EIRENE Code

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1. Purpose / Application

Fully three-dimensional neutral particle transport simulation in the plasma periphery and the divertor region. It is applicable to optimization of a divertor design for compression of neutral density to enhance the divertor functions and so on.

2. Developer / Improver

D.B. Reiter (IPP- Julich)

3. General Description (function, usage, etc.)

The parameter profiles related to neutral particles (temperature of neutral particles, source rate, momentum transfer rate, radiation power, etc.) are calculated by tracking the trajectory of large amounts of test particles in a three-dimensional grid model including plasmas, divertor components and the vacuum vessel, etc. The trajectories of the test particles caused by neutral-plasma/neutral-wall interactions are determined by the Monte-Carlo scheme in this code. The emission profiles (like H_α and so on) caused by neutral particles is calculated by the plasma parameters and the neutral density in each grid. Photon transport, neutral-neutral collisions and special atomic-molecular processes for analyzing plasma detachment can be optionally included. Plasma parameter profiles in the ergodic layer/the divertor legs and the distribution of a heat load and a particle flux on divertor plates are obtained by coupling the code with a peripheral plasma fluid code such as EMC3, B2 and NIMBUS or a one-dimensional plasma fluid code for analyzing the plasma parameters on the divertor legs.

On applying the EIRENE code to the LHD geometry, it is necessary to construct a three-dimensional grid model in which the surface of the divertor plates and the vacuum vessel consist of assemblies of triangles, and the volumes covered with the surfaces of the vacuum vessel must be composed of non-deformed hexahedrons (see Figure 1).

The following separated data base files are necessary for running the code. It has to be prepared as text based ones:

- Data base of plasma-wall interactions,
- Data base of atomic-molecular processes,
- Geometrical data of the three-dimensional grid model,
- Input file for setting numerical conditions for calculation,
- Plasma parameter profiles inside of the ergodic layer and on the divertor legs.

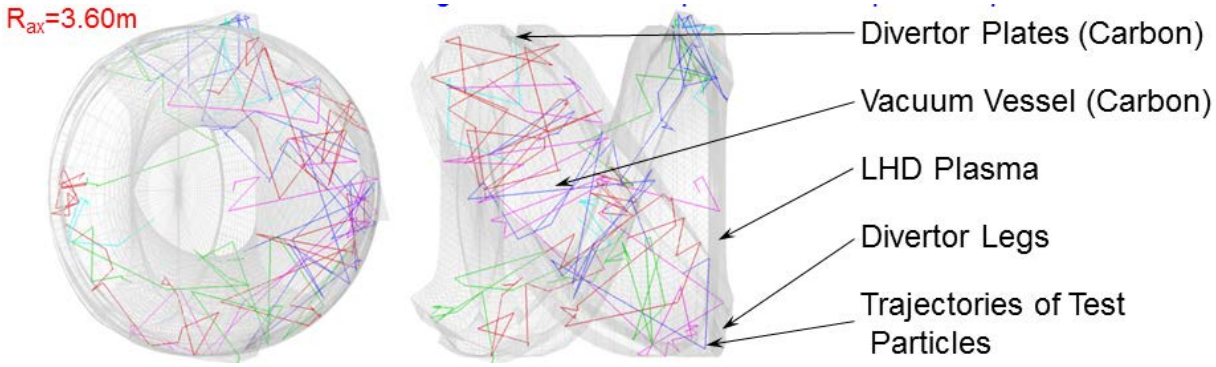

Figure 1 A three-dimensional grid model for the LHD geometry and trajectories of test particles representing neutral particles in EIRENE code.

4. Requirement in Use

4.1. Platform(s)

LHD numerical analysis sever (Fujitsu, PRIMEHPC FX100)

4.2. Required resources

About 6 hours (depending on the number of test particles), ~3 GB

4.3. Usability

The three-dimensional positions of grids on the ergodic layer and divertor legs has to be manually defined for preparation of the analysis of neutral particle transport in the plasmas. It requires special skills, and to check and fix the grid model is a very time-consuming work.

5. Type in Use

We can modify the source code and can easily include user defined modules in the code. Some papers written by the developer should be referred in publications and presentations. The usage of the code needs developer's permission.

References

[1] M. Shoji et al., Journal of Nuclear Materials 415 (2011) S557.

[2] M. Shoji et al., Journal of Nuclear Materials 390-391 (2009) 490.

[3] D. Reiter et al., Fusion Science and Technology 47 (2005) 172.