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Dynamical system analysis of Bianchi-I spacetimes in $f(R)$ gravity

Tuesday, 6 July 2021 09:55 (25 minutes)

We investigate a autonomous system analysis in terms of new expansion-normalized variables for homogeneous and anisotropic Bianchi-I spacetimes in $f(R)$ gravity in the presence of anisotropic matter. It is demonstrated that with a suitable choice of the evolution parameter, the Einstein's equations are reduced to an autonomous 5-dimensional system of ordinary differential equations for the new variables. Furthermore, for a large class of functions $f(R)$, which includes several cases commonly considered in the literature, all the fixed points are polynomial roots, and thus they can be determined with good accuracy and classified for stability. In addition, typically for these cases, any fixed point corresponding to isotropic solutions in the presence of anisotropic matter will be unstable. The assumption of a perfect fluid as source and or the vacuum cases imply some dimensional reductions and even more simplifications. In particular, it is found that the vacuum solutions of $f(R) = R^{\delta+1} with$\delta\$ a constant are governed by an effective bi-dimensional phase space which can be constructed analytically, leading to an exactly soluble dynamics. It is also shown that several results already reported in the literature can be re-obtained in a more direct and easy way by exploring our dynamical formulation.

Reference: S. Chakraborty, K. Bamba and A. Saa, Phys. Rev. D 99, 064048 (2019).

Primary author: BAMBA, Kazuharu (Fukushima University)

Co-authors: Dr CHAKRABORTY, Saikat (Indian Institute of Technology); Prof. SAA, Alberto (University of Campinas)

Presenter: BAMBA, Kazuharu (Fukushima University)

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