Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

Symmetry protected topological phases in two dimensions: Generalized Laughlin's argument and quantum pumps CHANG-TSE HSIEH, OLABODE MAYODELE SULE, SHINSEI RYU, ROB LEIGH, Department of Physics, University of Illinois at Urbana-Champaign — We generalize Laughlin's flux insertion argument in a way that it is applicable to interacting topological phases protected by unitary symmetries – either on-site or non-on-site – in two spatial dimensions. Large gauge invariance of the symmetry projected partition function of the one-dimensional edge theory can be used to argue the (non)conservation of the quantum number (corresponding to the projected unitary symmetry) under the large gauge transformation. If the edge does not conserve such quantum number, there is a flux-driven "quantum pump" between edges of the two dimensional system, which can be diagnosed as the nontrivial symmetry protected topological phase. This also gives the criteria of stability/gappability of the edge states that respect the symmetry. For non-on-site symmetry such as parity symmetry, the one dimensional edge theory is considered as the conformal field theory on an unoriented surface, such as Klein bottle, which arise naturally from a parity symmetry projection operation.

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Date submitted: 15 Nov 2013 Electronic form version 1.4