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SONICとSOLPSによるJT-60U非接触ダイバータプラズマモデリング
Modelling of the JT-60U detached divertor plasma by using SONIC and SOLPS codes

星野一生[1]、清水勝宏[1]、滝塚知典[2]、中村誠[1]
Kazuo HOSHINO [1], Katsuhiro SHIMIZU [1], Tomonori TAKIZUKA [2], Makoto NAKAMURA [1]

[1] 原子力機構、[2] 阪大工
[1] JAEA, [2] Osaka Univ.

The large heat load to the divertor plate is one of the crucial issues for magnetic fusion devices. The detached divertor operation is the most promising candidate to reduce the heat load and it has been achieved in many devices [1].

A number of divertor codes are being developed to analyze and predict the SOL/divertor plasma characteristics, such as the heat and particle loads to the divertor, the SOL flow pattern, and the neutral and impurity transport etc. It is challenging even for major two dimensional divertor codes to reproduce the detached divertor plasma observed in the experiments, especially significant reduction of the ion flux to the divertor target [2].

The numerical simulation for the JT-60U detached divertor plasma was attempted by using the suite of integrated divertor codes SONIC [3, 4]. Although the electron temperature at the outer strike point becomes less than a few eV with increasing the gas puff rate, the ion particle flux did not decrease. The rollover of the ion flux, which is a feature of the detachment, was not reproduced in the SONIC simulation.

In order to improve the detached divertor plasma model, effects of following models and processes on the detachment have been investigated [5, 6]: (1) large anomalous diffusion coefficient, (2) large chemical sputtering yield, (3) the radial diffusion loss from the private flux region, (4) the supersonic flow in the divertor region, (5) the wall pumping effect, and so on. The detachment characteristics in the SONIC simulation, i.e. T_e decreasing below 1-2 eV and ion flux decreasing at high density, is improved by synergetic effects of (1), (3) and (5). However, reduction of the ion flux is still insufficient compared with the experimental data.

In this study, the JT-60U detached divertor plasma is modeled by SONIC and SOLPS [7], and the results are compared for further improvement of the detachment model. SOLPS is the 2D divertor code used for the ITER divertor design.

In figure 1, the ion flux at the outer strike point is plotted as a function of the mid-plane density. Here, we should note these results are preliminary. The standard setup of each code is used, i.e., boundary condition, gas puff rate and so on, is not the same between SONIC and SOLPS simulations. Although the roll over can be observed in both cases, decrease in the ion flux is not significant.

In the presentation, the results and the simulation conditions will be compared in detail. Based on such results, improvement of the detachment model will be discussed.

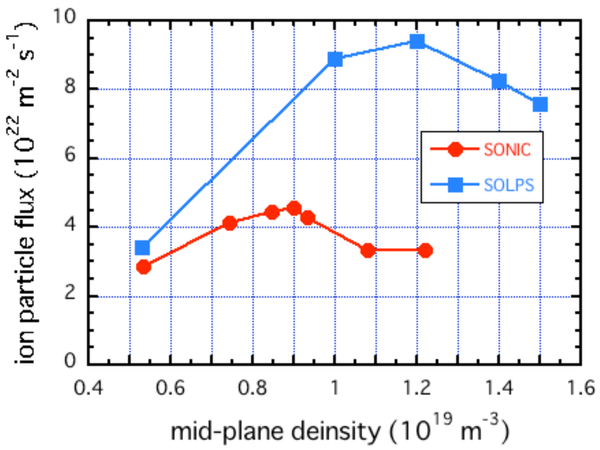

Fig.1 The ion flux at the outer strike point as a function of the outer mid-plane density.

References

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