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ArgonCube: A Modular LArTPC with Pixelated Charge Readout

ArgonCube is a novel, modular approach to Liquid Argon Time Projection Chambers (LArTPCs). ArgonCube segments the total detector volume into an number of electrically and optically isolated TPCs sharing a common cryostat, providing improved performance while also mitigating technical risks with LAr purity and electric field. The field shaping uses a continuous resistive plane, field-shell, instead of mechanical cage, minimising dead material near the active volume and reducing power dissipation in the case of HV breakdown. For the charge readout a pixelated anode plane is employed, with bespoke readout electronics providing cold amplification and digitisation, enabaling unambiguous true 3D event reconstruction with a flat efficiency as function of track angle. The light readout is achieved with large dielectric planes inside the field-shell, this minimises effects of Rayleigh scattering, allowing for the efficient detection of contained prompt scintillation, thus improving trigger efficiency. ArgonCube has already found application in the high multiplicity environment of the Deep Underground Neutrino Experiment (DUNE) Near Detector (ND). An ArgonCube prototype will be deployed as the core component of ProtoDUNE-ND at Fermilab in 2020.

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