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The critical layer and transition to turbulence in shear flows

Roughly speaking, lower branch solutions are traveling wave or equilibrium solutions of shear flows that are in-between laminar flow and turbulence. We describe the computation of a lower-branch family of traveling waves in pipe flow up to $\mathrm{Re} = 75000$ ($\mathrm{Re} =$ Reynolds number). At high Re, these traveling waves develop a critical layer away from the pipe wall. Such critical layers could be useful to visualize the structure of puffs observed in transitional flow. Because of the small number of unstable eigenvalues, the lower-branch solutions also appear to be connected to transition to turbulence as we will show.