Electron collisions in a Graphene Interferometer

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Résumé

Collisions of electronic excitations at an electronic beamsplitter provide an essential way of studying their coherence and indistinguishability. Their realization requires the generation of on-demand single electron excitations, their synchronization and the subsequent detection of the collision. We demonstrate coherent collisions of single electron excitations, generated by periodic voltage sine pulses, at a graphene Mach-Zehnder interferometer. Measuring and analyzing the shot noise of electrical current provides us with a complete view of the manipulated states' coherence structure : by tuning the time delay between the two injected excitations, we observe fermionic Hong-Ou-Mandel effect, whose visibility is a witness to the two-particle coherence, while the visibility of the Mach-Zehnder's interference pattern gives us access to single-particle coherence. The excellent visibilities enable comprehensive quantum state reconstruction, exemplified by the tomography of a Leviton state.The possibility of coherent operations involving flying qubits for entanglement is now within reach in graphene.

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sciencesconf.org:gdr-meso-ple-23:506083