S4-16: Quantum capacitances and inductances in the Quantum Hall Effect regime

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Abstract: In a two dimensional electron gas, low energy transport in presence of a magnetic field occurs in chiral 1D channels located on the edges of the sample. In the Buttiker’s description of a.c. quantum transport [1], the density of states of the 1D channels -which contains the drift velocity- scales the quantum capacitance and determines the amplitude of the imaginary part of the admittance. The topology determines the sign: in the case of an Hall bar, the emittance is an inductance. While it is a capacitance in the case of a corbino. Quantum capacitances and inductances are what finally limits the access time of quantum devices [2].

We performed low frequency a.c. electrical measurements (typically in the range 1kHz -100kHz) to obtain the ac admittance of quantum Hall samples in both topology, Hall bar and Corbino ring. Our samples have no gate, to exhibit only their inner electrochemical capacitance or inductance. I will discuss our measurement configuration, by the use of an impedancemeter, and what is the impact of the cables on the measurements [3]. Based on the Buttiker’s theory, I will explain what are the physical quantities accessible to our measurements.

I will present our results on the quantum capacitance obtained on Corbino rings and on the kinetic inductance of multiterminals Hall bars. Both quantities are related to the density of states of the chiral edge states, and allows to measure the drift velocity of carriers along these 1D conductors. In other words, the determination of the capacitance/inductance gives access to the transit time of electrons through the device.