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ORIGINAL ARTICLE

Statefinder parameter for varying G in three fluid system

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Abstract In this work, we have considered variable G in flat FRW universe filled with the mixture of dark energy, dark matter and radiation. If there is no interaction between the three fluids, the deceleration parameter and statefinder parameters have been calculated in terms of dimensionless density parameters which can be fixed by observational data. Also the interaction between three fluids has been analyzed due to constant G. The statefinder parameters also calculated in two cases: pressure is constant and pressure is variable.

Keywords Dark energy · Statefinder parameters

1 Introduction

The present acceleration of the universe as favored by the Supernovae type Ia data can be explained by some exotic matter dominated in the present universe which violates the strong energy condition is termed as dark energy (Perlmutter et al. 1998; Riess et al. 1998). This dark energy has the property that it has positive energy and sufficient negative pressure (Caldwell 2002; Caldwell et al. 2003). Dark energy occupies about 73% of the energy of our Universe, while dark matter about 23% and the usual baryonic matter 4%. There are different candidates obey the property of dark energy given by—quintessence (Peebles and Ratra 1998; Caldwell et al. 1998), k-essence (Armendariz-Picon et al. 2000), tachyon (Sen 2002), phantom (Caldwell 2002), ghost condensate (Arkani-Hamed et al. 2004; Piazza and Tsujikawa 2004), quintom (Feng et al. 2005; Guo et al. 2005), brane world models (Sahni and Shtanov 2003) and Chaplygin gas models (Kamenshchik et al. 2001).

Einstein's field equations have two parameters—the Newton's gravitational constant and the cosmological constant. The Newton's gravitational constant G plays the role of a coupling between geometry and matter in the Einstein field equations. In an evolving universe, it appears natural to look at this "constant" as a function of time. Dirac (1937) proposed for the first time the idea of a variable G on certain physical grounds. He has shown that $G \propto t^{-1}$, but his model ran in some difficulties. Some authors (Abdel Rahaman 1990; Mass 1994) have shown that G is an increasing function of time. Many other extensions of Einstein's theory with time dependent G have also been proposed in order to achieve a possible unification of gravitation and elementary particle physics or to incorporate Mach's principle in general relativity (Hoyle and Narlikar 1964, 1971; Brans and Dicke 1961). Canuto and Narlikar (1980) have shown that the G-varying cosmology is consistent with whatever cosmological observations presently available. According to Dirac's large numbers hypothesis, $\dot{G}/G \sim$ Hubble rate H (Melnikov 2009). Observations of Hulse-Taylor binary

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