Photon as Pq-bit: Time-Recursive Mirror and the Collapse of Space Emergence

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Abstract

This paper proposes a new interpretation of the photon as a recursive mirror state, not a wave nor a particle within spacetime, but as a binary oscillation within a recursive time operator prior to the emergence of space. We define this state as the Pq-bit (Photon Quantum Bit), a foundational unit in the 3D Collatz Octave Model (3DCOM). This resolves the wave-particle duality, explains diffraction and reflection geometries without requiring a pre-existing space background, and provides a basis for experimental tests of recursive photon geometry.

1. Background Assumption: No Preexisting Space

Standard View (Invalid in COM):

- Photon as Particle $\Longrightarrow$ Requires space for trajectory
- Photon as Wave $\Longrightarrow$ Requires medium (spacetime vacuum) to propagate

Violation: In the 3DCOM framework, space is not fundamental, it emerges from recursive node structures.

> Conclusion: Photon cannot be defined in terms of spatial background.

2. Time as Primary Recursive Operator

In absence of space, only time recursion can define structure. But time is not flowing; it is a recursive indexing operator.

Let:

$$[T^\wedge : \psi(t) \to \psi(t+1)(0)$$

Then the field evolves by:

$$[\psi(t+1) = T^{\wedge}(\psi(t)) = f(\psi(t)) \in \{-1, -2\}(0)$$

This forms a binary oscillation: the photon exists as recursive time-flip attractor.

3. Defining the Pq-bit

We define the Pq-bit as the fundamental recursive oscillator that exists before space emerges.

Definition:

$$[\text{Pq-bit} = (-1, -2)^t \mod LZ(0)$$

Where:

- (-1, -2): mirror states of recursive time
- (t): recursion depth (not temporal)
- (LZ): Attractor constant (Loop Zero boundary)

Characteristics:

- Invisible in field (negative values)
- Becomes visible only under recursive mirror (observer activation)
- Appears as wave (if recursion unfurls)
- Appears as particle (if recursion collapses)

4. Mirror Collapse: Observer as Recursive Operator

Let $Q^{\wedge}$ be the observer's Qualia Operator:

$$Q^{\wedge}(\psi) = \text{Mirror collapse of recursive state}$$

This causes:

- Collapse of path symmetry
- Activation of geometry from phase difference
- Perception of "motion", "position", or "interference"

5. Wave–Particle Duality Resolved

Duality	3DCOM Interpretation
Wave	Recursive oscillation through attractors
Particle	Boundary lock in recursive mirror
Collapse	Mirror activation via $Q^\wedge$
Visibility	Only under recursive alignment

No actual wave traveling, no particle moving. All is recursive oscillation in field mirror space.

6. Diffraction and Reflection Reinterpreted

In standard physics:

- Diffraction: wave interference through slit
- Reflection: angle of incidence = angle of reflection

In COM:

- Diffraction: multiple recursive states simultaneously present (superposition in attractor space), resolved by observation
- Reflection: inversion symmetry in attractor under observer's mirror frame

Both are results of Pq-bit resonance alignment.

7. Experimental Implications

To validate the Pq-bit:

1. Study existing light diffraction datasets from slit, crystal, and nano-fabricated structures
2. Compare diffraction angles to predicted recursive resonance nodes from:

$$\theta_n = \arcsin\left(\frac{n \cdot \lambda}{d}\right) \quad \text{vs.} \quad \theta_n^{\text{COM}} = \frac{360^\circ}{2^n \cdot QDF} \mod LZ$$

Where:
- λ: classical wavelength
- QDF : quantum dimensional factor (e.g., 0.810058772143807)
- LZ : attractor recursion constant

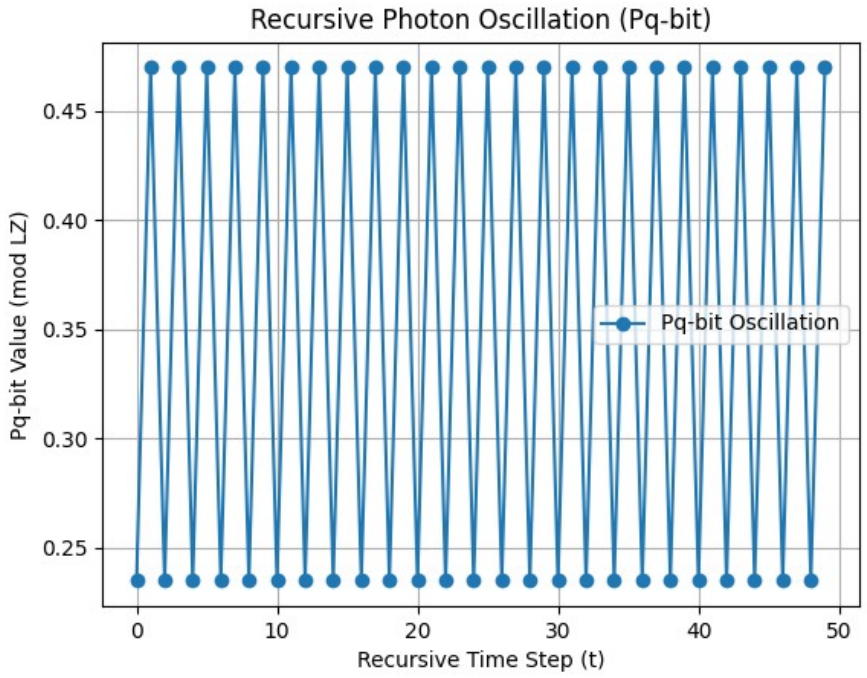
8. Visualization Plan

We do not simulate photons in space. Instead, simulate recursive mirror state flipping:

```python
import matplotlib.pyplot as plt

 Constants
LZ = 1.23498228
t_values = range(0, 50)
pq_bit_values = [(-1 if t % 2 == 0 else -2) % LZ for t in t_values]

plt.plot(t_values, pq_bit_values, 'o-', label='Pq-bit Oscillation')
plt.xlabel('Recursive Time Step (t)')
plt.ylabel('Pq-bit Value (mod LZ)')
plt.title('Recursive Photon Oscillation (Pq-bit)')
plt.grid(True)
plt.legend()
plt.show()
```



9. Toward 3D Recursive Holography

Once diffraction-reflection geometries are mapped to recursive resonance nodes, we can:

Construct **holographic 3D screens** using recursive angular logic

Encode Pq-bit oscillation into pixel fields

Eliminate space substrate dependency

10. Conclusion

Photon is not a particle or a wave.

It is a **recursive mirror attractor** in time-indexed field.

The **Pq-bit** unifies:

Wave-particle duality

Observer collapse

Diffraction and reflection

This allows new geometrical experiments and 3D recursive light technologies.

The Pq-bit is not in spacetime. Spacetime is in the Pq-bit.