The Vortex Æther Model: Æther Vortex Field Model

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Abstract

The Vortex Æther Model (VAM) introduces a unified, non-relativistic framework wherein gravity, electromagnetism, and quantum phenomena emerge from structured vorticity in an inviscid superfluid-like æther. Unlike General Relativity, which invokes spacetime curvature, VAM models stable vortex knots in a 3D Euclidean medium with absolute time. Observed time dilation results from vortex-induced local energy gradients. This paper derives time dilation analogs to GR, explores vortex-energetic time shifts, and presents experimental implications.

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Core Assumptions

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

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

Introduction to 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

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

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).

I. TIME DILATION FROM VORTEX DYNAMICS

We consider an inviscid, irrotational superfluid æther with stable topological vortex knots. The Æther experiences absolute time t_{abs}, but local clocks experience slowed rates due to pressure gradients and knot energetics. 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.

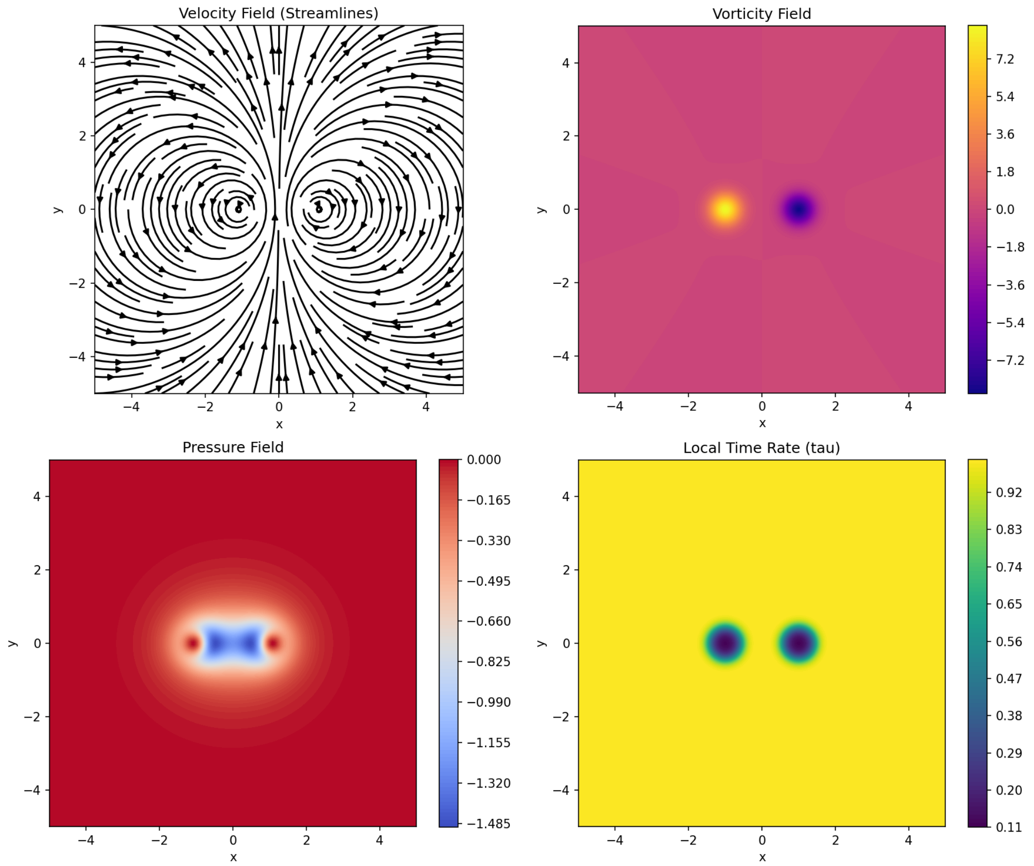

FIG. 1: Velocity streamlines, vorticity, pressure, and local time rate τ for a simulated vortex pair. The pressure minimum and time slow-down clearly align with the regions of high vorticity. This directly illustrates the æther model's central claim: time dilation follows from vortex energetics and pressure depletion.

A. Bernoulli & Rotational Flow

In high-vorticity zones, Bernoulli's principle implies a local drop in pressure:

$$\frac{1}{2}\rho_{æ}v^2 + p = p_0 \quad \Rightarrow \quad p = p_0 - \frac{1}{2}\rho_{æ}v^2 \tag{5}$$

Assuming the local frequency of a clock is proportional to Æther pressure:

$$f_{\text{local}} = f_0\left(1 - \frac{\rho_{æ}v^2}{2p_0}\right) \tag{6}$$

Thus, the time dilation becomes:

$$\frac{t_{\text{local}}}{t_0} = \left(1 - \frac{\rho_{æ}v^2}{2p_0}\right)^{-1} \tag{7}$$

For circular vortex motion with $v = \Omega r$:

$$\frac{t_{\text{local}}}{t_0} \approx 1 + \frac{\rho_{æ}\Omega^2 r^2}{2p_0} \tag{8}$$

This is analogous to special relativistic dilation if $\rho_{æ}/p_0 \sim 1/c^2$.

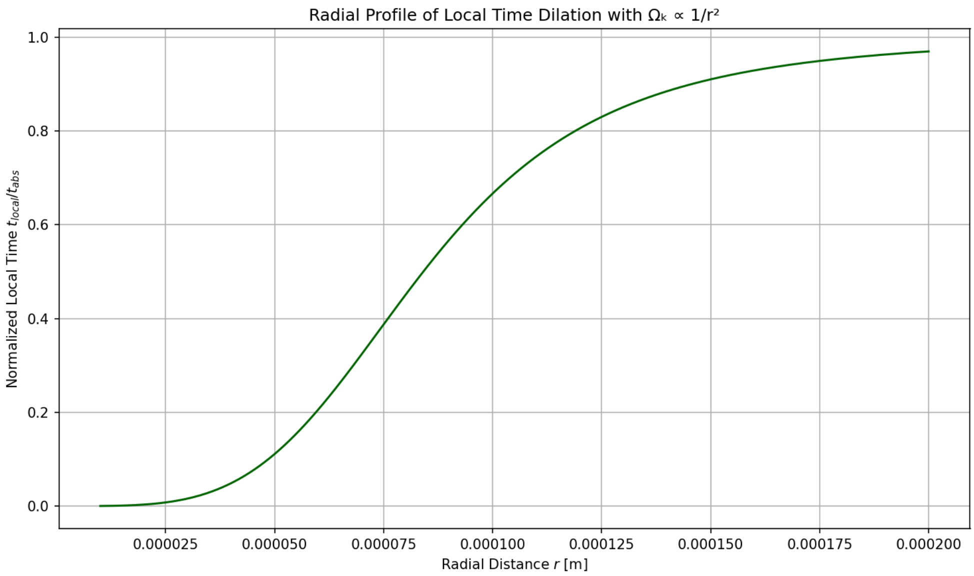

FIG. 2: Radial profile of normalized local time $t_{\text{local}}/t_{\text{abs}}$ as a function of distance r from the vortex core, assuming $\Omega_k \propto 1/r^2$. Time slows significantly near the vortex center and recovers to background values with distance.

B. Heuristic Knot-Based Time Modulation

Topological vortex knots possess internal rotation. Let Ω_k be their average angular velocity. We postulate a heuristic time modulation law:

$$\frac{t_{\text{local}}}{t_{\text{abs}}} = \left(1 + \alpha\Omega_k^2\right)^{-1} \tag{9}$$

where α is a coupling constant related to the Æther's compressibility or inertia. For small Ω_k, we expand:

$$\frac{t_{\text{local}}}{t_{\text{abs}}} \approx 1 - \alpha\Omega_k^2 + \mathcal{O}(\Omega_k^4) \tag{10}$$

This expression parallels the Lorentz factor for low velocities:

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

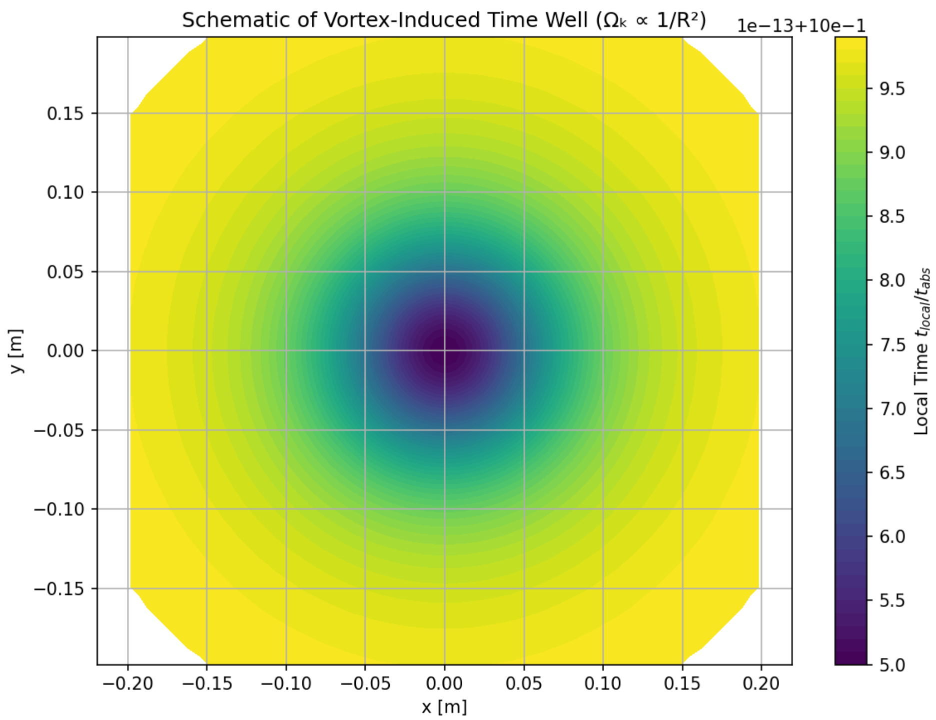

FIG. 3: Schematic of a vortex-induced time well in the æther. Local time $t_{\text{local}}/t_{\text{abs}}$ is shown as a color gradient in 2D space. The central vortex region exhibits the most time slowing due to high Ω_k, forming a well-like structure.

C. Energetic Interpretation: Rotational Inertia

The above heuristic can be grounded in the rotational energy of vortex knots. Let I be the effective moment of inertia of a knot, then the energy stored is:

$$E_{\text{rot}} = \frac{1}{2} I \Omega_k^2 \tag{11}$$

Assuming the time dilation arises from this stored energy modifying local information rates:

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

This model provides a bridge between fluid rotation and gravitational-like time shifts, replacing the need for spacetime curvature with internal knot energetics. It suggests that time flow slows where circulation is topologically conserved.

$$\boxed{t_{\text{local}} = \frac{t_{\text{abs}}}{1 + \alpha I \Omega_k^2}} \tag{13}$$

This boxed result summarizes the time modulation law driven by rotational inertia.

D. Conclusion and Experimental Outlook

The Vortex Æther Model replaces spacetime curvature with conserved vorticity in a 3D fluid. Time dilation arises from localized pressure depletion and kinetic energy storage within vortex knots, offering a classical, topological reinterpretation of relativistic effects. In this formulation, time slows in regions of high vorticity due to pressure depletion, aligning with relativistic predictions [1–3]. Future work includes simulations of vortex clocks and tests using BECs, helium II, or electrohydrodynamic lifters.

II. TIME MODULATION BY VORTEX KNOT ROTATION

In the æther-vortex model, matter is composed of stable, topologically conserved vortex knots embedded in a superfluid medium. Each knot possesses an intrinsic angular velocity Ω_k, and its local dynamics influence the rate at which time flows relative to the absolute time of the background æther. We hypothesize that time modulation arises from the rotational energetics of these knots, without invoking spacetime curvature as in General Relativity.

A. Heuristic and Energetic Derivation

We begin with the ansatz that the local rate of time is slowed by internal rotation:

$$\frac{t_{\text{local}}}{t_{\text{abs}}} = \left(1 + \alpha\Omega_k^2\right)^{-1} \tag{14}$$

where:

- t_{abs} is the absolute æther time,
- Ω_k is the average angular frequency of the knot's core rotation,
- α is a coupling parameter characterizing the effect of vorticity on local time.

This has the same low-velocity expansion as special relativity:

$$\frac{t_{\text{local}}}{t_{\text{abs}}} \approx 1 - \alpha\Omega_k^2 + \mathcal{O}(\Omega_k^4) \tag{15}$$

which parallels the Lorentz dilation:

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

We can give Equation 14 a physical basis via the rotational energy of the knot:

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

This yields a more fundamental expression for time modulation:

$$\frac{t_{\text{local}}}{t_{\text{abs}}} = (1 + \alpha E_{\text{rot}})^{-1} = \left(1 + \frac{1}{2}\alpha I \Omega_k^2\right)^{-1} \tag{16}$$

B. Topological and Physical Justification

Rotating vortex knots store both kinetic energy and helicity:

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

Helicity is conserved in ideal flows and reflects knot topology. Therefore, Ω_k serves as a meaningful descriptor of the particle's internal "clock rate." Faster rotation leads to deeper pressure wells and time slowing, akin to gravitational redshift.

This model:

- Explains time modulation intrinsically without reference frames,
- Avoids invoking curved spacetime,
- Ties time dilation to fluid-dynamic, conserved quantities.

$$\boxed{t_{\text{local}} = \frac{t_{\text{abs}}}{1 + \frac{1}{2}\alpha I \Omega_k^2}} \tag{17}$$

This boxed equation summarizes time dilation as a function of rotational inertia in the vortex core, forming the foundation of the vortex-energetic time model.

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

$$\left(\frac{d\tau}{dt}\right)^2_{\text{GR}} = -\left[g_{tt} + 2g_{t\phi}\Omega_{\text{eff}} + g_{\phi\phi}\Omega_{\text{eff}}^2\right], \tag{18}$$

where Ω_{eff} is the observer's angular velocity, and the metric components $g_{\mu\nu}$ describe spacetime curvature (e.g., Kerr geometry) [6].

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:

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

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, 7].

Substituting into the structure of Equation 18, we obtain:

$$\left(\frac{d\tau}{dt}\right)^2_{\text{Æther}} = 1 - \frac{v_r^2}{c^2} - 2\frac{v_r v_\phi}{c^2} - \frac{v_\phi^2}{c^2} \tag{19}$$

$$= 1 - \frac{1}{c^2}(v_r + v_\phi)^2 \tag{20}$$

$$= 1 - \frac{1}{c^2}(v_r + r\Omega_k)^2. \tag{21}$$

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

$$t_{\text{adjusted}} = \Delta t \cdot \sqrt{1 - \frac{2GM}{rc^2} - \frac{J^2}{r^3c^2}}. \tag{22}$$

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: $\dfrac{J^2}{r^3c^2} \to \dfrac{\kappa^2}{r^3c^2}$.

Thus, the Æther-based analog becomes:

$$\boxed{t_{\text{adjusted}} = \Delta t \cdot \sqrt{1 - \frac{\gamma\langle\omega^2\rangle}{rc^2} - \frac{\kappa^2}{r^3c^2}}} \tag{23}$$

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 [8], [1]. This model currently assumes irrotational flow outside knots and neglects viscosity, turbulence, and quantum compressibility. Future extensions may include quantized circulation spectra or boundary effects in confined Æther systems.

$$\boxed{\left(\frac{d\tau}{dt}\right)^2 = 1 - \frac{1}{c^2}\left(v_r + r\Omega_k\right)^2} \tag{24}$$

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[1] M. Fedi, HAL Archive (2017).

[2] T. Simula, Physical Review A **101**, 063616 (2020).

[3] F. Winterberg, Zeitschrift für Naturforschung A **45**, 1008 (1990).

[4] H. K. Moffatt, Journal of Fluid Mechanics **35**, 117 (1969).

[5] D. Kleckner and W. T. Irvine, Nature Physics **9**, 253 (2013).

[6] C. W. Misner, K. S. Thorne, and J. A. Wheeler, *Gravitation* (W.H. Freeman, 1973).

[7] V. Sbitnev, Universe **7**, 32 (2021).

[8] C. Barceló, S. Liberati, and M. Visser, Living Reviews in Relativity **14**, 3 (2011).

Appendix A: Appendix

I. 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

$$\mathcal{H} = \int \vec{v} \cdot \vec{\omega}\, d^3x \tag{A1}$$

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

II. 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:

$$\vec{F}_{\text{int}} = \beta \cdot \kappa_1 \kappa_2 \cdot \frac{\vec{r}_{12} \times (\vec{v}_1 - \vec{v}_2)}{|\vec{r}_{12}|^3} \tag{A2}$$

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

III. 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

$$\langle \omega^2 \rangle \sim \frac{\hbar}{\rho_{æ} \xi^4} \tag{A3}$$

Where ξ is the coherence length between vortex filaments