TT 3 Correlated Electrons: Quantum-Critical Phenomena

Time: Monday 09:30–10:45 Room: HSZ 301

TT 3.1 Mon 09:30 HSZ 301

Smeared Ferromagnetic Quantum Phase Transition in $CePd_{1-x}Rh_x$ — •Tanja Westerkamp, Robert Küchler, Adam Pikul, Nubia Caroca-Canales, Micha Deppe, Philipp Gegenwart, Julian Sereni, Christoph Geibel, and Frank Steglich — Max-Planck-Institut für Chemische Physik fester Stoffe, Dresden

Quantum phase transitions in Ce-based systems are presently a subject of strong interest. While there exists a number of compounds showing an antiferromagnetic quantum critical point (QCP), appropriate candidates for the study of the disappearance of a ferromagnetic (FM) state are very scarce. Theories favor a first-order transition in pure systems, while disorder might lead to a continuous second order QCP. In this respect the alloy $CePd_{1-x}Rh_x$ might be interesting, because it evolves from a FM Ce^{3+} state at $x = 0$ to a non-magnetic, valence fluctuating state at $x = 1$. A detailed investigation of this system by means of ac-susceptibility and specific heat at $T \geq 0.4$ K as well as thermal expansion at $T \geq 0.1$ K suggests a continuous suppression of the FM order. However, $T_C(x)$ shows an extended tale and the Grüneisen-ratio analysis raises doubts on a well defined QCP. Here, we report ac-susceptibility measurements down to very low temperatures $T \geq 0.02$ K at concentrations in the tale region of the phase diagram which characterize the nature of the quantum phase transition in this system.

TT 3.2 Mon 09:45 HSZ 301

Hidden Quantum Critical Point in $CeCoIn_{5-x}Sn_x$ Studied by Thermal Expansion and Grüneisen Ratio Divergence — •G. Donath[1], R. Küchler[1], P. Gegenwart[1], E.D. Bauer[2], J.L. Sarrao[2], and F. Steglich[1] — [1]Max-Planck-Institute for Chemical Physics of Solids, 01187 Dresden, Germany — [2]Los Alamos National Laboratory, Los Alamos, New Mexico, 87545 USA

The heavy fermion superconductor $CeCoIn_{5-x}Sn_x$ has attracted much interest because of a magnetic field-induced quantum critical point at H_{QCP} that coincides with the upper critical field H_{c2} for unconventional superconductivity. Most remarkably, it is not possible to separate both phenomena from each other. By contrast, H_{QCP} is pinned to H_{c2} if superconductivity is weakened by Sn substitution [1].
We present low-temperature thermal expansion measurements, $\alpha(T, B)$, for the various concentrations, $x = 0, 0.03, 0.06, 0.09, 0.12, 0.18$, and compare them with the predictions of the spin-density-wave theory for an antiferromagnetic quantum critical point.
Furthermore, the effect of Sn subsitution on the Grüneisen ratio $\Gamma(T) \propto \alpha/C$ (C: specific heat) is discussed.
[1] E.D. Bauer *et al.*, Phys. Rev. Lett. **94**, 047001 (2005)

TT 3.3 Mon 10:00 HSZ 301

Metamagnetic quantum criticality in $Sr_3Ru_2O_7$ studied by thermal expansion — •P. Gegenwart[1], F. Weickert[1], M. Garst[2], R.S. Perry[3,4,5], and Y. Maeno[4,5] — [1]Max-Planck Institute for Chemical Physics of Solids, Dresden, Germany — [2]Theoretical Physics Institute, University of Minnesota, USA — [3]School of Physics and Astronomy, University of St. Andrews, Fife KY16 9SS, Scotland — [4]International Innovation Center, Kyoto University, Japan — [5]Department of Physics, Kyoto University, Japan

We report low-temperature thermal expansion measurements on the bilayer ruthenate $Sr_3Ru_2O_7$ as a function of magnetic field applied perpendicular to the Ruthenium-oxide planes. The field-dependence of the c-axis expansion coefficient indicates the accumulation of entropy close to 8 Tesla, related to an underlying quantum critical point. The latter is masked by two first-order metamagnetic transitions which bound a regime of enhanced entropy. Outside this region the singular thermal expansion behavior is compatible with the predictions for a two-dimensional metamagnetic quantum critical end point (work available at cond-mat/0507359).

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TT 3.4 Mon 10:15 HSZ 301

Field-Induced Phase Transition in a Metalorganic Spin-Dimer System — •Y. Tsui[1], A. Brühl[1], K. Removic-Langer[1], V. Pashchenko[1], B. Wolf[1], M. Lang[1], G. Donath[2], A. Pikul[2], T. Kretz[3], H.-W. Lerner[3], M. Wagner[3], A. Salguero[4], T. Saha-Dasgupta[4], B. Rahaman[4], and R. Valenti[4] — [1]Physikalisches Institut, J.W. Goethe-Universität, Frankfurt, FOR-412, Germany — [2]Max-Planck-Institut für Chemische Physik fester Stoffe, Dresden, Germany — [3]Institut für Anorganische Chemie, J.W. Goethe-Universität, Frankfurt, FOR-412, Germany — [4]Institut für Theoretische Physik, J.W. Goethe-Universität, Frankfurt, FOR-412, Germany

We have investigated the field-induced magnetic order in a three-dimensional metalorganic spin-dimer system, $C_{36}H_{48}Cu_2F_6N_8O_{12}S_2$ (TK91). The nature of the dimers and their couplings have been identified by first principles Density Functional Theory calculations. We have performed electron spin resonance, magnetic susceptibility, specific heat and thermal expansion measurements on both powder and single-crystal samples, in applied magnetic fields up to $12T$ and at temperatures down to $\sim 0.1K$. Clear indications of a field-induced phase transition have been observed when the applied magnet field is above a temperature-dependent critical field $B_c(T) \sim 3T$. A similar field-induced phase transition was also observed in an inorganic compound $TlCuCl_3$. In case of $TlCuCl_3$, the phase transition was interpreted as the Bose-Einstein condensation (BEC) of magnons. We propose TK91 as another possible model system to study the BEC of magnons.

TT 3.5 Mon 10:30 HSZ 301

Kondo lattice model with finite temperature Lanczos method — •Ivica Zerec, Burkhard Schmidt, and Peter Thalmeier — Max Planck Institute for Chemical Physics of Solids, Nöthnitzer Str. 40, 01187 Dresden

The full Kondo lattice model (KLM) including localized spins and itinerant electrons is considered on finite size clusters using finite temperature Lanczos method (FTLM). The method is numerically exact for the finite size clusters. The study is focused on the weak coupling limit, where the competition between the RKKY interaction and the Kondo screening is analyzed by means of correlation functions and thermodynamic properties. Special attention is devoted to the finite size effects, which are important in that limit. From the analysis of the cluster calculations we derive a phase diagram in the T-J_K plane, where J_K is the coupling of local and conduction electron spins. It is compared to the phase diagram for the KLM without charge degrees of freedom and the Doniach phase diagram.