Theoretical Study of Viscosity in Monolayer and Bilayer Graphene

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Abstract:

The advancements in technology in recent years have allowed for the experimental realisation of ultraclean monolayer and bilayer graphene samples where impurity or phonon scattering are no longer the dominant scattering mechanism. The strong electron-electron interaction in these ultraclean samples results in the emergence of hydrodynamic electron behaviour where electron transport is governed by an electronic Navier- Stokes equation analogous to classical fluids. In this theoretical study, we carry out a theoretical calculation of dynamic viscosity in monolayer and bilayer graphene from a microscopic theory. We find a non-monotonic temperature dependence of the dynamic viscosity in both monolayer and bilayer graphene that approaches a universal limit at high temperature and strong electron-electron interaction. We show that our results agrees very well with available experimental data.

Figures

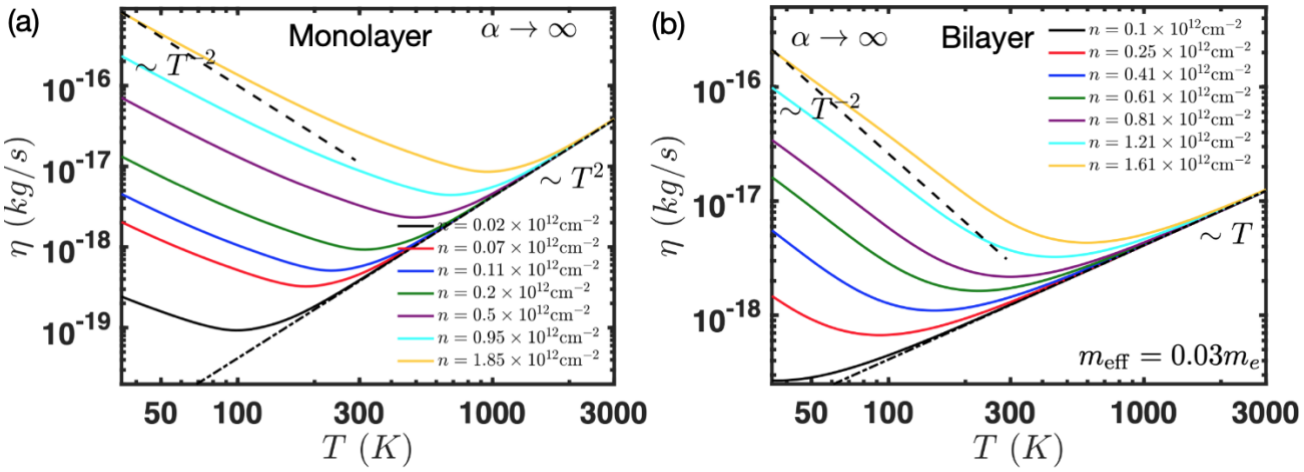

Figure 1: Dynamic viscosity as a function of temperature and Coulomb interaction strength. For both monolayer (a) and bilayer graphene (b), the viscosity is non-monotonic with temperature. At low temperature, the degenerate regime for unipolar hydrodynamics gives a density-dependent viscosity that increases at low temperature in contrast to high-temperature, where the ambipolar transport becomes density independent.