Matter density perturbations in teleparallel cosmology

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We study the cosmological perturbations in teleparallel dark energy models in which there is a dynamical scalar field with a non-minimal coupling to gravity \cite{1}. We use vierbein perturbation scenario in this work \cite{2}, and we find that the propagating degrees of freedom are the same as in quintessence cosmology despite that variables of the perturbed vierbein field are greater than those in metric theories. We numerically show some evident discrepancy from general relativity in the evolutions of the perturbations on all scales of the universe as seen in figure 1. We also demonstrate that the gravitational interactions are enhanced during the unique tracker evolutions in these models \cite{3,4}.

Figure 1: Evolution of the ratio of the gravitational potentials $\psi/\varphi$ with respect to the wavenumbers $k (h \text{ Mpc}^{-1})$ at present (redshift $z = 0$) in the potential-less teleparallel dark energy model proposed in \cite{3}, where $\psi(\varphi)$ is the temporal/spatial perturbation in the longitudinal gauge and the value in general relativity is $\psi/\varphi = 1$. The dashed line corresponding to $\psi/\varphi = 0.078$ is obtained from quasi-static approximation in the sub-horizon limit where the effective gravitational coupling constant can be derived, and it shows agreement with the numerical results from the large scales of the universe \cite{4}.

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