Plasmoid motion in helical plasmas

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Injecting small pellets of frozen hydrogen into torus plasmas is a proven method of fueling[1]. Since a plasmoid induced by pellet ablation drifts to the lower field side, the pellet fueling to make the plasmoid approach the core plasma has succeeded by injecting the pellet from the high field side in tokamak. On the other hand, such a good performance 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[2]. The purpose of the study is to clarify the difference on the motion of the plasmoid between tokamak and helical plasmas.

When a plasmoid is heated by bulk plasma, it is expanding along the magnetic field by sound speed and simultaneously drifts across the flux surface due to a tire tube force and a magnetic force induced by the magnetic field with curvature. The motion of the plasmoid is investigated in the LHD plasma by using the pellet ablation code (CAP)[3]. An equilibrium obtained by the HINT code[4] is used as the bulk plasma. Figures show the temporal evolution of the normalized averaged density, ρ/ρ_0, on the flux surfaces as a function of the normalized minor radius, ρ_s, where plasmoids A and B are initially located at the inner and outer sides of the torus on the horizontal elongated poloidal cross sections. The plasmoid B drifts to the lower field sides similarly to tokamak[3]. However, it is found that the plasmoid A has almost no drift motion. The plasma beta of the plasmoid becomes ~ 1 because the magnetic well is induced by the extremely large pressure of the plasmoid. Therefore, it is considered that the drift direction of the plasmoid depends on the change of the magnetic pressure and curvature induced by such a high beta. This fact might be one of the reasons why a good performance has not been obtained in the pellet injection from the high field side in LHD experiments. Such a difference between tokamak and LHD will be clarified.

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