L-H power threshold scaling with magnetic geometry on NSTX and the role of ion orbit loss. D.J. BATTAGLIA, C.-S. CHANG, S.M. KAYE, S. KU, PPPL, R. MAINGI, ORNL, NSTX TEAM — The L-H power threshold ($P_{LH}$) on the National Spherical Torus Experiment varies with X-point radius ($R_X$), plasma current ($I_p$), the direction of the ion grad-B drift and the amount of lithium evaporated on the divertor surfaces. The edge $T_e$ and $T_i$ (where $T_e \sim T_i$) just prior to the time of the L-H transition vary with the magnetic geometry, but are fairly independent of the neutral fueling rate and lithium conditioning. These observations are consistent with the X-transport theory, which describes the mean edge radial electric field ($E_r$) profile required to prevent non-ambipolar ion loss in a diverted plasma. A guiding-center orbit calculation in the absence of electric fields, collisions and flows provides insight into the dependence of the ion loss, and thus $E_r$, on the magnetic geometry and edge $T_i$. For example, the number of ion loss orbits remains constant as $R_X$ is reduced from 0.64m to 0.47m only if the edge $T_i$ increases by 60%. This is in agreement with self-consistent calculations of $E_r$ using the neoclassical XGC0 code and experiments that measured edge $T_e$ and $T_i$ to be 40 – 60% larger. Similar agreement is also observed between guiding-center calculations, XGC0 results and the measured $P_{LH}$ versus $I_p$ and ion grad-B direction.

1Supported by US DOE contracts DE-AC02-09CH11466 and DE-AC05-00OR22725.

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Date submitted: 22 Jul 2011
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