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Scalar perturbations in f(T) gravity using the 1 + 3 covariant approach

The cosmological scalar perturbations of standard matter are investigated in the context of extended teleparallel $f(T)$ gravity theories using the $1+3$ covariant formalism. After a review of the background gravitational field equations of $f(T)$ gravity and the introduction of the covariant perturbation variables, the usual scalar and harmonic decomposition have been performed, and the analysis of the growth of the density contrasts in the quasi-static approximation for two non-interacting fluids scenarios, namely torsion-dust and torsion-radiation mixtures is presented for the generic $f(T)$ gravity theory. Special applications to two classes of $f(T)$ gravity toy models, namely $f(T) = \mu T_0 \Big(\frac{T}{T_0}\Big)^n$ and $f(T) = T + \mu T_0 \Big(-\frac{T}{T_0}\Big)^n$, have then been made within the observationally viable regions of their respective parameter spaces, and the growth of the matter density contrast for both torsion-dust and torsion-radiation epochs of the Universe has been examined. The exact solutions of the dust perturbations, with growing amplitudes in cosmic time, are obtained for some limiting cases of n. Similarly, the long- and short-wavelength modes in the torsion-radiation case are treated, with the amplitudes either oscillating or monotonically growing with time. Overall, it is noted that $f(T)$ models contain a richer set of observationally viable structure growth scenarios that can be tested against up-and-coming observational data and can accommodate currently known features of the large-scale structure power spectrum in the general relativistic and ΛCDM limits.

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