Development of technology to study the ionosphere at Jicamarca

Danny Scipión

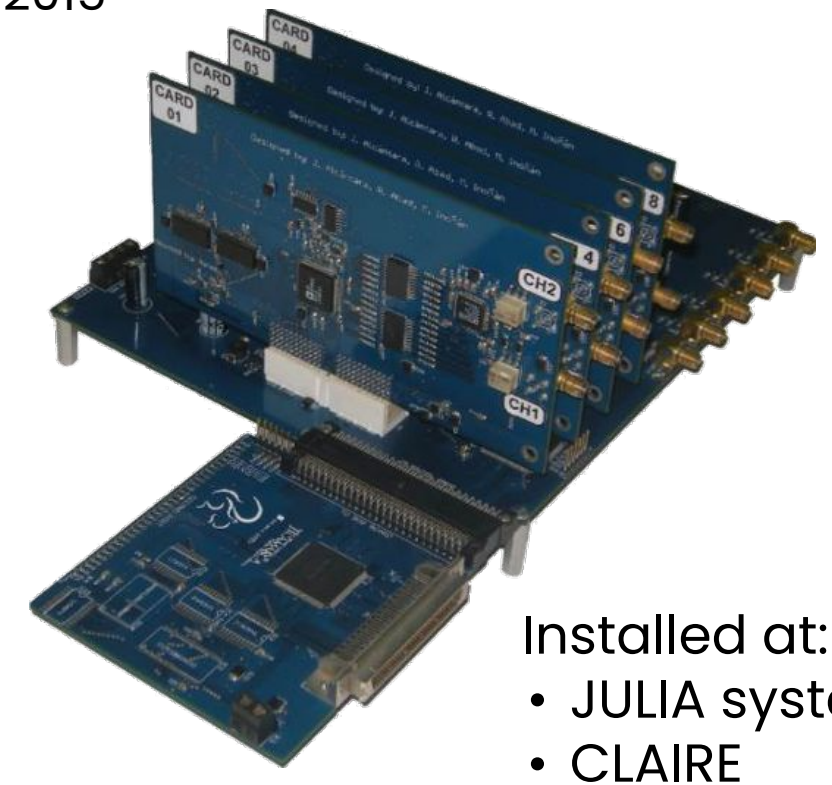
Jicamarca Radio Observatory

Acquisition radar systems

JARS 1.2

- 8 channel system
- 60 MHz clock
- 3 CPLD
- NiDAQ to PCI Express connection
- Dynamic range: 80 dB
- Max transfer speed per channel: 1 MHz
- Decimation range: 4 to 16384
- Max signal level: 1.41 Vpp @ 50 ohm

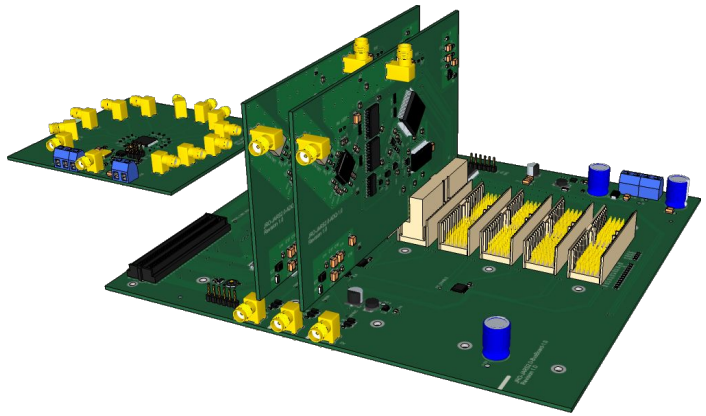
In operation since 2015



Installed at:

- JULIA system
- CLAIRE system
- Imaging system

JARS 2.0



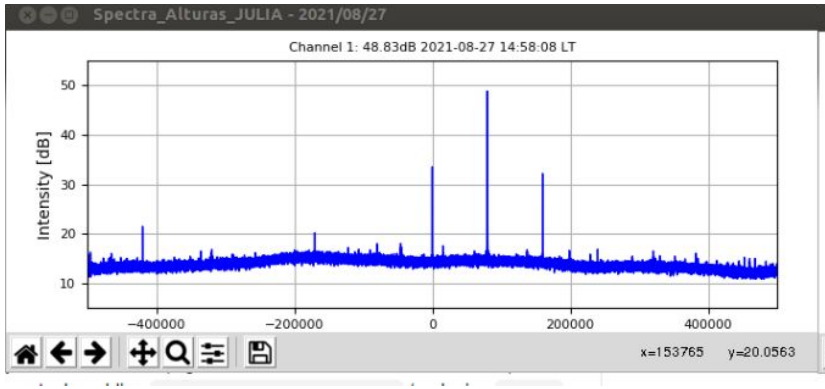
Ready for operation:

- JULIA system
- Backup

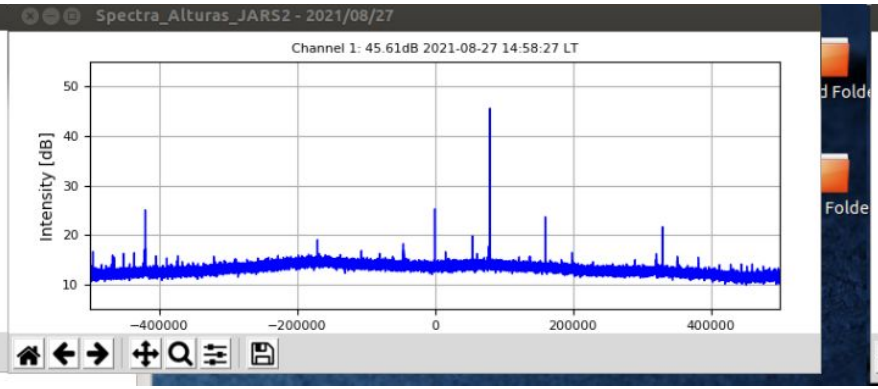
In operation since 2021

- 60 MHz clock distributed in 12 channels
- 3 FPGA
- Ethernet connection 1 Gbps
- Dynamic range: 80 dB
- Max transfer per channel (8): 2 MHz
- Firmware at 180 MHz
- Uses evaluation card Spartan/SoC
- Linux
- Digital RF (data storage)
- GNU radio (programming)

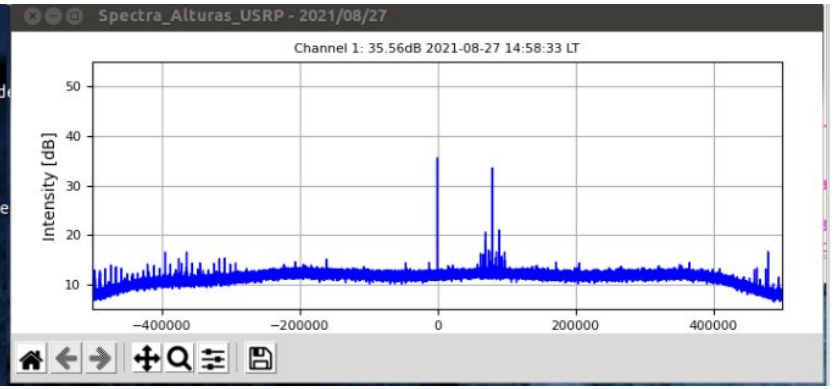
Systems comparisons



JARS 1.2



JARS 2.0



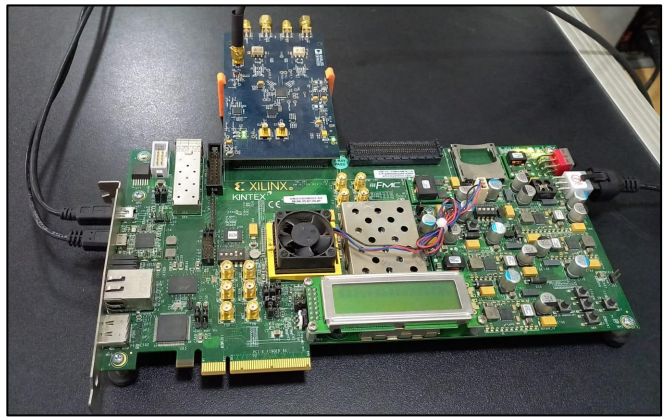
USR
P

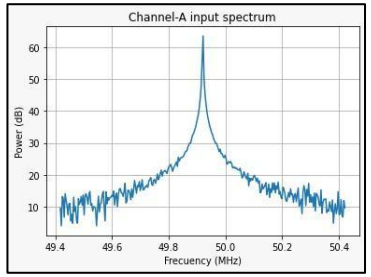
- Lower background noise
- Lower DC signal

JARS 2.X

- Acquisition card replaced with a last generation FPGA card
- Direct communication with ADC
- Simplified PCB
- Faster transfer rate

Under development





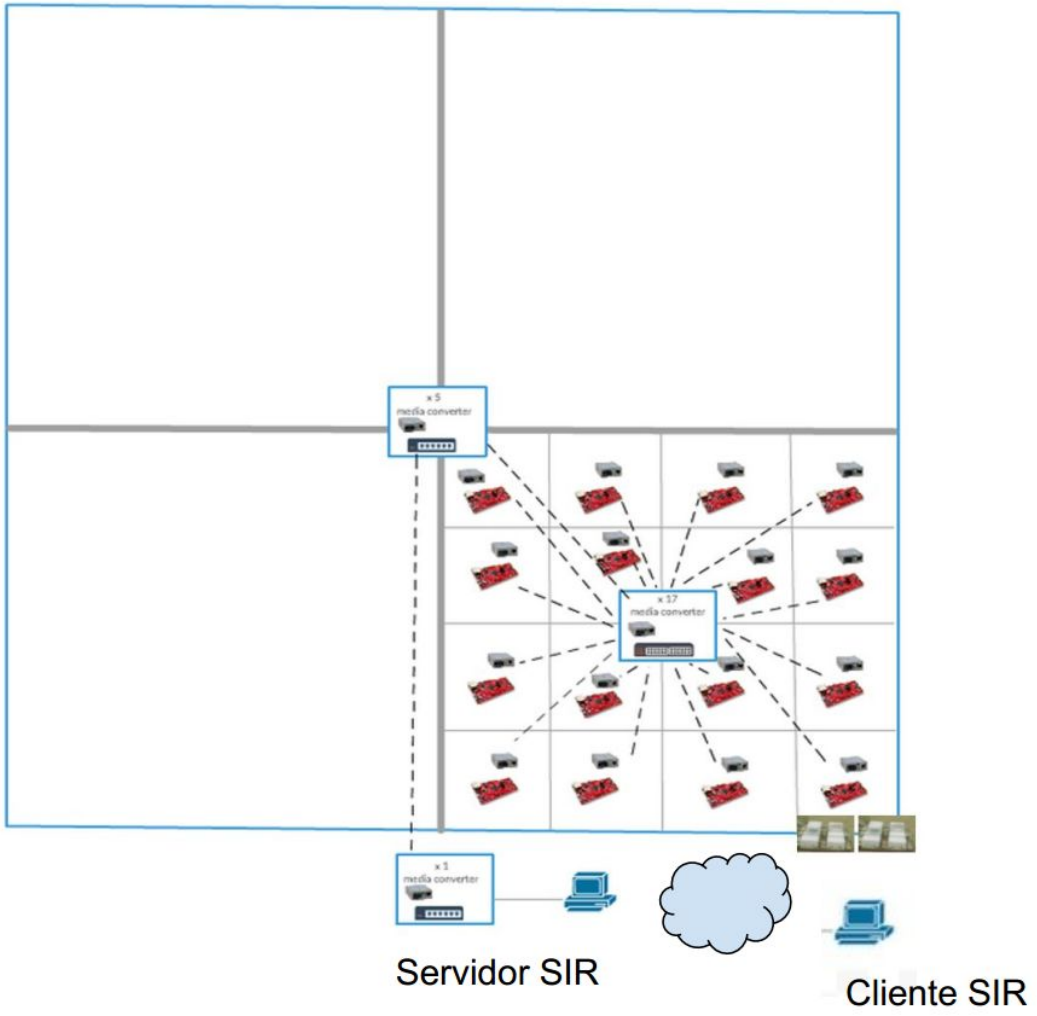
Automatic beam switching

Automatic beam switching (ABS)

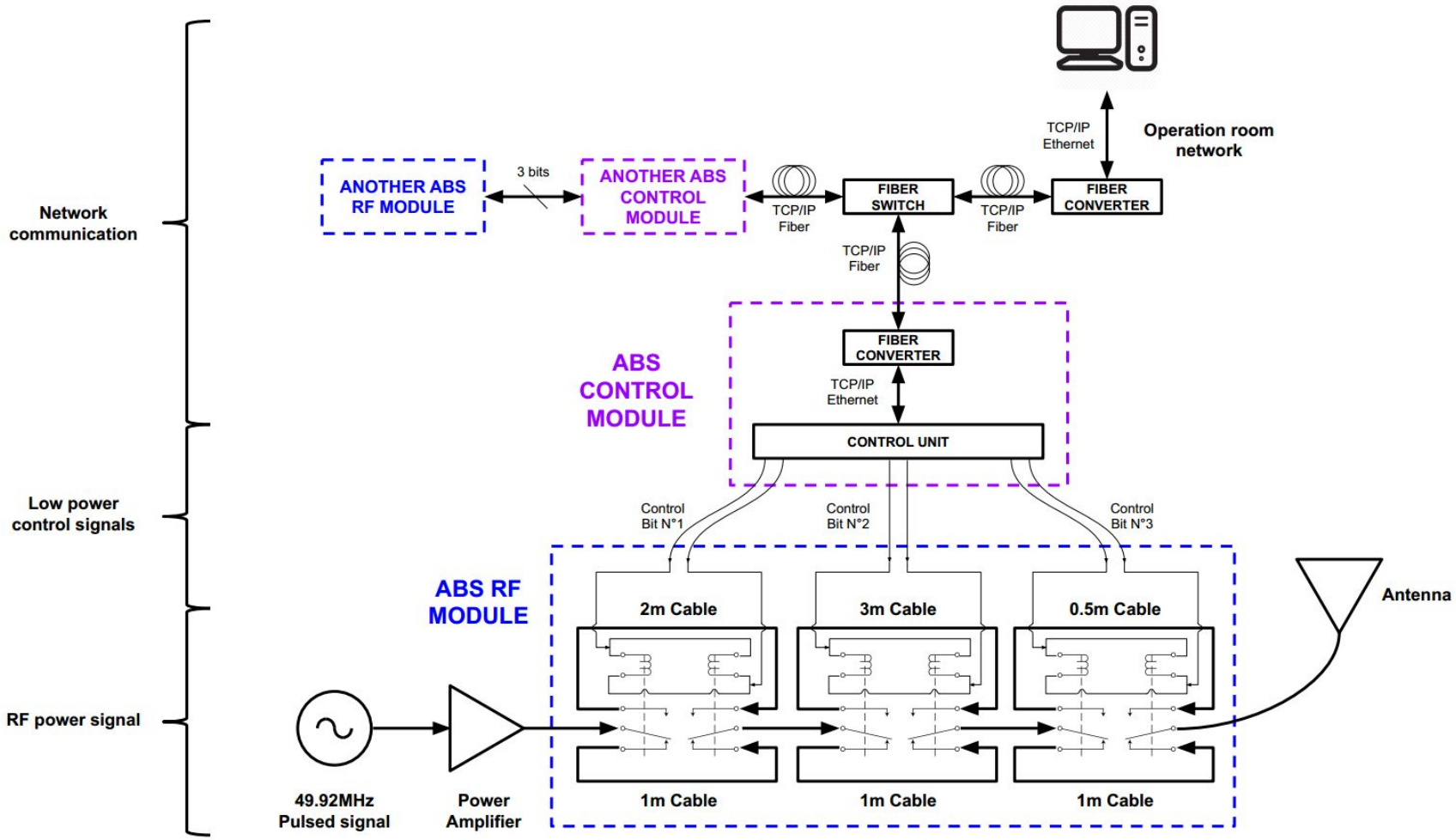
- Objective:
  - automatically change the antenna beam
- Parts:
  - RF module (2 polarizations)
  - Control module
  - Integrated SIR module

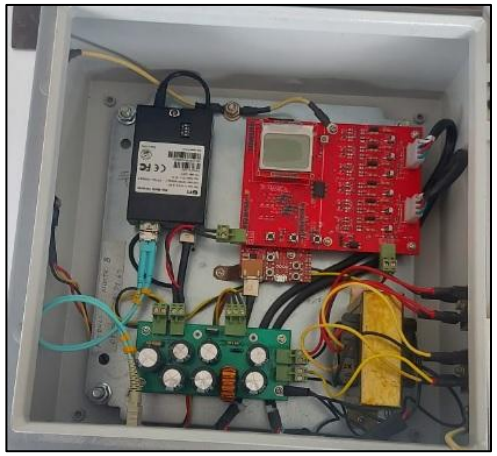
N-S quarters:
- installed

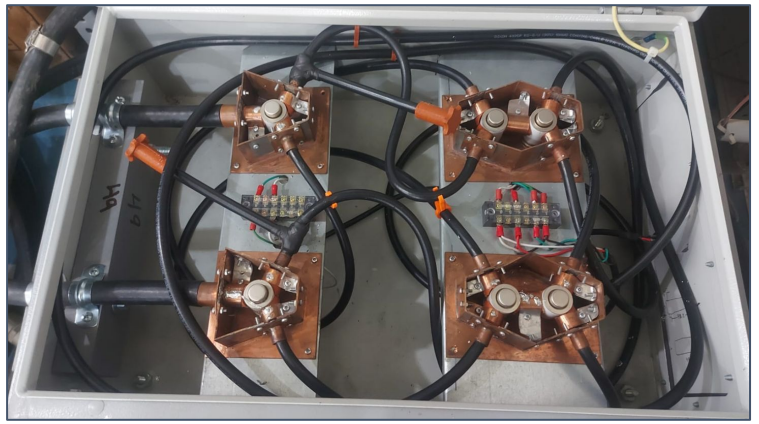
E-W quarters:
- finalized
- RF and power tests
- to be installed by the end of the year



Automatic beam switching



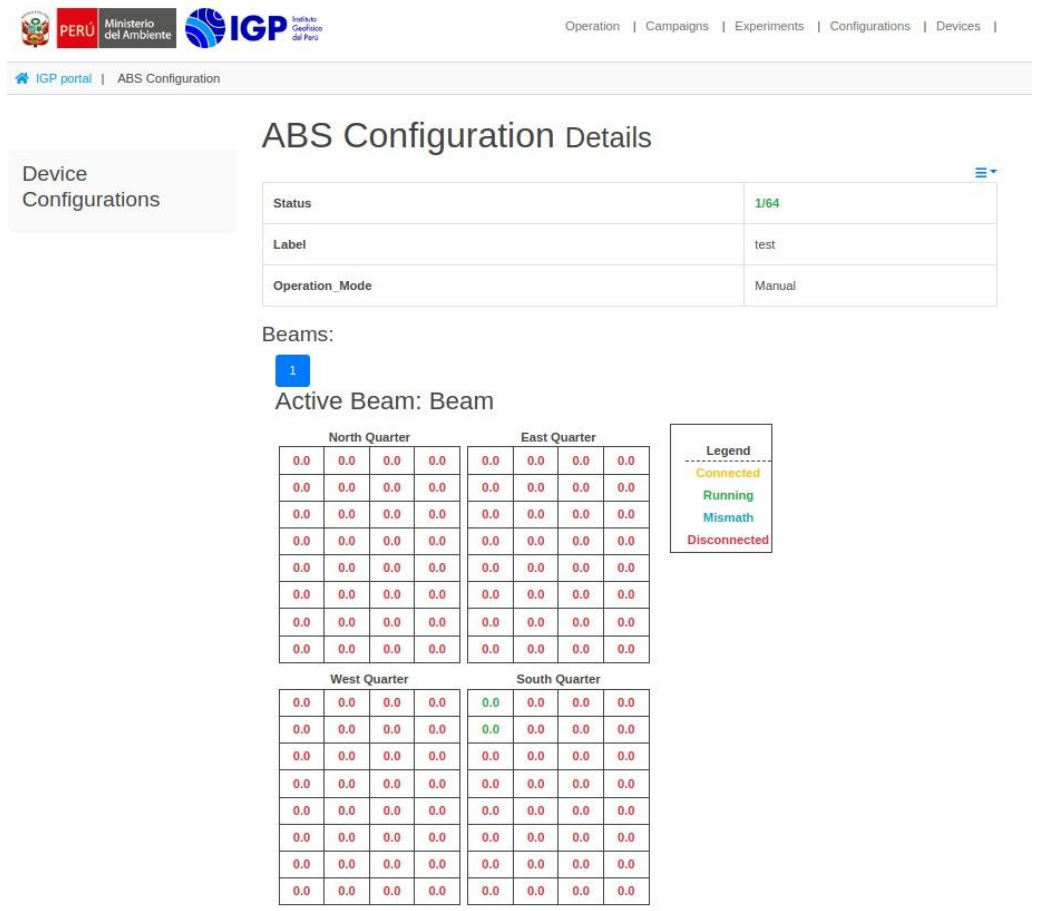




Integrated radar system

Integrated radar system

- Web based configuration
- Open source (Python)
- Integrated modules:
  - Acquisition configuration
  - Automatic beam switching
  - DDS (Direct digital synthesizer)
  - Radar configuration
- Experiment modes:
  - JULIA modes (day/night)



Additional instrumentation

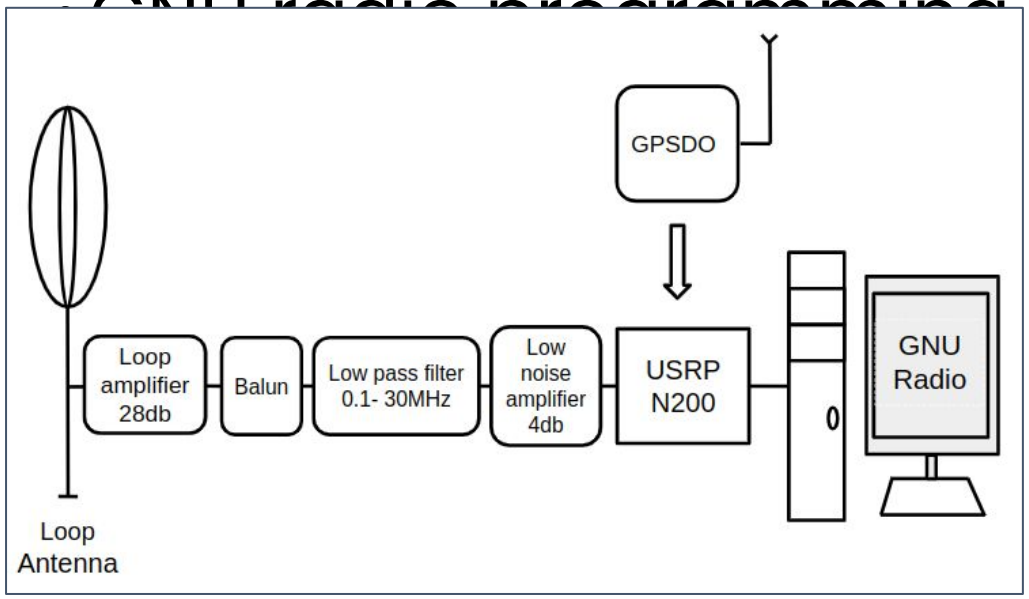
Magnetometers

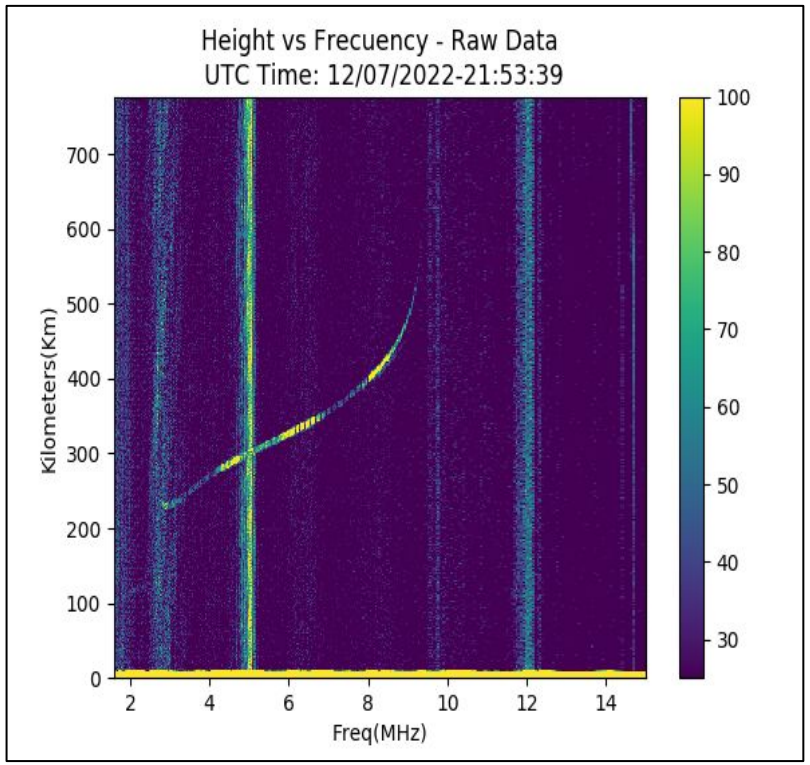
- Specifications:
  - Tri-axial sensor
  - Range: +/- 75000 nT
  - Dynamic range: +/- 250, 1000, 2500 nT
  - Resolution: 0.1 nT
  - Accuracy 0.25%
  - Offset at T=25°C < 1 nT
  - Power supply rejection > 100 dB
  - DC output impedance < 10 Ohm
  - Agreements with INPE (Brasil), UNAM (Mexico)

Developed in 2007

Ionosonde SDR receiver

- Goal: Obtain oblique sounding
- of frequencies: 1 - 20 MHz
- 2 polarizations
- GNU radio programming





Test 1st week on August

funded by UT Dallas (Dr. Valladares)

IGP

60 TH jica marca RADIO OBSERVATORY

*Ciencia para **protegernos***
*Ciencia para **avanzar***