DAY 2 (24 June): 9:40 – 10:20

Quantum Transport Phenomena of Massless Dirac Fermions

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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.