A Diagrammatic Extension to Dynamical Cluster Approximation based on the Two-Particle Irreducible Vertex at Intermediate Length Scales[1] CENGIZ SEN, University of Cincinnati, CYRILL SLEZAK, Hillsdale College, THOMAS MAIER, Oak Ridge National Lab, KAREN TOMKO, Ohio Supercomputer Center, MARK JARRELL, University of Cincinnati — We present a non-perturbative multi-scale extension to the Dynamical Cluster Approximation (DCA) based on the two particle irreducible vertex Γ. The correlations at short length scales are calculated exactly using Quantum Monte Carlo (QMC) on small cluster of size $N_c^{(1)}$, and long length scales are treated at the dynamical mean field level. Intermediate length scales are treated on a second cluster of size $N_c^{(2)} > N_c^{(1)}$ by approximating its two-particle irreducible vertex with that of the smaller cluster, which is calculated by retaining its full momentum and frequency dependence. The resulting self energy of the large cluster is calculated using the Schwinger-Dyson equation. The method is applied to the 2D Hubbard model with cluster sizes $N_c^{(2)} \geq N_c^{(1)}$ and the results are compared with those that are calculated using QMC by increasing the size of the small cluster $N_c^{(1)}$ up to $N_c^{(2)}$.

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