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NIFS-SWJTUジョイントプロジェクトにおけるCFQS装置設計研究の進展
Progress in design study of Chinese First Quasi-axisymmetric Stellarator (CFQS) under a collaborative program NSJP (NIFS-SWJTU Joint Project)

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The Chinese First Quasi-axisymmetric Stellarator (CFQS) is a future quasi-axisymmetric (QA) stellarator device, which will be constructed in Southwest Jiaotong University (SWJTU) in China. This is the international joint project of National Institute of Fusion Science in Japan and SWJTU, and its design work has been continued jointly [1-3].

A QA stellarator has mainly axisymmetric magnetic field components in the special magnetic coordinates (Boozer coordinates), which determine the guiding centre orbit, therefore, the neoclassical properties of the QA stellarator are similar to tokamak although inductive current is not required.

About ten years ago, CHS-qa, was designed as a post CHS device, which was a low aspect ratio (~3.2) QA stellarator. Based on this design, new configuration for the CFQS is obtained. The present parameters of magnetic field strength, the major radius, the aspect ratio and the toroidal periodic number are 1.0 T, 1.0 m, 4.0, and 2 respectively. The plasma boundary geometry is shown in Fig. 1, in which the color shows the magnetic field strength. Magnetic field strength is almost constant along the toroidal direction, and it changes in the poloidal direction, due to the quasi-axisymmetric property.

The 16 modular coil system is optimized by the NESCOIL code for this configuration. Top view of the coil system is shown in Fig. 2. By using this coil system, the free boundary equilibrium calculation by the VMEC is conducted, and the Shafranov shift and bootstrap current are estimated. The bootstrap current reaches 30 kA at β~1.5 %, and the good QA properties are maintained up to this β.

For the flexibility of the magnetic field configuration, 2 pairs of poloidal field coils are considered. The Shafranov shift is suppressed by the vertical field produced by those coils. Auxiliary toroidal field coils are also prepared for the rotational transform control. By this control, the radial position of rational surface (and islands) is adjusted to achieve Island Bundle Divertor (IBD) configuration [4].

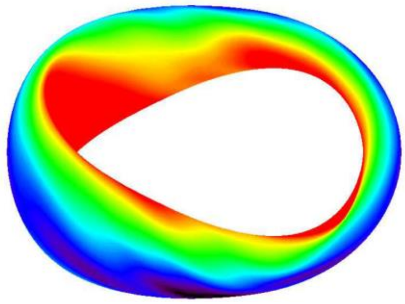

Fig.1 The plasma boundary of the CFQS. Color shows the magnetic field strength.

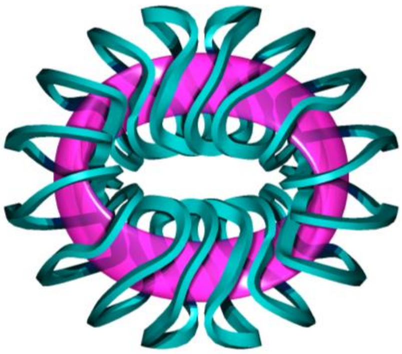

Fig.2 The modular coil system of the CFQS is shown with the plasma boundary.

[1] A. Shimizu *et al.*, to be published in Plasma and Fusion Research
[2] H. Liu *et al.*, Plasma and Fusion Research **13** (2018) 3405067.
[3] M. Isobe *et al.*, 45th EPS Conference on Plasma Physics, 2-6 July 2018, Prague, Czech Republic, Vol. 42A, P2.1043.
[4] S. Okamura et al., 45th EPS Conference on Plasma Physics, 2-6 July 2018, Prague, Czech Republic, Vol. 42A, P5.1034.