

Probing Reheating through UV Freeze-in Dark Matter at Lepton Colliders

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Dark matter (DM) genesis via Ultraviolet (UV) freeze-in embeds the seed of reheating temperature and dynamics in its relic density. Thus, the discovery of such a DM candidate can possibly open the window for post-inflationary dynamics. However, there are several challenges in this exercise, as freezing-in DM possesses feeble interaction with the visible sector and therefore very low production cross-section at the collider. We show that mono-photon (and dilepton) signal at the electron-positron collider, arising from DM effective operators connected to the SM field strength tensors, can still warrant a signal discovery. We study both the scalar and fermionic DM production during reheating via UV freeze-in, when the inflaton oscillates at the bottom of a general monomial potential. Interestingly, we see that right DM abundance can be achieved only in the case of bosonic reheating scenario, satisfying bounds from big bang nucleosynthesis (BBN). This provides a unique correlation between the collider signal and the post-inflationary dynamics of the Universe within single-field inflationary models

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