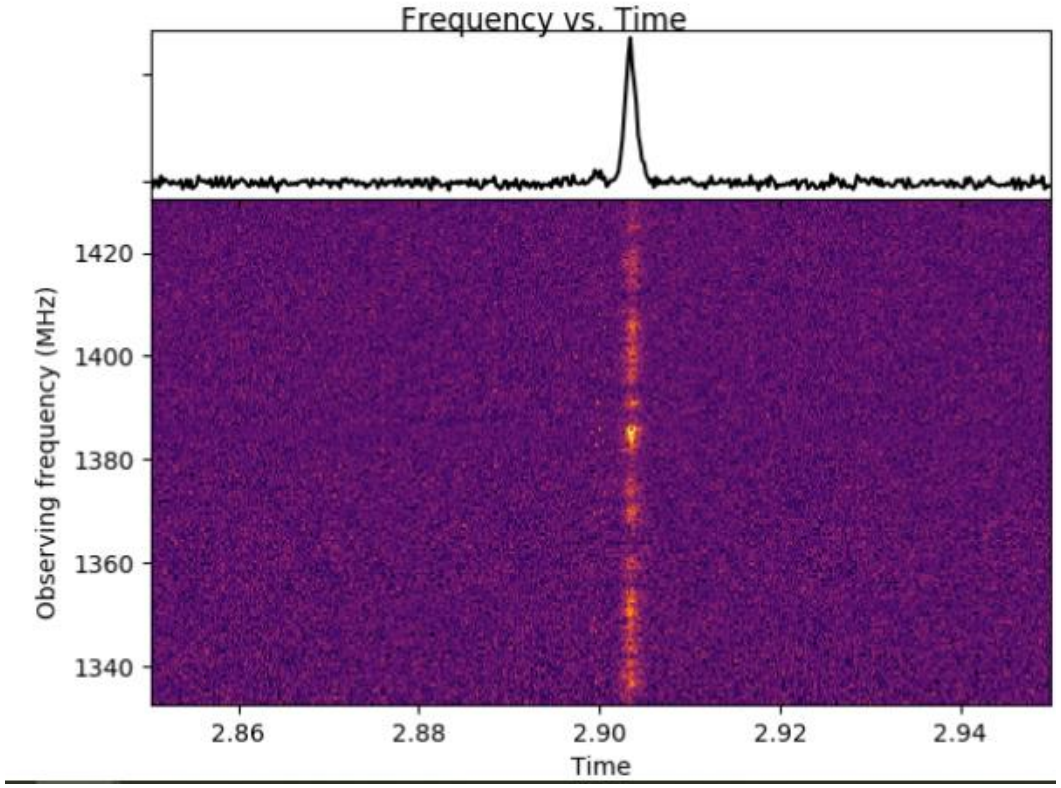
Deep Space Exploration Society
Science Meeting

Astropeiler Stockert 25 m Telescope Amateur Detection of FRB 20201124A



Source: ATel #14556: Extremely bright pulse from FRB20201124A observed with the 25-m Stockert Radio Telescope (astronomerstelegram.org)

April 26, 2021

Dr. Richard Russel, AC0UB

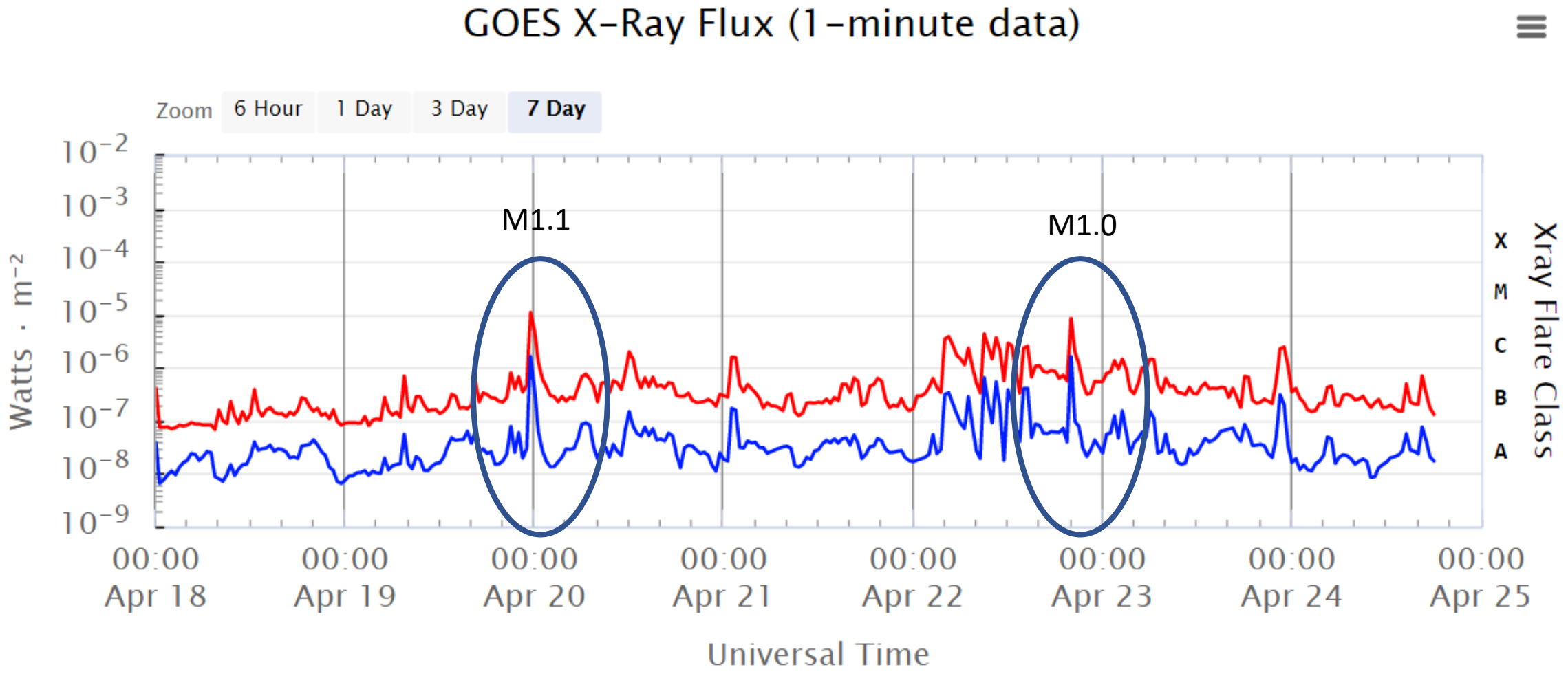
DrRichRussel@netscape.net

DSES.science

Information

- 9 ft Dish – Spectracyber running
- SuperSID – Working and porting data to Stanford
- Radio Jupiter – still need to get a new receiver and setup at site
- Pulsar:
  - Received 32 core computer
  - Ported Ettus software for N210 and B210
    - Able to see B210 (both channels)
  - Ported GNU software
    - Runs but there is a syntax error for pulsar gnu-radio-companion
  - Working on PRESTO installation
- Tropospheric transmission – 1296 MHz feed available
- EME systems – 1296 MHz feed available
- Moon Orbit determination using EME equipment
- Don Latham contact with 2nd 60 ft dish

Solar Flare Activity



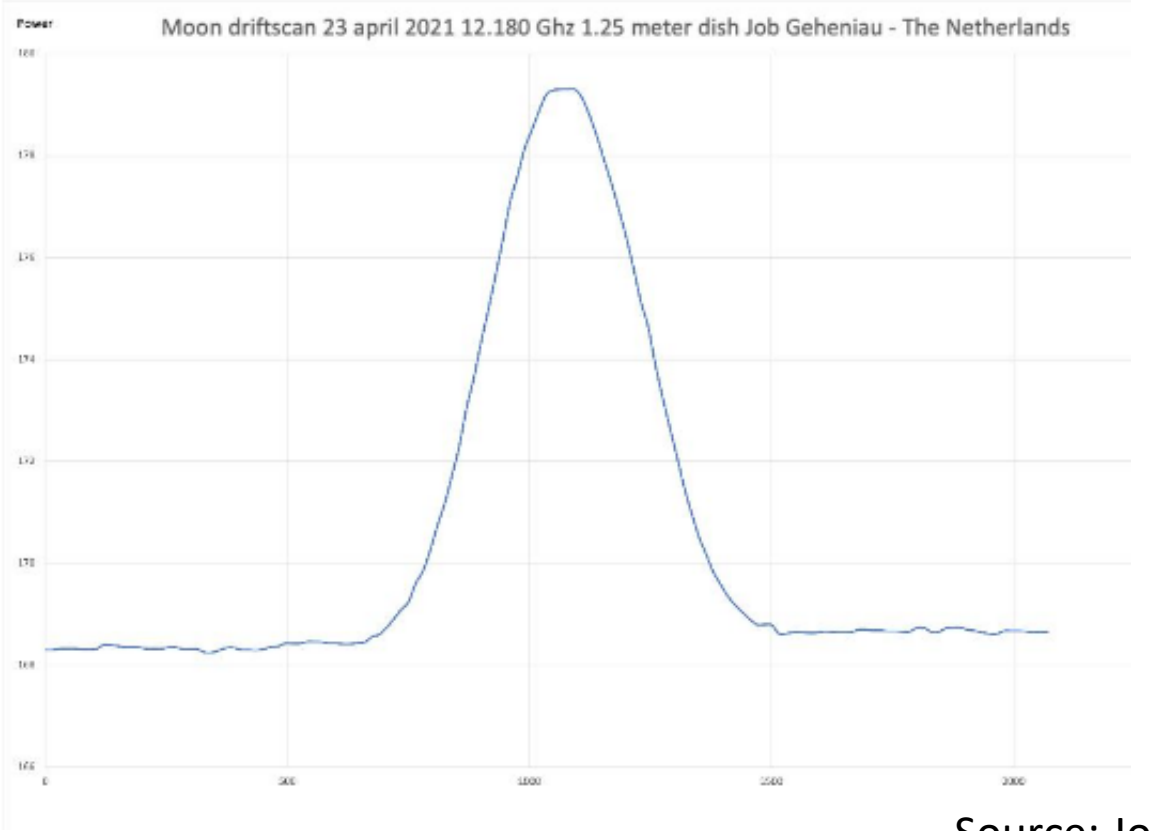
[GOES X-ray Flux | NOAA / NWS Space Weather Prediction Center]

Observing Sun and Moon at 12 GHz

[SARA] Moon Drift Scan V2

Yesterday I did a new driftscan. This one looks better at 12.180 Ghz
10 seconds per sample instead of 45.
What I do is add all the fft samples from SDR#.
That is the power on the y-axis against time on x-axis.
I only have no idea how to transform those values to dB.

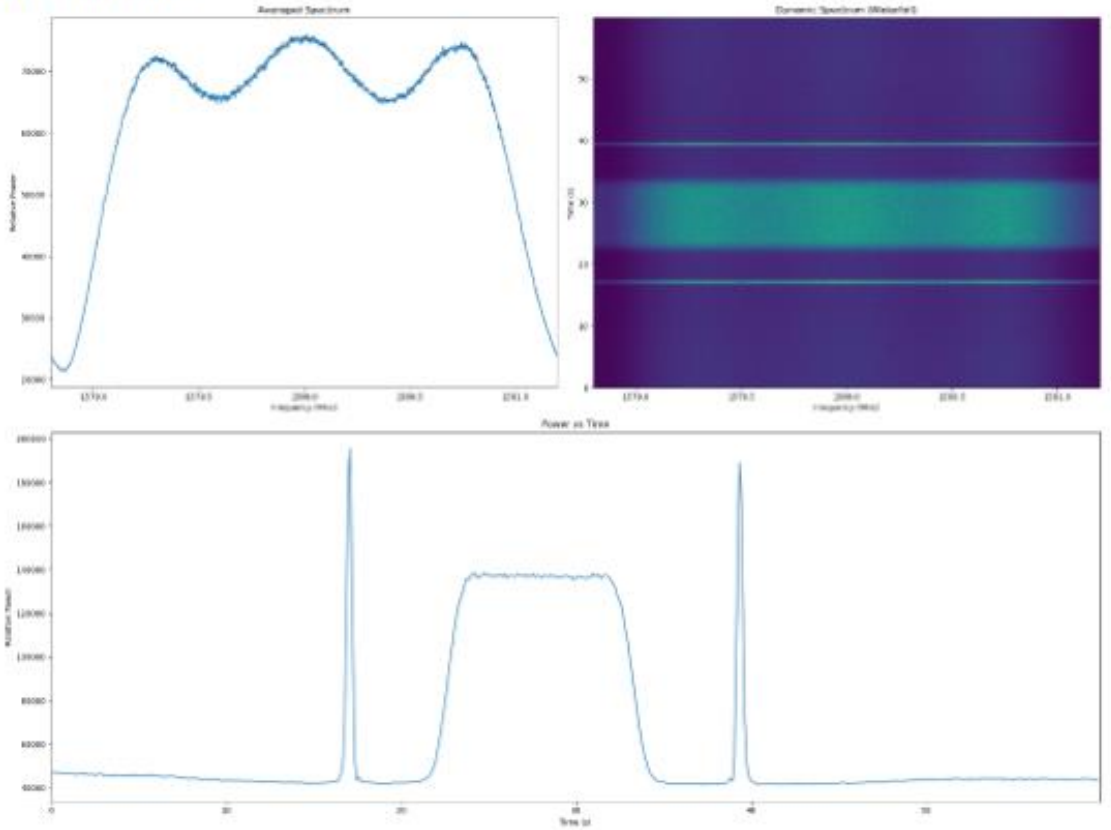
Job Geheniau



[SARA] Sun transit in 60 seconds

Here a 60 second transit.
I just pointed the dish to the cold sky and let it go to ground in 30 seconds and then up again.
You clearly see the cold sky noise, 2 times a sun transit and the ground noise.
Ground noise is about + 5 dB and Sun about + 6 dB what I measured with sdr#.
This graph is from Virgo.

Job Geheniau
The Netherlands



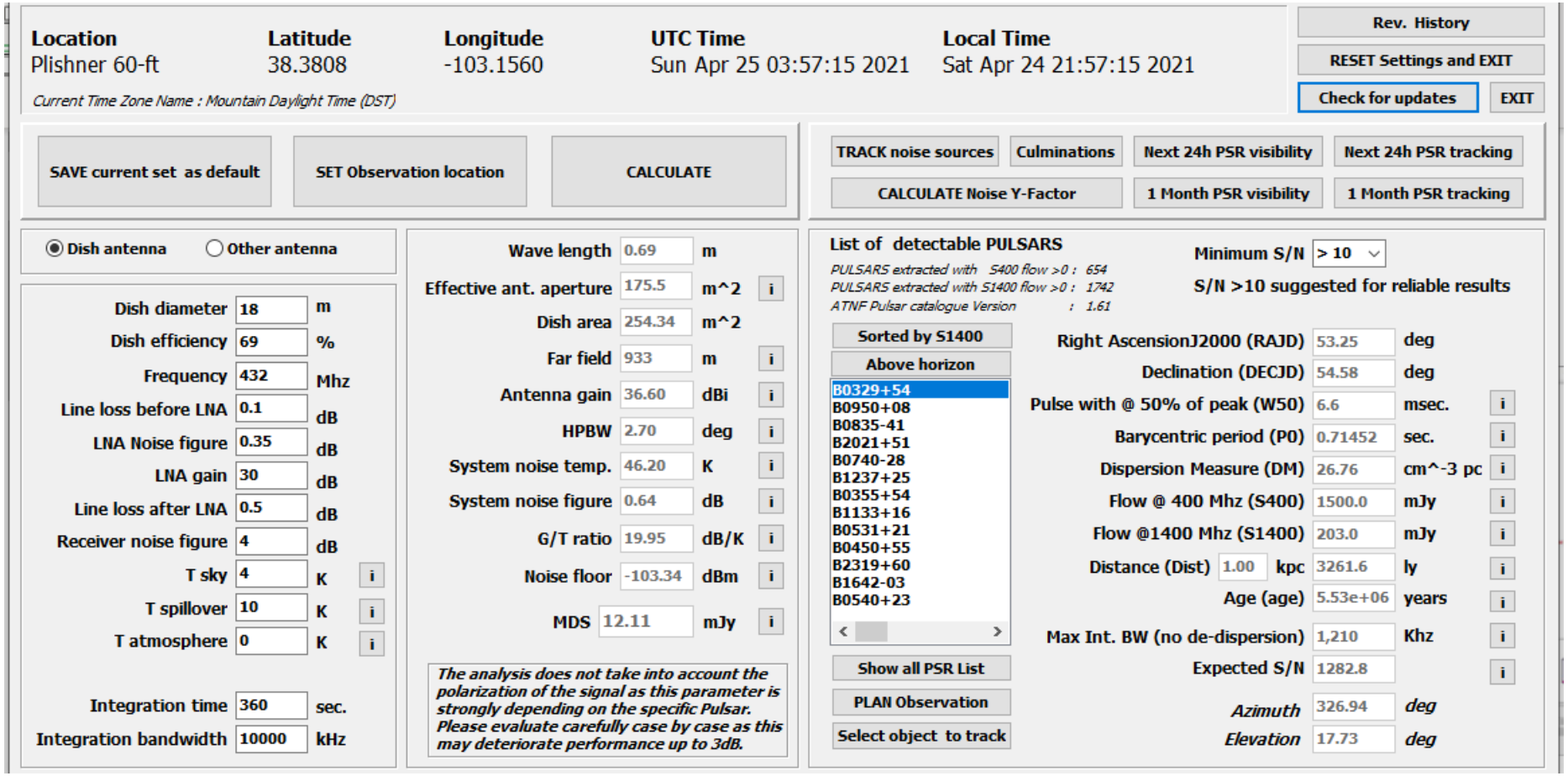
Source: Job Geheniau

Tools: MURMUR

Murmur 15.0.0 HOT

(1 vote) Download

Murmur is a program that evaluate characteristics of a receiving set-up and calculates the possibility to detect Pulsars.



[Murmur (i0naa.altervista.org)]

Tool for 3D Visualization

RE: [SARA] Sun transit in 60 seconds

Mario A. Natali (mario.i0naa@gmail.com) Fri, Apr 23, 2021 4:30 am

To: you (Bcc) + 1 more Details Slideshow

Sun_plot_Mario.jpg (104 KB)

Hi all

in order to generate 3D plots of noise sources you can try my program TotalPower (available from download section of my web site http://i0naa.altervista.org/) .

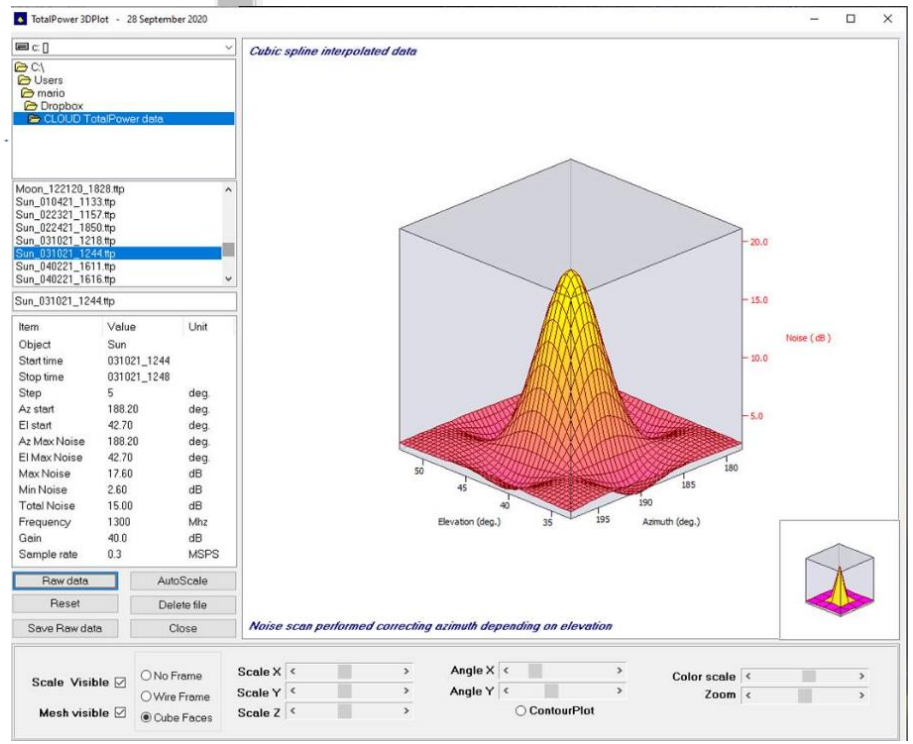
Attached is a sun plot generated few days ago with my 5m dish and about 4 minutes of automatic sky mapping.

TotalPower uses rtl-sdr as receiver and rotate the antenna working in conjunction with PSTrotator (https://www.qsl.net/yo3dmu/index_Page346.htm) .

More plots are available together with the program

TotalPower can also plot the HLine.

Mario A. Natali
Italy



Source: Home (i0naa.altervista.org)

Tool to Analyze Best Pulse from PRESTO

PRESTO Best profile analyzer HOT


(6 votes)

BestProfile analyzer is a program that reads the .bestprofile files generated from PRESTO , calculate S/N and shows all parameters.

Manual is not available yet as the program is still in BETA and I will appreciate all feedbacks

[PRESTO Best profile analyzer (i0naa.altervista.org)]

Astropeiler Stockert

- Amateur organization much like DSES in Germany

Aerial view of the site. Photo courtesy of Klaus Göhring

[Astropeiler - Die Technik für Azimut und Elevation (aktualisiert) - YouTube]

Dish control

The motion of the dish is controlled by a two layer structure of hard- and software. The lower layer directly controlling the azimuth and elevation motors, the brakes, end switches and other safety relevant systems is implemented using an industrial SPC shown below:

SPC racks

[Source: Astropeiler_Story_1]

FRB detection by Stockert telescope

Extremely bright pulse from FRB20201124A observed with the 25-m Stockert Radio Telescope

ATel #14556; *Wolfgang Herrmann (Astropeiler Stockert e. V.)*
on 16 Apr 2021; 15:47 UT
Credential Certification: Laura Spitler (lspitler@mpifr-bonn.mpg.de)

Subjects: Radio, Fast Radio Burst

Tweet

We report on the observation of an extremely bright pulse from FRB20201124A observed in L-band with the Stockert 25-m Radio Tele scope. Following the report of enhanced activity by the CHIME/FRB collaboration (ATel #14497) observations with this instrument began on 2021 March 31. Until April 15, a total of approx. 90 hours of observation time had been accumulated distributed over 12 days. Observations were carried out with 100 MHz bandwidth at a center frequency of 1380 MHz with 218.4 microseconds time resolution and 583 MHz spectral resolution. Data was analyzed for single pulses using PRESTO with an S/N threshold of 6. Candidates were subsequently inspected visually.

An extremely bright pulse was detected on 2021 April 15 at 12:23:19.369 UTC using the position of the source as given by Law et.al. in ATel #14526. This pulse had a fluence of 334 Jy ms (+/- 10%) and a peak flux density of 215 Jy (+/- 10%) giving an excellent S/N of 85. The full width half maximum of the pulse was 1.5 ms (+/- 0.2 ms) and the DM was determined to be 412.8 (+/- 0.2) pc/cm^3 We believe this is the pulse with the highest fluence detected from this source so far. A dynamic spectrum is available at the link below. A few other events were noted but the S/N was too low to be conclusive. The source seems to continue to be in an active state and observations will continue.

This detection supports the finding by Kumar et.al (ATels #14508, #14509) that bursts from this source can be detected with smaller apertures and further observations with such instruments are encouraged.

The Stockert 25-m Radio Telescope is located in the western part of Germany close to Effelsberg. It has been built in 1956 and, after a longer hiatus, is back in operation since 2011. It has been refurbished and fitted with new receivers and instrumentation. Presently the instrument is equipped with a dual linear polarization L-band receiver and achieves a SEFD of 1100 Jy. The observatory is operated by Astropeiler Stockert e.V., a non-profit organization of volunteers.

Antenna Diameter: 25m
Center Frequency: 1380 MHz
Bandwidth: 100 MHz
Polarization: Dual linear
Time resolution: 218.4 microseconds
Spectral Resolution: 583 MHz

Dates: March 31 – April 15, 2021
Total Time: 90 Hours

Analyzed for single pulses using PRESTO
Fluence: 334 Jy ms
Flux Density: 215 Jy
DM 412.8 pc/cm^3
Note: error ranges were calculated

[Source: ATel #14556: Extremely bright pulse from FRB20201124A observed with the 25-m Stockert Radio Telescope (astronomerstelegram.org)]

Position

VLA/realfast localization and deep imaging of FRB 20201124A

ATel #14526; *Casey Law (Caltech), Shriharsh Tendulkar (TIFR/NCRA), Tracy Clarke (NRL), Kshitij Aggarwal (WVU), Suryarao Bethapudy (UT-RGV), realfast collaboration, CHIME/FRB collaboration, VLITE collaboration*
on 7 Apr 2021; 18:56 UT
Credential Certification: Casey Law (claw@astro.caltech.edu)

Subjects: Radio, Fast Radio Burst

Referred to by ATel #: 14529, 14532, 14538, 14549, 14556

Tweet

We report results of new observations of FRB 20201124A (ATels #14497, #14508) with the Karl G. Jansky Very Large Array (VLA). On 2021-04-06, at 23h55m UT, we started a 50 minute observation in a frequency band from 1 to 2 GHz. Visibility data with a sampling time of 10 milliseconds was commensally run through the realfast FRB search system in real time (Law et al 2018).

The realfast system detected one burst with an MJD of 59311.0129359 (topocentric at 2.0 GHz) with SNR=26 and a dispersion measure of 420+-10 pc/cm3. This significance is measured in a single 10-ms image using a band from 1.3 to 1.5 GHz that includes all of the burst emission. We applied gain and flux calibration to the 10-ms image to measure a burst fluence of 2.4+-0.1 Jy ms. The burst position (J2000 epoch) is (RA, Dec) = (5:08:03.50, 26:03:37.8) with an uncertainty of 2" (dominated by estimated systematic error). The VLA and ASKAP localizations are formally inconsistent, and the VLA position is consistent with the optical center of the proposed host galaxy SDSS J050803.48+260338.0 (ATel #14515, #14516).

We have analyzed 5-s visibilities recorded from the same observation to generate a deep image of the FRB field. The VLA antennas are in the compact D configuration (1 km baselines), which has a resolution of 48" at 1.4 GHz and a confusion limit of 170 microJy. The full 1--2 GHz band image shows no source brighter than 500 microJy (3 sigma limit) at the FRB location. This field was also observed in the VLA Sky Survey epoch 1.2 in the 2--4 GHz band. No source is seen at the FRB location brighter than 500 microJy (3 sigma limit).

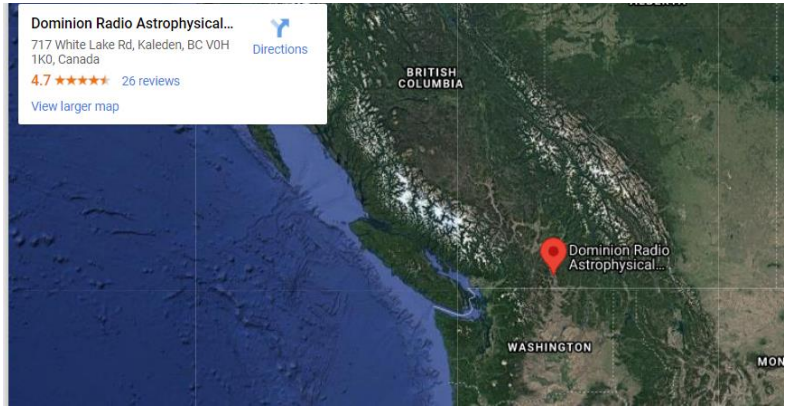
VLITE-Fast running on the VLA Low-band Ionosphere and Transient Experiment (VLITE, http://vlite.nrao.edu) commensally searched for the bursts using the incoherently summed (13 antenna) total intensity filterbank data in a 320-361 MHz frequency window. No bursts were found using the standard triggering of S/N>8 for machine learning based follow-up baseband dumps, placing a limit of ~ 40 Jy ms.

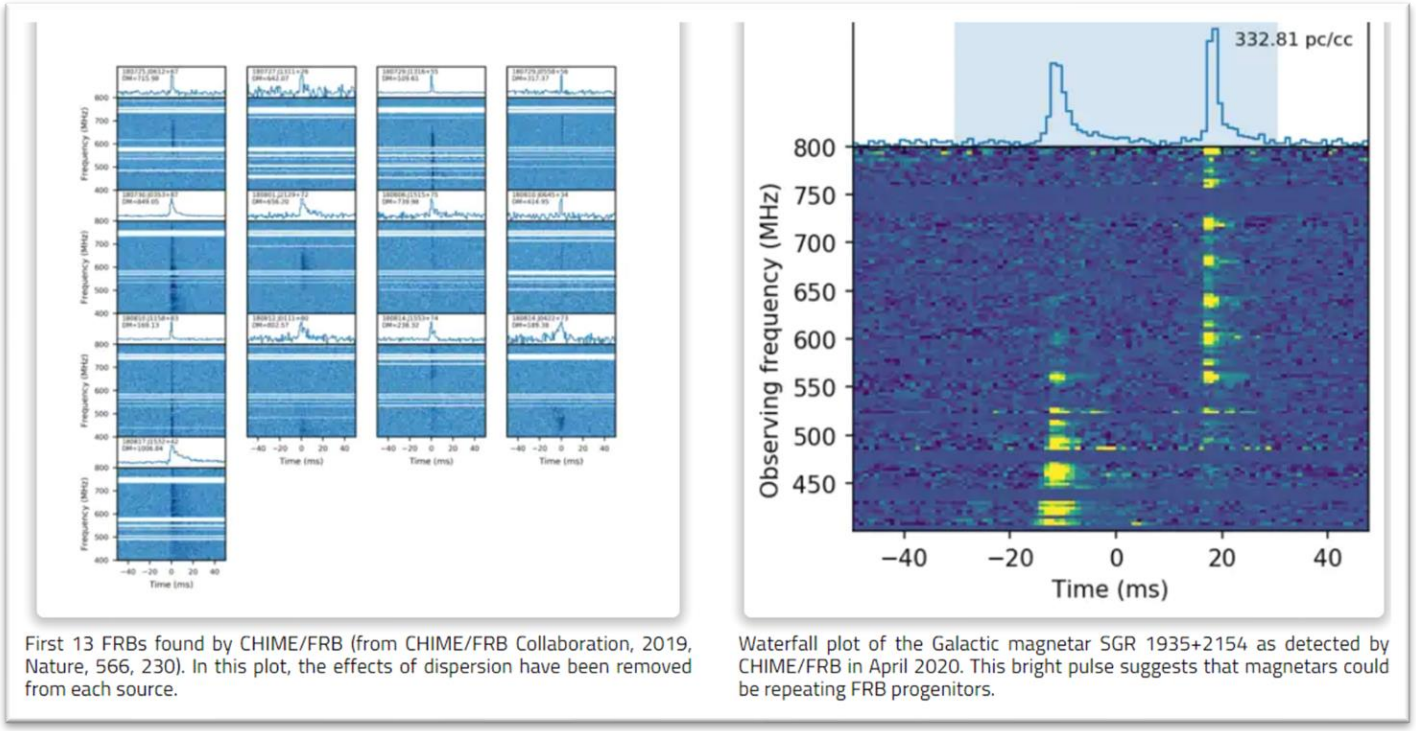
RA: 5:08:03.50

DEC: 26:03:37.8

Source: ATel #14526: VLA/realfast localization and deep imaging of FRB 20201124A (astronomerstelegram.org)

Canadian Hydrogen Intensity Mapping Experiment (CHIME)





First 13 FRBs found by CHIME/FRB (from CHIME/FRB Collaboration, 2019, Nature, 566, 230). In this plot, the effects of dispersion have been removed from each source.

Waterfall plot of the Galactic magnetar SGR 1935+2154 as detected by CHIME/FRB in April 2020. This bright pulse suggests that magnetars could be repeating FRB progenitors.

[Source: CHIME Experiment (chime-experiment.ca)](chime-experiment.ca)

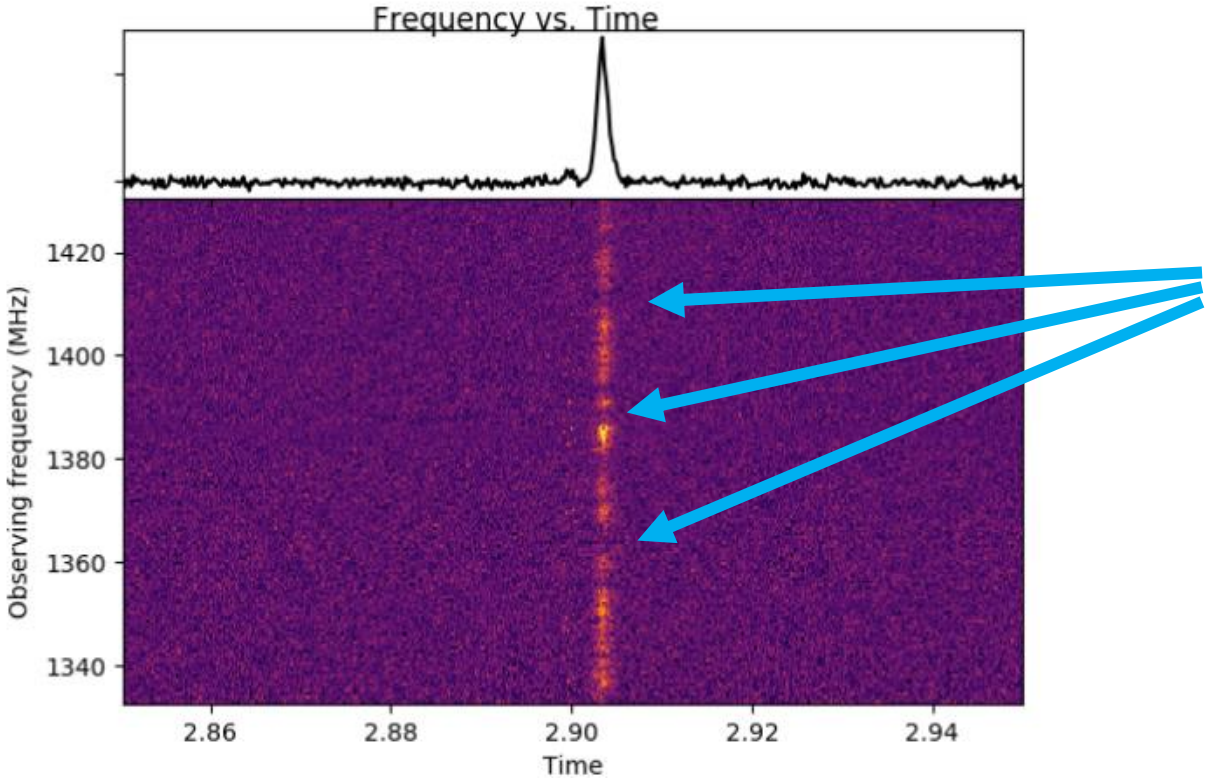
Stockert Dynamic Spectrum

FRB20201124A

An extremely bright pulse from FRB20201124A was detected on April 15th at 12:23:19.369 UTC.

This pulse had a fluence of 334 Jy ms (+/- 10%) and a peak flux density of 215 Jy (+/- 10%) giving an excellent S/N of 85. The full width half maximum of the pulse was 1.5 ms (+/- 0.2 ms) and the DM was determined to be 412.8 (+/- 0.2) pc/cm^3. We believe this is the pulse with the highest fluence detected from this source so far.

Below you will find the dynamic spectrum from this observation, the spectral resolution is 583 kHz/channel.



Note: frequency gaps

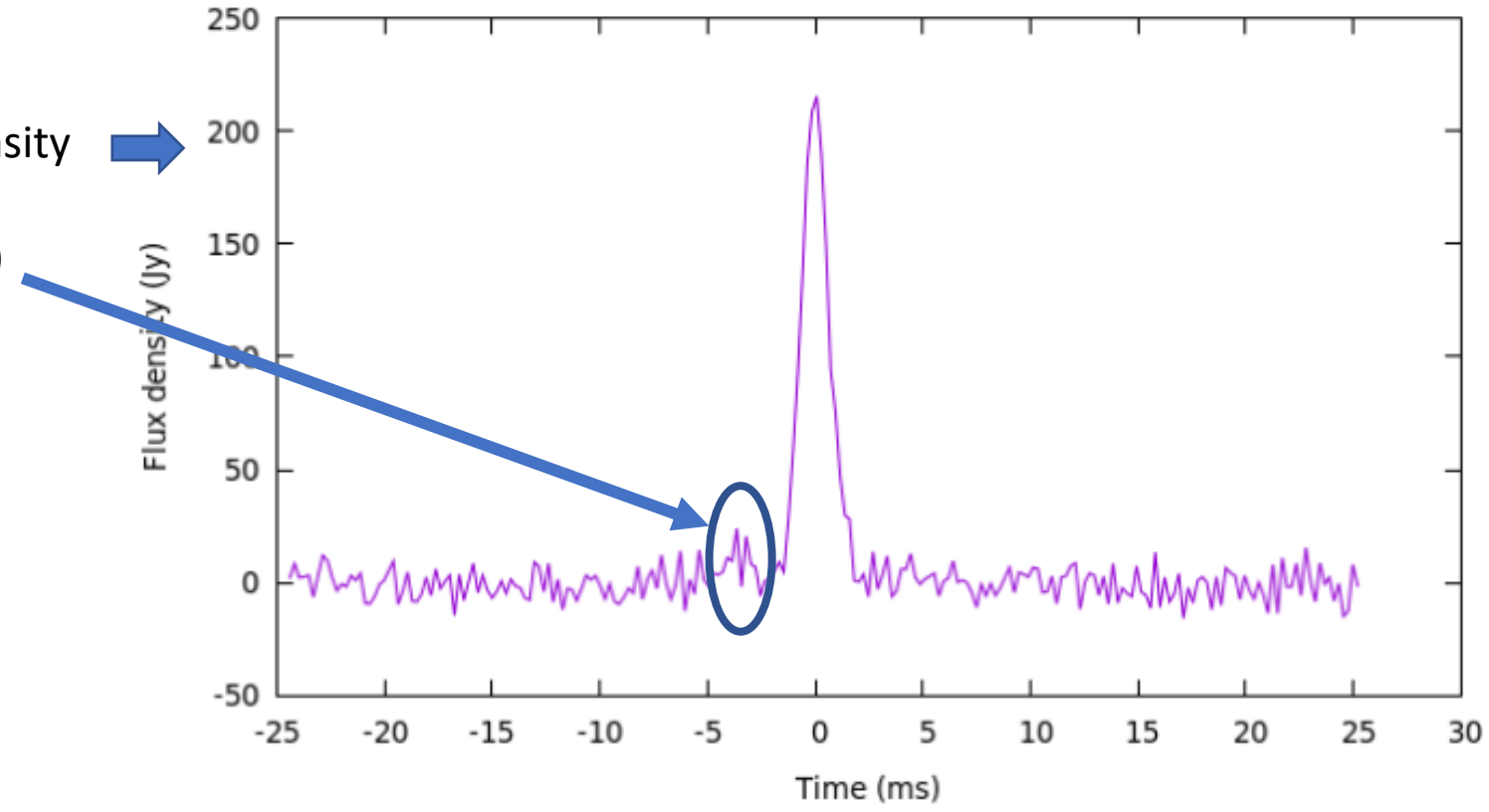
Source: FRB20201124A | Astropeiler Stockert e.V.

Stockert FRB Time Series

Please note that the small precursor to the pulse is due to an instrumental artefact and not part of the actual pulse. Below you will find the pulse profile in more detail.

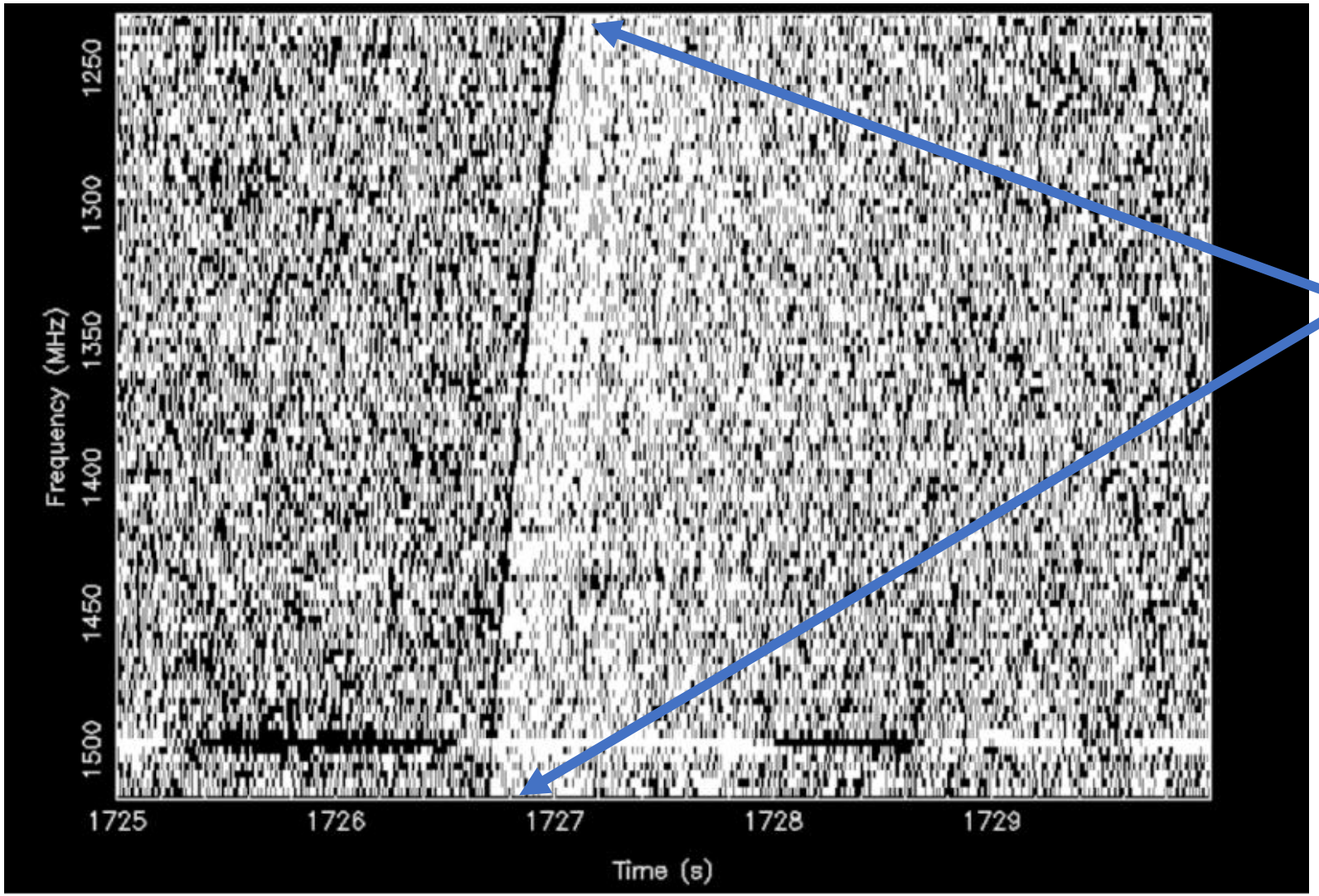
Note:

1) Calibrated flux density
2) Precursor pulse (telescope artifact)



Source: FRB20201124A | Astropeiler Stockert e.V.

Lorimer Burst



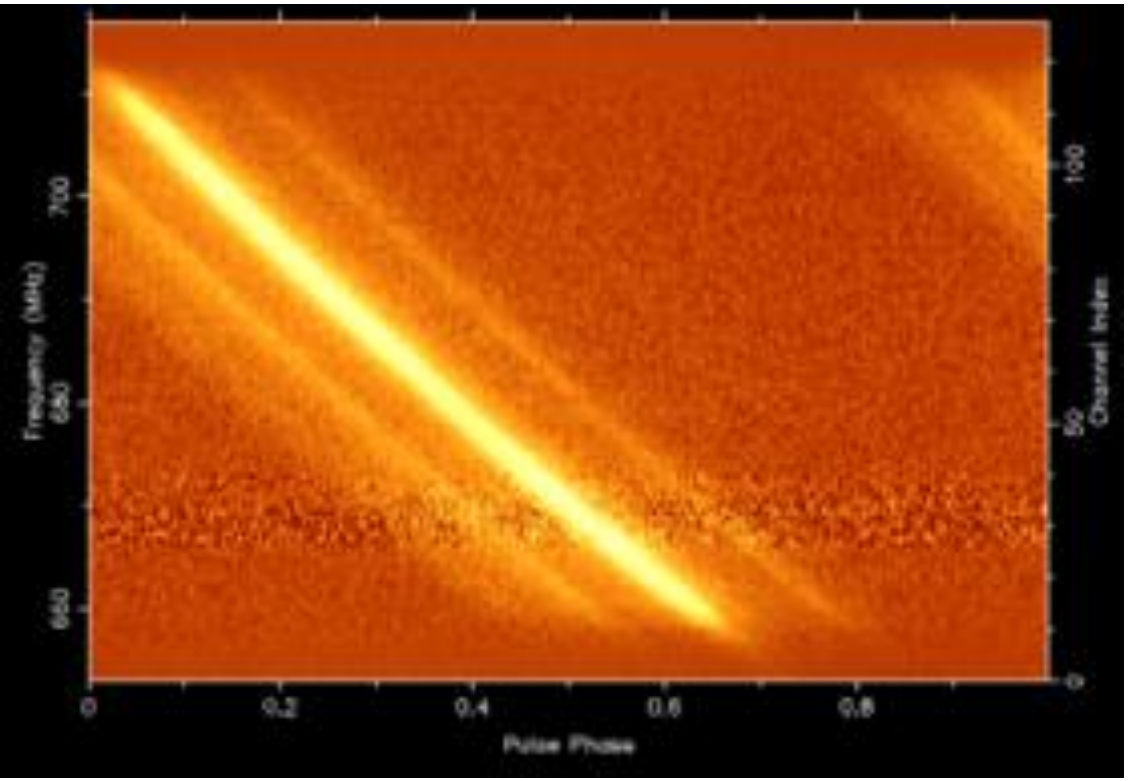
e first detected fast radio burst as described by Lorimer in 2006.[1]

Note:
Higher frequencies arrive earlier

Dispersion measure indicates that FRB is inter-galactic

Fast radio burst - Wikipedia

Dispersion Measure



$$DM = n_e D$$

Example

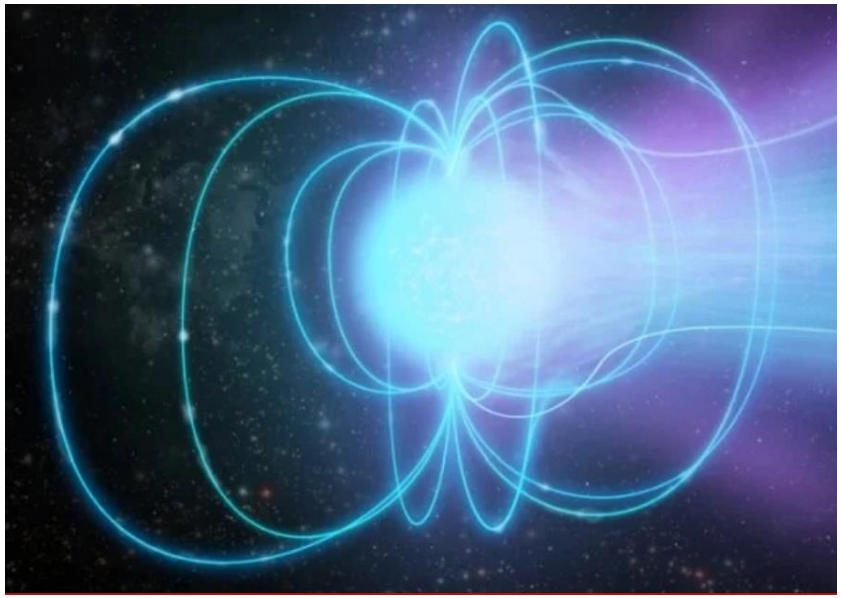
The binary pulsar PSR J0437-4715 has had its **parallax** distance determined from **pulsar timing** to be 156 pc. The dispersion of 2.643 pc cm^{-3} means that the mean electron density between the Earth and the pulsar is:

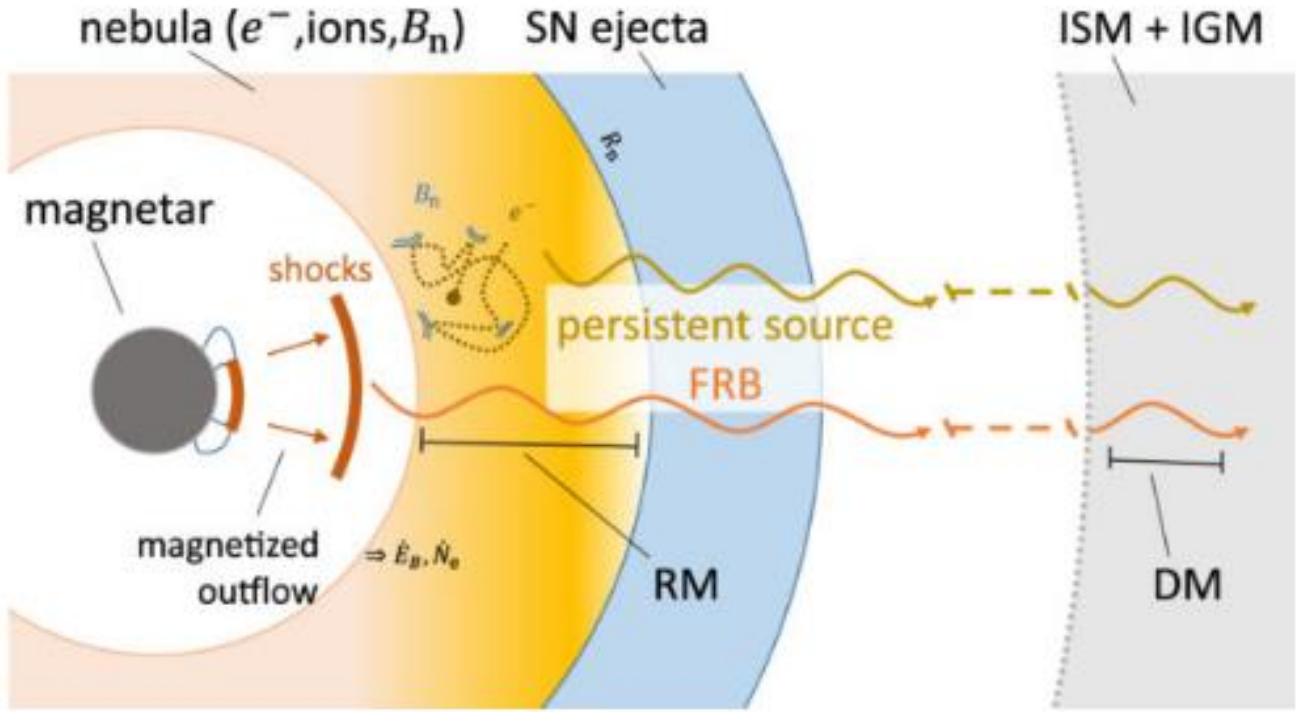
$$n_e = DM/D = 2.643/156 = 0.017 \text{ electrons}/cm^3$$

[Pulsar Dispersion Measure | COSMOS (swin.edu.au)]

FRBs may be associated with Magnetars

FRB: 200428 associated with magnetar SGR 1935+2154 inside Milky Way





Schematic of the authors' model, in which a young, flaring magnetar is embedded in a magnetized nebula trapped behind the shell of supernova ejecta. Electrons in the magnetized nebula emit the persistent radio radiation, and the nebula leaves an imprint on the burst emission — which originates from the magnetar — as well. [Margalit & Metzger 2018]

[It's Official: The Fast Radio Burst Coming From Within Our Galaxy Is Repeating (sciencealert.com)]

[Are Fast Radio Bursts from Flaring Magnetars? (aasnova.org)]

Can DSES Observe an FRB?

- YES (maybe)

- Configuration:
  - 1420 MHz feed
  - Bandwidth (highest possible)
  - Polarization (1 to 2)
  - Use new 32 core computer with B210 receiver
  - Observe based on queuing by Astronomers Telegram (CHIME telescope)
  - Maximize observing time: multiple days
- Analysis:
  - Get PRESTO single pulse analysis working
  - Learn how to differentiate RFI from FRBs

Calibration

Astron. Astrophys. 106, 190–196 (1982)

ASTRONOMY AND ASTROPHYSICS

Brightness Temperature Calibration for 21-cm Line Observations

P. M. W. Kalberla[1], U. Mebold[2] and K. Reif[3]

[1] Max-Planck-Institut für Radioastronomie, Auf dem Hügel 69, D-5300 Bonn 1, Federal Republic of Germany, now at Kapteyn Astronomical Institute, Groningen, The Netherlands
[2] Max-Planck-Institut für Radioastronomie, Auf dem Hügel 69, D-5300 Bonn 1, Federal Republic of Germany, now at the Radioastronomical Institute of the University of Bonn
[3] Radioastronomical Institute of the University of Bonn, Auf dem Hügel 71, D-5300 Bonn 1, Federal Republic of Germany

Received July 27, accepted October 5, 1981

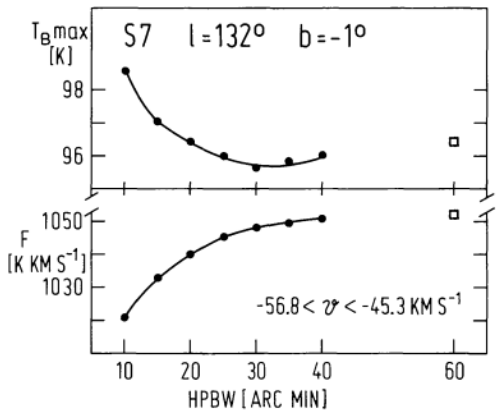


Fig. 4. Calibration data for the IAU standard position S7: peak brightness temperature T_B(max) and integrated line strength $F = \int T_B dv$ (the integration limits are indicated) as a function of the beam width HPBW of a 2-d gaussian beam. The open squares indicate data derived from uniformly weighted averages over a $1° \times 1°$ area. F and T_B(max) are corrected for the atmospheric extinction

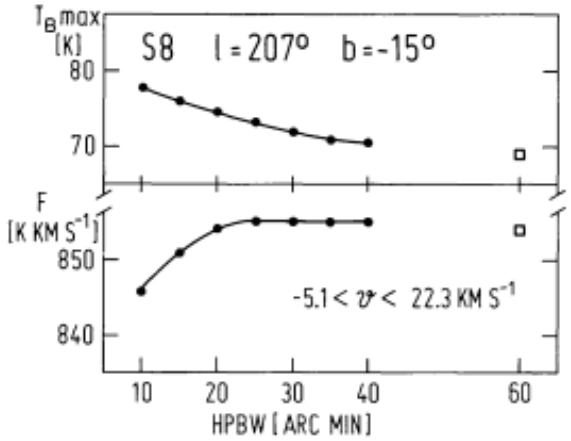


Fig. 5. Calibration data for the IAU standard position S8. Further details as for Fig. 4

Calibration Procedure:

1) Observe S7 periodically during normal observations
2) Ratio 21 cm observations with S7 to get absolute temperature of observation
3) Convert to Janskys (TBD procedure)

S7: Galactic Lat (b) -1 deg,
Long (L): 132 deg
RA: 02 06 12.59 DEC: +60 32 54.90

S8: Galactic Lat (b) 207 deg,
Long (L): -15 deg
RA: 05 47 21.34 DEC: -01 40 18.41

1982A&A...106..190K (harvard.edu)

60 ft Dish 21 cm Calibration Data Sheet

Date: _____ UTC
Receiver: _____ Gain Setting: _____
Integration Time: _____ seconds
Frequency: _____ MHz
Bandwidth: _____ MHz

S7 Observations: RA: 02 06 12.59 DEC: +60 32 54.90 use: 96K
S8 Observations: RA: 05 47 21.34 DEC: -01 40 18.41 use: 75K

Example: MJD: _____ Cal Level: _200_ Ratio: 96K/200 x target (20) = 9.6K (calibrated target temp)

#1: MJD _____Cal level:_____ Ratio: ____/_____ x _____ = _____K (calibrated target temp)
#2: MJD _____Cal level:_____ Ratio: ____/_____ x _____ = _____K (calibrated target temp)
#3: MJD _____Cal level:_____ Ratio: ____/_____ x _____ = _____K (calibrated target temp)
#4: MJD _____Cal level:_____ Ratio: ____/_____ x _____ = _____K (calibrated target temp)
#5: MJD _____Cal level:_____ Ratio: ____/_____ x _____ = _____K (calibrated target temp)

2021 Observation/ Feed Schedule

- May 2021
  - 1st 2 weeks: Skip Crilly Observations (specialized 1420 MHz feed
  - 1420 MHZ Feed for pulsar, FRB, and HI observations
  - 1296 MHz if EME team wants it
- June 2021
  - 1420 MHZ Feed for pulsar, FRB, and HI observations
  - 1296 MHz if EME team wants it
- July 2021
  - 1420 MHZ Feed for pulsar, FRB, and HI observations
  - 1296 MHz if EME team wants it

Questions?