§60. Analysis of the Three-dimensional Profile of Neutral Particle Density in Various Magnetic Configurations in LHD

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An operational condition for SDC (Super Dense Core) plasmas has been recently discovered by controlling neutral particles in the plasma periphery with repetitive fueling pellet injection. For sustaining the SDC plasmas, detailed investigation of neutral particles is an important task. For this reason, the behavior of neutral particles has been analyzed by using a neutral particle transport simulation code (EIRENE) with magnetic field line traces in the plasma periphery in various magnetic configurations [1].

The observed images of the visible profile of the plasma periphery taken from CCD cameras installed in a tangential port (6-T) and an outer port (3-O) are consistent with the images of the three-dimensional magnetic field line structures in the periphery. It suggests that the poloidal/toroidal distribution of the plasma flux density onto the divertor plates is roughly comparable to that of the strike points which are calculated by magnetic field line tracing from the position just outside of the last closed magnetic flux surface (LCFS) [2]. The calculated distribution of the density of the strike points is also consistent with the distribution of the incremental temperature of the divertor plates during plasma discharges in various magnetic configurations.

H_α intensity profile has been measured with a vertical array of H_α emission detectors installed in an outer port (1-O). Figure 1 indicates the calculated density profiles of neutral hydrogen molecules on the detector's surface for three different magnetic configurations (R_{ax}=3.50, 3.75 and 3.90m), in which the distribution of the plasma flux onto the divertor plates is assumed to be that of the strike points. Figure 2 shows the calculated H_α emission profiles for the three magnetic configurations. While, the neutral density and the H_α emission in the inboard side of the tours is higher than that in the outboard side in the two magnetic configurations (R_{ax}=3.50 and 3.75m), these parameters are relatively high in the outboard side for R_{ax}=3.90m.

Polarization resolved H_α spectra measured in various magnetic configurations were analyzed to identify the location of the H_α emission along the line of sight of the detectors [3]. It reveals that the strong emission area of H_α is horizontally moved from the inboard side to the outboard side with the magnetic configuration (radial position of the magnetic axis R_{ax}). This dependence is quietly consistent with the prediction by the neutral particle transport simulation. It indicates that the calculations by the neutral particle transport simulation are reasonable and reliable for analyzing the behavior of neutral particles in LHD plasmas.

Reference
1) Reiter, D. et al.: J. Nucl. Mater **196-198**, (1992) 1059.
2) Shoji, M. et al.: JPFR SERIES (to be published).
3) Iwamae, A. et al.: Phys. Plasmas **12**, (2005) 042501.

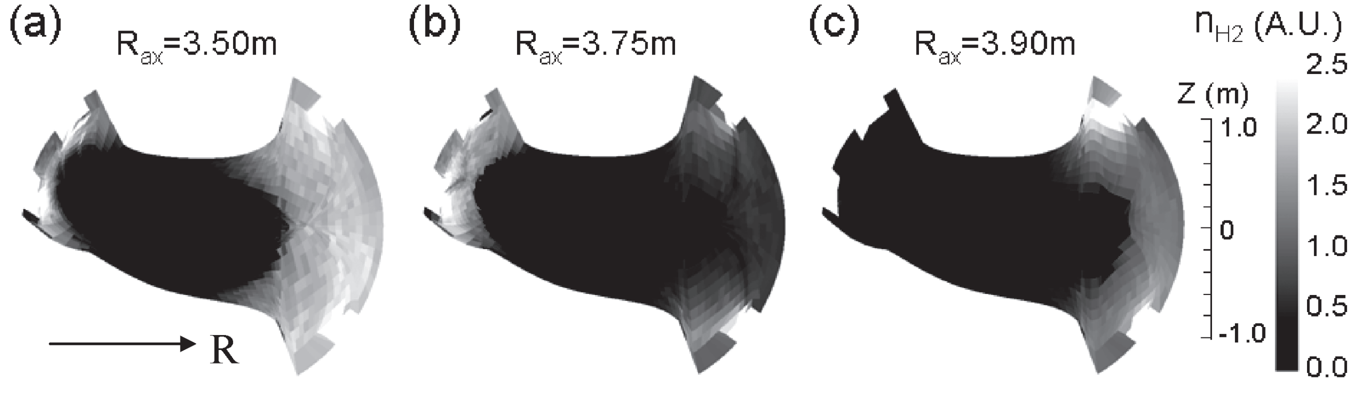

Fig. 1. The calculations of the density profile of neutral hydrogen molecules in the plasma periphery by the neutral particle transport simulation on the detector's surface for three different magnetic configurations (R_{ax}=3.50, 3.75, 3.90m).

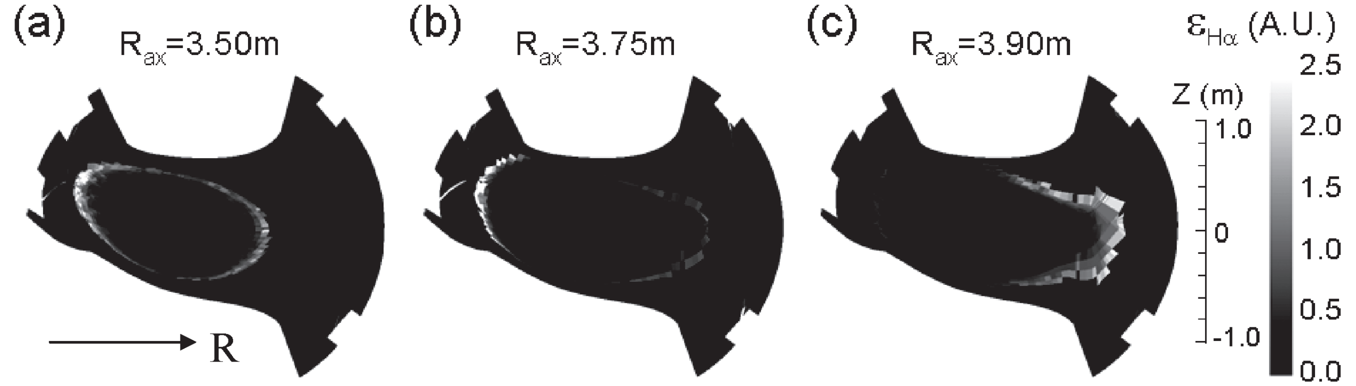

Fig. 2. The calculated profiles of H_α emission estimated by the neutral particle transport simulation on the detector's surface for three different magnetic configurations (R_{ax}=3.50, 3.75, 3.90m)