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| Title of the project | Cross correlations in grapheneAALTO 06 |
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| Description of the work | This project investigates cross correlations of a current in a graphene sheet. One of the most informative parameters, in studying the quantum properties of a current in mesoscopic samples, is the shot noise (current fluctuations). The current fluctuations are characterized by the 2nd order and higher moments of their probability distribution P. Experimentally, the mean of P is obtained by time averaging, i.e. by dc current. The second moment (the variance) of P, measures the amplitude of the current fluctuations. The third moment (the skewness) measures the asymmetry of the fluctuations. The existence of the third moment is related to the breaking of time reversal symmetry by the dc current. At zero bias, positive and negative current fluctuations are equivalent, so the third moment is equal to zero. Microwave signals will be used to calcu­late cross-correlation functions which are averaged to improve the signal-to-noise ratio. Values of a normalized cross-correlation function can vary between ±1. Usually one can relate the negative current-current correlation to charge carriers obeying the Pauli exclusion principle (fermions), whereas positive cross-correlation is attributed to bosons. However, two entangled electrons, forming a Cooper pair in the superconductor (the injecting contact), are emitted into different exit leads due to Coulomb repulsion, giving rise to positive cross-correlation. There are experiments showing successful Cooper pair splitting using a quantum wire divided into two quantum dots. Construction of the splitter using a monolayer graphene sheet is the main task of the project. To make an effective Cooper pair injector, the optimization of the transmissivity of the injecting contacts is of vital importance. With an optimized Cooper pair splitter the cross-correlation measurement will be carried out at mK tempera­tures in Otaniemi. |
| Amount of access given | 92 days |