HEAVY FERMION PROPERTIES IN THE KONDO LATTICE MODEL

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The Kondo lattice model is often used as a starting point to discuss low-energy properties of heavy-fermion systems. It includes a band of conduction electrons, interacting via an exchange with a regular array of immobile spins. We discuss this model in the framework of a quite novel projective renormalization method (PRM). Starting from a decomposition of the Hamiltonian into a dominant kinetic energy $\mathcal{H}_0$ and a Kondo-exchange $\mathcal{H}_1$, transition operators, due to $\mathcal{H}_1$, between the eigenstates of $\mathcal{H}_0$ are successively eliminated in this method. With this analytical technique we arrive at a solvable effective Hamiltonian $\tilde{\mathcal{H}}$ which consists of conduction electrons with renormalized dispersion $\tilde{\varepsilon}_{\mathbf{k}}$ and an RKKY interaction term which is naturally generated within the renormalization procedure. Here, $\tilde{\varepsilon}_{\mathbf{k}}$ can be interpreted as quasiparticle excitation. It turns out that $\tilde{\varepsilon}_{\mathbf{k}}$ is also temperature dependent. Whereas for high temperatures it resembles the unrenormalized fermionic excitation $\varepsilon_{\mathbf{k}}$, at low temperatures a dispersionless region around the Fermi surface arises due to the formation of a singlet state. Simultaneously, we find that a large γ coefficients develops in the specific heat at low temperatures. This feature is usually traced back to a huge effective mass of heavy fermion quasiparticles. Concerning the superconducting phase we shall also discuss the symmetry of the order parameter and the large discontinuity ΔC in the specific heat at T_c.