How Do Heavy Fermions Get Polarized And Die?

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In paramagnetic heavy fermion systems the f-spins dissolve into Kondo singlets and reappear within the Fermi volume, producing a “large” Fermi surface populated by heavy quasiparticles. According to theory, when a very large magnetic field is applied to such a system the Kondo singlets are broken and the fully polarized bare f-spins vanish from the Fermi volume, leaving behind a “small” Fermi surface populated by light quasiparticles. How the system passes from the low-field to the high-field limit is not clear. This talk will discuss recent transport and de Haas van Alphen studies of the archetypal heavy fermion systems CeRu$_2$Si$_2$ [1] and YbRh$_2$Si$_2$ [2], which are interpreted as showing that the f-electron disappears from the Fermi volume via two successive Lifshitz transitions: in the first transition a majority spin band sinks below the Fermi level, while in the second a new minority spin band appears at the Fermi level. While this interpretation is in accord with recent theoretical work of Kusminskiy et al. [3], it could be criticized on the grounds that only the first of the two postulated Lifshitz transitions have so far been observed.

References: