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Progress in Barium Tagging for nEXO

The "ideal" next generation neutrinoless double beta decay experiment would have large fiducial mass, on the tonne scale, and a method of perfectly discriminating against all background events. 136Xe is a unique isotope for double beta decay because it can be operated conveniently as the detector medium in a liquid or gas TPC. As a transparent non-solid medium, it could be breached by lasers or a probe. Thus it is conceivable, and perhaps possible, to eliminate all background, except rare 2ν decays, in a 136Xe TPC by detecting, or "tagging", the 136Ba daughter atom or ion at the site of the decay, identified by the charge and scintillation signals. It is projected that the next generation 136Xe experiment, nEXO, would be able to begin to probe the region of normal neutrino mass hierarchy with the implementation of barium daughter tagging in its second stage of operation.

Within the EXO Collaboration, efforts are underway to demonstrate barium atom tagging for a liquid xenon detector using laser fluorescence of single Ba atoms captured in solid xenon on an optical probe or laser ablation and resonance ionization of single Ba atoms captured on a metal or semiconductor tip. Probe manipulation studies in a test TPC and thermal ionization detection methods are also being pursued. Research on barium tagging for a xenon gas TPC includes methods of extraction of single Ba ions from high pressure Xe gas and transport to an ion trap for detection by laser fluorescence. Some of the progress in these barium tagging efforts will be highlighted in this paper.

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