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Quantum measurement in action[1]

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A quantum system subject to the infinitely-strong measurement of textbook physics undergoes a discontinuous, random state collapse. However, in practice, measurements often involve a finite-strength, continuous process whose iteration leads to a projective evolution only asymptotically. Moreover, if the observation apparatus is fully efficient informationally, the measured system can remain at all times in a pure state. The stochastic evolution of this pure state is trackable from the measurement record. Thus, an initial superposition of states can be usefully transformed by a partial measurement rather than be entirely destroyed. This striking property has been demonstrated in superconducting qubit experiments in which readout is performed by a microwave signal sent through a cavity dispersively coupled to the qubit, and thereafter processed by an amplifier operating at the quantum limit. Such accurate monitoring of a qubit state is an essential prerequisite for measurement-based feedback control of quantum systems.

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