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高周波放電型水素負イオン源における放電過程の数値解析，及びイオン衝突過程の影響評価

Numerical Analysis of Plasma Discharge in Radio-Frequency Driven Type H^- Source and Evaluation of Effect of Ion Collision Processes

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Negative hydrogen ion (H^-) sources with radio frequency (RF) inductively coupled plasmas (ICPs) are applied to the heating of magnetically confined fusion plasmas and to accelerators of high energy particle physics due to their potential for the high density H^- production and also for their high maintainability. In the previous study[1], we have developed a numerical kinetic model of the discharge process of the RF ICP aiming to clarify the basic physics of RF ICPs from kinetic view of point. Our model is based on an ElectroMagnetic Particle-in-Cell Monte Carlo Collisions (EM PIC MCC) method. The model consists of the 2D electromagnetic model and the 2D3V plasma dynamics model. The results obtained from the model are shown in Fig. 1-3. The results have shown that the time evolution of the volume averaged plasma density and the spatial profile of the plasma show different trends due to the discharge mode transition, which is one of the typical features of the RF ICPs[2].

Although the previous model is useful for qualitative investigation of the RF ICP discharge, it is mandatory to be improved in order to apply the model to more practical analysis because the model includes some assumption in order to simplify the calculation. In the present study, elastic/inelastic collision processes between ions and neutrals are taken into account, e.g., elastic collision, charge transfer and collision induced dissociation of H_2^+. Those ion-neutral collision processes are expected to play a key role to determine the plasma parameter or the spatial profile of the plasma. The volume averaged density and the kinetic energy and the spatial profile of the density for each charged particles will be shown and compared with the previous results in order to investigate the effect of the ion-neutral collisions on the discharge processes in the poster presentation.

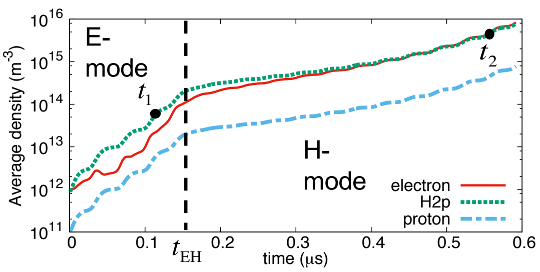

Fig.1 Time evolution of the volume averaged number density of each particle species.[1]

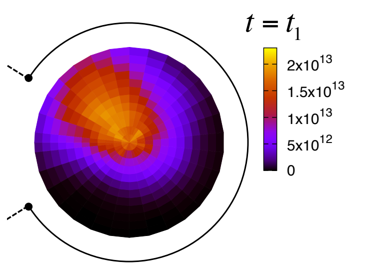

Fig.2 Spatial profiles of electron density where $t_1 = 0.111$ μs [1]

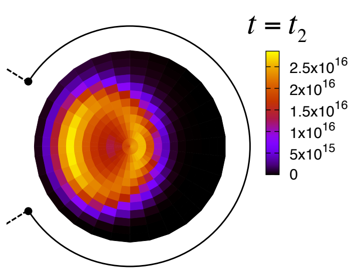

Fig.3 Spatial profiles of electron density where $t_2 = 0.590$ μs[1]

[1] K. Nishida, S. Mattei, S. Mochizuki, J. Lettry and A. Hatayama, J. Appl. Phys. **119**, 233302 (2016)

[2] Pascal Chabert and Nicholas Braithwaite. *Physics of Radio-Frequency Plasmas.* Cambridge University Press, New York, 2011.