§13. Analysis of Recycling Behavior and Plasma Optimization in a Tandem Mirror

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In open magnetic-confining devices, analysis of the particle balance in the plasma is one of the most important issues for optimizing the plasma performance. Therefore, it is important to evaluate the amount of the generated particles as well as measuring the loss particles. In GAMMA 10, the amount of the generated particles was evaluated from the Hα intensity measurements and the radial loss particles were measured by Ion Sensitive Probe (ISP) installed at the central-cell. Axial loss particles were measured by Loss Electron Diagnostic (LED) installed at the end-cell. When ECH in the central-cell (C-ECRH) was additionally applied to the ICRF heated plasmas, the degradation of diamagnetism in the central-cell was occasionally observed. We investigated the relationship between the degradation of the plasma parameter and the loss particles. The optimized condition of the C-ECH experiment was also investigated in terms of particle balance.

In order to understand the physical mechanism of the degradation of the plasma during the C-ECH, the experiment of the C-ECH injection without the confining potential was performed in order to verify the effect of the C-ECH. Figure 1 shows the temporal behavior of plasma parameters. The diamagnetism (DMcc) and electron line-density (NLcc) decreased in the C-ECH period. The signal of ISP and LED increased in the C-ECH period. These results indicated that there is a strong relationship between the degradation of plasma parameter and the loss particles.

On the basis of these results, the optimized condition of the C-ECH experiment was investigated. C-ECH experiment was carried out in the case of increasing the amount of the generated particles. Figure 2 shows the temporal behaviors of the plasma parameter for the quantity of gas puff (a) and the power of ICRF power (b). These results indicate that increasing of the amount of the generated particles can prevent the plasma collapse in the ECH period. It has been reported that the Hα intensity increases with the increase of the quantity of the gas puff or the power of ICRF.

In order to verify the above experimental results, the simulation analysis of the neutral particle transport has to be needed in a whole area of the central-cell by using Monte-Carlo simulation code (DEGAS). So far, the interior components in the west side of central-cell were implemented. In this study, the extension of the mesh in the whole central-cell was completed as shown in Fig.3. In the future, this mesh model will be extended to the west anchor-cell in order to evaluate the amount of the generated particles in a whole area of central-cell.

1) K. Hosoi et al., Proc. 27th Annual Meeting of JSPF (November 30, December 1-3, 2010 Hokkaido) (2010) 02P46.
2) K. Hosoi et al., 8th Int. Conf. on open Magnetic Systems for Plasma Confinement July 5-9 2010, Novosibirsk, Russia Poster No. 18.

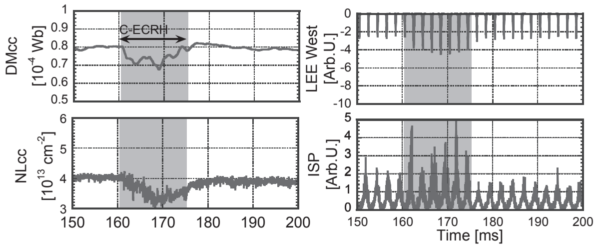

Fig. 1. Temporal behavior of plasma parameters in the C-ECH period. (DMcc: diamagnetism, Nlcc: electron line-density, LEE: end-loss electron current at the west end-cell, ISP: ion current of ion-sensitive probe at the central-cell)

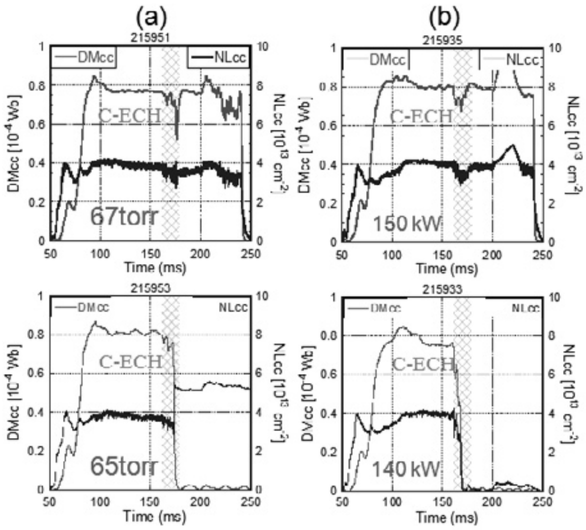

Fig. 2. Comparison of the temporal evolution of the plasma parameters in different experimental conditions on the amount of generated particles. Quantity of gas puff (a), ICRF power (b)

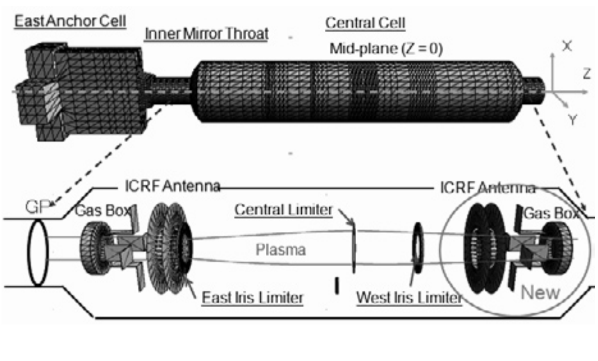

Fig. 3. The fully 3-dimentional DEGAS mesh-model