§25. Plasma Flow Measurement at Peripheral Region with ICRF Heating in GAMMA10

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Velocity field of plasmas is a fundamental physical quantity relating to the formation of the radial electric field and the transport barrier for improvement of the fusion plasma confinement. The GAMMA 10 device has demonstrated the confinement of the plasma with the ion temperature of around 1 keV in the central cell when applying the high power ion cyclotron resonance heating (ICRH); the relation between velocity field and confinement performance by the ICRH is one of the important topics.

In the present work, a four-tips-Mach probe has been prepared to investigate the velocity fields of the peripheral plasma in the central cell. The preliminarily measurements have shown the axial and azimuthal plasma flow velocity, where the former has been identified as the ExB-drift-induced flow. In this year, detailed temporal evolution of the plasma flow velocity, i.e., the Mach number, and the flow direction are investigated.

The experimental condition is chosen to have the high ion temperature mode, which is performed by the ICRH (RF1: 10MHz, RF2: 6.4 MHz) in the central cell under a magnetic beach configuration. Two Mach probes are located at axial locations of 128 cm from the axial center of the machine toward EAST and WEST sides, respectively. Both of the probes are located at r = 19 cm close to a limiter corresponding to the plasma edge The detailed configuration of the Mach probe tips at the EAST and WEST sides are shown in Fig. 1(a). Since the ion Mach number can be obtained from the two detection tips, the detection area of the tips are accurately calibrated by rotating the probe shaft. Figure 1(b) shows the ion saturation current intensity from each tip of the probe located in the EAST side as a function of the angle θ. The very similar signal intensity is successfully obtained; hence it is demonstrated that the axial and azimuthal ion Mach number can be estimated from the intensity ratio of the signals in addition to the total ion Mach number.

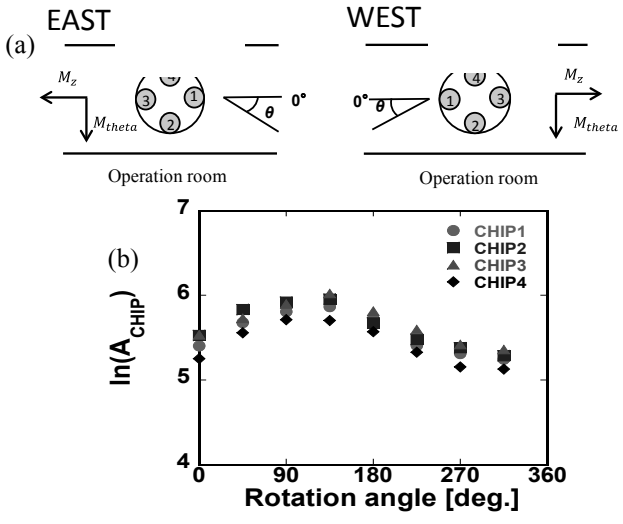

Fig.1: (a) Schematic of the configuration of the four-tips-Mach probes located at 128 cm from the axial machine center to the EAST and WEST sides. (b) The natural logarithms of the calibrated signal intensities from the Mach probe located in the EAST side.

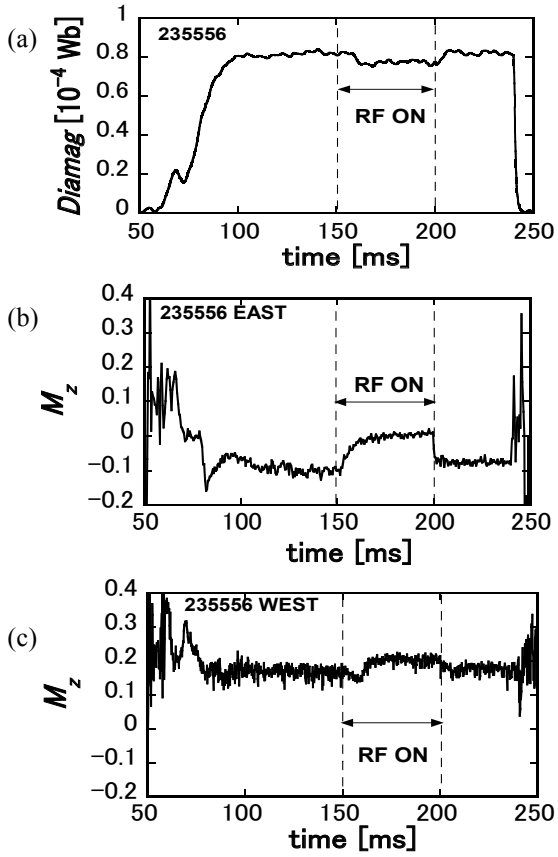

Fig. 2: Temporal evolutions of (a) the diamagnetic signal, and the axial ion Mach numbers measured at the (b) EAST and (c) WEST sides, where the ICRH (RF3: 10.3 MHz) is turned on for 150-200 msec as shown by the arrows.

Figure 2 shows the typical results of the temporal evolution of the axial ion Mach numbers measured in the (b) EAST and (c) WEST sides, together with (a) the diamagnetic signal, where the ICRH power (RF3: 10.3 MHz) is turned on from 150-200 msec. The simultaneous measurements at the EAST and WEST sides imply the change of the flow velocity of the peripheral plasma by the ICRH as seen in Figs. 2(b) and 2(c). Furthermore, the strong correlation with the diamagnetic signal is also identified; the detailed relation between the velocity fields and the plasma heating characteristics will be investigated with surveying the ICRH conditions.