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Intermediate shear flow states and the control of turbulence FABIAN WALEFFE, University of Wisconsin Madison, JUE WANG — Shear flows are observed in two states: laminar and turbulent. But what lies in-between, on the boundary between the basins of attraction of those two states? We show that there exist remarkable quasi-2D traveling wave states that consist of large scale streaks with O(1) spanwise modulation in the streamwise velocity sustained by large scale O(1/R) streamwise rolls and a single marginally stable streak instability eigenmode. The latter has a 2D critical layer structure. These states are directly related to the transition threshold, which is defined as the amplitude of the smallest perturbation that triggers transition to turbulence. The drag induced by these quasi-2D states is typically only 10 to 40 percent higher than the *laminar* drag, asymptotically as $R \to \infty$, in contrast, the ratio of the turbulent to laminar drag diverges with R. The quasi-2D states have clear and few modes of instability, and clear, large scale structure. Hence, we propose that these states offer a new and promising avenue for the control of shear turbulence in addition to their importance for theoretical understanding of transition and, together with their small scale 'upper branch' cousins, of the nature of shear turbulence.

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