CALLISTO status report/newsletter #103

1st light from Paraguay

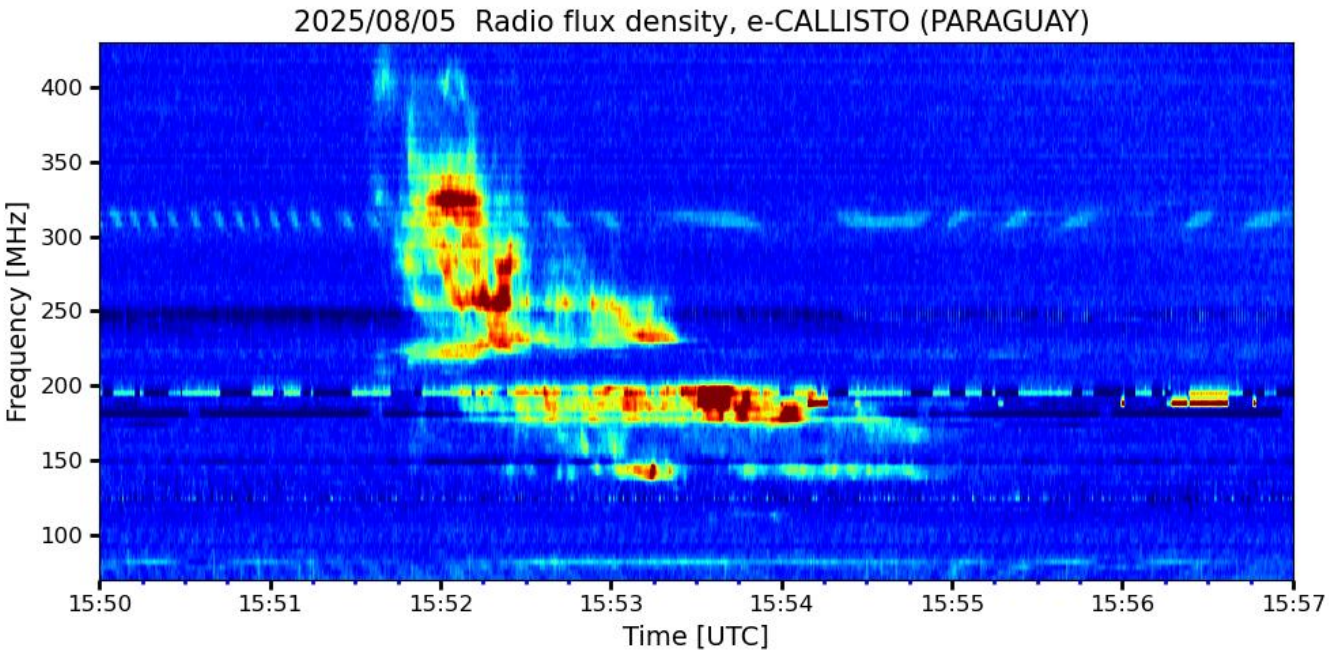


Fig. 1: Type II solar radio burst, observed with the new station in Paraguay. Contact: Diego Herbin Stalder Diaz <dstalder(at)ing.una.py>

Welcome on board of e-Callisto!

2025-08-07 Azores funds confirmed 475k€, 20k€ for new instruments.
2025-08-27 URUGUAY back on-line after tuner replacement. Congrats Andrea at al.
2025-12-12 Tool to view and manipulate FITS-file written in Python by Sahan S Liyanage, Sri Lanka.
Download and run the exe-file.
No Python installation required, exe-file contains everything required to run the application.
https://e-callisto.org/Software/Callisto-Software.html
Details below on page 4.

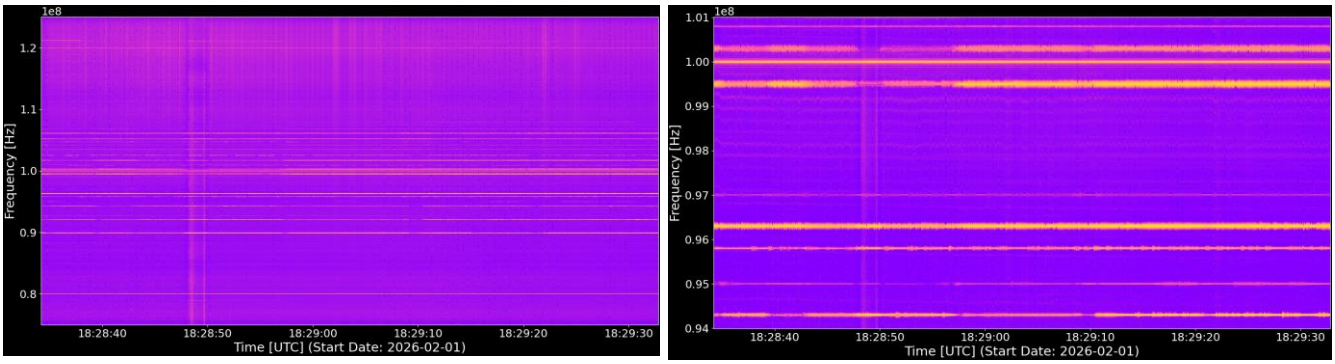
Report by Jimmy Fitzpatrick about progress SDR

I'm Jimmy Fitzpatrick, a software engineer and maintainer of *Spectre* - an SDR-agnostic program for recording radio signals and spectrograms. Mainly, applications include solar and jovian radio observations, educational outreach and citizen science.

What's new? In the last two years, we've made significant improvements to the program. Here's what's new as of the latest release:

- Wider SDR support (SDRplay, HackRF, RTL-SDR, USRP)
- Record spectrograms and I/Q samples (configurable file format, compatible with inspectrum, NumPy and Astropy)
- Wideband frequency sweeps (USRP, SDRplay)
- Long-form recordings
- Simple, intuitive CLI tool
- Native Linux support, including Raspberry Pi
- Simple installation with Docker

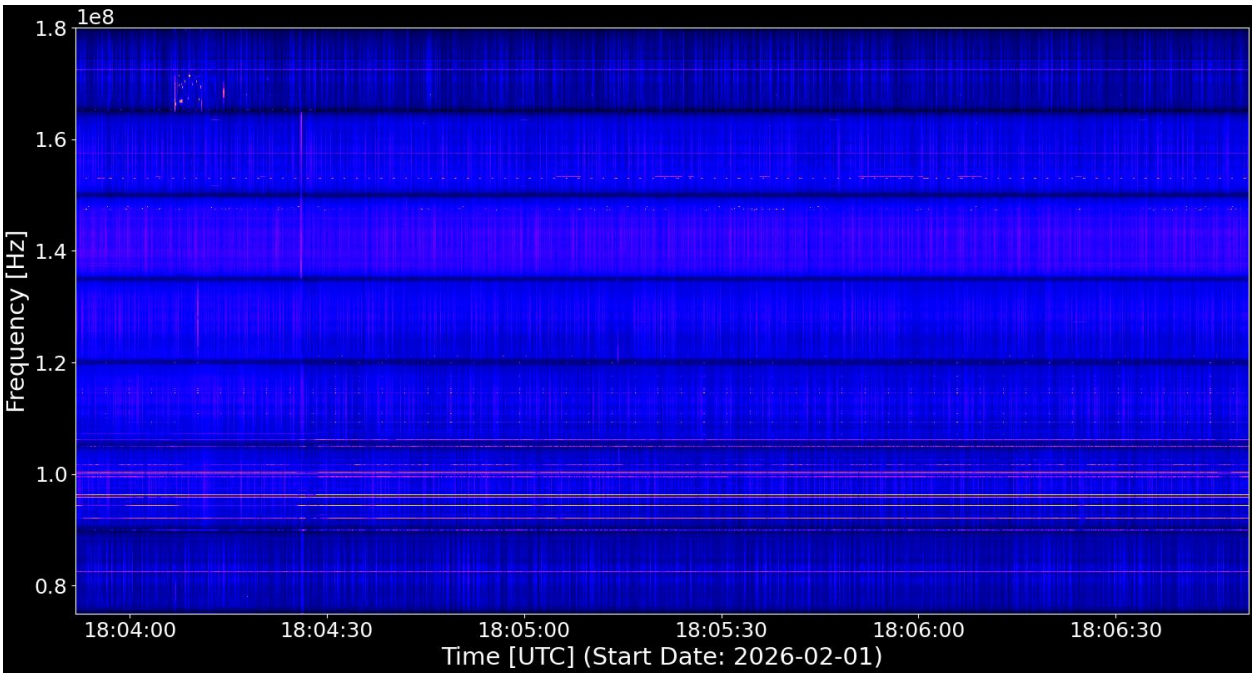
In action: *Spectre* streams complex I/Q samples into batched binary files using GNU Radio, then applies a short-time discrete Fourier transform to each batch to produce the spectrograms.



> A spectrogram of the FM band recorded with a USRP B200mini. Left panel: 50 MHz frequency range with 0.05 s time resolution and 6 kHz frequency resolution. Right panel: A detailed view of the same spectrogram over the 94–101 MHz frequency range.

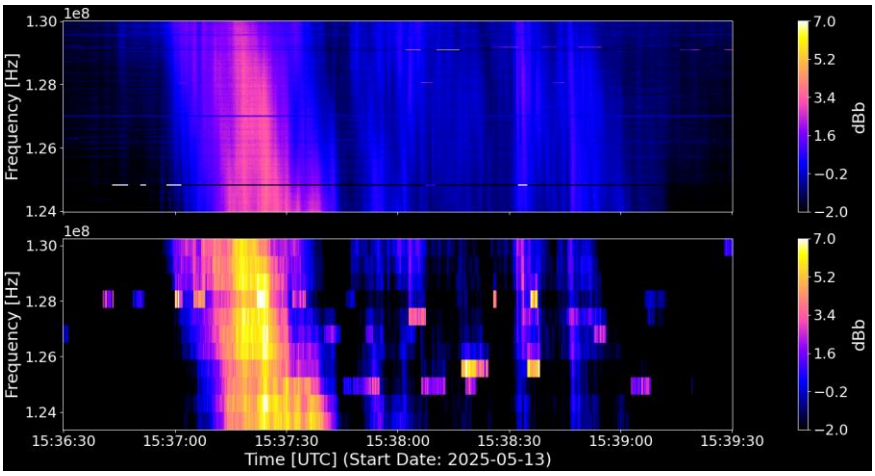
Spectre also supports recording wideband spectrograms by sweeping the centre frequency over a range in fixed increments. Once again, the complex samples are streamed into batched binary files using GNU Radio. However, this time, the receiver is re-tuned at runtime using the message-passing API.

Neighbouring I/Q samples captured at the same frequency constitute a *step*, and steps captured at incrementally increasing centre frequencies form a *sweep*. A short-time discrete Fourier transform is applied to each step, and the resulting spectrogram is averaged over time. The averaged spectra for each step are stitched together to form the spectrum for each sweep, which comprises the spectrogram.



> A spectrogram including the FM band recorded with a USRP B200mini over a 100 MHz frequency range with 0.15 s time resolution and 45 kHz frequency resolution. The dark horizontal lines are artefacts from low-pass filters (bandwidth 15 MHz); Spectre does not yet support steps that overlap in the frequency domain. The fluctuating background (vertical stripes) is probably an artefact due to the low dwell time (20ms).

I'm currently using *Spectre* to operate a solar radio monitoring station (left image) using a Raspberry Pi 4 Model B, an SDRplay RSP1A and an LPDA (CLP-5130-2N). I've no results yet, so I've attached a nice solar radio burst recorded last Summer using the program. My own results (right image, upper panel) are compared with those from the e-Callisto station in Alexandria, Egypt (right image, lower panel).



What's next? In 2026, we're exploring creating a distributed solar radio spectrometer comprising identical, low-cost stations using off-the-shelf SDRs. Whether you're interested in learning more about this project, using *Spectre*, or contributing to its development, we'd love to hear from you. You can find us on GitHub or email me.

Jimmy Fitzpatrick
jcfitzpatrick12(at)gmail.com

Sahan Liyanage (Sri Lanka) has just finalized a new update (v1.7.6) for the tool with the following features:

1. FIT File Export: You can now save raw, combined, or background-subtracted data as a FITS file with a modified header. This should be particularly helpful for those performing Machine Learning on solar radio FITS data. To use this, go to File > Export As > Export to FIT.

2. Newkirk Model Update: In the analyzer window for shock parameter calculations, the fold number for the Newkirk model has been added as a variable (1, 2, 3, 4).
3. Menu Organization: The menu bar is now more organized for better navigation.
4. Bug Fixes: Several typos and other minor issues have been resolved.

You can find the download links for Windows (.exe), Linux (.deb), and macOS (.dmg) here:
https://e-callisto.org/Software/Callisto-Software.html
Best regards,
Sahan Liyanage sahanslst(at)gmail.com

Sahan Liyanage is writing to inform you about my newest Python library, "**ecallistolib**", designed to download, read, process, combine, and plot e-CALLISTO data. I developed this library alongside the GUI application for those who prefer working with code and want to streamline their workflow without writing extensive lines of code.

Sahan Liyanage has published the library on PyPI, and you can find it at the following link:
https://pypi.org/project/ecallistolib/

The source code is also available here: **https://github.com/SaanDev/ecallistolib**

CESRA NEWS

https://heliowiki.smce.nasa.gov/wiki/index.php/SolarNuggets

CESRA nuggets:
Polarization Analysis of Type III Langmuir/Z-mode Waves with Coherent Magnetic Component Observations by SolarOrbiter
by T. Formánek et al.
https://www.astro.gla.ac.uk/users/eduard/cesra/?p=4033

On the limitations of using metric radio bursts as diagnostic tools for interplanetary coronal mass ejections
by J. Kandekar et al.
https://www.astro.gla.ac.uk/users/eduard/cesra/?p=4072

A Flare-related Decimetric Type-IV Radio Burst Induced by the X2 Radiation of Electron Cyclotron Maser Emission by Lv et al.
https://www.astro.gla.ac.uk/users/eduard/cesra/?p=4054

Observation and Modeling of Small Spatial Structures of Solar Radio Noise Storms using the uGMRT
by S. Mondal et al.
https://www.astro.gla.ac.uk/users/eduard/cesra/?p=4049

Multispacecraft Analysis and Modeling of Type III Radio Burst Exciter Deceleration in Inhomogeneous Heliospheric Plasma
by F. Azzolini et al.
https://www.astro.gla.ac.uk/users/eduard/cesra/?p=4112

Noise in Maps of the Sun at Radio Wavelengths
by T. S. Bastian et al.
https://www.astro.gla.ac.uk/users/eduard/cesra/?p=4075

New Instrument in Solar Flare Detection: A 50–55 GHz Millimeter-Wave Radiometer Spectrometer
by X. Xu et al.
https://www.astro.gla.ac.uk/users/eduard/cesra/?p=4107

First Robust Detection of Linear Polarization from Metric Solar Emissions: Challenging Established Paradigms
by S. Dey et al.
https://www.astro.gla.ac.uk/users/eduard/cesra/?p=4131

A Wide-Band High-Frequency Type-II Solar Radio Burst
by Vasanth et al.
https://www.astro.gla.ac.uk/users/eduard/cesra/?p=4136

Signatures of Confined and Eruptive Solar Flares in Microwave Spectra
by E. W. Cliver et al.
https://www.astro.gla.ac.uk/users/eduard/cesra/?p=4159

Tracing Ion-Scale Turbulence and Energy Cascade Rate from the Solar Corona to 1 au
by E. P. Kontar et al.
https://www.astro.gla.ac.uk/users/eduard/cesra/?p=4164

Solar Radio Wide-Band Spectroscopy and Imaging Facilities of the Chinese Meridian Project Phase II
by Yihua Yan et al.
https://www.astro.gla.ac.uk/users/eduard/cesra/?p=4170

AOB

- If you have some stuff to present to the Callisto community, please let me know
- CALLISTO or Callisto denotes to the spectrometer itself while e-Callisto denotes to the worldwide network.
- General information and data access here: https://e-callisto.org/
- e-Callisto data are hosted at University of Applied Sciences, Institute for Data Science FHNW in Brugg/Windisch, Switzerland. Additionally, data are available at ESA site here: ESA Space Weather Portal (https://swe.ssa.esa.int/).
- Backup server of FHNW in Spain active as: https://astrodoncel.uah.es/dashboard/index.php
- In case you (as the responsible person for operating and maintenance of Callisto) are leaving the institute or, if you are retiring, please send me name and email address of the successor.

Please do **NOT** respond to the email-address of the list-server where you have got this document from, it is a computer/robot. This computer will not give you any useful answer…
Respond instead directly to me at: cmonstein(at)swissonline.ch and to the Co-PI javier.bussons(at)uah.es

If you do not want to receive this newsletter, please send me an email and we will take your address out of the database. On the other hand, if you think someone else might be interested in this kind of info, please let me know his/her email-address to be added to the database.

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