ANGULAR RESOLVED PHOTOEMISSION ON PB-BI2201: DOPING-DEPENDENT EVOLUTION OF THE PSEUDOGAP IN THE UNDERDOPED CASE

L. Dudy, B. Müller, L. Lasogga, A. Krapf, H. Dwelk, C. Janowitz, R. Manzke
Institut für Physik (EES), Humboldt-Universität, D-10115 Berlin, Germany
H. Höchst
Synchrotron Radiation Center, University of Wisconsin-Madison, Stoughton, WI, USA

In search for the pairing mechanism of the hole doped high temperature superconductors there is still lively debate about the nature of the pseudogap [1] [5]. Some groups report a vanishing pseudogap around optimum doping [2] leading to the idea of a quantum critical point. Other measurements show a smooth convergence of the pseudogap temperature with the superconducting critical temperature in the overdoped region. This suggests to treat the pseudogap state as a normal state precursor of the superconducting gap due to local, dynamic pairing correlations in a state without long range phase coherence [3].

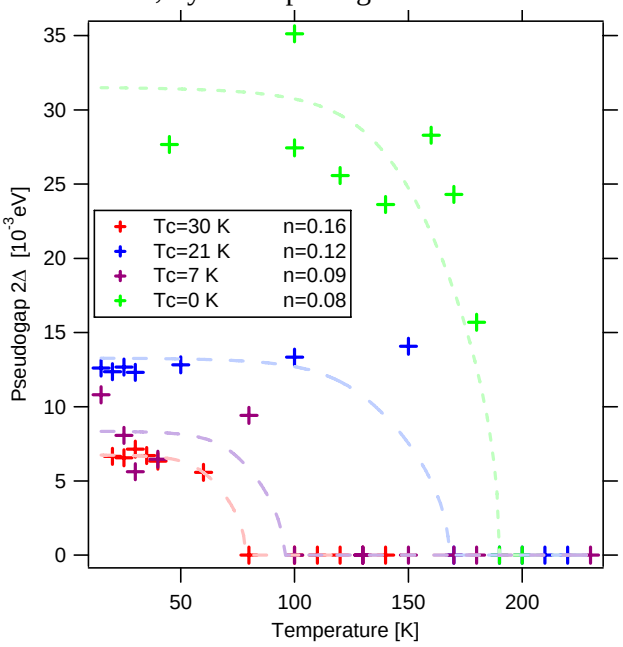

Fig. 1: Temperature dependence of the size of the pseudogap Δ^* for different doping.

Another striking fact revealed in the single-layer cuprate $Bi_2Sr_2CuO_6$ (Bi2201) and double-layer cuprate $Bi_2Sr_2CaCu_2O_8$ (Bi2212) a nearly independent pseudogap temperature T^* with the number of CuO_2 layers [4] while the magnitude of the pseudogap, Δ^*, itself is not.

We focused our work on angular resolved photoemission (ARPES) measurements of the Lead and Lanthanum doped one-layer single crystal of Bi2201.

Here we present temperature dependent ARPES data near the antinodal direction of four high-quality single crystals from the optimum doped $Pb_{0.4}$-Bi2201 (T_c=32K) down to the very underdoped (T_c~0K) case. The analysis of the data reveals the evolution of the pseudogap temperature T^* and magnitude Δ^* with respect to doping. For the three superconducting samples we found a nearly constant ratio between the zero-temperature gap and the pseudogap-temperature of $\Delta(0) \sim 0.49 k_B T^*$.

[1] T. Timusk and B. Statt, Rep. Prog. Phys. **62** (1999), 61-122
[2] J.L. Tallon et. al., Physica C **282-287** (1997) 236-239
[3] V.J. Emery and S.A. Kivelson, Nature **374** (1995), 434
[4] T. Honma et al., Phys. Rev. B **70** (2004) 214517 and cond-mat/0309597 (2003)
[5] M.R. Norman et al., cond-mat/0507031 (2005)