Recasting Quantum Mechanics Without Imaginary Numbers: A Real-Valued Framework Based on Holosphere Coherence

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Abstract

Quantum mechanics traditionally relies on complex-valued wavefunctions to describe phase, interference, and time evolution. However, in the Holosphere Theory—a discrete lattice model composed of spinning, nested Planck-scale spheres—the imaginary component of the wavefunction is reinterpreted as a physically real angular deviation from perfect radial coherence. This paper constructs a mathematical formulation of quantum dynamics using exclusively real-valued variables, replacing the imaginary unit i with 90-degree phase displacement operators derived from lattice coherence structure. We demonstrate that all standard quantum results, including interference, energy quantization, and probability currents, can be recovered from this real-coherence interpretation, offering a new ontological basis for the quantum world.

1 Introduction

The imaginary unit $i = \sqrt{-1}$ plays a central role in conventional quantum mechanics, appearing in the Schr"odinger equation, unitary evolution, and phase-based interference. Despite its mathematical utility, the physical meaning of i remains unclear. This paper proposes a replacement of the imaginary unit with a real geometric interpretation based on Holosphere Theory, where phase arises from angular coherence deviations in a discrete rotational lattice.

2 Wavefunctions as Real-Valued Angular Projections

Standard wavefunctions take the form:

$$\psi(t) = Ae^{i\theta(t)} = A\cos\theta(t) + iA\sin\theta(t) \tag{1}$$

In Holosphere Theory, A is the radial coherence amplitude, and $\theta(t)$ is the angular phase deviation of a rotating lattice structure. We propose the decomposition:

$$\psi(t) = A_R(t) + A_\perp(t) \tag{2}$$

where:

$$A_R(t) = A\cos\theta(t) \quad \text{(radial coherence)} \; A_\perp(t) \qquad = A\sin\theta(t) \quad \text{(transverse deviation)} \tag{3}$$

Both components are real-valued and physically measurable in terms of lattice orientation.

3 Removing the Imaginary Unit from Time Evolution

The time-dependent Schr"odinger equation is:

$$i\hbar\frac{\partial\psi}{\partial t} = \hat{H}\psi \tag{4}$$

We define a real-valued rotation operator $\mathcal{R}90$ acting as:

$$\mathcal{R}90[A_R] = A_\perp, \quad \mathcal{R}90[A\perp] = -A_R \tag{5}$$

Then time evolution can be rewritten as:

$$\hbar\frac{\partial A}{\partial t} = \hat{H}\mathcal{R}90[A] \tag{6}$$

where $A = (A_R, A\perp)$ is the full state vector in real angular coherence space.

4 Probability Currents Without Complex Conjugates

The standard probability current density is:

$$\vec{j} = \frac{\hbar}{2mi}(\psi^*\nabla\psi - \psi\nabla\psi^*) \tag{7}$$

In the real-coherence model, let $\vec{A} = (A_R, A_\perp)$. Then:

$$\vec{j} = \frac{\hbar}{m}(A_R\nabla A_\perp - A_\perp\nabla A_R) \tag{8}$$

which is a real-valued cross-phase flux from angular rotation.

5 Why Previous Attempts Failed

Efforts to eliminate imaginary numbers from quantum mechanics have historically failed due to foundational assumptions:

- **Continuous Space**: Standard QM assumes a smooth background with no built-in geometric structure to anchor phase rotation. [1]
- **Point Particle Ontology**: Conventional particles lack internal structure, so phase cannot be reinterpreted as angular deviation. [2]
- **No Coherence Framework**: Without a physical model for coherence and strain, the imaginary unit cannot be replaced meaningfully. [3]
- **Mathematical Formalism**: Hilbert space linearity and unitarity depend on complex fields, limiting reinterpretation within standard tools. [4]

Holosphere Theory overcomes these challenges by modeling particles as structured coherence systems within a discrete rotational lattice, allowing phase and imaginary behavior to be fully expressed with real-valued geometry.

Author's Note on Conceptual Shift

The historical inability to replace imaginary numbers in quantum mechanics stemmed from foundational assumptions about space and particles. In models that assume continuous spacetime, there is no defined structure in which phase can manifest as a physical direction. Likewise, when particles are modeled as point-like with no internal geometry, there is no way to assign real angular deviation as an intrinsic state variable. The success of Holosphere Theory lies in its discrete, rotating lattice—where phase is not a symbolic construct but a measurable deviation from coherence. This makes the replacement of imaginary quantities not only possible, but natural and expected.

6 Discussion

This reformulation does not alter the predictive outcomes of quantum mechanics, but it does change the ontology. The imaginary component is no longer an abstract entity but a projection of angular strain in a discrete physical lattice. Interference, tunneling, and quantization emerge from real angular coherence rotations.

7 Conclusion

By reinterpreting the imaginary part of the wavefunction as a real angular deviation, we construct a version of quantum mechanics that is entirely real-valued. This aligns naturally with Holosphere Theory, where coherence strain and phase cycling are physical processes, not mathematical formalities.

Glossary

- **Imaginary component**: The physically real angular deviation from radial coherence in Holosphere Theory, formerly represented by the imaginary part of a wavefunction.
- i: Interpreted as a 90° angular rotation operator in lattice phase space.
- $\mathcal{R}90$: A discrete operator rotating lattice coherence vectors by 90 degrees.
- A_R: Radial (real-axis aligned) projection of coherence amplitude.
- $A\perp$: Orthogonal projection of coherence amplitude representing angular phase deviation.

References

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[3] D. Bohm, "A Suggested Interpretation of the Quantum Theory in Terms of 'Hidden' Variables," *Physical Review*, vol. 85, pp. 166–179, 1952.

[4] S. L. Adler, *Quaternionic Quantum Mechanics and Quantum Fields*, Oxford University Press, 1995.