BOSE COLLOQUIUM

Friday, 12 June 2015 **11:30 a.m.** **Fermion**

Speaker:

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Title:

Topology in Heusler compounds – from a materials perspective

Abstract:

Topological insulators, Weyl metals and Skyrmions are a hot topic in condensed matter physics and materials science. The excitement in the physics community is comparable with the excitement when a new superconductor is discovered. Heusler compounds are a remarkable class of materials with more than 1,000 members and a wide range of extraordinary multifunctionalities [1] including half-metallic high-temperature ferri- and ferromagnets [2], multiferroic shape memory alloys, and tunable topological insulators [3] with a high potential for spintronics, energy technologies and magnetocaloric applications. The tunabilty of this class of materials is exceptional and nearly every functionality can be designed. Therefore it is

not surprising that we were able to design Heusler compounds with a band inversion and a non-trivial topology for multifunctional topological insulators (TI) [3] and Heusler compounds with large anisotropic exchanges and strong Dzyaloshinskii-Moriya interaction [4] with a high potential for Skyrmions. The topological state in these zero-gap semiconductors can be created by applying strain or by designing an appropriate quantum well structure, similar to the case of HgTe. Many of these ternary zero-gap semiconductors (LnAuPb, LnPdBi, LnPtSb and LnPtBi) contain the rare-earth element Ln, which can realize additional properties ranging from superconductivity (for example LaPtBi) to magnetism (for example GdPtBi) and heavy fermion behavior (for example YbPtBi). These properties can open new research directions in realizing the quantized anomalous Hall effect and topological superconductors. C1b Heusler compounds have been grown as single crystals and as thin films. The control of the defects, the charge carriers and mobilities can be optimized [5]. The band inversion is proven by ARPES [6]. Heusler compounds are similar to a stuffed diamond, correspondingly, it should be possible to find the "high Z"' equivalent of graphene in a graphite-like structure or in other related structure types with 18 valence electrons and with inverted bands [7]. Dirac cones and Weyl points can occur at the critical points. Weyl points, a new class of topological phases was predicted in NbP, NbAs and TaP [8]. We found ultrahigh magneto resistance, mobilities and Fermi arcs in this class, proving their topological electronic state [8].

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