New developments in the area of topological insulators

Topological insulators are a hot topic in condensed matter physics. The excitement in the physics community is comparable with the excitement when a new superconductor is discovered. HgTe and other systems such as Heusler compounds have an s-p-band inversion at the Fermi edge which makes this family suitable for the Quantum Spin Hall effect and topological insulators [1]. A new topological insulators was identified in cerium-filled skutterudite (FS) compounds. We find that two compounds, CeOs4As12 and CeOs4Sb12, are zero gap materials with band inversions between Os-d and Ce-f orbitals. Both compounds are predicted to become topological Kondo insulators at low temperatures, which are Kondo insulators in the bulk but with robust Dirac surface states on the boundary [2]. In the actinide compounds AmN and PuTe a band gap is opened by correlation effects. In a family of semiconductors with the simple NaCl structure band gaps up to 0.4 eV were found [3]. This is not so surprising since the SOC should be large in Actinides. Up to now there are no oxides which were identified to be topological insulators. $BaBiO_3$ is an oxide which shows a band inversion similar to HgTe. The superconductor $BaKBiO_3$ (BKBO) with Tc nearly 30 K emerges as a TI in the electron-doped region, whereas it is a superconductor in the hole-doped region. BBO exhibits a large topological energy gap of 0.7 eV [4]. We will discuss the necessary and sufficient conditions for new TI materials, based in symmetry and bonding arguments [5].

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