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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 that identifies the PQ symmetry as a common solution to the strong CP problem, the generation of radiative Dirac neutrino masses, and the origin of a multicomponent dark sector. Specifically, scotogenic Dirac neutrino masses arise at one loop level. The lightest fermionic mediator field acts as the second DM candidate due to a residual Z_2 symmetry resulting from the PQ symmetry breaking. The WIMP DM component resembles the well-known singlet-doublet fermion DM where the regions of the lower WIMP dark mass region are excluded. However, in our model, that region (for DM masses below
$lesssim$100 GeV) is reopened. 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 in neutrino telescopes

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