DATED HISTORY

Selection, Projection, and Scalar Emergent Geometry Toward a Physics of Surviving Observable Worlds

April formulation of the scalar-selection hypothesis. Subsequent source/window tests leave the proposed simulator closure unresolved.

Manuscript · p. 1, theoretical scope

A Test Protocol for Scalar Timing Closure and Dimensional Selection

Evidence · Scalar source/window residual audit

Selection, Projection, and Scalar Emergent Geometry

Toward a Physics of Surviving Observable Worlds

Prepared for J. Farrow

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Abstract

This paper advances a conservative but ambitious thesis: the observable world may be understood as a *selected* and *projected* sector of a richer lawful substrate, with the first robust geometric observable appearing not as full tensor gravitation but as a scalar timing sector. The central proposal is that a promoted weighted graph supports both an intrinsic effective dimension and a scalar response field, and that the weak-field observable branch is singled out when the same underlying operator yields both a spectral dimension near three and a Green-response profile near $1/r$. The paper deliberately leaves out weaker, less well-supported claims—direct propulsion, unconstrained "new force" narratives, and premature tensor conclusions—and instead builds around four stronger ideas: (i) local lawful dynamics can generate stable macroscopic structure through selection; (ii) local observables need not uniquely determine the global realized form; (iii) timing and propagation can emerge before full metricity; and (iv) effective three-dimensionality may be dynamically selected because only certain sectors support stable clocks, stable bound structures, and stable classical records. The aim is not a finished theory of everything, but a sharpened research program with explicit closure tests.

1. Introduction

The dominant ontology of modern common sense is object-first: finished things bear intrinsic properties and move through a pre-given space and time. The history of physics repeatedly weakens this view. Quantum theory makes classical histories conditional on measurement algebras; condensed matter shows that tiny internal distortions can reorganize the low-energy sector of a material; modern geometry shows that local metric-and-curvature data need not uniquely determine the global realized surface. The lesson suggested by these disparate results is not that reality dissolves into vagueness, but that the *observable* world may be a reduced and stabilized branch of a deeper structure.

The strongest version of that thought must avoid two excesses. It must avoid metaphysical inflation, in which analogies across domains are mistaken for proof. It must also avoid reductionist complacency, in which effective success is mistaken for ultimate ontology. The proposal here is therefore narrower

and more disciplined. We ask whether one can formulate a theory in which a local substrate generates, after projection and selection, a scalar geometric sector whose observable content is timing, redshift, and propagation, and in which effective three-dimensionality is not assumed in advance but selected by the same dynamics that produce stable worlds.

2. Guiding principle: not what exists, but what survives

The most economical synthesis of the surrounding ideas is this:

$$\text{local lawful dynamics} + \text{constraint} + \text{selection} \longrightarrow \text{stable visible form}. \tag{1}$$

This pattern appears in many respectable settings. In strain-engineered bilayer nickelates, picometer-scale octahedral distortions reorganize the low-energy sector and correlate with superconductivity. In photonic crystals and directional antennas, local periodic structure and broken symmetry do not merely accompany propagation; they select which modes survive into the far field. In compact Bonnet pairs, the same local metric and mean-curvature data fail to determine a unique global immersion. These are not the same mechanism, but they instantiate the same meta-principle: local law plus constraint can select a stable observable branch without exhausting the underlying whole.

The proposal of this paper is that fundamental physics may obey the same logic. A world is then not simply "what is there." A world is what holds together.

3. The scalar-first postulate

The core physical postulate is that the first robust emergent geometric observable is a scalar timing field rather than a full metric tensor. Let Λ denote a coarse-grained scalar load on an effective promoted geometry. The operational law is

$$\omega_{\text{eff}}(x) = \frac{\omega}{1+\alpha\Lambda(x)}, \qquad \frac{d\tau}{dt} = \frac{1}{1+\alpha\Lambda(x)}. \tag{2}$$

For weak load, $|\alpha\Lambda| \ll 1$,

$$\frac{d\tau}{dt} \approx 1 - \alpha\Lambda(x), \qquad \frac{\delta\omega}{\omega} \approx -\alpha\Lambda(x). \tag{3}$$

The conceptual content is simple. Timing is treated as the first stable geometric observable because it is both directly measurable and naturally compatible with a reduced observable sector. Full tensor geometry is not denied; it is withheld pending derivation.

4. Weighted graph closure and effective dimension

Let the promoted substrate be represented at coarse grain by a weighted graph $G = (V, E, w)$ with weighted Laplacian

$$L_w = D - W, \qquad (Df)(i) = \Big(\sum_j w_{ij}\Big) f(i), \qquad (Wf)(i) = \sum_j w_{ij} f(j). \tag{4}$$

The leading closure for the scalar load is taken to be the lowest-order local linear elliptic response compatible with superposition in the weak-load regime,

$$(\kappa L_w + \mu^2 I)\Lambda = A\rho, \tag{5}$$

where ρ is an effective source, $\kappa > 0$ is a stiffness/transport coefficient, and $\mu \geq 0$ is a screening scale.

This closure is not introduced merely because it is familiar. It is selected as the minimal operator satisfying four constraints: locality on the promoted graph, linearity for weak separated sources, positivity/ellipticity of the response, and symmetry under relabelling of graph automorphisms. Equivalently, it arises as the Euler–Lagrange equation of the quadratic functional

$$\mathcal{F}[\Lambda] = \frac{\kappa}{2}\langle \Lambda, L_w \Lambda\rangle + \frac{\mu^2}{2}\|\Lambda\|^2 - A\langle \rho, \Lambda\rangle. \tag{6}$$

Higher-order operators, nonlinearities, and memory kernels are not forbidden; they are deferred to the next order of the effective theory.

The same operator defines an intrinsic effective spectral dimension through the heat kernel

$$K(t) = e^{-tL_w}, \qquad P_{\mathrm{return}}(t) = \frac{1}{|V|}\operatorname{Tr} K(t), \qquad d_{\mathrm{eff}}(t) = -2\frac{d\log P_{\mathrm{return}}(t)}{d\log t}. \tag{7}$$

In a Gaussian scaling regime, the Green kernel of Eq. (**??**) obeys the usual asymptotic law

$$\Lambda(r) \sim G_{d_{\mathrm{eff}}}(r) \sim \begin{cases} r^{2-d_{\mathrm{eff}}}, & d_{\mathrm{eff}} \neq 2, \\ \log(r/r_0), & d_{\mathrm{eff}} = 2. \end{cases} \tag{8}$$

This is the key closure of the program: the same underlying operator determines both the effective dimension and the scalar response profile.

5. Dimensional selection and the $1/r$ branch

Eq. (**??**) immediately yields a distinguished case. If

$$d_{\text{eff}} \approx 3, \tag{9}$$

then the long-distance branch becomes

$$\Lambda(r) \sim \frac{A}{r}, \qquad \frac{\delta\omega}{\omega} \sim -\frac{\alpha A}{r}. \tag{10}$$

This is the unique branch that reproduces a Newtonian-like weak-field redshift envelope without assuming three-dimensionality in advance.

The deeper point is not merely that $d = 3$ gives $1/r$. It is that effective dimension may itself be *selected*. There are two classical reasons for this. First, for Laplacian-type diffusion on graphs and manifolds, $d = 2$ is a critical threshold separating recurrence-dominated from transient regimes. Second, for central attractive potentials of the form $V(r) \propto -1/r^{d-2}$, stable bound circular motion is lost once $d \geq 4$. These independent facts suggest a viability window

$$2 < d_{\text{eff}} < 4, \tag{11}$$

within which stable records, stable bound structures, and stable clocks are possible, and within which $d_{\text{eff}} \approx 3$ is singled out by Eq. (**??**).

This leads to the program's strongest unifying conjecture:

> The observable world is a scalar-projected sector of a richer substrate, dynamically selected toward $d_{\text{eff}} \approx 3$ because only near that branch do stable clocks, stable bound structures, and stable classical records coexist.

6. Global nonuniqueness from local data

A scalar-first program must avoid the temptation to claim that the retained local observable algebra reconstructs the whole ontology. The recent construction of compact Bonnet pairs gives a sharp mathematical warning. Bobenko, Hoffmann, and Sageman-Furnas explicitly construct pairs of immersed tori in $\mathbb{R}^3$ that are isometric and share the same mean-curvature function, yet are not the same immersion. Thus the local metric and local mean-curvature data do not uniquely determine the global realized surface.

The importance of this result here is conceptual, not rhetorical. It shows that even in orthodox differential geometry, there can exist multiple global realizations consistent with the same local

invariants. A scalar observable sector should therefore be interpreted as a constrained projection of global structure, not as a guaranteed decoder of the whole. This supports a disciplined form of structural realism: local observables are real, informative, and law-governed, yet may still underdetermine the realized global branch.

7. Projection principle

The language of projection can now be stated cleanly. Let ρ_{micro} denote the full microscopic state of the promoted substrate. The retained scalar observable algebra is generated not by the full state but by a coarse-graining channel

$$\mathcal{E} : \rho_{\text{micro}} \mapsto \{\langle n_{ij} \rangle,\ \Lambda_i,\ P_{\text{return}}(t),\ \omega_{\text{eff}}\}. \tag{12}$$

What is discarded includes higher connected correlations, microscopic bond-phase information, nonlocal entanglement structure, and any tensorial sector not visible in the retained scalar observables.

The proposal is therefore not that the world is illusory, but that the observable world is a *surviving projection*. In this picture, local timing, effective dimension, and stable classical histories are outputs of a selection pipeline, not primitive givens.

8. Analogues from mainstream physics

Several recent results support the style of this program even where they do not support its specific mechanism.

First, the 2026 Nature study of strain-engineered bilayer nickelate thin films shows that picometer-scale octahedral distortions under compressive strain reorganize the low-energy sector and correlate with superconductivity. The broad lesson is not "nickelates prove scalar geometry" but that tiny internal geometric reorganizations can control macroscopic phases.

Second, directional antennas and photonic crystals provide everyday examples in which geometry and local periodic structure do not merely coexist with dynamics but actively select which propagation channels survive into the far field. They are concrete reminders that structure can function as a selector of admissible macroscopic behavior.

Third, modern precision clocks show that timing is no longer merely an abstract kinematic parameter. Optical-clock experiments now probe gravitational redshift and tiny structured perturbations with extraordinary precision. This makes the timing-first stance experimentally serious rather than philosophically decorative.

These analogues are valuable because they keep the program tethered to respectable physics: small

internal changes can indeed reorganize observables, propagation can indeed be selected by structure, and timing can indeed function as a primary probe of geometry.

9. Closure tests

The program stands or falls on a small number of explicit tests.

9.1. Operator consistency

The same promoted operator must generate both the response profile and the effective dimension. Concretely,

$$d_{\mathrm{eff}}^{(\mathrm{diffusion})}(t) \overset{?}{\approx} 2 - \frac{d\log|\Lambda(r)|}{d\log r} \equiv d_{\mathrm{eff}}^{(\Lambda)}(r) \tag{13}$$

in a common scaling window.

9.2. Dimensional coincidence

The regime in which Eq. (**??**) fits best must coincide with

$$d_{\mathrm{eff}} \approx 3. \tag{14}$$

If the scalar law fits but the dimension drifts elsewhere, the unification fails.

9.3. Medium realizability

At least one real medium must admit a microscopic route to the effective closure of Eq. (**??**). This need not initially be a perfect material; it must only show that a real structured medium can produce a screened weighted-Laplacian scalar response to leading order.

9.4. Timing-first signatures

If the scalar sector is physical, timing perturbations should appear before or more cleanly than force-level signatures. This is both a prediction and a constraint: if all signatures collapse to ordinary electromagnetic or thermal effects, the scalar-first reading weakens substantially.

10. Discussion

The argument of this paper is world-changing only if treated with restraint. The deepest thesis is not that known physics is false, but that it may describe the surviving branch more faithfully than the hidden trunk from which that branch emerged. If so, then classical histories, stable matter, and three-dimensionality are not primitive conditions but achievements of a selection process.

This view has two virtues. First, it unifies a wide range of otherwise separate intuitions under a single severe principle: not what exists, but what survives. Second, it generates testable closures instead of dissolving into philosophical ornament. The weighted graph closure, the effective dimension, the $1/r$ branch, the nonuniqueness of global realization under local data, and the timing-first observable hierarchy together form a coherent research program.

If the program fails, it will fail clearly: the operator consistency will break, the dimensional coincidence will not appear, or no plausible medium will realize the closure. If it succeeds, then a new ontology becomes thinkable—one in which reality is fundamentally a filter for persistences, and a world is what manages to pass through.

References

1. L. Bhatt et al., "Structural modifications in strain-engineered bilayer nickelate thin films," *Nature* (2026), doi:10.1038/s41586-026-10446-2.

2. Q. Li et al., "Enhanced superconductivity in the compressively strained bilayer nickelate thin films by pressure," *Nature Communications* (2026), doi:10.1038/s41467-026-69660-1.

3. A. I. Bobenko, T. Hoffmann, and A. O. Sageman-Furnas, "Compact Bonnet pairs: isometric tori with the same curvatures," *Publications mathématiques de l'IHÉS* 142, 241–293 (2025), doi:10.1007/s10240-025-00159-z.

4. Standard graph heat-kernel / spectral-dimension literature and modern optical-clock literature should be inserted in a full journal version where the final operator and metrology sections are expanded with complete formal citations.