Study of non-axisymmetric divertor structure using 2-D IR and visible cameras and a 3-D heat conduction solver in NSTX

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Non-axisymmetric, *i.e.* 3-D, divertor heat and particle deposition often occurs in tokamaks for various reasons, while toroidal symmetry is usually assumed in the study of divertor flux distribution since the early days of the tokamak development. A 3-D heat conduction solver TACO [1] has been recently implemented in NSTX and improvement was made to address the issue of thin layer on the divertor surface [2]. This is a first attempt to study divertor heat flux profiles in a 2-D plane. A fast 2-D infrared (IR) camera covering toroidal angle (Φ) of up to ~70^{o} and a 2-D fast visible camera with capability of viewing nearly full divertor surface are being used to study the toroidal and radial structure of the divertor heat and particle deposition. The immediate application of this new technique is the study of 3-D divertor structure induced by the intrinsic and applied 3-D fields [3,4]. Another application is the ELM study as ELMs naturally produce helical filaments and they deposit heat and particles onto the divetor surface in a non-axisymmetric way.

The 2-D data converted from the (x,y) plane to the (r,Φ) plane makes the comparison with modeling much easier, *e.g.* the field line tracing and mode number identification, *etc*. The strike point splitting pattern in the 2-D plane during the n=1 and n=3 field application agrees well with the vacuum field line tracing and the triggered ELMs are confirmed to be phase-locked to the imposed field structure. ELMs are found to produce higher toroidicity of the deposited heat and particle flux. This technique enables us to account for the total power to the divertor more accurately than the toroidal integration of a 1-D radial profile, as well as the detailed deposition structure in both directions. Data for the intrinsic and applied 3-D fields as well as for the triggered and natural ELM filaments will be shown, and comparison with a 3-D boundary transport code, EMC3-Eirene, will be made.

This work was supported by the US Department of Energy, contract numbers DE-AC05-00OR22725, DE-AC02-09CH11466, and DE-AC52-07NA27344.

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