Parallel and E×B Flows in the DIII–D Divertor*

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Studies of parallel D^+ and impurity flows and $E\times B_T$ D^+ flows in the DIII–D divertor show that the flow patterns are very complex, and sensitive to divertor conditions. These flows are intimately related to divertor in-out asymmetries, impurity transport and particle and heat transport and therefre of extreme importance to understand divertor physics. The divertor parallel velocities, still vary 1–2 s after core conditions are stable, indicating that divertor time constants are long. The experimental results are compared to UEDGE 2-D simulations, showing fair agreement.

Poloidal $E\times B_T$ drifts on the private side of the separatrix circulate 10^{22} ions/s, or about 30% of the total ion flux to the target. These drifts are produced by the plasma potential gradients on both sides of the separatrix, driven by temperature gradients. The flows, which can explain in-out asymmetries in attached divertor plasmas, become weak during detachment.

Parallel D^+ divertor flows are measured with mach reciprocating probes. In attached plasmas, the D^+ parallel flow on the outer divertor SOL is toward the divertor target ("forward flow") whereas flow reversal develops at the separatrix as the divertor plasma approaches detachment. Upon detachment, as the density increases and the temperature drops, the deuterium flows approach Mach 1 over the whole divertor SOL. The combination of plasma parameters is such that the convected heat flux dominates, transporting 80% of the total heat flux to the target plates. The impurity ion flow, measured with divertor spectroscopy, feature both "forward" flows in the SOL and reversed flows near the separatrix in attached plasmas, similar to the background D^+ flow. Upon detachement, the forward impurity flow velocities increase whereas the reversed flows deccelerate, in rough agreement with the observed behavior of the deuterium ion flows.

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