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Global phase diagram and quantum criticality of the Ising-anisotropic Kondo lattice

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Heavy fermion systems provide a prototype setting to study quantum-phase transitions in strongly-correlated systems. Experiments on many quantum critical heavy-fermion metals have provided strong evidence for quantum criticality beyond the Landau framework, with magnetic order developing at a breakdown of the underlying Kondo effect and involving an abrupt collapse of the entire Fermi surface. To account for this local quantum criticality along with other possible types of quantum phase transitions, a global phase diagram has emerged [1] which, in addition to the competition between the Kondo effect and the tendency towards magnetism, also considers the effects of the quantum fluctuations of the local moments. Motivated by these developments, we investigated the effect of enhanced quantum fluctuations induced by a transverse magnetic field in an Ising-anisotropic Kondo lattice model [2]. Solved within an extended dynamical mean field theory using the numerical renormalization group, our work represents one of the very first concrete theoretical studies on the interplay between the Doniach tuning of RKKY vs. Kondo interactions and the local-moment quantum fluctuations. We demonstrate that local quantum criticality survives along a line of critical points with unchanged critical exponents. In addition to elucidating the theory of the Global Phase Diagram, our results also motivate new experimental tests of this T=0 phase diagram. Work done in collaboration with Kevin Ingersent and Qimiao Si. [1] Q. Si, Physica B 378, 23 (2006); P. Coleman and A. Nevidomsky, J. Low. Temp. Phys. 161, 182 (2010). [2] E. M. Nica, K. Ingersent, and Q. Si, arXiv:1603.03829 (2016).