Pulsed Field Calibration of Resistive Thermometry for Measurements of the Thermal Hall Effect and Thermal Conductivity

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Introduction

The thermal Hall (Righi-Leduc) effect κ_{xy} has recently come into the focus of the condensed matter community as a probe of the fundamental excitations of magnetic insulators, such as ferromagnets and spin liquid candidate materials. Moreover, measurements of κ_{xy} are a well-established method to investigate the character of Bogoliubov quasiparticles in superconductors, for example of the cuprate family. Thermal transport experiments in high magnetic fields (we use the NHMFL DC facility in Tallahassee) require careful calibration of the thermometers, both in zero and in high field, in order to eliminate spurious offsets of the data.

Experimental

We have calibrated two resistive thermometers simultaneously, in fields up to 50 tesla in the 65T short pulse magnet of the pulsed field facility (PFF) at LANL. Over the short duration of the pulse, the temperature of the sample is approximately independent of time, allowing us to assemble curves of resistance versus field under isothermal conditions. More than 30 curves were recorded in this way, in the temperature interval of 0.5-25 K.

Results and Discussion

Figure 1 shows selected calibration data assembled at low temperatures. Strong negative magneto-resistance of the thermometers was observed.

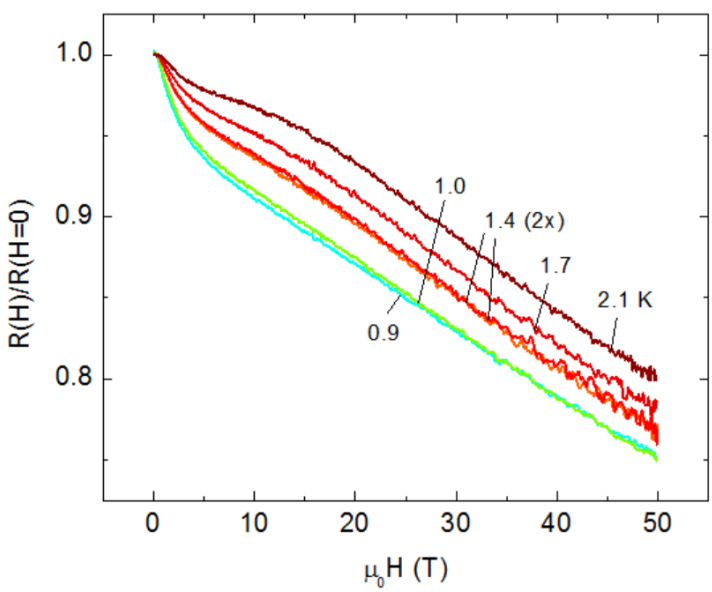

Figure 1.Relative magneto-resistance of one of the resistive thermometers. Only the ramps at decreasing magnetic field are shown in this plot, because they have lower relative noise levels. Raw data without smoothing or averaging is shown.

Conclusions

We have performed an extensive high-field calibration of two resistive thermometers in preparation of high-resolution measurements of thermal conductivity and the thermal Hall effect up to 35 (or 45) tesla.

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