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Report:

Doppler Broadened Positron Annihilation Lineshape(DBPARL) experiments yield the so-called S-parameter, a quantity which gives the fraction of electrons having low momentum among the electrons that annihilate with positrons injected to the sample [1]. Recently, step-like variation of the S-parameter have been found for various high temperature superconductors by cooling accross the transition temperature T_C . In conventional superconductors such behaviour could not be found. Especially in case of $YBa_2Cu_3O_7$ two narrow minima in the S-parameter have been measured[2] as presented within figure 1. However these effects have two possible explanations: An electron momentum redistibution or a temperature dependent positron trapping at defects of the given crystal. In the first case this effect should also appear in the Compton profile of $YBa_2Cu_3O_7$ because it is directly related to the electron ground state momentum density. This is of special importance because so far no evidence is reported related to the temperature effects in the Compton profiles of $YBa_2Cu_3O_7$ in past publications[3,4] .

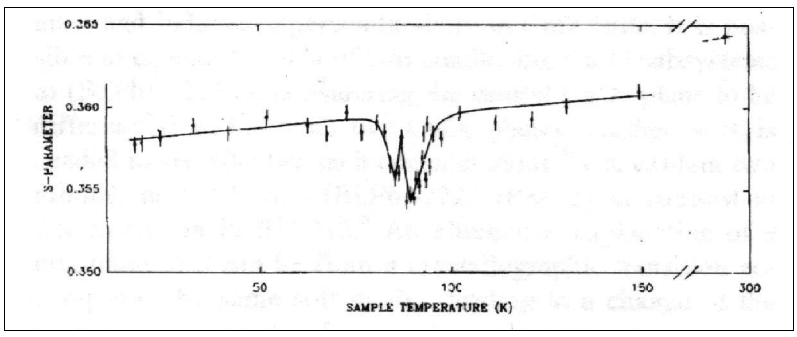

Figure 1: Variation of the DBPAR lineshape parameter S with sample temperature T for a Y-123 single crystal(Tc=89.5 K)[1]

We measured Compton profiles of an $YBa_2Cu_3O_7$ single crystal as a function of the temperature in [100] direction utilizing the Compton spectrometer at ID15B at the ESRF. The sample temperature was varied between 29K and 300K in small steps around the superconducting transition temperature of $T_C = 90.5K$. A 13 element solid-state germanium detector with corresponding MCAs was used and positioned at a scattering angle of 160°. The incident photon energy was set to 87.7 keV and a Sn foil has been used to reduce the yttrium fluorescence signal in the detector. Before summing up the single spectra each spectrum was corrected for energy shifts which correlated to the incident beam intensity. The sumspectra for a given temperature have been corrected for air absorbtion, sample absorption, absorption in the Sn foil and relativistic cross section after subtraction of electronic noise and background. Finally the corrected spectra have been converted to p_z-scale and normalized to the number of electrons. A statistical accuracy of about 0.1% at the Compton peak in a single detector has been reached by binning 8 channels, accumulating up to $1*10^6$ counts at the Compton peak. The $YBa_2Cu_3O_7$ single crystal was glued to a copper sample holder with two slots for Pt100 thermocouples directly above and below the sample. The temperature was set by a PID algorithm using a closed cycle cryostat. The readings of the thermocouples differed about 1K and the temperature variation within a single spectrum was about 0.2K.
The Compton profile differences between the Compton profile measured at room temperature and the Compton profiles measured at lower temperature is presented in figure 2. The difference spectra show an indication of a temperature effect close to the superconducting transition temperature in accord to the results of the DBPARL measurements. Nevertheless, the effect is very small and in a next step the data set has to be checked for consistency with earlier measurements accomplished with the same sample system.

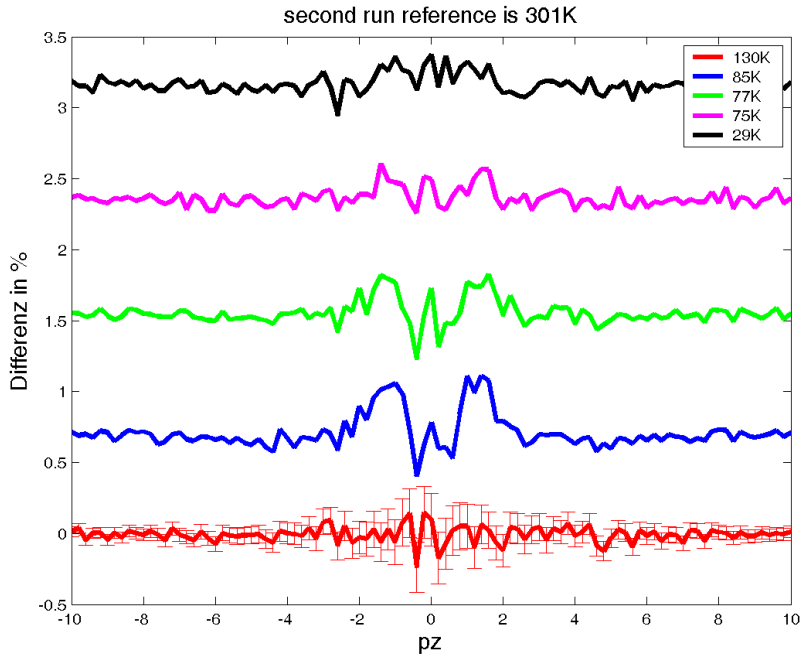

Figure 2: Compton profile differences at temperatures variing between 29K and 130K. The reference spectrum was measured at 301K. The difference is given relative to the CP maximum at 301K. To lower sample temperatures ,the spectra are shifted by 0.8 for a better overview of the data. Errorbars are given exemplarily for the spectrum at 130K.

[1] Udayan De and D. Sanyal Chap. V, Probing HTSC by Positron Lifetime and Doppler Broadening Investigations in Studies of High Temperature Superconductors Advances in Research and Application, Vol. 29, Nova Science Publishers Inc., New York (1999)
[2] Udayan De et al. Phys. Rev. B 62, 14519 (2000)
[3] S. Manninen et al. , Physica C 314, 19 (1999)
[4] G. D. Priftis et al. Physica C 223, 106 (1994) and G. D. Priftis et al., Proc. Sagamore XI Conference, Brest, France (1994)