Shot Noise in Transport through Quantum Dots: Toolbox to Study Quantum Physics

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In studying shot noise in transport through quantum dots, i.e. quasi zero-dimensional systems in semiconductors, one has access to quantum mechanical correlations in these systems in a variety of ways. So, one can apply ultrasensitive noise and correlation measurements which can give deep insight into the quantum mechanical properties of the systems studied. Such electron transport experiments with quantum dots can be performed in very similar ways to experimental arrangements in quantum optics. So, e.g. electron pairs can be generated on demand and the splitting and partitioning of these electron pairs can be investigated [1]. Coincidence correlation measurements allow the reconstruction of the full counting statistics, revealing regimes of statistically independent, distinguishable or correlated partitioning and are envisioned as a source of information on the quantum state of the electron pair. An astonishing bunching of electron pairs is observed for transmissions of the beam splitter being very different from 0.5 [1]. Another scheme often applied in quantum optics is the usage of feedback to influence the quantum mechanical states. Recently, feedback was also successfully applied in experiments with quantum dots and it was shown that the full counting statistics of such systems can be strongly influenced [2].

[1] N. Ubbelohde, F. Hohls, V. Kashcheyevs, T. Wagner, L. Fricke, B. Kästner, K. Pierz, H.W. Schumacher, R.J. Haug; Nature Nanotech. 10, 46 (2015)
[2] T. Wagner, P. Strasberg, J.C. Bayer, E.P. Rugeramigabo, T. Brandes, R.J. Haug; arXiv 1602.05466