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GAMMA 10におけるセントラル部電子加熱時の軟X線トモグラフィー計測
Soft X-ray tomography during ECRH of the central region in GAMMA 10

河原崎遼, 今井剛, 南龍太郎, 假家強, 沼倉友晴, 江口濯,
中澤和寛, 加藤貴輝, 南齋宏駿, 佐藤文哉, 上原真, 市村真
R. KAWARASAKI, T. IMAI, R. MINAMI, T. KARIYA, T. NUMAKURA, T. EGUCHI,
K. NAKAZAWA, T. KATO, H. NANZAI, F. SATO, M. UEHARA, M. ICHIMURA

筑波大学プラズマ研究センター
Plasma Research Center, University of Tsukuba

In the GAMMA 10 tandem mirror, the ion temperature in the central cell is much higher (several keV) than the electron temperature (30 - 50 eV) in the typical hot ion plasma produced by Ion Cyclotron Range of Frequencies (ICRF) heating. In order to reduce the electron drag by increasing the electron temperature, Electron Cyclotron Resonance Heating (ECRH) has been applied for the bulk electron heating in the central cell.

We measured the Soft X-ray(SXR) profiles during the ECRH using two X-ray semiconductor detector arrays to investigate the behavior of the plasma. Each of two detectors has lines of sight on the same plane of the plasma in the central region of the GAMMA 10. (Fig.1) The Cormack inversion method is applied to reconstruct 2 dimensional SXR images[1]. We used the Bessel function for the radial direction and the Fourier series for the azimuthal direction to expand the SXR profiles.

The ECRH is applied to the ICRF heated plasma for 10-20 ms. The ECRH power is 50-200 kW at 28 GHz. Intensity of the SXR increases rapidly, and its profile is stable with ECRH under the 100kW. On the other hand, with the high power ECRH, the oscillation of the SXR profile grows larger, and diamagnetism related to stored energy decreases. Fig. 2 shows SXR tomography images obtained from the cormack inversion during the 100kW ECRH. The SXR profile shift apart from the axis of the vacuum vessel, and is rotating to contour-clockwise direction. The frequency of these oscillations obtained from SXR intensity and line density are ~3kHz, It occurs 0.3-0.5 ms after the injection of the ECRH power. Simultaneously, radial ion current measured by the ion sensitive probe(ISP) increases, and line density and diamagnetism decreases with the high power ECRH. In the case of varying the antenna's position to the off axis direction, both fluctuation power of SXR intensity and ISP current increased.

These results indicate that non-symmetrical EC heating affects behavior of plasma. It is considered non-symmetrical electric field are excited by the ECRH power absorption and ExB related plasma transport causes the increase of the radial loss and deterioration of the confinement of the central region.

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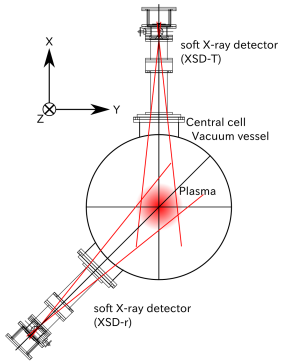

Fig.1 Schematic view of the SXR tomography system.

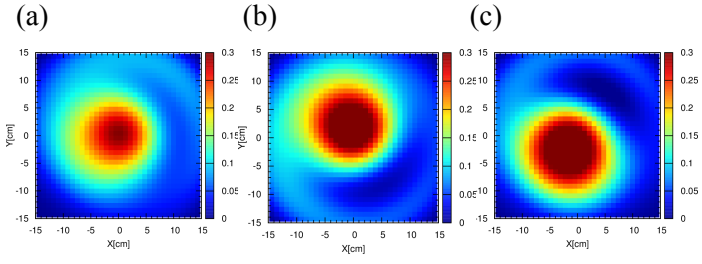

Fig. 2 Time evolution of the SXR profiles during ECRH for (a) t=160.5ms, (b) t=160.9ms, (c) t=161.3ms. The SXR profile is rotating and shifts apart from the axis of the vacuum vessel.

[1] Y. NAGAYAMA, J. Appl. Phys. 62, 2702 (1987).