DIVERTOR PLASMA STUDIES ON DIII–D: EXPERIMENT AND MODELING*

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In a magnetically diverted tokamak, the scrape-off layer (SOL) and divertor plasma provides some separation between the first wall and the core plasma, intercepting impurities generated at the wall before they reach the core plasma. If properly tailored, the divertor plasma can also serve to spread the heat and particle flux over a large area of divertor structure wall using impurity radiation and neutral charge exchange, thus reducing peak heat and particle fluxes at the divertor strike plate. Such a reduction will be required in the next generation of tokamaks, for without it, the divertor engineering requirements are very demanding. To successfully demonstrate a radiative divertor, a highly radiative condition with significant volume recombination and must be achieved in the divertor, while maintaining a low impurity content in the core plasma.

Divertor plasma properties are determined by a complex interaction of classical parallel transport, anomalous perpendicular transport, impurity transport and radiation, and plasma wall interaction. In this paper we will describe a set of experiments on DIII-D designed to provide detailed two dimensional documentation of the divertor and SOL plasma. Measurements have been made in operating modes where the plasma is attached to the divertor strike plate, and in highly radiating cases where the plasma is detached from the divertor strike plate. We will also discuss the results of experiments designed to influence the distribution of impurities in the plasma using enhanced SOL plasma flow. Extensive modeling efforts will be described which are successfully reproducing attached plasma conditions and are helping to elucidate the important plasma and atomic physics involved in the detachment process.

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