

Robustness of the δ_{CP} measurement at future long-baseline experiments

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The precision determination of the leptonic CP-violating phase δ_{CP} is one of the main goals of the upcoming long-baseline experiments DUNE and Hyper-Kamiokande. Within the standard three-flavor framework and the usual assumptions on neutrino cross sections – namely lepton universality and accurate nuclear modeling – both experiments are projected to reach high sensitivity to δ_{CP} .

In this talk I examine how robust this picture really is. First, I show that a model-agnostic, data-driven treatment of current cross-section data allows smooth deformations of $\sigma_{\nu e}$ that degrade the CP sensitivity by $3\text{--}4\sigma$ at maximal CP violation, exposing how much of the projected reach is rooted in theoretical assumptions rather than in measurements. Second, I show that even if these assumptions hold, any unmodeled new physics in neutrino propagation – illustrated by the NSI solutions to the present NOvA–T2K tension – affects DUNE and Hyper-Kamiokande differently due to their distinct matter effects, generating an artificial tension at the $\sim 3\sigma$ level between their inferred parameters. Taken together, these results suggest that, in the precision era, tensions between long-baseline experiments may themselves serve as a diagnostic tool, pointing either to hidden systematics or to physics beyond the Standard Model.

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