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Understanding neutrinos with accelerator beams and liquid argon time-projection chambers: ICARUS and DUNE

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A global program of experiments has worked towards characterizing neutrino oscillation over the past few decades. However, important parameters remain to be measured, and mysteries remain to be elucidated. Current and upcoming experiments are targeting the open questions and probing the consistency of the neutrino oscillation paradigm. Likewise, the liquid argon (LAr) time-projection chamber (TPC) has emerged as a sensitive particle detection technology for neutrino experiments.

A current generation of LAr TPC detectors are being used to study neutrinos while also gaining important experience in operating and analyzing with this technology. SBND, MicroBooNE, and ICARUS have collected or are collecting data from beams at Fermilab (near Chicago) to explore the possibility of a sterile neutrino and/or other beyond Standard Model (BSM) physics. SBND and ICARUS will be used to conduct a two-detector analysis as part of the Short Baseline Neutrino (SBN) Program. Additionally, these detectors are enabling important neutrino interaction studies necessary to prepare for the next generation of oscillation experiments.

One such oscillation experiment that will come online over the next years is the Deep Underground Neutrino Experiment (DUNE), which will install multiple 10 kiloton LAr TPCs underground in South Dakota (south of Saskatchewan) to conduct oscillation measurements with neutrinos originating in a beamline at Fermilab. A detector complex will be installed at Fermilab as well, to study the beam before the expected flavour oscillations. This "near detector"will also employ a LAr TPC, with a segmented and pixel-based design, as well as other technologies to constrain uncertainties in the oscillation measurement by characterizing the beam and neutrino interactions.

This talk will discuss the ICARUS and DUNE experiments, the LAr TPC detector technology, and the efforts to realize and leverage these experiments to better understand the properties of neutrinos.

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