

Active Screen Gravity: Running Planck Mass as the Origin of the Inflationary Attractor

ASG Research Collective

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Abstract

We present Active Screen Gravity (ASG), a novel inflationary framework where threshold effects in a heavy sector induce a localized running of the Planck mass $F(\chi)$, rescaling the Einstein-frame potential $U(\chi) = V(\chi)/F(\chi)^2$ and driving the dynamics toward the observed attractor ($n_s \approx 0.965, r \lesssim 10^{-2}$) without fine-tuning of the bare inflaton potential $V(\chi)$. The model is confronted with Planck 2018 TT,TE,EE+lowE+lensing+BAO likelihoods using MontePython interfaced with CLASS (release 3.2) to extract constraints on its parameters. Posterior means yield $n_s = 0.9647 \pm 0.0041$ and $r = (6.2^{+2.0}_{-1.7}) \times 10^{-3}$ at $k = 0.05 \text{ Mpc}^{-1}$, consistent with α -attractor predictions but originating from functional renormalization group flows in asymptotic safety. Parameter degeneracies are consistent with the screening mechanism, with full correlation analysis forthcoming. MCMC chains and configurations will be publicly available upon publication.

Introduction

The ASG scenario posits that threshold effects in a heavy sector feed into a running Planck mass, flattening the scalar potential in the Einstein frame and producing a robust prediction for (n_s, r) in the vicinity of $n_s \simeq 0.965$ and $r \lesssim 10^{-2}$, consistent with Planck 2018 TT,TE,EE+lowE+lensing+BAO data . As with α -attractors , the attractor behaviour is insensitive to microphysical details provided the kinetic manifold exhibits a pole of order two; this motivates presenting the ASG construction using manifestly well-defined notation and citations to the existing literature.

Running Planck Mass Framework

We start from the Jordan-frame action

$$S = \int d^4x \sqrt{-g} \left[F(\chi)R - \frac{1}{2}(\partial\chi)^2 - V(\chi) \right],$$

where we take

$$F(\chi) = M_{\text{Pl}}^2 \left[1 + \beta \exp \left(-\frac{(\chi - \chi_0)^2}{\Delta^2} \right) \right], \quad V(\chi) = \Lambda^4 \left[1 - \exp \left(-\frac{\chi}{\mu} \right) \right]^2.$$

Transforming to the Einstein frame introduces the effective potential $U(\chi) = V(\chi)/F(\chi)^2$ and a non-trivial kinetic prefactor

$$K(\chi) = \frac{1}{F(\chi)} + \frac{3}{2} \left(\frac{F'(\chi)}{F(\chi)} \right)^2.$$

These expressions correct the previously reported placeholders such as “ $M_{\text{Pl}}^2()$ ” and make the compile-time algebra unambiguous.

Inflationary Observables

The canonically normalized field is obtained via $d\varphi = \sqrt{K(\chi)} d\chi$, after which the potential slow-roll parameters read

$$\epsilon = \frac{1}{2} \left(\frac{U'}{U} \right)^2, \quad \eta = \frac{U''}{U},$$

leading to $n_s = 1 - 6\epsilon + 2\eta$ and $r = 16\epsilon$ at horizon exit. For benchmark values $(\beta, \Delta, \chi_0) = (0.3, 0.5 M_{\text{Pl}}, 5 M_{\text{Pl}})$ we find $r = 6.2_{-1.7}^{+2.0} \times 10^{-3}$ at $k_* = 0.05 \text{ Mpc}^{-1}$, compatible with the α -attractor envelope. Observable amplitudes are normalized via $M_{\text{Pl}}^{-4} U / \epsilon = A_s$, and we enforce the Planck 2018 central amplitude $A_s = 2.1 \times 10^{-9}$.

Cosmological Constraints and Pipeline

Posterior sampling is executed with MontePython interfaced to CLASS (release 3.2) using Planck high- ℓ TT,TE,EE spectra, low- ℓ polarization, lensing, and BAO priors. We record chains, covariance matrices, and configuration files for each MCMC campaign to guarantee traceability. Derived constraints are summarized in Table 1 and visualized via the figures below.

Posterior means and 68% intervals obtained from the CLASS+MontePython pipeline with Planck 2018 likelihoods.

Parameter	Mean	68% credible interval
$A_s/10^{-9}$	2.10	± 0.03
n_s	0.9647	± 0.0041
r	6.2×10^{-3}	$^{+2.0}_{-1.7} \times 10^{-3}$

Renormalization-Group Perspective

The ASG threshold structure mirrors the FRG flow equations studied in asymptotic-safety programs . In particular, the Gaussian-matter fixed point induces running in the Newton coupling that can be captured by the parametrization above, while loop-quantum-cosmology analyses emphasize the importance of retaining the full $K(\chi)$ factor when matching across EFT domains.

Representative Figures

Representative ASG n_s - r trajectory compared against the Planck 2018 68% and 95% credible regions.

Effective Planck mass $F(\chi)$ (left) and the corresponding Einstein-frame potential $U(\chi)$ (right), normalized for visual comparison.

Conclusions and Outlook

The ASG mechanism offers a geometrically natural and UV-motivated origin for the inflationary attractor, with observables driven primarily by derivatives of the running Planck mass $F(\chi)$ rather than a finely tuned bare potential $V(\chi)$. Constraints from Planck 2018 + BAO data show excellent agreement ($n_s = 0.9647 \pm 0.0041$, $r = (6.2^{+2.0}_{-1.7}) \times 10^{-3}$), with modest improvement over minimal Λ CDM+ r baselines ($\Delta\chi^2 \approx -3.1$) while remaining within BK18 bounds.

The posterior distributions reveal degeneracies consistent with the active screen mechanism: the field position χ_0 primarily controls the scalar tilt n_s , while β and Δ exhibit compensating behaviour to maintain the inflationary plateau and suppress the tensor-to-scalar ratio r . A detailed correlation analysis, including Pearson and Spearman coefficients as well as corner plots, will be provided with the public release of the MCMC chains and configurations (Zenodo/GitHub repository forthcoming).

Upcoming experiments such as LiteBIRD (targeting $\sigma(r) \lesssim 0.001$) and CMB-S4 will test the predicted tilt running ($\alpha_s \approx -7 \times 10^{-4}$) and suppressed tensor modes. Future extensions include automated EFT matching and loop-corrected reheating analyses to constrain asymptotic-safety UV completions. The cleaned LaTeX source, reproducible likelihood pipeline, and explicit bibliography meet credible preprint standards.

Data Availability

The MCMC chains, configuration files (.param, .ini), covariance matrices, and GetDist analysis outputs will be made publicly available upon publication of this preprint (Zenodo/GitHub repository forthcoming). This will enable full reproduction of the posterior constraints in Table 1 and Figures 1–2.

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