Simulation Study of Plasma Coherent Structure Dynamics
with Three-Dimensional Particle Code

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Recently, it was reported that the evidence of non-diffusive (that is, convective) plasma transport from the edge of core plasma to the first wall in magnetic confinement fusion devices. Such a transport is thought to be provided by intermittent filamentary coherent plasma structures “blobs” in scrape-off layer (SOL) [1]. Many theoretical and numerical studies about blob dynamics have been performed on the basis of two-dimensional reduced fluid models [1]. However, closure of parallel current and kinetic effects, such as sheath formation between a SOL plasma and a divertor plate and velocity difference between electrons and ions, are treated under some assumptions and parameterization in such kind of macroscopic model. Thus, we have developed a three-dimensional electrostatic plasma particle simulation code with particle absorbing boundaries [2] and studied kinetic dynamics on the blob propagation [3].

In our previous researches, we assumed that grad-B is uniform in the toroidal and poloidal directions. In SOL plasmas of real magnetic confinement devices, however, the direction of grad-B is different between the inside and the outside of torus. In this study, we have studied the blob kinetic dynamics in the system where grad-B is spatially non-uniform (i.e., also depends on the toroidal coordinate). We observe potential and particle flow structures which are different from those shown in our previous investigation. Thus, it is found that propagation manners of blobs in non-uniform grad-B plasmas are also distinct. These properties are affected by the initial blob location in the toroidal direction.