茨城県 IBARAKI Prefectural Government **MLF Experimental Report**	提出日(Date of Report) 2021/11/18
課題番号(Project No.) 2018PM0022 実験課題名(Title of experiment) 強相関電子材料の結晶・磁気構造に関する研究 実験責任者名(Name of principal investigator) 石垣　徹 所属(Affiliation) 茨城大学フロンティア応用原子科学研究センター	装置責任者(Name of responsible person) 石垣　徹 装置名(Name of Instrument : BL No.) iMATERIA: BL20 実施日(Date of Experiment) 2018/11/7, 11/26, 12/12

実験目的、試料、実験方法、利用の結果得られた主なデータ、考察、及び結論を記述して下さい。
実験結果などの内容をわかりやすくするため、適宜図表添付して下さい。
Please report experimental aim, samples, experimental method, results, discussion and conclusions. Please add figures and tables for better explanation.

1. 実験目的(Objectives of experiment)

Magnetic materials containing rare earth elements Eu and Sm, which include strong absorbing isotopes for thermal neutrons, are known to have interesting physical properties such as non–conventional heavy fermion states. It has become possible to observe diffraction peaks even of such highly absorbing materials, but it is difficult to make quantitative absorption correction necessary for obtaining accurate information on the crystal and magnetic structure. Therefore, we perform a powder neutron diffraction experiment on highly absorbing materials and examined the absorption correction method using the diffraction data.

2. 試料及び実験方法
Sample(s), chemical compositions and experimental procedure

2.1 試料 (sample(s))

Powder samples of Eu_2O_3 and LaB_6

2.2 実験方法(Experimental procedure)

Powder neutron diffraction data were measured on a time–of–flight (TOF) neutron diffractometer iMATERIA at J-PARC. Focusing on the fact that the effect of neutron absorption in matter becomes smaller as the incident neutron becomes higher energy, we analyzed using the data of the low–angle detector bank (scattering angle 2θ = 15 deg.). A double cylindrical cell was used as the sample holder.

3. 実験結果及び考察（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 results and discussion. If you failed to conduct experiment as planned, please describe reasons.

Figure 1 shows the diffraction patterns of Eu_2O_3 and LaB_6 at room temperature. The experimental absorption factors (A_{obs}) were obtained from the integrated intensities of these diffraction peaks and compared with the calculated absorption factors (A_{cal}) by taking into account the total path lengths of neutron through the crystals in the double-cylindrical cell [1]. In the high energy region above about 50 meV, A_{obs} was found to be roughly in agreement with A_{cal}. On the other hand, in the low energy region, A_{obs} and A_{cal} cannot be compared because the nuclear structural factor is small or there is no nuclear peak. From this comparison, it was also found that when the absorption cross section has a large dependence on the incident neutron energy E_i, it is necessary to take into account the effect of the time focus method of TOF powder neutron diffraction on the absorption correction. Furthermore, we focused on the fact that the E_i dependence of the background intensity in the low energy region in Fig. 1 is not linear. This is considered to be the effect of the incoherent scattering of vanadium in the sample holder being absorbed by the sample. In fact, it was found that this E_i dependence of the background intensity roughly reproduces that of A_{cal}.

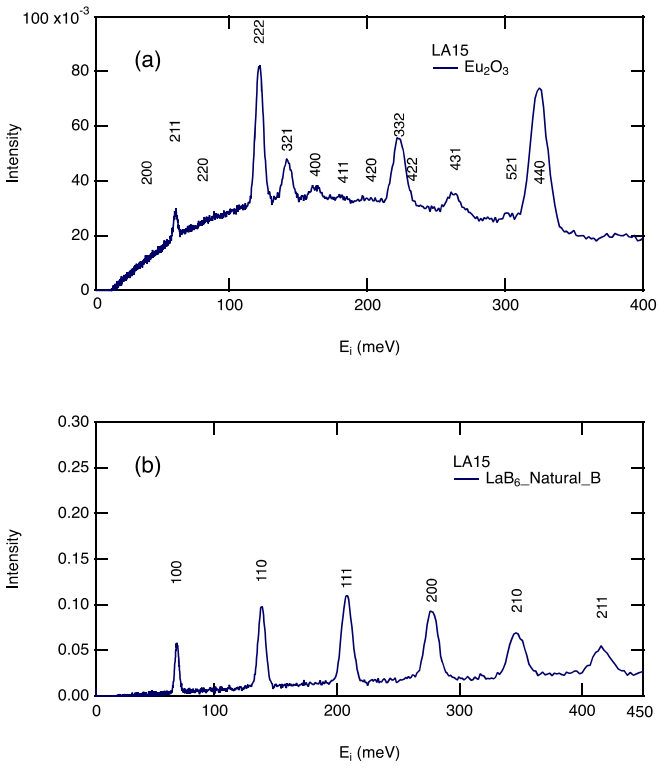

Fig. 1 Diffraction patterns at room temperature of (a) Eu_2O_3 and (b) LaB_6

[1] H. H. Paalman, and C. J. Pings, J. Appl. Phys. **33**, 2635 (1962)

4. 結論(Conclusions)

This study confirmed that the effect of the time focusing method of TOF powder neutron diffraction on the absorption correction should be taken into consideration. It was also found that absorption correction in the low energy region could be experimentally performed by using the incoherent scattering of vanadium.