実験報告書様式（一般利用課題・成果公開利用）

MLF Experimental Report

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装置責任者 Name of responsible person
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実験課題名 Title of experiment
Study on Neutronic Performance of JSNS

装置名 Name of Instrument/（BL No.）
NOBORU / BL10

実験責任者名 Name of principal investigator
Fujio MAEKAWA

実施日 Date of Experiment
2009/5/29 – 2010/6/1

所属 Affiliation
Japan Atomic Energy Agency

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 sample was used.

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.

We continued the *Study on Neutronics Performance of JSNS* with extending parameters to measure. Quantitative measurement of spectral intensity of fast neutrons in the MeV energy region is of interest in terms of shielding design of instruments and some irradiation purposes. To measure the fast neutron spectrum, we have developed a TOF neutron spectrometer based on CAMAC that has very good time resolution. To avoid pile-up due to high counting rate, a small plastic scintillator BC408 having 7mm in diameter and 2mm in thickness was used. A typical signal is shown in Fig. 1. Two peaks of the flash-gamma due to the two-bunch beam operation were clearly observed even for the 120-kW beam power operation. By using this system, a neutron spectrum in 3-25 MeV was obtained as shown in Fig. 2. This is the first neutron spectrum in MLF measured directly by a spectrometer. Comparison with the calculated spectrum is under way.

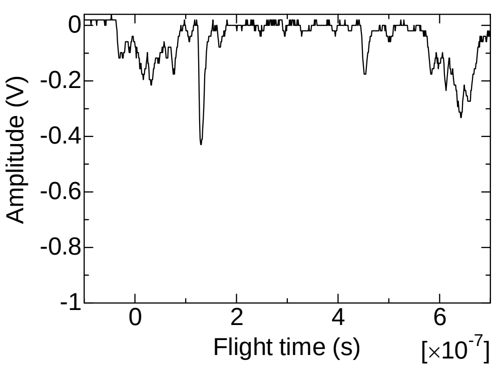

Fig 1. Raw signal of the scintillator for the 120-kW beam operation. Flash gamma peaks are found at flight time of 0 and 0.6 μs cause by two bunches beam extracted from RCS.

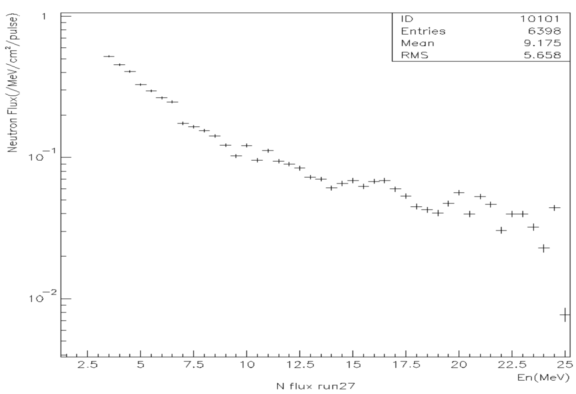

Fig 2. Preliminary result of the neutron flux spectrum in 3-25 MeV.

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

The fast neutrons were also measured with the foil activation method. Twelve threshold reactions of which sensitive energy ranged from 1 MeV to several hundreds of MeV were employed. The measured reaction rates were compared with the calculation, and found that the calculated values agree within a factor of 2 with the experimental data.

A luminosity distribution of neutron intensity on the viewed surface of the decoupled moderator was measured by using a 2-D detector, a Li glass scintillator attached on a position sensitive PMT, with utilizing a pinhole geometry. Figure 3 shows the measured distribution in an energy range from 1 meV to 100 meV. The neutron intensity is the strongest at the center as expected. The measured distribution agrees with the calculated one.

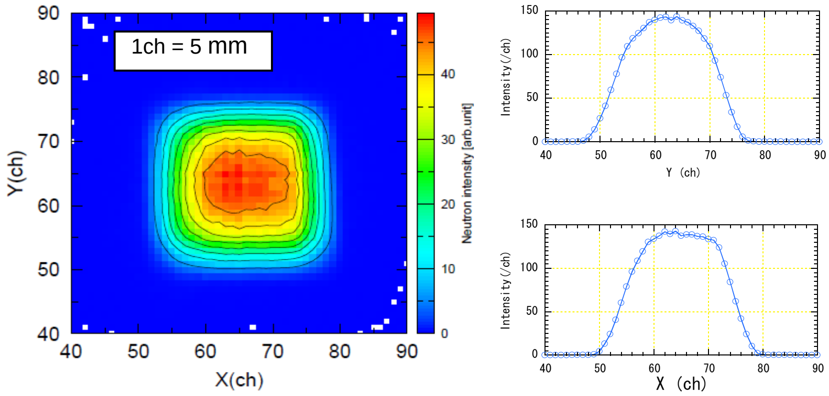

Fig. 3 The measured luminosity distribution of neutron intensity on the viewed surface of the decoupled moderator in an energy range from 1 meV to 100 meV.

The beam time in FY2009 was also used for emergent experiments such as the testing of a prototype WLS-type 2-D scintillation detector to be used for the Single Crystal Diffractometer (BL18) and some demonstration experiments for imaging. To confirm efficacy of a rotary collimator installed at the approximate middle of the beam line in the summer of 2009 is one of them. The collimator is composed of steel of 347mm and polyethylene of 50mm to effectively shield high-energy neutrons and gamma-flash coming from the spallation target. The collimation size can be selected from 100.0mm, 31.6mm, 17.8mm and 10.0mm square that correspond to the L/D ratios of 140, 190, 337 and 600, respectively. It was confirmed by measurement with neutron image plates as shown in Fig. 4 that sharpness of the measured images was improved significantly without degrading the signal to noise ratio when the smallest collimator (L/D=600) was selected. The rotary collimator brings another benefit to reduce the neutron intensity under the high-power operation. Fig. 5 shows neutron spectra measured with a He-3 detector of which efficiency is $1.0x10^{-5}$ at 0.025eV. The high energy limits of the spectra shift higher when smaller collimators are selected because saturation of the detector near T0 is mitigated by reducing the neutron and flash-gamma intensity.

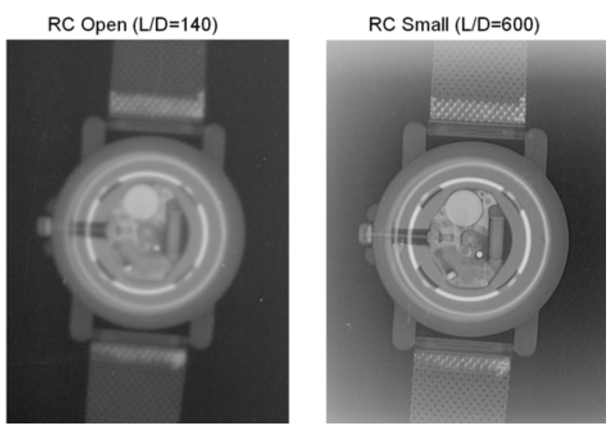

Fig. 4 Neutron transmission images of a watch with the rotary collimator open (left) and small (right).

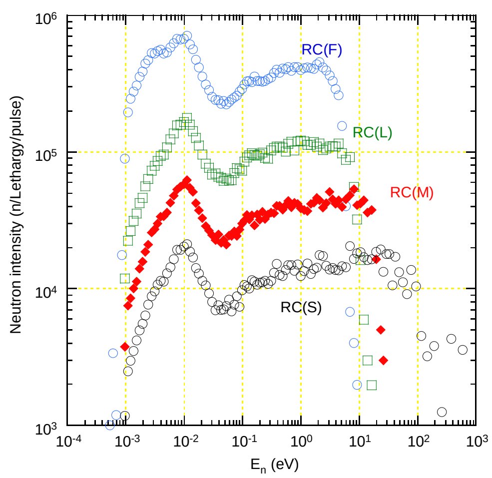

Fig. 5 Neutron spectra with the four rotary collimator openings.