

Exploring Leggett-Garg type Inequality Violations in Light of NO ν A and T2K Anomalies

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Recent anomalies observed in NO ν A and T2K experiments within the framework of standard three-flavor neutrino oscillations suggest the possibility of physics beyond the Standard Model (SM). In this study, we investigate the potential violation of Leggett-Garg type inequalities (LGtI) in the context of three-flavor neutrino oscillations, focusing on scenarios involving complex Non-Standard Interactions (NSI) with $\epsilon_{e\mu}$ or $\epsilon_{e\tau}$ couplings in long baseline accelerator experiments, considering both normal and inverted mass ordering. Our analysis reveals that LGtI violation is significantly enhanced in the normal ordering (NO) for the $\epsilon_{e\tau}$ scenario. At the same time, it is suppressed for the $\epsilon_{e\mu}$ scenario in T2K, NO ν A, and DUNE experiments. Moreover, we find that in the case of inverted ordering (IO), the DUNE experimental setup above 6 GeV exhibits LGtI violation, suggesting the possibility of the $\epsilon_{e\tau}$ new physics scenario. These findings shed light on the potential of LGtI as a probe for physics beyond the Standard Model in neutrino oscillation experiments.

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