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Report:

The understanding of the basic properties of high temperature superconductors is necessary to explain their physical properties. Despite of the through experimental and theoretical work fundamental questions like the Fermi surface characteristics are still to be solved. Experimental methods like angle-resolved photoemission and positron annihilation support at least partly Fermi surface type features but the interpretation of these results is difficult due to the sample dependent effects. In photoemission only few unit cells in depth are probed and using positrons high quality single crystals of reasonable size are required.

We have been using Compton scattering technique to study the Fermi surface properties of $La_{2-x}Sr_xCuO_4$ (LSCO) high temperature superconductor. The recent theoretical calculations and experiments show that even moderate momentum resolution is adequate to observe some of these Fermi surface signatures.

While measuring the Compton profiles using the high resolution spectrometer we have also collected Compton scattering spectra with a conventional Ge solid state detector. With moderate resolution, it can still reveal the main features of directional anisotropy and can be compared with the spectrometer data to check its consistency. Furthermore, with the detector limited high count rates the collected data will not be anymore statistically limited but the systematic fluctuations in the beam monochromaticity and the stability of the electronics, for example, will dominate the experimental accuracy.

Extracting the momentum distribution from the measured inelastic scattering spectrum involves several energy dependent and sometimes complicated corrections. However, comparison of derivatives of the experimental profile will reduce these effects but extremely low noise data is required to carry out numerical differentiation.

Figures below show the first and second derivatives of the experimental Compton profiles along c-direction and on the ab-plane. These are compared to the theoretical calculation based on KKK-method. It should be noticed that the statistical accuracy is adequate to extract useful information even from the second derivative. The theoretical calculation explains well the main features in the experimental data. More careful data analysis and numerical calculations are in progress to see if the minor deviations can be related to the Fermi surface topology.