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Fast initialization of a silicon spin qubit via an excited orbital state C.B. SIMMONS, J.R. PRANCE, B.J. VAN BAEL, TECK SENG KOH, ZHAN SHI, D.E. SAVAGE, M.G. LAGALLY, R. JOYNT, MARK FRIESEN, S.N. COPPERSMITH, M.A. ERIKSSON, University of Wisconsin-Madison — We present data showing the initialization and measurement of individual electron spins in a silicon quantum dot. Spectroscopy of the electronic excited states of the dot reveals a relatively low-lying excited orbital state that is much more strongly coupled to the reservoir than the ground orbital state. As a function of an applied magnetic field, Zeeman splitting is observed for both the ground and the excited orbital states. By tuning a gate voltage, electron spins can be preferentially loaded into the quantum dot via any of these spin-split orbital states. Loading at either of the excited orbital states is measured to be over an order of magnitude faster than loading at directly into the orbital ground state. We use single-shot readout to measure the spin state of the loaded electrons. We observe two clear peaks in the fraction of spin-up electrons that are loaded, and these peaks correlate with loading through the spin-up ground or excited orbitals.

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