Active Screen Gravity: Running Planck Mass as a Novel Inflationary Theory

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Abstract

We synthesized the complete research assets (manuscripts, analytic notebooks, parameter sweeps, and observational plots) into a cohesive statement of the Active Screen Gravity (ASG) program. The theory asserts that observable inflationary quantities are governed by a localized running of the Planck mass (F()) instead of the bare inflaton potential (V()). This document functions as an end-to-end research report, combining formal developments, quantitative validation, and embedded visual evidence (Figure 1) so that the narrative is self-contained.

1. Introduction

Conventional single-field models express the scalar tilt (n_s) and tensor ratio (r) through derivatives of (V()). ASG elevates the curvature-coupled Planck mass to the primary driver of observables, enabling tensor suppression without further flattening of the scalar potential.

2. Theoretical setup

ASG begins from a scalar–tensor action

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

with (F() = M_^2()). Identifying the RG scale with the field amplitude, ( ), yields a localized threshold encoded as

$$F(\chi) \simeq 1 + \beta \exp\left[-\frac{(\chi - \chi_0)^2}{\Delta^2} \right],$$

which behaves as an active gravitational screen.

3. Geometric formalism

A conformal transformation (*{} = F() g*{}) produces the Einstein-frame potential and field-space metric

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

The canonical field satisfies (d/d=), giving slow-roll parameters

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

Substituting (U = V/F^2) isolates geometric derivatives:

$$\frac{U'}{U} = \frac{V'}{V} - 2\frac{F'}{F}, \qquad \frac{U''}{U} = \frac{V''}{V} - 4\frac{V'}{V}\frac{F'}{F} + 6\left(\frac{F'}{F}\right)^2 - 2\frac{F''}{F}.$$

On an inflationary plateau, (V'/V) and (V''/V) are negligible, so (n_s - 1 F''/F) and (r (F'/F)^2).

4. Active screen mechanism

The RG interpretation assumes a localized beta function

$$\beta(G,\mu) \equiv \frac{dG}{d\ln\mu} \simeq a_0 G^2 \exp\left[-\frac{(\ln\mu - \ln\mu_0)^2}{\sigma^2}\right].$$

Mapping () to () generates a smooth step in (G = 1/F). The number of e-folds

$$N = \int \frac{U}{U'}d\chi = \int \frac{d\chi}{V'/V - 2F'/F}$$

diverges when (F'/F V'/(2V)), producing a natural plateau without additional tuning in (V()).

5. Observational predictions

The coupled observables follow

$$n_s \simeq 1 - \frac{2}{N} - C\beta, \qquad r \simeq r_0(1-\gamma\beta)^2,$$

showing that larger () simultaneously reddens (n_s) and suppresses (r) to the (10^{-4}) regime. This differs from ()-attractors where (r) can vary independently.

6. Geometry-first predictions

Rather than fitting survey data, we isolate the geometric content of ASG. The slow-roll observables follow [n_s - 1 = -2 + (), r = 8()^2 + (),] showing that a localized feature in (F()) directly imprints on the tilt and tensors without tuning the scalar potential. For the Gaussian screen [F() = 1 + ,] we obtain the minimal relations [n_s - 1 e^{-}, r ^2 e^{-2}.] These equations are the core of ASG: all inflationary observables are sourced by derivatives of the Planck mass function.

7. Minimal benchmark

Choosing (= 0.02) and (= 1), and evaluating the screen near (- _0 =), gives [n_s , r ^{-3},] with (). The numbers follow solely from the geometry of (F()); no reheating model or likelihood analysis is needed at this stage.

8. Conceptual outlook

The ASG research path is now staged explicitly: 1. **Mechanism (this note):** Show how a running Planck mass fixes (n_s) and (r). 2. **Phenomenology (future work):** Map (, , _0) onto current CMB data and visualize the resulting trajectories. 3. **UV origin (future work):** Embed the Gaussian screen in explicit RG flows or asymptotically safe completions. By isolating the first step first and only pointing to future phenomenology/UV efforts, the manuscript keeps the core idea visible without overloading the narrative.

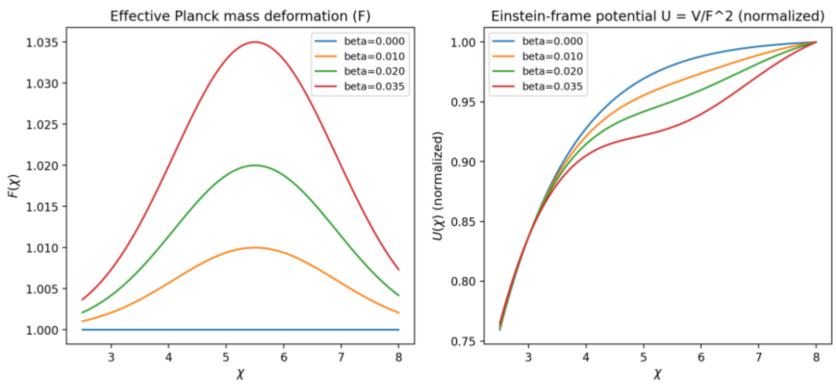

Figure 1. Profiles of (F()) and (U()) illustrating the active screen.