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Kondo breakdown and Berry phase effect in local-moment systems

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Experiments in heavy fermion metals have indicated quantum-critical behavior with inherently new quantum modes, raising the question of how quantum fluctuations lead local-moment systems into a new class of quantum critical points. We theoretically study the effect of Kondo breakdown, with an emphasis on how the Berry phase influences the critical behavior. The Berry phase has embodied quantum mechanics ever since Berry's seminal work in the early 1980s showing that the adiabatic evolution of a quantum system is characterized by a geometrical phase, the Berry phase, on top of the dynamical phase. It has found fruitful applications in all areas of physics ranging from atomic physics to quantum field theory. We consider the Bose-Fermi Kondo model, which plays an important role in the theoretical approaches to Kondo-breakdown quantum criticality. We address the model in terms of a coherent-state spin-path-integral representation, which explicitly brings out a Berry phase term in the action. We demonstrate that, the Kondo-destroying fixed point is an interacting one and is therefore beyond a description in terms of order-parameter fluctuations alone [1,2,3]. The implications for the nature of the critical point in local moment systems with easy-axis symmetry will be discussed as well [4].

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