TEMPERATURE AND DOPING DEPENDENT STUDY OF POLAR AMRO IN $Tl_2Ba_2CuO_{6+\delta}$

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Introduction

In previous studies at NHMFL, we have used angular magnetoresistance oscillations (AMRO) to determine the full three-dimensional Fermi surface [1] and the T- and **k**-dependent scattering rate [2] in heavily overdoped $Tl_2Ba_2CuO_{6+\delta}$ (Tl2201) (T_c = 15K). This latter investigation revealed a scattering rate that comprised three components, an isotropic impurity term, an isotropic electron-electron scattering term and an anisotropic T-linear term of unknown origin that had the same symmetry as the superconducting gap [3]. This report describes our attempt to explore this anomalous term in more detail.

Experimental

The initial T-dependent investigation was carried out on an individual single crystal at one azimuthal angle relative to the Cu-O-Cu bond direction. In the latest experiments performed on the 45Tesla Hybrid magnet in Tallahassee in April 2006, we managed to complete a much more detailed set of polar AMRO measurements over an increased temperature range (4K – 110K) and at five different azimuthal angles on three single crystals with T_c values varying between 15 and 20K.

Results and Discussion

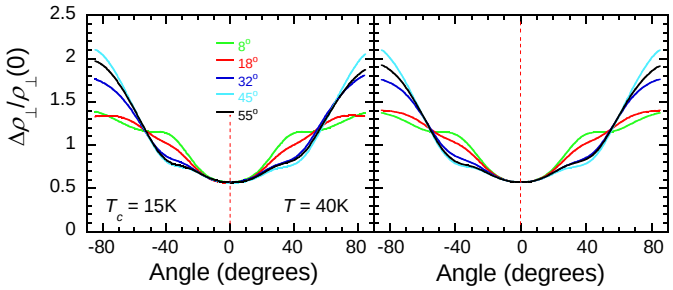

Figure 1. Left panel: Polar AMRO data in Tl2201 (T_c ~ 15K) at $\mu_0 H$ = 45T and different azimuthal angles relative to (π,0). Right panel: Least-squares fits of the data using an anisotropic $\omega_c\tau$. Note the level of detail even at this elevated temperature.

An example of the quality of the data and fit are shown in Fig. 1. From this comprehensive data set we can constrain our fitting parameters much more tightly and thereby determine with much greater accuracy the anisotropy in $\omega_c\tau$ and its T-dependence. A paper detailing these new developments is currently in preparation [4]. We have also accumulated sufficient data for different T_c values between 15K and 40K to establish an empirical correlation between the strength of the anisotropic scattering term and superconductivity [5]. This discovery places further constraints on the development of a successful theory of both the normal state transport properties and superconductivity in these important materials.

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References

[1] Hussey, N.E., *et al.*, Nature, **425**, 814-817 (2003).
[2] Abdel-Jawad, M. *et al.*, Nature Physics, **2**, 821-825 (2006).
[3] Taillefer, L., Nature Physics, **2**, 810-811 (2006).
[4] French M.M.J. *et al.*, in preparation.
[5] Abdel-Jawad, M. *et al.*, in preparation.