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Cosmological scenarios in Horndeski theory

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We present a systematic analysis of homogeneous and isotropic cosmologies in Horndeski model which is the most general scalar-tensor theory of gravity with second-order field equations.
A special attention is paid to the particular subclass of Horndeski theory, namely, the model with the scalar field ϕ possessing the nonminimal kinetic coupling to curvature given as $\eta G^{\mu\nu}\phi_{,\mu}\phi_{,\nu}$.
A very interesting and important feature of the model is that it provides an essentially new inflationary mechanism without any fine-tuned scalar potential.
Namely, at early cosmological times the domination of coupling terms in the field equations guarantees the quasi-De Sitter behavior of the scale factor: $a(t) \propto e^{H_\eta t}$ with $H_\eta = 1/\sqrt{9\eta}$.
Generally, the model admits a rich spectrum of solutions.
Some of them describe the standard late time cosmological dynamic dominated by the Λ-term and matter, while at the early times the universe expands with a constant Hubble rate determined by the value of the scalar kinetic coupling. For other solutions the Λ-term and matter are screened at all times but there are nevertheless the early and late accelerating phases. The model also admits bounces, as well as peculiar solutions describing "the emergence of time".
We find that the universe could transit from one de Sitter solution to another, determined by the coupling parameter. Furthermore, according to the parameter choices and without the need for matter, we can obtain a Big Bang, an expanding universe with no beginning, a cosmological turnaround, an eternally contracting universe, a Big Crunch, a Big Rip avoidance and a cosmological bounce. This variety of behaviors reveals the capabilities of the present scenario.

Type of contribution

Invited talk

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