What is measured in the scanning gate microscopy of a quantum point contact?

Jalabert, Rodolfo A.[1]

[1] *Université de Strasbourg*

Peeping electrons going by is one of the most fascinating issues of Quantum Mechanics. Attempting such an experiment in a solid-state environment, like in a two-dimensional electron gas, involves subtle ingredients such as decoherence and many-body effects, as well as cross-talks and other technical limitations. The conductance changes measured under the influence of a local perturbation (e.g. Scanning Gate Microscopy, SGM) have often been interpreted in the last decade as a mapping of the electron current density along a nanostructured device. In agreement with the dictates of Quantum Mechanics, our perturbative analysis shows that the SGM measurements in a phase-coherent nanostructure are not given by a local quantity, but by two scattering states impinging from opposite electrodes [1]. In the case of a Quantum Point Contact (QPC) exhibiting conductance quantization, the first-order contribution for weak tip voltages is significant only on the conductance steps, while the second-order correction is the dominant one on the plateaus. The latter contribution is always negative, exhibits fringes, and has a spatial decay consistent with SGM experiments on QPC.

[1] What Is Measured in the Scanning Gate Microscopy of a Quantum Point Contact? R.A. Jalabert, W.Szewc, S. Tomsovic, and D. Weinmann, Phys. Rev. Lett.; in press.