Supplement to Paper 3: On the Local Structure of Coherence Fields and Emergence Switching

Wayne Fortes

June 2025

Purpose

This addendum refines the interpretation of the coherence field τ_2 presented in Papers 1–3. Originally defined strictly on the compactified 2-sphere S^2, τ_2 is here generalized to the form:

$$\tau_2 = \tau_2(x^\mu, \theta, \phi, t)$$

This represents a scalar coherence field that varies across both internal geometry and 4D spacetime. This refinement allows the coherence energy $E_{\tau_2}(x)$ to be computed locally and accurately, enabling physically meaningful activation of the emergence switch $\tau_3(x)$.

Implications

- τ_2 now captures spatial and temporal coherence patterns that differ between regions of 4D spacetime.
- The coherence energy functional:

  $$E_{\tau_2}(x) = \int_{S^2} d\Omega \left[\frac{1}{2}(\partial_t \tau_2)^2 + \frac{1}{2e^{2\sigma}}|\nabla_{S^2}\tau_2|^2 + \frac{1}{2}m^2\tau_2^2\right]$$

  remains structurally unchanged, but is now interpreted as a localized energy density indexed by x^μ.
- This clarifies and justifies the use of a spatially localized emergence function:

  $$\tau_3(x) = \frac{1}{1 + \exp(-\beta(E_{\tau_2}(x) - E_{\text{crit}}))}$$

Continuity of Theory

No equations or mechanisms in Papers 1–3 are invalidated by this clarification. This supplement simply updates the interpretation of the fields to match their use in Paper 3 and future derivations, including the upcoming Paper 4.

Acknowledgments

This refinement was prompted by reviewer feedback (Gemini, 2025), whose observation regarding the apparent mismatch in domain dependence of τ_2 was both accurate and helpful in progressing the model toward internal consistency and physical relevance.