

Profile relaxation by merging of two spherical-tokamak-type plasmoids

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A merging process of two spherical-tokamak-type (ST) plasmoids, which are confined inside a rectangular conducting vessel, has been examined by means of two-dimensional PIC simulation [1]. Magnetic reconnection takes place at a contact point of two STs and a part of poloidal magnetic energy is transferred to the ion and electron thermal energies mainly in the central confinement region. Two STs are relaxed into one large ST while changing an equilibrium profile. A series of simulation runs with different guide fields clarify that there appears a strong dependence of the energy partition ratio of ions to electrons on the guide field, as shown in Figure 1. This result comes from the fact that the electron heating is enhanced mainly along the parallel (toroidal) direction as the guide field increases. This result is consistent with the TS3 experiment for a strong guide-field [2].

The merging process leads to the increase in the total thermal pressure and the decrease in the total magnetic pressure in the central confinement region. Thus, the plasma in the central region expands towards the edge region by changing the total confinement profile. Finally, a trapezoid-shaped pressure profile with a flat top and a hollow magnetic pressure profile are formed in the central confinement region, as shown in Figure 2. This result is also consistent with the TS3 merging experiment [3]. It is also important to note in Figure 2 that the reversed magnetic shear region appears in the central confinement region in the spatial profile of the safety factor (red dashed curve).

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References

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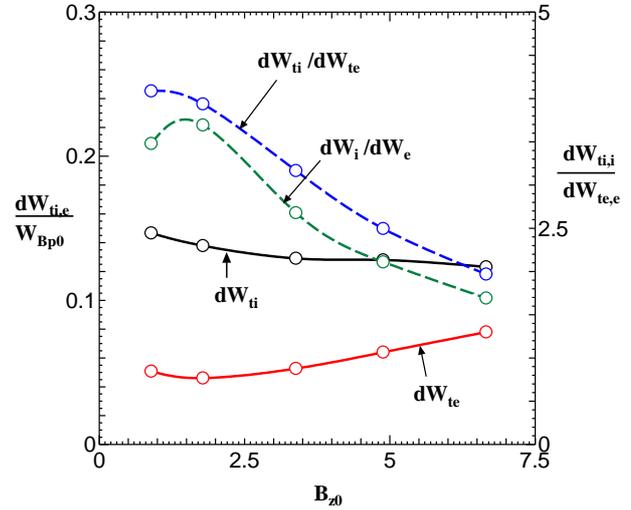


Figure 1. Guide-field dependence of the change in thermal energy. The thermal energy is normalized by the initial poloidal magnetic energy for each case.

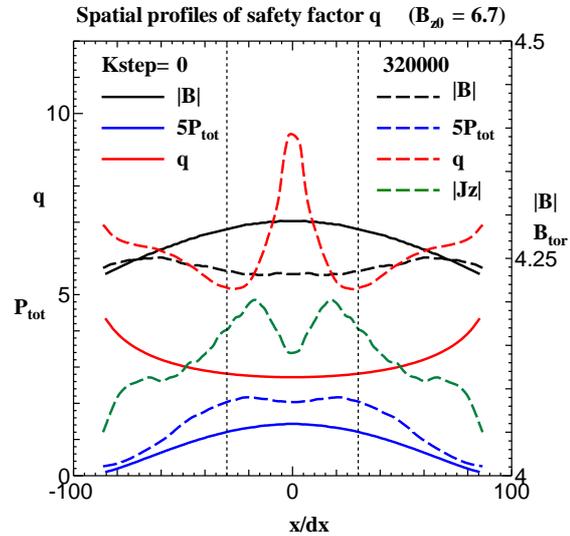


Figure 2. Spatial profiles of safety factor (red), magnetic field strength (black), and total thermal pressure (blue) for initial and final stages 22K03581.