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Cosmological effects of Late Forming Dark Matter

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The standard ΛCDM model with WIMP dark matter describes the large scale features of the universe quite well with some potential unsolved astrophysical problems in the small scale. In this study, we propose a different type of CDM which forms much after the BBN and before the epoch of matter radiation equality. We consider two such dark matter models. The Late Forming Dark Matter (LFDM) and the Ultra-Light Axion Dark Matter(ULADM). Both of these models show sharp suppression in small scale power followed by oscillations in the matter power spectra.We have compared our results with various power spectrum data available and found the formation redshift z_f to be greater than 10^5, at 99% CL. To check the effects of these features in the small scale power on the history of the universe, we study two cosmological observables in the framework of these models: the redshifted 21-cm signal from the epoch of reionization and the evolution of the collapsed fraction of HI in the redshift range $2 < z < 5$. We have studied these models assuming a fiducial model of reionization where a neutral hydrogen fraction $x_{\rm HI}$ = 0.5 must be achieved by z = 8. The reionization process allows us to put approximate bounds on the redshift of dark matter formation $z_f > 4 \times 10^5$ and the ULA mass $m_a > 2.6 \times 10^{-23}$ eV. The comparison of the collapsed mass fraction inferred from damped Lyman-α observations to the theoretical predictions of our models lead to the weaker bounds: $z_f > 2 \times 10^5$ and $m_a > 10^{-23}$ eV. All of these results are consistent with our previous results.

Summary

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