Quasi-Elastic Scatterings in Frustrated Magnet $YBaCo_4O_7$

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Geometrically frustrated magnets on the pyrochlore, triangular and kagome lattices exhibit various interesting magnetisms. One of the geometrically frustrated magnets is $RBaCo_4O_7$ (R=Ca, Y, and rare-earth elements)[1]. In the crystal structure of $RBaCo_4O_7$, the kagome and the large triangular lattices formed by CoO_4 tetrahedra stack alternately along the *c*-axis. The network of the exchange interaction between the spins in $RBaCo_4O_7$ is similar to that in the pyrochlore systems which have the alternating kagome and large triangular lattices along the [111] direction. The large antiferromagnetic interaction between the Co spins in $RBaCo_4O_7$ is expected to induce the magnetic frustration.

Previously, we have carried out the neutron scattering experiments in order to clarify the magnetic properties in $YBaCo_4O_7$[3,4]. In $YBaCo_4O_7$, two magnetic transitions were found at temperatures T_{c1}=70 K and T_{c2}=105 K. Below T_{c2}, the superlattice magnetic reflections were observed. Furthermore, the characteristic line-shape magnetic diffuse scattering has been also reported just above T_{c2}. The temperature dependence of the magnetic diffuse scattering indicates a possibility that the Z_2 vortex ordering occurs[4]. The purpose of the present study is to clarify the existence of the Z_2 vortex ordering in $YBaCo_4O_7$. The theoretical study for the triangular lattice suggests that the Z_2 topological transition induces the central peak in the dynamical structure factor.

The neutron measurement on $YBaCo_4O_7$ single crystal was performed by using the high energy resolution triple-axis spectrometer HER (C1-1) installed at JRR-3 in JAEA Japan. The final neutron energy was set at E_f=5 meV, and the energy resolution at the elastic position was about 0.2 meV. The single crystal was oriented with the [100] and [010] axes with the hexagonal unit cell in the horizontal plane.

The constant $\boldsymbol{Q}$-scans at the $\boldsymbol{Q}$-points (1.5,0,0) and (1.5+0.11,-0.22,0) have been measured for several T values. Around T_{c2}, the constant $\boldsymbol{Q}$-scans have the strong quasi-elastic scattering while the quasi-elastic scattering was negligibly small in the low and high T region. This temperature dependence of the quasi-elastic scattering is similar to that of the line-shape magnetic diffuse scattering.

The magnetic diffuse and the quasi-elastic scatterings observed in $YBaCo_4O_7$ are consistent with the Z_2 vortex transition proposed by the theoretical study[4]. Note that the Z_2-vortex transition has been proposed on the triangular lattice, whereas the Co-ions in $YBaCo_4O_7$ have the alternating kagome and large triangular lattices. In order to clarify the Z_2-vortex order of the complicated three-dimensional network of the magnetic correlation, further studies are necessary.

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