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Manipulating a qubit through the backaction of sequential partial measurements and real-time feedback CRISTIAN BONATO, MACHIEL BLOK, Delft Univ of Tech, MATTHEW MARKHAM, DANIEL TWITCHEN, Element-Six Ltd, VIATCHESLAV DOBROVITSKI, Ames Lab, RONALD HANSON, Delft Univ of Tech — Quantum measurements not only extract information from a system but also alter its state. Although the outcome of the measurement is probabilistic, the backaction imparted on the measured system is accurately described by quantum theory. Therefore, quantum measurements can be exploited for manipulating quantum systems without the need for control fields. We demonstrate measurement-only state manipulation on a nuclear spin qubit in diamond by adaptive partial measurements. We implement the partial measurement via tunable correlation with an electron ancilla qubit and subsequent ancilla readout. We vary the measurement strength to observe controlled wavefunction collapse and find post-selected quantum weak values beyond 10. By combining a novel quantum nondemolition readout on the ancilla with real-time adaptation of the measurement strength, we realize steering of the nuclear spin to a target state by measurements alone. Besides being of fundamental interest, adaptive measurements can improve metrology applications and are key to measurement-based quantum computing.

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