CROSS TOKAI **Experimental Report** J-PARC

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実験装置名／BL番号 Name of Instrument/BL
4SEASONS/BL01

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1．研究成果概要 （a）装置グループ内の成果、（b）ユーザー課題実装時における特筆すべきサポート、（c）ユーザー課題の執行状況について、まとめてください。A4 サイズ用紙使用のこと。

Outline of your activities. Following results at your instrument should be reported in A4 size papers: (a) results of your instrument group, (b) significant user support works, and (c) statistical summary of user experiments.

(a) Results of the instrument group

The experiments performed in the 2014 term are classified into the following three categories: (1) Performance tests to upgrade the instrument, (2) Calibrations of devices for stable operation of the instrument, and (3) Preliminary measurements for new scientific themes or short supplementary measurements for users. For the category (1), we performed performance evaluation measurements of new Fermi choppers, a radial collimator, N_2 monitors, a new data acquisition mode using TrigNet, and a IROHA2-based new instrument control system. For the category (2), we performed position calibration of newly installed ^{3}He detector tubes, phase calibration of choppers, and evaluation of background scattering by a new IVC tail of the cryostat. As for the category (3), we performed test measurements of phonon DOS of negative thermal expansion material ScF_3 and magnetic excitation of pyrochlore compound $Ho_2Ti_2O_7$, in addition to a supplementary measurement for a user's experiment of an iron-based superconductor FeSe. Here, we describe the results of the performance evaluation measurements of new Fermi choppers in detail, which are the most outstanding outputs in the instrument group use in the 2014 term.

Recently, we have developed two new Fermi choppers. One has a short (20 mm) slit package, and. the other has a supermirror-coated slit package (we call the latter chopper Magic chopper). The short chopper was designed to give higher transmission than the original chopper with a long (100 mm) slit package, while the angular divergence defined by the slits should give same energy resolutions as those for the original chopper. Figure 1(a) shows the flux gain of the new chopper, i.e., scattering intensity of a vanadium sample divided by that for the original chopper, for several rotating frequencies of the chopper. We found that the new chopper gives much higher neutron flux on the sample as expected. The gain is particularly significant at low energies and at high rotating frequencies (for examples, 1.9 for 43 meV and 250 Hz, and 17 for 18 meV and 300 Hz). Figure 1(b) compares the energy resolutions (full-widths at half maximum of the elastic scattering profiles) obtained by the short and original choppers. The both choppers give almost same resolutions as expected.

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

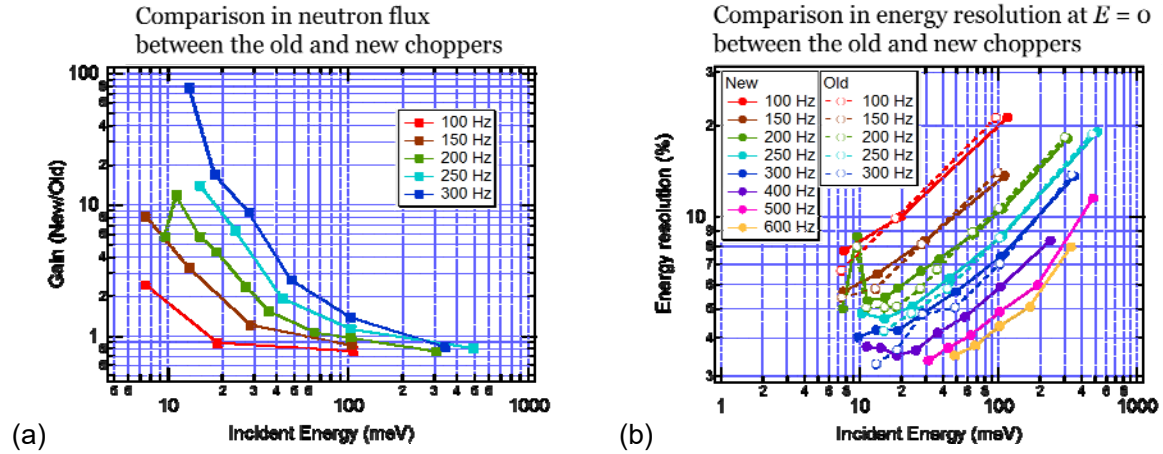

Fig. 1. Comparison of the performances of the short slit (new) chopper and the original long slit (old) chopper, evaluated by measurements of a vanadium sample. (a) Intensity gain. (b) Energy resolution for elastic scattering

On the other hand, the Magic chopper is aimed to give high transmission especially for low energies keeping the similar energy resolution as high energies taking advantage of the reflection by the supermirror on each slit. Unfortunately, the reflectivity of supermirror in the Magic chopper installed in this year was proved to be much lower than the ideal value due to a technical reason in the manufacturing process. Nevertheless, we performed the evaluation test of this “prototype” Magic chopper expecting we can characterize the basic performance of this kind of chopper. Figure 2 shows a time spectra of vanadium measured with the prototype Magic chopper compared with that measured with the original chopper. Sharp peaks show elastic scatterings for different incident energies. While the Magic chopper gives lower intensity in a shorter-time (higher-energy) region due to the imperfection of the supermirror, it gives substantial intensity in a longer-time (lower-energy) region where the intensity for the original chopper disappears. We should note that the Magic chopper gives intensity even in the second time frame (dotted vertical lines). 4SEASONS has disk choppers to suppress the overlap of the second frame, though they were stopped in the measurements of Fig. 2. Although disk choppers are not necessarily required on a conventional chopper spectrometer utilizing a Fermi chopper, the present result proves the correctness of the adoption of the disk choppers on 4SEASONS. The obtained results are quite useful for developing the Magic chopper in spite of the low intensity. Currently a new Magic chopper with much better supermirros is under development.

必要に応じて、A4 サイズの用紙に続きを記入して下さい。

Please use A4-size papers for further reporting, if necessary.

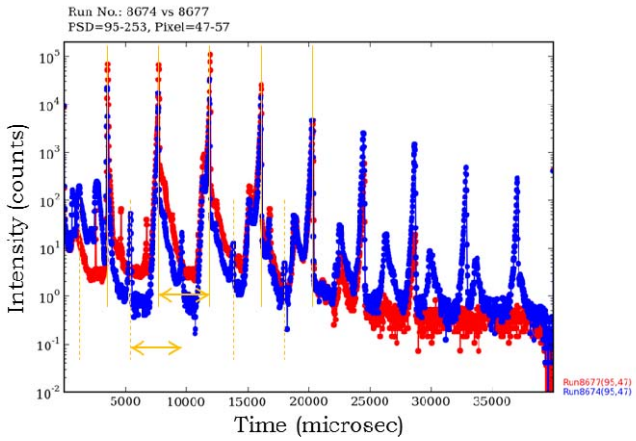

Fig. 2. Comparison of the time spectra of a vanadium sample measured with the Magic chopper (blue) and the original chopper (red). The choppers were rotated at 150 Hz. Solid and dotted vertical lines indicate time positions of the elastic peaks from the first frame and from the second frame, respectively.

(b) User support works

Instrument group staffs of 4SEASONS (R. Kajimoto (JAEA), M. Nakamura (JAEA), K. Ikeuchi (CROSS), K. Iida (CROSS), K. Kamazawa (CROSS)) performed user support works in pairs. One technical staff from CROSS (M. Ishikado) provided technical support. In addition, many staffs significantly contributed to the user support based on their specialty, such as software (Y. Inamura (JAEA)), sample environment (Y. Yamauchi (JAEA)), electric work (H. Tanaka (JAEA)), and machine design (W. Kambara (JAEA), K. Aoyama (JAEA)).

(c) Statistical Summary of user experiments

25 General Use proposals, 2 Trial Use proposals, and 1 Element Strategy Initiative Use proposal were approved for BL01 in JFY2014. One reserved proposal in 2014A was given a beamtime. One General Use proposal was canceled on request from the user. Unfortunately, 6 General Use proposals and a part of the Element Strategy Initiative Use proposal in 2014B were postponed due to the long shutdown of the facility caused by a fire accident in the muon facility and a trouble of the neutron source.