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Improvements on perturbative oscillation formulas including non-standard neutrino interactions

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We use perturbation theory to obtain neutrino oscillation probabilities, including the standard mass-mixing paradigm and non-standard neutrino interactions (NSI). The perturbation is made on the standard parameters $\Delta m^2_{21}/\Delta m^2_{31}$ and sin2(θ13) and on the non-diagonal NSI parameters, but keeps diagonal NSI parameters non-perturbated. We perform the calculation for the channels νμ ⟶ νe and νμ ⟶ νμ. The resulting oscillation formulas are compact and present functional structure similar to the standard oscillation (SO) case. They apply to a wide range in the allowed NSI space of parameters and include the previous results from perturbative approaches as limit cases. Also, we use the compact formulas we found to explain the origin of the degeneracies in the neutrino probabilities in terms of the invariance of amplitude and phase of oscillations. Then we determine analytically the multiple sets of combinations of SO and NSI parameters that result in oscillation probabilities identical to the SO case.

Collaboration name

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