Specific Heat of LiV$_2$O$_4$ up to 15T

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Introduction

The spinel oxide LiV$_2$O$_4$ is one of the few d-electron compounds that possess heavy fermion behavior. The large quasiparticle specific heat coefficient of LiV$_2$O$_4$ ($\gamma \sim 460$ mJ/mole K$^2$) [1] is close to that of the more traditional f-electron heavy fermion systems. The mechanism of such heavy fermion behaviour in LiV$_2$O$_4$ is not obvious and very controversial compared to the f-electron systems. While the heat capacity of LiV$_2$O$_4$ has been measured in low fields and low temperatures, the high magnetic field/low temperature behavior has not been investigated. Such an experiment is important because the coherence temperature for LiV$_2$O$_4$ is ~ 20 K, so that high magnetic fields may be needed to quench the formation of heavy quasiparticles.

Experimental

Crystals have been grown according to the flux method [2], and show a well-developed octahedral form bounded by {111} faces. Specific heat and magnetization measurements in low fields confirm the quality of the crystal. We have measured the specific heat up to fields of 15 T and temperatures from 2 K to 30 K in the 15T DC superconductor magnet at the NHMFL/LANL. Measurements from 0.5 K to 5 K using a $^3$He fridge are in progress. The ultimate goal is to extend these measurements to higher magnetic fields.

Results and Discussion

We have found a relative maximum between 2 K and 4 K that was not been seen before (Fig. 1).

The sample in this measurement had poor thermal contact to the calorimeter sample holder. In order to obtain a more homogeneous distribution of the temperature on the sample a gold coated sample will be used improving in this manner the thermal contact between the sample and our calorimeter.

Measurements of the specific heat below 2 K are in progress.

Conclusions

After improving the thermal contact between the sample and the calorimeter, these measurements will be extended to higher magnetic fields and lower temperatures in order to understand heavy fermion behavior in LiV$_2$O$_4$.

References