

	承認日 Date of Approval 2014/07/19 承認者 Approver TAKEDA Masayasu 提出日 Date of Report 2013/05/15
実験課題番号 Project No. 2012P0803 実験課題名 Title of experiment Development and application of on-beam SEOP based ^3He spin filter at BL17 実験責任者名 Name of principal investigator Takayuki OKU 所属 Affiliation J-PARC Center	装置責任者 Name of Instrument scientist Masayasu TAKEDA 装置名 Name of Instrument/(BL No.) SHARAKU / BL17 利用期間 Dates of experiments 2012/01/18-2012/01/24

1. 研究成果概要(試料の名称、組成、物理的・化学的性状を明記するとともに、実験方法、利用の結果得られた主なデータ、考察、結論、図表等を記述してください。

Outline of experimental results (experimental method and results should be reported including sample information such as composition, physical and/or chemical characteristics.

Figure 1 shows the picture and schematic top view of the experiment at BL17 SHARAKU. All of SEOP ^3He spin filter components were set in the SEOP BOX and the SEOP BOX was placed between the 8th slit (S8) and the 9th slit (S9) as shown in fig. 1. A ^3He spin filter cell was placed at $z = 16500$ mm where z is the distance from the moderator. The size of ^3He spin filter cell was 35 mm in diameter, 55 mm in length and pressure length product of the cell was 11 bar cm. A two-dimensional position sensitive neutron detector RPMT was placed at $z = 17700$ mm. A guide coil was set between the S8 and the SEOP BOX to avoid depolarization of a neutron beam. In this experiment, the ^3He spin filter was used as a neutron spin analyzer. A polarizing supermirror which consists of Fe/Si supermirrors and a neutron spin flipper has been installed at upstream from the sample position [1]. Specular and off-specular reflections from a sample with and without spin-flip can be measured.

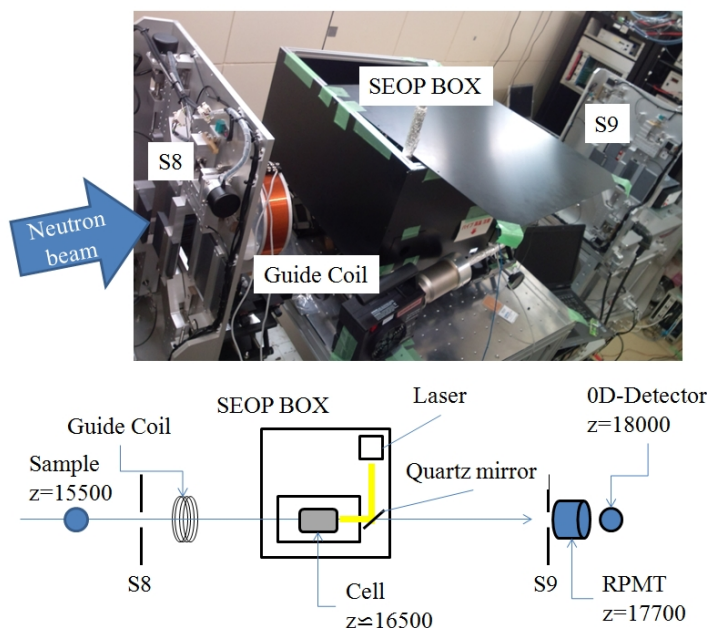


Figure 1. The picture and schematic top view of the experiment are shown. The SEOP BOX was set between the S8 and S9.

Specular and off-specular reflections from a sample with and without spin-flip can be measured.

In this study, we aim to evaluate a performance of the ^3He spin filter as a neutron spin analyzer. A Fe/Cr multilayered thin film with the giant magnetoresistance effect was used as a sample [2]. The sample was set at the $z = 15500$ mm which is the standard sample position on SHARAKU.

1. 研究成果概要(つづき) Outline of experimental results (continued).

Figure 2 shows the result of this measurement, (a) and (b) are the result with the applied magnetic field condition of 200 Oe with spin-flip and non spin-flip, (c) and (d) are the applied magnetic field 10 kOe with spin-flip and non spin-flip. In the low magnetic field condition with applied field of 200 Oe, the specular peak and off-specular reflection around $Q_z = 0.08 \text{ \AA}^{-1}$ are clearly observed, especially in the spin-flip condition. In the high magnetic field condition with applied field of 10 kOe, both of the specular peak and off-specular reflection around $Q_z = 0.08 \text{ \AA}^{-1}$ are disappeared. This result indicates the existence of the antiferromagnetic correlations in the low magnetic field condition, and in the high magnetic field condition the antiferromagnetic correlations are disappeared. These results are consistent with those reported in ref. [2]. A polarization of ^3He reached more than 60 % stably for 5 days during this experiment, which was estimated by NMR measurement. The neutron polarization degree, which is determined by the efficiencies of the polarizer, spin flipper and ^3He spin filter, was higher than 95 % for neutrons with $\lambda \geq 0.4 \text{ nm}$ in this experiment (fig. 3). The circle (red) and the square (blue) are the neutron spin polarization corresponds to the measurement with applied field condition of 200 Oe and 10 kOe, respectively. This result also shows that the ^3He spin filter works well during this experiment.

As a conclusion of this study, the ^3He spin filter worked stably for 5 days with the polarization of ^3He higher than 60 % and specular and off-specular reflections from the Fe/Cr multilayered thin film are successfully measured.

[1] TAKEDA M., et al., Chinese J. Phys., 50 (2012) 161.

[2] M. Takeda, et al., Physica B, 213&214 (1995) 248.

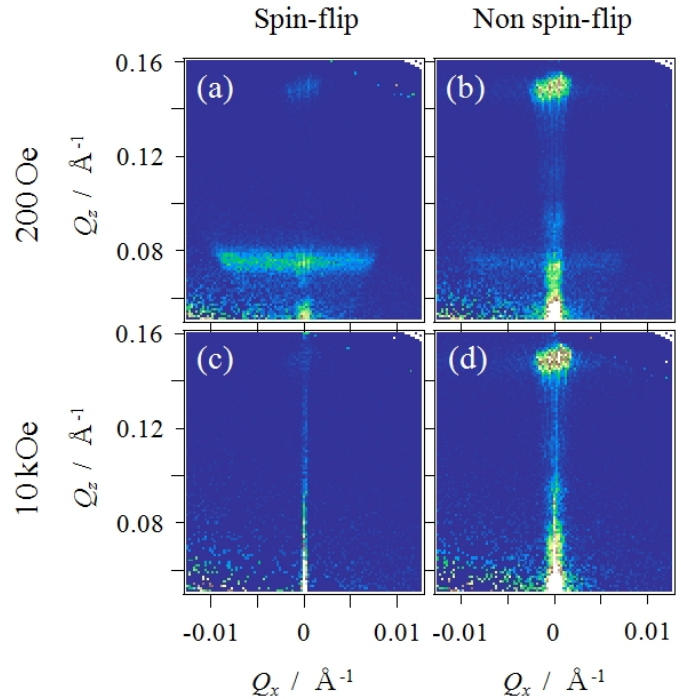


Figure 2. The obtained reflections as a function of Q_x and Q_z . (a) and (b) are the results of weak applied field 200 Oe with spin-flip and non spin-flip, (c) and (d) the strong applied field 10 kOe with spin-flip and non spin-flip.

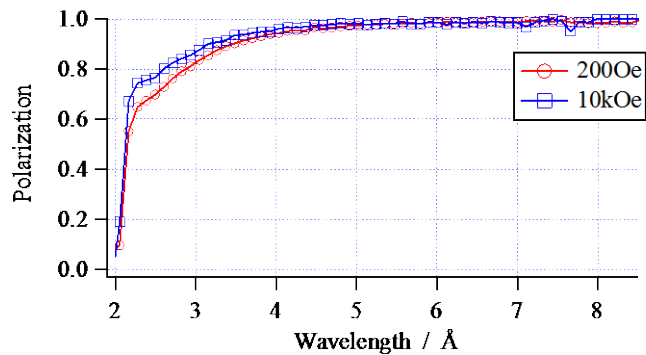


Figure 3. The neutron polarization degree obtained in this measurement is shown. The circle (red) and the square (blue) are the neutron spin polarization corresponds to the measurement with guide field condition of 200 Oe and 10 kOe, respectively.