Specific Heat and Magneto-caloric Effect in Polycrystalline Pr_3In

V.R. Fanelli (UC Irvine, Physics and MPA-NHMFL), M. Jaime (MPA-NHMFL), J.M. Lawrence (UC Irvine, Physics), A.D. Christianson (ORNL)

Pr_3In is a compound showing induced moment magnetism in a singlet-triplet system. Neutron diffraction, magnetic susceptibility and specific heat measurements reported by Christianson, et al. [1] show that Pr_3In exhibits induced moment antiferromagnetic (AF) order with T_N=11.4 K. Previous magneto-caloric effect (MCE) measurements on a single crystal sample of Pr_3In performed at NHMFL-LANL showed that a phase transition occurs near 1.9 T below 11 K[2]. Specific heat measurements under magnetic field (B) between 0 T and 15 T were also performed at NHMFL-LANL. The magnetic contribution to the specific heat revealed a very small feature for the antiferromagnetic phase transition. Our motivation is to further explore the evolution of the magnetic order with magnetic field. We measured the polycrystalline sample used in our recent neutron diffraction experiments, since susceptibility measurements showed different results for this sample than for the single crystals studied earlier.

Specific heat versus temperature and magneto-caloric effect (MCE) were measured at the 15T superconducting magnet at NHMFL-LANL. The magnetic contribution to the specific heat C_{magn} is obtained after subtracting the lattice contribution using measurements of the La_3In specific heat.

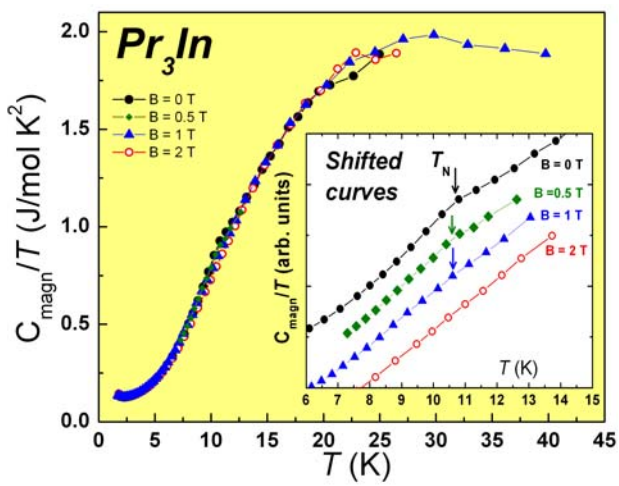

Fig. 1. Magnetic contribution to the specific heat of Pr_3In for magnetic fields between 0 T and 2 T. The inset shows the anomaly at T_N at different fields B.

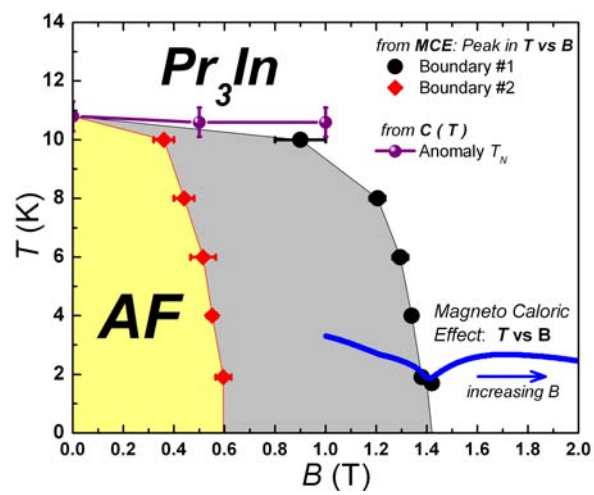

Fig. 2. The (B,T) phase diagram for Pr_3In determined from the specific heat and the MCE. The blue line shows how the phase transition temperature is determined from a typical MCE scan.

The magnetic field has the same effect on the specific heat as in the case of the single crystal, including a reduction of T_N (Fig. 1). On the other hand, the magneto-caloric effect shows *two* phase boundaries around 0.6 T and 1.4 T, below 11K for the polycrystalline sample, where the single crystal showed only one. Anisotropy and a preferred orientation of grains in the sample might explain the presence of two boundaries. The nature of this transition –ferromagnetic polarization or spin rearrangement—is currently under investigation and new neutron scattering data are being analyzed.

This work was performed at NHMFL-LANL, and supported by US DOE Grant No. DE-FG03-03ER46036, by NSF Cooperative Agreement No. DMR-0084173 by the State of Florida and US DOE, and partially supported by NHMFL IHRP.

References

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[2] Fanelli, V.R., *et al.*, Physica B (2007), doi:10.1016/j.physb.2007.10.152