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Liquid Argon TPCs for Neutrino Physics

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Liquid Argon Time Project Chamber detectors (LArTPCs) are particularly attractive for use in neutrino physics because of their exceptional capabilities in tracking, particle identification and calorimetric energy reconstruction, extended over very large LAr volumes acting as target for neutrino interactions.
Charged particles propagating in liquid argon produce free electron charge and scintillation light emission.
The freed electrons drift under the influence of an electric field applied across the detector volume. The read-out of the charge signal at the anode can be pursued either directly in liquid phase, without charge multiplication (Single Phase Technology), or through charge extraction and amplification in the gas above the liquid (Dual Phase Technology). In either case, highly segmented anodic planes enable 3D imaging and precise calorimetric energy reconstruction. The ability to separate electrons and photons by sampling the energy deposition before the buildup of an electromagnetic shower is key to the LArTPC performance in oscillation neutrino physics.
The efficient collection of the LAr scintillation light enables trigger capability and spatial localization, in particular for low energy neutrino events and rare underground signals. Novel photo collector concepts are under development for implementation in future large scale LArTPC detectors.
Special emphasis will be given on instrumental advances in the design of the DUNE experiment.