Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

Low-temperature conductivity and magnetoconductivity of two-dimensional Dirac fermions in topological insulators HAI-ZHOU LU, The University of Hong Kong — Low-temperature electronic transport in topological insulators exhibits a dilemma. A negative cusp in weak-field magnetoconductivity is widely believed to be the signature of weak antilocalization (WAL) from the topological surface states. WAL is a quantum interference effect that enhances the conductivity with decreasing temperature at very low temperatures. A magnetic field can destroy WAL as well as the enhanced conductivity, giving rise to the negative magnetoconductivity showing that WAL used to be there. However, the conductivity in most experiments was observed to drop logarithmically with decreasing temperature, a behavior opposite to WAL. We model the surface and bulk states in topological insulators as massless and massive Dirac fermions, and derive the conductivity formula as a function of magnetic field and temperature, by taking into account the quantum interference and electron-electron interaction simultaneously. The formula reconciles the dilemma by explicitly clarifying that the WL-like temperature dependence of the conductivity is dominated by the interaction while the WAL-like magnetoconductivity is mainly contributed by the quantum interference.

Hai-Zhou Lu
The University of Hong Kong

Date submitted: 14 Nov 2013 Electronic form version 1.4