

US-Japan Joint Institute for Fusion Theory
Annual Report of Activities
April 1, 1992–March 31, 1993

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1. Introduction

The general objective of the US-Japan Joint Institute for Fusion Theory (JIFT) program is *to advance the theoretical understanding of plasmas, with special emphasis on stability, equilibrium, heating, and transport in magnetic fusion systems*, through collaborations between Japanese and US fusion physicists.

The JIFT program is now in its twelfth year of successful operation. During its existence so far, it has sponsored 83 exchange scientist long-term visits, 45 topical workshops, and 45 joint computational projects.

The topics and also the participating scientists for the JIFT exchange visits, workshops, and joint computational projects are chosen with attention paid to having a balanced representation of critical issues in magnetic fusion research, including both fundamental problems as well as questions of near-term significance, and taking into account the specific capabilities and interests of both countries. The Japanese and US members of the JIFT Steering Committee agree together on the appropriateness of proposed topics before recommending them.

A number of general benefits have resulted over the years from the JIFT program, including the following: (1) JIFT has provided efficient communication channels for the latest theoretical research results, techniques, and directions; (2) JIFT activities have attracted serious participation from allied fields--e.g., fluid turbulence, statistical physics, computational science, space plasma physics, etc.--which tends to bring new scientific tools into the fusion program and enhance the stature of fusion physics; (3) JIFT exchanges have contributed to efficient utilization of international research facilities; and (4) JIFT emphasis on large-scale computational studies has reaped significant mutual benefits from the supercomputer resources and code-building expertise of both countries.

A report on the status of the various activities in the 1992-93 JIFT program is given in Section 3 of this report. A description of some specific technical accomplishments during the past year is given in Section 4. Plans for recommended activities during the next year are described in Section 5.

We begin in Section 2 by summarizing some recent changes in the JIFT management structure.

2. Management Structure

Until last year, JIFT had a Steering Committee with eight members (four Japanese and four American) and also two Management Committees, one in each country. The two co-chairmen of the Steering Committee were the director of the Institute for Fusion Studies of The University of Texas at Austin and the director of the International Center for Fusion Theory, a formal entity within the Institute of Plasma Physics of Nagoya University. The chairmen of the respective Japanese and US Management Committees, who were not members of the Steering Committee, had

the day-to-day responsibility for overseeing the progress of JIFT activities.

Last year it was agreed to modify this management structure. The JIFT still has a Steering Committee with eight members, four from each country, and two co-chairmen. However, the co-chairman on the Japanese side is now the director of the Theory and Computer Simulation Center at The National Institute for Fusion Science (into which the previous Institute of Plasma Physics had been subsumed four years ago). Also, the two local Management Committees have disappeared, and two other members of the Steering Committee, who are called co-executive secretaries, now have the responsibility for the ongoing oversight of JIFT activities. Furthermore, on the Japanese side, there are two official Advisors, both of whom are from the Japan Atomic Energy Research Institute; and on the US side there is an Advisory Committee comprised of several members. The names of the persons on the Steering Committee and the advisors are given below:

JIFT Steering Committee

US Members

R. Hazeltine (co-chairman)

J. Van Dam (co-executive secretary)

W. Sadowski

J. Dawson

Japanese Members

T. Sato (co-chairman)

M. Okamoto (co-executive secretary)

M. Wakatani

K. Mima

Japanese Advisors: T. Takeda and M. Azumi

US Advisory Committee: A. Aydemir, J. Johnson, W. Horton, J. Leboeuf, T. Tajima, and P. Terry.

In addition to these internal changes, there have also been some changes in how JIFT operates with respect to the larger program for all US-Japan fusion physics exchanges. The latter was recently reorganized under two committees, the Fusion Physics Planning Committee (FPPC) and the Fusion Technology Planning Committee (FTPC). JIFT operates alongside these two committees as the central vehicle for fundamental theoretical exchanges. Moreover, the JIFT activities are coordinated with the four FPPC areas of activity, viz., core plasma phenomena, edge behaviour and control, heating and current drive, and new approaches and diagnostics. As part of this coordination, Japanese and US members of the JIFT Steering Committee attended a meeting of the FPPC held in San Diego in November 1992, to prepare the upcoming year's exchange activity list.

During the November 1992 Division of Plasma Physics Meeting of the American Physical Society held in Seattle, WA, a special reception was arranged to honor three men for their longstanding services to the JIFT program: Professor Y. H. Ichikawa, who had since its inception been the Japanese co-chairman, and Prof. T. Kamimura and Prof. W. Horton, who had similarly

been the chairmen of the respective Japanese and US Management Committees. For more than a decade, these three, plus the director of the IFS, had guided and organized the activities of JIFT, so that it has become an established collaboration program between the US and Japanese fusion theory efforts.

3. Status of Current Activities

For the 1992-93 annual JIFT program (see Attachment A), it had been decided to hold three workshops in the US and one in Japan, instead of the the usual two workshops in each country, in order to try to enhance attendance. As it turned out, one of the three proposed US workshops fell through, and therefore the 1992-93 program ended up with two workshops in the US and one in Japan. For next year, the Steering Committee has recommended returning to the traditional schedule of two workshops in each country. Next year the annual meeting of the JIFT Steering Committee will be held in Japan.

During 1992-93, four Japanese physicists came to the US. However, due to budgetary and programmatic pressures, no US exchange scientist was able to go to Japan this year. The Steering Committee will attempt to improve this situation next year through closer communication between the two countries and with home institutional management. Also, the Steering Committee will attempt to schedule workshops to dovetail with other meetings, to continue to involve participation at workshops by interested experimentalists, and to invite relevant available scientists from other countries to attend workshops.

4. Technical Progress Highlights

Two recent JIFT exchange scientist activities led to fruitful research collaborations that culminated in papers selected for presentation at the 1992 IAEA Conference. The visit by Dr. C. Z. Cheng (PPPL) to NIFS as the 1990 JIFT visiting professor resulted in the first study of shear Alfvén eigenmodes induced by the helicity of the magnetic field in Heliotron/Torsotron plasma configurations.^{1,2} The visit by Prof. A. Lichtenberg (UC Berkeley) to NIFS as the 1991 JIFT visiting professor resulted in a theoretical model that explains major disruptions in tokamaks in terms of enhanced transport due to magnetic stochasticity on the growth of the $m=2$ tearing mode near the island separatrix.^{3,4}

Brief statements about the purpose, technical and/or programmatic highlights, benefits, and suggested follow-up actions for each of the 1992-93 JIFT exchange scientist, workshop, and joint computational project activities are given in the International Program Information System (IPIS) reports (see Attachment B). More detailed reports will be published in the forthcoming issue of the *JIFT Newsletter*.

5. Plans for Future Activities

The topics and themes of the exchange activities that have been proposed for next year (April 1, 1993-March 31, 1994) are consistent with the traditional emphasis of JIFT on fundamental theoretical issues, but at the same time have relevance to mainline programmatic interests of the countries. These activities are listed in Attachment C.

One workshop and three scientific exchange visits concern recent developments in computational methods, which, on the US side, are related to the Numerical Tokamak Project and, on the Japanese side, to the nonlinear plasma simulation program.

Two other workshops and exchange visits concern fundamental nonlinear plasma phenomena in toroidal plasmas.

One exchange visit focuses on three-dimensional equilibrium and stability, a topic that has always been an important, continuing theme for JIFT collaborations.

Two exchange visits concern alternate concepts, another traditional sub-area of JIFT.

One workshop partly concerns alpha physics problems generic to ignited plasmas and plasmas with high-power auxiliary heating, which is of relevance to present-day toroidal experiments and also to ITER and advanced non-toroidal machines.

The joint computational projects, which comprise the third part of the JIFT program (in addition to the exchange scientist visits and the workshops), usually arise as outgrowths of earlier workshops or scientific exchanges. Their number is periodically pruned, after their usefulness has been realized. Two joint computational projects were dropped after the 1992-93 program. One was a longstanding JIFT collaboration aimed at implicit methods for particle simulation codes that simulate low-frequency, large-spatial-scale electromagnetic plasma phenomena; this effort culminated in the publication of a significant paper.⁵

To the proposed 1993-94 JIFT program three new joint computational projects were added. Two are related to nonlinear plasma numerical simulations, directly relevant to the Numerical Tokamak Project in particular and to the study of turbulent transport in general. The third concerns transport modeling analysis based on the use of the FRC profile database. (The fact that all three of these new projects have JAERI scientists as participants indicates the express intention of JAERI to remain fully involved in the JIFT exchange program.)

References

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5. T. Kamimura, E. Montalvo, D. C. Barnes, J. N. Leboeuf, and T. Tajima, "Implicit Particle Simulation of Electromagnetic Plasma Phenomena," *J. Comp. Phys.* **100**, 77-90 (1992).