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Charge-to-light signal conversion in liquid xenon for future TPC detectors

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Proportional scintillation of electrons in liquid noble gases is a promising signal amplification mechanism for future time projection chamber experiments (TPC) with liquid xenon targets. The detection of the charge signal in state-of-the-art multi-tonne dark matter experiments, like XENONnT or LZ, relies on the extraction of the electrons into a thin gas phase where proportional scintillation occurs in electrical fields of O(10 kV/cm). In our approach, scintillation photons are produced in liquid xenon within a few μm of thin wires, where electrical fields of O(500 kV/cm) can easily be obtained.
Omitting the gas phase overcomes technical challenges limiting the performance of large detectors and allows alternative design approaches with potentially increased science reach.
We discuss the paradigm change in charge signal reconstruction using this amplification method with respect to the traditional dual phase scheme. Exemplary aspects with significantly improved detector performance will be shown.
Furthermore, we report on experimental measurements showcasing position sensitive event reconstruction capability in a small scale R&D detector.

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