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Gyrokinetic projection of the divertor heat-flux width from present tokamaks to ITER

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The edge gyrokinetic code XGC1 shows that the divertor heat flux width λq in between ELMs of Type I ELMy H-modes in two representative types of present tokamaks (DIII-D type for conventional aspect ratio and NSTX type for tight aspect ratio) is set mostly by the ion neoclassical orbit spread, which is proportional to 1/Ip, while the blobby turbulent spread plays a minor role. This explains the 1/Ip scaling of the heat flux width observed in present tokamaks. On the other hand, the XGC1 studies for ITER H-mode like plasmas show that λq is mostly set by the blobby turbulent spread, with the heat flux width being about 5X wider than that extrapolated from the 1/Ip scaling. This result suggests that the achievement of cold divertor plasmas and partial detachment required for power load and W impurity source control may be more readily achieved and be of simpler control issue than predicted on the basis of the 1/IP scaling. A systematic ongoing validation study of the XGC1 results on various existing tokamaks will also be presented, including JET that is the closest existing device to ITER. [This work is supported by US DOE, and computing resources supported by OLCF at ONRL.]

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