Nonlocal de Sitter $\sqrt{dS}$ gravity

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Abstract. Nonlocal de Sitter $\sqrt{dS}$ gravity model is defined by the action

$$S = \frac{1}{16\pi G}\int \sqrt{R-2\Lambda}(1+F(\Box))\sqrt{R-2\Lambda}\sqrt{-g}\mathrm{d}^4x$$

where $F(\Box)$ is an analytic function of the d'Alembert-Beltrami operator $\Box$ and its inverse $\Box^{-1}$. By this way, nonlocal operator $F(\Box)$ is dimensionless. The corresponding equations of motion for the metric $g_{\mu\nu}$ are presented.

We presented and discussed several exact cosmological solutions for homogeneous and isotropic universe. One of these solutions have properties similar to ones that are usually assigned to dark matter and dark energy. Some 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 case.

Moreover, we consider Schwarzschild-de Sit- ter metric of the $\sqrt{dS}$ gravity model. We present an approximative solution of linearized equation, which is related to space metric far from the massive body, where gravitational field is weak. The obtained solution is of particular interest for examining the possible role of non-local de Sitter gravity $\sqrt{dS}$ in describing the effects in galactic dynamics that are usually attributed to dark matter. The solution has been tested on the Milky Way and the spiral galaxy M33 and is in good agreement with observational measurements.

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Keywords: modified gravity; cosmological solutions; dark matter; dark energy.