Emergent General Relativity from Structured Swirl Dynamics in the Vortex Æther Model (VAM)

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Abstract

We present a unified derivation showing that both Special and General Relativity emerge as effective limiting behaviors of the Vortex Æther Model (VAM), a fluid-dynamic theory with absolute time and Euclidean space. In the low-vorticity limit, we recover Lorentz-invariant observables as consequences of swirl field kinematics. In curved swirl topologies, gravitational phenomena of GR arise from vorticity and pressure gradients, suggesting spacetime curvature is emergent from coherent vortex dynamics.

Key Equations and Definitions

$$\boxed{\frac{d\tau}{d\mathcal{N}} = \sqrt{1 - \frac{|\vec{v}_\theta|^2}{c^2}}} \quad \text{with} \quad |\vec{v}_\theta| = |\vec{\omega}|r \tag{1}$$

$$\boxed{T_v = \oint \frac{ds}{v_{\text{phase}}}} \tag{2}$$

$$\boxed{\nabla S(t) = \frac{dS}{d\mathcal{N}} + \vec{\omega}(\tau) \cdot \hat{n}} \tag{3}$$

$$\boxed{ds^2 = C_e^2 dT_v^2 - dr^2} \tag{4}$$

Temporal Constructs in VAM

Temporal Modes in the Vortex Æther Model

- $\mathcal{N}$ — **Aithēr-Time**: absolute global time
- τ — **Chronos-Time**: local proper time
- $S(t)^{\circlearrowleft/\circlearrowright}$ — **Swirl Clock**: internal rotational phase
- T_v — **Vortex Proper Time**: topological loop-based time

Gravitational Redshift Analogue

$$\boxed{\frac{d\tau}{d\mathcal{N}} = \sqrt{1 - \frac{\Gamma^2}{4\pi^2 r^2 c^2}}} \tag{5}$$

Conclusion

The Vortex Æther Model reinterprets relativistic and gravitational phenomena through fluid dynamics and internal topological clocks, offering a dual causality framework — radiative (c) and internal (C_e) — with falsifiable predictions in high-vorticity regimes.