Kondo Alloys: from local to coherent Fermi liquids

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The modification of the electronic structure induced by correlations is at the heart of condensed matter physics. In rare-earth systems one of the most relevant interactions is the antiferromagnetic coupling between local f-orbitals and conduction c-electrons: the Kondo interaction.

In dilute systems the Kondo interaction is well described by the single impurity Kondo model. At very low temperature this model has a universal behavior, that Nozieres in the 70′s described as a local Fermi liquid. On the other hand the concentrated regime is quite complex, since RKKY interaction may compete with Kondo effect. However, if magnetic ordering is neglected, the system forms a heavy Fermi liquid and coherence effects among f-orbitals “promote" them to form a large Fermi-surface (FS) together with c-electrons.

Recently it was proposed by two of us[1] that a topological 'Lifshitz-like' transition would separate the local (dilute) and coherent (dense) Fermi liquid regimes, since it is impossible to connect them analytically at zero temperature. This study was conducted in the limit of infinite Kondo coupling. In this limit the transition occurs when the number of electrons in the conduction band is equal to the number of impurities, i.e. of rare-earth atoms.

In order to go beyond the infinite coupling limit, and to get in touch with real systems, we carried out a numerical study of the Kondo Alloy Model in a Bethe Lattice. This model is an interpolation of the single impurity and the lattice hamiltonian using the concentration of magnetic sites and the band filling as control parameters. Moreover in the Bethe lattice, we can vary the coordination number of the lattice.

We used an algorithm inspired by the self-consistent treatment of disorder by Abou-Chacra *et al.*[2] and later adapted to strongly correlated systems by Dobrosavljevic and Kotliar [3]. It implements exactly the effects of disorder and gives access to full distributions of the local quantities.

Our results may shed a light in the low temperature physics of rare-earth alloys such as $La_{1-x}Ce_x$[…] or $Lu_{1-x}Yb_x$[…], in which it is possible to achieve both diluted and coherent regimes. These systems are well-known for the appearance of large Non-Fermi Liquid regimes for intermediate concentrations.

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