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Time-resolved ARPES and f-electron coherence[1]

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The coherence temperature, T*, sets an important energy scale in correlated f-electron systems. In this scale the hybridization gap opens at or in the vicinity of the Fermi level and the gap magnitude scales with effective quasiparticle mass. The new quasiparticle bands are heavy, as demonstrated by their small dispersion, and the quasiparticle lifetime is long, as seen by the narrow width of the peaks. Unless magnetic ordering suppresses the gap or mass enhancement is observed due to, e.g., magnetic excitations, the gap scales with effective mass in a universal manner across the heavy fermion systems. Possible deviations from this pattern, e.g. a small finite gap persisting at high temperatures above T* require models beyond a mean-field approach, and may be understood within e.g. the model of periodic array of Anderson impurities with correlations described by coupling to specific boson modes.

Self-energy approach is commonly used in ARPES of correlated systems. The coherent part of the self-energy corresponding to the gap formation is reduced at high temperatures, and the incoherent part corresponds to quasiparticle scattering. The coherent term in the self-energy expresses the mixing of f and d bands and is directly responsible for repulsion, producing the hybridization gap. This theoretical framework provides a direction towards understanding quasiparticle dynamics in correlated electron systems through ultrafast self-energy measurements and modeling. Here we show examples of time-resolved ARPES measurements of f-electron systems, providing valuable information about the evolution of coherence and the dynamics of the related quasiparticle states.

References

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