# 30pP03

## ガイド磁場磁気リコネクションにおけるイオン加熱の粒子シミュレーション
## Particle Simulations on Ion Heating in Magnetic Reconnection with Guide Field

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The spherical tokamak (ST) attracts the attention as a candidate of future fusion reactors, since STs can confine a higher-beta plasma compared to standard tokamaks. In plasma merging experiments of STs, two torus plasmas are merged to form a single torus plasma under magnetic compression. At the contacting point of initial two ST plasmas, magnetic reconnection occurs and a single ST plasma with high temperature is formed [1].

In plasma merging experiments, it is observed that electrons are heated in the vicinity of the reconnection point, whereas ions are heated in the downstream. The mechanism of such particle heating is considered to be crucial to a complete understanding of high-beta plasma formation. The clarification of the heating mechanism can lead to higher-performance of STs for realizing economical ST reactors in the future. So far shock heating [1] was suggested for the ion heating mechanism. In this paper, we report the new mechanism.

We investigate the ion heating mechanism in the downstream by means of particle simulations. Figure 1 shows the schematic diagram of our simulation model. The two torus plasmas in a ST device are drawn in the left part of Fig. 1 and the right part displays the area simulated by our PIC code named PASMO. This PIC area covers from the central reconnection point to the ion dissipation region and mimics the region near the contacting point of merging plasmas. The initial condition is one-dimensional equilibrium with a uniform guide magnetic field in the z direction.

In Fig. 2, we show ion velocity distribution integrated over a local region in the downstream. This figure demonstrates that the distribution spreads mainly in the $v_x$ direction, that is, ions are effectively thermalized. It suggests that the pickup mechanism [2, 3] plays a major role in the ion heating, since characteristic features of the velocity distribution in Fig. 2 fit well in that of picked-up particles. According to the theory of the pickup mechanism, nonadiabatic particles which enter the downstream across the separatrix become magnetized due to a strong guide field in the downstream and gain a convective velocity equal to the outflow velocity $v_0$, forming a ring velocity distribution with $v_0$, [3].

In the near future, we plan to compare simulation results obtained by PASMO with experimental results such as TS-3 and TS-4 at University of Tokyo and MRX at Princeton Plasma Physics Laboratory.

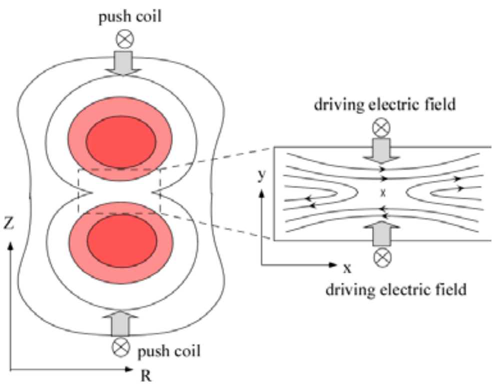


Fig. 1: Schematic diagram of our particle simulation model.

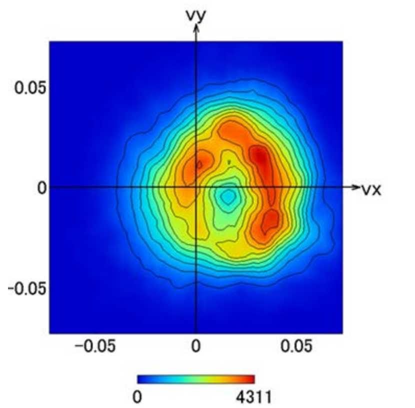


Fig. 2: Ion velocity distribution. We can see a ring-like structure.

[1] Y. Ono et al., Plasma Phys. Control. Fusion **54** 124039 (2012).
[2] E. Mobius et al., Nature **318** 426 (1985).
[3] J. F. Drake et al., Astrophys. J. Lett. **700** L16 (2009).