MLF Experimental Report	提出日 Date of Report
課題番号 Project No. 2016A0146 実験課題名 Title of experiment Internal strain measurement on short twist pitch ITER CS conductor 実験責任者名 Name of principal investigator Suwa Tomone 所属 Affiliation National Institute for Quantum and Radiological Science and Technology	装置責任者 Name of responsible person Aizawa Kazuya 装置名 Name of Instrument/（BL No.） BL19 Takumi 実施日 Date of Experiment 12/8-12/18

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.

1. ITER CS Conductor (solid): Cu, Cu-Sn, Nb_3Sn, Nb, Ta, Cr, stainless-steel
2. Nb_3Sn strands (solid): Cu, Cu-Sn, Nb_3Sn, Nb, Ta
3. Nb_3Sn filament (solid): Nb_3Sn, Nb
4. Barrier sample (solid): Nb, Ta
5. Jacket sample (solid): stainless-steel

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.

Internal strain measurement of 4 m ITER CS conductor with short twist pitch was performed by using BL19 TAKUMI. This conductor was already tested with ~15000 electromagnetic cycles by SULTAN. As shown in Figure 1, an incident beam was scattered at a selected position in the conductor. Diffracted beams were collected by two detectors, which are located at two orthogonal positions to the incident beam. The northern detector accumulated the diffracted beam in parallel to conductor axis, and the southern detector accumulated the scattered beam transverse to conductor axis. The measured gauge volume was 5 × 5 × 15 mm^3, which was determined by using an incident silt with a width of 5 mm and a height of 15 mm and radial collimators with a width of 5 mm. In order to have the same beam pass for each measurement, the conductor sample was turned over between the measurement at high loading side (HLS) and low loading side (LLS).

Figure 2 shows diffraction profiles of Nb_3Sn(211) plane at the HLS and LLS in the field center and 1150 mm from the field center of the conductor. Strain was defined as the difference between lattice parameter of the sample and filament sample. ⊿HWHM, which is associated with bending strain, was defined as the difference

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

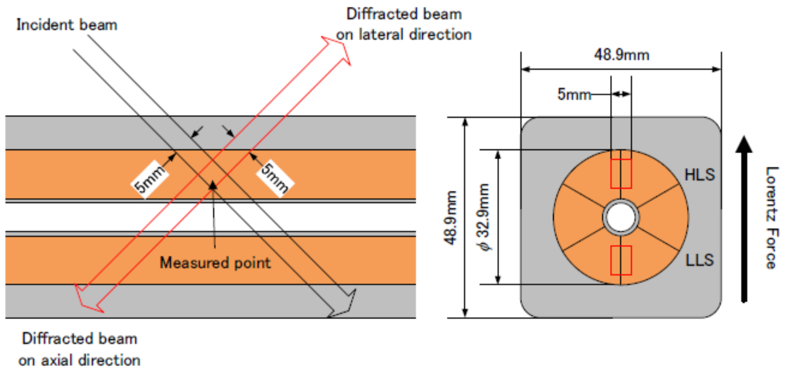

Fig. 1 Schematic view of the conductor sample

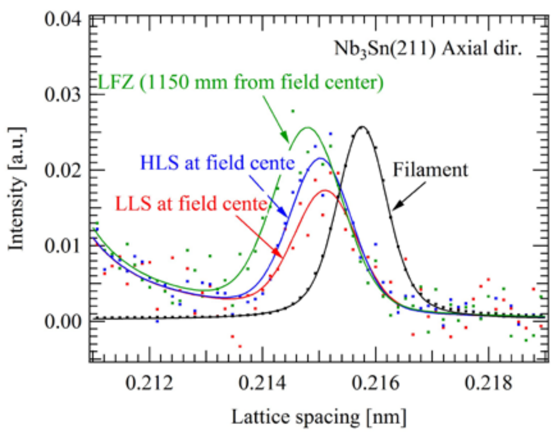

Fig. 2 Internal strain of Nb_3Sn in the conductor sample

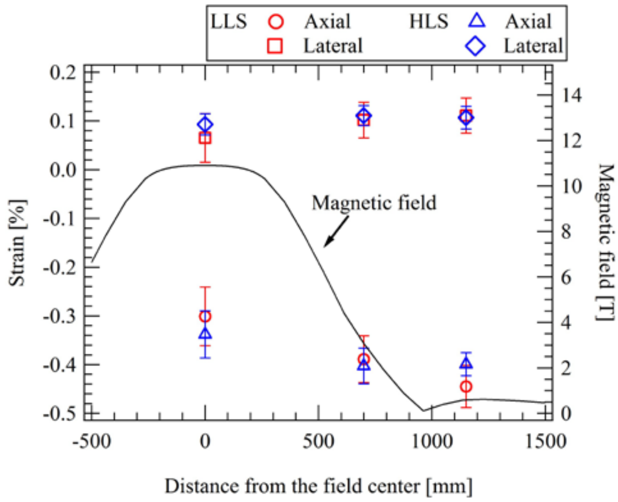

Fig. 4 Strain distribution of Nb_3Sn in the conductor sample

between the conductor sample and the Nb_3Sn strand sample. In contrast to longer twist pitch conductor which was measured in previous study, strain and ⊿HWHM of this conductor in the LLS at the field center were almost the same as those in the HLS.

Figure 3 shows internal strain of Nb_3Sn in the conductor sample which was evaluated from Nb_3Sn(211) peak with Pseudo-Voigt function. It is assumed that internal strain of Nb_3Sn at the 1150 mm from field center was not changed from initial state, because of lower Lorentz force. Axial strain of Nb_3Sn at the LLS and HLS in the field center was changed from compressive side to tensile side.

The neutron diffraction measurement was carried out to investigate internal strain state on the CS conductor with short twist pitch. Strain states were not different between the LLS and HLS at the field center. Therefore, short twist pitch conductor is successful to suppress the local bending of Nb_3Sn strands in the conductor. Moreover, it was found relaxation of the strain at the field center, which was considered to improve the conductor performance after the cyclic test at SULTAN.