High Field Heat Capacity of Two Dopings of YBCO

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Introduction

The experiments for 2014 focused on the field dependence of the absolute values of the low temperature heat capacity in the cuprate superconductors known as YBCO ($YBa_2Cu_3O_{6+\delta}$) δ=0.43 and 0.67. 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 specific heat is unique in tracking electronic density of states to the highest magnetic fields available.

Experimental

All experiments took place at the DC field facility in the 35 tesla magnet in Cell 12, using the system D 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

Over the course of 3 weeks of magnet time we confirmed the previous year's result that very underdoped YBCO (δ=0.4-0.49) shows an unexpected linear-in-field specific heat at low temperatures and highest fields. For δ=0.67, we observed specific heat well above the resistive transition, with new levels of precision for this material.

Conclusions

Specific heat measurements were highly successful and demonstrated the robustness of the technique in high magnetic fields when utilized to study complex systems such as superconducting cuprates.

Acknowledgements

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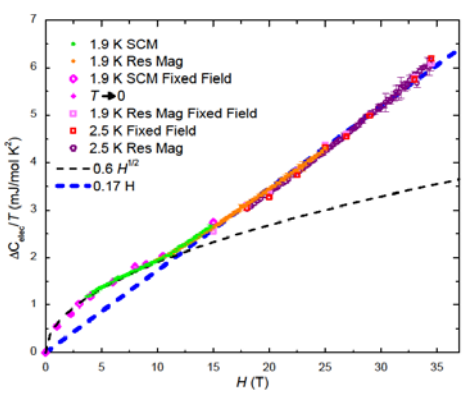

Figure 1: Previous year's result for δ=0.47 showing linear-in-field (H) electronic C/T, which is specific heat divided by temperature.

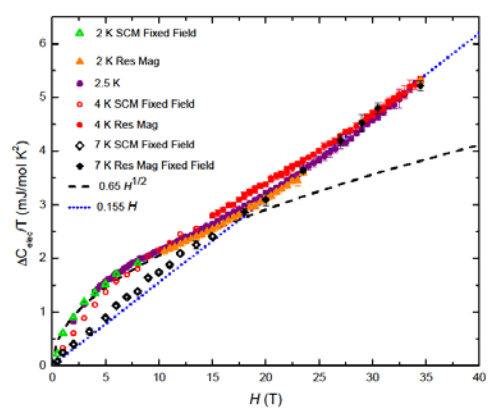

Figure 2: 2014 result demonstrating a similar onset of linear-in-field behavior for δ=0.43.