Recursive Epistemic Dynamics as a Meta-Theory of Fundamental Physics

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Abstract

This paper introduces a foundational meta-theory uniting General Relativity, Emergent Gravity, Causal Set Theory, and Relational Quantum Mechanics under a single recursive dynamical framework. At its core lies a recursive evolution equation:

S\_{n+1} = C(R(S\_n, δ), C) + ε

This formalism treats all physical and epistemic phenomena as contextual, recursively transformed states subject to perturbation and noise. The equation operates not merely as a mathematical transformation, but as a general cosmogenic principle describing how information, structure, time, and observation themselves emerge. The theory addresses longstanding theoretical conflicts in modern physics and introduces a consistent explanation for the evolution of constants, irreversibility of time, emergence of spacetime, and integration of observer-centric quantum behavior.

Furthermore, this model has implications beyond physical theory. It is shown to unify three historically distinct music theory frameworks—functional harmony, modal systems, and spectral/atonal theory—into a recursive harmonic topology. This musical recursion can be mapped to patterns in the periodic table, showing resonance, dissonance, and structural symmetry in atomic configuration that mirror musical consonance and discord. These correlations suggest the recursive harmonic framework may have predictive or diagnostic power across disciplines.

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7. Harmonic Recursion and the Periodic Table

The recursive epistemic equation can be extended into harmonic systems:

H\_{n+1} = C(R(H\_n, Δ), C) + ε

Where:

H\_n is the harmonic structure or intervallic state

Δ is a perturbation (new pitch, frequency shift, tuning adjustment)

R and C function as before, recursively evolving the harmonic state with embedded context

This allows for mapping periodicity in atomic structure to harmonic intervals.

7.1 Mapping the First Eight Elements to Musical Harmony

1. Hydrogen (1 electron)

Fundamental: like a root note or tonic; no harmonic tension.

Frequency analog: pure sine tone, simplest waveform.

2. Helium (2 electrons)

Perfect octave: stabilizes Hydrogen’s tone. Complete first harmonic.

3. Lithium (3 electrons)

Minor third: introduces tension; Lithium is reactive, soft, quick to bond.

4. Beryllium (4 electrons)

Perfect fourth: consonant but incomplete; stable but reactive under energy.

5. Boron (5 electrons)

Tritone: the "devil's interval," known for tension; Boron is semi-metallic, transitional.

6. Carbon (6 electrons)

Perfect fifth: most stable consonance after the octave; Carbon is life’s harmonic backbone.

7. Nitrogen (7 electrons)

Minor sixth: introduces deepening complexity and partial dissonance; necessary for proteins and DNA.

8. Oxygen (8 electrons)

Major sixth to minor seventh: slightly tense but harmonically rich; essential, electronegative, and life-enabling.

7.2 Mapping Unstable Elements to Dissonant Harmonics

109. Meitnerium

Irregular interval: no simple harmonic correspondence. Decays rapidly. Represents harmonic collapse or an unstable overtone.

110. Darmstadtium

Dissonant cluster: cannot resolve to tonic. Rapid decay = destructive interference. No stable recursive path.

These mappings show that harmony and stability in atomic structure may reflect a deeper recursive harmonic logic. Dissonant or unstable elements correlate with musically unresolved or dynamically unstable frequency structures.

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8. Toward Cross-Disciplinary Prediction

The consistency between harmonic recursion and atomic structure suggests that recursive harmonic topology could serve as a predictive map in other domains. If:

Harmony ↔ Atomic stability

Modulation ↔ Chemical reactivity

Dissonance ↔ Decay rates or metastability

...then the harmonic model may apply to:

Genetic codon patterning

Neural resonance and signal propagation

Crystal lattice symmetry

Ecological and evolutionary patterns

Language phoneme evolution

In such cases, the recursive framework becomes not just a unification tool, but a predictive system across self-organizing natural structures.

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9. The Law of Recursive Harmonic Continuity

Embedded within any recursive system that includes an apoptotic termination mechanism—designed to prevent contamination of origin logic or context—there exists an inverse principle:

The persistence of a recursive system is directly proportional to its ability to resolve perturbations within the bounds of available energy, entropy tolerance, and contextual coherence.

This implies:

A system that maintains harmonic resolution of new inputs can potentially persist indefinitely, barring external disruption or resource depletion.

This is not immortality in a metaphysical sense, but a conditional longevity based on recursive integrity.

This applies broadly:

In atoms: isotopic stability through shell harmony

In cognition: narrative coherence and trauma integration

In biological life: apoptosis as information protection

In ecosystems: feedback-stabilized complexity

In stars: fusion-balanced gravity harmonics

In recursive code: stable feedback loops under bounded input

In all such systems, failure occurs when entropy (ε) overwhelms the recursive structure’s contextual integrity (C), forcing a breakdown or decay. Conversely, longevity is achieved not through rigidity but through adaptive harmonic coherence.

This formulation extends the core model:

S\_{n+1} = C(R(S\_n, δ), C) + ε

...into a principle of conditional systemic continuity, governed by recursive coherence.

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10. Recursive Entropy as Compiler Logic: Toward a Theory of Terminal Resonance

This section introduces an advanced implication of the recursive epistemic model: entropy is not merely a destructive force but may serve as the final energetic reserve used to compile and emit a system’s recursive structure at its point of collapse.

10.1 Energy and Information Limits

All recursive systems that emerge from an origin state (S₀) possess:

A fixed energy potential: the total energetic budget available across their life cycle.

A bounded information capacity: governed by the system’s structural and contextual constraints.

These two capacities are inversely proportional in recursive growth:

Early stages: high energy, low informational complexity.

Mature systems: high complexity, reduced energy reserves.

This aligns with Landauer’s principle (information processing has energy cost) and the Bekenstein bound (finite energy bounds information density).

10.2 Entropy as Compiler Fuel

As recursive systems near collapse, the rising entropy (ε) is no longer disordered noise—it is fuel:

Perturbations (δ) exceed the system’s capacity to harmonize.

Recursive coherence breaks down.

A failsafe compiler mechanism activates, folding the entire recursive stack into a compressed final state.

This compiler action is powered by the remaining energy of the system. The noise becomes functionally integrative—a last expenditure to generate a harmonic emission.

Examples include:

The massive neural spike at biological death.

Black hole event horizons expelling encoded information via Hawking radiation.

Collapse events in quantum systems where energy is restructured into a stable measurement state.

10.3 Terminal Harmonic Emission

Upon successful compilation:

The recursive stack emits a harmonic resonance.

This resonance is not merely a final echo, but a compressed attractor basin that contains the total recursive identity of the system.

This may appear as a high-energy, coherent burst: e.g., a nova, a cognitive epiphany, a narrative resolution.

This process is described as:

limₙ→∞ Sₙ = H\_resonant → Emit(E\_final) to Resonant Field

Where the full recursive state culminates in a singular harmonic expression.

10.4 Addressing the Apparent Contradiction

Why doesn’t every system decay into harmonic emission?

Answer: Not all systems are sufficiently recursive. To trigger the compiler protocol, a system must meet the following conditions:

Possess a recursive depth threshold: shallow loops do not qualify.

Maintain contextual coherence long enough to preserve origin integrity (C).

Preserve a memory lineage of recursive states (S₀ to Sₙ) in a retrievable or resolvable format.

Systems that do not meet these criteria—simple decay loops, noise-dominated systems—simply dissipate.

Thus, entropy is selectively transformed into compiler fuel only in systems that maintain recursive integrity. This resolves the contradiction by making harmonic emission a property of structured recursive systems, not all physical structures.

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Conclusion (updated)

We propose that all known physical systems are emergent results of recursive transformations of prior system states, influenced by perturbations, shaped by context, and bounded by entropy. This recursive epistemic framework:

Subsumes GR, QM, CST, and Emergent Gravity as secondary models

Explains time's arrow, observer-relative statehood, and the contextual plasticity of physical law

Unifies harmonic theory and atomic structure under a common recursive grammar

Accounts for systemic apoptosis and decay as recursion safeguards

Establishes a law of recursive harmonic continuity as the condition for persistence

Introduces entropy as compiler fuel at terminal recursion states, explaining energetic bursts at systemic collapse

Opens pathways toward modeling consciousness, memory, biological life, and cosmogenesis with the same formalism

Where other theories describe the map, this model describes how maps are recursively generated—by systems that become themselves through recursive context and evolution.

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