Neutron scattering studies on frustrated spin systems

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Frustrated spin systems have received considerable attention due to a great diversity of exotic states and low-temperature behaviors. The frustration caused by either competing interactions or lattice geometries leads to a highly degenerate ground state, and therefore no long-range magnetic order should occur. However, the degeneracy can be lifted by a coupling between spin and other degree of freedoms. For the study of such unique spin systems, neutron-scattering experiments, which measure the collective behavior of spins or nuclei in a system, can provide important information. Here, I introduce the recent progresses in our group.

1. Novel excited state in geometrically frustrated magnet

Inelastic neutron scattering measurement on single crystalline sample of geometrically frustrated magnet $MgCr_2O_4$ clarified the spatial correlation of discrete excited modes at the energies of $\sim$4.5 meV and $\sim$9.0 meV in the antiferromagnetic ordered phase. The intensity distribution in the wide momentum space at each energy can be well reproduced in term of spin molecules with antiferromagnetically correlated hexamer (first excited state) and heptamer (second excited state) [1]. These results suggest that non-trivial and exotic magnetism potentially exists even in the ordered phase.

2. High-magnetic-field measurement on triangular lattice magnet

Application of an external magnetic field can release the spin frustration and induce new magnetic states. Field-induced transition was studied for a triangular lattice antiferromagnet $CuFeO_2$ with utilizing a newly developed pulse magnetic field system for neutron-scattering measurements [2]. At low temperature in the Néel ordered state, the spin structure successively changes with applying the field up to $\sim$30 T. We directly observed the magnetic superlattice structure at a fractional magnetization state of $CuFeO_2$ induced by high magnetic fields.

[1] K. Tomiyasu *et al.*, arXiv:0804.2993.
[2] K. Ohoyama, *et al.*, J. Magn. Magn. Mater. **310**, e974 (2007).