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Explorations of pseudo-Dirac dark matter having keV splittings and interacting via transition electric and magnetic dipole moments

We study a minimal model of pseudo-Dirac dark matter, interacting through transition electric and magnetic dipole moments. Motivated by the fact that xenon experiments can detect electrons down to ~keV recoil energies, we consider O(keV) splittings between the mass eigenstates. We study the production of this dark matter candidate via the freeze-in mechanism. We discuss the direct detection signatures of the model arising from the down-scattering of the heavier state, that are produced in Solar upscattering, finding observable signatures at the current and near-future xenon based direct detection experiments. We also study complementary constraints on the model from fixed target experiments, lepton colliders, supernovae cooling and cosmology. We show that next generation xenon experiments can either discover this well motivated and minimal dark matter candidate, or constrain how strongly inelastic dark matter can interact via the dipole moment operators.

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