§5. Motion of the Plasmoid in LHD Plasmas

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It is well known that a plasmoid induced by ablation drifts to the lower field side in tokamak plasmas, which leads to a good performance on fueling in tokamak. Such a good performance, however, has not been obtained yet in the planar axis heliotron; Large Helical Device (LHD) experiments, even if a pellet has been injected from the high field side. The purpose of the study is to clarify the difference on the plasmoid motion between tokamak and LHD plasmas by using the MHD simulation including ablation processes.

The three dimensional MHD code including the ablation processes has been developed by extending the pellet ablation code (CAP) [1]. The rotational helical coordinate system is used in the helical calculations as shown in Ref. [2]. The boundary is assumed to be a perfect conductor. The Cubic Interpolated Psudoparticle (CIP) method is used in the code as a numerical scheme [3].

It has been found in tokamaks that the drift motion to the lower field side is induced by a tire tube force and $1/R$ force in the major radius direction [4]. The first trial simulations on the motion of the plasmoid in LHD plasmas has been performed. Figures 1(a) and (b) show contours of plasma and magnetic pressures in different poloidal cross sections in LHD. Initial locations of the plasmoids are shown by circles indicated by A, B, C and D. The plasmoid indicated by A and C are located at the inner side of the torus, and those denoted by B and D are located at the outer side of it. Initial peak values of density and temperature of the plasmoid are 1000 times density and 1/1000 times temperature of the bulk plasma at the magnetic axis, respectively. The plasmoid, whose half width is $0.03R$, encounters the electrons with

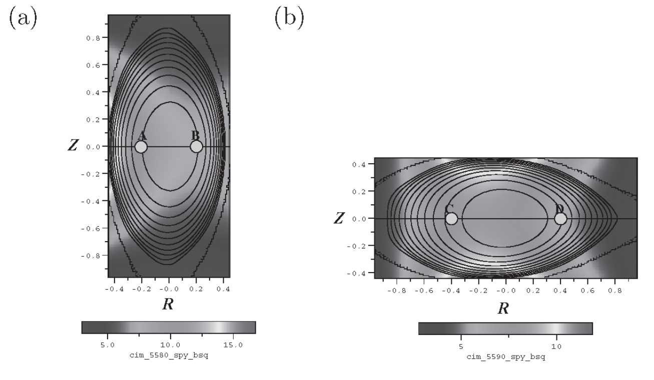

FIG. 1: *Initial locations of the plasmoids at the inside (A, C) and the outside (B, D) of the torus in two different poloidal surfaces, (a) and (b) in LHD, where contours of plasma and magnetic pressures are shown by lines and color, respectively.*

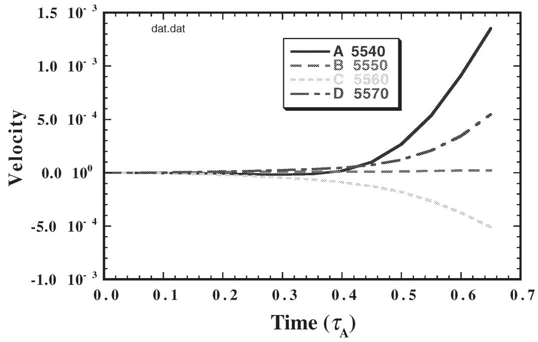

FIG. 2: *Velocities at the peak densities of the plasmoids A, B, C and D in Fig. 1.*

fixed temperature 2 keV and density 10^{20} m^{-3}. Figure 2 shows velocities at the peak densities of the plasmoids. The plasmoids for A and D drift in the positive direction of the major radius. The plasmoid for C drifts in the negative direction of it and that for B hardly drifts. It is found that the plasmoids for A, C and D drift to the lower field side when it refers to the contour of the magnetic pressure shown in Fig. 1. The plasmoid for B dose not drift in the direction of the major radius where the magnetic pressure is almost at a saddle point. Therefore, physics mechanism that the plasmoid drifts to the lower field side is common between tokamak and toroidal LHD. However, in helical plasmas, since (1) the distribution of magnetic field strength and the direction of the magnetic curvature change by both toroidicity as well as in tokamaks and helicity due to helical coils along the magnetic field lines and (2) the rotational transform becomes large in the plasma periphery, the plasmoid drifts inward or outward of the flux surfaces depending on the location. Thus, in LHD, when the plasmoid density is integrated along the magnetic field lines, the difference of the velocity in the direction of the major radius as shown in Fig. 2 may be reduced. This expectation seems to be consistent with the fact that there is no difference between the density profiles obtained by the pellet injections from various locations in LHD experiments. In order to confirm such an interpretation and to seek the ways obtaining good performance, long time simulations in the helical plasmas will be performed.

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