04pC08

QUEST定常プラズマにおけるH,He粒子リサイクリング

H/He recycling behavior in QUEST steady state plasma

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Long duration discharges with feedback controlled H2 fueling in QUEST were investigated. Particular interest of this work was atomic hydrogen / He behavior during the discharges. For that reason three permeation probes (PdCu40%) were added to monitor hydrogen incident flux at the different locations and He released from the wall during discharge was monitored by QMS. Gas balance was analyzed for sequential discharges.

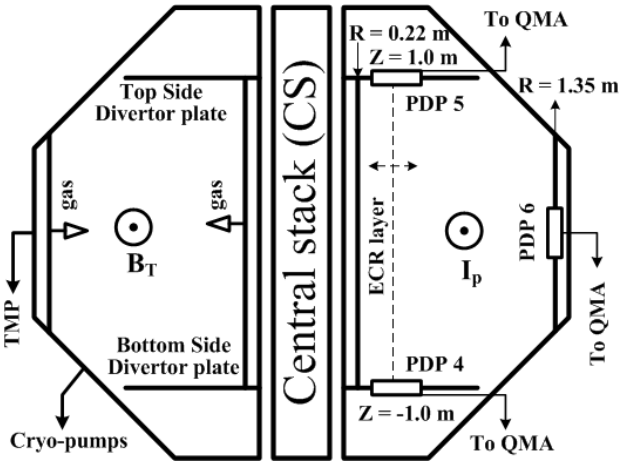

Fig.1 *Schematic view of permeation probes position in QUEST tokamak chamber.*

QUEST is a medium sized spherical tokamak device. The major and minor radii are 0.68 m and 0.4 m, respectively. The toroidal magnetic field in this experiments was 0.12-0.5 T. Hydrogen plasma was produced using two kinds of RF systems, 28 GHz and 8.2 GHz for short pulse (< 30 s) and long pulse (up to 300 s) plasma discharges. The plasma density was less than ≈ 10^{18} m^{-3}. The vacuum chamber consists of fully metallic (SS and W) first walls. The total surface area of the chamber wall is 35.5 m^2 and the volume is 13 m^3 including the extension ports. Stainless steel and tungsten covers 32 m^2 and 3.5 m^2, respectively. The temperature of the chamber walls was kept fixed at 100 ºC. Three PDP probes with PdCu 20 micron membrane are installed, as shown in Fig.1.

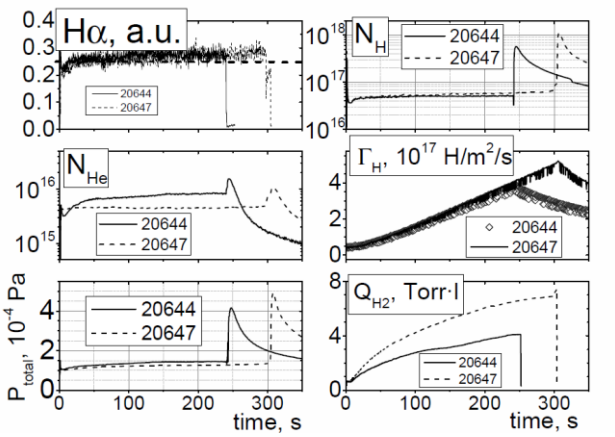

Fig. 2 Particle balance for long discharges. Shot numbers 20644, 20647.

In order to achieve steady state plasma, global gas balance in the chamber including the plasma area must be absolutely necessary. Feedback controlled H2 fueling is adopted to keep H_α constant, as shown in Fig. 2. Here H_α represents the particle recycling in the chamber. Two discharges lasting 240 to 300 sec are presented. H_α in both were well controlled, although the fuelled amount Q_{H2} were largely different. Thus, H2 partial pressure, N_{H2}, and PDP flux, Γ_H, could be kept constant. Although Γ_H increased linearly in time, the expected H-wall flux is considered to be similar to the wave form of H_α. The total pumped H2, $Q_{pump} = \int_0^{t_{end}} S_{pump} P(t)dt$ did not dominate the gas balance. The fraction of wall retention in two cases changed from 0.6(20644) to 0.8(20647), and both decreased slightly in time. The released particles from the wall, that is, He also reduced by a factor of 2 (20647).

[1] A Kuzmin et al., ‘Atomic hydrogen flux measurement using permeation probes in steady state QUEST spherical tokamak plasma’, 10th Int. Conf. on Tritium Science and Technology (2013)