Integer Quantum Hall Edge States far from Equilibrium

J. T. Chalker
Physics Department, Oxford University

In this talk I aim to give an overview of theoretical work with collaborators [1–6] on non-equilibrium many-body physics in integer quantum Hall edge states far from equilibrium. This work is motivated by experiments of two types, on systems built from integer quantum Hall edge states. The first type involves Mach-Zehnder interferometers, where the amplitude of Aharonov-Bohm oscillations in the differential conductance of the device gives a window onto electron coherence, and shows interesting behaviour when the system is driven out of equilibrium by a bias voltage [7]. The second type involves generation of a non-thermal electron distribution by bringing together at a point contact two quantum Hall edge states originating from sources at different potentials: the relaxation of this distribution to a stationary form is observed as a function of distance downstream from the contact [8]. I will discuss how far relaxation and loss of coherence in the electron system can be understood in terms of dispersion of collective modes for the edge states, or (at filling factor $\nu = 2$) the existence of two modes with different velocities. I will also outline how exact results can be obtained for a variety of models by combining bosonization with numerical evaluation of free-fermion expectation values.

---

[1] J. T. Chalker, Yuval Gefen, and M. Y. Veillette, Phys. Rev. B 76, 085320 (2007).
[2] D. L. Kovrizhin and J. T. Chalker, Phys. Rev. B 80, 161306(R) (2009).
[3] D. L. Kovrizhin and J. T. Chalker, Phys. Rev. B 81, 155318 (2010).
[4] D. L. Kovrizhin and J. T. Chalker, Phys. Rev. B 84, 085105 (2011).
[5] D. L. Kovrizhin, J. T. Chalker, Phys. Rev. Lett. 109, 106403 (2012).
[6] M. J. Rufino, D. L. Kovrizhin, and J. T. Chalker, Phys. Rev. B 87, 045120 (2013).
[7] I. Neder, M. Heiblum, Y. Levinson, D. Mahalu, and V. Umansky, Phys. Rev. Lett. **96**, 016804, (2006), and subsequent work by many groups.
[8] H. le Sueur, C. Altimiras, U. Gennser, A. Cavanna, D. Mailly, F. Pierre, Phys. Rev. Lett. **105**, 056803 (2010).