

Towards understanding the c-axis infrared response of underdoped cuprate superconductors

Tuesday, 24 July 2012 20:00 (2 hours)

Dominik Munzar and Jiri Vasatko,
Department of Condensed Matter Physics, Faculty of Science, and Central
European Institute of Technology,
Masaryk University, Kotlarska 2, 611 37 Brno, Czech Republic

The c-axis infrared (IR) conductivity of underdoped high- T_c cuprate superconductors reveals a pronounced pseudogap (PG) and, for materials with two CuO_2 planes per unit cell, signatures of coherent electronic coupling within the pair of closely spaced planes, in particular the so-called transverse plasma mode (TPM) located around 400 cm^{-1} . The PG develops below $T_{\text{much greater than } T_c}$, the TPM below T_{ons} , T_c less than T_{ons} much less than T . We report on results of our recent studies aiming at understanding these phenomena. (a) The formulas frequently used to describe the c-axis response of the coupled electron-phonon system of bilayer cuprate superconductors, that were originally obtained at the level of the phenomenological multilayer model (MLM), have been derived by using diagrammatic perturbation theory [1,2]. This provides a support for several important findings based thereon, in particular those of [3]. (b) The reported magnetic field (H perpendicular to the planes) induced changes of the TPM [4,3] have been clarified using the MLM [5]. Results of our analysis suggest that the response at $H=0$ and $T=T_c$ is close to that at $H = \text{ca } 25 \text{ T}$ less than H_{c2} and T much less than T_c , in accord with theories attributing the above T_c state to that of a superconductor lacking the long range phase coherence. (c) The qualitative difference between the manifestations of the PG in the c-axis IR response and those in the in-plane one belongs to major unsolved problems in the physics of the cuprates. In the third part of our contribution, implications of the MIR data reported by Yu et al. [6] will be discussed.

- [1] J. Chaloupka, C. Bernhard, D. Munzar, Phys. Rev. B 79, 184513 (2009).
- [2] J. Vasatko and D. Munzar, submitted to Phys. Rev. B, cond-mat 1203.6523v1.
- [3] A. Dubroka et al., Phys. Rev. Lett. 106, 047006 (2011).
- [4] A. D. LaForge et al., Phys. Rev. B 76, 054524 (2007).
- [5] J. Marek and D. Munzar, Journ. of Phys.: Condensed Matter 23, 415703 (2011).
- [6] L. Yu et al., Phys. Rev. Lett. 100, 177004 (2008).

Primary author: MUNZAR, Dominik (Masaryk University)

Presenter: MUNZAR, Dominik (Masaryk University)

Session Classification: Poster Session 2

Track Classification: High- T_c Cuprates