



Electronic inhomogeneity in a Kondo lattice

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Inhomogeneous electronic states resulting from entangled spin, charge, and lattice degrees of freedom are hallmarks of strongly correlated electron materials; such behavior has been observed in many classes of *d*-electron materials, including the high- T_c copper oxide superconductors, manganites, and most recently the iron-pnictide superconductors. The complexity generated by competing phases in these materials constitutes a considerable theoretical challenge - one that still defies a complete description.

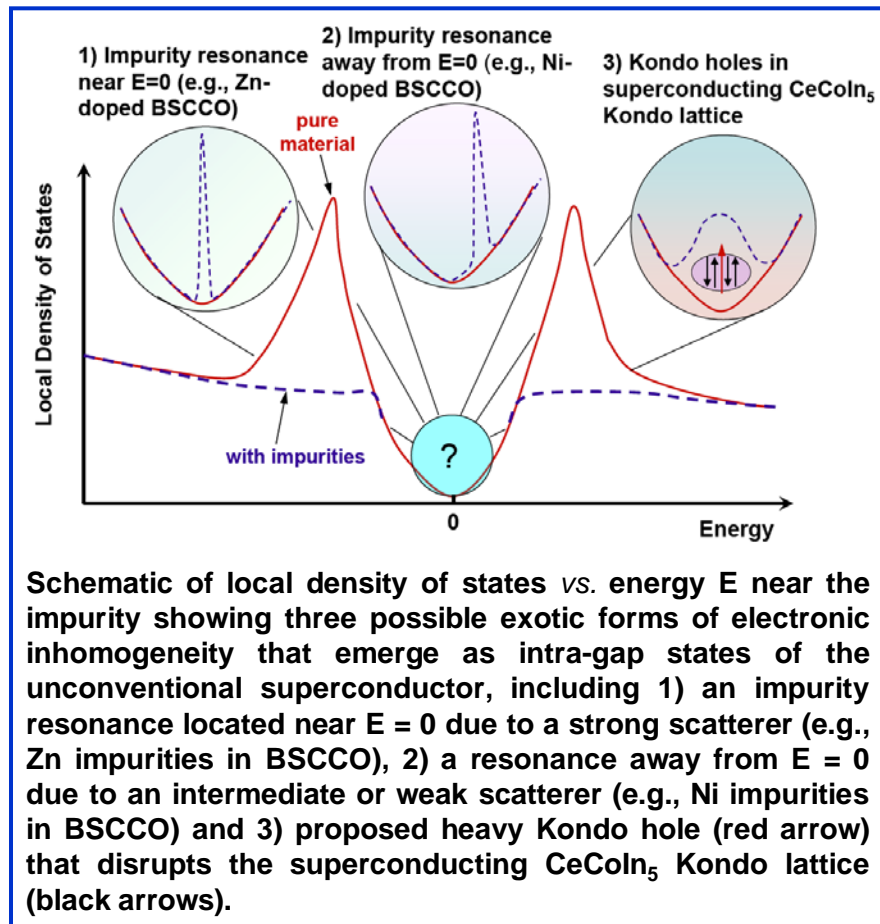
In this work we report a manifestation of electronic inhomogeneity in a strongly correlated *f*-electron system, using CeCoIn_5 as an example. A thermodynamic analysis of its superconductivity, combined with NQR measurements, shows that nonmagnetic impurities (Y, La, Yb, Th, Hg, and Sn) locally suppress unconventional superconductivity leading to local “Kondo holes”. This effect generates thus an inhomogeneous electronic state due to the disrupted periodicity of the Kondo lattice, in complete analogy with the high- T_c cuprates where doping by nonmagnetic Zn leads to the pattern known as “Swiss Cheese”. Our analysis may be generalized to include related systems, suggesting that electronic inhomogeneity should be considered broadly in Kondo lattice materials.

The result thus reveals again the similarity between properties of the high- T_c cuprates and the class of Heavy Fermion materials CeMIn_5 .

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Schematic of local density of states vs. energy E near the impurity showing three possible exotic forms of electronic inhomogeneity that emerge as intra-gap states of the unconventional superconductor, including 1) an impurity resonance located near $E = 0$ due to a strong scatterer (e.g., Zn impurities in BSCCO), 2) a resonance away from $E = 0$ due to an intermediate or weak scatterer (e.g., Ni impurities in BSCCO) and 3) proposed heavy Kondo hole (red arrow) that disrupts the superconducting CeCoIn_5 Kondo lattice (black arrows).