DETERMINATIVE POTENTIAL THEORY: A METAPHYSICAL FRAMEWORK FOR DETERMINACY, IRREVERSIBILITY, AND COSMOLOGICAL ORDER

Xiaozhou Zeng

ABSTRACT: This article develops Determinative Potential Theory (DPT), a structural metaphysical framework explaining how systems transition from symmetric coexistence of mutually exclusive possibilities to single-valued realized outcomes accompanied by irreversible traces. The theory addresses conceptual problems concerning determinacy, temporal order, and cosmological directionality. Three axioms—finite termination, intralayer single-value fixation, and non-zero rollback cost—yield propositions establishing a poset of determinative events, the emergence of temporal order from structural dependency, the impossibility of reversion, and the constraining role of early determinative events. The article compares DPT with modal metaphysics, quantum interpretations, structural realism, process philosophy, and entropy-based theories of time. DPT provides a unified metaphysical explanation of determinacy and cosmic structure, relevant to cosmology and natural philosophy.

KEYWORDS: Metaphysics; Irreversibility; Cosmology; Structural explanation; Determinacy; Temporal order

1. INTRODUCTION

Determinacy is often treated as an unquestioned feature of the cosmos, something already presupposed in our physical theories and metaphysical discussions. Yet once one pauses over the matter, a puzzle appears: if the world can be described, at least at certain stages or in certain layers, as comprising several mutually exclusive but equally admissible possibilities, then on what basis does a single course of reality become actual? Classical metaphysics delineates the domain of the possible and the actual but provides no internal demand that

possibility must eventually cease. Quantum mechanics, for its part, formalizes superposition with great precision, yet it leaves the appearance of definiteness—why this outcome rather than ongoing coexistence—conceptually unclear.[1] Thermodynamic models of temporal asymmetry likewise trace irreversibility to special initial conditions or statistical smoothing, without explaining why directionality should arise as a structural feature of reality itself.[2]

Determinative Potential Theory (DPT) begins from the observation that some forms of coexistence are not merely epistemic or perspectival but belong to the descriptive structure of a system. When two or more incompatible states inhabit the same descriptive layer—when they share an object domain, a predicate set, and a reference frame—there is no principled sense in which the world can sustain that coexistence indefinitely. Within such a layer, coexistence exerts a kind of structural pressure that must be resolved. DPT names the corresponding principle Determinative Potential: the inherent requirement that symmetric coexistence terminate.

On this view, a determinative event is not a causal intervention nor the result of an observer's action. It is the structural resolution of an unstable intralayer configuration. The event excludes all but one of the previously coexisting possibilities, thereby generating a determinate state. Crucially, this transition is not reversible: each determinative event leaves behind a trace—an imprint on the structure of the system—that cannot be erased without cost. These traces accumulate into a partially ordered structure that governs how determinative events can follow one another. When this order is read linearly, we obtain the phenomenon of time: temporal order is not a background container but the expressive form of determinative precedence.

The purpose of this article is threefold. First, it lays out the conceptual foundations required to articulate DPT. Second, it presents an axiomatic core from which the structural consequences of determinacy follow. Third, it explores the cosmological and philosophical implications of this framework, especially regarding irreversibility, the unity of scientific representations across layers, and

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1 Everett, Hugh, '"Relative State" Formulation of Quantum Mechanics', *Reviews of Modern Physics*, vol. 29, 1957, pp. 454–462.

2 Prigogine, Ilya, *The End of Certainty: Time, Chaos, and the New Laws of Nature*, New York, Free Press, 1997.

the emergence of large-scale cosmic order. The proposal is intentionally minimal: it does not explain why a specific possibility becomes actual, but it identifies the structural conditions under which determinacy and directionality must arise.

2. CONCEPTUAL FOUNDATIONS

Determinative Potential Theory begins by distinguishing forms of coexistence that are merely epistemic from those that arise within the structure of a description itself. The latter constitute what DPT calls intralayer coexistence: situations in which several incompatible possibilities are equally admissible under the same descriptive resources. This section articulates the conceptual elements necessary for analysing such coexistence: symmetric coexistence, descriptive layers, determinative resolution, and trace formation.

2.1 Symmetric Coexistence

Symmetric coexistence arises when multiple possibilities share the same descriptive standing and yet cannot be jointly realized. They are incompatible, but no predicate available within the layer differentiates them. What is striking about such coexistence is not that it is uncertain or probabilistic, but that it is structurally unresolved. The descriptive apparatus offers no means to privilege one possibility over others, and thus the coexistence persists only as long as the descriptive layer tolerates such symmetry.

This notion is deliberately modest. It does not claim that the world is fundamentally indeterminate, nor does it assert that possibility is metaphysically prior to actuality. Rather, it captures the point at which a description encounters an internal tension: the layer itself cannot host incompatible outcomes indefinitely without undermining its own coherence.

2.2 Descriptive Layers

A descriptive layer is defined by three jointly sufficient components—the object domain, the predicate set, and the reference frame. When two descriptions share these components, they are part of the same layer; when they differ, they belong to distinct layers. This distinction matters, because many apparent contradictions dissolve once one recognizes that they occur across layers rather than within one.

Quantum and classical descriptions provide a familiar example. Their predicates differ, their frames of reference diverge, and what appears contradictory at one level becomes intelligible when viewed as a shift of layer.[3] DPT depends on this distinction because symmetric coexistence is an intralayer phenomenon. Only when two possibilities inhabit the same descriptive layer can they exert the structural pressure that demands resolution.

2.3 Determinative Resolution

A determinative event is the structural transition from coexistence to a single realized state. It is not causal in the traditional sense; it is neither an effect of antecedent conditions nor an intervention from outside the system. Rather, it is the resolution of intralayer instability. Where symmetric coexistence cannot persist, determinative resolution must occur.

This conception avoids both voluntarist metaphysics and observer-dependent models. A determinative event does not depend on any act of measurement or intention. It is an inherently structural phenomenon: an incompatibility within the descriptive layer precipitates its own resolution.

2.4 Trace Formation

No determinative event is without consequence. Each one leaves behind a trace—an imprint on the structure of the system that encodes the realized outcome. Such traces cannot be erased without cost; they alter the constraints under which subsequent determinative events unfold. The idea that determination leaves a mark has historical antecedents in the sciences and natural philosophy, though DPT formulates it at a more abstract structural level.[4]

A trace is not necessarily material. It may be logical, structural, or relational. What matters is that it renders certain configurations possible and others impossible, thereby shaping the trajectory of events. Through the accumulation of traces, a structured order emerges—one that can be read, retrospectively and prospectively, as temporal direction.

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3 Wallace, David, *The Emergent Multiverse: Quantum Theory According to the Everett Interpretation*, Oxford, Oxford University Press, 2012.

4 Prigogine, Ilya, *The End of Certainty: Time, Chaos, and the New Laws of Nature*, New York, Free Press, 1997.

3. AXIOMATIC STRUCTURE

Determinative Potential Theory reaches its decisive clarity when articulated through a small set of structural commitments. These are not empirical laws, nor metaphysical postulates in the traditional sense, but the minimal constraints that any descriptive layer must satisfy once it contains incompatible possibilities. The axioms do not describe what the world *does*; they describe what a descriptive framework *cannot avoid* once symmetric coexistence arises. In this way, they express pressure points internal to structural description itself—places where a layer must yield, resolve, or transform in order to remain coherent.

Axiom A — Finite Termination

A descriptive layer cannot sustain incompatible possibilities indefinitely when nothing within that layer differentiates them. Such coexistence is structurally unstable: the layer can host it only temporarily, as a tension that demands its own resolution. Finite termination therefore expresses a limit inherent to intralayer description. If symmetric coexistence were allowed to persist without end, the layer would cease to function as a coherent framework, unable to articulate a determinate world at all. The axiom states, in short, that unresolved incompatibility has an intrinsic horizon beyond which it cannot be carried.

Axiom B — Single-Value Fixation

When symmetric coexistence terminates, it does so by establishing a single realized outcome within that descriptive layer. This selectivity is not a matter of causal priority or probabilistic weighting; rather, it reflects the simple fact that a layer cannot simultaneously affirm mutually exclusive determinations without compromising its coherence. Once a determinative event occurs, all competing possibilities become inadmissible relative to that layer's predicates and reference frame. To resolve is necessarily to resolve *one way*, and the singularity of the outcome follows from the internal demands of the descriptive structure itself.

Axiom C — Non-Zero Rollback Cost

Every determinative event leaves behind a trace: an imprint that encodes the realized outcome and reshapes the conditions under which subsequent events may unfold. These traces cannot be erased without structural expenditure; the

system cannot simply retract a determination and return to a condition of symmetric coexistence without compromising the very framework that enabled the determination in the first place. Irreversibility thus arises not from causal inertia or thermodynamic decay, but from the logical architecture of determinacy itself. Once inscribed, a trace binds what may follow.

Derived Structure

Once determinative events are understood as leaving traces that condition what may follow them, a structural ordering naturally emerges. If the trace of one event must be presupposed by another, then the former stands in a relation of precedence to the latter. This relation is reflexive, antisymmetric, and transitive; it therefore forms a partially ordered set of determinative events. At this stage we do not yet have time, but we have something that plays its role: an ordered backbone of dependency. When this structure is extended into a linear sequence, it yields the familiar phenomenon of temporal order—not as a primitive background, but as the expressive surface of deeper structural constraints.

4. CORE PROPOSITIONS

The axioms of DPT do not merely delimit the behaviour of incompatible possibilities; they also generate a set of structural consequences that illuminate how determinacy shapes the order of the cosmos. These propositions provide the bridge between the abstract commitments of the theory and the phenomena they render intelligible. What emerges is neither a temporal mechanics nor a causal model, but a set of constraints that, when traced through their implications, disclose the architecture of temporal direction and structural dependence.

Proposition 1 — Temporal Order as Linear Extension

Because determinative events leave traces that condition what may follow them, they stand in relations of precedence. These relations form a partially ordered set. A poset does not yet constitute a temporal sequence, but it contains the essential intuition: that some events can occur in either order, while others cannot. When one extends this structure into a linear sequence—when one reads it as a single chain among many admissible chains—one obtains what we ordinarily call temporal order. In this sense, time is not an imposed background

but the expressive unfolding of determinative precedence.

Proposition 2 — Cross-Layer Order Preservation

When descriptions shift between layers—such as from quantum to classical, or from local to cosmological—the predicates and reference frames change, yet structural coherence demands that determinative order be preserved. If one event presupposes the trace of another in one layer, any faithful mapping to a new layer must retain that relation. Without this, descriptions across layers would fragment, producing contradictory accounts of what depends on what. Cross-layer preservation of order thus anchors the unity of scientific representation.

Proposition 3 — Impossibility of Zero-Cost Rollback

Irreversibility in DPT does not arise from thermodynamic decay or statistical asymmetry, but from the architecture of trace formation. Because traces encode the realized outcome and condition what may come next, returning to a state of symmetric coexistence would require erasing or bypassing those traces. Such erasure is never cost-free. A descriptive layer cannot retract a determination without undermining the very structure that made the determination coherent. Hence, there is no inverse determinative event that simply restores the prior coexistence: structural rollback is intrinsically constrained.

Proposition 4 — Early Determination Constraints

Early determinative events exert a lasting influence on what follows. Their traces shape the field of admissible possibilities, narrowing the range of subsequent outcomes. This structure mirrors familiar features of cosmology, where early conditions exert disproportionate influence on large-scale order. Yet in DPT, this influence does not arise from dynamical equations or initial-value problems; it is a direct consequence of how traces accumulate. Early determinations thus function as anchors that orient the unfolding of the descriptive framework.

5. COSMOLOGICAL AND METAPHYSICAL IMPLICATIONS

The implications of Determinative Potential Theory become clearest when viewed through the lens of cosmological reasoning. Modern cosmology confronts a series of conceptual tensions—irreversibility, temporal orientation, stability of

large-scale structure, and the coexistence of incompatible descriptive frameworks—that cannot be fully resolved by physical models alone. DPT does not replace those models, but it clarifies the structural preconditions that make their coherence possible.

5.1 Temporal Directionality

In physical cosmology, temporal asymmetry is typically attributed to low-entropy boundary conditions or dynamical imbalances. Yet these explanations presuppose the very feature they attempt to justify: a directed unfolding of states. DPT reframes the issue. Temporal directionality arises not from energetic gradients but from the ordered accumulation of traces. Once a determinative event leaves an imprint that constrains what may follow, the resulting precedence relation cannot be undone without structural cost. The arrow of time is thus a manifestation of ordered dependency among determinations, rather than a product of statistical tendencies.

5.2 Single-Valued Cosmic History

A central challenge in contemporary cosmology is the temptation to treat large-scale history as branching or multiply realized. While such plurality may make sense across descriptive layers—quantum versus classical, for example—it cannot be sustained within a single layer without violating the internal coherence of the descriptive framework. DPT reinforces this point: once symmetric coexistence terminates within a given layer, only one trajectory remains admissible. Cosmic history, insofar as it is described within a unified layer, must therefore be single-valued.

5.3 Early Cosmic Lock-In

Cosmology often attributes the universe's large-scale coherence to conditions set in the earliest fractions of a second: inflationary dynamics, primordial fluctuations, symmetry breaking, and so on. While these accounts offer powerful physical models, they do not explain why early events should exert such enduring influence. According to DPT, the answer lies in trace accumulation. Early determinative events generate constraints that subsequent events cannot violate without structural contradiction. Their influence is not merely dynamical; it is architectural. They anchor the space of admissible developments, giving cosmic

evolution its characteristic stability.

5.4 Information Directionality

Information-theoretic accounts of the universe often rely on entropic or causal asymmetries to explain why information appears to "flow" in one direction. DPT provides a deeper structural grounding. Because each determinative event reshapes the field of admissible possibilities, information encoded in traces is inherently oriented. What follows must accommodate what has already been inscribed. The apparent directionality of information is thus a reflection of ordered constraint, not an emergent by-product of thermodynamic trends.

5.5 Layered Reality

Finally, DPT offers a way to reconcile the plurality of scientific descriptions used in cosmology. Quantum, classical, and thermodynamic accounts differ in their layers—object domains, predicates, and reference frames—yet their representations must remain mutually coherent. By requiring that determinative order be preserved across layers, DPT explains how these representations can diverge in content while converging in structural alignment. The universe can be multiply described, but not multiply determined.

6. COMPARATIVE DISCUSSION

A theory gains clarity not only through its internal articulation but also through contrast with neighbouring frameworks. The following comparisons do not aim to diminish the sophistication of existing approaches in metaphysics and cosmology. Rather, they highlight the specific gaps DPT is designed to address—gaps concerning determinacy, structural resolution, and irreversibility. The tone here is deliberately analytical rather than adversarial: each tradition offers important insights, but none directly confronts the structural pressures that motivate determinative potential.

Modal Metaphysics

Modal metaphysics provides a language for possibility, necessity, and counterfactual structure. Yet traditional modal frameworks do not require that possibilities ever terminate. They describe accessibility, not resolution. DPT

agrees that multiple possibilities may be admissible at a given stage, but it adds the claim that intralayer coexistence is structurally unstable: a descriptive layer cannot sustain mutually exclusive possibilities indefinitely. Modal metaphysics thus supplies the conceptual landscape, but DPT identifies the internal limit beyond which coexistence must collapse into determinacy.

Quantum Interpretation

Quantum theory gives perhaps the most vivid expression of coexistence through superposition, but the question of definiteness remains open. Interpretations diverge: some appeal to collapse, others to branching, others to decoherence. What unites these accounts is the absence of a structural explanation for why definiteness must occur at all. DPT does not enter the debate over mechanisms; rather, it reframes the issue. Within a single descriptive layer, incompatible possibilities cannot persist without disrupting the coherence of that layer. Determinacy is therefore required not by measurement, but by structural necessity.

Structural Realism

Structural realism emphasizes relational patterns as the primary ontological constituents of the world. DPT shares this emphasis on structure but notes that structural realism typically treats structures as static or enduring. What it lacks is a dynamic account of how structures become fixed—how a system moves from an unresolved configuration to a determinate relational pattern. DPT contributes precisely this missing piece: determinative resolution and trace formation supply the mechanism by which structural order becomes settled.

Process Philosophy

Process philosophy insists that becoming is more fundamental than being. DPT resonates with this orientation but reframes becoming in terms of structural resolution rather than metaphysical flux. Processes, on the DPT view, unfold as sequences of determinative events constrained by the traces they leave behind. In this way, DPT offers an alternative grounding for processual development: not the spontaneity of becoming, but the ordered transformation of intralayer tensions.

Entropy-Based Accounts

Thermodynamic and statistical accounts of the arrow of time ground irreversibility in low-entropy initial conditions or probabilistic asymmetries. These models are powerful but contingent: they describe how irreversibility manifests, not why it should exist. DPT complements these accounts by providing a structural explanation. Irreversibility arises because determinative events inscribe traces that cannot be removed without undermining the coherence of the descriptive layer. Entropy may track the macroscopic signatures of this asymmetry, but DPT identifies its conceptual origin.

7. LIMITATIONS AND FUTURE WORK

Every theoretical framework gains depth by acknowledging the boundaries of its present articulation. Yet for Determinative Potential Theory, these boundaries do not signal weakness so much as the horizon of its further development. DPT is intentionally minimal: it identifies the structural pressures that make determinacy and irreversibility unavoidable within a descriptive layer, but it does not attempt to foreclose the rich conceptual terrain that lies beyond these commitments.

First, DPT does not explain why a particular outcome becomes determinate. Its concern is with the necessity of resolution, not with the selection among admissible possibilities. This selectivity may depend on factors outside the scope of structural analysis and might ultimately require integration with physical, informational, or modal principles that DPT itself does not specify.

Second, while the theory asserts that traces impose non-zero rollback cost, it does not quantify that cost or articulate a general taxonomy of trace types. Different layers may encode traces through logical, physical, or relational means, and charting these variations is a task for future work. Such an account would deepen the connection between DPT and the sciences, showing how structural irreversibility manifests differently across domains.

Third, cross-layer mappings in DPT preserve determinative order, but the theory does not yet provide a fully formal account of how layers interrelate. A categorical or topological treatment of these relations could reveal new structural invariants and clarify how coherence is maintained across the diverse descriptive practices found in cosmology and physics.

Finally, the most ambitious direction lies in integrating DPT with existing

cosmological models. If determinative structure underlies temporal orientation, stability of large-scale order, and the unity of scientific representation, then DPT may offer a foundational layer upon which physical cosmology can build. This is not a limitation but an opportunity: DPT opens conceptual space that broader scientific and philosophical inquiry can now explore.

8. CONCLUSION

Determinative Potential Theory offers more than a reformulation of familiar metaphysical questions; it provides a structural foundation for understanding why a determinate cosmos is possible at all. By tracing determinacy to the internal limits of descriptive layers—rather than to causal mechanisms, epistemic updates, or probabilistic collapse—DPT reframes the origin of temporal order and irreversibility as consequences of structural necessity. Once symmetric coexistence arises, it cannot remain unresolved; once resolution occurs, it cannot be undone without destabilizing the very framework that made it possible. In this sense, determinacy is not an accident of physical evolution but a requirement of coherent description.

What follows from this is significant. Temporal directionality appears not as a derivative phenomenon but as the expressive surface of ordered dependency among determinative events. The unity of scientific representation across layers—quantum, classical, thermodynamic—derives from the preservation of determinative order, not from any reductive hierarchy. And the stability of cosmic history reflects not only physical processes but structural anchors laid down by early determinative events.

The ambition of DPT is therefore foundational. It does not seek to replace cosmology, physics, or metaphysics; rather, it aims to articulate the structural conditions that make their explanatory projects possible. If determinacy, irreversibility, and temporal orientation are indeed consequences of determinative potential, then these concepts are not merely features of the universe as we observe it—they are conditions that any coherent cosmos must satisfy.

Independent Researcher
Nancy, France
Phone number: +33 640885787
Email: leozeng@gmail.com

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