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Prospect of a light pseudoscalar dark matter

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The idea of with $EW-\nu_R$ model with additional GeV scale mirror fermions with large displaced vertices and extended Scalar sector is very appealing from the Collider perspective. The presence of a complex singlet scalar in this model helps to solve the strong-CP problem, satisfying the constraint coming from the present absence of neutron electric dipole moment, and without need of an axion.

Based on this model, in this work, we study the detailed scalar mass spectrum, having ~ 125 GeV Higgs-like scalar, which is allowed by the signal strength and lepton flavor violating constraints data. Besides explaining the ~ 125 GeV Higgs-like scalar, this scenario can also accommodate a non-thermal scalar dark matter candidate that can satisfy the relic density data.

The imaginary part of the complex singlet scalar in this model serves as a viable non-thermal feebly interacting massive particle (FIMP) dark matter candidate.

We identify the region of the parameter space for the freeze-in scenario, which is consistent with all the bounds from relic density and direct-indirect searches and discuss the possible future implications of this scenario.

Summary

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