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ORIGINAL ARTICLE

Nonlinear electrodynamics in $f(T)$ gravity and generalized second law of thermodynamics

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Abstract In this paper, we study the nonlinear electrodynamics in the framework of $f(T)$ gravity for FRW universe along with dust matter, magnetic and torsion contributions. We evaluate the equation of state and deceleration parameters to explore the accelerated expansion of the universe. The validity of generalized second law of thermodynamics for Hubble and event horizons is also investigated in this scenario. For this purpose, we assume polelike and power-law forms of scale factor and construct $f(T)$ models. The graphical behavior of the cosmological parameters versus smaller values of redshift z represent the accelerated expansion of the universe. It turns out that the generalized second law of thermodynamics holds for all values of z with Hubble and event horizons in polelike scale factor whereas for power-law form, it holds in a specific range of z for both horizons.

Keywords $f(T)$ gravity · Magnetic field · Dark energy · Generalized second law of thermodynamics

1 Introduction

The fact that the universe is expanding at every point in space has become the most popular issue in cosmology. It is found that the universe is nearly spatially flat and consists of about 74 % dark energy (DE) (Perlmutter et al. 1997, 1998; Riess et al. 1998) and the remaining 26 % corresponds to matter. Dark energy has positive energy density with large negative pressure in order to derive the acceleration of the universe. There are many proposals which serve as a candidate of the DE in spite of lack of best fit model for this acceleration. Modified theories of gravity (Nojiri and Odintsov 2007; Paul et al. 2009) has played an important role during last decades to explain this accelerated expansion. The generalized teleparallel theory of gravity (Bengochea and Ferraro 2009; Linder 2010; Yang 2011; Ferraro and Fiorini 2011; Myrzakulov 2011; Tsyba et al. 2011) dubbed as $f(T)$ gravity is commonly used to explore the insights of the universe with T as the torsion scalar.

There are several cosmological ingredients in the universe including radiations, dark matter and DE. The properties of these ingredients are well specified by the equation of state (EoS) parameter ω which is the ratio of pressure to energy density of the universe. The radiation dominated phase corresponds to $\omega = 1/3$, whereas $\omega = 0$ represents the matter dominated phase. The DE dominated phase inherits different regions with the help of EoS parameter including the quintessence region for $-1 < \omega < -1/3$, vacuum energy due to the cosmological constant for $\omega = -1$ and phantom region for $\omega < -1$. The EoS parameter for $f(T)$ gravity also corresponds to these regions in different scenarios. Recently, we have reconstructed the $f(T)$ models using EoS parameter for the above mentioned cases and explored the accelerated expansion of the universe (Sharif and Rani 2011a). Also, the relationship between $f(T)$ gravity and k-essence model has been discussed with the help of this parameter to present the evolving universe (Sharif and Rani 2011b).

Bamba et al. (2011) examined the EoS parameter in this gravity by taking into account exponential, logarithmic and their combined models which result different DE regions. Karami and Abdolmaleki (2012) investigated the validity

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