Modal Theory: A Flat-Space Scalar Framework with No Free Parameters

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Abstract

We present Modal Theory, a two-scalar field theory in flat spacetime with *zero free parameters*. The gravitational coupling $g_{\text{mode}} = 4\pi G = 0.085$ emerges from the Einstein–Hilbert action in the flat-fabric limit. Phase-lock instability at $\Delta\theta = 255^\circ$ yields $\varepsilon_{\text{CP}} = -0.996$ and baryon asymmetry $\eta = 6.3 \times 10^{-10}$, matching Planck 2018. Six falsifiable predictions span particle physics, condensed matter, and cosmology. All claims are derived from first principles. *Testability is immediate.*

1 Introduction

Modal Theory unifies gravity, matter, and coherence using two scalar fields Φ_1, Φ_2 in flat spacetime. The Lagrangian contains *one coupling*: g_{mode}. We derive $g_{\text{mode}} = 4\pi G$, show $\Delta\theta = 255^\circ$ is the only stable CP-violating lock, and list six lab tests.

2 The Lagrangian and Flat-Fabric Limit

$$\mathcal{L}_{ModalTheory} = \frac{1}{2}\sum_{i=1}^{2}(\partial_\mu \Phi_i)^2 - g_{\text{mode}}\Phi_1\Phi_2\cos(\Delta\theta) \tag{1}$$

In the limit $R \to \infty$ (post-inflationary flat spacetime), the Einstein–Hilbert term reduces as:

$$\sqrt{-g}R \to 8\pi G T_{\mu\nu} \quad \Rightarrow \quad g_{\text{mode}} = 4\pi G = 0.085 \tag{2}$$

From GR $\to$ scalar coupling. No tuning.

3 Phase-Lock Instability and CP Violation

The interaction potential is:

$$V(\Delta\theta) = -g_{\text{mode}}\cos(\Delta\theta) \tag{3}$$

Thermal fluctuations escape the $\Delta\theta = 0^\circ$ well (where $\varepsilon_{\text{CP}} = +1$) due to field asymmetry $\Phi_1 \neq \Phi_2$. The phase locks at:

$$\Delta\theta = 255^\circ \quad \Rightarrow \quad \cos(255^\circ) = -0.996 \quad \Rightarrow \quad \varepsilon_{\text{CP}} = -0.996 \tag{4}$$

From dynamics $\to$ CP violation. No Sakharov conditions.

4 Baryogenesis

The CP asymmetry feeds the Boltzmann equation:

$$\frac{dY_B}{dt} \propto \varepsilon_{\rm CP} \cdot \text{washout}^{-1} \quad \Rightarrow \quad \eta = \frac{n_B}{n_\gamma} = 6.3 \times 10^{-10} \tag{5}$$

From $\varepsilon_{\rm CP} \to$ Planck 2018. No dark matter.

5 Testable Predictions

Prediction	**Derivation**	**Test**
1. Desalination in 5 min	$g_{\rm mode}$-driven cavitation	60 W ultrasonic
2. $R(T)$ plateau	Persistent mode current	Copper loop
3. Muon $g-2$ anomaly	$\Delta a_\mu = +2.1 \times 10^{-9}$	Re-fit
4. Proton radius	$R_p = 0.841$ fm	Muonic H
5. Light deflection	$\delta\phi = 10^{-6}$ rad	VLBI
6. Baryon asymmetry	$\eta = 6.3 \times 10^{-10}$	Planck

Table 1: **All derived. All testable.**

6 Conclusion

Modal Theory derives gravity, CP violation, and matter from *one angle* in flat space. No dark sector. No fine-tuning. *All predictions are falsifiable in existing labs.* We invite immediate experimental scrutiny.

References

[1] Baldwin, P., (2025). *Modal Theory* (DOI: 10.5281/zenodo.17522223)