NES21-2021-000030

Abstract for an Invited Paper
for the NES21 Meeting of
the American Physical Society

Microwave readout of solid-state spin ensembles

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Defects in solids have emerged as a promising platform for quantum information science. 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. While high-fidelity state readout has been achieved for single spins, the techniques are not generalizable to ensembles of spins. This talk describes a novel, non-optical readout technique, which relies on microwave-accessible transitions. By coupling ensembles of spins to a microwave cavity, significant enhancement of the state-dependent dispersive shift produced by the ensemble is realized. We demonstrate this technique by employing an ensemble of nitrogen vacancy centers for magnetometry, achieving a sensitivity unconstrained by optical photon shot noise. In addition, we show this technique extends beyond diamond, paving the way for high-fidelity readout at room temperature.