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Self-sustained Flow States in a Square Duct HAKAN WEDIN, DAMIEN BIAU, ALESSANDRO BOTTARO, MASATO NAGATA, University of Genova, UNIVERSITY OF GENOVA TEAM, KYOTO UNIVERSITY TEAM — The transition from laminar to turbulent flow in a square duct is an intriguing problem of hydrodynamics. The laminar profile of the flow in a square duct is linearly stable and it is hence conjectured that transition to turbulence is caused by the emergence of finite amplitude solutions of the Navier-Stokes equations. Recent evidence suggests that these alternative solutions, in the form of traveling waves and with no connection to the laminar flow, provide the skeleton around which time-dependent trajectories in phase space can orbit, preventing relaminarization of the flow for long times. Here we present approximate nonlinear solutions or "self-sustaining-states" to the Navier-Stokes equations, obtained with an approach initiated by Waleffe. The nonlinear flow that emerges when using such states as initial conditions in direct numerical simulations is studied. Interestingly, the lifetime of such nonlinear solutions decreases with the increase of the stream-wise length of the computational domain, for values of Re near the edge of chaos.

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