

Configuration Characteristics of Tokamak-like Stellarator, Chinese First Quasi-axisymmetric Stellarator

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As an internationally collaborative project, the Chinese First Quasi-axisymmetric Stellarator (CFQS) will be fabricated and operated by Southwest Jiaotong University in China and National Institute for Fusion Science in Japan. The CFQS is a tokamak-like stellarator with low-aspect ratio. Via scan of the magnetic configurations with various aspect ratios, major radius and numbers of modular coils, the plasma boundary and modular-coil system for CFQS have been designed and optimized. The candidate parameters of CFQS are as follows: the major radius is 1.0 m, the toroidal magnetic field strength is 1.0 T, the toroidal periodic number is 2 and the aspect ratio is 4.0. The 16 modular coil system has been optimized and designed via minimizing the normal component of magnetic field on the target plasma boundary surface generated from the modular coils, as well as adjusting the main Fourier components of magnetic field strength produced by the modular-coil system to the original ones derived from the target configuration. With these optimized modular coils, VMEC free boundary calculation is conducted to check the beta limit of MHD equilibrium. Mercier stability, ballooning stability and neoclassical transport are calculated to evaluate the property of CFQS configuration. The MHD equilibrium of configuration is almost stable up to $\beta = 1\%$. The neoclassical transport in the CFQS is less than that in the W7-X in $1/\nu$ regime.