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Multi-pole orders and destruction of Kondo effect: Implications for quantum phase transitions in heavy-fermion systems EMILIAN NICA, University of British Columbia, HSIN-HUA LAI, WEN-JUN HU, Rice University, SHOU-SHU GONG, National Hig Magnetic Field Laboratory, QIMIAO SI, Rice University — Motivated by the heavy-fermion systems [1] which exhibits multi-polar orders, we theoretically study an effective field theory of a Kondo lattice model involving both spin and quadrupole degrees of freedom. The field theory contains a quantum non-linear sigma model of the antiferroquadrupolar (AFQ) phase ordered at (π, π) in spin-1 systems [2], with Kondo couplings to three-flavors of conduction electrons in both the spin and quadrupolar sectors. In the absence of the Kondo coupling, we demonstrate the stability of the (π, π) AFQ phase using density renormalization renormalization group analysis in the underlying spin model. Considering the Kondo couplings, we use the renormalization group analysis [3] to show their exact marginality. Our results imply a destruction of Kondo effects in both the spin and quadrupolar channels in the AFQ phase, thereby suggesting a sequence of quantum phase transitions involving successive destructions of Kondo effects in the spin and quadrupolar channels. Implications of our results for the global phase diagram of heavy fermion systems are discussed. [1] J. Custers et al, Nat. Mater. 11, 189 (2012). [2] A. Smerald et. al., Phys. Rev. B 88, 184430 (2013). [3] Yamamoto S.J. and Q. Si, Phys. Rev. B 81, 205106 (2010).

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