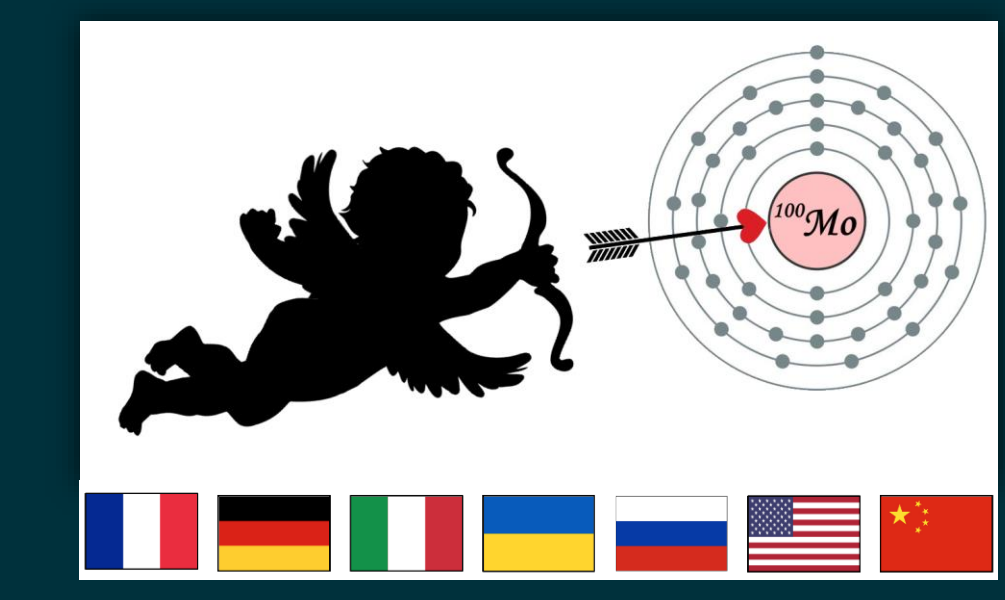


New limit from the search for $0\nu\beta\beta$ -decay of ^{100}Mo with the CUPID-Mo experiment



CUPID-Mo at Neutrino 2020, see also Posters:
#374 M. Zarytsky, #382 T. Dixon, #404 D. Poda, #418 P. Loaiza, #448 B. Welliver, #525 V. Singh

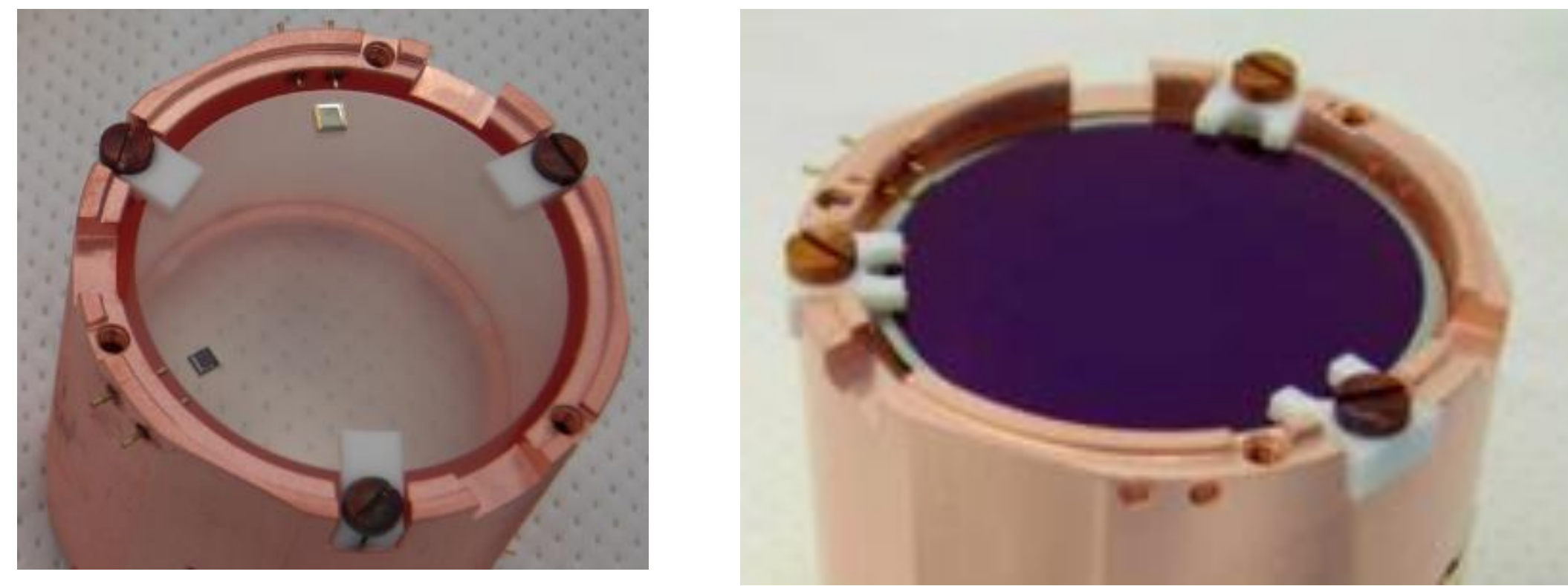
B. Schmidt on behalf of the CUPID-Mo collaboration
Lawrence Berkeley National Laboratory, Berkeley, USA - beschmidt@lbl.gov

http://cupid-mo.mit.edu
7 countries, 15 institutions,
110 scientists

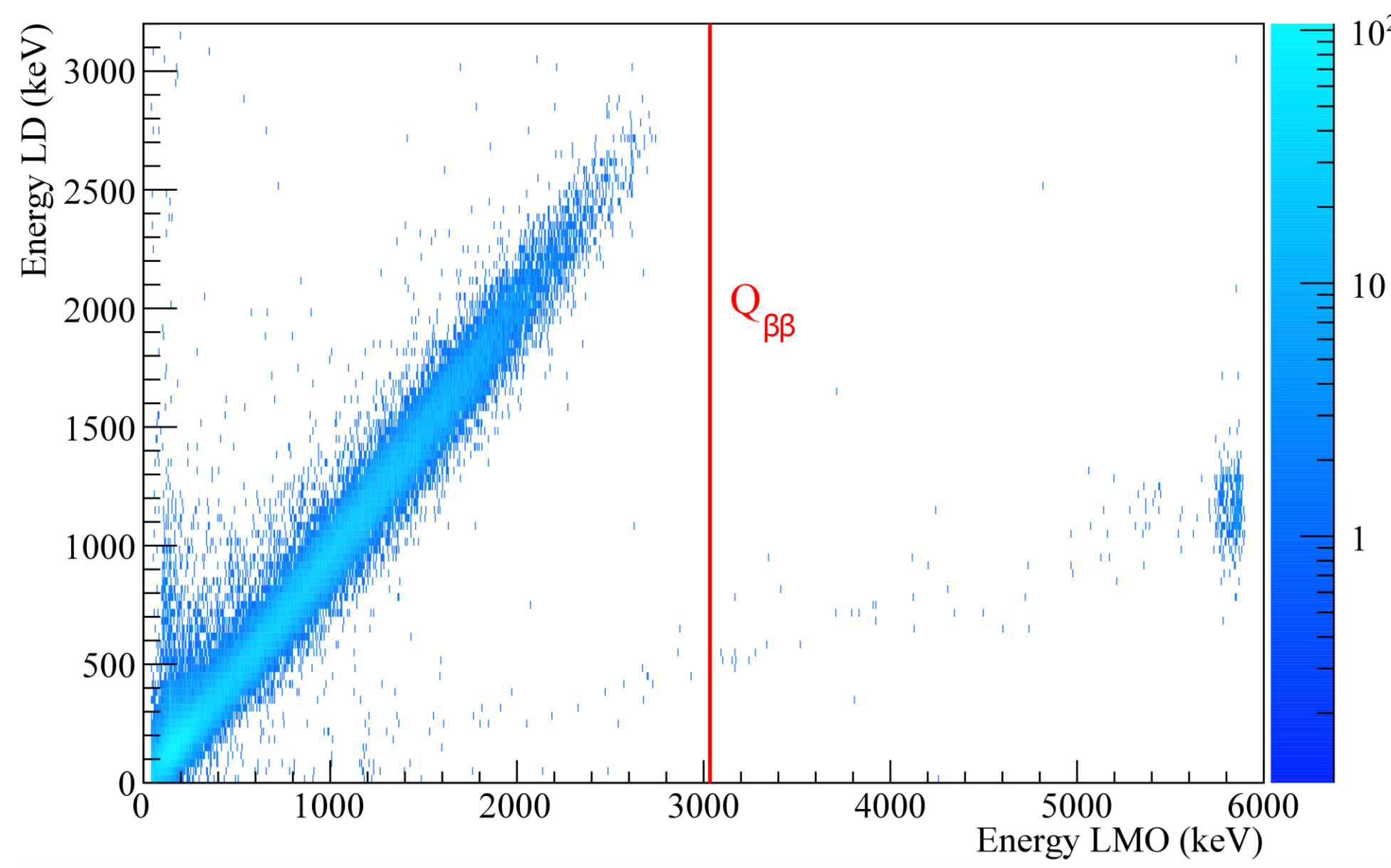
Poster #419

The CUPID-Mo experiment

- A cryogenic calorimetric search for $0\nu\beta\beta$ in ^{100}Mo at the Laboratoire Souterrain de Modane (France)
- 20 Detector modules with scintillating ~ 210 g Li_2MoO_4 crystals and associated light detectors (LD)
- (97.0 ± 0.2)% enriched in ^{100}Mo
- NTD-Ge sensors on both the LD and Li_2MoO_4 crystal

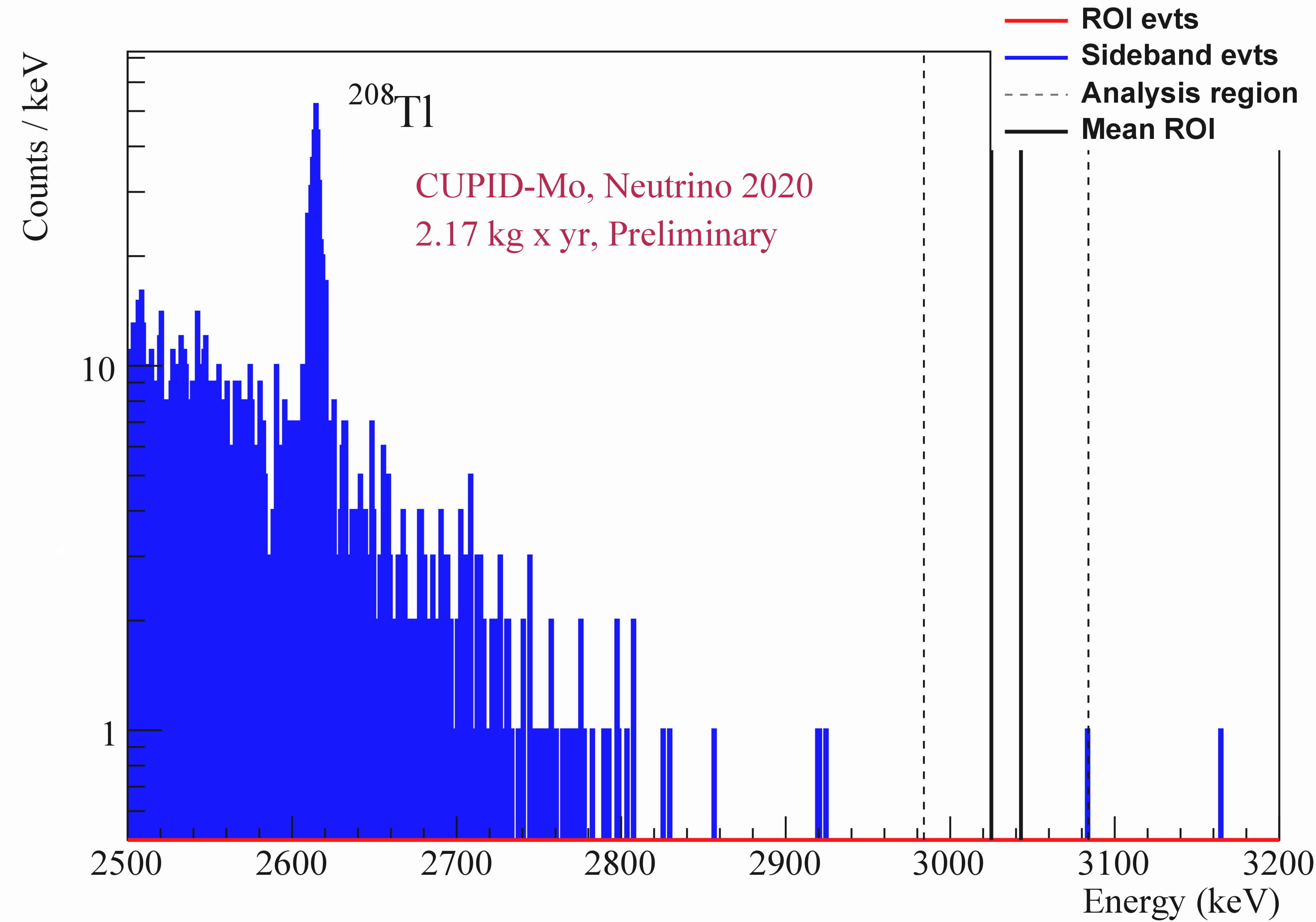


- High Q-Value: $Q_{\beta\beta} = 3034.4$ keV
- Efficient α discrimination better than 1:1000 through relative scintillation light yield [EPJ-C 80, 44, (2020)]



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 Li_2MoO_4 energy scale for β/γ events. α 's emit only $\sim 20\%$ of light, compared to β/γ .

Unblinding – A new leading limit on the $0\nu\beta\beta$ decay $T_{1/2}$ of ^{100}Mo



Zero events in $0\nu\beta\beta$ signal region with > 0.5 yr of physics data and 4 kg of $\text{Li}_2^{100}\text{MoO}_4$

One event in sideband of the Bayesian Counting Analysis

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

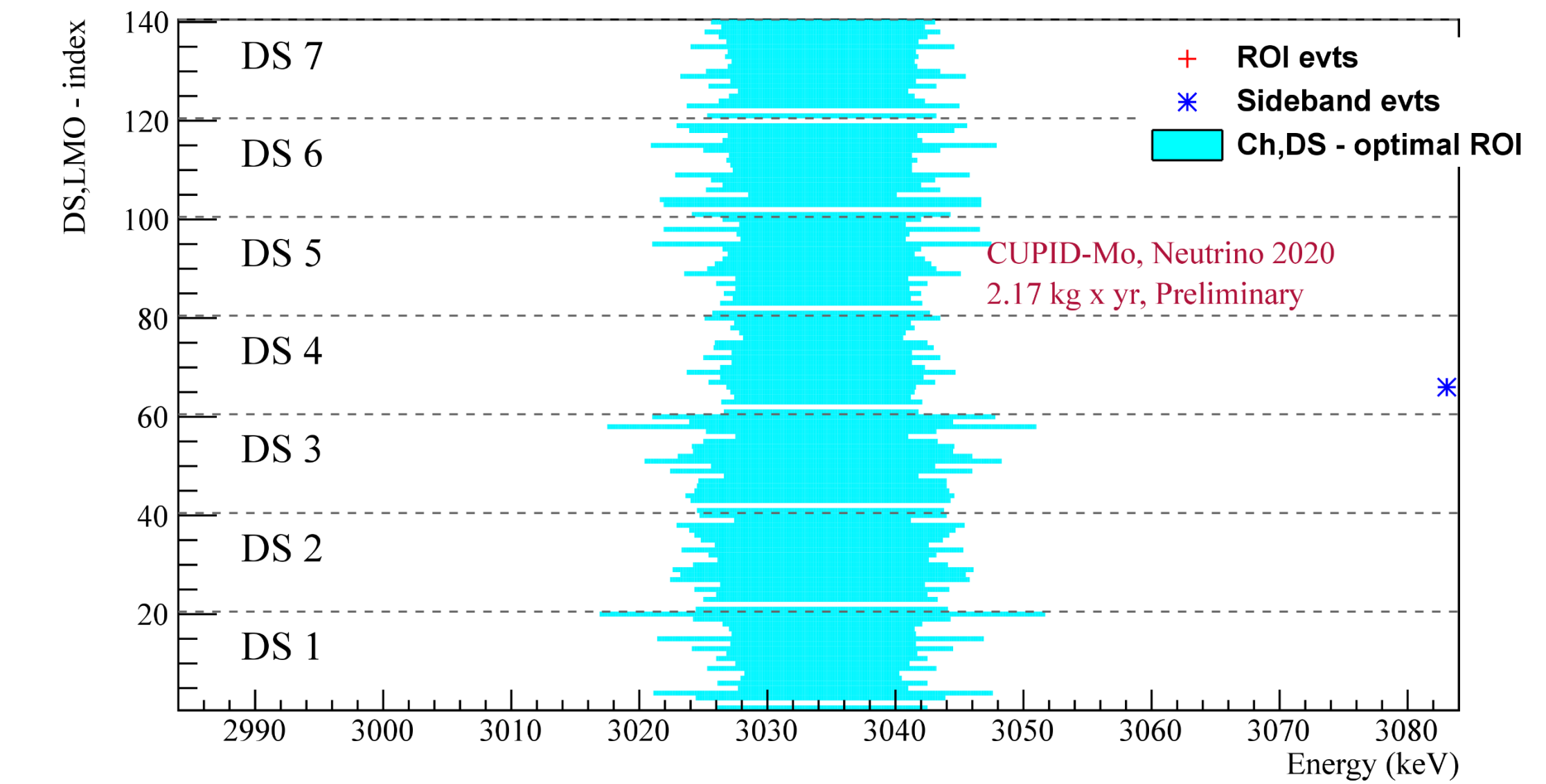
$m_{\beta\beta} < [0.31 - 0.54]$ eV, 90% c.i. dependent on the nuclear matrix element

Important step in demonstration of the detector technology for CUPID

Preliminary

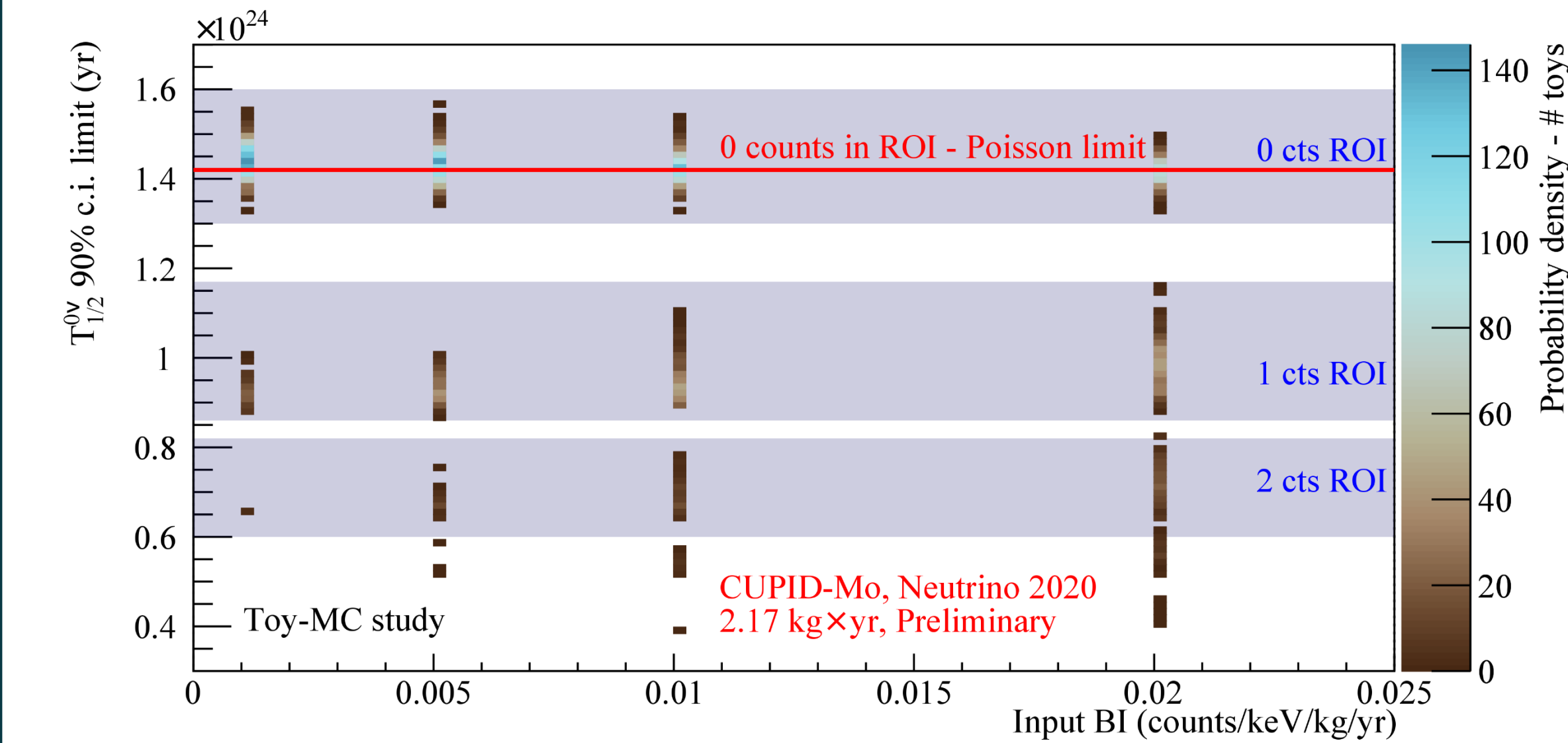
ROI selection for $0\nu\beta\beta$

- 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



Limit setting

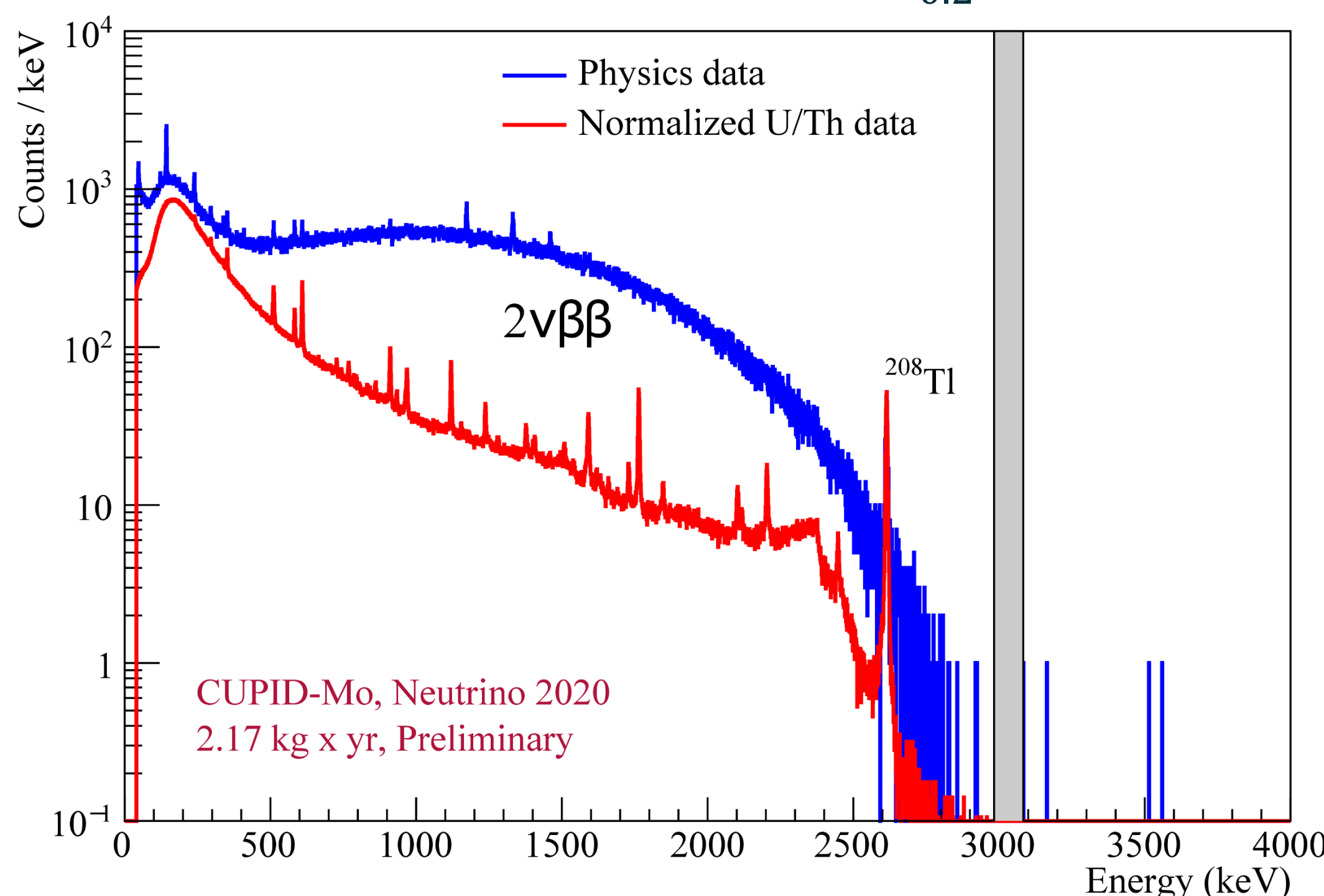
- Perform Bayesian counting analysis in signal ROI and side-bands of the $0\nu\beta\beta$ analysis region
- Exposure weighted mean of $0\nu\beta\beta$ selection efficiency (containment & analysis efficiency): 65%



- Uncertainties in isotopic fraction, containment, & efficiency included as nuisance parameters on global and DS level

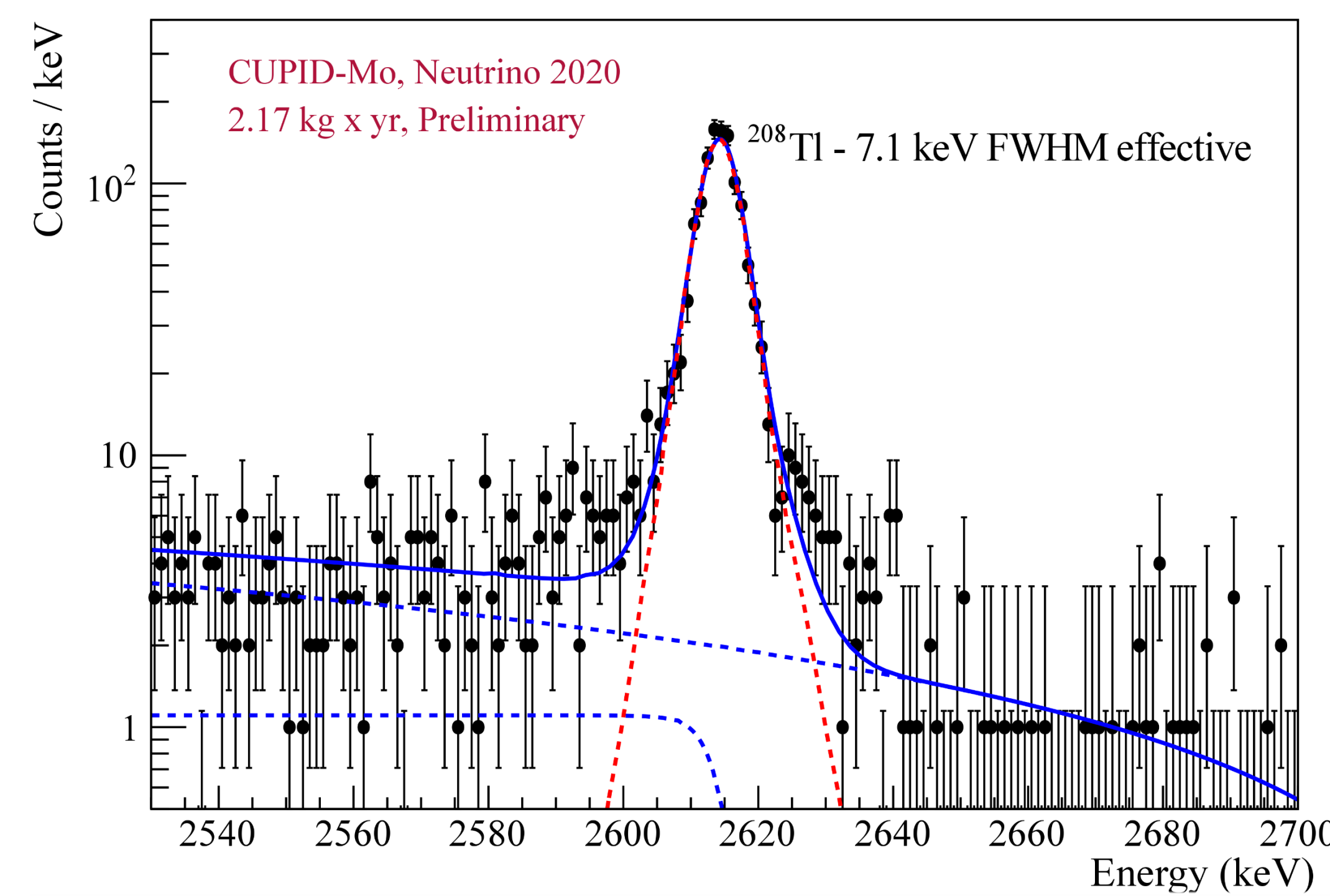
The blinded data

- 2.17 kg x yr physics data analyzed so far, 19/20 detectors selected for the analysis
- Analysis eff. $\epsilon = (90.5 \pm 0.4 \text{ (stat.)}^{+0.9}_{-0.2} \text{ (syst.)}) \%$



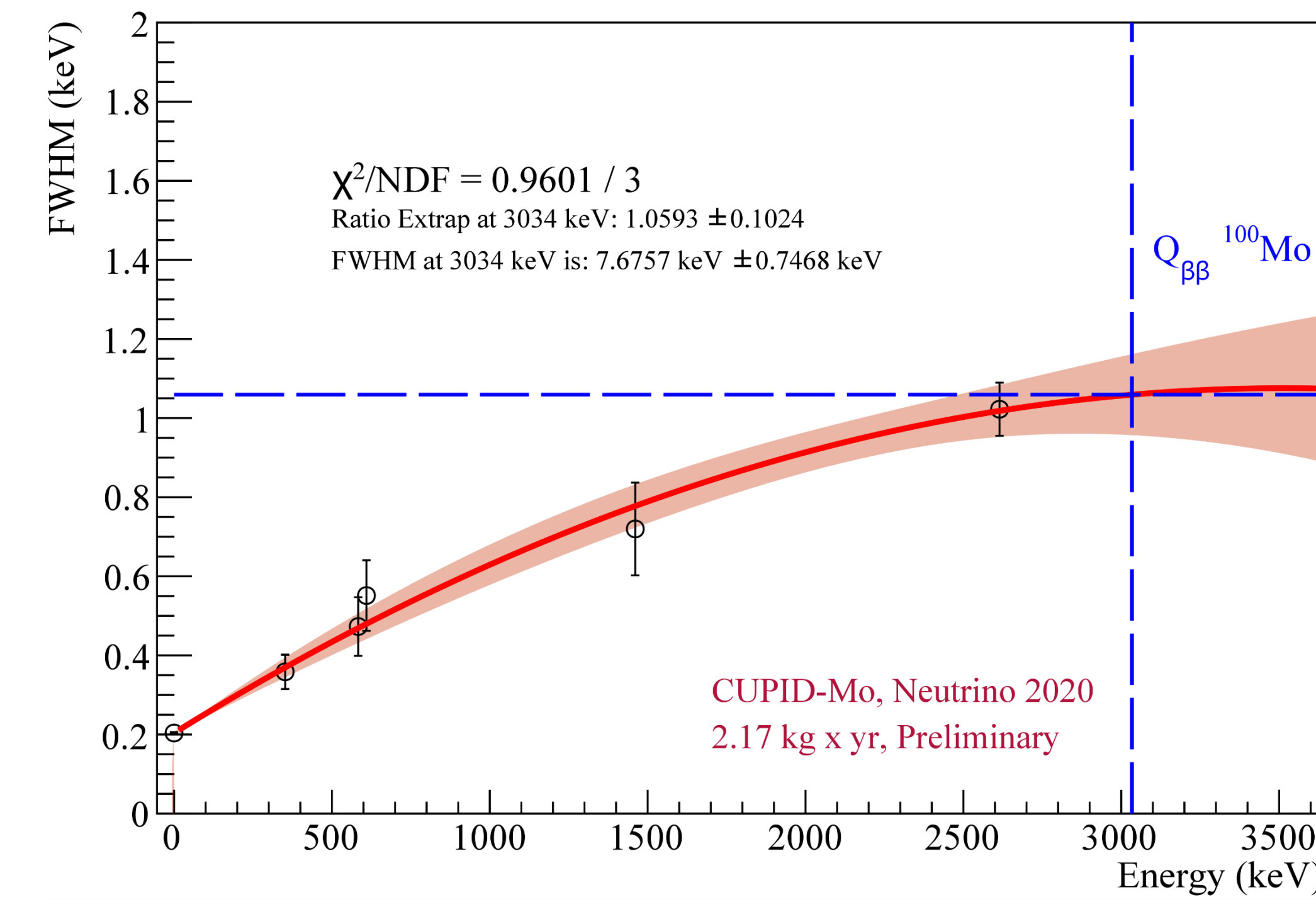
Individual ^{208}Tl resolutions

- 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

