MLF Experimental Report	提出日 Date of Report 2/4/2010
課題番号 Project No. 2009B0031 実験課題名 Title of experiment Experimental study on a calibration method of devices for neutrons from thermal to several 100 MeV using a spallation neutron source 実験責任者名 Name of principal investigator Tetsuro Matsumoto 所属 Affiliation National Institute of Advanced Industrial Science and Technology	装置責任者 Name of responsible person Fujio Maekawa 装置名 Name of Instrument/ (BL No.) NOBORU BL 10 実施日 Date of Experiment 1-2/2/2010, 24 h

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.

No use.

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.

1. Introduction

In the present experimental theme, we have developed neutron measurement devices that can be used in a high flux neutron field with a spallation neutron source. Characteristics of the devices are evaluated using the NOBORU facility.

The devices will be applied for the study on single-event phenomenon of a semiconductor and epi-thermal neutron calibration of radiation protection devices. Experimental hours were 24 hours.

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

2. Experiment

2.1 Detector

For the purposes, we must prepare detection devises that can be used in a high flux neutron field. We prepared a Bonner sphere spectrometer in this proposal research.

The Bonner sphere spectrometer is composed of neutron moderators and a spherical 3He proportional counter (CENTRONICS SP9 gas pressure 0.2 atm) . We used 6 kinds of moderator for the Bonner sphere spectrometer as shown in table 1. We prepared the Bonner sphere with the lead to be high sensitive to high energy neutrons as shown in figure 1.

2.2 Experimental setup

Experiment systems are shown in figure 2. A rotary collimator was inserted in the beam course in order to reduce neutron flux. Moreover, we adopted the low pressure (0.2 atm) ^{3}He proportional counter to perform measurements in the high flux neutron field. However, pulse height spectra observed with the Bonner sphere spectrometer was distorted by the gamma flash from the neutron source. Therefore, we set the lead blocks between the beam shutter and the spectrometer to shield the gamma flash as shown in figure 2.

An incident neutron beam had a spatial distribution because a rotary collimator was inserted in the beam course in the present experiment. We assumed a neutron beam with a 50 mm diameter and a uniform distribution at first. The response function of the spectrometer was derived using the MCNPX monte-carlo code (Nuclear data file is JENDL-High Energy file [1]) under this condition. The response function is shown in figure 3.

Neutron spectra were derived by means of an unfolding method using the response function and observed counts. We used MAXED and GRAVEL codes included UMG3.3 package [2] as an unfolding program. The GRAVEL is modified SAND-II code. Figure 4 shows the neutron spectra. On the other hand, under the experiment systems the neutron spectra were guessed by the MCNPX simulation. The calculated spectra are also shown in figure 4. There is a discrepancy between the two spectra. In figure 4, above 1MeV experimental results are lager than calculated ones. We think because we did not consider a neutron leakage caused by a small gap between lead blocks in our calculation.

In this data analysis, we used an assumption for beam condition. Therefore, these are preliminary results.
The response function will be derived under more detail condition in future. We will extract more precise information from the measurement data.

References

[1] Nuclear data center of JAEA: http://wwwndc.tokai-sc.jaea.go.jp/index.html
[2] M. Reginatto, et al.: Nucl. Instr. Methods **A476**, 242 (2002).

Table 1. Moderators used in the Bonner sphere spectrometer

diameter	material
3	polyethylene
4	polyethylene
5	polyethylene
6	polyethylene
10	polyethylene
357p	3" polyethylene, 5" lead, 7" polyethylene

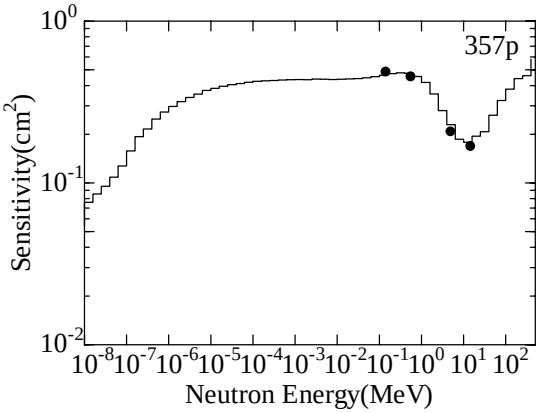

Figure 1. Detection efficiency curve of the Bonner sphere (moderator type of 357p)

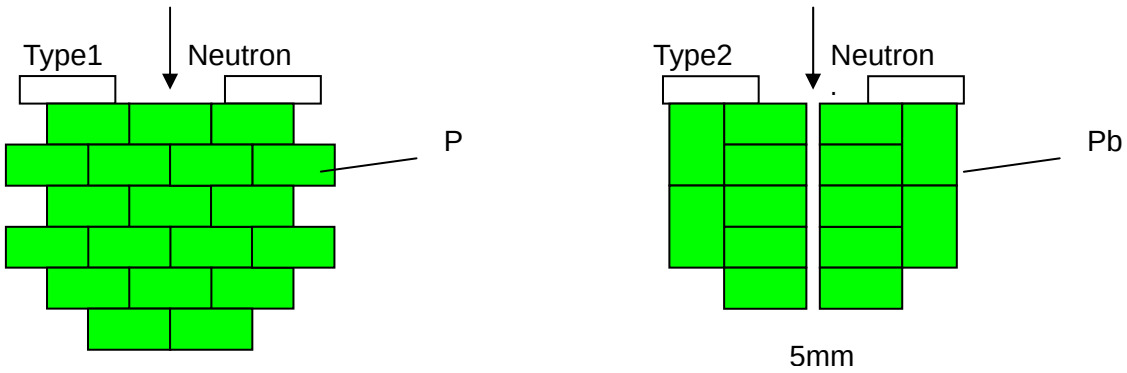

Figure 2. Experimental setup

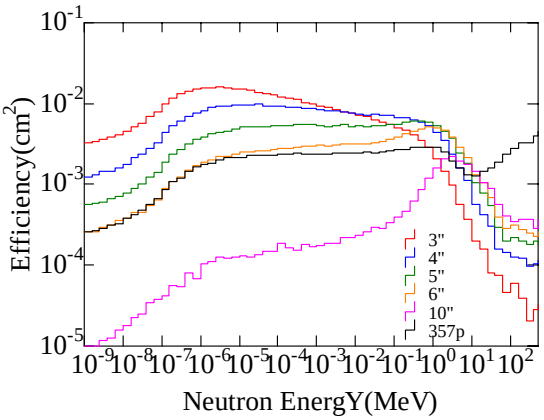

Figure3. Response function of the Bonner sphere spectrometer

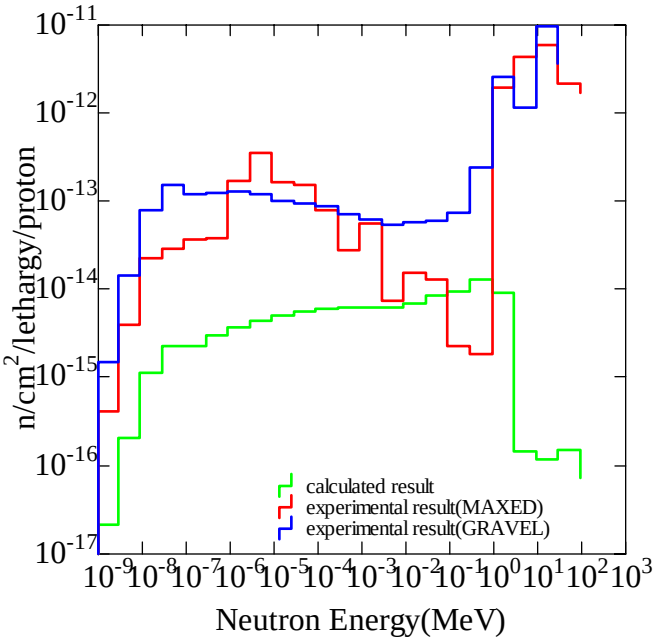

Figure4. Experimental results