

Section 1. Introduction: Why Entanglement Remains Conceptually Unresolved

Quantum entanglement has long stood as one of the most conceptually difficult features of quantum mechanics. From its earliest formulation, it has resisted ordinary intuition by appearing to imply a form of connection between spatially separated systems that has no clear analogue in classical physics. Einstein's phrase "spooky action at a distance" remains memorable precisely because it captures the enduring discomfort entanglement creates within the conceptual foundations of modern theory.

At the center of that discomfort lies an apparent tension between two principles that are each strongly supported in their own domain. On the one hand, Bell-type experiments demonstrate that entangled systems exhibit correlations that cannot be explained by local hidden variables and are insensitive to ordinary spatial separation. On the other hand, relativistic causality excludes any superluminal transmission of signals or causal influence. The coexistence of strong nonlocal correlation with strict causal locality has therefore generated decades of interpretive debate without producing broad agreement on what entanglement fundamentally is.

The dominant formal account of entanglement is framed in Hilbert space. Within that framework, entanglement is defined through the non-factorizability of joint quantum states, and correlations are encoded in tensor-product structure. This description is mathematically precise and empirically successful, but it remains ontologically opaque. Hilbert-space correlation specifies how outcomes are statistically related, yet it does not explain why spatially separated systems behave as though they belong to one unified relational structure, nor why such unity can exist without violating causal constraints.

For that reason, entanglement is often treated as a formal rule rather than as an intelligible physical structure. The no-signaling condition is then introduced as an external safeguard, ensuring compatibility with relativity while leaving unanswered the deeper question of why signaling is impossible in the first place. Correlation is retained, paradox is contained, but the underlying structure

remains unspecified. In this sense, entanglement is described with great precision and yet still not fully explained.

Paper A-5 proposes a structural reformulation of entanglement within the framework of the Chayut Universe Wave Function (CUWF). Rather than treating entanglement as correlation between quantum states, CUWF interprets entanglement as entropic synchronization between collapse configurations. On this view, entangled systems do not exchange information, transmit influence, or communicate across space. They remain synchronized because they are constrained by a shared entropic structure that precedes spacetime, temporal ordering, and causal direction in the usual sense.

The aim of this paper is therefore twofold. First, it replaces correlation-based accounts of entanglement with a structural description grounded in entropic synchronization and collapse-link topology. Second, it addresses the signaling paradox at its root by showing that information transfer is not merely forbidden by an auxiliary rule, but structurally impossible within the CUWF account of entanglement—without weakening or modifying any empirically established quantum prediction.

Within the broader CUWF architecture, Paper A-5 occupies a precise foundational position. Paper A-4 established the framework of entropic regimes and the quantum–classical transition. Paper A-5 now introduces the relational structure that binds physical systems prior to the emergence of time. In this role, entanglement functions as the structural substrate upon which later CUWF treatments of tunneling, temporal sequencing, and constraint-based causality can be built. By resolving entanglement at the pre-temporal and pre-causal level, the paper prepares the ground for a more coherent account of nonlocality, time, and causality within the CUWF program.