Application of the Dual Fermion-Dynamical Cluster Approach to the 1D Falicov Kimball Model

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— The Falicov Kimball model is the simplest model for correlated electrons. It was introduced to study metal-insulator transitions. In one dimension, it is known to possess a charge density wave (CDW) instability at zero transition temperature ($T_c$). However, finite cluster methods like Dynamical Mean Field Theory (DMFT), Dynamical Cluster Approximation (DCA), Cellular Dynamical Mean Field Theory (CDMFT), etc. show finite temperature CDW transition. In this paper, we study the model using the recently developed Dual Fermion-Dynamical Cluster approach that takes into account large length scale correlations through the auxiliary particles known as dual Fermions. We find that $T_c$ obtained from this method is lower than that obtained from the cluster methods. In particular, we study the scaling behavior of $T_c$ with the linear cluster size and also the scaling of other one-particle and two-particle quantities near the criticality.

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