Dual-Projection Informational Ontology: Projection Symmetry Between Physics and Mathematics

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Abstract

This paper develops a *dual–projection informational ontology* according to which what we usually call the "physical world" and the "mathematical world" are not two independent realms, but two projections of a single informational ground. Building on earlier work that models existence as a closed informational manifold and physical reality as the image of an irreversible projection [9, 10, 12], I argue that a second, structurally oriented projection yields the domain of mathematics. The physical projection generates a time–bound, entropic history by hiding information in ways that cannot be undone by any physically admissible process. The mathematical projection, by contrast, quotients out representational redundancies and isolates structural invariants without introducing an intrinsic arrow of time. Within this framework, the deep fit between physics and mathematics is no longer mysterious: both read the same informational manifold under different projection rules. I formulate a *Projection Symmetry Principle*, according to which laws of nature are structures that are invariant under both projections. I contrast this view with traditional Platonism, nominalism, structural realism, Tegmark's mathematical universe hypothesis, and Floridi's informational realism, and I address several objections. A toy example is used to illustrate the two projections in a simple setting. The aim is not to provide a complete theory, but to motivate a research program in which physical reality and mathematical structure are seen as two faces of one informational being.

1 Introduction: Two Worlds, One Origin

Our everyday and scientific discourse often seems to presuppose two quite different "worlds". On one side lies the *physical* world: extended in space and time, noisy and contingent, composed of concrete events and processes. On the other side lies the *mathematical* world: abstract, exact, and apparently timeless. We describe falling apples and orbiting planets in one language, and prime numbers and symmetries in another.

Yet, somehow, these two languages mesh. Equations written on a blackboard capture the behaviour of particles and galaxies with astonishing precision. Maxwell's equations describe electromagnetic phenomena; the Einstein field equations describe the large–scale geometry of space–time; Hilbert space formalism organises quantum mechanics. This raises two classic questions.

First, the *metaphysical* question: are there really two realms—one physical and one mathematical? If so, how are they related? If not, which is more fundamental, or what lies behind them both?

Second, the *applicability* question: why is mathematics so successful in describing the physical world? Is this success an accident, a reflection of how our minds work, or does it reveal something about the structure of reality? Wigner famously spoke of the "unreasonable effectiveness" of mathematics in the natural sciences [4]. A more systematic version of the thought that mathematics is indispensable to science is developed in the Quine–Putnam indispensability tradition, as defended for example by Colyvan [8].

In earlier work, I developed an informational ontology in which existence is represented as a closed informational manifold and reality as the result of an irreversible projection [9, 10]. Informational Projection Theory (IPT) applied this framework to physics, formulating a three–parameter informational Lagrangian and deriving the structure of gauge and gravitational couplings from informational constraints [12, 13]. A companion paper axiomatizes the underlying informational structures in a ZFC–internal way [11].

The present paper takes a further step on the *philosophical* side. I argue that we should not think of "the physical world" and "the mathematical world" as two separate realms at all. Instead, they are:

> two ways of looking at the *same* informational manifold, through two different projections.

More precisely:

- A *physical projection* produces a time–bound, entropic history in which only some informational distinctions remain visible.
- A *mathematical projection* produces a timeless landscape of structures in which only patterns and symmetries matter.

The two "worlds" are thus not ontologically independent domains, but two images of one underlying informational being. Once this is in place, the applicability of mathematics to physics becomes less mysterious: both physics and mathematics are reading the *same* informational ground, just at different levels and with different tolerances for what counts as "the same". I will call this overall view the *dual–projection informational ontology.*

In what follows I develop this idea in informal but structured terms. Section 2 introduces the notion of an informational manifold. Section 3 presents the physical and mathematical projections and illustrates them with a simple toy model. Section 4 explains why mathematics fits physics so well, including a minimal argument for dual projections and a formulation of the Projection Symmetry Principle. Section 5 discusses time, entropy, and the timelessness of mathematics. Section 6 explores philosophical consequences and situates the view among existing positions, including objections and replies. Section 7 concludes.

2 One Informational Manifold as Unified Being

The starting point is a simple ontological hypothesis:

> At the most fundamental level, what exists is informational structure.

By this I do not mean information in the everyday sense of messages, signals, or data stored on devices, but rather structured possibility: which distinctions can or cannot be drawn, which configurations are consistent, and how they can be related. I call the totality of this structure the *informational manifold* and denote it by X_I. The term "manifold" is intentionally loose; no specific mathematical model is assumed at this stage.

Three conceptual features matter for what follows.

Completeness

First, X_I is taken to be *informationally complete*: for every structure that can appear in any world—whether physical or mathematical—there is some configuration in X_I that realises it. This is a metaphysical rather than a technical claim: the manifold is not a fragment of a larger space of possibilities; it *is* the space of possibilities.

Closure

Second, X_I is *closed*: from its own standpoint, nothing is created or destroyed. All informational structure that ever can exist, exists timelessly as part of the manifold. What changes is not X_I itself, but how it is projected or revealed to embedded perspectives.

In earlier formal work, this closure was represented by an informational field I on X_I satisfying a condition analogous to $dI = 0$ and a conserved "norm" $\|I\|^2 = E_0$ [9, 10, 12]. For present purposes, it is enough to retain the idea that the total amount of informational structure is fixed and re–organised rather than created or annihilated.

Open and closed information

Third, it is useful to distinguish between what we might call “open” and “closed” information. Open information consists of aspects of the manifold that can, in principle, show up in the experience of embedded agents: information that can be accessed, manipulated, or made explicit in a projected world. Closed information, by contrast, shapes projected realities without being directly accessible from within them [10].

In previous work this was modelled by writing the informational field as a complex quantity $I = I_R + iI_I$ and imposing a constraint such as $\|I_R\|^2 + \|I_I\|^2 = E_0$ [12]. The details do not matter here. The important point is that the manifold can contain more structure than any particular projection reveals.

Dimensional remarks

In this paper I have intentionally left open the dimensionality of the informational manifold X_I. The dual–projection picture does not, as such, require X_I to have any particular number of dimensions. In my more technical work on Informational Projection Theory, however, a specific choice is made: X_I is modelled as a complex four–dimensional informational manifold, whose real projection yields a 3+1–dimensional physical space–time with one irreversible time dimension and three spatial dimensions [12, 13]. The mathematical projection, by contrast, naturally leads from the same four–dimensional informational base to infinite–dimensional spaces of structures (for example, Hilbert spaces or spaces of functions) in which mathematical theories live. The dual–projection ontology developed here is meant to be compatible with that more specific picture, while remaining neutral at the level of this philosophical exposition.

The next step is to explain how such projections work.

3 Two Ways of Looking: Physical and Mathematical Projections

The central move of this paper is to treat “worlds” as *images*. We do not have direct access to X_I in its full richness. Instead, any embedded perspective must in effect apply a map that identifies many underlying informational configurations as “the same” from that point of view.

By an *informational projection* I will mean, quite generally, any systematic way of “reading” the manifold X_I that identifies many underlying configurations as the same. Technically, one may think of this as a many–to–one map

$$\Pi : X_I \to Y$$

which induces an equivalence relation on X_I:

$$x_1 \sim_\Pi x_2 \quad \text{iff} \quad \Pi(x_1) = \Pi(x_2).$$

Different projections correspond to different criteria of sameness. In this paper I focus on two such criteria: one that produces a time–bound, entropic history (the physical projection), and one that produces a timeless space of structures (the mathematical projection).

In this section I introduce these two maps:

- a *physical projection*, which yields the physical world, and
- a *mathematical projection*, which yields the mathematical world.

Both are ways of reading the same manifold X_I. They differ in what they count as equivalent.

3.1 The physical projection: settling a history

The *physical projection* is the map that turns the informational manifold into a concrete, time–bound reality.

Intuitively, it does two things at once.

First, it tells us *which informational differences show up in reality.* Two configurations $x_1, x_2 \in X_I$ may differ in many ways, but those differences might not matter for how the world looks to an embedded observer: the same particles in the same places, the same fields with the same values, the same macroscopic events. In that case the physical projection sends them to the same physical state:

$$\Pi_{\text{phys}}(x_1) = \Pi_{\text{phys}}(x_2).$$

All finer distinctions are there in X_I, but reality does not register them.

Second, the physical projection is *irreversible* for any agent inside the world it produces. In pure set–theoretic terms, any surjection has a right inverse: one can choose a representative from each equivalence class. But this choice is a mathematical abstraction. It does not follow that there exists any *physically realisable* process that, given a physical state, reconstructs the full underlying informational configuration.

The irreversibility here is therefore *operational*: there is no way, compatible with the constraints of locality, finite resources, and the dynamics of the world, to undo the projection. Once information has been pushed "behind the horizon" of Π_{phys}, it cannot be brought back by any physically admissible sequence of operations.

This has a natural connection to entropy. If many configurations in X_I map to the same physical state $r \in R_{\text{phys}}$, we can measure how much information has been hidden by looking at the *preimage*

$$\Pi_{\text{phys}}^{-1}(r) = \{x \in X_I : \Pi_{\text{phys}}(x) = r\}.$$

The "size" of this set, in an appropriate informational measure, quantifies how many underlying possibilities are compatible with the observable state r. Taking a logarithm yields an entropy–like quantity:

$$S_{\text{phys}}(r) \propto \log\bigl(\text{measure of } \Pi_{\text{phys}}^{-1}(r)\bigr).$$

As the world evolves, more and more structure typically becomes hidden in this way. The entropy associated with accessible states tends to increase. A *physical history* is then a path $t \mapsto r(t)$ through the image of Π_{phys} along which such entropy growth is observed. The *direction* of time is the direction in which this entropy increases. This way of seeing time and entropy as internal to an irreversible projection was developed in more detail in [10, 13].

On this view, time and irreversibility are not primitive features imposed from outside. They are the internal way in which a reality generated by an irreversible projection *experiences its own information loss.*

3.2 The mathematical projection: extracting structure

The *mathematical projection* Π_{math} operates on X_I very differently. Instead of asking which configurations show up in experience, it asks which configurations share the same *structure.*

Two configurations $x_1, x_2 \in X_I$ may be quite different as concrete realisations, but still instantiate the same pattern of relations: they may be isomorphic graphs, isometric spaces, isomorphic group representations, and so on. Let us write $x_1 \sim x_2$ when x_1 and x_2 are structurally equivalent in this sense. The relation $\sim$ partitions X_I into equivalence classes. Each class $[x]$ can be thought of as a *mathematical object*: an abstract structure stripped of its particular realisation.

The mathematical projection then sends each configuration to its class:

$$\Pi_{\text{math}}(x) = [x].$$

The information that is "lost" under Π_{math} is purely *representational.* It consists of choices of labels, coordinates, encodings, or concrete realisers. When we pass from x to $[x]$, we drop these details but retain the pattern.

Crucially, mathematical structures are *re–presentable at will.* For any class $[x]$, we can typically choose a canonical representative: a simplest model, a normal form, or a particularly convenient encoding. Unlike in the physical case, nothing prevents us—in principle—from moving back and forth between an abstract structure and explicit realisations.

As a result, the mathematical projection does not generate entropy or an arrow of time. Inside the mathematical image M_{math}:

- the order in which we discover theorems does not affect their truth,
- proofs often correspond to reversible transformations of information,
- symmetries come with inverses and dualities.

Mathematics appears timeless not because it resides in a separate Platonic heaven, but because the projection that generates it *does not hide structure irreversibly.* It carves out structural invariants from X_I without creating a temporal asymmetry. In the companion paper [11], I give a first–order axiom system for informational structures that formally encodes this quotient–like behaviour of structural equivalence.

3.3 A toy example

A simple example may help fix the intuition. Consider the following toy model.

Let X_I be the set of all binary strings of length N:

$$X_I = \{0, 1\}^N.$$

We can think of each string $x = (x_1, \ldots, x_N)$ as a complete description of a highly simplified "world".

Physical projection. Define the physical projection by forgetting the last k bits:

$$\Pi_{\text{phys}}(x_1, \ldots, x_N) = (x_1, \ldots, x_{N-k}).$$

Then:

- The physical world R_{phys} is the set of binary strings of length $N - k$.
- For each physical state $r \in R_{\text{phys}}$, the preimage $\Pi^{-1}_{\text{phys}}(r)$ has size 2^k: any choice of the last k bits is compatible with the same observable state.
- If we define $S_{\text{phys}}(r) = k \log 2$, entropy counts the number of hidden bits.

In this toy picture, a history might be a sequence of length–$(N - k)$ strings in which more and more bits become effectively hidden in the last k positions, increasing entropy.

Mathematical projection. For the mathematical projection, suppose we identify strings that have the same number of 1s, regardless of order. Let $x_1 \sim x_2$ if x_1 and x_2 contain the same number of ones. Then:

- Each class $[x]$ is determined by a single number: the count of ones.

- The mathematical world M_{math} can be identified with $\{0, 1, \ldots, N\}$.
- The map $\Pi_{\text{math}}(x_1, \ldots, x_N) = \sum_{i=1}^{N} x_i$ sends each string to that count.

Here the mathematical projection ignores many details (the order and position of bits) but keeps a structural property: *how many ones are there?* The loss of information is representational, not entropic. We can always choose a canonical representative for each class, say a string with the appropriate number of leading ones followed by zeros. There is no analogue of an irreversible arrow of time.

This toy model is obviously too simple to capture real physics or mathematics. But it illustrates the intended contrast:

- the physical projection hides information in a way that can be quantified as entropy;
- the mathematical projection quotients out representational redundancy while keeping structural invariants, and it admits canonical representatives.

4 Why Mathematics Fits Physics So Well

Within the dual–projection picture, the famous puzzle about the "unreasonable effectiveness of mathematics" takes on a new form. We no longer ask how two independent realms—a physical universe here, a mathematical universe there—happen to line up. Instead, we ask how two projections of the same manifold overlap.

4.1 The basic idea

The physical projection Π_{phys} generates a concrete history: a sequence of physical states $r(t)$ that an embedded observer could experience. This history exhibits patterns: symmetries, conservation laws, regularities in how quantities change. These patterns are not coincidental. They reflect underlying constraints in X_I on how configurations can be related.

The mathematical projection Π_{math} is precisely the operation that abstracts these patterns into *structures*. It forgets how a pattern happens to be realised in a particular history and keeps only the abstract relations.

Whenever physics discovers a law or a robust regularity, we can therefore understand it as:

- a pattern in the physical history $r(t)$, and
- at the same time, an abstract structure in the mathematical world M_{math}.

4.2 A minimal argument for dual projections

The previous paragraphs sketch a picture. One might reasonably ask: why take the dual–projection step at all? The following is not a formal proof, but it shows how three plausible constraints can motivate it.

Consider the following desiderata:

(D1) **Temporal asymmetry in physics.** The physical world exhibits an arrow of time and entropy increase.

(D2) **Timelessness of mathematics.** Mathematical truths, once established, do not depend on when or where they are known; the mathematical domain appears atemporal.

(D3) **Deep fit.** There is a non–accidental, law–like fit between physics and mathematics.

Now add one more assumption:

(D4) **Unified ground.** It is preferable, other things equal, to avoid positing two entirely independent realms when a single underlying structure can explain their relation.

If we try to respect (D1)–(D4) simultaneously, we are led toward something like the dual–projection picture:

- (D1) suggests that the *physical* perspective involves an irreversible process that hides information, naturally modelled by a projection that generates entropy.
- (D2) suggests that the *mathematical* perspective should abstract away from such irreversible features and focus only on structure, naturally modelled by a quotient that discards representational details but not structural content.
- (D3) suggests that physical regularities and mathematical structures should be related systematically, not by coincidence—for example, by being two images of the same constraints.
- (D4) suggests that instead of positing two realms, we look for a single informational manifold that supports both kinds of projection.

Taken together, these desiderata strongly suggest that no *single* way of looking at X_I will do all the work. Any projection that builds in an arrow of time and entropy will, by that very fact, fail to capture the atemporal character of mathematics; any projection that keeps only structural invariants will, by construction, fail to reproduce the asymmetry of physical history. A dual–projection scheme is thus not an arbitrary duplication, but the minimal way of honouring both sides while still working with a single underlying manifold rather than two independent realms.

Under these constraints, a picture in which there is:

- one informational manifold X_I, and
- two distinguished ways of projecting it—one irreversible and entropy–generating, one structural and timeless,

is a natural candidate. It is not the only possible one, but it illustrates how the dual–projection move can be seen as a response to widely shared features of physics and mathematics, rather than as a free invention.

4.3 Projection symmetry: laws as joint fixed points

We can now formulate a central principle of the dual–projection ontology.

Projection Symmetry Principle. *Laws of nature are those structures that are invariant under both the physical and the mathematical projections.*

Concretely:

- On the physical side, a law manifests as a robust regularity across a wide range of physical states and histories: a conserved quantity, a symmetry, a dynamical rule, and so on.
- On the mathematical side, the same law appears as an abstract structure in M_{math}: a group, a differential equation, a geometric object, or a categorical pattern.

A law corresponds to a pattern in X_I that:

- is preserved when we project to R_{phys} and trace out physical histories, and
- is also captured, in abstract structural form, when we project to M_{math}.

Invariance under both projections is what I call *projection symmetry*. On this view, the deep connection between physical law and mathematical structure is not mysterious: it is built into the definition of law as a doubly invariant structure.

5 Time, Entropy, and the Absence of Time in Mathematics

The dual–projection ontology also clarifies the contrast between the temporal character of physics and the timeless character of mathematics.

From the standpoint of the manifold X_I, all consistent structure simply is. There is no global "before" or "after"; there is just the total pattern. Only when we restrict attention to the image of the physical projection and trace out a history do we get something that looks like:

- an initial state,
- a sequence of events,
- a tendency toward equilibrium.

As argued in Section 3, the increase of entropy along such a history is a measure of how much of the manifold has slipped out of reach of embedded observers. The flow of time is the way this information loss is experienced from within the projected world.

From the more technical IPT perspective mentioned in §2, one can say that the physical projection selects a $3+1$–dimensional, time–asymmetric space–time slice out of a complex four–dimensional informational manifold, whereas the mathematical projection ranges over arbitrarily high, often infinite, dimensional spaces of structures built from the same informational base. I will not rely on these dimensional details here, but they illustrate how the same underlying X_I can give rise to both a finite–dimensional, entropic world and an effectively infinite–dimensional, timeless mathematical arena.

By contrast, the mathematical projection does not select a single history, does not hide information behind horizons, and does not introduce an intrinsic notion of "earlier" and "later". Mathematical truths are invariant across physical histories. A theorem, once true of a structure, is true whenever and wherever that structure is instantiated.

Of course, human mathematicians discover theorems in time. Proofs are written, conjectures proposed, definitions revised. But this discovery process belongs to the physical projection: it is a sequence of brain states, conversations, and inscriptions in R_{phys}. The structures and truths discovered belong to the mathematical projection: they depend only on structural properties in M_{math}, not on when or by whom they are known.

We can therefore distinguish:

- *epistemic time*: the time it takes agents in the physical world to uncover mathematical structures;
- *ontic atemporality*: the fact that, once abstracted, these structures do not themselves change in time.

In short, physics is about what *happens*, given a particular way of forgetting; mathematics is about what *holds*, regardless of when or whether it happens. Both are real, but in different senses, and both draw on the same informational ground.

6 Philosophical Consequences and Related Views

If this picture is even roughly right, it reshapes several familiar debates in the philosophy of mathematics and the philosophy of science.

6.1 Beyond simple Platonism and nominalism

Traditional mathematical Platonism holds that mathematical objects inhabit an autonomous, non–spatiotemporal realm and that mathematical truths are facts about this realm. Recent realist and structuralist accounts, such as those of Shapiro and Resnik, emphasise that mathematics is about structures rather than about individual abstract objects [5, 6]. Nominalist and anti–realist positions, by contrast, deny that there are any such abstract entities, treating mathematics as a useful fiction, a language game, or a shorthand for talk about physical systems; Field's program in *Science Without Numbers* is a paradigmatic example of such nominalism [7].

The dual–projection view suggests a different option.

On the one hand, it agrees with Platonism and structuralist realism that mathematical structures have an *objective* aspect: they are not merely products of our linguistic conventions. On the other hand, it denies the need for a second, separate realm of Platonic entities. There is, on this picture, a *single* informational manifold X_I. Mathematical structures are aspects of X_I revealed by the mathematical projection, just as physical phenomena are aspects revealed by the physical projection.

Conversely, the view agrees with nominalists that what we do with mathematics is closely tied to the physical world—our practices, our theories, our explanatory goals. But it resists the reduction of mathematics to mere shorthand. The mathematical world M_{math} contains structures that may never be instantiated in any physical history, yet are still well–defined as patterns in X_I.

In this sense the dual–projection ontology is a kind of *informational structural realism*: what fundamentally exists are informational structures; physics and mathematics are two systematic ways of reading them. It can be seen as complementing structural realist approaches in the philosophy of science such as those of Ladyman and Ross [2] with a more explicit account of how mathematical and physical structures arise from a common informational source.

6.2 Necessity, contingency, and laws

The picture also clarifies the relation between necessary and contingent truths.

Statements about mathematical structures—about equivalence classes $[x]$ in M_{math}—have the flavour of *structural necessities*. If a theorem holds in a given structure, it holds whenever and wherever that structure is instantiated, regardless of what happens in any particular physical history.

Statements about physical facts—about what actually occurs along a particular history in R_{phys}—are *contingent*. There may be many possible histories compatible with the constraints of X_I; only one is actual.

Laws of nature sit at the intersection. The Projection Symmetry Principle proposes that a law corresponds to a structure that is:

- mathematically expressible as a pattern in M_{math}, and
- physically realised as a persistent regularity across a wide range of possible histories in R_{phys}.

Thus necessity and contingency are not two disjoint realms. They are two aspects of how the same informational manifold can be read: once through the lens of structure, once through the lens of a particular history.

6.3 Related views and comparisons

It is helpful to situate the dual–projection ontology among several existing approaches.

Traditional Platonism

Traditional mathematical Platonism posits two realms: a physical domain and a separate realm of mathematical entities. The dual–projection view agrees that mathematical truths are objective and timeless, but declines to multiply realms. There is one informational ground X_I; the mathematical world M_{math} is not a second universe but an image of X_I under a particular projection. This retains the realist intuition while avoiding the metaphysical burden of an entirely separate Platonic realm.

Nominalism and anti–realism

Nominalist and other anti–realist views treat mathematics as a convenient language for describing physical systems, or as a family of formal games without ontological commitment. The dual–projection picture can explain why mathematical practice is so closely tied to physics: we develop the parts of M_{math} that help us organise and predict R_{phys}. But it resists the idea that mathematics is nothing *but* such shorthand. Many structures in M_{math} may never be realised in R_{phys} yet are still genuine patterns in X_I.

Structural realism

Epistemic structural realism in the philosophy of science holds that what our best theories latch onto are not individual objects but relational structures [2]. The dual–projection ontology shares this emphasis on structure, but generalises it. Physical structures in R_{phys} and mathematical structures in M_{math} are both treated as aspects of the same informational manifold. Structural realism is thus extended from the physical to the mathematical domain, with both anchored in X_I.

Tegmark's mathematical universe hypothesis

Tegmark's mathematical universe hypothesis (MUH) suggests that the external physical world *is* a mathematical structure and that all consistent mathematical structures "exist" as parallel universes [3]. The dual–projection view is less radical and more layered. It does not identify reality with mathematics alone. Rather, it posits a single informational manifold X_I and distinguishes:

- the mathematical projection, which yields M_{math} as a space of structures; and
- the physical projection, which selects a particular entropic history within that space.

Time and entropy are not absorbed into mathematical structure wholesale; they arise from the specific way in which Π_{phys} hides information. The picture thus avoids some of the meta–level conflations that beset strong forms of MUH, while retaining the idea that mathematical structure is intimately related to physical reality.

Floridi's informational realism

Floridi's informational structural realism holds that reality is fundamentally made of informational structures, and that what exists are informational objects organised by rules and relations [1]. The present proposal shares this starting point but adds an explicit duality of projections. It distinguishes the information–to–physics map (which produces a time–bound, entropic world) from the information–to–mathematics map (which produces a timeless structural world). This allows it to address questions in the philosophy of mathematics—about the reality and timelessness of mathematical objects—within an informational realist framework.

Pancomputationalism

Various pancomputationalist views treat the universe as a computation or a network of computations. The dual–projection ontology is compatible with the idea that physical processes can be modelled as computations, but it locates computation within a broader picture. The fundamental entity is not a process but an informational manifold; projections and dynamics are defined on this manifold. Computations then become particular ways of traversing or updating informational configurations within X_I under the constraints imposed by Π_{phys}.

6.4 Objections and replies

Two natural objections help to clarify the proposal.

Objection 1: "This is just MUH in disguise."

One might object that, despite the talk of an informational manifold and projections, the view collapses into Tegmark's MUH: everything is a mathematical structure.

Reply. The dual–projection view is deliberately weaker. It does not claim that all that exists is mathematics. It claims that:

- there is an informational manifold X_I;
- mathematics is the image of X_I under a structural projection;
- physics is the image of X_I under an irreversible projection that generates time and entropy.

Mathematical language is used to describe these items, but the ontology distinguishes:

- X_I (an informational ground),
- M_{math} (a space of structures), and
- R_{phys} (a contingent history).

Time and entropy are not themselves mathematical structures inside a single object; they arise from how X_I is projected. This layered picture is closer to informational realism than to the strongest form of MUH.

Objection 2: "Why posit a manifold at all?"

Another objection is that the talk of an informational manifold is metaphysically heavy and perhaps unnecessary. Why not simply say that there are physical facts and mathematical facts, and stop there?

Reply. The answer depends on what explanatory ambitions one has. If we are content with a dual–realm picture—physics here, mathematics there—then perhaps no unifying ground is needed. The dual–projection view is motivated by the desire to:

- explain the deep fit between physics and mathematics in a unified way,
- account for both the temporal, entropic character of physics and the atemporality of mathematics,
- do so without positing two ontologically independent realms.

The informational manifold is a way of achieving this. It may be reformulable within other metaphysical frameworks, but in its present form it plays the role of a shared source: the "book" that both physics and mathematics are reading, each with their own projection rules.

7 Conclusion: Two Faces of One Being

The dual–projection informational ontology proposed here can be summarised in three claims.

First, there is a single informational manifold X_I that encodes all consistent structure. This manifold is informationally complete and closed: from its standpoint, nothing is created or destroyed.

Second, there are at least two distinguished ways of projecting this manifold:

- A *physical projection* produces a time–bound, entropic world by hiding information in ways that are irrecoverable for embedded agents. Time and entropy are internal manifestations of this irreversibility.
- A *mathematical projection* produces a timeless world of structures by quotienting out representational redundancies and isolating structural invariants, without generating an arrow of time.

Third, the physical and mathematical "worlds" are thus not ontologically independent realms, nor is one simply reducible to the other. They are *co–faces of one being*: two systematic ways in which the same informational reality can be made manifest.

From this vantage point, several puzzles look different. The effectiveness of mathematics in physics is no longer a miraculous match between two alien domains; it is a consequence of both domains tracking constraints in the same underlying manifold. Laws of nature emerge as structures that are fixed under both projections, expressed by the Projection Symmetry Principle. The contrast between temporal physics and timeless mathematics is traced back to two different ways of forgetting.

Much remains to be done. The present paper has been deliberately informal. A fuller treatment would require:

- explicit mathematical models of X_I, Π_{phys}, and Π_{math};
- a detailed analysis of how existing physical theories fit (or fail to fit) into the dual–projection scheme;
- a more systematic engagement with competing metaphysical accounts of mathematics and science.

But even in its schematic form, the dual–projection picture offers a unified way of seeing physics and mathematics as two perspectives on a single informational reality. If that way of seeing can be made precise, tested, and refined, it may help us understand not only why the world has the structures it does, but also why those structures can be written in mathematical form.

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