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Massive neutrinos and fermion mass hierarchy in a non-universal $U(1)_X$ extension with an invisible axion

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We present a non-universal $U(1)_X$ extension and an additional global anomalous Peccei-Quinn (PQ) symmetry to the standard model (SM). The scheme proposed allows us to distinguish among fermion families without introducing additional discrete symmetries and generating the correct ansatz of mass matrix to obtain the fermionic mass spectrum in SM. The symmetry breakdown is performed by two scalar Higgs doublets and two scalar singlets, where one of these has the excitation associated with the axion-particle which turns out to be a candidate for dark matter. The exotic sector is composed of an invisible axion a , one up-type T and two down-type $J^{1,2}$ heavy quarks, two heavy charged leptons E, \mathcal{E} and one right-handed $\nu_R^{e,\mu,\tau}$ additional neutrino per family. In addition, the large energy scale associated with the spontaneously breaking (SSB) of the PQ-symmetry provides a solution to the strong CP-problem, also giving masses to the right neutrinos in such manner that the active neutrinos acquire eV -mass values due to the see-saw mechanism implementation. We comment on the implications of the proposed model with electroweak baryogenesis.

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