ARTE

Astronomical Radio Transients Experiment

Claudia San Martín Luque

Electrical Engineer in Astronomical Instrumentation and Electronics

CATA

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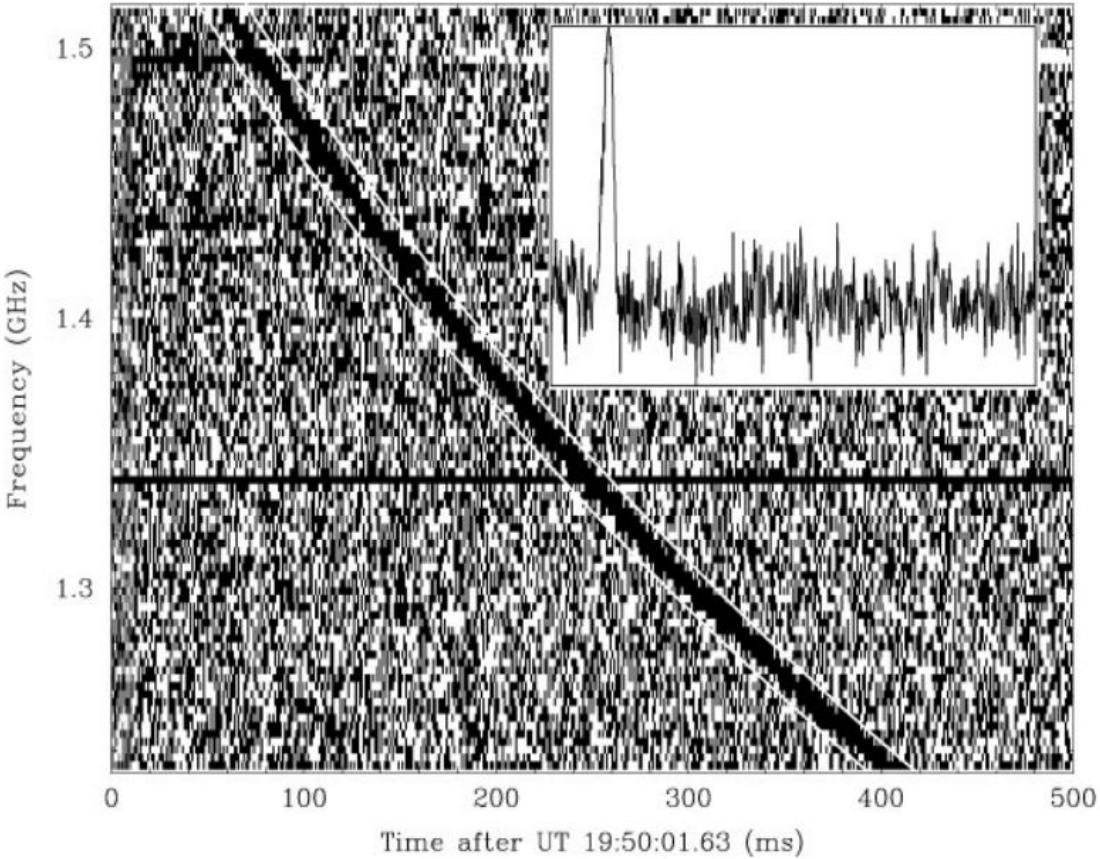
Context

FRBs

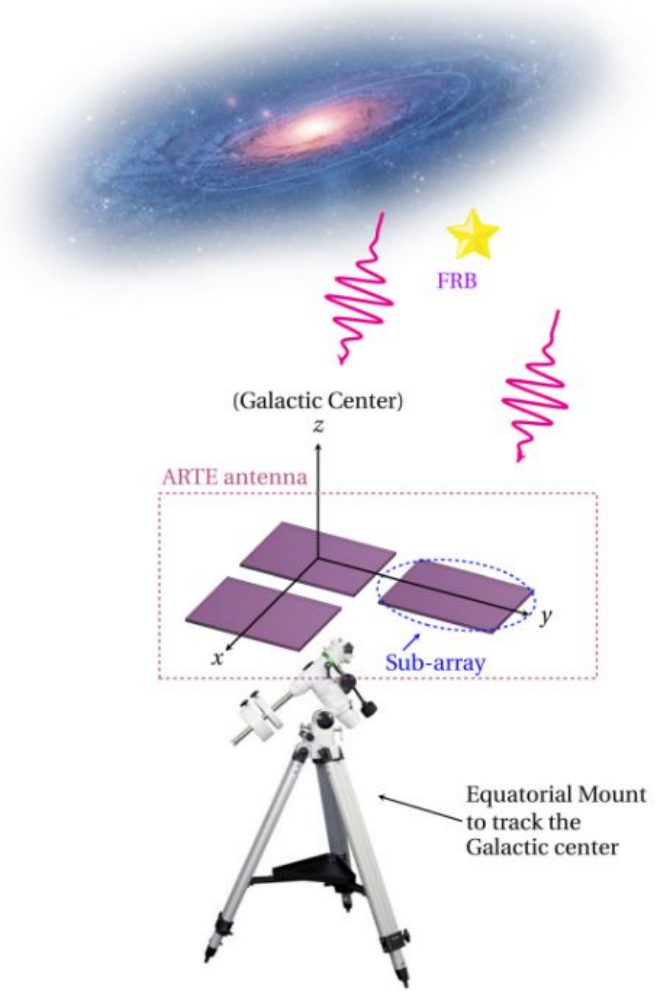
Fast Radio Bursts

- Short-duration, very high-energy radio wave pulses.
- Origin largely unknown.
- They are dispersed by propagation through ionized material in the interstellar and intergalactic medium.



ARTE

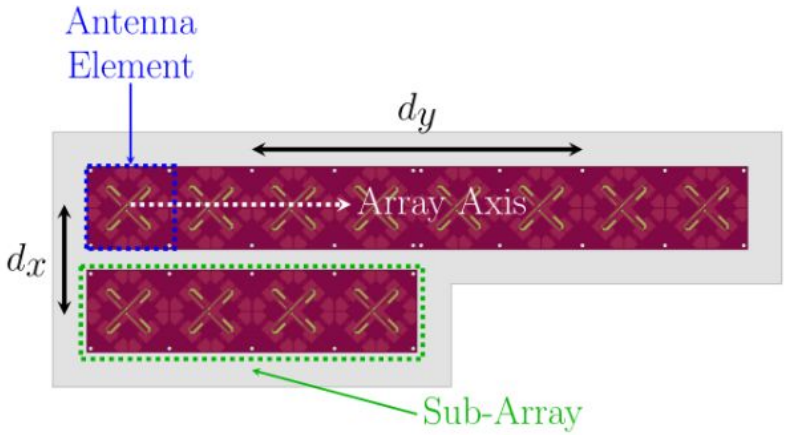
- Radio telescope located on Cerro Calán at the National Astronomical Observatory.
- It seeks to detect FRBs from the Galactic Center.
- Designed, built, and operated entirely by the team.
- Operates between 1.2 and 1.8 GHz.

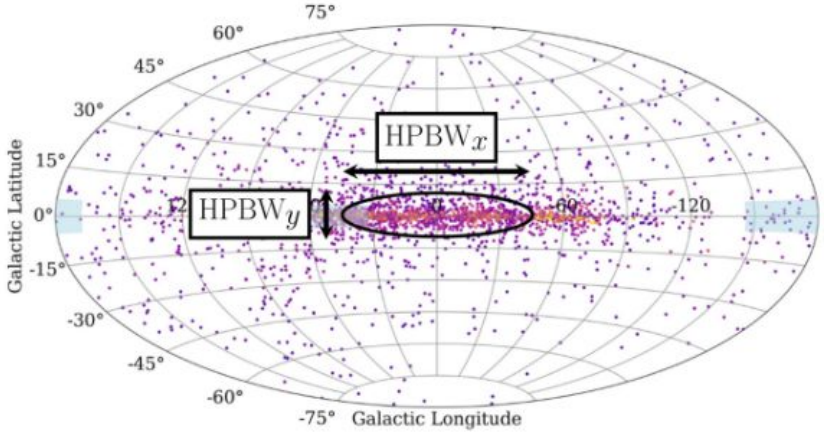


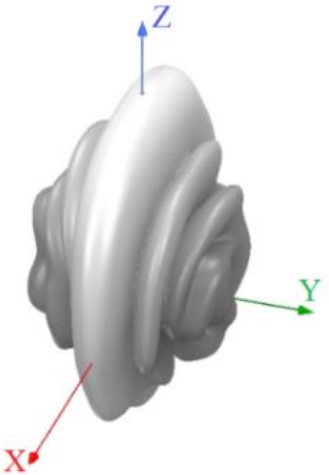
Antenna

Radiation Pattern

- There are 3 arrangements distributed in an L shape.
- The antenna beam is designed to match the angular distribution of the center of the Milky Way.
- Maximizes gain in the center of the Milky Way.



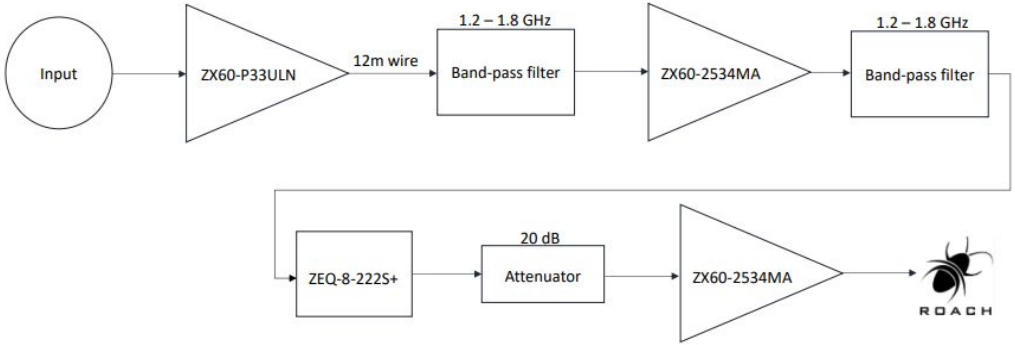


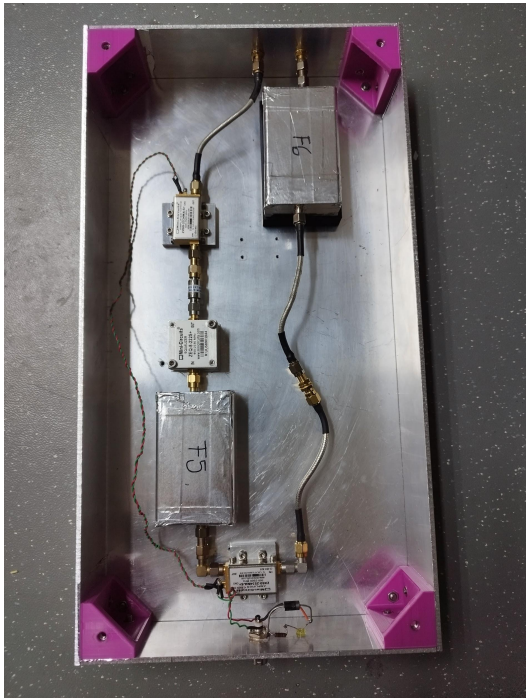


Microwave Receiver

Microwave Receiver

- A receiver is required for each antenna.
- It is mainly composed of amplifiers and filters.

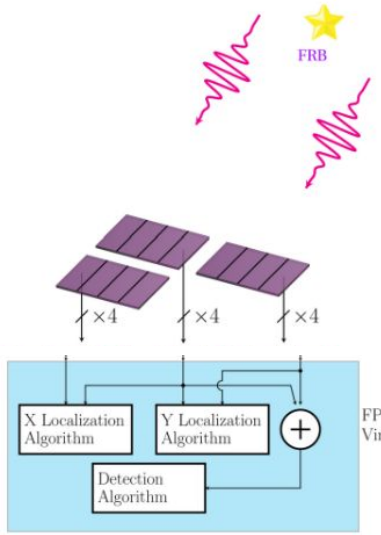


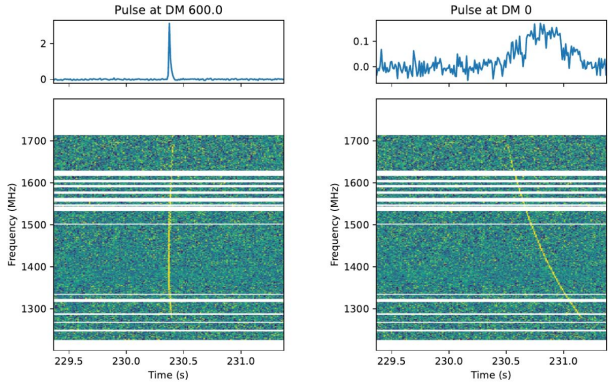


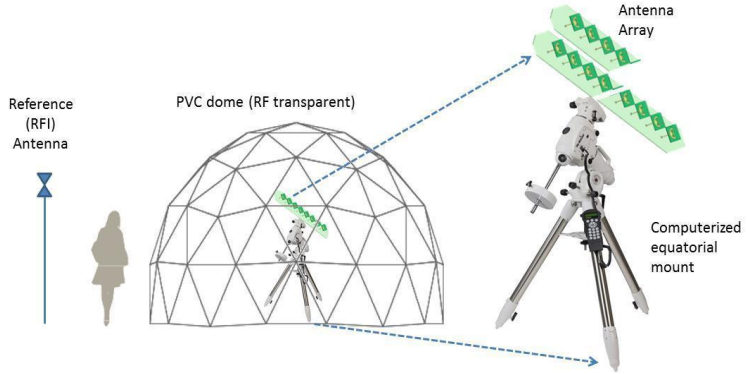
Digital System

Principal Features

- DoA (Direction of Arrival algorithm): L-shaped configuration of the antennas allows us to determine the direction of arrival of the FRB.
- We installed a fourth omnidirectional antenna that detects ambient signals allowing us to discard radio noise.
- Real time detection using dedispersion.



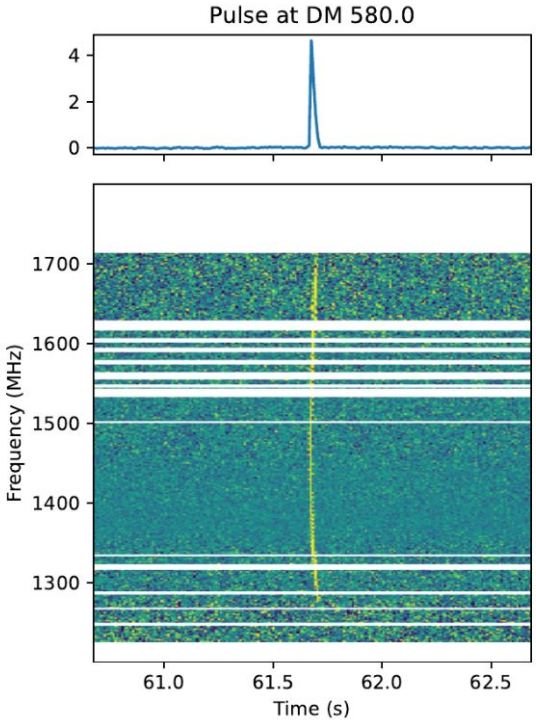


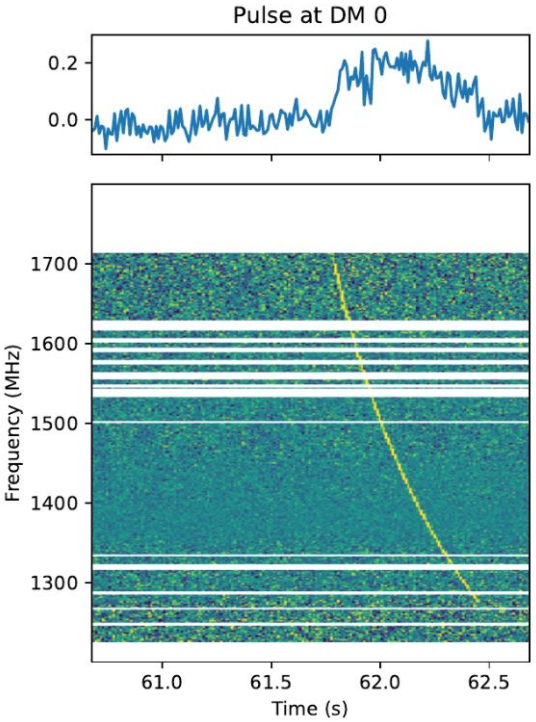


Data Processing and Detections

Post-processing

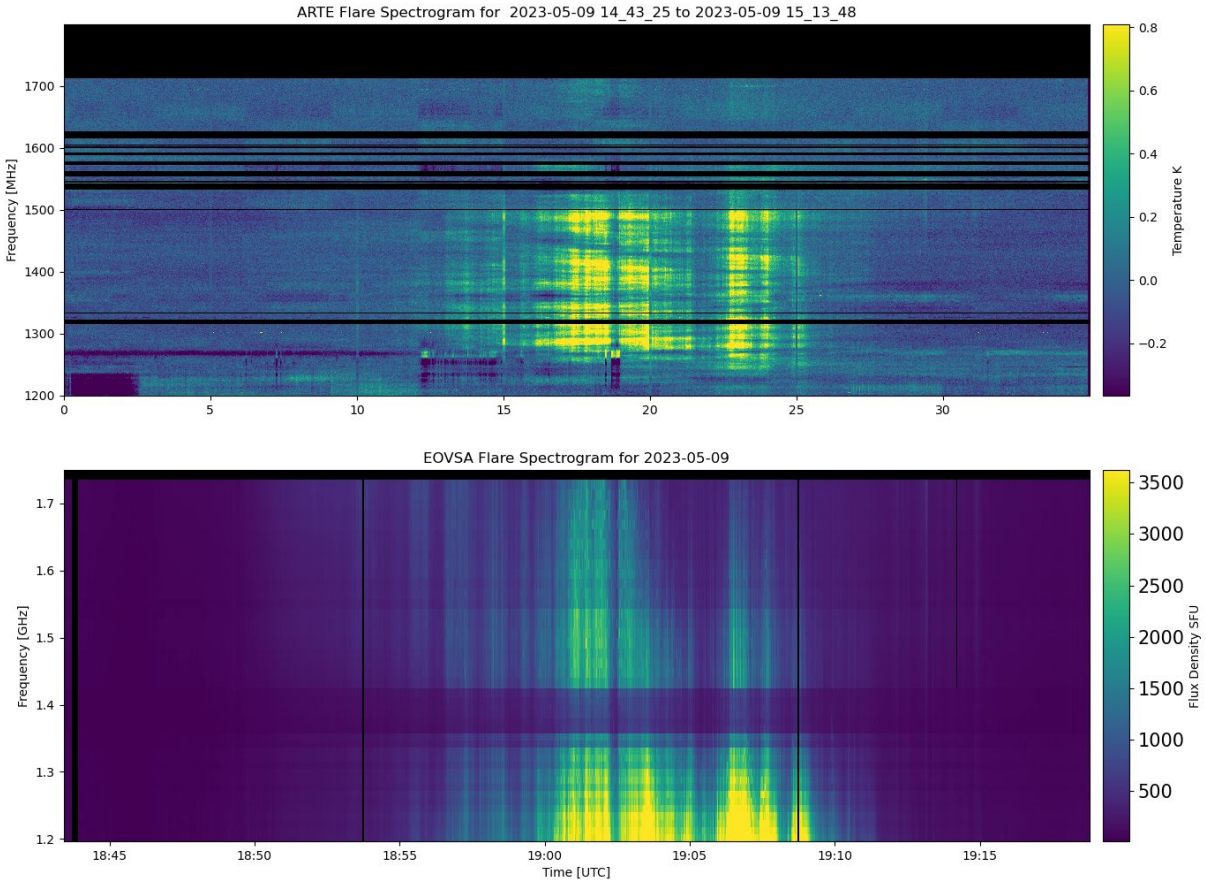
- Post-processing of the data is performed with a custom-developed pipeline that utilizes PRESTO, a software specifically designed for radio pulse detection.





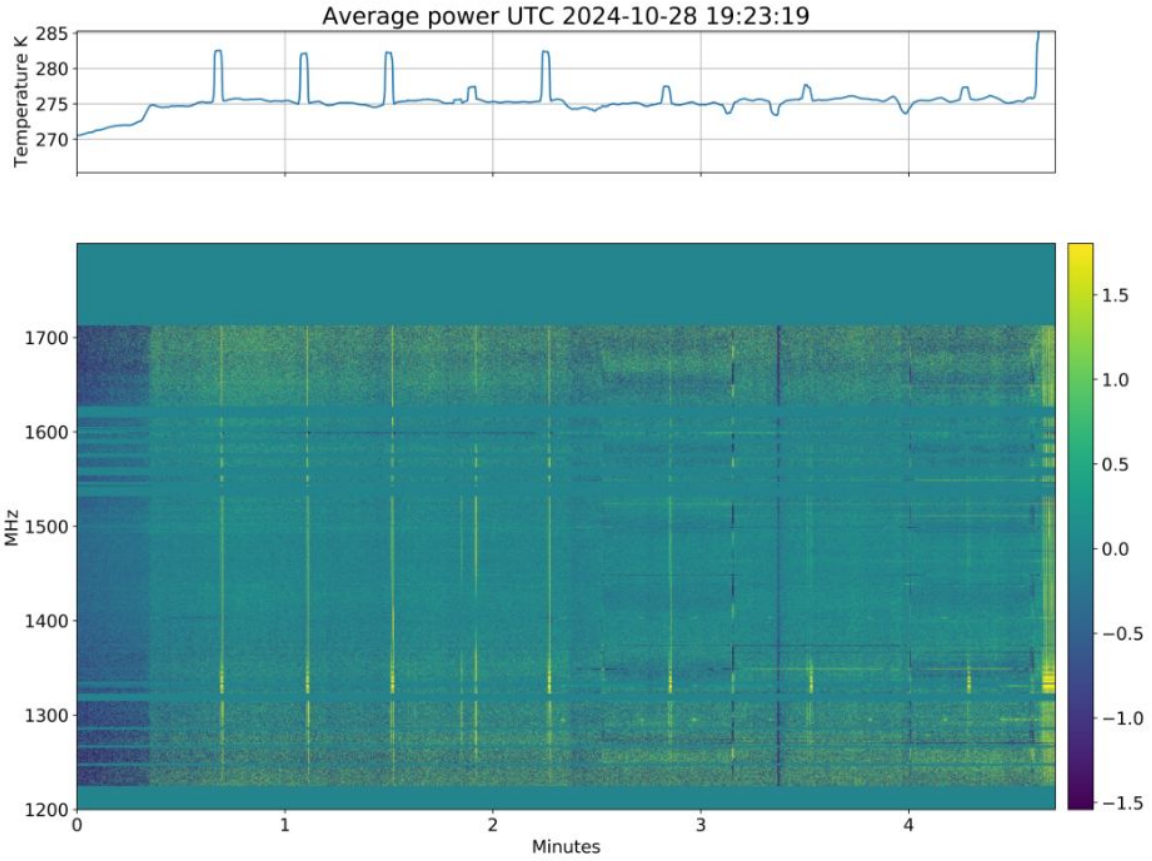
Solar Flare

- Example of a solar flare detected by ARTE in May 2023.
- Comparison with data from EOVSA, a radio telescope dedicated to studying the Sun between frequencies of 1 and 18 GHz.



Synthetic FRBs

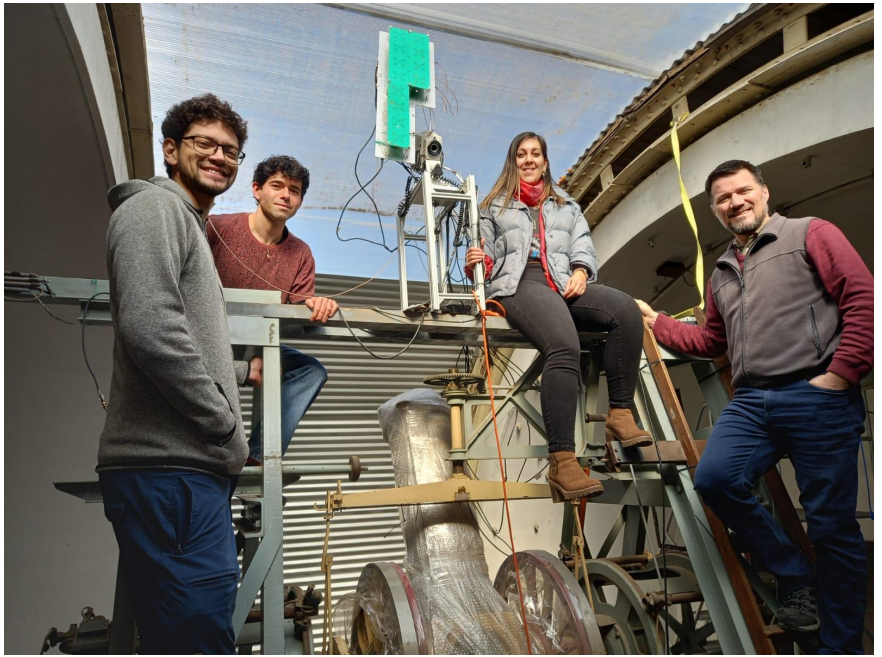
- Using an RFSoC (new generation of FPGAs), we generated pulses simulating FRBs. These are injected directly into the ARTE receiver or triggered from a nearby antenna.



Future Work

Future Work

- Achieve 100% automatic operation.
- Implement a raw data dump when a pulse is detected in real-time.
- Implement the second polarization.



Thank you

clsanmar@das.uchile.cl

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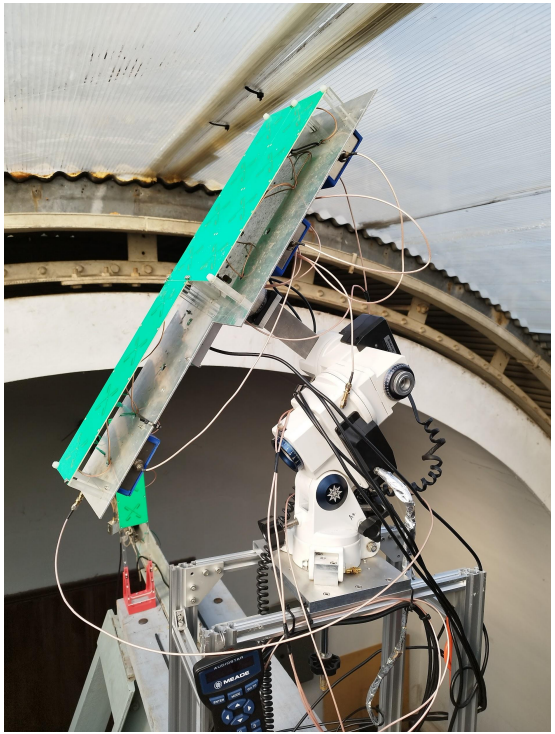
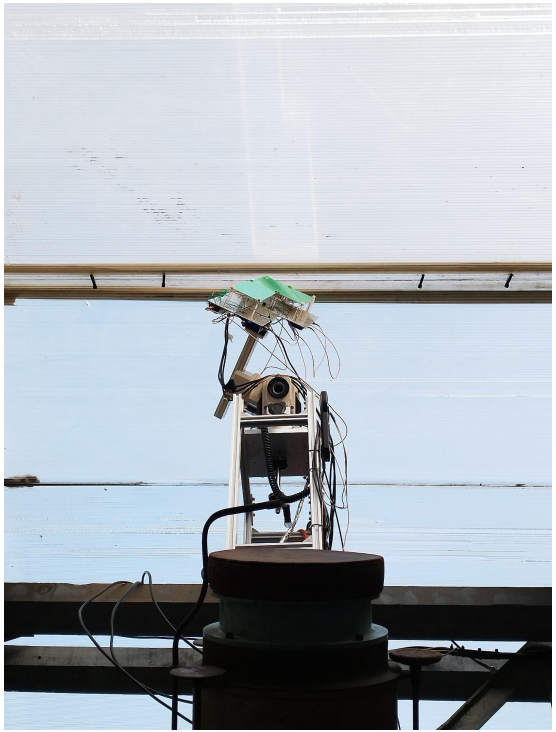
Antenna installed in the Meridiano building





Receiver and Digital System installed in the Meridiano building