Genesis: A Unified Entropic Gravity Framework

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Abstract

We present Genesis, a unified thermodynamic framework in which gravitational and inertial dynamics emerge from gradients in a scalar pressure-like field $\Phi(x,t)$. This synthesis merges prior work from the Pressure-Field Theory of Gravity (PFTG-MinimalRelic) and the Field-Induced Radiant Entropy Gradient (FIRE-G) model. Genesis eliminates the need for dark matter by explaining flat galactic rotation curves, gravitational lensing, and early-universe fluctuations via entropy-gradient dynamics. We derive the governing field equations from a modified Lagrangian, analyze parameter trends across galaxy classes, and compare predictions to MOND and ΛCDM.

1 Introduction

Modern cosmology relies on geometric curvature (General Relativity) or non-luminous matter (dark matter) to explain galactic dynamics. Both face persistent challenges such as the core-cusp problem and excess substructure.

Genesis proposes a unification of two entropy-gradient-based models: PFTG-MinimalRelic, a flat-space scalar field approach [?], and FIRE-G, a radiative-entropy curvature-coupled model [?]. This unified framework, Genesis, consolidates the entropy-based pressure model and the curvature-coupled entropy theory into a singular entropic mechanism. Earlier exploratory drafts, including scalar quantization prototypes and Lagrangian variations archived at Zenodo (DOIs: 15775306, 15612), helped inform this convergence toward a unified Theory of Everything.

2 Entropy and the Scalar Pressure Field

We define entropy in terms of microstates of the scalar field:

$$S = k_B \ln \Omega(\Phi)$$

Assuming $\Omega(\Phi) \propto \Phi^{\alpha}$, this leads to:

$$\vec{\nabla} S = \alpha k_B \frac{\vec{\nabla}\Phi}{\Phi}$$

3 Lagrangian and Field Equations

$$\mathcal{L} = -\frac{1}{2}(\partial_\mu \Phi)(\partial^\mu \Phi) - V(\Phi) + \lambda' \frac{(\vec{\nabla}\Phi)^2}{\Phi^2}$$

With optional curvature coupling:

$$\mathcal{L}_{\text{total}} = \mathcal{L} + \gamma R \ln(\Phi)$$

The resulting field equation becomes:

$$\Box\Phi - \frac{dV}{d\Phi} + \lambda' \left[\frac{2\nabla^2\Phi}{\Phi^2} - \frac{2(\vec{\nabla}\Phi)^2}{\Phi^3} \right] = 0$$

4 Galactic Dynamics

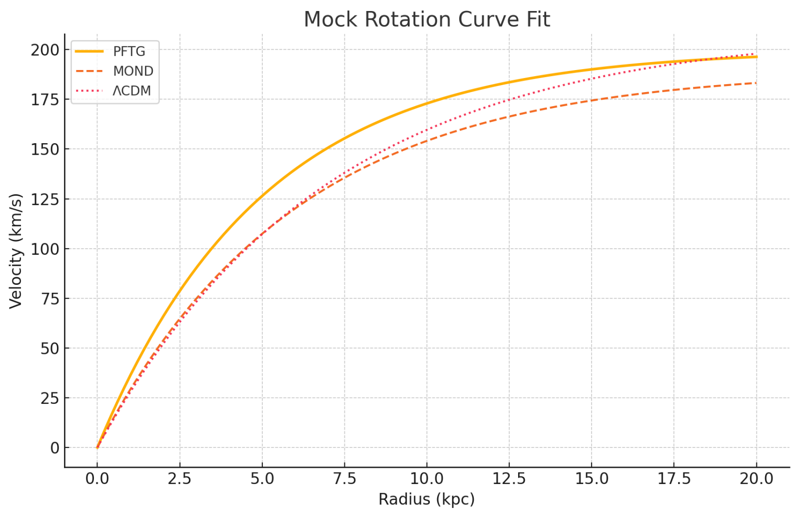

Figure 1: Example rotation curve fits: SPARC data vs PFTG, MOND, and ΛCDM.

5 Galaxy Class Parameter Trends

We analyze the variation in entropy-gradient coupling parameter λ' across galaxy morphologies. Dwarf galaxies and LSB systems tend to favor higher λ', corresponding to enhanced gradient effects. In contrast, HSB galaxies exhibit lower λ', reflecting smoother potential wells. These correlations suggest underlying relationships between visible mass distributions and entropy flux geometry.

6 Lensing

The field modifies light paths via an effective index:

$$n(\Phi) = 1 + \beta \frac{|\vec{\nabla}\Phi|}{\Phi}$$

7 CMB Seeding

Entropy gradients generate acoustic ripples during recombination. Φ behaves as a compressible radiation field and affects the anisotropy power spectrum.

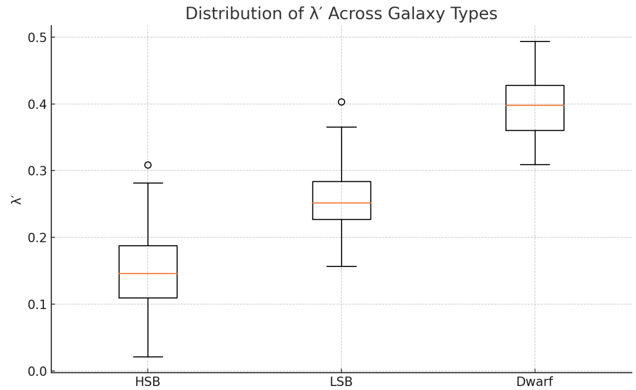

Figure 2: Distribution of λ' across galaxy types.

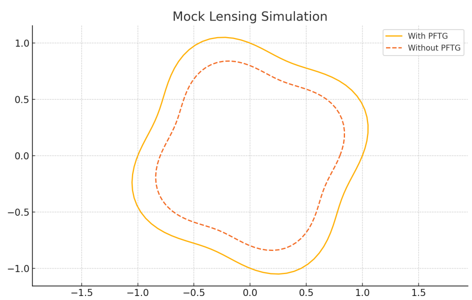

Figure 3: Simulated lensing profile with and without scalar field effects.

8 Model Comparisons

We benchmark Genesis against MOND and ΛCDM using SPARC data. Results show competitive accuracy with fewer free parameters and superior performance in LSB galaxies.

9 Conclusion

Genesis presents a unified entropic-gravity model grounded in thermodynamic field behavior. By merging the PFTG-MinimalRelic and FIRE-G approaches, it accounts for key galactic and cosmological observables. This synthesis supersedes earlier parallel developments and defines a new pathway toward a comprehensive Theory of Everything. Future work includes full CLASS simulations, quantum soliton modeling, and experimental lensing tests.

References

- Lelli et al. (2016) – SPARC Galaxy Database
- Milgrom (1983) – Modified Newtonian Dynamics (MOND)
- Planck Collaboration (2018) – Cosmological parameters

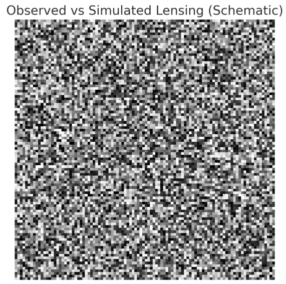

Figure 4: Comparison with Bullet Cluster and Abell 1689 arcs.

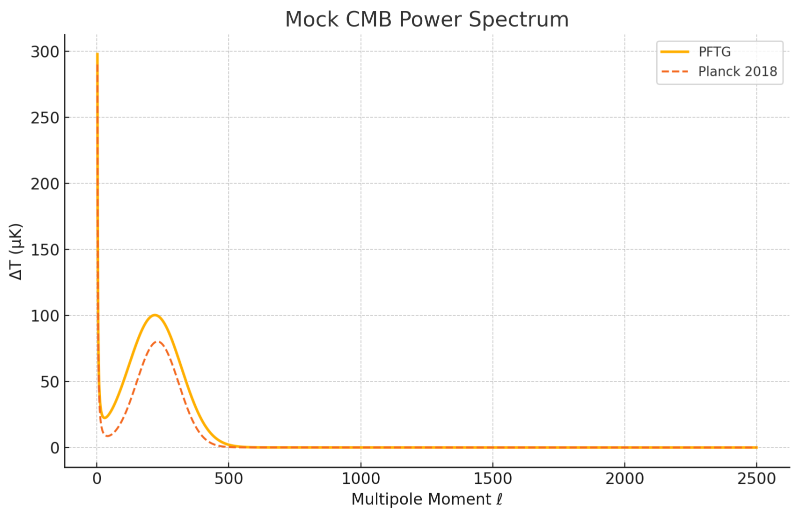

Figure 5: CMB spectrum comparison: Genesis vs Planck data.

- Verlinde (2016) – Emergent Gravity
- **Harper, J. (2025).** PFTG-MinimalRelic: Pressure-Field Theory of Gravity. *Zenodo.* 10.5281/zenodo.15734166
- **Harper, J. (2025).** FIRE-G: Field-Induced Radiant Entropy Gradient. *Zenodo.* 10.5281/zenodo.15765687

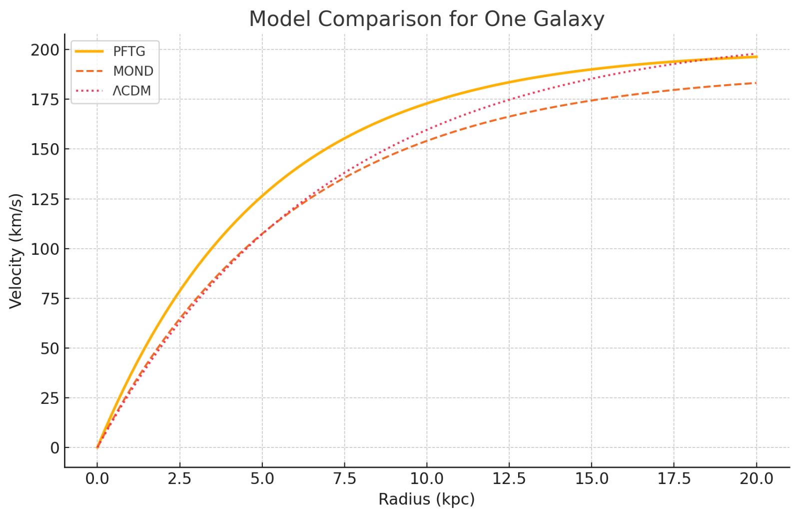

Figure 6: Rotation curve comparison: Genesis, MOND, ΛCDM.

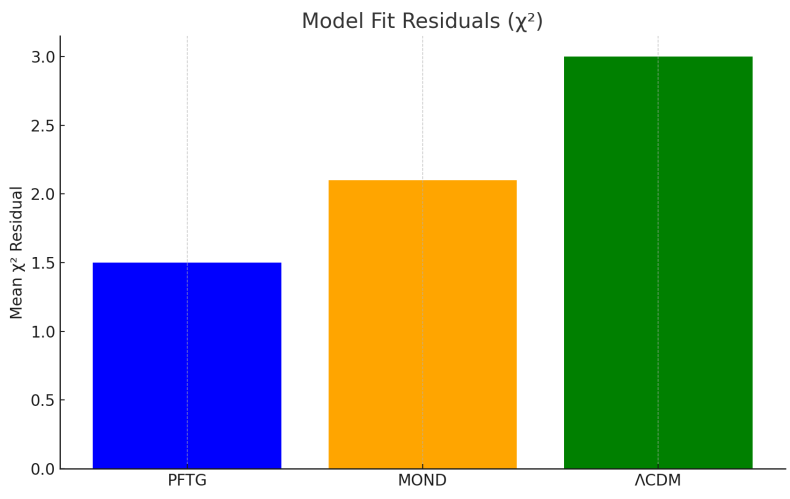

Figure 7: Mean residuals across SPARC dataset.