Electron quantum optics with quantized energy packets

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ABSTRACT

The on-demand generation of single-electron states in mesoscopic systems opened the way to the fascinating field of electron quantum optics, where individual fermionic quantum states are manipulated with methods borrowed from photonic quantum-optical experiments. Inspired by these outstanding achievements, we aim to examine the energy dynamics in one-dimensional conductors at the single-particle level, studying the partition of energy for single-electron excitations in optical-like setups. We will theoretically study how quantized energy packets behave in the solid state version of the Hanbury Brown-Twiss interferometer, as well as collisions of energy packets in the spirit of the Hong-Ou-Mandel experiment. The analogy with traditional quantum optics will be reinforced by looking also at quantum tomography protocols involving heat current and noise. We will finally explore the peculiar neutral edge modes of the fractional quantum Hall effect from an electron quantum optics perspective, which allows for the study of neutral modes dynamics at the single-particle level.