



European  
Funds



Republic  
of Poland



Foundation for  
Polish Science

European Union



NATIONAL SCIENCE CENTRE  
POLAND

# Testing of Veto Photon detection units for the Darkside-20k experiment

---

**Iftikhar Ahmad**  
AstroCeNT, Warsaw

**Annual meeting**

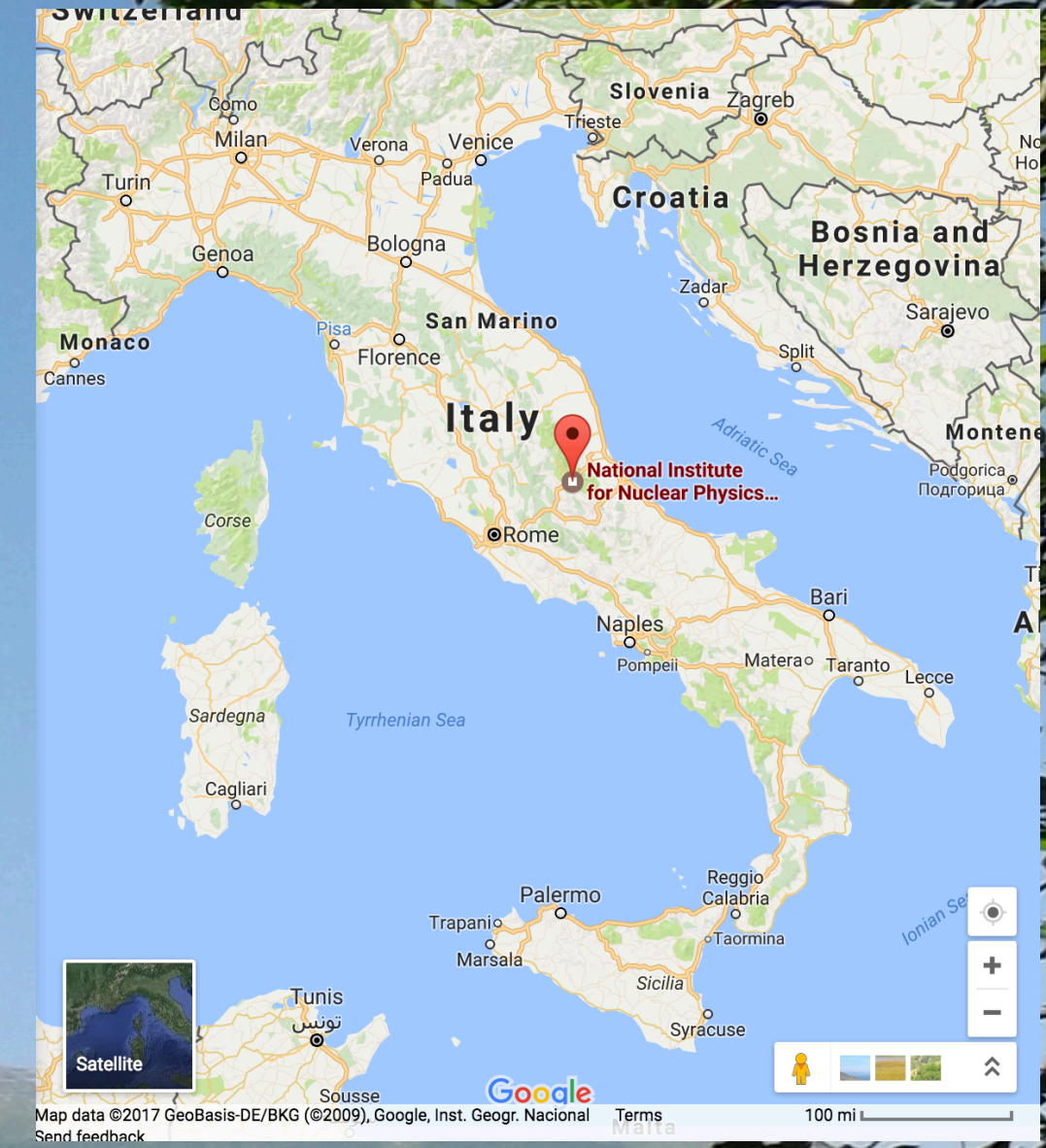
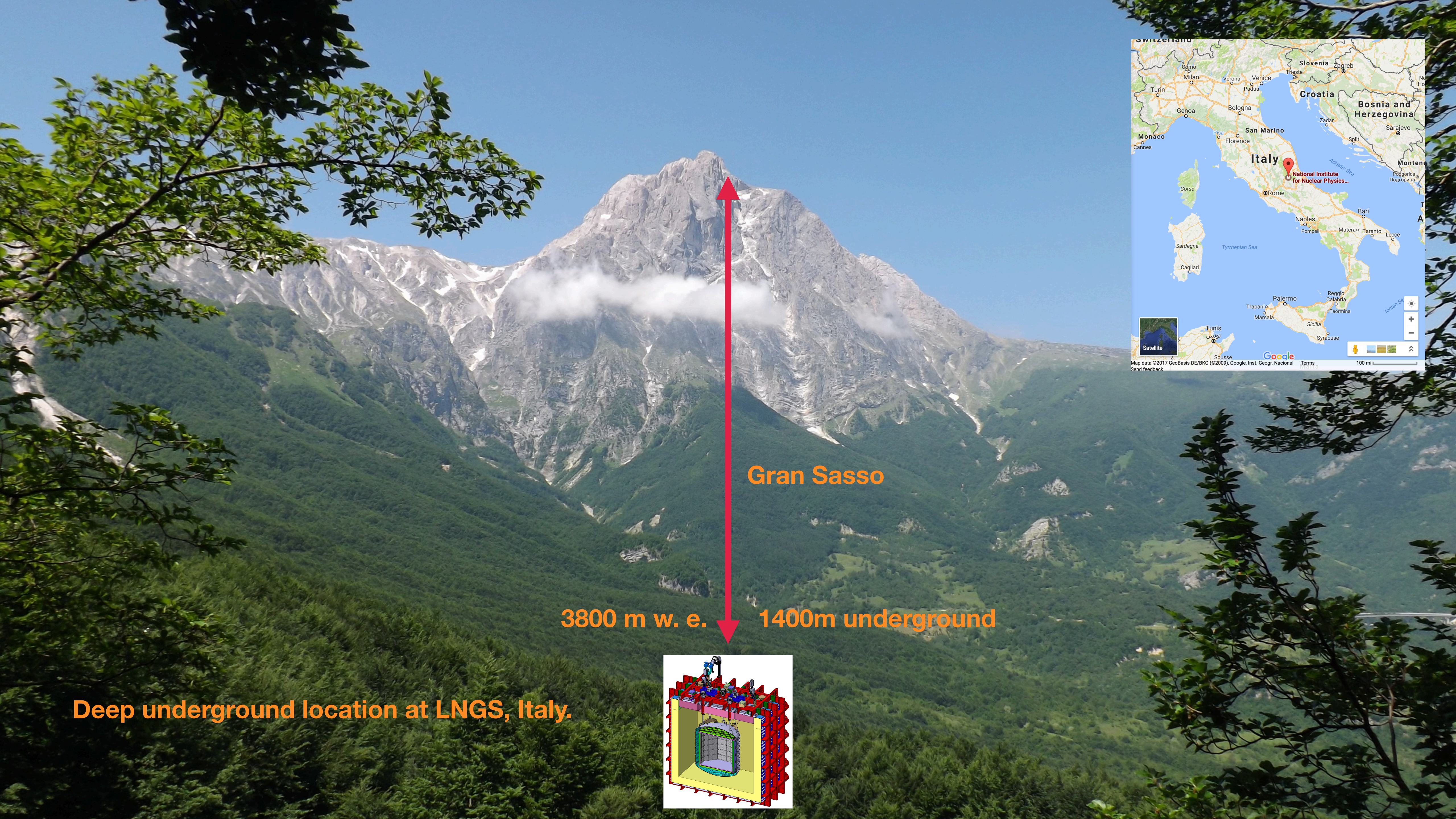
**ASTROCENT**



NICOLAUS COPERNICUS  
ASTRONOMICAL CENTER  
OF THE POLISH ACADEMY OF SCIENCES





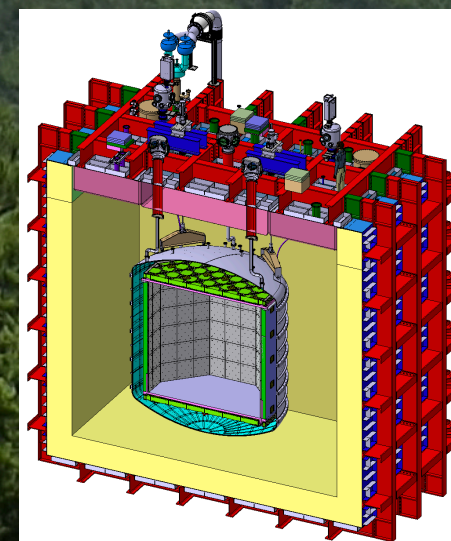


Gran Sasso

3800 m w. e.

1400m underground

Deep underground location at LNGS, Italy.



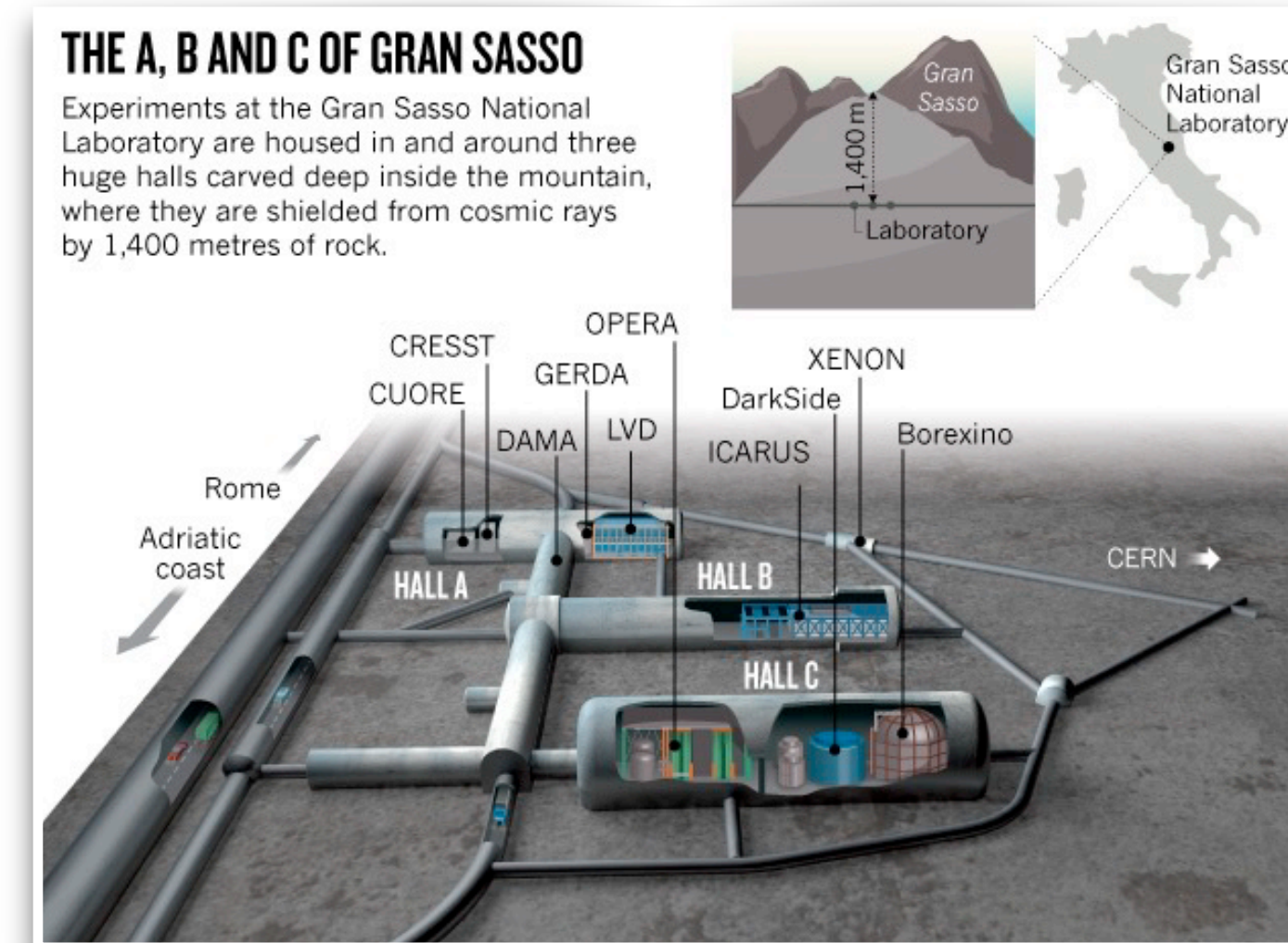


# DARKSIDE-20K EXPERIMENT

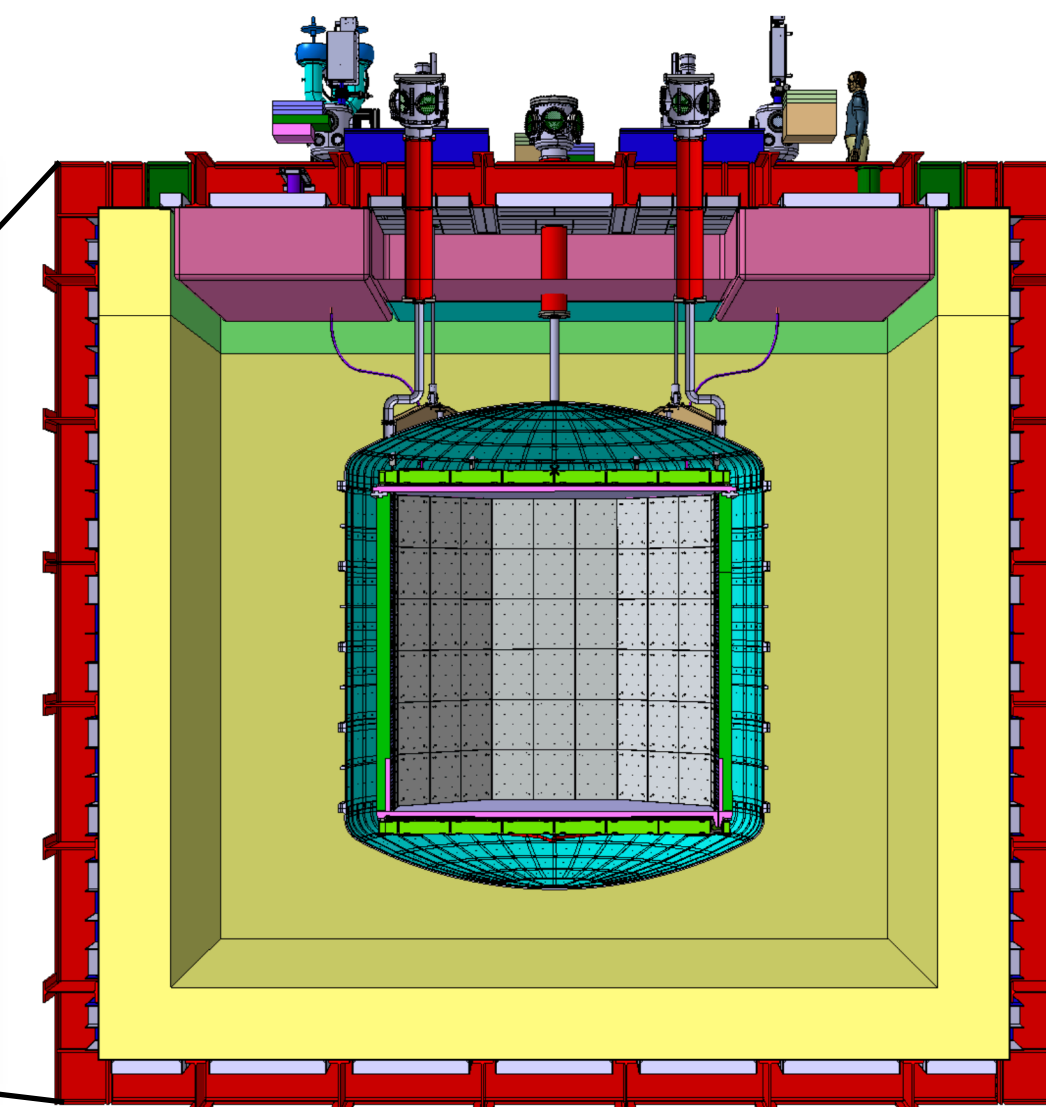
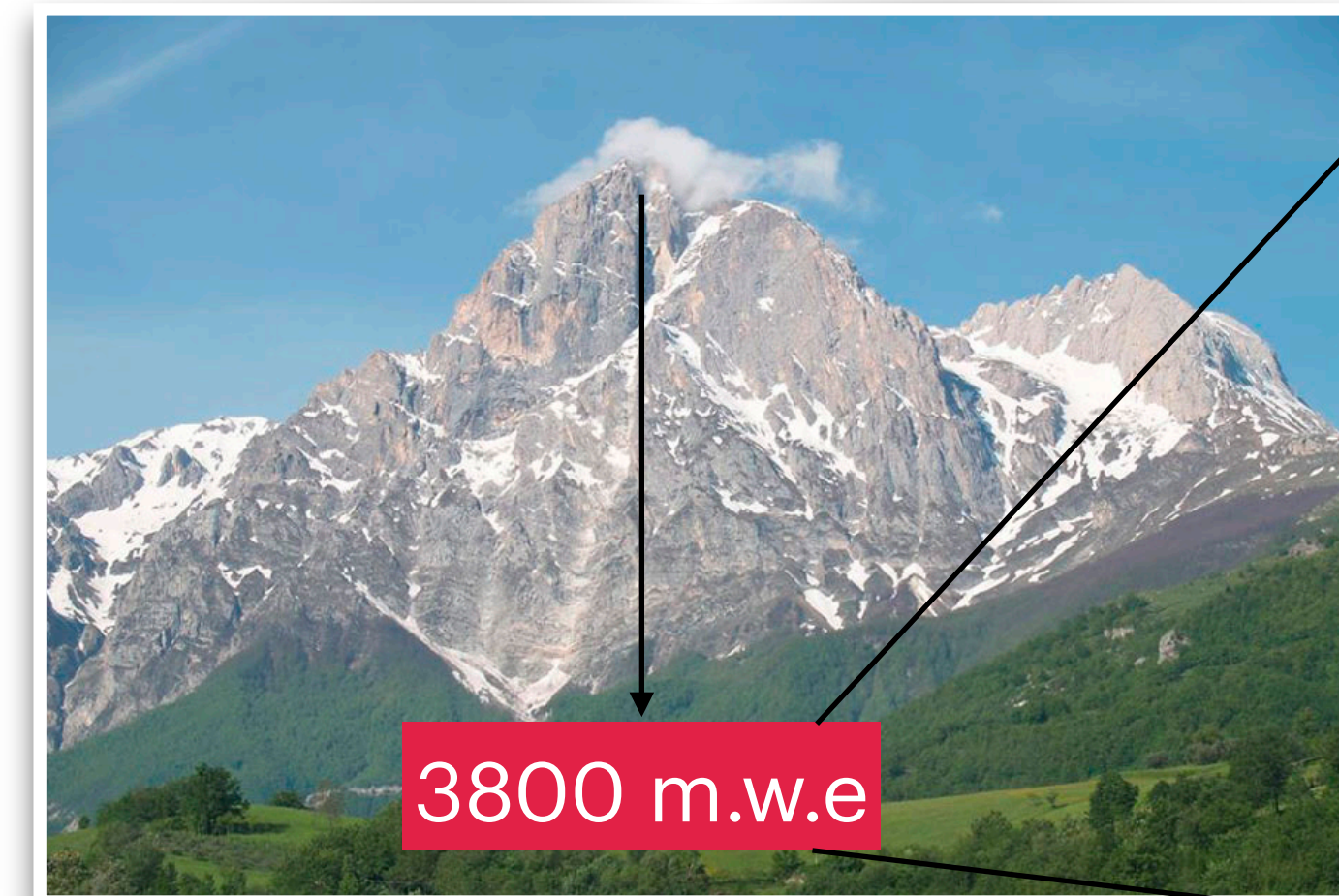
- DarkSide-20k experiment uses dual-phase Time Projection Chamber and is designed to detect WIMP scattering interactions from the dark matter halo.
- Commissioning expected by the end of **2026**.
- DarkSide-20k utilises many **state-of-the-art technologies**:

- **Novel cryogenic large area SiPM arrays (Photon detection unit)**
- **Utilises Underground Ar**
- **Time projection chamber circumscribed by PMMA walls**

- Sensitivity to WIMP-nucleon cross sections of  $\sim 10^{-47} \text{ cm}^2$  for WIMPs of  $1 \text{ TeV}/c^2$ .



**12-June-2024**

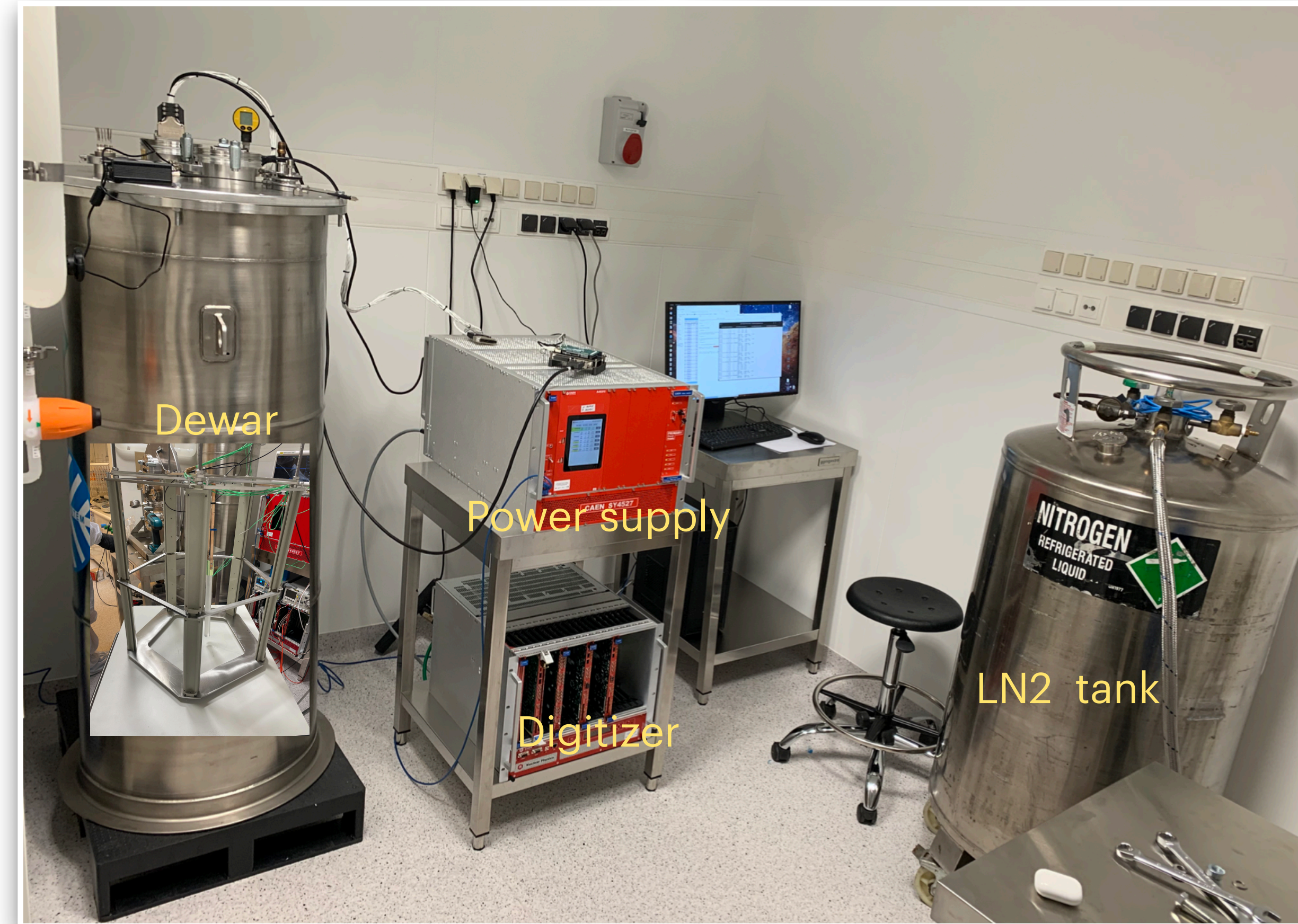


DarkSide-20k under construction at LNGS.



# TESTING FACILITY AT ASTROCENT

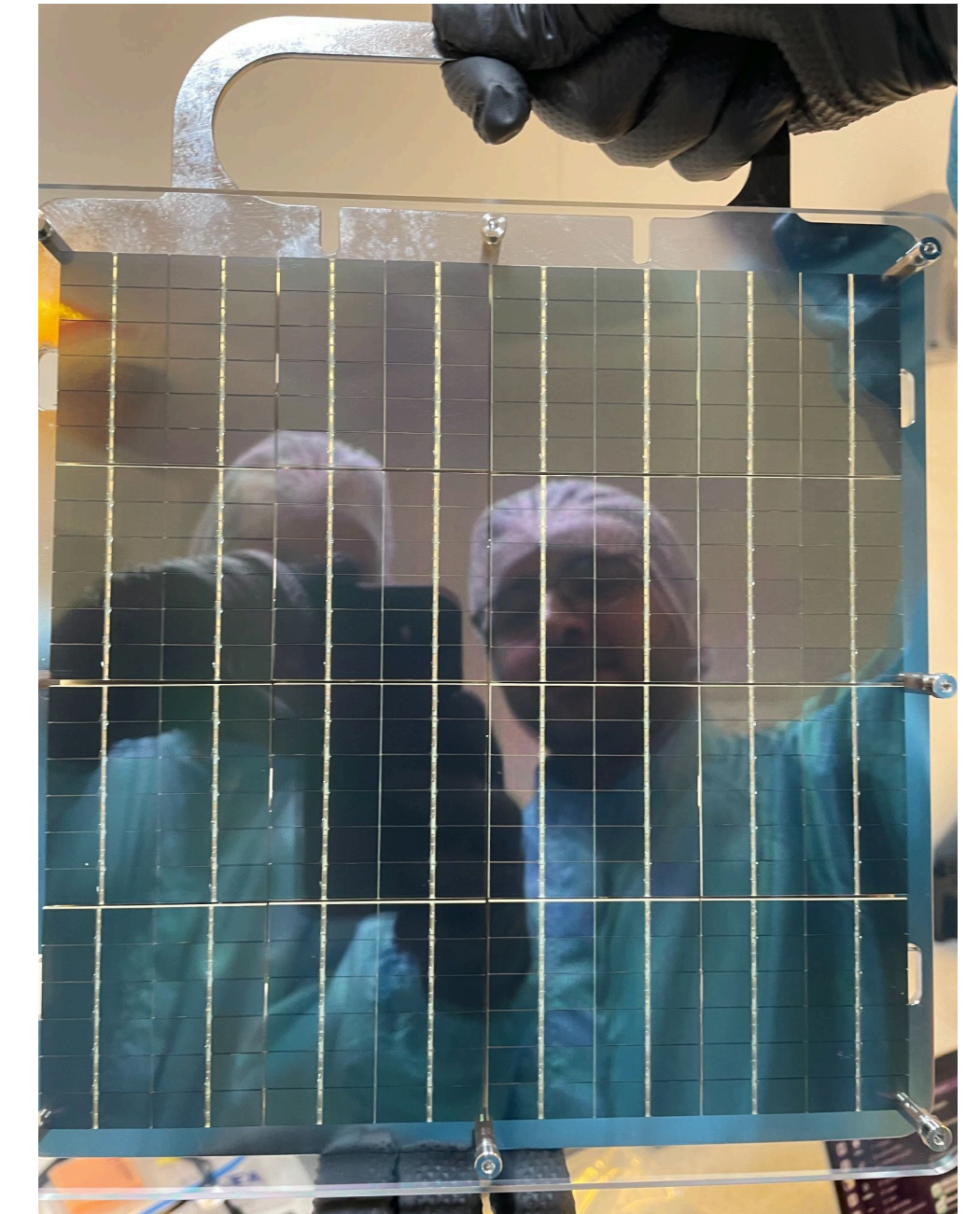
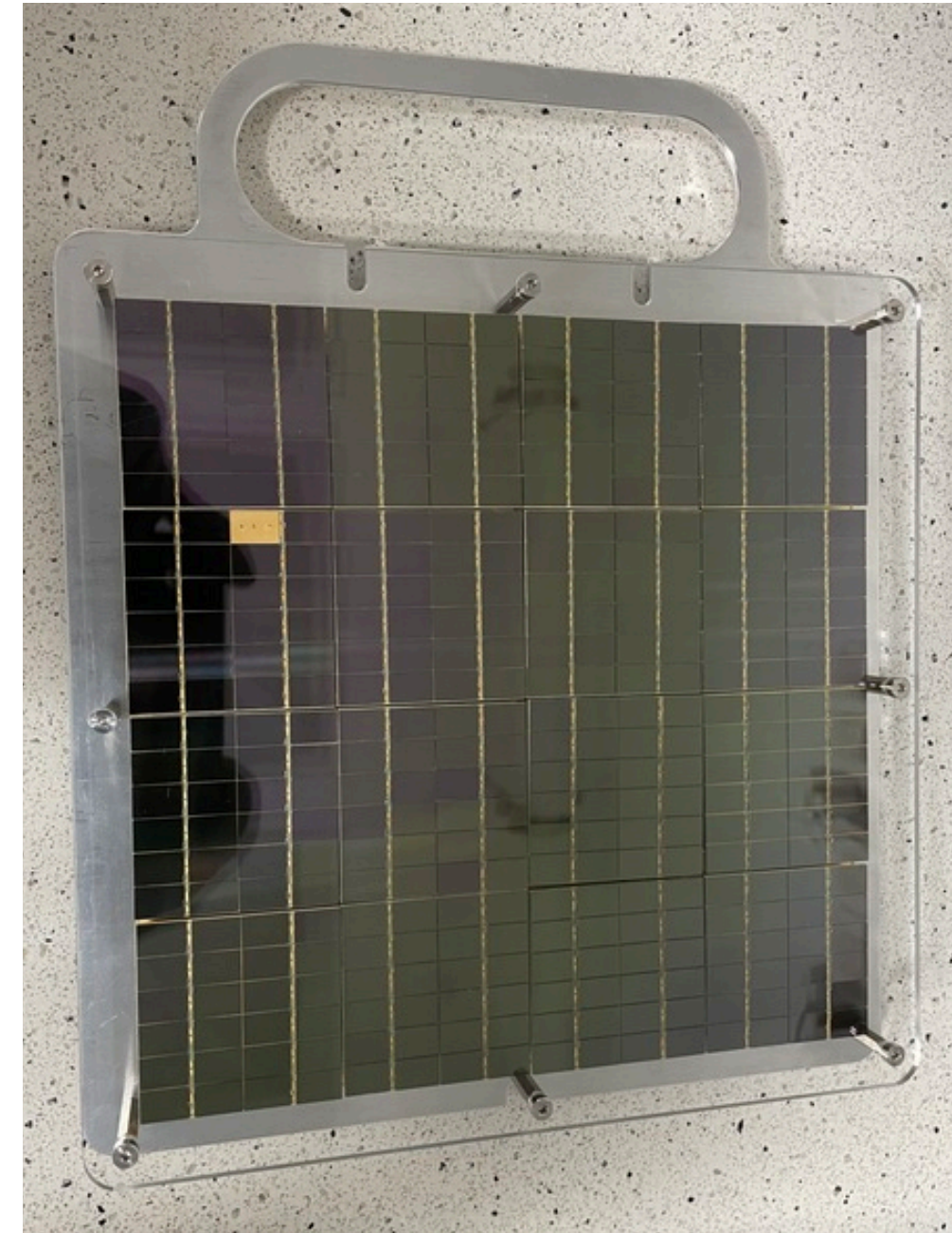
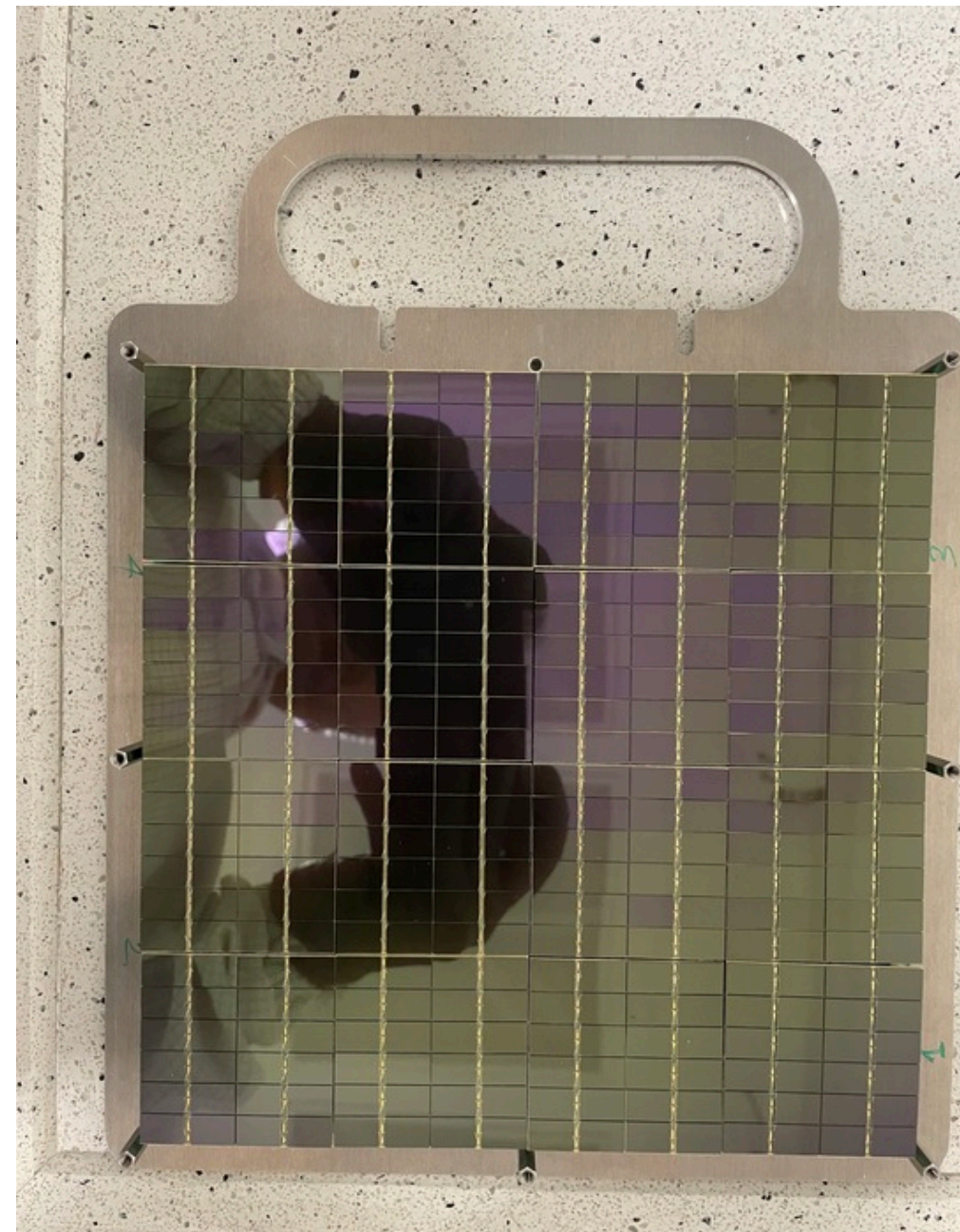
- SiPM wafers are tested and are produced at **NOA** (Nuova Officina Assergi, INFN-LNGS).
- **veto-Photon Detection Unit** testing at 3 sites: **AstroCeNT**, **Edinburgh**, and **Liverpool**.
- **QA/QC**: dust counting, Signal-to-noise ratio (SNR), charge plots, breakdown voltage, noise spectra.
- All facilities are **ready** for **production** and **testing**.
- About 50 veto-Photon Detection Units will be tested at Astrocent.



Testing facility @ Astrocent



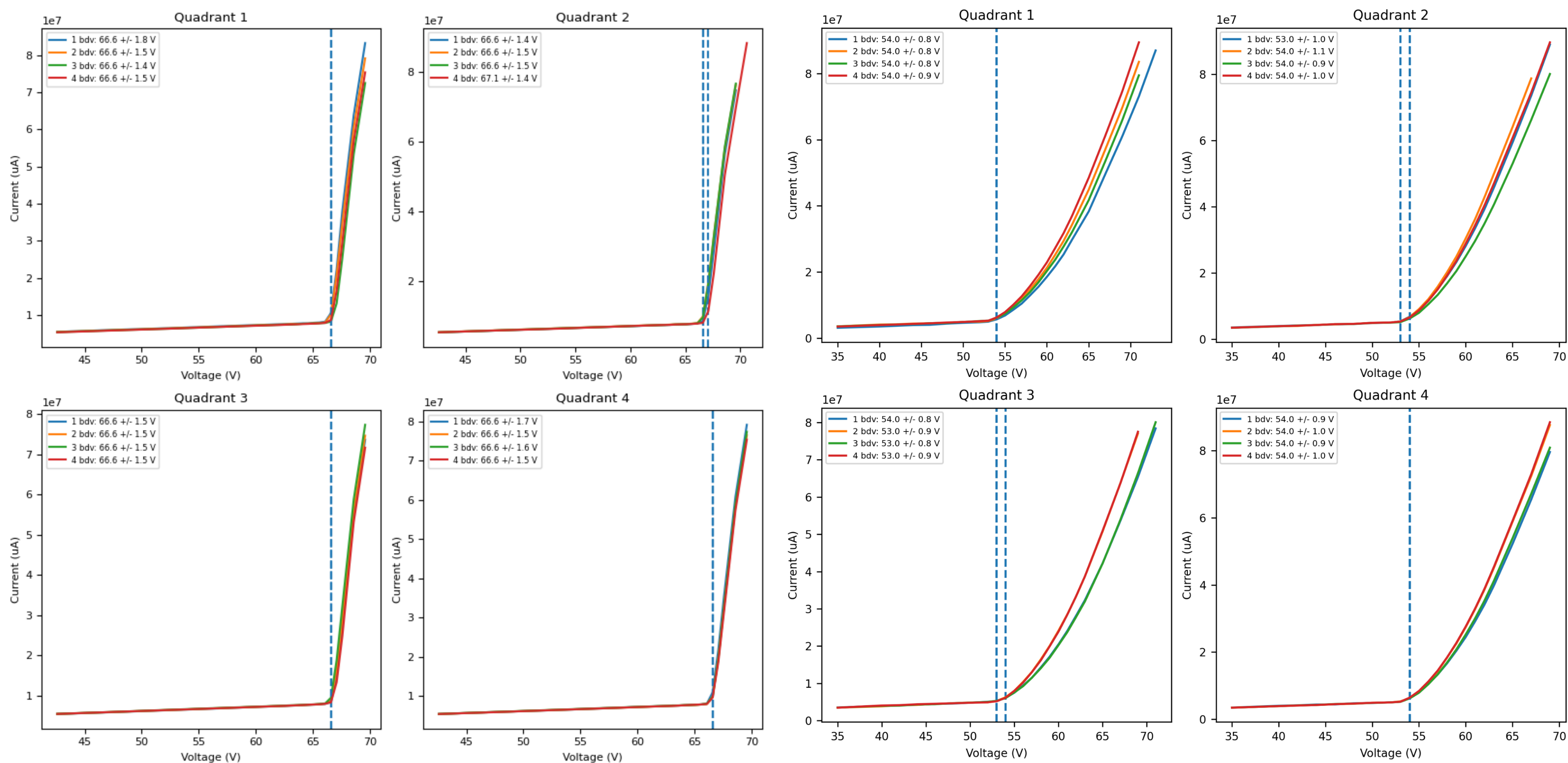
# VETO PHOTON DETECTION UNITS





# CURRENT-VOLTAGE CURVES/BREAKDOWN VOLTAGE

Current (uA)



Voltage (V)

Tested at room temperature

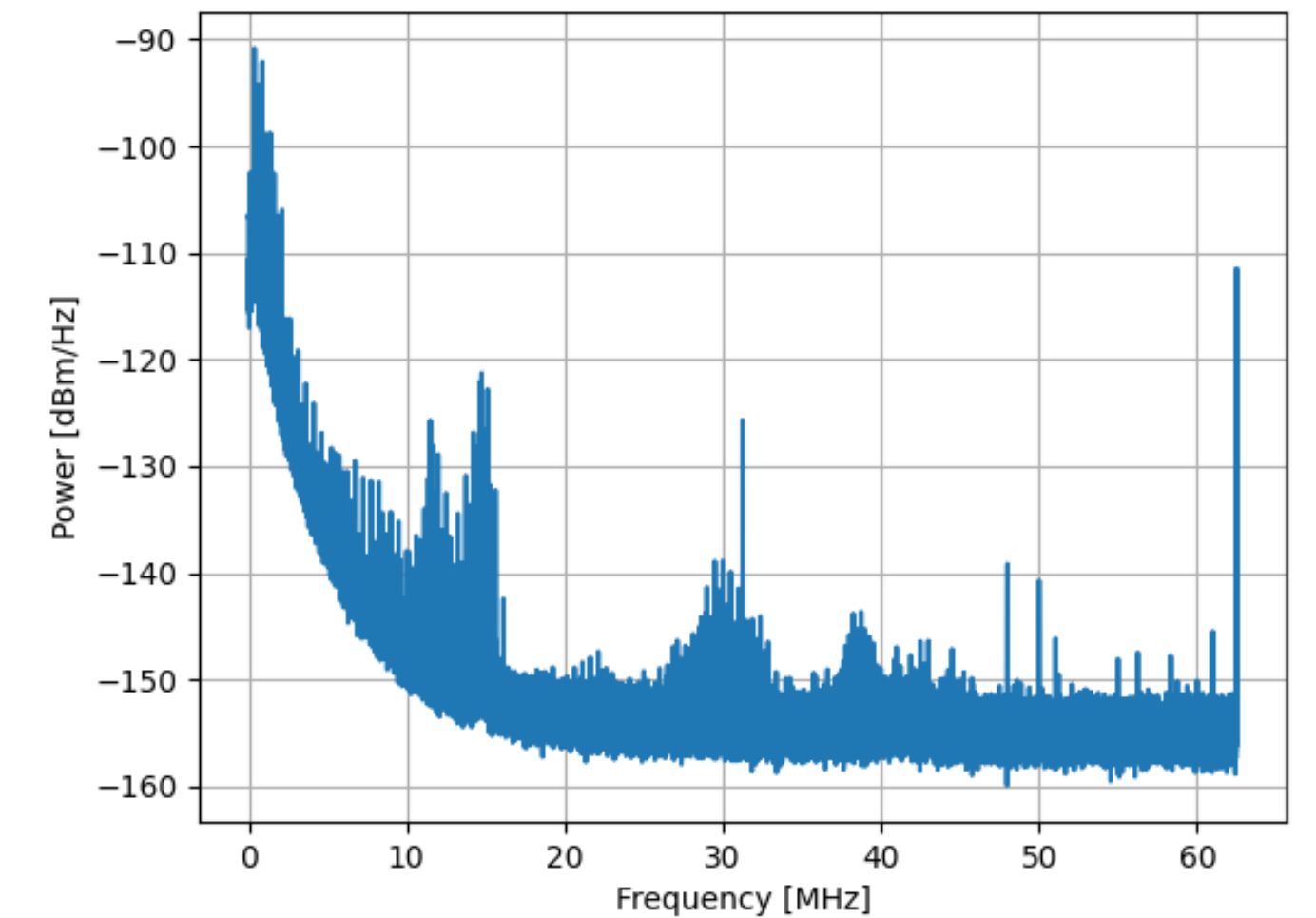
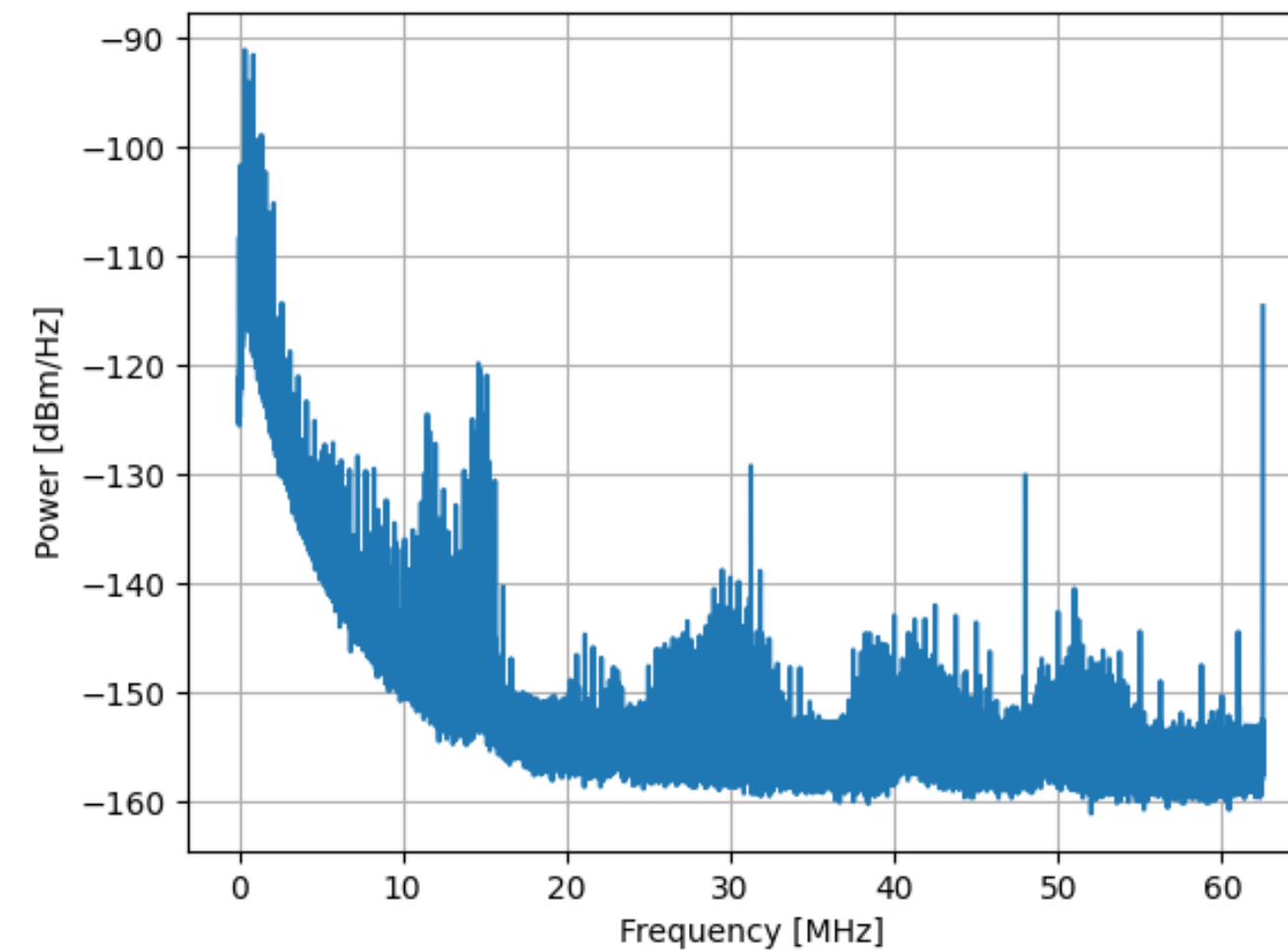
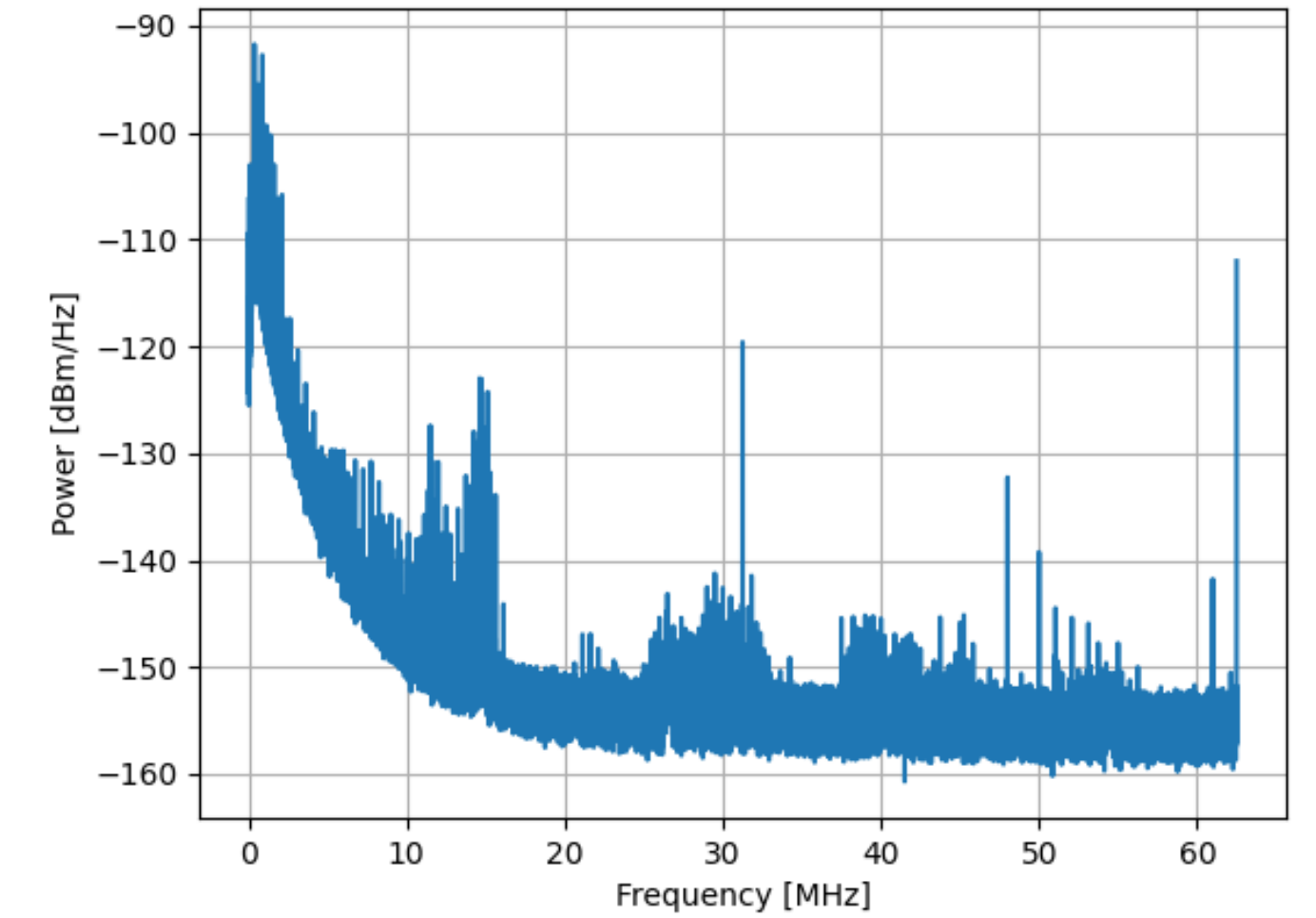
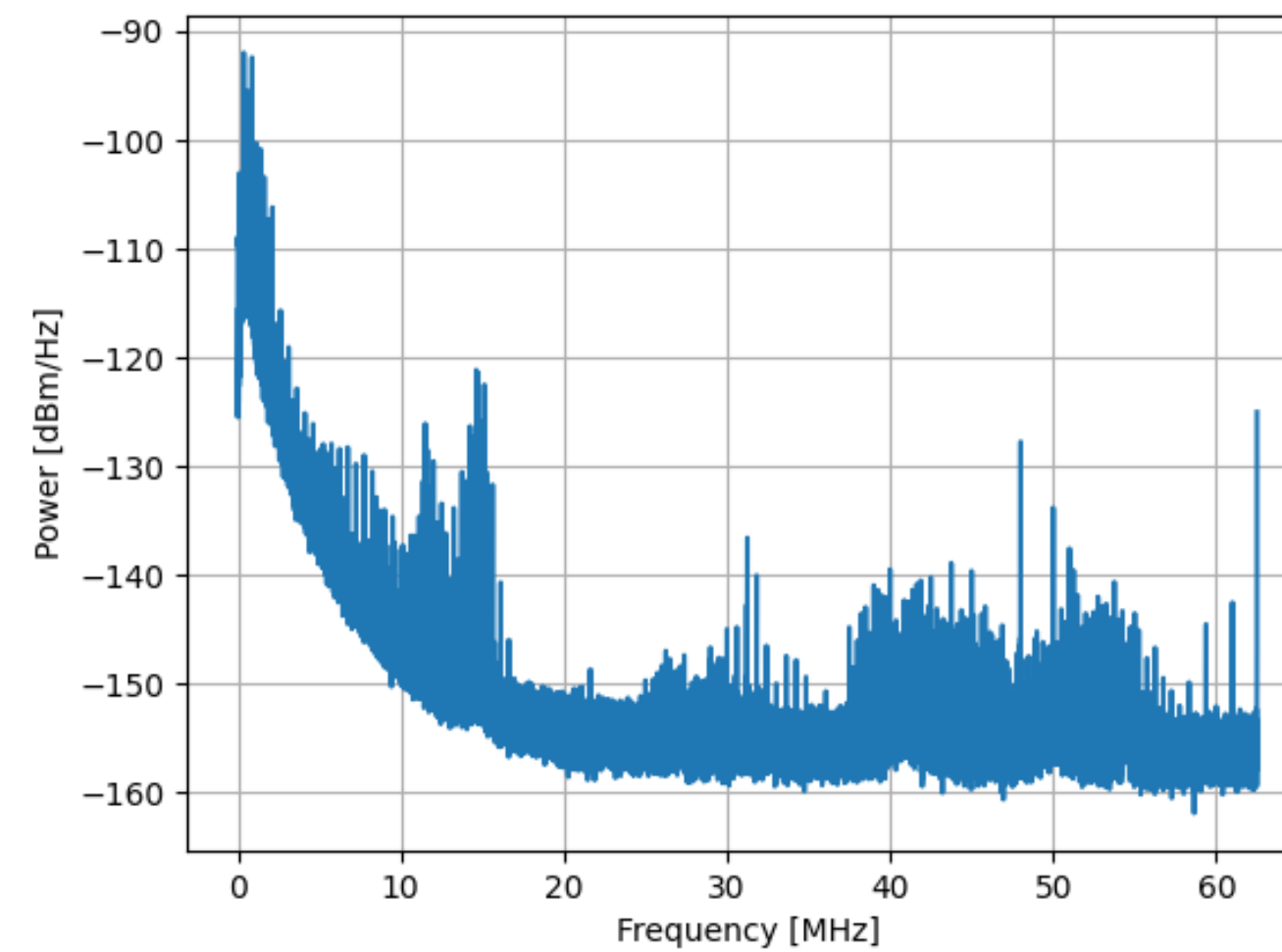
Tested in liquid nitrogen



# NOISE SPECTRA AT COLD

- Satisfies the requirement of DarkSide-20k.
- Comparable with other test sites.
- The data is taken at 40 V

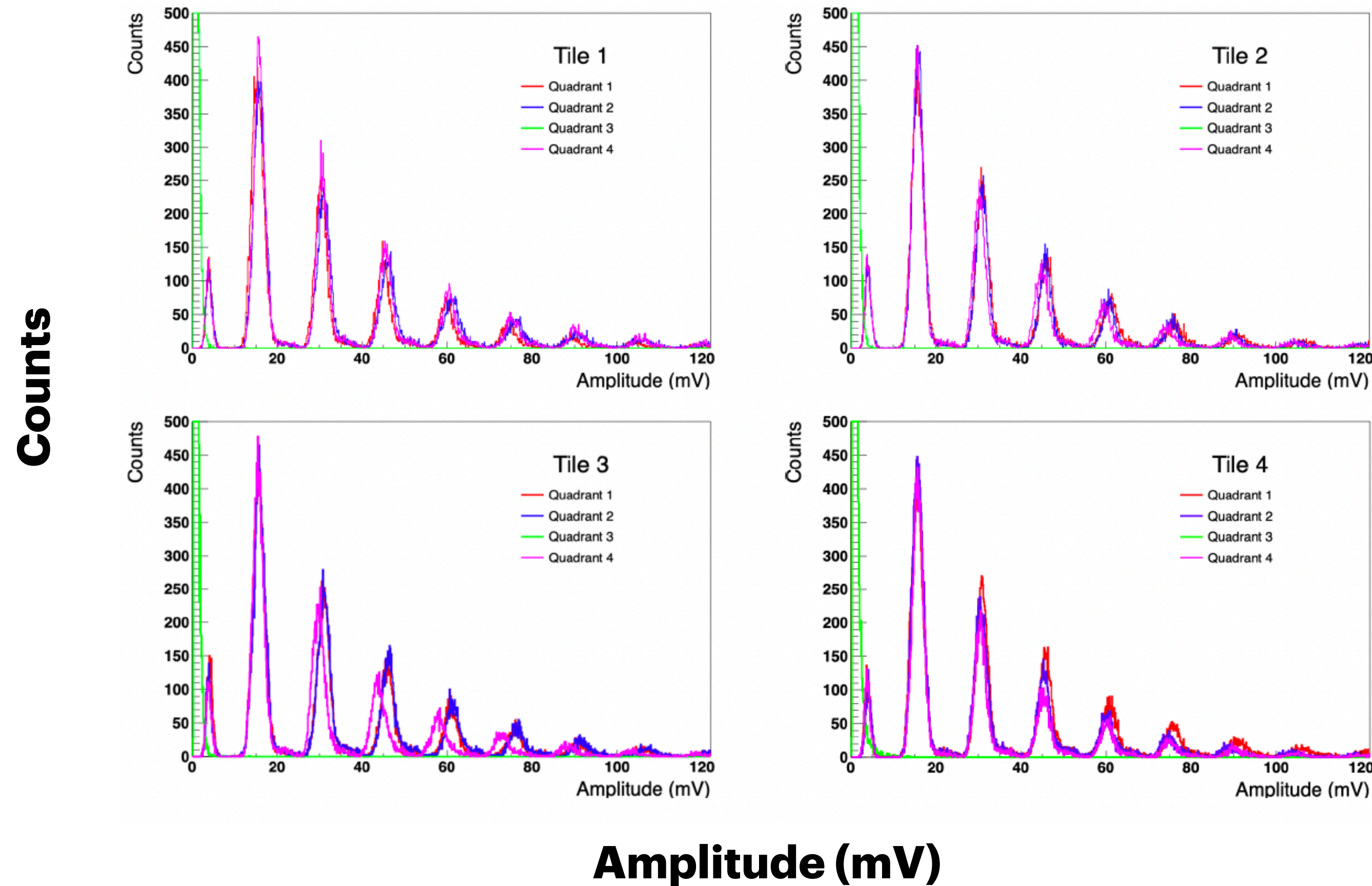
**Power (dBm/Hz)**



**Frequency (MHz)**



# LED CHARGE SPECTRA

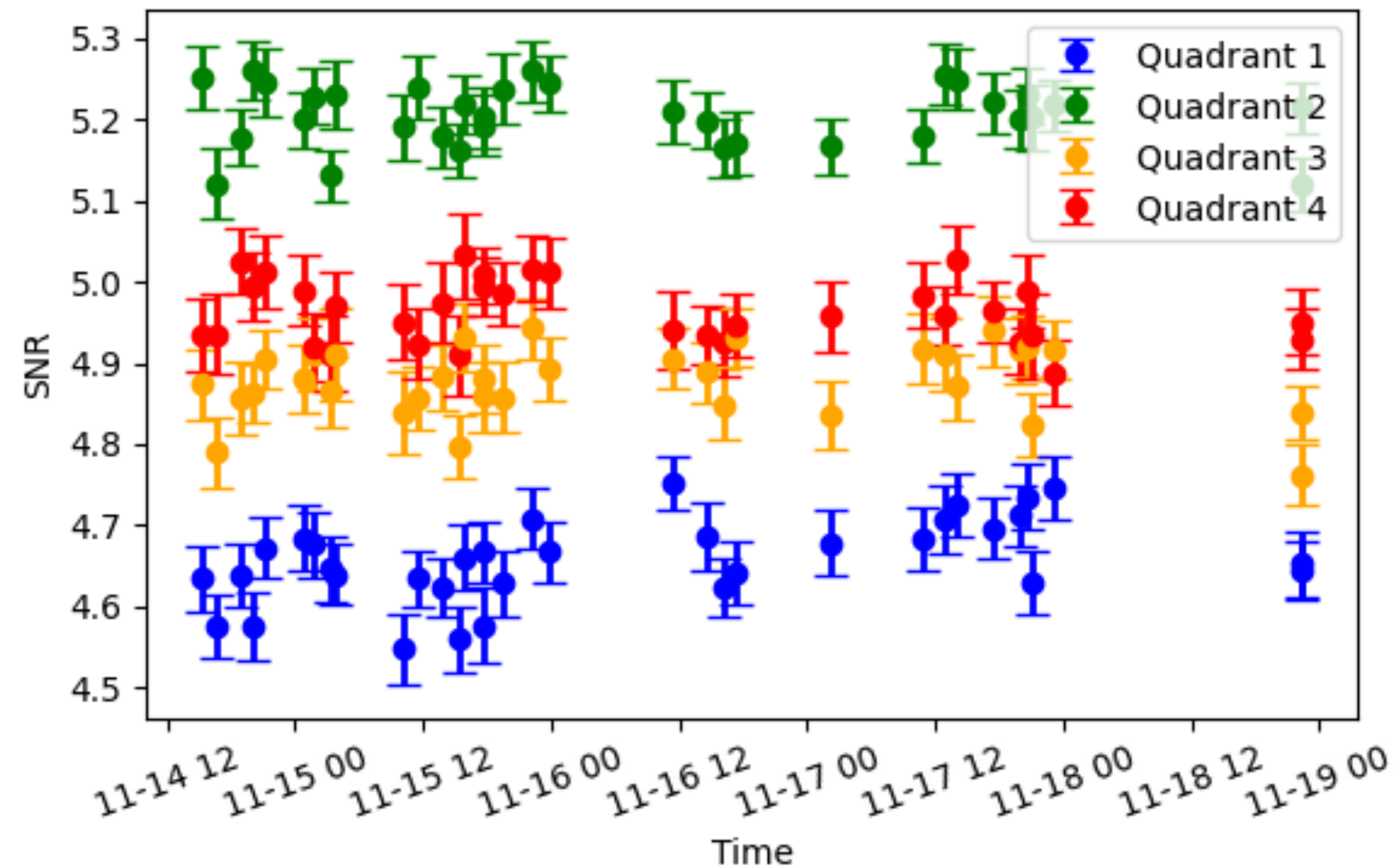


Quadrant 3 has a short circuit (green)

The charge spectra is produced the CAEN LED source with a specific intensity for each tile on the veto-Photon Detection Units.



# SIGNAL TO NOISE RATIO



**SNR for each quadrant  
1 week stability test**



# SUMMARY

- Large effort for DarkSide-20k is ongoing in all parts and the construction started in LNGS.
- DarkSide-20k **photosensors** represent a real technical challenge.
- DarkSide-20k will start data taking in the end of **2027 for 10 years.**
- A joint effort from all the **collaboration.**



**2024**

**2 Conference talks (Collaboration meeting, IDM-2024)**

**1 Seminar (Wednesday Colloquium)**

**1 Paper (3D $\pi$ : Three-Dimensional Positron Imaging, A Novel Total-Body PET Scanner)**

**1 Poster (LRT-2024)**

**Thank you**