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Axion and FIMP Dark Matter in a $U(1)$ extension of the Standard Model

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In the Standard Model a Dark Matter candidate is missing, but it is relatively simple to enlarge the model including one or more suitable particles.

We consider in this paper one such extension, inspired by simplicity and by the goal to solve more than just the Dark Matter issue.

Indeed we consider a local $U(1)$ extension of the SM providing an axion particle to solve the strong CP problem and including RH neutrinos with appropriate mass terms. One of the latter is decoupled from the SM leptons and can constitute stable sterile neutrino DM.

In this setting, the PQ symmetry arises only as an accidental symmetry but its breaking by higher order operators is sufficiently suppressed to avoid introducing a large θ contribution.

The axion decay constant and the RH neutrino masses are related to the same v.e.v.s and the PQ scale and both DM densities are determined by the parameters of the axion and scalar sector.

The model predicts in general a mixed Dark Matter scenario with both axion and sterile neutrino DM and is characterised by

a reduced density and observational signals from each single component.

Summary

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