Master project

Realistic modelling of quantum point contacts in integer quantum Hall effect

Quantum Hall effect is known for various exotic properties such as conductance quantisation to an astonishing precision or the existence quasiparticles having a fraction of the electron charge (for the fractional quantum Hall). One of the methods for observing this fractional charge is based on investigating tunnelling of the quasiparticles between two quantum Hall edges at a quantum point contact (QPC, Fig. 1a).

While this method is considered reliable with successful applications since 1997 (Fig. 1b), it produces a number of unexplained anomalies such as the fractional charge depending on the applied voltage (Fig. 1c). Similar, albeit less drastic, anomalies occur for integer quantum Hall effect.

In this project you will develop a realistic model of a QPC in integer quantum Hall and check whether it can explain the observed anomalies. You will perform analytic calculations (solving the Schrödinger equation for 1D systems, calculating current and noise within Landauer-Büttiker formalism) and numerical modelling (using Kwant).

Extra reading in case you want a deeper connection to the subject:
A review of quasiparticle tunnelling experiments
How to perform analytic calculations of tunnelling current and noise (read sections I and II only)

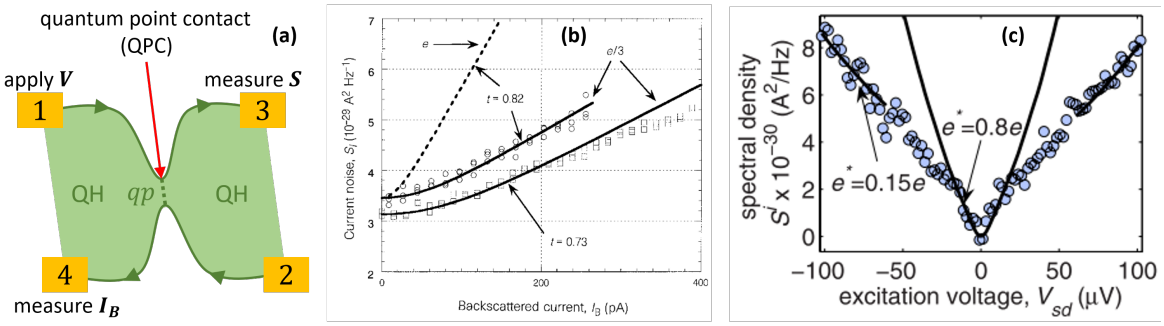

Figure 1. **(a)** QPC, where quasiparticles tunnel between quantum Hall edges. **(b)** Comparing the tunnelling current to its noise enables determining the charge of current carriers [source]. **(c)** Anomalies such as the dependence of the extracted charge on the applied voltage [source] remain unexplained.

APPLY NOW!

To apply for this position, send your application (including CV) by e-mail to: kyrylo.snizhko@gmail.com

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