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Report:

Compton profiles of polycrystalline MgB_2 have been measured as a function of temperature. The profiles were acquired at temperatures of 15, 55 and 293 K using both a scanning-crystal analyzer and a solid-state detector. The incident energy was 29 keV and the momentum resolution approximately 0.10 and 1.1 a. u. for the spectrometer and solid-state detector respectively. At the Compton peak we collected a total of 7.5×10^5 counts at each temperature using the spectrometer and hence the statistical inaccuracy was about 0.1 %. For the solid-state detector the corresponding numbers are about 7.0×10^6 counts and an inaccuracy of approximately 0.03 %.

MgB_2 is a novel superconductor with a remarkably high critical temperature of 39 K, hence there has been a huge interest in the material. However, the mechanism of superconductivity in the compound has not yet been fully determined. The aim of the experiment was to gain information about the ground state of MgB_2 both in normal and superconducting states. This will in turn lead to a better understanding of the superconducting mechanism in the material.

Our results, shown in Figures 1 and 2, show changes in the Compton profile as a function of temperature. Above the critical temperature these are explained by thermal expansion, whereas below the critical temperature they are evidence of changes in the electronic structure. As far as we know, this is the first observation of changes in the Compton profile in the transition from normal to superconducting state, related to changes in the electronic structure.

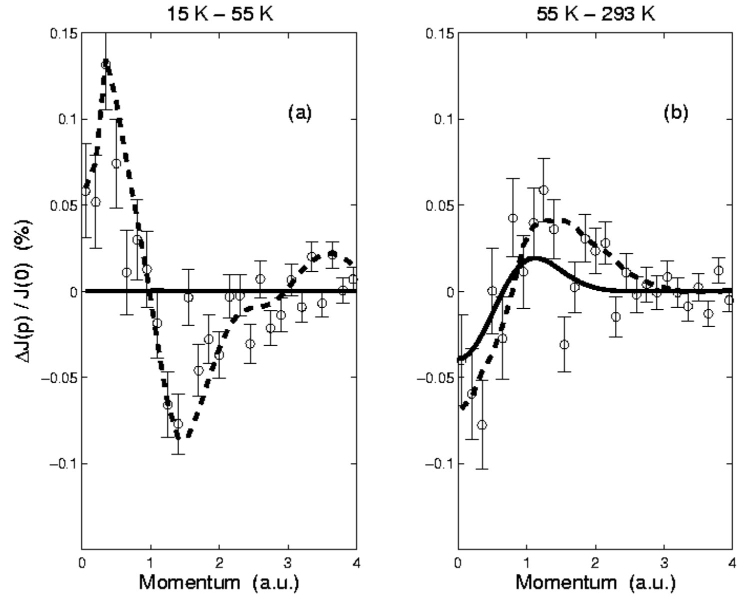

Figure 1. Differences in the experimental Compton profiles acquired at temperatures of (a) 15 K and 55 K and (b) 55 K and 293 K using the solid state detector ($\Delta p_z \approx 1.1$ a.u.). The thick solid lines are the corresponding differences given by a free electron model while the dashed lines are merely a guide for the eye.

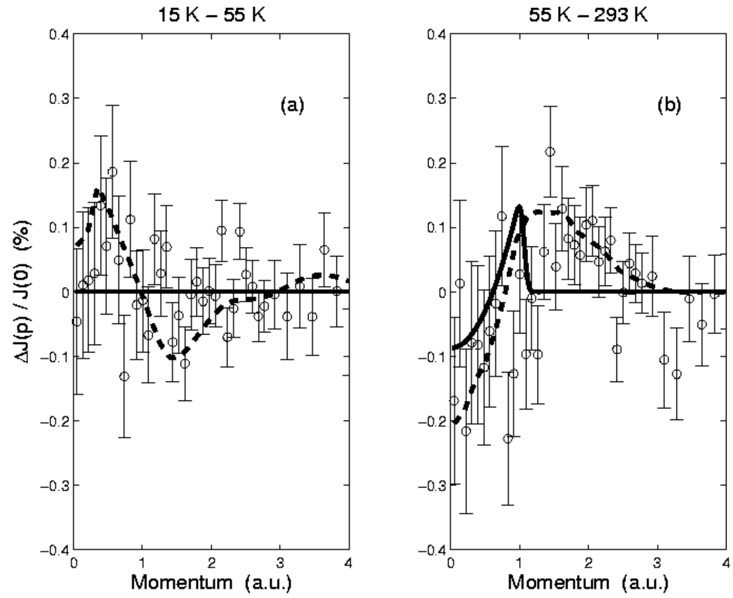

Figure 2. As for Figure 1, except that the data are acquired using the scanning-crystal spectrometer ($\Delta p_z \approx 0.10$ a.u.).