Divertor heat flux width prediction for tokamak plasmas

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At present, a very narrow divertor heat flux width may be a serious concern to ITER and future reactors, where the intensity of heat flux within such a narrow width will far exceed the thermal load capacity of the existing materials. Therefore, it is still an open problem to explore the physical mechanism that dominates the tokamak divertor heat flux width, which is also urgent to make a width prediction for ITER. Towards the physical understanding on tokamak divertor scrape-off layer (SOL) physics, a self-consistent one-dimensional radial transport model has been developed covering both core plasma and SOL region at tokamak midplane. The energy confinement time in the model is calibrated by the experimental scaling, where the radial diffusion coefficient in the SOL is in a reasonable range with the typical order of unit. Meanwhile, the basic two-point model has been also coupled to the model for the parallel transport in SOL region to determine the downstream parameters near the target It is found that: without significantly enhanced radial turbulent transport, the divertor heat flux width follows the empirical (Eich) scaling of current tokamaks but is much wider than the scaling to ITER-like scale, which reveals that the divertor heat flux width can be greater than 5mm for ITER size 15MA plasma.

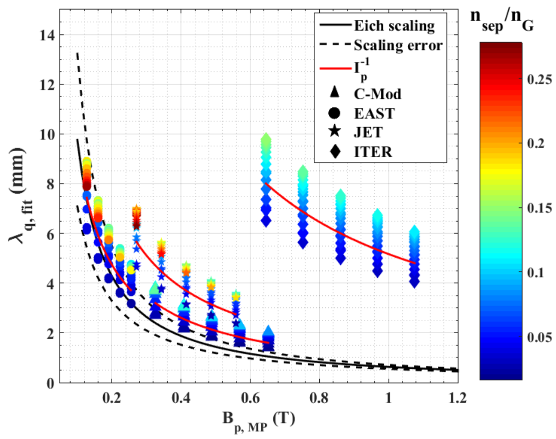

Figure 1. The divertor heat flux width versus $B_{p,MP}$ at outer midplane, where the colorbar is the ratio between the upstream separatrix density n_{sep} and the Greenwald density n_G .