Delta-T noise in quantum Hall junctions

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Noise is a fundamentally inescapable ingredient of any electronic device, that has now been broadly accepted as a key tool to improve our understanding of nanoscale conductors. Electronic noise is typically broken down into two contributions: thermal (or Johnson-Nyquist) noise and shot noise. Using atomic-scale metallic junctions [1], it was recently showed that under a temperature rather than a voltage bias, a finite non-equilibrium noise signal could be measured , which the authors dubbed "delta-T noise". This previously undocumented source of noise actually corresponds to some form of temperature-activated shot noise.

Here, we propose to investigate the fate of delta-T noise in a prototypical strongly correlated state, namely the edge states of the fractional quantum Hall effect (FQHE). We first study the current correlations of fractional quantum Hall edges at the output of a quantum point contact (QPC) subjected to a temperature gradient. We show that the tunneling of Laughlin quasiparticles leads to a negative delta-T noise, in stark contrast with electron tunneling, a result which arises from the interplay of strong correlations and fractional statistics [2].

We then move on to the situation of an inhomogeneous junction involving two coupled edge states belonging to Hall fluids with different filling factors [3]. In the specific case of an hybrid junction (1/3, 1), we are able to solve exactly the problem for all couplings and for any set of temperatures, showing that contributions linear in the temperature gradient are largely dominating. This then motivates us to derive a universal analytical expression connecting the delta-T noise to the equilibrium one up to lowest order in the temperature mismatch, for any junction involving two fluids belonging to the Laughlin sequence.

Beyond the inherent interest in studying delta-T noise in such systems, accessing properties that cannot be addressed by the usual voltage-induced shot noise, our work may help better understanding charge and heat transport in situations where strong electronic correlations are operating. This would, in turn, allow us to move toward a more involved investigation of the statistics and scaling dimension of their emergent excitations.

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