

## 7. Japan-Korea Fusion Collaboration Programs

NIFS and the National Fusion Research Institute (NFRI) in Korea have been collaborating in several areas of magnetic fusion research for 11 years. The main objectives are to advance the KSTAR experiment through the collaborative development of diagnostics and heating facilities, and also to collaborate in LHD experiment. The summary report of the collaboration was prepared until JCM in 2015. KSTAR experiment successfully continued from 2008 and has been achieved many excellent results. Another important aspect of this collaboration is human resource development for future fusion research.

### I. KSTAR collaboration

This collaboration consists of development projects for diagnostics and heating systems for the KSTAR experiment which were successfully completed in 2013 (JFY).

#### 1. Plasma Heating Systems

The Korea-Japan workshop on the physics and Technology of Heating Current Drive was held in Korea in February of 2015. Many physics, theoretical and technical issues were discussed by experts of both countries from various universities and institutes.

##### 1-1 Radio Frequency Systems

Both Parties continued collaboration and exchanged personnel and technical knowledge for the development of radio frequency technologies in fusion plasmas. NIFS researchers visited NFRI and discussed ICRF technology and the KSTAR experiment. Both Parties continued the collaboration for the development of the in-line polarization monitor for the use of the KSTAR ECRH experiments.

#### 2 Diagnostic Systems

NIFS and KSTAR groups discussed the measurement of KSTAR plasmas, modification of a diagnostics systems for better performance and development of new diagnostics systems.

##### 2-1 Bolometer Systems

Resistive bolometer arrays were removed from KSTAR for confirmation of failure. KO sent resistive bolometer arrays to the manufacturer for repair. For imaging bolometer system, KO replaced the control computer for improved performance, and performed the optical calibration of the IR camera and periscope in KSTAR.

##### 2-2 Edge Thomson Scattering System

NIFS continued the collaboration on the YAG Laser. As for polychromators, NIFS experts visited NFRI to participate in the KSTAR Thomson scattering calibration and experiment. Both experts continuously discussed about the improvement of KSTAR Thomson electric circuit.

Two NIFS experts on Thomson scattering attended the KSTAR conference.

##### 2-3 ECE Radiometer System

Two NIFS experts attended the KO-JA collaboration meeting on KSTAR diagnostics held in May 2014 at NFRI. They discussed further collaboration in the area of ECE diagnostics. One of the key issues was improvement of the components (for example, second detector) of the IF system.

##### 2-4 Charge Exchange Recombination Spectroscopy (CES)

The loan period of two lens-spectrometers from NIFS for the toroidal and poloidal CES system was extended. Poloidal rotation was measured from the poloidal CES system for the first feasibility test.

##### 2-5 Neutron and Energetic-ion Diagnostics

Commissioning of a DD neutron energy spectrometer (NES) prototype based on coincident counting of associated particles was continued at KSTAR in collaboration with Nagoya University (NU), NIFS, and NFRI. Three coincidence events due to neutrons were measured in NB-heated plasmas of KSTAR, indicating that the events are surely due to DD neutrons generated in KSTAR plasmas. Also, we continued to measure neutron images and spectra by using nuclear emulsion. The results have been presented in several international conferences and workshops from both NIFS and Korea sides. In addition to neutron diagnostics, joint work on scintillator-based fast-ion loss detector is ongoing.

##### 2-6 Soft X-ray CCD Camera (SXCCD)

An imaging diagnostic system using a soft X-ray CCD camera (SXCCD) will be transferred from NIFS to NFRI to monitor the flux surface shape in the KSTAR discharges. A researcher from NIFS visited NFRI to discuss the issues.

##### 2-7 Japan-Korea Seminar on Advanced Diagnostics

The 7th JA-KO Seminar on advanced diagnostics for steady-state fusion plasma was held in Kyoto in Aug. 17th - 20th, 2014. The next JA-KO Seminar will be held in 2016 in Korea.

### II. Human Resource Development

The total number of researchers that were exchanged between Japan and Korea in JFY 2014 were 80 from Japan to Korea and 40 from Korea to Japan. Workshops and Seminar of various fields were held in each country:

- Workshop on Physics and Technology of Heating and Current Drive in Daejeon
- 9th Workshop on KO-JA Fusion Material and Engineering Toward Next Generation of Fusion Devices in Jeju.
- Workshop on Modeling and Simulation of Magnetic Fusion Plasmas in Jeju
- Workshop on Tritium Recovery and Measurement Technology for Fusion Reactor Engineering in NFRI (Mutoh, T.)