Umklapp electron-electron scattering in bilayer graphene moiré superlattice

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Recent experimental advances have been marked by the observations of ballistic electron transport in moiré superlattices in highly aligned heterostructures of graphene and hexagonal boron nitride (hBN) [1, 2]. Here [3], we predict that a high-quality graphene bilayer aligned with an hBN substrate features T^2-dependent resistivity caused by umklapp electron-electron (Uee) scattering from the moiré superlattice, that is, a momentum kick by Bragg scattering experienced by a pair of electrons (see Figure 1). Substantial Uee scattering appears upon p doping of the bilayer above a characteristic threshold, and its contribution towards the resistivity grows rapidly with hole density, until it reaches a peak value, then falling off by an order of magnitude. This rapid, nonmonotonic dependence of resistivity, in the density range where the system is otherwise highly conductive, suggests the possibility of a nonconventional field-effect transistor operation [4, 5]. We also analyze the influence of an electrostatically induced interlayer asymmetry (and the associated band gap) in the bilayer and trigonal warping on the electron-electron umklapp scattering.

References

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Figures

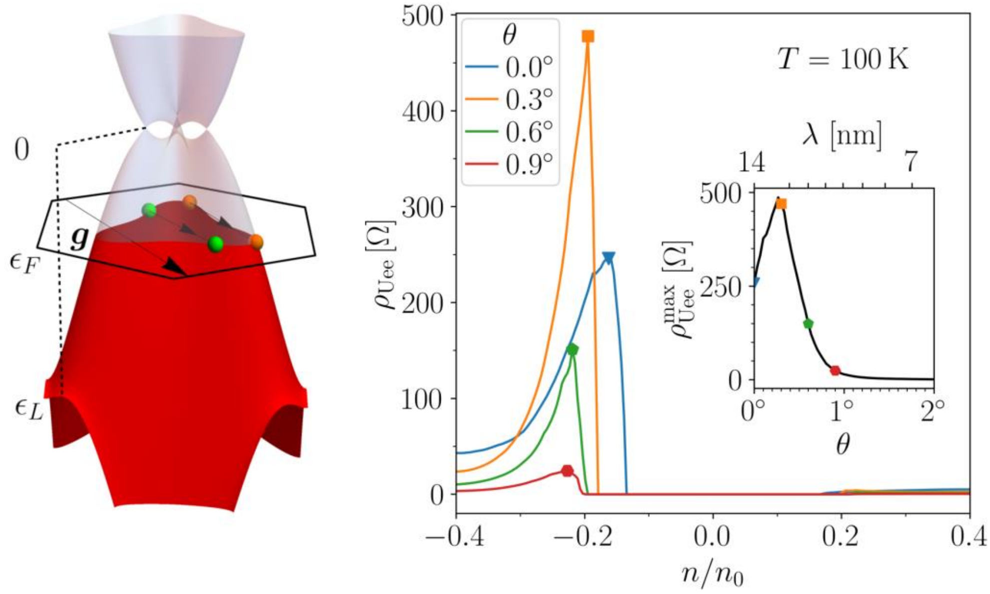

Figure 1: Left: Uee scattering in the superlattice. Right: the non-monotonic evolution of the resistivity contribution of Uee scattering, highlighted against superlattice period in the inset.