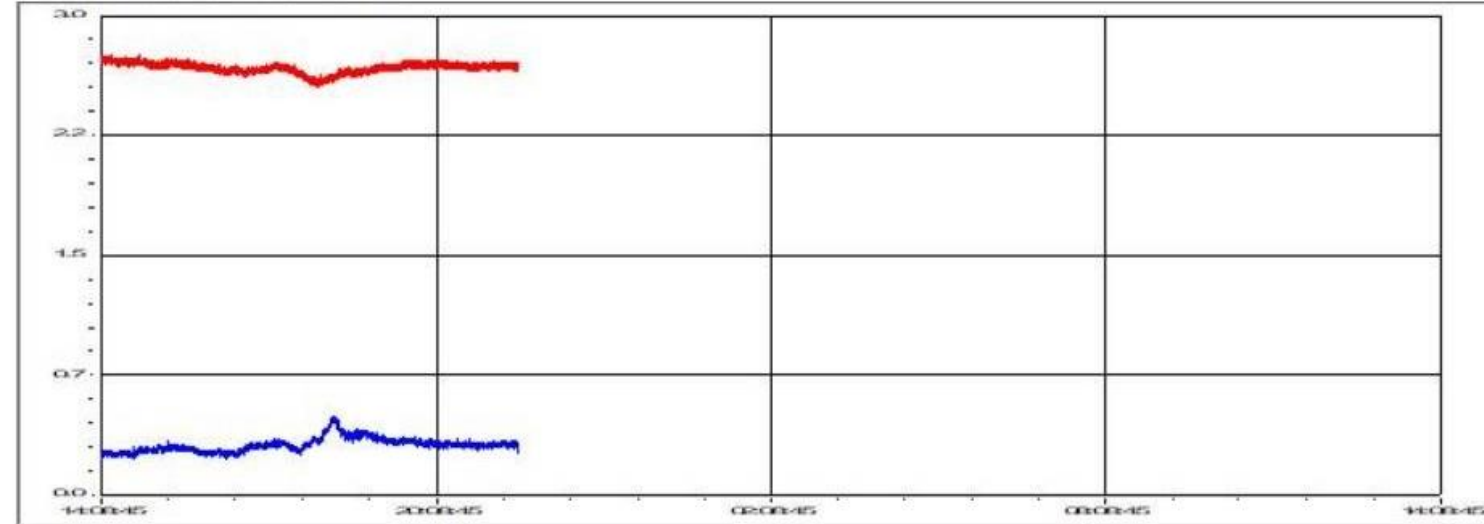


Radio Jove aerials set up in a school

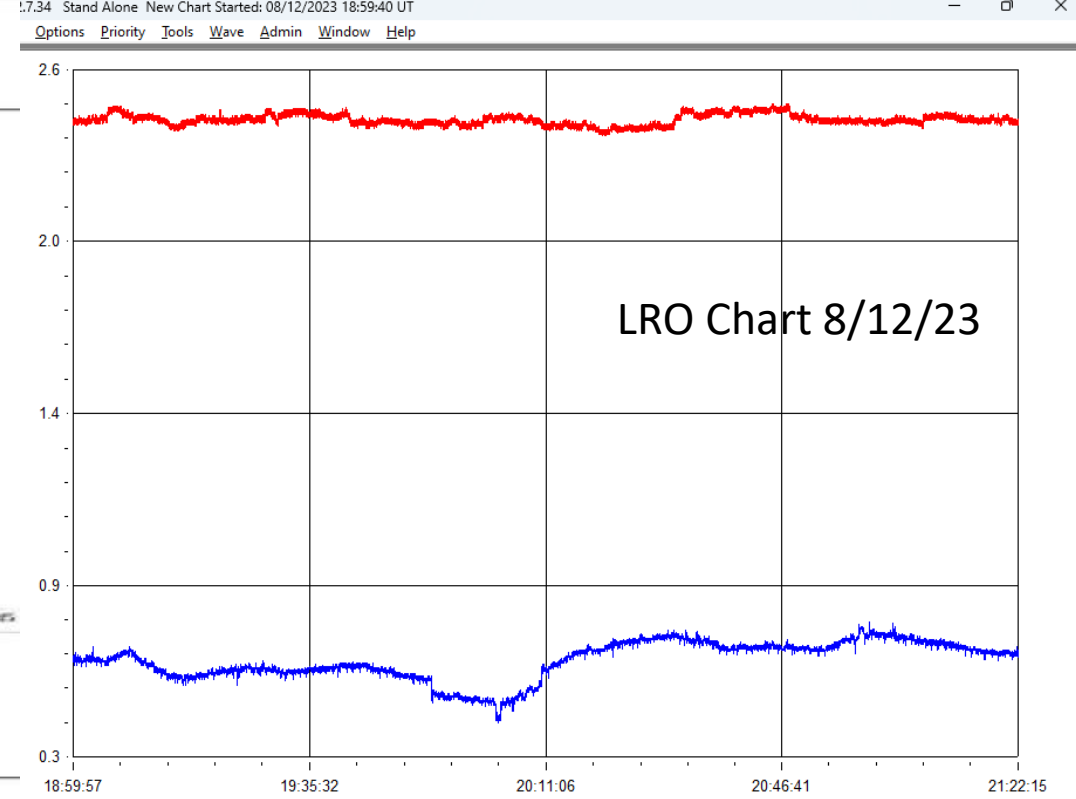
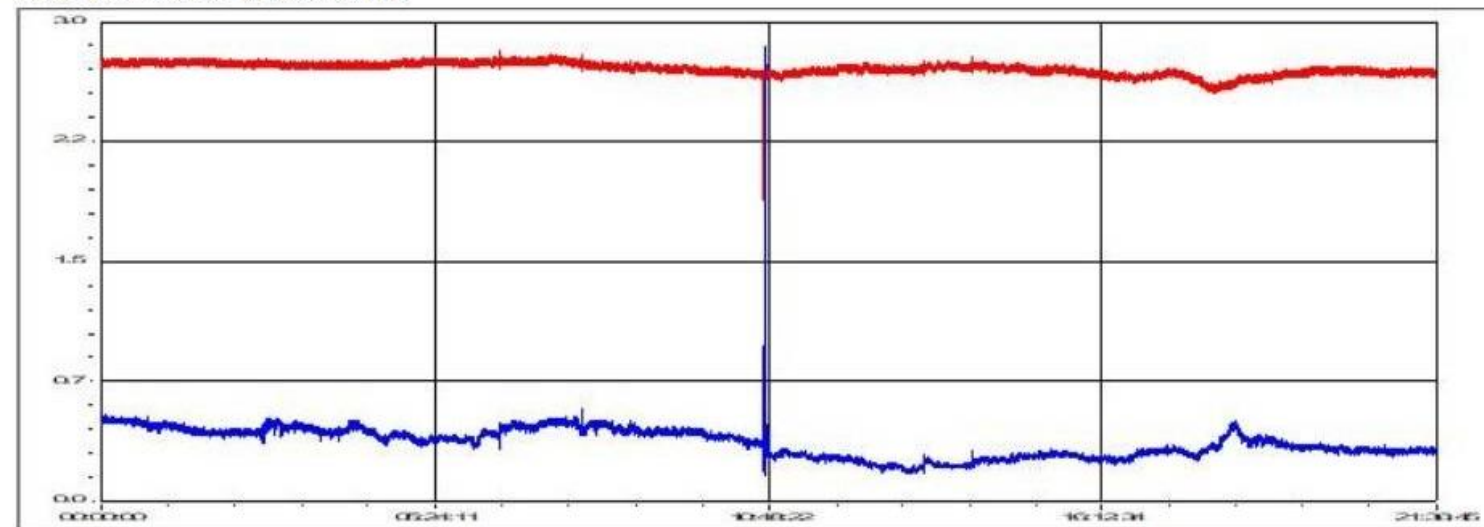


Magnetometer

The most recent chart:
Starts 12/13/2023 14:08:45 UT
Ends 12/14/2023 14:08:45 UT



Total observation: LRO Chart 13-14/12/23 – this is example live feed
Starts 12/13/2023 00:00:00 UT
Ends 12/13/2023 21:36:45 UT



*Magnetometer
data from LRO*

Muon Detectors

UKRAA CosmicWatch Muon Detectors

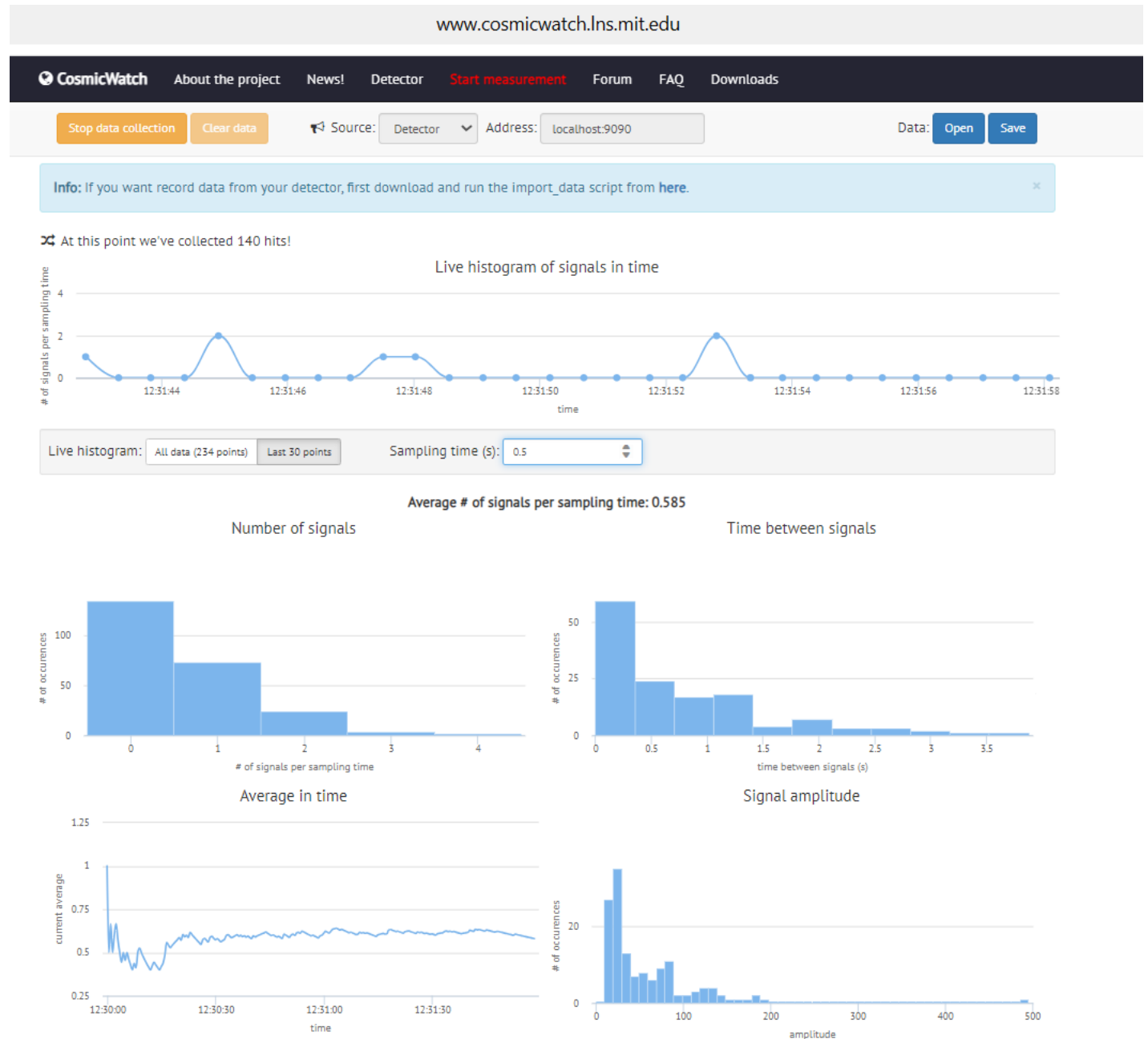


Left: The two muon detectors at LRO in master-slave configuration

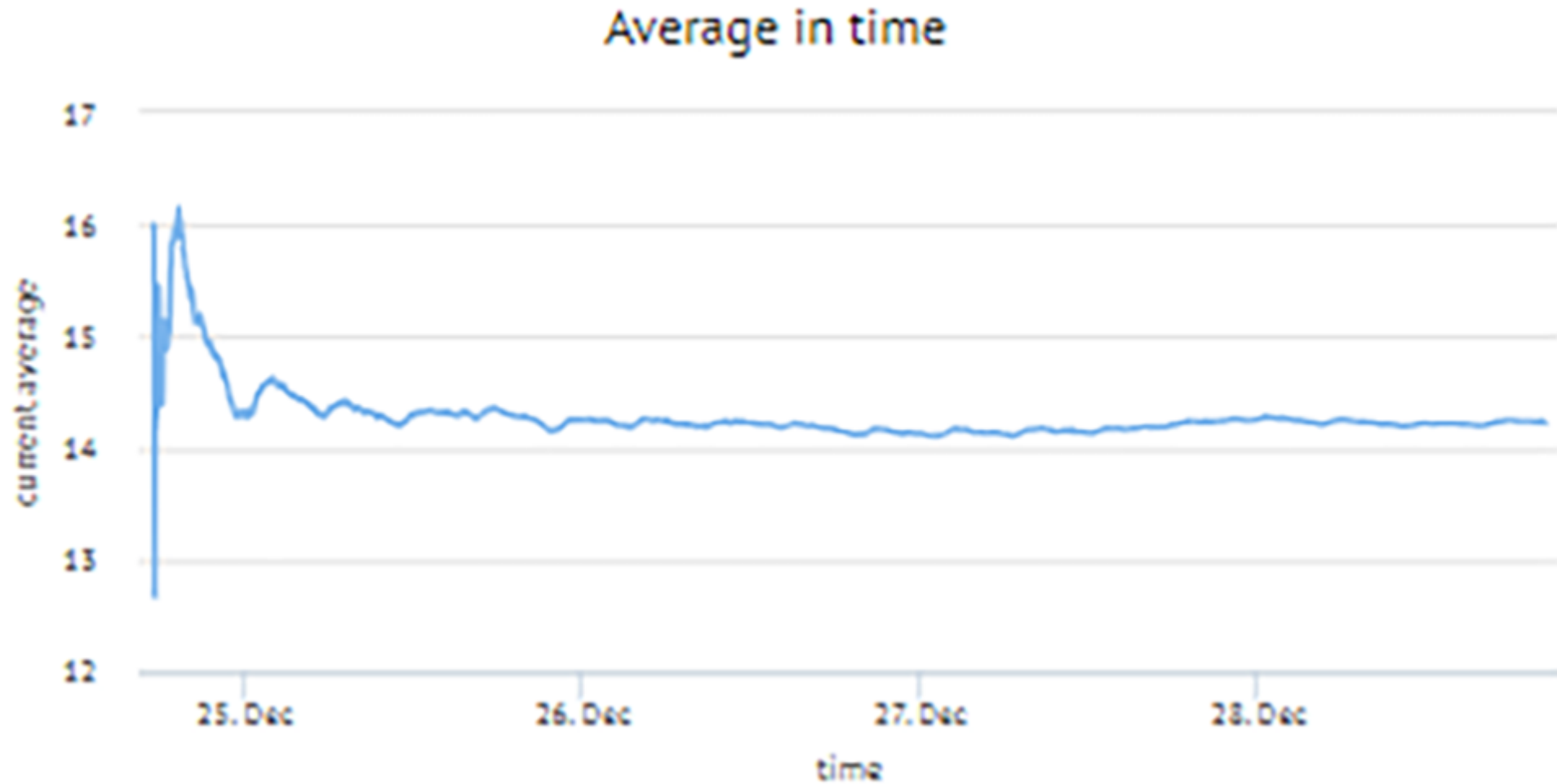
Muon Detectors

- The latest UKRAA creation.
- Build your own particle collider!
- Amazing to think that amateurs can detect these at home.
- Need two in order to isolate cosmic muons from terrestrial sources.
- You can build your own kit from UKRAA, or for a few pounds more, buy a ready made kit.
- This is the UKRAA's version of the Cosmic Watch Muon detector and support information is via that website.

Charting muon data via Cosmic Watch website (LRO Data)



No discernable change muon flux day vs night (LRO Data)



Effect of put lead mass under muon detectors (LRO data, coincidence mode)

- 0cm lead = 0.142 detections/second
- 1cm lead = 0.134 detections/second
- 2cm lead = 0.127 detections/second
- 4cm lead = 0.133 detections/second
- 5.5cm lead = 0.130 detections/second

Lessons learnt about these Muon Detectors

- Remove Windows driver and download and install new one for Arduino USB serial connection.
- Remember to install the two required dependent Python files.
- Powered via your Windows PC USB socket.
- Need mini-USB cable & 3.5mm stereo male-to-male audio cable.
- Download Github Python repository files.
- In those files on Github repository is an instruction manual – important to read.

Hydrogen line (1420.405MHz)
Mapping Exercise of the Milky Way
@ LRO

Detecting molecular hydrogen line in Milky Way can now be achieved easily and cheaply

- Milky Way hydrogen detection used to be expensive but can now be achieved with very cheap equipment from Amazon/elsewhere, using Software Defined Radio (SDRs) and hydrogen line filter/pre-amp, and satellite dish/other aerial.
- The Society of Amateur Radio Astronomers (USA/"SARA") has produced a project called "Scope in a Box", which led me to give this a try.

*Calibration of Scope in a Box in
SDR# Software with IF Average
plug in*

**This does similar job to flats and
darks in astrophotography**

50 ohm load used in place of aerial



Although now I use signal offset 3MHz to 1423MHz every other sample for calibration.

ezRA software for collecting and processing data and mapping it over known background of radio sources in Milky Way

(Has own collection program, alternative= SDR# IFAverage Plug-In to collect data)

Clear detection hydrogen on ezCol = ezRA Data

Figure 1

ezRA - Easy Radio Astronomy Data Collector v1230406a.py

LRO	Latitude	52.7	FreqCtrRef	1423.405000
	Longitude	-1.8	FreqCtr	1420.405000
	Amsl	81	FreqMin	1419.205000
			FreqMax	1421.605000

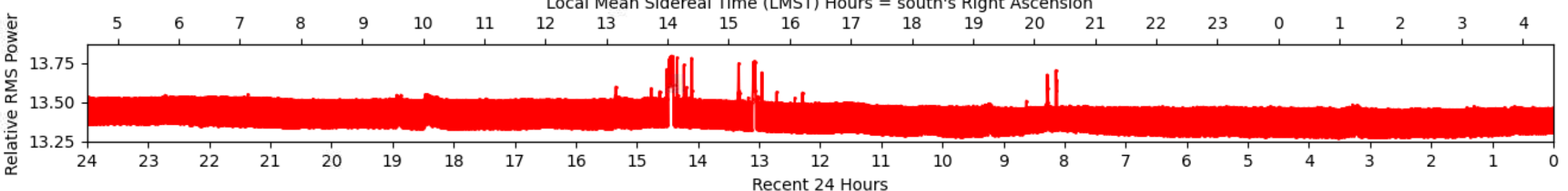
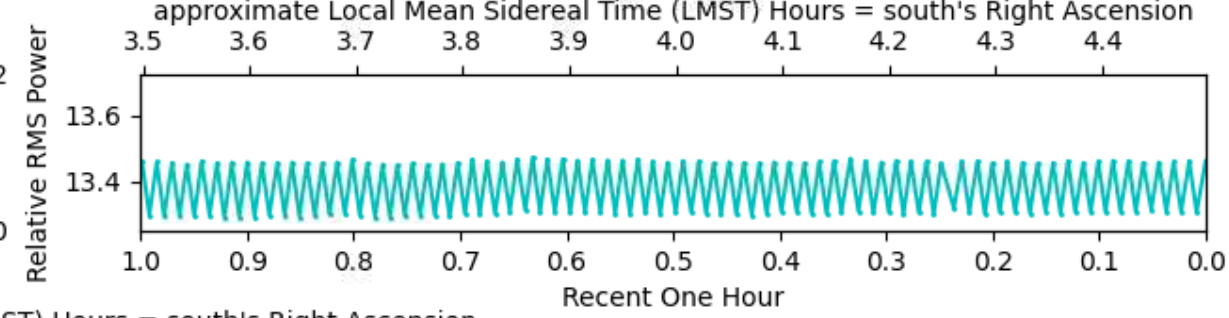
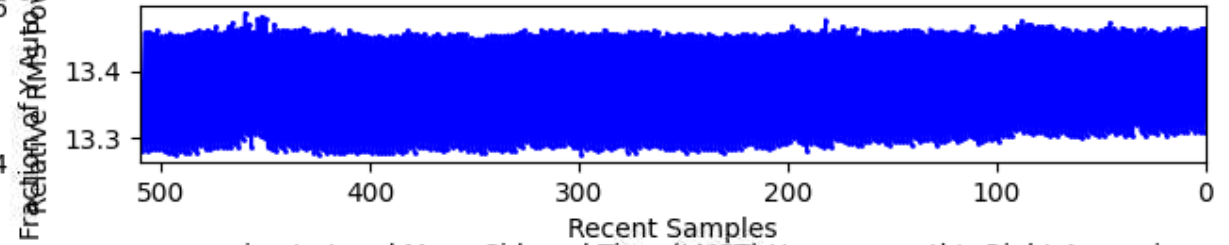
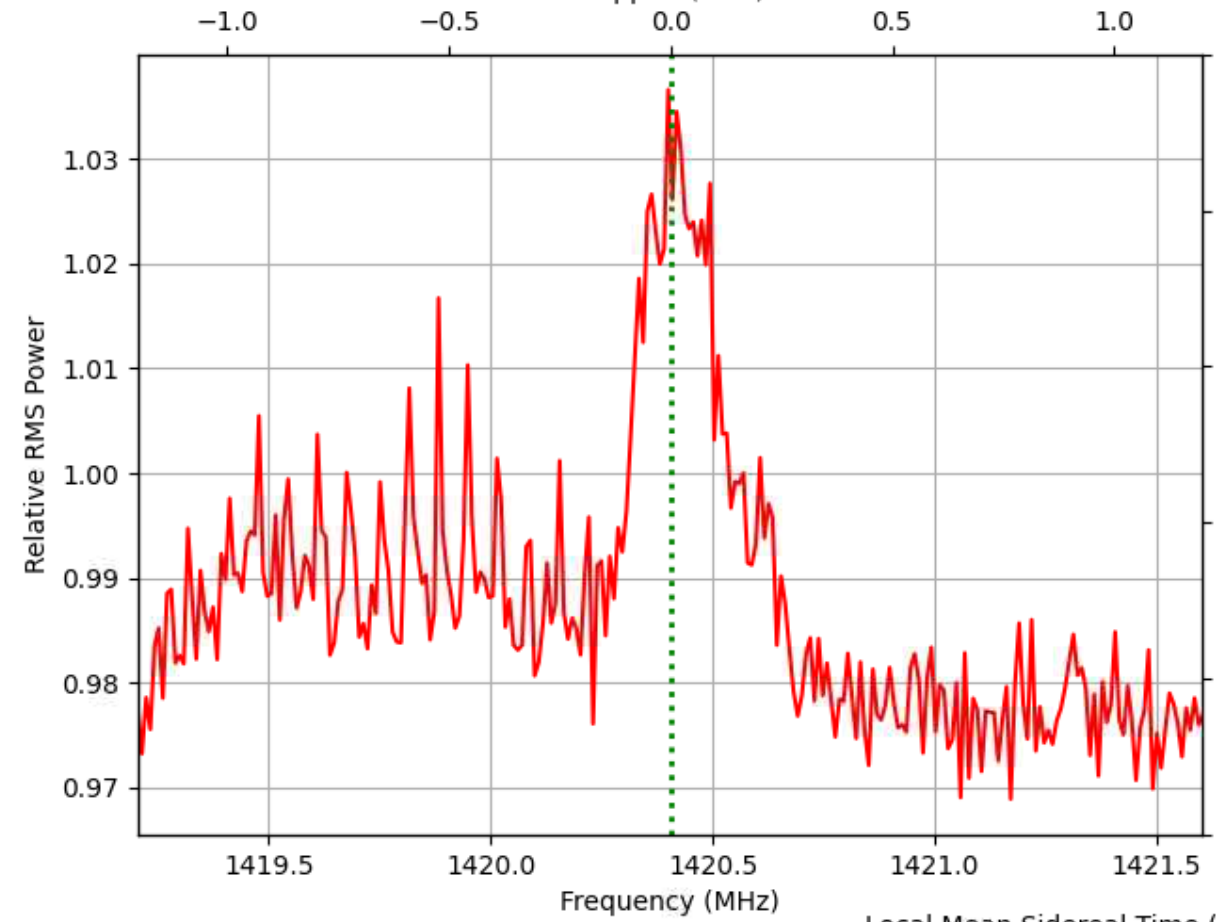
New Plot New File

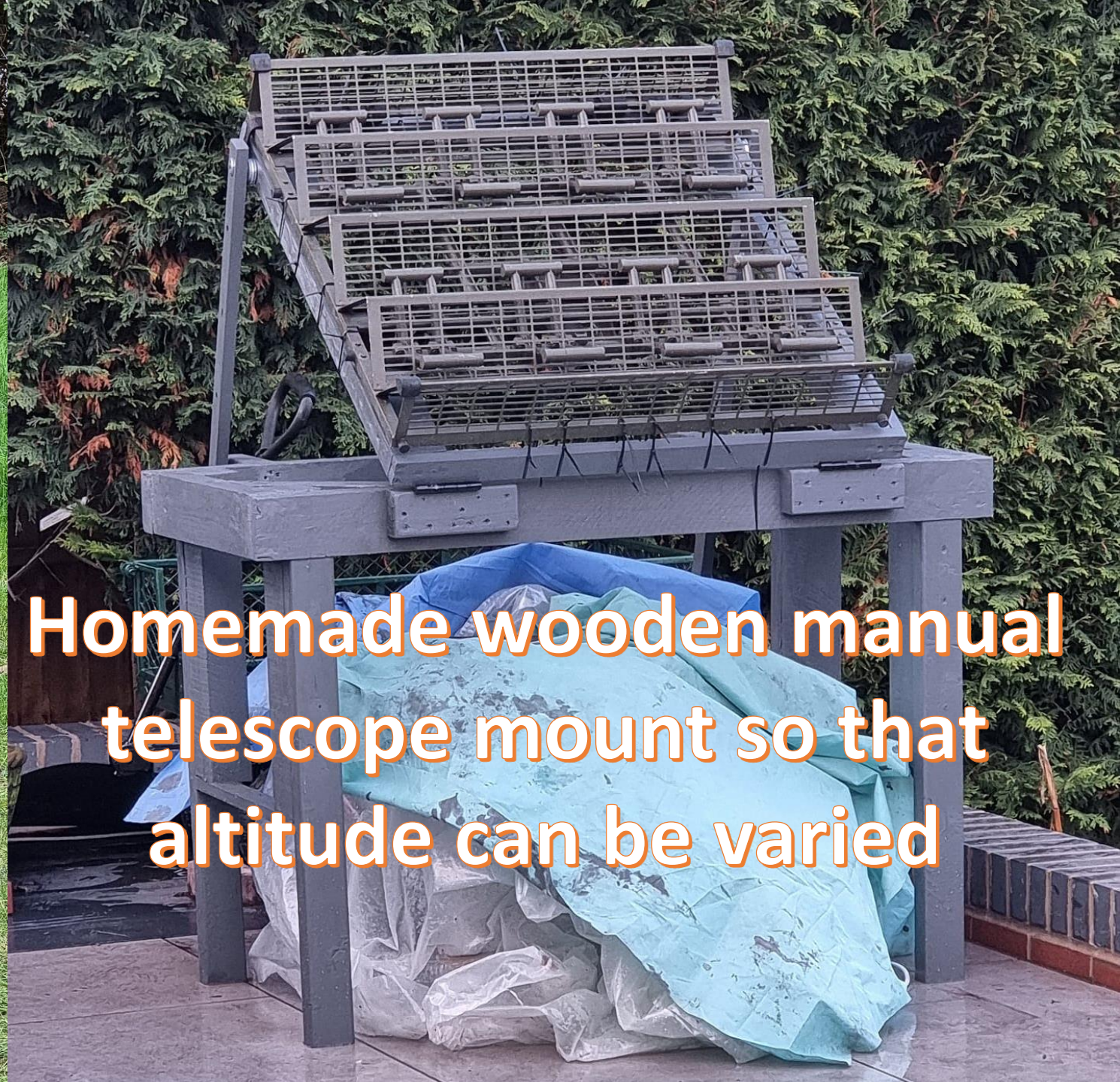
Collect Off
 Pause RefDiv
 Exit RefSub

Azimuth	<input type="text" value="163.0"/>	163.0	LRO231214_00.txt	
Elevation	<input type="text" value="78.8"/>	78.8	SampleQty	3248 R
FreqBinQty	256		2023-12-14 23:07:24 UTC	
Gain	49.6		2023-12-14 23:07:24 PC	
Integration	30.6 sec			

ezColIntegQty

Fraction of Y Auto Scale, Min and Max



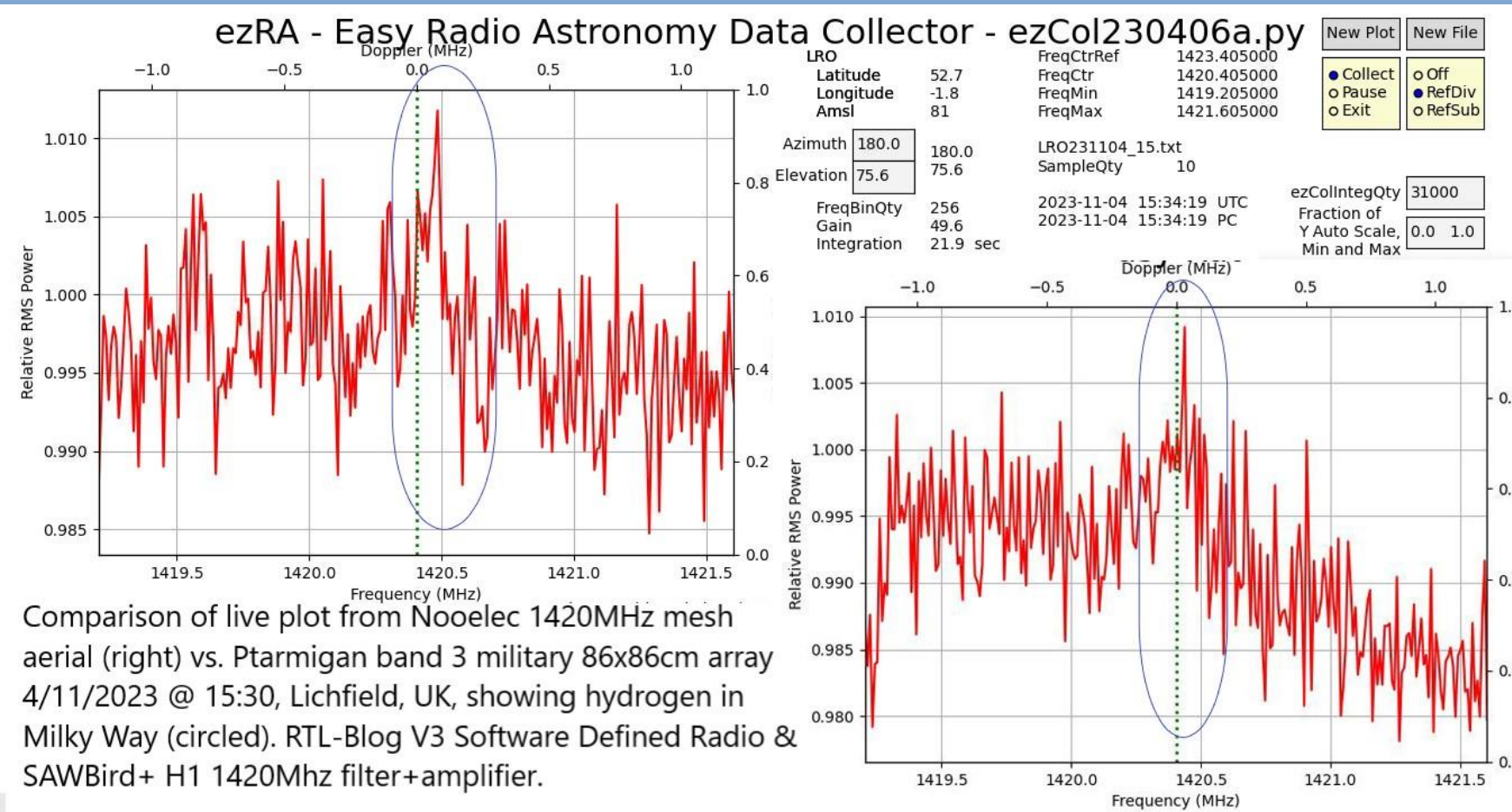


Homemade wooden manual telescope mount so that altitude can be varied

*Dealing
with dew –
a MAJOR
problem!!*

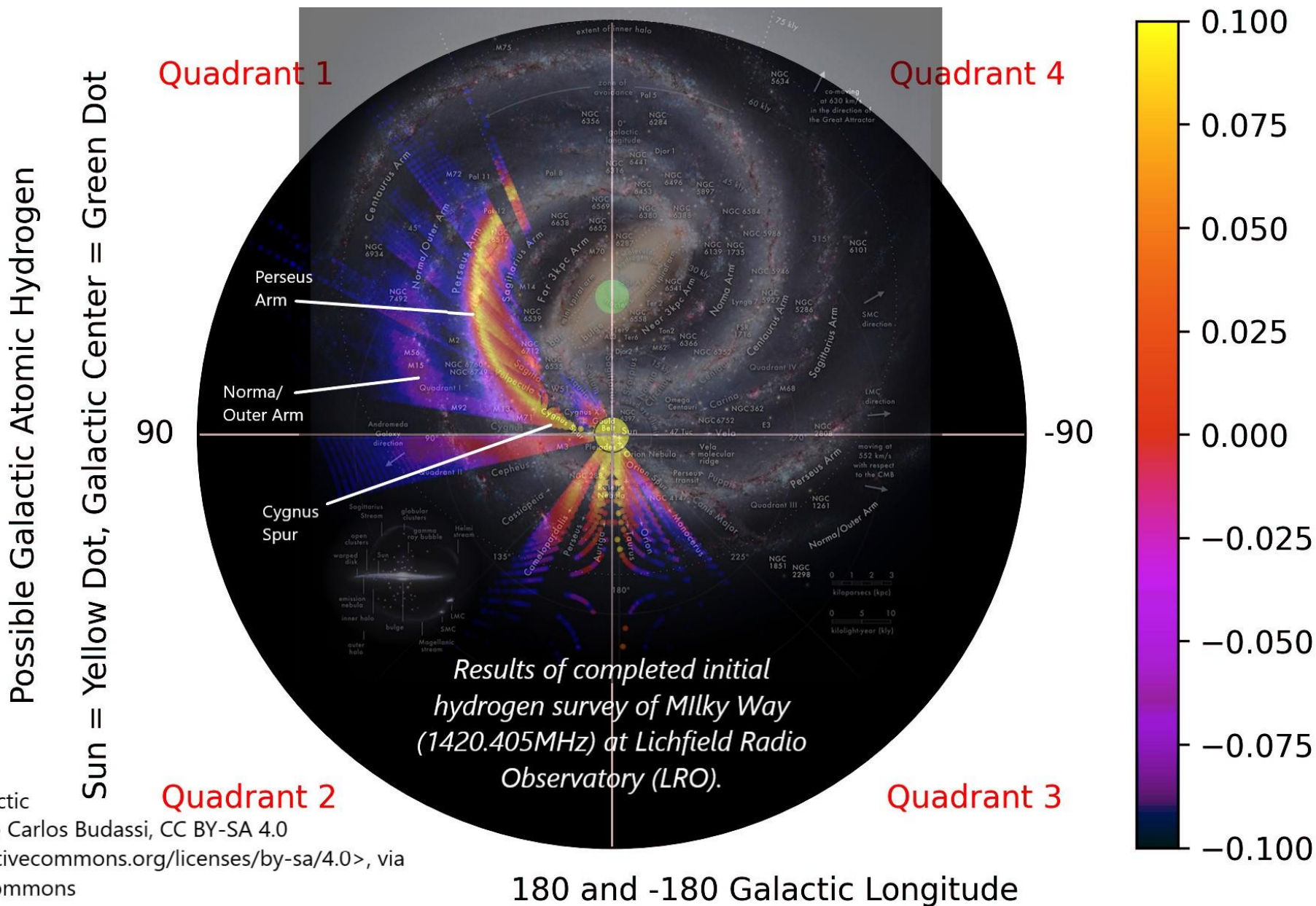


Testing the new Nooelec 1420MHz-tuned mesh aerial



Quite capable of detecting hydrogen

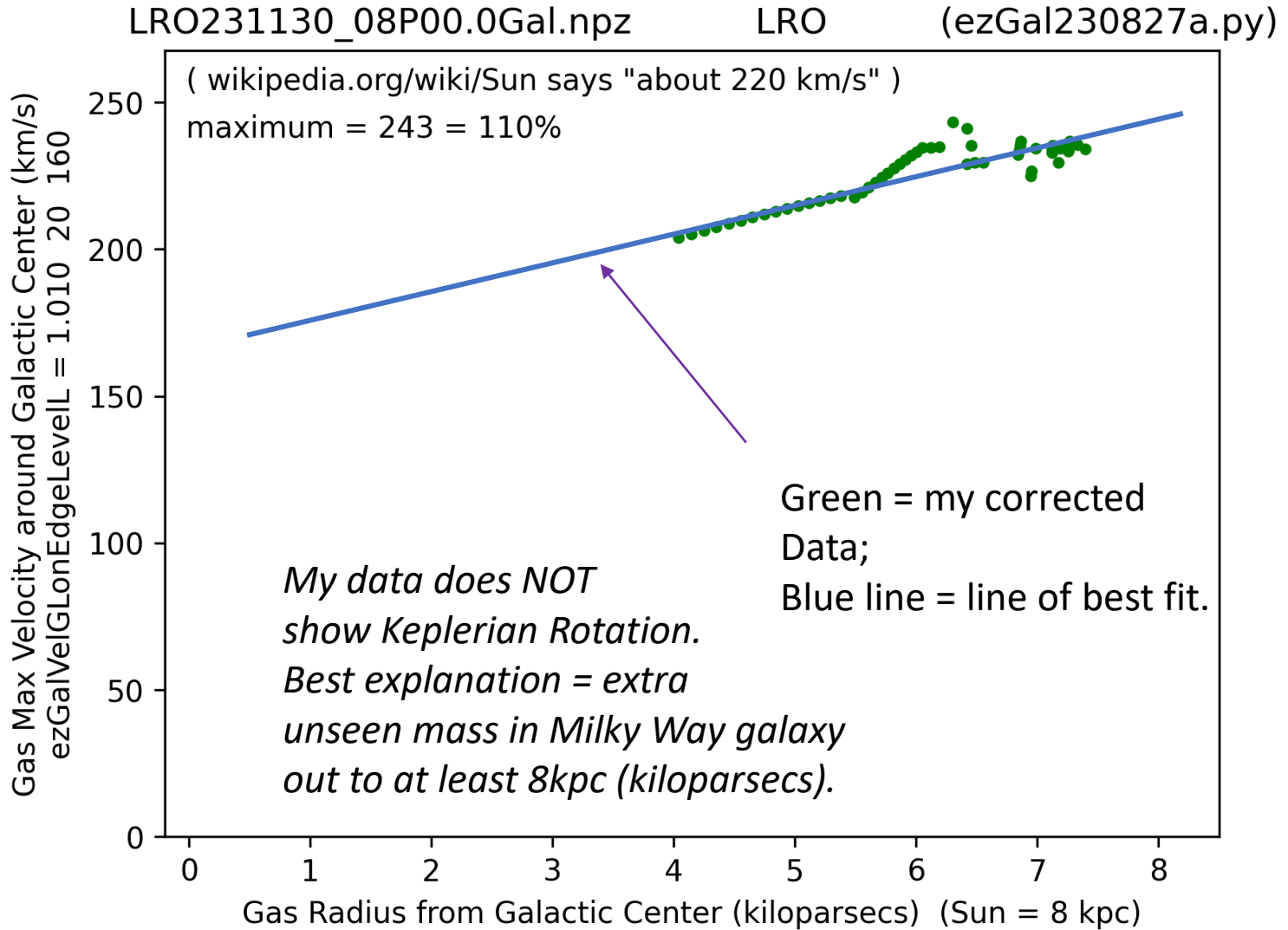
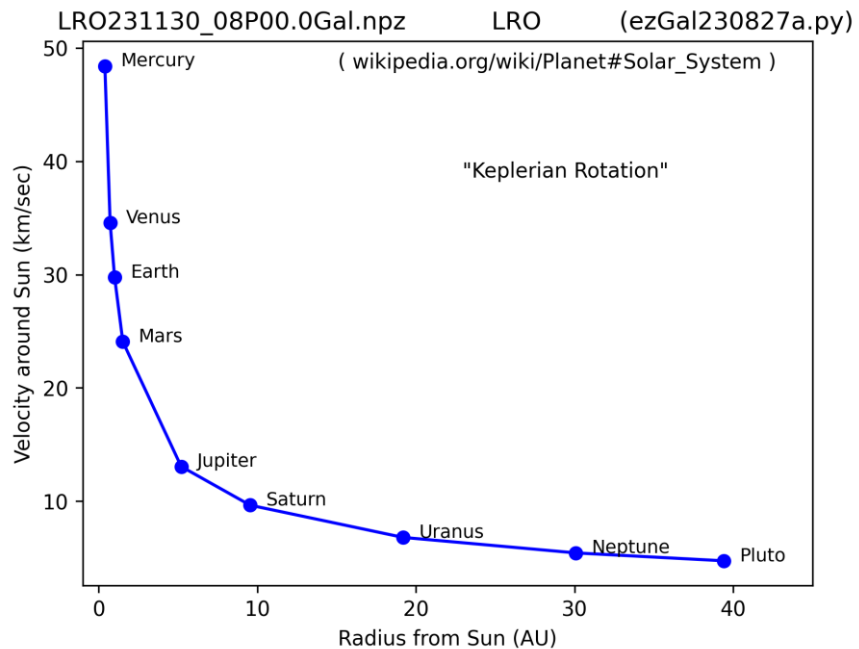
Mapping the Milky Way Arms



Overlaid Galactic Map by Pablo Carlos Budassi, CC BY-SA 4.0
<https://creativecommons.org/licenses/by-sa/4.0/>, via
 Wikimedia Commons

Dark Matter – galactic rotation curve from my data

Below is typical Keplarian Rotation Curve which would be expected without dark matter, on right my data (ezRA suite/Pharmigan array)



Simulation of galactic rotation WITHOUT Dark Matter (Left) vs WITH dark matter (Right); From Wikipedia

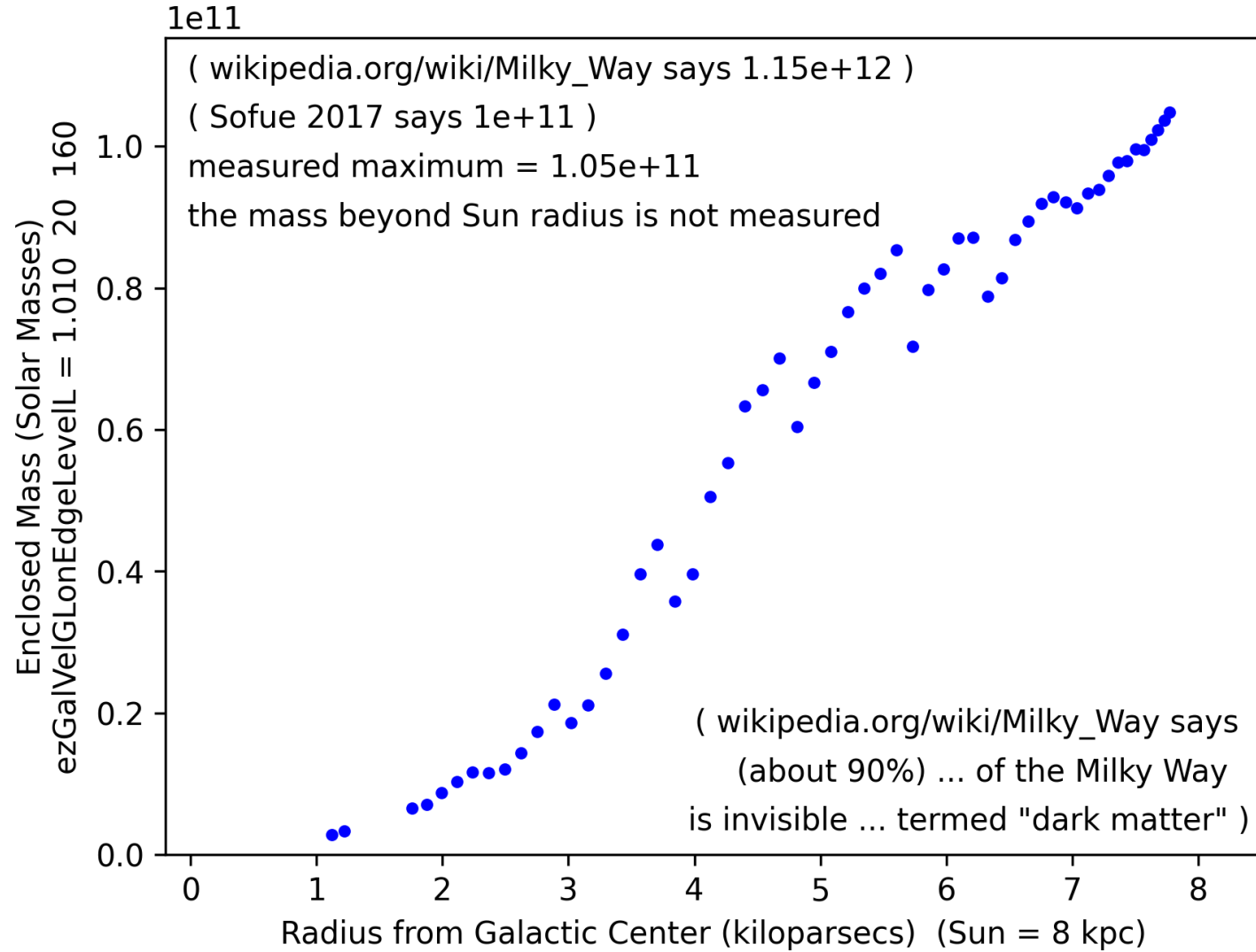


LRO231204_00_EI_21-0_Az_163P00.0Gal.npz

LRO

(ezGal230827a.py)

*Enclosed
Milky
Way
galactic
mass*

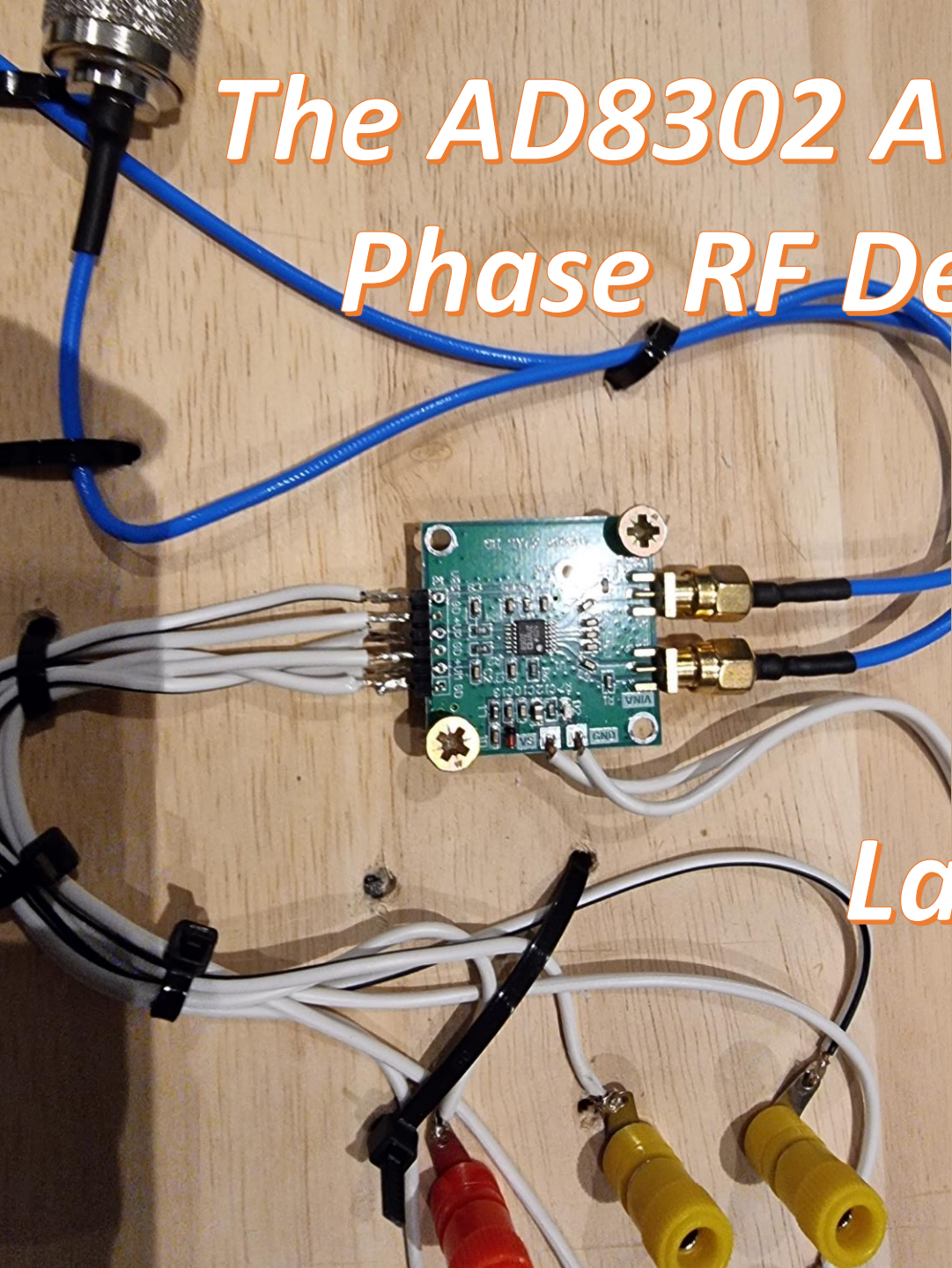


Lichfield Interferometer Radio Array (LIRA)

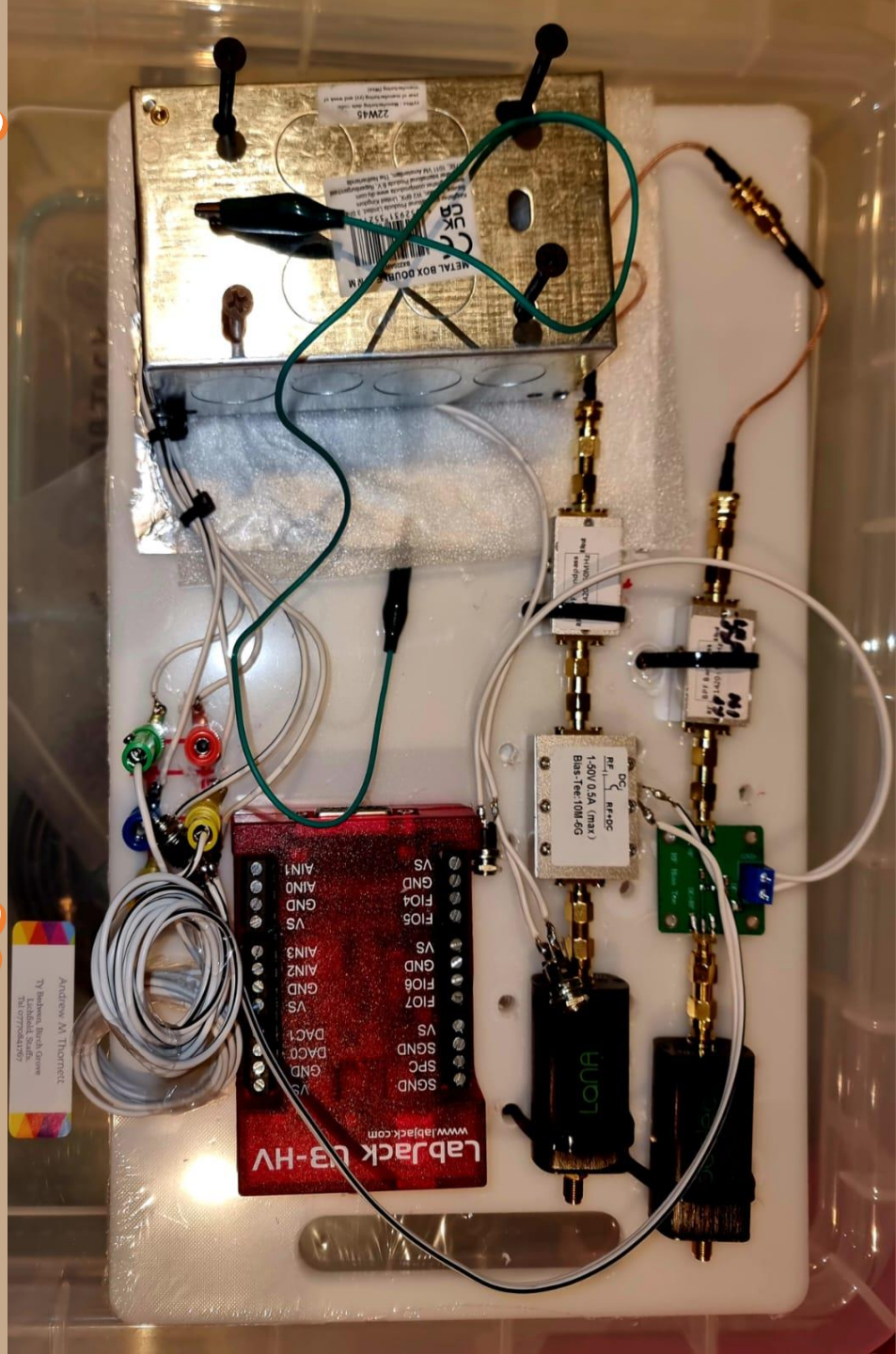
5m separation which is about maximum
For my garden



The AD8302 Amplitude Phase RF Detector



....and a
Labjack U3



Contact Details:

Dr Andrew Thornett

M6THO

andrew@thornett.net

www.astronomy.me.uk