Topology Equations

Complexity Committee Position Paper

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August 23, 2025

Purpose

We distill the bimetric teleparallel (BT8G) and CSR+ stack into a compact *Topology* layer: six foundational equations (bulk topology, locking, and positivity) and six extended equations (boundary flow, screening, and cosmology). Each is stated with a brief justification and a concrete application.

I. Notation

- Tetrads $e^a{}_\mu$, torsion $T^\lambda{}_{\mu\nu}$ (teleparallel)
- Phase θ (Josephson); dual sectors $(+/-)$
- Superpotential $S^{\rho\mu\nu}$
- Nieh-Yan denoted as NY
- Σ a codimension-1 interface
- Δ_Σ the Laplace–Beltrami on Σ
- $\phi = (1+\sqrt{5})/2$ (golden ratio)

II. Foundational Topology Equations

$$\boxed{\int_S \epsilon_{abc} T^a \wedge e^b \wedge e^c = 2\pi\, \chi(S), \qquad \chi(\mathrm{torus}) = 0.} \tag{1}$$

Justification: Teleparallel Gauss–Bonnet reduces to a boundary invariant; torus tiles enforce zero net torsion flux.

Application: Baseline flux neutrality that seeds CSR+ phase-lock and the toroidal lattice.

$$\Phi(\theta, \varphi) = \Phi_0 \, e^{i(n\theta + m\varphi)}, \quad n, m \in \mathbb{Z}. \tag{2}$$

Justification: Harmonics on T^2 form an integer lattice of normal modes.

Application: Discrete banding for the 741/315 Hz cascade and eigenmode indexing.

$$\oint_{C_i} \nabla \arg \Phi \cdot d\ell = 2\pi k_i, \quad k_i \in \mathbb{Z}. \tag{3}$$

Justification: Single-valuedness on T^2 protects integer phase slips.

Application: Defect bookkeeping and phase-slip energetics across tiles.

$$\mathcal{L}_T = \frac{\kappa}{2} T^{\lambda}{}_{\mu\nu} T_{\lambda}{}^{\mu\nu} \Rightarrow \mathcal{H}_T \geq 0. \tag{4}$$

Justification: TEGR torsion quadratic is positive-definite with Weitzenböck connection.

Application: Bounded Hamiltonian enabling stable phase damping and constraint control.

$$T^{a(+)}{}_{\mu\nu} - T^{a(-)}{}_{\mu\nu} = 2i\partial_{[\mu}\partial_{\nu]}\theta. \tag{5}$$

Justification: Variation of bimetric tetrads related by a local phase rotation.

Application: Maps phase gradients to torsion stress—the geometry/phase converter.

$$de^{a(+)} = \omega^{a}{}_{b(+)} \wedge e^{b(+)} + i\Omega^{a}{}_{b} \wedge e^{b(-)}. \tag{6}$$

Justification: Extends the teleparallel connection to a bimetric mediator Ω respecting locality.

Application: Gravity-only exchange channel behind the Jordan barrier.

III. Extended Topology Equations

$$n_\rho(S^{(+)\rho\mu\nu} - S^{(-)\rho\mu\nu})t_\mu s_\nu = J\sin\theta - \chi\Delta_\Sigma\theta + c_{\mathrm{NY}}\mathcal{N}_\Sigma. \tag{7}$$

Justification: Pillbox integration of the teleparallel divergence plus Josephson and NY sources.

Application: Tunes interface impedance to pass or pin phase; sets exchange across Σ.

$$\mu_T^{(+)} = \mu_T^{(-)}, \quad \mu_T \equiv \frac{\partial H}{\partial Q_{\mathrm{NY}}}, \quad \frac{d}{dt}(Q_{\mathrm{NY}}^{(+)} - Q_{\mathrm{NY}}^{(-)}) = -\int_\Sigma [J\sin\theta - \chi\Delta_\Sigma\theta + c_{\mathrm{NY}}\mathcal{N}_\Sigma]dA. \tag{8}$$

Justification: Quasilocal Hamiltonian H with NY charge Q_{NY} imposes chemical-potential equality at equilibrium.

Application: Tracks how bulk topology relaxes by boundary currents.

$$\mathcal{B}_\Sigma = \lambda_J \int_\Sigma L_{\mu\nu}T^{\mu\nu}dA + \frac{Z_\Sigma}{2}\int_\Sigma \theta^2 dA, \quad \lambda_J \to \infty \Rightarrow L_{\mu\nu}T^{\mu\nu}|_\Sigma = 0. \tag{9}$$

Justification: Boundary constraint enforces no direct matter–massive coupling; Z_Σ sets phase impedance.

Application: Guarantees GR/TEGR locally while allowing gravity-only exchange.

$$r_\star \sim \left(\frac{GM}{m_g^2}\right)^{1/3} \Xi_{\mathrm{TP}}, \qquad \frac{d\alpha_{\mathrm{eff}}(r)}{d\ln r} = -p\left(\frac{r_\star}{r}\right)^p \alpha_{\mathrm{eff}}(r),\ p \geq 1. \tag{10}$$

Justification: Balance massive-branch stiffness with torsion nonlinearities gives a Vainshtein-like radius; radial RG encodes screening.

Application: PPN safety (inside $r_\star$) with small, asymptotic Yukawa tails.

$$G_{\mathrm{eff}}(k,a) = G\left[1 + \alpha_{\mathrm{eff}}(a)\frac{k^2}{k^2 + a^2 m_g^2}\right], \quad \frac{d\alpha_{\mathrm{eff}}}{d\ln a} = \beta_\alpha(\chi, J, c_{\mathrm{NY}}; Z_\Sigma). \tag{11}$$

Justification: Integrate out Σ to get a Yukawa-modified Poisson operator with slow running from interface data.
Application: Predicts mild, testable scale-dependence in $f\sigma_8$ and lensing.

$$\boxed{\int_\Sigma (|\nabla_\Sigma \theta|^2 + m_\Sigma^2 \theta^2) dA \geq c_{\mathrm{NY}} \int_\Sigma \theta \mathcal{N}_\Sigma dA, \qquad m_\Sigma^2 \equiv \frac{J}{\chi}, \;\; \xi_\Sigma = m_\Sigma^{-1}. \qquad (12)}$$

Justification: Complete-the-square/Cauchy–Schwarz on the boundary functional with NY bias.
Application: Sets coherence patches and stability criteria for static equilibrium.

IV. Integration with Other Components

Into TETRAD

TE-F5 and TE-F6 are the bridge: the phase θ produces a torsion differential and couples via the cross-connection Ω; this is the minimal, local way the two tetrad stacks communicate without touching the matter frame.

Into TOROID

TE-F1–F4 are the torus backbone: flux neutrality (F1), mode lattice (F2), integer circulation (F3), and a positive torsion reservoir (F4). These feed the CSR+ Hamiltonian and radius-optimization logic.

Into TRANSLATIONS

The Josephson sector gives the drivers for TE-X1,X2,X6: J, χ and the NY bias enter the boundary law, the flow of Q_{NY}, and the coherence length.

V. Observable Signatures

Channel	**Signature**	**Why Topology**
Local PPN & pulsars	GR-like, no fifth force	TE-X3 barrier + TE-X4 screening
GWs	Tiny dispersion/leakage	Massive branch exists but decoupled from matter
LSS & lensing	Mild k-dependent G_{eff}	TE-X5 from boundary running
Lab cascades	Golden-ratio damping/coherence	TE-F4 + Josephson $\Rightarrow$ TE-X6

VI. Minimal Narrative

Choose the matter geometry first (Jordan-lock). Let gravity talk to itself behind a boundary that you control. The torus forces flux neutrality; the boundary sets how phase becomes geometry and how topology flows. Local physics stays GR; the sky carries the signal.