Exercise 8: Electron diffraction through a quantum point contact  Date  04.12.2014

Exercise 8:
„Single-Slit Electron Diffraction with Aharanov-Bohm Phase: Feynman´s Thought Experiment with Quantum Point Contacts”

In the publication*  


Feynman´s thought experiment of an added Aharanov-Bohm phase in a double-slit experiment is transferred to a one-slit experiment with ballistic electrons in a two-dimensional electron gas through a quantum point contact.

a) How are “temporal coherence” and “spatial coherence” defined?

b) Describe Feynman´s thought experiment in words as well as in a sketch.

c) Describe the experimental set-up (sketch), the experiment and the influence of the magnetic field.

d) Calculate the Fermi wavelength \( \lambda_F \) from the electron density in the sample \( n = 1.28 \times 10^{11} \text{ cm}^{-2} \). Compare this value to the width of the quantum point contact. Is the diffraction problem described by the Rayleigh or the Fraunhofer limit?

e) How does the number of modes transmitted through the quantum point contact depend on its width?

f) How do the authors explain the data shown in Fig. 2 (a) and (b)?

g) Compare Fig. 2 (b) with Fig. 1 (b) in the manuscript from exercise 4? What conclusions do you draw from this?

* The publication can be downloaded from the “Elektronische Zeitschriftenbibliothek der LMU München”