

Plasma transport in toroidally discontinuous limiter generated 3D SOL configurations of Aditya tokamak

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The coupled plasma-neutral transport characteristics in the Scrape-Off Layer (SOL) produced by toroidally discontinuous limiter are essentially 3-dimensional and show strong deviation from the usual uniform SOL approximations. In a recently performed second-phase of EMC3-EIRENE plasma transport simulations for the limiter generated SOL of both original Aditya and Aditya Upgrade configurations, a number of aspects related to 3D effects in SOL are addressed. The simulated flux balance for the update relevant block-limiter case indicates that with a reduced total recycling flux for equivalent edge plasma conditions, and with the reduction in chamber wall directed cross field particle fluxes, a wider regime of relatively stable plasma conditions might be accessible for the block-limiter configuration. Although a recycling source localized on the limiter surface is used in the present simulations for the simplicity, the mechanism of main chamber recycling process is essentially captured by the present 3D study where the ionization can be significantly higher in the closed field line sections of the SOL having both higher plasma and neutral density at the downstream toroidal locations. This combination of locally enhanced ionization and longer connection lengths is seen responsible for a radially growing perpendicular flux and convex radial density profiles. This effect, found to be dominant in the original ring-limiter configuration, is however seen to yield usual concave radial density profiles in the block-limiter case, indicating that for equivalent wall conditions, the localized wall recycling can be expected less intense in the block-limiter case. In studies on ALCATOR-C-MOD this effects in a 2D divertor SOL setup was observed leading to an enhanced recycling in main chamber and indicated the possibility of an alternate density limit, capable of restricting essential reactor relevant studies in a moderate size device. The present study captures the effect in toroidally discontinuous limiter generated 3D SOL of Aditya tokamak and highlights the capacity of the 3D EMC3-EIRENE simulation to analyze it in the large scale reactor relevant conditions.

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