Implementation of an astronomy experiment for galactic Fast Radio Burst detection.

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1. Introduction

A fast radio burst (FRB) is an astronomical phenomenon characterised by a short duration of the order of $\sim$ ms and a high spectral flux density of $\sim$100Jy (1Jy $= 10^{-26}$ Wm^{-2}). At the beginning it is observed as a high-energy pulse that sweeps all frequencies in a small time interval, and its origin is unknown. Due to the physical conditions of the interstellar medium through which a FRB propagates, the signal is dispersed, with the high frequencies arriving first. The time it takes for the FRB to sweep the band is directly related to the dispersion measure (DM) [1].

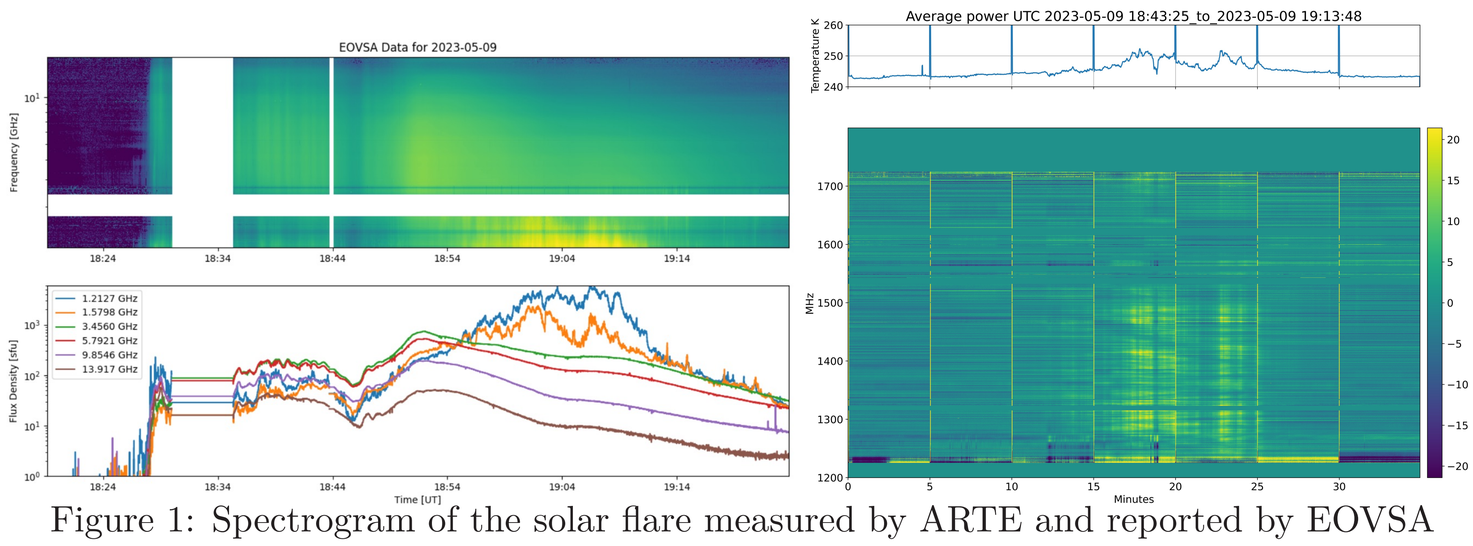

Figure 1: Spectrogram of the solar flare measured by ARTE and reported by EOVSA

3.Antennas

Main antenna is formed by three sub-arrays each of four elements. The purpose of the design is to match the radiation pattern to the galaxy. Additionally, two more sub-arrays were included in order to have information on the phase of the signal and thus calculate the Direction of Arrival (DoA) .

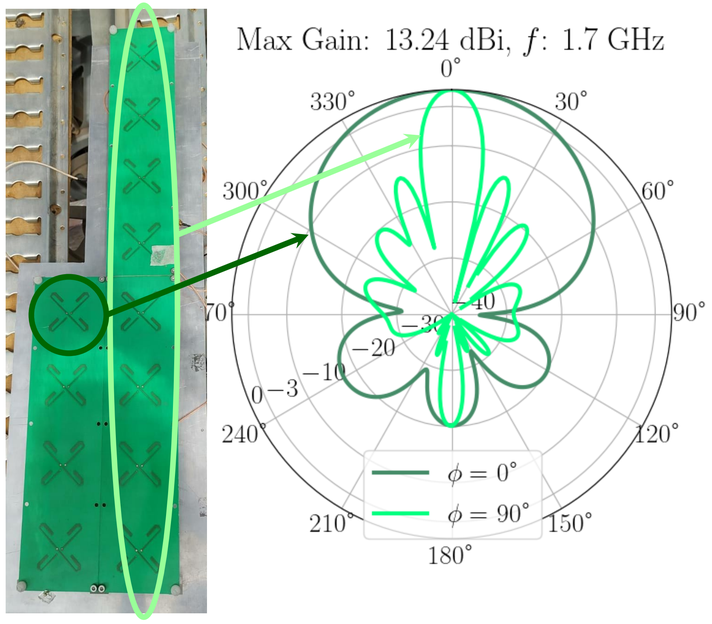

Figure 2: Main antenna and beam pattern

Top side of the antenna Figure 3(left) shows the feeds for each polarization. On the top, the two dipoles are designed in such a way that matching is achieved. In addition, the curved tracks (meanders) shows in Figure 3(right) were designed in order to reduce the size of the antennas and avoid the presence of grating lobes.

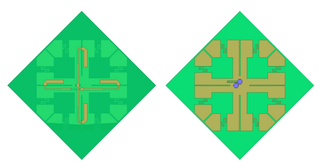

Figure 3: Single element

5. Acknowledgements

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2. ARTE

Astronomical Radio Transients Experiment (ARTE) is the name given to the radio telescope which aims to track the galactic centre in search of FRBs, using an array of antennas designed to that their radiation pattern matches the shape of the Milky Way galaxy, allowing greater sensitivity to galactic sources. Galactic events are expected to be extremely bright and therefore detectable with smaller antennas that have a smaller collecting area. This radio telescope is based on the development made by STARE-2 [2], but unlike it, the following improvements are proposed:

- Increased bandwidth
- Reference antenna for mitigation radio frequency interference (RFI)
- Galaxy-shaped radiation pattern
- Detection algorithm for Direction of Arrival (DoA)

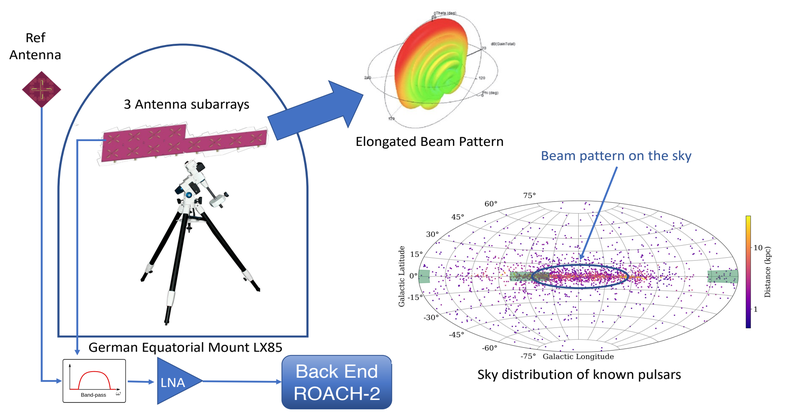

Figure 4: ARTE diagram and pulsar distribution

4. Microwave Receiver

The microwave receiver is formed by three individual amplification chains as shown in Figure 5. Each chain, is composed of a low noise amplifier, an equaliser and a bandpass filter. Operates in a bandwidth from 1.2 to 1.8 GHz, has a gain $\sim$ 81.5 dB and rejection $\sim$ 75 dB.

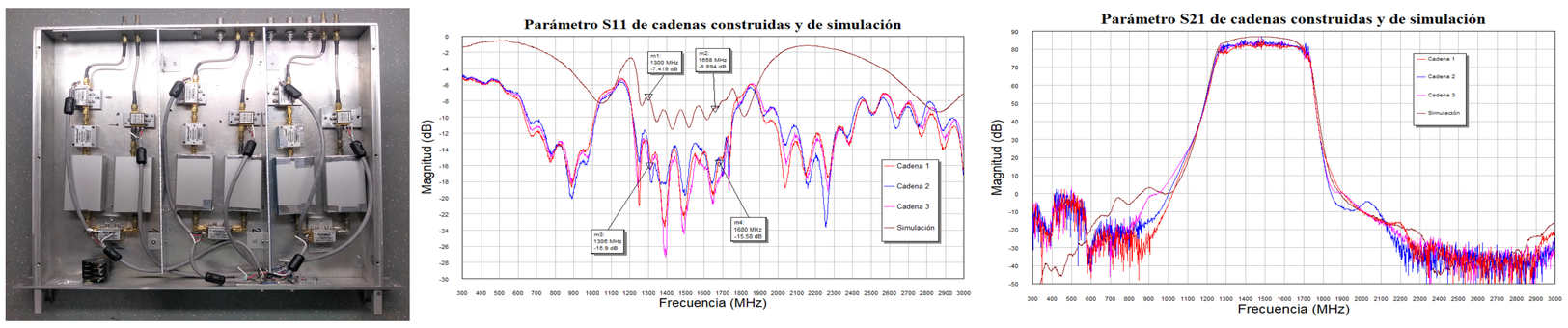

Figure 5: Top view microwave receiver S11 and S21 parameter

6. References

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[2] Christopher Bochenek, Daniel McKenna, Konstantin Belov, Jonathon Kocz, S. Kulkarni, James Lamb, Vikram Ravi, and David Woody. Stare2: Detecting fast radio bursts in the milky way. *Publications of the Astronomical Society of the Pacific*, 132:034202, 03 2020.