23Ap12

プラズマフィラメント輸送ダイナミクスにおける終端板の傾斜の効果
Effect of Tilted Plates on Plasma Filament Transport Dynamics

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The intermittent filamentary plasma structures called "blob" which have been detected in various magnetic confinement devices are thought to play a significant role in the radial non-diffusive transport in boundary layer plasmas. Thus, many theoretical and numerical works regarding the plasma filament dynamics have been conducted on the basis of two-dimensional reduced fluid models [1, 2]. On the other hand, we have investigated the microscopic, that is, kinetic dynamics on such plasma filament phenomena with the three-dimensional (3D) electrostatic particle-in-cell (PIC) simulation codes called "p3bd" and "up3bd" codes [3-6] which have been developed for the studies of boundary layer plasmas. Using the p3bd and up3bd codes, we have revealed the self-consistent current system in a filament [7], the temperature structure in a filament [7], and the ion temperature effect on the blob dynamics [8, 9]. Furthermore, the dynamics between a filament and impurity ions has been investigated [10, 11]. Also, the influence of ion mass on the filament dynamics has been studied with the 3D-PIC simulation [12, 13].

In our previous studies mentioned above, the external magnetic field is assumed to be perpendicular to the end plates. Thus, the plasma filament in the simulations is also elongated in the direction vertical to the end plates. However, in actual boundary layers of magnetic confinement devices, the magnetic field lines will run obliquely into the divertor plates. Therefore, in this study, we have improved the up3bd code in order to set the ambient magnetic field and a filament tilted to the radial (x) or the toroidal (y) directions. Since the Cartesian coordinate is applied in the up3bd code, it is difficult to modify the configuration of the end plates placed at z = 0 and L_z. Thus, in the simulation code, the magnetic field is provided obliquely as $\boldsymbol{B}$ = (cos ψ, 0, sin ψ) $B(x, z)$ or (0, cos θ, sin θ) $B(x)$. In order to form a filament along such an oblique magnetic field, the modified filament width in the x or y directions is given, and the positions of particles included in the filament, which have been set with the ordinary way [5], are shifted in the x or y directions as shown in Fig. 1. In the presentation, we will discuss the effect of the tilted plate on the plasma filament dynamics with the simulation results provided by the improved up3bd code.

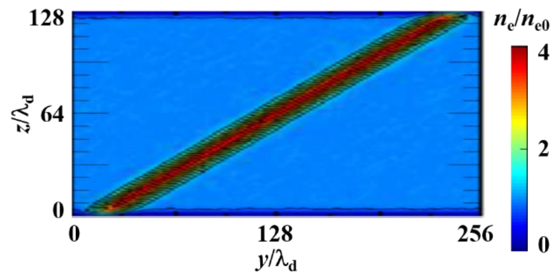

Fig. 1. Initial distribution of the electron density for the case in which the magnetic field is tilted to the toroidal (y) direction.

[1] S. I. Krasheninnikov, D. A. D'Ippolito, and J. R. Myra, J. Plasma Phys. **74**, 679 (2008) and references therein.
[2] D. A. D'Ippolito, J. R. Myra, and S. J. Zweben, Phys. Plasmas **18**, 060501 (2011) and references therein.
[3] S. Ishiguro and H. Hasegawa, J. Plasma Phys. **72**, 1233 (2006), doi: 10.1017/S0022377806006003.
[4] H. Hasegawa and S. Ishiguro, Plasma Fusion Res. **7**, 2401060 (2012), doi: 10.1585/pfr.7.2401060.
[5] H. Hasegawa and S. Ishiguro, Plasma Fusion Res. **12**, 1401044 (2017), doi: 10.1585/pfr.12.1401044.
[6] H. Hasegawa and S. Ishiguro, Proceedings of the 40th JSST Annual International Conference on Simulation Technology, 152 (OS11(1)-3) (2021).
[7] H. Hasegawa and S. Ishiguro, Phys. Plasmas **22**, 102113 (2015), doi: 10.1063/1.4933359.
[8] H. Hasegawa and S. Ishiguro, Plasma **1**, 61 (2018), doi: 10.3390/plasma1010006.
[9] H. Hasegawa and S. Ishiguro, Phys. Plasmas **26**, 062104 (2019), doi: 10.1063/1.5093561.
[10] H. Hasegawa and S. Ishiguro, Nucl. Fusion **57**, 116008 (2017), doi: 10.1088/1741-4326/aa7700.
[11] H. Hasegawa and S. Ishiguro, Nucl. Mater. Energy **19**, 473 (2019), doi: 10.1016/j.nme.2019.04.005.
[12] H. Hasegawa and S. Ishiguro, Preprints of 27th IAEA Fusion Energy Conference, TH/P7-12 (2018).
[13] H. Hasegawa and S. Ishiguro, 28th International Toki Conference, P1-73 (2019).