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The mechanism of long turbulent lifetimes in a low-dimensional model of plane Couette flow JAMES HITCHEN, ALEXANDER MOROZOV, SUPA, School of Physics and Astronomy, The University of Edinburgh, James Clerk Maxwell Building, Peter Guthrie Tait Road, Edinburgh, EH9 3FD, United — Recently, our understanding of the transition to turbulence has significantly changed due to the discovery of exact solutions of the Navier-Stokes equations and the introduction of the self-sustaining process in parallel shear flows. This theory has been very successful in describing the main features of weakly turbulent states, including the metastable nature of turbulence close to the transition and the super-exponential dependence of its lifetime on the Reynolds number. The main strength of this approach is that it allows for a semi-analytical description of the turbulent dynamics in the form of a rather low-dimensional model. Here we systematically develop a novel low-dimensional model that allows us to investigate the origin of the very long turbulent life-times close to the transition. We find that there exists a particular periodic orbit that acts as a porous reflecting barrier between the laminar and turbulent states, and that serves to greatly increase the time before relaminarisation.

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