MLF Experimental Report	提出日 Date of Report 2012.8.7
課題番号 Project No. 2012A0005 実験課題名 Title of experiment Collective dynamics of Ag ions in superionic conductors MAg_4I_5 (M=K, Rb) 実験責任者名 Name of principal investigator Shuta Tahara 所属 Affiliation University of the Ryukyus	装置責任者 Name of responsible person Kenji Nakajima 装置名 Name of Instrument/(BL No.) The Cold-Neutron Disk-Chopper Spectrometer (AMATERAS) / BL-14 実施日 Date of Experiment 2012.6.10 – 2012.6.13

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.

(1) Rubidium silver iodide, $RbAg_4I_5$

(2) Potassium silver iodide, KAg_4I_5

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.

Each sample was contained in Al-foil cell about 20g in weight. This Al-foil cell was set in the Al standard cell which was possessed by BL-14. The inside of Al standard cell was filled with He gas. In the case of $RbAg_4I_5$, the sample temperature was controlled within a wide temperature range from 10K to 348K by using the cryo-furnace. In particular, the measurement near the superionic transition at 122K was carried out at short intervals of 5K. Since KAg_4I_5 decomposes with $KAg_4I_5 \rightarrow AgI + K_2AgI_3$ below 311K, the sample temperature was kept at around 348K during the sample setup. We confirmed that the sample was not decomposed by the profile of the elastic powder diffraction. In this experiment, multi-E_i (E_i = 5.93, 10.53, 23.70, and 94.30 meV) measurement was carried out. The frequency of chopper revolution was 150Hz.

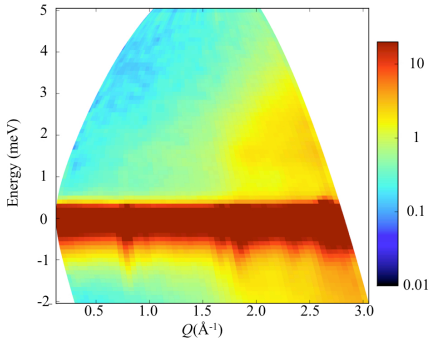

Figure 1. The inelastic neutron scattering spectrum for polycrystalline $RbAg_4I_5$ at 135K.

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

Figure 1 shows The inelastic neutron scattering spectrum with Ei = 10.53 meV for polycrystalline $RbAg_4I_5$ at 135K. The boson peak is observed at around 1.5 Å^{-1} < Q < 3.0 Å^{-1}, and 1.0 meV < E < 4.0 meV.

The energy dependences of the neutron scattering intensity, $I(E)$, at several Q points are shown in figure 2. Although no characteristic peak was observed at small Q (= 1.346 Å^{-1}), a single peak which means a low energy excitation is observed at around E = 1.5 meV and Q = 1.725 Å^{-1}. In more high Q (> 2 Å^{-1}) region, an additional peak at around 2.5 meV is clearly observed. Such two low energy excitation peaks were also reported in the case of superionic conductor Ag_3SI at around E = 2 and 5 meV. It was observed that these two peaks for $RbAg_4I_5$ were merged into a wide single peak at room temperature.

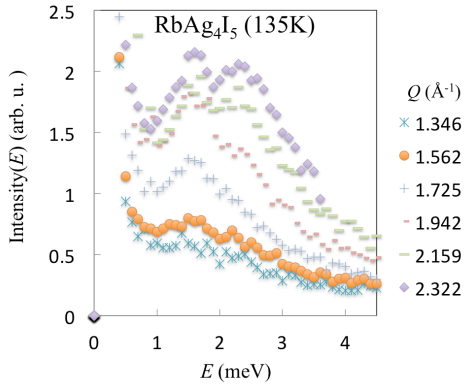

Figure 2. The energy dependence of the intensity for $RbAg_4I_5$ at 135K.

Figure 3 shows the Q dependence of the neutron scattering intensity, $I(Q)$, obtained from integration of $I(Q, E)$ along E for $RbAg_4I_5$ at 135K. Each integration region of energy is listed in the figure 3. The integration regions for blue and red makers are near boson peak positions at around E = 1.5 and 2.5 meV, respectively. The blue markers show a peak at around Q = 2 Å^{-1}, while the red ones show a peak at around Q = 2.2 Å^{-1}. The temperature dependence of height of this characteristic peak at around E = 1.5 meV, Q = 2 Å^{-1} across the phase transition at T = 122K was shown in figure 4. Near the transition point 122K, the temperature dependence of peak height is large compared with the temperature region of 110 – 115K and 130 – 135K. It may mean that the peak height relates to the conductance of Ag ions.

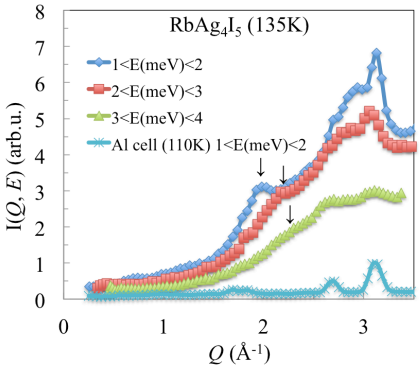

Figure 3. The Q dependence of the neutron scattering intensity, $I(Q)$, obtained from integration of $I(Q, E)$ to the E direction. Each integration region of energy corresponding to the color of marker is listed.

The stable temperature-region for KAg_4I_5 which is from 311K to 526K is narrower than that for $RbAg_4I_5$. Therefore, the measurement for KAg_4I_5 was carried out only at 348K. The inelastic neutron scattering spectrum for KAg_4I_5 shows very similar tendency to that for $RbAg_4I_5$. In particular, a peak at around E = 1.5 meV, Q = 2 Å^{-1} is also observed for KAg_4I_5 as a characteristic common property between $RbAg_4I_5$ and KAg_4I_5.

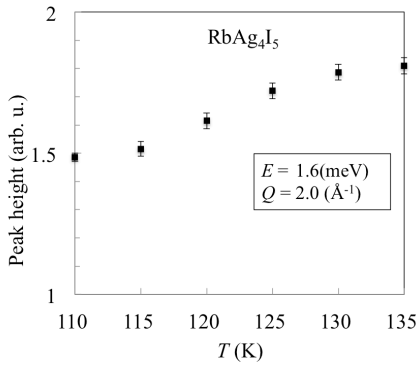

Figure 4. The temperature dependence of the peak-height at around Q = 2.0 Å^{-1} and E = 1.6 meV for $RbAg_4I_5$ across the phase transition at T = 122K.