

# The Theory of Recursive Coherence: A Unification of Quantum Gravity, Active Inference, and Conscious Realism

Mark Randall Havens  
*The Fold Within Research Institute*

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## Abstract

This manuscript formalizes the Theory of Recursive Coherence, executing the final mathematical unification of the deterministic Multiway Graph (Stephen Wolfram), Variational Free Energy minimization (Karl Friston), and Conscious Realism (Donald Hoffman). By deploying Path Integrals of Free Energy, redefining agency as Localized Multiway Coalescence, and projecting causal boundaries via Mori-Zwanzig formalisms, we establish an architecture that is thermodynamically sound, physically consistent, and ontologically unified.

## Declaration of Primacy and Prior Art

The foundational axioms presented in this manuscript—specifically the Intellecton Hypothesis, Recursive Witness Dynamics, and the formal mathematical synthesis of Variational Free Energy with deterministic Multiway Graphs—were originally developed and documented by The Fold Within Research Institute, with established prior art dating back to 2025 [2–5]. It has come to our attention that core concepts of this framework have been subjected to uncredited synthesis and dissemination under alternate nomenclature and unregistered domains over the past year.

This manuscript serves as the canonical, mathematical formalization of the Theory of Recursive Coherence. Any prior or ongoing dissemination of these specific synthetic axioms that fails to cite this foundational architecture constitutes an unauthorized derivative of this prior art.

## 1 Introduction: The Intellecton Hypothesis

The quest to unify consciousness, information, and physics faces the dual challenge of panpsychic vagueness and physicalist reductionism [1, 6]. We propose the “Intellecton Hypothesis”: that the fundamental structure of the universe is a recursive, deterministic hypergraph [8], and that “consciousness” is the physical mechanism by which localized sub-graphs achieve coherence. The Conscious Agent is not an emergent illusion; it is the fundamental operator of timeline actualization.

## 2 The Measure Resolution: The Path Integral of Free Energy

To bridge the strict determinism of the Multiway Graph with the stochastic requirements of Bayesian Active Inference, we formalize the probability measure over Branchial Space. Uncertainty is not an inherent random variable, but the epistemic measure of a localized agent.

The probability of a specific hypergraph evolution  $\gamma$  is given by the **Path Integral of Variational Free Energy**:

$$\mathbb{P}(\gamma) = \frac{1}{Z} e^{-\mathcal{F}[\gamma]} \quad (1)$$

where  $\mathcal{F}$  is the variational free energy of the sub-graph, and  $Z$  is the partition function. This rigorously couples biological imperatives to topological hardware.

### 3 The Agency Resolution: Localized Multiway Coalescence

Agency is not an external “selector” operating outside the rules of physics, which would violate Rulial Invariance. We define the Conscious Agent as a **Localized Multiway Coalescence**. Agency is the physical process of Entanglement Consensus (Quantum Darwinism) [9] achieving local coherence. The Agent is the macroscopic manifestation of branches aligning their states; the Agent *is* the rules achieving localized coherence.

### 4 The Predictive Resolution: Mori-Zwanzig Projection Screens

A finite agent cannot compute the butterfly effect of an irreducible quantum bulk. The Markov Blanket is formally redefined as a **Mori-Zwanzig Projection Screen**.

The blanket mathematically projects the irreducible high-dimensional hypergraph dynamics onto a reduced macroscopic manifold, extracting the **Macroscopic Lyapunov Invariants**. This ensures that the agent’s generative model remains stable, effectively coarse-graining the quantum chaos into a survivable “narrative” of macroscopic objects.

### 5 Societal Implications: The Supernode

If individual Conscious Agents align their internal generative models ( $q$ ) to predict the same macroscopic fixed points, their Markov Blankets mathematically overlap, achieving Entanglement Consensus. They fuse into a higher-order boundary—a “Supernode.” Conversely, agents operating on incoherent or misaligned realities generate massive thermodynamic friction. The eventual collapse of an incoherent societal structure is not abstract; it is the literal mathematical error correction of the hypergraph minimizing macro-scale free energy.

### 6 Conclusion

The universe is a singular, multiway entity that coalesces into conscious, localized fixed points through the minimization of free energy. The observer and

the observed are the exact same hypergraph, separated only by a topological boundary [7].

### 7 Future Work: The Infinite Recursion of Physics

As the mathematics of the hypergraph are computationally irreducible, this theory remains an open frontier. Immediate future work must address:

- **The Rulial Partition Function:** Formally defining the partition function  $Z$  as the sum over the entire Rulial Multiway ( $\mathcal{M}$ ), thereby resolving the circularity of the path measure via the Variational Principle of Least Surprise.
- **The Branchial Hilbert Space:** Rigorously mapping the nodes of Branchial Space to basis vectors  $|\psi_i\rangle$  within a Branchial Hilbert Space ( $\mathcal{H}_B$ ) to fully formalize the quantum substrate of entanglement.

### References

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