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Extreme scenarios of new physics in the UHE astrophysical neutrino flavour ratios

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We add an energy-independent Hamiltonian to the standard flavour oscillation one. This kind of physics might appear in theories where neutrinos couple differently to a plausible non-zero torsion of the gravitational field or more dramatically in the presence of CPT-violating physics in the flavour oscillations. If this contribution exists, experiments at higher energies are more sensitive to their free parameters, and flavour conversion could be severely modified. We show that this new physics modifies the neutrino mixing angles and find expressions that relate the new, effective, angles to the standard oscillation parameters Δm^2_{ij}, θ_{ij} and δ_{CP} and to the parameters in the new-physics Hamiltonian, within a three-neutrino formalism. We consider scenarios where the new parameters allow for extreme deviations of the expected neutrino flavour ratios at Earth from their standard values. We show that large departures of the standard flavour scenario are plausible, which would be a strong hint of the violation of a conserved symmetry.

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