（ ※本報告書は英語で記述してください。ただし、産業利用課題として採択されている方は日本語で記述していただいても結構です。 ）

CROSS TOKAI **Experimental Report** J-PARC	承認日 Date of Approval 2014/7/19 承認者 Approver Takeda Masayasu 提出日 Date of Report 2014/7/19
課題番号 Project No. 2013B0110 実験課題名 Title of experiment A quest for the spin current excited by neutrons 実験責任者名 Name of principal investigator TAKEDA Masayasu 所属 Affiliation Japan Atomic Energy Agency	装置責任者 Name of Instrument scientist TAKEDA Masayasu 装置名 Name of Instrument/（BL No.） SHARAKU (BL17) 実施日 Date of Experiment 2013/03/12 21:00 – 3/13 10:00

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.

Pt thin layer on a YIG substrate (Pt/YFe5O12)

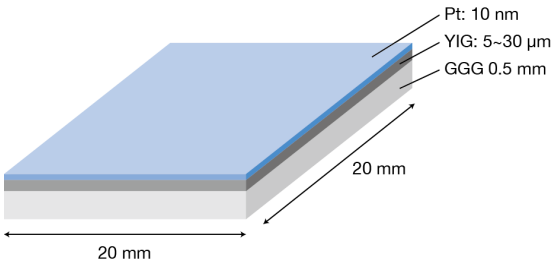

Fig. 1 Schematic illustration of the sample structure. This structure was slightly changed by the optimization

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.

Procedures of the measurements were straightforward. At the first, we confirmed the induction of the spin current by the temperature gradient controlled by a Peltier device. Next, the magnetic field dependence of the spin voltage with or without irradiation of unpolarized neutrons was measured with controlling the temperature gradient. If the spin-voltage signal appears even in the absence of the temperature gradient, the signal should be due entirely to the neutron irradiation. To further buttress the origin of this signal, we also measured the dependence of the generated spin currents on polarization direction using polarized neutrons. The sample face is set to be normal to the beam line in these measurements to accept neutrons as many as possible. Figure 2 is a picture of the sample holder

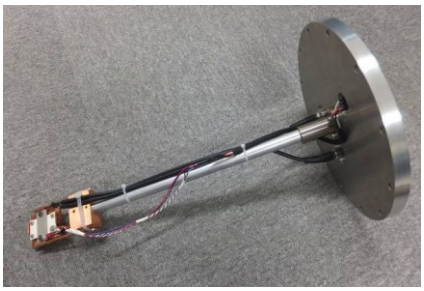

Fig. 2 A special sample holder for the spin-Seebeck effect measurements in the pole piece of the electromagnet of BL17.

specially made for this experiment.

Results of the measurements are summarized in Fig. 3. This graph shows the temperature-difference dependence of the electromotive force under four different conditions: 1. without neutron irradiation, 2. with unpolarized neutron irradiation, 3. with polarized neutron (up-spin) irradiation, and 4. with polarized neutron (down-spin) irradiation. The clear electromotive force induced by the spin current was detected in any cases. At the first glance, there is a distinct difference of the data between with and without neutron irradiation. However, the difference is the slops of the lines, which is not expected in the framework of the current theory of the spin Seebeck effect. If the spin current would be induced by neutrons, the slop should be constant and a finite electromotive force should be observed even with no temperature difference. We performed the second measurement without the neutron irradiation to confirm the slop-difference. Then, we did not see the difference as shown in Fig. 3. We have concluded that the difference is not induced by the spin current excited by the neutron irradiation. Sincerely speaking, there is no simple explanation of the difference. Anyway we do not believe that we succeeded in detection of the spin current generated by the neutron irradiation. We now carefully consider what is the next step of this challenging experiment.

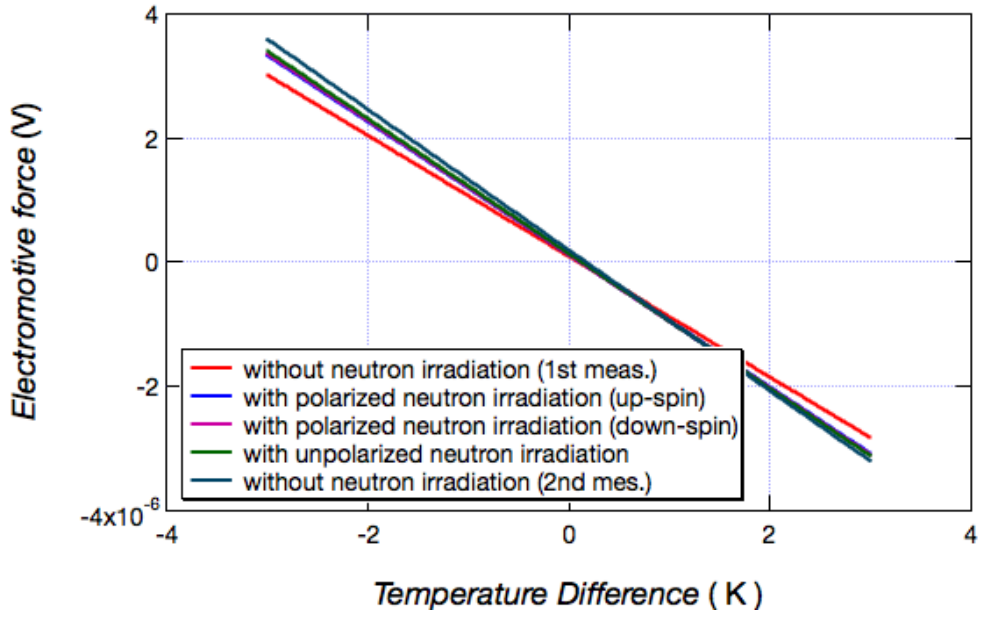

Fig. 3 Summary of the experiments which tried to detect the spin current induced by neutron irradiation.