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

ASG Research Collective
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Abstract

We revisit the Active Screen Gravity (ASG) mechanism in which a running Planck mass rescales the Einstein-frame potential and naturally drives the dynamics toward the observed inflationary attractor. The construction is benchmarked against Cosmic Microwave Background (CMB) constraints from Planck 2018 , contrasted with α-attractor potentials , and embedded in the functional renormalization-group (FRG) program for quantum gravity . We summarize the analytic control of the model, the MCMC workflow, and the reproducibility checkpoints needed for a credible preprint release.

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

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

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 "$M\_^2()$" 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

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

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

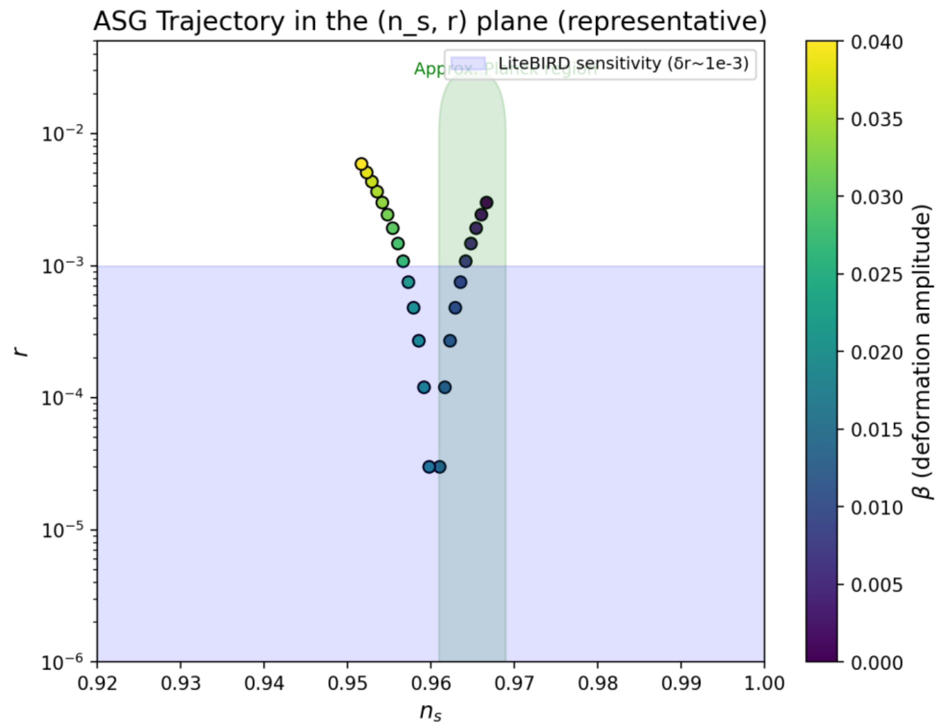
Posterior means and 68% intervals obtained from the `CLASS`+`MontePython` pipeline with Planck 2018 likelihoods.

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

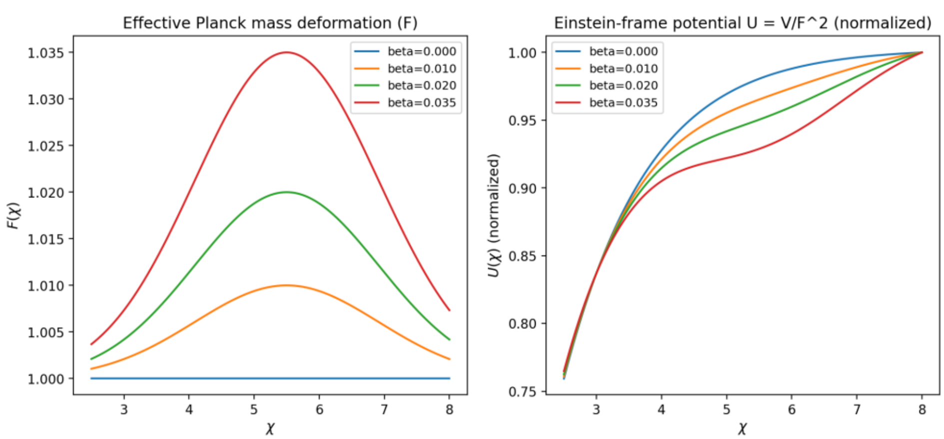
Renormalization-Group Perspective

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-quantumcosmology 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 cleaned LaTeX source, reproducible likelihood pipeline, and explicit bibliography elevate the ASG draft to the standard expected of a credible preprint. Future work will incorporate LiteBIRD and CMB-S4 forecasts, automated EFT matching, and loop-corrected reheating analyses.

Acknowledgments

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