JOINT INSTITUTE FOR FUSION THEORY

NEWSLETTER

December 1983

The Institute for Fusion Studies in Austin and the International Center for Fusion Theory in Nagoya work together to form the Joint Institute for Fusion Theory (JIFT). The primary purpose of JIFT is to foster the exchange of scientific research by providing a planned set of exchange visits and workshops between U.S. and Japanese theoretical plasma physicists working on the problems associated with the development of fusion systems. The JIFT Steering Committee will meet in early 1984 to approve the exchange scientist and Workshop plans for the period from April 1984 to March 1985. The committee representatives are Mr. I. Kawano, Director of Physical Research in the Ministry of Education, Prof. Y. Ichikawa, Director of ICFT Nagoya, Prof. K. Niskikawa of Hiroshima University, Dr. D. Nelson, Director of Applied Plasma Physics in the Department of Energy, Prof. M. Rosenbluth, Director of IFS, Austin, and Prof. J. Dawson of the University of California at Los Angeles.

Reports from Exchange Scientists

Dr. David Montgomery, William & Mary to Nagoya, May–August 1983.

Dr. Wonchull Park, PPPL to Nagoya, June–August 1983.

Dr. Dan Barnes, IFS to Nagoya, September 1983.

Dr. Akio Ishida, Niigata University to Cornell University & IFS, September– February 1983–84.

Dr. Tsuguhiro Watanabe, Hiroshima University to IFS, Nov. 1983 to March 1984.

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Workshops for 1983–1984

Japan to US:

(1) **Wave Heating and Current Generation**
Organizers: C. S. Liu and M. Porkolab
S. Tanaka and R. Sugihara
Location: GA Technologies (December 19–21, 1983)
(The Japanese delegation will also visit rf facilities at MIT and Princeton as part of the Workshop.)

(2) **3D MHD Simulation Studies**
Organizers: B. Carreras and T. Sato
Location: ORNL (March 19–23, 1984)

US to Japan:
(1) **Statistical Plasma Physics**
Organizers: John Greene and Yoshi Ichikawa
Location: Nagoya (February 20–25, 1984)

(2) **Transport and Instabilities in Open Ended Systems**
Organizers: R. Cohen and T. Kamimura
Location: Nagoya (August 1984)

Reports from Exchange Scientists

David Montgomery, at IPP, Nagoya, April–September, 1983

For the 1983–84 JIFT exchange program David Montgomery was the Visiting Professor in the Institute for Plasma Physics at the University of Nagoya. Dr. Montgomery, a Professor of Physics at the College of William and Mary in Williamsburg, Virginia, is well known for his fundamental research in the theory of plasma turbulence. Dr. Montgomery arrived in Nagoya at the end of April and returned home in early September.

During his stay in Japan he gave a series of lectures on the fundamentals of MHD turbulence at Nagoya. He visited and lectured at the Universities in Kyoto, Kyushu and Hiroshima. He also visited the Korea Advanced Institute of Science and Technology where Professor Duk-In Choi and others are working on problems of plasma turbulence.

In Nagoya, Montgomery worked with Dr. Tadatsugu Hatori on the theory of turbulent transport in magnetohydrodynamics. Working together they succeeded in deriving closed-form expressions for the turbulent transport coefficients (resistivity and viscosity) through an analysis of the effects of small-scale MHD turbulence on the large scale motion. The analysis clearly shows the conditions required for the Biskamp-Welter formula of negative anomalous resistivity to apply. For the 3D Strauss equations the anomalous resistivity may change sign depending on the shape of the spectrum. Montgomery feels that this collaboration was very productive—giving the first quantitative statements that can be made, without the use of a computer, about inverse cascade in MHD turbulence.

In Kyoto, Montgomery began a collaboration with three members (Drs. Mizushima, Yanase and Yamada) of the Tatsumi school of fluid turbulence. Together they pursued the development of the "modified zero fourth-cumulant approximation" as it would apply to MHD. This approximation is a Markovianized zero fourth cumulant approximation without the specific form of turbulent eddy damping assumed in EDQNMA of the French school of turbulence.

David Montgomery reports that living and touring in Japan is pure pleasure. Working at the IPP was also very enjoyable, but there is no escaping the fact that an American without some knowledge of Japanese is going to miss out on a great deal of what goes on around him. Except for occasional foreign visitors, most seminars are given in Japanese, and one can be only an observer, not a participant, in such an event. He suggests that the value of the exchanges would go up tenfold if the Americans were given intensive language instructions before they go to Japan.

Daily life in Japan gets easier and more satisfying the longer you are there, reports Montgomery. The first month is the hardest; then you begin to be able to deal with most everyday situations even though you don't speak the language. This is partly possible because the country "works" so well—commercial life, transportation, public services, etc.

In summary, Montgomery advises future exchange scientists to learn as much of the language as possible and then plan to stay for as long a period as possible. In this way he feels vou will reap the most from this opportunity to experience Japan.

As an expression of his appreciation, Dr. Montgomery states that he stands ready to help, as best he can, future exchange scientists prepare for their travel to Japan.

Wonchull Park, Nagoya, June–September 1983

From June 15 to the end of August, Dr. Wonchull Park from Princeton was an exchange scientist based at IPP Nagoya. He visited Kyoto and Tokyo Universities and the Japan Atomic Energy Research Institute.

In Nagoya, Dr. Park worked with the MHD theory group including Drs. Amano, Mizuno, Okamoto and Todoroki on the problems associated with the 3-D simulations of MHD plasmas. Discussions particularly concerned the use of conformal mapping method and the rates of magnetic reconnection.

At Tokyo University, Dr. Park visited with Prof. Miyamoto and toured the noncircular tokamak experiment called TNT-A and discussed the new reversed field pinch experiment called REPUTE-I.

In early July the Japanese held the first of a planned series of workshops on 3-D MHD problems at Kyoto University. Among others, the participants were Wakatani and Hanatani from Kyoto; Azumi from JAERI; Hayashi from Hiroshima; and Amano, Abe, Okamoto and Todoroki, and Park from Nagoya. An issue raised at the Workshop was the effect of the numerical dissipation contained in the 3D simulations. Hayashi reported observing a Petschek 3D type reconnection despite the relatively large numerical viscosity contained in his code.

At JAERI Park described his recent studies of high beta MHD systems and, in turn, learned of new results from Dr. Azumi and Dr. Takizuka. Azumi is developing a 3-D incompressible code using a stream function to represent the incompressible velocity in contrast to the IFS code of Aydemir and Barnes which adjusts the pressure to eliminate compressional effects. Park reports that Takizuka has a new difference scheme for the advection-diffusion equation required for the magnetic flux function in resistive MHD. The unconditionally stable scheme is reported to have small numerical diffusion and small dispersion.

Dan Barnes, Nagoya, September–October 1983

The first portion of a three month exchange visit to JIPP, Nagoya was completed by Dan Barnes of the IFS by continuing his collaboration with Prof. T. Kamimura on the develoment of a long-time-step, implicit particle simulation method. During this period of the collaboration, an implicit code for 2½-D simulations of fully electromagnetic phenomena in a bounded, conducting domain was developed. The algorithm has been tested in the most trivial case of uniform initial density, while being developed on both the NMFECC computers at LLNL and the JIPP computers in Nagoya. Concurrency of the evolving versions is being maintained by conventional communication and through the electronic mail of the MFE system.

While in Japan Dan Barnes visited the Osaka Laser Fusion Institute and was impressed both with the scope of the physics program and the technical capability of the Osaka facility, especially the GEKKO XII glass laser system assembled in the past two years.

The second portion of the three month exchange will again be accomplished mostly at JIPP. At that time the emphasis will turn toward evaluating the performance of the implicit electromagnetic algorithm in the vector processing environment provided by the Fujitsu VP100 being installed at JIPP in December, 1983. In addition to a new simulation technique, the collaboration will provide an early opportunity to compare the CRAY-I and the VP-100 on a state of the art plasma physics problem.

Akio Ishida, Niigata University, September–December 1983

Dr. Akio Ishida arrived at Cornell University in September to work with Professor Ravi Sudan.

Ishida and Sudan are currently working on a) the kink instability of a long fat field reversed cylindrical ion layer immersed in a background plasma and b) the tilt stability of a spheromak-ion ring hybrid system. The model for this calculation is based on a fluid description of the ring plasma system previously developed by A. Ishida. This work is being pursued at the Laboratory of Plasma Studies, Cornell University.

In December, Dr. Ishida will move to Austin to begin work at the Institute for Fusion Studies.

Tsuguhiro Watanabe, Hiroshima University

Dr. Watanabe is the Visiting Scientist at the IFS for the 1983–84 JIFT exchange program. Arriving in Austin in November, he has begun work with Jim Van Dam and Herb Berk on the problems associated with hot electron systems.

Dr. Watanabe has developed a number of methods for solving the 2D Vlasov equilibrium problem and is extending this study to 3D systems.

In November, he attended the US-Japan Workshop on heating and stability of energetic electron plasmas in mirrors and EBT, where he discussed ambi polar potential effects on drift wave stability. In December, he will attend the US-Japan Workshop on rf heating and give a report on "Theory of RF Current Drive."

Computer Link Between NMFECC and IPPCC

In response to the growing collaboration in magnetic fusion energy research, plans are developing for an effective computer link between the U.S. and Japanese fusion computer networks.

Immediately following the Los Angeles APS meeting Dr. David Nelson, with Dieter Fuss and Jim Leighton of the NMFECC, went to Nagoya to negotiate the technical implementation and initial uses of the computer link. Considerable programming will be required to install and debug the link. First operation is expected by November, 1984, possibly as early as September, 1984. Both terminal access and file transfer are planned over a 9.6 kbit/sec cuircuit. Initially, the packet switched TYMNET circuits to Japan will be used. As traffic builds up, a dedicated line may be installed. Initial use of the link will be for joint computational projects involving either theory or experiments. Usage of the link by JIFT is expected to increase the effectiveness of future exchanges. It will also allow joint computational projects without the necessity for long term exchanges.

Dr. Dan Barnes of the IFS, who is a veteran of the JIFT exchanges, will deal with the problems related to JIFT participation in the U.S.-Japan computer link. Barnes anticipates that both sides will realize a higher productivity from the exchange visits once it is possible for visitors to access their codes from either the US or Japan.

On balance, Nelson notes that there seem to be numerous advantages to both sides for a direct, limited access, computer link between NMFECC and IPPCC.