High Field Heat Capacity of YBCO 6.47

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Introduction

The experiments for 2013 focused on the field dependence of the absolute values of the low temperature heat capacity in the cuprate superconductors known as YBCO ($YBa_2Cu_3O_{6+\delta}$) with oxygen content 6.47. The goal was to explore the effect of field on the low lying electronic excitations of the superconducting state. This class of materials has been studied extensively in magnetic field, but with little attention to the superconducting, (i.e. 0 resistance) state for oxygen levels 6.45< O <6.49.

Experimental

All experiments took place at the DC field facility in the 35 tesla magnet in Cell 12, using the top loading cryostat. The experimental technique is entirely home-made, but employs user program cabling and probe. The measurement determines the heat capacity of a sample using thermometers that are calibrated at the NHMFL pulsed field facility to ensure high accuracy in any attainable magnetic field.

Results and Discussion

The experiments showed the expected behavior for fields of a few tesla but above 15 T there are clear and striking deviations from expectation. The signal to noise ratio and temperature stability were excellent, allowing for a high resolution measurement to reveal the details of the magnetic field dependence of the heat capacity.

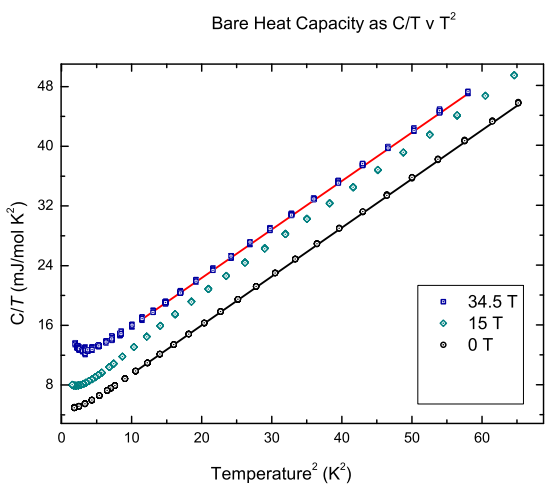

Figure 1 Specific heat capacity over temperature versus square of temperature for 3 magnetic fields. The plot shows the expected low temperature limiting behavior for crystalline materials, but with strong field dependence.

Conclusions

The results of the study are currently being written into a manuscript for peer-reviewed publication.

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