MAGNETIC PROPERTIES OF $CeNi_9Ge_4$, A SINGLE-IMPURITY TYPE NON-FERMI LIQUID SYSTEM

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Introduction

$CeNi_9Ge_4$ is a unique non-Fermi liquid (nFl) system[1]. Alloying studies performed on this material seem to imply that the nFl behavior is a single-impurity type. One of the proposed explanations of this behavior is based on a model[2] that assumes that the two lowest crystalline electric field (CEF) doublets are separated by a small energy approximately equal to the Kondo temperature, of order 1 K. This scenario can be realized if the ground state Γ_8 quartet is split into two doublets by the non-cubic environment of Ce.

The goals of this magnetic field study was to provide further insight into the nature of the low temperature behavior of $CeNi_9Ge_4$ and to evaluate the relevance of the known single impurity models.

Results and Discussion

Magnetization measurements on a polycrystalline sample were performed in fields to 5.5 T and for temperatures larger than 1.8 K. Specific heat was investigated in fields to 18 T and at temperatures down to 50 mK. There was an excellent agreement with previously reported results for overlapping field/temperature regimes, supporting the claim that the atomic disorder plays no major role.

The isothermal magnetization that was measured in a moderately high temperature/low field regime obeys a simple single-impurity scaling, $M=f(H/(T+T^*))$; where T^* is 5 K. However, neither Brillouin function corresponding to J=1/2 (doublet CEF ground state) nor J=3/2 (quartet CEF ground state) provides a good description of the magnetization.

The low field specific heat at temperatures larger than 1 K is more consistent with the J=3/2 than J=1/2 Kondo model. On the other hand, the J=1/2 Kondo model provides clearly more accurate description of the specific heat at lower temperatures and high magnetic fields. In particular, our analysis of C/T(H) at $T\rightarrow 0$ in terms of this model implies expected values of the effective moment and the Kondo temperature ($\mu_{eff} \approx 1\ \mu_B$ and $T_K \approx 1$ K).

Conclusions

Both the magnetization and specific heat in magnetic fields exhibit single-impurity behavior. The proposed model of the Kondo effect for two CEF doublets, separated by an energy of order 1 K ($\approx T_K$) is consistent with our results.

Acknowledgements

Supported by the Department of Energy, grant number DE-FG02-99ER45748 and the NHMFL In-House Research Program.

References

[1] Killer, U., *et al*., Phys. Rev. Lett., **93**, 216404 (2004).
[2] Desgranges, H.-U. and Rasul, J.W., Phys. Rev. B, **32**, 6100 (1985).