Title: Transport of 2D superconducting quantum Hall system and phase transition of 3D quantum Hall system

Abstract:

In the first part, we study the charge transmission (resistance) of a decoherent quantum Hall-superconductor edge, with the decoherence coming from metallic puddles along the edge. We show that the distribution of a decoherent edge is always peaked at zero charge transmission, which serves as a probe of coherence of superconducting chiral edge states. We further show that the distribution width decays exponentially in magnetic field and temperature. This agrees well with the recent experimental observation in graphene with superconducting proximity. In the second part, we investigate alternative non-CDW mechanisms by considering a 3D metal in strong magnetic fields with electrons coupled to a boson (e.g., phonon) field, aimed at understanding the recent observed 3D quantum Hall effect in ZrTe5 and HfTe5. We show that the model exhibits inevitable first order phase transitions at jumps of the number of occupied Landau level bands, which do not involve CDW. These transitions may drive the system into a phase separation state with percolation transitions. We further show this can lead to Hall resistivity quasi-plateaus similar to that observed experimentally, and can provide a natural explanation for the metal-insulator transition.