Effect of Changes in Separatrix Magnetic Geometry on Divertor Behavior in DIII-D

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Abstract. Results and interpretation of recent experiments on DIII-D designed to evaluate divertor geometries favorable for radiative heat dispersal are presented. Two approaches examined here involved lengthening the parallel connection in the scrape-off layer, $L_{\parallel}$, and increasing the radius of the outer divertor separatrix strike point, R_{OSP}, with the goal of reducing target temperature, T_{TAR}, and increasing target density, n_{TAR}. From 1-D two-point modeling based on conducted parallel heat flux, it is expected that: $n_{TAR} \propto R_{OSP}^{2} L_{\parallel}^{6/7} n_{SEP}^{3}$ and $T_{TAR} \propto R_{OSP}^{-2} L_{\parallel}^{-4/7} \mathrm{n}_{SEP}^{-2}$, where n_{SEP} is the midplane separatrix density. These scalings suggest that conditions conducive to a radiative divertor solution can be achieved at low n_{SEP} by increasing either R_{OSP} or $L_{\parallel}$. Our data are consistent with the above $L_{\parallel}$ scalings. On the other hand, the observed dependence of n_{TAR} and T_{TAR} on R_{OSP} displayed a more complex behavior, under certain conditions that can outweigh the expected dependencies. Our analysis indicates that deviations from the R_{OSP} scaling were due to the presence of convected heat flux, driven by escaping neutrals, in the more open configurations of the larger R_{OSP} cases. A comparison of “open” versus “closed” divertor configurations for the H-mode plasmas at the same density show that the “closed” case provides at least 30% reduction in the peaked heat flux in comparison with the “open” case and partial divertor detachment at lower plasma density.

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