

§16. A Study of Peripheral Plasma in Heliotron J by a Fast Camera

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Peripheral plasma turbulence measurement by fast camera was performed under Bi-directional collaborative activity¹⁻³. This year the super molecular beam injection (SMBI) was used to raise the electron density and to confirm the electron density dependence for H-mode accessibility.

Fig.1 shows typical waveform of SMBI experimental shot. Top is the electron density, the second is the NBI and ECH power, the third is H α emission, and the bottom is the diamagnetic signal. The start time of SMBI is 209ms, and last 2-3ms. The light intensity of H α emission increased simultaneously. NBI and ECH power were almost constant. The electron density increased with SMBI, however, the diamagnetic signal began to rise at ~212ms. This delay may account with the decrease of electron temperature due to SMBI. It is desirable to measure the electron density and temperature profile in Heliotron J. That will be planned next year.

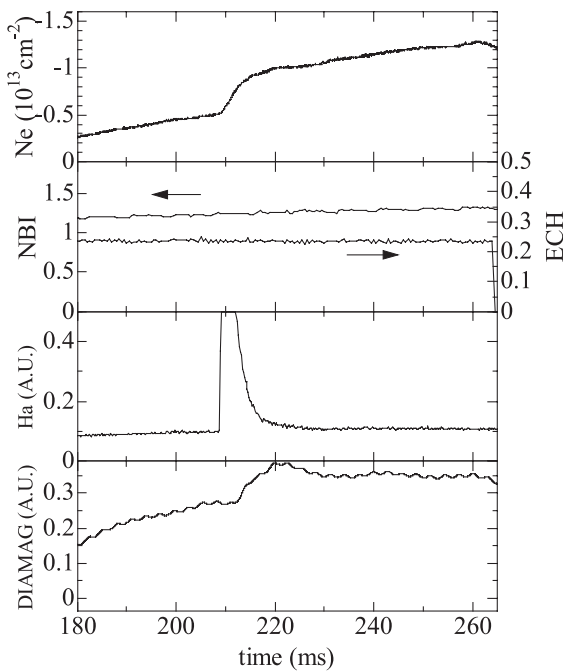


Fig. 1 Typical waveform of SMBI Heliotron J plasma

Before and after SMBI the peripheral turbulence were measured by the fast camera. Fig. 2 shows the raw camera picture with SMBI shot from the tangential port. In this image two ICRF antennas were brightened at the center region. Before SMBI the filamentary structure near the ICRF antenna are seen. The motion of the filamentary

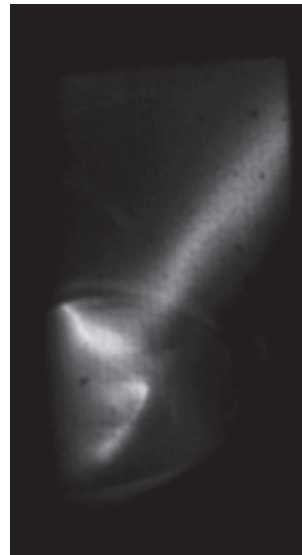


Fig. 2 Raw camera picture with SMBI

structure was almost anti-clockwise direction, however sometimes the rotation reversed.

That was called Phase I in Heliotron J plasmas. With many serious H-mode experiment of Heliotron J, the relationship between the rotation of the filamentary structure and H- and L-mode becomes clear. In H-mode the rotation is clockwise, and in L-mode the rotation is anti-clockwise in this image. However, before H-mode it is found that the rotation reversed sometimes, as if the

rotation was dithering. Also the diamagnetic signal and the electron density increased during this “dithering phase”. Usual this was named “Phase I” in Heliotron J. After this the term “Phase I” is used to call this “dithering phase”.

Figure 3 shows the rotation dithering during Phase I.

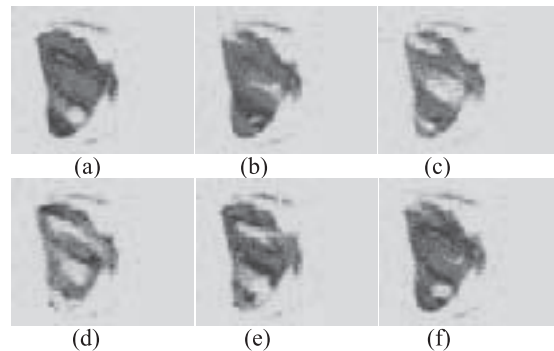


Fig.3 Two-dimensional phase images show the rotation dithering during Phase I

Time increase with (a) to (f) with 40000FPS

After SMBI this Phase I last with long time and sometimes it last till the end of discharges. That means there is no H-mode (and no L-mode) plasma in this shot. Usually H-mode of Heliotron J plasma well confined the electron, and the rise of the electron density causes the radiation collapse. This scenario does not meet the fusion reactor plasmas. In heliotron device much increase of the electron density is not favorable. On the contrary the electron density and the diamagnetic signal increased during Phase I plasma with no radiation collapse. Therefore, it is hoped that SMBI can enlarge the life of Phase I.

We are still investigating SMBI effect precisely near future.

- 1) N.Nishino, et. al, 16th PSI (2004)
- 2) N.Nishino, et. al, 17th PSI (2006)
- 3) N.Nishino, et. al, 18th PSI (2008)