ORIGIN OF MAGNETORESISTANCE ANOMALIES IN ANTIFERROMAGNETIC YBa$_2$Cu$_3$O$_{6+x}$

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9.7 cm

The crystals of tetragonal antiferromagnetic $YBa_2Cu_3O_{6+x}$ ($x \sim 0.3$) demonstrate an unusual behavior of the in-plane magnetoresistance, $\Delta\rho_{ab}/\rho_{ab} \propto \cos 2\phi$ on the orientation of the external magnetic field within the CuO_2 (a,b) plane [1]. This specific d-wave angular dependence is assigned to the effective hole transport through the low-lying excited purely oxygen doublet $O2pe_u$ state in CuO_4 plaquette, rather than the ground $b_{1g}(d_{x^2-y^2})$ state. The energy separation between these two states is estimated from the photoemission to be about $1.5 \div 2.0$ eV, however, this is typical for lattice response accompanying the Franck-Condon transition, and does not take into account the lattice relaxation energy which magnitude is believed to be of the order of $1 \div 2$ eV. Thus, the "thermal" energies of additional $b_{1g}(d_{x^2-y^2})$ and $O2pe_u$ holes forming the terms $b_{1g}^2{}^1A_{1g}$ and $b_{1g}e_u : {}^3E_u$, respectively, are likely to be comparable in value. The external magnetic field is believed to determine the orientation of the strong exchange field for the spin-triplet $b_{1g}e_u : {}^3E_u$ state of the hole CuO_4 center and owing to the spin-orbital coupling result in a specific orbital polarization of the E_u doublet. Namely this gives rise to the spatial d-wave like anisotropy of the hole transport. The experimental data allow to estimate the parameter of the effective spin Hamiltonian.

[1] Y. Ando, A.N. Lavrov, K. Segawa, Phys. Rev. Lett. **83**, 2813 (1999)

13.4 cm

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