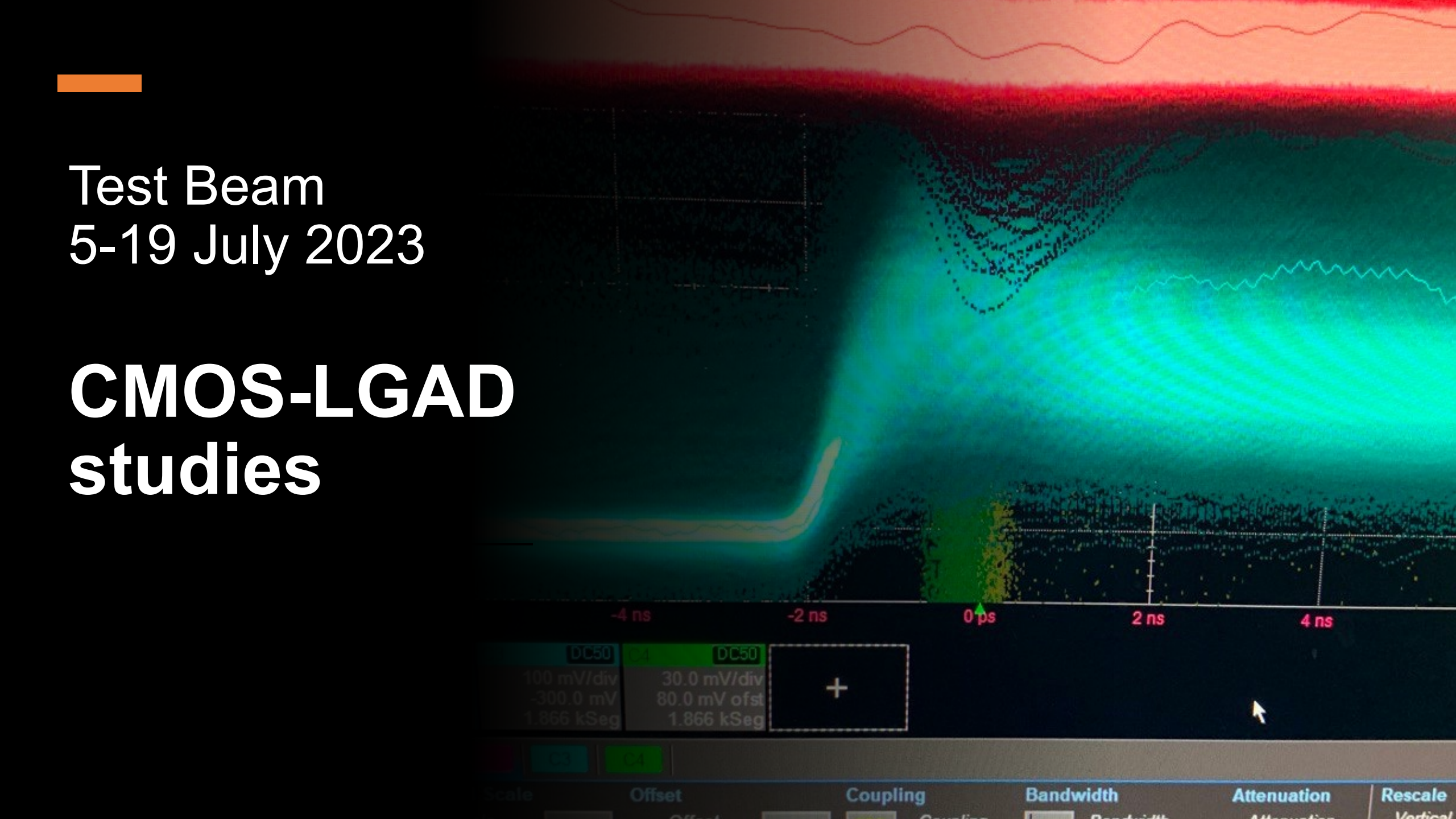
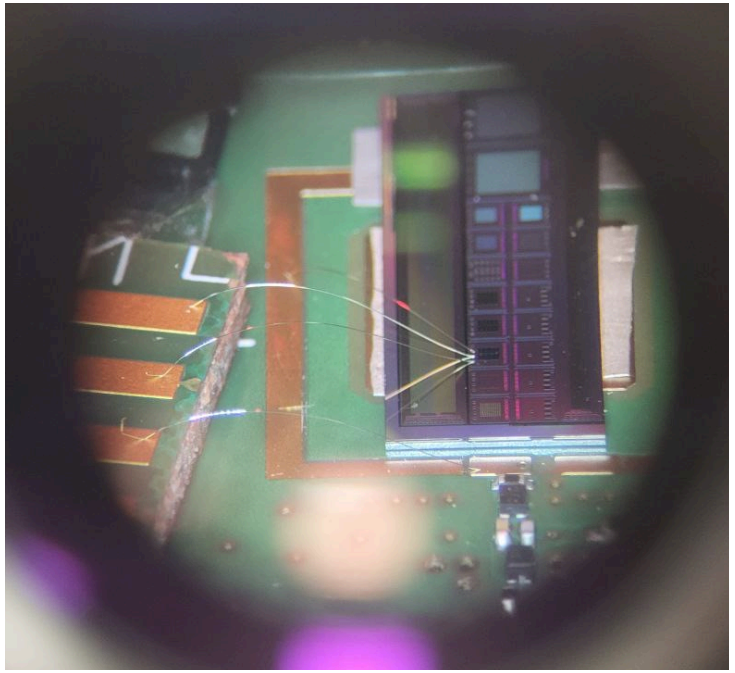
Test Beam
5-19 July 2023

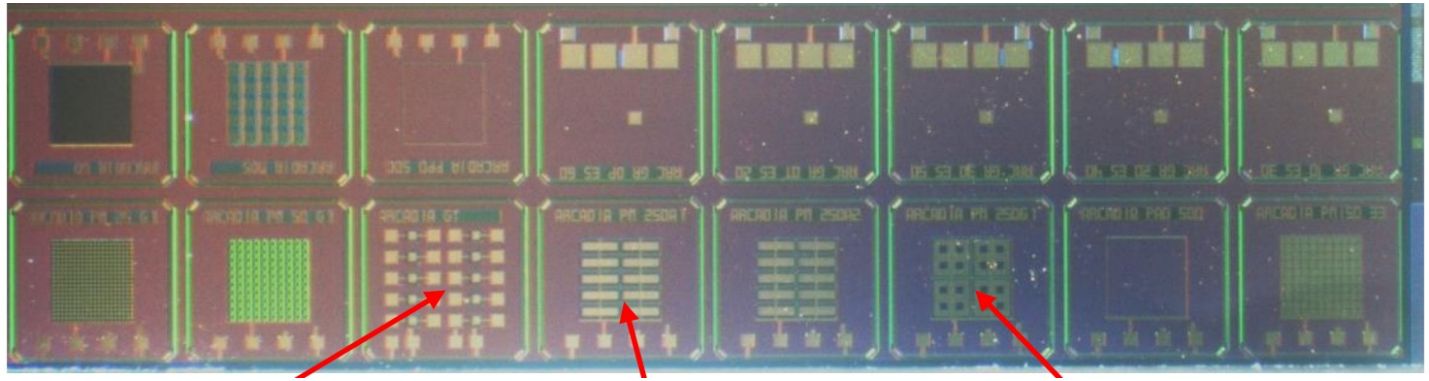
CMOS-LGAD studies



CMOS Passive Structures

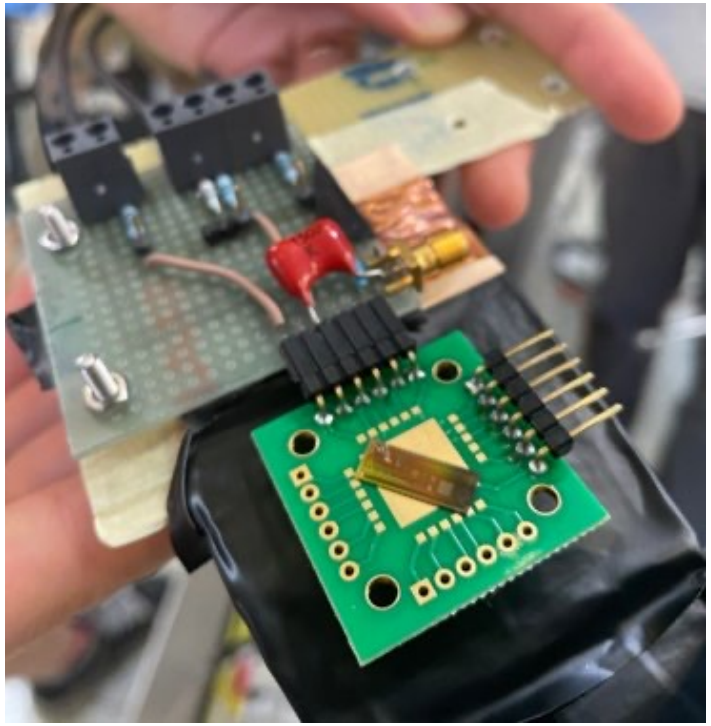
- First test of CMOS sensors with gain
- Test of the sensor concept (the chip readout board is going to be delivered) :
  - W6 passive structures : PM250_G1 and PM250_A1
- Sensor electrode AC coupled to the external amplifiers:
  - First amplification stage : modified LGAD board, G=6
  - Second amplification stage : Minicircuit amplifier, G=11.9



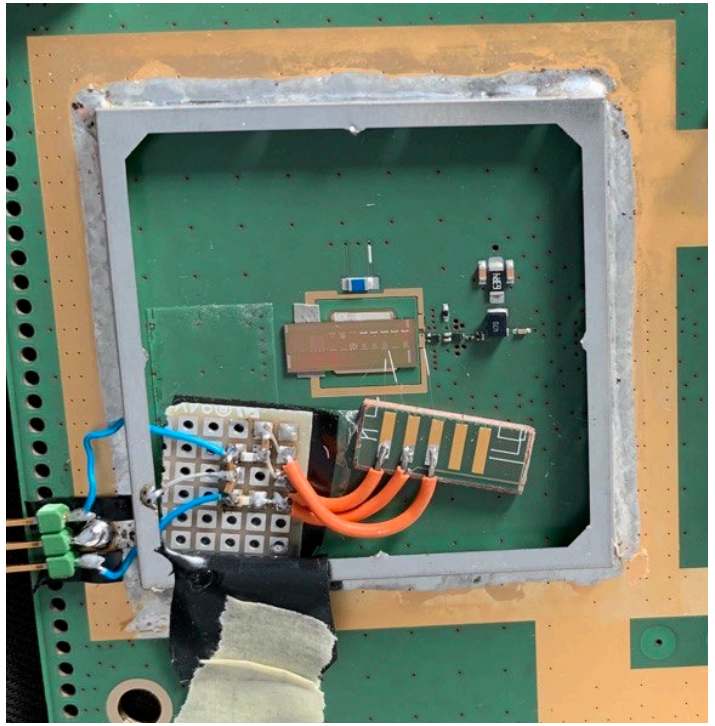


PM250_A1 structure

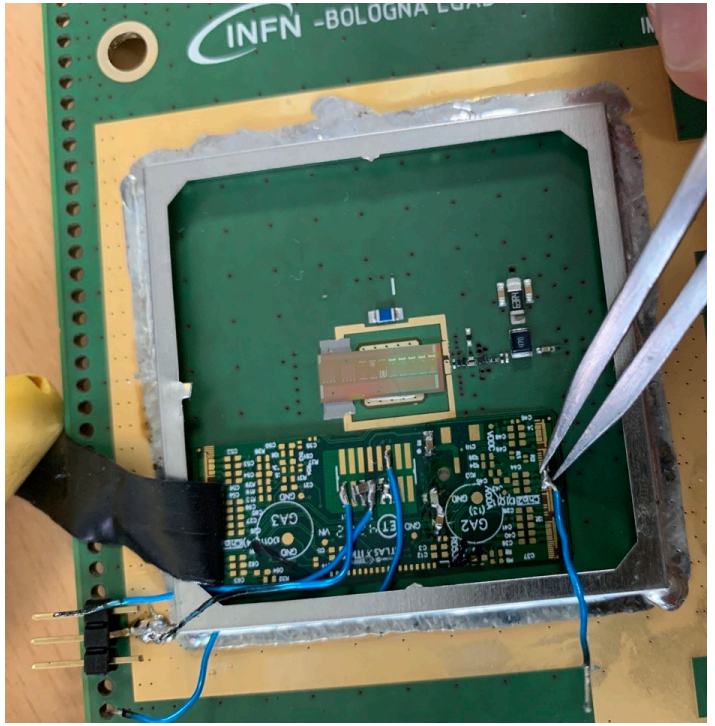
PM250_G1 structure



A



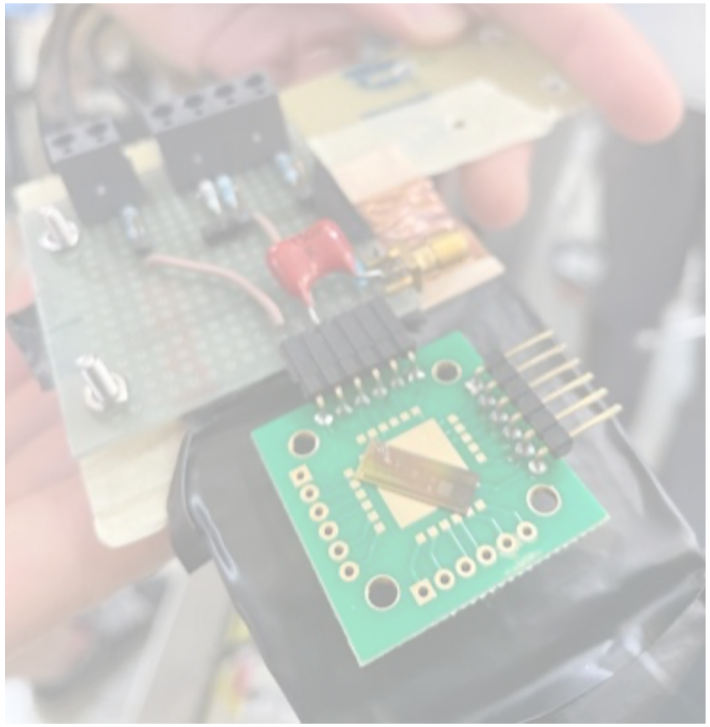
B



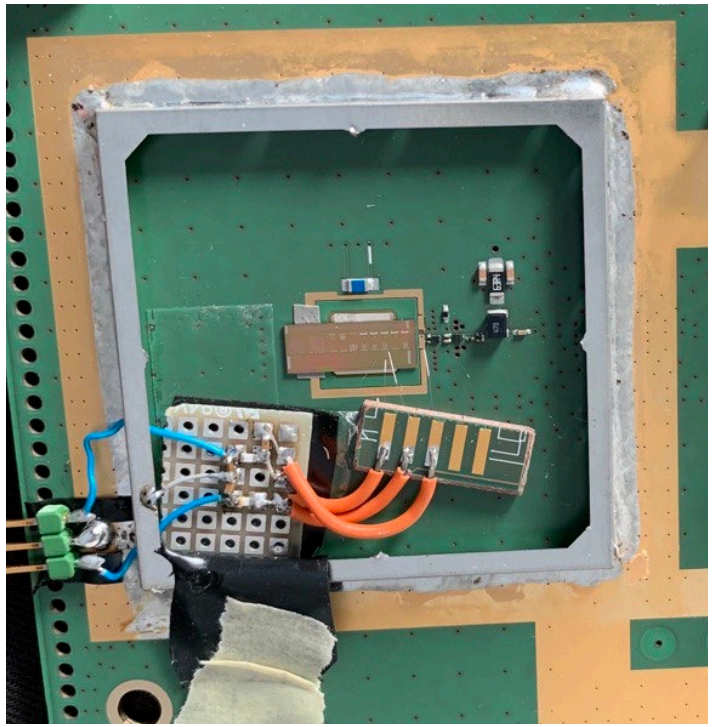
C

Different setup versions

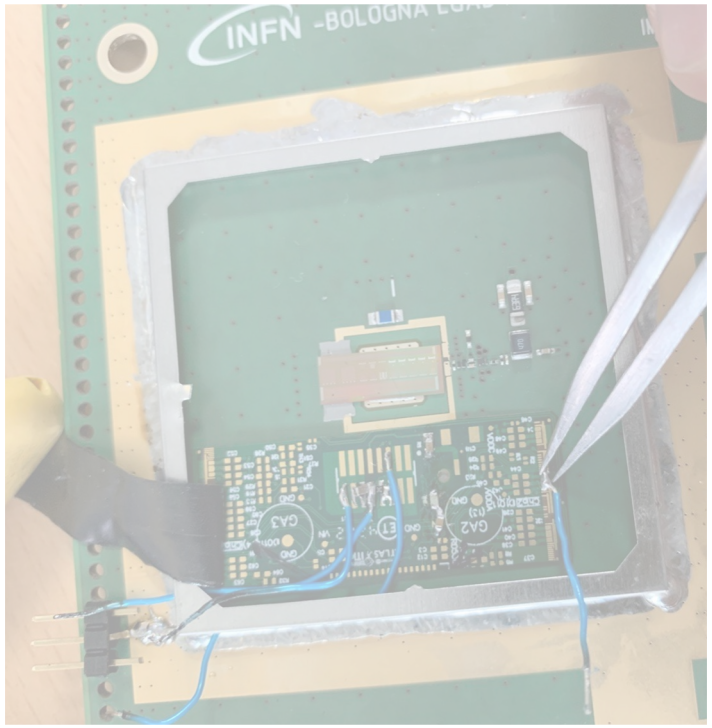
- **A**: Multipurpose board + mezzanine + 2 Minicircuit amplifiers → too noisy
- **B**: Santa Cruz Board – PCB with 5 ENIG pads + multi hole board – Minicircuit LEE-39+ amplifier
- **C**: Santa Cruz Board – flexible PCB – Minicircuit LEE-39+ amplifier



A



B

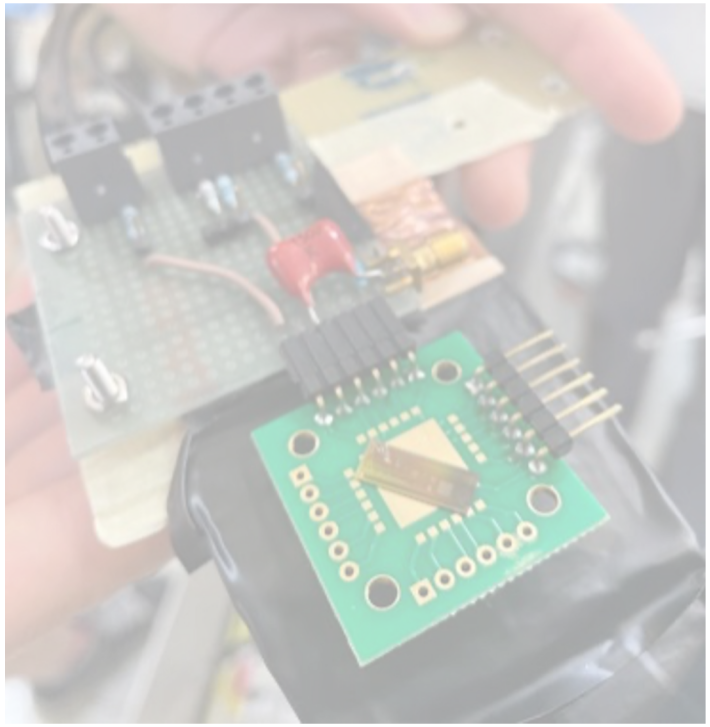


C

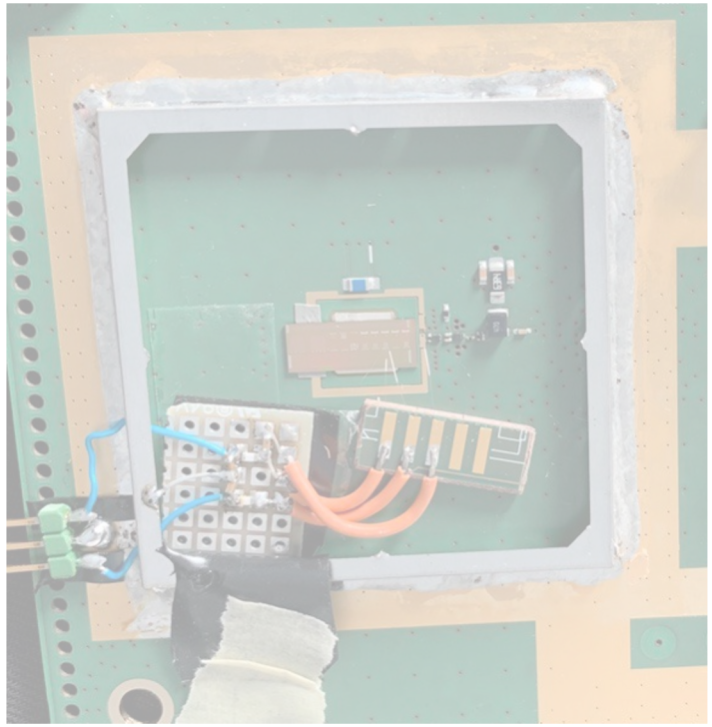
Different setup versions

B: Santa Cruz Board – PCB with 5 ENIG pads + multi hole board – Minicircuit LEE-39+ amplifier

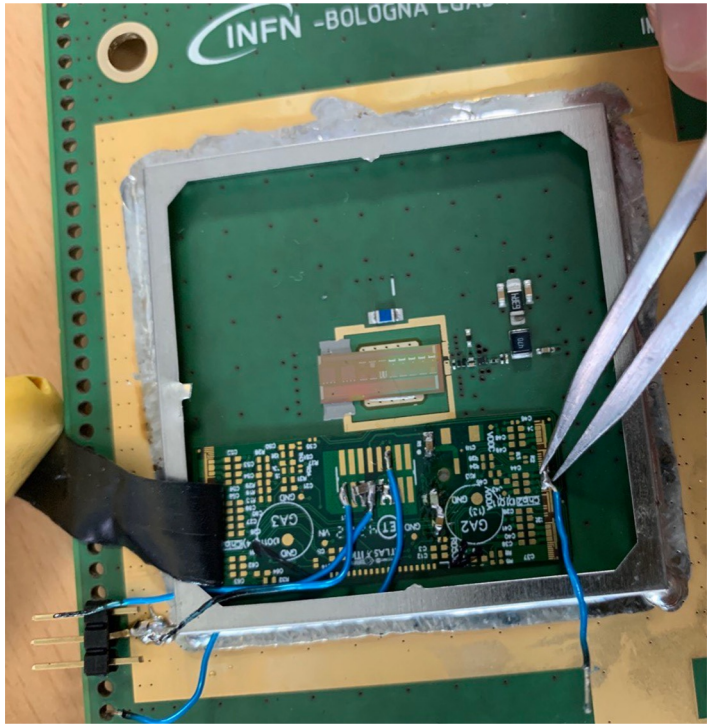
- Noise reduced to ~ 10-12mV (~ a 5 factor smaller than the previous version)
- Imposed a triple coincidence between CMOS and 2 LGAD → ~ 10 coincidences per spill (bandwidth at 200MHz)
- Data acquisition at: 200MHz and Full Bandwidth



A



B



C

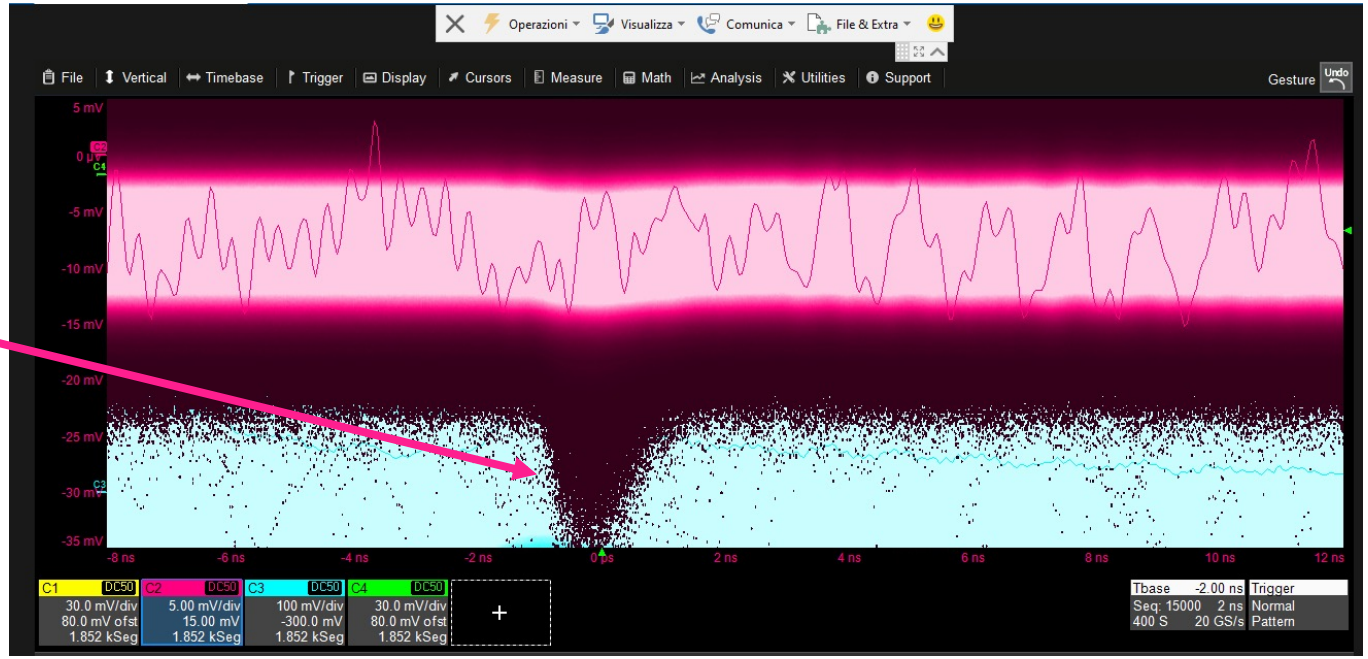
Different setup versions

- **C**: Santa Cruz Board – flexible PCB – Minicircuit LEE-39+ amplifier
- Noise reduced to ~ 7-8mV
- Imposed a triple coincidence between CMOS and 2 LGAD → ~ 8 coincidences per spill (bandwidth at 200MHz)
- Data acquisition at Full Bandwidth

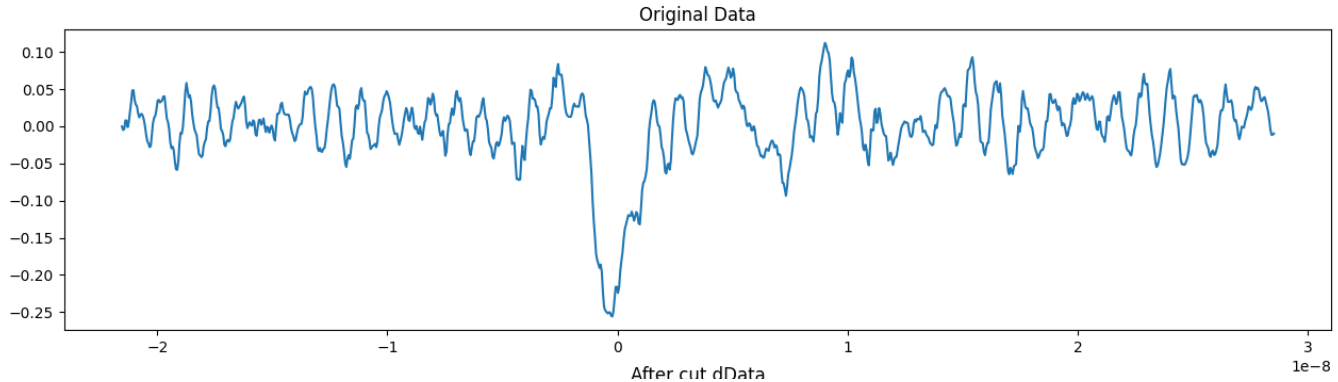
First Signals

CMOS-LGAD signals acquired at different time triggering on LGADs

→ It is possible to identify well defined waveform beyond the noise

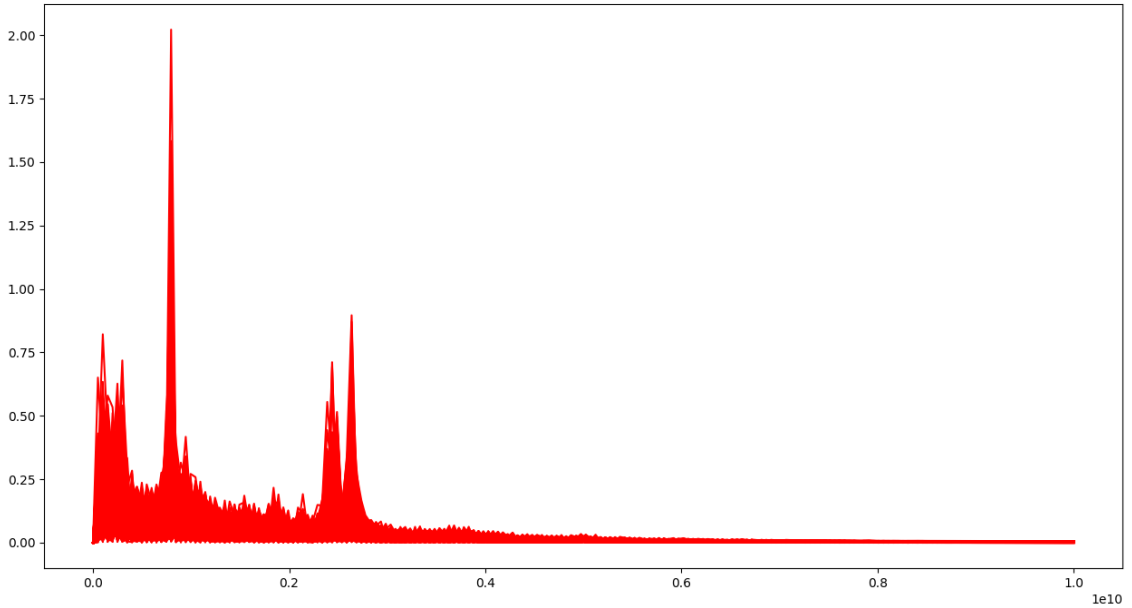


Offline analysis ⇨ Fourier Transform

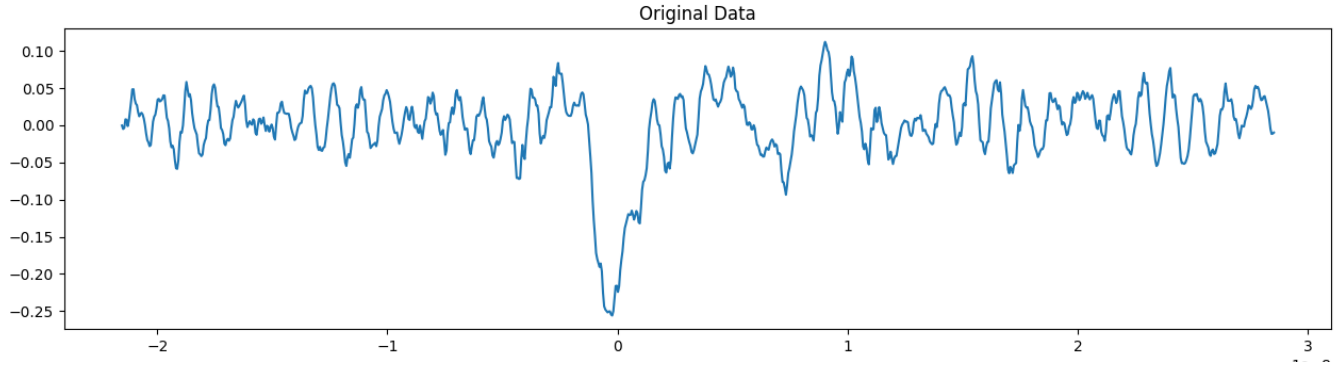


Original signal with noise → presence of a periodic frequency

Fourier Transform of the signal

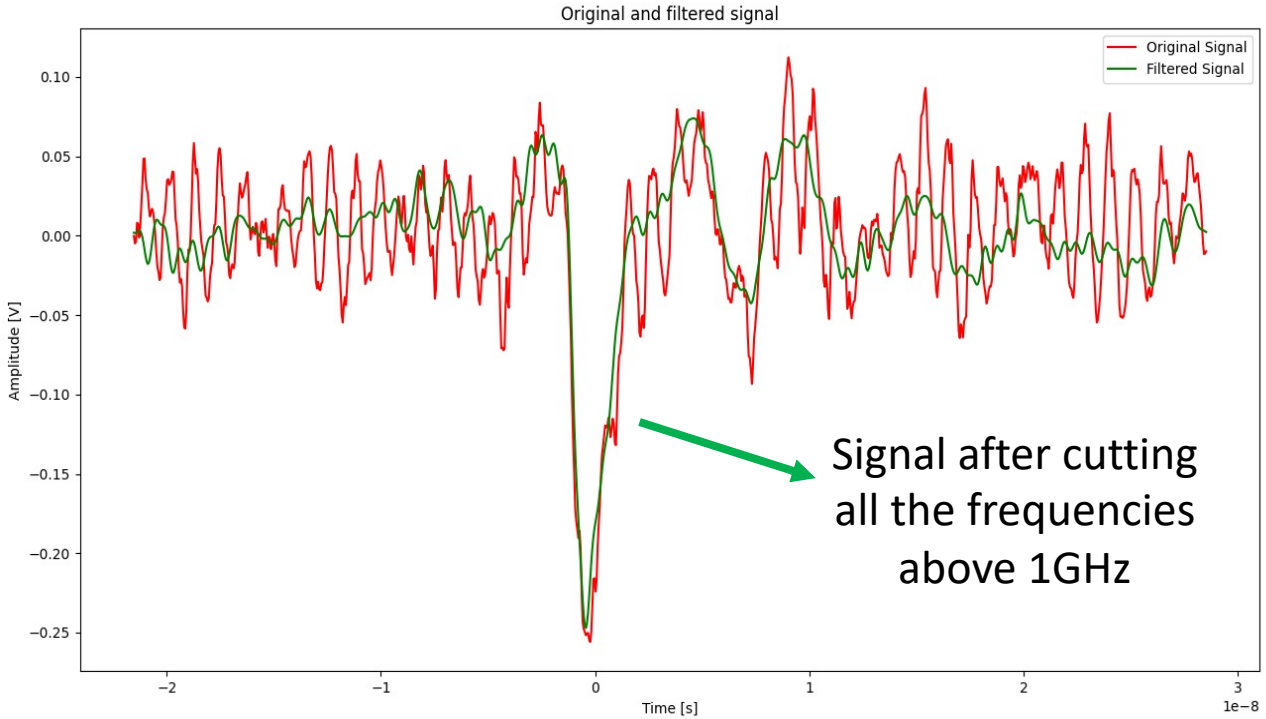


Offline analysis ⇨ Fourier Transform

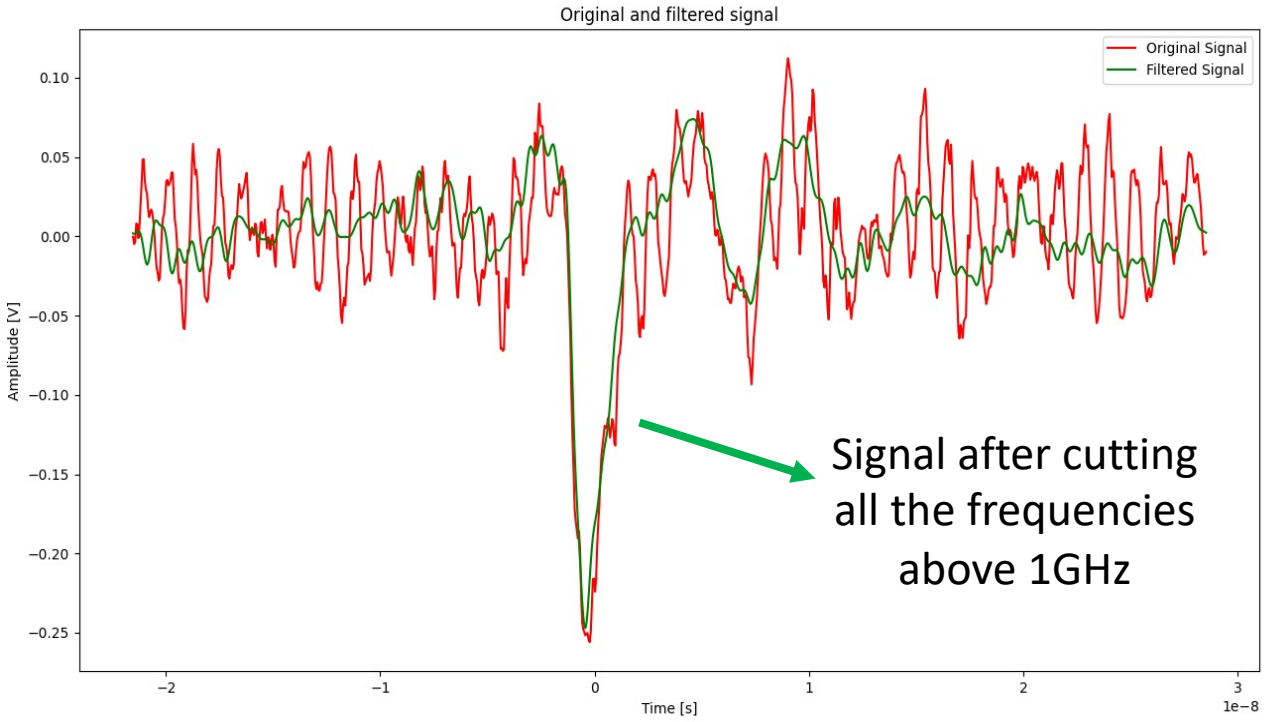


Original signal with noise → presence of a periodic frequency

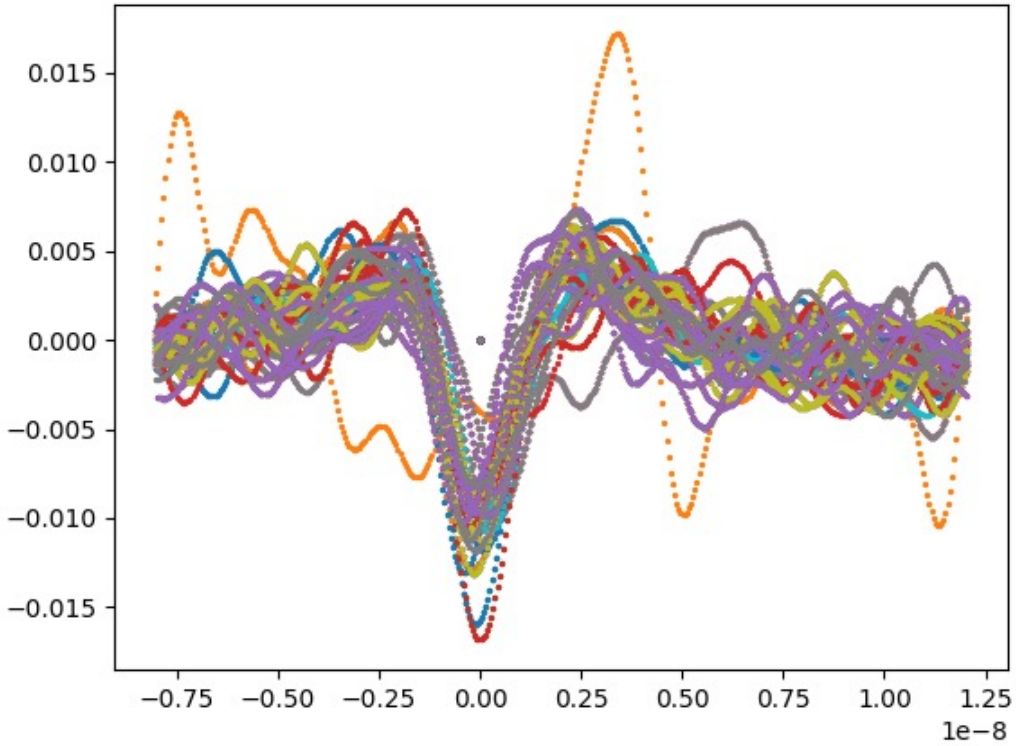
After the Fourier Transform of the signal



Offline analysis ⇨ Fourier Transform



Signal after cutting all the frequencies above 1GHz



Signals after frequencies cutting + a threshold at 8mV fixed to reduce further the noise

We are studying the best process to reduce the noise and carry on the data analysis

⇨ TO BE CONTINUED…