4 October 2025 ·

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Peer Review

Review of: "Measurement Problem from the Perspective of Wittgenstein's Philosophy"

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Review of the Paper:

Measurement Problem from the Perspective of Wittgenstein's Philosophy

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The central claim of the paper under review is that Wittgenstein's theory of language, when combined with the idea of microscopic quantum jumps, dissolves the measurement problem in quantum mechanics. My critique is that this hybrid proposal does not, in fact, dissolve the problem but only repackages it.

First, on the positive side, Wittgenstein's later philosophy can indeed help us see that many of the puzzles arise from linguistic confusions — from mixing distinct 'language-games.' Collapse and unitary evolution belong to different practices of discourse. Recasting collapse as a grammatical rule of discourse, however, does not provide a physical mechanism for definite outcomes or for the Born rule. Wittgenstein's therapy dissolves conceptual pseudo-problems but does not answer the physicist's demand for a model of how measurement yields actual results.

Second, microscopic quantum jumps, as used in quantum optics and trajectory formalisms, are not a

 doi.org/10.32388/I1QBRM

fundamental resolution either. They presuppose the existence of a measurement record and involve non-unitary updates conditioned on detection. They model open-system dynamics, but they do not explain how collapse arises from purely unitary evolution. In other words, they assume the very phenomenon they are supposed to explain.

Third, the dual rulebook of von Neumann remains unchanged. One still has deterministic, unitary evolution between jumps and discontinuous updates at the jumps. The critical issue of defining when and why a measurement occurs remains unanswered.

Fourth, the paper conflates epistemic and ontic levels. Collapse is treated as an epistemic update in Wittgensteinian terms, while quantum jumps are described as ontic events. This mixture leaves the framework unstable, neither purely pragmatic nor ontological.

Moreover, key technical problems are left unaddressed: the Born rule is assumed rather than derived, the preferred basis problem is relocated to the detector model without explanation, and decoherence is conflated with actual outcome selection. The shift from improper to proper mixtures is asserted by linguistic fiat, not physical justification.

In short, the supposed dissolution is circular. It relies on measurement records and assumptions that already encode collapse-like rules. Thus, the core measurement problem — how definite outcomes arise, why probabilities follow the Born rule, and where the measurement-system cut is drawn — remains untouched.

Wittgenstein's philosophy can indeed clarify why contradictions seem to arise, and microscopic jumps offer a useful modeling tool. But taken together they do not dissolve the measurement problem; they only relabel it.

Von Neumann's Two Processes

The author makes the following statement in Section III: ''A mathematical treatment of the measurement problem was also covered by this book for the first time. Since von Neumann, theorists of the measurement problem have rarely questioned the applicability of mathematics to the measurement

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problem. However, if we carefully read this book, we notice one questionable description at the very end where the measurement problem is covered. First, he assumes that the observed system and the observing apparatus are both described by Hamiltonians and that quantum mechanics is applicable to both the observed system and the apparatus. Second, he introduces a strange Hamiltonian describing the interaction between the observed system and the observing apparatus without giving a clear justification. The role of this interaction Hamiltonian appears to represent the transition.

Regardless of the form of the interaction Hamiltonian, it is apparent that he assumes that the transition from microscopic to macroscopic or quantum to classical is described by quantum mechanics and by mathematics."

Unfortunately, this is a misreading of von Neumann.

Von Neumann's treatment in *Mathematical Foundations of Quantum Mechanics* is often misunderstood. The interaction Hamiltonian he introduces is not an arbitrary or "strange" construct, but deliberately chosen: by coupling the system observable to the momentum operator of the apparatus pointer, it ensures a displacement of the pointer coordinate correlated with the system's eigenvalue. The consequence is an entangled state linking system eigenstates with distinct pointer positions. What von Neumann recognized, however, is that this still does not yield a definite outcome. For that reason, he introduced what he called Process 1, the projection postulate — a non-unitary, non-quantum rule that collapses the entangled superposition into one branch with Born-rule probabilities. Alongside this, his Process 2 is the usual unitary Schrödinger evolution. Thus, it is not the case, as the author claims, that von Neumann assumed the transition from microscopic to macroscopic is fully described by quantum mechanics and mathematics. On the contrary, von Neumann made explicit that an additional postulate, external to quantum mechanics proper, was required. The true tension in his scheme lies not in the measurement Hamiltonian, but in the coexistence of these two fundamentally different processes.

Bohr's Postulate of Classicality

Bohr's approach differs sharply from von Neumann's. Bohr insisted that the measuring apparatus must always be described in classical terms. Far from being a 'false step', as the author suggests, this postulate prevents the measurement problem from arising in the first place. If the apparatus is classical by definition, there is no need to reconcile two conflicting processes within quantum mechanics itself: the cut between system and apparatus is fixed at the outset. In this respect, Bohr's view is in fact close to Wittgenstein's: both emphasize that the role of a concept is determined by its use within a language-

doi.org/10.32388/I1QBRM

game, not by its supposed metaphysical extension. To demand that the apparatus be described quantum-mechanically is to misuse the grammar of physical discourse, extending it into a domain where it no longer applies. Bohr's postulate of classicality thus functions as a logical boundary condition, preventing the paradox from arising.

Declarations

Potential competing interests: No potential competing interests to declare.