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The impact of slip surfaces on exact coherent states: insight into the transition-to-turbulence[1] ETHAN DAVIS, JAE SUNG PARK, University of Nebraska-Lincoln — The effect of slip surfaces on the laminar-turbulent separatrix, or transition, in a channel geometry is studied by direct numerical simulation. Firstly, turbulence lifetimes, or the likelihood that turbulence persists, is investigated. Slip surfaces decrease the likelihood of sustained turbulence when compared with the no-slip case, and the likelihood is further decreased with increasing slip length. Secondly, a more deterministic approach is used to investigate the effect of slip surfaces on the transition to turbulence. To this end, exact coherent states, specifically nonlinear traveling wave solutions to the Navier-Stokes equations, are used as initial conditions. Lower-branch solutions are insightful for the study of transition as they lie along the laminar-turbulent boundary in state-space. Two solution families, P3 (core mode) and P4 (critical layer mode), are considered. For P3, slip surfaces induce earlier transition with negligible effect on the instability of the solution. For P4, on the other hand, slip surfaces delay the transition while weakening the instability. Beyond a critical slip length, the instability is totally eliminated, and flow is laminarized. Flow dynamics and structures are further discussed for these transition events.

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