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Diagrammatic Monte Carlo approach for diagrammatic extensions of dynamical mean-field theory – convergence analysis of the dual fermion technique JAN GUKELBERGER, University of Sherbrooke, EVGENY KOZIK, King's College London, HARTMUT HAFERMANN, Huawei Technologies Co. Ltd. — The dual-fermion approach provides a formally exact prescription for calculating properties of a correlated electron system in terms of a diagrammatic expansion around dynamical mean-field theory (DMFT). It can address the full range of interactions, the lowest order theory is asymptotically exact in both the weak- and strong-coupling limits, and the technique naturally incorporates long-range correlations beyond the reach of current cluster extensions to DMFT. Most practical implementations, however, neglect higher-order interaction vertices beyond two-particle scattering in the dual effective action and further truncate the diagrammatic expansion in the two-particle scattering vertex to a leading-order or ladder-type approximation. In this work we compute the dual-fermion expansion for the Hubbard model including all diagram topologies with two-particle interactions to high orders by means of a stochastic diagrammatic Monte Carlo algorithm. Benchmarking against numerically exact Diagrammatic Determinant Monte Carlo simulations allows us to systematically assess convergence of the dual-fermion series and the validity of these approximations.

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