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TH/P3-25: Characteristics of MHD Stability of High Beta Plasmas in LHD

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In order to understand characteristics of the MHD stability of high beta plasmas obtained in the LHD experiments, full MHD simulations including the chaotic magnetic field region have been performed for the first time. Nonlinear MHD simulation is carried out by using the MIPS code (MHD Infrastructure for Plasma Simulation) which solves the full MHD equations in the cylindrical coordinates (r, phi, z) based on an MHD equilibrium obtained by HINT2 without assuming existence of the nested flux surfaces. The simulations have been performed for three MHD equilibria where the central beta values are 7.5, 9 and 11 percent, respectively. For the magnetic Reynolds number S, we have carried out the simulation for two different S cases where S are chosen to 10ˆ5 and 10ˆ6. The used pressure profiles are similar to experimentally obtained ones. For the MHD equilibria used in this simulation, the Mercier unstable region shifts from core to periphery as beta increases. From the numerical results, as the beta increases, the dominant eigenmodes change from an internal ballooning mode to modes expanding into a chaotic magnetic field. This implies a chaotic magnetic field region should be included in the analysis of the high beta plasmas with unstable modes near plasma periphery. The linear growth rate decreases as the beta value and/or S increase, although beta dependence becomes weaker for lower S. Although the instabilities grow in the periphery region in the linear phase, the core region comes under the influence of the instabilities and the central pressure decreases in the nonlinear phase. However, the collapse of the central pressure strongly depends on S. As S increases, the degree of the collapse decreases, namely the saturated state strongly depends on S and the higher beta plasma can be maintained for higher S. Those results are consistent with a result that high beta LHD plasmas enter the second stable region of ideal ballooning modes as beta increases, and remaining destabilized ballooning modes are considered to be resistive type, of which characteristics will be clarified soon.

Country or International Organization of Primary Author

Japan

Primary author: Mr SATO, Masahiko (Japan)

Co-authors: Prof. WATANABE, Kiyomasa (National Institute for Fusion Science); Prof. NAKAJIMA, Noriyoshi (National Institute for Fusion Science); Dr SUZUKI, Yasuhiro (National Institute for Fusion Science); Prof. TODO, Yasushi (National Institute for Fusion Science)

Presenter: Mr SATO, Masahiko (Japan)

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