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The NEXT Search for Neutrinoless Double Beta Decay in Xe-136

The Neutrino Experiment with a Xenon TPC (NEXT) is an experimental program searching for neutrinoless double-beta decay (bbonu) in Xe-137 using high-pressure xenon time projection chambers (HPXe) with electroluminescent (EL) amplification of the ionization signal. This technology offers several advantages:
(a) Low intrinsic background—signals occur in the gas volume, away from surfaces where radioactive contaminants accumulate.
(b) Excellent energy resolution—in the range of 0.5–1.0 % FWHM at 2.5 MeV.
(c) Powerful topological signature—the ability to reconstruct the event topology as a double-electron track.
(d) Scalability—as the detector size increases, the signal-to-noise ratio improves linearly.
(e) Ba2+ tagging potential—the ability to identify the Ba2+ cation produced in \bbonu\ decay, which could enable a background-free experiment.
The NEXT-100 detector, designed to operate with up to 100 kg of xenon at 15 bar, is currently running at the Laboratorio Subterráneo de Canfranc (LSC), Spain. The collaboration is now preparing for the construction of a ton-scale HPXe detector, NEXT-HD, which could serve as the first module of a multi-ton, potentially multi-site program. This program has an asymptotic projected sensitivity to the bbonu decay half-life of T ˜5 10ˆ{27} y. Simultaneously, an intense R&D effort is underway to develop NEXT-BOLD, an HPXe detector equipped with sensors capable of detecting single Ba2+ ions with high efficiency. A future multi-module, multi-site NEXT-BOLD program could ultimately reach a sensitivity of T ˜ 10ˆ{28}$ˆy.

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