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Two single spin qubits with universal control and control of spin entanglement with exchange coupling[1]

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Single qubits and two-qubit gates are building blocks to prepare a universal set of logical operations. We use a micro-magnet technique to implement single spin qubits with individual quantum dots and two-qubit gates with inter-dot exchange coupling. I will talk about our recent experiments of a combined X-gate and exchange control to modulate and detect the degree of spin singlet coupling. The gate fidelity is restricted by X-gate operation time and fidelity. The X-gate is prepared by oscillating an electron inside a quantum dot with microwave (MW) in the presence of a micro-magnet induced field gradient. We have recently raised the MW power and optimized the magnet design to reduce the X-gate time < 3 nsec with improved gate fidelity much shorter than the dephasing time. We have also developed a technique to use the micro-magnet induced inhomogeneous Zeeman field to make faste Z-gate and CPHASE.

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