Relation of pedestal stability regime to the behavior of ELM heat flux footprints in NSTX-U and DIII-D

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It is found that pedestal plasma regime plays an important role in the behavior of ELM heat flux footprints. The effective area at the divertor surface that accommodates total power expelled by ELMs, the wetted area (A_{wet}), is crucial for the determination of ELM mitigation requirements for ITER. A_{wet} has been observed to broaden significantly during the ELM, compared to the inter-ELM values, in several tokamaks [1] where the pedestal plasma is usually against the peeling-ballooning stability boundary with intermediate to high toroidal mode number (n=10–20). However, in NSTX [2] and DIII-D, cases of significant contraction of A_{wet} by ELMs have been observed when the pedestal plasma is against the current driven kink/peeling boundary with low toroidal mode number (n=1–5). Data in DIII-D have shown that increasing pedestal collisionality (ν_e*=0.3 → 0.9 → 3.5) leads to more favorable ELM footprints behavior, i.e. from contraction toward broadening, being consistent with an ELITE analysis that shows movement of the operating point in the stability diagram from the peeling toward the ballooning side, i.e. most unstable for n=5 → 10 → 25, respectively. NSTX pedestal plasma is found to be dominantly on the peeling side [3], with ELMs usually reducing A_{wet}, although the pedestal ν_e* is generally higher than ~1 contrary to DIII-D. It is suspected that strong shaping in the ST geometry may have played an important role in determining pedestal stability in NSTX. Non-linear ELM simulation using BOUT++ is in progress to compare to the observed footprints behavior. ELM data from NSTX-U will be presented and compared to the DIII-D results. This work was supported by the U.S. DOE, contract numbers DE-AC05-00OR22725 (ORNL), DE-AC02-09CH11466 (PPPL), DE-AC52-07NA27344 (LLNL), and DE-FC02-04ER54698 (GA).

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