

Ion FLR effect in ion heating during the 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, is 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. The energy partition rate of ions to electrons is about 2.5 for typical cases. Initial two STs are finally relaxed into one large ST in which both the increase in the total thermal pressure and the decrease in the total magnetic pressure happen in the central confinement region, leading to the local enhancement of ion Larmor radius, as shown in Figure 1.

A series of simulation runs with different guide-field values are performed in order to clarify the role of ion finite-Larmor-radius (FLR) effects in ion heating during ST merging. Figure 2 shows that the dependence of the total amount of ion heating (H_i) on a typical ion Larmor radius ($\rho_{i,f}$) at a final relaxed stage, where the radius $\rho_{i,f}$ is defined by the local ion Larmor radius equal to the distance from the central o-point, and the total ion heating (H_i) is normalized by the total thermal energy of the initial ions. The ion heating increases in proportion to the ion Larmor radius $\rho_{i,f}$, suggesting that the ion heating is mainly controlled by the ion FLR effect. It is interesting to notice in Figure 2 that ion heating is more pronounced in the two cases with smaller guide-field values ($B_{z0}=1.23, 2.42$) and there appears a gap in the ion heating between the cases with larger and smaller guide-field values. This is because the local enhancement of ion Larmor radius is much clearer in the weaker guide-field cases, as shown in Figure 1. This result is also consistent with the TS3 merging experiment [2,3].

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References

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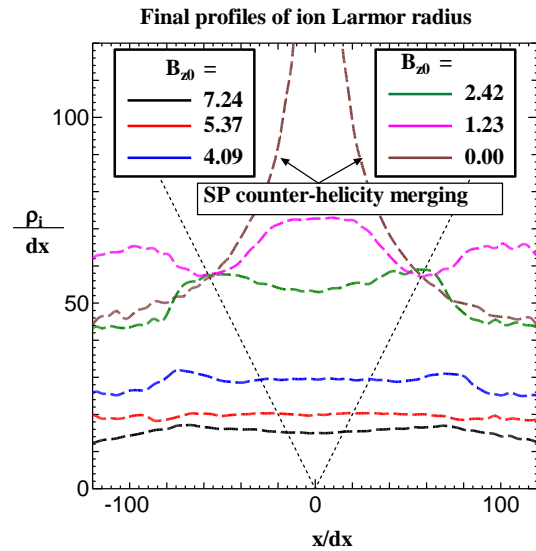


Figure 1 Spatial profiles of ion Larmor radius at a final relaxed stage.

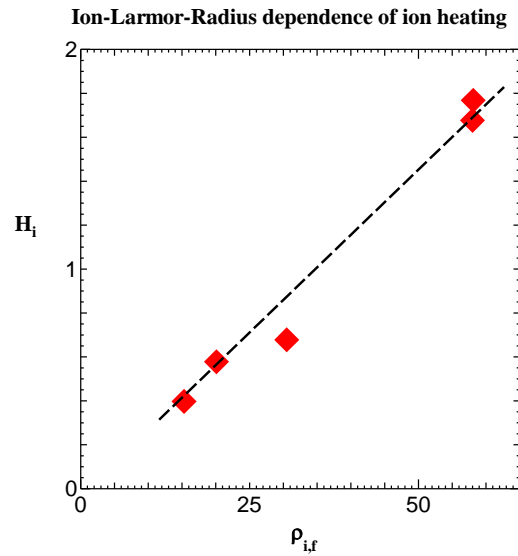


Figure 2 Dependence of the total amount of ion heating H_i on the typical ion Larmor radius $\rho_{i,f}$ at a final relaxed stage.