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トカマクの分岐平衡における非軸対称磁場構造に関する研究

Non-axisymmetric perturbations for bifurcated Magnetohydrodynamic equilibria in Tokamaks

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In tokamaks, the non-axisymmetric magnetic field affects the confinement of energetic ions and the magnetohydrodybanic (MHD) instability significantly. The non-axisymmetric field is mainly caused by the toroidal field (TF) ripples, which are produced by the finite number of TF coils. Therefore, if the TF ripples are sufficiently small, the plasma can be considered as the axisymmetric system. However, even if the plasma boundary is assumed to be axisymmetric, the three-dimensional (3D) helical core structure may appear for specific conditions with respect to the safety factor and plasma beta values. Since two different equilibrium states can be obtained for the same axisymmetric boundary conditions, these equilibria are called bifurcated equilibria [1].

To calculate and obtain the bifurcated states, 3D MHD equilibrium calculation code is necessary. The VMEC code, which is based on the energy principle in flux coordinates, is widely used for helical plasmas [2][3]. Cooper et.al. analyzed the bifurcated equilibria using VMEC code [4]. The examples of the axisymmetric and herical core structure are shown in Fig.1. However, since the nested flux surfaces are assumed to exist, the magnetic island and stochastic magnetic field do not appear in VMEC results. The effects of the magnetic island and the stochastic field on bifurcated equilibria have not fully discussed yet. Therefore, we intend to clarify these phenomena in this study using HINT code [5].

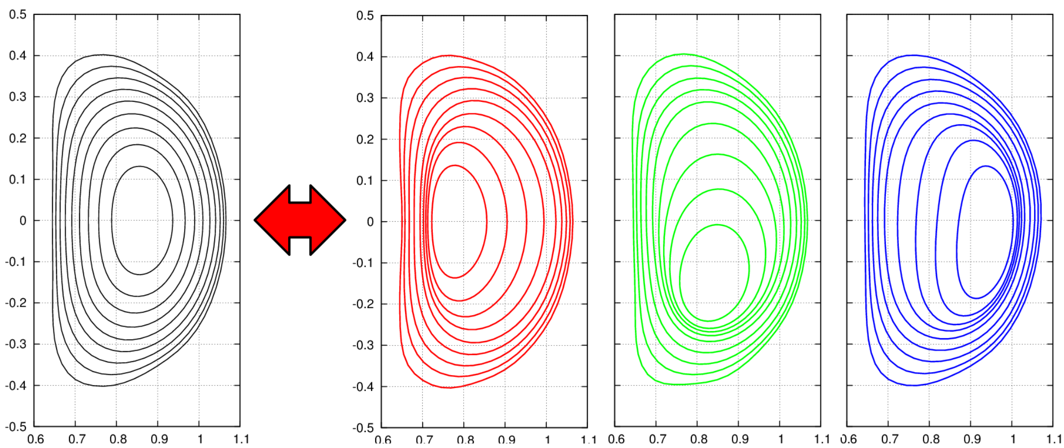

図 1: Axisymmetric and herical core structure which were obtained by the bifurcated MHD equilriburia

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