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Broadening of the divertor heat flux footprint with increasing number of ELM filaments in NSTX[1]

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We report on the broadening (narrowing) of the ELM heat flux footprint with increasing (decreasing) number of filamentary striations from in-depth thermography measurements in NSTX. Edge localized modes (ELMs) represent a challenge to future fusion devices, due to the high heat fluxes on plasma facing surfaces. One ameliorating factor has been that the divertor heat flux characteristic profile width (λ_q) has been observed to broaden with the size of ELM, as compared with the inter-ELM λ_q, which keeps the peak heat flux (q_{peak}) from increasing.[2,3] In contrast, λ_q has been observed to narrow during ELMs under certain conditions in NSTX, for both naturally occurring[4] and 3-D fields triggered[5] ELMs. Fast thermographic measurements and detailed analysis demonstrate that the ELM λ_q increases with the number of observed filamentary striations, *i.e.*, profile narrowing (broadening) occurs when the number of striations is smaller (larger) than 3-4.[6] With profile narrowing,[7] q_{peak} at ELM peak times is inversely related (proportional) to λ_q (the ELM size), exacerbating the heat flux problem. Edge stability analysis shows[8] that NSTX ELMs almost always lie on the current-driven kink/peeling mode side with low toroidal mode number (n=1-5), consistent with the typical numbers of striations in NSTX (0-8); in comparison 10-15 striations are normally observed in intermediate-n peeling-ballooning ELMs, e.g., from JET.[9] The NSTX characteristics may translate directly to ITER, which is also projected to lie on the low-n kink/peeling stability boundary.[10]

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