§22. EMC3-EIRENE Simulations of Linear Divertor Plasmas

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In a fusion reactor, large part of the huge heat flux escaped from the core must be diffused in front of the divertor target. One of the effective solutions is applying the "plasma detachment." In the linear plasma device simulating the edge and the divertor regions, detailed characteristics of the detached plasma has been investigated from the early period, and a number of simulations with a simple model were performed.

Recently, two-dimensional (2D) transport code: B2-EIRENE, which was often used in tokamak devices, has been applied to the plasma simulation of the PSI-2 linear device. In addition, the tandem mirror device GAMMA10 newly equipped the V-shaped divertor module with a three-dimensional structure, which requires a three-dimensional (3D) plasma simulation.

In this study, we have employs the 3D transport code: EMC3-EIRENE, which is applied for the simulation of the heliotron-stellarator device, to the linear plasmas. The main purposes are follows:

(1) Detached plasma simulation under the condition of the NAGDIS-II linear device, which has a large flexibility for the detached plasma experiment.
(2) Linear plasma simulation with a 3D V-shaped target installed in the GAMMA10.
(3) Complement progress with the LHD simulation, which was recently extended to include the grid of the divertor leg.

Firstly, we have tried to simulate linear plasma in the NAGDIS-II device. In the EMC3-EIRENE calculation, grid points are treated in the cylindrical coordinates (R, ϕ, z), where the components are the major radius R, the toroidal angle ϕ, and the height from the mid-plane z. Thus, we used the high aspect ratio approximation. Figure 1(a) shows the schematic diagram of the grid. The plasma source region was connected to the divertor test region. Intervals of the grid points in the radial direction were set to be short and large in the central and edge regions, respectively, as shown in Fig. 1(b).

Further, there is a large difference in relation to the plasma source in between the linear and the heliotron-stellarator devices. In the linear device, the plasma source exists along magnetic field lines with a radial distribution. Therefore, we are planning to include an arbitrary volume source in the plasma source region, in order to model the actual situation. After that, we will try the detached plasma simulation and install the 3D structure, as shown in Fig 2.

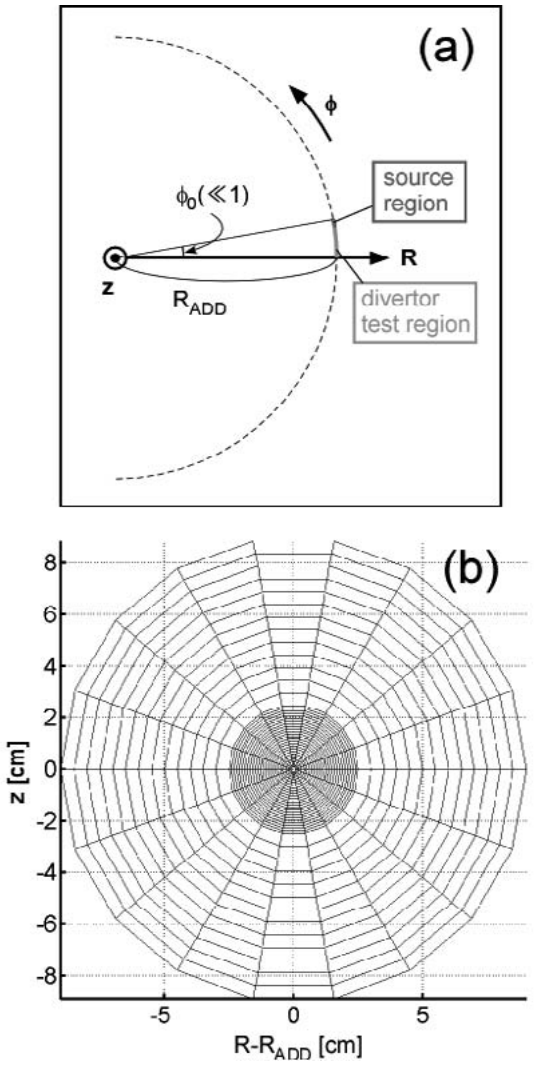

Fig. 1. (a) Upper view of the schematic diagram of the grid position. (b) Side view of the grid.

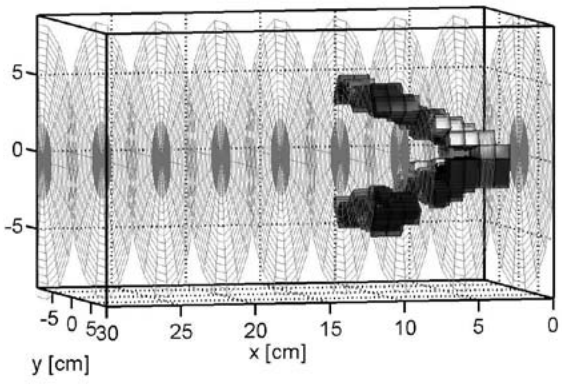

Fig. 2. Example of a V-shaped target with the linear-plasma mesh.