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Extended Correlation in Strongly Correlated Systems, Beyond Dynamical Cluster Approximation HERBERT FOTSO, Department of Physics, Georgetown University, SHUXIANG YANG, Department of Physics and Astronomy, Louisiana State University, HARTMUT HAFERMANN, Centre de Physique Theorique, Ecole Polytechnique, KA-MING TAM, JUANA MORENO, Department of Physics and Astronomy, Louisiana State University, THOMAS PRUSCHKE, Department of Physics, University of Goettingen, MARK JARRELL, Department of Physics and Astronomy, Louisiana State University, LOUISIANA STATE UNIVERSITY COLLABORATION, ECOLE POLYTECHNIQUE COLLABORATION, UNIVERSITY OF GOETTINGEN COLLABORATION — We present a new multi-scale approach for strongly correlated systems that combines the Dynamical Cluster Approximation and the recently introduced dual-fermion formalism. This approach employs an exact mapping from a real lattice to a DCA cluster of linear size L_c embedded in a dual fermion lattice. The short-length-scale physics is addressed by DCA cluster calculations, while the longer-length-scale physics is addressed diagrammatically using dual fermions. The bare and dressed dual fermionic Green functions scale as $\mathcal{O}(1/L_c)$, so perturbation theory on the dual lattice converges very quickly. E.g., the dual Fermion self-energy calculated with simple second order perturbation theory is of order $\mathcal{O}(1/L_c^3)$, with third order and three-body corrections down by an additional factor of $\mathcal{O}(1/L_c)$.

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