

Post-Reheating Inflaton-Mediated Dark and Visible Matter Scatterings: A Cosmological Perspective

Friday 19 July 2024 15:30 (15 minutes)

The initial density of both the Dark Matter(DM) and the Standard Model (SM) particles may be produced via perturbative decay of inflaton with different decay rates, creating an initial temperature ratio, $\xi_i = T_{DM,i}/T_{SM,i}$. This scenario implies inflaton mediated scatterings between the DM and the SM, that can modify the temperature ratio even for high inflaton mass. The effect of these scatterings is studied in a gauge-invariant model of inflaton interactions upto dimension-5 with all the SM particles including Higgs. It is observed that an initially lower(higher) DM temperature will rapidly increase(decrease), even with very small couplings to the inflaton. There is a sharp lower bound on the DM mass for satisfying relic density due to faster back-scatterings depleting DM to SM. For low DM masses, the CMB constraints become stronger for $\xi_i < 1$, probing values as small as 10^{-4} . The BBN constraints become stronger for lower DM masses, probing ξ_i as small as 0.1.

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Session Classification: Astro-particle Physics and Cosmology

Track Classification: 08. Astro-particle Physics and Cosmology