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Development of MHD equilibrium code by iterative method
反復法を用いたMHD平衡コードの開発

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For the analysis of the three-dimensional MHD equilibrium, several numerical codes like VMEC, HINT and PIES have been developed. The features of these codes are shown in table 1.

VMEC	・The magnetic coordinate system is used. ・MHD equilibrium equations are solved by energy principal. ・The nested magnetic surfaces are assumed.
HINT	・The cylindrical coordinate system is used in the latest version. ・MHD equilibrium equations are solved by the relaxation method
PIES	・The magnetic coordinate system is used to obtain the parallel current. ・MHD equilibrium equations are solved by the iterative method ・The magnetic field is obtained by Poisson’s equation.
Our code	・the cylindrical coordinate system is used. ・MHD equilibrium equations are solved directly by iterative method. ・the magnetic field is obtained by Biot-Savart law.

Table.1 Code feature

In our code, the existence nested magnetic surfaces is not assumed, so that it is expected to be able to describe the magnetic islands. Also our method is better suited for calculations of tokamak than HINT, because we use the iterative method.

In this research, we develop the two-dimension code applied to an axisymmetric tokamak as the initial step of three-dimensional code. In addition, the plasma boundary is specified by the divertor. A simple description of a tokamak configuration is given by the MHD equilibrium equations,

$$\nabla P = \vec{J} \times \vec{B}, \qquad (2.1)$$

$$\mu_0 \vec{J} = \nabla \times \vec{B}, \qquad (2.2)$$

$$\nabla \cdot \vec{B} = 0. \qquad (2.3)$$

In our method, these equations are solved directly. The main iteration process is shown in Fig.1.

We calculate the equilibrium of ITER with toroidal current I_{total} = 10[MA].

The contours of poloidal flux and safety factor of convergent plasma are shown in Fig.2 and Fig.3.

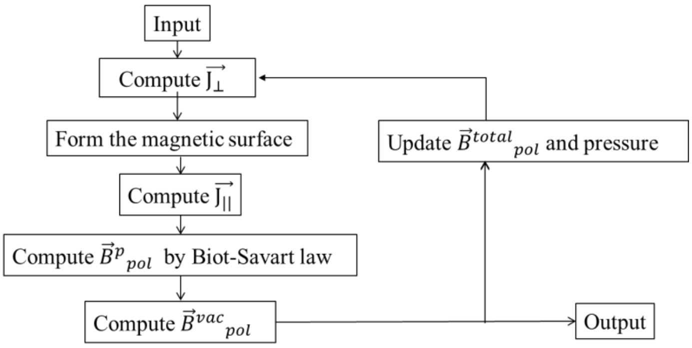

Fig.1 Code flow

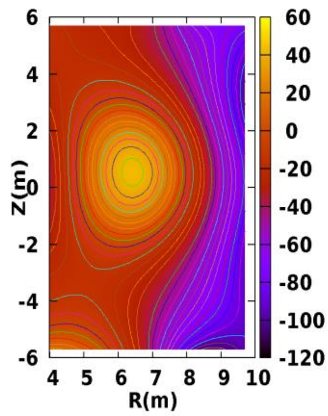

Fig.2 The equi-contours of poloidal flux

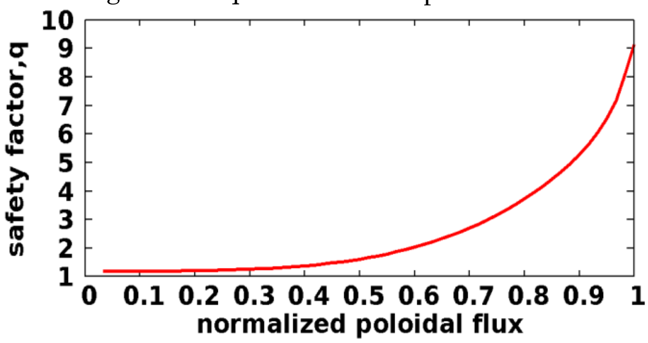

Fig.3 Safety factor, q