Events Before Physics:

On the Independence of Temporal Order from Mathematical Formalism

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Abstract

Natural processes unfold independently of human intention, desire, and theoretical description. Day and night alternate, seasons change, sediment layers accumulate, and tree rings grow without reference to coordinates, metrics, or mathematical formalisms. These processes establish an order of events that exists prior to any formal attempt to describe them.

This paper argues that physical discourse often suppresses the constructive interval between independent events and the mathematical structures later used to represent them. Observers first decide to describe events, then introduce concepts, coordinates, metric relations, and equations, and only afterwards project the resulting formal structures back onto the world as if they had been present there from the outset. Once this interval is concealed, the products of formalization are easily mistaken for the ontology of events themselves.

The paper therefore distinguishes the ontological order of events from the epistemic and mathematical structures constructed to model that order. Its central claim is that temporal order is independent of mathematical formalism and cannot be derived from it. Time, on this account, is not fundamentally a coordinate or metric parameter, but the canonical order of historical events.

Keywords: temporal ontology; canonical order; history; mathematical formalism; spacetime; philosophy of physics

Contents

1 Introduction

Natural events do not wait for theory. The alternation of day and night, the succession of seasons, the formation of mineral layers, and the growth of tree rings all occur independently of human will, desire, or description. Such processes exhibit order before any observer introduces coordinates, metrics, or equations. They do not begin to exist when formalized; rather, they are formalized only because they already occur.

The central claim of this paper is that temporal order is independent of mathematical formalism. This claim is stronger than the familiar thesis that metric structure is secondary. The point here is not merely that metrics come later, but that the whole formal apparatus of physical description arises only after a constructive interval in which observers decide to describe, select conceptual tools, and build mathematical schemes over events that have already taken place.

Physical theory often conceals this interval. It proceeds as if the movement were immediate: from independent events directly to formal temporal structures. But this passage is not immediate. Between events and formalism there stand acts of selection, abstraction, parametrization, and mathematical construction. Once these steps are suppressed, the products of representation are easily mistaken for features of reality itself.

The purpose of this paper is to restore that suppressed interval and to distinguish three levels: the ontological order of events, the epistemic reconstruction of that order, and the mathematical formalism imposed upon it. On this basis, the paper argues that no physical formalism can determine temporal ontology.

2 Events Independent of Description

Natural processes occur independently of human observers and independently of the desire to represent them. A tree does not wait for a calendar before adding a new ring. Sedimentary deposition does not require a coordinate chart in order for one layer to be laid down after another. Day follows night without reference to equations. These processes are not created by description; they are only later taken up by description.

What such examples exhibit is not yet a metric order but a sequential order. One event occurs after another. One trace is laid down later than another. One stage of a process succeeds a previous stage. This order is observable through traces and records, but it does not depend on the theories used to interpret them.

Definition 1. The *canonical order of events* is the non-arbitrary sequential order in which independent events occur and leave traces, regardless of whether those events are later measured, represented, or formalized by observers.

The notion of canonical order does not presuppose coordinates, durations, intervals, or spacetime geometry. It requires only that events occur and that their order can, at least in principle, be registered through traces, records, or observable consequences. Contemporary philosophy of spacetime often treats geometric structure as a fundamental feature of the world (Friedman 1983).

3 The Constructive Interval Between Events and Formalism

Between the occurrence of events and the appearance of physical formalism there exists a constructive interval. During this interval, an observer or community of observers does not merely witness events, but undertakes a sequence of epistemic acts.

Typically, this sequence includes:

1. the occurrence of events independent of the observer's will;
2. the desire to describe such events;
3. the introduction of conceptual and mathematical tools;
4. the continued occurrence of further independent events during the act of construction;
5. the application of the resulting formalism to selected domains;
6. the retrospective treatment of formal results as if they were ontological givens.

This interval is crucial. While the observer constructs a formal scheme, the world does not stop. New days pass, new rings form, new layers accumulate, and new events enter history. The formal apparatus is therefore itself generated within the order of events that it later seeks to organize.

Principle 1. No mathematical formalism can serve as the ontological precondition of the order within which that formalism itself is historically constructed.

This point blocks the common inversion in which a formal representation is treated as though it had generated the very order that made its construction possible.

4 The Constructive Temporal Interval

The argument of this paper requires a more precise designation for the interval between the independent occurrence of events and the later appearance of the mathematical structures used to describe them. This interval will be called the *Constructive Temporal Interval* (CTI).

Definition 2 (Constructive Temporal Interval)**.** The *Constructive Temporal Interval* (CTI) is the historically real interval within the order of events during which observers, starting from independently occurring events, construct the conceptual, symbolic, and mathematical means by which those events are later represented, organized, and theorized.

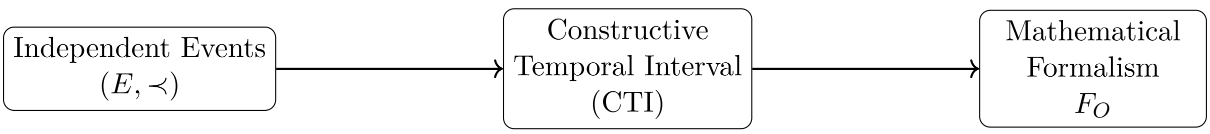

Figure 1: The Constructive Temporal Interval: formalism emerges only after a constructive process performed within the order of events.

The CTI is not external to history. It is itself part of the historical order of events. While observers introduce concepts, select parameters, construct coordinates, define metrics, and formulate equations, further independent events continue to occur. For this reason, the CTI cannot be treated as a merely logical or timeless relation between observation and theory. It is a temporally situated constructive process.

4.1 Internal Structure of the CTI

The CTI can be analytically decomposed into the following moments:

1. independent events occur and leave traces;
2. an observer or community of observers forms the intention to describe those events;
3. conceptual distinctions are introduced;
4. symbolic and mathematical structures are constructed;
5. the resulting formalism is applied to selected domains of events;
6. the formal results are liable to be reinterpreted as if they belonged to the ontology of events themselves.

This decomposition is not meant as a rigid chronological law for every episode in the history of science. It is an analytic articulation of the constructive sequence that is presupposed whenever formal structures are built over already occurring events.

Remark 1. The defining feature of the CTI is not merely that theory comes later than events, but that the construction of theory itself occurs within the same temporal order that theory later seeks to represent.

4.2 Formal Representation of the CTI

Let E denote the set of independent events, and let $\prec$ denote the canonical order relation on E, where

$$e_i \prec e_j$$

means that event e_i occurs prior to event e_j in the canonical order of history.

Let O denote an observer or an epistemic community, and let F denote a formal structure constructed by O for the purpose of representing certain relations among events in E.

The CTI can then be represented schematically as a mapping sequence

$$(E, \prec) \longrightarrow I_O \longrightarrow C_O \longrightarrow F_O,$$

where:

- E is the domain of independently occurring events;
- $\prec$ is the canonical order on E;

- I_O is the observer's intention to describe or organize events;
- C_O is the constructive activity of concept formation, parameter selection, and symbolic organization;
- F_O is the resulting formalism.

The crucial point is that F_O is produced only after the prior existence of $(E, \prec)$, and within the continuation of that same order. Accordingly, F_O cannot be ontologically prior to the ordered events whose representation made its construction possible.

4.3 The CTI Constraint

The foregoing structure yields a general constraint.

Principle 2 (CTI Constraint)**.** If a formal structure F_O is historically constructed within a canonically ordered domain of events $(E, \prec)$, then F_O cannot be the ontological source of $\prec$.

Argument. The construction of F_O is itself an event or sequence of events within $(E, \prec)$. Therefore, the order relation $\prec$ must already obtain for the constructive process to occur at all. A structure whose construction presupposes an ordered domain of events cannot consistently be treated as the ontological generator of that order. □

4.4 Minimal Mathematical Consequence

The CTI makes it possible to state the core asymmetry of the paper in a minimal formal way:

$$(E, \prec) \not\Leftarrow F_O \qquad \text{but} \qquad F_O \Leftarrow (E, \prec, I_O, C_O).$$

That is, the canonical order of events is not derived from formalism, whereas formalism is derived from already ordered events together with observer-dependent constructive acts.

This asymmetry expresses the central thesis of the paper: formalism depends on temporal order, not temporal order on formalism.

The hidden compression of physical theory consists precisely in the suppression of the CTI. Once the CTI is omitted, formal structures appear as if they followed directly from events themselves.

Contemporary discussions of temporal ontology have explored a variety of interpretations of time, ranging from relational and process-based views to thermodynamic and perspectival approaches (Rovelli 2018).

4.5 Temporal Priority Theorem

The central asymmetry defended in this paper can be stated in theorem-like form.

Theorem 1 (Temporal Priority Theorem)**.** *Let $(E, \prec)$ be the canonically ordered domain of independent events, and let F_O be a mathematical formalism constructed by an observer or epistemic community O within that domain. Then the order relation $\prec$ is ontologically prior to F_O.*

Argument. The construction of F_O is itself a historically situated act or sequence of acts. Such acts occur only within an already existing order of events. Therefore the canonical order relation $\prec$ must obtain for the construction of F_O to be possible at all. Hence F_O depends on $(E, \prec)$, whereas $(E, \prec)$ does not depend on F_O for its occurrence. □

The theorem does not claim that formalism is dispensable. It claims only that formalism is derivative with respect to temporal ontology. A mathematical structure may represent, organize, and predict relations within the order of events, but it cannot serve as the ontological source of that order.

$$(E, \prec) \Rightarrow F_O, \qquad F_O \not\Rightarrow (E, \prec).$$

This argument does not claim that the structures described by a theory did not exist prior to its formulation. The claim is different: a formalism whose construction presupposes an ordered domain of events cannot serve as the ontological ground of that order itself.

5 The Hidden Compression of Physical Theory

The hidden compression identified in this paper can now be stated more precisely: it is the suppression of the Constructive Temporal Interval (CTI). Once the CTI is omitted from the description of theory formation, the resulting formal structures appear as though they were directly read off from events themselves, rather than historically constructed within the order of those events.

In many presentations of physical theory the transition from observed events to formal temporal structures is treated as if it were immediate. Theoretical discourse frequently proceeds as though independent events directly revealed the metric or geometric structures used to describe them.

However, this appearance of immediacy results from a conceptual compression. A sequence of epistemic operations is silently suppressed, and the resulting formal structures are then retrospectively treated as if they had been present in the world from the beginning.

If the constructive process is written explicitly, the sequence has the following structure:

1. Independent events occur in the world.
2. An observer forms the intention to describe such events.
3. Mathematical structures are introduced in order to formalize them (coordinates, metrics, symmetries, equations).
4. While this formal construction takes place, further independent events continue to occur.
5. The resulting mathematical formalism is applied to selected phenomena.
6. Structures derived within that formalism are interpreted as features of the world itself.

In compressed theoretical narratives, steps (2)–(5) are often omitted, and the process is implicitly presented as if it consisted only of a direct transition

$$1 \rightarrow 6.$$

This compression produces the impression that formal temporal structures are ontological features revealed by observation. In fact, they arise only after a constructive interval in which observers select concepts, introduce parameters, and develop mathematical frameworks.

Principle 3 (No Direct Passage from Events to Formal Ontology)**.** There is no direct ontological transition from independent events to formal temporal structures. Any such structure arises only after a sequence of epistemic and mathematical constructions performed by observers.

Recognizing this hidden interval clarifies the relation between temporal ontology and physical theory. Events occur first. Theoretical formalisms are constructed later in order to organize and model those events. When the constructive interval is suppressed, the products of formalization are easily mistaken for the ontological basis of the events themselves.

6 Why Spacetime Geometry Appears Only After Formal Construction

The previous section identified a hidden constructive interval between the occurrence of events and the formal structures used to describe them. This distinction becomes particularly important in discussions of spacetime geometry.

In many physical narratives, spacetime geometry is presented as if it were directly revealed by observation. Events are assumed to occur within a pre-existing geometric structure, and physical theory is then interpreted as discovering the properties of that structure. However, a closer inspection of the epistemic sequence shows that spacetime geometry arises only after a series of conceptual and mathematical operations.

Observed events do not arrive equipped with coordinates, intervals, or metric relations. What is first available to observers are traces of occurrence: one event happened after another, one process succeeded another, and records preserve this sequential order.

Only after observers decide to describe these relations do the following steps occur:

a. the introduction of coordinate systems;

b. the definition of temporal and spatial parameters;

c. the formulation of invariance principles;

d. the construction of metric relations;

e. the derivation of geometric structures.

Within this sequence, spacetime geometry emerges as a formal product rather than an ontological precondition of events. Minkowski spacetime, Lorentz transformations, and timelike curves appear only once the mathematical apparatus required to define them has already been introduced.

Proposition 1. *Spacetime geometry cannot be ontologically prior to the events whose order makes the construction of that geometry possible.*

The point can be illustrated historically. The mathematical structure of Minkowski spacetime was introduced in the early twentieth century as a formal reorganization of relations already observed in electrodynamics and relativity theory. These relations themselves were identified through measurements, experiments, and observational records that existed prior to the geometric formulation.

While Minkowski geometry provides a powerful and elegant representation of those relations, it is nonetheless a representation constructed after the events it organizes. The geometry therefore belongs to the level of formal description rather than to the ontological level of the events themselves.

This observation does not diminish the explanatory power of physical theory. What it shows is that the role of theory is organizational rather than generative. Mathematical structures do not produce the temporal order of events; they are constructed to model that order once it has already been observed.

7 Temporal Order and Mathematical Formalism

Mathematical formalism can organize, compress, correlate, and predict. It can assign coordinates, define invariants, formulate metrics, and generate elegant structures. None of this, however, shows that formalism is ontologically primary.

To say that temporal order is independent of mathematical formalism is not to deny the utility or power of mathematics. It is to deny a stronger claim: namely, that mathematical structure constitutes the temporal ontology of the world. Formal structures arise as representational products. They are constructed over already occurring sequences of events.

Remark 2. The issue is not whether a metric can be useful, but whether metric description can be treated as the source of temporal order itself.

The answer defended here is negative. A metric may encode a relation among events once they are identified and organized, but it cannot generate the fact that events occurred in a determinate order before the metric was introduced.

8 Illustrative Cases

Example 1 (Day and night)**.** The alternation of day and night occurs independently of astronomical theory, clock conventions, or spacetime geometry. Formal models may describe and predict this alternation, but the sequence itself is not produced by those models.

Example 2 (Tree rings)**.** Successive tree rings provide a material record of sequential growth. An observer may later interpret these rings through annual cycles, climatic factors, or biological models, but the order of the rings does not depend on those interpretations.

Example 3 (Sedimentary layers)**.** Layered deposition records a sequence of formation. Geological theory may explain that sequence in different ways, but no theory creates the order in which the layers were deposited.

9 The Principle of Temporal Independence

The previous sections distinguished three levels that are often conflated in physical discourse: the independent occurrence of events, the epistemic reconstruction of their order, and the mathematical structures constructed to represent that order. Once these levels are separated, a more general principle becomes visible.

Principle 4 (Temporal Independence)**.** The temporal order of events is independent of the mathematical formalism used to describe it. Events occur and leave traces regardless of whether coordinates, metrics, or theoretical structures are introduced to represent them.

This principle follows from a simple observation. Mathematical formalisms are historically constructed within the very sequence of events that they later attempt to represent. The introduction of coordinates, the definition of metric relations, and the derivation of formal structures all take place at specific moments in the historical order of events.

Consequently, the formalism cannot serve as the ontological source of that order. At most, it provides a structured representation of relations that have already occurred independently of its construction.

Corollary 1. *No physical theory can determine the temporal ontology of the world. Physical theories operate at the level of formal organization and modelling of events whose order is already established independently of those theories.*

The role of mathematical formalism is therefore organizational rather than ontological. It allows observers to compress, correlate, and predict patterns within the order of events, but it does not generate the existence of that order itself.

10 Causality and the Order of Events

Discussions of temporal order are frequently formulated in terms of causality. Events are often said to be ordered because one event causes another, or because causal relations determine the structure of temporal succession. However, the argument developed in this paper does not rely on any notion of causal structure.

In fact, the introduction of causality at the ontological level would conflict with the architecture established earlier. The canonical order of events defined in Section 2 requires only that events occur and that their traces establish a sequential order. No assumptions about mechanisms, laws, or causal production are required.

10.1 The Absence of a Universal Causal Structure

There is no universally accepted notion of a single "causal structure of the world". Different disciplines employ the concept of causality in different and often incompatible ways.

- In statistical science, causality appears as causal models or causal graphs.

- In philosophy of science, it is analyzed through counterfactual or interventionist accounts.
- In general relativity, causal relations are derived from the metric structure of spacetime.
- In causal set theory, causality is postulated as a discrete relation among elements.

These uses are theoretical constructions rather than a universally recognized ontological structure. Each notion of causality arises within a specific formal framework. Consequently, causality cannot serve as a primitive foundation for temporal order without introducing precisely the type of theoretical structure that the present analysis seeks to distinguish from ontology.

10.2 Canonical Order Without Causality

The canonical order of events introduced earlier is not a causal order. It is a historical order established through traces.

Examples such as tree rings, sedimentary layers, or the alternation of day and night demonstrate this point. One layer appears after another, one ring is formed after another, and one day follows another. These sequences are observable without invoking any causal explanation.

The order therefore reflects succession rather than production. It records that one event occurred later than another, not that one event generated another.

10.3 Causality as Reconstruction Within the CTI

Within the framework proposed in this paper, causal interpretation appears only during the Constructive Temporal Interval (CTI).

Observers first encounter traces of events. They then introduce concepts, models, and theoretical relations in order to explain or organize those traces. Causal relations arise within this process of reconstruction.

Consequently, causality belongs to the epistemic level of theory construction rather than to the ontological level of the events themselves.

10.4 FIFO Order of Traces

When the source of events is not directly accessible, observers do not encounter causes but traces. What can be registered with certainty is the order in which traces appear.

This order can be characterized minimally as a FIFO (first-in–first-out) sequence:

$$t_1 \prec t_2 \prec t_3 \prec \dots$$

where each t_i denotes a trace registered by an observer.

FIFO order does not assert any mechanism linking the traces. It records only the historical order in which traces appear. For this reason, FIFO order constitutes a minimal ontological structure that does not depend on causal assumptions.

Theorem 2 (Causality Reconstruction Theorem). *Let $(E, \prec)$ denote the canonical order of events and let T denote the set of traces accessible to observers. Any causal relation inferred* *between events in E arises only through reconstruction performed within the Constructive Temporal Interval. Therefore causality cannot serve as the ontological ground of the order $\prec$.*

Argument. Observers have direct access only to traces of events and to the order in which these traces appear. The interpretation of traces as effects of underlying causes requires theoretical assumptions and models introduced during the CTI. Since such reconstructions occur within the ordered domain of events, causal relations cannot precede or generate the canonical order itself. □

10.5 Consequences

The result clarifies the relation between temporal order and causal theory. Temporal order is ontologically primary, whereas causal structures are theoretical reconstructions developed within the Constructive Temporal Interval.

In this sense, causal models belong to the same level as other elements of physical formalism: they organize and interpret events but do not constitute the ontological basis of their occurrence.

11 Historical Illustration: Minkowski and the Emergence of Spacetime

The Constructive Temporal Interval (CTI) can be illustrated through a well-known episode in the history of physics: the introduction of spacetime geometry by Hermann Minkowski in 1908 [6].

Before Minkowski's work, the phenomena later described within the spacetime framework were already well established. Experimental and theoretical investigations in electrodynamics had produced a set of empirical relations summarized in the Lorentz transformations and the principle of relativity.

These relations concerned observable processes such as the propagation of electromagnetic signals and the results of measurements performed in different inertial frames. The events themselves — experiments, observations, and recorded measurements — occurred independently of any geometric interpretation.

Minkowski's contribution consisted in introducing a new mathematical framework in which these relations could be expressed in a unified geometric form. Coordinates were reorganized into a four-dimensional structure, metric relations were introduced, and invariant intervals were defined.

In terms of the CTI, the sequence can be described as follows:

1. independent physical events and experimental observations occur;
2. empirical relations between these observations are established;
3. a mathematical framework is constructed to represent these relations;
4. the resulting geometric structure is interpreted as the spacetime structure in which events occur.

From the perspective developed in this paper, Minkowski spacetime is therefore not an ontological structure revealed directly by observation, but a formal representation constructed within the historical order of events. The geometry organizes relations among events that had already been observed and analyzed before the geometric formulation was introduced.

Recognizing this sequence makes the role of the CTI explicit. The spacetime formalism appears only after a constructive interval in which observers develop the mathematical apparatus needed to represent empirical relations among events.

12 Philosophical Consequences

The argument developed in the previous sections has several philosophical consequences for the interpretation of physical theory and for the relation between mathematics and temporal ontology.

12.1 Temporal Ontology and Physical Theory

If temporal order is independent of mathematical formalism, then physical theories cannot determine the ontology of time. They may provide powerful models that organize and correlate observations, but they do not generate the existence of the order they describe.

This implies that temporal ontology cannot be derived from the mathematical structures of physical theory. Spacetime geometries, coordinate systems, and metric relations may encode patterns within the order of events, but they do not constitute that order itself.

12.2 Mathematics as Epistemic Construction

The independence of temporal order from formalism clarifies the role of mathematics in physics. Mathematical structures function as epistemic instruments. They allow observers to represent relations among events, compress empirical regularities, and construct predictive models.

However, the success of such representations does not imply that the mathematical structures themselves are ontologically fundamental. Their status is representational rather than generative.

Recent philosophical work has also emphasized that scientific structures often arise from material and empirical constraints rather than from purely formal principles (Norton 2019).

12.3 Against the Retroactive Projection of Formalism

The analysis also reveals a recurrent philosophical error: the retroactive projection of formal structures onto the world as if they had governed events prior to their formulation.

Once the constructive interval between events and formalization is recognized, this projection becomes untenable. Mathematical frameworks are historically produced within the very sequence of events they later attempt to represent. Treating them as ontological preconditions of those events reverses the actual order of construction.

12.4 Physics as Epistemic Organization

These considerations suggest a more precise characterization of the role of physical theory. Physics should be understood as a system of epistemic organization: a structured attempt to describe, correlate, and predict patterns within the order of events.

This view does not diminish the power or importance of physical theory. Rather, it clarifies its domain. Physics operates at the level of representation and modelling, whereas the temporal order of events belongs to the ontological structure of the world itself.

12.5 Summary of the Argument

The central argument of this paper can be expressed in the following compressed form.

Proposition 2 (Events Before Physics)**.** *Independent events occur and establish a canonical temporal order before any mathematical formalism is introduced to describe them. Mathematical structures used in physical theory are constructed within that order and therefore cannot serve as its ontological source.*

From this observation the following relation between events, theory, and formalism follows:

$$\text{events} \longrightarrow \text{reconstruction} \longrightarrow \text{formalism} \longrightarrow \text{physical theory.}$$

The sequence cannot be reversed without suppressing the constructive interval in which observers introduce mathematical structures. When this interval is omitted, the products of formal representation are easily mistaken for ontological features of the world.

Recognizing this order clarifies the status of physical theory. Physics does not generate temporal order. Rather, it provides mathematical structures that organize and model relations within an already existing order of events.

13 Related Positions

The argument developed in this paper intersects with several well-known positions in the philosophy of physics and the philosophy of time. However, the notion of the Constructive Temporal Interval (CTI) differs in important respects from these approaches.

13.1 Kantian Approaches

In Kantian philosophy[4], temporal order is grounded in the a priori structures of human cognition. Time is not derived from experience but is a form of intuition that makes experience possible.

The position defended in this paper differs from this view in a crucial respect. The canonical order of events is not treated as a feature of human cognition but as an ontological structure manifested in the independent occurrence of events themselves. The CTI therefore does not describe the constitution of time by the mind, but the historically situated process by which observers construct formal representations of an already existing order of events.

13.2 Logical Empiricism

Logical empiricist approaches, such as those associated with Reichenbach, emphasize the role of conventions in the construction of temporal and spatial coordinates. These views highlight the importance of measurement procedures and coordination principles in physical theory.

The present argument shares the emphasis on the constructive role of observers, but it introduces an additional distinction. The CTI identifies a temporally situated interval between independent events and the later construction of formal structures. The emphasis is not only on conventional coordination but on the historical sequence in which formalism itself is produced.

13.3 Spacetime Realism

Contemporary spacetime realism often treats the geometric structure of spacetime as an ontological feature of the world. According to such views, the geometry of spacetime provides the fundamental structure within which events occur.

The analysis developed here challenges this interpretation. Spacetime geometry appears only after a constructive sequence in which observers introduce coordinates, invariance principles, and metric relations. These structures are therefore best understood as formal representations of relations among events rather than as the ontological framework that generates those events.

13.4 Structural Realism

Structural realism proposes that the structure captured by scientific theories reflects genuine features of reality, even if the theoretical entities themselves are revised or replaced.

The CTI perspective does not deny that formal structures may capture stable relations among events. What it denies is that such structures constitute the temporal ontology of the world. Mathematical structures are constructed within the temporal order they later describe, and their ontological status must therefore be interpreted with this asymmetry in mind.

14 Conclusion

Events occur before physics. They occur before coordinates, before metrics, before formal symmetries, and before equations. Human observers subsequently construct mathematical frameworks in order to describe, correlate, and predict those events. The resulting structures may be powerful, elegant, and indispensable for science, but they do not thereby become the ontological source of temporal order.

Temporal order is independent of mathematical formalism. What is primary is not metric time, but the canonical order of events. Physical theory belongs to the domain of epistemic and mathematical construction, not to the domain of temporal ontology itself.

This argument does not deny the effectiveness or empirical success of physical theories. It clarifies their epistemic role: physical theories organize and model relations within the order of events, but they do not constitute the ontological source of that order.

The title of this paper summarizes its central claim: events occur before physics. Physical theory arises only later as a mathematical organization of an already existing temporal order.

The central philosophical error criticized in this paper is the suppression of the Constructive Temporal Interval. Once that interval is restored, the dependence of physical formalism on prior temporal order becomes clear.

A A Formal Sketch of the Constructive Temporal Interval

This appendix provides a minimal formal representation of the Constructive Temporal Interval (CTI) introduced in the main text. The purpose is not to produce a complete mathematical theory of scientific construction, but to clarify the structural relations between events, observers, and formal structures.

A.1 Ordered Domain of Events

Let E denote the set of independently occurring events. Let

$$\prec \subseteq E \times E$$

be the canonical temporal order relation on E, such that

$$e_i \prec e_j$$

means that event e_i occurs prior to event e_j.

The pair

$$(E, \prec)$$

is therefore a partially ordered structure representing the canonical order of events.

A.2 Observers and Constructive Acts

Let O denote an observer or an epistemic community.

The observer performs a sequence of constructive operations:

$$C_O : (E, \prec) \to S_O$$

where S_O is a symbolic or conceptual structure produced through acts of selection, abstraction, and representation.

Examples of such acts include:

- selecting events to be measured,
- introducing parameters,
- defining coordinates,
- constructing symbolic descriptions.

These constructive operations occur within the temporal order $(E, \prec)$. They are themselves events belonging to E.

A.3 Emergence of Formal Structures

A mathematical formalism arises when symbolic structures are further organized into a formal system.

Let

$$F_O = \Phi_O(S_O)$$

denote the formal structure constructed by observer O.

Typical examples of F_O include:

- coordinate systems,
- metric relations,
- differential equations,
- geometric structures.

Thus the full constructive sequence can be represented schematically as

$$(E, \prec) \longrightarrow C_O \longrightarrow S_O \longrightarrow F_O.$$

A.4 The CTI Constraint

The key asymmetry identified in this paper can now be expressed formally.

Theorem 3 (CTI Constraint)**.** *Let F_O be a formal structure constructed through operations performed within the ordered domain of events $(E, \prec)$. Then F_O cannot be the ontological source of the order relation $\prec$.*

Argument. The construction of F_O consists of events performed by observer O. These constructive acts occur within the canonical order $(E, \prec)$. Therefore the order relation $\prec$ must already exist for the construction of F_O to take place. A structure whose construction presupposes an ordered domain cannot consistently be treated as the generator of that order. □

A.5 Formal Asymmetry

The relation between events and formalism therefore has the following asymmetric structure:

$$(E, \prec) \rightarrow F_O$$

but not

$$F_O \rightarrow (E, \prec).$$

In other words, formal structures depend on the prior existence of ordered events, whereas the canonical order of events does not depend on the formal structures later constructed to represent it.

This asymmetry captures the central claim of the paper: temporal order precedes and constrains mathematical formalism rather than being derived from it.

References

[1] H. R. Brown, *Physical Relativity: Space-time Structure from a Dynamical Perspective.* Oxford: Oxford University Press, 2005.

[2] A. Einstein, *Relativity: The Special and the General Theory.* New York: Henry Holt and Company, 1920.

[3] M. Friedman, *Foundations of Space-Time Theories: Relativistic Physics and Philosophy of Science.* Princeton: Princeton University Press, 1983.

[4] I. Kant, *Critique of Pure Reason*, P. Guyer and A. W. Wood, Eds. Cambridge: Cambridge University Press, 1998.

[5] T. Maudlin, *Philosophy of Physics: Space and Time.* Princeton: Princeton University Press, 2012.

[6] H. Minkowski, "Space and time," in *The Principle of Relativity*, H. A. Lorentz, A. Einstein, H. Minkowski, and H. Weyl, Eds., New York: Dover, 1952, pp. 75–91.

[7] A. A. Nekludoff, "Ontology of global time: Local observers, sources and destinations," 2026. DOI: `10.5281/zenodo.18655183`

[8] A. A. Nekludoff, "Theory of global time: Canonical order, operational time, and history immutability," 2026. DOI: `10.5281/zenodo.18860226`

[9] J. D. Norton, "The material theory of induction," *Philosophy of Science*, vol. 86, no. 5, pp. 778–800, 2019. DOI: `10.1086/704977`

[10] H. Reichenbach, *The Philosophy of Space and Time.* New York: Dover, 1958.

[11] C. Rovelli, *The Order of Time.* New York: Riverhead Books, 2018.