Pseudoparticle vertex impurity solver for quantum impurity models

(2, Oral)

Aaram J. Kim, Katharina Lenk, Jiajun Li, Martin Eckstein, Philipp Werner

[Times Roman regular font 11 pt, Presenter underlined]

1 Department of Physics and Chemistry, DGIST, 42988 Daegu, Korea

2 Department of Physics, University Hamburg, 22607 Hamburg, Germany

3 Departiment of Physics, University of Fribourg, 1700 Fribourg, Switzerland and Paul Scherrer Institute, Condensed Matter Theory, 5352 PSI Villigen, Switzerland

4 Department of Physics, University Hamburg, 22607 Hamburg, Germany

5 Departiment of Physics, University of Fribourg, 1700 Fribourg, Switzerland

We present a new Monte-Carlo-based impurity solver built upon the strong-coupling expansion of the three-point vertex functions. Using stochastically sampled the four-point pseudoparticle vertex, the triangular vertex is self-consistently updated via a two-dimensional time-stepping protocol. We significantly improve the low-order approximation schemes and eventually achieve numerically exact results. We analyze the performance and the convergence rate of the impurity solver using exactly solvable fermionic and bosonic models and analyze the efficiency of the vertex self-consistent scheme. As proof of principle, we discuss the physics of strong light-matter coupling in the spin-boson model representing an emitter in an optical waveguide.

[1] A. J. Kim et al., Phys. Rev. Lett. 130, 036901 (2023).

[2] A J. Kim et al., Phys. Rev. B 106, 085124 (2022).