Critical Exponent for the Quantum Spin-Hall Transition

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We study numerically the transport properties of disordered topological insulators. In this paper, we focus on the two-dimensional topological insulators with symplectic symmetry that are known as quantum spin-Hall systems. Some quantities such as critical exponents for divergence of the localization length and the probability distributions of conductance show universal properties at the metal-insulator transitions. The critical properties at the metal-topological insulator transition are expected to be the same as those at the metal-ordinary insulator transition. Recently, however, the critical conductance distributions were shown to be changed dramatically from those of topologically trivial systems to a novel distribution when the system has edge states[1]. On the other hand, whether the critical exponent depends on the topological nature of the system remains to be verified.
In this paper, we have confirmed that the critical exponent of the localization length is independent of the topological nature of the insulating phase. Instead of standard MacKinnon-Kramer parameter, we have evaluated the critical exponents for the systems with edge states by analyzing the second smallest positive Lyapunov exponent. We have found that the critical exponent, $\nu = 2.77 \pm 0.06$, coincides with that for topologically trivial systems. The case of quantum Hall systems will also be discussed.

[1]K. Kobayashi, T. Ohtsuki, H. Obuse, and K. Slevin: Phys. Rev. B **82**, 165301 (2010).