Differentiating Lorentz Invariance Violation and Non-Standard Interaction at Protvino to Super-ORCA experiment

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It is particularly challenging to discern between these two effects since the Hamiltonian of neutrino oscillation is modified in a similar manner by both Lorentz invariance violation (LIV) and non-standard interaction (NSI) in neutrino propagation. Their sole distinction is that the earth matter effect does not impact LIV, while NSI depends on matter density. Therefore, the theories defining NSI and LIV are absolutely equal for a fixed baseline experiment where matter density is constant. However, depending on their statistics with regard to the present and future bounds of these parameters, one can discriminate between these two scenarios in the long-baseline neutrino experiments since the NSI and LIV parameters have different current and future bounds. In this study, we try to distinguish between LIV and NSI in the context of DUNE and P2SO since these two upcoming experiments are expected to have very high statistics and be sensitive to the most significant matter effect. Our findings demonstrate that it is feasible to achieve good discrimination between LIV and NSI when considering LIV in the data and NSI in theory. For the parameter $a_{\mu\mu}$, P2SO yields the best separation between LIV and NSI at 3σ C.L. In this case, the value of the LIV parameter for which separation is possible lies within its future bound if one considers the value of the NSI parameter to be constrained by the present experiments. When it comes to discriminating of this kind, P2SO is more sensitive than DUNE.

Poster prize

Yes

Given name

Dinesh Kumar

Surname

Singha

First affiliation

University of Hyderabad

Second affiliation

Institutional email

19phph03@uohyd.ac.in

Gender

Male

Collaboration (if any)

Primary author: SINGHA, Dinesh Kumar (University of Hyderabad)

Co-authors: GHOSH, Monojit (Ruđer Bošković Institute, Zagreb, Croatia);   MAJHI, Rudra (Nabarangpur College, Nabarangpur - 764063, Odisha, India);   MOHANTA, Rukmani (University of Hyderabad)

Presenter: SINGHA, Dinesh Kumar (University of Hyderabad)

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