Three-dimensional neutral transport simulation during transport barrier formation in the JT-60U plasmas

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Simulation analysis of neutral particle transport is an important issue to investigate hydrogen recycling and transport phenomena in not only the plasma edge regions but also the core plasma region of magnetically confined plasmas. Neutral particles in periphery plasmas also play a crucial role on pedestal formation during transport barrier generation in high temperature plasmas. Neutral particle transport simulations based on Monte-Carlo methods have been widely used as a standard way to investigate neutral behavior in fusion devices. The DEGAS ver.63 Monte-Carlo code has been modified for fully three-dimensional simulation in the University of Tsukuba and recently started applying to JT-60U tokamak.

Figure shows the poloidal cross-section view of the newly designed mesh model for JT-60U. In the left side, the previous mesh model is presented and its consistency with the mesh model of the UEDGE plasma code has been ensured. The present mesh shown in the right side is developed based on the previous one and is extended to the plasma core and the divertor regions. The mesh is divide into 32 segments in the minor-radius direction and also divided into 28 in the azimuthal direction on the poloidal cross-section. 50 segments divided in the toroidal direction enable a detailed prediction of neutral density and Dα line-emission profiles and modeling of localized particle source, such as gas puffing and neutral beam injection. A preliminary simulation has been performed with the above full 3-D mesh model and it is found that predicted neutral density is significantly reduced toward the toroidal direction under the condition with the particle source localized in the toroidal direction.

In this paper we will describe the spatial structure of the neutrals and discuss the role of neutrals in mechanisms of the pedestal generation during transport barrier formation.

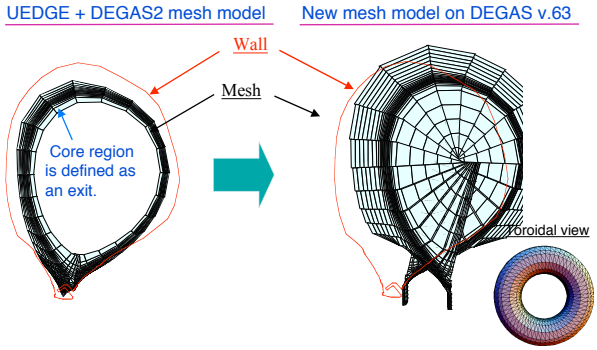

Figure Mesh model of JT-60U for the 3-D DEGAS simulation