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 2018-2019

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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, 2018–March 31, 2019

JIFT Steering Committee

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

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

January 29, 2019

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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 (2018-2019 PROGRAM)*

Most of the activities in the two categories—workshops and personal exchanges—that had been scheduled for the 2018-2019 JIFT program were carried out during the past year. Three workshops were successfully held, in addition to the JIFT Steering Committee meeting. In the category of personal exchanges, two Visiting Professor and eight Visiting Scientists made exchange visits.

Summary reports about JIFT activities for 2018-2019 are given below.

A 2018-2019 Workshops

Japan to US:

JF-1 US-Japan collaborations on co-designs of fusion simulations for extreme scale computing
Organizers: C. S. Chang (PPPL) & T.-H. Watanabe (Nagoya)
Location: PPPL, Princeton (USA)
Dates: Jul.29- Aug. 2, 2018
Summary:

The fourth US-Japan Joint Institute for Fusion Theory (JIFT) Workshop was held at the Princeton Plasma Physics Laboraotry, on July 29-2 of August. The purpose of the workshop was to promote US-Japan collaborations on co-design of fusion applications toward extreme scale computing, and on high performance computing in fusion simulations of core and edge plasma-material interactions. The first day was used for individual and group discussions. Fourteen researchers from Japan and twelve US researchers from a variety of research fields, such as computer science, fusion plasma theory, and the material science were invited to the workshop. Major topics presented at the workshop include prospects of high performance computing on the extreme-scale supercomputers, and recent progresses in fusion plasma simulations and material simulations.

JF-2 Theory and simulation on the high field and high energy density physics
Organizers: Y. SENTOKU (Osaka) & Alexey Arefiev (UCSD)
Location:: Portland, O (USA)
Dates: Nov. 3-4, 2018
Summary:

The purpose of this workshop was to discuss the theory and simulations of high field and high energy density physics and the potential applications. The workshop took place in Portland, Oregon on November 9 & 10. There were 24 oral presentations: 10 from Japan and 14 from the US. The total number of participants was about 30. We discussed the theory and the numerical modeling for laser acceleration, relativistic laser plasma interaction (LPI), ionization dynamics in LPI, kinetic equilibrium in LPI, spatiotemporal controlled new laser light, and fast ignition. Some experimentalists also attended and provided the latest experimental results to the theorists. The workshop went successfully, with constructive discussions and lively exchange of ideas. A lot of young scientists and students participated, which helps us maintain this area of research by getting them involved.

US to Japan:

JF-11 Multiscale simulations in plasma physics
Organizers: S. Ishiguro (NIFS), Bill Dorland (Maryland), Luis Chacon (LANL)
Location: Inuyama, Japan
Dates: January 11-12, 2019
Summary:

The US-Japan Joint Institute of Fusion Theory Workshop on "Multiscale Simulations in Plasma Physics" was held January 11-12, 2019 at Inuyama. This workshop focused on multi-scale simulation methods and simulation studies relevant to multi-hierarchy physics in fusion and other plasmas. Five US and twenty-seven Japan researchers in the variety of field such as plasma physics, molecular sciences, astrophysics participated in the workshop. Topics included implicit PIC simulations, explicit and implicit kinetic-ion/fluid-electron simulations, multiscale gyrokinetic simulations, multiscale plasma physics, such as ion/electron turbulence, turbulent kinetic magnetic reconnection. Multiscale simulations in material sciences and astronomical plasma were also included.

B. 2018-2019 Exchange Visits

Japan to US:

JF-4 Control of ignition and burn dynamics in fast ignition laser fusion by externally applied ultra-intense magnetic fields
Visiting Scientist: Tomoyuki JOHZAKI (Hiroshima University)
Location: IFS, Purdue University, West Lafayette, Indiana
Dates: Feb. 24-Mar. 8, 2019 (13 days); paid by Japan
Summary:

Dr. Johzaki has been collaborating for a number of years with Prof. A..Sentoku at Center for Materials Under eXtreme Environment (CMUXE), Purdue University on the simulation study for fuel implosion and fusion burning related to the fast ignition laser fusion. Dr. Johzaki has developed hybrid-type code "FIBMET" for calculating core heating and fusion burning for fast ignition laser fusion research. In this code, laser-produced electron and ion beams are treated by particle model, bulk plasma is treated by radiation-hydro model and fusion-produced alpha-particle is treated by multi-group transport model. Prof. Sunahara has developed radiation-hydro code "star-1D and -2D" for fuel implosion. This code includes laser heating by ray-tracing method and detailed atomic data (EOS and radiation Opacity tables). Using both codes, we evaluated core heating properties and proposed the fast electron beam guiding scheme using external magnetic field [1] and self-generated magnetic field [2] for enhancing core heating efficiency. The present collaboration program just started in this fiscal year (2018). The purpose of the program is to integrate the two codes for simulating the whole process from implosion to fusion burning excepting heating beam generation. (The generation of heating beam is calculated by PIC code since the kinetic effect should be considered.) In this fiscal year, we have implemented fusion burning and alpha-particle transport (multi-group diffusion model) in the star-2d code to calculate the process from implosion to fusion burning using this code to evaluate the ignition condition of fast ignition laser fusion. During the exchange program period, we have done the following code development:

(1) implementation of fusion reaction and alpha-particle transport (multi-group diffusion scheme). Related to this, temporal and spatial variation of material composition should be considered.
(2) A simple external heating routine, which calculates the core heating by artificially adding a heating term in the bulk-electron energy-conservation equation, has been installed.

After the exchange program period, we will evaluate the code adequacy by comparing the heating energy required for ignition in fast ignition scheme obtained by the star-2D simulation with that evaluated by the other codes (FIBMET and so on).

JF-7 Simulation Study of Magnetized Fast Ignition Fusion

Visiting Scientist: Toshihiro Taguchi (Setsunan University)
Location: Institute for Research in Electronics and Applied Physics, University of Maryland, College Park, College Park, Maryland
Dates: August 12-September 9, 2018 (29 days); paid by Japan
Summary:

The visiting scientist (Taguchi) has been collaborating for more than a decade with Prof. T. M. Antonsen, Jr. and Prof. Liu in the University of Maryland on the theoretical and simulation research about a high intensity laser-plasma interaction, which is directly related to the laser fusion scheme. One of the recent interesting topics is a magnetized fast ignition, which uses a kilo-tesla class magnetic field produced by a strong laser-plasma interaction as an electron beam guiding in a high density region.

In his JIFT research of this year, he and Prof. Antonsen started working on a new topic, the competition of resistive and non-resistive Weibel instabilities under a strong magnetic field. While the relativistic electrons travel through a high density region, they drive a backward electron flow in the background plasma and produce an unstable state consisting of forward propagating beam electrons and backward return electrons. When the resistivity in the background plasma is included, it may play an important role in the development of the two stream instability. They carried out a lot of simulation runs using a hybrid code, which includes a resistive term in an equation of motion for the background plasma. As a result, they showed that the resistive Weibel instability will be well suppressed under a strong magnetic field.

Dr. Taguchi also performed 2D PIC simulations in order to analyze the Raman instability induced by an incident laser field propagating through an underdense plasmas. This work was done with Prof. Liu and it is important for the laser fusion program in the NIF facility. They found that the Raman instability will take place when the intensity of an incident laser light exceeds a threshold value, about $3\text{x}10^{15}\text{W/cm}^2$. Now they are trying to estimate a reflectivity of the incident light in order to compare their simulation results with experimental ones.

Related Talk:

[1] T. Taguchi, "Competition between resistive and non-resistive Weibel instability under a strong external magnetic field",
2018 US-JAPAN WORKSHOP on theory and simulations of high-field and high energy density physics, Nov. 3 - 4, 2018, Portland, Oregon.

JF-8 Investigation of effects of helium bubble formation on plasma-material interaction

Visiting Scientist: Seiki Saito (Yamagata University)
Location: MAE, University of California San Diego, San Diego, California
Dates: Oct. 12 - Nov. 25, 2018 (45 days); paid by Japan
Summary:

When tungsten material is irradiated by helium plasma, helium bubbles are formed near the surface. Using the binary-collision-approximation-based simulation code AC∀T, the visiting scientist Dr. S. Saito found that the bubbles are disturbed by the motion of incident hydrogen atoms [1]. To discuss the effects of helium bubble formation on plasma-material interaction, Dr. S. Saito visited Dr. S.I. Krasheninnikov's Lab in MAE, University of California San Diego. As a phenomenon similar to a helium bubble, we also discussed the formation mechanism of platelet-like structures of self-trapped hydrogen induced by stresses in tungsten. The structure is found by Dr. R.D. Smirnov and Dr. S.I. Krasheninnikov by Molecular dynamics simulation [2]. In the case of helium bubbles, the bubbles form by local minimization of the potential energy of helium-tungsten interaction. This fact suggests that the helium bubble can be formed without thermal effects when helium atoms are distributed in tungsten with enough density. Therefore, we focused on investigating the necessity of thermal effects for the formation of the platelet-like structures by local minimization of the hydrogen-tungsten potential. To investigate these effects, Dr. S. Saito implemented the tungsten-hydrogen potential with the cooperation of R.D. Smirnov and S.I. Krasheninnikov, at first. Then, we performed calculations of energy minimization for hydrogen-tungsten system. We found that the platelet-like structures of hydrogen never generated without thermal effects. This fact suggests that the platelet-like structures of hydrogen and helium bubbles have different formation mechanism. During the stay, the visitor also discussed possibilities of developing the MD model of hydrogen recycling on tungsten divertor with the implemented tungsten-hydrogen potential and of coupling the AC∀T code with the reaction-diffusion code FACE developed by Dr. R.D. Smirnov.

[1] S. Saito, et. al, "Effect of polycrystalline structure on helium plasma irradiation of tungsten materials", Jpn. J. Appl. Phys. 57, 01AB06, (2017).
[2] R.D. Smirnov, and S.I. Krasheninnikov, "Stress-induced hydrogen self-trapping in tungsten", Nuclear Fusion 58 (12): 126016 (2018).

JF-9 Three-dimensional MHD equilibrium calculation by simulated annealing

Visiting Scientist: Masaru Furukawa (Tottori University)
Location: IFS, University of Texas at Austin, Austin, Texas
Dates: scheduled as February 27 - March 31, 2019 (33 days); paid by USA
Summary:

This exchange activity was carried out in March 6 - March 31, 2019. Dr. M. Furukawa has been collaborating with Dr. P. J. Morrison for some years, and has published two peer-reviewed papers on the topic of this exchange program. The topic is on the development of a new calculation method of three-dimensional magnetohydrodynamics (MHD) equilibria. The proposed method is named simulated annealing (SA) that is based on the Hamiltonian nature of the ideal MHD. By solving an artificial dynamics derived from the Hamiltonian description of the ideal MHD, the energy of the system is monotonically decreased while the Casimir invariants, the defects of the Poisson bracket, are preserved. Then the extremum of the energy gives us an MHD equilibrium. So far, we have demonstrated that the new method works to generate low-beta reduced MHD equilibria in two-dimensional rectangular domain and in cylindrical geometry. Especially MHD equilibria with magnetic islands were obtained in the cylindrical geometry. Moreover, we have extended our development to high-beta reduced MHD in axisymmetric toroidal geometry. We have successfully obtained large-aspect-ratio and circular cross-section tokamak equilibria as well as toroidally-averaged heliotron equilibria with high beta.

During this visit to IFS, we discussed (1) what state we obtain by the SA and (2) how to impose additional constraints other than the Casimir invariants that are built in the Poisson bracket. The SA has the Casimir invariants, however, they are quantities integrated over volume. On the other hand, we specify pressure and current density profiles when we solve the Grad-Shafranov (G-S) equation. The SA obtains a stationary state that is an energy extremum on a Casimir leaf, however, the G-S equilibrium should not be an energy extremum without the constraints on the profiles. In fact, if we perform the SA starting from a symmetric MHD equilibrium with a helical perturbation, the system does not come back to the symmetric equilibrium even though it is MHD stable linearly. Therefore, the SA tries to achieve an energy extremum in a broader region of the phase space generally than we normally assume. Then we need to restrict the phase space where the SA tries to find the energy extremum. Therefore we have formulated a method to impose constraints on the current density profile. The idea was first applied to a heavy top dynamics, and succeeded to obtain a stationary state that is not an energy extremum without the additional constraint. We will examine our method in two-dimensional vortex dynamics first, and to low-beta reduced MHD. We will also examine if our method can suppress fine-scale structure that appears in our simulations and in previous studies on two-dimensional vortex dynamics.

Related publications:

[1] M. Furukawa and P. J. Morrison, "Simulated annealing for three-dimensional low-beta reduced MHD equilibria in cylindrical geometry", Plasma Physics and Controlled Fusion 59, 054001 (11 pp) (2017).

[2] M. Furukawa, Takahiro Watanabe, P. J. Morrison, and K. Ichiguchi, "Calculation of large-aspect-ratio tokamak and toroidally-averaged stellarator equilibria of high-beta reduced magnetohydrodynamics via simulated annealing", Physics of Plasmas 25, 082506 (8 pp) (2018).

JF-10 Nonlinear extended MHD simulations of ballooning-type instability

Visiting Scientist: Hideaki Miura (NIFS)
Location: IFS, University of Texas at Austin, Austin, Texas
Dates: January 15- February 4, 2019 (22 days); paid by Japan
Summary:

This personal exchange has been proposed to enhance research collaboration with US researchers. Dr. Miura has collaborated with Dr. Wendell Horton and Dr. Linjin Zheng of Institute for Fusion Science (IFS), the University of Texas at Austin on numerical work of edge instability. They have published two peer-reviewed articles so far [1,2]. Recently they have extended the stability analysis to extended MHD simulations with edge current diffusivity model. Numerical simulations show that turbulence appears after growth of the current interchange tearing modes (CITM), and dominate the heat transfer across the last closed flux surface. During his visit to IFS, Dr. Miura has worked on the analysis of influences of the ExB drift which influences the growth of the CITM in collaboration with Dr. Horton and Dr. Zheng. This gives perspective on the growth of CITM under the ExB drift.

Related publications are as follows.

[1] L.Zheng, W.Horton, H. Miura et al., "Nonneutralized charge effects on tokamak edge magnetohydrodynamic stability", Physics Letters A 380
(2016) 2654-2657.

[2] H.Miura, L.Zheng, and W.Horton, "Numerical simulations of interchange/tearing instabilities in 2D slab with a numerical model for edge plasma", Physics of Plasmas 24, 092111 (2017).

US to Japan:

JF-12 Application of gyrokinetic models to energetic particle driven instabilities observed in LHD

Visiting Scientist: Donald A. Spong (ORNL)

Location: NIFS
Dates: Nov.19-26, 2018
Summary:

Prof. Donald Spong visited NIFS from Nov. 19-26, 2018. During this period Prof. Spong reviewed fast ion orbit calculations for LHD with Profs. Y. Fujiwara, R. Seki, H. Nuga, H. Yamaguchi, and Bill Heidbrink (who was visiting NIFS for a month). The context was with regard to how fast ion Monte Carlo models can be coupled with the FIDA diagnostic, which Bill was there to implement on LHD. Prof. Spong also discussed whistler waves, as observed in DIII-D with Prof. Y. Todo. The latter was interested in possibilities for simulating runaway driven whistlers within hybrid MHD-particle models (such as the MEGA code) and in PIC codes (as developed by researchers within his group). The main changes for the PIC models would involve including finite electron mass and relativistic effects, and for the hybrid MHD codes, including relativistic effects and full Lorentz orbits. Lastly, Dr. Spong reviewed the development of the FAR3D gyrofluid model with Jacobo Varela. We discussed recent papers he has written, ongoing modifications to the code, plans for an open source distribution of the code, and new projects (multi-species fast ions, negative triangularity shaping effects in DIII-D, calculations for the TJ-II stellarator, ITER simulations, and extension to 3 and 4 fast ion moment calculations.

JF-14 Extending the XGC code for stellarator/heliotron geometry
Visiting Scientist: Michael Cole (PPPL)
Location: NIFS
Dates: Jun.3-17, 2018
Summary:

Dr. Cole visited NIFS between June 3-17 and collaborated with Dr. Nunami on the extension of the XGC code to heliotron/stellarator geometry. He gave a presentation on the orbit losses near separatrices and their roles in the determination of the radial electric field and the Scrape-off Layer (SOL) thickness. He discussed the role of magnetic stochasticity in edge transport and the differences observed in Stellarators and Tokamaks.

JF-15 Electromagnetic turbulence in fusion plasmas
Visiting Scientist: M.J. Pueschel (U.TEXAS)
Location: U.KYOTO
Dates: July.16-20, 2018
Summary:

Dr. Pueschel visited the Fundamental Energy Science Department at Kyoto University from 7/12/2018 to 7/20/2018, where he gave two seminar talks and met with Prof. Ishizawa to discuss saturation processes of electromagnetic plasma microturbulence. In addition to conducting a code-code benchmark exercise, they investigated the roles of zonal flows, zonal fields, and mode self-interaction in setting transport levels of kinetic ballooning as well as collisionless microtearing turbulence regimes. Another topic discussed with Prof. Ishizawa was that of electromagnetic turbulence in low-shear stellarators, prompting a comparison of instability properties in HSX and Helitron-J geometries, with a focus on how the ballooning threshold is lowered with respect to magnetohydrodynamic stability.

JF-17 Transport on Stochastic Magnetic Field
Visiting Scientist: Aaron Bader (U. WISCONSIN)
Location: NIFS
Dates: Dec.2-9, 2018
Summary:

Dr. Bader discussed with his hosts the recent progress on the experimental identification and physics interpretation of 3D effects of magnetic field geometry on divertor transport. The 3D effects are elucidated as a consequence of competition between transports parallel (parallel to) and perpendicular (perpendicular to) to magnetic field, in open field lines cut by divertor plates, or in magnetic islands. The competition has strong impacts on divertor functions, such as determination of density regime, impurity screening, and detachment control. Dr. Bader and his hosts discussed how to evaluate effects of magnetic perturbation on the edge electric field and turbulent transport. Based on the experiments and numerical simulations, key parameters governing the 3D transport physics for the individual divertor functions are pumping efficiency through divertor density regime, impurity screening and detachment control.

JF-18 Simulation study on global kinetic transport process in torus plasmas
Visiting Scientist: Weixing Wang (PPPL)
Location: NIFS
Dates: Mar.20-Apr.21, 2019
Summary:

This JIFT collaboration was carried out by Dr. Weixing Wang (visitor from PPPL) and Dr. Shinsuke Satake (host at NIFS). As a visiting professor, Weixing Wang visited NIFS for one month with financial support provided by NIFS. The theme of this collaboration is the simulation study of neoclassical dynamics and transport in tokamaks with magnetic island perturbations. Simulation studies are being carried out by two global delta-f particle simulation codes, GTS and FORTEC-3D. GTS, developed at PPPL, is a gyrokinetic code in tokamak geometry (including magnetic perturbations) based a global gyrokinetic model that couples self-consistent neoclassical and turbulent dynamics. FORTEC-3D, developed at NIFS, is a 3D global drift kinetic code that simulates finite orbit neoclassical process and transport in both stellarators and perturbed tokamaks (e.g., from resonant magnetic perturbations). The collaboration includes the benchmark study which compares the simulation results of the two codes with respect to radial electric field, particle and energy fluxes, bootstrap current etc. in both unperturbed and unperturbed tokamak geometry. For this purpose, a C-MOD Ohmic L-mode plasma is chosen, and the corresponding MHD equilibrium used for FORTEC-3D simulations is generated by VMEC code based on the experimental data of pressure profile, q-profile and the shape of last magnetic surface, which is consistent with the equilibrium used for GTS simulations. During Wang’s visit in NIFS, a number of GTS simulations have been carried out for the C-MOD plasma, with and without a prescribed 2/1 island. GTS neoclassical simulations carried out in ion collision time scale include both electrons and ions, and calculate both radial electric field (n=m=0) and low-n (n < =4) components of potential which may correspond a convective cell. FORTEC-3D neoclassical simulations have been carried out (by Satake) for the C-MOD plasma with prescribed ideal MHD perturbations. Furthermore, FORTEC-3D is being extended to treating magnetic island perturbations, which will allow it to explore broad neoclassical physics in island geometry. Physics study of this collaboration focuses on the following issues: how the magnetic island affects neoclassical equilibrium electric field, and associated ExB flow structure; how the magnetic island modifies the bootstrap current, including the generation of helical current and possible JxB torque; island-induce NTV torque and its effect on plasma rotation. This collaboration will continue, and we are looking forward to a productive outcome. This includes publishing the research results on the aforementioned interesting, important issues.

During his visit at NIFS, Dr. Wang gave a theory seminar on “Effect of micro-turbulence on plasma self-driven macroscopic current generation”.

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	*Japanese Members*
F. Waelbroeck (IFS)—Co-Chairman	H. Sugama (NIFS)—Co-Chairman
A. Arefiev (UCSD)—Co-Exec. Secretary	S. Ishiguro —Co-Exec. Secretary
D. Spong (ORNL)	S. Murakami (Kyoto)
J. Mandrekas (DOE)	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***:** P. Bonoli (MIT), A. Friedman (LLNL), W. Horton (IFS), W. Tang (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 2019-2020 PROGRAM)*

The topics and themes of the exchange activities that have been proposed for the next year (April 1, 2019–March 31, 2020) 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 (2019-2020) is listed below.

A. 2019-2020 Proposed Workshops

Japan to US:

JF-1 Progress on advanced optimization concept and modeling in stellarator-heliotrons
Organizers: D. Anderson (Wisconsin Univ.) & S. Murakami (Kyoto Univ.)
Proposed Place/Time: Madison (USA) Jun.18-23, 2019

US to Japan:

JF-8 US-Japan collaborations on co-designs of fusion simulations for extreme scale computing
Organizers: M. Nunami (NIFS) & C. S. Chang (PPPL)
Proposed Place/Time: Kobe (Japan) Aug.5-7, 2019

JF-9 Theory and simulation on the high field and high energy density physics
Organizers: Y. Sentoku (Osaka Univ.) & Alexey Arefiev (UCSD)
Proposed Place/Time: Osaka (Japan) Sep.21-22, 2019

B. 2019-2020 Proposed Exchange Visits

Japan to US:

JF-2 Ignition and burn dynamics of magnetized fast ignition laser fusion
Visiting Scientist: T. Johzaki (Hiroshima Univ.)
Location: Purdue Univ.
Dates: Aug.24-Sep.8, 2019

JF-3 Asymmetric Implosion of Cone-guided Solid Targets
Visiting Scientist: H. Sakagami (NIFS)
Location: Univ. Nevada
Dates: Nov.17-30, 2019

JF-4 Electromagnetic turbulence in fusion plasmas
Visiting Scientist: A. Ishizawa (Kyoto Univ.)
Location: Univ. Texas
Dates: Mar.15-29, 2020

JF-5 Introduction of non-uniform dissipation to a quasi-monochromatic ray tracing
Visiting Scientist: K. Yanagihara (Nagoya Univ.)
Location: PPPL
Dates: May 17-Jun.30, 2019

JF-6 Simulation Study of Magnetized Fast Ignition Fusion
Visiting Scientist: T. Taguchi (Setsunan Univ.)
Location: Univ. Maryland
Dates: Aug.11-Sep.8, 2019

JF-7 Application of the gyrokinetic particle-in-cell code to non-thermal plasma dynamics in stellarator edge regions
Visiting Scientist: T. Moritaka (NIFS)
Location: PPPL
Dates: Oct.15-Nov.8, 2019

US to Japan:

JF-10 Nonlinear MHD effects on energetic particle driven instabilities
Visiting Scientist: B. Breizman (Univ. Texas)
Location: NIFS
Dates: Sep.9-13, 2019

JF-11 Simulations of energetic particle driven instabilities in toroidal plasmas
Visiting Scientist: D. A. Spong (ORNL)
Location: NIFS
Dates: Sep.9-13, 2019

JF-12 High energy and well-collimated ion beam generation by laser-driven magnetized electron sheath acceleration
Visiting Scientist: A. Arefiev (UCSD)
Location: Osaka Univ.
Dates: Sep.17-20, 2019

JF-13 Code development for studying MHD equilibrium with dynamically evolved equilibrium profiles
Visiting Scientist: L. Zheng (Univ. Texas)
Location: NIFS
Dates: Oct.20-27, 2019

JF-14 Extended MHD models for magnetically confined plasmas
Visiting Scientist: L. E. Sugiyama (MIT)
Location: NIFS
Dates: Jun.3-Aug.2, 2019