Contribution ID: **466** Type: **Poster**

Measurement of the 136Xe ββ2ν half-life with NEXT-White

Tuesday 7 September 2021 19:08 (1 minute)

The NEXT (Neutrino Experiment with a Xenon TPC) collaboration aims at the sensitive search of the neutrinoless double beta decay (ββ0ν) of 136Xe at the Laboratorio Subterraneo 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 ββ0ν search using both 136Xe-depleted and 136Xe-enriched xenon. In this talk, the measurement of the half-life of the two neutrino mode of the double beta decay (ββ2ν) 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 ββ backgrounds, measured with 136Xe-depleted data. These techniques allow for background-model-dependent and background-model-independent results, demonstrating the robustness of the ββ2ν 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 136Xe and with a background index below 5×10−4 counts/keV/kg/year, this detector will perform the first competitive ββ0ν 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, paving the way for future ton-scale phases.

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Session Classification: Poster Session II

Track Classification: Neutrino physics