The Vortex Æther Model:

A Unified Topological Field Theory of Mass, Gravity, and Time

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We present the Vortex Æther Model (VAM), a unified physical framework in which mass, gravity, and proper time emerge from topologically structured vorticity within a compressible, inviscid æther. In contrast to curvature-based relativity and Higgs-based mass generation, VAM describes particles as knotted vortex excitations, and gravity as a swirl-induced time deviation field. The theory reproduces classical phenomena such as gravitational redshift, time dilation, and frame-dragging through fluid-dynamic energetics, and calculates particle masses and physical constants from first principles. The Standard Model gauge groups SU(3), SU(2), and U(1) arise naturally from vortex topology and swirl symmetry, while canonical quantization defines a Fock-like Hilbert space over knot eigenstates. We develop a full path-integral formulation over topological sectors of the æther manifold, enabling quantum transitions, knot fusion, and helicity exchange interactions. Benchmarking against general relativity and experimental tests of gravitational time deviation support the model's viability. VAM offers a physically grounded, falsifiable, and derivational alternative to conventional quantum gravity and field theory models.

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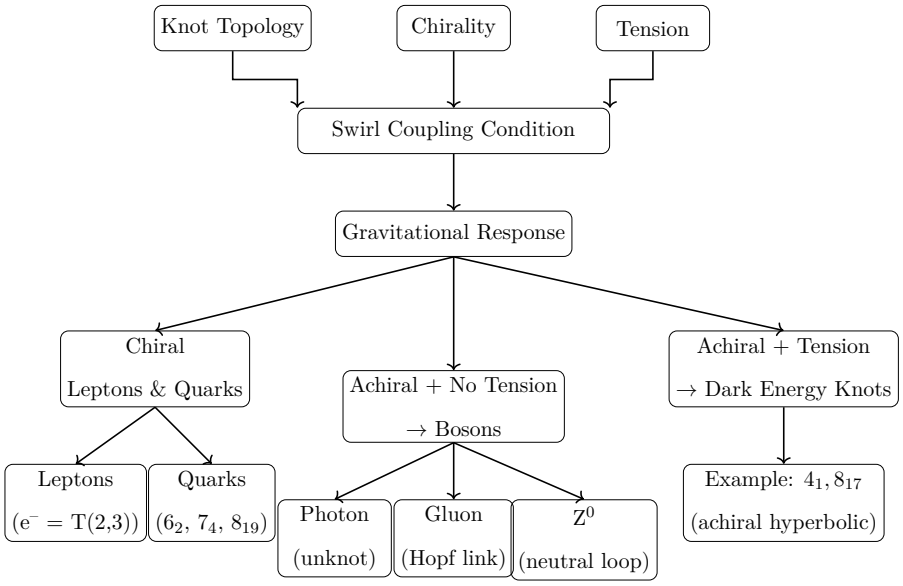

FIG. 1. Knot Classification by Swirl Coupling. The flowchart visualizes how knot topology, chirality, and curvature tension determine gravitational behavior, and how this leads to specific particle subclasses:

Chiral knots align with swirl fields and form matter: **leptons** (torus knots) and **quarks** (hyperbolic knots).

Achiral, tensionless structures like unknots and Hopf links are **bosons**, passively guided by swirl tubes.

Achiral knots with tension are expelled, forming **dark energy** candidates.

Contents

I. knot not knots

test versions of inline knot images: 0_1:

2_1: 

2_1: 

2_1: 

2_1: 

2_1: 

2_1: 

$T(3,2)$: 

$T(2,3)$: 

6_2: 

7_4: 

4_1: 

5_1: 

5_2: 

7_2: 

II. Introduction and Motivation

The quest for a unified framework of fundamental physics remains unresolved. While General Relativity (GR) provides a powerful geometric description of gravity [**?**], and the Standard Model (SM) successfully accounts for particle interactions via gauge symmetries [**?**], these theories are conceptually and structurally incompatible. GR is formulated as a smooth, four-dimensional Riemannian geometry with dynamical curvature, while the SM operates on flat spacetime with point particles, quantum fields, and externally imposed mass via the Higgs mechanism.

Despite their predictive power, both frameworks leave foundational questions unanswered:

- What is the origin of inertial mass, beyond spontaneous symmetry breaking?
- Why does proper time slow near massive bodies, and can this be described without

spacetime curvature?

- What underlying physical structure connects gravitation, mass-energy, and quantum phase?
- Can the values of fundamental constants (e.g., G, α, $\hbar$) be derived, rather than inserted?

The **Vortex Æther Model (VAM)** offers a new ontological starting point. It describes the universe as a structured, compressible, inviscid fluid—a physical æther—embedded in a 3D Euclidean manifold with an absolute æther time N. Within this medium, particles are not pointlike but are stable *topological knots* in the vorticity field. Mass, proper time, and gravitational attraction arise from swirl energetics, helicity density, and the emergent dynamics of local vortex configurations.

This approach does not invoke curvature or external scalar fields; instead, it derives time deviation, gravitational pressure, and inertial resistance from first principles in topological fluid mechanics. By defining a swirl scalar potential $\Phi(\vec{x}, t)$, a velocity field $\vec{v} = \nabla\Phi$, and a vorticity field $\vec{\omega} = \nabla \times \vec{v}$, the theory reconstructs gravity as a time-dilating flow field and quantizes particles as eigenmodes of knotted circulation.

VAM builds on and surpasses prior analog models of gravity (e.g., superfluid vacuum theory [**?**], analog BEC spacetimes [**?**]), but extends them into a complete field theory. It defines a Standard Model Lagrangian in terms of vortex knots and swirl symmetries, derives the values of m_e, G, and α from vortex geometry, and introduces a full canonical quantization scheme over a Hilbert space of knot eigenstates. It also aligns naturally with emergent gravity models like those of Jacobson [**?**] and Verlinde [**?**], while offering a mechanical substrate and observable predictions.

This paper presents the full structure of the Vortex Æther Model, from its ontological foundations and swirl dynamics to its quantized field theory, Standard Model reconstruction, and experimental predictions.

Acknowledgments

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