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Measurement of scintillation from proportional electron multiplication in liquid xenon using a needle

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While many current world-leading experiments utilise dual-phase noble element time projection chambers (TPC) to perform direct dark matter searches, a potential alternative that may be simpler and easier to scale-up is a single-phase TPC. However, achieving proportional scintillation and charge amplification directly in the liquid is challenging due to the electric fields required, but could enable similar background discrimination and event localisation capabilities as current experiments. Methods to achieve such amplification have been demonstrated using thin wires and micro pattern detector structures, but how they might be incorporated into an experiment remains elusive. We present a new approach to this challenge, with the first results with a novel method for charge amplification in liquid xenon that could be scaled to the size required for a direct dark matter search experiment. A thin needle-like electrode was used to provide a sufficiently high electric field in a liquid xenon time projection chamber test bench, read-out by two PMTs. The experimental set-up will be presented, along with measurements of the proportional scintillation in the liquid phase at several voltages. The next stage of the project will also be outlined, where the electrodes are incorporated into a multi-anode structure, like that employed by the spherical proportional counter used by NEWS-G, and how this could be implemented in a single-phase xenon detector like XMASS-I.

Collaboration

Role of Submitter

I am the presenter

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