ESRF	**Experiment title:** **Phase Separation in Cuprate Superconductors: Pseudogap and planar dimples in $YBa_2Cu_3O_x$**	**Experiment number**: **HE- 516**
Beamline: BM 29	**Date of experiment**: from: 6. Nov. 98 to: 13. Nov. 98	**Date of report**: 27-2-99
Shifts: 18	**Local contact(s)**: D. Bowron	*Received at ESRF:*

Names and affiliations of applicants (* indicates experimentalists):

J. Röhler Universität zu Köln, D-50937 Köln, Germany

J.B. Philipp Universität zu Köln, D-50937 Köln, Germany

G. Schröder Universität zu Köln, D-50937 Köln, Germany

E. Kaldis ETH Zürich, CH-8005 Zürich, Switzerland

K. Conder ETH Zürich, CH-8005 Zürich, Switzerland

Report:

We have measured at BM29 the low temperature behaviour (20-300 K) of the dimpling in the CuO_2 planes (spacing between the stacked Cu2 and O2,3 layers) of $YBa_2Cu_3O_x$ (x=6.859, 6.888, 6.96) by Y *K*-EXAFS. As shown in our recent work done at the ESRF [1], the nearly collinear three body scattering configurations Y-Cu2-Ba and Y-O2,3-Ba are extremely sensitive to bond bending in the superconducting planes. Since both include the same Ba layer, they can be used to determine the atomic displacements in the CuO_2 planes as function of doping and temperature. The method is straightforward and transparent since both scattering configurations can be well separated in *R*-space (for data sets with k>18 Å^{-1}). Our recent experiments have given strong evidence for significant anomalies in the temperature dependence of the dimpling around T=150 K>T_c, which is close to T^*, the characteristic temperature of the so-called normal state pseudogap. [2] In some underdoped samples (x<6.92) the temperature dependence of the dimpling was found to increase for $T<T^*$; in some overdoped samples (x>6.92), however, the dimpling exhibited a more or less linear increase upon cooling without any significant change of slope, surprisingly very similar to the spin-lattice relaxation, $(T_1T)^{-1}$, at the Y and Cu2 sites. Although we achieved *S/N* ratios close to 10^{-4}, the still relatively large scatter of the data points did not allow for an unambigous conclusion on a possible relationship between the anomalous temperature behaviour of the dimpling, *i.e*. a lattice anomaly, and the pseudogap behaviour established by many measurements of the static and dymanic spin susceptibilities. In this run we succeeded to improve the *S/N* by about one order to 10^{-5} of magnitude during all shifts, primarily by minimizing the thermal instabilities of the monochromator and by further optimizing the homogeniety of our absorbers. A typical result from this run (in the underdoped regime, x=6.888) is displayed in Figs. 1 (*left*) Comparison is made with a result from one of the previous runs in the overdoped regime, x=6.94 (*right*). The now achieved quality of the data is very encouraging now allowing us to establish from the temperature behaviour of the dimpling in the conducting planes the phase separation line between the pseudo gapped phases and the "normal" ungapped metallic phases.

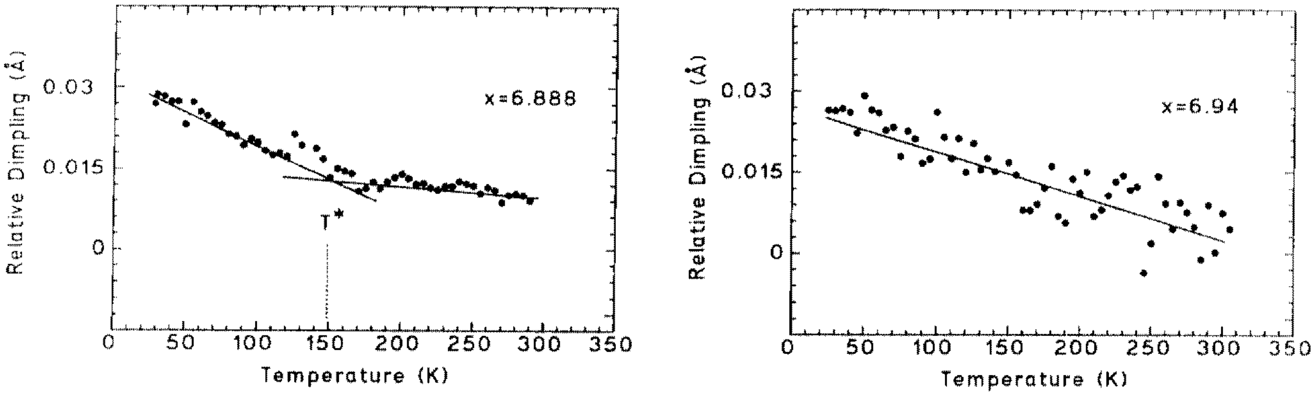

Fig. 1 *(left, **this run**)* Relative T-dependency of the dimpling in underdoped $YBa_2Cu_3O_{6.888}$. Note the kink at *T**=150 K. *(Right, **previous run**)* Relative T-dependency of the dimpling in overdoped $YBa_2Cu_3O_{6.94}$. Note the straight line, however only within the enhanced noise.

References

[1] J. Röhler, P.W. Loeffen, S. Müllender, K. Conder, E. Kaldis: *Local Structure Studies of the Underdoped-Overdoped Transition in $YBa_2Cu_3O_x$. Measurement of the ytttrium X-Ray Absorption-Fine-Structure.* In: *High -T_c Superconductivity 1996. TenYears after the Discovery,* E. Kaldis, E. Liarokapis, and K.A. Müller, eds., NATO ASI Series,**E343**, Kluwer, Dordrecht, 1997, pp.469-502.

[2] J. Röhler, S. Link, K. Conder, E. Kaldis: *The dimpling in the CuO_2 planes of $YBa_2Cu_3O_x$ (x=6.806-6984) at T=20-300 K.*, J. Phys. Chem. Solids, **59**, 1925-1928, 1998).