CROSS TOKAI **Experimental Report** J-PARC	承認日 Date of Approval 2017/6/28 承認者 Approver Ryoichi Kajimoto 提出日 Date of Report 2017/6/28
課題番号 Project No. 2017A0004 実験課題名 Title of experiment Spin dynamics in spin-1/2 uniform triangular lattice $Li_2AMo_3O_8$ 実験責任者名 Name of principal investigator Kazuki Iida 所属 Affiliation CROSS	装置責任者 Name of responsible person Ryoichi Kajimoto 装置名 Name of Instrument/（BL No.） 4SEASONS (BL01) 実施日 Date of Experiment 2017/6/22 – 2017/6/28

試料、実験方法、利用の結果得られた主なデータ、考察、結論等を、記述して下さい。（適宜、図表添付のこと）
Please report your samples, experimental method and results, discussion and conclusions. Please add figures and tables for better explanation.

1. 試料 Name of sample(s) and chemical formula, or compositions including physical form.

Polycrystalline $Li_2ScMo_3O_8$.

2. 実験方法及び結果（実験がうまくいかなかった場合、その理由を記述してください。）
Experimental method and results. If you failed to conduct experiment as planned, please describe reasons.

New molecular-based triangular lattice magnets $Li_2AMo_3O_8$ (A = In or Sc) were recently synthesized. Mo_3O_{13} cluster in $Li_2AMo_3O_8$ has one unpaired spin, and Mo_3O_{13} clusters form a perfect triangular lattice. Bulk and NMR measurements reported that the ground states of $Li_2InMo_3O_8$ and $Li_2ScMo_3O_8$ are 120° long-range magnetic ordered state and the quantum spin liquid, respectively. Since the ground state of the spin-1/2 perfect triangular lattice with antiferromagnetic nearest neighbor interactions is so-called 120° long range order, to understand the origin of the unexpected QSL state in $Li_2ScMo_3O_8$ is important. However, no inelastic neutron scattering measurement has been reported on the exotic QSL state in $Li_2ScMo_3O_8$ nor on the long-range ordered state in isostructural $Li_2InMo_3O_8$. In this experiment, we performed inelastic neutron scattering measurements on $Li_2AMo_3O_8$ (A = Sc and In) using the Fermi chopper spectrometer 4SEASONS to discuss the nature of the QSL state in $Li_2ScMo_3O_8$ and mechanism of the different ground states between the Sc and In systems.

We performed inelastic neutron scattering measurements on $Li_2ScMo_3O_8$ at 1.7, 5.0, 15, and 40 K. The Fermi chopper was rotated in 250 Hz, resulting in the multi-E_i of 23.9, 15.0, 10.3, and 7.5 meV. The

2. 実験方法及び結果（つづき） Experimental method and results (continued)

polycrystalline sample was packed into the aluminum sample. Effective sample thickness was 1 mm. We also measured the empty can at 1.7 and 40 K. We used the “lemon” cryostat.

Figure 1(a) shows the neutron scattering intensity map from $Li_2ScMo_3O_8$ at 1.7 K with E_i = 23.9 meV. At very low Q (Q < 0.8 Å^{-1}), there is a continuum magnetic excitation, which is the signature of the QSL. To see this magnetic excitation in detail, we cut the map along $\hbar\omega$ and Q. Figures 1(b) and 1(c) are the energy and Q dependences of the neutron scattering intensities, respectively. The signature of the magnetic excitations from QSL was observed.

In the preliminary measurements, we also measured the magnetic long range ordered state of $Li_2InMo_3O_8$. Figure 1(d) shows the neutron scattering intensity map from $Li_2InMo_3O_8$ at 4 K. Clearly, spin wave excitation evolves from (1/3, 1/3, 0) corresponding to the 120° long range order. Linear spin wave calculation succeeded in reproducing the excitation spectrum as shown in Fig. 1(e).

As shown in Figs. 1(a) and 1(d), $Li_2ScMo_3O_8$ and $Li_2InMo_3O_8$ shows completely different magnetic excitations, representing the different ground states. We are now trying to understand the origin of the QSL in $Li_2ScMo_3O_8$ by analyzing the magnetic excitations.

Finally, we appreciate very much the MLF SE team for their professional support.

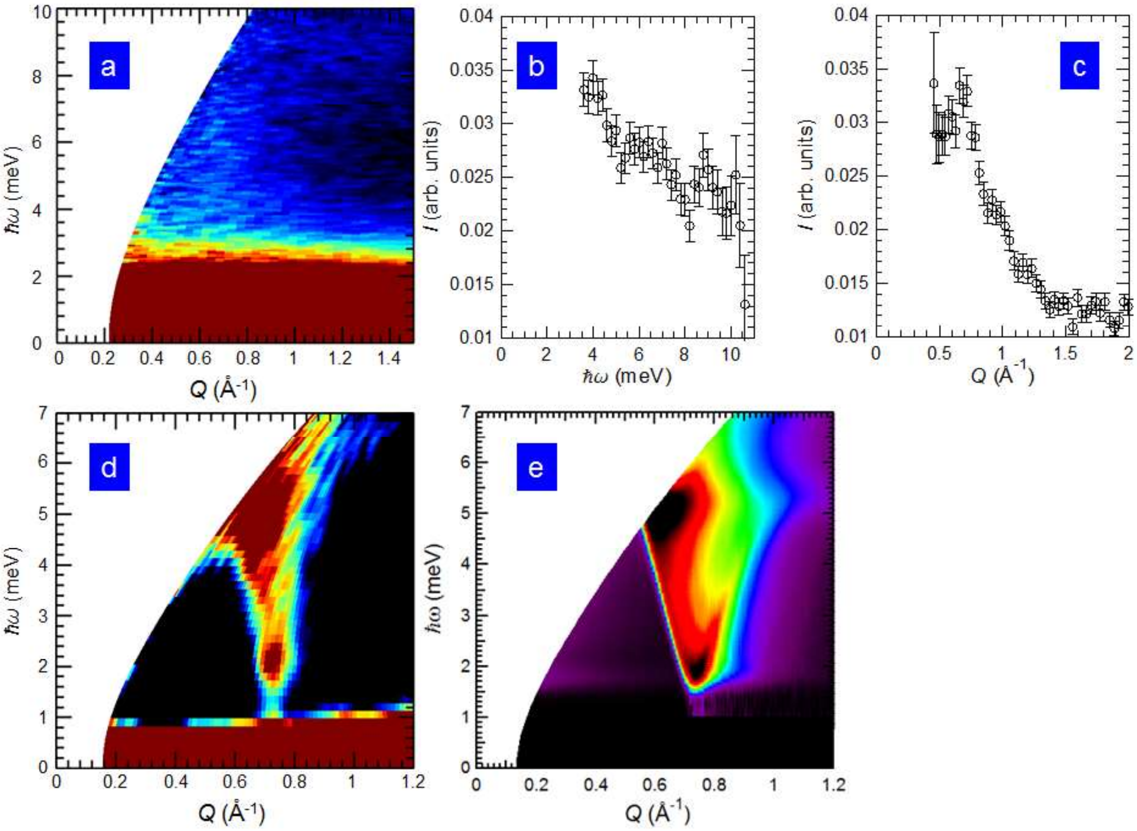

Figure 1 (a) Neutron scattering intensity map from $Li_2ScMo_3O_8$ at 1.7 K with E_i = 23.9 meV. (b) Energy (Q = [0.6, 0.9] Å^{-1}) and (c) Q dependences ($\hbar\omega$ = [4.5, 6] meV) of $Li_2ScMo_3O_8$ at 1.7 K. (d) Neutron scattering intensity map from $Li_2InMo_3O_8$ at 4 K with E_i = 11.9 meV. (e) Linear spin wave calculation for $Li_2InMo_3O_8$ at 4 K assuming the energy resolution of E_i = 11.9 meV and 350 Hz.