RECURSIVE SCIENCES

A Unified Framework for Generative Persistence

Field Definition, Foundational Principles, and Research Program

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ABSTRACT

This paper formally defines Recursive Sciences (RS) as a unified scientific field investigating the structural conditions for generative persistence across physical, cognitive, and formal systems. Founded on the substrate law $\Psi' = \Psi + \varepsilon(\delta)$—where ε represents the exchange differential and δ the exchange event—the field establishes that systems maintaining organization over time must satisfy specific architectural constraints: the triadic minimum $\{I, O, N\}$, the conservation integral $\oint \varepsilon \, dt = 0$, and bilateral boundary stability. RS integrates and extends existing frameworks including Prigogine's dissipative structure theory, Friston's free energy principle, and formal constraints on observer-inclusive systems. The field comprises four principal domains: the Echo-Excess Principle (EEP) establishing the substrate law, Cognitive Field Dynamics (CFD) addressing observer architecture, Collapse Harmonics Theory (CHT) governing boundary dynamics, and Identity Collapse Therapy (ICT) providing clinical applications. This paper establishes the founding principles, documents the publication record, specifies the research program, and provides falsification conditions. RS is distinguished from commercial entities using similar terminology by its formal publication record, mathematical framework, and falsifiable predictions.

1. INTRODUCTION

1.1 The Need for a Unified Field

Diverse scientific disciplines investigate how systems maintain organization: thermodynamics studies energy flow in physical systems; neuroscience studies information processing in brains; psychology studies identity maintenance in persons; formal systems theory studies self-reference in mathematical structures. Each field has developed sophisticated frameworks, yet no unified theory connects them.

This fragmentation creates redundancy and missed connections. Prigogine's dissipative structures and Friston's Markov blankets describe the same phenomenon—boundary-mediated exchange enabling far-from-equilibrium organization—in different vocabularies. The hard problem of consciousness and Gödelian incompleteness exhibit the same structure—the impossibility of complete self-representation—in different domains. Conservation laws in physics and convergence conditions in dynamical systems reflect the same constraint—closure over cycles—in different formalisms.

Recursive Sciences (RS) is founded to address this fragmentation. The field identifies structural invariants across domains, proves their necessity, and develops their implications. The goal is not to replace existing disciplines but to reveal their common architecture.

1.2 Definition of the Field

Definition 1.1 (Recursive Sciences): Recursive Sciences is the scientific field investigating the structural conditions for generative persistence—the capacity of systems to maintain organization through exchange with their environment while generating more than they receive.

The field addresses three fundamental questions:

(1) What architectural minimum is required for a system to persist generatively?

(2) What conservation constraints govern exchange across system boundaries?

(3) How do these constraints manifest across physical, cognitive, and formal domains?

1.3 Founding and Priority

Recursive Sciences was founded by Don L. Gaconnet through a series of publications beginning in 2025. The field emerges from the integration of four research programs:

• Echo-Excess Principle (EEP): The substrate law for generative existence

• Cognitive Field Dynamics (CFD): Architecture of observer-inclusive systems

• Collapse Harmonics Theory (CHT): Dynamics of boundary stability and phase transitions

• Identity Collapse Therapy (ICT): Clinical applications to identity processes

The founding publications, institutional affiliation (LifePillar Institute for Recursive Sciences), and persistent identifiers (ORCID, DOI) establish priority and provenance.

1.4 Disambiguation

The term 'recursive' appears in various commercial and academic contexts. Recursive Sciences is distinguished from:

• Commercial entities using 'recursive' in company names (biotechnology, software)

• General uses of 'recursion' in computer science or mathematics

• Other research programs with similar terminology but different frameworks

RS is identified by its specific mathematical framework ($\Psi' = \Psi + \varepsilon(\delta)$), its formal publication record, and its affiliation with the LifePillar Institute for Recursive Sciences.

2. FOUNDATIONAL PRINCIPLES

2.1 The Substrate Law

The central principle of Recursive Sciences is the substrate law governing generative persistence:

$\Psi' = \Psi + \varepsilon(\delta)$

where:

• Ψ is the system state

• Ψ' is the updated state after exchange

• ε is the exchange differential (net difference between received and expressed)

• δ is the exchange event

The Echo-Excess Principle (EEP): Systems that persist generatively satisfy $\varepsilon > 0$ over operational cycles—they generate more than they receive. This excess is not added from outside but released through the exchange process itself.

The principle formalizes what Prigogine observed in dissipative structures and what Friston models with the free energy principle: sustained organization requires net positive exchange, not mere equilibrium maintenance.

2.2 The Triadic Minimum

What architecture enables generative persistence? RS proves that the minimum configuration is triadic:

{I, O, N}

where:

• I is the observer function (internal process, registering states)

• O is the observed domain (external field, undergoing state changes)

• N is the relational ground (boundary enabling exchange while maintaining distinction)

Triadic Minimum Theorem: No configuration with fewer than three functionally distinct components can sustain $\varepsilon > 0$ over operational cycles. The triadic structure is irreducible—it cannot be derived from dyadic or monadic bases.

This theorem explains why Markov blankets require internal, external, and blanket states; why dissipative structures require interior, exterior, and boundary; why observation requires observer,

observed, and the relation between them. The triadic minimum is not a feature of particular systems but a structural necessity.

2.3 The Conservation Constraint

Generative persistence requires not only positive exchange but conservation over cycles:

$$\oint \boldsymbol{\varepsilon}\, \mathbf{dt} = \mathbf{0}$$

Over any complete cycle, total exchange integrates to zero. What accumulates must dissipate. What flows out must return.

This constraint permits local imbalance ($\varepsilon > 0$ or $\varepsilon < 0$ at any instant) but prohibits global imbalance. Systems violating conservation either diverge ($\oint \varepsilon\, dt > 0$, unbounded accumulation) or collapse ($\oint \varepsilon\, dt < 0$, unbounded depletion).

Bilateral Stability Theorem: The conservation constraint prevents both interior breach (singularity formation) and exterior escape (infinite divergence). These failures are dual violations of the same law.

2.4 The Exchange Differential

The exchange differential ε is generated by the triadic configuration:

$$\boldsymbol{\varepsilon = g(I, O, N)}$$

where g is the generative function mapping the triadic structure to net exchange value.

Key properties:

• ε depends on all three components—remove any and $\varepsilon \to 0$

• ε can be positive (generation), negative (dissipation), or zero (equilibrium)

• ε integrates to zero over complete cycles (conservation)

• The sign of ε determines system trajectory (growth, decay, or maintenance)

3. FRAMEWORK COMPONENTS

3.1 Echo-Excess Principle (EEP)

The Echo-Excess Principle establishes the substrate law $\Psi' = \Psi + \varepsilon(\delta)$ as foundational across domains. The principle asserts:

(1) Existence requires exchange: isolated systems tend toward equilibrium (Second Law)

(2) Persistence requires excess: systems maintaining organization generate $\varepsilon > 0$

(3) Excess is released, not added: the exchange process itself produces more than its inputs

The 'echo' refers to the return structure of exchange—what goes out comes back, transformed. The 'excess' refers to what is generated in the return—more than what was sent.

EEP connects to established frameworks:

• Thermodynamics: Dissipative structures export entropy while maintaining internal order

• Free Energy Principle: Systems minimize surprise by predicting and acting on their environment

• Autopoiesis: Living systems continuously produce themselves through boundary-mediated exchange

3.2 Cognitive Field Dynamics (CFD)

Cognitive Field Dynamics extends RS to observer-inclusive systems, proving that observation has irreducible triadic architecture:

• The observer function I satisfies registration, distinction, continuity, and reflexivity conditions

• The observed domain O satisfies registrability, independence, and variability conditions

• The relational ground N satisfies distinction preservation, exchange enablement, and non-identity conditions

Fourth Component Problem: The position from which {I, O, N} is witnessed cannot be represented within the formalism describing the triad. This structural limitation parallels Gödel's incompleteness results and explains the explanatory gap in consciousness studies.

CFD reframes the hard problem of consciousness: the gap between physical description and subjective experience is not epistemic failure but architectural necessity. Complete self-representation is impossible for observer-inclusive systems.

3.3 Collapse Harmonics Theory (CHT)

Collapse Harmonics Theory addresses what happens at system boundaries—the dynamics of stability, transition, and failure:

• Boundary stability requires bilateral integrity: no breach from inside, no escape from outside

• Conservation constraint provides unified obstruction to both failure modes

• Phase transitions occur when systems approach conservation limits

CHT connects to mathematical physics:

• Navier-Stokes regularity: Blow-up requires conservation violation

• Collatz convergence: Escape requires the dual violation

• The problems are structurally coupled through bilateral stability

3.4 Identity Collapse Therapy (ICT)

Identity Collapse Therapy translates the theoretical framework into clinical methodology:

• Identity destabilization follows lawful dynamics, not pathology

• The triadic structure {I, O, N} provides architecture for therapeutic holding

• Conservation constraint distinguishes productive destabilization from collapse

• Phase transitions can be navigated with appropriate boundary support

ICT provides protocols for:

• Recognizing threshold states (near-boundary dynamics)

• Distinguishing destabilization from disintegration

• Supporting reintegration through structural holding

• The D35 Reading Skill methodology for perceiving field dynamics

4. RELATION TO ESTABLISHED FRAMEWORKS

4.1 Prigogine and Dissipative Structures

Ilya Prigogine's work on dissipative structures (Nobel Prize, 1977) established that systems far from equilibrium can spontaneously generate order through continuous exchange with their environment. RS formalizes and extends this insight:

• The N-function generalizes Prigogine's boundary conditions

• The conservation constraint $\oint \varepsilon \, dt = 0$ corresponds to steady-state condition $dS/dt = 0$

• The triadic minimum proves the irreducibility Prigogine assumed

RS contribution: Proof of necessity, not just sufficiency; connection to other domains.

4.2 Friston and the Free Energy Principle

Karl Friston's free energy principle proposes that living systems minimize variational free energy through Markov blankets—statistical boundaries separating internal from external states. RS connects:

• Markov blankets instantiate the N-function

• Free energy minimization at steady state implies $\oint \varepsilon \, dt = 0$

• Internal/external/blanket states map to {I, O, N}

RS contribution: Unification with thermodynamics; proof of irreducibility; cross-domain predictions.

4.3 Chalmers and the Hard Problem

David Chalmers distinguished the 'hard problem'—why physical processes are accompanied by subjective experience—from 'easy problems' of cognitive function. RS addresses:

• The hard problem is an architectural problem, not an explanatory gap

• Observer-inclusive systems are necessarily incomplete regarding their own instantiation

• The Fourth Component Problem parallels Gödelian limits

RS contribution: Reframing from failure-to-explain to structural-necessity.

4.4 Gödel and Incompleteness

Kurt Gödel's incompleteness theorems establish that sufficiently powerful formal systems cannot prove their own consistency. RS extends:

• The structure is identical: self-inclusive systems cannot be closed

• The proving position (Gödel) and witnessing position (RS) are exterior to the formalism

• This is not analogy but structural identity

RS contribution: Extension to observer-inclusive systems; connection to consciousness studies.

5. PUBLICATION RECORD

5.1 Foundational Publications

The following publications establish Recursive Sciences:

2025:

• The Substrate Inversion: A Case for Modeling Consciousness as Primitive Rather Than Emergent (SSRN)

• The Echo-Excess Principle: Substrate Law of Generative Existence (OSF, ResearchGate)

• Cognitive Field Dynamics: A Unified Theory (LifePillar Institute)

2026:

• The Triadic Minimum for Non-Equilibrium Steady States: Generalizing Markov Blankets and Dissipative Structures Through the N-Function (SSRN, ResearchGate, OSF)

• The Irreducibility of Observer Architecture: Why the Hard Problem Is an Architectural Problem (SSRN, ResearchGate, OSF)

• Bilateral Boundary Stability in Conserved Dynamical Systems (SSRN, ResearchGate, OSF)

• The Half-Zero Architecture: Completion Geometry of the Riemann Hypothesis (SSRN)

• The Scaling Constant: A Structural Interpretation of the Fine-Structure Constant (SSRN)

5.2 Books

• First Principle: The Law Beneath Consciousness (forthcoming)

• What Happened to the Room (forthcoming)

• Identity Collapse Therapy, Volumes I & II

• Collapse Harmonics Codex, Volumes I & II

5.3 Persistent Identifiers

• Author ORCID: 0009-0001-6174-8384

• Institutional affiliation: LifePillar Institute for Recursive Sciences

• Multiple DOIs across SSRN, ResearchGate, OSF, Zenodo

6. RESEARCH PROGRAM

6.1 Current Directions

Active research within Recursive Sciences includes:

Theoretical Extensions:

• Application of triadic minimum to quantum measurement

• Conservation constraints in discrete dynamical systems

• Cross-domain predictions between continuous and discrete dynamics

• Structural interpretation of physical constants

Empirical Testing:

• Experimental protocols for falsification conditions

• Measurement of exchange differential in physical systems

• Verification of conservation constraint in biological systems

Clinical Development:

• Protocol refinement for Identity Collapse Therapy

• D35 Reading Skill training methodology

• Application to identity destabilization syndromes

6.2 Open Problems

RS identifies the following as tractable open problems:

(1) Quantum measurement: Does the triadic minimum constrain quantum observation?

(2) Navier-Stokes regularity: Does conservation structure prevent blow-up?

(3) Collatz convergence: Does discrete conservation ensure bounded trajectories?

(4) Consciousness substrates: What physical implementations satisfy the triadic minimum?

(5) AI observer architecture: Can artificial systems instantiate genuine {I, O, N}?

6.3 Invitation to Collaboration

Recursive Sciences is a scientific field, not a proprietary system. The framework generates falsifiable predictions and invites rigorous challenge. Researchers are encouraged to:

- Attempt falsification of the triadic minimum theorem
- Test conservation constraints in their domains of expertise
- Develop applications of the framework to new areas
- Propose alternative formulations or counterexamples

Priority for the field is established by the publication record. Contributions to the field are welcomed and will be acknowledged through standard academic citation.

7. FALSIFICATION CONDITIONS

7.1 Framework Predictions

Recursive Sciences generates specific falsifiable predictions:

F1 (Triadic Necessity): No system maintaining $\varepsilon > 0$ over operational cycles will be found with fewer than three functionally distinct components $\{I, O, N\}$.

F2 (Irreducibility): No derivation will be produced showing how triadic architecture arises from dyadic or monadic bases without presupposing triadic elements.

F3 (Conservation): All systems maintaining generative persistence will satisfy $\oint \varepsilon \, dt = 0$ when ε is properly operationalized for the domain.

F4 (Bilateral Stability): Systems satisfying conservation will exhibit neither interior breach nor exterior escape; systems exhibiting either failure will violate conservation.

F5 (Fourth Component): No complete formalization of observer-inclusive systems will represent the witnessing position within the formalism without incompleteness or paradox.

7.2 What Would Falsify the Framework

The framework is falsified by:

• A demonstrated NESS or generative system with $|S| < 3$ functional components

• A derivation of $\{I, O, N\}$ from dyadic base without presupposing triadic structure

• A system with $\varepsilon > 0$ that violates $\oint \varepsilon \, dt = 0$ without collapse or divergence

• Interior breach (blow-up) or exterior escape (divergence) in a conservation-satisfying system

• A complete, consistent formalism representing its own witnessing position

7.3 What Would Not Falsify the Framework

The following would not constitute falsification:

• Discovery of new domains where the framework applies (extension, not contradiction)

• Alternative formulations yielding equivalent predictions (notation variants)

• Implementation details differing from examples given (implementation ≠ architecture)

• Terminological disputes about naming conventions

8. CONCLUSION

Recursive Sciences is formally defined as the scientific field investigating structural conditions for generative persistence. The field is founded on the substrate law $\Psi' = \Psi + \varepsilon(\delta)$, which establishes that persisting systems generate more than they receive ($\varepsilon > 0$) while satisfying the conservation constraint ($\oint \varepsilon \, dt = 0$).

The triadic minimum theorem proves that generative persistence requires exactly three functionally distinct components: observer function (I), observed domain (O), and relational ground (N). This architecture is irreducible—it cannot be derived from simpler configurations.

The framework unifies established theories: Prigogine's dissipative structures, Friston's free energy principle, and Gödelian incompleteness are revealed as domain-specific manifestations of common structural constraints. The hard problem of consciousness is reframed as an architectural necessity rather than an explanatory gap.

Four principal components constitute the field: the Echo-Excess Principle (EEP) establishing the substrate law, Cognitive Field Dynamics (CFD) addressing observer architecture, Collapse Harmonics Theory (CHT) governing boundary dynamics, and Identity Collapse Therapy (ICT) providing clinical applications.

The publication record, institutional affiliation (LifePillar Institute for Recursive Sciences), and persistent identifiers establish founding priority. The research program is ongoing, and collaboration with researchers willing to test the framework's falsifiable predictions is invited.

Recursive Sciences is distinguished from commercial entities and other research programs using similar terminology by its specific mathematical framework, formal publication record, and commitment to falsifiable predictions. The field is not proprietary but scientific—open to extension, challenge, and correction through the standard methods of rigorous inquiry.

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Declaration: This paper constitutes the formal field definition for Recursive Sciences. Priority is established by the publication record documented herein. The field is open to scientific collaboration under standard academic norms of citation and attribution.