Energy Range of Magnetic Excitations in Percolating Two-Dimensional Heisenberg Antiferromagnet, Rb2Mn0.598Mg0.402F4

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Magnetic excitations in the percolating two-dimensional Heisenberg antiferromagnet, Rb2MncMg1-cF4, with c= 0.598 were investigated on the triple-axis spectrometer, GPTAS (4G) at JRR3M in JAEA (Tokai), in the energy range up to 20 meV. The magnetic concentration of this system is very close to the percolation threshold for a square lattice (cp = 0.593). The N el temperature of this system was determined to be 4 K by measuring the temperature dependence of the intensity of the magnetic (100) reflection. The inelastic spectra at (1+q,0,0) with q = 0 - 0.5 were measured with a fixed final energy Ef = 14.7 meV, at 1.5 K well below TN and at 200 K. The energy resolution was 0.7 meV (FWHM) at the elastic point.

In 2004 and 2005, we performed similar experiments to determine the energy range of magnetic fractons in this system, and it was reported the observation of dispersive excitations more than 10 meV on GPTAS [1]. However, the peak positions of the dispersive component were not consistent with the experiments on HER (C1-1) at JRR3M and on IRIS at ISIS. At present, we improved the shielding of the spectrometer, GPTAS, and preformed the experiment again. Figure 1 shows the observed excitation spectrum at the magnetic zone boundary (1.5,0,0) at 1.5 K. The dispersive component at around 12 meV observed in the previous experiment disappeared by the improvement of the shielding, and therefore, it was found to be spurious. We can still see a small peak at around 12 meV, and it was found to be phonon from its temperature dependence. Therefore, we found the energy range of the magnetic excitations to be less than 10 meV at the present experiment.

Also we previously reported dispersive excitations observed on HER and on IRIS. From the result of the precise analysis of the data taken on IRIS, the observed spectra on IRIS was found to quantitatively agree with the predicted dynamical structure factor of magnetic fractons [2], and the zone boundary energy of fractons was estimated to be less than 10 meV. And the dispersive spectra observed on HER can be interpreted as the Ising cluster excitations with a small dispersion. In the present experiment, we determined the energy range of the magnetic excitations in this system, and consistently demonstrated the magnetic fractons and other magnetic excitations.

References

[1] S. Itoh et al, Activity Report on Neutron Scattering Research Vol. 13 (ISSP, Univ. Tokyo 2006).
[2] K. Yakubo et al., J. Phys. Soc. Jpn. 62 (93) 2196.

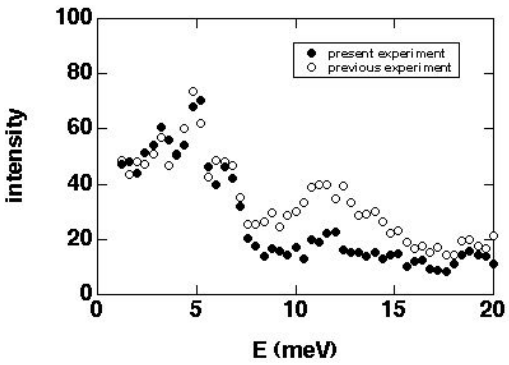

Fig. 1. Excitation spectra at (1+q,0,0) with q=0.5 at 1.5 K in Rb2Mn0.598Mg0.402F4 observed on GPTAS.