MLF Experimental Report	提出日 Date of Report
課題番号 Project No. 2012B0248 実験課題名 Title of experiment Visualization of 3D local atomic arrangement by neutron holography technique with white neutron 実験責任者名 Name of principal investigator Kenji Ohoyama 所属 Affiliation Institute for Materials Research, Tohoku Univ.	装置責任者 Name of responsible person Dr. Oikawa 装置名 Name of Instrument/（BL No.） BL10 実施日 Date of Experiment 11-12, FEB, 2013 13-17, MAR 2013.

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.

In this project, we aim at neutron holography experiments by the inverse method in J-PARC. For the inverse method, gamma-ray from neutron absorber elements will be observed, we will use elements with large neutron absorption cross sections, in contrast to normal neutron scattering experiments. In the experiments in 2012B, we used the following samples to estimate intensity of gamma ray from the absorber for feasibility tests.

$Si_{0.994}B_{0.006}$

$Ca_{0.99}Eu_{0.01}F_2$

Magnetic Material SmCo5 as a test sample of magnetic holography

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.

Since we are trying to perform world first neutron holography in pulsed neutron facilities, the main purpose in 2012B is feasibility tests whether the intensity of gamma ray and S/N ratio are practically enough for holography experiments, and exposure of technical problems which should be overcome by main experiments. Base on the obtained results in 2012B, we will decide sample conditions, the structures of Pb shield, and prepare required devices. As the first step, we used one day of our 5day beamtime in February 2013 for measurements of gamma ray from polycrystalline samples of Eu 1% doped CaF_2, $SmCo_5$, and B 0.6% doped Si. We used a BGO scintillation detector with a photomultiplier tube, and GateNet system, which were provided by BL10 group. Dr. Harada of BL10 kindly and fully supported our experiments. Fig.1 shows gamma ray spectra from a $Ca_{0.99}Eu_{0.01}F_2$ pollicrystalline sample for 500 sec. the horizontal axis is gamma energy channel. The black line indicates the background without the sample, blue and red gamma ray from the sample with distance between the sample and detector of 5cm and 10cm. In the most of the range, S/N~100 could be obtained, meaning that Eu doped CaF_2 is a good sample for main holography experiments.、

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

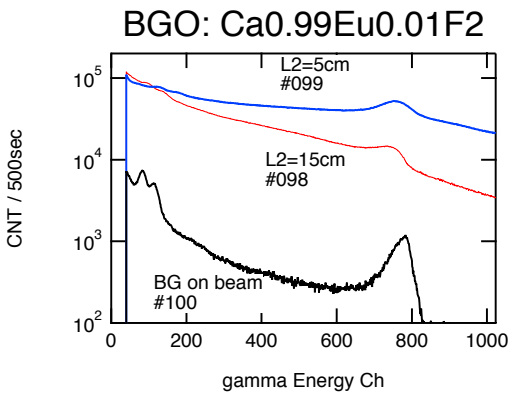

Fig.1 gamma ray spectra from $Ca_{0.99}Eu_{0.01}F_2$ single crystal.

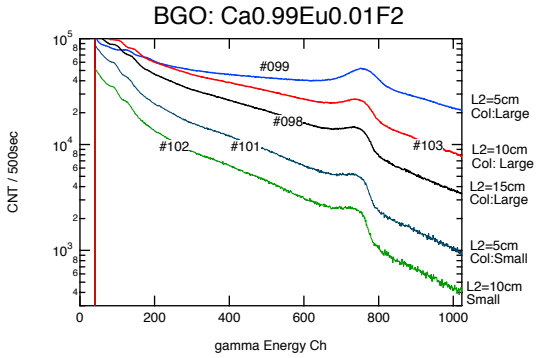

Fig.2 gamma ray spectra from $Ca_{0.99}Eu_{0.01}F_2$ single crystal under several experimental conditions.

Fig.2 shows several gamma ray spectra obtained different experimental conditions. From the measurements we found that the optimum distance between the sample and the detector must be about 10cm. Fig.3 shows gamma ray spectra from a ferromagnet $SmCo_5$, whish is a sample for magnetic holography (Fig.3). For $SmCo_5$, though S/N~10 was obtained, it is worse of those for Eu doped CaF_2, implying that for magnetic holography we should consider using polarised neutron beams.

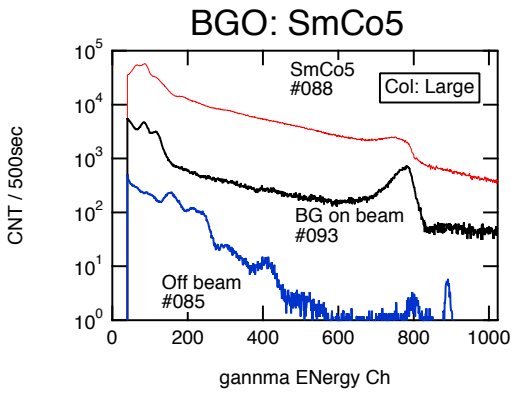

Fig.3 gamma ray spectra of a ferromagnet $SmCo_5$.

Based on the results of experiments in February, we tried holography experiments of a single crystal $Ca_{0.99}Eu_{0.01}F_2$ in March for 4 days. Though $Ca_{0.99}Eu_{0.01}F_2$ itself is not very important from academic view points, we should emphasise that this is the very first holography experiments in pulsed neutron facilities in the world. The single crystal was prepared in IMR. Dr. Harada fully supported the experiments as well. To obtain holograms, we used a dual axis goniometer (ϕ, ω). The ϕ-axis was rotated continuously during a measurement for 360°. The measured range of ω was 20°~150°; ω=0° was determined as the position where the ϕ-axis was parallel to the neutron beam of BL10. By Dr. Inamura' kind and full support, we could use event data treatment, which made it possible to create data set of ϕ and ω dependence of gamma ray spectra from independently obtained gamma ray intensity, position of the goniometer (ϕ, ω), and ToF data of the neutron monitor. The event treatment is quite important to realise holography experiments, because holography experiment require a huge number of measurement points of (ϕ, ω). Dr. Inamura also supported construction of the data analysis system for holography experiments system, as well. For the 4day experiments in March, we succeeded in obtaining (ϕ, ω) dependent gamma ray spectra, meaning that the world's first ToF neutron holograms can be created from the raw data. Data analysis and transform is now in progress in IMR.