Astrophys Space Sci (2012) 339:45–51
DOI 10.1007/s10509-011-0966-5

ORIGINAL ARTICLE

Dynamics of a magnetized Bianchi $V I_0$ universe with anisotropic fluid

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Received: 15 September 2011 / Accepted: 26 December 2011 / Published online: 12 January 2012

Abstract We discuss spatially homogeneous and anisotropic Bianchi type $V I_0$ cosmological model with anisotropic fluid and magnetic field. The energy-momentum tensor consists of anisotropic fluid with anisotropic EoS and a uniform magnetic field of energy density ρ_B. Exact solution of the field equations is obtained by using the condition that expansion is proportional to the shear scalar. We focus on the future evolution of the model both in the presence and absence of magnetic field. In particular, we address the question whether these models approach to isotropy.

Keywords Bianchi type-$V I_0$ · Anisotropic fluid · Accelerating universe · Magnetic field

1 Introduction

Recent cosmological observations of high-redshift Type Ia Supernovae gave the first indication that expanding Universe is accelerating (Perlmutter et al. 1998, 1999; Riess et al. 2004, 2007). The Balloon-born experiments such as BOOMERANG (de Bernardis et al. 2000; Komatsu et al. 2011) and MAXIMA (Stompor et al. 2001) have detected temperature fluctuations anisotropy of the Cosmic Microwave Background (CMB) radiations representing that universe is spatially flat. These data indicate that accelerating expansion of the universe is driven by mysterious energy with large negative pressure known as dark energy (DE). The above picture has further been strengthened by the current measurements of CMB spectrum obtained by Wilkinson Microwave Anisotropy Probe (WMAP) experiment (Bennett et al. 2003; Spergel et al. 2007) and large scale structure (Hawkins et al. 2003; Tegmark et al. 2004; Cole et al. 2005).

There are several attempts in different directions to propose the acceptable DE model. The simplest candidate of DE is the cosmological constant (Peebles and Ratra 2003; Komatsu et al. 2009). In alternate models, its value can vary with time and can be $\omega > -1$ (quintessence) (Sahni 2004; Padmanabhan 2008), $\omega < -1$ (phantom energy) (Caldwell 2002; Nojiri and Odintsov 2003) and time evolution from one region to another (quintom) (Feng et al. 2005; Guo et al. 2005). In addition, there are interacting DE models like Chaplygin gas (Bento et al. 2002; Zhang et al. 2006), holographic models (Hu and Ling 2006; Kim et al. 2006; Setare 2007) and braneworld models (Deffayet et al. 2002; Li 2004) etc.

A pure Friedmann-Lemaitre-Robertson-Walker (FLRW) spacetime with matter and radiation cannot explain the anomalies found in CMB anisotropies (de Bernardis et al. 2000; Stompor et al. 2001). But the existence of CMB anomalies is still subject to an intense debate (Bennett et al. 2011; Campanelli et al. 2011a, 2011b). This fact increased the interest in Bianchi cosmological models. Several authors have studied these models with anisotropic fluid model of DE. Rodrigues (2008) constructed a Bianchi type I ΛCDM cosmological model whose DE component preserves non-dynamical character but yields anisotropic vacuum pressure. Koivisto and Mota (2008a, 2008b) investigated the Bianchi I cosmological model containing interacting DE fluid with non-dynamical anisotropic EoS and perfect fluid component. It is found that if the EoS is anisotropic, the expansion rate of the universe becomes direction dependent at late

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