Two-particle interferometry for signal processing of a quantum electrical current

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Abstract

Quantum nanoelectronics has entered an era where quantum electrical currents built from single to few elementary excitations generated on demand. However, very limited tools have been implemented so far to characterize the emitted states. In this work, we present a two stage quantum analyzer able to extract single electron and hole excitations as well as their quantum coherences from a quantum electrical current. The first on-chip and quantum stage reconstructs, from two electron interferences, the Wigner distribution of an unknown electronic state without a priori knowledge. Using simple a.c. drives for demonstration, we reconstruct their Wigner distributions and can distinguish between quasi-classical and quantum drives. In the latter case, a second stage extracts through a signal procedure the relevant single electron and hole excitations localized within each emission period from the reconstructed Wigner distribution. This analysis is instrumental for characterizing and controlling single to few quantum excitations of the electronic fluid and for investigating electron/hole entanglement.

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