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Magnetic Impurities in cold atom systems

Motivated by the impressive recent advance in manipulating cold fermionic atoms I will focus on two problems involving magnetic impurities. Experimentally it requires the preparation of a Fermi sea of cold atoms that are confined by a shallow harmonic potential and a trapping of a few other atoms (that serve as magnetic impurities) in specially designed optical potential. When there is an antiferromagnetic exchange interaction between the itinerant atoms in the Fermi sea and the localized magnetic impurity it gives rise to the Kondo effect. The first problem employs the fact that fermionic atoms can have spin s>1/2 and thereby the magnetic impurity is over-screened. At low temperature, such system displays a non-Fermi liquid behavior. We establish a theoretical analysis of interacting cold fermionic atomic systems that are governed by an effective Hamiltonian whose low energy physics displays an over-screening by large spin. In addition, we indicate candidate systems in which it can be experimentally realized. In the second part, we explore and substantiate the feasibility of realizing the Coqblin-Schrieffer model in a gas of cold fermionic Yb atoms. Making use of different AC polarizabillities of the electronic ground state) and the long lived metastable state, it is substantiated that the latter can be localized and serve as a magnetic impurity while the former remains itinerant. The exchange mechanism between the itinerant $1S_0$ and the localized $3P_0$ atoms is analyzed and shown to be antiferromagnetic. The ensuing SU(6) symmetric Coqblin-Schrieffer Hamiltonian is constructed. A number of thermodynamic measurable observables are calculated in the weak coupling regime $T>T_K$ (using perturbative RG analysis) and in the strong coupling regime $T<T_K$ (employing known Bethe ansatz techniques).

Biography

Yshai Avishai did PhD at Weizmann institute. He is a professor of theoretical condensed matter Physics at Ben Gurion University, Beer Sheva Israel. He is a fellow of the American Physical Society, served as a Divisional Associate Editor for *Physical Review Letters*, was an Outstanding Referee for *APS journals*. He served as head of the Physics Department at Ben Gurion University, as head of the Ilse-Katz Center for Nanotechnology, as member of the Judging Committees for Israel prize in Physics and the Emet prize for exact Sciences. He is the author of 235 papers in high-level journals including *Physical Review Letters* and *Nature*, and an author of three books in Physics. He occasionally serves as Faculty Member at NYU-Shanghai University and YITP at Kyoto University, Japan. He visited and worked in numerous institutes around the world, Including Argonne National Laboratories, Lyon, Saclay, Orsay, Heidelberg, Tokyo, Kyoto, Hokkaido and others.

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