

Toroidal spin-up and velocity shear of a field-reversed configuration plasma

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A radial profile of toroidal flow in a field-reversed configuration (FRC) plasma generated by field-reversed theta-pinch (FRTP) method has been measured by a ion Doppler spectroscopy (IDS) system with a line-spectrum of impurity carbon (CV: 227.2nm) in previous experiments. This result indicates that the FRC rotates in paramagnetic direction just after formation phase. Then plasma accelerates in diamagnetic direction then reverses the rotation in diamagnetic direction at around 15 μ s from the formation. The toroidal flow velocity becomes comparable with an ion diamagnetic velocity at 25 μ s. However, the flow velocity out side the separatrix keeps small value or settled. It indicates the existence of flow shear in vicinity of the separatrix. Axial profile of toroidal velocity has also been observed. It shows different time evolutions of toroidal spin-up at around mid-plane and end region of the FRC as shown in Fig.1.

The observed results have also been compared with a numerical calculation by recently proposed toroidal spin-up mechanism which employs direct conversion of the kinetic angular momentum from the magnetic flux [2]. The calculated rotation velocity is consistent with the presented experimental results. However, the mechanism of formation velocity shear at the separatrix has never been verified yet. To study the mechanism, the rotation velocity in the weakly ionized plasma at the edge to chamber wall, which does not have bright line spectrum emission, has been measured by Mach probe method.

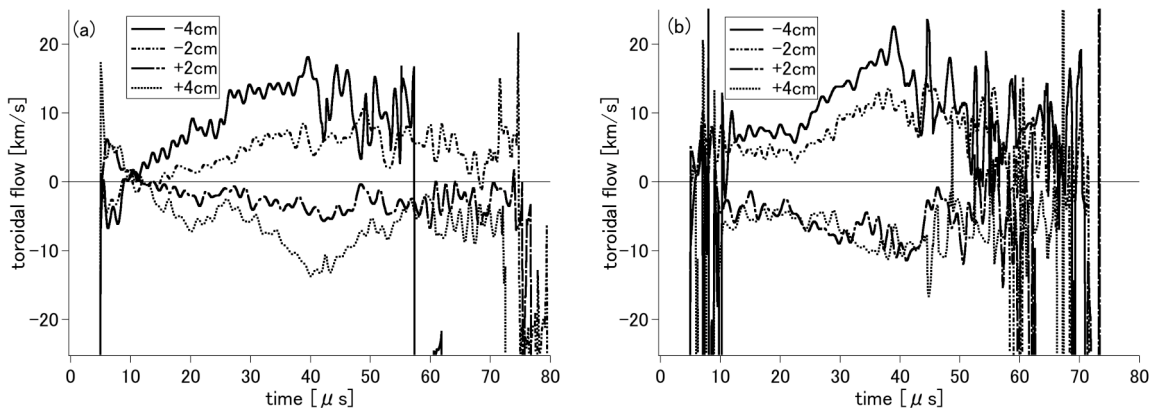


FIG. 1. Time evolution of toroidal flow at (a) $z = 16.5$ cm and (b) $z = 33.0$ cm.

[1] T. Asai *et al.*, in 17th international Toki Conference (ITC/ISHW2007) (2007) P1-015.

[2] T. Takahashi, *et al.*, Plasma Fusion Res. **2** (2007) 008