GYROKINETIC THEORY OF 2D MOMENTUM TRANSPORT AND THE L/H TRANSITION

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The theoretical formulation of 2D momentum transport in a gyrokinetic model is presented. The motivation for this theory is to be able to simulate an L/H transition that occurs at the separatrix between closed and open field lines in a tokamak. On the open field lines, the radial electric field is constrained by the plasma sheath potential at the divertor and the poloidal flow is governed by sources and since. The ion parallel velocity achieves sound speed at the edge of the sheath. On closed flux surfaces the poloidal flow is damped by collisional effects and the electric field is governed by toriodal rotation. To resolve the boundary layer between the closed and open field lines at the separatrix of tokamaks a 2D momentum transport model is required. The L/H transition occurs in this boundary layer and has been shown, with simplified models, to be well represented by a 2D momentum transport system (G.M. Staebler and R. J. Groebner, Nuclear Fusion, 55 (2015) 073008). Here we develop a rigorous gyrokinetic theory, based upon (H. Sugama and W. Horton, Phys. Plasmas, 5 (1998) 2560), that includes the plasma species parallel flows in the background equilibrium distribution function. Some of the effects of these flows on the linear stability of gyrokinetic instabilities, including the kinetic ballooning mode, are illustrated.

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