Contribution ID: **115** Type: **Poster**

Investigation of magnetic topology on spontaneous transition phenomena for high beta plasma of Large Helical Device

Wednesday, October 24, 2018 8:30 AM (4 hours)

A topological change of the magnetic field structure on a transition phenomenon is investigated in the Large Helical Device (LHD). In the high-beta plasma experiment of the LHD, the spontaneous transition phenomenon is sometimes observed [1]. After the transition, the plasma density is increased and then the plasma stored energy is increased. One important observation after the transition is the increasing plasma volume. This indicates following points: (i) the magnetic field structure in the plasma edge is changed by a plasma response of the beta-sequences, (ii) the effective plasma volume is expanded by the change of the magnetic field, (iii) the plasma stored energy is increased due to the expansion of the plasma volume. To understand how the magnetic field changes due to the plasma response of the beta-sequences, the 3D equilibrium is studied for the transition. For a magnetic configuration with the spontaneous transition, the magnetic field is topologically changed by the plasma response of the beta sequences. The vacuum magnetic island on edge rational surfaces shrinks and the stochastic magnetic field of the long connection length expands. Therefore, the effective plasma confinement region expands due to the topological change of the magnetic field. To the improvement of the plasma stored energy on the spontaneous transition, the topological change of the magnetic field is a key factor.

Country or International Organization

Japan

Paper Number

EX/P3-14

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Session Classification: P3 Posters