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Fermion mass, Axion dark matter, and Leptogenesis in SO(10) GUT

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SO(10) grand unified theory with minimum parameters in the Yukawa sector employs the Peccei-Quinn symmetry that solves the strong CP problem. Such an economical Yukawa sector is highly appealing and has been extensively studied in the literature. However, when the running of the renormalization group equations of the Yukawa couplings are considered, this scenario shows somewhat tension with the observed fermion masses and mixing. In this work, we propose an extension of the minimal framework that utilizes lower dimensional representations and alleviates this tension by introducing only a few new parameters. The proposed model consists of a fermion in the fundamental and a scalar in the spinorial representations. While the latter is needed to implement the Peccei-Quinn symmetry successfully, the presence of both is essential in obtaining an excellent fit to the fermion mass spectrum. In our model, axions serve the role of dark matter, and the out-of-equilibrium decays of the right-handed neutrinos successfully generate the matter-antimatter symmetry of the Universe.

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