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Gyrokinetic Simulations of the ITER Pedestal[1]

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It has been reported that low collisionality pedestals for JET parameters are strongly stable to Kinetic Ballooning Modes[2] (KBM), and it is, as simulations with GENE[3] show, the drift-tearing modes that produce the pedestal transport.[4] It would seem, then, that gyrokinetic simulations may be a powerful, perhaps, indispensable tool for probing the characteristics of the H-mode pedestal in ITER especially since projected ITER pedestals have the normalized gyroradius ρ^* smaller than the range of present experimental investigation; they do lie, however, within the regime of validity of gyrokinetics. Since ExB shear becomes small as ρ^* approaches zero, strong drift turbulence will eventually be excited. Finding an answer to the question whether the ITER ρ^* is small enough to place it in the high turbulence regime compels serious investigation. We begin with MHD equilibria (including pedestal bootstrap current) constructed using VMEC. Plasma profile shapes, very close to JET experimental profiles, are scaled to values expected on ITER (e.g., a 4 keV pedestal). The equilibrium ExB shear is computed using a neoclassical formula for the radial electric field. As with JET, the ITER pedestal is found to be strongly stable to KBM. Preliminary nonlinear simulations with GENE show that the turbulent drift transport is strong for ITER; the electrostatic transport has a highly unfavorable scaling from JET to ITER, going from being highly sub-dominant to electromagnetic transport on JET, to dominant on ITER. At burning plasma parameters, pedestals in spherical tokamak H-modes may have much stronger velocity shear, and hence more favorable transport; preliminary investigations will be reported.

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[2]S. Saarelma, M.N.A. Beurskens, D. Dickinson, et. al., Nucl. Fusion 53 123012 (2013)

[3]genecode.org

[4]D. Hatch, M. Kotschenreuther, et. al., 2015 US/EU Transport Task Force Workshop, Salem, MA April 2015