Abstract Submitted
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Coherent Control of a Nitrogen-Vacancy Center Spin Ensemble with a Diamond Mechanical Resonator[1] F. GUO, E.R. MACQUARRIE, T.A. GOSAVI, A.M. MOEHLE, N.R. JUNGWIRTH, S.A. BHAVE, G.D. FUCHS, Cornell University — In contrast to the traditional coherent control of the nitrogen vacancy (NV) center in diamond's triplet spin state with ac magnetic fields, we recently demonstrated that gigahertz-frequency lattice strain resonant with the m_s= +1 to -1 spin state splitting can also be used to drive spin transitions.[2] We present coherent spin control over NV center ensembles with a bulk-mode mechanical microresonator that generates large amplitude ac stress within the diamond substrate. Using these structures, we mechanically drive coherent Rabi oscillations between the -1 and +1 states. We also accurately model the Rabi dephasing with a combination of a spatially inhomogeneous mechanical driving field and magnetic noise from a fluctuating spin bath. Understanding mechanically driven dynamics in spin ensembles could have applications in sensing and quantum optomechanics where interactions can be enhanced by the number of spins. Moreover, these results demonstrate coherent mechanical control of the magnetically forbidden -1 to +1 spin transition, thus closing the loop on NV center ground state spin control and enabling the creation of a coherent Δ-system within the NV center ground state.

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[2]E. R. MacQuarrie *et al.* Phys. Rev. Lett. 111, 227602 (2013)

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