Coexistence of superconductivity and magnetism in a multi-layered cuprate

C. H. Lee(A), A. Iyo(A), K. Kihou(A), H. Kito(A) and K. Yamada(B)
(A) AIST, (B) IMR Tohoku Univ.

One of the most significant feature in high-Tc cuprates is that superconductivity is inextricably linked with antiferromagnetism. Crucial issue for understanding the mechanism of cooper pairs formation is whether the same carrier is responsible for both magnetic long range ordering and superconductivity. Recently, NMR and uSR measurements show that antiferromagnetism exists in superconducting phase of multilayered cuprates. In particular, NMR measurements suggest that antiferromagnetism coexists with superconductivity microscopically on a single CuO2 plane in underdoped HgBa2Ca4Cu5O12+d. Experiments using diffraction technique are highly required to clarify whether it is a long range ordering or not.

Neutron scattering measurements were carried out using a powder diffractometer, HERMES, and a triple-axis spectrometer, AKANE, at the JRR-3 reactor of JAEA at Tokai. On the experiments with HERMES, the incident neutron wavelength was fixed at 1.8265 A using (311) reflection of the Ge monochromator. The sequences of horizontal collimators were 12′-blank-S-22′ where S denotes the sample position. On the other hand, on the expermiments with AKANE, the incident neutron wavelength was fixed at 2.044 A using a pyrolytic graphite (PG) monochromator. The sequences of horizontal collimators were 12′-blank-S-15′. Powder of HgBa2Ca4Cu5O12+d was used as a sample.

Fig. 1 shows spectra of theta-2theta scan in HgBa2Ca4Cu5O12+d sample at T=12K and 300K. A peak around 2theta = 15.7 at T = 12K is also observed at T=300K, indicating that the peak include a fundamental nuclear peak of (003) or even some impurity phases. Even if magnetic component exists, the intensity should be quite small comparing to the observed peak intensity. A solid line depicts calculated spectra assuming magnetic moment of Cu atoms on inner CuO2 plane as 0.67uB estimated by NMR measurements. Clearly, such a well defined magnetic peak is not observed, indicating that the magnetic moment should be quite small. We also checked that well defined magnetic peak is not observable in a wide 2theta region.

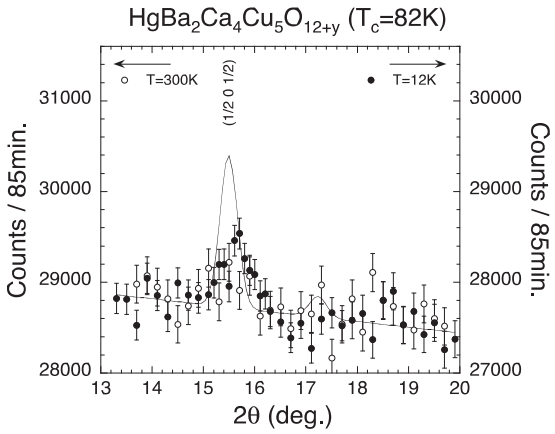

Fig. 1. Spectra of theta-2theta scan in HgBa2Ca4Cu5O12+d at T=12K and 300K. A solid line depict the result of simulation assuming 0.67 uB as magnetic moment of Cu atoms on inner CuO2 plane.