Charge-conserving equilibration of quantum Hall edge states

Edvin Idrisov[1], Ivan Levkivskyi[2], and Eugene Sukhorukov[3]

[1]*Department of Physics and Materials Science, University of Luxembourg, L-1511 Luxembourg, Luxembourg*
[2]*Hopper, Inc., Dublin, Ireland*
[3]*University of Geneva, Department of Theoretical Physics, 24, quai Ernest Ansermet, CH1211, Geneva, Switzerland*

We address the experimentally relevant situation, where a non-equilibrium state is created at the edge of a quantum Hall system by injecting charge current into a chiral edge state with the help of a quantum point contact, quantum dots, or mesoscopic Ohmic contact. We show that the commonly accepted picture of the full equilibration of a non-equilibrium state at finite distances longer than a characteristic length scale contradicts to the charge conservation requirement. We use a phenomenological transmission line model to account for the local equilibration process and the charge and energy conserving dynamics of the collective mode. By solving this model in the limit of long distances L from the injection point, we demonstrate that the correction of the electron distribution function to its eventual equilibrium form scales down slowly as $1/\sqrt{L}$.