Ion pressure gradient effects on Kelvin-Helmholtz and interchange instabilities

DAVID RUSSELL, JAMES MYRA, Lodestar Research Corporation — In the flow-free state, radial force-balance implies that the poloidal components of the ExB and ion diamagnetic drifts, $\tilde{\text{grad}}(P_i) / n$, are mirrored: $v_E + v_{di} = 0$. Analysis [1] of the linearized fluid equations shows that the mirrored state is stable in the absence of the interchange drive, $\tilde{\text{grad}}(P_e+P_i) / n$, i.e., the K-H instability is absent. With the interchange drive present, the mirrored-state growth rate passes through a global minimum value with increasing ion pressure gradient, due to sheared ExB flow and diamagnetic suppression, admitting a stability interval in a neighborhood of the minimum if other damping mechanisms are present. The K-H instability is recovered, absent the interchange drive, if force-balance is generalized to include neoclassical poloidal flows ($v_E + v_{di} + v_{nc} = 0$, $v_{nc} \tilde{\text{grad}}(T_i)$) [2], so that mirroring is lost. Implications for achieving a quiescent H-mode are discussed, and SOLT simulations, which include nonlinear ion pressure effects, are compared with the linear picture. [1] J.R. Myra et al., J. Plasma Phys. 82, 905820210 (2016). [2] L. Chôné et al., Phys. Plasmas 21, 070702 (2014).

1Work supported by the U.S. Department of Energy Office of Science, Office of Fusion Energy Sciences, under Award Number DE-FG02-97ER54392.

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Date submitted: 13 Jul 2016

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