Temperature dependent crossover behaviors in photoemission of strongly correlated f- and d-electron systems

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The Kondo effect in highly correlated rare-earth and actinide heavy fermion f-electron systems is well-known to exhibit a temperature-dependent crossover from high *T* fluctuating local moments to fully-screened moments at low *T*. For crystalline systems, a lattice coherence crossover behavior that is also experimentally manifested as low T downturns of the resistivity, and in the photoemission signatures of strong variations in the narrow-width *f*-peak intensity and in their band-crossing hybridization with non-*f* bands. The most prominent examples are for single *f*-electron (or *f*-hole) Ce, Sm or Yb compounds.

Another related, but different, *T*-dependent crossover behavior exists in *multi-electron multi-orbital* correlated *d*-electrons systems which arise from Hund's rules physics favoring high-spin configurations, and the interplay between different spin and orbital coherence temperature scales. Fewer examples exist of this Hund metal coherence crossover behavior in photoemission experiments, with Fe-based superconductors and ruthenate oxides being the most well-known. Here we present ARPES and spin-resolved ARPES of a triple-layer ferromagnetic strontium ruthenate that contains *two* separate narrow bands that exhibit a strong *T*-dependent crossover behavior that is unprecedentedly as strong as observed in any *f*-electron Kondo system [1]. Moreover, the two narrow *d* bands are shown to be *spin-polarized,* and with opposite-sign, highlighting the differences with Kondo screening, and are discussed in the context of a site- and orbital-differentiated Hund metal correlations in presence of magnetic order.

Keywords: Kondo effect, Hund metal, strong electron correlations, coherence.

[1]P. Ngabonziza, J. D. Denlinger, A. V. Fedorov, J. W. Allen, G. Cao, G. Gebreyesus. Author, R. M. Martin, "*Layer-dependent spin-resolved electronic structure in ferromagnetic triple layered ruthenate* $Sr_4Ru_3O_{10}$", Physical Review B (111) 115146 (2025).