Experimental Detection of Breathing-Based Phase Deviations in Superconducting Qubits: A Test of the BMQM Framework

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Abstract

We propose a novel experiment to test the predictions of Breathing Membrane Quantum Mechanics (BMQM), a theoretical framework positing that quantum states emerge from dynamic, nonlinear oscillations of a continuous membrane structure. The experiment is designed to detect breathing-based phase deviations in the evolution of entangled superconducting qubits. By measuring the phase drift in time-resolved quantum interference and identifying deviations from standard linear evolution, this setup aims to uncover oscillatory patterns consistent with the Sionic constant $\sigma \approx 1.7365$, the universal stability point predicted by BMQM.

1 Introduction

Standard quantum mechanics describes the evolution of physical systems through linear, unitary operations on Hilbert space. In contrast, the Breathing Membrane Quantum Mechanics (BMQM) framework postulates that quantum coherence and superposition arise from internal rhythmic oscillations of a fundamental geometric substrate, referred to as the breathing membrane Ω.

Central to BMQM is the concept of *breathing time* τ, an intrinsic temporal parameter unrelated to classical coordinate time t. The evolution of the membrane's local state $\psi(\tau)$ is governed by the nonlinear differential equation:

$$\frac{d^2\psi}{d\tau^2} = \frac{2\psi(1-\psi^2)}{(1+\psi^2)^3}, \tag{1}$$

which has periodic solutions whose fundamental frequency defines the *Sionic constant*, $\sigma = \omega_\sigma^2 \approx 1.7365$.

This paper outlines an experimental proposal to detect the presence of internal breathing-based corrections to quantum evolution using entangled superconducting qubits. The goal is to test whether measurable deviations from standard linear phase evolution can be observed and linked to the predicted frequency $\omega_\sigma \approx \sqrt{\sigma} \approx 1.317$.

2 Experimental Design

2.1 System Setup

We consider a pair of high-coherence superconducting qubits on a commercially available quantum processor (e.g., IBM Eagle or Rigetti Aspen-M). Each qubit is initialized in a superposition state:

$$|\psi\rangle = \alpha|0\rangle + \beta|1\rangle, \tag{2}$$

and entangled via a controlled-Z (CZ) gate to yield the Bell-type state:

$$|\Psi\rangle = \frac{1}{\sqrt{2}}(|00\rangle + e^{i\phi(t)}|11\rangle). \tag{3}$$

2.2 Measurement Procedure

Quantum state tomography is performed at regular time intervals t_n to extract the relative phase $\phi(t)$. The system is allowed to evolve with minimal environmental interaction to preserve coherence. The expected standard evolution is linear:

$$\phi_{\mathrm{QM}}(t) = \omega t + \delta, \tag{4}$$

but BMQM predicts a modulated phase:

$$\phi_{\mathrm{BMQM}}(t) = \omega t + A \cdot \sin^2(\omega_\sigma t + \theta_0). \tag{5}$$

2.3 Control Experiment

Identical circuits are run with deliberate decoherence introduced (e.g., thermal noise). Any breathing pattern observed in the high-coherence setup but absent in the noisy system strengthens the BMQM claim.

3 Predicted Results

Detection of a **secondary oscillation component** in $\phi(t)$ with frequency $\omega_\sigma \approx 1.317$ would be a signature of BMQM breathing. The pattern should be reproducible across different qubit pairs and platforms, indicating its universality.

4 Discussion

BMQM unifies particle identity, time, and interaction under geometric breathing.
Unlike standard quantum field theory, which relies on unitary evolution and external time, BMQM introduces internal rhythm τ and nonlinearity. This experiment aims to bridge the theoretical framework with physical observables, potentially revealing quantum structure hidden beneath Hilbert linearity.

5 Conclusion

If confirmed, this experiment would offer the first empirical indication that **quantum superposition is modulated by a deeper, rhythmic substrate** , validating key aspects of BMQM. It opens a new direction in quantum foundations where the geometry of breathing may replace linear time.

Acknowledgments

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