Negative Local Resistance Due To Viscous Electron Backflow In Graphene

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Graphene sheets encapsulated between thin slabs of boron nitride host a unique electron system that due to weak electron-phonon scattering allows micrometer-scale ballistic transport even at room temperature [1,2,3,4] whereas local equilibrium in the system is provided by frequent electron-electron collisions [5]. Under these conditions, electrons in doped samples behave as a highly viscous liquid and may exhibit hydrodynamic phenomena similar to classical liquids. In this talk I will report on results of combined theoretical and experimental work [6] showing unambiguous evidence for this long-sought transport regime. In particular, graphene exhibits an anomalous (negative) voltage drop near current injection points, which is attributed to the formation of *whirlpools* in the electron flow. Measurements of these nearly local electrical signals enable to extract the value of the kinematic viscosity ν of the two-dimensional massless Dirac fermion liquid in graphene, which is found to be an order of magnitude larger than that of honey, in quantitative agreement with many-body theory [7]. Our work shows a possibility to study *solid-state* nearly perfect fluidity [8] and turbulence using high quality graphene.

References

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