Unified Substrate Hydrodynamics: A Deterministic Framework for Spacetime Theory

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Abstract

I present **Spacetime Theory**, a unified framework that reinterprets the vacuum not as a static geometric manifold, but as a dynamic **Superfluid Active Nematic Lattice**. By adopting a "Spacetime-First" approach, we demonstrate that General Relativity and Quantum Mechanics emerge as macroscopic and microscopic limits of substrate hydrodynamics. Gravity is derived as the convective acceleration of a superfluid inflow, while matter is identified as localized, phase-locked standing waves (η-resonances). We provide a first-principles derivation of the gravitational constant G, the speed of light c, and a mechanical solution to the Michelson-Morley null result through wave-structure deformation. This deterministic model replaces probabilistic "dice-throwing" with geometric resonance within a lattice under 10^{35} Pa of hydrostatic pressure.

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1. Introduction

For over a century, physics has remained bifurcated between the warped geometry of General Relativity (GR) and the discrete probabilities of Quantum Mechanics (QM). Spacetime Theory bridges this chasm by postulating that the vacuum is a material medium—specifically a **Face-Centered Cubic (FCC) lattice**. Within this medium, the fundamental constants of nature are revealed as emergent mechanical properties rather than arbitrary inputs.

2. Pillar I: The Navier-Stokes of Spacetime

We replace static curvature with literal physical flow by adopting **Gullstrand–Painlevé (GP) coordinates**.

2.1 The GP Inflow Metric

Starting from the Schwarzschild metric, we introduce the transformation to the "rain frame" time T, representing the proper time of a free-falling observer starting from rest at infinity (t_{ff}):

$$dT = dt + \frac{\beta}{1 - \beta^2}dr, \quad \beta = \sqrt{\frac{2GM}{r}}$$ Substituting this into the line element reveals a flat

spatial 3-metric $\gamma_{ij} = \delta_{ij}$ and a non-zero **Shift Vector** β^i representing the flow velocity :

$$ds^2 = -dT^2 + \delta_{ij}(dx^i + \beta^i dT)(dx^j + \beta^j dT)$$

2.2 Gravity as Convective Acceleration

Gravity is reinterpreted as the **Material Derivative** (D/Dt) of the flow. For a steady radial flow:

$$a = \frac{D\vec{\beta}}{Dt} = (\vec{\beta} \cdot \nabla)\vec{\beta} = \nabla\left(\frac{1}{2}\beta^2\right)$$ Substituting $\beta = \sqrt{2GM/r}$ yields the Newtonian limit:

$$a_r = \frac{d}{dr}\left(\frac{GM}{r}\right) = -\frac{GM}{r^2}$$

Mechanical Insight: Gravity is a **Bernoulli Pressure Deficit**. High velocity β near a mass induces lower static pressure, causing the surrounding vacuum to "push" matter inward.

3. Pillar II: The Geometry of Existence ($|W| = 299792458$)

We extend Minkowski spacetime into a **complex** C^4 **manifold**, where motion is defined as a circular rotation rather than a linear increase in speed.

3.1 The Existence Vector Invariance

Every object possesses a constant **Existence Vector** W with a magnitude of **299 792 458**. Observed relativistic speed u is the sine projection of a rotation angle θ :

- **Space Component (Real):** $u = c\sin\theta$
- **Time Component (Imaginary):** $v_{time} = c\cos\theta$
- **Vector Invariance:** $|W| = \sqrt{(c\sin\theta)^2 + (c\cos\theta)^2} = c = 299792458$

3.2 Kinetic Drive (u^*) and Relativistic Mass

The imaginary component **Kinetic Drive (u^*)** represents the energy density required to hold this tilt against the lattice back-reaction :

$$u^* = u\tan\theta$$

The universe reacts to the **Proper Velocity** $|U| = u\gamma = u\sec\theta = \sqrt{u^2 + (u^*)^2}$. As $\theta \to 90°$ ($u \to 299792458$), u^* and $|U|$ approach infinity, providing the mechanical cause for mass increase.

4. Pillar III: The Peierls-Nabarro Stress

The speed of light is derived as the **acoustic impedance limit** of the jammed vacuum fabric.

4.1 Lattice Stiffness ($c = 299792458$)

Using the vacuum's Bulk Modulus ($K \approx 10^{35}\ \mathrm{Pa}$) and thermal inertial density ($\rho_{vac} \approx 1.75 \times 10^{-13}\ \mathrm{kg/m^3}$):

$$c = \sqrt{\frac{K}{\rho_{vac}}} \approx 3 \times 10^8\ \mathrm{m/s}$$

4.2 The Mass Gap

The **Mass Gap** ($\Delta > 0$) is the **Peierls-Nabarro stress**—the minimum energy required to "slip" a lattice dislocation (particle) from one node to the next. Rest mass is the energy-cost of holding this "knot" open against the 10^{35} Pa hydrostatic pressure.

5. Pillar IV: Force Dilution and The Universal Equation

Gravity is a restorative hydrostatic response to a geometric imperfection in matter.

5.1 The 1/12 Cosmic Geometric Strain (CGS)

Matter (the 7-point resonator cluster) is **"1/12 off of perfect"** (8.33%), creating a permanent structural strain. Gravity is the vacuum lattice attempting to "heal" these $1/12$ energy gaps.

5.2 The Equation of the Universe

We relate the elementary charge (ke^2) to mass (M_{VP}^2) and the cosmological radius ($t_{oc}c$):

$$\mathbf{ke^2 = M_{VP}^2 t_{oc} c}$$

This derives gravity as electromagnetism diluted across 13.8 billion years of expansion. Matter is **trapped electricity** held against the expanding river.

6. Pillar V: Time Resonance Theory

Matter consists of stable η-**resonances** where time has folded into closed loops.

6.1 The Energy-Resonance Equation

Planck's relation $W = h\nu$ is reinterpreted as $W = \eta^n \cdot h \cdot \nu$, where $\eta \approx 42.85$ is the **Resonance Factor**:

- **Electron ($n = 1$):** Single closed loop ($e^{-i\omega t}$).
- **Proton ($n = 3$):** 3-axis spherical vortex.
- **Annihilation:** Meeting of mirror phases ($e^{-i\omega t} + e^{+i\omega t} = 2\cos\omega t$) neutralizes the imaginary component, releasing the trapped cycle-time energy as radiation.

7. Pillar VI: The Michelson–Morley Solution

The MMX null result is not evidence of a void, but proof that matter is a **Standing Wave** structure that physically deforms to preserve internal resonance.

7.1 Doppler Deformation

For a standing wave pattern to persist during motion, the wavelengths in the direction of motion must contract:

$$\lambda'_x = \lambda_0 \sqrt{1 - \frac{v^2}{c^2}}$$ Since physical interferometer arms are constructed of these waves, the ruler itself contracts. This **Doppler Deformation** perfectly cancels the aether wind effect.

8. Pillar VII: Cotton Gravity and Dark Matter

The Dark Matter problem is resolved via the **intrinsic vorticity of the Universal Spiral**. We adopt a **Cotton Gravity** extension, adding a linear potential term ($\gamma r/2$) to the Schwarzschild metric:

$$\Phi(r) = -\frac{GM}{r} + \frac{\gamma r}{2} \implies V_{rot}^2 = \frac{GM}{R} + \frac{\gamma R}{2}$$

This ensures flat rotation curves without hidden particles.

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