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Ballistic miniband conduction in a graphene superlattice

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Heterostructures of graphene and hexagonal boron nitride can be prepared with very low disorder, such that electrons travel along ballistic trajectories over lengths that are accessible to direct measurements. I will discuss such transport experiments in this system which exhibit ballistic conduction phenomena, particularly the transverse electron focusing (or magnetic focusing) effect. Through electron focusing, we demonstrate ballistic conduction in the 14 nm period moire superlattice formed by the relative alignment of graphene and hexagonal boron nitride crystals. Quasiparticles in five successive minibands are shown to traverse skipping orbits extended over hundreds of superlattice periods. This experiment reveals the effective charge and Fermi momentum of quasiparticles as well as saddle points in the dispersion. We identify a crossover to hydrodynamic transport owing to the Coulomb interaction. A theory of nearly free Dirac fermions that obey semiclassical equations of motion describes the system well, and we quantitatively determine the interlayer interaction parameter and the superlattice-reconstructed miniband structure. M. Lee, J. R. Wallbank, et al., Science 353, 1526 (2016).