TT 55: TR: Topological Insulators 1 (jointly with HL and MA)

Time: Thursday 16:00–17:00 Location: HSZ 304

TT 55.1 Thu 16:00 HSZ 304

Topological phases in three-dimensional superconductors — •Andreas Schnyder — Max-Planck-Institut für Festkörperforschung, Heisenbergstrasse 1, D-70569 Stuttgart, Germany

We examine different topological phases in three-dimensional noncentrosymmetric superconductors with time-reversal symmetry by using three different types of topological invariants. Due to the bulk boundary correspondence, a non-zero value of any of these topological numbers indicates the appearance of zero-energy Andreev surface states. In fully gapped phases the presence of these surface states is independent of the surface orientation, whereas in nodal superconducting phases the Andreev states appear only for certain orientations of the surface. We find that some of these boundary modes in nodal superconducting phases are dispersionless, i.e., they form a flat surface band. These dispersionless Andreev surface bound states have many observable consequences. In particular, they lead to a zero-bias conductance peak in the scanning tunneling spectra. Furthermore, we discuss the appearance of surface Majorana modes in gapless superconducting phases.

TT 55.2 Thu 16:15 HSZ 304

Symmetry protected topological phases: An entanglement point of view — •Frank Pollmann[1], Ari Turner[2], Erez Berg[3], and Masaki Oshikawa[4] — [1]Max-Planck-Institut für Physik komplexer Systeme, Nöthnitzer Straße 38, 01187 Dresden, Germany — [2]Department of Physics, University of California, Berkeley CA 94720, USA — [3]Department of Physics, Harvard University, Cambridge, MA 02138, USA — [4]Institute for Solid State Physics, University of Tokyo, Kashiwa 277-8581 Japan

We propose a scheme to characterize topological phases in one dimensional systems in terms of properties of the entanglement spectrum. We discuss the application of this scheme in two specific examples. The first example is the Haldane phase for a S=1 chain. We show that the Haldane phase is protected by certain symmetries and characterized by a double degeneracy of the entanglement spectrum. The degeneracy cannot be lifted unless either a phase boundary to another, "topologically trivial", phase is crossed or the symmetry is broken. In the second example we apply these concepts to classify systems of interacting fermions in one dimension in the presence of time reversal and parity symmetry.

TT 55.3 Thu 16:30 HSZ 304

Electronic scattering and phonons in the 3D topological insulators Bi_2Se_3 and $Cu_{0.07}Bi_2Se_3$ — •Peter Lemmens[1,2], Vladimir Gnezdilov[1,3], Dirk Wulferding[1,2], and Helmuth Berger[4] — [1]IPKM, TU-BS, Braunschweig, Germany — [2]NTH, Germany — [3]ILTPE NAS, Ukraine — [4]EPFL, Lausanne, Switzerland

The Raman-active lattice vibrations of three dimensional topological insulators Bi_2Se_3 and $Cu_{0.07}Bi_2Se_3$ (R-3m) are investigated by Raman spectroscopy. All four expected Raman modes, $2A_{1g}$ and $2E_g$, were determined for the first time and compared with the theoretical predictions. Electronic scattering is observed as a quasielastic response in the doped material at higher temperatures.

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TT 55.4 Thu 16:45 HSZ 304

Multidimensional Angle-Resolved Photoemission Spectroscopy: Application to Topological Insulators — •Ovsyannikov R.[1], Lupulescu C.[1,2], Rienks E.D.L.[1], Fink J.[1], King P.D.C.[3], Baumberger F.[3], Hatch R.C.[4], Hofmann P.[4], Mi J.[4], Iversen B.B.[4], Lindblad A.[5], Svensson S.[5,6], and Eberhardt W.[1,2] — [1]Helmholtz Zentrum Berlin, Berlin, Germany — [2]Technische Universität Berlin, Berlin, Germany — [3]University of St Andrews, St Andrews, UK — [4]Aarhus University, Aarhus, Denmark — [5]MAX-lab, Lund, Sweden — [6]Uppsala University, Uppsala, Sweden

We will present a novel approach of performing photoelectron spectroscopy experiments and demonstrate its potential on the prototype topological insulator Bi_2Se_3. We use VG Scienta's ARTOF 10k, a time-of-flight electron spectrometer which combines position-sensitive detection with an advanced focusing electron lens system. The instrument allows the simultaneous recording of kinetic energy and the angular pattern of photoelectrons in a cone of up to 30° opening angle with very high resolution. Additionally, the temporal evolution of the sample electronic structure can be easily extracted from the corresponding data set. The experiments were carried out at the 10m NIM beamline at the BESSY II synchrotron facility, when operating in single bunch mode. We will show the temporal evolution of the topological state and the subsequent formation of a two-dimensional electron gas at the (0001) surface of the topological insulator Bi_2Se_3. We will also discuss the overall time resolution of the experimental setup.