The NEXT experiment: a high-pressure xenon gas (HPGXe) TPC for the search of neutrinoless double-beta decay.

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on behalf of the NEXT collaboration

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University of Zaragoza
Spain

Outlook

- NEXT COLLABORATION
- NEXT PROJECT: WHY A HPGXe TPC?
- PROJECT STATUS: R&D
- SUMMARY AND PROSPECTS

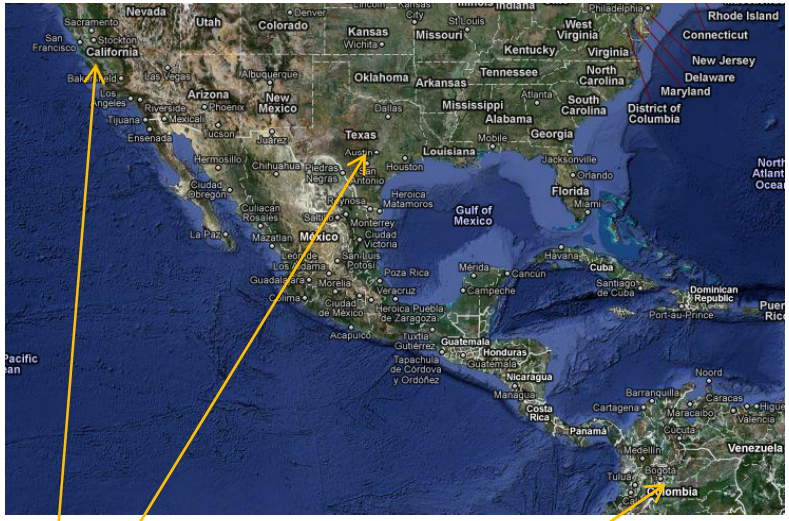
NEXT (Neutrino 0νββ decay Experiment with a Xenon TPC) collaboration

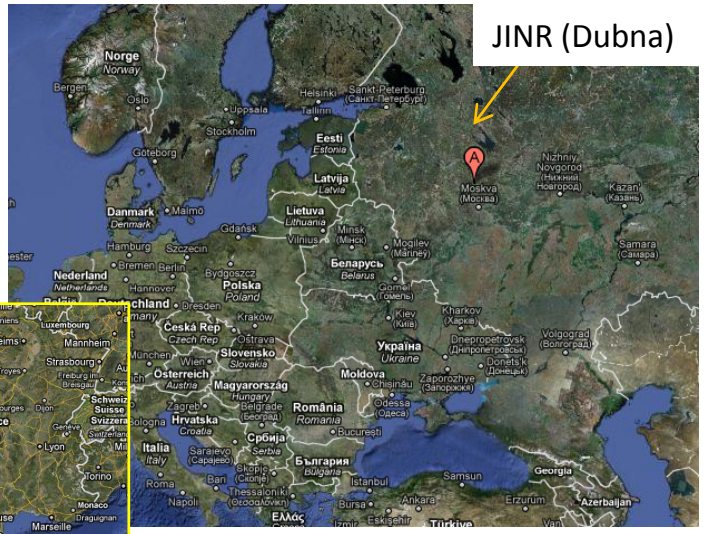
Spain provides:

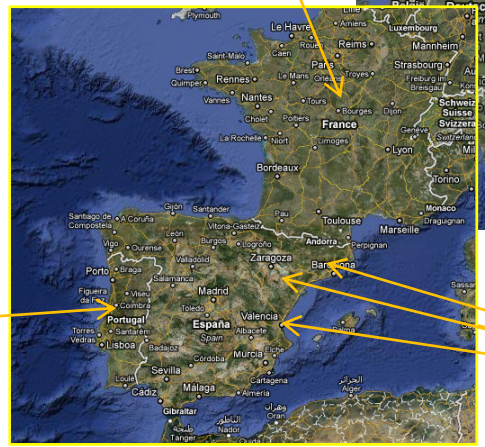
- Most collaborators
- Most of secured funding
- Host laboratory (Canfranc)

Smaller but key contributions from experienced groups in other countries:

- TPC detector design
- Gaseous Xe detectors
- Micromegas
- Xe supply and enrichment







The experiment it's approved for being placed at Canfranc Underground Laboratory *(LSC)*, at the Spanish Pyrenees ***(2450 m.w.e.)*.**

Main Hall (A), where NEXT will be installed

It is expected that the installations will be ready for utilization from ***September 2010.***

Why a Xe TPC?

- "source = target" kind of experiment
  - ✓ Single homogeneous medium (no surfaces/boundaries)
  - ✓ Scaling-up

- ✓ Xe easy to enrich
- ✓No long lived isotope to activate
- ✓ Purification and reuse

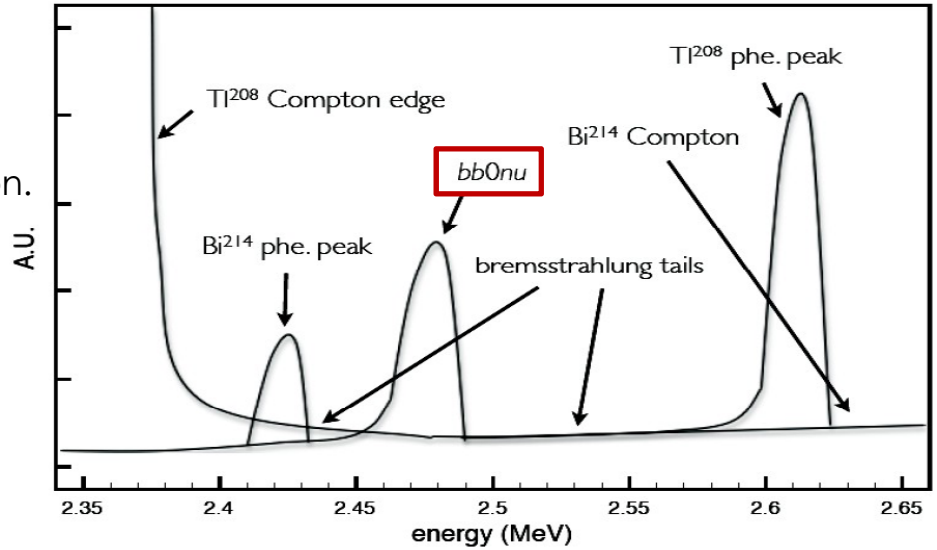
- ✓ Possibility to detect both **ionization** and **scintillation**

Why a Xe TPC? Physics Case

High $Q_{\beta\beta}$ value (2457.83 keV). Moreover *strategically* placed.

Main background sources:

- 2νββ mode, very weak (still to be measured!).
- ^{208}Tl, only bremsstrahlung tails and multi-Compton.
- ^{214}Bi.



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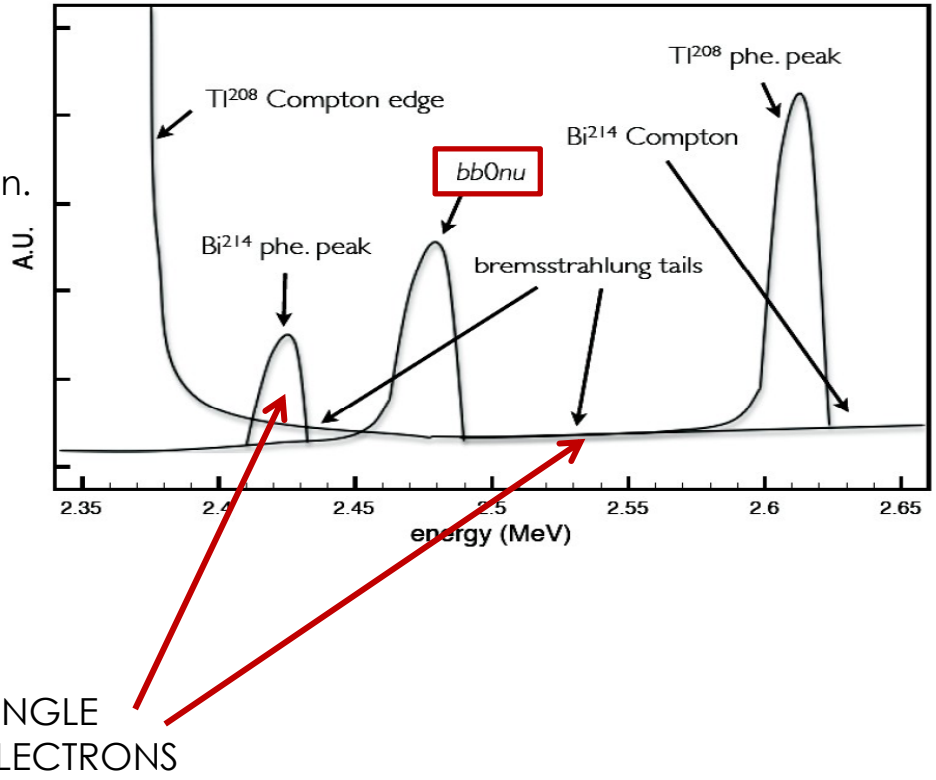
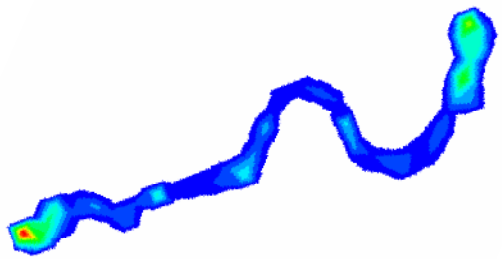


Why a Xe Gas TPC?

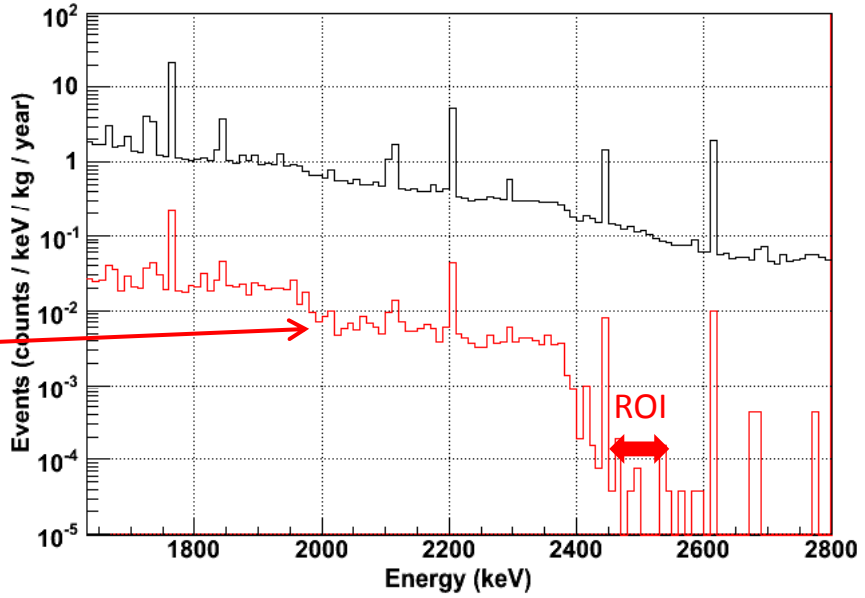
topological signature



Encouraging experience in the past : Gothard , in the 90's, performed a single electron rejection factor 1/30.

Example of rejection based on topology signature from simulated data.

- Only *one continuous track* events.
- Only events with *two blobs* in their *extremes*



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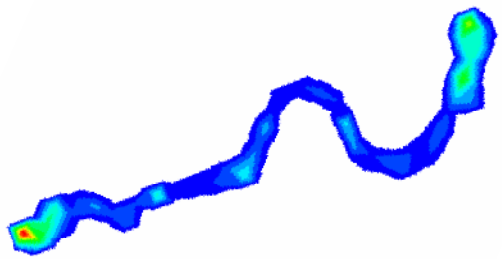


Not contemplated (as main line) in present projects.

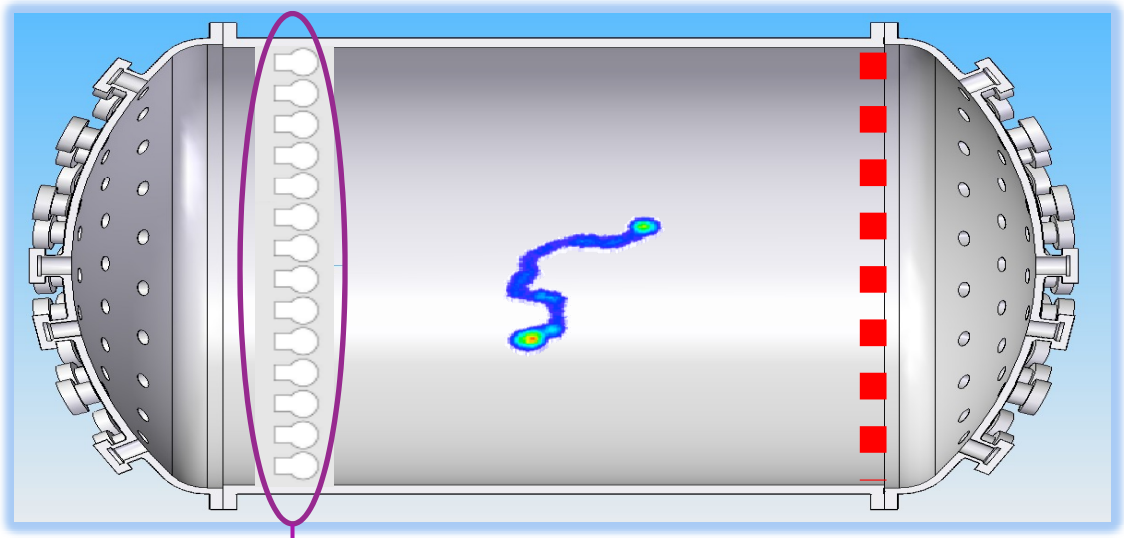
Override tradicional limitation of gas by applying the latest developments on TPC readouts.

- A new conceptual approach is required and R&D is needed.

Liquid Xe	Gas Xe
✓ Scalability	✓
✓ Compact	✗
Cryogenics Complexity	High P
✗ Topology	✓
✓ E resolution	✓

Conceptual design for NEXT-100

100 kg of ^{136}Xe @ 10 bar (~ 1.5 m height & 1.5 Ø m active volume)



t_0, primary scintillation: PMTs

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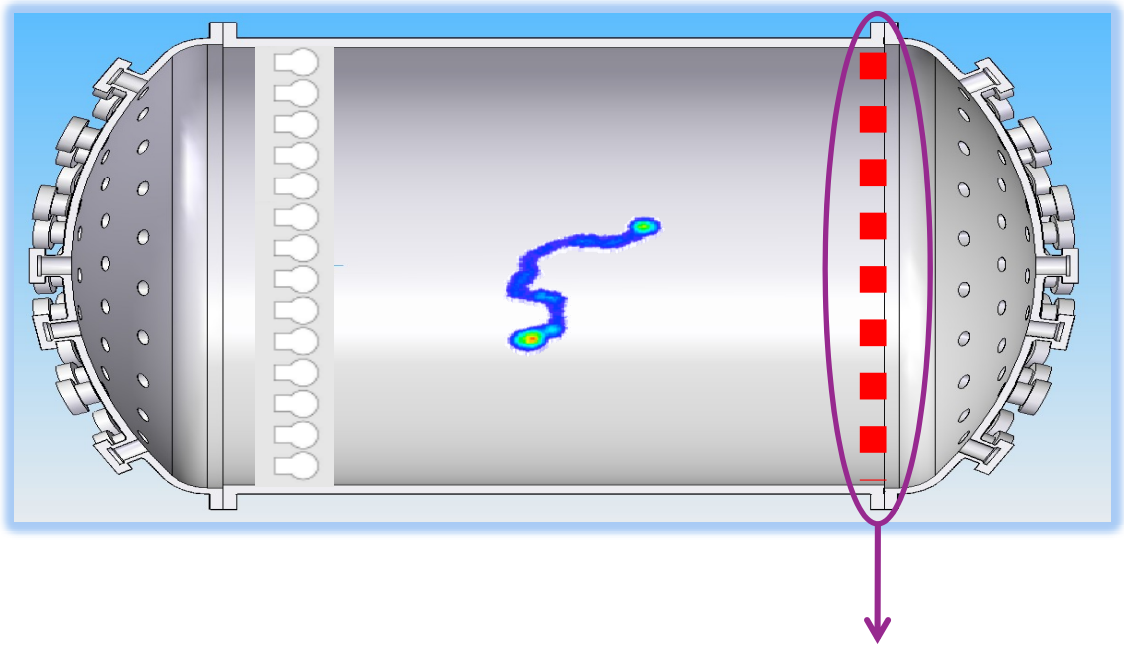

Tracking

- Electro Luminescence (EL) and photosensors: PMTs,APDs, SiPMTs (MPPC)
- Charge Amplification: microbulk micromegas

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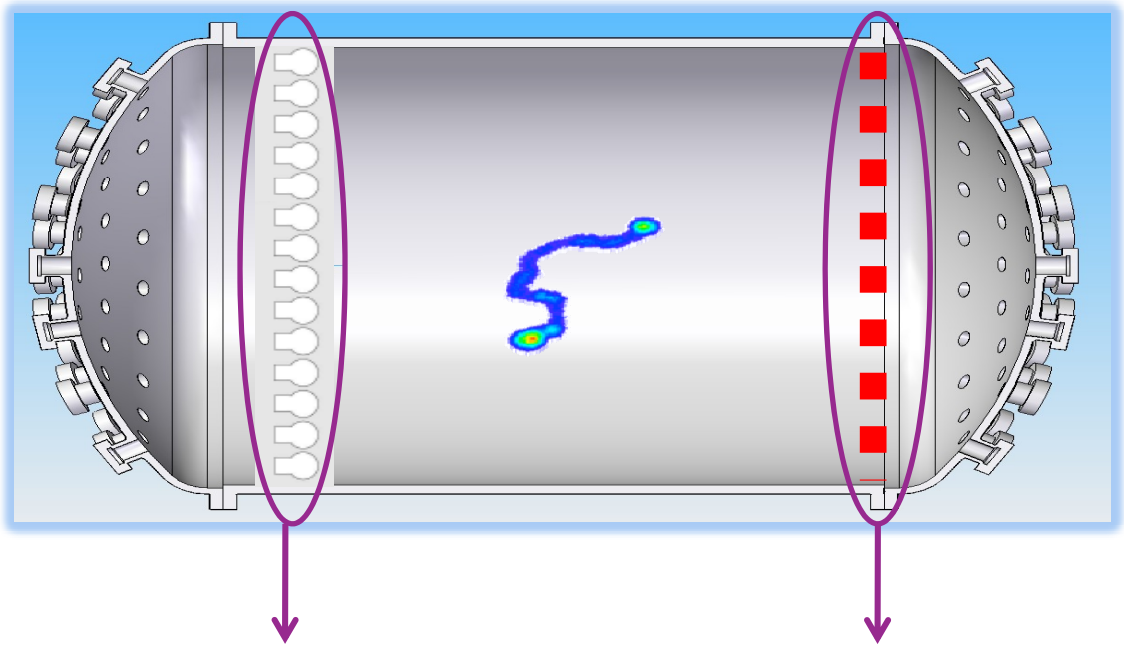
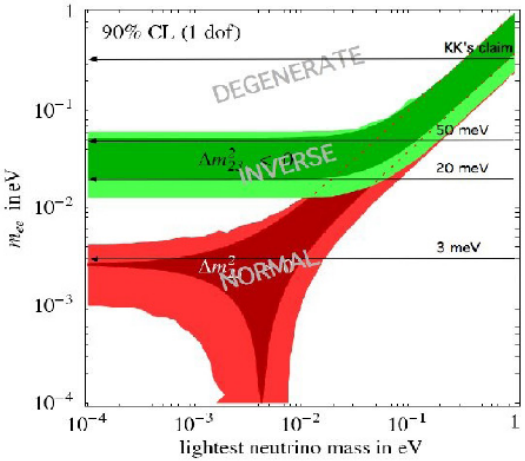


Energy (Aiming at 1% (FWHM) at the Qββ)

- Photosensors: PMTs, APDs
- Charge Amplification: microbulk micromegas

Why a Xe Gas TPC? Sensitivity to the 0νββ process

Just to show the physics potential of the NEXT-100 SOFT detector...

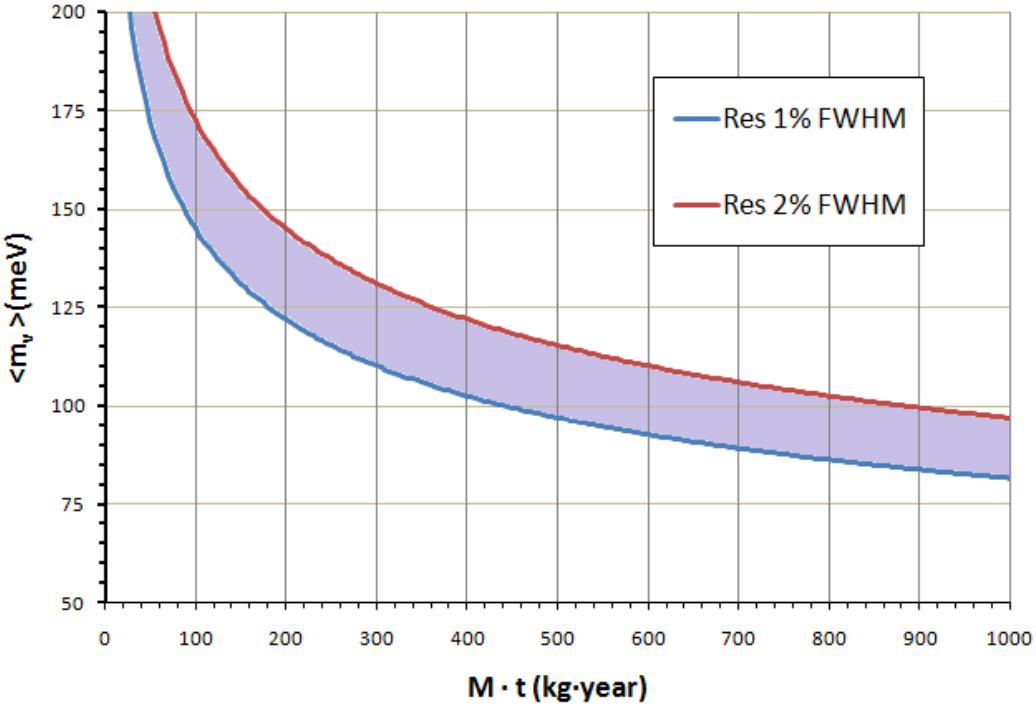


Conservative scenario:

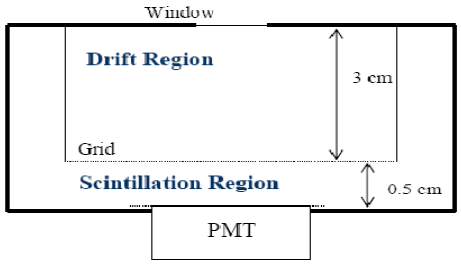
0.001 cts/keV/kg/year in ROI

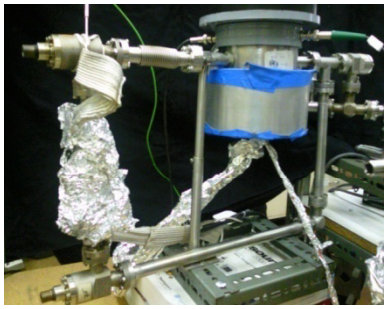
Simulations show that can be improved:

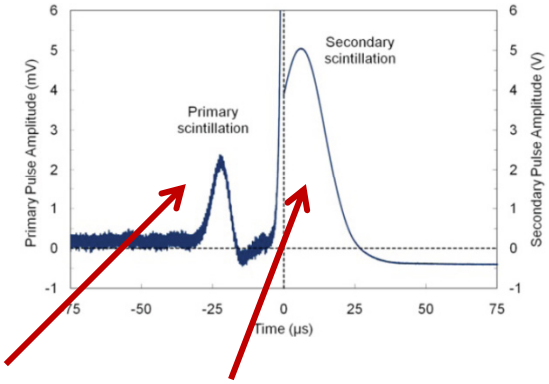
- selecting more radiopure materials
- once the background discrimination algorithms will be farer developed.

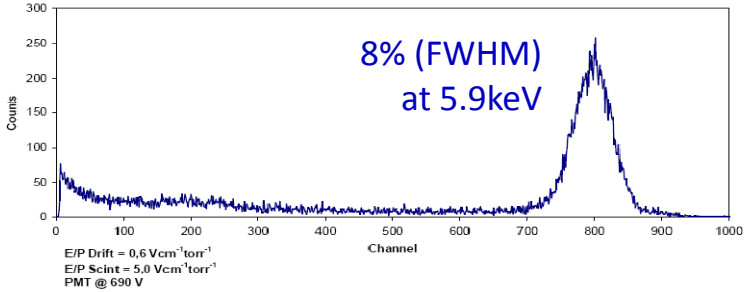


Status: R&D. NEXT0-EL demonstrators.



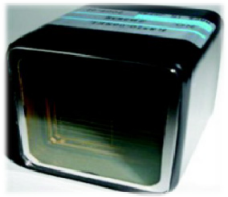






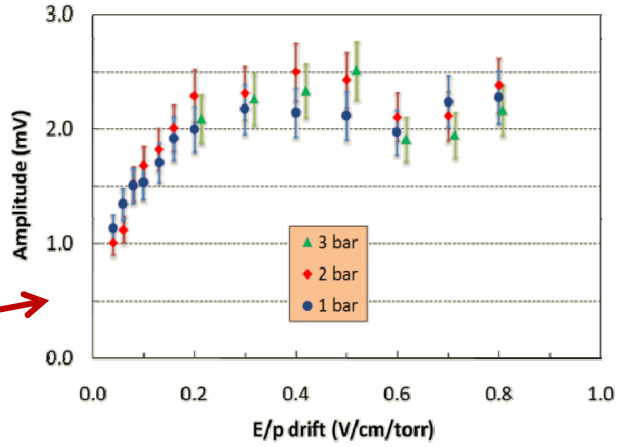
Primary and *secondary* scintillation with the same photosensor:

Hamamatsu R8520-06SEL PMTs, modification of XENON version.



EL has the best energy resolution potential in gas.

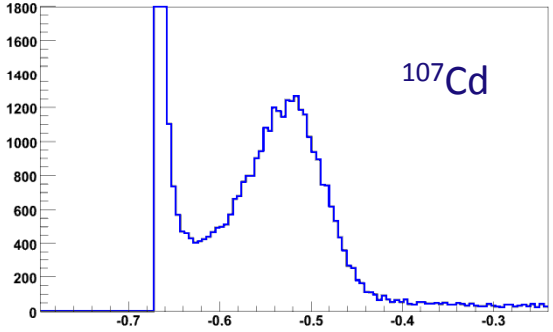
First studies towards high pressure



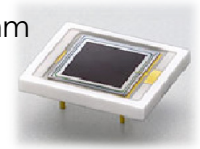
Status: R&D. NEXT0-EL demonstrators.

➢1.5 cm drift region
➢ 0.7 cm scintillation

Secondary EL with an array of five HAMAMATSU APDs



5x5 mm

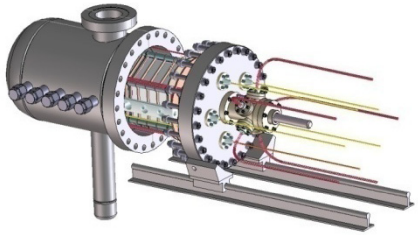


NEXT0.5/1-EL prototypes.

NEXT**0.5**-APDs

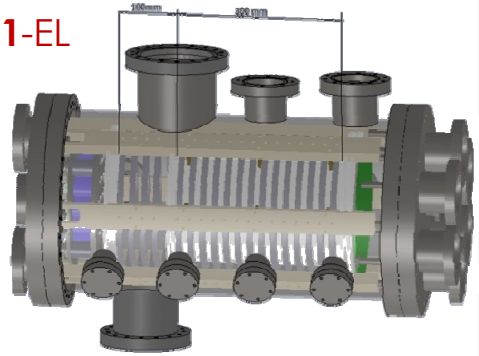
➢30 cm long
➢2 PMTs + 25 APDs
➢Ready this summer

NEXT**0.5**-PMTs



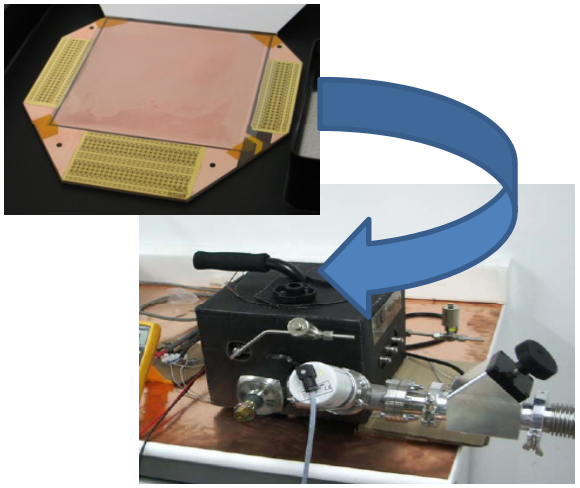
➢19 PMTs
➢Up to 20 bar
➢Purification gas system
➢Already running

NEXT**1**-EL



➢30 cm drift lenght
➢0.5 Kg of Xe at 10 bar
➢20 cm Ø readout (SiPMTs / APDs)
➢Ready this summer

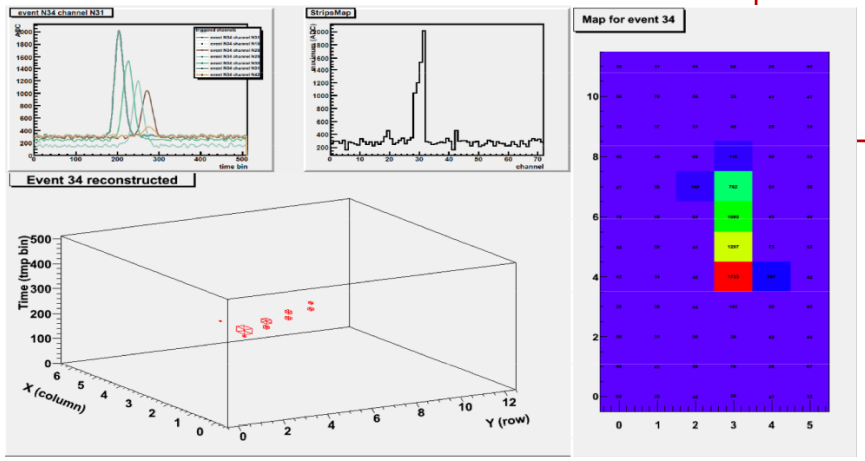
Status: R&D. NEXT0-MM demonstrator.



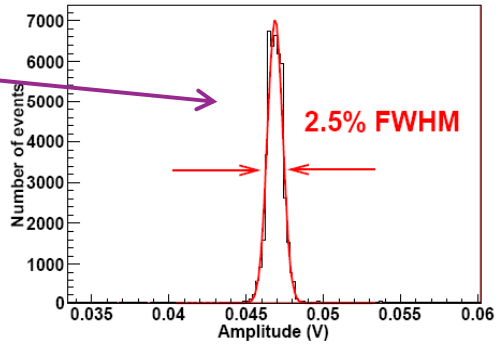
- Microbulk micromegas readout:
  - 10x10 cm^2 active area
  - 12x12 pixels.
- 6 cm drift length.
- Up to 10 bar.
- Connected to gas system which allows recirculation.

Routine measurements with ^{241}Am source (5.5 MeV alphas).

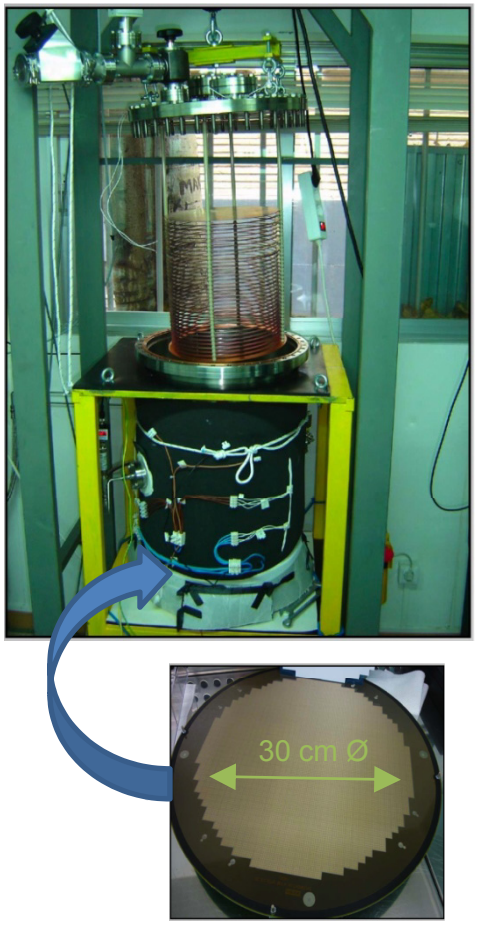
- ~3.0 % FWHM @ 5.5 MeV up to 5 bar Xe.
- 3D alpha tracks



Pure Xe @4 bar



Status: R&D. NEXT1-μM prototype.



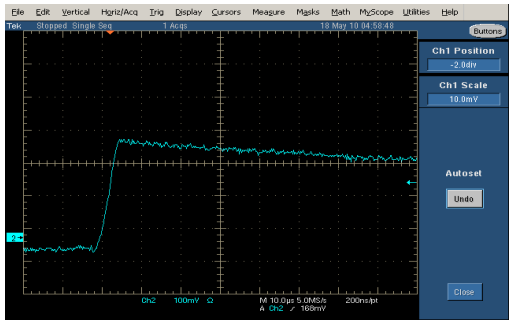
- 1 Kg of Xe @ 10 bar
- Gas system with recirculation

- ~35 cm drift length
- ~30 cm Ø readout active area
- Low-outgassing materials
- Bake out

- First readout:

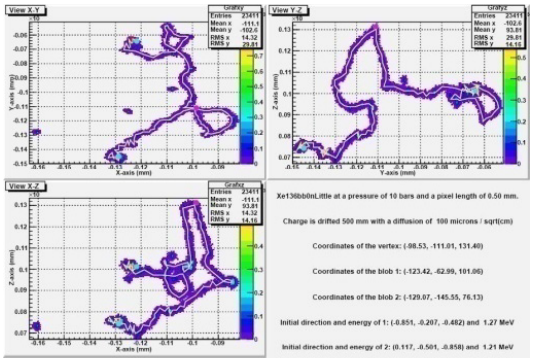
  bulk micromegas ~ 1200 pixels

First events
(cosmic muons)

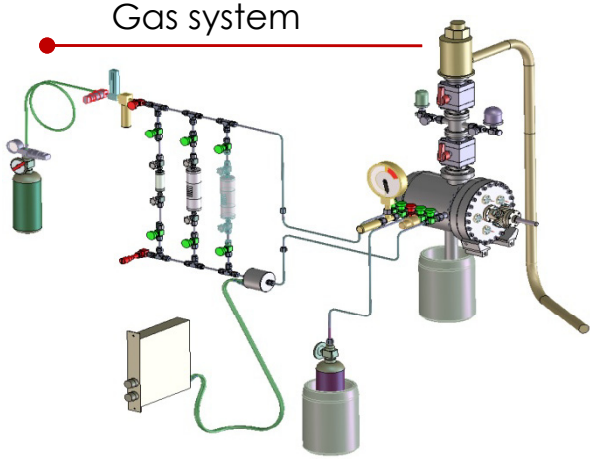


Status: Other activities

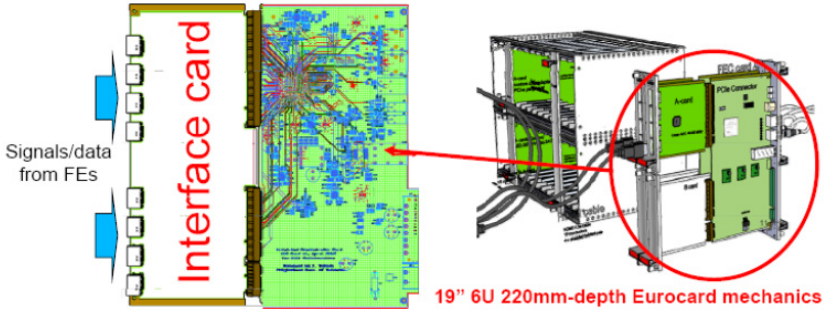
Simulations: physics, analysis and reconstruction algorithms.



Gas system



Electronics



And more:

Shielding and vessel studies for NEXT-100

Radiopurity measurements

...

Summary and prospects

NEXT aims a HPGXe TPC for a competitive $\beta\beta0\nu$ decay experiment.

The basic principle is to combine energy resolution and topology capabilities.

The experiment will be placed at Canfranc Underground Lab (LSC).

2010:	Operation of the prototypes.
Late 2010:	Preparation of site in the LSC.
Early 2011:	End of the R&D phase. Technology choice (definition of the detector)
2011:	First prototype operating at LSC.
2012:	Building NEXT-100.
2013:	NEXT100 commissioning