Modeling of Collisional Transport in Ergodic Region

R. Kanno[a,b], M. Nunami[c], S. Satake[a], H. Takamaru[d], M. Okamoto[d] and N. Ohyabu[a,b]

[a] *National Institute for Fusion Science, Toki 509-5292, Japan*
[b] *Department of Fusion Science, Graduate University for Advanced Studies, Toki 509-5292, Japan*
[c] *Research Institute for Sustainable Humanosphere, Kyoto University, Japan Science and Technology Agency, CREST, Uji 611-0011, Japan*
[d] *Department of Computer Science, Chubu University, Kasugai 487-8501, Japan*

kanno.ryutaro@LHD.nifs.ac.jp

Recent Large Helical Device experiments show that the transport modeling based only on the fluid equations neglecting kinetic effects is not sufficient for expressing the relaxation process in/around magnetic islands and ergodic region in the edge [1-4]. Statistical properties of the guiding center orbits in the ergodic region are previously studied in the monoenergetic test-particle simulations in detail [5]. The doubt on the validity of the stochastic diffusion theory for the collisionless limit has been reported.

The above results imply that the modeling of edge transport in the ergodic region should be reconsidered, and kinetic modeling is required for understanding stochastic transport in the ergodic region. In order to understand fundamental properties of the edge plasma in the ergodic region from the viewpoint of the kinetic treatment, we attempt a simulation study of neoclassical transport in the ergodic region. Here, even in the field line structure disturbed by the resonant magnetic perturbations (RMPs), the Coulomb collision causes the transition between a passing particle orbit and a trapped particle orbit in toroidal and helical ripples (localized and/or blocked particle orbits); in the present paper we call it the neoclassical effect on transport phenomena. Recently, we develop a new transport simulation code without the assumption of nested flux surfaces; the code is named "KEATS" [6,7]. The code is programmed by expanding the well-known Monte-Carlo particle simulation scheme based on the δf method. By using the KEATS code, it is possible to execute the investigation. We apply the KEATS code to a torus plasma having the ergodic region in the edge, and discuss the interpretation of the simulation results. In the interpretation, we should ask the reason why the noise created by RMPs can affect the radial transport for reconsidering the transport modeling.

[1] N. Ohyabu *et al.*, Phys. Rev. Lett. **88**, 055005 (2002).
[2] N. Ohyabu *et al.*, Plasma Phys. Control. Fusion **47**, 1431 (2005).
[3] Y. Nagayama *et al.*, Nucl. Fusion **45**, 888 (2005).
[4] R. Kanno *et al.*, Nucl. Fusion **45**, 588 (2005).
[5] A. Maluckov *et al.*, Physica A **322**, 13 (2003).
[6] M. Nunami *et al.*, Research Report NIFS Series No. NIFS-871 (2007).
[7] R. Kanno *et al.*, Plasma Fusion Res. **3**, S1060 (2008).