The Vortex Æther Model: Æther Vortex Field Model

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(Dated: March 27, 2025)

Abstract

The rate at which time flows in the local frame (near the knot) depends on the internal angular frequency Ω_k.

The Vortex Æther Model (VAM) introduces a unified, non-relativistic theoretical framework wherein gravity, electromagnetism, and quantum phenomena arise from structured vorticity within an inviscid superfluid-like Æther. Unlike General Relativity, which depends on four-dimensional spacetime curvature, VAM proposes that stable vortex knots in three-dimensional Euclidean space generate fundamental forces and quantized states through fluid dynamics and vortex topology. Central to this model is absolute universal time, where observed time dilation results from vortex-induced local energy gradients rather than relativistic effects. VAM yields experimentally testable predictions, including superfluid analogs of frame-dragging, magnetic fields in electrically neutral fluids, and atomic-scale quantization phenomena akin to those observed in helium II. Fundamental constants such as the vortex-core tangential velocity C_e and the Coulomb barrier radius r_c anchor core rotation speeds and interaction strengths, providing explicit testable parameters for experimental verification.

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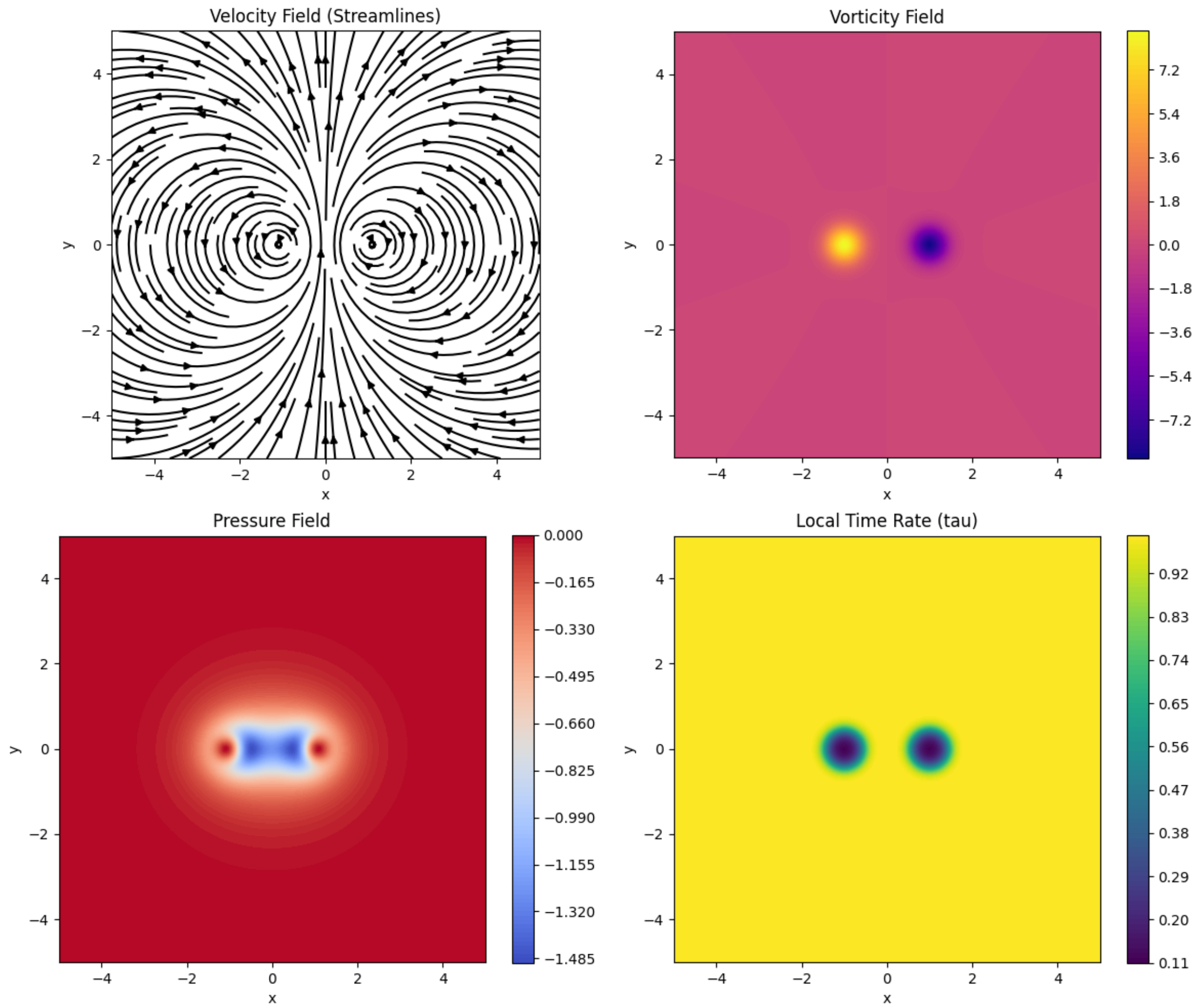

FIG. 1: Illustration of vorticity fields in Æther.

Core Assumptions

The Æther is modeled as an inviscid, incompressible superfluid governed by:

- Conservation of vorticity
- A 3D Euclidean medium with absolute time
- Particles as vortex knots
- Irrotational outside vortex cores, but with conserved vorticity inside knots
- Gravity from vorticity-induced pressure gradients

Let:

Symbol	Description
$\vec{v}$	Æther velocity field
$\vec{\omega}$	$\vec{\omega} = \nabla \times \vec{v}$
Vorticity	
$\rho_{æ}$	Æther density (constant)
Φ	Vorticity-induced potential
κ	Circulation constant
$\mathcal{K}$	Knot topological class (Hopf link, torus knot, etc.)

I. Fluid Dynamics and Vorticity Conservation

Euler Equation (Inviscid Flow)

$$\frac{\partial \vec{v}}{\partial t} + (\vec{v} \cdot \nabla)\vec{v} = -\frac{1}{\rho_{æ}} \nabla p \tag{1}$$

Taking the curl to get the Vorticity Transport

$$\frac{\partial \vec{\omega}}{\partial t} + (\vec{v} \cdot \nabla)\vec{\omega} = (\vec{\omega} \cdot \nabla)\vec{v} \tag{2}$$

II. Vorticity-Induced Gravity

We define a Newtonian like vorticity-based gravitational potential Φ:

$$\vec{F}_g = -\nabla \Phi \tag{3}$$

Where Φ is the Vorticity Potential:

$$\Phi(\vec{r}) = \gamma \int \frac{|\vec{\omega}(\vec{r'})|^2}{|\vec{r} - \vec{r'}|} \, d^3 r' \tag{4}$$

This mirrors the Newtonian potential but replaces mass density with vorticity intensity. This gives attractive force fields between vortex knots (like a particle).

IV. Vortex Knots as Particles

Each particle is a topological vortex knot:

- Charge twist or chirality of knot
- Mass integrated vorticity energy
- Spin knot helicity:

Helicity as Particle Identity

$$\mathcal{H} = \int \vec{v} \cdot \vec{\omega} \, d^3x \tag{5}$$

Stability knot type (Hopf links, Trefoil, etc.) and energy minimization in the vortex core

V. Vortex Thread Interaction

Interactions arise from exchange of vorticity or reconnections between vortex filaments:

- Attractive if threads reinforce circulation (parallel)
- Repulsive if threads cancel (antiparallel)
- Interaction strength:

$$\vec{F}_{\text{int}} = \beta \cdot \kappa_1 \kappa_2 \cdot \frac{\vec{r}_{12} \times (\vec{v}_1 - \vec{v}_2)}{|\vec{r}_{12}|^3} \tag{6}$$

Where κ_i are circulations of filaments and $\vec{r}_{12}$ is the vector between them.

VI. Thermodynamic Quantum Behavior from Vorticity Fluctuations

- Entropy $\leftrightarrow$ volume of vortex expansion or knot deformation
- Quantum transitions $\leftrightarrow$ topological reconnection events
- Zero-point motion $\leftrightarrow$ background quantum turbulence of the Æther:

Quantum Vorticity Background

$$\langle \omega^2 \rangle \sim \frac{\hbar}{\rho_{æ} \xi^4} \tag{7}$$

Where ξ is the coherence length between vortex filaments

I. TIME DILATION IN THE ÆTHER-VORTEX MODEL

The Æther knows only absolute time, but local clock rates do vary with knot dynamics. We consider an inviscid, irrotational superfluid æther where localized topological vorticity structures (vortex knots) govern fundamental interactions. The Vortex Æther Model posits that the rate at which time flows in the local frame (near the knot) depends on the internal angular frequency Ω_k. In this section, we derive time dilation analogues inspired by the predictions of general relativity (GR), based solely on pressure and vorticity gradients in the fluid.

A. Bernoulli-Based Local Time Modulation

In high-vorticity regions, Bernoulli's principle implies a drop in pressure near vortex cores:

$$\frac{1}{2}\rho_{æ}v^2 + p = p_0 \Rightarrow p = p_0 - \frac{1}{2}\rho_{æ}v^2 \tag{8}$$

Assuming that the local physical clock rate is proportional to pressure, we define the local frequency of time as:

$$f_{\text{local}} = f_0 \cdot \left(\frac{p}{p_0}\right) = f_0\left(1 - \frac{\rho_{æ}v^2}{2p_0}\right) \tag{9}$$

Thus, the dilation of local time relative to absolute (background) time becomes:

$$\frac{t_{\text{local}}}{t_0} = \left(1 - \frac{\rho_{æ}v^2}{2p_0}\right)^{-1} \tag{10}$$

Assuming a circular vortex flow where $v = \Omega r$, we obtain the Bernoulli-derived approximation:

$$\frac{t_{\text{local}}}{t_0} \approx 1 + \frac{\rho_{æ}\Omega^2 r^2}{2p_0} \tag{11}$$

This reduces time rate locally with higher knot rotation, modeling ẗime modulationẅithout relativity, where $\rho_{æ}/p_0 \sim 1/c^2$.

$$t_{\text{local}} = t_{\text{abs}} \cdot \left(1 + \alpha\Omega_k^2\right)^{-1} \tag{12}$$

This heuristic expression using Ω_k generalizes the local effect of rotational energy into a topological time-modulation law, consistent with the Bernoulli-derived expansion in the low-vorticity limit.

B. Vorticity-Induced Gravitational Time Dilation

In the æther-vortex framework, gravity emerges from pressure gradients induced by localized vorticity. Let $\Phi(\vec{r})$ be a scalar potential analogous to the Newtonian gravitational potential, defined by:

$$\Phi(\vec{r}) = \gamma \int \frac{|\vec{\omega}(\vec{r'})|^2}{|\vec{r} - \vec{r'}|} \, d^3r' \tag{13}$$

- High vorticity $\rightarrow$ low pressure $\rightarrow$ slowed time
- Define gravitational potential as:

We then define time dilation relative to a distant observer as:

$$t_{\text{local}} = t_\infty \cdot \sqrt{1 - \frac{2\Phi(\vec{r})}{c^2}} \tag{14}$$

Assume time dilation depends on vorticity potential:

$$t_{\text{local}} = t_\infty \cdot \sqrt{1 - \frac{2\Phi}{c^2}} = t_\infty \cdot \sqrt{1 - \frac{2\gamma}{c^2} \int \frac{|\omega|^2}{|\vec{r} - \vec{r'}|} \, d^3r'} \tag{15}$$

If the vorticity field is concentrated at a point-like knot (analogous to a mass), i.e., $|\vec{\omega}(\vec{r'})|^2 \sim \delta(\vec{r'})$, we retrieve a Newtonian-like form:

$$t_{\text{local}} = t_\infty \cdot \sqrt{1 - \frac{2\gamma\omega_0^2}{rc^2}} \tag{16}$$

This structure reproduces the general relativistic gravitational time dilation near a mass:

$$t_{\text{GR}} = t_\infty \cdot \sqrt{1 - \frac{2GM}{rc^2}}$$

C. Interpretation

In this formulation, time slows in regions of high vorticity due to pressure depletion, aligning with relativistic predictions [1–3]. In this model, time dilation arises from localized pressure depletion and kinetic energy storage within vortex knots, replacing the need for spacetime curvature with a fluid-dynamic framework. It offers a classical, topological reinterpretation of relativistic effects.

II. TIME MODULATION BY VORTEX KNOT ROTATION

In the æther-vortex model, matter is composed of topologically conserved vortex knots, stable structures embedded within a superfluid medium. These knots possess an intrinsic angular velocity Ω_k, and their local dynamics are hypothesized to influence the rate at which time is experienced relative to the absolute time of the background æther. Instead of using spacetime curvature (as in GR), we model how internal vortex motion slows local time due to its effect on energy, pressure, and information transfer rates in the surrounding æther.

A. Hypothesis: Time Rate Depends on Knot Rotation

Let Ω_k be the average angular velocity of a vortex knot. Since rotational motion in fluids can influence local energy density and pressure (via Bernoulli-like principles), we postulate that the **local time rate** t_{local} is affected by the internal rotational energy of the knot.

Assume the following ansatz:

$$\frac{t_{\text{local}}}{t_{\text{abs}}} = \left(1 + \alpha\,\Omega_k^2\right)^{-1} \tag{17}$$

where:

- t_{abs} is the absolute background time defined by the stationary æther.
- α is a model-dependent coupling constant (with dimensions [time]^2), characterizing how strongly rotational motion influences the perception of time.
- Ω_k is the scalar mean angular frequency of the knot's core circulation.

B. Interpretation of Equation 18

Equation 18 expresses how faster internal rotation (i.e., higher Ω_k) leads to a **slower local time rate**, mimicking time dilation. Unlike relativity, where velocity with respect to an observer or gravitational potential affects time, here it is the **internal rotational dynamics of topological structures** that alter time flow.

For small values of Ω_k, a Taylor expansion yields:

$$\frac{t_{\text{local}}}{t_{\text{abs}}} \approx 1 - \alpha\Omega_k^2 + \mathcal{O}(\Omega_k^4) \tag{18}$$

which shows a quadratic dependence analogous to the Lorentz factor in special relativity:

$$\frac{t_{\text{moving}}}{t_{\text{rest}}} \approx 1 - \frac{v^2}{2c^2}$$

C. Topological and Physical Justification

Rotating vortex knots are known to store both kinetic energy and helicity [4, 5]. Since topological helicity $\mathcal{H} = \int \vec{v} \cdot \vec{\omega}\, d^3x$ is conserved in ideal flows, and is related to knot complexity, we can view Ω_k as a physically meaningful descriptor of the particle's internal clock.

Thus, in this model:

- Time dilation occurs intrinsically and locally.
- There is no need for reference frames or spacetime curvature.
- All effects arise from conserved fluid-dynamic quantities and their energetics.

This approach provides an alternative to relativistic time dilation, rooted in the physics of topological fluid dynamics and supported by experimental observations of rotating coherent structures in quantum fluids.

III. PROPER TIME FOR A ROTATING OBSERVER

In General Relativity, the flow of proper time for a rotating observer in a stationary, axisymmetric spacetime is given by

$$\left(\frac{d\tau}{dt}\right)^2_{\text{GR}} = -\left[g_{tt} + 2g_{t\phi}\Omega_{\text{eff}} + g_{\phi\phi}\Omega_{\text{eff}}^2\right], \tag{19}$$

where Ω_{eff} is the observer's angular velocity, and the metric components $g_{\mu\nu}$ describe spacetime curvature (e.g., Kerr geometry) [**?**].

In a vortex-based Æther theory, we posit that time dilation arises not from spacetime curvature, but from the local motion of an inviscid superfluid medium. We associate metric-like effects with Æther flow variables:

$$g_{tt} \to -\left(1 - \frac{v_r^2}{c^2}\right),$$
$$g_{t\phi} \to -\frac{v_r v_\phi}{c^2},$$
$$g_{\phi\phi} \to -\frac{v_\phi^2}{c^2} r^2,$$

where v_r and v_ϕ are the radial and tangential components of Æther velocity, and $v_\phi = r\Omega_k$, with $\Omega_k = \kappa/(2\pi r^2)$ representing the local vortex rotation rate [1**?**].

Substituting into the structure of Equation 20, we obtain:

$$\left(\frac{d\tau}{dt}\right)^2_{\text{Æther}} = 1 - \frac{v_r^2}{c^2} - 2\frac{v_r v_\phi}{c^2} - \frac{v_\phi^2}{c^2} \tag{20}$$
$$= 1 - \frac{1}{c^2}(v_r + v_\phi)^2 \tag{21}$$
$$= 1 - \frac{1}{c^2}(v_r + r\Omega_k)^2. \tag{22}$$

This result mirrors the GR proper time flow structure, yet is entirely fluid-mechanical. It predicts the slowing of proper time near intense vortex structures due to Æther flow speeds approaching c, effectively creating a "time-well" analogous to gravitational redshift.

Kerr-Like Time Adjustment from Vorticity and Circulation

The General Relativistic form of time adjustment near a rotating mass, such as in the Kerr geometry, is approximately

$$t_{\text{adjusted}} = \Delta t \cdot \sqrt{1 - \frac{2GM}{rc^2} - \frac{J^2}{r^3c^2}}. \tag{23}$$

We now express this in Æther-vortex terms, replacing M and J with effective vorticity energy density and circulation:

- Mass-energy term: $\dfrac{2GM}{rc^2} \to \dfrac{\gamma\langle\omega^2\rangle}{rc^2}$,

- Angular momentum term: $\frac{J^2}{r^3c^2} \to \frac{\kappa^2}{r^3c^2}$.

Thus, the Æther-based analog becomes:

$$\boxed{t_{\text{adjusted}} = \Delta t \cdot \sqrt{1 - \frac{\gamma\langle\omega^2\rangle}{rc^2} - \frac{\kappa^2}{r^3c^2}}} \tag{24}$$

This formulation reproduces gravitational and frame-dragging time effects purely from Æther dynamics: $\langle\omega^2\rangle$ plays the role of gravitational redshift, and circulation κ encodes rotational drag. This approach aligns with recent fluid-dynamic interpretations of gravity and time [1**?**].

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Step-by-Step Derivation

1. Rotational Energy of a Vortex Knot

From classical mechanics:

$$E_{\text{rot}} = \frac{1}{2} I \Omega_k^2$$

where:

- I is the moment of inertia of the vortex core.
- Ω_k is the internal angular velocity of the knot.

2. Time Rate Reduction by Energy Storage

Assume local time rate slows with increasing internal energy:

$$t_{\text{local}} = \frac{t_{\text{abs}}}{1 + \alpha E_{\text{rot}}} = \frac{t_{\text{abs}}}{1 + \alpha \cdot \frac{1}{2} I \Omega_k^2} = \frac{t_{\text{abs}}}{1 + \frac{1}{2} \alpha I \Omega_k^2}$$

3. Series Expansion for Small Rotation (Low Ω_k)

Expanding:

$$\frac{t_{\text{local}}}{t_{\text{abs}}} \approx 1 - \frac{1}{2} \alpha I \Omega_k^2 + \mathcal{O}(\Omega_k^4)$$

This matches the special relativistic time dilation form:

$$\frac{t_{\text{moving}}}{t_{\text{rest}}} \approx 1 - \frac{v^2}{2c^2}$$

Final Expression

$$t_{\text{local}} = \frac{t_{\text{abs}}}{1 + \frac{1}{2} \alpha I \Omega_k^2}$$

This gives you a vortex-theoretic basis for time modulation, embedding rotational inertia and allowing quantitative modeling of local time slowdowns.