

## §44. Experimental Study of Compact Plasma Wall Interaction Experimental Device (CPD)

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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. University of Tokyo has been executed the RF heating experiments on TST-2. The plasma start up without ohmic heating coil by RF current drive has been developed on LATE constructed by the experimental group of Kyoto University. One of the effective ways to provide fuel into plasma is compact toroid (CT) injection, which has been proceeded in University of Hyogo. Some fast CCD cameras are installed on several toroidal devices by the collaborated study organized by Hiroshima University. 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. They proposed that particle control including in the plasma wall interaction (PWI) was crucial. In NIFS, rotating limiter to control the recycling of Hydrogen was proposed.

A compact ST called compact plasma wall interaction experimental device (CPD) was constructed to resolve the complicated issues concerning steady-state operation of magnetic fusion devices under the framework in by-directional collaboration program organized by NIFS and the collaborated program in the experiments are started in 2005. 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. In 2005, the systems of the compact toroid (CT) injection produced by the group of Hyogo University and the rotating limiter to control recycling are installed on CPD. In this report, we mainly report the results from the new tools.

### 2. Injection of CTs to CPD by use of the CT injection system

The CT injection system was installed on 2005 and the CT injection experiments were carried out on 2006. To make sure the condition of the CT production and of the

effect to the CPD device, the CT injection to CPD was carried out without any magnetic fields on CPD. The fueling system to CPD did not use and therefore all particles to CPD was taken in by CT plasma. After the CT injection, the fueling particles to produce the CT plasma may be taken in. However the signal of  $H_\alpha$  at the accelerated voltage of 0 kV shows the effect of the fueling particles for the CT production can be negligible.

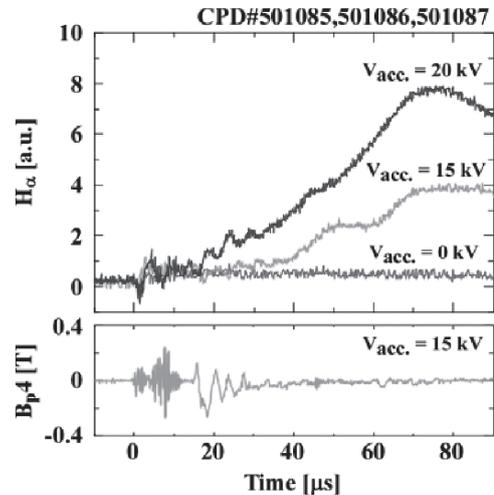


Fig. 1 Time evolutions of  $H_\alpha$  signal from CPD vacuum vessel for CT at the accelerated voltage of 0 (red line), 15 (Green one) and 20 kV (Blue one) show on the top figure. The bottom figure shows that the time evolution of the signal detected by a magnetic pick-up coil installed on the head of CT injection system.

### 3. POP experiments to control the recycling by use of the rotating limiter

The rotating limiter system was installed and POP experiments were carried out in RF plasma on CPD. In the case of RF plasma, main plasma was produced around the ECR layer and any closed magnetic structures did not exist in the vacuum vessel. Therefore the area of the rotating limiter is not so large compared with the total plasma attached wall area. The recycling was measured by the ratio of the  $H_\alpha$  signal at the limiter head to that from the center of plasma as shown in Fig. 2.

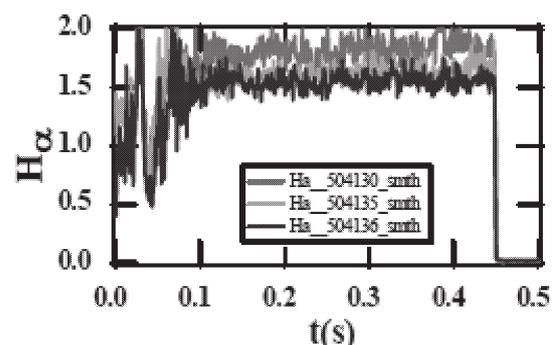


Fig. 2 The time evolutions of the ratio of the  $H_\alpha$  signal at the rotating limiter head to that from the center of plasma with Li layer (Green and Blue lines) and without one (Red line).