# Magnetic excitation in Co4B6O13

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Recently spin liquid in triangular lattice, Kagome lattice, Pyrochlore lattice, etc has been attracted much attention. Amongt them regular tetrahedron spin system, Co4B6O13, was discovered recently[1]. Co2+ (S=3/2) ions are on the corner of tetrahedron. Since the Co-Co intratetrahdron distance 3.25 A is shorter than the intertetrahedron 4.26 A this compound is expected to be an isolated tetrahedron spin system. The magnetic susceptibility shows broad maximum at T = 14 K and it decreases drastically at low temperature. No magnetic order is identified at T > 1.8 K. These are typical behaviors of spin gap system with nonmagnetic ground state. In the magnetization measurement an drastic increase was identified at H = 10 T and multistep anomalies were observed at 40 T and 60 T. These anomalies are supposed to be transition between eigenstates of Heisenberg antiferromagnetic tetrahedron cluster, S=0 (quartet), S=1 (ninefold multiplet), S=2 (elevenfold multiplet). However, in quantitative level, the data cannot be reproduced and additional terms such as Dzyaloshinskii-Moriya interaction and single ion snisotropy would be required. Even though rather complex, the isolated tetrahedron spin cluster is a rare experimental realization of exact solvable model with spin frustration. Hence to reveal the spin excitation of Co4B6O13 we performed inelastic neutron scattering experiments.

Powder sample was obtained by hydrothermal synthesis. As a starting material we used 11B oxide to reduce the absorption of neutron. Orange type cryostat was used to achieve low temperature. Inelastic neutron scattering experiment was performed at C1-1 beamline. The collimation setup is Guide-PG-40′-radial collimation-Be filter-Horizontally focused analyzer-open with Ef = 3 meV.

In Fig. 1 we show energy scan at q=1A-1. Well dfined peaks are observed at hw = 0.96, 1.18, 1.61, 2.44, 2.92, 4.15, and 4.66 meV. These peaks are identified dispersionless in similar scans at different q. With the increase of temperature the intensity decreases. These results measn that the peaks are of a magnetic cluster. The fine peak structure measn that the degenerated eigenstate of a Heisenberg cluster is splitted by peturbative terms as magnetic susceptibility and heat capacity data indicated. Q scans were also performed at several energies. The detailed data analysis is now under progress. The summary of this study will be published with additional nutron scattering experiment somewhere.

[1] H. Hagiwara et al., fall meeting of Japan Physical Socity, 20aQH (2008).

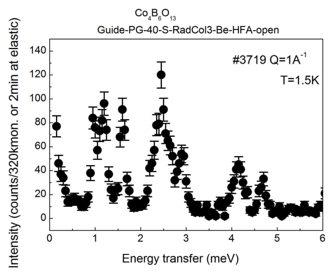


Fig. 1. Energy scan of Co4B6O13 at Q = 1A-1.