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ORIGINAL ARTICLE

Multiple ΛCDM cosmology with string landscape features and future singularities

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Abstract Multiple ΛCDM cosmology is studied in a way that is formally a classical analog of the Casimir effect. Such cosmology corresponds to a time-dependent dark fluid model or, alternatively, to its scalar field presentation, and it motivated by the string landscape picture. The future evolution of the several dark energy models constructed within the scheme is carefully investigated. It turns out to be almost always possible to choose the parameters in the models so that they match the most recent and accurate astronomical values. To this end, several universes are presented which mimic (multiple) ΛCDM cosmology but exhibit Little Rip, asymptotically de Sitter, or Type I, II, III, and IV finite-time singularity behavior in the far future, with disintegration of all bound objects in the cases of Big Rip, Little Rip and Pseudo-Rip cosmologies.

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1 Introduction

Astronomical observations indicate that our Universe is currently in an accelerated phase (Riess et al. 1998; Perlmutter et al. 1998; Hicken et al. 2009; Komatsu et al. 2009; Percival et al. 2010). This acceleration in the expansion rate of the observable cosmos is usually explained by introducing the so-called dark energy (for a recent review, see Bamba et al. 2012a). In the most common models considered in the literature, dark energy comes from an ideal fluid with a specific equation of state (EoS) often exhibiting rather strange properties, as a negative pressure and/or a negative entropy, and also the fact that its action was invisible in the early universe while it is dominant in our epoch, etc. According to the latest observational data, dark energy currently accounts for some 73 % of the total mass-energy of the universe (see, for example, Kowalski et al. 2008).

In an attempt at saving General Relativity and to explain the cosmic acceleration, at the same time, one is led to conjecture some exotic dark fluids (although some other variants are still being considered, see e.g. Cognola et al. 2005; Elizalde et al. 2004; Cai et al. 2010). Actually, General Relativity with an ideal fluid can be rewritten, in an equivalent way, as some modified gravity. Also, the introduction of a fluid with a complicated equation of state is to be seen as a phenomenological approach, since no explanation for the origin of such dark fluid is usually available. However, the interesting possibility that the dark fluid origin could be related with some fundamental theory, as string theory, opens new possibilities, through the sequence: string or M-theory is approximated by modified (super)gravity, which is finally observed as General Relativity with an exotic