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準軸対称ステラレータCFQSの物理工学設計と建設の進展
Development of physics/engineering design and construction of quasi-axisymmetric stellarator CFQS

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The CFQS [1-3] is the world's first quasi-axisymmetric stellarator, and now it is being constructed as the joint project of National Institute for Fusion Science in Japan and Southwest Jiaotong University in China. MHD equilibrium of the CFQS plasma was designed based on CHS-qa [4]. Major radius, magnetic field strength, aspect ratio, and toroidal periodic number of the CFQS are 1.0 m, 1.0 T, 4.0, and 2, respectively, and the engineering design study has been intensively advanced [5-8].

The main coil system is composed of 16 modular coils (MCs). For flexibility of magnetic field configuration, 12 toroidal field coils and 2 pairs of poloidal field coils are designed, of which detail is presented by S. Kinoshita, **23Pa45**. The electromagnetic force in CFQS is very strong due to compactness resulting from its low-aspect-ratio. For supporting structure, to withstand such strong electromagnetic force, partial coil cases, and cage like structure are employed. Finite element method (FEM) analysis has been done, and the results tell us that the stress on supporting structure is less than allowable level [5,6]. MCs are now being constructed by Hefei Keye Co., Ltd. in Hefei, China. Up to now, for 14 MCs, 1st vacuum pressure impregnation (VPI) process, by which conductors were fixed by resin, was already completed. For 2 of those 14 MCs, 2nd VPI has been also completed. Other 2 MCs are now under winding process. Detail construction method is presented by H. Tanoue, **23Pa46**.

The 3D-shaped vacuum vessel (VV) was designed to keep good accessibility to plasma, and the FEM analysis was also performed to check the effect of stress caused by atmosphere pressure [7], and the eddy current produced during operation [8]. Those results show that the stress is less than the allowable level and does not lead to significant problem. Parts of VV wall is manufactured by hot-press work to keep complicated shape with good accuracy. Those parts are connected by welding. Now, 1/4 toroidal section of VV is under construction and main manufacturing process has been finished. Soon, leak check and baking test will be performed. Details of manufacturing status of VV is presented by S. Nakagawa, **23Pa47**.

Plasma in the first stage experiment will be produced under the magnetic field strength of 0.1 T. On that condition, the electromagnetic force on MCs is weak. In order to accelerate construction of coil cases and supporting structure, we have simplified those designs. As an initial experiment, mapping experiment for measuring magnetic surfaces will be performed. Detail plan is presented by M. Shoji, **23Pa44**.

In this presentation, summary of CFQS design research, and current status of its construction will be presented.

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