# §75. Study on Plasma-Wall Interaction and Global Particle Balance in QUEST

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The achievement of the stable steady state operation (SSO) is one of the most important issues for the future fusion reactor. The issue contains not only subjects related to the core plasma such as confinement, heating and current drive but also those related to the plasma-wall interaction (PWI) such as hydrogen recycling. An objective of this research is to study hydrogen recycling and particle control for better understanding of PWI phenomena.

In this time, measurement of plasma-driven permeation (PDP) and particle balance analysis was carried out[1]. Figure 1 shows schematic diagram of QUEST and measurement positions of PDP. So far, Ni was used for a membrane of the PDP measurement but membrane material has been changed to Pd-Cu alloy to improve sensitivity of hydrogen permeation. The thickness of the membrane is 20 μm and it is supported by stainless steel mesh. The temperature of the membrane is controlled to keep at 573 K during the experiments.

Figure 2 shows waveforms of hydrogen discharges with the discharge duration of 240 s and 300 s. The plasmas were maintained by radio frequency (RF) waves with the frequency of 2.45 GHz. The RF power was 85 kW. The hydrogen gas was supplied by feedback control to keep the Hα line intensity constant. So, in the two discharges shown in Fig. 2, the Hα. line intensity was almost constant. And also, the pressure $P_{total}$ and the total amount of hydrogen atoms $N_H$ in the vacuum vessel were kept constant. In the both discharges, however, the trend of the external hydrogen gas supply $Q_{H2}$ is much different. The value of $Q_{H2}$ of the discharge (#20647) is higher than that of #20644. The hydrogen permeation flux $\Gamma_H$ increased with the discharge time although the Hα line intensity was kept constant. In spite of constant Hα line intensity, which is an index of hydrogen recycling, the additional gas supply was much different to keep the Hα line intensity constant. Pumping cannot contribute to the difference in $Q_{H2}$ of the both discharges, since the amount of pumping is small. In the both discharges, the number of He atoms in the vacuum vessel $N_{He}$ is different twice. It is suggested that the difference in $Q_{H2}$ of the discharges (#20647 and #20644) is attributed to the difference in the desorption amount of the both discharge, since the value of $N_{He}$ is considered to be an index of the amount of desorption from the wall.

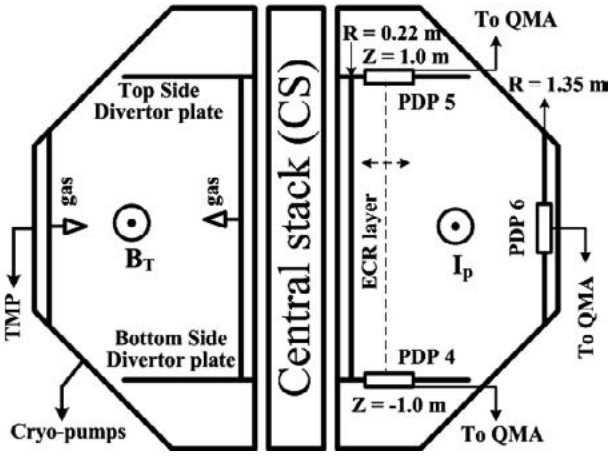


Fig. 1 Schematic diagram of QUEST and positions of PDP measurement (PDP 4, PDP 5 and PDP 6).

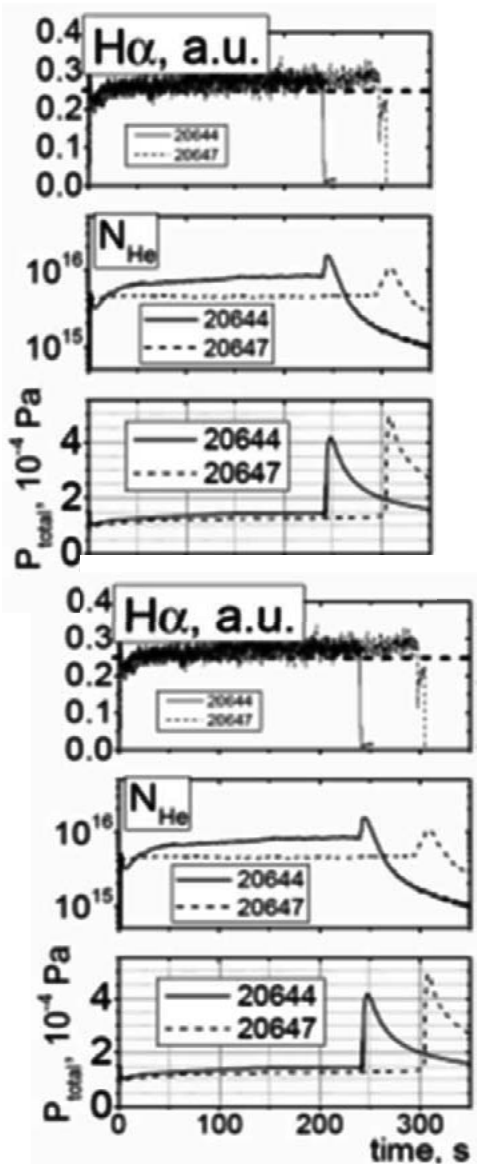


Fig. 2 Time evolution of the typical parameters of two long duration discharges.

1) Kuzmin, A., Zushi, H. et al.: 10th International Conference on Tritium Science and Technology (Nice, 2013) 7-57.