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Implementing arbitrary phase gates with non-Abelian anyons in the 5/2 fractional quantum Hall state DAVID CLARKE, KIRILL SHTENGEL, UC Riverside, PARSA BONDERSON, CHETAN NAYAK, Microsoft Station Q — Recent experiments [1] suggest that the elementary excitations in the 5/2 fractional quantum Hall (FQH) state are non-Abelian quasiparticles. It therefore may be possible to store and manipulate quantum information in this system in a non-local (and therefore fault-tolerant) fashion [2]. Unfortunately, the single-qubit phase gate necessary for universal quantum computation is not an available protected operation. Nonetheless, a noisy phase gate could suffice, as it may be used with protected operations to produce a gate of higher accuracy [3]. However, previous suggestions for the implementation of the phase gate are problematic due to their necessity for fine control over the motion of the quasiparticles. We propose a device that would implement a single-qubit phase gate by running a current of anyons through interfering paths around the computational anyons. While the resulting operation is not topologically protected, it is predicted to fall within the error correction threshold for physically realistic parameters. Supported in part by DARPA-QuEST and NSF grant DMR 0748925.

[1] R. L. Willett et al., arXiv:0807.0221v3
[2] S. Das Sarma et al., Phys. Rev. Lett. 94, 166802 (2005).
[3] S. Bravyi, Phys. Rev. A 73, 042313 (2006)

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