03aE59p

アーク放電型負イオン源内の原子密度・Balmer線強度分布解析
Numerical Study of Atomic Density and Balmer line intensity in Large Arc Driven Negative Ion Sources

柴田崇統、柏木美恵子、畑山明聖、井上多加志、花田磨砂也
T. Shibata, M. Kashiwagi, A. Hatayama, T. Inoue, and M. Hanada

慶大理工、原子力機構
Keio University, JAEA

In the study of large negative ion (H^-) sources for fusion devices such as JT-60SA, understandings of non-uniformity in extracted negative ion beam is one of the serious issues to obtain sufficient neutral beam injection (NBI) power in fusion plasmas. Since the H^- is produced from the atoms (H^0) on the plasma grid (PG) surface in Cs-seeded negative ion sources, it has been shown in the previous study that the local enhancement of the H^0 density and the resultant non-uniform H^0 flux to PG are possible origins of the H^- beam non-uniformity.

For more understandings of the non-uniformity, a detailed analysis of electron energy distribution function (EEDF) is very important, because the production of atoms is mainly a collision processes between molecules and electrons which have wide range of kinetic energy in negative ion sources. The purpose of this study is to understand the effect of the EEDF with above non-equilibrium features on the H^0 density distribution and the resultant H^0 flux to PG surface.

A Collisional-Radiative (CR) model and an atomic transport analysis are developed to calculate H^0 density distribution by taking into account (1) H^0 production due to H_2 dissociation, (2) ionization loss and (3) transport loss of atoms with the effect of the EEDF.

From the analysis, it has been shown that the H^0 production rate is enhanced by non-Maxwellian tail of the EEDF due to dissociative ionization process ($H_2(\Sigma_g^+)$ + e $\rightarrow$ $H^0(1s)$ + H^+) which has large threshold energy (up to 30.6 eV). The resultant H^0 density also shows non-uniform spatial profile even with the relaxation due to ionization and transport of H^0 (See Fig. 1). As shown in Fig. 2, the spatial distribution of the H_α line intensity is calculated from the H^0 density. The numerical result shows a good agreement with the line intensity obtained in the spectrometry. It has been clarified that the spatial profile of the line intensity is decided by of non-equilibrium feature of EEDF. The detail will be reported in the poster.

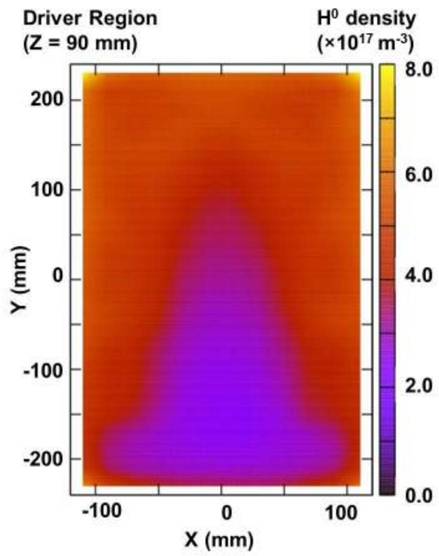

FIG. 1 Spatial distribution of H^0 density in the driver region of the JAEA 10A negative ion source.

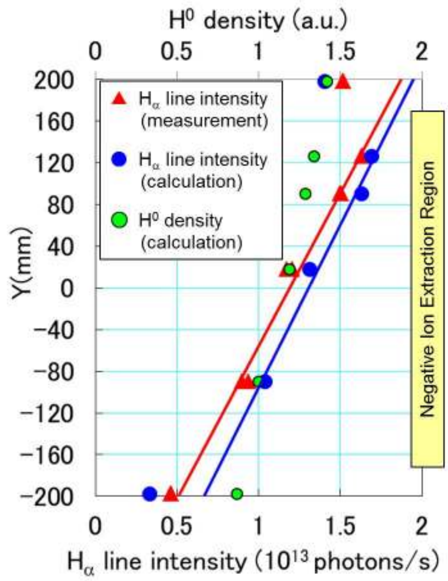

FIG. 2 Comparison of the Ha line intensity obtained in the calculation (blue circles) and by the spectrometry in the JAEA 10A negative ion source (red triangles).