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Kondo versus indirect exchange: the role of the lattice and the actual range of RKKY interactions in real materials ANDREW ALLERDT, Northeastern University, ADRIAN FEIGUIN, Department of Physics, Northeastern University, CARLOS BUSSER, Department of Physics and Arnold Sommerfeld Center for Theoretical Physics, GEORGE MARTINS, Department of Physics, Oakland University, Rochester — Magnetic impurities embedded in a metal interact via an effective Ruderman-Kittel-Kasuya-Yosida (RKKY) coupling mediated by the conduction electrons, which is commonly assumed to be long ranged, with an algebraic decay in the inter-impurity distance. However, they can also form a Kondo screened state that is oblivious to the presence of other impurities. We study the competition mechanisms between both effects on the square and cubic lattices by introducing an exact mapping onto an effective one-dimensional problem that we can solve with the density matrix renormalization group method (DMRG). We show a dramatic departure from the conventional RKKY theory, that can be attributed to the dimensionality and different densities of states, as well as the quantum nature of the magnetic moments. In particular, for dimension $d > 1$, Kondo physics dominates even at short distances, while the ferromagnetic RKKY state is energetically unfavorable. Our findings can have clear implications in the interpretation of experiments and for tailoring the magnetic properties of surfaces.

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