THR software and data products

THR /RPW TEAM: LESIA-Observatoire de Paris

- **Milan Maksimovic** – Lead Co-I
- **Antonio Vecchio** – Data Calibration
- **Quynh Nhu NGUYEN** – Software Developer
- **Pierre-Luc Astier** – THR Project Manager
- **Kamal Boughedada** – On-flight Softwares

THR receivers: electric and magnetic power spectral densities.

Analog Part:
Variable gain ***AGC*** (Automatic Gain Control):

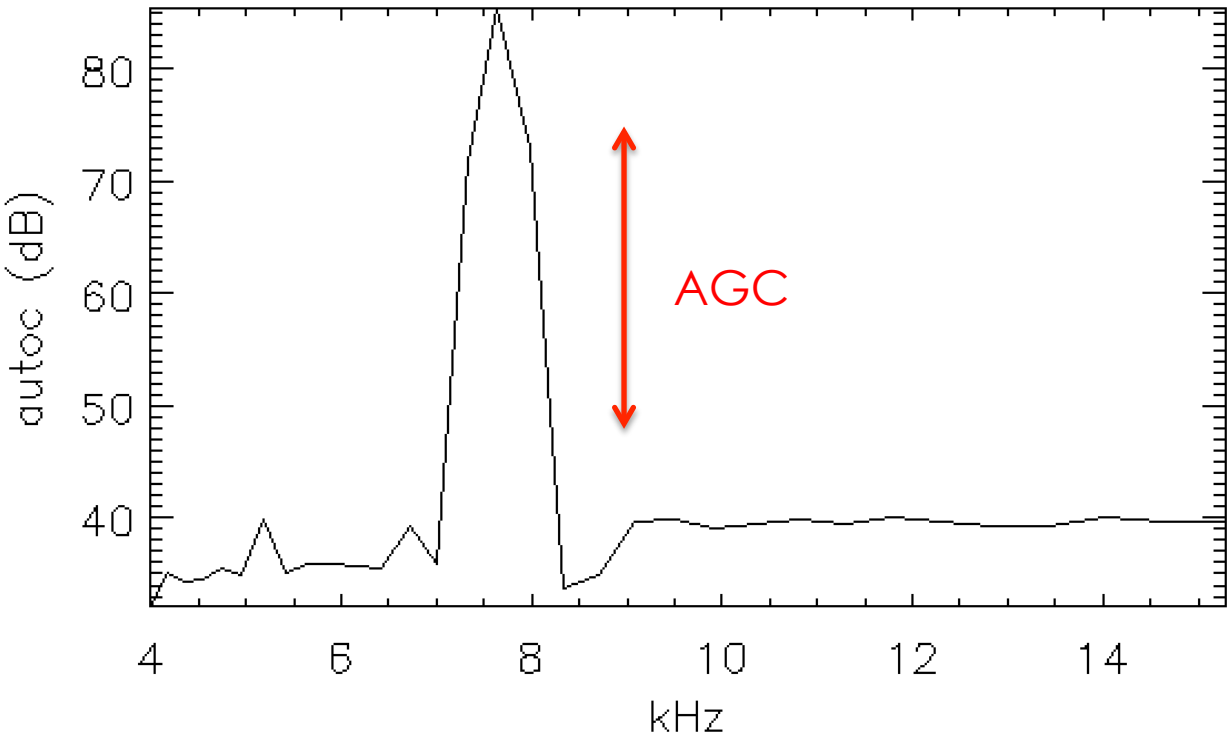
- amplify the signal up to a constant level: a way to measure the signal with an accuracy independent of the input level.

Digital Part:
The input voltage is digitized to know the instantaneous gain as a function of frequency (**Autocorrelations**).

TNR: spectra in 4 frequency band (32 log-spaced frequencies per band) 4 kHz - 1MHz	HFR: Sweeping receiver (NO autocorrelations) 500 kHz - 16MHz

Autocorr from a sinusoidal signal of fixed amplitude

The AGC defines the correct value of the amplitude



CALBAR corrects for instrumental response (amplitude, frequency and temperature) and combine together information from analog and digital part to retrieve the measured signal in physical units

TNR-HFR Calibrations Software **CALBAR (1.2.2)**

- Convert TNR-HFR L1 files to L2 (antenna level calibration)
- Written in IDL

- wrapper script for execution by ROC framework (tested)

- CALBAR reads L1 CDFs files and derives output L2 CDFs files.

- Calibration parameters (system level or stand-alone calibration) are provided by CDFs files

CALIBRATION S/W: STATUS AND PLAN

- CALBAR tested with stand-alone parameters and tested on measured signals (white noise + cosine oscillations) injected in the lab
- Calibration procedure tested on data from EM during the blank–test Toulouse (ambient temperature only): amplitudes and frequency of the injected mysterious signals are recovered
- Derivation of the calibration parameters as a function of the temperature from the system-level calibration (effect of experimental setup included)
- Calibration procedure for the full system implemented (includes phase calibration)

CALIBRATION S/W: STATUS AND PLAN

- Include the effect of the antenna in the CALBAR
- Check the calibration for very low amplitude signals
- Calibration of PFM - SCM data calibration with TNR-HFR

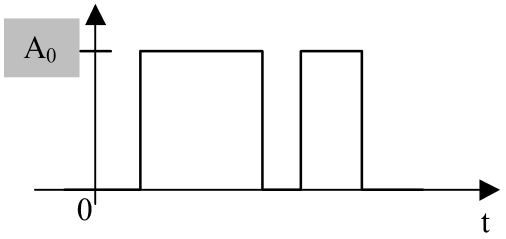
- Plan additional tests to check phase calibration.

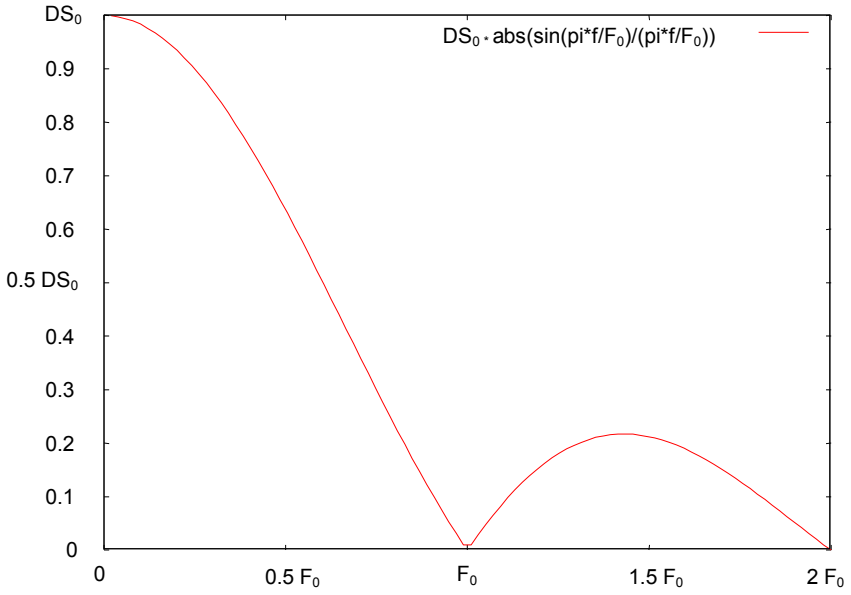
FFT tests on May 2019
TNR-HFR results

Antonio Vecchio, Milan Maksimovic
Pierre-Luc Astier and Kamal Boughedada

HFR internal calibration

- Pseudo rando noise source
- 5 cutoff frequencies F0: 4 TNR + 1 HFR

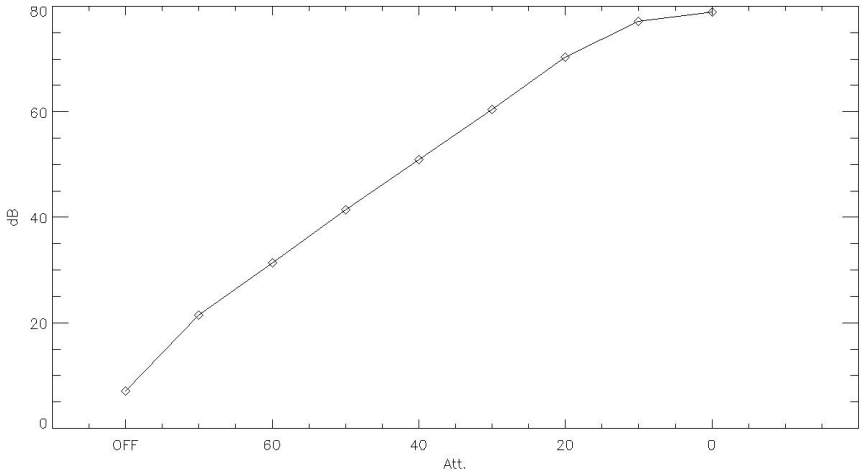




$$DS(f) = DS_0 \cdot \frac{\sin\left(\pi \cdot \frac{f}{F_0}\right)}{\pi \cdot \frac{f}{F_0}} \text{ avec } DS_0 = \frac{A_0}{\sqrt{2 \cdot F_0}}$$

F_0
Band A : ~48.8kHz
Band B : ~195kHz
Band C : ~781kHz
Band D : ~3.12MHz
Band HF : 25MHz

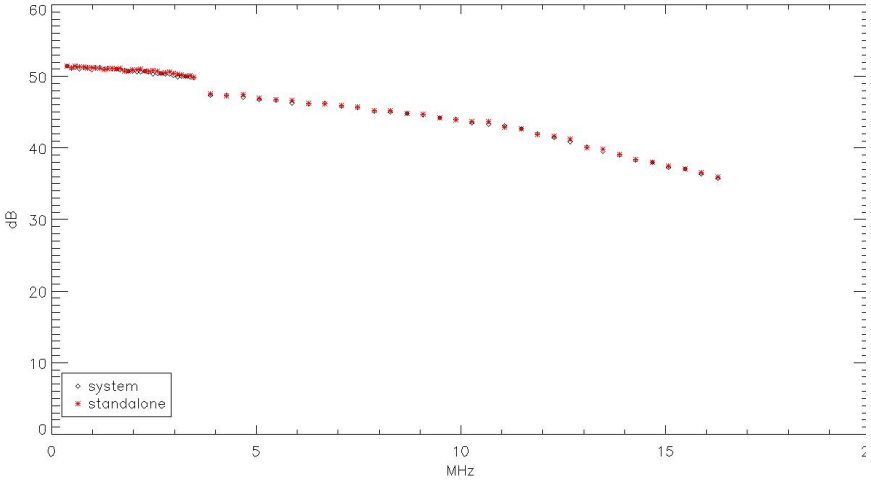
for a fixed frequency

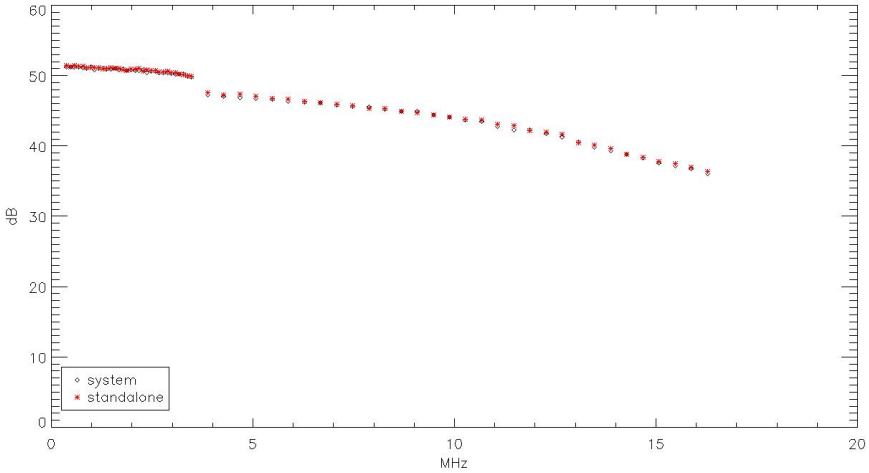


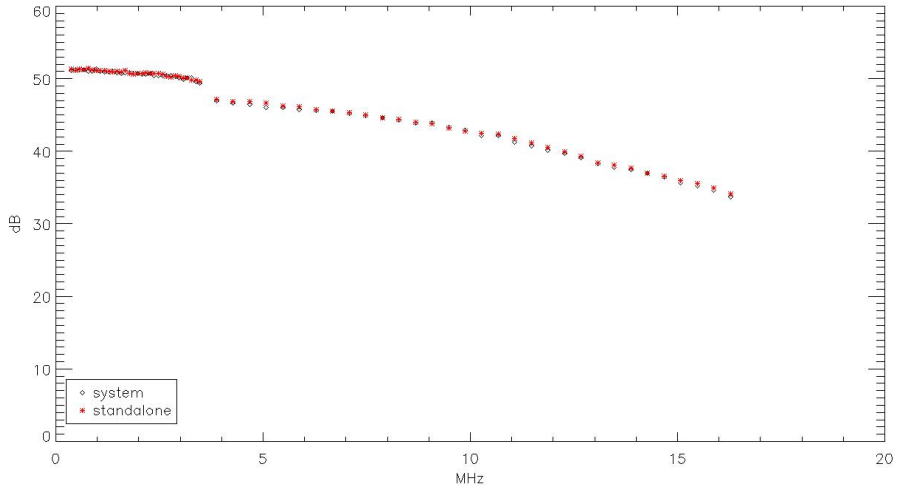
- 9 levels:
  - source off
  - 8 levels attenuations 0-70 @10 dB steps

HFR internal cal:

- HF1 32 freq – Δf=0.1 MHz
- HF2 32 freq – Δf=0.4 MHz



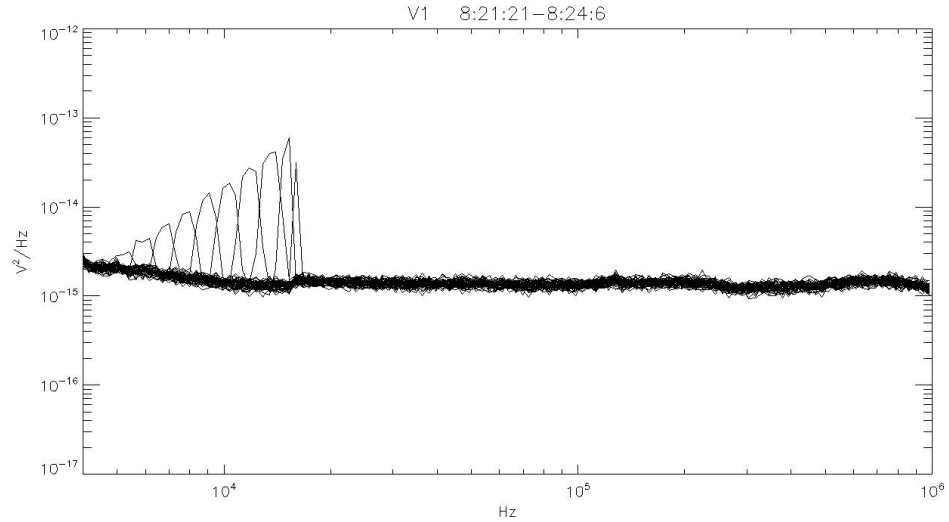


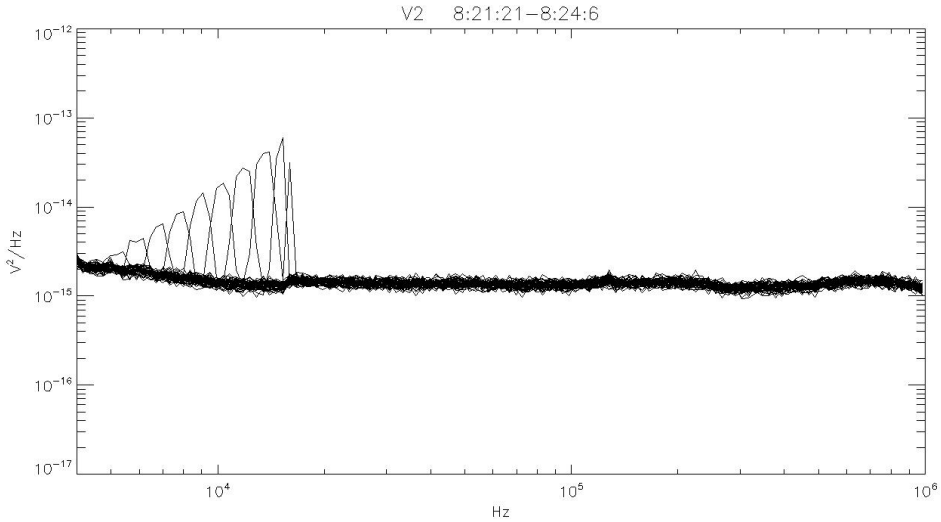


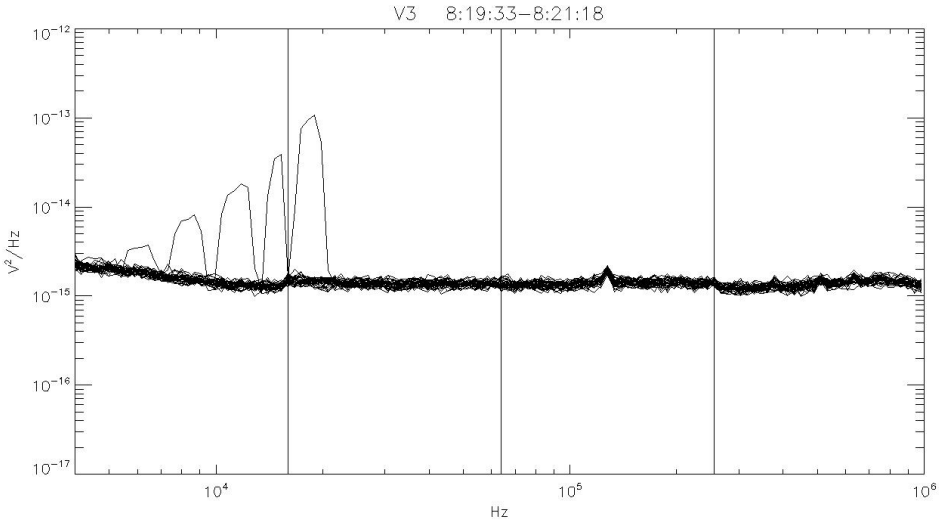
- Results of standalone and system level HFR internal cal are in complete agreeement
- NO drift observed

TNR data

Injected signal on SCM hoop

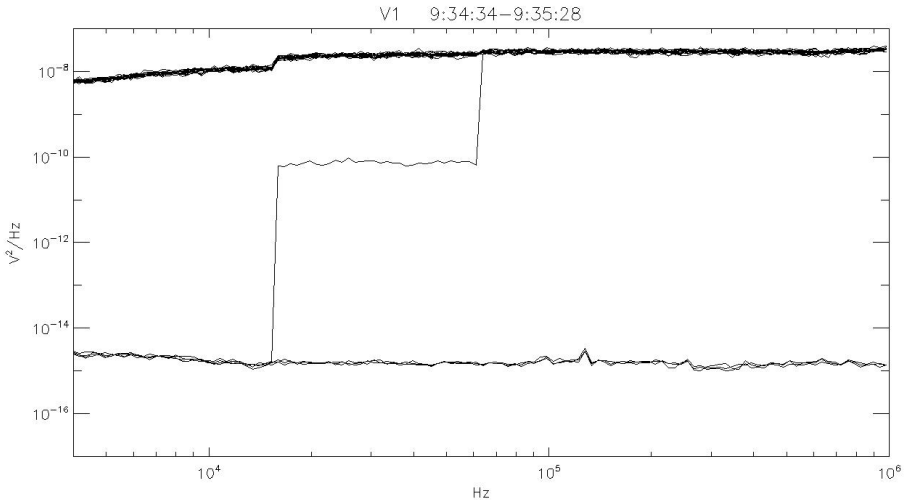


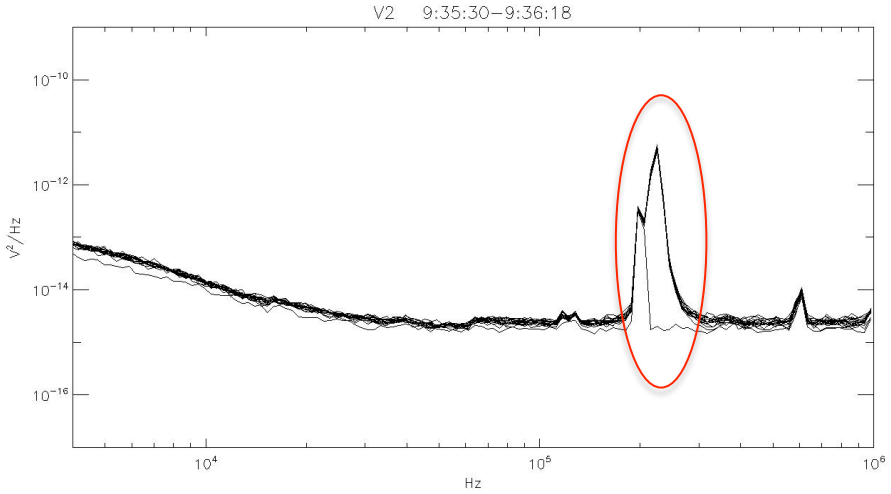


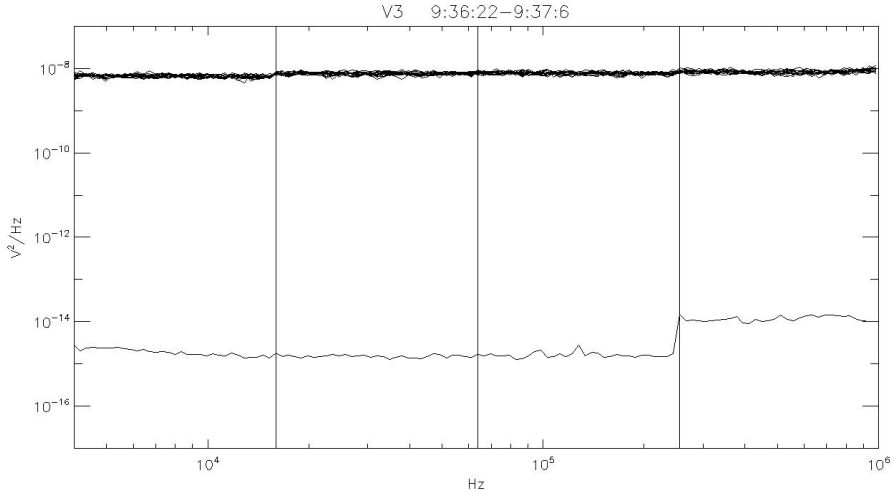


Sweep 10 Hz -> 25 kHz
Sweep type = LOG
Amplitude = 0.25 Vpp

Injected signal on SCM hoop



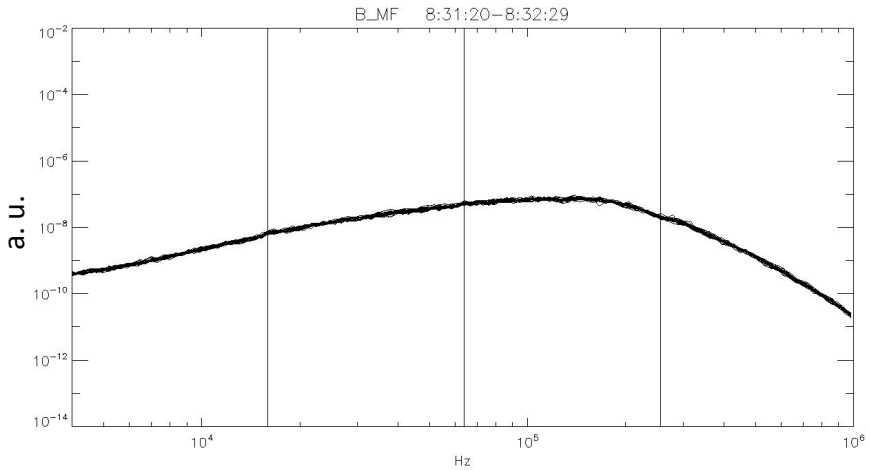


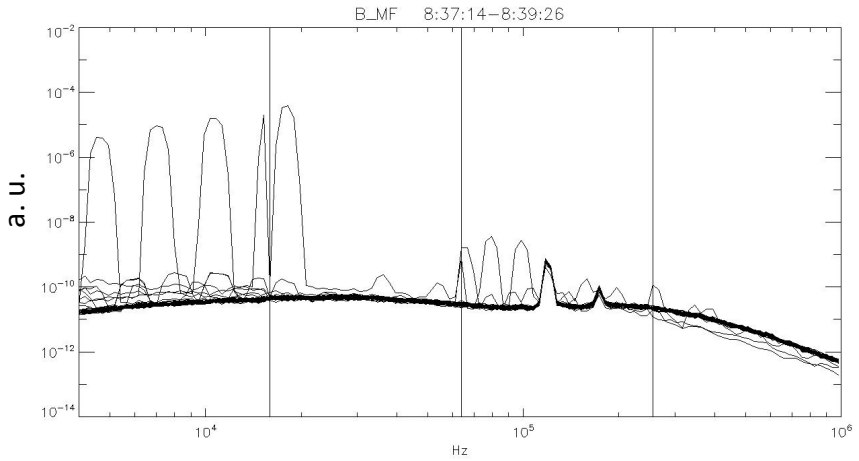


According with the timeline this should be test #34.

It is more plausible that this is a test like #5- noise input signal.

Injected signal on SCM hoop

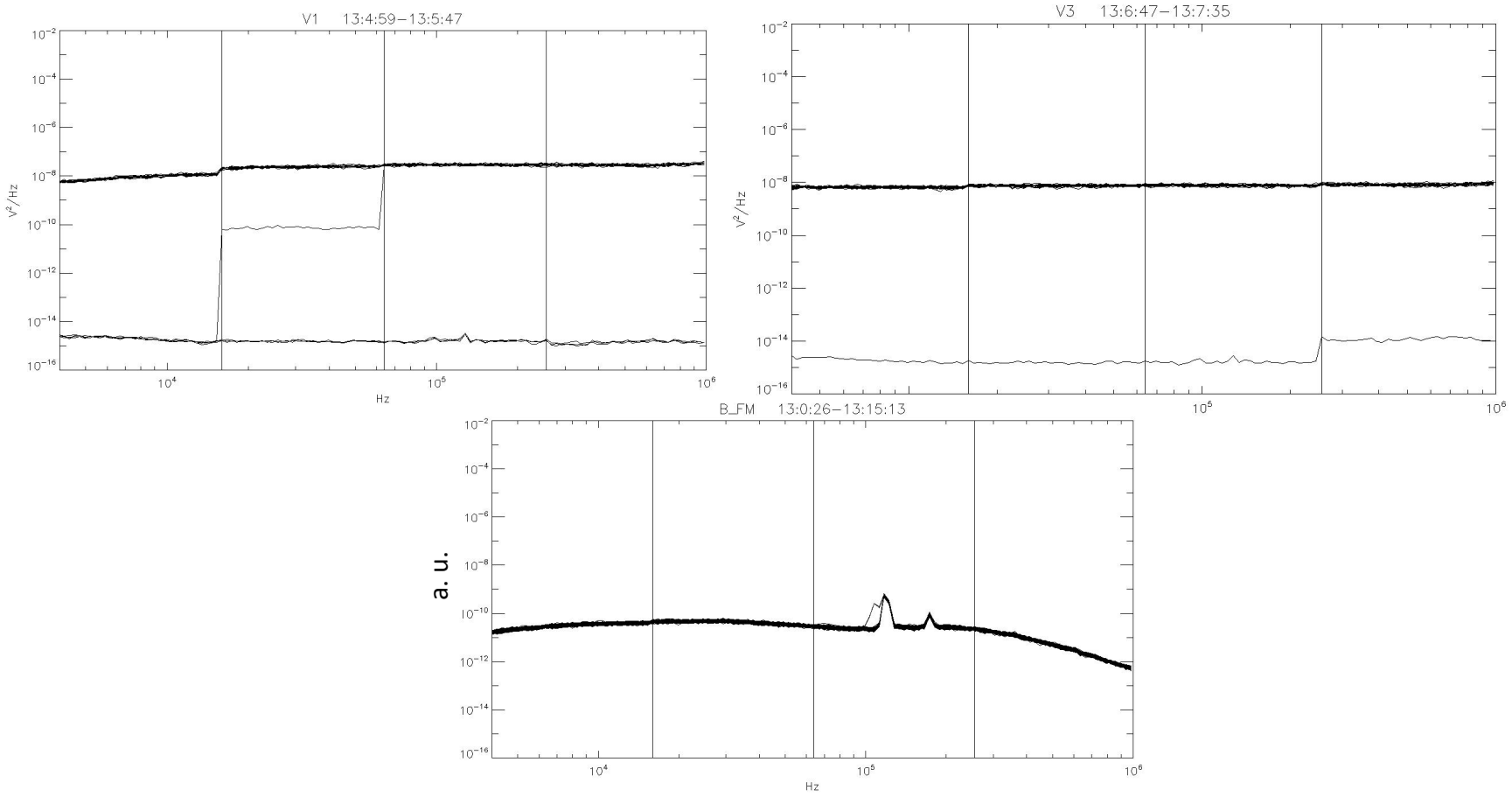




According with the time this should be test #2.

We see some data compatible with a noise injected signal and sweep.

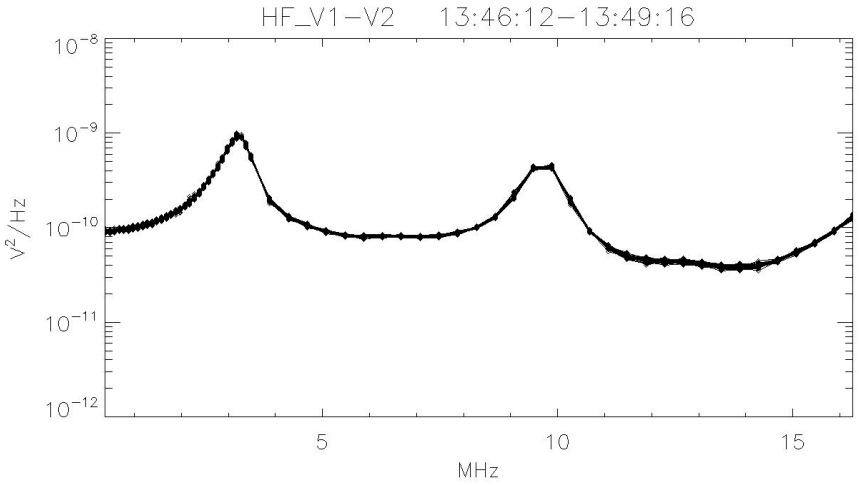
Injected signal on antennas

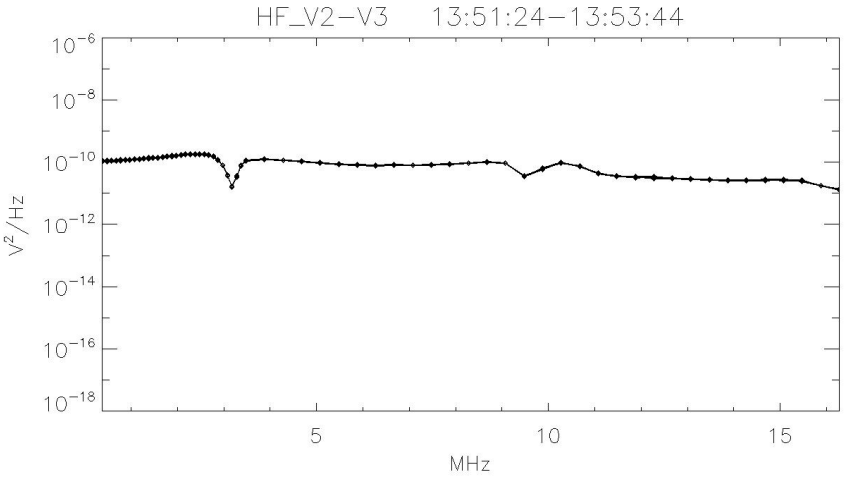


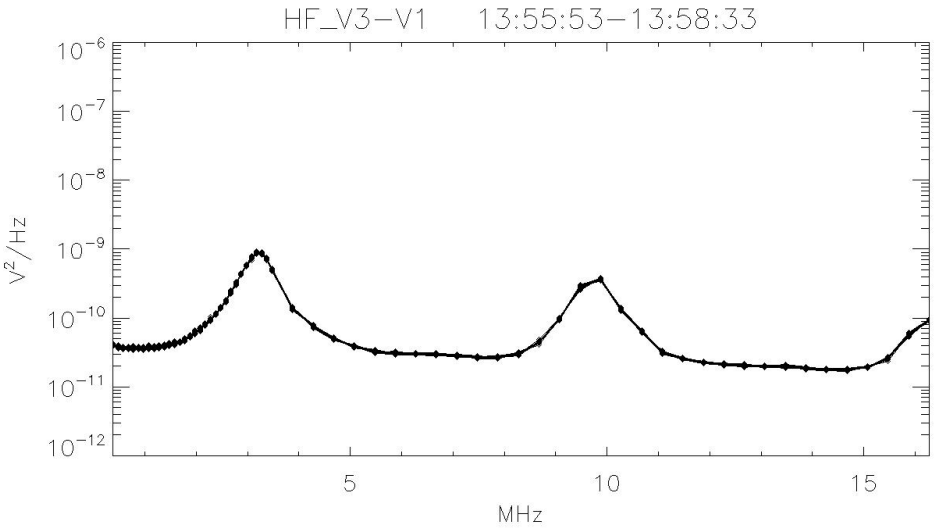
According with the time this should be test #21 (sweep type)

The data are compatible with an injected noise instead (gain ?)

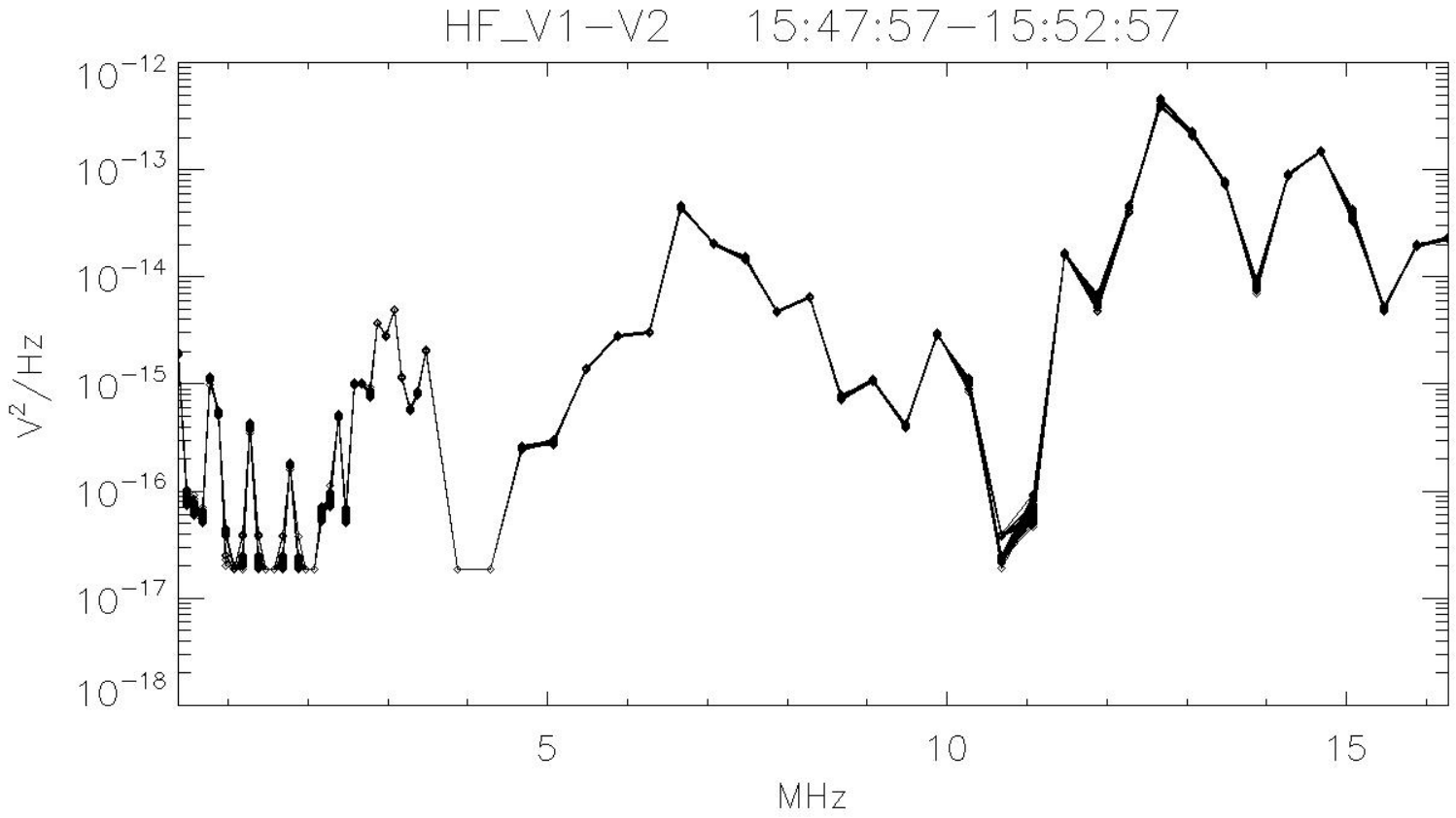
HFR data







Waveform generator settings :
Noise - Bw = 20 MHz -
Amplitude = 4 Vpp



NO waveform generation