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Evolution of Neutrino Mass-Mixing Parameters in Matter with Non-Standard Interactions

We explore the role of matter effect in the evolution of neutrino oscillation parameters in the presence of non-standard interactions (NSI) of neutrino. We derive approximate analytical expressions for the modified mass-mixing parameters in matter with NSI. We observe that only the NSI parameters in the (2,3) block, namely $\varepsilon_{\mu\tau}$ and $(\gamma - \beta) \equiv (\varepsilon_{\tau\tau} - \varepsilon_{\mu\mu})$ affect the running of θ_{23}. Though all the NSI parameters influence the evolution of θ_{13}, $\varepsilon_{e\mu}$ and $\varepsilon_{e\tau}$ show a stronger impact at the energies relevant for DUNE. The solar mixing angle θ_{12} quickly approaches to $\sim 90^{\circ}$ with increasing energy in both SI and SI+NSI cases. The change in $\Delta m^2_{21,m}$ is quite significant as compared to $\Delta m^2_{31,m}$ both in SI and SI+NSI frameworks for the energies relevant for the DUNE baseline. Flipping the signs of the NSI parameters alters the way in which mass-mixing parameters run with energy. We demonstrate the utility of our approach in addressing several important features related to neutrino oscillation such as a) unraveling interesting degeneracies between θ_{23} and NSI parameters, b) estimating the resonance energy in presence of NSI when θ_{13} in matter becomes maximal, c) figuring out the baseline length and neutrino energies required to have maximum $\nu_\mu \to \nu_e$ transition in the presence NSI. d) study the impact of NSI in $\nu_\mu \to \nu_\mu$ disappearance channel.

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