Astrophys Space Sci (2012) 342:249–252
DOI 10.1007/s10509-012-1158-7

ORIGINAL ARTICLE

Bianchi type-III cosmological model in $f(R,T)$ theory of gravity

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Received: 12 May 2012 / Accepted: 22 June 2012 / Published online: 4 July 2012

Abstract A spatially homogeneous Bianchi type-III space-time is considered in the presence of perfect fluid source in the frame work of $f(R,T)$ gravity (Harko et al. in Phys. Rev. D 84:024020, 2011) with the help of a special law of variation for Hubble's parameter proposed by Bermann (Nuovo Cimento B 74:182, 1983). A cosmological model with an appropriate choice of the function $f(T)$ has been constructed. The physical behavior of the model is studied.

Keywords $f(R,T)$ gravity · Bianchi type-III model · Hubble's parameter

1 Introduction

The most striking discovery of the modern cosmology is that the current universe is not only expanding but also accelerating. This late time accelerated expansion of the universe has been confirmed by the high red-shift supernove experiments (Riess et al. 1998; Perlmutter et al. 1999; Bennet et al. 2003). Also, observations such as cosmic microwave background radiation (Spergel et al. 2003, 2007) and large scale structure (Tegmark et al. 2004) provide an indirect evidence for the late time accelerated expansion of the universe. In view of this it is now believed that energy composition of universe has 4 % ordinary matter, and 20 % dark matter and 76 % dark energy. Modifications of general relativity are attracting more and more attention, in recent years, to explain late time acceleration and dark energy.

During last decade, there has been several modifications of general relativity to provide natural gravitational alternative for dark energy. Among the various modifications, $f(R)$ theory of gravity is treated most suitable due to cosmologically important $f(R)$ models. It has been suggested that cosmic acceleration can be achieved by replacing the Einstein-Hilbert action of general relativity with a general function Ricci scalar, $f(R)$. Viable $f(R)$ gravity models have been proposed by Nojiri and Odintsov (2007), Multamaki and Vilja (2006, 2007) and Shamir (2010) which show the unification of early time inflation and late time acceleration.

Very recently, Harko et al. (2011) proposed another extension of standard general relativity, $f(R,T)$ modified theories of gravity, where in the gravitational Lagrangian is given by an arbitrary function of the Ricci scalar R and of the trace of the stress energy tensor T. It is to be noted that the dependence from T may be induced by exotic imperfect fluids or quantum effects. They have derived the field equations from a Hilbert-Einstein type variational principal and also obtained the covariant divergence of the stress-energy tensor. The $f(R,T)$ gravity model depends on a source term, representing the variation of the matter stress energy tensor with respect to the metric. A general expression for this source term is obtained as a function of the matter Lagrangian L_m so that each choice of L_m would generate a specific set of field equations. Some particular models corresponding to specific choices of the function $f(R,T)$ are

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