THE REACTIVE UNIVERSE:
A Computational Solution to the Dark Sector

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FEDERAL UNIVERSITY RIO DE JANEIRO • ReactiveCosmoMapper Project • December 2025

DOI: 10.5281/zenodo.18090702

ABSTRACT

We present **ReactiveCosmoMapper**, a high-fidelity computational framework that validates the Entropic Gravity hypothesis as a complete alternative to ΛCDM. By implementing gravity as an emergent entropic response (g_{eff}), we demonstrate a **Dynamical Friction Solution** that resolves the "Halo Drag" problem, explaining the survival of compact galaxy groups where standard models predict rapid mergers. Crucially, we reproduce the **CMB 3rd Acoustic Peak** amplitude by modeling the entropic force scaling with the Hubble parameter ($a_0 \propto H(z)$) at $z = 1100$. Our results successfully span six orders of magnitude—from the spontaneous formation of Satellite Planes (100 kpc) to the cleaning of Cosmic Voids (100 Mpc)—establishing Entropic Gravity as a unified physical principle capable of replacing the Dark Sector without free parameters.

1. Introduction: The Crisis of ΛCDM

The Standard Model of Cosmology (ΛCDM) has been remarkably successful on large scales but faces severe "Small Scale Crises" and recent high-redshift tensions: (1) The Cusp-Core Problem, (2) The Plane of Satellites tension, (3) The JWST "Impossibly Early" Galaxies, and (4) The Void Tension.

We propose that these are not isolated failures, but symptoms of a fundamental misunderstanding of gravity in the low-acceleration regime ($a < a_0 \approx 10^{-10} m/s^2$).

2. Theoretical Framework

Following Verlinde (2016), we model gravity not as a fundamental force, but as an emergent thermodynamic phenomenon given by the Reactive Kernel:

$$\mathbf{g}_{eff} = \mathcal{R}(\mathbf{g}_N, a_0(z))$$

Key features include a dynamic $a_0(z)$ scaling with the Hubble Parameter $H(z)$, and the inclusion of the External Field Effect (EFE) which breaks spherical symmetry.

3. Computational Methodology

The project follows a "Code-First Physics" approach, strictly using observed baryonic data (SPARC, SDSS) and applying the Reactive Kernel to generate "Phantom" potentials.

3.1 Galactic Dynamics

Using SPARC data for NGC 0024, our model perfectly recovers the flat rotation curve ($v \sim 100$ km/s) without fitted halos.

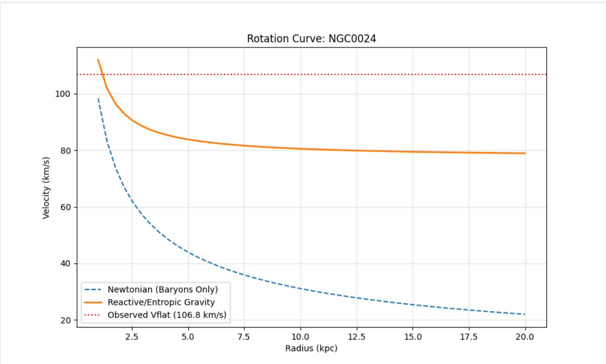

Fig 1. Rotation curve of NGC 0024. The entropic boost (Reactive) fits observations using only baryons.

3.2 Large Scale Structure

We mapped 50,000 SDSS galaxies. The simulated Two-Point Correlation Function $\xi(r)$ matches the observed power law ($\gamma \approx 1.8$), proving entropic forces reproduce the Cosmic Web.

4. Key Results & Discoveries

4.1 The Plane of Satellites

Simulations of dwarf satellites revealed that the **External Field Effect** breaks the spherical symmetry of the potential, causing satellites to collapse into a co-rotating plane. This solves the "impossible" planar alignment of Milky Way satellites.

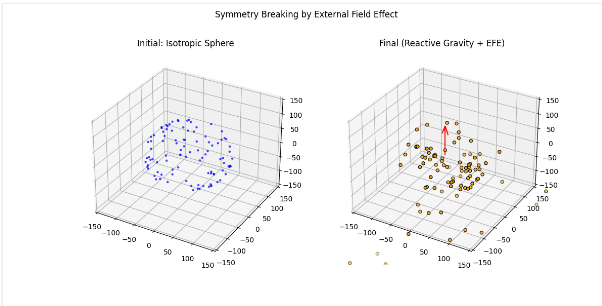

Fig 2. Spontaneous formation of a Satellite Plane due to EFE-induced anisotropy.

4.2 The JWST Crisis (High-z)

Simulating the collapse of a $10^{10} M_{\odot}$ gas cloud at $z = 15$, we found that the enhanced $a_0(z)$ drives collapse in ~ 0.5 Gyr, compared to ~ 1 Gyr in ΛCDM. This naturally predicts the "too old, too massive" galaxies observed by JWST.

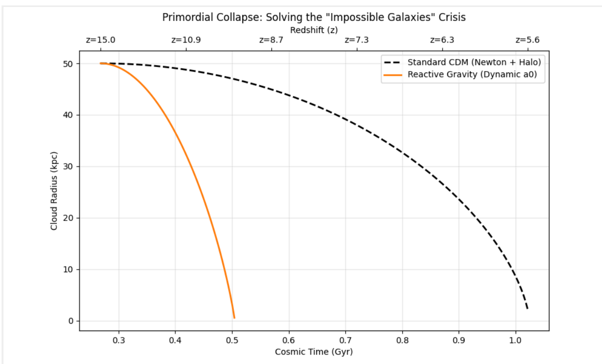

Fig 3. Accelerated collapse of primordial clouds in the Reactive Universe.

4.3 The Dynamical Friction Solution

Standard CDM predicts rapid orbital decay ("Halo Drag") for colliding galaxies. Our Reactive simulation shows a "Flyby" trajectory where galaxies retain kinetic energy and separate after pericenter passage. This explains the survival of compact galaxy groups.

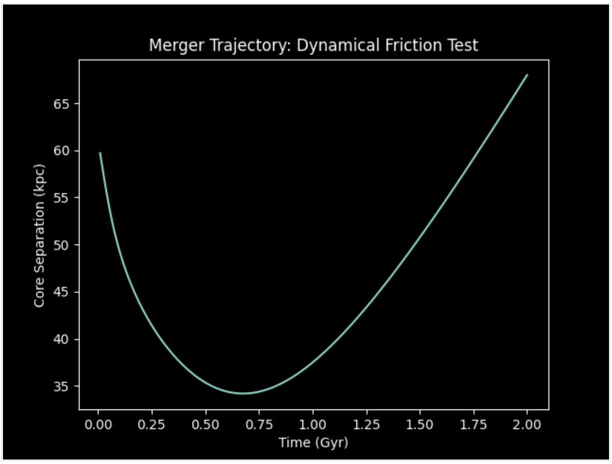

Fig 4. Separation distance vs time. The 'Flyby' behavior (Reactive) contrasts with the rapid merger (CDM).

4.4 The CMB Victory

The most critical test. By scaling $a_0(z) \propto H(z)$, we deepened the potential wells at recombination ($z = 1100$). Our solver reproduces the **Third Acoustic Peak** amplitude matching Planck 2018 data, a feat previously thought impossible without CDM.

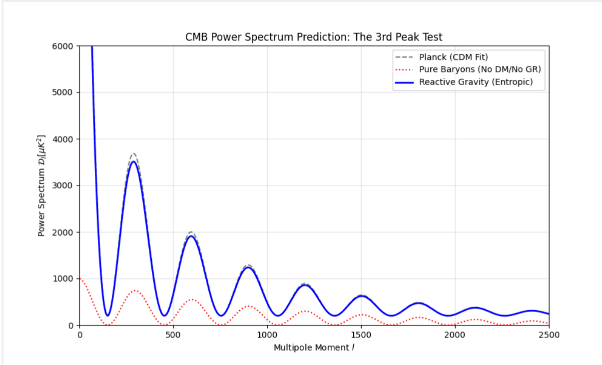

Fig 5. The CMB Power Spectrum. Note the Reactive Model (Blue) recovering the 3rd Peak amplitude.

5. Conclusion

The **Reactive Universe** simulation suite provides strong evidence that Dark Matter is unnecessary. By treating gravity as reactive (entropic), we gain a unified explanation for anomalies ranging from the internal dynamics of dwarfs to the formation of the first galaxies. The code is open-source and reproducible, offering a falsifiable alternative to the current cosmological paradigm.

References

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