Chez Pierre

Presents ...

Monday, February 3, 2020

12:00pm Noon

MIT Room 4-331

Chez Pierre Seminar

Denis Bandurin – Massachusetts Institute of Technology

"Interaction-dominated transport in graphene: old mysteries and new regimes"

Electron–electron (e–e) collisions can impact transport in a variety of surprising and sometimes counterintuitive ways. Despite long-time interest, experiments on the subject proved challenging because of the presence of momentum-relaxing scattering sources (e.g. phonons or impurities). Only recently, sufficiently clean electron systems in which transport dominated by momentum-conserving e–e collisions have become available, enabling the study of electron transport governed by interactions.

This talk will begin by discussing the behaviour in monolayer graphene which by now is relatively well understood. I will show that at elevated temperatures, the behaviour of graphene's electron fluid resembles that of classical liquids and gases with high viscosity [1,2]. I will discuss approaches that can be used to probe the transport governed by e–e interactions and talk about electron viscometry [3-4].

A very different behaviour is found for transport in twisted bilayer graphene (TBG). I will show that, unlike the case of monolayer graphene, e–e collisions in large-angle TBG can lead to the relaxation of electrical current and result in a quadratic temperature dependence of its resistivity. This surprising behaviour cannot be accounted for by existing scenarios (e.g. umklapp or multi-band scattering) and calls for alternative explanations.

[1] Negative Local Resistance Caused by Viscous Electron Backflow in Graphene, D. A. Bandurin, et al., Science 351, 1055 (2016).

[2] Fluidity Onset in Graphene, D. A. Bandurin, A. Shytov, et al., Nat. Comm. 9, 4533 (2018)

[3] Superballistic Flow of Viscous Electron Fluid through Graphene Constrictions, R. Krishna Kumar, D.A Bandurin, et al., Nat. Phys. 13, 1182 (2017).

[4] Measuring Hall viscosity of Graphene's Electron Fluid, A.I. Berdyugin et al., Science 364, 6436, 162-165 (2019)