Doping-induced band shifts and Lifshitz transitions in heavy-fermion metals

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For some heavy-fermion compounds, it has been suggested that a Fermi-surface-changing Lifshitz transition, which can be driven, e.g., by varying an applied magnetic field, occurs inside the heavy-fermion regime. Here we discuss, based on microscopic calculations, how the location of such a transition can be influenced by carrier doping. Due to strong correlations, a heavy band does not shift rigidly with the chemical potential. Intriguingly, we find that the actual shift is determined by the interplay of heavy and additional light bands crossing the Fermi level: doped carriers tend to populate heavy and light bands equally, despite the fact that the latter contribute a small density of states of excitations only. This invalidates naive estimates of the transition shift based on the low-temperature specific heat of the heavy Fermi liquid. We discuss applications of our results to recent carrier-doping experiments on the position of the so-called T* line in the T-B phase diagram of YbRh₂Si₂.