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Strong electron correlation effects in a quasiperiodic lattice

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Abstract

Strong correlations in the quasiperiodic systems have attracted much interest since the recent observation of quantum critical behavior in the Tsai-cluster quasicrystal compounds $Au_{51}Al_{34}Yb_{15}$. To clarify how electron correlations affect low temperature properties in quasiperiodic systems, we study the repulsive Hubbard model on the Penrose lattice. Using the real-space dynamical mean-field theory, we clarify that the quasiparticle weight strongly depends on the lattice site and its geometry when the system is close to the Mott transition point. Moreover, we find a temperature dependent distribution of local quantities characteristic of the Penrose lattice. This behavior originates from the local isomorphism which holds high geometrical regularity even if there are no translational symmetry. Moreover, we develop real-space dual fermion approach to investigate intersite correlations in inhomogeneous lattices and discuss how the Mott transition point is affected by taking nonlocal correlations into account. Our study clarifies how local and nonlocal correlations affect the local quantities in the quasiperiodic system.