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ORIGINAL ARTICLE

Power-law and logarithmic entropy-corrected Ricci viscous dark energy and dynamics of scalar fields

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Abstract In this work, I consider the logarithmic-corrected and the power-law corrected versions of the holographic dark energy (HDE) model in the non-flat FRW universe filled with a viscous Dark Energy (DE) interacting with Dark Matter (DM). I propose to replace the infra-red cut-off with the inverse of the Ricci scalar curvature R. I obtain the equation of state (EoS) parameter ω_Λ, the deceleration parameter q and the evolution of energy density parameter Ω'_D in the presence of interaction between DE and DM for both corrections. I study the correspondence of the logarithmic entropy corrected Ricci Dark Dnergy (LECRDE) and power-law entropy corrected Ricci Dark Energy (PLECRDE) models with the the Modified Chaplygin Gas (MCG) and some scalar fields including tachyon, K-essence, dilaton and quintessence. I also make comparisons with previous results.

Keywords Dark energy · Cosmology · Scalar fields · Cosmic acceleration

1 Introduction

Recent cosmological findings of Supernova Cosmology Project (Riess et al. 1998; Perlmutter et al. 1999, 2013), Wilkinson Microwave Anisotropy Probe (WMAP) (Tegmark et al. 2004), Sloan Digital Sky Survey (SDSS) (Allen et al. 2004) and X-ray (Spergel et al. 2003; Komatsu et al. 2009) give convincing indication that the observable universe is undergoing an accelerated expansion. To explain this phenomenon the notion of dark energy (DE) with negative pressure was proposed. At present there are a lot of theoretical candidates of DE including tachyon, K-essence, dilaton, quintessence, H-essence and DBI-essence, to name a few (Padmanabhan 2003; Sahni 2004). The simplest candidate for DE is the cosmological constant. From the point of view of quantum field theory, a cutoff at the Planck or electroweak scale leads to a cosmological constant which is, respectively, 10^{123} or 10^{55} times larger than the observed value, $\Lambda/8\pi G \sim 10^{-47}$ GeV^4. The absence of a fundamental symmetry which could set the value of Λ to either zero or a very small value leads to the cosmological constant problem (Sahni 2002).

The complete and correct description of explanation of DE should come from the consistent theory of quantum gravity. Such a theory does not yet exist and some approximations for this long-awaited theory are found including string theory and loop quantum gravity, which are only effective theories. The string theory is based on some conjectures (like AdS/CFT) and the holographic principle, according to the later the degrees of freedom of a physical system must scale according to the area and not by volume ('t Hooft 1993). Using the holographic principle, a model of Holographic DE (HDE) was proposed (Cohen et al. 1999; Li 2004). Formally the idea of HDE goes like "in quantum field theory a short distance cut-off is related to a long distance cut-off due to the limit set by formation of a black hole, namely, if ρ_Λ is the quantum zero-point energy density caused by a short distance cut-off, the total energy in a region of size L should not exceed the mass of a black hole of the same size, thus $L^3\rho_\Lambda \le LM_p^2$. The largest L allowed is the one saturating this inequality, thus $\rho_\Lambda = 3\alpha M_p^2 L^{-2}$" (Cohen et al. 1999), where α is a constant and M_p^2 is the reduced Planck mass.

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