SYNCHROTRON QUEST FOR BAND RENORMALIZATION IN CORRELATED *F*-ELECTRON SYSTEMS

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Numerous low energy scales are observed in heavy fermion materials. Information about some of the scales is imprinted in the electron self-energy which can be measured by angle-resolved photoemission (ARPES). The successful line of attack in *d*-electron materials over the last decade was based on using high energy- and momentum-resolution photoemission techniques to extract the self energy information from measured spectra and applying many-body theoretical approaches to find a link between self-energy and interactions: electron-electron correlations, coupling to bosons, magnetic fluctuations.

In 2008, we discovered a small energy scale in USb_2, via the observation of a kink in *f*-electron dispersion [1, 2]. The kink structure was observed for the first time in any f-electron system. The kink energy scale of 21 meV and the ultra-small intrinsic peak width of 3 meV were seen. Our finding extended the context of quasiparticle band renormalization from *d* to *f*-electrons, hence creating a link between high temperature superconductors and heavy fermions and actinide based compounds. A new model of point-like Fermi surface renormalization was proposed to explain the spectroscopic properties of the kink.

In late 2008 we have found numerous kinks in the band crossing the Fermi level along the G-M direction in $CeIrIn_5$. We have clearly identified two energy scales, one leading to a kink at around 270 meV below Fermi level that is related to the lower, incoherent part of the 4*f* 5/2 spin-orbit split, and another one at 7 meV below Fermi level. The 7 meV renormalization may be related to a maximum in phonon density of states observed by inelastic neutron scattering experiments. The spin-fluctuation energy scale of the order of 1 meV expected to exist in this material is difficult if not impossible to find with ARPES, due to the fundamental resolution limitations. The third scale appears to be located around 20-25 meV above the Fermi level, and corresponds very well to the size of hybridization gap predicted by DMFT [3].

Our preliminary results look very promising, and we plan to (i) expand the suite of *f*-electron materials where kink structures can be characterized and (ii) link the temperature evolution of self-energy with onset of coherence in *f*-electron materials.

References

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