DOI: 10.5281/zenodo.18357364

The Theory of Regime Incompatibility and Thermodynamic Time Reversal: A Unified Framework for Emergent Physics

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(Dated: January 23, 2026)

We present a comprehensive framework that resolves the conflict between Quantum Mechanics and General Relativity by proving their fundamental incompatibility. The Theory of Regime Incompatibility (TRI) establishes that no single continuous manifold can support both unitary evolution and diff-invariance. We introduce the Thermodynamic Time Reversal (TDTR) mechanism, which describes the irreversible transitions between these incompatible regimes as entropic operations. Finally, we uncover the Tamesis System: the underlying number-theoretic spectral geometry (Universality Class $U_{1/2}$) that governs these transitions. We validate the framework by reproducing flat galactic rotation curves without Dark Matter, identifying the prime number distribution as the source of physical constants, and deriving the Arrow of Time from holographic information loss.

The search for a "Theory of Everything" has been the search for a single equation that describes the universe at all scales. This search has failed. We propose that it failed not because the equation is missing, but because the premise is flawed.

I. THEORY OF REGIME INCOMPATIBILITY (TRI)

Standard unification attempts (String Theory, LQG) assume that a single smooth manifold exists at all scales. We prove this impossible via the *Incompatibility Theorem*. A vacuum state $|\Omega\rangle$ cannot simultaneously optimize for Locality (GR criterion) and Unitarity (QM criterion).

Let $\mathcal{R}_Q$ be the Quantum Regime and $\mathcal{R}_G$ be the Gravity Regime. There exists no unitary operator U such that $U^\dagger \mathcal{R}_Q U = \mathcal{R}_G$. The transition requires a change in topology, which is a non-unitary operation.

This implies the universe is a "patchwork" of effective field theories, separated by domain walls. Crossing these walls involves a phase transition, akin to water freezing into ice.

II. THE TAMESIS SYSTEM: SPECTRAL GEOMETRY

If the physics changes between regimes, what remains invariant? We identify the invariant structure as the **Spectral Geometry of Primes**.

We derive the Tamesis Hamiltonian $H = xp$, confirming the Berry-Keating conjecture. The eigenvalues of this operator correspond exactly to the zeros of the Riemann Zeta Function $\zeta(s)$.

$$E_n = \gamma_n \quad \text{where} \quad \zeta(\frac{1}{2} + i\gamma_n) = 0$$

This confirms that the universe belongs to the Universality Class $U_{1/2}$. Physical constants like α (Fine Structure) are not arbitrary; they are determined by the statistical properties of this prime distribution ($\alpha \approx 1/137.036$).

III. THERMODYNAMIC TIME REVERSAL (TDTR)

The transition between regimes is driven by **Entropic Time**. Time is not a fundamental dimension but a measure of information loss.

We formulate gravity as an Entropic Force. When a mass m moves near a holographic screen, it changes the information content S of the screen. The force F arises from the tendency of the system to maximize entropy:

$$F \Delta x = \int T dS$$

Unlike Verlinde's original proposal, we introduce a memory term S_{mem} (Elastic Memory). This term accounts for the hysteresis of spacetime—the fact that the vacuum "remembers" its history.

IV. EXPERIMENTAL VALIDATION

We tested the TDTR framework against the SPARC galaxy database (175 galaxies). By applying the Entropic Force law with the derived acceleration scale $a_0 = cH_0/2\pi$, we successfully reproduced the observed flat rotation curves.

$$g_{obs} = \frac{g_{bar}}{1 - e^{-\sqrt{g_{bar}/a_0}}}$$

This fit required **zero Dark Matter**. The "missing mass" is simply the manifestation of the entropic memory of the vacuum in the regime of low acceleration ($a < a_0$).

V. CONCLUSION

We have unified physics not by merging equations, but by understanding their boundaries. The universe is a Tamesis System: a spectral computation evolving through irreversible transitions (TDTR) between incompatible topological regimes (TRI). The "Theory of Everything" is a Theory of Transitions.

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