ARPES investigations on the novel electronic structure of Kondo/heavy fermion systems

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Abstract

Heavy fermion/Kondo behavior among rare earth intermetallics is believed to originate from the proximity of the 4*f* states to the Fermi level in them. As a result the 4*f* electron fluctuates between the 4*f* level and the valence band giving rise to valence instability. Such a phenomenon is at the heart of interesting and varied ground states like non-magnetic Kondo singlet state, mixed valent state, non-Fermi/Fermi liquid state etc. The formation of Kondo singlet state at low temperatures is marked by the 'promotion' of 4*f* spectral weight to the Fermi surface giving rise to its expansion. Central to this phenomenon is the interplay of the 4*f* degrees of freedom with the valence electronic degrees of freedom in respective compounds. Therefore a systematic study of such interplay is crucial for understanding the physics of these systems. In this talk we will present our results on few members of the RET_2Si_2 (RE-rare earth; T-transition metal) family of compounds exhibiting interesting properties like Kondo, heavy fermion, mixed valent behavior etc. The interplay is observed via the hybridization phenomena seen in the *k*-space for each compound resulting in dispersions induced into the 4*f* states due to the valence electrons along with the formation of the hybridization gap. These dispersing 4*f* states cross the Fermi level giving rise to the heavy fermion behavior in $CeRh_2Si_2$ and $YbRh_2Si_2$. Interestingly the temperature evolution, across a large temperature window across its Kondo temperature TK, of these heavy fermion states in $YbRh_2Si_2$ shows no change in their Fermi momenta which is curious. The electronic structure of $EuRh_2Si_2$ reveals interplay between massless Dirac fermions and massive heavy quasi-particles inside a single compound which is very surprising as well as the magnetic exchange splitting of the Shockley surface state in the antiferromagnetic phase of this compound. $CeRh_2Si_2$ reveals unusual hybridization phenomena inside its antiferromagnetic phase revealing the origin of the localized-itinerant dichotomy concerning 4*f* electrons inside it.