A Vertical Drift LArTPC for the DUNE experiment

The Deep Underground Neutrino Experiment (DUNE) will use a suite of large liquid argon (LAr) far detectors, 1.5 km deep underground and located 1300 kilometers from the LBNF beamline in the US. Four far detector modules are planned, each with a fiducial mass of 10 kt of LAr. At least the first two of these modules will be LAr Time Projection Chambers (TPC), and efforts have concentrated in the past few years to prove the feasibility of this technology at a large scale. Two large prototypes, the ProtoDUNEs, have been built at CERN for this purpose.

With the aim of optimizing the design of one of these modules, the collaboration is proposing a Vertical Drift (VD) LArTPC detector. This novel approach envisages a time projection chamber where the electrons drift vertically over a distance of 6m towards a PCB printed anode. The concept is developed from recent experience in running the ProtoDUNE detectors, where the very high LAr purity achieved proved it was possible to push for longer drift distances. It has also been shown that a PCB anode plane on the top is a possible alternative to the traditional vertical wire planes. Having only the cathode within the instrumented volume, such a design would reduce the amount of dead areas and in addition, the vertical disposition would allow access to some of the readout electronics of the TPC. However this proposal entails several technological challenges, among them, the need to operate the photo-detection system on a high voltage surface, as well as the difficulties in operating the high voltage system itself. The intense R&D campaign is currently in place to demonstrate this technology is presented here.

Primary authors: SACERDOTI, sabrina (APC); ON BEHALF OF THE DUNE COLLABORATION

Presenter: SACERDOTI, sabrina (APC)

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