Viscous Electron Fluids: Superballistic Conduction and Odd-Parity Hydrodynamics

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In strongly-correlated systems electrons can move in a coordinated way, reminiscent of the movement of viscous fluids and leading to surprising collective behaviors. Correlated transport in viscous electron flows can give rise to superballistic conduction in which interactions facilitate transport and allow conductance to exceed the fundamental Sharvin-Landauer ballistic limit. In other words, interactions and viscous effects, rather than presenting a hindrance for conduction, suppress dissipation and give rise to high-mobility transport. These predictions, published in January 2017 (doi: 10.1073/pnas.1612181114) were quickly followed by measurements of electron transport through graphene constrictions published in August 2017 which find that conductance below 150 K increases with increasing temperature (doi:10.1038/nphys4240), in agreement with theory. This work helped to identify the contribution to conductance arising due to electron viscosity and determine its temperature dependence. More generally, these results show that interactions and viscous effects can facilitate high-mobility transport, a potentially useful behavior for designing graphene-based devices.