

Development of an accelerator-driven Ba-ion source to optimize Barium tagging techniques for a nEXO upgrade

Neutrinoless double-beta decay ($0\nu\beta\beta$) offers a way to probe for physics beyond the Standard Model. Observation of $0\nu\beta\beta$ will validate the Majorana nature of neutrinos, demonstrate violation of lepton number leading to an explanation of the observed baryon asymmetry in the universe, and probe new mass generation mechanisms up to the GUT scale. The planned nEXO experiment will search for $0\nu\beta\beta$ decay in ^{136}Xe with a projected half-life sensitivity exceeding 10^{28} years at the 90% confidence level over 10 years of livetime, using a tonne-scale liquid xenon (LXe) time projection chamber (TPC). In parallel, research is ongoing for future upgrades to nEXO to suppress background and further increase this sensitivity. One such approach is the extraction and identification of the $\beta\beta$ -decay daughter Ba ion, also known as Ba tagging, which will ensure classification of an event as a $\beta\beta$ event irrefutably. Barium tagging would help next-generation, tonne-scale Xe TPC experiments like nEXO and NEXT reach sensitivities $\sim 10^{28}$ years. An accelerator-driven ion source is currently being developed at TRIUMF, where radioactive ions will be implanted inside an LXe volume for subsequent ion extraction and identification using methods under development by other groups within the nEXO collaboration. For the commissioning phase of the ion source, radioactive ions will be extracted electrostatically from LXe and identified via γ spectroscopy. The background for the project, the apparatus, and recent updates will be presented along with planned measurements.

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