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Cosmology of Chaplygin gas under reconstructed f(T) gravity and its consistency with the constraints imposed by CMB

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Chaplygin gas is a candidate of dark energy to explain the accelerating expansion of the universe [1]. Although it is not a field theory inspired model, its capability of unifying early inflation with late-time acceleration is well documented in the literature. Modified theories of gravity are an approach that does not require any specific model of dark energy to explain the late-time acceleration [2]. In our work we have considered f(T) gravity whose density contribution due to Torsion has been considered to be in the form of Chaplygin gas density. Under this consideration f(T) has been reconstructed. At this juncture, let us mention that the cosmic microwave background (CMB), that is measured by NASA's Wilkinson Microwave Anisotropy Probe, is the remnant of the radiation leftover from the Big Bang. It provides lots of information in cosmology. In the current work, the reconstructed f(T) gravity could be tested for its cosmological consequences and its compatibility with CMB constraints. The Chaplygin gas in this work is considered in the form of generalized Chaplygin gas (GCG) [3] having the equation of state in the following form:

$$p_{GCG} = -\frac{B}{\rho_{GCG}^{\alpha}} \tag{1}$$

where $0 \leq \alpha \leq 1$ and B is a positive constant. The equation of state parameter w_{GCG} has been studied and it has been observed less than -1 at early stage and coming towards -1 at late stage. The thermodynamics of this cosmological reconstruction of f(T) gravity has been studied and the generalized second law has been found to be valid. The primordial perturbations have been studied through scalar field fluctuations and Anisotropy stress has been studied accordingly.

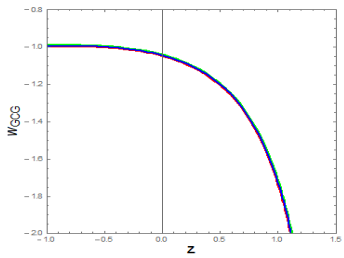

Figure 1. Evolution of EoS parameter w_{GCG} against redshift z for GCG.

The form of $\frac{f}{T}$ has been studied to check the compatibility with primordial nucleosynthesis and CMB constraints. It has been also checked whether the model is consistent with generic expansion of the universe. Finally, the stability of the model has been judged through squared speed of sound.

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