Topology bifurcation of magnetic flux surface in plasmas

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Transition from regular motion to chaotic one is often represented as a topological bifurcation of torus in phase space[1]. Islands are formed in nested tori by resonant perturbations, and global stochasticity can be induced. When global stochasticity sets in, anomalous transport (such as super-diffusion) can occur[2]. This topological bifurcation has been considered to occur in plasmas confined by toroidal magnetic devices; e.g., in case of sudden loss of confinement at "disruption" [3, 4] or at plasma edge[5] and so on[6,7]. Nevertheless, the bifurcation between resonant island and global stochastization has not been measured quantitatively in experiments. In this presentation we report the topology bifurcation between stochastic magnetic fields and nested magnetic island. Clear evidence of stochastization of the magnetic surfaces near a rational surface is obtained, in the core plasma, by analyzing heat pulse propagation driven by modulated electron cyclotron heating in the Large Helical Device[8]. The stochastization of the magnetic field lines is confirmed by the very fast propagation of the heat pulse, while the slow heat pulse propagation is observed in case of nested magnetic islands.

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