

Exploration of the beam profile using the ND280 detector in the T2K experiment

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There are several long-baseline neutrino oscillation experiments around the world, which study neutrino properties by observing the effects of neutrino oscillations over long distances. Most of these experiments also have near detectors to constrain the properties of the neutrino beam, such as its flux and energy spectrum, and to control systematic uncertainties. To achieve a narrower neutrino energy spectrum, it is often necessary to place the detector off-axis of the neutrino beam. This poster will primarily focus on the T2K experiment, specifically the near detector (ND280), which is positioned 2.5 degrees off the beamline axis.

In the T2K experiment, neutrinos are produced when accelerated protons hit a graphite target, generating secondary particles such as pions and kaons. These particles decay at different positions along the 96 m long decay volume. The location of the neutrino production affects the off-axis angle at which the neutrino arrives at the near detector, which in turn affects the neutrino energy spectrum observed.

In this poster, we propose a new experimental observable that explores the decay position of neutrino parent particles using different frames of reference defined along the decay volume and the neutrino direction reconstructed from muon and proton properties in CCQE events. This observable allows us to differentiate neutrinos produced before or after the center of the selected frame of reference along the decay volume. This measurement will improve our understanding of the distribution of the off-axis angle of neutrinos and, more importantly, their energy distribution. This observable can also provide indications of detector misalignment, beam alignment issues, or the average decay position of the parents of neutrinos in the decay volume, among other factors which affect the expected neutrino flux at the near detector.

Working Group

WG 2: Neutrino Scattering Physics

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