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Reconstructing Non-standard Cosmologies with Dark Matter

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Assuming the detection of a weakly interacting massive particle (WIMP) of dark matter (DM) occurs, its particle physics properties (mass m_χ , and thermally averaged DM annihilation cross section $\langle\sigma v\rangle$) are known and these disagree with the usual freeze-out mechanism, one can either look for different DM production mechanisms or for alternative cosmological scenarios. Here we consider the production of WIMP DM in scenarios where for some period at early times the expansion of the Universe was governed by a matter-component ϕ . We force the ϕ component to decay to SM radiation before BBN occurs, so radiation effectively dominates at this moment. The decays of ϕ imply a source of entropy production in the thermal bath which alters the Boltzmann equations and impacts the dark matter relic abundance. Using a particle physics model-independent approach, i.e. for given m_χ and $\langle\sigma v\rangle$, we study the reconstruction of the parameters characterizing the non-standard cosmology. We explore 4 different cases distinguished by the freeze-out occurrence with respect to some study points related with ρ_ϕ domination and ρ_ϕ decay (equality, critic, end) and attempt to present an analytic estimation of each regime separately.

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