

(※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。)

 MLF Experimental Report	提出日 Date of Report
課題番号 Project No. 2015A0183 実験課題名 Title of experiment Investigation of High Magnetic Field Phases in multi-ferroic $Ba_2CoGe_2O_7$ with nematic interaction 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 装置名 Name of Instrument/(BL No.) BL10 実施日 Date of Experiment 2016/06/11-13 2017/01/26-28

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.
$Ba_2CoGe_2O_7$ 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>The purpose of this proposal is to investigate the high magnetic field phase in two-dimensional square lattice antiferromagnet $Ba_2CoGe_2O_7$, in which a magnetic field induced electric polarization is observed. [Phys. Rev. Lett. 105, 137202 (2010)] The Neel order appears below $T_N=6.7$ K and a staggered antiferromagnetic structure in the (001) plane with slight canting is found. Although the magnetic structure is trivial, it is found that the magnetization curve is not linear to external magnetic field.</p> <p>We have measured the field dependence of (1, 0, 0) magnetic peak at by applying the magnetic field along the <i>c</i>-axis. The figures show the temperature dependence of (1, 0, 0) magnetic peak and the comparison of TOF spectrum measured at 25 T with two zero field spectra. We have also tried other magnetic fields, but the statistics is too low to judge their field variations. It was caused by the cut off of the beam power to 150 kW for the target trouble. In this beam power, we need 3-4 times longer accumulation time and an future extension in another proposal is needed to complete this task.</p>

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

As shown in the figures, we found the large increase of the magnetic peak intensity at 25 T. The uniform moment is about 69-65 % at this field and the antiferromagnetic moments contributing to the Bragg peak should be reduced. The experimental result is not very simple in the sense that the intensity variation does not meet with the simplest expectation. This is partly caused by the loss of the canting moment, but the domain redistribution must be checked by the zero field experiment for more quantitative analysis. We also confirmed that there is no clear shift of the wave vector between 0 and 25 T, but we found a small change of the TOF peak between 4.2 K and 2.5 K. This point will be examined in successive proposal.

In summary, the non-monotonic field dependence of the magnetic Bragg peak is found in the range of the field where a non-linear magnetization was observed. However, this change is confirmed to have no change of the magnetic wave vector in the resolution of the present experiment. The successive experiments is needed to examine the field dependence of the magnetic structure between 25 T and 35 T.

