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(I) Barium tagging: Extracting and identifying ions from liquid xenon for double beta decay searches

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Despite tremendous progress, key questions remain in the field of neutrino physics. Are neutrinos Dirac or Majorana fermions? What is their absolute mass scale and mass ordering? Neutrinoless double beta decay ($0\nu\beta\beta$) searches are sensitive probes aiming to answer these questions. $0\nu\beta\beta$ experiments are continuously striving to further reduce background levels in order to observe these exceedingly rare decays. Where possible, observing the daughter ion, e.g. a ^{136}Ba from a ^{136}Xe double beta decay, would eliminate all non-$\beta\beta$ background signals, therefore increasing the detector sensitivity by large factors and offering an unambiguous identification of a positive $0\nu\beta\beta$ signal. We are developing a system to extract and identify Ba ions from liquid xenon. The system consists of a capillary probe to transport the ion from the liquid Xe volume to a Xe gas environment, followed by an RF-only ion funnel to extract the ion to vacuum. Then, the ion is loaded into a linear Paul trap for identification by laser spectroscopy. A multi-reflection time of flight mass spectrometer is under development to verify the ion's mass A=136. Ion sources are also being investigated, in particular an accelerator-based in-liquid Xe Ba-ion source. I will discuss the various aspects of this system and present the status of their development at Canadian institutions. Once an efficient system is demonstrated, we plan to deploy a demonstrator ion extraction apparatus with the intent of testing the Ba-ion tagging scheme for $0\nu\beta\beta$ searches.

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Keyword-2

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Keyword-3

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