

 <b>MLF Experimental Report</b>	提出日 Date of Report 2011.07.04
課題番号 Project No. 2010B0021  実験課題名 Title of experiment High Magnetic Field Neutron Diffractions in Frustrated Multi-ferroics 実験責任者名 Name of principal investigator Hiroyuki Nojiri 所属 Affiliation Institute for Materials Research, Tohoku University	装置責任者 Name of responsible person Masahide Harada 装置名 Name of Instrument/(BL No.) BL10 実施日 Date of Experiment 2010.02.18-2010.02.19 2011.03.07-2011.03.11

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.
MnWO <sub>4</sub> 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.
<p>This proposal is the continuation of the 2010A. In the latter, we have measured the high magnetic field phase of the multi-ferroic compound BiFeO<sub>3</sub> and found that the high field phase is incommensurate. We have also made a short experiment on the multi-ferroic compound MnWO<sub>4</sub> up to 30 T. The data accumulation was poor for the weak intensity of 100 kW. In 2010B, we aimed at continuing the experiment on MnWO<sub>4</sub>.</p> <p>MnWO<sub>4</sub> shows the memory effect in high magnetic field. It consists of zig-zag chains running along the <i>c</i>-axis. For the strong spin frustration, three different magnetic phases; AF1(uudd), AF2 (non- collinear, incommensurate cycloidal), AF3(incommensurate sinusoidal) appear at zero field. There are at least three unknown phases in high magnetic fields; HF, IV and V. When a magnetic field is applied along the easy-axis, a distinct memory effect is found. Namely, the polarization between the AF2 and IV are always opposite irrespective of the initial polarization. Moreover, the memory is kept while the system is passing through the HF phase, where no polarization exists. The key experiment to understand the mechanism of the multi-ferroic behavior and the distinct memory effect in MnWO<sub>4</sub> is the determination of magnetic structures in the high magnetic field phases HF, IV and V.</p>

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

In the experiment in 2010A and also in a complementary one at SNS-ORNL up to 30 T, we have determined that the phase IV is incommensurate and that the HF phase has also small splitting in magnetic peak. In 2010B, we have first confirmed the pervious result up to 30 T. As shown in Fig. 1, a peak is observed at 4.6 msec by accumulation of data a few hours. This is the commensurate peak. The sample mounting, test experiment and low field(up to 30 T) were done without trouble before the break on 11, March morning.

On March 11, there is a short break of neutron beam delivery during the daytime and then we were ready for the 40 T experiment by 13:00 P.M. When we are filling the He for the restart of the neutron beam in the evening, the earthquake came and we had to evacuate from the site. So, we could not take the data at 40 T and we will continue the experiment in 2011A after the finishing of the recovery of MLF-J-PARC.

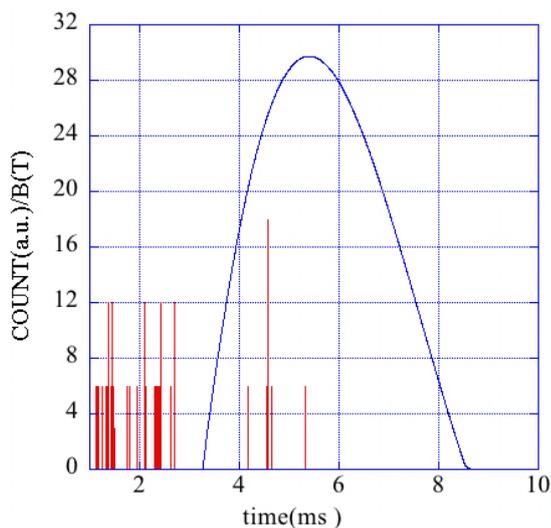


Fig. 1 Test data at 30 T.