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## EX/P5-28: Dependence of the L-H Power Threshold on X-point Geometry

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The L-H power threshold (P\_LH) on the National Spherical Torus Experiment decreases with larger X-point radius ( $R_x$ ) and the amount of lithium evaporated on the divertor surfaces. The edge T\_e (where T\_e  $T_i$ in the L-mode edge) at the L-H transition decreases 30 -40% with larger R\_x, but is fairly independent of the edge density, neutral fueling rate and lithium conditioning. These observations are consistent with the X-transport theory, which predicts that the edge radial electric field (E\_r) just inside the plasma separatrix must become more negative as T\_i or R\_x are increased in order to counteract non-ambipolar neoclassical ion orbit loss in a diverted plasma. Consequently, the E x B shearing rate, which is predicted to be favorable for triggering and sustaining H-mode, increases with both T\_i and R\_x. Self-consistent E\_r calculations using the XGC0 code provide insight into the dependence of the shearing rate on the magnetic geometry and edge T\_i. For example, the shearing rate remains constant as R\_x is reduced from 0.64m to 0.47m only if the edge T\_i profile is increased by 25%. Increasing the neutral recycling rate does not significantly alter the T\_i profile needed to maintain the same shearing rate, but does require more core heating to maintain the critical edge temperature. This is consistent with the experimental observations that P\_LH varies with R\_x and divertor recycling, while T\_e at the L-H transition only depends on R\_x. This agreement between theory and experiment provides a valuable tool for interpreting the hidden variables in the empirical P\_LH scaling relationships and for optimizing the heating requirements for ITER and other advanced tokamaks. XGC0 simulations are used to examine other known P\_LH dependences, including the ion grad-B drift direction, X-point height, ion species and plasma current.

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