

Kondo Effects without Magnetic Degrees of Freedom

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In this decade or so, Kondo phenomena without magnetic degrees of freedom have attracted much attention [1]. Of these issues, I would like to discuss the following two: (1) Multilevel Kondo effects, and (2) Charge Kondo effect related to the valence skipping phenomenon and the negative- U model.

While the effects (1) have attracted general interests following pioneering work by Kondo and Vadar and Zawadowski [1], its reality seems to have been reinforced after magnetically robust heavy fermion compound $\text{SmOs}_4\text{Sb}_{12}$, with filled-Skutterudite structure, was reported [2,3]. I discuss this problem from the viewpoint that heaviness of quasiparticles of this compound is caused by a multilevel Kondo effect [4]. It will be also discussed the multilevel Kondo effect is related intimately with a salient temperature dependence of Sm ion [5].

On the other hand, the effect (2) attracted renewed interests since superconductivity and magnetically robust $-\log T$ behavior in the resistivity was reported in $\text{Pb}_{1-x}\text{Tl}_x\text{Te}$ ($0.005 < x < 0.015$) [6] and interpreted by the negative- U mechanism [7], while the relevant negative- U mechanism (or valence skipping phenomenon) itself has been discussed theoretically since a quarter century ago [8,9]. Recently, we have succeeded in explaining this charge Kondo effect due to valence skipping phenomenon on the basis of a microscopic model in which the pair hopping interaction (between localized- and conduction-electrons) plays the spin-flip processes in the usual Kondo effect [10]. The importance of the pair hopping interaction relative to the usual Coulomb interaction is assured in the case of ion with high principal quantum number n in which the extension of the ns -state is considerably large. I discuss this problem from a theoretical point of view.

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References:

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