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Phase coherent transport in graphene

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The investigation of transport phenomena originating from quantum interference of electronic waves has proven to be a very effective probe of the electronic properties of conducting materials. Recent work has shown that this is also the case for graphene, a novel material consisting of an individual layer of carbon atoms, in which the electron dynamics is governed by the Dirac equation. After introducing the peculiar aspect of the low-energy electronic properties of graphene that are important to understand quantum interference in this material, I will present our experimental work. I will first discuss our study of Aharonov-Bohm conductance oscillations in graphene ring-shaped devices -which demonstrates directly the phase coherent nature of transport in graphene-, and emphasize an unusual dependence of the oscillation amplitude on the device conductance. Next I will touch upon the anomalous behavior of weak-localization observed in the experiments and compare it with our observations of supercurrent and superconducting proximity effect in graphene Josephson junctions. I will conclude by discussing the relevance of the two valleys in graphene for the understanding of quantum interference in this material.