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Nonlocal de Sitter Gravity

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General relativity (GR), i.e. Einstein theory of gravity, is recognized as one of the best physical theories – with nice theoretical properties and significant phenomenological confirmations. Nevertheless, GR is not a complete theory of gravity and there are many attempts to modify it. One of the actual approaches towards more complete theory is nonlocal modified gravity. Nonlocal gravity model, which we consider here without matter, is given by the action $S = \frac{1}{16\pi G}\int \sqrt{-g}\big(R - 2\Lambda + \sqrt{R-2\Lambda}\,\mathcal{F}($
$Box)\,\sqrt{R-2\Lambda}\big)d^4x$, where R is scalar curvature and Λ – cosmological constant. $\mathcal{F}($
$Box) = 1 + \sum_{n=1}^{+\infty}\big(f_n$
$Box^n + f_{-n}$
$Box^{-n}\big)$ is an analytic function of the d'Alembert-Beltrami operator
Box and its inverse
Box^{-1}. Derivation of equations of motion for gravitational field $g_{\mu\nu}$ is presented in [2]. To solve the corresponding equations of motion, we first solve equation
$Box\sqrt{R-2\Lambda} = q\sqrt{R-2\Lambda}$, where $q = \zeta\Lambda \quad (\zeta \in \mathbb{R})$ is an eigenvalue and $\sqrt{R-2\Lambda}$ is an eigenfunction of operator
Box. We presented several exact cosmological solutions for homogeneous and isotropic universe. One of these solutions mimics effects that are usually assigned to dark matter and dark energy, see [1]. Some other solutions are examples of the nonsingular bounce ones in flat, closed and open universe. There are also singular and cyclic solutions. All these cosmological solutions are a result of nonlocality and do not exist in the local de Sitter theory of gravity.

References

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Primary authors: DRAGOVICH, Branko (University of Belgrade); DIMITRIJEVIĆ, Ivan (University of Belgrade); STANKOVIC, Jelena (University of Belgrade); RAKIC, Zoran (University of Belgrade)

Presenter: STANKOVIC, Jelena (University of Belgrade)

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