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Exploring Non-Standard Interactions: LGt Inequality Violations in $\text{NO}\nu\text{A}$ and T2K Anomalies

The recent anomalies observed in $\text{NO}\nu\text{A}$ and T2K experiments within the standard three-flavor neutrino oscillation model suggest the possibility of physics beyond the Standard Model (SM). To address this, we explore Non-Standard Interaction (NSI) parameters that could explain these anomalies by analyzing the violation of Leggett-Garg-type inequalities (LGtI) in the framework of three-flavor neutrino oscillations. Specifically, we examine LGtI violations in scenarios involving complex NSI parameters, focusing on $\epsilon_{e\mu}$ and $\epsilon_{e\tau}$ couplings in long-baseline accelerator experiments, under both normal (NO) and inverted mass ordering (IO). Our findings indicate that LGtI violations are enhanced in the NO scenario for the $\epsilon_{e\tau}$ coupling in experiments like T2K, $\text{NO}\nu\text{A}$, and DUNE. Additionally, in the DUNE setup for IO, LGtI violations above 8.5 GeV could suggest the presence of new physics associated with the $\epsilon_{e\tau}$ NSI scenario.

Field of contribution

Phenomenology

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