Electron Transport in the Dirac Liquid

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The most recognizable feature of graphene's electronic spectrum is its Dirac point, around which interesting phenomena tend to cluster. At low temperatures, the intrinsic behavior in this regime is obscured by charge inhomogeneity. However, above liquid-nitrogen temperatures, thermal excitations usually overcome the disorder, creating an intrinsic plasma of Dirac fermions. This electron-hole plasma is strongly interacting and represents a quantum critical system where particle-particle scattering is governed by the Planckian frequency $k_B T/h$. Because the Dirac plasma is a well-characterized and tunable electronic system with exceptionally high mobility, it can serve as an insightful platform for understanding more complex Planckian systems, including strange metals and high-temperature superconductors in the normal state.

In this talk, I shall overview our recent work on electron transport in graphene near the Dirac point [1-3]. This will cover such topics as extreme electron-hole drag leading to nominally negative mobility for minority carriers, giant linear magnetoresistance in the extreme quantum limit and spectacular anomalies in differential resistance characteristic of the Schwinger mechanism for electron-hole pair production.

References

[1] A. I. Berdyugin et al, Science **375**, 430 (2022).
[2] Na Xin et al, Nature **616**, 270 (2023).
[3] L. A. Ponomarenko et al, in preparation (2024).