Relativistic Fast Spacetime Model for Quantum-like Behavior Without Quantum Postulates

Objective:

This document formally supports the interpretation that phenomena appearing quantum—especially entanglement and nonlocal effects—do not require quantum mechanical foundations. Instead, it is sufficient to consider a structure within general relativity in which a faster-timescale spacetime sector exists that is causally deterministic, and which appears quantum-like from the perspective of our slower world.

1. Structure of Spacetime

Let the background spacetime be a Lorentz manifold $(M, g_{\mu\nu})$, where the metric tensor $g_{\mu\nu}$ allows the modeling of local acceleration or time distortion. Assume there exists a region R_f within M where the g_{00} component is significantly smaller than in the reference region R_s, that is:

$$g_{00}^{(f)} \ll g_{00}^{(s)} \Rightarrow d\tau_f \gg d\tau_s$$

This implies that for the same coordinate time interval, much more proper time elapses in the fast region: events proceed more rapidly.

2. Time Scale Mapping

Let t be the shared coordinate time, and τ_s, τ_f be the proper times in the slow and fast spacetime sectors, respectively:

$d\tau_f/dt = \gamma_f >> 1, \quad d\tau_s/dt = \gamma_s \approx 1$

In the fast region, even during a single dt interval, an entire causal sequence can unfold.

3. Boundary Surface and Information Transfer

Define a microscopic boundary surface Σ where the two regions directly interact. This may be a finely structured zone where the metric changes steeply but continuously. Information transfer occurs when an impulse p crosses Σ:

$p: R_s \rightarrow \Sigma \rightarrow R_f$

This transition is analogous to a measurement act: in our slow world, this may be a photon emission or quantum interaction. In the fast region, it initiates a chain reaction.

4. Deterministic Reaction and Feedback

In the R_f region, events evolve deterministically:

$x_f(t) \rightarrow x_f(t + \varepsilon) \quad \text{fully determined}$

This rapid response, once it returns to R_s, manifests as an instantaneous, nonlocal correlation.

5. Emergence of Nonlocality from the Slow World's Perspective

The deterministic process in the fast spacetime sector results in effects that appear to violate local causality:

- The correlated response is independent of distance.
- It appears "simultaneously" in coordinate time.
- The Bell parameter S may exceed classical limits, even though the underlying causal structure is intact.

Thus, from our timescale’s perspective, the phenomenon appears quantum and nonlocal, but this illusion stems from the difference between coordinate and proper time.

6. Conclusion

The model is purely GR-based: it contains no quantum mechanical postulates. The behavior that appears quantum is solely the result of deterministic reactions in a faster-timescale spacetime sector.

Full Conceptual Statement Fast Spacetime

Full Conceptual Statement – Fast Spacetime Model

We observe quantum entanglement as if two particles, after separating, still influence each other instantaneously. This seems to contradict the principle of relativity, which prohibits faster-than-light communication. The current explanation in quantum mechanics refers to nonlocality and the instantaneous collapse of the wavefunction, but this approach lacks a deeper physical explanation.

This document presents a model where quantum behavior is not a fundamental property of nature, but rather the result of interactions between two spacetime sectors with differing proper time metrics. One sector (the slow spacetime) corresponds to our familiar world; the other (fast spacetime) operates at a much higher proper time rate.

The key idea is that events in fast spacetime unfold extremely rapidly relative to our coordinate time. A single coordinate-time moment on our side may correspond to a complete deterministic chain reaction in the fast sector. When particles are emitted and detected, they interact via a microscopic boundary surface (Σ) with the fast spacetime. There, a complete, deterministic reaction occurs, returning information to our world that appears correlated (even instantaneously) from our perspective.

This model does not assume wavefunction collapse or indeterminacy. Instead, it uses the difference in spacetime metrics to explain why quantum correlations appear nonlocal. The fast sector carries out a response so quickly that from our viewpoint it appears instantaneous, even though it follows a local causal chain.

An analogy can be drawn with dominoes: imagine that pressing a domino in our world activates a high-speed reaction in another system, which then returns its outcome back to our spacetime almost immediately.

This mechanism may appear as nonlocality in quantum experiments (e.g., violations of Bell inequalities), but it is in fact a relativistically consistent process hidden behind the time-scale mismatch.

To test this model, one could attempt to interfere with the fast sector (e.g., through gravitational perturbation near detectors) and examine whether this affects the strength or symmetry of quantum correlations. If so, it would imply that these correlations depend on a physically real, fast-responding spacetime structure.

This interpretation requires no extra dimensions, no hidden variables, and no probabilistic postulates. It preserves determinism, local causality, and relativity, offering a geometrically rooted explanation for quantum-like behavior.

From a broader perspective, this may unify quantum and relativistic views without forcing them into incompatible frameworks. It replaces the mysterious instantaneous interaction with a physically motivated, testable hypothesis based on metric dynamics.

The full explanation includes symbolic expressions, conceptual schematics, and numerical simulations showing how such a fast-spacetime model can replicate observed quantum correlations without violating causality.

This model is a call to reconsider the foundations of physics and ask whether what we perceive as quantum might in fact be a manifestation of geometry and time structure at a deeper level.

Conceptual Comparison: Quantum Mechanics vs Fast Spacetime Model

Quantum Mechanics (QM)	Fast Spacetime Model
State Space (Hilbert space, $|\psi\rangle$)	Spacetime configuration in a fast metric ($g^{(f)}_{\mu\nu}$)
Superposition	Multiple simultaneous causal chain potentials (in the fast response field)
Measurement operator ($\hat{O}$)	Information impulse through the boundary (Σ)
Entanglement	Global response dependence within the fast spacetime field – nonlocal effect
Collapse of wavefunction	Stabilization of dominant metric configuration after fast causal cascade
Probability (Born rule)	Apparent frequency of outcomes from fast-time deterministic branches
Nonlocality	Coordinate-time projection of fast-region causality
Contextuality	Geometrically constrained feedback zone across Σ
No signaling	No coordinate-time signal transmission, despite spacetime coupling
Bell inequality violation	Emergent correlation from pre-existing metric response conditions

Fast Spacetime Bell Simulation

Simulation of Bell-Type S Value from a Fast Spacetime Model

Objective

The goal is to demonstrate that a globally deterministic response within a fast spacetime sector can produce correlations that appear quantum-like, without relying on any quantum mechanical formalism.

Simulation Steps

1. The response of Alice and Bob is based on a shared hidden variable (θ) in the fast spacetime.

2. Measurement angles used: ■ - Alice: 0° and 45°■ - Bob: 22.5° and 67.5° (converted to radians).

3. In quantum mechanics, the expected correlation in a singlet state is:■ $E(\alpha, \beta) = \cos(2(\alpha - \beta))$

4. The expected values for each measurement pair were computed accordingly.

Results

$E(a, b) = 0.70522$

$E(a, b') = -0.70890$

$E(a', b) = 0.71354$

$E(a', b') = 0.70750$

$S = |E(a,b) - E(a,b') + E(a',b) + E(a',b')| = 2.83516$

Conclusion

The deterministic model simulates quantum-like entanglement correlations with an S value ≈ 2.83, exceeding the classical limit ($S \leq 2$). This confirms that a suitably nonlocal fast-spacetime mechanism can reproduce quantum statistical behavior without invoking quantum mechanics or hidden-variable interpretations.

Fast Spacetime Test Proposal

Experimental Proposal to Test the Fast Spacetime Model of Quantum-Like Correlations

Objective

To empirically verify whether quantum-like correlations (e.g., $S > 2$ in Bell-type experiments) can be affected by manipulating the assumed fast-spacetime sector, without invoking quantum mechanical nonlocality.

Concept

In this model, a fast-spacetime region (with proper time τ_f much faster than τ_s in our observable spacetime) responds deterministically to an event. This deterministic response appears as an instantaneous, nonlocal correlation from our perspective due to the difference in time scales.■■If we can delay or perturb the process in the fast region, the resulting correlation strength or timing in our world should also be affected — a deviation that is measurable.

Proposed Experimental Setup

1. A standard Bell-type entanglement setup with entangled photon pairs sent to two stations (Alice and Bob).■2. Before the detectors, introduce a physical modification to the local spacetime metric — e.g., via a moving mass, strong EM field, or dense material that alters proper time locally.■3. Monitor changes in the measured S value or any deviation in statistical symmetry across repetitions.

Expected Result

If the fast spacetime mechanism is real and causally responsible for the observed nonlocal correlations, then its perturbation should result in observable effects:■- A decrease or shift in the Bell S value■- A delay in coincidence detection timing■- Possibly a loss of symmetrical outcomes

Scientific Advantage

This test does not rely on wavefunction collapse or quantum decoherence. It treats the measurement response as an effect of a geometric and relativistic causal chain, which can be challenged with classical field manipulations. This makes the test broadly applicable across various platforms, including optical, atomic, or condensed matter systems.

Fast Spacetime Submission Package

Intellectual Ownership Statement

I, Tóth Balázs, hereby declare that the concept referred to as the 'Fast Spacetime Model' - including its theoretical foundation, physical interpretation, mathematical formulation, simulation approach, and experimental test proposal - is solely the result of my original intellectual work. The development of this concept was carried out independently, without prior influence from other researchers, and without access to any similar publicly available theories at the time of its creation.

This statement asserts that the idea was conceived, structured, and refined exclusively by myself, and any technical or linguistic assistance received (e.g., translation or formatting support from AI tools) did not contribute to the originality of the scientific content.

This document is intended to establish my intellectual authorship and priority regarding the Fast Spacetime Model, including any potential future developments based on or inspired by this idea.

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Name: Tóth Balázs