CUORE-CUPID Hands-on

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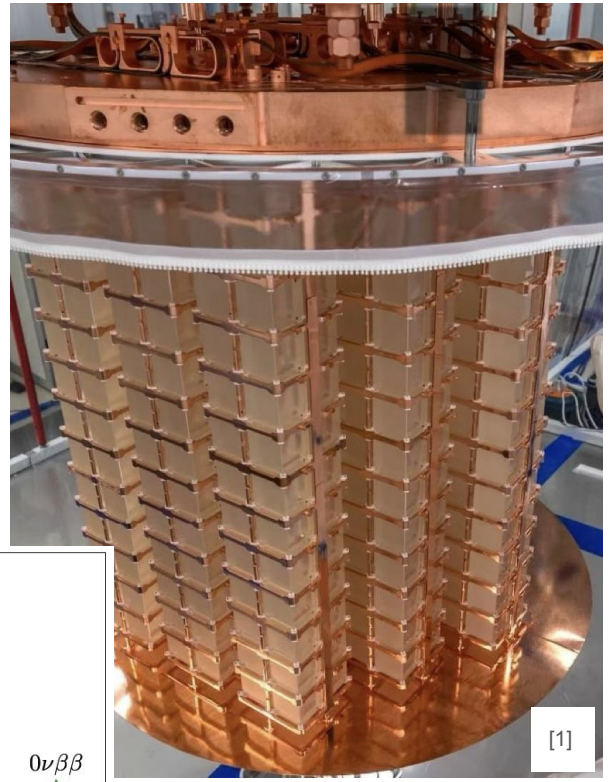
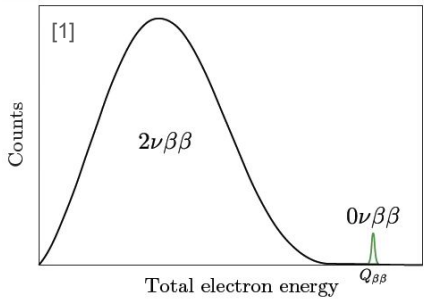
With the great help of: Serena D'Eramo, Shihong Fu, Dounia Helis, Simone Quitadamo and Ing. Rodolfo

CUORE

- **C**ryogenics **U**nderground **O**bservatory for **R**are **E**vents
- Main goal: 0νββ in ^{130}Te ($Q_{\beta\beta}$ 2527.5 keV)

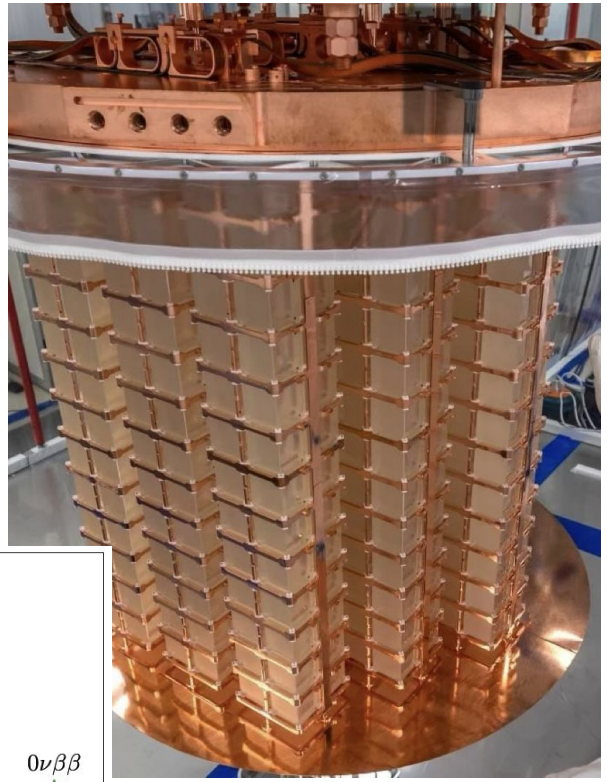


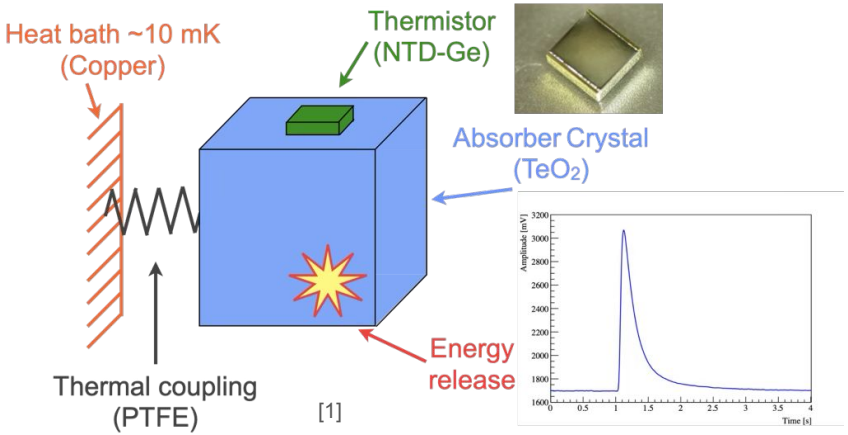


[1] Shihong Fu · PhD school on experimental astroparticle physics 2025

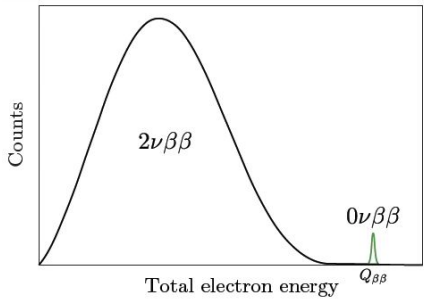
CUORE

- **C**ryogenics **U**nderground **O**bservatory for **R**are **E**vents
- Main goal: 0νββ in ^{130}Te ($Q_{\beta\beta}$ 2527.5 keV)
- Detectors ⟶ cryogenic bolometers (TeO_2)
- The thermal sensor is a Neutron Transmutation Doped (NTD) Ge thermistor





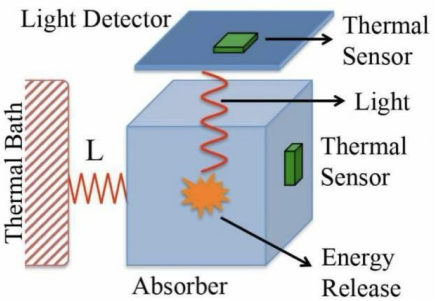
[1]



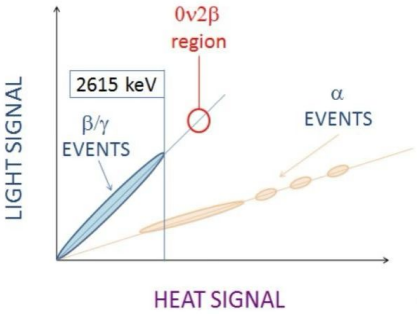
The CUORE upgrades we focused on

CUPID-like modules

Scintillating Bolometer [1]



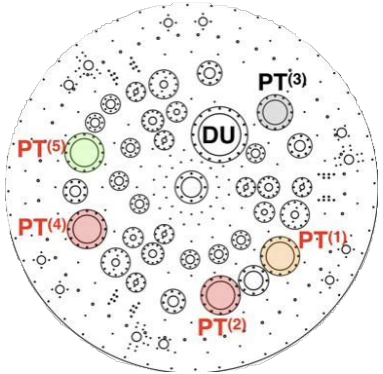
Particle Identification



Crystal dismounting and calibration spectra fitting

Cryostat upgrades

[1]

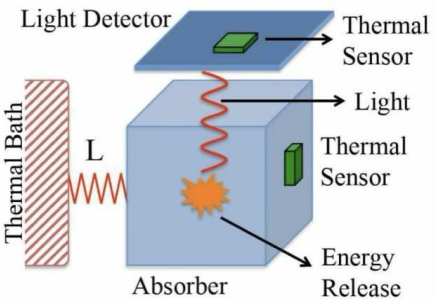


Study of aluminum thermal connectors

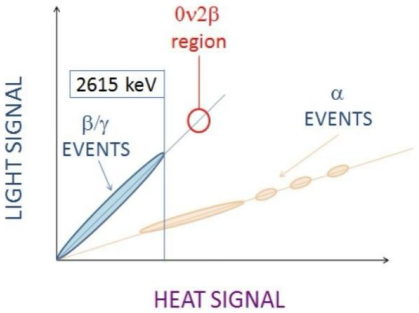
The CUORE upgrades we focused on

CUPID-like modules: alpha background rejection

Scintillating Bolometer

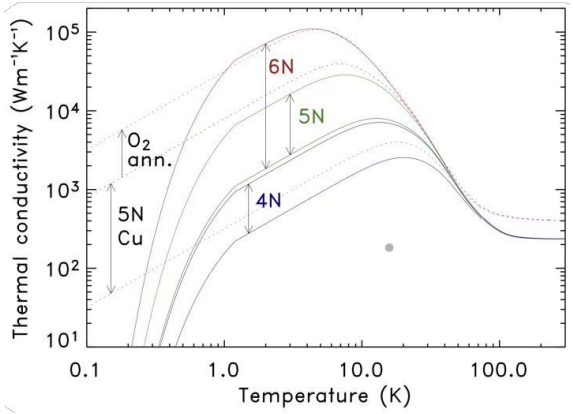


Particle Identification



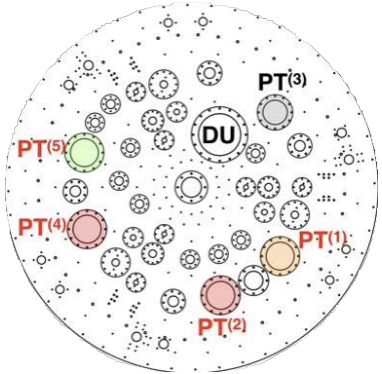
- **C**uore **U**pgrade with **P**article **ID**entification
- $0\nu\beta\beta$ in ^{100}Mo($Q_{\beta\beta}$ 3034 keV)
- Scintillating bolometers: particle discrimination via Ge LD

The CUORE upgrades we focused on



- Good thermal conductivity
- Strong mechanical coupling
- More flexible
- Foresee vibration transmission reduction

Cryostat upgrades



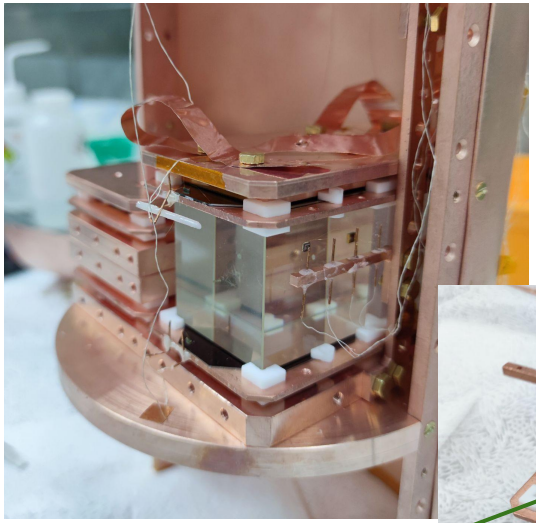
Study of aluminum thermal connectors

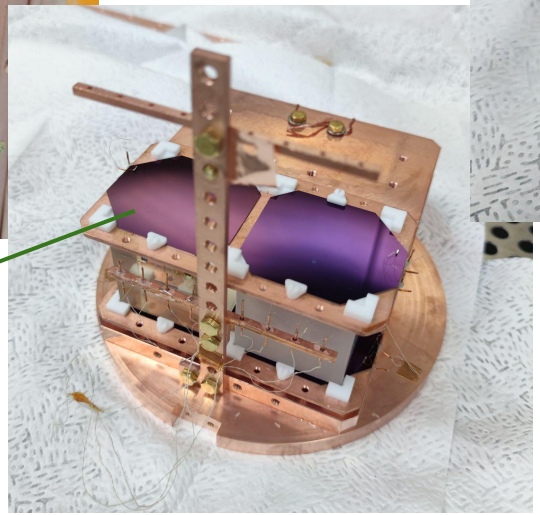
Hands on the detector: Cryostat & Cleanroom

CUPID-CCVR
Hall C

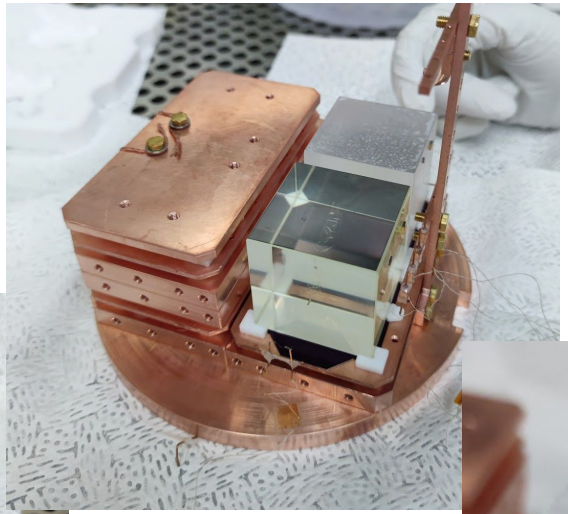
Hands on the detector: Cryostat & Cleanroom

Hands on the detector: Cryostat & Cleanroom

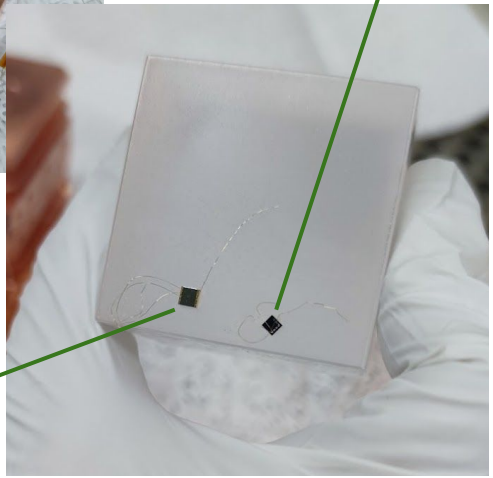




Germanium
LD

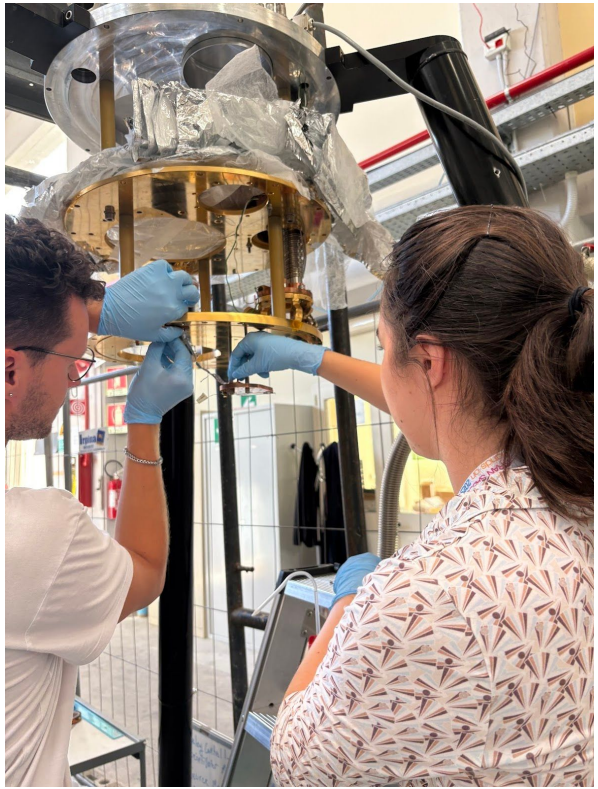


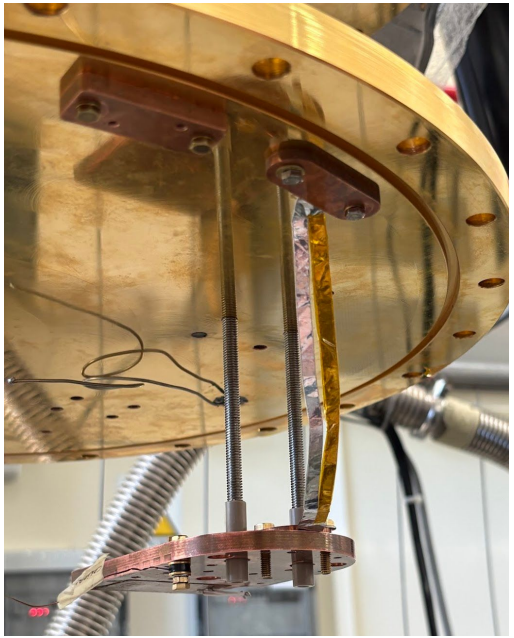
Heater



NTD

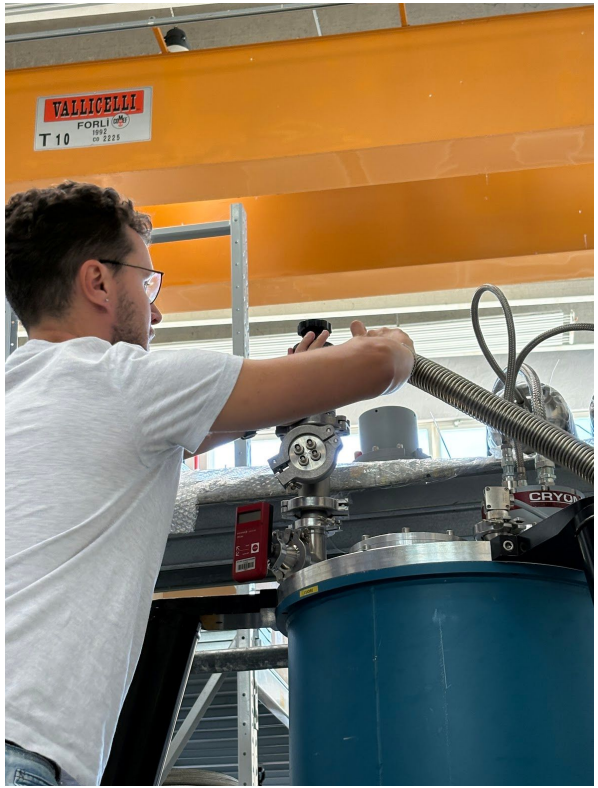
The Aluminium strip crafting and mounting in the Pulse Tube Cryocooler System





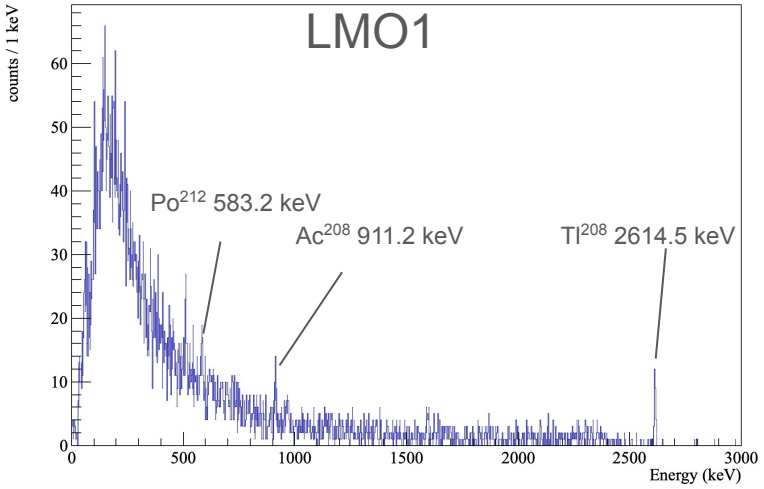
Leak detection of the cryostat

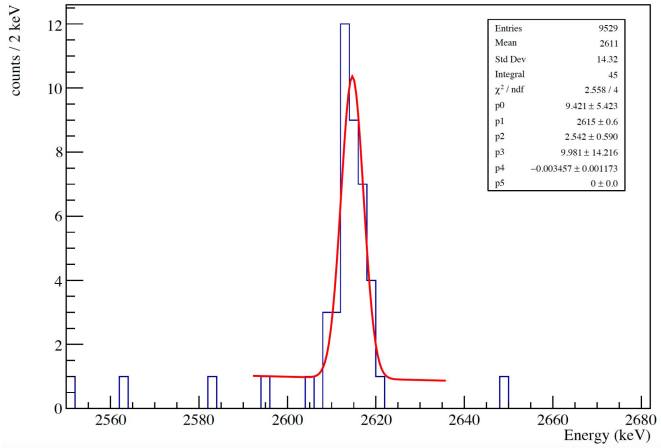
Leak found! 😄



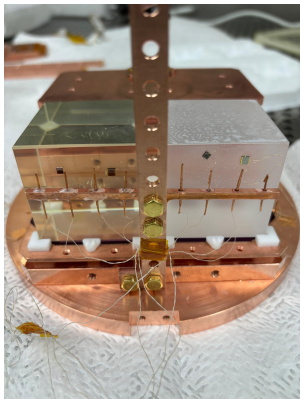
Calibrated spectra with peaks

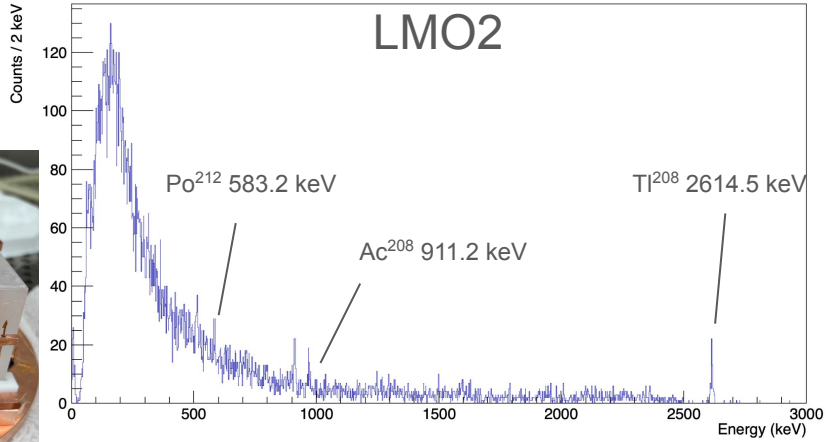
Radioactive source: 232Th





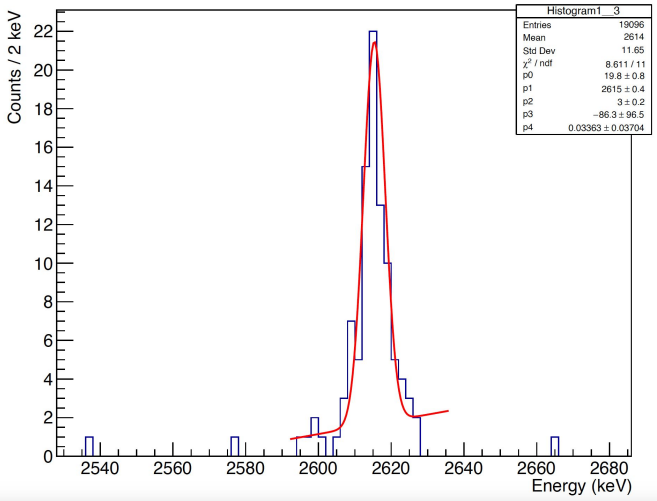
Lithium molybdate crystals (Li2MoO4)



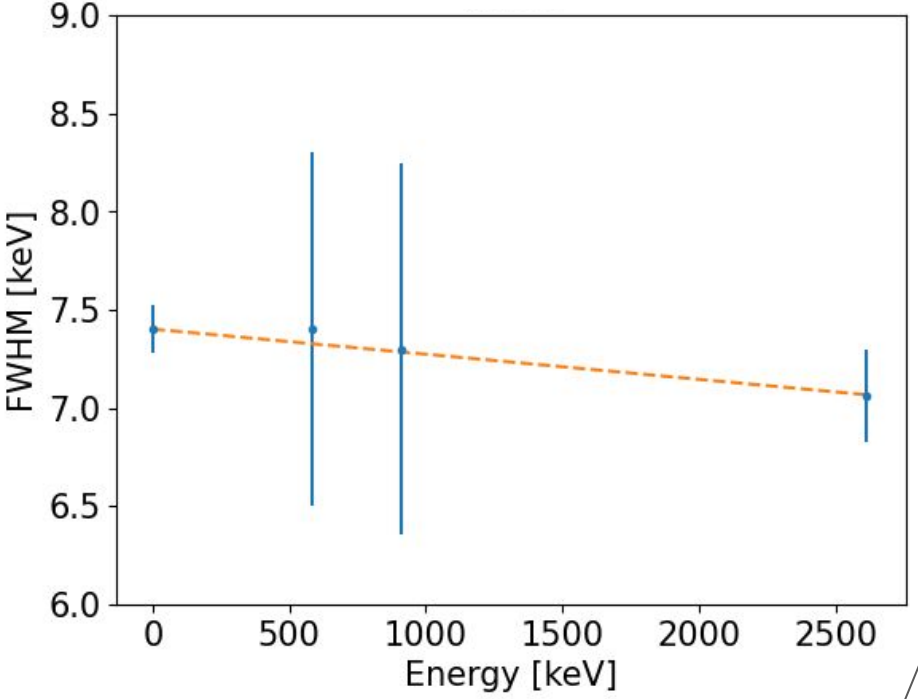


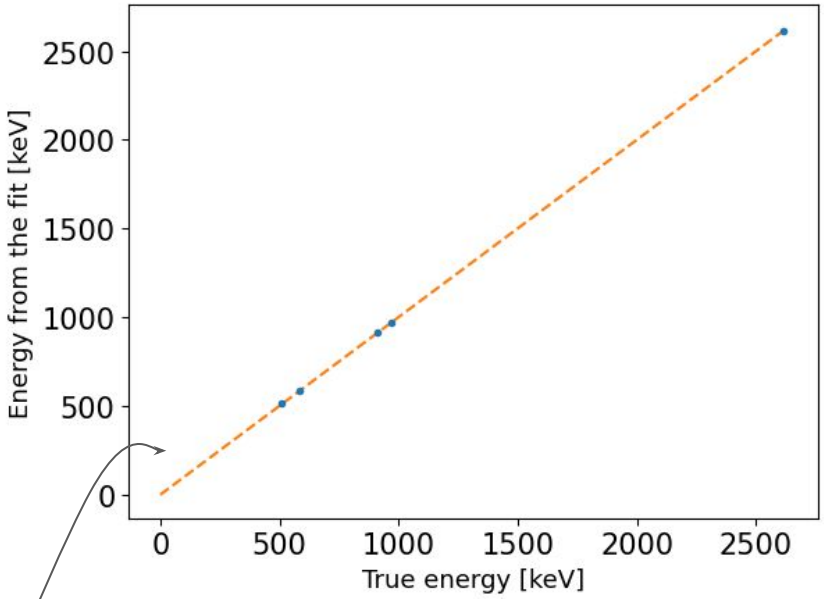
208Tl Full Energy Peak important because:

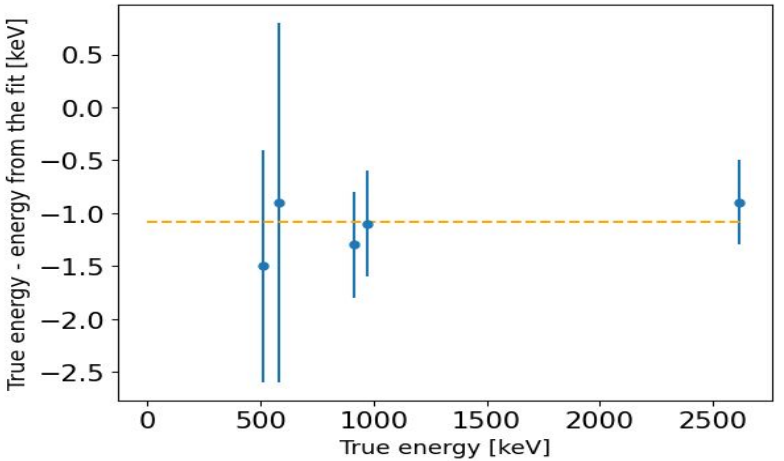
- Peak used to calibrate the spectra
- Energy close enough to the $Q_{\beta\beta}$



LMO1: FWHM & energy bias

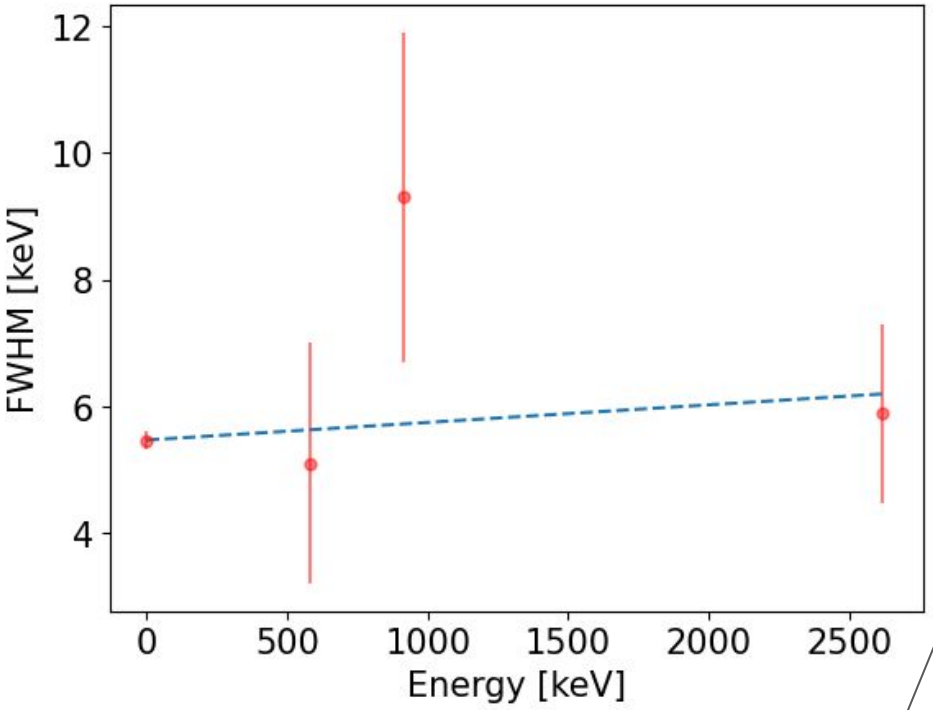


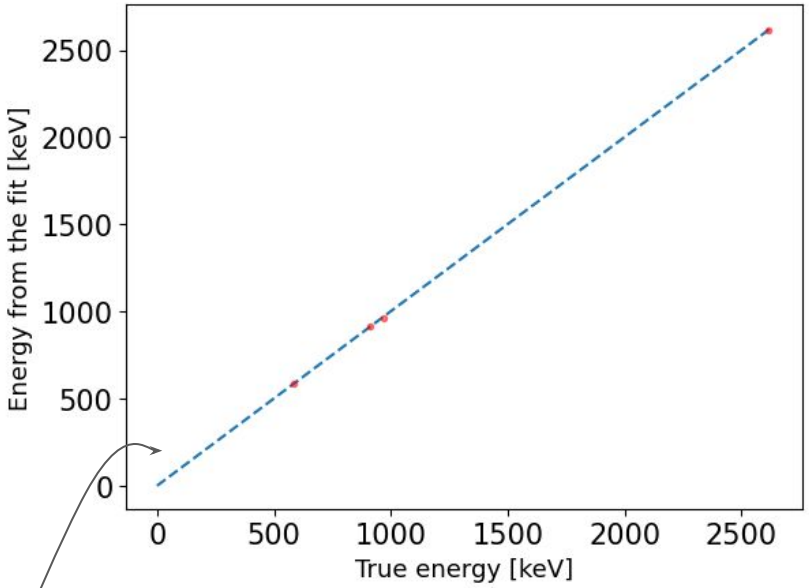


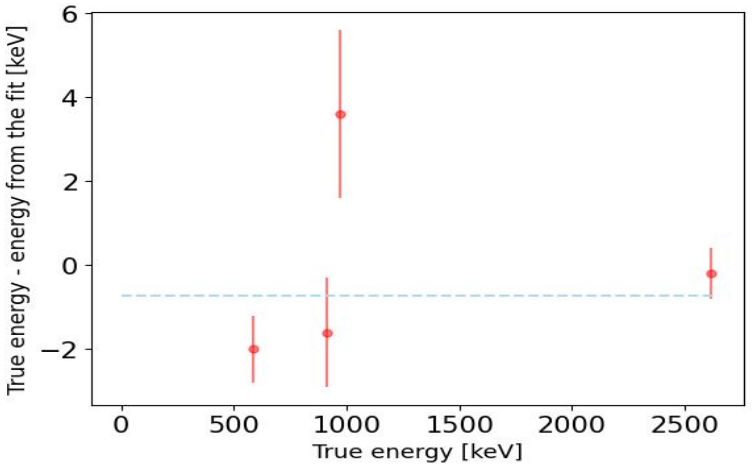


This curve will be used to correct the energy bias

LMO2: FWHM & energy bias







This curve will be used to correct the energy bias

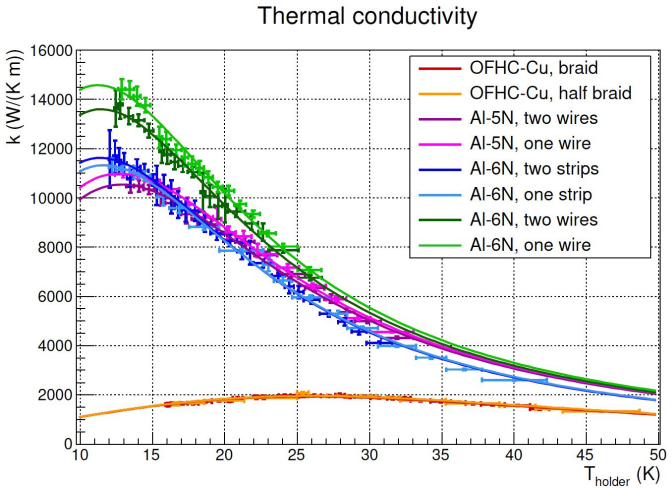
Study of aluminium thermalisations

The goal is to measure the thermal conductivity of aluminium-6N from 4 K to ~10 K with the Pulse Tube Cryocooler System in hall di montaggio.

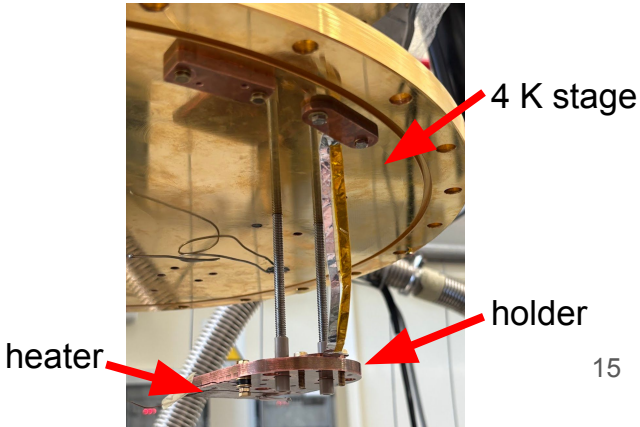
We crafted Al-6N strips as in the photo and mounted one of it in the cryostat, with one end attached to the 4 K stage and the other to the holder equipped with a heater.

Idea of the measurement:

1. Evaluate the thermal conductance (thermal conductivity+geometric factor) of the strip at different temperatures.
2. Cut one of the two substrips and measure the thermal conductance at different temperatures again → in this way, we decouple the contribution of boundary resistances.
3. Plus, by knowing the dimensions of the Al strip, we are able to estimate the intrinsic thermal conductivity of the Al-6N.

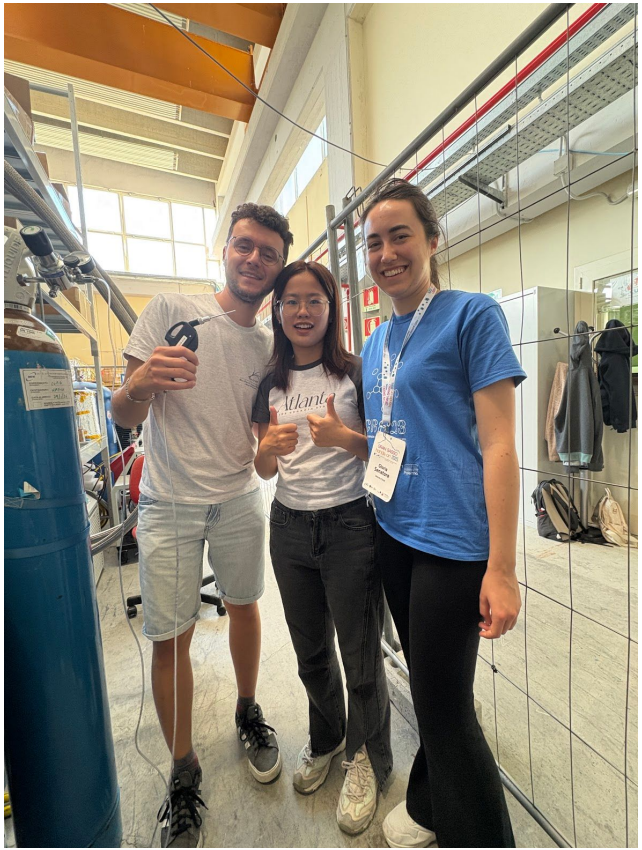


[2] "The role of marine microseisms in shaping the performance of CUORE and advancements for CUPID experiment" S. Quitadamo



Summary

1) First part:
    - We visited the underground cleanroom, dismounted two crystals under test to be used in CUPID
    - We evaluated the energy resolution & energy bias of the two detectors, and extracted the curves used to correct the energy bias
2) Second part:
    - We crafted the aluminium-6N thermalisations and mounted one of them in the cryostat in hall di montaggio with the goal of measure its thermal conductivity under 10 K → Problem with the cooling process 😭
    - We found a leak in the cryostat with the leak checker 😄
    - The project will continue with cooling down the cryostat and taking data to reconstruct the thermal conductivity curve under 10 K



THANKS!!!

BACKUP