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Topological Quantum Compiling LAYLA HORMOZI, GEORGIOS ZIKOS, NICK BONESTEEL, Dept. of Physics and NHMFL, Florida State University, STEVEN H. SIMON, Lucent Technologies — Certain exotic two-dimensional systems are thought to have the property that their quasiparticle excitations can be used for topological quantum computation (TQC).[1] In TQC, qubits are encoded using three or more quasiparticles, and quantum gates are performed by braiding the world-lines of quasiparticles around each other in specific patterns. Because the resulting quantum gates depend only on the topology of the braid, TQC is intrinsically fault tolerant. Here, we investigate the problem of finding braiding patterns which approximate a universal set of quantum gates (single qubit rotations, and CNOT gates) to any desired accuracy. In particular, we show precisely how a CNOT gate can be performed by weaving a pair of quasiparticles from the control qubit through the quasiparticles forming the target qubit, and set the stage for numerical calculations of the required braiding patterns. We will focus on certain quantum Hall states that might be realized either in solid state two-dimensional electron systems or in rotating Bose condensates, where TQC is in principle possible.[2] This work is supported by US DOE.

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