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ORIGINAL ARTICLE

Statefinder diagnostic and w–w' analysis for the agegraphic dark energy model with the sign-changeable interaction

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Abstract The statefinder diagnostic and w–w' analysis are useful methods for distinguishing different dark energy models. In this paper, we study the agegraphic dark energy (ADE) model with the sign-changeable interaction by using the statefinder diagnostic and w–w' analysis. The evolution trajectories of this model in the r–s and w–w' planes are plotted for different model parameters. It is shown that the model parameters significantly affect the evolution trajectories in the r–s and w–w' planes. Furthermore, we can differentiate the ADE model with the sign-changeable interaction from the LCDM model by means of the statefinder diagnostic and w–w' analysis.

Keywords Agegraphic dark energy · Statefinder · w–w' plane

1 Introduction

Current astronomical observations converge on the fact that the universe is accelerated expanding due to an exotic energy component with negative pressure which is called dark energy. Such component accounts for about 70 % of the total energy density. The simplest dark energy model is the cosmological constant model (LCDM), which can fit the observations well. In particular, the recent Planck data (Planck Collaboration 2013) are remarkably consistent with the predictions of the LCDM cosmology. Despite the success of the six-parameter LCDM model in describing the Planck data at high multipoles, the mismatch with the temperature spectrum at low multipoles and the existence of other "anomalies" at low multipoles, possibly indicates that the model is incomplete. Also, it is plagued with the well known fine-tuning and coincidence problems.

Recently, a new dark energy model, dubbed the agegraphic dark energy (ADE), has been proposed by Cai (2007). The energy density of ADE reads (Cai 2007)

$$\rho_d = \frac{3n^2 m_p^2}{T^2} \tag{1}$$

where $m_p = (8\pi G)^{-1/2}$, n is a constant and T is chosen to be the age of the universe

$$T = \int_0^a \frac{da}{Ha} \tag{2}$$

where $H \equiv \dot{a}/a$ is the Hubble parameter. Later, the new agegraphic dark energy (NADE) was proposed by Wei and Cai (2008a) by replacing the cosmic age T with the cosmic conformal age η. The ADE and NADE models have been widely studied by Wei and Cai (2008b, 2009), Kim et al. (2008a, 2008b), Wu et al. (2008), Zhang et al. (2008), Cui et al. (2010), Neupane (2009), Sheykhi (2009, 2010), Sheykhi et al. (2010), Setare (2010), Lemets et al. (2011), Sun and Yue (2011), Farajollahhi et al. (2012), Liu et al. (2012). The ADE with usual interaction was introduced and investigated by Wei and Cai (2009). The usual interaction is assumed to be $Q = 3cH\rho$ (Zimdahl et al. 2001; Guo et al. 2007; Pavon and Zimdahl 2005; Pereira and Jesus 2009; Setare 2006, 2007; Jamil and Rashid 2008), where c is a coupling constant denoting the transfer strength, and ρ is taken to be the density of dark matter, dark energy, or the sum of them. Obviously, these interactions are always positive or negative and hence can not change their signs. While

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