Network Model for Z_2 Quantum Spin-Hall Effects with Disorder

HIDEAKI OBUSE, AKIRA FURUSAKI, RIKEN, Japan, SHINSEI RYU, Kavli Institute for Theoretical Physics, University of California, Santa Barbara, CHRISTOPHER MUDRY, Paul Scherrer Institute, Switzerland — We study the effects of static disorder on the Z_2 quantum spin-Hall effect for noninteracting electrons propagating in two dimensions. To this end, a network model realizing the Z_2 quantum spin-Hall effect is constructed to account for the effects of static disorder on the propagation of noninteracting electrons subjected to spin-orbit couplings with the time-reversal symmetry. This network model is different from past network models belonging to the symplectic symmetry class in that the propagating modes along the links of the network has a single Kramers doublet. By investigating this network model numerically, it is found that a two-dimensional metallic phase of finite extent is embedded in insulating phases. We also find that the Anderson localization-delocalization transition between the metallic and Z_2 insulating phases belong to the conventional symplectic universality class in two dimensions.

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Date submitted: 04 Dec 2007

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