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Gyrokinetic study of edge blobs and divertor heat-load footprint

C.-S. CHANG, S.-H. KU, M. CHURCHILL, S. ZWEBEN, PPPL — In an attempt to better understand the complicated physics of the inter-related "intermittent plasma objects (blobs)" and divertor heat-load footprint, the full-function gyrokinetic PIC code XGC1 has been used in realistic diverted geometry. Neoclassical and turbulence physics are simulated together self-consistently in the presence of Monte Carlo neutral particles. Blobs are modeled here as electrostatic nonlinear turbulence phenomenon. It is found that the "blobs" are generated, together with the "holes," around the steep density gradient region. XGC1 reasserts the previous findings [1] that blobs move out convectively into the scrape-off layer, while the holes move inward toward plasma core. The measured radial width of the divertor heat load, mapped to the outer midplane, is found to be much less than the median radial size of the intermittent plasma objects, but is rather closer to the width of neoclassical orbit excursion from pedestal to divertor, yielding approximately the 1/Ip-type scaling found from our previous pure neoclassical simulation [3] or a heuristic neoclassical argument by Goldston [4]. However, it also shows some spreading by the intermittent turbulence. In ITER plasma edge, where the ion banana width at separatrix becomes negligibly small compared to the meso-scale blob size, blobs may saturate the 1/Ip scaling.

[1] D. D'Ippolito et al., Phys. Plasmas 18 (2011) 060501
[2] J. Boedo et al., Phys. Plasmas 10 (2003) 1670
[3] Report on DOE FES Joint Facilities Research Milestone 2010 on Heat-Load Width, Appendix H
[4] R.J. Goldston, Nucl. Fusion 52 (2012) 013009

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