Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

Magnetoelectric Effect in Topological Insulator Films Beyond Linear Response Regime[1] OLEG TRETIAKOV, DASHDELEG BAASANJAV, KENTARO NOMURA, Institute for Materials Research, Tohoku University — We study the response of topological insulator films to strong magnetic and electric fields beyond the linear response theory. As a model, we use three-dimensional lattice Wilson-Dirac Hamiltonian where we simultaneously introduce both magnetic field as Aharonov Bohm phase and electric field as potential energy depending on lattice coordinate. We compute the energy spectrum by numerically diagonalizing this Hamiltonian for electrons and obtain the quantized magnetoelectric polarizability. In addition, we find that the magnetoelectric effect vanishes as width of the film decreases, due to the hybridization of surface wavefunctions. Furthermore, by applying a gate voltage between the surfaces, we observe multiple quantized plateaus of θ-term. We explain that the multiple quantization rule of θ is mainly determined by the physics of Landau level structures on the top and bottom surfaces of topological insulator, whereas the small deviations from the exact quantization are coming from the asymmetry of the surface wavefunctions in the bulk. We also show that the magnetoelectric effect persists even for strong bulk interactions with magnetic field or magnetic impurities.

[1]We acknowledge support by the Grants-in-Aid for Scientific Research (No. 24740211, No. 25800184, and No. 25247056) from the MEXT, Japan.

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Date submitted: 13 Nov 2013 Electronic form version 1.4