Probing the 2/3 Edge Channel Quantum Coherence using Electronic Hong Ou Mandel Shot Noise Correlation

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We perform 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 in its middle, see Fig. 1.

Under weak reflection of the inner channel by the QPC, we combine a DC voltage V_{ds} and the RF excitation to probe the possible voltage reduction $V_{QPC} < V_{ds}$ across the QPC which may be expected occurring from the resistive nature of the $^2/_3$ edge channel. V_{QPC} is measured via the Josephson relation using the PASN noise singularity occurring when V_{QPC} obeys the Josephson relation $\frac{e}{3}V_{QPC} = hf$[1].

Then, applying the same coherent sine-wave RF excitation V_1 and V_2 on both contacts, but with a time-delay τ, 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 signals the existence of a finite quantum coherence of the $^2/_3$ edge channel[2], see Fig. 2.

Fig. 1. QPC in a counter-propagating channels setup. Charge carriers excited by V_1 and V_2 (of time lag τ) are partitioned; transmitted and backscattered currents I_T and I_B are filtered by a 2.5 ± 0.25 MHz LC circuit, ensuingly amplified by the cryogenic amplifiers. Signal is captured by a DAQ from with cross-correlations are computed. Additional details are found in [1].
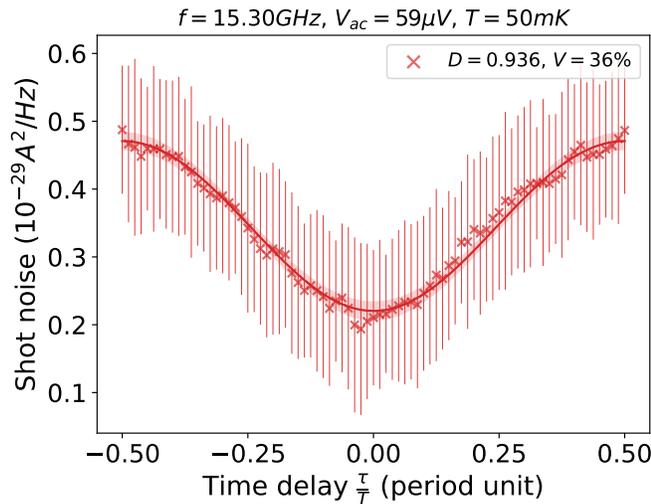

Fig. 2. HOM shot noise experiments shows that there is quantum coherence at $\nu = 2/3$. Visibility $\approx 36\%$. Measured data correspond to the $\times$ symbols; the fit corresponds to the solid line.
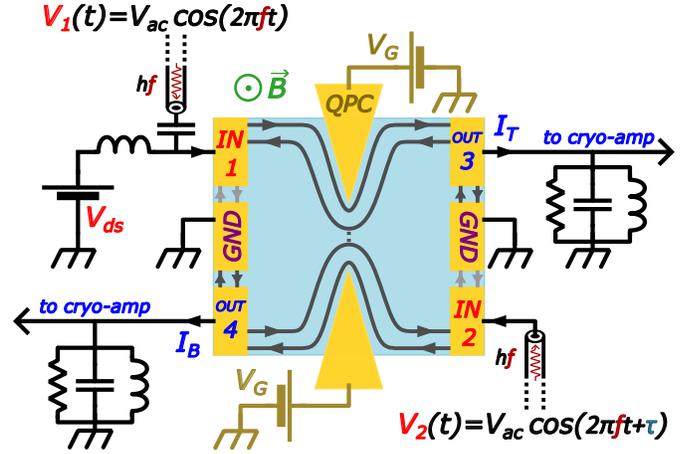
References

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