The CUPID-Mo experiment

- A cryogenic calorimetric search for 0νββ in 100Mo at the Laboratoire Souterrain de Modane (France)
- 20 Detector modules with scintillating ~210 g Li2MoO4 crystals and associated light detectors (LD)
  - (97.0 ± 0.2)% enriched in 100Mo
  - NTD-Ge sensors on both the LD and Li2MoO4 crystal
- High Q-Value: Qbb = 3034.4 keV
- Efficient α discrimination better than 1:1000 through relative scintillation light yield [EPJ-C 80, 44, (2020)]

Example of α discrimination for a detector after 200 days of physics data from March 2019 – April 2020; the LD is cross-calibrated against the Li2MoO4 energy scale for β/g events. α’s emit only ~20% of light, compared to β/γ.

Unblinding – A new leading limit on the 0νββ decay T1/2 of 100Mo

Zero events in 0νββ signal region with > 0.5 yr of physics data and 4 kg of Li2100MoO4

World leading limit on 0νββ of 100Mo: \[ T_{1/2} > 1.4 \times 10^{24} \text{ yr}, \text{ 90\% c.i.} \]

m_{\nu\nu} < \{0.31 – 0.54\} eV, 90\% c.i. dependent on the nuclear matrix element

Important step in demonstration of the detector technology for CUPID

Individual 208Tl resolutions

- Perform a simultaneous unbinned extended maximum likelihood fit to the 2615 keV peak in U/Th calibration data to extract Channel, Dataset based resolutions

Resolution scaling

- Estimate a global resolution scaling factor to relate the 2615 keV U/Th calibration resolution to the resolution at the Q-value in physics data

Energy scale bias

- Estimate a global energy scale bias from the position of gamma peaks in physics data versus Literature
- Check consistency in time through calibration data

Limit setting

- Perform Bayesian counting analysis in signal ROI and side-bands of the 0νββ analysis region
- Exposure weighted mean of 0νββ selection efficiency (containment & analysis efficiency): 65% 
- Uncertainties in isotopic fraction, containment, & efficiency included as nuisance parameters on global and DS level

ROI selection for 0νββ

- Optimize Channel-Dataset based ROI in S/B Likelihood space, maximizing the mean limit setting sensitivity for a final exposure of 2.8 kg x yr
- Take into account energy scale uncertainties in ROI

The blinded data

- 2.17 kg x yr physics data analyzed so far, 19/20 detectors selected for the analysis
- Analysis eff. ε = (90.5 ± 0.4 (stat.) ± 0.2 (syst.)) %

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