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核融合周辺プラズマにおけるブロブ輸送とその不純物輸送に対する影響の解析

Analysis of Effects of Plasma Blob on Impurity Transport in the Edge Plasma

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To realize stable energy production by tokamak device, impurity transport process is one of the most important subjects. Thus we need to understand it and background plasma physics in the SOL (scrape-off layer) correctly. By assuming plasma particles are transported by diffusion process from core region, it is predicted that the density in the SOL decreases with the exponential profile to the radial direction. However, by experimentally observations, the density profile is denser and flatter than expected in the distance from separatrix [1,2]. Convective transport e.g. the blob is one of the causes to form such profile. Research of effects of the non-diffusive transport by the blob on impurities hasn't been studied much. Therefore this study was made to clarify the impurity transport in the SOL by analyzing interactions between the blob and tungsten impurities.

The theoretical model for the plasma blob transport is proposed by Krasheninnikov [3]. Thus we modeled the blob propagation using 2D fluid model. The model consists of the vorticity equation and the continuity equation:

$$\frac{\partial n_{\mathrm{b}}}{\partial t} = [n_{\mathrm{b}}, \phi] + \mu \nabla_{\perp}^2 n_{\mathrm{b}} \tag{1}$$

$$\frac{\partial \nabla_{\perp}^2 \phi}{\partial t} = \left[\nabla_{\perp}^2 \phi, \phi\right] + \left[\log B^2, n_{\mathrm{b}}\right] + \mu \nabla_{\perp}^4 \phi, \tag{2}$$

where $[f, g] = \mathbf{b} \cdot (\nabla_{\perp} f \times \nabla_{\perp} g)$ is a Poisson bracket that indicates convective derivative, $\mathbf{B} = 2B_0 L_x / (2L_x + x)\, \mathbf{b}$ is the magnetic field, n_{b} is the blob density, ϕ is the electrostatic potential and μ is the diffusion coefficient. On the other hand, by the Boris-Buneman method, we modeled the impurity transport as particle simulation. To analyze of effects of the blob on the impurity transport, we coupled these models and run the integrated code. In the blob, the electrostatic potential distribution is formed due to the polarization (see Fig. 1). This potential hill and well have effects on the impurity ions dynamics. One of the preliminary results of tungsten ions transport is shown in Fig. 2. Figure 2 shows the existence of spots where the impurity ions trapped in the potential well and detrapped in the hill. From the preliminary results, the highest potential of the blob have important effects on the impurity transport.

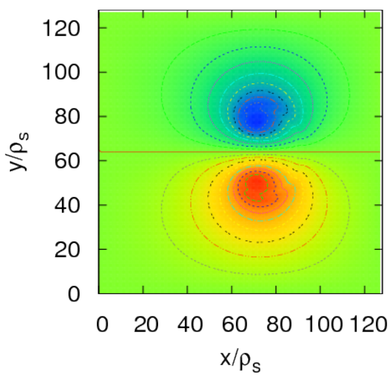

Fig. 1: The electrostatic potential distribution of the blob.

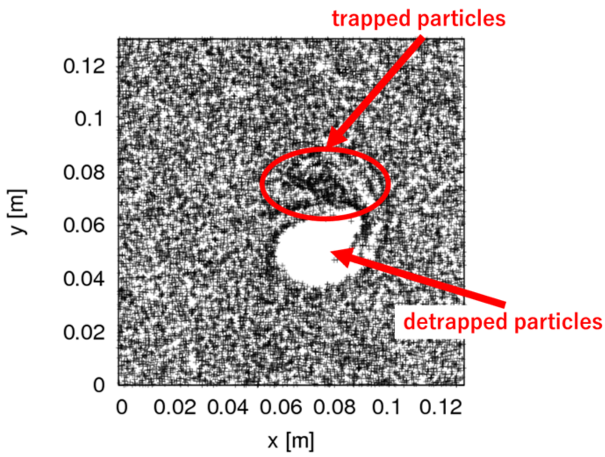

Fig. 2: 2D profile of the impurity ions.

[1] M. V. Umansky, S. I. Krasheninnikov, B. LaBombard, and J. L. Terry, Phys. Plasmas **5**, 3373 (1998).

[2] N. Asakura, N. Hosogane, K. Itami, A. Sakasai *et al.*, J. Nucl. Mater. **266**, 182 (1999).

[3] S. I. Krasheninnikov, D. A. D'Ippolito, and J. R. Myra, J. Plasma Phys. **74**, 679 (2008).