Abstract Submitted
for the DAMOP06 Meeting of
The American Physical Society

Semiconductor-based quantum computing: from physical gates to architectures JACOB TAYLOR, J. R. PETTA, H.-A. ENGEL, Harvard University Department of Physics, W. DÜR, University of Innsbruck, A. C. JOHNSON, Harvard University Department of Physics, A. YACOBY, Weissman Institute, C. M. MARCUS, Harvard University Department of Physics, P. ZOLLER, University of Innsbruck, M. D. LUKIN, Harvard University Department of Physics — Solid state approaches to quantum computation offer intriguing prospects for large scale integration and long term stability. However, achieving fault tolerant quantum computation entails significant mitigation of environmental couplings, which is particularly challenging in the solid-state. We will discuss the theoretical and experimental development of a scalable architecture for solid-state quantum computation based on actively protected two electron spin states in quantum dots. Specifically, we find a universal set of gates for two-spin states that can be implemented using only local electrical control, with explicit suppression of hyperfine interactions, the dominant source of error. The architecture allows for a modular, hierarchical design, and includes autonomous control and non-local coupling using controlled electron transport. Fault tolerance properties of the architecture will be considered.

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Date submitted: 27 Jan 2006 Electronic form version 1.4