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Observation of multiple exchange oscillation frequencies in Si/SiGe spin qubits MATTHEW RAKHER, HRL Laboratories, LLC — An all-electrical approach to quantum information processing with spin qubits in Si/SiGe quantum wells relies on the ability to quickly turn on and off the exchange interaction between electrons in neighboring quantum dots [1]. The quality of gates enabled by this technique depends critically on reliably achieving a specific value of exchange coupling for a given control voltage. In recent experiments [2], we have observed multiple exchange oscillation frequencies at the same control bias for several different devices. In particular, Fourier transforms of exchange oscillations measured as a function of evolution time reveal the presence of multiple frequencies over a wide range of pulse amplitudes. The data are suggestive of unwanted population of an excited singlet-triplet manifold that behaves similarly with bias as the qubit ground state pair. The occupation of excited singlet-triplet states can degrade gate performance in exchange-based quantum devices and we outline methods to observe and investigate these states. [1] K. Eng et al, Science Advances 1 (2015) [2] M.D. Reed et al, arxiv:1508.01223 (2015)

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