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Title: Algorithms for quantum cluster simulations with 100+ site clusters

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The dynamical cluster approximation (DCA) is a systematic extension beyond the single site approximation of dynamical mean field theory (DMFT) to include spatially non-local correlation in quantum many-body simulations. The method relies on effective solvers of the many-body problem on the cluster with N_c sites. The recently developed continuous time auxiliary field (CTAUX) algorithm has proven particularly effective for DCA simulations, as it does not suffer from time discretization problems of the Hirsch-Fye algorithm. CTAUX can be formulated in combination with sub-matrix updates [1] in order to map optimally onto modern processors with hierarchical memory architectures. Further algorithmic improvements, such as a modified FFT algorithm to efficiently deal with the random times, or high-frequency conditioning of the Matsubara sums allow us to further reduce the overall computational effort and improve scalability of the overall method. It is now possibly to routinely run quantum cluster simulations with 100+ sites on thousands or tens of thousands of CPU cores, and thereby reach the asymptotic limit in the computation of physically observable quantities. For example, simulations of up to 100 site clusters allow us to verify numerically, that the Neel temperature in the half-filled two-dimensional Hubbard model decays logarithmically with cluster size. We have also been able to converge the transition temperature T* for the pseudo-gap, showing unequivocally, that the model has a pseudogap phase at 2.5% doping. [1] E. Gull, P. Staar, S. Fuchs, P. Nukala, M. S. Summers, T. Pruschke, T. C. Schulthess, and T. Maier, Phys. Rev. B, 83, 075122 (2011)