

Abstract Submitted
for the MAR11 Meeting of
The American Physical Society

Topological quantization in units of the fine structure constant

JOSEPH MACIEJKO, Stanford University, XIAO-LIANG QI, Stanford University and Microsoft Research, Station Q, H. DENNIS DREW, University of Maryland, SHOU-CHENG ZHANG, Stanford University — Fundamental topological phenomena in condensed matter physics are associated with a quantized electromagnetic response in units of fundamental constants. Recently, it has been predicted theoretically that the time-reversal invariant topological insulator in three dimensions exhibits a topological magnetoelectric effect quantized in units of the fine structure constant $\alpha = e^2/\hbar c$. In this Letter, we propose an optical experiment to directly measure this topological quantization phenomenon, independent of material details. Our proposal also provides a way to measure the half-quantized Hall conductances on the two surfaces of the topological insulator independently of each other.

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Date submitted: 12 Nov 2010

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