Cosmological Foundations in Swirl String Theory

Omar Iskandarani
Independent Researcher, Groningen, The Netherlands[*]
(Dated: September 22, 2025)

This Canon Cheat-Sheet condenses *Swirl String Theory (SST)* for cosmology: definitions, constants, boxed master equations, and notational conventions. It emphasizes dimensional consistency, known-limit checks, and minimal assumptions.

FOUNDATIONS

- **Arena:** Flat $\mathbb{R}^3$ with absolute (Chronos) time.
- **Medium:** Homogeneous, incompressible swirl condensate of density ρ_f; circulation quantized in closed filaments ("swirl strings").
- **Gravity:** Emergent from swirl-pressure and clock-rate gradients; no curved spacetime.

SWIRL COSMOGONY (GENESIS VIA KNOTS)

- **Primordial:** Uniform, laminar state (topologically trivial).
- **Instability:** Fluctuations/reconnections nucleate closed loops (unknots).
- **Knot genesis:** Reconnection cascades stabilize nontrivial knots; topology protects excitation.
- **Freeze-in:** Energy is inherited via line-length and local topology.
- **Causal asymmetry:** Arrow of time measured by monotone growth of knot complexity and coherent volume fraction.
- **Inflation-like era:** Burst of coherence and reconnection leads to exponential growth of coherent domains.
- **Post-era:** Knots seed matter; coherence zones act as gravitational attractors.

SWIRL CLOCK, TIME DILATION, AND REDSHIFT

Define the swirl-clock factor

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

Cosmological redshift is interpreted as a clock-ratio:

$$1 + z \;=\; \frac{S_t^{-1}(\text{emit})}{S_t^{-1}(\text{obs})} \quad \text{(line-of-sight shear gives subleading corrections).}$$

Analogy (age 10): Clocks run slower near strong swirls; light leaving slow-clock regions looks redder, like a stretched spring.

[*] ORCID: 0009-0006-1686-3961, DOI: 10.5281/zenodo.17155748

EMERGENT GRAVITY FROM SWIRL PRESSURE

For axisymmetric swirl with azimuthal speed $v_\theta(r)$, steady Euler balance gives

$$\frac{1}{\rho_f}\,\frac{dp_{\rm swirl}}{dr} \;=\; \frac{v_\theta^2}{r},$$

so an effective inward acceleration $g_{\rm eff}(r) = v_\theta^2/r$, approximating $1/r^2$ attraction when $v_\theta \propto r^{-1/2}$.

VACUUM (CORE) ENERGY DENSITY SCALE

Assuming the core carries the characteristic swirl speed $\|\mathbf{v}_\circlearrowleft\| \approx v_\circlearrowleft$,

$$u \;=\; \tfrac{1}{2}\,\rho_{\rm core}\,\|\mathbf{v}_\circlearrowleft\|^2.$$

Numerical check (SI):

$$\rho_{\rm core} = 3.8934358266918687\times10^{18}\ \mathrm{kg\,m^{-3}},\quad \|\mathbf{v}_\circlearrowleft\| = 1.09384563\times10^{6}\ \mathrm{m\,s^{-1}} \;\Rightarrow\; u \approx 2.329\times10^{30}\ \mathrm{J\,m^{-3}}.$$

INVARIANT MASS LAW FOR KNOTTED EXCITATIONS (CANONICAL)

Let $L_{\rm tot}(K)$ be a *dimensionless* ropelength of knot K. The dimensionally correct SST mass law used in particle fits is

$$\boxed{M(K) \;=\; \left(\frac{4}{\alpha_{\rm fs}}\right) b(K)^{-3/2}\,\phi^{-g(K)}\,n(K)^{-1/\phi}\;\frac{u\,\big(\pi\,r_c^3\,L_{\rm tot}(K)\big)}{c^2}} \tag{1}$$

with b (braid index proxy), g (genus proxy), n (component count), and $\phi = \exp\!\big(\operatorname{asinh}\!\big(\tfrac{1}{2}\big)\big)$ per the Golden policy.

Units check. $u[\mathrm{J\,m^{-3}}]\cdot(\pi r_c^3 L_{\rm tot})[\mathrm{m^3}]/c^2 \to \mathrm{kg}$.

Mass scale per unit L_{tot} (numerical).

$$\frac{u\,\pi r_c^3}{c^2} = \frac{(2.329\times10^{30})\,[\mathrm{J\,m^{-3}}]\cdot\pi(1.40897\times10^{-15}\ \mathrm{m})^3}{(2.9979\times10^{8}\ \mathrm{m\,s^{-1}})^2} \approx 2.28\times10^{-31}\ \mathrm{kg}.$$

Including $4/\alpha_{\rm fs} \approx 5.48\times10^2$ sets the observed lepton/baryon scale once $L_{\rm tot}(e)$ is calibrated.

KNOT TOPOLOGIES FOR STANDARD PARTICLES

Designation	Representative knot	b	g	n
Electron e^-	Trefoil (3_1, torus)	3	1	1
Muon μ^-	Cinquefoil (5_1, torus)	5	2	1
Proton p	3-component chiral compound	3	2	3
Neutron n	as proton, different core strengths	3	2	3
Photon γ	Unknot (closed loop)	1	0	1

TABLE I. SST classification parameters (b, g, n) used in Eq. (**??**).

Proton–neutron split (internal geometry). Let $s_u \approx 2.828$, $s_d \approx 3.164$ denote geometric swirl volumes (e.g., from hyperbolic data of candidate subknots $5_2, 6_1$). With global scale $2\pi^2\kappa_R$ (e.g., $\kappa_R \approx 2$):

$$L_{\rm tot}^{(p)} = \lambda_b\,(2s_u + s_d)\,(2\pi^2\kappa_R),$$
$$L_{\rm tot}^{(n)} = \lambda_b\,(s_u + 2s_d)\,(2\pi^2\kappa_R),$$

preserving (b, g, n) while shifting masses via internal geometry.

SST $\leftrightarrow$ ΛCDM: MINIMAL DICTIONARY

- **Effective Hubble rate:** $1+z = S_t^{-1}(\text{em})/S_t^{-1}(\text{obs}) \Rightarrow H_{\text{eff}}(t) \equiv \frac{d}{dt}\ln(1+z) = -\frac{d}{dt}\ln S_t$.
- **Distances:** Use $H_{\text{eff}}(z)$ in FRW distance integrals, $D_L(z) = (1+z)\int_0^z \frac{c\,dz'}{H_{\text{eff}}(z')}$, with small corrections if S_t varies along the line of sight.
- **BAO/CMB:** Coherence correlation length plays the role of a standard ruler; freeze-out of swirl modes maps to acoustic peaks.
- **Growth:** Growth rate $f\sigma_8$ encodes build-up of coherent domains under reconnection and shear of $\mathbf{v}_{\circlearrowleft}$.

OBSERVATIONAL CONSEQUENCES AND FALSIFIERS

Falsifiable predictions

- **SN Ia host dependence:** After standardization, Hubble residuals correlate with local density (voids vs. clusters) via ΔS_t.
- **Strong-lens time delays:** Inferred H_0 shifts with environmental S_t; joint modeling predicts a sign/magnitude.
- **Redshift drift (Sandage test):** $\dot{z} = H_{\text{eff},0} - H_{\text{eff}}(z)/(1+z)$. SST curves differ if S_t evolves non-FRW-like.
- **BAO AP anisotropy:** Directional S_t gradients generate Alcock–Paczyński distortions at 10^{-3}–10^{-2}.
- **GW speed:** $c_{\text{GW}} = c$ (baseline $c_{13} = 0$); persistent $c_{\text{GW}} \neq c$ falsifies this sector.

CANONICAL CONSTANTS (SI)

Quantity	Symbol	Value
Swirl core radius	r_c	1.40897017×10^{-15} m
Effective density	ρ_f	7.0×10^{-7} kg m^{-3}
Core density	ρ_{core}	$3.8934358266918687\times10^{18}$ kg m^{-3}
Swirl speed (char.)	$\lVert\mathbf{v}_{\circlearrowleft}\rVert$	1.09384563×10^{6} m s^{-1}
Speed of light	c	2.99792458×10^{8} m s^{-1}
Fine structure const.	α_{fs}	$7.2973525693\times10^{-3}$

IMPLEMENTATION NOTES (DATA FITS)

1. Calibrate $L_{\text{tot}}(e)$ from M_e using Eq. (**??**).
2. Fix λ_b, κ_R on (e, μ, p); predict remaining leptons/hadrons and isotope splittings.
3. Infer $H_{\text{eff}}(z)$ non-parametrically from SN Ia; compare with BAO ruler from coherence correlation length.
4. Cross-validate with time-delay lenses and CMB acoustic scale to bound line-of-sight variations in S_t.