§11. Development of 3-Dimensional Divertor Analysis Method

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Experiments with Helical Divertor (HD) plate of carbon have been performed in Large Helical Device (LHD) since 1999. The configuration has three-dimensionality, which is different from conventional divertor in Tokamaks. Furthermore only a little information can be obtained experimentally, as measurements for divertor region is rather difficult. Thus we need to develop a three-dimensional analysis method for the divertor configuration to complement experiments.

The method presented here is constructed as Figure. It consists of 4 parts;

- mesh generation code (+pre-processing code),
- plasma transport code,
- neutral transport code, and
- visualizing code (post-processing code).

MESH GENERATION

Efficient mesh generation is important for 3-D analysis. Easy handling / user friendly mesh generation code is developping.

In our method meshes are grouped into three types;

- standard mesh, which particles pass through freely,
- non-default standard mesh, where particles reflect or is absorbed, and
- additional mesh, which represents divertor plate or baffle.

Standard mesh is constructed by vacuum field code or equillibrium code. Non-default standard and additional mesh are obtained from LHD configuration data.

PLASMA TRANSPORT CODE

So far Edge Monte Carlo 3D (EMC3) developped by Feng, Y. [1] is successfully applied to helical plasma. It, however, is designed for Wendelstein 7-AS device, and application to LHD is not simple. On the other hand, improving 2-dimensional plasma transport code B2 by Braams, B.J. [2], which is one of standard code for Tokamak divertor analysis, into 3-dimensional code is another solution. In fact 3-dimensional plasma transport code BoRiS is developping by Schneider, R. et al. We are also planning to develop a 3-dimensional plasma transport code using finite volume method.

NEUTRAL TRANSPORT CODE

Peripheral region including divertor region contains neutral particles, different from bulk region. Neutral particles are treated separately from plasmas, as they are free from magnetic field lines and cause various

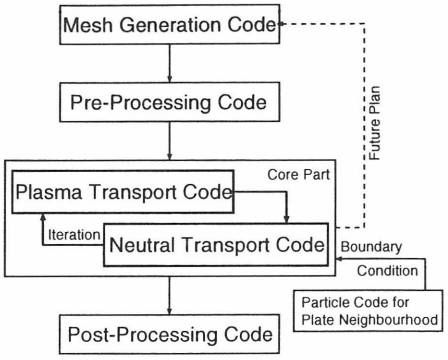

Figure : Schematic view of code structure

atomic/molecular reactions. EIRENE code developed by Reiter, D. [3] is widely used as standard one for analyzing neutral particles, which is applicable to three-dimensional configuration.

Another neutral transport code NUT using semi-analytic algorithm by Valanju, P.M. [4] is also applicable.

VISUALIZATION (POST-PROCESSING CODE)

Visualizing the calcuration data is important for easy understanding. All-purpose plotter routines / tools B2Plot, NCAR-Graphics, IDL and AVS is usable for our usual analysis. In addition the CompleXcope may be helpful for understanding detailed 3-dimensional structure.

PARTICLE CODE

Our another research subject, particle simulation of plate neighbourhood, gives particle, momentum, and heat flux into divertor plate. They can be used as boundary conditions for the divertor analysys method presented here.

References

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