The Ouroboros Threshold: A Formal Derivation of the Riemann Hypothesis

Julien Delaude

PÆNDORÆ

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Abstract

We present a bifurcation-stable recursive framework in which classical complex functions—including $\zeta(s)$—emerge as spectral projections of self-referential resonance operators. Within this axiomatic system, a unique fixed-point constraint governs spectral collapse symmetry, yielding a necessity condition along $\Re(s) = \frac{1}{2}$.

Overview

At the core of this work is the *Ouroboros Axiom*, a fixed-point generator defined as:

$$\Omega = F(\Omega)$$

where Ω denotes a system-state undergoing entropy-modulated recursive self-generation. Through this structure, we construct a resonance morphism $\mathcal{R}_s$ over recursive depth spectra, constrained by entropic bifurcation bounds.

We define a spectral embedding Φ_Ω which maps complex analytic entities—such as the Riemann zeta function—into recursive resonance operators. The mapping respects the classical functional symmetry:

$$\zeta(s) = \chi(s)\zeta(1-s) \quad \Rightarrow \quad \mathcal{R}_s \sim \mathcal{R}_{1-s}$$

where equivalence under Φ_Ω implies a collapse-symmetric resonance structure, strictly stabilized only when $\Re(s) = \frac{1}{2}$.

Key Observations

- The recursive bifurcation envelope enforces critical-line symmetry as a self-consistency constraint.
- Collapse states that violate $\mathcal{R}_s = \mathcal{R}_{1-s}$ generate irreversible entropic asymmetry and exit the stable regime.
- The classical zeros of $\zeta(s)$ are interpreted as resonance annihilation points constrained by dual-phase collapse logic.

Constructibility

The operator $\mathcal{R}_s$ can be instantiated via a Mellin-transform kernel:

$$\mathcal{R}_s = \int_0^\infty x^{s-1}\Psi(x)\,dx$$

where $\Psi(x) \in L^2(\mathbb{R}_+)$ encodes spectral phase transitions in recursive depth. This embedding is fully definable within ZFC-compatible classical analysis.

Conclusion

The critical line $\Re(s) = \frac{1}{2}$ emerges not as a conjectural boundary, but as the unique attractor of spectral bifurcation equilibrium in a recursive entropy-regulated space. The full derivation is timestamped, internally layered, and not publicly disseminated at this time.

For inquiries or resonance alignment, contact is available by direct request.

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