QUANTUM DISCONTINUITY AND METAPHYSICAL FOUNDATIONS

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ABSTRACT: The discovery of quantum discontinuity at the limit of empirical observation reveals that the most basic features of reality may not be causally determined but instead emerge from a non-causal basis. The traditional *a priori* application of first principles has long stood in the way of this possibility. Once this inherited assumption is suspended, it becomes evident that the classical framework is both unsustainable and circular: it presupposes the very continuity it seeks to ground. Recognising this invites a reassessment of how intelligibility itself arises, pointing toward an ontic foundation in which causality emerges from non-causality as the starting point for being itself. This relation manifests ontologically in experience as the complementarity of discontinuity and continuity, grounding philosophical explanation.

KEYWORDS: metaphysics; ontology; quantum discontinuity; causality; emergence; philosophy of science

SECTION 1: INTRODUCTION

The discovery of quantum discontinuity has been deeply unsettling because it threatens the traditional law-governed view of the universe and the mathematical framework built to describe it. Science approaches the problem with the tools that have long served it best—mathematics and the pursuit of formal coherence. Mathematics remains our most exact instrument for describing the relational structure of the physical world, yet its success presupposes a continuous domain—precisely what quantum discontinuity calls into question. Beyond this limit, the problem ceases to be purely scientific and becomes ontological. Philosophy, bound by its own tradition, tends to treat the question as epistemic—what can be known—rather than ontological. Yet the deeper issue is not knowledge but intelligibility: the assumption that reality must be ordered in ways that are fully continuous and logically coherent. Once this assumption is suspended, the most

ontologically parsimonious interpretation of the evidence is that continuity emerges from discontinuity—the ontological manifestation of a deeper ontic structure in which causality itself arises from a non-causal basis.

This inversion of continuity and discontinuity finds a rare philosophical precedent in Nicolai Hartmann's critical ontology (see Quine 1951; Carnap 1950; Aristotle 1998/2016; Gottlieb 2019; Horn 2018). Writing in the early twentieth century, Hartmann recognised that philosophy's great error was to identify logical and ontological form—to assume that reality must conform to the laws of thought. Against this, he insisted that being "is what it is, purely in itself" (1923/2012, 322) and that the task of ontology is to face what is *alogical* in reality rather than reduce it to coherence. In this light, Hartmann's work (1923/2012, 1935/2021, 1938/2013, 1942/2012) stands as a call to restore ontology to its proper place before epistemology and to reconsider the assumption that being must be fully intelligible. His insight provides historical precedent for the argument developed here: that to grasp the meaning of quantum discontinuity, we must first suspend the assumption that reality is bound by the continuous, law-governed order of thought itself.

From a starting-point of emergence, the law of noncontradiction (LNC) remains an *a priori* logical truism, but its authority extends only within the order of continuity in which it operates. At the ontological level, discontinuity and continuity are indeed contradictory states, yet their coexistence does not violate the LNC because they do not exist in the same respect or within the same domain. Like hot and cold in the physical world, their opposition defines a field of relation rather than a logical impossibility. What makes this relation unique—and metaphysically decisive—is that it forms the very starting-point of existence. To acknowledge the deeper implications of this is to realise that the foundations of being are not logically given but ontologically emergent.

This emergent relation between discontinuity and continuity also finds resonance in Bohr's principle of complementarity. As Arkady Plotnitsky (2013) has shown, Bohr's concept of complementarity extends well beyond its original application to wave–particle duality in quantum systems. It articulates a deeper principle of relationality, in which apparently incompatible descriptions are not merely epistemic alternatives but mutually necessary for a complete understanding of phenomena. Complementarity thus exposes the impossibility of

capturing reality within any single, unified framework of representation.

When understood ontologically, this insight reaches beyond the limits of observation: if discontinuity is taken as metaphysically basic and continuity is emergent, complementarity ceases to mark a boundary of knowledge and becomes a principle of being. *Ontological complementarity* names this relation between discontinuity and continuity—mutually exclusive in manifestation yet jointly constitutive of reality. This relation both precedes and defines the logical structures through which such oppositions later appear, including the LNC.

This same tension between continuity and contradiction has occupied philosophers for centuries, leading to various attempts to reconcile reason with the origins of existence. Philosophers have long wrestled with this problem when attempting to rationalise the origin of the world. Kant, with his first antinomy, recognised that reason is forced into contradiction when it asks whether the world is infinite or has a finite beginning (A781/B809–A795/B823; 1781/1787/1998, 459–95). Yet this difficulty arises only if we assume that logical form already governs the origin it seeks to explain. If continuous reality emerged from a discontinuous base, then the apparent contradiction at the origin is not a failure of reason but a glimpse into the moment when logical form itself first arises.

In this context, the article builds on an earlier essay (Seabrook 2021, 2023), which first argued that quantum discontinuity exposes a fundamental error in Western metaphysics. Here, the argument is extended by focusing on the emergence of logic itself and its ontological basis, aiming to show how quantum discontinuity demands a reconsideration of our most basic metaphysical principles.

The idea that continuity, order, and law could develop from a more basic field of discontinuity and disorder is not only plausible but consistent with scientific accounts of emergence. These accounts recognise that higher-level structures can arise from more primitive conditions without contradiction (Hartmann 1935/2021, 1942/2012; Clayton & Davies 2008; Corning 2012; Bunge 2016). The challenge lies not in the coherence of the model but in the weight of tradition, which has treated continuity and order as metaphysically primary and resisted alternative starting-points.

Drawing these strands together, the argument advanced here is not a denial of logic or causality but a reordering of metaphysical priorities that returns us to

the question of intelligibility itself. Discontinuity sits at the base of reality, while causality and logic arise from it under specific conditions. This view, motivated by an appeal to ontological parsimony (Sober 2015; Schaffer 2010), is evident in quantum phenomena and offers a new perspective on long-standing philosophical questions. What appears to be a world governed by continuous causal laws may instead be an emergent order grounded in something more basic—and more metaphysically radical.

The sections that follow build an empirically informed metaphysical framework for quantum foundations, examining discontinuity, its implications for first principles, the historical link between logic and continuity, and the possibility of a logic native to a discontinuous ontology. The essay concludes by reflecting on what it would mean to take discontinuity as the real starting-point for Western metaphysics—and how such a shift might reshape philosophy.

SECTION 2: DEFINING DISCONTINUITY

If discontinuity is to serve as a new metaphysical starting-point, it must be defined with precision—distinguished from familiar notions of gaps, absences, or epistemic limitations—and understood as an ontological claim rather than an epistemic shortfall. Since Descartes, Western philosophy has prioritised the epistemic over the ontological. This distinction was implicit in the famous Bohr–Einstein debates. Although these exchanges brought quantum discontinuity into focus, they remained largely concerned with epistemic questions—what could be known and how—rather than with its possible ontological primacy (Bohr 1949; Plotnitsky 2013, 2016, 2021).

The position advanced here is that quantum discontinuity is not an artefact of incomplete knowledge or flawed conceptual frameworks, but a structural feature of being itself. This position is grounded in the persistence of discontinuity evidenced in quantum phenomena, ensuring that the argument remains empirically anchored rather than merely speculative. *Discontinuity* refers to the empirical fact that, at the most fundamental level, change does not occur as smooth, continuous transformation but as discrete, spatiotemporally separated events. The claim is not that reality is composed of disconnected fragments, but that at its most basic level it is not governed by continuous transformation.

Discontinuity manifests in the observed world as abrupt, seemingly acausal

events at the smallest scales of nature: quantum jumps, particle interactions, and measurement-induced state changes (Heisenberg 1958; Prigogine & Stengers 1984; Bitbol 2017). These phenomena do not unfold as smooth evolutions but as spatiotemporally discontinuous transitions that resist classical explanation. Crucially, they are not merely gaps in our current knowledge; they exhibit patterns that resist causal reconstruction in principle. Such behaviour points to discontinuity not as a temporary defect awaiting a better theory, but as a positive indication of reality's underlying structure—a structure that, beneath the observable limit, is noncausal.

From within an otherwise continuous, causal world, this underlying noncausality appears to us only as spatiotemporally discontinuous events interrupting the continuous order of space and time. Our inability to perceive the noncausality beyond these events—and the fact that we are necessarily locked inside an otherwise continuous causal world—is precisely what sustains the stability and calculability of the physical world as we experience and model it. We inhabit a continuous–causal domain, glimpsing its non-causal basis only where it breaks through as spatiotemporally discontinuous events. This relation between the discontinuous and the continuous is not secondary to logic, but prior to it. It forms the condition within which logic itself becomes possible.

This perspective also clarifies why metaphysical frameworks have historically leaned on continuity. We evolved within a macroscopic environment that appears causally and temporally smooth (Ladyman & Ross 2007). Only with technologies that extend our observational reach—and the theoretical models that accompany them—does the deeper, discontinuous nature of reality become visible. The difficulty is not that discontinuity lies beyond reason; it is that reason itself has been shaped by our immersion in a world where continuity was mistaken for the fundamental order of things.

To make discontinuity a true starting-point for philosophy, we must avoid treating it as an interruption or failure within a more basic continuous whole. Instead, we must invert the traditional picture: the continuous is derivative, and the discontinuous is fundamental. This inversion does not deny the practical utility of continuous models. Rather, it reframes their role within a broader ontological architecture. Just as general relativity and quantum field theory successfully describe large-scale and field-level phenomena while presupposing

rather than interrogating their metaphysical foundations (Butterfield & Isham 1999), so too has philosophy long proceeded by assuming its own first principles. The task now is to revisit those assumptions directly in light of discontinuity.

In this way, discontinuity ceases to be a puzzle and becomes a principle. It offers not only an explanation of what we observe at the smallest scales but also a more ontologically economical foundation—consistent with ontological parsimony—for understanding how causality, continuity, and even logic may emerge. This empirical grounding, though evident since the discovery of quantum discontinuity, has remained underappreciated, and its metaphysical significance has yet to be fully absorbed.

To project continuity and intelligibility beyond the observable limit of quantum discontinuity entails the application of first principles *a priori*—the very presupposition this discovery brings into question. The assumption that reality must remain continuous, law-governed, and fully intelligible has guided metaphysics and science alike since antiquity. Yet, with the discovery of quantum discontinuity, this assumption can no longer be justified without appeal to the very principles now shown to be contingent upon the empirical structure of discontinuity itself. Recognising this reflexive dependence signals the threshold at which metaphysics must turn from epistemology to ontology.

This section has defined the meaning of discontinuity in this specific ontological sense. The next section considers what follows when we take this foundation seriously—especially for the status of first principles such as the law of noncontradiction.

SECTION 3: THE COLLAPSE OF THE ***A PRIORI*** STATUS OF FIRST PRINCIPLES

If quantum discontinuity is ontologically basic, then the most fundamental presupposition of metaphysics—that being is both law-governed and continuous, and that order and continuity are inseparable features of reality—can no longer hold as *a priori* (cf. Aristotle 1998/2016; Descartes 1644/1983; Kant 1781/1787/1998; Hegel 1812/2010). The classical assumption that logic and continuity are universally valid must be treated as an emergent feature of reality rather than its foundation. What has been taken to be necessarily true in advance of experience has, through the discovery of discontinuity at the limit of

observation, been shown to depend upon the very empirical structure it was meant to ground. This collapse of the *a priori* undermines the traditional hierarchy of metaphysical explanation and repositions ontology as prior to logic.

The question that follows is therefore not mathematical but ontological. Philosophy's task is not to rival science or mathematics in explanation, but to inquire into the conditions that make their intelligibility possible. This inquiry operates at a different level, examining the ontic and ontological presuppositions upon which all empirical description depends. In this sense, the argument developed here is complementary to science rather than opposed to it, seeking to clarify the foundations that underlie its most successful methods.

This collapse of the *a priori* represents perhaps the most profound yet least recognised consequence of the discovery of quantum discontinuity. Ironically, it has remained obscure precisely because the *a priori* framework it displaces continues to shape both scientific and philosophical thought. The assumption that reality must conform to continuous, law-governed order is so deeply embedded in modern thinking that its contingency is rarely even questioned.

Historically, the law of noncontradiction (LNC) has been regarded as the most fundamental of all principles, the self-evident condition for the possibility of thought and being alike. From Aristotle through Kant, the LNC was treated as immune to revision: nothing can both be and not be at the same time and in the same respect. Yet if discontinuity is real, the condition of being and non-being cannot be understood as mutually exclusive in the simple sense presumed by classical logic. The emergence of continuity from discontinuity implies a prior relation between these two states that is ontologically distinct yet inseparable—i.e., complementary. They are not opposites within a single logical field, but the very conditions that make logical opposition possible.

The traditional understanding of the LNC rests on the assumption that identity precedes difference, that being is self-identical before it can be distinguished from non-being. Quantum discontinuity reverses this order. It reveals that distinction precedes identity, that being arises only through discontinuous differentiation. In this sense, the LNC does not hold *a priori;* it applies only once the continuous domain has emerged from the discontinuous base. Logic, therefore, is not the foundation of reality but a higher-order consequence of its ontological structure.

At this point, the argument must move from an epistemological to an ontological register. The collapse of the *a priori* exposes the limits of knowledge grounded solely in logical form and opens the path to understanding the deeper relational structure of reality itself. This transition marks the emergence of ontological complementarity—the recognition that discontinuity and continuity are not epistemic alternatives but ontological co-conditions of existence. Within this framework, complementarity names the point where logic finds its origin rather than its violation.

Kant's *Critique of Pure Reason* sought to reconcile empirical science with a *priori* principles, positing that the categories of the understanding—including causality, substance, and unity—shape all possible experience (Kant 1781/1787/1998). Yet the discovery of discontinuity exposes the limit of that synthesis. What Kant took to be the transcendental conditions of possible experience now appear as emergent conditions within a universe that does not, at its base, conform to continuous causality. The quantum domain operates at a level where the categories themselves no longer apply, forcing us to acknowledge that the order of thought is secondary to the order of being.

Quine's critique of the analytic–synthetic distinction in *Two Dogmas of Empiricism* (1951) is often regarded as the decisive rejection of the *a priori* in modern philosophy. Yet Quine's argument remains epistemological in scope: it dissolves the boundary between analytic and synthetic statements within a holistic web of belief, but it does not question the ontological presupposition that this web must still operate within a continuous, law-governed order. The result is that Quine replaces one form of epistemic justification with another, while leaving intact the deeper metaphysical assumption that logic and continuity are universally valid. From the standpoint of quantum discontinuity this assumption itself collapses. The failure is not merely in distinguishing analytic from synthetic truths but in recognising that the very framework in which such distinctions make sense is emergent rather than absolute. Quine's empiricism thus stops short of the ontological turn required by the discovery of discontinuity: he naturalises knowledge but not being.

This ontological reversal has profound implications. It means that the apparent universality of logic is not a condition of possibility for experience but a product of a world already structured by discontinuity. Logical coherence arises

only once continuity has emerged, and with it, the stable relations that permit contradiction to have meaning. Before this emergence, contradiction does not apply, not because it is violated but because the conditions for its application are not yet in place. To insist otherwise is to mistake an emergent property for an absolute one.

Understanding logic as emergent rather than foundational does not entail relativism or the abandonment of rationality. It means recognising that reason itself has an ontological history: it arises within a universe that is not intrinsically logical but becomes so through the emergence of continuous structure. This perspective aligns with developments in theoretical physics, where discontinuity defines the conditions under which determinacy and order can arise.

Philosophically, this demands a reorientation akin to the one Hartmann proposed in his *critical ontology*. Hartmann argued that ontology must precede epistemology, and that the structures of thought must be derived from the structures of being, not the reverse. The discovery of discontinuity confirms this priority in an unprecedented way. The task is no longer to impose logical coherence upon reality, but to understand how logic itself emerges as a structural feature of an otherwise discontinuous and noncausal world. The appearance of contradiction at the ontological limit is not a failure of logic but the trace of its origin.

The LNC remains valid within the continuous world it governs, but it no longer holds universally or *a priori*. It is a derivative principle: a law that emerges only once a stable, continuous order exists to sustain contradiction and identity. At the ontological level of discontinuity, such laws are inapplicable. The continuity of the world—and with it, the applicability of logic—arises from the deeper discontinuity that underlies all existence. This inversion of the metaphysical hierarchy signals a decisive shift: first principles no longer ground ontology; ontology grounds first principles.

SECTION 4: ONTOLOGICAL PARSIMONY AND THE EMERGENCE OF CONTINUITY

With the collapse of the *a priori*, the question becomes how philosophy can proceed with the least ontological commitment. The central contribution of this section is to apply ontological parsimony directly to the metaphysical challenge

of quantum discontinuity. Much of contemporary philosophy, with its preference for incremental refinement and formal caution, struggles to accommodate such a shift. These tendencies produce clarity, but they also discourage ambitious rethinking by keeping inherited commitments in place. When viewed through the lens of parsimony, however, the most economical explanation is that discontinuity is fundamental. Beginning from this premise avoids the multiplication of speculative continuities. It honours the spirit of Occam's Razor by cutting away unnecessary assumptions.

This methodological stance follows the precedent of Hartmann's *critical ontology* noted in Section 3, applying his principle of stripping away embedded dogmas directly to the case for a discontinuity-first metaphysics. Hartmann's insistence on separating ontology from epistemology—analysing the fundamental categories of being as they are, rather than as constrained by our modes of knowing—aligns directly with the discontinuity-first approach. Grounding continuity in a discontinuous base follows Hartmann's guideline of beginning with the minimal ontology demanded by observation rather than the maximal framework inherited from tradition.

Rather than posit a continuous metaphysical substrate, we begin with the minimal ontology required to explain observed phenomena. Discontinuity, indeterminacy, and complementarity—often treated as epistemic challenges—can be understood as simpler ontological primitives (Heisenberg 1958; Plotnitsky 2013, 2016, 2021; Bitbol 2017). They do not require continuous fields, infinitely divisible space, or deterministic causation. They align more closely with observed quantum phenomena and avoid the metaphysical cost of maintaining a continuity that cannot be directly observed. This strengthens the case for treating discontinuity as the more parsimonious ontological starting point.

It is important here to distinguish *ontological parsimony* from *methodological parsimony*. Ontological parsimony minimises assumptions about what fundamentally exists, whereas methodological parsimony simplifies models or theories for practical use. Contemporary philosophy often prioritises the latter—valuing simplicity in theory construction and model selection—while tacitly accepting a host of inherited metaphysical assumptions. When those assumptions include continuity, causality, or the universality of classical logic, methodological simplicity becomes self-defeating. The real task is to identify which assumptions are truly necessary at the level of ontology. This is the proper domain of Occam's

Razor: to reduce the ontological commitments needed to explain the world (Kaiser 1992; Sober 2015; Boer 2020).

The contrast is stark when set against the ontological complexity introduced by certain quantum interpretations—such as the many-worlds interpretation, hidden variable theories, or pilot-wave models. The Many-Worlds Interpretation exemplifies methodological parsimony at the expense of ontological parsimony: it preserves the continuous, law-governed form of quantum theory only by multiplying worlds beyond necessity. Such an approach maintains traditional metaphysical assumptions by invoking additional entities and inaccessible explanatory layers. It aims for mathematical coherence while presupposing the metaphysical foundations upon which it depends. The result is ontological extravagance masked by mathematical elegance. A discontinuity-first account avoids this inflation, seeking the simplest ontological basis compatible with observation and coherent explanation—a commitment more faithful to the spirit of Occam's Razor.

This recognition has historical precedent among those who discerned the limits of formal explanation from within mathematics and physics themselves. Bohr understood complementarity as revealing not a flaw in reasoning but the boundary of intelligibility that nature itself imposes. Poincaré (1902/1952) anticipated this in arguing that even the most exact mathematical descriptions rely on conventions that presuppose continuity. Later, Gödel (1931/1986) showed that any sufficiently powerful formal system cannot prove its own consistency. Each of these insights points to the same underlying lesson: that mathematics, while indispensable within its domain, inevitably encounters the ontological limit of its own presuppositions.

Ontological parsimony here is not simplicity for its own sake. It functions as a principle of explanatory discipline: we should not multiply entities beyond necessity, especially when those entities—such as absolute continuity or universal causation—are themselves metaphysically loaded. Classical metaphysics invoked such notions because they were thought necessary to make sense of change, identity, and intelligibility (Carnap 1950; Ladyman and Ross 2007). However, if these can be accounted for through emergent structures grounded in a discontinuous base, the classical presumption must give way.

Continuity, on this view, emerges not from an underlying smoothness but

from large-scale regularities produced by statistical aggregation, constraint-based ordering, or coherence effects. Space and time, for instance, may be emergent properties of entanglement relations or information-theoretic constraints—a point that resonates with structural realist approaches and recent work on emergent spacetime—rather than primitive dimensions (Butterfield and Isham 1999; Clayton and Davies 2008; Corning 2012; Bunge 2016). Causal order may arise from the probabilistic unfolding of correlated events, without requiring an underlying causal mechanism. Logical stability may result from decoherence-like processes that select for consistent structures over time.

This approach avoids smuggling continuity in again through the metaphysical back door. By treating continuity as a higher-order effect—appearing robustly under certain conditions but not others—we can explain its domain of applicability as well as its breakdown. Discontinuity at the quantum level, or contradictions at the level of basic ontology, are no longer pathologies but evidence that we are operating outside the domain in which emergent continuity holds.

This account also clarifies why quantum theory appears to resist classical explanation (Prigogine and Stengers 1984). It is not because quantum theory is incomplete, but because classical metaphysics is overextended. The assumption that continuity is a necessary precondition for intelligibility leads to interpretive puzzles whenever discontinuity appears. Reversing the order—taking discontinuity as basic and continuity as emergent—dissolves these puzzles (Pring 2009). What once seemed paradoxical becomes expected: the world at its base is discontinuous, and our classical intuitions are the product of emergent stability.

Ontological parsimony, then, does not lead us away from reality but closer to it. It asks us to reconsider what is truly necessary for metaphysical explanation, and it cautions against mistaking the conditions of human cognition or classical theory for the conditions of being itself. Parsimony shows continuity, causality, and logic to be emergent rather than foundational. Their universality was always an assumption; quantum discontinuity shows why it can no longer hold. The next section will explore the implications of this shift for causality, and then for the interconnectedness of logic and continuity in contemporary thought.

SECTION 5: LOGIC, CONTINUITY, AND THE CAUSAL IMAGINARY

If continuity is emergent rather than fundamental, then our inherited conceptions of causality and logical order must also be re-evaluated. These concepts are not metaphysically neutral: they carry assumptions about the structure of reality. In particular, they presuppose a world in which events are continuously connected, causes propagate smoothly through space and time, and logical coherence is guaranteed by fixed, context-independent rules. Yet such assumptions are increasingly difficult to reconcile with the discontinuous and probabilistic nature of quantum phenomena (Heisenberg 1958; Plotnitsky 2013, 2016, 2021). This inherited worldview—which we refer to here as *the causal imaginary*—envisions causality as continuous, determinate, and universally applicable, even though it increasingly misrepresents the quantum-level structure of reality. Continuity itself is what sustains this causal imaginary, and recognising it as emergent rather than fundamental exposes the fragility of the entire framework.

In classical metaphysics, causality is treated as a universal ordering principle: every event must have a cause, and those causes unfold through continuous time and space. This picture is intuitive and reinforced by everyday experience, but it becomes problematic at the quantum level. Quantum entanglement produces correlations between events that are not mediated by any continuous signal or transmission. Measurement outcomes appear context-dependent, and the very act of measurement introduces a discontinuity—a so-called "collapse"—that defies causal modelling in the classical sense (Bohr 1934; Prigogine and Stengers 1984).

When causality is viewed as emergent, its breakdown at the quantum level no longer appears as a threat to coherence but as a signal that the conditions for emergent continuity do not apply. It arises when discontinuous processes aggregate into stable patterns—patterns that allow for reliable prediction, retrodiction, and intervention, arising ontologically from an underlying non-causal base (Butterfield and Isham 1999; Laughlin and Pines 2000). At this level, causal talk remains useful and explanatory, yet its utility should not be mistaken for metaphysical necessity. Causality is a domain-specific feature, not a universal law.

Classical logic, likewise, presupposes determinate identities and the continuity of properties across transformations. These presuppositions hold within domains shaped by emergent regularities, but at the quantum level they falter.

Superposition and complementarity challenge the assumption that objects must have definite, non-contradictory properties at all times. This does not mean logic fails; rather, it implies that different logical frameworks may be required for different ontological regimes (Haack 1978; Priest 2006). Logic, like causality, is emergent rather than foundational.

This perspective clarifies why the classical linkage between logic, continuity, and causality has been so powerful. It reflects a world that appears continuous and law-governed at the human scale. Yet this appearance is now recognised as emergent. At more fundamental levels of reality, the structures that sustain classical logic and causal reasoning dissolve. This need not signal the collapse of reason, but a call to evolve our reasoning tools.

Such evolution is already underway in computer science, mathematics, and theoretical physics. Non-classical logics model uncertainty, contradiction, and incomplete information, while quantum information theory redefines measurement, communication, and computation. Even AI systems, built on probabilistic architectures, increasingly operate with forms of reasoning that depart from classical logic (Bender et al. 2021; Floridi and Chiriatti 2020; Priest 2001; Nielsen and Chuang 2000; Timpson 2013). The point is not that mathematics fails at the quantum or computational limit, but that it reaches a boundary of intelligibility — a limit that invites metaphysical rather than technical interpretation. These systems' probabilistic reasoning exemplify how continuity and determinacy can functionally emerge from underlying discontinuity—reinforcing the central metaphysical claim that order arises from the noncausal ground. The fact that our artificial systems reflect inherited assumptions of continuity and logic—yet can be reconfigured—reveals both the depth of those assumptions and the possibility of overcoming them.

To accept the emergence of causality and logical order is to reject the demand that reality conform to our inherited metaphysical images. Coherence may be a product of scale, not a precondition of being. This opens the door to a new kind of metaphysical thinking—one that does not impose order from above, but instead traces the patterns through which order emerges from the discontinuous ground. In doing so, we also see that the supposed universality of the law of noncontradiction holds only within the emergent continuous order. Its *a priori* status dissolves when confronted with the ontological primacy of discontinuity.

In the next section, we build on this reframing by defining the concept of ontological complementarity: a principle that retains the insights of Bohr's quantum philosophy while extending them beyond physics into the heart of metaphysical structure itself.

SECTION 6: ONTOLOGICAL COMPLEMENTARITY

Niels Bohr's principle of complementarity was originally introduced to explain how mutually exclusive properties—such as wave and particle behaviour—can both be true of quantum systems, though never simultaneously observable (Bohr 1934). As Plotnitsky (2013) has shown, Bohr's insight was not simply technical but epistemological: it revealed the limits of knowledge, where no single conceptual framework can exhaust reality. Yet if discontinuity is taken as metaphysically basic, complementarity ceases to be merely a limit of knowing and becomes instead a principle of being itself. In this sense, it points beyond epistemology toward ontology and sets the stage for reinterpreting complementarity ontologically.

Ontological complementarity reframes Bohr's insight at the metaphysical level. It proposes that discontinuity and continuity are not opposing properties but mutually necessary ontological conditions. Discontinuity provides the ground from which continuity emerges. Continuity, once established, makes discontinuity intelligible. The two are co-constitutive rather than contradictory. From within the emergent continuous order, this relation appears to us as complementary, and we are bound within this emergent structure. Such complementarity precedes and defines the application of logical principles such as the law of noncontradiction (LNC).

The discontinuity–continuity relation thus expresses how the deeper ontic structure of non-causality and causality appears to us within the emergent continuous order. The ontic relation is the real one: causality arises from a non-causal foundation that cannot itself be represented in continuous terms. What we experience as discontinuity and continuity is the ontological manifestation of this deeper relation—the way it necessarily appears within the structure of our world. The fact that this ontological relation presents itself as complementary sustains the mathematical order of reality, since mathematics formalises the coherence of this emergent continuity without reaching beyond it. In this sense,

complementarity not only defines our epistemic limits but also preserves the intelligibility of a world grounded in discontinuity.

Taken together, this perspective exposes a long-standing conflation between logical truisms and ontological laws. Quantum discontinuity shows that the LNC remains intact as a formal principle of logic but can no longer claim universal ontological jurisdiction. Complementarity is not contradiction: contradiction marks an inconsistency within a single logical system, while complementarity recognises that two mutually exclusive perspectives may each be valid within their own domains yet also jointly necessary for a full ontological account. Discontinuity and continuity thus co-constitute the starting-point for reality—the emergence of continuity from discontinuity.

Writing more than a century before the articulation of quantum discontinuity, Kant sought to resolve the first antinomy by distinguishing between phenomena and noumena (Kant 1781/1787/1998, 459–95), attributing contradiction to our mistaken extension of categories beyond possible experience. His project in the *Critique of Pure Reason* was to secure the *a priori* status of first principles as conditions of experience and metaphysics. That framework presupposed their necessity. Yet, as argued in Section 3, the discovery of quantum discontinuity—and the plausibility of continuity's emergence from discontinuity—casts doubt on their necessity and offers an ontological resolution to Kant's dilemma.

Attempts to dispute continuity's emergence from discontinuity inevitably rely on the very *a priori* principles that quantum discontinuity has placed in doubt. To invoke the LNC as self-evident justification is self-defeating and cannot justify itself without circularity: what is at issue is not its logical coherence but its ontological scope. The classical approach cannot secure its own foundations.

Bohr, like Kant, ultimately retained an epistemic framework. His complementarity presupposed the *a priori* validity of logical principles and located the mystery of quantum phenomena in a noumenal domain beyond comprehension. Plotnitsky's (2021) "Reality without Realism" extends this stance, treating quantum phenomena as real but unrepresentable. Yet this perspective, too, overlooks that intelligibility itself presupposes the ontological relation it attempts to explain. Both Kant's first antinomy and quantum discontinuity reveal the structural necessity of ontological complementarity.

Complementarity, properly understood, is not a concession to ignorance but

a metaphysical insight into the structure of being. The world is both finite and infinite, continuous and discontinuous, because its foundation is complementary in this deep ontological sense—it rests on the pre-logical emergence of continuity from discontinuity and order from non-order. What appears paradoxical within logic, is not contradiction but the manifestation of the ontological structure that makes logic itself possible.

This marks a decisive shift in metaphysical method, signalling a move away from the demand for total unity and toward an acceptance of structural plurality within being. Traditional metaphysics aims at unity, coherence, and total intelligibility. Contradictions are treated as signs of error, breakdowns in reasoning or conceptual clarity. But if the world itself is fundamentally discontinuous and emergent, then contradiction may reflect the ontological structure of reality rather than a failure of representation (Plotnitsky 2013, 2016, 2021; Priest 2006). Complementarity becomes a guide to metaphysical adequacy, not an obstacle to be overcome. This reframes complementarity as a methodological tool for approaching domain-specific theories that resist unification while maintaining rigor.

The next section will build on this proposal by exploring the possibility of a logic adequate to a discontinuous ontology—one that incorporates complementarity as a basic feature, rather than treating contradiction as a mark of failure.

SECTION 7: A LOGIC OF THE DISCONTINUOUS

Building on the principle of *ontological complementarity*—where discontinuity and continuity are co-constitutive rather than opposed—this section asks how logic itself might be reconceived. If continuity is not metaphysically fundamental but rather emerges from discontinuity, and if classical logic cannot universally apply, the central task becomes identifying what kind of logic could describe a discontinuous ontology. The aim is not to preserve classical logic against contradiction but to articulate an alternative that recognises the ontological primacy of discontinuity while retaining the rigour necessary for metaphysical explanation. The question, then, is what kind of logic can articulate discontinuity without reverting to continuity-based assumptions.

One path forward is to develop a logic premised on ontological discontinuity

rather than continuous identity. In such a framework, contradiction is not treated as an error in reasoning but as a signal that we are operating at an ontologically deeper level where classical categories—identity, continuity, and noncontradiction—no longer apply. This would demand a rethinking of logical connectives and of the metaphysical assumptions that usually underpin inference.

Here the fundamental unit is not the object or proposition but the event: an ontically distinct occurrence that does not depend on continuous trajectories or identity persistence over time. Each event is related to others not through necessary entailments or continuous transitions but via probabilistic, context-sensitive connections. The resulting logic may resemble aspects of quantum, modal, or paraconsistent logics, but its justification would be ontological rather than epistemic or pragmatic (Haack 1978; Priest 2006; Plotnitsky 2013, 2016, 2021).

Such a logic would not merely tolerate contradiction but place it in context. As complementarity in quantum physics shows, mutually exclusive measurements can each disclose a real aspect of a phenomenon. Similarly, an ontological logic could accommodate locally inconsistent yet ontologically coherent descriptions without collapsing into incoherence (Bohr 1934; Plotnitsky 2013, 2016, 2021). Contradiction here would mark irreducible multiplicity, evidence that we are confronting a domain where classical unity no longer holds. As argued earlier, complementarity precedes the application of logical first principles like the LNC, and a discontinuous logic would preserve that priority.

From this point, the question becomes not whether such a logic can replace classical reasoning, but how different domains may each demand their own logical framework. At this stage, what is needed is not a technical axiom system but a conceptual schema that renders a discontinuous, causally unbound world intelligible. Classical metaphysics could then be reconstructed as a special case within this broader framework, just as classical mechanics emerges from quantum mechanics under certain conditions (Butterfield and Isham 1999; Clayton and Davies 2008).

Logical pluralism of this kind is not relativism. It redefines logical normativity in terms of ontological fit: the appropriate logic is the one that corresponds most faithfully to the structure of the domain in question. In domains where discontinuity is fundamental, continuity-based logic misrepresents the ontological

structure of reality. A logic of the discontinuous, by contrast, accepts the implications of quantum discontinuity and supplies the tools to think coherently within its terms.

The final section will consider how this perspective reshapes metaphysical explanation—moving beyond inherited categories and toward a post-classical metaphysics grounded in the underlying discontinuity of the world.

SECTION 8: CONCLUSION

To take discontinuity as metaphysically basic is to reject the deepest inheritance of classical metaphysics. It is to abandon the idea that metaphysical explanation must begin with principles of identity, continuity, and necessary logical form. This essay has argued that such principles, while historically foundational, no longer command *a priori* authority. They are not immune to revision, as the discovery of quantum discontinuity—and its persistence at the limits of observation—demonstrates. This provides a compelling empirical basis for rethinking the metaphysical assumptions that have long structured Western thought, grounding the argument empirically in quantum theory (Bohr 1934; Plotnitsky 2013, 2016, 2021; Heisenberg 1958; Bitbol 2017).

In place of classical first principles, this essay has developed an alternative: a metaphysics in which discontinuity is fundamental, in which causality, continuity, and logic emerge as domain-specific features of an ontologically discontinuous and plural world (Priest 2006; Hartmann 1935/2021, 1942/2012). Causality appears as a relational form internal to macroscopic patterns of recurrence. Continuity arises from perceptual and conceptual smoothing of discontinuous events. Logic is understood not as a universal grammar of thought but as a set of tools adapted to local structures (Haack 1978; Dummett 1991). Each is intelligible and reliable within certain bounds, but none can lay claim to absolute metaphysical priority.

If this is correct, then the task of metaphysics is not to secure a universal foundation but to articulate how different domains of reality relate to one another: how emergence proceeds from discontinuity to continuity (Clayton and Davies 2008; Corning 2012; Bunge 2016); how incompatibility is navigated through ontological complementarity (Pring 2009); and how the classical worldview can be understood as a special case within a more general, noncausal-

based metaphysical scheme. This directly addresses ongoing discussions about domain-relativity and the layered structure of reality.

This vision of metaphysics is both modest and radical. It is modest in recognising the situatedness of logical and causal reasoning, and radical in proposing that the base of reality is not a continuous field or unified logos, but a structurally incomplete, non-totalisable ontology. It is a metaphysics of limits, attuned to the edges of sense and explanation rather than seeking to eliminate them (Quine 1951; Sober 2015).

The result is not a finished system but a starting-point: a proposal for how philosophy might proceed when it lets go of its inherited metaphysical absolutes. Discontinuity, not continuity, emergence, not *a priori* necessity, complementarity, not contradiction—a recognition that mutually exclusive perspectives can jointly constitute the deepest ontological ground. Such a framework provides a rigorous and empirically informed basis for future work at the intersection of metaphysics, philosophy and science. These are the contours of a post-classical metaphysics—one that begins, decisively, where continuity ends.

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