HL 7: Topological insulators 1 (MA, jointly with HL, O, TT)

Time: Monday 9:30–10:45 Location: H10

Invited Talk HL 7.1 Mon 9:30 H10

Breaking time reversal symmetry in topological insulators — •Jagadeesh Moodera — Massachusetts Institute of Technology, Cambridge, MA 02139, USA

Breaking time reversal symmetry in a topological insulator (TI) can lead to many exotic properties, such as image magnetic monopole, topological magneto-electric effects as well as Majorana Fermions in superconducting TIs (STI). Recently Gedik*s group in MIT demonstrated that manipulating the magnetic properties via ultrashort light pulses, selectively exciting the spin states of the surface state by exploiting its spin texture to induce a transient magnetic state. Using linearly polarized light in a pump-probe experiment unusual behavior was seen by Muenzenberg group in Gottingen University. The TI surface state can be magnetically manipulated by proximity effect. The proximity-induced ferromagnetism in a TI/ferromagnetic insulator heterostructure breaks the time reversal symmetry in the TI: a large uniformly induced surface exchange gap appears on the TI without introducing scattering centers, thus keeping intact the transport of spin-momentum locked surface electrons as well as the superconducting pairing in an STI. This TI/ferromagnetic insulator bilayer system showed an induced interface magnetic moment accompanied by an unusual planar hysteresis magnetoresistance demonstrating the magnetic manipulation of the surface channel. This research is supported by ONR, NSF.

HL 7.2 Mon 10:00 H10

Magnetic properties of the Mn doped topological insulator Bi_2Te_3 probed by ESR — •S. Zimmermann[1], V. Kataev[1], Huiwen Ji[2], R.J. Cava[2], and B. Büchner[1] — [1]IFW Dresden, 01171 Dresden, Germany — [2]Dept. Chem., Princeton Univ., NJ 08544, USA

Doping of a topological insulator (TI) with magnetic elements can break the time reversal symmetry and thus open a gap in the protected spin polarized conducting surface states, driving the system into a quantum spin Hall regime [1]. Understanding of the interactions between localized magnetic moments of dopants via delocalized electrons that give rise to ferromagnetism in TIs is therefore of significant interest. Such interactions can be of a long-range character and can also be mediated by surface conducting states [2]. Electron Spin Resonance (ESR) spectroscopy is a sensitive local technique that can probe interactions of localized spins with conduction electrons as well as spin-spin interactions in semiconductors and metals. In this contribution we report an ESR study of the Mn spin dynamics and magnetic interactions in high-quality single crystals of the Mn doped 3-dimensional TI Bi_2Te_3 [3]. We have observed a well-defined ESR signal from Mn spins and have studied the temperature dependences of the ESR parameters for a set of Bi_2Te_3 crystals with different Mn doping levels. The experimental ESR data will be presented in detail and the doping dependence of the Mn spin relaxation via conducting states and the establishment of ferromagnetic order as seen by ESR will be discussed. [1] R. Yu et al., Science **369**, 61 (2010); [2] L.A. Wray et al., Nature Physics **7**, 32 (2011); [3] Y.S. Hor et al., PRB **81**, 195203 (2010)

HL 7.3 Mon 10:15 H10

Investigation of the relation between surface band gaps and magnetism in the magnetic topological insulator $(Bi_{1-x}Mn_x)_2Se_3$ — •Jaime Sánchez-Barriga[1], Andrei Varykhalov[1], Gunther Springholz[2], Hubert Steiner[2], Raimund Kirchschlager[2], Günther Bauer[2], Ondrei Caha[3], Enrico Schierle[1], Eugen Weschke[1], Akin Ünal[1], Sergio Valencia[1], Florian Kronast[1], and Oliver Rader[1] — [1]Helmholtz-Zentrum Berlin — [2]Johannes Kepler Universität Linz — [3]Masaryk University, Brno

The Dirac cone at the surface of a magnetic topological insulator is expected to open a band gap when ferromagnetically magnetized perpendicularly to the surface plane. Angle-resolved photoemission from epitaxial films of $(Bi_{1-x}Mn_x)_2Se_3$ shows for $x > 0.02$ a band gap at the Dirac point of a size that varies with Mn concentration, is much larger than theoretically predicted (~ 100 meV), and does not change with temperature from 7 to 300 K. Based on our measurements with x-ray magnetic circular dichroism (XMCD) we can exclude that the surface band gap is due to ferromagnetic order in the bulk or at the surface. In addition, we investigate by XMCD in photoemission microscopy the reported proximity magnetization induced by a ferromagnetic overlayer.

HL 7.4 Mon 10:30 H10

Mapping the influence of cobalt atoms on the topological states of Bi2Te3 — •Paolo Sessi, Thomas Bathon, Lydia El-Kareh, and Matthias Bode — Institute of Experimental Physics II, University Würzburg, Am Hubland, 97074 Würzburg

Topological insulators are characterized by linearly dispersing gapless topological surface states protected by time-reversal symmetry. For these states, spin is perpendicularly locked to its momentum by spin-orbit interaction resulting in a chiral spin structure that forbids backscattering. However, this is predicted to not be the case when magnetic impurities are introduced into the system. Here, by means of scanning tunneling microscopy we investigate the robustness of the surface states of Bi2Te3 when single Co atoms are deposited on the surface. By analyzing the energy dependence of the quasi particle interference pattern produced by coherent scattering of surface states, we will examine the influence of Co atoms on scattering channels and energy dispersion relation.