MEASUREMENTS OF BACKGROUND PLASMA FLOWS AND THEIR ROLE IN PARTICLE AND POWER BALANCE IN THE DIII–D DIVERTOR REGION*

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First direct measurements of the parallel plasma flow and electric fields in the divertor region of DIII–D have been obtained with Mach probes and spectroscopy. For attached conditions, we find that the background plasma flow speed over a wide region in the outer leg is increasing quickly as the divertor target is approached and approaches Mach one near the plate. For detached conditions we find that the speed of the flow is near sonic over a large region of the divertor (up to 15 cm from the target) and thus, neoclassically, brings particles and heat to the target by convection. We find that the heat flux to the divertor target can be largely explained by the calculated neoclassical heat flux. Our result is consistent with the fact that the gradient of electron temperature over the detached divertor region is low and can not support a substantial heat flux to the plate by conduction.

We have also measured the private region and inner divertor leg for attached plasmas and have observed substantial flow reversal (0.5 Mach) along a thin region centered at the separatrix between the private region and the outer leg. This finding has implications for the impurity transport since drag forces could bring the impurities to the X–point and thus to the core. There is supporting evidence for our result from experiments with the DiMES divertor erosion probe that shows that sputtered carbon from the outer strike point reaches the core and causes loss of density control and plasma contamination. Modeling with UEDGE predicts flow reversal at roughly the 40 eV contour. We will compare UEDGE modeling to our results.

We have found that strong electric fields (40 V/cm) exist along the boundaries between the different divertor regions, namely the inner leg, private region and outer leg. The fields will produce E×B flows. In summary our preliminary findings suggest that the divertor region supports a complex pattern of interacting flows and electric fields that, particularly for the radiative divertor, have implications for heat and particle fluxes and impurity transport and are, therefore, important to understand in order to improve divertor and ultimately, plasma performance.

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