Abstract Submitted
for the MAR16 Meeting of
The American Physical Society

Edge states and integer quantum Hall effect in topological insulator thin films SONG-BO ZHANG, Department of Physics, The University of Hong Kong, HAI-ZHOU LU, Department of Physics, South University of Science and Technology of China, SHUN-QING SHEN, Department of Physics, The University of Hong Kong — The integer quantum Hall effect is a topological state of quantum matter in two dimensions, and has recently been observed in three-dimensional topological insulator thin films. In this report, I will talk about the Landau levels and edge states of surface Dirac fermions in topological insulators under a strong magnetic field. We examine the formation of the quantum plateaux of the Hall conductance and find two different patterns, in one pattern the filling number covers all integers while only odd integers in the other. We focus on the quantum plateau closest to zero energy and demonstrate the breakdown of the quantum spin Hall effect as a result of the interplay of magnetic field and structure inversion asymmetry. We also reveal that the edge states exist only for the integer Hall conductance while no edge-state solution can be found for the "half-integer" Hall conductance. The addition of top and bottom surface Dirac fermions always form well-defined edge states, and gives an integer quantum Hall effect. This work establishes an intuitive picture of the edge states to understand the integer quantum Hall effect for Dirac electrons in topological insulator thin films.

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Date submitted: 03 Nov 2015 Electronic form version 1.4