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Estimating detector systematic uncertainties for the T2K far detector

Monday, 16 September 2024 15:05 (20 minutes)

Tokai to Kamioka (T2K) is a long-baseline neutrino oscillation experiment that measures oscillation parameters related to both $\nu_\mu(\bar{\nu}_\mu)$ disappearance and $\nu_e(\bar{\nu}_e)$ appearance in a $\nu_\mu(\bar{\nu}_\mu)$ beam. T2K uses Super-Kamiokande (SK) as its far detector, and SK detector systematic errors are currently among the leading sources of systematic uncertainty in the T2K oscillation analysis. Therefore, accurate understanding of detector mis-modelling and event reconstruction uncertainties in SK is crucial to the extraction of the neutrino oscillation parameters. The detector error estimation procedure quantifies uncertainties by fitting SK atmospheric MC to data in a Markov Chain Monte Carlo (MCMC) framework. Uncertainties are separated based on true event topology above Cherenkov threshold in the SK atmospheric MC in order to capture how the uncertainties should affect the different signal and background samples when propagated to the T2K beam oscillation analysis. The procedure has been upgraded for the upcoming analysis cycle to include systematics targeting newly added ν_eCC1$\pi^\pm$ and NCπ^0-enhanced analysis samples, among other changes, culminating in a 540 dimensional MCMC fit between atmospheric MC and data in SK. The far detector analysis chain and its integration into the broader T2K oscillation analysis will be discussed in this talk.

Working Group

WG 1: Neutrino Oscillation Physics

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