Chez Pierre

Presents ...

Tuesday, April 30, 2019

12:00pm Noon

MIT Room 4-331

Special Chez Pierre Seminar

Claudia Felser – Max Planck Institute

"Topological materials science"

Topology, a mathematical concept, recently became a hot and truly transdisciplinary topic in condensed matter physics, solid state chemistry and materials science. Since there is a direct connection between real space: atoms, valence electrons, bonds and orbitals, and reciprocal space: bands, Fermi surfaces and Berry curvature, a simple classification of topological materials in a single particle picture should be possible [1]. Binary phosphides are an ideal material class for a systematic study of Dirac, Weyl and new Fermion physics, since these compounds can be grown as high-quality single crystals. A new class of topological phases that have Weyl points was also predicted in the family that includes NbP, NbAs. TaP, MoP and WP_2. [3-5]. Beyond Weyl and Dirac, new fermions can be identified in compounds that have linear and quadratic 3-, 6- and 8- band crossings that are stabilized by space group symmetries [2]. Crystals of chiral topological materials CoSi, AlPt and RhSi were investigated by angle resolved photoemission and show giant unusual helicoid Fermi arcs with topological charges of ±2 [6,7]. In agreement with the chiral crystal structure two different chiral surface states are observed. A quantized photogalvanic effect was observed in RhSi [8]. In magnetic materials the Berry curvature and the classical anomalous Hall (AHE) and spin Hall effect (SHE) helps to identify potentially interesting candidates. As a consequence, the magnetic Heusler compounds have already been identified as Weyl semimetals: for example, Co_2YZ [9-11], and $Co_3Sn_2S_2$ [12]. The Anomalous Hall angle also helps to identify materials in which a QAHE should be possible in thin films. Heusler compounds with non-collinear magnetic structures also possess real-space topological states in the form of magnetic antiskyrmions, which have not yet been observed in other materials [13].

[1] Bradlyn et al., Nature 547 298, (2017), Vergniory, Let al., Nature 566 480 (2019),

[2] Bradlyn, et al., Science 353, aaf5037A (2016).

[3] Shekhar, et al., Nat. Phys. 11, 645 (2015)

[4] Liu, et al., Nat. Mat. 15, 27 (2016)

[5] Gooth et al., Nature 547, 324 (2017)

[6] Schröter, et al.; Nature Physics accepted, preprint arXiv: 1812.03310

[7] Sanchez, et al., Nature 567, 500 (2019) arXiv:1812.04466

[8] Rees, et al., preprint arXiv:1902.03230

[9] Kübler and Felser, EPL 114, 47005 (2016)

[10]. Wang, et al. Phys. Rev. Lett. 117, 236401 (2016)

[11] Chang et al., Scientific Reports 6, 38839 (2016)

[12] Liu, et al. Nat. Phys. Nature Physics 14, 1125 (2018)

[13] Nayak, et al., Nature 548, 561 (2017).