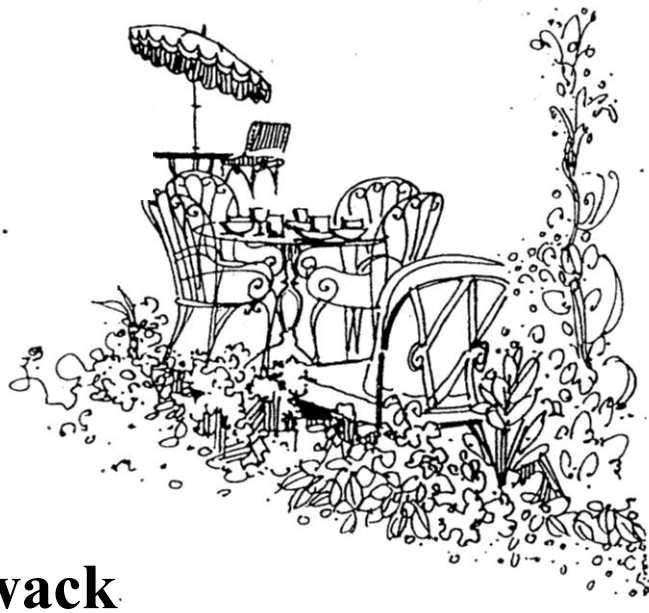
Chez Pierre

Presents ...

Monday, April 8, 2013
12:00pm
MIT Room 4-331



Katja Nowack
Stanford University

"Imaging currents in HgTe quantum wells in the quantum spin Hall regime"

Conducting edge channels at the sample boundaries are a key feature of the quantum spin Hall (QSH) state, which was predicted [1] and experimentally demonstrated [2] to be realized in HgTe quantum wells.
The existence of the edge channels has been inferred from transport measurements on sufficiently small devices, which find local [2] and non-local [3] conductance values close to the quantized values expected for ballistic edge channels and recently signatures of the spin polarization [4]. Here we directly confirm the existence of the edge channels by imaging the magnetic fields produced by current flowing in large Hall bars made from HgTe quantum wells using a scanning superconducting interference device (SQUID). From the magnetic images we reconstruct the current density in the device with several micron spatial resolution. These images distinguish between current that passes through each edge and the bulk. Upon tuning the bulk conductivity by gating or raising the temperature, we observe a regime in which the edge channels clearly coexist with the conducting bulk, providing input to the question of how ballistic transport may be limited in the edge channels. Our results represent a versatile method for characterization of new quantum spin Hall materials systems.

[1] B. A. Bernevig, T. L. Hughes & S. C. Zhang, Science 314, 1757–1761 (2006) [2] M. Koenig et al., Science 318, 766–770 (2007) [3] A. Roth et al., Science 325, 294–297 (2009) [4] C. Brüne et al., Nature Physics 8, 485–490 (2012)