§11. Application of EIRENE to LHD/LID

Takayama, A., Morisaki, T., Tomita, Y.,
Feng, Y., (IPP, Garching)

In Large Helical Device (LHD) experiments two types of divertor operation are scheduled. One is Helical Divertor (HD) operation using the natural diverted magnetic field in helical systems. The other is Local Island Divertor (LID) operation, where divertor plate is installed inside the $m/n = 1/1$ island configuration formed by additional poloidal magnetic field coils. Both operations have three-dimensionality, which is different from conventional divertor in Tokamaks. Thus we need to develop a three-dimensional analysis method for the divertor.

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

In the first step towards developing three-dimensional analysis method for divertor we apply the EIRENE code to LHD/LID configuration.

MESH GENERATION

At the beginning calculation mesh should be generated. If we do not couple the EIRENE code to a plasma code, rigorous mesh reflecting the exact magnetic field structure is not required. We, however, will couple it to a plasma code, so that sophisticated mesh should be made. As making adequate mesh for HD is rather difficult, LID is focused on first.

Mesh in the EIRENE code is grouped into three types. One is standard mesh, which particles pass through freely. Another is non-default standard mesh, where particles reflect or is absorbed. The other is additional mesh, which represents divertor plate or baffle.

Standard mesh is generated based on the vacuum field data of the LID configuration calculated by GOURDON code. Non-default standard mesh for vacuum vessel is made of a simplified data of LHD. Simple model plates are used for additional mesh of divertor plate and baffle, as the real geometry is rather complicated and making the rigorous data takes considerable time. An example of mesh for LHD/LID configuration is shown in Fig.1.

NEUTRAL / PLASMA PARAMETERS

Distribution of neutral particles on divertor plate is given as uniform on the area which magnetic field line crosses, for simplicity. For more precise treatment, it should be determined by tracing plasma particles.

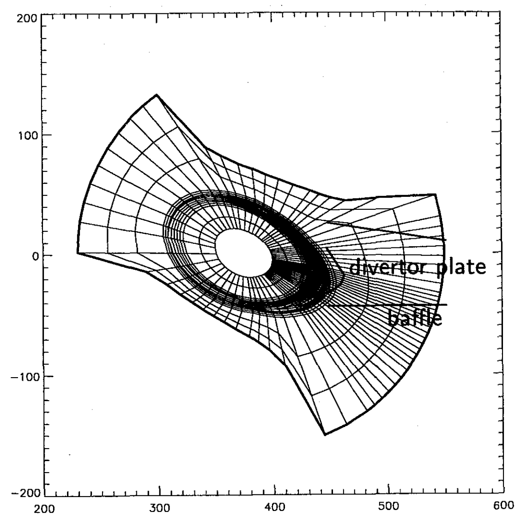

Fig. 1: An example of mesh for LHD/LID configuration

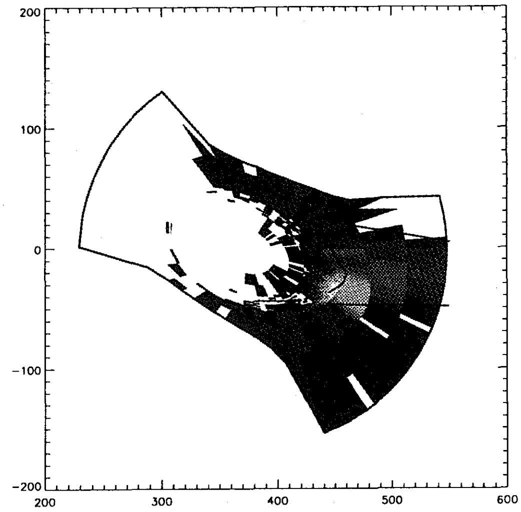

Fig. 2: An atom density profile by a test calculation

Both of plasma temperature and density are uniform in a test calculation. For more accurate simulation, more adequate temperature and density profile should be given. Or a plasma transport code linked with the EIRENE code will be used for another improvement.

One of results of test calculations is shown in Fig.2. This shows that the test calculation for LHD/LID is successful, as atom density profile consistent with the given neutral source distribution is obtained and baffle works properly.

FUTURE WORKS

The EIRENE code is ready to be applied to LHD/LID. It will be applied to LID engineering design with

- optimized mesh
- precise data of vacuum vessel and divertor plates
- improvement of neutral source distribution.

Application of the EIRENE code to LHD/HD is also planned. The final goal of our study is developing a three-dimensional plasma transport code in edge region, linked with the EIRENE code.