High-energy signatures of quantum criticality

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When a magnetic phase transition in a metal is driven to absolute zero temperature by a non-thermal control parameter, such as pressure or composition, the quantum fluctuations of the order parameter induce new universality classes and, possibly, new ground states of matter.
Experiments suggest that near such a quantum phase transition (QPT) in heavy-fermion (HF) compounds, notably $CeCu_{6-x}$ Au_x, the HF quasiparticles, formed by the Kondo effect below the Kondo temperature TK, disintegrate. The conditions for this breakdown have, however, remained obscure.
We propose a new criterion for distinguishing the Hertz-Millis (HM) and the local quantum critical (LQC) mechanism in heavy-fermion systems with a magnetic quantum phase transition (QPT) [1,2]. The criterion is based on our finding that the complete spin screening of Kondo ions can be suppressed by the RKKY coupling to the surrounding magnetic ions even without magnetic ordering and that, consequently, the signature of this suppression can be observed in spectroscopic measurements above the magnetic ordering temperature.
Applying the criterion to high-resolution photoemission measurements on $CeCu_6$-xAu_x [1,3] suggests that the QPT in this system is dominated by the LQC scenario, in agreement with previous experiments.

[1] M. Klein, A. Nuber, F. Reinert, J. Kroha, O. Stockert and H. v. Löhneysen, Phys. Rev Lett. 101, 266404 (2008).

[2] J. Kroha, M. Klein, A. Nuber, F. Reinert, O. Stockert and H. v. Löhneysen, J. Phys. Cond. Mat. 22, 164203 (2010).

[3] M. Klein, J. Kroha, H. v. Löhneysen, O. Stockert, and F. Reinert, Phys. Rev. B 79, 075111 (2009).