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ORIGINAL ARTICLE

Observational study of higher dimensional magnetic universe in non-linear electrodynamics

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Abstract In this work, we have considered the flat FRW model of the universe in $(n+2)$-dimensions filled with the dark matter and the magnetic field. We present the Hubble parameter in terms of the observable parameters Ω_{m0} and H_0 with the redshift z and the other parameters like B_0, ω, μ_0, δ, n, w_m. The natures of magnetic field B, deceleration parameter q and Om diagnostic have also been analyzed for accelerating expansion of the universe. From Stern data set (12 points), we have obtained the bounds of the arbitrary parameters by minimizing the χ^2 test. The best-fit values of the parameters are obtained by 66 %, 90 % and 99 % confidence levels. Now to find the bounds of the parameters (B_0, ω) and to draw the statistical confidence contour, we fixed four parameters μ_0, δ, n, w_m. Here the parameter n determines the higher dimensions and we perform comparative study between three cases: 4D $(n=2)$, 5D $(n=3)$ and 6D $(n=4)$ respectively. Next due to joint analysis with BAO observation, we have also obtained the bounds of the parameters (B_0, ω) by fixing other parameters μ_0, δ, n, w_m for 4D, 5D and 6D. The best fit of distance modulus for our theoretical model and the Supernova Type Ia Union2 sample are drawn for different dimensions.

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Keywords Higher dimension · Om diagnostic · Observational data · Observational constraints

1 Introduction

The origin of the classical Einstein field equations are Maxwell's electrodynamics which leads to the singular isotropic Friedmann solutions. Over the last few years the standard cosmological model, based on Friedmann-Robertson-Walker (FRW) geometry with Maxwell's electrodynamics has got sufficient amount of interest and many significant result are obtained (Kolb and Turner 1990; Murphy 1973; De Sitter 1917; Novello and Salim 1979; Novello et al. 1993; Garcýa-Salcedo and Breton 2000, 2005; Novello 2005; Klippert et al. 2000). Recently the non-linear electrodynamics (NLED) is a very interesting subject of research in general relativity. In 1934, Born and Infield (Born and Infield 1934) wanted to modify the standard Maxwell theory in order to eliminate the problem of infinite energy of electron. In present time a new approach (De Lorenci et al. 2002) has been taken to avoid the cosmic singularity through a nonlinear extension of the Maxwell's electromagnetic theory and black hole solution can be obtained (Kats et al. 2007; Anninos and Pastras 2009; Cai et al. 2008). Another interesting feature can be viewed that for construction of regular black hole solutions (Ayón-Beato and García 1998, 1999; Salazar et al. 1987), nonlinear electrodynamics theories are most powerful tool. The solution of the Einstein field equations together with NLED signifies the nonlinear effects in strong gravitational and magnetic fields. In the standard Maxwell Lagrangian, the nonlinear terms can be added by imposing the existence of symmetries such as parity conservation, gauge invariance, Lorentz invariance, etc.