Dilute Magnetic Topological Insulators

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Much of the recent work on topological insulators at Würzburg has focused on the effects of Mn-magnetic doping on the topological properties of HgTe based structures. I will discuss a number of these experiments in this talk.

Since HgTe is a II-VI material and Mn is a group II material, Mn doping does not lead to ferromagnetism, but the exchange coupling between the Mn moment and the bulk semiconductor does lead to modifications of the band structure, as well as an enhanced g-factor.

These effects lead e.g. to the occurrence of Hall quantization in Mn –doped HgTe quantum wells at fields as low as 20 mT, an effect closely related to, but not quite the same as the quantum anomalous Hall effect. The quantum Hall edge channels emerge directly from the helical edge channels of the quantum spin Hall effect at zero magnetic field.

At higher magnetic fields, the interplay between quantum Hall effect and topology may even lead to counter propagation of both types of edge channels, causing a direct transition between n=-1 and n=1 Hall plateaus as a function of magnetic field in samples with a suitable charge puddle landscape.

Finally, we study the quantum spin hall effect in Mn-doped quantum wells. We show that in such systems, perfect quantum spin Hall quantization is only reached at the lowest (mK range) temperatures, where Kondo screening compensates the scattering of the helical edge channels by the magnetic impurities.