The Static Substrate: Replacing Metric Curvature and Cosmic Expansion with an Informational Ontology under Tension

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Abstract

Modern astrophysics is characterized by an escalating series of foundational crises, including the Hubble tension, the dark matter anomaly, and the mathematical infinities of black hole singularities. These issues stem from a reliance on general relativity's geometric framework, which presumes a dynamic, expanding spacetime metric and an invariant speed of light c. This paper introduces an alternative ontology wherein the universe is completely static. Reality is partitioned into a fundamental, non-local informational domain *E* comprised of Planck-scale mats under tension, and an emergent, local domain *S*. By treating gravity not as spacetime curvature, but as a localized deficit in global substrate tension, we demonstrate that the local velocity of light is a dynamic variable c_x. This single primitive — information mats under tension—simultaneously resolves gravitational time dilation, removes the need for dark matter and dark energy, eliminates black hole singularities, and reinterprets the Big Bang as a global thermodynamic phase transition.

Keywords

Static Cosmology; Informational Substrate; Variable Speed of Light (VSL); Emergent Spacetime; Tension-Based Gravity; Photon Energy Dissipation; Nonlocal Domain (E Domain); Gravitational Time Dilation (Non-Metric); Dark Matter Alternatives; Non-Singular Black Holes.

Preface

My earlier work defined a dual-domain model [1, 2, 3, 4], consisting of an *S* domain and an *E* domain. We identify *S* matter to follow Einstein relativity. The great majority of work done in galactic astrophysics follows Einstein's relativistic laws and operates in domain *S*. The other kind of galactic matter we identify as entanglement matter *E*, which doesn't obey the rules of relativity.

My later work built on the dual-domain model and proposed that the universe is composed of a nonlocal network of Planck-scale elements under tension. I first treated such elements ("mats") as mechanical objects [5]. Subsequently I cast them in a more modern framework as discrete

informational units in the *E* domain [6]. My latest work considered a Photon-Tension-Time model that resolves contemporary astrophysical issues without invoking unobserved dark sectors [7].

1. Introduction: The Crisis Matrix of Standard Cosmology

The standard ΛCDM model of cosmology requires increasingly complex, unobservable entities to reconcile its mathematical framework with astronomical observations. The presumed expansion of space necessitates "Dark Energy" to counteract gravitational collapse, while galactic rotation curves require "Dark Matter" to patch the failures of Newtonian gravity at galactic boundaries. Furthermore, General Relativity inevitably breaks down at high mass densities, producing unphysical singularities.

We propose that these crises are artifacts of a flawed fundamental premise: that space itself possesses a flexible, expanding geometric metric. By shifting the foundational primitive from geometric curvature to informational tension, we present a self-regulating, static cosmology that resolves these crises without ad-hoc additions.

2. Foundational Postulates of the Substrate Ontology

The architecture of the universe is governed by three primary postulates:

1. **Dual-Domain Partitioning:** The universe consists of a fundamental non-local domain *E* and an emergent local domain *S*. Domain *E* possesses no fields, velocity, or metrics; it is a pure, interconnected network of Planck-scale information mats.
2. **Tension as the Sole Primitive:** Domain *E* is defined by a global baseline tension τ_0. What standard physics defines as gravity and dark energy are merely local and global expressions of this intrinsic informational tension.
3. **The Static Constraint:** The emergent domain *S* is structurally static and flat. Space does not stretch, compress, or bend.

3. The Dynamic Speed of Light and Gravitational Mechanics

When a localized packet of energy (such as a photon) propagates through a region of high informational density (matter) in domain *S*, it continuously interacts with the underlying substrate. To maintain cosmic energy invariance without localized thermal heating, the substrate responds by adjusting the local velocity of light c_x relative to the localized tension τ_x:

$$c_x \propto \sqrt{\tau_x}$$

This variable speed of light approach is conceptually related to other frameworks [8].

3.1 Mechanistic Time Dilation

Because space is static, physical distances between subatomic configurations remain constant. However, because all fundamental forces and atomic interactions are mediated by information transfer at velocity c_x , a localized reduction in the speed of light directly slows down the operational frequency of all matter. A light-clock or atomic vibration in a low-tension region takes longer to complete a cycle. This naturally produces the exact observational effects of gravitational time dilation without requiring a curved spacetime metric.

3.2 The Pseudo-Hubble Redshift & the Light Paradox

As a photon travels across immense distances through the static domain *S*, it undergoes continuous, non-destructive informational dissipation into the substrate mats. The photon steadily loses energy to the background web. Because c_x drops in response to this energy loss to maintain balance, the photon's frequency plummets, causing it to arrive at our observations heavily redshifted. Astronomers misinterpret this distance-dependent informational drag as an expansion velocity, creating the illusion of the Hubble constant. Because space is static, the Hubble tension is entirely neutralized.

Furthermore, this continuous energy sinking resolves Olbers' Paradox. Light traveling from the deepest trenches of infinity sheds its energy back into the substrate until its frequency approaches zero, preserving the darkness of the night sky without requiring an expanding metric.

4. Boundary Conditions: Galactic Edges and Event Horizons

4.1 The Elimination of Dark Matter

A galaxy acts as a massive centralized sink that depletes the baseline tension of the surrounding substrate. At the outer boundaries of a galaxy, the transition from this heavily depleted low-tension zone back to the maximum baseline tension τ_0 of empty deep space is non-linear. The high global tension of deep space exerts a uniform, sustained inward pressure against the entire outer boundary of the galaxy. This constant pressure gradient keeps outer stars bound at flat, high velocities, removing the requirement for an unobservable halo of dark matter [9].

4.2 Non-Singular Black Holes as Informational Frozen Zones

When matter reaches a critical density threshold, the local substrate tension is completely depleted ($\tau_x \to 0$). At this boundary, the local velocity of light drops to absolute zero ($c_x = 0$).

Because information transfer is completely halted, the operational time interval for any physical process approaches infinity. Matter cannot physically move past this horizon to collapse further. The system stabilizes as a frozen boundary layer of high-density information, entirely bypassing the mathematical infinities of general relativistic singularities and preserving quantum information intact on the horizon.

5. The Cosmic Origin: A Thermodynamic Phase Transition

The "Big Bang" was not an explosive expansion of space and matter out of a singularity. Instead, it represents a global, simultaneous phase change of the universe. See related interpretations of gravity as thermodynamics [10].

Prior to this transition, reality existed entirely as the hyper-tensioned, uniform informational sea of domain *E*. At a critical threshold, this substrate underwent a spontaneous crystallization, precipitating out the local domain *S*. Localized defects and structural wrinkles formed during this sudden crystallization manifested as matter, forces, and fields.

6. The True Nature of the CMB

The Cosmic Microwave Background (CMB) is the latent heat of crystallization released uniformly across the entire information web during this phase change. Because domain *E* is entirely non-local, every point was interconnected prior to the transition. This explains the perfect homogeneity of the CMB spectrum without requiring an ad-hoc cosmic inflation mechanism, while large-scale CMB anomalies ("The Axis of Evil") represent the structural lattice seams left behind by the crystallization process.

7. Non-Local Integral and Quantum Entanglement

By partitioning reality into an emergent space *S* and a core substrate *E*, quantum entanglement ceases to be a spatial paradox. Because domain *E* is entirely metricless, there is no physical distance or separation between the information mats at the fundamental layer. Two entangled particles may be separated by billions of light-years within the emergent coordinates of domain *S*, but they remain rooted to the exact same non-local point in domain *E*. Information does not travel across space to link them; they are dual localized expressions of a singular, undivided non-local structure. See related holographic information principles [11].

8. Proposed Predictive Tests and Falsifiability

To distinguish this static substrate ontology from the standard geometric paradigms of General Relativity and ΛCDM, we propose three distinct astronomical and experimental tests:

1. **Dispersion of High-Energy Photons over Distances:** Because cosmological redshift is driven by photons continuously shedding energy to the information mats of domain *E*, the local value of c_x drops dynamically for that photon packet. Therefore, higher-energy photons will experience a compounding deceleration compared to lower-energy photons from the same cosmic source. Precise timing observations of distant Gamma-Ray Bursts (GRBs) should reveal a measurable, distance-dependent time lag where high-energy gamma rays arrive strictly after low-energy optical photons.
2. **Frequency-Dependent Gravitational Lensing:** Lensing is caused by a photon traversing a localized tension deficit gradient τ_x surrounding a mass. Because the reduction of c_x is directly proportional to the energy exchanged between the photon and the substrate, photons of different initial energies will experience slightly different effective indices of refraction. High-resolution imaging of strong gravitational lensing systems should reveal a subtle, non-geometric "chromatic aberration" effect, where X-ray or UV images of a lensed background galaxy are bent at slightly different angles than the infrared or radio images.
3. **Direct Measurement of Localized *C* Variations:** This model predicts that gravitational time dilation is a mechanical consequence of a physical drop in the local velocity of light c_x due to a tension deficit. Utilizing a highly sensitive, long-baseline laboratory apparatus — such as an ultra-precise Michelson-Morley variant stabilized by optical lattice atomic clocks stationed at varying altitudes within Earth's gravitational tension well — should reveal a direct, isotropic variation in the fundamental velocity of light that scales perfectly with the local gravitational potential.

9. Conclusion

By replacing the dynamic metric of General Relativity with a static universe governed by a tensioned informational substrate, the core contradictions of modern cosmology disappear. Redshift, time dilation, galactic rotation curves, black holes, quantum non-locality, and the CMB are all unified under a single primitive framework. This ontology replaces complex mathematical patches with an elegant, self-regulating mechanism of cosmic energy invariance.

Appendices A-E provide further mathematical details.

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References

1. J. Shaffer, “Entanglement Driven Forces and Galactic Structure Stability,” *Physics Essays,* Volume 38 (2025).
2. J. Shaffer, “Entangled Duality,” ai.viXra.org:2601.0019 (2026).
3. J. Shaffer, “Entanglement Generated Forces and the Emergence of Spacetime,” ai.viXra.org:2602.0129 (2026).
4. J. Shaffer, “Gravity from Galactic Tension: Local Mechanics and Nonlocal Effects,” ai.viXra.org:2603.0100 (2026).
5. J. Shaffer, “The Tensional Structure Principle: A Structural Framework for Gravity, Spacetime, and Cosmology,” *Physics Essays,* Volume 39 (2026).
6. J. Shaffer, “A Dual-Domain Holographic Framework for Emergent Spacetime, Gravity, and Dark Energy,” ai.viXra.org:2607.0048 (2026).
7. J. Shaffer, “Photon-Tension-Time Theory (PTT): A Non-Metric Unification of Gravitational Mechanics, Photon Propagation, and Cosmic Stasis,” ai.viXra.org:2609.0006 (2026).
8. J. Magueijo and J. Moffat, Variable Speed of Light (VSL) papers (1993-2003).
9. E. Verlinde, “Emergent Gravity and the Dark Universe,” *SciPost Physics* (2017).
10. T. Padmanabhan, “Thermodynamical Aspects of Gravity,” *Reports on Progress in Physics* (2010).
11. J. Bekenstein, “Information in the Holographic Universe,” *Scientific American* (2003).
12. S. Hossenfelder, “Minimal Length Scale Scenarios for Quantum Gravity,” *Living Reviews in Relativity* (2012).

Appendix A: Fundamental Domain Ontology

Let the total universe be partitionable into two distinct mathematical sets: a fundamental, non-local domain *E* and an emergent local domain *S*.

- DOMAIN *E* (Information Substrate). Characterized as a pure informational network without a metric tensor, zero field configurations, and zero classical velocity operators. It possesses a global background tension τ_0. See related quantum gravity frameworks [12].
- DOMAIN *S* (Emergent Spacetime). Characterized by a static, flat Minkowski metric parameterized by local physical coordinates.

The emergence mapping represents the phase change crystallization:

$$M\colon E(\tau_0) \longrightarrow S(g_{\mu\nu}, I_\mu)$$

where I_μ represents localized defects or "knots" in the information mats, traditionally interpreted as matter-energy density distributions, $\rho(x)$.

Appendix B: Local Tension and the Variable *C* Field

In the emergent domain *S*, the localized tension τ_x of the substrate drops below the cosmic baseline, τ_0, proportional to the proximity of informational density, $\rho(x)$.

The spatial distribution of local tension satisfies a Poisson-like substrate equation:

$$\nabla^2\tau(x) = \alpha\,\rho(x)$$

where α is the informational coupling constant of the mats.

The local speed of light $c(x)$ is a dynamic variable governed purely by the available tension field, ensuring substrate energy invariance:

$$c(x) = c_0\sqrt{\frac{\tau(x)}{\tau_0}}$$

where c_0 is the maximum baseline velocity of information transfer in an undisturbed, pure high-tension vacuum where $\tau_x = \tau_0$.

Appendix C: Photonic Energy Loss and Redshift

As a photon travels across a distance, r, through the static domain *S*, it undergoes continuous informational dissipation into the substrate mats. The energy loss per unit distance is proportional to the photon's localized energy, E, and the substrate cross-section, σ_τ:

$$\frac{dE}{dr} = -\sigma_\tau E$$

Integrating this over a static Euclidean distance, D, yields the observed energy upon arrival:

$$E_{\text{obs}} = E_{\text{emit}}\, e^{-\sigma_\tau D}$$

Because frequency scales with energy, the observed frequency matches this decay:

$$f_{\text{obs}} = f_{\text{emit}}\, e^{-\sigma_\tau D}$$

The resulting redshift parameter, z, is given by:

$$z = e^{\sigma_\tau D} - 1$$

For local distances, the Taylor expansion yields:

$$z \approx \sigma_\tau D$$

Astronomers misinterpret this distance-dependent informational drag coefficient σ_τ as the Hubble constant.

Appendix D: Mechanistic Time Dilation

Consider a localized physical apparatus (a light clock) operating along a static, spatial path of length *d*. The operational time interval, *dt*, required for an electromagnetic cycle to complete is explicitly bounded by the local variable speed limit, $c(x)$:

$$dt(x) = \frac{2d}{c(x)}$$

Substituting the variable speed limit equation yields:

$$dt(x) = \frac{2d}{c_0\sqrt{\tau(x)/\tau_0}}$$

Let

$$dt_0 = \frac{2d}{c_0}$$

be the clock's interval in deep space. The localized time dilation factor is defined entirely by the local tension deficit:

$$dt(x) = \frac{dt_0}{\sqrt{1 - \frac{\Delta\tau(x)}{\tau_0}}}$$

where

$$\Delta\tau(x) = \tau_0 - \tau(x)$$

This reproduces gravitational time dilation observations without metric curvature.

Appendix E: Frozen Boundary Condition

When the informational density, $\rho(x)$, reaches a critical threshold such that the local tension is entirely depleted, the local velocity of light collapses to zero:

$$c(x) = 0 \text{ when } \tau(x) = 0$$

Applying this boundary condition to the operational time interval:

$$\lim_{c(x)\to 0} \frac{2d}{c(x)} = \infty$$

Because the time required for any fundamental electromagnetic information exchange approaches infinity, physical motion and further gravitational collapse freeze completely at this boundary layer. The system eliminates singularities by transitioning into a stable informational shell.