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Planck constraints on scalar-tensor cosmology and the variation of the gravitational constant

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Cosmological constraints on the scalar-tensor theory of gravity by analyzing the angular power spectrum data of the cosmic microwave background (CMB) obtained from the Planck 2015 results are presented. We consider the harmonic attractor model, in which the scalar field has a harmonic potential with curvature (β) in the Einstein frame and the theory relaxes toward the Einstein gravity with time.
Analyzing the TT, EE, TE and lensing CMB data from Planck by the Markov chain Monte Carlo method, we find that the present-day deviation from the Einstein gravity ${\alpha_0}^2$) is constrained as ${\alpha_0}^2 < 2.5\times10^{-4-4.5\beta}$ (95.45% C.L.) and ${\alpha_0}^2 < 6.3\times10^{-4-4.5\beta}$ (99.99% C.L.) for $0 < \beta < 0.4$. The time variation of the effective gravitational constant between the recombination and the present epochs is constrained as $G_{\rm rec}/G_0 < 1.0056$ (95.45% C.L.) and $G_{\rm rec}/G_0 < 1.0115$ (99.99% C.L.). We also find that the constraints are little affected by extending to nonflat cosmological models because the diffusion damping effect revealed by Planck breaks the degeneracy of the projection effect.

Summary

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