Astrophys Space Sci (2012) 342:253–256
DOI 10.1007/s10509-012-1154-y

ORIGINAL ARTICLE

Om diagnostic of dilaton dark energy with two-parameter ω in potential $[1+(\sigma-A)^2]e^{(-B\sigma)}$

X.M. Song · Z.G. Huang

Received: 13 June 2012 / Accepted: 20 June 2012 / Published online: 30 June 2012

Abstract Based on a new geometric diagnostic method-Om, we consider a new independent-model parametrization $\omega=\omega_0+\omega_1(\frac{z}{1+z})^n$. When we work in potential $W_\sigma[1+(\sigma-A)^2]e^{(-B\sigma)}$, we investigate the evolutional behavior of Om with respect to red-shift z and the influence of coupling parameter α on the trajectory of Om with respect to z. We get that phantom model of Dilaton dark energy can avoid the future singularity "Big Rip". The numerical results give current value of EOS $\omega_{\sigma_0}=-0.956$ which fits the latest observational data WMAP5+BAO+SNe very well.

Keywords Dark energy · Om diagnostic · Parametrization · Quintessence · Phantom

1 Introduction

In 1998, two teams (Riess 1998; Perlmutter et al. 1999) from American found that the brightness of SNe Ia as standard candle was smaller than the expected value, that is to say, our universe is undergoing a accelerated expansion phase. In the next several years, other observations including WMAP (Bennett et al. 2003; Hinshaw et al. 2008; Nolta et al. 2008), SDSS (Tegmark et al. 2004) also gave the above opinion a strong support. All these observations provide us such a outline of our universe: the Universe is flat and filled with an unclumped energy which provides the force of accelerated expansion and contributes about 73 % of the total energy density. 23 % dark matter density and 4 % baryon matter contribute to the remainder. Astrophysicists and theoretical physicists called this unknown energy "dark energy" (shorted DE). An important character of dark energy is that equation of state ω(EOS) is smaller than 0, that is $\omega=\frac{p}{\rho}<0$. So far, many dark energy models have been put forward, such as LCDM, Quintessence, Phantom, Holographic DE and so on. Among these models, LCDM is the most impossible and fundamental candidate of DE. However, LCDM suffers from two serious issues: Why the value of cosmological constant Λ is so tiny and not zero which is called "fine-tuning problem". Why the energy density of Λ is just comparable with the matter energy density in recent time which is called "coincidence problem". Quintessence and Phantom DE have been studied by many authors (Bagla et al. 2003; Amendola et al. 2006a; Elizalde et al. 2004; Nojiri and Odintsov 2006; Wetterich 1998; Copeland et al. 2006; Padmanabhan and Choudhury 2002; Sen 2002; Armendariz-Picon et al. 1999; Feinstein 2002; Fairbairn and Tytgat 2002; Frolov et al. 2002; Kofman and Linde 2004; Acatrinei and Sochichiu 2003; Alexander 2002; Lu 2005; Fang et al. 2006; Chiba et al. 2000; Amendola et al. 2006b; Singh et al. 2003). In Quintessence DE model, EOS ω should satisfy $-1<\omega<0$, while $\omega<-1$ in Phantom DE model. In our previous papers (Huang and Lu 2006; Huang et al. 2007a, 2007b), we have successfully constructed dilaton dark energy (shorted DDE) model where we consider dilaton as a scalar field. For EOS $\omega_\sigma>-1$ DDE model can be regarded as nonminimal coupled Quintessence model while For EOS $\omega_\sigma<-1$ DDE model can be regarded as nonminimal coupled Phantom model. So, we will consider Quintessence and Phantom in DDE model in this paper.

Om (Sahni et al. 2008), is constructed from the Hubble parameter $H=\frac{\dot{a}}{a}$ determined directly from observational data and provides a *null test* of the LCDM hypoth-

Supported by Natural Science Foundation of Jiangsu Province under Grant No. BK2011397.

X.M. Song · Z.G. Huang (✉)
School of Science, Huaihai Institute of Technology, Lianyungang, China
e-mail: zghuang@hhit.edu.cn