Chez Pierre

Presents ...

Monday, January 27, 2014
3:00pm
MIT Room 4-331

Special Chez Pierre Seminar

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Stanford University

"Imaging current in quantum spin Hall insulators"

Quantum spin Hall (QSH) insulators are a class of two-dimensional topological insulators that support a pair of edge modes within their bulk energy gap which are symmetry-protected against elastic backscattering. The QSH state was first predicted and experimentally demonstrated in HgTe quantum wells and more recently also in InAs/GaSb broken-gap quantum wells. The existence of the edge modes has been inferred from transport measurements on sufficiently small devices. In this talk, I will show images of current in large Hall bars made from HgTe and InAs/GaSb quantum wells, directly confirming the existence of edge modes in both materials. The images were obtained by measuring the magnetic fields produced by the current using a scanning superconducting interference device (SQUID). From the magnetic field images we reconstruct the current density in the device with a spatial resolution of several microns, as expected from the geometry of our present-generation SQUIDs. From the images we can disentangle bulk and edge contributions to transport, allowing us to comment on the resistance of the edges in the presence of bulk conduction induced through either gating or raising the temperature. These results are relevant for discriminating between proposed scattering mechanisms that may explain the non-ballistic nature of the QSH edge modes in devices with edges longer than several micron. In particular, our analysis suggests that the edge resistance is constant over a large temperature range implying that those scattering mechanisms which predict a power-law or stronger temperature dependence are likely not dominant.