Electron-hole Quantum Partition Noise in a Quantum Point Contact

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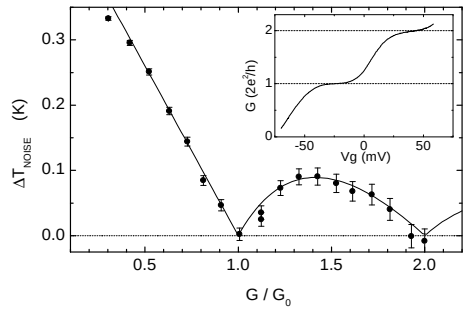
Can the Fano factor F associated to electron shot noise in a quantum conductor be measured without net current flowing though the conductor? We report here experimental results showing that this measurement is possible providing electron-hole pairs are created using radiofrequency photon excitation. The conductor is a Quantum Point Contact realized in a high mobility 2D electron gas. One contact is biased to a a.c. voltage $V_{a.c.} \approx \hbar\omega/e$ while the other contact is grounded, where the frequency $\nu = \omega/2\pi = 17.3$GHz or 8.7GHz $\gg k_BT/h$. Electrons emitted by the a.c. biased contact are photo-excited and give rise to a coherent superposition of electron-hole pairs arriving at the QPC. When the transmissions D_n of the QPC modes are different from 0 and 1, the electron-hole pairs dissociates because electrons and holes are separately partitioned into the outgoing states. This produces a fundamental quantum partition noise which we have observed for the first time [1]. No current is associated with these neutral excitations. The zero temperature shot noise is : $\overline{\Delta I^2} = 4h\nu G\left(\sum_{l=1}^{\infty} lJ_l(eV_{ac}/h\nu)\right)F\Delta f$ where $F = \frac{\sum_n D_n(1-D_n)}{\sum_n D_n}$. The Fano factor F is straightforwardly related to the noise and can thus be measured (see figure).



Shot noise variations versus conductance G in transmission units observed at 94mK (closed circles). The noise in units of noise temperature. The solid line is a comparison with theory with no adjustable parameters.

[1] L.-H. Reydellet *et al.*, to appear in *Phys. Rev. Lett. (2003).*