

# Upgrade of X-ray magnetic diffraction experimental system and its application to orbital ordering $\text{YTiO}_3$

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The X-ray magnetic diffraction (XMD) experiment is a powerful method to measure a magnetic form factor. A magnetic form factor is related to magnetic moment density distribution through the Fourier transform. Generally, magnetic form factor has spin-moment component and orbital-moment component. By using the XMD experiment, it is possible to measure the spin magnetic form factor and the orbital magnetic form factor, separately. This is the characteristic feature of the XMD experiment.

The XMD experiment was performed at the Photon Factory (PF) BL3C3 of the High Energy Research Organization (KEK). So far, we used a rather small electromagnet (0.85T), a low-power refrigerator (15K) and low-counting rate detector system ( $10^4$ cps). Here, we upgraded the XMD experimental system in order to apply this method to as many materials as possible and to perform the experiment more effectively. The upgrade was made for the X-ray counting system, the electromagnet and the refrigerator. In the upgrade of X-ray counting system, we used a high count-rate type SSD together with a new type of multi channel analyzer, and the X-ray counting rate capability was improved to  $10^5$  cps. In the upgrade of electromagnet, we adopted a larger magnet, and the maximum magnetic field was increased to 2T. In the upgrade of refrigerator, we used a more powerful one, and the lowest sample temperature was improved to 5K.

The upgraded system was applied to an orbital ordering compound  $\text{YTiO}_3$ . This compound is ferromagnetic below 30K, and measurement was made at 15K. In the previous study,<sup>1-3)</sup> we obtained the spin magnetic form factor of  $\text{YTiO}_3$  of the reciprocal lattice points of  $h\ 0\ l$  series. The magnetization measurement showed that the magnetic field of 2T was needed to saturate the magnetization along the b axis (the hard axis). So the upgrade of the magnet was essential for the XMD measurement with the magnetization aligned in the ab plane or the bc plane.

We measured the spin magnetic form factor for the reciprocal lattice points of  $0\ k\ 0$  ( $k=6, 8, 10, 12, 14, 16$ ),  $0\ 2k\ k$  ( $k=2, 4, 6$ ),  $3h\ h\ 0$  ( $h=1,2$ ),  $4h\ h\ 0$  ( $h=2$ ),  $5h\ h\ 0$  ( $h=1,2$ ) and  $5h\ 3h\ 0$  ( $h=1,2$ ). The results are shown in Figure 1. In Figure 1, the solid circles are the data obtained in this study and open circles are the data obtained previously.<sup>1-3)</sup> We applied the Maximum Entropy Method (MEM) to these data in order to obtain three dimensional spin density distribution in real space. The results will be shown in the conference.

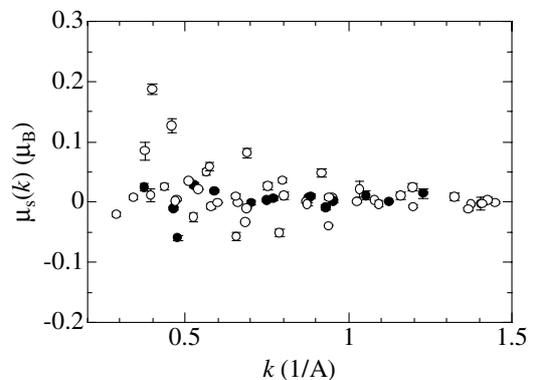


Figure 1. Spin magnetic form factor of  $\text{YTiO}_3$ . The solid circles are the data obtained in this study, and the open circles are the data obtained previously.<sup>1-3)</sup>

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