Nonequilibrium Spectra within the G1-G2 Scheme

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Accurate access to spectral functions for systems out of equilibrium remains a central challenge in many-body theory. While NEGF techniques can, in principle, yield detailed spectral information, their cubic scaling with the number of time steps significantly limits their applicability. Although the HF-GKBA mitigates some of this scaling issue, it effectively provides access to spectral information only at the mean-field level. The G1-G2 scheme [1] offers an exact, time-diagonal reformulation of the HF-GKBA that achieves linear scaling with the number of time steps. However, recovering spectral features from time-diagonal Green functions has proven difficult.

Only recently, the Real-Time Dyson Expansion (RT-DE) [2] was proposed to address some of these challenges, enabling access to spectral information beyond the mean-field level while maintaining favorable numerical scaling. In this talk, I explore how the RT-DE can be incorporated into the G1-G2 scheme and discuss the role of self-consistency within these approaches.

[1] N. Schlünzen, J.-P. Joost, and M. Bonitz, *Achieving the Scaling Limit for Nonequilibrium Green Functions Simulations*, PRL **124**, 076601 (2020)

[2] C.C. Reeves, and V. Vlcek, *Real-Time Dyson-Expansion Scheme: Efficient Inclusion of Dynamical Correlations in Nonequilibrium Spectral Properties*, PRL **133**, 226902 (2024)