Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

Symmetry, Defects, and Gauging of Topological Phases PARSA BONDERSON, MAISSAM BARKESHLI, MENG CHENG, ZHENGHAN WANG, Station Q, Microsoft Research — We examine the interplay of symmetry and topological order in 2+1D topological phases of matter. We define the topological symmetry group, characterizing symmetry of the emergent topological quantum numbers, and describe its relation with the microscopic symmetry of the physical system. We derive a general framework to classify symmetry fractionalization in topological phases, including phases that are non-Abelian and symmetries that permute the quasiparticle types and/or are anti-unitary. We develop a theory of extrinsic defects (fluxes) associated with elements of the symmetry group G, which provides a general classification of symmetry-enriched topological phases derived from a topological phase of matter with symmetry. The algebraic theory of the defects (G-crossed braided tensor category), allows one to compute many properties, such as the topologically distinct types of defects, their fusion rules, quantum dimensions, zero modes, braiding transformations, a generalized Verlinde formula, and modular transformations of the G-crossed extensions of topological phases. We also examine the promotion of the global symmetry to a local gauge invariance, wherein the extrinsic defects are turned into deconfined quasiparticle excitations, which results in a different topological phase.

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Date submitted: 14 Nov 2014 Electronic form version 1.4