Astrophys Space Sci (2012) 338:405–410
DOI 10.1007/s10509-011-0955-8

ORIGINAL ARTICLE

Interacting dark energy in Hořava-Lifshitz cosmology

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Received: 22 September 2011 / Accepted: 2 December 2011 / Published online: 22 December 2011

Abstract In this paper we study the interacting dark energy model in the framework of Hořava-Lifshitz cosmology. Using an additional canonical scalar field, we formulate Hořava-Lifshitz cosmology with an effective interacting dark energy sector. We show that the interacting dark energy model in the framework of Hořava gravity exhibiting phantom behavior.

Keywords Interacting dark energy model · Hořava-Lifshitz cosmology · Phantom

1 Introduction

Recent observations from type Ia supernovae (Riess et al. 1998; Perlmutter et al. 1999; Astier et al. 2006) associated with Large Scale Structure (Tegmark et al. 2004, Abazajian et al. 2004, 2005) and Cosmic Microwave Background anisotropies (Spergel et al. 2003, 2007) have provided main evidence for the cosmic acceleration. The combined analysis of cosmological observations suggests that the universe consists of about 70% dark energy, 30% dust matter (cold dark matter plus baryons), and negligible radiation. Although the nature and origin of dark energy are unknown, we still can propose some candidates to describe it, namely since we do not know where this dark energy comes from, and how to compute it from the first principles, we search for phenomenological models. The astronomical observations will then select one of these models. The most obvious theoretical candidate of dark energy is the cosmological constant Λ (or vacuum energy) (Einstein 1917; Weinberg 1989; Sahni and Starobinsky 2000; Carroll 2001; Peebles and Ratra 2003; Padmanabhan 2003) which has the equation of state parameter $w = -1$. However, as it is well known, there are two difficulties that arise from the cosmological constant scenario, namely the two famous cosmological constant problems—the "fine-tuning" problem and the "cosmic coincidence" problem (Steinhardt 1997). An alternative proposal for dark energy is the dynamical dark energy scenario. This dynamical proposal is often realized by some scalar field mechanism which suggests that the specific energy form with negative pressure is provided by a scalar field evolving down a proper potential. So far, a plethora of scalar-field dark energy models have been studied, including quintessence (Peebles and Ratra 1988; Ratra and Peebles 1988; Wetterich 1988; Caldwell et al. 1998; Zlatev et al. 1999), K-essence (Armendariz-Picon et al. 2000, 2001), tachyon (Sen 2002; Padmanabhan 2002; Setare 2007a), phantom (Caldwell 2002; Caldwell et al. 2003; Nojiri and Odintsov 2003a, 2003b; Setare 2007b) and quintom (Feng et al. 2005, 2006; Elizalde et al. 2004; Guo 2005; Li et al. 2005; Capozziello et al. 2006; Nojiri and Odintsov 2006; Setare 2006; Setare et al. 2008; Setare and Saridakis 2008a, 2008b, 2009), and so forth. An alter-

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