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NEXT: Measurement of the ^{136}Xe two-neutrino double beta decay half-life with NEXT-White

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The NEXT (Neutrino Experiment with a Xenon TPC) collaboration aims at the sensitive search of the neutrino-less double beta decay ($\beta\beta_{0\nu}$) of ^{136}Xe at the Laboratorio Subterráneo de Canfranc (LSC). The observation of such a lepton-number-violation process would prove the Majorana nature of neutrinos, providing also handles for an eventual measurement of the neutrino absolute mass. A first large-scale prototype of a high-pressure gas-Xenon electroluminescent TPC, NEXT-white, is being operated at the LSC since 2016. This 5-kg radiopure detector has already proven the outstanding performance of the NEXT technology in terms of the energy resolution ($<1\%$ FWHM at 2.6 MeV) and the topology-based background rejection. NEXT-White has also measured the relevant backgrounds for the $\beta\beta_{0\nu}$ search using both ^{136}Xe -depleted and ^{136}Xe -enriched xenon. In this talk, the measurement of the half-life of the two neutrino mode of the double beta decay ($\beta\beta_{2\nu}$) will be presented. For this measurement, two novel techniques in the field have been used: 1) a Richardson-Lucy de-convolution to reconstruct the single and double electron tracks, boosting the background rejection, and 2) a direct subtraction of the $\beta\beta$ backgrounds, measured with ^{136}Xe -depleted data. These techniques allow for background-model-dependent and background-model-independent results, demonstrating the robustness of the $\beta\beta_{2\nu}$ half-life measurement and the unique capabilities of NEXT. The physics program of NEXT-White will be completed in late 2021, when the construction of the NEXT-100 detector at the LSC starts. Holding 100 kg of ^{136}Xe and with a background index below 5×10^{-4} counts/keV/kg/year, this detector will perform the first competitive $\beta\beta_{0\nu}$ search within the NEXT roadmap. As validated with NEXT-White, NEXT-100 will reach a sensitivity to the half-life of 6×10^{25} y after 3 years of data taking.

Collaboration / Activity

NEXT

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