Divertor Heat Flux Scalings in the National Spherical Torus Experiment with and without Lithium Coatings*

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A fundamental engineering and physics concern for Spherical Tori (ST) is the heat load placed on the plasma facing components (PFCs). Divertor heat flux not only plays an important role in PFC lifetime but is also correlated to heat transport through the scrape-off layer (SOL) and cross-field transport in the edge plasma. Both of which ultimately impact the overall performance of ST reactor concepts. Near term research in this area at the National Spherical Torus Experiment (NSTX) is driven by U.S. DoE multi-machine joint research milestone in 2010. We report the first set of results from those studies in two papers: this paper focuses on the effect of engineering and externally controllable parameters, and an accompanying paper focusing on the effect of boundary shape.

Specifically we report the dependence of the lower divertor surface temperature and heat flux profiles (from infrared thermography) on input neutral beam power (P_{NBI}), plasma current, I_p, toroidal field B_t, and lithium conditioning in H-mode discharges. Previously we found[1] that the SOL heat flux widths (λ_q^{mid}, magnetically mapped from the divertor profiles obtained from thermography) decreased with I_p, and was relatively independent of P_{NBI} at high P_{NBI}; all of the previous results were limited to lower divertor triangularity ~ 0.5. Here we extended the studies to higher triangularity ~ 0.7, extending and confirming the previous trends up to $I_p \leq 1.2$ MA. Moreover a new more detailed scan of $2 \leq P_{NBI} \leq 6$ MW demonstrated that the λ_q^{mid} decreased with P_{NBI} in low trinagularity discharges. The heat flux profile appears to be relatively independent of the B_t. Finally, lithium conditioning results in ELM-free discharges, leading to a further ~ 50% contraction of the heat flux profile. Experimental details and implications will be discussed.

[1] R. Maingi, *et al*. J. Nucl. Mater. **363-365** (2007) 196-200

* Research sponsored by U.S. D.o.E. contracts DE-AC05-00OR22725, DE-AC52-07NA27344, and DE-AC02-09CH11466