Active Screen Gravity — Unified Scalar-Tensor RG Model

1. Motivation

We propose a scalar-tensor formulation of gravity where the effective Planck mass is a dynamical field.
The theory interprets gravitational running as an effective macroscopic manifestation of renormalization group flow.
This provides a unified description of inflation, late-time acceleration, and strong-curvature phenomena.

2. Action

The theory is defined by the covariant action:
$S = \int d^4x \sqrt{-g} \, [1/2 \, F(\chi) R - 1/2 \, (\nabla\chi)^2 - V(\chi)]$

where $F(\chi)$ acts as a dynamical Planck mass:
$M_{Pl}^2(\chi) = F(\chi)$

3. RG Interpretation

We interpret the scalar field χ as encoding running of gravitational coupling:
$G_{eff}(\chi) = 1/(8\pi F(\chi))$

Inspired by RG flow:
$dG/d \ln \mu = a G^2$

This implies logarithmic running of the effective Planck scale.

4. Cosmological Dynamics

In FLRW spacetime the field equations produce inflation for large curvature
and dark energy behaviour at low curvature without introducing separate fields.

Inflation arises near a quasi-inflection region of the Einstein-frame potential.

5. Perturbations

Scalar perturbations are obtained from the Mukhanov–Sasaki equation:
$v'' + (k^2 - z''/z) v = 0$
$z = a \varphi'/H$

This generates the primordial power spectrum $P_s(k)$.

6. Physical Interpretation

The theory represents an effective macroscopic description of vacuum polarization effects that dynamically modify gravitational strength across energy scales.

7. Predictions

- Inflationary spectral tilt
- Tensor-to-scalar ratio
- Late-time equation of state evolution
- Possible near-horizon modifications