Astrophys Space Sci (2013) 345:11–15
DOI 10.1007/s10509-013-1367-8

LETTER

A study on the role of $f(G)$ gravity on the emergent universe

Surajit Chattopadhyay · Rahul Ghosh

Received: 7 November 2012 / Accepted: 9 January 2013 / Published online: 23 January 2013
© Springer Science+Business Media Dordrecht 2013

Abstract Motivated by the recent work of Rastkar et al. (in *Astrophys. Space Sci.* 337:487, 2012) the present study has attempted to study the role of $f(G)$ gravity in the emergent universe. Different energy conditions are examined for the effective energy density and violation of strong energy condition is observed. Also, the behavior of the equation of state parameter is studied for the effective energy density and dark energy density. It is found that the equation of state parameter behaves like phantom in both of the cases.

Keywords $f(G)$ gravity · Dark energy

1 Introduction

The acceleration of the Universe can be explained either through dark energy or through the modification of gravity on large scales (Bertschinger and Zukin 2008). One way of presenting this kinematic property of the universe is to postulate the existence of a new entity—dark energy (DE) (for review see Copeland et al. 2006). Models with variable DE can be broadly divided into two main classes (Sahni and Starobinsky 2006): (i) Physical DE, in these models DE is the energy density of some new, very weakly interacting physical field. (ii) Geometrical DE, otherwise dubbed modified gravity models. Modified gravity is considered an alternative proposal for dark energy. A study distinguishing between modified gravity and dark energy has been made in Bertschinger and Zukin (2008). Usefulness of modified gravity theory have been described specifically in Nojiri and Odintsov (2007). The important property of gravitational dark energy is the fact that in this case no strange matter with negative pressure is introduced to describe the late time cosmic acceleration (Nojiri and Odintsov 2008). Here, the change of the decelerated expansion to the accelerated one is explained by the change of the properties of a gravitational theory in the course of the universe evolution (Nojiri and Odintsov 2008). The modified gravity theory has been reviewed in Nojiri and Odintsov (2007). In recent times, $f(R)$ gravity has drawn immense interest in attempting to explain the late-time accelerated expansion of the Universe. A plethora of literatures are available on the $f(R)$ gravity (e.g. Brookfield et al. 2006; Faulkner et al. 2007) and an extensive review on $f(R)$ gravity theories is presented in Sotiriou and Faraoni (2010). Some further references on $f(R)$ gravity are discussed below. In a recent work, Farasat Shamir et al. (2012) investigated $f(R)$ gravity using Noether symmetry approach by considering Friedmann Robertson-Walker (FRW) universe and spherically symmetric space times. In another work, the well-known energy problem has been discussed by Sharif and Farasat Shamir (2010a) in $f(R)$ theory of gravity by using the generalized Landau-Lifshitz energy-momentum complex in the framework of metric $f(R)$ gravity to evaluate the energy density of plane symmetric solutions for some general $f(R)$ models. In another work, Sharif and Farasat Shamir (2010b) explored static plane symmetric vacuum solutions using the metric approach of $f(R)$ theory. Sharif (2010) studied the exact vacuum solutions of

S. Chattopadhyay (✉)
Pailan College of Management and Technology, Bengal Pailan Park, Kolkata 700 104, India
e-mail: surajit_2008@yahoo.co.in

S. Chattopadhyay
e-mail: surajcha@iucaa.ernet.in

R. Ghosh
Department of Mathematics, Bhairab Ganguly College, Kolkata 700 056, India
e-mail: ghoshrahul3@gmail.com