Robust methods for fractional charge determination

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The Fractional Quantum Hall Effect (FQHE) is a fascinating manifestation of collective quantum phenomena. Elementary excitations are quasiparticles with fractional charge [1] and statistics (anyons) [2]. Both can be revealed through various methods based on non-equilibrium current correlations through a Quantum Point Contact (QPC) created in a Hall bar, where quasiparticles tunnel between opposite edge states. The determination of their fractional charge q has been conclusive only for Laughlin states, thus at simple fractional filling factors ν for which $q = \nu e$, and has been based on zero-frequency poissonnian shot noise [1]. Nonetheless, this determination is crucial to understand states for other values of ν , such as the Jain series, and for which the underlying microscopic models are still under debates.

We have developed a unifying perturbative approach for non-equilibrium transport [3,4,5] which offers more robust and advantageous methods. It doesn't require the knowledge of such microscopic models nor initial thermal states, but only few conditions. These methods rely on universal non-equilibrium fluctuation relations from which the Josephson-type frequency $\omega_J = qV/\hbar$ can be extracted. We will present first those based on high-frequency noise [5], which have been implemented by Gwendal Fève's group (coll.) to determine $q = e/3$ at $\nu = 2/3$ [6]. Secondly, we will address those based on the photo-assisted noise under an ac voltage, and implemented by D. C. Glattli's group to determine $q = e/5$ at $\nu = 2/5$ [7]. We will finally revisit the implementation and the charge of minimal excitations [8] under lorentzian pulses [3,4].

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