Лаборатория теоретической физики им. Н.Н. Боголюбова

Семинар

Современная математическая физика

состоится в четверг 28 мая в 14:30 в аудитории им. Д.И. Блохинцева

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On a Model of Nonlocal de Sitter Gravity

We consider nonlocal modification of the general theory of relativity in framework of the pseudo Riemannian geometry, with the nonlocality of the form $S = \frac{1}{16\,\pi G}\int d^4x\,\sqrt{-g}\,(R - 2\Lambda + \mathcal{H}(R)\mathcal{F}(\Box)\mathcal{G}(R))$, where $\mathcal{H}$ and $\mathcal{G}$ are differentiable functions of the scalar curvature R, and $\mathcal{F}(\Box) = \sum_{n=0}^{\infty} f_n\,\Box^n$ is an analytic function of the d'Alambert operator $\Box$. The first part of the lecture is a short overview of our investigations devoted to nonlocal models based on the action given by the formula above.

In the recent papers we deal with nonlocality of the form $\mathcal{H}(R) = \mathcal{G}(R) = \sqrt{R - 2\Lambda}$.

We investigated several classes of scaling factors for at, open and closed Universe, and we found some new exact cosmological solutions. Specially, we are paid our attention to the scaling factor of the form $a(t) = At^{\frac{2}{3}}\,e^{\frac{\Lambda}{14}t^2}$. This simple nonlocal de Sitter gravity model, which we denote by $\sqrt{dS}$ gravity, contains an exact vacuum cosmological solution which mimics dark energy and dark matter and is in very good agreement with the standard model of cosmology. The success of $\sqrt{dS}$ gravity motivated us to investigate how it works at the solar system and smaller scales than cosmic scale.

The next part of the lecture contains an applications of our model to the smaller scales than cosmic scale. We are investigating corresponding Schwarzschild-de Sitter metric of the $\sqrt{dS}$ gravity model, $d^4x = -A(r)dt^2 + B(r)dr^2 + r^2d\theta^2 + r^2sin^2\theta d\varphi^2$.

To obtain an exact solution, it is necessary to solve the corresponding not-tri linear differential equation. Since this is very hard problem, after the linearization of obtained equation, we found its solutions in weak gravitational field. The obtained approximative solution is of particular interest for further examining the possible role of non-local de Sitter gravity $\sqrt{dS}$ in describing the e ects 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 it is in very good agreement with observational data.

At the end, we extend our model by adding a scalar field into the action, and using corresponding equation of motions we find time-dependant expression for its scalar potential.