ISSN 0915-633X

INTERNATIONAL ATOMIC ENERGY AGENCY

17th IAEA Fusion Energy Conference
Yokohama, Japan, 19 - 24 October 1998

IAEA-CN-69/EXP2/14

NATIONAL INSTITUTE FOR FUSION SCIENCE

Potential Turbulence in Tokamak Plasmas

Y. Hamada, A. Nishizawa, Y. Kawasumi, A. Fujisawa, M. Kojima, K. Narihara, K. Ida, A. Ejiri, S. Ohdachi, K. Kawahata, K. Toi, K. Sato, T. Seki, H. Iguchi, K. Adachi, S. Hidekuma, S.Hirokura, K. Iwasaki, T. Ido, R. Kumazawa, H. Kuramoto, T. Minami, I. Nomura, M. Sasao, K.N. Sato, T. Tsuzuki, I. Yamada and T. Watari

(Received - Oct. 8, 1998)

NIFS-575 Oct. 1998

This report was prepared as a preprint of work performed as a collaboration reserch of the National Institute for Fusion Science (NIFS) of Japan. This document is intended for infomation only and for future publication in a journal after some rearrangements of its contents.

Inquiries about copyright and reproduction should be addressed to the Research Information Center, National Institute for Fusion Science, Oroshi-cho, Toki-shi, Gifu-ken 509-02 Japan.

RESEARCH REPORT
NIFS Series

This is a preprint of a paper intended for presentation at a scientific meeting. Because of the provisional nature of its content and since changes of substance or detail may have to be made before publication, the preprint is made available on the understanding that it will not be cited in the literature or in any way be reproduced in its present form. The views expressed and the statements made remain the responsibility of the named authors [illegible] necessarily reflect those of the government of the designating [illegible] organizations sponsoring this meeting cannot be held responsible for any material reproduced in this preprint.

NAGOYA, JAPAN

POTENTIAL TURBULENCE IN TOKAMAK PLASMAS

Y. HAMADA, A. NISHIZAWA, Y. KAWASUMI, A. FUJISAWA, M. KOJIMA, K. NARIHARA, K. IDA, A. EJIRI, S. OHDACHI, K. KAWAHATA, K. TOI, K. SATO, T. SEKI, H. IGUCHI, K. ADATI, S. HIDEKUMA, S. HIROKURA, K. IWASAKI, T. IDO, R. KUMAZAWA, H. KURAMOTO, T. MINAMI, I. NOMURA, M. SASAO, K. N. SATO*, T. TSUZUKI, I. YAMADA, AND T. WATARI

National Institute for Fusion Science, Toki, Japan, * present address : Advanced Fusion Research Center, RIAM, Kyushu University, Kasuga, Japan

Abstract

Microscopic potential turbulence in tokamak plasmas are investigated by a multi-sample-volume heavy ion beam probe. The wavenumber/frequency spectra S(k,ω) of the plasmas potential fluctuation as well as density fluctuation are obtained for the first time. The instantaneous turbulence-driven particle flux, calculated from potential and density turbulence has oscillations of which amplitude is about 100 times larger than the steady-state outwards flux, showing sporadic behaviours. We also observed large-scale coherent potential oscillations with the frequency around 10-40 kHz.

1. Introduction

Local measurement of plasma turbulence in a toroidal magnetic confinement device has been the target of the intensive experimental research, since the anomalous particle/ energy confinement may be caused by the microturbulence in the plasma. The heavy ion beam probe (HIBP) is particularly suited for the local study of the turbulence of tokamak plasmas because of the potentiality for density and potential measurement. It is, however, difficult to measure by HIBP potential fluctuations due to the microintability in the tokamak plasmas, since the fluctuating potential is smaller than the acceleration voltage of a probing beam by many orders. Therefore, the measurement of the potential turbulence in the core region of the tokamak plasma by HIBP tends to have a low signal-to-noise ratio (SNR) and only a few results were published so far [1]. In addition, the large-amplitude quasi-coherence modes with the frequency to 30 to 40 kHz, complicate the potential turbulence of small scale oscillations. To tackle these difficulties we enhanced the sensitivity of the measurement by increasing the beam current and by the employment of a multiple-detector system. By these improvements we are now able to obtain the wavenumber/frequency spectra S(k,ω) of the density and potential turbulence, and the wavenumber-resolved fluctuation-driven particle flux in the high temperature region of JIPP T-IIU tokamak plasma [2].

2. Experimental apparatus

a) Tokamak system.

The JIPP T-IIU tokamak was operated at 3 tesla. Its major radius is 93 cm with a minor radius of 23 cm. Nearly perpendicular neutral beam injection (NBI), with the injection line tilted in the co-direction (the direction of the plasma current) by only 9 degrees, is employed. The main diagnostics are a YAG Thomson scattering apparatus with 28 spatial measurement points and a 100 Hz repetition rate for detailed profiles of plasma density and electron temperature, an 8-channel-ECE polychromator, a 6-channel-FIR interferometer and a charge recombination spectrometer using NBI for ion temperature profiles.

b) a heavy ion beam probe

For the measurement of potential microturbulence, we have to use stable power supplies for the acceleration of the beam and for the energy analyzer of the secondary beam. We connected a very stable power source (up to 500 kV) originally developed for the electron microscope, to the electrostatic acceleration column of the accelerator. The chromatic aberration of the electron microscope is induced by the ripple of its high-voltage power source. The ripple in our case is reduced to less than 2 Volt for 500 kV. We also reduced the high-frequency ripple on the upper electrode of the parallel-plate energy analyzer to about 0.02 V out of 100 kV by use of an LC filter in SF_6 gas.

This parallel plate analyzer is intrinsically suitable for multiple sets of the entrance slit and detector (many sample volumes) since the electric field is uniform. We installed 7 sets of an input slit and 7 sets of detectors. The signals from 6 input slits are usually available without careful adjustment. A 500 keV thallium beam of a few tens of microamps can be focused to a diameter of about 2 millimeters in the tokamak by a cylindrical deflector and two electrostatic quadrupole lenses (doublet).

Each plate is made of stainless-steel and is connected to low-noise amplifiers. The sampling rate at 12 bits AD conversion is 2 MHz and the frequency band width of the detector amplifier shows the 3 dB decrease of gain at 300 kHz.

The displacement of the beam center in the poloidal direction (the change of the plasma potential at the sample volume) is detected by the difference of the upper ($su_j(t)$)and lower detector currents ($su_j(t)$,$su_j(t)$) normalized by sum of them (ND) by the following equation [3],

$$nd_{p,\,j}(t) = \frac{su_j(t) - sd_j(t)}{su_j(t) + sd_j(t)} .$$

The local density at the sample volume may be proportional to the sum of the detector currents and expressed by

$$s_j(t)=su_j(t) + sd_j(t)$$

3. Potential and density turbulence

a) Quasi-coherent mode

First of all we want to emphasize that the potential measured by a heavy ion beam probe has fairly large potential fluctuations at 30 to 40 kHz. Figure 1 shows Expanded view and Fourier spectra of the sum of the secondary current s, normalized ratio of upper and lower plates (nd_p) proportional to the local potential change at the sample volume.

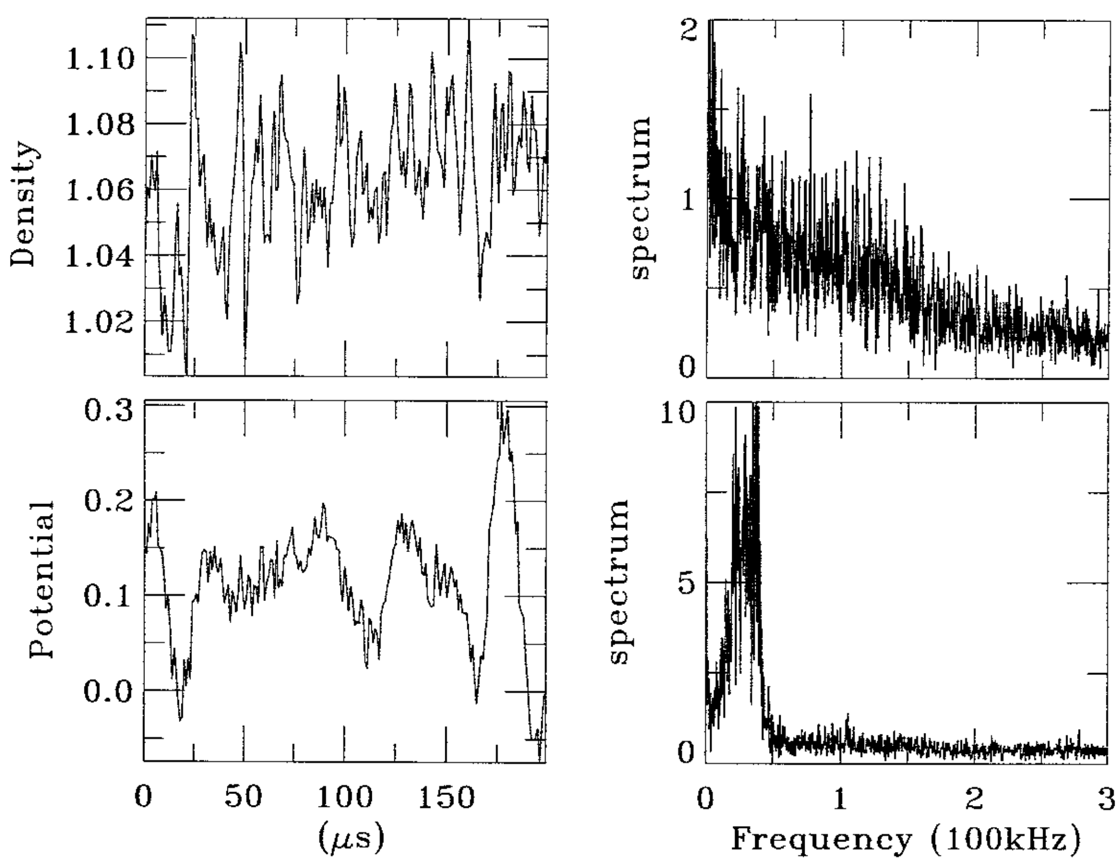


Figure 1. Expanded view and Fourie spectrum of the sum of the secondary beam intensity (proportional to local density) and nd(proportional to potential) at $r/a_p = 0.5$. Conversion ratio is 600V/nd in this case.

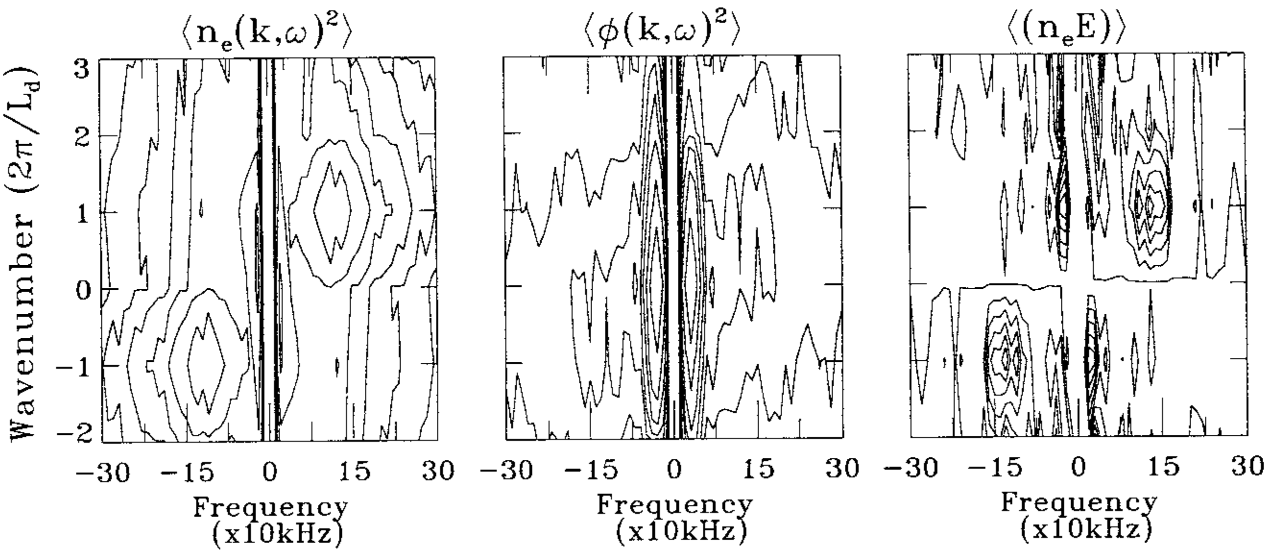
The sample volumes are around r/ap = 0.5. The density turbulence extends to higher frequency while the oscillations with around 40 kHz are dominant in the potential fluctuations. The potential fluctuation or beam energy fluctuation from Fourier spectrum of nd_p in Fig. 1 is about 60 $V_{p\text{-}p}$. since the conversion rate from nd to plasma potential change is 600V/nd. These potential fluctuation of the large amplitude in this frequency range were originally discovered in HIBP measurement at the TEXT tokamak[3].

The correlations of density (sum of the secondary beam), potential (change of the beam energy) $nd_{p,j}$, s_j is very small. The mode number of the potential oscillation can be estimated to be m=0 since the phase shift of the cross correlation coefficient $\rho(nd_{p,1}, nd_{p,j},)$ is almost zero and the peak values are almost 1. Accordingly, we can conclude that these potential fluctuations are large-scale and quasi-coherent. The correlation between density and potential turbulence is small.

In order to verify that these oscillations are not induced by several power supplies of high and low voltage in HIBP we checked the ripple of all power supplies. In addition, these oscillations are not observed when the plasma is replaced by the gas. Because of the fairly high injection energy of 300 kV to 500 kV, the injected Tl^+ ions are easily ionized to Tl^{++} by the puffed helium neutral gas in the tokamak vacuum vessel. Under the comparable detector currents by the intensive helium gas puffing, this large amplitude oscillations of 30-40 kHz disappears.

Our present conclusion is as follows. At the certain layer near the plasma boundary, there occurs regularly the potential fluctuations of the very large amplitude. Since the potential tends to the surface quantity because of the very high electric conductivity along the magnetic field line of force and the potential is an integral of the electric field across the magnetic field from the vacuum vessel to the certain magnetic surface, we can explain the m=0 property and no signals in the outer plasma area. Also, the ECE and soft x-ray pin diode signals comes out of rather hot area inside the certain layer, we can not find the correlation with ECE and soft x-ray.

b) high frequency turbulence



(a) (b) (c)

Figure 2. Contours of the two-dimensional (space/time) Fourie spectra of density and potential turbulence (a), (b). and <nE> proportional to the particle flux driven by the turbulence, (c). L_d = 2.5 cm.

Figure 2 shows the contours of two-dimensional (wavenumber/frequency) spectra of the density $S_{n_e}(k,\omega) = \langle |n_e(k,\omega)|^2 \rangle$, (a), potential $S_\Phi(k,\omega) = \langle |\Phi(k,\omega)|^2 \rangle$, (b)), and the quantity proportional to the turbulent- driven particle flux, real$[\langle n_e(k,\omega)\ E(k,\omega) \rangle]$, (c), at the position of about $r/a_p = 0.5$ and θ=0 (weaker B_t field side). The particle flux <nv> driven by the turbulent electric field is proportional to <nE> through E/B particle drift. $S_\Phi(k,\omega)$ is noisy but similar to $S_{ne}(k,\omega)$. Fig. 2(c) and detailed analysis shows that the oscillations around 150 kHz mostly cause the turbulence-driven particle flux. This flux is outwards and its magnitude corresponds to the particle confinement time of about 5 ms under the assumption of the uniformity of the flux on the magnetic surface.

Figure 3(a) shows the calculated turbulence-driven instantaneous total particle flux $\widetilde{n_e(t)}\,\widetilde{v(t)} = \widetilde{n_e(t)E(t)}/B_t$ at each sampling time of 1 μs for the case of Fig. 2. Figure 3(b) shows a time behaviour of the turbulence-driven total particle flux of Fig. 3(a) averaged for 100 μs. The characteristics of the wave forms are much similar in (a) and (b) even though the time scale is 1 μs/div. for the instantaneous particle flux (a) and 100 μs/div. for the averaged flux. The difference is that we are able to observe the averaged negative flux (outwards) readily among the large fluctuations in Fig. 3(b).

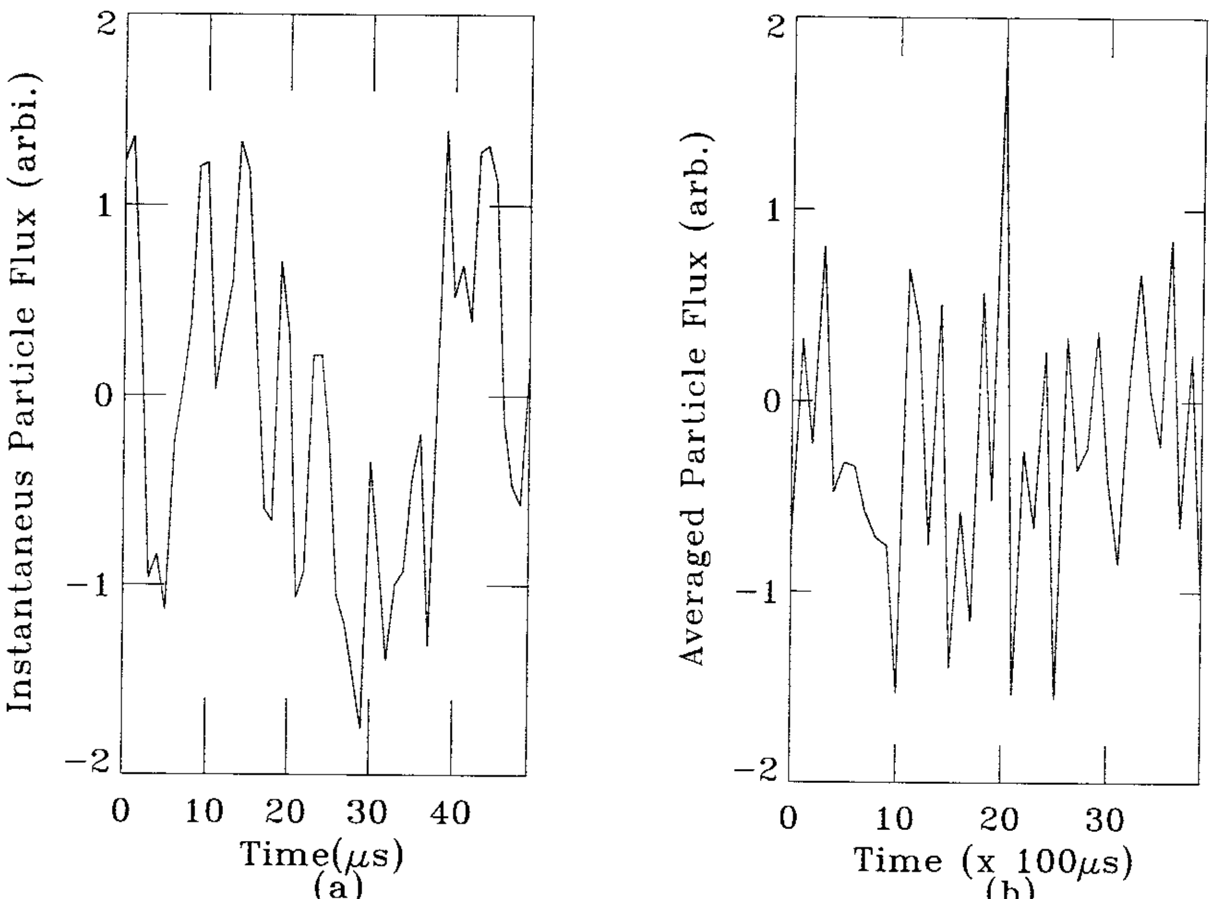


Figure 3. The instantaneous turbulence driven-particle total particle flux, (a) and the averaged(for 100μs) instantaneous particle flux, (b). Both have arbitrary vertical scales, but the vertical scale of (a) is 100 times larger than that of (b).

The appearance of the quasi-steady flux in Fig. 3(b) can be understood, since the main density turbulence has the correlation time of a few microseconds. The ratio of the instantaneous flux to the average flux is so large (about 100) and the polarity of the instantaneous flux is always changing. We may call these signals as sporadic or intermittent behaviour.

Reference

[1] Forster, J. C., et al., Trans. Plasma Sci. **22** (1994) 359.
[2] HAMADA, Y., et al., Nucl. Fusion **36** (1996) 515 , 1047, **37** (1997) 999.
[3] Tsui, H.Y.W. et al., Phys. Fluids **B5** (1993) 1274.

Recent Issues of NIFS Series

NIFS-511 K. Orito and T. Hatori,
Rotation and Oscillation of Nonlinear Dipole Vortex in the Drift-Unstable Plasma, Oct. 1997

NIFS-512 J. Uramoto,
Clear Detection of Negative Pionlike Particles from H_2 Gas Discharge in Magnetic Field, Oct. 1997

NIFS-513 T. Shimozuma, M. Sato, Y. Takita, S. Ito, S. Kubo, H. Idei, K. Ohkubo, T. Watari, T.S. Chu, K. Felch, P. Cahalan and C.M. Loring, Jr,
The First Preliminary Experiments on an 84 GHz Gyrotron with a Single-Stage Depressed Collector; Oct. 1997

NIFS-514 T. Shimozuma, S. Morimoto, M. Sato, Y. Takita, S. Ito, S. Kubo, H. Idei, K. Ohkubo and T. Watari,
A Forced Gas-Cooled Single-Disk Window Using Silicon Nitride Composite for High Power CW Millimeter Waves, Oct. 1997

NIFS-515 K. Akaishi,
On the Solution of the Outgassing Equation for the Pump-down of an Unbaked Vacuum System, Oct. 1997

NIFS-516 *Papers Presented at the 6th H-mode Workshop (Seeon, Germany),* Oct. 1997

NIFS-517 John L. Johnson,
The Quest for Fusion Energy, Oct. 1997

NIFS-518 J. Chen, N. Nakajima and M. Okamoto,
Shift-and-Inverse Lanczos Algorithm for Ideal MHD Stability Analysis, Nov. 1997

NIFS-519 M. Yokoyama, N. Nakajima and M. Okamoto,
Nonlinear Incompressible Poloidal Viscosity in L=2 Heliotron and Quasi-Symmetric Stellarators; Nov. 1997

NIFS-520 S. Kida and H. Miura,
Identificaiton and Analysis of Vortical Structures, Nov. 1997

NIFS-521 K. Ida, S. Nishimura, T. Minami, K. Tanaka, S. Okamura, M. Osakabe, H. Idei, S. Kubo, C. Takahashi and K. Matsuoka,
High Ion Temperature Mode in CHS Heliotron/torsatron Plasmas, Nov. 1997

NIFS-522 M. Yokoyama, N. Nakajima and M. Okamoto,
Realization and Classification of Symmetric Stellarator Configurations through Plasma Boundary Modulations, Dec. 1997

NIFS-523 H. Kitauchi,
Topological Structure of Magnetic Flux Lines Generated by Thermal Convection in a Rotating Spherical Shell; Dec. 1997

NIFS-524 T. Ohkawa,
Tunneling Electron Trap, Dec. 1997

NIFS-525 K. Itoh, S.-I. Itoh, M. Yagi, A. Fukuyama,
Solitary Radial Electric Field Structure in Tokamak Plasmas, Dec. 1997

NIFS-526 Andrey N. Lyakhov,
Alfven Instabilities in FRC Plasma; Dec. 1997

NIFS-527 J. Uramoto,
Net Current Increment of negative Muonlike Particle Produced by the Electron and Posititve Ion Bunch-method; Dec. 1997

NIFS-528 Andrey N. Lyakhov,
Comments on Electrostastic Drift Instabilities in Field Reversed Configuraiton, Dec. 1997

NIFS-529 J. Uramoto,
Pair Creation of Negative and Positive Pionlike (Muonlike) Particle by Interaction between an Electron Bunch and a Positive Ion Bunch; Dec. 1997

NIFS-530 J. Uramoto,
Measuring Method of Decay Time of Negative Muonlike Particle by Beam Collector Applied RF Bias Voltage; Dec. 1997

NIFS-531 J. Uramoto,
Confirmation Method for Metal Plate Penetration of Low Energy Negative Pionlike or Muonlike Particle Beam under Positive Ions; Dec. 1997

NIFS-532 J. Uramoto,
Pair Creations of Negative and Positive Pionlike (Muonlike) Particle or K Mesonlike (Muonlike) Particle in H2 or D2 Gas Discharge in Magnetic Field, Dec. 1997

NIFS-533 S. Kawata, C. Boonmee, T. Teramoto, L. Drska, J. Limpouch, R. Liska, M. Sinor,
Computer-Assisted Particle-in-Cell Code Development;Dec 1997

NIFS-534 Y. Matsukawa, T. Suda, S. Ohnuki and C. Namba,
Microstructure and Mechanical Property of Neutron Irradiated TiNi Shape Memory Alloy; Jan. 1998

NIFS-535 A. Fujisawa, H. Iguchi, H. Idei, S. Kubo, K. Matsuoka, S. Okamura, K. Tanaka, T. Minami, S. Ohdachi, S. Morita, H. Zushi, S. Lee, M. Osakabe, R. Akiyama, Y. Yoshimura, K. Toi, H. Sanuki, K. Itoh, A. Shimizu, S. Takagi, A. Ejiri, C. Takahashi, M. Kojima, S. Hidekuma, K. Ida, S. Nishimura, N. Inoue, R. Sakamoto, S.-I. Itoh, Y. Hamada, M. Fujiwara,
Discovery of Electric Pulsation in a Toroidal Helical Plasma; Jan. 1998

NIFS-536 Lj.R. Hadzievski, M.M. Skoric, M. Kono and T. Sato,
Simulation of Weak and Strong Langmuir Collapse Regimes, Jan. 1998

NIFS-537 H Sugama, W Horton,
Nonlinear Electromagnetic Gyrokinetic Equation for Plasmas with Large Mean Flows, Feb. 1998

NIFS-538 H. Iguchi, T.P Crowley, A. Fujisawa, S Lee, K. Tanaka, T. Minami, S. Nishimura, K. Ida, R. Akiyama, Y. Hamada, H., Idei, M. Isobe, M. Kojima, S. Kubo, S. Morita, S. Ohdachi, S. Okamura, M. Osakabe, K. Matsuoka, C. Takahashi and K. Toi,
Space Potential Fluctuations during MHD Activities in the Compact Helical System (CHS); Feb. 1998

NIFS-539 Takashi Yabe and Yan Zhang,
Effect of Ambient Gas on Three-Dimensional Breakup in Coronet Formation Process; Feb. 1998

NIFS-540 H. Nakamura, K. Ikeda and S. Yamaguchi,
Transport Coefficients of InSb in a Strong Magnetic Field; Feb. 1998

NIFS-541 J. Uramoto,
Development of v_μ Beam Detector and Large Area v_μ Beam Source by H_2 Gas Discharge (I), Mar 1998

NIFS-542 J. Uramoto,
Development of bar{v}$_\mu$ Beam Detector and Large Area bar{v}$_\mu$ Beam Source by H_2 Gas Discharge (II); Mar. 1998

NIFS-543 J. Uramoto,
Some Problems inside a Mass Analyzer for Pions Extracted from a H_2 Gas Discharge, Mar 1998

NIFS-544 J. Uramoto,
Simplified v_μ, bar{ v}$_\mu$ Beam Detector and v_μ, bar{v}$_\mu$ Beam Source by Interaction between an Electron Bunch and a Positive Ion Bunch, Mar. 1998

NIFS-545 J. Uramoto,
Various Neutrino Beams Generated by D_2 Gas Discharge; Mar.1998

NIFS-546 R. Kanno, N. Nakajima, T. Hayashi and M. Okamoto,
Computational Study of Three Dimensional Equilibria with the Bootstrap Current; Mar. 1998

NIFS-547 R. Kanno, N. Nakajima and M. Okamoto,
Electron Heat Transport in a Self-Similar Structure of Magnetic Islands; Apr. 1998

NIFS-548 J.E. Rice,
Simulated Impurity Transport in LHD from MIST; May 1998

NIFS-549 M M Skoric, T Sato, A M Maluckov and M S Jovanovic,
On Kinetic Complexity in a Three-Wave Interaction; June 1998

NIFS-550 S Goto and S. Kida,
Passive Saclar Spectrum in Isotropic Turbulence: Prediction by the Lagrangian Direct-interaction Approximation; June 1998

NIFS-551 T. Kuroda, H Sugama, R Kanno, M. Okamoto and W Horton,
Initial Value Problem of the Toroidal Ion Temperature Gradient Mode , June 1998

NIFS-552 T Mutoh, R. Kumazawa, T Seki, F Simpo, G. Nomura, T. Ido and T Watari,
Steady State Tests of High Voltage Ceramic Feedthoughs and Co-Axial Transmission Line of ICRF Heating System for the Large Helical Device , June 1998

NIFS-553 N Noda, K. Tsuzuki, A Sagara, N Inoue, T Muroga,
oronaization in Future Devices -Protecting Layer against Tritium and Energetic Neutrals-: July 1998

NIFS-554 S. Murakami and H. Saleem,
Electromagnetic Effects on Rippling Instability and Tokamak Edge Fluctuations; July 1998

NIFS-555 H. Nakamura , K Ikeda and S Yamaguchi,
Physical Model of Nernst Element; Aug 1998

NIFS-556 H. Okumura, S. Yamaguchi, H. Nakamura, K Ikeda and K Sawada,
Numerical Computation of Thermoelectric and Thermomagnetic Effects; Aug. 1998

NIFS-557 Y. Takein, M Osakabe, K. Tsumori, Y. Oka, O Kaneko, E Asano, T Kawamoto, R Akiyama and M Tanaka,
Development of a High-Current Hydrogen-Negative Ion Source for LHD-NBI System, Aug 1998

NIFS-558 M. Tanaka, A. Yu Grosberg and T Tanaka,
Molecular Dynamics of Structure Organization of Polyampholytes; Sep. 1998

NIFS-559 R Horiuchi, K. Nishimura and T Watanabe,
Kinetic Stabilization of Tilt Disruption in Field-Reversed Configurations, Sep. 1998
(IAEA-CN-69/THP1/11)

NIFS-560 S. Sudo, K Kholopenkov, K. Matsuoka, S. Okamura, C. Takahashi, R. Akiyama, A Fujisawa, K Ida, H Idei, H. Iguchi, M Isobe, S Kado, K Kondo, S Kubo, H Kuramoto, T Minami, S Morita, S Nishimura, M Osakabe, M. Sasao, B. Peterson, K. Tanaka, K Toi and Y. Yoshimura,
Particle Transport Study with Tracer-Encapsulated Solid Pellet Injection, Oct 1998
(IAEA-CN-69/EXP1/18)

NIFS-561 A Fujisawa, H. Iguchi, S. Lee, K. Tanaka, T Minami, Y Yoshimura, M Osakabe, K Matsuoka, S. Okamura, H Idei, S Kubo, S. Ohdachi, S Morita, R. Akiyama, K. Toi, H. Sanuki, K Itoh, K. Ida, A. Shimizu, S. Takagi, C Takahashi, M Kojima, S Hidekuma, S Nishimura, M. Isobe, A Ejiri, N. Inoue, R. Sakamoto, Y Hamada and M Fujiwara,
Dynamic Behavior Associated with Electric Field Transitions in CHS Heliotron/Torsatron : Oct 1998
(IAEA-CN-69/EX5/1)

NIFS-562 S. Yoshikawa,
Next Generation Toroidal Devices ; Oct 1998

NIFS-563 Y. Todo and T Sato,
Kinetic-Magnetohydrodynamic Simulation Study of Fast Ions and Toroidal Alfvén Eigenmodes; Oct 1998
(IAEA-CN-69/THP2/22)

NIFS-564 T. Watari, T. Shimozuma, Y Takeiri, R. Kumazawa, T. Mutoh, M. Sato, O Kaneko, K Ohkubo, S. Kubo, H. Idei, Y Oka, M Osakabe, T. Seki, K Tsumori, Y Yoshimura, R. Akiyama, T. Kawamoto, S. Kobayashi, F. Shimpo, Y. Takita, E Asano, S Itoh, G. Nomura, T. Ido, M. Hamabe, M Fujiwara, A. Iiyoshi, S. Morimoto, T Bigelow and Y P. Zhao,
Steady State Heating Technology Development for LHD ; Oct 1998
(IAEA-CN-69/FTP/21)

NIFS-565 A. Sagara, K.Y. Watanabe, K Yamazaki, O Motojima, M Fujiwara, O Mitarai, S Imagawa, H. Yamanishi, H Chikaraishi, A Kohyama, H. Matsui, T. Muroga, T Noda, N. Ohyabu, T Satow, A.A Shishkin, S Tanaka, T. Terai and T Uda,

LHD-Type Compact Helical Reactors;Oct. 1998
(IAEA-CN-69/FTP/03(R)

NIFS-566 N. Nakajima, J. Chen, K. Ichiguchi and M. Okamoto,
Global Mode Analysis of Ideal MHD Modes in L=2 Heliotron/Torsatron Systems;Oct 1998
(IAEA-CN-69/THP1/08)

NIFS-567 K. Ida, M. Osakabe, K. Tanaka, T. Minami, S. Nishimura, S. Okamura, A. Fujisawa, Y. Yoshimura, S. Kubo, R. Akiyama, D.S.Darrow, H. Idei, H. Iguchi, M. Isobe, S. Kado, T. Kondo, S. Lee, K. Matsuoka, S. Morita, I. Nomura, S. Ohdachi, M. Sasao, A. Shimizu, K. Tumori, S. Takayama, M. Takechi, S. Takagi, C. Takahashi, K. Toi and T. Watari,
Transition from L Mode to High Ion Temperature Mode in CHS Heliotron/Torsatron Plasmas;Oct. 1998
(IAEA-CN-69/EX2/2)

NIFS-568 S. Okamura, K. Matsuoka, R. Akiyama, D.S. Darrow, A. Ejiri, A. Fujisawa, M. Fujiwara, M. Goto, K. Ida H. Idei, H. Iguchi, N. Inoue, M. Isobe, K. Itoh, S. Kado, K. Khlopenkov, T. Kondo, S. Kubo, A. Lazaros, S. Lee, G. Matsunaga, T. Minami, S Morita, S Murakami, N. Nakajima, N. Nikai, S. Nishimura, I. Nomura, S. Ohdachi, K. Ohkuni, M. Osakabe R. Pavlichenko, B. Peterson, R. Sakamoto, H. Sanuki, M. Sasao, A. Shimizu, Y. Shirai, S. Sudo, S. Takagi, C Takahashi, S Takayama, M. Takechi, K Tanaka, K. Toi, K. Yamazaki, Y. Yoshimura and T. Watari,
Confinement Physics Study in a Small Low-Aspect-Ratio Helical Device CHS;Oct. 1998
(IAEA-CN-69/OV4/5)

NIFS-569 M.M. Skoric, T. Sato, A. Maluckov, M.S. Jovanovic,
Micro- and Macro-scale Self-organization in a Dissipative Plasma;Oct. 1998

NIFS-570 T. Hayashi, N. Mizuguchi, T-H. Watanabe, T. Sato and the Complexity Simulation Group,
Nonlinear Simulations of Internal Reconnection Event in Spherical Tokamak:Oct 1998
(IAEA-CN-69/TH3/3)

NIFS-571 A. Iiyoshi, A. Komori, A. Ejiri, M. Emoto, H Funaba, M. Goto, K. Ida, H Idei, S. Inagaki, S Kado, O Kaneko, K. Kawahata, S. Kubo, R. Kumazawa, S. Masuzaki, T Minami, J. Miyazawa, T. Morisaki, S. Morita, S. Murakami, S. Muto, T. Muto, Y Nagayama, Y Nakamura, H. Nakanishi, K Narihara, K Nishimura, N Noda, T. Kobuchi, S. Ohdachi, N. Ohyabu, Y. Oka, M Osakabe, T. Ozaki, B.J Peterson, A Sagara, S. Sakakibara, R. Sakamoto, H. Sasao, M. Sasao, K. Sato, M. Sato, T. Seki, T Shimozuma, M. Shoji, H. Suzuki, Y. Takeiri, K. Tanaka, K. Toi, T Tokuzawa, K. Tsumori, I. Yamada, H Yamada, S. Yamaguchi, M. Yokoyama, K.Y.Watanabe, T. Watari, R. Akiyama, H. Chikaraishi, K. Haba, S. Hamaguchi, S Iima, S. Imagawa, N. Inoue, K Iwamoto, S. Kitagawa, Y. Kubota, J. Kodaira, R. Maekawa, T. Mito. T. Nagasaka, A. Nishimura, Y. Takita, C. Takahashi, K. Takahata, K. Yamauchi, H. Tamura, T. Tsuzuki, S. Yamada, N. Yanagi, H. Yonezu, Y. Hamada, K. Matsuoka, K. Murai, K. Ohkubo, I. Ohtake, M. Okamoto, S. Sato, T. Satow, S. Sudo, S. Tanahashi, K. Yamazaki, M. Fujiwara and O. Motojima,
An Overview of the Large Helical Device Project; Oct. 1998
(IAEA-CN-69/OV1/4)

NIFS-572 M. Fujiwara, H. Yamada, A. Ejiri, M. Emoto, H. Funaba, M. Goto, K. Ida, H. Idei, S. Inagaki, S. Kado, O. Kaneko, K. Kawahata, A. Komori, S. Kubo, R. Kumazawa, S. Masuzaki, T. Minami, J. Miyazawa, T. Morisaki, S. Morita, S. Murakami, S. Muto, T. Muto, Y. Nagayama, Y. Nakamura, H. Nakanishi, K. Narihara, K. Nishimura, N. Noda, T. Kobuchi, S. Ohdachi, N. Ohyabu, Y. Oka, M. Osakabe, T. Ozaki, B. J. Peterson, A. Sagara, S. Sakakibara, R. Sakamoto, H. Sasao, M. Sasao, K. Sato, M. Sato, T. Seki, T. Shimozuma, M. Shoji, H. Sazuki, Y. Takeiri, K. Tanaka, K. Toi, T. Tokuzawa, K. Tsumori, I. Yamada, S. Yamaguchi, M. Yokoyama, K.Y. Watanabe, T. Watari, R. Akiyama, H. Chikaraishi, K. Haba, S. Hamaguchi, M. Iima, S. Imagawa, N Inoue, K. Iwamoto, S. Kitagawa, Y Kubota, J. Kodaira, R. Maekawa, T. Mito, T. Nagasaka, A. Nishimura, Y Takita, C. Takahashi, K. Takahata, K. Yamauchi, H. Tamura, T. Tsuzuki, S. Yamada, N. Yanagi, H. Yonezu, Y. Hamada, K. Matsuoka, K Murai, K. Ohkubo, I. Ohtake, M. Okamoto, S. Sato, T. Satow, S. Sudo, S. Tanahashi, K. Yamazaki, O. Motojima and A. Iiyoshi,
Plasma Confinement Studies in LHD; Oct. 1998
(IAEA-CN-69/EX2/3)

NIFS-573 O. Motojima, K. Akaishi, H. Chikaraishi, H. Funaba, S. Hamaguchi, S. Imagawa, S Inagaki, N. Inoue, A Iwamoto, S. Kitagawa, A. Komori, Y. Kubota, R. Maekawa, S. Masuzaki, T. Mito, J Miyazawa, T Morisaki, T. Muroga, T. Nagasaka, Y. Nakmura, A. Nishimura, K. Nishimura, N. Noda, N. Ohyabu, S. Sagara, S. Sakakibara, R. Sakamoto, S. Satoh, T Satow, M Shoji, H. Suzuki, K. Takahata, H. Tamura, K. Watanabe, H. Yamada, S. Yamada, S. Yamaguchi, K. Yamazaki, N Yanagi, T Baba, H. Hayashi, M Iima, T. Inoue, S. Kato, T. Kato, T. Kondo, S Moriuchi, H Ogawa, I Ohtake, K. Ooba, H. Sekiguchi, N. Suzuki, S. Takami, Y Taniguchi, T. Tsuzuki, N. Yamamoto, K. Yasui, H. Yonezu, M. Fujiwara and A. Iiyoshi,
Progress Summary of LHD Engineering Design and Construction; Oct. 1998
(IAEA-CN-69/FT2/1)

NIFS-574 K. Toi, M. Takechi, S. Takagi, G. Matsunaga, M. Isobe, T Kondo, M. Sasao, D.S. Darrow, K. Ohkuni, S. Ohdachi, R Akiyama A. Fujisawa, M. Gotoh, H. Idei, K. Ida, H. Iguchi, S. Kado, M. Kojima, S. Kubo, S. Lee, K. Matsuoka, T. Minami, S. Morita, N. Nikai, S. Nishimura, S. Okamura, M. Osakabe, A. Shimizu, Y. Shirai, C. Takahashi, K. Tanaka, T. Watari and Y. Yoshimura,
Global MHD Modes Excited by Energetic Ions in Heliotron/Torsatron Plasmas;Oct. 1998
(IAEA-CN-69/EXP1/19)

NIFS-575 Y. Hamada, A. Nishizawa, Y. Kawasumi, A. Fujisawa, M. Kojima, K. Narihara, K. Ida, A. Ejiri, S. Ohdachi, K. Kawahata, K. Toi, K. Sato, T. Seki, H. Iguchi, K. Adachi, S. Hidekuma, S.Hirokura, K. Iwasaki, T Ido, R. Kumazawa, H. Kuramoto, T. Minami, I. Nomura, M. Sasao, K.N. Sato, T. Tsuzuki, I. Yamada and T. Watari,
Potential Turbulence in Tokamak Plasmas;Oct. 1998
(IAEA-CN-69/EXP2/14)