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Bridging Experiments, Narrowing Uncertainties: When DUNE Meets T2HK to unveil insights into 2–3 Oscillation Sector

A meticulous determination of Δm^2_{31} and θ_{23} is indispensable for accurately evaluating the Earth's matter effect in long-baseline experiments, a key element in resolving the neutrino mass ordering conundrum and in measuring the CP phase in the 3ν paradigm. By reviewing the footprints of previous and ongoing experiments and considering the anticipated sensitivities from the upcoming IceCube Upgrade and KM3NeT/ORCA, we examine the expected advancements in the precision of 2–3 oscillation parameters that the next-generation long-baseline experiments, DUNE and T2HK, are set to provide, either independently or in combination. We underscore the significance of the complementarity between these two experiments, which substantially enhances the sensitivity to deviations from maximal mixing in θ_{23}, decisively excludes the wrong-octant solutions for θ_{23}, and enables exceptionally refined measurements of the 2–3 oscillation parameters, surpassing the capabilities of each experiment when considered in isolation. Our analysis shows that, for the current best-fit values of the oscillation parameters and assuming normal mass ordering (NMO), the combination of DUNE and T2HK can confirm a non-maximal θ_{23} and exclude the wrong octant solution with a statistical significance of approximately 7σ with their nominal exposures. Furthermore, we find that DUNE and T2HK together can enhance the existing 1σ precision on $\sin^2\theta_{23}$ and Δm^2_{31} by factors of 7 and 5, respectively, assuming NMO. Given the financial hurdles and the prolonged commitment required for the full 10-year operation of DUNE and T2HK, our study highlights that even with less than half of their nominal exposures, the collaboration between DUNE and T2HK can still achieve sensitivities in our phenomenological analyses that are on par with those expected from their full exposures individually. Finally, we highlight how the synergistic interplay between DUNE and T2HK can offer more stringent constraints on the ($\sin^2\theta_{23}$, $\delta_{\rm CP}$) plane, outstripping the reach of the standalone experiments.

Secondary track

T09 - Beyond the Standard Model

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