

Quantum superposition principle justified in a new non-Aristotelian finitary logic

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Abstract

In the proposed non-Aristotelian finitary logic (NAFL), truths for formal propositions can exist only with respect to axiomatic theories, essentially as temporary axiomatic declarations in the human mind. An undecidable proposition P in a consistent NAFL theory T is true/false with respect to T if and only if it has been axiomatically declared as true/false by virtue of its provability/refutability in an interpretation T^* of T . In the absence of any such axiomatic declarations, P is in a superposed state of "neither true nor false" and consistency of T requires the existence of a non-classical model for T in which $P \wedge \neg P$ is the case. Here T^* is an axiomatic NAFL theory that, like T , resides in the human mind and acts as the "truth-maker" for (a model of) T . Quantum superposition is justified by identifying "axiomatic declarations" for the truth/falsity of P (by virtue of its provability/refutability in T^*) with "measurement" in the real world. NAFL also explains and de-mystifies the phenomenon of entanglement. NAFL severely restricts classical infinitary reasoning, but possibly provides sufficient machinery for a consistent axiomatization of quantum mechanics.

Keywords: Quantum superposition, entanglement, non-classical logic, finitary reasoning.

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