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Topological Spin Liquid with Symmetry-Protected Edge States

YANCHENG WANG, Beijing National Laboratory for Condensed Matter Physics, and Institute of Physics, Chinese Academy of Sciences, Beijing 100190, China , YANG QI, Department of physics, Massachusetts Institute of Technology, Cambridge, MA 02139, USA , MENG CHENG, Department of Physics, Yale University, New Haven, CT 06520-8120, USA , CHEN FANG, ZI YANG MENG, Beijing National Laboratory for Condensed Matter Physics, and Institute of Physics, Chinese Academy of Sciences, Beijing 100190, China — Topological quantum spin liquids are topological state of matter with long-range entanglement encoded into the system. Yet direct observation of it is difficult and require nontrivial theoretical probe that do not have simple and transparent experimental correspondence. Here, we find way to bridge the gap between the fundamental feature of topological spin liquid and realistic experimental observation of it. We demonstrate, both theoretically and numerically, that the symmetry fractionalization of a Z_2 gapped spin liquid on a Kagome lattice protects gapless modes on a symmetric edge, i. e., the edge remains gapless as long as certain symmetries are preserved and the bulk gap is open. We hence propose that experimental observations of the edge modes in turn would confirm the existence of the symmetry enriched topological order. Our work opens the avenue of realistic and robust experimental detection of the seemingly ephemeral yet ubiquitous physics of topological spin liquids, including the manifestation of topological order, symmetry fractionalization and symmetry enriched topological phase.

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