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Time Slicing of Neutrino Fluxes in Oscillation Experiments at Fermilab

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The upcoming long baseline neutrino experiments have the goal of enhancing proton beam power to a multi-MW scale and utilizing large-scale detectors to address the challenge of limited event statistics. The DUNE experiment at LBNF will test the three neutrino flavor paradigm and directly search for CP violation by studying oscillation signatures in the high intensity ν_μ (anti-ν_μ) beam to ν_e (anti-ν_e) measured over a long baseline.\par
As long baseline neutrino experiments progress into a phase of increased precision, it becomes crucial to minimize systematic errors to a few percent in order to achieve their desired scientific objectives. One of the most demanding contributors to these systematic errors arises from the cross sections of neutrino-nucleus interactions.
During this presentation, a novel approach called the “stroboscopic approach” is introduced as an innovative research and development technique for neutrino beams. By exploiting the correlation between the true neutrino energy and the measured neutrino arrival time, this technique selects different neutrino energy spectra from a wide-band neutrino beam. It uniquely allows access to true energy information at the Far detector, which is not possible from any other existing part of the DUNE experiment.\par
Three different thrusts are necessary for the application of stroboscopic approaches, namely: 1) creation of short (˜300ps) proton bunch length, 2) implementation of fast timing to get equivalent time resolution in the detectors, 3) establishment of synchronization between the time at the detector and time of the bunch-by-bunch proton at the target. This talk will explain how the three different thrusts emerge from the same objective of understanding how the stroboscopic approach brings its own critical contribution to DUNE and US neutrino physics.\par
Obtaining a better understanding of the cross sections is critical for DUNE experiment and neutrino physics as a whole and US accelerator-based neutrino beams will benefit from this novel technique.

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