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# Energy Partition and Temperature Anisotropy in Merging Processes of two Spherical-Tokamak-type Plasmoids

Ritoku Horiuchi[1], Shunsuke Usami[1], Toseo Moritaka[1], and Yasushi Ono[2]
[1] National Institute for Fusion Science, [2] Graduated School of Frontier Sciences, University of Tokyo
e-mail: horiuchi.ritoku@toki-fs.jp

Magnetic reconnection is one of fundamental physical processes observed in various physical systems from astronomical objects to fusion devices, which results in the rapid energy conversion form magnetic energy to thermal and kinetic energy of plasmas and the change in magnetic field topology. In plasma merging experiments of two torus, a single torus plasma with higher temperature is formed through magnetic reconnection. In this paper, the energy conversion process during the merging of two Spherical-Tokamak-type plasmoids (STs) is studied by means of a two-dimensional particle-in-cell simulation in detail[1,2].

A series of simulation runs are carried out for different mass ratios from 100 to 800. The initial plasma, in which two STs exist, is in an unstable high-energy state. Thus, they start to move and approach each other under the action of an attracting JXB force. That is, an excess magnetic energy is first transferred to the ion kinetic energy because of its large inertia. Magnetic reconnection takes place in an interface region, where the poloidal magnetic field lines are antiparallel to each other but the toroidal magnetic field has the same sign. As shown in Fig. 1, most of dissipated magnetic energy black solid line) is converted to the ion thermal energy (red dashed line) and the electron thermal energy (black dashed line) finally. The energy conversion rate of ion to electron is approximately equal to 2:1.

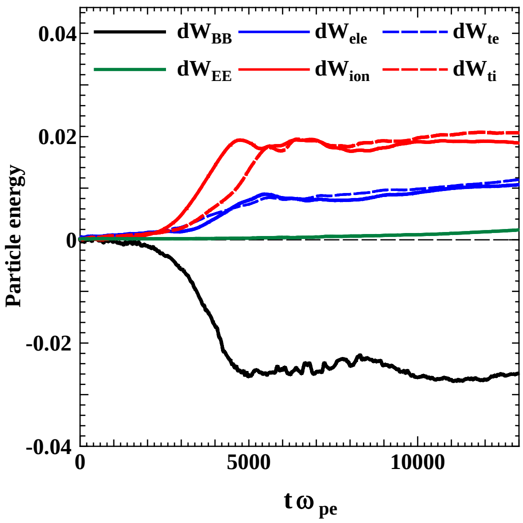


Figure 1. Time evolution of changes in magnetic field energy ($dW_{BB}$), electric field energy ($dW_{EE}$), total ion energy ($dW_{ion}$), total electron energy ($dW_{ele}$), ion thermal energy ($dW_{ti}$), and electron thermal energy ($dW_{te}$) for the case of mass ratio Mi/Me =400.

As shown in Fig. 2, this transfer process leads to the increases in a parallel component of electron temperature (black solid line) and a perpendicular component of ion temperature (green solid line) while keeping the other components almost constant. This is because the two-component electron distribution function with different velocity shifts along a toroidal magnetic field is formed around a reconnection point when two STs merge. On the other hand, an ion distribution function, consisting of three components with different velocity shifts perpendicular to the toroidal magnetic field, is formed around the reconnection point in the merging phase.

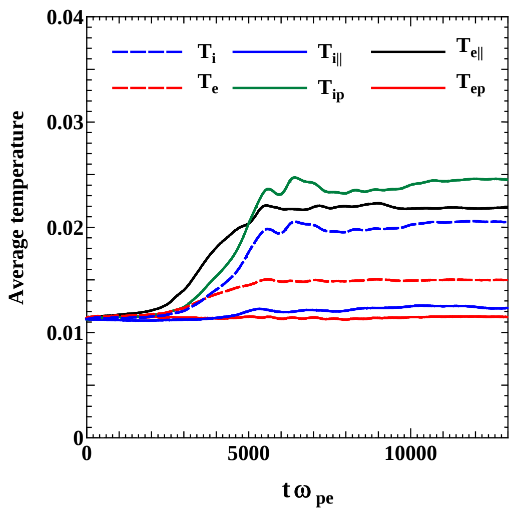


Figure 2. Time evolution of particle temperatures.

It is also found that a sharp peak appears impulsively in the electron parallel temperature profile in the merging phase, which is consistent with the Mega Ampere Spherical Tokamak (MAST) merging experiments[3]. The detail will be discussed in the presentation.

References

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