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ORIGINAL ARTICLE

Non-existence of Bianchi type-III bulk viscous string cosmological model in $f(R,T)$ gravity

M. Kiran · D.R.K. Reddy

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Abstract A spatially homogeneous and anisotropic Bianchi type-III space-time is considered in the presence of bulk viscous fluid containing one dimensional cosmic strings in the frame work of $f(R,T)$ gravity proposed by Harko et al. (Phys. Rev. D 84:024020, 2011). To get a determinate solution of the field equations of this theory, we have used (i) a barotropic equation of state for the pressure and density and (ii) the bulk viscous pressure is proportional to the energy density. It is interesting to observe that, in this case, Bianchi type-III bulk viscous string cosmological model does not exist and degenerates into vacuum model of general relativity.

Keywords Cosmic strings · Bulk viscosity · Bianchi type-III model · $f(R,T)$ gravity

1 Introduction

The current cosmological observations suggest to us that the present observable universe is undergoing an accelerating expansion (Riess et al. 1998; Perlmutter et al. 1999 and Bennet et al. 2003). The source driving this acceleration is known as 'dark energy' whose origin is still a mystery in modern cosmology. This is because of the fact that we do not have, so far, a consistent theory of quantum gravity. The accelerated expansion of the universe is driven by the negative pressure of the dark energy. 'The cosmological constant' is the most simple and natural candidate for explaining cosmic acceleration, but it faces serious problems and a large discrepancy between theory and observations (Copeland et al. 2006; Nojiri and Odintsov 2007). Hence, in recent years, there has been lot of interest in constructing dark energy models by modifying the geometrical part of Einstein–Hilbert action of general relativity. This approach is called as the modified gravity which can successfully explain the rotation curves of galaxies and the motion of galaxy clusters in the universe. Among the various modifications of general relativity $f(R)$ theory of gravity (Caroll et al. 2004) and $f(R,T)$ gravity (Harko et al. 2011) are attracting more and more attention during the last decade. It has been suggested that cosmic acceleration can be achieved by replacing Einstein–Hilbert action of general relativity with a general function $f(R)$ where R is a Ricci scalar. Chiba et al. (2007), Nojiri and Odintsov (2007), Multamaki and Vilja (2006, 2007) and Shamir (2010) are some of the authors who have investigated several aspects of $f(R)$ gravity models which show the unification of early time inflation and late time acceleration.

The analysis of the large scale cosmic microwave background fluctuations confirm that our present day physical universe is isotropic, homogeneous, expanding and is well represented by FRW model. But other analyses reveal some inconsistency.Analysis of WMAP data sets show us that the universe could have a preferred direction. Hence, the study the anisotropies Bianchi models are important. Harko et al. (2011) have investigated several aspects of $f(R,T)$ gravity including FRW dust model. The investigation of Bianchi type models in $f(R,T)$ gravity is also stimulating growing interest in anisotropic cosmological models of the universe. Adhav (2012) has obtained Bianchi type-I cosmological model in $f(R,T)$ gravity. Reddy et al. (2012a) have discussed Bianchi type-III cosmological model in $f(R,T)$ gravity while Reddy et al. (2013a), Reddy and Shanthiku-

M. Kiran · D.R.K. Reddy (✉)
Department of Mathematics, M.V.G.R. College of Engineering, Vizainagaram, Andhra Prades, India
e-mail: reddy_einstein@yahoo.com