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Direct Calibration of the Field Response Functions for the Liquid Argon Detectors

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Abstract—In a Liquid Argon Time Projection Chamber (LArTPC), ionization electrons drift through the induction wire planes toward the collection wire plane, current is induced on nearby wires. The induced current as a function of time is defined as the field response function. As the field response function is the first step of signal processing of a LArTPC, it is essential to establish a precise knowledge of the field response. Due to the numerical challenges of the 3D electric field generation, the existing field response functions of LArTPC is based on 2D GARFIELD simulation. In addition, the simulation is required to be validated by measurement. We propose to direct calibrate the field response functions for the wire-readout-based single-phase Liquid Argon Time Projection Chamber (LArTPC) by constructing a dedicated system to simulate the wire configurations of the LArTPC. A direct calibration of the field responses will improve the TPC signal processing, which is the foundation of the automated event reconstruction. This work is expected to benefit the MicroBooNE data analysis and to provide critical inputs for protoDUNE and DUNE. We also propose an in-situ field response calibration device in the future DUNE experiment.

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