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The ionisation laser calibration system for DUNE

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The Deep Underground Neutrino Experiment (DUNE) will use a neutrino beam, a near detector, and a set of massive far detectors to fully probe the three-neutrino oscillation paradigm. Measurements of neutrino mass ordering and CP violation will be possible in a single experiment, thanks to the exceptionally long baseline of 1,285 km combined with the wide energy spectrum covering two oscillation maxima, and the tracking and calorimetric capabilities of the liquid argon time projection chamber (LAr TPC) technology. Strict control of systematic uncertainties is also necessary, requiring thorough calibration of the DUNE detectors. In addition to the use of natural sources, deployed systems will also be used to calibrate DUNE's far detectors and the ionization laser system is one of them.

Via a 3-photon process, intense UV laser beams can ionize liquid argon and create straight tracks similar to muons. The laser system allows the creation of such tracks in precisely known locations inside the TPC and the modulation of their intensity. By comparing known and reconstructed track positions, this allows the observation of electric field distortions (due to space-charge or detector defects), but also the study of several effects on charge propagation and collection.

The prototype of this calibration system has been designed, fabricated, and installed in the ProtoDUNE-HD and ProtoDUNE-VD 1-kton scale LAr TPC prototype detectors, part of the Neutrino Platform at CERN. In this talk, we will present the design of the system, tests and validation, and integration in the ProtoDUNE-HD and ProtoDUNE-VD along with preliminary results from the commissioning phase at CERN.

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