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Probing new physics at Long Baseline Experiments via Scalar NSI

The phenomena of neutrino oscillations which confirms the non-zero masses of neutrinos, is the first firm experimental evidence of physics beyond the Standard Model(SM). According to SM neutrinos interact with matter through weak interactions mediating a W or Z bosons. The models describing Beyond Standard Model (BSM) physics often come with some additional unknown coupling of neutrinos termed as, non standard interactions(NSIs). The idea of neutrino NSI was initially proposed by Wolfenstein where the NSI is mediated by a vector boson. However, there is also a possibility of neutrinos to couple with a scalar field, which can offer unique phenomenology in neutrino oscillations. This type of scalar NSI appears as a medium-dependent correction to the neutrino mass term, which makes its effect interesting to probe further.

In this work, we have probed the impact of a scalar NSI in the long baseline sector, focussing at the three upcoming long-baseline (LBL) experiments: DUNE, T2HK and T2HKK. We show that the presence of scalar NSI may significantly impact the oscillation probabilities as well as the event rates at the detectors and the $\chi 2$ - sensitivities of CP measurements of the experiment. We also show that, a synergy among the LBL experiments (DUNE+T2HK, DUNE+T2HKK) may offer a better capability of constraining the scalar NSI parameters as well as an improved sensitivity towards CP-violation.

Keywords: Neutrino Oscillations, Non Standard Interactions, Beyond Standard Model.

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