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A Capillary Probe for Ion Extraction from Liquid Xenon

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Double beta decay is a process whereby two neutrons simultaneously decay into protons, emitting two electrons. These exceedingly rare decays have been observed with the emission of two neutrinos. However, if the neutrino is a Majorana fermion, i.e. it is its own anti-particle, double beta decays are also possible without the emission of any neutrinos. The ^{136}Xe $2\nu\beta\beta$ half-life has been measured to be on the order of 10^{21} years, with the lower limit on its $0\nu\beta\beta$ half-life being roughly 10^{25} years. Thus, multi-ton detectors are the next generation of search experiments. Then the search for neutrinoless beta decay is a challenge to push down backgrounds 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 other background signals. So-named barium tagging, then becomes the task of isolating and detecting a single ion in a potentially multi-ton detector medium. Many schemes have been proposed, and I will present progress towards using a capillary based probe for extracting individual ions from liquid xenon. I will show simulations of each step of the extraction and present the apparatus for the experiment.

Author: COLLISTER, Robert (Carleton University)

Co-authors: GORNEA, Razvan (Carleton University); KOFFAS, Thomas (Carleton University (CA)); EL-MANSALI, Ryan (Carleton University)

Presenter: COLLISTER, Robert (Carleton University)

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