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

In this work, the authors study the observation of the Violation of Equivalence Principle (VEP) in the so called 3+1 neutrino mixing scenario. Assuming the existence of an sterile neutrino, the mixing between the flavor and the massive states is described by $4 \times 4$ unitary matrix and the neutrino evolution depends on three mass squared differences. If the neutrino propagates through matter, the evolution also depends on the forward neutrino elastic scattering with the medium. In this paper, the authors consider the possibility that different neutrino flavors are affected differently by the gravitational potential. A consequence of the VEP would be the modification of the neutrino phase and therefore we can expect a deviation in the neutrino oscillation probability with respect to the 3+1 scenario. In order to explore the sensitivity to the VEP, the authors consider the flux of muon neutrinos from a muon storage ring that propagates through the Earth and it is detected in the proposed ICAL detector at INO.

As it is explained in section 2, neutrinos are created via leptonic charged currents given by $j^{\mu}_{W,L} \sim \sum_{\alpha} \overline{\nu_{\alpha L}} \gamma^{\mu} l_{\alpha L}$. The flavor state can be written as a linear combination of the massive states weigthed by $U^{*}_{\alpha k}$. In Eq.1, the authors used the complex conjugate of that weigthing factor. That should be corrected.

The variation of the Earth matter potential along the neutrino trajectory is described by a two layer approximation, where the density in each layer is given by the average value of the PREM model. The oscillation probability is given by the square of the products of the amplitudes for each layer, Eq.30. The first and the last term in that equation should include the matter effects since they correspond to the mixing matrix in the propagation through the upper mantle.

The authors take the value for $\theta_{14}$ from a combined analysis of Daya Bay, MINOS and Bugey-3. The reference used is older than the first Daya Bay results. That must be corrected.

Although the two BSM scenarios, the existence of an additional sterile neutrino and the Violation of the Equivalence Principle, addressed in this work are interesting by themselves, the goal of combining both of them it is to test an additional parameter. In addition, the quantification of the sensitivity it is not very robust due to the lack of any statistical analysis. All considered, I cannot recommend the paper for publication in European Physics Journal C.