26aD03P

回転するプラズマの軸方向逆転流の形成
Experimental study on axial flow reversal in a rotating plasma

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Effect of plasma rotation on the flow structure formation (helicity effect [1]) plays an important role to understand astrophysical phenomena such as plasma dynamo and transport phenomena in the fusion devices, and to develop plasma propulsion systems. Recently, we have experimentally studied the effect of plasma rotation in the HYPER-II device at Kyushu Univ[2]. The HYPER-II device consists of the plasma produce chamber (0.3 m in diameter and 0.95 m in axial length) and the diffusion chamber (0.76 m in diameter and 1.3 m in axial length). An argon plasma was produced by electron cyclotron resonance (ECR) heating with a 2.45 GHz microwave. A set of cylindrical electrode is installed to control the radial electric field in plasma. An $\mathbf{E} \times \mathbf{B}$ azimuthal plasma rotation is generated due to the radial electric field and the external axial magnetic field (see Fig. 1), where $\mathbf{E}$ and $\mathbf{B}$ denote the electric field and the magnetic field, respectively.

The axial ion flow velocity, U_z and azimuthal ion flow velocity, U_θ, in the diffusion chamber was measured with a directional Langmuir probe. It is found that the axial flow reversal near the center axis is generated, when the plasma strongly rotates in the azimuthal direction. Figure 2 shows the difference of axial flow between two different radii ($r = 0$ mm and $r = 100$ mm), which corresponds with the magnitude of axial flow velocity, as a function of vorticity. When the azimuthal plasma rotation becomes strong, the axial flow near the center axis relatively decreases. In addition, the density build up near the plasma center is also found in the rotating plasma case. This results indicates that the helicity effect is important to understand the flow structure formation. The details will be shown in the poster session.

[1] N. Yokoi *et al.*, Phys. Fluids **16**, 1186 (2004).
[2] K. Terasaka *et al.*, J. Plasma Phys. **81**, 345810101 (2015).

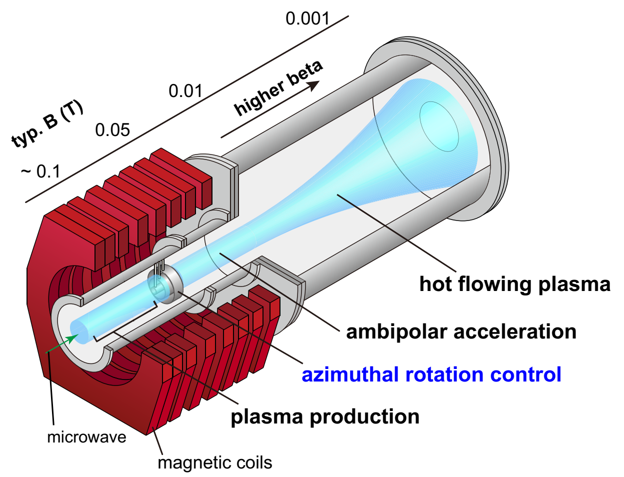

Fig. 1: A schematic diagram of the HYPER-II experiment. The cylindrical electrodes is installed at $z = 0.57$ m.

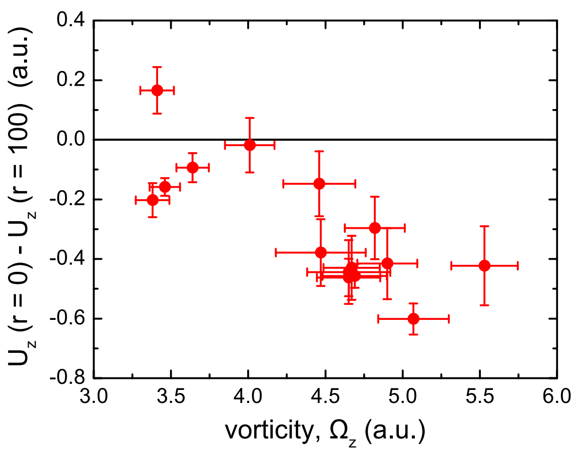

Fig. 2: Axial flow velocity difference $U_z(r = 0) - U_z(r = 100)$ as a function of vorticity.