

§45. Integration of PWI Experiments, Diagnostics, Simulation and Modeling in Steady State Plasma

Sakamoto, M. (RIAM, Kyushu Univ.)

PWI phenomena have wide-ranging time scale and spatial scale (i.e. multiscale). In this study, PWI phenomena have been investigated comprehensively from multiscale viewpoints¹⁻⁵). As a macroscopic approach, the following studies have been carried out: a recycling structure of the long duration discharges with profile measurements of H_{α} intensity and DEGAS simulation.

The H_{α} intensity was measured at 6 positions as shown in Fig.1. Figure 2(a) shows a toroidal profile of the H_{α} intensity. The plasma was sustained by 8.2 GHz LHCD with the power of 40kW. The line averaged electron density \bar{n}_e was $0.6 \times 10^{19} \text{ m}^{-3}$. The profile is well reproduced according to the following fitting equation;

$$I_{H\alpha}(x) = P_{mc} + \sum_{i=1}^4 P_i \exp\left[\frac{-|x-x_i|}{\lambda}\right] \quad (1)$$

where x is the toroidal length. P_{mc} is contribution of the main chamber recycling and is assumed to be homogeneous in the toroidal direction. The second term of the right-hand side means the contributions of the limiters and gas fueling, respectively. The poloidal limiter (PL) and the movable limiter (ML) are strong sources of the hydrogen recycling. The recycling hydrogen neutrals travel to the toroidal direction and the hydrogen flux decays with a characteristic length λ . Figure 2(b) shows the dependence of λ on \bar{n}_e . The value of λ decreases not inversely but gradually with increase in \bar{n}_e , i.e. $\lambda \propto \bar{n}_e^{-0.2}$. The density dependence of λ can be well reproduced by DEGAS simulation using a cylindrical model shown in Fig.2 (c), where a neutral source locates on the wall. By using a model shown in Fig.2 (d), where the neutral transport is blocked by the ring limiter, the data can not be reproduced. It means that the structure of $I_{H\alpha}$ profile is formed by the

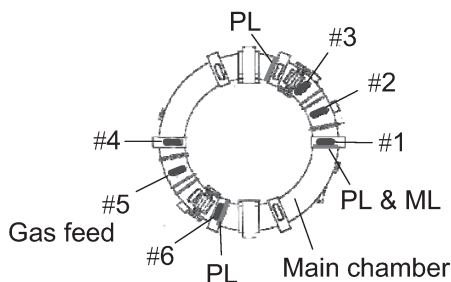


Fig.1 Top view of the vacuum vessel of TRIAM-1M. Measurement position of H_{α} intensity and the location of poloidal limiters (PL), a movable limiter (ML) and gas feed are shown.

transport of neutrals through SOL and periphery of the plasma.

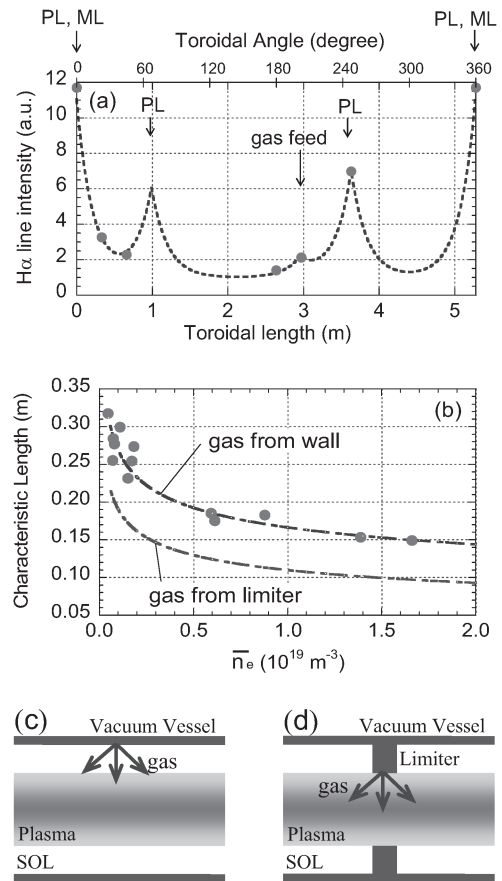


Fig.2 (a) Toroidal profile of H_{α} line intensity, (b) density dependence of λ estimated using equation (1). The broken lines are calculated by DEGAS simulation using cylindrical models (c) and (d).

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