Swirl–String Theory: Canonical Fluid Reformulation of Relativity and Quantum Structure

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Abstract

We present Swirl–String Theory (SST) as a canonical, mechanical reformulation of relativistic and quantum structure based on an incompressible, inviscid medium endowed with quantized internal rotation ("swirl strings"). We state kinematic axioms, fix the symbol set $\{\mathbf{v}_{\circlearrowleft}, r_c, \rho_{!f}, \rho_{!E}, \rho_{!m}\}$ and derive: (i) local time scaling from swirl speed; (ii) a stress–pressure correspondence replacing spacetime curvature in the weak field; (iii) circulation quantization leading to discrete particle attributes. We prove a Chronos–Kelvin invariant, construct an analogue metric, and show correspondence limits to GR and linear quantum wave equations. Dimensional anchors and numerical benchmarks are provided from a single constant set. We conclude with falsifiable predictions and a program for experimental probes.

Contents

1 Introduction

Motivation. Modern physics excels empirically yet rests on distinct ontologies for gravitation and quantum fields. SST posits a shared mechanical origin governed by incompressible kinematics, vorticity conservation, and circulation quantization.

Contributions. This paper (i) states the axioms; (ii) fixes symbols and constants; (iii) establishes GR/QFT correspondences; (iv) lists falsifiers.

2 Kinematic Axioms and Conservation Laws

K1. **Incompressible, inviscid continuum:** $\nabla \cdot \mathbf{v} = 0$, with Euler form $\frac{\mathrm{D}}{\mathrm{D}t}\mathbf{v} = -\nabla p/\rho_{!f}$.

K2. **Swirl time scaling (Chronos/Swirl–Clock):**

$$dt_{\text{local}} = dt_{\infty}\sqrt{1 - \frac{\|\mathbf{v}_{\circlearrowleft}\|^2}{c^2}}. \tag{1}$$

K3. **Kelvin circulation and material invariance:** $(\frac{\mathrm{D}}{\mathrm{D}t}(R^2\omega) = 0) underconditionsofincompressibility, bar$

Derived densities:

$$\rho_{!E} = \tfrac{1}{2}\rho_{!f}\|\mathbf{v}_{\circlearrowleft}\|^2, \qquad \rho_{!m} = \frac{\rho_{!E}}{c^2}. \tag{2}$$

3 Canonical Constants and Dimensional Anchors

We adopt the canonical set $\{\mathbf{v}_{\circlearrowleft}, r_c, \rho_{!f}, \rho_{!E}, \rho_{!m}, F^{\max}_{\mathrm{swirl}}, F^{\max}_{\mathrm{gr}}\}$.

Table ?? lists values and units (populated in Appendix ??).

Table 1: Canonical constants (to be numerically populated).

Symbol	Meaning	Dimension	Value (SI)
$\mathbf{v}_{\circlearrowleft}$	characteristic swirl speed	L T^{-1}	$1.09384563 \times 10^{6}\,\mathrm{m\,s^{-1}}$
r_c	core radius	L	$1.40897017 \times 10^{-15}\,\mathrm{m}$
$\rho_{!f}$	effective fluid density	M L^{-3}	$7.0 \times 10^{-7}\,\mathrm{kg\,m^{-3}}$
ρ_{core}	core density	M L^{-3}	$3.8934358266918687 \times 10^{18}\,\mathrm{kg\,m^{-3}}$
$F^{\max}_{\mathrm{swirl}}$	max swirl force	M L T^{-2}	$29.053507\,\mathrm{N}$
$F^{\max}_{\mathrm{gr}}$	max gravitational force	M L T^{-2}	$3.02563 \times 10^{43}\,\mathrm{N}$

4 Relativistic Correspondence: Analogue Metric and Weak Field

We define the effective line element

$$\mathrm{ds}^2 =: c^2 dt^2 \Big(1 - \tfrac{\|\mathbf{v}_{\circlearrowleft}\|^2}{c^2}\Big) - d\mathbf{x}^2, \tag{3}$$

which yields gravitational time dilation in the weak-swirl limit.

4.1 Stress–pressure mapping to Newtonian limit

4.2 Constraints and known-limit checks

5 Quantum Correspondence: Circulation Quantization

5.1 Action principle

$$\mathrm{S}_{\mathrm{SST}} = \int \Big[\tfrac{1}{2}\rho_{!f}\mathbf{v}^2 - \rho_{!f}\Phi(\rho_{!f}) - \lambda(\nabla \cdot \mathbf{v})\Big]\, d^3x\, dt. \tag{4}$$

Linearization about a stationary background leads to wave equations analogous to massive/massless sectors.

5.2 Topological sectors and particle taxonomy

6 Canonical Correspondences

7 Predictions and Falsifiers

1. Time dilation near rotating cores measurable via clock comparison (scaling with $\|\mathbf{v}_{\circlearrowleft}\|^2$).
2. Swirl–EMF coupling in rotating frames (separate dedicated paper; referenced test geometry).

Table 2: Dictionary between relativistic/quantum objects and SST quantities.

GR/QFT concept	SST counterpart
Metric curvature $R_{\mu\nu}$	Swirl-pressure tensor gradients
Stress–energy $T_{\mu\nu}$	Energy–momentum flux of $(\rho_{!f}, \mathbf{v})$
Quantum phase	String-phase circulation (quantized)
Planck constant $\hbar$	Circulation quantum (to be calibrated)

3. Astrophysical bounds: compact-object limits from $\rho_{!E}$ and $F_{\rm gr}^{\max}$.

8 Discussion and Outlook

Appendix A': Numerical Benchmarks (auto-filled)

Using the canonical constants $\|\mathbf{v}_{\circlearrowleft}\| = 1.09384563 \times 10^{6}\,\mathrm{m\,s^{-1}}$, $\rho_f = 7.0 \times 10^{-7}\,\mathrm{kg\,m^{-3}}$, $c = 2.99792458 \times 10^{8}\,\mathrm{m\,s^{-1}}$, and $r_c = 1.40897017 \times 10^{-15}\,\mathrm{m}$, we obtain:

$$\rho_E = \tfrac{1}{2}\,\rho_f\,\|\mathbf{v}_{\circlearrowleft}\|^2 = 0.5 \times (7.0 \times 10^{-7}) \times (1.09384563 \times 10^{6})^2 \tag{5}$$

$$= \boxed{4.187743917945338 \times 10^{5}\ \mathrm{J\,m^{-3}}}\ (=\ \mathrm{Pa}), \tag{6}$$

$$\rho_m = \rho_E/c^2 = \frac{4.187743917945338 \times 10^{5}}{(2.99792458 \times 10^{8})^2} = \boxed{4.65949350504008 \times 10^{-12}\ \mathrm{kg\,m^{-3}}}, \tag{7}$$

$$\frac{\|\mathbf{v}_{\circlearrowleft}\|}{c} = \boxed{3.648676278574026 \times 10^{-3}}, \tag{8}$$

$$\frac{dt_{\rm local}}{dt_{\infty}} = \sqrt{1 - (\|\mathbf{v}_{\circlearrowleft}\|/c)^2} = \boxed{0.999993343558553}, \tag{9}$$

$$E_{\rm core} = \rho_E\,\frac{4\pi}{3}\,r_c^3 = (4.187743917945338 \times 10^{5})\,\frac{4\pi}{3}\,(1.40897017 \times 10^{-15})^3 \tag{10}$$

$$= \boxed{4.906526191489413 \times 10^{-39}\ \mathrm{J}}. \tag{11}$$

Consistency: $\rho_m c^2 = \rho_E$ numerically to floating-point precision. Units: $[\rho_E] = \mathrm{J\,m^{-3}} = \mathrm{Pa}$, $[\rho_m] = \mathrm{kg\,m^{-3}}$.

Table 3: Benchmark values derived from the canonical constants.

Quantity	Expression	Value (SI)
Swirl energy density	$\frac{1}{2}\rho_f\,\|\mathbf{v}_{\circlearrowleft}\|^2$	$4.187743917945338 \times 10^{5}\,\mathrm{J\,m^{-3}}$
Mass-equivalent density	ρ_E/c^2	$4.65949350504008 \times 10^{-12}\,\mathrm{kg\,m^{-3}}$
Time-dilation factor	$\sqrt{1 - (\|\mathbf{v}_{\circlearrowleft}\|/c)^2}$	0.999993343558553
Core-volume energy	$\rho_E\,(4\pi/3)\,r_c^3$	$4.906526191489413 \times 10^{-39}\,\mathrm{J}$

A Dimensional Analysis and Numerical Validation

A.1 Units

A.2 Numerical benchmarks

B Derivation of a Swirl Coupling for G (optional)

Acknowledgments

Data and Code Availability

All computations and figure scripts will be released upon publication.

Conflict of Interest

The author declares no competing interests.