Abstract Submitted
for the MAR12 Meeting of
The American Physical Society

Thickness and Wave-Vector Dependence in the Inter-Surface Coupling of Topological Surface States of Sb(111) Films GUANGGENG YAO, FENG PAN, ZIYU LUO, WENTAO XU, JIATAO SUN, ANDREW THYE SHEN WEE, YUANPING FENG, XUE-SEN WANG, Department of Physics, Faculty of Science, National University of Singapore — Sb is a semimetal but possesses topological surface states (SSs) [1]. Taking advantage of quantum confinement effect for bulk states and topological protection for SSs, an Sb thin film could be a topological insulator. We explore this possibility using Fourier-transform scanning tunneling spectroscopy (FT-STS) and *ab initio* calculations for Sb(111) films of thickness ≤ 30 bilayers (BL). Quasiparticle interference (QPI) patterns of SSs and calculated band structures exhibit dramatic dependence on film thicknesses, reflecting variation of inter-surface coupling of SSs with film thickness and wave vector $\mathbf{k}$. One Kramers-pair of SSs forming a Dirac point at $\mathbf{k} = 0$ exist on each surface for 6-BL or thicker films. The inter-surface coupling of SSs not far away from $\mathbf{k} = 0$ is significant in the QPI patterns at ~ 10 BL. Such coupling is due to a relative large penetration depth of these SSs results in unpolarized states with large wave function amplitude in the interior of the film. [1] D. Hsieh et al., Science 323, 919 (2009); K. K. Gomes et al., e-print arXiv:0909.0921 (2009); J. Seo et al., Nature 466, 343 (2010).

Yuanping Feng
Department of Physics, Faculty of Science, National University of Singapore

Date submitted: 11 Nov 2011 Electronic form version 1.4