Orbital distribution of Mn-3d(e_g) electrons in the perovskite system $La_{1-x}Sr_xMnO_3$

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Perovskite-type manganites $La_{1-x}Sr_xMnO_3$ have been actively studied in relation to the colossal magnetoresistance. In this system, the importance of the orbital degree of freedom is pointed out as well as charge and spin. Recently, Endoh et al. have found the first-order transition from ferromagnetic metal (FM) to ferromagnetic insulator (FI) in the sample of x=0.12 by applying a magnetic field and/or lowering temperature[1]. In FI phase, the orbital ordering in the e_g electron state of Mn^{3+} ions is observed by the anomalous X-ray scattering measurements. The ordering state may be explained as $(d_{3x^2-r^2}/d_{3y^2-r^2})$ or $(d_{z^2-x^2}/d_{y^2-z^2})$. It is however, difficult to distinguish the two ordering state.

In this study, magnetic Compton profiles (MCP), which elucidate the momentum distribution of magnetic electrons, have been measured in $La_{0.88}Sr_{0.12}MnO_3$ single crystal at 9 K (FI phase) and 150 K (FM phase) to determine the orbital configuration in the ordering state. The magnetic Compton scattering is only induced by the spin moment and is insensitive to the orbital moment. Its profile however, depends on the orbital states occupied by the magnetic electrons. Figure 1 shows MCP at 9 K and 150 K which are denoted by closed and open circles, respectively. The profiles are normalized by the magnetization measured at each temperature. A difference in structure between the two MCP is clearly noticed at around P_z=0. Detailed analysis is in progress.

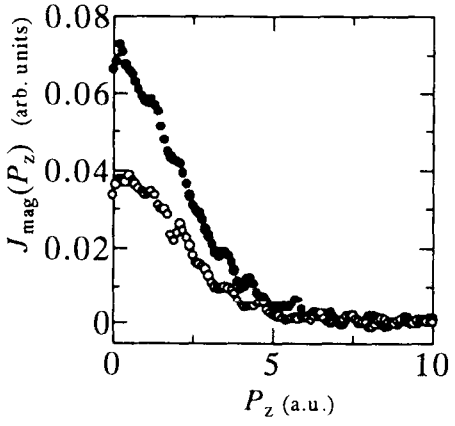

Fig. 1. Magnetic Compton Profiles in $La_{0.88}Sr_{0.12}MnO_3$ at 9 K (●) and 150 K (○).

References

1) Y. Endoh, K. Hirota, Y. Murakami, T. Fukuda, H. Kimura, H. Nojiri, K. Kaneko, S. Ishihara, S. Okamoto and S. Maekawa (unpublished).