§2. MHD Simulation of Pellet Plasmoid in LHD

Ishizaki, R.

It is well known that an ablation cloud; a high density and low temperature plasmoid, drifts to the lower field side in tokamak plasmas, which leads to a good performance on fueling in tokamak [1]. Such a good performance, however, has not been obtained yet in Large Helical Device (LHD) experiments [2]. In order to clarify the difference on the plasmoid motions between tokamak and LHD, MHD simulations have been carried out [3].

An initial plasmoid is located inside the torus on the horizontal elongated cross section as shown in Fig. 1(a). The helical plasma has a saddle point of the magnetic pressure on the poloidal cross section. Then, the plasmoid is located at the lower field side than the saddle point and the curvature vector is positive in the major radius direction. The simulation result is shown in Fig. 1(b). The plasmoid drifts slightly back and forth in the direction of the major radius. Figure 2 shows the physical picture explaining the force acting on the plasmoid. The magnetic field perturbation around the plasmoid is transformed into a dipole field because of the diamagnetic effect. Since the curvature vector of the equilibrium magnetic field is positive in the major radius direction, the field lines become dense and sparse in the upper and lower regions of the field lines, respectively, through the center of the plasmoid as shown in Fig. 2. Thus, the magnitude of the upper field line is larger than that of the lower one. The force acting on the plasmoid becomes negative in the major radius direction. The temporal evolution of the magnetic field perturbation is shown in Fig. 3. The dipole fields appear as shown in Fig. 3(a) at first, and subsequently the deformation of the fields is induced and the plasmoid drifts across the flux surface. However, the poloidal field prevents the plasmoid from drifting. Thus, the poloidal component of the magnetic field perturbation is induced inside the plasmoid in Fig. 3(b). The poloidal component becomes small in Fig. 3(c) and subsequently it is induced outside the plasmoid in Fig. 3(d). They are corresponding to the motion that the plasmoid drifts slightly back and forth in the direction of the major radius. It is found that the plasmoid motion in LHD are not corresponding to one in the tokamak in which the plasmoid drifts in the opposite direction to the curvature vector.

1) L. R. Baylor et al., Phys. Plasmas, **7**, 1878 (2000).

2) R. Sakamoto et al., *in proceedings of 29th EPS conference on Plasma Phys. and Contr. Fusion*, **26B**, P-1.074 (2002).

3) R. Ishizaki and N. Nakajima, Plasma Phys. Control. Fusion, **53**, 054009 (2011).

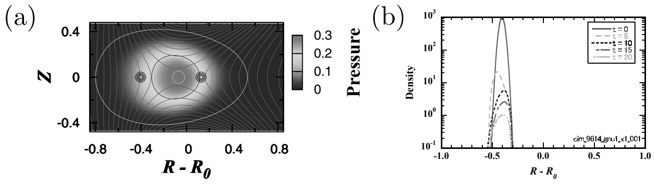

Fig. 1: (a) Poloidal cross section. Contours and colors show the magnetic and plasma pressures. Circle is an initial plasmoid. (b) Density profiles at $t = 0$ (solid), 5 (dashed), 10 (dotted), 15 (dash-dotted) and 20 (dash-dot-dotted).

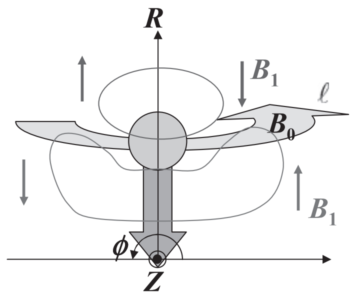

Fig. 2: Magnetic field perturbation around the plasmoid.

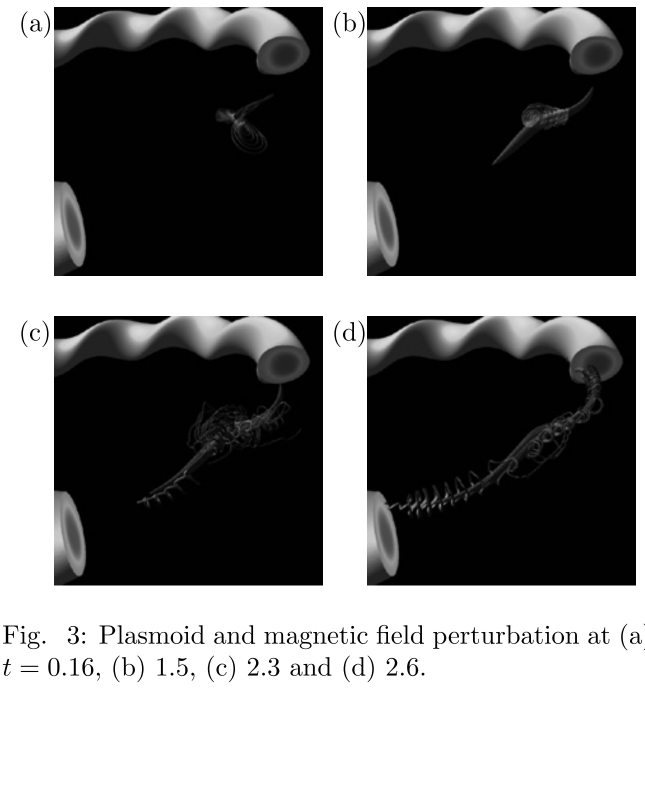

Fig. 3: Plasmoid and magnetic field perturbation at (a) $t = 0.16$, (b) 1.5, (c) 2.3 and (d) 2.6.