DAY 2: 9:00 – 9:40

Coulomb interaction, ripples, and the minimal conductivity of graphene

Igor Herbut
Simon Fraser University

I will show that the unscreened Coulomb interaction in graphene provides a positive, universal, and logarithmic correction to scaling of zero-temperature conductivity with frequency. The combined effect of the disorder due to wrinkling of the graphene sheet and the long range electron-electron interactions is a finite positive contribution to the dc conductivity. This contribution is disorder strength dependent and thus *non-universal*. The low-energy behavior of such a system is governed by the line of fixed points at which both the interaction and disorder are finite, and the density of states is exactly linear. An estimate of the typical random vector potential representing ripples in graphene brings the theoretical value of the minimal conductivity into the vicinity of $4e^2/h$, as observed in numerous experiments.

DAY 2: 9:40 – 10:20

Quantum Transport Phenomena of Massless Dirac Fermions

Kentaro Nomura
Tohoku Univiversity

Graphene is a two-dimensional carbon material with a honeycomb lattice structure. Originating to its Dirac-like spectrum, quantum transport phenomena of graphene reveal exotic behaviors, as seen in the localization problem and the quantum Hall effects. We have undertaken a numerical study of the conductivity of disordered two-dimensional massless Dirac fermions. The beta function of the Dirac hamiltonian subject to a random scalar potential shows novel behavior which is qualitatively different from that of the spin-orbit coupling model, although they belong same symmetry class. We provide an argument based on the spectral flows under twisting boundary conditions, which shows that none of states of the massless Dirac Hamiltonian can be localized. General types of disorder are also take into account to address the observed minimal conductivity at the charge neutral Dirac point.

K. Nomura, M. Koshino, S. Ryu, Phys. Rev. Lett. 99, 146806 (2007).
K. Nomura, S. Ryu, M. Koshino, C. Mudry, A. Furusaki, preprint arXiv :0801.3121.