A fast “hybrid” silicon double quantum dot qubit

TECK SENG KOH, ZHAN SHI, C.B. SIMMONS, J.R. PRANCE, JOHN KING GAMBLE, YUN-PIL SHIM, University of Wisconsin-Madison, XUEDONG HU, University at Buffalo, SUNY, D.E. SAVAGE, M.G. LAGALLY, M.A. ERIKSSON, MARK FRIESEN, S.N. COPPER-SMITH, University of Wisconsin-Madison — We propose a quantum dot qubit architecture that has an attractive combination of speed and fabrication simplicity. It consists of a double quantum dot with one electron in one dot and two electrons in the other. The qubit itself is a set of two states with total spin quantum numbers $S^2 = 3/4$ ($S = 1/2$) and $S_z = -1/2$, with the two different states being singlet and triplet in the doubly occupied dot. The architecture is relatively simple to fabricate, a universal set of fast operations can be implemented electrically, and the system has potentially long decoherence times. These are all extremely attractive properties for use in quantum information processing devices.

$^1$Work done was supported in part by ARO and LPS (W911NF-08-1-0482), by NSF (DMR-0805045, PHY-1104660, and a graduate fellowship to JKG), and by United States Department of Defense.