Astrophys Space Sci (2013) 345:405–413
DOI 10.1007/s10509-013-1399-0

ORIGINAL ARTICLE

Early decelerating & late time accelerating anisotropic cosmological models with dynamical EoS parameter

K.S. Adhav · A.S. Bansod · H.G. Ajmire

Received: 2 February 2013 / Accepted: 21 February 2013 / Published online: 6 March 2013

Abstract We have studied anisotropic and homogeneous Locally Rotationally Symmetric (LRS) Bianchi type-I, Bianchi type-V, Bianchi type-III, Bianchi type-VI_0, and Kantowaski–Sachs space-times with variable equation of state (EoS) parameter (w) in General Relativity. A special form of deceleration parameter (q) which gives an early deceleration and late time accelerating cosmological model has been utilized to solve the field equations. The geometrical and physical aspects of the models are also studied.

Keywords Anisotropic space-times · Dark energy · Special form of deceleration parameter

1 Introduction

The recent cosmological observations have provided increasingly convincing evidence that our universe is undergoing a late-time accelerating expansion (Riess et al. 1998; Bahcall et al. 1999; Bennett et al. 2003; Spergel et al. 2003), and we live in a favored spatially flat universe composed of approximately 4 % baryonic matter, 22 % dark matter and 74 % dark energy. Cunha (2009) has provided direct evidence caused for the present accelerating universe. Recently, Li et al. (2011) studied the present acceleration of the universe by analyzing the sample of baryonic acoustic oscillation (BAO) with cosmic microwave background (CMB) radiation and concluded that such sample of BAO with CMB increases the present cosmic acceleration which has been further explained by plotting graphs for change of deceleration parameter q with redshift $z < 2$.

Many authors have suggested a number of ideas to explain the current accelerating universe, partly such as scalar field model, exotic equation of state (EoS), modified gravity, and the inhomogeneous cosmology model. The dark energy EoS parameter $w = p/\rho$, where p is the dark-energy pressure and ρ is its energy density. The value $w < -1/3$ is necessary for comic acceleration. The simplest candidate for dark energy is the cosmological constant (Λ), for which $w = -1$. According to Caldwell et al. (2003), the matter with $w < -1$ give rise to Big Rip type of future singularity. Several ideas are proposed to prevent the Big Rip singularity, like by introducing quantum effects terms in the action (Elizalde et al. 2004; Nojiri and Odintsov 2004). Astashenok et al. (2012) have studied phantom cosmology without Big Rip Singularity. Recently, Bamba et al. (2012) have reviewed different dark energy cosmologies (isotropic) with early deceleration and late time acceleration. They have studied $f(R)$ gravity, $f(T)$ gravity and ΛCDM cosmological models representing the accelerating expansion with the quintessence/phantom nature in details. The problem of testing dark energy models and alternative gravity models to general relativity by cosmography have been also studied in details by them.

The anisotropy plays a significant role in the early stage of evolution of the universe and hence the study of anisotropic and homogeneous cosmological models becomes important. In the present paper, we have further extended the special form of deceleration parameter for the anisotropic models LRS Bianchi type-I (LRS B-I), Bianchi type-V (B-V), Bianchi type-III (B-III), Bianchi type-VI0 (B-VI_0) and Kantowaski–Sachs (K–S) space-times with variable EoS parameter in general relativity. The physical and geometrical aspects of the models are also discussed.

K.S. Adhav (✉) · A.S. Bansod · H.G. Ajmire
Department of Mathematics, Sant Gadge Baba Amravati University, Amravati 444602, India
e-mail: ati_ksadhav@yahoo.co.in