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Quantum Carrier Collimation in Locally Gated Graphene Heterojunction Devices

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While electron optics such as lensing and focusing have been demonstrated experimentally, building a collimated electron interferometer in two unconfined dimensions has remained a challenge due to the difficulty of creating electrostatic barriers that are sharp on the order of the electron wavelength. Owing to the suppression of backscattering experienced by the chiral quasiparticles, graphene provides an ideal medium to realize the quantum engineering of electron wave functions. In this presentation, we show our progresses in wave function engineering in graphene devices by demonstrating the conductance oscillations in extremely narrow graphene heterostructures where a resonant cavity is formed between two electrostatically created bipolar junctions. Analysis of the oscillations confirms that bipolar heterojunctions have a collimating effect on ballistically transmitted carriers. The robustness of the oscillatory conductance to scattering provides a novel probe of the ballistic physics of graphene at the Dirac point and makes graphene heterojunctions a promising tool for the coherent manipulation of carriers in mesoscopic systems.