Active Screen Gravity: Running Planck Mass as the Origin of the Inflationary Attractor (Journal Version)

Abstract

We present an extended formulation of Active Screen Gravity (ASG) including dynamical stability, perturbation theory, UV interpretation and reheating predictions. Inflationary observables are governed by derivatives of the running Planck mass $F(\chi)$, not by tuning the scalar potential. The model predicts correlated (n_s, r) trajectories testable by future CMB polarization missions.

1. Field-Theoretic Origin

We interpret χ as an ordinary inflaton coupled to heavy thresholds $m_i(\chi) = m_{i0} \exp(\chi/\Delta)$. Vacuum polarization induces

$$M_{Pl}^2(\chi) = M_0^2 + \Pi(\chi).$$

This produces the localized deformation

$$F(\chi) = 1 + \beta \exp(-(\chi - \chi_0)^2/\Delta^2).$$

Thus the running Planck mass arises dynamically rather than being assumed.

2. Dynamical Attractor Proof

Define $X = V'/V - 2F'/F$.

Evolution in e-fold time:

$$d\chi/dN = -X$$

$$dX/dN \approx 2(F''/F)X.$$

For Gaussian deformation $F''/F < 0$ near χ_0 so $X \to 0$.

Hence the cancellation regime is a stable attractor, not fine tuning.

3. Perturbations

Mukhanov-Sasaki equation:

$$v_k'' + (k^2 - z''/z)v_k = 0, \quad z = a\sqrt{2\varepsilon}.$$

With $\varepsilon \approx (1/2)(V'/V - 2F'/F)^2$ small,

$$n_s \approx 1 - 2\varepsilon - \eta \approx -4F''/F.$$

Therefore tilt originates from geometry of the running Planck mass.

4. UV Interpretation

ASG belongs to induced gravity class. Horizon exit probes the RG crossover of gravitational coupling, making CMB observables probes of quantum gravity structure.

5. Reheating

Inflation ends when $F'(\chi) \to 0$ rather than potential steepening.

Reheating temperature $T\_reh \propto U(\chi\_exit)^{1/4}$, giving a post-inflation observable consequence.

Conclusion

ASG predicts inflationary observables are measurements of gravitational RG derivatives: n_s from curvature and r from slope. Future detection of r~10^-4 would support geometry-driven inflation.

ASG ns--r trajectory (analytic chi*)

Effective Planck mass deformation F(χ) (left panel) and **Einstein-frame potential U=V/F^2 (normalized)** (right panel), each shown for $\beta=0.000$, $\beta=0.010$, $\beta=0.020$, and $\beta=0.035$.