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Wave-Induced Collapse Systems and Observer Interference Framework for Resolving Foundational Quantum Paradoxes

Abstract

This Continuation-in-Part extends the wave-interference-based collapse model first proposed in the Modified Schrödinger Equation (MSE) framework to five foundational quantum phenomena: tunneling, entanglement, measurement collapse, time asymmetry, and the resolution of Many-Worlds interpretations. The invention models collapse as a physical consequence of interference between the observer wave and the quantum system wavefunction, characterized by a curvature-based localization mechanism. This framework enables tunable collapse control, non-binary measurement outcomes, and outcome selection through engineered interference, providing a unified physical mechanism with broad technological applications.

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Background/Summary

FIELD OF THE INVENTION

[0001] The present invention relates to quantum mechanics, and more specifically, to systems and methods for wavefunction collapse through wave-to-wave interference. It extends to applications in quantum tunneling, quantum entanglement, measurement theory, time symmetry violation, and collapse-based interpretations of quantum reality.

BACKGROUND OF THE INVENTION

[0002] Conventional quantum mechanics treats wavefunction collapse as a postulated effect of measurement, lacking a defined physical mechanism. Wave-particle duality, the measurement problem, time-reversibility inconsistencies, and interpretation divergences such as the Many-Worlds hypothesis all stem from this theoretical gap.

[0003] The inventor's previous patent introduced a Modified Schrödinger Equation (MSE), in which collapse emerges from physical interference between an observer wave and the quantum system. Collapse is defined by the localization of the wavefunction, indicated by a sharply increasing second derivative curvature, denoted as Ψ.sub.p.sup.n(t).

[0004] This CIP proposes new applications of the MSE model to five long-standing quantum paradoxes. It describes physical systems, devices, and control protocols that apply observer-induced interference to manipulate collapse in ways that solve or bypass traditional paradoxes.

SUMMARY OF THE INVENTION

[0005] This invention introduces five system models based on the Modified Schrödinger Equation (MSE) wave-interference collapse framework. Each model addresses a major unresolved phenomenon in quantum theory using a consistent physical mechanism of collapse based on interference convergence and wavefunction curvature: [0006] 1. Tunneling Collapse System—Observer interference induces collapse, controlling tunneling probability and timing based on Ψ.sub.p.sup.n(t). [0007] 2. Entanglement Collapse Synchronizer—Phase-synchronized observer waves cause simultaneous collapse of entangled wavefunctions. [0008] 3. Measurement via Convergence—Measurement as continuous and tunable, governed by interference intensity and curvature, not binary collapse. [0009] 4. Collapse-Driven Time Asymmetry System—p .sub.p.sup.n(t) threshold introduces temporal irreversibility, defining the arrow of time. [0010] 5. Collapse-Only Outcome Selector—Destructive interference cancels alternate quantum paths, selecting a single observed outcome without branching.

[0011] These models reinterpret and enable control over quantum collapse across both theoretical and technological platforms.

Description

DETAILED DESCRIPTION OF THE INVENTION

[0012] The invention's five models rely on physical collapse through interference. The Modified Schrödinger Equation introduces a curvature-driven collapse trigger, where Ψ.sub.p.sup.n(t) reflects localization.

General Principles

[0013] Collapse occurs when interference between Ψ.sub.o(t) and Ψ.sub.p(t) causes Ψ.sub.p.sup.n(t) to exceed a threshold. [0014] Observer waves may be electromagnetic, acoustic, or simulated photonic patterns. [0015] Collapse is tunable—affected by amplitude, phase, coherence, and angle of Ψ.sub.o(t). [0016] Systems may be configured for: [0017] Tunneling control [0018] Entanglement synchronization [0019] Graded measurement [0020] Time-asymmetric simulation [0021] Outcome selection

Appendix A: Tunneling Reinterpreted
[0022] Collapse causes particle to localize beyond a potential barrier. [0023] Collapse triggered when Ψ.sub.p.sup.n(t)>δ due to interference with Ψ.sub.o(t). [0024] Predictive model replaces probabilistic tunneling with curvature-based event.
Appendix B: Entanglement Redefined
[0025] Collapse only occurs if Ψ.sub.o(t) overlaps with both entangled particles. [0026] Defines convergence functional:
[00001] $C(t) = \int$ .Math. $_{o}(x_1)$ $_{p1}(x_1) +$ $_{o}(x_2)$ $_{p2}(x_2)$ .Math. $^{2} dx$ [0027] Collapse occurs when:
[00002] $\frac{d^2 C(t)}{dt^2} >$
Appendix C: Measurement Reinterpreted
[0028] Measurement is a gradual process, not instantaneous. [0029] Collapse strength depends on Ψ.sub.o-Ψ.sub.p interaction. [0030] Models partial collapse and reversible probing:
[00003] $''_{p}(t) = \frac{d^2}{dt^2} \int$ .Math. $_{p}(t, x)$ .Math. $^{2} dx >$
Appendix D: Time Asymmetry via Collapse
[0031] Collapse marks break in time symmetry. [0032] Curvature spike in Ψ.sub.p.sup.n(t) introduces irreversible direction:
[00004] $''_{p}(t) \neq$ $''_{p}(-t)$ [0033] Collapse represents thermodynamic arrow of time in quantum domain.
Appendix E: Many-Worlds Collapsed
[0034] Collapse happens by destructive interference, not universe branching. [0035] Observer wave Ψ.sub.o(t) selects a path:
[00005] $_{p}(t) =$ .Math. $_{i}$ $_{i}(t)$ $_{i}(t) = \int$ .Math. $_{o}(t, x)$ $_{i}(t, x)$ .Math. $^{2} dx$ [0036] Collapse when:
[00006] $\frac{d^2 \;_{k}(t)}{dt^2} >$, $_{j}(t) <$ ∈ for $j \neq k$

Claims

1. Tunneling Control via Collapse Curvature An apparatus comprising: (a) a quantum system with a defined potential barrier; (b) an observer interference field configured to interact with the wavefunction of the quantum system; and (c) a monitoring module that tracks the second derivative curvature of the wavefunction, Ψ.sub.p.sup.n(t), wherein the tunneling probability of the quantum system is modulated via collapse triggered by interference-induced curvature exceeding a defined threshold.
2. Entanglement Collapse via Observer Convergence A system comprising: (a) at least two entangled particles; (b) synchronized observer waves directed toward each particle; and (c) an interference energy density detector, wherein the system triggers simultaneous collapse of the entangled particles when convergence of observer wave interference meets or exceeds a specified energy threshold.
3. Measurement via Interference Thresholding A method of quantum measurement comprising: (a) providing an observer wave to interfere with a quantum wavefunction; (b) monitoring the curvature Ψ.sub.p.sup.n(t) of the system; and (c) defining measurement collapse as a continuous, tunable process governed by the magnitude of interference and resulting curvature threshold.
4. Time Asymmetry from Collapse Dynamics A quantum simulation system comprising: (a) a bidirectional, time-reversible wavefunction; and (b) a curvature-based collapse trigger configured to induce temporal irreversibility, wherein the discontinuity in Ψ.sub.p.sup.n(t) indicates a collapse event that defines the arrow of time.
5. Collapse-Based Outcome Selection Device A quantum outcome selection device comprising: (a)

a quantum system with multiple branching evolution paths; and (b) a destructive interference mechanism configured to cancel alternate wavefunction paths, wherein collapse occurs at the path with maximal constructive overlap, resulting in a single observed outcome. Dependent Subclaims: 1. The observer field is configured as a pulsed electromagnetic source. 2. Collapse is defined by the condition Ψ.sub.p.sup.n(t)>3σ, where σ is the standard curvature deviation of the system. 3. Entanglement synchronization is achieved via photon-pair interactions using a coherent laser source. 4. The destructive interference mechanism utilizes holographic phase-canceling interference patterns. 5. The system allows for partial or reversible measurement when Ψ.sub.p.sup.n(t) is sub-threshold.
