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Asymptotic properties of a supposedly regular (Dirac-Born-Infeld) modification of general relativity

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Abstract. We apply the dynamical systems tools to study the asymptotic properties of a cosmological model based on a non-linear modification of General Relativity in which the standard Einstein-Hilbert action is replaced by one of Dirac-Born-Infeld type. It is shown that the dynamics of this model is extremely rich: there are found equilibrium points in the phase space that can be associated with matter-dominated, matter-curvature scaling, de Sitter, and even phantom-like solutions. Depending on the value of the overall parameters the dynamics in phase space can show multi-attractor structure into the future (multiple future attractors may co-exist). This is a consequence of bifurcations in control parameter space, showing strong dependence of the model's dynamical properties on the free parameters. Contrary to what is expected from non-linear modifications of general relativity of this kind, removal of the initial spacetime singularity is not a generic feature of the corresponding cosmological model. Instead, the starting point of the cosmic dynamics — the past attractor in the phase space — is a state of infinitely large value of the Hubble rate squared, usually associated with the big bang singularity.

Keywords: modified gravity, gravity, alternatives to inflation, physics of the early universe

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