§10. Plasma Rotation at a Peripheral Region of the Central Cell in GAMMA10

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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. Various diagnostics have been utilized for the observation of rotational behavior in central cell in GAMMA10. We can measure ion Mach number M_i of the confined plasma in a peripheral region, where a Mach probe is one of the simple and costless diagnostic tools for plasma flow field.

The purpose of this research is to measure an azimuthal plasma flow by using a Mach probe in the peripheral region of GAMMA10 and to clarify the effect of radial electric field on the E×B drift and diamagnetic drift in the high power ICRF regime.

We have utilized a 4-tip type Mach probe shown in Fig.1, which was set 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)-3)]

The tip numbers and flow direction were defined as shown in Fig.1. An ion Mach number and flow direction were derived from four ion saturation currents according to the following equations,

$$M_i = \sqrt{\left(\ln(j_1/j_3)\right)^2 + \left(\ln(j_2/j_4)\right)^2} \tag{1}$$

$$\varphi = \arctan\left(\frac{\ln(j_2/j_4)}{\ln(j_1/j_3)}\right) \tag{2}$$

We have measured the Mach number and flow direction angle of the ICRF heated plasma at r=18cm in the GAMMA10 device.[3)-5)] Figure 2 shows temporal waveforms of M_i and φ derived by using the 4-tip Mach probe. M_i attained to 0.35-0.4 and flow angle was 65 degree, which indicated that the central plasma rotates azimuthally in the direction of E×B drift and flow to the end cell region. When the ECRH power was applied to the ICRF heated plasma at the plug/barrier region, Mach number increased from 0.4 to 0.5 and flow angle also increased to nearly 90 degrees. The axial components of the Mach number M_z decreased in spite of the increase of M_θ. The increase of diamagnetic signal was also observed with the ECRH injection. This indicated an azimuthal rotation was related with the plasma confinement.

We should investigate a driving force of the axial plasma flow and the effect of the flow to the plasma confinement in GAMMA10. The effect of high-power RF heating on the plasma flow and the formation of radial electric field in the plasma should be pursued further.

1) Ando, A., et al., Contributions to Plasma Phys., 46 (2006) 335.
2) Ando, A., et al., J. Plasma and Fusion Res., 81 (2005) 451.
3) Nemoto, K., et al., Trans. of Fusion Science and Tech., 51 (2007) 223.
4) Ando, A., et al., *ibid,* 51 (2007) 217.
5) H.Muro et al., Proc. of 7th International Conference on Open Magnetic Systems for Plasma Confinement (OS2008) P32, (2008).

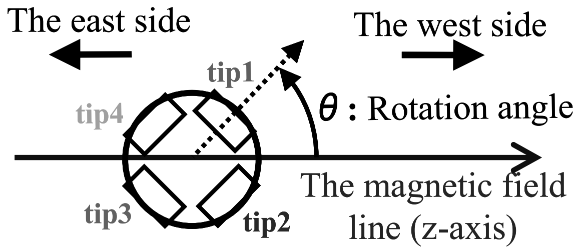

Fig. 1 Schematic of 4-tip type Mach probe. The rotation angle θ of the probe is defined as the figure.

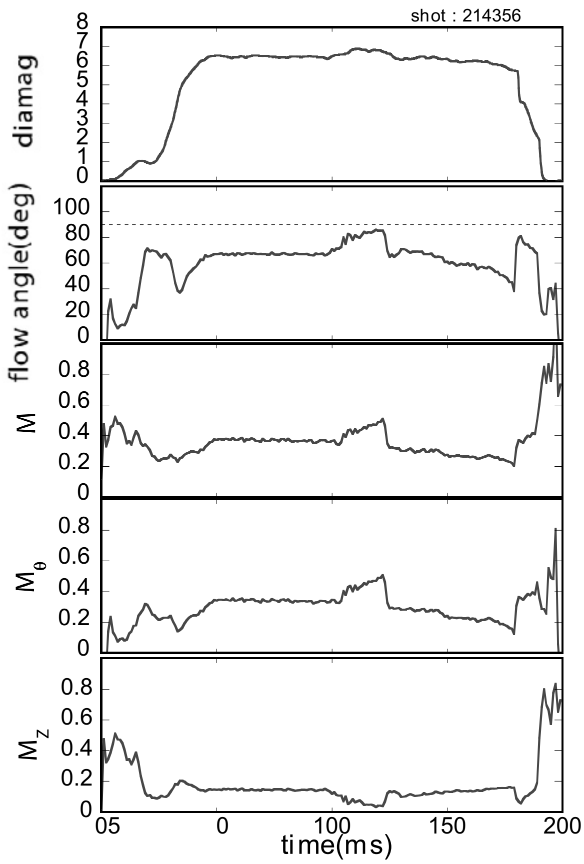

Fig. 2 Temporal waveforms of diamagnetic signal, plasma flow angle φ to the magnetic axis, total Mach number M_i, azimuthal and axial components of M_i. ECRH was applied to the plug/ barrier region from 100ms.