Probing the 2/3 fractional Quantum Hall edge channel using electronic Hong Ou Mandel shot noise correlation.

Christian D. Glattli[1], Avirup De[1], Charles Boudet[1], Jayshankar Nath[1], Maelle Kapfer[1], Preden Roulleau[1], David Ritchie[2], and Ian Farrer[3]

[1]*Université Paris-Saclay, CEA, CNRS, SPEC, 91191 Gif-sur-Yvette Cedex, France*
[2]*Cavendish Laboratory, University of Cambridge, J.J. Thomson Avenue, Cambridge CB3 0HE, UK*
[3]*Department of Electronic and Electrical Engineering, University of Sheffield, Mappin Street, S1 3JD, UK*

The physics of the 2/3 edge channel is still awaiting a satisfying physical modeling. Inspiring of validating theoretical models requires the input of new type of experimental information. Here, we go well beyond the traditional DC transport and noise studies and, instead, explore the dynamic of the carriers propagating in along a 2/3 edge. New information is obtained by performing photo-assisted shot noise (PASN) measurements and electronic Hong Ou Mandel (HOM) shot noise measurements by sending GHz microwave excitations on the contacts of a Hall bar with a Quantum Point Contact (QPC) in its middle.

Under weak reflection of the inner channel by the QPC, we combine a DC voltage Vds and the rf excitation to probe the possible voltage reduction V_{QPC}QPC is measured via the Josephson relation using the PASN noise singularity occurring when V_{QPC} obeys the Josephson relation (e/3)V_{QPC}=hf [1].

Then, applying the same coherent sine-wave rf excitation on both contacts, but with a time-delay, and measuring the cross-correlated partition noise of e/3 charge in the weak reflection regime, we observe HOM noise oscillations similar to that recently observed on the 2/5 and integer edge channel. The finite but weak visibility observed in these two-particle noise interference measurements suggests the existence of a finite quantum coherence of the 2/3 edge channel [2]. Moreover, sending periodic Leviton-like pulses of small 70ps witdh and 5GHz repetition rate, we observe, from the HOM signal, a large broadening of the pulses. This broadening show evidence of a long predicted charge diffusion mode [3] along the 2/3 edge channel.

The authors acknowledge the H2020 FET-OPEN UltraFastNano no. 862683 grant

[1] I. Taktak, M. Kapfer, J. Nath, P. Roulleau, M. Acciai, J. Splettstoesser, I. Farrer, D. A. Ritchie, D. C. Glattli, Two-particle time-domain interferometry in the Fractional Quantum Hall Effect regime, Nat Commun 13, 5863 (2022), https://doi.org/10.1038/s41467-022-33603-3.

[2] Avirup DE, Charles Boudet, Jayshankar Nath, M. Kapfer, P ; Roulleau, D. Ritchie2, Ian Farrer3, and D.C. Glattli1 “Finite quantum coherence of the fractional quantum Hall edge at filing factor 2/3”, in preparation.

[3] C. L. Kane, Matthew P. A. Fisher, and J. Polchinski, Phys. Rev. Lett. 72, 4129 (1994).