Quantum fluctuations in cuprates near critical doping are co-planar with CuO plane

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Introduction

Our recent measurements in LSCO cuprates (thin films [1] and bulk crystals [2]) have demonstrated true scale invariance of the transport behavior in the strange metal state near the critical doping in the cuprates. The linear-in-field resistivity observed at very high magnetic fields (Figure 1) cannot be understood within conventional dynamics of quasiparticles near the Fermi surface [1,2] It therefore indicates that strong magnetoresistance near critical doping originates from direct effect of magnetic field on quantum fluctuation in the strange metal state of cuprates. The question that we address in this set of experiments is: what is the angular anisotropy of such fluctuations? We find that these fluctuations are predominantly planar, i.e., linear-in-B behavior of resistivity at very high fields is, in fact, linear-in-B_z, the component of field perpendicular to copper-oxide plane.

Results and Discussion

See figure caption

Conclusions

The character of strong magnetoresistance observed in our previous measurements [1,2] indicates that near critical doping in cuprates magnetic field affects directly the dynamics of quantum fluctuation. In this set of experiments we find that only the component of field perpendicular to the copper-oxygen plane determines the linear-in-B resistivity at very high fields. This suggests that the linear-in-B resistivity has orbital rather then spin origin. One might speculate that the quantum fluctuations responsible for anomalous transport near critical doping are predominantly co-planar with copper oxide plane.

Acknowledgements

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References

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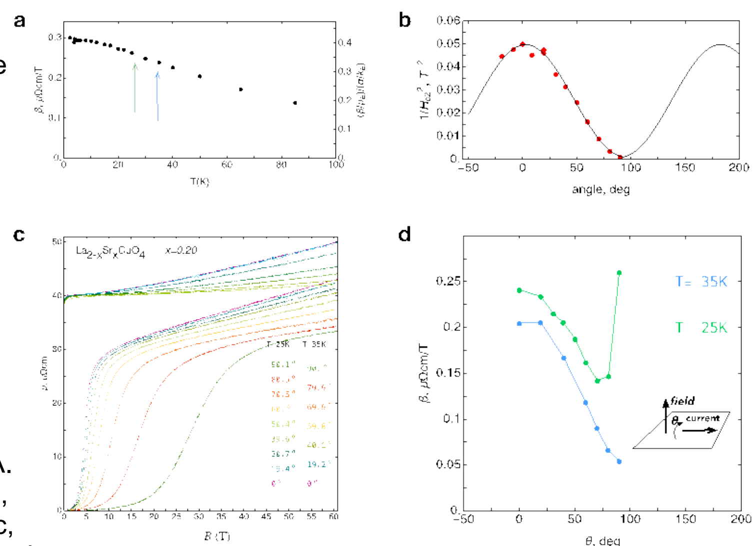

Figure 1. The temperature dependence of the high-field slope of resistivity dρ/dB (@65T, Figure 1a) indicates that the high-field regime at 65T is reached for temperatures below about 15K. H_{c2} grows very quickly with decreasing temperatures and have strong angular dependence (Figure 2b) – hence, in order to study angular dependence of linear-resistivity in a broad field range in the normal state we have to go to higher temperatures (arrows in Figure 1a). Although these temperatures are slightly above the saturation regime (Figure 1a), their angular dependence will still be representative of the dependence below 15K. Figure 1c shows field sweeps at two temperatures and a set of angles. The angular dependence of the high-field slope (at 65T) is shown in Figure 1d. The 35K set, slightly above zero-field Tc, (shown in blue) indicates nearly 4-fold increase in the field slope as we rotate magnetic field from a-b plane towards c-axis. The curve in green shows the angular dependence at 25K.