§40. Design and Fabrication of Compact Plasma Wall Interaction Experimental Device (CDP)

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1. Introduction

Spherical tokamak (ST) is a candidate for cost-effective fusion reactor and the improvement of the plasma performance of ST has been tried in many institutes, which is including in the experimental groups of University of Tokyo by use of TST-2 devices. The experimental group of Kyoto University has been done the development of the plasma start up without ohmic heating coil by RF current drive on LATE devices. One of the effective technique to provide fuel into plasma is compact toroid (CT) injection, which has been proceeded in University of Hyogo. Steady state operation is also a key issue to realize a fusion reactor. In the research of tokamaks, steady state operation will become crucial point and the trials to do long pulse operations in a large tokamak, JT-60U started. The experimental group of Kyushu University has many experiences to sustain the plasma current by use of RF current drive.

The cooperation of these experimental groups under the assistance with NIFS has the possibility to make a new way to realize the fusion reactor using steady state operation of ST. In 2003, we executed the collaboration, which TST-2 moved tentatively to Kyushu University and the RF injection experiment to TST-2 were done successfully[1,2]. On March, 2004, TST-2 moved to Kashiwa campus in University of Tokyo and this experimental program was completed. After this experimental program, the researchers feel the necessity of compact experimental platform of ST and we construct new compact ST called compact plasma wall interaction experimental device (CPD) under the framework in by-directional collaboration program organized by NIFS. The purposes of CPD are 1) confirmation of the effect of EBWCD, 2) investigation of the effect of wall temperature to PWI, 3) CT injection to ST, 4) study of the active control of PWI, 5) confinement study of energetic particles in ST, 6) role in the platform of innovative concept.

2. Specification of CPD

The schematic views of CPD are shown in Fig. 1. The major and minor radii are 0.3 and 0.2 m, respectively. The toroidal magnetic field is 0.25 T at R=0.25m. The features of CPD are 1) four toroidal return coils to investigate the confinement of the energetic particles in ST, 2) four F570 flanges to install the vacuum pump, heating sources, diagnostics and so on. A heating source is RF in frequency of 8.2 GHz up to 200kW. The waveguides to inject RF into plasma are available in the previous TST-2 experiment in Kyushu University. Three pairs of poloidal filed coils and center solenoid are installed on CPD. The center solenoid is able to provide the magnetic flux up to 100mVs. All of magnetic coils are driven by the power supplies for the magnetic coils of TRIAM-1M. Capability of these power supplies is enough to operate their coils and as the result, it is possible to do the feedback control of the plasma position.

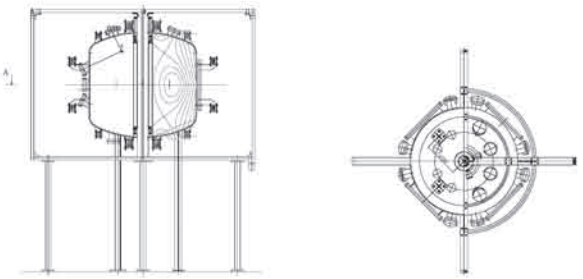

Fig. 1 Schematic side cross-sectional and Top views of CDP. The magnetic surfaces of standard configuration are overwriting on the side cross-sectional view.

3. Fabrication and check

Figure 2 shows the photograph of CDP just after the installation at the experimental hall of TRIAM-1M. The position is the same of previous TST-2. The check of vacuum leak and the energization of the magnetic coils are carried out and the results are well. After the installation of the RF heating system and diagnostics, the plasma experiment will be started.

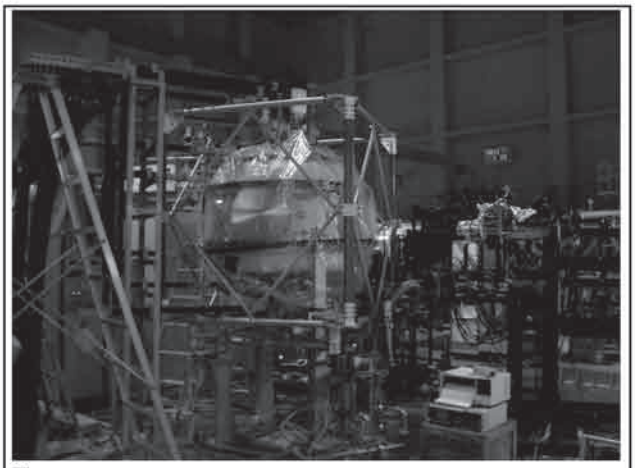

Fig. 2 The photograph of the CPD during vacuum leak check at the experimental hall of TRIAM-1M.

References

[1] Mitarai, O, et al., Rapid communication J. Plasma and Fusion res. Vol. 80, No.7 (2004)
[2] Kasahara, H., et al., Proc. the 31th EPS meeting (London) (2004).