

TO: Executive Secretaries of the US-Japan Fusion Research Collaboration
FROM: Steering Committee, US-Japan Joint Institute for Fusion Theory (JIFT)
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SUBJECT: JIFT Annual Report of Activities for 2020-2021

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Annual Report of JIFT Activities



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Annual Report of Activities

US-Japan Joint Institute for Fusion Theory

April 1, 2020–March 31, 2021

JIFT Steering Committee

Co-Chairmen: H. Sugama and F. L. Waelbroeck

Co-Executive Secretaries: S. Ishiguro and A. Arefiev

February 5, 2021

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1. INTRODUCTION

The Joint Institute for Fusion Theory (JIFT) is one of the three programs through which the US-Japan Fusion Research Collaboration is organized. The other two programs are the Fusion Physics Planning Committee (FPPC) and the Fusion Technology Planning Committee (FTPC).

The distinctive objectives of the JIFT program are (1) to advance the theoretical understanding of plasmas, with special emphasis on stability, equilibrium, heating, and transport in magnetic fusion systems; and (2) to develop fundamental theoretical and computational tools and concepts for understanding nonlinear plasma phenomena. Both objectives are pursued through collaborations between U.S. and Japanese scientists by means of two types of exchange program activities—namely, workshops and exchange visitors.

Each year the JIFT program usually consists of four topical workshops (two in each country), six exchange scientists (three from each country). So far, during its 38 years of successful operation, JIFT has sponsored 245 long-term visits by exchange scientists and 138 topical workshops.

- The *workshops* typically have an attendance of 15–30 participants, of whom usually three to seven scientists (depending on the particular workshop) travel to the workshop from the non-host country. Scientists from countries other than the U.S. and Japan are also often invited to participate in JIFT workshops, either as observers or multi-laterals.
- Of the approximately three *exchange visitors* in each direction every year, one (called the “JIFT Visiting Professor”) is supported by the host country, while the others (called “Exchange Scientists”) are supported by the sending country. The visits of the Exchange Scientists usually last from one to several weeks in duration, whereas the Visiting Professors normally stay for one month.

The topics and also the participating scientists for the JIFT exchange visits, and workshops are selected so as to have a balanced representation of critical issues in magnetic fusion research, including both fundamental problems as well as questions of near-term significance, and also to take 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.

2. SUMMARY OF COMPLETED ACTIVITIES (2020-2021 PROGRAM)

Most of the activities in the two categories—workshops and personal exchanges—that had been scheduled for the 2020-2021 JIFT program were deferred to 2021-2022 because of the COVID-19. However, two remote collaborations were successfully carried out instead of personal exchanges, and the JIFT Steering Committee meeting was held for discussing schedules for the 2020-2021 and 2021-2022 JIFT programs.

Summary reports about JIFT activities for 2020-2021 are given below.

A 2020-2021 Workshops

Japan to US:

JF-1 US-Japan collaborations on co- designs of fusion simulations for extreme scale computing

Organizers: C. S. Chang (PPPL) and Masanori Nunami (NIFS)

Location: Princeton Plasma Physics Laboratory, Princeton, New Jersey (US)

Dates: August 2-3, 2020

This workshop was deferred to 2021-2022.

JF-2 Theory and simulation on the high field and high energy density physics

Organizers: Alexey Arefiev (UCSD) and Y. Sentoku (Osaka)

Location: Memphis, TN (US)

Dates: November 7- 8, 2020

This workshop was deferred to 2021-2022.

US to Japan:

JF-8 Progress on advanced optimization concept and modeling in stellarator-heliotrons

Organizers: S. Murakami (Kyoto) and D. Anderson (Univ. Wisconsin)

Location: Kyoto (Japan)

Dates: September 23-25, 2020

This workshop was deferred to 2021-2022.

B. 2020-2021 Exchange Visits

Japan to US:

JF-3 Ignition and burn dynamics of magnetized fast ignition laser fusion

Visiting Scientist: T. Johzaki (Hiroshima Univ)

Location: Purdue Univ. Indiana (US)

Dates: Sep. 6-20, 2020

This exchange visit was deferred to 2021-2022.

JF-4 Simulation study of interchange mode dynamics

Visiting Scientist: K. Ichiguchi (NIFS)

Location: MIT, Boston (US)

Dates: Oct. 25-Nov.8, 2020

This exchange visit was deferred to 2021-2022.

JF-5 Optimization study of heliotron configurations

Visiting Scientist: H. Yamaguchi (NIFS)

Location: Univ. Wisconsin

Dates: July 29-Sep.1, 2020 (US)

This exchange visit was deferred to 2021-2022.

JF-6 Integrated transport simulation of HSX plasma

Visiting Scientist: Y. Morishita (Kyoto)

Location: Univ. Wisconsin (US)

Dates: Sep. 27-Oct.25, 2020

This exchange visit was deferred to 2021-2022.

JF-7 Theoretical study related to two-fluid equilibria

Visiting Scientist: A. Ito (NIFS); visiting researcher in IFS

Location: IFS-Univ. Texas, Austin (US)

Dates: Jan.12-Feb.12, 2021

This exchange visit was deferred to 2021-2022.

Electromagnetic turbulence in fusion plasmas

Visiting Scientist: Akihiro Ishizawa (Kyoto Univ.)

Location: IFS, University of Texas at Austin (US)

Dates: May 25-29, 2020

Summary:

This exchange visit was originally scheduled in March 8-22, 2020 and deferred to 2020-2021.

Instead of the exchange visit, the remote collaboration on electromagnetic turbulence was carried

out among Dr. A. Ishizawa, Dr. M.J. Pueschel, and other colleagues of IFS through email and online meetings in May 25-29, 2020. New findings obtained about electromagnetic turbulence in helical plasmas were presented at the APS meeting [1]. In addition, research results on microscopic tearing mode turbulence in the edge region of tokamaks obtained from collaboration in recent years were published in Nuclear Fusion [2].

Related publications:

[1] I.J. McKinney, M.J. Pueschel, C.C. Hegna, B.J. Faber, P.W. Terry, A. Ishizawa, J.N. Talmadge, D.T. Anderson, 'Kinetic ballooning mode turbulence in low-magnetic-shear 3D equilibria,' 61st Annual Meeting of the APS Division of Plasma Physics (2019), <https://meetings.aps.org/Meeting/DPP19/Session/UP10.15>

[2] M.J. Pueschel, D.R. Hatch, M. Kotschenreuther, A. Ishizawa and G. Merlo, 'Multi-scale interactions of microtearing turbulence in the tokamak pedestal,' Nuclear Fusion **60**, 124005, (2020).

US to Japan:

JF-9 Novel setups for laser-plasma interactions involving structured targets and applied magnetic fields

Visiting Scientist: A. Arefiev (UCSD)

Location: Osaka University (Japan)

Dates: May 18-22, 2020

This exchange visit was deferred to 2021-2022.

JF-10 Theoretical model of WDM regime driven by intense laser

Visiting Scientist: F. Graziani (LLNL)

Location: Osaka University (Japan)

Dates: May 18-22, 2020

This exchange visit was deferred to 2021-2022.

JF-11 Properties of high-energy-density material

Visiting Scientist: T. Ogitsu (LLNL)

Location: Osaka University (Japan)

Dates: June 8-12, 2020

This exchange visit was deferred to 2021-2022.

JF-12 Isochoric heating by fast ion beam driven by intense laser light

Visiting Scientist: A. Pak (LLNL)

Location: Osaka University (Japan)

Dates: July 7-14, 2020

This exchange visit was deferred to 2021-2022.

JF-13 Long time simulations of energetic particle driven instabilities

Visiting Scientist: D.A. Spong (ORNL)

Location: NIFS (Japan)

Dates: July 6-17, 2020

This exchange visit was deferred to 2021-2022.

JF-14 Kinetic-MHD hybrid simulations of energetic-particle driven instabilities

Visiting Scientist: Chang Liu (PPPL)

Location: NIFS (Japan)

Dates: May 11-Sep.10, 2020

Summary:

Instead of the exchange visit, Chang Liu (PPPL) has started a remote collaboration with Yasushi Todo (NIFS) and Hanzheng Li (graduate student of University of Tokyo) on a code benchmark for

kink and fishbone instabilities in a tokamak plasma using M3D-C1 and MEGA codes. Chang Liu will visit NIFS in July or August 2021 for one month.

3. PROGRAM ADMINISTRATION

JIFT has a Steering Committee consisting of eight members, four from each country. Two of these members are the Japanese and US co-chairmen. Two other members of the Steering Committee, the US and Japanese co-executive secretaries, are responsible for the ongoing daily oversight of the progress of JIFT activities. The co-chairman and co-executive secretary on the US side are, respectively, the director and a research scientist at the Institute for Fusion Studies (IFS) of The University of Texas at Austin. The Japanese co-chairman is the Leader of the Numerical Simulation Reactor Research Project at the National Institute for Fusion Science, and the Japanese co-executive secretary is the director of the Fundamental Physics Simulation Research Division in the Department of Helical Plasma Research at the National Institute for Fusion Science. Furthermore, on the Japanese side there is an Advisory Committee comprised of five members representing a spectrum of Japanese universities and the National Institutes for Quantum and Radiological Science and Technology; and on the US side there is an Advisory Committee comprised of five members representing a spectrum of US universities and national laboratories. The names of the persons on the Steering Committee and the names of the Advisors are listed below.

JIFT Steering Committee

US Members

F. Waelbroeck (IFS)—Co-Chairman
A. Arefiev (UCSD)—Co-Exec. Secretary
D. Spong (ORNL)
J. Mandrekas (DOE)

Japanese Members

H. Sugama (NIFS)—Co-Chairman
S. Ishiguro (NIFS)—Co-Exec. Secretary
S. Murakami (Kyoto)
Y. Sentoku (Osaka)

JIFT Advisors

Japanese Advisory Committee: Y. Todo (NIFS), Y. Kishimoto (Kyoto), Z. Yoshida (Tokyo), T.-H. Watanabe (Nagoya), M. Yagi (QST)

US Advisory Committee: J. Palastro (LLE/Univ. of Rochester), F. Graziani (LLNL), C. S. Chang (PPPL), and P. Terry (UWM)

The JIFT Steering Committee attempts to schedule workshops in such a way as to dovetail with other meetings. It also encourages participation at workshops by interested experimentalists and invites relevant available scientists from other countries to attend workshops.

As the principal program for fundamental theoretical exchanges in the US-Japan Fusion Research Collaboration, JIFT operates alongside the Fusion Physics Planning Committee (FPPC) and the Fusion Technology Planning Committee (FTPC). In particular, the JIFT activities are coordinated with the four FPPC areas of activity, viz., core plasma phenomena, edge behavior and control, heating and current drive, and new approaches and diagnostics.

4. PLANS FOR FUTURE ACTIVITIES (PROPOSED 2021-2022 PROGRAM)

The topics and themes of the exchange activities that have been proposed for the next year (April 1, 2021–March 31, 2022) are consistent with the traditional emphasis of JIFT on fundamental theoretical plasma physics issues. At the same time the proposed activities have direct relevance to the fusion science programmatic interests of both countries. The schedule of proposed activities for the coming year (2021-2022) is listed below.

A. 2021-2022 Proposed Workshops

Japan to US:

JF-1 US-Japan collaborations on co-designs of fusion simulations for extreme scale computing

Organizers: C.S. Chang (PPPL) and M. Nunami (NIFS)

Proposed Place/Time: Aug. 2021 at PPPL (US)

JF-2 Theory and simulation on the high field and high energy density physics

Organizers: Alexey Arefiev (UCSD) and Y. Sentoku (Osaka)

Proposed Place/Time: Nov. 2021 at Pittsburgh (US)

US to Japan:

JF-8 Progress on advanced optimization concept and modeling in stellarator-heliotrons

Organizers: S. Murakami (Kyoto) and D. Anderson (Univ. Wisconsin)

Proposed Place/Time: Sep. 2021 at Kyoto (Japan)

B. 2021-2022 Proposed Exchange Visits

Japan to US:

JF-3 Ignition and burn dynamics of magnetized fast ignition laser fusion

Visiting Scientist: T. Johzaki (Hiroshima Univ)

Location: Purdue Univ.

Dates: Sep. 2021

JF-4 Simulation study of interchange mode dynamics

Visiting Scientist: K. Ichiguchi (NIFS)

Location: MIT, Boston

Dates: Oct. 2021

JF-5 Optimization study of heliotron configurations

Visiting Scientist: H. Yamaguchi (NIFS)

Location: Univ. Wisconsin

Dates: July 2021

JF-6 Integrated transport simulation of HSX plasma

Visiting Scientist: Y. Morishita (Kyoto)

Location: Univ. Wisconsin

Dates: Sep. 2021

JF-7 Theoretical study related to two-fluid equilibria

Visiting Scientist: A. Ito (NIFS); visiting researcher in IFS

Location: IFS-Univ. Texas, Austin, Paid by IFS

Dates: Jan. 2022

Collaboration on Tokamak boundary plasma turbulence simulations for divertor heat flux width

Visiting Scientist: H. Seto (QST)

Location: Lawrence Livermore National Laboratory

Dates: Aug. 2021

Theoretical study on high energy density plasma creation and ion acceleration by kJ-class intense lasers

Visiting Scientist: N. Iwata (Osaka Univ.)

Location: Lawrence Livermore National Laboratory
Dates: Nov. 2021

US to Japan:

JF-9 Novel setups for laser-plasma interactions involving structured targets and applied magnetic fields

Visiting Scientist: A. Arefiev (UCSD)
Location: Osaka Univ.
Dates: July 2021

JF-10 Theoretical model of WDM regime driven by intense laser

Visiting Scientist: F. Graziani (LLNL)
Location: Osaka Univ.
Dates: June 2021

JF-11 Properties of high-energy-density material

Visiting Scientist: T. Ogitsu (LLNL)
Location: Osaka Univ.
Dates: June 2021

JF-12 Isochoric heating by fast ion beam driven by intense laser light

Visiting Scientist: A. Pak (LLNL)
Location: Osaka Univ.
Dates: July 2021

JF-13 Long time simulations of energetic particle driven instabilities

Visiting Scientist: D.A. Spong (ORNL)
Location: NIFS
Dates: Nov. 2021

JF-14 Kinetic-MHD hybrid simulations of energetic-particle driven instabilities

Visiting Scientist: Chang Liu (PPPL); recommended as a candidate for a visiting researcher in NIFS
Location: NIFS (paid by NIFS)
Dates: July 2021

Collaboration on Tokamak boundary plasma turbulence simulations for divertor heat flux width

Visiting Scientist: Xueqiao Xu (LLNL)
Location: QST
Dates: Nov. 2021