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

Ando, A., Aramaki, R., Jo, S. (Dept. Electrical Eng., Tohoku Univ.),
Ichimura, M., Yamaguchi, Y., Muro, H., Ouchi, T. (Plasma Research Center, Tsukuba Univ.)

Recently, a plasma flow has been recognized to play an important role in magnetically confined plasma, 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)]

When the tip numbers and flow direction are defined as in Fig.1, an ion Mach number and flow direction was derived from the following equations,

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

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

In order to confirm the measurement of flow direction, the 4-tip probe was rotated around its axis. The calculated the flow angle φ is shown as a function of θ in Fig.2. The difference was 55 degree in spite of probe rotation angle. This represents that the flow direction can be determined during the shot without rotating the Mach probe. The data also indicate that the central plasma rotates azimuthally in the direction of E×B drift and flow to the end cell region.

We have measured the Mach number and flow direction angle of the GAMMA10 plasma at r=18cm.[4),5)] Figure 3 shows temporal waveforms of M_i and φ derived by using the 4-tip Mach probe. When the ECRH power was applied to ICRF heated plasma, Mach number increased from 0.4 to 0.6 and flow angle also increased slightly. This correspond to an increase of azimuthal rotation velocity.

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 Research, **81** (2005) 451.
3) Ando, A., et al., Thin Solid Films, **506-507C** (2006) 692.
4) Nemoto, K., et al., Trans. of Fusion Science and Tech., **51** (2007) 223.
5) Ando, A., et al., *ibid,* **51** (2007) 217.

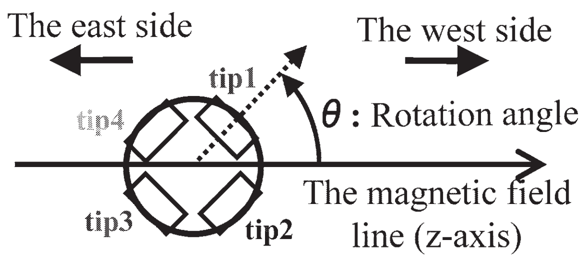

Fig. 1 Schematic of 4-tip type Mach probe. The rotation angle θ of the probe is defined as the figure.

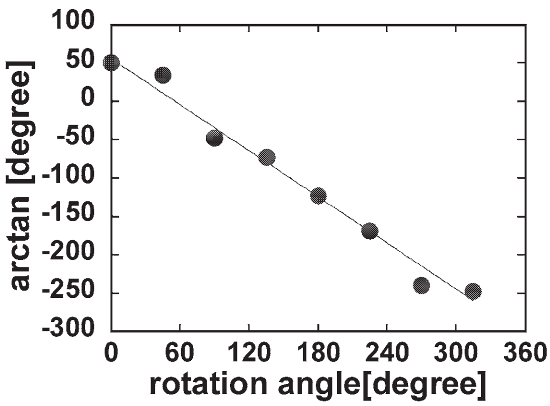

Fig. 2 Dependence of plasma flow angle φ on the rotation angle θ. Solid line is the least square fitting one.

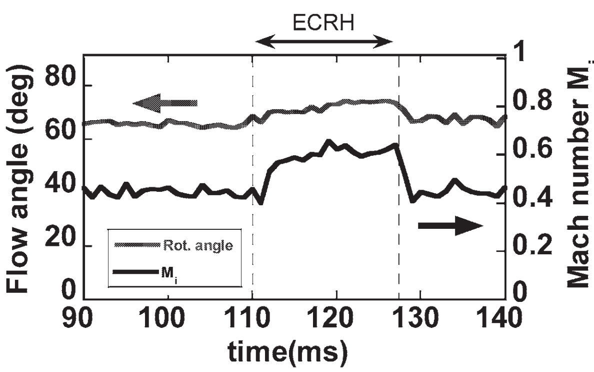

Fig. 3 Temporal evolutions of of plasma flow angle φ on the rotation angle θ. Solid line is the least square fitting one.