Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

2D symmetry protected topological orders and their protected gapless edge excitations XIE CHEN, Massachusetts Institute of Technology, ZHENG-XIN LIU, Tsinghua University, XIAO-GANG WEN, Massachusetts Institute of Technology — Topological insulators/superconductors with time reversal or particle-hole symmetry protected gapless edge excitations have been well characterized and classified in free fermion systems. However, it is not clear in general interacting boson or fermion systems, when such symmetry protected topological(SPT) orders exist with gapless edge excitations that are protected even against strong interactions. Here, we present a systematic construction of 2D interacting bosonic models with non-trivial SPT orders for any on-site symmetry of group G. We demonstrate the non-trivialness of the models by rigorously proving that the gapless edge excitations of the system is stable against any interaction as long as symmetry is not broken. We prove this result by developing the tool of matrix product unitary operator to study the nonlocal symmetry transformation on the edge degrees of freedom and revealing its relation to the non-trivial 3-cocycles of the symmetry group G. This relation between SPT orders and group cocycles has actually been established in 1D interacting systems and led to a complete classification of 1D SPT orders. We show here that this relation also extends to > 2 spatial dimensions and possibly provides a (partial) classification of SPT orders in all interacting systems.

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Date submitted: 07 Dec 2011 Electronic form version 1.4