

Abstract Submitted  
for the MAR07 Meeting of  
The American Physical Society

**Topological Insulators in Three Dimensions**<sup>1</sup> LIANG FU, CHARLES KANE, EUGENE MELE, University of Pennsylvania — We study three dimensional generalizations of the quantum spin Hall (QSH) effect. Unlike two dimensions, where the QSH effect is distinguished by a single  $Z_2$  topological invariant, in three dimensions there are 4 invariants distinguishing 16 “topological insulator” phases. There are two general classes: weak (WTI) and strong (STI) topological insulators. The WTI states are equivalent to layered 2D QSH states, but are fragile because disorder continuously connects them to band insulators. The STI states are robust and have surface states that realize the 2+1 dimensional parity anomaly without fermion doubling, giving rise to a novel “topological metal” surface phase. We show that the  $Z_2$  invariants can be easily determined for systems with inversion symmetry. This allows us to predict specific materials are STI’s, including semiconducting alloy  $\text{Bi}_{1-x}\text{Sb}_x$  as well as  $\alpha\text{-Sn}$  and  $\text{HgTe}$  under uniaxial strain.

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<sup>1</sup>This work was supported by NSF grants DMR-0605066

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Date submitted: 22 Nov 2006

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