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Progress towards understanding ITER's divertor heat-flux width from gyrokinetic simulation

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While prediction for the divertor heat-flux width in the wide range of the poloidal magnetic field in attached NSTX, DIII-D, NSTX and JET plasmas matches the Eich-14 scaling formula within the regression error bar, the XGC prediction for the full-current ITER showed over six times wider heat-flux width than the Eich value. There were questions from the community if this difference in the simulation results is from the large size effect, small ion gyroradius effect, or the large a/ρi effect (neoclassical), where a is the plasma minor radius and ρi is the ion gyroradius. More simulations of a lower current ITER H-mode and the recent smallest-ρi C-Mod plasmas again show agreement with the Eich formula, rejecting the possibility for the large size or small ρi effect. Deeper analyses of the simulation data, including a machine learning study, show evidence for different edge physics (trapped electron modes instead of blobs) being in play in ITER edge that spreads the divertor heat-flux wider. When the a/ρi effect is added to the Eich formula, distance between the smallest-ρi C-Mod and the full-current becomes very far in the parameter space removing the suspicion of an abrupt bifurcation in the ρi space. Study of the NSTX-U plasma further supports the spreading action of the heat-load by trapped-electron-modes. Most up-to-date understanding of the underlying physics and suggestions for corresponding experimental explorations on today's tokamaks will be discussed.
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