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Cosmology with nonminimal kinetic coupling and a Higgs potential

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In this work we continue an investigation of cosmological scenarios in the theory of gravity with the scalar field possessing a non-minimal kinetic coupling to the curvature, $\kappa G_{\mu\nu}\phi^\mu\phi^\nu$, [1-4]. Earlier, it was shown that the kinetic coupling provides an essentially new inflationary mechanism. Namely, at early cosmological times the domination of coupling terms in the field equations guarantees the quasi-De Sitter behavior of the scale factor: $a(t) \propto e^{H_\kappa t}$ with $H_\kappa = 1/\sqrt{9\kappa}$. In Ref. [4] we have studied the role of a power-law potential in models with non-minimal kinetic coupling. Now, we consider cosmological dynamics in such the models with the Higgs-like potential $V(\phi) = (\lambda/4)(\phi^2 - \phi_0^2)^2$. Using the dynamical system method, we analyze all possible asymptotical regimes of the model under investigation. As the most important result, we have found that, if the nonminimal coupling parameter κ is large enough to satisfy $2\pi G\kappa\lambda\phi_0^4 > 1$, then the local maximum of the Higgs potential becomes a stable node, and in this case one gets a late-time quasi-De Sitter evolution of the Universe. The cosmological constant in this epoch is $\Lambda_\infty = 3H_\infty^2 = 2\pi\lambda\phi_0^4$, and the Higgs potential reaches its local maximum $V(0) = \lambda\phi_0^4/4$. Additionally, using a numerical analysis, we construct exact solutions and find initial conditions leading to various cosmological scenarios.

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