

	承認日 Date of Approval 2014/4/25 承認者 Approver Ryoichi Kajimoto 提出日 Date of report 2014/4/25
実験課題番号 Project No. 2013I0101 実験課題名 Title of experiment Improvement of the Performance of 4SEASONS to Provide an Advanced Experimental Environments for Users 実験責任者名 Name of principal investigator Kazuhiko Ikeuchi (for Sundgae Ji, PI) 所属 Affiliation CROSS-TOKAI	装置責任者 Name of Instrument scientist Ryoichi Kajimoto 装置名 Name of Instrument/(BL No.) BL01 4SEASONS 利用期間 Dates of experiments 2013/04/01 09:00 – 2013/04/03 09:00 2013/05/16 11:00 – 2013/05/17 11:00 2014/02/20 11:00 – 2014/02/21 11:00 2014/04/03 11:00 – 2014/04/05 11:00

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.

BL01 4SEASONS, the Fermi chopper spectrometer, has been undergoing scientific commissioning and hosting users in various scientific fields. As the CROSS R&D project in 2013, we performed the subjects about **(1) Energy & Momentum transfer dependence of resolution function**, **(2) Numerical test for measurement with the 7T magnet**, **(3) Feasibility test of new materials**. The results will be returned to users as detailed and quantitative experimental data.

(1) Energy & Momentum transfer dependence of resolution function

An instrumental resolution function is necessary to compare calculation such as magnon (phonon) dispersion and intensities with experiment. However, energy and Q resolutions of 4SEASONS had not been investigated sufficiently. Therefore, to check experimentally whether analytically calculated resolutions of 4SEASONS are reasonable or not is important. For the energy-resolution measurement, commercial powder $C_4H_2I_2S$ was used, while for the Q -resolution measurement, polycrystalline Al_2O_3 was used. As shown in Figure, we figured out that experimental resolutions obtained by fitting $\hbar\omega$ and Q -dependences of the

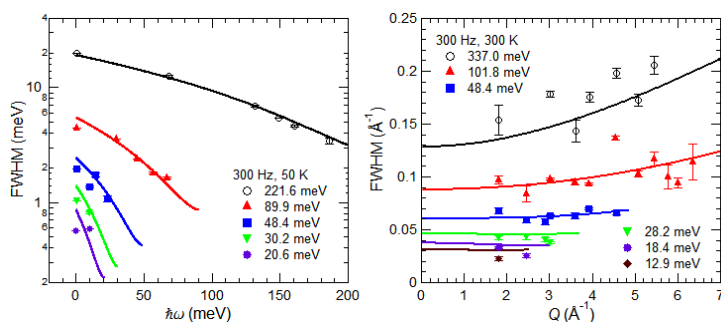


Fig. 1. Left panel : Energy transfer dependence of the energy resolution. Right panel : Momentum transfer dependence of the momentum resolution at $\hbar\omega = 0$ meV. Both were obtained for many E_i 's utilized in the multiEi method. Lines are calculated energy/momentum resolutions for each E_i [1].

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

scattered neutron intensities are well reproduced by analytically calculated resolutions for wide ranges of $\hbar\omega$, Q , and incident neutron energy at 4SEASONS. We published this result in *JPS Conference Proceedings* [1].

(2) Numerical test for measurement with 7T magnet

In advance of online operation of 7 T magnet at BL01 4SEASONS, we evaluated magnetic field distribution caused by the operation numerically.

According to the numerical simulation, an applied field of 1 T causes a magnetic field of 15 G around a turbo molecular pump installed just below the sample

position of the spectrometer. In addition, as shown in Fig. 2, an applied field also magnetizes Fe flame of the spectrometer and causes a residual field of 32 G by 7 T, and of 5 G by 1 T at the sample position. Based on the result, we will plan an experiment with magnet after careful consideration to protect BL items and the possibility of the polarization experiment.

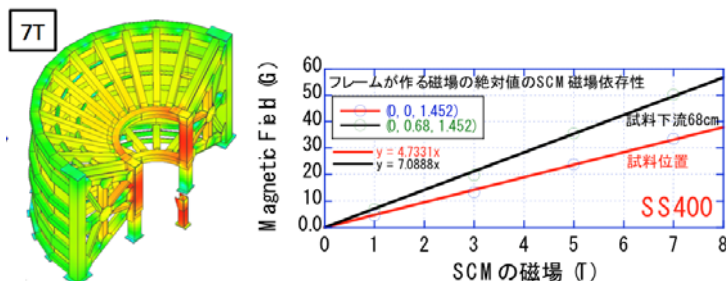


Fig. 1. Left panel : Visualized map of magnetization of the vacuum chamber due to $H = 7$ T operation. Right panel : Field dependence of the residual magnetization on the flame.

(3) Feasibility test of new materials

(3-1) A Li-ion battery is the most promising battery as a commercial storage battery. Thus, to investigate the Li diffusion in the positive electrode of the battery such as LiCoO_2 and LiMn_2O_4 , many quasi-elastic neutron scattering experiments at BL02 and diffraction measurements at BL08 are performed in J-PARC so far. Such measurements, however, only cover the reciprocal space near $\hbar\omega = 0$, and no measurement over the wide range of the reciprocal space has been performed. Here, we have performed inelastic neutron scattering measurements on LiCoO_2 using $E_i = 100$ meV neutrons, and we succeeded in measuring the phonon in LiCoO_2 in the wide range of temperature and the reciprocal space. We are now analyzing how the phonon affects the bulk properties in LiCoO_2 .

(3-2) In order to verify, how high energy BL01 can approach at low Q side, we carried out a test measurement for YBaFe_4O_7 which shows a streak-like magnetic excitation at $Q \sim 1.25 \text{ \AA}^{-1}$ with $dQ \sim 1 \text{ \AA}^{-1}$ width (HWHM). As a result, we could observe the streak unambiguously up to $\hbar\omega \sim 80 \text{ meV}$ (with a trace up to 100 meV).

[1] K. Iida *et al.*, *JPS Conf. Proc.* 1 (2014) 014016.

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