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Singlet-doublet Dirac fermion dark matter from Peccei-Quinn symmetry

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Weakly Interacting Massive Particles (WIMPs) and axions are arguably the most compelling dark matter (DM) candidates in the literature. Here, we consider a model where the PQ symmetry solves the strong CP problem, generates radiatively Dirac neutrino masses, and gives origin to multicomponent dark sector. Specifically, scotogenic Dirac neutrino masses arise at one-loop level. The lightest fermionic mediator acts as the second DM candidate due to a residual Z2 symmetry resulting from the PQ symmetry breaking. The WIMP DM component resembles the well-known
singlet-doublet fermion DM. While the lower WIMP dark mass region is usually excluded, our model reopens that portion of the parameter space (for DM masses below . 100 GeV). Therefore, we perform a phenomenological analysis that addresses the constraints from direct searches of DM,
neutrino oscillation data, and charged lepton flavor violating (LFV) processes. The model can be tested in future facilities where DM annihilation into SM particles is searched for by neutrino
telescopes.

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