Latest results of NEXT-DEMO, the prototype of the NEXT 100 double beta decay experiment

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NEXT is a 100 kg Electroluminescence (EL) High Pressure Xeon TPC. It will search for the neutrinoless double beta decay of $^{136}$Xe in the Laboratorio Subterráneo de Canfranc (LSC).

The features that make NEXT a powerful 100 kton experiment are:
- **Very good energy resolution**
- **Tracking capability**
- **Scalability** towards the 1 Ton scale

NEXT-DEMO is a 1 kg prototype built to demonstrate the technology to be used in NEXT 100.

The xenon active volume of the TPC comprises a 30 cm drift region, operated at a drift voltage between 200-1000 V cm$^{-1}$ and a 0.5 cm EL region with a reduced electric field of 1-2 kV cm$^{-1}$bar$^{-1}$. The pressure is 10 bar for all the studies of this paper.

It has been running for 3 years using different radioactive sources. Some measurements made so far are:
- energy resolution
- imaging of single and double electron tracks
- xenon gas properties (drift velocity, diffusion)

Studies with electromagnetic depositions

Energy released by gamma particles coming from $^{226}$Ra and $^{228}$Th sources have been corrected in drift direction, due to attachment, and XY according to individual PMT maps.

The corrected energy of the event is calculated by the weighted sum of the contributions of each individual PMT. This method behaves smoothly in all the energy range.

Once the energy spectrum is corrected, energy resolution of X-ray peak as well as photoelectric peak are obtained.

These results match the requirements for the NEXT-100 detector as they are below 1% at 0.02 MeV of $^{136}$Xe.

Studies with Alpha particle energy depositions

Using the anti-correlation we have defined the energy as the sum of the S1 signal plus the S2 signal weighted by the optical gain of our detector.

$$E = \lambda (N_1 + \frac{N_2}{10 EL})$$

We have obtained an energy resolution in the peak of 5.49 MeV from $^{222}$Rn of 2.83% FWHM, compared to 8% FWHM of a previous study in NEXT.

We were also able to identify another natural chain of Radon that was present in the gas.

Background studies are key for double beta decay experiments like NEXT in order to achieve the best sensitivity.


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