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Extraction of Ba ion from a liquid Xe volume

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The Standard Model (SM) of particle physics has been very successful in describing the elementary particles and their interactions. The search for neutrinoless double-beta decay ($0\nu\beta\beta$) offers a way to probe for physics beyond the SM. Observation of $0\nu\beta\beta$ would unambiguously demonstrate violation of lepton number. Additionally, it could also help explain the observed baryon asymmetry in the universe, validate the Majorana nature of neutrinos, and probe new mass generation mechanisms up to the GUT scale. The proposed 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. nEXO will employ a liquid xenon (LXe) Time Project Chamber (TPC) filled with 5 tonnes of Xe enriched to $\sim$ 90% ^{136}Xe. In parallel, new avenues are being investigated for future upgrades to nEXO with the aim to suppress backgrounds obscuring the $0\nu\beta\beta$ signal. One 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. Groups at McGill University and TRIUMF are developing an accelerator driven ion source to implant radioactive ions inside a volume of LXe, for subsequent ion extraction using methods under development by other groups within the nEXO collaboration. In the first phase of this development, ions will be extracted using an electrostatic probe for subsequent identification using γ spectroscopy. The motivation for the project, the experimental apparatus, and recent updates will be presented along with planned measurements.

Keyword-1

Ba-tagging

Keyword-2

Neutrinoless double beta decay

Keyword-3

nEXO

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