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]. Recently, we have established an empirical correlation between the magnitude of the anisotropic T-linear term and superconductivity [4]. This report describes our initial attempt to trace the dependence of this anisotropic term on temperature and the superconducting transition temperature.

Experimental

In our earlier investigations, we focused on studying the T-dependence of the AMRO signal in samples with T_c = 15-20K, and its doping dependence at a single temperature. In the latest experiments performed on the 45Tesla Hybrid magnet in Tallahassee in April 2007, we set out to perform a more detailed T-dependent investigation (4.2K - 90K) on a number of samples with higher T_c values.

Results and Discussion

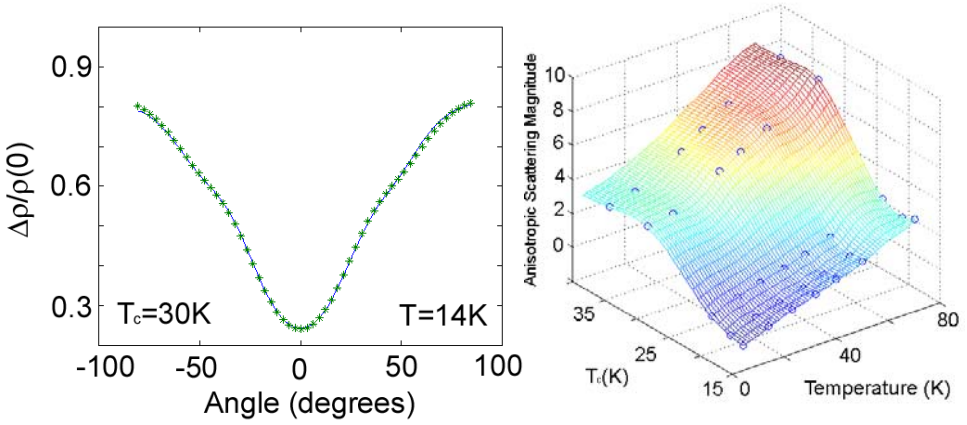

Figure 1. Left panel: Polar AMRO data in Tl2201 (T_c ~ 30K) at $\mu_0 H$ = 45T. Data is the solid line and asterisks are a least-squares fits of the data using an anisotropic $\omega_c\tau$. Right panel: Temperature and Tc dependence of the magnitude of the anisotropic component of the scattering rate.

An example of the data and the quality of the fitting are shown in the left panel of Fig. 1. From this data set we have confirmed that our AMRO analysis [5] is still relevant at these increased T_c values and that scattering is becoming increasingly anisotropic. The right panel summarizes the temperature and doping dependence of the anisotropic scattering term for all samples studied to date. This information, revealed by our measurements in unprecedented detail, will ultimately place firm constraints on the development of a successful theory of both normal and superconducting properties of these important and mystifying materials. A paper detailing these measurements is currently in preparation [6].

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References

[1] Hussey, N.E., *et al*., Nature, **425**, 814 (2003)
[2] Abdel-Jawad, M. *et al*., Nature Physics, **2**, 821 (2006)
[3] Taillefer, L., Nature Physics, **2**, 810 (2006)
[4] Abdel-Jawad, M *et al*, Phys. Rev. Lett. **99** 107002 (2007)
[5] Analytis, J. G. *et al*., Phys. Rev. B **76** 104523 (2007)
[6] French M.M.J. *et al*., in preparation.