Simulation of parallel SOL flows with UEDGE.

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Long-range near-sonic parallel plasma flows has been measured in the SOL of several tokamaks and were modeled numerically by many authors. Study of these flows is increasingly important since they control the divertor plasma state and cause substantial impurity migration and, in the next-step fusion devices, they can enhance tritium retention and dust spreading over. Moreover, such flows determine the boundary conditions on confined plasma, have connection to X-point dependent toroidal rotation of core plasma, and can affect the L-H threshold.

We used the edge plasma transport code UEDGE to study large parallel plasma flows (LPPFs) and different mechanisms which can drive such flows by simulating experimental edge-plasma data from several tokamaks. In modeling, we include intermittent blobby non-diffusive cross-field transport of ion species as convection with adjustable velocity profile.

In the report, we highlight the dominant role of ballooning-like asymmetry of cross-field transport in the LPPF formation and report the asymmetry values deduced from UEDGE modeling of single-null and double-null magnetic configurations. The effect of flows on impurity migration and divertor detachment will be discussed. Modeling results show common plasma flow pattern and asymmetry in cross-field transport for some current tokamaks as well as for ITER.

We also present the results on plasma profile simulation using UEDGE for unbalanced double-null divertor configurations in Alcator C-Mod. We vary the distance between secondary and primary separatrix and discuss the LPPF patterns as well as the “window frame” approach to determine the radial plasma flux profile at the outboard mid-plane.