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Simulating Anyon Interference to Measure the Levin-Wen Plaquette Operator WEIBO FENG, N.E. BONESTEEL, Department of Physics and NHMFL, Florida State University, DAVID DIVINCENZO, Forschungszentrum Juelich & RWTH Aachen — It may be possible to use the ground states of the Levin-Wen model for Fibonacci anyons as a non-Abelian surface code for fault-tolerant quantum computation [1]. To do this, it will be necessary to repeatedly measure the vertex and plaquette operators of the model to check for errors. Recently, two of us have constructed quantum circuits for performing such measurements [2]. Here we present an alternate measurement scheme based on simulating an interference experiment. This "experiment" can be thought of, roughly, as first inserting a pair of Fibonacci anyons with trivial total topological charge onto one edge of a plaquette, "braiding" one anyon all the way around the plaquette while the other remains fixed, and then either measuring the total topological charge of the two anyons or manipulating their state in a specific way. We construct explicit quantum circuits which can be used to simulate these processes and show how they can be used to measure the Levin-Wen plaquette operator on a quantum computer.

[1] R. Koenig, G. Kuperberg, and B.W. Reichardt, Ann. Phys. 325, 2707 (2010).
[2] N.E. Bonesteel and D.P. DiVincenzo, Phys. Rev. B 86, 165113 (2012).

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