Contribution ID: **289** Type: **Poster**

EX/P5-12: Effect of Changes in Separatrix Magnetic Geometry on Divertor Behavior in DIII-D

Thursday, 11 October 2012 08:30 (4 hours)

We report results and interpretation of recent experiments on DIII-D designed to evaluate divertor geometries favorable for radiative heat dispersal. Two approaches studied involved lengthening the parallel connection in the scrape-off layer (SOL), L_||, and increasing the radius of outer divertor target, R_TAR, with the goal of reducing target temperature, T_TAR, and increasing n_TAR. Based on 1-D two-point modeling: n_TAR propto [R_TAR]ˆ2 [L_||]ˆ6/7 [n_SEP]ˆ3 and T_TAR propto [R_TAR]ˆ-2 [L_||]ˆ-4/7 [n_SEP]ˆ-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_TAR or L_||. While our data are consistent with the above L_|| scalings, the observed scalings on R_TAR displayed a more complex behavior, under certain conditions deviating from the above scalings. Our analysis indicates that deviations from the RTAR scaling were due to the presence of convected heat flux, driven by escaping neutrals, in the more open configurations of the larger R_TAR cases. Modeling with the SOLPS code support the postulate that even small differences in the divertor geometry can change the divertor neutral trapping sufficiently to explain some of the discrepancy between experiment and two-point model predictions. When similar recycling conditions were maintained, as during a sweep over a more limited range, much of the expected dependence of and on was largely recovered. Our results also show that a significant fraction of the radiated power can be dissipated along the extended, outer divertor leg at higher density when the leg was attached, e.g., P_RAD,OD/P_RAD,TOT approx 0.3-0.4 with q_95=4-5. Our study includes both L-mode and H-mode plasmas. The ion BxnablaB drift is directed toward the X-point for both cases, and the collisionalities in the SOL straddle the conduction and sheath-limited regimes. Variation in poloidal length of the outer divertor leg was 25-75 cm and variation in radial placement of the outer divertor separatrix was 1.2 m to 1.7 m. The results of this study are relevant to some key tenets of divertor configurations with extended outer divertor legs, e.g., the isolated divertor. This work was supported by the US DOE under DE-FC02-04ER54698, DE-AC05-00OR22725, DE-AC04-94AL85000, DE-AC52-07NA27344, and DE-FG02-07ER54917

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Session Classification: Poster: P5

Track Classification: EXD - Magnetic Confinement Experiments: Plasma–material interactions; divertors; limiters; scrape-off layer (SOL)