BINGO

Bi-Isotope 0νββ Next-Generation Observatory

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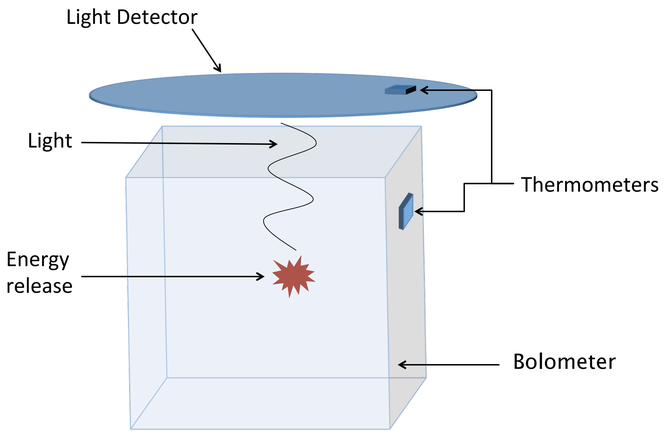
Neutrinoless double beta decay - 0νββ - search with cryogenic calorimeters

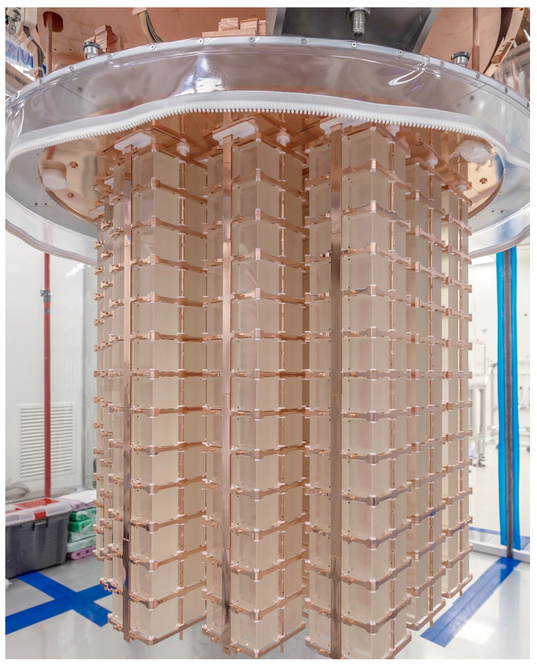


Motivation for *0νββ search*:

- Physics beyond the standard model
- Lepton number violating process
- Sensitive to neutrino mass and nature (Majorana/Dirac)

Advantages of cryogenic calorimeters:

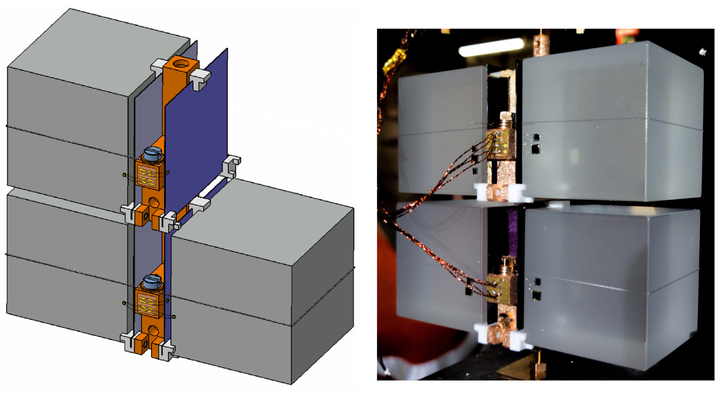
- Compatible with many candidate isotopes (^{100}Mo, ^{130}Te as most advanced – CUORE [1]/CUPID [2])
- Very good energy resolution (‰ – level at $Q_{\beta\beta}$)
- Source = Detector -> High efficiency
- Good background control and understanding



CUORE [1], the largest presently operating cryogenic calorimetric 0νββ search with 988 TeO_2 detectors

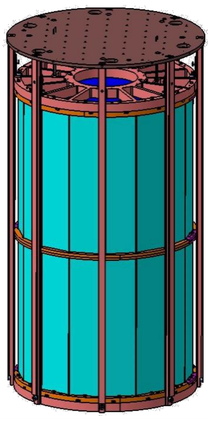
The three BINGO innovations

Novel detector assembly



An innovative detector holder:
Light detectors in-between Li_2MoO_4 detector and copper structure -> Strong reduction of background from β's from surfaces

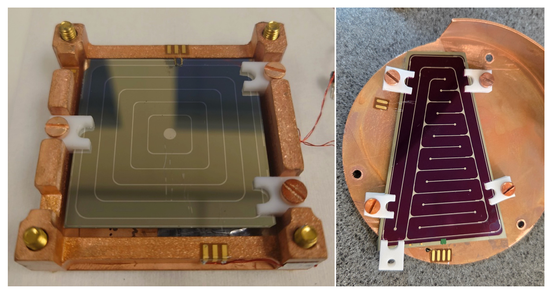
Active cryogenic veto



Active high density/radiopurity shield at 10 mK
For BINGO BGO scintillators, read out with NTL assisted light detectors

Goal: Suppress background from high energy γ's in particular ^{208}Tl decay and tagging of multi-Compton events

Neganov-Trofimov-Luke assisted light detectors



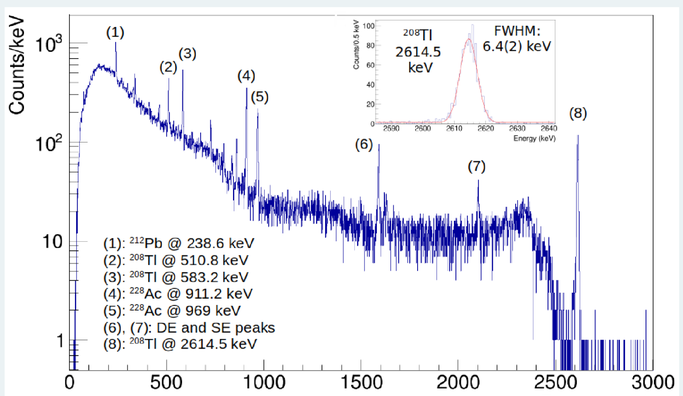
See also P. 474 (A. Armatol)

Provide sufficient Signal-Noise-Ratio for α/β discrimination in TeO_2 and pile-up rejection for 2νββ from ^{100}Mo
Developed for CROSS [3] & BINGO [4] from [5]
Adopted in CUPID [2]

Prototype results & Status at the Laboratoire Souterrain de Modane

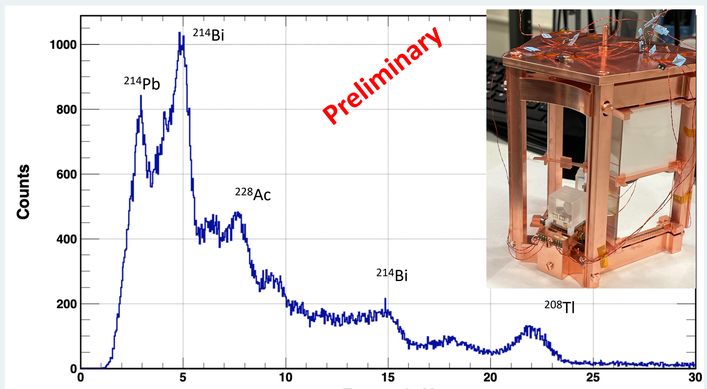
Detector prototypes operated at Orsay & LSC.

- 6.4(2) keV FWHM at 2615 keV
- Noise power spectrum equivalent to reference detectors



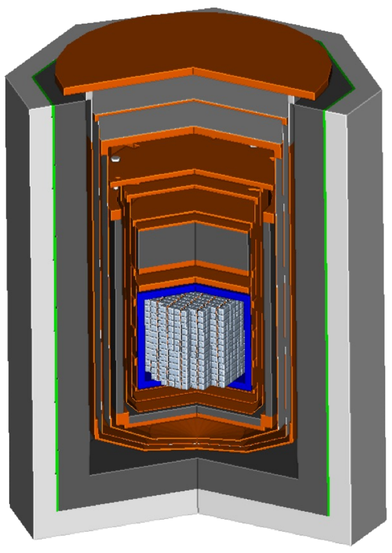
BGO veto prototypes operated at Orsay

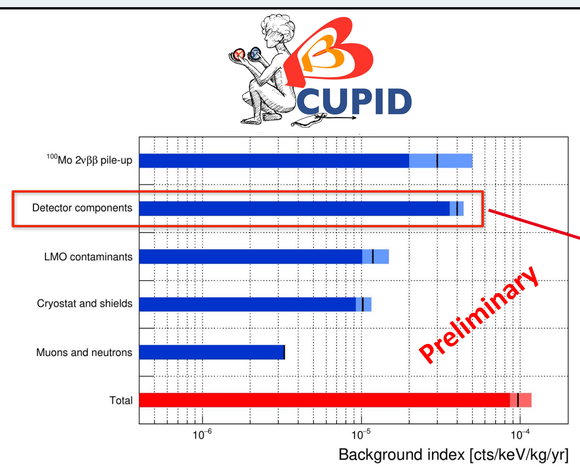
- Ongoing optimization of light yield & structure
- Preliminary light yield: ~8 keV/MeV
- LD Baseline resolution: O (100 eV)
- Next: Test with NTL assisted trapezoidal light detectors



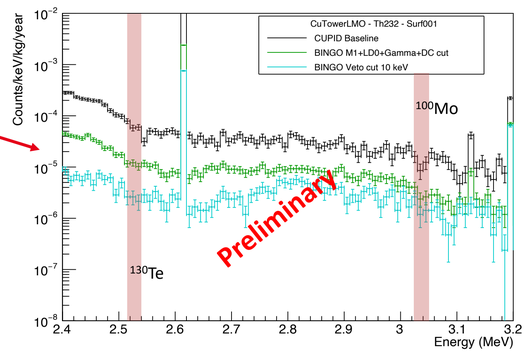
New cryostat installation at LSM – 04/2024

Scaling up





Background index targets:
CUORE: 10^{-2} counts/keV/kg/yr
CUPID: 10^{-4} counts/keV/kg/yr
BINGO: < 10^{-5} counts/keV/kg/yr



BINGO Geant4 simulation in CUORE shielding (copper surface) – O(x 10) improvement from surface contaminations possible

Related literature

[1] CUORE:
Progr. Part. and Nucl. Phys., 122, 103902 (2022)
Nature 604 (7904), 53-58 (2022)
arXiv:2404.04453 (2024)
[2] CUPID:
JINST 18 (06), P06018 & P06033 (2023)
EPJ-C 82 (9), 810 (2022)
arXiv:2203.08386 (2022)
arXiv:1907.09376 (2019)
[3] CROSS:
J. High Energ. Phys. 2020:18 (2020)
[4] BINGO:
EPJ Web of Conferences **290**, 04002 (2023)
arXiv:2402.12262 (2024)
[5] NTL assisted light detectors:
NIM A 940, 320-327, (2019)

See talk by C. Bucci and many posters
See P. 376, 501, 474 (Tuesday)
See P. 572, 206 (Thursday)
See P. 388, 343 (Tuesday)
See P. 474

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