Not just an electron waveguide or quantum box - uncovering the structure of carbon nanotubes in transport

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Abstract

In all cases from an open quantum system to strong Coulomb blockade, transport measurements on single wall carbon nanotubes reveal fascinating insights into the molecular structure and the behaviour of the electronic wavefunction.

The primary Fabry-Perot interference pattern of elecrons passing through a carbon nanotube reflects the distance of the contacts. However, this first-order picture does not take into account band structure or symmetry properties of the macromolecule. We demonstrate how the electronic interference pattern probes the graphene dispersion relation, and find that its details reflect the chirality of the specific nanotube at hand.

In the opposite limit of a single electron strongly confined to a quantum dot, we look at the eight lowermost single-particle quantum states. Their dispersion in a strong axial magnetic field demonstrates how through cross-quantization modification of the boundary conditions shifts the weight of the electron wavefunction. The field not just influences electronic properties but also the Franck-Condon coupling of vibrational side bands.

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