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ORIGINAL ARTICLE

LRS Bianchi-I anisotropic cosmological model with dominance of dark energy

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Abstract The present study deals with spatially homogeneous and anisotropic locally rotationally symmetric (LRS) Bianchi type I cosmological model with dominance of dark energy. To get the deterministic model of Universe, we assume that the shear scalar (σ) in the model is proportional to expansion scalar (θ). This condition leads to $A = B^n$, where A, B are metric potential and n is positive constant. It has been found that the anisotropic distribution of dark energy leads to the present accelerated expansion of Universe. The physical behavior of the Universe has been discussed in detail.

Keywords LRS Bianchi type I Universe · Dark energy and distance modulus curve

1 Introduction

The discovery of the accelerated mode of expansion of the Universe stands as a major breakthrough of the observational cosmology. Survey of cosmological distant type Ia supernovae (SNe Ia; Riess et al. 1998; Perlmutter et al. 1999) indicated the presence of a new unaccounted-for Dark energy (DE) that opposes the self-attractions of matter and causes the expansion of Universe to accelerate. This acceleration is realized with negative pressure and positive energy density that violate the strong energy condition. This violation gives a reverse gravitational effect. Due to this effect, the Universe gets a jerk and the transition from the earlier deceleration phase to the recent acceleration phase takes place (Caldwell et al. 2006). The cause of this sudden transition and the source of accelerated expansion are still unknown. The state of the art in cosmology has led to the following present distribution of the energy densities of the Universe: 4% for baryonic matter, 23% for non baryonic dark matter and 73% so-called DE (Spregel et al. 2007).

The isotropy of the cosmic microwave background (CMB) radiation, first seen by the cosmic background explorer (COBE) satellite (Smoot et al. 1992) and then reinforced by the Wilkinson Microwave Anisotropy Probe (WMAP) data (Hinshaw et al. 2003), together with the assumption that we are not in spacial position in the Universe, underlines the cosmological principles, according to which we live in a homogeneous and isotropic Universe described by a FRW line-element. Tiny deviation from perfect isotropy at the level of 10^{-5}, have also been reported by Benett et al. (1996) and thereafter confirmed by high resolution WMAP data. The observed CMB anisotropy spectrum is in impressive agreement with the predictions of ΛCDM model. Koivisto and Mota (2008a, 2008b) proposed the mechanism of DE with anisotropic equation of state (EoS) parameter which is very attractive because cosmic anisotropy originates from the actual dominant component of the Universe and then could be directly tested, for example, by either observations of the magnitude and redshift of type Ia supernovae or cosmic parallax effects of the distance source. DE has been conventionally characterized by the equation of state (EoS) parameter $\omega^{(de)} = p^{(de)}/\rho^{(de)}$ which is not necessarily constant. The simplest DE candi-

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