Against the wind

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Phys. Fluids **11** (1999), 2977-2983.

Abstract:

The linear and the nonlinear dynamics of open unstable flow in a finite domain of size L is studied on a modified supercritical Ginzburg–Landau equation. When the advection term is nonzero, the bifurcation to a finite-amplitude state occurs when the instability is absolute, even for large L. The standard weakly nonlinear theory is limited to a control parameter domain of size varying as L^{-5} due to the nonnormality of the linear evolution operator. The fully nonlinear solution is given and two generic cases are discussed: a supercritical case in which the instability is absolute and a subcritical case in which the instability is solely convective. The subcritical case gives a mathematical example of a bypass transition due to transient growth. The supercritical case allows a fully quantitative comparison, including the effect of the domain size, with results obtained by Büchel *et al.* for the size of the bifurcated solutions in the Taylor–Couette problem with throughflow.