§9. Plasma Flow Measurement at a Peripheral Region of the Central Cell in GAMMA10

Ando, A., Takahashi, N., Hashima, Y., Izawa, Y. (Dept. Electrical Eng. Tohoku Univ.), Ichimura, M., Ikezoe, R., Yokoyama, T. (Plasma Research Center, Tsukuba Univ.)

Recently, a plasma flow has been recognized to play an important role in magnetically confined plasmas, especially in open magnetic systems. The relation between radial electric field and azimuthal plasma rotation should be investigated for the confinement study in high power ICRF heating. We have measured ion Mach number M_i and flow direction at the peripheral region of the confined plasma in GAMMA10 by using a 4-tip type Mach probe. The purpose of the research is to investigate the E×B drift and diamagnetic drift and to clarify the effect of plasma flow on a radial electric field in the high power ICRF regime. Measurement of Mach number in GAMMA10 plasma has been performed with high power ICRF and ECRH at plug/barrier section.

4-tip type Mach probes were set in both east and west side at 1.28m apart from the center of GAMMA10 and moved radially in the peripheral region. It has four probe tips and Mach number and flow direction can be derived from the four signals[1),2)]

In GAMMA10 high T_i mode were observed with high power ICRF heating using RF antennas（RF1: 10MHz，RF2: 6.4MHz）set at the central region. We have measured the Mach number M_i and pitch angle φ of the ICRF heated plasma at r=18cm in the GAMMA10 device.[3),4)] Figure 1 shows typical waveform of Mach number M when a periodic behavior was observed in the Mach number. Axial and azimuthal componenst of Mach number M_z and M_θ are also shown in the figure. The direction of the flow is outward in axial direction and ion diamagnetic rotation in azimuthal direction. This indicated that the central plasma rotates azimuthally in the direction of E×B drift and flows to the end cell region. Both of M_z and M_θ oscillated in phase.

Additional ICRF (RF3) was applied at 160ms in order to heat ions at the central region of GAMMA10. Figure 2 shows waveforms of line integrated density (NLCC) and axial Mach numbers M_z measured by using two Mach probes located at both west and east sides. M_z was 0.4 and positive at wast side and negative at east side. The positive value of M_z corresponds to westward direction of plasma flow. Then the data shows that plasma flows outward in both directions. When the RF3 power was applied, an increase of line integrated density (NLCC) occurred as shown in the figure. M_z measured by both probes decreased to almost zero at the moment.

We should investigate further the effect of high-power RF heating to the plasma flow and the formation of radial electric field.

1) Ando, A., et al., Contributions to Plasma Phys., **46** (2006) 335. J. Plasma and Fusion Res., **81** (2005) 451.
2) Ando, A., et al., Trans. of Fusion Science and Tech., **51** (2007) 217.
3) Nemoto, K., et al., *ibid,* **51** (2007) 223.
4) H.Muro et al., Fusion Science and Technology **55** (2009) 172.

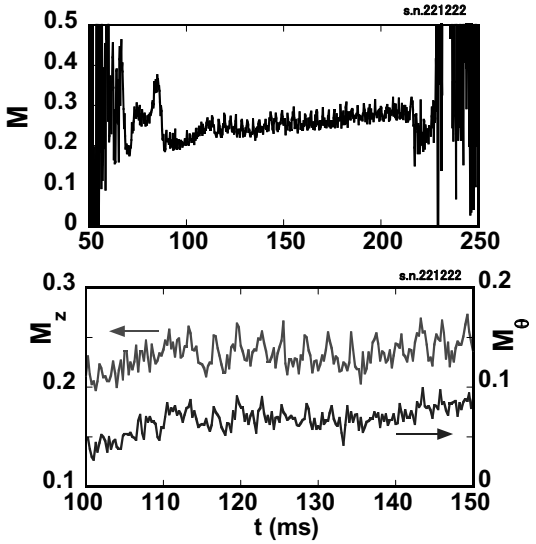

Fig. 1 Waveform of Mach number M derived from 4-tip Mach probe. Axial and azimuthal components, M_z and M_θ are shown.

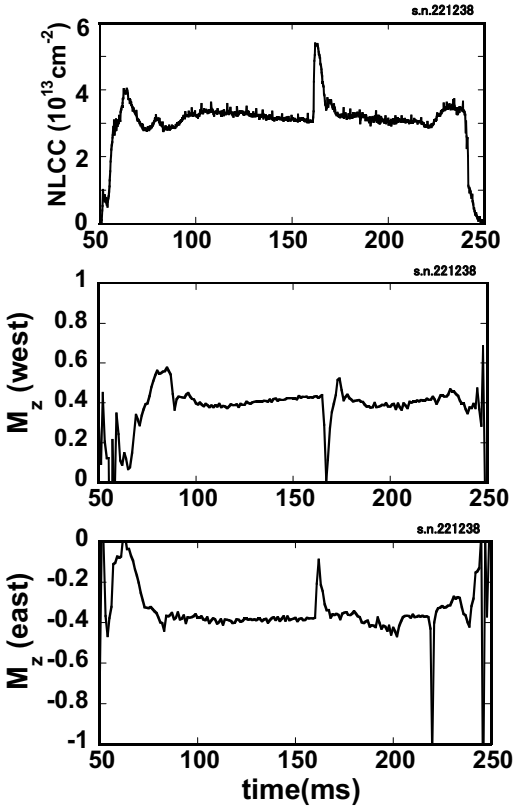

Fig. 2 Waveform of line integrated density and Mach probe signal M_z measured at east and west sides in GAMMA10. ICRH (RF3) was applied at 160 ms.