Quantum control of spins in silicon

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One of the remarkable features of spins in the solid state is the enormous range of time-scales over which coherent manipulation is possible. If one considers gate-controlled manipulation of nuclear spins at one extreme [1], and strongly-interacting multi-electron qubits at the other extreme [2-4], coherent control of spins in semiconductors has been demonstrated with over 9 orders of magnitude variation in the manipulation time. Remarkably, confining three electrons in two neighboring quantum dots enables all electrical control and measurement of spin dynamics on time scales less than one nanosecond [5]. In this talk I will discuss the interesting commonalities and contrasts between the two limiting cases: qubits composed of a single-spin, be it electron or nuclear, where magnetically-driven manipulation is required, and qubits composed of multiple electrons, for which case direct electric-field manipulation is possible.

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