Abstract Submitted
for the MAR05 Meeting of
The American Physical Society

Numerical Calculations of Braiding Patterns for Topological Quantum Computation GEORGIOS ZIKOS, LAYLA HORMOZI, NICK BONESTEEL, Dept. of Physics and NHMFL, Florida State University, STEVEN H. SIMON, Lucent Technologies — In topological quantum computation[1] (TQC) quantum gates are performed by moving quasiparticle excitations of certain two-dimensional states around each other in a specific way. The world-lines of these particles then sweep out braids in 2+1 dimensions and the resulting quantum gate is determined by the topology of this braid. We present numerical results for braiding patterns which can be used for TQC with quasiparticles whose braiding properties are described by the quantum group $U_q(su(2))$ with $q = e^{i2\pi/5}$ which is believed to be relevant for certain fractional quantum Hall states.[2] Specifically, we show that braids obtained by a brute-force search of up to 46 crossings can be combined to produce a CNOT gate with an accuracy of $\sim 10^{-3}$. We then show how these braids can be systematically improved using the Solovay-Kitaev construction with the braid length growing polylogarithmically in the desired accuracy. This work is supported by US DOE.

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Date submitted: 01 Dec 2004 Electronic form version 1.4