2022/06/14

Status of Neutrinoless Double Beta Decay Experiments

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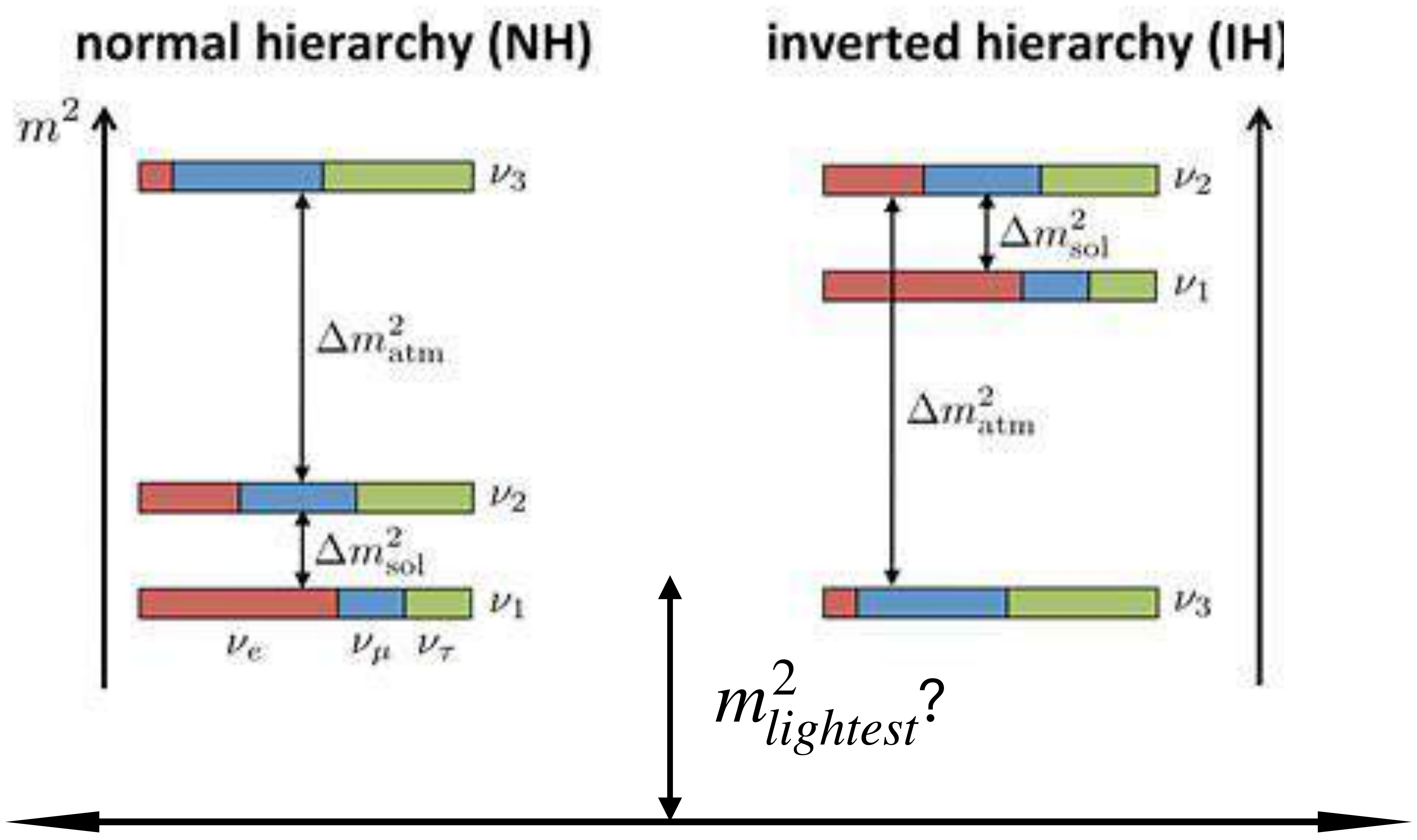
IUPAP Nuclear Symposium

Neutrino Masses & Ordering

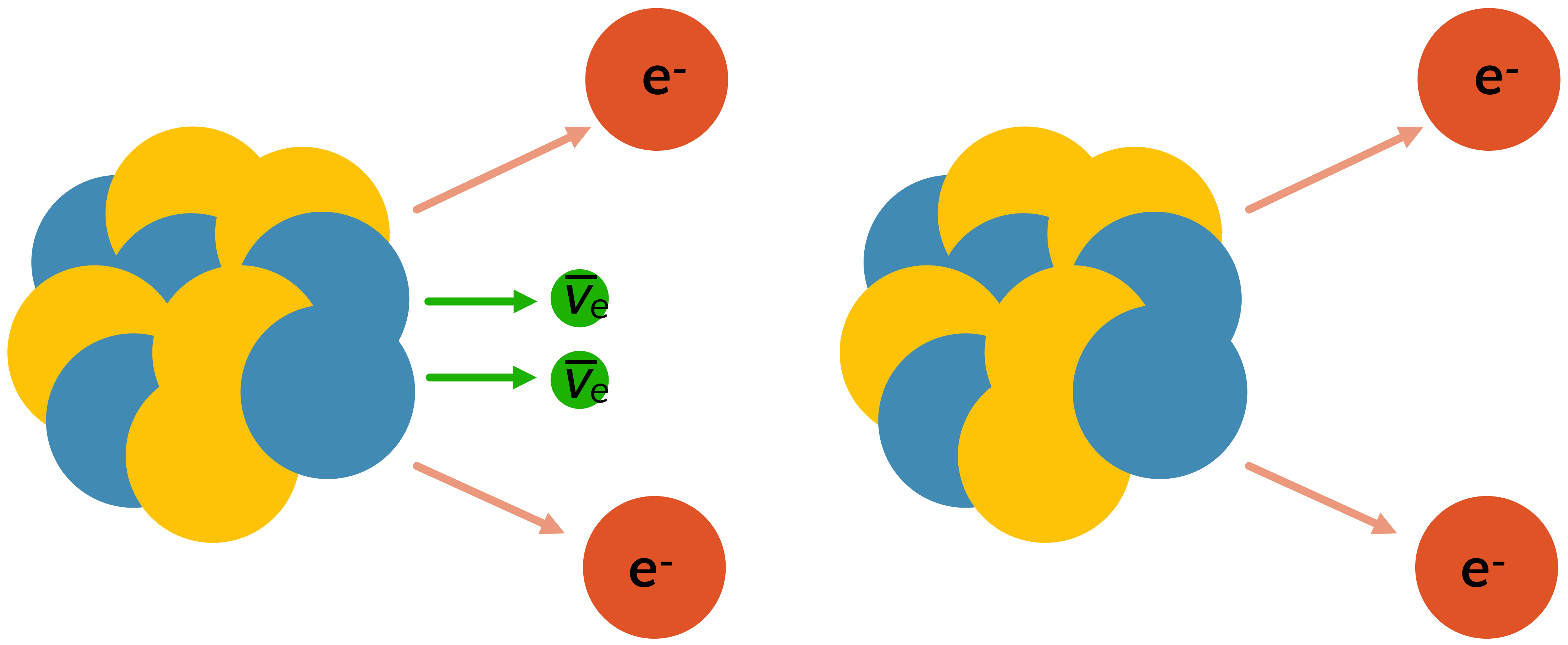
- Neutrinos are colourless, chargeless, weakly interacting fermions
- Neutrinos have distinct mass and flavour eigenstates
- Oscillation experiments have determined the mass splittings
- But the mass scale and mass ordering is yet unknown

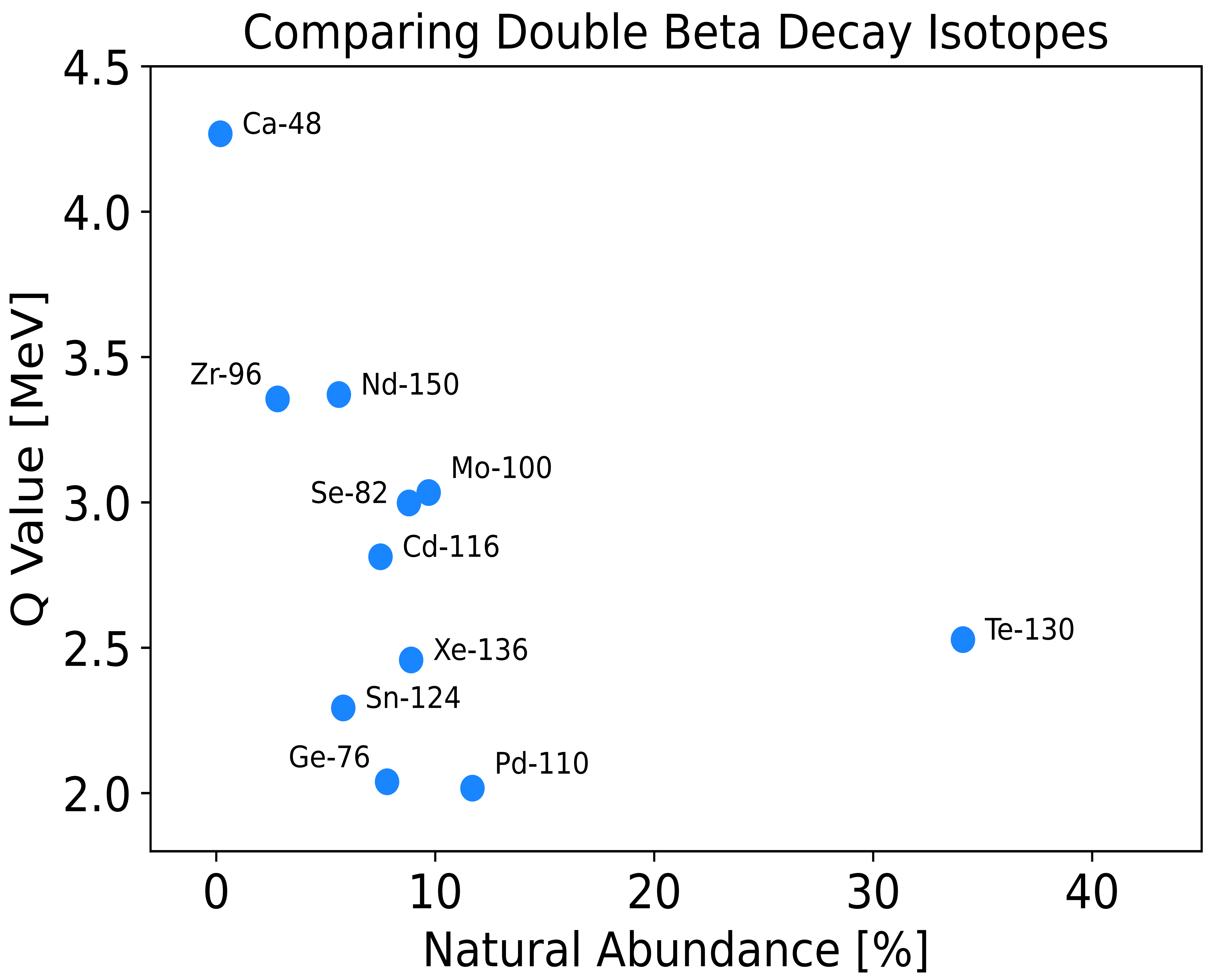


Double Beta Decay

- Rare Nuclear Process
- Available to even-even isotopes where single beta decay is energetically-forbidden

- If neutrino is a Majorana fermion, then those isotopes could undergo neutrino-less double beta decay (0νββ)

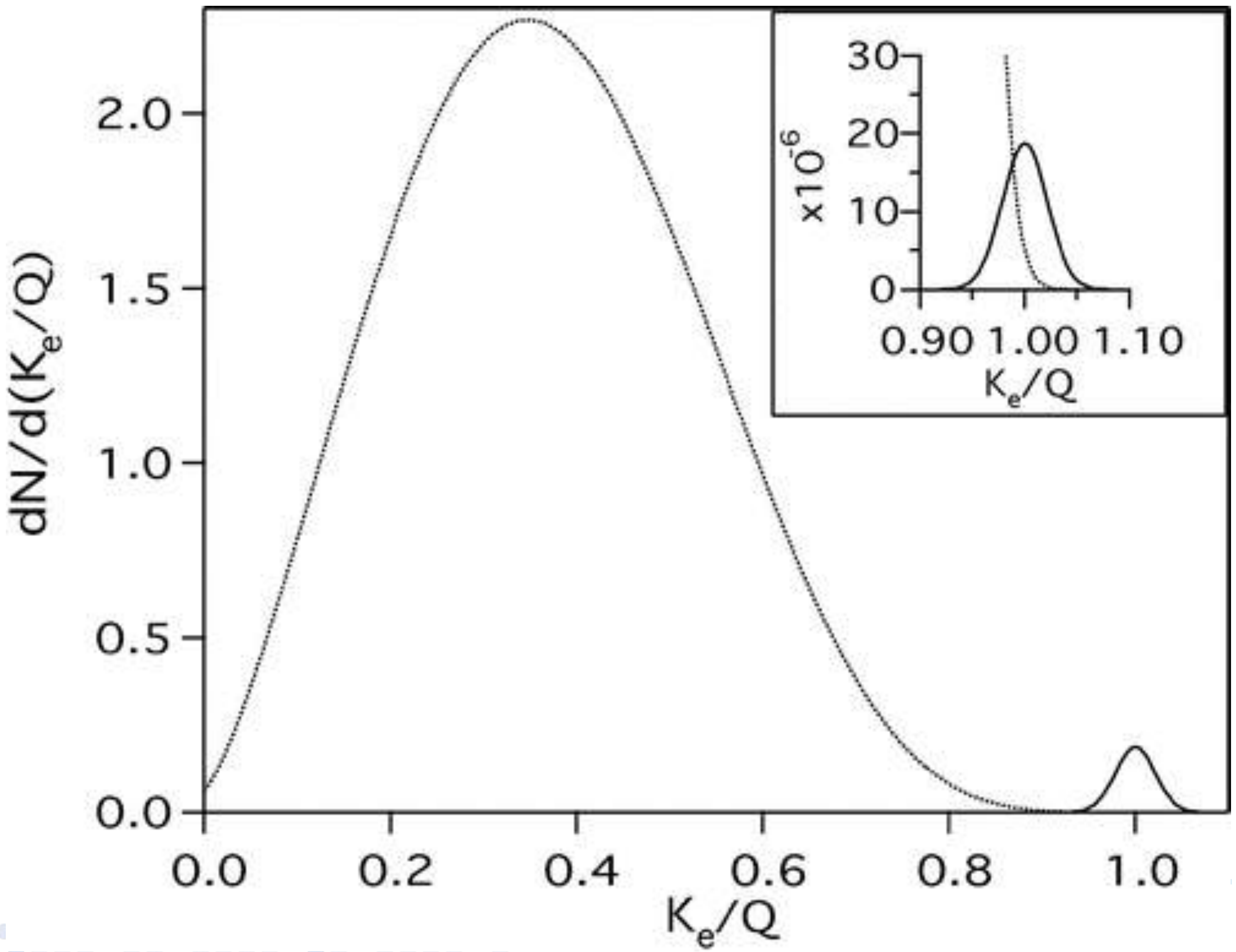




IUPAP Neutrino Panel Report § 5.3

Double Beta Decay

- Key experimental signature for 0νββ is a peak in visible energy at the Q-value of the nucleus, smeared by detector resolution.
- Experiments are designed to minimize backgrounds around the Q-value.

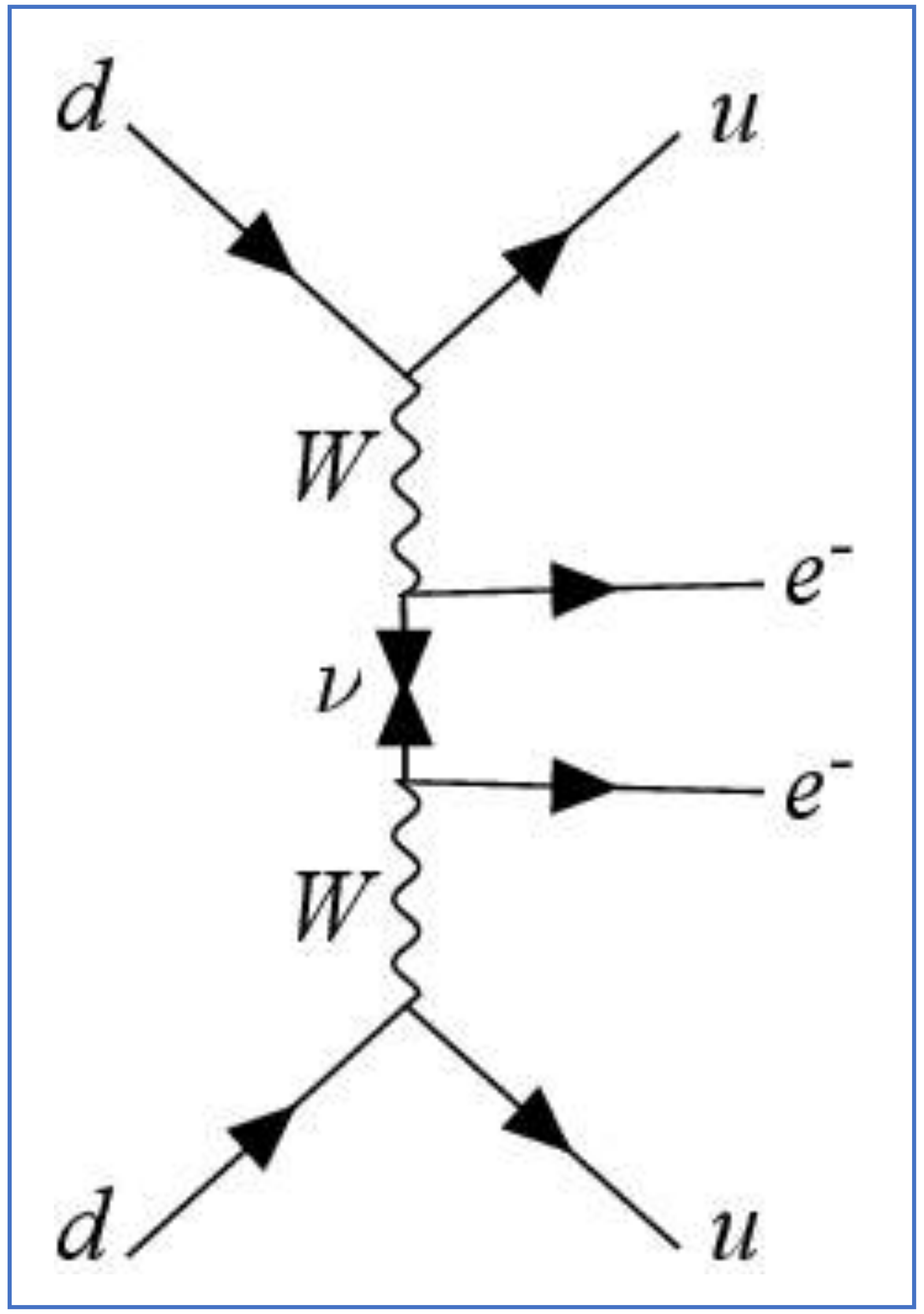


Neutrinoless Double Beta Decay

- There is no scenario in which observing 0νββ decay would not be a great discovery:
  - Majorana neutrinos
  - Lepton number violation
  - Probe new mass mechanism up to the GUT scale
  - Probe key ingredients in generating cosmic baryon asymmetry

$$(T^{0\nu}_{1/2})^{-1} = \frac{\langle m_{\beta\beta}\rangle^2}{m_e^2} G^{0\nu} g_A^4 |M^{o\nu}|^2$$

- The connection with the effective ν mass also means that the observation of 0νββ decay can provide information on the ν mass scale, provided that:
  - The mechanism producing the decay is understood
  - The nuclear matrix element is calculated with sufficiently small uncertainty



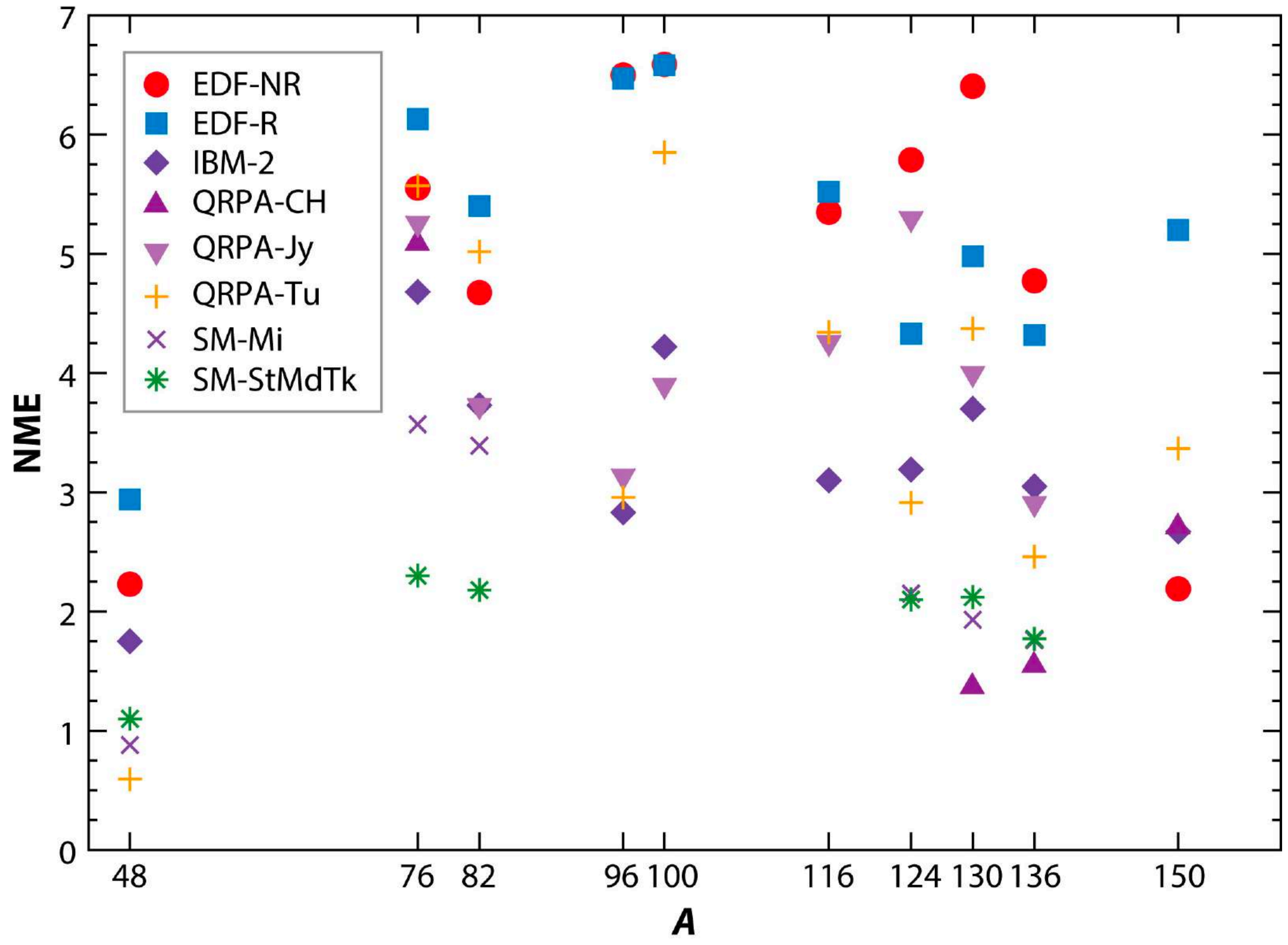
IUPAP Neutrino Panel Report § 5.3

Neutrinoless Double Beta Decay

- Significant theoretical uncertainty in NMEs
- Useful to use $m_{\beta\beta}$ to compare different isotopes

$$(T^{0\nu}_{1/2})^{-1} = \frac{\langle m_{\beta\beta}\rangle^2}{m_e^2} G^{0\nu} g_A^4 \,|\, M^{0\nu} \,|^2$$

$$\langle m_{\beta\beta}\rangle = \left| \sum_{i=1}^{3} U_{ei}^2 m_i \right|$$



https://doi.org/10.1146/annurev-nucl-101918-023407

Neutrinoless Double Beta Decay

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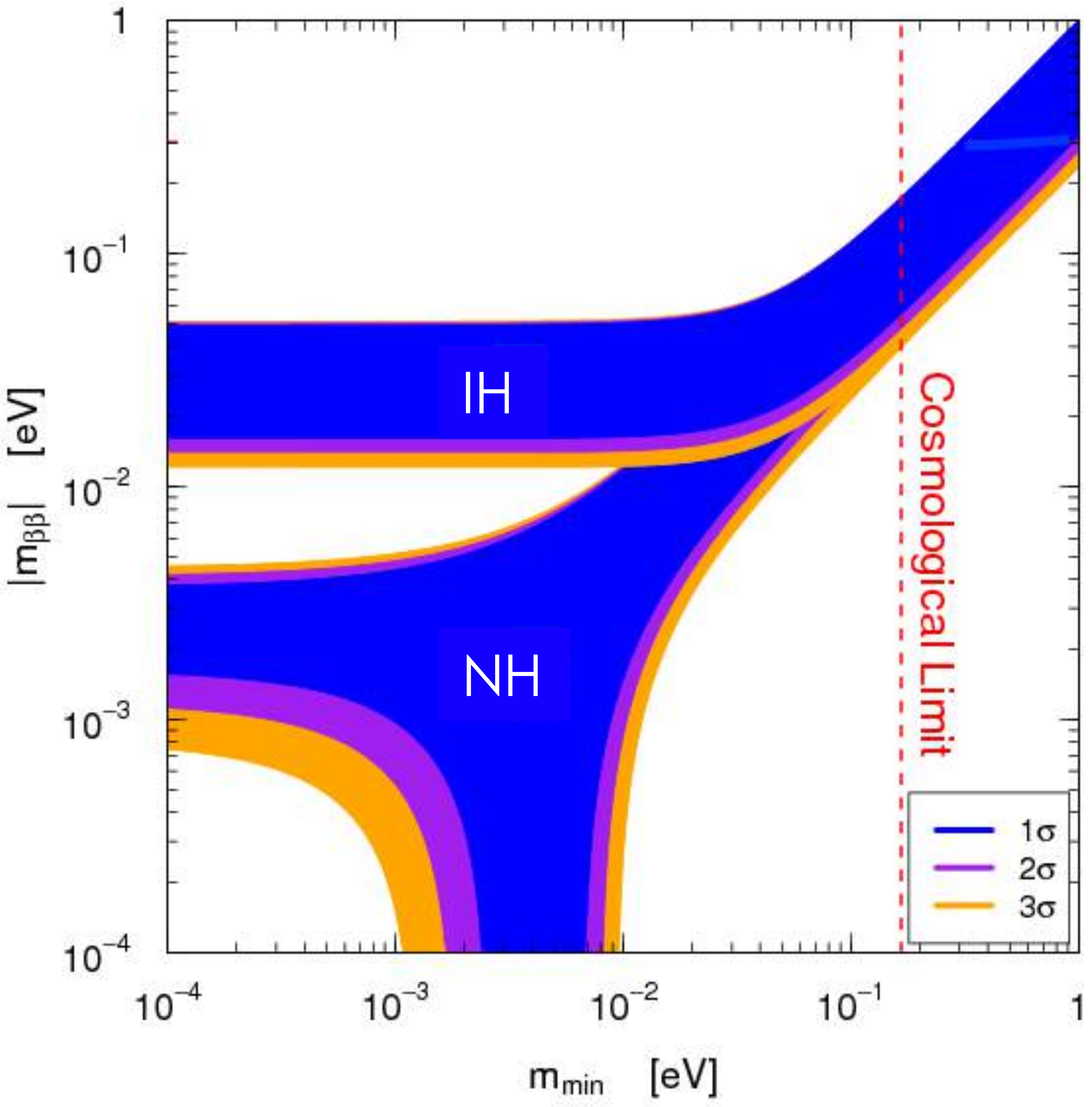
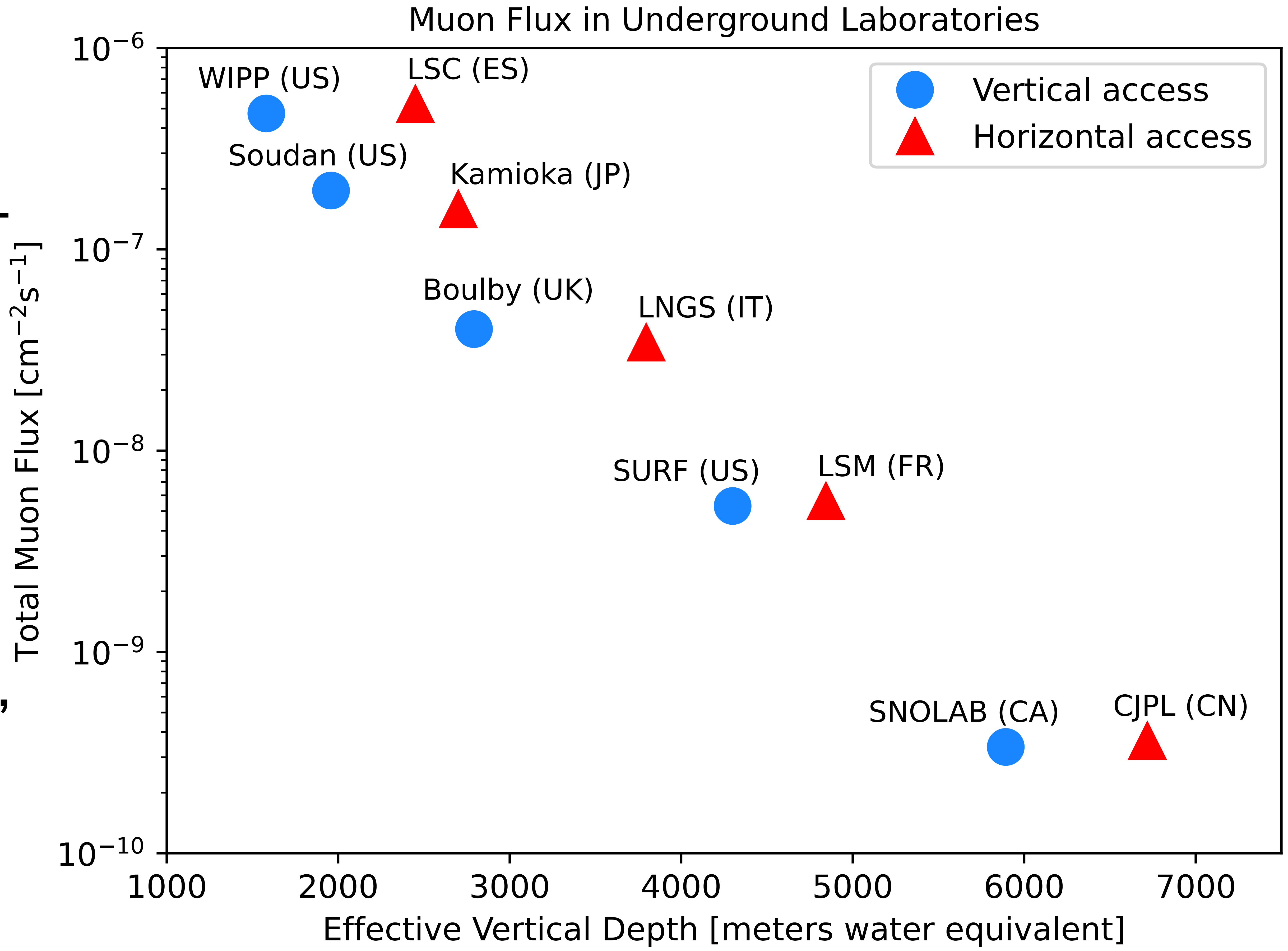
$$\langle m_{\beta\beta}\rangle = \left| \sum_{i=1}^{3} U_{ei}^2 m_i \right|$$

- New physics sensitivity can be parameterized by $m_{\beta\beta}$ reach



How to Measure Neutrinoless Double Beta Decay?

- Long half-lives necessitate large exposures
  - Large detectors, Long run time, Isotopic enrichment
- Statistical Significance requires good signal-to-background ratio
  - Very low background rates
  - Great energy resolution
- Cosmogenic backgrounds require deep underground locations
- All experiments require strict material assay, handling, and compatibility
- Many detector technologies available for different isotopes



Adapted from Chin. Phys. C 45 (2021) 2, 025001

A healthy neutrinoless double-beta decay program requires more than one isotope.

A healthy neutrinoless double-beta decay program requires more than one isotope.

- Nuclear matrix elements are not very well known and any given isotope could come with unknown liabilities
- Different isotopes correspond to vastly different experimental techniques
- 2-neutrino background is different for various isotopes
- Understanding the mechanism producing the decay requires the analysis of more than one isotope

CUPID

supernemo collaboration

Zero neutrino double beta decay search KamLAND-Zen

nEXO

next

SNO+

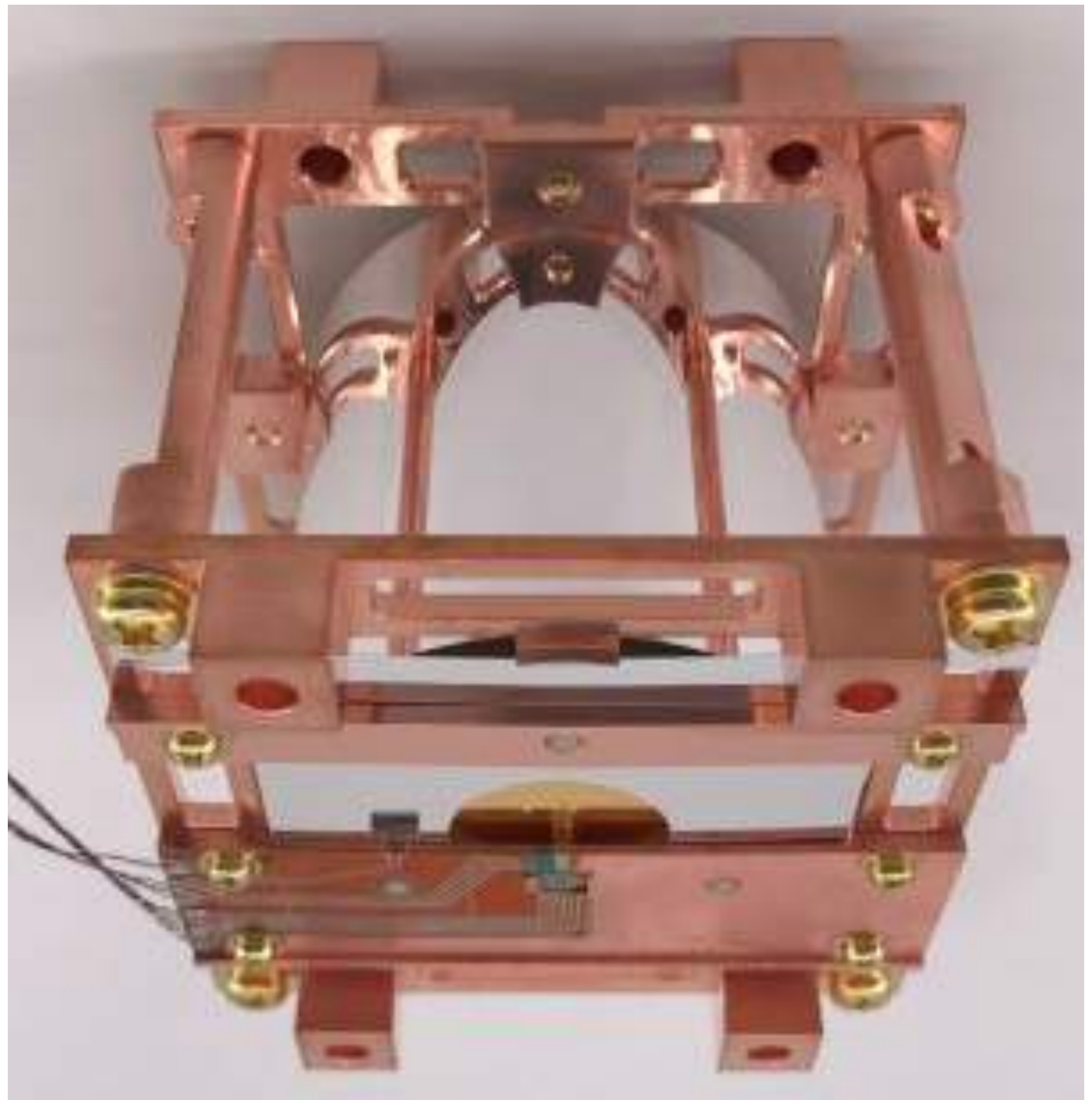
AMoRE

LEGEND

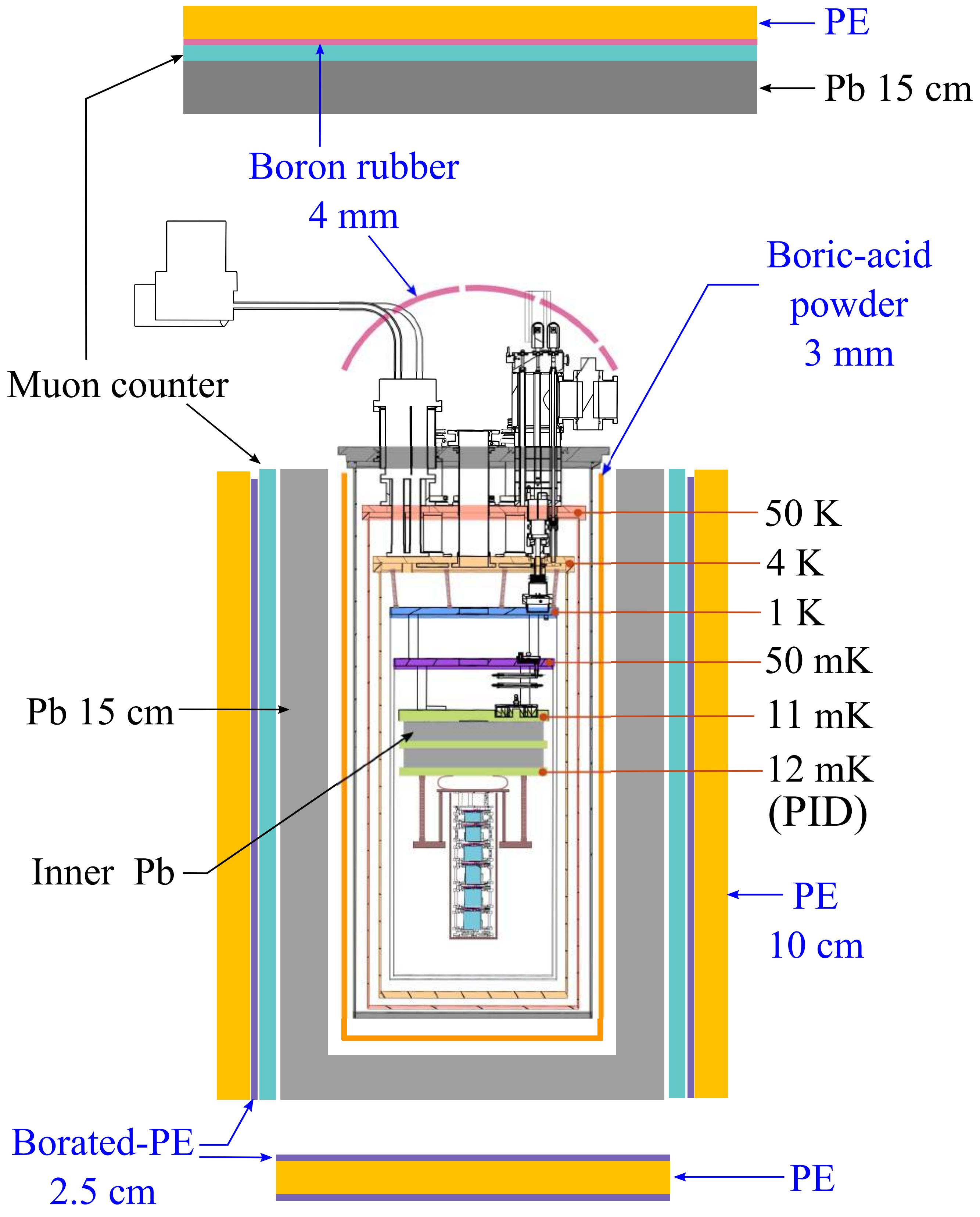
AMoRE

from Yoomin Oh, Nu'22

AMoRE



arXiv:2107.07704

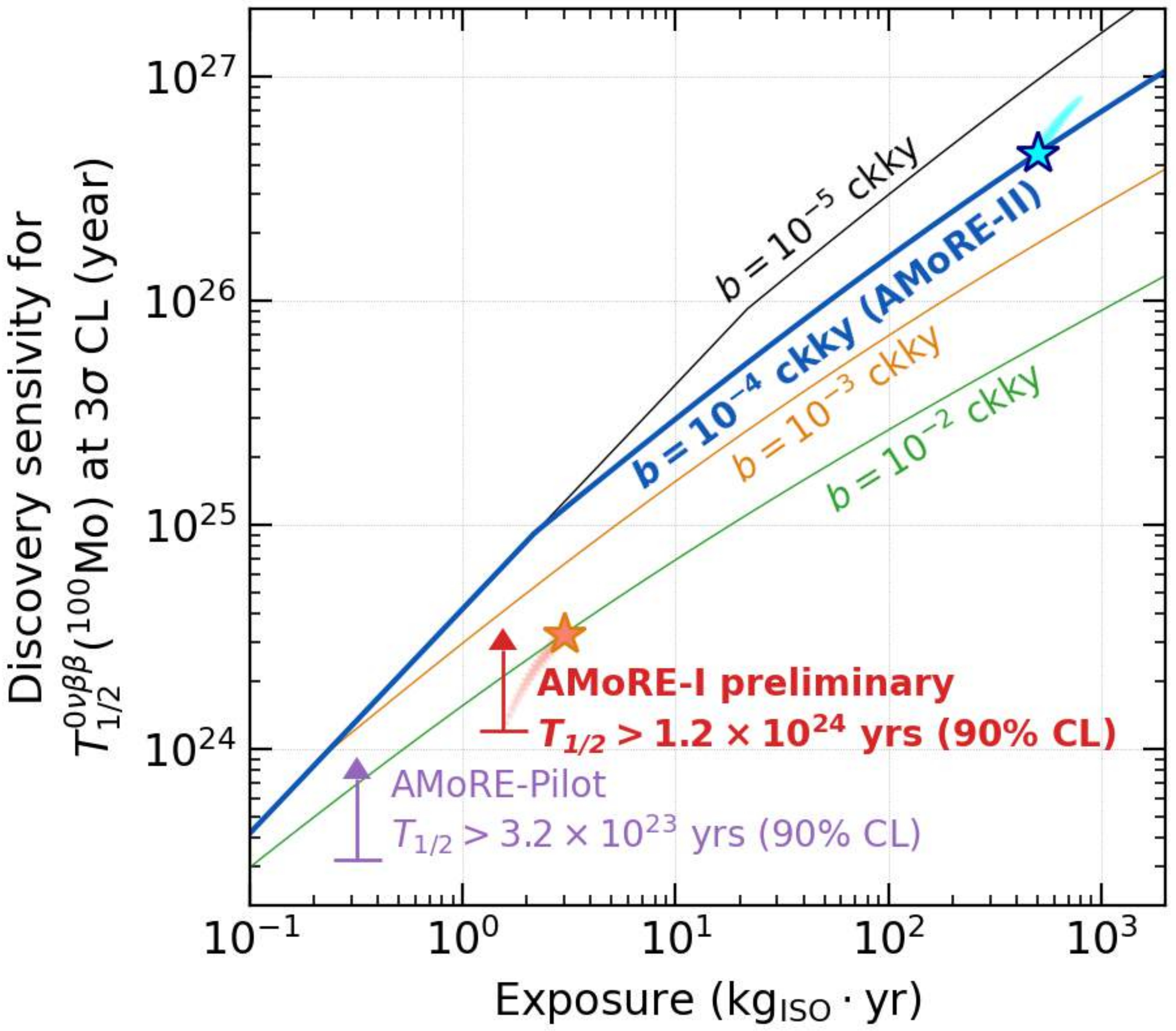


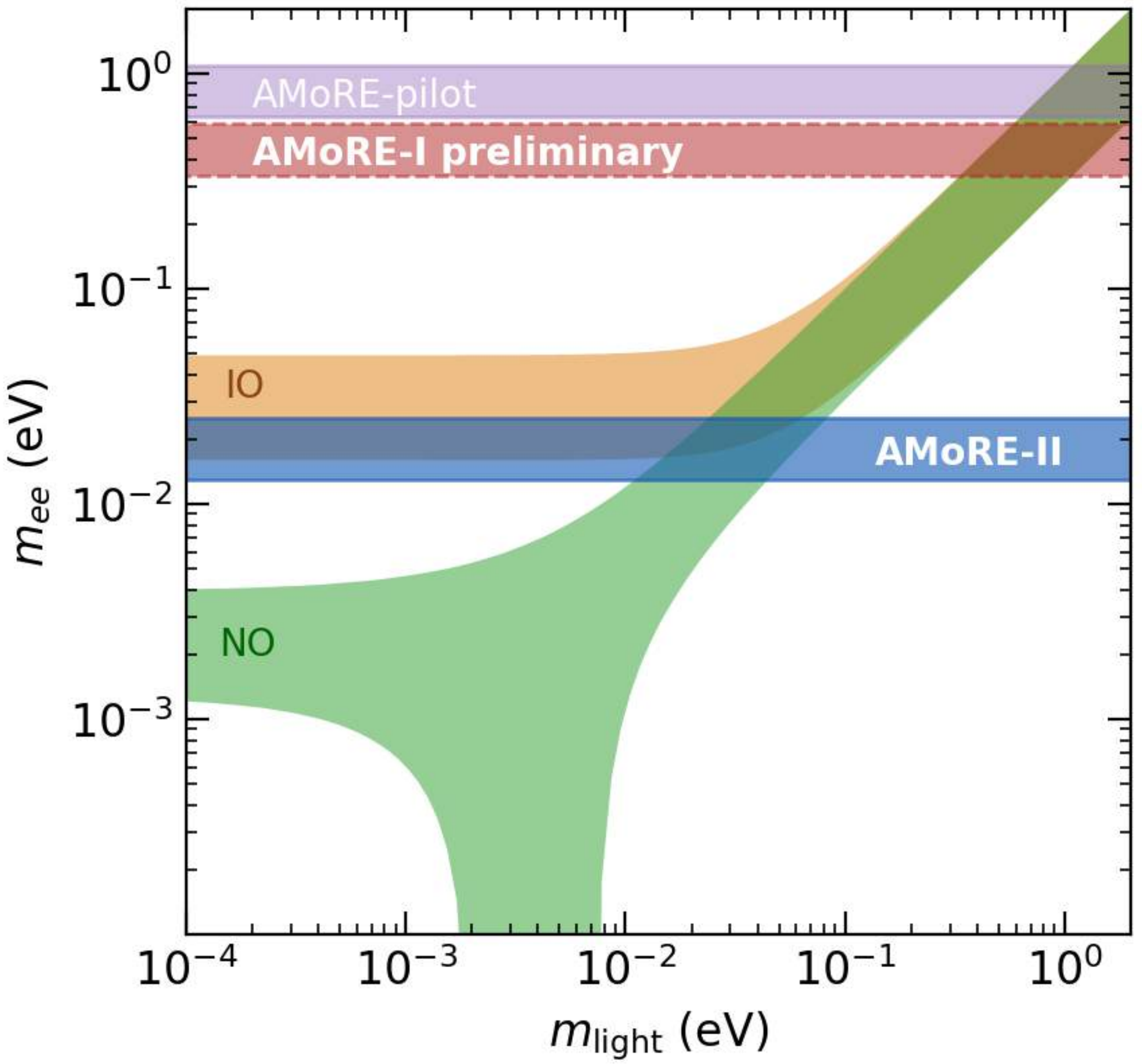
- $CaMoO_4$ and Li_2MoO_4 Crystals, > 95% enriched in ^{100}Mo
- Photon and Phonon readout
- Energy Resolution: ~10 keV FWHM @ 2.6 MeV
- Staged approach at Yemilab
    - AMoRE Pilot : 1.89 kg, 700 m
    - AMoRE-I : 6.19 kg, 700 m
    - AMoRE-II : 27 kg -> 178 kg, 1000m

[Mo-100, $Q_{\beta\beta}$ = 3034 keV, 9.74% NA]

AMoRE

from Yoomin Oh, Nu'22





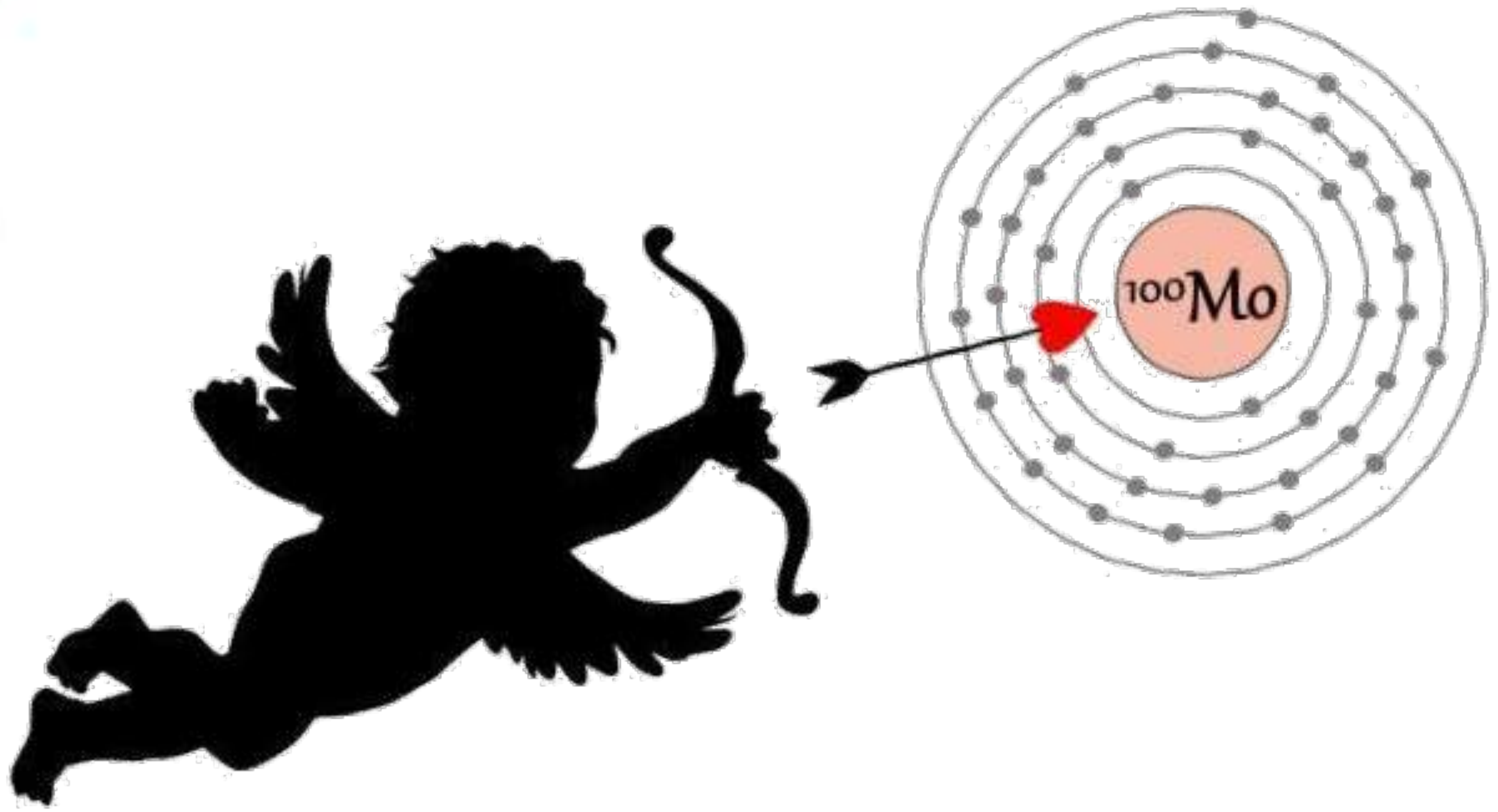
Preliminary result of AMoRE-I

- Exposure: 3.44 (1.67) kg·yr
- Background level ~ 0.04 counts/keV/kg/year at 2860-3200 keV.
- $T^{0\nu}_{1/2} > 1.2 \times 10^{24}$ y

AMoRE-II starts its data taking soon to head for $T^{0\nu}_{1/2} > 5 \times 10^{26}$ y

[Mo-100, $Q_{\beta\beta}$ = 3034 keV, 9.74% NA]

CUORE



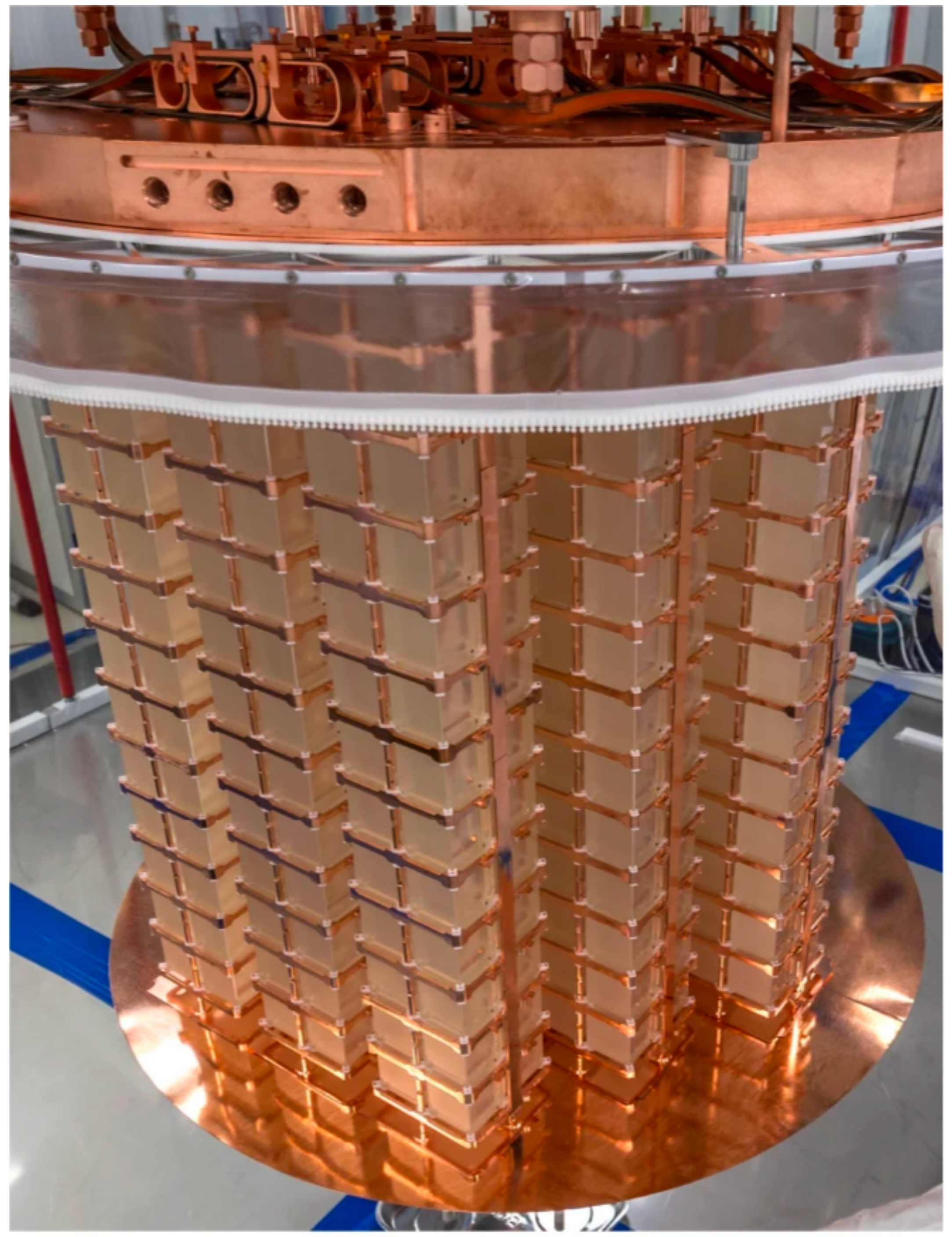
CUPID-0

CUPID

from Anastasiia Zolotarova, Nu'22
& Irene Nutini, Nu'22

from I. Nutini, Nu'22

CUORE

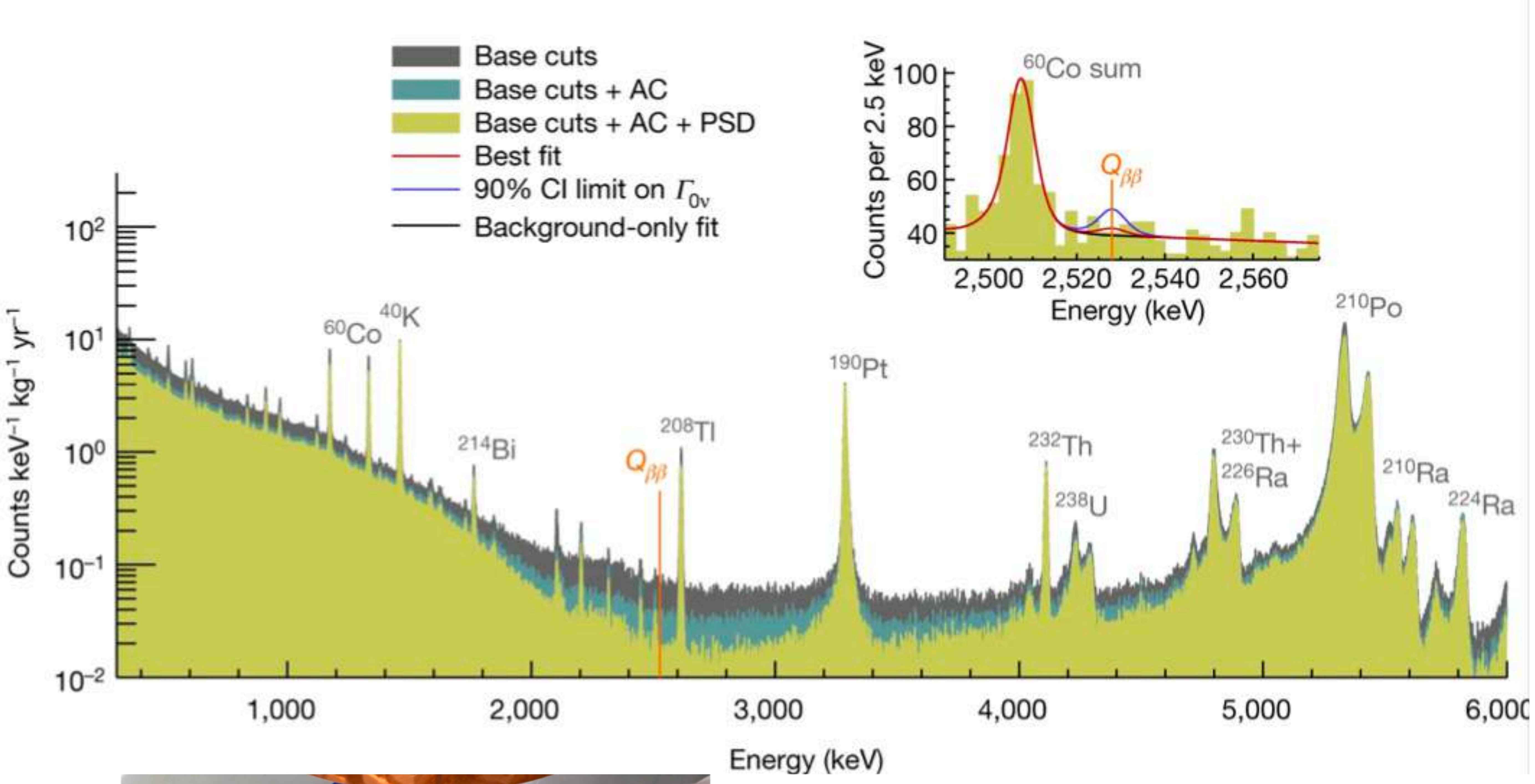


- 988 TeO_2 crystals in 19 towers
- 10 mK cryostat in LNGS (1400m, 3800 mwe)
- 206 kg of ^{130}Te, 188kg ^{128}Te

[Te-130, $Q_{\beta\beta}$ = 2528 keV, 34% NA]

from I. Nutini, Nu'22

CUORE



- 988 TeO_2 crystals in 19 towers
- 10 mK cryostat in LNGS (1400m, 3800 mwe)
- 206 kg of ^{130}Te, 188kg ^{128}Te

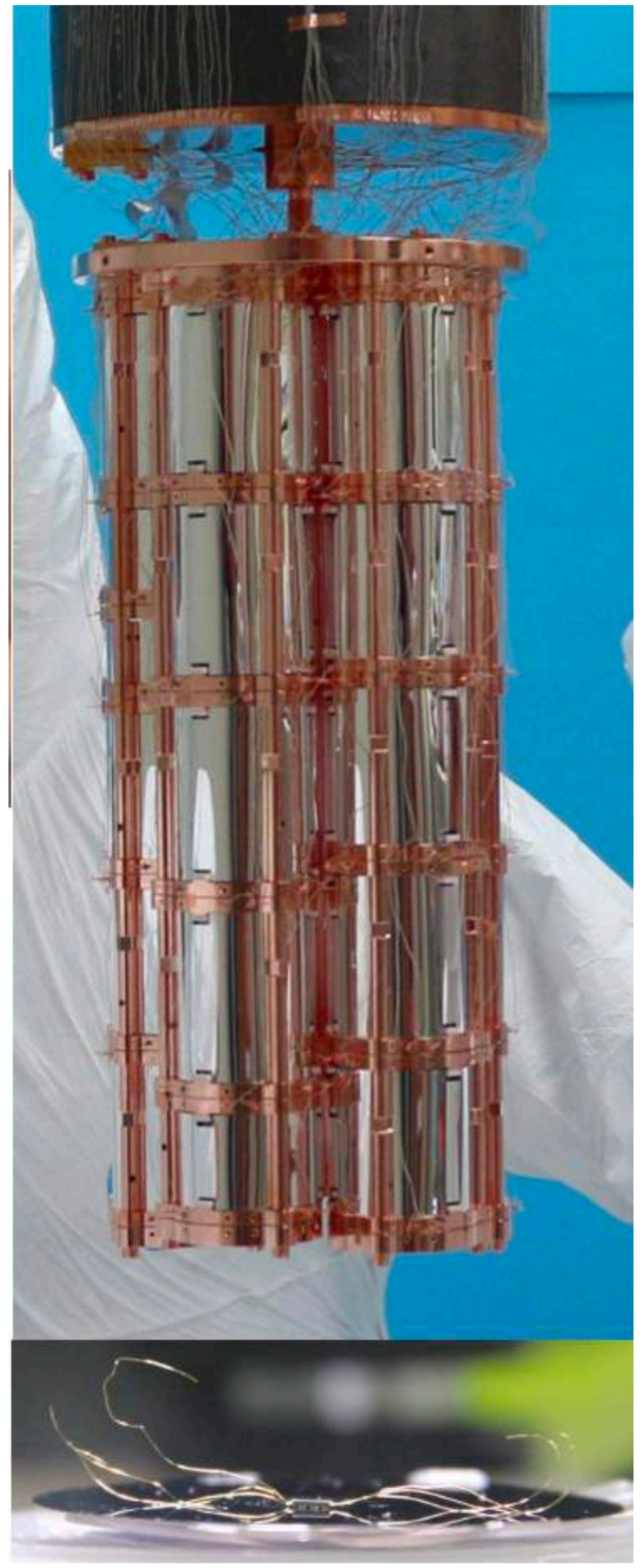
- ^{130}Te, $Q_{\beta\beta}$ = 2528 keV, 34% NA
- 7.8 keV FWHM @ $Q_{\beta\beta}$
- $T^{2\nu}_{1/2}$ (^{130}Te) = [7.71 $^{+0.08}_{-0.06}$(st) $^{+0.12}_{-0.15}$(sy)] x 10^{20} y
- $T^{0\nu}_{1/2}$ (^{130}Te) > 2.2 x 10^{25} y
- $m_{\beta\beta}$ < 90 - 305 meV

- ^{128}Te $Q_{\beta\beta}$= 866.7 keV, NA: 31.74%
- $T^{0\nu}_{1/2}$ (^{128}Te) > 3.6 × 10^{24} y

Nature 604 (2022) 7904, 53-58; arXiv:2205.03132; PRL 126, 171801 (2021)

[Te-130, $Q_{\beta\beta}$ = 2528 keV, 34% NA]

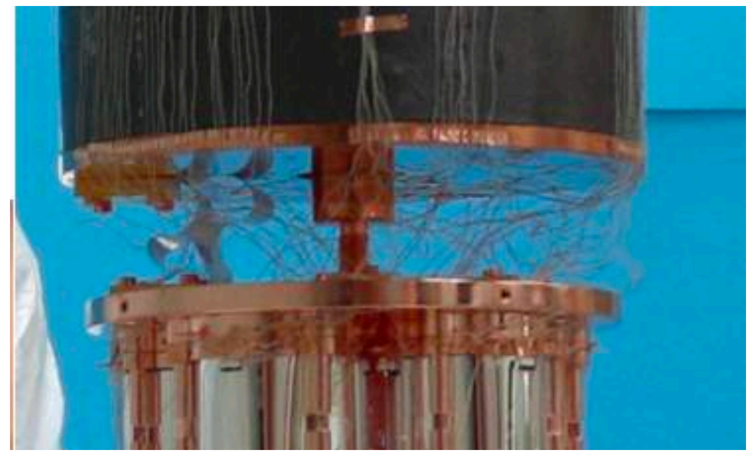
CUPID-0

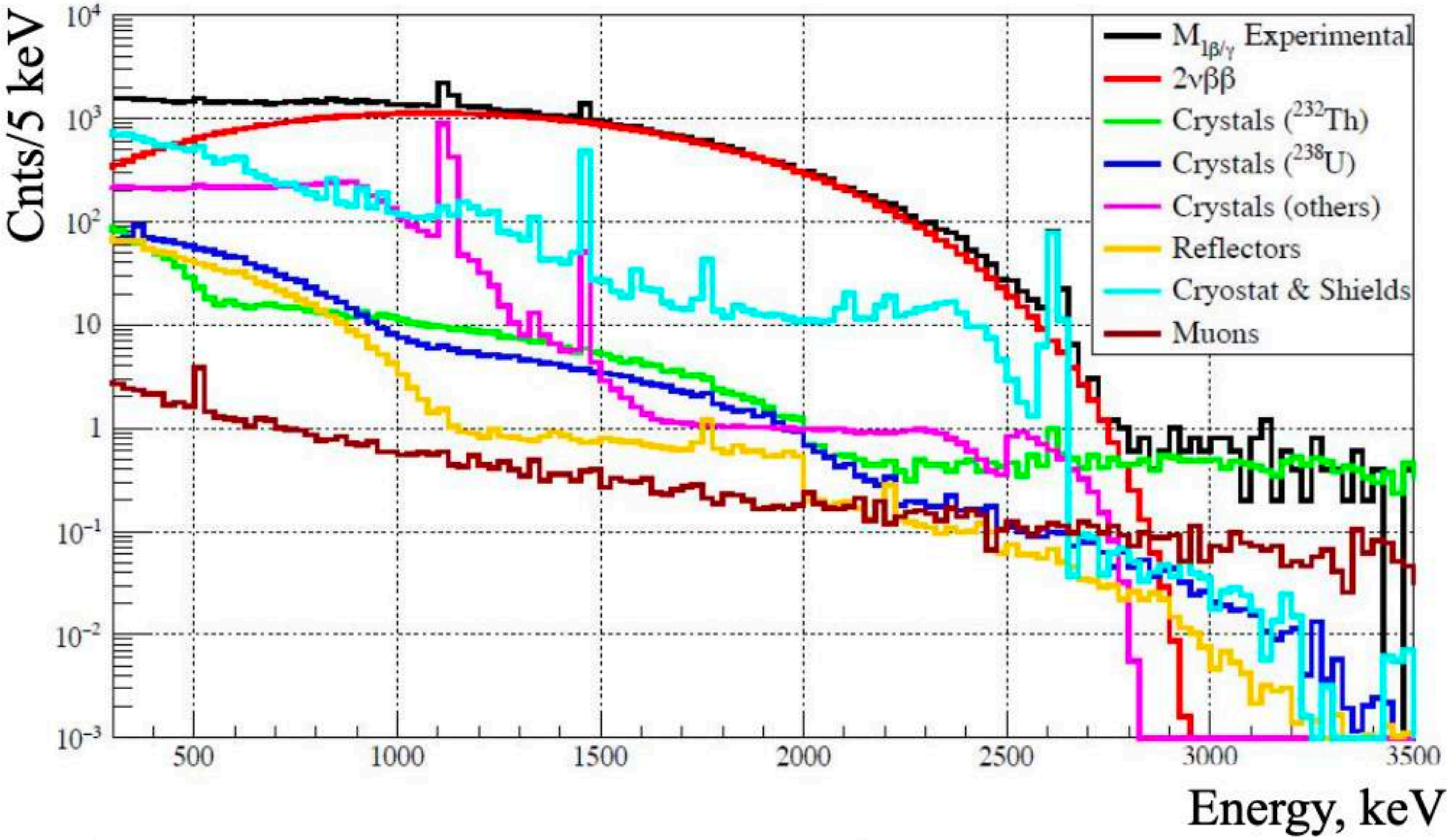


- 95% enriched $Zn^{82}Se$ bolometers
- 5.17kg ^{82}Se, $Q_{\beta\beta}$ = 2998 keV
- 10 mK cryostat in LNGS (1400m, 3800 mwe)
- FWHM @ $Q_{\beta\beta}$ = (20.05 ± 0.34) keV

[Se-82, $Q_{\beta\beta}$ = 2998 keV, 8.8% NA]

from A. Zolotarova, Nu'22





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- 10 mK cryostat in LNGS (1400m, 3800 mwe)
- FWHM @ $Q_{\beta\beta}$ = (20.05 ± 0.34) keV
- $T^{2\nu}_{1/2}$ = [8.6 ±0.03(st) $^{+0.19}_{-0.13}$(sy)] x 10^{19} y
- $T^{0\nu}_{1/2}$ > 4.6 x 10^{24} y
- $m_{\beta\beta}$ < 263-545 meV

EPJC (2018) 78:428; PRL 123, 262501 (2019); PRD 100, 092002 (2019); PRL 123, 262501 (2019); EPJC 79, 583 (2019); EPJC 81, 722 (2021) arxiv:2206.05130

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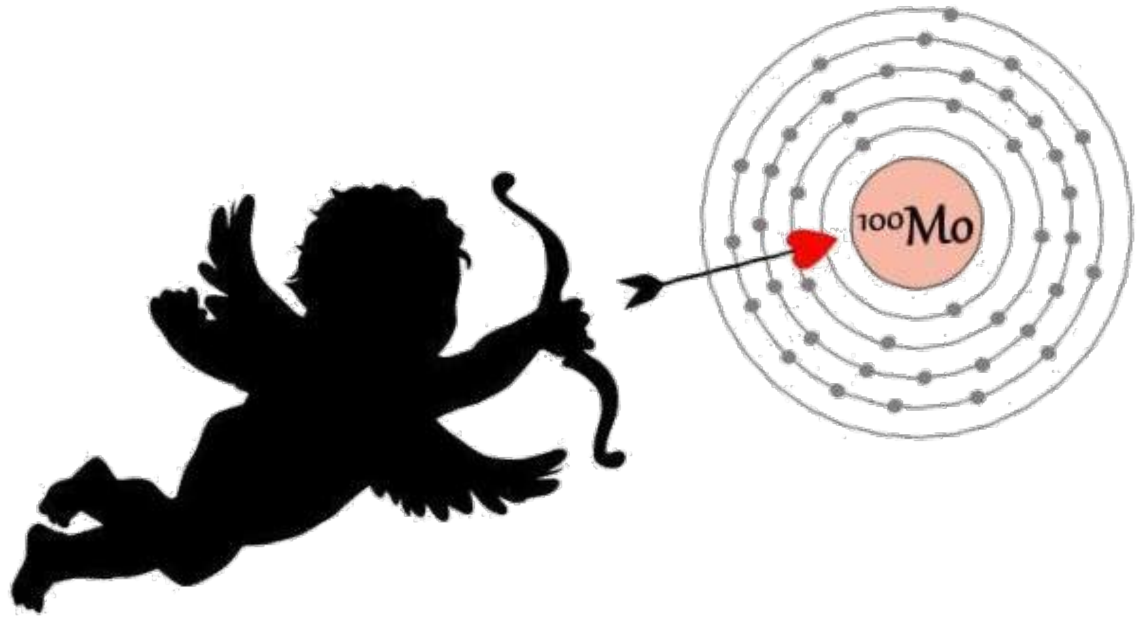
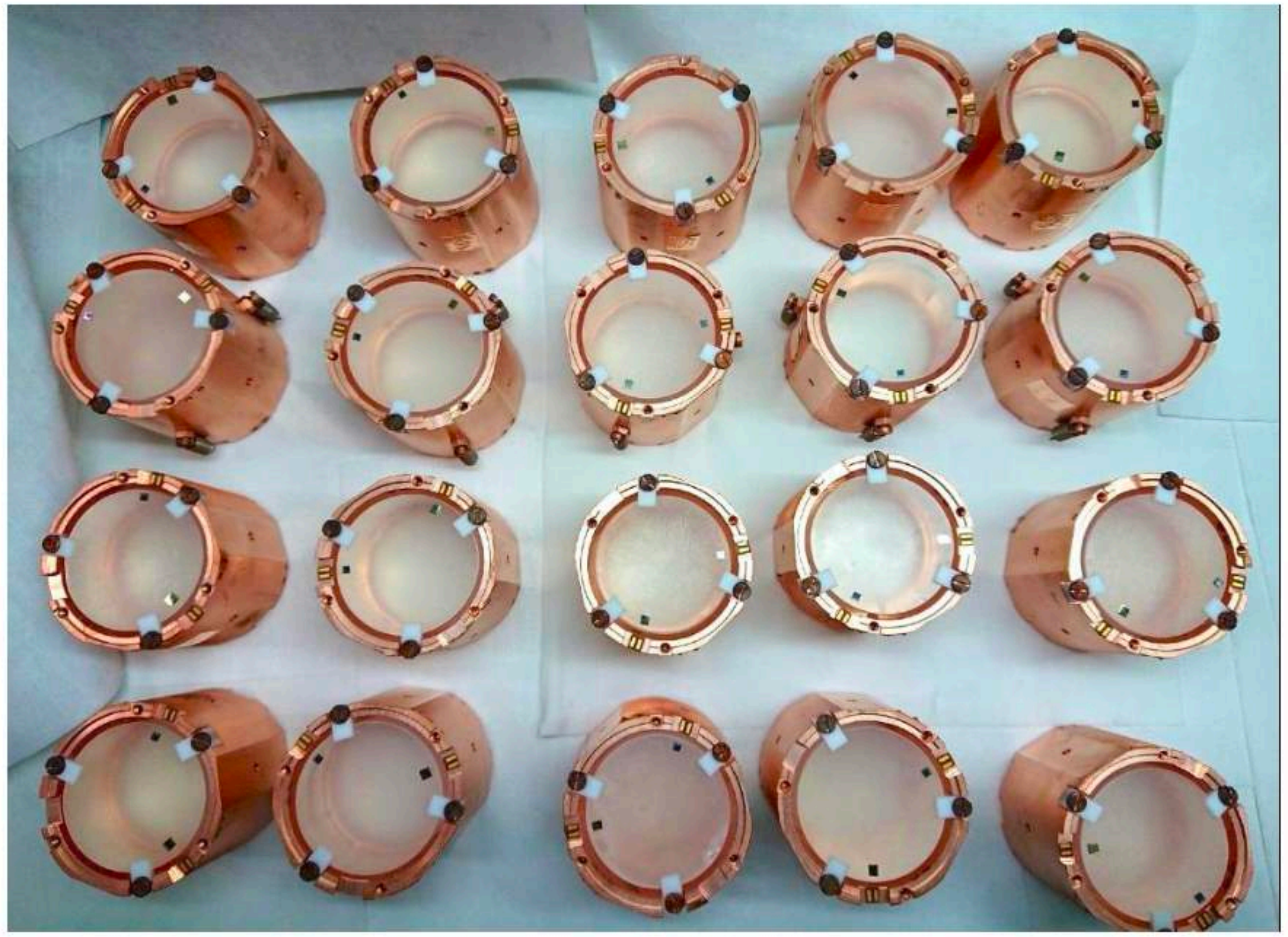
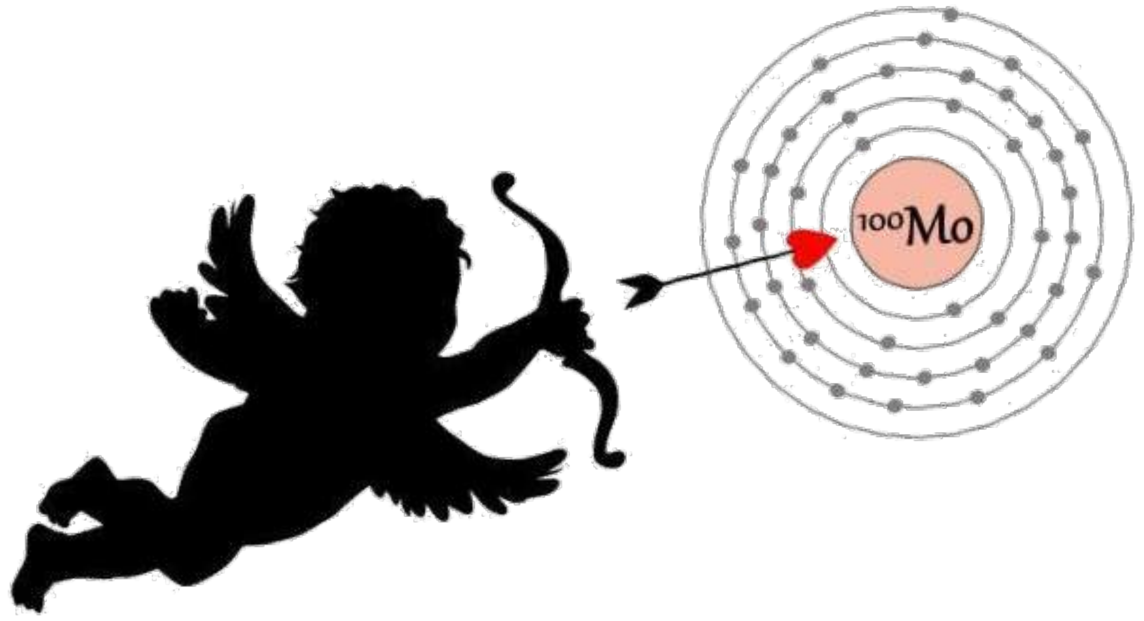


from A. Zolotarova, Nu'22

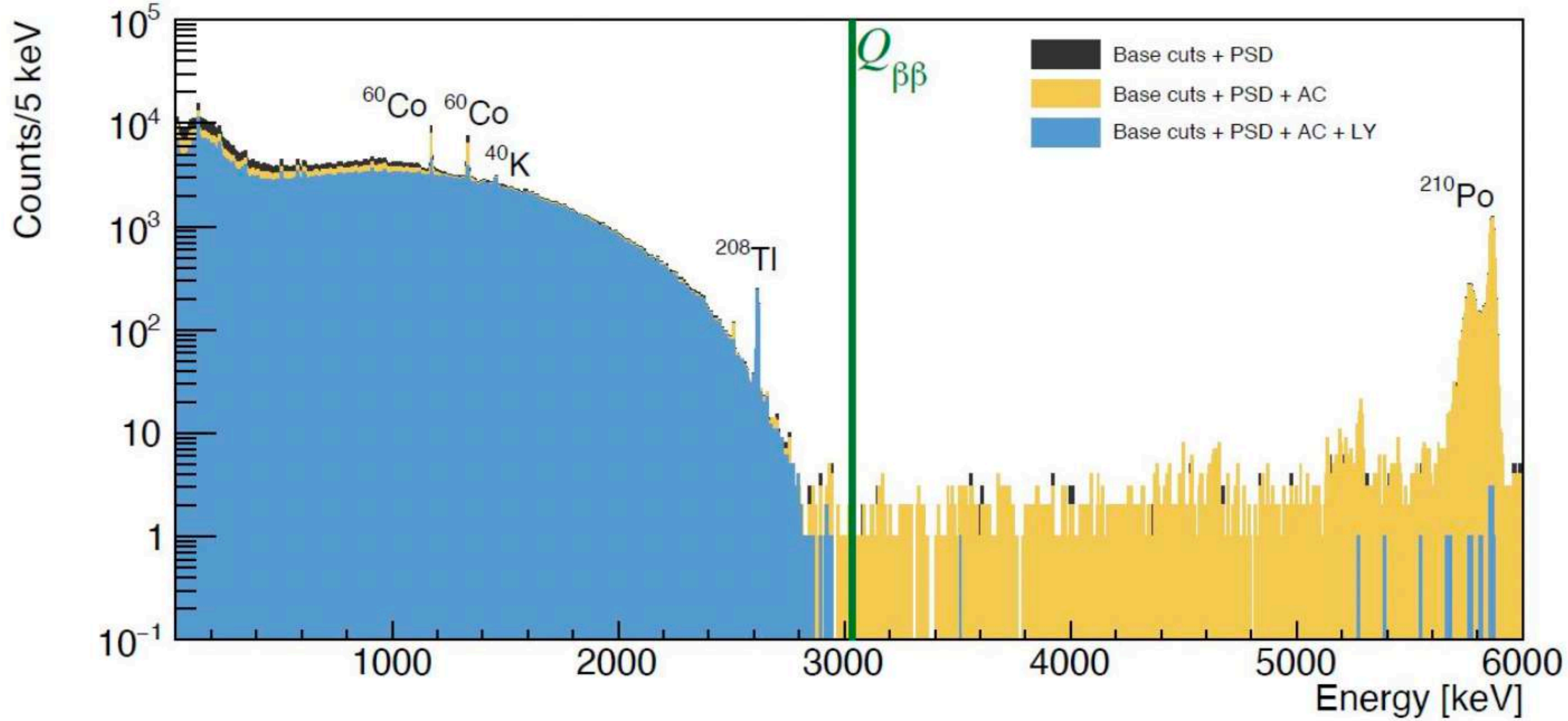


- $Li_2{}^{100}MoO_4$ Scintillating Crystals
- 2.26kg ^{100}Mo, $Q_{\beta\beta}$ = 3034 keV
- 7.38 keV @ $Q_{\beta\beta}$ FWHM
- Laboratoire Souterraine de Modane (1700m, 4800 mwe)

[Mo-100, $Q_{\beta\beta}$ = 3034 keV, 9.7% NA]



from A. Zolotarova, Nu'22



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- $T^{0v}_{1/2} > 1.8 \times 10^{24}$ y
- $m_{\beta\beta} < 240$-490 meV

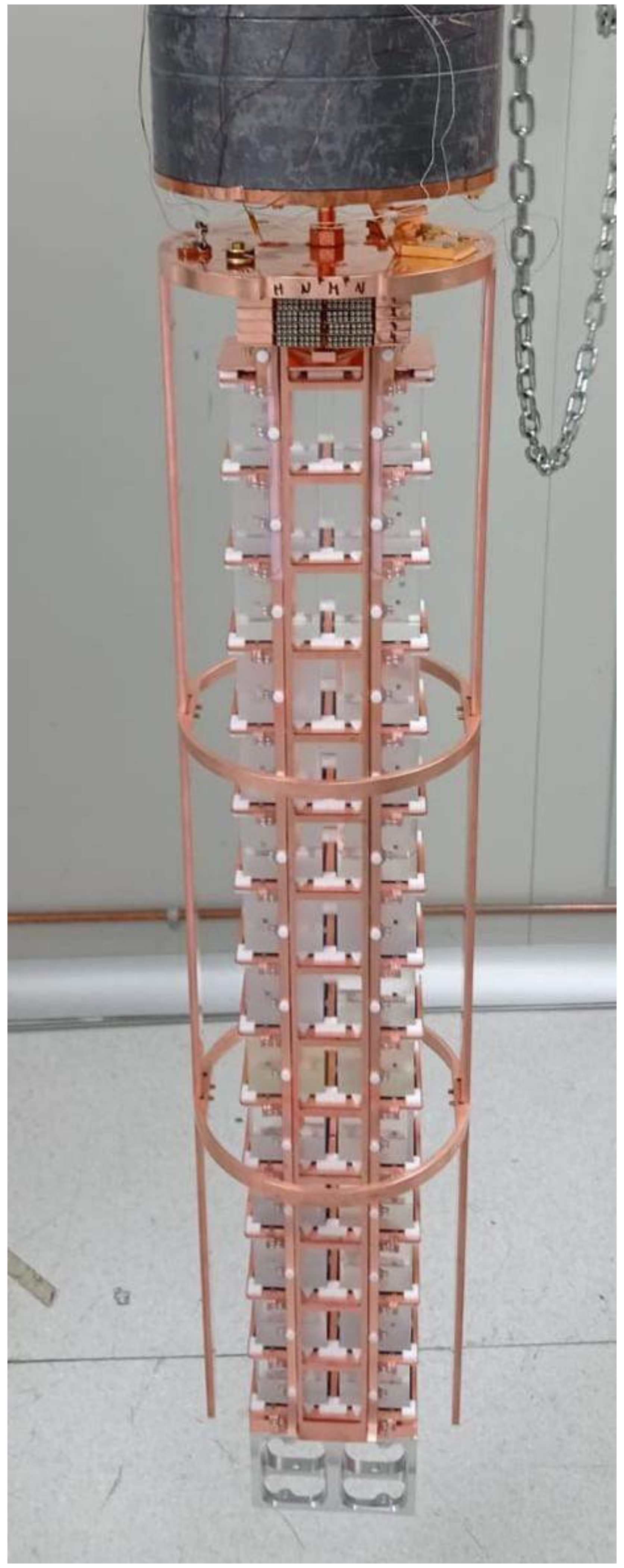
PRL 126, 181892 (2021); JINST 16 (2021) P03032; EPJC 80, 44 (2020); EPJC 80, 674 (2020)

[Mo-100, $Q_{\beta\beta}$ = 3034 keV, 9.7% NA]

from Anastasiia Zolotarova, Nu'22

CUPID

SNOLAB



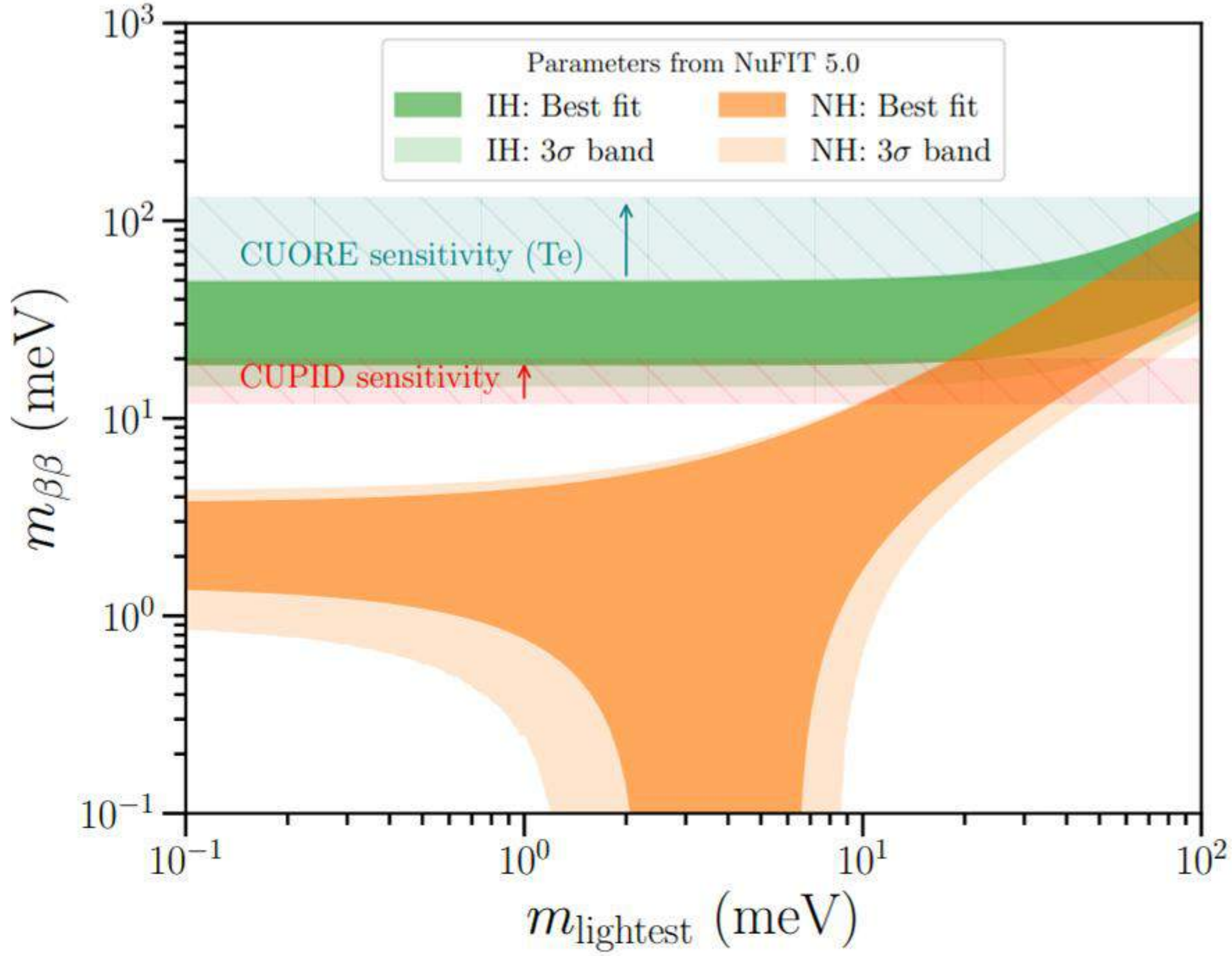
$Li_2{}^{100}MoO_4$ scintillating bolometers

- Enrichment > 95%
- 1,596 crystals, 240 kg of ^{100}Mo
- FWHM <10 keV at $Q_{\beta\beta}$ (3034 keV)
- LNGS, CUORE Cryostat

[Mo-100, $Q_{\beta\beta}$ = 3034 keV, 9.7% NA]

from Anastasiia Zolotarova, Nu'22

CUPID



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Projected Discovery sensitivity at 3σ:

- $T^{0\nu}_{1/2} = 10^{27}$ yr
- $m_{\beta\beta}$~12-20 meV

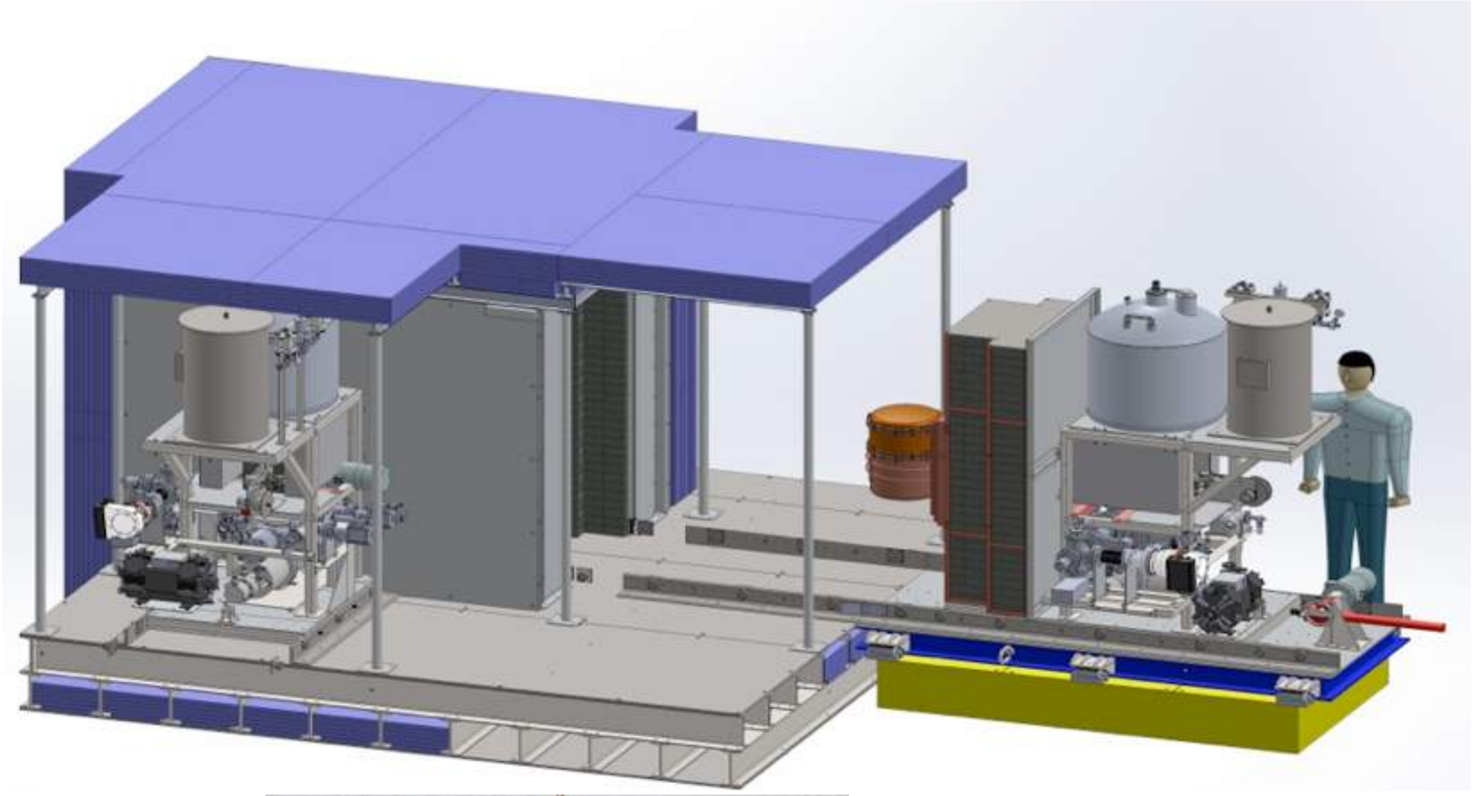
EPJC (2021) 81:104; JINST 16 (2021) P02037; arXiv:2011.11726; arXiv:2202.06279

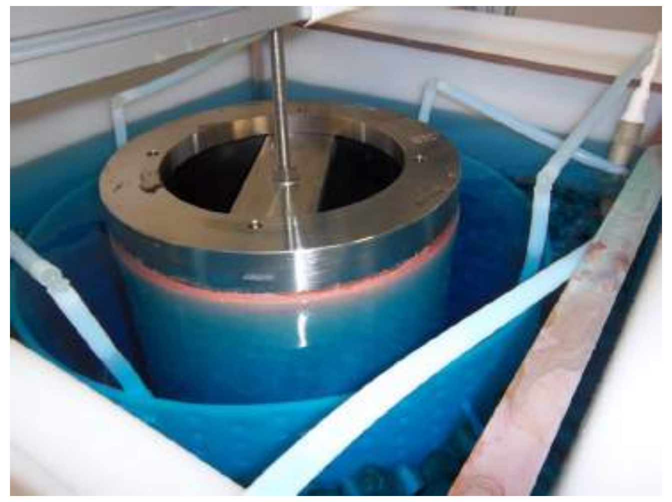
[Mo-100, $Q_{\beta\beta}$ = 3034 keV, 9.7% NA]

LEGEND

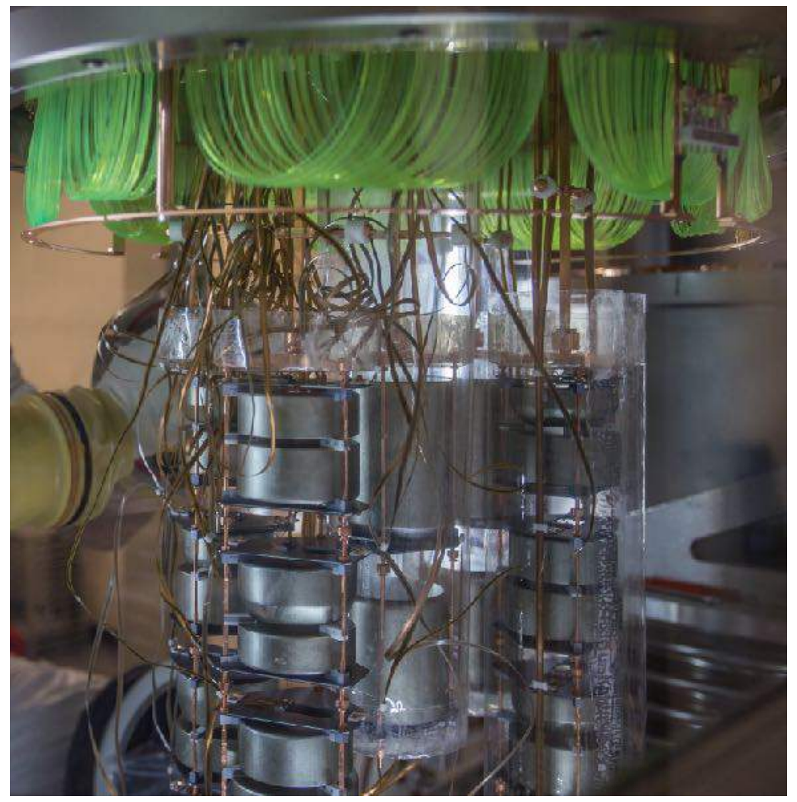
from Ryan Martin

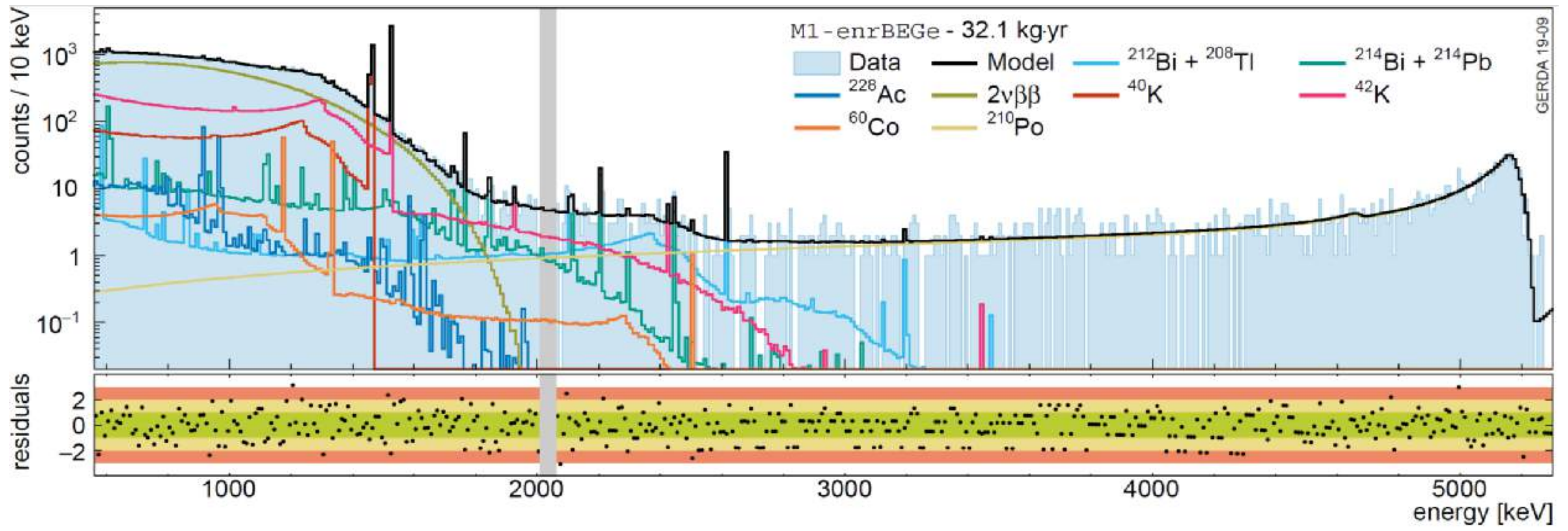
MAJORANA Demonstrator





from R. Martin





MAJORANA Demonstrator at SURF:

- Two compact vacuum cryostats + shielding (Cu/Pb)
- 29kg enriched detectors, 15kg natural abundance
- **Best energy resolution of any 0νββ experiment**
- $T^{0\nu}_{1/2} > 8.3 \times 10^{25}$ yr (90% C.I.) $m_{\beta\beta} < 113 - 269$ meV

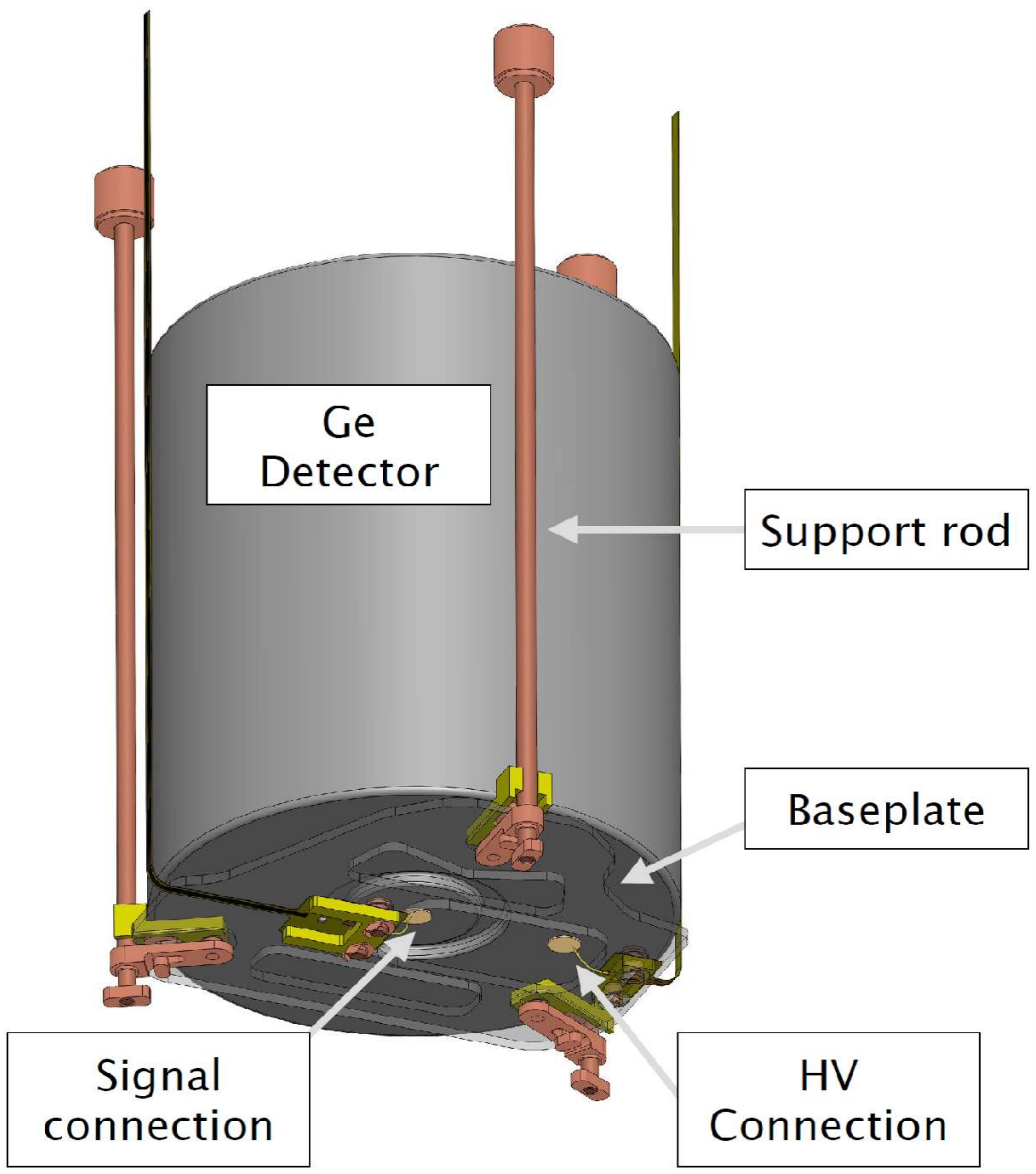
GERDA at LNGS:

- Detectors deployed in liquid argon as scintillating veto
- 35kg of enriched detectors (coax + BEGe)
- **Lowest background index of any 0νββ experiment**
- $T^{0\nu}_{1/2} > 1.8 \times 10^{26}$ yr (90% C.L) $m_{\beta\beta} < 79 - 180$ meV
- PRL 125, 252502 (2020)

[Ge-76, $Q_{\beta\beta} = 2039$ keV, 7.8% NA]

LEGEND

from R. Martin



arXiv:2107.11462

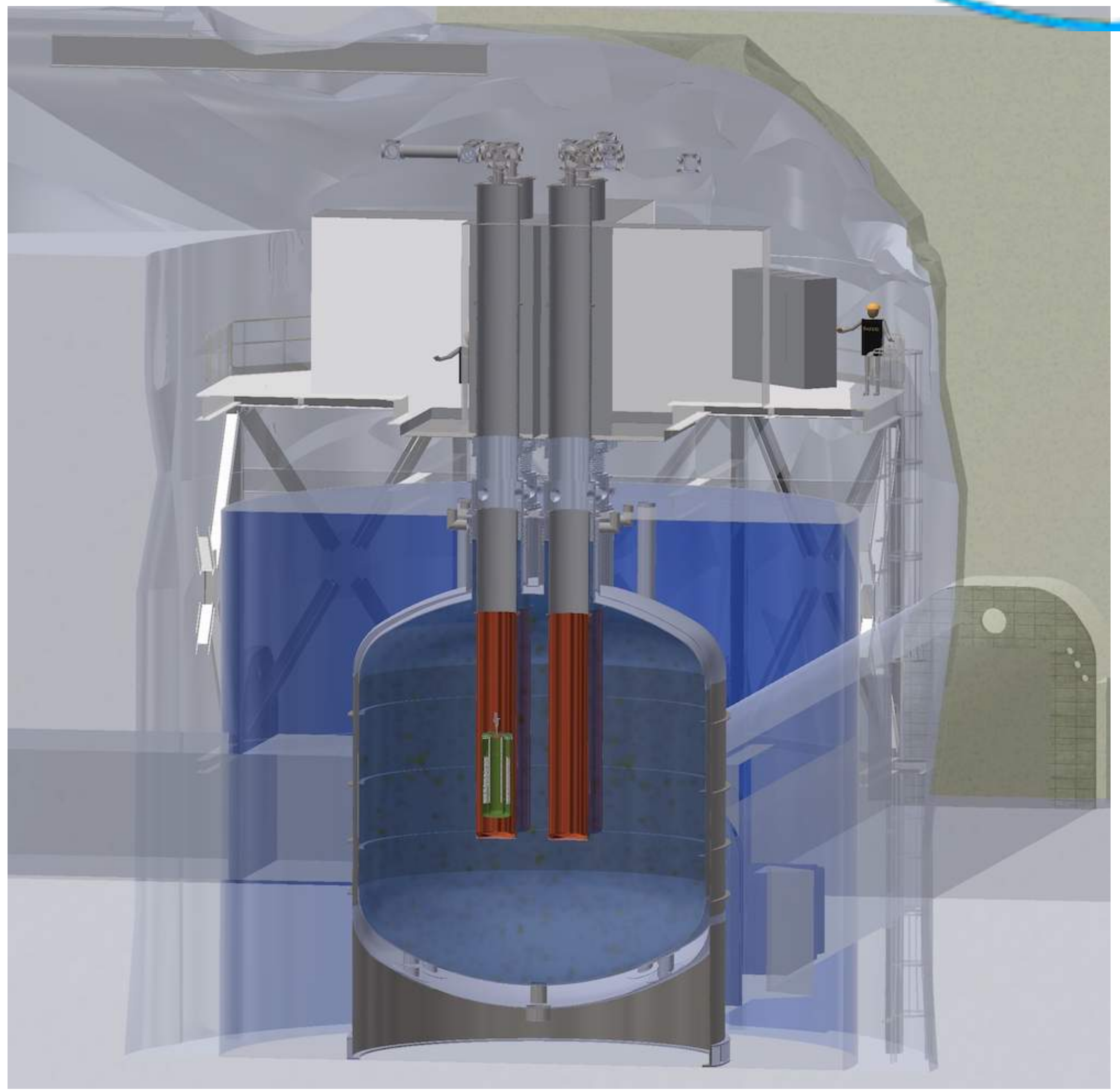
- Ge Crystals > 90% enriched in ^{76}Ge
- Energy Resolution: 0.1% @ $Q_{\beta\beta}$
- New Inverted Coaxial Point Contact Detectors
- Staged approach, LNGS & SNOLAB
- L-200: 200 kg, 1400m
- L-1000: 1000 kg, 1400/2070m

[Ge-76, $Q_{\beta\beta}$ = 2039 keV, 7.8% NA]

LEGEND

from R. Martin

SNOLAB



- LEGEND-200 experiment to deploy 200 kg of enriched detectors and make use of the existing GERDA infrastructure at LNGS.
- Currently commissioning with 185 kg. Target is to explore half-lives of 10^{27} years with 5 years of data taking
- LEGEND-1000 proposed for 1000 kg of enriched detectors (baseline at SNOLAB), Goal is 3σ detection of a 0νββ signal for half-lives of 10^{28} y

arXiv:2107.11462

[Ge-76, $Q_{\beta\beta}$ = 2039 keV, 7.8% NA]

from R. Martin

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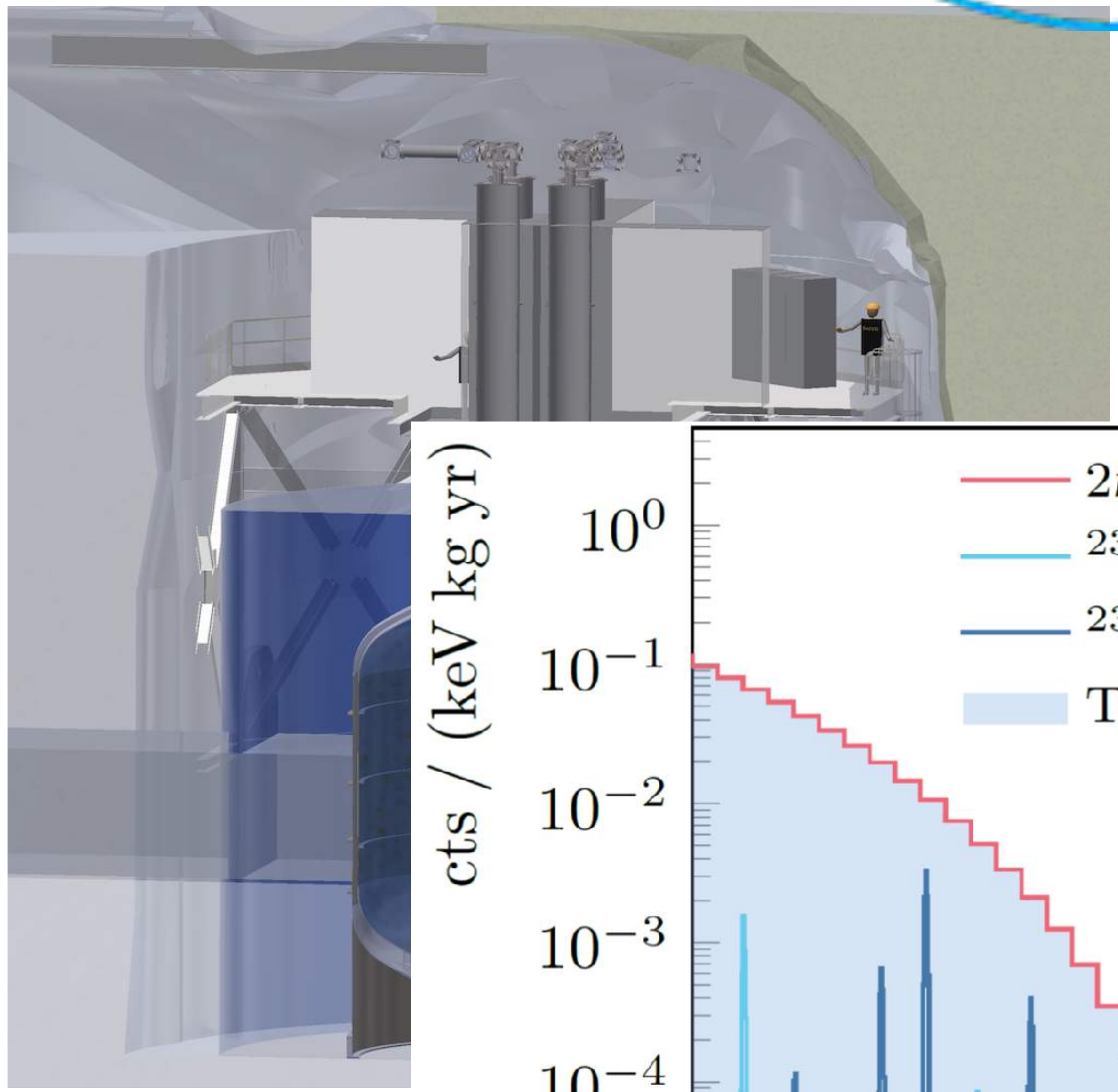
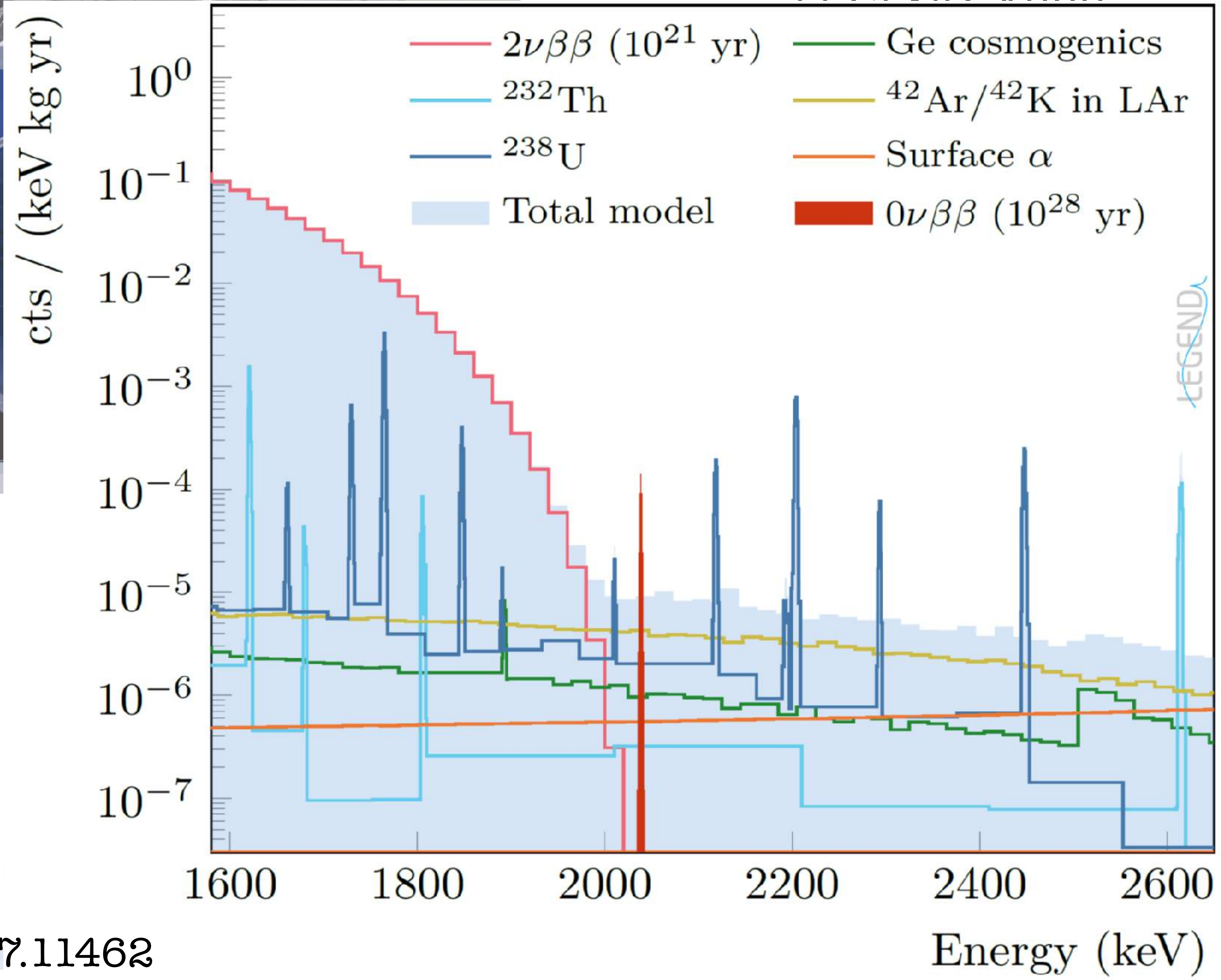
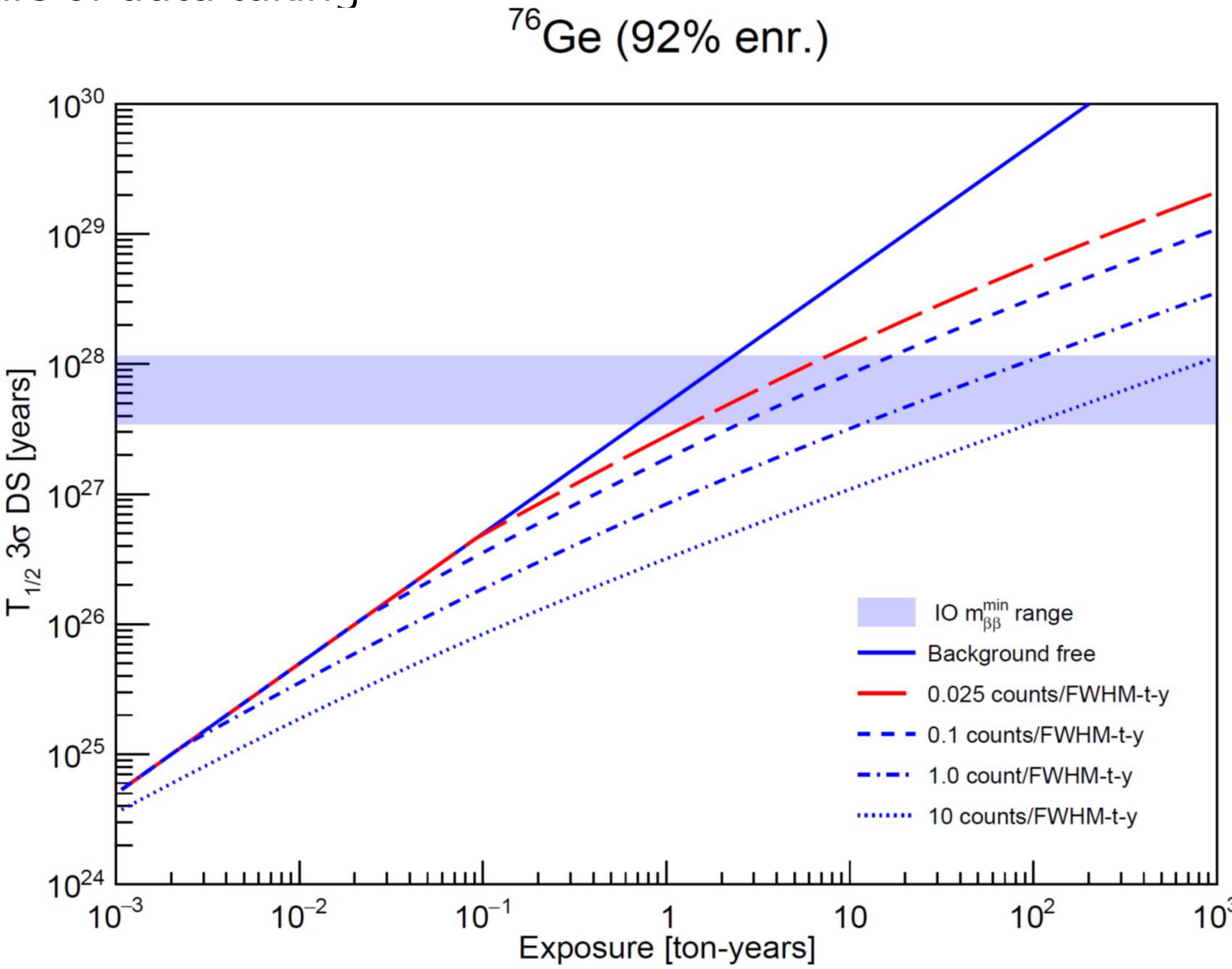




arXiv:2107.11462



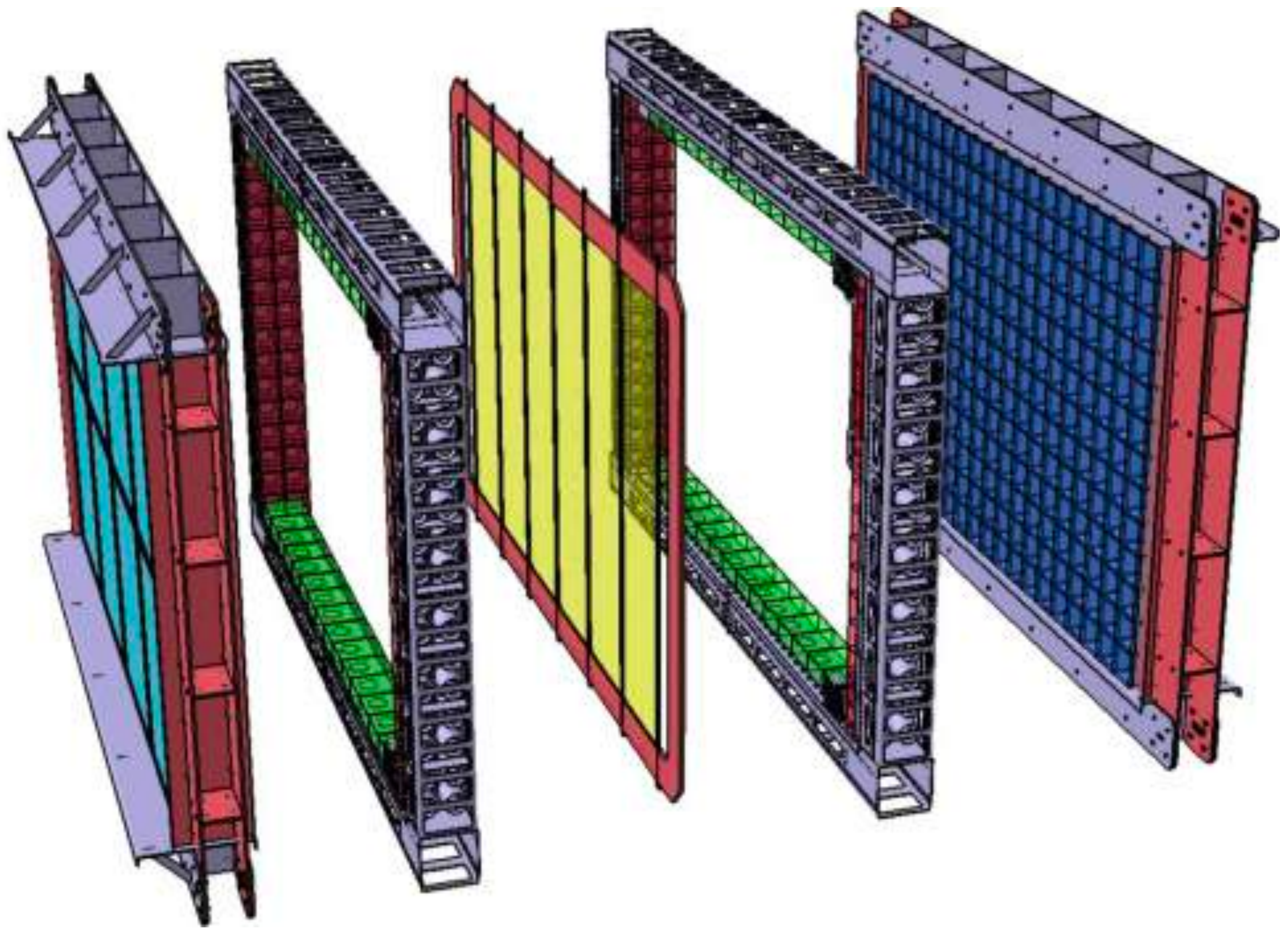
[Ge-76, $Q_{\beta\beta}$ = 2039 keV, 7.8% NA]

supernemo

collaboration

from David Waters & Christine Marquet

supernemo collaboration



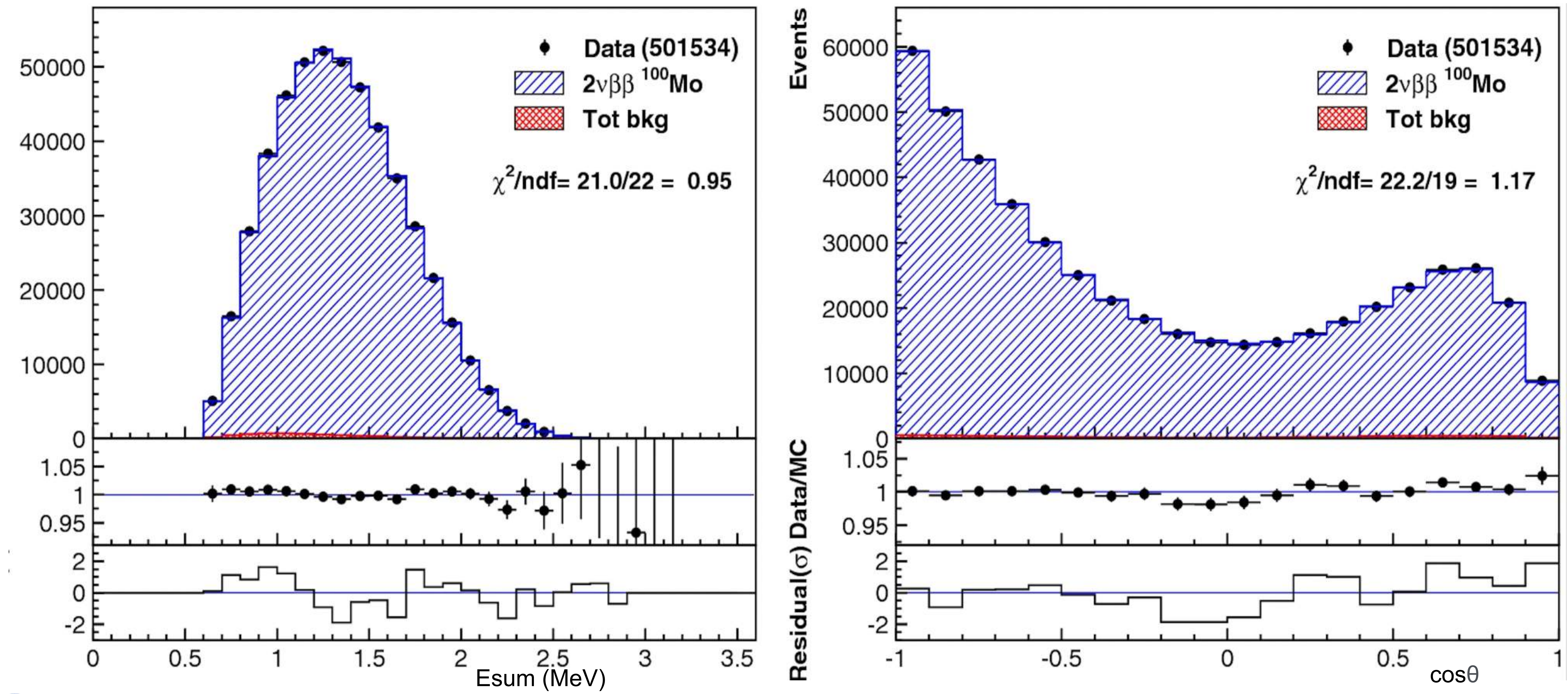
- Tracking Calorimeter
- Foil: 6kg solid ^{82}Se
- Tracker: 2034 Geiger Cells
  - Identification of e^-, e^+, γ, α, ββ kinematics & topology
- Calorimeter: 712 optical modules of plastic scintillator & PMTs
  - Individual e^- & γ energies
- Magenetic Coil for Particle ID
- Laboratoire Souterraine de Modane 1700m, 4800 mwe

[Se-82, $Q_{\beta\beta}$ = 2998 keV, 8.8% NA]

from D.Waters & C.Marquet

NEMO-3 Analysis

- 500,000+ $2\nu\beta\beta$ events; multiple isotopes (^{100}Mo shown)
- Exotic decay mechanism searches: [EPJC (2019) 79:440]
- Search for periodic modulations: [Phys. Rev. C 104, L061601 (2021)]
- Decays to excited states, e-γ separation: [Nucl. Phys. A 996, 121701 (2020)]



Super-NEMO Projections

- Expected Sensitivity: $T_{1/2} > 4 \times 10^{24}$ y
- Expected Exposure: 17 kg*y
- Background: < 10^{-4} cts/keV/kg/y

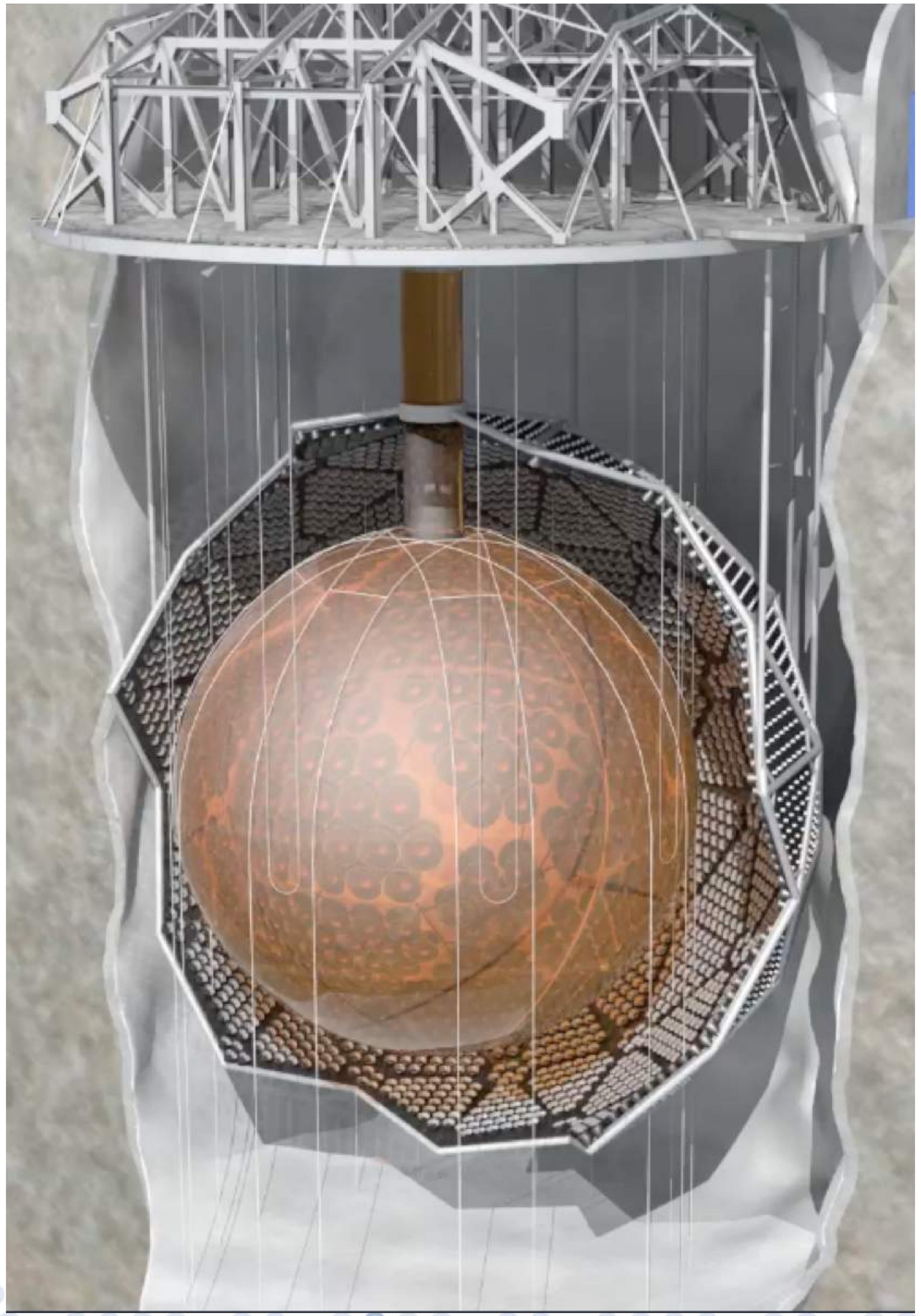
[Mo-100, $Q_{\beta\beta}$ = 3034 keV, 9.7% NA]
[Se-82, $Q_{\beta\beta}$ = 2998 keV, 8.8% NA]

SNO+


SNO+

SNO+

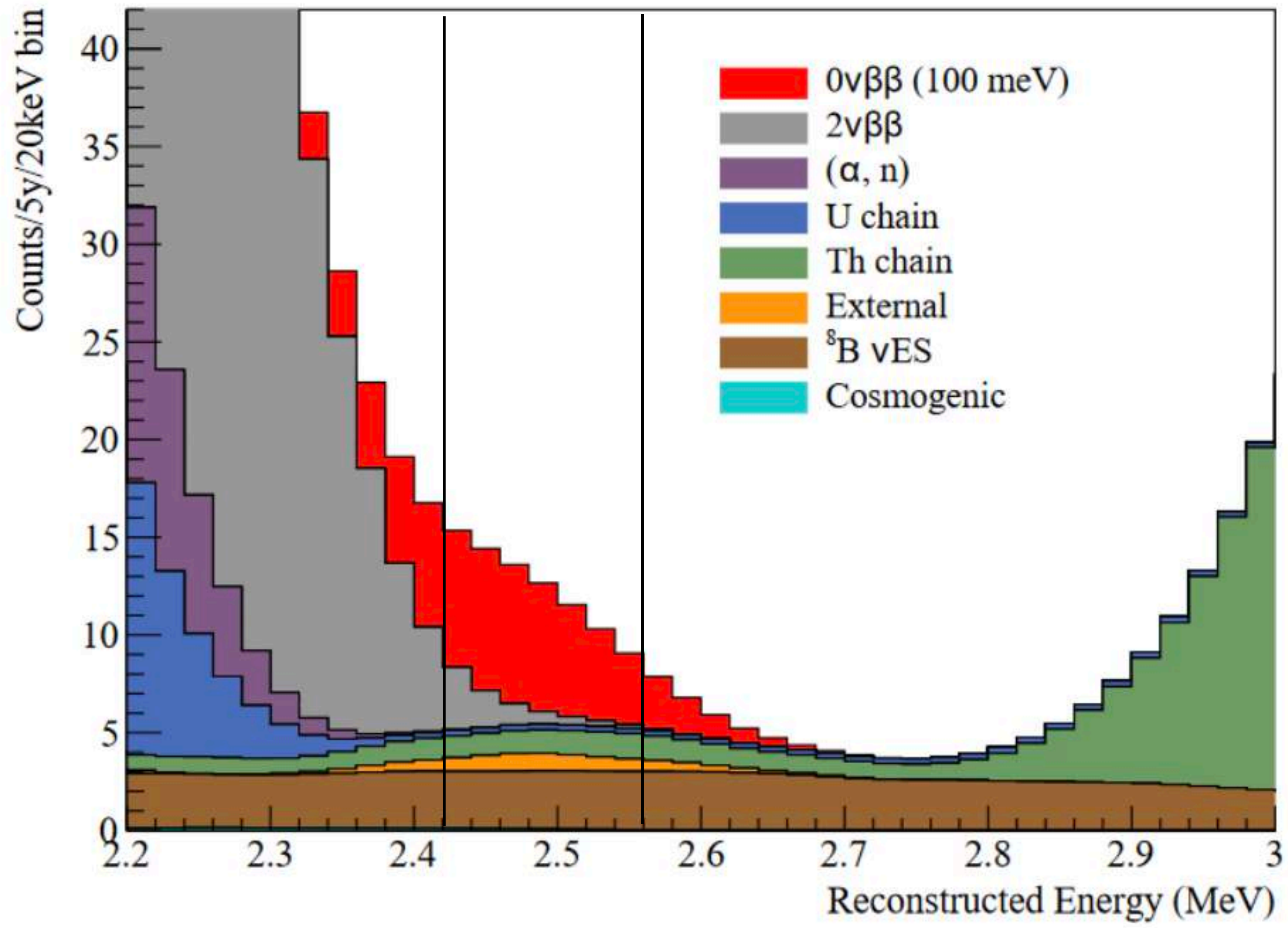
- 2 km rock overburden
- Acrylic Vessel ⌀ 12 m
- 900 tonnes ultra pure water
- 780 tonnes LAB
  - 2.2g/L PPO
- 9300 photo-multiplier tubes
- 5400 tonnes water shielding



Multi-purpose Physics Detector

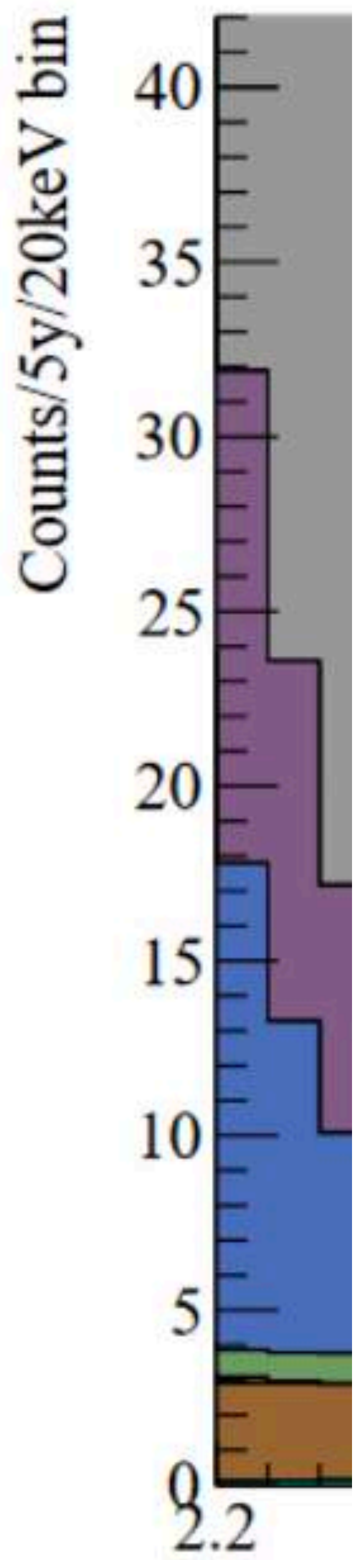
- Measurement of ^{8}B solar neutrinos with very low backgrounds: [Phys. Rev. D 99, 012012 (2019)]
- World-leading limits in invisible nucleon decay: [Phys. Rev. D 99, 032008 (2019), arXiv:2205.06400]
- High efficiency neutron detection in ultra pure water: [Phys. Rev. C 102 014002 (2020)]
- Full Detector Description: [JINST 16 P08059 (2021)]
- Detector Optics in Water Phase: [JINST 16 P10021 (2021)]
- Scintillator Characterization: [JINST 16 P05009 (2021)]
- Event-by-Event Directionality in Scintillator: In prep
- Updated ^{8}B Solar Results: In prep

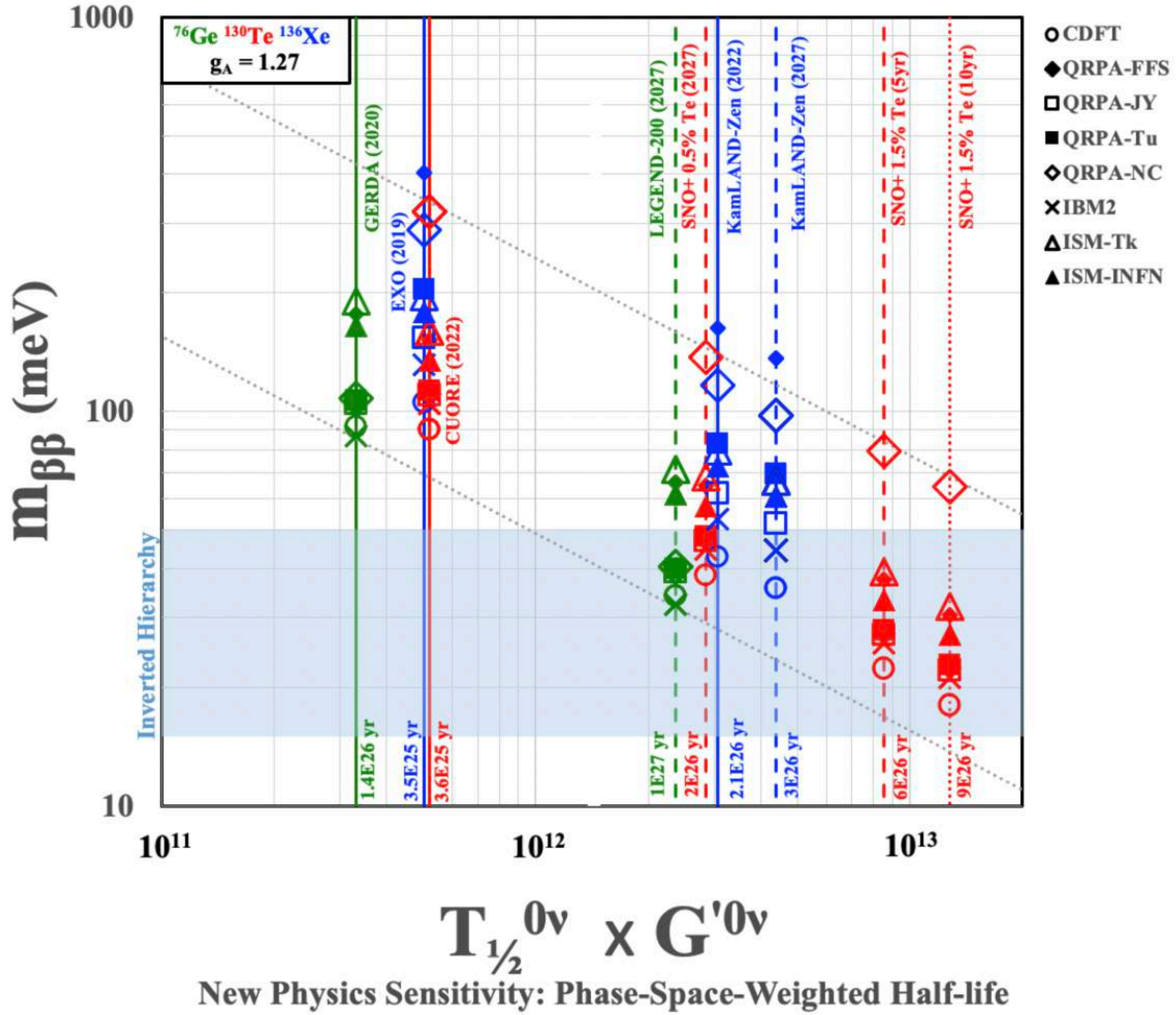
[Te-130, $Q_{\beta\beta}$ = 2528 keV, 34% NA]



- 3900 kg Te, $Q_{\beta\beta}$=2528 keV, 34% NA
- At SNOLAB (2070m, 6000 mwe)
- Natural Te loaded as metal organic complex (Te-diol) into Liquid Scintillator
- Economical, scalable approach to 0νββ; achieving sensitivity to $m_{\beta\beta}$ in the Inverted Hierarchy
- Full-scale Te-diol batches in 2022/23
- Following demonstration of operations and approvals by SNOLAB, begin Te-loading in 2024: 0.5% (1300 kg ^{130}Te)
- $T^{0\nu}_{1/2}$ > 2.1 x 10^{26} y
- $m_{\beta\beta}$ < 37-89 meV

[Te-130, $Q_{\beta\beta}$ = 2528 keV, 34% NA]





- 3900 kg Te, $Q_{\beta\beta}$=2528 keV, 34% NA
- At SNOLAB (2070m, 6000 mwe)
- Natural Te loaded as metal organic complex (Te-diol) into Liquid Scintillator
- Economical, scalable approach to $0\nu\beta\beta$; achieving sensitivity to $m_{\beta\beta}$ in the Inverted Hierarchy
- Full-scale Te-diol batches in 2022/23
- Following demonstration of operations and approvals by SNOLAB, begin Te-loading in 2024: 0.5% (1300 kg ^{130}Te)
- $T^{0\nu}_{1/2}$ > 2.1 x 10^{26} y
- $m_{\beta\beta}$ < 37-89 meV
- R&D on higher (up to 3%) Te-loading ongoing [DOI:10.1088/1742-6596/888/1/012084]

[Te-130, $Q_{\beta\beta}$ = 2528 keV, 34% NA]

KamLAND

Kamioka Liquid scintillator Anti-Neutrino Detector

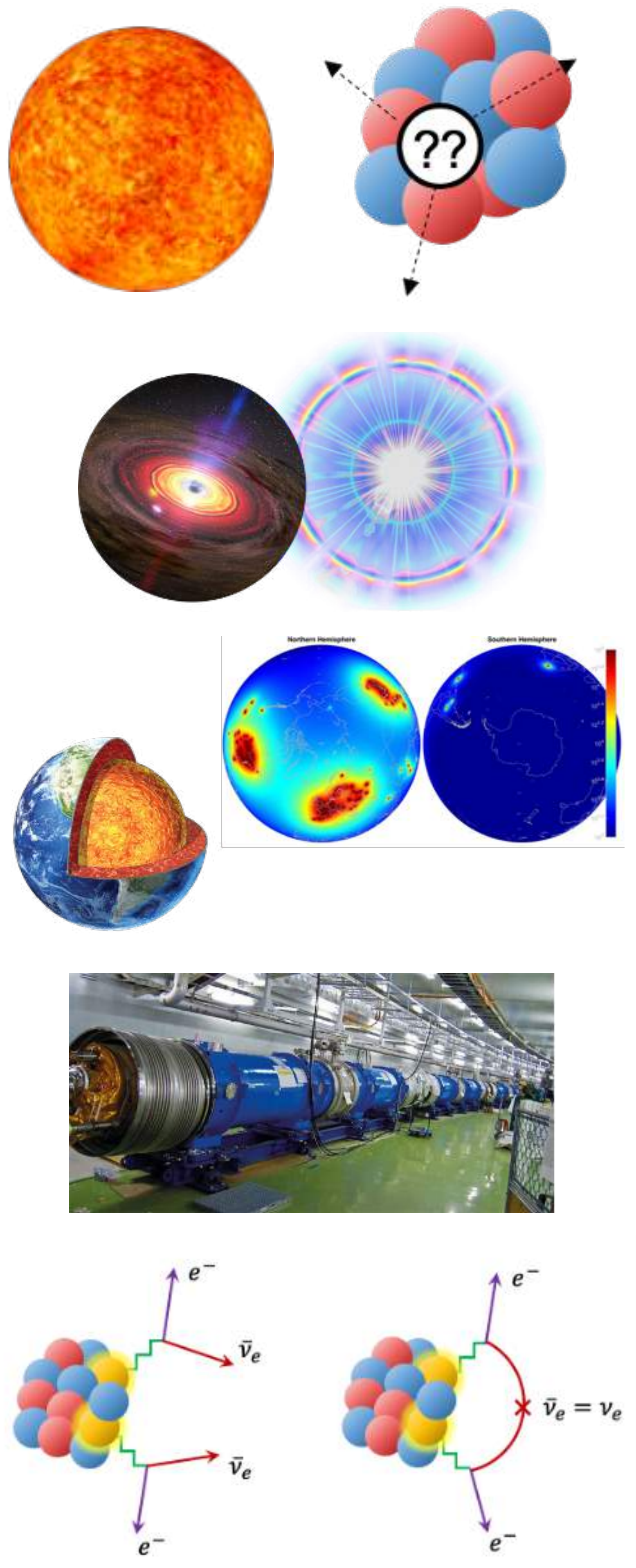
Zero neutrino double beta decay search

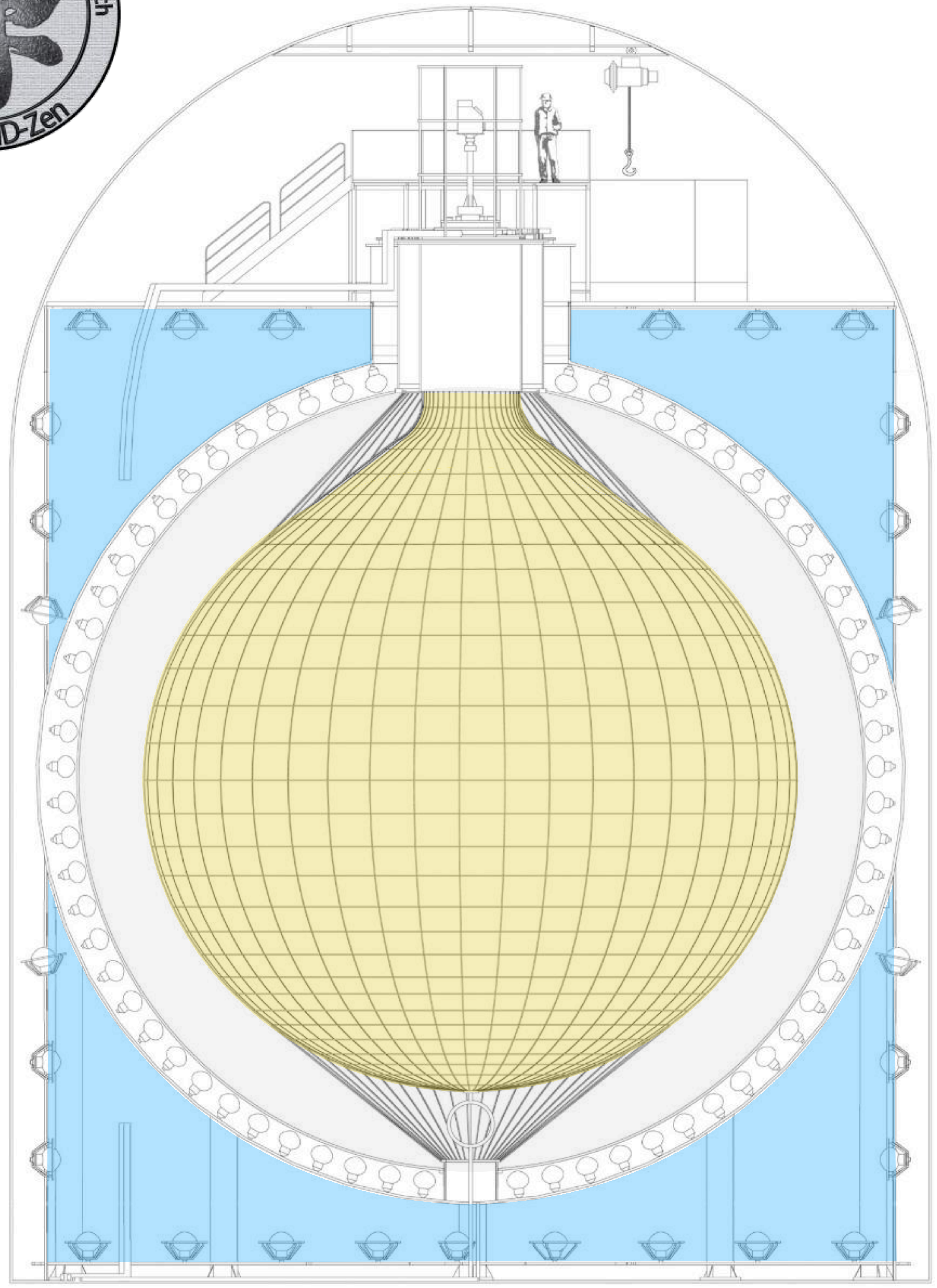
禅

KamLAND-Zen

from Lindley Winslow

from L. Winslow

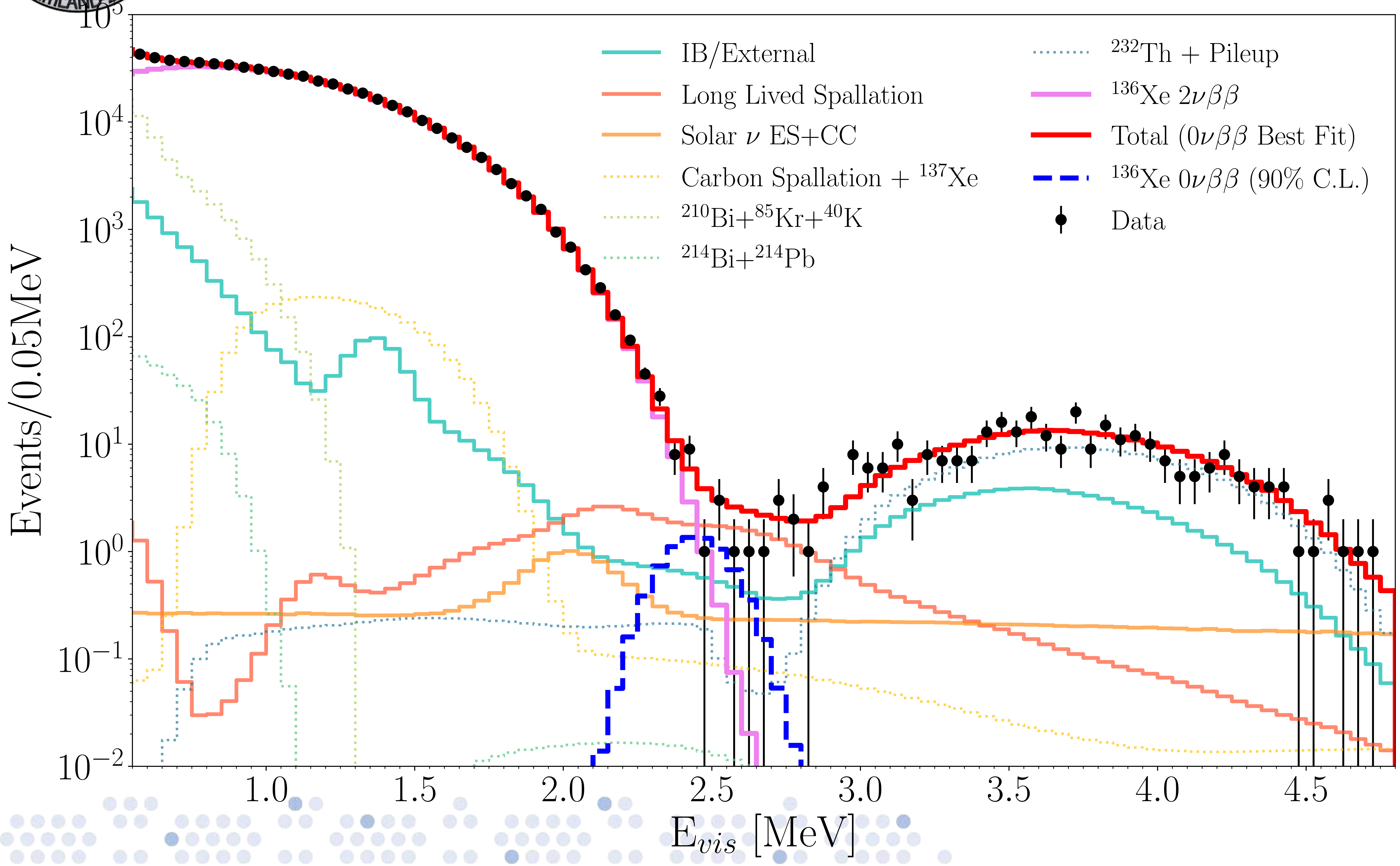




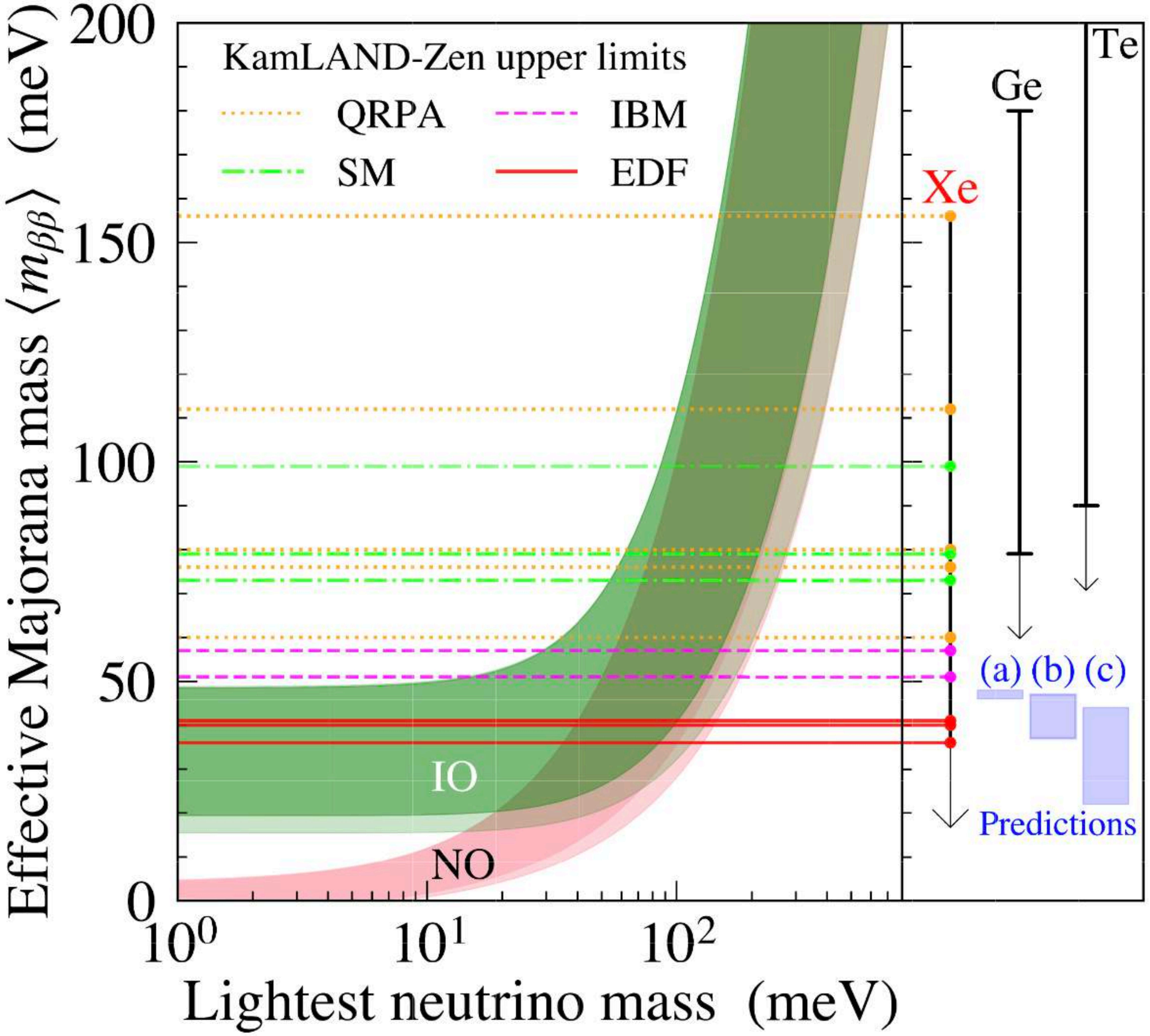
- KamLAND Detector, Kamioka Mine
  - 1,000 m, 2,700 mwe
- 1 kton ^{136}Xe Loaded Liquid Scintillator in 13-m-diameter transparent balloon
- Viewed by 1,879 photomultiplier tubes
- Energy Resolution: 6.7%/√E(MeV)
- Vertex Resolution: 13.7cm/√E(MeV)
- Water Cherenkov outer detector (for tagging muons)
- LMA Solution to Solar Neutrino Problem: [PRL 100, 221803 (2008)]
- First Observation of Geoneutrinos: [Nature 436, 499-503 (2005)]

[Xe-136, $Q_{\beta\beta}$ = 2458 keV, 8.9% NA]

from L. Winslow



from L. Winslow



- KLZ-800:
  - $T^{0\nu}_{1/2} > 2.0 \times 10^{26}$ y (90% CL)
- KLZ-400 + KLZ-800:
  - Limit: $T^{0\nu}_{1/2} > 2.3 \times 10^{26}$ y (90% CL)
  - $m_{\beta\beta} < 36 - 156$ meV
- Improved light yield, light collection, and increased Xe loading in scintillating balloon

arXiv:2203.02139; arXiv:2203.01870

[Xe-136, $Q_{\beta\beta} = 2458$ keV, 8.9% NA]

from J.J. Gomez-Cadenas

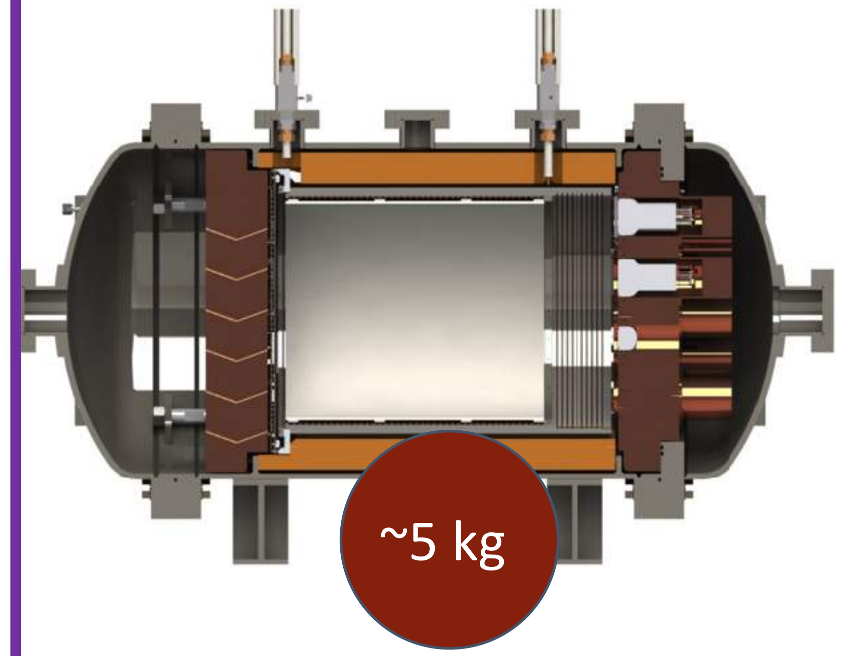
from J.J. Gomez-Cadenas

NEXT-White

2015-2021

Background model assessment

$2\nu\beta\beta$ measurement for ^{136}Xe

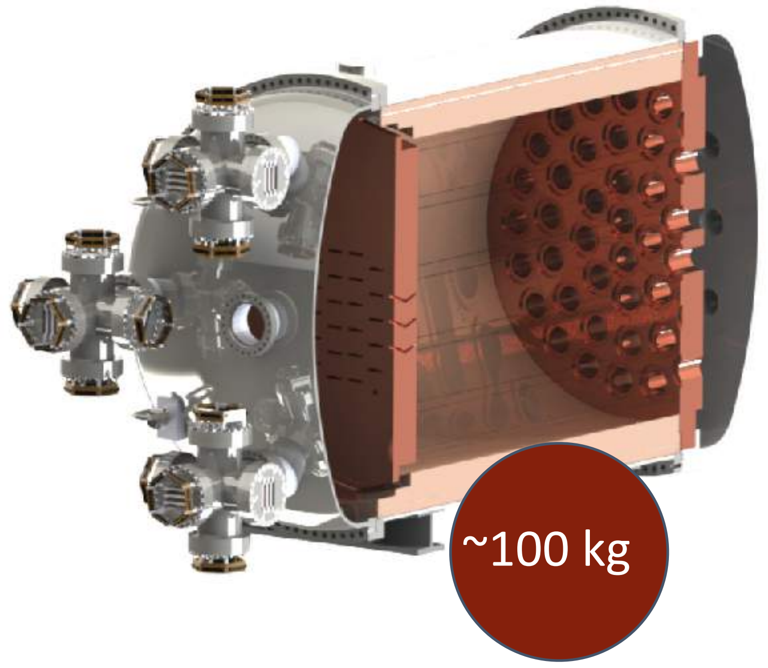


NEXT-100

2022-2025

Background model assessment

Neutrinoless double beta decay search in ^{136}Xe



NEXT-HD

2026?

Neutrinoless double beta decay search through inverted neutrino mass ordering

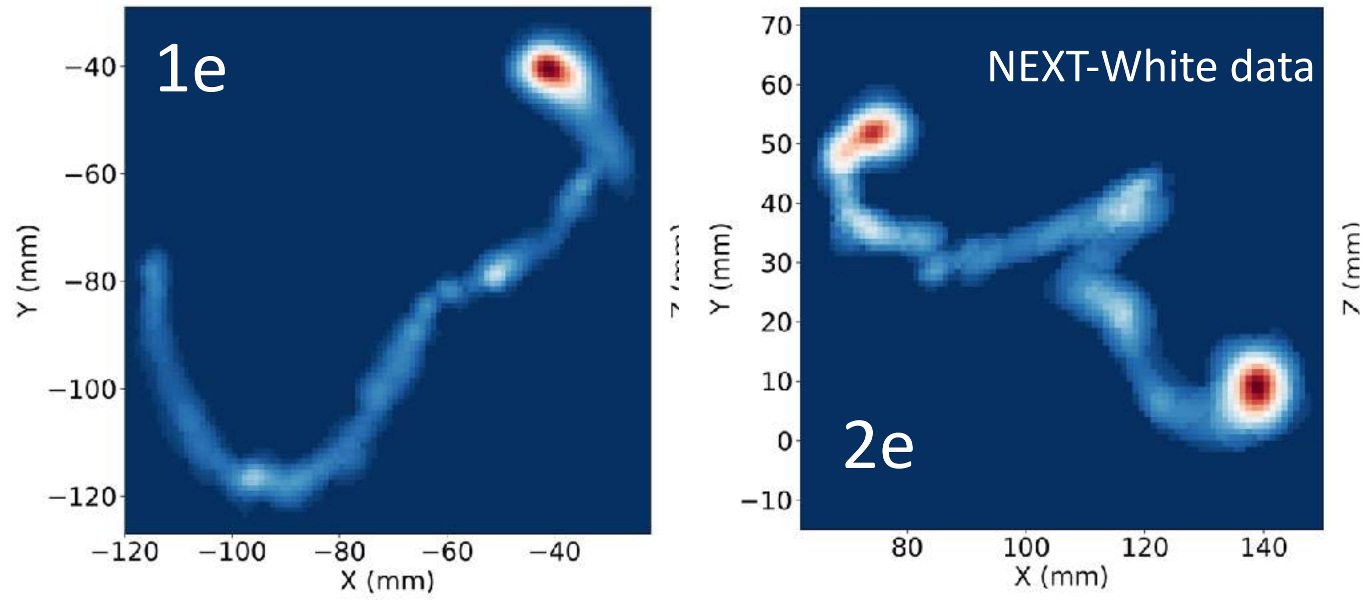
NEXT-BOLD

Barium tagging for background-free experiment

2015 2021 2022 2025 2026

- Xe-136 Gas Time Projection Chamber
- TPC gives topological event identification to distinguish event types
- Laboratorio Subterráneo Canfranc
- Staged Approach:
- NEXT-White (2015-2021)
  - 5 kg
  - Bkg model assessment
- NEXT-100 (2022-2025)
  - 100 kg
  - Bkg model assessment
  - $0\nu\beta\beta$ search

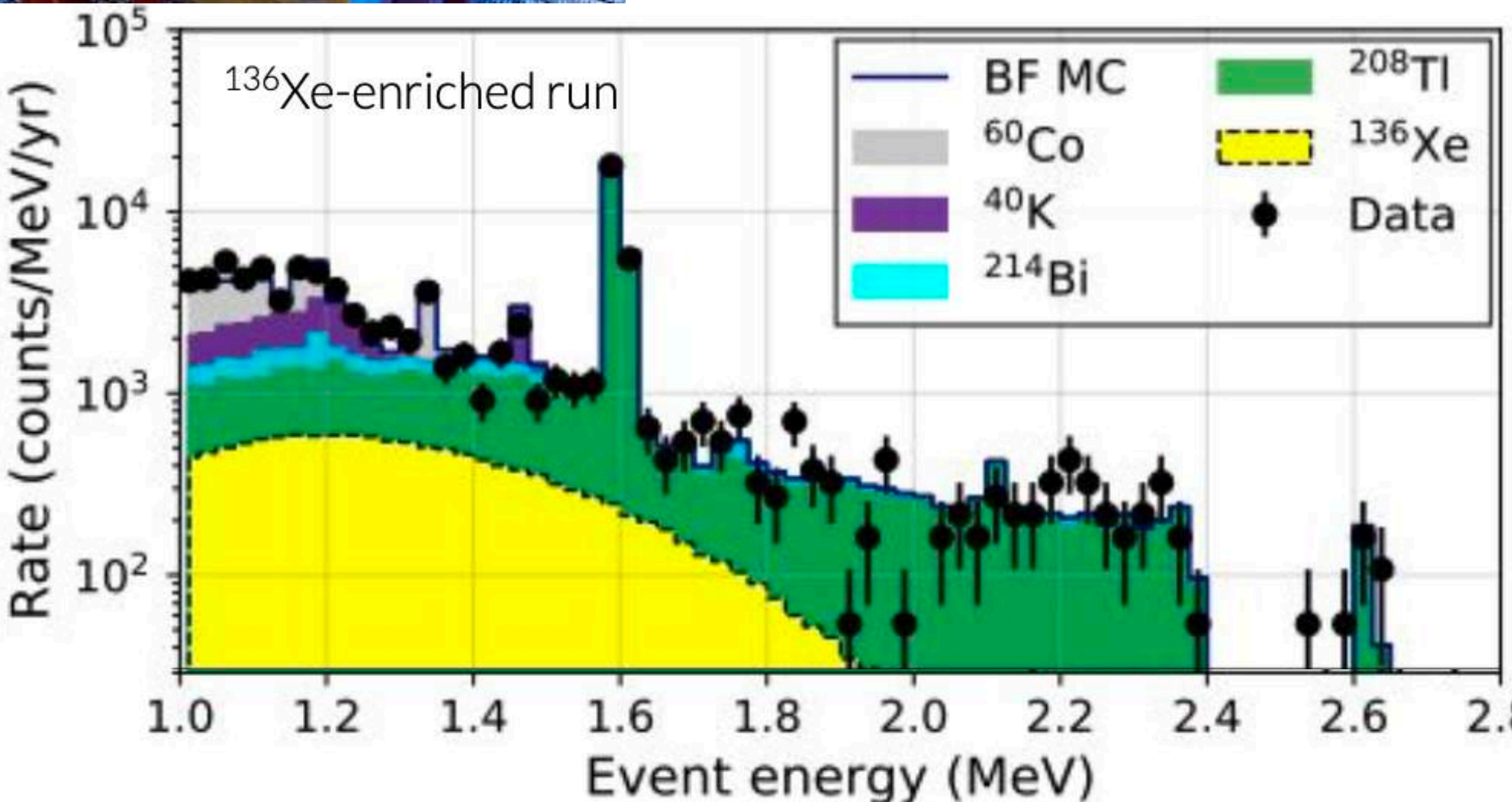
- Future Goal: < 1% FWHM energy resolution
- Looking to detect daughter ion, $^{136}Ba^{++}$

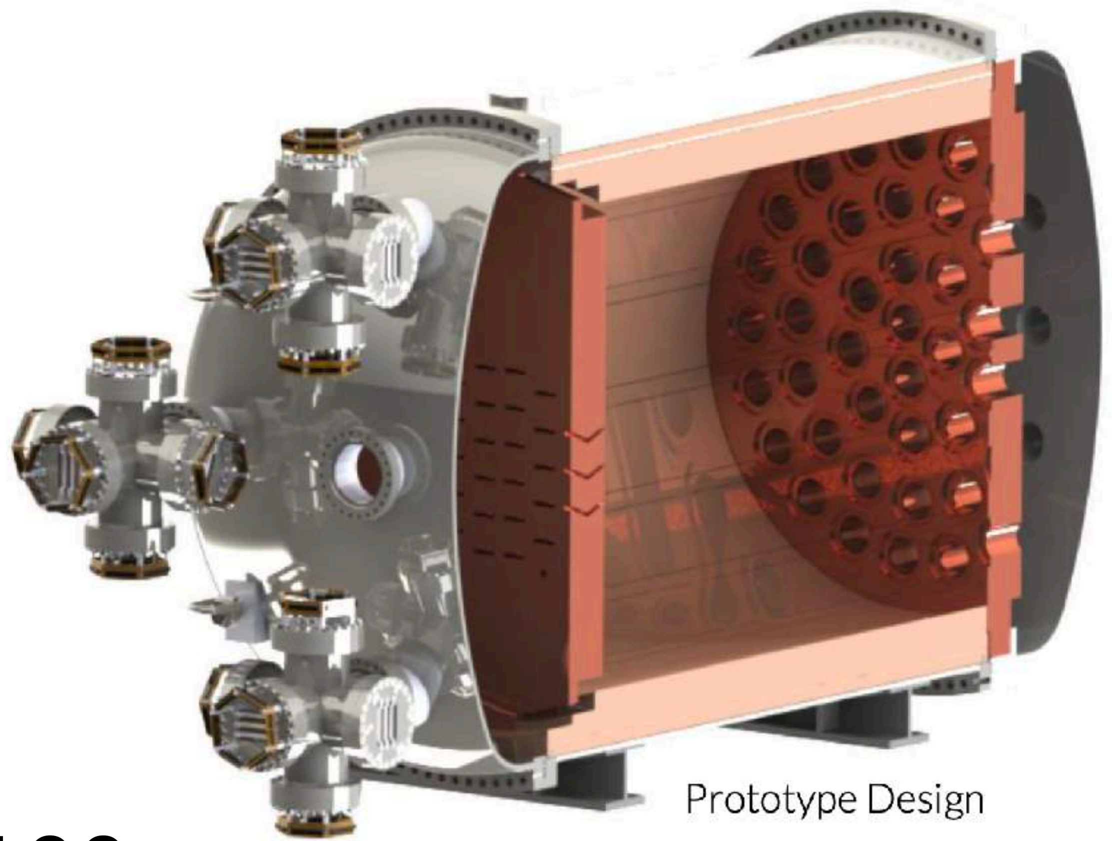


from J.J. Gomez-Cadenas

- NEXT-White
- Energy resolution: 0.91±0.12% FWHM at 2.6 MeV
- 5 kg Xe Gas
- $T^{2\nu}_{1/2} = 2.34\ ^{+0.85}_{-0.49} \times 10^{21}$ y

JHEP 10 (2018) 112; JHEP 10 (2019) 051; Phys.Rev.C 105 (2022) 5, 055501; JHEP 10 (2019) 052; JHEP 01 (2021) 189; JHEP 07 (2021) 146; JINST 13 (2018) 10, P10020; JHEP 10 (2019) 230





- NEXT-100
- Under construction at the LSC
- Goals: demonstration of nearly background-free conditions at 100 kg scale, 0νββ search, technology demonstrator for ton scale [JHEP 05 (2016) 159]
- Target background rate: 4×10^{-4} counts/(keV·kg·yr), or ~1 count/(ROI·yr)
- Sensitivity: $T^{0\nu}_{1/2} > 6.0 \times 10^{25}$ y

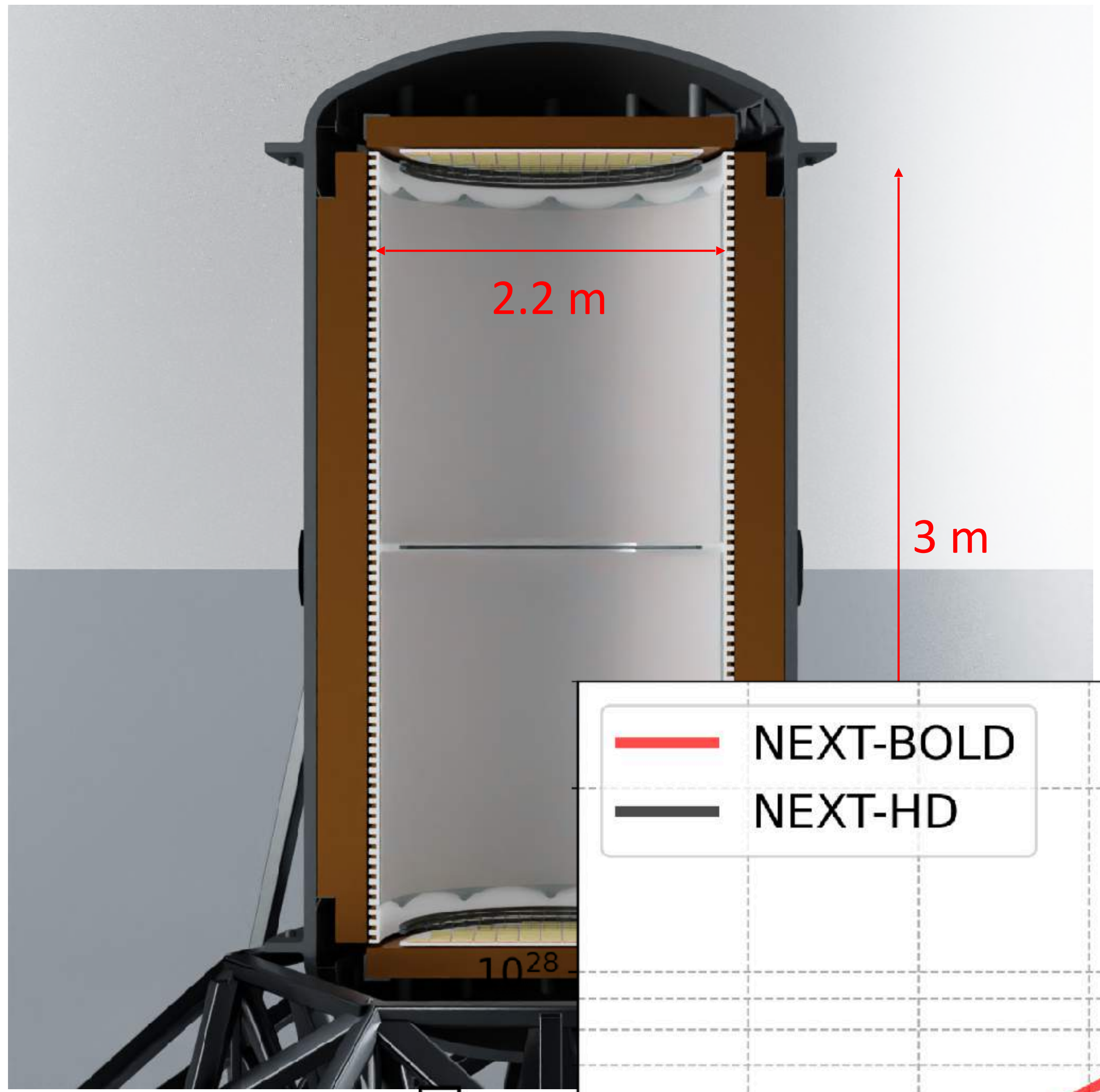
arXiv:1511.09246

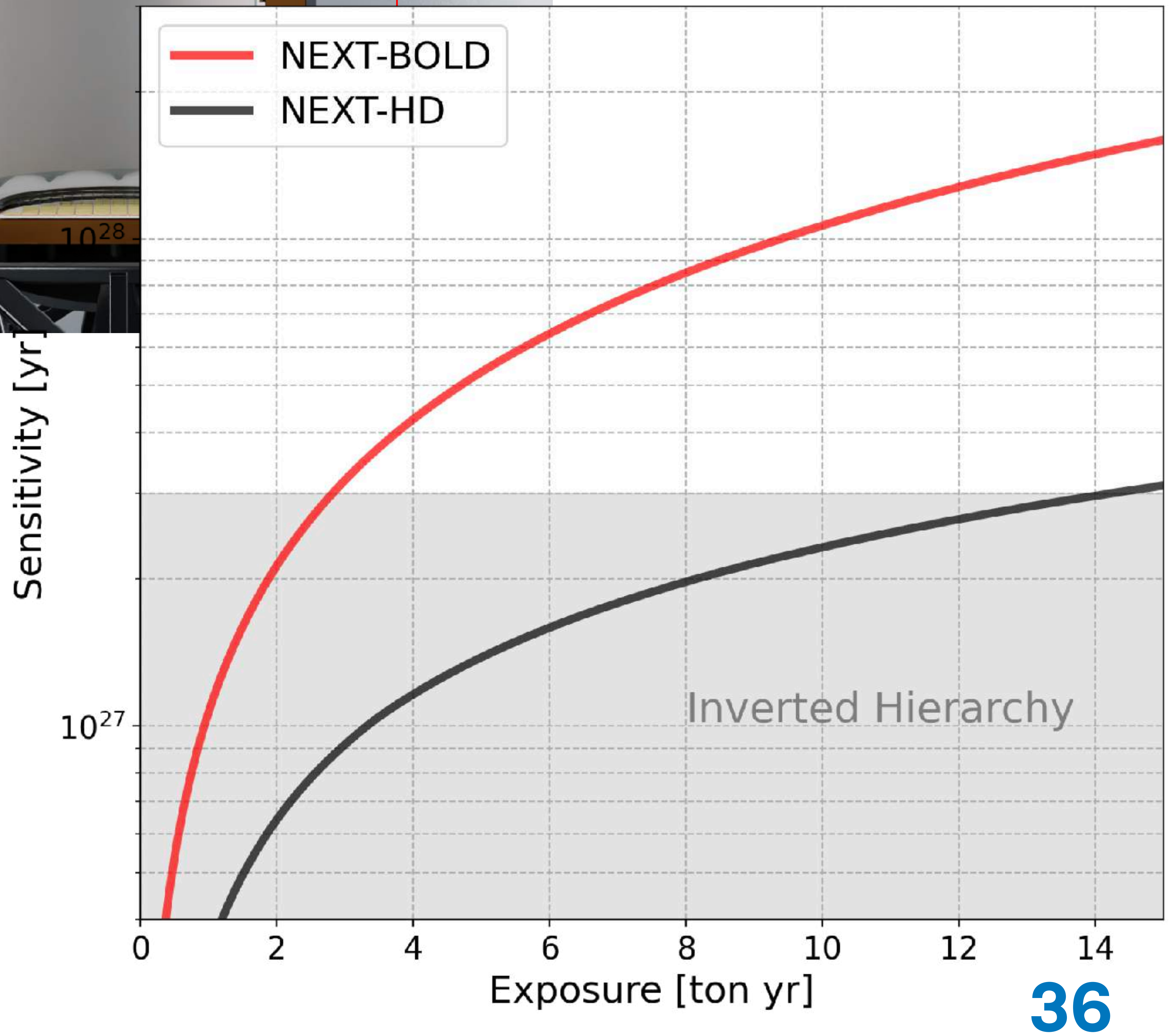
[Xe-136, $Q_{\beta\beta}$ = 2458 keV, 8.9% NA]

Tonne Scale

from J.J. Gomez-Cadenas

- NEXT-HD first module, proposed to operate at the LSC, can reach 10^{27} yr sensitivity with 4 ton·yr exposure, with ~1 tonne ^{136}Xe gas
  - Siting of subsequent modules TBD (likely a deeper site). [JHEP 2021 (2021) 08, 164]
- To explore 10^{28} yr sensitivity, further background reduction and higher efficiency are essential
- Both may be achieved with NEXT-BOLD, implementing Barium Tagging
- Single molecule fluorescent imaging employed to detect Ba^{++} produced in double beta decay - could enable truly a background-free tonne-scale technology





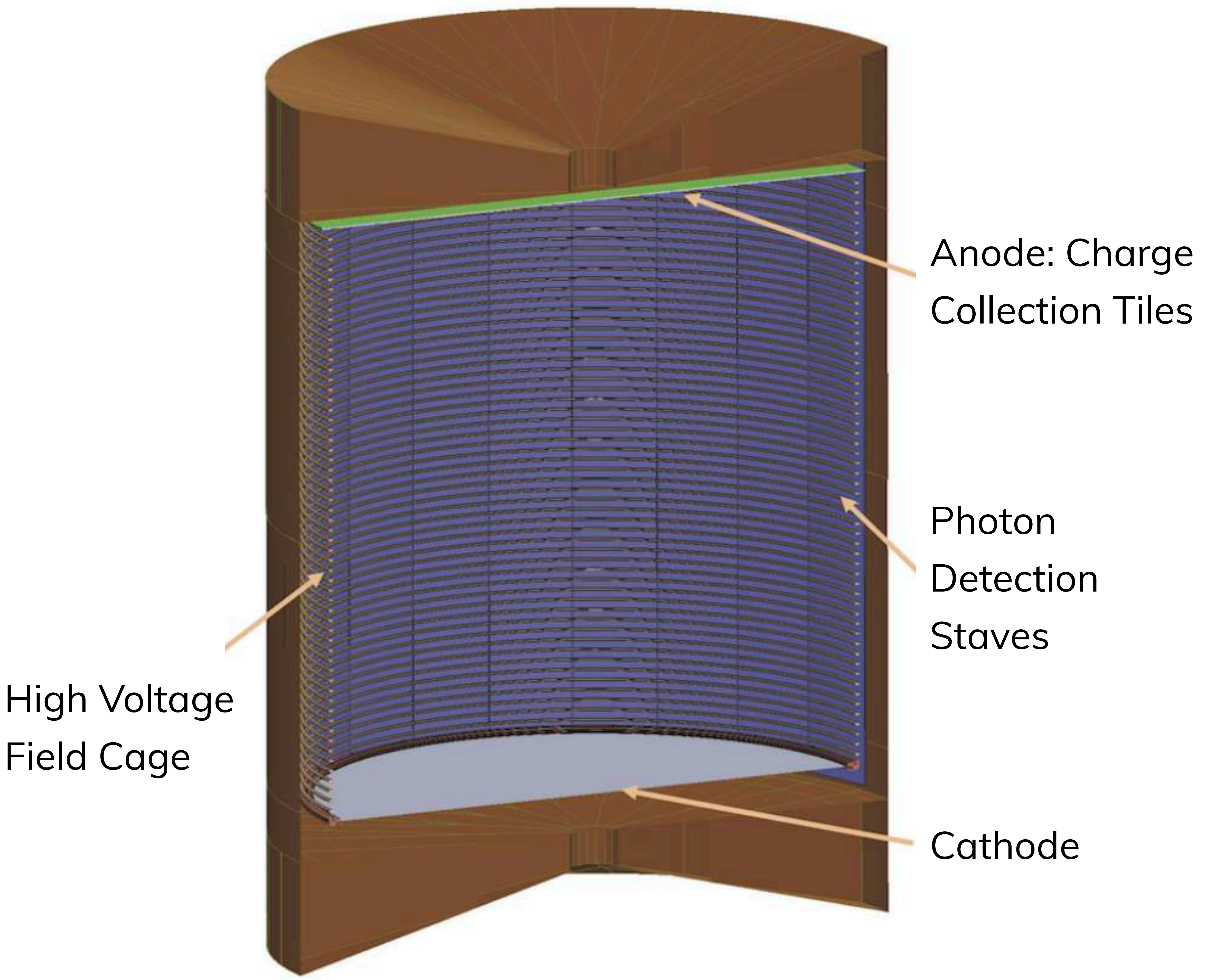
[Xe-136, $Q_{\beta\beta}$ = 2458 keV, 8.9% NA]

JINST 11 (2016) 12, P12011; Phys.Rev.A 97 (2018) 6, 062509; Phys. Rev. Lett. 120 (2018) 13, 132504; JINST 15 (2020) 04, P04022; Sci.Rep. 9 (2019) 1, 15097; ACS Sens. 6 (2021) 1, 192-202; arXiv:2109.05902; Nature 583 (2020) 7814, 48-54 , arXiv:2109.05902

nEXO

nEXO

SNOLAB

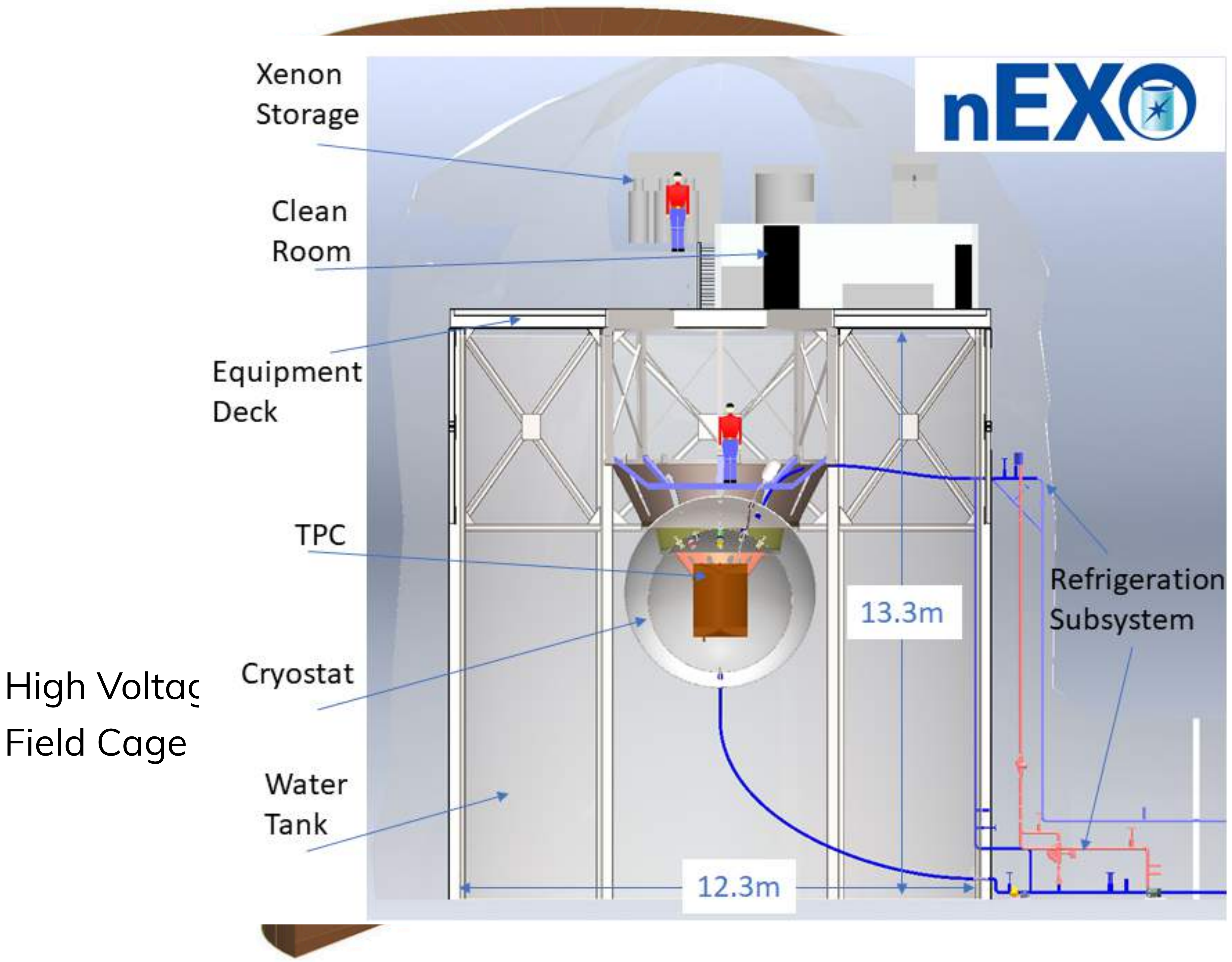


arXiv:1805.11142

- Continuation of EXO-200 program
  - First measurement of $2\nu\beta\beta$ in ^{136}Xe [PRL 107, 212501 (2011)]
  - $T^{0\nu}_{1/2} > 3.5 \times 10^{25}$ yr (90% CL)
  - $m_{\beta\beta} < (93 - 286)$ meV [PRL 123 161802 (2019)]
- nEXO: 5 tonne Liquid Xenon TPC
- Xe-136, $Q_{\beta\beta}$ = 2458 keV, 8.9% NA
- SiPM for 175nm scintillation light detection, ~4.5 m^2 array in LXe
- Tiles for charge read out in LXe
- In-cold electronics inside TPC
- Energy Resolution <1% at $Q_{\beta\beta}$
- Limit: $T^{0\nu}_{1/2} > 1.35 \times 10^{28}$ y

[Xe-136, $Q_{\beta\beta}$ = 2458 keV, 8.9% NA]

nEXO



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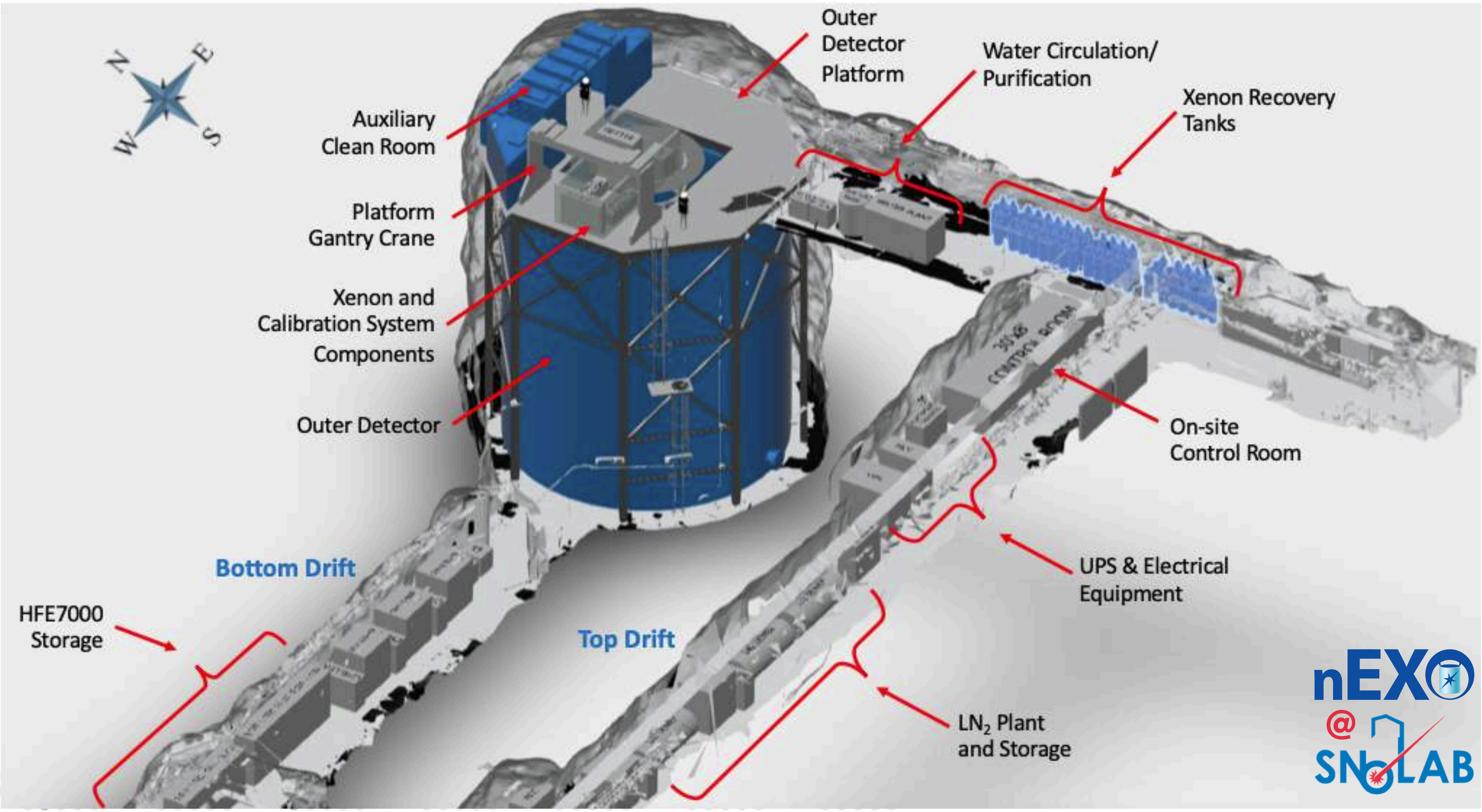
- In-cold electronics inside TPC
- Energy Resolution <1% at $Q_{\beta\beta}$
- Limit: $T^{0\nu}_{1/2} > 1.35 \times 10^{28}$ y
- Proposed for SNOLAB's Cryopit (6000 mwe)

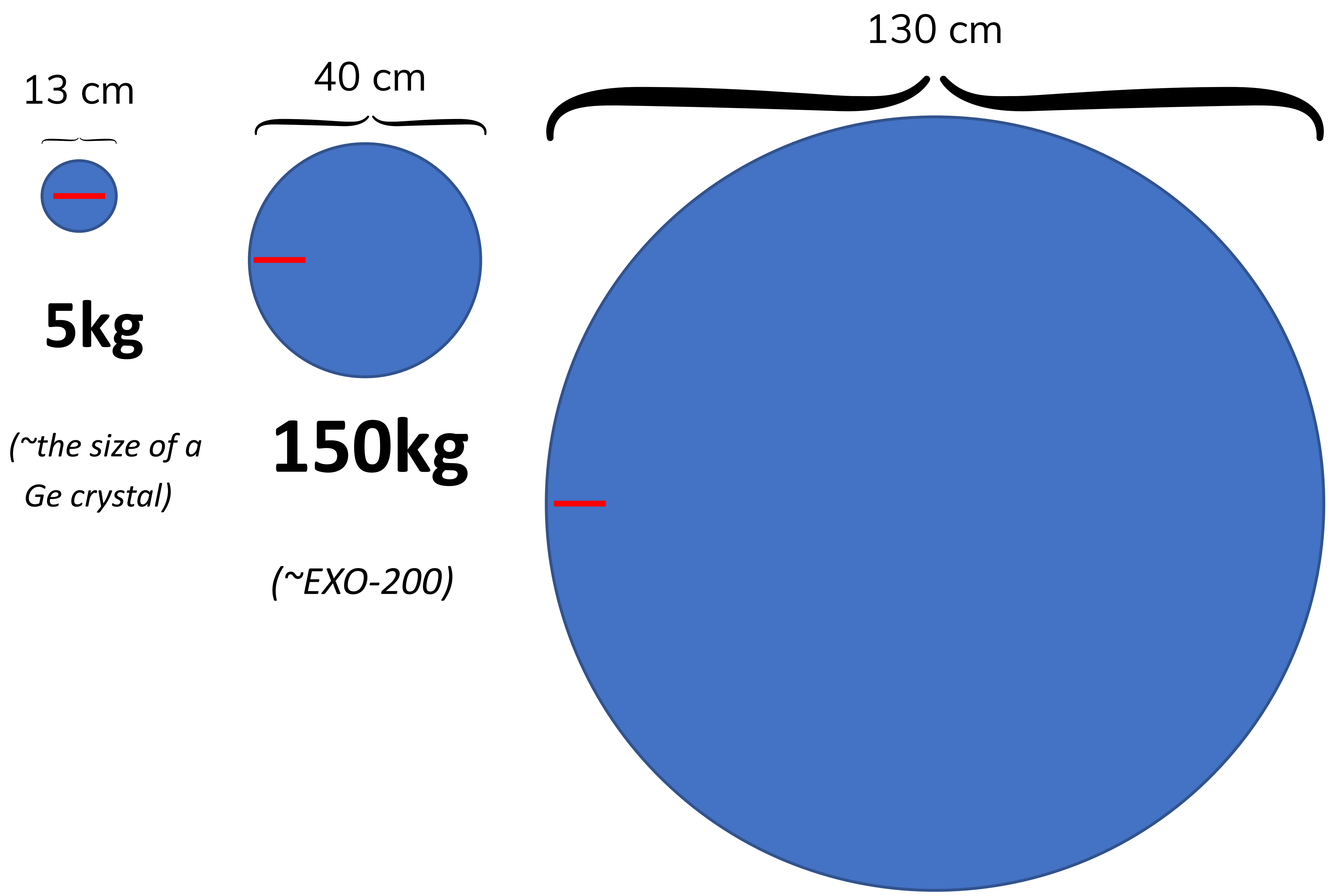
[Xe-136, $Q_{\beta\beta}$ = 2458 keV, 8.9% NA]



N
E
W
S
Outer Detector Platform
Water Circulation/ Purification
Xenon Recovery Tanks
Auxiliary Clean Room
Platform Gantry Crane
Xenon and Calibration System Components
Outer Detector
On-site Control Room
UPS & Electrical Equipment
Bottom Drift
Top Drift
HFE7000 Storage
LN_2 Plant and Storage
nEXO
@
SNOLAB

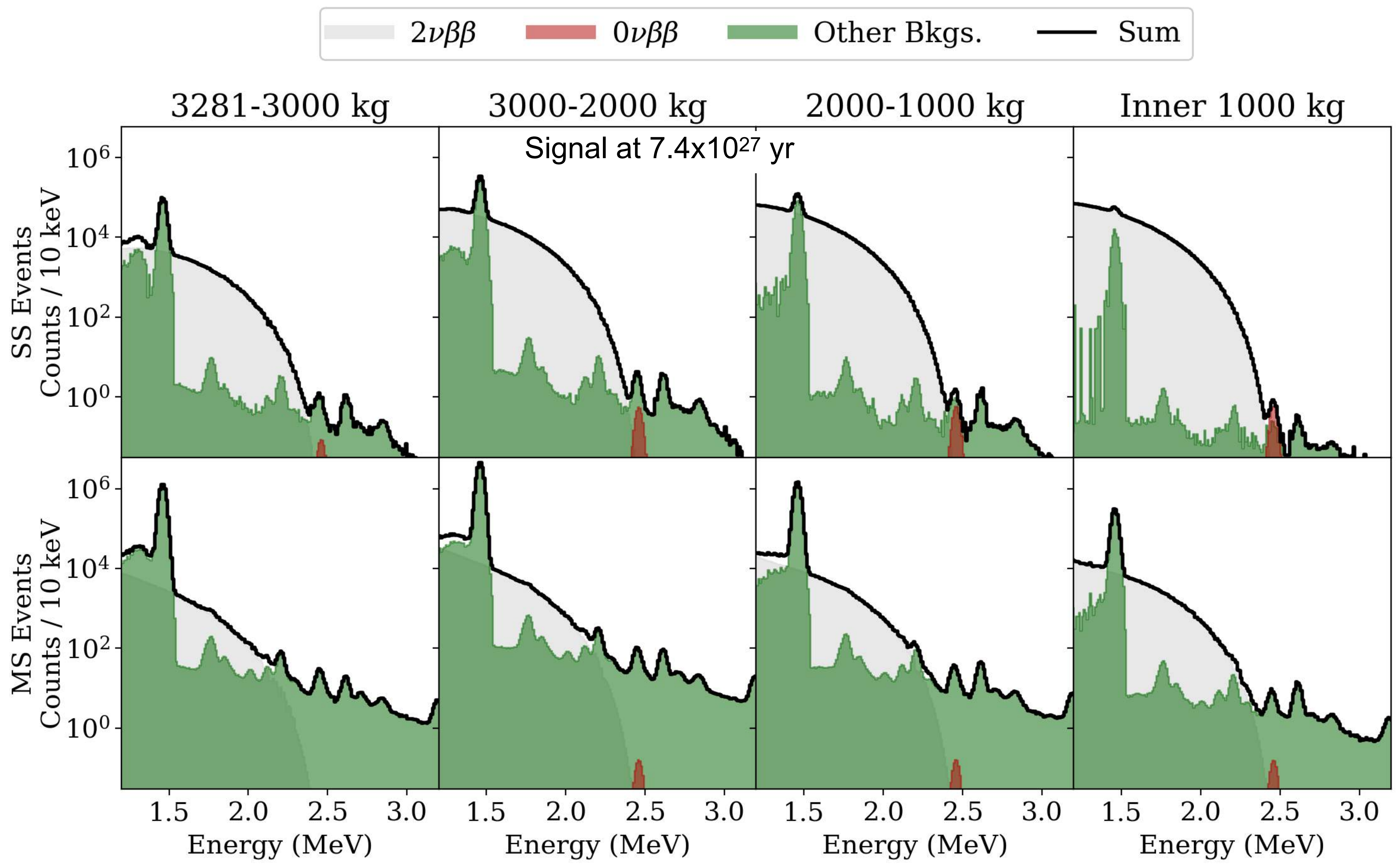
nEXO

SNOLAB



5000kg (nEXO)

2.5 MeV γ attenuation length 8.7cm = —

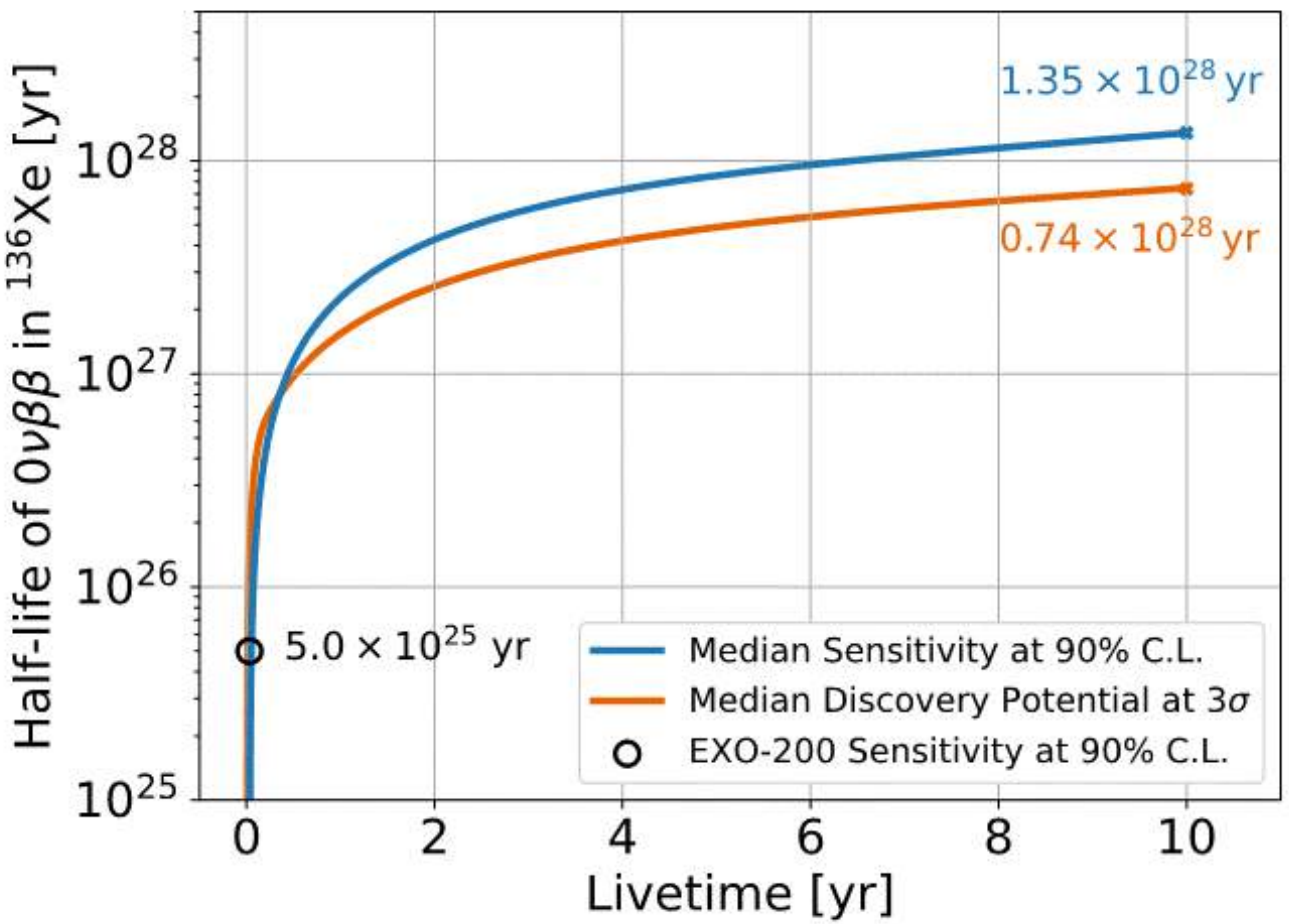


[J. Phys. G: Nucl. Part. Phys. 49 (2022) 015104]

[Xe-136, $Q_{\beta\beta}$ = 2458 keV, 8.9% NA]

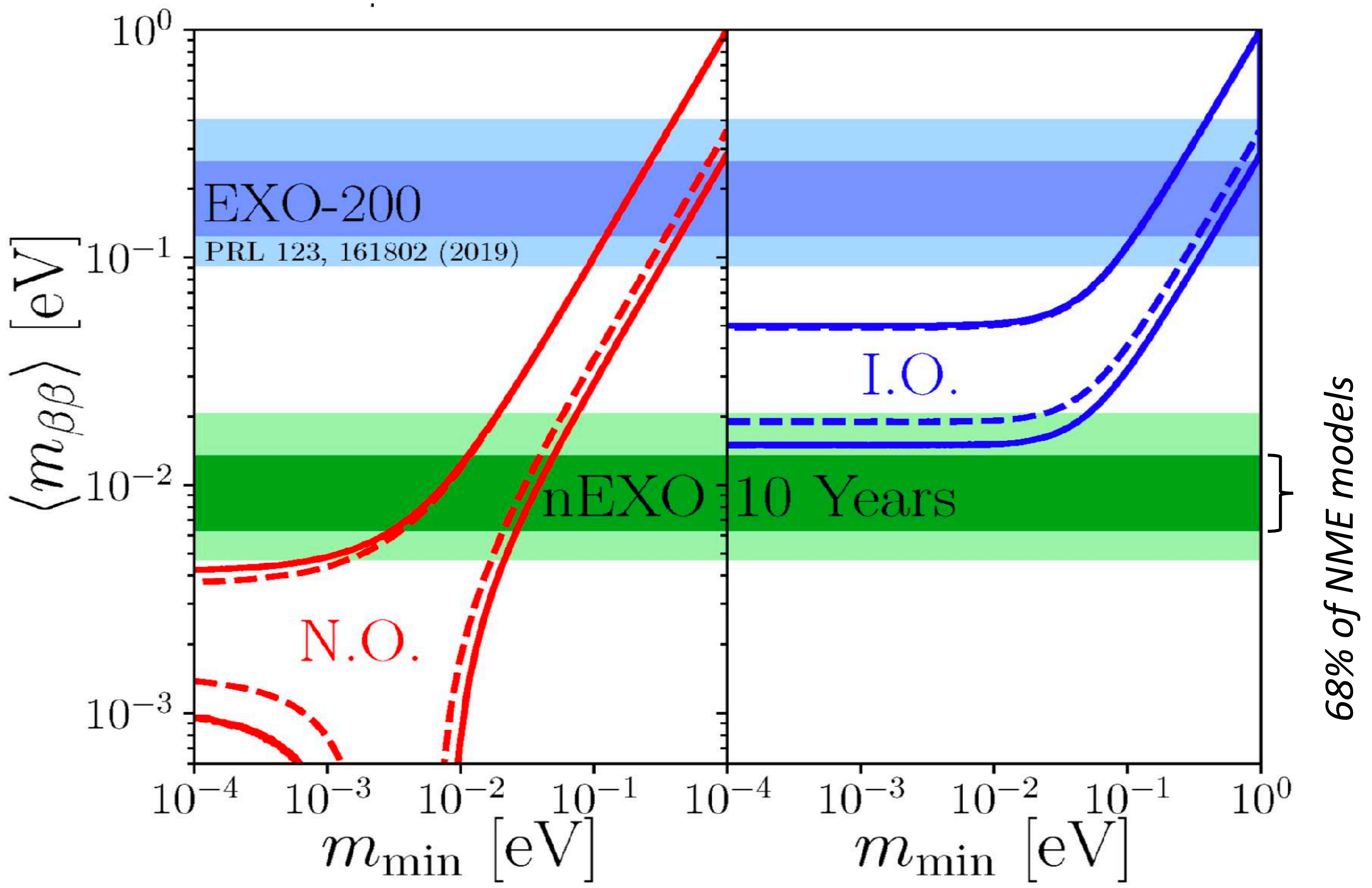
nEXO

SNOLAB



nEXO sensitivity reaches 10^{28} yr in 6.5 yr data taking

Allowed parameter space and nEXO exclusion sensitivity (90% CL):



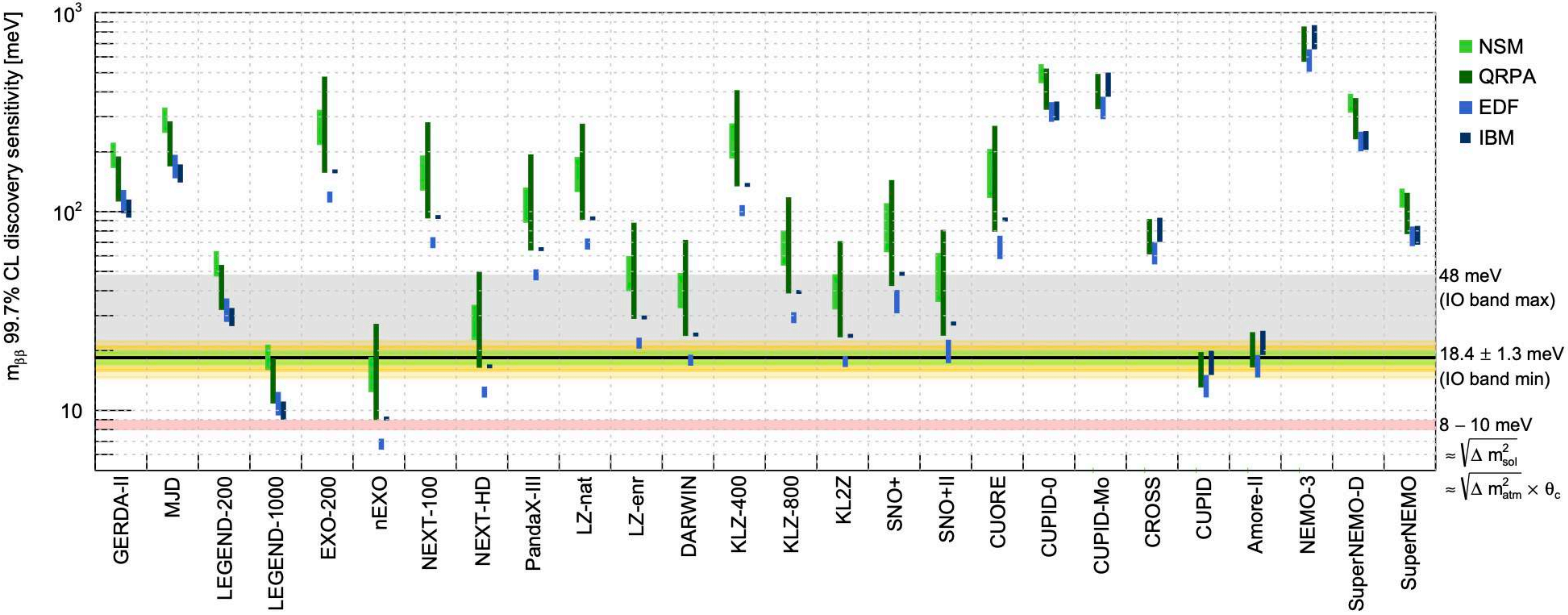
[J. Phys. G: Nucl. Part. Phys. 49 (2022) 015104]

[Xe-136, $Q_{\beta\beta}$ = 2458 keV, 8.9% NA]

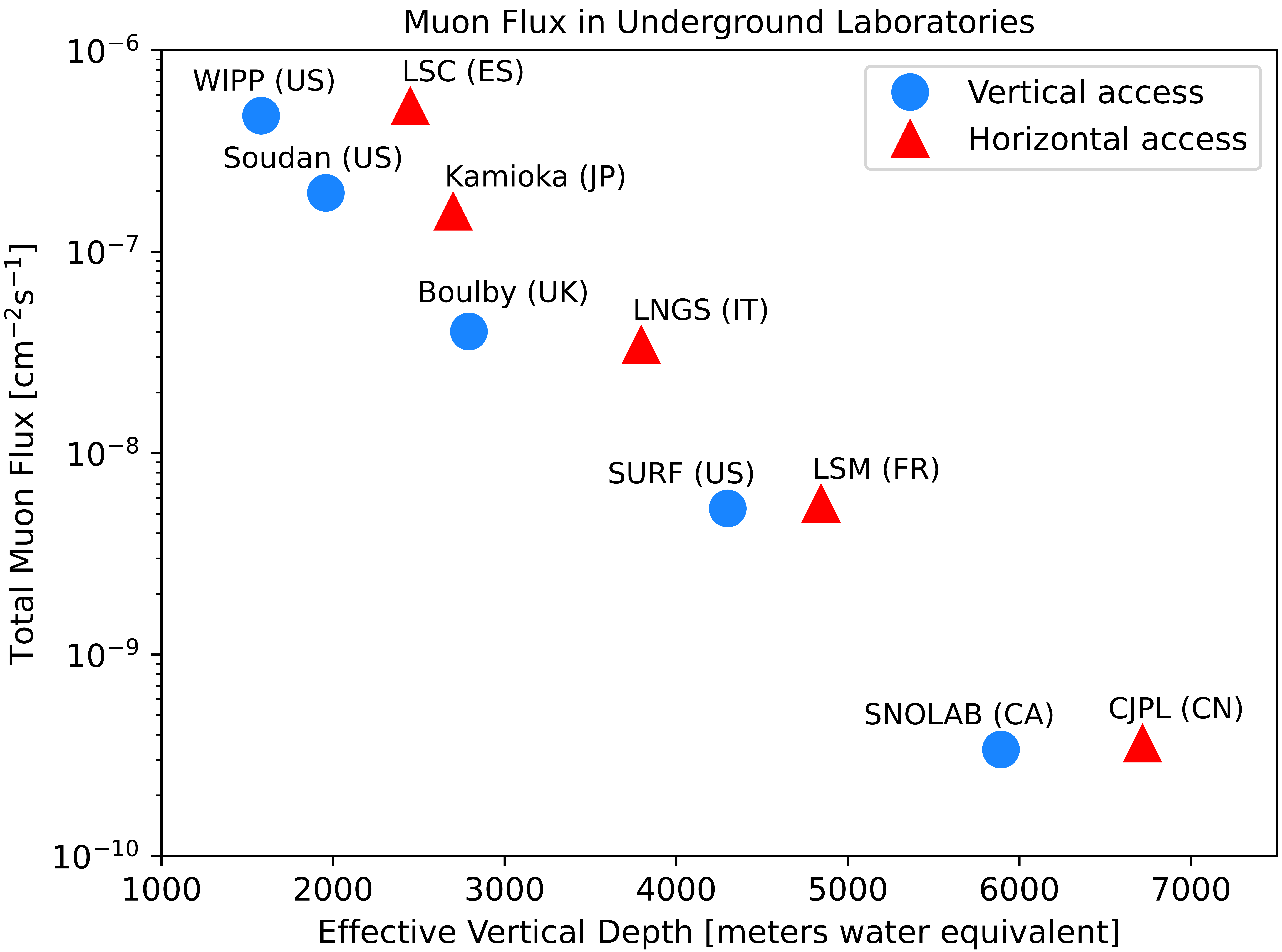
What's Next?

Discovery sensitivities of current- and next-generation 0νββ experiments

Schönert, Nu'22



[arXiv:2202.01787]



Adapted from Chin. Phys. C 45 (2021) 2, 025001

A healthy neutrinoless double-beta decay program requires more than one isotope.

- Nuclear matrix elements are not very well known and any given isotope could come with unknown liabilities
- Different isotopes correspond to vastly different experimental techniques
- 2 neutrino background is different for various isotopes
- Understanding the mechanism producing the decay requires the analysis of more than one isotope

North America - Europe Workshop on Future of Double Beta Decay

September 29, 2021 to October 1, 2021
Gran Sasso National Laboratory (LNGS)
Europe/Rome timezone

Enter your search term

- Overview
- Timetable
- Pre-registration form
- Accommodation
- Travel info
- Venue

Contact
doublebeta@lngs.infn.it

The Majorana nature of neutrino and the possible contribution of neutrinos to explain the matter-antimatter asymmetry in the universe are among the most challenging physics goals in the next decade. The purpose of the North America-Europe workshop on Double Beta Decay is to stimulate the discussion between the North American and European double beta decay community and the corresponding funding agencies to consolidate a strategy and define a path to the discovery of Majorana neutrinos. The discussion will focus on the upcoming generation of high sensitivity projects, their discovery potentials and the underground infrastructures.

INFN APPEC The Workshop is jointly organized by INFN, APPEC and DOE.

"The international stakeholders in neutrino-less double beta decay research do agree in principle that the best chance for success is an international campaign with more than one large ton-scale experiment implemented in the next decade, with one ton scale experiment in Europe and the other in North America."

https://agenda.infn.it/event/27143/

Summary

- A solid international 0νββ program explores at least two different isotopes.
- Many experiments are using different technologies to search for 0νββ using different isotopes
- Experiments are scaling up based on existing projects and new R&D
- Lower backgrounds and larger exposures are key to increasing future sensitivities

Thanks to all who shared slides!

SNOLAB

Experiment	Isotope	Isotope Mass [kg]	Technology	Half-life Sensitivity [y]
AMoRE	Mo-100	178	Scintillating Bolometer	5×10^{26}
CUPID	Mo-100	240	Scintillating Bolometer	10^{27}
LEGEND	Ge-76	1000	Inverted Coaxial Point Contact Detectors	10^{28}
supernemo collaboration	Se-82	100	Tracking Calorimeter	4×10^{24}
SNO+	Te-130	1300	Liquid Scintillator	2.1×10^{26}
KamLAND-Zen	Xe-136	745	Liquid Scintillator	2.6×10^{26}
next	Xe-136	100	Gas Time Projection Chamber	6.0×10^{25}
nEXO	Xe-136	5000	Liquid Time Projection Chamber	1.35×10^{28}