Dependence of the L-H Power Threshold on divertor balance and heating method in NSTX

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H-mode access is a critical issue for next step devices, such as the International Thermonuclear Experimental Reactor (ITER), which is projected to have a modest heating power margin over the projected L-H power threshold (PLH). The importance of a second X-point in setting the value of PLH has been clarified in recent experiments on several tokamaks. Specifically a reduction of PLH was observed when the magnetic configuration was changed from single null (SN) to double null (DN) in the MAST, NSTX, and ASDEX-Upgrade devices [1]. In the spherical tokamaks MAST and NSTX, changes to the drsep parameter (the separation of the two X-points mapped to the outer midplane) of the order of an ion gyro-radius (3-5 mm) changed PLH by a factor of two. The effect is smaller in ASDEX-Upgrade, i.e. PLH decreased by 20% in DN as compared with SN. The change of PLH is thought to be related to the changes of the radial electric field just inside the separatrix [1, 2], possibly due to a change in the scrape-off-layer flow pattern, e.g. as reported in the Alcator C-MOD device [3].

Motivated by these results, detailed PLH studies on NSTX have compared discharges with neutral beam and rf heating, as a function of drsep. Similar PLH values and edge parameters are observed with the two heating methods in the same magnetic configuration, with PLH ~ 0.6 MW lowest in DN and increasing to ~ 1.1 MW and 2-4 MW in lower-SN and upper-SN configurations respectively (ion grad-B-drift towards lower X-point). To interpret these results in the context of neoclassical theory, these data are being simulated with the XGC kinetic transport code (C.S. Chang, et. al.). The evolution of the experimental profiles of parameters in L-mode before the L/H transition will be compared with these simulations.

[1] MEYER, H. et al., Nucl. Fusion 46 (2006) 64.

[2] MEYER, H. et al., Plasma Phys. Control. Fusion 47 (2005) 843.

[3] LABOMBARD, B. et al., Nucl. Fusion 44 (2004) 1047.

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