TO: Executive Secretaries of the US-Japan Fusion Research Collaboration

FROM: Steering Committee, US-Japan Joint Institute for Fusion Theory (JIFT)

DATE: February 20, 2014

SUBJECT: JIFT Annual Report of Activities for 2013-2014

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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, 2013–March 31, 2014

JIFT Steering Committee

Co-Chairmen: R. Horiuchi and F. L. Waelbroeck

Co-Executive Secretaries: H. Sugama and A. Arefiev

February 21, 2014

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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 33 years of successful operation, JIFT has sponsored 200 long-term visits by exchange scientists and 119 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 several weeks to two or three months in duration, whereas the Visiting Professors normally stay for three months.

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 (2012-2013 PROGRAM)*

Almost all of the activities in the two categories—workshops and personal exchanges—that had been scheduled for the 2013-2014 JIFT program were carried out during the past year. Four workshops were successfully held, in addition to the JIFT Steering Committee meeting. In the category of personal exchanges, one Visiting Professor and ten Visiting Scientists made exchange visits.

Summary reports about JIFT activities for 2012-2013 are given below.

A. 2013-2014 Workshops

US to Japan:

JF-11 ***New Aspects of Plasma Kinetic Simulation***
Organizers: H. Ohtani (NIFS) and A. Arefiev (IFS)
Location: NIFS
Dates: November 22-23, 2013
Summary:

This was the 6th workshop in the series of annual Joint Institute for Fusion Theory (JIFT) workshops focused on kinetic plasma simulations. These workshops have served as a successful platform for the development of productive working relationships between Japanese and US scientists in carrying out computational research on fusion plasmas and related scientific issues. Plasma kinetic simulations, such as particle-in-cell simulation and gyrokinetic simulations, play an important role in investigating a fine structure and/or small-scale phenomena in fusion plasmas. Nowadays, peta-scale supercomputers are being developed towards exa-scale systems. Innovative modeling and simulation techniques, such as adaptive mesh refinement, implicit time-differencing, the Monte Carlo method, delta-f and gyrokinetic formulations, the variational principle, multi-hierarchy model, etc, are also being developed to tackle the challenges posed by multi-scale problems. The purpose of this specific workshop was to bring together American and Japanese researchers to exchange ideas and report recent research progress on plasma kinetic simulations. The goal of the workshop was to highlight the development and application of novel methods in the context of various plasma physics problems, including fusion, reconnection, and laser-plasma interactions. Thirty three participants attended the workshop. There were 21 oral presentations (6 from US, 12 from Japan, 1 from China, and 1 from Canada).

Related publications:

The agenda, abstracts, presentations, and photographs can be obtained from the workshop web site (http://www-fps.nifs.ac.jp/ohtani/JIFT2013/index.html).

JF-12 ***Theory and Simulation on Fast Ignition Target Design***

Organizers: Hideo Nagatomo (Osaka University) and Pravesh Patel (Lawrence Livermore National Laboratory)
Location: Kishu-Minabe Royal Hotel, Minabe, Wakayama, Japan
Dates: September 16-18, 2013
Summary:

The purpose of this workshop was to understand the detailed physics in fast ignition, and advanced target design to increase the heating efficiency using theoretical and computational studies. There were 7 oral presentations (2 from the US, 5 from Japan). The presentations covered the compression of magnetic field in an implosion, laser plasma interaction and high-energy electron beam transport in strong magnetic field, ion-based fast ignition, and integrated physics and simulations. In particular, theoretical and computational results on the application of the strong magnetic field for the enhancement of the heating efficiency were presented. The high energy density physics under the strong magnetic field were discussed as well.

Japan to US:

JF-1 ***Present status and prospects of theory and simulation on 3D physics in toroidal plasmas***

Organizers: C. Hegna (Wisconsin) and M. Yokoyama (NIFS)
Location: Univ. of Wisconsin, Madison, USA
Dates: July 3-5, 2013
Summary:

The prevalence of 3-D physics is a theme common to both the stellarator/heliotron and RFP confinement configurations. The US-Japan JIFT Workshop held in Madison, June 3-5, 2013 provided a forum from theory and computation researchers to compare and contrast how different topical areas of magnetic confinement physics are treated in these two communities. Additionally, opportunities for improving theory and modeling effort were identified. Topical areas discussed at this meeting included 3-D MHD equilibrium, magnetic island physics, extended MHD modeling, energetic ion confinement, transport modeling, gyro-kinetic simulation, impurity transport and divertor modeling. The workshop gathered experimentalists and theorists from Japan and the US to review recent progress in 3-D physics and highlight challenges. There were 24 oral presentations including 5 from Japanese scientists and 19 from the US community.

Related publications:

The agenda, presentations, and photographs can be obtained from the workshop web site (http://www.cptc.wisc.edu/conf/usjapan2013/index.html).

JF-2 ***Recent studies of extended MHD and MHD simulations***

Organizers: L. Sugiyama (MIT) and H. Miura (NIFS)
Location: Denver, Colorado USA
Dates: November 9-10, 2013
Summary:

The purpose of this workshop was to exchange ideas and initiate new collaborations on nonlinear simulations of large-scale, macroscopic modes in fusion devices. Such modes include vertical instabilities and resistive wall modes (RWM) that generally cause disruptions as well as less damaging events such as sawtooth oscillations, edge localized modes (ELM), neoclassical tearing modes and Alfvén eigenmodes. For many of these modes the growth rates are too small to be described accurately by MHD and two-fluid models must be used. This introduces new time scales and corresponding numerical challenges. Another difficulty that was discussed during this workshop is the modeling of energetic particles and their effects on macroscopic modes. The workshop attracted a dozen participants including five from Japan.

JF-17 ***JIFT Steering Committee Meeting***
Organizers: Ritoku Horiuchi (NIFS) and François Waelbroeck
Location: Toki, Japan
Dates: November 20, 2013
Summary:

Participants at the steering committee meeting reviewed the status of JIFT activities for 2013-14 and discussed recommendations for exchange activities during 2014-15.

B. 2013-2014 Exchange Visits

Japan to US:

JF-3 ***Study on turbulent transport in magnetized plasmas by gyrokinetic simulation***
Visiting Scientist: Masanori Nunami (NIFS)
Location: Institute for Fusion Study, The University of Texas at Austin, Austin, TX
Dates: February 2 - February 19, 2014 (18 days); paid by US
Research Summary:

Dr. Nunami has been working for a few years on the ion temperature gradient (ITG) turbulent transport simulation in helical plasmas such as the Large Helical Devise (LHD). In his recent works, he proposed a reduced transport model of ITG turbulence in helical plasmas based on the turbulence simulations. His collaborator for this visit, Dr. Barnes, has expertise on gyrokinetic turbulence simulation in magnetized plasmas and has developed multi-scale turbulence simulation methods. Recently, Dr. Barnes moved to Institute for Fusion Study of the University of Texas at Austin (IFS) from MIT. In the past few years, Drs. Nunami and Barnes have discussed gyrokinetic turbulence physics in international conferences and workshops. Based on these discussions, they tried in this visit to improve the reduced transport model. The current model cannot treat the up-shift phenomena of the critical temperature gradient for the ITG instability, namely "Dimits shift". They focused on the relation between the linear growth rate and the decay time of zonal flows. If the effect of the decay time is included in the expression of turbulent fluctuations, the up-shift phenomenon may be incorporated in the model. Dr. Nunami presented a seminar on Feb. 17 about the turbulent transport simulation in helical plasmas. He also discussed with Prof. Horton the effects of impurities on the ITG instability. They developed a concrete plan to complete the work and publish it.

JF-4 ***Survey on integrated modeling of tokamak disruptions***
Visiting Scientist: Akinobu Matsuyama (JAEA)
Location: General Atomics at San Diego, California
Dates: February 2 - November 3-17, 2013 (14 days); paid by Japan
Research Summary:

This exchange activity was carried out by means of budget support from JAEA. Dr. Matsuyama visited General Atomics at San Diego and discussed with Drs. V. S. Chan, V. A. Izzo, and P. B. Parks, and with experimental scientists for the DIII-D tokamak. A main topic of this collaboration is runaway electrons (REs) generated during tokamak disruptions, which is an active area of the present research towards ITER. Dr. Izzo and her collaborators have developed a RE orbit simulation code coupled to the nonlinear MHD simulation (NIMROD). She carried out for the first time simulations of disruptions mitigated by the massive gas injection, especially including the nonlinear evolution of disruptive instabilities, whose effect on the RE confinement has been demonstrated. The visitor, Dr. Matsuyama, has developed a 3D particle simulation code for REs especially including for the first time the RE generation process with 3D guiding-center orbits, which has not yet been implemented in NIMROD. These two simulations are currently complementary and in the future, an integrated modeling of REs including both the RE generation and nonlinear MHD will be crucially important for the prediction of disruptions in ITER. This visit is intended to be the first of a continuing collaboration. Dr. Matsuyama presented his results in a seminar and discussed with Dr. Izzo the direction of future developments of the integrated disruption codes. In addition, effort has also been devoted to implementing the NIMROD simulation data into the ETC-Rel code, and conversely the ETC-Rel perturbation model into NIMROD. The NIMROD orbit calculation has well reproduced the results obtained by the ETC-Rel, the latter showing that the stochastic loss of REs in disruptive phenomena exhibits strong energy dependence due to finite orbit-width effects in the relativistic regime relevant to present tokamaks and ITER.

JF-5 ***Nonlinear Simulation of Energetic Particle Dynamics***
Exchange Scientist: Andreas Bierwage (JAEA)
Location: University of California, Irvine (UCI), California
Dates: November 10-24, 2013 (15 days); paid by Japan
Summary:

First hybrid simulation results for a JT-60U scenario, where off-axis fishbone (FB) modes were observed, were presented at APS-DPP meeting in Denver and in a seminar given at University of California, Irvine (UCI). The simulations show a beam-ion-driven mode that is tentatively interpreted as an energetic particle mode (EPM). As in the experiments [2,3], the mode has toroidal mode number n=1 and dominant poloidal mode number m=2. The frequency of the mode is about 6 kHz, matching the local fast ion precession frequency. These results were compared with experimental observations, discussing similarities and proposing explanations for the differences found. For instance, excessively large growth rates and amplitudes in the simulations are attributed to the fact that kinetic thermal ion (KTI) effects, such as Landau damping, were not yet included. At UCI, we developed an interface between our hybrid code MEGA and the EFIT and TRANSP codes, which will allow us to run MEGA for DIII-D scenarios, where off-axis fishbone modes similar to those seen in JT-60U were observed. Analytical work was performed with the goal of extending MEGA so as to include KTI effects. Useful guidance for these derivations, which are still in progress, was obtained during discussions with Dr. Fulvio Zonca at the preceding APS-DPP meeting. These achievements constitute crucial steps ahead towards our goal of clarifying the processes that occur during off-axis FB in JT-60U and DIII-D, and making relevant predictions for burning plasmas, where similar phenomena are expected to occur and where they may affect the fusion performance, current drive and heat load on plasma facing components.

JF-6 ***Small-scale effects on macroscopic instability in finite beta and low collisionality plasmas***
Exchange Scientist: Atsushi Ito (NIFS)
Location: Plasma Science and Fusion Center, Massachusetts Institute of Technology, Cambridge, Massachusetts
Dates: January 27-Feburuary 9, 2014 (14 days); paid by Japan
Research Summary:

Dr. Ito worked with Dr. J. J. Ramos on the dependence of the stability of the drift-tearing mode on the closure condition of the fluid equations. They studied the drift tearing instability using two-fluid models with gyroviscosity to account for the effects of the ion diamagnetic drift. The conventional two-fluid models are valid for collisional plasmas. In the fluid moment equations for low collisionality plasmas, the parallel heat flux that appears in the gyroviscosity and the parallel and perpendicular pressure equations due to the non-Maxwellian part of the velocity distribution function cannot be neglected. In order to obtain a reasonably simple form of the linear eigenmode equations from the fluid moment equations, the collaborators assumed the MHD ordering and retained only the first order diamagnetic effects. They obtained the eigenmode equations for the drift tearing instability including perturbations of the anisotropic pressure and the parallel heat flux. They continue to study the linear stability of the drift-tearing mode by solving the eigenmode equations numerically.

JF-8 ***Simulation study of neoclassical transport and viscosity in nonaxisymmetric plasmas***
Visiting Scientist: Shinsuke Satake (NIFS)
Location: Princeton Plasma Physics Laboratory, Princeton, NJ
University of Wisconsin, Madison, WI
Dates: October 6 - 13 (Princeton); 14- 25 (Madison) 2013 (20 days) Paid by Japan
Research Summary:

From the previous JIFT exchange program in 2008, Dr. Satake has been collaborating with Dr. J. K. Park and his collaborators on the numerical evaluation of neoclassical toroidal viscosity in tokamaks with non-axisymmetric magnetic field perturbations and has published several papers related to this collaborative research activity [1-3]. During the exchange in 2013, they discussed the plan for further collaborations such as benchmarking the FORTEC-3D code, which has been developed by Satake, and the POCA code[4] which Dr. K. Kim in PPPL develops, in a more realistic magnetic field configuration such as DIII-D with RMP field. Also, They discussed the improvement of analytic formulae derived by Park to evaluate neoclassical viscosity.

At Wisconsin university, Satake collaborated with Dr. J. Talmadge and his student J. Smoniewski about the application of the FORTEC-3D code to neoclassical transport analysis in HSX plasmas. They have been using DKES/PENTA code[5] to evaluate neoclassical fluxes in HSX, but one of the problems is that DKES assumes incompressible ExB rotation. Since the ion temperature in HSX plasma is usually very low compared to that of electrons, ion poloidal Mach numbers can be close to or larger than unity in core region, and the incompressible ExB assumption is not valid. Since FORTEC-3D can treat the compressibility of ExB flow, they discussed how to utilize the code for the transport analysis of HSX plasmas. Smoniewski learned to use the code and implemented it on the NERSC supercomputer environment. This is the first application of the code to quasi-symmetric configuration like HSX, and they plan to use it to study the neoclassical transport phenomena in a neoclassical-optimized configuration of HSX.

Related publications:

[1] S. Satake et al., Phys, Rev. Lett. **107**, 055001 (2011)
[2] S. Satake et al., Plasma Phys. Control Fusion **53**, (2011)
[3] S.Satake et al., Nucl. Fusion **53**, 113033 (2013)
[4] K. Kim et al., Phys, Rev. Lett. **110**, 185004 (2013).
[5] D. A. Spong, Phys. Plasmas. **12**, 056114 (2005)

JF-9 ***Study on Fast Ignition by Photon-Pressure Accelerated Ion Beam with Next Generation Ultra-intense Laser***

Exchange Scientist: Tomoyuki Johzaki (Hiroshima University)
Location: University of Nevada, RENO, Reno, Nevada
Dates: October 19 - November 3, 2013 (16 days); paid by Japan
Research Summary:

Dr. Johzaki has been collaborating for a number of years with Prof. Y. Sentoku at University of Nevada, Reno (UNR) on the simulation study for the relativistic laser plasma interaction related to the laser fusion. Dr. Johzaki has developed the Fokker-Planck codes for fast electron transport and fast ions, and then analyzed and optimized the processes of those fast particles generation and energy transport to the imploded core for the fast ignition laser fusion. Prof. Sentoku has developed a PIC code including particle collision, ionization and radiation damping processes. In the past collaboration, they have developed the simulation model for the collision and ionization, and then have revealed the effects of collisional processes on the fast electron transport in the high-Z Au cone. In these collaboration works, they came around the idea for enhancing the core heating efficiency, which is the core heating by ion beam generated by radiative pressure acceleration with circularly-polarized ultra-intense laser pulse. In the 2012 exchange program, they have carried out the one-dimensional integrated simulations (PIC simulations for beam generation and Fokker-Planck simulations for core heating) and demonstrated the potential probability for C^{6+} beam driven fast ignition laser fusion.

In this fiscal year (2013), they have developed a 2D transport code for fast ion based on the particle method, and carried out two-dimensional integrated simulations (PIC for beam generation and hybrid simulation for core heating) by assuming the more realistic situation. Through this exchange program, they showed the laser and target conditions required for generation of C^{6+} beam used for core heating driver in fast ignition laser fusion. The summary of obtained results is described in the following.

From the coupled transport and hydro simulations, they evaluated the beam condition required for ignition of highly compressed DT fuel target (ρ = 300 g/cm^3 and ρR = 3 g/cm^2). It was found that the beam particle (C^{6+}) energy of 100 ~ 200 MeV minimizes the beam energy required for ignition and the beam duration of ~ 1 ps is suitable for ignition in terms of beam generation and core heating. After this evaluation, they estimated the laser and target condition for generation of the required beam on the basis of the simple relativistic hole boring model. To confirm the estimated condition, they carried out 2D PIC simulations for relativistic laser-plasma interactions. Then, it was found that fast ion beam with averaged particle energy $<\varepsilon_p>$ of 210 MeV is obtained when the carbon target with the ion number density of 90 n_{cr} (n_{cr} is the critical density for a laser with wavelength of 1 μm) is irradiated with the circularly-polarized laser with the intensity of 6x10^{22}W/cm^2 and wavelength of 1 μm. In this case, the energy convergence efficiency of laser to ion beam of 12 % was obtained. If assuming the laser spot of 24 μm□ and pulse duration of 700fs, the required laser energy for beam generation is ~190 kJ and the resultant beam energy of 23 kJ, which satisfy the beam condition required for ignition.

JF-10 ***Study of Coherent Structures in Boundary Layer Plasmas***

Exchange Scientist: Hiroki Hasegawa (NIFS)

Location: Center for Energy Research (CER), University of California, San Diego (UCSD), La Jolla, California
Dates: January 26 – February 23, 2014 (29 days); paid by Japan
Research Summary:

Dr. Hasegawa started collaboration with the group led by Prof. Krasheninnikov during his visit at University of California, San Diego (UCSD). Dr. Hasegawa has been developing the three-dimensional electrostatic particle-in-cell (PIC) simulation code for the study of the plasma blob dynamics and studying the microscopic effects on the blob dynamics with the particle simulation code [1, 2]. His host, Prof. Krasheninnikov, proposed the theory of plasma blobs as the mechanism of the non-diffusive (convective) radial plasma transport in the scrape-off layer (SOL) and his group has investigated the blob dynamics theoretically and numerically with fluid models. In this exchange activity, the participants started studying the effect of drift waves on the blob dynamics with particle simulations. Although the group led by Prof. Krasheninnikov examined this problem with the two-fluid (Braginskii) model simulation, there is a question whether such collisional fluid equations are sufficiently accurate in view of the parameter region for typical tokamak edge. Thus, his group validated the results of the collisional fluid model simulation by comparing them with the drift wave dispersion relation in such a parameter region. In this activity, Dr. Hasegawa aimed at validation of the drift wave effect with particle simulations. At first, he has developed the particle simulation code for the investigation of the effect of collisionless drift waves on the blob dynamics. Then, he plans to apply collision processes to the particle simulation code in order to perform calculations where the parameters of typical SOL will be employed.

Related publications:

[1] S. Ishiguro and H. Hasegawa, J. Plasma Phys. **72**, 1233 (2006).
[2] H. Hasegawa and S. Ishiguro, Plasma Fusion Res. **7**, 2401060 (2012).

US to Japan:

JF-13 ***Multi-scale simulations for particle acceleration in laser plasma***
Visiting Scientist: Alex Arefiev (IFS)
Location: Institute of Laser Engineering at Osaka University,
Kansai Photon Science Institute (Japan Atomic Energy Agency)
Kyoto University
Dates: Sept. 8 - Sept. 25 (three weeks); paid by US
Research Summary:

The host on Japanese side was Prof. Hideo Nagatomo from Institute of Laser Engineering at Osaka University. During the first part of the visit, Dr. Arefiev attended The Eighth International Conference on Inertial Fusion Sciences and Applications (IFSA 2013), where he gave a talk. The talk focused on how super-ponderomotive electrons can be produced by a high amplitude electromagnetic wave in subcritical plasma. During the second part of the visit, Dr. Arefiev visited three research institutions: Institute of Laser Engineering at Osaka University, Kansai Photon Science Institute (Japan Atomic Energy Agency), and Kyoto University. Dr. Arefiev visited Prof. Kunioki Mima at ILE, where they discussed aspects of electron acceleration in sub-critical plasmas by intense laser fields. He also visited the experimental group of Dr. Kiminori Kondo and discussed experimental results of Dr. Kondo's group on electron and ion acceleration by a short-pulse laser. Dr. Arefiev subsequently discussed his recent work on a relativistic ionization wave with Dr. Bulanov, who made several constructive suggestions for future work. Dr. Arefiev then visited Prof. Yasuaki Kishimoto in Kyoto University. They discussed several problems that arise in a laser-irradiated jet that contains liquid density deuterium droplets (clusters). Dr. Arefiev presented his recent work on a relativistic ionization wave. Dr. Kishimoto suggested potential collaboration on laser-cluster interactions at the experimental facility at ILE (Osaka).

JF-14 ***Study of turbulent transport based on gyrokinetic simulation***
Exchange Scientist: C. S. Chang (Princeton Plasma Physics Laboratory)
Location: National Institute for Fusion Science, Toki, Japan
Dates: November 18-23, 2013; paid by US
Research Summary:

Dr. Chang visited NIFS to exchange ideas with Dr. Sugama and other NIFS scientists regarding gyrokinetic simulations of turbulent transport. The topic of the research was kinetic effects on Scrape-Off Layer (SOL) turbulence and in particular on the filamentary coherent structures called blobs that dominate the SOL transport. The extreme-scale gyrokinetic PIC code XGC1 has recently been modified to describe the necessary physics. In the corresponding simulations, the boundary condition for the electrostatic solver is that the potential on the material wall surrounding the plasma is grounded (or specified). The simulation is for the entire plasma volume, thus, does not need an artificial edge-core boundary. Gyrokinetic ions and drift kinetic electrons are simulated together with the Monte Carlo neutral particles recycled from material wall. Realistic electron mass is used. During his visit, Dr. Chang presented his work at the Toki Conference on "Extreme scale gyrokinetic simulaion of muliscale edge blobs and its implication to edge-core interaction," and another one at the US-Japan JIFT workshop on "A fully nonlinear 2D Fokker-Planck equation solver." His interaction with the Japanese fusion scientists included an in-depth discussion about the 6D kinetic simulation of the coherent turbulence structure in the open field lines with Dr. Hasegawa and Dr. Ishiguro, especially about the interaction of blobs with the Debye sheath at the wall, and about the kinetic damping effect on multiscale gyrokinetic turbulence with Dr. Yasuaki Kishimoto.

JF-15 ***Numerical Analysis of Energetic Particle Transport by Alfvén eigenmodes***
Exchange Scientist: Donald A. Spong (ORNL)
Location: National Institute for Fusion Science, Toki, Japan
Dates: November 18-23, 2013 (one week); paid by US
Research Summary:

This exchange was combined with attendance at the 23rd International Toki Conference (ITC-23), Nov. 18-21, 2013 and the JIFT 2013 meeting on New Aspects of Plasma Kinetic Simulation, Nov. 22-23, 2013. During this period, the visiting scientist had several discussions with Dr. Y. Todo on the topics of using GPU (graphical processing unit) accelerators with particle-based kinetic stability models and gyrokinetic models for 3D systems. A test version of the AE3D-K stability code had recently been adapted to GPUs on the Titan supercomputer system and has indicated favorable performance improvements. Dr. Todo was interested in the programming methods used since he will be adapting his MEGA code to the next generation of computers available in Japan, which will likely have either GPU co-processors or something similar. We also discussed recent work (collaboration of D. Spong, I. Holod, and Z. Lin) in which the GTC global gyrokinetic code has been adapted to use VMEC 3D equilibria for application to modeling core turbulence and fast ion instabilities in stellarators. Finally, discussions were held with M. Osakabe related to modeling of fast ion instabilities in LHD low density regime discharges using the DELTA5D Monte Carlo transport code.

Related publications:

[1] D.A. Spong, B.N. Breizman, D.L. Brower, Ed D'Azevedo, C.B. Deng, A. Konies, Y. Todo, and K. Toi, "Energetic-Particle-Driven Instabilities in General Toroidal Configurations," Contributions to Plasma Physics Vol. **50**, 708 (2010).
[2] D.A. Spong, E. D'Azevedo, and Y. Todo, "Clustered frequency analysis of shear Alfven modes in stellarators," Physics of Plasmas Vol. 17, 022106 (2010).

JF-16 ***Physics of the n=1 Magnetic Island on LHD***
Exchange Scientist: F. L. Waelbroeck (Institute for Fusion Studies, University of Texas at Austin)
Location: National Institute for Fusion Science, Toki, Japan
Dates: May 12-18, 2013; paid by U.S.
Research Summary:

This visit continues a multi-year collaboration by Drs. Waelbroeck and Ishizawa on the dynamics of magnetic islands.[1] The collaborators used the visit mainly to complete previous work and submit a paper on the interaction of magnetic islands with turbulence, which is now published.[2] Dr. Waelbroeck also had discussions with Dr. Sakakibara concerning the observations of the n=1 island on LHD and with Prof. Itoh concerning the interaction of magnetic islands, drift-type turbulence, and zonal flows. The collaborators made plans for further studies on the effects of velocity shear on magnetic islands.

Related publications:

[1] A. Ishizawa, F. L. Waelbroeck, R. Fitzpatrick, W. Horton, and N. Nakajima, “Magnetic island evolution in hot ion plasmas,” Phys Plasmas **19**, 072312 (2012).
[2] A. Ishizawa and F. L. Waelbroeck, “Magnetic island evolution in the presence of ion temperature gradient-driven turbulence,” Phys Plasmas **20**, 122301 (2013).

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 Research Project at the National Institute for Fusion Science, and the Japanese co-executive secretary is the director of the Fusion Theory and 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 several members representing a spectrum of Japanese universities and the Japan Atomic Energy Agency; and on the US side there is an Advisory Committee comprised of several 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	R. Horiuchi (NIFS) —Co-Chairman
A. Arefiev (IFS)—Co-Exec. Secretary	H. Sugama (NIFS)—Co-Exec. Secretary
D. Spong (ORNL)	A. Fukuyama (Tokyo)
J. Mandrekas (DOE)	H. Nagatomo (Osaka)

JIFT Advisors

Japanese Advisory Committee: N. Nakajima (NIFS), S. Ishiguro (NIFS), Y. Kishimoto (Kyoto), Z. Yoshida (Tokyo), H. Naito (Yamaguchi), M. Yagi (Kyusyu), T. Ozeki (JAEA)

*US Advisory Committee***:** P. Catto (MIT), V. Chan (GA), B. Cohen (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.

Note that information about the JIFT program, including annual schedules of exchange activities, can be found on the JIFT web site at http://peaches.ph.utexas.edu/jift/.

4. *PLANS FOR FUTURE ACTIVITIES (PROPOSED 2014-2015 PROGRAM)*

The topics and themes of the exchange activities that have been proposed for the next year (April 1, 2014–March 31, 2015) 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 (2014-2015) is listed below.

A. 2014-2015 Proposed Workshops

Japan to US:

Progress in Kinetic Plasma Simulation
Organizers: H. Ohtani (NIFS) and A. Arefiev (IFS)
Proposed Place/Time: New Orleans, Oct.31-Nov.1, 2014

Theory and Simulation on the new frontier of fast-ignition
Organizers: J. Sunahara (ILT) & J. Fernandez (LANL)

Proposed Place/Time: Austin, Texas, Nov.3-5, 2014

US to Japan:

Present Status and Prospects of Theory and Simulation on 3D Physics in Toroidal Plasmas
Organizers: M. Yokoyama (NIFS) and C. Hegna (U. Wisc)
Proposed Place/Time: Kyoto, Jun.3-5, 2014

Recent Studies of Extended MHD and MHD Simulations
Organizers: H. Miura (NIFS) and L.E. Sugiyama (MIT)
Proposed Place/Time: Kyoto, June 4-6, 2014

B. 2012-2013 Proposed Exchange Visits

Japan to US:

Passive-scalar and passive particle simulations in a magnetized plasma
H. Miura (NIFS), Visiting Professor
U. Texas, March 2015; paid by US

Gyrokinetic simulations of microtearing instability
R. Numata (Hyougo) (NIFS), Visiting Scientist
U. Maryland, Aug.31-Sep.13, 2014; paid by Japan

Simulation Study of Magnetized Fast Ignition Fusion
T. Taguchi (Setsunan), Visiting Scientist
U. Maryland, Aug.- Sep.2014; paid by Japan

Simulation study on L-H transition using BOUT++ code
George Breyiannis（JAEA) Visiting Scientist
LLNL, Aug. 31-Sep.14, 2014; paid by Japan

Development and Its Applications of innovative scheme of numerical simulation for relativistic laser-plasma interactions in fast ignition laser fusion
T. Johzaki (Hiroshima), Visiting Scientist
University of Nevada Reno; October 4 – November 2, 2014; paid by Japan

Simulation study of ICRF Heating in the quasi-helical symmetric configuration
S. Murakami (Kyoto), Visiting Scientist
U. Wisconsin, Jul.13-27, 2014; paid by Japan

Development of Laser Plasma Analysis Code and Framework for Distributed Visualization
H. Sakagami(NIFS), Visiting Scientist
Nevada, Jan. 25-Feb. 7, 2015; paid by Japan

US to Japan:

Development of advanced predictive modeling capabilities for LHD
A. Pankin (Tech-X), Visiting Professor
NIFS; April-June, 2014; paid by Japan

Theoretical Analysis of Vortex Structures in Plasmas
S. M. Mahajan (IFS, U. Texas Austin), Visiting Scientist
Tokyo, Jan.5- Jan.12, 2015; paid by US

Simulation of Alfven eigenmodes in toroidal plasmas
D. A. Spong (ORNL), Visiting Scientist

NIFS; June 2 – June 13, 2014; paid by US

Extension of MHD Stability Analysis for 3D and Nonlinear Problems
L. Zheng (IFS, U. Texas Austin), Visiting Professor
NIFS, May 12-Aug.15, 2014; paid by Japan