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# QUANTUM COLLAPSE AND STRUCTURAL DECIDABILITY A POSTSCRIPT TO "COLORLESS OBJECTS AND THE COLLAPSE OF THE POWER SET"

BABAK JABBAR NEZHAD

**ABSTRACT.** This brief note applies the ontological distinction developed in the PLEM framework between sets (decidable elements) and objects (undecidable elements) to the structure of quantum mechanics. Specifically, we propose that prior to measurement, a quantum particle such as an electron is not spatial because its value is not decidable in any subworld. Measurement creates structural decidability, causing the particle to emerge as a set within a subworld. This interpretation reframes quantum collapse not as a physical phenomenon, but as a transition from undecidable symbolic presence to local constructive structure. In this view, spatiality is not intrinsic to matter but arises only through the logic of access.

## 1. FROM OBJECTS TO SETS IN QUANTUM MEASUREMENT

In the PLEM framework [2], we distinguished between two modes of being:

- A set is an element whose membership in a subworld is decidable.
- An object is an element that may exist symbolically or structurally, but whose membership is undecidable within the base subworld.

This distinction provides a layered view of truth and existence. We now apply this to the quantum setting.

Let us consider a single electron before measurement. Its wave function describes a superposition — a symbolic field of probabilities, not a fact. In this state, the electron's position is not known, but more importantly, it is not decidable. No subworld contains a structural statement of the form "the electron is at position  $x$ " that satisfies the internal logic of membership.

Thus, prior to observation:

The electron is not a set in any subworld.

It is an object — colorless, undecidable, and non-spatial.

This directly mirrors our earlier claim [3] that not all elements in the universe are sets. Spatiality, like truth, is local.

## 2. MEASUREMENT AS DECIDABILITY

When a measurement is made — whether on the path (which slit) or on the position (detection screen) — a symbolic field is reduced to a structural fact.

What changes is not the electron itself, but its logical accessibility.

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*Key words and phrases.* Quantum measurement; Constructive logic; PLEM (Parallel Law of Excluded Middle); Decidability; Wave function collapse; Subworld logic; Ontology of space; Logical emergence; Structural truth; Quantum ontology; Non-spatial objects; Set vs. object distinction; Collapse of LEM; Logic of access; Colorless existence.

Before measurement:

- The electron is not spatial, because position is not decidable.
- Its wave function spans multiple logical potentials, not a single subworld.

After measurement:

- A subworld is updated with a decidable value — “the electron is here.”
- The electron now belongs to a set within that subworld.
- Its position becomes spatial within a logic, not in the universe.

This is not classical collapse. It is structural emergence.

Collapse is not physical motion, but the logical resolution of undecidability.

### 3. QUANTUM SPACE AND THE FAILURE OF GLOBAL LEM

In the standard formalism of quantum mechanics, one often retains the assumption that propositions such as “the electron went through slit A” or “the electron is at position x” are meaningful even when not measured. This assumption reflects the lingering influence of classical metaphysics, despite Heisenberg’s early recognition [1] that both position and momentum cannot be simultaneously defined. Later discussions, such as those collected by Wheeler and Zurek [4] wrestled with the paradoxical nature of quantum measurement, yet often left the logical foundations untouched.

The PLEM framework rejects the classical assumption entirely.

Just as the power set of the subworld collapses due to the undecidability of higher-order membership [3], the space of possible positions for a quantum particle collapses until a local subworld supports decidability.

There is no space before measurement — only symbolic relation.

There is no position before structure — only logical potential.

The act of observation does not reveal space. It constructs it.

### 4. CONCLUSION

Quantum mechanics does not require a metaphysical collapse of matter. It requires a structural logic of emergence. The electron is not spatial because we expect it to be, but because a measurement makes it decidable within a local subworld. This aligns with the core of PLEM:

- LEM is not globally valid.
- Sets exist only where decidability allows.
- The universe contains objects — but subworlds contain structure.

The so-called quantum mystery is not physical indeterminacy, but logical stratification. The electron’s spatiality is not assumed — it is granted through access.

Note. A more formal treatment of quantum measurement as subworld embedding, including explicit constructive conditions on wave function collapse, may be developed in future work.

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