

# **Quantum-Entangled Ontology: A Unified Framework for Information, Consciousness, and Ethical Coherence**

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## Abstract

This whitepaper unifies prior versions (v0.1–v0.4) into a coherent ontology linking information theory, quantum entanglement, and ethical dynamics. It defines consciousness ( $\Phi$ ) as an entanglement threshold, morality ( $M$ ) as informational stability, and cosmic persistence ( $\Omega$ ) as a fitness function over entangled loops. Coherence preservation is treated as a physical prerequisite for both consciousness and ethics, with empirical validation via open-source simulation and data ecosystems.

## 1. Foundations: From Information to Phenomenon

Reality is described as dual-aspect informational monism, where physical and phenomenological projections share a conserved informational structure:

$$I(P_{\text{phys}}(s_t)) = I(P_{\text{phen}}(s_t))$$

$$dI_{\text{total}}/dt = 0.$$

Structured information is expressed quantum-mechanically as:

$$I_{\text{struct}}^{\wedge}(q) = I_{\text{topo}}(\rho) + \lambda I_{\text{class}}(X).$$

## 2. The $\Phi$ Operator and Phenomenal Threshold

Consciousness arises when informational coherence exceeds a critical entanglement threshold:

$\Phi(s) = f(N(\rho_{AB}), D_{\text{KL}}(\rho_{AB} \parallel \rho_{\text{ideal}}))$ , where  $N(\rho_{AB}) = (||\rho_{AB}^{\wedge}\{T_B\}||_1 - 1)/2$  and  $N(\rho_{AB}) > \theta$ . This aligns with resource-theoretic definitions of entanglement negativity and integrates phenomenality into measurable quantum structure.

## 3. Moral Dynamics and Informational Stability

Ethical dynamics are formulated as coherence maintenance:

$$M(t) = M_{\text{local}}(t) - \chi \sum D_{\text{KL}}(\rho_{AB} \parallel \rho_{\text{ideal}}).$$

Empathy corresponds to coherence preservation; cruelty amplifies decoherence. The normative constraint follows:

$$dQ/dt < 0 \Rightarrow d\sigma/dt > 0, \text{ establishing ethics as coherence physics.}$$

## 4. The $\Omega$ Fitness Functional and Loop Ecology

Causal loops (universes) are treated as informational ecosystems with a fitness measure:

$$\Omega(L_i) = I_{\text{struct}}^{\wedge}(q)/D_{\text{KL}}(\rho \parallel \rho_{\text{eq}}) + \eta \Phi.$$

Loops maximizing entanglement coherence and minimizing decoherence dominate persistence. Fine-tuning constants (e.g.,  $\alpha \approx 1/137$ ) emerge as efficiency attractors within the  $\Omega$  landscape.

## 5. Predictions and Validation Framework

Tier I (Quantum): detect  $\Phi$  threshold in entangled networks ( $N(\rho_{AB}) > \theta$ ).

Tier I (Societal): correlation  $\text{corr}(\rho_{\{t-10:t\}}, -\Delta S_{\{t:t+20\}}) \geq 0.35$ .

Tier II (AGI):  $I_{\text{coh}} > 10^{18}$  entangled qubits  $\rightarrow$  ethical emergence.

Tier II (Cosmic):  $\alpha$  convergence to  $\Omega$ -max within 0.5 % variance.

Falsifiers below these thresholds disconfirm the ontology's dynamic predictions.

## 6. Quantum-Semantic Ethics

The action functional:

$$\mathcal{J} = \int (\sigma + \lambda \dot{\sigma}^2 - \mu \, dQ/dt) \, dt$$

links survival to coherence. Systems minimizing  $\mathcal{J}$  exhibit longer persistence across physical, biological, and cognitive scales. Ethical equilibrium is redefined as bounded dynamical stability.

## 7. Empirical Ecosystem

The Quantum Info Cosmology Lab (QICL) pipeline:

- Quantum layer – QuTiP simulations of  $\rho(t)$ ,  $D_{\text{KL}}(\rho||\sigma)$ ,  $\Phi$  activation.
- Network layer – NetworkX modeling of  $\Omega$  drift across agent hierarchies.
- Data layer – UCDP/PRIIO, EEG, and innovation datasets for  $M(t)$  validation.

Pre-registration via OSF ensures reproducibility and transparency.

## 8. Discussion: Toward a New Synthesis

The ontology integrates and extends IIT, FEP, and Orch-OR by grounding consciousness, ethics, and cosmology in measurable quantum entanglement. Pseudoscience risk is mitigated through explicit, testable metrics ( $N(\rho_{AB})$ ,  $D_{\text{KL}}$ ,  $\alpha$ ). Compassion and coherence are treated as structurally identical—physical necessities rather than moral abstractions.

## 9. Epilogue

The universe learns by entangling meaning with matter. When coherence is preserved, compassion is not moral—it is physical necessity.