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On the Equilibrium and Stability of ITER Relevant Plasmas with Flow

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We present recent results on steady states of translational symmetric and axisymmetric ITER relevant plasmas with incompressible sheared flow in connection with a generalized Grad-Shafranov equation and on their stability [1-2]. The presentation includes equilibria either with monotonically increasing safety factor profiles pertinent to the L-H transition or with reversed magnetic shear. Linear and nonlinear solutions of the generalized Grad-Shafranov equation including non parallel flows of plasmas surrounded by a diverted boundary are constructed analytically, quasi analytically and numerically. It turns out that the electric field makes the safety factor flatter and increases the magnitude and shear of the toroidal velocity in qualitative agreement with experimental evidence on the formation of Internal Transport Barriers in tokamaks, thus indicating a stabilizing effect of the electric field. For parallel flows the linear stability is examined by applying a sufficient condition [3]. In this case one equilibrium corresponding to the H-state is potentially stable in the sense that the stability condition is satisfied in an appreciable part of the plasma while another solution corresponding to the L-state does not satisfy the condition. In the majority of the equilibria considered stabilization is caused by the variation of the magnetic field in the direction perpendicular to the magnetic surfaces (related to the magnetic shear) in conjunction with the sheared flow, depends on the plasma shaping and is sensitive to the up-down asymmetry.

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