

VERSF Field Relationships

Reference table: each field and object in the VERSF–BCB framework — its epistemic status, layer within the BCB hierarchy, physical meaning, and derivation chain.

Symbol	Name	Status	Layer	What it is	Derives from / connects to
Primitive layer					
e	Commitment event	Primitive	Admissibility	A localised spacetime moment at which a distinction between possible states becomes an irreversible physical fact.	Structural necessity: commitment events are required to define physical distinguishability — without them, no measurable quantities exist. Not derived. Sources all other fields.
t	Physical time	Primitive	Admissibility	The ordered accumulation of irreversible commitment events. No prior time parameter is assumed — temporal structure is defined by the partial ordering of events and the cumulative count of committed distinguishability.	Not derived from pre-existing time. Time emerges from the causal order of commitment events. The rate at which commitment accumulates determines effective proper-time flow in the emergent continuum limit, connecting time directly to gravity, κ , and entropy.
s / τ_{proto}	Proto-time / commitment density field	Primitive	Admissibility	The ordering parameter for irreversible commitment events — a pre-geometric sequence index that underlies physical time before the continuum limit is taken. Also identified as the commitment density field s under retarded boundary conditions.	Not derived from pre-existing time or geometry. Proto-time is the discrete ordering of commitment events; it becomes continuous time in the continuum limit. Under retarded boundary conditions, s is identical to κ (established in the κ -field equivalence paper) — the fluctuation picture and the commitment-field picture are two decompositions of the same object.
$N_{\text{committed}}$	Committed distinguishability count	Primitive	Admissibility	Integer count of irreducibly committed distinguishability units at a spacetime point.	Directly from commitment events. Gives source strength $q = N_{\text{committed}}$ for both the κ -field and the gravitational sector.
Primary field layer					
$\rho(x, t)$	Committed record density	Primary	Field	Continuous field encoding the local density of irreversibly committed distinguishability per unit spacetime volume. ρ carries energy density associated with irreversible distinguishability and is the conserved source of all dynamical fields in VERSF.	Coarse-grained continuum limit of $N_{\text{committed}}$ event counts. Its conserved energy density distinguishes it from an informational quantity. Entropy, mass, κ , and gravity all derive from it — it is the common source of both the κ -field (fluctuation) sector and the gravitational (macroscopic) sector.

Symbol	Name	Status	Layer	What it is	Derives from / connects to
$\rho_0(x, t)$	Background committed density	Derived	Field	The locally stable committed background — the part of ρ representing already-settled, irreversible structure.	Stable extremum of $F(\rho)$. Parent of κ via $\rho = \rho_0 + \kappa$.
Energetic structure					
$F(\rho)$	Commitment free energy	Open	Energetic	Functional encoding the energetic cost of a given committed density configuration. Has a minimum at the stable background ρ_0 .	Structurally required by VERSF commitment energetics. Only the existence and convexity of $F(\rho)$ are required for all present structural results — its detailed form affects coefficients but not structural predictions. Exact form not yet derived from fold-interface dynamics.
$S_{\text{BCB}}[\rho, \kappa]$	BCB action (variational representation)	Derived	Energetic	The action functional whose variation yields the VERSF field equations. The BCB (Bit Conservation and Balance) Lagrangian is the action-principle face of VERSF — it encodes the same constraint structure as the commitment density formulation, expressed as a variational principle.	Derived from ρ and κ via the BCB Lagrangian structure. The constraint picture (commitment density ρ sourcing fields) and the variational picture (action S_{BCB} extremised) are equivalent representations of the same underlying physics — BCB is the variational form of VERSF, not a separate theory. Established in the BCB–VERSF equivalence paper.
$m^2_{\kappa} = F''(\rho_0)$	κ -field mass	Derived	Dynamical	The restoring coefficient for κ -fluctuations. Measures how stiffly the committed background resists perturbation.	Second derivative of F at ρ_0 . Scale set by CCC threshold: $m^2_{\kappa} = \alpha_{\kappa}(\rho c^3/\hbar)^{1/2}$. Enters κ -field equation directly.
$\chi(L) = \rho L^4/\hbar c$	CCC threshold	Derived	Threshold	Dimensionless measure of whether a region of scale L contains sufficient committed density to sustain persistent causal structure. Stable when $\chi \gtrsim 1$.	From VERSF causal-commitment geometry. Defines coherence scale ξ and constrains m_{κ} , ε , and the onset of gravitational response.
Dynamical layer — κ sector					
$\kappa(x, t)$	Commitment fluctuation field	Derived	Dynamical	The propagating perturbation of the committed record density about the background. Carries the causal after-effect of new commitment events through spacetime.	$\kappa \equiv \rho - \rho_0$. Governed by the damped massive field equation. Sources G_{κ} and thereby $K(\tau)$. Under retarded boundary conditions, κ is identical to the commitment density field s ; the fluctuation picture ($\kappa = \rho - \rho_0$) is a decomposition for analytical purposes, not a distinct ontology. At large scales, κ -field dynamics coarse-grain into gravitational response: κ represents local propagating fluctuations of ρ , while gravity

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					represents the macroscopic steady-state structure of ρ — different regimes of the same field.
$J(x) = g\sigma(x)$	Commitment production source	Derived	Dynamical	The local rate at which irreversible commitment events generate new κ -field excitations. Not a free source — it is the record-production density.	Coarse-grained from point events $\sum g_i \delta^{(4)}(x-x_i)$. In the decay setting, $\sigma(t) \propto a(t)$, coupling κ to the unstable amplitude.
γ_m	Damping coefficient	Derived	Dissipative	Effective friction coefficient governing how κ -excitations dissipate into the unresolved sub-threshold record bath.	Markovian (Ohmic) limit of integrating out the bath $\{q_n\}$ with spectral density $S(\omega) \approx \eta\omega$. γ_m is not a free parameter — uniquely determined by the spectral density of sub-threshold record modes. A theorem about open systems, not an insertion.
$S(\omega)$	Bath spectral density	Open	Dissipative	Distribution of frequencies of sub-threshold record modes that absorb κ -excitations. Determines whether damping is Ohmic or non-Ohmic.	Computable in principle from the sub-threshold record spectrum. Currently unspecified — determines non-Ohmic corrections to γ_m and the full dissipation kernel.
Propagator and kernel layer					
$G_\kappa(\tau)$	Retarded Green's function	Derived	Propagator	Exact causal propagator of the damped κ -field. Encodes how a commitment event at time s influences κ at all $t > s$.	Exact solution: $G_\kappa(\tau) = \theta(\tau) e^{-\gamma_m \tau} \sin(\omega_\kappa \tau) / \omega_\kappa$. Parent of $K(\tau)$.
$K(\tau) = \Gamma_0 \delta(\tau) + \lambda G_\kappa(\tau)$	Memory kernel	Derived	Kernel	Full kernel governing non-Markovian decay. Sum of instantaneous Markovian and retarded oscillatory memory terms.	Read from the integro-differential equation for $a(t)$ after substituting G_κ . Extended-source form: $K_{\text{eff}}(\tau) \sim A \cos(\omega_\kappa \tau + \phi) / \tau$.
$K_{\text{eff}}(\tau)$	Effective (extended-source) kernel	Derived	Kernel	Spatially integrated kernel for a macroscopic source. The $1/\tau$ algebraic envelope is a geometric consequence of causal propagation in 3+1D.	Spatial integral of G_κ over source volume. The $1/\tau$ form is forced by the non-analyticity of the retarded propagator at the light-cone boundary $r = c\tau$, as derived in the kernel paper via stationary-phase analysis.
Gravitational / macroscopic layer					
$\Sigma(x)$	Entropy-loading density	Derived	Meso	Scalar field measuring the local loading of distinguishability capacity in the substrate. Controls proper-time suppression and gravitational response.	Derived from $\rho(x, t)$ through coarse-grained entropy flux. Σ is the coarse-grained statistical representation of the same committed distinguishability that, at the

Symbol	Name	Status	Layer	What it is	Derives from / connects to
ρ_{bound}	Gravitationally active committed density	Derived	Macroscopic	The gravitationally active component of ρ — the portion that participates in macroscopic constraint propagation and sources gravitational response.	<p>microscopic level, appears as fold density gradients. The two descriptions are equivalent under coarse-graining — not separate physical mechanisms. Governs gravitational time dilation, decoherence thresholds, and horizon formation.</p> <p>Same object as $\rho(x, t)$ evaluated in the bound (committed) sector. Sources gravitational fields through two equivalent representations of the same underlying quantity — committed distinguishability: (1) fold density gradients (exact, microscopic); (2) entropy loading and finite-capacity response (statistical, macroscopic, coarse-grained limit of (1)). These are not two separate mechanisms — they are equivalent under coarse-graining. The fold description is exact; the entropic description is its statistical limit.</p>
$\Phi_{\text{bound}}(x)$	Commitment (gravitational) potential	Derived	Macroscopic	Scalar potential encoding the macroscopic response of the substrate to gradients in committed distinguishability. Determines gravitational acceleration and proper-time suppression.	Derived from ρ_{bound} via $\nabla^2 \Phi_{\text{bound}} = 4\pi\kappa \rho_{\text{bound}}$. The fold-gradient and entropy-loading routes to this potential are equivalent under coarse-graining — the fold view is exact, the entropy view is its macroscopic statistical limit. Φ_{bound} is the scalar that unifies both descriptions.
$\Phi(x), g_{\mu\nu}$	Gravitational field / metric	Derived	Macroscopic	Emergent geometric or force field arising from spatial gradients in ρ and the finite-capacity response of the substrate. Encodes proper-time suppression, gravitational attraction, and curvature-like behaviour.	From $\rho(x, t)$ via fold density gradients (exact microscopic route) and entropy/capacity loading (coarse-grained macroscopic route) — two representations equivalent under coarse-graining of the same committed distinguishability. Linear regime: $\nabla^2 \Phi \propto \rho_{\text{bound}}$. Relativistic regime: maps to GR metric. Gravity and κ -field are different regimes of the same ρ -sourced dynamics — not separate physics.
$g_{\mu\nu}$ (GR)	Relativistic metric (effective)	Effective	Descriptive	The smooth Lorentzian metric of general relativity, emerging as the macroscopic	Effective description only — valid in the continuum, large- ρ limit. Reduces to VERSF microscopic structure below the CCC

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				continuum description in the large committed-density limit.	threshold. Not fundamental; the underlying reality is ρ and κ .
Thermodynamic / emergent layer					
s	Entropy	Emergent	Emergent	Coarse-grained scalar summary of how many commitment-compatible microstates are consistent with a given macrostate. Monotonically related to ρ but not identical to it.	Derived from ρ by counting compatible microstate configurations. Does not propagate or source κ — a statistic of ρ , not a field. Key distinction: ρ is dynamical; entropy is a derived summary. Entropy loading (Σ) feeds back into the gravitational sector via proper-time suppression.

Status key

Primitive structural necessity. **Primary** foundational dynamical object. **Derived** follows from prior objects by theorem. **Open** structurally required; exact form not yet computed. **Emergent** statistical summary; not a propagating field. **Effective** valid continuum approximation in limiting regime.

Derivation chain for gravity:

Commitment events \rightarrow folds (microscopic) $\rightarrow \rho_{\text{bound}} \rightarrow \Sigma$ (entropy loading, coarse-grained limit of folds) \rightarrow capacity response \rightarrow gravity

The fold-gradient and entropy-loading descriptions are equivalent under coarse-graining — the same committed distinguishability viewed at different levels of resolution. The fold description is exact; the entropy description is its statistical macroscopic limit.