Ground states, quantum phase transitions and electron spectroscopies in 5f-systems

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Intermetallic compounds containing actinide ions exhibit a broad spectrum of physical phenomena at low temperatures. The latter include heavy quasiparticles, unconventional superconductivity and various forms of long-range (magnetic) ordering. The sometimes enigmatic properties of these compounds derive from the competition between the strong correlations among the 5f electrons and band formation. Previous model calculations suggested that the intra-atomic Hund's rule-type correlations may lead to the dual nature of 5f electrons which is reflected e. g. in the co-existence of itinerant 5f-derived heavy quasiparticles and local magnetic excitations. Here we present model calculations starting from the Anderson model in the intermediate valent regime. Adopting a slave-boson formulation we calculate ground states for extended crystals and discuss quantum phase transitions which may occur upon field- or pressure tuning. Focussing on small clusters we calculate the spectral functions for valence band and core level photoemission spectroscopy. The central focus are characteristic features reflecting the dual nature of the 5f electrons.