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 MLF Experimental Report	提出日 Date of Report
課題番号 Project No. 2014A0298 実験課題名 Title of experiment High Magnetic Field Neutron Diffraction in Shastry-Sutherland System - Step 2 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 Takashi Ohara 装置名 Name of Instrument/(BL No.) BL18 実施日 Date of Experiment 2014.11.5-11.10

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.
<p>SrCu₂(BO₃)₂ single crystal</p>

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>We have made the second experiment by using a wide-angle solenoid coil generating 40 T and have achieved several improvements from the 1st experiment of the proposal 2012B0147. The final goal of this experiment is to investigate the magnetization plateaus observed in quasi two-dimensional materials. The sample is the Shastry and Sutherland lattice and the realization is found in SrCu₂(BO₃)₂. The compound has a unique orthogonal arrangement of dimers in two-dimension. For the frustration between the nearest neighbor and the next-nearest neighbor interactions, the effective repulsive interaction acts among triplets. The hopping of triplets is strongly suppressed for the orthogonal dimer network. These two special conditions result in the formation of plateau state.</p> <p>In the present experiment, we have investigated the 1/8 plateau appearing at around 28.5 T and the state above 1/8 plateau. Combining our new capacitor bank and the wind-angle solenoid, we can access to 40 T. Figure 1 shows the new capacitor bank of 90 kJ storing energy. It can be set in the limited space of BL18. The temperature was cooled down to 2 K, which is limited by the power of the pump for 4He-depressuring. This point must be improved by using larger pump and/or the 3He system in the next experiment.</p> <p>Figure 2 shows the TOF spectrum in (h,0,0) zone. The pulsed magnetic field is applied to the index of (7/8 0 0). We could not found magnetic Bragg peak in this setting. Although a fast adiabatic cooling effect is expected in pulsed magnetic fields, it is unclear at present if the wave vector for 1/8 plateau phase is different or the temperature was not low enough.</p>

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

Figure 3 shows the TOF spectrum at 32.6 T, which is located between 1/8 and 1/4 magnetization plateaux. We found no peak in this condition.



Fig. 1 New 90 kJ Capacitor Bank

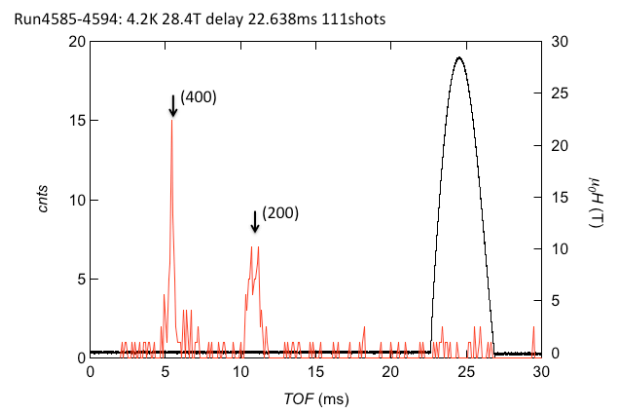


Fig. 2 TOF Spectrum at 28.4 T

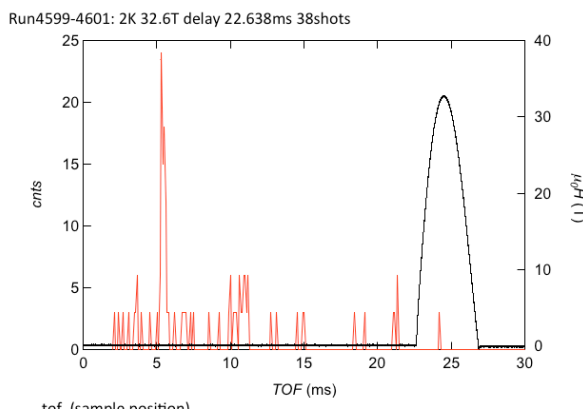


Fig. 3 TOF Spectrum at 32.6 T

To be summarized, in the step II experiment, we could reach the 1/8 plateau and the state between 1/8 and 1/4 plateaux. However, no magnetic peak was found in high magnetic fields. At this moment, it is not clear, if the wave vector is not in the (h 0 0) zone or not. On the other hand, we could take the TOF spectrum in high magnetic fields including (200) and (400). The estimate of the intensity of magnetic Bragg peaks proposed by different models is in progress for the step III experiment. Since we can access the magnetic field above 30 T now, we are going to introduce the ^3He low temperature device in the next step.