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The Violation of Equivalence Principle and Four Neutrino Oscillations for Long Baseline Neutrinos

Violation of equivalence principle predicts that neutrinos of different flavour couple differently with gravity. Such a scenario can give rise to gravity induced flavour oscillations in addition to the usual mass-flavour neutrino oscillations during the neutrino propagation. Even if the equivalence principle is indeed violated, their measure will be extremely small. We explore the possibility to probe the violation of equivalence principle (VEP) for the case of long baseline (LBL) neutrinos in a 4-flavour neutrino framework (3 active + 1 sterile) where both mass and gravity induced oscillations are considered. To this end, we have explicitly calculated the oscillation probability in 4-flavour framework that includes in addition to the mass-flavour mixing in matter, the gravity-flavour mixing also. The energy eigen values are then obtained by diagonalising such a 4-flavour mixing matrix. The formalism is then employed to estimate the wrong and right sign muon yields at a far detector for neutrinos produced in a neutrino factory and travel through the Earth matter. These results are compared with the similar estimations when the usual three active neutrinos are considered.

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