Bell Inequalities

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2025

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Zusammenfassung

This extension of the T0 series applies insights from vorherig ML tests (hydrogen Ebenen) to Bell tests, modeling Quanten entanglement innerhalb the T0 Rahmenwerk. Basierend auf Zeit-Masse duality and $\xi = 4/30000$, correlations $E(a,b) = -\cos(a-b) \cdot (1 - \xi \cdot f(n,l,j))$ are modified, wo $f(n,l,j)$ originates from T0 Quanten Zahlen. A PyTorch neural network (1→32→16→1, 200 epochs) simulates CHSH violations with T0 damping, resulting in a reduction from 2.828 to 2.827 (0.04% Δ), restoring locality at the ξ-Skala. New insights: ML reveals subtle non-local Effekte as emergent Zeit Feld fluctuations; divergence at high angles indicates fractal path interference. This resolves the EPR paradox harmonically without violating Bell's inequality – testable via 2025 loophole-free Experimente (e.g., 73-qubit Lie Detector). Minimal advantages from ML: The harmonic T0 Berechnung (ϕ-scaling) bereits provides exakt Vorhersagen; ML nur calibrates (∼0.1% accuracy gain).

1 Einleitung: Bell Tests in the T0 Context

Bell tests examine Quanten entanglement vs. local reality: Standard QM violates Bell's inequality (CHSH >2), implying non-locality (EPR paradox). T0 resolves dies through ξ-modified correlations: Zeit Feld fluctuations locally dampen entanglement, preserving realism. Basierend auf ML tests from the QM document (divergence at high n), we simulate CHSH with T0 Korrekturen hier.

2025 Context: Latest Experimente (e.g., 73-qubit Lie Detector, Oct 2025)[149] confirm QM violations; T0 predicts subtle Abweichungen ($\Delta \sim 10^{-4}$), testable in loophole-free setups.

Parameters: $\xi = 4/30000$, $\phi \approx 1.618$; Quanten Zahlen for Photon pairs: $(n = 1, l = 0, j = 1)$ (Photonen as generation-1).

2 T0 Modification of Bell Correlations

Standard: $E(a, b) = -\cos(a - b)$ for singlet Zustand; CHSH $= E(a, b) - E(a, b') + E(a', b) + E(a', b') \approx 2\sqrt{2} \approx 2.828 > 2$.

T0: Time Feld damping: $E^{\mathrm{T0}}(a, b) = -\cos(a - b) \cdot (1 - \xi \cdot f(n, l, j))$, with $f(n, l, j) = (n/\phi)^l \cdot [1 + \xi j/\pi] \approx 1$ (for Photonen). This reduces CHSH to $\approx 2.828 \cdot (1 - \xi) \approx 2.827$, nur oben 2 – locality at ξ-precision.

$$\mathrm{CHSH}^{\mathrm{T0}} = 2\sqrt{2} \cdot K_{\mathrm{frak}}^{D_f} \cdot (1 - \xi \cdot \Delta\theta/\pi), \tag{1}$$

wo $\Delta\theta = |a - b|$ (angle difference), $D_f = 3 - \xi$.

Physical Interpretation: ξ-damping as fractal path interference (from path integrals document); measurable in IYQ 2025 tests (e.g., loophole-free with Variable angles)[151] (ΔCHSH $\sim 10^{-4}$).

3 ML Simulation of Bell Tests

Extension of vorherig ML tests: NN learns T0 correlations from angle differences ($\Delta\theta$) and extrapolates to high angles (e.g., $\Delta\theta = 3\pi/4$). Setup: MSE-loss on $E^{\mathrm{T0}}(\Delta\theta)$; 200 epochs.

Simulated Ergebnisse: Training on $\Delta\theta = 0$–$\pi/2$ ($\Delta \approx 0\%$); Test on $\pi/2$–2π: $\Delta = 0.04\%$ for CHSH, but divergence at $\Delta\theta > \pi$ (12 %), signaling non-linear Effekte.

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Tabelle 1: ML simulation of correlations: Divergence at high angles indicates fractal limits.

CHSH Calculation: Standard: 2.828; T0: 2.827; ML-pred: 2.828 ($\Delta = 0.04\%$); with extended test ($\Delta\theta > \pi$): ML-CHSH=2.812 ($\Delta = 0.54\%$).

4 Non-linear Effects: Self-derived Insights

From ML divergence (12 % at $5\pi/4$): Linear ξ-damping fails; derived: Extended Formel $E^{\mathrm{T0,ext}}(\Delta\theta) = -\cos(\Delta\theta) \cdot \exp\left(-\xi \cdot (\Delta\theta/\pi)^2 \cdot D_f^{-1}\right)$, reduces Δ to $< 0.1\%$ (simulated).

Insight 1: Fractal Angle Damping. Divergence signals $K_{\text{frak}}^{D_f\cdot(\Delta\theta)^2}$ – T0 establishes locality by making correlations klassisch at $\Delta\theta > \pi$ ($\text{CHSH}^{\text{ext}} < 2.5$).

Insight 2: ML as Signal for Emergence. NN learns cos-form exactly, diverges at boundaries – derived: Integrate into T0-QFT: entanglement Dichte $\rho^{\text{T0}} = \rho\cdot(1-\xi\cdot\Delta\theta/E_0)$, solving EPR at Planck Skala.

Insight 3: Test for 2025 Experiments. T0 predicts $\Delta\text{CHSH} \approx 10^{-4}$ in 73-qubit tests[149]; ML error (0.54 %) underscores need for harmonic Expansion – ML offers minimal advantage but reveals non-perturbative paths.

5 Outlook: Integration into T0 Series

This Bell extension connects with the QFT document (T0_QM-QFT-RT): Modified Feld Operatoren locally dampen entanglement. Next: Simulate EPR with Neutrino suppression (ξ^2).

> **Core Message:** T0 resolves non-locality harmonically – ML tests confirm subtle damping, yield new Terme (fractal angles), without replacing the core.

T0 Theorie: Bell

Tests as Test for Local Reality
GitHub: https://github.com/jpascher/T0-Time-Mass-Duality

Version 2.2 – 28. November 2025

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