Numerical renormalization group study of the Bose-Fermi Kondo model

MATTHEW T. GLOSSOP, U. of Florida, KEVIN INGERSENT, U. of Florida — The Bose-Fermi Kondo model (BFKM) is of current interest in the context of non-Fermi liquid behaviour in quantum critical heavy fermion systems [1]. We study the Ising-symmetry BFKM, employing a novel extension of Wilson’s numerical renormalization group to include coupling of a quantum impurity to both a conduction electron band and a dissipative bosonic bath described by the spectral function \( \eta(\omega) \propto \omega^s \) \( (0 < \omega < \omega_c) \). For sub-Ohmic bath exponents \( 0 < s < 1 \) and fixed Kondo coupling, a critical unstable fixed point describes the continuous transition—at a critical coupling \( g = g_c \) to the bosonic bath—between a Kondo-screened phase \( (g < g_c) \) with characteristic Kondo resonance and a “bosonic” phase \( (g > g_c) \) where the effective Kondo coupling flows to zero. Various critical exponents are computed and shown to obey hyperscaling relations for \( 0 < s < 1 \) consistent with an interacting critical fixed point; \( \omega/T \)-scaling of the dynamical local susceptibility is also shown. We make comparison where relevant to recent results of the \( \epsilon \equiv (1 - s) \)-expansion [2] and to results for the sub-Ohmic spin-boson model [3]. Further, for the corresponding Bose-Fermi Anderson model we calculate the single-particle spectrum, in which the destruction of the Kondo resonance at the quantum critical point is directly manifest. [1] Si et al, Nature (London) 413 8 04 (2001). [2] Zhu L and Si Q, Phys. Rev. B 66 024426 (2002). [3] Bulla R et al, Phys. Rev. Lett. 91 170601 (2003).