

13. Bidirectional Collaborative Research Program

The bidirectional collaborative research program started in 2004 as a third collaborative category of NIFS. This program is different from other two in that the budget is paid separately by the Ministry of Education, Culture, Sports and Technology. The purpose of the program is to enforce the activities of nuclear fusion research in universities after the Committee of the Science Subdivision under the Council for Science and Technology required executing their plan by promoting collaborative research. This policy of the committee is summarized in the report “Policy for executing Japanese nuclear fusion research”, where it is pointed out that continuous scientific research activity is necessary for a comprehensive understanding of toroidal plasma physics under the parameters which can be extrapolated to the fusion reactor. Therefore the Large Helical Device (LHD) has been selected as one of four principal fusion research programs in Japan, and NIFS is expected to expedite collaborating research. It is also noted in the report that the universities must contribute to the study of important issues in nuclear fusion research, such as the function of electrostatic potential on plasma confinement, high beta plasma physics, optimum magnetic configuration for plasma transport, steady state plasma generation, and so on. NIFS is requested to play a leading role in the execution of these studies among universities as an inter-university research institute.

The bidirectional collaborative research program has been set up so as to accomplish the role of NIFS proposed above. In past collaborative programs, university researchers come to NIFS and joined the research activity at NIFS. But in this program, the opposite movement of researchers is encouraged, that is, NIFS researchers can go to the universities and join the research activities carried out at the universities. Hence a more efficient use of resources in both facilities is possible and the synergetic effect is expected. The current program involves four major university research centers; Plasma Research Center, University of Tsukuba / Laboratory of Complex Energy Process, Institute of Advanced Energy, Kyoto University / Institute of Laser Engineering, Osaka University / Advanced Fusion Research Center, Research Institute for Applied Mechanics, Kyushu University. In this collaborative program, the researchers of NIFS and of those four research centers can move back and forth to each other to work on the same research subject. In addition to this, each research center can have its own collaboration programs using its major facility so that the researchers of other universities can come and join as if the facility belonged to NIFS. It is unique and important that all these activities are supported financially as research subjects of the NIFS bidirectional collaborative research program. The subjects of the bidirectional research program are subscribed from all over Japan every year as one of the

three categories of the collaboration research program of NIFS, and the collaboration committee, which is organized under the administrative board of NIFS, adjudicates and selects the subjects.

One of the important roles of the collaboration committee is to make a plan for evolving the research activities in universities according to the guide line of “Policy for executing Japanese nuclear fusion research”. In Kyushu University, a new device, QUEST (Q-shu University Experiment with Steady State Spherical Tokamak) which is a normal conducting small spherical tokamak, finished its construction in 2007, and the first plasma was successfully obtained in June 2008. The objective of QUEST is to study the high-beta long-pulse operation in spherical tokamak, and the experimental program is conducted by the executing board which includes the researchers in Japanese universities other than Kyushu University.

Other topic of this year is that the data acquisition system of NIFS (LABCOM/X) has extended its function to store the experimental data of QUEST and GAMMA10 via SNET which is based on a closed VPN on Japanese academic internet backbone SINET3. The collaborators of QUEST and GAMMA10 can access their data more easily from their universities using the same procedure as that for LHD.

In this year, sixty eight subjects were adopted in this category, among which were 12 at Tsukuba University, 18 at Kyoto University, 18 at Osaka University, and 20 at Kyushu University. All of these collaborations were carried out successfully. Among these subjects, 56 topics are reported here.

(Komori, A.)

List of reports

-National Institute for Fusion Science-

- N 1. "Planning of the All-Japan ST Research Program," by Takase Y. , et al. (Univ. of Tokyo).

-University of Tsukuba-

- T 1. "Studies of Plasma Potential Formation and Potential Confinement, and Effects of Radial Electric Field Structure on Transport," by Imai T. (Univ. of Tsukuba).
T 2. "Plasma rotation at a peripheral region of the central cell in GAMMA10," by Ando A. et al. (Tohoku Univ.).
T 3. "Imaging Study of Dynamic Behaviors of Plasma Using Phase-Imaging Interferometer," by Mase A. et al. (Kyushu Univ.).
T 4. "Development of spectroscopy method using a collisional-radiative model in the GAMMA 10 plasma," by Yoshikawa M. et al. (Univ. of Tsukuba).
T 5. "Initial Results of TWDEC Experiments in GAMMA 10 Tandem Mirror," by Takeno H. et al. (Kobe Univ.).
T 6. "Analysis of Edge Plasma Turbulence and Neutral Particle Transport in Open Magnetic Field Configuration Plasmas," by Nakashima Y. et al. (Univ. of Tsukuba).
T 7. "Development of efficient microwave transmission system for GAMMA 10," by Imai T. et al. (Univ. of Tsukuba).
T 8. "Study on Electron Distribution Function and Spatial Structure of Weakly Relativistic Electrons in Microwave and Mirror Devices," by Ogura K. et al. (Niigata Univ.).
T 9. "Three-Dimensional Analysis of the Propagation of ICRF Waves in the GAMMA 10 Central Cell," by Fukuyama A. et al. (Kyoto Univ.).
T 10. "Spontaneous Excitation of Ion Cyclotron Range of Frequency Waves in GAMMA 10," by Ichimura M. et al. (Univ. of Tsukuba).
T 11. "Compact Toroidal Magnetic Concepts in Mirror Magnetic Field," by Yamazaki K. et al. (Nagoya Univ.).

-Kyoto University-

- K 1. "Confinement Improvement Studies of Advanced Helical Systems," by Sano F. (Kyoto Univ.).
K 2. "ICRF Heating Experiment in Heliotron J," by Mutoh T. et al. (NIFS).
K 3. "Considerations on magnetic configurations of Heliotron J towards improved confinement," by Yokoyama M. et al. (NIFS).
K 4. "A study of peripheral plasma in Heliotron J by a fast camera," by Nishino N. et al. (Hiroshima Univ.).
K 5. "Effects of Configuration Control on the Neoclassical Viscosity in Heliotron-J," by Nishimura S. et al. (NIFS).
K 6. "Development of Long-distance Correlation Diagnostic for Turbulence Structure Analysis and its Application to HJ-LHD Comparative Studies," by Fukuda T. et al. (Osaka Univ.).
K 7. "Study of D_α Line-Emission Spectroscopy and Edge

Neutral Transport in Non-Axisymmetric System," by Nakashima Y. et al. (Univ. of Tsukuba).

- K 8. "Theoretical Study and Its Experimental Verification for Effects of Toroidal Currents on MHD equilibrium," by Suzuki Y. et al. (NIFS).
K 9. "Radial Electric Field Control by Electrode Biasing in Heliotron J," by Kitajima S. et al. (Tohoku Univ.).
K 10. "Measurement of C IV line emission using a C IV-filtered AXUV diode array in the CH₄ SMBI experiment on Heliotron J," by Tamura N. et al. (NIFS).
K 11. "Directional Probe Experiments in the Heliotron J," by Nagaoka K. et al. (NIFS).
K 12. "Studies of MHD Equilibrium and Stability in Heliotron," by Sakakibara S. et al. (NIFS).
K 13. "Optimization of magnetic configuration using additional trim coils," by Okamura S. et al. (NIFS).
K 14. "Experiments on Helical Nonneutral Plasmas confined on magnetic surfaces of Heliotron J," by Himura H. et al. (Kyoto Inst. Tech.).
K 15. "Condition Study of Edge Transport Barrier Formation with Comparison between CHS and Heliotron J," by Minami T. et al. (NIFS).
K 16. "Heat flux measurement with thermal probe method in Heliotron J edge plasma," by Matsuura H. et al. (Osaka Pref. Univ.).

-Osaka University-

- O 1. "Design of Tritium Recovery System for Laser Fusion Reactor," by Fukada S. et al. (Kyushu Univ.)
O 2. "Investigation of Cascade-typed Falling Liquid Film Flow along First Wall of Laser-Fusion Reactor," by Kunugi T. et al. (Kyoto Univ.)
O 3. "Design study on foam-cryogenic targets by integrated simulations," by Nakao Y. et al. (Kyushu Univ.)
O 4. "Development of Gas Gun for Target Injection in Laser-Fusion Reactor," by Endo T. (Hiroshima Univ.)
O 5. "Design Feasibility Analysis of a Dry Wall Chamber in a Fast-ignition Laser Fusion Reactor Design FALCON-D," by Goto T. et al. (Univ. of Tokyo)
O 6. "Target and Related Material Development for FIREX-I," by Nagai K. et al. (Tokyo Inst. Technol.)
O 7. "Study on ablation of liquid wall in laser fusion reactor using punched-out targets," by Kurahashi S. et al. (Osaka Univ.)
O 8. "Laboratory Experiments on Aerosol Formation by Colliding Ablation Plumes (LEAF-CAP)," by Hirooka Y. et al. (NIFS)
O 9. "Laser Ablated Plasma Plume Energetics (APPLE) Study," by Tanaka K. A. et al. (Osaka Univ.)
O 10. "Dynamics of ablation plumes produced by fusion products in laser fusion liquid wall chamber," by Norimatsu T. et al. (Osaka Univ.)
O 11. "A diagnostic of laser-imploded target at fast ignition by Uniformly Redundant Penumbral Array Camera," by Nozaki S. et al. (Univ. of Ryukyus)
O 12. " Degeneracy diagnostics of imploded DT plasmas based

on nuclear reaction products measurement," by Nakao Y. et al. (Kyushu Univ.)

-Kyushu University-

- Q 1. "Survey of optimum tangency radii for Neutral Beam Injection on QUEST (Q-shu University Experiment with Steady State Spherical Tokamak)," by Osakabe M. et al. (NIFS)
- Q 2. "Study of Hydrogen Recycling and Neutral Particle Behavior in Spherical Torus Plasmas," by Nakashima Y. et al. (Univ. of Tsukuba)
- Q 3. "Establishment of Active Control of Hydrogen Recycling in QUEST," by Tokunaga K. et al. (Kyushu Univ.)
- Q 4. "Study of the operation scenarios in QUEST," by Mitarai O. et al. (Tokai Univ.)
- Q 5. "A Study of Plasma Start-up in Spherical Tokamak devices," by Ejiri A. et al. (Univ. of Tokyo)
- Q 6. "Development of a New NBI system by Washer gun-type Ion Beam Source," by Ono Y. et al. (Univ. of Tokyo)
- Q 7. "QUEST plasma measurement using a fast video camera," by Nishino N. et al. (Hiroshima Univ.)
- Q 8. "Active particle control in the compact spherical tokamak CPD by a Li-gettered poloidal limiter," by Hirooka Y. et al. (NIFS)
- Q 9. "Formation of Initial Magnetic Surface by ECH under Various Aspect Ratios," by Maekawa T. et al. (Kyoto Univ.)
- Q 10. "Experiments of current start-up by RF on QUEST," by Hanada K. et al. (Kyushu Univ.)
- Q 11. "An advanced fuelling by compact toroid injection on the QUEST device," by Fukumoto N. et al. (Univ. of Hyogo)
- Q 12. "Japanese Fusion Virtual Laboratory between LHD, QUEST, and GAMMA10," by Nakanishi H. et al. (NIFS)
- Q 13. "Development of the Advanced Diagnostics for Steady State Operation in spherical tokamak QUEST," by Zushi H. et al. (Kyushu Univ.)
- Q 14. "Scenario Discussion and Development Study for Sustainment of Steady State ST Plasma Configuration," by Idei H. et al. (Kyushu Univ.)
- Q 15. "Plasma-wall interaction and divertor particle control in steady state plasma," by Sakamoto M. et al. (Kyushu Univ.)
- Q 16. "Establishment of an Environment for Remote Participation and Control on QUEST Experiments," by Hasegawa M. et al. (Kyushu Univ.)