

CP Violating Dark Photon Kinetic Mixing and Type-III Seesaw

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The hypothetical dark photon portal connecting the visible and dark sectors of the Universe has received considerable attention in recent years, with a focus on CP-conserving kinetic mixing between the Standard Model (SM) hypercharge gauge boson and a new $U(1)_X$ gauge boson. In the effective field theory context, one may write down non-renormalizable CP-violating kinetic mixing interactions involving the X and $SU(2)_L$ gauge bosons.

We construct for the first time a renormalizable model for CP-violating kinetic mixing that induces CP-violating non-Abelian kinetic mixing at mass dimension five.

The model grows out of the type-III seesaw model, with the lepton triplets containing right-handed neutrinos playing a crucial role in making the model renormalizable and providing a bridge to the origin of neutrino mass. This scenario also accommodates electron electric dipole moments (EDM) as large as current experimental bound, making future EDM searches an important probe of this scenario.

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