

Monte Carlo simulation of the CUPID array

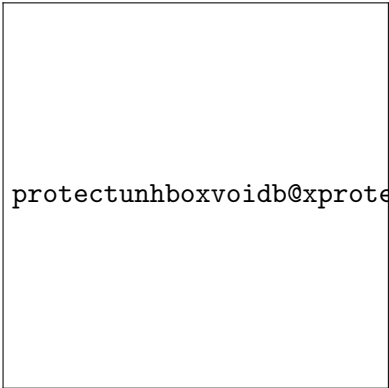
Joe Camilleri

DNP October 2021

jcamilleri@vt.edu

September 30, 2021

- Proposed $0\nu\beta\beta$ search using bolometric array of 1596 lithium molybdate crystals, deployed in the CUORE¹ cryostat.
- Aims to eliminate dominant background of alpha particles present in CUORE.

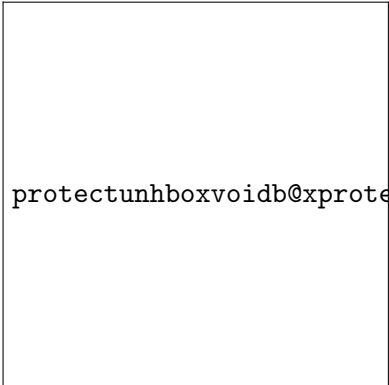


protectunhboxvoidb@xprotect

Figure: rendering of proposed CUPID array of Li_2MoO_4 crystals

¹Clarke and Braginski 2004.

- Li_2MoO_4 crystals allow for discrimination of α backgrounds from $\beta\beta$ events ($Q=3034\text{keV}$) via high-light yield scintillation signals.
- relatively high isotopic abundance of ^{100}Mo (10%)
- enrichment above 95% already demonstrated in CUPID-Mo



protectunhboxvoidb@xprotect.

Figure: CUPID bolometer and rejection scheme

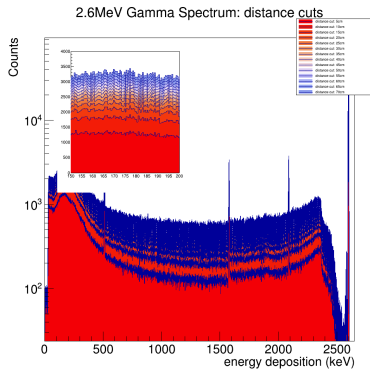
- With respect to coincidences, the rate of $2\nu\beta\beta$ events is not negligible in CUPID array (calculate this)
- Minimizing the distance cut helps avoid mis-labelling random $2\nu\beta\beta$ coincidences as multiplicity 2.
- Assuming a simple muon veto geometry, increasing the distance cut rejects more muon events.

protectunhboxvoidb@xprotect

distance cut in the CUPID array

CUPID

- events within a trigger time window that are also within the specified distance cut are rejected
- man
- dude

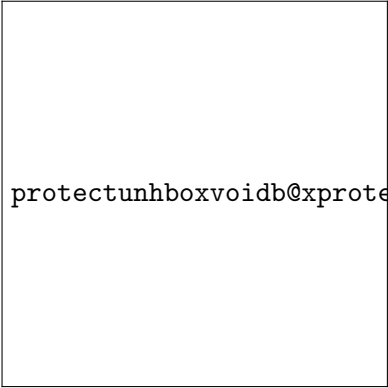


gnarly

integration time in the CUPID array

CUPID

- guy
- man
- dude



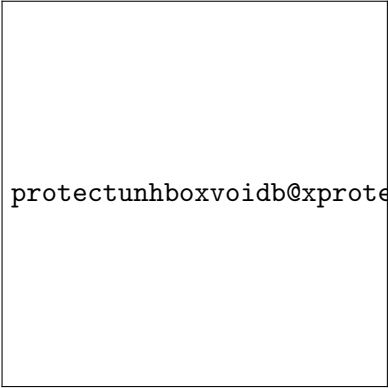
protectunhboxvoidb@xprotect.

Figure: gnarly

$2\nu\beta\beta$ efficiency and the muon background

CUPID

- guy
- man
- dude



protectunhboxvoidb@xprotect.

Figure: gnarly