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Novel LArTPC technologies for near detectors

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To explore the neutrino sector through oscillation experiments, we measure neutrino flavor transformations as a function of energy at the far detector. A near detector (ND), positioned close to the beam source, offers vital in-situ constraints on key uncertainties in flux, neutrino cross-sections, and detector smearing. Liquid argon TPC (LArTPC) technology has revolutionized neutrino interaction imaging with enhanced precision and resolution, and is now a key detector component in numerous experiments.

In this talk, I will discuss the technologies, design, and purpose of various LArTPCs being deployed as near detectors in accelerator-based neutrino oscillation experiments. I will highlight the recently operational Short Baseline Near Detector (SBND) at Fermilab in the BNB beam and the LAr ND for the upcoming long-baseline Deep Underground Neutrino Experiment (DUNE). I will describe how advancements in LArTPC technology tackle the challenges of high-power beams at the ND, where intense neutrino flux can rapidly saturate a monolithic LArTPC with projective wire readout due to charge pile-up. To address this, the ND-LAr for DUNE is designed as a modular detector featuring optically isolated TPC modules and pixelated charge readout.

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