Abstract Submitted
for the MAR10 Meeting of
The American Physical Society

Inter-surface interactions in a 3-dimensional topological insulator : Bi_2Se_3 thin film[1] HOSUB JIN, JUNG-HWAN SONG, ARTHUR FREEMAN, Northwestern University — Recently much attention has focused on 3-dimensional strong topological insulators as a new quantum state of matter, such as Bi_2Se_3 and Bi_2Te_3. One of their intriguing features is a topologically protected surface state whose quasiparticle dispersion shows a Dirac cone. Due to lack of backscattering and robustness against disorder and interaction, surface states have the potential to be perfect conducting channels which carry not only charge but also spin currents. Here, we present a theoretical study of electronic structures and surfaces of thin film Bi_2Se_3 using the highly precise FLAPW method[2]. Our calculated results focus on the interaction between surface states on opposing sides of the slab. The gap opening from the inter-surface interaction can be easily explained by simple symmetry arguments considering both time-reversal and spatial inversion. For a 6 quintuple layer slab (~6 nm), a 1.06 meV gap at the $\overline{\Gamma}$ point survives due to the inter-surface interactions, and we discuss how to preserve the massless excitations despite this inter-surface interaction.

[1]Supported by DOE.
[2]Wimmer, Krakauer, Weinert, Freeman, Phys. Rev. B, **24**, 864 (1981)

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Date submitted: 20 Nov 2009 Electronic form version 1.4