Measurement and analysis of visible line spectra with inhomogeneous spatial distribution in LHD

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Introduction

Neutral gas pressure at the plasma edge region affects the plasma confinement performance. In LHD, neutral gas pressure at the plasma edge region is inhomogeneous and it may caused by the complicated three-dimensional structure. Local helium line intensities have been analyzed with using Zeeman splitting. Hel line intensities around the inboard X-point are extremely stronger than those of other places. The line intensity depends on some parameters so it is important to evaluate electron temperature and electron density at the location where the line intensity is strong. It is available for the estimation of electron temperature and electron density to apply the ratios of Hel line intensities. When the magnetic configuration changes, the distribution of ion flux to the divertor plates also changes. We measure the line intensity distribution for different magnetic configurations and investigate its relationship with the ion flux distribution.

Experimental results

Spatial Distribution of the ratios of HeI

The ratios of HI

The dependence on \( T_e \) and \( n_e \)

The dependence on \( n_e \)

Summary

(1) Spatial distributions are measured in LHD with 26 vertical sightlines. Spatial distributions of Hydrogen, Carbon and Helium are all inhomogeneous. When the magnetic axis is shifted outwardly, the ion flux distribution is drastically changed, so new peak appear around the outboard X-point.

(2) The ratios of Helium and Hydrogen were applied to the analyses of local electron temperature and electron density to investigate the dependence on line intensity. With a configuration of \( R_\alpha=3.6m \), atoms exist around the inboard X-point. With a configuration of \( R_\alpha=3.9m \), the peak around the outboard X-point may be caused by atom density.

(3) \( T_e \) and \( n_e \) values determined from the ratios of helium lines and hydrogen lines. As a result, a comparison among three sightlines of \( n_e \) evaluated from HI ratio denotes the same tendency of \( n_e \) evaluated from HeI ratio, but the values are not accord with each other. Within a factor of 2, it may be caused by the difference between the radial location of HeII and HI.