§3. Plasmoid Motion in the Magnetic Island of the LHD

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Experiments done in LHD to better understand the affects of magnetic islands on particle transport have highlighted distinct differences in the particle dynamics near magnetic island o- and x-points compared to those without an island [1]. In order to explain the experimental results, MHD simulations on the pellet plasmoids have been carried out by using the CAP [2].

In these experiments, the RMP coil was used to produce large $m/n = 1/1$ islands near the edge of a helium plasma with $R_{ax} = 3.6$ m and $B_T = 2.75$ T. Small hydrogen pellets were injected into discharges without islands or into discharges with an island o-point positioned at the pellet injection point. Figure 1 shows the differences in density response to a series of pellets injected into the island o-point in shot 122033 and into shot 122023 without an island at two radial positions $R = 4.358$ m and $R = 4.117$ m. The o-point injection shows a significantly larger difference between these two locations when the pellet first enters the island and the peak decreases much more rapidly than in the case without an island. In both cases there is an inward pinch of the pellet mass but this pinch is significantly stronger in the case without an island. Figure 2 shows the initial positions of the pellets with the radius of 0.2 mm in the MHD simulations. (a) and (b) show the horizontally elongated poloidal cross sections without and with $m/n = 1/1$ magnetic island. 1, 2, 3 and 4 are corresponding to the radial positions 1, 2, 3 and 4 shown in Fig. 1. The pellet 4 is located in the magnetic island. Figure 3 shows the temporal density evolutions of the pellets at 1, 2, 3 and 4 positions. The density increase induced by pellet 1 is largest and the ones by pellets 2 and 4 are smallest. These results qualitatively agree with the experimental data in which the pellet plasmoid drifts to the magnetic axis in the case without the island. On the other hand, the simulation results do not explain the experimental data in which the density change is large within the island. The physical mechanism will be clarified in the future work.

1) T. E. Evans, EX/1-3, 25th IAEA Fusion Conf. (2014).

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

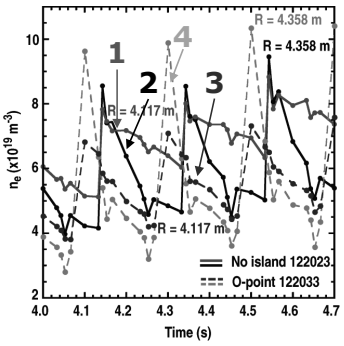

Fig. 1: Time evolution of the Thomson scattering ne following the injection of multiple pellets into the o-point (122033) and the x-point (122026) of an $m/n = 1/1$ island located near $R = 4.358$ m.

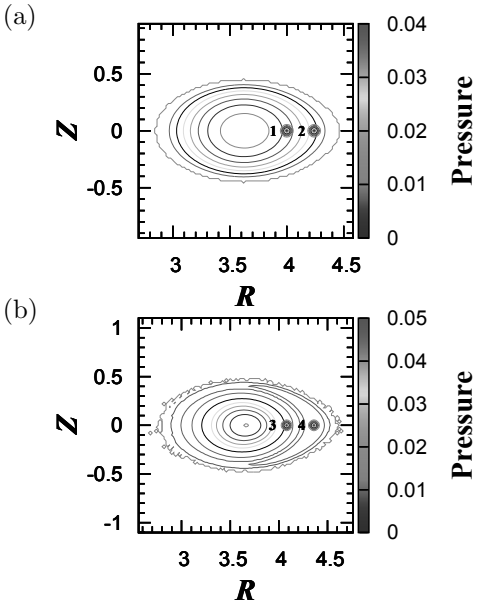

Fig. 2: (a) and (b) show the horizontally elongated poloidal cross section without and with the magnetic island. 1, 2, 3 and 4 show the initial positons of the plasmoids.

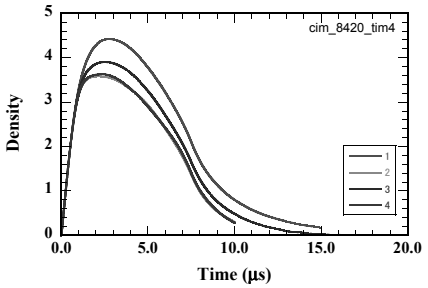

Fig. 3: The temporal evolutions of the plasmoid densities.