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LHDヘリカルダイバータにおけるデタッチメント時の熱・粒子負荷分布変化
Modification of heat and particle loads distributions on the helical divertor in LHD

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The heat and particle loads on the helical divertor in the heliotron configuration is non-uniform in both toroidal and poloidal directions. Plasma transport in the LHD SOL in which the intrinsic ergodic layer and magnetic island chains are embedded affects the non-uniformity. Increment of the transport across the field lines can expand the wet area in the both directions. In detachment experiments in LHD, the modification of the non-uniformity is observed.

Reduction of the heat and particle loads to divertor is a crucial issue to realize fusion reactor. To realize heliotron-type reactor which is free from plasma current, divertor heat and particle control experiments have been conducted in LHD to obtain understandings of physical mechanisms of the control which can be applied to that in future heliotron-type reactor as well.
To reduce the heat and particle loads, expansion of the wet area is effective. The helical divertor configuration has large divertor area compared to poloidal-divertor in similar size tokamaks because double-null like divertor rotates with the helical coils in the configuration. However, for the non-uniformity of the heat and particle deposition profile on the divertor, the heat and particle fluxes are large in some locations (see Fig. 1). The numerical simulation with 3-D plasma and neutral transport code, EMC3-EIRENE, showed that increment of transport across the field lines can modify and expand the non-uniform deposition three-dimensionally as shown in Fig. 1(a) and (b) which show the divertor footprints in one toroidal section in LHD. In experiment, it is observed that the transport becomes larger in higher temperature discharge, and the divertor particle flux profile modified as predicted by the simulation qualitatively [1, 2].
The modification of the non-uniformity is observed during the divertor detachment experiments in LHD [3-5]. Figure 2 shows an example. The ratio between the ion saturation current to the inboard and the top divertor largely changed in detachment discharge.

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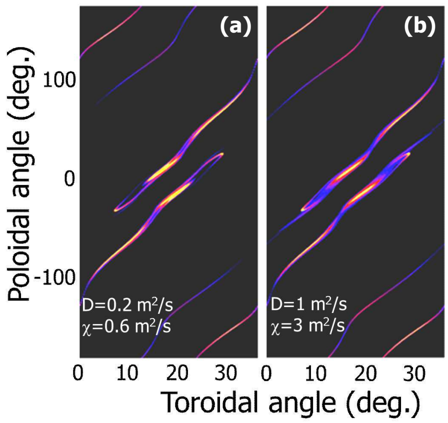

Fig. 1. Divertor footprints of particle flux for different cross-field transport coefficients. (a) Smaller transport case. (b) Larger transport case.

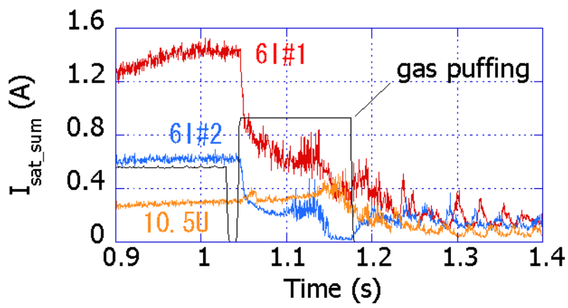

Fig. 2. Time evolutions of the ion saturation current at the torus inboard (6I#1, 6I#2) and top (10.5U) divertor plates. After the termination of the gas