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ORIGINAL ARTICLE

Bianchi type-II, VIII & IX perfect fluid magnetized cosmological models in Brans-Dicke theory of gravitation

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Abstract Spatially homogeneous Bianchi type-II, VIII & IX charged perfect fluid cosmological models in Brans-Dicke theory of gravitation are obtained and presented. Various physical and geometrical features of the models are also discussed.

Keywords Bianchi type-II · VIII & IX metrics · Brans-Dicke scalar tensor theory · Perfect fluid distribution · Electromagnetic field

1 Introduction

Magnetic field plays a vital role in the description of the energy distribution in the universe as it contains highly ionized matter. Strong magnetic fields can be created due to adiabatic compression in cluster of galaxies. Large scale magnetic fields give rise to anisotropies in the universe. It is believed that the presence of electromagnetic field could alter the rate of creation of particles in the anisotropic models. A cosmological model which contains a global magnetic field is necessarily anisotropic since the magnetic field vector specifies a preferred spatial direction. Also, electromagnetic field directly affects the expansion rate of the universe. The occurrence of magnetic fields on galactic scale is well-established fact today, and their importance for a variety of astrophysical phenomena is generally acknowledged as pointed out Zeldovich et al. (1993). Horrison (1973) has suggested that magnetic field could have a cosmological origin. The presence of primordial magnetic field of cosmological origin in the early stages of the evolution of the universe has been discussed by eminent author's viz. Misner et al. (1973), Asseo and Sol (1987), Melvin (1975), Kim et al. (1991), Wolfe et al. (1992), Kulstrud et al. (1997). Anisotropic magnetic field models have significant contribution in the evolution of galaxies and stellar objects. Bali and Ali (1996) had obtained a magnetized cylindrically symmetric universe with an electrically neutral perfect fluid as the source of matter. Cosmological models with an incident magnetic field for different space times have been investigated by several authors viz. Tupper (1977), Roy and Prakash (1978), Lorenz (1980), Bali and Tyagi (1998), Pradhan and Sing (2004), Pradhan and Pandey (2005), Katore and Rane (2006), Wang (2006), Pradhan et al. (2007, 2011) Pradhan (2007, 2009), Amirhashchi et al. (2011).

Brans and Dicke (1961) theory of gravitation is well known modified version of Einstein's theory. It is a scalar tensor theory in which the gravitational interaction is mediated by a scalar field ϕ as well as the tensor field g_{ij} of Einstein's theory. In this theory the scalar field ϕ has the dimension of the inverse of the gravitational constant. In recent years, there has been a renewed interest of the gravitational constant. The latest inflationary models (Mathiazhagam and Johri 1984), possible "graceful exit" problem (Pimental 1997) and extended chaotic inflations (Linde 1990) are based on Brans and Dicke theory of gravitation.

Brans-Dicke (1961) field equations for combined scalar and tensor field are

$$G_{ij} = -8\pi\phi^{-1}T_{ij} - \omega\phi^{-2}\left(\phi_{,i}\phi_{,j} - \frac{1}{2}g_{ij}\phi_{,k}\phi^{,k}\right) - \phi^{-1}\left(\phi_{i;j} - g_{ij}\phi^{;k}_{;k}\right) \tag{1.1}$$

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