Massachusetts Institute of Technology
Department of Physics

Condensed Matter Theory Seminar

"Quantization of Heat Flow (and its breakdown) in Fractional Quantum Hall States"

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Abstract: Quantum mechanics sets an upper bound on the amount of heat flow in ballistic one-dimensional channels. While the quantum of **electrical** conductance is $G_e=e^2/h$, the quantum of **thermal** conductance is $G_{th}=\pi^2 k_B^2 T/3h$ – being a unique fundamental constant. This constant does not depend on the charge, the exchange statistics, or even the interaction strength among the heat-carrying particles. Unlike the relative ease in determining the quantization of electrical conductance, the experimental manifestation of measuring the quantization of thermal conductance had been proven difficult. While the universality of the thermal conductance quantum in weakly interacting particles (phonons, photons, and electronic Fermi-liquids) had been demonstrated, no such measurement was performed on strongly interacting particles. We report a determination of quantized heat flow in a strongly interacting system of 2D electrons - specifically of fractional states in the first Landau level. Aside from proving this quantization in the ubiquitous particle-like ν=1/3 state, we studied also the hole-conjugate states $\frac{1}{2}<\nu<1$. These states were shown before to harbor ***downstream*** charge modes accompanied by counter-propagating ***upstream*** neutral modes. With the prediction that each charge mode carry the same amount of heat as that of a neutral mode, the expected net chirality dictates the total thermal conductance G_{th} at the edge. States studied were, ν=2/3, 3/5, 4/7, with 0, -1, -2 , respectively (in unites of the quantum of thermal conductance). Recent new results will be described briefly.

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11:00am
Wednesday, August 9, 2017
Duboc Room (4-331)

Host: Liang Fu