Exercise 3: Quantization of conductance in nanowires

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| Name |  |
| Date | Assistant |

Include the graphs, which you base your analysis on, to the answer form.

The level of detail of a complete answer is such that the answer fits in the box if typed in average handwriting.

Instead of typing in the boxes below, you may write on separate sheets.

The numbering of the questions below refers to the corresponding report instruction. Notice that not all the latter questions will be considered in this form assignment.

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| 7. Calibration of the I-V converter: express the I-V conversion coefficient k=1/R in terms of R0, V0 and Vout, where R0 is the resistance of the resistor used in the calibration of the setup, V0 is the voltage applied over the resistor and Vout is the measured output voltage of the I-V converter. What is the value of k? Give an error estimate for the value of k. |
| 8. Derive an expression to convert the measured voltage Vout to conductance G of the contact using the I-V conversion coefficient k and the applied voltage V0. Give an error estimate for the value of G. |
| 12. Based on the theory (sect. 2), derive an expression which gives an upper limit to the quantum numbers nx and ny. Using this expression, calculate the number of conductance channels when V0=20mV and Lx=Ly =10nm. What is the conductance of such a nanowire? |
| 13. Choose the best voltage trace you got in your measurements. Convert the measured voltage to conductance G and normalize it to the units of quantum of conductance (Gnorm=G/G0). Plot the normalized conductance Gnorm as a function of time. Matlab command *readmatrix()* may be useful in reading the .csv files. Describe in your own words how quantization of conductance is observed in the figure. |
| 14. Use all the traces you have measured and plot a histogram of all the normalized conductance values. MatLab function *histogram()* may be helpful. Choose the number of bins (of equal width) in a way that best illustrates the data. Based on the theory (section 2), how would you expect the histogram to look like? Consider possible reasons why deviation from the ideal behavior may be seen. |