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Coherent mechanical control of a single electronic spin

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Quantum control of spins via electrical, magnetic, and optical means has generated numerous applications in metrology and quantum information technology. In this talk we present an alternative control scheme that uses the mechanical motion of a resonator to coherently control spins. Specifically, by coupling the motion of a magnetically coated mechanical oscillator to a single nitrogen-vacancy (NV) defect in diamond, we demonstrate manipulations of both the amplitude and phase of the NV's electronic spin. Coherent control is achieved by synchronizing NV-addressing optical and microwave manipulations to the driven motion of the coupled mechanical oscillator, which additionally allows for a stroboscopic readout of the resonator's motion. We demonstrate applications of this mechanical spin control to sensitive nanoscale scanning magnetometry and discuss the potential for sensitive motion sensing of nanomechanical resonators.