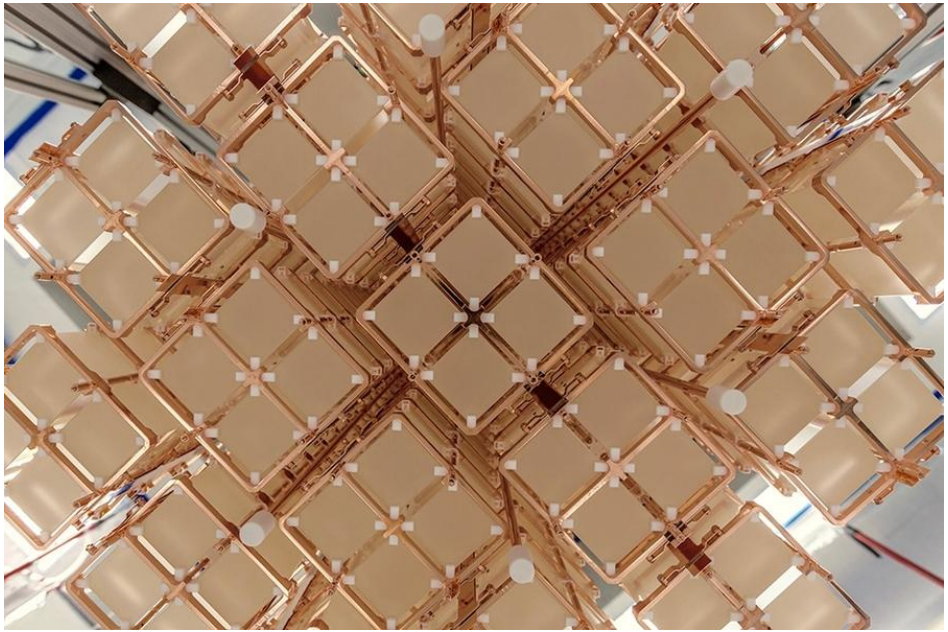
GSSI Astroparticle Physics Scientific Fair 2024



Searching for Majorana neutrinos with low temperature detectors

CUORE and CUPID experiments at Laboratori Nazionali del Gran Sasso

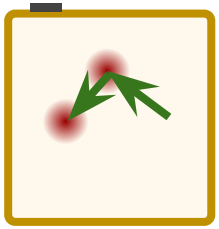
CUORE

CUPID

Simone Quitadamo

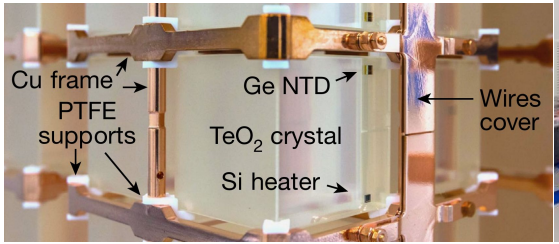
The CUORE and CUPID experiments

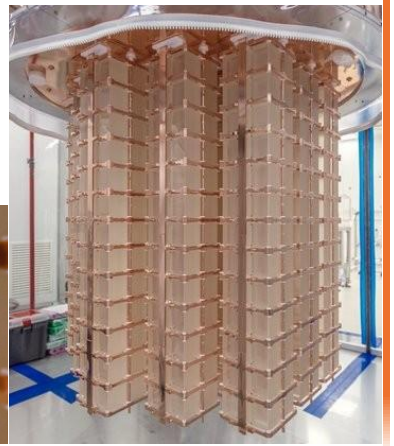
Cryogenic **U**nderground **O**bservatory for **R**are **E**vents



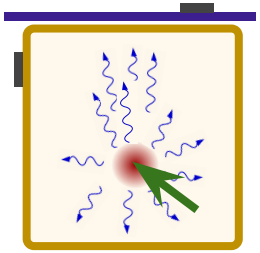
- CUORE: **988 TeO_2 crystals at ≃15 mK** read out by Ge-NTD thermistors.
- **Experiment running since 2017 at LNGS.**
- **Search for $0\nu\beta\beta$ decay in ^{130}Te.**

- First ton-scale experiment employing mK-scale detectors.
- Design Sensitivity: $T^{0\nu}_{1/2}(^{130}\text{Te}) = 9 \cdot 10^{25}$ yr **≃50 meV Majorana mass**.



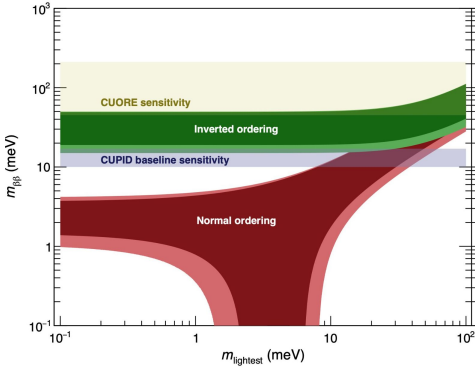


CUORE **U**pgrade with **P**article **ID**entification



- CUPID: **≃1600 $Li_2{}^{100}MoO_4$ crystals operated at ≃15 mK** read out by Ge-NTD coupled to **Ge light detectors**.
- Data-taking expected to start around 2030.

- **Combined heat+light read-out** to perform particle identification, achieving **99.99% α bkg discrimination.**
- Hosted in the upgraded CUORE cryogenic facility.
- Physics goal: $T^{0\nu}_{1/2}(^{100}\text{Mo}) \sim 1.4 \cdot 10^{27}$ yr **≃10 meV Majorana mass. Explore the entire inverted ordering** region of ν masses.

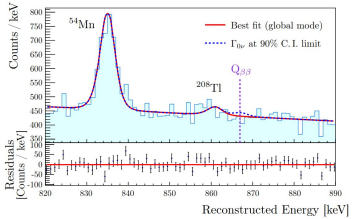


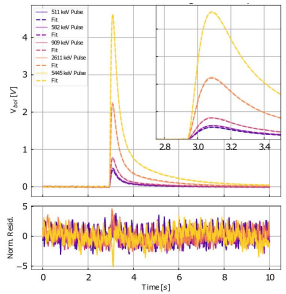
Ph.D. project opportunities

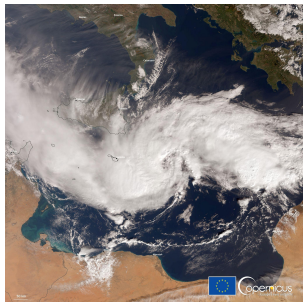
CUORE activities

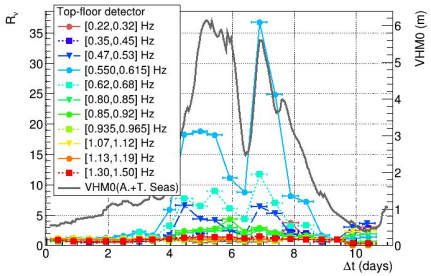
Data analysis

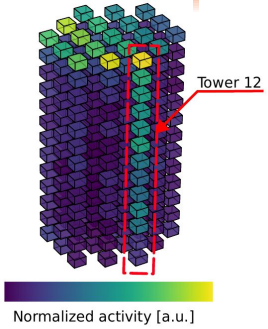
- ➔ ***Rare decays***
  $\beta\beta$ decays, on excited states, …
- ➔ ***Exotic processes***
  Dark Matter & axions,
  CPT violation, …
- ➔ ***Detector studies***
  sensitivity to marine microseisms,
  background model,
  thermal mode, …











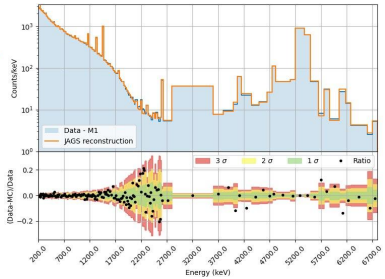
CUPID activities

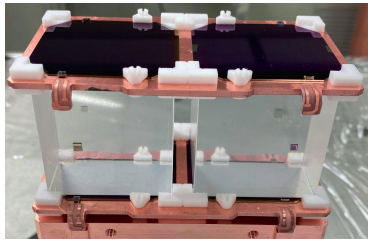
R&D

- **Full-tower CUPID demonstrator;**
- Finalize detectors geometry and assess detectors performance;
- Development of **cryogenic technologies** (thermal switches, material conductance studies, …).

Software

- **Background studies** and projections with MC simulations;
- **Neural network** for pile-up rejection.





The CUORE - CUPID group @ LNGS

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