Impact of the radial electric field profile to the magnetic topology and comparisons with models of the edge transport

in the Large Helical Device

Y. Suzuki1,2, K. Ida1,2, K. Kamiya3, M. Yoshinuma1,2, H. Tsuchiya1, M. Kobayashi1,2,

G. Kawamura1, S. Ohdachi1,2,S. Sakakibara1,2, K. Y. Watanabe1,2, S. Hudson4, Y. Feng5,

T. Morisaki1 and the LHD experiment group

*1 National Institute for Fusion Science, Toki, Japan*

*2 SOKENDAI, the Graduate University for Advanced Studies Toki, Japan*

*3 Naka Fusion Institute, Japan Atomic Energy Agency, Naka, Japan*

*4 Princeton Plasma Physics Laboratory, Princeton, USA*

*5 Max-Planck-Institut fuer Plasmaphysik, Greifswald, Germany*

In the Large Helical Device (LHD) experiments, the significant pressure gradient is observed in the edge region where 3D MHD equilibrium analyses predict the stochastization of magnetic field lines. Therefore, experimental investigation of this edge plasma behaviour is attracting much interest in identification of plasma response to stochastic magnetic fields or topological change of magnetic fields due to plasma, in other words, recovery of nested flux surfaces. Results from the LHD experiment suggest the identification of Er shear is a key in understanding how the magnetic field structure is modified by Resonant Magnetic Perturbation (RMP) in tokamak plasmas. In this study, we have studied the stochastization of magnetic field lines due to the plasma response by the radial electric field, *E*r. When magnetic field lines become stochastic or open and connected to the vessel, electrons are lost along these field lines while ions are trapped. Then, strong *E*r shear from negative to positive appears at the boundary. It has been found that this position of strong *E*r shear moves to the outward of the torus with increasing . Comparing 3D MHD equilibrium analyses, positions of maximum *E*r shear are observed in the region with strongly stochastic field lines. In the stochastic region, the effective connection length of magnetic field lines becomes shorter than the electron mean free path because both opened and closed field lines appear and overlap. Therefore, the plasma boundary is determined by the degree of stochastic magnetic field lines and collisionality. In addition, the edge transport modelling is improved. In this study, the radial electric filed in the experiment is compared to the edge transport simulation.