Tailoring the electronic texture of a topological insulator via its surface orientation

Lucas Barreto[1], Wendell Simoes e Silva[2], Malthe Stensgaard[1], Søren Ulstrup[1], ●Marco Bianchi[1,4], Xie-Gang Zhu[1], Maciej Dendzik[3] and Philip Hofmann[1].

[1] *Department of Physics and Astronomy, Interdisciplinary Nanoscience Center (iNANO), Aarhus University, 8000 Aarhus C, Denmark.*

[2] *Departamento de Física, Universidade Federal de Minas Gerais, 30123-970, Belo Horizonte, Brazil.*

[3] *Centre for Nanometer-Scale Science and Advanced Materials (NANOSAM), Smoluchowski Institute of Physics, Jagiellonian University, Reymonta 4, 30-059 Kraków, Poland.*

[4] email: bianchi@phys.au.dk

Topological insulators are characterised by an insulating bulk band structure, but topological considerations require their surfaces to support gap-less, metallic states. Meanwhile, many examples of such materials have been predicted and found experimentally, but experimental effort has concentrated on the closed-packed (111) surface of these materials. Thus, the theoretical picture of an insulating bulk embedded in a metallic surface from all sides of a crystal still needs to be confirmed.

Here we present angle-resolved photoemission spectroscopy results from the (110) surface of the topological insulator $Bi_{1-x}Sb_x$ ($x \approx 0.15$). As expected, this surface also supports metallic states but the change in surface orientation drastically modifies the band topology, leading to three Dirac cones instead of one. This illustrates the possibility to tailor the basic topological properties of the surface via its crystallographic direction. Here it introduces a valley degree of freedom not previously achieved for topological insulator systems.