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Dark Matter production during Warm Inflation via Freeze-In

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We present a novel perspective on the role of inflation in the production of Dark Matter (DM). Specifically, we explore the DM production during Warm Inflation via ultraviolet Freeze-In (WIFI). We demonstrate that in a Warm Inflation (WI) setting the persistent thermal bath, sustained by the dissipative interactions with the inflaton field, can source a sizable DM abundance via the nonrenormalizable interactions that connect the DM with the bath. Compared to the (conventional) radiation-dominated (RD) UV freeze-in scenario for the same reheat temperature (after inflation), the resulting DM yield in WIFI is always enhanced, showing a strongly positive dependence on the mass dimension of the non-renormalizable operator. Of particular interest, for a sufficiently large mass dimension of the operator, the entirety of the DM abundance of the Universe can be created during the inflationary phase. For the specific models we study, we find an enhancement in DM yield of up to 30 orders of magnitude relative to RD UV freeze-in for the same reheat temperature. Our findings also suggest a broader applicability for producing other cosmological relics, which may have a substantial impact on the evolution of the early Universe.

Presenter: MONTEFALCONE, Gabriele

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