

Combined neutrino and antineutrino charged current cross section measurement on carbon with zero final state pions in the T2K near detector complex

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T2K is a long baseline neutrino oscillation experiment, located in Japan. A muon (anti)neutrino beam peaked at 600 MeV is produced in the J-PARC facility and measured by near detectors and the Super-Kamiokande far detector. The main goal is to measure the neutrino oscillation parameters. T2K can run in both neutrino and antineutrino mode, enhancing the sensitivity to charge-parity violation (CPV) in the lepton sector. Measuring oscillation parameters requires precise knowledge of the (anti)neutrino interaction cross sections.

We present an improved cross section analysis which utilizes combined data samples of multiple detectors and in multiple beam configurations, the first of its kind. It will be used to measure the muon neutrino and antineutrino cross sections on carbon with no final state pions. This technique fully exploits the correlations between the samples' systematic uncertainties, allowing for their efficient cancellation. Since the two utilized T2K near detectors sample different neutrino energy spectra, this measurement will allow to better understand the energy dependence of neutrino interactions, thereby offering a direct probe of the physics that are responsible for the largest uncertainties in T2K oscillation analyses.

In addition, by measuring both neutrino and antineutrino cross sections, it is possible not only to better tune theoretical models of nuclear effects such as multinucleon interactions, but also to properly understand the asymmetry between neutrino and antineutrino interactions, the latter being of fundamental importance for CPV experiments that measure the asymmetry between neutrino and antineutrino oscillation rates.

Working group

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