5. Network-Type Collaboration Research

The NIFS General Collaboration has been based on a one-to-one (especially, NIFS-to-University) collaborative system. Some collaborations, however, require the use of more than one experimental facility in different universities and institutes in order to achieve their objectives. In the network-type collaboration, this type of collaboration becomes practicable by providing travel expenses for travelling between universities, which has not been admitted as a rule in the general collaboration projects.

Since FY 2011, NIFS has employed this network-type collaboration. Three projects from different fields were accepted in FY 2011 for the first time. The challenges of these collaborations were spread over various fields.

Before starting the collaborations, a collaboration plan for the year should be submitted. The includes the items regarding how the collaboration between research institutes will be planned, i.e., who will go when and where for what purpose.

In this fiscal year 2016, six proposals were accepted. The first three proposals are the continuing subjects since FY2014. The next two projects are the continuing subjects since FY2015, and the last proposal is a new project from FY2016. The titles of the research projects are listed below.

(1) “Study of MHD equilibrium dynamics due to rapid change of the plasma status and the interaction with the confinement properties” Y. Nakamura (Kyoto University).
(2) “Observation and control of self-governing events in compact torus plasmas” M. Inomoto (The University of Tokyo).
(3) “Study on surface modification of plasma-facing material and particle recycling using long-term samples” Y. Nobuta (Hokkaido University).
(4) “Estimation of regional and seasonal variations for environmental tritium and radon concentrations in Japan” M. Furukawa (University of the Ryukyus).
(5) “Elucidation of Dynamics of O- and X-points by Alliance of Plasma Experiments, Simulations and Solar Observation” M. Ono (The University of Tokyo).
(6) “Self-organization via fast electrons in spherical tokamaks” Y. Takase (The University of Tokyo).

Fig. 1 Exercise on environmental tritium analysis for students in NIFS by M. Furukawa (University of the Ryukyus).

The item (1), (2), (5) and (6) are related to the intercommunication of researchers and students and comparison of the results obtained in the different devices in universities, institutes and NIFS. The item (3) is related to the treatment and inspection of samples using instruments in the different institutions. And the item (4) needs the movement of researchers and students over the wide areas to collect samples in different places. All proposals take advantage of the merit of the network-type collaboration.

The major achievements of two representative projects are briefly outlined below.

"Observation and control of self-governing events in compact torus plasmas" M. Inomoto (The University of Tokyo)

This network collaboration program promotes collaborative researches among small-scale and high-beta plasma studies such as spheromaks, field-reversed configurations (FRCs), reversed-field pinches (RFPs), spherical tokamaks (STs), and so on. Remarkable achievements are as follows. (1) Ohmic current drive was successfully applied on FRC plasmas in which current flows perpendicularly to the magnetic field. (2) ST merging process was investigated by using newly developed soft X-ray imaging system, accurate flux surface reconstruction technique, and particle-in-cell simulation. (3) Turbulent measurement system using fluctuating UV emission signals was developed and examined. (4) Plasma source using rotating magnetic field was proposed and developed. (5) ST reactor design concept was developed in consideration of fast proton behavior generated from D-^{3}He reaction, initial current drive by using an iron core, and novel particle fueling method by axial merging. Most of these collaboration studies were performed among university research groups as 94 person-day business trips including 48 person-day by graduate students, improving research efficiency and young human resources.

"Estimation of regional and seasonal variations for environmental tritium and radon concentrations in Japan" M. Furukawa (University of the Ryukyus)

In order to estimate the background tritium level in Japan, the measurement of monthly tritium concentration has been carried out on the environmental water samples collected at Hokkaido University of Science, NIFS and five sites in Okinawa Island. In addition, the measurement of atmospheric radon concentration has been started around NIFS. As an additional service, to encourage the research skill of student, exercise for the analysis of environmental tritium has been performed at NIFS. The tritium concentration of precipitation at University of the Ryukyus in the middle part of Okinawa Island (range: 0.06-0.21 Bq/L, period: June 2014-March 2016) is clearly lower than those obtained at NIFS (0.15-0.61 Bq/L, June 2014-March 2016) and at Hokkaido University of Science (0.15-0.73 Bq/L, July 2015-March 2016). Also, the results indicate that the tritium concentration of inland water in Okinawa Island (0.08-0.52 Bq/L, June 2014-March 2016) is considerably lower than those obtained in the mainland of Japan (0.36-2.66 Bq/L, Sugihara *et al.*, 2008). These suggest that the latitude effect brings the low tritium concentration in Okinawa Island. In addition, it is considered that the decrease with physical half-life of tritium originated from the past atmospheric nuclear tests contributes to the low tritium concentration in Okinawa Island.

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