Max-Planck-Institut für Struktur und Dynamik der Materie

Max Planck Institute for the Structure and Dynamics of Matter

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CFEL Seminar room IV (Bldg. 99)

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Numerically exact full counting statistics of the Anderson impurity model

The full characterization of charge transfer processes in molecular junctions requires techniques for evaluating not only the first and second moments of charge currents, but also higher-order statistical cumulants of the charge transfer process. The complete set of cumulants gives access to the full counting statistics (FCS) through the so-called generating function [1].

To date, the computation of generating functions for FCS in fermionic systems has been restricted to either noninteracting [2] systems or to specific limiting parameter ranges in correlated systems [3]. Despite the existence of various approximation methods, only very few numerically exact results exist in this field.

In this talk, we present a new method [4] for calculating the FCS of a generic nonequilibrium interacting fermionic model, valid for arbitrary temperatures, voltages and interaction strengths. This method is based on the recently-developed inchworm diagrammatic quantum Monte Carlo(iQMC) method [5], which uses a technique for the summation of propagators up to times previously inaccessible to conventional nonequilibrium quantum Monte Carlo methods. It will be discussed how, using a modified hybridization expansion [6] of the generating functionfor the FCS in the Anderson impurity model (AIM), the problem of FCS canbe mapped to an equivalent problem in iQMC.

To test the method, we present noninteracting benchmarks against a recent time dependent FCS formalism based on a path integral nonequilibrium Green's function (PI-NEGF) technique [2]. We then go on to discuss the effect of electron-electron interactions on time-dependent charge cumulants, the first passage time distribution (FPTD) and probability distributions for the transfer of n-electrons. We find 'queuing` behaviour in the FPTD caused by electronic correlations, and discuss how this is manifested in the peak-shifts of n-particle probability distributions with increasing n. Finally, we observe a fascinating crossover in the shot noise and nonequilibrium Fano factor from Coulomb blockade to Kondo effect – dominated physics.

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[3] Carr, S. T., Bagrets, D. A. and Schmitteckert, P. (2011): PRL 107(20), 206801

[4] Ridley, M., Singh, V. N., Gull, E., and Cohen, G. (2018): arXiv:1801.05010

[5] Cohen, G., Gull, E., Reichman, D. R., and Millis, A. J. (2015): PRL, 115(26) 266802

[6] Gull, E., Millis, A. J., Lichtenstein, A. I., Rubtsov, A. N., Troyer, M., and Werner, P. (2011): Rev. Mod. Phys. 83(2), 349

Host: Angel Rubio