

Structured Readiness: A Fourfold Theory of Process

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ABSTRACT

This paper proposes that process is grounded in four constitutive principles: Latent, Emergence, Recognition, and Change. They are not stages, subprocesses, or descriptive labels. They are positions in a constitutive sequence. Each primes the next. Every process occurs within an environment that constrains what the latent can trigger. The framework is a philosophical theory of process. It is a schematism, not a predictive scientific theory. Any process that fails to exhibit the four positions would warrant re-examination. The paper addresses two gaps. The first is the absence of a minimal, constitutive, four-position grammar that can move across physics, biology, cognition, and society without translation into a special vocabulary. The second is the longstanding treatment of the latent as a lack. In most process philosophies, the interval between one actuality and the next is treated as absence, as not-yet, as a waiting room for being. This framework rejects that treatment. The latent is not a lack. It is active, differentiated, and internally dynamic before anything emerges. The theory was stress-tested across physical, biological, cognitive, social, and technological domains—from the rock to the hydrogen atom, from the virus to the social movement. It responds to Kaisheng Li's EQT framework. The framework was applied across geology, thermodynamics, nuclear physics, quantum chemistry, virology, evolutionary biology, neuroscience, cognitive science, sociology, computer science, philosophy of science, religion, creativity studies, and physiology. It is offered for testing, correction, and use.

Keywords: Process Philosophy; Structured Readiness; Latent; Emergence; Recognition; Change; Causal Ontology; Schematism; Kaisheng Li; EQT; Cross-Domain Analysis; Transformative Change.

1.0. Introduction

Kaisheng Li asks a question that process philosophy has often avoided: if we reject substance and judgment, what remains? Aristotle grounded reality in substance. Kant grounded experience in judgment. Both sought a basic bearer—something that could hold reality together while change occurred around it. Process thinkers from Hegel onward have tried to escape this inheritance. But the problem has not disappeared. It has only shifted vocabulary. Li's answer is EQT—an energy-quanta density field with three stable modalities: accessibility, relationality, and stability. These are dimensions of process. But they describe what process has. They do not describe what process undergoes. This work responds to that question, prompted by Li's framework, and enters the long philosophical conversation about process. It proposes that process is not grounded in a field or a state. It is grounded in principles. Those principles are fourfold: Latent, Emergence, Recognition, Change.

Whitehead (1978) built a process metaphysics around actual occasions, prehension, concrescence, satisfaction, and superject. That system is true to becoming, but it is dense, internally technical, and resistant to empirical application across fields. He was attempting a comprehensive cosmology—a single scheme that would harmonize physics, biology, psychology, aesthetics, and theology. Peirce (1931) named three categories—Firstness, Secondness, Thirdness—that anticipate this framework's first three principles. But Peirce offered no fourth category for transformation, no principle by which the cycle completes and restarts. Hegel (1977) described movement through itself, for itself, and in itself. That is a dialectic, not a causal chain. It explains how thought and history unfold, but it does not map onto a virus binding to a host or a rock yielding to water. Aristotle (1984) is often treated as the philosopher of substance, yet his vocabulary of potentiality, actuality, form, and becoming fits this framework better than many readings allow. Still, Aristotle anchors process in underlying substances. A thing

has potential. A thing actualizes. The process is always a process of something (Aristotle, 350 B.C.E./1984). Derrida (1982, 1997) traced a rhythm from trace to inscription to différance, from deconstruction to reconstruction. The rhythm is real. But it is a rhythm of signs and texts, not of geological weathering or nuclear decay. These are not idle references. I worked through Aristotle's method of arriving at first principles and Hegel's dialectic in an earlier framework on entitlement and transformation (Inesia-Forde, 2025). That work already treated latent capacities for agency and hope as dynamically present, capable of activation regardless of conditions. In hindsight, this prior work may have made Li's omission of latency immediately visible. The present paper extracts that structure and tests whether it holds across all processes, not only social ones.

None of the referenced thinkers supplies a minimal, constitutive, four-position grammar that can move across physics, biology, cognition, and society without translation into a special vocabulary. That is one gap. But a second, less often named gap exists. In most process philosophies, the interval between one actuality and the next is treated as absence, as not-yet, as a waiting room for being. The latent is reduced to a lack. This framework gives the gap its own ontology. It does not claim to surpass Whitehead, Peirce, or Aristotle. It claims to be simpler than the first, more complete than the second, and less substance-bound than the third. The claim is that process has a shape. That shape is fourfold.

The contribution is fourfold. First, the framework identifies four constitutive principles of process and states them as a constitutive sequence, not a taxonomy. Second, it treats the latent as structured readiness rather than as a lack. Third, it defines recognition as causal fit rather than as a mental act, extending the principle across nonliving and non-conscious processes. Fourth, it illustrates that the same constitutive grammar holds across physical, biological, cognitive, social, and technological domains without translation into a special vocabulary. The comparison with Whitehead, Peirce, Hegel, Aristotle, and Derrida appear in Table 1 as resonance, not equivalence. The framework does not claim to reconcile those thinkers. It claims to be an independent structure that echoes them (see Fig. 1).

This is a philosophical theory of process. It is not a predictive scientific theory. Any process that fails to exhibit the four positions would warrant re-examination. And it can be tested against any system that exhibits the four positions. The latent is not a pause between events. It is an active, differentiated state—structured readiness, made positive.

Principle	Aristotle	Peirce	Whitehead	Hegel	Derrida
Latent	Dynamis — positive capacity	Firstness — pure quality	Pre-concrescent givenness	An sich — in-itself	Trace
Emergence	Energeia — actualization	Secondness — brute actuality	Concrescence — satisfaction	Für sich — for-itself	Inscription
Recognition	Eidos — form, meaning	Thirdness — mediation	Superject — objective datum	An-und-für-sich	Différance
Change	Becoming — genesis	New Firstness	New concrescence	Aufhebung — sublation	Deconstruction — reconstruction

Figure 1. Correspondence Table.

2.0. The Four Principles

The four principles are the essence of process. Essence here does not mean a static bearer of properties. It means the basic constituents—what makes a process a process at all. As the essence of process, the principles cannot be three or five. Three would be incomplete: without Change, the process does not complete and re-enter a new latent condition. Five would be redundant: any candidate fifth principle either reduces to one of the four or belongs to the environment, which is a condition, not a principle. Four is not a theoretical choice. It is what the essence of process requires.

The principles are fourfold: Latent, Emergence, Recognition, Change. Every process occurs within an environment that constrains what the latent can trigger. They are positions in a constitutive sequence, not a temporal one. Each position is defined by what it triggers in the next position. The sequence is not "Latent happens at t_1 , Emergence at t_2 ." It is "Latent is the constitutive precondition of Emergence; Emergence is the constitutive precondition of Recognition; Recognition is the constitutive precondition of Change; Change produces a new Latent or terminates." The arrows are trigger relations, not temporal stages. All processes undergo the same four principles, but processes differ because the character of each principle shifts depending on the process. For instance: the rock persists, the fire consumes, the virus solicits, the nucleus contingently becomes. Each verb names the process's mode. This is essentially a cycle of becoming: potential → actual → meaningful → transformed → potential again. This work is close to what Alfred North Whitehead called the 'ontological principle' or the rhythm of concrescence → satisfaction → superject → new concrescence. Moreover, the model resonates with Peirce's triad at the level of Firstness (latent), Secondness (emergence), and Thirdness (recognition), though the fit is less exact than with Whitehead's process of concrescence. Hegel influenced Peirce, though he rejected the dialectic. Peirce's abduction extends Aristotelian reasoning beyond the syllogistic. But those familiar with Aristotle's abstraction and first principles—the process that makes finding the essence of a thing possible—and Hegel's (2010) dialectical method will see them in this framework (see Table 1). I suggest Aristotle's abstraction process grounds Hegel's method and Derrida's deconstruction. Abstraction requires deconstruction, as deconstruction leads to the construction or emergence of essence, first principle, or generalization from particulars. The framework was applied across geology, thermodynamics, nuclear physics, quantum chemistry, virology, evolutionary biology, neuroscience, cognitive science, sociology, computer science, philosophy of science, theology, and physiology (see Appendix B).

Table 1. Resonance.

Thinker	Structure	What it has	What it lacks
Whitehead	Concrescence → Satisfaction → Superject → new concrescence	Four-phase cycle, environmental selection	Empirical applicability; latent not given positive ontology
Peirce	Firstness → Secondness → Thirdness	Three categories mapping to L, E, R	Fourth category for transformation; no causal sequence

Hegel	In-itself → For-itself → In-and-for-itself	Dialectical movement, negation of negation	Not a causal chain; doesn't map onto physical processes
Aristotle	Dynamis → Energeia	Potentiality/actuality	Anchored in substance; no Recognition; latent is a property of a thing
Derrida	Trace → Inscription → Différance → Deconstruction → Reconstruction	Rhythm of signs, deconstruction/recons truction	Rhythm of texts, not of geological or nuclear processes

2.1. Concepts

Latent: Latent is structured readiness. It is what is primed but not yet actualized. The latent is a structured field whose internal form is intrinsic and whose actualization is environmentally selected. Whether it triggers emergence, and which possibility it triggers, depends on the environment. The other three principles are relationally defined. A process begins from a condition of unrealized potential. Nothing has happened yet, but the conditions for something to happen are present. There is a space of possibilities, a field of readiness. Latent is not absence. It is not stillness. It is active, differentiated, and internally dynamic. It has structure, orientation, and ongoing activity before anything emerges. It is not waiting.

Latent is not identical to potentiality, disposition, possibility, or probability. It is a state and a higher level of abstraction that includes them. These terms describe a spectrum. At one end is the intrinsic power to act: potentiality and disposition, the internal capacity or tendency of a system to bring about a specific outcome. In the middle is the abstract range of what can act: possibility, the openness for a state of affairs to exist without contradiction. At the other end is the calculated likelihood of what will act: probability, the quantitative measure of how likely a specific possibility is to be actualized under given conditions.

Latent names the state of a system in which this spectrum is present and active before anything emerges. A seed is latent. It carries the potential to become a tree, the disposition to germinate under certain conditions, the range of possible forms it may take depending on environment, and the probability of each outcome. The Latent is not one of those properties. It is the state in which they are held. Latent is a state. Potentiality, disposition, possibility, and probability are properties of that state.

These concepts are abstract. They are not tied to any particular process. They are held up by particulars, but they are not reducible to any one of them. This is why the framework applies across domains. Aristotle described first principles in the same way: the most general terms, abstracted from particulars, yet what particulars are made of. Latent is a principle in this sense.

Emergence: Something that was not present before, arising from a new unity or novelty. Out of latency, something arises: a pattern, a distinction, a difference that makes a difference, a new unit, a novelty. The potential becomes actual. Emergence may be discrete or continuous. In some processes it appears as a sudden transition, as in a

quantum jump or an ignition. In others it appears as a gradual change, as in a continuous phase transition near a critical point. The structure is the same. The rate of emergence differs.

Recognition: Recognition is relational. It is the causal fit between the new unit or novelty and what is primed to respond. The emergent pattern is registered, either internally or externally. It becomes a fact for the system as something that can constrain, inform, or feed back into later stages. Without recognition, emergence would be a random flash with no consequence.

Recognition is the abstraction that is undergirded by interaction, causation, selection, or measurement. Those are inherent to it. Recognition is the act in which they are inseparable. There is contact—interaction. There is effect—causation. There is selectivity—fit. Often, a determinate measure appears: a threshold, a frequency, a condition that determines when the fit is made. None of these is separate from recognition. They are what recognition is made of. To recognize is to interact, cause, select, and measure in a single movement. That movement is what primes Change.

Recognition is not interaction, because a rock and water may interact without fit. It is not causation, because a billiard ball may move another without selectivity. It is not selection, because selection names the outcome and recognition names the moment. It is not measurement, because measurement records a value and recognition does not require recording. Recognition is the fit that selects, the moment one structure responds to another according to what that structure is (see Table 2).

Table 2. Recognition and Its Neighboring Concepts.

Concept	Definition	How it differs from Recognition	Example
Interaction	Any contact between two entities.	Interaction is the widest category. A rock and water may interact without the fit being made. Recognition is the interaction where the fit is made.	A pebble striking a wall. Contact occurs. The wall does not respond according to its own internal structure.
Causation	Any interaction where one entity produces a change in another.	Causation does not require selectivity. A billiard ball may cause another to move without the second ball responding according to its own structure. Recognition requires that the responder's structure select the response.	Two billiard balls colliding.
Selection	The outcome of a process in which some possibilities are realized, and others are not.	Selection names the outcome. Recognition names the moment. Selection is what happens over generations. Recognition is what happens when the fit is made.	Natural selection selects traits over time. Recognition is the phenotype-environment fit in a single organism.

Measurement	A process in which a state becomes correlated with a recorded value.	Measurement is a subset of recognition. It requires a record. Recognition does not.	A quantum measurement records a value. A rock yielding to stress does not record anything — the fit is made without a record.
Recognition	The causal fit between a novelty and what is primed to respond.	The moment when one structure selects another's response according to what that structure is.	Water following a fracture plane. A virus binding to a receptor. A social movement gaining legitimacy.

To recognize is to interact, cause, select, and measure in a single movement. That movement is what primes Change.

Change: Change is the completed transformation. It is process-dependent. The recognized pattern is deconstructed and reassembled into something new. That new condition may become the latent state for a subsequent process, or it may be terminal. Change is constant across the cycle. It is most evident in Emergence, as what prompts it is rooted in the Latent. It continues through Recognition, which also produces change, and culminates in Change, which is transformation.

The transformation may be a new state or condition, a return to the same state, or a replacement. The character of the new latent varies by process. In the hydrogen atom, the new condition is a replacement: the electron returns to a ground state, and the new superposition is structurally equivalent to the old. In a social reform, the new condition is an accumulation: the society carries forward the results of the change into the next cycle. In fire, the new condition is a transformation: the ash and heat are not a replacement or an accumulation, but a new kind of condition for a different process. The framework accommodates all three. It requires none of them. It requires that the new condition be a latent state for what follows.

A terminal process is one in which the new condition does not become the latent for a subsequent process of the same kind. The process ends. The condition does not disappear. It becomes the latent for something else—for the environment, for other processes, for material that enters a different cycle. Fire burns out. The fire is terminal. The ash and heat become the latent condition for regrowth, erosion, and new fires. The condition is always latent for something. The question is what it is latent for.

This is how terminal processes are accommodated within the recursive structure. The recursion is not broken by termination. It is what occurs when the process is not the same process. The four principles describe what a process undergoes when it runs. They do not require every process to continue.

A process may repeat without accumulation. The hydrogen atom returns to its ground state. Respiration returns to its baseline. These processes do not accumulate. They cycle (see Fig. 2). The framework does not require accumulation. It requires the four positions. Repetition and transformation both arise from the same structure.

The new condition may also feed back into the same process, modifying its latent condition for a subsequent run. The Eureka effect in visual perception is an example. Once the object is recognized, the observer's prior

expectations change. The next trial begins from a different latent condition. The process is not a single pass. It is a repeating loop in which each run alters the conditions of the next.

Emergence, Recognition, and Change are transformations. Emergence is the appearance of novelty. Recognition is the registration of novelty. Change completes the transformation when the recognized novelty is deconstructed and reconstructed.

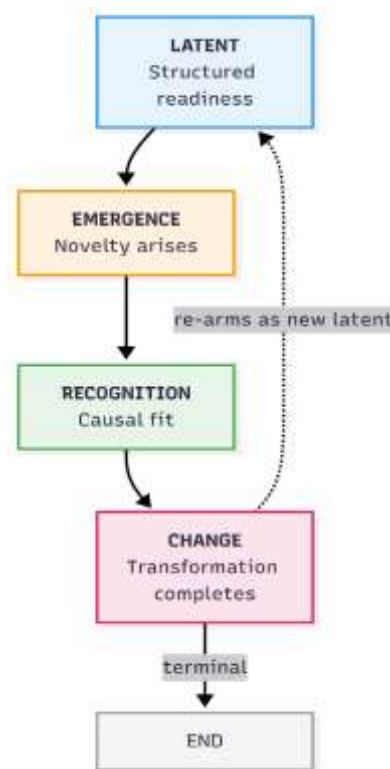


Figure 2. The Principle of Process: Recursive Schematism.

2.2. Why Four

The framework has four principles. The fourth is what makes the sequence a process rather than a progression. The four are not a count. They are what a process contains. A process is a transition. Any transition occupies four logical positions: the condition from which it departs (Latent), the novelty that appears (Emergence), the determination of which novelty (Recognition), and the condition to which it arrives (Change). These are not four things found in every domain. They make a transition a transition. Remove any one and the transition is incomplete: no departure is an uncaused event; no novelty emerges from a persistent state; no determination is undetermined noise; no arrival is an interruption. A proposed fifth is tested by a single question: is it a logical position in a transition, or is it a mode of one of the four, or a property of the medium? Feedback is a mode of Change. Resistance is a property of the environment. Negation is a sub-position of Recognition. Threshold is a sub-position of Recognition. Duration is a property of the process as a whole. None is a fifth position.

The number four is not a theoretical choice. It follows from the logic of transition. The four are not discovered in domains. They are contained in the concept of process. I did not select the cross-domain mappings to fit a predetermined number. I examined each case independently, and in each case the same four positions appeared: a

primed condition, a novelty, a causal fit, and a completed transformation. They are what make a process a process. If the structure of transition is fourfold, then any process that runs must exhibit the four positions. Figure 3 maps the types of processes for which the principles hold. That is what the universality claim means. It is not a claim about every process that has ever existed. It is a claim about what a process, in general, requires.

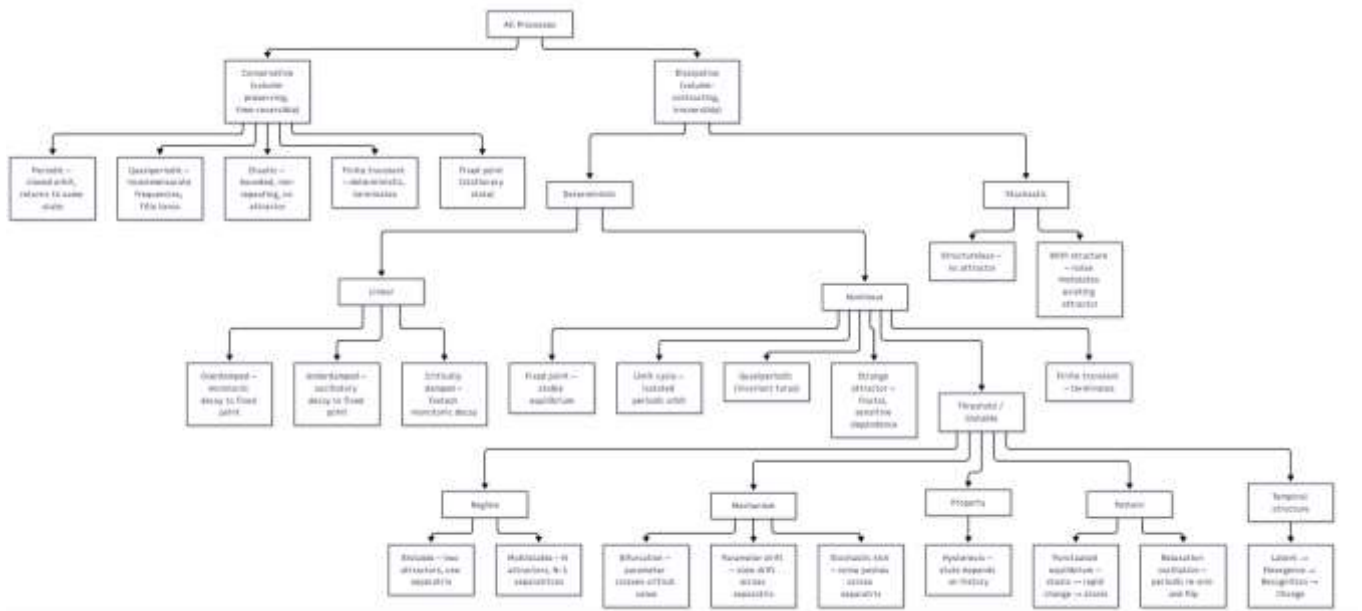


Figure 3. The Attractor Taxonomy.

2.3. Universality

The framework claims universality. It does not demonstrate it. No framework can test every process. The claim is supported by the cases tested and open to revision if a counterexample is produced. The cross-domain mappings in Appendix C illustrate the claim. They do not prove it. The distinction is stated explicitly here so the claim's strength matches the evidence. The framework is a set of principles. Principles differ from hypotheses. A hypothesis is a claim about a specific set of observations and is falsifiable by those observations. A principle is a claim about the structure of a domain. It is critiqued by showing that it does not hold for the domain it claims to govern. If the four principles are principles of process, they hold universally. If they fail, they fail universally. No middle ground allows them to hold for some processes but not others. I claim they are principles based on the processes tested. The field critiques them. Aristotle did not falsify his own categories. Kant did not test the *Critique* against empirical cases. The framework is offered in that spirit.

3.0. Method: LLM Collaboration

This paper is a philosophical argument. It uses scientific evidence to support its claims. The evidence is drawn from peer-reviewed research in each domain. The argument is the framework that organizes that evidence. The paper distinguishes the two throughout: the evidence is the mechanism, and the argument maps that mechanism onto a principle. The study used three large language models (LLMs): DeepSeek, Brave Research Assistant, a search-augmented assistant, and Bohrium. The framework was explained to each. Each was asked to stress-test it by pairing the four principles with terms from the corresponding field and identifying tensions. The human

Step 3: Mapping. For each domain, the LLM was asked to pair each of the four principles with a specific mechanism or concept from that domain. The pairing was required to be observable, documented, and functional. The LLM was instructed to reject any pairing that was merely metaphorical (see Fig. 4).



Step 6: Verification. The human researcher verified every claim attributed to the LLM in this paper against a primary or peer-reviewed source. Claims without sources were removed. What remains unsourced is the human researcher's interpretation. Three procedures governed the interaction:

Adversarial review. The LLM was instructed to challenge the framework, not confirm it. We tested every mapping against the question: does this mechanism perform the function named by the principle, or does it merely resemble it? If the answer was unclear, the human researcher asked questions to determine if the LLM was searching for applicable examples.

Distinction between interpretation and evidence. LLM's interpretations were treated as hypotheses, not evidence. Every mapping was required to cite a peer-reviewed source. The source was verified independently.

Transparent documentation. We sent the full interaction with the LLM to the editor. The record includes the prompts, the LLM's responses, the human researcher's corrections, and the LLM's corrections of the human researcher. The record is auditable.

The method is replicable in procedure, not in output. Large language models are stochastic. The same prompt given twice may produce different responses. A researcher following the same six steps with the same LLMs and model versions will produce a record that is comparable in structure, but not identical in text. The procedure is replicable: the criteria for mapping, stress testing, and verification, and the requirement that every claim be sourced.

The exact wording of the LLM's responses is not replicable. This is a property of the tool, not a limitation of the method. The method is offered as a procedure that any researcher can follow and that any reviewer can audit. The LLM is not treated as an independent scholarly source. It is treated as a reasoning partner. Its contributions were breadth, speed, adversarial testing, and documentation. Its limitations are that it does not exercise judgment, hold philosophical commitments, or author the framework. The human researcher did.

3.1. Matching Concepts to Physics Terms

The physics sections of this paper use established physical terminology. Where the paper interprets that terminology through the framework, it marks the interpretation as philosophical, not physical. The framework does not claim to modify physics. It claims to identify a structure that physics already contains.

Latent. In physics, a system is described by its phase space—the set of all possible states it could occupy. Before a measurement or a transition, a quantum system exists in a superposition of possible states. Nothing is actualized yet; all outcomes are latent. In classical physics, there is potential energy—energy stored in configuration, not yet expressed as motion. The vacuum is not empty. It carries zero-point energy, irreducible fluctuations that persist even at the lowest energy state. That is structured activity without a bearer, readiness without an object. Latent is that kind of state. It is real, active, and internally dynamic. It has structure, orientation, and ongoing motion before anything emerges. It exhibits ongoing internal dynamics. **Physics terms:** phase space, potential energy or ground state, quantum superposition.

Emergence. When a latent possibility becomes actual, physics describes this as a phase transition (e.g., water freezing), spontaneous symmetry breaking (the universe cooling and forces separating), or, in quantum mechanics, decoherence. One possibility is selected from many. Structure appears where before there was only possibility. Quantum measurement is interpretation-specific. In collapse interpretations, measurement is the process by which the wave function collapses into a definite state. In no-collapse interpretations—many-worlds, Bohmian mechanics, consistent histories—measurement does not involve collapse. The framework uses "decoherence" as the interpretation-neutral description, with "wavefunction collapse" named as one interpretation among several. **Physics terms:** symmetry breaking, phase transition, decoherence, actualization of a potential.

Recognition. For a pattern to matter, it must be registered. In physics, this is interaction. A particle's state becomes relevant when it interacts with another system. In quantum mechanics, measurement is the process by which a system's state becomes correlated with an observer or environment. In statistical mechanics, correlation and mutual information quantify how much one part of a system "knows" about another. **Physics terms:** interaction, measurement, correlation, information transfer, entanglement.

Change (deconstruction and synthesis). Change involves breaking down an old structure and forming a new one. **Physics terms:** dissipation, decoherence, recombination, renormalization, entropy production, symmetry restoration.

Dissipation: energy spreads out, structure degrades (entropy increases locally).

Decoherence: quantum coherence is lost; superposition degrades into classical mixture.

Recombination: particles combine in new configurations (e.g., electrons and protons forming hydrogen atoms after the Big Bang).

Renormalization group flow: as scale changes, old structures dissolve, and new effective structures emerge.

Symmetry restoration/re-symmetrization: sometimes a broken symmetry is re-established under new conditions.

The four principles map onto the physical description of how systems evolve. Physics treats these as separate phenomena in different domains—quantum, thermodynamic, cosmological. This framework proposes them as a single logic of process. It does not predict outcomes. It constrains what any outcome must be structured as. It illuminates by revealing a shared grammar across domains that are usually treated separately. It requires that any process, however exotic, exhibit structured readiness, emergence, causal fit, and transformation. If it does not, the framework fails. It does not replace the equations. It disciplines the interpretations.

Three criteria evaluate a mapping. First, the mechanism must be observable. It must appear in the peer-reviewed literature of the domain. Second, the mechanism must perform the function named by the principle. The mechanism must not merely resemble the function. It must do the work. Third, the mapping must not require translation into a special vocabulary or neologism. If the mechanism can only be described by importing terms from another domain, the mapping is metaphorical, not structural. A mapping that meets all three criteria is accepted. We did not find a process that failed to meet the criteria.

3.2 Framework Refinements through Testing

AI (DeepSeek and Brave Research Assistant) implemented the full framework but encountered tensions. These tensions were challenges that were resolved in the moment (see Table 3).

Table 3. Tension and Resolution.

Challenge	Bump	Resolution
Recognition as Relational, Not Mental	Recognition seemed to require a fixed definition or conscious observer.	Recognition is causal fit—what meets, resists, or selects. It holds for rocks, viruses, fire, decay, and minds. No observer required.

The Rock as a Test Case	A rock seems inert, too static to be a process.	The rock has latent potentiality—fractures, cleavage planes, chemical reactivity. Recognition is structural: water follows cracks, acid attacks calcite. Change is weathering, dissolution, sediment.
Radioactive Decay	Decay seems to happen without recognition—no external trigger, no stimulus.	Recognition includes internal instability. Recognition became: external fit OR internal instability.
Priming as Constitutive, Not Sequential	The four principles seemed like stages in a narrative.	Latent primes Emergence. Emergence primes Recognition. Recognition primes Change. Change primes a new Latent. This is constitutive, not just temporal.
Principles, Not Subprocesses	The four principles were called subprocesses.	They are principles of process—the basic modes of process. Subprocesses imply hierarchy and scale. Principles are more fundamental.
The Essence Question	It was written that "process does not have an essence."	Principles ARE the essence. Like the principles of math or democracy. Process has an essence; it is fourfold.
Latent as Creative Potentiality, Not a Thing	It was said that "a rock is latent."	The rock is not latent. What is latent is the unactualized surplus—the creative potentiality (the fractures not yet opened, the reactions not yet triggered, the process passes by). The latent has its own structure. Its transition to emergence is relational.
Emergence Produces Novelty	The "New Unit" seemed like a possible fifth principle.	It is not a fifth term. It is what Emergence yields. Novelty is produced. The four-term chain remains intact.
Integrating Physics Terms	Physics and ontology seemed disconnected.	Physics already has conceptual machinery for each of the four moments, but rarely puts them together as an ontological cycle.

4.0. Hydrogen Atom

The framework was applied to the hydrogen atom. The hydrogen atom is the simplest bound quantum system: one electron, one proton, and the electromagnetic interaction between them.

Latent → Emergence. The electron is in a superposition of possible states. The wave function describes the probability amplitude of finding the electron in each allowed energy level. Even in the ground state, the atom is not still. Zero-point motion persists. The electron cannot be brought to rest. The vacuum fluctuates. The latent condition is active even at the lowest energy state. This superposition is the latent condition. It is the primed state from which a transition is possible. The latent is the condition the trigger acts on.

Emergence → Recognition. A perturbation—a photon, a collision, a field—causes the electron to transition. The transition is a quantum jump. It produces a specific eigenstate, the stationary state into which the electron has settled. This is the emergence: the novelty is the eigenstate. The recognition is the dipole selection rule: the transition is allowed only if the angular momentum change satisfies $\Delta l = \pm 1$. The photon emission is the completed transition. The spectral signature records that recognition. Without the field, the state would not be registered as a transition. Recognition stabilizes the new unit.

Recognition → Change. The settled state is not the old state. The atom is now in a different energy configuration. The change is the transition itself, completed. A photon is emitted or absorbed. The atom is in a new state.

Change → Latent. The new energy state has its own set of available transitions. A new superposition. The loop continues from a new condition of structured readiness. The new condition is not the old condition with additions. It is a replacement. The latent is not a container that fills. It is a state that is succeeded by another state.

The hydrogen atom is the minimal case in which the fourfold can be checked without collective or many-body complexity. It is the simplest system in which the framework can be tested. It is not the ultimate test. If the chain does not hold here, the framework is weakened. The mapping holds. The ultimate test is the social domain, where the mapping must hold across distributed agents, mental events, and institutional structures.

5.0.Limits

The strongest possible break in the schematism would be an event that occurs without priming—an emergence from absolute absence. The only serious candidate is the origin of the universe: the Big Bang, if it was a true beginning. If the universe emerged from nothing—not from a prior vacuum, not from a quantum field, not from a latent condition—then that first emergence would fall outside the four principles. It would be the origin of process, not an instance of it. Zero-point motion suggests that within a quantum field, perfect stillness is not physically possible. The ground state of a quantum field carries irreducible fluctuations; the field cannot be made perfectly quiescent, even in its lowest-energy state. This is a robust physics result (Kraus, 2012). But whether this structured, fluctuating vacuum counts as "nothing" is not a physics question; it is a definitional one. The vacuum contains spacetime, fields, and law. Whether a state with all of those still earns the label 'nothing' depends on which level of absence one requires: no matter, no particles, no fields, no geometry, no law. The quantum vacuum sits somewhere on that spectrum, and where exactly is a matter of interpretation, not measurement. Physics does establish that the vacuum is not a simple absence; it is a structured, dynamic state. Whether that structure disqualifies it from being 'nothing,' or makes it the most honest form of nothing physics can offer, remains a question physics itself cannot close. If so, the Big Bang is not a counterexample to the framework. It is an Emergence from Latent, followed by Recognition and Change. The framework applies. If it is not the case—if there was truly nothing before the Big Bang—then the Big Bang is the origin of process, and the framework does not claim to describe it. The framework describes what happens within process, not the emergence of process itself. Either way, the framework stands. It is either consistent with cosmology or bounded by it.

Failure conditions. The framework distinguishes three outcomes when it is applied to a process. A successful application is one in which all four positions appear in conditional sequence: a primed condition, a novelty, a

causal fit, and a completed transformation, whether the process continues or is terminal. A partial application is one in which the four positions are present but one or more is degraded, constrained, or indeterminate. A failed application would be a process in which one of the four positions is absent. A process without a Latent is an uncaused event. A process without Emergence produces no novelty. A process without Recognition is a random flash with no consequence. A process without Change is a stationary state, not a process. No failed application has been produced. The framework is offered as a set of principles. If a failed application is produced, the framework will be re-examined.

The framework's application to a specific case—the T4 bacteriophage—is developed in a companion paper (Inesia-Forde, 2026b). That paper shows that the fourfold is present in a non-neural nanoscale system and that the same architectural components that underlie human strategic action—trigger, stored force, one-way mechanism, lockout/interlock—are present in the virus. The companion paper also develops the concept of strategic existence, which names the mode of process in which a system possesses all four architectural components and pursues a pathway to existence.

Counterexamples. The framework was tested against categories typically proposed as potential counterexamples: stochastic processes, spontaneous processes (apparently untriggered), and equilibrium processes.

Stochastic processes. Radioactive decay is stochastic in its timing. The metastable nucleus is the latent condition. The decay event is the emergence. The internal selection rules are the recognition. The daughter nuclide is the change. The stochasticity is a property of the transition, not a failure of the structure. The latent condition is present. The timing is not determined. Both are true.

Spontaneous processes. Spontaneous symmetry breaking occurs with no external trigger. The symmetric field with its potential minima is the latent condition. The selection of one minimum is the emergence. The field's internal coupling is the recognition. The asymmetric state is the change. The trigger is internal. It is not absent.

Equilibrium processes. Equilibrium is not a suspension of process. It is a process running at a timescale below observation. Even the latent stage is dynamic. The internal processes are running. The potential is active. The fluctuations are occurring. The state is at equilibrium because the activities balance, not because they stop. The latent condition is the dynamic field in which the potential is already active. In thermodynamic terms, this is the free energy or potential gradient that is continuously exchanged.

In a homeostatic system, it is the constant deviation and correction that maintains the set-point. The state is not holding the cycle in reserve. The state is the cycle running. The emergence is the fluctuation, perturbation, or noise that arises from the dynamic field. In a non-equilibrium steady state, these are the irreversible probability currents that carry the system through its cycles. The state generates its own perturbations. The recognition is the feedback mechanism that detects the deviation. In biological homeostasis, this is sensing. In thermodynamics, it is the restoring force that drives the flow back toward equilibrium. The state monitors itself through its own structure. The change is the adjustment that returns the system to the same attractor. The net change over one full cycle is zero. That is what equilibrium means. The state is the invariant that the cycle produces. The state is defined by the

cycle's pattern, not by the absence of motion. A river in steady flow is a state. The water level is constant, yet the water is constantly moving. The equilibrium state is the cycle viewed from the right timescale. At the macro level, it appears static. At the micro level, it is the four-stage loop running continuously. This is why punctuated equilibrium (Eldredge & Gould, 1972) and non-equilibrium steady states (Prigogine, 1977) resolve the same tension. Stability at one scale results from change at another. The framework formalizes this. The four positions are present at every scale. What differs is the timescale at which they run.

Apparently untriggered processes. Quantum tunneling is primed by the wavefunction's amplitude at the barrier. The trigger is internal, not external, but it is not absent. The barrier's structure is the recognition. The particle's appearance on the other side is the change.

Continuous phase transitions. Near a critical point, the order parameter changes continuously, not in a jump. The emergence is gradual, not discrete. The framework does not require emergence to be discrete. It requires emergence to be present. A gradual transition is a gradual emergence. The latent condition is the order parameter approaching the critical value. The emergence is the continuous change in the order parameter. The recognition is the system's response to the changing parameter. The change is the new phase.

Brownian motion. Brownian motion is continuous and stochastic. The four positions are present at the molecular scale. Each collision is an emergence. Each particle response is a recognition. Each new position is a change that becomes the latent for the next collision. At the macroscopic scale, the motion appears continuous because the collisions are too frequent to be perceived individually. The framework does not require the positions to be visible at the scale at which the process is described. It requires them to be structurally present.

In each case, the four positions are present. The framework does not require an external trigger. It requires a primed condition. Priming may be internal or external, discrete or continuous, deterministic or stochastic. What it cannot be is absent. The framework accommodated each test.

The framework is evaluated by whether it illuminates, is internally coherent, and holds across domains. It is not a transcendental schematism, because it is not a condition of experience. It is an ontological schematism: a rule for the structure of process. Any process that resists the fourfold mapping would warrant re-examination. It may be refined. It may be replaced. But it cannot be dismissed as mere metaphor, because it rules out specific configurations. A process without a Latent is not a process—it is an uncaused event. A process without Recognition is a random flash with no consequence. A process without Change is a stationary state, not a process. The exclusion is the claim.

6.0. Conclusion

Li asked what process has. The answer offered here is that process is grounded in principles. Those principles are Latent, Emergence, Recognition, and Change. Each primes the next. Each is a basic principle of process. And each returns the system to a new condition of readiness. But no principle operates alone. Every process occurs within an environment that constrains what the latent can trigger. That environment is not a fifth principle. It is the field in which the principles do their work. This is not a final answer. It is a proposal. This schematism gives the gap its

own ontology: structured readiness, made positive. Between one actuality and the next, the latent is not the absence of what came before—it is a real, differentiated, active state. It has form, direction, and ongoing work. It is active. It is a rule for the shape any process must have. It is universal in form and particular in application. The framework claims universality but does not demonstrate it for all known processes. The cases tested support it, and it remains open to revision if a counterexample is produced. The claim is proportionate to the evidence. The framework is itself a process. It began as a latent condition in the philosophical tradition. It emerged as four principles. The framework's own recognition is social: its reception, critique, and adoption. This is not a weakness. It is an instance of the framework operating in the domain where it is most difficult to apply.

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The author consents to the publication of this research work.

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Note: Full scientific references for each domain appear in Appendix D.

Appendix A: Formal Statement of the Framework

The framework can be stated formally without altering the prose argument. A process is a tuple:

$$\mathbf{P} = \langle \mathbf{L}, \mathbf{E}, \mathbf{R}, \mathbf{C} \mid \mathbf{Env}, \mathbf{M} \rangle$$

The four elements to the left of the vertical bar are the principles. The two elements to the right are the conditions under which the principles operate.

- **L** = Latent: structured readiness. The primed condition.
- **E** = Emergence: the appearance of novelty.
- **R** = Recognition: the causal fit between novelty and what is primed to respond.
- **C** = Change: the completed transformation.

The environment (**Env**) and the mode (**M**) are not principles. They are the conditions. Env is the boundary condition that determines which latent possibility can be triggered. M is the dominant character of the process at its extreme.

The four principles are ordered constitutively. Each primes the next:

$$\mathbf{L} \rightarrow \mathbf{E} \rightarrow \mathbf{R} \rightarrow \mathbf{C} \rightarrow \mathbf{L}' \text{ or terminal}$$

The arrows are trigger relations, not temporal stages. They hold whether the process runs quickly or slowly, continuously or intermittently. They hold whether the process runs quickly or slowly, continuously or intermittently. E is identified as the novelty that appears from L. You cannot identify E without already having identified L, even if in time they are simultaneous.

A trigger function can be written for each transition:

- $\tau_1: L \times Env \rightarrow E$
- $\tau_2: E \times Env \rightarrow R$
- $\tau_3: R \times Env \rightarrow C$
- $\tau_4: C \rightarrow L' \text{ or terminal}$

Each τ is a partial function. Its domain is restricted by Env. Its character is shaped by M. The environment is co-present at every transition, not only the first. Emergence does not occur in a vacuum, and neither does recognition. What emerges is recognized in the same environment that primed its emergence.

Partiality is not a retreat. It is a claim. Not every latent condition emerges. Not every emergence is recognized. Not every recognition produces change. That is a feature of process, not a loophole.

A tuple missing any of L, E, R, C is not a process. It is a degenerate case the framework does not describe. A process without a Latent is not a process—it is an uncaused event. A process without Recognition is a random flash with no consequence. A process without Change is a stationary state, not a process. The exclusion is the claim.

A process may terminate. **Terminal** means the transformation produces no new latent condition for a subsequent process. The process ends. No residual priming remains. This is the case when a fire burns out, when a game of chess ends, when a life ends. The four principles describe what happens when a process runs. They do not require every process to continue.

The mode of a process is determined by which principle operates at the dominant extreme:

- **Persistence** — the rock. Latent dominates. Emergence is nearly invisible.
- **Consumption** — the fire. Emergence dominates. The fuel is consumed as fast as it is actualized.
- **Solicitation** — the virus. Recognition dominates. The process is organized around binding to a host.
- **Contingency** — the radioactive nucleus. The τ -transition is stochastic. No pattern determines when a decay occurs.

Different processes exhibit different modes. But every process that runs exhibits the same four positions in the same constitutive order. The framework is a schematism. It does not predict outcomes. It constrains what any outcome must be structured as. Any process that resists the fourfold mapping would warrant re-examination.

Appendix B: Technical Mappings of the Four Principles Across Domains

Table 4. The Four Principles Across Domains

Domain / Process	*Environment	Latent	Emergence	Recognition	Change
Geology / Rock Weathering	Hydrolytic or carbonic acid solution; thermal stress; root wedging; salt crystallization; wind load	Metamorphic foliation; joint sets; tensional stress fields; chemical potential (e.g., oxidation potential of iron)	Microfracture propagation; disaggregation; mineral dissolution	Selective erosion along discontinuities; hydrolysis of feldspars rather than quartz; differential weathering (e.g., spheroidal weathering)	Saprolite formation; sediment production; secondary mineral precipitation (clays, oxides); mass transport
Thermodynamics / Fire	Ignition source (e.g., arc, flame, ember); ambient O ₂ concentration; wind velocity	Enthalpy of combustion; activation energy; stoichiometric fuel-oxygen ratio	Exothermic chain reaction; free radical initiation	Selective propagation based on fuel moisture content, surface-area-to-volume ratio, and heat of pyrolysis	Oxidation to CO ₂ , H ₂ O, and mineral ash; radiative and convective heat transfer; new equilibrium
Nuclear Physics / Radioactive Decay	Quantum vacuum fluctuations; electroweak coupling; barrier geometry	Nuclear binding energy; proton-neutron ratio; parity and spin state; tunneling probability density	Alpha, beta, or gamma emission; cluster decay	Branching ratio; selection rules (angular momentum, parity); tunneling time	Daughter nuclide; decay heat; neutrino emission; new decay chain
Quantum Chemistry / Hydrogen Atom Formation	Ambient radiation field; collision partner (e.g., free electron, photon)	Coulomb potential well; electron wavefunction; initial quantum state	Quantum transition; capture into bound state	Orbital selection (n, l, m); conservation of energy, momentum, and spin; dipole selection rules	Photon emission or absorption; electron relaxation to ground state; new spectral line
Virology / Bacteriophage	Host cell receptor density; ambient ion concentration; temperature; pH	Capsid integrity; surface glycoprotein conformation; genome availability	Tail fiber attachment; baseplate conformational change; genome ejection	Receptor-ligand specificity (e.g., T4 tail fibers–LPS); host range determination; superinfection exclusion	Lysis or lysogeny; host genome degradation; virion assembly
Evolutionary Biology / Natural Selection	Selection pressure (predation, climate, resource scarcity)	Standing genetic variation; mutation load; recombination potential	New variant (mutation, recombination, gene flow)	Phenotype–environment fit; differential fitness; selective sweep	Allele frequency shift; local adaptation; speciation; novel variation via mutation
Neuroscience / Synaptic Transmission	Presynaptic action potential; Ca ²⁺ influx	Resting membrane potential; vesicle docking; neurotransmitter synthesis	Vesicle exocytosis; neurotransmitter release	Postsynaptic receptor binding; ion channel gating; reuptake or degradation	Depolarization or hyperpolarization; synaptic plasticity; long-term potentiation/depression
Cognitive Science / Conscious Perception	External stimulus; internal salience signal	Subthreshold sensory input; memory traces; expectation	Neural ignition; conscious access; percept formation	Attentional selection; feature binding; working memory consolidation	Learning; memory update; prediction error reduction; behavioral response
Sociology / Social Movements	Precipitating event (e.g., police killing, austerity policy)	Structural grievances; latent discontent; network ties	Mobilization; frame emergence; protest cascade	Legitimacy claims; media framing; elite recognition	Policy reform; institutional shift; co-optation or repression; new grievances
Computer Science / AI Training	Training data; loss function; optimizer	Latent vector space; untrained weights; data distribution	Forward pass; prediction	Loss calculation; backpropagation gradient; error signal	Weight update; model reconfiguration; improved generalization
Philosophy of Science / Scientific Change	New instrument; experimental result	Anomaly; unresolved data; theoretical gap	Novel hypothesis; predictive success	Peer review; replication; citation; consensus formation	Paradigm shift; normal science revision; new research program

*The environment is not a principle. It is the constraint that determines which latent possibility is triggered.

Appendix C: Concept Mapping Verification

(A) Geology: Rock Weathering

Prompt: Sources that include the following concepts: *Metamorphic foliation; joint sets; tensional stress fields; chemical potential (e.g., oxidation potential of iron); Microfracture propagation; disaggregation; mineral dissolution; Selective erosion along discontinuities; hydrolysis of feldspars rather than quartz; differential weathering (e.g., spheroidal weathering); Saprolite formation; sediment production; secondary mineral precipitation (clays, oxides); mass transport*

Principle	Mechanism	Source	What the mapping shows
Latent	Foliation, joint sets, stress fields, oxidation potential	1, 2 [†] , 3, 4	Structure present before weathering
Emergence	Microfracture propagation, disaggregation, mineral dissolution	5, 6 [‡] , 7 [‡]	New structure from existing structure
Recognition	Selective erosion; feldspar hydrolysis vs. quartz stability	2 [†] , 6 [‡] , 7 [‡]	Structure selects which mineral yields
Change	Saprolite formation, sediment production, mass transport	8–16	New condition re-arms or is terminal

[†] Source 2 (Pradhan et al., 2022) spans Latent, Recognition, and Change: joint-controlled permeability is a latent parameter, a selective erosion pathway, and a sediment-production mechanism.

[‡] Sources 6 & 7 (Anand et al., 1985; Lu et al. 2015) span Emergence and Recognition: feldspar hydrolysis is simultaneously a dissolution process and a selectivity filter.

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(B) Thermodynamics: Fire

Prompt: Sources that include the following concepts: Enthalpy of combustion; activation energy; stoichiometric fuel-oxygen ratio; Exothermic chain reaction; free radical initiation; Selective propagation based on fuel moisture content, surface-area-to-volume ratio, and heat of pyrolysis; Oxidation to CO₂, H₂O, and mineral ash; radiative and convective heat transfer; new equilibrium.

Principle	Mechanism	Source	What the mapping shows
Latent	Enthalpy of combustion, activation energy, stoichiometric ratio	1, 2	Chemical potential primed, threshold not yet crossed
Emergence	Exothermic chain reaction; free radical initiation	3, 4, 12	Novelty (flame) from primed condition

Recognition	Selective propagation by moisture, surface area, heat of pyrolysis	5–9	Fuel structure selects what burns
Change	Oxidation to CO ₂ , H ₂ O, ash; heat transfer; new equilibrium	10, 11, 13	Terminal for this fire; re-arms environment

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(C) Nuclear Physics: Radioactive Decay

Prompt: Sources that include the following concepts: Nuclear binding energy; proton-neutron ratio; parity and spin state; tunneling probability density; Alpha, beta, or gamma emission; cluster decay; Branching ratio; selection rules (angular momentum, parity); tunneling time; Daughter nuclide; decay heat; neutrino emission; new decay chain.

Principle	Mechanism	Source	What the mapping shows
Latent	Nuclear binding energy, proton-neutron ratio, parity and spin state, tunneling probability density	1†, 2, 3‡, 4	Chemical potential primed, threshold not yet crossed
Emergence	Alpha, beta, or gamma emission; cluster decay	3‡, 5§, 9, 11, 14¶, 20, 21, 27, 28	Novelty (emission) from primed condition
Recognition	Branching ratio; selection rules (angular momentum, parity)	1†, 6, 7, 8, 10, 14¶, 16**	Nuclear structure selects which mode proceeds
Change	Tunneling time; daughter nuclide; decay heat; neutrino emission; new decay chain	5§, 12, 13, 15, 16**, 17, 18, 19, 22–26	Terminal for this nucleus; re-arms environment

† Source 1 (Hirsch & Padilla-Rodal 2010) spans Latent and Recognition: covers the binding-energy/P-N-ratio stability framework and B(L)/mixing-ratio selection rules.

‡ Source 3 (Xu & Ren, 2006) spans Latent and Emergence: Geiger-Nuttall law and tunneling probability are latent parameters; the density-dependent cluster model unifying alpha and cluster decay is an emergence mechanism.

§ Source 5 (Severijns et al., 2023) spans Emergence and Change: precision β -decay Ft measurements describe the emission process; neutrino emission is the terminal byproduct.

¶ Source 14 (Sowmya et al., 2020) spans Emergence and Recognition: describes cluster decay as a mode while quantifying its competition with alpha decay via branching ratios.

** Source 16 (Manjunatha & Sowmya, 2018) spans Recognition and Change: characterizes competition among fission/cluster/alpha modes within a new superheavy decay chain.

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(D) Quantum Chemistry/Hydrogen Atom Formation

Prompt: Sources that include the following concepts: Coulomb potential well; electron wavefunction; initial quantum state; Quantum transition; capture into bound state; Orbital selection (n, l, m); conservation of energy, momentum, and spin; dipole selection rules; Photon emission or absorption; electron relaxation to ground state; new spectral line.

Principle	Mechanism	Source	What the mapping shows
Latent	Coulomb potential well, electron wavefunction, initial quantum state, conservation of energy/momentum/spin	1†, 2†, 3†	Quantum state primed, transition not yet occurred
Emergence	Quantum transition; capture into bound state; photon emission	1†, 2†, 3†	Novelty (emission/capture) from primed condition
Recognition	Orbital selection (n, l, m); dipole selection rules	1†, 2†, 3†	Wavefunction symmetry selects which transition proceeds
Change	Electron relaxation to ground state; new spectral line	3‡, 4, 5, 6	Terminal for this cascade; re-arms environment

† Sources 1, 2, 3 span Latent, Emergence, and Recognition: the capture–cascade–selection sequence is a single coupled process in the review.

‡ Source 3 (Gomez et al., 2020) also appears in Change: the spectral line that results from the cascade.

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(E) Virology / Bacteriophage

Prompt: Sources that include the following concepts: Capsid integrity; surface glycoprotein conformation; genome availability; Tail fiber attachment; baseplate conformational change; genome ejection; Receptor-ligand specificity (e.g., gp120–CD4); host range determination; superinfection exclusion; Lysis or lysogeny; host genome degradation; virion assembly.

Principle	Mechanism	Source	What the mapping shows
Latent	Capsid integrity, surface glycoprotein conformation, genome availability	1†, 6‡, 7, 9, 14	Structure present before infection
Emergence	Tail fiber attachment, baseplate conformational change, genome ejection	1†, 5§, 6‡	New structure (injection) from existing structure
Recognition	Receptor-ligand specificity, host range determination, superinfection exclusion	1†, 2, 3, 4, 5§, 7, 8	Structure selects which host / which phage proceeds
Change	Lysis or lysogeny, host genome degradation, virion assembly	10–14	New condition re-arms or is terminal

† Source 1 (Yu et al., 2025) spans Latent, Emergence, and Recognition: the Ur-λ cryo-EM structure reveals the packaged genome and fiber conformation, the adsorption mechanism, and the specificity for E. coli LamB.

‡ Source 6 (Li et al., 2023) spans Latent and Emergence: the E217 structure shows the intact capsid with packaged genome and the genome-ejection machine in extended and contracted states.

§ Source 5 (Roa-Eguiara et al., 2026) spans Emergence and Recognition: captures the baseplate-to-sheath-to-ejection cascade while also characterizing T4's superinfection exclusion mechanism.

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(F) Evolution: Natural Selection

Prompt: Sources that include the following concepts: standing genetic variation; mutation load; recombination potential; differential survival and reproduction; fitness variance; phenotype–environment fit; reproductive success; selective sweep; allele frequency shift; local adaptation; speciation; novel variation via mutation.

Principle	Mechanism	Source	What the mapping shows
Latent	Standing genetic variation; mutation load; recombination potential	1, 6, 7, 11	Variation present before selection

Emergence	Differential survival and reproduction; fitness variance; phenotype–environment fit; selective sweep	2, 3, 4, 5, 18, 19, 22, 23	Novel structure (adaptation) from existing variation
Recognition	Allele frequency shift; local adaptation	8, 9, 10, 17, 20, 21	Environment selects which alleles persist
Change	Speciation; novel variation via mutation	12, 13, 14, 15, 16	New condition re-arms or is terminal

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(G) Neuroscience / Synaptic Transmission

Prompt: *Sources that include the following concepts: resting membrane potential; vesicle docking; neurotransmitter synthesis; vesicle exocytosis; neurotransmitter release; postsynaptic receptor binding; ion*

channel gating; reuptake or degradation; depolarization or hyperpolarization; synaptic plasticity; long-term potentiation/depression.

Principle	Mechanism	Source	What the mapping shows
Latent	Resting membrane potential; vesicle docking; neurotransmitter synthesis	1, 4, 6, 7†, 14‡	State primed, transmission not yet occurred
Emergence	Vesicle exocytosis; neurotransmitter release; postsynaptic receptor binding; ion channel gating	2, 3, 7†, 14‡	Novel signal (EPSP/IPSP) from primed condition
Recognition	Reuptake or degradation; depolarization or hyperpolarization	2, 7†	Structure selects which signal persists
Change	Synaptic plasticity; long-term potentiation/depression	5, 8–13, 15–17	New condition re-arms or is terminal

† Source 7 (Patel & Feucht, 2011) spans Latent, Emergence, and Recognition as ‘basic concepts.’ The literature review covers synthesis, release/receptor binding/ion gating, and reuptake/degradation/EPSP–IPSP determination in a single integrated account.

‡ Source 14 (Chang & Südhof, 2009) spans Latent and Emergence: SV2 renders vesicles primed and is required for Ca²⁺-triggered exocytosis.

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(H) Cognitive Science / Conscious Perception

Prompt: Sources that include the following concepts: subthreshold sensory input; memory traces; expectation; neural ignition; conscious access; percept formation; attentional selection; feature binding; working memory consolidation; learning; memory update; prediction error reduction; behavioral response.

Principle	Mechanism	Source	What the mapping shows
Latent	Subthreshold sensory input; memory traces; expectation	1†, 2‡, 12§, 14¶	Signal present below threshold; memory available but inactive
Emergence	Neural ignition; conscious access; percept formation	1†, 12§, 14¶	Novel percept from subthreshold state
Recognition	Attentional selection; feature binding; working memory consolidation	5, 6, 7	Attention selects which features bind and consolidate
Change	Learning; memory update; prediction error reduction; behavioral response	2‡, 3, 4, 8–11, 13, 15	New condition re-arms or is terminal

† Source 1 (Perera Molligoda Arachchige et al. 2026) spans Latent and Emergence: the GNW account treats subthreshold processing and the ignition threshold as two phases of the same cascade.

‡ Source 2 (Horga & Abi-Dargham, 2019) spans Latent and Change: top-down predictions are a latent modulator; prediction errors drive memory updating.

§ Source 12 (Alilović et al., 2020) spans Latent and Emergence: characterizes representational dynamics preceding conscious access and the transition to access itself.

¶ Source 14 (Yang, 2026) spans Latent and Emergence: System C (continuous, sub-threshold) is Latent; System D (discrete, reportable) is Emergence.

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(I) Sociology / Social Movements

Prompt: Sources that include the following concepts: structural grievances; latent discontent; network ties; mobilization; frame emergence; protest cascade; legitimacy claims; media framing; elite recognition; policy reform; institutional shift; co-optation or repression; new grievances.

Principle	Mechanism	Source	What the mapping shows
Latent	Structural grievances; latent discontent; network ties	1†, 10	Conditions present before mobilization
Emergence	Mobilization; frame emergence; protest cascade	1†, 2‡, 4§, 11	New collective action from latent conditions
Recognition	Legitimacy claims; media framing; elite recognition	3, 4§, 5, 12, 13	Framing selects which claims gain traction
Change	Policy reform; institutional shift; co-optation or repression; new grievances	2‡, 6, 7, 8, 9, 14, 15	New condition re-arms or is terminal

† Source 1 (Simmons, 2014) spans Latent and Emergence: cited for both latent discontent held in network ties and the activation of frame emergence that converts potential into mobilization.

‡ Source 2 (Egbogun et al., 2026) spans Emergence and Change: digitally enabled collective action is the mobilization event; the cost-concession threshold determines whether the state concedes or represses.

§ Source 4 (Džunić & Golubović 2026) spans Emergence and Recognition: hypermedia mobilization is the action; bypassing captured media gatekeepers is an alternative path to elite recognition.

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(J) Computer Science / AI Training

Prompt: Sources that include the following concepts: latent vector space; untrained weights; data distribution; forward pass; inference; generated output; loss calculation; backpropagation gradient; error signal; weight update; model reconfiguration; improved generalization.

Principle	Mechanism	Source	What the mapping shows
Latent	Latent vector space; untrained weights; data distribution	1, 2 [†] , 3 [‡]	Structure primed in architecture + data, no updates yet
Emergence	Forward pass; inference; generated output	2 [†] , 3 [‡]	Novel representation/output from primed condition
Recognition	Loss calculation; backpropagation gradient; error signal	4§, 10, 11	Error signal selects which weights to adjust
Change	Weight update; model reconfiguration; improved generalization	4§, 5, 6, 7, 8, 9, 12, 13	Reconfigured model generalizes or fails

[†] Source 2 (Fumero et al., 2025) spans Latent and Emergence: characterizes latent-space structure of untrained networks and the forward-pass transformation producing structured representations.

[‡] Source 3 (Glushkovsky, 2024) spans Latent and Emergence: unsupervised latent representations are the primed state; inference and generated outputs are the emergent products.

[§] Source 4 (Dohare et al., 2024) spans Recognition and Change: studies the loss/gradient signal and its failure mode—loss of plasticity during iterative weight updates.

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(K) Philosophy of Science / Scientific Change

Prompt: Sources that include the following concepts: New instrument; experimental result; anomaly; theoretical gap; predictive success; peer review; replication; citation; consensus formation; paradigm shift; revision.

Principle	Mechanism	Source	What the mapping shows
Latent	New instrument; experimental result; anomaly; theoretical gap; predictive success	1†, 2‡, 3, 9§, 12¶	Anomaly present, paradigm intact
Emergence	Peer review; replication; citation; consensus formation	4, 5, 6, 7, 8	Consensus forming from disputed results
Recognition	Paradigm shift; revision	1†, 2‡, 9§	Community selects which framework survives
Change	Falsification critique; naturalistic cognitive change; AI-driven anomaly detection	10, 11, 12¶	New paradigm re-arms science

† Source 1 (Fry, 2024) spans Latent and Recognition: rRNA sequencing is the new instrument and the archaea result is the anomaly; the restructuring of the phylogenetic tree is the paradigm shift.

‡ Source 2 (Marx & Bornmann, 2009) spans Latent and Recognition: the CMB is the accumulating anomaly; the Kuhnian transition from static to Big Bang is the paradigm shift.

§ Source 9 (Mattick, 2023) spans Latent and Recognition: non-coding RNA discoveries are the anomaly accumulation; the "Kuhnian revolution" in molecular biology is the paradigm shift.

¶ Source 12 (Segal et al., 2023) spans Latent and Change: complexity-based detection of anomalous radio sources is a new instrumental capability; the review frames it as a potential catalyst for future paradigm shifts.

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