Divertor heat and particle flux profile modification during 3-D field application in NSTX

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The externally applied 3-D fields have been used to suppress [1] or trigger [2] ELMs and are considered to be used in the International Thermonuclear Experimental Reactor (ITER). It is found that the non-axisymmetric magnetic perturbations modify the heat and particle flux profiles at the divertor in NSTX H-mode plasmas [3]. It produces multiple strike points radially separated, formed by the so-called 'lobe' structure. A weak strike point (SP) splitting in both profiles, *i.e.* 'intrinsic' SP splitting, is observed even before the application of 3-D fields due to the intrinsic error fields. This intrinsic SP splitting is 'amplified' by the externally applied 3-D fields. Divertor profiles become broadened by the formation of SP splitting, with the peak values at the separatrix largely unchanged. The amplified SP splitting by the applied 3-D fields was simulated by a field line tracing code and was compared with the measurement for n=1 and n=3 cases. It is found that the location and spacing of the simulated split strike points well agree with the observation. The inclusion of internal plasma response in the simulation did not affect the result substantially. Time response of the amplification is as fast as 3-4ms, which is consistent with the field line penetration time through the vacuum vessel. The pedestal electron temperature and density profiles show noticeable reduction by the applied 3-D fields but the electron collisionality (ν^*_e) is not found to change substantially. The SP splitting observed in the heat flux profile in NSTX occurred also in significantly low pedestal ν^*_e (~0.2-0.3) compared to the DIII-D result, where it is only observed for ν^*_e >0.5 [4]. Understanding the effect of 3-D fields on the divertor profiles and how it causes the profile modification, and predicting their impact in the future machine is crucial in the divertor heat and particle handling performance for both the conventional and spherical tokamaks.

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