## §11. Strike Point Patterns on the LID Head in Various LHD Configurations

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The test particle simulation is carried out in order to investigate the neoclassical effect on strike point patterns of ions on the Local Island Divertor (LID) head in various Large Helical Device (LHD) configurations. Control of the edge plasma by means of the LID is aimed to realize high temperature divertor operation (HT-operation). It is important to investigate whether or not the particle flux, in particular the ion flux crossing the island separatrix, is successfully guided to the rear side of the island where the target plates are placed to receive the particle load.

According to the collisionality and the magnetic field line structure, the particle orbits mainly contributing the particle flux from the core region to the LID head vary; in the present paper we call it the neoclassical effect on the edge transport phenomena. The pattern on the LID head is numerically observed by tracing the guiding center orbits of the test particles under the effects of the Coulomb collision.

In the vacuum field for the case with $R_0 = 3.6$ m, almost all particles are expected to drift into the island and to be guided to the rear part of the LID head, because the island separatrix is not seriously perturbed by the currents in the island control coils, where $R_0$ is the major radius of the magnetic axis. On the other hand, the island in the case with $R_0 = 3.75$ m is surrounded with ergodic field lines, and the performance of the island divertor is expected to be deteriorated because a fraction of the particles can escape to the wall, being guided along field lines in the ergodic zone.

We find in the test particle simulations that the strike point patterns on the LID head are varied according to the collisionality and the field line structure. The pattern for the case of $R_0 = 3.6$ m sensitively depends on the collisionality. For the case of $\lambda_{\mathrm{mfp}}/L_{\mathrm{c}} \approx 0.3$, the particles strike the edge of the LID head and the pattern is given by the trapped particle orbits, see Fig.1(a), where $\lambda_{\mathrm{mfp}}$ is the mean free path and $L_{\mathrm{c}} \approx 100$ m is the connection length given as a length along a field line connecting the core region to the LID head. Of course, for the case of $\lambda_{\mathrm{mfp}}/L_{\mathrm{c}} > 1$, almost all particles are guided to the rear part of the LID head and the pattern is characterized by the passing particle orbits along to the field lines of the island separatrix. On the other hand, for the case of the configuration with $R_0 = 3.75$ m the pattern is characterized generally by the passing particle orbits along the field lines of the island separatrix. In particular, for the case of $\lambda_{\mathrm{mfp}}/L_{\mathrm{c}} \approx 0.3$, almost all particles are guided to the rear part of the LID head, against our forecast, see Fig.1(b). When the case of $\lambda_{\mathrm{mfp}}/L_{\mathrm{c}} \ll 1$ is considered, the particles strike the edge of the LID head.

We have seen that the neoclassical effect plays the important role in determining the strike point patterns on the LID head. Since the mean free path under HT-operation is very large ($\lambda_{\mathrm{mfp}}/L_{\mathrm{c}} \gg 1$), the passing particles mainly contribute the particle transport. The passing particles move along the island separatrix, and the improvement of the performance of the LID in both the configurations is expected.
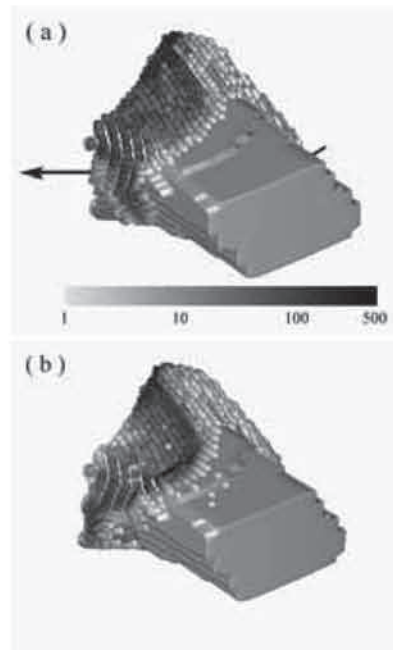


Figure 1: The strike point patterns, indicated by colored dots, on the LID head for the case of $E = 300$ eV and $\lambda_{\mathrm{mfp}}/L_{\mathrm{c}} \approx 0.3$, where (a) $R_0 = 3.6$ m and (b) $R_0 = 3.75$ m.

## References

[1] Komori, A. et al. : Plasma Physics and Controlled Fusion Research, 1994 (IAEA, 1995).

[2] Ohyabu, N. et al. : J. Nucl. Mater. **220-222** (1995) 298.