Abstract Submitted
for the MAR17 Meeting of
The American Physical Society

Topological interferometer and encoder GUANYU ZHU, Joint Quantum Institute, Univ of Maryland-College Park, ABOLHASSAN VAEZI, Stanford University, JUVEN WANG, Institute for Advanced Study, Princeton, MOHAMMAD HAFEZI, Joint Quantum Institute, Univ of Maryland-College Park — We propose a topological Ramsey interferometer based on controlled flux insertion in the context of cold-atom realization. The synthetic flux inserted into the defects of the topological system is induced by lattice shaking and controlled by an ancilla atom through the Rydberg-blockade mechanism. By inserting the flux, one can twist one ground state of the topological system into another, conditioned by the ancilla. One can hence use many-body Ramsey interference to extract topological degeneracy and braiding statistics. In the case of a single-layer $\nu = 1/m$ fractional quantum Hall (FQH) state, the interference pattern acquired from readout of the ancilla qubit has a periodicity of $m\Phi_0$ flux ($2\pi m$ phase) and hence shows an m-fold ground-state degeneracy. In the case of bi-layer FQH state connected by tunnels or twist defects, one can create effective genus and hence thread flux into different non-contractible cycles of a torus. One is hence able to do braiding and extract the braiding statistics in the ground-state manifold without creating actual anyons. In addition, we show how the ancilla can be used to encode quantum information into the topological qubit, which opens up the possibility of using synthetic topological material as a protected quantum memory.

Guanyu Zhu
Univ of Maryland-College Park

Date submitted: 11 Nov 2016 Electronic form version 1.4