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Microwave readout of solid state spin ensembles

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Defects in solids have emerged as a promising platform for quantum sensing. Leading candidates, such as nitrogen-vacancy color center in diamond, can be initialized into pure quantum states, can be coherently controlled, and can have relatively long-lived quantum coherence at room temperature. Lack of high-fidelity state readout, however, has limited the utility of solid-state quantum devices. Despite extensive experimental effort, no universal, readout technique has been achieved for solid-state spin ensembles. Here we demonstrate a novel, non-optical technique for readout using microwave-accessible transitions. By coupling ensembles of spins to a microwave cavity, we realize a dramatic enhancement of the state-dependent dispersive shift produced by the ensemble, paving the way for high-fidelity readout at room temperature. We demonstrate this technique by employing an ensemble of nitrogen vacancy centers for magnetometry, achieving a sensitivity unconstrained by optical photon shot noise.

[1]Ultrasensitive Atomic Sensors