RESISTIVITY OF A QUANTUM CRITICAL POINT IN $CeCoIn_5$

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Introduction

Non-Fermi liquid behavior, as characterized by a T-linear resistivity and a T log(T) behavior in specific heat, is observed in zero field in the heavy fermion system $CeCoIn_5$.[1] The application of magnetic field along the c-axis has revealed a field tuned quantum critical point surprisingly coincident with the superconducting (H_{c2} = 4.95 T).[2] Thus a question arises, as to whether this is an accidental coincidence, or whether the two are physically linked together for some unknown reason. By applying the magnetic field in the plane the superconducting H_{c2} increases to 11.8 T. This work investigates how the quantum critical field shifts relative to H_{c2} with field tuning.

Experimental

We measured resistivity in single crystals of $CeCoIn_5$ for magnetic fields perpendicular to the c-axis, ranging between 12 T and 18 T and temperatures between 50 mK and 3K, in the 20 T superconducting magnet at the National High Magnetic Field laboratory, using a dilution refrigerator. This compliments previous measurements of specific heat on $CeCoIn_5$ measured under the same conditions.[3]

Results and Discussion

Fig. 1 summarizes our results. H_{c2} changes by a factor of 2.3 for H//c versus H//ab, but the behavior remains the same.[3]

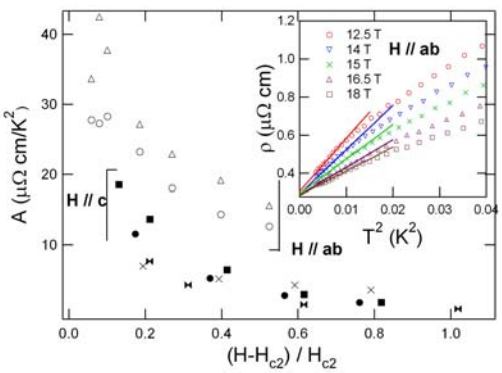

Figure 1: The coefficient of the T^2 contribution to resistivity as a function of reduced field for two field orientations as deduced from the straight lines in the inset.

Conclusions

Thus independent of field orientation the quantum critical field is tied the superconducting H_{c2}. This coupled with a similar observation in Sn doped $CeCoIn_5$ suggests there is an underlying physical reason for which the two are tied together.[4] We suggest either an extremely unconventional superconducting quantum critical point or an antiferromagnetic quantum critical point whose zero temperature phase transition drives the superconductor normal. For details see ref. [3].

References

[1] Petrovic, C., *et al*., J. Phys. Cond. Mat., **13**, L337-L342 (2001).
[2] Paglione, J., *et al*., Phys. Rev. Lett., **91**, 246405-1-4 (2003); Bianchi, A., *et al*., Phys. Rev. Lett., **91**, 257001-1-4 (2003).
[3] Ronning, F., *et al*., http://arxiv.org/abs/cond-mat/0409750 (2004).
[4] Bauer, E.D., *et al*., http://arxiv.org/abs/cond-mat/0409559 (2004).