Appendices

Appendix A — Canonical Symbols and Notation

Symbol	Meaning	Role in C-6
$\mathcal{M}^E$	Entropic manifold	Dynamical arena for collapse PDEs
τ	Entropic evolution variable	Evolution parameter; not identical to physical time
σ	Abstract configuration label	Labels streamlines, initial conditions, sectors, or DOF indices
$X^I(\sigma, \tau)$	Configuration field	Collapse trajectory field over $\mathcal{M}^E$
$\dot{X}^I, \ddot{X}^I$	First and second τ-derivatives of X^I	Collapse velocity and acceleration
V^I	Velocity field	First-order reformulation variable, $V^I = \partial X^I/\partial \tau$
$\psi(x, \tau)$	Occupancy or probability-like density	Ensemble description of collapse states
$\Phi(X, \tau)$	Entropic potential	Drives collapse toward basin minima
$g^I{}_j$	Metric tensor on $\mathcal{M}^E$	Geometric measure used in PDE evolution

Symbol	Meaning	Role in C-6
$T^I{}_j$, T^{IJ}	Stability tensor	Encodes local stability, eigenmodes, and metric-like structure
$\Xi^I{}_j$, Ξ^{IJ}	Entanglement tensor	Transport connectivity and nonlocal coupling field
$\mathcal{R}^I{}_j{}^{KL}$	Curvature tensor	Curvature response of the evolving entropic manifold
$R^I{}_j$, $\bar{R}$	Ricci curvature / coarse scalar curvature	Curvature flow and macro-cosmological driver
$\Gamma^I{}_j{}^K$	Entanglement-induced connection	Determines geodesic deflection and transport
λ_{min}	Minimum eigenvalue	Soft-mode and bifurcation indicator
λ_{soft}	Soft eigenmode	Branch-sensitivity / quantum-like decision mode
det(T)	Determinant of stability tensor	Conifold pinch trigger
Ξ_{eff}	Effective entanglement strength	Wormhole threshold detector
Ξ_c	Critical entanglement threshold	Wormhole-transfer activation bound
K	Sectional or effective curvature	Basin birth and local topology indicator
H	Hessian of Φ	Local basin formation and stability diagnostic
N_{eff}	Effective DOF count	Renormalized degree-of-freedom flow variable

Symbol	Meaning	Role in C-6
ℓ	Scale parameter on $\mathcal{M}^E$	Used in coarse-graining and renormalization
$\mathcal{C}\_\ell$	Coarse-graining operator	Maps full fields to effective fields at scale ℓ
$\mathfrak{B}$_a	Basin region	Local macro/meso basin domain
$\mathcal{A}$	Attractor set	Classical-like steady collapse region
J	Collapse current	Used in boundary and conservation conditions

Appendix B — Equation Map of C-6

Equation / Expression	Location	Function
$T^{IJ} \longrightarrow T^{IJ}(\tau)$	Section 2	Converts stability geometry into dynamic field
$\Xi^{IJ} \longrightarrow \Xi^{IJ}(\tau)$	Section 2	Converts entanglement into transport field
$\mathcal{R}^I{}_j{}^{KL} \longrightarrow \mathcal{R}^I{}_j{}^{KL}(\tau)$	Section 2	Converts curvature into evolving memory field
$\ddot{x}^I + \Gamma^I{}_j{}^K \dot{x}^j \dot{x}^K = 0$	Section 3	C-5 geodesic law used as starting point
$x^I = x^I(\sigma, \tau)$	Section 3	Field promotion from one trajectory to collapse ensemble
$\partial^2 x^I/\partial\tau^2 + \Gamma^I{}_j{}^K(\partial x^j/\partial\tau)(\partial x^K/\partial\tau) = F^I$	Section 3	Core collapse wave equation

Equation / Expression	Location	Function
$\partial x^I/\partial\tau = v^I$	Section 3	First-order flow variable definition
$\partial v^I/\partial\tau = -\Gamma^I_{jK} v^j v^K + F^I$	Section 3	First-order velocity evolution
$\partial\tau Tij = -2Rij + \Phi ij(T, \Xi, \nabla\Xi, \nabla T, \ldots)$	Section 4	Modified Ricci-type flow of stability metric
$Y = (Tij, \Xi ij), \partial\tau Y = H(Y)$	Section 4	Curvature-field fixed point map
$H(Y^*) = 0$	Section 4	Defines stable curvature / topology fixed point
$K(x^*, \tau\_c) = 0, \partial K/\partial\tau > 0$	Section 5	Basin birth criterion
$\lambda\_min \longrightarrow 0, \partial\lambda\_min/\partial\tau < 0$	Section 5	Soft-mode bifurcation criterion
$\det T(x^*, \tau\_c) = 0$	Section 5	Conifold pinch formation criterion
$\Xi\_eff(A, B; \tau\_c) > \Xi\_c$	Section 5	Wormhole-transfer threshold
$\int\psi(x,\tau)dV = const$	Section 5.6	Occupancy conservation under non-absorbing boundary conditions
$E\_collapse = \int\psi(x,\tau)\Phi(x,\tau)dV$	Section 5.6	Collapse energy functional
$\bar{g}^I_j = \mathcal{C}\_\ell[g^I_j]$	Section 6	Coarse-grained metric at scale ℓ
$\mathcal{R}^I_{jKL} = \mathcal{C}\_\ell[\mathcal{R}^I_{jKL}]$	Section 6	Coarse-grained curvature tensor
$\partial N(\ell,\tau)/\partial \ln\ell = \beta\_N$	Section 6	Renormalization flow of DOF count
$N\_eff(\tau+\Delta\tau)=\mathcal{R}\{N(\tau)$	$\lambda\_soft, \mathcal{R}, \Xi\_eff, \ldots\}$	Section 6.4.1

Equation / Expression	Location	Function
dU/dτ = F(U(τ))	Section 7	Discretized solver form
Ξ_effᴵj(x,x′;τ)=∫Kᴵj(	x—x′	;ℓ)ψ(x′,τ)dx′

Appendix C — Topology-Event and Boundary-Condition Summary

Event / Condition	Mathematical Trigger	Topological Effect	C-7 Action
Basin birth	K ⟶ + and H becomes positive-definite	New attractor appears	Register new basin
Soft-mode bifurcation	λ_min ⟶ 0, then sign change	Basin splits into branches	Track eigenvector and split attractor
Conifold pinch	det(T) ⟶ 0 and neck radius shrinks	Manifold forms singular neck	Refine mesh / trigger topology monitor
Wormhole transfer	Conifold pinch + Ξ_eff > Ξ_c	Nonlocal bridge forms	Add graph/FEM nonlocal coupling
Basin merge	Barrier disappears between basins	Two attractors become one	Merge basin registry entries
Basin death	Basin depth or volume ⟶ 0	Attractor dissolves	Remove basin and redistribute occupancy
Curvature breathing	R̄(τ) oscillates or changes regime	Epoch transition	Update macro-regime label
Renormalized DOF jump	topology event or λ_soft collapse	Effective DOF count changes	Update N_eff and resolution level
Absorbing boundary	trajectory reaches sink region	Occupancy removed	Decrease mass / terminate trajectory

Event / Condition	Mathematical Trigger	Topological Effect	C-7 Action
Reflecting boundary	$n \cdot \nabla \Phi = 0$ and $n \cdot J = 0$	No outward flow	Enforce no-flux condition
Periodic / identified boundary	$\partial \mathcal{M}^E$ glued topologically	Boundaryless compact behavior	Identify nodes / wrap topology

Appendix D — Numerical Randomness Metrics

Metric	Formula	Interpretation	Use in C-7
Branch probability	$p_i = N_i / N\_total$	Frequency of attractor capture	Estimates quantum-like randomness
Collapse entropy	$S = -\Sigma p_i \ln p_i$	Maximum value indicates strongest indeterminacy	Detects high-uncertainty branching regimes
Bifurcation spectrum	distribution of λ_soft before/after split	Measures instability depth and onset	Early warning for branching
Outcome variance	Var(x_final)	Spread of final collapse endpoints	Validates simulation against experiment-style statistics
Attractor capture rate	N_capture / $\Delta\tau$	Rate at which trajectories snap into basins	Quantifies decision-surface activity
Branch asymmetry		$p_1 - p_2$	or generalized imbalance
Entanglement-correlation score	Corr(outcome_A, outcome_B	Ξ_eff)	Measures nonlocal collapse correlation

Randomness is therefore not assumed as a primitive. It is measured as statistical structure in attractor selection near soft-mode branching surfaces.

Appendix E — Kernel Families for Ξ_eff Nonlocal Coupling

The effective nonlocal coupling field can be computed using:

$$\Xi\_\mathrm{eff}^{I}{}_{j}(x,x';\tau) = \int K^{I}{}_{j}(|x-x'|;\ell(\tau))\,\psi(x',\tau)\,dx'$$

Kernel Type	Formula	Behavior	When to Use
Gaussian	$K \propto \exp(-$	$x-x'$	$^2 / 2\ell^2)$
Lorentzian	$K \propto 1 / (1 +$	$x-x'$	$^2 / \ell^2)$
Power-law / 1/r^α kernel	$K \propto 1 /$	$x-x'$	$^\alpha$
Adaptive hybrid	Gaussian ⟶ power-law under wormhole threshold	Changes behavior during topology event	Use when Ξ_eff > Ξ_c and det(T) ⟶ 0 simultaneously

Default C-7 recommendation: Gaussian kernel with adaptive $\ell(\tau)$.

Optional switching rule: if wormhole conditions are met, transition from Gaussian to power-law kernel for the active nonlocal channel.

Appendix F — Bridge Map: C-4 ⟶ C-5 ⟶ C-6 ⟶ C-7

Paper	Role	Main Output	Relationship to C-6
C-4	Tensor Field Theory	T, Ξ, $\mathcal{R}$, field equations, deterministic basin switching	Supplies algebraic tensor objects
C-5	Entropic Manifold Geometry	$\mathcal{M}^E$, metric, connection, curvature, topology, conifolds, geodesics	Supplies geometric arena and path structure
C-6	PDE Dynamics of the Entropic Manifold	Collapse wave PDE, curvature flow, topology rules, multi-scale dynamics, solver design	Converts geometry into executable dynamics
C-7	Numerical CUWF Solver	Discretized solver, event detection, scenario simulations, observable extraction	Executes the C-6 engine

Core transition:

C-4 defines what exists.

C-5 defines where it lives.

C-6 defines how it evolves.

C-7 computes what happens.

Final statement: C-6 is the operational engine of the CUWF C-Series. It transforms tensor geometry into a PDE-driven universe model that can be simulated, tested, and compared against physical phenomena.