From False to True - Vacuum:
Transition: From Quantum Mechanics to Spacetime Geometry

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Abstract

We propose a conceptual framework in which quantum mechanics (QM) and general relativity (GR) represent two complementary domains of physical reality: the false vacuum of non-geometric Schrödinger space and the true vacuum of Einsteinian geometry. In this view, rest mass arises from longitudinal perturbations in the Higgs field aligned with particle motion, inducing a slowing below the speed of light and potentially accounting for dark matter (DM). The transition between the two regimes is governed by the global wave function and mediated at a critical surface—interpreted as an event horizon (EH)—where energy transforms from potential to kinetic form. Gravitation, absent in the false vacuum, emerges geometrically in the true vacuum. The bijective relationship between inertial and gravitational mass underpins this duality. We draw analogies to mesomeric structures in chemistry and suggest observational consequences for high-energy physics and cosmology. This framework invites a re-evaluation of the physical meaning of mass, space, and time, aiming to unify QM and GR not by quantizing gravity, but by clarifying their domains of applicability.

1 Introduction

Our contemporary understanding of the universe rests upon two pillars: quantum mechanics (QM) and general relativity (GR). Yet these pillars stand on conceptually incompatible foundations. While QM operates in a probabilistic, non-geometric configuration space governed by the Schrödinger equation, GR unfolds within a continuous, curved spacetime shaped by mass-energy through Einstein's field equations. Attempts to unify both frameworks have so far failed to yield a fully satisfactory theory.

This paper proposes a different approach: instead of merging QM and GR, we view them as two complementary but distinct representations of physical reality. QM is interpreted as a metastable "false vacuum"—a non-geometric Schrödinger space dominated by potential energy—while GR corresponds to a "true vacuum"—a geometric Einstein space dominated by kinetic energy. At the heart of this transition lies the Higgs field, whose longitudinal perturbations may generate rest mass and serve as a dynamical bridge between these regimes.

The transition is not abrupt but mediated through a surface of bijective correspondence, mathematically reflected in the equality of inertial and gravitational mass, and geometrically represented by a boundary: an event horizon (EH). This EH is not only the boundary of a black hole but, more generally, the projection surface where the probabilistic quantum domain projects into classical spacetime. The bijective character of this mapping is critical: it allows a reversible transformation between potential and kinetic energy domains, aligning with conservation laws and preserving quantum coherence up to the interface.

We suggest that taking this dual structure seriously requires a philosophical reorientation. Rather than treating spacetime and mass as fundamental, we propose they emerge from the

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dynamics of a field (the Higgs field) embedded in a non-geometric backdrop. This inversion of perspective—viewing geometry as emergent and projection-based—challenges deeply held assumptions, but may offer a coherent bridge between QM and GR. We further propose observational signatures that could make this model falsifiable, including Higgs-dark matter couplings, thermal footprints in cosmology, and gravitational structures near black hole horizons.

2   Theoretical Framework

2.1   Schrödinger Space as False Vacuum

In the standard quantum mechanical picture, a particle is described by a wave function ψ, evolving under the Schrödinger equation:

$$i\hbar\frac{\partial\psi}{\partial t} = \hat{H}\psi.$$

This equation is defined on a Hilbert space, not in geometric spacetime. The wave function encodes probabilities rather than trajectories, and physical observables arise as expectation values. No curvature or gravity appears at this level.

We interpret this domain as a "false vacuum": a non-geometric energy state in which potential energy dominates. The Higgs field, with its characteristic potential

$$V(\phi) = \mu^2\phi^2 + \lambda\phi^4,$$

serves as the dynamical background. Longitudinal perturbations of the Higgs field—aligned with the motion of particles—introduce a decelerating effect, reducing particle velocity below c, and thereby giving rise to rest mass:

$$E_{\text{pot}} = mc^2 = \text{Higgs interaction.}$$

These perturbations may account for dark matter, which interacts gravitationally but remains otherwise inert. The rest mass emerges as a local compression of degrees of freedom in the Higgs field, preventing particles from moving at the speed of light unless uncoupled (e.g., photons).

2.2   Einstein Space as True Vacuum

In contrast, GR describes the dynamics of spacetime via the Einstein field equations:

$$G_{\mu\nu} = 8\pi T_{\mu\nu}.$$

Here, mass-energy determines the curvature of spacetime, and particles follow geodesics described by:

$$\frac{d^2x^\mu}{d\tau^2} + \Gamma^\mu_{\alpha\beta}\frac{dx^\alpha}{d\tau}\frac{dx^\beta}{d\tau} = 0.$$

We call this domain the "true vacuum", characterized by minimal energy configurations in which kinetic energy dominates. Gravitation arises naturally as a consequence of the geometric deformation of spacetime.

Within this domain, rest mass acts as a geometric source of curvature. However, this mass originated in the false vacuum, via the interaction with the Higgs field. Once projected into the Einstein space, it acquires gravitational influence, though its origin remains non-geometric.

2.3 The Interface: Event Horizon and Bijective Mapping

The interface between Schrödinger and Einstein space is represented metaphorically and physically by an event horizon. In classical GR, the Schwarzschild radius $r = 2GM/c^2$ defines a surface beyond which signals cannot escape. In our framework, this surface generalizes to any boundary where the longitudinal structure of the Higgs field collapses into a geometric projection.

At this EH, the global wave function satisfies a boundary condition reminiscent of the Wheeler-DeWitt equation:

$$\hat{H}\psi = 0,$$

which encodes the timeless state of the universe. The EH thus becomes a surface of thermodynamic and informational projection, where entropic flow and the arrow of time emerge. This echoes the thermodynamic interpretations of gravity proposed by Jacobson [2] and extended by Verlinde [3].

2.4 Energy Conversion and Time's Arrow

The fundamental process unifying these two vacua is the transformation of potential energy into kinetic energy:

$$E_{\text{pot}} \rightarrow E_{\text{kin}}.$$

In this picture, time, space, and velocity are emergent consequences of this irreversible process. The second law of thermodynamics ($\Delta S \geq 0$) reflects the net flow from false to true vacuum, aligning with cosmic expansion and the decrease in energy density:

$$\rho(t) \propto a(t)^{-n}.$$

The speed of light acts as a limiting state: a particle without mass (no interaction with the Higgs field) moves at c and carries only kinetic energy:

$$E = pc.$$

Thermal radiation such as the cosmic microwave background (CMB) or Hawking radiation encodes this transition, functioning as a fossil record of the energy flow through the EH.

3 Interpretation and Analogies

Just as the benzene molecule is best described by mesomeric resonance between two structures, our physical world is best understood as the resonance between two approximations: QM and GR. Each fails to describe the full "rhino" of physical reality but succeeds in complementary regimes.

From this perspective, mass, time, and gravitation are not absolute but emergent properties arising at the EH projection surface. The equality of gravitational and inertial mass—long a mystery—is a natural consequence of their common origin in longitudinal Higgs dynamics. This projection-based view recontextualizes familiar structures without requiring quantization of spacetime or geometry.

The metaphor extends to cognitive and emotional domains: emotional states may correspond to potential energy in the false vacuum, which becomes kinetic action once projected through a thermodynamic interface. This is not a claim of reductionism, but of structural analogy: information, energy, and motion are tied through a universal mechanism of entropic transformation.

4 Observational Consequences and Falsifiability

While speculative, the framework suggests several testable predictions:

- **Higgs–Dark Matter Interaction:** If dark matter consists of longitudinal perturbations in the Higgs field, collider experiments (e.g., LHC or HL-LHC) might detect anomalous couplings or energy flows in Higgs decay channels.

- **CMB and Expansion Rate:** The thermal spectrum and scaling behavior of the CMB may reflect the energy transformation model, potentially refining the effective equation-of-state parameters or late-time acceleration behavior.

- **Gravitational Lensing near EH:** Detailed measurements of gravitational behavior near black hole horizons (e.g., via the Event Horizon Telescope) might reveal asymmetries indicative of a field-based interface.

Further predictions may arise from numerical simulations of longitudinal Higgs modes and their gravitational projections.

5 Conclusion

We have outlined a conceptual framework in which QM and GR are not incompatible, but refer to different energy states—false and true vacua—linked by a dynamical interface mediated through the Higgs field. Rest mass and gravitation are not fundamental, but emergent from longitudinal perturbations in a non-geometric field structure. The event horizon functions not only as a boundary in space, but as a projection surface in phase space and thermodynamics.

Instead of quantizing gravity, we suggest beginning by *separating* QM and GR cleanly and interpreting their bijective correspondence at the EH. This reversal of methodological perspective—clarity before unification—may provide a more grounded path toward a unified physical theory.

References

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