23P036-P

Study of filament features of edge plasma fluctuations using fast video cameras with a combination of Langmuir probe measurements in Heliotron J (II)

N. Nishino[1], L.Zang[2], M. Takeuchi[3], T. Mizuuchi[4], S. Ohshima[5], K. Kasajima[6], M.Sha[2], K. Mukai[2], H.Y. Lee[2], K. Nagasaki[4], H. Okada[4], T. Minami[4], S. Kobayashi[4], S. Yamamoto[4], S. Konoshima[4], K. Hanatani[4], Y. Nakamura[2], and F.Sano[4]

西野信博[1]，臧 臨閣[2]，竹内正樹[3]，水内亨[4]，大島慎介[5]，笠嶋慶純[6]，沙 夢雨[2]，向井清史[2]，李炫庸[2]，長崎百伸[4]，岡田浩之[4]，南貴司[4]，小林進二[4]，山本聡[4]，木島滋[4]，花谷清[4]，中村祐司[2]，佐野史道[4]

[1]*Graduate School of Engineering, Hiroshima University, Higashi-hiroshima, Japan*
[2]*Graduate School of Energy Science, Kyoto University, Gokasho, Uji, Japan*
[3]*Naka Fusion Institute, Japanese Atomic Energy Agency, Naka, Japan*
[4]*Institute of Advanced Energy, Kyoto University, Gokasho, Uji, Japan*
[5]*Pioneering Research Unit for Next Generation, Gokasho, Uji, Japan*
[6]*Department of Engineering, Kyoto University, Kyoto, Japan*

京都大学エネルギー理工学研究所〒611-0011 宇治市五ヶ庄

In Heliotron J a combination system of a fast camera, a gas puff and a hybrid probe is installed first time for the edge plasma turbulence study. This complex system enables us to get good information on plasma turbulence and its behavior, especially the dynamics of the filament structure, in the edge region. Up to now we have testified the gas puff system for GPI, in particular the quantity of gas puff is very sensitive for Heliotron J plasma. In this meeting we will report mainly the first observation of filament images with GPI and SMBI (another port) in NBI plasma.

1. Introduction

Applying a supersonic molecular beam injection (SMBI) [1] to Heliotron J plasma the plasma stored energy increased beyond the saturation level in the conventional gas puff condition [2]. The previous experiments suggest that some change in the edge plasma turbulence (ex. dynamics of a filament structure in the turbulence) might be related to the observed difference in the plasma performance between the SMBI and the conventional gas puff cases.

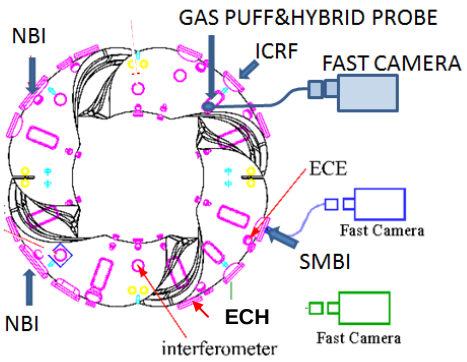

Fig.1 Top view of Heliotron J. The locations of fast cameras, the gas puff for GPI and the hybrid probe are illustrated.

Therefore, the effect of SMBI on the behavior of filament structure in the edge plasma turbulence is very interesting from the viewpoint of fueling and plasma turbulence itself. Fast cameras or combination probes of Langmuir/magnetic probes have been used to study the behavior of edge plasma in many devices [3–7], where in particular simultaneous measurement with a fast camera and probes is very powerful.

In this paper, the behavior of edge plasma turbulence during SMBI was studied using a combination of the fast camera with GPI, Langmuir probes and a set of magnetic probes in Heliotron J.

2. Experimental Setup

Heliotron J is a medium sized helical-axis heliotron device with an L = 1/M = 4 helical coil [8, 9]. Figure 1 shows a top view of Heliotron J and the locations of fast cameras and the other equipment referred to this study. Also, the vacuum flux surfaces of the standard field configuration of Heliotron J [11] at the fast camera measurement port section, #14.5, are shown in Fig. 2. Due to the limitation of the port space a fast camera is installed at the lower port and a gas puff for GPI (gas puff imaging) and a hybrid probe system are installed at the upper port, respectively. In this experiment

FASTCAM SA5 (Photron) and FX K-5 (NAC image technology) are used to take high-speed movies of Heliotron J plasma.

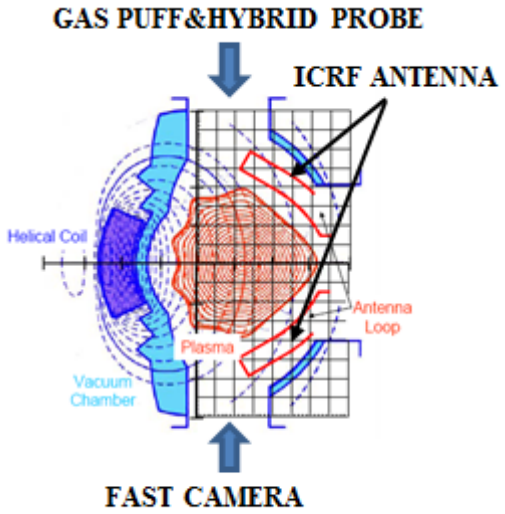

Fig. 2 Crosssection of #14.5 port section where ICRF antenna is installed. The fast camera is set at the bottom port and the gas-puff and the hybrid probe are installed at the top port. The vacuum flux surfaces of the standard field configuration are also illustrated.

3. SMBI with GPI

In this experiment the gas puff at #14.5 is used for GPI to enhance the brightness from the probe side of the edge plasma, and the filament images in this side are observed by the fast camera. The hybrid probe system provides data of ion saturation current I_s, floating potential V_f, and three directional magnetic fluctuation simultaneously. Therefore, we can measure many of key local parameters associated with the filament behavior.

Up to now a lot of amount of injection gas for GPI is required to observe the filament structure by the fast camera and the increase of electron density is not so small. We have to adjust the gas puff quantity in near future. A typical fast camera image with GPI at #14.5 is shown in Fig.3. This figure shows the positions of the upper ICRF antenna in the right side, the hybrid probe system in the center and the gas puff exit in the left side, respectively. Due to GPI it is thought that the fast camera image mainly comes from the upper side of the peripheral plasma.

During SMBI at #11.5, the suppression of the magnetic fluctuation is observed from power spectra of the magnetic probe signal from the hybrid probe system at #14.5. On the other hand, the fluctuation of I_s was not suppressed perhaps due to excitation of a very low frequency instability. This frequency range is out of the detectable frequency range of the magnetic probes. This low frequency instability is believed to be an MHD activity probably caused by too much amount of gas injection in this particular case. Therefore, The adjustment of gas quantity would help us to get better results.

In this meeting we will report the precise results of this complex measurement included in the fast camera of NBI experiment and if in time, we will also present those results of ECH and/or ICRF experiment.

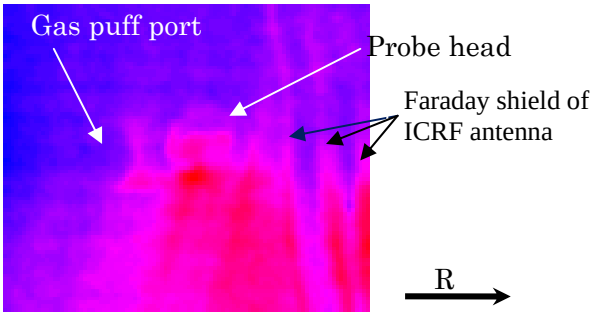

Fig.3 Snapshot image of an NBI plasma with SMBI (#11.5) and GPI (#14.5) at #14.5
The stripe in the right side is Faraday shield of ICRF antenna. Major radius direction is right.

Acknowledgments

The authors are grateful to the Heliotron supporting group for their excellent arrangement of the experiments. This work is performed with the support and under the auspices of the Bi-directional collaboration research program (NIFS04KUHL006) between Hiroshima University and IAE Kyoto University. One of the authors (N.N) acknowledges S. Nishino for continued encouragement.

References

[1] L. Yao, in: New Developments in Nuclear Fusion Research, Nova Sci. Pub, 2006, 61–87.
[2] T. Mizuuchi, et al., to be published in J.Nucl.Mater.
[3] R. Maqueda *et al.*. Rev. Sci. Instrum., **72** (2001), 931.
[4] S.J. Zweben *et al.*. Phys. Plasmas, **9** (2002), 1981.
[5] T. Mizuuchi *et al.*. J. Nucl. Mater., **337–339** (2005), 332.
[6] N. Nishino *et al.*. J. Nucl. Mater., **363–365** (2007), 628.
[7] F. Sano *et al.*. J. Plasma Fusion Res. Ser., **3** (2000), 26.
[8] T. Obiki *et al.*. Nucl. Fusion, **41** (2001), 833.