Relational Quantum Mechanics and the Determinacy Problem

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Abstract

Quantum mechanics describes certain systems as being in superpositions of their properties, yet every measurement on every system that we are able to perform yields a determinate result. The ``orthodox'' formulation of the theory builds this in by including a postulate that such superpositions ``collapse'' at the time of measurement. This strategy fails to really explain why such measurements are determinate, is unacceptably imprecise, and makes observation basic in fundamental physical theory, which looks like the wrong sort of process for the job. The problem of the interpretation of quantum mechanics is the problem of finding a more satisfactory understanding of the formalism in the face of these problems. Carlo Rovelli's relational interpretation of quantum mechanics holds that a system's states or the values of its physical quantites as normally conceived only exist relative to a cut between a system and an observer or measuring instrument. Furthermore, on Rovelli's account, the appearance of determinate observations from pure quantum superpositions happens only relative to the interaction of the system and observer. Jeffrey Barrett has pointed out that certain relational interpretations suffer from what we might call the ``determinacy problem,'' but the interpretations that Barrett considers make facts relative to branches of the universal wave function rather than to system/observer cuts. Thus, Barrett misclassifies Rovelli's interpretation, which differs from the interpretations that Barrett explicitly worries about and has the resources to escape his particular criticisms. Rovelli's interpretation still leaves us with a paradox having to do with the determinacy of measurement outcomes, which can be accepted only if we are willing to give up on certain elements of the ``absolute'' view of the world.

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