The Specific Heat of $CeIn_3$ at Low Temperatures

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Introduction

The $CeIn_3$ compound is a typical dense-Kondo compound which orders antiferromagnetically (AF) below the Néel temperature Tn = 10.1 K. This compound exhibits a heavy fermion behavior at low temperatures and a superconducting state occurs in the vicinity of the critical pressure of AF order (about 2.5 GPa). The magnetic field dependent phase diagram for $CeIn_3$ shows a possible quantum critical point around 60 T, where the Néel temperature goes to zero and the quasiparticle effective mass m^* increase. Specific heat measurements permits us to obtain the Sommerfeld coefficient γ and to describe the behavior of the effective mass m^* as function of the magnetic field at this phase diagram region. deHaas van Alphen measurements [1] between 14 and 65 T shows the effective mass increases with the applied field.

Experimental

The proposal of this work is to study initially the low magnetic field region of this phase diagram by performing thermodynamics measurements on a 2.2mg $CeIn_3$ single crystal. For this, we have performed heat capacity measurements using the thermal relaxation method at dilution fridge temperatures and under applied magnetic fields up to 18 T using the 20T superconducting magnet located at the NHMFL-LANL and a sapphire plate calorimeter.

Results and Conclusion

Figure 1 shows the measured sample specific heat at two different magnetic fields. We have obtained the Sommerfeld coefficient by fitting the experimental data using the relation $C/T = \gamma + C_{Schottky}/T$. At this temperature range the phonon contributions was neglected. We show the behavior of γ (which is proportional with the effective mass) as function of the applied field in figure 2. The value for γ at zero field is comparable to previous report [2]. We observe a minimun around 14 T which is consistent with field induced hot spots in the Fermi surface, giving rise to an increase in the effective mass for orbits that pass through or near the hot spots [3]. We plan to extend this work to higher magnetic fields.

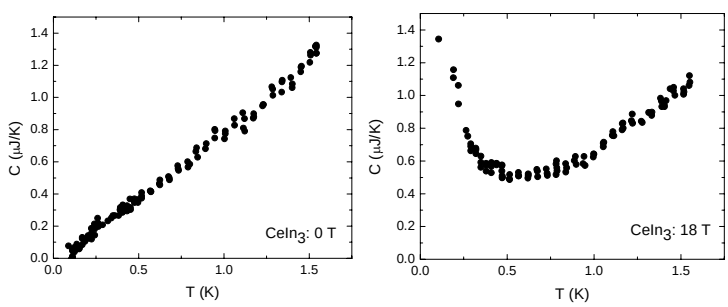

Figure 1 – The measured specific heat for $CeIn_3$ at 0 and 18 T.

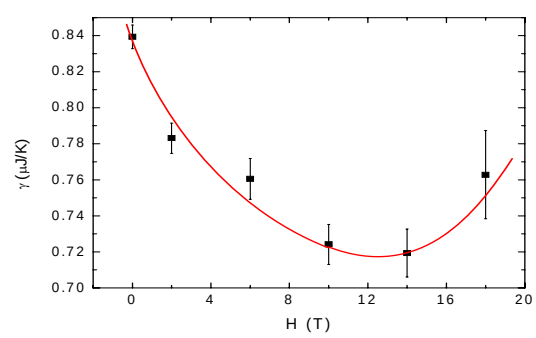

Figure 2 – γ as function of the applied field.

Acknowledgements

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References

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[2] Satoh, K., *et al*. Physica C, **186-188**, 658-660 (1993).
[3] Harrison, N., *et al*, In press 2007.