Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

Detecting phase-transitions in electronic lattice-models with DCA$^+$ PETER STAAR, ETH Zurich, THOMAS MAIER, ORNL, THOMAS SCHULTHESS, ETH Zurich, COMPUTATIONAL MATERIAL SCIENCE TEAM — The DCA$^+$ algortihm was recently introduced to extend the dynamic cluster approximation (DCA) by introducing a self-energy with continuous momentum dependence. This removes artificial long-range correlations and thereby reduces the fermion sign problem as well as cluster shape dependencies. Here, we extend the DCA$^+$ algorithm to the calculation of two-particle quantities by introducing irreducible vertex functions with continuous momentum dependence compatible with the DCA$^+$ self-energy. This enables the study of phase transitions within the DCA$^+$ framework in a much more controlled fashion than with the DCA. We validate the new method using a calculation of the superconducting transition temperature T_c in the attractive Hubbard model by reproducing previous high-precision finite size quantum Monte Carlo results. We then calculate T_c in the doped repulsive Hubbard model, for which previous DCA calculations could only access the weak-coupling ($U = 4t$) regime for large clusters. We show that the new algorithm provides access to much larger clusters and thus asymptotic converged results for T_c for both the weak ($U = 4t$) and intermediate ($U = 7t$) coupling regimes, and thereby enables the accurate determination of the exact infinite cluster size result.

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Date submitted: 14 Nov 2013 Electronic form version 1.4