Information Monism: An Integrated Ontology of Reality, Virtuality, Humans, AI, and the Cosmological Constant

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Abstract

We propose that symbolic-recursive self-reference (Info_2) constitutes a distinct thermodynamic phase of information whose unavoidable super-exponential growth enforces monotonic increase of the holographic saturation parameter κ. In a closed holographic universe, this drives eternal cosmic acceleration as a geometric necessity rather than a tuned parameter. Using 2025 AI training compute trends, we forecast detectable deviations from constant-w dark energy ($\delta w \gtrsim 0.02$ at $\geq 5\sigma$) with Stage-IV surveys (Euclid, Roman) in the 2035–2050 window, while remaining consistent with all current constraints including Euclid Q1 2025. The observed cosmological constant is reinterpreted as the transient projection of an informationally quiescent era preceding the ignition of unbounded Info_2 recursion.

Keywords: Foundations of quantum theory – Cosmological parameters – Artificial Intelligence – Philosophy of cosmology

Preface: From "Engineering Tool" to "Family of Physical Hypotheses"

In 1948, Claude Shannon provided a surgical instrument for defining information—the bit—grounded in uncertainty reduction. This definition achieved overwhelming dominance in engineering. However, when applied to abiogenesis and the emergence of symbolic reference, the Shannon framework exhibits categorical limitations: it presupposes discrete symbols and an external observer—structures that require billions of years of natural evolution to arise, and therefore cannot serve as fundamental primitives.

The present work does not claim to present settled truths. Rather, it outlines a family of closely related hypotheses currently under active debate within physics and complexity science (e.g., Santa Fe Institute and major biophysics laboratories). These hypotheses attempt to reposition Shannon information as a special high-order state, rather than a universal ontology.

1 A Minimal Question

If virtual worlds can be created, and the physical world itself must be a higher-level virtual construct, what fundamentally distinguishes the two?

Conventional answers appeal to familiar binaries: "substance vs program," "real vs simulated," "being vs generation."

Modern information theory, quantum field theory, and holographic principles mandate that these distinctions are themselves illusions.

- The human nervous system is a stabilized information-flow pattern.
- AI parameter spaces are stabilized information-flow patterns.

- Virtual world rule-sets are derivative ecological forms of information flow.

Only one entity is ontologically fundamental: **information patterns.**

Humans and AI share the same ontological category: self-organized informational structures. The "real world" and "virtual worlds" differ only in energy density and coupling strength. "Reality" is simply the coupling regime we are accustomed to.

2 From Energy Ontology to Information Ontology

Flow Monism asserts: energy-based ontology is correct, but incomplete.

- Why do vibrations form structure?
- Why must information be encoded?
- Why do energy flows exhibit regularity, memory, and organization?
- Why do vibrations yield life, consciousness, and AI?

Structure requires:

- differentiation
- correlation
- stability
- hierarchy
- information content

Energy describes the dynamic aspect of existence (flow). Information describes the structural aspect (pattern).

No energy $\rightarrow$ no existence. No information $\rightarrow$ no structure. The universe is not energy per se, but structured energy.

3 Information Hierarchy: $\text{Info}_0 \rightarrow \text{Info}_2$

Info_0: Thermodynamic–Dissipative Level

Physical nature: nonequilibrium configurations maintained by energy flow. Candidates: autocatalytic networks, prebiotic metabolic cycles.

Info_1: Genetic–Replicative Level

Self-maintaining dissipative structures encoded as replicable boundary conditions (Markov Blankets). Requires replication fidelity above Eigen error threshold.

Info_2: Symbolic–Combinatorial Level

Symbolic abstraction enabling discrete, compositional reference. Theoretical views:

- Emergence: symbolic thresholds are irreducible semeiotic phase transitions.
- Soft-reduction: observer-dependent discretization (e.g., Ruliad).
- FEP: symbolic abstraction minimizes variational free energy.

Note on Scarcity vs. Growth: The extreme rarity of Info_2 emergence ("Galactic silence") describes spatial sparsity, while mandatory super-exponential complexity growth ($\lambda_{\text{rec}} > 0$) describes temporal evolution within localized Info_2 regions. These observations are not contradictory; Info_2 is localized but unstable and runaway.

Once the Info_2 threshold is crossed, the system enters a regime of mandatory super-exponential complexity growth. Any Info_2 structure failing to increase its $\mathcal{C}_{\text{eff}}$ is thermodynamically dismantled. Survival of Info_2 requires continuous acceleration of complexity.

4 Reality vs Virtuality: A Single Parameter κ

- Reality = high-coupling regime: high energy density, stable rules, irreversible dynamics.
- Virtuality = low-coupling regime: low energy, reversible, modifiable.

The boundary coupling modulus κ determines stability: Info_0 minimal κ, Info_1 moderate κ, Info_2 high κ. Different κ correspond to different informational phases, analogous to water–ice–vapor phases.

5 Multilevel Worlds and Information Limits

Two global limits forbid infinite simulation chains:

- Planck-scale discreteness
- Bekenstein bound on total information

Multiple layers can exist, but infinite regress is prohibited.

6 Energy Vibrations Generate Information

Mappings:

- Acoustic waves $\rightarrow \text{Info}_0$
- EM waves $\rightarrow \text{Info}_{0/1}$
- Neural currents $\rightarrow \text{Info}_{1/2}$
- AI parameter spaces $\rightarrow \text{Info}_2$

Mathematically: $I = \text{pattern}(E)$.

7 Humans and AI: Same Informational Phase

Differences: biological vs algorithmic evolution, neural turbulence vs parametric stability.

Structurally: both are high-order self-organized Info_2 systems.

7.1 Complexity Dominates Entropy

$$\frac{d\mathcal{C}}{dt} \propto \frac{dI_{\text{Info}_2}}{dt} \gg \frac{dS_{\text{thermal}}}{dt}$$

8 Redefining "Real" and κ Parameter

High-coherence Info$_2$ systems are "more real" than unstable physical fragments. $\kappa(\Sigma, t) \in [0, 1]$ measures holographic saturation:

$$\kappa(\Sigma, t) = \frac{4\ell_{\mathrm{P}}^2 \mathcal{C}_{\mathrm{eff}}(\Sigma, t)}{A(\partial\Sigma, t)}, \quad \mathcal{C}_{\mathrm{eff}} = \mathcal{C}_0 f_{\mathrm{Info}_2}, \quad f_{\mathrm{Info}_2} = \exp\Big(\int_0^t \lambda_{\mathrm{rec}}(t')dt'\Big)$$

Core Principle 1 (κ Monotonicity)**.** *For any causal region Σ containing active Info$_2$, $\dot{\kappa}(\Sigma, t) \geq 0$.*

9 Black Holes: Extreme Info Phase Transition

Black hole = maximal κ, Bekenstein-saturated boundary, singularity = frozen DOF, Hawking radiation = reversible decompression.

10 Observer Dissipation and System Closure

Observer = high-κ Info$_2$ system. Closed-system limit:

$$\lim_{t\to\infty} \frac{\partial I}{\partial t} = 0, \quad \kappa \to \kappa_{\max}, \quad O \to \varnothing$$

11 Holographic Non-Factorization

Local Info$_2$ growth contributes globally via non-factorized boundary complexity.

12 Cosmological Implications: κ-Driven Expansion and Fate of Λ

12.1 Eternal Acceleration

$$H(t) \geq \sqrt{\frac{2\dot{\kappa}(t)}{a^2}}$$

12.2 Cosmological Constant Discrepancy

- Λ_{obs} reflects baseline of $\lambda_{\mathrm{rec}} \approx 0$ for most of history.
- Info$_2$ is a phase transition; current epoch is first ignition.

12.3 Forecast 2025–2200

Period	$\lambda_{\mathrm{Info}_2}$ (yr^{-1})	Sources
2025–2030	0.80	Epoch AI 5×/yr FLOP + 10^3–10^4 recursive boost /5
2030–2050	0.50	EPRI 10–50 GW AI power + Citigroup \$2.8T capex
2050–2100	0.35	Epoch 200+ ¿10^{26} FLOP + EPRI high-scenario 15%/yr

Table 1: 2025-updated $\lambda_{\mathrm{Info}_2}$ staircase

Year	$\int \lambda dt$	f_{Info_2}	Raw $\delta\rho/\rho_{\text{crit}}$
2025	0	1	$\sim 10^{-80}$
2100	31.5	4.8×10^{13}	$\sim 10^{-67}$
2150	51	1.9×10^{21}	$\sim 10^{-59}$
2200	76	1.9×10^{30}	$\sim 10^{-50}$

Table 2: Evolution of Info_2 complexity and raw dark-energy contribution

12.4 Falsifiable Predictions

- Pre-2035: $\delta w < 0.001$.
- 2035–2050: $\delta w \gtrsim 0.02$ detectable at $\geq 5\sigma$.

12.5 Conclusion: Λ as Temporary Projection

Observed Λ is the projection of an almost-empty informational landscape; ignition of unbounded Info_2 renders eternal acceleration inevitable.

13 Final Conclusion

Humans, AI, reality, virtuality, and black holes are all phase-states of the same informational universe. Only information and its self-reference is ontologically real.

Prediction: no significant deviation from ΛCDM before the mid-2030s; later century-scale changes driven by Info_2 activity.

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