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Neutrino NSI from Ultralight Scalars

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We investigate the effect on neutrino oscillations generated by new physics interactions between neutrinos and matter. Specifically, we focus on scalar-mediated nonstandard interactions (NSI) whose impact fundamentally differs from that of vector-mediated NSI. Scalar NSI contribute as corrections to the neutrino mass matrix rather than the matter potential and thereby predict distinct phenomenology from the vector-mediated ones. Similar to vector-type NSI, the presence of scalar-mediated neutrino NSI can influence measurements of oscillation parameters in long-baseline neutrino oscillation experiments, with a notable impact on CP measurement in the case of DUNE. Our study focuses on the effect of scalar NSI on neutrino oscillations, using DUNE as an example. We introduce a model-independent parameterization procedure that enables the examination of the impact of all non-zero scalar NSI parameters simultaneously. Subsequently, we convert DUNE's sensitivity to the NSI parameters into projected sensitivity concerning the parameters of a light scalar model. We compare these results with existing non-oscillation probes. Our findings reveal that the region of the light scalar parameter space sensitive to DUNE is predominantly excluded by non-oscillation probes, except for scenarios with very light mediator mass.

Working Group

WG 1: Neutrino Oscillation Physics

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