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LETTER

Interaction between tachyon dark energy and modified Chaplygin gas

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Abstract In the present work we assume that the universe is dominated with a two component mixture which do not evolve separately but interact non-gravitationally with one another. we consider the issue of the tachyon as a source of the dark energy and modified Chaplygin gas as background fluid. So we study the interacting between tachyon field and modified Chaplygin gas in different forms of interactions term Q in both flat and non-flat FRW universe. Then we reconstruct the potential and the dynamics of the tachyon field which describe tachyon cosmology. Also we find a equivalence potential for MCG in this model. Next we study two dark components respect to redshift and we find the conditions that are required for the stability of this model.

Keywords Tachyon field · Modified Chaplygin gas · Interacting dark energy · Non flat universe · Redshift

1 Introduction

A complementary cosmological observation confirms that our universe is not only expanding, but also is undergoing an accelerating phase (Riess et al. 1998; Perlmutter et al. 1999; Spergel et al. 2003a, 2007; Tegmark et al. 2004; Abazajian et al. 2005). This accelerated expansion can be formally associated with one small positive cosmological constant linked with Einstein field equations, or more generally with the existence of dark energy. Though its nature and cosmological origin still remain a completely open question nowadays. One can refer to Copeland et al. (2006) for recent reviews. There are various candidates to play the role of the dark energy such as cosmological constant (or vacuum energy), which has the equation of state $\omega = -1$ (Einstein 1917, 1952; Weinberg 1989; Padmanabhan 2003), a large class of scalar-field (Peebles and Ratra 1988; Ratra and Peebles 1988; Armendariz-Picon et al. 2000; Sen 2002c; Nojiri and Odintsov 2003), including quintessence, K-essence, phantom, tachyon, etc. Other approaches are braneworld models (Deffayet et al. 2002; Sahni and Shtanov 2003; Setare 2006), vector filed dark energy model (Sadeghi et al. 2010), Chaplygin gas fluid models (Kamenshchik et al. 2001a; Gorini et al. 2004) and etc. In order to drive the accelerated expansion of universe it is required to have $\omega < \frac{-1}{3}$. Present observation data confirm that the range of EOS of dark energy is as $-1.38 < \omega < -0.82$ (Amanullah et al. 2010). One of the interesting models of dark energy which results in a class of string theories is tachyon field. Sen (2002a, 2002b) showed that the decay of D-branes produces a pressureless gas with finite energy density that resembles classical dust. Also its equation of state smoothly interpolates between 1 and 0 (Gibbons 2002). Meanwhile the tachyon can also act as a source of dark energy depending upon the form of the tachyon potential (Padmanabhan 2002; Abramo and Finelli 2003; Guo and Zhang 2004; Copeland et al. 2005). Present observations of the cosmic microwave background (CMB) and the deuterium abundance in the universe suggest that $\Omega_{baryon} = 0.04$. It is very much smaller than the total energy density in the universe which conclude from the observed anisotropy in the CMB (Spergel et al. 2003b). $\Omega_{tot} = \frac{8\pi G\rho}{3H^2} = 1.02 \pm 0.02$. So both dark energy and dark matter are regarded essential missing pieces in the cosmic puzzle.

$$\Omega_{tot} - \Omega_{baryon} = ?$$

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