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Decay of streaks and rolls in plane Couette-Poiseuille flow. (English) Zbl 07333070
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Summary: We report the results of an experimental investigation into the decay of turbulence in plane Couette-Poiseuille flow using ‘quench’ experiments where the flow laminarises after a sudden reduction in Reynolds number Re . Specifically, we study the velocity field in the streamwise-spanwise plane. We show that the spanwise velocity containing rolls decays faster than the streamwise velocity, which displays elongated regions of higher or lower velocity called streaks. At final Reynolds numbers above 425, the decay of streaks displays two stages: first a slow decay when rolls are present and secondly a more rapid decay of streaks alone. The difference in behaviour results from the regeneration of streaks by rolls, called the lift-up effect. We define the turbulent fraction as the portion of the flow containing turbulence and this is estimated by thresholding the spanwise velocity component. It decreases linearly with time in the whole range of final Re . The corresponding decay slope increases linearly with final Re . The extrapolated value at which this decay slope vanishes is $Re_{a_z} \approx 656 \pm 10$, close to $Re_g \approx 670$ at which turbulence is self-sustained. The decay of the energy computed from the spanwise velocity component is found to be exponential. The corresponding decay rate increases linearly with Re , with an extrapolated vanishing value at $Re_{A_z} \approx 688 \pm 10$. This value is also close to the value at which the turbulence is self-sustained, showing that valuable information on the transition can be obtained over a wide range of Re .

MSC:

76 Fluid mechanics

Keywords:

transition to turbulence; turbulent transition

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