SST Canon v0.3.4 — Cheat Sheet

Core setup (arena & objects)

- **Arena:** R^3 with absolute time; incompressible, inviscid swirl medium.
- **Strings:** closed, thin *swirl strings* with core radius and tangential speed at $r =$; excitations can be knotted/linked.
- **Topological labels:** braid index b, genus g, component count n; dimensionless ropelength L_{tot}.

Canonical constants (SI)

$= 1.09384563e6\ \mathrm{m\,s^{-1}}$, $= 1.40897017e-15\ \mathrm{m}$, $\rho_{\text{core}} = 3.8934358266918687e18\ \mathrm{kg\,m^{-3}}$, $\rho_f = 7.0e-7\ \mathrm{kg\,m^{-3}}$, $\alpha_{\text{fs}} = 7.2973525643e-3$, $c = 2.99792458e8\ \mathrm{m\,s^{-1}}$.

Master energy & mass (volume form)

$$\boxed{E_{\text{SST}}(V) = \frac{4}{\alpha\,\varphi}\Big(\tfrac{1}{2}\,\rho_f\,{}^2\Big)V\ ,}\qquad \boxed{M_{\text{SST}}(V) = E_{\text{SST}}/c^2\ .}$$

(Heuristic volume law; used for quick scaling checks.)

Invariant mass law (canonical, used in code)

Define the swirl energy density scale on the core

$$u = \tfrac{1}{2}\,\rho_{\text{core}}\,{}^2, \qquad V(K) = \pi^2(r_c L_{\text{tot}}) = \pi^3 L_{\text{tot}}.$$

With the canonical topological multiplier

$$\Xi_{\text{top}}(K) = \frac{4}{\alpha_{\text{fs}}}\,b^{-3/2}\,\varphi^{-g}\,n^{-1/\varphi},$$

the *invariant mass law* is

$$\boxed{M(K) = \frac{4}{\alpha_{\text{fs}}}\,b^{-3/2}\,\varphi^{-g}\,n^{-1/\varphi}\,\frac{u\,\pi^3\,L_{\text{tot}}}{c^2}.}$$

Leptons: invert to solve L_{tot} from $M_\ell^{(\text{exp})}$.

$$L_{\text{tot}}^{(\ell)} = \frac{M_\ell^{(\text{exp})}c^2}{\big(\frac{4}{\alpha_{\text{fs}}}b^{-3/2}\varphi^{-g}n^{-1/\varphi}\big)\,u\,\pi^3}.$$

Baryons (exact_closure):

$$L_p = \lambda_b(2s_u + s_d)\mathcal{S}, \quad L_n = \lambda_b(s_u + 2s_d)\mathcal{S}, \quad \mathcal{S} = 2\pi^2\kappa_R,\ \kappa_R = 2,\ \lambda_b = 1.$$

Let

$$K = \left[\tfrac{4}{\alpha_{\mathrm{fs}}}\, 3^{-3/2}\, \varphi^{-2}\, 3^{-1/\varphi}\right] \frac{u\,\pi^3\mathcal{S}}{c^2}.$$

Fitting (s_u, s_d) from $M_p^{(\mathrm{exp})}, M_n^{(\mathrm{exp})}$:

$$\begin{bmatrix} 2 & 1 \\ 1 & 2 \end{bmatrix}\begin{bmatrix} s_u \\ s_d \end{bmatrix} = \frac{1}{K}\begin{bmatrix} M_p^{(\mathrm{exp})} \\ M_n^{(\mathrm{exp})} \end{bmatrix}, \quad s_u = \frac{2M_p^{(\mathrm{exp})} - M_n^{(\mathrm{exp})}}{3K}, \quad s_d = \frac{M_p^{(\mathrm{exp})}}{K} - 2s_u.$$

Swirl Clock (local time rate)

$$\boxed{\frac{dt_{\mathrm{local}}}{dt_\infty} = \sqrt{1 - \frac{\|\|^2}{c^2}} = \sqrt{1 - \frac{\|\boldsymbol{\omega}\|^{22}}{c^2}} \quad (r =).}$$

Swirl pressure law (Euler corollary)

Steady azimuthal drift $v_\theta(r)$:

$$\boxed{\frac{1}{\rho_f}\frac{dp_{\mathrm{swirl}}}{dr} = \frac{v_\theta(r)^2}{r}.}$$

Flat $v_\theta \to v_0$ gives $p_{\mathrm{swirl}}(r) = p_0 + \rho_f v_0^2 \ln(r/r_0)$.

Photon sector (unknot boson, lossless waves)

Transverse swirl potential $\mathbf{a}$ with $\mathbf{v} = \partial_t\mathbf{a}$, $\mathbf{b} = \nabla \times \mathbf{a}$,

$$\mathcal{L}_{\mathrm{swirl}} = \frac{\rho_f}{2}\big(|\mathbf{v}|^2 - c^2|\mathbf{b}|^2\big), \quad \partial_t^2\mathbf{a} - c^2\nabla \times (\nabla \times \mathbf{a}) = 0,\ \nabla\cdot\mathbf{a} = 0,$$

lossless radiation; map to $(\mathbf{E}, \mathbf{B})$ by a constant rescaling.

Calibration modes (mass tables)

- **exact_closure (used below):** e, μ, τ exact via solved L_{tot}; (s_u, s_d) fit so p, n exact.
- **canonical:** fixed (s_u, s_d); baryons predicted.
- **sector_norm:** fixed (s_u, s_d) with one λ_b to make p exact; n predicted.

Benchmarks (exact_closure mode)

Caption: Errors in atoms/molecules = missing binding energy contribution, not model failure.

Species	Known mass (kg)	Predicted mass (kg)	Error (%)
electron e-	9.109384e-31	9.109384e-31	0.0000
muon μ-	1.883532e-28	1.883532e-28	0.0000
tau τ-	3.167540e-27	3.167540e-27	0.0000
proton p	1.672622e-27	1.672622e-27	0.0000
neutron n	1.674927e-27	1.674927e-27	0.0000
Hydrogen-1 atom	1.673533e-27	1.673533e-27	0.0000
Helium-4 atom	6.646477e-27	6.689952e-27	0.6549
Carbon-12 atom	1.992647e-26	2.005276e-26	0.6330
Oxygen-16 atom	2.656017e-26	2.674532e-26	0.6980
H_2 molecule	3.367403e-27	3.347066e-27	-0.6040
H_2O molecule	2.991507e-26	3.009885e-26	0.6139
CO_2 molecule	7.305355e-26	7.354340e-26	0.6704

Diagnostics (exact_closure)

$u = \frac{1}{2}\rho_{\mathrm{core}}^2$, $\mathcal{S} = 2\pi^2\kappa_R$ with $\kappa_R = 2$; (s_u, s_d) from the 2×2 closure system; $\lambda_b = 1$.

Dimensional checks (spot)

$$[u] = \mathrm{J\,m^{-3}}, \quad [\pi^3 L_{\mathrm{tot}}] = \mathrm{m}^3, \quad \Rightarrow\ [M] = \frac{\mathrm{J}}{c^2} = \mathrm{kg}.$$

BibTEX(non-original background)

```
@article{Helmholtz1858,
  author  = {Helmholtz, Hermann von},
  title   = {Über Integrale der hydrodynamischen Gleichungen...},
  journal = {J. Reine Angew. Math.}, year = {1858},
  doi     = {10.1515/crll.1858.55.25}
}
@article{Kelvin1869,
  author  = {Thomson, William (Lord Kelvin)},
  title   = {On Vortex Motion}, journal = {Trans. R. Soc. Edinburgh},
  year    = {1869}, doi = {10.1017/S0080456800019378}
}
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@book{Batchelor1967,
  author = {Batchelor, G. K.}, title  = {An Introduction to Fluid Dynamics},
  year   = {1967}, publisher = {Cambridge Univ. Press}
}
@book{Saffman1992,
  author = {Saffman, P. G.}, title  = {Vortex Dynamics},
  year   = {1992}, publisher = {Cambridge Univ. Press}
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@misc{NISTCODATA2018,
  author = {NIST},
  title  = {CODATA Recommended Values of the Fundamental Constants (2018)},
  howpublished = {\url{https://physics.nist.gov/cuu/Constants/}},
  year   = {2019}
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  author = {Jackson, J. D.}, title = {Classical Electrodynamics},
  edition= {3rd}, year = {1999}, publisher = {Wiley}
}
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