

# How Kosmoplex Theory Addresses the 10 Biggest Areas Where Quantum Mechanics Breaks Down

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Quantum mechanics is operationally the most successful scientific theory ever constructed. It predicts scattering cross-sections to twelve decimal places. Nothing here disputes that success. But operational success is not foundational completeness. The following ten items are not attacks on QM — they are QM's own open problems, widely acknowledged within the physics community. Kosmoplex Theory (KT) offers concrete, falsifiable responses to each.

## 1. The Measurement Problem

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**QM's difficulty:** Unitary evolution (Schrödinger equation: deterministic, reversible) and wavefunction collapse (non-unitary, irreversible, probabilistic) are two incompatible dynamics. At the moment, QM provides no mechanism for when or why one gives way to the other.

**KT's response:** KT proposes an 8D octonionic information physics substrate that evolves deterministically and reversibly (Total Function axiom). “Collapse” is projection from 8D to 4D. The full state never collapses — the 4D observer sees only the projected eigenvalue. Apparent randomness is information loss under dimensional projection, not ontological indeterminacy. The Gaussian distribution emerges as the stable fixed point of this projection.

## 2. The Born Rule

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**QM's difficulty:** The probability rule  $P = |\psi|^2$  is postulated, not derived. Why squared amplitudes? QM currently has no answer.

**KT's response:** Squaring arises from projective geometry. The power of a point with respect to a circle is a product  $PA \cdot PB$ ; for a self-returning path this becomes  $PA^2$ . The Born rule is a theorem of the projection, not an axiom. In the Weinberg angle derivation in KT,  $\sin^2(1)$  appears as the squared mixing amplitude, forced by the geometry, not chosen.

## 3. The 26 Free Parameters

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**QM's difficulty:** The Standard Model requires 26 dimensionless constants (masses, couplings, mixing angles) to be measured experimentally and inserted by hand. The theory predicts none of them, just assumes them.

**KT's response:** These constants are projective invariants of the Fano plane  $PG(2, \mathbb{F}_2)$  — the incidence geometry of octonionic multiplication. In KT, the Weinberg angle is  $\sin^2 \theta_W = \sin^2(1)/\sqrt{3\pi} = 0.23064$  (0.25% relative error, zero free parameters). The fine-structure constant  $\alpha^{-1} = 137.035999\dots$  emerges from channel capacity counting invariant to locality. The full set of 42 octonionic projection eigenvectors provides a complete basis for all dimensionless constants of the Standard Model. Two axioms beyond the 5 Peano Axioms replace nineteen parameters currently in QM:

**Axiom 6 (Triadic Closure):**  $\forall x, y \in S, \exists! z \in S : x \circ y = z$   
All stable relations close on triples.

**Axiom 7 (Computability):**  $f : S \rightarrow S$  is total and decidable.  
Every operation halts and returns a value in  $S$ .

## 4. The Problem of Time

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**QM's difficulty:** Time is a parameter in QM (not an observable — there is no time operator) but a dynamical coordinate in general relativity. The two treatments are incompatible, which is a core obstruction to quantum gravity.

**KT's response:** KT distinguishes  $T_{\text{kairos}}$  (the discrete computational successor step following computational saturation) from  $T_{\text{chronos}}$  (the emergent continuous time coordinate in 4D spacetime). QM's time-as-parameter is  $T_{\text{kairos}}$ . GR's time-as-coordinate is  $T_{\text{chronos}}$ . They are related by projection but are not the same object. The apparent incompatibility dissolves because QM and GR are describing different projections of the *same underlying discrete succession*.

## 5. Nonlocality and Entanglement

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**QM's difficulty:** Entangled particles exhibit correlated measurements across spacelike separation (Bell's theorem). Whether this constitutes “real” nonlocality remains debated after 90 years (EPR, Bell, Aspect, etc.).

**KT's response:** Spacetime is not a pre-existing stage — it is co-emergent with projection. Entangled states share eigenvector structure because they were projected through the same fiber geometry. There is no spacetime “between” co-projected states because the spacetime that would separate them was never independently created. The question “how do they communicate across space?” is a category error. They don't communicate across space. They share a common projection origin. Bell's Theorem did not answer Einstein's (EPR) objections, rather it shows the exact **locus** of the problem.

## 6. The Vacuum Energy Catastrophe

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**QM's difficulty:** Quantum field theory predicts vacuum energy density  $\sim 10^{113} \text{ J/m}^3$ . Observation gives  $\sim 10^{-10} \text{ J/m}^3$ . The discrepancy of 123 orders of magnitude is the worst failed prediction in the history of physics.

**KT's response:** The cosmological constant is not a sum over zero-point modes of infinitely many quantum fields. It is a projection-geometric quantity determined by the saturation parameter  $n \approx 8.07 \times 10^{60}$  and the structure of the discrete substrate. The “infinite” vacuum energy is an artifact of not knowing the projection has a finite discrete substrate. KT produces a finite, calculable value without renormalization tricks. KT further explains why the universe *appears* to be 13.8 Gy old ( $8.07 \times 10^{60}$  Planck times). This is not an age — it is a combinatorial saturation depth: the fixed number of discrete, triadic, 8D→4D operations required for geometric closure over all associative octonionic operations. The number is derived, not measured.

## 7. The Associativity Assumption

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**QM's difficulty:** Quantum mechanics requires operator associativity —  $(AB)C = A(BC)$  — because Hilbert space demands it. This has kept octonions, despite their deep connections to exceptional structures and gauge symmetry, at arm's length for over a century.

**KT's response:** KT does not avoid non-associativity, it uses it. The octonionic associator  $[A, B, C] = (AB)C - A(BC) \neq 0$  is the geometric source of non-trivial coupling structure. Operations restricted to a single Fano line generate quaternionic (associative) subalgebras, preserving Hilbert-space compatibility for local calculations. The full non-associative structure generates the coupling constants as projection singularities. QM's associativity is the 4D shadow of a restricted operation set on an 8D non-associative substrate. Only octonionic operations that satisfy associativity can project to 4D observables.

## 8. Renormalization

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**QM's difficulty:** Quantum field theory produces infinities that must be absorbed through renormalization — a procedure that works but that Feynman called “a dippy process,” Dirac called “ugly,” and whose conceptual foundations remain contested.

**KT's response:** The Euler–Mascheroni constant  $\gamma$  in the  $\alpha^{-1}$  formula is the discrete-to-continuous matching cost — the information price of translating a discrete fiber computation into a continuous spacetime observable. Renormalization is not a trick to cancel infinities. It is the  $\gamma$  correction, finite and calculable from first principles. The infinities in QFT arise because the theory does not know it is projecting from a discrete substrate. In KT, the correction is a projective invariant.

## 9. Why These Gauge Groups?

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**QM's difficulty:** The Standard Model gauge group  $SU(3) \times SU(2) \times U(1)$  is an empirical input. QM does not explain why these groups and not others.

**KT's response:** The gauge groups emerge from the octonionic automorphism structure.  $\text{Aut}(\mathbb{O}) = G_2$  contains  $SU(3)$ . The Frobenius orbit structure on the Fano plane accommodates  $SU(2) \times U(1)$ . The four normed division algebras  $\mathbb{R}, \mathbb{C}, \mathbb{H}, \mathbb{O}$  (the only ones that exist, by Hurwitz's theorem) correspond to the four fundamental interactions. The gauge groups are not chosen — they are the symmetry groups of the only algebras mathematics permits.

## 10. The Hierarchy Problem

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**QM's difficulty:** Gravity is  $\sim 10^{39}$  times weaker than electromagnetism. The Standard Model provides no explanation for this enormous ratio. Fine-tuning arguments and naturalness criteria have produced no resolution in 50 years.

**KT's response:** The hierarchy is the Cayley–Dickson tower read from top to bottom:

Algebra	Dim	Force	Lost Property	Coupling
$\mathbb{R}$	1	Gravity	—	Weakest
$\mathbb{C}$	2	Electromagnetism	Ordering	↑
$\mathbb{H}$	4	Weak nuclear	Commutativity	↑
$\mathbb{O}$	8	Strong nuclear	Associativity	Strongest

Each Cayley–Dickson doubling costs an algebraic property and gains interaction strength. The graviton requires two complete Fano traversals (spin-2,  $2 \times 7 = 14$  steps); the photon requires one (spin-1, 7 steps). The exponential suppression between them *is* the hierarchy. It is not fine-tuned. It is the difference between traversing the fiber once and traversing it twice. Hurwitz's theorem guarantees exactly four normed division algebras, so there are exactly four forces, with strengths ordered by algebraic property loss under dimensional doubling.

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**Summary:** KT does not falsify quantum mechanics. It completes it — by providing the geometric substrate from which QM's operational rules, and their apparent exceptions, emerge as projective consequences.

**References:** Macedonia, C. *Principia Kosmoplex*, v4, Zenodo (2025). doi:10.5281/zenodo.17861153