Electromagnon in multiferroic system $Ba_2CoGe_2O_7$

Minoru Soda and Takatsugu Masuda

Neutron Science Laboratory, Institute for Solid State Physics, University of Tokyo, Tokai, Ibaraki 319-1106, Japan

Multiferroics, in which a ferroelectricity is induced by a complex magnetic structure, has attracted much attention. For several multiferroic materials, the electric component of light connects with the oscillation of magnetization in the low energy excitation. This coupling of the spin and the polarization waves is known as electromagnon.

Multiferroics and electromagnon have been reported in multiferroic system $Ba_2CoGe_2O_7$ having the collinear magnetic structure.[1,2] Previously, we have performed inelastic neutron scattering on $Ba_2CoGe_2O_7$ to identify the electromagnon observed by light scattering experiment at E~4 meV using the triple axis spectrometer.[3] We found one acoustic and two optical modes. All the excitations are reasonably reproduced by the extended spin wave theory. However, the magnetic excitation at E~4 meV was observed as a single peak in spite of the result that two modes, the longitudinal and the transverse modes, having similar energies exist in the extend spin wave theory. To clarify the detail of the electromagnon, the neutron experiment with the high resolution has been carried out by using the HYSPEC at SNS.

The intensity map at around 4 meV which corresponds with the electromagnon energy was measured at 1.5 K in the wide $\boldsymbol{Q}$-range. The $|\boldsymbol{Q}|$-dependence of the intensity is almost explained by the Co^{2+} magnetic form factor, and the intensity along $(0,0,l)$ is twice larger than that along $(h,0,0)$. This is consistent with the extend spin wave theory. Figure 1 shows the energy dependence of the neutron intensity at several $\boldsymbol{Q}$-points. The slightly dispersive magnetic excitation was observed at around 4 meV, and the energy width of this magnetic excitation is wider than that of the experimental resolution. This indicates the possibility that both longitudinal and the transverse modes exist as expected in the extend spin wave theory. Hereafter, we need to carry out the mode analysis by the polarized neutron experiment.

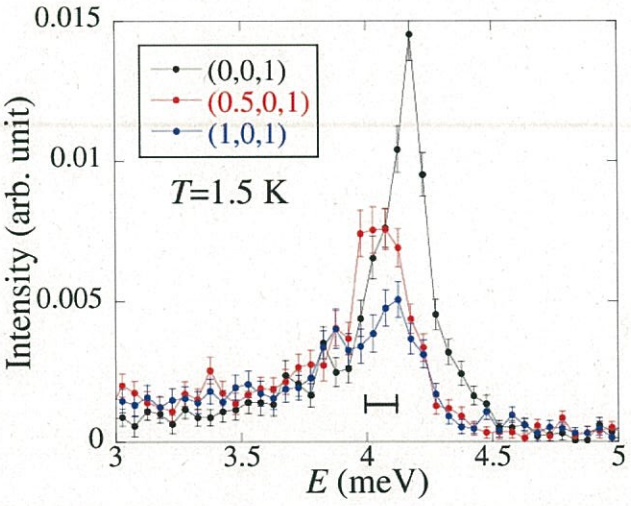

Fig. 1 Energy dependence of the neutron intensity at around 4 meV. Bar exhibits the resolution width.

[1] H. Murakawa *et al.*, PRL **105** 137202 (2010).

[2] I. Kezsmarki *et al.*, PRL **106** 057403 (2011).

[3] M Soda *et al.*, PRL **112** 127205 (2014).