Mobility and its Temperature Dependence in LSCO: Dissipative Motion?

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Introduction

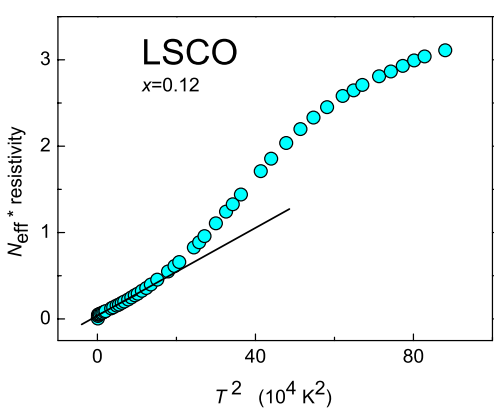
There are numerous attempts in the literature to explain the temperature dependence of the Hall coefficient, R_H, (or of the Hall angle, $ctg(\theta_H(T))$ in terms of a difference in the temperature dependence for various scattering processes entering the Boltzmann equation. Actually, as we have shown in [1], the *T*-dependence of $R_H(x,T)$ in LSCO comes about through the thermal activation of holes from local bound states seen by ARPES at antinodal points. The effective number of carriers is:

$$n_{Hall} = n_0(x) + n_1(x)\exp(-\Delta(x)/T) \qquad [1]$$

and is the sum of the contributions due to the external doping and from thermally activated carriers. The activation energy, $\Delta(x)$, deduced from the Hall data, coincides with the distance to chemical potential for the so-called van Hove "flat bands" measured by ARPES. Therefore in the conductivity expression $\sigma = ne^2\tau/m^*$ one should use $n_{Hall}(x,T)$ for *n* to determine the true temperature dependence of τ, or mobility, $\mu = (e/m^*)\tau$.

Results and Discussion

In Figure for *x=0.12* we plotted, as an example, the product of $N_{eff}(T)\cdot\rho(T)$ (N_{eff} is the number of carriers from Eq.[1] per Cu, resistivity ρ is in $m\Omega\cdot cm$) against T^2. At *T* below ~ 400K the quadratic dependence is clearly seen. Assuming that this T^2 -dependence results from a Fermi liquid (FL) form for $1/\tau = Const\cdot T(T/T_F)$ with *Const* of order of unity, one would arrive to T_F ~ 50*(m*/m)* ~ 200K. At *T* above ~ 400K (i.e., above *T*(x)*- the pseudogap temperature) the *T*- behavior is also close to the quadratic dependence with a somewhat different slope that would give even smaller estimate: T_F ~100-150K (the resistivity data are mainly from [2]). For any FL the quadratic dependence for the relaxation has its meaning *only* at $T<<T_F$. (This observation would also excludes a notion of small Fermi- pockets!). Analysis of similar plots for other dopant 's concentrations leads to close values for the energy scale "T_F".



Conclusions

We thus have shown that the mobility of a single carriers in LSCO is rather low, and its temperature dependence cannot be interpreted in a Fermi liquid picture. We suggest that carriers move in a dissipative medium.

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References

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[2] Ono, S., *et al.*, Phys. Rev. B **75**, 113103 (2007).