Current Progress in Engineering/Physical Studies and Fabrication of the Chinese First Quasi-axisymmetric Stellarator (CFQS)

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As an internationally collaborative project, the Chinese First Quasi-axisymmetric Stellarator (CFQS) is being fabricated in China and will be jointly operated by Southwest Jiaotong University (SWJTU) in China and National Institute for Fusion Science (NIFS) in Japan to prove inherent advantages of the quasi-axisymmetric (QA) magnetic configuration. The main 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. An optimized modular coil system considering finite-size coils has been designed to reduce its construction complexity while keeping precisely the QA features, i. e., significant decrease of neoclassical transport and stabilization of MHD equilibria. A cage-like supporting structure is designed to sustain strong electromagnetic forces under 1.0 T operation and meanwhile preserve enough space for heating and diagnostic systems. The vacuum vessel with 46 ports is sufficiently robust against the effects of the atmospheric pressure, self-weight, and baking temperature by *finite element* method analysis. At the beginning of 2020, a mock-up modular coil (MC4), which has the most complicated 3D structure, has been successfully manufactured with a fabrication error less than 1.0 mm. At present, the 16 modular coils and the vacuum chamber are being fabricated. By now, more than half of the modular coils have been manufactured and tested in high quality. The vacuum vessel and the supporting system are also under construction. It is envisaged that all the components will be finished and assembled in SWJTU by the end of 2022.