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**Hybrid optical-electrical detection of donor electron spins with bound excitons in silicon** C. C. LO, M. URDAMPILLETA, P. ROSS, University College London , M. F. GONZALEZ-ZALBA, Hitachi Cambridge Laboratory, J. MANSIR, University College London, S. A. LYON, Princeton University, M. L. W. THEWALT, Simon Fraser University, J. J. L. MORTON, University College London
— Electrical detection of spin resonance is a powerful technique for understanding the dynamics of spins in semiconductors. For electrons bound to shallow donors in silicon, thus far it has been demonstrated by coupling donors to spin readout partners, such as paramagnetic defects or conduction electrons, which fundamentally limit the donor coherence times. Here we demonstrate electrical detection of donor bound excitons in a silicon device, and show that the spin-selective bound exciton transitions can be exploited for the electrical detection of coherent spin manipulation of isolated donors. We use this method to measure electron spin Rabi oscillations, and we are able to obtain long intrinsic electron spin coherence times, limited only by the donor concentration. Furthermore, we address critical issues for adopting such a hybrid optical-electrical detection scheme for single spin detection in silicon nanodevices, laying the foundations for realizing a versatile readout method for single spin readout with relaxed magnetic field and temperature requirements compared with spin-dependent tunneling. [arXiv:1411.1324]

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