MLF Experimental Report	提出日 Date of Report
課題番号 Project No. 2014A0224 実験課題名 Title of experiment μSR study of BEDT-TTF-based organic antiferromagnets with β' phase 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 2014/5/25-2014/5/28

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.

β'-(BEDT-TTF)$_2$ICl$_2$

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.

Organic compound β'-(BEDT-TTF)$_2$ICl$_2$ shows antiferromagnetic transition at 22 K under ambient pressure and precession μSR signal is observed below Neel temperature, T_N. This compound becomes superconductor under ultra-high pressure around 8 GPa. Antiferromagnetic correlation is considered to play important role for superconductivity of β'-(BEDT-TTF)$_2$ICl$_2$ and microscopic study of magnetic state under high pressure is desired. We have carried out preliminary μSR measurement β'-(BEDT-TTF)$_2$ICl$_2$ under high pressure at TRIUMF and found that both Nèel 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)$_2$ 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 high 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 μSR measurement using new high pressure cell is desired.

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

We carried out high-pressure μSR experiment for organic antiferromagnet β'-(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 3.3 ton and corresponding pressure is estimated to be about 0.7 GPa at room temperature. It should be noted that pressure is somewhat reduced at low temperatures due to contraction of pressure medium. Figure 1 shows zero-field μSR signal of β'-(BEDT-TTF)$_2$ICl$_2$ around Neel temperature. Since μSR signal of β'-(BEDT-TTF)$_2$ICl$_2$ above Neel temperature is temperature-independent and μSR signal begin to change below 26.9 K, Neel temperature increases to about 27-28 K. Previous results about pressure dependence of Neel temperature suggests that pressure of present work is about 0.4 GPa. Figure 2 shows zero-field μSR signal under 3.3 ton of β'-(BEDT-TTF)$_2$ICl$_2$ at 60.9 K (normal state) and 7.4 K (antiferromagnetic state), respectively. Precession μSR signal from β'-(BEDT-TTF)$_2$ICl$_2$ can be observed in the antiferromagnetic state and new high-pressure cell is found to be useful for low density materials such as organic systems. Precession frequency at 7.4 K is 0.17 MHz which is almost the same as the ambient pressure value. Since the precession frequency is enhanced to 1 MHz above 0.7 GPa, some significant change, e. g. pressure-induced magnetic phase transition, is expected between 0.4 and 0.7 GPa and further study is desired.

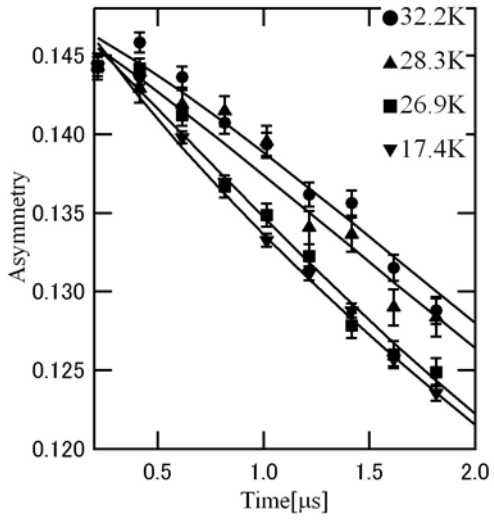

Fig. 1 μSR spectrum for β'-ET$_2$ICl$_2$ around the Neel temperature.

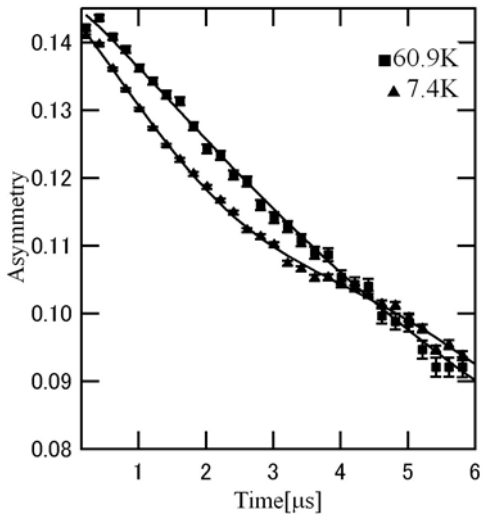

Fig. 2 μSR spectrum for β'-ET$_2$ICl$_2$ in the normal and antiferromagnetic state.