Impurity Transport Caused by Blob and Hole Propagations

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It is first demonstrated that transport of impurity particles are caused by blob and hole propagations by means of the three dimensional (3D) electrostatic Particle-in-Cell (PIC) simulations:

(1) The biased density profile of impurity in the blob / hole is formed by the polarization drift (see Fig. 1).

(2) Such a density profile propagates with the blob / hole (see Fig. 2).

(3) The effective radial diffusion coefficient for impurity ions by a single blob / hole is estimated at $D_{imp} \sim D_B$ from the observed impurity flux in the simulation where the initial impurity density has a radial gradient (see Fig. 3). (Here, D_B is the Bohm diffusion coefficient.)

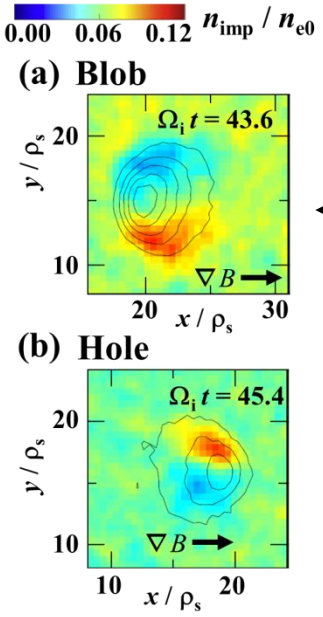

Fig. 1: Impurity ion density distributions in poloidal cross-section with the blob (a) / hole (b) propagation, where $m_{imp} / m_i = 4$. Here, the contour lines in each panel represent the electron density distributions.

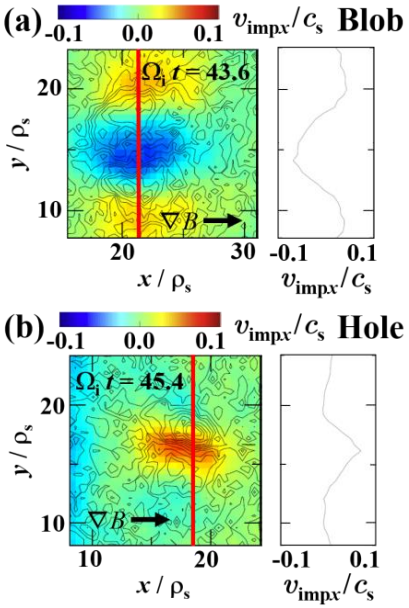

Fig. 2: Distributions of the radial (x) components of impurity averaged velocity in the blob (a) and hole (b) cases. In each figure, the left panel shows the 2D profile in the poloidal plane, while the right panel presents the 1D profile along the red line in the 2D profile. Here, the contour lines in the 2D profiles represent the impurity density.

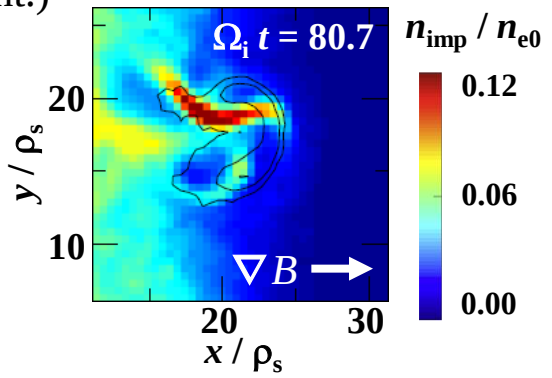

Fig. 3: Impurity ion density distribution in poloidal cross-section with the hole propagation where the initial impurity density has a radial gradient. Here, the contour lines in the panel represent the electron density distributions.