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Observation of Heat Load on the Castellated Tungsten Block by Back-Scattered Particles from Intentionally Misaligned Protruding Edge

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KSTAR has been involved in studying leading edge heat loads since 2014 by using series of multi-purpose, brazed W blocks (W-Cu-CuCrZr). They are mounted and assembled into two adjacent, inertially cooled graphite tiles installed in the outer divertor target region of KSTAR, within the field of view of an infrared (IR) thermography system installed in an upper lateral port and to which special modifications have been made for this study to increase the spatial resolution to ˜0.4 mm/pixel on the block surface. The blocks are arranged in different groups, with toroidal gaps of 0.5 mm addressing a specific issue: a variety of leading edge heights (0.3, 0.6, 1.0, and 2.0 mm), from the ITER worst case to heights even beyond the extreme value tested on JET. Adjustment of the outer divertor strike point position is used to deposit power on the different blocks in different discharges, but with emphasis in these first studies on studying power loading as a function of leading edge height. The measured power flux density on flat regions of the surrounding graphite tiles is used to obtain the parallel power flux, q|| impinging on the various W blocks.

Experiments have been performed in L-mode and Type I ELMing H-mode, but owing to the low power flux densities in L-mode, the inter-ELM H-mode exposures provide the best IR data. Discharges are run at Ip = 600 kA, BT = 2 T, PNBI = 3.5 MW, leading to a hot attached divertor with typical pulse lengths of ˜10 s and total field line incidence angles of 2-3 at the strike point (cf. 2.5 on ITER).

During the experiment, an interesting feature was observed: there was clear evidence of heat load on the castellated tungsten block by back-scattered particles from intentionally misaligned protruding edge. The line profiles show three different peaks corresponding to: one from the protruding edge, two others from the edge and surface of block in front of the protruding one. The deconvoluted heat flux profile and corresponding intensity ratio of each peak show that up to 46 % of IR intensity was originated from the block in front of the protruding one: around 44 % from the edge and 2 % from the surface. The peak intensity of back scattered profile depends strongly on the strike point location, which indicates the contribution of energetic ions during ELM.

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