Massive surface states of topological materials

Sergueï Tchoumakov*[1], Andreas Inhofer[2], Victor Jouffrey[3], Erwann Bocquillon[2,4], Bernard Plaçais[2], David Carpentier[3], Marcello Civelli[5], and Mark Goerbig[6]

[1]Laboratoire de Physique des Solides (LPS) – CNRS : UMR8502, Université Paris Sud - Paris XI – Bât. 510, Université Paris Sud, 91405 Orsay cedex, France

[2]Laboratoire Pierre Aigrain (LPA) – CNRS : UMR8551, Université Pierre et Marie Curie (UPMC) - Paris VI, Université Paris VII - Paris Diderot, Ecole Normale Supérieure de Paris - ENS Paris – Département de Physique Ecole Normale Supérieure 24, rue Lhomond F-75231 Paris Cedex 05, France

[3]Laboratoire de Physique de l'ENS Lyon (Phys-ENS) – CNRS : UMR5672, École Normale Supérieure (ENS) - Lyon – 46 allée d'Italie 69007 Lyon, France

[4]Physikalisches Institut (EP3) Universität Würzburg – Universität Würzburg Am Hubland 97074 Würzburg, Germany

[5]Labortoire de Physique des Solides (LPS) – Universé Paris Sud – France

[6]laboratoire de physique des solides – CNRS : UMR8502, Université Paris XI - Paris Sud – France

Abstract

The condensed matter realizations of gaped and gapless materials where the low-energy physics reproduce the Dirac equation show surprising surface states when inverted and normal gaps are in contact. These surface states are spin-momentum locked, are usually more metallic than the bulk states and are topologically protected. Such topological surface states (TSS) have been identified by angle resolved photoemission spectroscopy (ARPES), scanning tunneling spectroscopy (STM) and transport.

Along with these TSS the same experiments indicate the existence of massive surface states (MSS) attached to both the valence and conduction bands and that are influenced by band bending. One explanation for this effect is that one observes the quantum-well states associated to the lower (resp. higher) part of the conduction and valence bands due to downward (resp. upward) band-bending. In this description the gaped surface states are a consequence of band bending.

In this talk we will discuss another origin of these massive surface states, as a consequence of a finite-sized interface between the inverted- and normal-gaped materials. The role of band bending is to delocalize and reduce the energy of these states which allows for their manipulation.

*Speaker