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3D-Reconstruction of Tau Neutrinos in LArTPC Detectors

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The Deep Underground Neutrino Experiment (DUNE) is a next-generation neutrino experiment currently under construction. DUNE will consist of two high-resolution neutrino interaction imaging detectors exposed to the world's most intense neutrino beam, with the Near Detector at Fermilab and the Far Detector 1,300 km away in the Sanford Underground Research Facility in South Dakota, US.

The high statistics and excellent resolution capabilities of DUNE's ^{40}Ar detector will allow us to make precision studies of oscillation parameters capable of searching for CP violation in the lepton sector, testing interaction models, and studying phenomena that have until now, seemed too complex to measure, like ν_τ detection and therefore, providing the completion of the 3-flavor neutrino paradigm. Knowledge of the ν_τ detection can impact a broad spectrum of open questions. Among these include searching for non-standard neutrino interactions, constraining the unitarity of the PMNS matrix, searching the sterile neutrinos, and studying neutrino interactions.

In the case of LArTPC data, the detector hits can be considered nodes in a graph, and the edges represent the spatial and temporal relationships between them. By using graph neural networks, it is possible to exploit these relationships and improve the accuracy of particle identification and reconstruction. During my presentation and specifically for tau neutrino reconstruction, I will show the effectiveness and reliability of our in-house developed graph neural network (GNN), NuGraph2. This GNN classifies detector hits based on the particle type responsible for their production, assuring that the system accurately identifies and categorizes information based on its unique characteristics.

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