Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

Emergent quantum size effects at topological insulator surfaces

PHIL D.C. KING, Kavli Institute at Cornell for Nanoscale Science, USA & University of St Andrews, UK, M.S. BAHRAMY, RIKEN-ASI, Japan, G. BALAKRISHNAN, University of Warwick, UK, R. ARITA, N. NAGAOSA, RIKEN-ASI & University of Tokyo, Japan, F. BAUMBERGER, University of Geneva, Switzerland

— Bismuth-chalchogenides are model examples of three-dimensional topological insulators. Their ideal bulk-truncated surface hosts a single spin-helical surface state, which is the simplest possible surface electronic structure allowed by their non-trivial Z_2 topology. However, real surfaces of such compounds, even if kept in ultra-high vacuum, rapidly develop a much more complex electronic structure[1] whose origin and properties have proved controversial. Here we demonstrate that a conceptually simple model, implementing a semiconductor-like band bending in a parameter-free tight-binding supercell calculation, can quantitatively explain the entire measured hierarchy of electronic states.[2] In combination with circular dichroism in angle-resolved photoemission experiments, we further uncover a rich three-dimensional spin texture of this surface electronic system, resulting from the non-trivial topology of the bulk band structure. Moreover, our study sheds new light on the surface-bulk connectivity in topological insulators, and reveals how this is modified by quantum confinement.

[1]P.D.C. King et al., Phys. Rev. Lett., 107 (2011) 096802
[2]M.S. Bahramy, P.D.C. King et al., Nature Commun. 3 (2012) 1159

Phil D.C. King
Kavli Institute at Cornell for Nanoscale Science, USA
& University of St Andrews, UK

Date submitted: 27 Nov 2012 Electronic form version 1.4