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Observation of spin-light coherence for single spin measurement and control in diamond[1]

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The long spin coherence and optical addressability of nitrogen-vacancy (NV) centers in diamond makes them excellent candidates for studies of quantum information science with potential technological applications. We demonstrate the coherent coupling of light to the electronic spin of a single NV center for both non-destructive, single-spin readout via the Faraday effect and unitary, single-spin control via the optical Stark effect[3]. By monitoring the Faraday effect of laser light focused on a single NV center and detuned from optical resonances, we are able to read out an NV center's spin state without destroying it, in contrast to traditional spin readout techniques which polarize the spin during measurement. In a complimentary way, the spin coherently rotates in response to the light through the optical Stark effect, which we demonstrate as a method of all-optical spin control. These measurements have important consequences for future single-spin quantum non-demolition measurements and spin-photon entanglement schemes in diamond that may be exploited for the development of quantum repeater technologies and photonic coupling of spins over large distances.

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[2]In collaboration with G. D. Fuchs, L. C. Bassett, and D. D. Awschalom

[3]B. B. Buckley, G. D. Fuchs, L. C. Bassett, D. D. Awschalom, *Science Express* (DOI: 10.1126/science.1196436)