（ ※本報告書は英語で記述してください。ただし、産業利用課題として採択されている方は日本語で記述していただいても結構です。 ）

CROSS TOKAI **Experimental Report** J-PARC	承認日 Date of Approval 2015/1/4 承認者 Approver Jun-ichi Suzuki 提出日 Date of Report 2014/6/24
課題番号 Project No. **2013B0052** 実験課題名 Title of experiment Reorientation slow dynamics of skyrmion lattice in Cu2OSeO3 実験責任者名 Name of principal investigator Taku J Sato 所属 Affiliation Tohoku University	装置責任者 Name of Instrument scientist Jun-ichi Suzuki 装置名 Name of Instrument/（BL No.） TAIKAN (BL-15) 実施日 Date of Experiment 3.21-3.25

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.

Name of sample: Cu_2OSeO_3
Chemical formula: Cu_2OSeO_3
Physical Form: Single crystal

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.

Reorientation slow dynamics of skyrmion lattice in Cu_2OSeO_3

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In recent years there have been great interests in emergent electromangetic effects induced by topological spin textures, in particular, skyrmion. Among several compounds that show skyrmion lattice at low temperatures, Cu_2OSeO_3 is the only insulating compound that exhibits skyrmion phase. Also believed is that Cu_2OSeO_3 is a multiferroic material, where cross-correlated electromagnetic effects are expected. Skyrmion phase in the insulating compound may be of technical importance since it can be manipulated by external forces, such as an electric field, without dissipation of energy.

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

In earlier experiments, it has been shown that Cu_2OSeO_3 exhibits two skyrmion lattice phases SkX(1) and SkX(2), which are related with each other by the 30 degrees rotation in the hexagonal skyrmion-lattice plane. In this experiment we have tried to switch the two phases by the external electric field, as the first attempt to manipulate the skyrmions by the external field.

The experiment was performed at TAIKAN (BL-15) of J-PARC/MLF. The single crystal sample of 5mmX5mmX2.5mm is attached to the self-made sample base consisting of single crystal sapphire plate, and is set to the standard closed-cycle refrigerator. The sample temperature was monitored by the temperature sensor, placed onto the sapphire plate. External magnetic field was applied by using a electromagnet with the field being parallel to the incident neutron path. We set the [110] of the sample also along the incident neutron path. External electric field was applied using a high-voltage generator, with the field direction being roughly parallel to the [001] direction.

The first trial was made with phi0.4mm electrodes. It turns out that the heat flow from the room temperature side is too high, and there appears a huge temperature gradient between the sample and the temperature sensor on the sapphire plate. Hence, we made a thermal anchor to the cold state of the closed-cycle refrigerator. Consequently, the temperature difference between the sample and thermometer is less than 5K, which may be acceptable.

The obtained data are described in what follows. Figure 1(left) is the SANS pattern in the SkX(2) phase, obtained at T = 54 K, H = 150 Oe, and V = 0 V. Note that the temperature and magnetic field are nominal ones, and to be corrected. On the other hand, the SANS pattern with the applied electric field is shown in Fig. 1(right), where T = 54 K, H = 150 Oe, and V = 1500 V. Unfortunately, the detector at the lowest angle was not working properly, so that some of the low-Q region could not measured. This is the reason why the peak shape is distorted in the figures. Nevertheless, we clearly observed that rotation of the hexagonal lattice induced by the electric field. Further experiment is definitely necessary to conclude the external electric field effect to the skyrmion lattice, and to elucidate the origin and mechanism of the effect. We strongly suggest that the TAIKAN team will replace the low-Q detectors, so that the whole Q range can be measured with sufficient statistics.

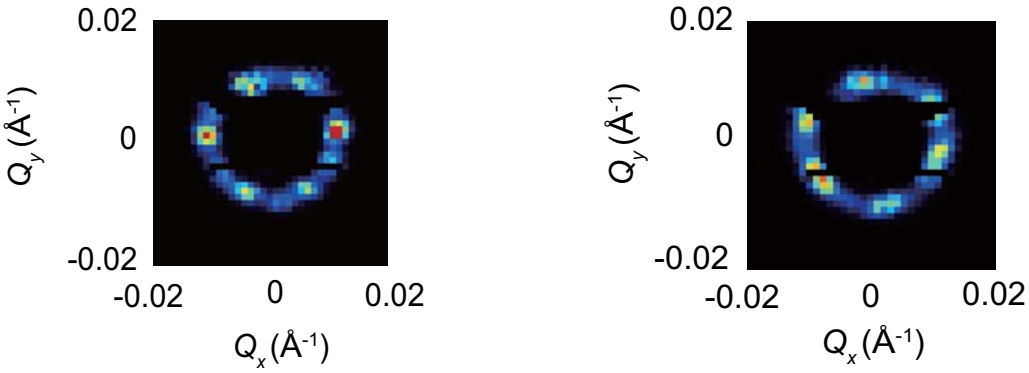

Fig. 1: (Left) SANS pattern observed at T = 54 K, H = 150 Oe, and V = 0V, which is in the SkX(2) phase. (Right) SANS pattern observed at T = 54K, H = 150 Oe, and V = 1500V. Clear rotation of the hexagonal diffraction pattern was observed.