Strong suppression of shot noise in a feedback controlled single-electron transistor

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We demonstrate the strong suppression of shot noise in a single-electron transistor using an exclusively electronic closed-loop feedback [1]. The occurrence of shot-noise, due to the random emission of electrons with the quantized charge e^-, was first postulated in vacuum diodes by W. Schottky in 1918 [2] and is becoming the dominant source of noise in present-day mesoscopic conductors [3]. Our implemented feedback loop monitors and adjusts the counting statistics in a single-electron transistor [4] With increasing feedback response we observe a stronger suppression and faster freezing of charge current fluctuations, leading to a highly accurate and stable tunneling current [1,5]. Our technique is analog to the generation of squeezed light in quantum optics, using in-loop photo detection [6, 7]. Sub-Poisson single-electron sources will pave the way for high-precision measurements in quantum transport similar to its optical equivalent [7].

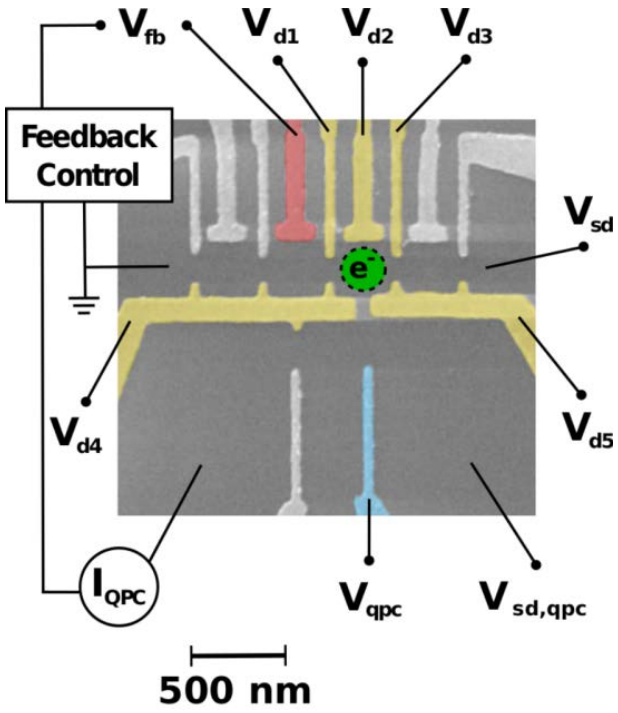

Figure 1: *SEM image of our feedback controlled single-electron transistor (SET), consisting of a gate defined quantum dot (QD) with coupled quantum point contact (QPC) charge detector. The sample is based on a two-dimension electron gas (2DEG) in GaAs/AlGaAs.*

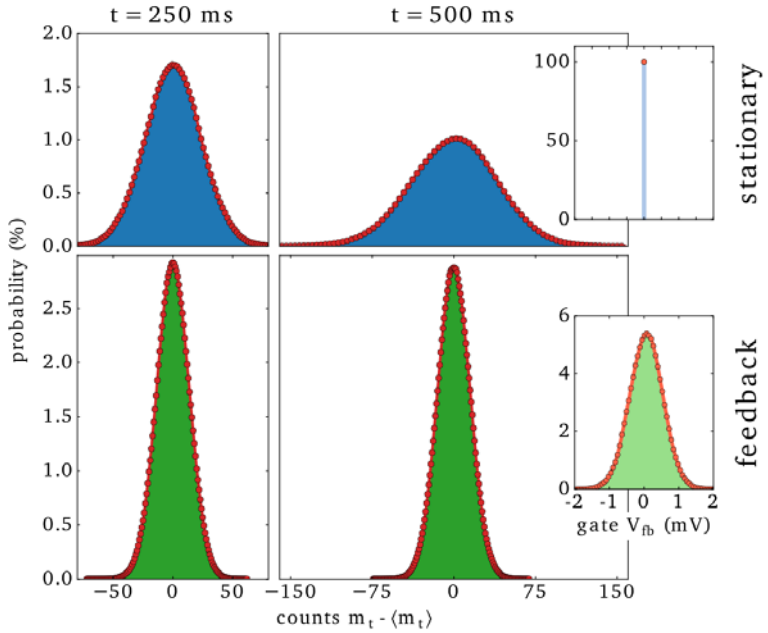

Figure 2: a,b, *The counting distributions of the stationary quantum dot (blue) are shown for two different values of t. A strong temporal broadening of the charge fluctuations is visible.* ***c,d,*** *In comparison the distributions of the feedbacked quantum dot (green) are clearly suppressed and temporally frozen.* ***e,f,*** *At the same time the distribution V_{fb} transforms from a single-valued Delta-peak into a broad distribution.*

[1] T. Wagner, P. Strasberg, J. C. Bayer, E. P. Rugerambigabo, T. Brandes and R. J. Haug, Nature Nanotech., advanced online publication doi:10.1038/nnano.2016.225 (2016)

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