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DIRAC FERMIONS IN HgTe QUANTUM WELLS

Laurens W. MOLENKAMP

Physikalisches Institut(EP3) der Universität Würzburg
Am Hubland, 97074 Würzburg, Germany

Abstract:

HgTe quantum wells have a linear band dispersion at low energies and thus mimic the Dirac Hamiltonian.

Changing the well width tunes the band gap (i.e., the Dirac mass) from positive, through zero, to negative.

Wells with a negative Dirac mass are 2-dimensional topological insulators and exhibit the quantum spin Hall effect, where a pair of spin polarized helical edge channels develops when the bulk of the material is insulating.

Our transport data provide very direct evidence for the existence of this third quantum Hall effect.

Wells with a thickness of 6.3 nm are zero gap Dirac systems, similar to graphene. However, zero gap HgTe wells possess only a single Dirac valley, which avoids inter-valley scattering.