Some features of new holographic dark energy model in Hořava-Lifshitz gravity

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Abstract In this work, we have considered the interaction of new holographic dark energy (NHDE) with dark matter and tachyonic field in both interacting and non-interacting cases in Hořava-Lifshitz gravity. In all cases we have studied the nature of equation of state parameters, statefinder parameters, deceleration parameter, *Om* diagnostic and speed of sound.

Keywords New holographic dark energy · Statefinder · *Om* diagnostic · Hořava-Lifshitz gravity

1 Introduction

The gravitational properties of the some dark components are known that they occupies about 73% of the energy of our universe, but their behavior is not known. This situation makes us suspect that modifying gravity in the infrared (IR) might address the dark energy (Padmanabhan 2003, 2005; Bean et al. 2005; Sahni and Starobinsky 2000; Copeland et al. 2006) with negative pressure, has been one of the most active and mysterious field in modern cosmology and which is the cause of accelerated expansion of our universe (Knop et al. 2003; Riess et al. 2007; Astier et al. 2006; Bennett et al. 2003; Tegmark et al. 2004). Einstein introduced the simplest dark energy model for static universe, called cosmological constant Λ, with EOS $w = -1$ and fit the observations well. Since the cosmological constant is facing fine-tuning problem, then many dark energy models, with EOS time dependent, have been proposed for solving the above problem. Some of the important DE models are: quintessence, K-essence, phantom, tachyon, dilaton, quintom, Chaplygin gas, braneworld models, holographic dark energy, Ricci dark energy, agegraphic dark energy etc. (Peebles and Ratra 1988; Armendariz-Picon et al. 2000; Sen 2002; Caldwell 2002; Amendola 2000; Sahni et al. 2003; Kamenshchik et al. 2001; Cai 2007; Setare 2006, 2007a, 2007b, 2007c; Setare and Vagenas 2009).

A new DE model, called holographic DE model is proposed based on the validity of the effective local quantum field theory, which is famous as "holographic principle" (Hořavaand Minic 2000, 2001; Thomas 2002), where the UV cut-off Λ is related to the IR cut-off L due to the limit set by the formation of a black hole (Fischler and Susskind 1998; Li 2004; Li et al. 2009; Zhang 2005; Enqvist and Sloth 2004; Huang and Gong 2004). Holographic dark energy model (HDEM) also facing some problems: (i) HDEM with Hubble horizon can not derive the accelerated expansion of the universe (ii) HDEM with event horizon can derive the universe with accelerated expansion but the arising problem with the event horizon which is the global concept of spacetime and existence of it depends on the future evolution of the universe only for a universe with forever accelerated expansion. (iii) HDE with the event horizon is not compatible with the age of some high redshift objects.

For the above problems of HDEM, Granda and Oliveros (2008) proposed a new DE model which is the modification of the HDEM, is known as new holographic dark energy model (NHDEM) (Granda and Oliveros 2008, 2009; Yu et al. 2010; Debnath and Chattopadhyay 2011). NHDEM de-

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