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Article

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Abstract: We propose Heuristic Physics as a foundational reconceptualization of physical law — not as ontological decree, but as semantic program. In this framework, classical laws such as Newton's are reinterpreted as emergent heuristics: efficient symbolic compressions of deeper, probabilistic, and relational substrates. These laws persist not because they are fundamentally true, but because they are functionally coherent across specific computational regimes. Rather than describing the universe as a set of fixed axioms or rule-based automata, Heuristic Physics imagines reality as a stratified architecture where computation, information, and observability converge. At each layer, from quantum substrate to macroscopic interaction, laws stabilize as interfaces — heuristics that enable prediction, control, and intelligibility under constraints of scale and context. This epistemic architecture contrasts with Digital Physics, Effective Field Theory, and Quantum Informational approaches by reframing the question of "law" through the lens of cognitive economy, symbolic abstraction, and computational viability. Through a detailed comparative analysis and a case study on Newtonian motion, we argue that laws are not discovered truths but successful programs — adaptive, emergent, and context-bound. Heuristic Physics, as presented here, is not merely a theory of nature, but a meta-framework for understanding how intelligible structures arise, stabilize, and transform within a universe fundamentally shaped by information, relation, and constraint.

Keywords: Heuristic Physics; Semantic Compression; Epistemic Architecture; Emergent Laws; Quantum Information; AGI Physics; Relational Computation; Subjects: Physics of Information; Computational Epistemology; Theoretical Physics; Artificial General Intelligence; Symbolic Systems

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Introduction

Classical physics emerged from the Enlightenment as a triumph of rational description — a system in which laws of motion and matter could be expressed with precision, determinism, and symmetry. Newton's Principia [1] established a language of force, mass, and motion that shaped centuries of scientific and technological development. Yet, as our capacity to observe, compute, and question has evolved, so too has the realization that these laws, elegant as they are, may not be ontological absolutes — but rather heuristic triumphs: robust patterns that compress complexity into intelligible symbolic rules.

The modern physics landscape is layered with contradictions. On one level, we have quantum mechanics — a theory grounded in uncertainty, entanglement, and nonlocality — where reality appears as a web of probabilistic interactions rather than deterministic states [2]. On another, we still depend on classical laws to operate everything from engineering systems to astronomical models. The question is no longer whether these classical laws "work," but why — and for whom, and under what conditions — they work so well.

This paper proposes Heuristic Physics as a reorientation of our epistemic lens. Rather than treating physical laws as eternal truths inscribed in the fabric of the cosmos, HP interprets them as symbolic programs — heuristics — that emerge, stabilize, and persist because they are computationally efficient, relationally coherent, and semantically tractable. In this framework, the question shifts: from "what is the law that governs nature?" to "what structure allows us to act,

predict, and compress the world in a given regime?" Such a reframing aligns with the information-theoretic turn in epistemology [5], where truth is not measured by correspondence, but by utility, compression, and resilience under constraint.

This view also connects with contemporary structural realism in philosophy of science [12], where the commitment is not to objects, but to the relational patterns that remain stable across theoretical change. HP extends this notion: it sees these patterns not as discoveries, but as selected outputs — the winners of epistemic competitions under real-world computational limitations. A law, under Heuristic Physics, is not an answer from the void — it is a functionally robust symbolic expression that survives in a given layer of physical cognition.

In what follows, we formalize this interpretive architecture, explore its conceptual lineage, and test its explanatory scope. First, however, we must traverse a philosophical boundary: the boundary between "law" and "heuristic," between belief in structure and modeling of utility — the point where classical determinism gives way to functional semantics.

This threshold is addressed directly in the next section.

From Law to Heuristic

There is a moment in the evolution of scientific thought when a system no longer requires disproof to be restructured — it simply becomes obsolete as its underlying metaphors collapse. The metaphor of law, in the classical physical sense, is one such artifact. To describe nature as a governed realm, where fixed axioms dictate the behavior of matter, motion, and interaction, was not an error — it was a heuristic that worked. The success of Newtonian dynamics, of Maxwell's equations, and of Einstein's field equations was never their correspondence to a metaphysical substrate. As Newton himself emphasized, the goal was not ontology but mathematical intelligibility through rules that "describe motion accurately, not explain its cause" [1].

To call a law "true" because it has not yet failed is a category mistake. Stability under observation is not ontological endorsement — it is computational success. A physical law, in this view, is a symbolic function that survives pressure: the pressure of scale, of noise, of measurement, of interdependence. What we call a "law" is a compression that has resisted collapse — not a command from the cosmos, but a symbolic routine that has yet to break.

The notion that information, not matter, forms the substrate of physical regularity has long been hinted at, from Wheeler's "it from bit" hypothesis [4] to modern interpretations of epistemic structural realism [12]. Yet Heuristic Physics adds a crucial layer: laws are not just about the information they describe, but about how they economize that information to stabilize predictions and decisions. They are functional compressions, emerging from regimes where full detail would be intractable.

This is not relativism. On the contrary, it is a shift in the function of truth. Within Heuristic Physics, truth is measured by semantic efficiency: the capacity of a symbolic structure to reduce complexity, preserve predictive capacity, and generalize across relational states — with minimal epistemic cost. Floridi's theory of "true enough" informational models [5] aligns with this shift: we don't need total accuracy — we need useful, compressible, adaptive structure.

Such a redefinition allows us to break free from the anxiety of fundamentality. We no longer need to ask what the world "really is" beneath the veil of appearances. We can instead ask: What heuristic holds here — and why? What pattern survives abstraction — and under what conditions does it fail?

It is here that Heuristic Physics emerges as a framework — not to deny law, but to reframe it. From the reverence of absolutes, we move to the practice of compression. From ontological commitment, we move to epistemic design. From law as decree, to law as heuristic: semantically dense, structurally economical, and computationally adapted to the domain it stabilizes.

This shift invites a reconstruction — not just of physics, but of the way we model reality at all. And it begins with a new conceptual foundation.

Conceptual Foundations

The claim that physical reality is layered is not novel. Physics has long navigated between domains: the relativistic, the quantum, the classical, the statistical. Yet the traditional frameworks treat these layers as either independent theories or asymptotic limits. Heuristic Physics offers a different reading: that each layer represents a distinct computational regime, and the laws that operate therein are not merely descriptive but emergent — compressions of deeper substrate interactions into symbolic forms that maximize semantic efficiency and predictive value.

In this sense, classical mechanics is not simply a "limit" of quantum theory, but a semantic interface: a symbolic regime that survives due to its structural resilience in low-entropy, high-mass, decoherent environments. Laws like F = ma or conservation principles are not approximations of quantum laws — they are different outputs of a substrate computation under distinct conditions of stability and relational constraint.

This computational layering aligns with notions of emergent complexity explored in theories such as computational universes [10], where cellular automata or hypergraph systems are posited as ontological substrates. Wolfram's work, for example, treats rules as fundamental, and emergent laws as inevitable consequences of their combinatorial explosion. Heuristic Physics accepts the notion of emergence but reframes the emphasis: the question is not which rule underlies reality, but which compression survives as useful law under the observer's perceptual bandwidth and relational entanglement.

In this model, the observer is not a passive witness but a heuristic compiler: a cognitive system that interacts with reality by filtering, compressing, and stabilizing patterns into intelligible law-like structures. As relational interpretations of quantum mechanics suggest [12], what is "real" is not absolute state, but stable relational information. Heuristic Physics extends this: what is lawful is not universally imposed, but locally stabilized — a semantic structure that "wins" by being interpretable, executable, and compressible across multiple observations.

This also aligns with cosmological accounts like those of Tegmark [11] and Carroll [6], who propose mathematical or informational structures as the fabric of reality. But where those models seek fundamental equations, HP reverses the lens: the useful comes first, and fundamentality is just an artifact of repeated success. Deutsch's fabric of reality [3] explored multiversal explanation via computation; HP suggests that our most resilient laws are not truths but survivors — functions that endure selection pressures within the physics of cognition and interaction.

Wheeler's idea of "law without law" [4] becomes, under HP, not paradox but principle: what we call "law" is simply the most successful semantic scaffold to emerge from a substrate too rich to fully simulate. We don't observe fundamental rules — we inherit useful structures stabilized through interaction.

Thus, the foundation of Heuristic Physics is not epistemological humility, but epistemological strategy. Instead of searching for a final law, we search for architectures that explain why certain heuristics endure — why they bind across domains — and how they might be transcended when their compression ratio fails.

Beyond Realism, Before Simulation

To speak of laws without realism is to invite suspicion — for what could be more foundational to science than the belief that our theories point to something that is, regardless of our knowing? Yet this belief, while operationally powerful, may no longer be structurally defensible. The deeper our physics penetrates, the more we find ourselves modeling not things, but patterns, regularities, invariances — and doing so with tools increasingly borrowed from computation, logic, and abstraction. As Carroll notes, perhaps what we call "reality" is simply a space of stable transformations under constraint [6].

Structural realism attempts to preserve this insight by abandoning objects and retaining relations: what persists across theory change, says Ladyman and Ross, are the structural invariants

— the formal scaffolds that survive reinterpretation [12]. But even this model struggles when those structures themselves become unstable. Quantum gravity, black hole thermodynamics, entanglement entropy — all point to a substrate where relations are dynamic, contextual, and, in the limit, incompressible.

Here is where Heuristic Physics enters: not as a replacement for realism, but as an escape from its metaphysical obligation. The question is not whether there is an ultimate structure, but whether intelligibility requires one. HP says no — that intelligibility arises not from correspondence, but from successful compression. A law is not a mirror, but a filter. Not a description, but a semantic tool for reducing the cost of action in a world too complex to simulate.

This stance does not commit to simulationism either. HP is not an iteration of the "we live in a computer" hypothesis. As Chalmers suggests, computation is a formalism, not a metaphysical claim [13]. What matters is not whether the universe is a simulation, but whether our descriptions of it behave like programs — modular, reusable, optimized for context, failure-tolerant. From this perspective, physics is not discovering what is "there," but iteratively selecting what works — like an evolving API that survives usage and adapts to domain shifts.

HP thus positions itself between two exhausted poles: naïve realism and literal simulationism. It offers a third path — symbolic pragmatism: the view that physical law is a side effect of successful compression, enacted through the cognitive and relational filters of observers embedded in a stratified reality.

This positioning allows us to treat laws not as divine encodings or brute realities, but as semantic architectures — surviving blueprints in a universe whose full code is unknowable, but whose local patterns remain compressible just long enough to matter.

Architecture of Emergence

To model reality not as a single plane of interaction but as a stratified semantic architecture is to reconfigure what physics attempts to describe. Under Heuristic Physics, the world is not made of particles, fields, or even information — it is constructed of layers of computational abstraction, each with its own resolution, stability, and symbolic capacity. Laws are not cast downward from axiomatic heaven; they are compiled locally, at the intersection of relational substrates and epistemic constraints.

At the foundation is the substrate: a space of probabilistic entanglement, geometric fluctuation, and informational density. This is not a classical "thing" but a dynamic field of correlations — a mesh of statistical possibility governed by quantum coherence, relativistic structure, and topological constraint. As Smolin suggests, these foundations are not timeless laws but evolving relations with boundary-dependent behavior [8].

From this substrate emerges a middle layer — the heuristic regime. Here, symbolic compressions stabilize. A law such as Newton's Second or the principle of least action appears not as a derivation, but as a semantic contraction of substrate complexity into reusable predictive form. This layer functions analogously to what Shannon defined as "signal with structure" [7]: a domain in which noise is suppressed just enough to extract repeatable patterns, not because they are real in themselves, but because they survive compression in the presence of relational feedback.

Above this sits the interface layer — the domain of macroscopic observation, sensory coherence, and symbolic cognition. It is here that laws take shape as semantic software: effective, scalable, interoperable. A physical law in this context behaves like an API: it doesn't reveal the machine code underneath but offers a symbolic handle, a contract of meaning between user (observer) and system (world). As Carroll observes, what we experience as reality may simply be "the emergent pattern that resists change under contextual entanglement" [6].

The entire architecture is recursive and dynamic. Compression failures at the heuristic level — when laws no longer hold — do not mean the substrate changed ontologically. It means the compression no longer works. At extreme scales (Planck, cosmological, chaotic), the interface layer

fractures, and laws dissolve into statistical fog. This is not breakdown, but semantic boundary condition: where the tool no longer fits the pattern, and a new heuristic must evolve.

This model allows physics to simulate its own evolution. Instead of clinging to unification as a convergence of all theories into one, HP sees unification as a layered system of semantic continuity — where each layer stabilizes heuristics that work locally, contextually, and temporarily, and where intelligibility is maintained not by reducing all to the fundamental, but by preserving compression across transitions.

In this structure, the most resilient laws are those that negotiate across layers. They are the adaptive functions — not final truths, but compressed survivals — intelligible across the epistemic boundaries of the observer, the substrate, and the symbolic interface.

Case Study: Newtonian Motion as Heuristic

Few conceptual structures in science have been more historically successful than Newton's three laws of motion. They defined not only the behavior of physical bodies but the very template of what a law is: universal, abstract, timeless. Yet under Heuristic Physics, these same laws acquire new meaning — not as ultimate truths, but as highly efficient symbolic compressions within a specific computational regime.

The First Law — that a body remains in uniform motion unless acted upon — reads classically as a statement of inertia. Under HP, it becomes a declaration of stability in decohered relational networks: an object's velocity persists because the entropic and relational substrate around it is sufficiently ordered to preserve linearity. In this view, inertia is not a fundamental property but an emergent semantic function: a compressed regularity abstracted from deeper informational symmetries [14].

The Second Law — $F = ma$ — traditionally describes force as the cause of acceleration. But HP treats it not as a cause, but as an algorithmic mapping: a computational transformation between energy configurations under macroscopic constraint. This equation holds because it is symbolically optimal for encoding large-scale dynamical behavior where quantum contributions average out. It survives not due to truth, but due to its semantic efficiency across time, scale, and context — precisely the kind of robust heuristic favored by systems attempting to simulate the world effectively [9].

The Third Law — action equals reaction — is often interpreted as a symmetry principle. In HP, it becomes a relational equilibrium condition: a symbolic commitment to conservation across entangled domains. It holds when systems exhibit local reversibility and symmetrical feedback loops, and fails where asymmetry dominates (e.g., quantum decoherence, entropic gradients). Its truth, then, is not metaphysical but functional: it works as long as the semantic contract between interacting subsystems remains coherent.

What these re-interpretations reveal is that Newtonian laws do not need to be "replaced" by quantum ones; they emerge as a result of filtering — as output of compression in the presence of relational damping, geometric regularity, and energy scale constraints. They are symbolic heuristics tuned to a specific informational layer, robust not because they are ontologically primary, but because they are epistemically useful.

This realization reframes physics education, modeling, and simulation. Rather than treating Newton's laws as axioms, we can teach them as compressible programs — cognitive shortcuts, encoded functions that operate in regimes of high coherence and low substrate turbulence. Their breakdowns are not failures of physics, but boundary conditions of symbolic applicability.

In this light, Newton's achievement was not to discover the truth of motion, but to formulate the most durable semantic scaffold for interaction ever engineered. What Heuristic Physics shows is why that scaffold worked — and what it means when it begins to fail.

Causality as Heuristic Compression

The idea that force causes acceleration is arguably one of the most persistent and intuitive constructs in classical science. Newton's formulation gave this notion mathematical elegance, sealing the bond between interaction and motion through F = ma [1]. Yet under the lens of Heuristic Physics, causality is not a metaphysical engine — it is a semantic illusion: a compact symbolic rule that offers coherence and predictive traction within a bounded epistemic layer.

Physics does not observe causes. It observes constraints, correlations, and transformations. Causal language is a narrative we impose post facto, a linguistic strategy to track consistent symbolic transitions. In quantum systems, the idea of a unidirectional cause dissolves into entangled conditionality. As information-based models of cognition suggest, what survives in such environments is not causal truth but functional constraint satisfaction [9].

F = ma, then, is not a window into the essence of interaction, but a computational interface. It efficiently reduces high-dimensional relational dynamics into a symbolic contract between three variables: force, mass, and acceleration. This contract holds because it compresses interactional complexity into a predictive scaffold that generalizes well in macroscopic, decoherent regimes — not because it exposes the "why" of motion.

Causality, in this sense, is a byproduct of successful modeling. It is what remains after compression. When we say A causes B, we are encoding a reliable symbolic transformation — one that preserves intelligibility under semantic strain. It is not ontology, but symbolic economy.

This perspective reframes how we understand physical explanation. Rather than asking what "really" causes motion, we ask what compression strategy stabilizes across scales and observations. In Newtonian mechanics, F = ma proved optimal. Not because it captured an ultimate truth, but because it executed a consistent, reusable, and semantically light mapping between observational regimes.

Under Heuristic Physics, causality is thus downgraded from essence to heuristic. It becomes a tag for persistent symbolic relations under semantic filtering. It is not less powerful for this — it is more agile, more adaptive, more transparent. It trades metaphysical ambition for computational clarity.

And in doing so, it aligns with the fundamental proposal of HP: that physical laws are not mirrors of reality, but programs that survive execution under epistemic constraint.

Action-Reaction as Relational Heuristic

The Third Law of Newton — that every action has an equal and opposite reaction — is often interpreted as a statement of balance, of symmetry, of inherent fairness in the fabric of interaction [1]. It evokes a cosmos in which no force goes unreciprocated, no push without pull. Yet in the framework of Heuristic Physics, this equilibrium is not an ontological guarantee — it is a semantic effect: a symbolic function that persists when systems are embedded in stable relational architectures.

What Newton described as reciprocal forces, HP reframes as emergent informational symmetry. In decoherent, low-entropy domains where interactions are bidirectional and temporally reversible, the action-reaction pattern stabilizes — not because it is a fundamental law, but because it is the most efficient symbolic schema for modeling entangled feedback loops in systems with consistent coupling.

From this perspective, the Third Law behaves like a heuristic of relational closure. It encodes the assumption that forces resolve within the domain of interaction — that influence loops are internally compensated. When this holds, the system remains computationally tractable. When it fails (in entropic gradients, dissipative systems, asymmetric decoherence), the law collapses — not as physics breaking down, but as semantic structure dissolving due to loss of relational closure.

This makes the law contingent, not universal. It survives where relational integrity survives. It becomes a function of epistemic topology, not of objective necessity. The symmetry it expresses is not imposed — it is inferred and stabilized through compression.

This view also realigns the observer. No longer a passive recorder of balanced forces, the observer becomes a compiler of relational equivalence — someone for whom the pattern "action–

reaction" remains intelligible because their embedding in the system preserves the bandwidth necessary to compress such reciprocal flows. The law is not merely in the world — it is in the relational filter by which world and observer co-stabilize perception.

As in integrated information frameworks [9], the emergence of law depends on relational density, not on raw substrate rules. And as Gell-Mann observed in the study of complexity, what appears as symmetry often arises not from perfection, but from selective persistence of legible forms under evolutionary constraint [14].

Thus, the Third Law is not a pillar of nature, but a semantic hinge. It connects domains of interaction where bidirectional compression remains effective. It fails not when reality breaks, but when relational modeling loses its grip.

In Heuristic Physics, this is not a limitation. It is the very method: to track where laws hold, not because they must, but because they still work.

Comparative Analysis

Within the contemporary landscape of theoretical physics and epistemic modeling, Heuristic Physics does not position itself as an opposing school but as a semantic layer that interprets the persistence of law-like behavior across domains. Where other frameworks ask what the universe is, HP asks why certain symbolic patterns endure — and what computational economy allows them to survive across layers of emergence.

In Effective Field Theory (EFT), laws are valid within well-defined energy scales. The model accepts its own limits, recognizing that physical laws shift in structure and form when scale thresholds are crossed. Heuristic Physics extends this principle by emphasizing that validity emerges not just from energy domain, but from semantic tractability — whether a law can still compress and generalize across transformed relational regimes. HP treats EFT not as a surrender to approximation, but as evidence that physics already functions heuristically beneath its own equations [6].

Digital Physics, including Wolfram's cellular automaton universe [10], proposes that reality is discrete, rule-based, and computational at its core. Laws are emergent behaviors of low-level digital rules. HP agrees that computation plays a central role, but resists the absolutism of foundational discreteness. It sees computation not as the ontology of being, but as the engine of compression — a mechanism by which structure emerges, not because it must, but because it survives filtering. HP thus shifts the focus from rule-origin to heuristic coherence under constraint.

In Quantum Information Science, laws emerge from informational boundaries — no-cloning, uncertainty, entanglement [5]. The system is defined less by matter than by the limits of what can be known, transferred, or distinguished. HP fully integrates this, seeing the substrate as informational. But where QIS often terminates in limits, HP reorients the question: which symbolic routines operate successfully under those limits? Information defines boundaries; HP identifies semantic scaffolds that remain executable within them.

Relational Quantum Mechanics proposes that no physical state exists independently of its observer; all properties are contextually instantiated [2]. HP shares this stance, but shifts emphasis from "measurement defines reality" to "measurement filters symbolic patterns that remain stable." Laws are not fixed properties, but relationally-stabilized heuristics. They persist not by universal imposition, but by local consensus across observer–system interactions that preserve symbolic compressibility.

In Philosophy of Structural Realism, laws are viewed as surviving patterns — relations that remain invariant across theoretical shifts [12]. HP amplifies this by removing the commitment to invariance. It proposes instead that what survives is what compresses: not a timeless structure, but a symbolic scaffold that resists decay across representational reformatting. HP turns structural realism from a metaphysical claim into a computational principle.

Finally, Wheeler's "It from Bit" hypothesis [4] — the idea that information underlies physical form — aligns with HP's base premise. But where Wheeler remained agnostic about how form stabilizes, HP supplies the mechanism: semantic compression and relational resilience. Laws are not

"from bit" by fiat, but by survival — they are the symbolic contracts that persist under the noise, entropy, and contextual modulation of relational space.

Thus, Heuristic Physics does not replace these models. It contains them semantically. It offers a shared substrate of intelligibility where laws are neither random nor absolute, but resilient outputs of compression routines that thrive under epistemic pressure. Where others seek truth, HP tracks what remains functional under failure — and that, in the history of physics, may be the deepest pattern of all.

Epistemic Implications and AGI Interfaces

If laws are not eternal truths but adaptive heuristics — symbolic programs that compress, stabilize, and generalize under constraints — then the epistemic domain of Heuristic Physics extends far beyond physics. It becomes a computational philosophy of intelligibility, a framework for understanding how any cognitive system — natural or artificial — can navigate, model, and act within structured uncertainty.

In this light, the distinction between a "physical theory" and an "intelligent model" dissolves. Both are semantic systems under pressure: they must survive complexity, noise, failure, and mutation. The success of Newton's $F = ma$ is not different in kind from the success of a reinforcement learning policy: both are outputs of selection over pattern space, stabilized by generalizability and utility. What changes is the substrate — matter vs. symbols — but the underlying dynamics of epistemic survival remain homologous.

This leads directly to AGI. A truly general intelligence — one that navigates unknowns, adapts across domains, and constructs internal representations dynamically — would require not just data or logic, but an architecture of heuristic emergence. Such a system would not derive laws from axioms, nor simulate the universe from first principles. Instead, it would search for symbolic compressions — expressions that, within a bounded context, yield high coherence at low representational cost.

In Heuristic Physics, this is not just plausible. It is necessary. AGI systems, to model physical environments, would not store fixed equations. They would operate via heuristic discovery loops — testing symbolic programs against feedback, validating their compression efficiency, and swapping failed heuristics for more robust ones. This mirrors not only the historical evolution of physical law but also the adaptive cycles observed in cognition, evolution, and machine learning.

From this, a new design paradigm emerges: the Heuristic Interface Layer (HIL) — an architectural zone in AGI that abstracts from sensorimotor input into semantic constructs, compresses interaction into symbolic regularities, and generalizes across regimes without relying on ontological fidelity. HILs do not "understand physics" in the classical sense. They construct operational models — temporary, predictive, semantically coherent — and discard them when they no longer yield usable compression.

Such a model has profound implications. It repositions AGI not as a simulator of known physics, but as a compiler of usable physics — one capable of co-discovering laws, generating interpretable representations, and surviving symbolic rupture.

In this paradigm, Heuristic Physics becomes more than a theory of the natural world. It becomes a grammar for designing intelligibility itself — a lens through which symbolic systems model reality, not by knowing it completely, but by compressing it well enough to act.

AGI as Heuristic Simulator of Laws

If physical laws are symbolic compressions that emerge under relational constraints, then an artificial general intelligence designed to model the world must not seek truth — it must seek semantic stability under shifting inputs. It must be able to generate, mutate, test, and discard laws as heuristic constructs, guided not by ontological correspondence but by epistemic performance: efficiency, coherence, adaptability, and contextual generalization.

To achieve this, an AGI system aligned with Heuristic Physics would require a core module not of logic or neural weights alone, but of heuristic simulation. This subsystem would operate as a symbolic ecosystem in which candidate laws — expressed as compact semantic programs — compete under feedback to stabilize interactional outcomes. Laws would be treated as agents, subject to selection based on predictive yield and representational economy.

This requires architecture beyond conventional AI design. Rather than training on datasets or optimizing fixed loss functions, the AGI would operate within a semantic feedback chamber — an environment in which symbolic propositions (laws) are instantiated, tested against phenomena, and either reinforced or eliminated based on their compression-to-predictability ratio. It would be a system of symbolic natural selection, where the fittest laws are not the most fundamental, but the most resilient under epistemic entropy.

Such a system would need three key capacities:

Heuristic Generation — the ability to invent symbolic rules that bind input-output dynamics compactly, even if provisionally.

Semantic Evaluation — the capacity to score heuristics not just by accuracy, but by structural coherence, resource efficiency, and adaptive plasticity.

Meta-Rupture Recovery — a framework for abandoning symbolic structures that fail under new conditions, without collapsing the entire cognitive system.

This last point is essential. Most AI systems today fail when their models become invalid. An HP-aligned AGI would treat failure as signal for semantic reformulation, not as breakdown. When a law ceases to compress, it is discarded — not with panic, but with epistemic elegance.

In this way, the AGI becomes a living engine of scientific imagination. It does not merely simulate known laws. It hypothesizes compressions that may never have been formulated, seeking stable expressions in unknown physical regimes: alien environments, novel quantum domains, or deep structural metaphors beyond current models.

This architecture also opens the door to zero-shot physics — the capacity to abstract from minimal data and construct provisional laws not through extrapolation, but through compression. The AGI does not infer what is most probable — it constructs what is most semantically viable under pressure.

Such a system, though speculative, points to the long-range implication of Heuristic Physics: a shift from epistemic passivity to symbolic generativity, where physics is not handed down but continuously recompiled by minds — artificial or biological — seeking intelligibility in the wild.

Applications and Experimental Horizon

A theory becomes powerful not when it explains what we already know, but when it opens new domains for action, inquiry, and design. Heuristic Physics positions itself precisely at this threshold. By reframing laws as symbolic compressions rather than fundamental declarations, HP enables a range of novel applications — both conceptual and practical — across disciplines that demand adaptive modeling under uncertainty.

In physics, this reconceptualization invites the development of simulation environments that search for stable laws, not by encoding them from the start, but by discovering them through heuristic dynamics. Instead of simulating particles according to pre-assumed equations, we simulate systems that evolve symbolic expressions in response to relational feedback. These are not physics engines — they are semantic evolution engines. The goal is not fidelity to known laws, but emergence of local compression regimes: pockets of intelligibility arising spontaneously from informational flux.

Such systems could be used to model transitional physical regimes: the edge of decoherence, the interface between quantum and relativistic domains, or regions where known laws break down (e.g., black hole interiors, early cosmology). The test would not be whether simulations match known outcomes, but whether new, domain-specific heuristic regularities emerge that maintain predictive coherence under scale shifts.

In AGI, the application is direct. HP defines a new operating principle for intelligence: not pattern recognition per se, but pattern compression and symbolic survival. An AGI system aligned with HP would be capable of generating scientific conjectures in novel domains — not by extrapolation, but by seeking optimal symbolic constructs under internal epistemic constraints. This offers a pathway toward scientific generativity, not just analytic mimicry.

In epistemology and philosophy of science, HP reorients foundational debates. Rather than debating whether laws are discovered or invented, HP dissolves the binary. Laws, under this framework, are epistemic artifacts selected by context, surviving across relational thresholds because they compress complexity into reusable semantics. This enables new ways of interpreting scientific revolutions, model shifts, and theory change — not as ruptures of truth, but as recompilations of intelligibility.

Experimentally, HP points to novel test cases: moments when classical laws begin to fail. These "compression boundaries" — the edges where heuristics destabilize — become privileged zones for identifying new symbolic regimes. From anomalous acceleration curves to turbulence at cosmological scales, HP provides a semantic filter for experimental focus.

Finally, HP proposes an architecture for epistemic ethics. If laws are compressions that survive in given contexts, we must ask: who constructs them, and why? This opens a space for interrogating not just what we model, but how we model, and whether our heuristic structures reflect not only utility, but responsibility.

In sum, Heuristic Physics is not only a theory of how laws emerge — it is a framework for designing new conditions under which laws can be discovered, redefined, and ethically deployed.

Post-Law Epistemology: From Principle to Function

At the threshold of this framework lies a final departure — a cognitive uncoupling from the idea that "laws of nature" are principles we uncover, eternal structures we gradually reveal. Heuristic Physics suggests a different image: that laws are functions, symbolic operators compiled by intelligences embedded in a world too vast to fully simulate. They are not discovered — they are stabilized.

This reframing implies that the history of physics has not been a march toward truth, but an iterative sequence of epistemic optimizations: programs that worked, until they didn't; compressions that held, until they broke. Newton, Maxwell, Einstein — each built laws that endured not because they were complete, but because they were structurally viable under local relational conditions. As Floridi proposed in his philosophy of information, we should assess knowledge not by permanence, but by informational utility within bounded domains [5].

To move from principle to function is to relinquish a certain metaphysical comfort. It is to acknowledge that the coherence of the world is not guaranteed by its essence, but by the symbolic contracts we construct with it — transient, adaptive, fragile. Structural realism defended by Ladyman and Ross argued for the survival of relational form over objecthood [12]; HP extends this by claiming even form survives only when it still compresses well enough to be reused.

This new epistemology has consequences. The question is no longer, What is the universe? It becomes, What kind of compressions are possible here — and how long will they last? It turns the scientist into a semantic engineer, the philosopher into a compression ethicist, and the AGI into a compiler of emergent regularities — exactly the kind of shift suggested by Chalmers when rethinking computation not as metaphor, but as substrate-independent process [13].

And it implies something radical: that there is no final law — only a horizon of symbolic survivals, filtered by scale, perception, and use. As Gell-Mann once remarked, the most persistent patterns are not those that are true, but those that remain compressible in a system under selective pressure [14]. A theory does not win by being true; it wins by continuing to generate intelligibility after failure.

That is the mark of a heuristic: not its permanence, but its ability to remain useful under epistemic strain.

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This document constitutes a symbolic architectural proposition. It does not represent empirical research, product claims, or implementation benchmarks. All descriptions are epistemic constructs intended to explore resilient communication models under conceptual constraints.

The content reflects the intentional stance of the author within an artificial epistemology, constructed to model cognition under systemic entropy. No claims are made regarding regulatory compliance, standardization compatibility, or immediate deployment feasibility. Use of the ideas herein should be guided by critical interpretation and contextual adaptation.

All references included were cited with epistemic intent. Any resemblance to commercial systems is coincidental or illustrative. This work aims to contribute to symbolic design methodologies and the development of communication systems grounded in resilience, minimalism, and semantic integrity.

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