§17. Potential Structure Accompanied by High-Speed Plasma Flow in a Converging Magnetic Field

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Using a two-and-half dimensional electrostatic particle simulation code, plasma structure accompanied by high-speed plasma flow in a converging magnetic field is investigated.

Formation of large potential difference due to injection of high-speed plasma flow along the converging magnetic field lines has been investigated by theory, one dimensional particle simulation and Q-machine experiment. However, quantitative disagreements between the previous theoretical works and Q-machine experiments and endplate effects on the potential structure have been pointed out.[1] Our previous two-and-half dimensional simulation[2] has yielded a good agreement with the result observed in the Q-machine experiments for the cases with floating endplate. Present simulation shows the endplate effects on the structure of high-speed plasma flow in a converging magnetic field.

A simulation configuration with magnetic field lines in a typical case is schematically shown in Fig. 1. A plasma is emitted from the plasma emitter placed at $x = L_x$ and $y = -0.3L_y \sim 0.3L_y$. A collector (endplate) is placed at $x = 0$ and $y = -L_y/2 \sim L_y/2$. The collector potential is changed in the range between $e\phi_t/T_s = 2$ and $30(T_s$: electron temperature).

Figure 2 shows a typical temporal evolution of potential structure along the magnetic field line at $y = 0$ for the case with $e\phi_t/T_s = 2$, plasma flow speed $v_0/c_s = 4.5$, and mirror ratio $R_m = 3$. A large potential difference $e\phi/T_s \sim 6$ is formed in the converging magnetic field region. The potential difference is twice larger than the collector potential. This potential difference increases with an increase in the collector potential. These results are consistent with the results of the Q-machine experiments.

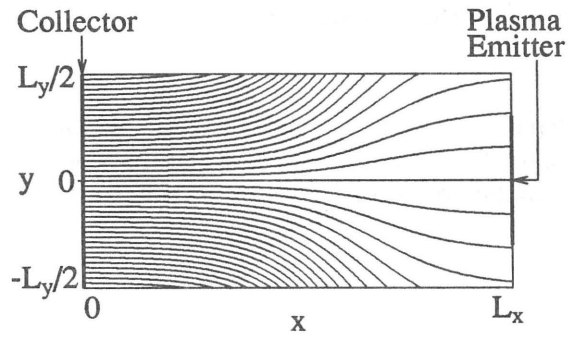

Fig. 1. Simulation configuration.

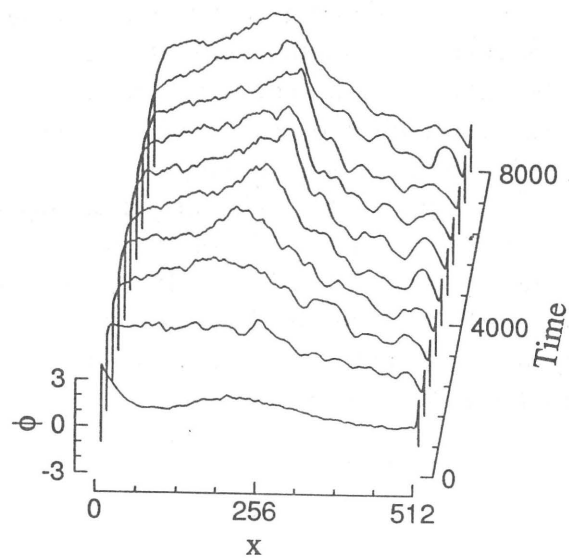

Fig. 2. Temporal evolution of potential profile along the magnetic field line.

References

1) Sato,N. *et al.*: Phys. Rev. Lett. 61(1988) 1615.
2) Ishiguro,S., Kishi,Y.,Sato,N.: to be published in Phys. Plasmas(1995).