MLF Experimental Report	提出日 Date of Report May 22, 2013
課題番号 Project No. 2012A0081 実験課題名 Title of experiment Magnetic properties of an organic Mott insulator β'-(BEDT-TTF)$_2$ICl$_2$ studied by inelastic neutron scattering 実験責任者名 Name of principal investigator Seiko Kawamura 所属 Affiliation MLF, J-PARC	装置責任者 Name of responsible person Kenji Nakajima 装置名 Name of Instrument/（BL No.） AMATERAS (BL14) 実施日 Date of Experiment November 8-12, 2012

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: β'-(BEDT-TTF)$_2$ICl$_2$

Formula: $(C_{10}S_8H_8)_2$ ICl$_2$

State and weight: tiny single crystals, 1.5 g

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.

Experimental method

β'-(BEDT-TTF)$_2$ICl$_2$ is an organic dimer-Mott insulator having a quasi-two dimensional (2D) crystal structure. About 230 pieces of tiny single crystals are aligned on aluminum plates so that the *a**-axis is perpendicular to the aluminum plate (namely the 2D plane is parallel to the plate) and that the *c*-axis is co-aligned with each other (Fig. 1). The aluminum plates on which the samples were mounted were set to an aluminum frame to mount in a standard aluminum sample cell (Fig. 1). Helium gas and indium seal were not used to prevent scattering from helium free particles. The sample was cooled down to 7 K with a closed-cycle ^{4}He refrigerator. For inelastic scattering measurements, the incident neutron energies E_i = 15, 7.7, 4.7 and 3.1 meV were chosen. The *a**-axis, which corresponds to the stacking direction, is set to be parallel to the incident neutron beam.

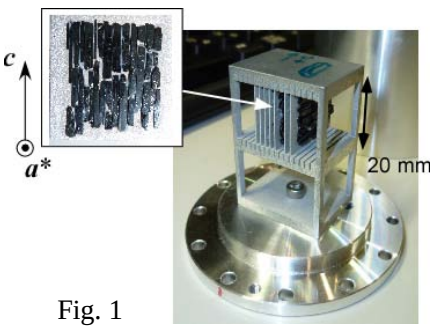

Fig. 1

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

Results

After the sample orientation was checked, we tried to search magnetic Bragg peaks along the a^*- and b^*-axes using white beam. Although we chose the configurations where the first magnetic Bragg peaks (0.5, 0, 0) and (0, 0.5, 0), are expected to be observed with the most intense E_i, they could not be observed within statistics error. Very recently we knew the results of the neutron diffraction study on this system using four-circle diffractometer perfomed by Y. Noda et al. (unpublished, by private communication). They observed magnetic Bragg peaks at (0.5, 0.5, 0) and its equivalent positions, and they reported that the (0.5, 0, 0) and (0, 0.5, 0) peaks should disappear due to an extinction rule (according to a Master's theses in his co-worker).

As the first-order magnetic Bragg peaks appear at $\boldsymbol{Q}$ = (0.5, 0.5, 0) and its equivalent positions, it is expected that the magnetic excitation is also observed around there. Figures 2 shows the E-Q slices along the k direction at h = 0.5 ± 0.2 and l = 0 ± 0.2 with E_i = 7.7 meV, observed at 7 and 46 K. The Bose factors are already corrected. A dispersive excitation signal was observed at around k = 0.5 at 7 K. It is needed to check whether similar dispersion is observed at any equivalent positions or not, in order to conclude that this is magnetic excitation due to the 3D order. The other equivalent positions are however out of the observable (h k l) region for the present configuration. We need to rotate the sample to do that. Because this material has been regarded as a 2D system, magnetic excitation rods may be observed along the a^* axis just above T_N = 22 K. where the intensity in the h direction can be integrated. Then we are planning to propose the next study to observe such excitations due to the 2D magnetic correlation.

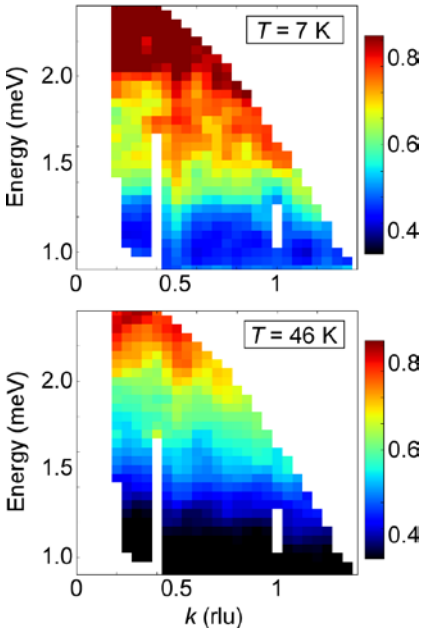

Fig. 2: E-Q slices along the k direction around h = 0 and l = 0.5 with 7.7 meV.