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Inflation and ACT DR6

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Abstract. The recent results from the Atacama Cosmology Telescope (ACT DR6) have shifted the preferred value of the scalar spectral index to n_s=0.9743±0.0034, placing several well-established inflationary models, including the Starobinsky model, close to the 2σ boundary in the r-n_s plane. Motivated by this tension, we investigate two different approaches to reconcile inflationary predictions with the latest ACT observations. First, we study the power-law plateau inflationary potential within the framework of standard Einstein gravity and demonstrate that it naturally predicts values of n_s and r that lie within the 1σ ACT confidence region across a broad range of model parameters. Second, we embed the Starobinsky potential in Einstein–Gauss–Bonnet gravity, where the non-minimal coupling between the inflaton and the Gauss-Bonnet invariant significantly modifies the inflationary dynamics. We show that both hyperbolic tangent and exponential coupling functions successfully shift the model predictions into the 1σ ACT allowed region. Furthermore, in both scenarios, the predicted running of the scalar spectral index remains fully consistent with the ACT n_s-α_s constraints, providing viable alternatives compatible with current cosmological observations.

Keywords: cosmology, Einstein–Gauss–Bonnet gravity, Starobinsky potential, inflationary model, inflaton.

Introduction

Inflation is a very short, accelerated phase of expansion in the very early universe, during which the universe undergoes extreme expansion. The scenario was originally proposed to address problems with the hot big bang theory, such as the horizon and flatness problems [1–4]. In addition to successfully addressing these shortcomings, the inflationary scenario provides a mechanism for generating the primordial quantum fluctuations that seed the large-scale structure of the universe [5]. During this phase, a scalar field, known as the inflaton, slowly rolls down its potential, sustaining a quasi-de Sitter expansion. The scenario has been studied and extended in many directions, including non-canonical scalar field [6, 7], warm inflation [8–10], constant-roll inflation [11, 12], and so on.

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Over the past two decades, there has been enormous observational support for inflation. Successive Planck releases [13–15] confirmed the near scale-invariance of the primordial scalar power spectrum and constrained the scalar spectral index $n_s$and tensor-to-scalar ratio *r*. The most recent data from the Atacama Cosmology Telescope (ACT) has sharpened these constraints considerably [16, 17]. A joint analysis of Planck and ACT DR6 data yields n_s=0.9743±0.0034, which shows a shift in the scalar spectral index [16, 17]. The upward shift in n_srelative to the Planck 2018 central value has direct consequences for the selection of inflationary models. The Starobinsky model [18], which predicts n_s≈1-2/N_k for N_k≈60e-folds, now lies near the 2σboundary of the ACT r-n_s plane and is effectively disfavoured. The broader class of α-attractor models at large αand the natural inflation potential face similar pressure. This has prompted a broad re-examination of inflationary potentials in the light of ACT data.

In the general category, there are two distinct approaches for building models consistent with ACT. The first is to work within standard Einstein gravity and identify potentials whose predictions naturally fall in the higher $n_s$region preferred by ACT. In this regard, the Power-Law Plateau (PLP) potential,

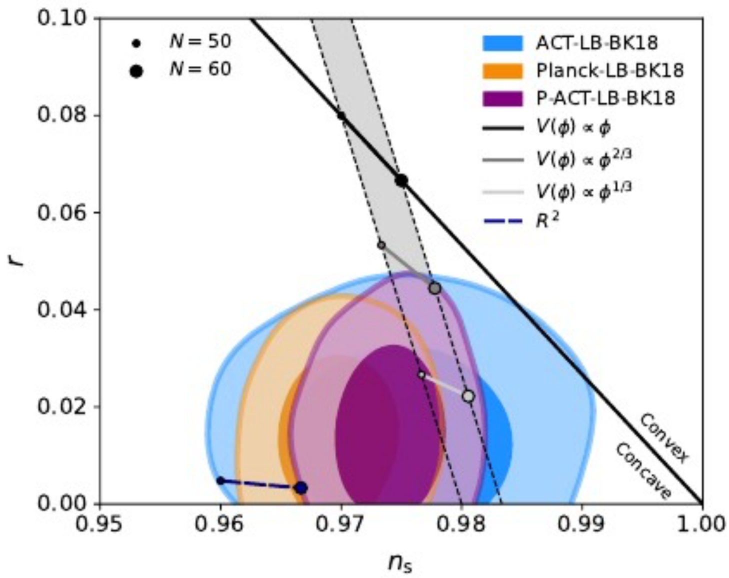
$$V\left(\phi\right) = V_0\left(\frac{\phi^n}{\phi^n + m^n}\right)^q,$$

motivated by supersymmetry [19–21], can be addressed as such a potential. Its free parameters nand qallow the prediction n_sand rto fall within the preferred range, and for many combinations they lie within the 1σACT contour. The second approach is to examine a potential disfavored in standard gravity within a modified gravity framework. Einstein–Gauss–Bonnet (EGB) gravity is a well-motivated example: rooted in string theory, it extends the Einstein–Hilbert action with a quadratic Gauss–Bonnet (GB) curvature term that couples non-minimally to the inflaton field via a coupling function ξ(ϕ)[22–26]. Such modifications alter the inflationary dynamics and can shift model predictions into the observationally preferred region, even for potentials that fail in standard gravity.

In this paper, we combine both approaches, drawing on two of our recent studies [21, 27]. In the first, we investigate the PLP potential in standard gravity and demonstrate its agreement with ACT DR6 data across a wide range of the parameters *n* and *q*[21]. In the second, we embed the Starobinsky potential within EGB gravity and show that the resulting *r*–n_s predictions fall within the 1σregion of the ACT plane for two distinct GB coupling functions of the form[28]

$$\xi(\phi) \propto \tanh(\xi_2\phi) \quad \text{and} \quad \xi(\phi) \propto \exp(\xi_2\phi)$$

The paper is organized as follows. Sect. III covers the PLP inflation in Einstein gravity, and Sect. IV presents the EGB framework and the Starobinsky potential results. Sect. V summarises the main findings.



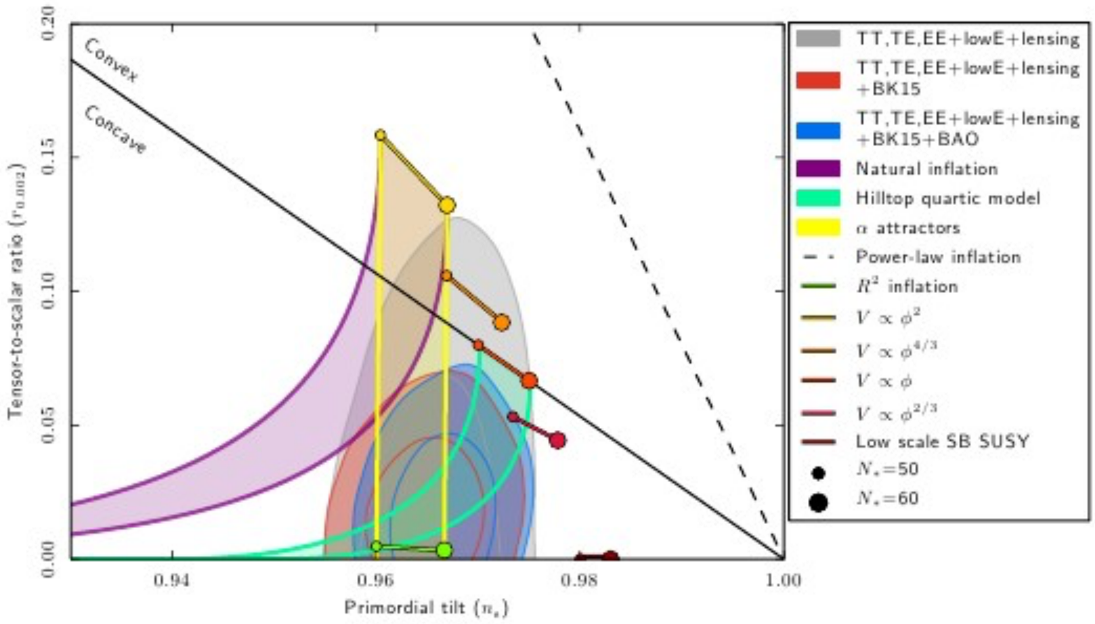


Figure 1. Planck vs ACT, figures taken from [16, 17, 29]

Planck vs ACT: Observational Landscape

The Planck mission has made significant contributions to primordial cosmology over the last few decades as one of the most dependable and accurate probes of the early cosmology. The Planck 2018 results set an upper limit on the tensor-to-scalar ratio r<0.056at the pivot scale k_*=0.05 Mpc^{-1}[15] and limited the scalar spectral index to n_s=0.9649±0.0042. For intensity and polarisation scales of $\ell \gtrsim 2000$ and $\ell \gtrsim 800$, respectively, the Planck measurement is dominated by noise, leaving a sizeable chunk of the primordial power spectrum entirely unexplored. ACT has both technical and physical observational advantages over Planck. In terms of sensitivity and resolution, the ACT DR6 data represent a substantial advancement over the Planck legacy dataset. The improved noise performance in polarisation, combined with finer angular resolution, allows the E-mode power spectrum to be measured within the cosmic variance limit up to ℓ=1700[16, 17], opening a window into small-scale primordial physics inaccessible to Planck. Additionally, as a ground-based telescope, ACT may be updated in the future. The constraints on the tensor-to-scalar and scalar spectral index from the Planck 1σobservational area are displayed in the left panel of Fig. 1. Additionally, it shows the various inflationary models and how well they match the data.

The Starobinsky model has taken centre stage among all the models depicted in the illustration. In addition to satisfying the observational limitations, the model's origin has been validated. Similar to the Starobinsky model, α-attractors are a similar class of models that have been consistent with the previous CMB observations. The landscape of inflationary models has been significantly altered by recent developments in observational cosmology, especially the revelation of the ACT DR6 data [16]. After striking an agreement with Planck [15], models that were earlier considered the community consensus now face significant observational problems. One notable example is the Starobinsky model [18], which is currently in significant conflict with the ACT DR6 constraints [17], despite being the most well-known inflationary scenario for many years. However, certain models that were inconsistent with the Planck results are now observationally plausible, at least in the 2σrange, e.g., $V \propto \phi^{2/3}$. Only a small number of models remain compatible with the ACT data; for instance, the PLP model remains in the observationally viable range. If we move away from the standard Einstein gravity to some higher-order modified gravity, such as EGB, it is rather natural to achieve a higher value of the scalar spectral index. In the following sections, we review our previous works on PLP and Starobinsky in EGB gravity.

POWER-LAW PLATEAU INFLATION IN STANDARD GRAVITY

We consider a scalar field ϕminimally coupled to gravity in standard Einstein gravity. The action is

$$S = \int d^4x \sqrt{-g}\left(\frac{M_p^2}{2}R - \frac{1}{2}g^{\mu\nu}\nabla_\mu\phi\nabla_\nu\phi - V\left(\phi\right)\right) \qquad (1)$$

where $g$is the determinant of the metric $g\mu\nu$, $R$is the Ricci scalar, $\phi$is the inflaton, $V(\phi)$is its potential, and Mp=1/8$\pi G$is the reduced Planck mass. Varying the action in a spatially flat FLRW background yields the following Friedmann equations

$$H^2 = \frac{1}{3M_p^2}\left(\frac{1}{2}\dot{\phi}^2 + V\right), \dot{H} = -\frac{\dot{\phi}^2}{2M_p^2}, \tag{2}$$

and the Klein–Gordon equation for the inflaton,

$$\ddot{\phi} + 3H\dot{\phi} + V'(\phi) = 0, \tag{3}$$

where dots denote time derivatives and primes denote derivatives with respect to ϕ.

The inflationary phase requires the inflaton to roll slowly along its potential, keeping the kinetic energy well below the potential energy. This slow-roll condition is encoded in the parameters

$$\epsilon = -\frac{\dot{H}}{H^2}, \eta = \frac{\ddot{\phi}}{H\dot{\phi}}$$

both of which must be small during inflation. Under the slow-roll approximation ($\epsilon,|\eta| \ll 1$), the dynamical equations simplify to

$$3M_p^2 H^2 \simeq V(\phi), 3H\dot{\phi} \simeq -V'(\phi). \tag{4}$$

For successful inflation and solving the horizon and flatness problems, the universe must undergo about 55-65e-folds of expansion. The amount of inflation is measured by the number of e-folds

$$N_k = \int_{t_e}^{t_*} H\, dt = \int_{\phi_e}^{\phi_*} \frac{H}{\dot{\phi}}\, d\phi, \tag{5}$$

where the subscript emarks the end of inflation and *marks the moment the pivot scale k_*=0.05" " Mpc^(-1)exits the Hubble horizon.

The key inflationary observables are the scalar spectral index n_sand the tensor-to-scalar ratio r, expressed in terms of the potential slow-roll parameters

$$\epsilon_V = M_p^2 \frac{V'^2}{2V^2}, \eta_V = M_p^2 \frac{V''}{V},$$

as [1, 21]

$$n_s - 1 = -6\epsilon_V + 2\eta_V, r = 16\epsilon_V. \tag{6}$$

Inflation ends when $\epsilon_v(\phi_e)=1$. Using Eqs. (4) and (5), the field value at horizon crossing ϕ_* is determined by integrating back $N_k \approx 60$e-folds from ϕ_e, after which Eq. (6) gives n_sand rat the pivot scale.

Supersymmetry (SUSY) is the last space-time symmetry beyond Poincaré symmetry permitted by the Coleman–Mandula no-go theorem [30]. From a SUSY-motivated construction [19, 20], one arrives at the Power-Law Plateau (PLP) potential

$$V(\phi) = V_0 \left(\frac{\phi^n}{\phi^n + m^n}\right)^q, \tag{7}$$

where $V_0>0$ is a constant, m is a mass scale taken here as $m=M_p$, and n,q are real free parameters. The specific case $n = 2$, $q = 1$ is the original SUSY-motivated choice [19]; here we treat both nand qas continuous free parameters to explore the broader model landscape.

For the potential to retain its plateau shape, one requires $\phi \gg m$; otherwise Eq. (7) reduces to the monomial form V∝ϕ^nq, which is observationally excluded [19].

Substituting Eq. (7) into the slow-roll expressions (6), using the relation $\epsilon_1(\phi_e)=1$to find the scalar field at the end of inflation. Then, integrating the e-fold equation (5), one can determine the field at horizon crossing time. Utilizing the result, we obtain $n_s$and r at horizon crossing as a function of n, q, and N_k. Fig. 2 shows the resulting $r-n_s$ predictions compared against the ACT DR6 observational contours for N_k=55and N_k=65 and for several representative choices of the parameters n and q.

STAROBINSKY IN EGB

EGB gravity extends the Einstein–Hilbert action with a quadratic curvature correction, GB term, non-minimally coupled to the inflaton field through a coupling function $\xi(\phi)$. Higher-order curvature terms and their couplings to scalar fields naturally emerge as quantum corrections to the gravitational action in string theory, which serves as the motivation for this modified theory of gravity [22, 31–33]. Models with non-minimal coupling of this type can yield small values of the tensor-to-scalar ratio and, crucially, can reconcile inflationary potentials that are disfavoured in standard gravity with the latest observational data. One of the distinguishing features of EGB gravity is its inherent tendency to produce a slightly higher spectral index n_s. This behaviour originates from the geometric nature of the GB coupling, which modifies the inflationary slow-roll dynamics without requiring any additional fine-tuning of the model parameters [34–39].

The action of the model reads [40]

$$S = \int d^4x\sqrt{-g}\left[\frac{1}{2}R - \frac{1}{2}g^{\mu\nu}\partial_\mu\phi\,\partial_\nu\phi - V\left(\phi\right) - \frac{1}{2}\xi\left(\phi\right)\mathcal{G}\right] \tag{8}$$

where
$$\mathcal{G} = R_{\mu\nu\rho\sigma}R^{\mu\nu\rho\sigma} - 4R_{\mu\nu}R^{\mu\nu} + R^2$$

is the GB invariant. In a spatially flat FLRW background, using the reduced Planck units

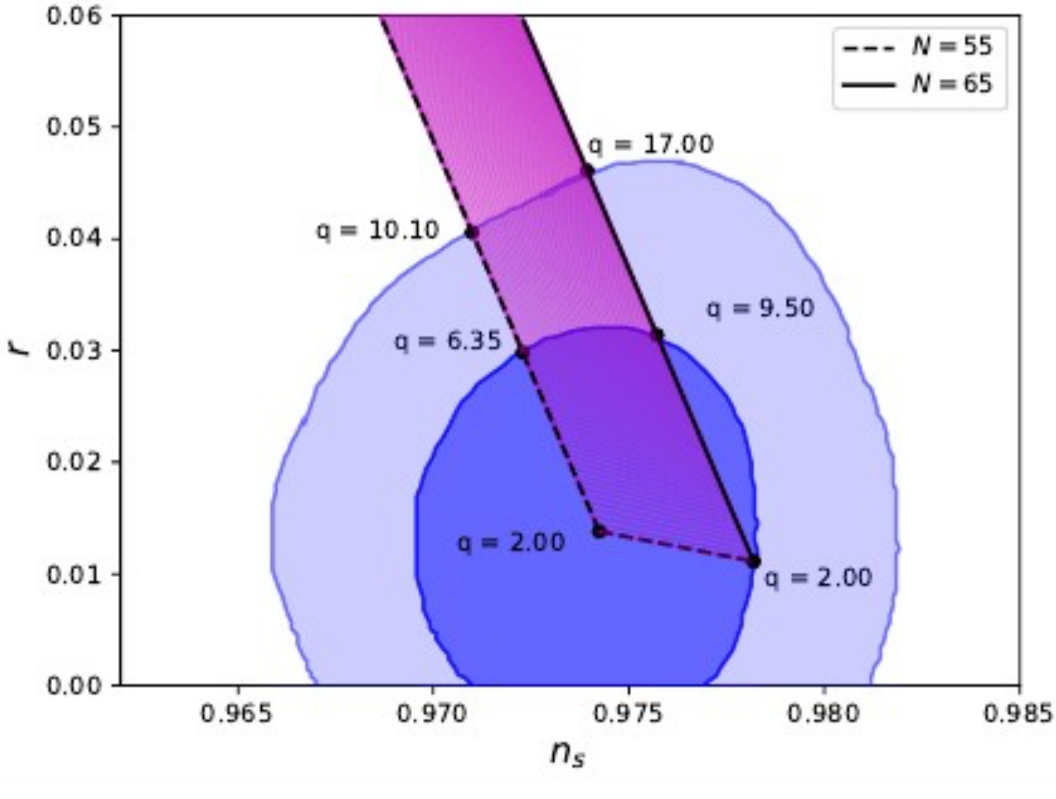
$$M_p^2 = \left(8\pi G\right)^{-1} = 1,$$

the modified Friedmann equations can be written as

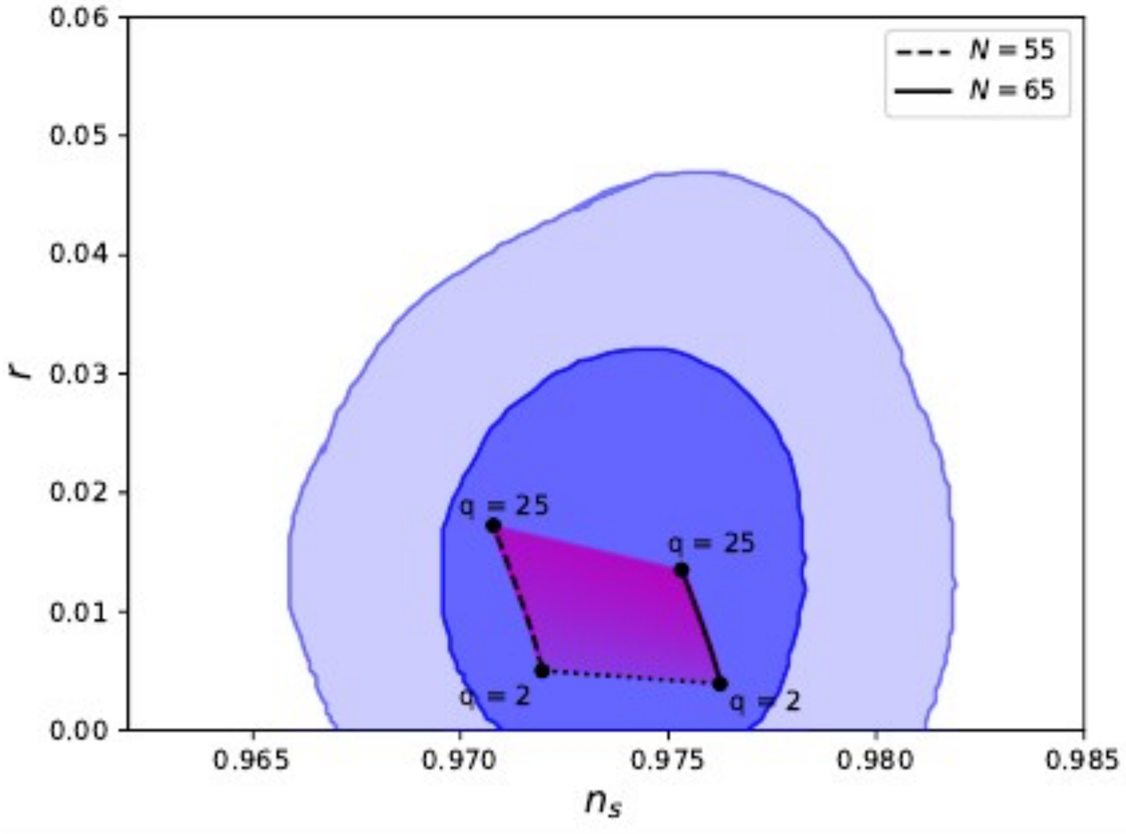
$$6H^2\left(1 - 4\xi_{,\phi}\dot{\phi}H\right) = \dot{\phi}^2 + 2V \tag{9}$$

$$2\dot{H}\left(1 - 4\xi_{,\phi}\dot{\phi}H\right) = -\dot{\phi}^2 + 4H^2\Psi, \tag{10}$$

where Ψis defined in the subsequent equations of the model.

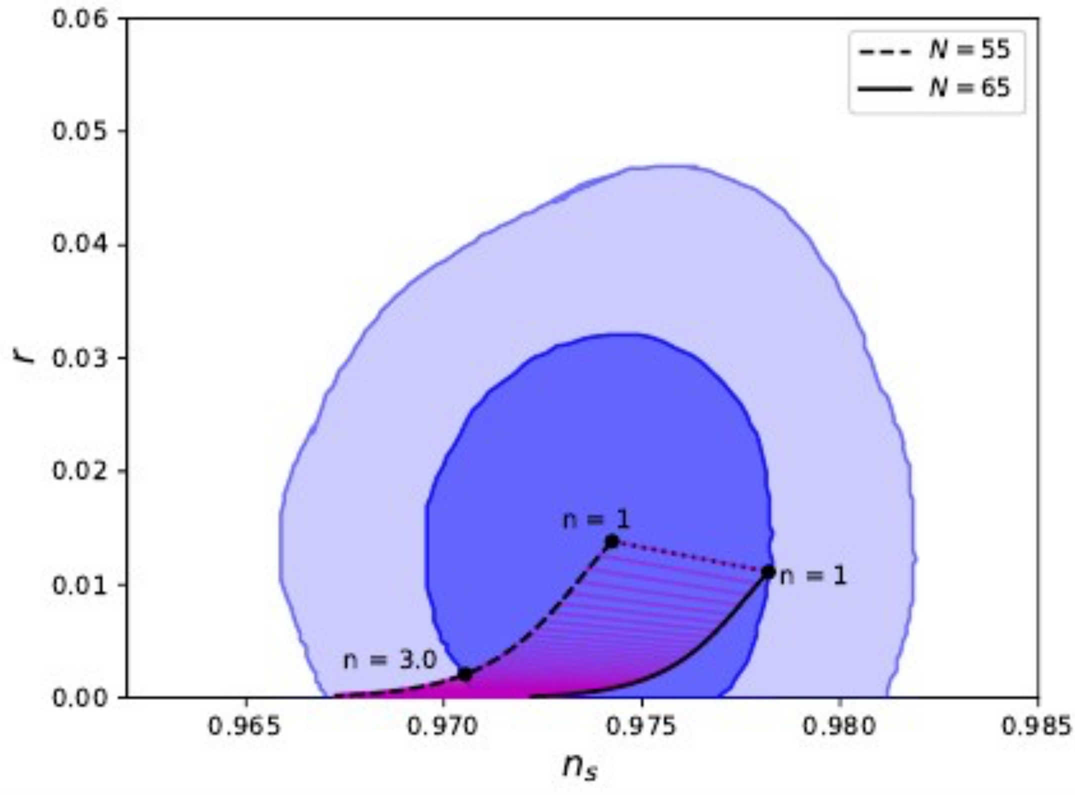


(a)n=1



0.06
0.05
0.04
0.03
0.02
0.01
0.00
r
0.965
0.970
0.975
0.980
0.985
n_s
$N = 55$
$N = 65$
q = 25
q = 25
q = 2
q = 2

(b)n=2



0.06
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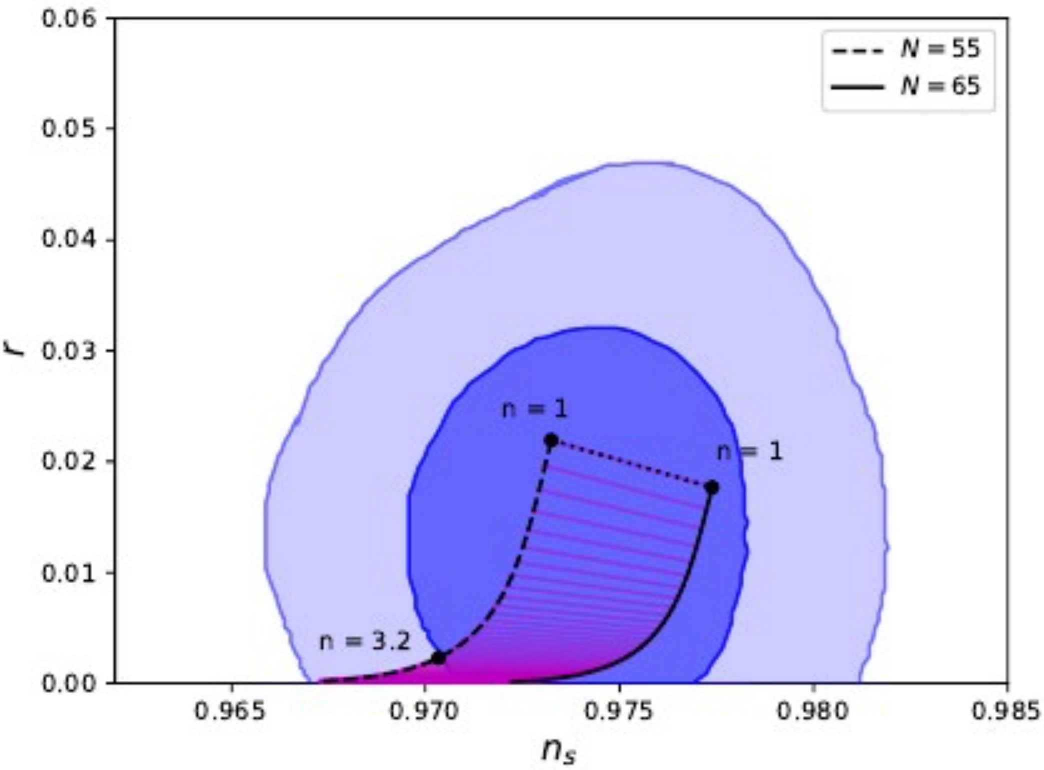
n_s
$N = 55$
$N = 65$
n = 1
n = 1
n = 3.0

(c)n=3



(d)n=4

Figure 2. Predicted r-n_s values of the PLP model compared with ACT DR6 contours, for m=M_p. Solid (dashed) black lines correspond to N_k=65(N_k=55). Panels (a) and (b) show fixed values of nwhile qvaries; panels (c) and (d) show fixed values of q while n varies.

The model remains well within the 1σACT contour for a broad range of parameters. and the inflaton equation of motion is

$$\ddot{\phi} + 3H\dot{\phi} = -V_{,\phi} - 12H^2\xi_{,\phi}\left(\dot{H}\middle|H^2\right),$$

where (11)

$$\Psi = \xi_{,\phi\phi}\dot{\phi}^2 + \xi_{,\phi}\ddot{\phi} - H\xi_{,\phi}\dot{\phi}.$$

Switching to the number of e-folds *Nvia dN=Hdt*, the exact dynamical system is [41]

$$\frac{d\phi}{dN} = \chi,$$

$$\frac{d\chi}{dN} = \frac{3\left[3-4\xi_{,\phi\phi}H^2\right]\xi_{,\phi}H^4\chi^2 + \left[3B + 2\xi_{,\phi}V_{,\phi} - 3\right]H^2\chi}{H^2\left(B-2\xi_{,\phi}H^2\chi\right)} - \frac{4V^2X}{H^2\left(B-2\xi_{,\phi}H^2\chi\right)}$$

$$-\frac{\chi}{2H^2}\frac{dH^2}{dN},$$

$$\frac{dH^2}{dN} = \frac{H^2\left[\left(4\xi_{,\phi\phi}H^2-1\right)\chi^2-16\xi_{,\phi}H^2\chi-16V^2\xi_{,\phi}X\right]}{2\left(B-2\xi_{,\phi}H^2\chi\right)}, \qquad (12)$$

with

$$\chi = \frac{\dot{\phi}}{H}, B = 12\xi_{,\phi}^2H^4 + \frac{1}{2},$$

and

$$X = \frac{12\xi_{,\phi}H^4 + V_{,\phi}}{4V^2}.$$

The inflationary phase is characterized by the standard slow-roll hierarchy

$$\epsilon_1 = -\frac{\dot{H}}{H^2}, \epsilon_{i+1} = \frac{d\ln \mid \epsilon_i \mid}{dN}, \tag{13}$$

and an additional GB-induced hierarchy,

$$\delta_1 = 4\xi_{,\phi} H^2 \chi, \delta_{i+1} = \frac{d\ln \mid \delta_i \mid}{dN}. \tag{14}$$

The scalar spectral index and tensor-to-scalar ratio are [41]

$$n_s = 1 - 2\epsilon_1 - \frac{2\epsilon_1\epsilon_2 - \delta_1\delta_2}{2\epsilon_1 - \delta_1}, r = 8 \mid 2\epsilon_1 - \delta_1 \mid. \tag{15}$$

The inflaton potential is the Starobinsky potential [18]

$$V\left(\phi\right) = V_0\left(1\middle| e^{-\sqrt{\frac{2}{3}}\phi}\right)^2, \tag{16}$$

which also arises in R^2 gravity and the α-attractor framework. Here, we employ two distinct kinds of EGB couplings, as

$$\xi\left(\phi\right) = \frac{\xi_1}{V_0}\tanh\left(\xi_2\phi\right), \xi\left(\phi\right) = \frac{\xi_1}{V_0}e^{-\xi_2\phi}, \tag{17}$$

where $\xi_1$and ξ_2 are constant free parameters. Several other types of couplings have also been considered in the past [42–49]. To apply the slow-roll approximation, one introduces the effective potential [40, 50, 51]

$$V_{\rm eff}\left(\phi\right) = -\frac{1}{4V(\phi)} + \frac{1}{3}\xi\left(\phi\right), \tag{18}$$

which reduces the e-fold integral to

$$\frac{dN}{d\phi} \simeq -\frac{1}{4V\, V_{\rm eff,\phi}}, H^2 \simeq \frac{V}{3}, \chi \simeq -4V_{\rm eff,\phi}. \tag{19}$$

The observables are then obtained by evaluating Eqs. (13)–(15) at the pivot-scale crossing. Exact results are obtained by numerically integrating the full system.

Results: hyperbolic (tanh) coupling

Fig. 3 shows the $r-n_s$ predictions for the tanh coupling with fixed and varying ξ_2, compared against the ACT $r-n_s$ contours. In the absence of GB coupling, the Starobinsky potential falls in the *2σ*ACT region. Activating the coupling shifts the predictions toward larger $n_s$and smaller r. For ξ_2=0.006 and N_k=60, the model gives n_s=0.974 and r=0.0044, well within the *1σ*ACT contour. Reducing or increasing ξ_2 beyond this range moves the predictions outside the *1σ*boundary. The slow-roll and exact numerical results are in close agreement, confirming the validity of the approximation.

The parametric space of (ξ_1, ξ_2)is explored in Fig. 4. Blue dots mark all pairs consistent with the *1σ*ACT contour. The combination of blue and red dots covers the 2σregion. For ξ_1=1, the acceptable range is

$$0.002 < \xi_2 < 0.01,$$

this interval narrows as ξ_1increases. The parametric space also exhibits a sign-flip symmetry, namely, the model predictions are unchanged under

$$(\xi_1, \xi_2) \to (-\xi_1, -\xi_2).$$

Results: exponential coupling

For the exponential coupling, the $r-n_s$ results are shown in Fig. 5, for fixed ξ_2=1and varying ξ_1. Increasing $\xi_1$raises n_s and lowers r, drawing the predictions into the *1σ*ACT region. The range

$$1.3 < \xi_1 < 2.1$$

satisfies the *1σ*constraint. Again, the slow-roll and numerical approaches agree well.
The parametric space for the exponential coupling is shown in Fig. 6. Unlike the tanh case, no sign-flip symmetry exists, and the exponential coupling does not vanish at ξ_2=0. For ξ_1=1.8, the acceptable range is

$$0.85 < \xi_2 < 1.1$$

narrowing to

$$1.25 < \xi_2 < 1.3$$

at ξ_1=3.8. The 2σ-compatible region in ξ_2 is wider than for the tanh coupling.

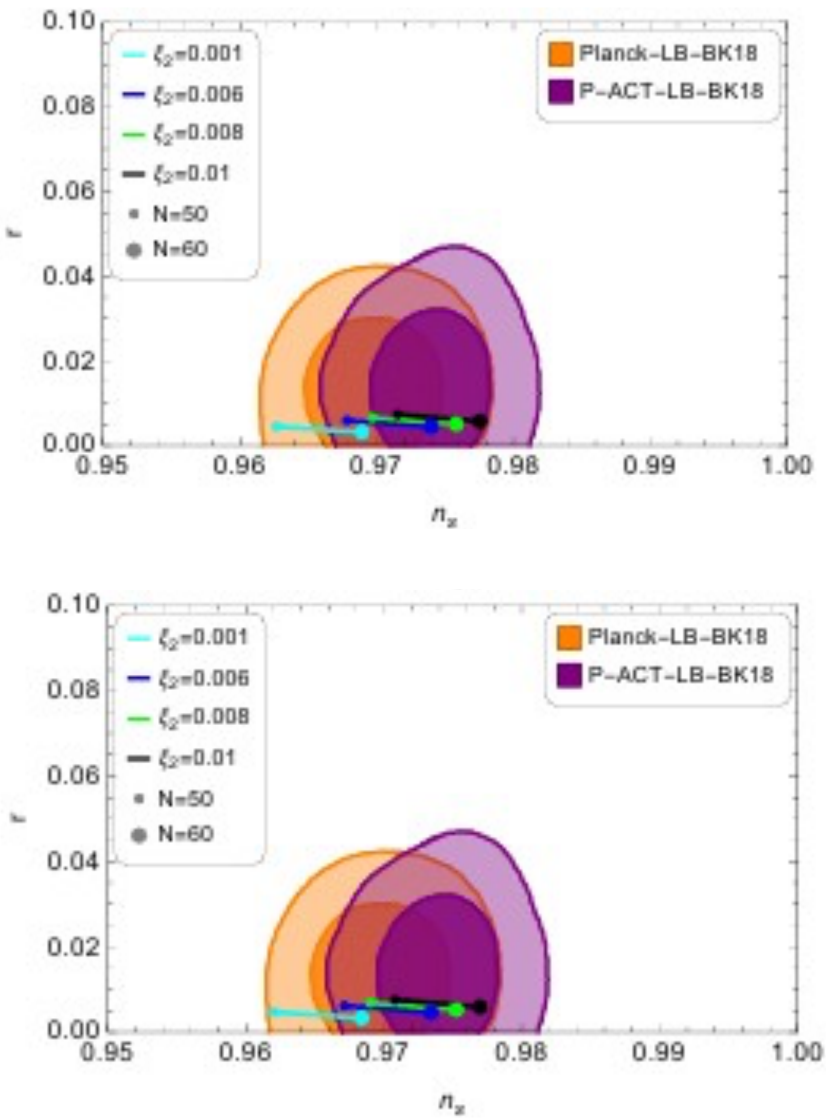


Figure 3. Predicted r-n_s values for the Starobinsky potential with tanh GB coupling (ξ_1=1, varying ξ_2)from (a) the standard slow-roll approximation and (b) exact numerical integration. Large (small) markers correspond to N_k=60(N_k=50). The black point marks the no-coupling limit, which falls in the 2σACT region.

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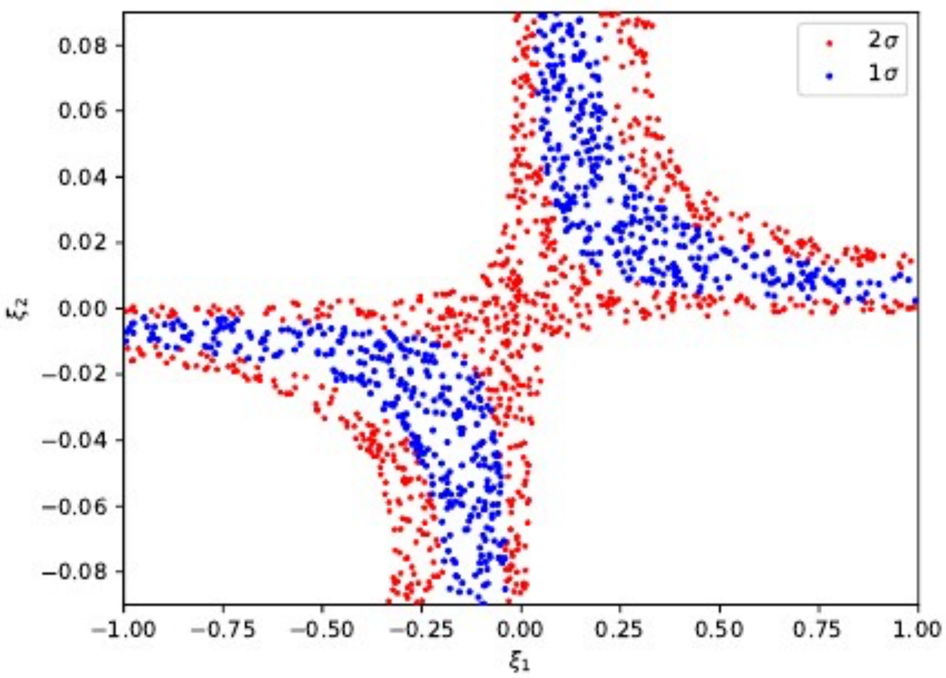

Figure 4. Parametric space of (ξ_1,ξ_2)for the tanh coupling. Blue (blue + red) dots mark pairs within the 1σ(2σ) ACT region for N_k=60.

Both coupling functions confirm that the Starobinsky potential, while disfavoured in standard gravity, is fully consistent with ACT data when embedded in EGB gravity. As an additional check, the running of the scalar spectral index

$$\alpha_s = \frac{dn_s}{dlnk}$$

was computed. For the tanh coupling (ξ_1=1, ξ_2=0.006, N_k=60), one obtains

$$\alpha_s = -5 \times 10^{-3},$$

and for the exponential coupling (ξ_1=1.8, ξ_2=1), one finds

$$\alpha_s = -3.85 \times 10^{-3}.$$

Both values are within the $1\sigma n_s$-α_s contour reported by ACT.

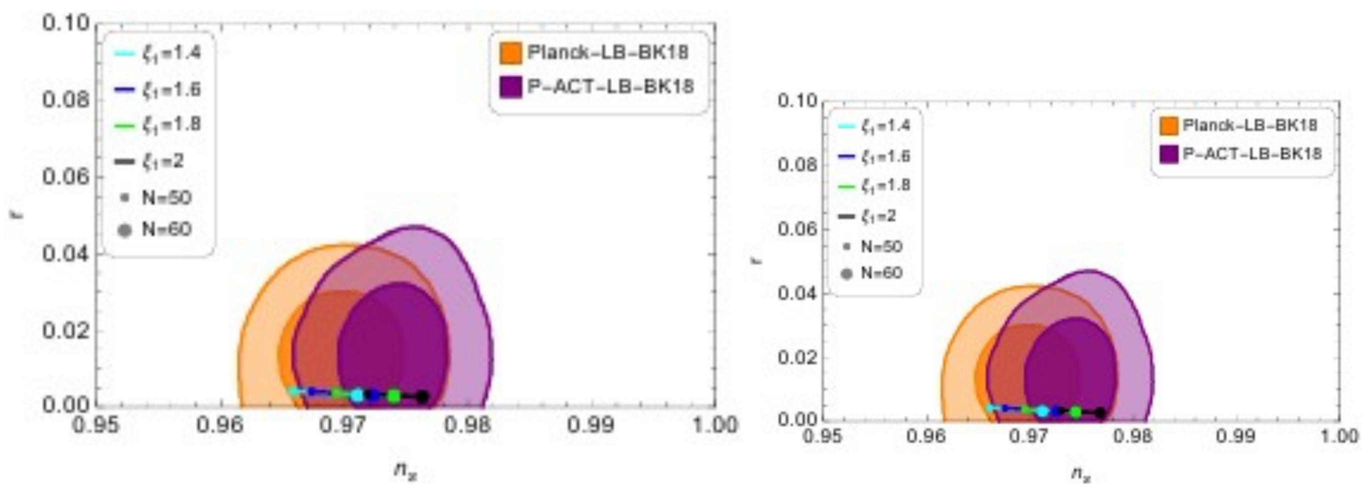

Figure 5. Predicted r-n_s values for the Starobinsky potential with exponential GB coupling (ξ_2=1, varying ξ_1)from (a) the standard slow-roll approximation and (b) exact numerical integration.

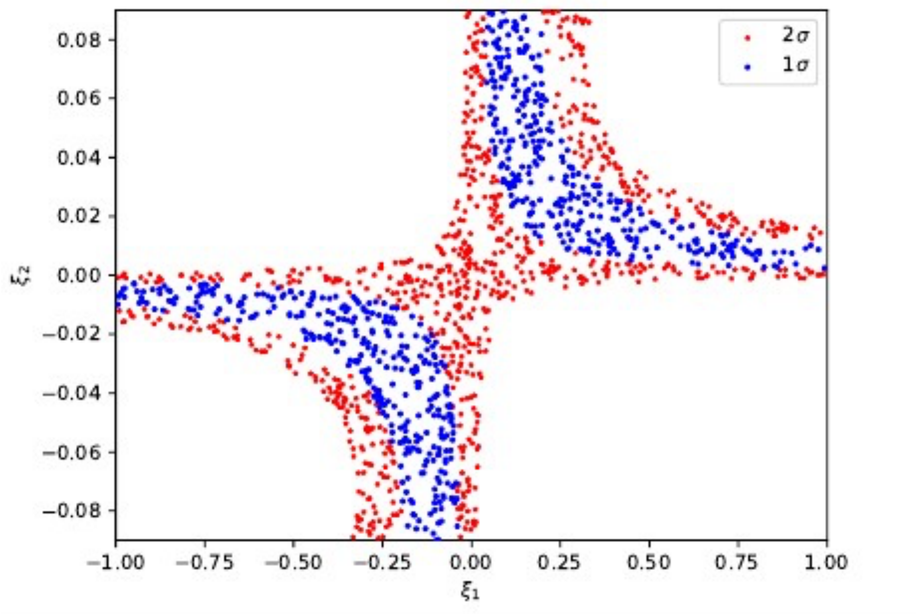

Figure 6. Parametric space of (ξ_1,ξ_2)for the exponential coupling. Blue (blue + red) dots mark pairs within the 1σ(2σ) ACT region for N_k=60.

Conclusion

The ACT DR6 data release has significantly shifted the observational landscape of inflationary cosmology. The joint Planck + ACT analysis yields

$$\mathrm{n_s} = 0.9743 \pm 0.0034$$

a value notably higher than the Planck 2018 central value of

$$\mathrm{n_s} = 0.9649 \pm 0.0042.$$

This upward shift has pushed several long-favoured inflationary models to or beyond the 2σboundary of the $r - n_s$ plane. The Starobinsky model and the wider class of α-attractor potentials, which had been in excellent agreement with Planck, are now effectively disfavoured by ACT. The situation calls for either identifying potentials that naturally accommodate the higher n_s within standard gravity or embedding known potentials in modified-gravity frameworks in which the additional dynamics can reconcile the predictions with the new data.

We have pursued both routes. In the first, the Power-Law Plateau (PLP) potential was studied within standard Einstein gravity. The model predictions fall within the *1σ*ACT contour across a wide range of the free parameters *n* and *q*. In particular, for *n*=2 the model remains inside the *1σ*boundary across the entire range

$$\mathrm{q} \in [2{,}25]$$

for both N_k=55and N_k=65, while for *n* = 1 the *1σ*-compatible range extends up to

$$\mathrm{q} = 9.5(\mathrm{N_k} = 65)$$

and

$$\mathrm{q} = 6.35(\mathrm{N_k} = 55).$$

Higher e-folds consistently widen the allowed parameter space, and the SUSY-motivated case n = 2proves particularly robust. In the second approach, the Starobinsky potential was embedded within EGB gravity using two distinct GB coupling functions. For the tanh coupling with

$$\xi_1 = 1, \xi_2 = 0.006$$

the model gives

$$n_s = 0.974, r = 0.0044$$

for N_k=60, well within the 1σACT contour, with the acceptable range

$$0.002 < \xi_2 < 0.01$$

for ξ_1=1. For the exponential coupling, the 1σconstraint is satisfied in the range

$$1.3 < \xi_1 < 2.1$$

at fixed ξ_2=1. The running of the spectral index was also computed,

$$\alpha_s \simeq -5 \times 10^{-3}$$

for the tanh coupling and

$$\alpha_s \simeq -3.85 \times 10^{-3}$$

for the exponential coupling, both consistent with the ACT n_s-α_s contour. The GB coupling thus rescues the Starobinsky potential from observational exclusion without any fine-tuning of the potential itself.

Taken together, the results confirm that the tension between standard plateau-type models and ACT data can be resolved through careful model building, either by choosing a potential with sufficient parameter freedom in standard gravity or by embedding a disfavoured potential within a well-motivated modified-gravity framework.

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The contribution of the authors

Yogesh performed the analytical and numerical investigations, prepared the figures, and wrote the manuscript.

Abolhassan Mohammadi contributed to the theoretical development of the inflationary models, analysis of the results, and manuscript revision.

M. Sami conceived and supervised the research project, coordinated the study, contributed to the interpretation of the results.

All authors discussed the results and approved the final version of the manuscript.

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Инфляция и ACT DR6

Аннотация. Недавние результаты, полученные с помощью Atacama Cosmology Telescope (ACT DR6), сместили предпочтительное значение скалярного спектрального индекса до n_s=0.9743±0.0034, что привело к тому, что несколько хорошо известных инфляционных моделей, включая модель Старобинского, оказались близки к границе 2σ на плоскости $r - n_s$. Мотивированные данным противоречием, мы исследуем два различных подхода для согласования инфляционных предсказаний с последними наблюдательными данными ACT. Во-первых, мы изучаем инфляционный потенциал степенного плато (power-law plateau) в рамках стандартной гравитации Эйнштейна и показываем, что он естественным образом предсказывает значения n_s и r, лежащие в пределах области доверия ACT уровня *1σ*для широкого диапазона параметров модели. Во-вторых, мы рассматриваем потенциал Старобинского в рамках гравитации Эйнштейна–Гаусса–Бонне, где неминимальная связь между инфлатоном и инвариантом Гаусса–Бонне существенно изменяет инфляционную динамику. Мы показываем, что как гиперболическая тангенциальная, так и экспоненциальная функции связи успешно смещают предсказания модели в допустимую область ACT уровня 1σ. Кроме того, в обоих сценариях предсказанное значение бегущего скалярного спектрального индекса полностью согласуется с ограничениями ACT на плоскости n_s-α_s, обеспечивая жизнеспособные альтернативы, совместимые с современными космологическими наблюдениями.

Ключевые слова: космология, гравитация Эйнштейна–Гаусса–Бонне, потенциал Старобинского, инфляционная модель, инфлатон.

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Инфляция және ACT DR6

Аңдатпа. Atacama Cosmology Telescope (ACT DR6) телескопының соңғы нәтижелері скалярлық спектрлік индекстің қолайлы мәнін n_s=0.9743±0.0034деңгейіне дейін ығыстырды, нәтижесінде Старобинский моделі сияқты кеңінен танылған бірнеше инфляциялық модельдер $r-n_s$жазықтығындағы 2σшекарасына жақындады. Осы қайшылыққа байланысты біз инфляциялық болжамдарды ACT-тің соңғы бақылау деректерімен сәйкестендірудің екі түрлі тәсілін зерттейміз. Біріншіден, біз стандартты Эйнштейн гравитациясы аясындағы дәрежелік плато (power-law plateau) инфляциялық потенциалын қарастырамыз және оның модель параметрлерінің кең ауқымы үшін ACT-тің 1σсенімділік аймағында орналасқан n_s және r мәндерін табиғи түрде болжайтынын көрсетеміз. Екіншіден, біз Старобинский потенциалын Эйнштейн–Гаусс–Бонне гравитациясы аясында қарастырамыз, мұнда инфлатон мен Гаусс–Бонне инварианты арасындағы бейминималды байланыс инфляциялық динамиканы елеулі түрде өзгертеді. Біз гиперболалық тангенс те, экспоненциалдық байланыс функциялары да модель болжамдарын ACT-тің рұқсат етілген 1σаймағына сәтті жылжытатынын көрсетеміз. Сонымен қатар, екі сценарийде де скалярлық спектрлік индекстің жүгіруінің болжанған мәні ACT-тің n_s-α_s шектеулерімен толық сәйкес келеді, осылайша қазіргі космологиялық бақылаулармен үйлесетін өміршең балама модельдерді ұсынады.

Түйін сөздер: космология, Эйнштейн–Гаусс–Бонне гравитациясы, Старобинский потенциалы, инфляциялық модель, инфлатон.

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