Journal of Cosmology and Astroparticle Physics
An IOP and SISSA journal

Received: May 30, 2026
Revised: July 23, 2026
Accepted: July 27, 2026
Published: September 9, 2026

Constraining quintessential inflation with ACT: A Gauss-Bonnet gateway

Yogesh,[a,d] **Imtiyaz Ahmad Bhat**,[b] **Mayukh R. Gangopadhyay**[c] **and M. Sami**[d,e]

[a] *Institute for Theoretical Physics and Cosmology, Zhejiang University of Technology, Hangzhou 310023, China*
[b] *Department of Physics, Islamic University of Science and Technology, Awantipora, J&K-192122, India*
[c] *Department of Physics, School of Advanced Sciences, Vellore Institute of Technology (VIT), Chennai Campus, Chennai 600127, Tamil Nadu, India*
[d] *Centre for Cosmology and Science Popularization (CCSP), SGT University, Gurugram, Haryana, 122505, India*
[e] *Eurasian International Centre for Theoretical Physics, Astana, Kazakhstan*

E-mail: yogeshjjmi@gmail.com, bhat.imtiyaz@iust.ac.in, mayukhraj.g@vit.ac.in, sami_ccsp@sgtuniversity.org

Abstract: Recent results from the Atacama Cosmology Telescope (ACT), which, when combined with Planck, CMB lensing, DESI DR2 with BAO data, indicate a higher and more tightly constrained scalar spectral index, $n_s = 0.9743 \pm 0.0034$ (P-ACT-LB), place several inflationary models under tension, with quintessential inflation pushed close to or beyond the 2σ boundary in the r–n_s plane for this dataset combination. In this work, we revisit quintessential inflation within the framework of Einstein–Gauss–Bonnet (EGB) gravity, where a scalar field non-minimally coupled to the Gauss–Bonnet invariant modifies the inflationary dynamics. We consider three representative coupling functions — exponential, hyperbolic secant, and hyperbolic tangent — and show that the exponential and sech-type couplings can shift the predicted values of r and n_s into the 1σ region allowed by the P-ACT-LB-BK18 combination, thereby restoring consistency with these observations. In contrast, the tanh-type coupling remains disfavoured, underscoring the sensitivity of inflationary observables to the coupling structure. We further investigate the reheating phase using a model-independent parameterisation and demonstrate that viable thermal histories can be realised even in the absence of a potential minimum, with reheating temperatures consistent with Big Bang nucleosynthesis bounds. We emphasise that the quantitative conclusions are conditional on the choice of dataset combination: the preference for a higher n_s is driven by the ACT data and, indirectly, by DESI BAO, whereas combinations based on Planck alone or including the latest SPT-3G data yield lower central values of n_s and correspondingly milder tension for

https://doi.org/10.1088/1475-7516/2026/09/064

JCAP09(2026)064