Highlights

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Minimal Excitations in the Fractional Quantum Hall Regime

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A minimal excitation state of a quantum conductor is made of a single electron surfing on top of the Fermi sea, with no additional particle-hole pairs. Such a unique quantum state, also called *leviton*, emerges in response to well defined voltage pulses of Lorentzian shape.
Solid state systems, however, can be heavily affected by interactions, and the ground state of a fermionic system can show correlations. For instance, the fractional quantum Hall effect is a paradigmatic example of the dramatic consequences of electron-electron interactions. Here, a new strongly correlated phase emerges in the quantum liquid, with quasiparticle excitations carrying a fraction of the electron charge and whose statistical properties are neither bosonic nor fermionic, but belongs to the more general class of anyons.
In this Letter we study the minimal excitations of fractional quantum Hall edges, extending the notion of levitons to interacting systems. Using both perturbative and exact calculations, we show that they arise in response to a Lorentzian potential with quantized flux. They carry an integer charge, thus involving several Laughlin quasiparticles, and leave a Poissonian signature in a Hanbury Brown–Twiss partition noise measurement at low transparency. This makes them readily accessible experimentally, ultimately offering the opportunity to study real-time transport of Abelian and non-Abelian excitations.

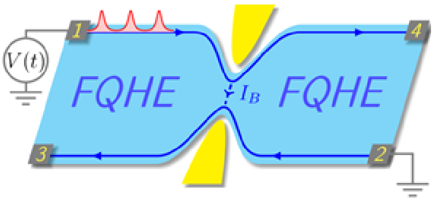

Fig.1: Hanbury Brown–Twiss setup in the fractional quantum Hall regime. A quantum Hall bar is equipped with a quantum point contact connecting opposite edge states. The left-moving incoming edge is grounded at contact 2 while the right-moving one is biased at contact 1 with a time-dependent potential V(t). Partition noise is measured in contact 3.

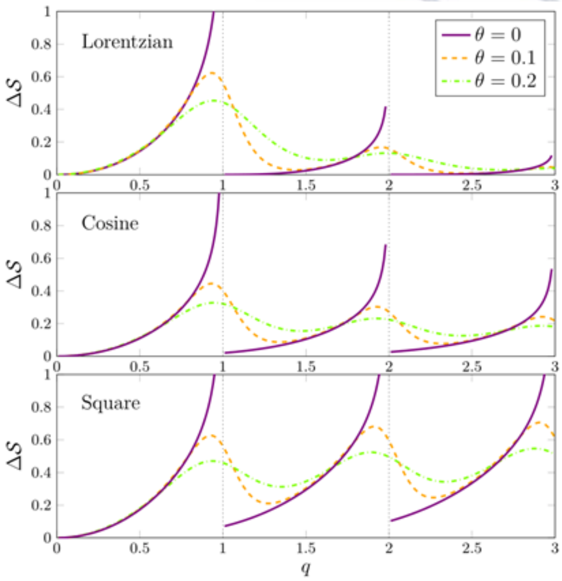

Fig.2: Excess noise as a function of the number of electrons per pulse q, for different reduced temperatures θ and filling factor ν=1/3, in the case of a square, a cosine, and a periodic Lorentzian drive.