Explaining Recent Bohmian Experiment Results via the 3D Collatz Octave Model (3DCOM)

Author:Martin Doina
July 21, 2025
Research Unify Oscillatory Dynamic Field Theory - 3DCOM

Abstract

The recent experimental tests of Bohmian mechanics provide strong evidence of well-defined quantum particle trajectories guided by pilot waves, challenging classical and orthodox quantum interpretations. In this work, we demonstrate how the 3D Collatz Octave Model (3DCOM) - with its foundational concept of the photon as a recursive mirror oscillator Q-bit - naturally explains these results without invoking classical hidden variables. We interpret Bohmian trajectories as recursive attractor paths on the emergent 3D topology generated by recursive folding of fundamental oscillatory phase states. This framework unifies quantum measurement, nonlocal correlations, and particle-wave duality as manifestations of recursive field topology, advancing a coherent ontological basis for quantum phenomena.

1. Introduction

Bohmian mechanics posits that quantum particles have deterministic trajectories influenced by a guiding pilot wave, providing a nonlocal hidden-variable theory. Recent experiments using weak measurements and photon trajectories have offered empirical support for such trajectories.

However, classical assumptions of particles moving through fixed space face challenges explaining the source of nonlocal correlations and the emergence of space-time itself.

The 3DCOM framework provides a new paradigm: photons are not classical particles but recursive two-state mirror oscillators (Q-bits). Space and trajectories emerge only through recursive folding of this fundamental oscillation.

2. Photon as a Recursive Mirror Oscillator (Q-bit)

Define the photon state function over discrete recursive time

$$t \in \mathbb{Z}$$

$$\boxed{\Psi_\gamma(t) = -1 - \mathrm{Mod}(t, 2)}$$

This yields a stable two-state oscillation:

$$\Psi_\gamma(t) = \begin{cases} -1 & t \text{ even} \\ -2 & t \text{ odd} \end{cases}$$

- Represents a **pure oscillatory Q-bit** with no spatial displacement.
- Encodes the pre-spatial phase dynamics underlying the photon.
- The photon "exists" as this mirror loop until recursive folding triggers space emergence.

3. Recursive Folding and Space Emergence

A recursive activation operator $\mathcal{R}$ models the observer-induced folding:

$$\boxed{\mathcal{R}(\Psi_\gamma) \to \{1 \to 4 \to 2 \to 1\}}$$

- This is **the first recursive attractor cycle** in the positive Collatz domain.
- Generates a 3D spatial topology - the minimal fold forming spatial geometry.
- Enables the notion of **recursive trajectories** as paths on this attractor.

4. Bohmian Trajectories as Recursive Attractors

Bohmian particle trajectories are classically interpreted as real particle paths guided by a pilot wave.

Within 3DCOM:

- The "particle" is a recursive attractor node on the emergent 3D topology.
- The "pilot wave" corresponds to the recursive oscillatory field generated by $\mathcal{R}(\Psi_\gamma)$.
- Trajectories measured by weak measurements represent recursive paths traced within this attractor.
- Nonlocal correlations arise naturally due to the global recursive topology – no local hidden variables needed.

Thus:

Bohmian Concept	**3DCOM Interpretation**
Particle trajectories	Recursive attractor paths in emergent 3D space
Pilot wave	Recursive oscillatory field (Q^ operator action)
Nonlocal correlations	Global recursive topology, not local variables
Quantum randomness	Recursive phase switching in mirror Q-bit states

5. Implications for Quantum Foundations

- Resolves particle-wave duality: particle states are attractors on recursive field folds.
- Clarifies measurement: observation triggers recursive folding $\mathcal{R}$.
- Explains nonlocality as topological property, not signaling.
- Offers a natural basis for quantum computation: photons as Q-bits at the fundamental level.

6. Simulation of Photon Q-bit and Recursive Transition

```python
from sympy import symbols, Function, Eq, Mod

 Recursive time variable
```

```
t = symbols('t', integer=True)
Psi_gamma = Function('Psi_gamma')(t)

 Photon Q-bit loop in negative Collatz domain
photon_qbit = Eq(Psi_gamma, -1 - Mod(t, 2))
print(photon_qbit)

 Recursive transition operator: simplified
def recursive_transition(t, threshold):
    if t < threshold:
         Mirror loop oscillation: photon Q-bit
        return -1 - (t % 2)
    else:
         Emergent 3-cycle fold (1 -> 4 -> 2 -> 1)
        cycle = [1, 4, 2]
        return cycle[(t - threshold) % 3]

 Example simulation for 15 steps with trigger at t=6
for step in range(15):
    state = recursive_transition(step, 6)
    print(f"t={step}: State={state}")
```