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Phase Coherent Charge Transport in Graphene Quantum Billiards

CHUN NING LAU, Physics Department, University of California, Riverside

As an emergent model system for condensed matter physics and a promising electronic material, graphene's electrical transport properties has become a subject of intense focus. Via low temperature transport spectroscopy on single and bi-layer graphene devices, we show that the minimum conductivity value is geometry dependent and approaches the theoretical value of $4e^2/\pi h$ only for wide and short graphene strips. Moreover, we observe periodic conductance oscillations with bias and gate voltages, arising from quantum interference of multiply-reflected waves of charges in graphene. When graphene is coupled to superconducting electrodes, we observe gate tunable supercurrent and sub-gap structures, which originate from multiple Andreev reflection at the graphene-superconductor interfaces. Our results demonstrate that graphene can act as a quantum billiard with a long phase coherence length. *This work was supported in part by DOD/DMEA-H94003-06-2-0608.*