Floquet Theory of Electron Waiting Times in Quantum Coherent Conductors

David Dasenbrook, Christian Flindt, and Markus Büttiker

Département de Physique Théorique, Université de Genève, 1211 Genève, Switzerland
david.dasenbrook@unige.ch

The distribution of waiting times between charge detection events has recently gained some interest in theoretical mesoscopic physics [1-5]. As an alternative to full counting statistics (FCS), which is typically evaluated in the long time limit, it allows for a complementary characterization of electron transport on short and intermediate time scales.
Waiting time distributions (WTD) can be used as a tool to investigate the interplay between extrinsic and intrinsic time scales in periodically driven systems. However, while there have been results on waiting times in classical driven systems [2], a formalism for WTDs in phase coherent systems with an external time-dependence has so far been lacking. We present such a formalism for one-dimensional non-interacting systems based on a Floquet scattering approach [6].
We demonstrate the usefulness of our formalism by means of two examples: a quantum point contact (QPC) whose transmission is weakly and slowly modulated [7] and the application of Lorentzian voltage pulses of integer charge to an ideal conductor [8-9].

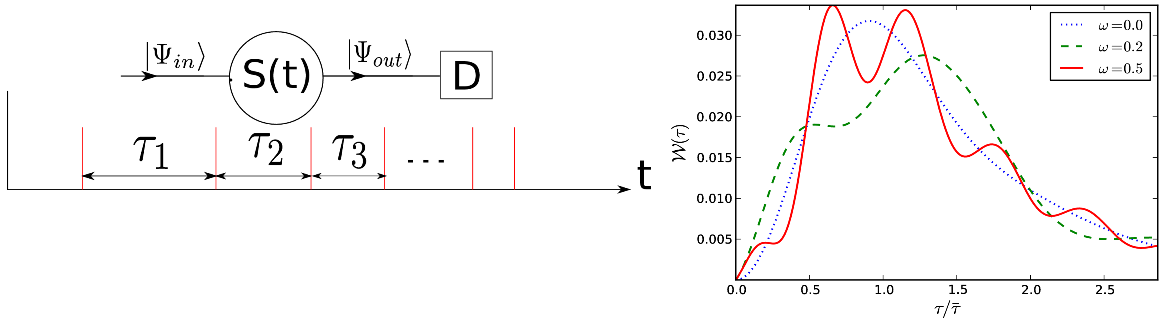

Fig. 1: (Left panel): Schematic setup for detecting waiting times for a time-dependent scatterer S(t). The outgoing state is analyzed by a single-particle detector that records a time trace of detection events. The WTD is the probability distribution of time spacings between detections. (Right panel): WTDs for a QPC with modulated transmission coefficient for different frequencies of the modulation.

[1] T. Brandes, Ann. Phys. 17, 477 (2008)
[2] M. Albert, C. Flindt, and M. Büttiker, Phys. Rev. Lett. 107, 086805 (2011)
[3] M. Albert, G. Haack, C. Flindt, and M. Büttiker, Phys. Rev. Lett. 108, 186806 (2012)
[4] K. Thomas and C. Flindt, Phys. Rev. B 87, 121405(R) (2013)
[5] L. Rajabi, C. Pöltl, and M. Governale, Phys. Rev. Lett. 111, 067002 (2013)
[6] M. H. Pedersen and M. Büttiker, Phys. Rev. B 58, 12993 (1998)
[7] J. Zhang, Y. Sherkunov, N. d'Ambrumenil, and B. Muzykantskii, Phys. Rev. B 80, 245308 (2009)
[8] J. Keeling, I. Klich, and L. S. Levitov, Phys. Rev. Lett. 101, 196404 (2008)
[9] J. Dubois, T. Jullien, C. Grenier, P. Degiovanni, P. Roulleau, and D. C. Glattli, Phys. Rev. B 88, 085301 (2013)