Contribution ID: **541** Type: **Poster**

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

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

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.

Supported by US DOE contracts DE-AC02-09CH11466 and DE-AC05-00OR22725.

Country or International Organization of Primary Author

USA

Primary author: Mr BATTAGLIA, Devon (USA)

Co-authors: Dr DIALLO, Ahmed (PPPL); Dr LEBLANC, Benoit (Princeton Plasma Physics Laboratory); Dr CHANG, Choong-Seock (Princeton Plasma Physics Laboratory and KAIST); Dr MENARD, Jonathan (Princeton Plasma Physics Laboratory); Dr MAINGI, Rajesh (Oak Ridge National Laboratory); Dr BELL, Ron (Princeton Plasma Physics Laboratory); Dr KU, Seung-Hoe (Princeton Plasma Physics Laboratory); Dr KAYE, Stanley (Princeton Plasma Physics Laboratory, Princeton University, Princeton NJ, 08543 USA); Dr GERHARDT, Stefan (Princeton Plasma Physics Laboratory)

Presenter: Mr BATTAGLIA, Devon (USA)

Session Classification: Poster: P5

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