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The next neutrinoless double beta decay experiment

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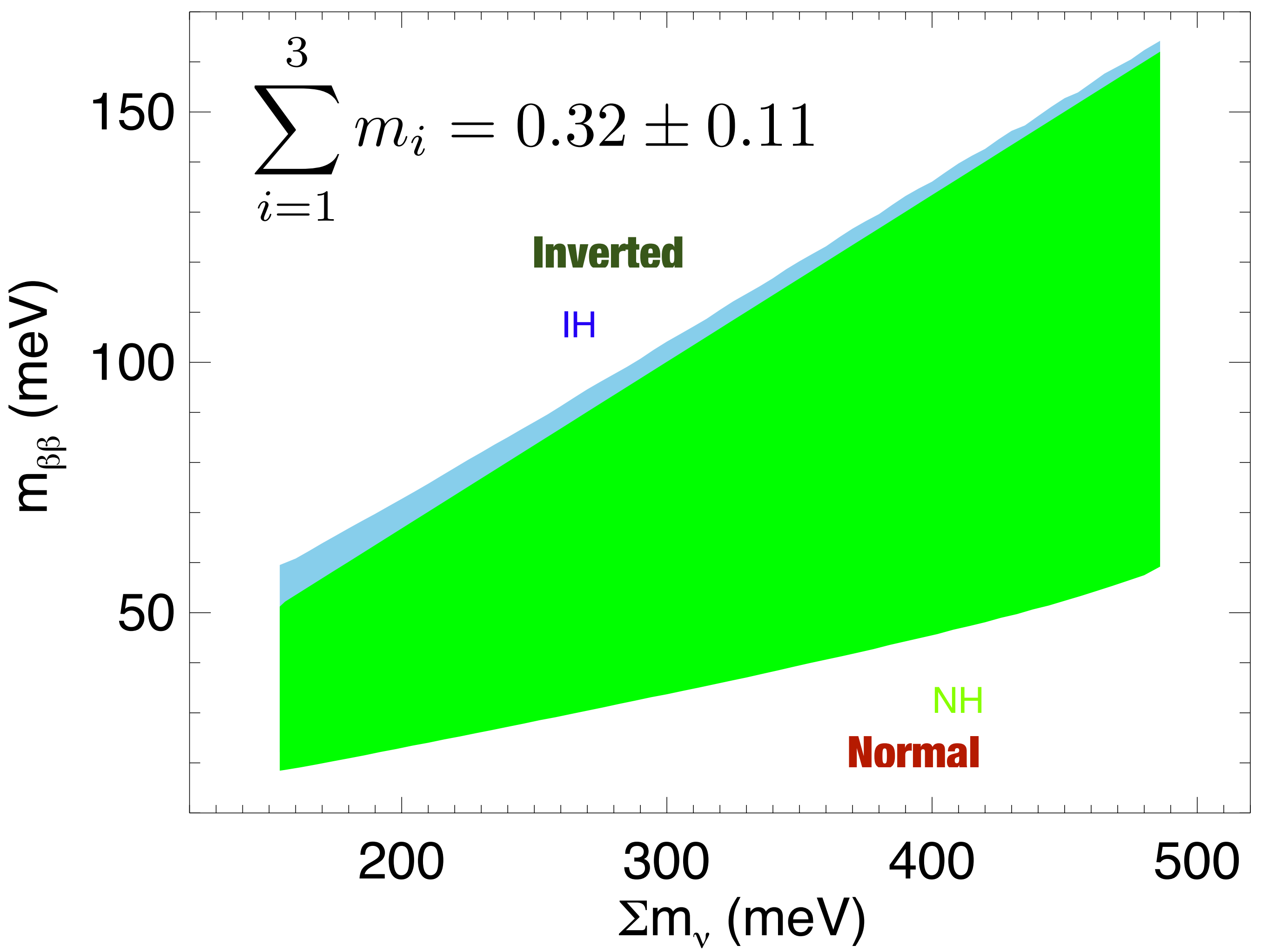
IFIC (CSIC & UVEG)

Fermilab/Argonne, February 2014



ββ0ν searches

Outstanding questions about neutrinos

Identity	Dirac or Majorana fermion?
Mass scale	What is the neutrino mass value?
Mass ordering	Normal or inverted?
Mixing	Is CP symmetry violated in the neutrino sector?
Species	Are there light sterile neutrinos?

Are neutrinos massive? Maybe….

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Massive neutrinos solve a cosmological conundrum

10 Feb 2014

Scientists have solved a major problem with the current standard model of cosmology identified by combining results from the Planck spacecraft and measurements of gravitational lensing in order to deduce the mass of ghostly sub-atomic particles called neutrinos.

The team, from the universities of Manchester and Nottingham, used observations of the Big Bang and the curvature of space-time to accurately measure the mass of these elementary particles for the first time.

The recent Planck spacecraft observations of the Cosmic Microwave Background (CMB) – the fading glow of the Big Bang – highlighted a discrepancy between these cosmological results and the predictions from other types of observations.

The CMB is the oldest light in the Universe, and its study has allowed scientists to accurately measure cosmological parameters, such as the amount of matter in the Universe and its age. But an inconsistency arises when large-scale structures of the Universe, such as the distribution of galaxies, are observed.

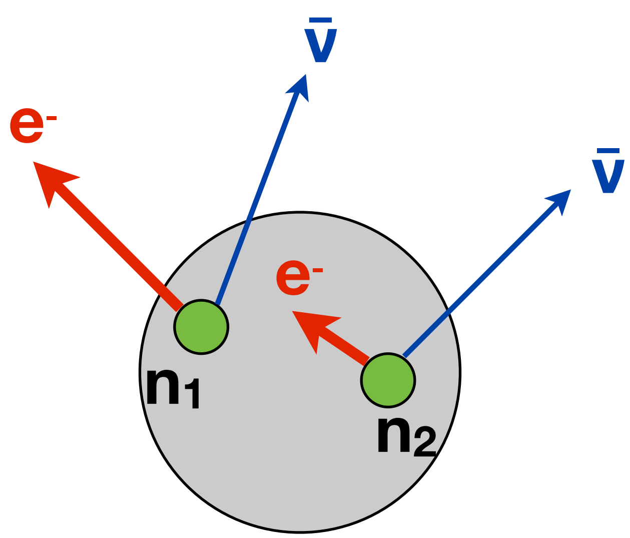
Professor Richard Battye, from the University of Manchester's School of Physics and Astronomy, said: "We observe fewer galaxy clusters than we would expect from the Planck results and there is a weaker signal from gravitational lensing of galaxies than the CMB would suggest.

"A possible way of resolving this discrepancy is for neutrinos to have mass. The effect of these massive neutrinos would be to suppress the growth of dense structures that lead to the formation of clusters of galaxies."

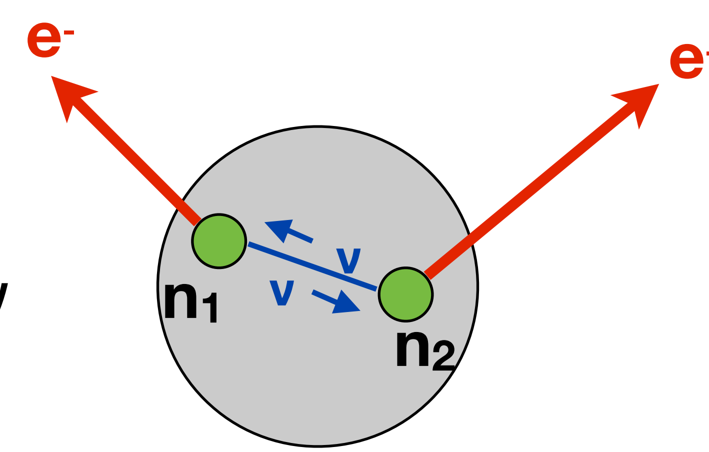
Double beta decay

- Rare (Z,A)→(Z+2,A) nuclear transition, with emission of two electrons
- Two basic decay modes

ββ2ν



ββ0ν



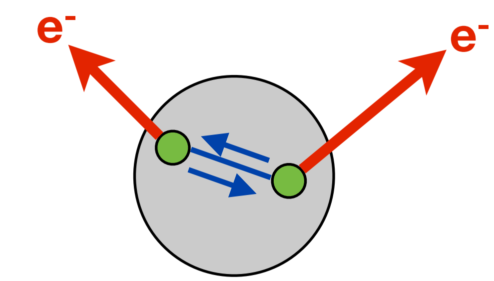
Two neutrino mode

- Observed in several nuclei
- 10^{19}-10^{21} yr half-lives
- Standard Model allowed

Neutrinoless mode

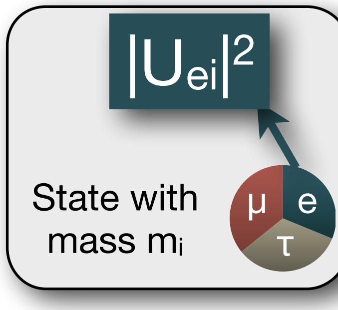
- Not observed yet in Nature
- >10^{25} yr half-lives
- Would signal Beyond-SM physics

Neutrinoless double beta decay and the neutrino questions



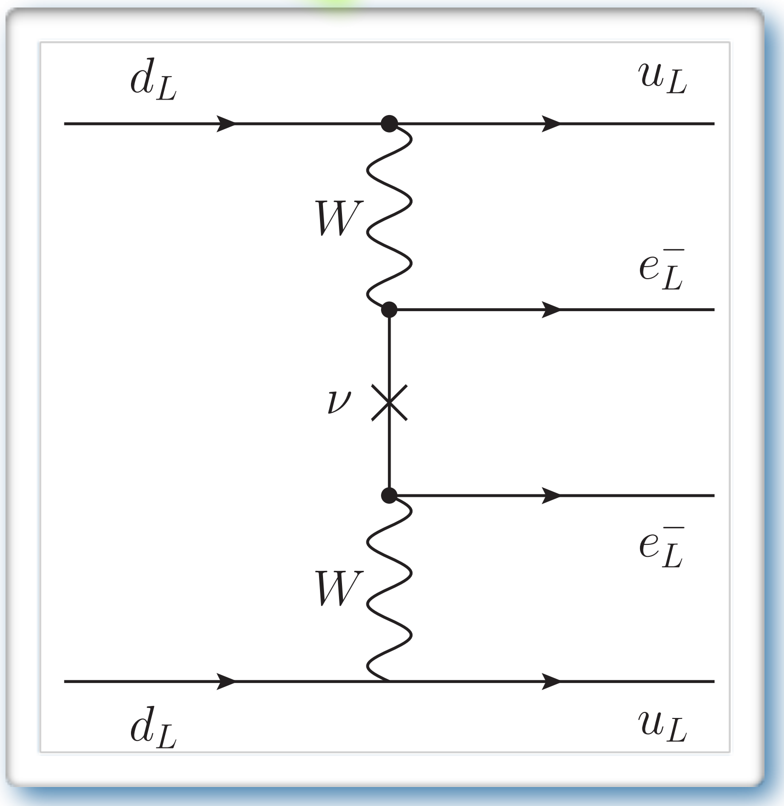
$(\text{Rate})_{\beta\beta0\nu} \propto m_{\beta\beta}^2$

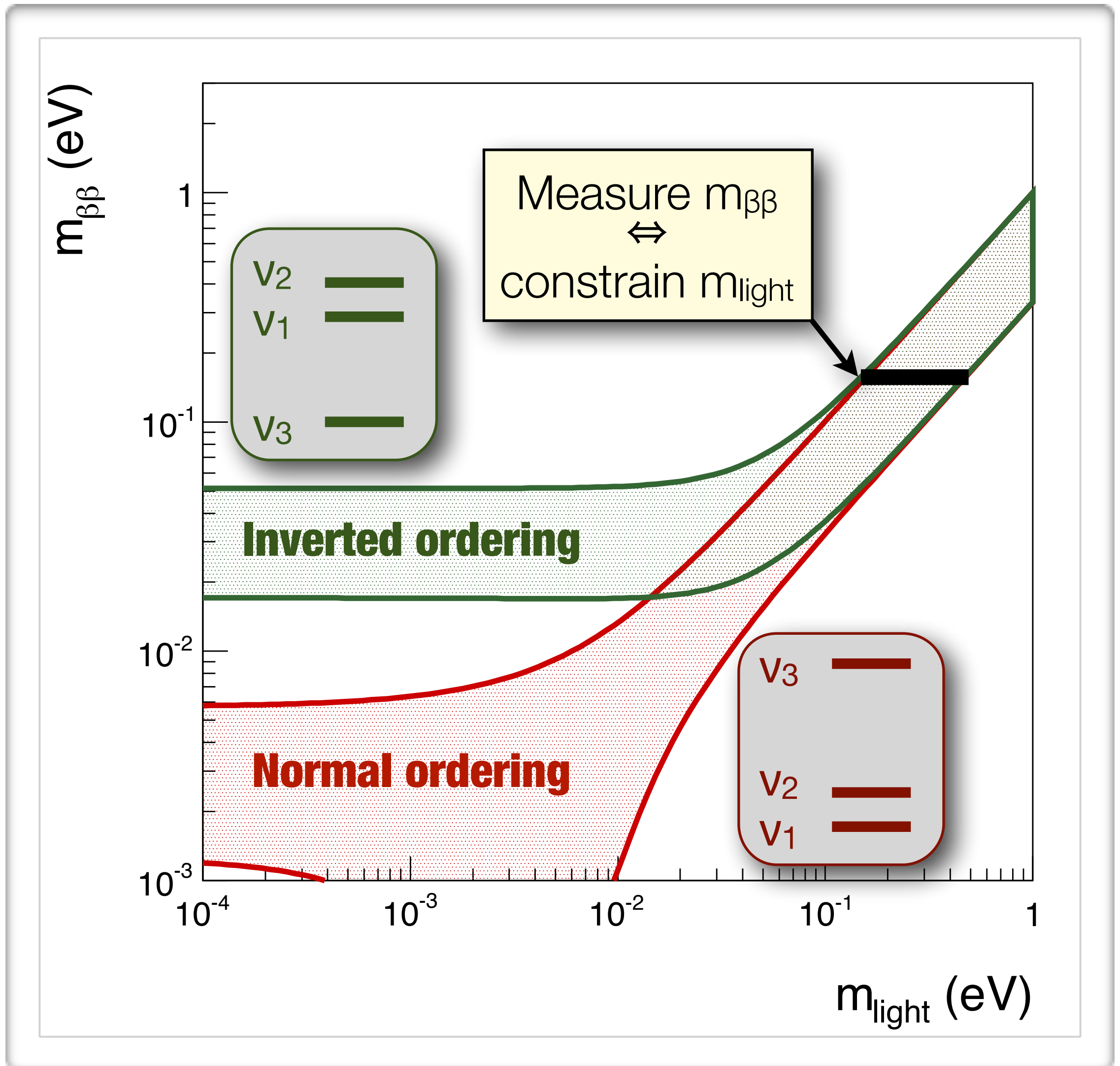
Majorana ν mass:
$m_{\beta\beta} \equiv \left| \sum_i m_i U_{ei}^2 \right|$



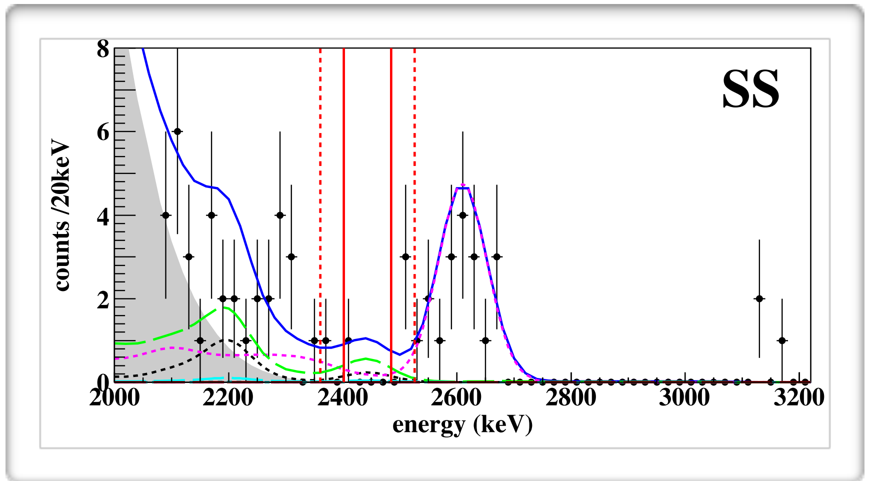
Lepton number violating process implying massive Majorana neutrinos

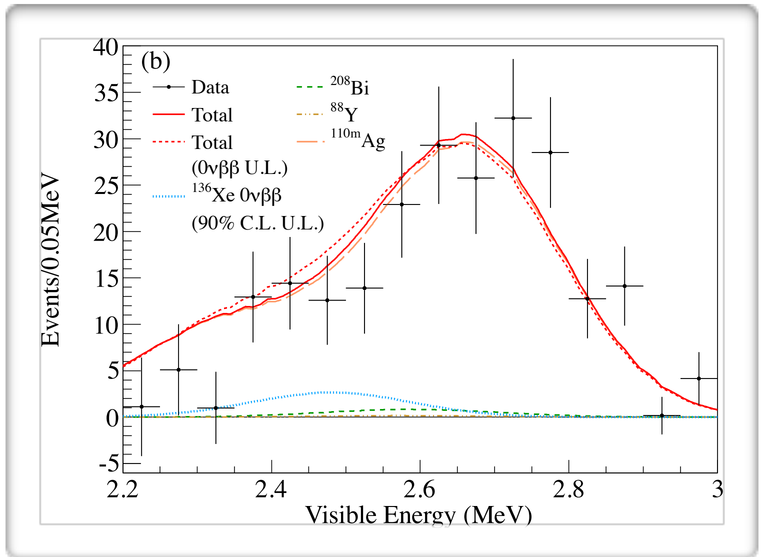
- Identity
- Mass scale
- Mass ordering
- Mixing
- Species

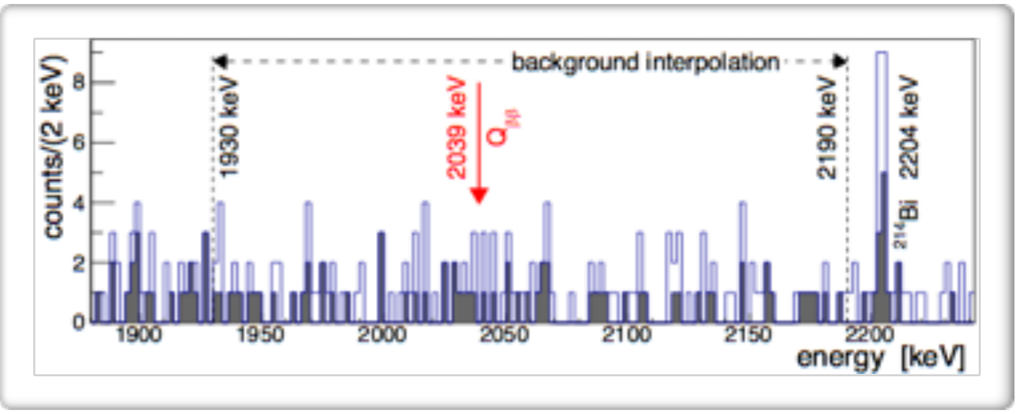




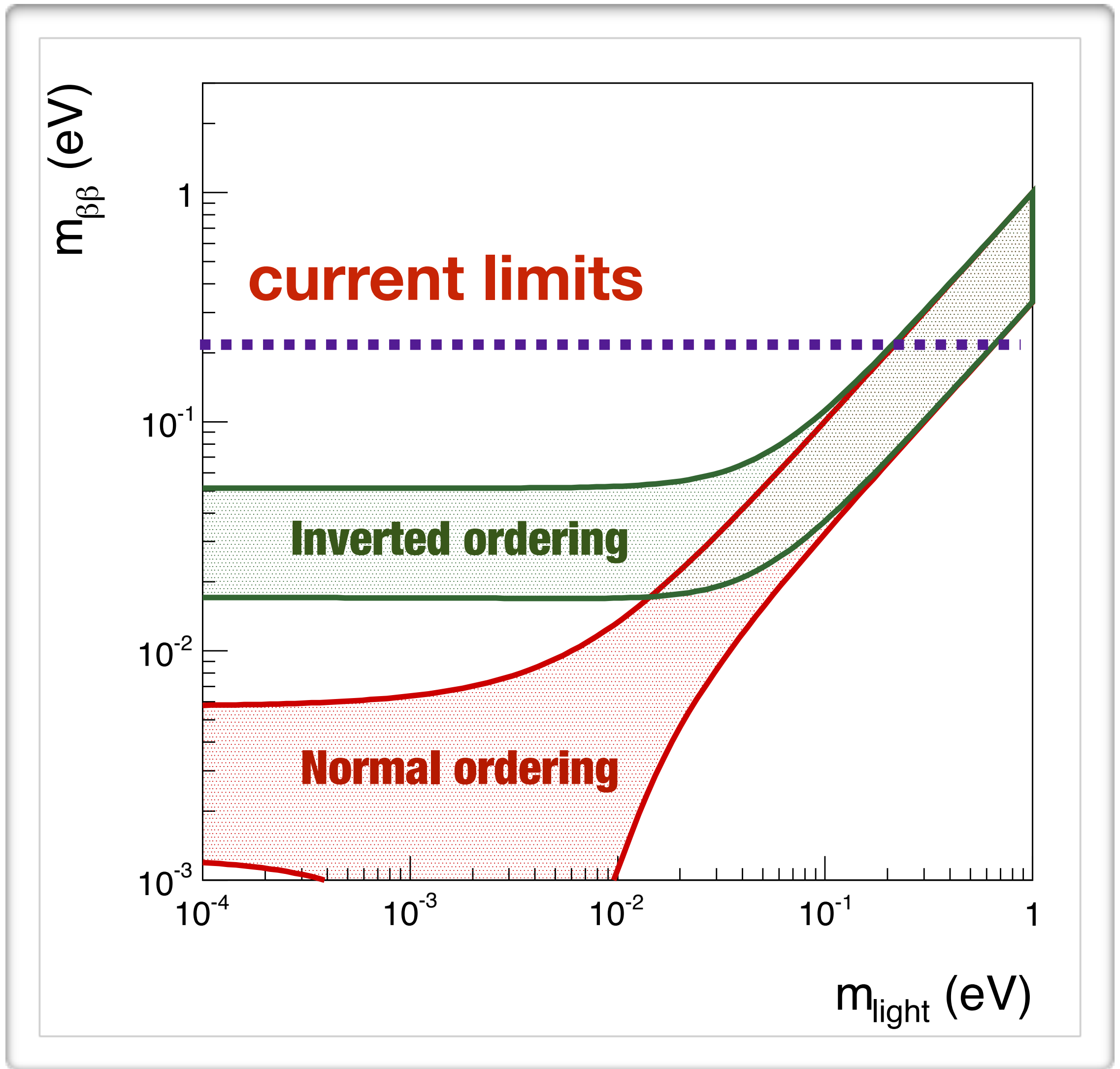
Majorana landscape in 2014







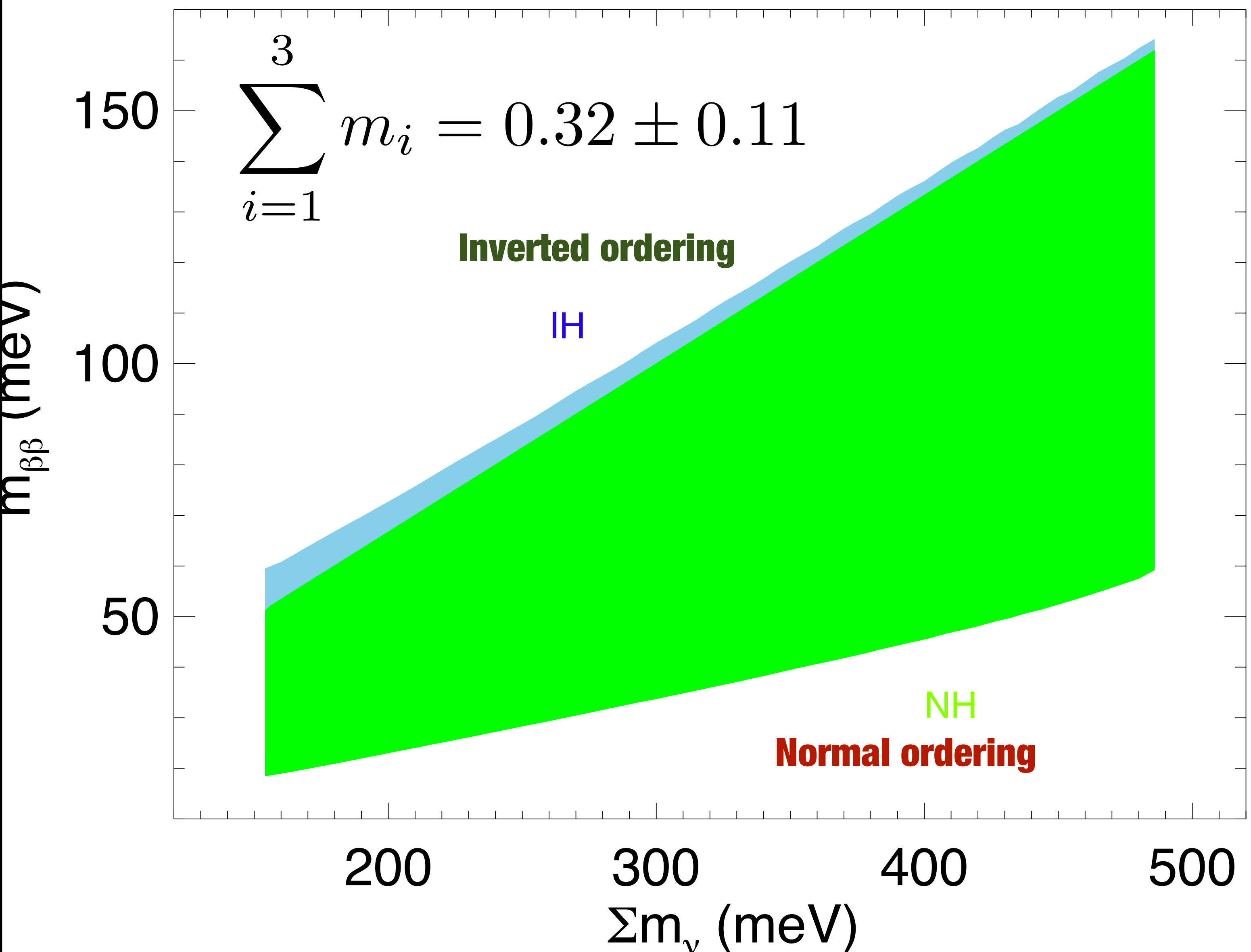
- Claim for ββ0ν strongly disfavored by null results in ^{136}Xe and ^{76}Ge
- $m_{\beta\beta}$ < 200 meV



Majorana landscape revisited

Evidence for Massive Neutrinos from Cosmic Microwave Background and Lensing Observations

Phys. Rev. Lett. 112, 051303 (2014)



- Discovery window: 20 mev-150 mev
- current experiment sensitivity outside window.
- A more sensitive "100 kg scale" experiment could have a chance of making a discovery
- Design "ton-scale" to "close the window" (=discovery if neutrino is a Majorana particle).

Discovery potential of xenon-based neutrinoless double beta decay experiments in light of small angular scale CMB observations

JCAP 1303 (2013) 043

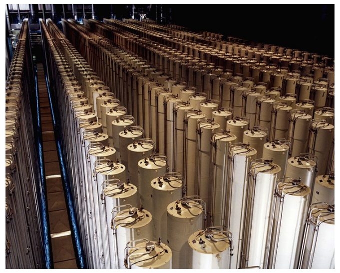
Neutrino Experiment with a Xenon TPC

(a trademark brand, not to be confused with nEXO)

Why NEXT? — Advantages of HPXe technology

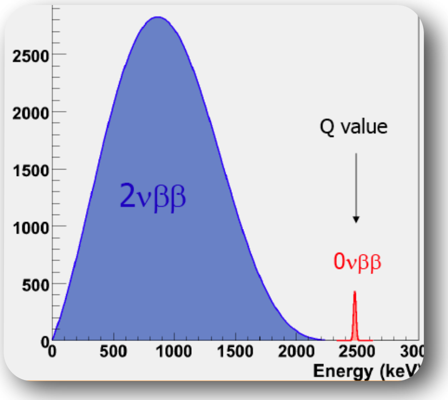
$$T_{1/2}^{-1} \propto a \cdot \epsilon \cdot \sqrt{\frac{Mt}{\Delta E \cdot B}}$$

Cost



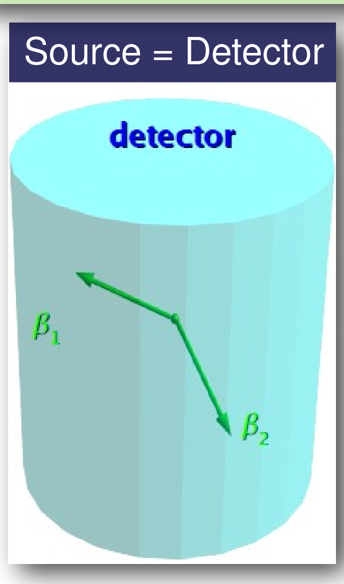
Xenon is the cheapest and easiest to enrich of all ββ isotopes. No long lived radioactive isotopes. There is already 1 ton of enriched xenon in the World.

ΔE



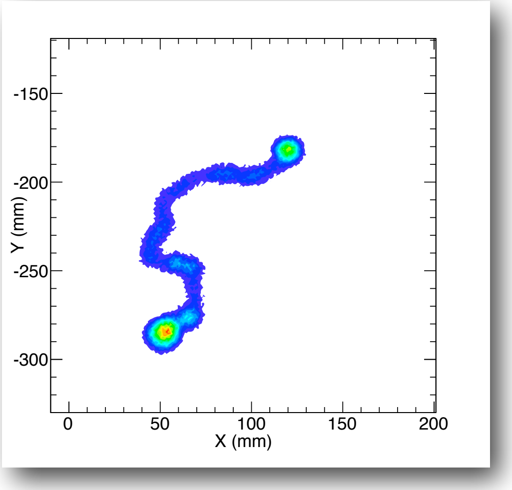
HPXe TPC is the only xenon detector that provides good energy resolution

Scalability



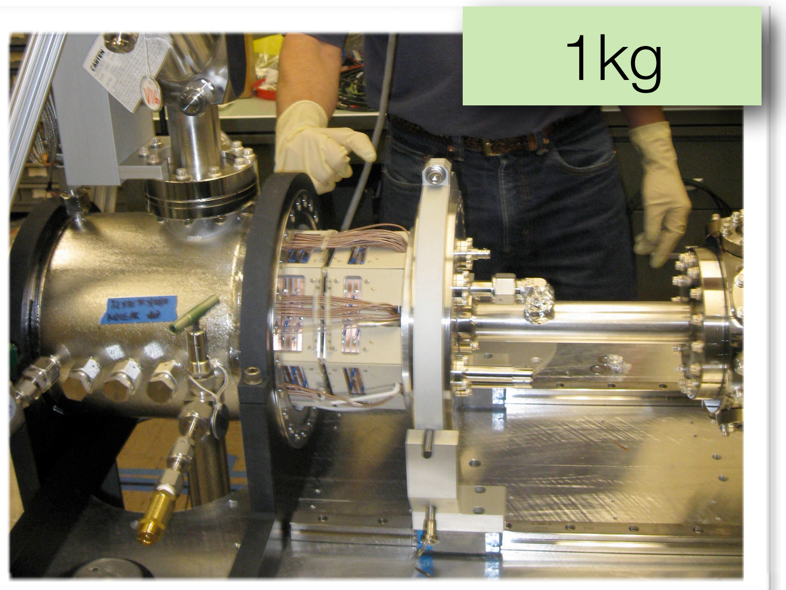
Xenon is a noble gas suitable to build a TPC. No dead areas, S/N improves with L

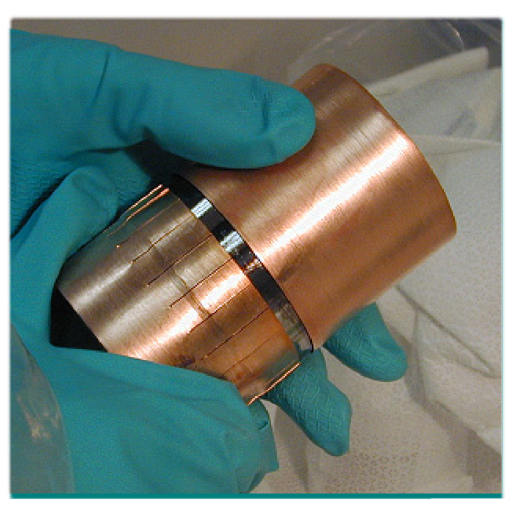
Background

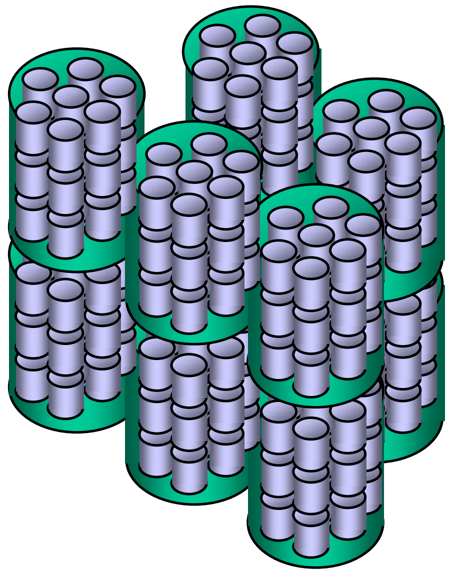


HPXe TPC is the only xenon detector that provides topological signal

Scalability





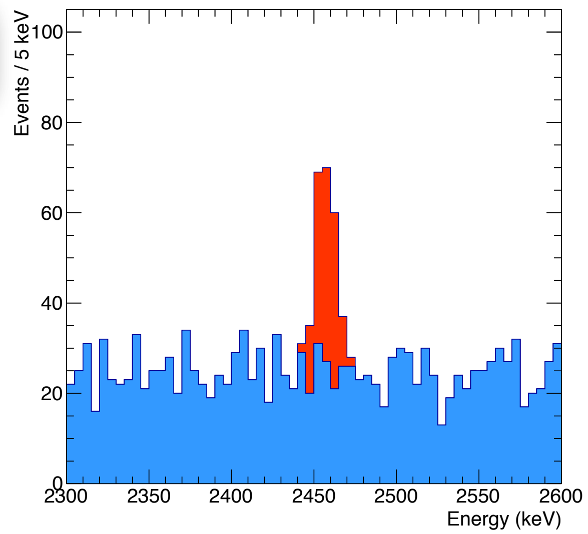


210 2.35 kg crystals

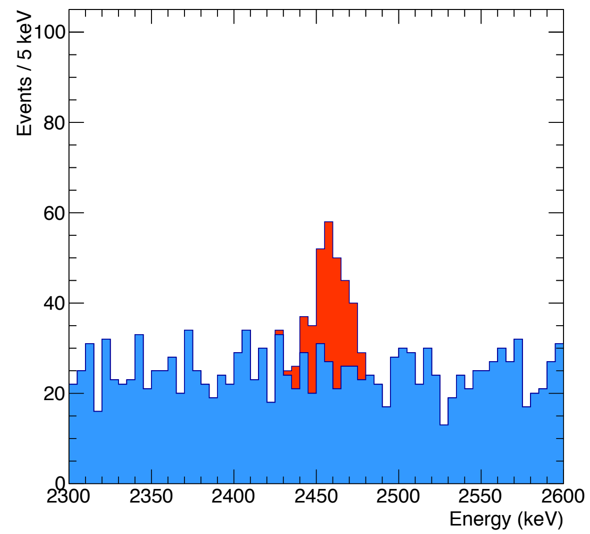
Economy of scale: Double L, signal increases 8 (L^3), background increases 4 (L^2), S/N improves by a factor 2

Energy resolution
(Fano factor in gas and EL amplification)

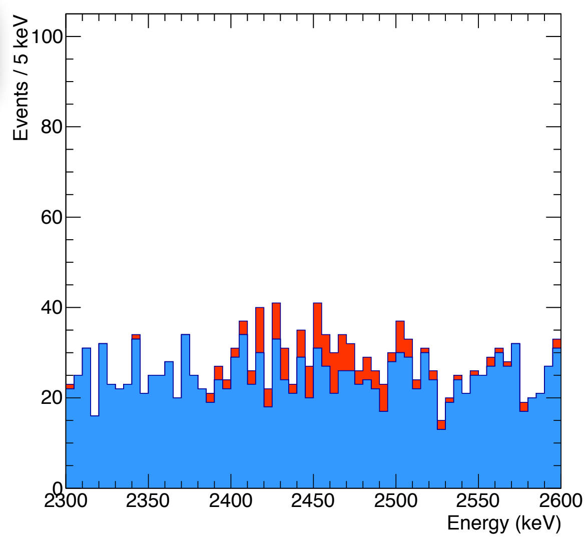
0,5 % FWHM



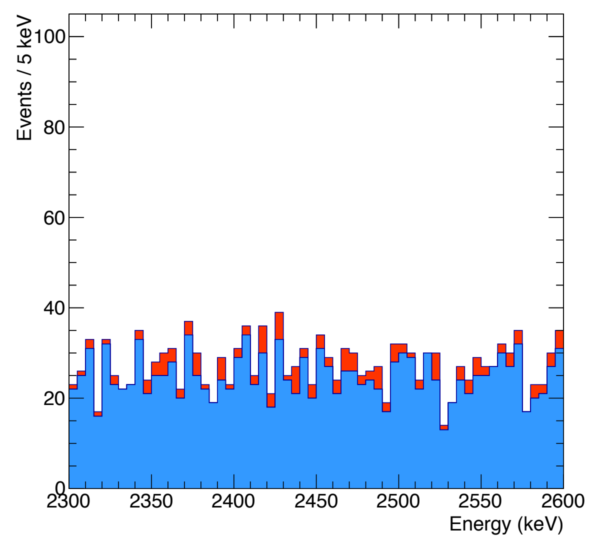
1,0 % FWHM



4,0 % FWHM



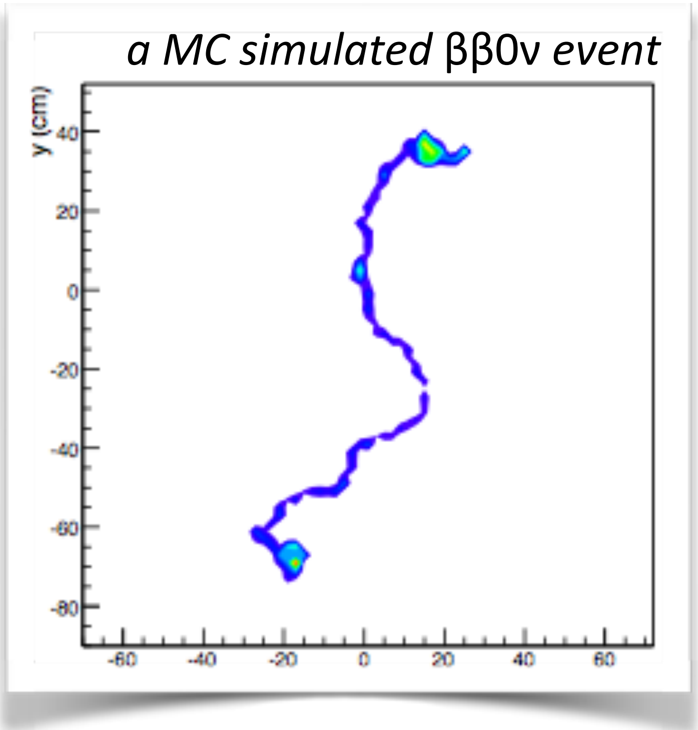
10 % FWHM

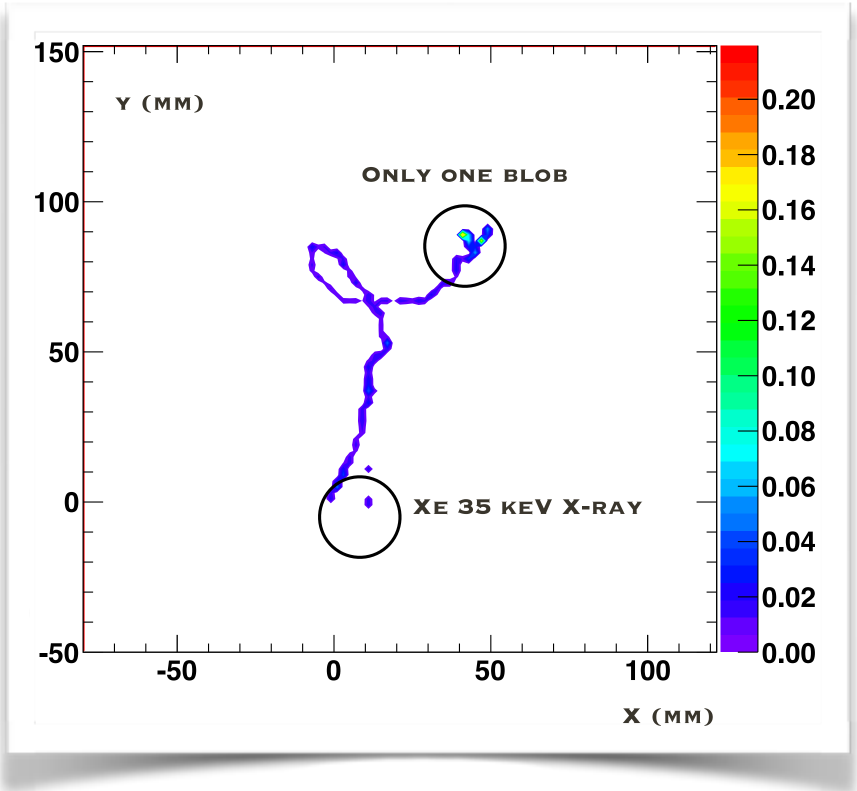


Signal and background:

- Signal: mν ~200 meV and an exposure of 5 ton year.
- Background 1 count/keV/ton/year.

Topological background reduction

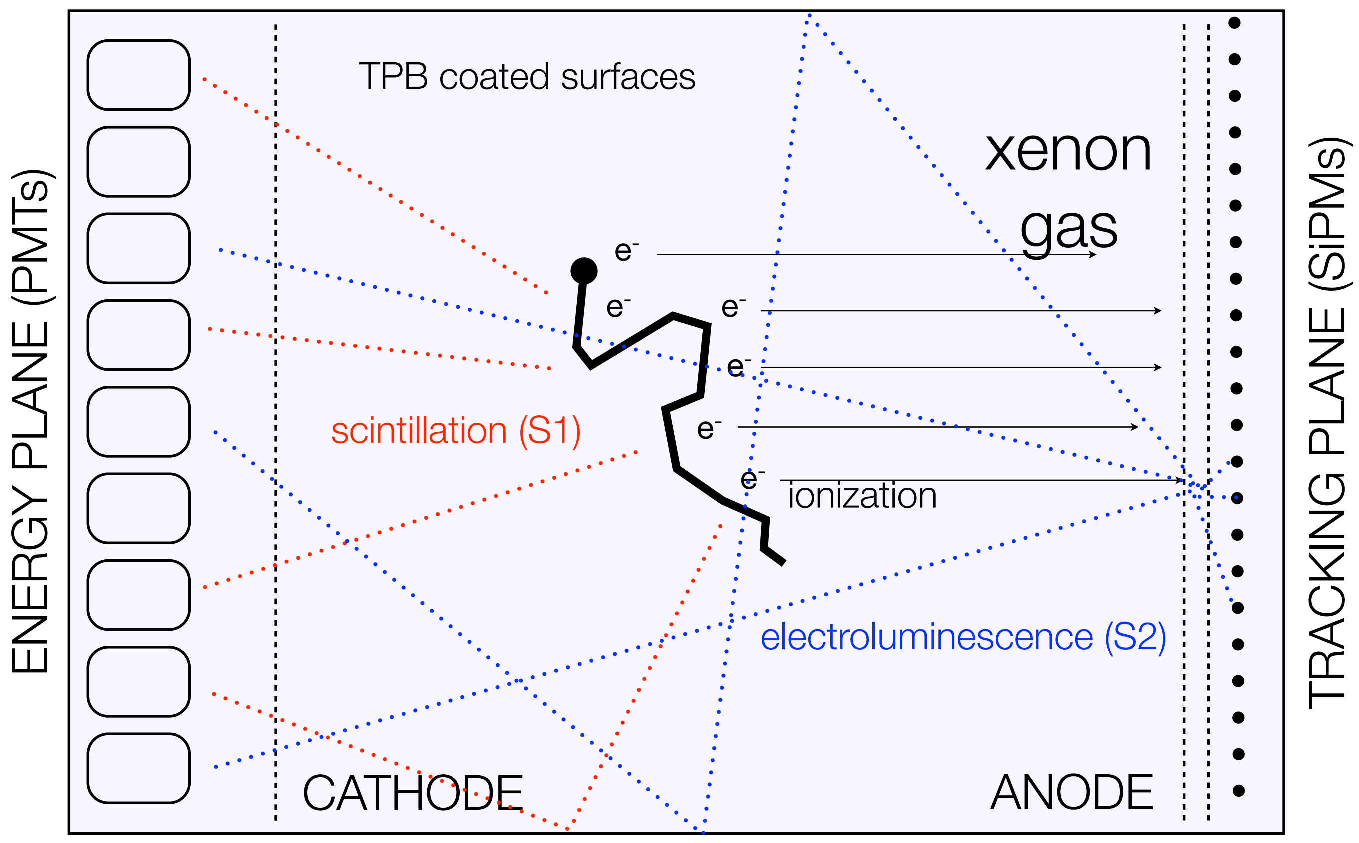




- In xenon gas at 15 bar, a ββ event is a twisted track, 10 cm long, with two energy blobs at the two ends and no additional floating clusters.
- Instead the backgrounds are single electrons, accompanied 85% of the time by X-rays (Xenon de-excitation).

The NEXT experiment

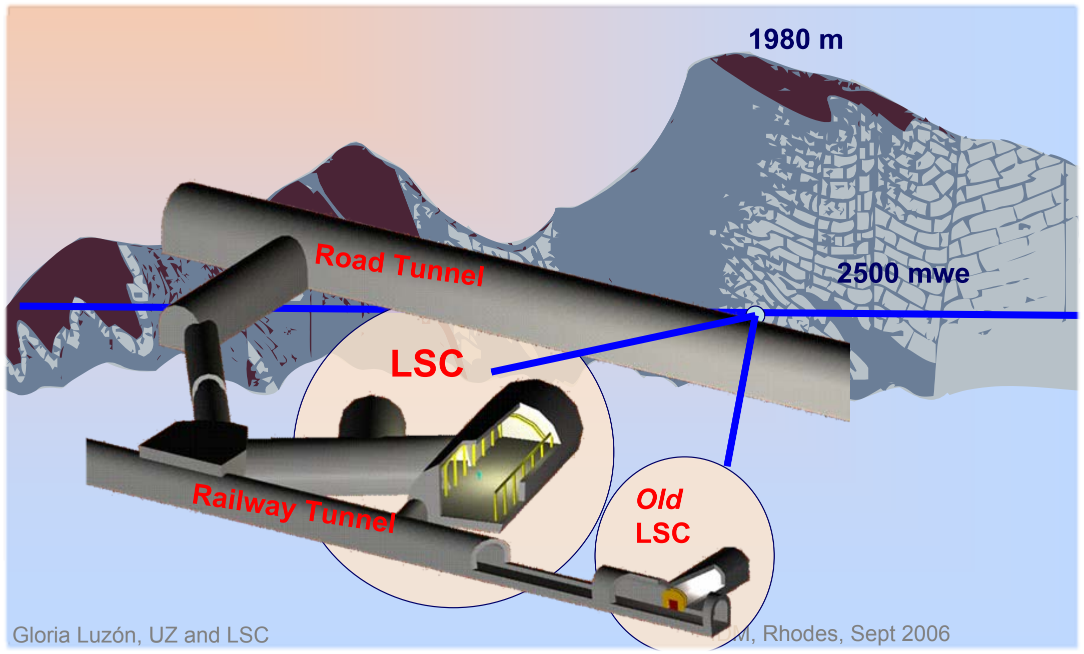
What is next



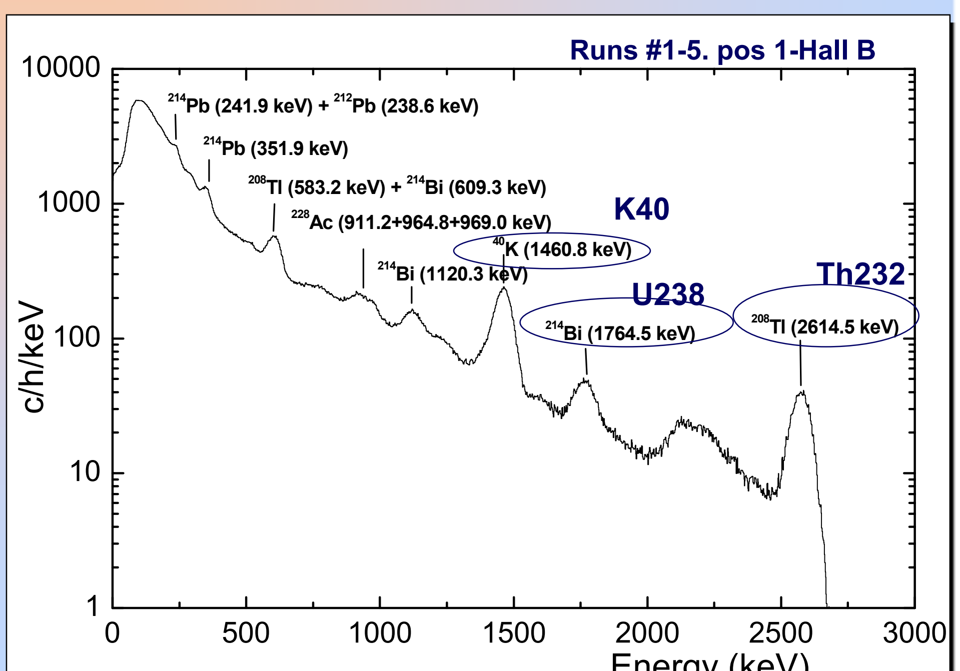
- It is a High Pressure Xenon (HPXe) TPC operating in EL mode.
- It is filled with 100 kg of Xenon enriched at 90% in Xe-136 (in stock) at a pressure of 15 bar.
- The event energy is integrated by a plane of radipoure PMTs located behind a transparent cathode (energy plane), which also provide t0.
- The event topology is reconstructed by a plane of radiopure silicon pixels (MPPCs) (tracking plane).

EL mode is essential to get lineal gain, therefore avoiding avalanche fluctuations and fully exploiting the excellent Fano factor in gas

Canfranc Underground Laboratory (LSC)



Gamma spectrum



Radon measurement and control

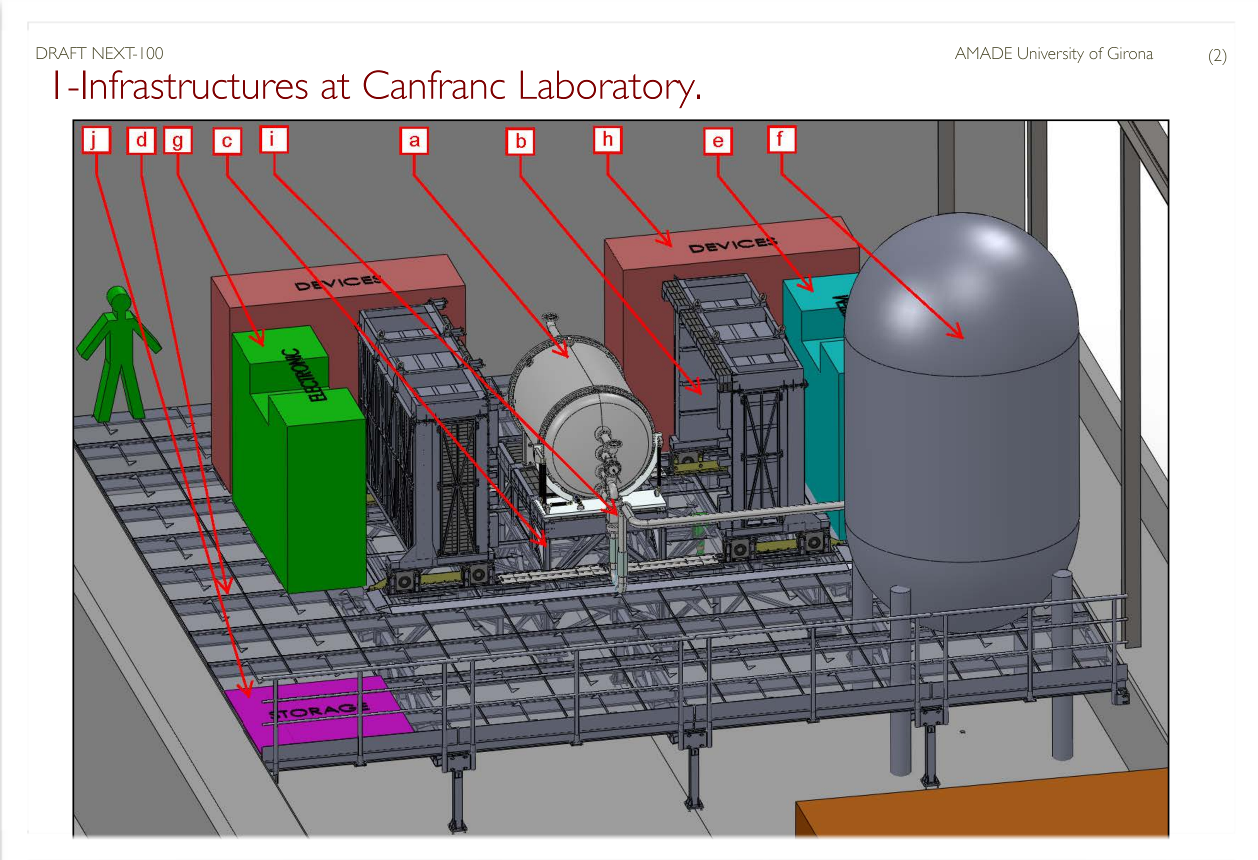
- 1st and 2nd set of measurements: Jan – Jun2006

18 runs of 6-7 days each in halls A & B

Radon concentration in Bq/m3

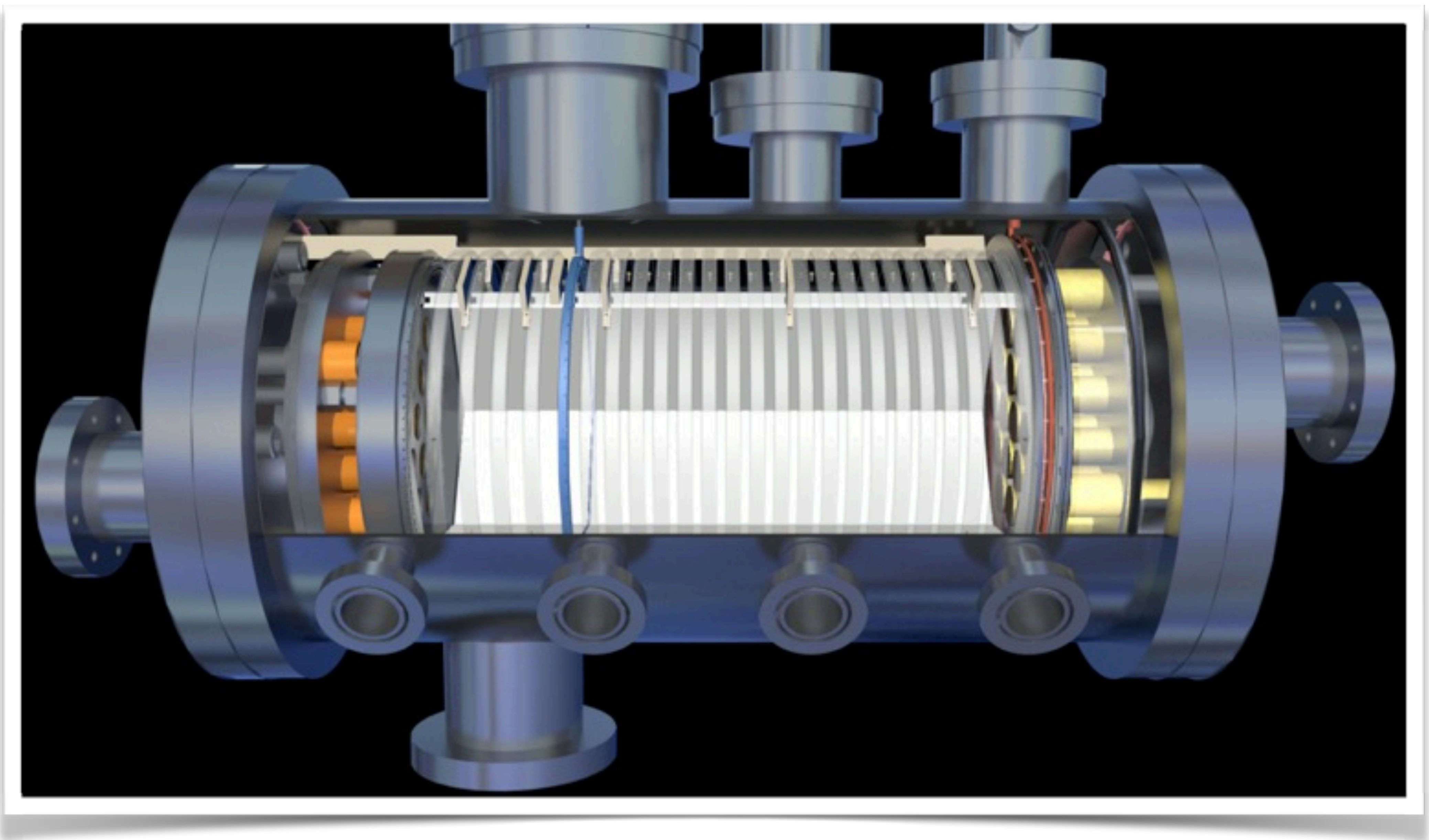
Hall A	66.2 ± 0.4
Hall B	71.6 ± 0.4
Air entrance	72.0 ± 1.9

NEXT at LSC



Infrastructures: platform, lead castle, gas system, emergency recovery system, completed or being installed at the LSC main hall in 2014. In stock, 100 kg of enriched xenon and 100 kg of depleted xenon.

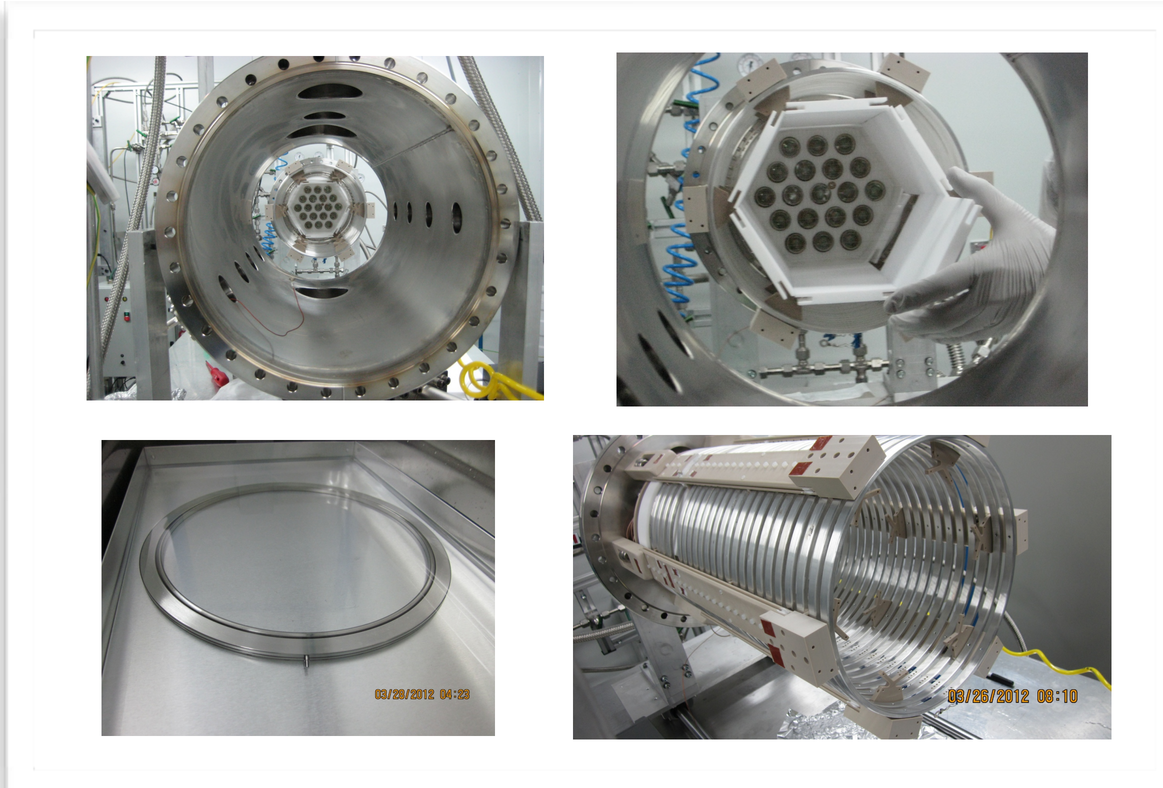
NEXT technology



DEMO main components (HPXe technology)

Pressure Vessel

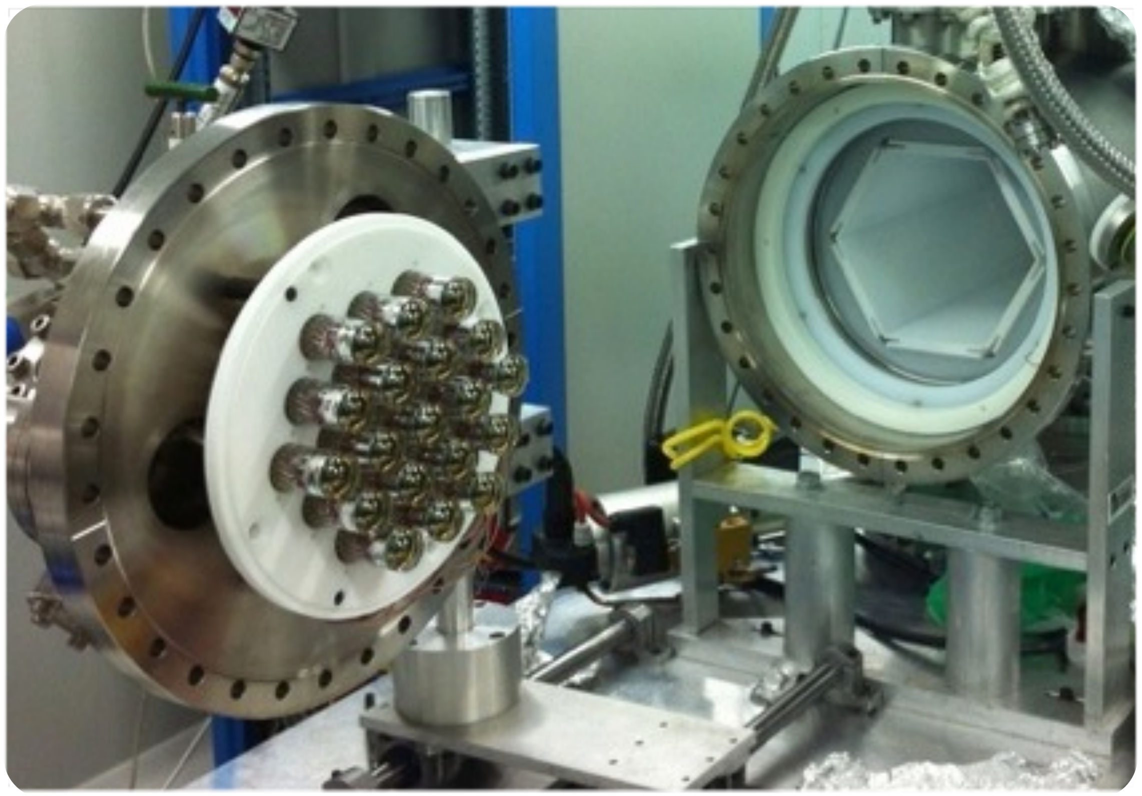
10-20 bar operation.



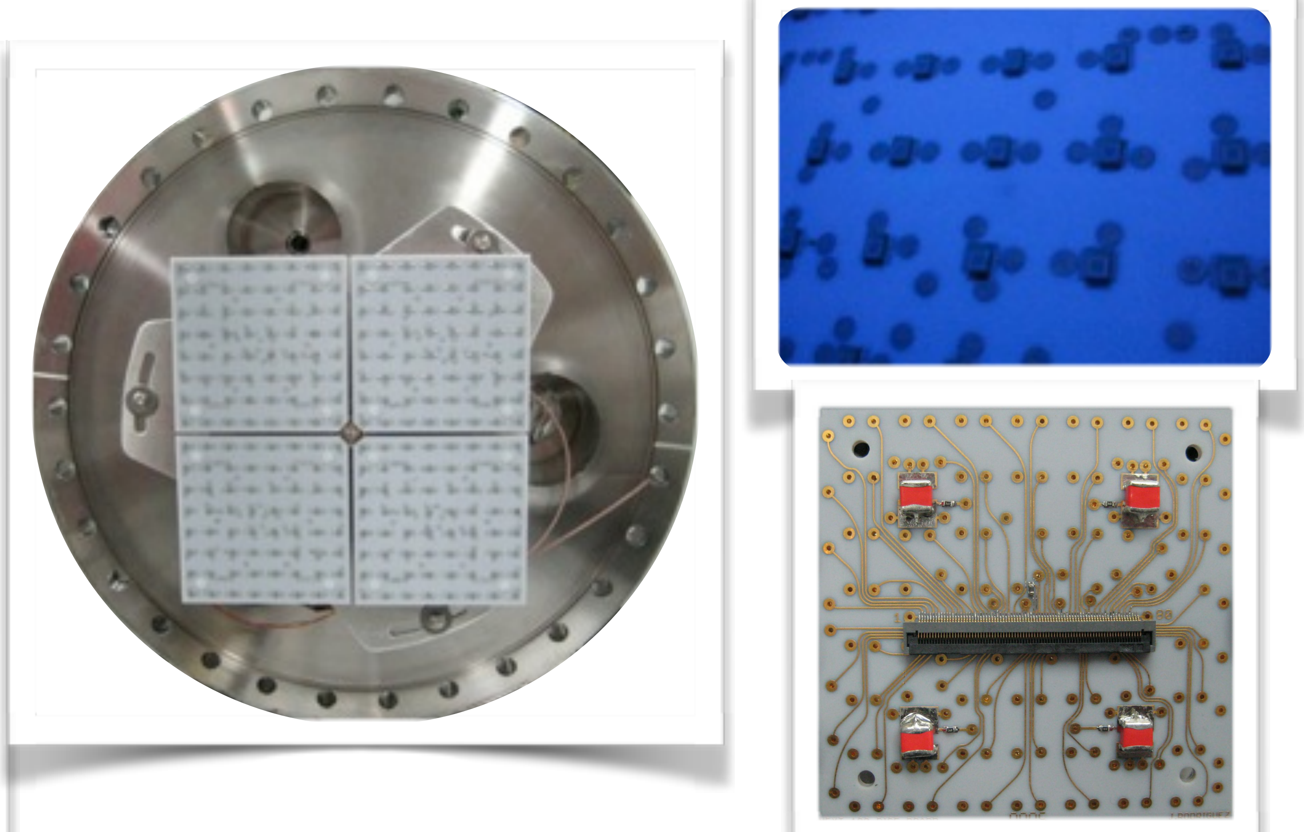
Field cage & light tube

Light tube made of Teflon coated with TPB to shift UV light to blue. Drift field of 350 kV/cm. EL field of 15 kV for ~10^3 photons/e. TPB operation stable in DEMO

DEMO main components (HPXe technology)



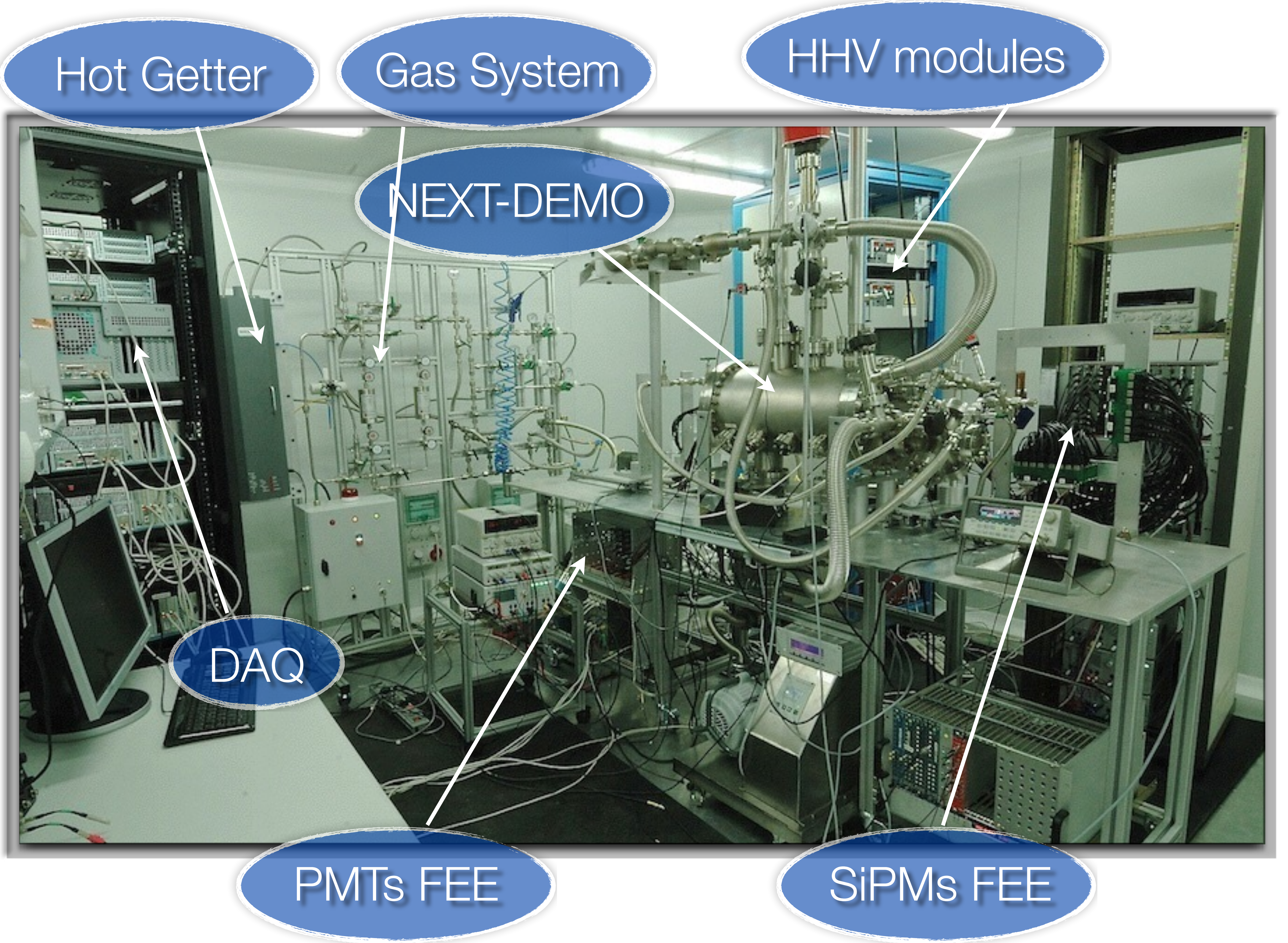
Energy plane



Tracking plane

19 PMTs (30 % coverage) 1” diameter, pressure resistant but not radiopure

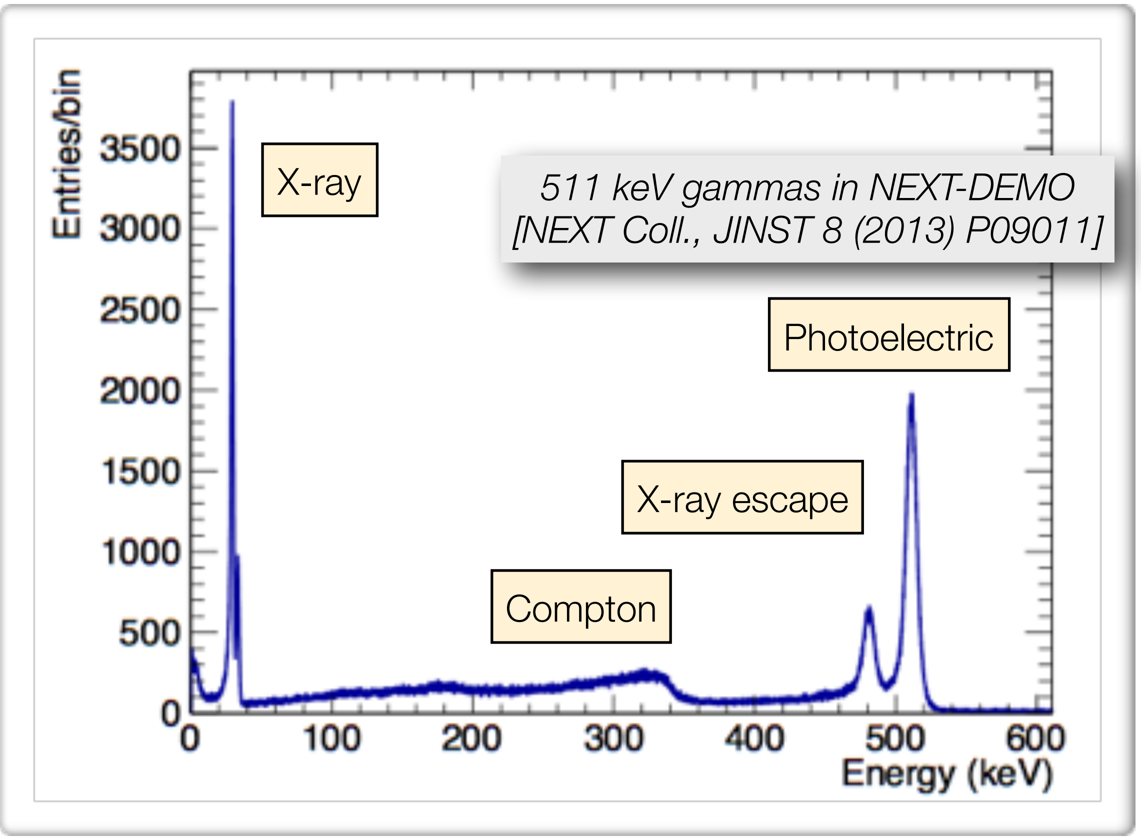
4 x 64 SiPms, Cuflon boards coated with TPB. Pitch at 1 cm. Moderately radio pure, except for capacitors and connector.


Hot Getter
Gas System
HHV modules
NEXT-DEMO
DAQ
PMTs FEE
SiPMs FEE

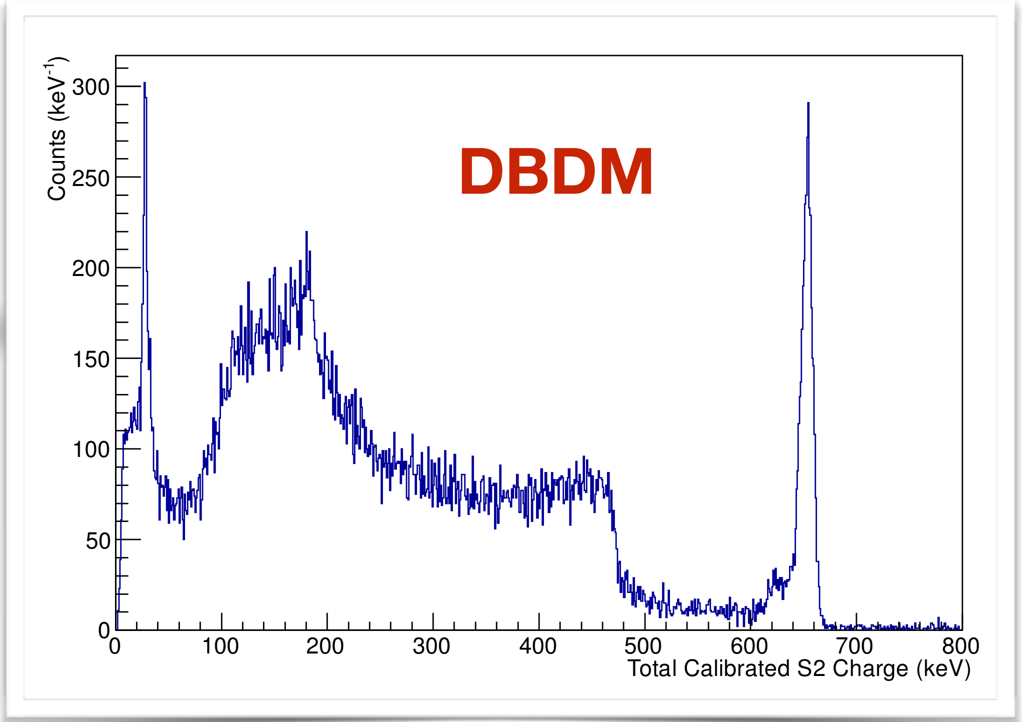
NEXT R&D: detector performance achievements

- 1.8% FWHM energy resolution for 511 keV electrons over large fiducial volume

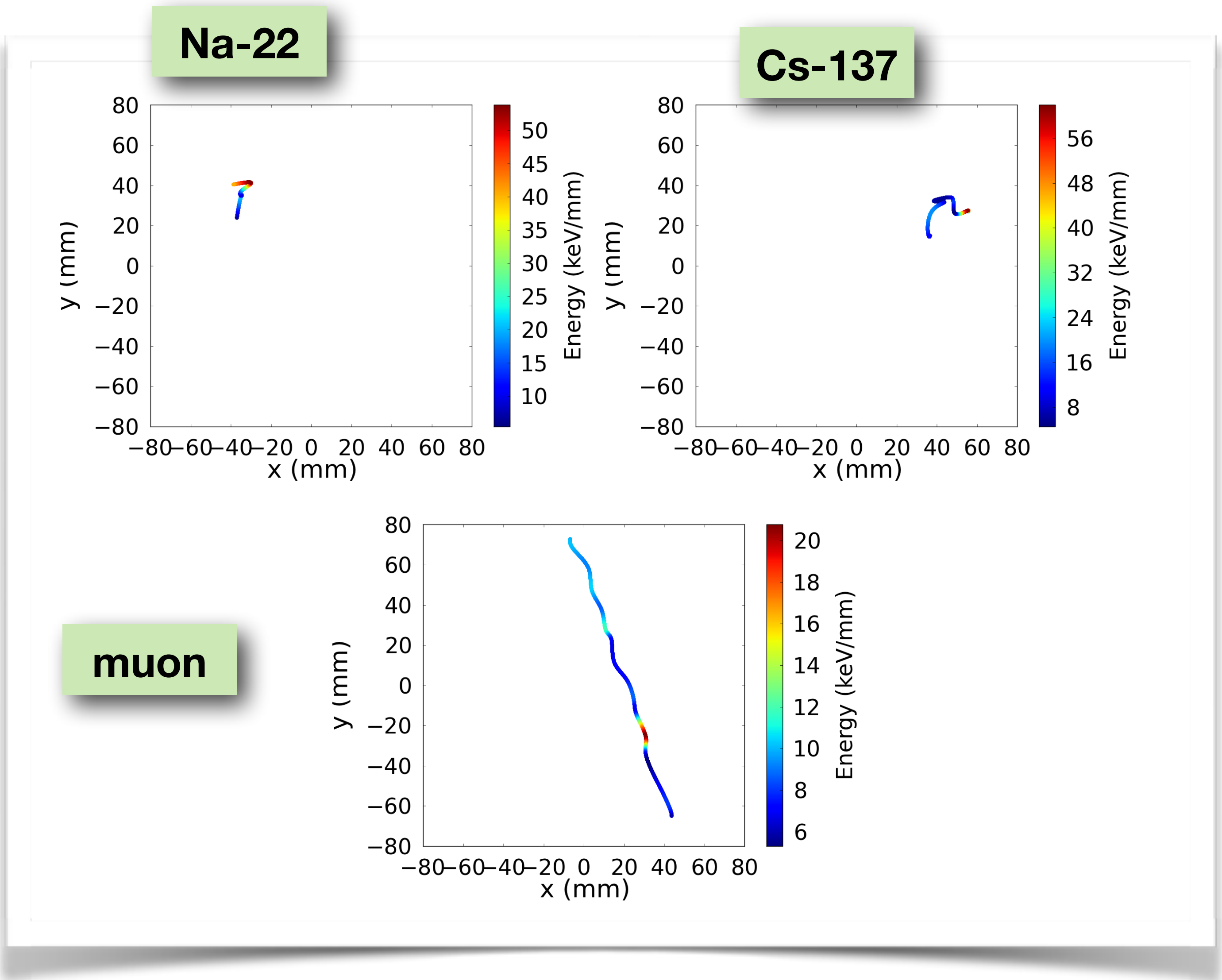
- Extrapolates to 0.75% FWHM at $Q_{\beta\beta}$ energy of 136Xe decay

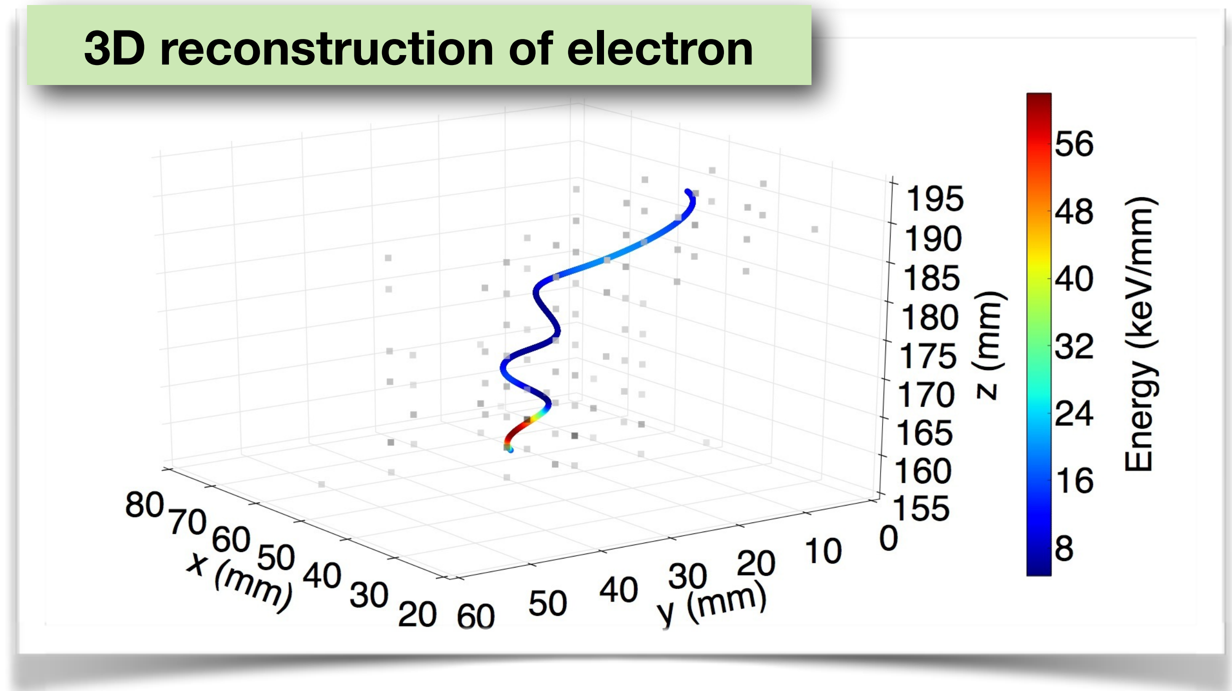


- The DBDM prototype at LBNL extrapolates to **0.5 % FWHM** at $Q_{\beta\beta}$ using 660 Cs-137 electrons



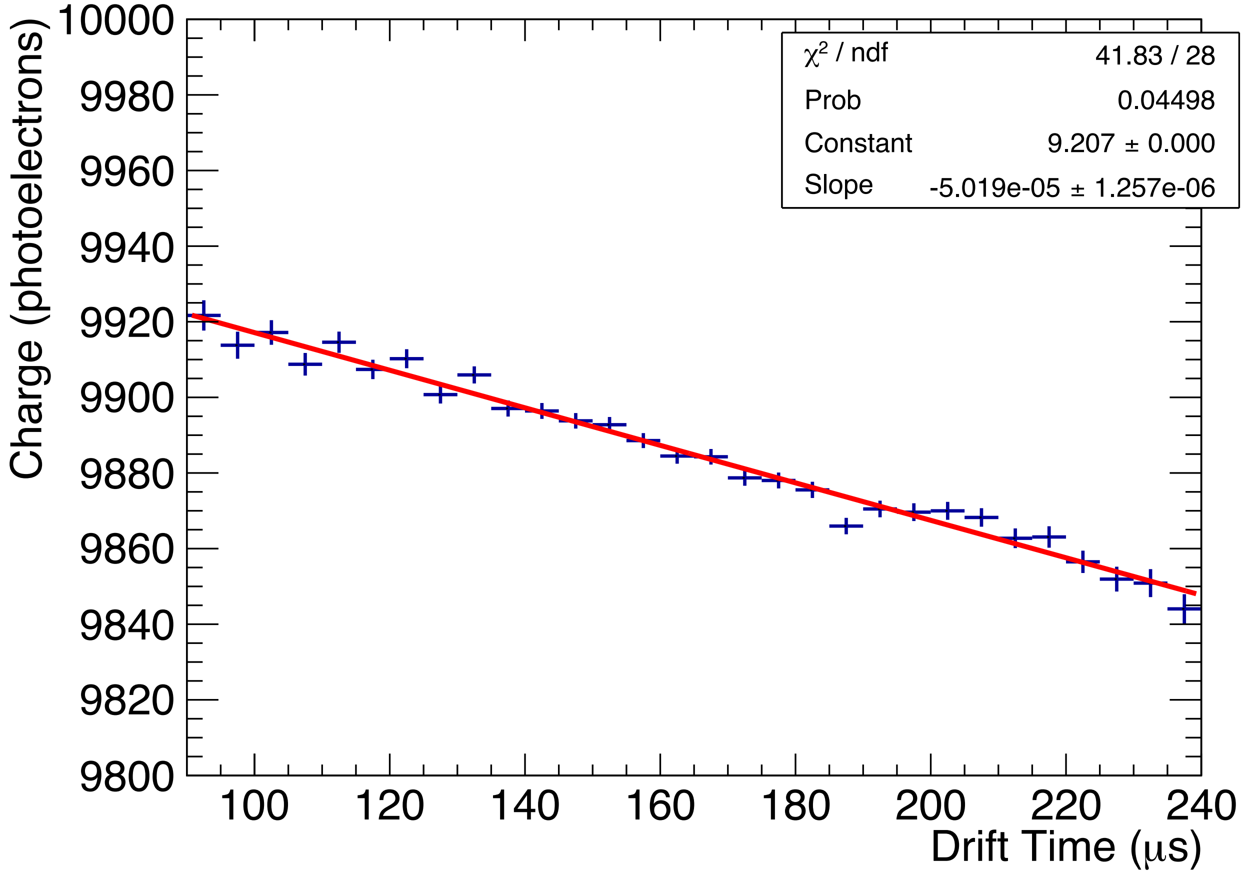
Topology of the signal in next





- Higher energy deposition clearly visible at electron track end-point.
- Tracks reconstructed using SiPMs + PMTs

Lifetime in DEMO



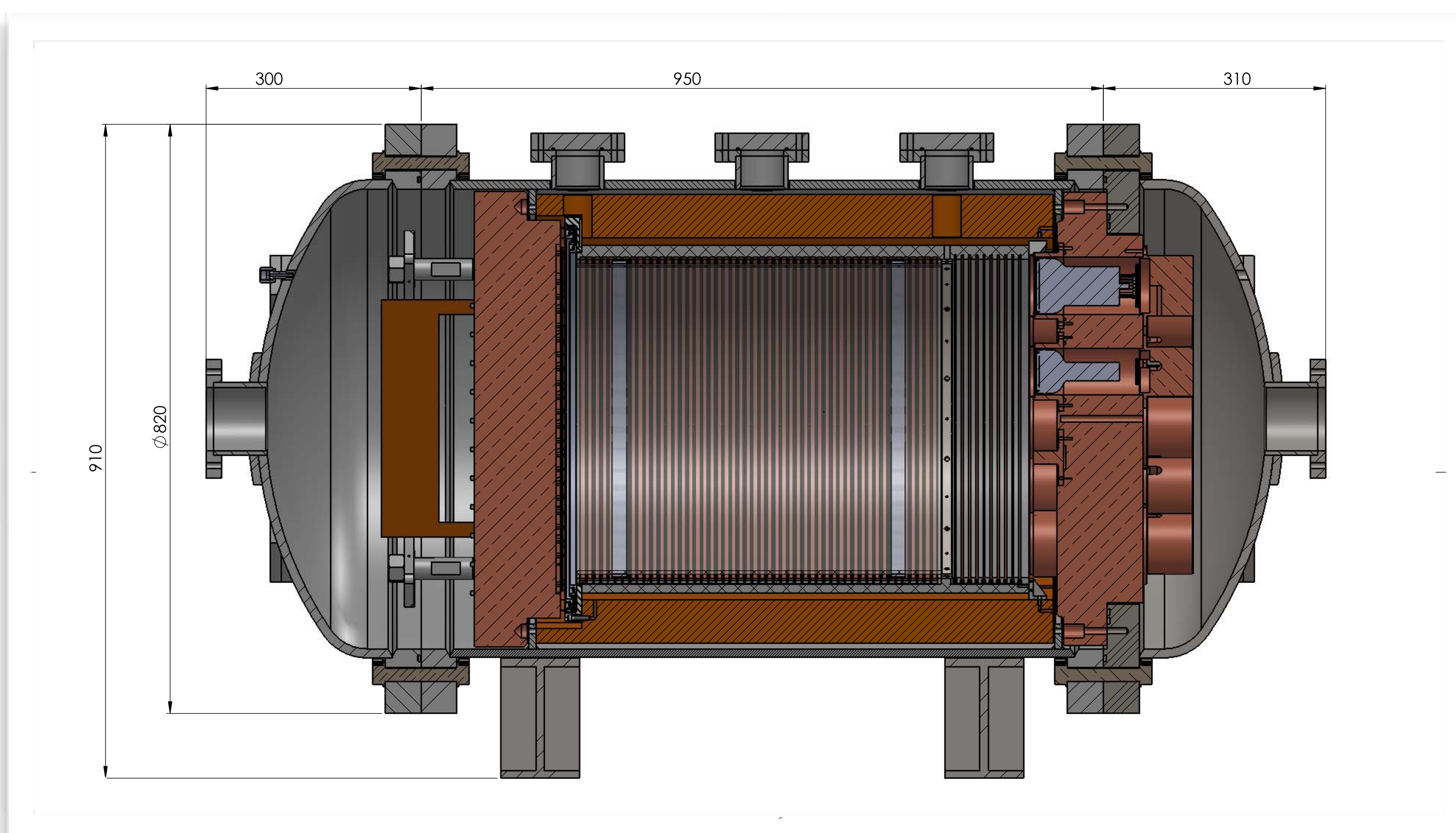
- Electron lifetime (mean life) in excess of 10 ms.
- NEXT-100 drift 1 ms

R&D

(2008-2013)

ββ2ν

(2014-2016)

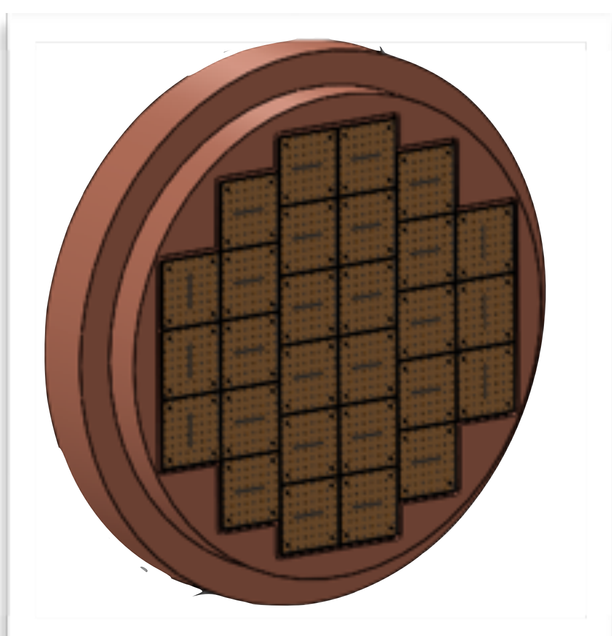


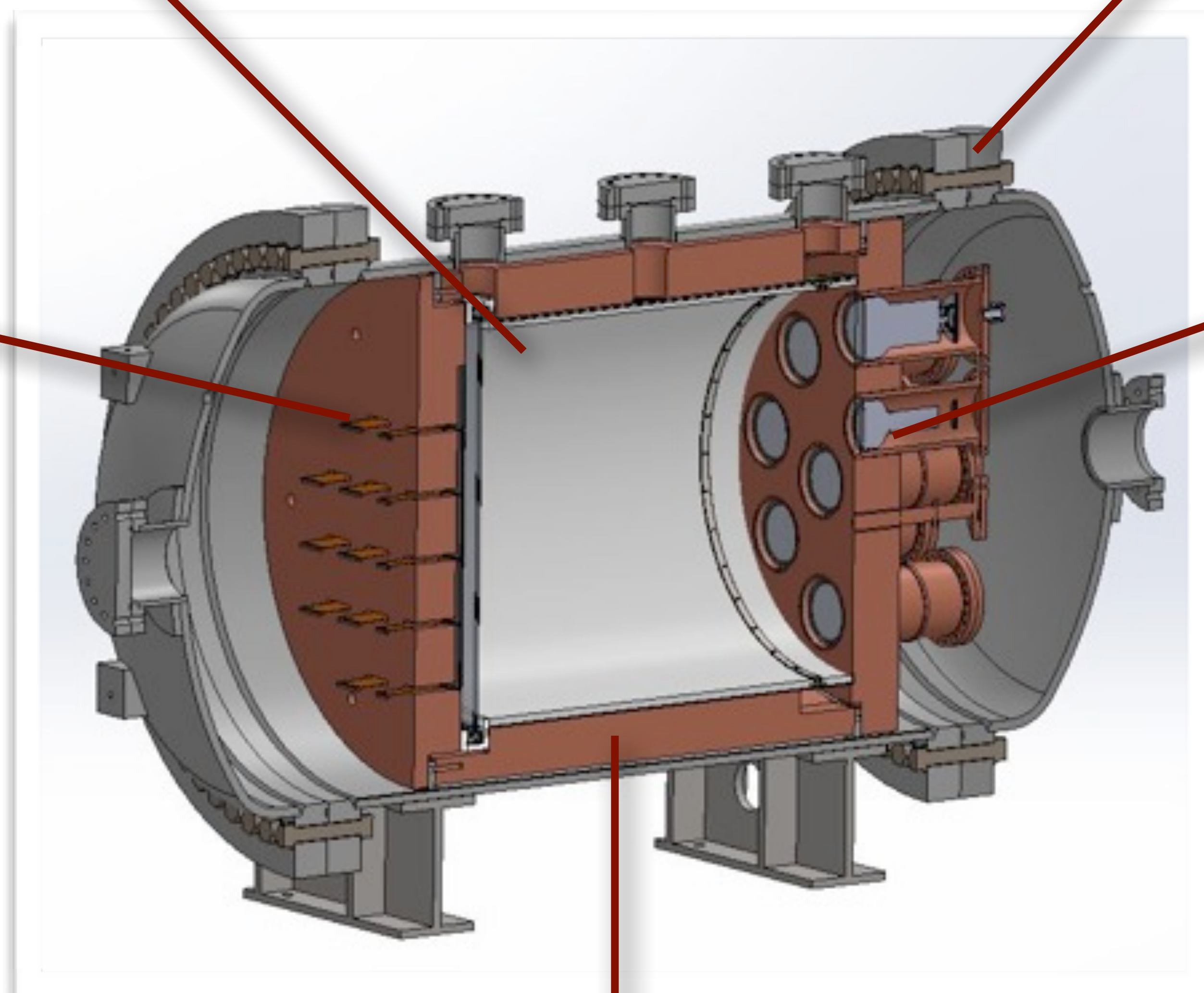
NEW (NEXT-WHITE) at glance

Time Projection Chamber:
10 kg active region, 50 cm drift length

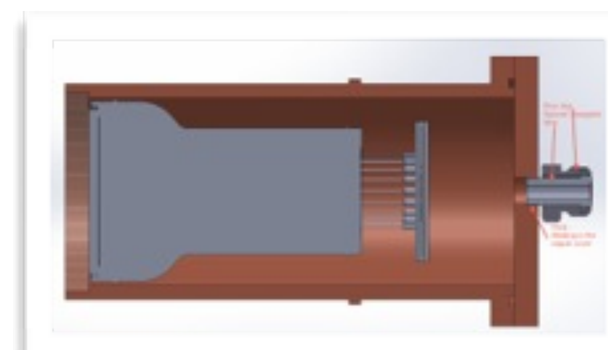
Pressure vessel:
316-Ti steel, 30 bar max pressure

Tracking plane:
1,800 SiPMs,
1 cm pitch





Energy plane:
12 PMTs,
30% coverage



Inner shield:
copper, 6 cm thick

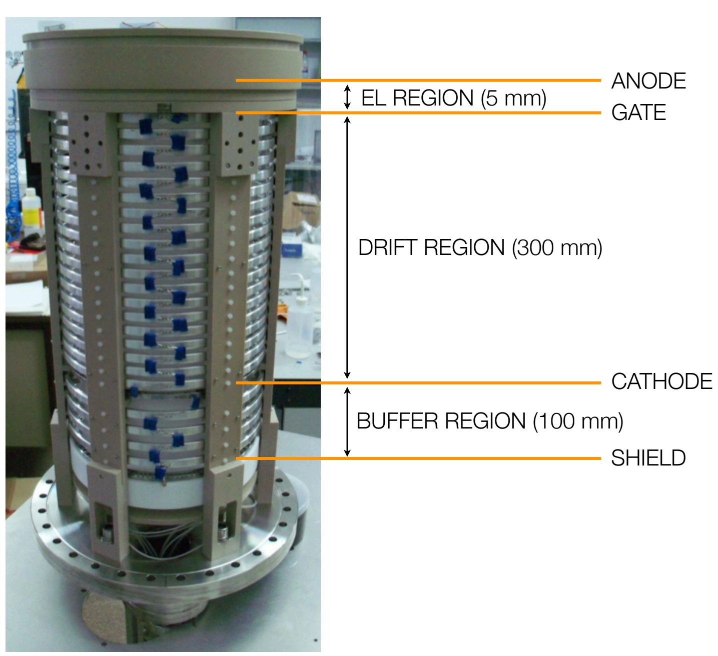
From DEMO to NEW

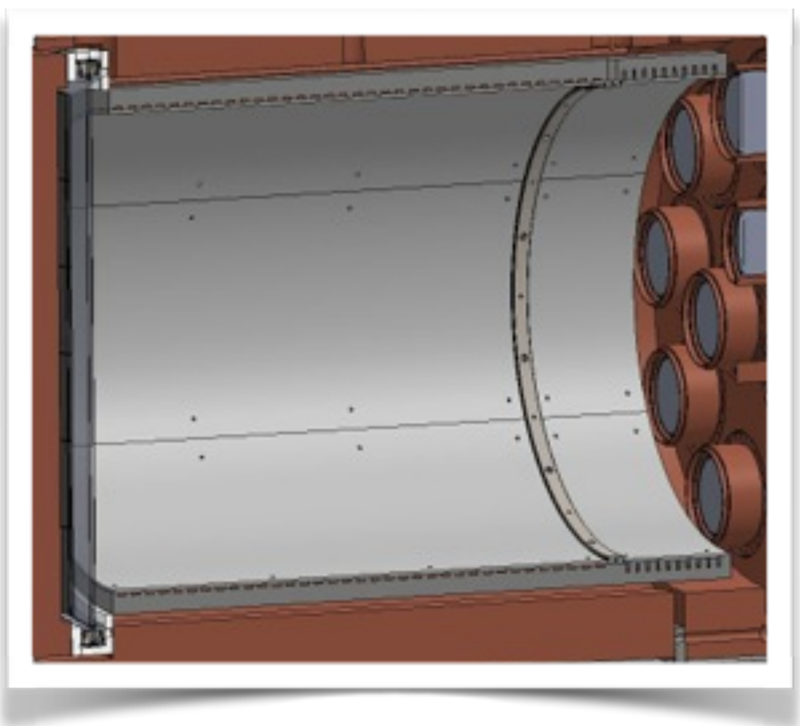
Pressure vessel

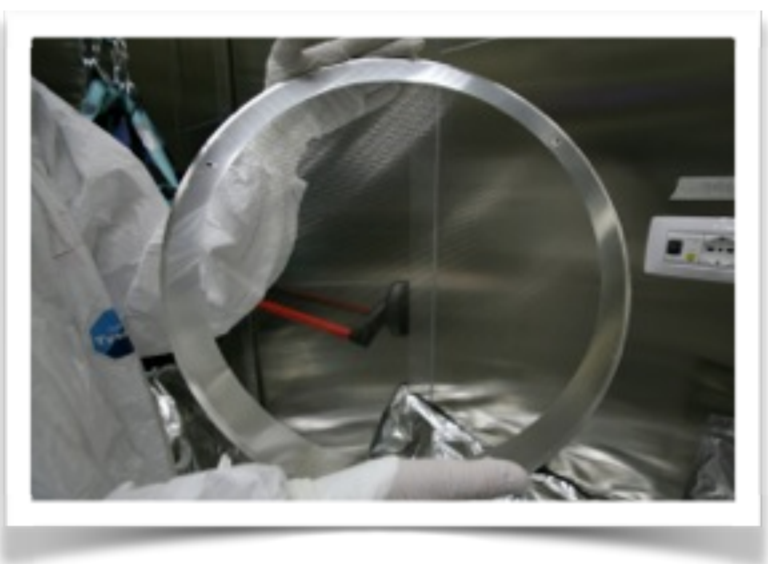
Field cage

Larger vessel, takes higher pressure (up to 30 bar), 10 kg at 15 bar.

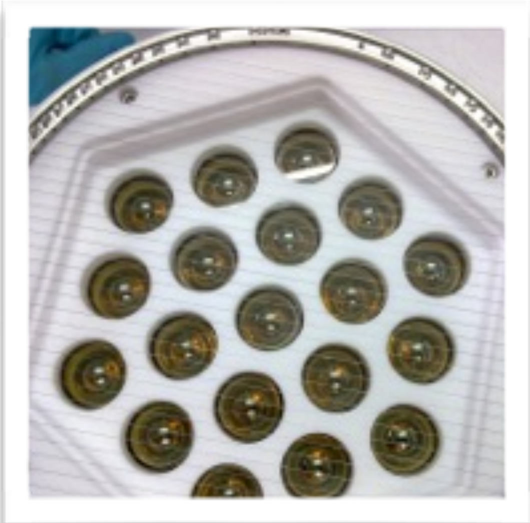
50 cm drift, polyethylene body with inner copper rings, radiopure resistors, larger grids

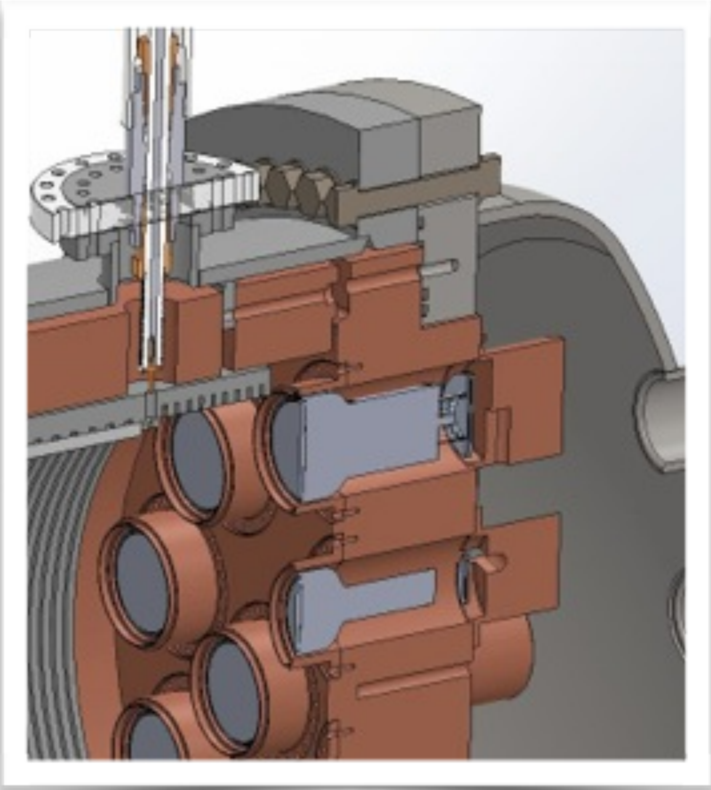


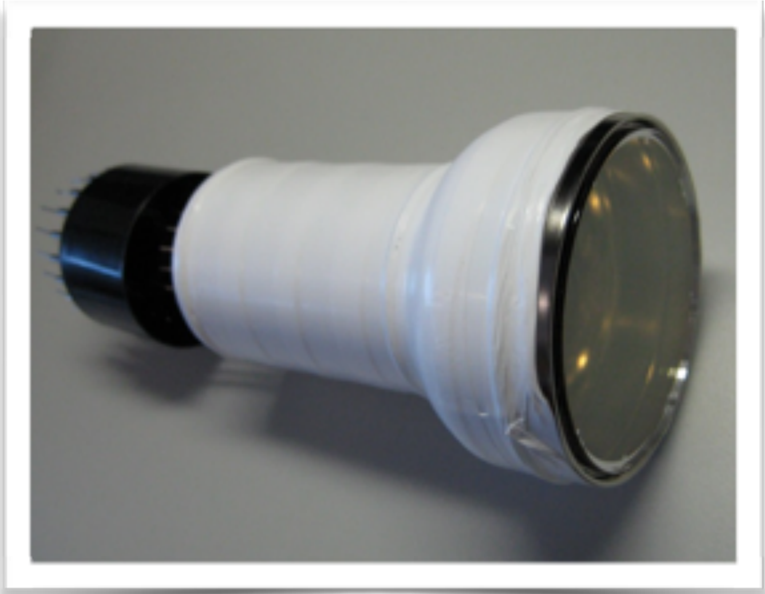




Energy plane

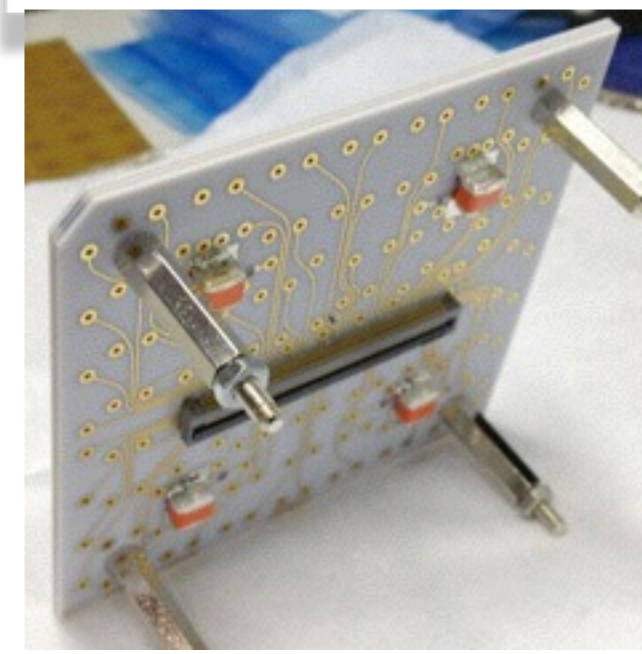


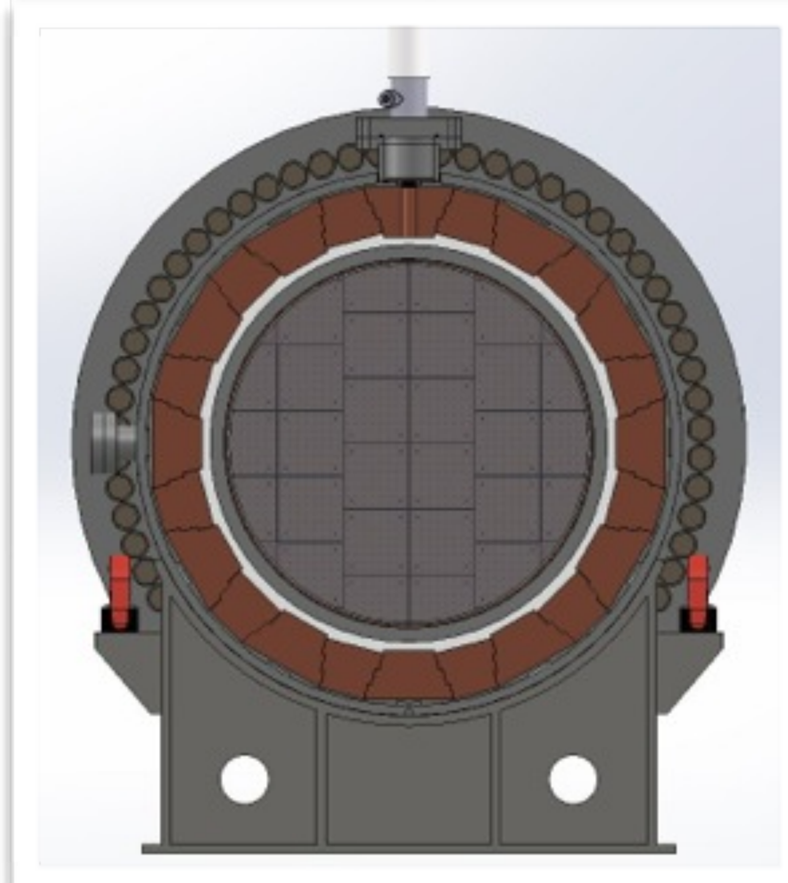


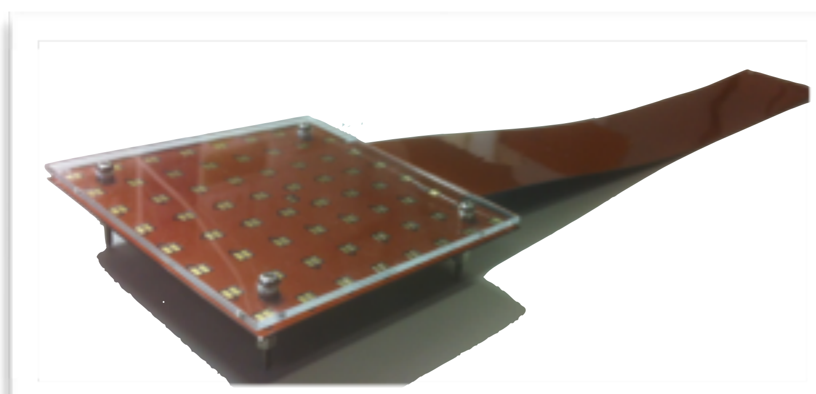


- Radiopure 3” R11410 PMTs manufactured by Hamamatsu; 500 μBq/unit (Bi-214), 150 μBq/unit (Tl-208).
- Same type used by Xenon and LUX. Ample community for join development (improvements).
- They need to be operated in radio pure enclosures (made of copper) coupled to the gas by sapphire windows coated with TPB

Tracking plane board

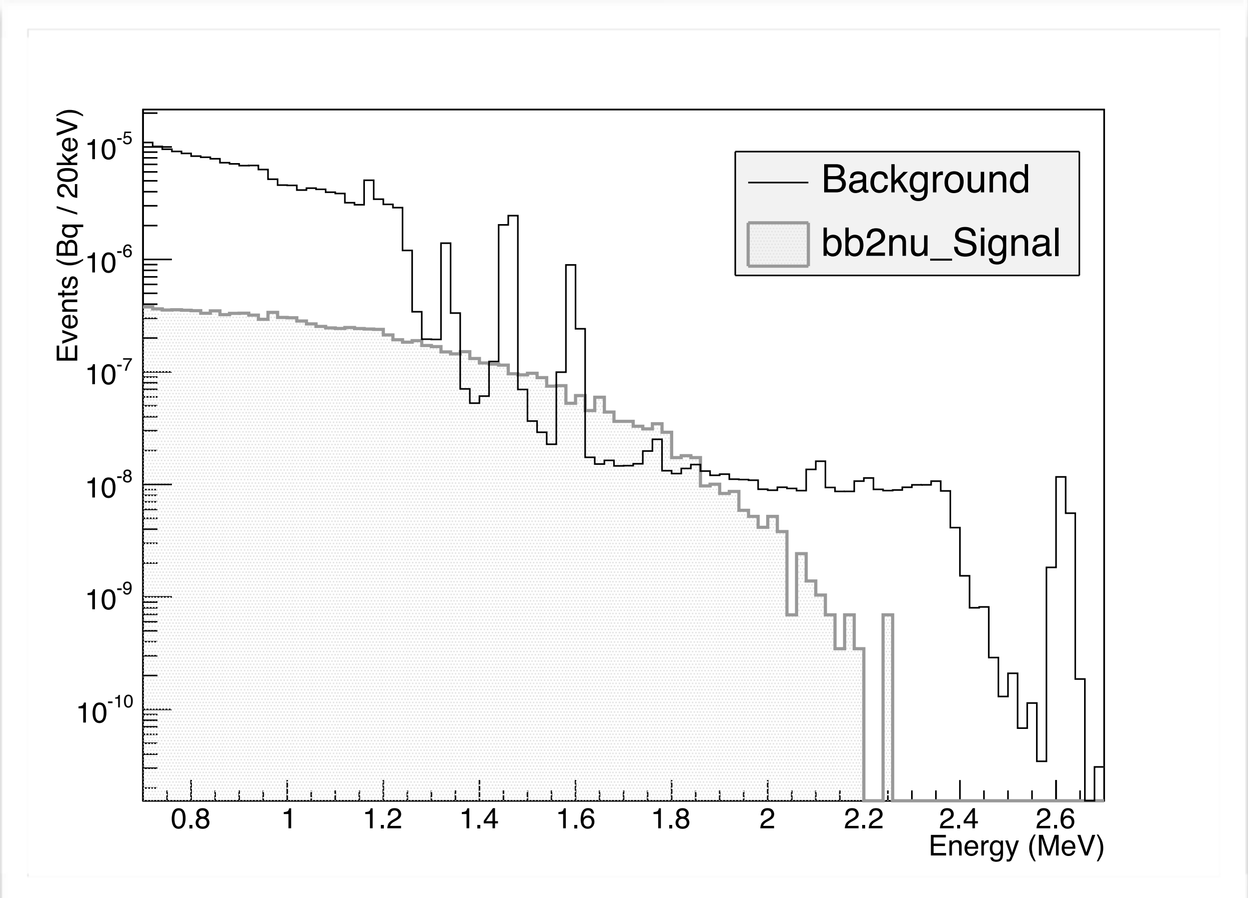


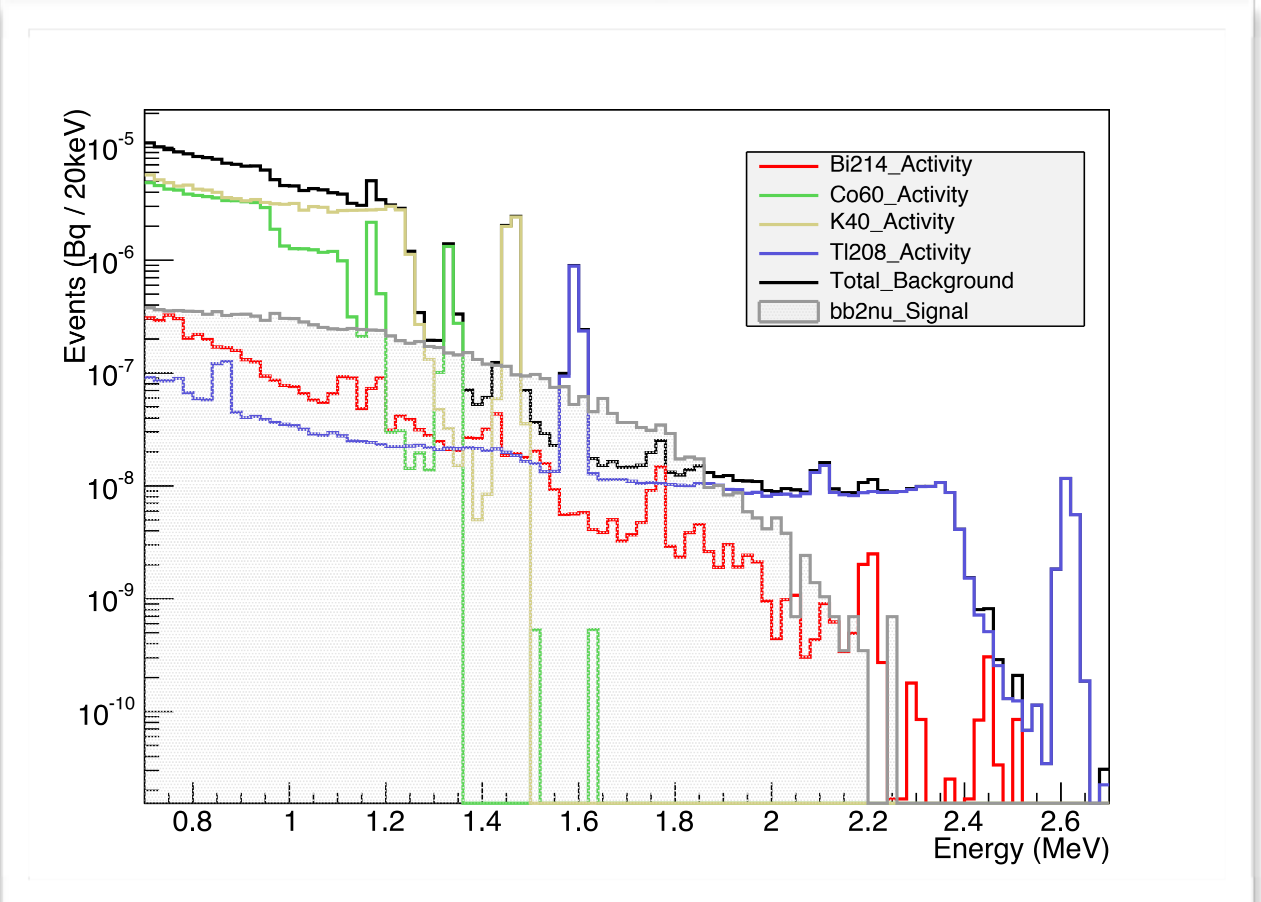




- 4 —> 30 KDBs use Kapton rather than Cuflon.
- Circuit includes a long piggy tail that runs through a copper shield. Connector and capacitors shielded from gas (12 cm copper

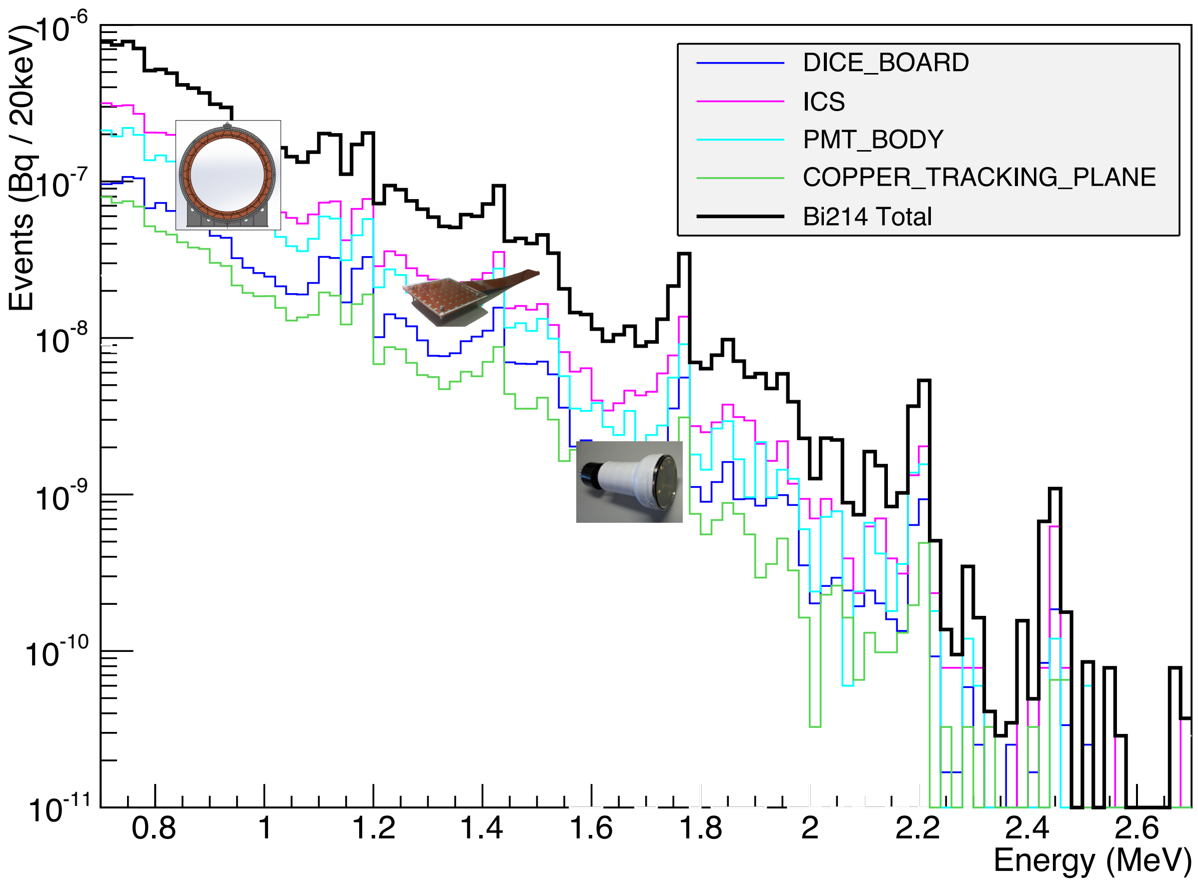
Expected activity in NEW (ββ2ν regime)

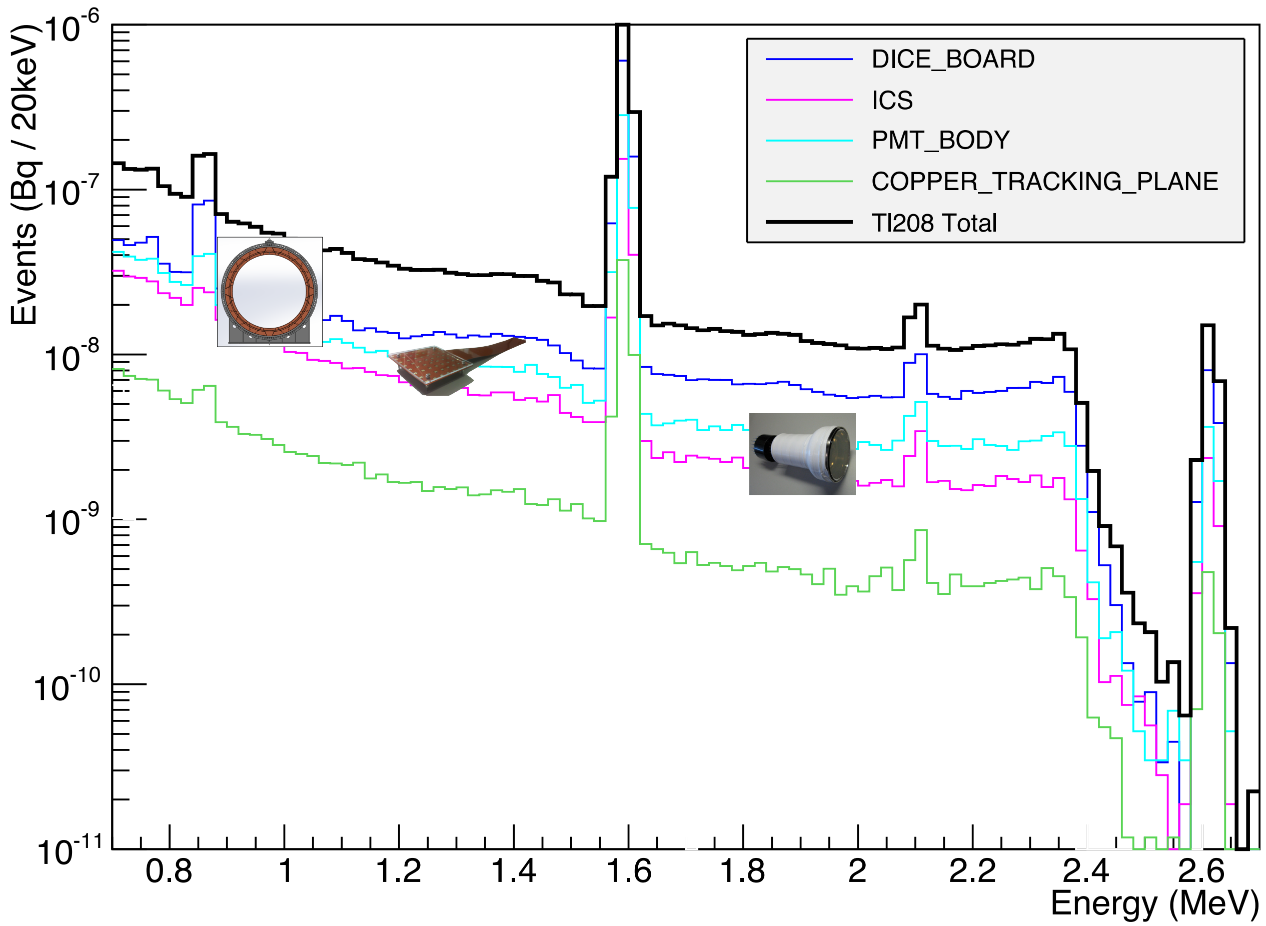




- The low energy part of the spectrum (<1.2 MeV) is dominated by K-40 and Co-60 backgrounds emanating from the sensors (PMTs and KDBs).
- The high energy part of the spectrum (> 1.9 MeV) is dominated by Bi-214 and Tl-208 backgrounds.
- The ββ2ν signal can be measured in NEW between 1.3 and 1.9 MeV.

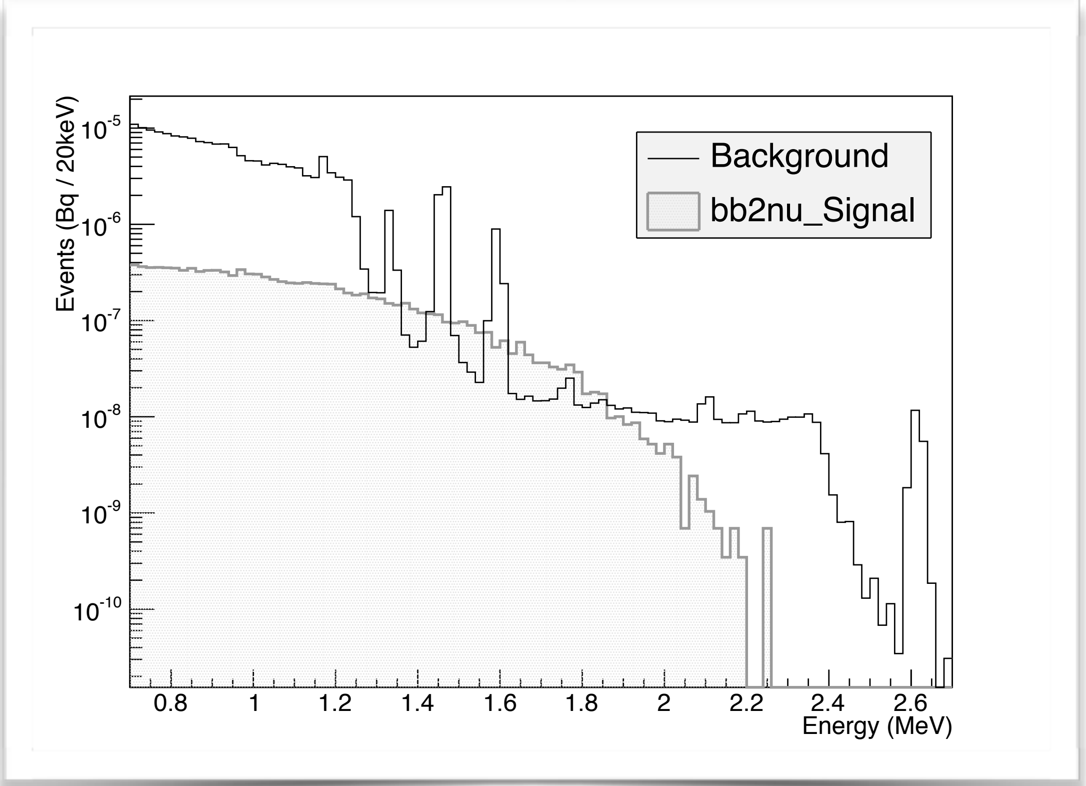
Sources of Bi-214 in NEW

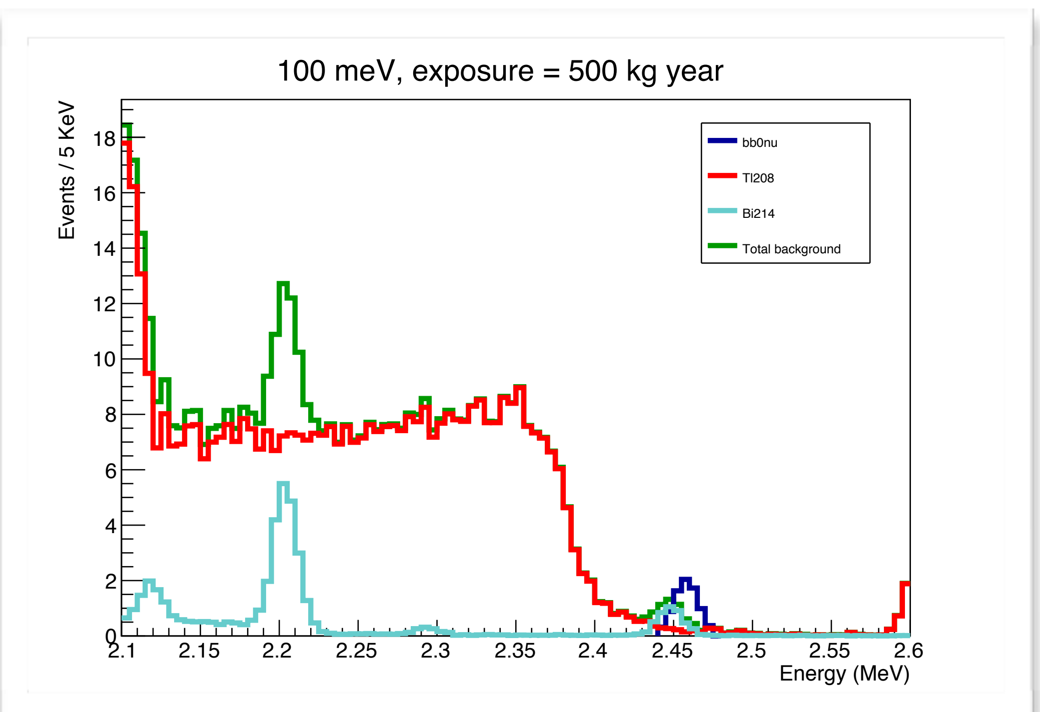




The three major sources of background are the sensors and the residual radiation from the copper.

Goals of NEW

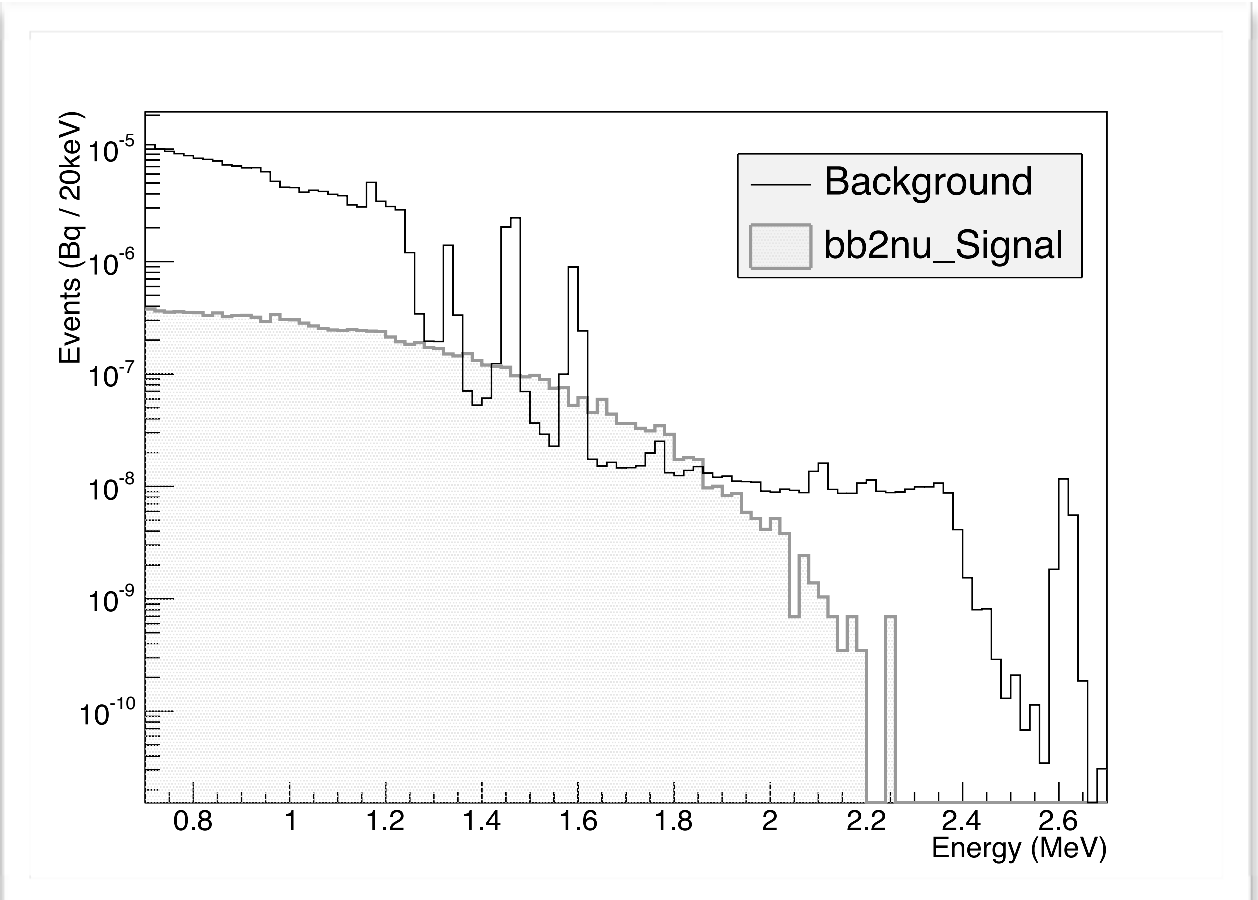


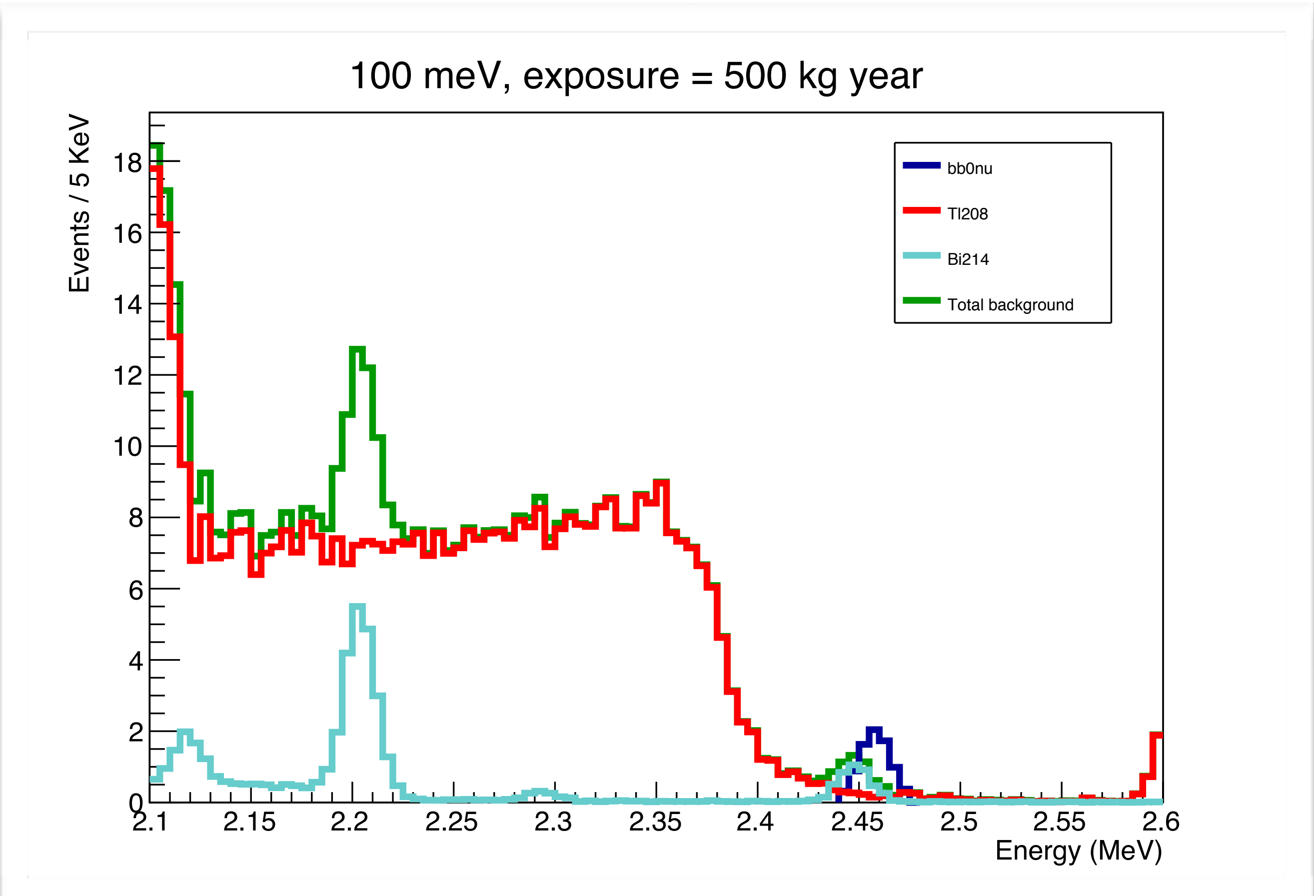


- Measure the expected backgrounds from the different isotopes, but specially Bi-214 and Tl-208.
- Validate NEXT background model using measurement.
- Identify any unexpected source of background (correct if needed)
- Observe ββ2v signal.
- Demonstrate energy resolution: our goal is to reach 0.5 % FWHM in the large detector.
- Demonstrate topological signature from data (ββ2v and Tl-208 double escape peak).
- Certify technology and underground operation with enriched xenon.

R&D	ββ2ν	ββ0ν (100 meV)
(2008-2013)	(2014-2016)	(2016-2020)

The ββ0ν landscape





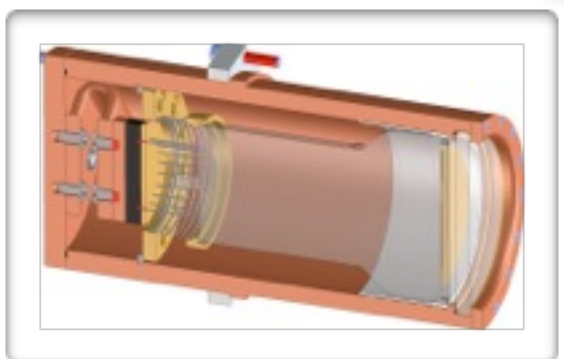
- The ββ0ν landscape in Xe-136 is much less populated by backgrounds than the ββ2ν landscape.
- The situation would have been much better if Qββ would have been at 2.5 MeV.
- On the other hand, energy resolution helps to separate signal from Bi-214 peak.

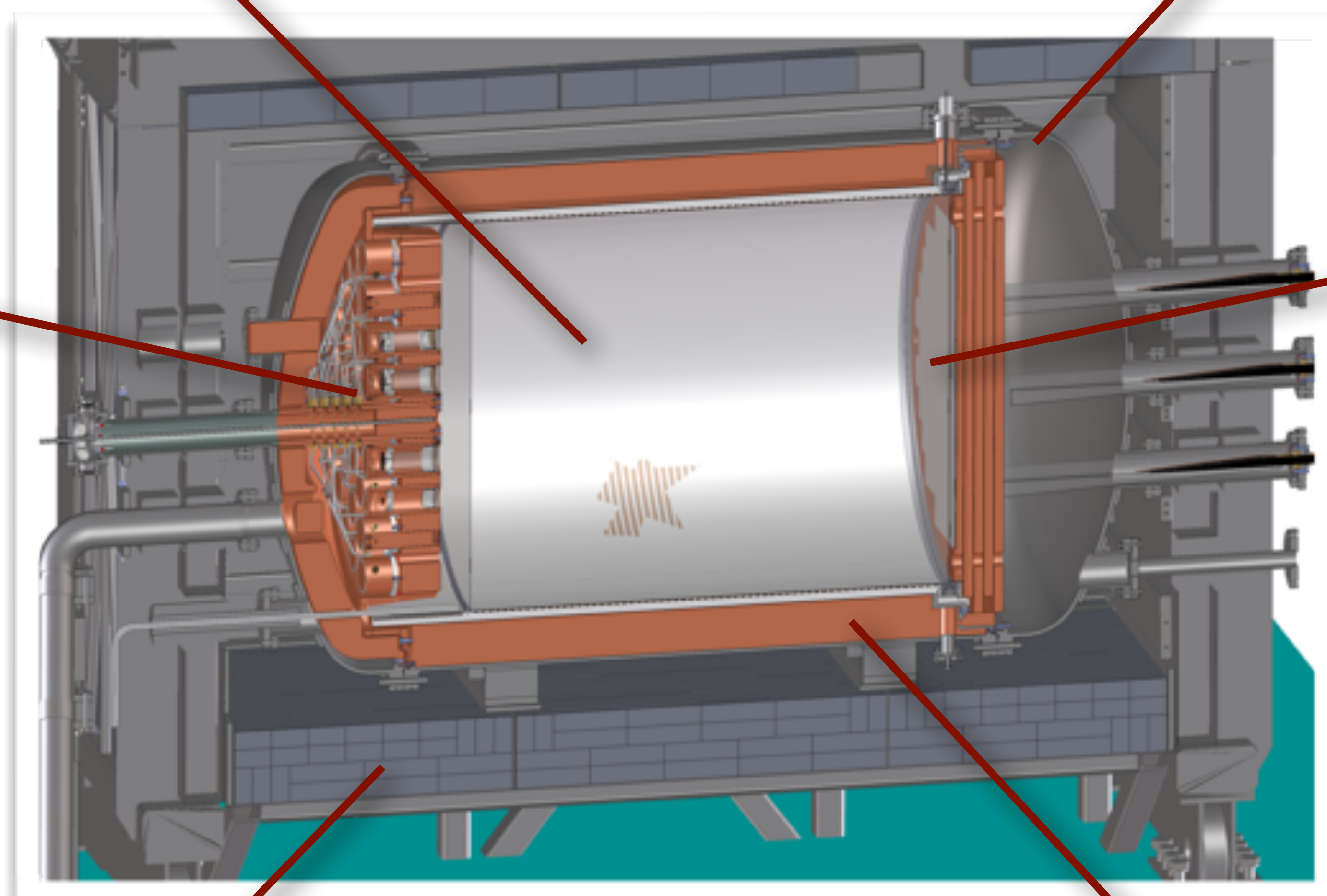
NEXT 100 kg detector at LSC: main features

Time Projection Chamber:
100 kg active region, 130 cm drift length

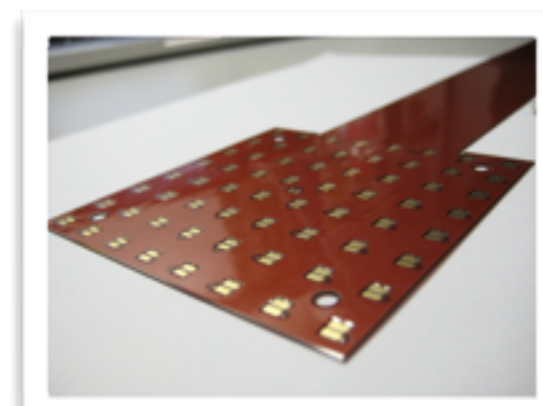
Pressure vessel:
stainless steel,15 bar max pressure

Energy plane:
60 PMTs,
30% coverage



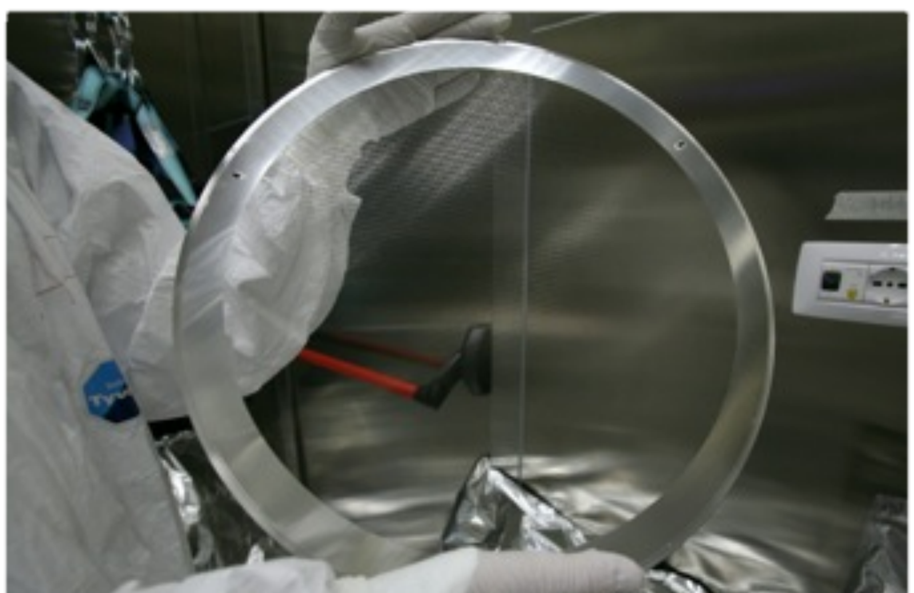


Tracking plane:
7,000 SiPMs,
1 cm pitch



Outer shield:
lead, 20 cm thick

Inner shield:
copper, 12 cm thick

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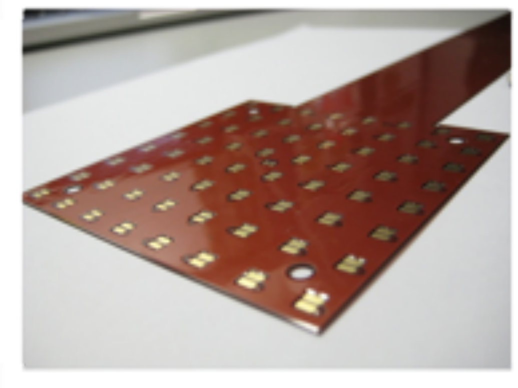
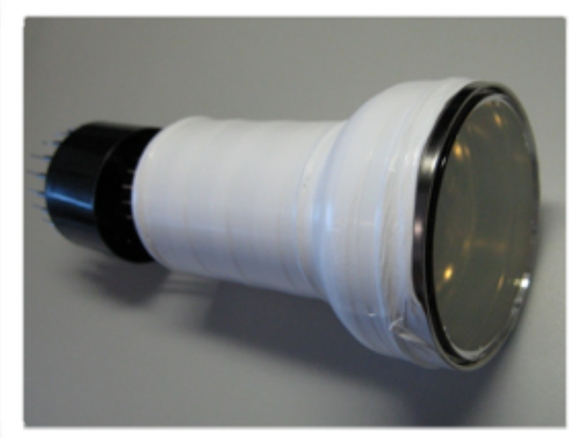
NEXT 100 kg radioactive budget



Kapton Dice boards

- Kapton and copper;107 units
- Activity Tl-208: —0.040 mBq/unit
- Activity Bi-214: —0.030 mBq/unit



PMTs

- Hamamatsu R11410-10; 60 units
- Activity Tl-208: —0.140 mBq/unit
- Activity Bi-214: —0.500 mBq/unit

Sensors:
Activity level ~3 mBq per plane. Actual measurements. Not shielded.

NEXT 100 kg radioactive budget

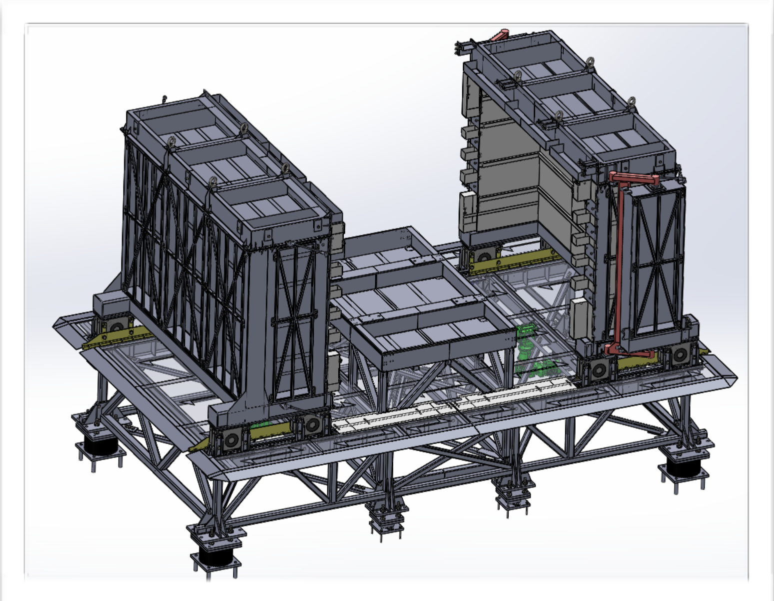
Vessel

- Stainless steel 316Ti; 1121 kg
- Activity Tl-208: <0.150 mBq/kg
- Activity Bi-214: <0.460 mBq/kg

Activity shielded by ICS

Shielding

- Lead; 13000 kg
- Activity Tl-208: <0.048 mBq/kg
- Activity Bi-214: <0.460 mBq/kg

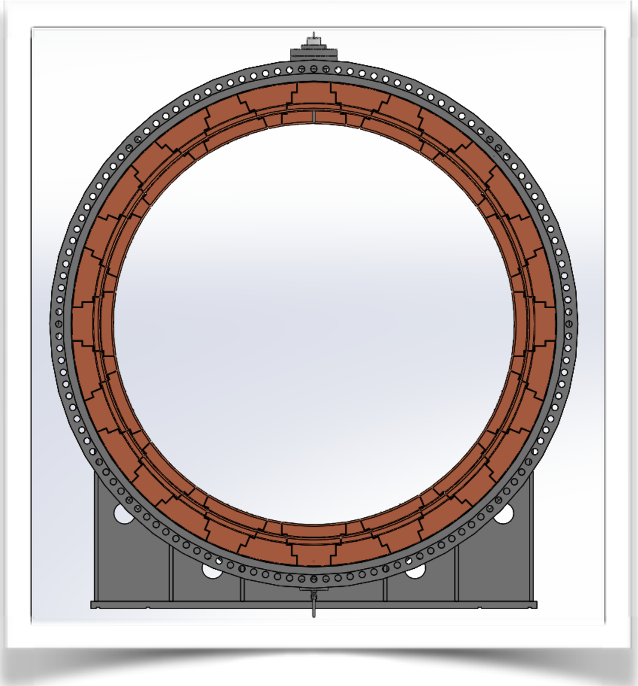


Lead Castell and Pressure Vessel:
Activity shielded by ICS. Uncertainty related to upper limits has moderate impact in radioactive budget due to ICS suppression.

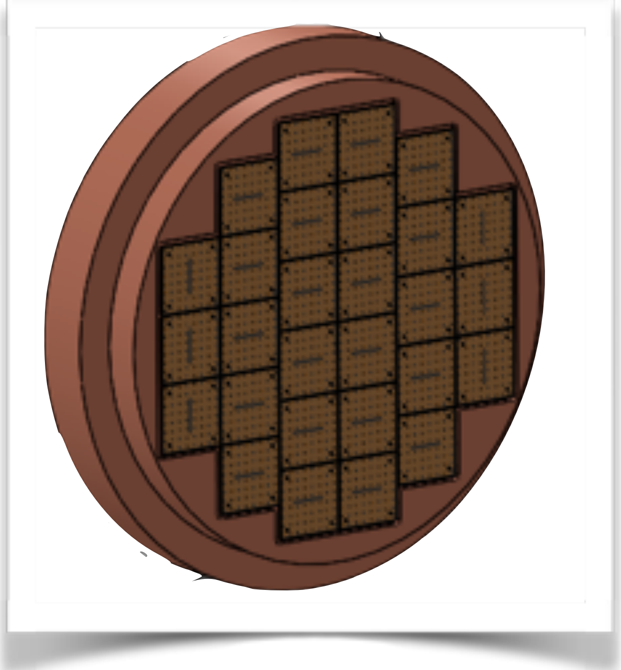
NEXT 100 kg radioactive budget

ICS, and support plates

- Copper (CuA1); ~9500 kg
- Activity Tl-208: <0.001 mBq/kg
- Activity Bi-214: <0.012 mBq/kg

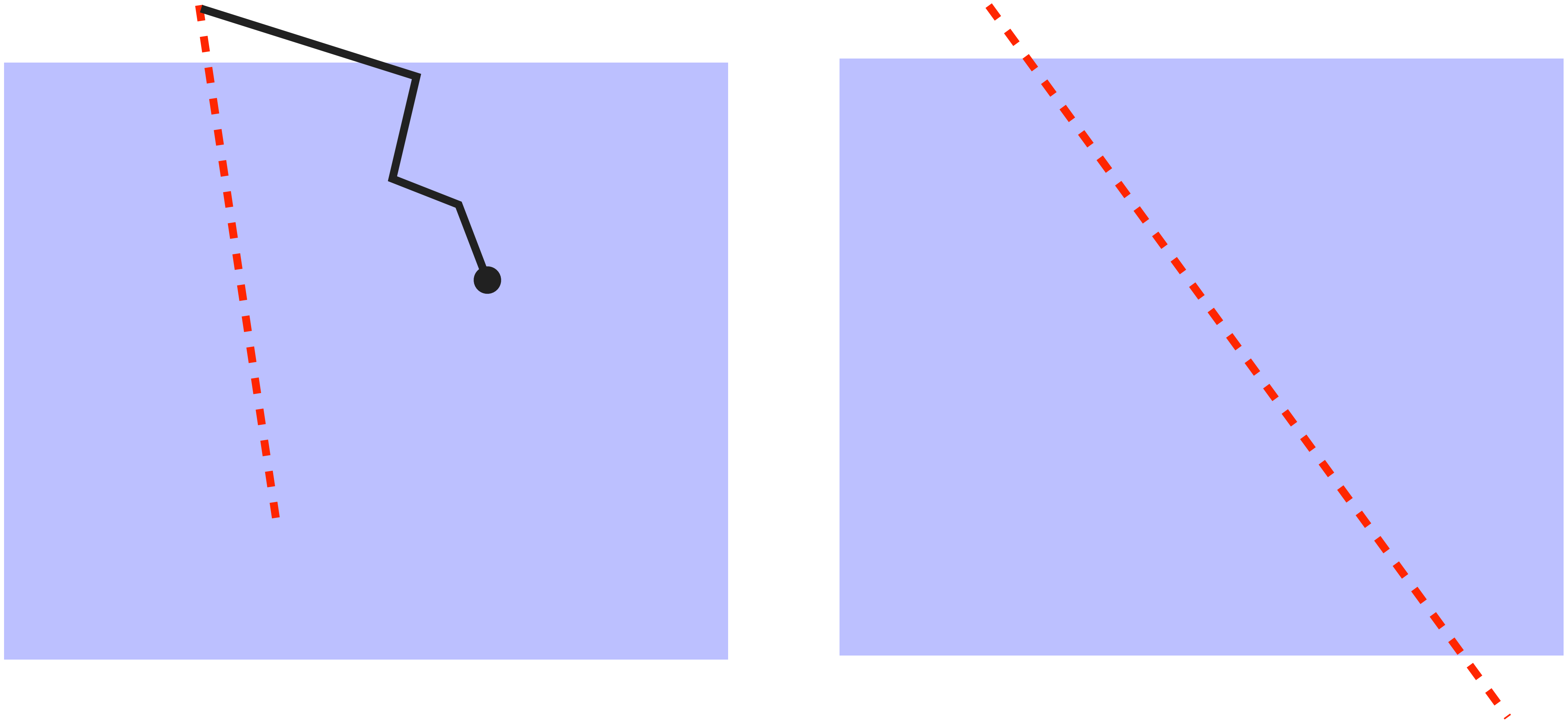


Copper
Electroformed commercial copper. Current measurements show our stock to be very radio pure, but only limits so far.



Residual radioactivity of ICS partially shielded (self-shielding)

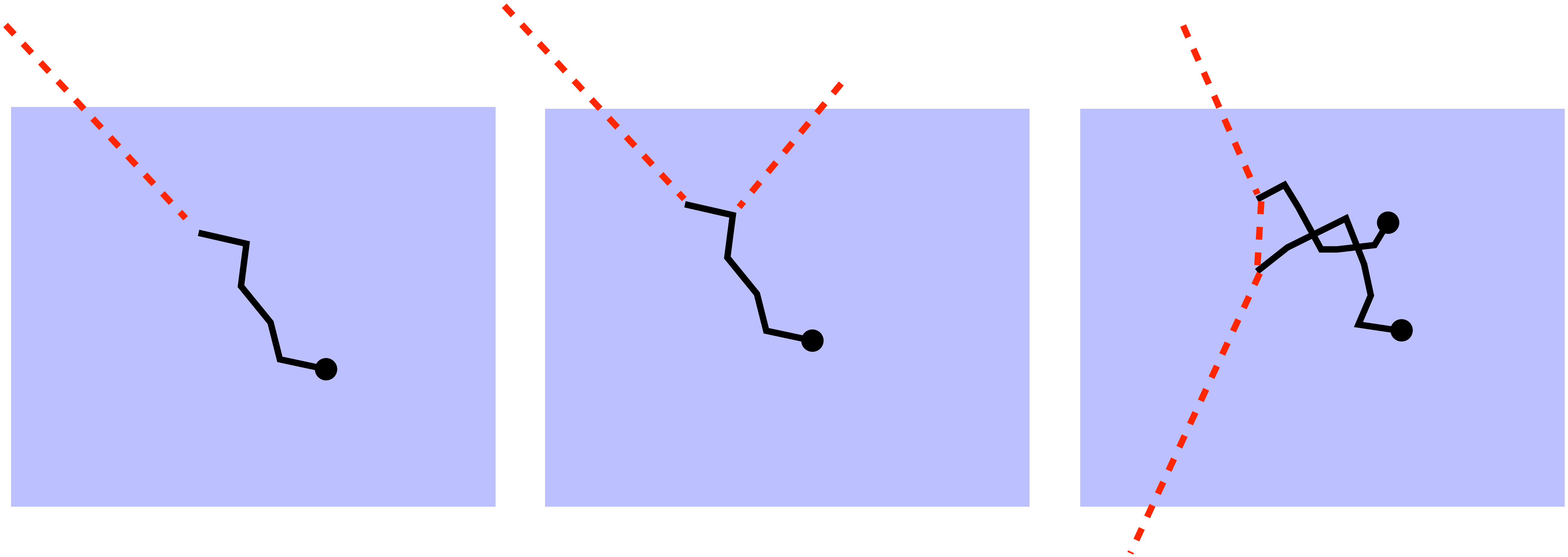
NEXT100 rejection of backgrounds



A transparent target, away from surfaces

- Veto of effectively all charged backgrounds entering the detector (left). High-energy gammas have a long interaction length (>3 m) in HPXe.

NEXT100 rejection of backgrounds



<u>The 2-electron signature</u>

- Interaction of high-energy gammas (from Tl-208 and Bi-214) in the HPXe can generate electron tracks with energies around the Q value of Xe-136. However, electron often accompanied of satellite clusters and single blob deposit

NEXT100 rejection of backgrounds

	$0\nu\beta\beta$	Tl-208	Bi-214
Fiducial E>2 MeV	67.86%	0.25%	0.01%
ROI	95.52%	8.99%	64.66%
1 track	74.60%	1.86%	12.54%
2 blobs	73.76%	9.60%	9.89%

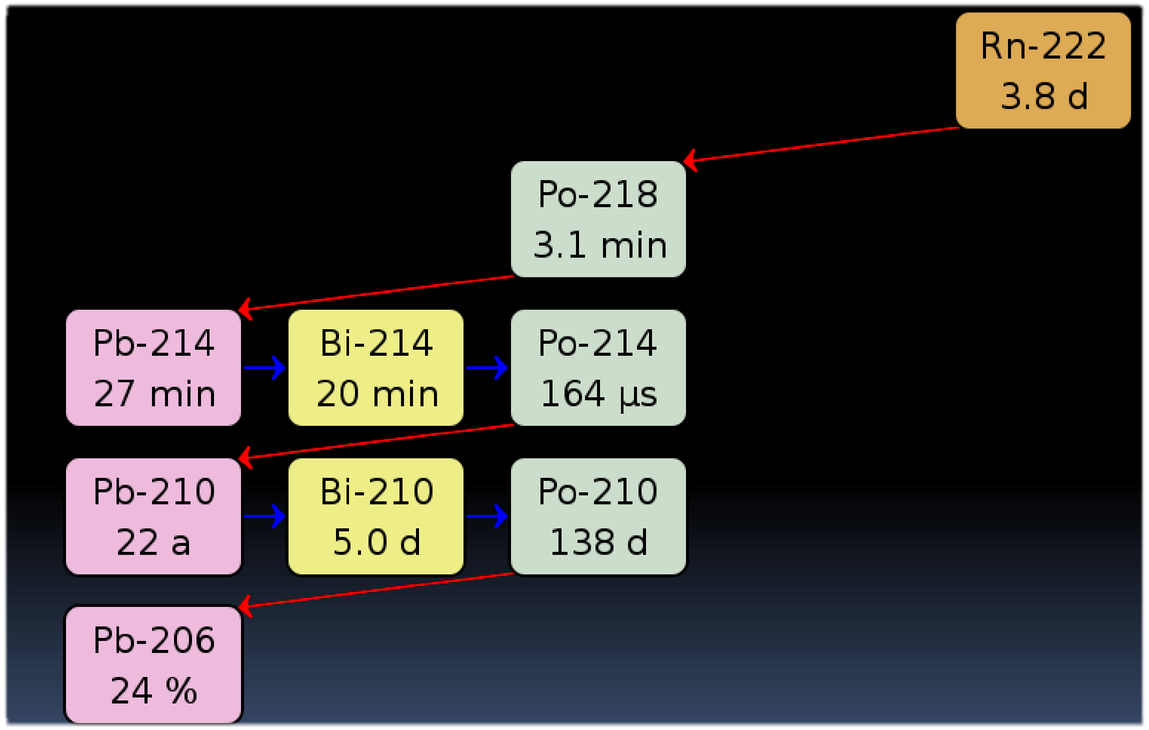
The 2-electron analysis

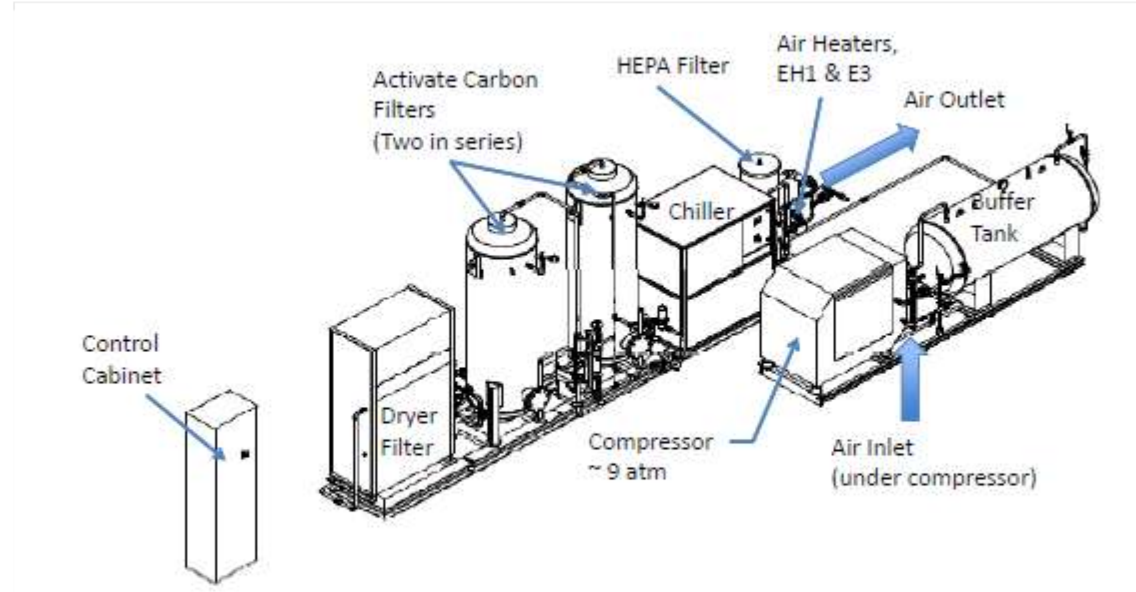
- Effect of the filters (cuts) defining an event with 2 electrons and energy in a ROI of 2σ around $Q_{\beta\beta}$. Efficiency for signal ~35% for suppression factors 4-8 x 10^{-7}
- WILL BE VALIDATED by NEW

NEXT 100 expected background

	Activity (Bq)		Rejection Factors		Final rate (ckky)	
	Tl-208	*Bi-214*	*Tl-208*	*Bi-214*	*Tl-208*	*Bi-214*
Dice Boards	4,28E-03	3,21E-03	7,90E-07	8,85E-07	3,047E-05	2,560E-05
PMTs	8,40E-03	3,00E-02	3,30E-07	2,68E-07	2,498E-05	7,244E-05
Field Cage	4,38E-03	1,53E-02	5,30E-07	8,02E-07	2,091E-05	1,107E-04
ICS	1,326E-02	1,105E-01	1,100E-07	8,400E-08	1,315E-05	8,365E-05
Vessel	1,66E-01	5,16E-01	1,10E-08	2,80E-09	1,644E-05	1,301E-05
Shielding Lead	6,266E-01	1,084E+00	2,000E-09	1,000E-10	1,129E-05	9,763E-07
SUBTOTAL	8,23E-01	1,76E+00			1,172E-04	3,063E-04
TOTAL BKGND	2,58E+00				**4,24E-04**	

Radon

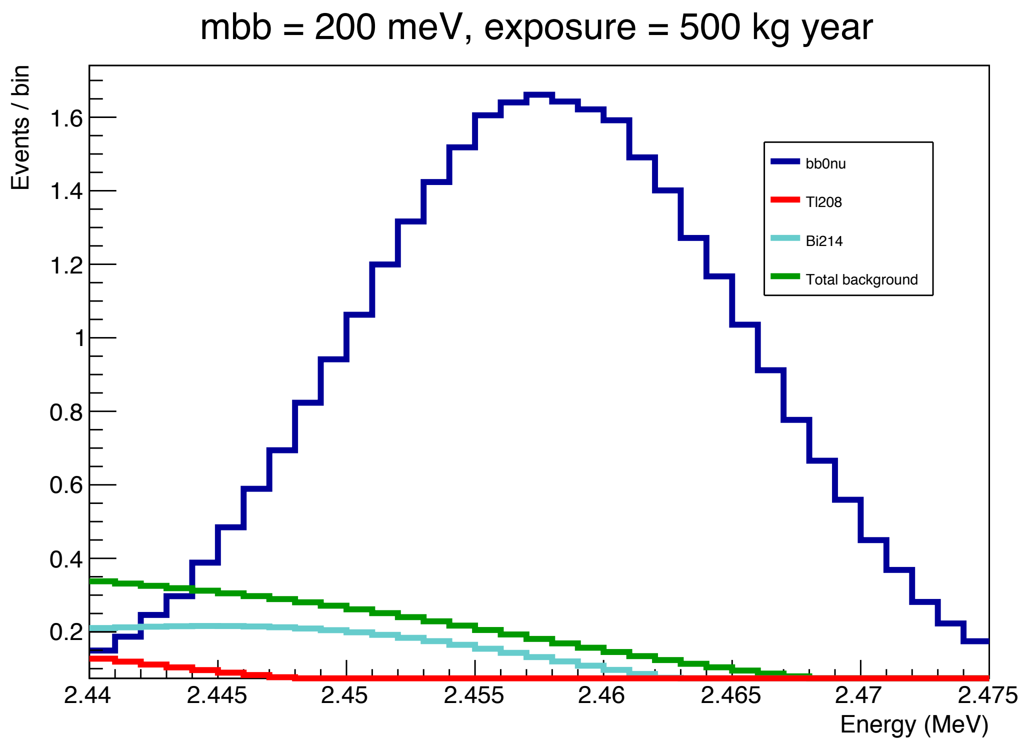


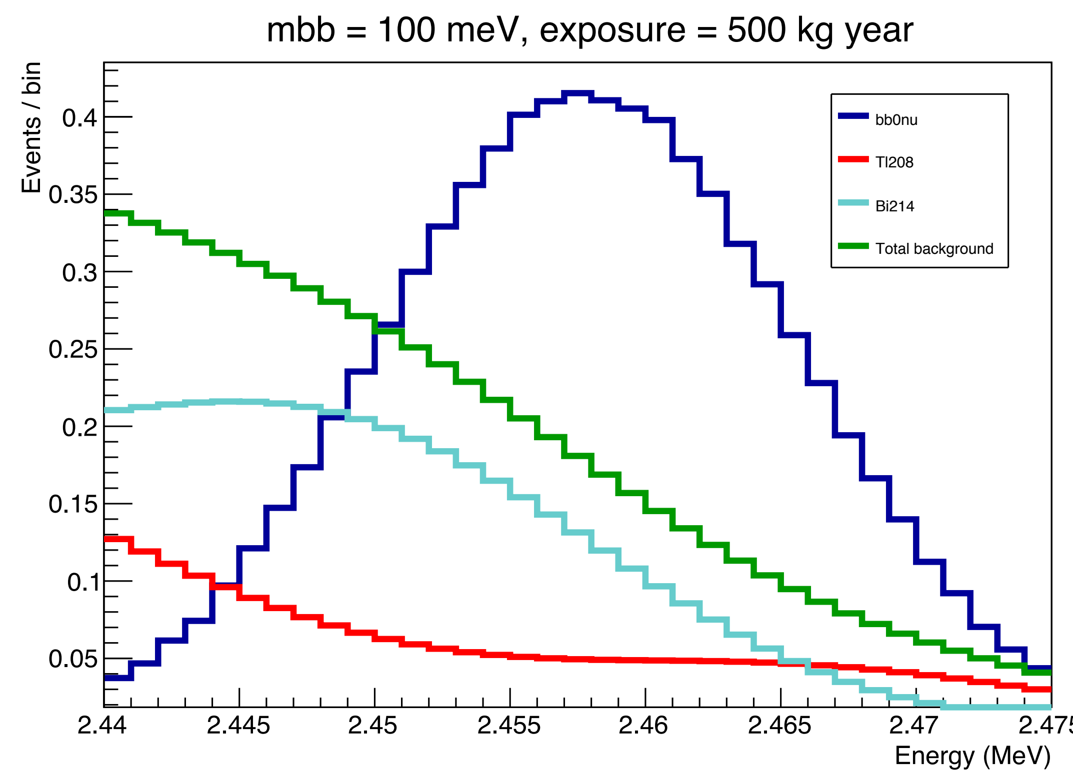


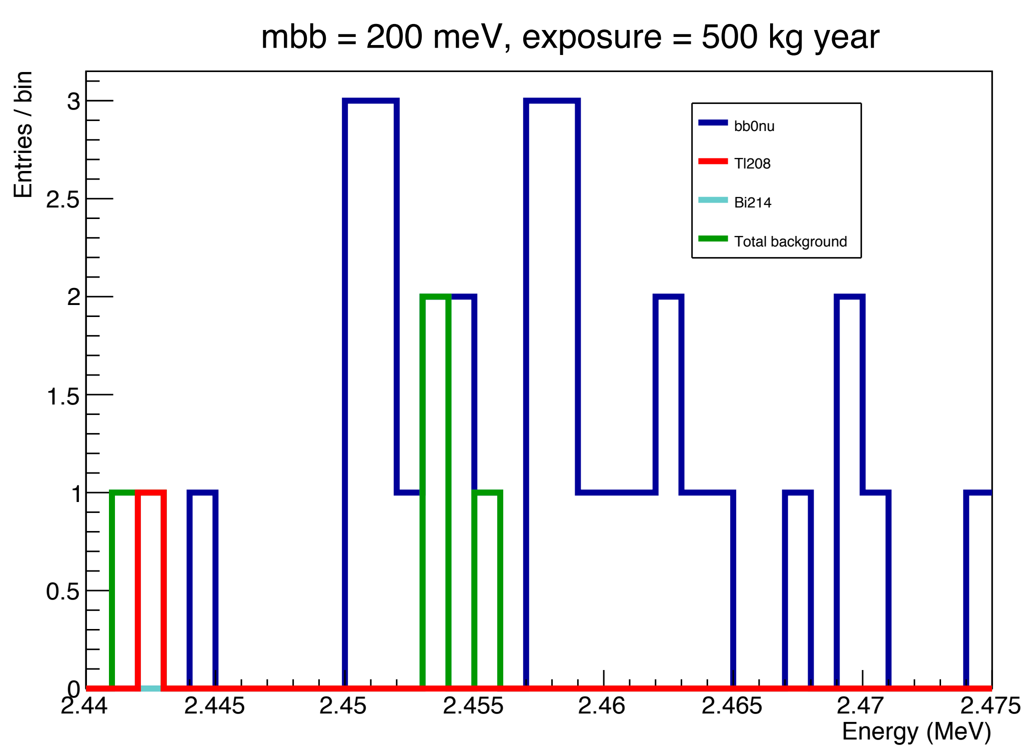
Layout of radon reduction system

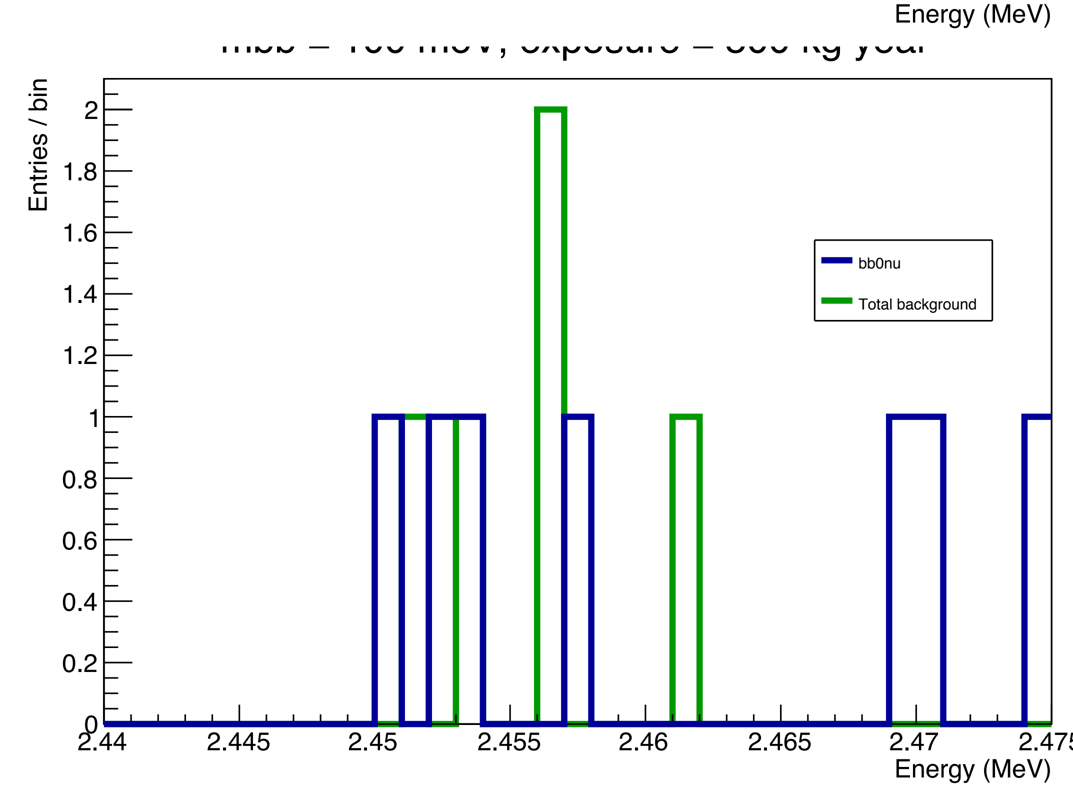
- Activity: 70 Bq/m^3 in LSC air.
- Volume of air inside lead castle: 6 m^3.
- Background rate of Bi-214 coming from Rn-222: 2 x 10^{-2} ckky.
- Standard Radon suppression systems achieve 3 orders of magnitude of suppression. Thus: 2 x 10^{-5} ckky. For NEXT-100 operation 2 orders of magnitude would be enough.

Physics reach

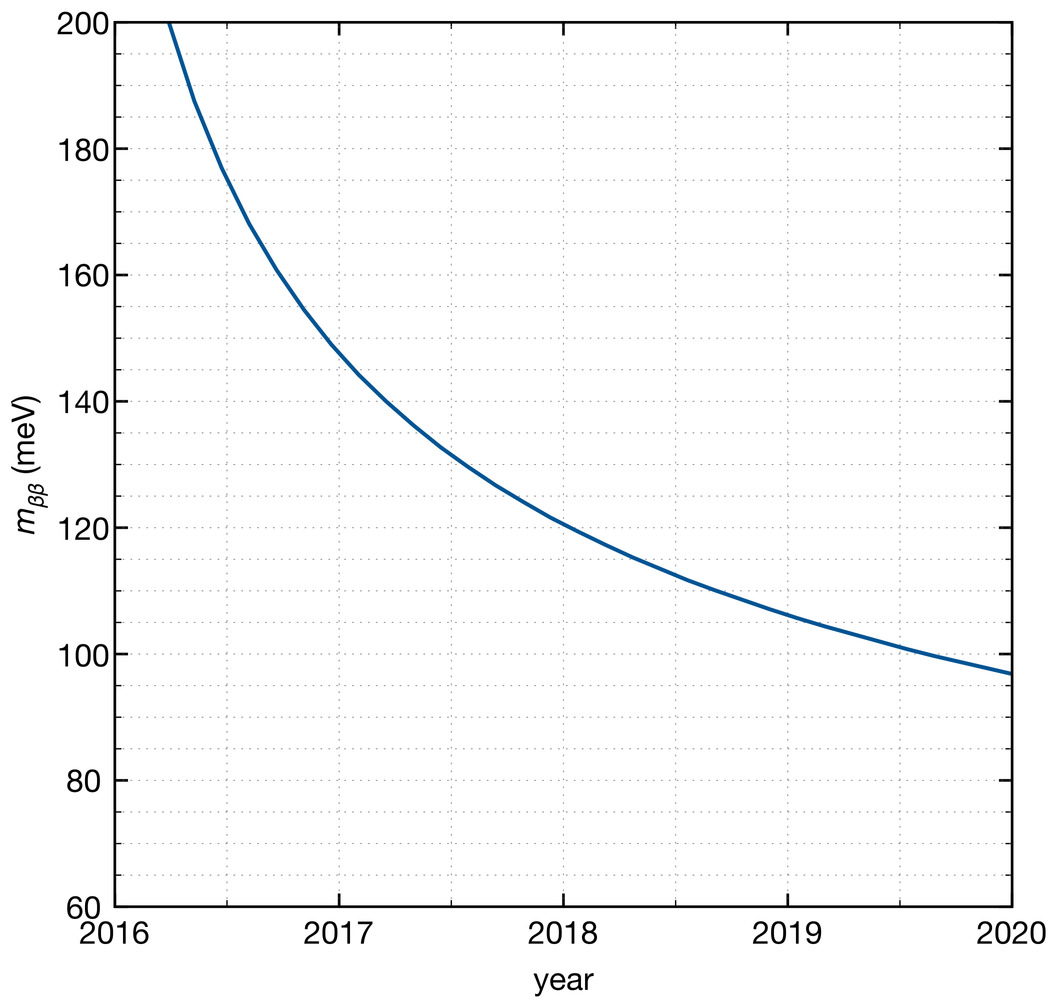


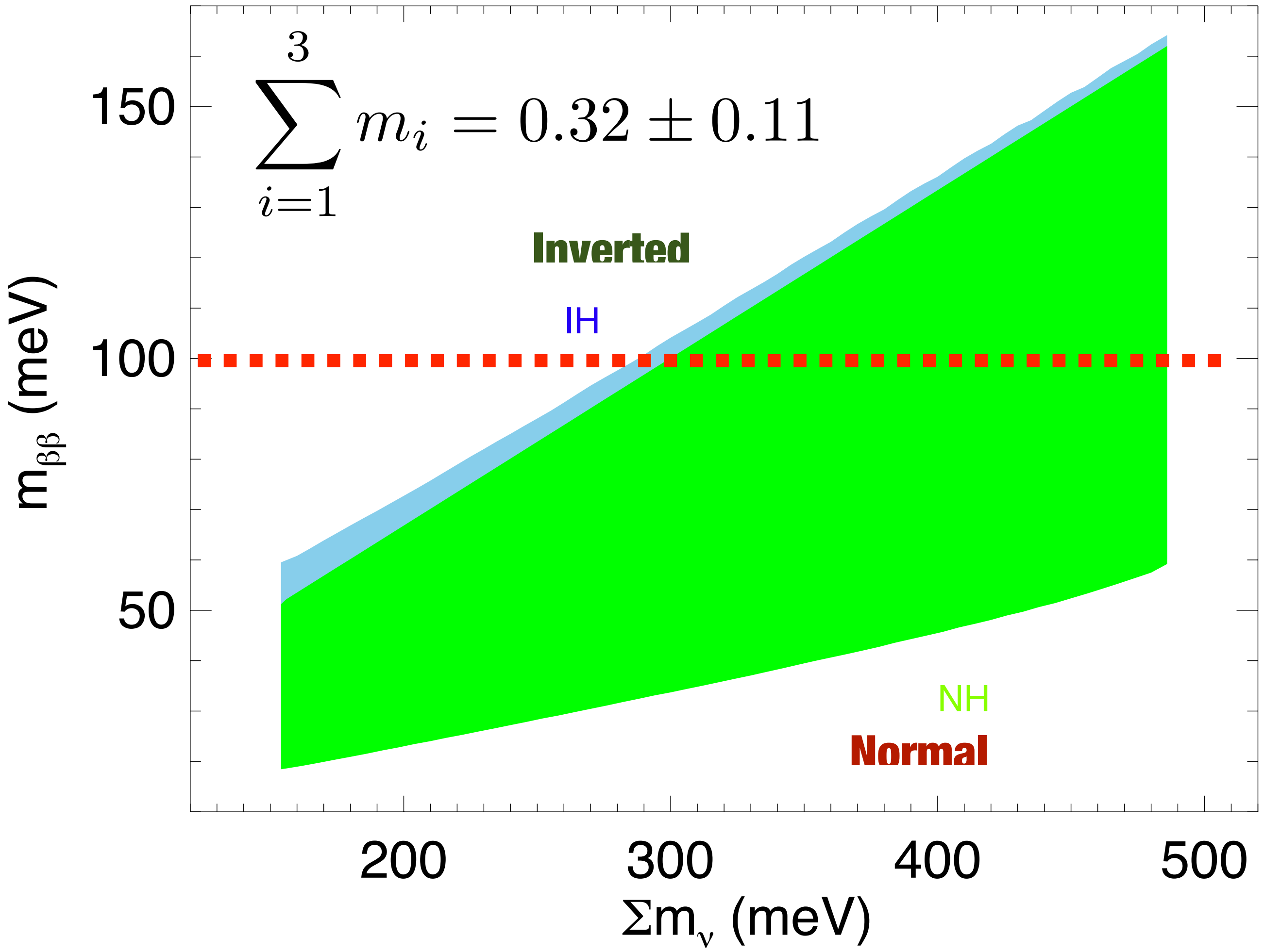






Physics reach





- Reach mv < 100 meV.
- Very likely this will be unexplored ground in 2020.
- Thus, NEXT has a chance of making a discovery or seeing a hint.

NEXT100 program

Background model and sensitivity:

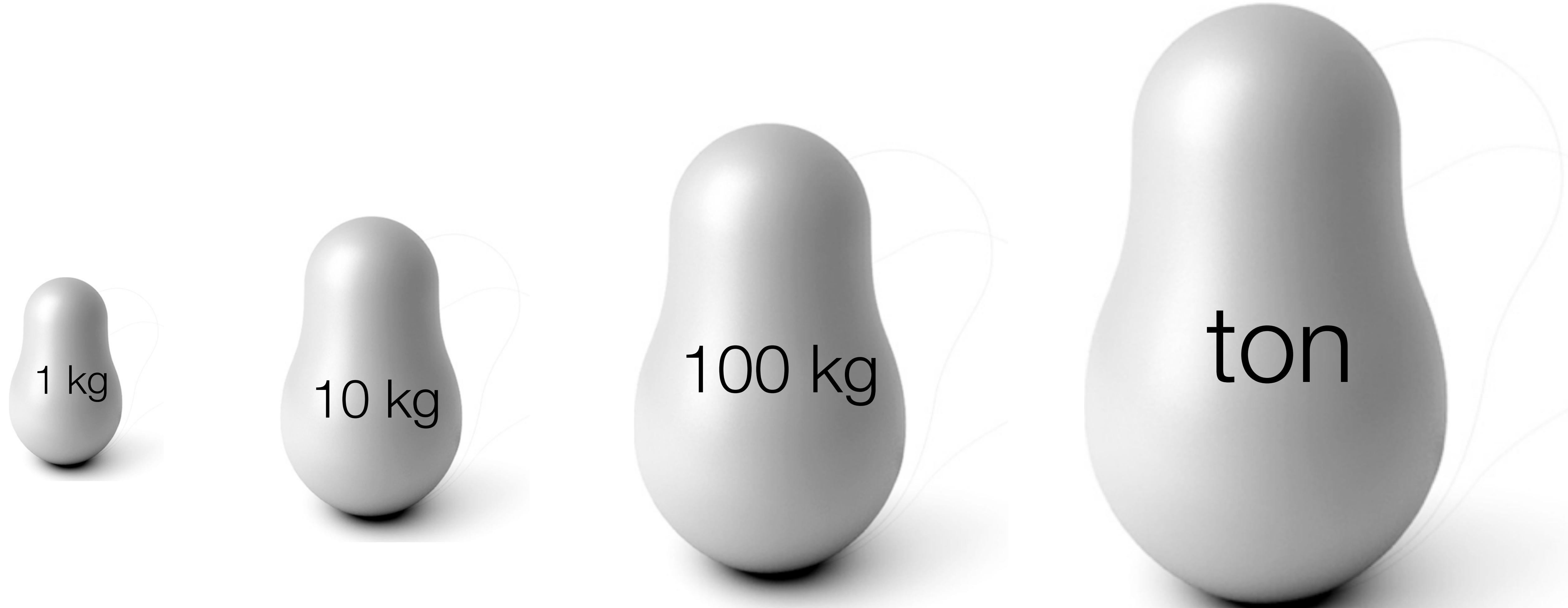
- Uncertainties in activities of materials due to limited sensitivity translate into uncertainties in sensitivity. Improve radio purity measurement techniques
- Understand all sources of background, including unexpected (e.g. radon sources, cosmogenics). NEW operation.

Energy resolution and topological signal:

- Goal: achieve near-to-Fano resolution (0.5 % FWHM) in the full detector. NEW operation.
- Fully exploit the power of the signal topology. Characterise with 2ββ and Tl double escape peak. NEW operation.

Challenges:

- Grids (size, stored energy, sparks). R&D under way.
- Reduce radioactive budget. KDB circuits without adhesive layers. ultra radio pure copper.
- Understanding TPB (uniformity, stability, glow). DEMO, NEW operation.



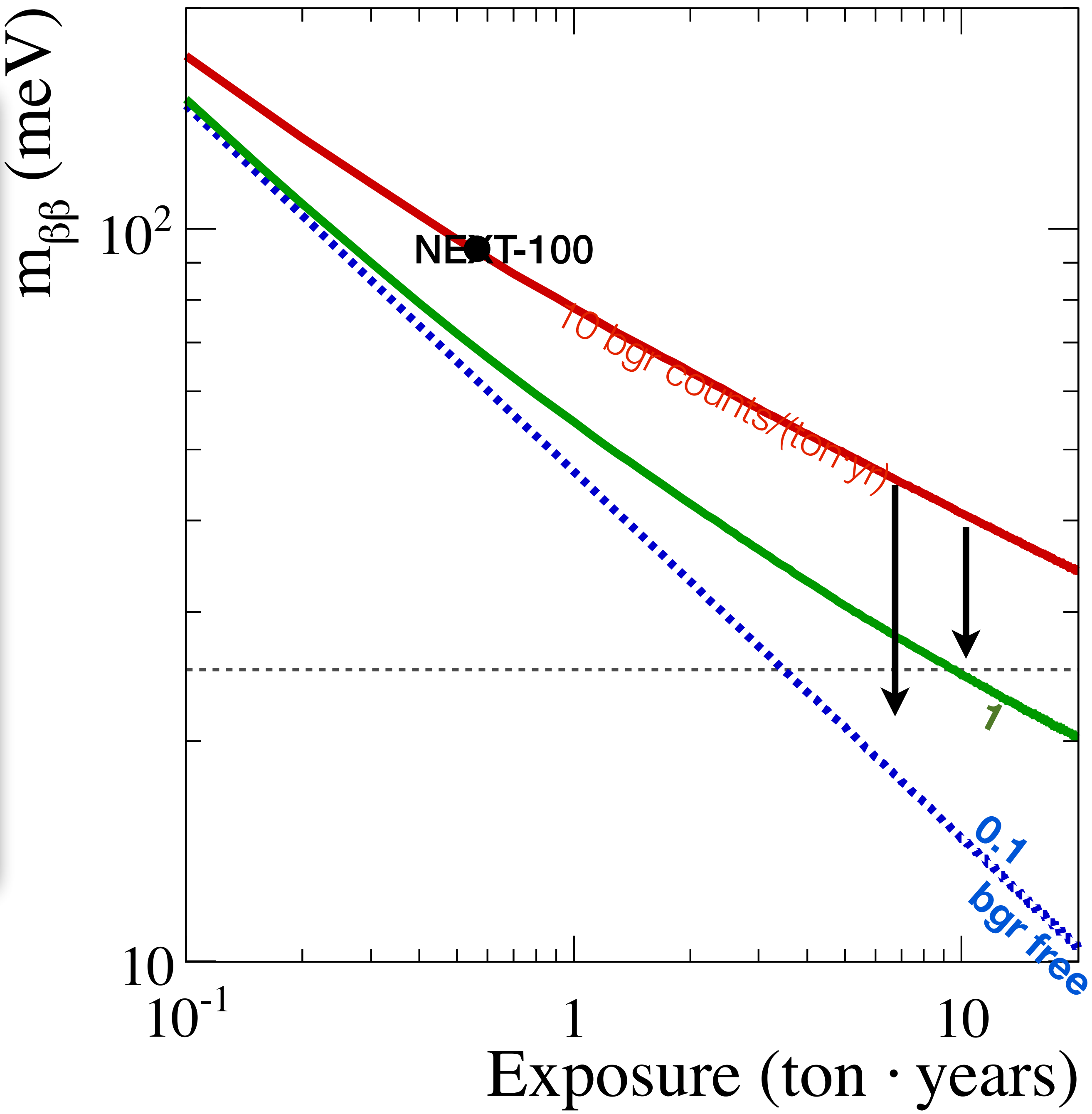
R&D	ββ2ν	ββ0ν (100 meV)	ββ0ν (20 meV)
(2008-2013)	(2014-2016)	(2016-2020?)	(2020?)

Background requirements

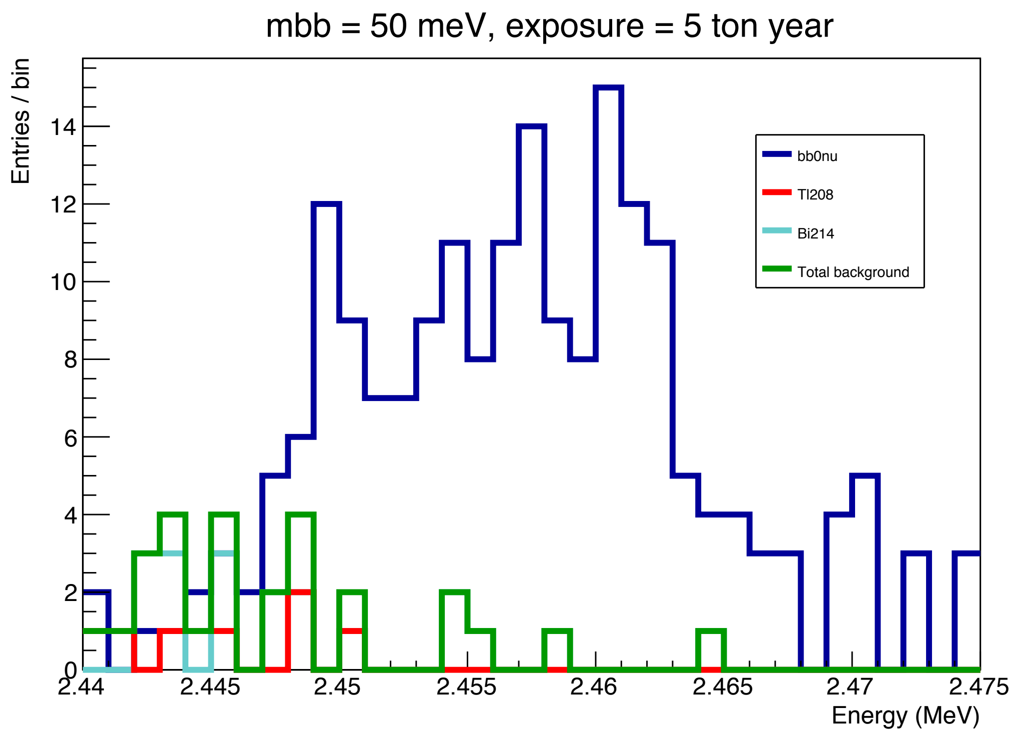
- Ton-scale detector is necessary but not sufficient requirement to reach ~20 meV

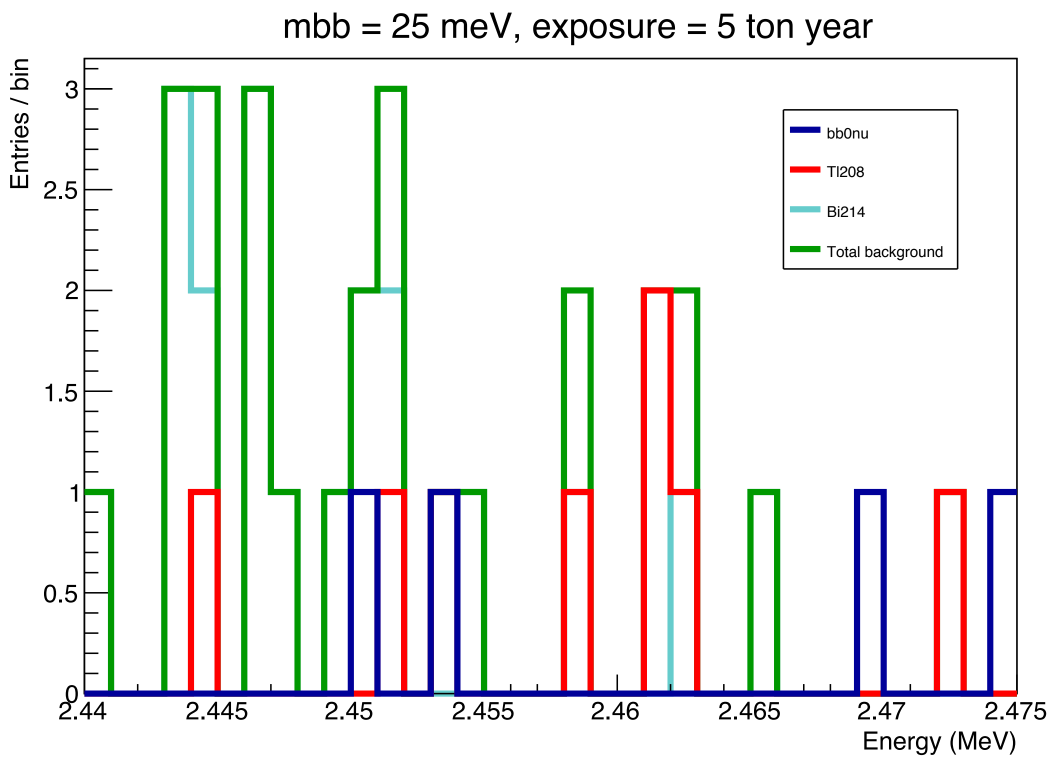
- However, a relative background reduction of 1/5 appears possible (1/2.5 comes from economy of scale). In this case one would be able to fully cover the inverse hierarchy.

- First need to build and operate NEXT-100 to fully understand backgrounds



Physics reach

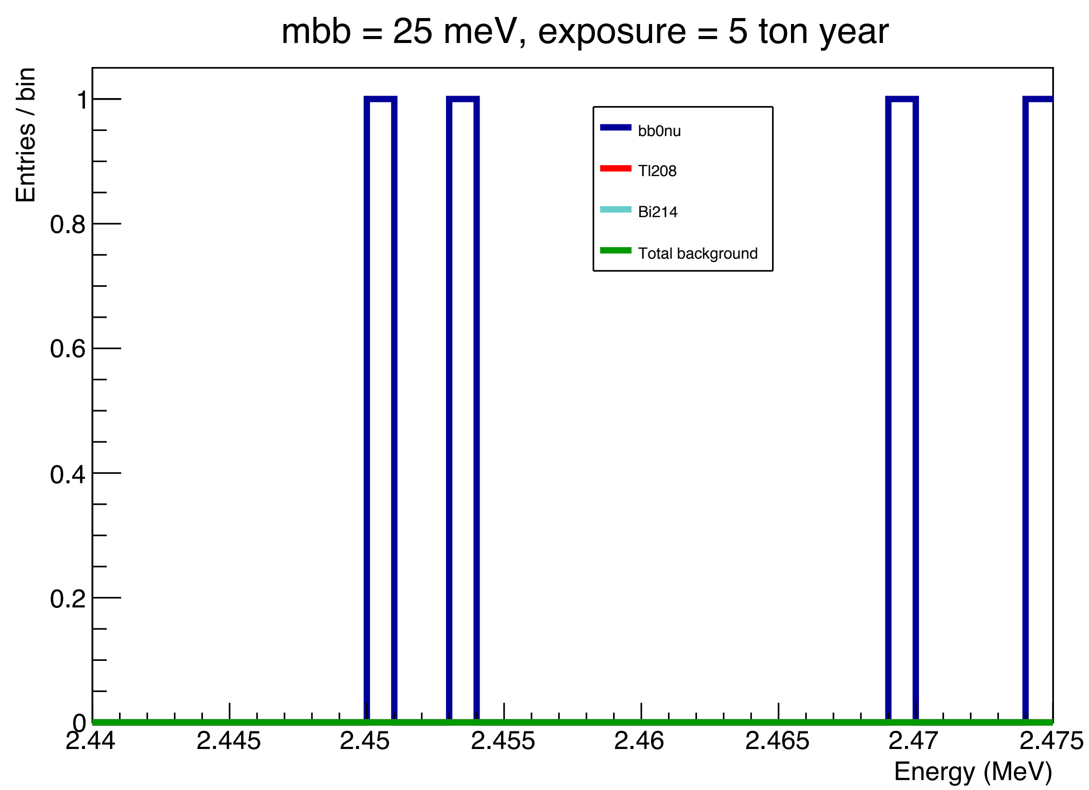


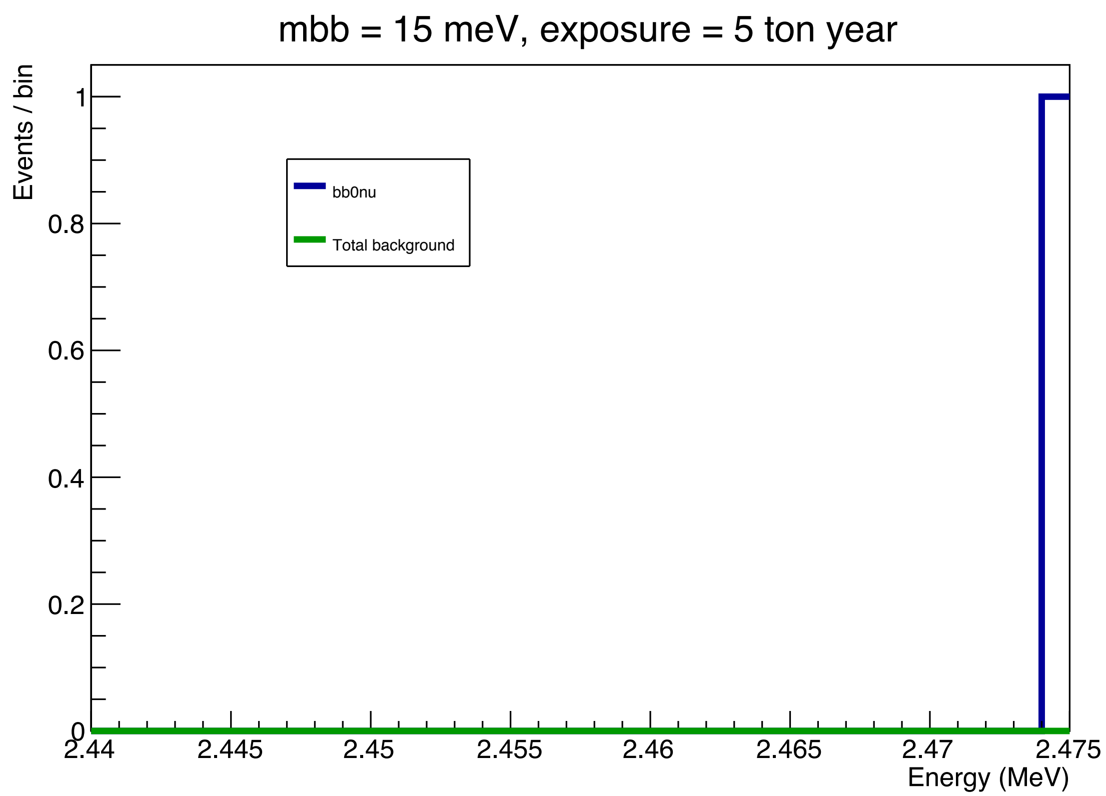


b=5 x 10^{-4} ckky

- Increasing the detector mass but not improving the background rate will not allow to fully explore the inverted hierarchy.

Physics reach ($b=10^{-4}$ ckky)



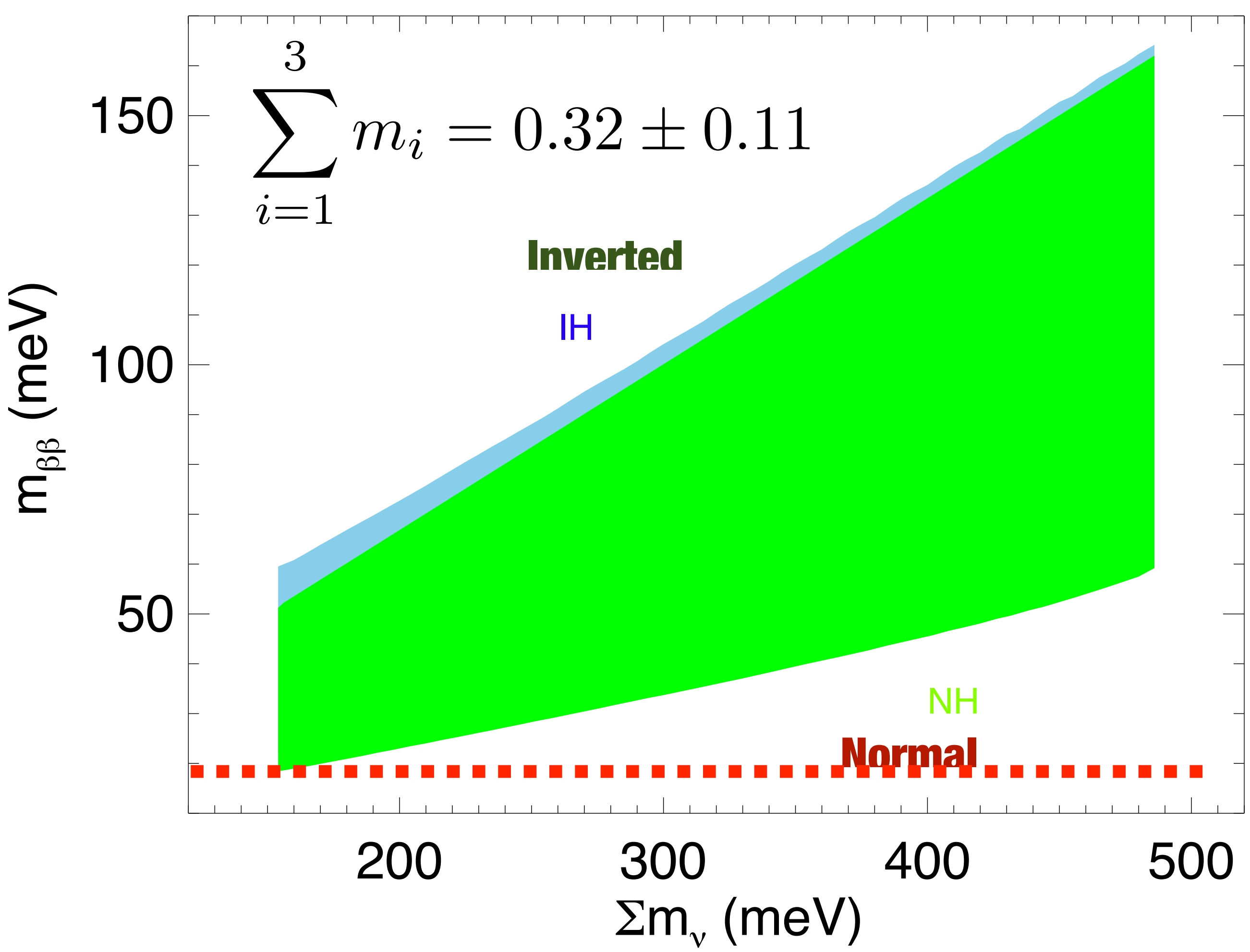


$b=10^{-4}$ ckky

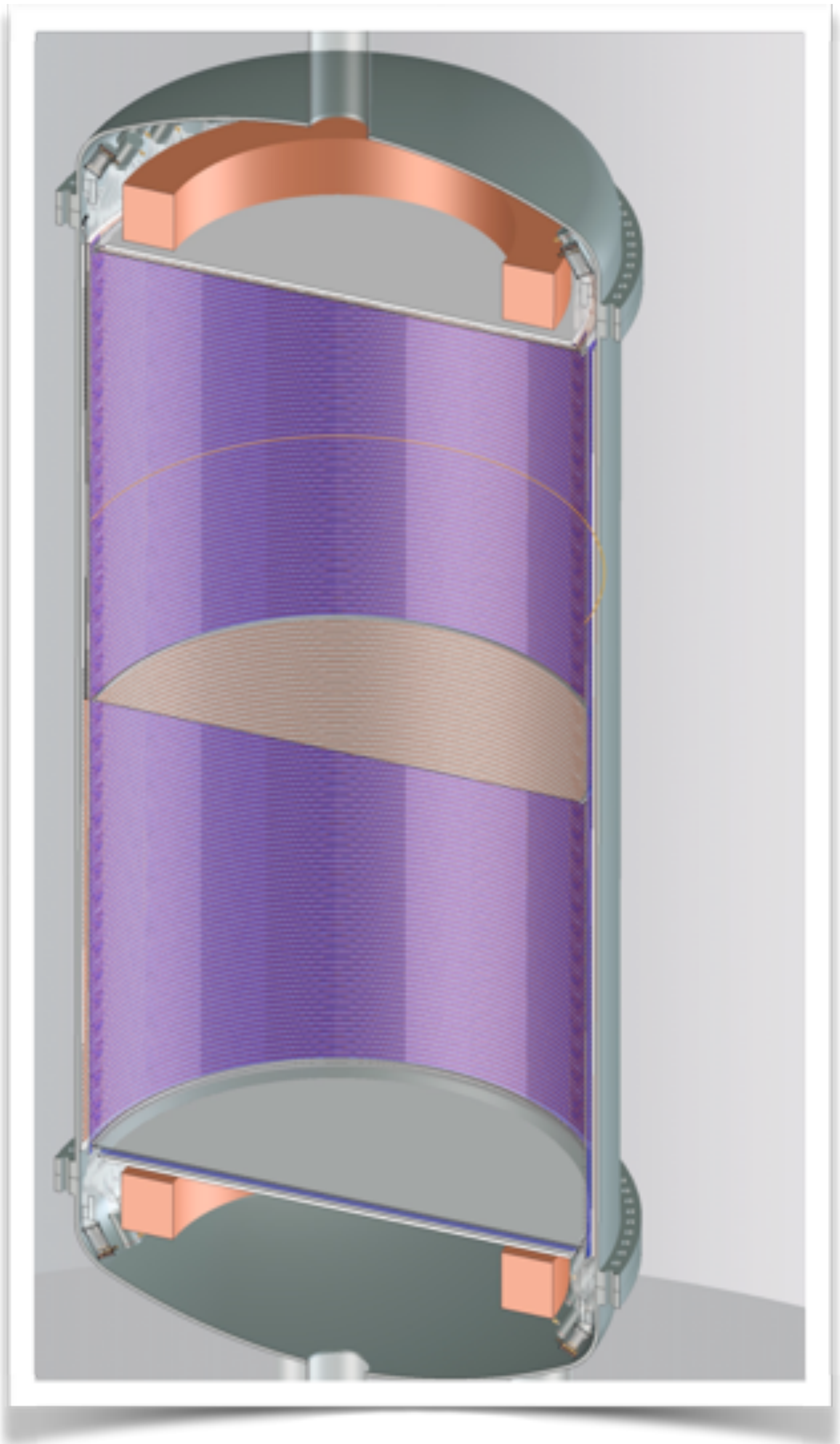
- Increasing the detector mass **and** improving the background rate by a factor of 5 will cover the inverted hierarchy (~20 meV). At 10^{-4} ckky the regime is virtually background free.

Majorana Gas Instrumented with Xenon

MAGIX

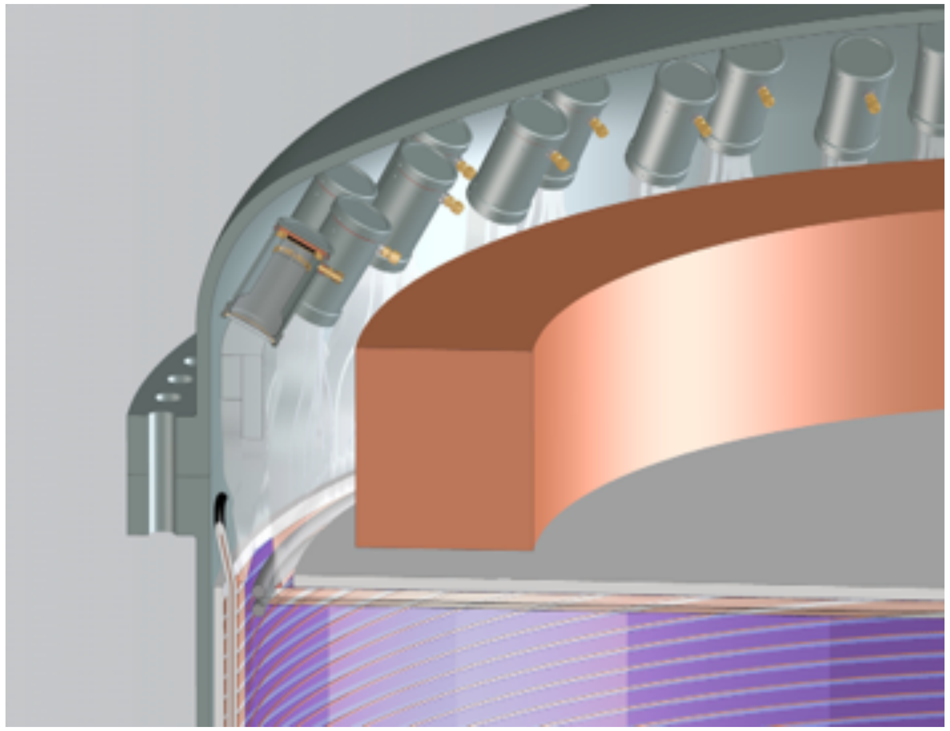


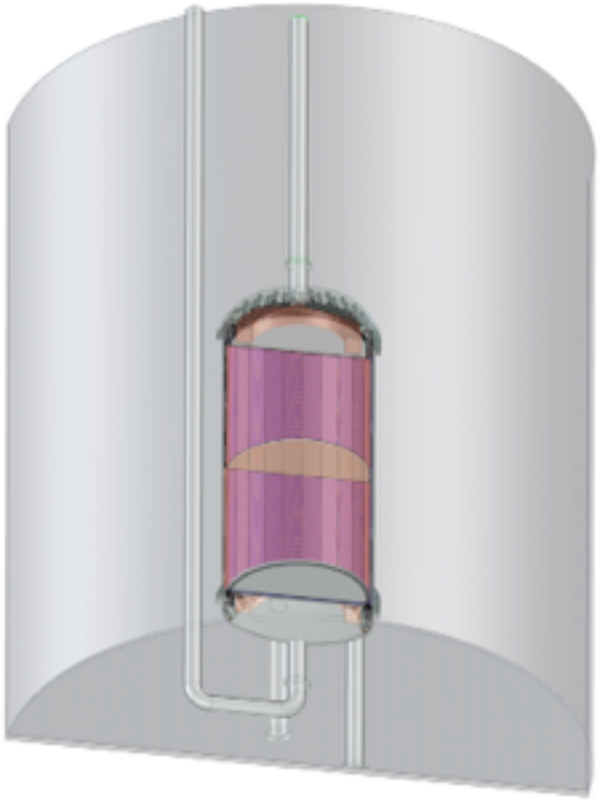
What is MAGIX



- Baseline concept.
- It is a symmetric TPC filled with O(1 ton) of Xenon enriched at 90% in Xe-136 at a pressure of 15 bar.
- The drift length is 2 x 2 m (2 ms drift, DEMO measures lifetimes of > 10 ms)
- The TPC radius is about 1 m.
- The active volume is about 12 m^3 (1 ton at 15 bar)
- The event energy is integrated by wavelength shifting light guides surrounding the gas and read by PMTs located outside the fiducial volume.
- The event topology is reconstructed by two planes of radiopure silicon pixels (MPPCs by default).

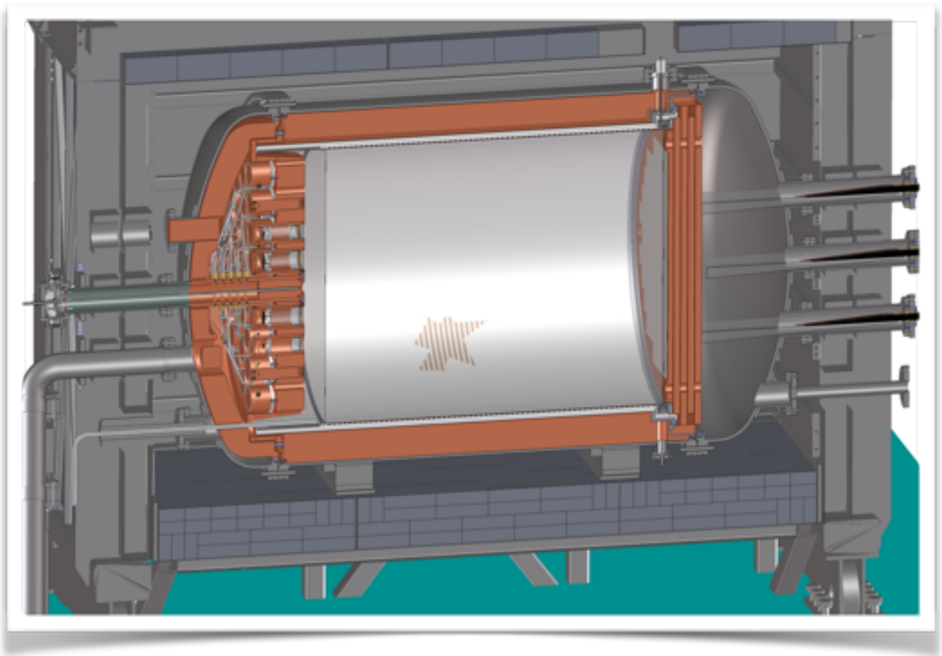
What is MAGIX

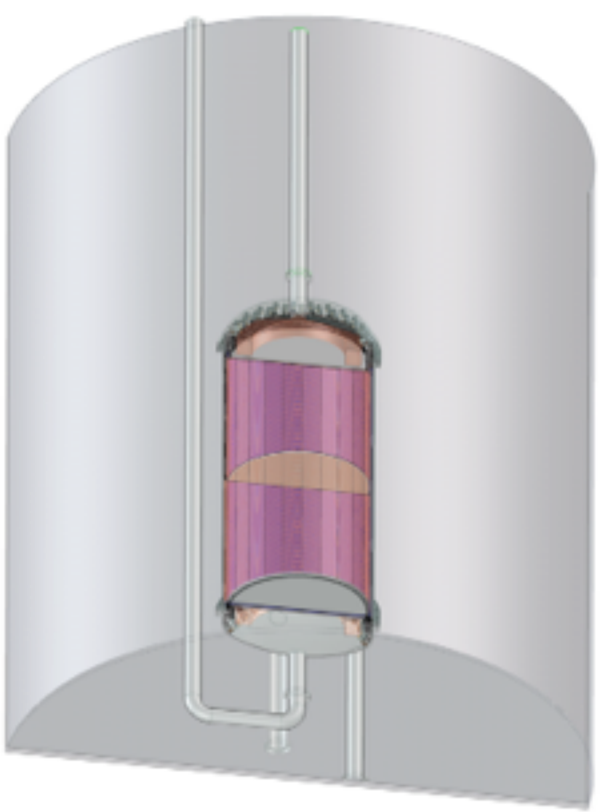




- PMTs outside the fiducial area, shielded by copper. This eliminates one of the three dominating sources of background.
- Detector inside a water tank with better stopping power than lead may allow to reduce the thickness of ICS.
- Use of ultra radio pure copper for the ICS (< 2-3 mBq) and/or reduction of total ICS mass may reduce the radioactive budget associated to ICS. Water is also better for muon shielding and neutron shielding.
- R&D to improve KDBs (reduce/remove/ improve glue between layers).
- Economy of scale automatically yields a factor ~2.5 background reduction.

NEXT & MAGIX





- A HPXe TPC with a mass in the range of the ton, can explore the inverted hierarchy, reaching ~20 meV and operating as a virtually background-free detector.
- However the construction of such detector requires a strong international collaboration, and substantial funding (~30 M$).
- It also requires a sophisticated control of the HPXe EL technology and radio pure techniques.
- In addition of having a physics case of its own, NEXT is the ideal springboard for MAGICX.

The NEXT Collaboration

IFIC Valencia • Zaragoza • Politécnica Valencia • Santiago de Compostela • Autónoma Madrid • Girona

LBNL • Iowa State • Texas A&M

Coimbra • Aveiro

JINR

A. Nariño

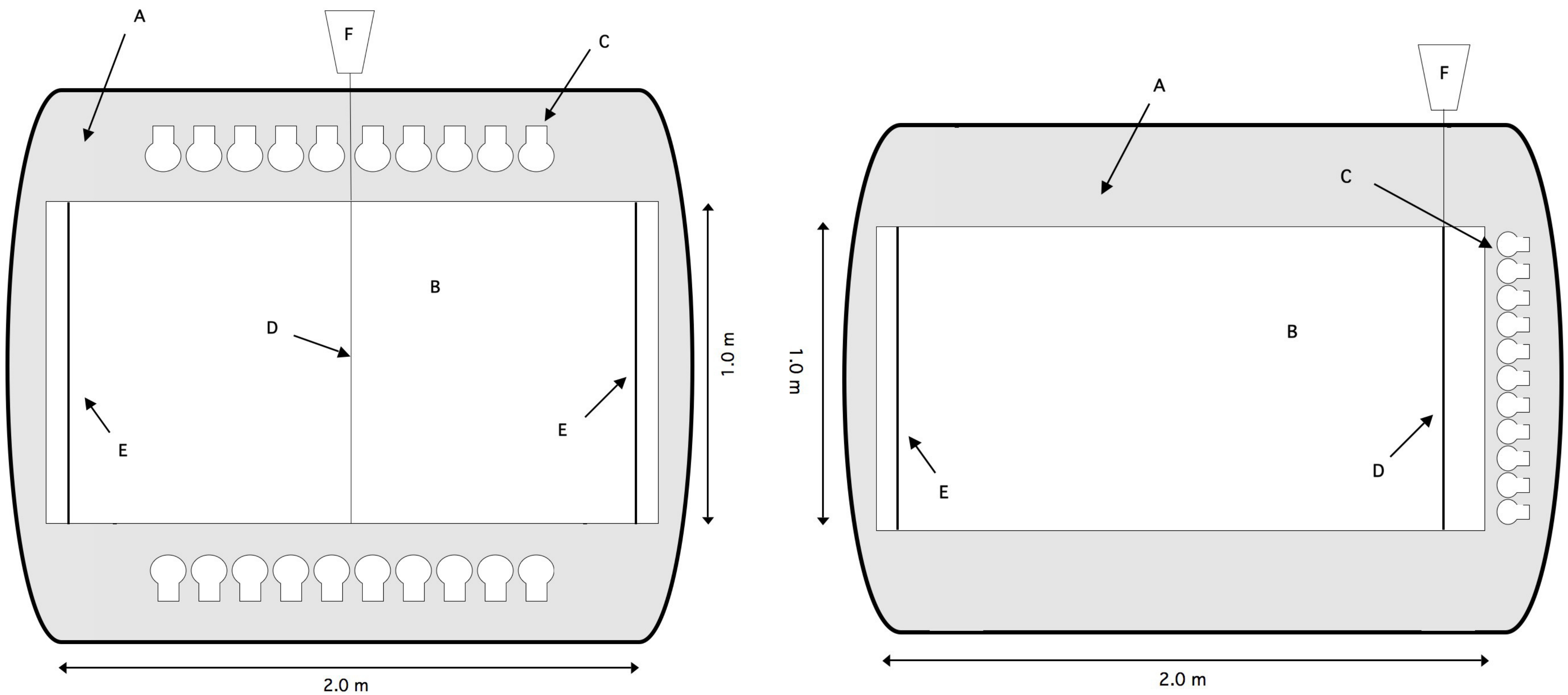
Status of the NEXT collaboration

- R&D period: spanish groups, in particular IFIC, benefited from USA know-how, which was essential for the construction, deployment and commissioning of prototypes and for the design of NEXT-100. The project owns heavily to the insights of Nygren, the know-how of White, and the generosity of both.
- NEXT is approved, substantially funded, (including and AdG from ERC) infrastructures are being deployed at LSC and first phase of the experiment (NEW) starts in 2015.

- The NEXT-100 phase of the experiment (2016-2020) needs the contribution of strong groups adding man power, know-how and (modest) funding.
- MAGIX (Ton scale) requires a much stronger and international collaboration. But NEXT-100 is a necessary step!
- The USA participation has been essential for the project and we very much hope that this participation is reinforced for the NEXT-100 phase of the experiment.

To James White, friend and mentor

2008: JJGC proposes the NEXT experiment to the LSC (EOI).



“The readout will probably be done with micro pattern device (Micromegas, LEM and GEM are suitable alternatives) although the use of wires is not excluded”

2009: D. Nygren **High-pressure xenon gas electroluminescent TPC for 0-n bb-decay**

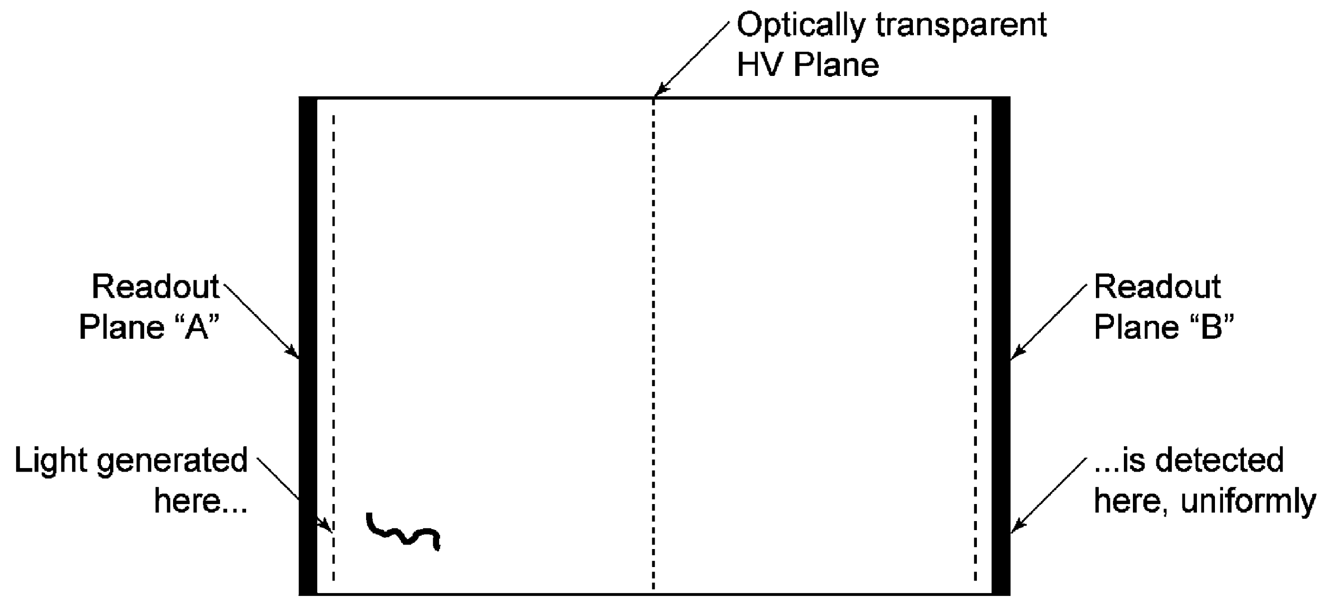
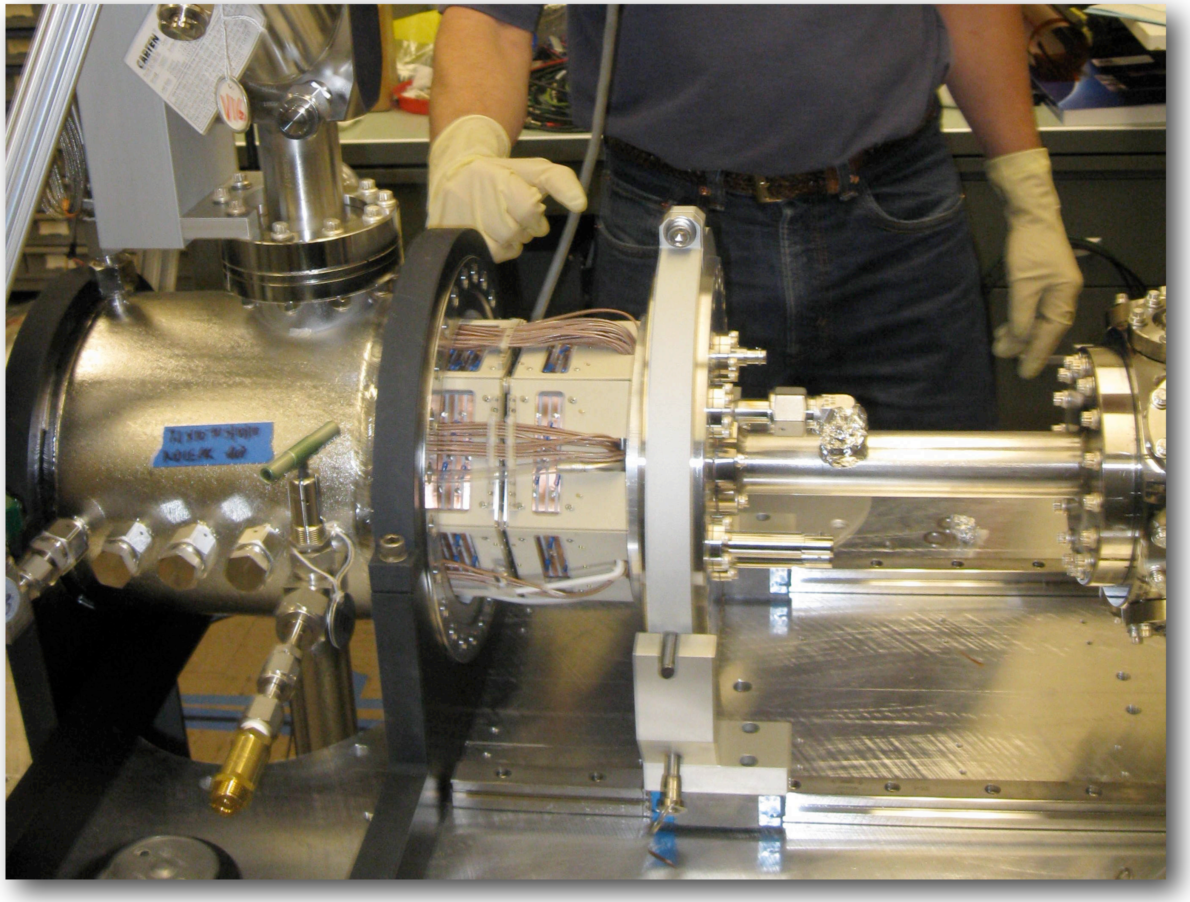


Fig. 3. Separated-function concept, illustrating the possibility to detect EL light at plane B originating from plane A, or vice-a-versa. The event, shown as a wiggly track, generates primary scintillation recorded at both planes. Subsequently, EL light generated at plane A is detected almost uniformly everywhere on plane B for a precise energy measurement.

**"A high-pressure xenon gas TPC can provide both event topology information and optimized energy resolution for the detection of bb decay in ^{136}Xe. The result of optimization indicates that, at the ^{136}Xe Q-value of 2480 keV, an energy resolution of dE/E < 5x 10-3 FWHM may be realizable, even at the 1000 kg scale. Signal detection by electroluminescence appears essential to realize this performance.
"**

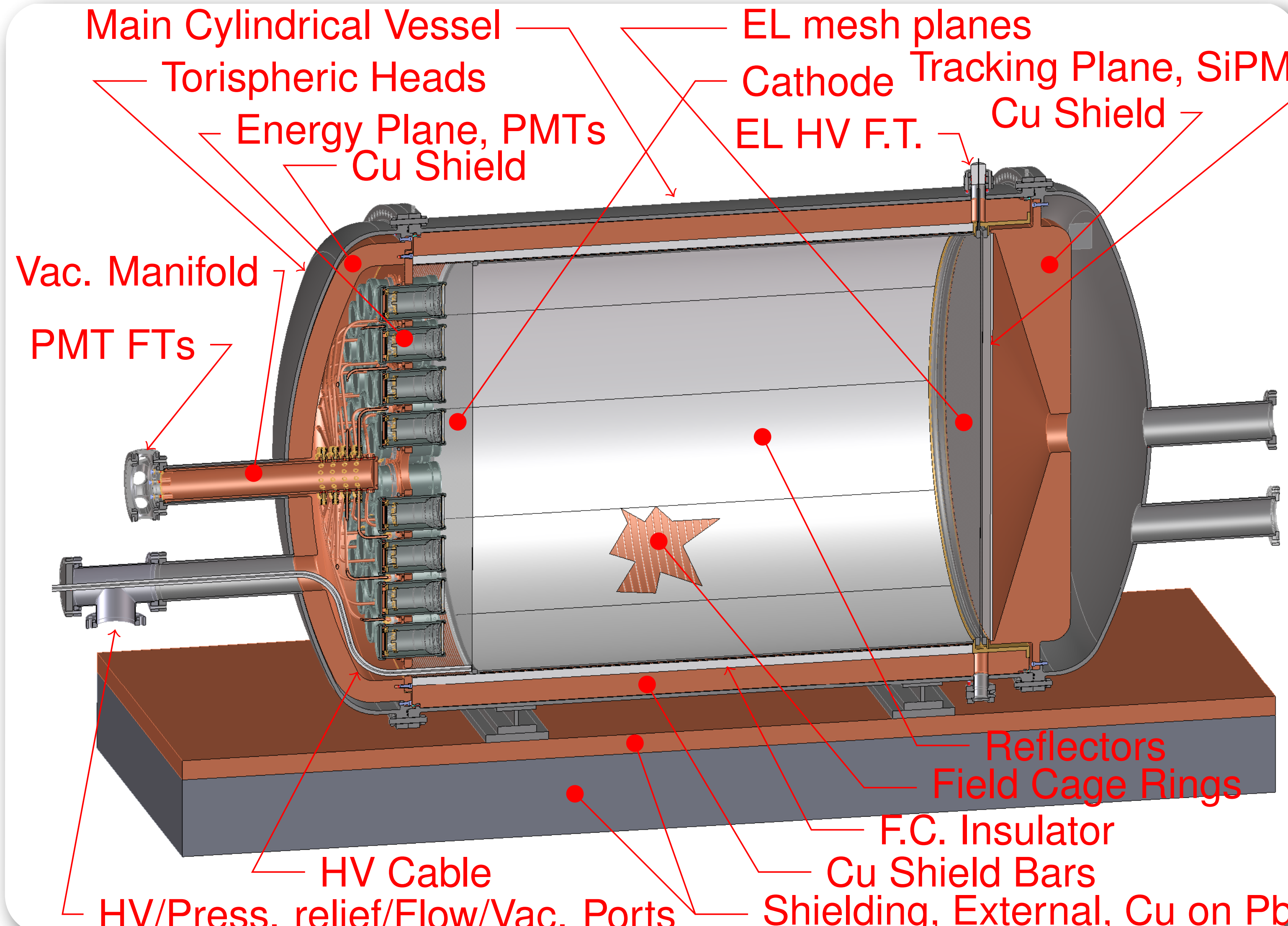
Nuclear Instruments and Methods in Physics Research A 603 (2009) 337–348

2010/2011: DEMO (IFIC) and DBDM EL prototypes (LBNL) built and commissioned



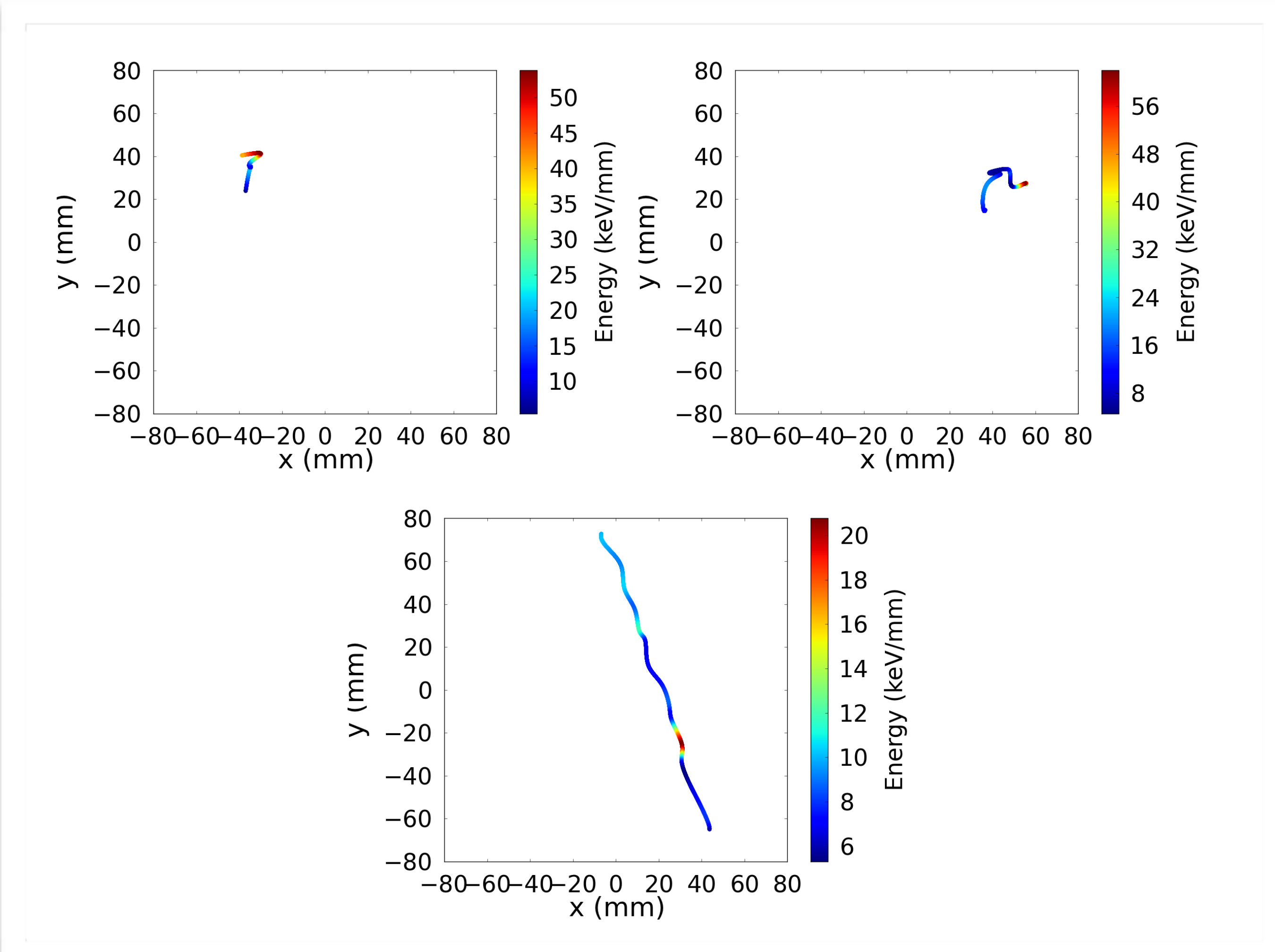
DEMO @ IFIC made possible thanks to the crucial contribution of J. White and C. Sofka. Spanish groups benefited enormously from USA groups know-how.

2012: Technical Design Report adopts the ANGEL design proposed by J. White (TAMU)



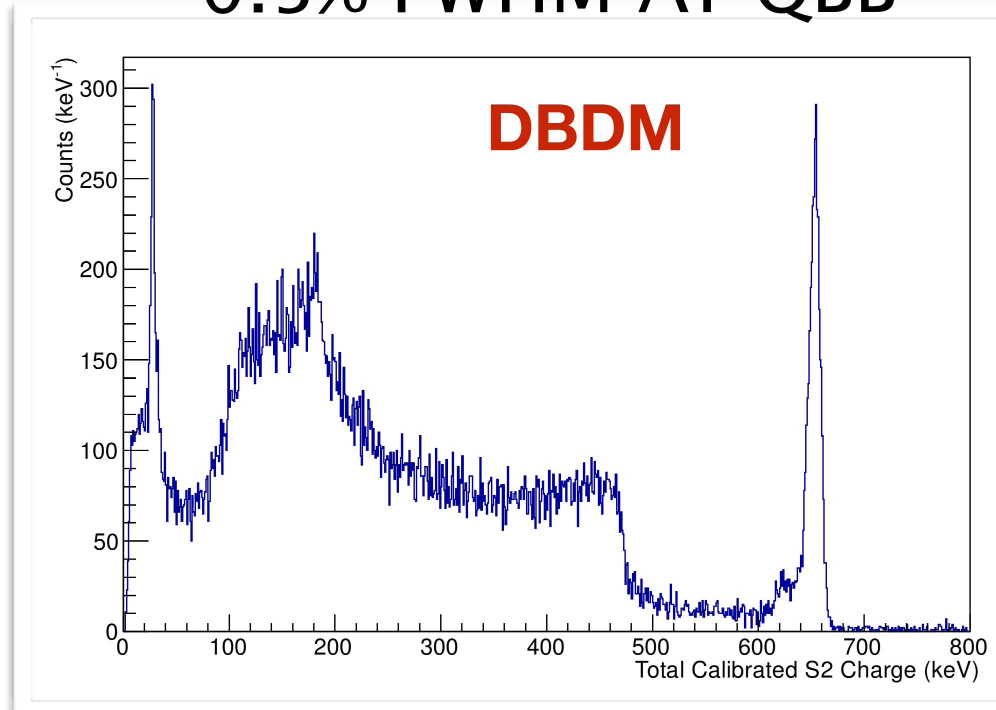
NEXT-100 concept and design: LBNL, TAMU, IFIC

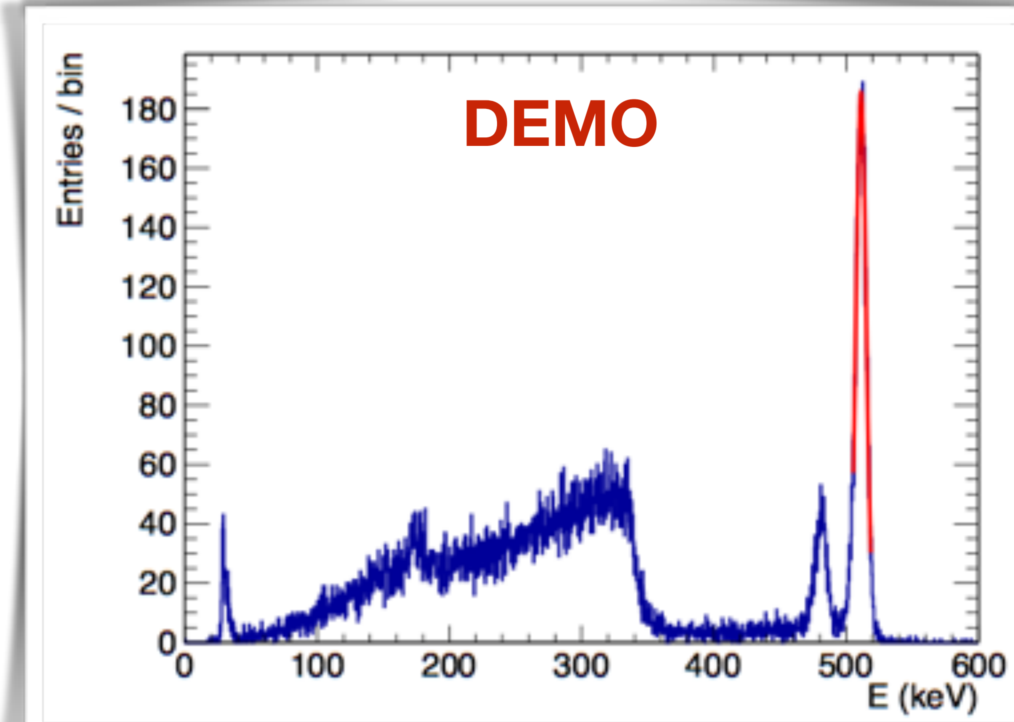
2013: Papers from DEMO and DBDM showing excellent energy resolution and topology



- **V.~Alvarez *et al.* [NEXT Collaboration],** ``Initial results of NEXT-DEMO, a large-scale prototype of the NEXT-100 experiment," arXiv:1211.4838 [physics.ins-det].
- **V.~Alvarez, *et al.* [NEXT Collaboration],** "Near-Intrinsic Energy Resolution for 30 to 662 keV Gamma Rays in a High Pressure Xenon Electroluminescent TPC," arXiv:1211.4474 [physics.ins-det].

0.5% FWHM AT QBB



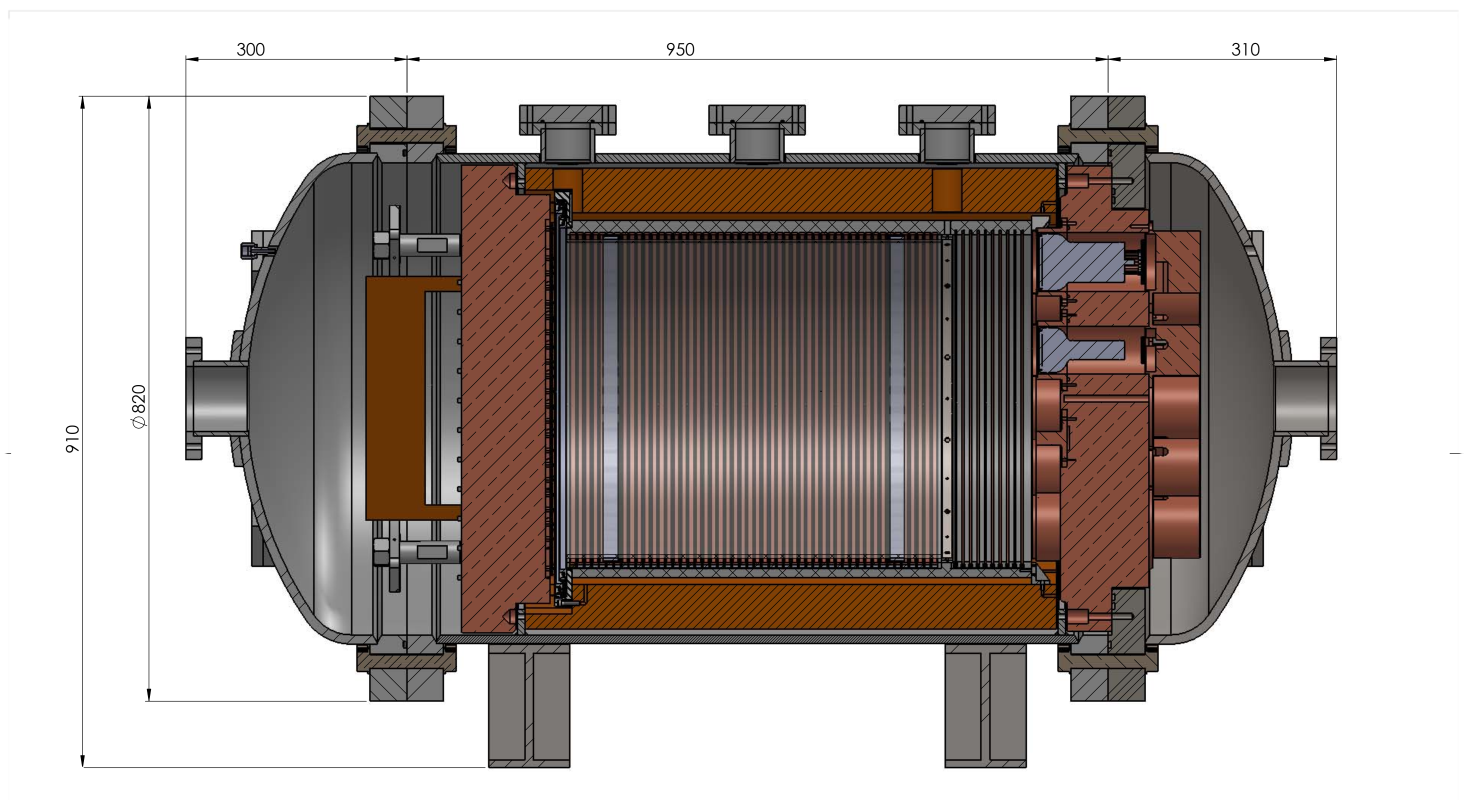


0.75 % FWHM AT QBB

2014: AdG from ERC granted to JJGC: Launching Next-White (NEW) detector

European Research Council
Established by the European Commission

AdG/ERC grant: 2014-2019 (3 M€)



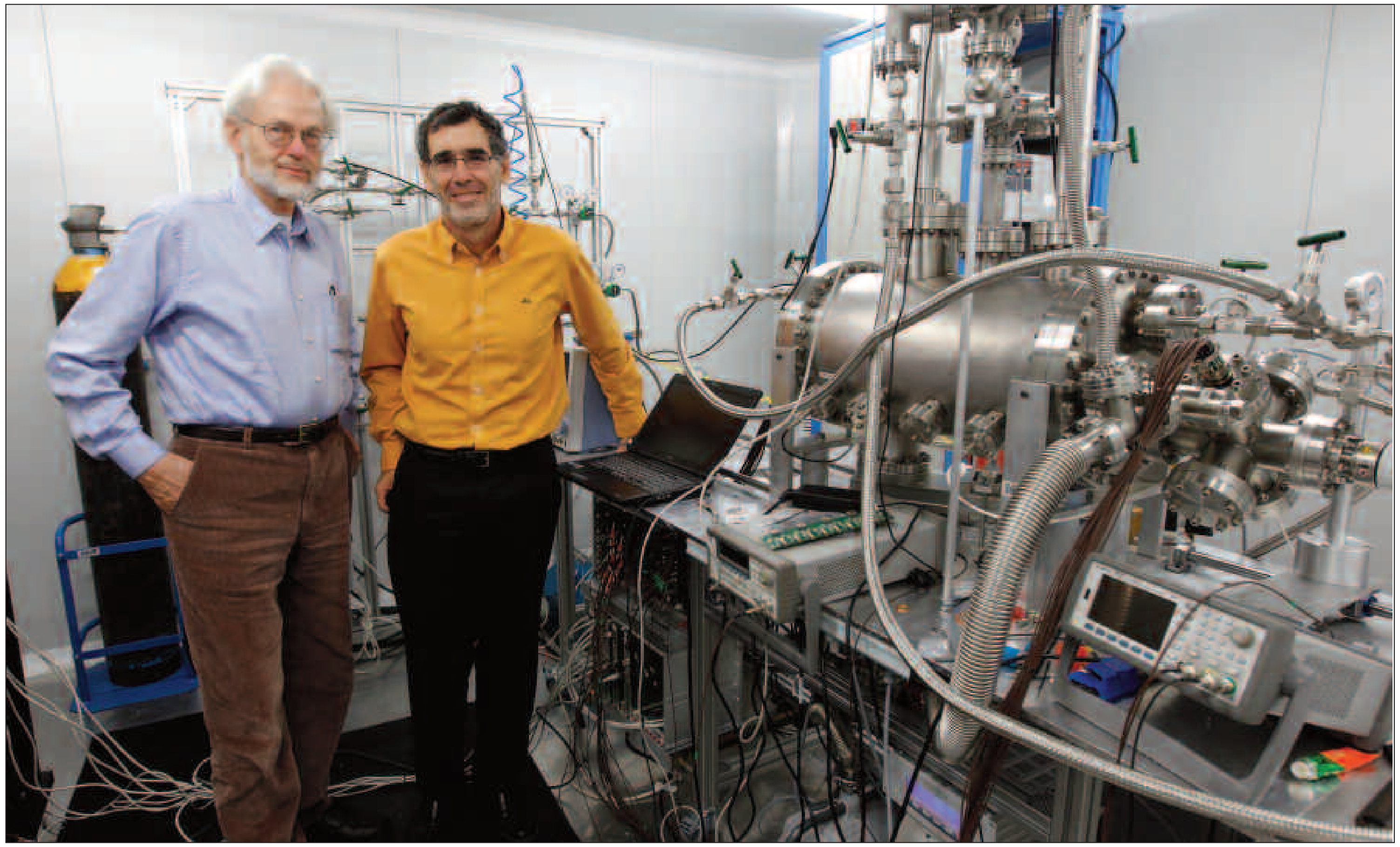
First phase of NEXT-100: 10 % of the mass, 20 % of the sensors, underground, radiopure. Measure background mode, validate technology, show 2-electron topological signature, measure bb2nu mode

«NEXT catapulta a los físicos españoles a un papel estelar en el estudio del neutrino»

▶ Nygren participa en Valencia en el diseño de un experimento para comprobar si el neutrino es su antipartícula

RAFEL MONTANER VALENCIA

■ Valencia ha sido a lo largo de esta semana la capital mundial del proyecto NEXT, quizás el experimento más ambiciosos que se va a realizar en España en física de neutrinos. El Instituto de Física Corpuscular (IFIC), un centro mixto del Consejo Superior de Investigaciones Científicas (CSIC) y la Universitat de València, ha acogido una reunión de 60 científicos de España, EE UU, Francia, Rusia, Portugal y Colombia para ultimar el diseño de este detector diseñado para observar si el neutrino es su propia antipartícula. Se trata de un detector con un tanque de titanio de un m^3 que contiene 100 kilos de gas xenón a presión y una Cámara de Proyección Temporal (TPC) que comenzará a operar en 2013 en el Laboratorio Subterráneo de Canfranc, bajo 1.000 metros de roca. Entre los



Nygren junto a Gómez Cadenas y un prototipo a escala 1:10 del detector NEXT en el IFIC. FERRAN MONTENEGRO