MLF Experimental Report	提出日 Date of Report July 26, 2011
課題番号 Project No. 2010A0011 実験課題名 Title of experiment Development of neutron scintillator monitor detector 実験責任者名 Name of principal investigator Tatsuya Nakamura 所属 Affiliation Japan Atomic Energy Agency, J-PARC center,	装置責任者 Name of responsible person Dr. F. Maekawa 装置名 Name of Instrument/(BL No.) NOBORU /(BL10) 実施日 Date of Experiment Jun. 25-26, Nov. 26-28, Dec.13-14 2010

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.

An aluminum rod, vanadium rod and tin crystals were irradiated with neutrons to check the detector performances.

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.

Development of a large area scintillator detector for "SENJU"

This experimental term was focused to test the wavelength-shifting fibre detector developed for "SENJU" instrument. "SENJU" is a single crystal diffractometer to be installed in the BL18 of MLF. Main subject of the instrument is to research into material science under the extreme condition such as at high pressure, electromagnetic field, and low temperature with a small sample volume of 1mm^3. The specifications required for the detector was very unique; detector efficiency more than 50% for thermal neutrons, spatial resolution of 4 mm, gamma sensitivity ~10^{-6}, a large detective area. Moreover the detector cost should be within the budget, and the 33 detector modules have to be delivered by the end of FY2011. We have been tackling this challenging subject and found solutions within the year.

Figure 1 A first test detector for "SENJU" instrument delivered just a week before the June run.

Figure 1 shows a first test detector delivered in the mid June,

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

Figure 2 Experimental setup at the BL10.

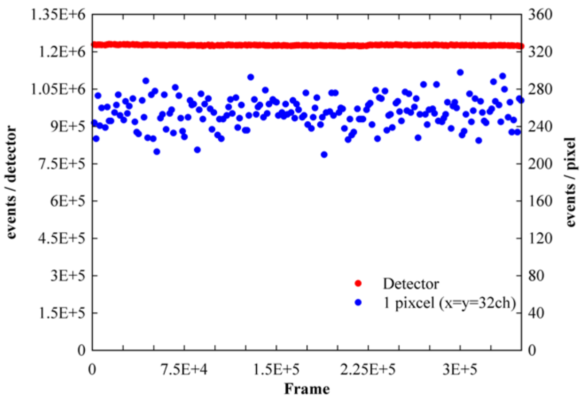

Figure 3 Neutron count rate over 4 hours. The counts in the whole detective area (red line) and in a one pixel (blue dot) were shown.

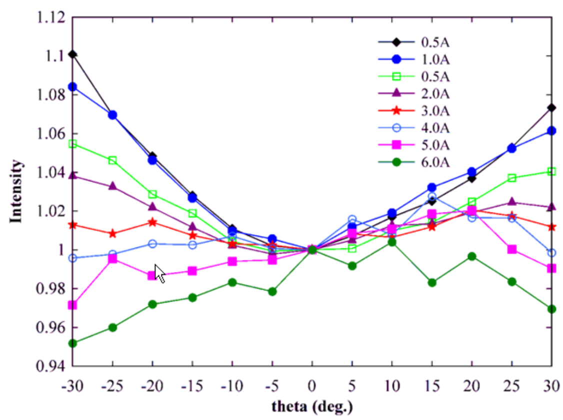

Figure 4 Normalized count intensity against inclined incidental neutrons .

just before the experimental run in June. The prototype detector was designed following with the development work in the laboratory. The detector employed the wavelength shifting fibres to read out scintillation light generated in neutron absorption in the ZnS/$^{10}B_2O_3$ screen. The fibres for x and y directions were placed in the pitch of 4 mm. In the iBIX detector a half mm fibres were placed side by side to maximize the light collection yield, but this detector structure resulted in a considerable amount of electronics heat and the cost of the detector. Non-packed fibre configuration made the detector efficiency decreased to 70% of the iBIX detector but it gave a good compromise between the light collection and the cost, ensuring the large detector coverage and count stability in the end.

Figure 2 shows an experimental setup at the BL10. The detector performances were evaluated in comparison to a reference detector that employed the ZnS/^{6}LiF scintillator screens. The detector efficiency of the SENJU prototype detector was measured around 30% for thermal neutrons.

Figure 3 shows neutron count rate measured over 4 hours. The detector measured neutrons scattered by a polyethylene rod. Thanks to major revision of the amplifier card the count stability improved significantly from the iBIX detector; no electronics oscillation observed over 4 hours. This result demonstrated the robustness of the developed detector system.

Figure 4 shows normalized counts against inclined incidental neutrons. In SENJU the detector module placed at the top on a bank accepts neutrons scattered in ~30 degrees. One concern was that the detector efficiency might vary significantly in such an angled incident to the detector. The results revealed that the detector efficiency increased by 10% for neutrons with a shortest wavelength of 0.5 A, which is a shortest in SENJU whilst decreasing with neutrons with longer wavelength. The wavelength dependence of the counts was well understood by taking into account the effective thickness of the scintillator. The count variance in incident angle was in the acceptable level, and should be calibrated in practical use.