Multipoint correlation functions: spectral representation, numerical evaluation, and improved estimators

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Abstract:
Multipoint correlation functions describe the many-body processes relevant to transport properties (e.g., vertex corrections to the conductivity) and spectroscopy (e.g., inelastic scattering of photons and neutrons). However, the non-perturbative computation of multipoint functions for strongly correlated systems at low temperatures, especially on the real-frequency axes, has been notoriously challenging. In this talk, I will present some recent breakthroughs made by my colleagues and me. We have derived the generalized spectral representations of generic multipoint functions that encompass all many-body formalisms (zero-temperature, Matsubara, and Keldysh) for the first time [1], and developed the numerical renormalization group (NRG) method for computing local multipoint functions of quantum impurity systems by evaluating such spectral representations [2]. Very recently, we have devised the symmetric improved estimator for three- and four-point functions [3]. With these, we can now compute real-frequency multipoint functions for strong interactions and low temperatures with high accuracy, which goes beyond the reach of the other approaches.

[1] F. B. Kugler*, S.-S. B. Lee*, and J. von Delft, Phys. Rev. X 11, 041006 (2021). (*: equal contributions)
[2] S.-S. B. Lee, F. B. Kugler, and J. von Delft, Phys. Rev. X 11, 041007 (2021).
[3] J.-M. Lihm, J. Halbinger, J. Shim, J. von Delft, F. B. Kugler, and S.-S. B. Lee, arXiv:2310.12098.