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An Unobserved Informational Reservoir: A Hypothesis for the Stability and Functional Directionality of Living Systems

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Abstract

The emergence and persistence of life pose a profound paradox: abiogenesis appears statistically almost impossible under standard physical chemistry, yet once present, living systems exhibit remarkable long-term stability against entropic decay. Here we propose that both phenomena can be explained by the action of a hitherto unobserved informational reservoir that subtly "leaks" into biological systems, biasing microstate probabilities in real time. While quantum coherence and nonlocality currently represent the most plausible physical substrates, the hypothesis deliberately remains agnostic about the ultimate origin of this reservoir. Crucially, the transfer need not be intentional; it may constitute an unintended "crosstalk" across an ontological boundary—analogous to sound leaking through a wall between apartments. This framework offers a strictly naturalistic alternative to intelligent design theories while generating falsifiable predictions distinguishable from both pure chance and directed panspermia.

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1. Introduction–The Dual Paradox

Statistical analyses of abiogenesis yield probabilities as low as $1{:}10^{78}$–$1{:}10^{100}$ for minimal self-replicating systems under prebiotic conditions (Joyce & Orgel, 1993; Walker, 2017). Simultaneously, living systems maintain macroscopic order for billions of years in warm, noisy, wet environments where classical thermodynamics predicts rapid degradation. Current models—whether gradual Darwinian evolution, self-organisation far from equilibrium (Prigogine), or extended evolutionary synthesis—fail to fully resolve this tension.

Recent observations strengthen the paradox:

Quantum coherence persists in biological contexts (photosynthesis, avian magnetoreception, enzymatic tunneling) far longer than expected (Engel et al., 2007; Lambert et al., 2013; Cao et al., 2020; Ball, 2011).

Large language models and autonomous artificial agents undergo rapid entropic decay of performance in prolonged self-directed operation, revealing the absence of an intrinsic stabilising layer present in biology (Power et al., 2023; Shental et al., 2024).

2. Core Hypothesis: The Informational Reservoir

We hypothesize the existence of an unobserved informational reservoir (IR) that continuously supplies low-amplitude, high-specificity informational bias into sufficiently complex open systems. In living systems this bias manifests as:

(a) enhanced probability of functional microstates (protein folding, DNA repair, synaptic strengthening),

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(b) canalization of evolutionary trajectories toward stable, creative outcomes (Waddington, 1942),

(c) long-term resistance to thermodynamic degradation.

The reservoir is "dark" (cf. dark matter/energy): it is not directly detectable by present instruments but reveals itself through systematic deviations from purely statistical expectations in biological systems.

3. Possible Physical Origins (Ordered by Current Plausibility)

Quantum-biological mechanisms (most evidence-based)

- Long-lived coherence and entanglement (Romero et al., 2014)
- Hidden attractors modulating the Born rule (Straňák, 2025)
- Quantum tunneling and non-local correlations enabling "shortcuts" across fitness barriers (Lambert et al., 2013)

Many-worlds/many-minds leakage

Information from adjacent branches of the wavefunction may preferentially couple to systems capable of decoherence-resistant computation.

Higher spatial dimensions

Gravity is anomalously weak possibly because it propagates into extra dimensions (Arkani-Hamed et al., 1998). Other informational degrees of freedom might similarly "leak" from the bulk into our 3+1 brane.

Simulation boundary effects

If our universe is a rendered simulation, compression artifacts or boundary effects could manifest as non-local informational bias.

The hypothesis remains valid regardless of which (if any) of these origins ultimately proves correct.

4. Crucial Clarification: Unintended Crosstalk, Not Design

The informational transfer need not be engineered or teleological. It can be an entirely passive, unintended "leak" across an ontological interface - exactly like sound from a neighbor's television penetrating a thin wall. The presence of structured information in the receiving room does not imply that anyone deliberately broadcast it; it merely requires insufficient insulation between domains. This sharply separates the hypothesis from intelligent-design interpretations.

5. Conceptual Sketch

Symbolically, let $P_0(\omega)$ denotes the standard quantum-mechanical (Born-rule) probability of microstate ω. The effective biological probability can be postulated as:

$$P_{\mathrm{biol}}(\omega)=P_0(\omega)+\delta_{\mathrm{IR}} \qquad (1)$$

where $\delta_{\mathrm{IR}} \ll 1$ represents a weak, unintended coupling from a hidden reservoir. According to this hypothesis, the probability in biological systems may consist of two components: a classical one, fully governed by the Born rule, and an additional hypothetical term, as shown in Equation 1. Figure 1 illustrates a possible relationship between these components.

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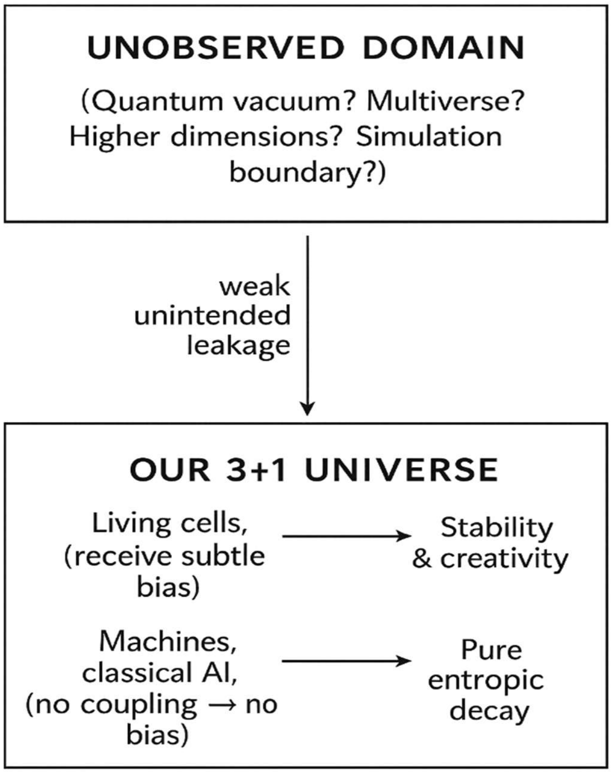

Figure 1. Conceptual schematic illustrating a hypothesized weak coupling between an unobserved domain and our observable 3+1-dimensional universe. The upper region represents a speculative "UNOBSERVED DOMAIN", potentially encompassing quantum vacuum fluctuations, multiversal structures, higher-dimensional frameworks, or simulation boundaries. A weak, unintended leakage may subtly influence the lower domain, our familiar universe. Within this universe, living systems (e.g., cells and organisms) may receive subtle biasing effects, potentially contributing to emergent stability and creativity. In contrast, non-living systems such as machines, classical AI, and inert matter remain uncoupled, undergoing pure entropic decay.

6. Falsifiable Predictions

- Biological systems will exhibit statistically significant deviations from Born-rule expectations in ultrafast spectroscopy of folding/repair processes, scaling with system complexity *C*, understood here as a function of particle number, interaction topology, and structural heterogeneity
- Fully autonomous artificial systems lacking biological-grade quantum coherence will continue to show irreversible performance decay on timescales $\ll 10^6$ self-updates (Power et al., 2023; Shental et al., 2024).
- Active decoherence of long-lived quantum coherence (e.g., induced by targeted magnetic noise) in living cells will accelerate entropic degradation beyond classical expectations (Cao et al., 2020).
- No such reservoir effects will be detectable in purely inorganic complex systems.

6.1 Signal-to-Noise Regime for Detection

The hypothesized δ_{IR} term is expected to be maximally detectable in biological systems operating close to thermodynamic equilibrium with minimal internal energy fluxes (e.g., dormant states, minimal cells, low-temperature in vitro assays). In such "quiet" regimes, classical stochastic noise is suppressed, rendering even weak unintended leakage statistically significant. Conversely, far-from-equilibrium chaotic regimes (high metabolic throughput, turbulent environments, or high-energy particle collisions) are predicted to mask δ_{IR} through overwhelming intrinsic noise—analogous to an inability to hear a neighbor's television during a hurricane.

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7. Conclusions

The extreme improbability of life's origin combined with its observed stability and creative directionality suggests the action of an unobserved informational reservoir. The hypothesis is naturalistic, compatible with current physics, explicitly non-teleological, and generates clear experimental tests. Future work should focus on high-precision quantum sensing in vivo and long-term autonomous AI trials.

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