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ORIGINAL ARTICLE

# How effective is new variable modified Chaplygin gas to play the role of dark energy—a dynamical system analysis in RS II brane model

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**Abstract** Motivated by some previous works of Rudra et al. we set to explore the background dynamics when dark energy in the form of New Variable Modified Chaplygin gas is coupled to dark matter with a suitable interaction in the universe described by brane cosmology. The main idea is to find out the efficiency of New variable modified Chaplygin gas to play the role of DE. As a result we resort to the technique of comparison with standard dark energy models. Here the RSII brane model have been considered as the gravity theory. An interacting model is considered in order to search for a possible solution of the cosmic coincidence problem. A dynamical system analysis is performed because of the high complexity of the system. The statefinder parameters are also calculated to classify the dark energy model. Graphs and phase diagrams are drawn to study the variations of these parameters and get an insight into the effectiveness of the dark energy model. It is also seen that the background dynamics of New Variable Modified Chaplygin gas is consistent with the late cosmic acceleration. After performing an extensive mathematical analysis, we are able to constrain the parameters of new variable modified Chaplygin gas as $m < n$ to produce the best possible results. Future singularities are studied and it is found that the model has a tendency to result in such singularities unlike the case of generalized cosmic Chaplygin gas. Our investigation leads us to the fact that New Variable Modified Chaplygin gas is not as effective as other Chaplygin gas models to play the role of dark energy.

**Keywords** Dark energy · Dark matter · Dynamical system · Statefinder parameters

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## 1 Introduction

Recent cosmic acceleration is a well-known and accepted fact in the cosmological society currently (Perlmutter et al. 1999; Spergel et al. 2003). The root cause for this phenomenon is still under research. However of late there have been some speculations regarding the existence of a mysterious negative pressure component which violates the strong energy condition i.e. $\rho + 3p < 0$. Because of its invisible nature this energy component is aptly termed as dark energy (DE) (Riess et al. 2004).

Since the concept of DE flourished in the last decade, cosmologists all over the world started searching for a suitable model of DE. As a result various DE models have come into existence of late. DE represented by a scalar field[1] (Nojiri and Odintsov 2004) is often called quintessence. Not only scalar field but also there are other Dark fluid models

[1] In the presence of a scalar field the transition from a universe filled with matter to an exponentially expanding universe is justified.