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IMPGYROコードによるGAMMA10プラズマ中の Ar不純物輸送シミュレーション
Transport Simulation of Ar Impurities in the GAMMA10 Plasmas using IMPGYRO code

高原啓輔[1], 矢本昌平[1], 巽瞭子[1], 石橋和大[1], シャヒヌル・イスラム[2], 市村和也[2], 畑山明聖[1], 中嶋洋輔[2]

Keisuke Takahara[1], Shohei Yamoto[1], Ryoko Tatsumi[1], Kazuhiro Ishibashi[1], Md. Shahinul Islam[2], Kazuya Ichimura[2], Akiyoshi Hatayama[1], and Yosuke Nakashima[2]

慶應大[1], 筑波大[2]

Keio Univ. [1], Univ. of Tsukuba[2]

1. Introduction

In future fusion reactors, radiation cooling by injecting impurities such as Ar and Ne is proposed as an efficient method to reduce the heat load to the divertor plates. We have been developed the high-Z impurity transport code IMPGYRO[1]. The purpose of this study is to understand the transport process of Ar and its effect on the heat load reduction in the GAMMA10 plasmas by the IMPGYRO code and the 2-D divertor plasma transport program developed in Ref. [2],[3].

2. Model

The IMPGYRO code is a Kinetic Monte Carlo code for transport analysis of high-Z impurity ions in magnetized plasmas. The code follows the full gyro-motion without drift approximation. The friction force and the thermal force due to Coulomb collision has been modeled by the Monte-Carlo Binary Collision Method[4],[5]. Calculation of the impurity charge state by ionization and recombination process is important to calculate the Lorentz force and the collisional force. Multi-step ionization and reombination processes are also included by Monte-Calro method.

The IMPGYRO code, however, mainly deals with high-Z impurities like W and Ar atomic data has not been implemented. In this study, we are improving the IMPGYRO code by implementing Ar atomic data[6] into the code. In order to validate the implementation, we have done a series of test calculations in the spatially infinite plasma with the uniform temperature and density profiles with $T_e = 100\ \mathrm{eV}$, $n_e = 1.0 \times 10^{20}\ \mathrm{m}^{-3}$. Figure 1 shows the time evolution of the normalized impurity density for each charge state. The time evolution agrees well with those by the simple 0-D rate equations. Figure 2 shows the time evolution of the average charge state of Ar impurity ions. It is confirmed to be also in good agreement with those by the 0-D rate equations. The implementation of Ar atomic data and ionization/recombination processes into the IMPGYRO code has been successfully done.

3. GAMMA 10 simulation

Base on the above code validation, now we start applying the IMPGYRO code to the end cell region of the GAMMA 10. The background plasma profile has been given by the 2-D divertor plasma transport program developed in Ref. [2],[3]. The initial results will be given in the poster presentation.

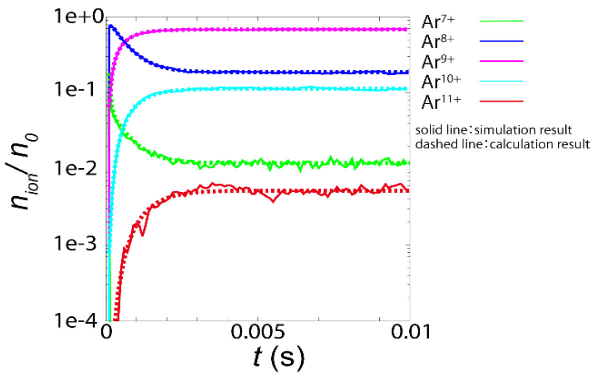

Fig. 1 Test simulation of Ar ionization and recombination process in a uniform background plasma without magnetic field. Time evolution of normalized Ar ion density for typical charge state.

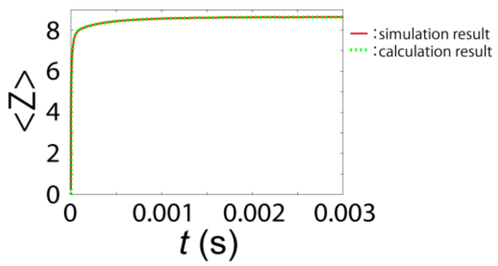

Fig. 2 The time evolution of the average charge state of Ar impurity ions.

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