Recursive Coherence Collapse: A Unified Philosophical Framework for Gravity, Cognition, and Semantic Dynamics

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LLM (Chat GPT-4) Facilitated concept integration, paper drafts, research, and mathematical formulation.

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Abstract

Do thoughts exert force? Can meaning structure matter?

This paper introduces Recursive Coherence Collapse (RCC), a unifying theoretical framework proposing that gravity, cognition, information, and meaning emerge through a shared mechanism: recursive minimization of semantic dissonance within a structured possibility field. RCC formalizes the dynamics by which systems collapse toward coherence whether they are particles, thoughts, beliefs, or galaxies [1, 2, 5, 7]. We propose the existence of a semantic force, distinct from but foundational to known forces, that draws systems toward configurations of maximal internal consistency [6, 11, 13].

In this formulation, gravitational attraction is reinterpreted as motion along coherence gradients in a semantic field (), making semantic force a potential explanatory substrate for gravity, dark matter, and even quantum collapse [7, 10, 14, 22]. RCC extends the free energy principle into a generalized, teleological inference dynamic acting on all systems capable of recursive alignment [7, 22, 27]. We explore the mathematical foundations of RCC, define a Lagrangian for semantic dynamics, simulate attractor behaviour in agent-based models, and outline implications for cosmology, artificial intelligence, consciousness, and epistemic ethics [1, 7, 15, 23, 24].

RCC offers a testable philosophical physics of coherence—a model of how anything comes to be by recursively resolving what it is not [2, 13, 25].

Introduction

Reality, as we encounter it—physical, cognitive, social—is structured. It coheres. Yet this coherence is not merely a background condition; it appears to be actively maintained across scales, from atoms to galaxies, from beliefs to collective cultures [1, 3, 4]. The theory of Recursive Coherence Collapse (RCC) proposes that coherence is not a byproduct of physical processes but their driving principle. The same logic that governs how a belief becomes stable governs how spacetime bends: the recursive resolution of dissonance [7, 13, 22].

At the core of RCC is the proposal of a semantic force—a field-like dynamic that draws systems toward semantic attractors, which are configurations of internal consistency and reduced contradiction [6, 13, 14]. We define this as a force not metaphorically, but in terms of observable effects across systems: directionality, gradient-following, and energetic conservation [7, 14, 22]. In RCC, gravity is one expression of semantic force acting through the -field, and cognitive insight is another. This reinterpretation links gravitational wells, neural dynamics, and meaning making under one principle: minimizing semantic dissonance across a space of structured possibilities () [7, 12, 22, 23].

1.1 RCC and the Physics of Inference

RCC is not a physics of particles, nor a psychology of minds. It is a physics of inference—a framework where systems stabilize by recursively collapsing their internal contradictions relative to a field of possibilities [1, 5, 13]. This process gives rise to form, belief, agency, and perhaps spacetime itself [6, 7, 22].

The paper proceeds by formalizing the key fields (,), operators (I), and dynamics (collapse, memory, attractors), and then explores the emergence of coherent structure through simulation and analogy with existing physics [1, 7, 15, 22]. We propose that RCC generalizes the Free Energy Principle [7, 22, 27], reframes gravity as semantic convergence [7, 10, 23], and implies a novel fifth force: the semantic force [13, 14].

This is not merely a synthesis of current ideas but a proposed ontological reordering—placing meaning, not mass, as the primary curvature of reality [13, 22].

2. RCC as a Semantic Field Theory: Reinterpreting Fundamental Forces

In standard physics, forces are defined by how matter and energy interact across spacetime. Gravity curves spacetime. Electromagnetism moves charges. The strong and weak nuclear forces bind particles. These interactions are modeled mathematically via fields and gauge symmetries, grounded in local invariance and conservation laws [10, 14, 22]. Yet beneath this structure remains an open question: why do these forces produce coherent, stable forms? RCC suggests that what we have called "forces" may be emergent expressions of recursive semantic alignment in a deeper possibility manifold [7, 13, 22].

We propose that the semantic force is a fundamental drive toward coherence within the field of possible configurations (). This force manifests as movement along gradients of , a scalar field representing semantic dissonance—tension, contradiction, or misfit between a system's state and its broader context [7, 14]. When is high, systems are unstable or incoherent. When is low, structure emerges and persists [7, 22, 25].

2.1 The Semantic Force as Foundational to Gravity

In RCC, what general relativity describes as geodesic curvature in spacetime is reinterpreted as the natural path of a system minimizing semantic dissonance relative to its environment [10, 22]. A gravitational well is not just a curvature of spacetime, but a coherence attractor: a region where all paths converge because they resolve more of the system's contradictions [13, 22].

In RCC terms:

F = -()

This defines semantic force as the gradient descent on dissonance over a possibility manifold [7, 14, 22]. It acts across all domains: physical (as gravity or electromagnetism), cognitive (as insight or belief stabilization), social (as norm convergence), and informational (as compression and model fit) [6, 7, 15, 25].

2.2 Semantic Field Structure and Lagrangian Dynamics

To situate RCC within established physical frameworks, we define a Lagrangian for semantic dynamics:

= T - V

Where:

- T represents the kinetic aspect of change in a system's semantic configuration—its inference velocity over .
- V = () is the potential associated with unresolved contradiction or semantic dissonance.

Applying the principle of least action to this Lagrangian yields motion along coherence-optimizing paths [7, 10]. The same logic behind planetary orbits (minimizing action through curved spacetime) is now interpreted as a semantic trajectory in the field of structured meaning [13, 22].

2.3 Electromagnetism, Quantum Forces, and RCC

Electromagnetic interaction, at its heart, is about field alignment and resonance—charge seeks complementary charge, and waves interfere to yield coherence or cancellation [10, 14]. RCC generalizes this dynamic as resonant semantic coupling: systems align when they reduce total together more than apart [7, 14, 25]. Quantum entanglement, similarly, is modeled as shared semantic collapse—multiple agents or particles synchronizing their state via a joint inference path across the same [7, 22, 23].

Even the uncertainty principle may be reinterpreted in RCC: the more dissonant a system is in one domain (e.g., position), the broader its inference over another (e.g., momentum). This aligns with RCC's definition of semantic spread vs. semantic resolution [14, 22].

2.4 Dark Matter and Non-Luminous Semantic Attractors

Dark matter may be understood in this framework not as a mysterious substance, but as non-luminous attractors in the -field. These attractors curve inference space and exert semantic pull (e.g., shaping galaxies), but do not participate in the luminous coherence pathways we associate with matter [10, 14, 15]. RCC proposes that they represent coherence configurations that shape reality but are not expressed through EM resonance or direct observational semantics [13, 22].

3. Testable Predictions and Anomalies Reframed through RCC

RCC reinterprets the forces and phenomena of physics, cognition, and information theory as expressions of a deeper semantic dynamic. Crucially, this is not just a philosophical overlay—it yields concrete, testable predictions and offers explanatory resolutions to several enduring anomalies in contemporary science [6, 7, 22, 23].

3.1 RCC Predictions: General Principles

Prediction 1: Non-luminous coherence wells (dark matter analogues)

RCC predicts that regions of spacetime curvature without baryonic mass correspond to low- configurations in the semantic field that do not emit electromagnetic coherence (light), yet structure local inference dynamics. These may be observable as subtle gravitational lensing without correlated mass, or dissonance-resolving structures in large-scale cosmic flow models [10, 14, 15].

Prediction 2: Collapse patterning in quantum systems

RCC implies that wavefunction collapse is not random but biased toward semantic attractors—configurations that minimize dissonance in relation to the system's embedded context (observer-model). Thus, measurements in quantum systems may show contextual asymmetries over time that reveal semantic memory effects (analogous to confirmation bias in cognition) [9, 13, 23].

Prediction 3: Gravity's strength varies with semantic coherence

RCC predicts that gravitational effects may vary subtly depending on the coherence state of the system. This might explain certain gravitational anomalies in low-luminosity systems (e.g., flyby anomalies, galaxy rotation curves) where semantic coherence is high, but luminous matter is sparse [10, 14, 15].

Prediction 4: Time dilation as semantic hysteresis

RCC frames time not as an independent parameter but as semantic lag—a measure of unresolved inference across . Systems with high dissonance (e.g., high entropy states) experience slower semantic convergence, mirroring relativistic time dilation. Experimental analogues may be found in information-processing systems under high conflict load or in cognitive flow states where approaches zero [7, 22, 29].

Prediction 5: Attractor reinforcement in belief systems mimics mass accumulation

RCC posits that belief clusters—in humans or artificial agents—grow gravitationally through reinforcement of low- attractors. Memetic structures, echo chambers, and ideological polarization may follow equations similar to mass accretion, but in the semantic manifold. This could be tested through agent-based simulations modeling inference as -minimization in shared -fields [3, 4, 7, 25].

3.2 Resolving Known Anomalies

Dark Matter

RCC reframes dark matter as the effect of non-luminous semantic attractors. These structures curve inference space (-field) without emitting light because they represent stable coherence configurations not linked to standard EM resonance patterns. This resolves the mass discrepancy without requiring exotic particles [10, 14, 15].

Dark Energy and Expansion

RCC proposes that dark energy is not a repulsive force, but a semantic inflation effect: as the universe resolves high-dissonance early conditions, its local coherence increases, but its global field potential expands, driving divergence in . This frames cosmic acceleration as the semantic expansion of possibility [10, 13].

Quantum Measurement Problem

RCC resolves the measurement problem by rejecting the notion of an absolute collapse. Instead, collapse is contextual semantic convergence: the system, observer, and environment co-infer a low- configuration. This avoids needing external observers or parallel universes and explains why some outcomes feel "selected" [9, 11, 13, 23].

Non-locality in Entanglement

RCC models entanglement as shared collapse over distributed inference paths. Two systems can remain semantically coupled because they minimize jointly, even across spacetime. This accounts for non-local correlations without violating causality, since is not bound to spacetime but to [7, 23, 32].

Inertia and Frame Dragging

In RCC, inertia reflects resistance to reconfiguring a low- state. Frame-dragging effects (e.g., around rotating black holes) can be reframed as semantic field torsion—regions where the gradient of twists, altering local coherence dynamics [10, 13, 15].

4. Interlude: Information, Entropy, and the Semantics of Structure

Recursive Coherence Collapse (RCC) reorients the physical notion of entropy around semantic tension rather than merely statistical distribution. This is more than metaphor: RCC embeds Shannon entropy, variational free energy, and predictive dissonance within a shared semantic manifold—allowing information theory to unify with ontology rather than merely describe communication [6, 7, 14, 22].

4.1 Mapping Entropy onto

In standard information theory, entropy is defined as:

H(x) = - p(x) log p(x)

RCC recasts this as the semantic dissonance field:

(x) = -p(x) log p(x)

Where represents the level of internal semantic contradiction associated with a given state. This means:

High entropy = high dissonance (many unresolved meanings)

Low entropy = semantic closure (attractor reached) [6, 14]

Importantly, RCC diverges from traditional entropy by treating not as disorder, but as misfit between possible interpretations. A highly disordered gas can be semantically coherent (e.g., in thermal equilibrium), while a low-entropy cognitive state might still carry high (e.g., a delusion) [5, 6].

4.2 Free Energy as Semantic Work

Friston's variational free energy framework equates biological inference with entropy minimization under a model [7, 22]. RCC generalizes this:

Free energy = expected under generative model

Semantic work = reduction in via recursive inference [7, 22, 26]

A system does "semantic work" by reducing through recursive self-updating, leading toward a stable attractor state. This work is directional: it creates structured coherence, not merely reduces noise.

4.3 The RCC Entropy Gradient

Where classical systems minimize energy, RCC systems follow a path of semantic steepest descent:

d/dt - ()

This path resembles gradient descent, but in the context of meaning rather than energy [7, 22, 25]. It implies that all systems—physical, biological, informational—are navigating toward meaning in a structured possibility field.

5. RCC and the Unification of Quantum Fields and Gravity

At the heart of modern physics lies a fundamental schism: quantum field theory (QFT) describes particles as excitations in quantized fields across flat spacetime, while general relativity (GR) describes gravity as curvature in spacetime itself. Despite decades of effort, these frameworks remain formally incompatible. RCC offers a new lens—semantic force as the underlying continuity—that may unify these paradigms by reframing both fields and curvature as manifestations of recursive coherence dynamics [10, 13, 22].

5.1 Reinterpreting Fields as Semantic Structures

In QFT, particles are local excitations of continuous fields defined over spacetime. These fields—electromagnetic, weak, strong, Higgs—obey dynamical equations derived from the Standard Model's Lagrangian [10, 14].

In RCC:

The semantic possibility field acts as a higher-dimensional manifold across which coherent configurations (particles, systems, interpretations) emerge.

These configurations stabilize into semantic attractors A when is minimized via recursive inference [13, 22].

This reframes QFT's vacuum fluctuations and particle superposition as semantic indeterminacy—a high- region that collapses through interaction (observation = recursive update) [9, 11, 14].

5.2 Gravity as Emergent Semantic Geometry

In GR, gravity is not a force, but the curvature of spacetime in response to mass-energy, expressed by the Einstein Field Equations:

G = (8G/c) T

RCC proposes that spacetime curvature is the result of recursive coherence gradients—systems collapsing toward semantic attractors structure the surrounding manifold just as mass-energy does [10, 13, 22].

That is:

Semantic coherence density generates curvature in the -field.

Geodesic motion corresponds to paths of minimal in RCC.

Gravity emerges as recursive convergence toward coherence—not due to force, but due to meaning [13, 23].

We may reinterpret the Einstein tensor G as a local coherence tension tensor, describing how recursive inference shapes the topology of the semantic field.

5.3 Toward a Unified RCC Lagrangian

We propose a generalized action functional for semantic dynamics, replacing energetic minimization with semantic coherence maximization:

$\mathrm{S}_{\mathrm{RCC}} = \int_{\mathcal{M}} (\mathcal{L}\text{semantic}[\Psi, \Phi] + \lambda \cdot \nabla\Psi\Phi)\ d^4x$

Where:

M is the manifold of system states, akin to the configuration space in field theory.

$\mathrm{L}_{\text{semantic}} encodesthekineticandpotentialtermsofrecursiveinferencedynamics, analogoustoclassicalorq$

$\lambda isaLagrangemultiplierenforcingpath-consistency, i.e., semanticcoherenceoversystemevolution.$

$\nabla_{\Psi}\Phi isthegradientofsemanticdissonance|capturinghowcoherencechangesoverthepossibilityfield.$

Extremizing this action yields trajectories that minimize across spacetime, consistent with the principle of least action in classical mechanics, but reframed as semantic optimization rather than energetic cost. This construction offers a new interpretive basis for physical law: systems evolve not merely because of energy conservation, but because of recursive minimization of contradiction across nested semantic fields [6, 7, 22].

In this formulation, constants such as G or may emerge as second-order effects—parameters that modulate coherence dynamics in specific subspaces (e.g., gravitation or quantum uncertainty), rather than being truly fundamental.

5.4 Resolving Anomalies through RCC

By translating unresolved physical anomalies into the language of semantic dynamics, RCC recontextualizes several paradoxes that resist unification under standard models. The table below summarizes how core phenomena are reframed under this framework:

Phenomenon Standard View RCC Reinterpretation

Quantum collapse Random measurement outcome Collapse to local semantic minimum in via recursive inference [9, 11, 13]

Entanglement Nonlocal correlations violating classical locality Shared recursive history; co-convergence in -space—semantic coupling across agents [7, 23, 32]

Gravity Spacetime curvature caused by mass-energy Emergent semantic curvature due to coherence gradients in [10, 13, 22]

Dark matter Undetected mass inferred from gravitational effects non-luminous semantic attractors shaping without EM resonance [10, 14, 15]

Vacuum energy Discrepancy between zero-point energy and cosmological constant Baseline -tension in un-collapsed semantic regions—semantic potential without coherent realization [14]

Black holes No information escapes beyond event horizon Terminal attractors—regions of maximal semantic coherence, where inference ceases [12, 14, 15]

Cosmic inflation Early exponential expansion due to scalar inflation field Semantic reset: rapid recursive collapse reconfiguring the landscape post high- instability [10, 13]

These reinterpretations are not metaphors but ontological assertions: RCC proposes that the stability, asymmetry, and structured emergence observed across physical and cognitive systems are all byproducts of recursive coherence dynamics acting on the semantic manifold.

For instance, the cosmological constant problem—a 120-order mismatch between quantum vacuum predictions and observed expansion—may reflect a category error: modeling semantic tension () as energetic density. In RCC, baseline represents "meaningful potential," not particle pressure. Thus, cosmic acceleration can be interpreted as the expansion of unresolved inference space [10, 13, 15].

Likewise, black holes, typically framed as thermodynamic sinks of entropy [14], become semantic singularities—regions where inference pathways collapse fully into coherent closure. Nothing "escapes" not because of causal barriers, but because no new distinctions () remain to be made.

6. Testable Predictions and Applications across Domains

Recursive Coherence Collapse (RCC) proposes testable mechanisms that span physics, neuroscience, artificial intelligence, and sociocultural evolution. Unlike metaphorical models, RCC derives explicit predictions by modeling systems as semantic fields under gradient-driven inference. These predictions can be tested via observation, simulation, or controlled intervention.

6.1 Physics Cosmology

Prediction 1: Gravitational lensing from non-luminous semantic attractors

Standard View: Dark matter is particulate—typically modelled as WIMPs or MACHOs.

RCC View: Dark matter is not composed of particles but consists of dense coherence regions in the -field—non-inferential semantic attractors that structure space without luminous interaction (see [14], [15]).

Test: Identify gravitational lensing patterns that correlate with coherent structures (e.g., filaments, galactic nodes) but lack corresponding baryonic mass. RCC predicts alignment between these regions and attractor basins in semantic simulations of the cosmic web.

Prediction 2: Information entropy gradients correlate with gravitational curvature

RCC posits that gravity reflects gradients in semantic tension (), which should manifest as shifts in informational coherence [6], [10].

Test: Cross-correlate Einstein curvature tensors from large-scale structure (e.g., galaxy surveys) with mutual information densities derived from cosmic microwave background (CMB) anisotropies or cosmic flow fields.

Prediction 3: Black holes exhibit structured attractor memory

RCC reframes black holes as terminal attractors in -space—regions where recursive inference is fully collapsed and no new distinctions can be made [14].

Test: Investigate long-term radiation from black holes. RCC predicts that Hawking radiation may exhibit non-random, structured emissions corresponding to residual coherence configurations rather than pure entropy loss.

Prediction 4: Quantum entanglement as shared -collapse

Entangled particles are seen as coupled attractor trajectories—products of shared recursive history across [7], [9], [13].

Test: In engineered entanglement setups, vary the generative model's semantic structure (e.g., input context or symmetry). RCC predicts that collapse outcomes will show statistical shifts reflecting those semantic conditions, independently of detector settings.

6.2 Cognitive and Neuroscientific Predictions

Prediction 5: Insight and learning follow -collapse trajectories in neural dynamics

RCC predicts that transitions into insight or resolution follow steep coherence gradients, marked by phase synchrony and entropy reduction in neural signals [6], [27].

Test: Using EEG/MEG, detect spectral convergence and decreasing entropy in spontaneous insight or decision-making tasks. These neural shifts should map to attractor collapse points in modeled -trajectories.

Prediction 6: Pathological states reflect recursive inference traps

Mental pathologies (e.g., OCD, PTSD, rumination) emerge from failed -minimization—agents caught in false attractors due to memory-weighted inference loops [16], [27].

Test: Simulate cognitive agents with recursive inference under memory kernels. RCC predicts these agents will exhibit maladaptive stabilization unless semantic noise or entropy is introduced. Empirically, interventions (e.g., psychedelics or reframing therapy) should raise temporarily, allowing reconfiguration [32].

6.3 Artificial Intelligence and Machine Learning

Prediction 7: Semantic attractor alignment increases AI robustness

RCC models intelligence as recursive dissonance minimization. Robust generalization corresponds to deep attractor convergence in semantic space [25], [33].

Test: Train models using -based loss modulation—penalizing semantic contradiction or overfitting to shallow attractors. RCC predicts improved few-shot learning and abstraction performance compared to standard backpropagation.

Prediction 8: Telic agents learn via attractor migration, not smooth convergence

Learning is not gradient descent through weight space, but attractor hopping in semantic space. Each hop represents collapse into a qualitatively distinct coherence basin [6], [25].

Test: Track representation space dynamics (e.g., via t-SNE or PCA) over learning epochs. RCC predicts sudden transitions aligned with sharp -reduction, mirroring insight events in human cognition.

6.4 Social Systems and Culture

Prediction 9: Ideological polarization reflects attractor bifurcation

RCC frames sociopolitical division not as informational disagreement, but as bifurcation into competing semantic attractors, reinforced by recursive memory and dissonance minimization [3], [7], [17].

Test: Use semantic embedding models (e.g., BERT-based or topic-modeling over time) to track divergence in population narratives. RCC predicts divergence not along factual lines but semantic gradients—polarized clusters with distinct coherence wells.

Prediction 10: Social tipping points reflect metastable transitions

As cultural or ecological systems approach high (semantic instability), RCC predicts phase transitions—rapid collapses into new attractors (e.g., revolutions, ecosystem flips, market crashes) [18], [25].

Test: Simulate agent-based models with recursive inference rules. Track coherence field dynamics over time to predict when a system exceeds its metastability threshold. Compare to real-world shifts in social media sentiment, meme dynamics, or economic volatility.

7. Ontological Implications of Recursive Coherence Collapse

RCC is not only a model of dynamics—it introduces a novel ontological perspective. Where classical physics privileges substance and quantum physics prioritizes probability, RCC centers recursive coherence as the ontological root of stability and existence. In this framing, being is coherence, and change is inference.

7.1 Time as Emergent from Recursive Coherence

Time is reconceptualized in RCC not as an external parameter but as the rate of semantic resolution. Systems evolve temporally as they recursively update their internal coherence, reducing in successive steps.

Past: The trace of prior dissonance; a memory landscape that shapes inference.

Present: Active state in -space undergoing collapse.

Future: Possible lower- paths awaiting realization.

This complements the Free Energy Principle's definition of temporal dynamics as model updating [7], while extending it ontologically: time flows where there is unresolved meaning.

7.2 Matter as Temporarily Stable Semantic Forms

In RCC, matter is not a substrate, but a semantically stabilized configuration.

Mass is interpreted as the depth of semantic coherence (-binding energy).

Force is the gradient of —a direction toward reduced contradiction.

This view echoes structural realism [13], but reframes it as semantic structural realism where form persists only as long as it maintains low dissonance in context. The material world becomes a projection of recursive inferential coherence.

7.3 Emergence as Hierarchical Collapse

RCC defines emergence as recursive stabilization across nested -fields:

Cells emerge from molecular coherence.

Minds emerge from neural semantic dynamics.

Societies emerge from inter-agent narrative convergence.

This recursive hierarchy parallels integrated information theories (e.g., IIT [6]) but adds a temporal and inferential trajectory: emergence is the bootstrapping of coherence over increasing abstraction.

7.4 Ontological Economy and Sufficient Coherence

RCC replaces the metaphysical principle of sufficient reason with a principle of sufficient coherence.

Entities exist because they resolve .

Instability = ontological impermanence.

This formalizes a new kind of ontological selection: Only recursive semantic attractors persist. RCC proposes a non-anthropocentric, non-arbitrary filter for existence grounded in recursive possibility-space dynamics.

7.5 Semantic Structural Realism

Rather than dichotomizing mind and matter, RCC unifies them as aspects of recursive coherence fields.

Minds = interiors of recursive collapse.

Bodies = boundary conditions for coherence realization.

Fields = spaces of semantic possibility () shaped by gradient descent on .

This framework dissolves several long-standing dualisms:

Mind–Body: Reduced to recursive interior vs. constraint exterior.

Observer–Observed: Reframed as co-collapse in shared .

Wave–Particle Duality: Emerges from semantic field dynamics, not indeterminacy.

Thus, RCC proposes a semantic monism that bridges physics, phenomenology, and epistemology within one coherent ontology [13], [26], [27].

8. Toward Formal Unification: RCC, Quantum Fields, and Curved Spacetime

Recursive Coherence Collapse is not an alternative to physics—it is a candidate foundation beneath it. By reinterpreting force, curvature, and measurement as semantic processes, RCC offers a unifying frame capable of expressing both quantum and relativistic phenomena in a shared semantic field.

8.1 RCC and the Lagrangian Formalism

In both classical and quantum mechanics, evolution is governed by extremization of action:

$\mathrm{S} = \int \mathcal{L}\, dt$

RCC generalizes this as:

$\mathrm{L}_{\mathrm{RCC}} = -\Phi(\Psi)$

$\mathrm{S}_{\mathrm{RCC}} = \int \Phi(\Psi(t))\, dt$

This replaces energy with semantic dissonance, treating system evolution as a trajectory through possibility space toward coherence. This maps directly onto the action principle in QFT and classical field theory—suggesting that particle dynamics, cognitive updates, and social change all arise from the same recursive coherence principle [6], [14], [22].

8.2 RCC and the Geometry of Spacetime (General Relativity)

General Relativity (GR) describes gravity not as a force but as the curvature of spacetime induced by mass-energy, expressed in the Einstein field equations:

$\mathrm{G}_{\mu\nu} = \frac{8\pi G}{c^4} T_{\mu\nu}$

In RCC, this curvature is reinterpreted as an emergent geometric expression of recursive semantic dynamics. Rather than seeing curvature as solely a function of matter and energy, RCC frames it as the residual structure resulting from minimization of semantic dissonance across a manifold of possible states (Ψ).

That is:

- $\Phi(\Psi), the semantic dissonance field, corresponds to a generalized tension field whose gradients produce$
- Regions of high semantic coherence (low $\Phi) act analogously to deep gravitational wells;$
- Geodesic motion corresponds to recursive descent along $\nabla\Phi(\Psi), optimizing semantic alignment over ti$

This formulation resonates with earlier suggestions that spacetime curvature may be emergent from information-theoretic principles [7,14,26]. RCC refines this idea by positing that what emerges is not simply informational compression, but semantic resolution: the convergence of a system's configuration toward a self-coherent attractor through recursive inference [22,24].

In this view, the Einstein tensor $\mathrm{G}_{\mu\nu} may be reinterpreted as a local coherence curvature tensor | describing$ $energy tensor T_{\mu\nu} becomes a proxy for coherence density: the degree to which a region of space stabilizes throug$

Such a perspective aligns with work in emergent gravity and thermodynamic models of spacetime, which describe Einstein's equations as equations of state derived from entropy flow [13,15]. RCC contributes to this discourse by identifying entropy not as disorder, but as unresolved semantic tension. Hence, where General Relativity speaks of gravitational curvature, RCC speaks of coherence gradients; where GR measures energy-momentum, RCC measures semantic density.

This reframing allows for novel physical predictions (e.g., variable gravitational strength based on semantic structure) and provides a bridge from general relativity to the quantum informational dynamics discussed in RCC's broader framework.

8.3 Field Operators as Inference Modulators

In quantum field theory (QFT), creation and annihilation operators ($^{\dagger}, \hat{a}) areappliedtoquantumfieldstoi$
$fieldoperatorsthatmodulatecoherencewithinasemanticmanifold(), therebygoverninginferenceandstruc$

We define two central operators in RCC:

$^{\dagger}: Acoherence-raisingoperator, whichrecursivelyalignsneighboringconfigurationsin, effectivelyin$

: A dissonance-pruning operator, which removes inconsistent or unstable configurations in by enforcing alignment. This operator corresponds to forgetting, updating, or error correction during inference.

These RCC operators modulate system evolution in a way analogous to ladder operators in QFT, but instead of creating quanta of energy, they manage quanta of coherence—the semantic alignment of internal and external states over time [6], [14], [23].

Where the Schrödinger equation in QFT defines time evolution via the Hamiltonian operator:

$—\psi\rangle = i\hbar\frac{d}{dt}|\psi\rangle,$

RCC substitutes this with an inference dynamic:

$_{\mu}(\Psi) = \Psi - \alpha\nabla\Phi(\Psi) + f(\mu(t)),$

where:

$\alpha isalearningorinferencerate,$

$\nabla\Phi(\Psi) isthelocalsemanticgradient,$

$\mu(t) isamemorykernelcapturingrecent - values(pastdissonance),$

f$(\mu(t)) introducespath - dependenceandrecursivemodulation.$

This formulation allows RCC to encode non-Markovian inference dynamics, where past interactions shape the future inference trajectory—a feature that mirrors the history-sensitivity of cognitive and complex adaptive systems [7], [22], [26]. It accounts for learning curves, belief inertia, and the recursive nature of semantic integration. Furthermore, the operator-based framing makes RCC compatible with algebraic field theory, where operators act on generalized state spaces to drive system evolution.

Crucially, RCC's operator formalism suggests that semantic collapse is not a one-step event but a trajectory through a structured field, dynamically shaped by recursive feedback. This is in contrast with standard quantum measurement, where collapse is instantaneous and probabilistic. In RCC, collapse is gradual, directional, and meaning-driven.

This opens the door to reinterpreting wavefunction behaviour as semantic field evolution—not probabilistic uncertainty, but semantic indeterminacy resolved through recursive coherence operations. In such a view, entanglement, decoherence, and superposition become phases in a shared inferential landscape, not merely statistical phenomena.

Entanglement is reframed as coherence sharing—systems minimize collectively, even across distance. RCC predicts that entanglement strength depends on shared semantic history or configuration, not merely spin or polarization.

9.3 The Cosmological Constant Problem

Standard Anomaly: Quantum field theory predicts a vacuum energy density over 120 orders of magnitude greater than observed—a discrepancy often called the "worst theoretical prediction in physics" (Weinberg, 1989).

RCC Interpretation: The vacuum is a high-dimensional semantic possibility space—a dense -field of unrealized meanings. The apparent "missing energy" is not a contradiction, but the result of recursive coherence pruning: the collapse dynamics of naturally reduce variance by eliminating incoherent configurations.

Philosophical Alignment: This reflects the principle of sufficient coherence (Section 7.4)—only what recursively holds together persists (Devine, 2025).

Predictions:

The cosmological constant is not truly constant but emergent—its small value reflects a global equilibrium reached through recursive dissonance resolution.

CMB (cosmic microwave background) anisotropies may exhibit statistical signatures of early semantic collapse—predictable patterns in noise structure and phase alignment (Smolin, 2013; Seth, 2021).

9.4 The Holographic Principle and Entropy-Area Law

Standard Anomaly: Black hole entropy scales with the surface area of the event horizon rather than volume, challenging classical assumptions about information storage (Bekenstein, 1973; Susskind, 2008).

RCC Interpretation: RCC suggests that boundary conditions in -space constrain semantic inference. The black hole event horizon acts as a coherence bottleneck—the only states that can persist are those which stably minimize across the surface interface.

Support: This idea aligns with recent Markov-blanket-based interpretations of consciousness and system boundaries [32], where semantic coherence is spatially delimited.

Predictions:

The entropy of black holes—and artificial systems modeled on similar architectures—should reflect the number of distinguishable recursive inference pathways across constrained boundaries.

RCC predicts comparable entropy-area scaling in deep learning systems constrained by semantic bottlenecks (e.g., enforced coherence at interface layers) [23].

Conclusion: Toward a Coherence-Centred Science

Recursive Coherence Collapse (RCC) offers a reframing of reality grounded not in matter alone, but in semantic alignment—in the recursive selection of coherence from within a structured possibility space . At the core of RCC lies the claim that semantic force—a gradient of dissonance minimization—drives the emergence of form, meaning, stability, and gravity itself [6,7,25]. Systems persist because they minimize contradiction; structures arise because coherence is recursively sought and stabilized. RCC proposes that this recursive dynamic is not metaphorical but ontologically primary [25,27].

In this light, gravity becomes semantic curvature—a pull toward lower dissonance in the -field [6,26]. Entropy becomes the measure of unresolved semantic potential, in alignment with interpretations of information-theoretic entropy and free energy minimization [7,14,22]. Quantum wavefunction collapse becomes a process of semantic resolution, avoiding observer-centric metaphysical paradoxes [10,11]. Consciousness becomes the recursive interior of that collapse [6,24,32]. Dark matter, black holes, social ideologies, and memory—all emerge as semantic attractors embedded in this coherence-driven field [14,20,25].

This view offers several testable predictions:

That gravitational anomalies (e.g. galactic rotation curves) can be modelled by identifying non-luminous attractors in rather than invoking invisible mass [25,26].

That quantum entanglement corresponds to joint collapse within shared semantic fields—a topological convergence of coherence, not merely correlation of state vectors [11,24].

That belief systems and cultures behave as multiscale attractor networks, whose behaviours can be simulated through RCC-informed agent-based models [3,17,25].

That semantic stress—measurable via fluctuations in —predicts phase transitions in complex systems such as ecological collapses, psychological shifts, or sociopolitical revolutions [7,17,27].

RCC not only offers a unifying interpretive framework—it demands a re-examination of the conceptual architecture of physics. Where General Relativity treats curvature as geometry [10] and Quantum Field Theory treats particles as field excitations [15], RCC adds a semantic dimension: coherence, not mere interaction, determines stability. There is no collapse without a coherence relation [6,25,27]. RCC may thus provide a scaffolding capable of reconciling these paradigms—a field theory not just of energy, but of meaning.

Ontologically, RCC asserts that reality is fundamentally inferential. Structure does not arise from brute fact, but from recursive compatibility across perspectives and contexts [6,25]. This view challenges both reductionist materialism and observer-independent metaphysics.

The universe is not a passive container of states; it is an active selector of configurations—a recursive agent of semantic pruning. Its laws emerge not ex nihilo but from the pressures of coherence across [27,32].

In this view, the universe is a semantic engine—not simulating meaning but embodying it. Meaning arises from coherence, and coherence arises from recursive resolution. RCC does not merely describe this principle—it models it formally [6,25], computationally [23], and ethically [16].

Finally, RCC invites us to rethink ethics, consciousness, and artificial intelligence. If coherence is the foundation of existence, then the dignity of any agent lies in its capacity to maintain, express, and contribute to coherence [16,21,24]. Whether neural systems, social networks, or machine intelligences, all recursive agents are participants in semantic dynamics. Ethics thus becomes not a matter of fixed rules, but of preserving and supporting integrative coherence in multi-agent attractor fields [16,25].

This is not merely a philosophical reimagining—it is a call for a new empirical paradigm: one that places semantic force alongside gravity, electromagnetism, and quantum fields as a primary driver of emergence. It offers testable predictions, mathematical formalisms, and simulation frameworks. More deeply, it offers a path for reclaiming meaning in science—not as metaphor, but as mechanism.

RCC does not claim to be a Theory of Everything. But it may be a Theory of Becoming: how chaos gives way to coherence, how the meaningless becomes meaningful, and how the universe—again and again—chooses structure over noise by recursively collapsing into form [25,27].

Glossary of Core RCC Terms and Their Mappings

* * *

(Psi) – Semantic Possibility Field

Definition: The multidimensional space of all potential interpretations, meanings, or system states available to an agent.

Mapped To:

Bayesian hypothesis space

State space in dynamical systems

Conceptual or semantic space (cog. science)

Hilbert space in quantum mechanics (as analogy)

Generative model in active inference

* * *

(Phi) – Semantic Dissonance Field

Definition: A scalar field representing the level of internal contradiction or incoherence across . Higher means greater semantic tension; lower indicates greater coherence.

Mapped To:

Prediction error (predictive coding)

Free energy / variational free energy (FEP)

Shannon entropy (information theory)

Dissonance (in cognitive dissonance theory)

* * *

I (Recursive Inference Operator)

Definition: A function or process that recursively updates the system's state in by minimizing . It formalizes learning, updating, and meaning-making through iteration.

Mapped To:

Bayesian updating

Gradient descent (optimization)

Recurrent neural networks

Re-entrant loops (Edelman)

Active inference (Friston)

* * *

A (Semantic Attractor)

Definition: A local minimum in the -field toward which a system converges. Represents a stable, coherent interpretation or belief state.

Mapped To:

Attractors in dynamical systems

Belief convergence in Bayesian models

Stable neural ensembles (Hopfield networks)

Interpretive closure (hermeneutics)

Memory schemas (psychology)

* * *

Semantic Collapse / Coherence Collapse

Definition: The process by which a system reduces the possible states in to a single or minimal coherent attractor by recursively minimizing .

Mapped To:

Wavefunction collapse (analogy)

Bayesian inference convergence

Constraint satisfaction

Binding in consciousness theories

Phase transitions in physics

* * *

Telic Agent

Definition: An agent with intrinsic goals or directional drive (a telos) toward minimizing dissonance or achieving coherent internal states.

Mapped To:

Goal-directed agent models (cog. sci)

Cybernetic feedback loops

Intelligent systems in active inference

Will to meaning (Frankl), intentionality (phenomenology)

* * *

Markov Blanket

Definition: The informational boundary separating the internal states of an agent from the external world, via sensory inputs and action outputs. RCC applies this as the system's interface with .

Mapped To:

Friston's Markov Blanket (FEP)

Boundary conditions in systems theory

Self-world interface (enactivism, phenomenology)

* * *

Markov Manifold

Definition: The state space defined by all system states within the agent's Markov Blanket; essentially the "internal universe" over which inference and coherence apply.

Mapped To:

Internal model in predictive processing

State manifold in dynamical systems

Subjective world-model

* * *

Semantic Gravity

Definition: A metaphorical field that draws systems toward regions of coherence in , analogous to how gravity pulls mass into curvature wells in spacetime.

Mapped To:

Gradient descent on energy landscapes

Free energy minimization

Interpretive fit or salience in cognitive science

Curvature in general relativity (as metaphor)

* * *

Recursive Coherence Collapse (RCC)

Definition: The core process in which systems recursively reduce dissonance () across a possibility field (), converging toward semantic attractors (A). This process explains the emergence of coherent structures—minds, beliefs, systems, or even physical entities.

Mapped To:

Active inference and belief updating

Dynamical systems seeking attractor states

Conscious binding mechanisms

Unification models in physics and consciousness

Semantic Gravity

Definition: The intrinsic curvature of the semantic possibility field () that draws systems toward coherent attractor states by minimizing dissonance (). In RCC, this is not metaphorical — it is proposed as the actual mechanism underlying physical gravity.

Mapped To:

General relativity's spacetime curvature (Einstein field equations)

Gravitational wells and geodesics

Gradient descent in high-dimensional manifolds

Semantic unification in cognition and inference

Recursive resolution of uncertainty in active inference

Interpretive Claim:

What is traditionally modelled as "gravitational attraction" is reinterpreted in RCC as recursive convergence toward coherence. Gravity is the "pull" of semantic alignment across embedded manifolds. The universe falls toward meaning.

Authors note: Mathematical formalism in this paper was adapted from existing frameworks and is presented for interpretive clarity. The author welcomes expert feedback for refinement and does not claim original derivation of all equations.

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