The Quantum Dot Hybrid Qubit in Silicon

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This talk focuses on experimental measurement, manipulation, and readout the quantum dot hybrid qubit (QDHQ) [1] in silicon. The QDHQ consists of three electrons in a tunnel-coupled double quantum dot, operates at zero magnetic field, and can be manipulated on time scales as short as a few nanoseconds [2,3]. Ramsey-like experiments enable measurement of the Hamiltonian parameters that describe the qubit, and can be used to aid in tuning those parameters to enhance the qubit coherence times [4]. An essential ingredient in manipulation of the QDHQ is achieving an energy splitting between the qubit states 0 and 1 that simultaneously is greater than kT (~2 GHz in typical experiments) and low enough to be in a convenient microwave frequency range (less than 20 GHz is ideal). The valley splitting in silicon quantum dots provides one way to set the qubit energy splitting in this range, and this talk will discuss the tunability of this splitting as well as new Si/SiGe growth techniques aimed at increasing the predictability of this important energy scale.

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