Levitons, minimal excitation states for single electron sources in electron quantum optics

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A simple approach to realize an on-demand electron source is to apply a voltage pulse on a contact of a mesoscopic conductor such that the resulting current pulse injects a single charge in the conductor. At first sight, the idea seems too naive to produce something useful. However this procedure actually works [1]. More surprisingly it contains a rich physics: the generation of a new type of excitation carrying a single particle: a leviton. This minimal excitation state has been theoretically predicted 20 years ago by L. Levitov and collaborators [2] who found that a voltage pulse with Lorentzian shape produces a noiseless state. In this talk, I will present experimental generation of levitons and report electron quantum optics applications: a two-leviton quantum interference experiment, the electrical analog of the photonic Hong Ou Mandel experiment revealing perfect electron coherence. With single electron sources (SES), electron quantum tomography is accessible and a complete picture of the Leviton wave-function can be experimentally given [3]. Finally, I will extend the periodic SES approach to the pseudo-random binary injection of levitons for future electronic flying qubits [4].

[1] J. Dubois et al, Nature 502, 659-663 (2013)

[2] Levitov et al., J. Math. Phys. 37, 4845-4856 (1996)

[3] T. Jullien et al., Nature 514, 603-607 (2014)

[4] D.C. Glattli and P. Roulleau, arXiv:1702.00499