

Electron quantum optics in ballistic chiral conductors

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The ballistic propagation of electronic waves along the quantum Hall edge channels of a two dimensional electron gas bears strong analogies with photon optics. Ballistic and one-dimensional propagation are ensured by the chiral quantum Hall edge states and electronic beam splitters can be implemented using quantum point contacts. These analogies have inspired a whole set of experiments, including the realization of electronic Mach-Zehnder [1] and Hanbury-Brown & Twiss [2] interferometers, providing an efficient tool to understand both the wave and corpuscular nature of electronic propagation in quantum conductors. However, fundamental differences with photon optics remain [3] : firstly from the presence of the Fermi sea and secondly from the Coulomb interaction between electrons. Using single electron emitters [4], these analogies and differences can now be probed down to the single particle scale which proves particularly efficient to test the limits of the single particle description and the emergence of many body physics [4].

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- [1] Ji *et al*, Nature **422**, 415 (2003)
[2] Henny *et al*, Science **284**, 296 (1999).
[3] E. Bocquillon, V. Freulon, F.D. Parmentier, J.-M. Berroir, B. Plaçais, C. Wahl, J. Rech, T. Jonckheere, T. Martin, C. Grenier, D. Ferraro, P. Degiovanni and G. Fève, Annalen der Physik (Berlin), **526**, 1 (2014).
[4] G. Fève, V. Freulon, J.-M. Berroir, P. Degiovanni, B. Plaçais, A. Cavanna, Y. Jin and G. Fève, Science **316**, 1169 (2007).
[5] D. Ferraro, B. Roussel, C. Cabart, E. Thibierge, G. Fève, C. Grenier and P. Degiovanni, Phys. Rev. Lett. **113**, 166403 (2014).