Significant widening of divertor power flux distribution with increasing SOL power due to enhanced anomalous transport at Wendelstein 7-X

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Power exhaust remains an important issue for future fusion reactors. For instance, ITER, featuring the typical poloidal divertor where the width of the scrape-off layer (SOL) is of order of 1 mm, may be damaged due to overheating if not properly mitigated [1]. Here stellarators with an island divertor [2] offer an attractive alternative concept of the heat exhaust. The island divertor utilizes large magnetic islands at the plasma boundary, which are intersected by the divertor target plates. In the standard configuration there are 5/5 magnetic islands, each of the island connects two out of ten divertor units: one upper and one lower divertor. The heat, which crosses the separatrix is transported inside those islands towards the divertor target plates. As the connection lengths of field lines in the SOL islands are much longer than in tokamaks and the temperature gradients in the SOL are not very high, it is expected that ExB drifts may contribute equally to the transport in the SOL as the convective or conductive transport channels, which leads to rather complex heat and particle transport mechanisms in the 3D geometry of an island divertor.

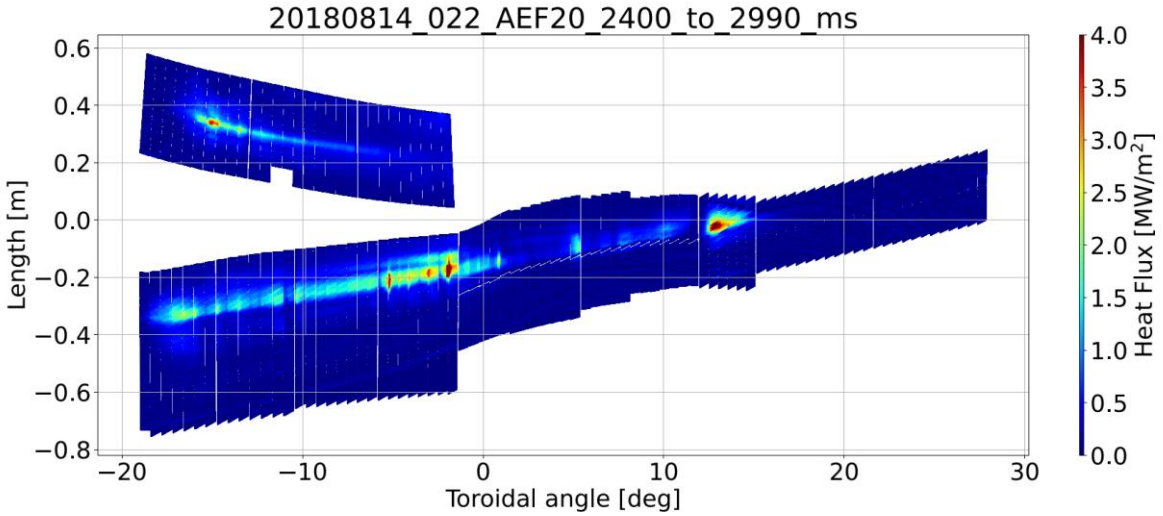

Figure 1. Heat flux distribution on the surface of divertor in module 2. Two strike-lines appear on the vertical (upper) and horizontal (lower) divertor target plates. The color scale represents the magnitude of the divertor power loads.