Double beta decay results from the CUPID-0 experiment

Emanuela Celi, Gran Sasso Science Institute on behalf of CUPID-0 collaboration
Scintillating cryogenic calorimeters

Scintillating calorimeters operating at ~10 mK → double read-out via heat & light.
- **Source = detector** → high efficiency;
- Excellent **energy resolution** (<1%);
- Modular design → **large scalability**;
- Possibility to study **different isotopes**;
- \( \text{LY}_\alpha \neq \text{LY}_\beta \) and shape parameters allow **Particle identification**;

**Excellent technology to search for Neutrinoless Double Beta Decay**

See F.Ferroni’s talk ([link](#))
The CUPID project

- Next generation ton-scale experiment based on enriched Li$_{2}^{100}$MoO$_{4}$ scintillating crystals (arXiv:1907.09376);
- $Q_{\beta\beta}^{(100}Mo) = 3034$ keV;
- Target background $\sim 10^{-4}$ counts/keV/kg/y;
- Expected to cover the entire inverted mass hierarchy of neutrino mass;

- Pathfinder experiments:
  - CUPID-o $\rightarrow$ enriched Zn$^{82}$Se crystals;
  - CUPID-Mo $\rightarrow$ enriched Li$_{2}^{100}$MoO$_{4}$ crystals;
    See P.Loaiza’s talk (link)

Cuore Upgrade with Particle IDentification

See A.Giuliani’s talk (link)
The CUPID-0 experiment

- Located at LNGS;
- 24 ZnSe crystals enriched at >95% of \(^{82}\text{Se}\) + 2 natural ones;
- \(Q_{\beta\beta}^{(82\text{Se})} = (2997.9 \pm 0.3) \text{ keV} \) → low background region;
- 31 Ge Light detectors;
- GeNTD thermistors as temperature sensors;
- Reflective foils to increase light collection;
- Total mass: **10.5 kg ZnSe**;
Phase I results

- Most stringent limit on $^{82}\text{Se }\nu\bar{\nu}\beta\beta$ half-life $T_{1/2}^{0\nu} > 3.5 \times 10^{24}\text{y} (90\% \text{ C.I. limit})$;
- Comprehension of the background in experiments based on scintillating calorimeters;
- Most precise measurement of $^{82}\text{Se }2\nu\beta\beta$ half-life: $T_{1/2}^{2\nu} = [8.60 \pm 0.03 (\text{stat})_{+0.19}^{0.13} (\text{syst})] \times 10^{19}\text{yr}$.
CUPID-0 phase II

Upgrade

• Removal of reflecting foils → tag surface contaminations;

• Muon veto surrounding cryostat → confirm the Background Model result;

• Internal copper shield → improve the background at low energy;

Phase I spectrum normalized to Phase II exposure.
No delayed coincidence applied.

Effect of the 10 mK shield and 
65Zn decay at low energy.
54Mn from cosmogenic activation of copper (10 mK).
60Co peaks (TBC)
Thanks for the attention!