


実験報告書様式(一般利用課題・成果公開利用)

(※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。)

 <b>MLF Experimental Report</b>	提出日 Date of Report
課題番号 Project No. 2013B0126 実験課題名 Title of experiment $\mu$ SR study of organic antiferromagnet $\beta'$ -(BEDT-TTF) <sub>2</sub> ICl <sub>2</sub> under high pressure 実験責任者名 Name of principal investigator Kazuhiko Satoh 所属 Affiliation Graduate School of Science and Engineering, Saitama University	装置責任者 Name of responsible person Yasuhiro Miyake 装置名 Name of Instrument/(BL No.) D1 実施日 Date of Experiment 2014/3/21-2014/3/23

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.
$\beta'$ -(BEDT-TTF) <sub>2</sub> ICl <sub>2</sub>

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.
<p>Organic compound <math>\beta'</math>-(BEDT-TTF)<sub>2</sub>ICl<sub>2</sub> shows antiferromagnetic transition at 22 K under ambient pressure and precession <math>\mu</math>SR signal is observed below Neel temperature, <math>T_N</math>. This compound becomes superconductor under ultra-high pressure around 8 GPa. Antiferromagnetic correlation is considered to play important role for superconductivity of <math>\beta'</math>-(BEDT-TTF)<sub>2</sub>ICl<sub>2</sub> and microscopic study of magnetic state under high pressure is desired. We have carried out preliminary <math>\mu</math>SR measurement <math>\beta'</math>-(BEDT-TTF)<sub>2</sub>ICl<sub>2</sub> under high pressure at TRIUMF and found that both Neel temperature and spontaneous precession frequency in the antiferromagnetic state are strongly enhanced at 1.8 GPa. Below 0.7 GPa, however, amplitude of precession signal becomes small and we cannot detect precession signal. As one hole is injected to (BEDT-TTF)<sub>2</sub> dimer, spin of dimer is considered to be 1/2 and magnitude of spin will be same in high pressure. Enhancement of precession frequency above 0.7 GPa and absence of precession component below 0.7 GPa suggest that pressure-induced magnetic phase transition occurs around 0.7 GPa and volume fraction of high-pressure magnetic phase increases with pressure. In order to confirm this suggestion, precise high pressure <math>\mu</math>SR measurement using new high pressure cell is desired.</p>

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

We carried out high-pressure  $\mu$ SR experiment for organic antiferromagnet  $\beta'$ -(BEDT-TTF) $_2$ ICl $_2$  using newly designed high pressure cell which has relatively high signal-to-noise ratio in order to investigate the influence of pressure on the magnetic state. Applied load is 2 ton and corresponding pressure is estimated to be about 0.4 GPa at room temperature. It should be noted that pressure is somewhat reduced at low temperatures due to contraction of pressure medium. Figure 1 and 2 show preliminary zero-field  $\mu$ SR signal of  $\beta'$ -(BEDT-TTF) $_2$ ICl $_2$  with at 40.4 K (normal state) and 4.9 K (antiferromagnetic state), respectively. Precession  $\mu$ SR signal from  $\beta'$ -(BEDT-TTF) $_2$ ICl $_2$  can be observed below  $T_N$  and new high-pressure cell is also useful for low density materials such as organic systems. Roughly 20 % muons stop at sample and other 80 % muons stop at high pressure cell. Figure 3 shows temperature dependence of precession frequency. These data are almost the same those at ambient pressure and high-frequency precession signal which is observed above 0.7 GPa is not observed in the present experiment. Further experiment above 0.4 GPa is necessary in order to confirm pressure-induced magnetic phase transition in  $\beta'$ -(BEDT-TTF) $_2$ ICl $_2$ .

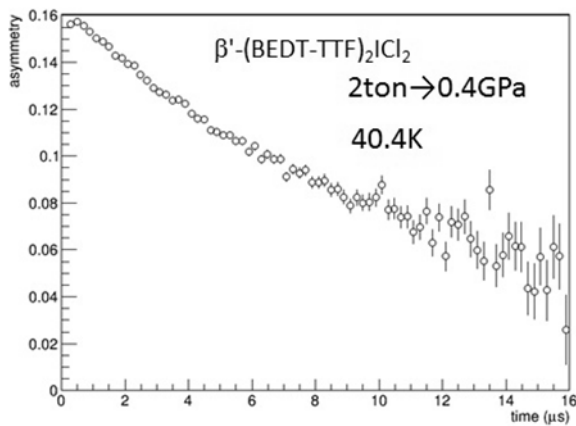


Fig. 1  $\mu$ SR spectrum for  $\beta'$ -ET $_2$ ICl $_2$  in the normal state.

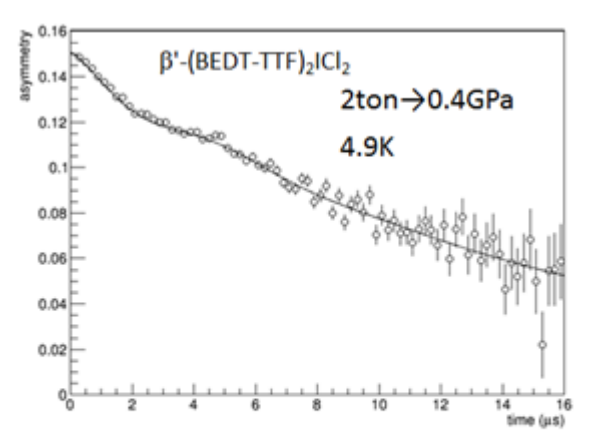


Fig. 2  $\mu$ SR spectrum for  $\beta'$ -ET $_2$ ICl $_2$  in the antiferromagnetic state.

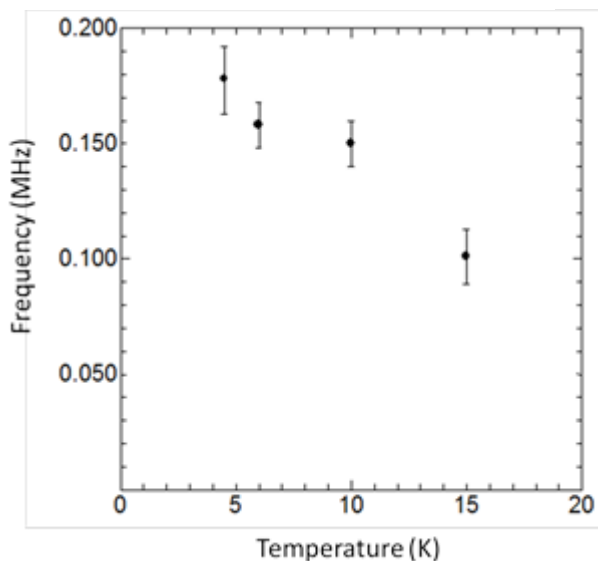


Fig. 3 Temperature dependence of muon precession frequency of  $\beta'$ -ET $_2$ ICl $_2$  in the antiferromagnetic state.