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CNOT for Fibonacci anyons with only one mobile quasiparticle[1]

LAYLA HORMOZI, GEORGIOS ZIKOS, NICK BONESTEEL, Dept. of Physics and NHMFL, Florida State University, STEVEN H. SIMON, Bell Laboratories, Lucent Technologies — Certain two-dimensional systems with non-abelian quasiparticle excitations can be used for topological quantum computation (TQC). In TQC qubits are encoded using 3 or 4 quasiparticles and quantum gates are carried out by braiding quasiparticle world lines. We focus on the problem of finding explicit braiding patterns that yield a universal set of quantum gates, using Fibonacci anyons — quasiparticles which are thought to exist in an experimentally observed fractional quantum Hall state at filling fraction $\nu = 12/5$. In previous work[2] we have shown how to construct arbitrary controlled rotation gates (which together with single qubit gates provide a universal set of quantum gates) by moving a pair of quasiparticles from the control qubit around the quasiparticles in the target qubit while keeping the latter at fixed positions. In this talk we show how to take advantage of one of the structural properties of Fibonacci anyons (namely the fusion matrix) to construct a certain class of two-qubit gates (including CNOT) with only *one* mobile quasiparticle — therefore reducing the number of braiding operations by a factor of two.

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[2]N.E. Bonesteel, L. Hormozi, G. Zikos, and S. H. Simon, Phys. Rev. Lett. **95**, 140503 (2005).

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