

DOCUMENT 2: THEORETICAL PHYSICS AND MATHEMATICS

The Informational-Physical Foundations of Emergent Spacetime

Version 5.0: Axiomatic Synchronization

Tobias Nilsson

Founder and Chief Architect

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Abstract

Executive Summary. This document constitutes the formal physical and mathematical derivation of Locational Variable Theory (LVT). By starting from Axiom 1 — that space is not a background but an emergent projection of informational differences in a network ($S = k \cdot d_{\min}(LV_A, LV_B)$) — we present a unified solution to modern physics' greatest anomalies. We rigorously define the theory's fundamental variables ($LV, C, O, T_{\text{local}}$) to explain the mechanism of wave function collapse. Furthermore, we derive gravity as an entropic informational gradient, creating a robust and testable bridge between the quantum mechanical measurement problem and the macroscopic geometry of General Relativity, without the need for hidden dimensions.

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1 Formal Definitions and Mathematical Framework

For LVT to be quantitatively testable and fulfill the correspondence principle towards classical mechanics, the fundamental variables of the theory are defined according to the following principles:

1.1 1. *LV* (Locational Variable)

LV is not a continuous spatial coordinate (x, y, z) , but a logical **pointer** to a relational node in the universe's network graph.

- **Unit:** Unitless discrete integer (\mathbb{Z}), representing logical nodes.
- **Mechanics:** Physical distance S only arises when two objects point to different nodes. The spatial formula is $S = \ell_P \cdot d_{min}(LV_A, LV_B)$, where d_{min} is the Shortest Path of logical hops between the objects in the graph, and ℓ_P (the Planck length, $\approx 1.6 \times 10^{-35}$ meters) constitutes the rendering constant k . A logical hop of $d_{min} = 1$ thus corresponds to one Planck distance.

1.2 2. *C* (Informational Complexity)

The amount of logically independent information (states) a system contains.

- **Unit:** Bits (Shannon entropy).
- **Mechanics:** For a macroscopic object, C is directly proportional to the object's mass (m) and thermodynamic entropy. It acts as the object's "file size" in the source code.

1.3 3. *O* (Observation / Environmental Decoherence)

The measure of informational exchange and environmental entanglement between a localized quantum state and the surrounding matrix.

- **Unit:** A dimensionless scalar ($0 \leq O \leq 1$), strictly derived from the state's quantum mechanical purity ($\text{Tr}(\rho_S^2)$).
- **Mechanics:** $O = 0$ represents a theoretically perfectly isolated, pure quantum state. $O \approx 1$ represents a maximally mixed state resulting from frequent interaction with a macroscopic, thermal environment (e.g., atmospheric scattering or thermal radiation).

1.4 4. T_{local} (Local Reality Threshold)

The local threshold field for the universe's computational capacity. It dictates when the matrix is forced to lock the object's *pointer* to a unique network node to avoid paradoxes (the No-Cloning theorem).

- **Unit:** Bits (same dimension as C).
- **Mechanics:** Acts as the universe's local "RAM memory" for quantum uncertainty, whose value varies depending on the entropy density of the surrounding matrix.

2 Introduction: The Informational-Ontological Inversion

Anomaly: Why does the universe exhibit an exact geometric order (General Relativity) macroscopically, if space at the quantum level lacks defined locations and is determined by probability waves?

LVT's Solution: Geometry is not fundamental; it is a computational byproduct.

Standard cosmology models the universe as a continuous metric ($g_{\mu\nu}$) filled with quantum fields. LVT inverts this hierarchy. Spacetime is not the stage where physics plays out; spacetime is the perceived result of data processing in the universe's source code. At the quantum level, the informational source code constitutes a stochastic spin network. Macroscopically, this dynamic graph-theoretical structure is smoothed out into the continuous geometry we experience.

Distance (S) and Time (t) do not exist *a priori*. They are parametric renderings of differences between unique node-pointers:

$$S = k \cdot d_{\min}(LV_A, LV_B) \quad (1)$$

$$t = \sum \Delta(LV \cdot O)_{\text{Planck}} \quad (2)$$

- S describes the matrix's **Spatial Resolution** (where k converts network hops to meters).
- t describes the matrix's **Temporal Update Frequency**.

3 The Solution to the Measurement Problem (Quantum-Classical Boundary)

Anomaly: Why do particles assume a fixed classical position upon measurement (Schrödinger's cat)?

LVT's Solution: Wave function collapse is the matrix's logical defense mechanism.

The transition to classical space ("Decoherence") is strictly governed by LVT's fundamental equation:

$$\boxed{C \cdot O \geq T_{\text{local}}} \quad (3)$$

In order for the matrix to maintain a superposition (many possible outcomes open simultaneously), processing power is required. The mathematics elegantly explains why the macroscopic and microscopic worlds appear different:

- **The Quantum World (Electron):** Has an extremely low C (few bits). For the product ($C \cdot O$) to surpass the field's local RAM memory T_{local} , a high value of O (a strong measurement) is required. Until this occurs, the electron lacks a locked LV -pointer and spreads as a probability wave in the network.
- **The Macro World (Apple/Cat):** Has an enormous C (quadrillions of atoms/bits). Even with a vanishingly small interaction with the environment ($O \approx 0.0001$), the massive complexity will drive the product ($C \cdot O$) far above the threshold value T_{local} . An "informational crash" is avoided by the matrix immediately saving and locking the system's pointer to a unique network node. This is why we never observe cats in superposition.

4 Gravity as an Entropic Gradient and the Correspondence Principle

Anomaly: How can the discrete nature of quantum mechanics be reconciled with the continuous spacetime of General Relativity?

LVT's Solution: LVT's discrete informational matrix transitions asymptotically to the continuous metric at macroscopic scales (The Correspondence Principle).

Matter represents an extreme concentration of LV -pointers. This creates a local gradient in the informational density. According to the law of least resistance, the universe strives to equalize informational differences to save computational power.

The gravitational force (\vec{F}_g) is formulated within LVT as the negative gradient of the difference in LV :

$$\vec{F}_g \propto -\nabla(\Delta LV) \quad (4)$$

Matter moves towards massive objects (like Earth) because the matrix requires the least logical energy if the smaller object's pointer is integrated with the larger object's network structure.

Correspondence with Newton/Einstein: For macroscopic bodies, where the number of LV -pointers approaches infinity, LVT's discrete algebra smooths out into a seemingly continuous surface. The informational gradient $\nabla(\Delta LV)$ is rendered macroscopically as curved spacetime, which recreates $F_g = G \frac{m_1 m_2}{s^2}$ and $g_{\mu\nu}$. Gravity is not a pulling force; gravity is space trying to clean up the source code.

5 Electromagnetism and the Topological Exclusion Principle

Anomaly: If atoms consist of 99.99% empty space, why does solid matter feel hard? Why cannot a hand pass through a wooden table via perfect atomic alignment?

LVT's Solution: Electrostatic repulsion and the Pauli Exclusion Principle are macroscopic manifestations of the matrix's computational firewall preventing logical data overwrites.

In the kinetic paradigm, electromagnetism is described via virtual photon exchange and electrostatic fields. In LVT, the fundamental forces are redefined as network management protocols.

5.1 Photons and Charge (The Ping Protocol)

A photon is not a physical projectile traveling through a vacuum. It is a discrete informational update—a "ping"—transmitted along the logical edges of the network graph (E_{env}). These information exchanges are the literal mechanism that generates the observation scalar (O).

Electric charge is formulated as **Topological Parity**, dictating how nodes integrate:

- **Opposite Charges (+/-):** Possess compatible algorithmic protocols. The matrix efficiently creates new logical edges between them, pulling their *LV*-pointers together to minimize computational overhead.
- **Like Charges (-/-):** Possess incompatible protocols. Forcing their *LV*-pointers to merge requires exponentially increasing processing power, generating a topological resistance that is classically rendered as electrostatic repulsion.

5.2 The Hand and the Table: Topological Exclusion

When macroscopic objects (such as a hand and a table) interact, classical physics relies on electron cloud repulsion to explain solidity. LVT formulates this as an absolute informational limit.

Every external spatial coordinate (a specific *LV*-pointer) has a finite maximum bandwidth governed by the local reality threshold (T_{local}). If you attempt to push a hand through a table, you are forcing the billions of atoms in the hand (C_{hand}) to assume the exact same logical *LV*-pointers as the billions of atoms in the table (C_{table}).

If they were to overlap, the localized informational density would instantly spike:

$$(C_{hand} + C_{table}) \cdot O \ggg T_{local} \quad (5)$$

To prevent an immediate logical crash (a "Blue Screen" in the fabric of reality where multiple objects occupy the exact same data vector), the universe's rendering engine

executes a **Topological Exclusion**. It generates an infinite algorithmic resistance against assigning the two masses the same *LV*-address.

What a human experiences as "hard wood" or "solid matter" is not physical contact with particles; it is the physical sensation of the universe's source code refusing to overwrite existing data. The hand is stopped by a fundamental IP-address conflict in the matrix.

This absolute limit is driven by the matrix's fundamental **Uniqueness Principle** (the informational equivalent of the No-Cloning Theorem). The universe must preserve the unique identity of localized data. If the hand and the table shared the exact same *LV*-pointer, the matrix would lose the ability to differentiate their states, resulting in a catastrophic data overwrite. Solidity is simply the universe enforcing spatial uniqueness.

6 Kinetic Friction and Informational Erasure

Anomaly: If physical contact is merely a Pauli-driven boundary limit, why does moving two surfaces against each other generate mechanical resistance and dissipate heat?

LVT's Solution: Friction is not a mechanical force; it is the thermodynamic cost of chaotic topological data rewriting, governed by Landauer's Principle.

In classical mechanics, kinetic friction is attributed to the physical interlocking and scraping of microscopic surface asperities. In the LVT framework, friction is an emergent informational phenomenon.

6.1 Topological Drag (Server Lag)

When two macroscopic surfaces are kinetically forced to slide against one another, the matrix must continuously update the *LV*-pointers of billions of interacting boundary nodes. Because physical surfaces are microscopically chaotic, these updates are not smooth, collective translations. The structured, highly organized information of the material boundaries (low entropy) is violently deformed and broken.

The mechanical resistance we perceive as "drag" or "friction" is simply **Topological Drag**—the universe's computational engine struggling to process massive, chaotic, and conflicting data updates at the collision boundary.

6.2 Heat as Deleted Source Code

According to information theory, specifically **Landauer's Principle**, it is physically impossible to erase or scramble ordered data without dissipating heat into the environment.

When friction tears apart the microscopic structure of a surface, the universe does not magically erase the atoms from existence. Instead, it permanently shatters that highly organized structural data into chaotic, random background noise. The thermal energy

(heat) generated by friction is not a magical byproduct of movement. It is the literal thermodynamic exhaust emitted when the universe deletes the structured source code of the surface atoms.

By redefining friction as the thermodynamic cost of erasing data, LVT seamlessly connects everyday mechanical resistance to the fundamental laws of quantum computing and entropy.

7 Time, Causality, and Spatio-Temporal Duality

In LVT, strict causality is preserved by defining c (the speed of light) as the informational matrix's fixed **conversion constant** between logic and geometry:

$$c \equiv \frac{\text{Spatial Resolution}}{\text{Temporal Update Frequency}} \approx \frac{\ell_p}{t_p} \quad (6)$$

During *kinetic movement*, the matrix must calculate and render each logical step (ΔLV) in an unbroken sequence, which takes time.

Quantum Entanglement (Internal vs. External LV): In quantum entanglement, LVT handles spatial separation by distinguishing between *internal* and *external* node-pointers. Two entangled particles share exactly the same source code for their state; their mutual logical distance is $\Delta LV_{\text{internal}} = 0$. If one changes, the other changes immediately because they constitute the same logical node. At the same time, they have unique relations to the lab around them ($\Delta LV_{\text{external}} \neq 0$), causing the matrix to render a macroscopic distance (S) between them. This preserves causality c for classical space, but allows instantaneous information sharing in the source code.

8 Macrodynamic Extremes: Black Holes, Dark Matter/Energy and Big Bang

8.1 Black Holes: Topological Compression at T_{\max}

When the informational density ($C \cdot O$) of a system approaches the matrix's absolute processing limit, or **critical threshold** (T_{\max}), the local network faces a computational overflow. To prevent a systemic crash, the internal LV -pointers of the mass are synchronized:

$$\lim_{C \cdot O \rightarrow T_{\max}} |\Delta LV| = 0 \implies S = 0 \quad (7)$$

The black hole is a **Topological Compression** in the source code; inside the event horizon, no spatial distance (S) exists.

Because the local processor is running at absolute maximum capacity to maintain this compression, it cannot afford the computational overhead required to calculate the

reflection or scattering trajectories of incoming photons. Instead, incident light is simply assimilated into the singular node without calculation, resulting in a perfect optical void.

Furthermore, to avoid violating the laws of thermodynamics (the destruction of information), the truncated structural data is encoded onto the Event Horizon as a 2D holographic phase boundary. **Hawking radiation** is therefore not magic, but the thermodynamic exhaust governed by Landauer's Principle—it is the **quantization noise** that physically "spills over" as heat when the matrix permanently deletes spatial variables to force billions of unique values into a single, compressed node.

8.2 Dark Matter

Dark matter is information that borders on the reality threshold (T_{local}):

$$(C \cdot O \lesssim T_{\text{local}}) \quad (8)$$

Because it lacks a locked external *LV*-pointer, it cannot interact with electromagnetic fields (light requires an exact location to be absorbed). Its complexity (C), however, is sufficient to curve the underlying informational gradient, creating gravity. Dark matter is "pre-local" information.

9 Dark Energy and the Source Code's Zero Point

The Big Bang is not the beginning of *time*, but the absolute **zero point in the source code** ($\Delta LV = 0$). The Cosmic Microwave Background (CMB) is the noise of the universe's fundamental update frequency.

As the universe's total informational complexity (C_{total}) constantly increases (the second law of thermodynamics), the matrix generates more unique nodes to point to. Because more nodes render more S , we experience the universe as expanding:

$$\frac{dS}{dt} \propto \frac{dC_{\text{total}}}{dt} \quad (9)$$

Dark energy is the matrix's logical capacity increase.

10 Conclusion

Locational Variable Theory offers a unified, formally defined ontology. By establishing that location is a logical pointer (*LV*) and introducing the threshold variables (C, O, T_{local}), we resolve the conflict between Relativity (the rendered) and Quantum Mechanics (the source code).

Barriers previously considered physically absolute are reduced here to testable, computational matrix parameters. LVT explains the extremes of the universe with high-school

algebra and logical elegance, and constitutes the irrefutable foundation for information-driven engineering.

*End of Document 2 — Version 5.0.
LVT Theoretical Framework (Open Source).*