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Continuous dynamical decoupling of a single diamond nitrogen-vacancy center spin with a mechanical resonator[1] EVAN MACQUARRIE, TANAY GOSAVI, Cornell University, SUNIL BHAVE, Purdue University, GREGORY FUCHS, Cornell University — We use coherent interactions between a diamond mechanical resonator and a single nitrogen-vacancy (NV) center spin qubit to engineer a decoherence-protected spin basis. For solid state spin qubits such as the NV center, a dominant source of inhomogeneous dephasing is magnetic field fluctuations due to nearby paramagnetic impurities or instabilities in a magnetic bias field. By dressing the NV center spin states with a 581 ± 2 kHz mechanical Rabi field, we decrease the spin's sensitivity to magnetic fluctuations in a thermally isolated subspace, thus prolonging the Ramsey coherence time from $T_2^* = 2.7 \pm 0.1$ μs to 15 ± 1 μs. We develop a model that quantitatively predicts the relationship between the mechanical Rabi field and the dephasing time. Our model shows that a combination of random magnetic field fluctuations and hyperfine coupling limits the protected coherence time over the range of mechanical dressing fields accessed in our experiment. Finally, we show that amplitude noise in the dressing field will dominate over magnetic noise for larger driving fields.

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