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Real-time adaptive quantum measurements on a single spin in diamond for sensing and quantum information protocols MACHIEL BLOK, CRISTIAN BONATO, RONALD HANSON, Delft Univ of Tech — Real-time feedback based on quantum measurements is a crucial ingredient for many proposed quantum information and sensing technologies. Implementation requires high-fidelity measurements as well as fast electronics that perform the control operation. A single electron spin, associated with the Nitrogen-Vacancy defect in diamond, forms an excellent test bed for real-time feedback protocols, since it can be read out with high fidelity in a single shot using optical transitions and maintain coherence for long times. Here we demonstrate an adaptive phase estimation protocol to sense DC magnetic fields with very high precision. The magnetic field is measured with a Ramsey interferometry sequence which is repeated many times. When adjusting the parameters of the Ramsey sequence in real time based on the outcome of previous measurements, the sensitivity of our magnetometer shows scaling close to the fundamental Heisenberg limit ($\sim 1/N$) as the number of measurements N is increased.

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