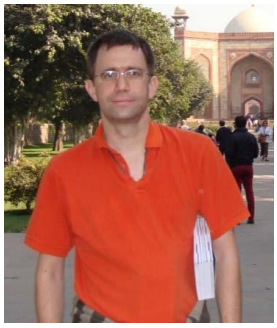
量子材料科学中心
International Center for Quantum Materials
Seminar

Weak antilocalisation in topological insulators with strong spin-orbit scattering



Dimitrie Culcer
School of Physics, The University of New South Wales

Time: 10:00 am, Nov. 21, 2014 (Friday)
时间：2014年11月21日（周五）上午 10:00
Venue: Conference Room A (607), No. 5 Science Building
地点：理科五号楼607会议室

Abstract

Topological insulators (TI) have revolutionised our understanding of insulating behaviour. They are insulators in the bulk but conducting along their surfaces, thanks to surface states in which the spin and the charge are strongly coupled by means of the spin-orbit interaction. Much of the recent research on TI focuses on overcoming the *transport bottleneck* [1], namely the fact that surface state transport is overwhelmed by bulk transport stemming from unintentional doping. The key to overcoming this bottleneck is identifying unambiguous signatures of surface state transport. This talk will discuss one such signature, which is manifest in the coherent backscattering of electrons in TI. Because of the strong spin-orbit coupling in TI one expects to observe weak antilocalisation rather than weak localisation, meaning that coherent backscattering increases the electrical conductivity [2]. The features of this effect, however, are rather subtle, because in TI the impurities have strong spin-orbit coupling as well, greatly increasing the complexity of the problem [3]. I will show that spin-orbit coupled impurities introduce an additional time scale, which is expected to be shorter than the dephasing time, and the resulting conductivity has a *linear dependence* on the carrier number density, a behaviour hitherto unknown in 2D electron systems. The result we predict is directly observable experimentally and would provide a smoking gun test of surface transport. Furthermore, I will also briefly discuss the effect of electron-electron interactions on transport in this regime.

[1] D. Culcer, Physica E **44**, 860 (2012).
[2] G. Tkachov and E. M. Hankiewicz, Phys. Rev. B **84**, 035444 (2011).
[3] W. Liu, P. Adroguer, X. Bi, E. M. Hankiewicz, and D. Culcer, to be published.

About the Speaker

Prof. Culcer received his both Bachelor and Master degrees in physics from University of Oxford in 2000 and his Ph.D. in physics from University of Texas at Austin in 2005. After working as a postdoctoral researcher at Argonne National Laboratory and University of Maryland at College Park, he became a professor at University of Science and Technology of China in 2010. Since 2013 to present, he has been a Senior Lecturer in the University of New South Wales.