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ORIGINAL ARTICLE

Stability analysis of agegraphic dark energy in Brans–Dicke cosmology

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Abstract Stability analysis of agegraphic dark energy in Brans-Dicke theory is presented in this paper. We constrain the model parameters with the observational data and thus the results become broadly consistent with those expected from experiment. Stability analysis of the model without best fitting shows that universe may begin from an unstable state passing a saddle point and finally become stable in future. However, with the best fitted model, There is no saddle intermediate state. The agegraphic dark energy in the model by itself exhibits a phantom behavior. However, contribution of cold dark matter on the effective energy density modifies the state of the universe from phantom phase to quintessence one. The statefinder diagnosis also indicates that the universe leaves an unstable state in the past, passes the LCDM state and finally approaches the sable state in future.

Keywords Brans–Dicke theory · Agegraphic · Stability · Attractor · Statefinder · Best fitting

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1 Introduction

Cosmological probes such as Cosmic Microwave Background (CMB) (Dunkley et al. 2009; Gold et al. 2009; Hill et al. 2009; Hinshaw et al. 2009; Nolta et al. 2009; Komatsu et al. 2009), Supernova type Ia (SNIa) (Knop et al. 2003; Garnavish et al. 1998; Perlmutter et al. 1997; Frieman et al. 2008; Sako et al. 2008; Riess et al. 2004, Weak Lensing (Leauthand et al. 2010; Kubo et al. 2009; Sato et al. 2009), Baryon Acoustic Oscillations (BAO) (Parkinson et al. 2010; Percival et al. 2010; Wang et al. 2009; Benitez et al. 2009), 2dF Galaxy Redshift Survey (2dFGRS) (Cole et al. 2005; Croton et al. 2005; Wild et al. 2005) at low redshift and DEEP2 redshift survey (Yan et al. 2009; Sawicki et al. 2008; Schiavon et al. 2006) at high redshift, have given us cross-checked data to determine cosmological parameters with high precision. These parameters indicate that our universe is nearly spatially flat, homogeneous and isotropic at large scale, i.e. a Friedmann-Robertson-Walker (FRW) with zero curvature, and has entered an accelerating epoch at about $z \approx 0.46$ (Riess et al. 2004). In addition, from ΛCDM model, the universe consists of 0.046 baryonic matter, 0.228 non-relativistic unknown matter, called as cold dark matter (CDM), and a significant amount of 0.726 smoothly distributed dominant dark energy (DE) (Komatsu et al. 2009).

The equation of state (EoS) of DE, is the main parameter which determines the gravitational effect on the dynamics of the universe, and can be measured from observations without need to have a definite model of DE. Strong evidences suggest that the EoS of DE lies in a narrow range around $w \approx -1$ with a smooth behavior (Riess et al. 2004; Amanullah et al. 2010). We can classify the EoS parameter of DE with respect to the barrier $w = -1$, namely the phantom divide line (PDL) (Cai et al. 2010). That is, DE with the