Scanning gate microscopy simulations of the double slit electron interferometer

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Scanning gate microscopy (SGM) [1] probes the local properties of the systems with two-dimensional electron gas by sweeping the surface of the sample with a biased tip of the atomic force microscope (AFM). Potential perturbation introduced to the system by the charged tip affects the transport of Fermi level electrons inside the 2DEG buried shallow beneath the surface and modifies the systems conductance. Col8b03eca2b7lecting the conductance at each position of the tip one prepares so-called conductance maps (G-maps). The maps can be used for validation of the our understanding of the the quantum transport phenomena present in systems based on 2DEG [2].

In this paper we consider a setup with a pair of quantum point contacts which are fed by a common input lead and simulate the SGM conductance maps [3]. In our calculations we consider a fully coherent electron transport by solving the one-electron effective mass Schrödinger equation using the finite difference approximation. In order to evaluate the conductance of the system we use the Landauer approach. The effective potential of the tip is assumed to be short range (Lorentzian type). We investigate the possibility of mapping the double slit electron interference pattern using the SGM technique. We explain that the double slit interference is present for all the incident subbands, but disappears in the Landauer summation. As a result the calculated G-maps for large Fermi energies do not contain any signature of the double slit interference. We propose a setup with the filter of incident subbands which can be used as a double slit interferometer, with a well resolved Young pattern in the SGM conductance maps.

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