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Cryogenic RWELL: high gain with quenched discharges

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"Large volume Liquid Argon (LAr) Time Projection Chambers (TPC) are the technology of choice to study the elusive nature of neutrinos and to search for dark matter (DM) particles. Within the volume of noble liquid, neutrino or DM interactions produce prompt scintillation light and ionization electrons. The former is readout using UV light sensors while the latter are drifted under the influence of an electric field to the detection elements. In a single phase TPC, these detection structures are immersed in LAr, with no feasibility to amplify the primary light or charge. In dual-phase (liquid and vapor) TPCs, electrons are extracted from the liquid into the vapor phase and detected either through electroluminescence or after moderate avalanche multiplication. Studies with Large Electron Multipliers (LEMs) have shown the ability to reach charge gains of the order of 100 at 87K. However, the presence of occasional discharges could damage the readout electronics and cause significant deadtime to the detector. In this presentation we discuss the "Cryogenic Resistive WELL" (RWELL) concept. It is a single-sided THGEM (WELL) electrode coupled to readout electronics through an insulating sheet coated with resistive layer optimized for operation at LAr temperature. Similar to the RWELL operation at room temperature, higher maximum gain can be achieved also at cryogenic temperature. Relative to standard LEM and standard WELL detectors, the magnitude of the discharges measured with the cryo-RWELL is much smaller, thus potential damage to the readout electronics and discharges-related dead times are mitigated.

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