Force Polarity Inversion as the Mechanism of Cosmogenesis

A Unified Framework for Dark Matter, the Big Bang, and Quantum Duality

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"God does not play dice." — *A. Einstein*
He doesn't. We are just too far from the table to see where they land.
— L.F.C.M.F.

Abstract

Core Hypothesis. We propose that the Big Bang constitutes a force polarity inversion event within a pre-existing substrate—a medium we currently observe as dark matter. A discrete transformation $\mathcal{T}$ acting on the substrate's gauge structure produced the Standard Model's three forces as an inverted-polarity projection. Gravity, being a geometric property of spacetime (base manifold) rather than a gauge interaction (fiber bundle), would remain invariant under $\mathcal{T}$—making it the sole channel through which the two sectors interact.

Conjectural Consequences. The following are not established results but conjectures that require independent formalization and empirical testing: (i) dark matter invisibility from structural gauge incompatibility; (ii) wave-particle duality as competition between two gauge regimes; (iii) quantum probability as a resolution limit imposed by the derived sector's energy ceiling; (iv) the speed of light as an inherited energy ceiling (Appendix A—speculative); (v) dark energy as a mass-asymmetry effect between substrate and derived sector; (vi) an observable multiverse from multiple inversion events sharing the same gravitational manifold.

Scope. This is a conceptual companion to a formal paper [18] that proves gauge incompatibility and gravitational invariance kinematically. The present document develops the full architecture and identifies formalization targets.

Contents

1. Motivation and Core Intuition

Several persistent features of modern physics motivate this framework:

- **The composition puzzle:** Baryonic matter constitutes ∼5% of the universe's energy budget, dark matter ∼27%, dark energy ∼68%. Existing models accommodate this ratio as a parameterized input rather than deriving it from a generative mechanism.

- **The detection paradox:** Despite decades of direct detection experiments (XENON, LUX, PandaX, LZ [16]), no dark matter particle has been observed via non-gravitational channels. Successive generations have progressively constrained WIMP cross-sections. The null results may reflect a structural impossibility rather than insufficient sensitivity.

- **The gravity exception:** All evidence for dark matter comes exclusively through gravitational effects. Standard models account for this by assigning small non-gravitational couplings. This framework explores a more restrictive possibility: gravity is the *only* channel, because it operates at a geometric level structurally independent of the gauge interactions that the inversion separates.

- **The measurement problem:** Existing interpretations of quantum mechanics handle wave-particle duality through different strategies—Copenhagen treats collapse as axiomatic, de Broglie–Bohm postulates a guiding wave, many-worlds eliminates collapse by branching. None identifies a physical mechanism connecting quantum behavior to known cosmological structure.

The core intuition: the Big Bang did not create something from nothing. It created the *distinction* between something and nothing by inverting the polarity of force interactions within a pre-existing dark-matter substrate. What we call "real" is a projected inversion of what we call "nothing." Each is the shadow of the other, and gravity is the memory that they were once unified.

2. The Hypothesis

2.1 The Pre-Existing Substrate

We postulate that prior to the Big Bang, there existed a substrate governed by a complete set of fundamental interactions. This substrate is what we now observe as dark matter. It is not a residual byproduct of the Big Bang; rather, the Big Bang is a local event within it.

Formally, we treat the substrate as a gauge sector: quantum fields carrying charges under $G_0 = SU(3)' \times SU(2)' \times U(1)'$, propagating on a shared spacetime manifold M with metric $g_{\mu\nu}$. Its degrees of freedom are gauge fields (connections on a principal bundle with structure group G_0) and matter fields (sections of associated vector bundles in representations of G_0). It is not a background spacetime state nor a modification of gravity—it is a complete particle-physics sector. This definition is provisional and may be refined during formalization.

The relationship is analogous to a phase transition: ice crystals forming within liquid water. The water (substrate) is the medium; the ice (visible matter) is the localized excitation. The Big Bang is the nucleation event, not the origin of the medium.

2.2 The Inversion Event

The Big Bang constitutes a force polarity inversion: a transformation $\mathcal{T}$ acting on the substrate's gauge group. $\mathcal{T}$ acts on three classes of objects:

Gauge group: $$\mathcal{T} : G_0 \to G_1 = SU(3) \times SU(2) \times U(1) \tag{1}$$

Couplings: $$\mathcal{T} : \{g'_3, g'_2, g'_1\} \to \{g_3, g_2, g_1\} \tag{2}$$

Representations: $$\mathcal{T} : R_0 \to R_1 \text{ such that } R_0 \perp R_1 \text{ in } \mathcal{G} \tag{3}$$

Matter fields: $$\mathcal{T} : \psi_0 \text{ (charged under } G_0) \to \psi_1 \text{ (charged under } G_1\text{, singlet under } G_0) \tag{4}$$

Metric: $$\mathcal{T} : g_{\mu\nu} \to g_{\mu\nu} \text{ (invariant)} \tag{5}$$

Matter fields in the derived sector are singlets under the substrate's gauge group. A singlet cannot exchange gauge bosons with a group under which it carries no charge. Cross-sector interaction is algebraically zero. The metric is invariant: both sectors curve the same spacetime.

2.2.1 Nature of the Transformation

Five candidates, ordered from least to most radical: (a) chirality inversion ($\psi_L \leftrightarrow \psi'_R$), closest to mirror matter [3]; (b) generalized charge conjugation of all gauge quantum numbers, with anomaly cancellation issues; (c) coupling sign inversion ($g \to -g$), not a symmetry in non-Abelian theories; (d) outer automorphism of the gauge group, mapping representations to inequivalent ones; (e) orthogonal embedding in $\mathcal{G} \supset G_0, G_1$ with $\mathrm{Tr}[T_a^{(0)} T_b^{(1)}] = 0$, the strongest version. The companion formal paper [18] develops options (a), (b), and (e) in full mathematical detail, proving the Gauge Incompatibility Theorem (Theorem 2.3: zero interaction vertex) for option (e).

2.3 The Gravitational Exception

We postulate the Geometric Invariance Principle: $\mathcal{T}$ *acts exclusively on internal gauge symmetries and leaves spacetime geometry invariant.*

This follows naturally: the Einstein–Hilbert action $S_{\mathrm{EH}} = \frac{1}{16\pi G_N} \int d^4x \sqrt{-g}\, R$ depends on no charge, no color, no chirality—only on the metric. Any entity that exists, regardless of gauge sector, curves spacetime. The companion paper [18] proves this as Theorem 3.1.

If this principle holds, dark matter would not be "weakly interacting"—gravity would be the only interaction defined at the level of the manifold itself, prior to and independent of the gauge structure that $\mathcal{T}$ inverts.

2.4 The Ontological Implication

The categories of "real" and "nothing" are artifacts of the observer's position relative to the inversion boundary. An observer in the substrate sector would perceive its own matter as real and our baryonic matter as dark. Gravity is the scar of the original unity.

2.5 Dark Energy as Mass-Asymmetry Effect

The $\sim$68% of the energy budget attributed to dark energy may not require an independent substance. If the substrate constitutes the overwhelming majority of the universe's mass-energy, the gravitational-thermodynamic pressure it exerts on the derived sector would manifest, from within our sector, as a dominant expansive force.

The three components (5%, 27%, 68%) would derive from a single quantity: the thermodynamic asymmetry of the inversion. As the universe expands, baryonic matter dilutes but the substrate (the medium, not the content) does not dilute in the same way. The expansion accelerates because the derived sector becomes progressively less able to resist the substrate's pressure.

Formal derivation requires showing that the resulting effective equation of state reproduces $w \approx -1$.

2.6 Multiple Derived Sectors

If the Big Bang is a local inversion within the substrate, there is no reason it was unique. Multiple inversions at different energy thresholds would produce distinct derived sectors, coexisting within the same substrate, gravitationally connected but gauge-invisible to each other.

This differs from the standard multiverse (Linde, Susskind): those universes are causally disconnected. Here, other sectors share the same gravitational manifold and are observationally accessible.

Possible signatures: the CMB Cold Spot (integrated Sachs-Wolfe imprint of another sector's mass), spectral structure in the NANOGrav [15] gravitational wave background (superposition from multiple inversions), anomalous cosmic voids, and disputed bulk flows.

Falsifiability: all effects must be purely gravitational. Any non-gravitational anomaly would falsify, not support. The gravitational wave spectrum offers a binary test: spectral structure (peaks) vs. smooth power law.

3. Quantum Mechanical Implications

3.1 The Dual-Regime Hypothesis

If both sectors coexist spatially, every particle in our sector exists within the substrate's field influence. We propose: wave-particle duality arises from competition between two gauge regimes. Without G_1 interaction, the substrate's forces impose delocalized, wave-like behavior. Upon measurement (G_1 gauge interaction), our sector's forces dominate and the particle localizes.

Central tension: the core hypothesis establishes zero gauge coupling between sectors (Theorem 2.3 of [18]), yet here we propose dynamical influence of the substrate on visible-sector particles. Possible resolutions include: influence via shared spacetime geometry (the substrate's energy density shapes the metric, constraining particle propagation), or vacuum-level effects on propagators not captured by tree-level vertex analysis. This remains the central open problem of the quantum extension and must be resolved in formalization.

3.2 The Measurement Problem: A Possible Physical Interpretation

Measurement would be a physical intervention in which G_1 forces are applied to a system previously governed by G_0 forces. Collapse would correspond to the transition of gauge-regime dominance. Under this interpretation, collapse would not require consciousness—only physical coupling to our sector's gauge fields.

3.3 Decoherence Given Physical Substance

Macroscopic objects are in constant interaction with G_1 matter; the substrate cannot compete. They are permanently "collapsed." A single particle in vacuum, shielded from G_1 interactions, would be dominated by the substrate and behave as a wave. Testable: the quantum-to-classical transition curve may differ from standard einselection predictions. Arndt's group (Vienna) could in principle probe this.

3.4 Entanglement as Single-Entity Projection

If the substrate contains the same fundamental degrees of freedom, two entangled particles with opposite quantum numbers may not be two entities—they may be a single substrate entity projected as two complementary manifestations by the inversion. Measuring one fixes the other because the source is one. No transmission of information; no action at a distance.

This suggests a geometric reinterpretation: what appears as two correlated particles at a distance may correspond, in the substrate, to a single entity whose internal structure projects as complementary quantum numbers on this side.

3.5 Quantum Probability as Resolution Limitation

Quantum probability may not be ontological but epistemic—a structural limitation in our capacity to resolve the substrate's dynamics, which operate above our inherited energy ceiling. What we call "quantum randomness" may be deterministic dynamics sampled at insufficient resolution.

This raises the possibility that the Born rule ($|\Psi|^2$) could in principle be derived rather than postulated—as the necessary statistical distribution of deterministic substrate dynamics observed through the energy filter of the inversion. We do not attempt this derivation here. Its success or failure would be a significant test of the quantum extension.

3.6 Compatibility with Bell's Theorem

Bell's theorem excludes *local* hidden variables. The substrate's variables are explicitly non-local from our sector's perspective—they exist in a regime not bounded by our c. The framework passes through Bell's filter because the energy ceiling that defines locality in our sector is a derived property, not a fundamental one. This is a structural feature, not a loophole.

3.7 The Wave Function as Substrate Dynamics

Ψ would be a coarse-grained description of how the substrate's forces distribute a particle in the absence of G_1 interactions. The Schrödinger equation would be a dynamical equation for the substrate's influence written in the only language available within the derived sector's energy budget.

This reinterpretation would not alter any prediction of standard quantum mechanics. It proposes an ontology beneath the formalism—it does not modify the formalism.

4. Relationship to Existing Theoretical Work

CPT-Symmetric Cosmology (Turok, Boyle [1]): shares the symmetry-boundary view of the Big Bang but proposes temporal mirror, not gauge inversion. Their dark matter (sterile neutrinos) has residual coupling; ours has zero.

Mirror Matter (Foot, Volkas [3]; Mohapatra [2]): structurally similar but treats sectors as co-existing from the start. We treat one as derived from the other through a specific generative event.

Dark Sector Physics (Arkani-Hamed [4]; Profumo [5]): postulates a hidden sector but does not explain *why* it is separate. We propose the mechanism.

Emergent Gravity (Verlinde [6]; Jacobson [7]): supports the claim that gravity operates at a level prior to gauge interactions.

Stochastic Quantum Mechanics (Nelson, 1966 [8]; Bohm [9]): Nelson proved a background medium can generate the Schrödinger equation. Bohm postulated a guiding wave without identifying its origin. Our framework proposes a specific identity for the medium (the substrate's gauge fields), suggests a collapse mechanism (regime transition), and, if formalized, could unify quantum foundations with cosmology.

Supersolid Dark Matter (Guo, 2024): proposes dark matter as a passive medium that "waves" in wave-particle duality. We propose an active sector with its own gauge physics, generating different decoherence predictions.

5. Formalization Roadmap

Steps 1–2 (completed in [18]): formal definition of $\mathcal{T}$ with three realizations and proofs of gauge incompatibility (Theorem 2.3) and gravitational invariance (Theorem 3.1).

Includes a toy model ($SU(5)_L \times SU(5)_R \times \mathbb{Z}_2$) with anomaly cancellation, BBN compatibility, and order-of-magnitude predictions for self-interaction cross-sections and gravitational wave spectra.

Step 3: Derive the dark-to-baryonic mass ratio from the thermodynamics of the inversion (Sakharov-like conditions).

Step 4: Derive the post-inversion particle spectrum. Does $\mathcal{T}$ produce exact $SU(3) \times SU(2) \times U(1)$?

Step 5: Derive Schrödinger equation from substrate-particle interaction dynamics, extending Nelson's result with the identified physical medium.

Step 6: Derive the dark energy equation of state from mass asymmetry (show $w \approx -1$).

Step 7: Testable predictions—null direct detection (kinematic); self-interaction σ/m (requires G_0); GW spectrum (requires $V(\Phi)$); decoherence anomalies; dark energy dynamics correlating w with dark matter distribution.

6. Philosophical Note

Augustine of Hippo (*Confessions*, Book XI) argued that time was created with the universe. Our framework extends this: not only time, but the distinction between "something" and "nothing" was created by the inversion. Prior to $\mathcal{T}$, the substrate simply *was*.

Hegel's dialectic posited that Being and Nothing are identical in abstraction and that their unity is Becoming. The inversion can be read as a formal instantiation: the substrate (Being) generates visible matter (its negation) through a transformative event (Becoming), sustained by gravity (the residual unity).

The wave function is not an abstraction—it would be the physical imprint of the substrate on visible matter. We see the shadow; the substrate sees the substance.

The three numbers (5%, 27%, 68%) may not be independent facts but three projections of a single event.

7. Collaboration Sought

This document represents a conceptual framework developed from first principles by an independent researcher. What is needed to advance it: a co-author with expertise in quantum field theory, discrete symmetries, fiber bundle geometry, and early-universe cosmology; mathematical formalization of the regime-competition dynamics; derivation of the Born rule from substrate dynamics; and connection to existing experimental programs (LISA, KATRIN, Arndt interferometry group, Bullet Cluster observations).

This is a genuine intellectual partnership proposal, not ghostwriting. The goal is a co-authored preprint on arXiv (hep-th or gr-qc) followed by submission to Physical Review D or JCAP.

A. Speculative Extension: The Speed of Light as Inherited Energy Ceiling

This appendix is speculative and is not required by the core framework. It is separated because it engages with the deep structure of special relativity.

If our universe is a derived excitation within a substrate, it may inherit a fundamental energetic constraint: c would be the maximum propagation rate permitted by the derived sector's energy budget—a property of the sector, not of light itself.

If this held: $E = mc^2$ would acquire a new reading (mass as substrate energy frozen below the inversion threshold); the substrate would not be bound by c (providing a physical basis for quantum non-locality); and quantum probability could reflect insufficient resolution of dynamics occurring above our energy ceiling.

This requires: (a) showing c can emerge as a derived quantity without contradicting Lorentz invariance; (b) a mechanism for the substrate's propagation regime to differ from ours; (c) connection to the specific value of c. Until a formal demonstration is provided, this remains a direction for exploration, not a result.

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