TWO QUANTUM CRITICAL POINTS IN $Ce(Ru_{1-x}Rh_x)_2Si_2$; nFl BEHAVIOR IN THE MAGNETICALLY ORDERED STATE OF $U(Pt_{0.94}Pd_{0.06})_3$

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Introduction

The magnetic phase diagram of $Ce(Ru_{1-x}Rh_x)_2Si_2$ contains a spin-density-wave (SDW) magnetic ordering temperature approaching T=0 at both x ≈ 0.03 and 0.35-0.4 (i. e., a dome-shaped phase boundary) *and* long range, local moment antiferromagnetism, T_N = 36 K, in pure $CeRh_2Si_2$ suppressed with Ru-doping to T=0 at x ≈ 0.6-0.65. Thus, there is the possibility of *two* quantum critical points ('QCP').

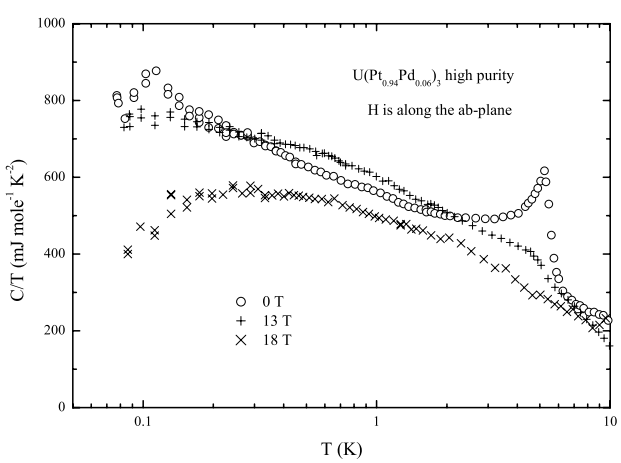
$U(Pt_{0.94}Pd_{0.06})_3$ is magnetically ordered at T_N=6 K and is known to show non-Fermi liquid ('nFl') behavior at low temperatures in the specific heat in the ordered phase.

Experimental

Using SCM-1 at NHMFL, Tallahassee, measurements were made on the specific heat, C, down to 0.05 K in fields ≤ 18 T on a single crystal collage of $U(Pt_{0.94}Pd_{0.06})_3$ to investigate the field and temperature dependence of the nFl behavior. Similar measurements were performed on both poly- and single-crystalline samples of $Ce(Ru_{1-x}Rh_x)_2Si_2$ around x=0.4 and 0.6, i. e. near the two possible QCP's.

Results and Discussion

Fig. 1 below shows the results for the low temperature specific heat divided by temperature vs logT of $U(Pt_{0.94}Pd_{0.06})_3$, field aligned in the ab plane. The field begins to induce Fermi liquid behavior (C/T → constant) at low temperatures in 13 T, while 18 T clearly suppresses the fluctuations associated with the (as yet unknown) quantum critical point below 0.3 K.



One principal result [1] of the measurements on $Ce(Ru_{1-x}Rh_x)_2Si_2$ is that the specific heat divided by temperature, C/T, for x=0.6 near $T_{local\ moment}$→0 is proportional to logT over 2 1/2 decades of temperature down to the lowest temperature of measurement, 0.04 K, indicative of strong fluctuations near a QCP.

Conclusions

Specific heat data at dilution refrigerator temperatures continues to reveal fundamental insights into the nature of quantum criticality at T → 0.

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References

[1] Kim, J. S., *et al.,* Phys. Rev. B. **74**, 165112, 1-9 (2006).