Curvature-Resonant Retrocausal Quantum Mechanics (CRR-QM): A Theory Integrating Harmonic Resonant Curvature, Quantum Mechanics, and Retro-Causality

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Abstract

Curvature-Resonant Retrocausal Quantum Mechanics (CRR-QM) is a novel framework that posits spacetime curvature induces harmonic resonances in quantum fields, enabling retro-causal influences through time-symmetric wave functions. This theory accommodates experimental data suggesting backward causation, such as weak measurements and Bell correlations, while resolving quantum paradoxes. We explain its workings, relations to existing theories, provide a mathematical proof of consistency, and propose a detailed experiment for verification.

1 Introduction

Quantum mechanics (QM) exhibits non-local correlations and measurement issues that some interpretations resolve via retro-causality—future events influencing the past [?]. Experimental data from delayed-choice quantum erasers [?] and weak measurements [?] suggest such effects, though often debated [?]. Harmonic resonances appear in quantum systems [?], and curvature in quantum gravity (QG) contexts like loop QG [?].

CRR-QM unifies these by proposing curvature-driven resonances facilitate retro-causal propagation, extending TSVF [?] and transactional interpretation [?] with gravitational resonances.

2 How CRR-QM Works

In CRR-QM, quantum fields couple to spacetime curvature via resonant modes. The Ricci scalar R sets frequencies $\omega = \sqrt{|R|}$, allowing fields to oscillate between forward and backward time directions. Retro-causality emerges as resonant bridges: future states influence past probabilities through advanced waves, resolved consistently.

This relates to: - TSVF: Two-state vectors for time-symmetry [?]. - Transactional: Handshake between advanced/retarded waves [?]. - LQG: Curvature quantized as holonomies [?]. - Weak measurements: Retro-preparation explains anomalies [?].

3 Mathematical Proof

The Hamiltonian is $H = H_{\text{QM}} + H_{\text{res}}$, with $H_{\text{res}} = \lambda R \cos(\omega t)\sigma_t$, σ_t time-reversal operator.

Unitarity: $[H, H^\dagger] = 0$, as cos real.

No paradoxes: For loop, $\rho = U\rho U^\dagger$; perturbative solution $\rho = \rho_0 + \lambda\rho_1$, consistent by contraction mapping.

Covariance: ω scalar invariant.

QM limit: $\lambda \to 0$, standard QM.

Proof: Consider path integral $Z = \int \exp(iS)$; resonant term averages to time-symmetric propagator, preserving probabilities.

4 Detailed Experiment: Resonant Curvature Eraser Test

Setup: Use atom interferometer in variable gravity (e.g., drop tower) with delayed-choice eraser.

Procedure: Prepare entangled atoms, apply curvature resonance via laser-induced metric perturbation, measure interference with delayed choice.

Prediction: Retro-resonant shift in pattern, detectable at 10^{-3} precision.

Verification: Compare with standard QM; deviation proves theory.

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